GOBIERNO DE CHILE
FUNDACIÓN PARA LA
INNOVACIÓN AGRARIA

CONTENIDO DEL INFORME TÉCNICO

PROGRAMA DE FORMACIÓN PARA LA INNOVACIÓN AGRARIA

1. Antecedentes Generales de la Propuesta

Nombre **Asistencia a 4º Symposium del Cerezo**

Código

Entidad Responsable Postulante Individual : **Universidad de Concepción**

Coordinador: **Jean Paul Joublan**

Lugar de Formación (País, Región, Ciudad, Localidad): **EEUU: Oregon, Washington, Canadá: Summerland**

Tipo o modalidad de Formación: **Asistencia a evento Internacional**

Fecha de realización: **24/ 06 / 2001 al 04/07/2001**

Participantes: presentación de acuerdo al siguiente cuadro:

Nombre	Institución/Empresa	Cargo/Actividad	Tipo Productor (si corresponde)
Jean Paul Joublan	U. de Concepción	Docente	

Problema a Resolver: detallar brevemente el problema que se pretendía resolver con la participación en la actividad de formación, a nivel local, regional y/o nacional.

El ojetivo era complementar la formación y transferencia para hacer aportes relevantes al proyecto "Bases para el Desarrollo del cerezo en Chile"FIA C98-1- A-091 y los beneficiarios de estos proyectos. Se pudo compartir durante el simposio con la gente del INRA, con respecto a las variedades, que ellos nos han entregado. Además, se pretendía tener una idea de las nuevas tendencias en los aspectos económicos, de manejo en el huerto y en postcosecha.

Se presentaron además los resultados que se han obtenido de las prospecciones de material naturalizado en el sur de Chile; se discutiron también los resultados de nuestros clones de guindo ácido para portainjertos que se desarrollan en conjunto con el INRA.

Es importante para el proyecto "que se lleva a cabo en La Universidad de Concepción contar con la información que ahí se divulgó y poder contactar personas del ámbito para poder

intercambiar opiniones y generar respuestas para nuestra realidad. Otro de los aspectos de relevancia era el obtener e incrementar contactos mundiales en esta especie y evaluar como se inserta Chile en este mundo del cerezo.

Objetivos de la Propuesta

2. Antecedentes Generales: describir si se lograron adquirir los conocimientos y/o experiencias en la actividad en la cual se participó (no más de 2 páginas).

Con respecto a los antecedentes concretos que se pudo recabar para el proyecto antes mencionado se puede destacar:

1.- Se pudo discutir sobre los diferentes portainjertos que se están probando en las experiencias que tenemos en Chile. Tabel Edabriz que se tiene como un portainjerto enanizante y que se incluye en los ensayos con que se cuenta es muy susceptible a Virosis, las que le causan la muerte y por ende de la planta completa (PDV y PNRSV). No es factible pensar en el desarrollo de este portainjerto bajo las condiciones de los viveros en Chile, para esto se debe contar con plantas certificadas y no con el material con que se propaga hoy en día. Otros aspectos con respecto a portainjertos se tocarán más adelante en este informe. Uno de los puntos importantes fue observar los portainjertos en esas latitudes y en suelos arenosos de baja fertilidad, donde no funcionan bien los patrones enanizantes. Estos portainjertos además inducen frutos más pequeños en general lo que perjudica la calidad.

2.- En cuanto a variedades se puede decir que se obtuvo información pero como todo se debe probar bajo nuestras condiciones. Lo que se debe tener claro es que variedades con problemas virosos enfrentan serios problemas. Un punto c[illegible] se discute a nivel mundial es sobre todo la gran similitud en los objetivos y el material ge[illegible]co presente en todo el mundo. Las variedades de los diferentes programas de mejoramiento al final se parecen mucho unas a otras debido a que se utilizan prácticamente los mismos padres. El objetivo de obtener variedades autofertiles queda un poco en duda debido a que no es esencial y al producir cosechas excesivas reduce en forma importante los calibres de los frutos.

3.- En las prácticas de manejo y sobre todo en la poda de formación se pudo observar que las prácticas utilizadas por los estadounidenses y canadienses no distan mucho de las prácticas que se utilizaron en Chile por muchos años, como el "central leader" con algunas formas nuevas como una desviación el "steep leader" y otros más modernos como el "Spanish bush" "vasito español" a la manera norteamericana y el "Vogel central leader". Sin embargo, en opinión personal el Solaxe poco difundido en EEUU y el resto del mundo tiene muchos beneficios y ventajas que no son apreciadas o desconocidas en los huertos visitados.

4.- En cuanto al riego, fertilización, control de heladas, lucha contra la partidura del fruto y control de malezas se pudo apreciar lo más importante en cuanto a la práctica general adoptada.

5.- En manejo de cosecha, postcosecha, maquinarias de proceso, empacado, atmósfera modificada se pudo observar interesantes avances y formas de organización.

6.- Una práctica de manejo que se debe analizar a parte es la aplicación de reguladores de crecimiento en los frutos. En EEUU prácticamente la única variedad o las más importante lejos es BING, principalmente por su versatilidad y firmeza en postcosecha. Esto se debe a que los

packings de gran envergadura (Procesan en una línea 20 t/hora) o mediana están calibrados para recibir esta variedad. Para esto producen el fruto a diferentes altitudes distribuyendo la cosecha y aplicando AG_3 para obtener calibres de gran envergadura. Se puede aumentar el peso del fruto en 1 o 2 g con la aplicación de este regulador de crecimiento.

7 .- La producción de cereza orgánica no esta ausente a pesar que en este país existe graves prolemas como la mosca de la cereza; pero sin embargo es un mercado pequeño pero que si es estable. La idea es reemplazar los pesticidas y fertilizantes por productos de fuente orgánica; este concepto difiere de la idea de orgánico que se tiene en Europa.

8.- Un punto que requiere detenerse para analizarlo es la baja incidencia de cáncer bacterial. La pregunta que se puede hacer es:¿ las prácticas de manejo como riego y fertilización son las adecuadas?. ¿Se realiza un buen control del patógeno con los producto, dosis y cobertura como lo hacemos en Chile? Y finalmente ¿nuestros portainjertos y plantas al establecer un huerto son las más adecuadas?

3. Itinerario Realizado: presentación de acuerdo al siguiente cuadro:

Fecha	Actividad	Objetivo	Lugar
24 - 26 de junio de 2001	Participación en el Symposium Temas: mejoramiento genético, entomología y visita técnica 27 de junio. El 25 de junio se hizo una visita a un huerto de 500 ha y packing en la zona de Dalles al costado del río Columbia. La visita del 27 fue a huertos de Bing y ensayos de portainjertos principalmente en el Valle del Columbia y el Yakima.	Recopilar antecedentes técnicos, económicos y personales de técnicos, agricultores y comerciantes que participen del evento	Oregon (Hotel Best Western Hood River Inn)
28 y 29 de junio de 2001	En el Symposium se vieron los aspectos de fisiología y manejo de huerto. Se realizó una visita al Valee de Yakima donde se observaron ensayos en los aspectos de reguladores de crecimiento y otros de formación de árboles. Se vio patología y postcosecha. Business meeting	Se le asigna importancia para evaluar la disposición a invertir, comprar y comercializar cerezas desde el sur de Chile es decir después del 15 de Diciembre.	Washington (Hotel Shilo Inn en Richland)
30 de junio al 2 de julio	Visita Summerland Research Center y huertos de cerezos en el valle del Columbia y Okanogan. Se Visitó el packing de cerezas más grande del mundo. En el lago Chelan se visitó una producción orgánica de cerezas y finalmente en Penticton se vistó un huerto y la estación experimental	Conocer y obtener información sobre uno de los centros más importantes en el mundo para la obtención de variedades de cerezo y entrevista personal con Franck KAPPEL director del programa. Se obtuvo información de producción orgánica de cereza y algunos ensayos con portainjertos	Bus Oregon a (Penicton) Summerland.

Señalar las razones por las cuales algunas de las actividades programadas no se realizaron o se modificaron.

4. Resultados Obtenidos: descripción detallada de los conocimientos adquiridos. Explicar el grado de cumplimiento de los objetivos propuestos, de acuerdo a los resultados obtenidos. Incorporar en este punto fotografías relevantes que contribuyan a describir las actividades realizadas.

Se pudo discutir sobre los diferentes portainjertos que se están probando en las experiencias que tenemos en Chile. Tabel Edabriz que se tiene como un portainjerto enanizante y que se incluye en los ensayos con que se cuenta es muy susceptible a Virosis, las que le causan la muerte y por ende de la planta completa (PDV y PNRSV). No es factible pensar en el desarrollo de este portainjerto bajo las condiciones de los viveros en Chile, para esto se debe contar con plantas certificadas y no con el material con que se propaga hoy en día. Este portainjerto no es adecuado tampoco para la zona norte de nuestro país con suelo y teperaturas muy altas para su adaptación, sin embargo esto está en discusión, lo que si se pudo observar es que en suelos arenosos este patrón se comporta bastante mal, reduciendo en forma importante los calibres de los frutos y afectándose en forma importante su desarrollo. Esto también es válido para el otro portainjerto Gisela 5 que a pesar de no ser sensible a virosis su desarrollo con estos patógenos se ve muy afectado. Otros puntos importantes para el Gísela 5 y Tabel son que debe cuidarse muy bien tanto la fertilización como el riego. Gisela 6 es una buena alternativa que se debe tomar en cuenta por su mayor vigor co respcto a estos otros y su tolerancia a problemas de virus. Tabel, Gisela 7, 11 e incluso 10 son muy sensibles a virus y su muerte es inevitable, para las condiciones actuales de propagación de nuestro país no son viables (Ensayo inoculación de virus en Prosser WSUniversity). Maxma 14 un buen portainjerto que no está presente en EEUU pero lo están retomando debido al éxito que tiene e Francia. Tampoco tienen mucha idea sobre el Pontaleb, de una gran proyección en nuestro paísUn punto que debe destacarse con respecto los ensayos de patrones vistos en Prosser es que no se detectaban diferencias significativas en el vigor de los árboles injertados sobre distintos portainjertos incluyendo los Gisela, los Damil, Inmil y Camil de origen Belga. Un portainjerto para cerezo de buena proyección es el P-HL A (y C) de origen checo que podría tener un interesante devenir en los próximos años. Sin embargo en ensayos con "Hedelgingen" se pudo aprecias una aparente incompatibilidad. Weiroot 158 es un portainjerto que se encuentra en el país pero no se apreciaron grandes ventajas de este patrón en los trabajos presentados, salvo en Italia donde junto al MM 14 presentaron una alta eficiencia productiva y no redujeron significativamente el tamaño de los frutos. Otros patrones también evaluados en el mundo son el CAB 6 de buena proyección pero nada destacable, sin embargo presenta gran cantidad de sierpes al igual que CAB 11 y Vladimir (selección de *P cerasus*). Otros patrones de relativamente reciente ingreso al mundo de los ensayos en cerezo son los PiKu.

Los portainjertos enanizantes como el Gisela 5, Tabel, y también GM61/1 y Gisela 10 incluso se mostraron en todos los ensayos como inductores de una disminución significativa del tamaño de los frutos en las distintas variedades. Sin embargo, estos patrones inducen una menor sensibilidad a lla partidura de frutos, esto se basa en una menor importación de agua desde las raíces cuando llueve.

El Mazzard es el patrón más utilizado en los huertos vistos en los 3 estados visitadostodavía y se le maneja con gran intensidad de poda. Es un patrón que no reduce el tamaño de los frutos y que a pesar de su vigor puede ser manejado en forma eficiente. Uno de los problemas más importantes es u baja precocidad en entrar en producción.

En los portainjertos ensayos realizados en SUMMIT y Garnet muestran que en general los portainjertos enanizantes disminuyen el tamaño del fruto.

	SUMMIT			GARNET		
	Tabel	G5	MM14	Tabel	G5	MM14
% diam. tronco	72	41	100	52	57	100
Prod. Kg /cm^3	46	66	40	61	69	39
Kg / arbol	143	116	168	122	142	145
G / fruto	8.1	8.6	8.7	6.0	6.2	6.6

También hay ensayos con P-HL A que muestran una disminución del tamaño.

Un resultado interesante obtenido en Portugal es que a medida que se injerta más alto con patrones enanizantes, se disminuye el vigor de la variedad (la diferencia se hizo entre 10 y 60 cm).

En cuanto a variedades se presentaron algunas de reciente introducción al mercado en los diferentes programas de mejoramiento en el mundo.

Programa de Summerland:

- **Skeena,** variedad autofertil, floración media tardía, 11,1 g de peso de fruto promedio, firme, con una supuesta tolerancia a partidura. Madura 14 días después que Van.
- **Sttaccato**, variedad que le asignan gran importancia los mejoradores de esta parte del mundo debido a lo tardía, más tardía que Sweetheart, de 11 g de peso de fruto, 17 de cracking. Los agricultores de este país no quieren que se entregue esta variedad a otros paises, principalmente a EEUU.
- **Sonata,** es autofertil, tiene un fruto de 12 a 13 g, es moderadamente susceptible a partidura de fruto firme y madura una semana después de Van. Existen comentarios negativos con respecto a su producción.
- **Celeste (Sumpaca),** de fruto firme, con 10,7 g de peso promedio, autofertil pero con dificultades en la producción.
- **Cristalina (Sumnue),** de 10 g de peso de fruto, madura 5 días antes que Van, tolerante a partidura, se puede cosechar sin pedicelo y es del Grupo II de polinisación.
- **Samba,** madura casi con Van de 11,6, bastante firme, de buena tolerancia a partidura, autofertil, pero no es una variedad precoz.

Se debe tener mucho cuidado con las variedades que dicen ser resistentes o tolerantes a partidura en este programa, esto ya que el clima en verano es absolutamente seco. De aquí la diferencia de apreciación con respecto a **Swetheart**, que dicen sería tolerante a partidura lo que en experiencias europeas no es así. También se debe tener cuidado con esta variedad debido a la presencia de virosis en las plantas propagadas. Un dato práctico con respecto a **Summit** es investigar bajo nuestras condiciones como mejorar la firmeza del fruto retrasando la cosecha (punto a investigar).

Celeste es una variedad que es sensible a partidura y con un árbol difícil de conducir, fue abandonada en Francia.

Variedades húngaras:

- **Rita,** que madura 2 semanas antes que Napoleon de 8 a 10 g
- **Anita**, madura 6 días después, muy firme , 8 g, bueno para la industria y cosecha mecánica.
- **Aida,** 10-11g madura 10 días después de Burlat, para cosecha mecánica.
- **Peter,** 10 días antes de Burlat sería su madurez
- **Alex,** autofértil, de 8 a 9 g
- **Ukrodnaya,** madura 10 días después de van, 10 – 12 g

Variedades Australianas:

Sus objetivos en el mejoramiento son resistencia a partidura, frutos de gran tamañ (> 25 mm), autopolinizantes y de maduración temprana.

- **Sir Tom**: autofertil, tolerante a partidura, de 10,8 g de peso de fruto.
- **Sir De**n: de pedicelo largo, para fresco, 9,3 g y de muy buena producción
- **Dame Roma**: Sensible a partidura de 10,9 g pero el 90% de los frutos mide ás e 25 mm de diámetro.

Existe una selección de KB 7,1 de 17 g de fruto promedio.

Programa Italiano:

- **Sweet Early**: Similar a Burlat en madurez de 9 g
- **Grace Star:** de 12 g y homogénea al madurar
- **Black star:** Resistente a partidura de 10,5 g y autifertil.
- **Lala Star**: Semi compacta (SPUR), autofertil, de 8,2 g precoz en entrar en producción similar a Lapins en el fruto, muy productiva

Washington State University (Greg Lang):
Objetivos: fruto de gran tamaño y calidad autofertil, resistente a mildew, de floración tardía y tolerante a partidura, focalizadas en nichos de mercado.

- **Tieton** (1998) Stella x Burlat: Fruto firme, 11 –13 g, madura 6 a 8 días antes que Bing, tiene una prolongada vida en postcosecha y el pedicelo tiene mayor vida que el fruto incluso. Polinizada por BING.. Tiene una gran producción en los portainjertos nuevos (G 5, 6 ,12, Tabel.
- **Columbia** (Stella x Beaulieu): autofertil, de fruto firme, grande, alto contenido de azúcar excelente sabor. Florece tardíamente con una alta producción y baja susceptibilidad a partidura.
- **Liberty Bell** (Rainier x Bing) x Stella: de fruto firme, rojo, con 11 a 13 g de peso que madura 10 días después de Bing. Tiene alta producción, es autofertily sensible al viento.

Francia – INRA:
Estas variedades no son autofertiles porque en el programa francés no se busca esta característica. Esto se basa en la certeza que las variedades autofertiles presentan en general menores tamaños de fruto debido a su gran producción.

trade, and the rapid expansion of production in various emerging nations, the economic picture is rapidly changing. Many smaller, less efficient producers face financial failure, as varieties they grow have returned well below their expenses for the past five seasons. As these orchards are removed, the present owner may not have the resources to replant, and will go out of the fruit production business.

Throughout this downturn, production in the region of the major tree fruits continues to rise. Apple and pear production increases are slowing, though the mix of new trees planted promise major changes in the availability of the more popular varieties. Pear production is increasing very slowly, as demand remains static, and exports are almost counterbalanced by imports into North America. Sweet Cherry production is poised to increase markedly, as plantings have increased by 60% or more over the past five years. Increased production from these recent plantings will enter the market during the period between 2001 and 2011.

This is a period of rapid change and turmoil in the tree fruit industry, but the general feeling amongst the growers is cautious optimism. They are certain that their efficiency and the quality of the fruit produced in the region will give them the competitive edge in the world market, assuring the industries' long-term survival. However, many individual family farmers are uneasy about their personal future, and are not certain how the industry will reconfigure over the next decade.

- **Ferpin**
- **Feria**
- **Ferpact**
- **Fertar:** gran vigor, madura 36 a 40 días después de Burlat o 10 a 12 días después de Sweethearth, con un fruto de 10,5 a 12 g tolerante a partidura.
- **Ferobri:** Madura 10 a 14 días después de Burlat y es lo que podría llamarse "resistente" a partidura. Su fruto pesa 11 a 12 g
- Fermina (V3122): madura 22 a 24 días después de Burlat con 10 a 11 g.

No se presentan los datos de guindo ácido, debido a que no era parte del objetivo del viaje y por que de lo contrario sería muy extenso todo el informe.
Una visión general de las visitas efectuadas puede resumirse de la siguiente forma:

En cuanto a la poda de Formación y manutención se puede decir que el sistema de Eje Central es el más aplicado en los huertos visitados. La poda de manutención requiere de sendos cortes de poda en invierno hasta la madera de 2 años generándose brotes en primavera verano que alimentan los frutos en la madera de 2 y 3 años. Este sistema es bastante exgente en mano de obra y también poco precoz en entrar en producción. El Vasito Español otro sistema de formación utilizado pero sobre todo en plantaciones de 1 a 3 años es un sistema en el que podan en forma intensa y en suelos de alta fertilidad se utilizan portainjertos enanizantes solamente, se parte con 4 ramas madres. Se poda intensamente de manera de reducir el crecimiento y de lograr producción en la base de las ramas, esto se realiza durante el periodo de crecimiento. El Steep Leader es un sistema que puede ser aplcado en toda circunstancia y algunos huertos experimentales o nuevos 4 a 5 años ocupan este sistema. El Vogel Central Leader es un sistema en que se al árbol a tener ángulos muy abiertos a través de "Pinzas para colgar la ropa". Se va formando loas diferentes ramas a lo largo del eje distribuidas en forma homogénea. Todos estos sistemas están explicado en forma más detallada en publicación anexa "Cherry training Systems" de Lynn Long (2001).

Otro aspecto a destacar es la aplicación de AG_3 para el incremento del tamaño del fruto, esto se realiza en forma común en todos los huertos del valle visitado. Esta práctica se realiza en el momento del cambio de color del fruto desde verde a amarillo (3 a 3,5 semanas antes de la cosecha), en dosis de 25 ppm y en un volumen de 1500 a 2000 l/ha aprox. En algunos huertos incluso lo realizan en 2 o 3 oportunidades y en dosis que pueden alcanzar los 40 ppm sobre todo en Sweethhaert (no en BING). Los resultados son bastante interesantes alcanzándose 1,5 a 2 g de incremento en el peso promedio del fruto. Tiene si efectos negativos a tener en cuenta, uno es el retraso de la madurez del fruto en alrededor de una semana (puede ser también positivo según donde se encuentre) y aumenta la susceptibilidad a partidura, tampoco se debe aplicar en huertos orgánicos. En todo caso los resultados son espectaculares en el amaño de los frutos.

El riego se realiza casi exclusivamente a través de microaspersión, lo que implica un mejor mojamiento, eficiencia y calidad en general que el riego efectuado en Chile. La fertilización se hace a través del equipo de riego (fertirrigación). Esto podría explicar en parte la menor incidencia de cáncer bacterial en este país, además se debe destacar la excelente calidad sanitaria de las plantas de vivero(libres de virus y *Pseudomonas sp*). Las situaciones de estrés en que viven las plantas en nuestro país es una d las posibles explicaciones de la alta incidencia de este problema en Chile. No se debe olvidar también el tipo de maquinaria que en Chile es bastante deficiente sin llegara cubrir todo el árbol y con problemas en la dosificación y

homogeneidad del producto aplicado. La fertilización foliar se realiza con Zinc 1 a 2 aplicaciones por temporada. Calcio no aplican debido al efecto en la disminución en el tamaño de los frutos.

El Boro como microelemento es interesante de investigar sobre todo por su efecto durante la polinización ya que en guindo ácido aplicaciones de boro aumentaron el número de frutos. Se realizan aplicaciones también de Etephon (200 ppm) para botar las hojas, la Promalina 500 ppm) por el contrario retrasa la caída de las hojas. Este producto aumenta el tamaño de las yemas, adelanta la floración y aumenta la cuaja de frutos. Se puede ver también el efecto de urea foliar en dosis de 2,4, 6 % en aplicaciones al árbol durante el otoño ayudan a botar las hojas (también se realiza en Chile. "Apogee" es regulador de crecimiento con un efecto de antigiberelina se aplica en investigación para reducir el tamaño de los árboles en 1/ mayo y junio (existen experiencias en Chile pero no se sabe si el producto va a ser comercializado).

Otro trabajo interesante es la aplicación de aceite vegetal de comer (de maiz el mejor) para raleo de frutos. La aplicación se realiza durante la floración pero tiene que realizarse temprano ya en plena floración (80%) o tiene resultados, los efectos tienen que analizarse en cada país para evaluar su utilización. El secreto de esta aplicación esta en el producto, que debe ser natural, para emulsionar el a aceite. Esta información no fue dada por la persona que realizó el trabajo. Otro punto interesante durante la floración es el efecto de la temperatura en la cuaja, se vio que con temperaturas de 15°C hay una mayor cuaja de frutos que con 25°C.

El control de heladas merece una mención especial debido al uso de equipos muy costosos como hélices fijas. Las utilizan para control de heladas y disminuir la incidencia de partiduras cuando corresponde. También utilizan helicópteros para secar los árboles cuando puede haber partidura. Con un 30% de frutos partidos no es económica la cosecha.

La cobertura con plástico para evitar problemas tanto durante la floración (menos) como durante la madurez par evitar la partidura. Los resultados muestran que la disminución de la partidura de frutos no fue total esto principalmente debido a que los huertos no se riegan. También la cobertura disminuyó el contenido de azúcares de los frutos y ayuda a disminuir el efecto de las heladas. En rainier por falta de color establecen una cinta a modo de espejo en el suelo que refleja toda la luz.

La eficiencia en la cosecha es destacable sobre todo los trabajadores que en un predio de 500 ha cosechan 450 kg/día en jornadas de 9 horas, en un huerto viejo de 15 año con escaleras una altura de 3,5 metros. La cosecha puede ser bastante espectacular yendo de las 7 ton/acre (ton real) (15 ton/ha) hasta las 11 ton/ acre (24 ton/ha) en huertos de Sweetheart sobre Mazard de 10 años.

Como polinizante de Bing utilizan Lapins porque tiene buen calibre y emplean 2 panales por acre ($/ha).

En los aspectos de costos se puede destacar que el costo de poda para ellos puede alcanzar los 300 a 400 US$ por temporada

Un aspecto interesante es un trabajo inglés en el que se daba a conocer la oferta de cerezas en ese mercado.

	En	Feb	Mar	Abr.	May	Jun	Jul	Ago	Sep	Oct	Nov	Dic
NZ	X	X										X
Australia	X	X										X
Chile										X	X	X
Sudafrica											X	X
España Turquía					X							
Resto Europa						X	X					
Noruega								X	X			

Prácticamente la oferta esta presente todo el año en el mercado inglés, sólo faltan los meses de marzo y abril para cubrir todo el año. Existen algunas semanas dentro del resto de los meses del año en los cuales la oferta no existe. Existe un incremento importante del consumo o segundo "pick" durante los meses de Diciembre a febrero en este país y que destaca el trabajo presentado.

Cuadro de superficie y producción de cerezas en EEUU (2000)

	Superficie		**producción**	**fresco**	**congelado**	
	acre	ha	%	%	%	
California	19000	7689	42	66		
Washington	18000	7285	23	72		
Oregon	11000	4452	19	39		
Michigan	7900	3197	13	3		75
Otros	2100	850	3			
Total	58000	23473	100			

La variedad para proceso que desplazado a Napoleón en los EEUU es la variedad **GOLD** con un precio de 34 centavos por libra es decir 75 centavos de dólar por kilogramo ($495).

Existen packing que procesan 20t/ hora y con un costo que va de los 25 centavos de dólar por libra (55 centavos por kg) hasta los 45 a 55 centavos de dólar, a esto se le debe sumar el costo de cosecha que es de 15 centavos de dólar por libra es decir 33 centavos por kilogramo. En este valor influye la velocidad con que pasa la fruta por el packing, es así como factores como frtos pequeños, heterogeneidad de calibre el hecho de cambiar de variedad como por ejemplo BING a otra como Lapin o Swetheart puede ser muy complicado por los costos de empacado que ello implica.

El equipo de procesos funciona con diferentes organigramas pero básicamente es lo mismo desde el punto de vista del sistema en dos de los packing visitados. Los frutos se movilizan por el agua (500 ppm de Hipoclorito de Sodio y 1°C) para evitar los golpes y para iniciar el proceso de vaciado. Los frutos son primeramente seleccionados después calibrados en cintas

divergentes. Posteriormente son embalados en cajas de 18 y 20 kilogramos según el destino. En esta etapa existe diferentes sistemas en los cuales se emplean bolsas de permeabilidad diferencial a los gases o se suministra una atmósfera modificada con 3 % de O_2 y 18 a 20 % de CO_2 después de haber extraído todo el aire del envase creando vacío. El equipo sella la bolsa plástica para ser enviada. Los frutos de deshecho van a plantas de jugo. Se visitó un packing bastante interesante con una tecnología bastante aplicable a nuestras condiciones cuyas fotos se muestran en donde corresponde.

Con respecto a cerezos orgánicos se visitó un huerto de 10 ha aproximadamente en los cuales el principal problema era el control de la mosca de la cereza, el cual realizaban con piretrina (Piganic producto comercial orgánico), La fertilización la hacen con compost de gallina y harina de pescado (Huerto en el lago Chelan).

5. Aplicabilidad: explicar la situación actual del rubro en Chile (región), compararla con la tendencias y perspectivas en el país (región) visitado y explicar la posible incorporación de los conocimientos adquiridos, en el corto, mediano o largo plazo, los procesos de adaptación necesarios, las zonas potenciales y los apoyos tanto técnicos como financieros necesarios para hacer posible su incorporación en nuestro país (región).

Uno de los aspectos más relevantes para el futuro del desarrollo en Chile del cerezo es la importancia de contar con material de calidad y probado bajo nuestras circunstancias. Por ejemplo no se sabe si la variedad Sweetheart que tenemos en Chile está libre de virus o es la variedad que venía desde Canadá ya con problemas de virosis, Francia tiene este problema con las plantas de esta variedad. Todos lo patrones enanizantes tienen problemas cuando se injertan variedades con virus, esto unido a la falta de un programa serio de certificación de material en Chile impide pensar en portainjertos como Tabel (muerte de plantas de este portainjerto con virus) o Gisela 5 (escaso desarrollo). Estos patrones tampoco son una alternativa para suelos pobres o en zonas cálidas. Por lo tanto debe cuidarse mucho el material propagado así como donde se establezcan las plantas.

En estos momentos debe evitarse establecer plantas con portainjertos enanizantes debido a su efecto en el calibre del fruto y los riesgos de muerte y vigor de plantas de plantas. Portainjertos de vigor intermedio con prácticas de manejo que induzcan una rápida produción seben ser las soluciones para chile en estos momentos.

No hay un programa de mejoramiento de esta especie en Chile, por lo tanto la incorporación rápida de variedades a nuestro país es un factor esencial para obtener variedades de reconocida calidad o potencialmente interesantes. Si en estos momentos hay una variedad interesante en el mundo es muy difícil entrarla a Chile en forma rápida y poder producir, esto debido a las últimas normas del SAG (resolución de 1998). Para esto se requiere de un programa de ingreso de material en forma rápida y segura como por ejemplo el cultivo in vitro:

a.- Se puede obtener una plantación comercial de una variedad en 1 o 2 años versus los 6 a 7 años que demora la introducción y producción de una variedad en estos momentos. Esto si no existen problemas fitosanitarios en el intertanto.
b.- El ingresar material "in vitro" tiene una ventaja muy importante desde el punto de vista sanitario con respecto al ingreso de tierra, insectos, hongos, bacterias e incluso virus

c.- Puede incorporarse rápidamente el material a un programa de mejoramiento por técnicas de biología molecular.

Con respecto a reguladores de crecimiento el AG_3 se puede incorporar a la producción en Chile debido a la exigencia en tamaño de fruto que viene en el futuro del mercado de la cereza. Los diámetros que hoy se exportan en Chile como por ejemplo 22 mm, no serán aceptados en el futuro cercano. Variedades como Van también deben cuestionarse así como las variedades autofértiles para el Norte y Centro de Chile debido a este problema. Excesos de carga redundarán en frutos pequeños y sin mercado. El Calcio es un microelemento que se aplica en forma normal en Chile y que disminuye el tamaño del fruto, este elemento debería eliminarse de los programas de manejo de los huertos debido a su escaso efecto en la partidura y a la falta de investigación de sus beneficios en postcosecha.

El riego y la fertilización son elementos que se deben tener muy presentes no sólo por la producción que es muy baja en Chile y los problemas que causan al afectar el tamaño del fruto, sino también por el cáncer bacterial que puede estar muy relacionado con este manejo.

El tamaño del fruto también es afectado por los virus presentes en las plantas y el estado sanitario general del árbol, lo que es muy deficiente en Chile. Además se debe considerar que los portainjertos enanizantes disminuyen el tamaño de los frutos y en muchos casos en EEUU no son una alternativa por este problema.

En Chile la incidencia de Cáncer bacterial, estaría relacionada en gran proporción por el **manejo de riego, fertilización, aplicación de pesticidas** (dosis, equipos de aplicación y cobertura) y **lo heterogéneo y el estado sanitario (virosis) de los portainjertos y variedades** utilizadas en este momento. Esta es la conclusión a la que s ha llegado con los asesores externos que han venido a Chile.

El actual nivel técnico de producción en Chile no alcanza para llegar a producción de 20 ton/ha que son los niveles que se hablan en Europa y EEUU (24 t/ha incluso).

La incorporación del cultivo orgánico debe hacerse para atacar ese mercado que aunque sea pequeño constituye una buena oportunidad para productores nacionales. Sin embargo, el desarrollo de esta alternativa está atada a resolver los problemas anteriormente expuestos para que sea una realidad. Chile desde el punto de vista fitosanitario posee ventajas en esta especie sobre todo en lo relativo a problemas entomológicos (mosca de la cereza) y algunos fungosos (Monilia).

Incorporar la variedad Gold para procesos es un punto a retener debido a su calidad para procesos ya reconocida en terreno en EUU.

Conclusiones:

1.-Se debe tener cuidado con los mercados de Enero y Febrero donde Nueva Zelanda y Australia son competencia directa. Sobre todo para la zona sur de Chile.

2.-Se deben incorporar las técnicas de formación aplicadas en Europa, principalmente técnicas asociadas al Solaxe debido al menor costo en poda y cosecha así como al menor riesgo fitosanitario que tiene realizar menos cortes de poda.

3.- Deben utilizarse en la medida de lo posible portainjertos homogéneos en cada huerto y que posean una precocidad en producción importante (Pontaleb, MM14, G6, G5 y Tabel si se puede, incorporar P-HLA, los Piku). Obviamene tiene que dilucidares portainjerto y variedad más adecuada. Por ejemplo se debe tener cuidado en suelos arenoso con portinjertos de bajo vigor.

4.- En conclusión se requiere de un programa de certificación de material lo que es muy importante en esta especie, para que realmente se llegue a un huerto moderno.

5.- El manejo del riego, la fertilización , control de malezas, sanitario, de manejo de reguladores de crecimiento y poda es muy importante de mejorar en Chile. Est se puede lograr a través de la investigación y la incorporación de técnicas simples en huertos para mejorar la sanidad, la calidad de los frutos (calibre) y la producción.

El riego debe ser presurizado (goteo o microaspersión a evaluar). Fertilización, nitrógeno y su influencia en la producción y calidad de exportación (Incluye vida de postcosecha). Boro, Zinc y calcio como microlementos deben ser investigados. Se debe tener especial cuidado con patrones menos vigorosos.

Investigar las prácticas a implementar para producir productos libres o con la menor cantidad de pesticidas.

6. Contactos Establecidos: presentación de acuerdo al siguiente cuadro:

Se presentan algunas direcciones, las más importantes el resto se presentan en cuadro anexo.

Institución/Empresa	Persona de Contacto	Cargo/Actividad	Fono/Fax	Dirección	E-mail
CTIFL Francia	Gérard Charlot	Ingeniero	3346601 1054 y 3346601 6228	30127 Bellegarde Francia	charlot @ctifl.fr
Oregon State University	Lynn LONG	Ph D Extensionista Oregon State U.	5412965 494	400 E, Scenic Drive, Suite 2.278, The Dalles, OR	Lynn.long@orst.edu

				97058 USA	
International Plant selection	Alexandre Darnaud	Dueño	3349030 0018	Route de marseille of 125 – Montelimar cedex, France	Intpsel@ wanadoo. fr
SAT Rio Cinca	Manuel Raventós	Dueño	34.97434 5141	Finca san Miguel, San Miguel, Huesca, España	Cpfinca @svt.es
U. degli Studi di Milano – Dipartam-ento di produzione vegetale	Claudia Piagnani	Investigadora en biotecnología	3902706 00165	Via Celoria 2 , Milano, Italy 20133	Claudia.p iagiani@ unimit.it
Agri-Food Canada	Frank Kappel	Mejorador	2504946 373		Kappelf @em .agr.ca

7. Detección de nuevas oportunidades y aspectos que quedan por abordar: señalar aquellas iniciativas detectadas en la actividad de formación, que significan un aporte para el rubro en el marco de los objetivos de la propuesta, como por ejemplo la posibilidad de realizar nuevos cursos, participar en ferias y establecer posibles contactos o convenios. Indicar además, en función de los resultados obtenidos, los aspectos y vacíos tecnológicos que aún quedan por abordar para la modernización del rubro.

- Es muy importante incorporar tecnologías en los aspectos e proceso de los frutos que se exportan, sobre todo en el manejo de packing, tratamientos, temperatura, atmósferas modificadas y embalajes. Somos los principales exportadores del Hemisferio Sur en esta especie y no estamos la altura de lo que esto significa en cuanto a investigación y desarrollo.

- El futuro de esta especie es muy competitivo en el ámbito comercial y debe realizarse una buena promoción e investigación en esta especie en el mundo.

- Se pretende establecer un convenio con el CTIFL de Francia con quién estableceríamos un convenio como Universidad y con los productores que ellos agrupan para establecer convenios comerciales para atacar mercados en conjunto y compartir formación e información en esta especie. En este marco se intentará invitar un grupo de agricultores franceses para el próximo año.

8. Resultados adicionales: capacidades adquiridas por el grupo o entidad responsable, como por ejemplo, formación de una organización, incorporación (compra) de alguna maquinaria, desarrollo de un proyecto, firma de un convenio, etc.

9. Material Recopilado: junto con el informe técnico se debe entregar un set de todo el material recopilado durante la actividad de formación (escrito y audiovisual) ordenado de

acuerdo al cuadro que se presenta a continuación (deben señalarse aquí las fotografías incorporadas en el punto 4):

Tipo de Material	Nº Correlativo (si es necesario)	Caracterización (título)
Ej.:		
Artículo	1°	ISHS 4th International Cherry Syposium - The Dalles Tour
	2°	Segundo Anuncio 4° Symposium
	3°	Post Symposium Tour
	5°	Cherry Training Systems
	6°	CATTS (Controled Atm/Temp. Trat System) Quarantine treatments
	7°	New Sweet Cherry Cv. in Italy
	8°	Characterization of rootstock Influence on Flower Bud and Spur Formation...
	9°	Sweet Cherry prospection in Southern Chile (Artículo llevado)
	10°	Stone Fruit Program (Sweet Cherry) Summerland
	11°	Infos Cerise (Variedades) Francia
	12°	Infos Cerise (Portainjertos) Francia
	13°	Ambrunés Sweet Cherry Quality Factors
	14°	Controlled Atmosphere of Bing
	15°	Lista de participantes en e Simposio y programa y abstract
Foto	1	Valle Wanatchee, diferentes alturas de producción
Foto	2	Huerto Producción orgánica
Foto	3	Huerto orgánico
Foto	4	Huerto nuevo
Foto	5	Huerto alta densidad
Foto	6	Arbol anillado en alta densidad
Foto	7	Control Heladas
Foto	8	Variedades Summerland
Foto	9	Variedades Summerland
Foto	10	Packing – Bins

10. Aspectos Administrativos

10.1. Organización previa a la actividad de formación

a. Conformación del grupo

____ muy dificultosa ____ sin problemas ____ algunas dificultades

(Indicar los motivos en caso de dificultades)

b. Apoyo de la Entidad Responsable

____ bueno ____ regular __XXXX__ malo

(Justificar)

c. Información recibida durante la actividad de formación

XXXX amplia y detallada ____ aceptable ____ deficiente

d. Trámites de viaje (visa, pasajes, otros)

____ bueno XXX regular ____ malo

e. Recomendaciones (señalar aquellas recomendaciones que puedan aportar a mejorar los aspectos administrativos antes indicados).

Es difícil obtener las visas desde provincia.

10.2. Organización durante la actividad (indicar con cruces)

Ítem	Bueno	Regular	Malo
Recepción en país o región de destino	XXXX		
Transporte aeropuerto/hotel y viceversa	XXXX		
Reserva en hoteles	XXXX		
Cumplimiento del programa y horarios	XXXX		

En caso de existir un ítem Malo o Regular, señalar los problemas enfrentados durante el desarrollo de la actividad de formación, la forma como fueron abordados y las sugerencias que puedan aportar a mejorar los aspectos organizacionales de las actividades de formación a futuro.

11. Conclusiones Finales

12. Conclusiones Individuales: anexar las conclusiones individuales de cada uno de los participantes de la actividad de formación, incluyendo el nivel de satisfacción de los objetivos personales (no más de 1 página y media por participante).

Me permitió ver la realidad en un país muy diferente a las condiciones del resto de los países productores de esta especie que yo conocía. Los volúmenes así como la organización son diferentes a lo que se puede realizar e nuestro país. Son criterios muy simples pero que en la práctica les resultan muy bien. Tienen una buena variedad que es BING y Rainier para fresco y Napoleón para procesos (ahora GOLD). También pero en mucho menor importancia está Lapins y Sweetheart. Los programas de mejoramiento no tienen mucho impacto sobre lo que cultivan y plantan los agricultores. Tienen un fruto de calidad aplicando reguladores de crecimiento con un clima sin lluvia en primavera o durante la cosecha, con diferentes altitudes par adelantar o retrasar la producción. Con "packing" enormes para un consumo interno y la exportación.

Fecha: 24 de julio 2001

Nombre y Firma coordinador de la ejecución: _____

Jean Paul Jaubtan M.
Ingeniero Agrónomo

→ 13-N-7-19 = Foliar quarta aplicación

ISHS 4th International Cherry Symposium

The Dalles Tour

25 and 27 June

→ Bing/G6
→ 30% cracking no coated
→ helices y helicopteros para recer
→ aplic. 25 ppm AG en todos lados
→ Regina G6 6/12 6/5
=) ran a bop

- Zn Bo
→ N 40 pounds

Lynn E. Long
Oregon State University
The Dalles, Oregon

→ Rows nº de polos 10% polyados
→ Nº 40 pounds / acre
→ Helices, helicopteros para recer arboles
→ AG aplicación 25 ppm cuantas Aplicaciones ?

America's Cherryland: Wasco County, Oregon

Wasco County, in North-Central Oregon, borders the Columbia River and is located at the eastern end of the beautiful Columbia River Gorge and the western end of the Columbia Basin. The principal crops are dryland wheat, livestock, mostly cattle and tree fruits, mainly sweet cherries. Besides agriculture, other principal industries include power generation from two local dams and aluminum production.

Approximately three-fourths of the 22,000 people of Wasco County live in or near The Dalles, which is the county seat, located along the Columbia River, 85 miles east of Portland. The Dalles is the main shopping center for the region with an excellent medical center and community college.

The weather features four distinct seasons with warm summers, cool winters and many clear sunny days. The Columbia Gorge and Mid-Columbia areas are noted for their outstanding beauty, and year-round recreational opportunities including hunting, fishing, skiing, windsurfing, and hiking.

Cherries have been grown in Wasco County since the county was first settled in the 1850's. Wasco County is well suited for cherry production due to its deep, fertile soils and hilly terrain providing good air drainage and frost-free growing conditions. However, the most important factor contributing to the success of the cherry industry in Wasco County is its location east of Mt. Hood. The rain shadow provided by Mt. Hood provides the county with many sunny days and only 12 inches of precipitation per year. Sunny days are very important to mature the crop and to keep the cherries from being damaged by rain as they begin to ripen.

The average orchard size in Wasco County is 80 acres (32 hectares), but many orchards are 200 to 400 acres (81 to 162 hectares) in size. Most growers produce only cherries. Historically, other tree fruit crops were produced including plums, apricots and peaches, but cherries have provided the best return over the long haul and are now about the only crop produced. We grow about 7,500 acres (3.038 hectares) of cherries and only about 300 acres (122 hectares) of other tree fruit crops including apples and pears.

The average sweet cherry production in Wasco County is 25,000 tons (22.675 metric tons). Approximately 40% of these cherries are grown for the fresh cherry market, 40% are made into maraschino and other processed cherries and 20% are canned or used for ice cream and yogurt production.

Historically, the fresh sweet cherry industry in the PNW of the U.S. has been based exclusively on one cultivar, Bing. Bing is a very old cultivar, discovered over 100 years ago in Oregon. The two Northwest states of WA and OR annually produce 50,000 to 60,000 tons (45.350 to 54.420 metric tons) of fresh cherries per year. This averages 55% to 75% of the total fresh production in the U.S.

All but a few thousand tons of the fresh cherries grown in Wasco County are the cultivar Bing. This is an excellent cherry. Probably its two best attributes are its flavor and firmness. However, new varieties are beginning to be grown in Wasco County that provide certain advantages over Bing. These advantages include fruit size, rain cracking resistance and alternate harvest timing. Included here are Lapins and Sweetheart, two late ripening cherries from Canada and Chelan and Tieton, two early ripening cherries from Washington State University.

The processed cherry market is based on a yellow cherry variety called Royal Ann. Through a process developed by Oregon State University in the 1920's cherries are preserved and eventually made into maraschino, glacé and fruit cocktail cherries.

Cherries are part of the landscape and tradition of Wasco County and help to define the people and cities of Wasco County, Oregon.

Potential Fresh Cherry Cultivars for the Mid-Columbia

1/19/2001

Cultivar	Harvest Timing (1)	Approx. Fruit Size	Bloom Timing (1)	Pollinizers	Precocity	Productivity	Suggested Rtstock (a)	Split Susc.	Firm-ness	Tree Form	Fruit Flavor (2)	Overall Quality (2)
Chelan	-10 to -12	11 to 10 row	-2 to -3 overlaps Bing	Bing, Lapins Van, Rainier	excellent	high can overset	Mazzard	< aver.	exc.	mod. spreading	good tart-sweet	very good
Tieton	-6 to -9	9 1/2 row + 10 to 14 grs.	-2 overlaps Bing	Bing, Lapins B.R.,Van,SwHrt	low	poor	GI 5,6, (12?)	> aver.	exc.	vigorous upright	good mild	very good
Cristalina	-5	10 to 9 row 10 grams	+3 to +5	Bing, Rainier Skeena, B.R.	good	high	Mazzard	<aver.	very good	mod. upright	very good mod. Sweet	very good
Bing	0	11 to 10 row 8.5 grams	mid-season	Lapins, Rainier Van, B.R.	moderate	mod. high	Mazzard Gisela 5,6,12	> aver.	exc.	upright	excellent tart-sweet	excellent
Sandra Rose	+3	9 1/2 + 11.6 grams	mid or mid-late	self-fertile	moderate	high	Mazzard GI 5,6,12?	< aver.	good w/ G.A.?	spreading	very good mild-sweet	very good (l)
Sonata	+7	9 1/2 row + 12.7 grams	mid-late	self-fertile	good	high	Mazzard	> aver. (d)	exc.	mod. spreading	good acidic	good to very good (e)
Attika (Kordia)	+10 to +14 (b)	10 row	late -c-	Regina, Sandra Rose, Symphony	good	high & regular	Mazzard GI 5,6 (12?)	< aver.	exc.	spreading	excellent tart-sweet	very good
Lapins	+10 to +14 may be later	10 to 9 row 10.6 grams	-3	self-fertile	moderate	high can overset	Mazzard Gisela 5,6,12?	< aver.	exc.	vigorous upright	excellent tart-sweet	excellent (f,g)
Skeena	+14	9 1/2 + 11.6 grams	mid-late	self-fertile	good	high	Mazzard	< aver.	exc.		good	excellent
Regina	btwn. Lapins & Sweetheart	10 row +	late	Attika, Sandra Rose, Sam,Gold	good	poor	GI 5,6, (12?)	< aver.	exc.	mod. spreading	very good mild-sweet	excellent
Sweetheart	+21 may be later	10 row 8.8 grams	-2	self-fertile	excellent	high can overset	Mazzard	aver.	exc.	mod. spreading	good mild-sweet	very good (g,h)

Fruit and Tree Characteristics

- **a** data lacking on Gisela 12
- **b** large harvest window
- **c** sensitive to frosts immediately before and during bloom
- **d** susceptible to nose cracks due to blossom end dimple
- **e** nose cracks may cause sort-out grading by inspectors
- **f** wind damage can be a problem in early years
- **g** trees show some cold sensitivity
- **h** fruit quality may be detrimentally affected in hot sites
- **I** fruit firmness may be a concern

Note: Information provided in this chart is 'best available' and subject to change

Interpretive Footnotes

1 Listed in days and relative to Bing
(-) earlier and (+) later

2 Subjective measurement

Lynn E. Long
O.S.U. Extension Service

Potential New Cherry Varieties for Oregon

Lynn E. Long, OSU Extension, The Dalles

Chelan[1]

Production Experience: Developed and tested at Prosser, Washington under similar growing conditions to north-central Oregon. For several years now, fruit, grown in Washington and The Dalles, has been successfully packed and shipped by a Wasco County packer. Trees grown in Wasco County have produced high quality fruit but experience is still limited.

Fruit: Chelan can be harvested as early as 10 to 12 days before Bing. The cherry is reportedly Bing size or slightly smaller, however, young trees in Wasco County have consistently produced fruit of equal or larger size. The cherry is similar to Bing in appearance with mahogany red skin and medium to dark red flesh. Fruit is firm and flavorful with some tolerance to cracking.

Bloom: Self-infertile, compatibility Group V (S_3S_5). First bloom is a few days before Bing. Bloom, however, is prolific and generally overlaps Bing. Cross-pollinizers include Rainier, Bing, Van, Black Republican, Lapins and Sweetheart. Incompatible with Tieton.

Rootstock: Chelan fruits heavily requiring good management to achieve optimal fruit size. Precocious rootstocks are, therefore, not needed to achieve early production and a Chelan/Gisela combination may be difficult to manage. Not recommended with Mahaleb.

Tieton[1]

Production Experience: Developed and tested at Prosser, Washington under similar growing conditions to north-central Oregon. Trees have been recently planted in Wasco County but there is limited production experience.

Fruit: Harvest window is six to nine days before Bing. The fruit is very large, potentially 9 row and larger with a beautiful glossy mahogany red finish. The cherry is similar to Bing in appearance with medium red flesh. Fruit has excellent firmness and a mild flavor. The susceptibility to rain cracking is similar to Bing.

Bloom: Self-infertile, compatibility Group V (S_3S_5). Begins blooming slightly ahead of Bing, but generally overlaps well. Cross-pollinizers include Rainier, Bing, Van, Black Republican, Lapins and Sweetheart. More than one pollinizer may be needed to encourage productivity.

Rootstock: Productivity is light to moderate on standard rootstocks. Productivity and precocity may be improved on dwarfing rootstock such as Gisela 5 or 6. The tree grows vigorously on Gisela 6 with some overgrowth at the graft union. Tree vigor seems to be more balanced on Gisela 5.

Cristalina[2]

Production Experience: Developed at the Summerland Research Station and released in 1996. Trees planted several years ago in The Dalles have cropped for two years.

Fruit: Harvest timing is approximately 5 days before Bing. Cristalina produces large, firm fruit averaging 10 to 9 row in size. The fruit is Bing-like with a dark red skin and flesh. The flavor is moderately sweet with a little less acid than Bing. It is tolerant to rain splitting. Considered by Dr. Frank Kappel of Agriculture Canada as the best early cherry from the Summerland breeding program.

Bloom: Self-infertile, compatibility Group II (S_1S_3). In 2000 it bloomed a few days after Bing in The Dalles test plot. Potential pollinizers include Bing, Rainier, Skeena, Tieton and Black Republican.

Rootstock: I have found Cristalina to be precocious in The Dalles and the tree is said to be productive. For this reason, precocious and productive rootstocks may not be needed or advised.

Sonata[2]

Production Experience: Developed at the Summerland Research Station and released in 1996. Growers and scientists from the Mid-Columbia have evaluated the fruit in Canada since 1994. Trees planted several years ago in The Dalles have cropped the last two years.

Fruit: Harvest period is one week after Bing. Fruit is very firm and very large, 9 row and larger with a shape similar to Van. The color is black with a beautiful luster making a nice pack. The flavor is acidic to moderately sweet. It appears that the fruit is more acidic in the cooler conditions of Canada and sweeter in warmer, sunnier locations. Stems are long and thick. The blossom end can develop a slight dimple. There is indication that this small dimple alone can be sufficient to treat affected cherries as sort-outs by USDA inspectors. Sonata is susceptible to rain cracking.

Bloom: Self-fertile, no pollinizer is needed. Blooms late and may serve as pollinizer for Regina.

Rootstock: A self-fertile variety that is said to produce a good crop annually, so productive rootstocks may not be needed or advised.

Attika (Kordia)

Production Experience: Widely planted in Europe. One Italian packing house recently recommended Attika (Kordia) to growers as their primary cherry. This cherry has been available for some years in the Pacific Northwest. Stemilt Growers, Inc. has found marketing of the cherry somewhat problematic due to its heart shape that is negatively associated with Lambert.

Fruit: Harvest can begin as early as 10 days after Bing. Fruit is very firm and has a very solid texture. Fruit size is a very consistent 10 row. The color is mahogany and the shape is cordate. The flavor is very appealing with a strong, sweet flavor. Good tolerance to rain cracking.

Bloom: Self-infertile , compatibility Group VI (S_3S_6). Blooms late. Possible pollinizers include Regina, Symphony and Sandra Rose. If need be Hedelfingen or Sam could be grown as a two dimensional pollen tree similar to a crabapple in an apple block. Although bloom is late, Attika is sensitive to frost while still in the bud stage.

Rootstock: A very precocious and productive tree even on standard rootstock. Commonly grown on dwarfing rootstocks in Europe including Gisela 5.

Lapins

Production Experience: Commercially grown in Canada for nearly 25 years. There is considerably less experience with this cherry in the Pacific Northwest but nevertheless it is a heavily planted variety over the last ten years. Grower and packers seemed to have solved a number of initial quality issues most likely caused by improper production practices and harvest timing.

Fruit: Ripens 10 to 14 days after Bing. The fruit is firm with a mahogany-red skin and a lighter red flesh. Lapins produces a large, crack tolerant cherry averaging 10 to 9 row in size. This is one of the best tasting varieties from the Summerland breeding program.

Bloom: Self-fertile, blooming just ahead of Bing.

Rootstock: On standard rootstock Lapins is of average precocity but very productive with a tendency to overset. This characteristic is intensified with the use of dwarfing rootstocks. Nevertheless, a number of growers in the Hood River Valley are successfully growing Lapins on Gisela 5 and 6 with heavy annual pruning.

Skeena[2]

Production Experience: Only limited evaluation in the Pacific Northwest. Test trees in Wasco County are still juvenile. There has been some production experience in Canada where the variety originated.

Fruit: Listed as ripening 14 days after Bing. The fruit is very large, a full gram larger than Lapins. The cherry is round and picks red to mahogany in color and is said to remain firm whether grown under cool or hot conditions. The flavor is good but not exceptional. There is good tolerance to splitting.

Bloom: Self-fertile, so no pollinizer is needed. Blooms moderately late, several days after Bing.

Rootstock: The tree is said to be very productive, spreading and precocious, so precocious rootstocks may not be needed or advised.

Regina

Production Experience: Over the last few years Regina has been widely planted in northern Europe and is rapidly replacing old standard varieties. Pacific Northwest scientists and growers have, on several occasions, observed high quality Regina fruit in European orchards. The oldest trees in the Pacific Northwest have just come into production so local evaluation of the fruit is limited.

Fruit: Ripens between Lapins and Sweetheart. Fruit quality is high, with firm, dark red cherries averaging 10 row and larger. The flavor is pleasant but rather mild. Reports out of Germany indicate that Regina has consistently produced quality crops even in years of heavy rain.

Bloom: Self-infertile, compatibility Group II (S_1S_3). Blooms late. Possible pollinizers include Attika (avoid frost pockets), Symphony, Sandra Rose, Schneiders, Sam and Gold. Regina tends towards low productivity, therefore multiple pollinizers are recommended. In addition to the typical pollinizer pattern growers should consider planting a second or third pollinizer in the row. Sam or Gold could be planted with minimal space, pruned hard each year and grown only for their pollen.

Rootstock: Due to low productivity, precocious, productive rootstocks such as Gisela 5 or 6 should be considered.

Sweetheart

Production Experience: Developed at the Summerland Research Station and named in 1994. There have been some large and small plantings of Sweetheart in the Mid-Columbia in the last few years but little production experience. According to one nurseryman, Sweetheart is the best selling new variety produced at the nursery.

Fruit: A very late cherry with harvest beginning 21 days after Bing. The fruit is very firm and large, averaging 10 row in size. The cherry is round and picks as a bright red cherry. The flavor is only fair until fully ripe but improves to a nice tart-sweet flavor when ripe. Sweetheart is tolerant to rain cracking and avoids most rains due to its late ripening date.

Bloom: Self-fertile, therefore no pollenizer is needed. The tree blooms slightly ahead of Bing.

Rootstock: Sweetheart is precocious and very productive, therefore it is not recommended with dwarfing rootstocks.

[1]*Information provided, in part, by Dr. Greg Lang, MSU.* http://Fruit/Prosser.WSU.edu

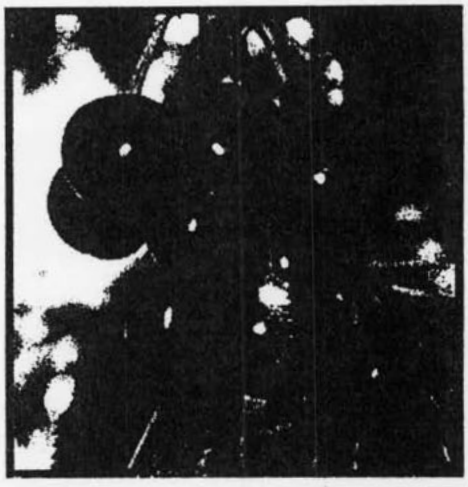
[2]*Information provided, in part, from Cherry Catalogue, Frank Kappel and Richard MacDonald, Agriculture and Agri-Food Research Centre, Summerland, B.C., Canada.*

Second Announcement and Call for Abstracts

ISHS

4th International Cherry Symposium

"Advances in Cherry Genetics, Physiology, Technology, and Management"



24 June - 29 June 2000

Hood River, Oregon and Richland, Washington

A meeting of the ISHS Fruit Section Working Group on Cherry Production

In collaboration with Washington State University, Oregon State University, and Michigan State University

15 March 2001
Abstracts due
1 May 2001
Symposium registration due (without late fee)
25 May 2001
Lodging reservations due
Deadline for Symposium cancellations with refund (minus US $50 fee)
1 June 2001
Deadline for tour cancellations with refund

Symposium Website:
http://ishscherry.prosser.wsu.edu

The Pacific Northwest

We invite you to participate in the 4th International Cherry Symposium, a meeting of the ISHS Fruit Section Working Group on Cherry Production. The symposium program will be split between two locations, the Hood River Inn at Hood River, Oregon, and the Shilo Inn at Richland, Washington.

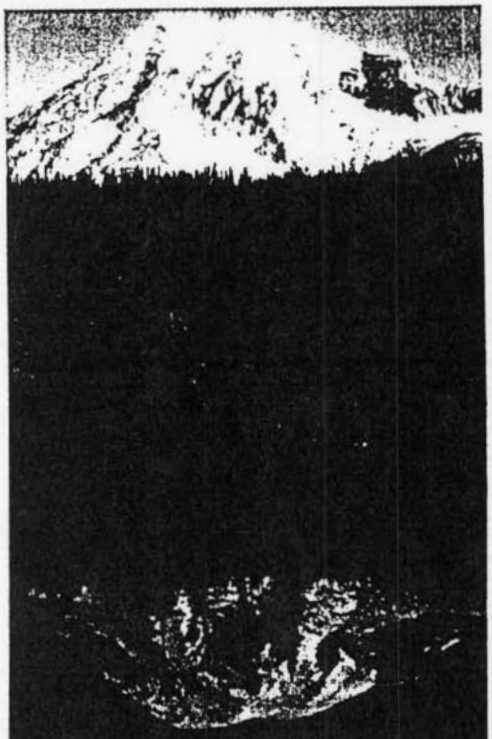


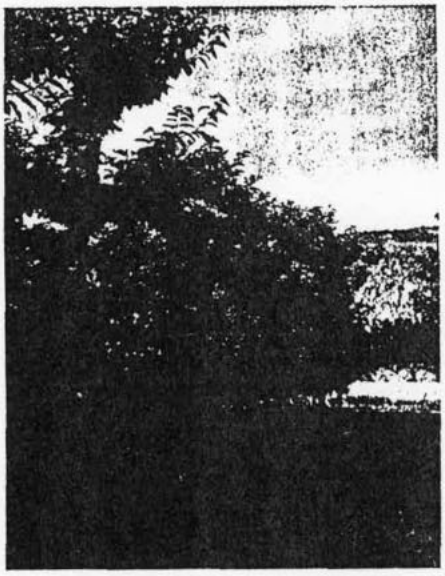
Photo courtesy of National Park Service

The Pacific Northwest, home to countless natural and man-made wonders, is divided into two distinct climatic regions. The mild, maritime western areas of Washington and Oregon are separated from the arid, steppe regions in the east by the towering Cascade Mountain range. In addition to spectacular attractions such as Mt. Rainer and Mt. St. Helens, the Cascade Mountains create a rain shadow which limits Eastern Washington and Oregon to 150-300 mm of annual precipitation -- perfect for irrigated fruit production.

The Pacific Northwest sweet cherry industry, located primarily east of the Cascade Mountains in Washington and Oregon, accounts for 65% or more of all North American sweet cherry production (fresh market and processed). Harvest season continues from late May and early June in the earliest districts until late August in the northern most areas of Washington and southern British Columbia, Canada. The region leads the world in fresh market sweet cherry exports. Major areas of production are concentrated along the river valleys of the mighty Columbia, the Yakima, the Willamette, and the Okanogan, with particular concentrations near the cities of Yakima, Pasco/Kennewick/Richland, The Dalles, and Wenatchee.

Many important sweet cherry varieties originated in the Pacific Northwest, including Bing, Rainier, Van, and Lapins, with research centers at Hood River, Prosser (Washington), and Summerland (Canada) contributing significantly to the progressiveness of the industry. The region is also home to some of the most important tree fruit nurseries in the United States.

Invitation to Participate



The Symposium will focus on both sweet (*Prunus avium*) and tart (*Prunus cerasus*) cherry research, bringing together the latest results and technologies from academic institutions, research centers, industry scientists, graduate students, and progressive growers worldwide. Oral, poster, and workshop sessions, as well as field tours, will foster information exchange, idea synthesis, and scientific dialogue in relaxed settings. If registration applications exceed venue accommodations, the Organizing Committee will give priority consideration to those contributing papers to the formal program.

For regularly updated information on the Symposium and the area:
http://ishscherry.prosser.wsu.edu

Pre-Symposium Tour

A 1.5 day (23-24 June) pre-symposium tour of Oregon's Willamette Valley will be led by Dr. Anita Azarenko (Oregon State University). The cost for coach travel, tour and accomodation (1 night, double occupancy) will be US $175. Space will be limited to fill one or two travel coaches. Itinerary details will be updated at the Symposium website (address above).

Friday, 22 June
Pre-Symposium tour arrivals to Portland Airport

Saturday, 23 June
Tour Meadowlake Nursery, McMinnville, Oregon
Tour Don Nusom Cherry Orchard, Gervais, Oregon
Tour Lewis-Brown Research Farm, Oregon State University
Tour Winery, Willamette Valley
Overnight in Corvallis, Oregon

Sunday, 24 June
Late morning departure
Travel from Corvallis to Hood River via Mt. Hood or Columbia Gorge Scenic Area

Symposium Program

Sunday, 24 June - Hood River Inn

All Day - Arrivals to Best Western Hood River Inn from Portland Airport via shuttle, own car, or Pre-Symposium tour.

Afternoon - Registration and poster set-up

Evening - Opening Reception beside the Columbia River

Monday, 25 June - Hood River Inn

Morning - Opening address, worldwide cherry status, breeding and genetics, new varieties

Mid-day - Buffet lunch, browse poster session 1

Afternoon - Preliminary working groups and issues to address, research and orchard tour (The Dalles, Hood River)

Evening - Cookout / barbecue

Tuesday, 26 June - Hood River Inn

Morning - Rootstocks

Mid-day - Buffet lunch, browse poster session 2

Afternoon - Entomology, processing

Evening - Working group meetings

Wednesday, 27 June - Field day/Coach transit

Morning - Depart for Richland, Washington

Travel - Tour cherry operations and research in the Columbia and Yakima valleys, visit a Washington winery, arrival at Shilo Inn (check-in)

Evening - Poster set-up, dinner on own (optional cafe evening meal if desired)

Thursday, 28 June - Shilo Inn/Richland

Morning - Tree physiology and management

Mid-day - Buffet lunch, browse poster session 3

Afternoon - Tree physiology and management, research and orchard tour (Yakima valley)

Evening - Working group meetings

Friday, 29 June - Shilo Inn/Richland

Morning - Pathology, postharvest

Mid-day - Buffet lunch, browse poster session 4

Afternoon - Working group reports and discussion, business meeting

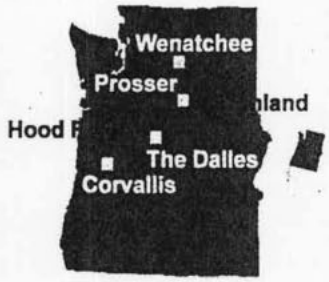
Evening - Closing sessions and banquet

The Symposium orchard and research tours will provide opportunities to examine varieties, rootstocks, training systems, production and packing line technologies, and other recent developments in cherry research and production.

Symposium Venue and Lodging

The Symposium program will be split between two locations, the Hood River Inn at Hood River, Oregon, and the Shilo Inn at Richland, Washington (see map). Hood River is 1 hour by ground transport from the international airport at Portland, Oregon, and Richland is 15 minutes by ground transport from the regional airport at Pasco, Washington. Symposium rooms have been block-reserved until 25 May 2001; participants must make their own actual reservations and arrangements directly with the Hood River Inn and the Shilo or Hampton Inn.

Hood River Lodging (24-26 June)
Hood River Inn (1-800-828-7873)
Reservations with credit card by 25 May 2001
(block reservation code 3441)
Single/2 queen bed / Villageview (1-2 persons) US$79
Single/2 queen bed / Riverview (1-2 persons) US$95
2-room suite (fireplace / sofa couch or
jacuzzi / queen bed) (1-2 persons) US$165
Extra person is US$12, 8% room tax



Richland Lodging (27-29 June)
Shilo Inn (www.shiloinns.com, 1-800-222-2244)
Reservations with credit card by 25 May 2001
Single Queen (1-2 persons) US$59
Single King (1-2 persons) US$69
Double Queen (1-4 persons) US$69
Extra person is US$10, 10% room tax

Hampton Inn (www.hampton-inn.com, 1-800-426-7866)
Reservations with credit card by 25 May 2001
(block reservation code ICR)
Single King (1 person) US$89
Single/2 queen (2 persons) US$94
Extra person is US$5, 10% room tax

Partner Tours

Concomitant with the Symposium program, tours for accompanying persons will be organized to sample the region's many historical and recreational opportunities. Itinerary details will be updated at the Symposium website (address above).

Partner Tour 1 (space limited to 40, US $40 each for transportation, tour guide, museum fees, etc.)
Monday, 25 June - Columbia River Gorge Scenic Area / The Dalles
Morning departure from Best Western Hood River Inn

Partner Tour 2 (space limited to 40, US $60 each for transportation, tour guide, national monument fees, etc.)
Tuesday, 26 June - Mt. St. Helens Volcanic National Monument
Morning departure from Best Western Hood River Inn

Partner Tour 3 (space limited to 40, US $40 each for transportation, tour guide, museum fees, etc.)
Thursday, 28 June - Lower Yakima Valley (nuclear history, desert ecology, wineries, art)
Morning departure from Shilo Inn, Richland

Partner Tour 4 (space limited to 40, US $45 each for transportation, tour guide, museum fees, etc.)
Friday, 29 June - Upper Yakima Valley (Native American history, fruit industry, breweries, art)
Morning departure from Shilo Inn, Richland

Post-Symposium Tour

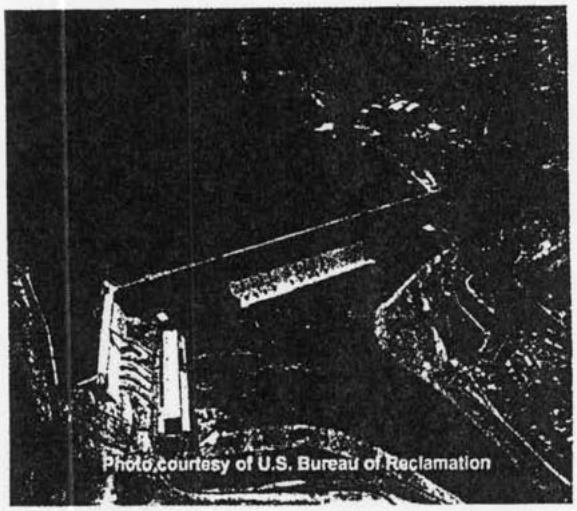


Photo courtesy of U.S. Bureau of Reclamation

A 3 day (30 June - 2 July) post-symposium tour of Washington's Columbia Basin and British Columbia's Okanogan Valley will be led by Dr. Frank Kappel (Ag-Canada, Summerland). The cost for coach travel, tour, Saturday dinner and accomodation (2 nights, double occupancy) will be US $375. Space will be limited to fill one or two travel coaches.

Saturday, 30 June

Morning departure from Shilo Inn, Richland
Tour Columbia Basin orchards
Tour large packing facilities
Barbecue/Cookout
Overnight Wenatchee, Washington

Sunday, 1 July

Late morning departure from Wenatchee
Tour upper Columbia River, Grand Coulee Dam
Tour Okanogan Valley, enter Canada
Overnight Penticton, British Columbia

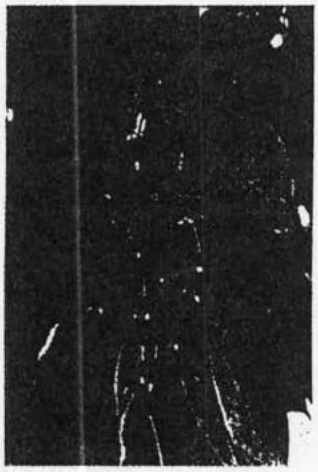
Monday, 2 July

Morning orchard tour
Tour of Pacific Agriculture Canada Summerland Research Centre
Lunch at Summerland Research Centre Gardens
Tour small packing lines and common fruit broker system

Tuesday, 3 July

Departures (on own) from Penticton via airplane, bus, or car

Organizing and Scientific Committees



Organizing Committee

Conveners:
Gregory Lang, Michigan State University
Lynn Long, Oregon State University

Members:
Anita Azarenko, Oregon State University
Tim Facteau, Oregon State University
Gary Grove, Washington State University
Frank Kappel, Agri-Food Canada
Gene Kupferman, Washington State University
Roberto Nuñez-Elisea, Oregon State University
Fern Wilcox, Oregon State University Extension

Scientific Committee

The Organizing Committee plus:
Bob Andersen, Cornell University
Andrew Granger, SARDI Australia
Amy Iezzoni, Michigan State University
Ron Perry, Michigan State University
Lars Sekse, Planteforsk Norway
Tony Webster, HRI England
Pierre-Eric Lauri, INRA France
Msami Yamaguchi, Institute of Fruit Tree Science, Japan

REGISTRATION FORM

4th International Cherry Symposium

REGISTRATION DUE BY 1 MAY 2001

**ISHS 4th International Cherry Symposium, Michigan State University,
A338 Plant and Soil Science Building, East Lansing, MI 48824-1325.
Phone 1-517-355-8393, Fax 1-517-432-3490, Email ishs@msu.edu**

All confirmations will be made via email. Inquiries and registrations via email are welcomed.

Title: _____ Last Name: _____ First Name: _____

Organization: _____

Address: _____

_____

Work Phone: _____ Email: _____

Fax: _____ Partner Name: _____

Special Requirements: _____

Please advise of any special dietary or disability requirements

Registration Fee *(all full registrations include Abstract Book, Acta Horticulturae, transportation, lunches and dinners except Wednesday)*

ISHS Member (#_____)	US $450	
Non-member	US $500	
Student	US $300	
Single Day (growers, as space is available)	US $125	
Late Fee	US $50	
Total A		

Optional Activities and Partners Program

Richland Cafe Evening (27 June)	US $35	
Partner Reception and Dinners (24, 25, 26, 28, 29 June)	US $100	
Columbia Gorge Partner Tour (25 June)	US $40	
Mt. St. Helens Partner Tour (26 June)	US $60	
Lower Yak. Valley Partner Tour (28 June)	US $40	
Upper Yak. Valley Partner Tour (29 June)	US $45	
Total B		

Pre-Symposium Tour (23-24 June 2001)

Coach travel, tour, accomodation (1 night, double occupancy) US $175	
Total C	

Post-Symposium Tour (30 June - 2 July 2001)

Coach travel, tour, Saturday dinner, accomodation (2 nights, double occupancy) US $375	
Total D	

Payment *by money order or credit card to: ISHS Cherry Symposium*

Total A	
Total B	
Total C	
Total D	
Total Payment	

Please charge to: Visa ☐ Mastercard ☐

Card Number: _____ Expiry Date: _____

Amount: _____

Signature: _____ Date: _____

ISHS

Cherry Symposium Tour

June 30 & July 1. 2001

Timothy J. Smith & Gene Kupferman

Washington State University

Wenatchee

ISHS Cherry Symposium Tour

Saturday, June 30

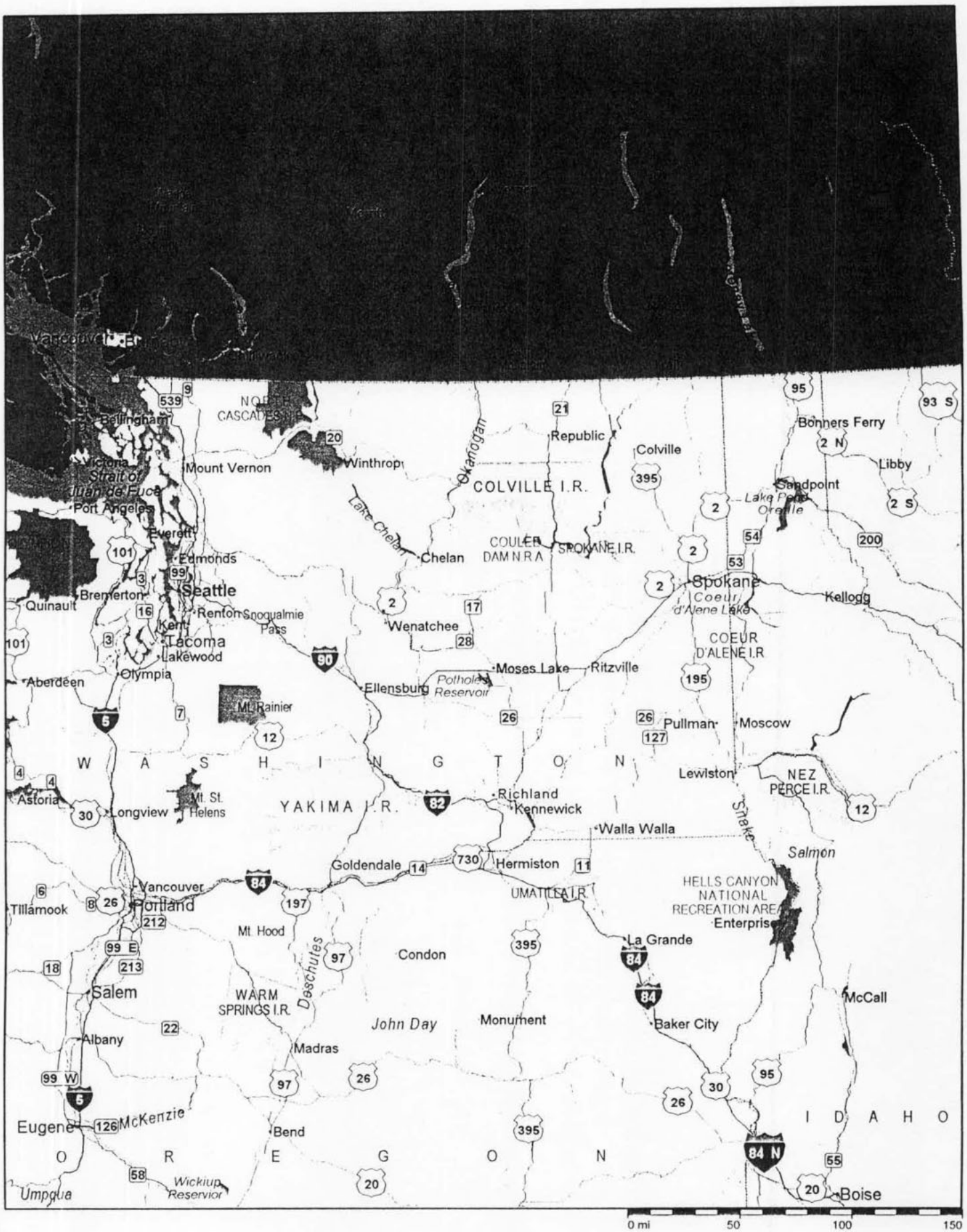
Contact Person:
Timothy Smith
Cellular Phone: (509) 669-9715

9:00 a.m. (09:00)	**The Bus will *leave* the Richland Shilo Inn.** Travel through the central Columbia River Basin to Wenatchee. Travel time approximately three hours. The Wenatchee region packed about 58 percent of the fresh sweet cherries produced last year in Washington. The harvest of sweet cherries is extended in this region, due to the great elevation, soil and slope aspect differences, and the planting of various varieties. The main crop, Bing, and later varieties such as Lapins, Sweetheart, Lambert and Rainier have harvest dates ranging from about June 20 until Early August.
12:00 - 12:40	**Buffet lunch** in Wenatchee.
12:50 - 1:30	**Stemilt Growers, Inc. Packing Plant**, one of the worlds largest sweet cherry packing facilities.
1:30	**Leave for lower elevation cherry stops:**
1:50 - 2:15	**Cherry growth regulator plot** - Dr. Don Elfving, Washington State University, will discuss research on the effect of ethephon and/or prohexadione calcium (Apogee) on young cherry tree growth and productivity.
2:30 - 3:00	**S.A.W. Cherry Orchard** - Topic: "Steep Leader" training of various sweet cherry varieties. We will view 4th, 8th and 12th year Chelan, Bing, Rainier, and Lapins on Mazzard, spaced 3 x 6 meters to 6 x 6 meters. "Steep Leader" is a common, highly productive training system used over the past 15 years in North Central Washington. Jeff Heath, Stemilt Growers field advisor, will describe management of this system.
3:15 - 4:45	**Check into Motel** (Comfort Inn, 815 N. Wenatchee Avenue, Wenatchee, telephone (509) 662-1700. *If you get left behind at one of the Wenatchee area tour stops, contact a taxi (phone 663-7799, 662-2126, or 886-4222) and rejoin the group here.*
4:45 (16:45)	**Leave for afternoon tour of Wenatchee Heights and Stemilt Hill**, a sweet cherry growing region above the city of Wenatchee. This growing area has an elevation range of about 550 meters to 950 meters, as contrasted to the 200 meter elevation of the Columbia River in this region. This production area produces a significant percentage of the USA late sweet cherry crop.

5:10 - 5:45	**Wenatchee Heights orchard.** Norm Gutzwiler orchard, to view various Gisela rootstocks with various varieties. Also, on this site Dr. Jim McFerson of the Washington Tree Fruit Research Commission will discuss his cherry blossom chemical thinning research plot.
5:45	**Travel through high elevation forest to Stemilt Hill region.**
6:15	**Kyle Matheson's home for dinner and International Cherry Production Roundtable Discussion.**
8:30 p.m. (?)	**Bus could leave** for those who wish to return to the motel, and the second trip would leave at approximately 9:45 p.m.

Sunday, July 1

8 a.m. (08:00)	**Bus will depart from the motel.** Travel to Lake Chelan by way of east side of the Columbia River.
9:15	**Stop at the Ray Fuller organic apple and cherry orchard.** Talk about sweet cherries with Phillip Unterschuetz, who has been advising Pacific Northwest organic producers for over 20 years. Mr. Untershuetz will give a brief over-view of organic production. Look, listen, and take lake view pictures. Depart 9:40.
11:00 - 12:10	**Omak area cherry stops.** Ron Moon will be our local host. Ron is an orchard advisor for Northwest Wholesale, and an experience and leader in the regions' cherry production. Main points of interest to be illustrated are the innovative planting and training methods used to produce Sweetheart and Lapin Cherries. **Stop 1**. Second year Sweetheart on Mazzard planted 2.1 by 4.5 meters. Discuss planting and early training of the tall spindle tree. The orchard is Lapins on mazzard, central leader, 10th and 6th leaf. Tree spacing is 3 x 6 meters. The orchard is well pruned and highly productive. Discussion: training to encourage both high production and large fruit. **Stop 2.** Sweetheart on mazzard, 5th leaf spindle, planted 1.2 x 4.2 meters. Sweetheart on mazzard, 10th leaf spindle, 2.1 x 4.2 meters. Discuss advantages and management of the spindle system.
12:30 - 1:20	**Lunch at Agriplex in Omak.** Served by the Okanogan County Cattleman's Association. Beef will be on the menu.
1:30 - 2:15	**Travel to Oroville.**
2:15 - 3:30	**Orchard Covers and Management**: Hosted by Golddigger Fieldman, Danny Fletcher, and Grower, Jack Nelson. Topic: practical management of covered Bing and Rainier cherries.
3:45 to 4:00	**Arrive at Canadian Border**.



MICROSOFT AUTOMAP

Streets Plus

2000-2800 meters in height. Most of the Pacific Northwest is covered by mountains and coniferous forest, another significant percentage is high elevation desert, and less than 10 percent of the land is high quality farmland. Between the major mountain ranges are various broad valleys, plateaus, and basins. These regions are generally covered with deep soils, often from volcanic origin, as the Cascade Range has 14 relatively recent or active volcanic peaks. Tree fruit production is scattered throughout the lower elevation inter-mountain areas, but is concentrated in the valleys and basins immediately to the east of the Cascade Mountains. Orchard elevation is quite variable, ranging from 20 - 1000 meters above seas level.

The center of the region is drained by many minor streams and large rivers connected to the Columbia River, which is almost 2000 Km long, and flows at an average rate of 2840 cubic meters per second.

2.2 Climate

The climate of the region is greatly influenced by the Pacific Ocean. Cool, wet, low pressure, weather systems move from the southern Gulf of Alaska to cross the entire Pacific Northwest. These weather disturbances are often separated by only 3-5 days, except during the months of June, July and August, when a general high pressure system moves up from the south, bringing warm, dry summers to the entire region. These Pacific Ocean air masses temper the climate during the winter, excluding the much colder air masses that may move south from central Canada. Winter temperatures, generally 0C to –10C, provide proper conditions for dormancy development and proper chilling of the trees, but rarely cause serious tree damage. However, about every 15-20 years, severe cold is experienced during a time that trees are not sufficiently hardy, and fruit trees are injured or killed.

In the fruit production areas, Spring weather develops rapidly, concentrating the various districts blossom periods. Apples bloom at lower elevations about the first week of April, and flower progressively to highest elevations about a month later. Spring frost is a threat in low, flat orchards, but is infrequent and light on slopes. Summer daily high temperatures average about 31C during July and early August, with peaks during a few days exceeding 38C. Autumn temperatures are conducive for the development of high internal quality and red color in fruit, moderate (15-22C) during the day, and cool (7-10C) at night. Season length and total heat units tend to bring fruits to maturity during the cool fall weather. Latest apple varieties are harvested in early November, after which temperatures may fall to levels that damage the fruit.

The moisture in the northern Pacific weather systems is dropped mainly on the western side and higher elevations of the Cascade Mountains, making some of the higher peaks among the wettest places on earth. The deep snow that accumulates during most winters recharges groundwater and feeds rivers and streams that often pass through the deserts situated on their leeward eastern sides. Precipitation in these East-slope rain shadow regions is scant, averaging about 125-250 mm/year and falling mostly during the winter.

2.3 Major Resources

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2.3 Major Resources

The abundant supply of water flowing through the region provides growers a dependable supply of irrigation water, and an abundance of relatively inexpensive hydroelectric energy to power their irrigation pumps, storage, and packing facilities. Another major resource is the system of regional irrigation districts, most of which were developed and maintained by local growers long before governments became involved in land reclamation projects. The producers have also financed an effective marketing system, and have developed numerous associations, some of which collect fees from the growers to further their interests in marketing and research.

2.4 Production Regions

From south to north: *California*: The central valley of this state is one of the most productive and diverse agricultural production areas on earth. Deciduous tree fruits are produced mainly in the northern half of this valley, and constitute a very small fraction of this regions' agricultural output. Peaches, nectarines, plums, and Bartlett (Williams) pears are the major tree fruit crops produced in this region.
Medford, Oregon: This production area is in the southeast corner of this state, between the coast mountain range and the Cascade Mountains. Winter storage pears, especially Bosc (Keiser Alexander) and Comice, are the major crops produced.
Mid-Columbia district of Oregon: This production district includes the cool, relatively wet Hood River Valley, which produces winter storage pears, predominantly D'Anjou. The eastern side of this district, near The Dalles, is comparatively warmer and has less Spring precipitation, so is a major producer of Sweet Cherries.
The Yakima Valley of Washington: This valley extends from the eastern slopes of the Cascade Mountains, eastward 150 km into the central lowlands of Washington. Irrigated agriculture is diversified in this valley, but tree fruits are the leading crops produced. It is the center of tree fruit production in the Pacific Northwest, producing almost half of the apples, pears and sweet cherries grown in Washington.
The Columbia Basin of Washington: This central region of Washington State covers a region about 200 by 100 km, within which about 120,000 ha are irrigated. The major tree fruits produced in this region are apples, with planting and production increasing rapidly over the past 15 years. Surveys indicate apple plantings have increased by approximately 20,000 ha during this period.
The Wenatchee District of Washington: This district includes the Columbia River and Okanogan River Valleys of Northcentral Washington. Most fruit produced in this relatively mountainous region is grown in the narrow river valleys, including a number of lesser river valleys extending from the Columbia or Okanogan Rivers, westward into the Cascade Mountains. This region includes diverse growing conditions induced by the varied topography and elevation range. These diverse microclimates enable growers in the area to lead North America in production of winter storage pears, especially D'Anjou and Bosc, and to grow the later season 30% of Pacific Northwest sweet cherries. This region also produces about 30% of Washington State Apples.
Okanagan Valley of British Columbia, Canada: This region is the warmest, driest part of Canada, and therefore serves as a center for Canadian tree fruit and wine grape production. This valley extends from the international border, connecting to the Okanogan River valley of the USA, northward about 100km. Within this region, apples, pears, sweet cherries and peaches are major crops. As this valley has a

number of highly picturesque lakes and mountains, it is a popular vacation destination, and a significant percentage of the stone fruits are sold directly to the consumer. The industry is relatively small compared to the competition directly to the south, but has continued to modernize and invest in new fruit orchards and varieties. Sweet Cherries developed in this region are rapidly gaining world-wide popularity.

Table 1 – Production in 1000 metric tonnes of major deciduous tree fruits in the Pacific Northwest region of North America.

Region	Apples	Pears	Sweet Cherries	Peaches
Washington	2350	345	87	23
Oregon	72	227	36	3
N. California	395	268	50	709
Br. Columbia	136	35	27	35
Total PNWest	2817	840	173	735
Total USA	4450	865	208	996

2.5 Apples

Varieties: Red Delicious is, by far, the most produced variety. This variety has lost favor in the market over the past decade, and is declining in production from 65% of the crop 15 years ago to about 45% of production in the year 2001. Golden Delicious is also declining in popularity, but constitutes 14% of production, followed by Fuji (10%), Granny Smith (8%), and Gala (7%). Production of Gala is most rapidly increasing. Production of other varieties such as Fuji, Braeburn, Cameo, Honeycrisp, and Pink Lady are increasing slowly, as orchards are replanted and young orchards develop full production levels.

Production systems: Older orchards, planted on seedling or other vigorous free-standing rootstocks at 275-525 trees/ha, are rapidly being replaced by modern planting systems. Most newer orchards are trellised, non-spur varieties on Malling 9 or East Malling 26 rootstock, planted at 1400-3600 trees/ha. Most training systems have been tested, with the best economic returns from single row, three wire, upright training systems, planted at about 1500 tree/ha. On good sites, full yields are attained in 3-4 years after planting, on "old" orchard sites, full yields may not be reached until at least 5 years after establishment.

Yields: Yields vary by variety and season. For the past decade, the apple industry has been in a somewhat alternate bearing mode, with even numbered years bringing ever-larger crops, and odd numbered years producing about 25 million 20kg boxes less than the previous season. While yields can be very much higher in specific instances, normal good yields are about 60 tonnes/ha for productive varieties, such as Golden Delicious, 50 tonnes/ha for standard varieties, such as Red Delicious, and an average of 40-45 tonnes/ha for less productive varieties, such as Gala and Fuji.

Pest management issues: The orchards of the Pacific Northwest have much less insect and disease pressure compared to most production regions of the world. Due to the low level of precipitation in the Spring and Summer, many common foliar and fruit fungus and bacterial diseases are not present, or are relatively simple to manage.

Apple scab is a potential problem in some districts, but can be controlled with 2-3 sprays on an average season. Most apples receive no sprays for the prevention of this disease. Fungicides are generally applied for powdery mildew, which can be a problem on a number of the newer varieties. Major insects include Codling Moth, the "key" pest, San Jose Scale, leafrollers, stinkbugs, and assorted other sporadic or minor pests. Most growers maintain biological control of injurious mites, and few miticides have been applied since the 1960's. Growers generally spray about 4-6 times a season to control pests, and spend about $500/ha per season for application and materials.

2.6 Pears

Varieties: Pears divided into two groups in the region. The first group is made up of Bartlett (Williams), which is mostly processed into canned halves or diced into fruit cocktail. About ¼ of the Bartlett crop is grown in a manner that produces a larger, more attractive fruit, and is sold fresh out of cold storage during the 4-5 months after harvest. The other classification of pears is the "winter" pear, mostly D'Anjou or Bosc (Keiser), which are sold for about 8-10 months after harvest. Other winter pear varieties produced include Comice, Red D'Anjou, and Concorde.

Production systems: Almost all pear trees in the region are 35-100 years old, planted on Bartlett seedling, and spaced to about 275 trees/ha. They are maintained at about 4.5 meters in height. When the trees are properly pruned, fruit is large and of high quality. As varieties have remained popular for generations, and high yields of superior quality fruit are common, there has been no need to remove and replace these large trees. However, it is not economically possible to plant new pear orchards on these rootstocks and tree spacing. New plantings are now more likely to be on Old Home x Farmingdale #87 rootstock, at 800 to 1200 trees/ha. These trees are free-standing, and come into production starting in year 3 or 4 after planting, and come into full production by year 7 to 9. These plantings are ultimately thinned to a spacing of about 240 to 500 tree/ha, and remain in production indefinitely.

Yields: Most standard pear varieties yield between 40 and 50 tonnes/ha. The fruit sold fresh is thinned or pruned to encourage fruit to grow to a size of 200 grams or larger, preferably in the range of 220-250 grams.

Pest management issues: Pear Psylla is, by far, the key pest. The species, *Cacopsylla pyricola* (Foerster), is particularly suited to the climate and pear production systems of the region, and is a constant threat to fruit quality and tree health. This pest has developed resistance to all insecticides, except those it has been subjected to most recently. Growers spray 5-8 times per season, using very expensive new classes of insecticides, and may not be certain that their efforts will control the pest. There are encouraging research and demonstration projects presently underway, demonstrating enhanced control through early season application of kaolin clay and the maintenance of biological agents. D'Anjou pears are especially susceptible to foliar damage by mites, so an intensive pest management effort continues on this variety for this pest group. Fire Blight, a bacterial disease caused by *Erwinia amylovora* , is the most dangerous pear disease. This pathogen attacks pears through the flowers under warm wet conditions. Pears are primarily produced in the Pacific Northwest USA where the local spring weather is not conducive to fire blight infection.

2.7 Sweet Cherries

Varieties: For many years, due to its high quality and demand in the market, the only sweet cherry variety of any economic importance in the major production areas of the region was Bing. Bing produces large, crisp, flavorful fruit, but splits and softens in rain, so production is limited to specific dry climatic zones. Those varieties used to pollenate Bing, such as Van, are perceived to be lesser quality, so generally received far lower prices in the market. Rainier, a large, light colored, red blushed sweet cherry has slowly gained in production over the past 20 years. In an effort to extend the production season, and avoid time periods when production is highest, varieties that ripen earlier or later than Bing have become increasingly popular over the past decade. The most commonly planted early variety is Chelan, the most popular late harvest varieties are Lapins and Sweetheart.

Planting systems: While growers in the region are well aware of the various rootstocks available from research programs around the world, Mazzard rooted trees, planted about 275-350 trees/ha remains the most popular planting system for cherry. Fruit size is a major factor in economic returns to the growers, and other rootstocks continue to produce inconsistent fruit size in research and demonstrations in the region. Trees are usually trained to multiple upright leaders. Mature trees are heavily pruned to maintain fruit quality.

Yields: Production begins about 4-5 years after planting, and full yields are attained in about 8-10 years. Average yields are 18 tonnes/ha, but a well-managed orchard will often yield 25-30 tonnes/ha of large, high quality fruit.

Pest management issues: The key pest is Cherry Fruit Fly, which does very little damage to the crop, but is a quarantine issue in important markets. Growers spray 3-4 times per season to assure that this pest does not infest their fruit. Other insects that may need control include Black Cherry Aphid, Leafrollers, and Shothole Borer. The most common disease is Powdery Mildew, which does little damage if managed moderately. Other diseases that may cause damage in some orchards include Pseudomonas Bacterial Canker (a serious problem on younger trees) and Verticillium Wilt. Bird feeding damage is widespread, and growers have tried numerous devices that are said to "scare" or otherwise repel birds, with little success.

Weather related problems: Untimely rain is the greatest threat to sweet cherry production. Rain that wets the trees for more than 10-14 hours while temperatures are 20C or higher can split and soften near-ripe fruit, rendering it useless. Growers blow trees as dry as possible with air-blast sprayers and hovering helicopters during wet periods, and have been generally successful reducing damage during the past 5 seasons. In past decades, growers expected to lose their crop one or two seasons out of five, recently, crop losses have been rare. This is unlikely to continue. Wind can damage fruit, as can heat in excess of 36C that lasts more than 2-3 days during the July (30 days post-harvest) flower bud setting period.

3. Concluding Remarks

Fruit production has expanded rapidly during the past 50 years in this region, due to the many competitive advantages the growers enjoy, and the high economic returns the industry could give to the relatively proficient producer. With the advent of international

APOGEE AND ETHREL EFFECTS ON YOUNG 'LAPINS' CHERRY TREES
East Wenatchee, WA

Don C. Elfving
WSU Tree Fruit Research & Extension Center, Wenatchee, WA

In Washington State, cherry trees on Mazzard rootstock grow vigorously for several years and are not precocious. This planting consists of 'Lapins'/Mazzard cherry trees planted in 1999 at 3 X 4.9 m (10 X 16 ft). Experimental treatments began in May, 2001 (3rd leaf). Previous results with Apogee and Ethrel on sweet cherry suggest that two applications 3 weeks apart may provide satisfactory growth control and stimulation of flowering. The objectives of this trial are: 1) to evaluate both tree growth and flowering/yield responses to a two-application program of various combinations of Apogee, Ethrel and the two mixed together; 2) to explore the contribution to vegetative growth control and to stimulation of flowering of each bioregulator when applied separately vs. together. The treated trees have all received two applications in total (controls unsprayed). Treatment combinations include Apogee alone, Ethrel alone, Apogee + Ethrel as a tank mix, Apogee or Ethrel alone followed by the tank mix, or the tank mix followed by either Apogee or Ethrel alone. Results to date (6/20) show that 2 applications of Apogee alone have reduced terminal shoot extension by 12%, 2 applications of Ethrel alone have reduced growth by 37% and 2 applications of the tank mix have reduced terminal shoot growth by 66%.

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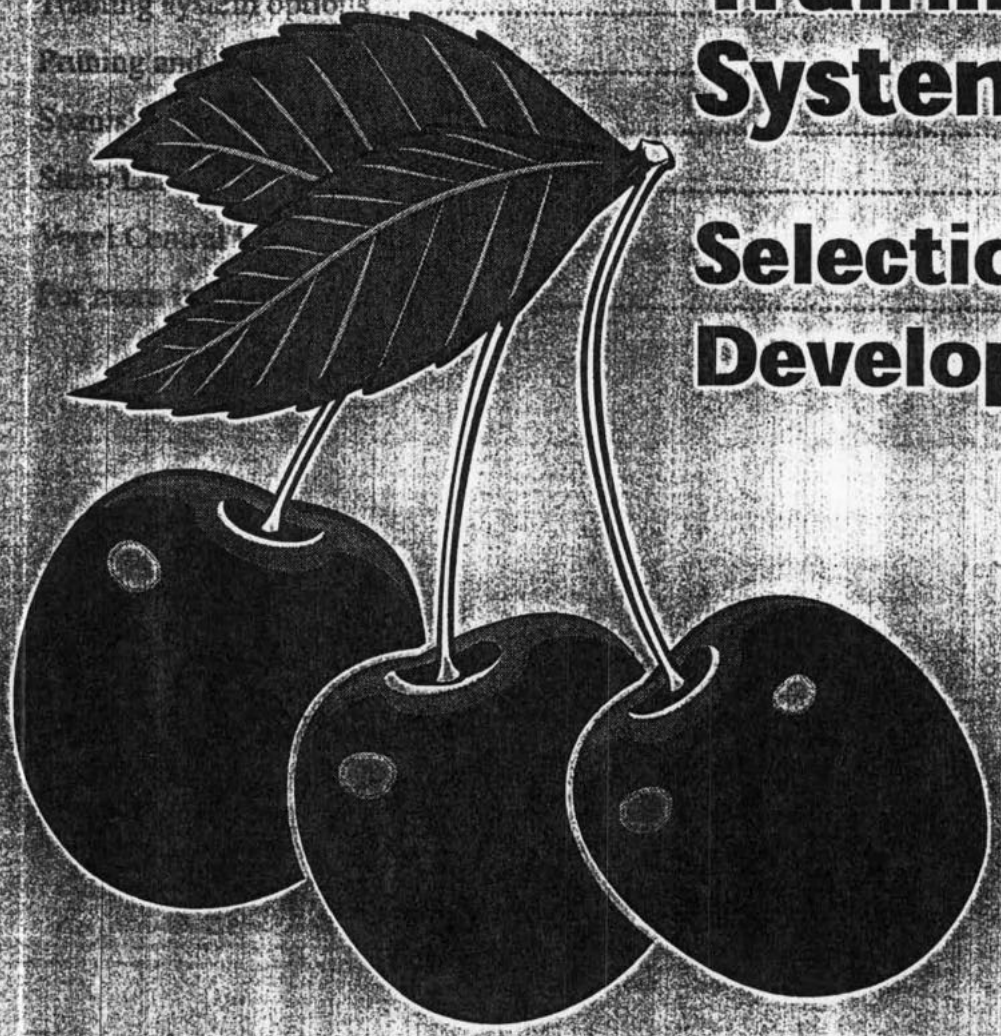
Cherry Training Systems: Selection and Development



Prepared by Lynn Long, Extension agent, Wasco County, Oregon State University.

The author wishes to thank the following individuals for their assistance in the preparation of this publication. Without their help, this publication would not have been possible.

[illegible] Vogel
[illegible] Marsal
[illegible] Gomez

A Pacific Northwest Extension Publication
Oregon State University • University of Idaho • Washington State University

Contents

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Cherry Training Systems:
Selection and Development

While the objectives of pruning and tree training have changed little over the years, the need for attention to pruning and training has increased dramatically. Pacific Northwest cherry growers now compete in a world market, making fruit size and quality increasingly important. In addition, labor is less available and more expensive than in the past. Trees must be easy to maintain, and fruit must be of high quality and easy to harvest. A good training system provides a structural framework that will accomplish these goals.

Understanding the tree

Cherry trees present three significant challenges to an orchard manager:

- **Excessively vigorous growth**—Cherry trees are large and vigorous. Without some type of manipulation, they produce long shoots with few lateral branches. This trait makes maintenance difficult and limits fruit production.
- **Delayed fruiting**—Pruning can control a tree's vigor and produce more branches that are closer together. However, pruning, especially dormant heading cuts, tends to delay fruit production in young trees by directing the tree's energy to vegetative growth. With typical heading cuts and standard rootstocks, cherry trees rarely produce a crop before the fifth or sixth leaf. Moreover, any other factor that increases tree vigor, such as deep, productive soils or over-fertilization, also tends to delay the onset of floral initiation.
- **Narrow crotch angles**—Cherry trees tend to produce branches with narrow crotch angles. These angles often are weak and prone to *bark inclusion,* a condition in which bark is trapped between the trunk and the branch, preventing layers of annual wood from growing together. Splitting can occur at these locations.

With the introduction of dwarfing and precocious (early-bearing) rootstocks (such as Gisela 5, 6, and 12), some of the negative characteristics of cherry trees can be altered. With these rootstocks, it is possible to harvest a crop in the third leaf. Tree size is controlled more easily, and branches naturally form at wider angles. However, without proper management and pruning, these trees may produce smaller fruit.

Whatever the variety and rootstock combination, annual shoot elongation is imperative for maximum fruit quality. The largest and highest quality cherries are produced at the base of the previous season's growth and on 1- to 3-year-old spurs. Therefore, the goal of an orchard manager should be to grow an abundance of new 10- to 12-inch shoots throughout the tree while limiting the number of old spurs.

Training system options

There are many training systems, both supported and freestanding, that are used by cherry growers around the world. This publication describes three commercially successful systems: Steep Leader, Spanish Bush, and Vogel Central Leader. Each has strengths and weaknesses. Choosing the right system depends on a number of factors, including growing conditions, variety, rootstock, labor availability, and management skills.

Consider carefully before selecting a training system. Understanding how various factors interact with one another is an important part of making the right choice.

Table 1.—Appropriate uses of various training systems.

Growing conditions*	Steep Leader	Spanish Bush	Vogel Central Leader
Good soils	✔	dwarf rootstocks only	dwarf rootstocks only
Poor soils	✔	✔	✔
Frosty sites	✔	—	✔
Rootstocks and varieties*			
Full-size rootstocks	✔	poor soils only	—
Dwarfing rootstocks	✔	✔	✔
Precocious varieties	✔	✔	✔
Precocious varieties/dwarfing rootstocks	✔	✔	—
Characteristics of the training system			
Requires higher management skills	—	✔	✔
Produces high early yields	—	✔	✔
Reduces harvest costs	—	✔	—

*A "✔" indicates the system is appropriate.

Pruning and training techniques

The developmental process of these training systems uses the following pruning and training techniques.

Heading into 1-year-old wood

This cut stimulates the growth of lateral branches and often is used in the early developmental stages of cherry training systems to force branching. Since heading into young wood invigorates the area around the cut, this type of cut tends to delay fruiting. This cut is used extensively in the Spanish Bush and Steep Leader systems.

Heading into older wood

This cut also encourages lateral branches, but it lacks some of the invigorating effects of cuts made into 1-year-old wood; therefore, it does not delay fruiting to the same degree. However, fruit buds usually are removed with this cut, reducing the crop. Heading cuts into older wood often are used to stiffen branches or remove downward-hanging (pendant) wood. This cut can be used in all three training systems.

Stub or renewal cut

A stub cut is used to renew fruiting wood in order to keep it young and productive. There are two types of stub cuts. In the first type, an existing branch is cut back to a point from 1 inch to several feet of its origin in order to grow a new branch (Figure 4).

This cut is used when there are no lateral branches capable of replacing the current terminal. Existing or adventitious buds grow from the point of the cut, and a new branch is selected. This cut is common in all three systems to maintain fruit quality and size.

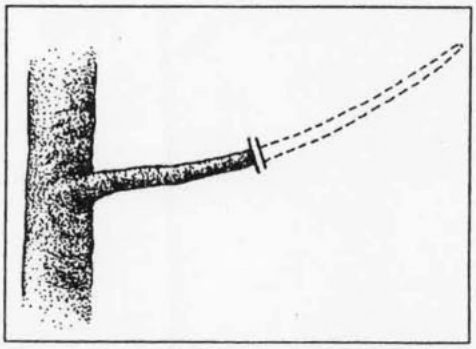


Figure 4.—Stub cut with no lateral branching.

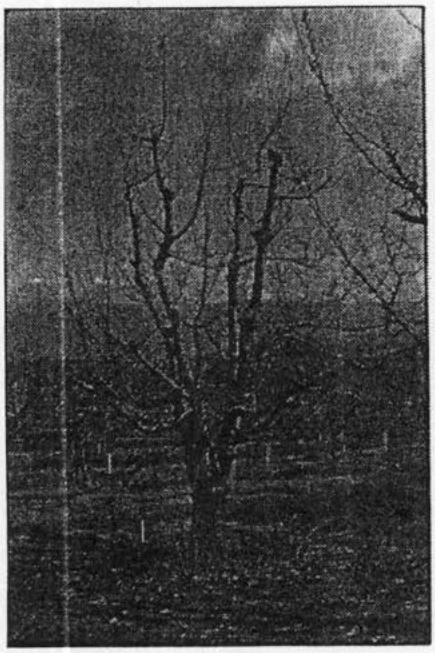


Figure 1.—Steep leader.

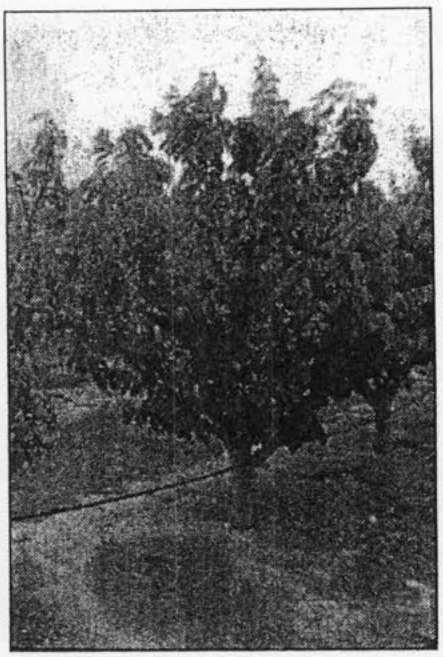


Figure 2.—Spanish bush.

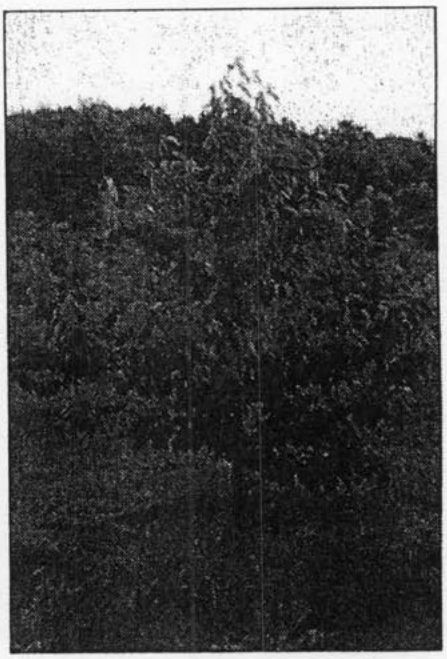


Figure 3.—Vogel central leader.

Steep Leader

The Steep Leader system (Figure 1) is an adaptation of the open vase system commonly used by Pacific Northwest growers. It is best suited for low- to moderate-density orchards on full-size rootstock. It is possible to produce moderately large crops of large, good-quality cherries by the seventh or eighth leaf. However, because this system usually is used with trees grown on full-size rootstock, production usually does not begin until the fifth or sixth leaf, and trees generally are taller than those trained with the other two systems.

Spanish Bush

The Spanish Bush system (Figure 2) produces a true pedestrian orchard of very high density, where the majority of fruit can be harvested from the ground without ladders. This is an advantage where labor availability and cost are of high concern.

It might be possible to use this system with full-size rootstock on poor soils, especially with highly productive varieties (such as Sweetheart). Generally, however, with the good soils commonly found in the Pacific Northwest, a dwarfing rootstock is needed to help control tree growth and vigor.

Without a precocious rootstock, production is delayed due to the extensive number of heading cuts made to establish the system's framework. In addition, due to small tree size, this system should not be selected for frost-prone locations.

Vogel Central Leader

The Vogel Central Leader (Figure 3) is a precocious system of moderately high density that is easy to grow and maintain. High early yields are possible with this system. Tree shape encourages good light penetration throughout the tree. Due to the single leader nature of this system, a dwarfing rootstock is necessary to help maintain reasonable tree height.

The second type of stub cut is used most commonly in the Vogel Central Leader system, but it also can be used with the Steep Leader system. If a lateral branch begins to grow upright or simply is too mature, it can be cut back so that an existing secondary branch can take over the terminal growth. The primary lateral should be headed to within several buds of the point of origin of the secondary branch (Figure 5).

It is important that the stub consist of live wood and that the secondary branch terminal *(a)* be higher than the remaining stub *(b)*. This prevents vigorous vertical wood from growing out of the stub, and it keeps the secondary branch more horizontal and less vigorous.

Brunner cut

The Brunner cut is a combination of two cuts used to control tree vigor in young trees (Figure 6). A heading cut is made into a strong (temporary) vertical branch *(a)* at the same time a weaker (permanent) adjacent branch is headed *(b)*. The purpose is to divert vigor away from the weaker branch in favor of the strong branch. The strong branch then is removed completely in midseason *(c)*.

This procedure allows heading cuts to be made into permanent branches without over-invigoration, thereby reducing the potential for delayed fruiting. This cut can be used in the establishment years of the Steep Leader and Spanish Bush systems.

Thinning cut

Thinning cuts remove entire branches at their point of origin and tend to open the tree to better light penetration. Thinning cuts stimulate growth from a more extensive region than heading cuts. They also are less invigorating, so they are less prone to delay fruiting. Thinning cuts are used in all three systems.

Limb manipulation

Most varieties of cherries have a very upright growth habit with narrow branch angles. Therefore, bark inclusion and subsequent weak attachments can become a problem. In addition, this growth habit produces a tree base narrower than the tree top, which allows for poor light penetration.

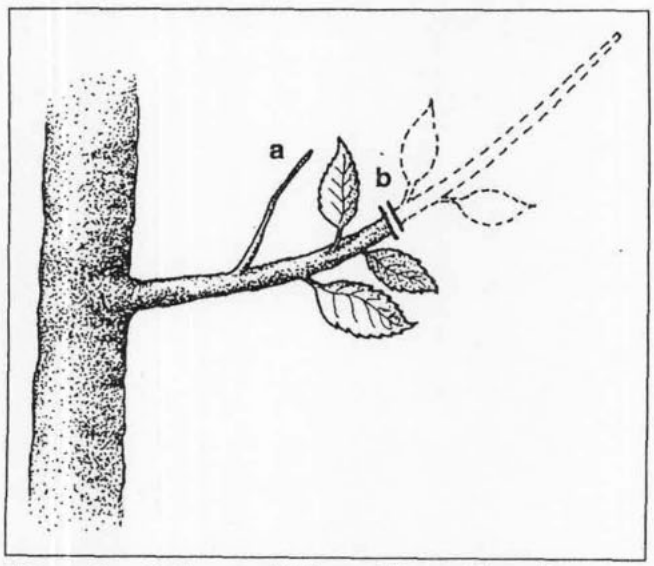


Figure 5.—Stub cut with lateral branching. Note live buds on the stub and the relative height of branch terminals "a" and cut "b."

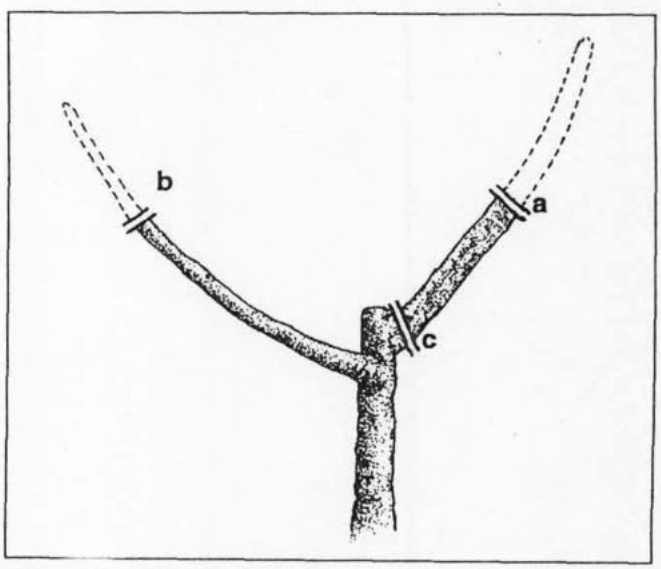


Figure 6.—Brunner cut.

To broaden the base and strengthen limb attachments, you must widen the crotch angles. Besides improving light penetration, spreading helps reduce branch growth and encourages early fruit production (precocity).

To establish wide crotch angles for the Steep Leader or Spanish Bush systems, place a toothpick between the trunk and a young, 3- to 4-inch shoot growing from the trunk. Manipulate branch angles while the tissue still is green but after shoots have grown to 3 or 4 inches in length.

In moist climates where the risk of bacterial canker infection is high, or to establish the proper branch angle for the Vogel Central Leader system, a clothespin can be used as a spreader. Attach the clamp to the trunk and force the shoot to establish at a 90-degree angle.

There are several ways to spread more mature branches. With the Steep Leader and Vogel Central Leader systems, young branches are spread to a more horizontal angle by tying them to hop clips inserted in the ground. In the Spanish Bush system, two parallel wires usually are strung on opposite sides of the row, and branches are tied to the wires.

Summer pruning

Summer pruning can be used in any of the three systems, but it is a key component of both the Spanish Bush and Vogel systems. Because summer pruning tends to be less invigorating than dormant pruning, it tends to encourage precocity in young trees. However, with some system-variety-rootstock combinations, it can lead to overproduction, so it should be balanced with dormant pruning when necessary. In addition, laterals that form following a summer cut generally have narrower branch angles.

Promalin

Instead of severe heading cuts, which tend to delay fruiting, cherry growers often use Promalin to increase branching. Mix Promalin with latex paint according to label directions and apply to 1-year-old branches at the green tip stage of bud development. For best results, paint the entire region of the branch where laterals are desired, not just the buds. It might be necessary to remove a third of a strongly growing branch to force branching at the base.

Promalin works most consistently in moderate to warm spring temperatures (daytime temperatures above 60°F). Promalin is not a required component of any of these systems, but it can be used in any system to increase branching and precocity.

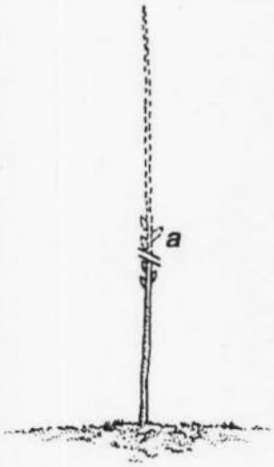
Scoring

Scoring is another method used to encourage branching. Scoring can be used in any system. Score the branch to the depth of the cambium just above a bud. The cut should extend one-third to one-half the circumference of the branch. To assure adequate response on vigorous trees, you must make a relatively broad cut. A number of tools can be used; for example, you can achieve the desired effect by taping together two hacksaw blades.

Spanish Bush

In the Spanish Bush system, numerous branches help to reduce tree vigor, imparting a small tree structure and encouraging fast and easy tree maintenance and harvest. Since tree size is small, light can penetrate readily through a properly pruned tree, encouraging high fruit quality. In addition, high tree density provides high early yields.

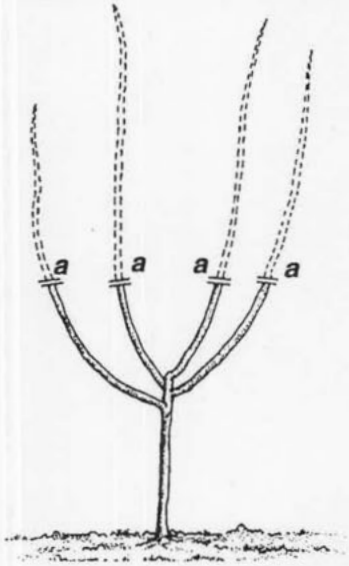
At planting



Head whip.

Plant trees 8 to 10 feet apart in the row with 15 to 18 feet between rows, depending on soil fertility, rootstock, terrain, and equipment size. At bud break, head the whip 12 to 30 inches above the ground, depending on the desired height of primary branches and the presence of buds below the cut ***(a)***. Spread developing shoots to obtain wide crotch angles. Encourage strong tree growth.

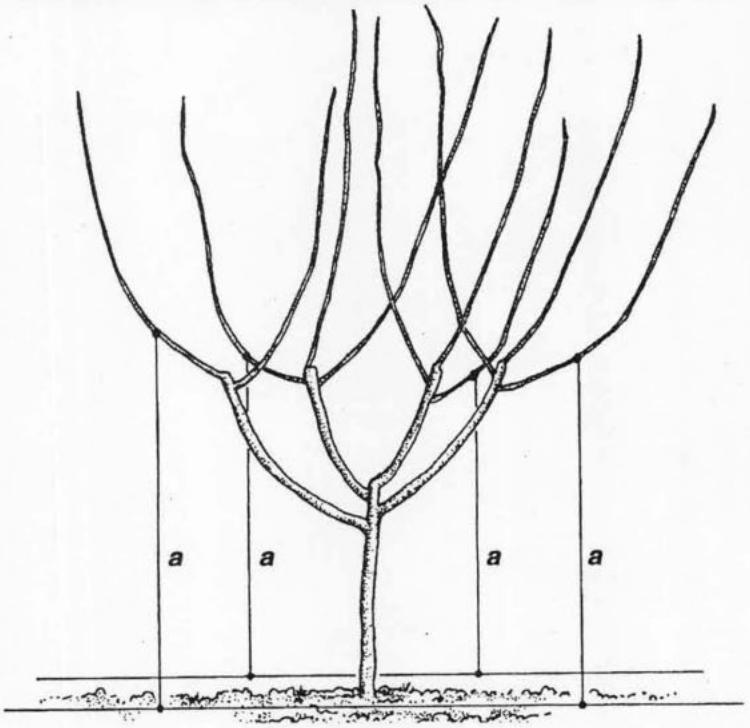
First growing season



Head primary branches.

Allow primary branches to grow 20 to 24 inches in length before making these cuts so the branches will be strong enough to respond with vigorous growth. Cut branches back to a height of 6 inches above the cut made at planting ***(a)***. Cut all branches at the same level. This is the only cut during the first growing season.

Continued—First growing season

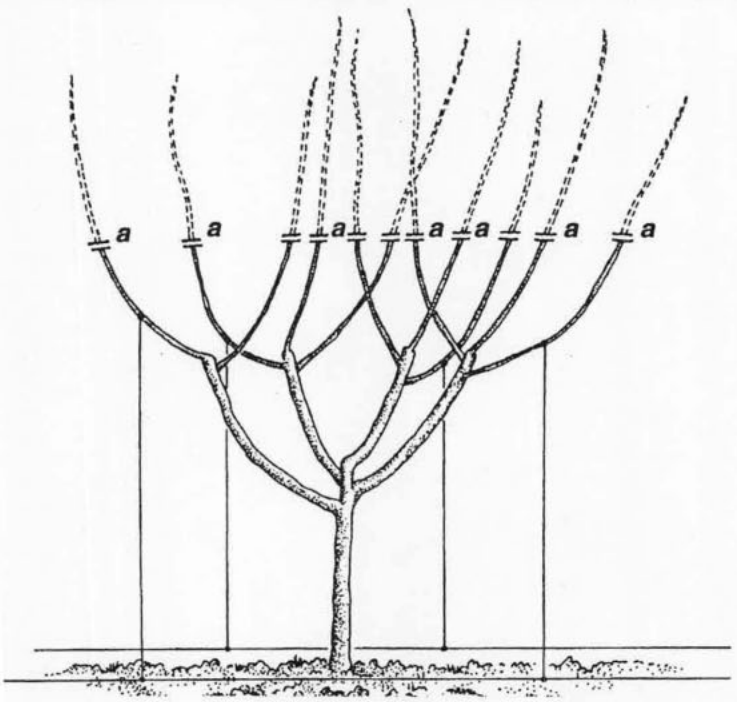


Tie down branches (optional).

By autumn of the first growing season, secondary branches should have grown 20 to 24 inches in length. Run two parallel wires at ground level, one on each side of the tree row, and anchor them to the ground. Tie down secondary branches to the ground wires to open and spread the tree ***(a)***. You can remove the wire system by the end of the second growing season.

Spreading is especially important for upright varieties such as Lapins.

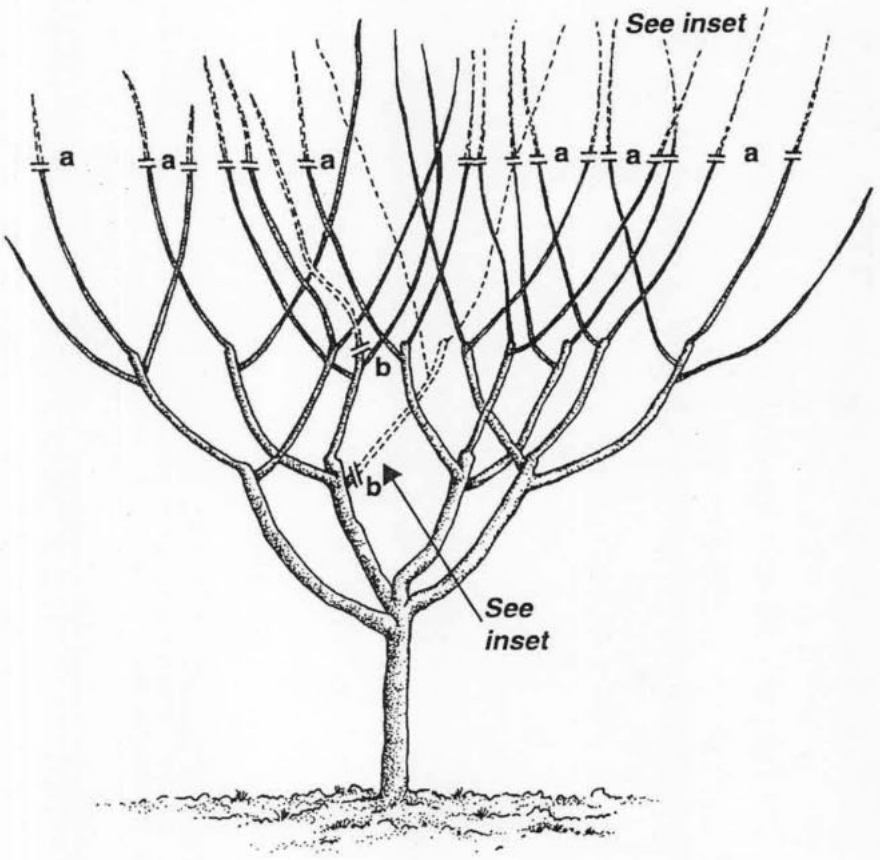
Second spring

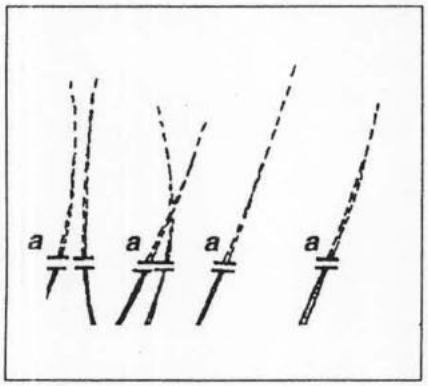


Head secondary branches.

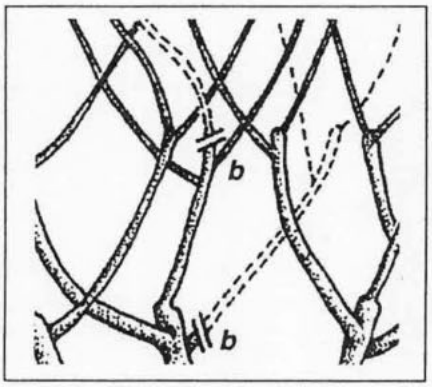
If secondary branches have reached 20–24 inches in length, head them back to 10 inches during bloom of the second growing season ***(a)***. Otherwise, wait until they grow to 20–24 inches long. Again, make all cuts at the same level.

Continued—Second spring





a.—Head tertiary branches.



b.—Thin for light penetration.

Head tertiary branches.

By late spring, tertiary branches should have grown to nearly 24 inches in length. Except for center and horizontal branches, cut back the new growth to 10 inches above the previous cut ***(a)***. Make all cuts at the same level. Leave horizontal branches unheaded so they can produce fruit. Also leave center branches intact to force a more spreading growth habit. (They will be thinned out after fruiting begins.)

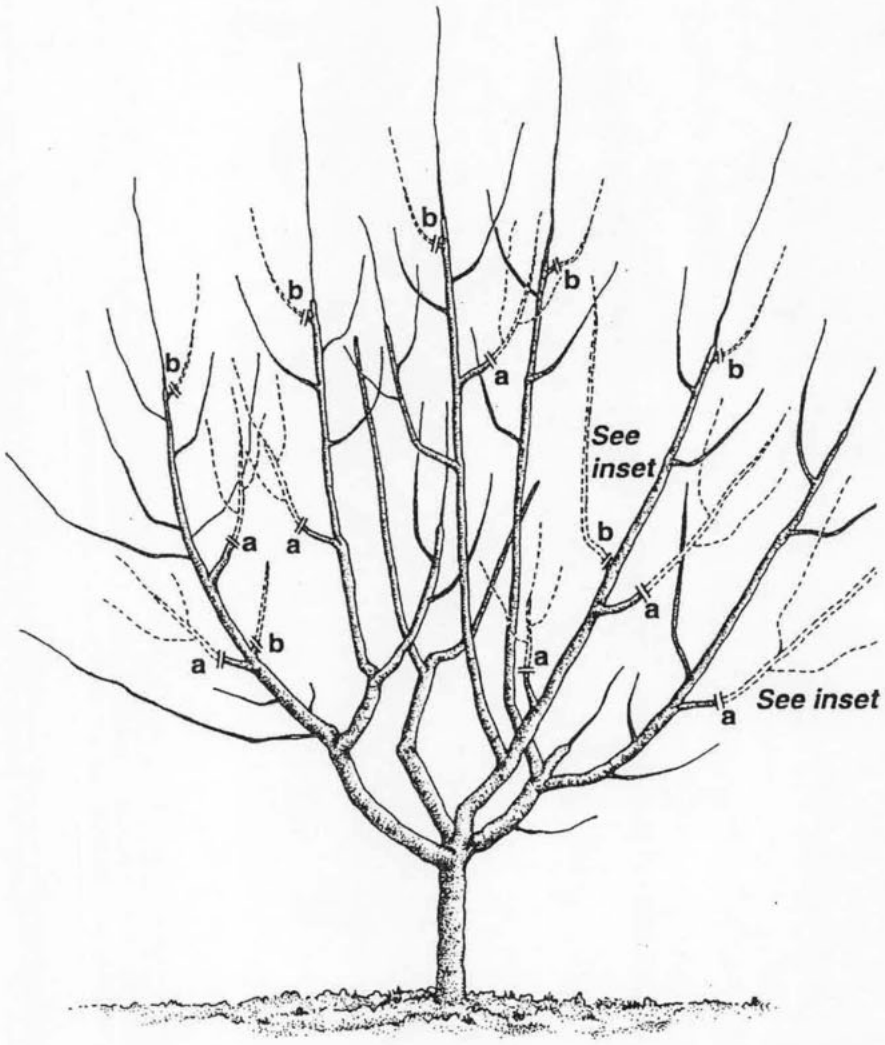
These are the last training cuts made in the formation of the tree. Pruning of the tertiary branches is particularly important for upright, poorly branching varieties such as Bing and Lapins and for strong rootstocks such as Mazzard and Mahaleb. For naturally branching varieties such as Sweetheart or weaker rootstocks such as Gisela 5, this final heading cut might not be necessary.

Thin for good light penetration.

At the same time, you might need to thin some branches in order to allow better light penetration. Thin out vigorous, upright branches while leaving weaker, horizontal branches to fruit ***(b)***. From now on, thin branches at every pruning.

At the same time, discourage strong tree growth. Reduce fertilizer applications until the tree begins to fruit so that new shoot growth is less than 2 feet long.

After harvest or dormant, at maturity



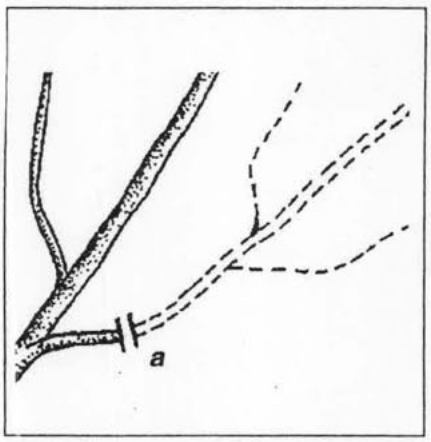
Renew fruiting wood.

At maturity, secondary or tertiary branches become permanent scaffold branches. Fruit develops on weak, renewable branches growing from the permanent scaffolds. To maintain fruit size, fruiting wood must be renewed regularly. Stub back about a quarter of the fruiting branches each year so that in 4 years all fruiting wood is renewed ***(a)***.

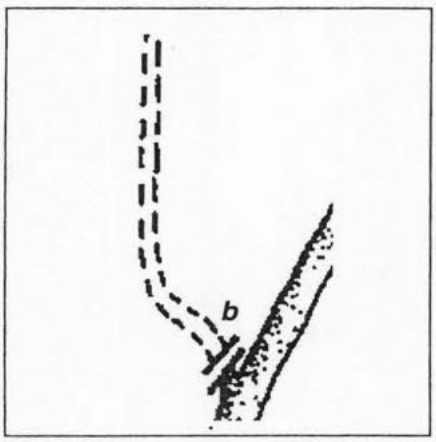
This pruning normally is done after harvest as a summer cut. However, depending on rootstock and tree vigor, you might elect to prune during the dormant season to encourage growth, vigor, and fruit size.

Thin for light penetration.

Thin out branches in the inner canopy that are interfering with light penetration. Thin out vigorous, upright branches while leaving weaker, horizontal branches to fruit ***(b)***.

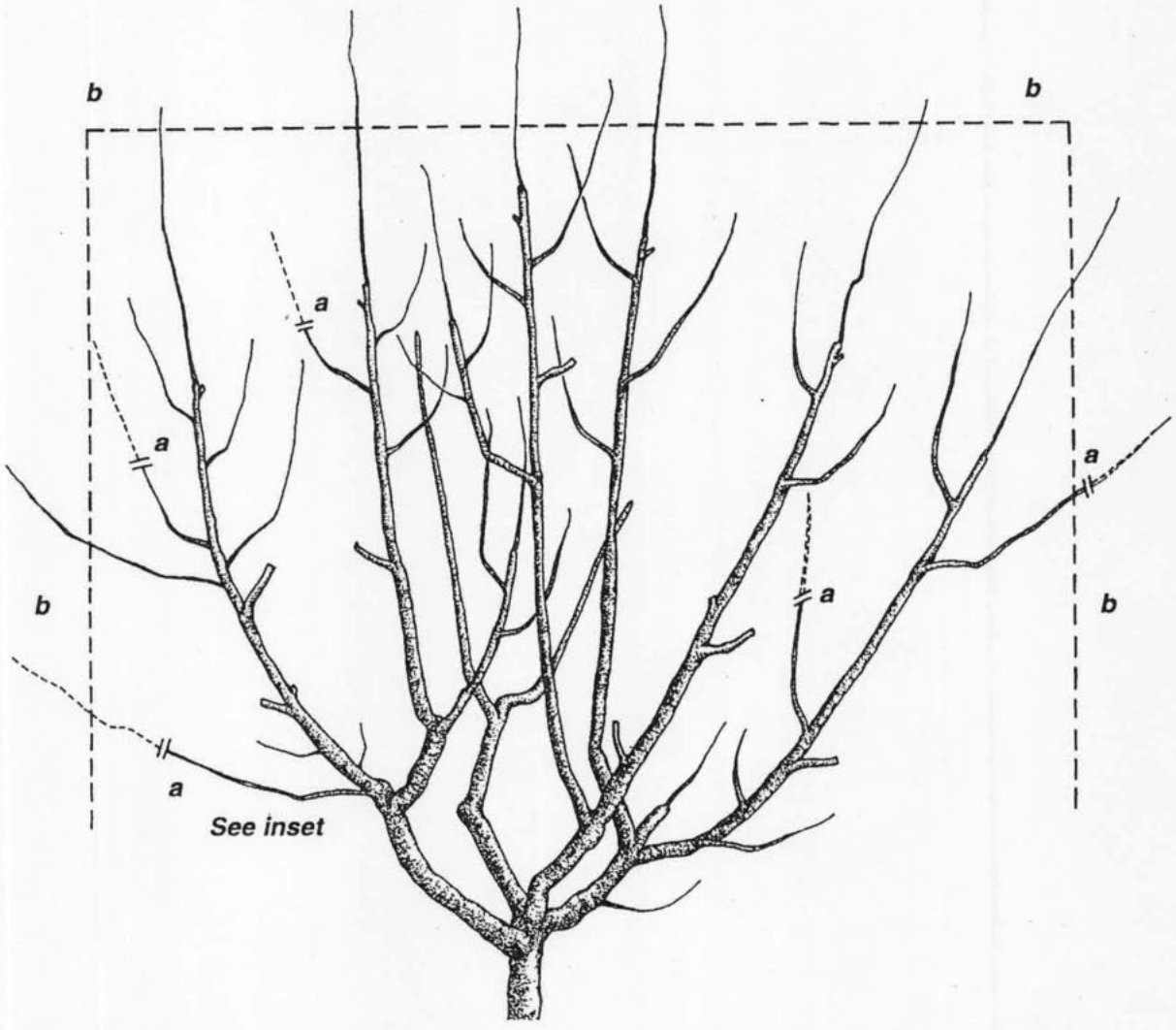


a.—Renew fruiting branches.



b.—Thin for light penetration.

Continued—After harvest or dormant, at maturity

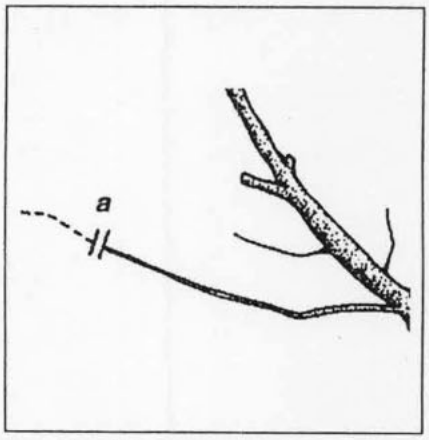


Head fruiting wood to increase fruit size.

To reduce fruit load and increase fruit size, head back long fruiting wood after harvest or during the dormant season *(a)*.

Top and hedge the tree annually in the autumn.

At maturity, top trees at 8 feet and hedge them annually *(b)*.

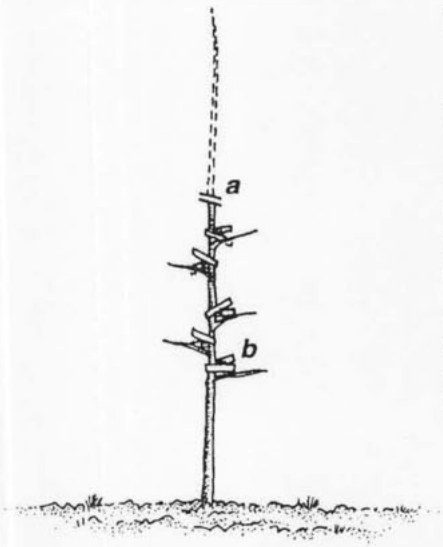


a.—Head fruiting wood.

Steep Leader

A moderate-density orchard is possible on standard rootstock with the Steep Leader system. Each nearly vertical leader is treated as a separate spindle producing young wood and high-quality fruit.

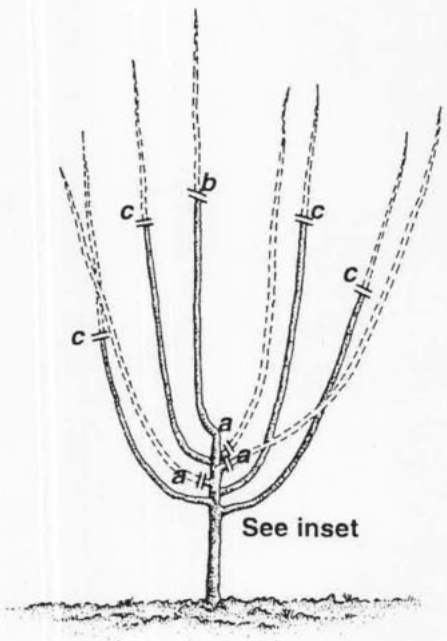
At planting



Head whip.

Plant trees 16 to 20 feet apart in the row with 18 to 24 feet between rows, depending on soil fertility, terrain, equipment size, and the manager's skill level. At planting, head the whip 30 to 36 inches above the ground, based on the desired height of primary scaffold branches ***(a)***. Use toothpicks or clothespins to establish wide branch angles ***(b)***.

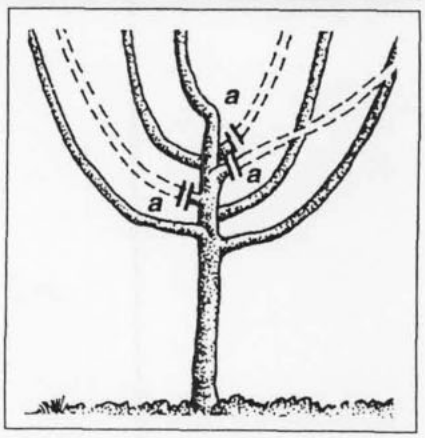
First dormant season



Select leaders.

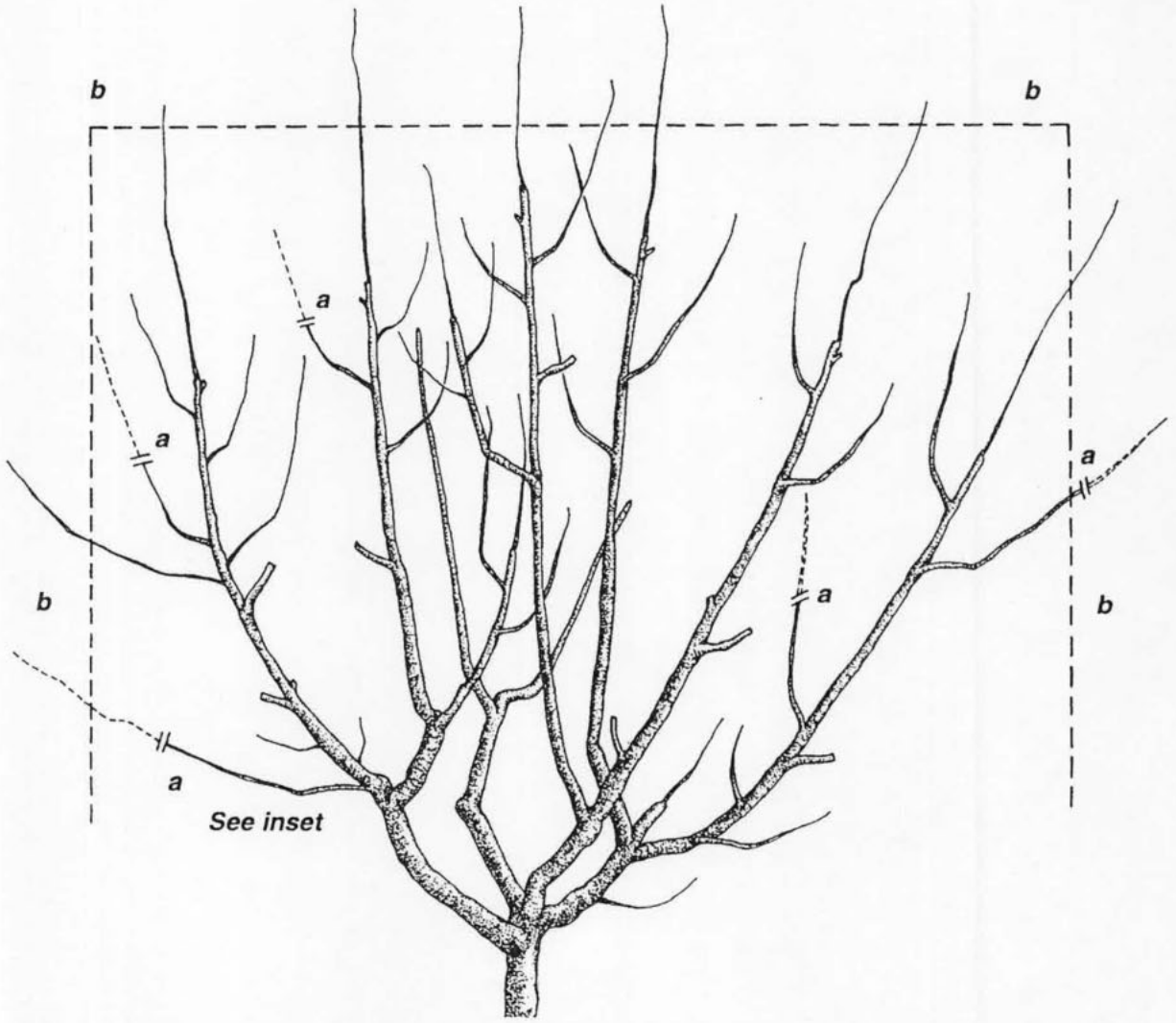
Select three permanent leaders if in-row spacing is less than 20 feet. Otherwise, select four well distributed leaders ***(a)***. Allow leaders to grow nearly vertical. You might wish to leave one or two other leaders as temporary branches, including vigorously growing branches that would tend to invigorate the tree if removed ***(b)***.

Head leaders 2 to 3 feet from the trunk to encourage branching and establish a permanent bottom whorl ***(b and c)***.



a.—Select leaders.

Continued—After harvest or dormant, at maturity



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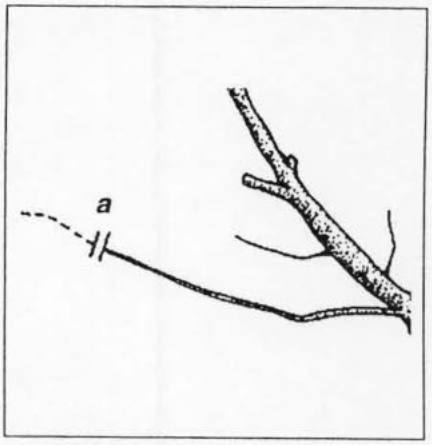
Top and hedge the tree annually in the autumn.

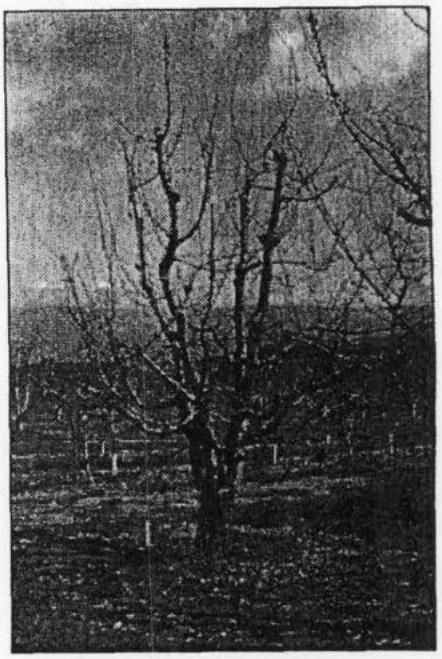
At maturity, top trees at 8 feet and hedge them annually *(b)*.



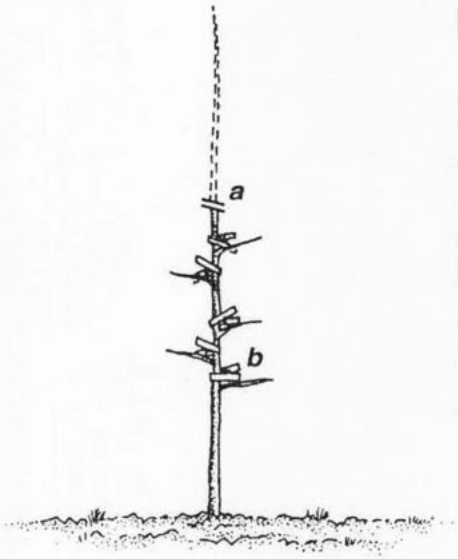
a.—Head fruiting wood.

Steep Leader

A moderate-density orchard is possible on standard rootstock with the Steep Leader system. Each nearly vertical leader is treated as a separate spindle producing young wood and high-quality fruit.



At planting



Head whip.

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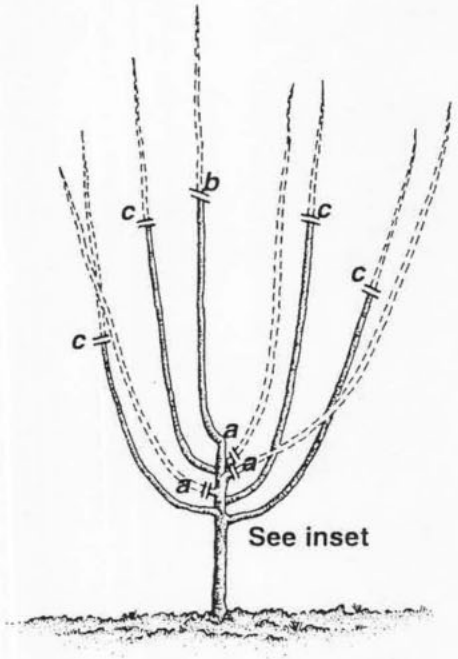
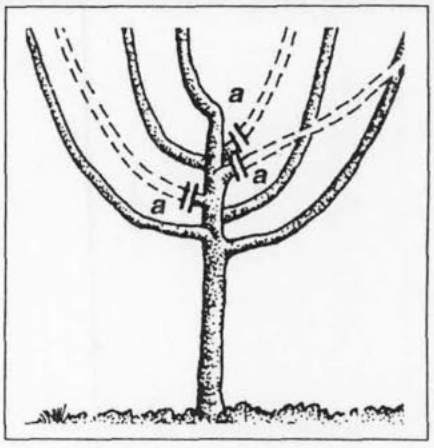
First dormant season



Select leaders.

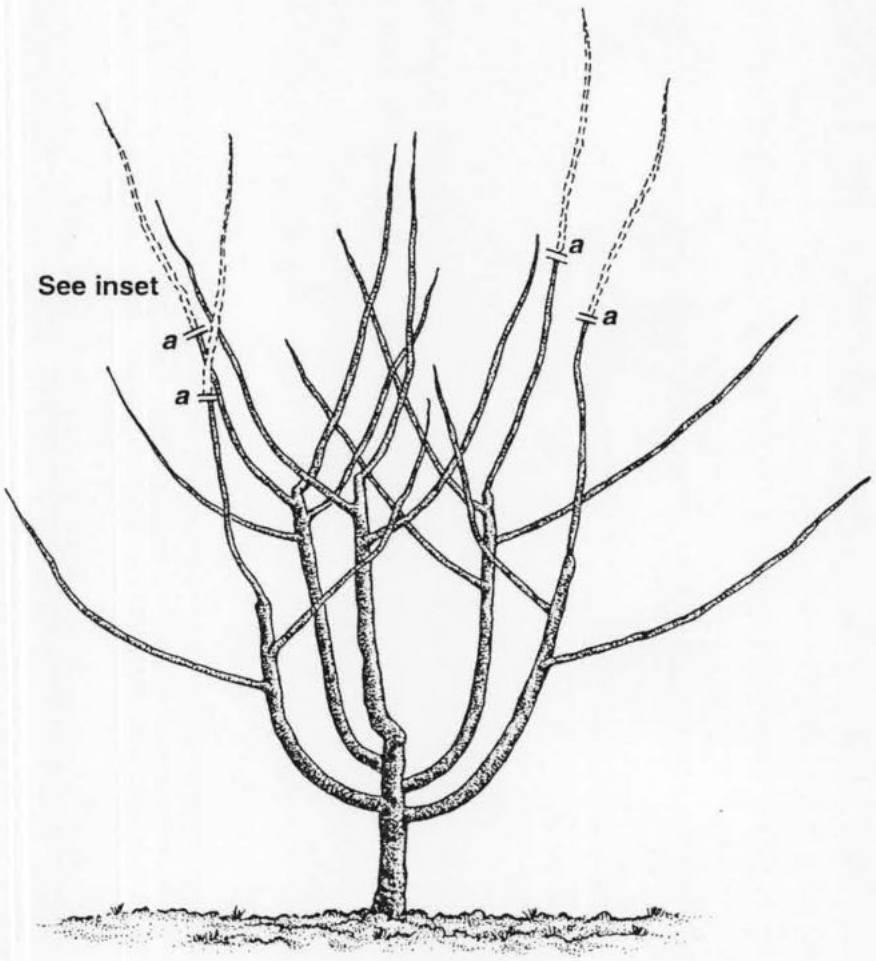
Select three permanent leaders if in-row spacing is less than 20 feet. Otherwise, select four well distributed leaders ***(a)***. Allow leaders to grow nearly vertical. You might wish to leave one or two other leaders as temporary branches, including vigorously growing branches that would tend to invigorate the tree if removed ***(b)***.

Head leaders 2 to 3 feet from the trunk to encourage branching and establish a permanent bottom whorl ***(b and c)***.



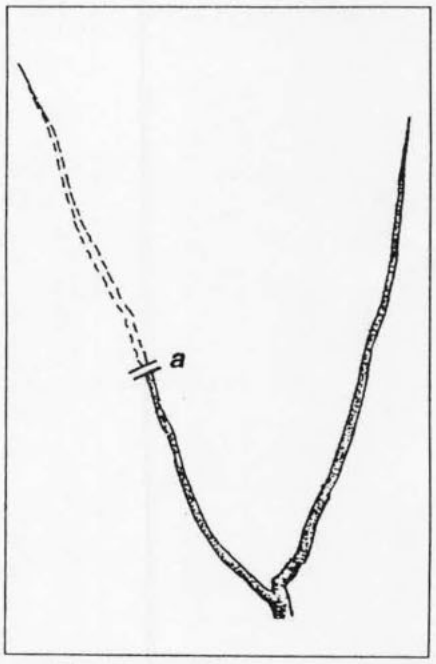
a.—Select leaders.

Second dormant season or spring second leaf



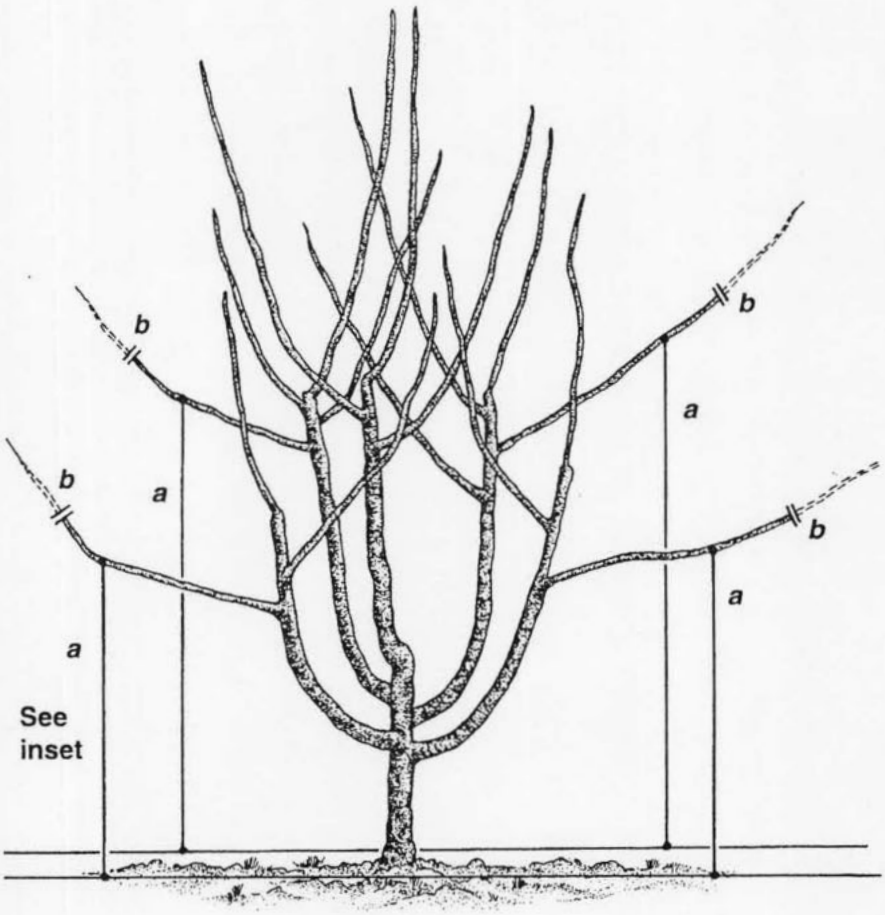
Choose secondary branches that will continue terminal growth.

Select one branch per leader to serve as an extension of the permanent scaffold branch. Head this branch approximately 2 feet from its point of origin ***(a)***.



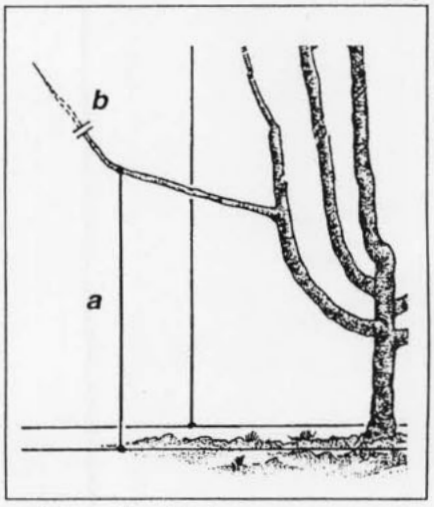
a.—Head secondary branches.

Continued—Second dormant season or spring second leaf



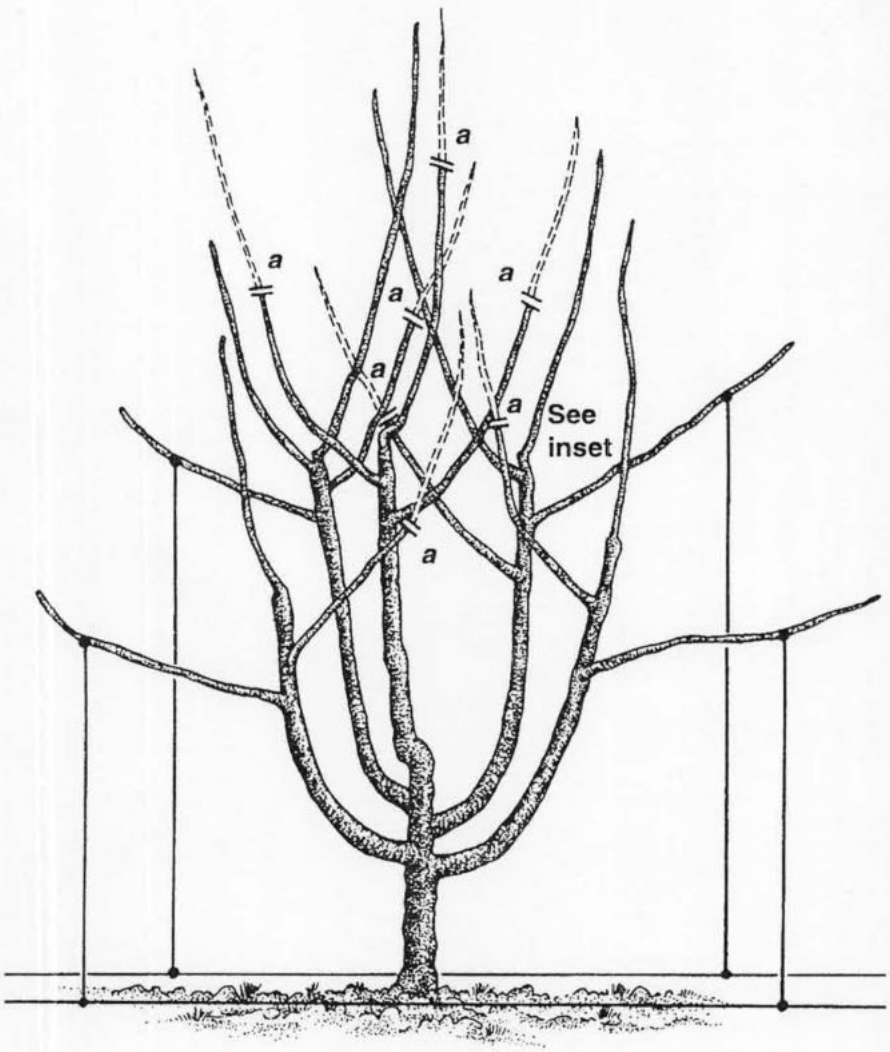
Establish a permanent bottom whorl.

Select one outside secondary branch per scaffold, and tie it to horizontal in order to establish a permanent bottom whorl ***(a)***. Head these branches 2 to 3 feet from their base ***(b)***.



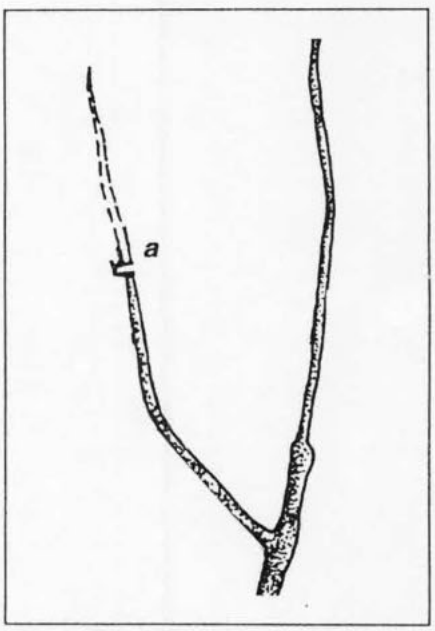
a & b.—Establish a permanent bottom whorl.

Continued—Second dormant season or spring second leaf



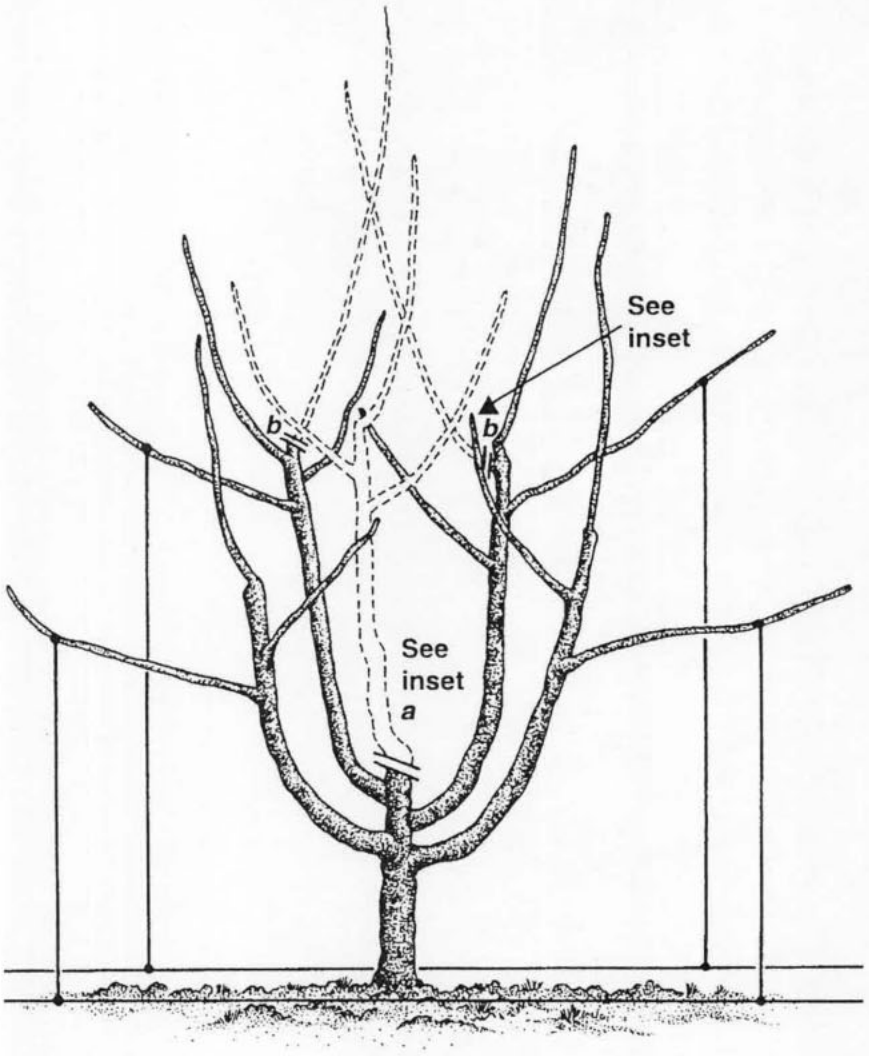
Leave temporary secondary branches to divert vigor.

It might be necessary to leave several temporary branches until fruiting begins in order to control overall tree vigor. Head these branches at about 2 feet ***(a)***.



a.—Head temporary secondary branches.

Dormant or spring pruning to maturity

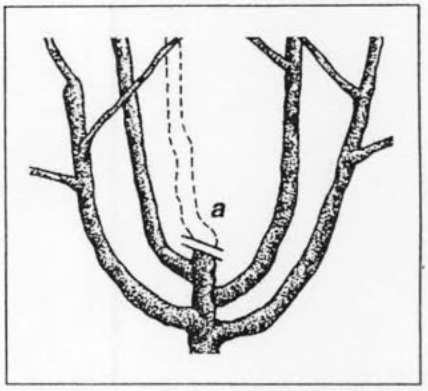


Thin to weak wood.

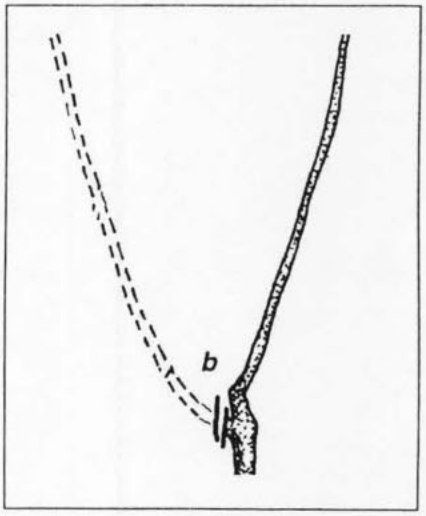
Select smaller and weaker wood as permanent branches. Thin out very strong wood ***(a)***.

Leave branches unpruned to encourage fruiting.

As the tree matures, leave temporary branches unheaded in order to encourage early fruit production. Remove these branches once the tree begins to fruit, and growth slows ***(b)***.

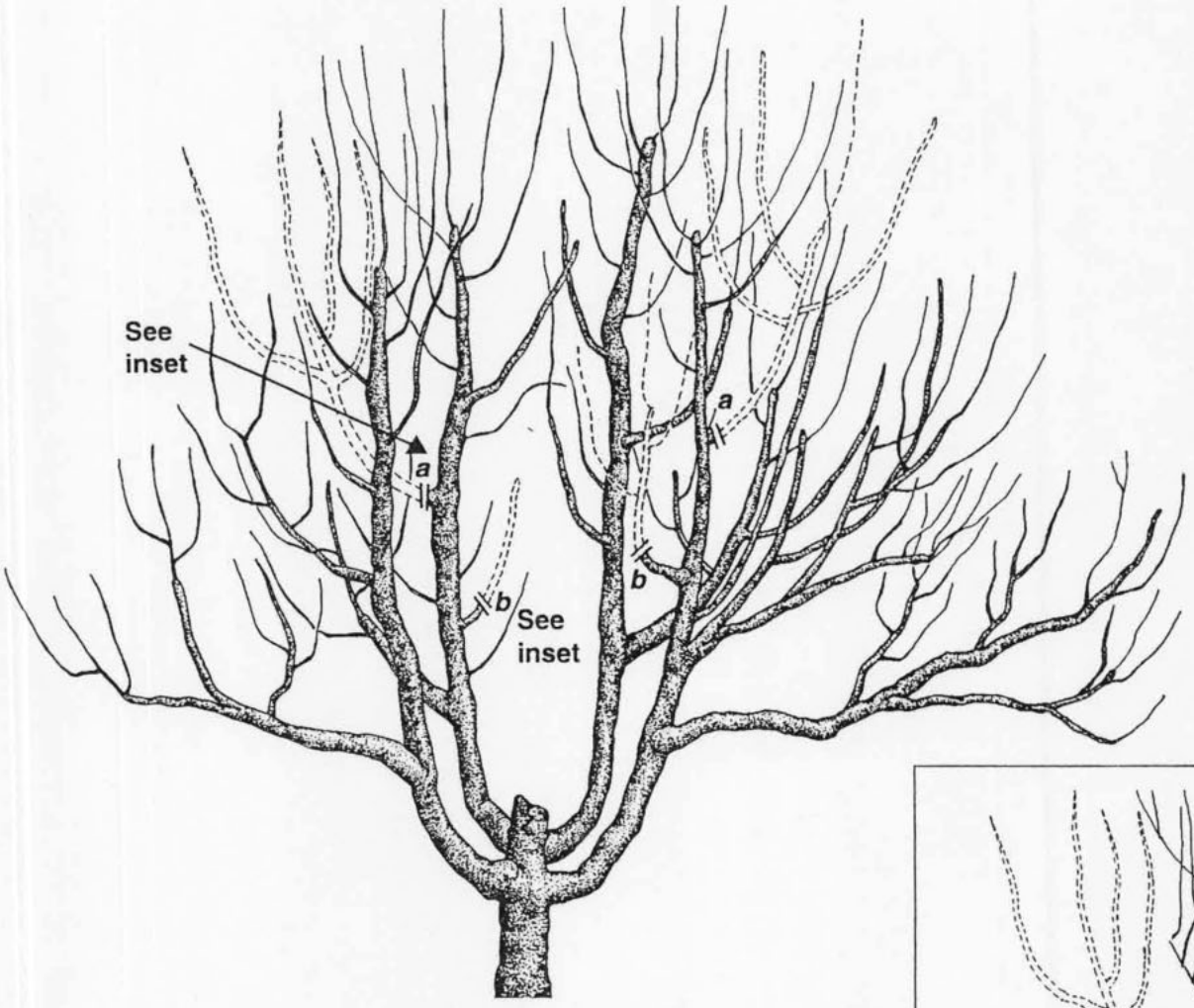


a.—Thin out very strong wood.



b.—Remove temporary branches.

Dormant or summer pruning at maturity

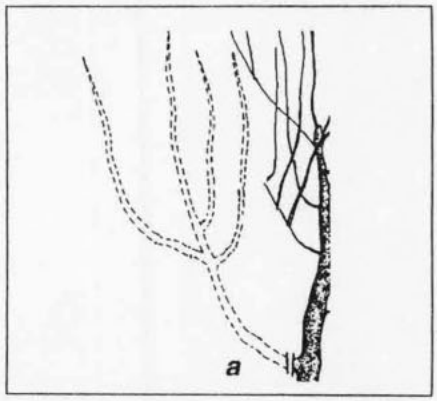


Remove overly vigorous branches.

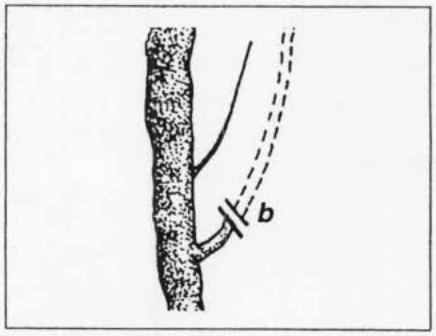
Remove any branches with a basal diameter greater than two-thirds the diameter of the parent branch ***(a)***. The biggest wood should be at the bottom of the tree. Keep in mind the idea of "big, smaller, smallest" as you work up the tree.

Renew wood.

Each leader should be treated as an individual spindle tree growing its own young wood. Since the best quality cherries are grown on young wood, favor it by stubbing back one or two older branches each year ***(b)***. This secondary wood should be no more than 3 years old.

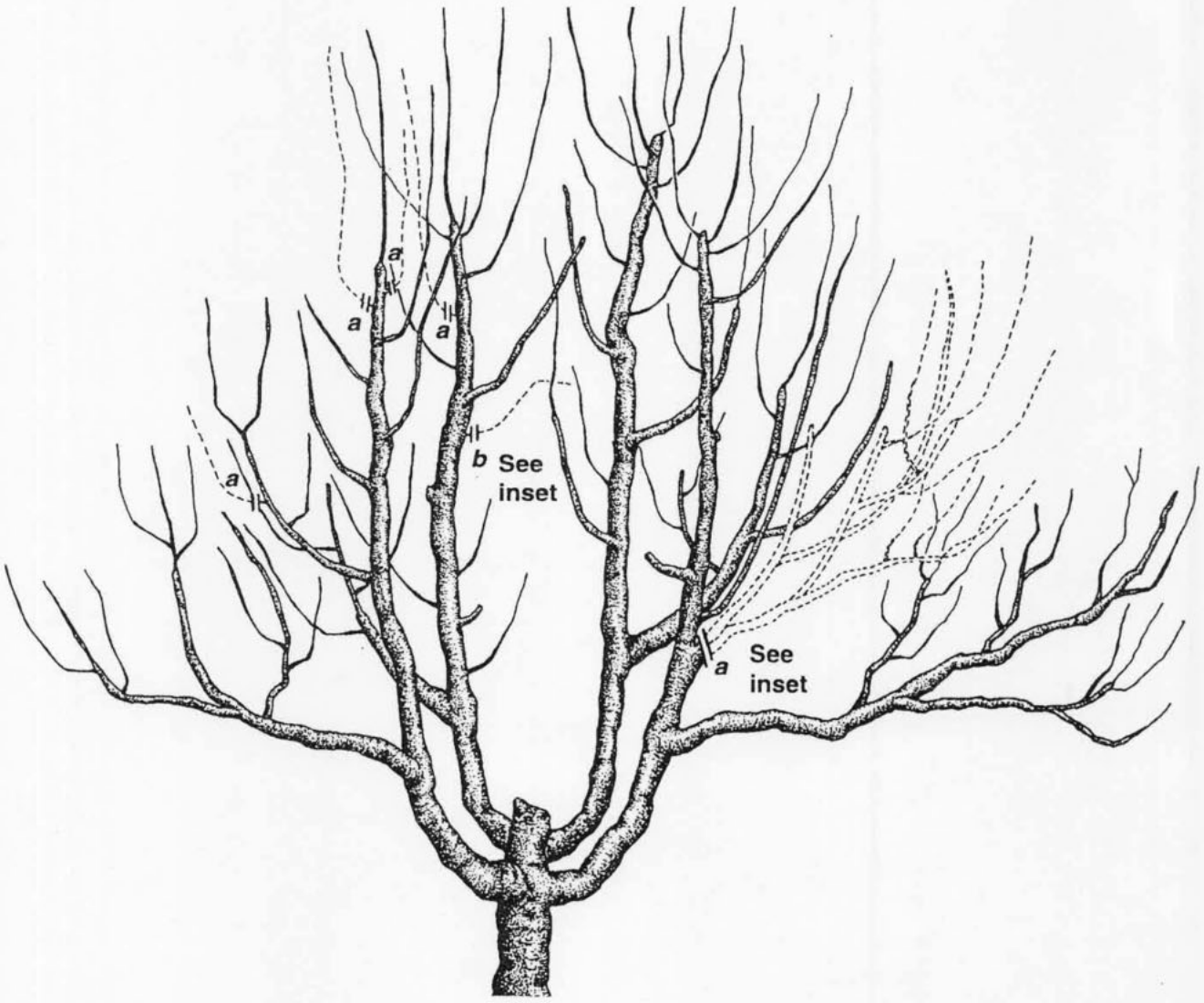


a.—Remove vigorous branches.



b.—Renew wood.

Continued—Dormant or summer pruning at maturity

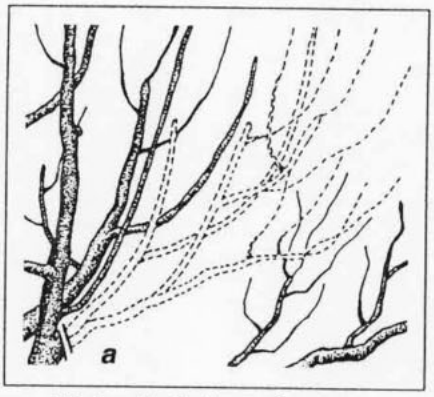


Maintain light paths.

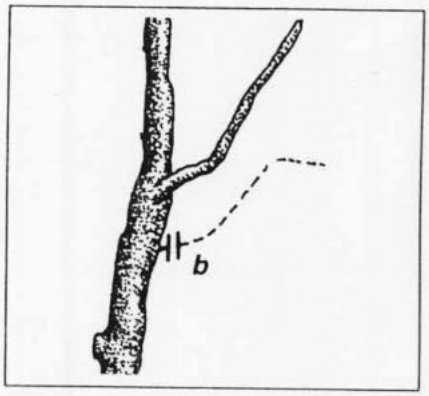
Remove wood that is shading lower branches in order to maintain quality production throughout the tree *(a)*.

Remove pendant wood.

Pendant wood tends to overset and/or produce small cherries *(b)*.

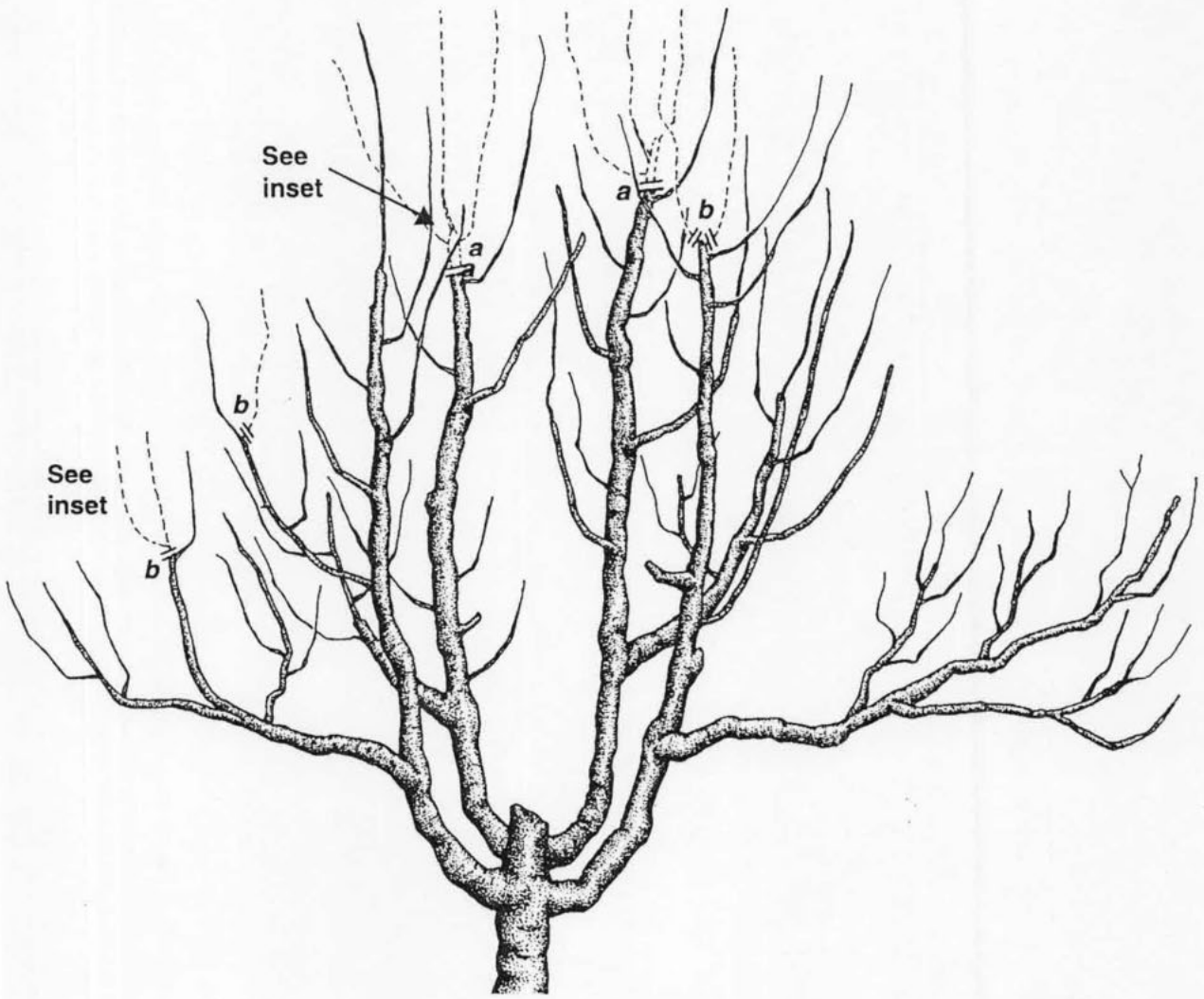


a.—Maintain light paths.



b.—Remove pendant wood.

Continued—Dormant or summer pruning at maturity

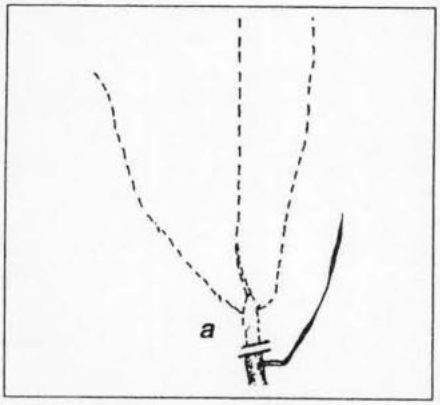


Maintain proper tree height.

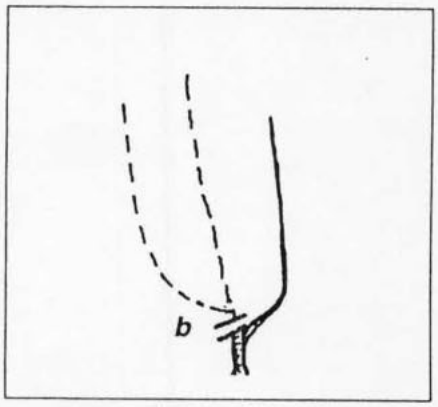
As the tree reaches maximum height, prune the top back to weak laterals *(a)*.

Reduce leader tips to one shoot.

Single out tips at the end of main leaders *(b)*. Also, where adjacent branches are the same size, remove one. This helps to reduce shading.

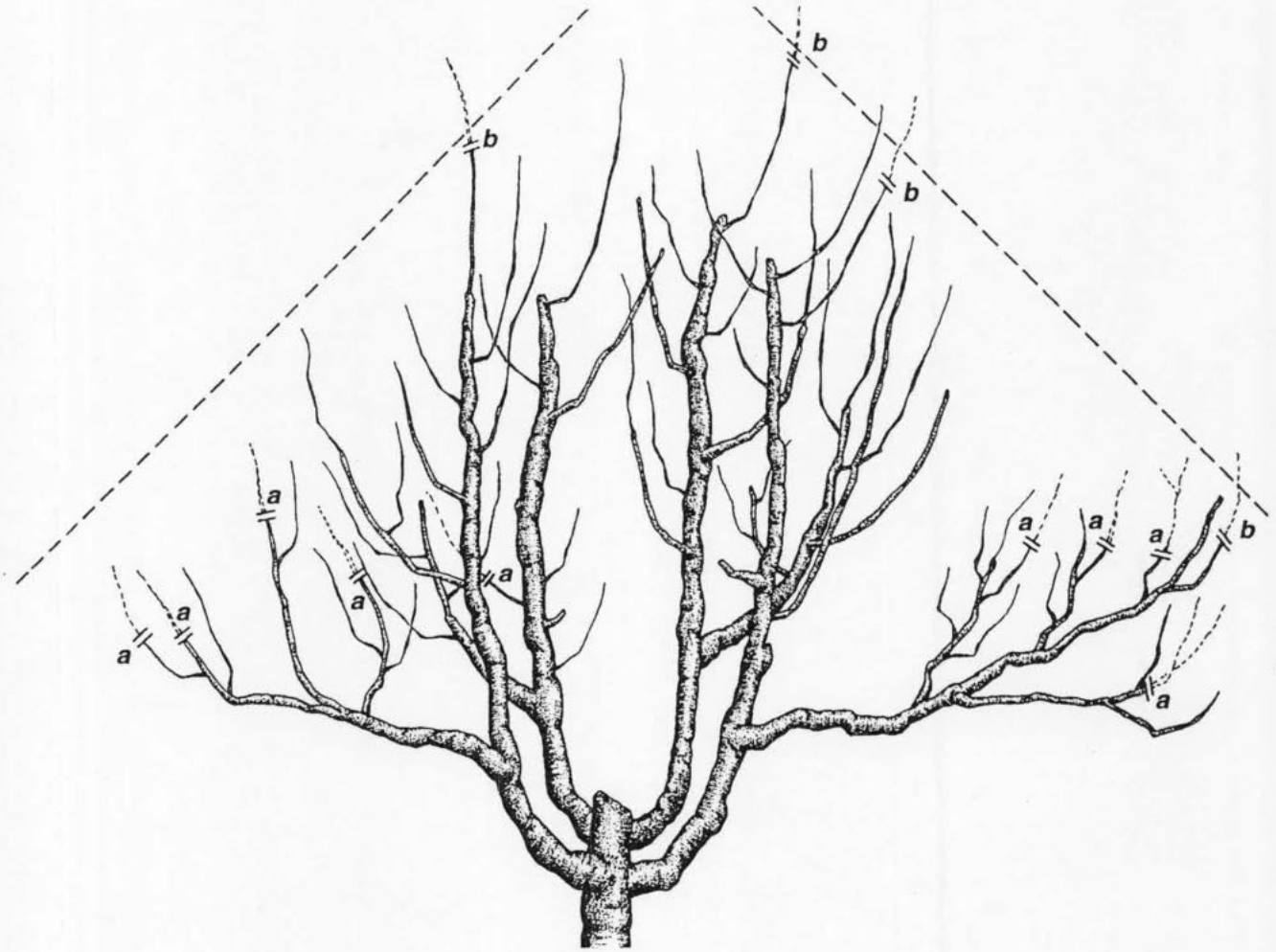


a.—Maintain tree height.



b.—Reduce leader tips to one shoot.

Continued—Dormant or summer pruning at maturity

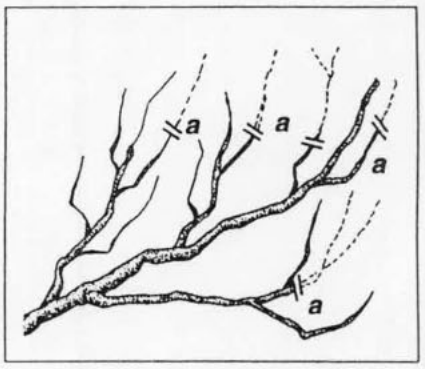


Tip lower branches.

Tipping the lower branches reinvigorates this region of the tree where vigor is hardest to maintain, and helps to ensure large cherries. Tip only what you can reach from the ground with loppers ***(a)***. The top rarely needs to be invigorated, and tipping in the top causes shading.

Maintain a pyramid shape to the tree.

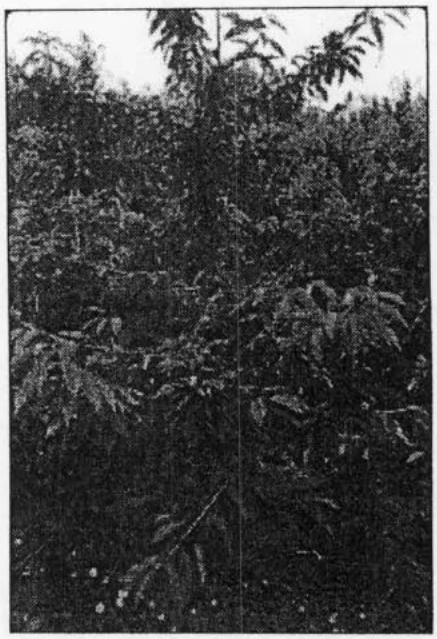
To encourage good light distribution and high-quality fruit throughout the tree, a pyramid shape should be the goal of mature tree pruning ***(b)***. Keep in mind that branch sizes from bottom to top should follow the pattern of "big, smaller, smallest."



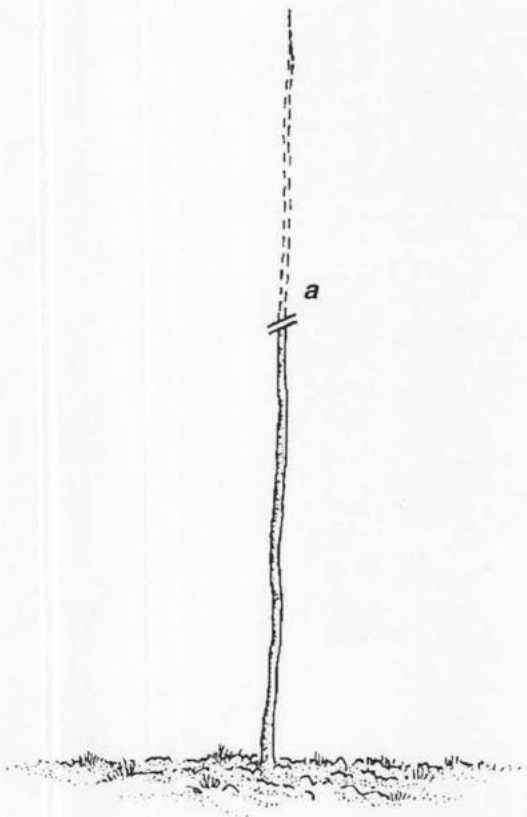
a.—Tip lower branches.

Vogel Central Leader

By taking advantage of the inherent central leader nature of a young cherry tree, the Vogel Central Leader system requires little establishment pruning. This factor, coupled with modest growth characteristics and an intermediate planting density, helps to provide for high early yields.



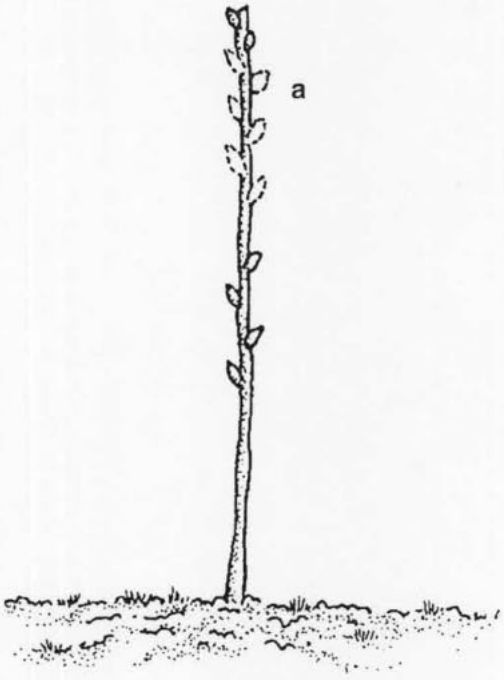
At planting



Head whip.

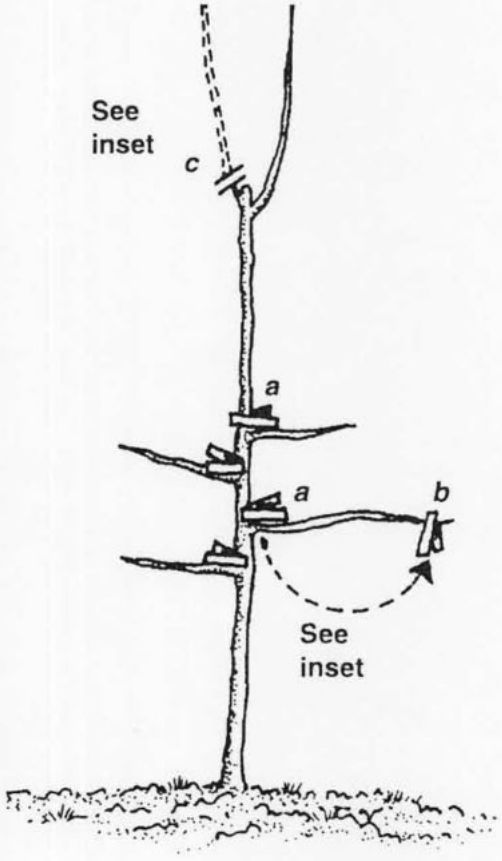
Plant trees 8 to 12 feet apart in the row with 15 to 18 feet between rows, depending on soil fertility, rootstock, terrain, and tractor size. At planting, head the whip 30 to 36 inches above the ground, based on the desired height of the primary fruiting branches *(a)*.

First spring



Remove buds at bud swell.

As buds swell in early spring, allow the top two buds to remain, while removing the next five to six buds ***(a)***. This procedure is intended to reduce leader competition and provide for wider branch angles.

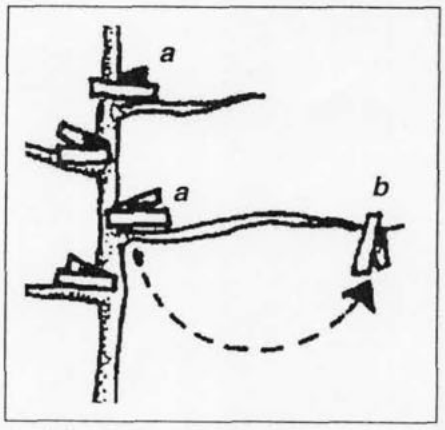


Establish branch angle.

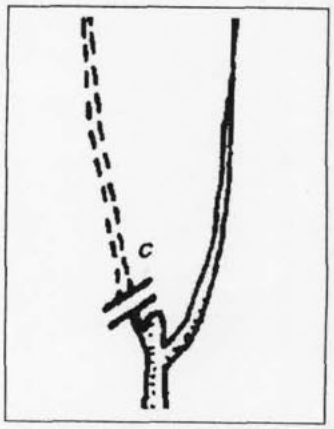
When the remaining lateral shoots have grown to 3 or 4 inches in length, attach a clothespin at a 90-degree angle to the trunk just above these shoots ***(a)***. Move the clothespins to the shoot tip after 2 to 3 weeks to help keep the shoot flat ***(b)***. For adequate weight, use large plastic clothespins rather than wooden pins.

Moderate growth helps to maintain a horizontal branch angle. For this reason, generally avoid fertilizers until cropping begins.

At the same time, if both top buds grew, select the weaker shoot to form the new leader and remove the other ***(c)***.

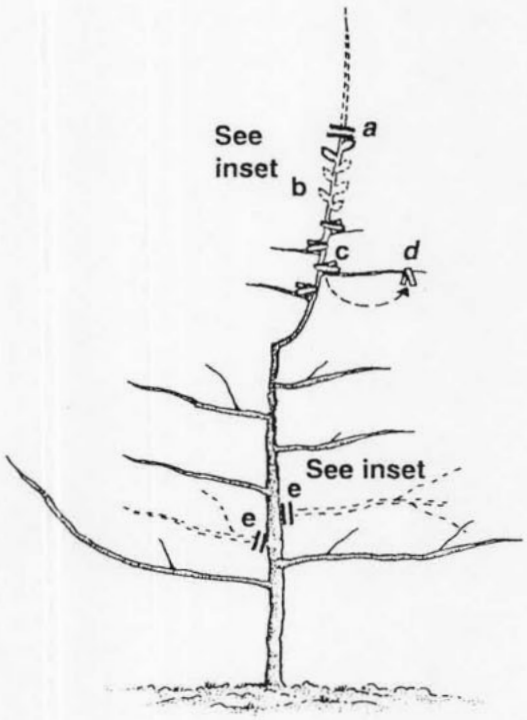


a & b.—Spread shoots



c.—Remove the stronger shoot.

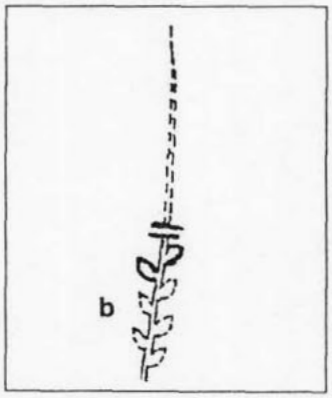
Spring pruning, until maturity



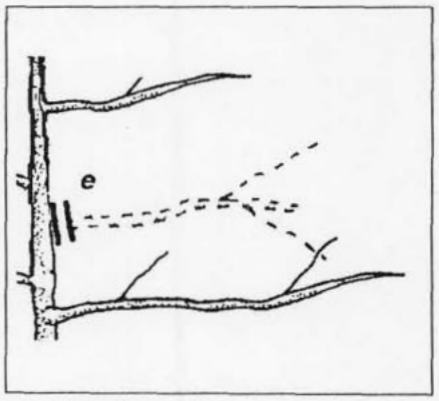
Continue training branches.

Head the leader only if its growth during the previous year was greater than 32 inches ***(a)***. Treat the leader as in the establishment year. Keep the top two buds and remove the next five to six buds ***(b)***. Apply clothespins to emerging shoots ***(c and d)***.

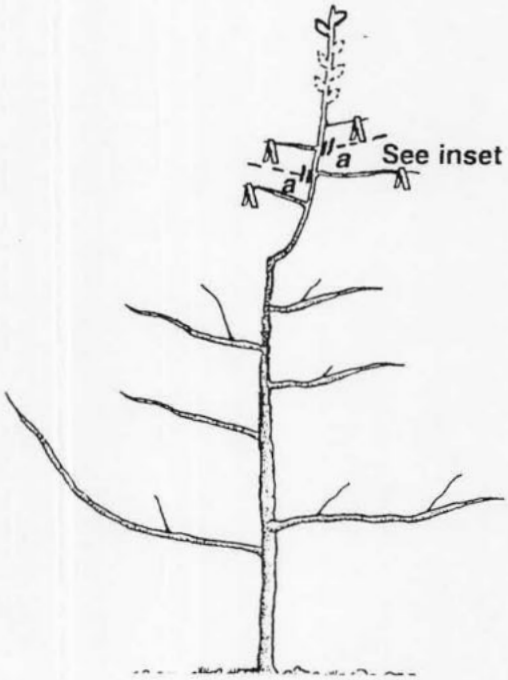
Encourage branches to grow throughout the entire length of the trunk in a spiral rather than allowing distinct whorls to develop. As branches mature, maintain a greater distance between the branches by thinning out those that are closely spaced in order to provide for adequate light penetration ***(e)***.



b.—Remove buds.

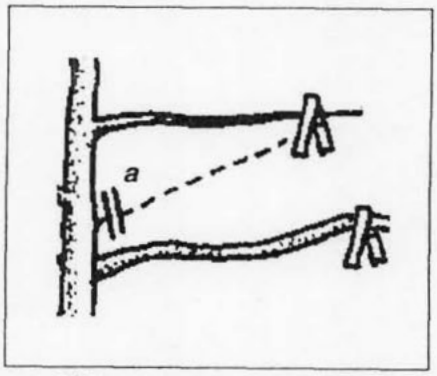


e.—Thin branches.



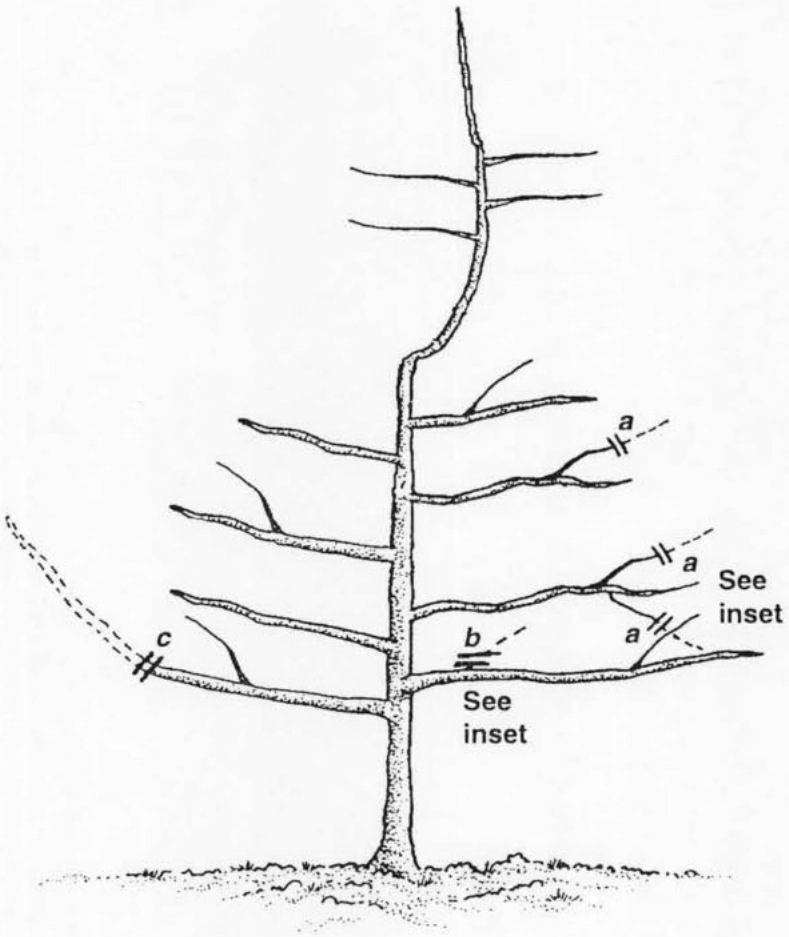
Thin emerging shoots.

Thin emerging shoots, if necessary, to provide for good light distribution throughout the tree ***(a)***.



a.—Thin emerging shoots for light penetration.

Spring or summer, years 2 and 3

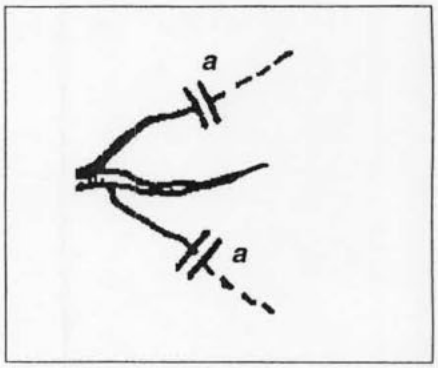


Maintain a dominant terminal on all lateral branches.

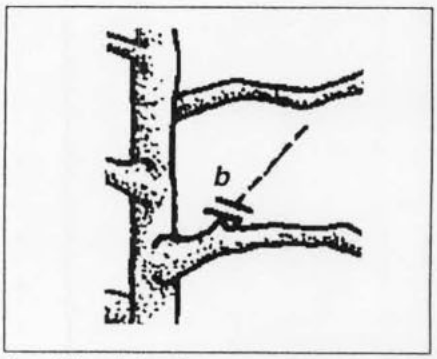
Pinch side shoots on laterals *(a)*.

Pinch back or remove vertical shoots growing from primary laterals only if they are growing within a few inches of the trunk *(b)*. Leave all other shoots growing off the primary lateral, and allow them to develop as potential renewal branches.

Stub back primary laterals that are growing vigorously upright, being sure to leave a live stub *(c)*.

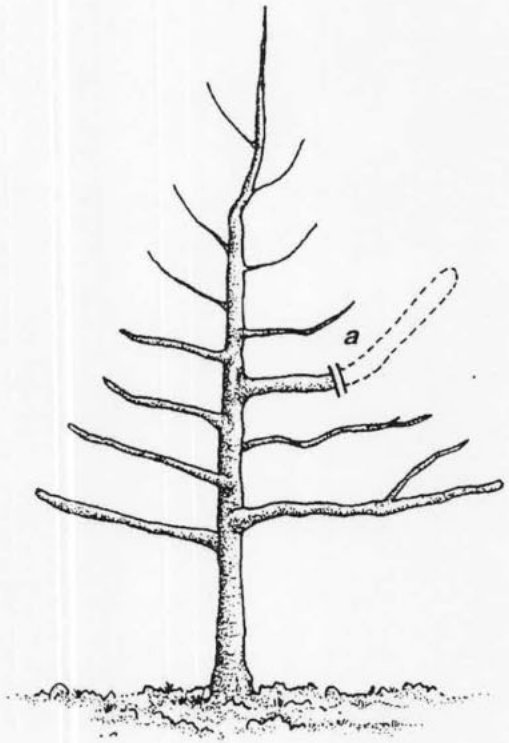


a.—Pinch side shoots.



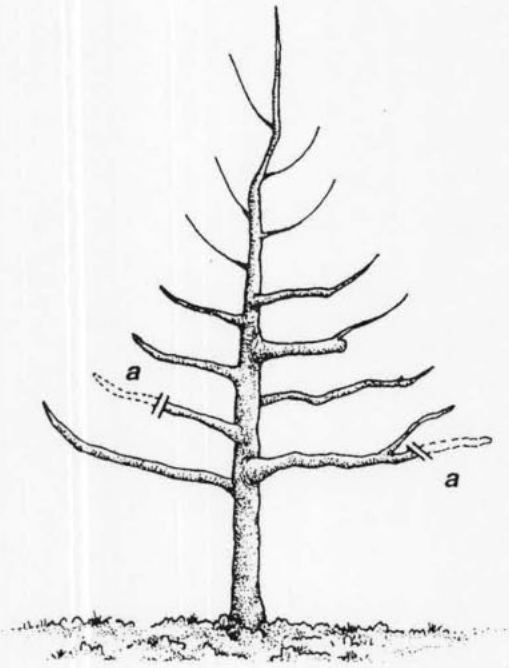
b.—Pinch back or remove vertical shoots near trunk.

Continued—Spring or summer, years 2 and 3



Stub back or remove thick branches.

Stub back or remove branches thicker than one-half the trunk diameter to allow good light distribution throughout tree ***(a)***.



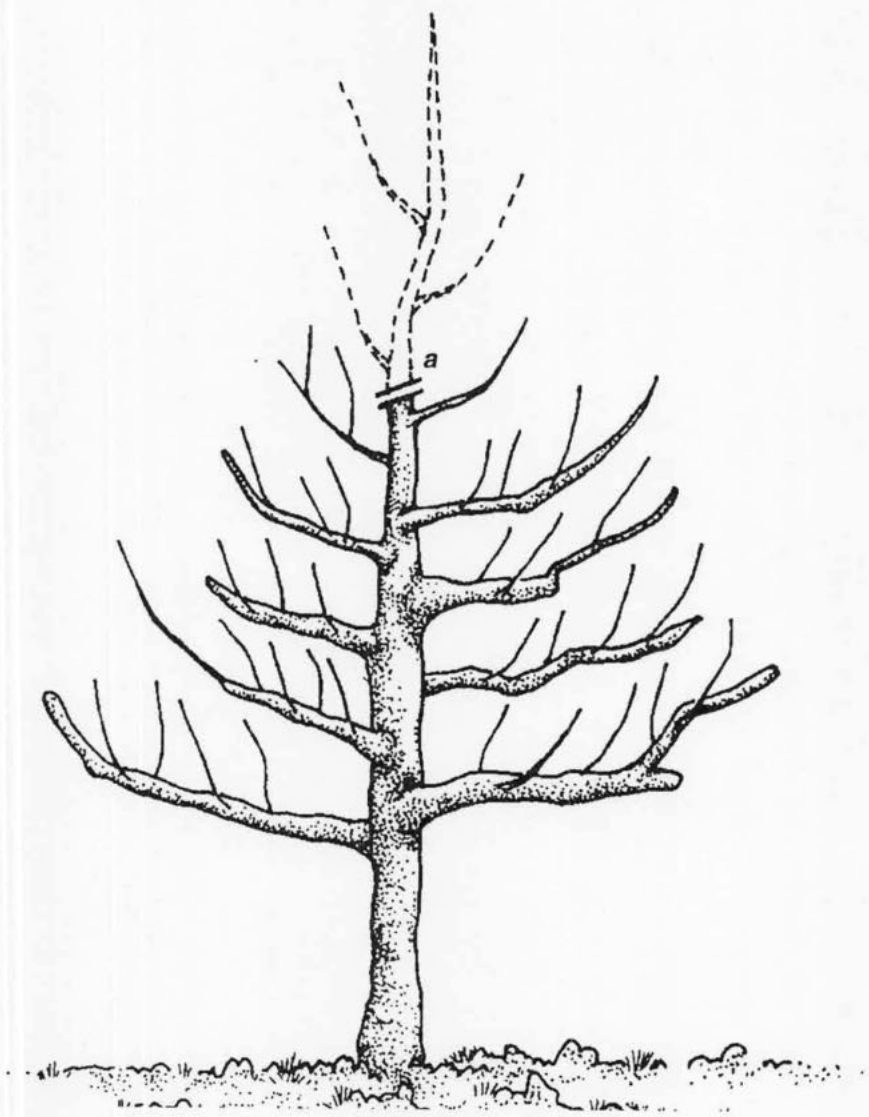
Maintain light penetration and encourage fruiting wood.

In order to promote young fruiting wood and encourage large fruit size, stub back several laterals each spring ***(a)***. Remove pendant wood first, and then older wood that has been allowed to fruit for 3 or 4 years. There should be a good balance between established fruiting wood and renewal shoots. To maintain the typical "Christmas tree" shape, be sure to stub lower branches farther from the trunk than upper branches.

Spring or summer, at maturity

Repeat the procedures shown on pages 23 and 24 each year to maintain good light distribution and maximum fruit size throughout tree. In a large, mature tree, there may be as many as 15 to 20 renewal cuts made per year, but each tree needs to be evaluated individually. More cuts are needed to invigorate weaker trees or to reduce overcropping.

Postharvest, at maturity



Maintain tree height.

Make no attempt to control tree height until tree growth begins to slow. You can maintain tree height by cutting the tree top back to a flat, weak lateral ***(a)***. Depending on tree vigor, you can remove as much as 4 feet of height.

CATTS (Controlled Atmosphere/Temperature Treatment System): A Novel Tool for the Development of Quarantine Treatments

Lisa G. Neven and Elizabeth J. Mitcham

ABSTRACT Controlled atmosphere (1.0% O_2, 15% CO_2) in combination with high temperature (45 and 47°C) was compared with high temperature alone to determine the impact of combination heat and controlled atmosphere treatments on mortality of 5th instars of codling moth, *Cydia pomonella* (L.), in sweet cherries. The combined treatment unit is termed CATTS for Controlled Atmosphere/Temperature Treatment System. LT_{99}s at 45 and 47°C were 64 and 44 min, respectively, for the combined treatments and 124 and 72 min, respectively, for high temperature alone. This research demonstrates the potential effectiveness of controlled atmosphere in combination with high temperatures as a quarantine treatment against codling moth larvae in sweet cherries.

In international trade of commodities, the importing country determines the level of risk that insects, weeds, or pathogens pose to the country's agriculture. To reduce this risk, limitations are imposed by the importing country on particular commodities or pests that are called phytosanitary or quarantine restrictions. These restrictions on trade must have a scientific basis and should not constitute unwarranted barriers to free trade.

A case in point is the importation of U.S. sweet cherries into Japan. Codling moth, *Cydia pomonella* (L.), a common pest of apples in Europe and North America, does not occur in Japan. Although the incidence of codling moth in commercially grown cherries is rare, Japan considers this pest a threat to its agriculture. Therefore, to prevent its introduction, Japan has imposed a quarantine restriction on cherries from any country that has codling moth. To minimize the risk of accidental introduction of this pest, all fresh cherries from the United States that are shipped to Japan first must undergo a fumigation treatment with methyl bromide (FAO 1983). In 1994, >737,005 boxes (7,370 t) of sweet cherries from the Northwest were shipped to Japan (Ken Severn, personal communication). This level of trade may be jeopardized because of the impending loss of methyl bromide.

On 1 January 2001, the production and import of methyl bromide, perhaps the most effective and widely used fumigant for meeting insect quarantine restrictions, will no longer be allowed in the United States. Its classification as a Class I ozone depleter by the Montreal Protocol (UNEP 1992) has led the U.S. Environmental Protection Agency to mandate its removal from the chemical register under the 1990 Federal Clean Air Act. Methyl bromide became the principal fumigant for quarantine treatments after ethylene dibromide was removed from the chemical register in 1984. It is likely that no other fumigant will be registered in the near future that can replace methyl bromide. Loss of this fumigant could severely affect the trade of many commodities if suitable alternative treatments are not developed.

Temperature extremes have been studied as potential quarantine treatments for pests in temperate fruits (Armstrong 1994, Neven 1994, Neven and Rehfield 1995). A treatment of 47°C for 25 min caused 100% mortality of 5th-instar codling moth, the stage most tolerant to this temperature (Yokoyama et al. 1991). Heat treatments above 42°C are more effective than those below this temperature, regardless of the rate of heating (Neven 1994, Neven and Rehfield 1995).

Controlled atmosphere has been used for control of insects in a number of fresh commodities (Hallman 1994). Traditional controlled atmosphere cold storage of apples, with 1–3% O_2 and 1–5% CO_2, is no more effective in causing larval mortality of codling moth than cold storage in air (Toba and Moffitt 1989, 1991). Controlled atmosphere is more lethal to codling moth when applied in combination with an elevated temperature (Soderstrom et al. 1990, Whiting et al. 1991, 1992a, b). Controlled atmospheres of 21% O_2 and 60% CO_2 or 0.5% O_2 and 10% CO_2, at 25°C, enhanced codling moth mortality (Soderstrom et al. 1990). A decrease in LT_{99} (estimated exposure time to achieve 99% mortality) was noted when the temperature associated with the CA (0.4% O_2, 5% CO_2) was increased from 20 to 40°C (Whiting et al. 1992a, b); duration of exposure to temperatures within this range required to achieve 99% codling moth mortality decreased from 15.3 d to 14.3 h. It was not known whether fruit could tolerate exposure to high temperatures under controlled atmospheres.

We have found that high quality, freshly harvested 'Bing' sweet cherries withstand exposure to high temperatures (45–47°C) for short durations (60 and 25 min, respectively) without significant loss of quality (unpublished data). Cherries that have been exposed to these temperatures show no significant changes in titratable acidity, soluble solids, or firmness, for up to 2 wk after treatment. Stem browning, however, was a problem with heat treatments as well as with methyl bromide treated cherries.

To determine whether the duration of the heat treatments could be shortened by combining high temperature with a controlled atmosphere, a unique quarantine research chamber was designed and built. This chamber controls temperature, atmospheric gases, humidity, and air speed. We call this chamber CATTS for Controlled Atmosphere/Temperature Treatment System and report the results of its use in the development of a quarantine treatment for codling moth in sweet cherries.

Materials and Methods

Cherries infested with codling moth larvae were treated in the CATTS quarantine treatment research chamber in the Department of Pomology at the University of California, Davis. We determined the CATTS specifications and the unit was designed and built by Techni-Systems of Chelan, WA. The chamber is a flow through, airtight system with temperature, dew point, air speed, and atmosphere controls. It differs from previously described units (Gaffney et al. 1990, Gaffney and Armstrong 1990, Sharp et al. 1991) because atmospheres can be controlled. Temperature is controlled within ±0.1°C between ambient and 60°C. Humidity is monitored with a

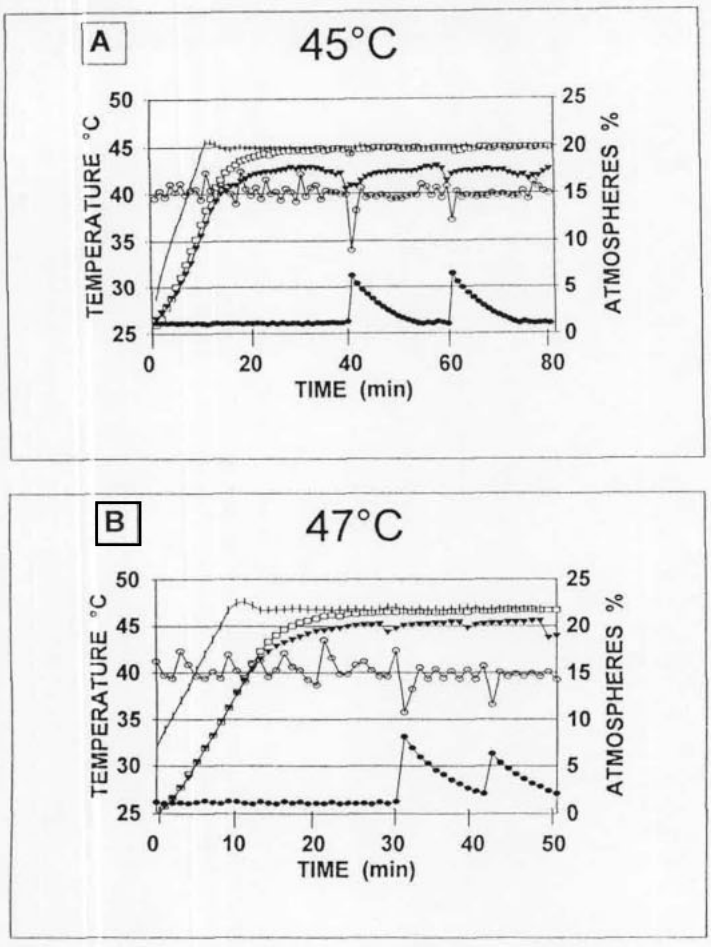


Fig. 1. Conditions during heat treatments with controlled atmospheres of cherries infested with 5th-instar codling moth. (A) 45°C. (B) 47°C. +, chamber air temperature; ▲, dew point, ❑, core fruit temperatures; ●, $\%O_2$; ○, $\%CO_2$ levels.

chilled mirror dew point analyzer (EG & G, Waltham, MA). Humidity is controlled either by regulating dew point relative to fruit surface temperature or by air temperature. Humidity is attained through injection of atomized water into the air stream to maintain the dew point to within ±0.2°C. Air flow is controlled by a variable speed drive unit to within ±0.2 m/s from 0 to 3.0 m/s. Controlled atmospheres are generated by automatic injection of air, carbon dioxide, or nitrogen. Oxygen is controlled to within ±0.1% from 0.0 to 21%. Carbon dioxide is controlled to within ±0.1% from 0.1 to 80%. A personal computer (486DX) is used to control and monitor the system. The chamber is portable and holds 3 fruit lugs (58.4 by 38.1 by 40.6 cm).

Codling moth larvae were reared on an artificial diet developed by Toba and Howell (1991). Fifth instars were transferred with a camel's hair paint brush onto mature Bing cherries at a ratio of 1 larva per cherry. The larvae burrowed into the cherries within a few minutes following transfer. Infested cherries were placed in plastic containers (19 by 16 by 6 cm) covered with nylon organdy. The containers were packed into 50 gal (211.3 liters) ice coolers, kept at ambient temperature (22–25°C) overnight, and shipped by air freight from the USDA–ARS laboratory in Yakima, WA, to the U.C. Davis campus with a transit time of 6 h. At Davis, the infested cherries were removed from the containers and placed in nylon organdy bags. The bags were placed in vented treatment bins and the bins placed in the CATTS chamber. For combination treatments, a controlled atmosphere of 1.0% O_2 and 15% CO_2 was established before the cherries were placed in the chamber. Subsequently, the chamber was heated to 45 or 47°C. Temperature ramp rate, the rate at which the temperature changed in the chamber, was 100°C/h (1.66°C/min). Air speed was 2 m/s and the dew point was set 2°C below the surface temperature of the coolest fruit. The experiment consisted of a factorial design in which the factors were temperature (45 and 47°C), atmosphere (controlled atmosphere or ambient air), and duration of exposure. Samples of infested cherries (50 cherries per sample, 1 larva per cherry) were removed at 3 different times during the course of the experiment. Control larvae were subjected to the same conditions as the controlled atmosphere treated larvae, except they were exposed to ambient air (21% O_2, <0.04% CO_2). The experiment was replicated 4 times. A group of infested cherries (200 cherries) were not exposed to high temperature to determine natural mortality. Control and treated cherries subsequently were hydrocooled for 6 min at 0°C, then stored for 2 d at 0°C.[1] Cherries were removed from the cold room 24 h prior to assessing mortality to reduce the effects of cold torpor and to allow for easy assessment of mortality.

Cherries were examined for surviving larvae. Larvae were scored as live, dead, or moribund. Moribund larvae were held for 5 d at room temperature on artificial diet, then assessed for survival.[2]

Data were corrected for natural mortality according to Abbott (1925). These data were then transformed to arcsin $\sqrt{x}$, a standard transformation for data expressed as percentages (Steel and Torrie 1980), before analysis by ANOVA with SAS general linear models procedure (PROC GLM, SAS V. 6.04) (SAS Institute 1987). LT_{99}s were estimated by regression analysis (PROC REG) (SAS Institute 1987).

Results of tests on fruit quality will be covered in another publication. We note, however, that soluble solids, titratable acidity, and firmness were not affected. Some stem browning and minor pitting of the fruit were evident.

Results and Discussion

The unit required 7 min to achieve 15% CO_2 and ≈26–28 min to achieve 1.0% O_2 (Table 1). Subsequently, the chamber precisely controlled CO_2 levels to within ±0.1%. The controlled atmosphere was reestablished within 15 min after opening the chamber to remove samples (Fig. 1). Reestablishment of O_2 level took much long-

Table 1. Treatment parameters for cherries infested with 5th-instar codling moth

Parameters[a]	Treatment times and temp.,°C	
	45	47
Maximum center temp.	44.1± 0.15	46.1± 0.1
Time to max center temp.[b]	23 ± 1.0 min	25 ± 1.0 min
Time to reach 42°C	16 ± 1.0 min	13 ± 1.0 min
Time to reach 44°C	23 ± 1.0 min	16 ± 1.0 min
Time at max temp.[c]	57 ± 1.0 min	25 ± 1.0 min
Time to establish CA[d]	28 ± 1.0 min	26 ± 0.0 min

[a]Values represent average fruit core conditions during treatments. Averages of 16 fruits probed per treatment, 4 replicates, ± SEM.

[b]Ramp time.

[c]Time at maximal treatment temperature = total treatment time (80 and 50 min for 45 and 47°C, respectively) – time to max center temp. (line 2).

[d]Controlled atmosphere, 1.0% O_2, 15% CO_2, established before heating.

[1]Cherries are routinely hydrocooled (0–4°C) either directly after harvest or following methyl bromide fumigation. Following packing,they are held in cold storage (-1 to 0°C) for 2 to 14 d, depending on whether they are shipped by air freight or boat. The 2 d of cold storage in this experiment represent the shortest duration a cherry would be stored prior to marketing.

[2]This is a standard method for assessing mortality in quarantine treatments.

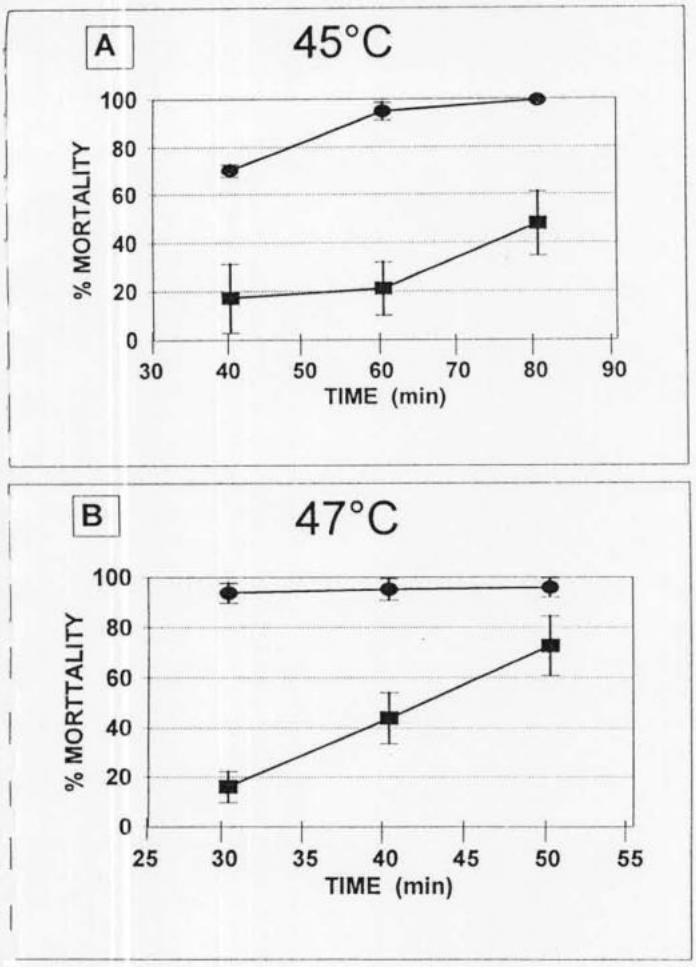


Fig. 2. Mortality of 5th-instar codling moth in infested cherries following heat treatments with and without controlled atmospheres. (A) 45°C. (B) 47°C. Values represent mean corrected mortality (see text) ± SE. ●, heat + CA; ■, heat alone; $n = 200$.

than CO_2 levels after sample removal, as evidenced by the breaks in the curves (Fig. 1). This was because nitrogen and CO_2 are injected into the chamber whereas low O_2 levels are obtained by displacement of air by the other 2 gases. Humidity was satisfactorily controlled to regulate the dew point temperature.

Combination treatments (heat + CA) resulted in higher codling moth mortality than heat alone (Fig. 2). Combined treatments increased mortality levels by 3.5 and 5-fold at the 40 and 60 min sample periods, respectively, and 2-fold at the 80 min sample period for the 45°C treatment (Fig. 2A). Addition of the controlled atmosphere reduced the LT_{99} almost 50% (Table 2). Effects of combination treatments were magnified as the temperature increased from 45 to 47°C (Fig. 2B). Larval mortality at 30 min, just 5 min following attainment of >46°C, was only 18%. However, when the controlled atmosphere was added, mortality was >90%, more than a 5-fold increase. Addition of the controlled atmosphere reduced the LT_{99} by 40% (Table 2). Whiting et al. (1991, 1992a, b) noted that LT_{99}s of 5th-instar codling moth and light brown apple moth, *Epiphyas postvittana* (Walker), decreased when the temperature of controlled atmosphere treatments (0.4% O_2, 5% CO_2) was raised from 20 to 40°C. At 40°C, Whiting et al. (1992a) reported an LT_{99} of 14.3 h. Our results, using 1.0% O_2, 15% CO_2, resulted in an LT_{99} of 64 and 44 min at 45 and 47°C, respectively (Table 2).

Table 2. Summary of 5th-instar codling moth larval mortality in response to heat and heat plus controlled atmosphere treatments

Temp., °C	Controlled atmosphere	LT_{99}[a]
45	Ambient air	124 min
45	1.0% O_2, 15% CO_2	64 min
47	Ambient air	72 min
47	1.0% O_2, 15% CO_2	44 min
40[b]	0.4% O_2, 5% CO_2	14.3 h

[a] LT_{99}, Time of treatment in which 99% mortality is predicted by regression analysis (PROC REG, SAS Institute [1987]).
[b] Data taken from Whiting et al. 1992a.

Larval mortality was 50% after an exposure to 45°C forced air for 80 min (Fig. 2A). When the ramp time (23 min) is subtracted from the total treatment time (80 min), the time the larvae were exposed to 44°C was 57 min (Table 1). For the 47°C treatment, larval mortality was only 75% after 50 min (Fig. 2B). This corresponds to an exposure to 46°C of 25 min (Table 1). The mortality levels do not completely agree with data from our unpublished preliminary research; in our preliminary research, using a forced air heating unit without controlled atmosphere, we observed 100% mortality of 5th instars after 60 min at 45°C and 100% mortality after 25 min at 47°C. The differences are most likely because of the ramp rate. In the current study, the chamber temperature changed from 22 to 45 or 47°C at a rate of 1.66°C/min, which resulted in a heating rate in the cherries of 1°C/min. In the forced air heating unit, the chamber was set at the treatment temperature when infested fruit were added, resulting in a fruit heating rate of 4.4°C/min. These results indicate that slower heating rates require longer exposures at the final treatment temperature to achieve the same levels of mortality as treatments with more rapid rates of heating.

The mode of action of a combination high temperature/controlled atmosphere treatment on insect physiology is not well understood. Friedlander (1983) explained that a high CO_2 environment reduces NADPH formation, slows ATP requiring reactions, reduces production of glutathione, and inhibits the regeneration of acetylcholine from choline. In addition, the accumulation of CO_2 in the hemolymph taxes the ability of carbonic anhydrase to catalyze the formation of bicarbonate (Miller 1974, Wigglesworth 1983), producing a lower hemolymph pH because of the formation of carbonic acid. Temperature also affects pH; as temperature increases, neutral pH decreases. Lower pH may have a dramatic effect on membrane function and cellular metabolism. Opening of spiracles is regulated by internal CO_2 levels, O_2 demands, and relative humidity. High temperatures increase insect metabolism and demand for O_2. Low levels of O_2 can induce anaerobic metabolism and may also affect neuron efficiency (Fleurat-Lessard 1990). Therefore, a treatment employing high temperature, high CO_2, and low O_2 should be effective in causing insect mortality. Our results indicate that using a controlled atmosphere with a heat treatment provides an additional stress that enhances larval mortality over that of the heat treatment alone. The total length and intensity of a heat treatment can be dramatically reduced by the addition of a controlled atmosphere. We believe that combination treatments show great promise for the development of alternative, nonchemical quarantine treatments.

Acknowledgments

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References Cited

Abbott, W. S. 1925. A method of computing the effectiveness of an insecticide. J. Econ. Entomol. 18: 265–267.

Armstrong, J. W. 1994. Heat and cold treatments, pp. 103–119. *In* R. E. Paull and J. W. Armstrong [eds.], Insect pests and fresh horticultural products: treatments and responses.CAB International,Wallingford, UK.

FAO Plant Production and Protection Paper 50. 1983. International plant quarantine treatment manual. Food and Agriculture Organization of the United Nations, Rome, Italy.

Federal Clean Air Act. 1990. Public Law 101–549, enacted 15 November 1990. Washington, DC.

Fleurat-Lessard, F. 1990. Effect of modified atmospheres on insects and mites infesting stored products, pp. 21–38. *In* M. Calderon and R. Barkai-Golan [eds.], Food preservation by modified atmospheres. CRS, Boca Raton.

Friedlander, A. 1983. Biochemical reflection on a non-chemical control method: the effect of controlled atmosphere on the biochemical processes in stored product insects. pp. 471–486. *In* Proceedings, 3rd International Working Conference on Stored Product Entomology. Kansas State University, Manhattan.

Gaffney, J. J., and J. W. Armstrong. 1990. High-temperature forced air research facility for heating fruits for insect quarantine treatments. J. Econ. Entomol. 83: 1959–1964.

Gaffney, J. J., G. J. Hallman, and J. L. Sharp. 1990. Vapor heat treatment research unit for insect quarantine treatments. J. Econ. Entomol. 83: 1965–1971.

Hallman, G. J. 1994. Controlled atmospheres. pp. 121–138. *In* R. E. Paull, and J. W. Armstrong [eds.]. Insect pests and fresh horticultural products: Treatments and Responses. CAB, Wallingford, UK.

Miller, P. L. 1974. Ventilation in active and in inactive insects. pp. 367–390. *In* M. Rockstein [ed.], Principles of insect physiology. Academic, New York.

Neven, L. G. 1994. Combined heat treatments and cold storage effects on mortality of fifth-instar codling moth (Lepidoptera: Tortricidae). J Econ Entomol. 87: 1262–1265.

Neven, L. G., and L. M. Rehfield. 1995. Comparison of pre-storage heat treatments on fifth instar codling moth (Lepidoptera: Tortricidae) mortality. J. Econ Entomol. (in press).

SAS Institute. 1987. SAS user's guide: statistics. SAS Institute, Cary, NC.

Sharp, J. L., J. J. Gaffney, J. I. Moss, and W. P. Gould. 1991. Hot-air treatment device for quarantine research. J. Econ. Entomol. 84: 520–527.

Soderstrom, E. L., D. G. Brandl, and B. Mackey. 1990. Responses of codling moth (Lepidoptera: Tortricidae) life stages to high carbon dioxide or low oxygen atmospheres. J. Econ. Entomol. 83: 472–475.

Steel, R.D.G., and J. H. Torrie. 1980. Principles and procedures of statistics: a biometrical approach. 2nd ed. McGraw-Hill, New York.

Toba, H. H., and J. F. Howell. 1991. An improved system for mass-rearing codling moths. J. Entomol. Soc. BC. 88: 22–27.

Toba, H. H., and H. R. Moffitt. 1989. Controlled atmosphere cold storage as a postharvest quarantine treatment for codling moth on apples, pp. 213–224. Proceedings, International Conference of Technical Innovation of Freezing and Refridgeration of Fruits and Vegetables, Davis, CA, 9–12 July 1989.

1991. Controlled-atmosphere cold storage as a quarantine treatment for nondiapausing codling moth (Lepidoptera: Tortricidae) larvae in apples. J. Econ. Entomol. 84: 1316–1319.

United Nations Environmental Programme (UNEP). 1992. Methyl bromide: atmospheric science, technology & economics. U.N. Headquarters, Ozone Secretariat. Nairobi, Kenya.

Whiting, D. C., S. P. Foster, and J. H. Maindonald. 1991. Effects of oxygen, carbon dioxide, and temperature on the mortality responses of *Epiphyas postvittana* (Lepidoptera: Tortricidae). J. Econ. Entomol. 84: 1544–1549.

Whiting, D. C., S. P. Foster, J. Van Den Heuvel, and J. H. Maindonald. 1992a. Comparative mortality responses of four Tortricid (Lepidoptera) species to a low oxygen-controlled atmosphere. J. Econ. Entomol. 85: 2305–2309.

Whiting, D. C., J. Van Den Heuvel, and S. P. Foster. 1992b. Potential of low oxygen/moderate carbon dioxide atmospheres for postharvest disinfestation of New Zealand apples. N.Z. J. Crop and Hort. Sci. 20: 217–222.

Wigglesworth, V. B. 1983. The physiology of insect tracheoles. Adv. Insect Physiol. 17: 85–148.

Yokoyama, V. Y., G. T. Miller, and R. V. Dowell. 1991. Response of codling moth (Lepidoptera: Tortricidae) to high temperature, a potential quarantine treatment for exported commodities. J. Econ. Entomol. 84 528–531

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NEW SWEET CHERRY CULTIVARS & SELECTIONS FROM CMVF-DCA IN BOLOGNA, ITALY

Silviero Sansavini and Stefano Lugli
Centro Miglioramento Varietale in Frutticoltura
Dipartimento Colture Arboree (DCA) , University of Bologna (Italy)

The University of Bologna's CMVF-DCA's sweet cherry breeding program was established 20 years ago to pursue the following key *objectives*.

- Introduce self-fertility
- Extend ripening seasonality, especially for earliness
- Enhance crop performance (early bearing, steady yield);
- Enhance fruit size quality diversification (color, firmness, falvor traits)
- Tolerance to rain-induced cracking

Results. Of the 6,000 seedlings produced to date from crosses, one-third have been fully assessed. The program's current status in this connection is:

- Selection stages 2 and 3 for 15 self-fertile seedlings begun in 1990
- The cultivars Blaze Star*, Early Star® Panaro 2* and LaLa Star* commercially released in 1997
- The cultivars Sweet Early® Panaro 1* commercially released in 2000
- The cultivars Black Star* and Grace Star* commercially released in 2001
- 2 promising selections being monitored

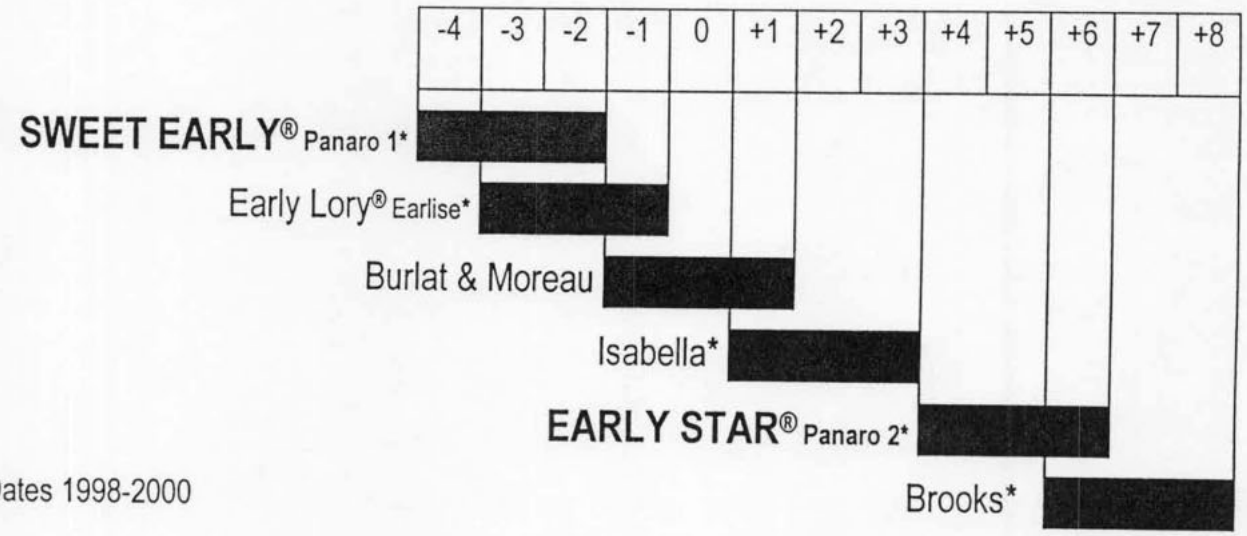
CRPV at Cesena, the clearing-house for breeders' rights, has applied for EU patents for the 1997 releases and won the exclusive rights at public auction to multiply them in Italy at four nurseries.

The following data sheets (1998-2000) provide the profiles of the salient traits of the CMVF-DCA's new cultivars and advanced selections in order of ripening date (see figure).

SWEET EARLY® Panaro 1*

Origin. Burlat x Sunburst cross of 1984: The original seedling, DCA BO 84.704.006 (G45), was selected at Vignola (Modena Province) in 1990-1992 and assessed from 1997 to 2000 in Selection II fields of CRPV-DCA at Monteleone (Forlì Province, Azienda Bonandi Holdings), at Savignano Sul Panaro (Modena Province, Azienda Quartieri Holdings) and at the Azienda Zanetti Holdings at Castrocaro (Forlì Province).
Tree. High vigor, standard growth habit, extended canopy, many feathers. Self-fertile.
Bloom. Medium-early, diffuse, steady over time.
Ripening date. Extra-early (2 -4 days before Burlat), uniform (18 May in 1998 and 2000; 20 May in 1999) and hangs fairly well on tree.
Fruit. Large size (9-10 g); slightly depressed-spheroid, symmetrical. *Skin:* thin with red color, uniform and shiny dark-red overcolor (blackish at full maturity) extending to 90% of surface. *Flesh:* pinkish, medium-poor firmness, (<Burlat), juicy, typically sweet taste (>15°brix) with low acidity (<4 g/l malic acid). *Peduncle:* medium-long, average thickness. *Stone:* average size.
Field Performance. Medium-early cropping (year 4-5), medium-high, steady yielding, bears well on spurs and one-year-old wood, medium-low susceptibility to cracking in rainy years, especially in peduncle area (max: 20% cracking in 1997).
Overall rating. promising self-fertile cultivar because of its extra-early (2-4 d ahead of Burlat) uniform (one-run picking) ripening, attractive fruit (shiny dark-red skin) appearance and large size. Despite its soft flesh, it hangs well on tree.

Sweet Early® Panaro 1 and Early Star® Panaro 2
Ripening date in days' difference to Burlat (22 May)



Avg. Dates 1998-2000

EARLY STAR® Panaro 2*

Origin. Bigarreau Burlat x Stella compact crossed in 1983. The original seedling, DCA BO 83.705.001 (G25), was selected at Vignola (Modena Province) in 1990-1992 and assessed

Bonandi Holdings), at Savignano Sul Panaro (Modena Province, Azienda Quartieri Holdings) and at the Azienda Zanetti Holdings at Castrocaro (Forlì Province).

Tree. Very vigorous, upright rootstock habit, slight feathering, standard cropping habit. Self-fertile.

Bloom. medium-early, steady and average extent.

Ripening date. Early and uniform: 4-6 days post-Burlat.

Fruit: very large (9-11 g), symmetrical, depressed cordiform. *Skin:* thin, red with dar-red overcolor (blackish at full maturity). *Flesh:* pink, blushed near stone, very firm, average flavor-taste traits. *Peduncle:* medium-short, large. *Stone:* medium-large.

Field performance. Under standard conditions, initial cropping is medium-late (>year 6-7) and yield is average in comparison to other self-fertile cultivars. However, with semi-dwarfing rootsocks and proper pruning in training, i.e. summer cutting, bending and arching of shoots and branches, Early Star® has shown good yields by year 4. In rainy years, fruits have medium susceptibility to cracking, especially in the apical area (max: 30% cracking in 1997-1998).

Overall rating. Its value resides in its being an early ripener at a time when there are no other premium varieties.

DCA BO 85.705.001

Origin. This selection is from a 1985 New Star x New Star cross. The original seedling, DCA BO 85.705.001 (C9), was selected at Vignola (Modena Province) in 1990-1992 and ha been under assessment since 1997 in Selection II fields of CRPV-DCA at Monteleone (Forlì Province, Azienda Bonandi Holdings) and at Savignano Sul Panaro (Modena Province, Azienda Quartieri Holdings).

This is a self-fertile selection whose value resides in its medium-early ripening (same date as Celeste® Sumpaca*). The tree is medium vigorous with compact-like, semi-spur habit, early initial cropping and good, steady yields. The fruit is noteworthy for its blAck skin at full maturity with good size (9 g), firm flesh, optimum flavor, very aromatic. Peduncle is medium-short and the stone is very small.

GRACE STAR*

Origin. 1984 free-pollination of Burlat. The original seedling, DCA BO 84.703.003 (F23), was selected at Vignola (Modena Province) in 1990-1992 and assessed from 1997 to 2000 in Selection II fields of CRPV-DCA at Monteleone (Forlì Province, Azienda Bonandi Holdings) and at Savignano Sul Panaro (Modena Province, Azienda Quartieri Holdings).

Tree. Medium-high vigor, standard, semi-upright habit. Self-fertile.

Bloom. Early, diffuse, steady.

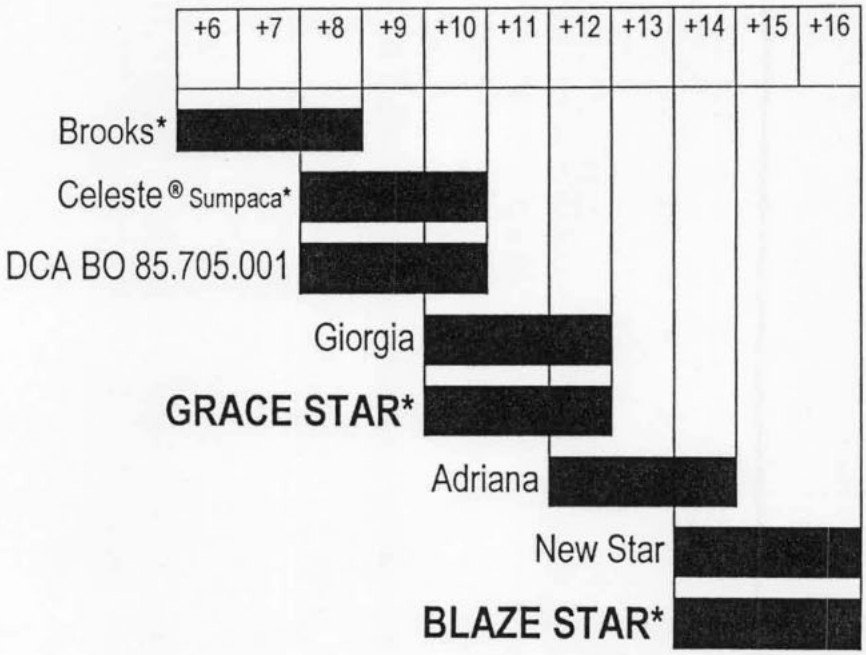
Ripening date. Medium-early (10-12 days after Burlat), uniform (1 June in 1998 and 2000; 3 June in 1999); Hangs on tree well.

18°brix) with good acidity level (7-8 g/l malic acid). *Peduncle*: long, average thickness. *Stone*: medium-large.

Field performance. Early initial bearing (year 3), high, steady yields, crops well on spurs and year-old wood. In rainy years, fruit is susceptible to average cracking, especially in the basal peduncle area (max: 30% cracking in 1999).

Overall rating. Its value resides in its medium-early (same as Giorgia), uniform ripening and attractive appearance of fruit (shape, color, size). Over the years, its high-yielding has never been to the detriment of fruit size, even without yield dormant pruning/fruit thinning. Thanks to a cropping that is unifromly distributed along limbs and in the basal area of year-old shoots as well as a long peduncle, harvest yields have always been very high.

Ripening date of Grace Star* and Blaze Star* in days to Burlat (22 May)



Avg. Dates 1998-2000

BLAZE STAR*

Origin. 1985 Lapins x Durone compatto di Vignola cross. The original seedling, Selection DCA BO 85.721.006 (E8), was selected at Vignola (Modena Province) in 1990-1992 and assessed from 1997 to 2000 in Selection II fields of CRPV-DCA at Monteleone (Forlì Province, Azienda Bonandi Holdings) and at Savignano Sul Panaro (Modena Province, Azienda Quartieri Holdings).

Tree. Medium vigor, broad canopy, many feathers, standard bearing. Self-fertile.

Bloom. Intermediate date, diffuse, steady.

Ripening date. Intermediate at 14-16 days after Burlat (same as New Star, i.e. 5 June in 1998 and 2000; 8 June in 1999); hangs well on tree.

Fruit. Average size (8-9 g), heart-shaped. *Skin*: average thickness, red with uniform, shiny dark red overcolor covering entire surface. *Flesh*: pinkish, average firmness, good sugars (16-

Field performance. Very early initial cropping (year 2-3); high, steady yielding. Fruit size, which is medium-large in the first cropping years (>9 g), may subsequently diminish because of excessive fruit-sets; this is why annual dormant pruning is important from year 4-5 on. In rainy years, fruits have a low susceptibility to cracking (max: 10% in 1997-1998); hangs well on tree.
Overall rating. Its value is in its high yield potential, fairly good fruit quality and size, ripening when New Star does, and is far less susceptible to cracking than the latter.

BLACK STAR*

Origin. 1985 Lapins x Burlat cross. the original seedling, DCA BO 85.723.002 (D2), was selected at Vignola (Modena Province) in 1990-1992 and assessed from 1997 to 2000 in Selection II fields of CRPV-DCA at Monteleone (Forlì Province, Azienda Bonandi Holdings) and at Savignano Sul Panaro (Modena Province, Azienda Quartieri Holdings).
Tree. Medium-high vigor, standard habit tending to broad, good feathering. Self-fertile.
Bloom. Intermediate date, diffuse, steady.
Ripening date. Intermediate at 16-18 days after Burlat, uniform (7 June in 1998 and 2000; 9 June in 1999); hangs very well on tree.
Fruit. Large size (9-11 g), heart-shaped, symmetrical. *Skin*: average thickness, shiny dark red with uniform blackish overcolor covering entire surface and it has a slight graininess (most evident when over-ripe). *Flesh*: red, very firm (comparable to the traditional "duroni" fruits), average juiciness, fine texture, optimum quality, very sweet (>18°brix) and good acidity (7-8 g/l malic acid). *Peduncle*: medium-long and thick. *Stone*: medium-large.
Field performance. Early initial cropping (year 3) high, steady yielding on both spurs and year-old shoots. In rainy years, fruits have shown almost no susceptibility to cracking (on a par with others like Adriana and Sam).
Overall rating. Its value is in its overall package of traits—self-fertile, medium ripener with overall performance comparable to the best self-fertiles as to tree and to the traditional Vignola "duroni" cultivars as to fruit traits with the extra of almost total tolerance to cracking. The uniformly distrubuted fruiting along the limbs and year-old basal shoots means high harvest yields. Optimum tree hang retention means that harvesting can be extended over a week or more with Black Star*.

LALA STAR*

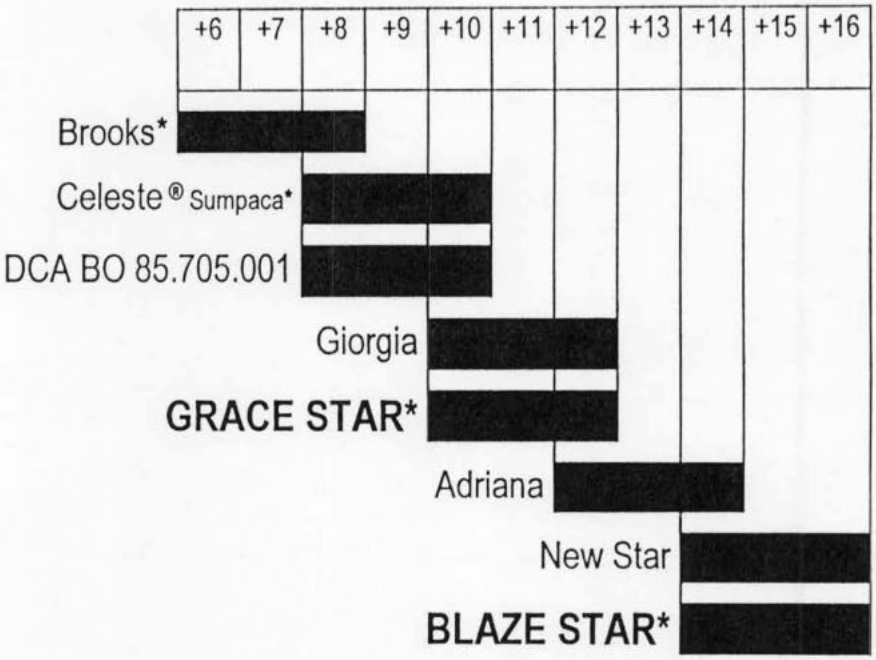
Origin. 1985 Lambert compact x Lapins cross. The original seedling, DCA BO 85.710.009, was selected at Vignola (Modena Province) in 1990-1992 and assessed from 1997 to 2000 in Selection II fields of CRPV-DCA at Monteleone (Forlì Province, Azienda Bonandi Holdings), at Savignano Sul Panaro (Modena Province, Azienda Quartieri Holdings) and at the Azienda

18°brix) with good acidity level (7-8 g/l malic acid). *Peduncle*: long, average thickness. *Stone*: medium-large.

Field performance. Early initial bearing (year 3), high, steady yields, crops well on spurs and year-old wood. In rainy years, fruit is susceptible to average cracking, especially in the basal peduncle area (max: 30% cracking in 1999).

Overall rating. Its value resides in its medium-early (same as Giorgia), uniform ripening and attractive appearance of fruit (shape, color, size). Over the years, its high-yielding has never been to the detriment of fruit size, even without yield dormant pruning/fruit thinning. Thanks to a cropping that is unifromly distributed along limbs and in the basal area of year-old shoots as well as a long peduncle, harvest yields have always been very high.

Ripening date of Grace Star* and Blaze Star* in days to Burlat (22 May)



Avg. Dates 1998-2000

BLAZE STAR*

Origin. 1985 Lapins x Durone compatto di Vignola cross. The original seedling, Selection DCA BO 85.721.006 (E8), was selected at Vignola (Modena Province) in 1990-1992 and assessed from 1997 to 2000 in Selection II fields of CRPV-DCA at Monteleone (Forlì Province, Azienda Bonandi Holdings) and at Savignano Sul Panaro (Modena Province, Azienda Quartieri Holdings).

Tree. Medium vigor, broad canopy, many feathers, standard bearing. Self-fertile.

Bloom. Intermediate date, diffuse, steady.

Ripening date. Intermediate at 14-16 days after Burlat (same as New Star, i.e. 5 June in 1998 and 2000; 8 June in 1999); hangs well on tree.

Fruit. Average size (8-9 g), heart-shaped. *Skin*: average thickness, red with uniform, shiny

Field performance. Very early initial cropping (year 2-3); high, steady yielding. Fruit size, which is medium-large in the first cropping years (>9 g), may subsequently diminish because of excessive fruit-sets; this is why annual dormant pruning is important from year 4-5 on. In rainy years, fruits have a low susceptibility to cracking (max: 10% in 1997-1998); hangs well on tree.
Overall rating. Its value is in its high yield potential, fairly good fruit quality and size, ripening when New Star does, and is far less susceptible to cracking than the latter.

BLACK STAR*

Origin. 1985 Lapins x Burlat cross. the original seedling, DCA BO 85.723.002 (D2), was selected at Vignola (Modena Province) in 1990-1992 and assessed from 1997 to 2000 in Selection II fields of CRPV-DCA at Monteleone (Forlì Province, Azienda Bonandi Holdings) and at Savignano Sul Panaro (Modena Province, Azienda Quartieri Holdings).
Tree. Medium-high vigor, standard habit tending to broad, good feathering. Self-fertile.
Bloom. Intermediate date, diffuse, steady.
Ripening date. Intermediate at 16-18 days after Burlat, uniform (7 June in 1998 and 2000; 9 June in 1999); hangs very well on tree.
Fruit. Large size (9-11 g), heart-shaped, symmetrical. *Skin*: average thickness, shiny dark red with uniform blackish overcolor covering entire surface and it has a slight graininess (most evident when over-ripe). *Flesh*: red, very firm (comparable to the traditional "duroni" fruits), average juiciness, fine texture, optimum quality, very sweet (>18°brix) and good acidity (7-8 g/l malic acid). *Peduncle*: medium-long and thick. *Stone*: medium-large.
Field performance. Early initial cropping (year 3) high, steady yielding on both spurs and year-old shoots. In rainy years, fruits have shown almost no susceptibility to cracking (on a par with others like Adriana and Sam).
Overall rating. Its value is in its overall package of traits—self-fertile, medium ripener with overall performance comparable to the best self-fertiles as to tree and to the traditional Vignola "duroni" cultivars as to fruit traits with the extra of almost total tolerance to cracking. The uniformly distrubuted fruiting along the limbs and year-old basal shoots means high harvest yields. Optimum tree hang retention means that harvesting can be extended over a week or more with Black Star*.

LALA STAR*

Origin. 1985 Lambert compact x Lapins cross. The original seedling, DCA BO 85.710.009, was selected at Vignola (Modena Province) in 1990-1992 and assessed from 1997 to 2000 in Selection II fields of CRPV-DCA at Monteleone (Forlì Province, Azienda Bonandi Holdings), at Savignano Sul Panaro (Modena Province, Azienda Quartieri Holdings) and at the Azienda

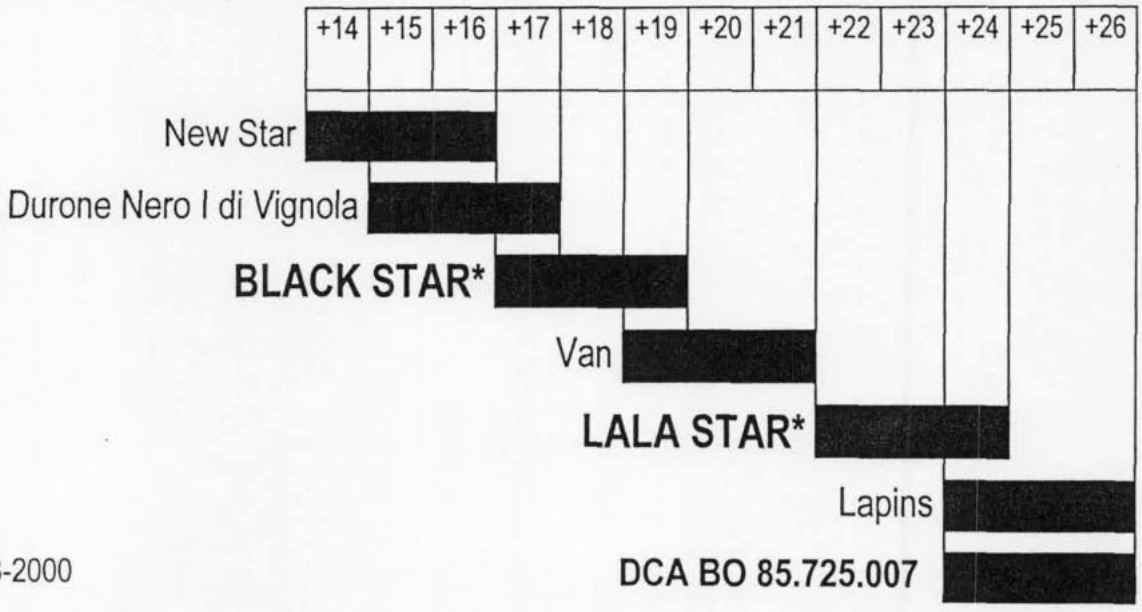
Ripening date. Medium-late, 22-24 days after Burlat.

Fruit. Medium or medium-large (circa 8-9 g), depressed heart-shaped. *Skin*: thin, red, uniform shiny dark-red overcolor. *Flesh*: red, good firmness, pleasing taste-flavor, proper sugars (18-20°brix)-to-acid (8 g(l malic acid) ratio. *Peduncle* is medium-short, thin. *Stone*: average size.

Field performance. Very early initial cropping, high, steady yielding. Good tree hang; fruit of average susceptibility to cracking in rainy years, especailly on sides (max: 40% cracking in 1998).

Overal rating. Noteworthy self-fertile for its semi-spur habit, fast initial bearing, good quality fruits that ripen a few days before Lapins.

Ripening date of Black Star * and LaLa Star* in days' difference to Burlat (22 May)



Avg.Dates 1998-2000

DCA BO 85.725.007

Origin. 1985 Lapins x Lapins cross. The original seedling, DCA BO 85.725.007 (E33), has been under assessment since 1997 in Selection II fields of CRPV-DCA at Monteleone (Forlì Province, Azienda Bonandi Holdings) and at Savignano Sul Panaro (Modena Province, Azienda Quartieri Holdings).

This self-fertile selction's main value lies in its late ripening date (same as Lapins), average tree vigor, upright habit, slight feathering, medium-early initial cropping, good, steady yielding, large-sized fruit (9-11 g) with bright red skin color and shiny dark-red overcolor, average flesh firmness, and good taste-flavor, medium-long peduncle and medium-small stone.

Characterization of Rootstock Influence on Flower Bud and Spur Formation in Sweet and Sour Cherry

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Introduction

Cherry rootstocks have been selected for a number of reasons, including precocity, productivity, vigor control, disease tolerance, adaptability to different soils or climates, etc. With some of these rootstocks, there is a potential problem of excessive cropping levels when grafted to very productive scion cultivars. Excessive cropping can result in poor fruit quality and stunted vegetative growth. One of the ways to study this, and perhaps eventually develop potential strategies to manage it, is to more precisely characterize how rootstock genotype influences floral architecture and placement on the scion; that is, how different rootstocks affect the patterns of floral node development along shoot growth, including quantification of spurs, buds, and flowers.

The NC-140 regional tree fruit rootstock project established a trial of cherry rootstocks across North America in 1998, using 'Bing' and 'Hedelfinger' sweet cherry (*Prunus avium* L.) and 'Montmorency' sour cherry (*P. cerasus* L.), of which the latter two cultivars were included in the Michigan trial. This plot is being used to characterize rootstock influence on the placement of flowers, buds, spurs, blind nodes, lateral branches, and ultimately crop load, on two-year-old shoots. This work is preliminary and only the results for 'Hedelfinger' sweet cherry will be presented here.

Materials and Methods

Plant materials: 'Hedelfinger' sweet cherry on 18 rootstocks (see results), established spring 1998 in an Emmet-Leelanau sandy loam at Michigan State University's Northwest Horticultural Research Station near Traverse City.

Cultural practices: Trained to a central leader, drip irrigation, fertilization and protective sprays applied as by standard recommendations.

Experimental design: The NC-140 plot is a randomized complete block. For this study, there were five single tree replications per rootstock and 3 relatively uniform branches were sampled per tree.

Experimental unit: On each branch, the two-year-old section (shoot growth from 1999) was divided into three equal parts, based on length (Fig. 1) and the following data were collected from each part:

# of nodes,
# of spurs,
# of blind nodes,
# of vegetative bud-only nodes,
# of lateral shoots,
# of buds per spur,
# of flowers per bud, and
# of fruit set (not reported).

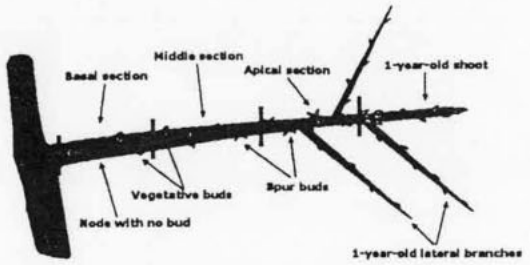

Figure 1. Typical two-year-old sweet cherry branch delineated by red bars.

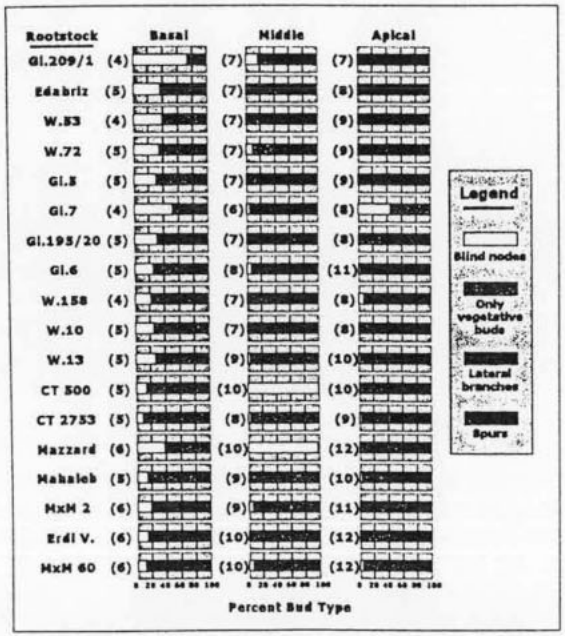

Figure 2. Percentage of nodes within each section (basal, middle, apical) of two-year-old sweet cherry shoot with: no buds (white), only vegetative buds (Green), lateral branches (Brown), or spurs (Red). Number of nodes in each section is indicated in parentheses for comparison.

Results

The floral architecture data are split into three groups, based on rootstock-induced differences in scion vigor. Table 1 shows data from low vigor rootstocks, Table 2 from intermediate vigor rootstocks, and Table 3 from high vigor rootstocks.

Table 1. The number of flowers per bud, buds per spur, and mean number of flowers for six low vigor sweet cherry rootstocks.

	Shoot Section								
	Basal			Middle			Apical		
Rootstock	No. buds/ spur	No. flowers/ bud	Total flower no.	No. buds/ spur	No. flowers/ bud	Total flower no.	No. buds/ spur	No. flowers/ bud	Total flower no.
Gi.209/1	2.3	2.6	4.4	3.3	2.2	33.1	4.4	2.3	24.4
Edabriz	--	--	0.0	1.7	3.5	24.4	3.5	3.4	54.0
W.83	1.9	3.3	3.2	2.5	3.2	43.4	4.1	2.9	56.1
W.72	1.0	3.1	1.9	1.8	2.7	21.4	3.9	2.7	53.7
Gi.8	2.2	3.9	10.5	3.1	3.1	51.0	4.4	2.8	37.0
Gi.7	2.9	3.2	14.5	3.9	3.6	51.0	5.2	3.4	73.9

Table 2. The number of flowers per bud, buds per spur, and mean number of flowers for seven intermediate vigor sweet cherry rootstocks.

	Shoot Section								
	Basal			Middle			Apical		
Rootstock	No. buds/ spur	No. flowers/ bud	Total flower no.	No. buds/ spur	No. flowers/ bud	Total flower no.	No. buds/ spur	No. flowers/ bud	Total flower no.
Gi.195/20	3.2	3.4	30.5	4.5	3.3	102.3	5.3	3.0	57.6
Gi.6	2.7	3.3	16.5	3.0	3.3	67.5	4.1	2.7	58.1
W.158	3.5	3.2	3.5	1.9	3.3	20.0	2.5	3.2	36.0
W.10	1.5	3.0	1.2	2.0	2.7	15.7	3.2	2.0	29.9
W.13	--	--	0.0	1.4	2.7	2.0	1.7	2.6	12.9
CT 500	--	--	0.0	1.0	2.0	0.0	2.2	2.4	20.3
CT 2753	--	--	0.0	1.0	2.0	0.2	1.7	1.7	0.2

Table 3. The number of flowers per bud, buds per spur, and mean number of flowers for five high vigor sweet cherry rootstocks.

	Shoot Section								
	Basal			Middle			Apical		
Rootstock	No. buds/ spur	No. flowers/ bud	Total flower no.	No. buds/ spur	No. flowers/ bud	Total flower no.	No. buds/ spur	No. flowers/ bud	Total flower no.
Mazzard	--	--	0.0	--	--	0.0	1.1	1.8	0.7
Mahaleb	--	--	0.0	1.1	2.7	1.3	2.1	1.9	14.8
MxM 2	--	--	0.0	--	--	0.0	2.2	2.2	2.7
Erdi V.	--	--	0.0	--	--	0.0	1.8	2.3	6.7
MxM 60	--	--	0.0	--	--	0.0	1.7	1.9	3.4

Summary

Data yet to be analyzed include shoot lengths and fruit set, as well as all data for 'Montmorency' sour cherry. With both 'Montmorency' and 'Hedelfinger' analyses, rootstock effects can be compared across species. Analyses thus far show that rootstock genotype affects sweet cherry floral architecture and placement, including relative amount of spur and lateral branch development.

The characterization of flowering architecture and fruit placement on two-year-old shoots will provide a better understanding of potential crop placement within the canopy, and its proximity to different leaf populations. Managing both crop placement and leaf area populations via pruning

SWEET CHERRY'S PROSPECTION IN SOUTHERN CHILE

ABSTRACT

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A germplasm evaluation of wild and seed propagated sweet cherries in Southern Chile was carried out in 1998, 1999 and 2000. The German settlements during nineth century were the origin of this varieties. The following characteristic proprieties was evaluated: weight of twenty fruits, shape, polar and equatorial diameter, length of stem, shape of fruits end, soluble solids, flesh colour, skin colour, pH and acidity.

Fruits weight varies from 5,2 to 8,25 g per fruit. The length of stems were moderate to long; the most important shape end of this fruit was W "double u" form, soluble solids were higher at the minimum level of the international standards. The colour flesh was light yellow and the mainly was red to dark red.

The best fruit weight and size was founded in Osorno (aprox. 43° SL) with 8,25 g per fruit. The skin colours varies from white to dark red with some bicolored varieties. Some resistance to craking was evaluated in varieties with the best size.

INTRODUCTION

At present in Chile, the cherry has became one of the most growing orchards during the last years. This development was more evident between 1994 and 1995, period in which 450 ha were planted (Meyer, 1997).

Due to this permanent increase, the total Chilean production has gone from 12,500 tons in 1989 to 27,000 tons in 1999. Actually the planted surface in Chile is about 4,830 ha (Medel, 2000).

The climatic and edaphic adaptability of this specie in the Southern part of this country (IX and X Region), had been studied by professionals from Austral University of Chile Agrarian Science Faculty, they found that exist a very good productive growing, even in difficult conditions, with in important potential to increasing the harvest period with similar varieties to those used in the Central Zone (E. Burlat, Rainier, Sam, Pigeon's heart,

Van, Bing, Stella, Lambert). They report that it's possible to found some sweet cherry family orchards and solitary trees seed propagated in this region. We can found selections grafted in Mericier and sour cherry scion (Medel, 1998).

OBJECTIVES

The objective of this experiment has been to identify ecotypes of *Prunus avium* L. in potential zone production in the South of Chile (IX and X Region).

MATERIALS AND METHODS

The exploration was carried out between December 1998 and January 1999 in the IX and X country's regions. The following zones were visited: Cuesta Lastarrias, Temuco, Faja Maizan, Pitrufquen, Gorbea, San Pablo, Osorno, Pichil, Puerto Octay, Puerto Fonck, Ensenada and Puerto Varas. After choosing the trees, 100 fruits of each one were harvested, which were maintained to 4°C.

The following fruit characteristics were evaluated: medium weight of 20 fruits, shape, polar diameter, ecuatorial diameter, long and peduncle's diameter, shape of fruit end, ventral suture, dorsal side-saddle, soluble solid (°Brix), flesh colour, skin colour (Ctifl colours code), pH and acidity (meq/5 ml of juice).

The studies were developed at University of Concepcion's Agronomy Faculty's Fruit growing Laboratory. The method and messured for the determination were:

- To determine medium weight for 20 fruits, there was used a 1,000 g electronic balance.
- Caliper was used for diameter measures and peduncle length.
- The percentages of soluble solids was founded through a refractometer.
- The Ctifl colour code was used to identify the skin colour.

· To measure the juice's pH there was used a digital pHmeter which was previously calibrated with buffer pH 4 and buffer pH 7.

· The acidity was determined by titulation using Potassium Hydroxide (KOH) 0.1 N and Phenolphthalein.

(Hevia, 1997; Edin et al, 1997)

During the period of hivernal withdrawal (June 2000) scions of each ecotype were picked to propagate this material and evaluate it in different edaphoclimatic areas.

RESULTS AND DISCUTION

The prospected trees of "Faja Maizan" area have a average age of 70 years, they are part of family gardens and they are growing by themselves. The vigour of these trees is depressed, due mainly to age and the absence of management techniques. This material was brought by the German settlers at the beginning of 1900. This fruit has good organoleptic characteristics, good flesh, skin colour, and cracking resistant too. The small size and the low average fruit weight (Figure 1 and 3) are the negative characteristics that affect it commercial value. This can be related in part with age, absence of irrigation, fertilization and sanitary condition (Medel, 1998).

The prospected material of Pitrufquen is a cherry grafted in a wild sour cherry 25 years ago, approximately. This fruit presents good organoleptic characteristics and a great flesh firmness. Besides, it shows a fruit average weight of 5.8 g (year 1999) and 5.3 g (year 2000) as it is shown on Figure 1 to 3. The polar and equatorial diameter goes between 18 and 19 mm (Figure 1 and 3) which defined it as a small size fruit (Lichou et al, 1990; Saunier, 1997).

There was found a white skin cherry in Gorbea, this is a not common characteristic in this specie, since usually they present tonalities that goes from purple to bicolour. The worst characteristic that this fruit presents is the little pulp firmness (Yamamoto et al, 1990; Ystans and Medland, 1994).

In the tenth Region there were found mature fruits at the ending of January, which can be very interesting since this fruit production period in Chile could be longer by using late flowering varieties and resistant to cracking.

In Osorno, the fruit was collected from family gardens located next to the city. This material was brought to the country in 1950 by German settlers, who distributed among the farmers of the area. The prospected trees present a similar production date among them, at the ending of January. The size went between 17.7 and 26 mm (Figure 6), which define it as a medium weight fruit, that can be interesting in commercialization terms. They present good organoleptic characteristics, too. During the two prospection years, most of the fruits of the trees did not present cracking, this is a very interesting characteristic to be followed in a second step, propagate with the objective of renewal the material and increase the vigour (Zoffoli, 1995).

Puerto Fonck is located next to Llanquihue lake in the northeastern side, there is a climatic zone which helps to cherry production. The lake has positive influence on this zone since the risk of spring chilling (frost) is reduced in a very considerable way.

The lakes zone is an area that must continue being under studies, performing tests that evaluate ecotypes and late varieties, conduction systems and root stock. This zone's prospected fruit presented good organoleptic characteristics, medium size that went between 19.3 and 23.2 mm as shows on Figure 1 and 4. The best characteristics that this fruit presented were the pulp firmness and absence of cracking fruit.

The 1999 and 2000 prospected trees present a fruit weight between 3.64 to 8.25 g (Figures 1-6). In Osorno it was found the tree with more potential fruit size for future research, if the other characteristic of this ecotype present some interest.

All fruit prospected in the IX and X chilean regions in both seasons presents Kidney-shaped fruit.

The peduncle length observed in both season went between 3.6 to 5.7 cm. this characteristics talk about varieties or ecotypes with moderated an long peduncle.

The "double u" (w) shape of the end of the fruit was the most wide observed form. Only the tree number 8 present an U shape (Fig. 4).

The soluble solids contents went from 11.7 to 28.8° Brix. But normally the range varied from 17.8 to 28.8, this contents were the most important quality requirement for sweet cherry (Sotomayor, 1995 a; Sotomayor, 1995 b; Yan to, 1973).

The colour flesh was light yellow in all the ecotypes, except the number 8 tree, whose pulp was purple.

The skin colour was prospected with Ctifl's colour card in most varieties went from red to dark red. Only two ecotypes were bicolor, trees number 9 and 11.

CONCLUSION

A very important number of fruits trees prospected had similar characteristics in skin color, flesh color, peduncle length, solubles solid and end fruit shape. The soluble solids were higher of the minimum level of the internationals standarts.

The prospected ecotypes in the X region showed the best soluble solids contents and size.

The zones close to Lago Llanquihue (X Region), are the most adequate for late flowering cherry production

Figure 1. Characteristics of the prospected fruits in the IX Region, years 1999 and 2000.

FRUIT CHARACTERISTICS	FAJA MAIZAN 1999			FAJA MAIZAN 2000		
	Tree 1	Tree 2	Tree 3	Tree 1	Tree 2	Tree 3
Medium weight of 20 fruits (g)	4,43	5,7	3,64	4,76	4,9	3,64
Shape	Kidney	Kidney	Kidney	Kidney	Kidney	Kidney
Polar diameter (mm)	18,7	18,0	17,7	20	17	18,5
Equatorial diameter (mm)	20,6	20,1	19	22	19	19
Long of peduncle (cm)	4,7	5,0	5,2	4,3	5,3	5,0
Diamet of Peduncleo	0,2	0,21	0,1	0,2	0,1	0,1
Shape of Fruits end	W	W	W	W	W	W
Solid Soluble SS (° Brix)	17,7	22	17	22,1	28,8	25,8
Flesh colour	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
Skin epidermis (Ctifl)	3	3	3	3	3	3
*pH	3,5	3,4	3,5	3,7	3,5	3,5
Titulable Acidity meq/5 ml of juice	0,1	0,12	0,15	0,10	0,11	0,16

Figure 2. Characteristics of the prospected fruits in the IX Region, years 1999 and 2000.

FRUIT CHARACTERISTICS	PITRUFQUÉN 1999	PITRUFQUÉN 2000
	Tree 4	Tree 4
Medium weight of 20 fruits (g)	5,8	5,3
Shape	Kidney	Kidney
Polar diameter (mm)	18,0	18
Equatorial diameter (mm)	20,1	19,3
Long of peduncle (cm)	5,3	5,1
Diamet of Peduncleo	0,1	0,1
Shape of Fruits end	W	W
Solid Soluble SS (° Brix)	20	21
Flesh colour	Yellow	
Skin epidermis (Ctifl)	4	4
*Ph	3,8	3,3
Titulable Acidity meq/5 ml of juice	0,10	0,12

Figure 3. Characteristics of the prospected fruits in the IX Region, years 1999 and 2000.

FRUIT CHARACTERISTICS	GORBEA 1999		GORBEA 2000	
	Tree 5	Tree 6	Tree 5	Tree 6
Medium weight of 20 fruits (g)	5,7	6,3	5,2	6,3
Shape	Kidney	Kidney	Kidney	Kidney
Polar diameter (mm)	20	20,9	22	21
Equatorial diameter (mm)	22,3	20,3	25	22
Long of peduncle (cm)	4,77	4,7	4,5	4,8
Diamet of Peduncleo	0,1	0,2	0,1	0,2
Shape of Fruits end	W	U	W	U
Solid Soluble SS (° Brix)	20	19,6	19	19,5
Flesh colour	White	White	White	White
Skin epidermis (Ctifl)	White	White	White	White
*pH	3,4	3,4	3,6	3,6
Titulable Acidity meq/5 ml of juice	0,12	0,12	0,10	0,15

Figure 4. Characteristics of the prospected fruits in the X Region, years 1999 and 2000.

FRUIT CHARACTERISTICS	OSORNO 1999			OSORNO 2000		
	Tree 7	Tree 8	Tree 9	Tree 7	Tree 8	Tree 9
Medium weight of 20 fruits (g)	8,25	7,5	6,3	7,7	7,3	6,5
Shape	Kidney	Kidney	Kidney	Kidney	Kidney	Kidney
Polar diameter (mm)	22,8	27	22,6	23	25	21
Equatorial diameter (mm)	25,4	26	17,7	24	24	25
Long of peduncle (cm)	3,62	4,0	3,9	4,1	4,2	4,0
Diamet of Peduncleo	0,09	0,1	0,1	0,1	0,2	0,1
Shape of Fruits end	W	U	W	W	U	W
Solid Soluble SS (° Brix)	21	22	26	24	24	27
Flesh colour	Yellow	Purple	Yellow	Yellow	Purple	Yellow
Skin epidermis (Ctifl)	4	5	Bicolour	4	5	Bicolour
*pH	3,8	3,4	3,0	3,5	3,4	3,4
Titulable Acidity meq/5 ml of juice	0,14	0,10	0,09	0,11	0,11	0,08

Figure 5 Characteristics of the prospected fruits in the X Region, years 1999 and 2000.

FRUIT CHARACTERISTICS	OSORNO 1999		OSORNO 2000	
	Tree 10	Tree 11	Tree 10	Tree 11
Medium weight of 20 fruits (g)	4,22	6,1	4,4	6,1
Shape	Kidney	Kidney	Kidney	Kidney
Polar diameter (mm)	17,8	19,9	19	22
Equatorial diameter (mm)	20,3	22,5	21	24
Long of peduncle (cm)	5,3	5,3	5,4	5,7
Diamet of Peduncleo	0,1		0,1	0,1
Shape of Fruits end	W	W	W	W
Solid Soluble SS (° Brix)	17,9	19,6	18	18,8
Flesh colour	Yellow	Yellow	Yellow	Yellow
Skin epidermis (Ctifl)	4		4	Bicolour
*pH	3,3	3,8	3,8	3,1
Titulable Acidity meq/5 ml of juice	0,11	0,18	0,14	0,17

Figure 6 Characteristics of the prospected fruits in the X Region, years 1999 and 2000.

FRUIT CHARACTERISTICS	PUERTO FONCK 1999		PUERTO FONCK 2000	
	Tree 12	Tree 13	Tree 12	Tree 13
Medium weight of 20 fruits (g)	6,3	5,3	5,7	5,3
Shape	Kidney	Kidney	Kidney	Kidney
Polar diameter (mm)	20,7	19,3	20	21
Equatorial diameter (mm)	23,2	21,8	23	22
Long of peduncle (cm)	5,3	5,1	4,3	4,5
Diamet of Peduncle	0,1	0,1	0,1	0,1
Shape of Fruits end	W	W	W	W
Solid Soluble SS (° Brix)	11,7	12,9	17,8	18,6
Flesh colour	Yellow	Yellow	Yellow	Yellow
Skin epidermis (Ctifl)	2	2	2	2
*pH	3,3	3,2	3,2	4,0
Titulable Acidity meq/5 ml of juice	0,12	0,14	0,16	0,16

BIBLIOGRAFÍA

Bienfait, D. 1988. Caractéristiques du sol. In: L' arboriculture fruitière. Pp. 411.

Edin, M.; Lichou, J.; Saunier, R. 1997. L'éclatement. Cerise les variétés et leur conduite.89-94.

Hevia, F. 1997. Comportamiento de cerezas en postcosecha para consumo fresco. In: Actualidad mundial en el cultivo del cerezo (ed.) Joublan, J.P. Universidad de Concepción, Facultad de Agronomía.

Lichou, J.; Edin, M..; Tronel, C..; Saunier, R. 1990. Caractéristiques physiques du sol. In: Le cerisier. 159 p.

Medel, F.1987. Arboles frutales: situación y potencial en el sur de Chile. Universidad Austral de Chile y Corporación de Fomentos de la Producción 77 p.

Medel, F. 1998. Potencial productivo del cerezo en el sur de Chile. Revista frutícola. COPEFRUT S.A. Vol. 19 N° 2.

Meyer, M. 1997. Mercado del cerezo, perspectivas para Chile. In: Actualidad mundial en el cultivo del cerezo (ed.) Joublan, J.P. Universidad de Concepción, Facultad de Agronomía 160 p..

Saunier, R. 1997. Portainjertos y variedades de cerezas, actualidad y tendencias en Francia. In: Actualidad mundial en el cultivo del cerezo (ed.) Joublan, J.P. Universidad de Concepción, Facultad de Agronomía 160 p.

Sotomayor, C. 1995 a. Todo lo que usted desea saber sobre el cerezo (I). Chile Agrícola. Vol. XX N° 204.

Sotomayor, C. 1995 a. Todo lo que usted desea saber sobre el cerezo (II). Chile Agrícola. Vol. XX N° 205.

Yamamoto, T. 1973. Cracking and water relationship of the sweet cherry fruit. In: Journal of Yamagata Agriculture and Forestry Society, 30, 74-85.

Yamamoto, T., Kudo, M. and Watanabe, S., 1990 Relationship between the degree of fruit cracking of sweet cherry and the distribution of surface stress of the fruit analysed by a Newly Developed system. In: J.J.S.H.S., 59(3), 509-517.

Ystans, J. and Meland, M. 1994. Craking susceptibility of sweet cherries grown in Norway. International conferences on cracking cherries. Traverse City, Michigan. 24 p.

Zoffoli, J., 1995. Manejo de postcosecha de cerezas. El cultivo del cerezo: nuevas variedades, portainjertos y sistemas de conducción 56 p.

PACIFIC AGRI-FOOD RESEARCH CENTRE

SUMMERLAND

STONE FRUIT PROGRAM
(Sweet Cherries)

Frank Kappel
Rob Brownlee
Richard MacDonald
Darrell-Lee McKenzie
Paul Randall
Warren Walters

revised: June 2001

The PARC Summerland laboratory was established in 1914 as a Dominion Experimental Farm. The prime concerns were to find out which crops, crop varieties and breeds of livestock were best suited to the area and to find solutions to production problems. The first orchards were planted in 1916.

Today PARC Summerland staff conduct research in several different areas to enhance the agricultural sector locally, regionally, and nationally. The three broad areas of expertise at the Centre are Horticulture and Environment, Food Research, and Biotechnology. Horticulture and Environment research includes the tree fruit breeding programs, production systems, and entomology among others. The Food Research group brings added value to agricultural products through research on postharvest physiology, modified atmosphere packaging, sensory evaluation, and the exciting new area of functional foods. The Biotechnology scientists provide national leadership in research at the molecular level on plat/pathogen interactions and plant virology.

Facilities

- 320 ha site, of which approximately 60 ha are irrigated and available for research.
- Modern laboratory and office complex with food research pilot plant and library.
- Research greenhouses.
- Summerland Ornamental Gardens and museum.

HORTICULTURE AND ENVIRONMENT

- Pesticide resistance
- Integrated pest management
- Insect behavioural ecology
- Orchard management
- Analytical chemistry
- Crop diversification
- Soil chemistry
- Apple and cherry breeding
- Postharvest pathology
- Land use, GIS
- Viticulture

FOOD SCIENCE

- Food processing and products
- Food chemistry
- Food microbiology
- Food engineering
- Crop utilization
- Postharvest physiology

BIOTECHNOLOGY

- Nematology
- Plant virology
- Plant physiology
- Tissue culture
- Molecular mycology
- Fruit quality
- Molecular plant pathology
- Insect virology

Meteorological Data (79 year averages) for Summerland, British Columbia, Canada

Annual mean temperature (79 year average):		8.9°C or 48°F
Mean minimum temperature for winter months, Dec., Jan., and Feb.:		-4.9°C or 23°F
Mean minimum temperature:	Nov.	-1°C or 30°F
	Dec.	-4°C or 25°F
	Jan.	-6°C or 21°F
	Feb.	-4°C or 25°F
Extreme minimum temperature:	Nov.	-23°C or -9.4°F (1985)
	Dec.	-29.5°C or -21.1°F (1968)
	Jan.	-30°C or -22°F (1950)
	Feb.	-26.5°C or 15.7°F (1936)
Mean maximum temperature for summer months, June, July, and Aug.:		26.2°C or 79.2°F
Mean maximum temperature:	May	20°C or 68°F
	June	24°C or 75°F
	July	28°C or 82°F
	Aug.	27°C or 81°F
Extreme maximum temperature:	May	35.5°C or 95.9°F (1936)
	June	38.5°C or 101.3°F (1924)
	July	40°C or 104°F (1941)
	Aug.	38°C or 100.4°F (1971)
Last killing frost in spring (-2°C [28°F] or lower):		April 5
First killing frost in fall (-2°C [28°F] or lower):		Nov. 2
Growing season (above -2°C [28°F]):		209 days
Annual precipitation (rain and snow combined):		291 mm or 11.5 in.
Average annual sunshine:		2023 hours

Research Centre: latitude: 49° 34' N
longitude: 119° W

- weather station: 454.5 metres above sea level and 115.5 metres above Lake Okanagan

New sweet cherry varieties recently introduced from the Pacific Agri-Food Research Centre - Summerland fruit breeding program.

Name	Maturity (days - or + Van)	Ave. fruit weight (g)	Firmness (durometer[Z])	Firmness (g/mm)[X]	Flavour	Cracking	Shape	Pollination	Notes
Santina	- 8	9.5	69	173	moderately sweet	moderately tolerant	oval	self-fertile	fair quality
Sumpaca Celeste	- 6	10.7	71	225	good, sweet	good tolerance	kidney	self-fertile	cropping level questionable
Sumnue Cristalina	- 5	10.0	68	226	moderately sweet	tolerant	heart (slightly compressed)	group II	can be picked stemless
Van	0	8.7	78	225	very good	moderately tolerant	kidney	group II	standard
Bing	0	9.0	70	171	very good	moderately tolerant	round	group III	standard
Sumste Samba	+ 2	11.4	74	234	moderately sweet, good	good tolerance		self-fertile	not precocious
Sandra Rose	+ 3	11.6	70	156	sweet, very good	good tolerance	round	self-fertile	firmness is a concern
Sumleta Sonata	+ 7	12.7	77	224	moderately sweet	moderately susceptible	kidney (with dimple in blossom end)	self-fertile	prone to nose splits
Lapins	+ 11	10.6	76	219	good	tolerant	round	self-fertile	standard
Skeena	+ 14	11.6	80	231	sweet, good	good tolerance	round	self-fertile	good quality
Symphony[Y]	+ 20	10.6	75	189	moderately sweet	good tolerance	kidney	self-fertile	fruit drop, test only

[Z] A durometer is an instrument that provides a dimensionless reading from 0 to 100. The higher the number the firmer the fruit.
[X] FirmTech firmness device measures the amount of force required to compress the fruit a constant distance. The larger the number the firmer the fruit.
[Y] Since naming the cultivar Symphony, a possible problem with fruit drop or "shattering" has come to light. **Only plant this cultivar as a test**.

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SWEET CHERRY SELECTIONS

Introduction

There has been a sweet cherry breeding program at Summerland since 1936. The objectives at that time were to develop a cherry with the characteristics of Bing and Lambert, that matured earlier, were more resistant to cracking, and could be used as pollinizers for those varieties. A great deal of progress has been made since that time. This is the latest catalogue describing the most promising sweet cherry selections worthy of testing. A number of changes have been made to the layout of the catalogue and these include: a) the catalogue has been divided into three sections: historical information of older Summerland varieties; recent introductions; and recent and new selections; b) the new selections have been divided into dark and blushed cherries and arranged in order of ripening.

Breeding Objectives

The ultimate goal of the breeding program is to provide high quality sweet cherry cultivars for the cherry growers of Canada. Three broad objectives direct the sweet cherry breeding program at the Pacific Agri-Food Research Centre (PARC) at Summerland. These are: a) diversify the "product", this will allow growers to take advantage of marketing niches; b) environmental adaption to the major growing areas in British Columbia and Ontario, to insure consistent production of high quality fruit; and c) reduce the cost of production for growers. Improvements of the primary traits such as: early onset of bearing, high yields, self-compatibility, extended ripening season, fruit size and quality, flesh firmness, and cracking resistance, will insure that the three broad objectives will be met.

Recently Introduced Varieties

A number of selections have been named in the past year (*Santina, Sumpaca Celeste, Sumnue Cristalina, Sumste Samba, Sandra Rose, Sumleta Sonata, Skeena* and *Symphony*) and most have been submitted for Plant Breeders' Rights in Canada and plant patenting in the USA. Partners of the okanagan PLANT IMPROVEMENT COMPANY Ltd. (PICO) are also moving to protect these new varieties in their respective countries. The two-part names are being used because the first name (eg. Sumpaca, Sumnue, Sumste, and Sumleta) was first registered in France and now must be included in the official name of the variety. The cultivars Santina and Samba have been named for our European cooperators and should only be considered for testing and not commercial plantings. Symphony was named to comply with Plant Breeders' Rights legislation and should only be considered for testing. **It has a disorder that causes the fruit to easily detach from the stem and fall.**

Selection Protocol

Each cherry season about 300 samples are evaluated in the lab. The evaluation protocol continues to evolve. Generally, as the fruit matures, a random sample of each selection is brought into the lab and evaluated for average fruit weight (in grams), natural cracking, the type of splits (nose, side, or bowl), a modified cracking index (water bath for 2 and 4 hours), fruit firmness (using a durometer and beginning in 1997 a new firmness testing device [FirmTech]), soluble solids content, pH and titratable acidity of juice samples and colour of the fruit. Trials for storage suitability of the selections and varieties was begun in 1997. Also, during the 1996/1997 winter the fruit bud hardiness of the selections were evaluated using controlled laboratory freezes.

New sweet cherry varieties recently introduced from the Pacific Agri-Food Research Centre - Summerland fruit breeding program.

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ROOTSTOCK AND PRUNING AND TRAINING TRIALS

1) LAPINS/GISELA 5 FERTIGATION TRIAL

Trial planted spring 1998. Rootstock: Gisela 5 (Gi 148/2) Variety: Lapins

Treatments (started spring 1998): (Irrigation by micro-sprinkler except treatment using drip irrigation.)

Low soil solution N concentration - fertigated for 6 weeks.

Medium soil solution N concentration - fertigated for 6 weeks.

High soil solution N concentration - fertigated for 6 weeks

Medium N rate applied through drip irrigation and regular schedule.

Postharvest N application.

Medium N rate plus single application of P in early May.

Medium N rate plus 6 weeks of K fertigated.

Control - broadcast N applied May 1st annually at 150 Kg N/ha.

2) EDABRIZ TRAINING SYSTEM TRIAL

Trial planted spring 1995. First fruited 1997. Rootstock: Tabel® Edabriz Variety: Summit

The objective of the trial is to investigate the effect of training system (tree shape) on growth, yield, and fruit size of sweet cherry trees.

Treatments: Free Standing Central Leader
Free Standing Open Centre
Mini-Tatura Trellis (Y-trellis)
Drapeau Marchand (angle planting)

Yield and fruit size of Summit trees on Edabriz trained to four different training systems.

Training system	1997 Yield (kg/tree)	1998 Yield (kg/tree)	1999 Yield (kg/tree)	2000 Yield (kg/tree)	Cumulative Yield (kg/tree)	1998 Average fruit weight (g)	1999 Average fruit weight (g)	2000 Average fruit weight (g)
Open centre	0.13 a	0.47 a	1.30 b	5.5 a	7.4 a	13.0 ab	14.2 a	13.2 a
Angled	0.29 a	0.45 a	2.35 a	5.1 a	8.2 a	12.1 c	12.4 c	11.3 c
Central leader	0.27 a	0.55 a	0.69 b	1.7 b	3.2 b	12.6 bc	13.8 ab	12.8 ab
Y-trellis	0.24 a	0.71 a	2.33 a	7.1 a	10.4 a	13.6 a	13.4 b	11.8 bc

3) VARIETY SUITABILITY FOR EDABRIZ (Tab 6)

Trial planted spring 1995. First fruited 1997. Rootstock: Tabel® Edabriz

Varieties:			
	Summit	Bing	Van
	Lapins	Sweetheart	Rainier
	Celeste	Hedelfingen	Viscount
	Vogue	Sunburst	13S-39-51 (Sonnet)
	13N-07-19	Sonata	13N-07-39
	13N-07-70	Cristalina	Sylvia
	11W-14-40	11W-26-58	

	Yield			Cum. Yield	Fruit size		
	1997	1998	1999		1997	1998	1999
Variety		(kg)		(kg)		(g)	
11W-14-40	0.2	0.4	1.3	1.9	8.3	8.9	11.9
11W-26-58	0.3	0.01	0.1	0.4	9.8	4.6	9.2
13N-07-19	0.2	0.4	0.2	0.8	10.5	11	10.1
13N-07-39	2.2	1.2	4	7.4	10.4	11.2	10.5
13N-07-70	0.6	0.9	5.8	7.3	9	10.7	11
Bing	0.3	1.4	5.2	7	8.8	9.5	9.5
Celeste	1.1	1.5	3	5.7	10	11.3	11.9
Cristalina	0.7	1	4.8	6.5	10	10.3	9.7
Hedelfingen	0.3	0.6	5.8	6.7	8.1	8.4	10.6
Lapins	0.5	0.4	5.3	6.2	8.7	9.5	10.5
Rainier	0.1	0.4	1.9	2.4	6.5	5.9	8.2
Sonata	0.5	0.3	1.7	2.6	12.2	12.2	12
Sonnet	0	0.1	0.1	0.2	.	12	8.9
Sunburst[z]							
Sweetheart	0.7	0.5	0.6	1.8	6.6	6.9	9.1
Sylvia	0.5	0.4	0.8	1.7	9.8	11.1	11.8
Van	1.3	0.8	3.9	6	8.9	9.3	8.7
Viscount	0.02	0.6	4.5	5.1	.	9.7	10.4
Vogue	0.4	0.6	4.2	5.2	6	6.2	6.5

[z] Trees dying.

Todo en Arena

4) Late Season Cherry Pruning Trial

Treatments:			
	CLNHA	Central Leader-No Heading-High Density	(4.75m x 2m)
	ML	Multiple Leader	(4.75m x 3m)
	CLNHB	Central Leader-No Heading-Lower Density	(4.75m x 3m)
	CLH	Central Leader-Heading	(4.75m x 3m)

planted spring 1999 mazzard rootstock

Pruning & Training Spring 2000: Buds on leaders were scored above the bud just at bud swell. Buds were removed just below heading cut or below terminal bud of the leader (when leader was not headed).

Pruning and Training Spring 2001: Buds were removed just below heading cut or below terminal bud of the leader (when leader was not headed). Laterals were headed only on the CLH treatments. No heading of laterals in other treatments.

5) A, J, & M Rootstock Second Test

Trial planted spring 1996. Varieties: Bing, Lapins

Rootstocks: F12/1 (control), A, J, M

	1998 Yield (kg)	1999 Yield (kg)	2000 Yield (kg)	Cumulative Yield (kg)	Yield efficiency (kg/cm^2)	1999 Average fruit weight (g)	2000 Average fruit weight (g)	1999 Trunk cross-sectional area (cm^2)
Rootstock								
A	0.008 a	0.03 a	0.94 a	0.97 a	0.014 a	9.7 a	9.6 a	60.1 b
J	0.006 a	0.06 a	1.28 a	1.35 a	0.018 a	8.9 a	10.3 a	79.2 a
M	0.012 a	0.24 a	1.25 a	1.50 a	0.024 a	9.1 a	10.1 a	81.2 a
F12/1	0.001 a	0.01 a	0.49 a	0.50 a	0.005 a	8.5 a	9.2 a	92.8 a
Cultivar								
Bing	0.013 a	0.04 a	0.54 b	0.60 a	0.008 a	9.2 a	9.2 b	73.7 a
Lapins	0.001 b	0.12 a	1.42 a	1.55 a	0.022 a	9.0 a	10.4 a	82.9 a

The rootstock A is the only tootstock that appears to be somewhat dwarfing with trees about 65% the size of F12/1. To date the rootstock has not had an effect on yield. In 2000 Lapins was more productive than Bing and had larger fruit.

6) WEIROOT ROOTSTOCK TRIAL

Trial planted spring 1996. Variety: Bing

Rootstocks: F12/1 (control) W154 W53 W158 W72
Gi 196/4

Rootstock	Yield (kg/tree) 1998	Yield (kg/tree) 1999	Yield (kg/tree) 2000	Cumulative yield (kg/cm^2)	Average fruit weight (g) 1999	Average fruit weight (g) 2000	Trunk cross-sectional area (cm^2)	Root suckers 1999 (#)
F12/1	0.006 c	0.007 b	0.02 c	0.03 c	8.8 a	-	82.7 ab	20 c
GI 196/4	0.68 ab	1.72 a	5.72 ab	8.12 ab	9.8 a	11.3 a	87.4 a	10 c
W53	0.80 a	1.78 a	7.0 a	9.54 a	9.9 a	10.0 a	36.9 c	37 bc
W72	0.36 abc	0.86 ab	3.5 b	4.7 b	9.1 a	9.9 a	16.7 c	10 c
W154	0.09 bc	0.02 b	0.04 c	0.16 c	6.6 b	-	37.5 c	145 a
W158	0.30 abc	0.67 b	3.19 bc	4.15 bc	9.1 a	10.9 a	63.8 b	47 b

Trees on W53 and Gi 196/4 have been the most productive since the first fruit in 1998. The most efficient trees have been those on W53 and W72. To this point fruit size has not been affected by rootstocks. Suckering has been an extremely difficult problem for W154. The most dwarfing are those on W53, W72, and W154.

7) SWEETHEART ROOTSTOCK TRIAL

Trial planted spring 1998. Variety: Sweetheart

Rootstocks: mazzard, P50, J, Gisela® 5, Gisela® 6

Rootstock	Trunk cross-sectional area 1998 (cm^2)	Trunk cross-sectional area 1999 (cm^2)	Yield 2000 (kg/tree)
mazzard	7.9 b	22.4 a	0.029 c
Gisela® 5	3.7 d	10.0 c	0.330 a
Gisela® 6 → GI 148/1	5.2 cd	14.9 b	0.215 ab
P50	10.6 a	22.8 a	0.009 c
J — cerezas	6.7 bc	16.7 b	0.103 bc

Trees on G5 (Gisela® 5) are the smallest followed by G6 and J, whereas the trees on P50 and mazzard are the largest. The trees on both Gisela rootstocks had the highest yields in the first year of fruiting.

8) NC140 - 98 Regional Rootstock Trial

Trial planted spring 1998. Variety: Bing

Rootstocks:				
	Gisela 6	Gisela 5	Gisela 7	W154
	Gi 195-20	Gi 209-1	Gi 318-17	W158
	Gi 473-10	Edabriz	mazzard	W53
	Prunus mahaleb	W10	W13	W72

P50 as observation.

Rootstock	2000 Trunk cross-sectional area (cm^2)	2000 Yield (kg/tree)	2000 Average fruit weight (g)	2000 Number of suckers (#)
mazzard	44.2 abc	0 e	.	0 d
mahaleb	48.4 a	0.002 e	5.9 a	0.4 d
G5	37.5 cde	0.034 ab	7.5 a	0.1 a
G6	44.7 abc	0.012 bcde	7.2 a	0 d
G7	44.1 abc	0.032 abc	8.1 a	2.1 d
Gi 195/20	39.9 bcd	0.048 a	8.0 a	0.4 d
Gi 209/1	28.7 fg	0.028 bcde	7.7 a	0 d
Gi 318/17	45.2 ab	0.003 ed	7.3 a	0.1 d
Gi 473/10	31.3 efg	0.011 bcde	8.8 a	32.1 a
Edabriz	32.4 efg	0.010 bcde	7.7 a	1.2 d
W10	42.7 abc	0.012 bcde	7.3 a	11.9 bc
W13	44.8 abc	0.006 de	6.5 a	24.6 a
W53	26.4 g	0.028 abcd	8.4 a	5.4 cd
W72	32.3 efg	0.033 ab	7.8 a	16.0 b
W154	28.9 fg	0.008 cde	7.5 a	26.5 a
W158	34.5 def	0.003 e	6.4 a	7.6 bcd

The smallest trees were on the rootstocks W53, Gi 209/1, and W154 followed by Gi 473/10, Edabriz, and W72. The largest trees were on the rootstocks mahaleb and Gi 318/17. There were some fruits on some of the rootstocks but it is too early to comment. Gi 473/10, W154, and W13 have severe suckering problems.

Ctifl

La Tapy

SEFRA

serfel

CEFEL

Infos Cerise.

N°1 (Mai 99)

SOMMAIRE

Editorial

Le choix variétal cerise commence à s'élargir et va encore progresser dans les prochaines années. Gamme variétale plus complète, des plus précoces aux plus tardives, cerises plus fermes et plus grosses...Attention à ne pas tomber dans le piège de trop de variétés et d'une dégradation de la qualité gustative.

- trop de variétés au même moment et c'est l'incapacité de constituer des lots homogènes et de communiquer sur le nom des variétés
- des variétés de qualité gustative médiocre et c'est, à terme, la baisse assurée de la consommation .

Point sur la nouvelle charte variétale cerise

Une nouvelle charte nationale de caractérisation et de comportement des variétés et porte-greffe fruitiers a été signée le mercredi 22 avril 1998 par la FNPF, le CEP, l'INRA et le Ctifl au siège du Ctifl. Cette charte qui associe les stations régionales d'expérimentation fruitières, présente deux activités distinctes :

- la caractérisation : études distinction, homogénéité, stabilité (DHS)
- l'étude du comportement agronomique des nouveaux cultivars.
- l'INRA est le responsable de la phase « caractérisation et de l'introduction des variétés
- le Ctifl est le coordonateur du stade comportement
- les éditeurs / obtenteurs sont les décideurs de l'entrée dans le dispositif de leurs variétés, respectivement au stades caractérisation et comportement

1. Phase de caractérisation des nouvelles variétés

- le Ctifl est associé à cette démarche sous la responsabilité de l'INRA, seul interlocuteur des éditeurs.
- les visites des variétés protégeables en caractérisation seront strictement interdites sauf pour les caractérisateurs (INRA, Ctifl) les obtenteurs et les éditeurs pour leurs variétés. Pour les variétés du domaine public, les représentants de l'organisme de l'inscription au catalogue peuvent également avoir accès aux informations concernant leur matériel.
- les expositions variétales ne seront pas autorisées à ce stade.

2. Phase comportement de la variété.

- coordination confiée au Ctifl au titre de sa mission de coordination du réseau Ctifl/ Stations régionales demandée par l'ONIFLHOR. La coordination sera assurée par Gérard Charlot responsable [illegible]

éditeurs / obtenteurs et aboutit à la délivrance du COV et (ou) à l'inscription au catalogue.
Le Ctifl s'appuiera sur un groupe constitué d'un représentant de chacun des organismes : Ctifl, INRA, CEP FNPF, Stations régionales.
Ce groupe examinera les demandes faites contractuellement au Ctifl émanant directement des éditeurs pour leurs variétés et de l'INRA ou de la FNPF pour les variétés du domaine public. Il arrêtera la liste des variétés rentrant dans le dispositif de comportement.

Balandran un verger de comportement.

- possibilité d'intégrer de façon simultanée le réseau de comportement et le volet caractérisation sous réserve de la décision de l'éditeur.
Le Ctifl, les stations régionales participeront à ce dispositif de comportement des nouvelles variétés
- une confidentialité, généralement de 2 à 3 ans à partir de la date de plantation, sera exigée par les éditeurs pour des raisons de stratégie d'entreprise

Le point sur les variétés

Les informations données ci-dessous sont issues principalement des observations réalisées dans le cadre d'un réseau piloté par le Ctifl associant, le Ctifl (M. Edin, G. Charlot, F. Floc'hlay), l'INRA (R. Saunier, J. Claverie), et les Stations Régionales : La Tapy (V. Simard) , SEFRA (C. Chamet, R. Minodier, B. Guisnet, C. Gratadour), SERFEL (Ph. Blanc), CEFEL (JF Larrieu, JF Saint-Hilary), Sica Centrex, VEREXAL (J. Guiot), AREFE (C. Gigleux).

Il y a environ une trentaine de variétés de cerise cultivées en France. Sur les 55 000 tonnes de cerises douces produites chaque année 10 variétés représentent 80% des tonnages. Il s'agit de :
- maturité précoce : Burlat (37%),
- maturité de saison : Summit (3%), Stark et Van (15% à elles deux), Reverchon (10%),
- maturité tardive : Belge ,Badacsony et Meched (2% à elles trois), Duroni 3 (2%), Hedelfingen (13 %).
Dans les années à venir les tonnages de Burlat et surtout de Reverchon vont baisser, ceux de Van, Stark et Hedelfingen vont se stabiliser, enfin la production de Belge et surtout de Summit va fortement progresser.

Objectifs actuels concernant la sélection variétale :

- zones précoces : des variétés plus précoces que Burlat avec un calibre équivalent ou supérieur et une meilleure fermeté.
- toutes zones : combler le trou de production entre Burlat et Summit. La variété Garnet®Magar qui entre dans cette catégorie est malheureusement trop sensible à l'éclatement..
- zones tardives : pour la commercialisation de cerises tardives il faut un fruit de très bonne qualité : calibre, qualité gustative, tenue en distribution car la concurrence des autres fruits d'été est très importante à cette époque (abricots, pêches, nectarines)
D'une manière générale et quelle que soit sa période de maturité, les qualités d'une variété de cerise devraient être les suivantes : productive mais en ayant la faculté de s'autoréguler, calibre homogène et calibre moyen d'au moins 25 mm, tolérante à l'éclatement et au monilia, bonne qualité gustative, bonne tenue en distribution.
De nouvelles variétés arrivent sur le marché à l'heure actuelle. Les observations ci-dessous ont été réalisées par l'INRA, le Ctifl et les stations régionales dans des collections variétales de 2 à 3 arbres. Le suivi de vergers commerciaux chez les producteurs par le Ctifl et les stations régionales permettront de mieux connaître ces nouvelles variétés. Il faut garder à l'esprit que pour commercialiser des lots homogènes (c'est une demande majeure de la distribution) il convient d'avoir des lots suffisamment importants de chaque variété. Il faut donc rénover le verger, élargir la gamme variétale actuelle sans multiplier à l'excès les variétés pour constituer des lots homogènes et pouvoir communiquer sur les variétés. Pour cela il semble que 8 à 10 variétés bien adaptées à chacun des terroirs soient suffisantes pour couvrir toute la campagne de cerise. Les nouvelles variétés ne devront être définitivement sélectionnées que si elles apportent des **avancées techniques significatives par rapport aux variétés déjà cultivées**. Cela devrait se faire dans le cadre d'une politique claire de plantation au sein de chaque bassin de production voir au sein de chaque structure commerciale.
Enfin, il convient de choisir judicieusement les pollinisateurs pour ne pas perturber la protection phytosanitaire de la parcelle, l'idéal étant une maturité voisine ou décalée d'au moins 7 jours par rapport à la variété principale.

Variétés de maturité avant Burlat

Primulat®Ferprime – INFEL 3094
COV en cours
- vigueur : assez forte à forte
- port : semi-érigé à semi-étalé
- floraison : précoce, 5 à 7 jours avant Burlat
- pollinisateurs : Van, Burlat, Sweetheart®Sumtare
- mise à fruit : rapide
- productivité : bonne et régulière
- maturité : étalée, début 3 à 5 jours avant Burlat
- calibre : moyen, voisin à supérieur à Burlat pouvant chuter rapidement en cas de surcharge
- fermeté : moyenne (voisine de Burlat)
- qualité gustative : moyenne à bonne, moins sucrée que Burlat.

Earlise® Rivedel - INFEL 3314
- vigueur : moyenne à forte
- port : semi-érigé
- floraison : très précoce
- pollinisateurs recommandés : Sweetheart® Sumtare, New Moon® Sumini, Lapins, Burlat
- mise à fruit : rapide
- productivité : variété très productive
- maturité : 2 à 4 jours avant Burlat, hétérogène
- calibre : légèrement supérieur à Burlat (8-9 g) éviter le porte-greffe Tabel et faire une taille de fructification sévère pour éviter une production excessive qui pénalise le calibre et retarde la maturité des fruits

- sensibilité à l'éclatement : forte, supérieure à Burlat
- éditeur : CEP

Intérêt : à **, variété précoce arrivant avant Burlat, attention à bien maîtriser la charge des arbres sinon fermeté, calibre et qualité gustative limites en cas de charge importante.*

- fermeté : légèrement plus ferme que Burlat
- sensibilité à l'éclatement : très sensible à l'éclatement dès la véraison, supérieure à Burlat (type Garnet)
- éditeur : Delbard.

*Intérêt : *, variété intéressante par la maturité précoce de son fruit, attention au calibre (surproduction) et à la grande sensibilité à l'éclatement.*

Variétés de maturité entre Burlat et Summit

Coralise® Gardel –(n° d'étude C 381)
le clone actuellement diffusé est atteint de PDV
- vigueur : le clone actuel est de vigueur moyenne (clone sain +30%)
- floraison : même époque que Burlat
- pollinisateurs recommandés : Burlat, Van, Stark, Bigalise®Enjidel (Balandran 98 : 35,4 %)
- mise à fruit : très rapide
- productivité : très forte
- maturité : Burlat + 11 jours ± 4
- calibre : voisin de Burlat (8-8.5g), pour maintenir le calibre éviter de planter sur Tabel®Edabriz, nécessite une taille de fructification sévère.
- fermeté : moyenne à bonne
- sensibilité à l'éclatement : très peu sensible à l'éclatement
- Éditeur : Delbard

*Intérêt : ** , Variété intéressante pour sa maturité, sa tolérance à l'éclatement, attention au calibre seulement moyen*

Bigalise® Enjidel - INFEL® V 3499
Le clone actuellement diffusé est virosé (PDV)
- vigueur : moyenne pour le clone virosé
- port : demi érigé.
- floraison : époque de Burlat
- pollinisateurs recommandés : Burlat (Balandran 98 : 48,8 %), Van, Hedelfingen, Stark, Coralise®Gardel (Balandran 98 : 51,8 %)
- mise à fruit très lente sur porte-greffe vigoureux
- maturité : Burlat + 10-14j à Nîmes et +15-19j à Valence
- calibre : gros potentiel de calibre (11-12g) même avec une forte charge.
- fermeté : fruit très ferme, très bonne tenue sur l'arbre
- qualité gustative : bonne à couleur 4, moyenne après conservation au froid
- aspect du fruit : moyen
- sensibilité à l'éclatement : sensible à l'éclatement au stade véraison et moyenne ensuite
- éditeur : Delbard

*Intérêt : • à **, variété intéressante pour la date de maturité, la fermeté et le calibre de son fruit. Préférer les porte-greffe nanisants (Tabel) ou semi-nanisants (MM14), taille longue pour hâter la mise à fruit, sensibilité à l'éclatement à préciser.*

Céleste® Sumpaca
- autofertile
- maturité : Burlat + 12-14 jours
- sensibilité à l'éclatement : très sensible à l'éclatement sur une longue période
- très sensible au monilia
- éditeur : IPS

Intérêt : variété non recommandée du fait de sa trop grande sensibilité à l'éclatement

Early Van Compact INFEL®
Le clone actuellement diffusé est virosé. Un clone sain issu de thermothérapie est actuellement à l'étude.
- vigueur : forte (clone virosé : vigueur faible en vieillissant).
- port : semi-érigé
- floraison : - 4 à + 4 j / Burlat
- pollinisateurs : Burlat, Sweetheart®Sumtare, New Moon®, à préciser selon les régions
- mise à fruit : rapide
- production : irrégulière pour le clone virosé
- maturité : Burlat + 13 j
- calibre : bon mais hétérogène selon la charge (8 à10 g)
- fermeté : très bonne
- qualité gustative : très bonne
- sensibilité à l'éclatement : peu sensible

*Intérêt : *, pour sa date de maturité, attention au calibre*

New Moon® Sumini - INFEL® V 3028
- floraison précoce
- pollinisateurs recommandés : Earlise® Rivedel, Lapins, Sweetheart® Sumtare
- maturité : Burlat + 15-18 jours
- fruit de bon calibre, ferme, de bonne présentation et de bonne tenue sur l'arbre, ne pas cueillir avant la couleur 4-5 car acide avant
- sensible à l'éclatement
- éditeur : IPS

*Intérêt : *, époque voisine de Summit, sensible à l'éclatement.*

Bellise®Bedel V 3660 (n° d'étude : C 472)
Des plants greffés sur MM14 sont disponibles aux producteurs dès l'hiver 98/99. Le clone actuellement diffusé est sain.
Variété en expérimentation
- floraison : Burlat – 2 j
- productivité : bonne
- maturité : Burlat + 10 j à préciser (Burlat + 5-6 j en 97-98 à Balandran à la couleur 3-4 et production 3)
- calibre : bon (8,5-10 g)
- fermeté : bonne (moyenne à bonne à Balandran, inférieure à Coralise® : 54-60 en 97-98)
- qualité gustative : moyenne à bonne, sucrée, peu acide, consommable dès couleur 3
- sensibilité à l'éclatement : moyenne à préciser (éclatement pédonculaire peu marqué en 97 à Balandran)
- éditeur : Delbard

*Intérêt : *, pour la maturité de son fruit entre Burlat et Summit, la fermeté et le calibre de son fruit, attention à la sensibilité à l'éclatement qui semble assez forte. Maturité exacte à préciser*

Variété de maturité voisine de Summit

Arcina®Fercer-V 2680
- vigueur : très forte
- port : demi-érigé
- mise à fruit : très lente, préférer des porte-greffe nanisants ou semi-nanisants, pratiquer la taille longue et favoriser la mise à fruits sur des rameaux faibles pendants.
- productivité : faible et irrégulière : des essais de taille longue conduits par l'INRA semblent indiquer que cette variété peut produire normalement et régulièrement.
- maturité : B + 17-20 j.
- calibre : très gros (10-12 g)
- fermeté : très bonne
- qualité gustative : très bonne
- sensibilité à l'éclatement : forte pendant toute la période de maturité
- sensibilité au gel de printemps : forte
- éditeur : CEP

Intérêt : cette variété, à la mise à fruit capricieuse, nécessite la mise au point d'un mode de conduite adaptée (solaxe), d'autre part elle est sensible à l'éclatement.

Canada Giant®Sumgita
Mêmes caractéristiques que Summit

Fernier-INFEL®V 2315.
- vigueur : forte
- floraison : époque Burlat
- pollinisateurs recommandés : Stark, Coralise®Gardel, Hedelfingen, Burlat
- mise à fruit : assez lente, améliorée sur Tabel et MM14
- productivité : bonne et régulière, rarement de surcharge
- maturité : Nîmes : Burlat+18-23j, Valence : Burlat+21-24j (Summit+4j)
- calibre : fruit de bon calibre (8-10g), homogène, facile à cueillir
- fermeté : bonne, bonne tenue sur l'arbre
- qualité : fruit brillant
- sensibilité à l'éclatement : faible à moyenne à préciser
- éditeur : CEP

Intérêt : à **, pourrait remplacer Van, intérêt à préciser, devrait être greffée sur Tabel®Edabriz pour améliorer sa mise à fruit dans les situations fertiles*

Samba® Sumste - INFEL® V 2945
- arbre vigoureux, semi-érigé, moyennement ramifié
- mise à fruit lente et production moyenne
- floraison très précoce : -2 à -6 j /Burlat
- pollinisateurs recommandés : Lapins, New Moon® Sumini, Sweetheart® Sumtare
(autofertilité en cours d'étude)
- maturité : Burlat + 17-20 j.
- calibre : bon
- fermeté : bonne
- qualité gustative : moyenne, fruit très acide jusqu'à la couleur 4, doit être récolté à la couleur 5-6
- sensibilité à l'éclatement : très peu sensible
- éditeur : IPS

Intérêt : variété intéressante pour la fermeté et le calibre du fruit et sa tolérance à l'éclatement, l'utilisation de porte-greffe nanisant ou semi-nanisant pourrait améliorer sa mise à fruit et sa production,
Qualité gustative à surveiller : ne pas récolter avant la couleur 5 sous peine de mettre sur le marché des cerises de très mauvaise qualité.

Simcoe® Probla - INFEL® V 2284
- maturité : Burlat + 15-20 jours
- fermeté : fruit ferme et de bon calibre
- qualité gustative : acide jusqu'à la couleur 4, à récolter à la couleur 5-6
- sensibilité à l'éclatement : assez sensible à l'éclatement
- éditeur : IPS

Intérêt : période où le choix est important.

Variété de maturité après Summit

Germersdorf V 2345
Clone sain 2345 disponible aux producteurs à partir de l'hiver 1998/99
- floraison : Burlat +5-6j correspondant à celle de Duroni 3.
- productivité : bonne
- maturité : Burlat +25-30j (époque d'Hedelfingen)
- calibre : bon (8-9g)
- fermeté : bonne
- qualité gustative : moyenne à bonne
- sensibilité à l'éclatement : faible à moyenne

Intérêt : variété intéressante comme pollinisateur de Duroni 3

Régina V 2868
- vigueur : forte
- floraison : tardive
- pollinisation : Duroni 3,
- mise à fruit : rapide
- productivité : très bonne
- floraison : époque de Duroni 3.
- variété conseillée comme pollinisateur de Duroni 3
- maturité : Burlat + 30-35j
- calibre : assez bon (7,5-9,5 g)
- fermeté : bonne
- qualité gustative : sucrée, moyenne à bonne (moyennement juteuse)
- sensibilité à l'éclatement : très faible

Intérêt : à **, variété intéressante pour sa maturité tardive, comme pollinisateur de Duroni 3 voire comme variété principale, et sa très faible sensibilité à l'éclatement, surveiller le calibre*

Sweetheart® Sumtare V 2696
Le clone actuellement diffusé est atteint de PDV. Un clone sain est en cours d'authentification.
- vigueur : faible à moyenne pour le clone virosé.
- floraison précoce : 1 à 6 jours avant Burlat.
- variété autofertile.
- mise à fruit : très rapide.
- productivité : très forte.
- maturité : 32 à 35 jours après Burlat.
- calibre : fruit de calibre moyen.

Il faut beaucoup la tailler pour maintenir un calibre de 8 g.
- fermeté : très bonne, de belle présentation
- qualité gustative : très bonne de très bonne tenue sur l'arbre
- sensibilité à l'éclatement : moyenne
- éditeur : IPS.

*Intérêt : • à **, pour sa maturité tardive, son autofertilité attention au calibre, sensibilité à l'éclatement à préciser. Le greffage du clone actuel est déconseillé sur Tabel®Edabriz*

Duroni 3

Du fait de sa grande sensibilité à la bactériose ne pas former les arbres à moins de 60 à 80 cm du sol.
- en coteau : production bonne et régulière
- en plaine : production faible à très faible sur Maxma Delbard®14 Brokforest et SL 64, moyenne sur Tabel®Edabriz
- pollinisateurs : Régina, Germersdorf, Successa

Amélioration de la pollinisation :
- verger en place : surgreffage de rameaux à l'intérieur de chaque arbre avec la variété de cerise acide Successa.
- nouvelles plantations : mise en place sur le rang d'un plant de Successa greffé sur Maxma Delbard®14 Brokforest tous les 9 m.

Skeena (13S43 48) V2941.
- floraison : Burlat + 4-7 jours

C.O.V. U.E. en cours
- pollinisateurs : variété autofertile (La Tapy , SEFRA 1998)
- mise à fruit : rapide
- productivité : bonne
- maturité : B + 28-32 j
- calibre : bon (9-10.2 g sur Tabel®Edabriz)
- fermeté : très bonne
- aspect : bien
- qualité gustative : moyenne, couleur 5 minimum
- sensibilité à l'éclatement : moyenne à très sensible selon les sites
- éditeur : IPS

*Intérêt : • à **, variété très tardive de belle présentation, ne pas cueillir avant code 5 pour une qualité gustative acceptable*

G. Charlot, F. Floc'hlay, (Ctifl), M. Edin (Ctifl/ SEFRA), Ch. Chamet (SEFRA), V. Simard (La Tapy), Ph Blanc (Serfel), JF. St-Hilary (CEFEL)

Le programme de création variétale de l'INRA

Les objectifs de l'amélioration génétique du cerisier visent à modifier d'une façon profitable pour le producteur les aspects négatifs de la culture. Ils doivent aussi permettre d'améliorer la qualité pour le consommateur puisque cette espèce *(P. avium)* est presque uniquement destinée à la consommation directe (exception faite pour les bigarreaux d'industrie).

Dès le début des années 80 et compte tenu de la grande variabilité génétique de cette espèce, l'Unité

Auparavant, quelques travaux de mutagenèse (utilisation du cobalt 60) réalisés sur les bourgeons des variétés Burlat et Géant d'Hedelfingen n'avaient pas permis d'obtenir les résultats escomptés. Seuls deux descendants de Géant d'Hedelfingen présentent des particularités intéressantes. L'un s'est révélé très résistant au gel printanier, l'autre doit être considéré comme une curiosité botanique dont les feuilles sont extrêmement longues et étroites alors que le fruit est très mucroné.

de Recherches Fruitières INRA de Bordeaux a mis en place un programme de création variétale par hybridation intra-spécifique.

Les principaux objectifs retenus pour l'amélioration de cette espèce peuvent se résumer ainsi :

*** pour le fruit :**

- qualité gustative,
- calibre du fruit,
- fermeté et résistance au transport,
- résistance à l'éclatement,
- grosseur du noyau,
- élargissement de la gamme de maturité,
- facilité de cueillette avec ou sans pédoncule,
- résistance au monilia

*** pour l'arbre :**

- rapidité de mise à fruit,
- autofertilité,
- floraison tardive et résistance aux gelées printanières,
- résistance aux *Pseudomonas*, à l'anthracnose,
- recherche de type "spur".

L'ensemble de ces travaux de création variétale a permis d'observer plus de 10 000 hybrides.
A partir du programme développé depuis une vingtaine d'années, l'Unité de Bordeaux a sélectionné et mis à la disposition des arboriculteurs quatre cultivars qui sont déjà largement diffusés. Il s'agit :

- FERBOLUS (VERDEL®) 1985
- FERCER (ARCINA®) 1987
- FERNIER 1994
- FERPRIME (PRIMULAT®) 1997

Ferprime qui mûrit une semaine avant Burlat présente des qualités d'ensemble proches de Burlat mais avec une mise à fruit rapide. Plus de 30 000 greffons certifiés ont été distribués en 1998.

Quatre nouveaux cultivars déjà largement expérimentés font l'objet d'une prémultiplication.
Il s'agit de :

- FERPIN qui mûrit 2 à 4 jours après Burlat avec un poids moyen voisin de 11 g.
- FERPACT qui mûrit 23 jours après Burlat avec un poids moyen de fruit de 12,5 g. La mise à fruit est très rapide et l'arbre est relativement compact.
- FERIA qui mûrit 26 jours après Burlat avec un poids moyen de 14 g et une mise à fruit rapide.
- FERRADOR variété bicolore à gros fruit (13-14 g) qui mûrit après Rainier. Intéressante pour la consommation en frais.

Une soixantaine de présélections sont actuellement observées au niveau 1. Parmi celles-ci une trentaine ont été placées dans 5 sites expérimentaux au cœur des régions de production où elles sont expérimentées sur deux porte-greffe différents : EDABRIZ (TABEL®) et BROKFOREST (MAXMA-DELBARD®-14) à raison de 10 répétitions pour chaque porte-greffe.

Quelques nouveaux cultivars à gros fruits pouvant se récolter mécaniquement sont également à l'étude dans plusieurs vergers.

En ce qui concerne les fruits d'industrie (type Napoléon), plusieurs séries de croisements ont permis d'élargir la gamme de maturité. Une dizaine de nouvelles sélections, qui présentent les caractéristiques agronomiques et technologiques recherchées, ont été obtenues. Deux d'entre elles sont en prémultiplication.

L'élargissement de la gamme de maturité et le calibre des fruits étant les objectifs au moins partiellement atteints, les travaux actuels sont plus précisément orientés vers la résistance à l'éclatement et l'autofertilité.

Dans le domaine des biotechnologies, l'unité entreprend des travaux sur l'emploi de marqueurs moléculaires permettant d'établir une "carte d'identité" génétique des cultivars. Une technique visant à déterminer les allèles de stérilité (S) est mise en œuvre, ce qui devrait permettre de connaître les intercompatibilités possibles. Pour l'immédiat, ce travail de recherches des meilleures combinaisons polliniques est réalisé en étroite collaboration avec le Ctifl et la SICA La Tapy.

... Saunier – J. Claverie, INRA Bordeaux

Brèves

Homologations en cours

- **PRM 12 RP** (éthephon) : APV en été 98 pour faciliter la chute :s fruits (cerise d'industrie) : dose : 0,3 l / hl,
LMR : 3 ppm, délai d'emploi avant récolte : 15 jours
Benlate : APV sur monilia sur fleurs, rameaux, fruits depuis ievrier 98 (0,06 Kg de produit commercial par hl, délai d'emploi ...ant récolte : 3 jours)
le **Topsin** (de la firme Jagri) remplace dorénavant le Pelt 44 (Monilia sur fleurs et rameaux) : même matière active, ...me dosage et mêmes conditions d'emploi
- **Delan** : tests résidus complémentaires en 99 avant

Journées d'information.

Sefra : (renseignements au 04-75-60-73-40)

La Tapy :
- le 6 mai à partir de 9 h : journée cerise
- le 17 juin à 15 h : présentation des variétés (une seule journée)
(renseignements au 04-90-62-69-34)

Serfel :
- le 2 juin à 14 h : variétés cerise et éclatement
- le 16 juin à 14 h : variétés cerise et abricot

Ctifl

La Tapy

SEFRA

serfel

Infos Cerise.

N°0 (Mai 98)

SOMMAIRE

Editorial

Ce bulletin d'information technique est élaboré à partir des références techniques acquises par l'ensemble des partenaires travaillant sur la cerise. Il est envisagé deux numéros par an : un avant la campagne cerise en mars avril et un en novembre. Il est principalement destiné à tous les techniciens qui ont une action de conseil auprès des producteurs de cerise et des structures commerciales. C'est un moyen de diffuser rapidement les nouvelles références techniques.

Le point sur les porte-greffe.

Les informations données ci-dessous sont issues principalement des observations réalisées dans le cadre d'un réseau piloté par le Ctifl associant, le Ctifl (M. Edin, G. Charlot, F. Floc'hlay), l'INRA (J. Claverie), et les Stations Régionales : La Tapy (V. Simard) , SEFRA (C. Chamet), SERFEL (Ph. Blanc), CEFEL (JF Saint-Hilary), VEREXAL (J. Guiot), AREFE (C. Gigleux).

Le comportement des porte-greffe du cerisier est très étroitement lié au terroir (sol, climat). Il convient donc de bien les étudier dans les sols où l'on compte les développer.

Selon les zones de production et les exploitations les qualités attendues d'un porte-greffe sont sensiblement différentes. Elles sont principalement de quatre ordres :

1) porte-greffe nanisant (niveau 2-3) plus rustique que le Tabel (pucerons noirs, chlorose, type de sol) avec un bon maintien du calibre des fruits.

2) porte-greffe de niveau de vigueur intermédiaire entre le Tabel (niveau 2) et le MM14 (niveau 6) avec une rapidité de mise à fruit équivalente à celle du MM14.

3) porte-greffe d'une vigueur équivalente au SL64 mais avec une mise à fruit plus rapide et plus tolérant à l'asphyxie.

4) porte-greffe d'une vigueur équivalente au merisier avec une mise à fruit plus rapide, tolérant à la sécheresse et à la bactériose.

Correspondants permanents : G. Charlot, Ctifl – M. Edin, Ctifl SEFRA – S. Charmont, La Tapy – Ph. Blanc, SERFEL

Porte-greffe nanisant et semi nanisant.

	Tabel® Edabriz	Maxma Delbard® 14-Brokforest	*Gisela 5* (Nouveau porte-greffe en expérimentation)
origine	clone de Prunus cerasus	Prunus mahaleb X Prunus avium	*Prunus cerasus X Prunus canescens*
Editeur en France	GIE CEPAGRI	Delbard	*Star Fruits*
Niveau de vigueur (% du merisier)	20-30	60-70	*20-30 (équivalent au Tabel)*
Distances de plantation	4.5 à 5 m entre les rangs 1.5 à 3 m sur le rang	6 à 7m entre les rangs 4 à 5m sur le rang	*4.5 à 6m entre les rangs* *1.5 à 2.5m sur le rang*
Variétés à éviter	Earlise. Coralise. Van. Stark, Lapins, Sweetheart. variétés virosées		*Earlise, Coralise, Van, Stark, Lapins, Sweetheart*
Ancrage	moyen	bon	*moyen à bon*
rapidité mise à fruit	très rapide (2 à 3e feuille)	rapide 4 à 5e feuille	*très rapide 2e feuille (> Tabel)*
Niveau de production	très élevé	élevé	*très élevé (> Tabel)*
Maturité du fruit / SL64	retard de 1 à 4 jours	aucune incidence	*aucune incidence*
Incidence sur le calibre	↘ si taille insuffisante	↘ si taille insuffisante (variétés très fertiles)	*↘↘ si taille insuffisante*
Drageonnement	faible à moyen	nul	*faible*
Sensibilité aux virus	forte	faible	*faible*
Sensibililté à la chlorose	moyenne à forte éviter Ca actif > 8%	faible	moyenne à forte éviter Ca actif > 8%
Sensibilité carence Mg	faible	forte	*non connue*
Sensibilité excès d'eau	faible à moyenne	moyenne (intermédiaire entre SL64 et merisier)	*faible à moyenne*
Sensibilité au pourridié	forte	non connue	*moyenne*
Observations	Très forte sensibilité aux pucerons noirs surtout les 3 1ères années Sensible aux campagnols A éviter pour les productions très précoces. Ne pas greffer de variétés virosées **Porte-greffe très exigeant en sol et techniques culturales, notamment irrigation et taille.** Peut améliorer la mise à fruit et la production des variétés Fercer, Bigalise. Duroni 3	Sensible au nématode Pratylenchus vulnus Eviter les sols superficiels Irrigation généralement nécessaire Maîtriser le niveau de charge par la taille pour Maintenir le calibre des fruits.	*Porte-greffe en expérimentation dont le comportement agronomique en France reste à préciser.* *Très bonne résistance au froid hivernal* *Bonne résistance au chancre bactérien* ***Porte-greffe très exigeant en sol et techniques culturales, notamment irrigation et taille*** *Semble induire un certain dégarnissement à la base des rameaux*

Porte-greffe de vigueur équivalente au Sainte Lucie.

	Ste Lucie 64	Pontaleb® Ferci (Ste Lucie 405)	Maxma Delbard ® 60-Broksec (**Nouveau porte-greffe en expérimentation**)
Origine	clone de Prunus mahaleb (X par bouturage)	sélection de SL (X par semis)	Prunus mahaleb X Prunus avium
Editeur en France		GIE CEPAGRI	Delbard
Niveau de vigueur % du merisier	80-90	80-90	80-90
Distances de plantation	7 à 8 m entre les rangs 5 à 6 m sur le rang	7 à 8 m entre les rangs 5 à 6 m sur le rang	7 à 8 m entre les rangs 5 à 6 m sur le rang
Ancrage	très bon	très bon	très bon
Rapidité mise à fruit	moyenne (6 à 7 ans)	moyenne (5 à 6 ans)	moyenne à bonne (5-6 ans)
Niveau de production	bon	bon supérieur au SL64	bon supérieur au SL64
Maturité du fruit	aucune incidence	aucune incidence	aucune incidence
Drageonnement	nul	nul	nul
Sensibilité aux virus	faible	faible	non connue

Porte-greffe de vigueur équivalente au Sainte Lucie.

	Ste Lucie 64	Pontaleb® Ferci (Ste Lucie 405)	Maxma Delbard ® 60-Broksec (Nouveau porte-greffe en expérimentation)
origine	clone de Prunus mahaleb (X par bouturage)	sélection de SL (X par semis)	Prunus mahaleb X Prunus avium
Sensibilité à la chlorose	nulle	nulle	non connue
Sensibilité excès d'eau	très sensible	très sensible	non connue
Sensibilité au pourridié	forte	forte	non connue
Observations	très sensible au phytophthora, verticilliose, Pratylenchus penetrans et campagnols	port plus ouvert que le SL64 très sensible au phytophthora, verticilliose, campagnols	résistant au phytophthora **bonne tolérance à la sécheresse.** Il pourrait avantageusement remplacer les merisiers en conditions de culture difficiles

Merisiers.

	Merisier de semis	Pontavium® Fercahun	Pontavium® Fercadeu
origine	Prunus avium	sélectioon de Prunus avium	sélectioon de Prunus avium
Editeur en France		GIE CEPAGRI	GIE CEPAGRI
distances de plantation	8 m X 8 m	8 m X 8 m	8 m X 8 m
ancrage	très bon	très bon	très bon
rapidité mise à fruit	très lente (6-8 ans)	très lente (6-8 ans)	très lente (6-8 ans)
niveau de production	moyen	moyenne à bonne	moyenne à bonne
maturité du fruit		retard de 5 jours de Burlat / F12-1	retard de 3 jours de Burlat / F12-1
drageonnement	faible	faible	très faible
Sensibilité aux virus		faible	
Sensibililté à la chlorose		moyenne	
Sensibilité carence Mg			
Sensibilité excès d'eau		moyenne	moyenne
Sensibilité au pourridié		moyenne	moyenne
Observations		très sensible au Pratylenchus vulnus, moyennement sensible au crown gall et aux campagnols	très sensible au Pratylenchus vulnus, moyennement sensible au crown gall et aux campagnols

Merisier F12-1 : clone de Prunus avium, mise à fruit très lente, drageonnement élevé, sensibilise les variétés au chancre bactérien, très sensible au crown gall en pépinières. Ce porte-greffe ayant beaucoup d'inconvénients est actuellement peu utilisé.

Pontavium : des recherches sont actuellement menées par l'INRA pour améliorer la germination des semences.

G. Charlot (Ctifl), M. Edin (Ctifl/ Sefra), V. Simard (La Tapy), Ph Blanc (Serfel).

Brèves

Homologation éthéphon

Une démarche d'homologation de l'éthéphon pour faciliter la récolte des cerises d'industrie a été engagée auprès de la société Rhône-Poulenc par le Ctifl la FNPF et les Stations Régionales (La Tapy, ...) en nov 1997.

Des compléments d'études sur les résidus seront réalisés par la Protection des Végétaux en 1998 et le produit devrait être homologué à la fin de l'année 98.

Autres produits à l'étude.

Dans le cadre des usages mineurs, quatre matières actives sont étudiées en 1998 contre les acariens, le gnomonia , le puceron noir et le botrytis.

Journées d'information.

Sefra : présentation variétale le 2 juillet à 14 h (renseignements au 04-75-60-73-40)

La Tapy : présentation des collections variétales le jeudi 28 mai à 15 h et le mardi 16 juin à 15 h (renseignements au 04-90-62-69-34)

Serfel : journée portes ouvertes cerise (variétés, éclatement) le mercredi 10 juin à 14 h.

Dégâts de gel.

Des gels successifs (23 et 25 mars, 14 avril) ont détruit une partie parfois importante de la production de cerise. Les dégâts sont très variables selon les secteurs géographiques, les variétés, la localisation de la parcelle. Des observations ont été réalisées par les différents partenaires sur la sensibilité des variétés selon les stades phénologiques au moment du gel et feront l'objet de publications après analyse des résultats.

'AMBRUNÉS' SWEET CHERRY QUALITY FACTORS CHANGES DURING RIPENING

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INTRODUCTION

•It is of great importance:
- to know how cherries change when harvest day is coming
- if there is an index quality that indicates the beginning and/or the end of harvest

•It is important to establish some color standards to be used as ripening indexes

•Firmness is another attribute that defines fruit quality and determines storage potential and shelf life of perishable products.

•**OBJECTIVE** ⇨ To determine the optimum harvest time of 'Ambrunés' sweet cherry

MATERIALS & METHODS

Plant Material

- Sweet cherries (Prunnus avium L. 'Ambrunés') were randomly hand picked in Valle del Jerte, Cáceres (Spain) rom trees from the same age
- Fruits were transported the same day of harvest, about 625 Km in a ventilated car to the laboratory in Murcia
  Cherries were selected from uniform external color and caliber and freedom from damages
  Fruits were picked up in four different ripening stages
- The first harvest was 60 days after full bloom and at 6-7 day intervals the following samples were picked
  5 replicates of 12 fruits each one were used for analysis

Physical quality attributes

- Weight was determined using a scale with an accuracy of ± 0.01 g (Mettler, Madrid)
  Equatorial diameter was assayed by a micro-meter with an accuracy of 0.02 mm (Mitutoyo, Tokyo)
- Firmness (N) was measured by compression in the equatorial region of fruits with a Lloyd LR 10K (Fareham, Hants, UK)
  External skin color (3 different measurements at 3 equidistant points on the equatorial region of each individual fruit) was measured in a Minolta CR 300 color-difference meter (Ramsey, NJ) using C standard C.I.E. illumination, 0° viewing and results were expressed as CIELab color space units

Chemical quality attributes

Soluble solids content (SSC) was measured with an Atago N1 refractometer (Tokio, Japan) (refractometric reading at 20°C) and expressed in °Brix

The pH was measured with a Crison 501 pH meter (Barcelona, Spain)

Titratable acidity (TA) was assayed by titrating 5 mL of juice sample using 0.1N NaOH to pH 8.1 and expressed as g of malic acid/100mL

CONCLUSIONS

After evaluating the most important physical and chemical quality parameters of 'Ambrunés' sweet cherry during ripening, it can be concluded that the best harvest date is located approximately at 80 days after full bloom (fourth harvest of our study). At this date fruit reached the highest growth, and adequate edible portion/stone ratio, enough firmness, a typical color of skin and an appropriate balance between sugars and acids

Overall, we can establish the optimum date of harvesting for fresh consumption of 'Ambrunés' sweet cherry in the study area in about 80 days from the full bloom, when the SSC is close to 17° Brix, firmness 5 N, color (Chroma 32.7 and Hue 29.2) and weight 7.8 g

ACKNOWLEDGMENTS

Authors are grateful to 'Agrupación de Cooperativas del Valle del Jerte for supplying 'Ambrunés' sweet cherries

RESULTS

Fig 1. Changes in weight of 'Ambrunés' sweet cherry during ripening in tree. Values are mean of 3 replicates. Vertical bars represents standard deviation

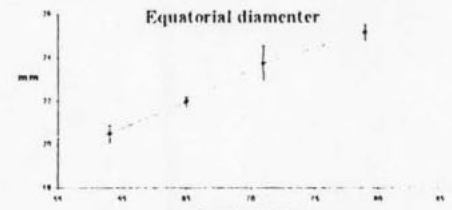

Fig 2. Changes in equatorial diameter of 'Ambrunés' sweet cherry during ripening in the tree. Values are mean of 3 replicates. Vertical bars represent standard deviation

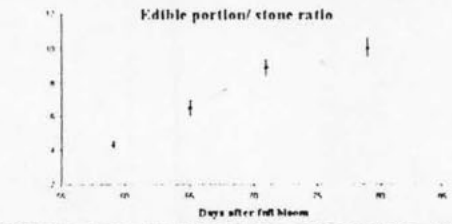

Fig 3. Changes in edible portion / stone ratio of 'Ambrunés' sweet cherry during ripening in tree. Values are mean of 3 replicates. Vertical bars represent standard deviation

Table 1. Changes in flesh firmness and color of 'Ambrunés' sweet cherry during ripening in the tree. Values are mean of 3 replicates.

Days of full bloom	Flesh Firmness (N)	L*	Chroma	Hue Angle
59	6.54±0.44	72.06±1.91	39.18±1.39	93.33±5.83
65	6.04±0.20	58.67±0.86	38.31±0.44	53.79±1.72
71	5.14±0.11	47.06±1.59	41.83±0.65	39.53±1.11
79	4.89±0.29	36.22±0.82	32.66±2.11	29.21±1.08

Table 2. Changes in total soluble solids content (SSC), titratable acidity (TA) and SSC/ TAratio of 'Ambrunés' sweet cherry during ripening in tree. Values are mean of 3 replicates.

Days of full bloom	SSC °Brix	TA g malic acid/100 ml	SSC/TA
59	10.76±0.26	0.51±0.07	20.12±0.79
65	12.56±0.26	0.60±0.04	20.42±1.01
71	15.24±0.26	0.72±0.03	21.21±0.80
79	16.68±0.46	0.66±0.03	25.23±0.76

CONTROLLED ATMOSPHERE STORAGE OF 'BING' SWEET CHERRIES

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INTRODUCTION

Cherries are extremely perishable fruits and do not lend themselves to prolonged cold storage (two to three weeks). The main problems during storage are stem browning, fruit softening, and usually a loss of characteristic flavor.

OBJECTIVES

To evaluate the use of controlled atmosphere to extend fruit quality of 'Bing' sweet cherries.

MATERIAL & METHODS

Fruit was harvested at an export maturity stage and packed in a 5-kg wooden box with a perforated polyethylene liner. Fruit was stored for 21 days at 1°C and 95% RH, in controlled atmosphere (CA) and ambient air as the control.

Treatments

- **CA** 0% CO_2 + 2% O_2
  10% CO_2 + 2% O_2
  10% CO_2 + 10% O_2
- **Control (Air)** 0.03% CO_2 + 21% O_2

Fruit were evaluated at harvest, after 21 days in storage (CA or air), after 2 days at 8°C in air after removal from CA, and after 2 days of complementary ripening at 20°C.

The fruit quality parameters evaluated were:

Fruit color: Munsell scale

1 =moderate red (2.5R4/10), 2 =dark red (2.5R2/7)

Stem color: scale according to the percent of the stem which was brown

1 = non, 2 = slight, 3 = moderate, 4 = severe

Firmness (N): Penetrometer Effegi, 4.5mm tip.

Soluble solids content (°Brix): Thermo-compensated refractometer, Atago.

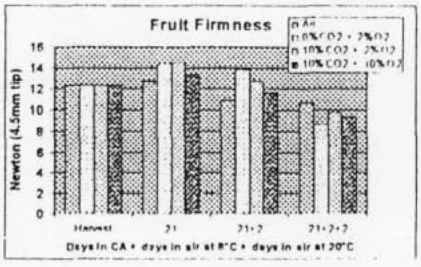
Decay: visually, percent fruit with decay.

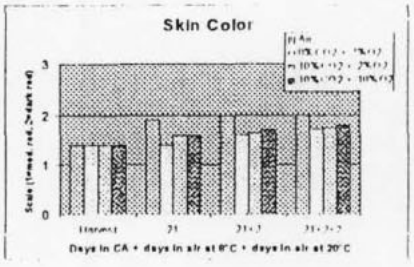
Sensory evaluation: conducted with 12 trained panelists, evaluating the fruit according to flavor quality, flavor intensity, and off-flavors.

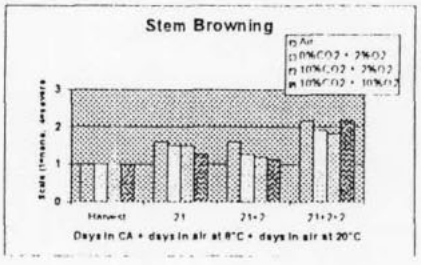
The experiment was a completely randomized design. The exp. unit was the box with 4 reps per treatment. From each box, 100 fruit were evaluated. ANOVA and Duncan test at 5% was done.

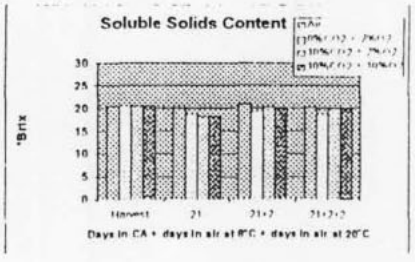
RESULTS

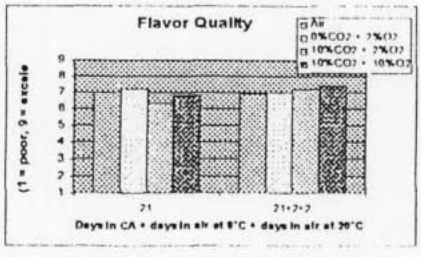
Results of firmness, fruit and stem color, soluble solids content, flavor quality and intensity are shown in the following figures. Overall, the 10% CO_2 + 2% O_2 atmosphere was best, with beneficial effects on skin color and absence of off-flavors after the complementary ripening period. Fruit were evaluated for decay, however, no decay was observed in any treatment.

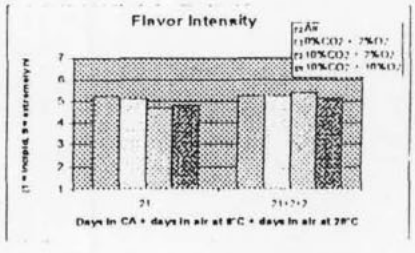












CONCLUSIONS

- The primary benefits of the use of CA for 'Bing' cherries were on the skin and stem color. Both high CO_2 and low O_2 inhibit the darkening of the skin, while only low O_2 effectively maintained the green color of the stem.
- The 10% CO_2 + 2% O_2 atmosphere resulted in the best fruit quality, with beneficial effects on skin and stem color and absence of off-flavors.

4th International Cherry Symposium Roster

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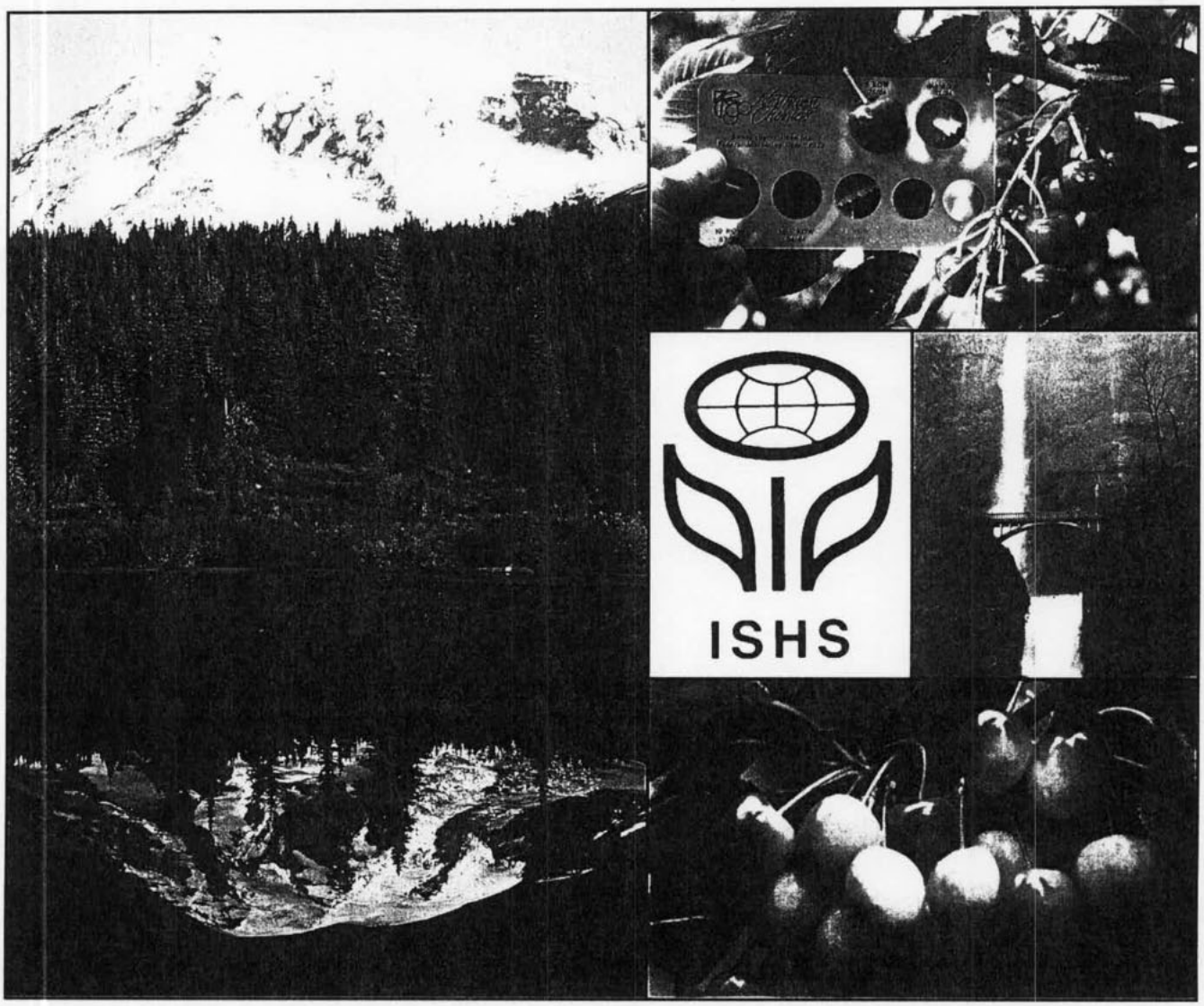
4th International Cherry Symposium

"Advances in Cherry Genetics, Physiology, Technology, and Management"

24 – 29 June 2001
Hood River, Oregon and Richland, Washington



Program and Abstracts

Jean Paul Jobbins

4th International Cherry Symposium Sponsors

Oregon State University
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Oregon Sweet Cherry Commission
Washington Tree Fruit Research Cherry Commission
Washington State Fruit Commission
California Cherry Advisory Board
Cherry Marketing Institute
Wasco County Fruit & Produce League

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4th Cherry Symposium Scientific Program

SUNDAY 24 JUNE 2001

All day shuttles from Portland Airport to Hood River Inn

Registration	2:00 - 8:00 pm Set-up of posters for Poster Sessions I and II	
Welcoming Reception	6:00 - 8:00 pm Co-Convenors: Welcome and opening comments	Lang and Long

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MONDAY 25 JUNE 2001

Registration 7:30 - 8:15 am

Opening Statements and Objectives of Symposium

Monday morning	8:15-8:20 am	ISHS Working Group Chair:	Sekse
	8:20-8:25 am	ISHS Fruit Section Officer:	Sansavini
	8:25-8:30 am	Symposium Co-Convenor:	Lang

Breeding and Genetics - Sweet cherries

Monday morning 8:30-10:15 am Moderator: Kappel

New sweet cherry variety and selection showcase (8-10 minutes each):

8:30	Kappel	Summerland, Canada program
8:40	Apostol	Budapest, Hungary program
8:50	Granger	Lenswood, Australia program
9:00	Sansavini	Bologna, Italy program
9:10	Lang	Prosser, Washington program
9:20	Tobutt	East Malling, United Kingdom program
9:30	Andersen	Cornell, New York program
9:40	Lauri	INRA, France program
9:50		Sweet Cherry Breeding Discussion

Coffee Break 10:15-10:45 am

Breeding and Genetics - Sour cherries

Monday morning 10:45-12:00 pm Moderator: Apostol

New sour cherry variety and selection showcase (8-10 minutes each):

10:45	Apostol	Budapest, Hungary program
10:55	Bors	Saskatchewan, Canada program
11:05	Schuster	Dresden-Pillnitz, Germany program
11:15	Iezzoni	Michigan State, United States program
11:25	Inantsy	Újfehértó, Hungary program
11:35	Burak	Ataturk, Turkey program
11:45		Sour Cherry Breeding Discussion

Lunch 12:00-1:15 pm Hood River Inn, Hood River
Set-up of posters for Poster Sessions I and II

Breeding and Genetics - Biotechnology and molecular genetics
Monday afternoon 1:15-3:00 pm Moderator: Wiersma

1:15	Amiri	*In vitro* shoot tip grafting of 'Black Mashad' sweet cherry
1:30	Meneghelli -	Adventitious leaf regeneration in *Prunus*
1:45	Roche	An *in vitro* leaf bioassay to evaluate resistance of sweet cherry genotypes to *Pseudomonas syringae* pv. syringae ⇐
2:00	Zhou	Genetic analysis and DNA fingerprinting of sweet cherry cultivars and selections using amplified fragment length polymorphisms (AFLP)
2:15	Kacar	Determination of molecular genetic structure of some sweet (*Prunus avium* L.) and sour cherry (*Prunus cerasus* L.) varieties using microsatellite techniques
2:30	Iezzoni	Cherry genomics: current status and potential future impact on cherry research and production
2:45		Breeding and Genetics Discussion

Orchard/Technology/Variety Research Tour
Monday afternoon 3:15-6:30 pm Tour Leaders: Long and Nunez

Orchard View Farms and Packing House (The Dalles)
OSU Mid-Columbia Agricultural Research & Extension Center (Hood River)

Special Dinner and Program
Monday evening 7:30-9:30 pm Host: Seavert

Traditional Native American salmon barbecue dinner (OSU Mid-Columbia Agricultural Research & Extension Center, Hood River)

TUESDAY 26 JUNE 2001

Rootstocks - Breeding, selection, and evaluation trials
Tuesday morning 8:00-10:45 am Moderator: Hrotko

8:00	Hrotko	Growth and productivity of 'Danube' (Érdi Bõtermõ) sour cherry trees on Mahaleb inbred lines
8:15	Magein	Growth, flowering and fruiting potentials of new dwarfing rootstocks selected into the progenity of Damil® (GM 61/1)
8:30	Rozpara	Frutana® – a new interstock for sweet cherry trees
8:45	De Salvador	Performance of new and old cherry rootstocks in different soils and climatic conditions
9:00	Stehr	Experiences with dwarfing sweet cherry rootstocks in Northern Germany
9:15	Granger	The effect of three rootstocks on the yield and fruiting of sweet cherry (*Prunus avium* L.)
9:30	Grzyb	Results of a sweet cherry rootstock trial in northern Poland
9:45	Hilsendegen	Preliminary results of a German sweet cherry rootstock trial
10:00	Charlot	Tabel®Edabriz : a dwarf rootstock for intensive sweet cherry orchards
10:15		Rootstock Discussion

Coffee Break 10:30-11:00 am

Poster Session I: Rootstocks
Tuesday morning 11:00-12:15 pm

Franken-Bem	GiSelA 5 rootstock performance in Germany
Battistini	Victor: A semi-dwarf cherry rootstock for dry conditions
Kappel	The 1998 NC-140 regional sweet cherry rootstock trial - Results from western North America
Pedersen	Incompatibility between eighteen sweet cherry cultivars and nine different rootstocks
Kaska	Effects of various rootstocks on the growth of `0900 Ziraat' sweet cherry variety in K.Maras, Turkey
Nishimura	Sweet cherry rootstock breeding at Yamagata
Spinardi	Effect of rootstock on the fruit quality of `Lapins' and `Stella' sweet cherry (*Prunus avium* L.)
Perry	Preliminary performance of `Hedelfinger' sweet cherry on ten rootstocks in the 1998 NC-140 trial
Perry	Preliminary performance of `Montmorency' sour cherry on eleven rootstocks in the 1998 NC-140 trial
Cowgill	Five year performance of six sweet cherry cultivars on five dwarfing rootstocks

	Maguylo	Characterization of rootstock influence on flower bud and spur formation in sweet and sour cherry

Lunch 12:30-1:30 pm Hood River Inn, Hood River

Global Cherry Economics

Tuesday afternoon 1:30-3:30 pm Moderator: Long

1:30	Howell	NRSP5 and the international exchange of cherry clones
1:45	Lemus	Survey of the Chilean sweet cherry industry
2:00	Zilkah	Prospects and problems of growing early season sweet cherries under plastic cover
2:15	Wermund	Consumer purchasing behaviour, attitudes and perceptions with respect to United Kingdom sweet cherries
2:30	Ricks	The Michigan sweet cherry industry: Economic trends
2:45	Willett	Challenges in the international marketing of Northwest-grown fresh sweet cherries
3:00	Montoya	Growing organic cherries in Chile
3:15		Global Economics Discussion

Presentations by prospective convenors of 2005 ISHS Cherry Symposium

Tuesday afternoon 3:30-3:45 pm

Australia, Chile, others ??

Poster Session II: Breeding, genetics, and biotechnology

Tuesday afternoon 4:00-6:00 pm Cherry product showcase and reception

Sweet cherry breeding and evaluation

Stehr	Screening of sweet cherry cultivars in Northern Germany
Sansavini	New sweet cherry cultivars developed at the University of Bologna's Arboriculture Department (DCA)
Kappel	New sweet cherry cultivars from PARC-Summerland
Apostol	The main sweet cherry cultivars in Hungary
Lang	New sweet cherry cultivars and selections from Washington State University
Godini	The Italian sweet cherry evaluation project
Bekefi	Cross-compatibility studies in some Hungarian sweet cherry hybrids
Choi	A preliminary study of physiological and S-allele specific breakdown of self-incompatibility in sweet cherry
Kaska	A comparison of the adaptations of Turkish and foreign sweet cherry cultivars in the K.Maraş region of Turkey
Zilkah	Characterization of new imported early season sweet cherry cultivars in Israel

Choi	The influence of accelerated flower development on pollen quality in sweet cherry
Joublan	Evaluation of sweet cherry germplasm in southern Chile

Sour cherry breeding and evaluation

Schuster	Sour cherry breeding at Dresden-Pillnitz
Iezzoni	Screening cherry germplasm for resistance to leaf spot
Apostol	The main sour cherry cultivars and candidates in Hungary
Iezzoni	Sour cherry breeding at Michigan State University
Szabo	Fertility of sour cherry varieties selected in Hungary

Molecular genetics and biotechnology

Zhou	Sweet cherry genetic analysis and DNA fingerprinting using AFLPs
Rafizadeh	Explant formation from shoot-tip cultures of sweet cherry
Schuster	Meiotic investigations in a *Prunus avium* x *P. canescens* hybrid
Piagnani	A somaclonal variant in `Hedelfinger' sweet cherry
Kacar	Molecular characterization of some sweet (*Prunus avium* L.) and sour (*Prunus cerasus* L.) cherry cultivars using RAPD markers

Dinner 6:30-7:30 pm Hood River Inn, Hood River

Concomitant Sessions A & B
Tuesday evening 8:00-10:00 pm

1. Ad hoc working group meetings (*e.g.*, rootstocks, orchard systems, marketing & economics); moderators to be announced

2. Breeding and Genetics - International S-allele Workshop

Iezzoni, moderator	Overview, charge of workshop
Tobutt	S-alleles, molecular markers, nomenclature
Wiersma	S-alleles, molecular markers
Tao	S-alleles, molecular markers
Schmidt	S-alleles, pollination groups
Andersen	S-allele repository, pollination groups
	Workshop Discussion and Resolutions

WEDNESDAY **27 JUNE 2001**

Check out of Hood River Inn

All-day Interstate Transit Tour:
- Cherry variety trials, The Dalles
- Rootstock/training system trial, Hazeldell Farms, The Dalles
- Lunch, Celilo Falls, Oregon

- USDA-ARS Entomology Research Center, Parker, Washington
- Rainier harvest and packing for premium markets, Grandview, Washington

Arrive and check in, Shilo and Hampton Inns, Richland, Washington

Set-up for Poster Sessions III and IV

Dinner on your own or optional Richland Café Evening (6:15-9:15 pm)

THURSDAY 28 JUNE 2001

Production Physiology - Orchard systems

Thursday morning 8:00-10:15 am Moderator: Lauri

8:00	Santos	Rootstock and budding height affect sweet cherry orchard growth
8:15	Sansavini	Dwarfing rootstocks compared in a high-density, V-trained 'Van' sweet cherry trial
8:30	Simard	Six vase-training systems: description and effect on fruit ripening and fruit quality
8:45	Lemus	Comparison among Solaxe and Spanish bush training systems for 'Rainier' and 'Van' sweet cherries in the Chilean central zone growing area
9:00	Balkhoven	Evaluation of 'Lapins' sweet cherry high density plantings, rootstocks and plastic roofs
9:15	Lauri	Training sweet cherries to improve fruit size and quality - An overview of some recent concepts and practical aspects developed at INRA France
9:30	Lauri	Extinction training of sweet cherries in France - Assessment after six years of experiments at INRA
9:45	Lang	Pruning theory to promote sweet cherry fruit quality involves fruiting habit, shoot competition, and leaf populations
10:00		Orchard Systems Discussion

Coffee Break 10:15-10:45 am

Production Physiology - Nutrition, photosynthesis, & water relations

Thursday morning 10:45-12:00 am Moderator: Nielsen

10:45	Nielsen	Nutrient and water management for high density sweet cherry
11:00	Whiting	Fruit-to-leaf area ratio affects fruit quality and whole-canopy source-sink relationships in sweet cherry
11:15	Flore	Are soft sour cherries related to crop load?

11:30	Dencker	Effects of rootstock, wintering temperature, and potassium fertilization on yield components of young sour cherries
11:45	Guak	Effects of urea and plant bioregulators (ethephon and Promalin®) on reserve N, cold hardiness, and cropping of sweet cherry trees
12:00		Orchard Physiology Discussion

Lunch 12:15-1:30 pm Shilo Inn, Richland
Set-up of posters for Poster Sessions III and IV

Production Physiology - Growth & development
Thursday afternoon 1:30-3:30 pm Moderator: Elfving

1:30	Elfving	Prohexadione-calcium and ethephon reduce shoot growth and increase flowering in young, vigorous sweet cherry trees
1:45	Guak	Controlling growth of sweet cherries with Prohexadione-Ca and its effects on cropping and fruit quality
2:00	Ju	Early blossom thinning of sweet cherry trees with vegetable oil emulsion
2:15	Popovski	Microsporogenesis of sour cherries in the region of Skopje
2:30	Beppu	Increased endogenous gibberellin level induces early embryo sac degeneration of 'Satohnishiki' sweet cherry in warm region
2:45	Kataoka	Involvement of UV rays in fruit coloration of several sweet cherry cultivars during maturation
3:00	Usenik	Seasonal changes in polyphenols of `Lapins' sweet cherry grafted on different rootstocks
3:15		Growth and Development Discussion

Orchard/Technology/Variety Research Tour
Thursday afternoon 3:30-6:30 pm Tour Leaders: Lang and Whiting

Rainier Orchard Packing (Grandview)
WSU Irrigated Agricultural Research & Extension Center (Prosser)

Dinner 6:30-7:30 pm Shilo Inn, Richland

Concomitant Sessions C & D
Thursday evening 8:00-9:30 pm Washington wine and cheese reception

C. Ad hoc working group meetings (*e.g.*, breeding and genetics, pathology, entomology, postharvest); moderators to be announced

D. Poster session III: Production physiology

Orchard systems

Dencker	Yield efficiency of sour cherry on 10 sites in Denmark and Sweden

Pahnwar	Sweet cherry cultural practices in Pakistan
Sitarek	Performance of sweet cherry trees on Gisela® 5 rootstock
Andersen	Natural growth habit of sweet cherry maiden trees
Rozpara	Effect of P-HL A® rootstock on the growth, productivity and fruit quality of six sweet cherry cultivars
Balmer	Optimization of planting densities of sweet cherries on Tabel®Edabriz (*P. cerasus*) rootstock
Mujica	Sweet cherry growing in Chile: rootstocks and training systems - an overview

Growth and development

Hrotko	Effect of BA (6-Benzyladenine) and GA 4+7 in repeated treatments on feathering of sweet cherry cultivars in nursery
Manriquez	Prohexadione-Ca, a gibberellin biosynthesis inhibitor, can effectively reduce vegetative growth in `Bing' sweet cherry trees
Moreira	The effect of hydrogen cyanamide on sweet cherry maturation
Beppu	Environmental factors and prevention of the occurrence of double pistils in sweet cherry
Hogetveit	Cause of damage to 'Van' sweet cherry flower buds on the southern coast of Norway
Choi	Sweet cherry genotype affects biochemical and structural features of fruit cell walls
Usenik	The influence of different rootstocks on leaf mineral composition and fruit quality of `Lapins' sweet cherry
Loescher	Defining sink activities in developing cherry fruit, the importance of acid invertase gene expression and enzyme activities in comparison to those of other enzymes potentially related to sink activity and sugar accumulation in sour cherry (*Prunus cerasus*)
Szabo	Self sterile and self fertile sour cherries equally need insect (bee) pollination

Rain-cracking

Ju	Vegetable oil emulsion treatment reduces rain-induced cracking of sweet cherries
Slingerland	Tree covers provide superior protection against rain-induced sweet cherry fruit cracking in comparison with intermittent calcium chloride misting during rain
Weaver	Calcium chloride reduces rain-cracking of sweet cherries

FRIDAY 29 JUNE 2001

Protected Culture and Rain-Cracking Workshop

Friday morning 8:00-10:00 am Moderator: Flore

8:00	Godini	Susceptibility to cracking of thirty sweet cherry cultivars

8:15	Schmidt	On the cracking of sweet cherries
8:30	Yamaguchi	Relationship of cell sizes of fruit skin and flesh firmness with degree of fruit cracking among sweet cherry (*Prunus avium* L.) cultivars
8:45	Wermund	Cracking susceptibility of sweet cherries in the UK in relation to calcium application and cover systems
9:00	Sekse	Fruit cracking in sweet cherries (*Prunus avium* L.) - an integrated approach

Poster Summaries:

9:15	Ju	Vegetable oil emulsion treatment reduces rain-induced cracking of sweet cherries
9:20	Slingerland	Tree covers provide superior protection against rain-induced sweet cherry fruit cracking in comparison with intermittent calcium chloride misting during rain
9:25	Weaver	Calcium chloride reduces rain-cracking of sweet cherries
9:30		Workshop Discussion and Resolutions

Coffee Break 10:00-10:30 am

Postharvest physiology and technology

Friday morning 10:30-12:00 pm Moderator: Kupferman

10:30	Kupferman	Temperature management and modified atmosphere packaging: Keys to the preservation of sweet cherry quality
10:45	Kappel	Resistance of advanced sweet cherry selections and cultivars from the PARC-Summerland breeding program to fruit surface pitting
11:00	Spotts	Control of brown rot of sweet cherry fruit with a preharvest fungicide, a postharvest yeast, and modified atmosphere packaging
11:15	Ozanich	Automating quality assurance - nondestructive measurement of cherry fruit quality parameters
11:30		Postharvest Discussion

Lunch 11:45-1:00 pm Shilo Inn, Richland

Pathology and Entomology

Friday afternoon 1:15-3:15 pm Moderator: Grove

1:15	Grove	Epidemiology of powdery mildew of sweet cherry
1:30	Eastwell	Cherry virus disease management
1:45	Apostol	Breeding for sweet and sour cherry disease resistance in Hungary
2:00	Grove	Influence of temperature and wetness duration on infection of cherry and peach by *Wilsonomyces carpophilus*
2:15	Smith	*Rhagoletis indifferens* Curran (western cherry fruit fly) and its management in the Pacific Northwest United States

2:30	Yee	Effects of supplemental food sources on western cherry fruit fly survival and fecundity
2:45	Yee	Trapping western cherry fruit fly with ammonia
3:00		Pathology and Entomology Discussion

Coffee Break 3:15-3:45 pm

Working group reports and business meeting

Friday afternoon 3:45-4:30 pm Moderators: Sekse and Sansavini

- Working group reports
- Other ISHS Cherry working group business
- Vote on site and hosts for 5th Symposium (2005)
- Other related business

Poster Session IV: Postharvest Technology, Pathology, and Entomology

Friday afternoon 4:30-5:30 pm

Postharvest technology and fruit quality

Borve	Non-abscised aborted fruits as a source of inoculum for fungal pathogens causing fruit decay in sweet cherry
Luchsinger	Controlled atmosphere storage of 'Bing' sweet cherries
Yanez	Export potential for Chilean fresh sweet cherries
Kohler	Skin color is a parameter to determine the maturity of sour cherries
Luchsinger	'Ambrunés' sweet cherry quality factors change during ripening
Loescher	Expression of expansins is coordinated with that of other cell wall modifying enzymes during fruit softening in the nonclimacteric sour cherry

Pathology, entomology, and breeding for resistance

Budan	Field evaluation of cultivar susceptibility to leaf spot (*Blumeriella jaapii* [Rehm] Arx.) at the Romanian sour cherry genebank
Budan	Screening of 100 sour cherry genotypes for *Monilia laxa* (Aderh&Ruhl) field resistance
Budan	Breeding sour cherry for resistance to leaf spot (*Blumeriella jaapii* [Rehm.] Arx.): promising new selections
Hassani	Trunk canker in sweet and tart cherry cultivars
Cowgill	A review of cherry fruit fly from the eastern USA perspective

Banquet and Closing Program

Friday evening6:30-9:30 pm WSU Tri-Cities Campus

Oral Presentations

New promising sweet cherry selections in Hungary

Janos Apostol
Research Institute for Fruitgrowing and Ornamentals, H-1223 Budapest, Park u. 2, Hungary

6/240 Æ 22 mm, self-fertile, ripens 3 weeks before `Burlat'
5/62 (`Rita') Æ 23-24 mm, ripens 2 weeks before `Burlat'
6/5 (`Péter') Æ 25-26 mm, self-fertile, ripens 1 week after `Burlat'
6/12 (`Sándor') Æ 24-25 mm, self-fertile, ripens 1-4 days after `Burlat'
6/39 (`Pál') Æ 26-27 self-fertile, ripens 10 days after `Burlat'
42/114 (`Carmen') Æ 26-28 mm, ripens 1 week after `Burlat'
13/20 (`Aida') Æ 27-29 mm, ripens 14 days after `Burlat'
`Krupnoplodnaja' Æ 25-27 mm, ripens 3 weeks after `Burlat'

Dwarf sour cherry breeding at the University of Saskatchewan

Robert H. Bors
University of Saskatchewan, Department of Plant Sciences, Saskatoon, SK, S7N 5A8, Canada

Sour cherry breeding on the Canadian Prairie started in the 1940's when Dr. Les Kerr began hybridizing *Prunus fruticosa* x *P. cerasus*. In 1966, the University of Saskatchewan inherited Dr. Kerr's advanced selections and began a sour cherry breeding program. In recent years, dwarf sour cherries with commercial potential have been selected. Crossing the Kerr selections with *P. cerasus* cultivars has resulted in hybrids possessing cold hardiness, dwarf stature and good fruit quality. Bred at a zone 2B site, selections have been successfully tested in Zones 2 and 3. Soluble solids of advanced selections started from 14 to 17 degrees Brix in late July and increased steadily from 16 to 22 degrees Brix in late August. Many seedlings have 4.0 g fruits but only two selections average 6.0 g fruits. Height of seven and eight year seedlings ranged from 1.0 to 3.1 m and averaged 2.4 m. Pull force tests indicated fruit could be mechanically harvested as early as late July and ease of detachment remained constant to the end of August. Number of suckers ranged from 0 to 24 with an average of seven per tree. Most fruits in the population are a dark red or black when fully ripe but a few are bright red. Diseases are extremely rare in all test sites in Saskatchewan. It is not known if this is due to resistance or avoidance. A very early ripening selection, `SK Carmine Jewel', was released in 1999. A large fruited, mid season selection is planned for release in 2002 or 2003.

Evaluation of new sour cherry clones originated from North-Eastern Hungary

T. Szabó and F. Inántsy
Research and Extension Centre for Fruit Growing, 4244 Újfehértó, Hungary

The sour cherry selection program in North-Eastern (NE) Hungary was initiated more then 30 years ago to provide new `Pándy'-type (Kõrösi) clones for fresh fruit export and for the processing industry. The scientists of the Research Station found an almost intact sour cherry population rich in types in this region.

The objectives of the program were to obtain new sour cherry clones possessing properties like self fertility, high productivity, good fruit quality (size, firmness, color), suitability for mechanical harvesting, having strong structural branches and a dry abscission layer. In the earlier period, three clones were evaluated and introduced: `Újfehértói fürtös', `Debreceni bõtermõ', and `Kántorjánosi 3'.

Now we can present the data on selected clones which were collected from the Kisvárda subregion (located in NE Hungary as well). The most promising ones are more productive than those obtained earlier. The most important features are similar to the previous three: winter hardiness, flower freezing tolerance, and canopy structure suitable for mechanical harvesting. The fruits exhibit the following characteristics: firm round shape, small round freestone pit, dry stem scar, high soluble solids, balanced sugar-acid ratio, good colored juice and skin, and mean fruit size 5-6 grams (22-23 mm).

Clonal selection of Kütahya sour cherry (*Prunus cerasus* L.)

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Turkey, as for many other temperate fruit species, is the centre of origin of sour cherry as well. Kütahya variety is very well known local variety, with very high fruit quality and attractiveness. Thus, Kütahya cultivar has been grown for centuries in nearly all around the country. In the earlier studies many types have been evaluated and 22 types out of them have been selected as a part of National Selection Program and forwarded for adaptational trials.

This study was carried between 1992-1999 to determine the phenological, pomological and technological characteristics and select the best type of Kütahya sour cherry (*Prunus cerasus* L.) cultivar among 22 types which have been selected in the second step of the National Selection program.

The experiment was established by planting 7 trees grafted on *P. avium* for each type in 1992. Phenological, pomological and technological characteristics of the types have been evaluated, 12 characteristics were examined and 8 parameters were taken into account as the selection criteria. These were; yield, flesh/stone ratio, juice *ratio,* juice colour, taste, soluble solids/acid ratio, fruit size and attractiveness. The data were evaluated according to the "Modified Weighted-Rankit" methods and the types with

1353, 1408 and 1350 numbers were selected and suggested as promising types of Kütahya sour cherry.

In vitro shoot tip grafting of `Black Mashad' sweet cherry

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Among many indigenous and exotic sweet cherry (*Prunus avium*) cultivars in Iran, `Black Mashad' is a native of Iran and the most important, due to unique features such as: the largest volume (8 cm^3), size (8 g) and the most firmness and sweetness. The skin is black and the flesh is red, firm, and juicy. The flavor is very good and a little acidic. The study of union grafting and also mass propagation of disease-free plants of this cultivar by the new technique of shoot tip grafting (STG) on *P. cerasus* `Talkheh Albaloo', as a rootstock, was investigated. The results showed that after aseptic preparation and planting of `Telkhah Albaloo' in the gelled medium *in vitro*, compatibility with the scion was good. At first, the seedling was cut at about 25mm height at 50-55 days *in vitro*. The scions were obtained by tissue-culturing the shoot tip of `Black Mashad' *in vitro*. Grafting was done aseptically by inserting a small piece (5mm) of the scion. The union process was completed after 10-12 days. The percentage of successful STG explants was 65-70%. The rate of scion growth was very slow in the first week, but it increased after the second week.

Adventitious leaf regeneration in *Prunus*

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Shoot regeneration is a difficult problem for cherry species. We have developed a two-stage process that results in high rates of regeneration in some genotypes. Initially, leaves of several clones previously established in tissue culture were tested for leaf regeneration. The interspecific *Prunus* hybrids, Gi 154-4 and Gi 154-7, two of 15 clones tested, regenerated a small number of shoots when placed on Murashige-Skoog (MS) medium and a combination of TDZ (5-10 µM) and NAA or IBA (0.5-2.5 µM). Using these two clones, we developed a two-stage process to initiate and then promote elongation of adventitious shoots. In the first stage, increasing the agar concentration from 8 to 12 g/L, increasing $CuSO_4$ from 0.1µM to 1.1µM, and a combination of 10 µM TDZ and 1.25 µM NAA markedly improved shoot initiation. After 20 days, the cultures were transferred to a medium containing 5 µM BAP and 0.5 µM NAA. This second stage retarded callus growth and allowed adventitious meristems to elongate and form visible shoots. Applying this procedure to seven of the original 15 clones and one additional new clone resulted in seven of the eight clones regenerating adventitious shoots. Changing the basal medium from MS to Driver-Kuniyuki Walnut (DKW) medium further increased the number of regenerating sites/leaf and meristems/leaf.

An *in vitro* leaf bioassay to evaluate resistance of sweet cherry genotypes to *Pseudomonas syringae* pv. syringae

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Sweet cherry genotypes were rated for resistance to bacterial canker, caused by the organism *Pseudomonas syringae* pv. syringae, using an *in vitro* excised leaf bioassay. Resistance to a combination of four pathogenic bacterial strains was determined by depositing 2µl of bacterial suspension on a wounded leaf midrib. Treatments included excised leaves inoculated with water, a nonpathogenic strain (JL2000), and a mix of four pathogenic strains (SD443, SD447, W4N54, and W4N108) of bacteria at 106 cfu/ml and 108 cfu/ml. Following inoculation, the leaves were incubated in a growth chamber (16 h light at 25C; 8 h dark at 20C) for 7 days. After the incubation period, resistance was recorded on a scale from 0 to 4 with a score of 4 indicating high susceptibility. Genotypes from the MxM series showed the greatest resistance (0-1), while the most susceptible genotypes included 'Corum', 'Royal Ann', and 'Rainier'. These results correlated well with those obtained from excised twig inoculations.

Genetic analysis and DNA fingerprinting of sweet cherry cultivars and selections using amplified fragment length polymorphisms (AFLP)

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Amplified fragment length polymorphisms (AFLP) were used to analyze genetic variation of, and relationships between, sweet cherry cultivars and selections from the breeding program at the Pacific Agri-Food Research Centre in Summerland. Fluorescently labeled fragments were separated and detected using an automated genetic analyzer. After pre-screening with 30 primer combinations, 6 pairs of primers were used for amplification of a total of 67 cultivars and selections. A total of 625 scorable fragments was obtained from these cultivars and selections , of which 118 were polymorphic. An average of 20 markers per primer pair was revealed. Scoring the absence and presence of the 118 markers produced a unique binary code for each cultivar or selection. Genetic similarity was determined using simple match coefficients which counts both positive matches and negative matches within 118 polymorphic fragments over both cultivars. Simple match coefficients ranged from 0.47 to 0.89 among all tested cultivars and selections. When all common fragments were included, the 67 cultivars and selections shared 90% of the DNA fingerprints. AFLP analysis is a good DNA fingerprinting technique to evaluate genetic distance and relationships in small plant genomes such as sweet cherry.

Determination of molecular genetic structure of some sweet (*Prunus avium* L.) and sour cherry (*Prunus cerasus* L.) varieties using microsatellite techniques

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Molecular markers can detect differences among varieties directly at the DNA level. Analysis can thus be shifted from phenotype to genotype, using isoenzymes, RFLPs, RAPDs and/or microsatellites (syn. simple sequence repeats, SSRs) as markers for cultivar identification.

In this research, microsatellite analysis was performed on sweet and sour cherry varieties and open pollinated sour cherry plants. Ten sweet and ten sour cherry varieties, plus fourteen open pollinated plants, were tested with eleven microsatellite primers isolated from peach (*P. persica* L. Batsch (Peach Group)], sweet (*P.avium* L.) and sour (*P.cerasus* L.) cherries. Genetic similarity values (Nei and Li, 1979) were calculated, and UPGMA (unweighted pair-group method analysis) cluster analysis was performed to generate dendograms.

Scorable microsatellite bands were produced with all primer-variety combinations. The cherry varieties showed high levels of polymorphism with 4 to 17 different alleles amplified per primer pair. Primer pceGA34 isolated from sour cherry showed a high level of polymorphism. However, microsatellite analysis was not able to distinguish some variety/types.

Cherry genomics: current status and potential future impact on cherry research and production

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Why are the fruit from some cherry cultivars larger than those of others? Why is the incidence of rain-induced fruit cracking low for some cultivars and high for others? Why do some cherry rootstocks cause scion dwarfing and others result in no size control? Why do only some cherry cultivars succeed in locations with extremely cold winters and others in locations with mild winters? Can genomics research, integrated with physiological and biochemical analyses, create new opportunities for answering these questions?

Theoretically, the technologies for globally and quantitatively measuring mRNA and protein expression are feasible. Given these advances, what is the status of their application to genomics/proteomics in cherry, and how might the cherry research community work together to collectively answer such questions of critical importance to profitable cherry production? Are some production problems more suited to a genomics approach than others? This paper will compare the status of cherry genetics relative to

Prunus genetics, thereby providing a foundation for discussion of cherry genomics and what the future may hold.

Growth and productivity of 'Danube' (Érdi Bõtermõ) sour cherry trees on Mahaleb inbred lines

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Growth reducing rootstocks are essential for planting of intensive sweet and sour cherry orchards. In the context of a cherry rootstock breeding project at the Department of Fruit Science, 'Danube' (Érdi bõtermõ) sour cherry trees were planted in 1989 on inbred lines of Korponay mahaleb rootstock. The objective was to select growth reducing mahaleb seedling rootstocks that would provide good yield efficiency and growth homogeneity.

In the orchard, a considerable ratio of second generation inbred lines reduced tree size; only one population promoted greater vigor in comparison to Korponay seedling, which represents the first selfed generation. We concluded that the large majority of the second selfed generation (inbred line seedlings) can be used as growth reducing rootstocks for `Danube'. The evaluation of productivity on these inbred line seedlings revealed a wide range of cumulative yield efficiencies. Based on these results, the yield capacity was not necessarily related to the low vigor and the precocious yields caused by the rootstocks. 'Danube' sour cherry trees on a number of the low vigor seedling populations showed low yield efficiency and low survival rate in comparison to Korponay mahaleb seedlings. However, six populations were found to have similar or higher yield efficiencies compared to Korponay. Considering the yield efficiency of individual trees, tree size, and survival, only five inbred lines showed similar or higher productivity per unit area compared to Korponay. Careful selection of those seed trees can make it feasible to find mahaleb seedling rootstocks with medium vigor and high yield efficiency.

Based on homogeneity tests using orchard data from sour cherry trees budded on various seedling populations, it can be stated that trees budded on second generation inbred lines are, in general, more uniform compared to those budded on Korponay seedling (first selfed generation). The improvement in homogeneity of rootstock seedling populations provides advantages both in the nursery and the orchard.

Growth, flowering and fruiting potentials of new dwarfing rootstocks selected into the progenity of Damil® (GM 61/1)

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Based on differences in precocity and intensity of flowering exhibited within the three previously-selected Belgian rootstocks (Inmil®, Damil® and Camil®), a new selection program began in 1985 within seedlings obtained from Damil® open pollination to improve precocity of flowering and to maintain tree vigor such as obtained from Damil®. More than 120 seedlings have been propagated vegetatively and grafted with `Burlat' and `Lapins' sweet cherry, characterized respectively by their low and high flower inductive capacity. These have been planted progressively at three different locations, with growth, flowering, and fruiting traits observed annually.

Twenty-eight potential candidate rootstocks have been identified with a higher flower cluster intensity than that observed on Damil®, occasionally in the early third year but certainly in the fourth year after planting.

Frutana® – a new interstock for sweet cherry trees

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Frutana® is a type of *Prunus fruticosa* Pall. found in eastern-south part of Poland. This is probably a natural hybrid of *P. fruticosa* Pall. x *P. cerasus* L. The Frutana® tree grows weakly, although stronger than others types of *P. fruticosa* Pall., and is characterized by winter hardiness and good health. For these reasons, Frutana (earlier known as *P. fruticosa* No. 8) was used in research as an interstock for sweet cherry trees. The selection and research have been carried out since 1972, at the Research Institute of Pomology and Floriculture in Skierniewice. This interstock causes weak growth of sweet cherry trees, from 40 to 60% depending on the scion cultivar, and increased productivity (yield). It is very suitable for use as an interstock for intensive orchards. Frutana® was patented in Poland in 2000.

Performance of new and old cherry rootstocks in different soils and climatic conditions

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Within the framework of a National program supported by the Italian Ministry for Agricultural and Forestry Policy, during winters 1992-93 and 1996-97, three different experimental fields were planted in the North (Forlì), Centre (Rome) and South (Catanzaro) of Italy .The cultivars `Stella' and `Lapins' were grafted onto the following rootstocks: F12/1M (induced mutation of F12/1), Franc n°3 (selections of *P. avium*), CAB 6P, CAB 11E, Edabriz, Weiroot 158, Vladimir (selections of *P. cerasus*), SL 64, Magyar (a selection of *P. mahaleb*), MaxMa 14 and MaxMa 97 (*P. mahaleb* x *P. avium*), Victor (unknown genetic origin), Colt (*P. avium* x *P. pseudocerasus*), GM 9 (*P. incisa* x *P. serrula*), GM 61/1 (*P. dawyckensis*), GM 79 (*P. canescens*), Gisela 5 (*P. cerasus* Schattenmorelle x *P. canescens*), Gisela 10 (*P. fruticosa* x *P. avium*), and Argot (*P. mahaleb* x *P. avium*).

Comparison of vegetative parameters showed that the most vigorous rootstocks were those originated from *P. mahaleb* and *P. cerasus*, species, followed by Colt. Victor and MaxMa14 were less vigorous than these and showed the highest production and efficiency. The weakest rootstocks were GM 9, GM 61/1, and Gisela 5, which induced poor tree growth and high mortality.

Gisela 10, GM 79, and Edabriz induced low vigor and a good crop efficiency, but seemed to be negatively affected by physiological stress induced by the hot climatic conditions of southern Italy, as demonstrated by the collapse of many trees. *P.avium* selections showed an intermediate growth and yield, generally less than Colt. A high number of suckers was observed with Vladimir, CAB 6P and CAB 11E, while a fewer suckers were seen with Victor and MaxMa 14.

Average fruit weight was variable and influenced both by rootstock and orchard location. The best quality was obtained with *P. mahaleb* selections in the South and with *P. cerasus* and *P. mahaleb* in the North.

Gisela 5, Gisela 10, Edabriz and GM 61/1 reduced fruit size significantly. The trial located in Rome was planted recently and it is too early to report any definitive conclusions. Preliminary data show a slightly higher vigor of MaxMa 97 and Argot compared to Colt, and clearly higher production and efficiency of MaxMa 14 and Weiroot 158 compared to all the other rootstocks.

Experiences with dwarfing sweet cherry rootstocks in Northern Germany

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Further investigation of a national German sweet cherry rootstock trial, planted in 1989 with 22 different rootstocks, has confirmed previously-reported preliminary results. With `Regina', the best cropping per tree was obtained with Weiroot 158, Giessen (Gi) 209/1 (bred at Giessen, selected at Ahrensburg), and Gisela 5, the latter of which has been recommended since 1998 to growers for commercial production in Northern Germany. Yield per tree volume was best with Gi 209/1 and Gisela 10, and also good with Gisela 5 and Gisela 4. Gi 209/1 is still very interesting for high density systems under rain cover protection and needs more future investigation and more rootstock production.

In a younger trial with 'Regina' begun in 1995, Gisela 5 has thus far given the best cumulative cropping results, compared to Weiroot 13, Weiroot 53, Weiroot 154, Weiroot 158, Mazzard and Colt. Comparing 4 cultivars ('Viola', 'Oktavia', 'Regina' and 'Kordia') on Colt and Gisela 5 since 1996, all cultivars on Gisela 5 produced smaller trees but better yields per tree than Colt. With some cultivars in this plot, additional results have been documented with Gisela 6, Weiroot 53, Weiroot 158, Gi 318/17, PiKu 4.20 and PiKu 4.83 from Dresden-Pillnitz.

Finally, first impressions on vegetative growth will be given for the Czech rootstocks P-HL-A and P-HL-B, as well as with the PiKu series compared to other well known standards like Mazzard, Colt and Gisela 5, which were planted in 1998.

The effect of three rootstocks on the yield and fruiting of sweet cherry (*Prunus avium* L.)

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Three cherry rootstocks were evaluated at Lenswood, South Australia, for their effect on yield and quality of the sweet cherry (*Prunus avium* L.) varieties `Venus', `Stella' and `Sam'. The trials were planted in 1980 and this paper reports on observations made from 1990 through 1996. Previous results from the trial site during 1985-1989 had shown no significant differences in yield, fruit weight, proportion of rain-cracked fruit or fruit diameter. Contrary to this, results from the period 1990-1996 showed many differences. Over this 7 year period, Mahaleb (*P. mahaleb*) and Stockton Morello *(P. cerasus*) rootstocks yielded more fruit than Mazzard (*P. avium*). Average yields were 22.8, 22.7 and 19.2 kg/tree, respectively. In 1990, Mahaleb was the highest yielding rootstock and in 1992 it was Stockton Morello. In 1993, 1994 and 1996 all rootstocks supported similar yields. In 1991, Mazzard produced more fruit than Stockton Morello and in 1995 the reverse occurred; in both years, the yield of Mahaleb was not significantly different from the yield of either Mazzard or Stockton Morello. The lowest

average yield for all rootstocks occurred in 1993, which was attributed to below average minimum temperatures during flowering.

On average, across all 7 years varieties grafted to Mazzard suffered more rain-cracking damage (21.3%) than those grafted on Mahaleb and Stockton Morello, 18% and 17.9% respectively. Lowest rain-cracking damage was recorded in 1991, although 1996 had similar levels of rain damage, and the highest was in 1992. These years correspond with the lowest and highest rainfall recordings for December, the main harvest period. Rainfall was 12.4 mm in December 1991 and 164 mm in 1992, the latter approximately three times the average rainfall for that month. In 1991, Stockton Morello had the most rain-cracking while in 1996 Mahaleb exhibited more rain damage than Stockton Morello. In 1990, 1994 and 1995, similar levels of rain damage occurred for all three rootstocks. Stockton Morello produced fruit with the lowest weights in 1995 (6.5 g) and 1996 (8.1 g); there were no differences between rootstocks in fruit weight in the other years. The proportion of fruit with a diameter greater than 25 mm was lowest for Stockton Morello in 4 of the 7 years. The proportions of fruit with diameters greater than 25 mm on Mazzard and Mahaleb were similar to each other in 5 out of 7 years.

Results of a sweet cherry rootstock trial in northern Poland

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'Rivan', `Burlat', `Merton Premier', 'Büttner's Red' and 'Hedelfinger' sweet cherry trees grafted on P-HL A (syn. P-HL 84), P-HL C (syn. P-HL 6), MaxMa Delbard ® 14 Brokforest, and F 12/1 clonal rootstocks as well as on Mazzard seedlings were investigated for growth, yield, fruit weight, tree decline and suckering. The field experiment was carried out at the Experimental Station in Miłobądz from 1992 to 2000. The trees on F 12/1 were regarded as a control. Trees in the orchard were not irrigated.

The growth of nine-year-old trees was reduced significantly by both P-HL rootstock types, more by C than A. The dwarfing effect of MaxMa Delbard® 14 Brokforest was similar to P-HL C. No significant differences were found in vigor between trees grafted on Mazzard seedlings and F 12/1.

Cumulative yields and the productivity index for trees on P-HL rootstocks and MaxMa Delbard® 14 Brokforest were higher than for those on F 12/1. Those rootstocks that reduced tree growth also exhibited reductions in fruit size. However, the trees on MaxMa Delbard® 14 Brokforest had a higher tendency to decrease the mean fruit weight than those on P-HL A and P-HL C rootstocks.

During first year after planting, all 'Hedelfinger' trees on P-HL A declined from an apparent physiological incompatibility between rootstock and scion. Suckering was not a problem in this trial.

Preliminary results of a German sweet cherry rootstock trial

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Identification of rootstocks suitable for dwarf sweet cherry tree cultivation is the goal of this national trial. Some new rootstock selections were grafted with two standard cultivars (`Hedelfinger´ and `Regina´) and tested at several sites. The results at the single locations are compiled for a common evaluation. The trial was planned by the national working group for evaluation of fruit growing. Data collection and trial leadership is made by SLVA Oppenheim.

After common propagation, the trees were planted at 9 locations (Bavendorf, Dresden, Müncheberg, Oppenheim, Veitshöchheim, Witzenhausen, and partly at Weinsberg, Jork, and Wilhelminadorp/NL). The trial began in 1996 and the probable end will be 2004. The trial design consists of 6 trees per treatment in 2 replications with a plant spacing of 4.5 m x 2.5 m. The treatments are divided in 2 groups: rootstocks with additional irrigation (`Gisela 4´, `Gisela 195/20´, `Gisela 497/8´, `Damil´, `Pi-Ku 4.20´, `Weiroot 154´, `Weiroot 158´, `Gisela 5´) and rootstocks without irrigation (`Ahrensburg 318/17´, `Tabel Edabriz´, `Piku 8.1´, `Piku 4.83´). Through 2000, only 4 treatments exhibited mortality at 3 of the 7 locations: `Hedelfinger´/`Weiroot 158´ (17%), `Regina/`Weiroot 158´ (14%), `Hedelfinger´/`Tabel Edabriz´ (10%), and `Hedelfinger´/`Piku 8.1´ (2%).

Comparing all locations, the reproductive and vegetative performance of the rootstocks shows heterogeneity. For some rootstocks, the influence of location on variability is greater than the variation between rootstocks. Other rootstocks are more homogeneous across locations. The largest trunk cross section areas are found with the rootstocks `Piku 4.20´, `Gisela 318/17´, `Piku 4.83´, and sometimes with `Gisela 4´ and `Gisela 195/20´. The smallest are with `Damil´, `Tabel Edabriz´ and `Weiroot 158´. With respect to productivity, represented as specific yield, the highest levels are with `Gisela 195/20´, `Gisela 5´, `Gisela 4´ and sometimes with `Tabel Edabriz´, `Weiroot 154´, and `Piku 4.20´.

Tabel®Edabriz : a dwarf rootstock for intensive sweet cherry orchards

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Tabel®Edabriz was selected by INRA and Ctifl during the late 1980s. It was one of the first dwarf rootstocks for sweet cherry orchards. The oldest orchards are now 11 years old. This paper gives data concerning comparative trials conducted on Tabel®Edabriz and other rootstocks as well as a first overview of the orchards planted with Tabel®Edabriz.

Tabel®Edabriz reduces the size of the trees : it is 50 to 70 % less vigorous than Mazzard. This improves picking speed.

Tabel®Edabriz requires fertile soils. It is susceptible to chlorosis, especially when the pH is higher than 8. During the first 5 years, aphid populations should be closely

monitored, because in case of attacks the trees may die. The varieties grafted on this rootstock must be virus free. The trees start bearing at an early age and the productivity is very good.

NRSP5 and the international exchange of cherry clones

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The National Research Support Project #5 (NRSP5) is a conduit for the international exchange of deciduous fruit tree selections. The program is located at Washington State University's Irrigated Agriculture Research and Extension Center in Prosser, Washington, USA. It was established in 1955 and originally was named IR-2 (Interregional Project #2). Historically, this virus detection and therapy program has been considered the premier source of clean propagation material for state-run certification programs in the United States and also for distribution of American cultivars internationally. In 1988, the United States Department of Agriculture's Animal and Plant Health Inspection Service granted NRSP5 permission to act as a plant introduction and quarantine site for stone and pome fruit selections. The importation permit, in combination with NRSP5 function in producing virus-tested trees, completed a loop that now allows the Program to play a major role in the international distribution of all new stone and pome cultivars.

Recognized worldwide as a reliable source of pathogen-free propagation material, NRSP5 became a site where breeders and nurserymen from any country can send their selections for virus testing and subsequent distribution to cooperators around the world. Thus, NRSP5 is now a center of activity for the international exchange of new and promising cherry selections. This role is possible because of the multi-functional nature of NRSP5 to perform and improve scientific virus testing and therapy for safe importation, maintenance, and export of fruit tree selections.

Survey of the Chilean sweet cherry industry

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Chile has 5,313 hectares (1999) which produces 30,000 tons of sweet cherries, mainly for fresh fruit production; 80% of this is exported. The traditional area of cherry production ranges from Curicó to Santiago (150 km). A new area is beginning to be developed in the 1,300 km south of Santiago. The traditional area, in general, presents some advantages for cherry production: sufficient winter chilling, low incidence of spring frosts and winds. Climatic conditions are dry during the growing season. However, phytosanitary problems like *Pseudomonas campestris* pv. *syringae* and virus diseases

affect cherry production. Commercial varieties are mainly 'Bing', 'Van', 'Early Burlat', and 'Lambert'. New varieties are in strong development in recent years. Orchard management mainly uses furrow irrigation, but drip irrigation is being increasingly established. Orchard density is increasing in new plantations, and tree size is less than traditional to promote earlier harvests. Postharvest management utilizes transport and low temperature storage, which has been a big challenge for the Chilean cherry industry. International prices are attractive to Chilean growers since production provides fresh fruit to the Northern Hemisphere during the "counter" seasons of November and December. We are conducting studies to grow cherries in non-traditional areas to extend the harvest from October to February.

Prospects and problems of growing early season sweet cherries under plastic cover

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Covering sweet cherry trees with plastic during bloom, fruit set, and fruit development has the potential to advance fruit maturity prior to the normal picking time. The early maturing fruits have a significant economical benefit for being marketed with little or no competition.

Experiments were carried out in a sweet cherry orchard located on the central mountain ridge (950 m above sea level) in Israel. Two adjacent rows of 'Burlat' as a main crop and 'Black Tartarian' as a pollinizer were sprayed with hydrogen cyanamide to break dormancy and covered with UV-absorbing and full spectrum transmitting plastic sheets. During the period from hydrogen cyanamide treatment to 10% of buds at the balloon stage (budbreak), the temperature under the plastic cover was maintained at 26 °C by raising the side plastic sheets. During bloom, the temperature under the plastic cover was maintained at 22 °C, and during fruit growth the side plastic sheets were raised when the temperature reached 25 °C. Fruits under the plastic matured 20 days earlier than the control fruits. Eighty percent of that advanced period was attributed to the budbreak period.

The main problematic results were low fruit set and low productivity of trees under the plastic cover. This problem has been addressed by using fruiting trees grown in pots, under controlled temperature regimes. It was shown that budbreak is the period that is most susceptible to elevated temperature. The amount and viability of pollen was influenced adversely by temperature. Day and night temperatures have been manipulated to find an optimal regime that will not be harmful to tree productivity, yet will allow significant advancement of fruit maturity.

Consumer purchasing behaviour, attitudes and perceptions with respect to United Kingdom sweet cherries

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It is widely perceived by the trade (supermarkets and growers) that sweet cherries are one of the most popular summer fruits in the United Kingdom (UK), yet very little market research has been undertaken to explore how the popular appeal of cherries might be exploited by innovative marketing and in-store merchandising. To understand consumers' purchasing and consumption behavior with respect to cherries, and the extent to which these vary between shoppers in the UK, a quantitative survey was carried out in four geographical areas in July 2000. 480 consumers were interviewed from three different supermarket chains. The results provide clear evidence that opportunities exist for market development and segmentation, by store, meal occasion and demographics (age, income, household composition). Overall, the 'ideal' cherry, in the eyes of the UK consumer, should be large, dark, and sweet, with a glossy appearance, but sufficient variation exists in terms of when cherries are purchased, for whom they are purchased, the primary motivation for purchase and the way in which they are consumed, to offer genuine opportunities for a more innovative approach to the marketing and merchandising of the UK cherry crop.

The Michigan sweet cherry industry: Economic trends

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Cherries – both sweet and tart - are a major part of the Michigan fruit industry. Michigan sweet cherry production provides an important portion of the U.S. production of this crop, especially for brined cherry markets. Michigan's markets for sweet cherries are also substantially interrelated to the supplies and markets for sweet cherries in the Pacific Coast states of Washington, Oregon and California, where sweet cherry production is considerably larger than in Michigan. The cherry industries in both Michigan and the Pacific Coast states are evolving in many important ways as they are influenced by an array of dynamic economic and technological forces. Analysis of a number of key trends helps to provide insights into the industry's current situation as well as a number of important changes that have been occurring in recent years. Such trends also have implications for the industry in the future.

Bearing acres of sweet cherries in Michigan have been relatively stable during much of the 1980s and 1990s. The non-bearing acres have remained relatively low throughout the 1990s. As a result of these low levels, an increasing proportion of Michigan's existing acreage has been moving into the older age categories. Along with Michigan's stable bearing acres, sweet cherry production in the state has fluctuated around a relatively stable long-term trend during the last 20 years. This situation is in a notable contrast to the substantially increasing production trend in some other states such as in Washington.

Acreage trends in Michigan have shown some changes in the variety mix of the state's sweet cherries over time. Two light varieties, `Gold' and `Emperor Francis', are now the most widely planted sweet cherry varieties in Michigan, and both have shown somewhat upward trends in their acreage. `Napoleon', another major light variety, has shown a declining acreage trend. Within the dark varieties, `Hedelfinger', `Schmidt' and `Ulster' make up the largest acreages. The acreage of `Hedelfinger' has shown a relatively stable trend. `Schmidt', on the other hand, has had a trend of gradually declining acreage.

A number of other important trends related to the Michigan sweet cherry industry have been analyzed. These are indicative of the changing Michigan industry situation, as well as Michigan's position in relation to the larger U.S. sweet cherry industry.

Challenges in the international marketing of Northwest-grown fresh sweet cherries

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The Pacific Northwest excels in the production of high quality sweet cherries (*Prunus avium* L.) for fresh consumption. Sweet cherries are produced on more than 15,000 ha, by just over 3,000 growers, in the states of Idaho, Montana, Oregon, Utah and Washington. Oregon and Washington, where the majority of the cherry growing districts are located, also represent the bulk of the production with over 14,500 ha of sweet cherries between the two states. In the 2000 crop year, Northwest cherry growers produced an estimated 71,000 tonnes of cherries worth an estimated $230,543,098. Of that production, 34% was exported to over 32 countries throughout the world.

While this is a remarkable achievement, access for the export of sweet cherries to other countries is constrained by a number of factors. The Northwest Horticultural Council represents Northwest cherry growers with the responsibility to help identify and evaluate international trade barriers affecting sweet cherries and to suggest strategies and priorities for the elimination of these barriers. Principally, these barriers include market demand (affected by local economies, cultural factors, and transportation issues), tariff and tax-related import restrictions, non-tariff barriers (principally phytosanitary requirements), and a lack of international harmonization of pesticide maximum residue levels. Each of these can independently and collectively have a major impact on the industry's ability to sell cherries in a given market. Specific examples will be discussed, with a focus on issues currently being pursued in the trade policy arena by the Northwest Horticultural Council on behalf of the fresh sweet cherry industry. Our goal is to make Northwest sweet cherries more broadly available to discriminating consumers around the world.

Growing organic cherries in Chile

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The need to be environmentally responsible is increasingly important as concerns are expressed more frequently about the possibility of long-lasting contamination or exploitation from some highly-intensive farming methods. This need is reflected in the interest of health-conscious consumers who purchase organic food products.

Chile offers enormous comparative advantages for fruit growing due to its particular geographic location: the Atacama desert to the north, the Andes mountains to the east, icebound territories to the south, and the Pacific Ocean to the west. Among all the fruits grown in our country, cherries appear to be one of the crops with the highest potential to be grown organically. This has to do with a number of production and marketing-related factors. First, cherry trees exhibit vigorous growth habits, and second, there are low disease pressures in our environment. Furthermore, fruit attractiveness and profitability are high, due to the early "off-season" presence in destination markets. Chile is the main "off-season" cherry supplier for the northern hemisphere. Orchard area planted to cherries has risen more than 100% over the last decade, which will mean large volumes of fruit on the market in the coming years. This significant rise in yield for the four-week harvest season, which reaches its peak the second week of December, will cause prices to drop, thereby reducing the profitability for this crop. However, one of the advantages of organic food production is that some consumers are willing to pay higher prices for fruit perceived to be healthy and raised in an environmentally friendly manner. Consequently, organic fruit production seems to be a technically and economically feasible alternative for the fruit sector.

Organic fruit production is a qualitative concept, and no official statistical information is available at this moment. The only usable information comes from informal, non-governmental sources. Organic cherry production is just beginning in Chile, with the first shipments overseas not exceeding 5,000 cases. However, due to the sizable number of hectares currently undergoing a transition period, the future looks very promising for the organic cherry growing sector. Growth expectations for Chilean organic production will depend not only on the development of organic production methodologies, but also on marketing and export strategies. The main problems to be solved to optimize organic cherry production include proper nitrogen fertilization, good weed control, and first and foremost, an adequate pest and disease management plan with regard to destination market phytosanitary requirements.

Rootstock and budding height affect sweet cherry orchard growth

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Four cherry cultivars were chip-budded in August 1997 at 10, 20 and 30 cm above soil on Edabriz, Gisela 5 and MaxMa 14, and at 10, 30 and 60 cm on CAB 11E

and *Prunus avium*. The objective was to study the effects of rootstock and budding height on tree growth, both at the nursery phase and, mainly, throughout their orchard life.

After the nursery phase, a trial was set up at three distinct pedoclimatic sites located in north-central Portugal, 50 km apart: Bragança, Mirandela and Vila Real. Three commercial cultivars ('Burlat', 'Van' and 'Summit') were selected to establish a randomized complete block design with double split, containing 2 plants for the smallest plots and 2 replications, involving 90 plants per replication. The local cultivar 'Saco', also included in the experiment, was planted as a border, separating the main plots. Inter-row distance was 5 m and in-row distances were chosen according to the relative vigor of the rootstock.

At the end of the second year of growth, important differences were already noticeable with regard to trunk girth, total stem length and number of shoots per plant, as compared to the previous season, with similar effects being seen at all three experimental sites. However, the plant girth of the five rootstocks was visibly and markedly different between the three sites. Comparative girths on Edabriz, Gisela 5, (MaxMa 14 and CAB 11E) were, respectively, 58, 64 and 85% of that on *P. avium*. Tree vigor varied inversely with budding height in the case of all rootstocks. Concerning the differences between cultivars, the regional 'Saco' grew noticeably less than the others in all the rootstocks, and that was probably due to it being infected with three viruses: apple chlorotic leaf spot (ACLS), prunus necrotic ringspot (PNRS) and prune dwarf (PD).

Dwarfing rootstocks compared in a high-density, V-trained 'Van' sweet cherry trial

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A field trial was begun in 1994 to examine the response of `Van' sweet cherry to 10 clonal rootstocks at a planting density of 1670 trees/ha in a V-training system. The seven-year data set indicates that the stocks Avima, Colt, MaxMa 14 and CAB 6P induced the highest vigor thus far, with Weiroot 154 and 158 showing medium vigor (semi-dwarfing), and Weiroot 53 and the Gisela series (clones 10, 5 and 1, in that order) the lowest vigor (dwarfing). The best performing trees for yield are those budded to Weiroot 158 and 154, followed by CAB 6P and MaxMa 14; the Gisela 1 trees have exhibited the poorest yield response. High yield efficiency indices (TCSA/yield cumulated to year 7) have been recorded for Gisela 5 and 10, followed by Weiroot 158 and 53; the high-vigor clones *supra* have low efficiency scores. The best response for fruit size has been found with Avima, Gisela 10 and MaxMa 14, while fruit quality traits (firmness, soluble solids, acidity) show minimal or only slightly significant differences among the tested stocks.

Six vase-training systems: description and effect on fruit ripening and fruit quality

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In France, the most popular cherry tree architecture is the vase. Its conceptualization and implementation vary among production areas. The objective of this demonstrative trial was to compare 6 of the most typical vase training systems in France.

Two systems are imposed using heading cuts, with the removal of the one-year-old portion of the branch. The pruning is done during dormancy in winter. The "G. Devaux" is more structured than the "G. traditionnel". The trees have more branches and the severity of each heading cut depends of the branch vigor. Two other vase systems are trained mainly with thinning cuts. The "GTV" system requires, during the second summer only, heading cuts to obtain a bush architecture. On the "GTL" system, notching to promote new shoots on the scaffold branches is done during the second winter. The final two systems are trained with bending and thinning cuts. For the "Eventail" system, the severity of the angle of inclination for bending depends on the branch vigor. It needs about 8 to 10 scaffold branches. The "G Evolutif" needs only 4 to 5 scaffold branches that are bent at 45 ° compared to the horizontal position.

Eight trees (4 of `Summit' and 4 of `Belge'), all grafted on MaxMa® 14, were planted in 1993 for each training method. Beginning in 1994, we have recorded the different interventions (pruning, bending, notching...) made on each system, as well as yield, fruit size, color, and soluble solids. Volume of the canopy has also been recorded since 1999. To date, even if the results differ by cultivar, the more productive systems (tonnes/ha) are those without winter heading cuts. However, with `Summit', the yield of the G.Devaux is similar to the GTV and GTL. Also, the results on fruit production per tree volume are fairly different. Regarding fruit size, thus far the G traditionnel, with the poorest yield, don't result in the biggest fruits; the largest fruits are obtained with the GTV.

The oral presentation will present the 2000 and 20001 harvest results, including canopy volume, yield (kg/ha, kg/tree volume, cumulative yield) and fruit quality (size, color, soluble solid).

Comparison among Solaxe and Spanish bush training systems for 'Rainier' and 'Van' sweet cherries in the Chilean central zone growing area

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Vegetative, reproductive, and productive characteristics of 'Van' and 'Rainier' sweet cherry, trained on either Solaxe or Spanish bush systems, were measured on 5-year-old trees at La Platina Research Centre, metropolitan region, Chile, during the 2000-2001 growing season. The Solaxe system had higher yields: 8.5 kg/tree with 'Van' and 7.7 kg/tree with 'Rainier', compared to the Spanish bush system, which yielded 5.2

kg/tree with 'Van' or 4.2 kg/tree with 'Rainier. Also, fruit distribution along the productive branches was more even for the Solaxe training system. Furthermore, the Solaxe trees had better structure and less wood removal during annual pruning (less than 10%).

On the other hand, the Spanish bush system had longer shoots and a stronger trunk and limbs, regardless of cultivar. Neither phenology , fruit set or quality were affected by the two training systems with either cultivar, perhaps due to the young age of the trees. Nevertheless, fruit weight averaged 6.8 g, a good size under Chilean central zone conditions. Both systems performed better than traditional cherry training systems used in Chile, with respect to labor efficiency in harvest and fruit handling.

Evaluation of 'Lapins' sweet cherry high density plantings, rootstocks and plastic roofs

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From 1993 to 1999, a planting systems trial was conducted with `Lapins' guarded by `Sunburst' trees. Five planting systems were compared; slender spindle (3.5 x 1.5 m), Le Page-hedge (2.5 x 1.5 m), super spindle (2.5 x 1.0 m), vertical cordon (2.0 x 0.5 m), and cordon in Güttinger V-hedge (2.5 x 0.4 m), so tree number per ha varied from 1,900 to 10,000. Two of the four replicates were covered by plastic roofs in the spring of 1995. Slender spindle and Le Page trees were grown on three rootstocks, Inmil (GM 9), Damil (GM 61/1), and Edabriz (Tabel®); the other tree shapes were grown only on Inmil and Edabriz.

Edabriz was the most productive rootstock. Cumulative production per tree during five cropping years, for slender spindle and Le Page, was 35.4 kg for Edabriz, 15.0 kg for Inmil, and 13.8 for Damil. Fruit weights on Edabriz, Inmil and Damil, averaged over five years and for slender spindle and Le Page, was 9.8, 9.7 and 10.0 g, respectively. Cumulative production per tree on Edabriz, Inmil and Damil was 30.4, 16.1, and 10.6 kg without plastic roofs and 40.4, 13.9, and 17.0 kg/tree with plastic roofs, respectively. Plastic roofs increased production, but not significantly. Covering with roofs resulted in a 0.8 g (significant) higher fruit weight averaged over all tree shapes. Without roofs, 32.9% of the production had cracked fruits, whereas only 24.3% was cracked with roofs.

The higher the planting density, the higher the production per ha. Slender spindles (1,900 trees/ha) on Edabriz produced 68.3 tons/ha, while cordons (10,000 trees/ha) on Edabriz yielded 116.2 tons/ha. Fruit weight was largest on the slender spindles (10.1 g) and smallest (9.4 g) on the cordons.

In June 1996, measurements revealed that the higher the planting density and the more vigorous the rootstock, the higher the light interception. Edabriz cordons intercepted 75%, and slender spindles on Inmil 17%, of sunlight. The plastic roofs intercepted 14% of the incoming light, which decreased sugar content in the fruit. Fruits on slender spindle and vertical cordon trees on Edabriz, both with and without plastic roofs, were evaluated for taste. Fruits of both tree shapes without roofs were appreciated equally well, but fruits from slender spindles under roofs were more desirable than fruits

from cordons under roofs. This was due to the greater size of the fruits coming from slender spindles, despite their lowered sugar content.

Results of the economic evaluation will be discussed.

Training sweet cherries to improve fruit size and quality - An overview of some recent concepts and practical aspects developed at INRA France

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The Goblet, with an open-center framework, still remains the standard training system in France. It often appears to be more time- and labor-consuming than other more recent systems based on the use of size-controlling rootstocks (MaxMa Delbard® 14 Brokforest, Tabel® Edabriz, Gisela 5) with higher tree densities per hectare. For a decade now, a research program has been developed at INRA to integrate knowledge of the growth and fruiting characteristics of the cherry tree more effectively, so as to reduce the time before the first commercial harvest and also the labor spent in training.

Our training proposals are based on two principles: maintaining the natural hierarchy between the trunk and side branches, and controlling of the growth of the trunk and the branches by bending rather than by heading cuts. These main principles define the Solaxe training system initially developed for apple.

Recent developments of Solaxe in cherry orchards have given rise to the need to more effectively control tree crop, which was greatly promoted by the use of both dwarfing rootstocks and branch bending for maintaining optimal fruit quality (size and color). In traditional systems, such as Goblet, the balance of fruiting to vegetative growth is obtained by annually repeated heading or thinning cuts, usually during winter because of the greater time available during this period. This results in strong reiteration mechanisms, which may generate an imbalance between growth and fruiting.

Experiments have been carried out to analyze the long-term effects of thinning cuts specifically applied to fruiting spurs. This method is called extinction training. This paper presents an experiment, carried out in a commercial orchard, on various degrees of extinction applied to 6-year old Solaxe-trained trees of `Summit' on Tabel® Edabriz. Results show that the best fruit sizes were obtained with 30 to 50% of fruiting spurs removed. Experiments are underway, in connection with the Mafcot network (Maîtrise de la Fructification - Concepts et Techniques; Fruiting Control - Concepts and Applications), to integrate these methods into an overall proposal for canopy management.

Extinction training of sweet cherries in France - Assessment after six years of experiments at INRA

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For a number of years in France, the Solaxe training system has been proposed for sweet cherries as a way of increasing tree density per hectare and of reducing time before the first commercial crop. Planting distances are usually 4.5 to 5 m between the rows and 1.5 to 2 m within each row, giving tree densities ranging from 1000 to 1500 trees per hectare. Bending, rather than heading cuts, is used to control vegetative growth of the trunk (at a height of 2.5 to 3 m) and side branches. For certain cultivars, bending is also used to increase fruiting.

More recently, the removal of fruiting spurs on side branches has been proposed as a training tool for improving the balance between vegetative growth and fruit load. This method, known as extinction, has now been integrated in training programs in several commercial orchards with the collaboration of the applied research network Mafcot (Maîtrise de la Fructification - Concepts et Techniques; Fruiting Control - Concepts and Applications).

This paper presents two experiments carried out (i) on 10- and 6-year old trees, in order to compare standard winter heading cuts and extinction, and (ii) on 6-year old trees, in order to evaluate how the cultivar (`Burlat', `Duroni 3', `Sumele', `Summit') affects growth and fruiting responses to various heading cuts and extinction treatments, all removing approximately 30% of the fruiting spurs.

Synthesis of these experiments confirms the benefits of the extinction method, as compared to standard heading cuts, for improving fruit size while maintaining a good balance between vegetative growth and fruiting. Although not quantified in this study, these extinction experiments resulted in two unexpected side effects that are now being studied carefully: enhanced fruit maturity (by 2 to 4 days) in the early-ripening `Burlat' and reduced sensitivity to European brown rot. The better light and air penetration within the canopy brought about by extinction training may explain these observations.

Pruning theory to promote sweet cherry fruit quality involves fruiting habit, shoot competition, and leaf populations

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Fundamental concepts :
- precocious vs. non-precocious fruiting habit due to rootstock or cultivar
- branch placement and thinning-type cuts to maintain good light distribution throughout the canopy (prevention of light limitations)
- prevention of seasonal vigor limitations (primarily, nitrogen and water), irrespective of rootstock effect on tree `vigor'

Relationships :
- flower bud and spur formation, density of buds/spur, positional density of spurs/shoot
- leaf populations, and hence leaf area, differs positionally on shoots
- intra-shoot leaf populations differ in source-sink relationships
- fruits and leaves are compete for resources
- young trees have limited storage capacity, often out of balance with precocious fruit load demands
- fruit quality is strongly influenced by storage reserves (and hence previous season activity) as well as current photosynthesis activity and partitioning

Nutrient and water management for high density sweet cherry

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A block of `Lapins' sweet cherry (*Prunus avium* L.) on Gisela 5 rootstock was planted in April 1998 at a spacing of 4m (within row) x 4.5m (between row). Commencing the year of planting, eight annual irrigation/nutrition treatments were established with 6 replicates in a randomized complete block design. Each experimental plot contained 2 border and 2 measurement trees. Treatments included (1-3) three rates of fertigated N applied 8 weeks post full bloom as $Ca(NO_3)_2$; (4) the medium fertigated N rate also with P fertigation in spring; (5) the medium fertigated N rate with K-fertigation in June; (6) N only broadcast in early spring; (7) also with post harvest N (August); and (8) medium N rate, drip-irrigated. Excepting treatment (8), irrigation was applied via micro-sprinkler and irrigation was scheduled to meet evaporative demand based on an electronic atmometer. In the first 3 growing seasons, annual measurements were made of tree vigor and leaf nutrient concentration, and fruit yield and quality were measured after the fruiting began.

The 1999 crop consisted of a few fruit on most trees, while the 2000 crop was small, ranging from 1.7 to 3.6 kg/tree (0.9-2.0 tonne/ha) for various treatments. Tree vigor was affected by treatment, with drip-irrigated trees smaller (height) than most of the trees fertigated by micro-sprinkler. Leaf N concentration increased linearly with rate of fertigated N. Lowest leaf N concentrations were observed for drip-irrigated trees even though soil solution N concentrations were higher for this treatment. Leaf P concentration was affected more by N fertigation rate than by P fertigation. The yield of the first crops has been higher for the trees receiving drip irrigation when compared with trees receiving micro-sprinkler irrigation. In general, fruit quality, including the number of rain-induced cracks, has been affected little by treatments. Fruit size has been large, averaging above 12g for all treatments in 2000.

Fruit-to-leaf area ratio affects fruit quality and whole-canopy source-sink relationships in sweet cherry

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We investigated the effects of fruit-to-leaf area ratio on the efficiency of, and capacity for, whole-canopy net CO_2 exchange (NCE) (using an automated whole-canopy gas exchange system), as well as vegetative and fruiting characteristics of 7-year-old 'Bing'/Gisela 5 sweet cherry trees. Different fruit-to-leaf area ratios were established by manually removing dormant fruit buds completely (no fruit, NF), thinning to one floral bud/spur (T), or no thinning (control, C). Mean whole-canopy fruit-to-leaf area ratios at harvest were ca. 0, 20, and 84 fruit/m^2 for NF, T, and C, respectively.

In all treatments, whole-canopy NCE increased through June 26 (harvest in fruiting treatments), then declined rapidly. During the preharvest interval, whole-canopy NCE rates were higher in fruiting trees but no differences were found between T and C. Seasonal means of regressions of daily whole-canopy NCE rate were approximately 2.43, 3.14, and 3.30 $\mu mol \cdot m^{-2} \cdot s^{-1}$ for NF, T, and C, respectively. Seasonal means of diurnal net CO_2 assimilation were 401, 448, and 443 g CO_2/tree for NF, T, and C, respectively.

Mean shoot length was inversely correlated to fruit-to-leaf area ratio: 47, 43,and 41 cm for NF, T, and C, respectively. Mean trunk cross-sectional area increased by 30, 25, and 20% in NF, T, and C, respectively, between May 1 and September 30. Fruit-to-leaf area ratio was negatively correlated to fruit quality: compared to C, fruit from T trees showed 25% greater mean weight, 20% higher mean soluble solids, and 315% greater proportion of premium fruit (25 mm or larger diameter). Crop load also influenced subsequent flower bud initiation: mean floral buds per two-year-old spur were 4.2, 4.3, 3.9 and mean flowers per bud were 3.7, 3.3, and 2.5 for NF, T, and C, respectively. These results provide a foundation for continued studies of balanced cropping (*i.e.*, yield *vs.* quality) and carbon budget development in sweet cherry on vigor-controlling Gisela rootstocks.

Are soft sour cherries related to crop load?

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Sour cherries which lack firmness at the time of harvest usually do not become any firmer during postharvest soaking (prior to processing). It is difficult to remove the pits from these soft fruit, with much internal flesh tissue lost as the pit is removed, resulting in crushed or mutilated fruit product in the can or freezer. Unfortunately, marginally soft fruit is not observable until after mechanical harvest or physical handling of the harvested crop. Losses to growers and processors are estimated conservatively at $6.3 million annually, but in some years losses are severe, *i.e.*, in 1992, 1995, and 1998, losses averaged $14.3 million.

Experiments were conducted at three orchards in Northwest Michigan to determine the effect of fruit load and boron on fruit quality after harvest. In 1999, we adjusted crop load at pit hardening. In general, low leaf:fruit ratios delayed ripening as indicated by delayed fruit abscission, coloration, soluble solids accumulation, and smaller size. Low leaf :fruit ratio did not decrease fruit firmness before harvest, and it did not decrease the number of good fruit after a simulated harvest (splat) test. However, in 2000 we adjusted leaf :fruit ratio by removing 2/3 of the fruit either within 7 days of petal fall (PF treatment) or at the start of pit hardening (PH treatment). In addition, boron was applied to trees with and without high crop loads at two different locations. Fruit from trees with high leaf :fruit ratios (>4-6 leaves/fruit) were of better quality than were fruit from trees with a low leaf:fruit ratio (<2 leaves/fruit). Harvest date was delayed for the latter treatment. The effect was greater if the leaf:fruit ratio was adjusted within 7 days of petal fall rather than at pit hardening. The application of boron as a foliar spray reduced fruit quality, and resulted in a greater leaf boron content. These results suggest that boron may play a role by affecting cell wall integrity not associated with increased fruit set.

Effects of rootstock, wintering temperature, and potassium fertilization on yield components of young sour cherries

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The aim of this experiment was to test the yield efficiency, fruit set, and flower bud mortality of 'Stevnsbaer' sour cherry (*Prunus cerasus* L.), when trees were grown on the rootstocks Weiroot 10 and Colt. During three seasons, trees were grown in large containers and irrigated daily with a complete nutrient solution. On Colt, a treatment with additional potassium fertilization in the second year was included as well. After the second growing season, trees were wintered in the field (lowest recorded air temperature was –12 ^{0}C) or in a cold storage (at 4 ^{0}C). Fruit set and yield efficiency were recorded in

the third growing season. In August of the second year, there were significant differences for leaf K, P, Ca, Mg, Mn and Zn concentrations between the two rootstocks. Colt had very low potassium concentrations. Applying additional soil potassium to Colt increased leaf concentrations of K and decreased Ca, Mg and Mn.

In the field, 76 % (on Weiroot 10) to 89-91 % (on Colt) of all flowers were killed on extension shoots during winter. Mortality rates were less on short spurs, which on Weiroot trees had only 29 % dead flowers. K-fertilization increased the spur mortality from 62 to 76 % on Colt. Trees wintered in cold storage only had 0-8 % damaged flowers on spurs and shoots. Fruit set (based on live flowers) was quite similar on trees wintered in the field and cold storage, but Weiroot 10 had a higher fruit set on extension shoots than did Colt, and K-fertilization improved the fruit set significantly on extension shoots of Colt.

The yield efficiency was improved markedly on Weiroot 10 as compared to Colt in the third growing season. This improvement was caused by an increased fruit set as well as higher winter survival rates of flowers. Colt had very low leaf concentrations of potassium, but additional K-fertilizers only improved the yield efficiency of Colt when trees were wintered without any frosts.

Effects of urea and plant bioregulators (ethephon and Promalin®) on reserve N, cold hardiness, and cropping of sweet cherry trees

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In deciduous fruit trees, reserve N is known to play an important role in early season growth and flower bud development. To improve tree reserve N, we sprayed four-year-old 'Lapins'/Mazzard trees with four rates of urea (0, 2, 4 or 6%) on 25 September and 2 October, 2000. Ethephon (200 ppm) as a leaf senescence promoter and Promalin® (250 ppm BA + 250 ppm GA_{4+7}) as a senescence delaying agent were combined with urea - the aim being to determine how bioregulator-altered leaf senescence/abscission affects N remobilization from leaves. Each bioregulator was applied 3 days before and 3 days after the first urea spray.

Urea sprays increased total N concentrations in leaves and dormant woody tissues, including flower buds and shoots. Ethephon significantly advanced leaf senescence and abscission, resulting in improved N remobilization. Accordingly, ethephon increased and Promalin® decreased N concentrations in shoots. Interestingly, flower bud N concentrations were reduced by ethephon but increased by Promalin®. This variation in bud N between PBR treatments could be related to differences in the stage of bud development at the time of sampling. The Promalin® treatment resulted in larger and more advanced buds. Total nonstructural carbohydrate concentrations in these dormant tissues were unaffected by urea or PBR treatment. Time of bloom was slightly delayed by ethephon and advanced by Promalin®, each by about one day compared to the untreated control. Cold hardiness of flower buds, assessed by differential thermal analysis (DTA) in early December and mid-March, was unaffected by urea but slightly increased

by ethephon (mean exotherm temperatures were -20.0 vs -18.5 °C in early December; -15.0 vs -13.8 °C in mid-March). Interestingly, Promalin® did not affect flower bud hardiness at either time, despite advanced bud development in the treated trees. Shoot hardiness in early December, assessed by visual injury to xylem parenchyma following controlled freezing, was unaffected by urea but substantially decreased by the Promalin® treatment (by about 6 °C), and slightly increased by ethephon.

Prohexadione-calcium and ethephon reduce shoot growth and increase flowering in young, vigorous sweet cherry trees

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'Bing' sweet cherry (*Prunus avium* L.) trees on Mazzard seedling root are typically very vigorous and do not flower for several years after planting. An effective program for reducing vegetative vigor and encouraging precocity in such trees would be beneficial for growers. Prohexadione-calcium (P-Ca, Apogee®, BASF), ethephon (Eth, Ethrel®, Aventis CropScience) or tank mixes of these two bioregulators were applied to young, vigorous 'Bing'/Mazzard sweet cherry trees starting when terminal shoots reached approximately 30 cm in length. P-Ca alone reduced shoot growth to a modest extent in most trials; Eth alone reduced shoot growth to about the same extent as P-Ca. Single applications of a tank mix of P-Ca and Eth strongly reduced or completely stopped shoot growth in trials in central Washington (WA); similar treatments had much less effect in southern WA. In 2000, trials included programs of two applications to the same trees (3 weeks apart) consisting of: 1) 2 applications of P-Ca alone, 2) a single P-Ca application followed by a tank-mix of P-Ca and Eth, or 3) 2 applications of a P-Ca/Eth tank mix. In central WA, this approach greatly reduced shoot growth and some treatments improved flowering the following year. In southern WA, the reduction in growth from double tank-mix treatments was less strong and flowering was not increased. Some treatments stimulated the formation of a second flush of vegetative growth in late summer. Similar results were observed in one trial with young 'Lapins'/Mazzard cherry trees.

Controlling growth of sweet cherries with Prohexadione-Ca and its effects on cropping and fruit quality

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Growth control experiments conducted over three seasons involved 4-5 year-old 'Lapins'/Mazzard sweet cherry *(Prunus avium* L.) trees. Prohexadione-Ca (Apogee®), a

gibberellin biosynthesis inhibitor, was applied as a foliar spray at 0, 125, 250 ppm at various growth stages, *i.e.*, 15-, 30-, or 55-cm initial shoot growth. Apogee® reduced terminal extension linearly with increasing rate, with the extent of growth control being dependent of the time of application. Early applications (at 15-cm long initial growth or earlier) did not reduce total shoot growth; rather, they produced better growth due to the resumption of growth later in the season. Meanwhile, late applications (when new growth was 55-cm long or later) were less effective compared to the applications at 30-cm long . The best combination of rate and time was 250 ppm Apogee® applied at 30-cm initial growth, resulting in a 25% reduction of total growth. In the season of treatment, Apogee® increased fruit weight and fruit firmness in two of three experiments but did not affect fruit set, yield, and juice soluble solids and titratable acidity. A carryover effect on shoot growth the following year was observed, especially at 250 ppm applied at 30-cm or later; such trees grew slightly more than untreated trees. However, there were no carryover effects on fruit set, fruit weight, yield, or selected fruit quality parameters. Apogee® had no effect on return bloom in one experiment where this parameter was measured.

Early blossom thinning of sweet cherry trees with vegetable oil emulsion

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Vegetable oil emulsions at 1%, 3%, and 5% were sprayed on 'Bing' cherry trees at popcorn, 20%, 50%, and 80% full bloom (FB), respectively. When applied at earlier phenophases, oil emulsion injured flower petals and prevented the opening of late developed flowers. The young fruit from the unopened flowers had arrested development and abscised after petal fall, while the early-developed flowers with higher vigor opened and set fruit normally. The thinning effects of oil emulsion were concentration and application time dependent, with the higher concentration and earlier application being more effective. Oil emulsions at 1% and 3% applied at popcorn to 20% FB thinned to acceptable degrees. Oil at 5%, however, over-thinned. Oil emulsion was less effective when applied at 50% FB and was not effective at 80% FB even at high concentrations. Oil treatments increased fruit size and soluble solids contents, but did not injure fruit or foliage either at application or afterwards.

Microsporogenesis of sour cherries in the region of Skopje

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The microsporogenesis of four sour cherry cultivars (`Oblachinka', `Shumadinka', `Haiman's', and `Keleris 14') were studied in the region of Skopje. The

examinations were carried out in the research-collection orchard of sour cherries at the Agricultural Institute in Skopje in 1994 and 1995.

On average, the shortest duration of microsporogenesis was found in `Shumadinka' and `Haiman's' (nine days), and the longest in `Oblachinka' (eleven days). It begins about 30 days before bloom. Besides homologous chromosomes, the sour cherry also forms unhomologous ones. This results in irregular conjugation of chromosomes in prophase I. In the later phases of partitioning, these lag behind, and often form micronuclei and create various groups of microspores.

The highest percentage of regular cells in telophase I occurred in `Haiman's' (79.4 %). From 29.6 % of cells with irregular distribution of chromosomes, 8.2% had only one micronucleus and 0.9% had four micronuclei. Cells with 5 micronuclei were noted only in `Oblachinka' (1.3%) in 1995. `Oblachinka' also had the highest number of irregular cells (28.9%). The cells with one (9.5%) and two micronuclei (9.6%) were again most widespread. In the phenophase II, the highest percentage of regular mother cells was found in pollen of `Haiman's' (83.9%). The cells with 1, 2 and 3 micronuclei were most widespread, while cells with four micronuclei were observed only in `Oblachinka' in 1995 (1.7%). Cells with 5 micronuclei were not found in this phenophase.

The cultivars `Keleris 14' (86.5%) and `Haiman's' (85.7 %) had the highest percentage of regular tetrads and `Oblachinka' (81.6%) the lowest. Irregular tetrads with one (9.2%) and two micronuclei were most widely present in `Obalachinka', which also had tetrads with 3 and 4 micronuclei. Triads were found in `Shumadinka' (0.4%) and in `Haiman's' (1.0%). Pentads were the most frequent poliads. They were most frequent in `Shumadinka' (3.4%) and least frequent in `Kelleris 14' and `Oblachinka'. Hexads were very rare, ranging from 0.6% in `Kelleris 14' and `Oblachinka' (0.6%) to 1.7% in `Haiman's'.

A high positive correlation is found between the regularity of microsporogenesis and pollen fertility.

Increased endogenous gibberellin level induces early embryo sac degeneration of 'Satohnishiki' sweet cherry in warm region

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Recently, cultivation of sweet cherries has been attempted in the warm region of Japan, while poor fruit set becomes the serious problem preventing stable production. To clarify the cause of poor fruit set in the warm region, we investigated the effect of temperature on the development of reproductive organs, the endogenous gibberellin (GA) levels and the fruit set of 'Satohnishiki' sweet cherry. The effects of exogenous GA and paclobutrazol (PBZ) on embryo sac development were studied simultaneously.

Trees were grown in sunlit growth chambers controlled at 15 °C, 20 °C and 25 °C during the day and grown under field conditions at night, from one month before anthesis to petal fall. The high temperature hastened blooming but reduced the flower size. Fruit set decreased in concert with the increase in temperature.

The anatomical characteristics and endogenous GA levels of flowers were compared between the trees grown at 15 °C and 25 °C. Temperatures hardly affected the growth of pollen tubes in pistils. At 25 °C, the nucelli and embryo sacs degenerated more rapidly than at 15 °C. Flowers that developed at 25 °C had a higher endogenous GA level than had those at 15 °C.

A solution of 10 and 100 ppm GA_3 was sprayed on bursting buds. At anthesis, the GA level of flowers from the buds with 10 ppm GA_3 application was nearly double that of the control. GA treatments considerably increased the percentage of ovules with a degenerated embryo sac or nucellus by 2 days after anthesis.

A solution of 500 ppm PBZ was sprayed on whole trees in mid-September. At anthesis the following spring, the endogenous GA level of PBZ-treated flowers was considerably lower than that of the control. PBZ treatment prolonged embryo sac longevity.

These results reveal that rapid degeneration of the embryo sac and nucellus is a major reason for the reduction in fruit set when the developing flower buds are exposed to high temperatures. Furthermore, it is suggested that the GA level may be involved in the regulation of the development of the embryo sac and nucellus, and that early embryo sac degeneration at high temperature might be induced by increased endogenous gibberellin levels.

Involvement of UV rays in fruit coloration of several sweet cherry cultivars during maturation

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In blush-skinned sweet cherry cultivars, the fruit coloration is one of the important parameters determining marketability. Generally, the light environment markedly influences the degree of coloration. The measurement of lighting conditions in the field showed that the penetration of UV light, as well as visible light, into the fruit markedly decreased inside the tree canopy. In this study, to investigate the lighting conditions for fruit coloration during maturation, UV and white light were artificially illuminated to the detached fruit of several cultivars at different maturity.

The detached fruit were wrapped with plastic film and were illuminated with UV and white fluorescent light for 48 h or kept in the dark at 20 °C. In 'Satohnishiki' fruit collected at mid stages of maturation (before starting coloration), UV-A at 2.35 W/m^2 greatly enhanced the red coloration compared to the dark control. White light illumination at 15 $\mu mol/m^2/s$, however, hardly affected fruit coloration. White light did not have any synergistic effect on fruit coloration even when combined with UV-A. UV-B illuminated at 2.37 W/m^2 caused discoloration of the skin. Although ' Napoleon' and 'Takasago' (`Rockport Bigarreau') responded to these illuminating conditions similarly to 'Satohnishiki', these cultivars seemed less sensitive than 'Satohnishiki'. On the other hand, in 'Seneca', coloration proceeded even in the dark and reached to the same level as under the illumination of UV-A.

UV-A stimulation of coloration in 'Satohnishiki' fruit occurred at any stage of maturity. However, the effectiveness was relatively less during early stages of maturation. UV-A illumination was also effective in the coloration of fruit with poor color even at later stages of maturation. These results suggest that the coloration of fruit in the blush-skinned cultivars is largely influenced by the existence of UV rays.

Seasonal changes in polyphenols of `Lapins' sweet cherry grafted on different rootstocks

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The purpose of this report was to determine how different rootstocks for sweet cherries affect the metabolism of the cultivar during growth. The influence of rootstock on the concentrations of polyphenol substances in the phloem of the shoots and leaves was studied. The experiment utilized 'Lapins' grafted on three different rootstocks (F 12/1, Gisela 5 and W 158). Samples were collected on six days (14 April, 17 May, 13 June, 17 July, 17 August, and 28 September) in 2000. The concentration and composition of polyphenol substances were determined by HPLC analysis. It was established rootstocks differentially altered the concentrations of polyphenol substances (catechin, epicatechin, p-coumaric acid, fumaric acid, genistein) during the growth period.

Susceptibility to cracking of thirty sweet cherry cultivars

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Nowadays, Apulia (Southern Italy) is the most important cherry producer in Italy. New varieties are introduced by growers to complement those traditionally grown, often without ascertaining their adaptability to local environmental conditions. Among disregarded characteristics is the susceptibility to rain-induced fruit cracking. The problem is worthy of consideration even if rainfall in Apulia during cherry ripening (May 15 June 20) is not as heavy and frequent as in other world cherry growing districts. The cracking index of the following thirty varieties has been evaluated over two years according to Verner's method, as modified by Christensen: `Adriana', `Badacsony', `Belge', `Bertiello', `Big Lory', `Bing', `Celeste', `Early Van Compact', `Ferrovia', `Garnet', `Germerdorfer', `Giorgia', `Hedelfinger', `Lambert', `Lambert Compact', `Lapins', `Larian', `Linda', `Lory Bloom', `New Star', `Noire de Meched', `Ruby', `Sam', `Schneiders Röte Späte Knorpelkirsche', `Starking Hardy Giant', `Summit', `Sunburst', `Sylvia', `Van', and `Vesseaux'. The study confirmed that the susceptibility

to cracking is a characteristic linked to genotype. No variety was totally resistant, but some of the little known varieties showed an interesting level of resistance. A susceptibility scale is proposed.

On the cracking of sweet cherries

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In a sweet cherry breeding program, 48 progenies with data from several years and 1,179 plants were analyzed for their cracking behavior in relation to rainfall, from picking day until 6 days before harvest, together with their respective parents. As could be expected, the correlation over 26 parental cultivars with 254 pairs of data (several trees and years) was low, r = 0.31***. The correlation coefficient over all 2,380 pairs of progeny data was lower still, with r = 0.27***. About half of the progenies had significant positive correlations, varying from r = 0.84*** to 0.20*. Among the non-significant progenies, there were even two negative correlations.

There was no clear relation between the cracking of the parents and the resulting progenies. The progenies generally have higher values than their respective parents with few exceptions. As expected,Van is among the cultivars with the highest cracking percentages as parent and as cultivar with 32 and 28% respectively.

Rotting of fruit following rain 3-6 days before harvest gives low positive non-significant correlations for half of the progenies and low negative non-significant correlations for the other half. Over all parental cultivars there is no correlation.

Relationship of cell sizes of fruit skin and flesh firmness with degree of fruit cracking among sweet cherry (*Prunus avium* L.) cultivars

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The degree of fruit cracking, fruit skin cell sizes, and fruit firmness were examined to study the factors involved in cracking in 30 sweet cherry and two sour cherry cultivars. A cracking index was determined by the water immersion method and classified into seven grades. Fruit firmness was measured by Rheometer using a 3 mmφ plunger. Cell sizes of skin were measured at the fruit top, cheek, suture and stalk cavity, and in two directions: parallel (length) and right angle (width) to the suture. Significant coefficient correlations with cracking indices were obtained for fruit firmness (r=0.643**), cell length at fruit top (r=0.658**), cell width at fruit top (r=0.555**), cell width at suture (r=0.409*), and fruit weight (r=0.660**). The coefficient of multiple correlation was also calculated, and the highest coefficient was obtained between the cracking index and fruit firmness + all data of cell size (r=0.857**). The

coefficient between the cracking index and cell length at top + fruit firmness was also high (r=0.790**).

Cracking susceptibility of sweet cherries in the UK in relation to calcium application and cover systems

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To understand the susceptibility and resistance of cherry cultivars to cracking, with and without covering systems in the United Kingdom (UK), can help to identify the need for investment in covers and particular varieties. The cracking indices (Christensen, 1972) for 'Van', 'Colney' and 'Summersun', grown either under covers or with calcium application, were identified and correlated with osmolarity and TSS. These figures were also compared with the cuticular thickness and variation in the outer epidermal layers using transmission electromicroscopy. This study has highlighted the need for further work to anticipate future successful production of cherries in the UK.

Fruit cracking in sweet cherries (*Prunus avium* L.) - an integrated approach

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A model accounting for the physiological mechanisms acting in sweet cherry fruit cracking is now established, supported by recent and older research data.

The fruit imports water through its stem and over its surface. Recent studies of stem import by potometric water uptake (in the range 9-14×10^{-6} $dm^3 \times hour^{-1} \times fruit^{-1}$) to detached fruits (Ullensvang) were well in accordance with older data (8-14×10^{-6} $dm^3 \times hour^{-1} \times fruit^{-1}$) from weight (Denmark) and volume (USA) increase measurements. Potometric water import occurred also against a physical pressure made by enveloping the fruit into gypsum. Saturating the fruit surface with water led only to a slight reduction of uptake. Surface import of water was studied by weight measurements (Ullensvang), and was significantly less in size (4-10x10^{-6} $dm^3 \times hour^{-1} \times fruit^{-1}$) than the stem import.

The fruit loses water over its surface, and most likely also through its stem under certain conditions. Experiments conducted recently (Ullensvang) showed that water loss from fruits in dry air was approximately tenfold of that from fruits in water-saturated air.

Water conductivity of the cherry cuticle was investigated (Germany) and differences were found between different locations on the fruit surface. Possible varietal differences have, however, not been investigated.

The model explaining cherry fruit cracking then appears as:

- The main water import to the cherry fruit is through the stem. It is responsible for the turgor pressure in the fruit, which is a neccessity for fruit cracking

- Water import over a wet fruit surface is of less magnitude. It causes damage to the bearing structures of the fruit surface, *i.e.*,the cuticle and outer epidermal cells
- The two events in combination are usually the cause of fruit cracking, but a sufficient turgor pressure can cause cracking alone
- The occurrence of cuticular fractures is a complicating factor
- The magnitude of water uptake into, and loss from, the fruit is essential in the model, together with the properties of the morphological structures comprising the fruit surface, *i.e.*, the cuticle and the outer epidermis layer.

Efforts to avoid cracking should concentrate on:

- Avoiding or reducing wetness on the fruit surface
- Manipulating water transport over the cuticle (calcium)
- Supplying water regularly to the tree to reduce cuticular fractures

Temperature management and modified atmosphere packaging: Keys to the preservation of sweet cherry quality

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Temperature management affects the postharvest life of 'Bing' cherries through its influence on the rate of decay, changes in fruit and stem color, softening, pitting and reduction in acidity. Colder cherries are more susceptible to impact forces, resulting in more pitting. However, warmer cherries are more susceptible to decay, softening and a rapid decline in acidity.

Modified atmosphere (MA) packaging slows cherry deterioration when fruit are held at or below 2 °C, but does not slow quality deterioration when fruit are warmer (4-7 °C). Sealing MA packages with heat or twist ties resulted in creation of the desired carbon dioxide levels within 24 hours. Various MA films were tested on 'Bing' cherries with varying results, which will be presented.

Resistance of advanced sweet cherry selections and cultivars from the PARC-Summerland breeding program to fruit surface pitting

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Fruit of 15 selections and cultivars were harvested in the morning when they were judged to have reached commercial maturity. Fruit were left for 4 hrs. at 4 °C and injured by dropping a 10g weight, with a 2.43 mm diameter head, 6 cm onto individual fruit. Fruit were then stored in clam shells at 1 °C for 14 days. Fruit samples were weighed at harvest and after storage, and amount of weight loss was calculated. Fruit were then rated

visually for severity of pitting, using the following scale: 4 = no pitting; 3 = slight pitting; 2 = moderate pitting; and 1 = severe pitting. Impressions of the pits were then made using Aquasil™LV Smart Wetting® Impression Material, using a Dentsply Caulk applicator and Intra-Oral Tips. Once the impressions had set they were stored in glass vials that were flushed with N before sealing and vials were stored at room temperature. The diameter, depth, and area of the pit were measured using the impressions and an image analysis system that consisted of a dissecting microscope with a video camera. The image was captured, calibrated for spatial dimension, then analyzed using ImagePro Plus software (Media Cybernetics, Silver Spring, Md.).

Of the cultivars studied, `Symphony' was the most resistant to pitting based on visual evaluations, depth of pit, pit diameter, and area of pit. The selection 13N-06-49 was the least resistant, with the poorest visual rating and largest pits. `Lapins', `Skeena', `Sweetheart', and `Symphony' were more resistant than `Bing' to pitting injury. The visual rating of `Staccato' was better than that of `Bing' and it had a smaller pit diameter than `Bing', but other measurements were similar to `Bing'. There were also significant correlations among the various parameters measured. Visual rating was significantly correlated to the size measurements of the pits. Also, size of pit was correlated to weight loss and date of harvest.

Control of brown rot of sweet cherry fruit with a preharvest fungicide, a postharvest yeast, and modified atmosphere packaging

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An integrated approach was studied for control of postharvest brown rot (*Monilinia fructicola*) of sweet cherry fruit. Sweet cherry trees of `Lapins' and `Lambert' were sprayed with propiconazole (Orbit 3.6E) at 0.28 kg/ha, four days before harvest or left unsprayed. One day after harvest, fruit were dipped in a suspension of *Cryptococcus infirmo-miniatus* strain YY6 (CIM) at 2.5 x 10^8 CFU/ml or water, both containing *M. fructicola* at 1.0 x 10^4conidia/ml. CIM was a WDG formulation. Treated fruit were stored at –0.5 °C and 2.8 °C in air or in modified atmosphere packaging (MAP). Disease incidence was evaluated after 20 and 42 days at 2.8 °C and -0.5 °C, respectively. Preharvest propiconazole and postharvest *C. infirmo-miniatus* were similarly effective for control of brown rot. A significant propiconazole-*C. infirmo-miniatus* synergism was observed. Modified atmosphere significantly reduced brown rot compared to air-stored fruit. The storage temperature regime effect was inconsistent. This integrated decay control approach was effective and is especially relevant since postharvest fungicide options for cherry are limited.

Automating quality assurance - nondestructive measurement of cherry fruit quality parameters

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This report describes previous work using two different near-infrared (NIR) spectrometers to non-destructively measure the sugar content of whole cherries. The measurement of total acidity in whole apples using NIR will also be reviewed, as the approach is also applicable to cherries. Finally, a rapid and low-cost approach for measuring acidity in juice using a drop-count titrator will be summarized.

The NIR spectra of cherries were measured using a commercially available spectrometer from Zeiss and an in-house built six wavelength photometer. The firmness of each cherry was measured using a load-cell based device (Firmtech2 – Bioworks, Stillwater, Okla.) and then each cherry was juiced and the Brix was measured using a digital refractometer (Atago, Japan). Partial least squares (PLS) analysis was used to relate the NIR spectra to the Brix and firmness. Data pre-processing and PLS algorithms were written in "C" and MATLAB (MathWorks, Natick, MA).

Within a cherry genotype (*e.g.*, `Bing'), correlation of the NIR spectrometer data with Brix was high (R^2 = 0.8-0.9) and the standard error of prediction was ~0.6 °Brix. For the six wavelength photometer device, correlation with Brix was moderate (R^2 = 0.6-0.7) and standard error of prediction was ~1.0 °Brix, which still allowed good separation of low, medium, and high sugar content fruit with a potentially low-cost device. Both NIR data sets had little or no correlation with firmness.

Similar NIR equipment has also been used to measure the total acidity of whole `Fuji' apples. While the correlations of NIR data with "total acidity as malic acid" were moderate, fruit could still be sorted into low, medium and high acid content. It is expected that acidity of cherries could also be measured with similar performance.

The generation of NIR calibrations initially require that samples also be destructively analyzed using an accepted reference technique. Because of this laborious calibration step, and due to the length and complexity of a total acidity titration, a simple method to measure total acidity in fruit juice (apple, cherry, *etc.*) was developed using visual detection of the color endpoint (Berkeley Instruments, Richland, Wash.).

Epidemiology of powdery mildew of sweet cherry

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Powdery mildew of cherry, which is caused by *Podosphaera clandestina*, is the most serious disease in the irrigated production areas in the Pacific Northwest. The disease commonly affects foliage and less commonly fruit. Fruit infection occurs when rains occur near harvest. *P. clandestina* survives winter as cleistothecia in tree crotches, bark crevices, and on the orchard floor that persist to mid- May. Ascospore release and

primary infection result from 25 mm rain at 10 °C or greater. In the absence of early season rains, epidemics can be initiated when tree trunks are wetted during the initial irrigation application. The incubation and latent periods following primary infection are temperature-dependent, but normally consist of 5-7 day periods in Eastern Washington.

Once powdery mildew is evident, the fungus is already producing copious amounts of conidia, the secondary spore type. Conidia dispersal is diurnal, via wind currents, and also is enhanced by the physical impaction of water droplets on infected leaf surfaces. Spore clouds resulting from rain events late in fruit development may greatly increase the likelihood of fruit infection. Foliar disease incidence and severity continue to increase beyond the harvest period. In most orchards, the production of cleistothecia begins when fungicide applications are terminated at harvest.

The disease is managed by integrating chemical and cultural practices, but management has been complicated by the development of fungicide resistance. Sulfur, benzimidazole, demethylation-inhibitors (DMI), and strobilurin fungicides are registered for management of cherry powdery mildew. Sulfur use is restricted by temperature and by possible deleterious effects on beneficial insect populations. Benzimidazole and DMI fungicide use is limited due to resistance concerns, while the availability of strobilurin fungicides is limited by phytoxicity issues. Washington researchers recently demonstrated the efficacy of narrow-range petroleum oils for use in management programs. The use of oils is restricted to no later than pit hardening, but postharvest applications can be used to suppress cleistothecia formation. In orchard trials, alternations of oil, DMI, and strobilurin fungicides provided disease control equal to industry standard spray approaches, while offering the additional benefit of sound fungicide resistance management strategies.

Cherry virus disease management

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Virus-associated diseases of cherry are numerous both in the number of different viruses involved and in the frequency with which the diseases are encountered. Among horticultural crops, the control of diseases in cherry caused by viruses and virus-like agents are amongst the most challenging. The initial exclusion of viruses from new plantings by the use of virus-free planting stock is the most economically and biologically sound strategy for disease control. Yet, in spite of our best efforts, virus-induced disease can still become established in orchards. This precipitates the need for implementing rational control strategies to reduce the economic impact of disease.

In recent years, significant progress has been made in the identification and control of these diseases. With increased knowledge of the etiological agents associated with disease, the possibility of enacting appropriate management decisions improves. Several factors interplay in the decision-making process, including the biology of disease agents, the specific cultivar that is being protected, the environment in which the cherry

trees are being grown and the frequency of disease occurrence. Despite recent advancements in fruit tree virology, many unresolved questions remain.

Breeding for sweet and sour cherry disease resistance in Hungary

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Susceptibility to *Cytospora* sp. fungi:

In the last 10-15 years, an apoplexy-like disease of sweet and sour cherry, caused by a die-back disease, has been detected often in Hungary. Some of the infected, dying or dead trees show brown, necrotic tissue in the xylem under the healthy-looking bark, starting from the crown and extending to several annual rings. This symptom spreads over the trunk to the secondary or even younger branches. Other trees have canker wounds caused by mechanical injuries. In those cases, both the bark and the xylem under the bark are dead and gummosis is frequent. The pathogen is *Cytospora leucostoma*. However, we have isolated from the necrotic tissues *C. rubescens* as well. It is most difficult to protect the trees from this disease, for the fungus lives, propagates, and produces toxin within the xylem. The best solution is prevention, which might be possible by growing tolerant varieties.

In the scope of sweet and sour cherry breeding since 1997, we have evaluated 13 cultivars after artificial infection with *C. rubescens* and *C. leucostoma*. Both species were more susceptible to *C. rubescens* than to *C. leucostoma.* There were great differences in tolerance among the cultivars. Both in the lab and the orchard, `Meteor korai', `Csengõdi', and `Újfehértói fürtös' proved to be tolerant (the bark necrosis was 9.3, 10.2 and 11.4 mm, respectively). Susceptible varieties were: `Érdi jubileum', `Érdi bõtermõ' and `Cigánymeggy 59' (with necrosis of 26.4, 22.4 and 22.6 mm).

Susceptibility of sweet and sour cherry hybrids to *Blumeriella jaapii*:

Blumeriella jaapii is well-known with growers all over Europe and America. This fungus is responsible for early leaf fall and has caused serious financial losses several times since the early 1990's . The breeding of resistant sweet and sour cherry varieties has been going on since 1991 in our Institute, during the early years as an American - Hungarian collaboration.

Every year, hundreds of young hybrid progeny of high quality market varieties were repeatedly infected in a screen house with an ascospore and conidia suspension. Symptoms (spots on leaves) were assessed and scored from 1 to 5, the last time in September. The examined hybrids showed great variability in susceptibility. There were numerous resistant or tolerant progeny among the `M 221' x `Csengõdi', `Érdi bõtermõ' x `Csengõdi', `Érdi bõtermõ' x `Valerij Cskalov', and `Kántorjánosi' x `Csengõdi' combinations.

Influence of temperature and wetness duration on infection of cherry and peach by *Wilsonomyces carpophilus*

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The effects of temperature and wetness duration on infection of sweet cherry (*Prunus avium* L.) and peach (*P. persica* L.) by *Wilsonomyces carpophilus* (Lev.) Adaskaveg, Ogawa & Butler were determined under controlled conditions. Young foliage of cherry seedlings and peach trees were inoculated with a conidial suspension of *W. carpophilus* and subjected to wetness periods of 0-24 hr at temperatures of 5-30 °C. On cherry, disease severity increased with increased wetness duration at each temperature tested, *e.g.*, at 15 °C, severity increased from 0 lesions/cm^2 at 0 hr to 0.11, 1.9, 6.8 and 9.1 lesions/cm^2 after 6, 12, 18, and 24 hr, respectively. After 24 hr of wetness, the maximum disease severity of 10.5 lesions/cm^2 was obtained at 20 °C. Although severity values were different, the general responses to temperature and wetness period were similar on peach. Multiple regression equations using temperature and wetness duration as independent variables adequately described infection of cherry and peach foliage. The incubation period on cherry was 2, 2, and 3 days at 5, 15, and 25 °C, respectively, while the latent period was 7 days at 15-25 °C. Conidia survived up to 4 months under conditions of low humidity at 5-30 °C.

***Rhagoletis indifferens* Curran (western cherry fruit fly) and its management in the Pacific Northwest United States**

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Western cherry fruit fly (CFF) is native to North America, and has been found in the Pacific Northwest states since the 1940's. This pest lives only on cherry and has a single generation per season. It may emerge from the soil over an eight-week period, with peak emergence occurring about the time of harvest.

Even though they are rarely found in commercial orchards, CFF is the primary insect pest of sweet cherries in the region. Quarantine agreements between the region and other states or countries result in a zero tolerance for CFF larvae in packed fruit. Fruit is inspected by the State Department of Agriculture for infestation as it comes to the packinghouse, prior to acceptance, and after packing. Fruit is rarely found to be infested. However, larvae are found during inspections from one to five times per season. The entire load of infested fruit is rejected, and all other fruit from that grower is intensively inspected for signs of CFF.

This zero tolerance has forced growers into intensive control programs to achieve perfect control. County-financed pest control boards find and eradicate infestations in home orchards, where the great majority of fruit flies exist. Commercial growers begin spraying when first fly emergence is detected on infested trees, or when temperature-

driven models indicate emergence has commenced in the region. Traps are not effective in commercial orchards. Growers continue to spray every week to 10 days, depending on product used, until harvest is completed.

The advent of the Federal Food Quality Protection Act (FQPA) has caused special concern to sweet cherry growers, as the two products most commonly used to control CFF, azinphos-methyl and carbaryl, are receiving special regulatory attention during the evaluation process, due to their very common usage on high-profile crops. It is likely that adjustments in pre-harvest interval would greatly restrict the usefulness of these products for pest control in sweet cherries, as the target pest is most present near the harvest period. Alternative, effective, and environmentally acceptable CFF control materials and methods will be discussed.

Effects of supplemental food sources on western cherry fruit fly survival and fecundity

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Supplemental food sources for WCFF such as aphid honeydew and bird feces may be scarce in some environments. When such food is scarce, can flies resort to cherries alone as a food source both for survival and egg production? Frick et al. (1954) reported that flies fed on juices from feeding punctures on cherries, but no subsequent work has been done on this aspect of fly ecology.

The objective of the study was to determine if flies that are exposed to cherries alone can survive and produce eggs as well as flies that had cherries and a sugar/yeast diet. Replicates were single female and male flies held in pint-sized cages. Cherries were replaced every 3 days and numbers of eggs laid in the cherries recorded.

Trapping western cherry fruit fly with ammonia

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Ammonia was evaluated as an attractant and trap bait for western cherry fruit fly. When ammonia was dissolved in the drowning solution of a wet trap (Trappit dome trap), the greatest numbers of flies were captured with a 0.5% solution, with many fewer flies captured at higher (2%) and lower (0.03%) percent solutions. When a range of concentrations of ammonia in water was formulated in vials, with release of ammonia through a small hole in the vial lid, the greatest numbers of captured flies were in traps baited with the strongest concentration of ammonia (28%) tested.

Poster Presentations

GiSelA 5 rootstock performance in Germany

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The economic and production importance of 'Gisela 5' rootstock in Germany has been assessed by annual nursery production numbers and the results of a questionnaire that was distributed to extension specialists in the main German sweet cherry growing regions. A comparison of the total sweet cherry area with that planted in the last 5 years shows a significant increase in planting of sweet cherries, primarily on new (dwarfing or semi-dwarfing) rootstocks at the expense of conventional rootstocks, with significant planting of 'Gisela 5'.

Adaptation of 'Gisela 5' to German soil and climatic conditions is assessed as good (with one exception). Irrigation is necessary in regions with less than 500mm precipitation and is recommended in other areas. No special sensitivity to diseases or pests - as compared to conventional cherry rootstocks - is reported from any region. Support in the first 3-5 years is preferred in several sites, especially if the tree is trained as a central leader. Planting of 'Gisela 5' in Germany is expected to continue to increase in the future, as more planting material becomes available and additional irrigation strategies become established.

Victor: A semi-dwarf cherry rootstock for dry conditions

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The nursery Battistini dott. Giuseppe produces 4 million rootstocks for fruit trees annually, through micropropagation. Of this, about 1,000,000 are cherry rootstocks. This production is sold in Europe and in the Mediterranean area. The nursery constantly conducts experimentation with new cherry varieties and rootstocks. The most important goals of these selections are to obtain dwarf rootstocks and cultivars that produce large fruit and abundant production.

Four years ago, the nursery patented in Europe a new semi-dwarf rootstock called 'Victor'. The original plant is a native of the Tibetan area and it is a *Prunus cerasus* selection. This plant was obtained from seeds imported from that region 13 years ago by Battistini Giuseppe. Initially, the plants obtained from these seeds were selected by the nursery according to vigor and compatibility with local varieties. This experiment led us to find and select just one seedling that did not, however, differ much from the others. In fact, it showed only minor vigor, while the graft compatibility with all the seedlings tested was good.

The best genotype selected in the preliminary trials was then tested in 2 subsequent experiments started by the Italian researchers R. F. De Salvador, A. Albertini, and S. Lugli, in the winter 1992-93.

The result of these experiments were quite positive and showed that 'Victor' is dwarfing, with high yields and early fruiting. Furthermore, it is compatible with many cultivars and showed good adaptation to different soil/climatic conditions.

The 1998 NC-140 regional sweet cherry rootstock trial - Results from western North America

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This trial was planted in the spring of 1998 in British Columbia, California, Colorado, Oregon (2 sites), Utah, and Washington. `Bing' was the scion variety and the rootstocks tested are: mazzard, *Prunus mahaleb*, Gisela (GI) 5, GI 6, GI 7, Giessen (Gi) 195/20, Gi 209/1, Gi 318/17, Gi 473/10 (GI 4) , Edabriz, Weiroot (W) 10, W 13, W 53, W 72, W 154, and W 158. The only rootstock that had not lost any trees through 1999 was Gi 195/20 and the rootstock with the greatest loss was mazzard followed by Gi 473/10. The greatest overall losses occurred in Utah. The largest trees through 1999 were in Washington (Prosser), followed by Oregon (Corvallis); the smallest trees were in Colorado. Rootstocks providing the largest trees were GI 6 and Gi 318/17. The smallest trees were on W 53, followed by W 72 and Edabriz. Data for the 2000 growing season will also be provided.

Incompatibility between eighteen sweet cherry cultivars and nine different rootstocks

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Preliminary results were obtained from a trial of eighteen sweet cherry cultivars and nine rootstocks and interstocks in different combinations. The cherry varieties included 'Karina' ,'Kordia', ' Lapins', 'Nabigos', 'Newstar', 'Regina' 'Sam', 'Sommerset', 'Starking Hardy Giant', 'Stella', 'Sunburst', 'Sweetheart', 'Sylvia', 'Ulster', 'Van', 'Vanda', 'Viola' and 'Boambe de Cotenari'. The rootstocks were 'Colt', 'Gisela 5', 'Weiroot 10', 'Weiroot 158', DAN 6', 'DAN 12' and *P. avium* (virus free). In combination with interstocks, *P. avium* was used as the rootstock and 'Colt', 'Weiroot 10', 'Weiroot 158', Gisela 5', 'DAN 6', 'DAN 12', 'DAN 13' , and 'DAN 17' as the interstocks. As a control, branches of *P. avium* were used as an interstock on *P. avium* rootstocks.

Grafting was done in one week, from 14 to 21 March, 2000, with interstocks grafted in two steps. First, the interstock was split-grafted on the rootstock after which the scion was split-grafted on the interstock. The length of the interstock was approximately

10 cm. The grafted plants were planted in 5 L black plastic containers and cultivated in a greenhouse with an 18 °C floor heating temperature until the connection between scion and rootstock was established. After four weeks, the temperature was lowered to 12 °C.

The trees were taken out of the greenhouse on June the 8th and placed in a nursery area with drip-irrigation. Measurements of compatibility were made, such as numbers of dead or living plants, trunk diameters, numbers of branches, and the heights of trees at the end of the first growing season.

Effects of various rootstocks on the growth of `0900 Ziraat' sweet cherry variety in K.Maras, Turkey

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`0900 Ziraat' is the main export sweet cherry variety of Turkey. An experiment was started in 2000 to study the effects of dwarfing rootstocks such as Gisela 5, MaxMa, Weiroot, and SL-64 on this variety. *Prunus avium* seedlings and F-12/1 clonal rootstock were used as controls. The experiment was designed with 4 replicates, each of which consisted of 4 trees. The trees were distributed randomly in the experimental orchard. In between the `0900 Ziraat' trees, `B. Gaucher' and `Stark Gold' trees were planted as pollinizers. The trees were drip-irrigated.

At the time of planting (Spring, 2000) and at the end of growing season, the stem diameters (10 cm above the budding point) were measured. In the Autumn 2000, shoot lengths and stem heights were also measured. Flower bud formation and other phenological observations were recorded.

The seasonal diameter growth of `0900 Ziraat' was 6.25 mm on MaxMa, 3.09 mm on Gisela 5, and 3.11 mm on *P. avium* seedling and SL-64. Shoot growth of `0900 Ziraat'/Gisela 5 was very weak. It was observed that scion flower buds formed on Gisela 5 and SL-64, while there was either no or very few flower buds on Weiroot, MaxMa and *P. avium.*

Sweet cherry rootstock breeding at Yamagata

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A breeding program for sweet cherry rootstocks was started at Yamagata based on interspecific hybridization among *Prunus* species. Principal breeding objectives included dwarfing ability, disease resistance, easy-propagation ability by hardwood cuttings, graft-compatibility with leading sweet cherry cultivars, and high and stable yield.

Out of 335 hybrids obtained by crossing among *P. incisa* Thumb., *P. nipponica* Matsum., *P. pauciflora*, *P. pseudocerasus* L., and other *P.* spp., we have preselected 25 plants with good propagation ability and good graft-compatibility with scion cultivars.

Among several hybrids tested as rootstocks, shoot growth of `Benisyuhou' sweet cherry grafted on R-30-3 was less than that on Aobazakura standard rootstock, which suggests that R-30-3 may be a dwarfing rootstock. However, graft compatibility of this hybrid with `Benisyuhou' was not very high. Rootstock-cultivar trials are currently being evaluated.

Effect of rootstock on the fruit quality of `Lapins' and `Stella' sweet cherry (*Prunus avium* L.)

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The effect of rootstock on fruit quality of `Stella' and `Lapins' sweet cherry was investigated. *Prunus avium* L. rootstock Sel Noisetec 4, *P. cerasus* L. rootstocks CAB 11E, Edabriz, and Vladimir, and *P. padum* seedlings were compared. Trees were planted in 1994 and trained to a vase canopy architecture.

Fruits were sampled at full ripeness in 1999 and analyzed for sugars and organic acids by gas chromatography and for vitamins (β-carotene, α-tocopherol and ascorbic acid) by HPLC. Moreover, total polyphenols and anthocyanins were evaluated spectrophotometrically.

Fruit from `Stella' exhibited higher levels of malic acid, polyphenols and anthocyanins, whereas those from `Lapins' had a significantly higher vitamin content. Among the rootstocks, the best was Sel Noisetec 4, influencing positively the levels of glucose, fructose, sorbitol and vitamins. Another interesting rootstock was CAB 11E, which induced a similar sugar composition as Noisetec 4 and higher levels of polyphenols and anthocyanins.

`Stella' and `Lapins' grafted on Vladimir showed significantly lower amounts of all the biochemical compounds analyzed. Also, Edabriz had a negative effect on the fruit quality, particularly on vitamins, but affected positively the level of anthocyanins.

Preliminary performance of `Hedelfinger' sweet cherry on ten rootstocks in the 1998 NC-140 trial

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An NC-140 sweet cherry rootstock trial was established at 5 sites (Michigan, Pennsylvania, South Carolina, New York and Ontario, Canada) in 1998. This preliminary report summarizes the performance of `Hedelfinger' on only 10 rootstocks tested uniformly across all 5 sites. Except where noted, each site established the trees in a randomized complete block design with 8 replications of single plant plots per rootstock. This early report examines rootstock influence on tree survival and vigor after 3 years,

and blossom density and cropping in the third year. Significant cropping of `Hedelfinger' in 2000 was only recorded in Ontario and Michigan, where the average yield among all treatments was less than 0.4 and 0.1 kg/tree, respectively. Differences in cropping were not statistically significant among all rootstocks in Michigan and not among the top 8 rootstocks in Ontario. The highest yields were recorded on Gisela (GI) 7, Giessen Gi) 195/20 and Weiroot (W) 53. The most vigorous trees are at Michigan and South Carolina, and the least vigorous are at Ontario and New York. Trees are most dwarfing on GI 5 and Edabriz, and most vigorous on Mazzard seedling, W 10 and W 158. Spring 2000 blossom density (expressed as a ratio of numbers of blossom clusters per trunk cross sectional area) was greater at Michigan than at 2 other sites (data for New York and South Carolina not presented). `Hedelfinger' appeared to be most precocious on Gi 195/20, GI 7, GI 6, and GI 5. Data will also be presented on additional rootstock treatments not common among all sites.

Preliminary performance of `Montmorency' sour cherry on eleven rootstocks in the 1998 NC-140 trial

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An NC-140 sour cherry rootstock trial was established at 6 sites (Michigan, Wisconsin, Pennsylvania, Utah, New York and Ontario, Canada) in 1998. This preliminary report summarizes the performance of `Montmorency' on only 11 rootstocks tested uniformly among all 6 sites. Except where noted, each site established the trees in a randomized complete block design with 8 replications of single plant plots per rootstock. This early report examines rootstock influence on tree survival and vigor after 3 years, and blossom density and cropping in the third year.

Cropping of `Montmorency' averaged less than 0.5 kg/tree for all sites and rootstocks in 2000 (no yield reported by Utah). Ontario reported significantly higher yields than all other states, with two rootstocks approaching 2.0 kg per tree. Highest yields were on Giessen (Gi) 195/20, Gisela (GI) 6, and GI 7, and lowest on Weiroot (W) 10, mahaleb seedling and W 158. The most vigorous trees after 3 years are in Michigan and Utah, and the least vigorous are in Ontario. Thus far, differences among all rootstocks are relatively minor, with trees on mahaleb largest and on Edabriz smallest. Spring 2000 blossom density (expressed as a ratio of numbers of blossom clusters per trunk cross sectional area) was greater at Pennsylvania than at 4 other sites (data for New York not presented). `Montmorency' appears to be most precocious among 5 sites (none recorded for Wisconsin) on Gi 195/20, GI 6, GI 5 and GI 7. Three trees on W 53 in Michigan died during 2000. Preliminary diagnosis suggests tree collapse was due to Prune Dwarf or Prunus Necrotic Ringspot virus infection. Data will also be presented on additional rootstock treatments not common among all sites.

Five year performance of six sweet cherry cultivars on five dwarfing rootstocks

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Six sweet cherry cultivars on five Gisela rootstock selections were established in 1995 at the Rutgers Snyder Farm, Pittstown, New Jersey. There were no significant cultivar x rootstock interactions for trunk cross-sectional area (TCSA), total yield in 2000, cumulative yield, cumulative yield efficiency, or tree survival. `Hartland' and `Ulster' had the largest TCSA, irrespective of rootstock. Trees on Gisela 6 and Gisela 7 had the largest TCSA. `Royalton', `Sam', and `Somerset' had the smallest TCSA. Trees on Gisela 1 and Gisela 5 had the smallest TCSA. `Hartland' produced the highest (significant) total yield in 2000, and had the highest cumulative yields on Gisela 1 and Gisela 5. `Royalton', `Lapins', and `Somerset' had the lowest cumulative yields. Trees on Gisela 6 and Gisela 11 had the lowest cumulative yields. There were significant cultivar x rootstock interactions for number of rootsuckers and yield efficiency in 2000. There was significant cultivar x rootstock interaction for bacterial canker incidence. `Royalton', followed by `Lapins', were observed to have high bacterial canker incidence, which ultimately appeared to be associated with tree mortality.

Characterization of rootstock influence on flower bud and spur formation in sweet and sour cherry

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With some of the newer, precocious cherry rootstocks, there is a potential problem with excessive cropping levels when grafted to very productive scion cultivars. One of the ways to study this, and perhaps to eventually develop strategies to manage it, is to more precisely characterize how rootstock genotype influences precocious floral architecture and placement on the scion, thereby quantifying the anticipated development of the spurs, buds, and flowers that may lead to excessive cropping.
Using `Hedelfinger' and `Montmorency' on 18 different rootstocks in the 1998 NC-140 regional North American rootstock trial, the placement of flowers, buds, spurs, blind nodes, lateral branches, and crop load are being recorded. With `Hedelfinger', across rootstock genotypes, as vigor increased, spur incidence decreased. Spurs were more prevalent on late shoot growth (more apical) compared to early shoot growth (more basal). In general, flower number per bud tended to be highest on basal portions of two-year-old shoots, even though these portions tended to have the fewest spurs. Total flowers per two-year-old shoot ranged from ~ 1 to ~220. Specific results by rootstock, and the potential implications for crop load management, will be discussed.

Screening of sweet cherry cultivars in Northern Germany

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Recent results from the sweet cherry selection work of the Fruit Research Station are presented. Included are cherry cultivars from Germany and other countries in Europe and North America, which are potentially promising for cherry production in Northern Germany. Northern Germany's market situation is characterized by close proximity to customers, who very often buy their cherries directly from the grower.

All new cultivars have to be compared with a group of recommended standards, representing a ripening period of 5-6 weeks. Many of these recommended standards are from the former breeding program at Jork, which began in the 1950s and put special emphasis on cracking resistance and tree health, due to the humid climate of this area. New cultivars also must have high fruit quality, particularly fruit size and firmness. Very often, a compromise has been found between these goals.
The main standard cultivars from the former Jork breeding program are 'Erika', 'Johanna', 'Valeska', 'Oktavia', 'Viola', 'Karina', and the latest ripening but most successful of all, 'Regina'. Standard and new cultivars are described for their ripening time, fruit and tree characteristics. In the early ripening period, 'Naprumi' from Dresden-Pillnitz and 'Merchant' from Great Britain could fill production gaps, as well as 'Namare' and 'Sunburst' in the mid-season, although there still are some improvements possible. In the later maturing season, 'Kordia' is very strong competition for 'Oktavia', 'Viola' and 'Karina', because of its very high fruit quality. However, cropping results are not always satisfactory with 'Kordia'. In the very late season after 'Regina', 'Hudson' and 'Sweetheart' are discussed. There are still some questions about tree health with 'Sweetheart', and about yields with 'Hudson', which perhaps can be improved by dwarfing rootstocks.

New sweet cherry cultivars developed at the University of Bologna's Arboriculture Department (DCA)

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Four years after the initial releases in the 'Star' sweet cherry series (`Early Star® Panaro 1', `Blaze Star', and `LaLa Star'), the DCA announces the release of three new cultivars developed in the same breeding program.

- `Sweet Early® Panaro1' (Dca Bo 84.706.004), which ripens very early (several days before `Burlat'), with large, very sweet fruits having a semi-firm flesh and low acidity.
- `Grace Star' (Dca Bo 84.703.003), which ripens medium early (right after `Celeste') and is interesting for its precocity, high yields and attractive, good-sized fruits.
- `Black Star' (Dca Bo 85.723.002), which ripens mid-season (a few days before `Van') and is marked by very good precocity, consistently high productivity, and large, firm, flavorful fruits that are resistant to rain-induced cracking.

New sweet cherry cultivars from PARC-Summerland

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The sweet cherry breeding program has been ongoing at the Pacific Agri-Food Research Centre (PARC) Summerland, B.C. since 1936. The current objectives of the program are 1) diversification; 2) environmental adaptation; and 3) reduction of cost of production. A number of cultivars have recently been introduced and they include: `Santina', `Sumpaca Celeste', and `Sumnue Cristalina' (early to mid-early season); `Sumste Samba', `Sandra Rose', and `Sumleta Sonata' (mid-season); and `Skeena' and `Staccato' (late season). They span the cherry ripening season from 8 days before `Van' to about 26 days after `Van'. All these cultivars are red to dark red when ripe. Fruit size is good with all cultivars having average fruit weights greater than 10 g (except `Santina'). Most of the varieties have good fruit firmness. Total soluble solids levels range from about 16% to over 19%. Natural cracking levels for some of the selections are lower than for the standard cultivars `Van' and `Bing' and are a definite improvement.

The main sweet cherry cultivars in Hungary

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Cultivated sweet cherry varieties and the year of their introduction in Hungary: `Burlat' (1971), `Valerij Cskalov' (1993), `Margit' (1987), `Linda' (1988), `Solymári gömbölyû' (1968), `Szomolyai fekete' (1968) `Germersdorfi' clones (1982), `Van' (1976), `Hedelfinger' (1956), `Katalin' (1989), `Kordia' (1997), `Kavics' (1999), and `Alex' (1999).

The propagation distribution of sweet cherry cultivars in Hungary:

`Burlat'	14%
`Margit'	2%
`Linda'	4%
`Solymári gömbölyû'	1%
`Germersdorfi' clones	35%
`Van'	15%
`Hedelfinger'	2%
`Katalin'	14%
`Szomolyai fekete'	8%

New varieties (5%) include:

`Valerij Cskalov'	Æ 23-24 mm, ripens at the same time as `Burlat'
`Kordia'	Æ 23-25 mm, ripens 2 weeks after `Burlat'
`Kavics'	Æ 23-25 mm, ripens 3 weeks after `Burlat'
`Alex'	Æ 24-25 mm, ripens 5 weeks after `Burlat'

New sweet cherry cultivars and selections from Washington State University

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A sweet cherry breeding program for the Pacific Northwest United States was initiated by the USDA in 1949 under Harold Fogle, who released `Rainier' and `Chinook'. This program became a Washington State University program in the 1960s under Tom Toyama. Selection of Toyama's crosses continued under physiologist Ed Proebsting following Toyama's retirement in 1985, resulting in the release of Chelan, Cashmere (self-fertile), Glacier (self-fertile), Index (self-fertile), Simcoe, and Olympus. Further selection under physiologist Greg Lang has resulted in the recent release of Tieton (PC 7144-6), self-fertile Columbia (PC 7146-8), and self-fertile Liberty Bell (PC 7064-3), and the imminent release of PC 8011-3, an early-ripening blush cherry similar to `Rainier'. Furthermore, breeding efforts were renewed in 1996 by Lang and James Olmstead, with particular emphasis on fruit quality, self-fertility, and disease resistance (especially powdery mildew). Selection for fruiting qualities of these crosses will begin in 2002.

The Italian sweet cherry evaluation project

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To support and coordinate the regular development of Italian horticulture, in 1993 the Italian Ministry of Agriculture launched and funded a national program to evaluate the performance of new and old cultivars of pome and stone fruits, including cherries. The author of the present paper is the national coordinator of the subprogram "Cherries". As a result of many years of activity carried out mainly by Italian research institutions, 81 cherry cultivars have been progressively included into the Program. Studies of the performance of these cultivars are being carried out in 14 orchards by an equal number of research groups, eight of which are located in Northern Italy and six in Southern Italy.

The varieties have been grafted onto Colt (for northern Italy) and Mahaleb (for southern Italy) rootstocks. Only cultivars endowed with large fruit (7-8g), red skin, and semi-firm to firm flesh have been evaluated. Participating institutions are required to prevent distribution and diffusion of any cultivars protected by patent rights.

After the first two years of cropping, the cultivars judged as "promising" are classified in "List C", whereas those that perform poorly are discarded. After 5 years of production:
i) cultivars with excellent horticultural (*i.e.*, phenological, biological, morphological, and technological) characteristics and suited to widespread distribution are classified in "List A";
ii) cultivars suited for particular industrial purposes, or having a local interest and limited acreage, are classified in "List B";
iii) cultivars with a negative evaluation are classified in "List X".
Due to the horticultural importance attached to the ability to bear a crop with their own gametes, several self- fertile varieties have also been included in the Program and are now under evaluation.

Cross-compatibility studies in some Hungarian sweet cherry hybrids

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The sweet cherry breeding at the Research Institute for Fruitgrowing and Ornamentals has been going on for 50 years. It was started by Sándor Brózik with selections of local varieties, then it was followed by cross-breeding. This work has resulted in several valuable hybrids and cultivars, many of them self-fertile. These self-fertile cultivars are highly productive and bear regularly, so growers can expect secure yields year-in and year-out. In our opinion, a profitable orchard in the future will consist of self-fertile and self-sterile varieties as well. In order to determine the compatible combinations, we have begun fertilization studies.

Six self-sterile hybrids as the maternal parent were pollinated artificially with self-fertile partners in twenty combinations over two years (the partners in each cross bloom at the same time). The level of fruit set was assessed. Characteristics of pollen tube growth in the style and nucellus that reveal cross-compatibility were studied in some combinations. The percentage of self-fertility, and the quality and quantity of pollen of father partners were determined. Our detailed data will be presented.

A preliminary study of physiological and S-allele specific breakdown of self-incompatibility in sweet cherry

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The effects of specific S-alleles and environmental conditions on breakdown of self-incompatibility in sweet cherry were investigated. Among the S-genotypes, the highest breakdown rate occurred in S3S4 genotypes (2 - 7 % fruit set). The breakdown rate, expressed as either fruit set or pollen tube growth rates, did not differ among cultivars within the same S-genotype combination. Depending on temperatures from 10 °C to 25 °C, the percentage of breakdown (expressed as unrestricted pollen tube growth) ranged from about 0 to 25 % in self- or cross-incompatible pollinations of all S-genotype combinations. The S3S4 genotypes almost always had the highest breakdown rate at all temperatures. However, no specific S-allele gave an elevated effect on overcoming self-incompatibility.

A comparison of the adaptations of Turkish and foreign sweet cherry cultivars in the K.Maras region of Turkey

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The purpose of this experiment was to compare the growth, bloom times, fruit characteristics, harvest dates, yields, etc. of well known foreign cultivars with those of theTurkish standard, `0900 Ziraat'. The experiments were established in several sweet cherry growing regions but in this paper, only the results of the K.Maras experiment will be presented.

In the experiment, 3 Turkish (`Dalbast', `Veysel', and `0900 Ziraat') and 20 foreign (`Belge', `Celeste', `Kordia', `Garnet', `Ferboulus', `Fercer Arcina', `Lambert', `Lapins', `Meckenheimer', `Noir de Meshed', `Octavia', `Precoce de Bernard', `Rainier', `Sweetheart', `Star', `Summit', `Sunburst', `Techlovan', and `Talegal') were planted in March, 2000. All were budded on *P. avium* seedlings. The experiment was established with 6 trees of each cultivar, with single tree replication, and the trees were drip irrigated.

Trunk diameters (10 cm from the graft union) were measured at planting and after leaf fall, and shoot length was measured in the winter of 2000. Trunk and shoot growth and phenological results will be discussed.

According to the preliminary results, the highest growth rate was observed in `Rainier' (8.6 mm/season) and the lowest growth rate was seen in `Fercer Arcina' (1.9 mm/season). There were no flower buds on any of the varieties.

Characterization of new imported early season sweet cherry cultivars in Israel

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Early season cultivars have an economical importance so that new domestic and export markets could be developed. Sweet cherry (*Prunus avium* L.) cultivars 17 H 580, 40 E 50 and 106 EB 325 were imported to Israel for potential use as early season cultivars. They

were propagated *in vitro*. Thermotherapy in combination with shoot-tip culturing was successfully applied to eliminate existing virus infection. The chilling requirement, bloom time, and date of ripening of both 40 E 50 and 106 EB 325 are similar to `Burlat'. Their fruit size is about 20% less `Burlat', but their productivity is higher. Both are self-infertile and require cross-pollination. The chilling requirement of 17 H 580, which is self-fertile, is significantly lower than that of `Burlat'. Fruits are also borne on annual twigs. Fruits are 50% the size of `Burlat', and ripen slightly earlier. 17 H 580 is interesting for production in low chilling areas, if fruit size can be improved.

The influence of accelerated flower development on pollen quality in sweet cherry

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Most tree fruit breeding programs are very long-term and land intensive due to the long juvenile period. Also, pollinations can usually be made only once a year. Therefore, pollen quality and quantity are two essential elements for fruit breeding. To use early blooming cultivars as maternal (seed) parents and late blooming cultivars as paternal (pollen) donors, pollen should be collected far in advance of the normal maternal flowering stage. For such later blooming cultivars, the branches should be collected between the "delayed dormant" and "tight cluster" blossom development stages, and forced into flowering in the laboratory or greenhouse.

The effect of this premature promotion of flower development on pollen quality was studied in three sweet cherry cultivars. Cultivar did not affect pollen germination. Flowers forced at the delayed-dormant stage (about 35 days prior to natural full bloom) had significantly reduced pollen germination when averaged across cultivars. Pollen from fully open flowers had the highest germination, followed by half- and un-open flowers.

Evaluation of sweet cherry germplasm in southern Chile

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A germplasm evaluation of wild and seed-propagated sweet cherries in Southern Chile was carried out from 1998-2000. The German settlements during the nineteenth century were the origin of these varieties.

The following characteristics were evaluated: weight of twenty fruits, shape, polar and equatorial diameter, length of stem, shape of fruit end, soluble solids, flesh color, skin color, pH, acidity and cracking percentage. Fruit weights varied from 5.2 to 8.25 g/fruit. Cracking percentage varied from 0 to 27 %.

The best fruit weight and size was found in Osorno (approx. 43° SL) with 8.25 g/fruit. The skin colors varied from white to dark red, with some bicolored varieties. Some resistance to cracking was evaluated in varieties with the best size.

Sour cherry breeding at Dresden-Pillnitz

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The sour cherry breeding program was started in 1965 by Wolfram at Müncheberg. In 1971 the sour cherry breeding was continued at Dresden-Pillnitz. The main breeding goals are high productivity, quality, self-fertility, disease tolerance to *Monilinia* ssp., *Pseudomonas syringae*, *Blumeriella jaapii* and Prunus Necrotic Dwarf Virus and suitability for mechanical harvesting. Several crossing series were carried out. In result five new varieties and four clones were selected. In the most cases they did not achieved the high yield of the variety 'Schattenmorelle'. But they are more tolerant to diseases.

Meiotic investigations were carried out to detect the reason of the low fertility in sour cherry varieties. In result it was possible to detect a relationship between the low fruit set and the pairing frequencies of the chromosomes in the metaphase I. The observed meiotic instability indicates a disharmony in the genome constitution of the allopolyploid sour cherries.

Screening cherry germplasm for resistance to leaf spot

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All the sour cherry (*Prunus cerasus* L.) varieties grown in the U.S. are susceptible to cherry leaf spot (*Blumeriella jaapii*) and currently the disease must be controlled chemically. Therefore, a major goal of the MSU sour cherry breeding program is the development of new varieties that have stable resistance to cherry leaf spot. Due to the long life of a cherry orchard, it is important that the leaf spot resistance bred into new varieties be durable, reducing the probability of a future breakdown in resistance.

Our preliminary data suggests that one source of potential resistance has already been identified in the interspecific cherry hybrid GI 148-1 (*P. cerasus* `Schattenmorelle' x *P. canescens*). It is likely that other sources of resistance to cherry leaf spot can be found within the available cherry germplasm. The objectives of this study were to screen the available cherry germplasm for resistance to an array of leaf spot isolates from sour cherry and other Prunus species. Before we could begin screening, a rapid screening assay was developed using detached leaves to maximize the limited plant material

available. Fungal isolates from various varieties of sour cherry and other Prunus species growing in Michigan were also collected for use in the screening experiments. Due to the extremely slow growth rate of *B. jaapii* isolates on conventional leaf spot growth media (Lima Bean Agar), alternative means of culturing the fungus *in vitro* also had to be developed in order to produce enough inoculum for inoculation of leaf disks. A new means of culturing *B. jaapii* on cherry fruit agar allowed us to produce up to 6 x 106 spores/ml per petri dish.

Results from the comparison of infection of excised leaf disks and whole plants showed that there was no difference in infection or symptoms produced between the two. These and other preliminary results from screening trials are discussed.

The main sour cherry cultivars and candidates in Hungary

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Cultivated sour cherry varieties and the year of their introduction in Hungary: `Meteor korai' (1965), `Favorit' (1970), `Korai pipacsmeggy' (1979), `Csengõdi' (1990), `Érdi jubileum' (1980), `Érdi bõtermõ' (1970), `Maliga emléke' (1993), `Újfehértói fürtös' (1970), and `Kántorjánosi' (1994).

Candidate varieties include:

`Érdi nagygyümölcsû'	Æ 23-25 mm, ripens 8 days after `Meteor korai'
`Piramis' (2/152)	Æ 24-26 mm, ripens the same time as `Meteor korai'
`Du 1'	Æ 22-24 mm, ripens 12-14 days before `Meteor korai'

The propagation distribution of sour cherry cultivars in Hungary:

`Pándy'	4%
`Cigány'	4%
`Meteor korai'	4%
`Érdi jubileum'	5%
`Érdi bõtermõ'	27%
`Maliga emléke'	3%
`Újfehértói fürtös'	22%
`Kántorjánosi'	14%
`Debreceni bõtermõ'	10%
Others	7%

Sour cherry breeding at Michigan State University

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The sour cherry breeding program at MSU was initiated in 1983 with the goal of developing cultivars which are disease resistant and have fruit quality superior to Montmorency. In general, fruit quality is acceptable in many of the seedlings. Two selections with excellent but very different fruit quality attributes will be described. However, the bigger challenge continues to be breeding for high yields. We hypothesize that the reduced fruit set encountered in sour cherry may be due to partial self-incompatibility and meiotic irregularities and aneuploidy resulting in early fruit abortion. Understanding these two phenomena and their impacts on fruit set is a major goal of the program. In addition, yields may be reduced due to freeze damage to the flowers in the spring. Therefore, selection is for cherry varieties that bloom late in the spring. To support the breeding effort, a sour cherry linkage map is under development with the goal of comparative mapping with the peach and almond linkage maps. The utility of comparative mapping will be discussed using bloom time as an example.

Fertility of sour cherry varieties selected in Hungary

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The third most important (based on volume) fruit species grown in Hungary is the sour cherry. The diversity and scale of sour cherry cultivars is most variable and unique here, even on a worldwide relative scale. The assortment increases continuously as a result of breeding and selection of land races.

Beginning with the 16th century, several towns of East-Hungary (Debrecen, Mátészalka, Nyíregyháza, Újfehértó) developed centers of sour cherry production. The sour cherry populations of that countryside are still very rich in variability. To date, three self-fertile cultivars have been selected as spontaneous accessions: `Debreceni bõtermõ', `Kántorjánosi', and `Újfehértói fürtös'. These yield regularly and are adapted to mechanical harvest. Their fruit characteristics are comparable to the best-known cultivar in Central Europe, `Pándy meggy', which is utilized for both fresh and processing markets.

The productivity of these varieties has been recorded under conditions of self-fertility and open pollination from1983 to 2000. The results have been highly variable. The average results of the 17 years showed regularities of relevance as the cultivars set less fruit by autogamy than by allogamy: `Debreceni bõtermõ' set 5.5 % by self pollination, 22.5 % by open pollination; `Kántorjánosi' set 4.6 % and 20.2%, respectively; and `Újfehértói fürtös' set 5.4 % and 22.2 %, respectively. Cross pollinations between these three cultivars and the self-incompatible `Pándy meggy' proved that none of them is a suitable pollinizer of `Pándy meggy', nor did the reciprocal

combinations produce a sufficient fruit set. Poor fertilization has been noted in the combinations `Újfehértói fürtös' x (`Debreceni bõtermõ' or `Kántorjánosi'), whereas the rest of combinations proved to be sufficiently fertile.

Explant formation from shoot-tip cultures of sweet cherry

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Tissue-cultured plantlets of *Prunus avium* L., which were produced from shoot-tip culture, were rooted and grown in perlite in jars. Their roots were excised and introduced on MS medium. The basal medium was supplemented with different combinations and concentrations of benzyladenine (BA), indolebutyric acid (IBA), and gibberellic acid (GA). Two kinds of structures were produced: a) individually isolates shoots, and b) callus like structures, producing 4 to 20 shoots.

Meiotic investigations in a *Prunus avium* x *P. canescens* hybrid

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Prunus canescens Bois. is a wild cherry tree with spreading branches and a height up to 2 meters. It is located in Central- and West China. According to taxonomic characteristic features Reader (1962) classified *P. canescens* in the subgenus *Cerasus*, section *Pseudocerasus*. Schmidt (1973) concluded after analysing crosses between *P. avium* and *P. cansecens* that *P. canescens* must be integrated in the section *Eucerasus* together with *P. avium*, *P. cerasus* and *P. fruticosa*.

To confirm this hypothesis meiotic investigations of pollen mother cells were made in a hybrid of *P. avium* x *P. canescens*. This hybrid shows morphological characteristic features of both parents.

In result of the meiotic studies all of the 25 analyzed pollen mother cells showed homologous chromosome pairing. Eight bivalents were found in 19 pollen mother cells. The other six pollen mother cells showed two univalents and seven bivalents. Multivalents were not observed.

These results confirm the observation of Schmidt (1973) that *P. canescens* should belong to the section *Eucerasus*.

A somaclonal variant in `Hedelfinger' sweet cherry

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Reduction of tree size still represents the main goal of cherry breeding to lower training and harvest costs. Somaclonal variation and/or genetic transformation techniques can be considered a tool for improving cherry. The present research has been carried out as part of a program whose aim was to develop an early screening procedure to select putative somaclones of *Prunus avium* `Hedelfinger' (H) based on physiological, morphological and molecular parameters related to the light quality modulation of plant growth and development.

Somaclone HS has been isolated inside a population of regenerated shoots from H leaf explants. DNA analyses conducted by ISSR (Interspaced Simple Sequence Repeat) system revealed polymorphism between the somaclone HS and the wild type propagated by microcutting. When tested under different light quality conditions *in vitro*, proliferating shoots of somaclone HS showed a different pattern of growth and development, with the main modifications related to apical dominance and chlorophyll production. Under white light, H shoots showed a higher apical dominance compared with somaclone HS. Somaclone HS shoots grown *in vitro* under blue light had a peculiar bushy habit due to low leader shoot growth, relatively high node (bud) formation alongside the stem, and reduced 'distance from the apex' expressed as the number of nodes included between shoot apex and the first shoot or disclosed bud. Preliminary investigations on *in vivo* acclimatized HS plants confirmed these results. Darkness affected chlorophyll a and b accumulation to a greater extent in somaclone HS than in H, not only *in vitro* but also in *ex vivo* conditions. All the data indicate that the somaclone HS is a variant genotype and the mutations could be related to growth and functionality.

Molecular characterization of some sweet (*Prunus avium* L.) and sour (*Prunus cerasus* L.) cherry cultivars using RAPD markers

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Randomly amplified polymorphic DNA (RAPDs) markers, obtained by the polymerase chain reaction (PCR), were tested on 48 genotypes: thirty-one sweet (*P. avium* L.) and seventeen sour (*P. cerasus* L.) cherry varieties.

RAPD analysis discriminated all the genotypes. One hundred and eighty primers have been tested for the RAPD analysis. With these a total of 431 DNA bands were produced, 176 of them being polymorphic. Their analysis with a numerical taxonomy method produced an UPMGMA dendogram illustrating the similarity of the analyzed varieties.

Thus, the verified RAPD analysis show that this easy, simple and relatively inexpensive approach is particularly suited for different purposes, such as cultivar identification and definition of taxonomic relationships.

Yield efficiency of sour cherry on 10 sites in Denmark and Sweden

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The purpose of this investigation was to study the winter mortality of flower buds and yield efficiency of 'Stevnsbaer' sour cherries (*Prunus cerasus*) on Colt rootstock in seven Danish and three Swedish orchards. All trees had been planted in the early 1990s and trained as spindle trees. 12 representative trees were selected on each site, and in March 2000, a total of 480 short spurs and 480 annual shoots were sampled for bud dissections. Stem diameter and crown volume were measured, and the total number of well-developed spurs per tree was estimated. Full bloom was in early May, and yields were recorded in August by mechanical harvesting. Flower bud dissections under the microscope showed floral mortality rates of annual shoots between 20 and 82 percent in March. In all orchards, the mortality was smaller on short spurs (0-30 % dead flowers). Two (out of three) Swedish orchards had the highest mortality rates. The average tree crown volume ranged from 8 to 23 m^3 on the 10 sites, and average yields ranged from 14 to 57 kg/tree. There was a positive correlation ($r^2 = 0.32$***) between tree size and yield, but the relationship between number of spurs and yield was stronger ($r^2 = 0.64$***). The yields were quite high on the Swedish sites in year 2000, and comparing all orchards, correlations between floral mortality of annual shoots and yield did not exist. However, within both the Danish sites ($r^2 = -0.39$***) and the Swedish sites ($r^2 = -0.42$*) floral mortality and yield per tree were negatively correlated. Factors affecting yield efficiency of middle-aged sour cherries are discussed.

Sweet cherry cultural practices in Pakistan

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The sweet cherry varieties found in Pakistan include `Early Black' (`Tontal'), `Guingnes de Lamaurie', `Bigarreaus', `Bigarreaugros Courte', `Bigarreau Amber', `Napoleon', `Coe's Late Carnation', `Old Early Black', `Knight's Early Black', `Early Rivers', `Red Early', and `Frogmore'. Cherries are grown in a variety of soils, requiring

2-3 doses of irrigation during summer. They normally require 75-100 kg nitrogen, 90 kg $P_2 0_5$, and 110 kgs K_2O per acre annually.

Sweet cherry fruits contain volatile compounds: benzaldehyde, 2-heptanone, linalool, acetic acid, isovaleric and octanoic acids, plus a neutral lipid fraction containing wax, esters, sterols, and triterpene acid. Fruit softening occurs concomitant with an increase in total pectin per fruit. Cherries are stored at 0-2 °C with 3-10% O_2 and 10-12% CO_2.

Further research is needed to determine the best cultivars, suited to Pakistan soil and climatic conditions, drought and rain resistant varieties, and better rootstocks.

Performance of sweet cherry trees on Gisela® 5 rootstock

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The influence of Gisela® 5 rootstock on the growth, yield and fruit quality of 'Burlat', 'Vega', 'NY 9801' and 'Kordia' sweet cherry was investigated. Trees of the same cultivars grafted on Mazzard seedlings *(P. avium* L.*)* were used as a control. The field experiment was carried out on grey-brown podzolic soil at the Experimental Station in Dąbrowice (Central Poland) from 1995 to 2000. In the orchards, a drip irrigation system was installed for applying water during the vegetation season.

The results revealed that, in comparison to Mazzard, Gisela® 5 reduced significantly the growth of sweet cherry trees. Depending on cultivar, trunk cross-sectional areas of six-year-old trees grafted on Gisela® 5 were from 18 to 33% smaller than those on Mazzard.

Cumulative yields and yield efficiencies for all of the sweet cherries on Gisela® 5 were higher than for the control trees. The trees of all cultivars tested on Mazzard had larger fruits than those on Gisela® 5. Fruit soluble solids were not affected by rootstock.

Natural growth habit of sweet cherry maiden trees

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The natural growth habit (syllepsis) of maiden trees of commercially important standard and newly released (Cornell-Geneva breeding program) sweet cherry cultivars, grafted on either *Prunus mahaleb* or Giessen rootstocks (hybrids of *P. cerasus* and *P. canescens*) were examined during two consecutive seasons in commercial nurseries in New York State. During the test period, the trees were left unpruned and no lateral branch promotion procedures were applied. The trees on Giessen rootstocks were less

vigorous than those on *P. mahaleb*. In spite of year-to-year variation, the performance of trees assessed by tested characteristics [number of feathers (TNF), tree height (TH) and stem diameter(SD)] was qualitatively consistent (repeating order of increasing or decreasing values of tree quality characteristics). Among the trees of ten different cultivars on *P. mahaleb*, there were two or three groups of cultivars distinguished by branching behavior. The comparison of tree quality characteristics, especially for TNF, between the cultivars on different Giessen rootstocks, showed that the cultivar *per se* was the main factor influencing branching. In trees of most cultivars, the correlations between TNF and SD were significant, whereas those between TNF and TH were not. The possibility of using stem diameter as more reliable parameter for estimating tree quality, and its propensity for feathering, will be discussed.

Effect of P-HL A® rootstock on the growth, productivity and fruit quality of six sweet cherry cultivars

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The growth, yield, winter hardiness and fruit quality of six sweet cherry cultivars grafted on P-HL A rootstocks were analyzed. The trees started to bear in the third year after planting. P-HL A significantly reduced tree size and increased productivity in comparison to Mazzard seedling, which was used as a control. Rootstock did not influence of sweet cherry fruit size.

Optimization of planting densities of sweet cherries on Tabel®Edabriz (*P. cerasus*) rootstock

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At Ahrweiler (western Germany) in March 1994, a sweet cherry trial was planted to compare planting densities between 1666 and 5000 trees/ha in a V-shaped 30° spindle system and a V-shaped 60° trellis system with regard to their quantitative and qualitative performance. Varieties were 'Starking Hardy Giant', 'Noire de Meched', 'Fercer', 'Lapins' and 'Regina' (planted 1995), all grafted on Tabel®Edabriz (*P. cerasus*). The trial was completely covered by a rain shelter construction.

The first harvest showed a positive correlation between planting density and yield, but also a large influence of the cultivar. Highest yields were obtained by 'Lapins' at 5000 trees/ha. The yield development with time was consistent for each training system: while yields from the 30° spindle increased continuously, the 60° trellis hedge had decreasing yields in 2000. Also, fruit size of the trellis hedge decreased in 1999 and 2000.

Rain covers didn't completely prevent fruit cracking and rotting, but gave an efficient protection against frost during flowering in 1997. 'Lapins', which exhibits a very dense and bunched fruit set, was particularly susceptible for cracking. Consequently, cultivar choice is also important for covered orchards, and control of *Monilia* should not to be neglected.

Sweet cherry growing in Chile: rootstocks and training systems - an overview

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Sweet cherry growing in Chile has undergone significant changes over the last few years. The desire by the growers to reduce the non-bearing period and facilitate various harvest tasks, along with achieving higher fruit quality as demanded by export markets, has created the need to both intensify the orchards and improve crop management techniques by introducing new varieties, rootstocks, and training systems.

The most widely used rootstocks are Mazzard (seedling and F-12), *P. mahaleb* seedling, *P. cerasus* seedling, and Colt. New clones have been introduced, such as the Gisela and Weiroot series, MaxMa 14, and CAB 6P. Plantings on these rootstocks are relatively young (fourth leaf) and results regarding adaptability have been erratic and uncertain so far, due to the diverse edaphoclimatic conditions under which cherries are grown.

Even though a large percentage of the area planted to sweet cherries still uses traditional training systems (large tree size, widely spaced, vigorous and shapeless architectures left to grow freely), the newer plantings are being trained mainly under the open vase or central leader systems (all its variations) at a planting density of 667-888 trees/ha. Trellis systems (Tatura, Drapeau Marchand), at a planting density reaching 2000 trees/ha, are less common.

Effect of BA (6-Benzyladenine) and GA 4+7 in repeated treatments on feathering of sweet cherry cultivars in nursery

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In 1993, a series of trials was begun to determine the effect of 6-benzyladenine (6-BA) on feathering of one-year-old sweet cherry trees in the nursery. In the first year, 0.02% 6-BA (water soluble formulation, Paturyl 10 WSC) treatment was applied three times to one-year-old sweet cherry trees. This treatment did not affect the number and length of long shoots; however, the number of spurs increased significantly.

In a further trial in 1997, 6-BA and GA4+7 were separately applied in a nursery trial to stimulate the lateral branching of one-year-old 'Germersdorfi FL 45' sweet cherry trees. The following treatments were applied: 0.06% 6-BA treatment 3 times, and 0.06%

6-BA 3 times with two additional 0.04% GA4+7 applications. Growth, as well as the number and length of laterals were measured at the end of the growing season. 6-BA treatments significantly increased the total number of laterals in comparison to the untreated control. Additional GA4+7 treatments did not affect the total number of laterals, but increased the length of lateral shoots.

The effect of different BA concentrations (0.04%, 0.06% and 0.08%) and repeated treatments on lateral shoot formation of sweet cherry trees was studied in 1998. The results showed that 0.04% BA sprayed three times with two additional GA4+7 sprays improved the feathering of sweet cherry varieties ('Burlat', 'Germersdorfi FL 45', 'Linda') in the nursery. The higher concentration (0.06%) seems to be suitable to increase the number of short shoots and decrease apical growth of nursery trees of the easily feathering 'Van'. The repeated sprays (3x, 4x, 5x) of the higher (0.06%) BA concentration did not affect the terminal growth of 'Van' trees, but improved the shoot formation of laterals shorter than 30 cm. We conclude that 0.04% BA sprayed three times with two GA4+7 sprays is suitable to improve the feathering of one-year-old nursery trees. The higher number of repetitions might be suitable to increase the number of short shoots and decrease apical growth of `Van' cherry trees.

Prohexadione-Ca, a gibberellin biosynthesis inhibitor, can effectively reduce vegetative growth in `Bing' sweet cherry trees

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A two-year investigation has been carried out in mature, vigorous `Bing' cherry trees near Rancagua, Chile. Prohexadione-Ca (BAS 125 11 W), a gibberellin biosynthesis inhibitor, has been applied at 3 concentrations (75, 150 and 300 mg a.i./L) separately in springtime (preharvest) and in autumn (postharvest) by spraying the trees (4 trees/treatment), plus a non-treated control. No effects of autumn-applied treatments were found for reduction of vegetative growth, neither during season of application or the next. Springtime-applied Prohexadione-Ca treatments were effective in significantly reducing vegetative growth as measured by shoot length. The reduction in shoot length, both in lateral and terminal positions, for each springtime-applied Prohexadione-Ca treatment, was proportional to the concentration applied. No definitive recommendations can yet be given, as further work is required and no measurements on fruit quality have been conducted; however, this bioregulator seems promising in achieving growth control under vigorous conditions typical of Chilean cherry orchards.

The effect of hydrogen cyanamide on sweet cherry maturation

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In Northwest Portugal, sweet cherry cultivation has the ideal ecological-field conditions in the Douro south region, namely at these locations: Cinfães and Resende, especially the latter. Cherry production near the Douro river is the earliest in the country, which makes it more competitive. This advantage can be enhanced by using active growth regulators to break dormancy and advance maturation. Hydrogen cyanamide is a growth regulator which promotes the breaking of dormancy in fruit trees, grapes, and kiwi fruit. It also stimulates the growth of shoots, and advances bloom, fruit maturation and size. It is especially recommended winter chilling temperatures are lacking such that budbreak would be irregular.

Our aim was to study the best time to apply hydrogen cyanamide to advance bloom of 'Burlat' sweet cherry. At the same time, to provide cross-pollination, we also treated 'Van', which is not the earliest but is the main pollinizer variety. This work tested three dates of application and was performed from 1997-99.

Our results confirm the ability to advance bloom and fruit maturation, for both cultivars, from 4 to 5 days. Applications on 30th January (45 to 50 days before bloom) promoted the greatest advance. The use of this growth regulator, under our experimental conditions, did not increase productivity or fruit size.

Environmental factors and prevention of the occurrence of double pistils in sweet cherry

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For sweet cherries cultivated in warm regions of Japan, the occurrence of abnormal flowers with double pistils can be a serious problem. In this study, the effects of environmental conditions on the occurrence of double pistils were examined. Furthermore, several methods to prevent the occurrence of the disorder were attempted.

High temperature treatments during flower bud formation delayed the progression of flower differentiation. The formation of double pistils occurred when the trees were exposed to high day temperatures above 30 °C. High temperatures also caused the formation of pistil-like appendages that replaced anthers. High temperature induced the occurrence of double pistils most severely in buds that contained sepal and petal primordia at the beginning of the treatment, and the frequency of occurrence of double pistils was slightly lower in buds treated at the earlier stage of flower differentiation. On the other hand, high temperature had little effect on pistil doubling in buds with differentiated stamen and pistil primordia.

At lower temperatures, severe water stress did not induce the occurrence of double pistils. In contrast, severe doubling occurred regardless of the level of soil

moisture at higher temperatures. Under field conditions, severe water stress by the restriction of watering hardly affected the frequency of double pistils.

Artificial shading in summer markedly reduced the percentage of flower primordia with equally developed twin pistils in the buds, and hence reduced the percentage with double pistils the following spring.

Forcing conditions accelerated flower differentiation considerably. Therefore, in mid-July, when the maximum temperature began to rise rapidly, petal and stamen primordia had been formed in the buds under forcing conditions, which reduced double pistil formation remarkably.

These results suggested that high temperature above 30 °C at earlier stages of flower differentiation is a critical factor in the formation of double pistils in sweet cherry, and that artificial shading or forcing culture can be applied to sweet cherry production in warm areas to reduce double pistil formation.

Cause of damage to 'Van' sweet cherry flower buds on the southern coast of Norway

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Commercial production of sweet cherries on the Southern Coast of Norway has been inhibited by high risk of crop failures due to extensive damage of flower buds.

Rain covers of plastic to protect against fruit cracking have become the standard in Norway. Similar covers used from early spring offers opportunities for reducing infection pressures of diseases caused by 1) fungi and 2) bacteria. Such covers might also offer opportunities for modifying the climate in ways leading to less damage of flower buds before and during flowering, resulting in better pollination.

The aim of this investigation is to develop a strategy for reducing the risks of bud damage by: locating production to "low risk areas and locations"; making better use of the rain covers to prevent diseases linked to bud damage; and preventing possible mineral deficiencies. Study of the factors leading to damage of flower buds on the Southern Coast of Norway was initiated in early spring 2000 and will continue into 2002.

Thus far, the observations confirm that: 1) damage to the buds happens at least two months before bud break; 2) sites with more stable, less fluctuating temperatures during the winter show less damage; 3) sites at the coast (Lindesnes) with a boreal climate and 60 kilometers upcountry from the coast had very little bud damage (< 20%); and 4) orchards between the coast and inland had much damage (> 50%).

All the investigated orchards suffered from deficiency of Zn, except the orchard in Lindesnes with no significant damage at all (< 5%) to the flower buds. All orchards with > 50% damage to flower buds had leaf analysis indicating Zn-deficiency and they were infected with bacterial canker (*Pseudomonas syringae*).

Sweet cherry genotype affects biochemical and structural features of fruit cell walls

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The composition of sweet cherry fruit cell walls and its relation to firmness was investigated for six genotypes based on previous firmness data and harvest date at Summerland, B.C. Among the genotypes, 'Merpet' had the lowest fruit firmness (the earliest harvest), followed by 13S-27-17, 'Celeste', 13S-34-50, 'Lapins', and 'Sweetheart' (the latest harvest). In general, the firmer fruit genotypes had a greater concentration of alcohol insoluble residues (AIR) and more total AIR per fruit. Softer fruit genotypes had a greater amount of polymers weakly associated to the cell wall (*e.g.*, the water soluble fraction). However, softer fruit genotypes had a lower amount of a highly esterified population of the tightly bound pectins (*e.g.*, Na_2CO_3 soluble fraction). The level of total hemicellulosic neutral sugars and uronic acids showed no relationship with fruit firmness. Xyloglucan in hemicellulose fractions seemed to be lower in softer fruit genotypes but it was not consistent across all genotypes. Sugar composition, molecular mass of each fraction and total Ca content and their relation to fruit firmness in sweet cherry will be discussed.

The influence of different rootstocks on leaf mineral composition and fruit quality of `Lapins' sweet cherry

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In 'Lapins' sweet cherry grafted on ten different rootstocks (F 12/1, Gisela 4, Gisela 5, Gisela 12, MaxMa 14, Pi-Ku 4/20, Edabriz, W 13, W 72 and W 158), the effect of rootstock on leaf mineral composition (N, P, K, Ca, Mg, S, B, Cu, Fe, Mn, Mo and Zn) was studied. It was established that rootstock influenced the concentrations of N, K, Ca, Mg, Fe, Mn and Zn in the leaves of 'Lapins'. The highest influence of rootstock was observed in the concentration of potassium.

The contents of sugars and organic acids in 'Lapins' fruits were determined using HPLC. The concentrations of sugars (sucrose, glucose, fructose), sorbitol, and organic acids (malic, shikimic and fumaric) were determined. Different rootstocks affected the concentrations of individual sugars in the fruits; however, the greatest influence was noted on the concentrations of organic acids in 'Lapins'.

Defining sink activities in developing cherry fruit, the importance of acid invertase gene expression and enzyme activities in comparison to those of other enzymes potentially related to sink activity and sugar accumulation in sour cherry (*Prunus cerasus*)

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Sink activities are often poorly or only partially defined, but collectively these must reflect the coordinated expression of a number of genes for import and utilization of translocated photosynthetic products. In sour cherry, sorbitol and sucrose are the major carbohydrates translocated to the fruit where several enzymes are potentially important in fruit sink activity, including sorbitol dehydrogenase (SDH), sucrose synthase (SuSy), and the acid and alkaline invertases. We determined sugar composition and enzyme activities for SDH, SuSy, and several invertases during cherry fruit development. We also cloned genes encoding these sorbitol- and sucrose-metabolizing enzymes and a potential sucrose transporter from a cherry fruit cDNA library. Results showed that glucose, fructose and sorbitol were the major sugars accumulating late in fruit development. Sucrose was not even a minor constituent. Correspondingly, among the sorbitol- and sucrose-metabolizing enzymes, acid invertase activity was most closely related to hexose accumulation. Acid invertase RNAs (*AI-1* and *AI-2*) were highly expressed in later development stages when sugars accumulated. Activities of SDH, SuSy, and alkaline invertase were low and changed relatively little throughout fruit development. Genes encoding SuSy and a sucrose transporter were strongly expressed only in young fruit prior to pit hardening. In contrast, SDH mRNA was constitutively expressed throughout fruit development. Our results suggest two distinct sucrose unloading mechanisms during cherry fruit development, a symplastic mechanism at an early stage and an apoplastic mechanism at a later sugar-accumulation stage. Overall, acid invertase may play the most important role in determining fruit sink activity and final fruit sugar content.

Self sterile and self fertile sour cherries equally need insect (bee) pollination

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Experiments were conducted with five sour cherry cultivars four of them were self fertile and one was self sterile. Different but always reduced levels of fruit set were obtained by limiting the duration of the effective bee pollination period. The limitation of the bee pollination period definitely affected the fruit set of all the cvs. Thus, no doubt, both self sterile and self fertile sour cherries equally need insect (bee) pollination to set a profitable yield.

Vegetable oil emulsion treatment reduces rain-induced cracking of sweet cherries

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'Rainier' cherry trees were sprayed with vegetable oil emulsions at 1%, 2.5%, and 5%, respectively, one day before forecasted rain. Untreated trees served as control. Oil emulsion at 1% reduced fruit cracking by 50%. At 2.5% or 5%, oil emulsion reduced the level of control fruit cracking (30% - 50%) to about 10%. Oil application did not cause phytotoxicity to fruit or trees.

Tree covers provide superior protection against rain-induced sweet cherry fruit cracking in comparison with intermittent calcium chloride misting during rain

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Rain-induced cracking of sweet cherries is a serious problem that results in large crop losses at harvest in many cherry production areas of the world. The most widely held view is that cracking is caused by the direct absorption of rainwater through the fruit skin. Several calcium compounds, including calcium chloride ($CaCl_2$), have been evaluated in the past as orchard sprays, all with inconsistent results. A method which intermittently applies a 0.5-0.1 % $CaCl_2$ solution to trees during a rain event has been reported to significantly reduce rain-induced fruit cracking (Flore et al, 1997). In addition, rain exclusion tree covers have been reported to significantly reduce cracking in wet years. An experiment (RCB design) with four replications was established in 1998 to measure the reduction in fruit cracking of 'Vandalay' /Mazzard trees (planted in 1989) treated with: a) an intermittent 0.5% (w/v) $CaCl_2$ solution applied with an overhead micro-sprinkler during each rainfall event within three weeks of harvest; b) covered with polyethylene plastic; and c) left untreated. In one out of three years, fruit cracking from covered trees was significantly reduced by 22% (P=0.001) in comparison with untreated trees. In contrast, $CaCl_2$ did not significantly reduce fruit cracking, even though cracking was reduced numerically by 11% in comparison with untreated control trees. Fruits from $CaCl_2$ treated trees were significantly smaller and had significantly lower percent soluble solids in one of the three years (P=0.01). These data indicate that in a three year test which differed in rainfall, tree covers provided that greatest protection against rain-induced fruit cracking and that misting with $CaCl_2$ inadequately controlled fruit cracking and indeed had a detrimental effect on fruit size, soluble solids, and tree health.

Calcium chloride reduces rain-cracking of sweet cherries

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Calcium chloride ($CaCl_2$), applied during rainfall through overhead sprinklers, offers a key to reducing rain cracking of sweet cherries. The $CaCl_2$ modifies the ionic content of the rainwater, changing its osmotic potential. This slows down the rate at which rainwater enters through the skin of the cherry, lowering the amount of cracking.

North American protocols for applying a weak solution of calcium chloride through overhead sprinklers during rainfall were modified to suit New Zealand conditions and a 2.5 ha block of cherries was treated during the 1997/98 harvest. Over five cultivars, there was a 50 % reduction in the level of cracked fruit. The area treated was extended to 10 ha and, with some adjustment to dilution rate and timing, a fourth season's application was evaluated during 2000-2001.

A programmable CR10 datalogger with tipping rain gauge controlled the pumps. The system turned on after 0.5 mm of rain, injecting $CaCl_2$ for a 5 min application. It then shut down until a further 0.5 mm of rain had fallen, then repeated the cycle for another 5 min. These cyclic applications continued for as long as it rained. The overhead sprinkler application rate was 4 mm/hr. The concentration of the solution over the trees was 0.5 % $CaCl_2$. Eight separate rain events that triggered the injection system were recorded over the 2000-01 harvest period, resulting in differing levels of cracking in each variety.

Cracking in untreated plots was 4.9 % for `Dawson', 21.3 % for `Stella' and 47.4 % for `Lambert'. $CaCl_2$ treatment significantly reduced the amount of cracking to 0.9 %, 8.6 %, and 16.7 %, respectively.

Non-abscised aborted fruits as a source of inoculum for fungal pathogens causing fruit decay in sweet cherry

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Fruits of sweet cherry (*Prunus avium* L.) can abort from time of fruit set to harvest. It is known from peach that non-abscised aborted fruits may be colonized by *Monilinia fructicola* that causes brown rot and acts as a source of secondary inoculum for healthy fruits.

Disease incidence of non-abscised aborted and healthy sweet cherry fruits was investigated during two growing seasons. Fruits from two cultivars (`Van' and `Lapins') were assessed during 4-6 weeks in June and July, with the last assessments 2-4 weeks prior to harvest. The fruits were either surface sterilized (in 0.5% NaOCl) or dipped in

distilled water, both for 1 min, prior to incubation at 20 °C for 7 days in saturated air. Symptoms of fungal diseases were recorded at day 1, 2, 3, 4 and 7 after incubation.

Aborted fruits had much higher disease incidence after incubation than healthy fruits; the mean of 3 trials was 58% higher disease incidence on aborted fruits. In 1999, after 7 days of incubation, disease incidence on aborted `Van' fruits was 54 % and on healthy fruits 15 %. In 2000, fruits had higher incidences of disease, 63 and 81 % on aborted fruits and 1 and 9 % on healthy fruits for `Van' and `Lapins', respectively. Surface sterilized fruits had less decay than non-sterilized fruits, but differences were small. After incubation commenced, symptoms always appeared earlier in aborted compared to healthy fruits. The most frequently observed fungal pathogens were *Glomerella cingulata*, *Monilinia laxa* and *Botrytis cinerea*. A higher disease incidence and more rapid disease development in aborted fruits indicated that these are more vulnerable to fungal colonization than healthy fruits early in fruit development. Thus, non-abscised, aborted fruits may act as important hosts of secondary inoculum for healthy fruits.

Controlled atmosphere storage of 'Bing' sweet cherries

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The objective of this study was to evaluate the use of controlled atmospheres (CA) to extend fruit quality of 'Bing' cherries. Fruit was harvested at an export maturity stage and packed in a 5-kg wooden box with a perforated polyethylene liner. Fruit was stored up to 21 days at 1°C and 95% RH, in controlled atmosphere (10% CO_2 + 10% O_2, 10% CO_2 + 2% O_2, and 0% CO_2 + 2% O_2) and ambient air as the control.

Fruit were evaluated at harvest, after 21 days in storage (CA or air), 2 days at 8 °C in air after removal from CA, and after 2 days of complementary ripening at 20 °C. Fruit and stem color, firmness (4.5mm tip), soluble solids content, and decay incidence were monitored. A sensory evaluation was conducted with 12 trained panelists, evaluating the fruit according to flavor quality, flavor intensity, and off-flavors.

The 10%CO_2 + 2%O_2 atmosphere resulted in the best fruit quality, with beneficial effects on skin and stem color and absence of off-flavors after the 2-day period of complementary ripening at 20 °C. The primary benefits of the use of controlled atmosphere for cherries were on the skin and stem color. Both high CO_2 and low O_2 inhibit the darkening of the skin, while only low O_2 effectively maintained the green color of the stem.

Export potential for Chilean fresh sweet cherries

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Chile, located in the southwestern corner of South America, is an outstanding grower of fresh fruit, including cherries, which has led the country to reach the stage of the principal producer and supplier of cherries in the contrast season for the North Hemisphere.

The region where we are located (the 8th Region of Bio-Bio) is characterized by the production of large-sized fruit of excellent color, with varieties that ripen over four or five weeks, with harvest beginning the last week of November.
From a phytosanitary point of view, the Bio-Bio Region meets perfect and previous conditions for cherry growing. Due to natural barriers, orchards are well protected by the Andes Mountain Range in the east and by the Pacific Ocean in the west, diminishing risks of plagues and diseases, allowing fruit production with minimum applications of pesticides.

Skin color is a parameter to determine the maturity of sour cherries

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The development of skin color was examined during maturation of 9 sour cherry cultivars. To characterize the maturity every other day, over a period of 6 weeks, several fruit quality data were collected: skin color, weight, diameter, firmness, removal force, soluble solids, and acidity. The goal of the study was to determine the optimal harvest date by the skin color typical for the cultivar.

By using a spectrophotometer (CM 3500d, Minolta), it was possible to obtain an objective estimation of the skin color. A spectrum of RAL Design system was used as check colors and imported in a database. Skin color was measured using the color coordinates (L*a*b) for comparison with RAL-system, which identified the RAL color that best overlapped.

Each sampling was comprised of 20 fruits. After examination, the determination of color could be controlled visually by a color palette. For the 9 cultivars, 5 RAL colors were found to characterize the skin color before, during and after maturity. With the RAL-system, the cultivars could be classified in typical color groups. The development of skin color during maturation found only 2 RAL-color types for `Morina´ sour cherry.

'Ambrunés' sweet cherry quality factors change during ripening

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'Ambrunés' sweet cherry, one of the most widely produced cultivars in Spain, was characterized. Harvest occurred in the Valle del Jerte (Cáceres, Spain) at four dates between May and June, corresponding to different ripening stages from about 60 to 80 days after full bloom. The last picking date was determined by that considered to be the optimal harvest date for fresh consumption, according to normal commercial practice in the zone. As a particular characteristic of this cultivar, fruits were picked without stems. The most significant quality parameter changes occurred between the first and the fourth harvest date, ranging as follows: weight from 3.5 to 8 g, caliber from 20 to 25 mm, flesh:stone ratio (w/w) from 4 to 10, flesh firmness from 6.5 to 4.7 N, total soluble solids content from 10.5 to 16 °Brix, titratable acidity from 0.5 to 0.6 % malic acid, and maturity index (total soluble solids content / titratable acidity ratio) from 20 to 25. Skin color changes ranged from 70 to 35 for lightness (L* parameter), from -3 to 25 for a*, and from 40 to 15 for b* parameter.

Expression of expansins is coordinated with that of other cell wall modifying enzymes during fruit softening in the nonclimacteric sour cherry

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A dozen different hydrolytic enzymes may be involved in wall modifications during fruit softening. In developing and ripening sour cherries we have studied the expression of a number of these hydrolases. We have also studied the expression of the genes for two expansins which are plant proteins with the capacity to mediate extension of cell walls, a role that is apparently accomplished through the weakening of interactions between the cell wall's hemicellulosic components and cellulose microfibrils. Expansins may play a prominent role in tissue softening by facilitating access of hydrolytic enzymes to specific cell wall polymers. We evaluated the potential for coordinate action of expansins and several other cell wall modifying enzymes during tissue softening in the nonclimacteric fruit of *P. cerasus* (tart cherry). We describe the characterization of two expansin genes, designated PcEXP1 and PcEXP2, expressed in cherry fruit mesocarp tissue. PcEXP1 and PcEXP2 RNAs were relatively highly expressed at an advanced stage of development when the fruit was undergoing simultaneous enlargement and softening, but these genes were only very weakly expressed early in development when the fruit was growing rapidly but was not softening. From a collection of expressed sequence tags (ESTs), we

identified cherry orthologs of several genes encoding proteins with known roles in cell wall modification. The onset of expansin gene expression was coordinated with the initiation of expression of genes encoding a potential xyloglucan endotransglycosylase (PcXET1), a pectin methylesterase (PcPME1), a pectate lyase (PcPEL1) and a polygalacturonase (PcPG1). Consistent with these molecular findings, compositional analyses revealed that softening was correlated with a striking decrease in the pectin content, but not of cellulose or hemicellulose. Taken together, these results suggest that expansins may act in tissue softening in *P. cerasus* fruit through a coordinated process involving a xyloglucan endotransglycosylase and several specific pectin-degrading enzymes.

Field evaluation of cultivar susceptibility to leaf spot (*Blumeriella jaapii* [Rehm] Arx.) at the Romanian sour cherry genebank

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During 1996-1999, in the field collections located at the Research Institute for Pomology (Pitesti) and at the Fruit Research Station (Focsani), 100 sour cherry genotypes (cultivars, clones, and local types) were investigated regarding their susceptibility to leaf spot (*Blumeriella jaapii* (Rehm) Arx.). The experimental plots are situated in the middle of other cherry orchards affected by relatively high natural infection with specific pathogens. The meteorological conditions were very favorable for the spread of fungus, especially in 1999 at Pitesti and 1996 at Focsani, concomitant with the hottest and most humid summer in the last decade. In the period of evaluation, no chemical protection was applied and, therefore, over the years, disease infection pressure increased in the orchard.

Frequency (F%) and intensity (I%) of leaf fungus attack was determined during four consecutive years. The frequency of infected leaves varied between 24% and 100% at Pitesti and from 26% to 57% at Focsani. The less susceptible cultivars - `Timpurii de Cluj', `Montearly', `Reine des Conserves', `Louis Philip', `Spanka', `Royale Duke', `Mari timpurii', `Suda Hardy', `Heimanns Conserven', `Olivet', and `Eugenia' - and the most ssusceptible cultivars - `Hartoi Meggy', `Lutowka', `Stockton Morello', `Pandy 50', `Cigany Meggy 3', `Cigany Meggy 50', `Gorsemkrik', `Granatnaia', `Drobeta', `Kelleris 16', `Sumadinka', `Ostheim', `Schattenmorelle', `Liubskaia', `Frango', `Suraia', `Nefris', and Bagdatska' - have been classified.

To estimate the value of the real extent of infection, the intensity of the attack, as surface of the leaf covered by spots, was determined. The highest number of spots was found in `Podbielski', `Suraia', `Crassa Severa', `Ostheim', `Hartoi Meggy', `Gorsemkrik', `Espera', `Gubens Ehre', `Richmont', `Pandy 114', `Liubskaia', `Cernookaia', `476-II-56-B', `Schattenmorelle', `Stockton Morello', `Bagdatska', and `Pitic'. In fact, defoliation is the result of correlated effects of incidence and severity of infestation and shows the exact degree of sensitivity of genotypes to the disease. The most affected by defoliation were `Hartoi Meggy', `Liubskaia', `Bagdatska', `Schattenmorelle', `Lutowka', `Gorsemkrik', `Espera', `Kelleris 16', `Suraia', and

`Stockton Morello'; in contrast, `Timpurii de Cluj', `Olivet', `Mari timpurii', `Montearly', `Eugenia', `Royal Duke', and `Vrancean' were only slightly affected. In the Romanian collection, none of the genotypes can be considered to have immunity to leaf spot, but some of them are highly resistant. The results will be discussed in terms of usefulness of the cultivars for the breeding program.

Screening of 100 sour cherry genotypes for *Monilia laxa* (Aderh&Ruhl) field resistance

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Studies were conducted in the field collections located at the Research Institute for Pomology (Pitesti) and at the Fruit Research Station (Focsani). After two years, during which no fungicides were applied, a very intense attack of brown rot (*Monilia laxa*) was recorded in spring of 1998. The high amount of precipitation during flowering, with low daily temperatures, favored spread of the fungus with increased incidence and severity. The symptoms of brown rot were observed on the blossoms, spurs and the young herbaceous shoots, with great differences between genotypes or kind of affected organs. A group of 73 genotypes were found with lesions and 27 with no symptoms on any organ.

Frequency of the injured blossoms ranged between zero (34 cultivars) to 90% at Pitesti and from zero (37 cultivars) to 83% at Focsani. An extremely severe incidence occurred on `Pandy 16' (90%), `Crisana 15/10' (90%), `761-II-41 C' (85%), `NY 3794' (83%), `Cernookaia', `Focsani 3', `NY 7037', and `Meteor', with 80% affected blossoms. The incidence of damaged young shoots varied from zero (39 cultivars) to 25% at Pitesti and from zero (55 cultivars) to 39% at Focsani. The highly susceptible cultivars were `Gubens Ehre' (39%), `Lutowka' (34%), `761-II-41 C' (25%), `Pandy 16' (25%), `Early Richmond', `Cigany Meggy 3', `Meteor', `NY 6939', `Mocanesti 15/2', `Nana', and `Ujfehertoi furtos' with 20% injured shoots.

Data for each cultivar will be shown and discussed in the paper.

Breeding sour cherry for resistance to leaf spot (*Blumeriella jaapii* [Rehm.] Arx.): promising new selections

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The ultimate objective of the Romanian sour cherry breeding program is to create and release varieties that are resistant or highly tolerant to leaf spot. Therefore, at the Research Institute for Pomology (Pitesti), various crosses have been made since 1980. To achieve this objective and obtain cultivars with acceptable commercial value, it is necessary to combine this characteristic with other desirable traits such as high yields,

self–compatibility, high fruit quality, moderate tree vigor, etc. Consequently, following 5 years of observation in the seedling field, 7 selections (most of them progenies of the F_2 generation) showing a good level of resistance to leaf spot were planted (1993) as 12 grafted trees each to determine their horticultural features.

In the new orchard, the chemical control of fungal diseases has been essentially reduced to 4 sprays, with only one - Saprol CE, 2 l/ha (triforin 190 g/l), produced by American Cyanamid – for leaf spot. Under such conditions, two selections, clones `HV 45/40' and `HV 43/32', proved to be highly resistant to *Blumeriella jaapii*, maintaining healthy leaves during the entire growing season. These selections were obtained in 1986 from the crosses (`Spanca' x `Heimanns Conserven') x `Sirpotreb' and (`Anglais Hative' x `Visin Tufa') x `Olivet', respectively. In 2000, treatment with Saprol was eliminated, but there was little natural fungal spread due to unfavorable meteorological conditions (a droughty, tropical summer). The selections ripen early mid-season and have very good fruit quality, but are moderately productive, yielding less than the standard cultivar `Nefris'. A briefly description of the pomological characteristics of the selections will be presented in the paper.

Trunk canker in sweet and tart cherry cultivars

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The study was carried out in 1997 in the cherry collection of the Horticulture Department. The collection consisted of 60 sweet and sour cherry cultivars, each one with 3 trees that had been planted in 1992. Some cultivars showed a kind of canker in the south part of the trunk, probably caused by unfavourable climatic conditions and by *Sphenoptera* sp. The results were interesting, with variation among the cultivars for canker occurrence, canker length (CL), canker width (CW), and canker width/trunk circumference (CW/TC). The symptom was observed only on 34 cultivars (57 %), among them: CL was highest in `Burlat', `Moreau', `Reverchon', `Jean', and `Soratie Lavasan' with 90, 72.7, 69.7, 63.7 and 62.0 cm; CW was highest in `Moreau', `Reverchon', `Marezou', `Burlat', and `Maremotte' with 34.3, 24.2, 23.0, 23.0, and 20.7 cm; and CW/TC was greatest in `Moreau', `Marmotte', `Marezou', `Burlat', and `Reverchon' with 0.795, 0.598, 0.589, 0.581, and 0.544 cm, respectively.

The cultivars `NO 19', `NO 28', `Gium', `Aberdeh', `Ghermeze Uromieh', with 59.0, 54.3, 52.3, 52.3, and 51.7 cm, had the highest TC, and `Alamout', `Montmorency', `Hamedan 2', `Bigarreau Napoleon', and `Star King', with 27.7, 31.3, 31.7, 33.3, and 34.0 cm, respectively, had the lowest TC . The phenotypic and genotypic correlations between CL and TC were estimated to be -0.070 and -0.026, and between CW and TC were estimated to be -0.036 and -0.016, respectively. The broad sense heritability of TC, CL, and CW was 0.72, 0.74 and 0.80, respectively.

A review of cherry fruit fly from the eastern USA perspective

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A review of the literature indicates that eastern cherry fruit fly and black cherry fruit fly are the two most significant direct pests of cherry in the eastern United States and eastern Canada. Both were classified as a single species until the middle of the twentieth century. Today, distinct differences between the two species have been demonstrated. Both cherry fruit flies (CFF) have similar seasonal biology: one generation per year throughout their geographic ranges. Damage to the fruit occurs in two ways, feeding by the adults and feeding by the maggots. Oviposition injury by the adult may occur, but the primary fruit damage results from the feeding of the larvae within the fruit. Fresh market and processed cherries for local and export markets have a zero tolerance for CFF damage, and most growers apply preventative sprays of organophosphate insecticides for control.

The most effective means of monitoring both CFF species is the use of baited, fluorescent yellow sticky board traps. At low insect densities, these are not considered reliable enough to make pest control decisions. Traps are good indicators to detect the beginning of first CFF emergence, but they are not good indicators of the level of infestation. Therefore, chemical controls are applied to cover the entire activity period of the flies. Alternatives to chemical control of CFF species have been attempted, but with limited success. Degree-day models have proved reliable at predicting adult CFF emergence. Insecticide treatments should begin within 5 to 6 days after the first fly emerges. A long-residual insecticide should be applied every 10-21 days through the completion of harvest to kill adults before they can lay eggs.

FOTOS

FOTO 1

VALLE DE WANATCHEE CON LAS DIFERENTES ALTURAS DONDE SE PRODUCE EN DIFERENTES ÉPOCAS SEGÚN LA ALTITUD (VISTA) HUERTO DE Stemilt (Bing, Rainier y Lapins)

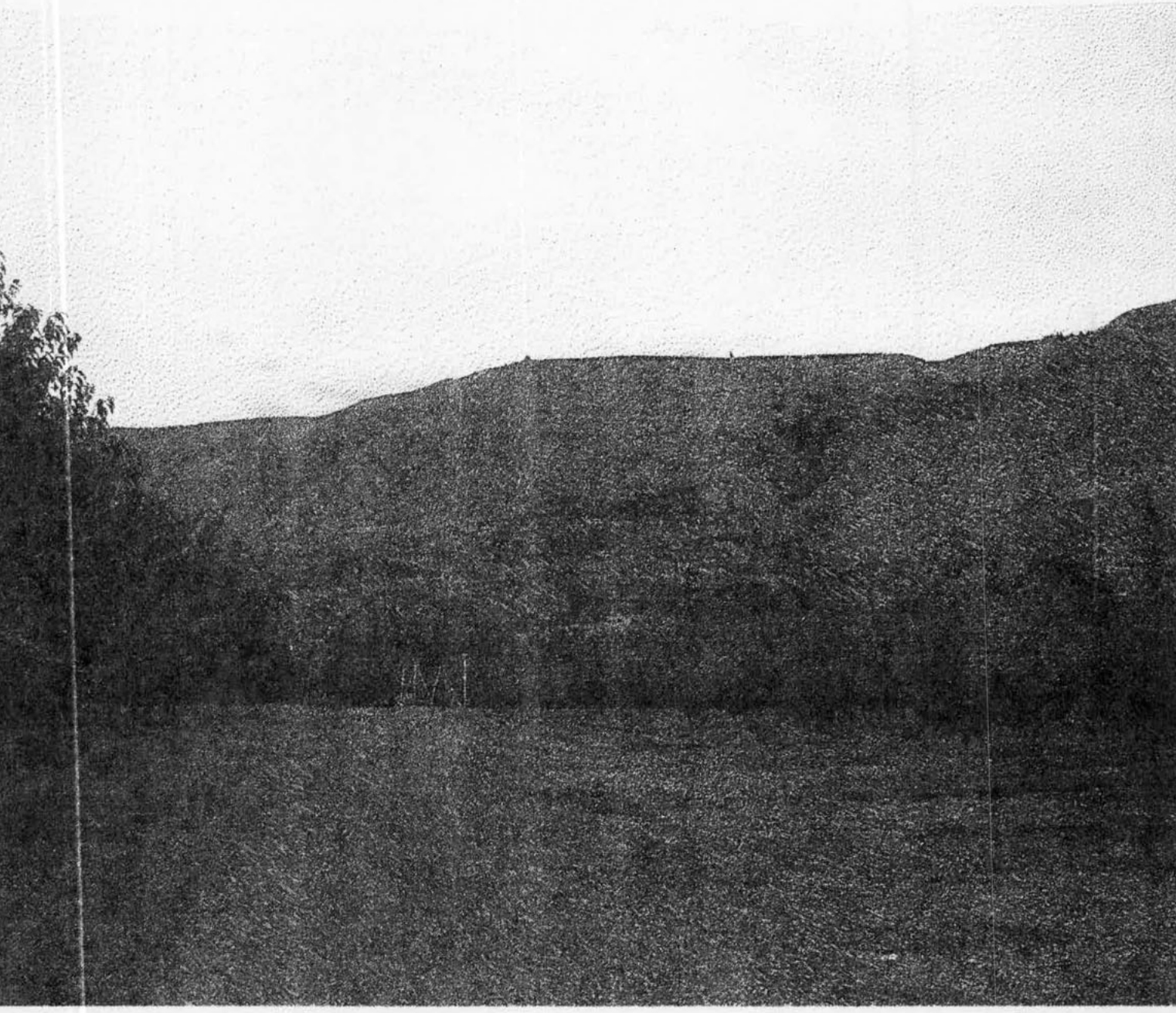
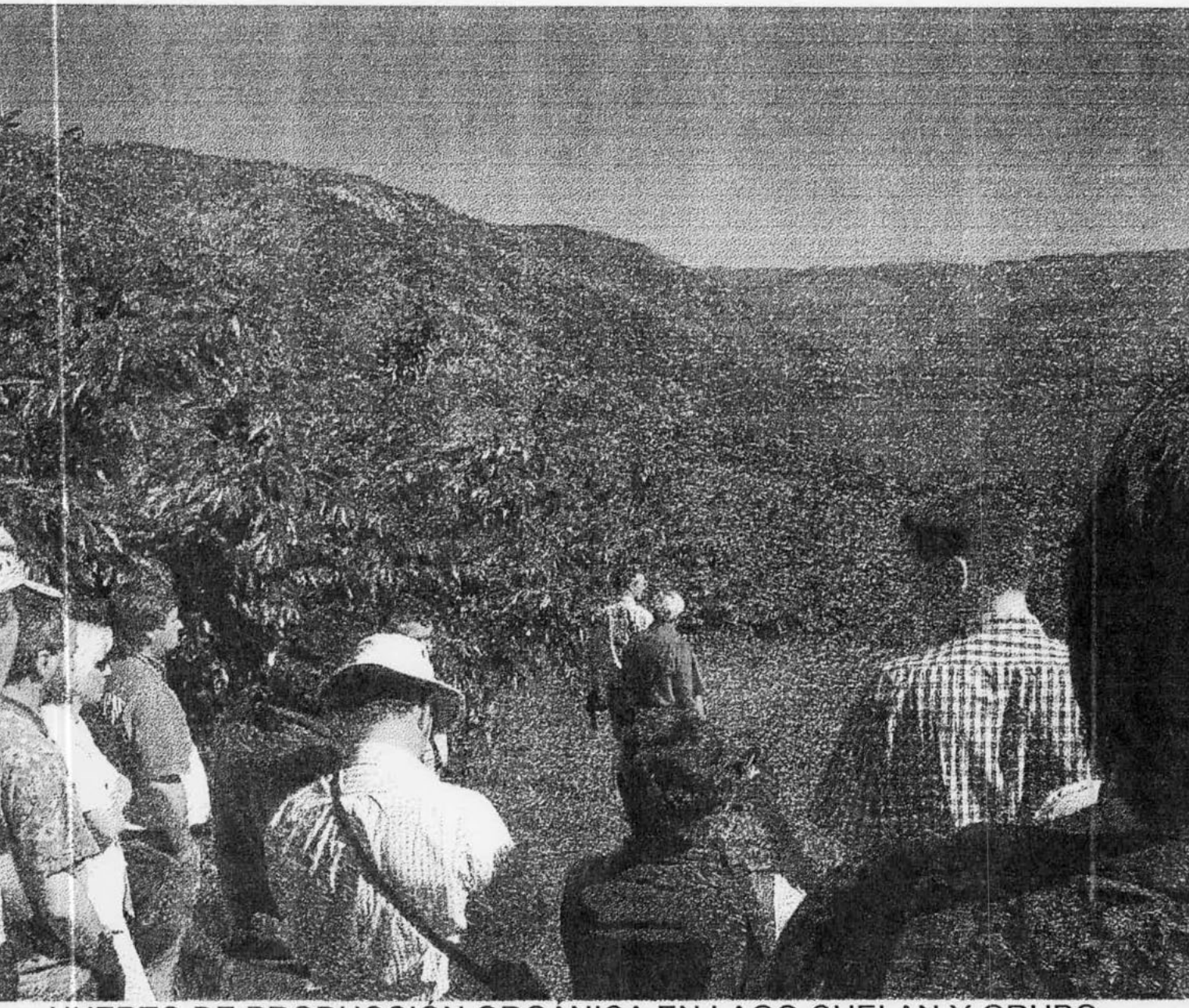
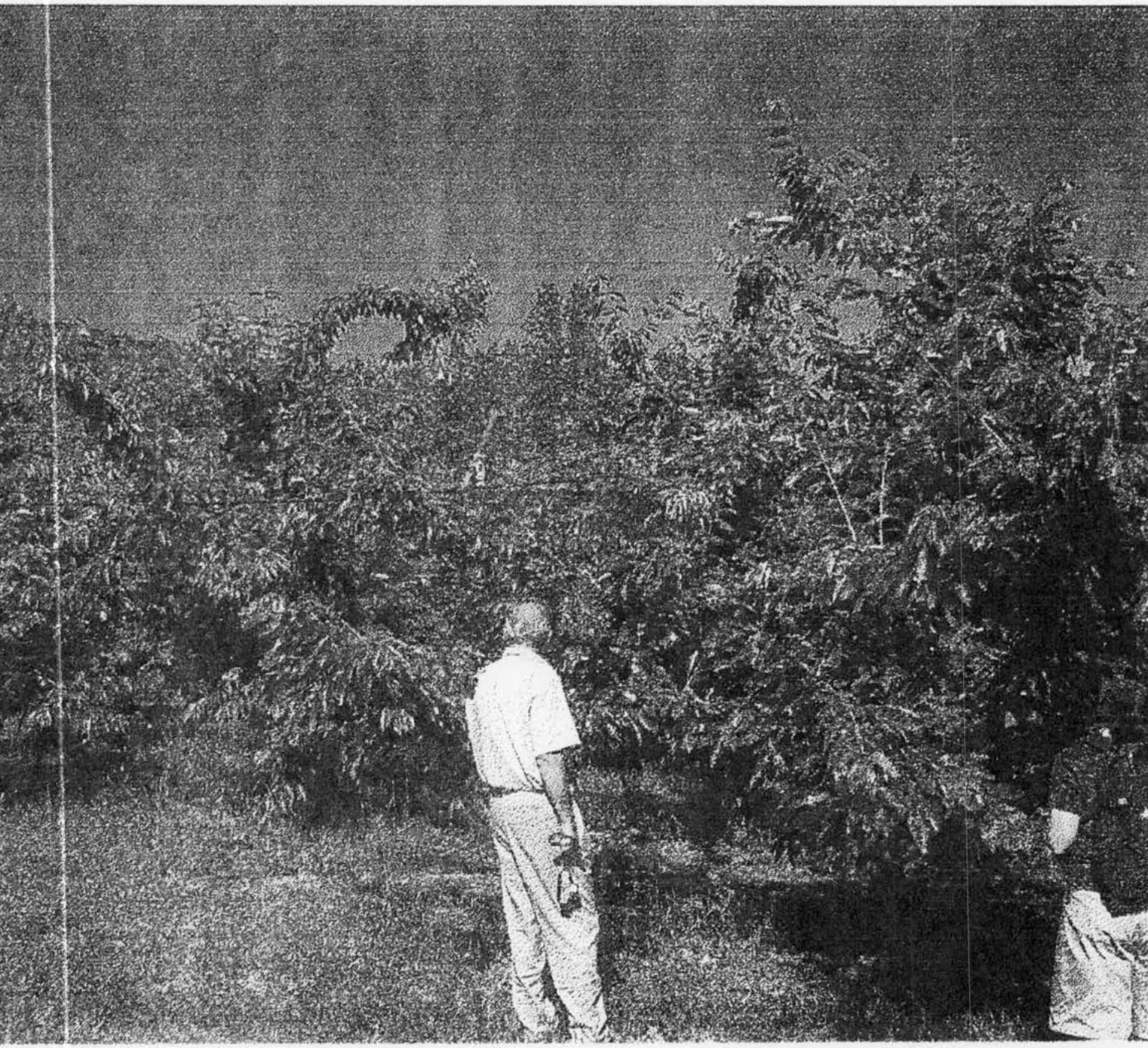


FOTO 2



HUERTO DE PRODUCCIÓN ORGÁNICA EN LAGO CHELAN Y GRUPO

FOTO 3



HUERTO ORGANICO, CONTROL DE MALEZAS CON MULCH, VIGOR Y ESTDO GENERAL (BING Y RAINIER)

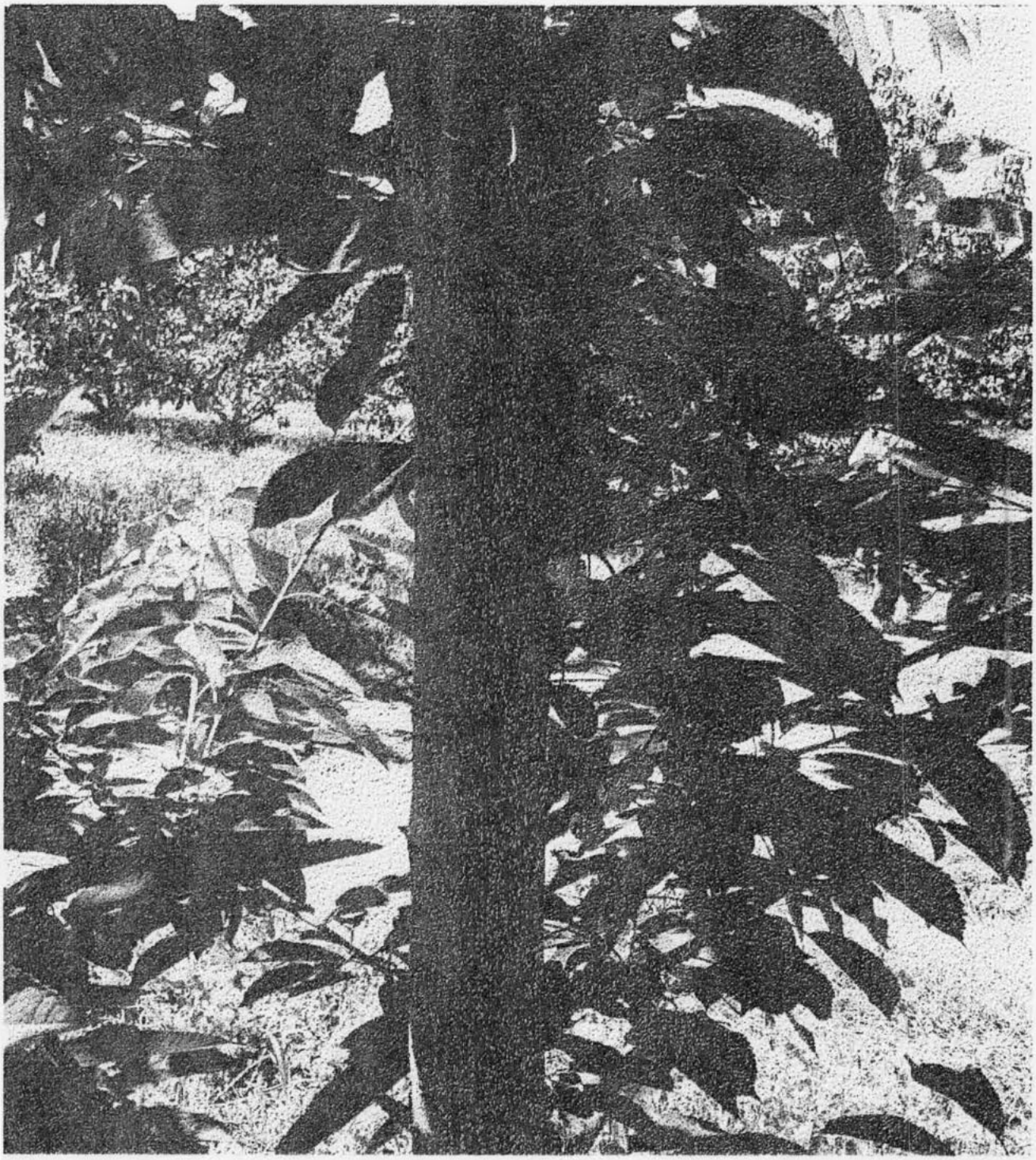
FOTO 4

HUERTO NUEVO DE LAPINS EN VALLE DEL OKANOGAN (FORMACIÓN, CONTROL DE MALEAS, RIEGO, PROTECCIÓN TRONCO, DISTANCIA DE PLANTACIÓN 3,5 X 5 m APROX.)

FOTO 5

ALTA DENSIDAD EN OKANOGAN VALLEY, SOBRE MAZZARD Y CON PODA 2,3 X 5 m APROX

FOTO 6



ARBOL EN ALTA DENSIDAD EL MISMO HUERTO, ANILLADOS PARA DISMINUIR VIGOR (NO SE HABLÓ DE ESO EN LA CHARLA)

FOTO 7

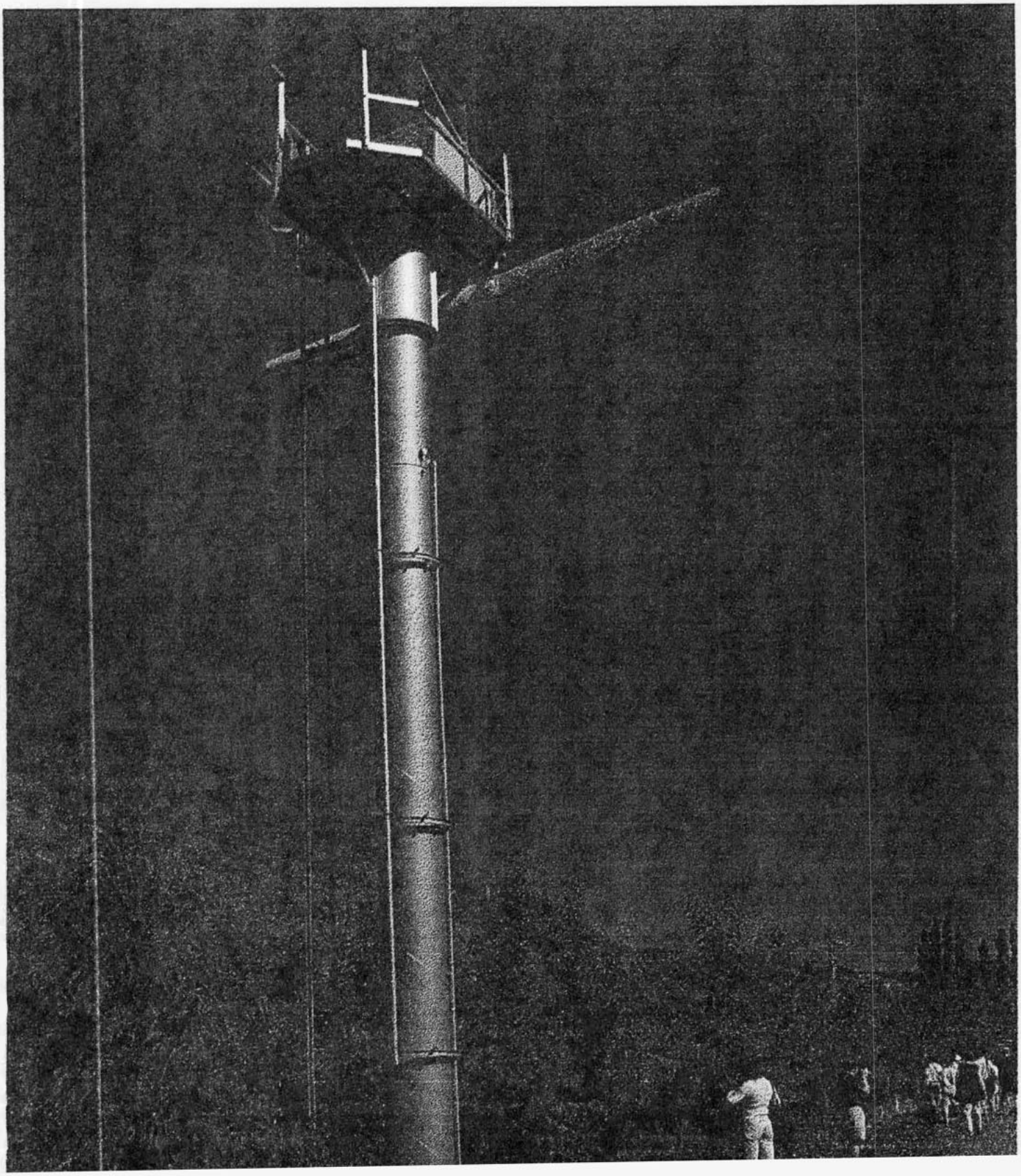


FOTO 8

VARIEDADES DE SUMMERLAND

FOTO 9

VARIEDADES DE SUMMERLAND

FOTO 10

PACKING EN CANADÁ – BINS Y MANEJO DE CEREZAS DE EXPORTACIÓN