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5th International Cherry Symposium

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Rootstock and Management Practices Evaluation To Avoid Cherry Replant Disease in Chile

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Abstract

Since spring 2002, several trials to determine detrimental effects on replanted cherry trees have been conducted in cherry production area of Chile. Comparisons of tree growth achieved on methyl bromide treated soil (Non replanting condition) in relation to non treated soil were performed. Tree growth as trunk cross sectional area (TCSA) was evaluated, considering the high relationship of it with total leaf area. In Rancagua (34°10' S, 70°45' W), 10 rootstocks under a replant condition of an orchard growing on *P. mahaleb* were evaluated. All the rootstocks were affected in comparison to fumigated soil, obtaining 25 to 65% of the growth achieved on it. The most affected were *P. mahaleb*; Maxma 14; F12-1 and Maxma 60; while Gisela 6; Cab 6; Colt and Gisela 5 were affected in a lower magnitude. Similar response showing less affected trees was detected in Curicó (34°55' S, 74°12' W). Less affected vigorous rootstock, growing in a replanting soil, showed similar tree growth to less vigorous rootstock on a fumigated soil. Planting right after, or 1 or 2 year after orchard removal was also evaluated; comparative tree growth of 2.5:1 (fumigated: non fumigated), were obtained for 0 or 1 year waiting, and 1.4:1 after 2 years waiting. Methyl Bromide and 1,3-dichloropropene (1.3-D) were better soil fumigants for cherry replant disease than chloropicrin (C) or 1.3-D plus C which was intermediate between C or 1.3-D alone.

INTRODUCTION

Replant disease is common and important in fruit trees, showing a delayed fruit production and poor tree growth (Utkhede and Smith, 1994), which can be uniform (Hoestra, 1968) or uneven across the field, especially in the first season of growth (Mc Kenry, 1999). However, sometimes symptoms are more difficult to recognize (Mai *et al.*, 1994). The nature of the problem can be a complex of biotic (several kinds of fungi, actinomycetes, bacteria and nematodes) or abiotic factors (phytotoxins, nutrient imbalance, soil pH, soil structure and drainage) (Utkhede and Smith, 1994).

The total or partial suppression of the problem with broad spectrum fumigants, like methyl bromide or other treatments has been well documented (Xue and Yao, 1998), as well as cultivating or leaving the land fallow prior to replanting for a number of years (Mc Kenry, 1999), that in peach orchards can be up to 4 years fallow or rotation to non-woody rooted crops; in cherry trees, 18 to 20 waiting years were mentioned by Fregoni (1962), cited by Zucconi and Monaco (1986). Using rootstocks of less related species can be an alternative to overcome growth restriction imposed by replant disease.

This paper summarizes several trial carried out since 2002 in former cherry orchards, with the objective of quantify the magnitude of the replant disease effects and to evaluate managements tools to overcome it.

MATERIAL AND METHODS

Different trials comparing tree growth achieved on fumigated soil (non replanting condition) in relation to non treated soil (replanting condition) were established. Tree growth was evaluated as trunk cross sectional area (TCSA), given the high relationship between it and leaf area (data not shown).

Rootstock Trials

In Rancagua (34°10' S, 70°45' W), right after the 2001 harvest, a cherry/*P.mahaleb* orchard was pulled out. Next winter a rootstock trial was established over fumigated and non fumigated soil with 10 rootstocks. Cultivar/rootstock combinations were as follow: 'Bing' growing on F12-1, Colt and Cab 6; 'Summit' on Maxma 14, Weiroot 158, Gisela 5, Gisela 6 and Maxma 60; 'Sweetheart' on Santa Lucia 64; and 'Regina' on *P. mahaleb*. Methyl bromide at 68 g/m^2 was used as soil fumigant; treated soil was covered for one week with polyethylene and trees were planted after two weeks of ventilation. A block design with 10 replications of one tree was applied. At the end of the vegetative period, growth was evaluated as tree fresh weight.

In autumn 2004, in Curicó (34°55' S, 74°12' W), a similar trial was established, with 'Bing' over 8 cherry rootstocks (*P. mahaleb*; Maxma 14; Maxma 60; F12-1; Gisela 6; Cab 6; Colt and Pontaleb), five replications by rootstock were used. 1.3-dichloropropene (1.3-D) at 300 L/ha was used as soil fumigant, applied by TRICAL Inc. Growth was evaluated as increase of trunk cross sectional area (TCSA).

In both trials, separately for each rootstock, fumigation effect was analyzed with ANOVA and Tukey (5%) Test; initial TCSA was considered as covariance.

Waiting time trials

In Rancagua, in the same orchard of the previous trial, tree growth after one season after planting was evaluated. The trees were planted either right after orchard removal (2002), or 1 (2003) and 2 (2004) years after. The growth was evaluated, comparing tree growth on fumigated and non fumigated soil. Methyl bromide was used as soil fumigant applied as it was described before. T-test (5%) was used to compare both growing conditions.

Growth as response to different soil fumigants

In the same orchard in Rancagua, in order to determine the growth response to different soil fumigants in a replant condition, planting right after orchard removal, a comparison between different commercial treatments was performed. 1.3-dichloropropene (1.3-D; 300 kg/ha); chloropicrin (C; 300 kg/ha) and the mix of both (MIX; 150 kg/ha 1.3-D plus 150 kg/ha C) were applied to approximately 1 ha; an adjacent plot of 10 trees was treated with methyl bromide (MB; 68 g/m^2). Tree growth, as TCSA at the end of the vegetative period, of 15 trees of each commercial condition and 10 trees in MB plot were evaluated.

RESULTS AND DISCUSSION

Rootstocks

In Rancagua trial, growth of all the rootstocks was affected by replant condition, being the growth on non fumigated soil between 25 to 65 % in respect to those reached on the fumigated one (Figure 1). Considering the differences on growth between both treatments, independent of the cultivar, *P. mahaleb*, Maxma 14, F12-1 and Maxma 60 were the most affected rootstocks; Weiroot 158 and Santa Lucía 64 showed intermediate effects on them, while Gisela 6, Cab 6, Colt and Gisela 5 were the least affected rootstocks

In Curicó trial, established under furrow irrigation, in both soil conditions, the growth of the trees was less than expected. Despite this situation all the rootstocks showed less growth on non fumigated soil (Figure 2), reaching from 33% to 67% the growth of those on fumigated soil, being statistically different, only in Cab 6, Gisela 6, *P. mahaleb* and Maxma 60, where the growth in the non fumigated condition was around 40% of those on the fumigated condition.

Accordingly these results, in Rancagua no rootstock, except SL 64, presented tolerance to the replant disease, because all of them showed growth significantly increased when the soil was fumigated. On the other hand, in Curicó trial, there were some rootstocks, that even though their growth was increased when the soil was fumigated, this increase was not significant, so, no replant susceptibility could be associated to those rootstocks. However, this trial was furrow irrigated and the growth, as it was mentioned before, was much less than expected, conditions that could be masked the expected differences to be found in all the rootstocks. Also, it is possible to visualize that a specific response of a rootstock could be differently affected by management condition, making more difficult to generalize the results.

Waiting time

At the three waiting times tested (Figure 3), the tree growth on fumigated soil was better than this reached on non fumigated soil. Planting right after orchard removal a ratio between growth of both treatments of 2.2 : 1 (fumigated : non fumigated conditions) was obtained; the same magnitude of reduction was obtained after one year of land fallow. With two year of waiting (2 year), the ratio between both treatments decreased to 1.4 : 1, getting this year the poorest total growth of the trees.

Soil fumigants

All the tested fumigants induced better tree growth in relation to those reached by trees on non fumigated condition (Figure 4). The better response, a ratio of 2.7 : 1 (fumigated : non fumigated) was obtained with MB and 1.3-D. The MIX obtained an intermediate response, while C presented the lowest response, with a ratio of 2.3 : 1 and 1.9 : 1, respectively.

Acknowledgments

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Figures

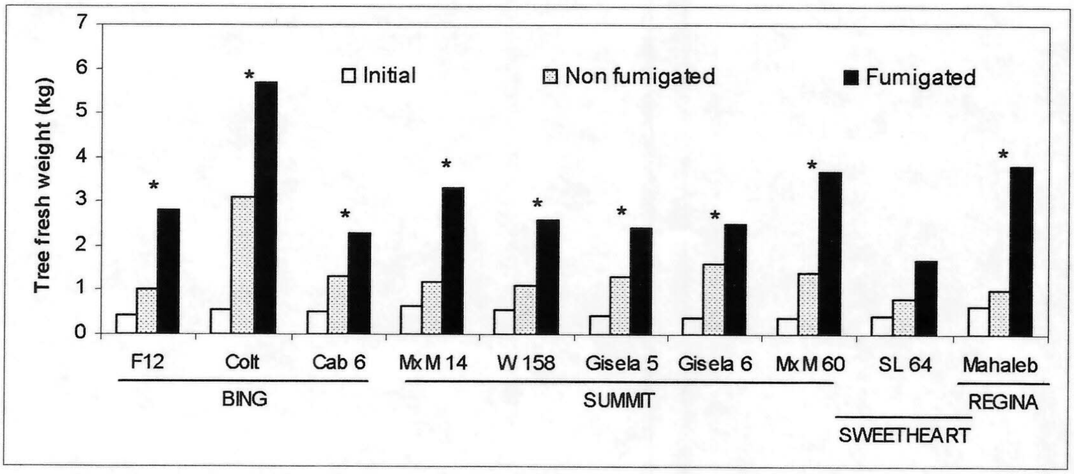


Fig. 1. Tree growth at the end of the first season, expressed as fresh weight, of cherries on different rootstocks, planted on fumigated and non fumigated soils in a replant condition. Data collected from Rancagua trial. * statistical differences between treatments (p<0,05).

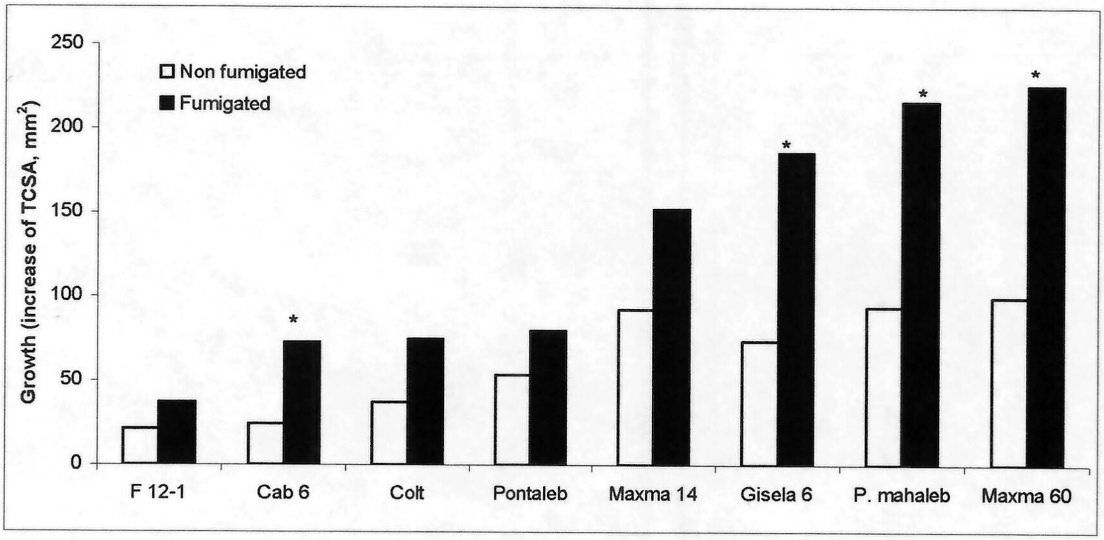


Fig. 2. Tree growth at the end of the first season, expressed as increase of TCSA, of cherries on different rootstocks, planted on fumigated and non fumigated soils in a replant condition. Data collected from Curicó trial. * statistical differences between treatments ($p<0,05$).

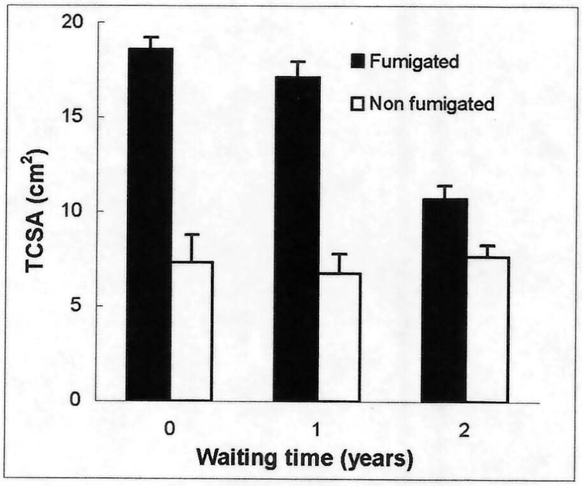


Fig. 3. Trunk cross sectional area at the end of the first season, for cherry trees growing in fumigated and non fumigated soil in a replant condition, planted after 0; 1 or 2 years land fallow.

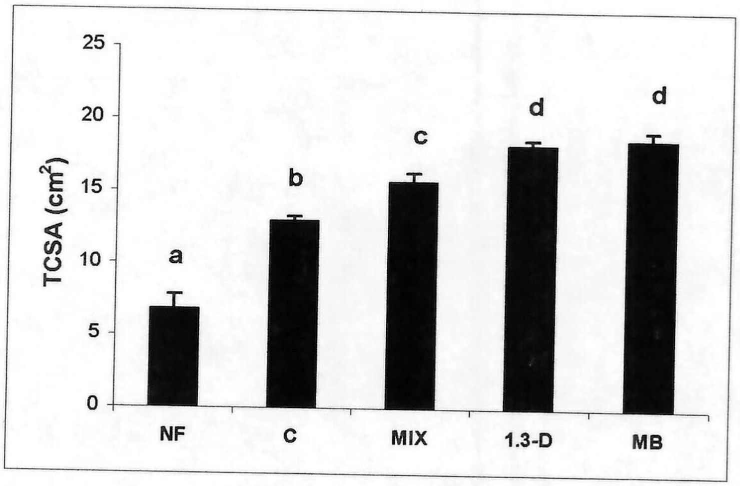


Fig. 4. Trunk cross sectional area at the end of the first season, for cherry trees planted in a replant condition, on soil treated with different soil fumigants.

OBIERNO DE CHILE
INIA LA PLATINA

Cherry tree response to Hydrogen Cyanamid treatment under low chilling Conditions

Gamalier Lemus
INIA La Platina
CHILE

ABSTRACT
In north of Chile in the irrigated valleys of Elqui, Limarí, and Choapa chilling hours varies W-E from 150 to 800 h, depending on the altitude. High temperatures can occur during daytime in winter that reduce the real accumulation of chilling hours needed for bud break of cherry trees. To overcome this effect, Hydrogen Cyanamid (HC) was used on cherry trees and its effect evaluated during three seasons. Brooks and Newstar cherry trees were treated with 1.25% H C plus 2% mineral oil. HC was applied every week during June, July and August. Time to full bloom, flowering and fruit development were measured in all seasons. Control trees showed late flowering and a long bloom period as a consequence twigs showed both fruit and flower developing simultaneously. The use of HC treatments advanced full bloom up to 60 days and the flowering period was almost halved compared with the control treatments. Fruit set was not dependant on flowering time or HC treatment. The results showed that HC is a proper tool to advance and concentrate cherry bloom. A minimum level of chilling hours are required for the adequate response of cherry trees.

INTRODUCTION
Chilean cherry industry is mainly developed in areas having medium to low chilling accumulation for the main commercial varieties, (Lemus and Valenzuela, 2005), thus the management of bud break and flowering is required. Previously, Hydrogen Cyanamid (HC) was evaluated in Chile, as a chilling hour compensator for cherry trees (Lemus, 1997; Lemus, 1998; Lemus *et. al.*, 1989(a) ; Lemus *et. al.*, 1989(b)).

The experiments showed that flowering could be advanced about 15 days and harvest by 9 days, with the use of HC for cherry trees growing near Santiago Area. Treatments with solutions from 1.5% to 2.0% of HC, lower dosage required a surfactant, were, effective when the volume of water applied was between 500and 1.500 l/ Ha.

With an early harvest the best fruit prices are achieved in the export market. Spreading the cultivation of cherry trees, to areas of low chilling hours such as Choapa, Limarí and Elqui valleys, 250 to 400 kilometers north to Santiago city. In these valleys winter chilling varies from 150 to 800 h below 7ºC (42ºF). The use of HC as a management tool for bud breaking and reduction of flowering times could allow the introduction of cherry trees as a competitive fruit tree for these areas.

MATERIAL AND METHODS
The experiments were conducted during three seasons in the irrigated valleys of Choapa, Limarí and Elqui, 250 to 400 kilometers north to Santiago city. Winter chilling varies from 150 to 800 h (below 7°C (42°F) depending altitude.

Table 1 shows the varieties, HC dose, volume of water and time of application to five replicates of each variety.

Date of bud break. Time to different bloom stages and date of harvest were recorded, each variety considered a control tree with no application of HC

Table 1. Cherry varieties treated with Hydrogen Cyanamid. Timing, treatments, wetting, and replications.

Varieties		Treatments
Bing	Kordia	
Van	Lambert	From June to August each 7 days.
Brooks	Garnet	1.25% plus mineral oil 2%
Lapins	Sunana	1,500 liters per hectare
Newstar	Celeste	Five replications per treatment

RESULTS AND DISCUSSION

a) Chilling accumulation measurement

Along the different valleys, chilling hours accumulation vary, according the altitude. If chilling hour accumulation is measured as the sum of the hours below 7°C (Weinberger, 1950) Chilecito showed the highest value and the poorest condition was for Semita (Figure 1).

However, if Chilling is accumulated as suggested by Richardson *et. al.* or Gilreath and Buchanan, The distribution of chilling accumulation varies dramatically. According Richardson *et. al.* Tuquí is the place with more chilling accumulation, meanwhile, Semita is the place where less chilling accumulation presents (Figure 2).

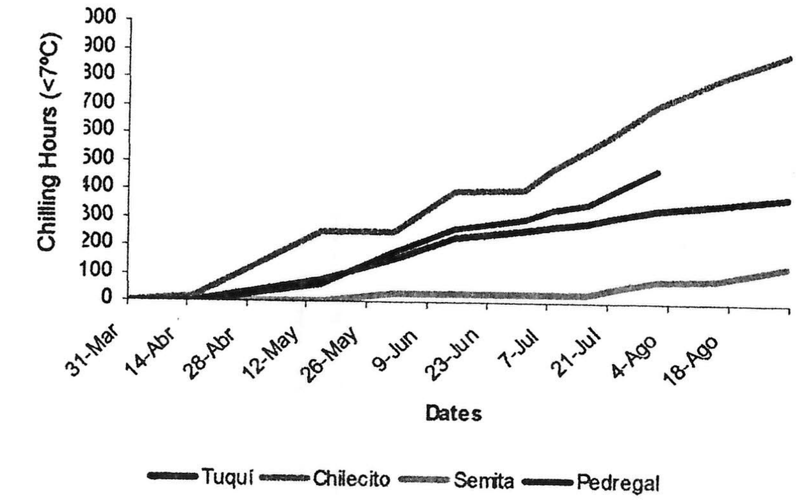


Figure 1. Chilling hour accumulation, according Weinberger, at different places of the Limarí Valley. Winter 2004.

Figure 3 shows the behavior of the chill unit accumulation according to Gilreath and Buchanan (Florida Units). This method, again, shows Semita as the place with less chilling units, during winter time, and Tuquí is the coldest area.

Situations exposed in Figures 1 to 3 suggested that Florida Units proposed by Gilreath and Buchanan are the best way to evaluate chilling accumulation at the valleys submitted to this study.

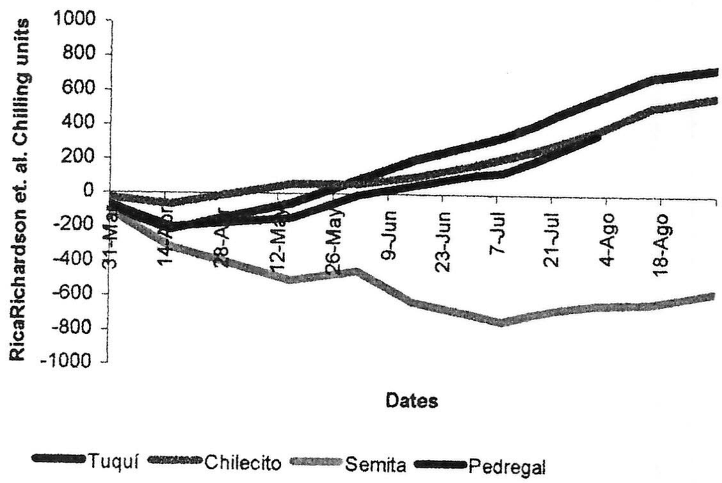


Figure 2. Chilling accumulation, according Richardson *et. al.*, at different places of the Limarí Valley. Winter 2004.

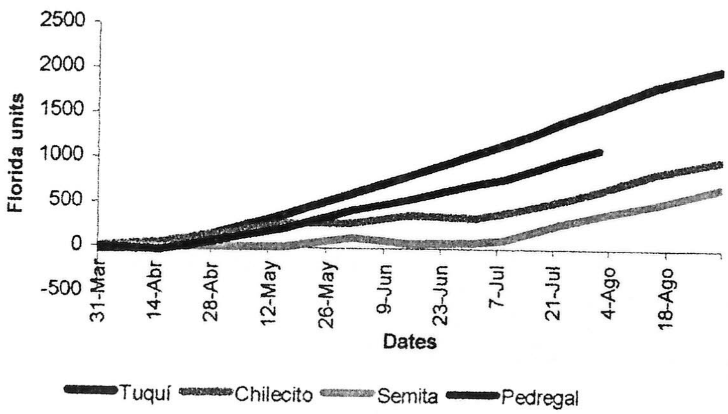


Figure 3. Chilling accumulation, according Gilreath and Buchanan method, at different places of the Limarí Valley. Winter 2004.

b) Response to Hydrogen Cyanamid.

Tree response to HC depends mainly on previous chilling accumulation. Figure 4 shows that control trees (S/aplic on Figure 4) began to show the first flowers after October 4th. By other hand, July 15th treatment showed full bloom on September 6th, and August 1th treatment presented full bloom on September 20th (Figure 4).

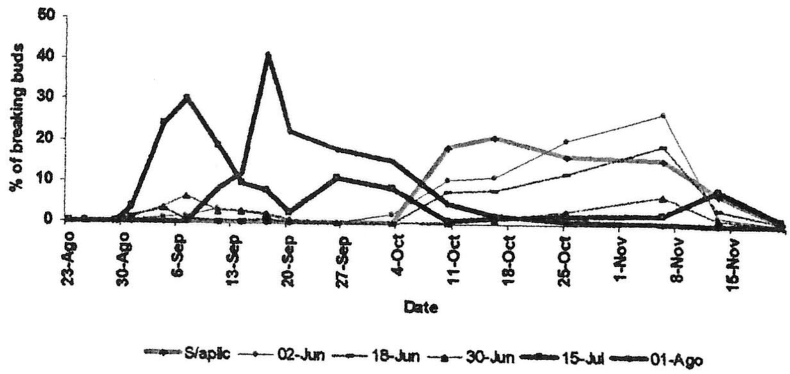
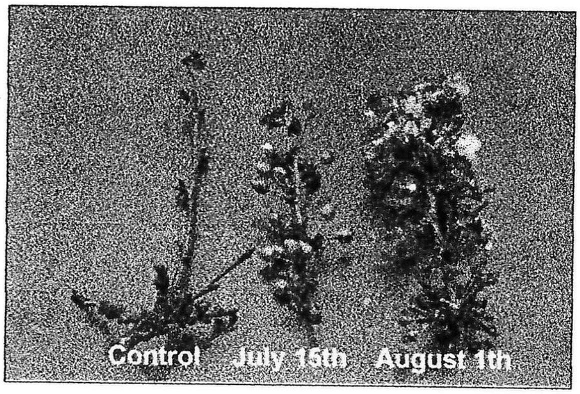


Figure 4. Hydrogen Cyanamid effect on 'Van' cherry trees. Tuquí, Limarí Valley, Chile. 2001.



Not only flowering is modified by HC treatments, but also leafing and fruit development (Figure 5). Cherry that grows naturally in the area, show flowers, immature and mature fruits together in the summer. Thus only possibility to cultivate cherry trees in the Chilean north is by using a chilling accumulation replacement; and HC can be an alternative.

Figure 5. Effect of three CH treatment dates on 'Van' cherry flowering and leafing. Tuquí, October 2th, 2001.

Table 2 shows the advance in the first flowering and full bloom in different varieties for different application dates of HC.

Table 2. Advanced flowering (days) and full bloom (days), according the date of HC treatment, compared with control trees. Tuquí, Limarí, Chile. 2001.

CULTIVAR	FLOWERING		FULL BLOOM	
	July 15th	August 1th	August 1th	July 15th
Van	34	21	32	35
Bing	40	29	42	43
Kordia	48	35	47	55
Lambert	67	53	45	59

Data presented here was corroborated using different varieties, in different seasons. Figure 6 shows the situation in winter 2004. In Semita, where chilling accumulation was poor, flowering was advanced by at least 3 weeks in 'Brooks', and 2 weeks in 'Newstar'. On the other hand, under these conditions 'Brooks' reacts better to poor chilling accumulation than 'Newstar' (Figure 6).

Data presented here was corroborated using different varieties, in different seasons. Figure 6 shows the situation in winter 2004. In Semita, where chilling accumulation was poor, flowering was advanced by at least 3 weeks in 'Brooks', and 2 weeks in 'Newstar'. On the other hand, under these conditions 'Brooks' reacts better to poor chilling accumulation than 'Newstar' (Figure 6).

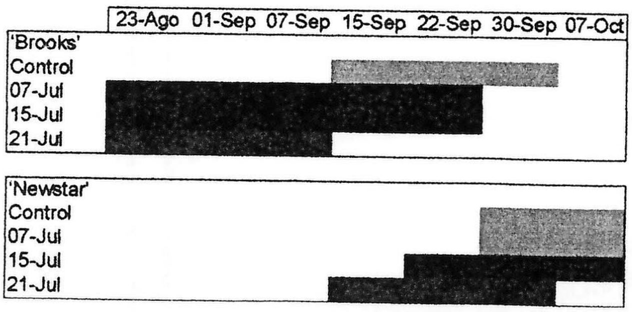


Figure 6. Flowering periods in two cherry varieties treated with HC in different dates. Semita, Limarí Valley. 2004.

CONCLUSIONS

- Hydrogen Cyanamid advances and concentrates cherry flowering period in poor chilling accumulation areas.

- Proper timing depends by previous chilling accumulation. 300 to 350 Richardson *et. al.* units or 700 to 900 Florida units) are necessary to achieve a good response in flowering and fruit set. Early applications promote a long and irregular flowering. Late treatments can delay flowering and cause bud damage.

- Hydrogen Cyanamid can be used like a powerful tool in order to managing cherry flowering and harvest time.

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Physiological Response of Sweet Cherry to Chemical Thinners

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Introduction

Previous research in our lab has shown great potential for chemical blossom thinners to reduce crop load and improve fruit quality in productive sweet cherry (*Prunus avium* L.) orchard systems. One likely mechanism of thinning is the reduction in net carbon balance and assimilates to developing fruit. The mechanism involved in reduction of net carbon exchange rate (NCER) is unclear and is explored in this work. The objective of this work is to evaluate the physiological effect of chemical blossom thinners and a post-bloom thinner on 'Bing'/ 'Gisela®5' sweet cherry.

Materials & Methods

The chemical blossom thinning and post bloom thinning trials took place in Prosser, WA in 2005. The following chemical thinners were applied with an airblast sprayer to 'Bing'/ 'Gisela® 5' sweet cherry trees at 20% and 80% full bloom (April 3 and April 8): 4% vegetable oil emulsion (VOE), 2% ammonium thiosulphate (ATS), 2% fish oil + 2.5% lime sulphur (FOLS), 1% tergitol, and an untreated control. A separate set of 'Bing'/ 'Gisela® 5' sweet cherry trees were treated with a post bloom thinner (2% fish oil + 2.5% lime sulphur) approximately 2 weeks after full bloom (April 28).

Single-leaf NCER, stomatal conductance (PP Systems, Haverhill, MA) and leaf chlorophyll fluorescence (Hansatech Instruments, Ltd.) was evaluated during the leaf recovery period. Leaves were considered recovered when NCER values were statistically the same between treatments.

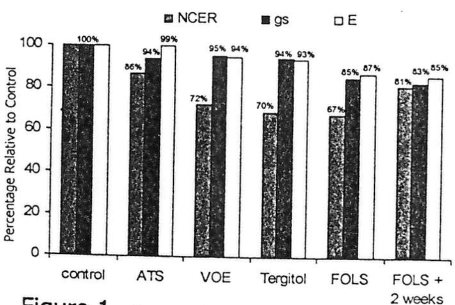

Figure 1 Overall effect of chemical thinners on net carbon exchange rate (NCER), stomatal conductance (g_s) and evaporation rate (E) represented as a percentage relative to the untreated control. Chemical blossom thinners (ATS, VOE, Tergitol, FOLS) were applied 20% and 80% full bloom; a post bloom thinner (FOLS) was applied 2 weeks after full bloom.

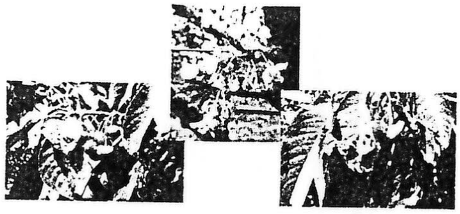

Table 1 Effect of chemical blossom thinners (20% and 80% full bloom) and a post-bloom thinner (14 days after full bloom) on sweet cherry net carbon exchange rate (NCER), stomatal conductance (g_s), and fluorescence parameters (Fo, Fv, ΦPSII, qP). Values represent means from the entire recovery period analyzed by ANOVA ($p = 0.05$).

Bloom Treatment 20% and 80% bloom	NCER ($\mu mol\ m^{-2} s^{-1}$)	gs ($mmol\ m^{-2} s^{-1}$)	Fo	Fv
Control	7.0 a	82.9 a	384 [illegible]	1239.8 a
ATS	5.9 b	73.4 ab	339 c	1215.8 a
VOE	5.1 bc	75.8 ab	379 ab	1064.1 b
Tergitol	5.0 bc	73.6 ab	361 abc	1054.9 b
FOLS	4.7 c	68.5 b	347 bc	1050.9 b

Post bloom Treatment 2 weeks after bloom	NCER ($\mu mol\ m^{-2} s^{-1}$)	gs ($mmol\ m^{-2} s^{-1}$)	ΦPSII	qP
Control	12.2 a	115.0 a	[illegible] a	0.942 a
FOLS	9.9 b	97.5 b	[illegible].707 b	0.902 b

Results & Discussion

All chemical blossom thinning agents significantly reduced single-leaf NCER and numerically reduced stomatal conductance. Both timings of FOLS (bloom and 2 weeks after bloom) significantly suppressed NCER and stomatal conductance (Figure 1, Table 1). Leaf recovery occurred after approximately 17 days following the 80% full bloom application (Figure 2A). In comparison, leaves applied with the post-bloom thinner recovered more quickly, after approximately 1 week (Figure 2B).

- Relative to the control, net carbon exchange rate in ATS, VOE, Tergitol and FOLS treatments was 86%, 72%, 70%, and 67%, respectively.
- There was a smaller reduction in NCER in the post bloom FOLS treatment (81% of the control) compared to the blossom treatment (67% of the control, Figure 1). In addition, the post bloom treatment experienced a shorter recovery period than the blossom treatment, which suggests that leaves become less susceptible to damage with maturity.
- Stomatal conductance was significantly suppressed by bloom and post-bloom treatments of FOLS (15% and 17%, respectively), suggesting that stomatal closure is involved with NCER reduction (Table 1, Figure 1).

Results & Discussion cont.

- ATS and FOLS blossom treatments significantly lowered dark fluorescence yield (Fo), compared to the control. Reductions in Fo indicate damage to the photosystem II pigment structure.
- Variable fluorescence (Fv) was significantly lower in VOE, tergitol and FOLS blossom thinner treatments. Reduction in Fv indicates thylakoid damage, which in turn affects the PSII quantum yield. Photoinhibition has been linked with low Fv values (Krause and Weis, 1984).
- Post-bloom FOLS treatment significantly affected the efficiency of photosystem II reaction centers. The reduction of PSII and qP suggests a mechanism for NCER reduction in treated leaves.
- Response of sweet cherry NCER, g_s, and leaf fluorescence to chemical thinners varies with the type of thinner and leaf maturity.

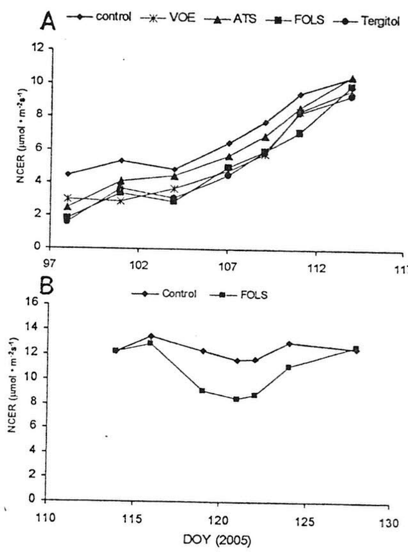

Figure 2 Net carbon exchange rate influenced by chemical blossom thinners applied at 20% and 80% full bloom (A) and a post-bloom thinner (B) applied 14 days after full bloom.

We gratefully acknowledge financial support from the WA Tree Fruit Research Commission

Krause, G. H., and Weis, E. 1984. Chlorophyll fluorescence as a tool in plant physiology: Interpretation of fluorescence signals. *Photosynthesis Research* 5:139-157

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MICROPROPAGATION OF TWO CHERRY ROOTSTOCKS AND THEIR BEHAVIOUR IN THE NURSERY AND IN THE ORCHARD.



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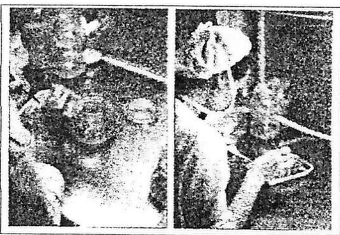
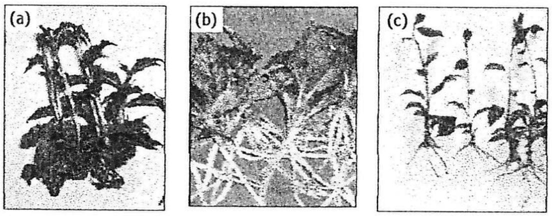
INTRODUCTION

Where fruit science aims at improving product quality and at a sustainable use of resources, selection of the most suitable rootstock is of primary importance. There is no ideal rootstock for all varieties and all situations of soil and climate, but several rootstocks having different characteristics, which can be matched to a given variety according to the soil type and climatic conditions of the growing environment, *and* according to farm organization and the availability of irrigation water.

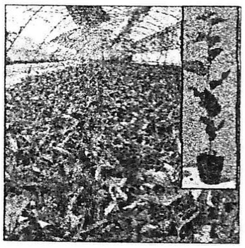


MATERIALS AND METHODS

The experiments were carried out in Greece. The cherry rootstocks CAB 6P (*P. cerasus*) and SL 64 (*P. mahaleb*) were propagated in vitro in a commercial tissue culture laboratory. Explants from actively growing shoots were collected from controlled virus-free mother plants and sterilized using a solution of sodium hypochlorite at 2% for 20 minutes. The culture medium used for the first stage was WPM, while for shoot proliferation the modified MS culture medium was used for both rootstocks. Shoot elongation was achieved with the MS medium modified differently for each rootstock, and the rooting medium was half-strength MS containing 1mg/l IBA for CAB 6P and 2mg/l IBA for SL 64.



Multiplication (a) and rooting (b) of CAB 6P; rooting of SL64 (c).



CAB 6P acclimation; in the inset after 40 days.

CAB 6P in the nursery (June '05).

RESULTS AND DISCUSSION

The rate of multiplication was 2.5–3.0 for CAB 6P and 4.0–5.0 for SL 64. Rooting reached 80–85% with CAB 6P and 90–95% with SL 64. Survival of the plantlets during acclimation was 90-95% for CAB 6P and 85-90% for SL 64. After approximately 40 days in the greenhouse, the plants were 20-25cm tall and 3-4mm in diameter.

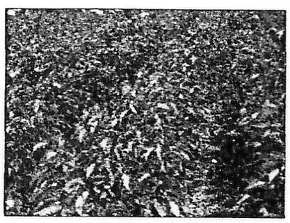
They were transferred to the nursery in May and by the end of August had reached a height of 120-150cm and a diameter at the point of grafting of 8-10mm. Grafting was effected from the end of August to mid September using two dormant buds for each plant of four varieties (Tragana, Ferrovia, Bigarreau Burlat, Ziraat) and was 100% successful for both rootstocks with all four varieties.

By December of the following year the plants were 150-180cm tall and showed perfect compatibility at the point of grafting.

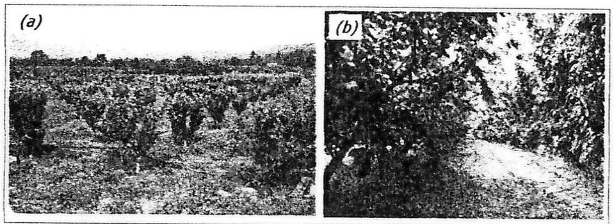
One-year-old trees planted in orchards in northern Greece presented no compatibility problems with any of the four varieties over the subsequent 4-5 years. CAB 6P showed a tendency to suckering depending on soil management practices, as well as earlier cropping and lower vigour compared to SL 64.

CONCLUSIONS

The two rootstocks tested showed good multiplication rates for commercial micropropagation. Both performed extremely well in the nursery: rapid growth, successful grafting and no compatibility problems. Both can be recommended – each according to its specific characteristics - to overcome problems deriving from certain biotic and abiotic stress conditions.



Sweet cherry varieties grafted on CAB 6P (nursery June '05)



Two year-old sweet cherry (cv Tragana) grafted on CAB 6P (a) and four year-old (cv Ferrovia) on SL 64 (b).

?RELIMINARY TESTING OF A REFLECTIVE GROUND COVER: ;WEET CHERRY GROWTH, YIELD, & FRUIT QUALITY

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∧ATERIALS & METHODS

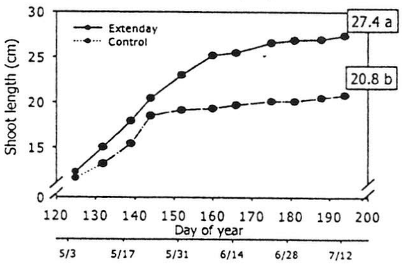
ı 2004 we applied at full bloom a white, reflective fabric ground ver (Extenday®) in Prosser, USA to a 9-year-old 'Bing'/'Gisela®1' :hard and near Santiago, Chile to a 4-year-old 'Bing'/Mazzard :hard. In Prosser, we evaluated shoot and fruit growth rates, ınk cross-sectional area, and leaf chlorophyll (SPAD 502 meter, ıolta) twice weekly throughout the growing season. At harvest in th orchards, tree yield was recorded. 100-fruit sub-samples were llected and mean diameter, weight, soluble solids, firmness, and lour were assessed. In Prosser, a second sub-sample was stored 21 d in regular atmosphere cold storage (2 – 4°C). Quality of ıse fruit was evaluated after returning to room temperature. Leaf ; exchange was evaluated on 28 May (early stage III of fruit velopment) in Prosser using a CIRAS-2 (PP Systems).

:ESULTS & DISCUSSION

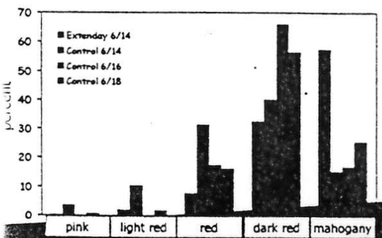
'EGETATIVE GROWTH:

Vith Extenday®, we observed an increase in shoot growth :es and an extension of about 2 weeks in the period of active ɔot elongation (Fig. 1). As a result, final shoot length was 32% gher in Extenday®-treated trees. Secondary growth rates :re also higher in trees with ground cover – annual trunk cross-ctional area (TCSA) increment was 90% greater. Extenday® ı not affect the seasonal trend of trunk expansion. terestingly, secondary growth rates of trees with ground cover ring stage III of fruit expansion were twice as high as those thout. This is a period of intense competition among eristems for assimilates and the higher expansion rates of a ɛak sink such as secondary meristems implies improved source-ık relations in trees treated with Extenday® despite greater :getative growth.

r many crops, SPAD 502 meter readings are related positively leaf chlorophyll content. We found leaf SPAD meter readings :re similar between treatments in early spring, but became ɔgressively higher in trees with reflective ground cover (data : shown). By mid-July (day of year 200), leaf chlorophyll was ɔut 7% higher in trees with Extenday® ground cover.



IGURE 1 Effect of Extenday® fabric row cover on the seasonal trend of mean shoot length.



URE 2

ABSTRACT

We examined the effects of a full-season application of a white, woven fabric reflective ground cover (Extenday®) on 'Bing' sweet cherry growth, yield and fruit quality near Prosser, USA, and Santiago, Chile. In Prosser Extenday® increased mean shoot length by 32%, annual trunk cross-sectional increment by 90%, and increased leaf chlorophyll content by 7% (estimated by SPAD 502 meter) compared to untreated. In both locations, based on comparisons of fruit colour, firmness, and soluble solids, fruit from Extenday®-treated trees reached optimum maturity ca. 5 days earlier. At comparable maturity, fruit from Extenday®-treated trees were similar in size and soluble solids, but had 9% greater firmness than untreated fruit. Following 21 d in cold storage, Extenday®-treated fruit had 8% higher soluble solids, and were 16% firmer than untreated fruit. Leaf net CO_2 exchange rate in the canopy interior was 50% higher with Extenday® suggesting increased supply of assimilates to those trees.

TABLE 1 Effect of Extenday® reflective fabric row cover on fruit weight, soluble solids, and firmness. Data followed by different letters are significantly different within column (P<0.05).

Treatment/Harvest date	Fruit weight (g)	Soluble solids (°brix)	Firmness (g/mm)
Extenday®, 14 June	8.1 ab	22.2 a	269 a
Control, 14 June	7.9 b	20.3 b	262 ab
Control, 16 June	8.0 ab	21.1 ab	245 c
Control, 17 June	8.4 a	20.1 b	268 a
Control, 18 June	8.3 ab	22.1 a	248 bc
Quality after 21 d cold storage (% change)			
Extenday®, 14 June	-2%	+1%	0%
Control, 14 June	-3%	-1%	-14%
Control, 16 June	+3%	-5%	-10%
Control, 18 June	+3%	-4%	-11%

Throughout trees treated with Extenday® in 2004, there were significantly more flowers per spur in 2005 compared with untreated trees (Fig. 3). This is likely due to much improved light levels in the canopy interior from increased reflection of radiation by Extenday® and improved carbon balance (i.e., source-sink relations) within Extenday®-treated trees. Indeed, we found light-saturated net CO_2 exchange rates of leaves in the canopy interior were ca. 50% higher from trees treated with the ground cover; though Extenday® had no effect on NCER of leaves in the well sunlit canopy exterior (Fig. 4). We found no effect of Extenday® on dark respiration and therefore, treated trees had improved carbon balance.

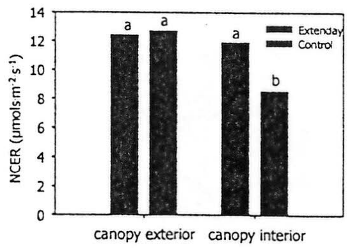


FIGURE 4 Effect of Extenday® fabric row cover on light saturated leaf net CO_2 exchange rate (NCER) during early stage III of fruit development (28 May). Bars with different letters are significantly different by LSD (P < 0.05).

RESULTS & DISCUSSION

FRUIT YIELD & QUALITY:

We found no effect of Extenday® on fruit yield in Prosser or Santiago. Yield in Prosser was 9.8 ± 0.8 kg and 9.5 ± 0.8 kg for treated and untreated trees, respectively. The lack of yield response is not surprising because Extenday® had no effect upon fruit set (data not shown) or individual fruit weight. Moreover, because fruit quality was good overall, it does not appear that fruit growth was limited by availability of assimilates. However, we hypothesize that Extenday® would improve fruit size or tree carrying capacity of more productive trees in which increased carbohydrate supplies (Fig. 4) may mitigate potential assimilate limitations.

As 'Bing' fruit mature and ripen, their skin and flesh colour progress from pink to mahogany, their size, fresh weight, and sugar content increase, and flesh firmness decreases. 'Bing' fruit are picked primarily by skin colour, second by soluble solids. Colour variability exists within every tree at harvest, dark red fruit are considered saleable but slightly under-ripe; mahogany is the optimum. Based on comparisons of fruit weight, colour, firmness, and soluble solids, fruit in both locations treated with Extenday® reflective ground cover reached optimum commercial maturity about 5 days sooner than those untreated (Fig. 2, Table 1). Even 4 days after the harvest of Extenday®-treated fruit, the untreated fruit in Prosser were still predominantly dark red (Fig. 2). Indeed, we do not know when untreated fruit would have equaled the colour of those treated with Extenday® nor what the quality of those fruit would have been. However, despite being ostensibly less mature based on colour comparisons, untreated fruit were similar in weight and soluble solids, but less firm than Extenday®-treated fruit (Table 1). We hypothesize that the Extenday® treatment unequally hastened the processes of fruit ripening because colour development, sugar accumulation, and achievement of final fruit size were advanced to a greater extent than fruit softening.

Following 21 d cold storage, fruit weight and soluble solids were relatively unchanged, irrespective of treatment (Table 1). Fruit had not yet shriveled and had good overall appearance. However, control fruit had softened significantly during storage; firmness was on average 11.7% lower than it was at harvest. In contrast, Extenday®-treated fruit did not show any loss in firmness. The benefit of Extenday® on fruit storage quality is likely related to its effect on fruit maturation and ripening. Storability of fruit is related to its physiological status at harvest.

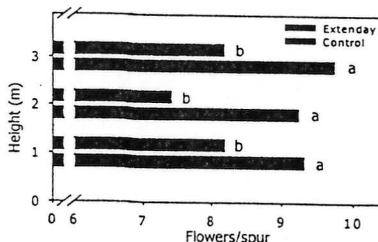


FIGURE 3 Effect of Extenday® fabric row cover in 2004 on the number of flowers per spur at three canopy heights (m above soil surface) in 2005. Bars with different letters are significantly different by LSD (P < 0.05).

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HERBICIDE INFLUENCE ON THE GROWTH OF YOUNG SWEET CHERRY TREES IN A HIGH – DENSITY ORCHARD

FRUIT GROWING INSTITUTE PLOVDIV

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INTRODUCTION

Weeds strongly compete for water and nutrient substances in the first years after the establishment of the fruit plantations when the plants are still young and they have comparatively shallow root system. Until recently, the prevailing concept in our country has been that the herbicide application during the first years after planting of the fruit trees was not recommendable due to the risk of growth disturbance. It was due to fact that the major group of herbicides applied until and at the beginning of the 1990 ,s contained the active substances of the triazine herbicides. In Bulgarian, as well as in foreign literature there are data available about the toxicity of those herbicides when applied during in the first year of the stone fruit species, including in young sweet cherry plantations. There are limited data about the herbicide application in vegetative rootstocks of the Gisela series.

An aim of the present investigation was to study the effect of the chemical weed control on the specific composition of the weeds and the rate of weeding, the duration of the herbicide effect, the vegetative and the initial production habits of three sweet cherry cultivars grafted on the vegetative rootstock Gisela 5.

MATERIAL AND METHODS

The investigation was carried out in the period 2002 – 2004 in a young high density sweet cherry orchard planted in the spring of 2001, where the soil is alluvial-meadow and pH – 6,8. with a spacing 5,0 X 3,0 m. In the year of tree planting the area was treated with total leave herbicide glyphosate /Roundup – 10 l/ ha / –for preliminary clearing of the perennial roots and the rootsucker weed vegetation. Until establishing the orchard the soil was maintained free of weeds by shallow tillage. In the spring of the second year, prior to the beginning of vegetation, the row strip was treated with pendimethalin (Stomp 33 EC- 4 l/ha). In the next two years /2003 and 2004/ pendimethalin (Stomp 33 EC- 6 l/ha) was applied again during the same period. When the post effect of pendimethalin ended /in the middle of July/ the row strip was maintained against secondary weeding until the end of vegetation by two treatments with glyphosate (Roundup – 6 l/ha).

The following variants on Gisela 5 rootstock were set: 1) Bigarreau Burlat- treated; 2) Control - Bigarreau Burlat – untreated, non-weeded; 3) Kordia– treated; 4) Control - Kordia – untreated, non-weeded; 5) Lapins – treated; 6) Control - Lapins– untreated, non-weeded. The experiment was set by the long-row method in three replications by 3 trees in each one.

The effect of the soil herbicide pendimethalin was studied at the two rates applied on: the specific weed composition and the degree of weeding (in dynamics – on the 30th, 60th, 90th and 120th day after the date of treatment by the quantity-weight method); the duration of post-effect herbicide action; the vegetative habits of the cultivar-rootstock combinations – mean length of one shoot /cm/, crown volume /V - m 3/ and the trunk cross sectional area (TCSA) /S -cm 2/.

During 2004, the first real crop of the trees, the total yield /in average per tree in kg/ and the mean weight of a fruit /g/ were also reported.

RESULTS AND DISCUSSION

The weed association in the in-row strip of the plantation consisted of 15 weed species: *Lamium purpureum* L., *Lamium amplexicaule* L., *Veronica hederifolia* L., *Stellaria media* L., *Capsella bursa-pastoris* L., *Polygonum aviculare* L., *Chenopodium album* L., *Sonchus oleraceus* L., *Amaranthus retroflexus* L., *Portulaca oleracea* L., *Setaria viridis* L., *Bromus arvensis* L., *Sonchus asper* L., *Erigeron canadensis* L., *Lactuca serriola* L.

The applied rate of pendimethalin (Stomp 33 EC – 4 l/ha) realized an efficient control against all the weed species forming the weed association in the in-row strip of the plantation with a three-month duration of the herbicide effect /Table 1/.

Stellaria media L. – 0,3 plants per square meter in average were reported in the treated area, at an average total number of weed plants in the control- 10,7. Very good herbicide efficiency of pendimethalin – Stomp 33 EC – 4 l/ha was detected on the 60th day and on the 90th day after treatment. On the 60th day the appearance of single plants of *Capsella bursa-pastoris* L. – 1,6 plants in average per m2 – was established in the treated area, at an average total number of weed plants in the control 0,5. It could be explained by the resistance of the species against the active substance pendimethalin.

On the 90th day plants of *Portulaca oleracea* L., which is a typical representative of the late secondary weeding, appeared in the treated variant.

Similar results were obtained about the herbicide efficiency of the applied higher rate of pendimethalin – Stomp 33 EC – 6 l/ha during the next two years of the study, the period of the herbicide post-effect being 120 days /Table 2/.

The efficient control of weeding ensured the overcoming of the competitive effect of the weeds for water and nutrients in the first months of the tree vegetation, which created favourable conditions for the growth and development of the cultivar-rootstock combinations.

External symptoms of phytotoxicity or delayed growth of the trees in the treated variants were not observed. The lack of a depressing effect of pendimethalin at both rates applied was also confirmed when reporting the biometric characteristics at the end of vegetation.

In the three years of the study the plants of the variants treated with herbicides had bigger values of the mean length of a shoot and a bigger crown volume /Figure 1 and 2/.

Similar results were obtained concerning the TCSA, which was bigger in the trees of the variants, in which efficient weed control was provided by application of herbicides /Figure 3/. In the year of the initial fruiting, the plants of the variants treated with herbicides had higher average yield per tree /Table 3/. No differences in the mean weight of a fruit were established between the plants treated with herbicides and those of the control.

Table 1

Variants	Weeds											
	30-days				60-days				90-days			
	psc/ m 2	% or control	Weight /g/	% of control	psc/ m 2	% of control	Weight /g/	% of control	psc/ m 2	% of control	Weight /g/	% of control
1.Control	10.7	100	56,4	100	16,3	100	189,1	100	53,7	100	180,6	100
2.Stomp 33 EC-4l/ha	1.6	15.0	7,5	13,3	4,9	30,1	46,3	24,5	12,2	22,7	46,4	25,7

Table 3

Variants	Yield per tree /kg/	Mean weight of fruit /g/
1	0,770	6,7
2	0,290	6,6
3	5,050	11,0
4	4,500	11,0
5	14,450	11,1
6	10,200	9,9

Table 2

Variants	Weeds															
	30-days				60-days				90-days				120-days			
	psc/ m 2	% of control	Weight /g/	% of control	psc/ m 2	% of control	Weight /g/	% of control	psc/ m 2	% of control	Weight /g/	% of control	psc/ m 2	% of control	Weight /g/	% of control
1.Control	14,7	100	14,4	100	46,9	100	108,6	100	43,3	100	134.8	100	20.4	100	613.2	100
2.Stomp 33 EC-6 l/ha	0,8	5,4	6,5	45,1	0	0	0	0	0.9	2.1	27.7	20.5	25.1	123.0	70.4	11.5

Figure 1. Effect of the chemical control against weeding on the mean length of the shoot / cm/

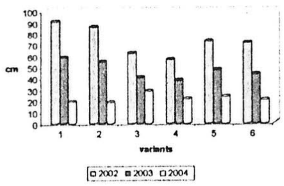


Figure 2. Effect of the chemical control against weeding on the crown volume /m3/.

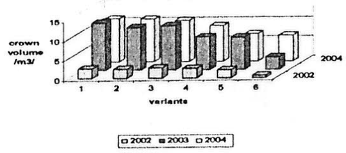
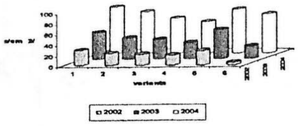


Figure 3. Effect of the chemical control against weeding on the TCSA/cm2/.



CONCLUSION

An efficient weed control in the first three years after the planting of high density sweet cherry plantation on Gizela 5 has been achieved by applying of soil and foliar herbicide. That created favourable conditions for the tree growth during the whole vegetation, eliminating the weed competition for water and nutrients.

Depressing tree growth reaction in response to the two rates of application of the soil herbicide **pendimethalin** was not observed at that stage of the development of the trees. The better vegetative growth and the beginning of bearing after the application of those two herbicides give the grounds to recommend them for weed control in high density sweet cherry orchards on Gizela 5 rootstock.

ISHS – The 5th International Cherry Symposium, June 06 – 10,2005, Bursa - Turkey

PROMISING SWEET CHERRY CULTIVARS IN SLOVENIA

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key words: cherry, cultivars, yield, vigour, physical-chemical fruit characteristics, fruit quality

abstract: Sweet cherry growing in Slovenia has a more than a hundred and forty-year-long tradition. The Gorica region has a leading position in cherry cultivation. Systematic research on sweet cherry cultivars started after 1959 when a collection orchard was planted in Šempeter near Gorica. According to the research outcomes the assortment as a list of proposed cultivars for sweet cherry growing in Slovenia has been changed several times. In 1993 the Fruit Growing Centre Bilje was established and since then, the research on sweet cherry cultivars and rootstocks has been one of the most important activities in the Centre. During this period we have tested 72 cultivars planted in two collection orchards on two locations. After a several-year-long investigation into recent cherry cultivars of foreign origin the most important cultivars for general growing have been proposed in Slovenia: 'Burlat', 'Celeste', 'Giorgia', 'Van', 'Sunburst', 'Germersdorfska' and 'Lapins'. 'Early Lory', 'Burlat C1', 'Biggareau Moreau', 'Isabella', 'Prime Giant', 'Garnet', 'Brooks', 'New Star', 'Big Lory', 'Canada Giant', 'Summit', 'Kordia', 'Regina' and 'Sweet Heart' are cultivars for local growing. Among cultivars of limited importance the promising cultivars are medium-maturing Slovene cultivar 'Vigred' and late-maturing local cultivars 'Petrovka' and 'Pavliška'.

In the paper the results of vigour and productivity of some of the most promising sweet cherry cultivars in Slovenia as well as physical and chemical characteristics of the cherry fruits are evaluated.

introduction: Great contribution to the cherry production development in the last decade has been achieved by the research into weaker cherry rootstocks (Callesen, 1998; Fajt in Komel, 2004; Usenik in Štampar, 2004), by the introduction of newer cultivars (Kappel in Lane, 1998; Lugli et al., 2004) and by modern training systems (Štampar, 2002).

materials and methods: From 1985 till 2004 we tested 72 cultivars of sweet cherries on two locations Bilje and Stara gora. Each cultivar was presented by 3-6 trees. The cultivars were observed over 3-5 years. The yield was measured per tree. An average sample of 50 fruits was used for the measurements of fruit and stalk weight, a sample of 20 fruits was used for the measurements of fruit and stone dimensions and stalk length. The content of soluble solids was determined with a refractometer Atago WM-7, the content of total acids was measured with an automatic titrator Metrohm 719 S Titrino.

Data of tree vigour of the cultivars planted in Stara gora (circumference 20 cm above the graft union; height (h), width (w) and length (l)) were collected annually at the beginning of the growth period per tree, from which tree volume was calculated $V=(\pi*h*(l/2)*(w/2))/3$. Yield efficiency (kg/cm2) was calculated using the ratio of cumulative yield to trunk cross section area (TCSA). We evaluated external fruit characteristics (colour and skin shine) and organoleptic characteristics (firmness, taste, aroma). The results of tree vigour, yield and yield efficiency of the cultivars planted in Stara gora the programmes EXCEL 97 and STATGRAPHICS Plus 4.1 were used. Statistically significant differences were determined using the Duncan's multiple range test at the level of probability $p = 0.05$.

results and discussion: The cultivar characteristics encompassed vegetative parameters among which we were the most interested in tree vigour defined by trunk growth and crown volume (Table 1) and generative parameters among which were yield per tree, yield efficiency and average fruit weight (Table 2, Fig 1). The results of some sensory characteristics (firmness, taste and general characteristics) of the best evaluated cultivars are displayed in Table 3. Fig 2 shows the contents of soluble solids and total acids.

Tree vigour, regular production and high yield depend on numerous factors, mostly on a genotype, its adaptability to pedo-climatic conditions of the area, weather conditions during the growth period, production technology (Predieri et al. 2003). The differences in tree vigour, yield and organoleptic fruit characteristics among the cultivars in our experiment were the consequence of a genotype and weather conditions during growth periods, while the production technology was equal and optimal.

Table 1: Vegetative parameters of sweet cherry cultivars on the location of Stara gora.

Cultivar	Trunk growth (cm) 1995-2004	Tree volume (m^3) 2004
Burlat	47,6 abc'	16,6 abcde
Bigg. Moreau	43,1 bcde	23,0 abc
Bigg. Burlat	48,2 abc	20,1 abcde
Burlat C1	45,3 abcd	14,8 bcde
Isabella	38,8 cdef	16,3 abcde
Ljubljanska	34,5 defg	15,4 abcde
Celeste	54,5 a	21,0 abcde
Prime Giant	33,1 defg	12,6 bcde
Big Lory	51,8 ab	22,6 abcd
Giorgia	40,4 bcdef	23,5 ab
Brooks	30,2 fg	12,4 ef
Glorius Star	31,0 efg	10,8 e
New Star	41,9 bcdef	16,54 abcde
Canada Giant	34,2 defg	13,9 abcde
Anellone	39,6 cdef	23,0 abc
Van	41,3 bcdef	15,7 abcde
Summit	40,3 bcdef	11,2 de
Sunburst	38,6 cdef	17,7 abcde
Germersdorfer	39,0 cdef	16,8 abcde
Ferrovia	24,3 g	10,2 e
Hedelfinger	34,5 defg	11,6 cde
Elisa	33,0 defg	11,3 de
Pavliška	37,2 cdef	16,8 abcde
Durone III	39,2 cdef	25,3 a
Sweet Heart	23,3 g	11,7 cde

' Means separation at 5 % level (Duncan Multiple Range Test).

Tablo 2: Generative parameters of sweet cherry cultivars on the location of Stara gora.

Cultivar	Ripening time with regard to 'Burlat'*	Cummulative yield (kg) 2000-04	Yield (kg) /tree	Yield efficiency (kg/cm²)	Fruit weight (g)
Burlat	0	78,96 bcdef'	15,8	0,37 fghij	7,1
Bigg. Moreau	0	51,97 cdef	10,4	0,24 j	7,0
Bigg. Burlat	0-3	77,49 bcdef	15,5	0,34 ghij	7,0
Burlat C1	+3	65,04 cdef	13,0	0,30 ij	6,9
Isabella	+7	54,22 cdef	10,8	0,35 ghij	7,8
Ljubljanska	+7-10	34,65 f	6,9	0,31 hij	7,8
Celeste	+10	88,58 bcde	17,7	0,28 ij	9,1
Prime Giant	+10	59,84 cdef	12,0	0,54 defg	10,0
Big Lory	+10-15	56,17 cdef	11,2	0,21 j	9,8
Giorgia	+11	142,03 a	28,4	0,92 b	6,0
Brooks	+12	94,75 bcd	19,0	0,70 cd	8,4
Glorius Star	+12-16	48,51 cdef	9,7	0,47 efghi	7,8
New Star	+13	97,65 abc	19,5	0,84 bc	7,2
Canada Giant	+17	74,51 bcdef	14,9	0,57 def	8,6
Anellone	+17-19	40,34 ef	8,1	0,29 ij	9,1
Van	+18	118,85 ab	23,8	0,71 cd	7,7
Summit	+19	55,02 cdef	11,0	0,37 fghij	10,7
Sunburst	+20	79,83 bcdef	16,0	0,60 de	10,1
Germersdorfer	+20-23	78,85 bcdef	15,8	0,55 defg	9,3
Ferrovia	+22	44,04 def	8,8	0,52 defgh	8,4
Hedelfinger	+22	57,91 cdef	11,6	0,61 de	7,7
Elisa	+26-28	40,49 ef	8,1	0,34 ghij	10,3
Pavliška	+26-28	43,24 def	8,6	0,28 ij	9,7
Durone III	+26-28	74,35 bcdef	14,9	0,46 efghi	7,5
Sweet Heart	+35	88,97 bcde	17,8	1,20 a	8,2

* Ripening time defined with regard to the cultivar 'Burlat' (in the Fruit Growing Centre Bilje ripes 20 th of May).
'Means separation at 5 % level (Duncan Multiple Range Test).

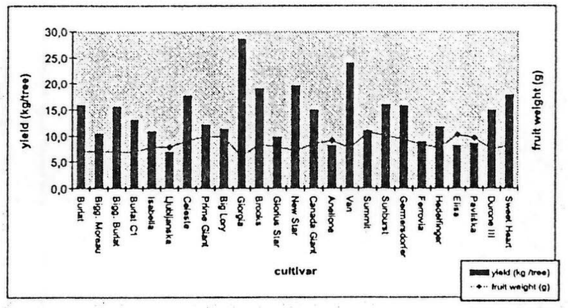
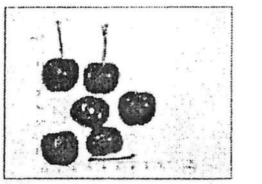


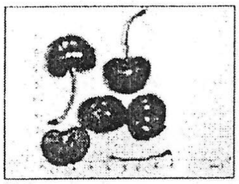
Figure 1: Yield (kg/tree) and fruit weight (g) of cultivars on the location of Stara gora.

Table 3: Some of the fruit characteristics of selected sweet cherry cultivars.

Cultivar	Firmness	Taste	General fruit characteristics
Bigg. Burlat	semi-firm	good-excellent	excellent
Burlat C1	semi-firm	good-excellent	very good
Celeste	semi-firm -firm	good	excellent
Prime Giant	firm	excellent	excellent
Big Lory	firm	excellent	excellent
Vigred	* firm	excellent	excellent
Brooks	firm	good	very good-excellent
Canada Giant	semi-firm	good	very good-excellent
Anellone	firm -very firm	good	excellent
Van	firm	good-excellent	very good-excellent
Summit	semi-firm	excellent	excellent
Sunburst	semi-firm	good	excellent
Elisa	very firm	good-excellent	excellent
Pavliška	firm	excellent	excellent
Regina	very firm	excellent	excellent
Kordia	firm	excellent	excellent

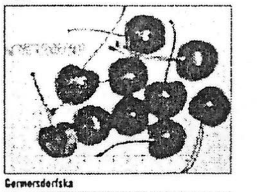


Burlat

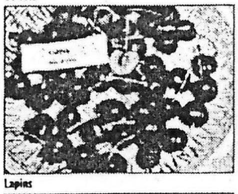


Celeste

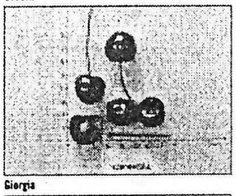
Brooks



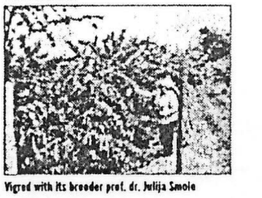
Germersdorfska



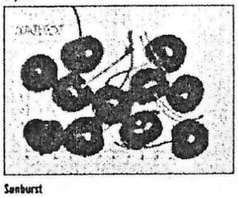
Lapins



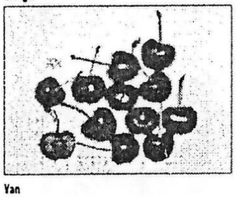
Giorgia



Vigred with its breeder prof. dr. Julija Smole



Sunburst



Van

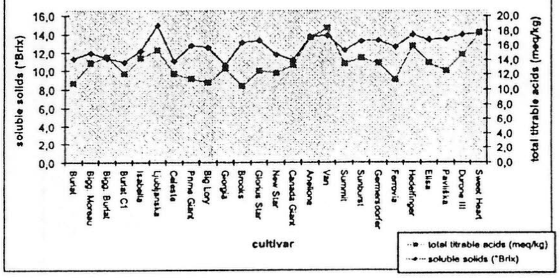


Figure 2: Soluble solids (°Brix) and total titrable acidity (meq//kg) in sweet cherry cultivars of Stara gora.

conclusions: In the last 20 years of the research into sweet cherry cultivars in Slovenia we have investigated 72 cherry cultivars of foreign and local origin. The outcomes of the research into phenological phases, yield and yield efficiency, physical-chemical and organoleptical characteristics of cultivars, were the basis for the changes in the national fruit variety list which in Slovenia, as a rule, alters every 4 years.

Nowadays the national fruit variety list of 2002 provided cultivars which have obtained the best results and are therefore recommended for the intensive sweet cherry production in Slovenia. Those cultivars are 'Burlat', 'Celeste', 'Giorgia', 'Van', 'Sunburst', 'Germersdorfer' and 'Lapins'. Less important cultivars are: 'Early Lory', 'Biggareau Burlat', 'Burlat C1', 'Bigarreau Moreau', 'Isabella', 'Vigred', 'Prime Giant', 'Garnet', 'Brooks', 'New Star', 'Big Lory', 'Canada Giant', 'Summit', 'Bing', 'Hedelfinger', 'Ferrovia', 'Petrovka', 'Kordia', 'Regina' and 'Sweet Heart'.

The local cultivar 'Pavliška' deserves attention irrespective of the fact that it is not included in the 2002 national fruit variety list. Its organoleptic characteristics are excellent as well as its general external fruit characteristics. Its disadvantage is not precocious fruiting.

Prunus cerasus and *Prunus fruticosa* as interstock for sweet cherry trees

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The aim of this rootstock trial

Examine the intergrafted effect on growth and yield efficiency in our soil and climate conditions

Cultivars

'Van' and *'Germersdorfi óriás'*

Tested intergrafted combination

P. fruticosa intergrafted:

- 'Prob'(hibrid) /mahaleb seedling
- 'Selektion 1' /mahaleb seedling

Sour cherry intergrafted:

- 'Meteor korai'/sour cherry seedling
- 'Debreceni bőtermő'/sour cherry seedling
- 'Pándy meggy'/mahaleb seedling
- 'Érdi bőtermő'/mahaleb seedling'

Kontroll:

- 'C 2493' Mazzard seedling
- 'SL 64' mahaleb rootstock

Environmental conditions

Soil : sandy loam layered on alluvial ground, high pH (7.8) and Ca content (18%), low organic matter content (1.2%)

Climate: yearly average temperature: 10.8 C°, sunshine hours total in a year: 1998, yearly precipitation: 520 mm (average of the past 50 years)

Orchard conditions

Planted at spacing 5x3 m, in 1990 spring. Trained to central leader type (modified Brunner-spindle). The orchard is not irrigated.

Trial design and methods

Trial design: three tree/plot, repeated four times in randomized blocks.

Measured data: trunk circumference, canopy size/tree, crop weight/tree, 100 fruits' weight/tree.

Calculated data: Trunk cross sectional area (TCSA) in cm², projected canopy area in m², canopy volume in m³. Cumulative yield (CY) kg/tree (1995-2004), cumulative yield efficiency (CYE) kg/TCSA cm². Mean fruit weight (MFW) of 100 fruit/tree in g/fruit (1997).

Table 1. Tree number and survival

Rootstock	'Germersdorfi óriás'				'Van'			
	1990	1998	2004	%	1990	1998	2004	%
'Prob' /mah	4	2	0	*0*	6	5	1	*17*
'Sel. 1' /mah	2	2	1	*50*	-			
'Meteor k.'/sch	13	12	11	*85*	9	9	7	*78*
'Debr. bőt.'/sch	10	10	8	*80*	6	6	6	*100*
'Pándy m.'/mah	8	8	7	*88*	9	9	8	*89*
'Érdi bőt.' /mah	6	6	5	*83*	4	4	0	*0*
'SL 64' mah	2	2	2	*100*	-			
'C2493' maz.	-				9	9	9	*100*

Results

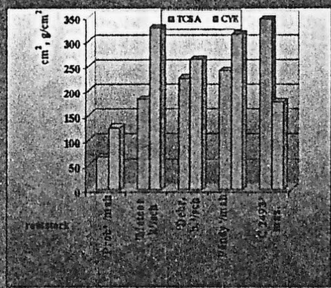

Figure 1. Growth (TCSA, cm²) and cumulative yield efficiency (CYE, g/cm²) of 'Van' (2004)

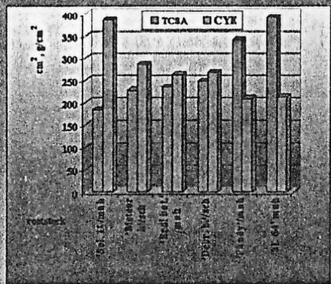

Figure 2. Growth (TCSA, cm²) and cumulative yield efficiency (CYE, g/cm²) of 'Germersdorfi' (2004)

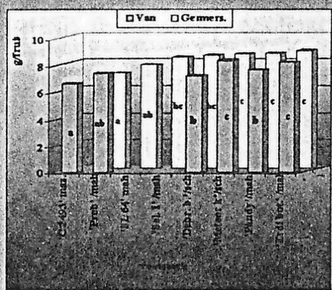

Figure 3. Mean fruit weight (g/fruit, 1997)

Conclusion

- Intergrafted sour cherries on both *mahaleb* and sour cherry rootstock reduced the tree vigour, and increased the yield efficiency.
- Considering the longevity *Prunus fruticosa* 'Selektion 1' and 'Prob' *(P. fruticosa x mahaleb hybrid)* intergrafts, these combinations can not be recommended.
- Promising intergrafts are :
  - 'Van'/'Meteor korai' and 'Pándy meggy' sour cherry
  - 'Germersdorfi óriás'/ 'Meteor korai', 'Debreceni bőtermő' and Érdi bőtermő sour cherry interstock both rootstock (*mahaleb* and *cerasus* seedling).
- Fruit size on all *Prunus cerasus* interstem was larger.

Table 2. Tree size (TCSA and canopy size) of 'Germersdorfi' (2004)

Rootstock	TCSA		Canopy area		Canopy volume	
	cm²	%	m²	%	m³	%
'Sel. 1'/mah.*	184.2 -	47	1.24 -	18	1.62 -	13
'Meteor k.'/sch.	227.9 a	58	5.70 a	84	9.36 a	74
'Érdi bőt.'/mah.	233.9 a	60	5.75 a	85	9.48 a	75
'Debr. bőt.'/sch.	246.8 a	63	6.96 a	102	12.52 a	99
'Pándy m.'/mah.	341.9 ab	87	7.68 a	113	14.19 a	112
'SL 64' mah.	393.0 b	100	6.80 a	100	12.65 a	100

Table 3. Cumulative yield (CY) and cumulative yield efficiency (CYE) of 'Germersdorfi' (2004)

Rootstock	CY	CYE		
	kg/tree	kg/cm²	kg/m²	kg/m³
'Pándy m.'/mah.	55.3 a	0.209 a	10.99 a	6.78 a
'SL 64' mah.	77.2 b	0.213 a	17.39 b	10.21 a
'Érdi bőt.'/mah.	52.9 a	0.263 b	11.48 ab	6.99 a
'Debr. bőt.'/sch.	51.3 a	0.267 ab	11.99 ab	7.87 a
'Meteor k.'/sch.	52.5 a	0.286 ab	13.30 ab	8.91 a
'Sel. 1' /mah.*	71.5 -	0.388 -	58.50 -	44.16 -

Table 4. Tree size (TCSA and canopy size) of 'Van' (2004)

Rootstock	TCSA		Canopy area		Canopy volume	
	cm²	%	m²	%	m³	%
'Prob'/mah. *	66.9 -	19	1.21 -	10	1.22 -	5
'Meteor k.'/sch.	182.0 a	53	6.39 a	52	11.28 a	43
'Debr. bőt.'/sch.	225.1 a	65	6.96 a	56	12.60 a	48
'Pándy m.'/mah.	240.2 a	70	8.58 a	69	16.16 a	62
'C 2493' maz.	345.1 b	100	12.35 b	100	26.15 b	100

Table 5. Cumulative yield (CY) and cumulative yield efficiency (CYE) of 'Van' (2004)

Rootstock	CY	CYE		
	kg/tree	kg/cm²	kg/m²	kg/m³
'Prob'/mah. *	7.3 -	0.125 -	12.86 -	14.40 -
'Meteor k.'/sch.	45.1 a	0.327 b	10.52 b	7.44 b
'Debr. bőt.'/sch.	52.5 ab	0.264 ab	10.00 ab	6.37 ab
'C 2493' maz.	53.7 ab	0.177 a	5.75 a	3.47 a
'Pándy m.'/mah.	65.8 b	0.315 b	11.28 b	7.39 b

*-only one tree

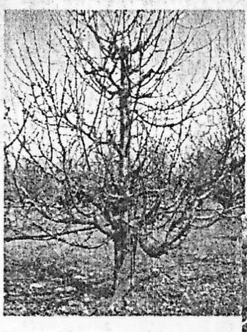

Figure 4. 'Germersdorfi' tree on SL 64 rootstock

Figure 5. 'Van' tree with 'Pándy' intergrafted on mahaleb seedling

Figure 6. 'Germersdorfi' tree with 'Érdi bőtermő' intergrafted on mahaleb seedling

Figure 7. 'Germersdorfi' tree with 'Pándy' intergrafted on mahaleb seedling

ONGOING RESEARCH PROJECTS AT YALOVA-ATATÜRK CENTRAL HORTICULTURAL RESEARCH INSTITUTE

HYBRIDIZATION PROGRAM OF "0900 ZİRAAT" SWEET CHERRY CULTIVAR

1- HYBRIDIZATION

Aim: Obtaining new self-fertile and high quality sweet cherry cultivars by using reciprocal hybridization of 0900 Ziraat with other self-fertile cultivars such as Stella, Sweetheart etc.

Experiment Establishment Date: 2001
So far 250 breds were planted in the field. The program is under progress and result of reciprocal hybridization of 2004 is shown in Table 1.

Table 1. Reciprocal hybridization (2004)

Reciprocal Hybridization	Pollinated flowers	Seeds obtained	Stratified seeds	Germinated seeds	Germinated seeds (%)	Sown seeds
Stella x 0900Ziraat	10081	4359	3766	1927	51	3311
0900Z x Stella	6854	328	245	154	63	240
09Z x Sweethart	1121	117	90	42	47	90
09Z x Celeste	996	162	133	60	45	
09Z x Lapins	796	32	21	12	57	20
Celeste x0900Z	136	33	30	23	77	23
Total	22646	5512	4585	2340	51	4087

2- MUTATION

Aim: In order to obtain dwarf and/or semi-dwarf types of 0900 Ziraat.
The study is carried out in conjunction with Ankara-Nuclear Agricultural Research Institute of Atomic Energy Institution. The buds of 0900 Ziraat cultivar were irradiated with different doses of gamma rays during dormant season and then the buds were budded with chip budding techniques.
Irradiation plants were planted in the field (Table 2).

Table 2. The plants after irradiation with different gamma ray doses.

Applied Doses	Number of mutated plants
25 Gy	65
30 Gy	76
35 Gy	73
40 Gy	64
45 Gy	54
50 Gy	60
55 Gy	17
60 Gy	-

ONGOING RESEARCH PROJECTS AT YALOVA-ATATÜRK CENTRAL HORTICULTURAL RESEARCH INSTITUTE

SWEET CHERRY VARIETY / ROOTSTOCK TRIAL

The study is conducted at four different ecological zones of Turkey including Yalova.

Experiment establishment Date: 2001

Cultivars: Main cultivar 0900 Ziraat

Pollinators: Bigarreau Gaucher and Stark's Gold

Rootstocks: *Prunus avium* (seedling)
Mazzard F 12/1
Ma X Ma 14
Gisel A 5
Weiroot 158
Mahaleb SL 64
Tabel (Edabriz)
Irrigation: Drip
Training: Modified Leader

Yield and tree growth as the end of 2004

Rootstocks	Tree Survival (%)	Tree Height (cm)	Trunk Cross-Sectional Area (cm^2)	Cumulative Yield (kg/tree)	Yield Efficiency (kg/ cm^2)
P. avium	100.00	464.0	116.12	0.19	0.001
Mazzard F 12/1	100.00	395.0	68.67	-	-
Mahalep SL 64	93.75	459.0	184.35	0.53	0.002
Ma x Ma 14	100.00	447.0	135.08	0.14	0.001
Gisel A 5	93.75	328.0	42.26	1.50	0.035
Weiroot 158	50.00	317.0	49.24	0.18	0.004
Tabel(Edabriz)	87.50	267.0	32.23	1.23	0.038

Pomological records

Rootstocks	Fruit weight (g)	TSS (%)	Pedicel weight (g)	Pedicel length (cm)	Stone weight (g)	Fruit/pedicel+ stone ratio
P.avium	8.20	13.47	0.12	9.79	0.40	15.76
M F12/1	-	-	-	-	-	-
M SL64	9.72	14.78	0.17	8.93	0.42	16.47
MaxMa 14	9.49	14.48	0.13	9.34	0.46	16.08
Gisel A5	10.80	14.81	0.17	10.90	0.48	16.61
Weiroot158	11.27	15.65	0.13	10.92	0.46	19.10
Tabel (Edabriz)	9.48	14.99	0.18	10.72	0.48	14.36

ONGOING RESEARCH PROJECTS AT YALOVA-ATATÜRK CENTRAL HORTICULTURAL RESEARCH INSTITUTE

SWEET CHERRY VARIETY TRIAL

The trials have been conducted at three different ecological zones of Turkey includingYalova.

Experiment establishment Date: 2001
Cultivars: 0900 Ziraat, Celeste, Newmoon, Sweetheart, Veysel, Lapins, Kordia, Techlovan, Summit, Cristalina, Noir de Meched, Belge, Precoce de Bernard, Ferboulus Verdel, Octavia, Rainier, Venüs, Sunburst, Star, Macleinheimer.
Rootstock: *Prunus avium* (seedling)
Irrigation: Drip
Training: Modified Leader

Phenological observations (2004)

Cultivars	Bud swelling	Bud burst	Beg. of Flowering (%5)	Full bloom (%70)	End of bloom (%90)	Harvest date	Leaf fall
Ferbolous Verdel	24/3	29/3	06/4	10/4	24/4	-	15/12
Kordia	23/3	01/4	07/4	10/4	24/4	-	20/12
Regina	23/3	02/4	05/4	09/4	26/4	-	16/12
Star	18/3	24/3	05/4	08/4	19/4	-	17/12
Sweetheart	18/3	22/3	29/3	06/4	18/4	10/6	10/12
Venus	18/4	22/3	29/3	06/4	18/4	-	15/12
Rainier	12/3	19/3	26/3	02/4	08/4	-	13/12
0900 Ziraat	24/3	02/4	05/4	10/4	26/4	-	15/12
Newmoon	18/3	22/3	29/3	02/4	17/4	11/6	20/12
Noir de Meched	19/3	30/3	05/4	10/4	23/4	-	17/12
Celeste	23/3	01/4	05/4	10/4	25/4	11/6	8/12
Techlovan	19/3	29/3	02/4	07/4	21/4	12/6	13/12
Veysel	16/3	24/3	05/4	08/4	24/4	-	16/12
Sunburst	23/3	05/4	08/4	10/4	23/4	-	9/12
Octavia	26/3	06/4	08/4	10/4	23/4	-	17/12
Precoce de Bernard	15/3	23/3	27/3	02/4	16/4	-	18/12
Summit	23/3	01/4	08/4	12/4	22/4	15/6	16/12
Macleinheimer	25/3	05/4	08/4	12/4	22/4	16/6	10/12
Lapins	15/3	24/3	05/4	07/4	18/4	-	9/12
Belge	18/3	26/3	06/4	09/4	22/4	16/6	16/12
Fercer-Arcina	18/3	23/3	30/3	06/4	18/4	-	20/12
Telegal	19/3	24/3	02/4	06/4	16/4	-	20/12
Cristalina	23/3	05/4	08/4	10/4	22/4	-	16/12

Pomological records and yield(2004)

Cultivars	Fruit weight (g)	TSS (%)	Pedicel weight (g)	Pedicel length (cm)	Stone weight (g)	Yield (kg/tree)	Fruit/pedicel+ stone ratio
Sweetheart	9,34	14.00	0.12	7.96	0.51	4.4	14.82
Rainier	9.57	13.48	0.11	11.47	0,46	2.6	16.79
Newmoon	8.75	11.82	0.13	4.21	0.49	3.4	14.11
Celeste	12.01	14.43	0.11	8.02	0.37	3.4	25.02
Techlovan	9.85	15.05	0.12	6.18	0.45	5.6	16.80
Summit	9.31	12.38	0.12	4.06	0.43	1.4	16,92
Macleinheimer	10.14	13.81	0.11	6.96	0.40	-	19.88
Belge	8.92	13.42	0.11	8.99	0.48	1.7	15.12

SWEET CHERRY VARIETY TRIAL - 2

The trials have been conducted at three different ecological zones of Turkey includingYalova.
Experiment Establishment Date: 2002
Cultivars: 0900 Ziraat, Celeste, Newmoon, Sweetheart, Veysel, Lapins, Kordia, Techlovan, Summit, Cristalina, Noir de Meched, Belge, Precoce de Bernard, Ferboulus Verdel, Octavia, Rainier, Venüs, Sunburst, Star, Macleinheimer.
Rootstock : *GiselA5*
Irrigation: Drip
Training: Modified Leader

Table 1. Growth and Cumulative Yields of the Cultivars (2002 -2005)

Cultivars	Trunk diameter (cm)	Trunk cross-sectional area (TCSA) (cm^2/ tree)	Cumulative yield (kg/tree)	Cumulative yield per 1cm^2 TCSA (kg)	Tree habit and vigor
0900 Ziraat	19.37	29.85	1.87	0.062	Semi-upright, medium
Veysel	15.79	19.82	1.25	0.063	spreading, weak
Sunburst	22.26	39.41	1.70	0.053	Semi-upright, medium
Venüs	24.64	48.32	1.90	0.039	Upright-spreading, vigorous
Octavia	21.72	37.57	1.40	0.037	Semi-upright, medium
Techlovan	23.04	42.28	4.25	0.100	Semi-upright, vigorous
Belge	15.66	19.50	1.50	0.076	Semi-upright, weak
Regina	22.10	38.85	1.12	0.028	Semi-upright, vigorous
Cristalina	23.20	42.83	3.75	0.087	Semi-upright, vigorous
Newmoon	23.70	44.74	1.37	0.030	Semi-upright, vigorous
Rainier	23.04	42.27	4.50	0.106	Upright-spreading, vigorous
P.de Bernard	21.98	38.45	2.00	0.052	Upright-spreading, vigorous
F.Verdel	19.62	30.65	2.17	0.070	Upright-spreading, medium
Lapins	19.37	29.85	2.20	0.073	Upright, medium
Kordia	14.06	15.68	0.77	0.049	Spreading, weak
Summit	20.00	31.84	1.50	0.047	Semi-upright, medium
Celeste	17.36	23.96	1.32	0.055	Semi-upright, weak
Sweetheart	11.68	10.82	0.82	0.075	Spreading, very weak

Table 2. Phenological observation of the cultivars. (2002 -2005)

Cultivars	Bud burst	Begining of flowering (%5)	Full bloom (%70)	End of bloom (%90)	Harvest date (2002 -2004)	Defoliation (2002 -2004)
0900 Ziraat	12-25 March	08-14 April	10-19 April	20-26 April	07-20 June	25 Nov.-10 Dec.
Veysel	15-23 March	05-11 April	06-17 April	17-23 April	18 May -06 June	20 Nov.-12 Dec.
Sunburst	18-26 March	06-12 April	09-15 April	16-24 April	01-15 June	18 Nov -05 Dec.
Venüs	11-15 March	05-10 April	10-15 April	15-20 April	25 May-10 June	20 Nov.-10 Dec.
Octavia	14-18 March	06-12 April	09-18 April	14-27 April	05-18 June	25 Nov.-13 Dec.
Techlovan	10-15 March	01-10 April	07-15 April	15-23 April	24 May-11 June	21 Nov.-09 Dec.
Belge	12-20 March	05-11 April	08-16 April	16-24 April	30 May -16 June	23 Nov.-11 Dec.
Regina	13-20 March	05-14 April	10-18 April	17-25 April	05-18 June	24 Nov.-12 Dec.
Cristalina	16-25 March	04-10 April	11-18 April	19-25 April	06-21 June	21 Nov.-13 Dec.
Newmoon	18-27 March	06-11 April	10-17 April	18-24 April	25 May-11 June	25 Nov.-15 Dec.
Rainier	07-13 March	01-08 April	04-14 April	13-19 April	27 May -18 June	19 Nov.-07 Dec.
P.de Bernard	08-13 March	02-10 April	03-14 April	11-20 April	17 May -04 June	21 Nov.-13 Dec.
F.Verdel	19-25 March	03-12 April	08-17 April	14-23 April	30 May –12 June	21 Nov.-09 Dec.
Lapins	14-24 March	01-07 April	04-13 April	13-19 April	28 May -10 June	15 Nov.-02 Dec.
Kordia	12-20 March	02-10 April	02-14 April	11-20 April	19 May -05 June	22 Nov.-15 Dec
Summit	20-27 March	04-11 April	06-15 April	14-23 April	28 May-14 June	20 Nov.-13 Dec.
Celeste	21-28 March	06-12 April	09-16 April	17-23 April	25 May-12 June	17 Nov.-02 Dec.
Sweetheart	19-25 March	05-11 April	08-16 April	15-22 April	29 May -15 June	16 Nov.-03 Dec.