9TH INTERNATIONAL

AR SYMPOSIUM 2004

SOUTH AFRICA

PROGRAMMEABSTRACTS

IXth International Pear Symposium

Dear participants

On behalf of the Organising Committee I am delighted to welcome you to the IXth International Pear Symposium. The Department of Horticultural Science, University of Stellenbosch, with assistance from ARC Infruitec-Nietvoorbij and technical consultants, has been planning this meeting for several months on behalf of the Pear Working Group of the Fruit Section of the International Society for Horticultural Sciences (ISHS). We are now looking forward to meeting the more than 100 participants from 16 countries. We have a very full programme with three days of oral and poster presentations and a one-day field trip. The large number of scientific contributions received has enabled us to prepare an opportunity for the stimulating exchange of the latest research and advances in technology in all areas of the pear industry from around the world. Leisure activities will allow for visits to interesting places, good cuisine and wonderful company.

We are sure that you will find South Africa a unique experience and a beautiful country for this meeting and we hope that you will enjoy the relaxed atmosphere and warm hospitality of the South Africans. South Africa has become one of the world's most popular vacation and conference destinations and we trust that you will find your visit most fruitful and enjoyable.

Prof Karen Theron, Convenor

Organising Committee

Karen Theron, Convenor
Marius Huysamer
Wiehann Steyn
Piet Stassen
Stephanie Wand
Elke Martin
Gustav Lotze
Chris Jurisch
Christo Strydom
Taaibos Human
Retha Venter, Secretariat

Scientific Committee

Prof Karen Theron, South Africa: Convenor
Tom Deckers, Belgium
Marius Huysamer, South Africa
Frank Maas, Holland
Stefano Musacchi, Italy
Hiroshi Gemma, Japan
Deirdre Holcroft, South Africa
Nigel Cook, South Africa
Enrique Sanchez, Argentina
Silviero Sansavini, Italy
Piet Stassen, South Africa
Wiehann Steyn, South Africa
David Sugar, USA
Stephanie Wand, South Africa
Tony Webster, United Kingdom

WE WISH TO THANK THE SUPPORT FROM

AGRICULTURAL CONSULTORS INTERNATIONAL

ARC INFRUITEC-NIETVOORBIJ

BERGSIG WINE ESTATE

CANNING FRUIT PRODUCERS ASSOCIATION

GREEN MARKETING INT

KATOPE CAPE

NETAFIM

SA DRIED FRUIT

SA ROOIBOSTEE DISTRIBUTORS

STARGROW

TRU-CAPE

VALENT BIOSCIENCES

PROGRAMME

SUNDAY 1 FEBRUARY 2004

Registration from 16.00-19.00

Welcome reception 19.00 -

Buses depart for Stellenbosch Lodge and Guesthouses from 21.00

MONDAY 2 FEBRUARY 2004

Registration from 8.00-9.00

TIME	AUTHOR/S	TITLE
9.00-9.10	Theron K.I.	Welcoming on behalf of Organising Committee – Symposium Administration.
9.10-9.20	Van Huyssteen L.	Welcoming on behalf of the University of Stellenbosch.
9.20-9.30	Webster T.	Welcoming on behalf of ISHS.

PLENARY SESSION

9.30-9.55	Bangerth F.	Regulatory mechanisms in fruit development from flower induction to ripening. 1
9.55-10.20	Strydom D.K.	Evolution of the pear training model in South Africa. 2
10.20-10.30		Questions

10.30-11.0 TEA

11.00-11.15	Sanchez E.	Status of the pear industry in South America. 3
11.15-11.30	Seavert C.	Status of the pear industry in North America. 4
11.30-11.45	Deckers T.	Status of the pear industry in Europe. 5
11.45-12.00	Saito T.	Status of the pear industry in Asia. 6
12.00-12.15	Brewer L.	Status of the pear industry in Australasia. 7
12.15-12.30	Ferrandi C.	Status of the pear industry in Africa. 8

12.30-13.30 LUNCH AND POSTERS

SESSION I (13.30-15.30): FRUIT QUALITY

13.30-13.50	1. Steyn W.J., Wand S.J.E., Holcroft D.M. & Jacobs G.	Red colour development and loss in pears. 9 → interessante ←
13.50-14.10	2. Bertelsen M.	Reflective mulch improves fruit size and flower bud formation of pear cv 'Clara Frijs'. 10
14.10-14.30	3. Lötze E. & Bergh O.	Early prediction of ripening and storage quality of pear fruit in South Africa. 11

14.30-14.50	4. Wand S.J.E., Steyn W.J., Mdluli J. & van den Dool K.	Use of evaporative cooling to improve 'Rosemarie' and 'Forelle' fruit blush colour. 12
14.50-15.10	5. Huybrechts C. & Valcke R.	Fluorescence imaging to study physiological changes in 'Conference' pears during a shelf-life experiment. 13
15.10-15.30	6. Maas F.	Dynamics of fruit growth in Conference as affected by soil water tension and climatic conditions. 14

15.30-16.10 TEA AND POSTERS

SESSION II (16.10-17.30): REPRODUCTIVE BIOLOGY

16.10-16.30	7. Farkas A.	Morphology and histology of the nectary in Hungarian local pear cultivars. 15
16.30-16.50	8. Goldway M., Zisovich A.H., Shaffir S. & Stern R.A.	Application of *S*-allele molecular analysis as mean to elucidate low yields in the pear orchard. 15
16.50-17.10	9. Stern R.A., Dag A., Zisovich A., Shafir S. & Goldway M.	Sequential introduction of honeybee colonies increases cross-pollination, fruit-set and yield of 'Spadona' pear (*Pyrus communis* L.). 16
17.10-17.30	10. Flaishman M.A., Shargal A., Stern R.A., Lev-Yadun S., Shlizerman L. & Grafi G.	The synthetic cytokinins CPPU and TDZ prolong the phase of cell divisions in developing pear (*Pyrus communis* L.) fruit. 17
17.50	Buses depart for University of Stellenbosch: Campus on Foot and reception at Coetzenburg	
22.00	Buses depart for Spier Estate and Stellenbosch Lodge	

TUESDAY 3 FEBRUARY 2004

Full day field excursion. Buses depart from Spier Estate at 7.30, and return by 18.00.

WEDNESDAY 4 FEBRUARY 2004

Registration from 7.30-8.00.

SESSION III (8.00-9.40): BREEDING AND EVALUATION

8.00-8.20	11. Human J.P.	Progress and challenges of the South African pear breeding program. (Invitation) 18
8.20-8.40	12. Musacchi S., Ancarani V., Gamberini A., Giatti B. & Sansavini S.	Progress on selection of better quality pears through the University of Bologna breeding program. 19
8.40-9.00	13. Milutinovic D.M., Nikolic M. & Tanaskovic B.	Characteristics of F1 generation arising from Butira Precoce Morettini x Bella di Giugno. 20
9.00-9.20	14. Johnson D., Spencer J., Webster T. & Adam S.	Orchard comparisons of new quince and *Pyrus* rootstock clones. 21
9.20-9.40	15. Arzani K.	Progress in national Asian pear project: study on the adaptation of some Asian pear (*Pyrus serotina* Rhed) cultivars under Iranian environmental conditions. 22

9.40-10.30 TEA AND POSTERS

SESSION III (CONTINUED) (10.30-11.10): BREEDING AND EVALUATION

10.30-10.50	16. Reighard G.L., Ouellette D.R., Brock K.H. & Bell R.L.	Field performance of fireblight tolerant, *Pyrus communis* selections in South Carolina.
10.50-11.10	17. Silva J.M., Barba N.G., Barros M.T. & Torres-Paulo A.	'Rocha', the pear from Portugal.

SESSION IV (11.10-12.30): GENETICS AND BIOTECHNOLOGY

11.10-11.30	18. Van Dyk M.M., Koning G., Simayi Z., Booi S., Maharaj R., Selala M.C., Du Preez M.G., Labuschagné I.F., Warnich L. & Rees D.J.G.	Molecular genetic studies on pears in the Western Cape.
11.30-11.50	19. Simard M.H., Dumoulin C. & Demilly D.	Ploidy level evaluation of rootstock selections and *Pyrus* genus accessions.
11.50-12.10	20. Flaishman M.A., Bryer Y., Shargal A. & Grafi G.	Expression of Cyclin B and histone H1 kinase activity mark reproductive bud break in pear grown in the hot climate of Israel.
12.10-12.30	21. Flaishman M.A., Shlizerman L., Cohen Y., Sivan L. & Kerem Z.	Expression of the health-beneficial stilbenes in transgenic Spadona pear (*Pyrus communis* L.).

LUNCH AND POSTERS		
SESSION V (13.40-15.20): POSTHARVEST		
13.40-14.00	22. Bai J. & Chen P.M.	Extending shelf-life of partially ripened 'D'Anjou' pears by 1-methylcyclopropene treatment. 23
14.00-14.20	23. Crouch I.	The effect of SmartFresh™ (1-methylcyclopropene) on the postharvest handling and storage quality of pears. 24
14.20-14.40	24. Vaysse P.	Sensory analysis of new pear varieties. 25
14.40-15.00	25. Predieri S., Gatti E., Rapparini F., Cavicchi L. & Colombo R.	Sensory evaluation and pear fruit quality. 26
15.00-15.20	26. Seavert C.F., Turner J., Marin A. & Colonna A.	Sensory evaluation of pear cultivars in the Pacific Northwest, U.S.A.
15.20-15.45 TEA AND POSTERS		
SESSION V (CONTINUED) (15.45-16.25): POSTHARVEST		
15.45-16.05	27. Mielke E.A., Drake S.R. & Elfving D.C.	'Concorde' pear flavor, texture and storage quality improved by manipulating harvest maturity. 27
16.05-16.25	28. Crouch E.M., Holcroft D.M. & Huysamer M.	Mealiness of 'Forelle' pears – quo vadis? 180
MARIOUS.		
SESSION VI (16.25-16.45): GENERAL		
16.25-16.45	29. Seavert C.F.	Remaining globally competitive in the US tree fruit industry with the national tree fruit technology roadmap. 28
16.45-17.15	AGM, including brief presentations by potential hosts for next symposium.	
19:00 for 19:30 Evening: Moyo Buffet at Spier - Buses collect participants from Stellenbosch Lodge and Guesthouses at 18:45		

THURSDAY 5 FEBRUARY 2004

Registration from 7.30-8.00

SESSION VII (8.00-10.00): PLANTING SYSTEMS

8.00-8.20	30. Cook N.C. & Du Plooy P.	Architectural analysis of pear cultivars grown under South African conditions and the relevance to local maintenance pruning strategies.
8.20-8.40	31. Reynolds L., Jacobs J. & Theron K.I.	Variation in pruning severity and branch quality on primary and secondary growth of 'Packham's Triumph' pears (*Pyrus communis* L.).
8.40-9.00	32. Bertelsen M.	Multi-branched V-systems improves productivity and manageability of a vigorous pear cultivar.
9.00-9.20	33. Asin L., Montserrat R., Carbo J., Vilardell P. & Carrera M.	Comparison of 5 intensive training systems in terms of cost, yield and fruit quality of 'Conference' pear.
9.20-9.40	34. Musacchi S., Ancarani V., Gamberini A., Gaddoni M., Grandi M. & Sansavini S.	Training systems for high density pear planting.
9.40-10.00	35. Vercammen J.	Financial result of different planting systems of 'Conference' pear.

10.00-10.45 TEA AND POSTERS

SESSION VIII (10.45-12.25): GROWTH REGULATION

10.45-11.05	36. Deckers T. & Schoofs H.	Natural or chemical growth regulation on pear trees.
11.05-11.25	37. Maas F.	Effect of Regalis (prohexadione-Ca) on shoot growth, fruit production and return bloom in 'Conference' and 'Doyenné du Comice' pears.
11.25-11.45	38. Asín L., Dalmau R., Bonany J., Pages J.M., & Vilardell P.	Effect of prohexadione-Ca on growth regulation, return bloom, fruit set and fruit quality in 'Conference' and 'Blanquilla' pears.
11.45-12.05	39. Vercammen J., van Daele G. & Gormand A.	Root pruning: a valuable alternative to reduce the growth of 'Conference' pear.
12.05-12.25	40. Maas F.	Root pruning and girdling as methods to control shoot growth and fruit production in pear.

12.25-13.25 LUNCH AND POSTERS

SESSION IX (13.25-15.05): PEST MANAGEMENT

13.25-13.45	41. Addison P.	Post-harvest control of grain chinch bug *Macchiademus diplopterus* (Distant) on pears in the Western Cape Province.

13.45-14.05	42. Ingels C.A., Van Steenwyk R.A., Varela L. & Elkins R.	Codling moth management through postharvest control.
14.05-14.25	43. Dunley J.E., Madsen T. & Greenfield B.M.	Organic and IPM programs for areawide pest management of pear.
14.25-14.45	44. Welter S.C. & Cave F.	Alternative pheromone dispensing strategies for management of codling moth in pears.
14.45-15.05	45. Addison M.F.	Suppression of codling moth populations in South African apple and pear orchards using sterile insect release.

15.05-15.45 TEA AND POSTERS

SESSION X (15.45-17.05): DISEASE MANAGEMENT

15.45-16.05	46. Elkins R.B, Ingels C.A. & Lindow S.E.	Control of fire blight by *Pseudomonas fluorescens* A506 introduced into unopened pear flowers.
16.05-16.25	47. Brewer L. & Alspach P.	Fruit and leaf incidence of *Venturia pirina* in mixed European and Asian pear progenies.
16.25-16.45	48. Postman J.D., Spotts R.A. & Calabro J.	Pear scab resistance in *Pyrus* germplasm.
16.45-17.05	49. Serdani M., Spotts R.A., Calabro J. & Postman J.D.	Evaluation of *Pyrus* germplasm collection for resistance to powdery mildew.

CLOSING REMARKS: SYMPOSIUM CONVENOR

18:15 Participants collected from Spier, Stellenbosch Lodge & Guesthouses
19:00 Evening: Closing banquet "Pear & Wine delight" at Kirstenbosch Botanical Gardens.

LIST OF POSTERS

#	Authors	Title
1	K. Arzani and M. Koshesh-Saba	Study on compatibility and pollen tube growth of some Asian pear (*Pyrus serotina* Rhed) cultivars.
2	K. Arzani, H. Khoshghalb and G. Karimzadeh	Scion/rootstock influence on grafting success, early performance, tree survival and efficiency of nutrient uptake of some Asian pear (*Pyrus serotina* Rhed) cultivars.
3	M.T.F. Barros, C.I. Hipólito and C.G.M. Baptista	Improvement of in vitro rooting of 'Rocha' and other portuguese pear cultivars (*Pyrus communis* l.) in response to changes in auxin induction and darkness treatments.
4	N.V. Bassil, C. Neou, and J.D. Postman	Development of *Pyrus* microsatellite markers from Genbank sequences.
5	J. Bonany, M. Casals, P. Vilardell, L. Asin, R. Dalmau	Effect of BA, NAA and ethephon as thinning agents of 'Conference' pear.
6	S. Booi, M.M. van Dyk, M.G. du Preez, I.F. Labuschagné and D.J.G. Rees	Molecular typing of red and green phenotypes of 'Bon Rouge' pear trees with the use of microsatellites.
7	G.E. Burger, H.M. Griessel & M. Huysamer	Developing an industry-related method for inducing friction discolouration to pear fruit.
8	M. Carrera, M.T. Espiau and J. Gomez-Aparisi	Performance of 'Conference' and 'Doyenné du Comice' pears on two quince and five OH x F rootstock selections.
9	E. Costes, A. Acou, A. Belouin, M. Lelezec and M.H. Simard	Heritability of morphological and architectural characters in three pear progenies.
10	J. De Coster, J.J. Simonse, P.G.P. Geurts, P van Arkel, H.J. Weber, T. Deckers, N. Cook	Concorde, a promising pear cultivar.
11	J. De Coster, J. Bouma, F. Papzstein, M. Brijs, J. Blasek, T. Deckers, N. Cook	Dicolor, a new red pear cultivar.
12	P.F. de Jong, A. Boshuizen, B.Heijne	Test of fungicides against *Stemphylium vesicarium* with or without a warning system.
13	J.P. De Melo-Abreu, N.G. Barba, J.M. Silva	Phenology prediction in 'Rocha' pear under mild winters.
14	M.G. du Preez, I.F. Labuschagné and D.J.G. Rees	Differential gene expression patterns for red and green phenotypes of 'Bon Rouge' pear trees.
15	T. Eccher and R. Pontiroli	Old pear varieties in Northern Italy.
16	R.B. Elkins, K.M. Klonsky and R.L. DeMoura	Sample cost of production for transitioning from conventional codling moth control to aerosol-released mating disruption (puffers) in pears.
17	I. Iglesias and L. Asín	Performance of some pear rootstocks in NE-Spain.
18	A.L. Knight, P. Van Buskirk and R. Hilton	Monitoring codling moth in pear with the pear ester.
19	M. Le Lézec, A. Belouin and M.H. Simard	A selection from *Pyrus betulaefolia* as a new pollinator for the main *Pyrus communis* cultivars.
20	S.M. Liu, G.R. McGregor and S.M. Richards	Combining ability of fruit appearance and eating quality in pears.
21	J.J. Meintjes, P. Stassen and K.I. Theron	Effect of different rates of prohexadione-calcium and girdling on shoot growth and fruit quality of different pear cultivars.

22	R. Miletic, D.M. Milutinovic, M. Zikic, M.M. Milutinovic and G. Djakovic	Water content of leaves in different pear cultivars during the vegetative period in relation to rainfall.
23	D. M. Milutinovic, G Jakovic, M.M. Milutinovic and R. Miletic	Variability in the wild pear population in West Serbia.
24	D. Neri, C. Urbinati, G. Savini and A. Sanchioni	Age determination and tree-ring growth dynamics in old trees of 'Angelica' pear (*Pyrus communis* L.).
25	F. Rapparini and S. Predieri	Volatile constituents and pear aroma studied by dynamic headspace technique.
26	L.P. Reynolds, G. Jacobs and K.I. Theron	Reproductive bud development of pears (*Pyrus communis* L.) with emphasis on the bourse shoot.
27	L.P. Reynolds, G. Jacobs and K.I. Theron	Effect of scoring during flower induction or initiation phase on return bloom in *Pyrus communis* L.
28	P. Robert, T. Raimbault, M. Le Lézec and M.H. Simard	Resistance of some *Pyrus communis* cultivars and *Pyrus* hybrids to the pear psylla *Cacopsylla pyri* (Homoptera, Psyllidae).
29	F.I.A. Rumayor, C.A. Martínez and R.J.A. Vázquez	Breeding pears for warm climates in Mexico.
30	T. Saito, Y. Sawamura, N. Takada, M. Shoda, O. Terai, K. Abe and K. Kotobuki	Breeding of homozygotes of self incompatible haplotype in Japanese pear (*Pyrus pyrifolia* Nakai).
31	M. Sharifani and P. Kolesik	Analysis of ovule and ovary dimensions in pears.
32	M. Sharifani and J. Magarey	Effect of pollination on fruit set in 'Packham's Triumph' pear.
33	C.F. Seavert, J. Moore and S. Castagnoli	The economic costs and returns of establishing and producing high density pears in Hood River, Oregon, USA.
34	C.F. Seavert, J. Moore and S. Castagnoli	The economic costs of producing pears in Hood River, Oregon, USA.
35	C.F. Seavert	An evaluation of site-specific management strategies in the US pear industry.
36	J. Turner, J.Bai, C.F. Seavert, A. Marin and A. Colonna	Evaluation of harvest maturity, quality aspects, and sensory evaluation of pear cultivars in the Pacific Northwest, USA.
37	P.J.C. Stassen and M.S. North	Nutrient requirements of 'Forelle' pear trees on two different rootstocks.
38	P.D. VanBuskirk and R.J. Hilton	The challenges of implementing a successful IPM program in pear.
39	M.M. van Dyk, G. Koning, Z. Simayi, S. Booi, R. Maharaj, M.C. Selala and D.J.G. Rees	Development of microsatellite markers for marker-assisted breeding in pears (*Pyrus* spp.)
40	J. Bonany, R. Dolcet, E. Claveria, I. Iglesias, L. Asin and M.H. Simard	Breeding of pear rootstocks. First lime-induced chlorosis and vigour evaluation under field conditions of new interespecific rootstocks.
41	D. Kim, J.H. Hwang, I.S. Shin, H.J. Lee, Y.U. Shin and S.S. Hong	Development of molecular markers linked to several fruit traits in Oriental pear.
42	S.S. Hong, I.S. Shin, H.M. Cho, M.J. Yoon and C.H. Lee	Analysis of functional compounds content in pear.
43	K. Sagredo and T. Cooper	Pear production in Chile: Situation and trends.

ORAL ABSTRACTS

MONDAY 2 FEBRUARY: PLENARY SESSION

Hormonally Regulated Processes in Fruit Development from Flower Induction to Ripening.

F.K. Bangerth
Department of Special Crop Cultivation and Crop Physiology, Univ. of Hohenheim, 70593 Stuttgart, Germany.

Fruit growth and development is, to a considerable extent, controlled by plant hormones and the pear fruit is no exception. Great progress in understanding these processes has been achieved using "model plants", like *Arabidopsis*. However, results of this kind are not always applicable in fruit production of perennial trees, as will be explained by means of some of the following examples. Long before the pear flower becomes visible hormones like GAs and CKs are involved in the transformation of the meristematic to a florigenic meristem. Thereafter, auxin seems to regulate early competition/dominance reactions among the developing flower primordia. Following the visible appearance of the flowers, pollination/fertilization leads, in a sequential manner, to a burst of hormones (CKs, GAs, IAA etc.), which trigger cell division/enlargement and, therefore, growth of the fruit possibly by affecting gene expression for cyclins and expansins. The possibility to induce parthenocarpic fruit development by the application of some of these hormones, and in this way replace the process of fertilization, demonstrates the importance of these hormones during fruit set. Similarly important is the reduction of a too heavy fruit set by hormones or bioregulators, like NAA, BA or ethephon. These substances seem to exert their effect via an interference with the basipetal IAA export and possibly ABA concentration of the fruit, which enhances the natural (June) drop. During these early stages of fruit development several ongoing processes already can predetermine important fruit characteristics, such as firmness or Ca-concentration etc., which considerably contribute to fruit quality much later during fruit life. It will be demonstrated that this again is influenced by plant hormones. Possibly the most obvious hormonal effect in the lifetime of a climacteric pear is the induction of ripening by ethylene. Preventing production and/or action of this hormone also affects the orderly ripening process which, beside storage life, decisively alters a great number of quality attributes of pear fruits.

SESSION I: FRUIT QUALITY

1. Red Colour Development and Loss in Pears.

W.J. Steyn[1], S.J.E. Wand[1], D.M. Holcroft[2] and G. Jacobs[1]
[1]Department of Horticultural Science, University of Stellenbosch, Private Bag X1, Matieland, 7602, South Africa.
[2]Dole Fresh Vegetables, P.O. Box 1759, Salinas, CA 93902, USA.

The endogenous and environmental regulation of red colour development in blushed and full red pears (*Pyrus communis* L.) is reviewed referring to the extensive apple literature. Colour development in pears has an underlying developmental component. Generally, highest anthocyanin concentrations are attained in immature pears and colour tends to fade towards harvest. This is contrary to most other crop species where maximum pigmentation and colour are attained in ripe fruit. Because of this pigmentation pattern, net anthocyanin degradation at high temperatures result in pre-harvest red colour loss in susceptible pear cultivars. Susceptibility depends on capacity to accumulate anthocyanin and on whether low temperatures are required for anthocyanin synthesis. Unlike apples, where red colour development in all cultivars

seems to require or benefit from low temperatures, not all pear cultivars seem to respond to low temperatures. Light appears to have two opposing effects in pears, being both required for anthocyanin synthesis, but also apparently increasing red colour loss through increased degradation of anthocyanin.

2. Reflective Mulch Improves Fruit Size and Flower Bud Formation of 'Clara Frijs' pear.

M. Bertelsen
Department of Horticulture, Danish Institute of Agricultural Sciences, P.O.Box 102, DK-5792 Aarslev, Denmark.

Extenday, a reflective foil, was tested in a 12-years-old experimental pear planting in Denmark in the years 2001 to 2003. The aim of the experiment was to examine whether benefits in the form of increased fruit size, advanced maturity and improved flower bud formation could be achieved by the use of the foil, and to determine if the investment was profitable. The Extenday foil was tested at two different tree spacings, either 1.5 x 3.25 m or 2 x 4 m. Foil of different widths was fastened to tree trunks using rubber bands so that it covered ca. 90% of the area between the rows. The foil was placed in the orchard shortly after bloom and kept there until after harvest. In all years, fruit size was improved by Extenday treatments, or trees carried significantly larger crop loads that reached the same fruit size as the less loaded control trees. In 2002, a year of high yields, the fruit size distribution optimum of the Extenday trees was shifted from 60-65 mm to 65-70 mm. The effect on size was also confirmed by fruit growth measurements that showed an increased daily growth rate. Fruit quality was monitored on a weekly basis during the last month before harvest, but there was no indication that the Extenday treatment sped up fruit maturation. On the contrary, fruit firmness, soluble solids content, starch degradation, as well as fruit colour were similar to the control at harvest. Flower bud counts were carried out on 30 trees in the spring of 2003. Trees from the Extenday treatment were found to have twice as many flower buds as the control trees despite having carried similar crop loads the year before. Economic calculations show the Extenday foil to be profitable when used in 'Clara Frijs' plantings, especially in years of large crop loads when both fruit size and flower bud formation may be improved.

3. Early Prediction of Ripening and Storage Quality of Pear Fruit in South Africa.

E. Lötze[1] and O. Bergh[2]
[1]Dept. of Horticultural Science, Univ. of Stellenbosch, Private Bag X1, 7602 Matieland, South Africa.
[2]CAF, 20 Munnik Street, Strand, 7140, South Africa.

Maturity indices records for the main pear cultivars in two areas were compiled to study the fluctuation in TSS (total soluble solids), firmness and starch breakdown during consecutive seasons. Heat units, sunlight hours, fruit size, days after bloom and soil type were used in the calculation of rate of change in TSS levels, firmness and starch breakdown during the last five to six weeks before the picking date. These variables were shown to have an effect on the internal fruit quality. High temperatures were found to result in a faster decrease in firmness levels while increased sunlight hours improved the TSS levels. Orchards on sandy soils showed consistent lower TSS levels and firmness when different orchards were compared during consecutive seasons. Equations were fitted to the data for each cultivar and area to develop models for the prediction of the different indices. The predicted rate of change of the different indices were compared with the actual values to test the accuracy and proved to explain more than 80% of the fluctuation during consecutive seasons. The results also showed that the rate of change for these indices could be estimated as early as the middle of December. These models are considered important tools to assist growers, pack houses and marketers in identifying seasons when fruit will have a short shelf life. Picking dates, cold storage and marketing can be adapted to ensure the best possible fruit quality.

4. Use Of Evaporative Cooling To Improve 'Rosemarie' And 'Forelle' Fruit Blush Colour.

S.J.E. Wand, W.J. Steyn, J. Mdluli and K. van den Dool
Department of Horticultural Science, University of Stellenbosch, Private Bag X1, Matieland, 7602, South Africa.

Downgrading of fruit due to insufficient red colour has limited the profitability of lucrative blushed pear cultivars (*Pyrus communis* L.). In 'Rosemarie', poor fruit colour has been ascribed to pre-harvest red colour loss during periods of high temperature. The use of overhead evaporative cooling (EC) to improve red colour in blushed pears was evaluated over three seasons in Stellenbosch, South Africa. 'Rosemarie' fruit that received pulsed EC applications from two weeks before harvest at air temperatures exceeding 28°C were redder than control fruit at harvest. EC initiated earlier in fruit development led to larger fruit but with a lower TSS concentration and firmness, and sunburn incidence was reduced. EC had no effect on 'Forelle' colour but reduced firmness and TSS. Though EC could be used to improve 'Rosemarie' fruit colour in warm production areas, its effect was relatively small compared to colour change in response to temperature.

5. Fluorescence Imaging to Study Physiological Changes in 'Conference' Pears during a Shelf-life Experiment.

C. Huybrechts and R. Valcke
Laboratory of Molecular and Physical Plant Physiology, Dept S.B.G., Limburgs Universitair Centrum, Universitaire Campus, B-3590 Diepenbeek, Belgium.

Red-light chlorophyll fluorescence can be used to determine the physiological state of plants and is induced after excitation with UV or blue light. Chlorophyll fluorescence imaging has showed potential to predict fruit quality and storage potential as well as the incidence of physiological disorders during storage. Two major changes affect the level of chlorophyll fluorescence emission during fruit ripening and senescence. Fluorescence decreases either due to loss of photosynthetic competence per unit chlorophyll leading to reduced PSII activity or due to a decrease in chlorophyll content associated with fruit ripening and senescence. In this experiment, a transportable chlorophyll fluorescence imaging system build in the laboratory of Molecular and Physical Plant Physiology was used to study physiological changes in 'Conference' pears during shelf-life experiments. 'Conference' pears were bought in a local store and fluorescence measured over a few weeks in order to detect physiological changes during this period. The results will be used to determine whether the chlorophyll fluorescence imaging system is able to predict the shelf-life quality of 'Conference' pears.

6. Dynamics of Fruit Growth in 'Conference' as Affected by Soil Water Tension and Climatic Conditions.

F. Maas
Praktijkonderzoek Plant & Omgeving, Section Fruits (PPO-Fruit), Plant Sciences Group, Wageningen University and Research Center, Lingewal 1, 6668 LA Randwijk, The Netherlands.

Root pruning has become standard practice for growth control of pear trees in the Netherlands since the ban on CCC in 2001. However, too strong pruning may reduce fruit size or decrease fruit quality due to insufficient uptake capacity for water and nutrients by the remaining root system. Therefore, growers are only recommended to apply root pruning when there is the possibility of irrigation. In order to optimize irrigation and growth control, more information is needed on the dynamics of fruit growth as related to water availability in the soil and evaporation by the tree canopy. A technique to monitor the water demand of the tree would be helpful for establishing the relationships between water availability, water uptake and evaporation of trees before and after root pruning. Depending on the amount of water stress experienced by the tree the grower might decide to carry out additional root pruning, supply water to the trees of reducing evaporation by sprinkling water on top of the trees. In 2001, daily fluctuations in trunk diameter and fruit diameter were measured with linear voltage displacement transducers. Daily shrinkage and increase in trunk diameter and fruit growth were directly related to the level of sunlight, temperature en relative humidity. On an average sunny day in July, trunk diameter started to decrease around 10 am, when air temperature increased strongly, until 8 pm when air temperature started to decline. Fruit diameter growth of 'Conference' followed the same trend, mainly taking place at night and early morning, except on cloudy days when growth continued during daytime. The rate of fruit diameter growth was fairly constant at ca. 0.04 mm h^{-1} whenever it occurred. These observations suggest that the daily increase in fruit diameter is determined by the number of hours in which water availability in the tree was sufficient to allow fruit growth. Apparently this only occurs when the evaporative demand of the tree is less than the water uptake capacity of the tree, i.e. when trunk diameter does not decrease. In 2002, fruit diameter was recorded weekly for individual fruits on trees that were root pruned in June and either received no or optimal irrigation. Although root pruning, especially in trees without irrigation, significantly affected tree growth, neither root pruning nor irrigation affected fruit growth. Fruit size increment was almost linear from early May up to harvest at the beginning of September and was on average 3.9 mm per week. Relationships between fruit growth, climatic condition, soil water availability and cultural practices will be further discussed.

SESSION II: REPRODUCTIVE BIOLOGY

7. Morphology and Histology of the Nectary in Hungarian Local Pear Cultivars.

Á. Farkas
Dept. of Botany, University of Pécs, 7624, Pécs, Ifjúság u. 6., Hungary.

The topography, morphology and histology of nectary have been studied in twelve Hungarian local pear cultivars in a Hungarian cultivar collection (Újfehértó) for 3 years. The intrafloral nectary is receptaculo-ovarial, lining the adaxial surface of the plate-like receptacle and the apical part of the ovary. The gland is automorphic on the apical part, in some cases also on the basal part, protruding out of the receptacular tissues. A narrow zone of the nectariferous tissue is stretching along the style, allowing nectar accumulation in the gap between the style and the nectary. Pear nectary is covered by a smooth cuticle, the thickness of which slightly varies with cultivars and seasons. In the medial longitudinal section of the flower epidermal cells are palisade-like or square-shaped, sometimes papillate. Guard cells of nectar stomata can be found either at the level of epidermal cells (mesomorphic type) or sunken a few cell rows below the epidermis (xeromorphic type). Below the stomata, among the cells of the glandular tissue, nectar-storing intercellular cavities of varying size can be found. The glandular tissue consists of small, dark-staining cells. In some cultivars the nectariferous tissue can be well distinguished from the nectary parenchyma, consisting of larger, light-staining cells. In other cultivars a mosaic-like structure can be observed, where glandular cells are mixed with parenchyma cells, with no sharp distinction between the two tissue types. In some taxa correlation can be observed between the size of the nectary and nectar production, which may have importance in cultivar selection.

NOTES

8. Application of *S*-Allele Molecular Analysis as Mean to Elucidate Low Yields in the Pear Orchard.

M. Goldway[1], A.H. Zisovich[1,2], S. Shaffir[2] and R.A. Stern[1]
[1]MIGAL - Galilee Technological Center, P.O.B 831, Kiryat-Shmona 11016, Israel.
[2]Triwaks Bee Research Center, Department of Entomology, The Hebrew University of Jerusalem, Faculty of Agricultural, Food and Environmental Quality Sciences Rehovot 76100, Israel.

The European pear (*Pyrus communis* L.) carries the gametophytic self-incompatibility fertilization system (GSI). Orchards of trees carrying GSI contain at least two cultivars, which are fertilization-compatible with each other. However, compatibility may be full when the cultivars differ in both their *S*-loci or partial when they share one of the two *S*-loci. Semi-compatibility between cultivars can lead to yield reduction, since half of the pollinator's pollen is rejected. Identification of semi-compatibility according to yield levels is not always trivial, since many factors are involved in yield production. On the contrary, the application of molecular analysis, for the identification of *S*-RNase alleles, can clearly determine the genetic compatibility between cultivars. In Israel the yield of the European pear is relatively low. The main cultivar is 'Spadona' and its pollinators are 'Coscia', 'Gentile' and 'Spadochina'. In order to elucidate if semi-*S*-allele compatibility could provide the explanation for the low yields, the *S*-allele content of the four cultivars was determined. It was found that 'Spadona' shares one of its *S*-alleles with each of its pollinators and therefore is semi-compatible with them. In this analysis four *S*-alleles were cloned out, of which three were new. In order to identify potential fully-compatible pollinators for 'Spadona', additional cultivars that are being considered for introduction into Israel were analyzed. In this latter analysis, five new *S*-alleles were identified some of them with interesting features concerning GSI, which will be discussed.

9. Sequential Introduction of Honeybee Colonies Increases Cross-Pollination, Fruit-Set and Yield of 'Spadona' pear (*Pyrus communis* L.).

R.A. Stern[1], A. Dag[2], A. Zisovich[1], S. Shafir[3] and M. Goldway[1]
[1]Migal, Galilee Technology Center, P.O.B. 831, Kiryat Shmona 11016, Israel.
[2]Department of Fruit tree, Institute of Horticulture, ARO, The Volcani Center, P.O. Box 6, Bet Dagan 50250, Israel.
[3]The B. Triwaks Bee Research Center, Department of Entomology, Faculty of Agricultural, Food and Environmental Quality Sciences, The Hebrew University of Jerusalem, Rehovot 76100, Israel.

The 'Spadona' (*Pyrus communis* L.) pear exhibits full self-incompatibility, therefore its fruit production depends entirely on cross pollination, especially by honeybees, which are the ultimate pear pollinators. In the present study, the effect on yield of sequential introduction of honeybee colonies and doubling their density was studied. It was found (in three consecutive seasons, 2001-2003) that increasing the density of colonies from 2.5 colonies per ha, as was recommended previously, to 5.0 colonies per ha at one introduction (10% bloom) did not increase bee activity on the trees and did not improve fruit set and yield, except for one case of a small orchard with heavy competition from surrounding flora. However, introducing the colonies sequentially (half at 10% bloom and half at full bloom), with only a low ratio of colonies (1.25 + 1.25 per ha, respectively), increased the number of bees per tree and their mobility among the rows, and consequently increased fruit set and yield by 50-80%.

10. The Synthetic Cytokinins CPPU and TDZ Prolong the Phase of Cell Divisions in Developing Pear (*Pyrus communis* L.) Fruits.

M.A. Flaishman[1], A. Shargal1, R.A. Stern[2], S. Lev-Yadun[2], L. Shlizerman[1] and G. Grafi[4]
[1]Department of Fruit Trees, Institute of Horticulture, ARO, The Volcani Center, P.O. Box 6, Bet Dagan, 50250, Israel.
[2]MIGAL, Galilee Technology Center, P.O. Box 90000, Rosh Pina 12100, Israel.
[3]Department of Biology, Faculty of Science and Science Education, University of Haifa – Oranim, Tivon 36006, Israel.
[4]Department of Plant Sciences, The Weizmann Institute of Science, Rehovot 76100, Israel.

The basic relationships among cytokinin signaling, cell divisions and fruit growth are known. Final fruit size depends on the combined effects of the number of cells present at fruit set, the number of subsequent cell divisions, and the extent to which cells expand. Most studies related to the cell cycle were performed on cultured cells or model plants in optimal laboratory conditions. The question, however, of how cytokinin signaling and cell divisions regulate fruit growth under field conditions has not been addressed. The effect of the synthetic cytokinin CPPU and Thidiazuron (TDZ) on fruit size of the small-fruited 'Spadona' (*Pyrus communis* L.) pears was examined during 4 consecutive years. CPPU (10-20 ppm) or TDZ (15-30 ppm), applied two weeks after full bloom caused an appreciable increase in fruit size, without affecting fruit shape and seed number. CPPU and TDZ-treated fruits displayed a significant increase in the number of cells along the fruit radius. This increase correlates with a prolonged phase of cell division as demonstrated by histone H1 kinase assay as well as by the detection of G2 nuclei by fluorescence-activated cell sorter (FACS) analysis. However, no correlation was found between H1 kinase activity and the expression levels of both cyclin B1 and Cdc2, the components of the mitotic CDK. Cell size was not affected by CPPU or TDZ application.

NOTES

WEDNESDAY 4 FEBRUARY : SESSION III: BREEDING AND EVALUATION

11. Progress and Challenges of the South African Pear Breeding Program.

J.P. Human
ARC Infruitec-Nietvoorbij, Private Bag X 5013, Stellenbosch, 7599, South Africa.

Imported cultivars are usually poorly adapted to South African conditions and in order to stay competitive on overseas markets the South African pear industry needs new climatically adapted cultivars. The pear breeding program in South Africa is largely funded by the local industries (Deciduous Fruit Producers' Trust, Canning Fruit Producers' Association & Dried Fruit Technical Services), which in turn specify the breeding objectives to coincide with market needs. The present cultivar range is not without problems. There are currently no full-red cultivars with good storage ability and few full-green pear cultivars without knobliness. Locally bred blushed pear cultivars, such as 'Rosemarie' and 'Flamingo', are currently too sensitive to climate changes resulting in sub-optimal blush colour development. The high demand of blushed cultivars from overseas marketers and the potential high returns for local producers highlight the importance of addressing the colour problem in the breeding programme. The breeding program is also aiming towards developing other unique products to fill niche market gaps. Products include "miniature pears", suitable for "kiddies packs" and unusual product types such as Asian x European pear hybrids. The pear breeding and evaluation program thus concentrates on the following areas: breeding climatically adapted blushed cultivars; a range of full-red cultivars with good storage ability; attractively shaped green pears, new product types such as Asian x European pear hybrids and the development of unique products such as miniature pears.

12. Progress on Selection of Better Quality Pears through the University of Bologna Breeding Program.

S. Musacchi, V. Ancarani, A. Gamberini, B. Giatti and S. Sansavini
Dipartimento di Colture Arboree, University of Bologna, Bologna, Italy.

The University of Bologna pear breeding program includes a series of crosses made in three periods starting in 1978. The main goals were to: i) diversify and improve fruit quality and time of ripening; ii) select new red skin pears; iii) find new genetic sources of resistance to *Cacopsylla pyri* and to *Erwinia amylovora* (fire blight) and iv) find a hybrid (*Pyrus communis* x Nashi) pear for the fresh market. At the moment more than 100 advanced selections (S2) are under evaluation. Some of them seem really interesting for quality traits and harvest time, like the selection 92051124-8 obtained from a 'Harvest Queen' x 'Bartlett' cross that ripens at the end of July. Further advanced selections will be presented.

13. Characteristics of F1 Generation Crosses of Cultivars Buttira Precoce Morettini x Bella Di Guigno.

D. M. Milutinovic, M. Nikolic and B. Tanaskovic
Faculty of Agriculture, University of Belgrade, 11080 Belgrade, Serbia and Montenegro.

The objective of our programme was obtaining new, early maturing summer pear varieties with good fruit size, like cultivar Buttira Precoce Morettini, but with better eating quality. Crossing was done with 'Buttira Precoce Morettini' and 'Bella di Giugno'. A bearing plantation of 101 seedlings, together with the parent varieties, is situated in Ljubic near Cacak (Serbian Institute for Research in Agriculture, Center for Fruit and Viticulture). Characteristics of both parents ('Buttira Precoce Morettini' as female and 'Bella di Giugno' as male) are present in all 101 seedlings in the F1 generation. In every year in every

tested characteristic, namely fruit mass, fruit dimensions, stem length, soluble solids content and time of fruit maturation, there was large variability. 'Buttira Precoce Morettini' ripened from 23 to 30 July, 'Bella di Giugno' from 24 to 29 June, and the F1 seedlings from 16 July (seedling numbers 52/7 and 79/8) to 26 July (seedling number 74/7). Generally, fruit from all seedlings ripened closer to the later cultivar (Buttira Precoce Morettini) than to the early 'Bella di Giugno'. Fruit mass of 'Bella di Guigno' ranged from 167g to 170g, and in the F1 seedling generation from 33.7g (seedling number 3/8) to 102.1g (seedling number 75/8) or 129.7g (seedling number 66/8). The soluble solids content in 'Buttira Precoce Morettini' ranged from 13.7% to 13.8% and 'Bella di Giugno' from 16.9% to 17.3%. The seedlings had a soluble solids content from 10.3% (seedling 3/8) to 17.3% (seedling 60/7). We selected two seedlings, numbers 75/8 and 66/8 as prospective new varieties.

14. Orchard Comparisons of New Quince and *Pyrus* Rootstock Clones.

D. Johnson, J. Spencer, T. Webster and S. Adam
Horticulture Research International, East Malling, Kent, ME19 6BJ, United Kingdom.

The breeding and selection of new quince and *Pyrus* rootstock clones suitable for the common pear (*P. communis* L.) continues at HRI East Malling in the UK. One new quince clone, EMH, has been released to commerce and evaluations of this dwarfing clone have continued in grower trials both in the UK and in several countries in continental Europe. EMH induces very good fruit size in scions grafted onto it, although it does tend to induce poorer yield precocity than EMC in some trials. Another East Malling quince selection, C.132, proved to be slightly more dwarfing than EMC in trials conducted some years ago, both in the UK and the Netherlands. Results will be presented of more recent trials of C.132. Several *Pyrus* rootstock selections from the East Malling breeding programme are also showing some preliminary promise. Results of trials comparing these with the standard commercial quince rootstocks and with promising quince and *Pyrus* rootstocks from breeding programmes in other countries will also be presented.

15. Progress in the National Asian Pear project: A study on the Adaptation of Some Asian Pear (*Pyrus serotina* Rhed) Cultivars under Iranian Environmental Conditions.

K. Arzani
Department of Horticulture, Faculty of Agriculture, Tarbiat Modarres University (TMU), P.O. Box 14155-4838 Tehran, Iran.

Pear (*Pyrus communis* L.) is an important fruit of temperate regions of Iran. The area of pear culture in Iran consists of 19 219 hectares with production of about 180 000 tonnes. Most pear orchards in Iran are located in Tehran (Karaj), Khorasan, Isfahan, East and West Azarbayjan and Ghazvin province. The Iranian fruit industry is not experienced in the culture and production of Asian (Japanese) pear (*Pyrus serotina* Rehd.) cultivars. In order to evaluate some Asian (Japanese) pear cultivars under Iranian climatic conditions, the national research project was started in 1997 at the Department of Horticultural Science, Tarbiat Modarres University (TMU). Nine Asian pear cultivars named 'KS'_{6}', 'KS'_{7}', 'KS'_{8}', 'KS'_{9}', 'KS'_{10}', 'KS'_{11}', 'KS'_{12}', 'KS'_{13}' and 'KS'_{14}' were introduced to Iran from Belgium. Scions were budded on European pear (*Pyrus communis* L.) and quince (*Cydonia oblonga* L.) seedling rootstocks in August 1998. Growth characteristics and performance of the cultivars were measured from 1999 to 2003. Results indicated that all Asian pear cultivars showed a good performance on European pear seedling rootstocks, although their growth was affected by genotypes. On European pear rootstock, 'KS'_{6}' and 'KS'_{10}' showed better early growth performance and survival. In the first fruit bearing season of 2001, 'KS'_{8}' showed the lowest fruit number per tree, and 'KS'_{7}' the highest fruit number. 'KS'_{9}' did not produce any fruit in the 2001 season. In the second season of 2002, 'KS'_{7}' again produced the highest and 'KS'_{9}' the lowest fruit number. Taste test panel results indicated a good fruit taste of 'KS'$_6$, 'KS'$_7$, 'KS'$_{10}$, 'KS'$_{11}$ and 'KS'$_{14}$, but 'KS'$_9$ showed fruit skin and internal disorders on the tree before harvest. Research is continuing on budded cultivars to study rootstock effects adapted to the soil and climatic conditions of the country. The second phase of the project has been started with planting of some of the genotypes in the North (Gorgan), Centre (Abarkooh), and North-west (Khorasan) of Iran in March 2003, and will continue with planting in new fruit growing regions such as Isfahan, Ormieh and Mashhad during the 2004 season.

16. Field Performance of Fireblight Tolerant, *Pyrus communis* Selections in South Carolina.

G.L. Reighard[1], D.R. Ouellette[1], K.H. Brock[1] and R.L. Bell[2].
[1]Clemson University, Department of Horticulture, Clemson, South Carolina, 29634-0319, USA.
[2]USDA-ARS Appalachian Fruit Research Station, 45 Wiltshire Road, Kearneysville, WV, USA.

Six pear cultivars and nine advanced *P. communis* selections having fireblight tolerance were planted together with 'Bartlett' in 1996 and 1997 near Clemson, South Carolina. Disease resistance, tree growth, phenology, precocity, fruit maturity and fruit weight and yield were evaluated through year 2003. Among cultivars and selections, almost all exhibited some leaf bronzing, necrosis and partial defoliation by mid-summer in 2001 and 2002. However, selection 78304-057, 'Harrow Sweet', and 'Honeysweet' had few or no leaf symptoms. 'Stark's Delicious' was the most vigorous cultivar followed by 'Potomac', 76128-009 and 'Harrow Delight'. Mean full bloom dates among *P. communis* cultivars and selections varied by 10 days with only 78304-057 blooming later (3 days) than 'Bartlett'. Secondary or rattail flower production was common in most years for 'Harrow Delight' and selections 76128-009 and 66125-035. Cumulative fruit yields per tree were highest in 'Potomoc' (138kg), 76128-009 (131kg), 'Starking Delicious' (120kg) and 78304-057 (111kg). The lowest yielding cultivars or selections were 'Honeysweet', 'Harrow Sweet' and 66131-021 ('Blake's Pride'). Largest mean fruit weights were from NY10346 (285g), 76115-010 (253g), 'Bartlett' (242g) and 67218-083 (233g). Average fruit maturity date based on pressure readings among cultivars and selections varied by 38 days. 'Harrow Sweet' and NY10346 were the only 2 pears to ripen (~10 days) after 'Bartlett'. 'Harrow Delight', 66170-047, 71655-014 and 76115-010 ripened the earliest, ~ 4 weeks before 'Bartlett'. No cultivars or selections were significantly injured by fireblight through 2003.

17. 'Rocha', the Pear from Portugal.

J.M. Silva[1], N.G. Barba[2], M.T. Barros[1] and A. Torres-Paulo[3]
[1]Instituto Superior de Agronomia, Lisboa, Portugal.
[2]Escola Superior Agrária de Santarém, Santarém, Portugal.
[3]Associação Nacional dos Produtores de Pereira Rocha, Cadaval, Portugal.

The original 'Rocha' pear tree, probably a chance seedling, dates from middle 19th century and is described by an early 20th century author as being in the garden of Pedro Rocha, a horse dealer from Sintra, near Lisbon. It is not easy to market a 'new' pear cultivar, pear consumers being very conservative, but the 1991/92 campaign, with an European deficit on the offer side, provided the export opportunity for 'Rocha' growers. The export to Canada, Brazil, United Kingdom, France, Spain and Ireland peaked 50 000 t in 1997/98, another bad year for the Italian pear crop. Retailers praise the good shelf life of this attractive yellow summer pear. It is not as juicy as 'Doyenné du Comice', but has a good taste and flavour. It is less messy than 'Beurre Hardy' to eat without a knife and plate. The usual picking date is around August 15 and the pear stores well at 0-1°C up to April, especially under controlled atmosphere. 'Rocha' pear, however, is very sensitive to pear scab and to *Stemphylium* sp. It is moderately sensitive to pear psylla, less than 'Beurre Hardy' or 'Forelle'. Fire blight has not yet been detected in our country, but according to French researchers say that 'Rocha' is not among the most sensitive cultivars.

NOTES

SESSION IV : GENETICS AND BIOTECHNOLOGY

18. Molecular Genetic Studies on Pears in the Western Cape.

M.M. van Dyk[1], G. Koning[1], Z. Simayi[1], S. Booi[1], R. Maharaj[1], M.C. Selala[1], M.G. du Preez[1], I.F. Labuschagné[2], L. Warnich[3] and D.J.G. Rees[1]
[1]Department of Biotechnology, University of the Western Cape, Private Bag X17, Bellville, 7535, South Africa.
[2]Agricultural Research Council, Infruitec, Nietvoorbij, Private Bag X5013, Stellenbosch, 7599, Western Cape, South Africa.
[3]Department of Genetics, University of Stellenbosch, 7600, South Africa.

The breeding of pears in South Africa at the Agricultural Research Council has historically been based on the selection of quality traits. However, with the development of molecular markers and genetic maps for pear, it is now possible to implement the use of marker assisted selection (MAS) for pears for both durable resistance and quality trait selection. The focus of our research program has been on the implementation of microsatellite markers from the apple and pear reference genetic maps, and the development of microsatellite markers, using apple and pear genomic and cDNA sequence data. A number of new markers have been identified and tested. The optimisation and multiplexing of the complete set of markers is ongoing for apple and pear, and the current status of the program will be described. In addition, we are exploiting two bud mutation systems in the 'Bon Chretien' pear, one giving an extreme red colour ('Bon Rouge') and the other giving a lowered chilling requirement ('Early Bon Chretien'). The genetic mapping and molecular studies of these systems will be summarised.

19. Ploidy Level Evaluation of Rootstock Selections and *Pyrus* Genus Accessions.

M.H. Simard[1], C. Dumoulin[1] and D. Demilly[2]
[1]INRA, Unité d'Amélioration, des Espèces Fruitières et Ornementales, 42 Rue G. Morel, BP57, 49071 Beaucouzé Cedex, France.
[2]GEVES-SNES, Rue G. Morel, BP24, 49071 Beaucouzé Cedex, France.

Pear production needs a dwarfing pear rootstock. INRA's Angers pear rootstock breeding programme is based on *Pyrus* interspecific hybridization using *P. communis, P. nivalis* and *P. heterofolia.* INRA's Angers *Pyrus* collection contains 85 taxons: 46 genotypes belong to occidental *Pyrus* species, 25 to oriental ones and 14 to other species. In *P. nivalis* (perry pear), a large scale of induced vigor has been obtained among progenies of 'Poire Branche' ('G hybrids') and 'Rouge de Vigné' ('RV hybrids'). G28-120 is the most promising genitor and RV139 the most dwarfing. As low induced vigor genotypes have a particular habit, the hypothesis that they are not diploid has been postulated. Flow cytometry technique is an efficient and rapid method to evaluate the ploidy level of plants. *Pyrus* species and rootstock selections have been tested using mature leaves of one-year-old shoot and DAPI fluorochrome. Two progenies (25 and 15 plants, respectively) with 'Pyriam' as female and G28-120 or P2532 (genitor belonging to *P. heterofolia)* as male have also been evaluated. One to ten taxons per species and at least two replicates per hybrid have been tested. The results show that most accessions from *Pyrus* genus are diploid. In perry pear *(P. nivalis)* some varieties are triploid; aneuploids were selected as G28-120 and RV139. Two hybrids selected from G28-120 (open pollination) are also aneuploid.
The hybrids selected in the two controlled progenies from 'Pyriam' are diploid. These results are discussed as well as the prospects for the Angers pear rootstock breeding program.

20. Expression of Cyclin B and Histone H1 Kinase Activity Mark Reproductive Bud Break in Pear Grown in the Hot Climate of Israel.

M.A. Flaishman[1], Y. Bryer[1], A. Shargal[1] and G. Grafi[2]
[1]Department of Fruit Trees, Institute of Horticulture, ARO, The Volcani Center, P.O. Box 6, Bet Dagan, 50250, Israel.
[2]Department of Plant Sciences, The Weizmann Institute of Science, Rehovot 76100, Israel.

In warm-winter regions, spraying pear orchards with dormant breaking chemicals during winter can induce sufficient bud break. We investigated the relationships between winter dormancy and cell cycle regulation in the low chilling requiring pear (*Pyrus communis* L.) cultivar 'Spadona' by combining morphological, histological and biochemical methods. The study was conducted in two orchards located in regions with different climatic conditions: at 40 m and at 700 m above sea level. In both orchards, bud development was arrested during winter dormancy. While examining the phenotypic changes in the reproductive buds, we found an increase in their weight toward the end of dormancy. A sequence of flow cytometry analysis during dormancy and release in both orchards, showed that the existence of G2 nuclei correlated with the phenotypic changes in the buds and with histological observations on cell cycle in the developing flower bud. In order to find molecular markers for bud break, we followed the seasonal expression of several key cell cycle regulators. While CDC2 was constitutively expressed during both dormancy and dormancy release, the expression of cyclin B was correlated with the amount of chilling units accumulated by the reproductive buds, in the two different orchards. In addition, the expression of histone H1 kinase activity was correlated with the expression of cyclin B. In both orchards, reproductive buds showed an increase in histone H1 kinase activity as well as in cyclin B level 10 days before any phenotypic changes were visible. It is suggested that the expression level of cyclin B and the activity of histone H1 kinase can serve as markers for early stages of reproductive bud break in pear.

21. Expression of the Health-Beneficial Stilbenes in Transgenic 'Spadona' Pear (*Pyrus communis* L.)

M.A. Flaishman[1], L. Shlizerman[1], Y. Cohen[1], L. Sivan[1,2] and Z. Kerem[2]
[1]Department of Fruit Trees, Institute of Horticulture, ARO, The Volcani Center, P.O. Box 6, Bet Dagan 50250, Israel.
[2]Institute of Biochemistry, Food Science and Nutrition, Faculty of Agricultural, Food and Environmental Quality Sciences, The Hebrew University of Jerusalem, Israel.

The requisite low-chilling Spadona pear (*Pyrus communis* L.) cultivar is the main pear variety grown in Israel. An efficient and reproducible system for *Agrobacterium*-mediated transformation of this cultivar was recently developed. To introduce health-beneficial compounds into 'Spadona' it was transformed with grapevine (*Vitis vinifera* L.) cDNA encoding stilbene synthase transcriptionally regulated by an enhanced cauliflower mosaic virus (CaMV) 35S promoter. The gene encoding stilbene synthase is responsible for the synthesis of the compound resveratrol. Resveratrol and its glycosides are considered to have health beneficial effects, including anti-ageing, anti-inflammatory, anti-platelet and anti-carcinogenic activities. Six transgenic 'Spadona' plants were obtained from 276 infected explants, corresponding to a transformation efficiency of 2.2%. Transgenic plants carrying the stilbene synthase gene were identified via polymerase chain reaction. Transgenic plants accumulated several new compounds not present in the wild-type pear - these were identified as stilbenes by high-performance liquid chromatography analysis. Stilbene production was monitored in both tissue culture and 1-year-old rooted transgenic plants. In tissue culture, the major stilbene was piceid with traces of resveratrol, and in the leaf of the 1-year-old 'Spadona', piceid and resveratroloside were recorded. Stilbene levels varied among transgenic lines. Anti-oxidant and anti-carcinogenic activities of the transgenic pear lines will be discussed.

SESSION V : POSTHARVEST

22. Extending Shelf-Life of Partially Ripened 'd'Anjou' Pears by 1-Methylcyclopropene Treatment.

J. Bai and P.M. Chen
Mid-Columbia Agricultural Research and Extension Center, Oregon State University, 3005 Experiment Station Drive, Hood River, Oregon 97031, USA.

'D'Anjou' pears (*Pyrus communis* L.) were pre-conditioned with 100 $\mu L.L^{-1}$ (ppm) ethylene at 20°C for 0 (un-conditioned), 1, 2, 3 and 4 day(s) after being stored in regular air (RA) for 2 and 4 months or in a controlled atmosphere (CA) (2% O_2 + 1% CO_2) for 8 months at -1°C. Both un-conditioned and ethylene pre-conditioned fruit were then subjected to either 1.0 $\mu L.L^{-1}$
1-methylcyclopropene (MCP) or no-MCP treatment (Control) at 20°C for 24 hours. Regardless of storage condition and length, MCP-treated fruit softened much slower than Control fruit if the fruit had been pre-conditioned with 100 $\mu L.L^{-1}$ ethylene for 3 days or shorter at 20°C. We have demonstrated that 1 $\mu L.L^{-1}$ 1-MCP treatment of partially ripened 'd'Anjou' pears extends the shelf life for as long as 14 days in the retail markets.

23. The effect of SmartFresh™ (1-methylcyclopropene) on Post Harvest Handling and Storage Quality of Pears.

I. Crouch
Capespan Technology Development, Capespan (Pty) Ltd, P O Box 1231, Stellenbosch, 7599, South Africa.

SmartFresh™ is an exciting new breakthrough in the post harvest storage of fresh fruit and vegetables. American scientists at North Carolina State University identified 1-methylcyclopropene (1-MCP), an antagonist ethylene inhibitor in horticultural products. The technology, now known as SmartFresh™, has been acquired and developed for use on fresh fruit and vegetables by AgroFresh Inc, a Rohm and Haas Company. Due to its ethylene blocking effect, SmartFresh™ has incredible potential to maintain the quality of fresh produce during cold storage and shelf life. SmartFresh™ has been registered for application on apples since 2002 and has been successfully applied commercially within the USA and South Africa. Research into its commercial application on pears is currently underway worldwide. Capespan Technology Development is responsible for research supporting registration in South Africa, and has been testing the product on pears since 1999. SmartFresh™ proved effective in extending storage duration and shelf life at a range of concentrations over all cultivars tested. Application of similar concentrations of SmartFresh™ to pears, as those applied to apples, resulted in fruit that did not ripen normally. Fruit remained too firm and skin colour development was inadequate. Application of SmartFresh™ at lower concentrations to fruit at more advanced maturities enabled effective improvements in fruit storage duration and shelf life without adversely affecting eating quality. The significance of these findings will be discussed.

24. Sensory Analysis of New Pear Varieties.

P. Vaysse
Ctifl, Centre de Lanxade, BP 21 24130 La Force, France.

Sensory evaluation is a technique allowing measurement of the sensory characteristics of food as perceived by man. Sensory analysis consists of identifying the sensory characteristics of a product by a trained tasting panel (12 to 15 panelists). The panel uses a list of terms (descriptors), generated by the panel itself, in describing the product. Each panelist rates each descriptor on a scale ranging from 0 to 10, depending on his or her sensory perception. The decriptors relate to:

- appearance; intensity of colouring, presence of spots, and extent of bronzed skin,
- smell and flavour; intensity of overall taste, vegetal note, cooked pear, sweet and acid flavours, astringency, and
- texture: characterising the fruit as to crunchiness, juiciness, meltiness and coarseness.

Before being tasted, the pears are matured in a ripening room with a temperature of 18°C and relative humidity of 95%. The fruits are tasted at their gustatory optimum, i.e. a firmness of 1.5kg/0.5cm². In this paper, the sensory profiles of six new varieties (Harrow Delicious, Taylors Gold, Verdi, Eliott, Forelle et Angélys) are compared to the traditional varieties Williams, Conférence and Doyenné du Comice.

25. Sensory Evaluation and Pear Fruit Quality.

S. Predieri[1], E. Gatti[1], F. Rapparini[1], L.Cavicchi[2] and R.Colombo[2]
[1]IBIMET-CNR-BO, Bologna, Italy.
[2]CISA Mario Neri, Imola, Italy.

World production of European pears is based on a limited number of well-known traditional cultivars, each having distinctive fruit quality traits. The definition of major quality traits is fundamental to allow consistent and comparable measurements of fruit quality level. This means that despite the number of role players involved in the pear production industry a common approach should be chosen. The concept of quality of a pear at harvest, and during or after storage is different from that of the quality of fruit at the time of consumption. Thus, an increasing number of scientists suggest that quality should be observed from the point of view of the final user: the consumer. Choosing this point of view, sensory evaluation is of major importance. Sensory-based techniques are increasingly being used in supporting breeding and testing new cultivars of different species. Consumer science states that appearance (visible quality) of fruit is a primary criterion for a favorable purchase decision, and specific consumer tests can assess fruit visual appeal. As related to eating quality, pear flavor depends on a delicate balance of sugars, acids, phenolics, and aromatic compounds, with a number of additional factors, such as texture, also influencing perception. The traits of importance in pear sensorial quality are: juiciness, sweetness, acidity, pear aroma, astringency, aftertaste, flesh texture and firmness. Eating quality is difficult to measure objectively. However, analytical measurements coupled with adequate sensorial tests can be of help in assessing overall fruit quality. Sensory evaluation is currently applied in Regione Emilia-Romagna, Italy for the optimization of fruit quality of standard pear cultivars and to evaluate new cultivars.

26. Sensory Evaluation of Pear Cultivars in the Pacific Northwest, USA.

C.F. Seavert[1], J. Turner[1], A. Marin[2] and A. Colonna[2]
[1]Oregon State University, Mid-Columbia Agricultural Research and Extension Center, 3005 Experiment Station Drive, Hood River, OR 97031, USA.
[2]The Food Innovation Center, 1207 NW Naito Parkway, Suite 154, Portland, OR 97209-2834, USA.

There are currently twenty-six pear cultivars in the cultivar trial at the Mid-Columbia Agricultural Research and Extension Center grown and tested for adaptability to the Pacific Northwest region. New and marketable pear cultivars from around the world that show economic promise and regional adaptability will continue to be evaluated. Determining consumer acceptance is an important step in cultivar evaluation. A sensory evaluation protocol was developed and implemented. In 2002, 253 participants sampled eight different cultivars at two different venues. The cultivars sampled included green 'd'Anjou' and green 'Bartlett' as commercial standards, three international cultivars recently introduced to the commercial orchardist. and three untested cultivars from the USDA disease resistant breeding program in Kearneysville, West Virginia. Participants rated pears on appearance, overall like/dislike, and purchase intent, and ranked each cultivar sampled in order of overall preference. Preliminary results suggested that two of the USDA cultivars ranked higher than green 'Bartlett' for overall liking score. In the second venue green 'Bartlett' and one of the USDA cultivars rated higher in visual appearance scores. Data suggest that untested and unknown cultivars may actually be preferred over commercial standards. The project goal in 2003 will be to collect 1 000 surveys and compare consumer preferences for commercial standards versus new untested cultivars.

27. 'Concorde' Pear Flavor, Texture, and Storage Quality Improved by Manipulating Harvest Maturity.

E.A. Mielke[1], S.R. Drake[2] and D.C. Elfving[3]
[1]Mid-Columbia Agricultural Research and Extension Center, Oregon State University, 3005 Experiment Station Drive, Hood River, Oregon 97031, USA.
[2]USDA, ARS-TFRL, 1104 N. Western Avenue, Wenatchee, Washington 98801, USA.
[3]Tree Fruit Research and Extension Center, Washington State University, 1100 N. Western Avenue, Wenatchee, Washington 98801.

'Concorde' has become a commercial pear in the United States' Pacific Northwest, with nurseries reporting sales of approximately 150 000 trees through 2003. Initial studies suggest 'Concorde' may have inherited 'Conference's' sensitivity to CO_2 and ethylene and low boron induced physiological disorders. Samples stored for four months have developed astringency previously reported in England. 'Concorde' can be harvested over 10 to 14 days without loss and store well in either regular air (RA) or controlled atmosphere (CA) storage. The ten-day delay resulted in no change in flavor or firmness but did enhance soluble solids (SS) and fruit size. An additional 14-day harvest delay resulted in overly sweet fruit. Fruit stored longer than 30 days ripened to a smooth buttery texture, while fruit stored for 120 days was dry and mealy on ripening. 'Concorde' pears can be stored in RA storage for periods not to exceed 90 days. Earlier harvest should be considered when RA storage is expected to exceed 90 days; however, the earlier the harvest the greater the danger of the fruit developing astringency during storage. Regardless of harvest, 'Concorde' pears can be placed in CA storage for periods of 90 days with no serious quality losses, particularly if the CA is maintained at 1.5% O_2 and 1.0% CO_2 at 1°C. In CA with 1.5% O_2, CO_2 levels of 3.0% or 5.0% significantly increase core breakdown. Low oxygen CA (1.0% O_2 and <0.1% CO_2) at –1°C is not recommended as severe senescent scald results.

28. Mealiness of 'Forelle' Pears – *quo vadis?*

E.M. Crouch[1], D.M. Holcroft[2] and M. Huysamer[1]
[1]Dept. of Horticultural Science, University of Stellenbosch, P. Bag X1, Matieland, 7602, South Africa.
[2]DOLE Fresh Vegetables, P.O. Box 1759, Salinas, CA 93902, USA.

'Forelle' (*Pyrus communis* L.), a late season blushed pear cultivar grown in South Africa, requires a minimum of 12-weeks cold storage (-0.5 °C) to ripen evenly. Mealiness, a dry texture disorder, may develop at this time. In contrast to other pear cultivars, longer cold storage periods result in less mealiness. This could be related to insufficient total ACC build up and ethylene production, for juicy texture development, during ripening. 'Forelle' were stored for 3 weeks at -0.5°C, treated with ethylene ($100 \mu L \cdot L^{-1}$, 24h, 20°C), stored at 20°C for 2 days and thereafter 3 weeks at -0.5°C. While treated fruit had

± 5 times higher total ACC concentration and 251.76 $\mu L \cdot kg^{-1} \cdot h^{-1}$ ethylene production, compared to almost no ethylene production in control fruit, both developed 100% mealiness. Mealiness could not be linked to insufficient ethylene production during shorter storage periods. Harvest maturity, a well-known influential factor of mealiness, was tested by harvesting fruit 2 weeks prior to commercial harvest, during commercial harvest, and 2 and 4 weeks after commercial harvest. Mealiness occurred at all harvest dates after 6 weeks at -0.5°C and 7 days at 15°C. Storage temperature was also tested as another influential factor of mealiness. Fruit were stored at -0.5°C, 4°C and 7.5°C for 6 weeks and ripened for 7 days at 15°C. Fruit stored at 4°C and 7.5°C ripened with 0 and 8% mealiness, respectively, in contrast to 70% in control fruit. Results could, however, not be confirmed in 2002 and 2003 as all treatments exhibited low mealiness levels (<4%). As high temperatures prior to harvest may influence mealiness, overhead evaporative cooling was applied during early fruit development and 2 weeks prior to harvest. Little to no mealiness developed in all treatments making it difficult to conclude if cooling prior to harvest affects mealiness. The significance of these findings will be discussed in relation to seasonal variations.

SESSION VI : GENERAL

29. Remaining Globally Competitive in the US Tree Fruit Industry with the National Tree Fruit Technology Roadmap.

C.F. Seavert
Mid-Columbia Agricultural Research and Extension Center, Oregon State University, Hood River, Oregon 97031, USA.

The U.S. tree fruit industry has based its success on production efficiency, product quality, and worldwide marketing. One third of its apple, pear, and sweet cherry crops are exported. To sustain its success in domestic and international markets, this industry must rapidly adjust to the dynamics of globalized trade and technology. In large part, globalization is a direct result of a worldwide proliferation of technology that has enabled many to effectively compete in areas from which they were once excluded. Ironically, it is also technology that will empower American agriculture to remain competitive in a global economy. The U.S. tree fruit industry will remain economically viable only if it systematically reduces production costs and delivers premium quality fruit to the consumer. Research must be conducted and technologies developed to improve the sustainability, efficiency, and quality of fruit production. Producers and their work force, the backbone of many rural agricultural communities, must have access to these technologies and the means to improve their economic situations. Rapid, easily accessible rural communications systems must be developed. Decisions about how and where technology can be implemented are critical. The entire industry and its research community must be involved in this initiative. We have prepared a roadmap to fulfill our vision. This roadmap is the collaborative product of industry and research community participants. We first define our industry's overriding problem – increased global competition in tree fruit markets. Then we identify key barriers – escalating production costs and increased demands for fruit quality. Finally, we describe essential research and development areas and set specific near-, medium-, and long-term R&D priorities to overcome these barriers. While the immediate beneficiaries of this effort are the producers, work force, and communities of the U.S. tree fruit industry, its ultimate success will be the continued supply of the highest quality fruit to consumers worldwide.

30. Architectural Analysis of Pear Cultivars Grown Under South African Conditions and the Relevance to Local Maintenance Pruning Strategies.

N.C. Cook[1] and P. du Plooy[2]
[1]Department of Horticultural Science, University of Stellenbosch, Private Bag X1, Matieland, 7602, South Africa.
[2]DuToit Group, P.O. Box 236, Ceres, 6835, South Africa.

Initially, 2-year-old pear branches were classified into groups based on the length and position of lateral shoots. Four groups were formed that ranged from cultivars with a spurred growth habit and strong apical control, to cultivars with a spreading growth habit and weak apical control. Secondly, the development of fruiting branches was observed for up to five years by observing the five developmental alternatives of the terminal buds of laterals, i.e., dormant, vegetative, reproductive without fruit, reproductive with fruit, and abortion. Under local conditions two general problems were observed. A large proportion of buds remain vegetative giving rise to poor flowering, and many buds remain dormant, probably due to the use of vigorous rootstocks and inadequate winter chilling. Local training systems address these shortcomings through the use of rest-breaking agents, girdling, and winter pruning techniques. Winter pruning strategies for locally important cultivars can be split into two broad approaches. In one approach spurs are renewed within spur systems, primarily via bourse shoots. In the other, spurs are renewed via year-old shoots. The motivation for the use of these systems is discussed in light of the above architectural findings.

31. Variation in Pruning Severity and Branch Quality on Primary and Secondary Growth of 'Packham's Triumph' Pears *(Pyrus Communis* L.).

L.P. Reynolds, G. Jacobs and K.I. Theron
Department of Horticultural Science, University of Stellenbosch, Private Bag X1, Matieland, 7602, South Africa.

The influence on sink strength of severe dormant pruning and quality of 2-year-old wood was investigated during the 2002/03 season on 'Packham's Triumph' pear (*Pyrus communis* L.) trees in the Western Cape, South Africa. Primary growth increased by 40 % for short bearing units (SBU) and 140 % for thick bearing units (BU) as compared to long bearing units (LBU) and thin BU, respectively. Increased primary growth was due to increased fruit set and fruit size. Since the increase in primary growth is less for SBU compared to thick BU, it is evident that branch diameter influenced sink strength more than branch length. The size of the xylem transport system increases more than the size of the phloem as branch diameter increase. The increase in xylem transported metabolites, in particular root-derived cytokinin, seems to predominantly influence the magnitude of the sink strength.

32. Multi-branched V-systems Improve Productivity and Manageability of a Vigorous Pear Cultivar.

M. Bertelsen
Department of Horticulture, Danish Institute of Agricultural Sciences, P.O.Box 102, DK-5792, Aarslev, Denmark.

In an attempt to find a suitable training system for the vigorous pear cultivar 'Clara Frijs' (*Pyrus communis* L.), two types of Y-trees trained to a V-trellis were tested and compared to standard spindle

trees. Three planting distances were used: 1, 1.5 and 2 m. The Y-trees were trained with four main branches. Depending on planting distance, the main branches were allowed to carry one, two or three side branches. all of which were allowed to reach the top of the trellis before they were headed back. The first crop was taken in the third leaf in 1998, and there was no difference in precocity depending on planting systems. Trees on the V-trellis produced 40 % higher crops in years when the general cropping level was high. In low-cropping years, the difference between systems was even greater, but not always significant. After the 2002 harvest the Y-trees had yielded a total of 87 tons, while the spindle trees had only just reached 60 tons. The biennial bearing index was similar for all systems. Fruit size was significantly larger on the spindle trees the first 3 cropping years, but in 2001 and 2002 no size difference was detectable in spite of larger crop loads on the Y-trees. Fruit quality was evaluated in 2002 and no significant differences between systems were found. Planting distance affected yield significantly. Increasing the number of trees by 50% caused a 15% increase in the accumulated yield, while a doubling of the trees from 1300 to 2600 tree/ha resulted in a 34% yield increase. On a per tree basis fruit size was negatively affected by closer tree spacing, but the total amount of large fruits was similar at all spacings. Tree trunk circumference was larger in the Y-trees, but the need to prune was smaller and more short spurs capable of forming flower buds were present. It is concluded that the Y-trees are both more productive and easier manageable and therefore represent a favourable alternative to spindle trees.

33. Comparison of 'Conference' Pear in Five Intensive Training Systems with regard to Yield, Labour Timing and Fruit Quality in the Northeast of Spain.

L. Asin[1], R. Montserrat[1], J. Carbo[2], P. Vilardell[2], M. Carrera[3]
[1]Institut de Recerca i Tecnología Agroalimentaries (IRTA), Estació Experimental de Lleida, Avda. Rovira Roure 191, 25198 Lleida, Spain.
[2]Institut de Recerca i Tecnología Agroalimentaries (IRTA), Estació Experimental de Mas Badia, Crta de La Tallada s/n, 17134 Canet de la Tallada, Spain.
[3]Centro de Investigación y Tecnología Agroalimentaria de Aragón (CITA), Crta. Montañana 930, Apdo. 727, 50080 Montañana, Spain.

A study on five intensive training systems was carried out during the first five years after planting in two different growing areas of Catalonia (NE-Spain): Lleida and Girona. The objective of the study was to explore the possibilities of improving precocity and yield of 'Conference' pear (*Pyrus communis* L.) trees. There were three tatura trellis training systems using preformed trees (tatura 4-branches, tatura 2-branches and tatura 1-branch) and two central axes training systems with preformed trees. Control trees were trained to a central axis using non-preformed trees. Density of planting ranged from 2133 to 5333 trees per hectare, with trees spaced at 0.5 to 1.25 m within rows and 3.75 m between rows. The tatura and central axis systems had higher yields than the control training system. However, tatura training systems required more time and had higher planting and pruning costs. The tatura 2-branches system cost the most to establish (29966 euros per ha), while the control system cost the least (7880 euros per ha). In Girona, yields were lower than in Lleida because of using a replant site and specific soil characteristics. No differences on fruit quality and size were detected between systems.

34. Training Systems for High Density Pear Planting.

S.Musacchi, V.Ancarani, A.Gamberini, M.Gaddoni, M.Grandi and S.Sansavini
Dipartimento di Colture Arboree, University of Bologna, Bologna, Italy.

High density planting (HDP) of pears is expanding due to the widespread use of quince rootstock clones able to reduce tree size and induce early bearing. However, HDP increases cost pressures so that the break-even point only occurs eight to ten years after establishment. The combination of HDP and compact tree architecture is fundamental to achieve production goals. The University of Bologna, in 1997, started a trial to compare and evaluate production and economical aspects of seven combinations of

cultivar, planting density and training system. We utilised three cultivars, 'Abbé Fétel', 'Conference' and 'Doyenné du Comice', on two quince rootstocks, clone C and Sydo. Four density levels were used; very high density planting (VHDP) (7936 trees per ha), high density planting (HDP) (5555 trees per ha), medium density planting (MDP) (3968 trees per ha), and low density planting (LDP) (1984 trees per ha). The training systems were the vertical cordon on clone C for VHDP, V-shape on clone C for MDP and HDP, slender spindle and drapeau on clone C for MDP, and slender spindle and drapeau on Sydo for LDP. For 'Abbé Fetel', the vertical cordon on clone C at VHDP and the V-shape at HDP proved to be the most productive combinations yielding a cumulative total of 32 and 47 kg per tree (257 and 262 t per ha, respectively) over the first seven years after establishment. 'Conference' showed, with the same two training systems, an equivalent trend of production with cumulative yields of 179 t per ha and 181 t per ha, respectively. 'Doyenné du Comice' achieved the highest cumulative yields (132 t per ha) with the vertical cordon on clone C at VHDP followed by the V-shape on clone C at MDP (120 t per ha). It must be underlined that the investments required by VHDP require in turn high farm-gate prices for equitable returns to growers. This means that today, in Italy, if the farm-gate price is lower than 0.40 € per kg, the break-even point is at least ten years and the entire enterprise is at risk.

35. Financial Results of Different Planting Systems of 'Conference' pear.

J. Vercammen
PCF-Proeftuin Pit- en Steenfruit, Fruittuinweg 1, 3800 Sint-Truiden, Belgium.

In order to help fruit growers chose between planting systems, seven different planting systems for 'Conference' (*Pyrus communis* L.) were planted in 1994. Besides production and fruit quality, attention was also paid to costs and labour. Planting systems included in the test were: bush-spindle shape on Quince C with a planting distance of 3.50 x 1.50 m, an intensive V-system on Quince C (3.20 x 0.80 m), trees with a small volume on Quince C, a traditional V-system on Quince C, the hedge of Tienen on Quince Adams, the table system on Quince Adams and the long pruning on Quince A. At planting and during the first years of growth, V-systems are high in cost and labour. From the fourth year of growth, costs are more or less the same as for other planting systems. Nevertheless, the number of working-hours per hectare remains higher. Contrary to the first years, this now result from the higher production per hectare and from more time required for pruning. The long pruning system and the hedge of Tienen have the lowest total costs after nine years of growth. They also demand the least labour. Highest yields are obtained with the V-systems. All other planting systems give comparable yields, 20 to 25% smaller than with the V-hedges. When only comparing yields of the last three years, the differences between the planting systems are smaller than in the first years with yields of the hedge of Tienen, the table system and the long pruning system comparable with that of V-systems. On the other hand, the bush spindle shape and the trees with a small volume yielded less over the last three years. After nine years the best financial result is obtained with the classical V-hedge, followed by the long pruning system and the hedge of Tienen. The hedge of Tienen, the table system and the long pruning system have made up a large part of their arrears since 2001. These trees only came into full production during the last few years. Trees with a small volume, still in first position after six years of growth, has fallen back to the last position. This is due to big fluctuations in yield after the interdiction on CCC. When interpreting these results one has to take into account that in the first years after planting the V-hedges, the trees with a small volume and the bush-spindle shape were sprayed with CCC, which made these systems come into production earlier.

NOTES

SESSION VIII : GROWTH REGULATION

36. Natural or Chemical Growth Regulation on Pear Trees.

T. Deckers and H. Schoofs
RSF – Royal Research Station of Gorsem, Sint-Truiden, Belgium.

Since the loss of the growth regulator chlormequatchloride (CCC) in 1998, pear growing in intensive training systems has become more difficult and fruit growers are looking for alternative ways to control vegetative growth. First of all, training and pruning methods were adapted; there is a strong preference for single row systems, primarily central leader, trellis or intensive V systems. A pruning system that can keep vegetative growth reactions under control becomes important. The effect of each pruning intervention on vegetative growth reaction of the pear trees should be considered and growth stimulating pruning interventions should be avoided. There is also a change in rootstock choice from the strong growing Quince A rootstock to Quince Adams and the weak growing Quince C rootstock. Root pruning in different intensities or stem incisions with a chainsaw are used to reduce vegetative growth and to improve crop regularity. The results of these measures are difficult to predict and there can be important effects on fruit quality at harvest or during storage. Prohexadione-Ca (ProCa) is a new growth regulator for growth control on apple and pear trees. The extent of growth reduction differs between pear cultivars; growth reduction is strong in 'Doyenné du Comice', medium in 'Conference' and very weak in 'Beurré Alexander Lucas'. ProCa can also negatively affect return bloom. This negative effect on flower bud formation is strongly dose dependent. Results of three consecutive years of application of ProCa at different dosages on the pear cultivars 'Conférence' and 'Doyenné du Comice' will be discussed in this paper. It becomes clear that ProCa will never be able to replace CCC as growth regulator and that a better understanding of the natural growth pattern of a pear tree will be more important in the future. Within the guidelines for integrated fruit production (IFP) chemical growth regulation is not allowed and recently many discussions were held in different European countries regarding this issue. It is clear that preference should be given to natural ways of vegetative growth control and an overall use of chemical growth regulators is not indicated. On the other hand, it is necessary to find a solution for unbalanced pear trees in the absence of a crop. Therefore, the exact potential of ProCa should be known.

37. Shoot Growth, Fruit Production and Return Bloom in 'Conference' and 'Doyenné du Comice' Treated With Regalis (Prohexadione-Calcium).

F. Maas
Praktijkonderzoek Plant & Omgeving, section Fruits (PPO-Fruit), Plant Sciences Group, Wageningen University and Research Center, Lingewal 1, 6668 LA Randwijk, The Netherlands.

Regalis was registered in The Netherlands as a growth regulator for pear in 2003. Since the ban on the chemical growth retardant chloromequat (CCC), growers had to rely on mechanical methods for controlling shoot growth of their trees. Although good growth control can be obtained by pruning the roots and/or incising the trunk of the trees, these methods are more difficult and time consuming to apply than spraying a growth regulator. In apples, good results of Regalis on growth control and fruit production have been widely observed. However, in pears the results of application of Regalis have not always been satisfactory and were often not as good as those obtained in the past with CCC or more recently with root pruning or trunk incision. In the Netherlands a number of trials with Regalis have been performed during the last decade on 'Conference' and 'Doyenné du Comice'. Generally, Regalis reduced shoot growth with the extent of growth reduction depending on the concentration and number of applications. Contrary to CCC and Ethrel, shoot growth reduction by Regalis is not accompanied with an increase in return bloom. In fact, high concentrations and three or more applications of Regalis frequently reduced return bloom. Regrowth of shoots during summer occurs more frequently on Regalis-treated trees than on trees treated with either CCC or Ethrel. Regalis did not significantly affect fruit set in 'Conference' and 'Doyenné du Comice' and fruit production was not affected in the year of application.

Long-term trials are needed to evaluate effects of Regalis on year-to-year production and to investigate its potential use to prevent alternate bearing in 'Doyenné du Comice'. Trials are required to explore the possible use of Regalis in combination with root pruning for growth control in pear.

38. Effect of Prohexadione-Ca on Growth Regulation, Return Bloom, Fruit Set and Fruit Quality in Conference and Blanquilla, the Main Pear Cultivars in Spain.

L. Asín[1], R. Dalmau[1], J. Bonany[2], J.M. Pages[2] and P. Vilardell[2]
[1]Institut de Recerca i Tecnología Agroalimentaries (IRTA), Estació Experimental de Lleida, Avda. Rovira Roure, 191, 25198 Lleida, Spain.
[2]Institut de Recerca i Tecnología Agroalimentaries(IRTA), Estació Experimental Mas Badia, Crta de La Tallada s/n, 17134 Canet de la Tallada, Spain.

The gibberellin biosynthesis inhibitor, prohexadione-Ca, was evaluated over 2000 to 2002 in two growing areas (Girona and Lleida) to study its adoption as a growth regulator for 'Conference' and 'Blanquilla'. Prohexadione-Ca was applied at rates of 100 to 400 g ha^{-1} distributed in three to six foliar treatments. Application of prohexadione-Ca significantly reduced vegetative growth expressed in terms of shoot length. However, important differences were observed between cultivars and among treatment schedules. Percentage reduction in shoot length for 'Conference' and 'Blanquilla' was 14 to 32% and 12 to 33% respectively, and in some cases an improvement in fruit size was detected. A maximum dosage throughout the season to avoid a reduction in return bloom could be set at approximately 3 kg ha^{-1} for 'Conference' and 6 kg ha^{-1} for 'Blanquilla'. Our data show that prohexadione-Ca can be a suitable option to control growth of pear orchards; nevertheless it is necessary to extend the studies on treatment schedules to improve growth reduction and fruit set, and to avoid lower return bloom.

39. Root Pruning: a Valuable Alternative to Reduce the Growth of Conference trees.

J. Vercammen, G. van Daele and A. Gormand
PCF- Proeftuin Pit- en Steenfruit, Fruittuinweg 1, 3800 Sint-Truiden, Belgium.

The interdiction on chlormequat in 1999 led to an enormous demand for alternative methods to reduce the growth of 'Conference' pear (*Pyrus communis* L.) trees. Subsequent research showed that one sided root pruning, twice during the season, can be a good alternative to chloromequat for reduction of growth. When applied properly, root pruning can produce a considerable reduction in growth, less pruning hours and a uniform yield. However, it should be taken into consideration that root pruning also influences absorption of water and nutrients. When root pruning is applied in March, the effect on growth is visible especially in the reduction of number of shoots and possibly also in the reduction in shoot length. However, these are mainly results of reduced water uptake during the dry summer. With root pruning growth occurs mainly at terminal positions while growth inside the tree is less vigorous. With proper application of root pruning (1-sided, beginning of March), more one-year shoots will end in terminal buds and often there will also be more flower buds on the older wood. Because of the larger number of flower buds and the less vigorous growth, root pruning usually gives a more uniform yield. Root pruning modifies the absorption of nutrients. Therefore it is necessary to increase the level of the standard fertilisation on the plots where root pruning will be applied. We obtained good results with an additional amount of ten units of nitrogen on the tree strip. Root pruning increases sugar levels and reduce firmness with subsequent earlier ripening of fruit in the season of application. The fruit grower should be aware of the increased maturity at harvest. Earlier harvest dates and the adaptation of fertilisation should reduce the incidence of yellowing fruit. Root pruning has a residual effect on growth and even after three to four

years a reduction in shoot number is still evident. Evidently, root pruning should not be applied each year. In conclusion: root pruning of the vigorous growing 'Conference' should be considered as a standard orchard procedure in conjunction with the consequential adaptation of harvest time and fertilising practises.

40. Root Pruning and Trunk Incision as Methods to Control Shoot Growth and Fruit Production in Pear.

F. Maas
Praktijkonderzoek Plant & Omgeving, section Fruits (PPO-Fruit), Plant Sciences Group, Wageningen University and Research Center, Lingewal 1, 6668 LA Randwijk, The Netherlands.

Non-chemical methods to control shoot growth and to promote flower bud development and fruit set of pear trees have been known and used for centuries. During the second half of the 20^{th} century these cultivation practices were replaced by chemical growth retardants like paclobutrazol and chloromequat (CCC). Since 2001 all chemical growth retardants for pear were forbidden in The Netherlands. Consequently, growers were forced to reconsider alternative, non-chemical methods such as root pruning and trunk incision to reduce the vigour of high-density pear orchards. However, these techniques are risky. Too strong pruning may result in reduced fruit size and a decrease in fruit quality due to insufficient uptake capacity for water and nutrients by the remaining root system. As root-pruned trees are more likely to suffer from drought stress, growers are only recommended to apply root pruning when they have the possibility to supply water to their trees, either by drip irrigation or by a sprinkler system. In 2000, two experiments were started to compare the effects of root pruning and trunk incision on growth, production, fruit quality and return bloom in 'Conference' and 'Doyenné du Comice'. Another aim of these trials was to determine the most suitable time during the season to apply root pruning or trunk incision. Finally, for 'Conference' the effects of these methods on four and 10-year old trees were compared. Root pruning and trunk incision reduced shoot growth to a similar extent as previously achieved by applications of CCC without negatively affecting fruit size and fruit quality. The effect of root pruning and trunk incision did not differ significantly between times of application. Both root pruning and trunk incision promoted flower bud development.

SESSION IX : PEST MANAGEMENT

41. Post-Harvest Control of Grain Chinch Bug *Macchiademus diplopterus* (Distant) on Pears in the Western Cape Province.

P. Addison
ARC Infruitec-Nietvoorbij, Private Bag X5013, Stellenbosch, 7599, South Africa.

The grain chinch bug (GCB) is endemic to the Western Cape and as such is classified as a quarantine pest. It is a direct pest of wheat and moves into adjacent orchards when the wheat is harvested (November), looking for sites in which to shelter, such as in the stalk and calyx area of pears. During this time, no feeding occurs and the insects lie dormant until the following winter when reproduction takes place. This project evaluated post-harvest control methods to ensure that packed pear cartons were free of live GCBs and acceptable to international quarantine standards. Cold storage trials were carried out at a commercial cold store in Ceres. Field-collected GCB adults were subjected to controlled atmosphere conditions (treatment) and regular atmosphere conditions (control) for a total period of 6 weeks during 2001 and 10 weeks during 2002 and 2003. During 2001 and 2002, the trials were carried out by packing GCBs and pears into cardboard boxes with plastic liners as for export, whereas during 2003 the GCBs and pears were placed directly into open plastic lug boxes without liners. During each year, the trials were replicated five times, using a total of 62 500 bugs. The results showed that GCBs appear to be very well cold-adapted and that at least nine weeks will be required to achieve 100% mortality under controlled atmosphere conditions if cardboard boxes with plastic liners were used. A mortality of 100% was never achieved under regular atmosphere conditions. If no cardboard boxes and plastic liners were used, mortality of GCB occurred one week earlier under controlled atmosphere conditions. It was concluded that low temperature in itself is not sufficient to effectively sterilize pears from GCB infestations as the time required to achieve 100% mortality would probably compromise fruit quality or be unacceptably long.

42. Codling Moth Management Through Postharvest Control.

C.A. Ingels[1], R.A. Van Steenwyk[2], L. Varela[3] and R. Elkins[4]
[1]University of California, Cooperative Extension, Sacramento County, CA, USA.
[2]University of California, Insect Biology Division – ESPM, Berkeley, CA, USA.
[3]University of California, Cooperative Extension, North Coast, CA, USA.
[4]University of California, Cooperative Extension, Lake and Mendocino Counties, CA, USA.

A substantial postharvest infestation can result in large codling moth (CM) populations in the subsequent spring. Postharvest development and control of CM in 'Bartlett' pear orchards were examined over 7 years. Some larvae were found to enter diapause in early July and all larvae that completed development by mid-August entered diapause. Postharvest fruit stripping left an average of 230 fruit/ha compared to 2900 fruit/ha in non-stripped plots, and it reduced the postharvest fruit infestation by 93%, with an 86% reduction in diapausing larvae. The postharvest use of insecticides, such as Lorsban or Guthion, reduced the following spring's overwintering flight by 70 to 80%. The application of the plant growth regulator, ethephon, shortly after harvest promotes early ripening and fruit drop. The pears rot faster than the larvae can complete their development. In a trial using a hand-gun sprayer, the postharvest application of 3.5 L/935 L water/ha (900 ppm) ethephon increased fruit drop from 28% in the untreated control to about 80%. Substantial fruit drop occurred 2 weeks after application. Applications of 2.3 and 4.7 L/935 L water/ha with an orchard sprayer significantly enhanced ripening of rattail fruit and reduced the percent of CM that could complete development. Rattail fruit are less mature than green fruit and thus stay firm for a long time, which make them excellent breeding sites for CM. Ethephon must be applied as soon as possible after harvest to gain the greatest benefit from its use, and it is only useful where harvest is complete by mid-August.

43. Organic and IPM programs for Areawide Pest Management of Pear.

J.E. Dunley, T. Madsen and B.M. Greenfield
Washington State University, Tree Fruit Research and Extension Center, Wenatchee, Washington, USA.

Areawide management programs for insect pests of apple and pear in the Western US have been successful since their inception a decade ago, primarily targeting codling moth through the use of mating disruption to replace organophosphate insecticides. Pear psylla, another important pest of pear, is amenable to areawide management in that it is highly dispersive and has a number of potential natural enemies in surrounding native woodland. Establishing organic orchards or orchards using soft management practices among conventional orchards has often been difficult in that pests readily migrate in from adjacent conventional orchards, yet natural enemy immigration is limited by the pesticide used in the conventional management programs. Organic pest management used on an areawide basis could provide more opportunities for immigration of biocontrol agents by reducing pesticide barriers to movement. In 2002, an Areawide Organic Management Program was established on 310 ac of contiguous pear, surrounded by native vegetation in a small valley near Peshastin, Washington, USA. Organic pest management practices were implemented for insect and mite control throughout the project. However, other organic practices were not required (e.g., nutrient, rodent, and weed management were often by conventional practices), and approximately 50% of the acreage was Certified Organic. Over two years, there was a reduction in pesticide use, and an associated reduction in insecticide costs. However, there have been no correlated increases in overall natural enemy densities. Fruit yield and quality has been maintained, and alternative marketing programs have been attempted.

44. Alternative Pheromone Dispensing Strategies for Management of Codling Moth in Pears.

S.C. Welter and F. Cave
Department of Environmental Science, Policy, and Management, University of California, Berkeley, CA, U.S.A

Pheromone mating disruption is currently one of the most prevalent control strategies in California pear orchards. Two alternative dispensing strategies, microencapsulated formulations and aerosol emitters, were evaluated. High dose aerosol emitters were evaluated relative to effective pheromone plume length using releases of sterile codling moths within a grid pattern. Suppression of recapture of sterile moths was used as an indirect measure of pheromone activity. Active areas for trap suppression varied over time, but plumes up to 150 m by 600 m were estimated and used to design optimal deployment patterns. Use of reduced rates (1 emitter per 1-2 ha) provided effective control against low-moderate populations in many cases, whereas significant damage was observed at higher pressures similar to conditions with hand-applied dispensers. Use of combination programs of hand-applied and aerosol applicators were evaluated in 2003 to address higher pressure situations with some preliminary success. Sprayable formulations were studied in multiple cropping systems with effective trap suppression and detectable electroantennagram (EAG) signals ranging from 2 weeks and up to 6 weeks. However, capsules exposed to sunlight conditions demonstrated loss of antennal activity within 7 days of exposure. Greater observed successes in walnuts, *Juglans regia* L, using sprayable formulations, compared to Bartlett pears is hypothesized to result in part from differential canopy development between the two cropping systems.

45. Suppression of Codling Moth Populations in South African Apple and Pear Orchards Using Sterile Insect Release.

M.F. Addison
Department of Entomology and Nematology, University of Stellenbosch, Private Bag X1, Matieland, 7602, South Africa.

Codling moth, *Cydia pomonella* L. (Lepidoptera: Tortricidea), is the key pest of apples and pears in South Africa. To date the control of codling moth in apple and pear orchards has depended on the application of insecticides and in some cases pheromone mediated mating disruption. Due to the development of resistance to insecticides and restrictions placed on the use of certain insecticides, control of codling moth has become problematic. Sterile insect release (SIR) of codling moth has been investigated as a potential addition to the current control strategy. The cost-benefit of codling moth SIR under local conditions, mass culture methods and initial field trials have been completed. It is envisioned that codling moth SIR will be used in conjunction with insecticide sprays and/or pheromone disruption. A large-scale pilot project is planned for the South Western Cape.

NOTES

46. Control of Fire Blight by *Pseudomonas fluorescens* A506 Introduced into Unopened Pear Flowers.

R.B. Elkins[1], C.A. Ingels[2] and S.E. Lindow[3]
[1]UC Cooperative Extension, 883 Lakeport Blvd., Lakeport, CA 95453, USA.
[2]UC Cooperative Extension, 4155 Branch Center Road, Sacramento, CA 95827, USA.
[3]University of California, Dept. Plant and Microbial Biology, 111 Koshland Hall, Berkeley, CA 94720, USA.

Pseudomonas fluorescens strain A506 is a bacterium that confers biological control of fire blight by preemptive competitive exclusion of *Erwinia amylovora* and is commercially available as Blightban A506®. Best control is achieved if the antagonist is applied to newly opened flowers. However, since flowers of pear cultivars such as Bartlett can emerge for several weeks, the bacterium must be applied three or more times even though it can spread throughout the tree after application. We thus investigated, over a multiple year period, a means to ensure that it is the initial colonist of flowers by introducing it into flower buds with a penetrating organo-silicon surfactant, Breakthru®. The proportion of flowers colonized with strain A506 throughout the spring generally increased with increasing concentrations of surfactant in which the bacteria were applied in a single application at the time of first bloom. Importantly, throughout the main bloom and into delayed bloom, populations of the antagonist on most flowers on trees inoculated only one time at "first bloom" with strain A506 in 0.2% or 0.5% Breakthru® remained as high or higher than those on trees receiving weekly applications of the same amount of A506 alone. Colonization of flowers from early-season applications was poor if flower buds were too tightly closed at the time of application. No fruit russet was observed at harvest when treatments were applied before substantial bloom had occurred, but russet occurred at later application times. A single application of strain A506 at very early bloom reduced the costs of control.

47. Fruit and Leaf Incidence of *Venturia pirina* in Mixed European and Asian Pear Progenies.

L. Brewer and P. Alspach
HortResearch Nelson Research Centre, P.O.Box 220, Motueka, New Zealand.

In New Zealand, pear scab is caused by the fungus *Venturia pirina* as *Venturia nashicola,* the scab fungus of Asian pear has not been recorded in New Zealand. Scab can affect both the leaves and fruit, and symptoms vary in intensity. Resistance to scab is widespread in the Asian and Chinese pear germplasm (*Pyrus pyrifolia* Nakai and *Pyrus bretschneideri* Rehd) but limited from European pears (*P. communis).* We report the results of 3 years scab assessment of a breeding population consisting of 14 families with varying degrees of Asian/Chinese and European pear in their pedigree. In particular, we consider the distinction between lesions on the leaf and those on the fruit. In 2000, a high infection year, 57% of the 446 trees from crosses with no more than 50% European ancestry were scab free, and most (94%) of the remainder were free of leaf lesions but had some level of fruit lesions. Most (82%) of the 56 trees with more than 50% European ancestry exhibited scab lesions on both the leaves and the fruit. In 2002, scab was less severe overall and few trees were assessed. In this year, trees with no more than 50% European were virtually all (94% of the 81 trees) completely scab-free, but the majority (62% of the 21 trees) of those with more than 50% European once again showed both leaf and fruit lesions. Assessments will be carried out again in 2003. Based on the 2000 result, it would not be worthwhile undertaking a seedling screening for leaf scab resistance (as is done for apples) since most seedlings showed no leaf lesions, but almost half exhibit fruit lesions.

48. Pear Scab Resistance in *Pyrus* Germplasm.

J.D. Postman[1], A. Spotts[2] and J. Calabro[2]
[1]United States Department of Agriculture (USDA), Agricultural Research Service (ARS), National Clonal Germplasm Repository (NCGR), Corvallis, Oregon, USA.
[2]Oregon State University, Mid-Columbia Agricultural Research and Extension Center, Hood River, Oregon, USA.

The 1800 *Pyrus* clones at USDA-ARS-NCGR-Corvallis represent world diversity for pears. A "core" subset of 31 Asian cultivars (AC), 119 European cultivars (EC), 8 hybrid cultivars (HC), and 45 species selections was evaluated for resistance to pear scab caused by *Venturia pirina* Aderh. Three potted, grafted trees of each core accession were artificially inoculated, and grown under greenhouse conditions ideal for infection. Orchard trees were evaluated during 10 years for natural fruit scab (FS), and during 3 years for percent of leaves with leaf scab (LS). FS was rated on a scale of 1 to 9 (1 = no scab). Only 28 clones produced leaf symptoms following greenhouse inoculation; however 24 of these also rated high for natural LS in the field. All AC were nearly free of natural infections of both FS and LS. No AC had a mean FS rating greater than 5, and 42% had 0 or negligible ratings. Nineteen percent of EC had mean FS ratings >5, and 8% had 0 or negligible scab. Average LS incidence was 3.3% of leaves for EC compared to 0.4% for AC. More than 64% of EC had >1% LS. EC with negligible FS and LS include 'Arganche,' 'Batjarka,' 'Brandy,' 'Erabasma,' 'Muscat,' and 'Passe Crassane'. Incidence of both FS and LS in HC was intermediate between that of AC and EC. Most species selections had negligible FS, except *P. cordata* which rated 5. FS was positively correlated with LS. Of 23 EC rated high for FS, 21 also had >1% LS. This study has identified pear cultivars that may be grown without chemical scab control, and which may be useful in breeding for resistance.

49. Evaluation of *Pyrus* Germplasm Collection for Resistance to Powdery Mildew.

M. Serdani[1], R.A. Spotts[1], J. Calabro[1] and J.D. Postman[2]
[1]3005 Experiment Station Drive, Hood River, Oregon 97031, USA.
[2]USDA-ARS National Clonal Germplasm Repository (NCGR), 33447 Peoria Road, Corvallis, Oregon 97333, USA.

Powdery mildew (PM), caused by the fungus *Podosphaera leuchotricha*, occurs in most pear-growing areas of the world. PM causes economic losses due to reduced market value of russeted fruit as well as the increased need for fungicides. A recent study of PM resistance was done using the core *Pyrus* germplasm collection at NCGR-Corvallis, which consists of about 200 cultivars and species selections identified to represent most of the genetic diversity present of this crop. It includes 30 Asian cultivars (ASN), 106 European cultivars (EUR) as well as hybrids and pear species selections. Trees were evaluated for PM symptoms from natural field infections during 2002 and 2003, by counting the number of leaves with symptoms on ten current year shoots. In 2001, three trees of each core accession were grafted on potted seedling rootstocks, artificially inoculated in a greenhouse, grown under suitable PM conditions and evaluated for symptoms. EUR were overall more susceptible to PM than ASN, with 47% of EUR (compared to 25% of ASN) in the field and 93% of EUR (compared to 43% of ASN) in the greenhouse being infected with PM. Average PM incidence in the greenhouse (8% for ASN and 31% for EUR) was much higher compared to field infections (2% for ASN and 6% for EUR). In the field, 33% ASN and 38% of EUR with PM symptoms had a mean PM value of >10%. Symptoms were more severe in the greenhouse, with 62% ASN and 80% of EUR with PM symptoms having a mean PM value of >10%. Cultivars with consistent low PM ratings may have good promise for developing improved PM resistant cultivars in future pear breeding programs.

NOTES

POSTER ABSTRACTS

1. Study on Compatibility and Pollen Tube Growth of Some Asian Pear (*Pyrus serotina* Rhed) Cultivars.

K. Arzani and M. Koshesh-Saba
Department of Horticulture, Faculty of Agriculture, Tarbiat Modarres University (TMU), P.O. Box 14155-4838 Tehran, Iran.

This experiment was conducted during the 2003 growing season, in order to explore flowering and pollination aspects of some Asian pear cultivars introduced to Iran through Belgium by the Department of Horticultural Science (National Research project NO. 4225), Tarbiat Modares University (TMU) in 1998. For flowering time and period, as well as the self- and cross compatibility and incompatibility study, nine Asian pear cultivars including KS_6, KS_7, KS_8, KS_9, KS_{10}, KS_{11}, KS_{12}, KS_{13} and KS_{14} were used. Two branches on each of four trees of each cultivar were selected for controlled pollination. For prevention of any unwanted pollen contamination and pollination by insects, selected shoots were protected with cotton tissue bags. For controlled cross pollination, all flowers were emasculated and protected before anthesis and hand pollination was carried out 2 days after anthesis. In order to monitor pollen tube growth in the style, samples were taken at 44, 72 and 96 hours after pollination and fixed in FAA solution. Preliminary results indicated that KS_9 is a semi-self incompatible cultivar (fruit set = 2.8%). There were differences in flowering period and time of bloom of the studied cultivars, although coincidence of flowering existed between some cultivars such as KS_{13} and KS_{11}. In addition, results based on the field and *in-vitro* pollen tube growth tests indicated cross-compatibility between KS_{11}, KS_{13} and KS_8. Also, preliminary observations of flowers showed differences in flower morphology in terms of shape and color.

2. Scion/Rootstock Influence on Grafting Success, Early Performance, Tree Survival and Efficiency of Nutrient Uptake of Some Asian Pear (*Pyrus serotina* Rhed) Cultivars.

K. Arzani[1], H. Khoshghalb[1] and G. Karimzadeh[2]
[1]Department of Horticulture, Faculty of Agriculture, Tarbiat Modarres University (TMU), P.O. Box 14155-4838 Tehran, Iran.
[2]Department of Plant Breeding, Faculty of Agriculture, Tarbiat Modarres University (TMU), P.O. Box 14155-4838 Tehran, Iran.

This experiment was conducted in order to evaluate performance of some Asian (Japanese) pear cultivars (*Pyrus serotina* Rehd.) on European pear (*Pyrus communis* L.) seedling rootstocks under Tehranian environmental conditions during the 2000 and 2001 growing seasons. The experiment was started in 2000 with budding of nine Asian pear cultivars named `$KS'_6$, `KS'_7, `$KS'_8$, `KS'_9, `$KS'_{10}$, `KS'_{11}, `$KS'_{12}$, `KS'_{13}, `KS'_{14} and the local 'Shahmiveh' cultivar (European pear) on European pear seedling rootstocks. The performance of budded trees was evaluated with some growth and physiological measurements during two complete growing seasons (2000 and 2001) at the Department of Horticultural Science, Tarbiat Modarres University (TMU), Tehran, Iran. Results showed more than 80% grafting success in the first season. Microscopic examination 2 to 4 weeks after budding showed good callus production in the grafting site on all cultivars. In the second season after budding 10% of grafted trees failed to grow, but differences between cultivars were not statistically significant. There were significant differences between cultivars in leaf mineral concentrations, such as N, P, K, Ca, Mg, Mn and Zn. The highest N, P and K were observed in `$KS'_9$, `KS'_{12} and `$KS'_6$, respectively, and the lowest concentrations in 'Shahmiveh', `KS'_6 and 'Shahmiveh', respectively.

3. Improvement of In Vitro Rooting of 'Rocha' and Other Portuguese Pear Cultivars (*Pyrus communis* L.) in Response to Changes in Auxin Induction and Darkness Treatments.

M.T.F. Barros, C.I. Hipólito and C.G.M. Baptista
Instituto Superior de Agronomia, Lisboa, Portugal.

An efficient procedure for in vitro rooting of shoots obtained from shoot-tip culture was regarded as a key issue in a programme aiming at virus elimination from traditional Portuguese pears. Hence, intense efforts have been made for a continuous improvement of rooting protocols. In the first set of experiments presented, shoots were submitted either to Long Induction Pre-treatments (LIPs) of 10 days in media with 5 μM or 10 μM IBA or to Brief Induction Pre-treatments (BIPs) of 16 hours in 0.5 mM or 1.0 mM IBA. After LIPs or BIPs the shoots were transferred to a similar but auxin-free media. In both cases the shoots stayed in darkness for the first 5 days. 'Rocha' showed no significant differences in rooting efficiency when LIPs and BIPs were compared. In contrast, rooting was strongly enhanced by LIPs in 'Pérola' and by BIPs in 'Carapinheira'. The 16-h BIPs, however, led to excessive callusing. In subsequent experiments, the effects of shorter BIPs (2, 4, 8 or 16 h) and of restricting the darkness period to the duration of each BIP were evaluated. BIP duration had no significant effect on rooting percentage but in 'Rocha' the 8-h BIP led to a higher number of roots per rooted shoot. A reduced darkness period was highly favourable to 'Carapinheira', both in terms of rooting percentage and number of roots per rooted shoot. Darkness periods coinciding with BIPs of short duration were thereafter applied with success in rooting of several pear cultivars and micropropagated woody indicators, and are a valuable tool in the ongoing sanitation programme.

4. Development of *Pyrus* microsatellite markers from GenBank Sequences.

N.V. Bassil, C. Neou, and J.D. Postman
United States Department of Agriculture (USDA), Agricultural Research Service (ARS), National Clonal Germplasm Repository (NCGR), Corvallis, Oregon 97333, USA.

Our objectives are to develop molecular markers to identify accessions, eliminate duplication, and characterize the genetic diversity of the National Clonal Germplasm Repository (NCGR) *Pyrus* (pear) collection. Simple sequence repeat (SSR) or microsatellite markers have become the marker of choice for genotype identification. A method was developed to identify microsatellite-containing SSRs from existing pear GenBank sequences. A total of 366 genomic, mRNA and EST *Pyrus* nuclear sequences were screened for microsatellite sequences using the Perl script SSRIT. Microsatellite-containing nucleotide sequences were compared against known gene sequences contained in GenBank using the BLASTN algorithm. For sequences with homology to known genes, the location of the microsatellite in the gene was predicted by aligning genomic and mRNA sequences using the CLUSTALW algorithm. Primer3 software was used to design eighteen primer pairs that flank eleven of the 47 repeat-containing loci identified by SSRIT. Once the optimum annealing temperature of each primer pair was determined by gradient PCR, the resulting SSRs were evaluated for their ability to amplify a product and detect polymorphisms in eight cultivars of *P. communis*, three accessions of *P. pyrifolia* and one *Pyrus* hybrid. Two primer pairs amplified fragments larger than the expected size and were discarded. Eleven out of the remaining sixteen SSR loci amplified in all three species and appeared polymorphic after separation on 3% agarose. Fluorescent forward primers for six of these pear SSRs were synthesized and will be used to determine the usefulness of these GenBank-derived microsatellite loci in generating unique fingerprints for pear germplasm.

5. Effect of BA, NAA and Ethephon as Thinning Agents of 'Conference' Pear.

J. Bonany[1], M. Casals[1], P. Vilardell[1], L. Asin[2], R. Dalmau[2]
[1]Institut de Recerca i Tecnología Agroalimentaries(IRTA), Estació Experimental Mas Badia, Crta de La Tallada s/n, 17134 Canet de la Tallada, Spain.
[2]Institut de Recerca i Tecnología Agroalimentaries (IRTA), Estació Experimental de Lleida, Avda. Rovira Roure, 191, 25198 Lleida, Spain.

Trials on 'Conference' orchards were carried out over 1998 to 2003 in two growing areas, Girona and Lleida, in North-eastern Spain. Various thinning treatments of 6-BA, NAA and Etephon were applied alone or in a mixture, and were compared with a hand thinned control treatment. Fruit set on trees that received 6-BA at 200 ppm differed significantly from that of unsprayed control trees with no interaction with the year of treatment. Adding NAA at 10 to 15 ppm slightly increased the efficacy of 6-BA at 200 ppm compared to when the 6-BA were applied alone. No effect of Ethephon at 200 ppm was observed compared to untreated trees. Although thinning treatments did not affect fruit yield, average fruit weight was higher in some trials.

6. Molecular Typing of Red and Green Phenotypes of 'Bon Rouge' Pear Trees with the Use of Microsatellites.

S. Booi[1], M.M. van Dyk[1], M.G. du Preez[1], I.F. Labuschagné[2] and D.J.G. Rees[1]
[1]Department of Biotechnology, University of the Western Cape, Private Bag X17, Bellville, 7535, South Africa.
[2]Agricultural Research Council, Infruitec-Nietvoorbij, Private Bag X5013, Stellenbosch, 7599, Western Cape, South Africa.

Bon Rouge is a red pear cultivar derived from a rare, spontaneous bud mutation of the green pear cultivar William's Bon Chretien (Bartlett). We have observed that Bon Rouge trees generate revertants at a high frequency to produce green tissues in clonal stripes on stems and fruit. We aim here to establish whether this instability is the result of chimerism or genetic instability, and to examine the molecular mechanism of this trait. A closed cross between Bon Rouge x Packham's Triumph pears generated an F_1 population with a 1:1 segregation of the red:green phenotype, indicating a simple Mendelian inheritance of this trait. However, this does not address the mechanism of the reversion. We are currently mapping apple and pear simple sequence repeats (SSRs/Microsatellites) on the F_1 progeny. Both apple and pear microsatellites were used in this study because of the high level of cross-species cross-reaction. Microsatellites that show a high level of polymorphism are being used to construct a linkage map with the aim of identifying those markers which are tightly linked to the gene/s of interest.

7. Developing an Industry-Related Method for Inducing Friction Discolouration to Pear Fruit.

G.E. Burger[1], H.M. Griessel[2] & M. Huysamer[1]
[1]Department of Horticultural Sciences, University of Stellenbosch, Private Bag X1, Matieland, 7602, South Africa.
[2]Tru-Cape Fruit Marketing (Pty) Ltd., AECI complex, De Beers Avenue, 7310, South Africa.

Friction discolouration is causing the South African pear (*Pyrus communis* L.) industry multi-million rand losses due to blemished fruit being rejected for the export market and being sold locally. To prevent such losses, this disorder needs to be studied intensely, but research on a large scale is difficult to replicate. This paper reports on a standardized method to induce such damage to fruit samples during laboratory-scale research trials, allowing for a very cost effective way in which trials can be conducted under controlled conditions. A laboratory shaker has been modified to simulate the degree of friction that is

experienced on pear packing lines. The impact of each experimental replicate was measured using an electronic impact recording device ("electronic apple"). Increasing the revolutions per minute of the laboratory shaker gave rise to a concomitant increase in impact levels, as well as an increase in the skin browning index of the fruit. The data generated on the shaker were correlated to impacts measured on an actual packing line, and fruit damage could be reliably simulated on a small scale. Data for trials on 'Packham's Triumph', 'Doyenne du Comice' and 'Bon Chretien' pears will be reported.

8. Performance of 'Conference' and 'Doyenné du Comice' Pears on Two Quince and Five OH x F Rootstock Selections.

M. Carrera, M.T. Espiau and J. Gomez-Aparisi
Centro de Investigación y Tecnología Agroalimentaria de Aragón, Apt. 727, 50080, Zaragoza, Spain.

Previous research has demonstrated the higher productivity of 'Conference', in suitable environment conditions, on quince rootstocks than on seedling. Although the performance of the latter is satisfactory in terms of total production and quality of the fruit, the vigorous trees obtained on it reduces its interest. In soils with little tendency to induce chlorosis, quince is the better choice as rootstock, but in soils with pH over 8.2 or active lime higher than seven to eight (12 to 14 % in some areas), the use of quince becomes problematic or even impossible. An important aim of our fruit research projects is to seek a reasonable alternative to quince as a pear rootstock. To investigate the possibility of using some of the 'Old Home' x 'Farmingdale' (OH x F) clonal selections instead of seedling rootstocks in the calcareous soils of the Ebro basin, a trial with two important cultivars, 'Conference' and 'Doyenne du Comice', was planted in February 1992. The most important semi-dwarfing OH x F clones, (numbers 40, 69, 87, 282 and 333) were compared with commercial seedling rootstock (only 'Conference') and two Quince rootstocks, Adam's 232 and Provence INRA BA 29. The trial was planted in a sandy loam soil with medium to low fertility, and at low risk of lime-induced chlorosis to ensure optimum performance of the quince rootstocks. After nine crops (1995 to 2003) of 'Conference', the highest cumulative yields have been on OH x F 69, OH x F 40 and OH x F 87 and the lowest on Adam's 232, whereas seedling and BA 29 were intermediate. Among the OH x F clones, OH x F 282 and OH x F 333 produced the lowest yields. The vigor obtained on seedling was significantly greater than on any other rootstock. OH x F clones produced trees of similar vigor, intermediate between seedling and quince. Productivity (accumulated yield/TCSA) has been highest on quince, intermediate on OH x F 69, OH x F 87 and OH x F 40, lower on OH x F 333 and OH x F 282 and lowest on seedling. Average fruit size from 1995 to 1997 was best on quince. However, from 1998 to 2003, fruits on BA 29 and seedling were slightly bigger compared to other rootstocks. After seven crops (1996 and 1998 to 2003) of 'Doyenne du Comice', the highest cumulative yields have been on quince Adam's, followed by BA 29. Yields were significantly lower on OH x F clones; OH x F 333 produced the lowest yield of the trial. Trees on BA 29 and OH x F 333 were the most and least vigorous, respectively. Productivity (accumulated yield/TCSA) has been highest on quince Adam's, intermediate on BA 29, lower on OH x F 87, OH x F 69, OH x F 40 and OH x F 282 and lowest on OH x F 333. In 2002, considered the optimal crop for this cultivar, the average fruit size was similar on all rootstocks. The superiority of quince Adam's as a rootstock for this cultivar is beyond doubt.

9. Heritability of Morphological and Architectural Characters in Three Pear Progenies.

E. Costes[1], A. Acou[12], A. Belouin[2], M. Lelezec[2] and M.H. Simard[2*]
[1] INRA, équipe AFEF UMR BEPC, 2 place Viala, 34060 Montpellier cedex 1, France.
[2] INRA , Unité d'Amélioration des Espèces, Fruitières et Ornementales, 42 Rue G. Morel, BP57, 49071 Beaucouzé Cedex, France.

The shape and architecture of fruit trees have a direct impact on their production. This study aimed at analysing these features in the pear tree, in order to provide preliminary results on their heritability which

can be used for breeding programmes. It was carried out on three pear progenies obtained from crossing 'Harrow Sweet', a cultivar with a high agronomical interest, with three classical cultivars ('Lombacad', 'Abbé Fétel', 'Doyenné du Comice'). The trees were grafted on quince BA29 and were seven year-old, each tree representing a given genotype. Two branches were observed per tree on thirty trees per progeny. The considered variables were classified into (i) morphological, i.e. related to branch form, (ii) topological, i.e. related to growth and branching and (iii) flowering and fruiting traits. The genotypic influence on these variables was studied by decomposition of their total variance into different components and broad sense heritabilities were calculated. The different values of broad sense heritability obtained in the three progenies and for the different features will be presented and discussed with respect of the total variability measured and the genetic proximity of the parents. In addition, correlation between variables will be discussed in order to simplify the field observations.

10. Concorde, a Promising Pear Cultivar.

J. De Coster[1], J.J. Simonse[2], P.G.P. Geurts[2], P van Arkel[3], H.J. Weber[4], T. Deckers[5], N. Cook[6]
[1]Wolvendreef 52, 3210 Linden Belgium.
[2]U.R. Wageningen P.P.O. sector fruit Randwijk 6668 L.A. Nederland.
[3]Dienst Landbouwvoorlichting Mijlstraat 20, PB 840, 5280 A.V. Boxtel Nederland.
[4]Versuchsanstalt für Obstbau, Walpozzheimerstrasse 48, 53475 Bad Neuenahr-Ahrweiler Deutschland.
[5]RSF – Royal Research Station of Gorsem, Sint-Truiden, Belgium.
[6]Department of Horticultural Science, University of Stellenbosch, Private Bag X1, Matieland, 7602, South Africa.

'Concorde' is a very promising pear cultivar that resulted from a cross between Doyenné du Comice, a very tasty cultivar, and 'Conference', the most popular cultivar in Europe today. The upright habit of this half spur cultivar makes Concorde suitable for spindle and super spindle orchards, but one of the consequences is more tree training work. On the other hand, spur type growth provides more flower buds, better fruit set and higher production. The fruit shape is perfect pyriform. The skin of the fruit is green with russetting sometimes covering up to 20 % of the surface. Normally there is no blush while a brownish background may sometimes be present. The average fruit size is normally 7 to 10 mm bigger than 'Conference'. 'Concorde' achieves higher scores than 'Conference' in nearly all taste tests, and sometimes scores even higher than 'Doyenné du Comice'. The place in the market of this crisp and crunchy cultivar is near 'Conference', but there is no doubt that 'Concorde' can be among the top five cultivars. 'Concorde' has very low susceptibility to scab, providing an opportunity for organic production. It is also not susceptible to fire-blight, mainly because it does not produce late-flowers (second flowering). 'Concorde' stores better than 'Doyenné du Comice' and many other cultivars. 'Concorde' might replace 'Beurré Alexander Lucas' in the German pear market, and might also do well in eastern European countries. More than two years ago, a pear expert working group was started, including people from The Netherlands, Germany and Belgium. Convinced of the value of 'Conference', they also started to investigate the possibilities of 'Concorde'. The more than 20 hectares planted to 'Concorde' in England, the 15 hectares in Belgium and the six hectares in The Netherlands underscore its big potential.

11. Dicolor, a New Red Pear Cultivar.

J. De Coster[1], J. Bouma[2], F. Papzstein[2], M. Brijs[3], J. Blasek[4], T. Deckers[5], N. Cook[6]
[1]Wolvendreef 52, 3210 Linden Belgium.
[2]Ceskolipská 6, 41205 Litomerice, C.z.
[3]S.A.D. Duminieves 1 Citov, C.z.
[4]R.S.F.G., Holovoncy, C.z.
[5]RSF – Royal Research Station of Gorsem, Sint-Truiden, Belgium.
[6]Department of Horticultural Science, University of Stellenbosch, Private Bag X1, Matieland, 7602, South Africa.

Dicolor is a winter pear (*Pyrus* communis L.) cultivar of Czech origin, selected from the cross between 'Nordhäser Winterforelle' and 'Williams' and registered in 1997. A medium vigorous cultivar with a conical, medium dense canopy, fruits are born on spurs. Total annual production fluctuates around 100 tons in the Czech Republic. Fruits have an attractive appearance and very good eating quality with fine flesh texture. The fruit is medium-sized and its shape is oblong ovate pyriform with a short stalk connected obliquely to the axis of the fruit. A bright red blush covers two thirds of the otherwise yellow surface. The flesh is white, fine, aromatic and very juicy with a sweet and spicy taste. The skin is smooth and thin. Fruit is used for fresh consumption and preservation. Harvesting takes place from the middle of October, fruit ripens in November and can be stored until May or June. Some years ago The Vozar Fruitcentre in Slowakia started to see potential for this red pear. Three years ago, we introduced Dicolor as a juicy, long-storage new red pear cultivar with a perfect taste even after a long storage period. After many years searching for a productive, good tasting red pear, we are optimistic about the possibilities for 'Dicolor'. Sempra Praha a.s. holds the breeders right of the cultivar.

12. Test of Fungicides Against *Stemphylium vesicarium* with or without a Warning System.

P.F. de Jong[1], A. Boshuizen[2], B.Heijne[1]
[1]Applied Plant Research (PPO) Fruit, P.O. Box 200, 6670 AE Zetten, The Netherlands.
[2]Horti Bureau Wageningen, P.O. Box 592, 6700 AN Wageningen, The Netherlands.

Stemphylium vesicarium causes brown spot in pears. The fungus especially causes severe damage in Southern Europe. In recent years the disease has also been found in the Netherlands and to a lesser extent in Belgium. Conference, the cultivar that is most commonly grown in the Netherlands, is one of the most susceptible cultivars. The most important fungicides that are allowed in the Netherlands against *S .vesicarium* on 'Conference' were tested over a period of two years. Some of these fungicides were tested together with a Dutch warning system to find a way to reduce the number of sprays. The fungicides that were tested were: thiram, tebuconazole and trifloxystrobin. The preventive fungicides were sprayed weekly from end of bloom until harvest. When in combination with the warning system, fungisides were sprayed after an infection. Symptoms on leaves and on fruit were counted. Infections with *S. vesicarium* were reduced, in the case of the best fungicide, by 83% on leaves and 49% on fruit in 2002. The following year infection reduction of 100% and 89% were attained on leaves and fruit, respectively. When fungicides were sprayed according to the warning system the number of fungicide treatments was reduced by 44% in 2002 and 65% in 2003. In 2002, there was no significant difference in the percentage of infections between the preventive treatments and application according to the warning system. In 2003, fruit sprayed after an infection were significantly more infected than fruit sprayed weekly, but less infected than the untreated plots.

Sugestión p. cálculo de volumen de agua, velocidad, etc

13. Phenology Prediction in 'Rocha' Pear under Mild Winters.

J.P. De Melo-Abreu[1], N.G. Barba[2], J.M. Silva[1]
[1]Instituto Superior de Agronomia, Tapada da Ajuda, 1349-017 Lisboa, Portugal.
[2]Escola Superior Agrária de Santarém, 2001-904 Santarém, Portugal.

The main region of 'Rocha' pear cultivation in Portugal is the central coast of the country , where insufficient winter chilling occurs in many years. Often, in recent years, chilling requirements were not met. Under these circumstances the use of dormancy breaking chemicals is compulsory. It would be useful, for its accurate use, to forecast the flowering date and other phenological stages. Flowering date can vary with up to 30 days between different years. It is believed that a minimum of 600 h under 7°C is required for dormancy breaking in 'Rocha'. However, this system of quantifying dormancy has proven to be rather inaccurate. An analysis of 10 years of phenology records (1963-1972) was used in an attempt to parameterise a model, which is a generalization of the Utah model, to predict flowering date. The standard error of the predictions of the model is 1.3 days and the extreme flowering dates, 34 days apart, we predicted with an absolute error of one day. The model was compared with commonly used models. The chilling units predicted by the model to simulate the end of endodormancy and the thermal time for the forcing phase leading to full flowering and to subsequent phenological events are also presented.

14. Differential Gene Expression Patterns for Red and Green Phenotypes of 'Bon Rouge' Pear Trees.

M.G. du Preez[1], I.F. Labuschagné[2] and D.J.G. Rees[1]
[1]Department of Biotechnology, University of the Western Cape, Private Bag X17, Bellville, South Africa.
[2]Agricultural Research Council, Infruitec-Nietvoorbij, Private Bag X5013, Stellenbosch, 7599, Western Cape, South Africa.

The Bon Rouge pear (*Pyrus communis* L.) under commercial production in the Western Cape region of South Africa is known to revert to its parent phenotype, William's Bon Chretien, (Bartlett). To investigate the underlying mechanism controlling the production of red pigment, anthocyanin, which is produced in response to a variety of stress conditions including pathogen and UV light stress, we compared gene expression between red-leaved Bon Rouge pear trees and their green sports. Differential display reverse transcription-polymerase chain reaction was used to detect differential gene expression between the two phenotypic variants with confirmation by quantitative RT-PCR. Several cDNA bands representing genes that are differentially regulated were cloned, sequenced and subjected to similarity searches on an available database using the BLAST tool. Eight cDNA clones showed significant similarity to known genes including those associated with light stress, pathogenesis responses and protein synthesis. Despite there being only a single gene difference between red and green genotypes, this extensive pattern of altered gene expression suggests this system presents an opportunity to identify a controlling element/gene for stress responses in plants.

15. Old Pear Varieties in Northern Italy.

T. Eccher[1] and R. Pontiroli[2]
[1]Di.Pro.Ve., University of Milan, via Celoria 2, 20133 Milan, Italy.
[2]C.I.VI.FRU.CE., Regione Lombardia, via Emilia 7, 27058 Voghera, (PV), Italy.

At the Department of Vegetal Production of the University of Milan there is the largest Italian collection of fruit models, amounting to about 1700 pieces, most of which were modelled and moulded in the second half of the Nineteenth Century by an ingenious artist and pomologist, Francesco Garnier Valletti. There are as many as 309 models of different pear varieties. With another 231 models from different

sources, about five hundred pear varieties are represented. This collection shows the great number of pear varieties grown in Northern Italy 150 years ago. In the same period, Burdin Nurseries published a catalogue with more than 250 commercial pear cultivars, and, in the year 1901, the pomologist Girolamo Molon, grew more than 300 pear cultivars in the experimental field of the Royal High School of Agriculture in Milan. Nowadays the number of pear varieties commercially grown in Italy is very limited, as more than 80% of total annual pear yield is due to only five cultivars (Abbé Fètel, Bartlett (Williams), Conference, Doyenne du Comice and Beurrè Bosc). The renewed interest in germplasm preservation has led public and private institutions to establish collections of old varieties, many of which are not identified or cannot be identified. One such collection was established by Lombardia Region at C.I.VI.FRU.CE. The comparison of the unknown fruits with the models of the Garnier Valletti collection, which reproduce not only the shape and colour, but also the size and the weight of the fruit, can be very useful in identifying the ancient varieties.

16. Sample Cost of Production for Transitioning from Conventional Codling Moth Control to Aerosol-Released Mating Disruption (Puffers) in Pears.

R.B. Elkins[1], K.M. Klonsky[2] and R.L. DeMoura[2]
[1]U.C. Cooperative Extension, 883 Lakeport Blvd., Lakeport, CA 95453, USA.
[2]Agricultural & Resource Economics, University of California, One Shields Avenue, Davis, CA 95616-8512, USA.

Codling moth (CM) (*Cydia pomonella)* is the primary pest of pear in California. Larvae bore into the core and feed. Organophosphate (OP) insecticides are applied three or more times as a control. Pheromone mating disruption (MD) has decreased the number of OP sprays nearly 100% and allowed use of selective materials. A field demonstration project encompassing 65 ha from 1996 – 1998, 202 ha in 1999, 332 ha in 2000, 526 ha in 2001and 459 ha in 2002, provided the basis for a comprehensive cost comparison. Pesticide use data from monthly reports submitted by the growers participating in the Lake County, California project, "Areawide Implementations of Mating Disruption in Pears Using Puffers", was used. Crop production budgets were prepared from the data, comparing annual costs for seven years to a conventional production budget. Evaluations of damage from 1996 – 2001 showed similar yields and fruit quality between the conventional and aerosol MD practices, thus resulting in increased grower participation in the project. Total operating costs for each of the seven years using current costs (2003) declined compared to conventional/standard practices. During the first two years in the MD program, total operating costs decreased $109 and $89, respectively, per year. From the third to seventh years, savings were $247 to $511/ha per year, an average of $352/ha per year or $8/ton. Fluctuations in savings were mainly due to the variability in psylla and mite applications, as well as a post harvest spray for rust mite that began in the sixth year due to the reduced sprays in the previous years. Savings are minimal during the first two years of transitioning into the MD program, but become significant beginning in the third year.

17. Performance of Some Pear Rootstocks in NE-Spain.

I. Iglesias and L. Asín
IRTA- Estació Experimental de Lleida, Alcalde Rovira Roure 177, 25198-Lleida, Spain.

Eleven pear rootstocks were evaluated from 1996 to 2003 at the IRTA's Experimental Station of Lleida. Clonal rootstocks (quince and OH x F), some (EMC and EMA) with 'Doyenné du Comice' interstems and one seedling rootstock were used. All these rootstocks were grafted to 'Conference'. Self-rooted 'Conference' trees were included in the evaluation. Trees were planted in 1996 at a spacing of 4 m x 1.75 m and trained to a central axis. Bloom time was essentially the same for all rootstocks. The most vigorous rootstocks were OH x F 333 and seedling, followed by self-rooted 'Conference' and OH x F 69. OH x F selections were all more vigorous than quince rootstocks. Of the quince rootstocks, BA-29 and Comice/MA had almost the same vigour while M-C was the weakest. The use of an interstem increased tree vigour, but did not affect yield. Highest cumulative yields per tree were obtained on self-rooted 'Conference' trees and the lowest on seedling and OH x F 69. Adjusting cumulative yields for rootstock vigour and converting yields to tons per ha accentuated differences between rootstocks with quince rootstocks, especially EMC, giving higher yields. Yield efficiency was inversely correlated to tree vigour. The most efficient rootstocks were EMC, Sydo and Adams. Seedling, self-rooted 'Conference' and OH x F clones had the lowest efficiencies. Self-rooted trees and seedling rootstock showed the least sensitivity to iron chlorosis, BA-29, OH x F 333 and OH x F 69 were of intermediate sensitivity and M-C was the most sensitive. Harvest date was not affected by rootstock and there were no significant differences in fruit firmness. Sugar content (IR) and titratable acidity were higher on quince compared to others rootstocks. Quince rootstocks, in particular BA-29 and EMA, gave bigger fruit while self-rooted, seedling and OH x F rootstocks gave smaller fruit sizes. No significant differences were observed on fruit shape. Self-rooted trees had the least russeting, followed by OH x F types and seedling with M-C showing the most russeting.

18. Monitoring Codling Moth in Pear with the Pear Ester.

A.L. Knight[1], P. Van Buskirk[2] and R. Hilton[2]
[1]Yakima Agricultural Research Laboratory, U.S.D.A., A.R.S, Wapato, Washington State, USA.
[2]Southern Oregon Research & Extension Center, Oregon State University, Central Point, Oregon, USA.

The pear ester, ethyl (2*E*,4*Z*)-2,4-decadienoate, is a potent kairomonal attractant for male and female codling moth (*Cydia pomonella* L.). Lures loaded with the pear ester have been useful in the establishment of action thresholds, timing insecticide sprays, and assessing female mating status of codling moth, particularly in orchards treated with sex pheromones for mating disruption. Initial studies reported that the pear ester was most effective in walnuts (*Juglans regia* L.), less attractive in apple (*Malus domestica* Borkh), and least attractive in Bartlett pear (*Pyrus communis* L.). However, our results have shown that the attractiveness of the pear ester for codling moth varies significantly among pear cultivars. Traps baited with the pear ester in 'Comice' and 'D'Anjou' orchards caught significantly more moths than sex pheromone-baited traps. The two lures were similar in attractiveness in 'Bosc' orchards. The effectiveness of the pear ester should be evaluated in additional pear cultivars.

19. A Selection from *Pyrus betulaefolia* as a New Pollinator for the Main *Pyrus communis* Cultivars.

M. Le Lézec, A. Belouin and M.H. Simard
INRA, Unité d'Amélioration des Espèces Fruitières et Ornementales, 42 Rue G. Morel, BP57, 49071 Beaucouzé Cedex, France.

After screening a large collection of pear genetic resources, the clone P337-41 from *Pyrus betulaefolia*, introduced from Bologna (Italy) in 1952, was selected at INRA Angers as a new pollinator for the main *Pyrus communis* pear cultivars grown in France, namely 'Williams', 'Conference' and 'Doyenné du Comice'. This new pollinator is able to cover a large range of flowering from early ('Harrow Sweet') to late ('Doyenné du Comice'). The number of flowers is high and regular each year; therefore pollen is available for a long period. The flowers are quite attractive to bees and transfer of the pollen to the commercial pear cultivars is optimal. This new selection has no high susceptibility to the main diseases and pests of pears. After the success of ornamental *Malus* as pollinators for apple orchards, this *Pyrus* clone could be well appreciated by the pear growers. Propagation of this clone is in progress through the French nurserymen associated in the CEP-Innovation group.

20. Combining Ability of Fruit Appearance and Eating Quality in Pears.

S.M. Liu[1], G.R. McGregor [2] and S.M. Richards[1]
[1]DPI, Tatura, VIC 3616, Australia.
[2]DPI, Knoxfield, VIC 3176, Australia.

Combining abilities for fruit appearance and eating quality were estimated for 14 pear genotypes used as parents in the Australian pear breeding programme and their derived families. Seedlings of families were planted between 1993 and 1996 at DPI, Tatura, Victoria, with 3.0 m inter-rows and 0.5 m intra-rows in six blocks. Harvested fruits were placed in cold storage at 0°C, ripened at room conditions of 18°C for one week and then scored for fruit appearance and eating quality using a 1 to 5 point inverse and 1 to 9 point hedonic scale in 2002 and 2003, respectively. Mean seedling scores skewed to poor fruit appearance and eating quality with no correlation between them. Large variations were associated with 2003 assessment for both attributes and their GCA and SCA effects. All parents had zero GCA effect for eating quality. Heritability estimate was low (0.08 ~0.29) for fruit appearance and zero for eating quality. The ranking of GCA effects of parents were moderately correlated between seasons (r^2=0.36, P=0.02). BPM, Eldorado, Guyot and Corella had GCA effects for better fruit appearance, but Packham's Triumph, Comice and Winter Cole for poor appearance. SCA effects were in favour of better fruit appearance and eating quality in 8 out of 23 families, respectively, and a weak rank correlation existed between seasons across families for eating quality. The results indicate that good genetic gain can be obtained based on phenotypic selection for fruit appearance using a detailed scale in fruit assessment. Selection for good eating quality can be successful, based on family and then individual performance assessed over seasons.

21. Effect of Different Rates of Prohexadione-Calcium and Girdling on Shoot Growth and Fruit Quality of Different Pear Cultivars.

J.J. Meintjes, P. Stassen and K.I. Theron
Department of Horticultural Science, University of Stellenbosch, Private Bag X1, Matieland 7602, South Africa.

Prohexadione-Calcium (P-Ca) is a promising new shoot growth retardant that is already registered on apples in America (Apogee®) and Europe (Regalis®). This gibberellin biosynthesis inhibitor with limited persistence and low toxicity were tested on five different pear cultivars. P-Ca reduced shoot growth in all the cultivars, but there was a marked difference in sensitivity towards different rates of P-Ca between the different cultivars. Fruit set was improved in some of the cultivars, which led to a decrease in final fruit size. P-Ca caused a decrease in return bloom in some of the cultivars. Girdling only reduced shoot growth in one of the cultivars and did not improve fruit set in any of the cultivars. Girdling improved final fruit size and return bloom in almost all the cultivars. The data is described and the different cultivars categorized according to their sensitivity towards P-Ca.

22. Water Content of Leaves in Different Pear Cultivars during the Vegetative Period in Relation to Rainfall.

R. Miletic[1], D.M. Milutinovic[2], M. Zikic[1], M.M. Milutinovic[3] and G. Djakovic[2]
[1]Institute Serbia, Center for agricultural and technological research, 19000 Zajecar, Serbia and Montenegro.
[2]Faculty of Agriculture, University of Belgrade, 11080 Belgrade, Serbia and Montenegro.
[3]Institute PKB INI "Agroekonomik" 11213 Padinska skela, Belgrade, Serbia and Montenegro.

In this paper we present results of testing water contents in leaves of different pear cultivars in relation to drought. Measurements were taken in collection orchards in Zajecar, Timocka Karaina (East Serbia) over

4 years (1999 to 2002). Ten cultivars were tested: Junsko zlato, Bella di Guigno, Bittira Precoce Morettini, Santa Maria, Williams, Abate Fetel, Curie, Passe crassane, Packham's Triumph and Drouard. East Serbia, especially the narrow area Timocka Kraina, is well known as a dry area with low rainfall during the vegetative period of the pear. Water contents of leaves of different cultivars of pear measured in the same month varied between years, and rainfall was different in the same month of different years too. Coefficients of correlation between monthly precipitation, air temperature and water contents of leaves during the vegetative period (April – October), showed high dependability of water contents of leaves on precipitation and air temperature.

23. Variability in the Wild Pear Population in West Serbia.

D. M. Milutinovic[1], G Jakovic[1], M.M. Milutinovic[2] and R. Miletic[3]
[1]Faculty of Agriculture, 11080 Belgrade, Serbia and Montenegro.
[2]INI PKB "Agroekonomik", 11213 Padinska Skela, Serbia and Montenegro.
[3]Institute "Serbia" Center for Agricultural and Technological Research, 19000 Zajecar, Serbia and Montenegro.

In the region of west Serbia (State of Serbia and Montenegro), in the mountains Cer, Rujevo and Jagodnja, *Pyrus communis* L. is found in its natural habitat. The largest towns in the area are Loznica, Krupanj, Mali Zvornik and LJubovija. The wild pear forests contain numerous genotypes that have been classified according to various fruit characteristics. We separated 14 genotypes of pear which have been studied extensively in situ. The variability in characteristics of fruits is expressed in fruit mass, length of stem, number of seeds per fruit, color of fruit skin and other characteristics. Fruit mass in the 14 genotypes varied from 7.9 g (genotype number 4A) to 38.8 g (genotype number 10). The length of the fruit stem differs between the genotypes, ranging from 18.6 mm (genotype 11) to 38.2 mm (genotype 2). The number of seeds per fruit varied from 2.3 (genotype 'Drenca') to 9.5 (genotype 9). There are also differences between genotypes in the studied population with regards to other pomological characteristics.

24. Age Determination and Tree-Ring Growth Dynamics in Old Trees of 'Angelica' pear (*Pyrus communis* L.).

D. Neri[1], C. Urbinati[2], G. Savini[1] and A. Sanchioni[3]
[1]Dept. Energetics, Polytechnic University of Marche, Ancona, Italy.
[2]SAPROV, Polytechnic University of Marche, Ancona, Italy.
[3]ASSAM, Ancona, Italy.

In central Italy at Serrungarina (Marche Region), the 'Angelica' pear cultivar (*Pyrus communis* L.) is still cultivated on small hilly farms. Gallesio described 'Angelica' in his treaty Pomona (1800). However, its origin is not known and numerous synonyms are reported, such as 'Santa Lucia'. In the studied area, 'Angelica' reached the maximum acreage during the 1930's. It was still popular up to the 1950's, but after the rapid industrial growth and the diffuse abandonment of rural areas, the production rapidly decreased. Recently, a few farmers started to recover 'Angelica' cultivation in traditional free-standing open vases, and the annual production can be estimated as 500 tons, with alternate bearing. The fruits, harvested in early September and cold stored up to the end of December, are much appreciated by the local market for their high quality and taste. The local government and the regional agricultural agency, together with the Marche Polytechnic University, developed a four-step project including clonal selection, virus free nursery production, rationalisation of the cultivation, and label and trade mark development. Moreover, the apparent relevant age of some trees (based on farmers' personal communications and tree physiognomy) motivated the attempt at a dendrochronological analysis. Annual tree rings series of some old (living and dead) trees have been constructed in order to determine their cambial age and to assess their growth dynamics in relation to main climatic or land use changes and other disturbance factors.

25. Volatile Constituents and Pear Aroma Studied by Dynamic Headspace Technique.

F. Rapparini and S. Predieri
IBIMET-CNR-BO, Bologna, Italy.

Pear aroma is, together with taste, a major determinant of fruit quality. "Aroma" consists of the aromatic volatiles that define the distinctive pear fruit flavour. The dynamic headspace method is a very efficient work-up procedure for the analysis of the qualitative and quantitative flavour patterns of fruits. The volatiles of pear fruits of different cultivars were studied using a dynamic headspace sampling technique. Identification and quantification of the different components contributing to the flavour character were analysed by thermal desorption gas chromatography and mass spectrometry (TD-GC-MS). Over 80 compounds were detected at a wide range of concentrations and molecular weights. The volatile profile was characterized by compounds in groups of esters, aldehydes, ketones, alcohols and hydrocarbons. In all the tested cultivars, esters comprised the largest portion (often more than 80%) of the volatiles emitted by the pear fruits. Volatile emission from fruits was studied by comparing different post-storage conditions and fruit manipulations.

26. Reproductive Bud Development of Pears (*Pyrus communis* L.) with Emphasis on the Bourse Shoot.

L.P. Reynolds, G. Jacobs and K.I. Theron
Department of Horticultural Science, University of Stellenbosch, Private Bag X1, Matieland 7602, South Africa.

Knowledge of reproductive bud development is required for consistent yields in pear fruit production. The aim of this study was to gain more insight into the development of the primordial bourse shoot. The importance of bourse shoots stems from their ability to become reproductive, which can lead to bourse-over-bourse bearing. The progression of reproductive bud development in 'Forelle' and 'Rosemarie' was studied from primordial bourse shoot initiation until dormancy the following season. The primordial bourse shoot development in the reproductive bud before full bloom is poorly documented. The primordial bourse shoot was initiated in February 2003. The primordial bourse shoot progressed during dormancy with a plastochron length of 60 days in June. The rate of preformed leaf formation increased rapidly until August when the plastochron was 5 days. 'Rosemarie' primordial bourse shoot development was more advanced at full bloom which is one of the possible reasons for the higher bourse-over-bourse bearing habit of this cultivar. The number of leaves of the bourse shoot was significantly more than that of 'Forelle', which has a low tendency for bourse-over-bourse bearing. Flower initiation of the terminal bud of the bourse shoot was 56 and 77 days after full bloom for the 'Forelle' and 'Rosemarie', respectively. Initiation was well correlated with the cessation of bourse shoot growth. An increase in mitotic activity occurred during flower differentiation of the terminal bourse bud with a peak of floral appendage formation during December and January. From February until dormancy enlargement of the floral parts took place.

27. Effect of Scoring During Flower Induction or Initiation Phase on Return Bloom in *Pyrus Communis* L.

L.P. Reynolds, G. Jacobs and K.I. Theron
Department of Horticultural Science, University of Stellenbosch, Private Bag X1, Matieland 7602, South Africa.

The influence of scoring during the flower induction phase in 'Doyenne du Comice' and 'Rosemarie' pears was investigated in the Western Cape, South Africa. The yield of 'Doyenne du Comice' increased with 38% in scored trees compared to the control. The increase in yield was due to 50% more fruits on the scored trees in comparison to the control trees. The increase in fruit number was due to a higher percentage reproductive buds per tree and improved quality of these buds. For the 'Rosemarie' scoring at the correct time resulted in a 40% increase in reproductive buds. Scoring disrupts basipetal transport of auxin in the phloem, which results in reduced apical dominance and an increase in root-derived cytokinins. More meristems can respond to inductive conditions and the higher concentration of cytokinins during inductive conditions leads to improved flower quality.

28. Resistance of Some *Pyrus Communis* Cultivars and *Pyrus* Hybrids to the Pear Psylla *Cacopsylla pyri* (Homoptera, Psyllidae).

P. Robert[1], T. Raimbault[1], M. Le Lézec[2] and M.H. Simard[2]
[1]INH, UMR PaVé, 2 Rue Le-Nôtre, 49045 Angers Cedex 01, France.
[2]INRA, Unité d'Amélioration des Espèces Fruitières et Ornementales, 42 Rue G. Morel, BP57, 49071 Beaucouzé Cedex, France.

Cacopsylla pyri is the major insect pest in French pear orchards. Cultivars of pear trees resistant to *C. pyri* would offer an interesting alternative to insecticide control. However, all major cultivars grown in France are susceptible to pear psylla. Some interspecific hybrids have a high level of resistance to pear psylla, but the bad quality of the fruits limits the usefulness of these hybrids in breeding programs. To identify other sources of resistance, screening of 16 *Pyrus* genotypes was conducted in a mesh-covered tunnel during 3 months. The cultivar 'Williams', known to be sensitive to pear psylla, was considered as susceptible control. The hybrids 'Katman' and 'NY10355' were considered as resistant controls. The observations were carried out on 7 or 8 plants per genotype. The number of eggs was recorded on the 8 upper leaves of the shoots 15 days after the adult infestation. The number of eggs was ranked from 0 (0 eggs) to 4 (> 100 eggs). The number of nymphs was recorded on the 8 upper leaves of the shoots: 36, 63 and 98 days after the infestation. The number of nymphs was ranked from 0 (0 nymphs) to 4 (> 100 nymphs). Three *P. communis* accessions were identified as having medium levels of resistance to pear psylla: the cultivars 'Doyenné de Poitiers' and 'D'Août Lamer' and the hybrid 'SEL80-79-69' ('Docteur Jules Guyot' x 'Bella di Giugno'). Several interspecific hybrids were identified as highly resistant: 'Gutui', 'BP6', 'BP81' and 'P20R5A70'.

29. Breeding Pears for Warm Climates in Mexico.

F.I.A. Rumayor[1], C.A. Martínez[2] and R.J.A. Vázquez[2]
[1]Turín 315 Ote. Col. Villa Olímpica C. P. 25230 Saltillo, Coahuila, México.
[2]Department Horticulture, University Aut. Agraria Antonio Narro

Mexico contains at least 30 different climatic and almost 50 ecological zones. In tropical and subtropical regions, winter temperatures are not low enough to satisfy chilling requirement of temperate zone pears and spraying of hydrogen cyanamid and oil have been necessary to achieve bud break and cropping. Developing pear cultivars adapted to the subtropics is the main breeding goal of breeding programs in

Brazil. Because of the lack of low chill pear germoplasm, developing high quality pears adapted to Mexico requires hybridization of high quality, high chilling pears like 'Anjou', 'Gamboa' and 'Kieffer' with the low chilling, low quality pear 'Hood'. This cultivar from Florida has a chilling requirement of 250 chill hours; however, we found some segregant seeds from self pollinated 'Hood' with 0 chilling hours requirement or the non dormant gene that was found in evergreen 'Tetela' peaches and 'Anna' apples. This paper reports preliminary data from the Mexican program conducted at Coahuila, Mexico, where the climate is semidesert, altitude of 1950 meters above sea level and a milder winter climate with 150 - 300 chill hours. This program, started in 2001, describes the chilling requirement of seeds from low and high chill hours. We expected and found better quality in the 'Hood' x 'Anjou' crosses.

30. Breeding of Homozygotes of Self Incompatible Haplotype in Japanese Pear (*Pyrus pyrifolia* Nakai).

T. Saito, Y. Sawamura, N. Takada, M. Shoda, O. Terai, K. Abe and K. Kotobuki
Department of Breeding, National Institute of Fruit Tree Science, Tsukuba, Ibaraki, 305-8605, Japan.

Homozygotes of self-compatible haplotypes are useful tools to determine unknown S-genotype cultivars. To date, we have selected *S2*, *S3* and *S4sm* homozygotes. The objective of this study is to select *S4*, *S5* and *S7* homozygotes in Japanese pear. '421-6' and '421-24', which were selected among seedlings from selfing of 'Shinsui' (*S4S5*), are compatible with the pollen of 'Shinsui'. Pollen of '421-6' is incompatible with 'Yakumo' (*S1S4*) and 'Gold Nijisseiki' (*S2S4*), while compatible with 'Housui' (*S3S5*). On the other hand, pollen of '421-24' is incompatible with 'Housui' and 'Okusankichi' (*S5S7*), while compatible with 'Yakumo' (*S1S4*). '420-50', which was selected among seedlings from selfing of 'Okusankichi', is compatible with the pollen of 'Okusankichi'. Pollen of '420-50' is incompatible with 'Hougetsu' (*S1S7*), while compatible with 'Housui'. According to PCR-RFLP analysis, only one S-RNase fragment is present in these three lines and that of '421-6' is digested by *Nde*I, that of '421-24' is digested by *Alw*NI and that of '420-50' is digested by *Acc*II. These results suggest the S-genotypes of '421-6', '421-24' and '420-50' are *S4S4*, *S5S5* and *S7S7*, respectively.

31. The Economic Costs and Returns of Establishing and Producing High Density Pears in Hood River, Oregon, USA.

C.F. Seavert, J.Moore and S. Castagnoli
Mid-Columbia Agricultural Research and Extension Center, Oregon State University, Hood River, Oregon 97031, USA.

The average winter pear production in the Hood River Valley is about 35 tons per hectare. Many pear trees in the Hood River Valley are over 50-years old. These blocks produce less than the County average and growers are faced with the dilemma of either leaving these blocks in production or renewing with new pear plantings. In a recent Oregon State University study, the variable cash costs to establish a hectare of pears is US \$24 253 and \$56 611 when all costs of production are included. However, the economic cost to establish pears does not yield adequate returns on investment to the grower. Therefore, growers must anticipate changes to price, yield or expect a lower return on investment to make this orchard a prudent business investment. It can be achieved by doing any one of the following: 1) increasing pear prices by 18.5 percent from \$150 to \$178 per bin, 2) increasing anticipated yield by 22 percent (4, 7, 15, 29, 39 and 49 tons per hectare for years 4, 5, 6, 7, 8 and 9, respectively), 3) change to a rootstock that can yield the same tons per hectare but begins yielding in Year 2 and reaching full production by Year 7, or 4) decreasing the rate of return for machinery, land and previous years' establishment costs to 5.74 % for all ownership costs. What routinely happens is the grower will accept the lower return on investment. However, this is not a practical business decision for a grower's long-term survival. Despite the high costs of establishing high-density pear blocks growers remain interested in pear scions and rootstocks that can generate profits as well as keep them competitive in a global marketplace.

32. The Economic Costs of Producing Pears in Hood River, Oregon, USA.

C.F. Seavert, J.Moore and S. Castagnoli
Mid-Columbia Agricultural Research and Extension Center, Oregon State University, Hood River, Oregon 97031, USA.

The average pear production in the Hood River Valley is about 35 tons per hectare for winter pears, 30 tons for fresh market 'Bartlett' pears and about 40 tons for canning market 'Bartlett' pears. Based on these averages, per hectare gross incomes are US $9 534/ha for winter pears, $10 215/ha for fresh market 'Bartlett' pears, and $9 988/ha for canning market 'Bartlett' pears. The variable cash costs are US $6 150/ha, $7 024/ha, and $6 547/ha for winter pears, fresh market 'Bartlett' pears, and canning market 'Bartlett' pears, respectively. When fixed non-cash costs are included, the total cost to produce pears is US $9 232/ha, $10 106/ha, and $9 237/ha for winter pears, fresh market 'Bartlett' pears, and canning market 'Bartlett' pears, respectively. The long-run net projected returns a grower can expect in the Hood River Valley are US $302/ha, $21/ha, and $751/ha for winter pears, fresh market 'Bartlett' pears, and canning market 'Bartlett' pears, respectively. However, the costs not included are continuous orchard renewal, family living, owner management and income taxes. The two latter costs can be quite difficult to estimate, but the average cost to renew orchards is approximately US $13.53/ton and about $20/ton for family living costs. When both of these costs are included, the grower must deplete farm equity and cash reserves to maintain the farm business for the long-run.

33. An Evaluation of Site-Specific Management Strategies in the US Pear Industry.

C.F. Seavert
Mid-Columbia Agricultural Research and Extension Center, Oregon State University, Hood River, Oregon 97031, USA.

Site-specific farm management is the term used to describe farming with consideration of landscape differences. This project highlights the economic benefits to employ precision agricultural technologies to track yield differences, identify possible variables in the field that cause the greatest amount of variability, and use technologies to eliminate that variability. When dollar returns per tree were compared to trunk cross sectional area (TCSA) from a grower's orchard and a block at the OSU-MCAREC Experiment Station, the returns varied from $3 to $35 per tree. The TCSA also ranged from 150 to 725 cm^2. From this information, the potential to increase revenues to justify the implementation of any particular technology was estimated. To calculate the revenue potential from completely removing per tree yield variability in a block, a boundary condition was established, assuming that total per tree yield is optimized when the per tree returns lie on the boundary condition line and therefore, the returns per tree is perfectly correlated with TCSA. In this particular data set, if every dollar return per tree did lie on the boundary condition line the return to total revenues would increase US $4 172/ha/year. A partial budget compared the increased revenues, decreased costs to the increased costs, and decreased revenues of implementing a minor change to this orchard system. The projected net present value of implementing changes to this orchard is US $12 004/ha over a ten-year period. Eliminating all yield variability within a 30-year old orchard may not be realistic at this time. However, the net present value for this ten-year analysis could be the upper limit for dollars invested to eliminate orchard variability before young trees are planted. Identifying differences in the field before planting could greatly affect future profitability.

34. Consumer Sensory Evaluation of Pear Cultivars in the Pacific Northwest, U.S.A.

J. Turner[1], J. Bai, C.F. Seavert[1], A. Marin[2] and A. Colonna[2]
[1]Oregon State University, Mid-Columbia Agricultural Research and Extension Center, 3005 Experiment Station Drive, Hood River, OR 97031, USA.
[2]The Food Innovation Center, 1207 NW Naito Parkway, Suite 154, Portland, OR 97209-2834, USA.

The pear cultivar field trial is a two-phase program for evaluating cultivars that are newly developed or recently patented. Phase One contains 26 cultivars each with 5 trees. Data collected in phase one focuses on bloom period, fruit set, optimum harvest maturity, ripening characteristics, storage disorders, and evaluation of dessert quality. Cultivars deemed acceptable from phase one are planted in phase two and tested more extensively. Phase two will have a maximum of five cultivars each with forty trees. All cultivars are being evaluated using a protocol created by The Hood River Grower-Shipper's Association research sub-committee, project leaders and cooperating scientists participating in selection and/or rejection of specific cultivars. In 2002, the sensory evaluation of pear dessert quality was implemented using pear consumers. Participants rated pears on appearance, overall like/dislike, purchase intent, and ranked each cultivar sampled in order of preference. Two hundred and fifty-three participants sampled fruit at two different venues. Two commercial cultivars (green d'Anjou and green Bartlett), three different numbered cultivars from the USDA disease resistant breeding program in Kearneysville, West Virginia, and the recently introduced cultivars Taylor's Gold and Concorde were evaluated. All pears were pressure tested and averaged between 3.8 and 2.5 lbs. At the first evaluation the USDA 66170-047 and green Bartlett ranked the highest in visual appearance. However, the USDA 78304-057 and the USDA 71655-014 were statistically higher in liking scores than green Bartlett, Concorde, Taylor's Gold, Chateau Royale, and Abate Fetel. At the second venue USDA 78304-057 and USDA 66170-047 ranked the highest in visual appearance. Green Bartlett and USDA 71655-014 were rated highest in overall liking scores.

35. Analysis of Ovule and Ovary Dimensions in Pears.

M. Sharifani[1] and P. Kolesik[2]
[1]Horticulture Department, Gorgan Agricultural Sciences University, Gorgan, Iran.
[2]Discipline of Soil and Land Systems , School of Earth and Environmental Sciences, The University of Adelaide, Australia.

This study has been conducted to analyse and compare ovule dimensions between different pear species and cultivars. Fruit and seed characteristics were correlated with ovule dimensions to understand which variable show significant relations. Pear flowers were collected at anthesis from *P. boissierana*, *P. betuleafolia*, *P. pyraster*, *P. koroshinsky*, *P. cossoni*, *P. ussriensis maxim*, *P. longipes*, the Japanese pear cultivar Nijiisseiki, and the *P. communis* cultivars Sensation and Lemon Bergomot. Petal, sepals and anthers were discarded and ovules were fixed in 3% glutaraldehyde in 0.025 M phosphate buffer (pH 7.0) or in FAA (formaline: acetic acid:50% ethanol, 5:5:90). Sections, 3 or 4 μm thick, were stained with periodic acid-Schiff's reagent and toulidine blue using light microscopy. Length and diameter of ovaries and ovules were measured. Comparison of means using Duncan test at 5% showed that 'Nijisseiki' and *P .ussriensi maxim* had the longest and shortest ovules, respectively. The largest ovule diameters belonged to *P .cossoni*, *P. boissieran* and *P. longipes* while the smallest diameter belonged to *P .koroshinsky*. Pear species and cultivars did not differ in ovary length. *P. brestchendri* and the Japanese pear 'Nijisseiki' had the smallest and largest ovary diameters, respectively. A significant correlation was found between seed length and pulp thickness of fruits.

36. Effect of Pollination on Fruit Set in 'Packham's Triumph' Pear.

M. Sharifani[1] and J. Magarey[2]
[1]Horticulture Department, Gorgan Agricultural Sciences University, Gorgan, Iran.
[2]40, Magarey RD, Coromandle valley, S.A, 5051, Australia.

'Packham's Triumph' pear is considered to be an outcrossing cultivar due to its self-incompatibility characteristics. It is also considered facultative parthenocarpic under South Australian conditions. The character of parthenocarpy can change the result of pollination in an open orchard situation. An experiment was conducted to determine changes in fruit set, seed set and fruit weight with increasing distances from pollinator trees and bee hives in rows of 'Packham's Triumph'. An orchard with one row of 'Josephine' pollinator trees on the outside of a solid stand of many rows of 'Packham's Triumph' was used in the study. Fruit set, seed set and fruit weight of five randomly selected trees in each of five successive 'Packham's Triumph' rows at distances of 5.5, 11, 16.5, 22 and 27 meters from the pollinator row were measured. To determine fruit set, 120 flowers were labeled on each of the five replicate trees. Fruit weight and seed set was determined from a sample of ten fruit per tree. Results indicated that seed set decreased linearly with increasing distance from the row of pollinator trees while fruit set decreased, but not linearly with distance. In contrast, fruit weight increased linearly ($P<0.05$) with increasing distance from the pollinator row. No changes were observed in fruit set, seed set and fruit weight with increasing distance between experimental trees and hives. For confirmation of the pollen source, GPI isozyme markers were applied. Results of isozyme analysis extracted from random seeds obtained from the different rows confirmed the effectiveness of 'Josephine' as pollen source for 'Packham's Triumph'.

37. Nutrient Requirements of 'Forelle' Pear Trees on Two Different Rootstocks.

P.J.C. Stassen[1] and M.S. North[2]
[1]Department of Horticultural Science, University of Stellenbosch, Private Bag X1, Matieland 7602, South Africa.
[2]Division of Horticulture, ARC Infruitec-Nietvoorbij, Private Bag X5013, Stellenbosch 7600, South Africa.

Accurate water and fertilizer management are essential in the modern high intensity orchard systems to enable the manipulation of both reproductive and vegetative development. Such control may also ensure the possibility of higher quality fruit with longer storage potential. Various studies have been conducted in regard to establishing the annual plant fertilization requirements, including those of apples, peaches, wine grapes, mangos and avocados. However, there exists little information regarding the requirements of pear trees on rootstocks of differing vigour, especially under intensive cultivation conditions. For this study, young and mature 'Forelle' pear trees on vigorous (BP1) and dwarfing (Quince A) rootstocks were divided into various morphological components (roots, stems, leaves, shoots and fruit), each portion massed and a mineral analysis conducted. From the results it is clear that one-year-old pear trees do not differ in their element requirements on the different rootstocks, and the annual amounts were smaller than expected. The nine-year-old 'Forelle' trees produced 28 t ha^{-1} and 25 t ha^{-1} on Quince A and BP rootstocks respectively. Their annual requirements for macro elements (N, P, K, Ca and Mg) were determined by calculating losses and fixation. The requirements were expressed in g element per kg yield. 'Forelle' on the more vigorous BP1 shows higher requirements than the more dwarfing Quince A rootstock mainly because of the higher mass of summer and winter wood removed as prunings. Similar results were achieved for the micro elements which were expressed as mg element per kg yield. From these results, annual fertilization guidelines based on the yield may be determined.

38. The Challenges of Implementing a Successful IPM Program in Pear.

P.D. VanBuskirk and R.J. Hilton
Southern Oregon Research & Extension Center, Oregon State University, Central Point, Oregon, USA.

The Southern Oregon Research and Extension Center has been developing and refining an integrated pest management (IPM) program in pear for many years. A five year, multi-state areawide IPM project, the Codling Moth Areawide Management Program (CAMP) 1995-99, demonstrated that growers could significantly reduce their synthetic pesticide use and lower pesticide costs with the use of mating disruption for control of codling moth. By 2000, an estimated 50% of the pear acreage in southern Oregon was using this IPM approach. In 2001 and 2002, new projects were initiated with the goal of stabilizing and extending the codling moth mating disruption system to 75% of pome fruit acreage. Blocks as small as 20 acres were used to demonstrate the utility of codling moth mating disruption at that scale. However, in 2002 and 2003, the use of mating disruption declined to less than 40% of the pear acreage in southern Oregon due to a combination of economic pressure and the perceived increased risk of pest problems in the IPM program. Our results from 2001-2003 show that IPM continues to be effective when properly managed, both at large and small scales. The perception that the IPM program involves greater risk is primarily due to the fact that inadequate monitoring can lead to increased pest problems. Our IPM approach has proven to be successful and easily implemented on cultivars such as 'Bosc' and 'Comice' but more intensive management is needed on 'Bartlett' owing to that cultivar's greater susceptibility to codling moth.

39. Development of Microsatellite Markers for Marker-Assisted Breeding in Pears (*Pyrus* spp.).

M.M. van Dyk, G. Koning, Z. Simayi, S. Booi, R. Maharaj, M.C. Selala and D.J.G. Rees
Department of Biotechnology, University of the Western Cape, Private Bag X17, Bellville, 7535, South Africa.

Microsatellites are becoming the marker of choice for cultivar identification and breeding, even though the initial costs for their development are high. With the construction of a reference linkage map for *Malus*, consisting primarily of microsatellite markers, it is now possible to exploit this information to develop genetic maps for pears also, and thus develop markers for use in marker-assisted breeding programs. A cross-species survey has shown that it is possible to amplify microsatellite repeats (SSRs) using *Malus* primers on *Pyrus*. We currently are implementing SSRs obtained through literature for *Malus* and *Pyrus*. In addition, we are developing new SSR markers from the analysis of genomic and cDNA sequences from *Malus* and *Pyrus*. Candidate SSRs have been identified with Tandem Repeats Finder, and then optimised for PCR and tested for polymorphism in both *Malus* and *Pyrus*. Markers are then multiplexed together for higher throughput screening and mapping. We will describe the generation of a set of new markers and preliminary mapping data of these on pear and apple mapping populations. The integration of the reference map markers and the new markers from this project will allow the generation of a higher density map that is portable between species.

40. Breeding of Pear Rootstocks. First Lime-Induced Chlorosis and Vigour Evaluation under Field Conditions of New Interspecific Rootstocks.

J. Bonany[1], R. Dolcet[2], E. Claveria[2], I. Iglesias[3], L. Asin[3] and M.H. Simard[4]
[1]IRTA-EEA Mas Badia, Mas Badia, 17134- La Tallada, Girona, Spain.
[2]IRTA- Centre de Cabrils, Ctra de Cabrils s/n 08348 Cabrils, Barcelona, Spain.
[3]IRTA -EE Lleida, Rovira Roure, 177, 28196-Lleida, Spain.
[4]INRA, Unité d'Amélioration des Especes Fruitières et Ornamentales, BP 57 Beaucouzé Cedex, France.

Traditionally, either seedlings of *Pyrus communis* or clonal selections of *Cydonia oblonga* have been used as pear rootstocks. *Pyrus communis* seedlings used as rootstocks, although generally tolerant to lime-induced chlorosis, are too vigorous for use in intensive orchards. On the other hand, clonal selections of quince rootstocks used in most European orchards (i.e., BA29, ADAMS, SYDO, EMA or MC), even though interesting for the range of vigour reduction, have a restricted utilization in certain growing areas due to their sensitivity to lime induced-chlorosis or incompatibility problems with certain cultivars. In 1998, a collaborative pear rootstock breeding program was started by INRA and IRTA to obtain an interspecific rootstock of low vigour, tolerant to lime-induced chlorosis and compatible with the major pear cultivars. Crosses were carried out between 'Pyriam', a new clonal *Pyrus* rootstock from INRA, and five species, *Pyrus communis cordata*, *Pyrus amygdaliformis*, *Pyrus amygdaliformis persica* and *Pyrus elaegrifolia*. Additionally, seeds were obtained from open pollinated 'Williams' trees. All these seedlings were planted in a highly chlorosant soil and were grafted to 'Conference'. Vigour and chlorosis were evaluated under field conditions over a period of three years. Plants from the crosses with *P. elaegrifolia* or *P. comunis cordata* were the less vigorous, while those from crosses with *P. elaegrifolia*, *P. comunis cordata* or *P. amygdaliformis persica* showed a lower degree of chlorosis. The combination of vigour and chlorosis indicate than seedlings obtained from crosses of 'Pyriam' with 'Williams', *P. amygdaliformis* or *P. comunis cordata* are interesting options to achieve a well adapted pear rootstock.

41. Development of Molecular Markers Linked to Several Fruit Traits in Oriental Pear.

D. Kim[1], J.H. Hwang[1], I.S. Shin[1], H.J. Lee[2], Y.U. Shin[1] and S.S. Hong[1]
[1]National Horticultural Research Institute, RDA, Suwon, 440-706, South Korea.
[2]School of Plant Science, Seoul National University, Seoul, 157-742, South Korea.

To develop molecular markers linked to fruit traits, several important fruit characteristics such as skin color, the amount of grit cells, hardness, core size, and weight were investigated and genetically analyzed in 135 F1 progenies from the cross between 'Niitaka' (*P. pyrifolia* Nakai) and 'Suhyangri' (*P. ussuriensis* Maxim.). All characteristics investigated in this study, except the amount of grit cells, showed normal distribution. To detect molecular markers linked to several fruit characters, high quality genomic DNAs were extracted and sorted into two DNA pools by bulked segregate analysis. For development of the molecular marker related with specific fruit characteristics, we selected 2 RAPD and 7 AFLP markers. From the results of the RAPD marker system, fruit firmness and skin color specific markers were selected at OPD08-500 and OPD05-850 in each characteristic. AFLP markers with 64 primer combinations selected eight markers linked with skin color (EaacMcag-440 and EaggMcag-470), the amount of grit cell (EacaMcac-259, EacaMctt-330, and EagcMcta-170), hardness (EaacMctg-350), and fruit shape (EacaMctt-340 and EaagMctg-330). The selected markers were cloned and sequenced to use as stable co-dominant markers for the increase of pear breeding efficiency. The selected two AFLP markers linked with the amount of grit cells were sequenced successfully from EacaMcac-259 and EacaMctt-330 with their original marker sequences.

42. Analysis of Functional Compounds Content in Pear.

S.S. Hong[1], I.S. Shin[1], H.M. Cho[1], M.J. Yoon[2] and C.H. Lee[1]
[1]National Horticultural Research Institute, RDA, Suwon, 440-706, South Korea.
[2]Department of Horticulture, Korea University, Anamdong 5-1, South Korea.

The pear, containing beneficial compounds such as organic acids, sugars, amino acids and ascorbic acid (vitamin C) that support human health, is one of the most important sources of functional beverages. In particular, flavonoids and phenolic acids which occur at high levels in pear fruit, have recently received extensive attention as potential sources of natural antioxidants, and due to their anti-inflammatory and antiproliferative activity against cancer cells. Genotypic variation in sorbitol content, total phenol content, total flavonoid content and total oxygen scavenging capacity (TOSC) was evaluated using 119 cultivars at the ripe (ready-to-eat) stage, so as to select breeding materials among major *Pyrus* species including *P. pyrifolia*, *P. ussuriensis*, *P. bretschneideri*, *P. communis*, etc. The sorbitol content ranged from 5 to 43 $mg{\cdot}g^{-1}$ fresh weight and 'Kako' belonging to *P. hybrid* had the highest sorbitol content (43.5 $mg{\cdot}g^{-1}$ of fresh weight) of the cultivars measured followed by 'Hori' (32.6 $mg{\cdot}g^{-1}$ of fresh weight). Contents of total phenols and flavonoids showed great differences among cultivars, with a ten-fold difference between highest and lowest contents. 'Chungseori', 'Woljin', 'Chungsilri' and 'Andongmukbae' derived from domestic pear were classified into a group with high levels of total phenols, total flavonoids and TOSC. Quercetin, a kind of flavonoid, also varied in content between species, but there was no significant difference in luteolin content.

43. Pear production in Chile: Situation and trends.

K. Sagredo[1] and T. Cooper[2]
[1]Department of Horticultural Science, University of Stellenbosch, Private Bag X1, Matieland, 7602, South Africa.
[2]Departamento de Producción Agrícola, Universidad de Chile, Casilla 1004, Santiago, Chile.

Pear production is concentrated in the central zone of the country (32°-36°33' S), under temperate climatic conditions. It is the fifth largest fruit crop in the Chilean export basket, representing 5% of planted area of fruit trees (approximately 10 000 ha), 200 000 t of total production in 2003 and a 60% packout for the export market, valued at US $65 207 000. Chile holds a share of 8% of the world pear exports and 22% of the Southern Hemisphere exports. Fruit is exported mostly to Europe and USA. However, because of lower crop profitability the planted area and total yield have been decreasing since 1991, with 7 700 ha estimated for the 2003/2004 season, of which 94% are European pear and 95% are mature, bearing orchards. The main cultivar has been 'Packham's Triumph', which represented 53% of the total Chilean pears exported in 2003, followed by 'Beurre Bosc' (11%) and other minor cultivars such as 'Coscia', 'Abate Fetel', 'D'Anjou' and 'Bartlett'. The main problems for commercial pear production in Chile are low orchard productivity, poor precocity and some quality problems being detected in the export market. The aim of this study was to analyze the pear production in Chile, in terms of evolution of the planted area, cultivars and technical management aspects.

IX[th] INTERNATIONAL PEAR SYMPOSIUM PARTICIPANT LIST

SURNAME	INSTITUTION	COUNTRY	E-mail	FAX
Addison, Matthew	University of Stellenbosch, Matieland P/Bag X1, Stellenbosch	South Africa	mfa@sun.ac.za	
Addison, Pia	ARC Infruitec-Nietvoorbij, P/Bag X5013, Stellenbosch	South Africa	pia@infruit.agric.za	+27 21 809 3584
Antman, Shimon	Ministry of Agriculture, Bet Dagan 28	Israel	shiant@shaham.moag.gov.il	972 3 9485878
Arzani, Kazem	Tarbiat Modarres University, PO Box 14155, Theran	Iran	arzani_k@modares.ac.ir	98 21 4196524
Asin, Luis	Inst Recerca Techn, Avda.Rovira Roure,191, 25198 Lleida	Spain	luis.asin@irta.es	973 238 301
Bai, Dr Jinhe	Oregon State Univ, 3005 Experiment Station Dr, Hood River	USA	jinhe.bai@oregonstate.edu	1 541 386 1905
Balkhoven, Henny	DLV Plant BV, Haagwinde, 4007 VA Tiel	Netherlands	H.H.Balkhoven@DLV.NL	31 334 634 862
Bangerth, Fritz	Dep Spec Crop Cult and Crop Phys, Univ. of Hohenheim, 70593 Stuttgart	Germany	fkbang@uni-hohenheim.de	
Barba, Nuno	Escola Superioir Agraria de Santarem, Quinta do Galinheiro	Portugal	nunogbarba@esa-santarem.pt	351 243 307 301
Barros, Maria	Instituto Superioir de Agronomia, Tapada da Ajuda, Lisboa	Portugal	barrosma@isa.utl.pt	351 213 623 262
Bertelsen, Marianne	Danish Inst of Agric Sciences, Kirstinebjergvej, Aarslev	Denmark	marianne.bertelsen@agrsci.dk	45 639 04395
Brewer, Lester	HortResearch, PO Box 220, Motueka, Nelson	New Zealand	lbrewer@hortresearch.co.nz	64 3 528 7813
Brink, Daan	ACI, Postnet 230, P/B 29, Somerset West, 7130	South Africa	daan@tdpk.co.za	27 21 8801990
Burger, Gerrit	Univ Stellenbosch, Dept Horticulture, P/Bag X1, Matieland	South Africa	13071327@sun.ac.za	27 21 808 2121
Cook, Nigel	Univ Stellenbosch, Dept Horticulture, P/Bag X1, Matieland	South Africa	nigel.cook@agr.kuleuven.ac.be	27 21 808 2121
Costa, Carlo	ARC – Infruitec, P/Bag X 5013, Stellenbosch	South Africa	carlo@infruit.agric.za	27 21 809 3400
Cronje, Paul	Univ Stellenbosch, Dept Horticulture, P/Bag X1, Matieland	South Africa	paulcronje@sun.ac.za	27 21 808 2121
Crouch, Elke	Univ Stellenbosch, Dept Horticulture, P/Bag X1, Matieland	South Africa	elke@sun.ac.za	27 21 808 2121
Crouch, Ian	Capespan, PO Box 505, Bellville	South Africa	ian@ctd.capespan.co.za	
De Jong, Peter Frans	Praktijkonderzoek Plant & Omgewing, Lingewal1 PO Box 200 Zetten	Netherlands	peterfrans.dejong@wur.nl	31 488473717
Deckers, Tom	RSF Research Station, 3800 St Truiden	Belgium	tom.deckers@pcfruit.be	32 6743 18
Djakovic, Goran	Poparski put 90, 14000 Valjevo, Serbia & Montenegro	Serbia	gdjakovic@hotmail.com	
Doron, Israel	Ministry of Agriculture, Mishol Yona 1, Kazrin 12900	Israel	isrdor@shaham.moag.gov.il	
Du Plooy, Pierre	Du Toit Group, Po Box 236, Ceres	South Africa	pierre@dutoit.com	27 23 3161229
Dunley, John	Washington State Univ, WSU-TFREC, 1100 N Western Dr, Wenatchee	USA	dunleyj@wsu.edu	1 509 662 8714
Eccher, Tommaso	Di PRO.VE.Univ Milano, Via G Celoria, 2 20133 Milano	Italy	tommaso.eccher@unimi.it	39 02 503 16553
Elkins, Rachel	Univ of California, 883 Lakeport Blvd, Lakeport, CA	USA	rbelkins@scarlet.ucdavis.edu	1 707 263 3963
Espiau, Maria Teresa	CITA, Apd 727 50080 Zaragoza	Spain	mespiau@aragob.es	34 976 716335
Farkas, Agnes	Univ of Pecs, Dept Botany, H-7624 Pecs, Ifjusag u.6	Hungary	gigi@ttk.pte.hu	36 72 501520
Flaishman, Moshe	Volcani Centre, Dept Horticulture, PO Box 6 Bet-Dagan, 50250	Israel	vhmoshea@agri.gov.il	972 3 9669583
Freeman, Tanith	Ceres Fruit Growers, P/Bag X 67, Ceres	South Africa	tanith.freeman@cfg.co.za	27 23 3161703
Frias, Mauricio	Private Consultant, Las Heras 445 B Curico	Chile	mauriciofrias@~~123.cl~~ Terra.cl	56 75 318068
Goldway, Martin	MIGAL, Galilee Tech Centre, PO Box 381, Kiryat Shmona	Israel	goldway@migal.org.il	972 4 6944980
Guzman Perez, Tomas	Zacualpan, Veracruz	Mexico	tomasgp@lycos.com	

SURNAME	INSTITUTION	COUNTRY	E-mail	FAX
Hemly, Douglas	Greene & Hemly Inc. 11275 Hwy 160, Courtland Ca 95615	USA	doug@greeneandhemly.com	1 916 775 1246
Hemly, Matthew	Greene & Hemly Inc, 11275 Hwy 160, Courtland Ca 95615	USA	matt@greeneandhemly.com	1 916 775 1246
Holcroft, Deirdre	Dole Fresh Vegetables, PO Box 1759, Salinas CA 93902	USA	deirdre_m_holcroft@na.dole.com	1 831 6785415
Hong, Seong-Sig	National Hroticultural Research Inst, 475 Imok-Dong, jang-Gu Suwon	Korea	hss6611@rda.go.kr	82 31 2403681
Human, Taaibos	ARC – Infruitec-Nietvoorbij, P/Bag X5013, Stellenbosch	South Africa	taaibos@infruit.agric.za	27 21 809 3400
Hurndall, Richard	Deciduous Fruit Producers Trust, Suite 275, Postnet, Stellenbosch	South Africa	richard@dfpt.co.za	27 21 882 8966
Huybrechts, Roland	Limburgs Univ Centrum, Univ Campus, Dept SBG, 3590, Diepenbeek	Belgium	christy.huybrechts@luc.ac.be	32 11268301
Huysamer, Marius	Univ Stellenbosch, Dept Horticulture, P/Bag X1, Matieland	South Africa	huysamer@sun.ac.za	27 21 8082121
Ing, George	Winter Pear Control Comm, PO Box 946, Hood River OR97031	USA	geoing@gorge.net	1 541 386 1177
Ingels, Chuck	Univ of California, 4145 Branch Center Rd. Sacramento	USA	caingels@ucdavis.edu	1 916 875 6233
Ireland, John	Fowler Nurseries Inc, 525 Fowler Rd Newcastle, CA 95658	USA	fowler@foothill.net	1 916 645 7374
Jacob, Helmut	Geisenheim Research inst D 65366 Geisenheim, Von Lade Srasse	Germany	jacob@te-gm.de	49 6722 502 560
Jacobs, Prof Gerard	Univ Stellenbosch, Dept Horticulture, P/Bag X1, Matieland	South Africa	gj@sun.ac.za	27 21 8082121
Josifovic, Gordana	Univ Belgrade, Bulevar Aresenija Carnojevica, 11070 Novi Beograd	Serbia	gdjakovic@hotmail.com	
Jurisch, Chris	Arbor Tech, 58 Helderzicht Rd, Somerset West	South Africa	christj@mweb.co.za	27 21 8528637
Kers, Marcel	DLV Plant BV, Duiker 5, 4007 Rd, Tiel	Netherland	m.kers@dlv.nl	31 344 635 083
Langford, Garry	Pome fruit Improvement, 35 Fourteen Turn Creek Rd, Grove TAS 7109	Australia	garry@apfip.com.au	613 62664023
Liu, Shiming	Dept Plant Industries, P/Bag, Ferguson Rd, Tatura, VIC 3616	Australia	shiming.liu@dpi.vic.gov.au	61 3 5833 5337
Lotze, Elmi	Univ Stellenbosch, Dept Horticulture, P/Bag X1, Matieland	South Africa	elotze@sun.ac.za	27 21 808 2121
Lotze, Gustav	Univ Stellenbosch, Dept Horticulture, P/Bag X1, Matieland	South Africa	gfal@sun.ac.za	27 21 808 2121
Maas, Frank	PPO-Fruit, Lingewal 1, NL 6688 LA Randwijk	Netherlands	frank.maas@wur.nl	31 488 473717
McClain, Bob	California Pear Adv Board, 1521 I Str, Sacramento	USA	bob@calpear.com	1 916 446 1063
McClain, Ginny	Greene & Hemly Inc, PO Box 223, Courtland, CA 95615	USA	bob@calpear.com	1 916 446 1063
Meintjies, Kobus	Univ Stellenbosch, Dept Horticulture, P/Bag X1, Matieland	South Africa	emvdb@sun.ac.za	27 21 808 2121
Mielke, Eugene	Oregon State Univ, 3005 Expr St Dr, Hood River, Oregon 97031	USA	eugene.mielke@oregonstate.edu	1 541 386 1905
Miljkovic, Snezana	UN Dev Program, Bratislava Petrovic BB, 37220 Brus,	Serbia	orionos@ppt.yu	
Milutinovic, Momcilo	Bulevar Aresenija Carnojevica, 11070 Novi Beograd	Serbia	gdjakovic@hotmail.com	
Mourao, Isabel	Escola Superior Agraria – Reoios, 4990-706 Ponte de Lima	Portugal	isabelmourao@esa.ipvc.pt	351 258 909 779
Musacchi, Stefano	Univ Bologna, Dip Colture Arboree, Viale fanin 46, Bologna	Italy	musacchi@agrsci.unibo.it	39 051 209 6400
Neri, Davide	Univ Politecnica delle Marche, Via Brecce Bianche, Incona	Italy	neri@univpm.it	39 071 2804 239
Nikotovic-Stojicic, Jasmina	Djuke Dinic 7, 11000 Beograd	Serbia	gdjakovic@hotmail.com	
North, Mike	ARC – Infruitec-Nietvoorbij, P/Bag X5013, Stellenbosch	South Afric	mike@infruit.agric.za	27 21 809 3400
Olivier, Prof Christina	Associacao Nac de Produtores de Pera Rocha	Portugal	isabelmourao@esa.ipvc.pt	351 258 909 779
Postman, Joseph	USDA Agric Research Service, 33447 Peoria Rd, Corvallis, Oregon	USA	jpostman@ars-grin.gov	1 541 738 4205
Predieri, Stefano	IBIMET – CNR-BO, Via Gobetti, 101, 40128 Bologna	Italy	s.predieri@ibimet.cnr.it	39 051 6399 024
Rains, Greg	Blue Star Growers Inc, PO Box 1 Cashmere, WA 98815	USA	grains@crcwnet.com	1 509 782 3646

SURNAME	*INSTITUTION*	COUNTRY	E-mail	FAX
Reighard, Gregory	Clemson Univ, Dept Horticulture, Box 340319, Clemson SC	USA	grghrd@clemson.edu	1 864 656 4960
Reynolds, Louis	ACI, Postnet 230, P/B 29, Somerset West, 7130	South Africa	louis@sun.ac.za	27 21 808 2121
Rood, Paul	Paul Rood Orchards, Michigan State Hort Soc, Covert, Michigan	USA	tesskalhorn@aol.com	1 6167641771
Rumayor, Aroldo	Pear Breeder, Turin 315 OTE, Col Villa Olimpica, CP 25230, Saltillo	Mexico	airum2@hotmail.com	4 15 16 63
Sagredo, Karen	Univ Stellenbosch, Dept Horticulture, P/Bag X1, Matieland	South Africa	13722008@sun.ac.za	27 21 808 2121
Saito, Toshihiro	Nat Inst of Fruit Tree Science, 21 Fujimoto Taukuba Ibaraki	Japan	saito@affrc.go.jp	81 29 838 6475
Seavert, Clark	Oregon State Univ, 3005 Exper Station Dr, Hood River, Oregon	USA	clark.seavert@oregonstate.edu	1 541 386 1905
Serdani, Maryna	Oregon State Univ, 3005 Exper Station Dr, Hood River, Oregon	USA	maryna.serdani@oregonstate.edu	1 541 386 1905
Sharifani, Mehdi	Horticulture Department, Gorgan Agricultural Sciences University, Gorgan	Iran	mmsharifani@yahoo.com	
Silva, Joao	Instituto Sup de Agronomia, Tapada da ajuda, 1349-017 Lisboa	Portugal	barrosma@isa.uti.pt	351 213 623 262
Simard, Marie Helene	INRA, 42, rue G Morel BP57, Beaucouze Cedex	France	simard@angers.inra.fr	33 2 41 22 57 55
Slingerland, Ken	Ontario Min Agric & Food, Box 8000, 4890 Victoria Ave N, Ontario	Canada	ken.slingerland@omaf.gov.on.ca	905 562 5933
Smith, Duncan	Western Farm Service, Po Box 314, Walnut Grove,California 95690	USA	duncans@frontiernet.net	1 916 776 2098
Stassen, Prof Piet	Univ Stellenbosch, Dept Horticulture, P/Bag X1, Matieland	South Africa	pstassen@sun.ac.za	
Stern, Raphael	Migal, Galilee Tech Centre, PO Box 831, Kiryat Shmona	Israel	raffi@migal.org.il	972 4 6944980
Steyn, Wiehann	Univ Stellenbosch, Dept Horticulture, P/Bag X1, Matieland	South Africa	wsteyn@sun.ac.za	
Strydom, Christo	Wolseley Fruit Packers, Box 144, Wolseley	South Africa	cathy@wolfpackpears.co.za	27 23 231 0601
Theron, Karen	Univ Stellenbosch, Dept Horticulture, P/Bag X1, Matieland	South Africa	kit@sun.ac.za	
Torres-Paulo, Armando	ANP- Port Pear Growers Assoc, Pateo do Municipio, Cadaval	Portugal	torres.paulo@frutus.pt	351 262 74 00 20
Turner, Janet	Oregon State Univ, 3005 Exper Station Dr, Hood River, Oregon	USA	janet.turner@oregonstate.edu	1 541 386 1905
Valcke, Roland	Limburgs Univ Centrum, Dept SBG, B3590 Diepenbeek	Belgium	roland.valcke@luc.ac.be	32 11 268301
Van Buskirk, Philip	Oregon State Univ, 569 HanleyRd, Medford, OR 97502	USA	philip.vanbuskirk@orst.edu	1 541 776 7373
Van der Lingen, Jean	ARC – Infruitec-Nietvoorbij, P/Bag X 5013, Stellenbosch	South Africa	jean@infruit.agric.za	27 21 809 3400
Vaysse, Pierre	Ctifl, Centre ed Lanxade, BP 21, 24130 La Force	France	vaysse@ctifl.fr	33 5 53 58 17 42
Vercammen, Jozef	PCF-Proeftuin,, Fruittiunweg 1, 3800 Sint Truiden	Belgium	jef.vercammen@pcfruit.be	32 11 691518
Voigt, Frederik	SAPO, P/Bag X 5023, Stellenbosch	South Africa	frederik@saplant.co.za	27 21 883 3487
Wand, Stephanie	Univ Stellenbosch, Dept Horticulture, P/Bag X1, Matieland	South Africa	sjew@sun.ac.za	27 21 808 2121
Webster, Tony	ISHS, 1 Pine Grove, Maidstone, Kent	UK	twebster@pinegro.u-net.com	
Welter, Stephen	Univ California, 201 Wellman Hall, Berkeley CA 94720	USA	welters@nature.berkeley.edu	1 570 642 0477
Yonai, Fyal	Perot Hagolan Packing House AP Golan Heights, 12436	Iasael	pgeyal@netvision.net.il	972 4 6961488
Zerbini Eccher, Paola	IVTPA, via Venezian 26 I-20133, Milan	Iatly	zerbini.ivtpa@interbusiness.it	39 2 236 5377

101

NOTES

44. The Effect of 1-MCP on the Quality of 'Conference' and 'Abbé Fétel' Pears.

P. Eccher Zerbini, P. Cambiaghi, M. Grassi & A. Rizzolo
I.V.T.P.A., via G. Venezian 26, I-20133 Milan, Italy.

The ethylene antagonist 1-methylcyclopropene (1-MCP), through binding to the ethylene receptors, blocks ethylene actions such as fruit maturation. Pears must undergo some ripening after harvest and storage before becoming eating ready. Applying 1-MCP to pears requires careful dosage in order to retard ripening without preventing it. The effect of 1-MCP treatment (25 and 50 ppb) on 'Conference' and 'Abbé Fétel' pears stored for five months in normal (NA) and controlled atmosphere (CA) was studied. Treatments were repeated every two months in storage. 1-MCP-treated fruit stayed greener than control fruit. Fruit treated with 25 ppb 1-MCP behaved similar to control fruit, while fruit treated with 50 ppb showed delayed softening during shelf life and produced less ethylene, especially if stored in CA. The effect of 1-MCP on firmness and ethylene production lasted for about one month in NA storage and three months in CA storage for 'Conference', but less for 'Abbé Fétel'. The repetition of 1-MCP treatment was not very effective, perhaps due to a too long interval between treatments. 'Abbé Fétel' pears showed a higher ethylene production rate during shelf life and were less sensitive to 1-MCP dosage than 'Conference' pears. 'Abbé Fétel' fruit softened during shelf life whatever the 1-MCP dose and the duration of storage, but, after three months in NA, the 1-MCP-treated fruit still had a good flavour and a better texture than control fruit, which softened with a firm texture and a watery taste.

2000 ha de pera Rocha en Portugal,
y produce entre 100 y 200.000 tns.

Breeding of pear rootstocks. First evaluation of new interespecific rootstocks for tolerance to lime-induced chlorosis and vigour under field conditions

5

Bonany[1], J. R. Dolcet-Sanjuan[2], E. Claveria[2], I. Iglesias[3], L. Asin[3], M.H. Simard[4]
(1)IRTA-EEA Mas Badia, Mas Badia, 17134- La Tallada, Girona, España
(2)IRTA- Centre de Cabrils, Ctra de Cabrils s/n 08348 Cabrils, Barcelona, España
(3)IRTA-EE Lleida, Rovira Roure, 191, 25198-Lleida, España
(4)INRA, Unité d'Amélioration des Especes Fruitières et Ornamentales, BP 57 Beaucouzé Cedex, France

Introduction

Traditionally, either seedlings of *Pyrus communis* or clonal selections of *Cydonia oblonga* have been used as pear rootstocks in commercial orchards. Although *Pyrus communis* seedlings are generally used as rootstocks for their tolerant to lime-induced chlorosis, they show an excessive vigour for modern intensive European orchards. On the other hand, clonal selections of quince rootstocks, such as BA29, ADAMS, [illegible]DO, EMA or MC, used in most European orchards for their range of reduced vigour, they have a restricted utilization in certain growing areas due to their sensitivity to lime-induced chlorosis or incompatibility problems with certain cultivars. In 1998, a pear rootstock breeding program was started in collaboration between INRA and IRTA to obtain an interspecific rootstock of low vigour, tolerant to lime-induced chlorosis and compatible with the major pear cultivars.. Results of first field evaluation of tolerance of lime-induced chlorosis and vigour are reported.

Material and methods

In 1998, in a joint breeding project between INRA and IRTA, a series of crossings were carried out between 'PYRYAM', a clonal *Pyrus* rootstock recently released by INRA, and 5 *Pyrus* species reported to have some degree of tolerance to lime-induced chlorosis, *Pyrus communis cordata* (P256), *Pyrus amygdaliformis* (P257), *Pyrus amygdaliformis persica* (P264) and *Pyrus elaeagrifolia* (P1588). Additionally, seeds from open pollinated 'Williams' (P415) were collected. Hybrids obtained, after stratification and germination were planted in the year 2000 in the EE Lleida in Catalonia, NE Spain in a soil with high lime content (18,7% and 33,1% Calcium Carbonate equivalent in the soil and subsoil, respectively). Due to high variability in soil characteristics, experimental setup consisted of planting a quince BA29 rootstock every other hybrid as a reference for vigour and tolerance to chlorosis measurements. In May 2001, both the hybrids and BA29 were budded with 'Conference'. During 2002, lime-induced chlorosis was evaluated using a visual scale (Sanz and Montañés, 1997).Vigour was measured as diameter of stem 5 cm above rootstock union and then classified in 5 categories according to the vigour of neighbour

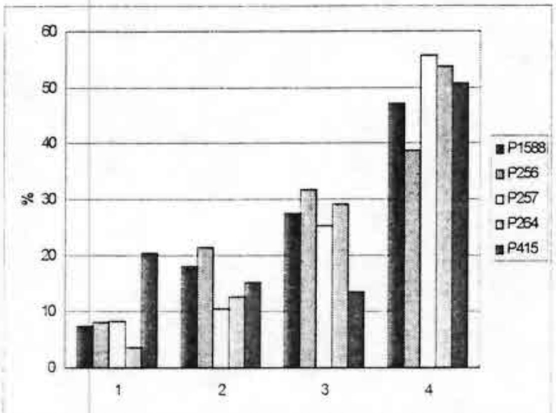


Figure 1 Distribution of % of individuals in distinct vigour classes (1: <50% ; 2: 50-75%; 3: 75-100%; 4: >100% of vigour with regard BA29) in different crossings (PYRIAM with *Pyrus communis cordata* (P256), *Pyrus amygdaliformis* (P257), *Pyrus amygdaliformis persica* (P264), *Pyrus elaeagrifolia* (P1588), and free pollinization of ' Williams' (P415)

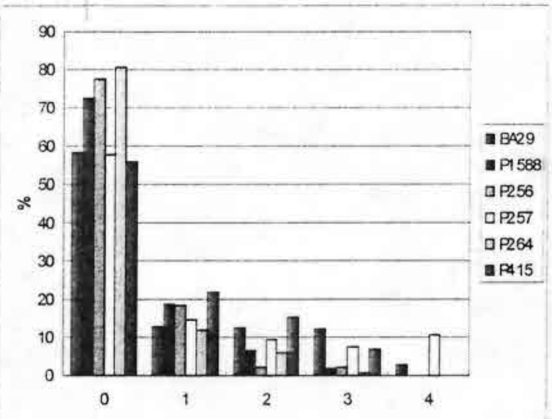


Figure 2 Distribution of % of individuals in distinct classes of sensitivity to lime-induced chlorosis (0: No symptoms of chlorosis; 4: tree with young leaves of white-yellow colour and some necrotic areas. Rest of leaves of green-yellow colour, Sanz and Montañés, 1997) in 'Conference' budded on BA29 and progenies of different crossings (Pyriam with *Pyrus communis cordata* (P256), *Pyrus amygdaliformis* (P257), *Pyrus amygdaliformis persica* (P264), *Pyrus elaeagrifolia* (P1588), and free pollinization of ' Williams' (P415)

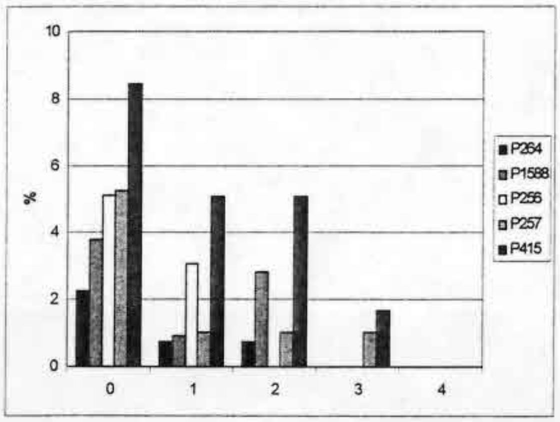


Figure 3 Distribution of % of individuals in distinct classes of sensitivity to lime-induced chlorosis (0: No symptoms of chlorosis; 4: tree with young leaves of white-yellow colour and some necrotic areas. Rest of leaves of green-yellow colour, Sanz and Montañés, 1997) in 'Conference' budded on BA29 and progenies of different crossings (PYRIAM with

Results and discussion

Hybrids obtained showed a high variation regarding its tolerance to lime-induced chlorosis and vigor (Figure 1, Figure 2). More than 50% of the seedlings from crosses with P257, P264 and P415 had more than 50% of the vigour of BA29 (class 4). On the other hand a high proportion of seedlings from crosses with P1588 and P256 were found on low vigour classes (class 1, 2 and 3). However, individuals from cross with P415 (open pollinated 'Williams'), although as mentioned the majority of individuals had a vigour greater than BA29, were also the most frequent (20,32%) in the class of vigour 1 (lower than 50% of BA29). Although the major part of the hybrids were more vigorous than the reference BA29, results show there is a potential for reduction of vigour using interspecific crossings with certain *Pyrus* species. There is a substantial percentage of individuals in each crossing falling in the lowest vigour class (<50% of vigour of BA29) ranging from 3,74 % in the case of cross with P264 to 20,3 % for cross with P415. In general, as far as tolerance to lime-induced chlorosis, hybrids from crossings with P1588, P256 and P264 a 72,64, 77,5 and 80,6% of the individuals respectively were classified in class 0 (higher tolerance). In contrast trees with BA29 as rootstock only 58,33% of the individuals were classified in this category confirming the potential of *Pyrus* as rootstocks with certain tolerance to lime-induced chlorosis. Combination of the two characters of interest, high tolerance to lime-induced chlorosis (class 0, no symptoms) and low vigour (class 1, <50% of BA29 vigour), results in a percentage of individuals between 2% and 8% depending on the cross (Figure 3). Seedlings from open pollination of 'WILLIAMS' (P415) and derived from cross with *Pyrus amygdaliformis* (P257) and *Pyrus communis cordata* (P256) are those with a higher percentage of individuals that combine both characters of interest. Further evaluation of these characters and other characters of agronomical interest is needed.

References

Lombard, P.B. y M.N. Westwood. 1987. Pear rootstocks. In: Rootstocks for fruit crops (C.R. and R.F. Carlson, eds), p. 145-183

The Challenges of Implementing a Successful IPM Program in Pear

Philip VanBuskirk and Richard Hilton
Southern Oregon Research & Extension Center Central Point, Oregon 97502, USA.

Grower Education and Information Transfer

To ensure that IPM information and research results concerning new technology are relayed to users in a timely fashion, it is important to:

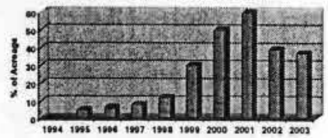
•build and maintain an active technical support structure, by creating local and regional advisory groups which actively involve growers

•develop and instruct growers in the use of interactive IPM web sites that provide information on: notification of pest alerts, insect and disease development models, research results, the ability to ask questions on IPM, and provide links to other IPM related sites

•disseminate information by use of local/regional newsletters, field and indoor meetings, round table discussions with pest control advisors, and articles in trade journals and the popular press

Economics/Grower Perceived Risk

Percent of Acreage Using Mating Disruption



Adoption of IPM in southern Oregon and the Pacific Northwest over the last two years has stalled and in some cases retreated. The current state of pome fruit economics encourages cost cutting by growers. Mating disruption along with the labor involved in application is still considered expensive by many growers. Pest consulting is often cut when profit margins are low. However, insufficient pest monitoring leads to pest problems and the perception that an IPM program increases the risk of pest injury when compared to a conventional approach. As long as economic returns for pome fruits remain low and organophosphate use remains relatively inexpensive and requiring minimal monitoring, orchardists may continue to opt for the control program which is perceived to be less risky and easier to manage.

Summary

While the southern Oregon IPM programs continue to show success in reducing pesticide costs to growers along with the reduction or elimination of organophosphates in their spray programs, there are many factors that still impede the adoption of IPM. Therefore, it is imperative that research and demonstration projects be aggressive in their educational outreach and training components and highlight the positive economic impact to potential users. In addition, educating the public about IPM can be a useful tool in enlisting community support which is essential for the creation and maintenance of a successful IPM program.

Introduction

The Southern Oregon Research & Extension Center has been developing and refining an integrated pest management (IPM) program in pear for many years. The IPM program developed and utilized over the past ten years has proven successful in: reducing organophosphate and other synthetic pesticide use, maintaining control of pear pests, producing a quality product, and reducing spray costs. However, the current state of orchard economics has resulted in a reduction in IPM. Even though spraying costs can be reduced with an IPM program, the up front costs associated with mating disruption and the cost of more intensive management coupled with a perception that an IPM program increases grower risk has slowed adoption. The reality is that an IPM program based on mating disruption for control of codling moth in conjunction with intensive pest monitoring results in savings up to and beyond the additional costs associated with the application of mating disruption and the higher level of pest monitoring.

In order to keep growers engaged in the adoption and implementation of
IPM in pear, the Southern Oregon Research and Extension Center has found that progress can be achieved when educational outreach is combined with a research effort that encourages grower participation.

New Technology

Implementation of new technology is a vital component of a successful IPM program. In order to ensure that pest management is achieved in the most cost effective manner, new tactics and tools need to be assessed constantly. Examples of novel techniques that have been field-tested in southern Oregon pear orchards:

•DA lure for monitoring CM

•Particle films (kaolin) for control of pear psylla

•Alternative mating disruption techniques: sprayables and puffers

•Attract and kill for control of CM

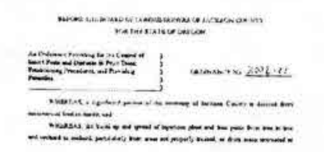
•IGRs and codling moth virus for control of CM

•Tower sprayers to improve spray deposit and reduce drift

Intensive Monitoring

Intensive monitoring is imperative if an IPM program is to succeed. Unfortunately, when an IPM program is instituted without the higher level of pest monitoring or proper training of pest managers that is required the risk of incurring economic injury is increased. Therefore, the availability of educational manuals along with a continued program of training on IPM techniques allows growers and scouts to develop and maintain the expertise required to implement a successful IPM program.

Community Involvement & Education



A successful IPM program requires the involvement of the local community. The passing of county ordinances that prohibit the abandonment of orchards is important when orchards in the area are attempting to use mating disruption. The education of home orchardists has been accomplished with newspaper ads, the distribution of pamphlets, and the use videos shown on local cable TV to provide information on the the potential impact that their uncared for trees may have on IPM programs being implemented in neighboring orchards.

Research and Demonstration

Research and demonstration projects conducted in grower orchards demonstrate that full investment in an IPM program has positive benefits and serves to familiarize growers with new technologies while increasing their pest management expertise.

1989-93 On-farm trials and Experiment Station research were combined to develop an IPM program based on new mating disruption technology for control of codling moth.

1994 Pilot project involving 2 growers and 50 acres, funded by the IPPC (Integrated Plant Protection Center) at Oregon State University, demonstrated the feasibility of the new IPM program on a commercial scale.

1995-99 CAMP project conducted in an area of contiguous orchard, up to 7 growers and 500 acres were involved. Pesticide reduction and cost savings were documented, funded by the USDA-ARS (Agricultural Research Service).

2001-present Areawide II, funded by IFAFS/RAMP, continues on-farm demonstrations of IPM programs on smaller acreages coupled with new research on mating disruption and biological control technologies.

2002 A one year project funded by the American Farmland Trust, growers successfully implemented IPM programs without using organophosphate insecticides and a program to deal with pest problems generated by abandoned orchards and backyard trees was initiated.

DEPARTMENT OF PRIMARY INDUSTRIES

Primary Industries Research Victoria

Plant Genetics & Genomics

Combining Ability of Fruit Appearance and Eating Quality in Pears

S.M. Liu[A], G.R. McGregor[B] and S. M. Richards[A]

[A]DPI Tatura Centre, Ferguson Rd, Tatura, VIC 3616, Australia; [B]DPI Knoxfield Centre, 621 Burwood Hwy, Melbourne, VIC 3156, Australia

AIM:

- To investigate combining ability and heritability estimates of pear appearance and eating quality quantified with hedonic scales.

MATERIALS & METHODS:

Fruits came from seedling trees of breeding families grown at DPI, Tatura Centre, Victoria, Australia. They were derived from intercrossing 14 European pear genotypes (Table 2) and planted from 1993 to 1996 in six orchard blocks.

Samples of 4 to 6 fruits per tree were harvested at the estimated harvest date, and stored at 1°C for 7 weeks. After cold storage, fruits were ripen at 18°C for 7 days prior to sensory assessment.

Fruit appearance and eating quality were scored according to a 5-point inverse and a 9-point hedonic scale in 2002 and 2003, respectively.

Univariate analyses were conducted using a mixed model as follows, by ASReml statistical software: $y_{ijk}=\mu+b_i+g_j+g_k+s_{jk}+e_{ijk}$, where y, b, g, s and e are a given score for quality attribute, fixed orchard block effect, general combining ability (GCA) effect of parent, specific combining ability (SCA) effect of family and random residual effect.

Narrow-sense heritability (h^2) was derived from GCA, SCA and residual variance components (Table 3). Spearman rank correlation coefficient was estimated to rank GCA or SCA effects across seasons.

RESULTS:

The distribution and mean seedling quality score were skewed to poor appearance and eating quality, but superior phenotypes existed among assessed seedlings in either season (Table 1). Correlation was not significant between two attributes within each season (r^2=0.05, P>0.05).

Table 1. Number of seedlings and basic statistic parameters

	Appearance		Eating quality	
	2002	2003	2002	2003
No seedlings	380	534	360	468
Range	2-5	1-9	1-5	1-8
Mean	3.93	3.36	3.76	2.94
SD	0.75	1.69	0.61	0.89

Note: Due to the different scales used, in 2002 higher scores indicate poor quality, but in 2003 indicate better quality

GCA effects varied with parents for appearance, but were zero for eating quality in both seasons (Table 2). BPM, Eldorado, Guyot and Corella showed GCA effects for better appearance. The rank correlation was moderate but significant for fruit appearance between seasons (r^2=0.36, P<0.05).

Table 2. GCA effect and ranking for fruit appearance and eating quality scores

Parent	Appearance				Eating quality	
	2002	Ranking	2003	Ranking	2002	2003
HW606	-0.154	1	-0.139	8	0.0	0.0
BPM	-0.118	2	0.308	3	0.0	0.0
Eldorado	-0.111	3	0.197	6	0.0	0.0
Guyot	-0.095	4	0.604	1	0.0	0.0
Corella	-0.010	5	0.510	2	0.0	0.0
Josephine	-0.003	6	-0.224	10	0.0	0.0
L'Inconnu	-0.003	7	-0.242	11	0.0	0.0
Potamac	0.014	8	0.018	7	0.0	0.0
Howell	0.034	9	0.222	5	0.0	0.0
I11-13B-83	0.040	10	-0.161	9	0.0	0.0
WBC	0.059	11	0.307	4	0.0	0.0
Packham's T	0.080	12	-0.613	13	0.0	0.0
Comice	0.103	13	-0.968	14	0.0	0.0
Winter Cole	0.134	14	-0.552	12	0.0	0.0

Note: Due to the different scales used, in 2002 smaller estimates indicate better GCA effect, but in 2003 indicate poorer GCA effects.

Among 23 families assessed in both seasons, 8 families possessed SCA effects for better appearance (Fig. 1) or eating quality (Fig. 2) (red dots). The rank correlation for eating quality was significant but weak across seasons (r^2=0.18, P<0.05).

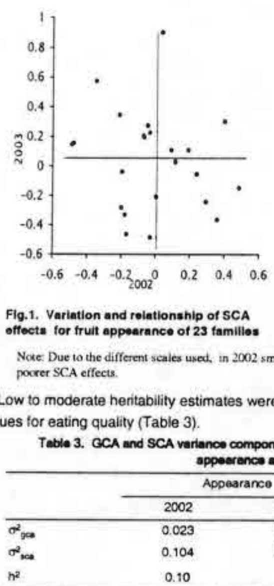


Fig.1. Variation and relationship of SCA effects for fruit appearance of 23 families

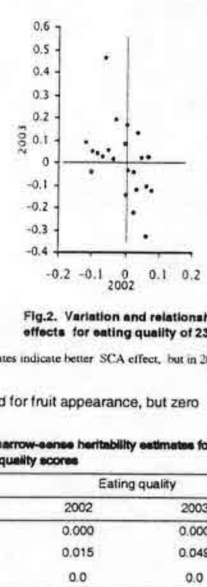


Fig.2. Variation and relationship of SCA effects for eating quality of 23 families

Note: Due to the different scales used, in 2002 smaller estimates indicate better SCA effect, but in 2003 indicate poorer SCA effects.

Low to moderate heritability estimates were obtained for fruit appearance, but zero values for eating quality (Table 3).

Table 3. GCA and SCA variance components and narrow-sense heritability estimates for fruit appearance and eating quality scores

	Appearance		Eating quality	
	2002	2003	2002	2003
σ^2_{gca}	0.023	0.319	0.000	0.000
σ^2_{sca}	0.104	0.247	0.015	0.049
h^2	0.10	0.29	0.0	0.0

$h^2 = 4\sigma^2_{gca}/(4\sigma^2_{gca}+4\sigma^2_{sca}+\sigma^2_e)$.

CONCLUSIONS:

- Selection for recombinants with good appearance and eating quality can be successful, as no adverse correlation exists between them.
- Parental genotypes, BPM, Eldorado, Guyot and Corella, possess good ability to transmit their good fruit appearance into seedling progeny.
- Good genetic gain can be achieved based on phenotypic selection for fruit appearance; selection for eating quality can be more successful in the families with large and desired SCA effects across seasons.
- A more extensive hedonic scale attributes to the increased magnitude of the estimates, and then by enhancing selection efficiency of breeding for fruit quality.

Project Team: Graeme McGregor, Shiming Liu, Sue Richards & Dave Haberfield

Acknowledgment:
Funds for this project were provided by Horticulture Australia Limited

Contact for project information: Graeme McGregor
Telephone: 61-3-9210 9332
Facsimile: 61-3-9800 3521
email: graeme.mcgregor@dpi.vic.gov.au

Victoria
The Place To Be

Authorised by the Victorian Government, Department of Primary Industries, Ferguson Road, Tatura.
Printed by Department of Primary Industries, Ferguson Road, Tatura, January 2004.
ISBN 1 74146 013 1
www.dpi.vic.gov.au

"Pyriam" : A new pear rootstock

Simard M.H., Michelesi J.C.

Institut National de la Recherche Agronomique, Centre d'Angers, Unité d'Amélioration des Espèces Fruitières et Ornementales, BP57, 49071 Beaucouzé Cedex (France). e-mail : simard@angers.inra.fr

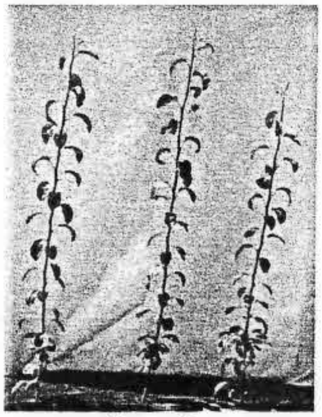


Photo n°1 :
"Pyriam" in nursery

"Pyriam" (OH11) is a pear rootstock (*Pyrus communis*) obtained in 1967 at the INRA Fruit and Ornamental Plant Breeding Unit of Angers in a breeding programme initiated by B. Thibault, J.C. Michelesi and L. Hermann to create a clonal pear rootstock, compatible with pear varieties, inducing a low vigor to the scion.

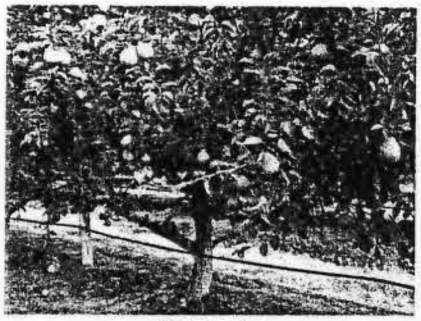


Photo n°2 :
"Williams" on "Pyriam"

Four pear genotypes have been chosen as female for open pollination (O.P.): the rootstocks "Fieudière 3" and "Kirschensaller" ; the varieties "Beurré Hardy" and "Old Home". Thirty two seedlings of each of these genotypes have been grafted by "Williams" or "Passe-Crassane" and planted in 1969 to make selection on induced vigor, productivity and graft-compatibility. Among these 128 seedlings, 9 genotypes have been selected in 1981, for their induced vigor close to BA29 and their good productivity : **OH11** ("Old Home" OP11), **OH20**, **OH33** ; **BH13** ("Beurré Hardy" OP13), **BH15** ; **K14** ("Kirchensaller" O.P.14), **K15**, **K32** ; **F26** ("Fieudière 3" O.P.26).

Then distinctive qualities of these 9 selections have been evaluated: tolerance to fire blight (Lemoine J., Michelesi J.C. and Allard G., 1996), ability to propagate, habit in nursery, compatibility with "Williams" (Le Lézec M., Lecomte P., Laurens F. and Michelesi J.C., 1997). OH11 and at least OH20 and OH33 have been choosen for their good ability to propagate, their tolerancy to fire blight, their good growth in nursery and their good compatibility with "Williams".

Fig. 1 : Vigor induced by rootstocks to «Williams» variety

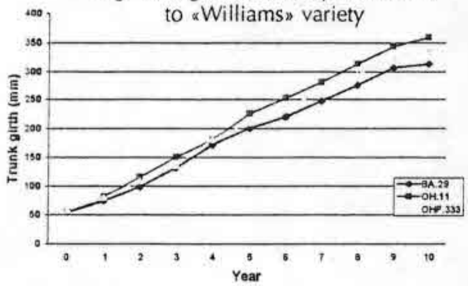


Table 1 : Orchards results with "Williams"

	Cumulated Yield (Kg/tree)			Index of Productivity (IP)			Fruit size above 70 (%)		
Year	BA 29	OH 11	OHF 333	BA 29	OH 11	OHF 333	BA 29	OH 11	OHF 333
3	5	9	8	3	6	6	62	40	21
4	14	35	28	8	19	15	52	24	24
5	42	64	51	21	28	24	48	39	45
6	73	97	79	33	38	33	40	35	43
7	119	154	129	48	55	49	25	26	29
8	165	205	172	59	65	58	35	42	39
9	188	230	194	61	67	60	-	-	-
10	257	307	259	82	85	77	-	-	-

$IP : \frac{\text{Cumulated Yield}}{\text{Trunk Girth}} \times 100$

Fruit size : % of fruits with diameter above 70 mm

In 1990, orchards of these 3 genotypes grafted by "Williams" have been planted in several locations. The results obtained at INRA (Table 1) have been confirmed by the others experiments. With "Williams", OH11 gives the best results inducing a slightly higher vigor (Fig. 1), an equal productivity and a fruit size close to BA 29.

In the South-East of France, on calcareous soils, orchards of "Williams" grafted on OH11 show homogeneous and durable production without chlorotic leaves compared to those grafted on BA29. Thus this open pollination of Old Home (OH11=P2395) has been released as "Pyriam" for "*Pyrus* resistant to *Erwinia amylovora*" in 1997. "Pyriam" is potentially of great value under mediterranean conditions, particularly in South-East of France where it could replace BA29. Large experiments are in progress in connexion with Ctifl and regional experiment stations.

Lemoine J., Michelesi J.C. and Allard G., 1996. Quelques porte-greffe pour le poirier : bouturage herbacé et semi-ligneux (II), Arbo Fruit, 490, 24-29.

Le Lézec M., Lecomte P., Laurens F. and Michelesi J.C., 1997. Sensibilité variétale au feu bactérien (2° partie). Arbo Fruit., 504, 33-37.

INRA

A selection from *Pyrus betulaefolia* as a new pollinator for the main *Pyrus communis* cultivars.

M. Le Lezec, A. Belouin, MH. Simard

INRA Centre d'Angers, UMR GenHort, 42 rue Georges Morel, 49071 Beaucouzé cedex, France.

The pear cultivars (*Pyrus communis*) are self-incompatible ; in any orchard, inter-fertile cultivars have to be planted. Cultivar association is dependent on a same flowering time and inter pollen compatibility. Moreover, in a given place, the cultivars of market value could not fulfill these conditions. A selection only devoted to pollinate the main cultivars could be a quite interesting proposal.

Several *Pyrus* species were screened as potential pollinators. PARRY (1976) emphasized 4 of them : *Pyrus amygdaliformis, Pyrus longipes, Pyrus nivalis, Pyrus salicifolia.* KURENNOI (1985) investigated among *Pyrus betulaefolia, Pyrus syriaca* and *Pyrus salicifolia.* At INRA ANGERS, research was initiated in 1990 within a large collection planted in 1960. A selection from *Pyrus betulaefolia,* introduced from BOLOGNA (Italy) in 1952, was selected as the best candidate.
This clone, P337-41, was studied in 3 French locations : ANGERS, West - BERGERAC, South West - NIMES, South East.

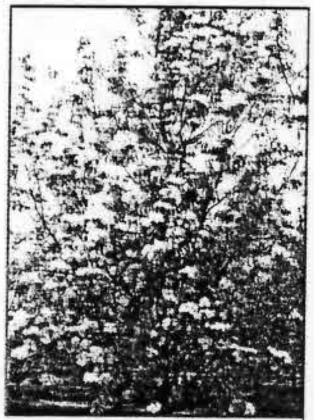


Fig. 1 : The tree during full bloom

The tree has a spreading habit, a strong vigour and develops numerous brindles ending in a flower bud. Grafting has to be perform on *Pyrus* rootstock and not on quince. The French nurserymen associated in the CEP-Innovation group will propagate a virus-free clone, when available.

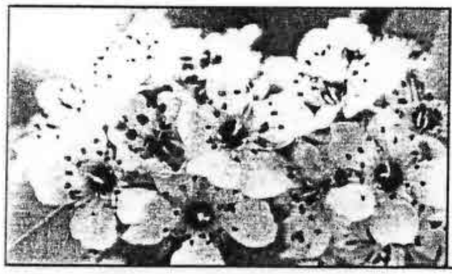


Fig. 2 : Clusters during full bloom

Flowering is very abundant and regular each year ; the average number of flowers per cluster is 13. A whole cluster has viable pollen for 2 or 3 weeks. P337-41 covers a large range of flowering from early as "Harrow Sweet", to late as "Doyenné du Comice" (Tab.2).

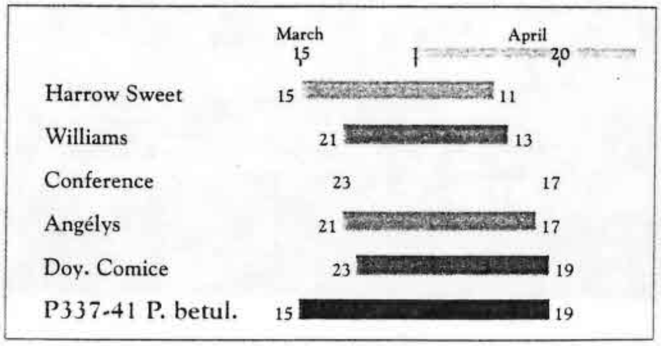
The percentage of germinating pollen grains is around 50%. Pollination experiments were performed on three varieties : Williams, Conference and Doyenné du Comice. (Tab. 1)

Table 1 : Performance of P337-41 as a pollinator : number of seeds per fruit.

	Williams	Conference	Doyenné du Comice
P337- 41	5,5	6,5	4,5
Epine du Mas (control)	8,6	8,5	8,5

The clone P337-41 originating from *Pyrus betulaefolia* is recommended as a pollinator of the main varieties grown in France, Williams, Conference and Doyenné du Comice. Each year, this new selection has a lot of flowers available for pollination on a long period - 2 or 3 weeks. As for the apple, we advise the grower to display the pollinator in each row, a one-in-ten plant.

Table 2 : Extreme values of flowering time at ANGERS from 1998 to 2002 (5 years).



KURENNOI V.N., 1985. The possibility of using the wild pear species Pyrus betulaefolia as a pollinator for table varieties in single variety plantations. Povysh. urozhainosti plod. i ovoshch. kul'tur. 34-38, (English summary).
PARRY M.S., 1976. Rep. E. Malling Res. Sta. for 1975 : 40

Performance of 'Conference' pear on self-rooted trees and several Old Home x Farmingdale, seedling and quince rootstocks in Lleida (Catalonia NE-Spain)

I. Iglesias
IRTA-Estació Experimental de Lleida
Rovira Roure, 191, 25198-Lleida, España
e-mail: ignasi.iglesias@irta.es

IRTA Institut de Recerca i Tecnologia Agroalimentàries

Introduction

In Spain pear is the third most important deciduous fruit tree species after peach and apple, with 32356 ha in 2002. Catalonia is the most important region with 13623 ha, mainly located in Lleida and Tarragona. The most important cultivars are 'Blanquilla' and 'Conference', which together account for 64% of total pear production. In contrast to apple and peach, the availability of new pear rootstocks is very limited. The effect of rootstock on the growth of different varieties has been well studied. It is one of the most effective options for growth control, as it has a direct effect upon fruit quality and homogeneity. Due to the loss of chlormequat chloride (CCC) in the European Union in January 2000, the use of dwarfing rootstocks and root punning have become the two most interesting options for controlling tree vigour. Despite the importance of pear in the main growing areas of Catalonia, there is a lack of information about the agronomical performance of some new rootstocks. The objective of this study was to provide information about the agronomical performance of some clonal *Pyrus* rootstocks, quince, seedling and self-rooted 'Conference' trees at the IRTA Experimental Station of Lleida (NE-Spain).

Material and methods

The trial was carried out at the IRTA-Experimental Station of Lleida (NE-Spain). 'Conference' trees were planted in February 1996. The soil is a Xerorthent Typic mesic mixed (calcareous) and superficial (SSS, 1994) with a 1.7 % organic content, pH=8.2 and with 8.5% active lime. Trees were trained using a central leader system and spaced 4 x 1.75 m. apart.

Blooming period (Fleckinger stages), yield, fruit size, fruit quality (firmness, SSC and TA) and number of root suckers per tree were recorded. Twenty representative fruits per elemental plot were used to determine fruit quality. Tree vigour was expressed as a trunk cross-sectional (TCSA) 20 cm above the graft union. Space occupied by the trees of different rootstocks was visually recorded and related to TCSA. Cumulative yield efficiency (CYE) calculated and expressed in kg/cm^2. Iron sensitivity was evaluated using a visual scale with a range of 0 to 5, where 0 = no symptoms, 5= yellow colour and/or necrotic leafs, proposed by Sanz and Montañés (1997). The experimental design was a randomised complete block with 4 replications and elemental plots of four trees. Controls were carried out on the two central trees of each plot. Controls were carried out on the two central trees of each plot. Yields, fruit size, fruit quality and yield efficiency were tested with analysis of variance using the Statistical Analysis System software (SAS, 1997); statistical significance was assessed at P=0.05. When the analysis was statistically significant (F-test), Tukey's Test for separation of means

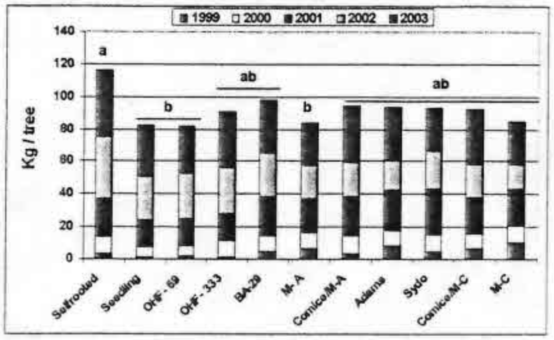


Figure 1: **The influence of rootstock on cumulative yield to year 8 for 'Conference' at the IRTA-EE Lleida. Trees were planted in 1996.**

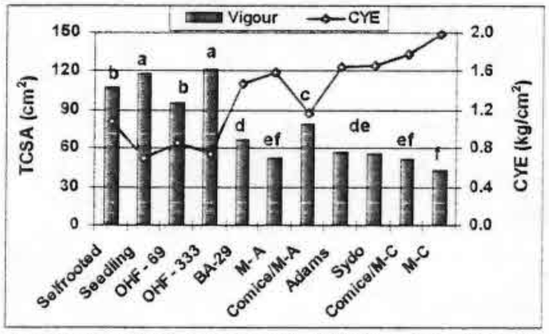


Figure 2: **The effect of rootstock on vigour (TCSA) and cumulative yield efficiency to year 8 for 'Conference' at the IRTA-EE Lleida.**

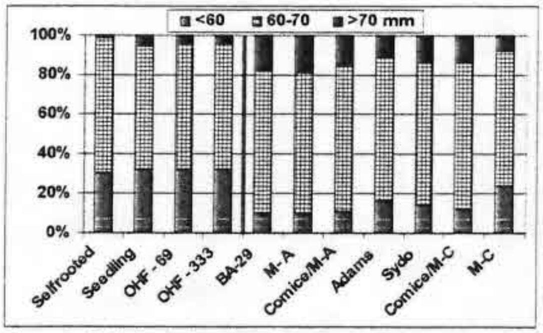


Figure 3: **Fruit distribution (%) of 'Conference' on several different rootstocks at the IRTA-EE Lleida. Mean values for the period 1999-2003.**

Table 1: **Fruit distribution (%) of 'Conference' on several different rootstocks at the IRTA-EE Lleida. Mean values for the period 1999-2003.**

	Firmness (kg)	SSC (°Brix)	TA (g/L)	L/D	Russeting	Hue angle (°)
SELF ROOTED	6.1 a	14.4 bcd	1.50 d	1.59 ab	1.33 d	114.1 a
SEEDLING	5.9 abc	13.5 e	1.55 d	1.62 a	2.31 bc	113.9 a
OHxF-333	6.0 ab	13.9 de	1.62 bcd	1.61 a	2.20 c	114.0 a
OHxF-69	6.1 ab	14.2 cd	1.77 abc	1.59 ab	2.55 abc	113.8 ab
BA-29	5.9 abc	14.7 abc	1.80 abc	1.50 d	2.73 ab	113.4 bc
COMICE/M-A	5.8 bc	14.9 ab	1.90 a	1.51 d	2.70 ab	113.3 bc
M-A	5.8 abc	14.4 bcd	1.80 abc	1.58 abc	2.61 abc	113.2 c
ADAMS 332	5.8 bc	14.7 abc	1.80 abc	1.52 cd	2.65 ab	112.6 de
SYDO	5.8 abc	14.4 bcd	1.82 ab	1.54 bcd	2.52 abc	113.1 cd
COMICE/M-C	5.8 abc	15.0 a	1.75 abcd	1.56 abcd	2.63 abc	112.3 e
M-C	5.6 c	14.9 ab	1.75 abcd	1.58 abc	2.79 a	112.2 e

Different letters in the same column represent significant differences at $P \leq 0.05$ by Tukey's test when the F-test was significant in the ANOVA.

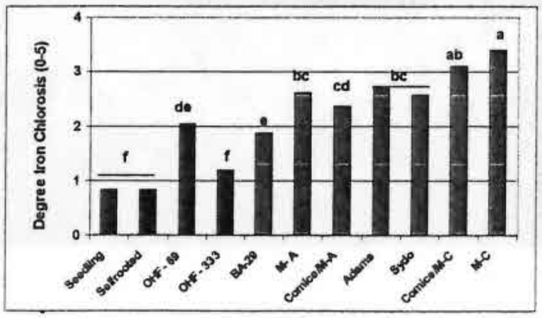


Figure 4: **Effect of rootstock on iron chlorosis of 'Conference' trees. Mean**

Results and discussion

Cumulative yields show significant differences between rootstocks; the highest and most precocious were obtained with the quinces M-C, M-A and Adams 332, and the lowest with seedlings and OHxF clones (*Figure 1*). The least vigour was recorded with M-C and the greatest with OHxF-333 and seedlings. OHxF-69 and self-rooted trees produced greater vigour than quince rootstocks. The weakest rootstocks were also significantly more efficient than the most vigorous ones. No differences in yield efficiency were registered between seedlings and OHxF clones. Self-rooted trees provided intermediate values with respect to quince and OHxF clones (*Figure 2*). Similar values were reported by Westwood et al. (1976). Denby and Meheriuk (1987) reported greater efficiency on OHxF 69 than on OHxF 333 using 'Swiss Bartlett' pear, and also early yields with OHxF 87. Fruit size distribution were recorded as mean values for the period 1999-2003. The highest values for fruit size were observed on quince rootstocks, among them the lowest values for the percentage of fruits >70mm were obtained for M-C. No differences were registered between the other rootstocks, particularly when self-rooted, seedlings and OHxF clones were compared (*Figure 3*). Fruit firmness induced by quince rootstocks was, in general, similar to that obtained with OHxF clones, seedlings and self-rooted trees. SSC and TA were lower for these rootstocks than for quince, which may be indicative of higher quality (*Table 1*). Fruits from self-rooted trees always exhibited a lesser degree of russeting than the rest, with intermediate values being obtained for OHxF clones and seedlings, regardless of differences between quince rootstocks. Fruit colour expressed as Hue angle registered lower values for quince rootstocks than for self-rooted trees, OHxF clones and seedlings (*Table 1*). Self-rooted trees, seedlings and OHxF 333 were the most tolerant to iron chlorosis and OHxF 69 showed similar sensitivity to BA-29, while M-C was always the most sensitive (*Figure 4*). **The OHxF series are usually considered as exhibiting moderate tolerance, similar to that of seedlings (Lombard and Westwood, 1987; Westwood and Lombard, 1983).**

References

• DENBY, L.G.; MEHERIUK, M., 1987. Performance of 'Swiss Barlett' pear on several Old Home x Farmindale quince and seedling rootstocks in British Columbia. HortScience, 22(5):871-872.
• LOMBARD, P.B. and M.N. WESTWOOD. 1987. Pear rootstocks. In: Rootstocks for fruit crops (C.R. and R.F. Carlson, eds), p. 145-183.
• SANZ, M., L. MONTANÉS, L., 1997. Diagnostico visual de la clorosis férrica. Int. Téc. Econ. Agraria, 93: 7-22pp.
• WESTWOOD M.N.; LOMBARD, P.; BJORNSTAND, H.O., 1976. Performance of Bartlett pear on standard Old Home x Farmindale clonal rootstocks. J. Am. Soc. Hort. Sci. 101: 161:164.
• WESTWOOD M.N.; LOMBARD, P., 1983. Pear

Combining ability of fruit appearance and eating quality in pears

S.M. Liu[A], G.R. McGregor[B] and S.M. Richards[A]
[A] Primary Industries Research Victoria, Plant Genetics and Genomics, DPI, Tatura Centre, Ferguson Road, Tatura, VIC 3616, Australia. Tel: 61-3-58245505; Fax: 61-3-5833 5337; Email: shiming.liu@dpi.vic.gov.au.
[B] Primary Industries Research Victoria, Plant Genetics and Genomics, DPI, Knoxfield Centre, 621 Burwood Highway, Melbourne, VIC 3176, Australia

Keywords: General combining ability (GCA), specific combining ability (SCA), narrow-sense heritability, correlation

Abstract

Combining abilities for fruit appearance and eating quality were estimated for 14 pear genotypes and their derived families used in the Australian pear breeding programme. Data from sensory assessment of 30 and 35 families in 2002 and 2003, respectively, was used in the analysis. Mean quality scores skewed to poor fruit appearance and eating quality. There was no correlation between fruit appearance and eating quality in either year. Large variations were observed in 2003 for both attributes and for estimates of GCA and SCA effects. All parents had zero GCA effect for eating quality. Narrow-sense heritability estimates ranged from 0.10 to 0.29 for fruit appearance and were zero for eating quality.

The rankings of GCA effects of parents were moderately correlated between seasons (r^2=0.36, P<0.05). BPM, Eldorado, Guyot and Corella showed large GCA effects for better fruit appearance, but Packham's Triumph, Comice and Winter Cole showed GCA effects for poor appearance. SCA effects contributed to better fruit appearance and eating quality in 8 out of 23 families assessed in both seasons. Rank correlation was significant but weak for SCA effects of eating quality across seasons (r^2=0.18, P<0.05).

The results indicate that good genetic gain can be obtained based on phenotypic selection for fruit appearance using a 9-point hedonic scale for fruit assessment. Selection for good eating quality can be successful within families with large and desired SCA effects over seasons.

INTRODUCTION

Fruit quality is a comprehensive response of human preference to fruit appearance and eating quality. As appearance and eating quality are difficult to measure objectively, fruit breeders rely on sensory assessment to identify the most promising phenotypes among progenies derived by controlled crosses (Bell et al., 1996; Hampson et al., 2000). To improve the success of this selection strategy, knowledge of the inheritance of sensory attributes for fruit quality becomes essential. In this study, we report estimates of combining ability and heritability for pear fruit appearance and eating quality measured with predefined hedonic scales in the Australian National Pear Breeding programme.

MATERIALS AND MATHODS

Fruits assessed in this study came from seedling trees of breeding families grown at DPI, Tatura Centre, Victoria, Australia. All seedling trees were planted from 1993 to 1996 in six orchard blocks with 3 m inter-rows and 0.5 m between seedlings within a row. The blocks were managed according to commercial practice.

Data from 30 and 35 families, which included over 360 and 460 seedling trees for 2002 and 2003, respectively (Table 2), were used in the study. These families were derived from intercrossing 14 European pear genotypes (Table 3). The number of seedling trees assessed per family ranged from 5 to 46.

Fruit harvest and storage were carried out as follows in both seasons. Fruit harvest date was determined based on maturity dates for parental genotypes, and change of fruit skin colour and firmness. Samples of 4 to 6 fruit were harvested for each seedling tree at each harvest, and then stored under cool room conditions of 1°C for approximately 7 weeks. For productive trees, fruit were harvested and stored two or three times at 2 week intervals. After cold storage, fruits were ripened under controlled temperature conditions of 18°C for 7 days, prior to sensory assessment.

Sensory assessment was carried out by a panel of at least 3 people. Both fruit appearance and eating quality were scored according to a 5-point inverse and a 9-point hedonic scale in 2002 and 2003, respectively (Table 1).

The univariate analyses were based on a mixed model as follows for each season:

$$y_{ijk}=\mu+b_i+g_j+g_k+s_{jk}+e_{ijk}.$$

where y_{ijk} is a given score for quality attributes of individual trees, b_i is a fixed effect for orchard block i, g_j and g_k are the general combining ability (GCA) effects for female and male genotypes, respectively, s_{jk} is the specific combining ability (SCA) effect for the family derived from parents j and k, and e_{ijk} is the random residual effect. For trees with multiple harvest dates, the highest score was used in the analysis as it was likely to represent genotypic potential.

The above model was fitted using ASReml (Gilmour et al., 2000). Narrow-sense heritability (h^2) was calculated as follows: $h^2= 4\sigma^2_{gca}/(4\sigma^2_{gca}+4\sigma^2_{sca}+\sigma^2_e)$, where $\sigma^2_{gca,}$ σ^2_{sca} and σ^2_e are estimated GCA, SCA and residual variance components, respectively (Falconer, 1989). Spearman rank correlation coefficients were used to compare GCA and SCA effects across seasons.

RESULTS

The distribution and mean quality scores were skewed to poor appearance and eating quality across assessed seedling trees in both seasons (Table 2). Phenotypic variation was similar for both attributes in 2002, but in 2003 was almost twice as large for appearance as for eating quality. There were phenotypes with superior appearance or eating quality (Table 2), and correlation was not significant between them within each season (r^2=0.05, P>0.05).

GCA effects varied with parents for appearance, but were zero for eating quality in both seasons (Table 3). BPM, Eldorado, Guyot and Corella had larger values and tended to improve fruit appearance. In contrast, Packham's Triumph, Comice, and Winter Cole had smaller values and contributed to poor appearance. Genotypic difference for GCA effects was larger in 2003 than in 2002. However, a moderate rank correlation (r^2=0.36, P<0.05) existed for genotypic GCA effects between seasons (Table 3).

The estimates of SCA effects for 23 families are presented in Figures 1 and 2 as they were assessed in both seasons. The estimates differed with families for both quality attributes, and 13 and 15 families exhibited consistency for SCA effects across seasons for fruit appearance and eating quality, respectively. Among them, 8 families possessed SCA effects for good appearance (Fig. 1) or eating quality (Fig. 2). The difference in SCA effects among families was larger in 2003 than in 2002, and a weak rank correlation was found for the estimates of eating quality across seasons (r^2=0.18, P<0.05).

The magnitude of σ^2_{gca} and σ^2_{sca} estimates was larger in 2003 than in 2002 for fruit appearance (Table 4), and the relative importance of σ^2_{gca} also resulted in a higher estimate for heritability in 2003. Heritability estimates were zero for eating quality in both seasons due to zero values of σ^2_{gca} estimates.

DISCUSSION

Although the majority of assessed seedling trees produced poor quality fruits, phenotypes with either better appearance or eating quality were identified. As no adverse correlation exists between these quality attributes, it is not difficult to select recombinants with excellent fruit appearance and eating quality as long as a large number of seedling hybrids are assessed. This evidence agrees with a very low retention of pear seedling hybrids at primary stages of evaluation in our breeding programme, and accords with pear breeding practice world-wide (Bell et al., 1996).

Estimates of GCA effects and heritability both suggest that fruit appearance is controlled by additive gene effects, but eating quality is predominantly governed by non-additive gene effects. Among parental genotypes, BPM, Eldorado, Guyot and Corella possess good ability to transmit their superior fruit appearance to seedling progeny.

A moderate heritability estimate for fruit appearance in 2003 implies that good genetic gain can be achieved based on phenotypic selection (Lerner, 1958; Hansche, 1983). In contrast, to improve eating quality, a strategy exploiting non-additive gene effects should be emphasised. Non-additive gene effects can be utilised in fruit crops due to their clonally-propagated nature (Bringhurst, 1983). As genetic variation is similar within families to between families (Simmonds, 1996), and the magnitude and directions of estimates of SCA effects varied with families and also with seasons in this study, selection for promising phenotypes can be more fruitful in families with large and desired SCA effects across seasons.

The larger magnitude of estimates in 2003 is more likely to be a result of a more extensive hedonic scale used for quality assessment in that season. The expanded scale seems to be better in differentiating underlying genotypic difference of phenotypic performance. Thus, choosing an appropriate scale is of utmost importance to understanding the inheritance of fruit quality attributes, and thereby enhancing selection efficiency of breeding for fruit quality.

ACKNOWLEDGEMENTS

The authors acknowledge funding support for this research provided by Horticulture Australia Limited and technical assistance from John Washbourne, Paul Pierce, David Haberfield, and Barry Collins. The authors are also grateful to Bill Ashcroft and Alvin Milner for their critical reading of the manuscript.

Literature Cited

Bell, R.L., Quamme, H.A., Layne, R.E.C. and Skirvin, R.M. 1996. Pear. p.441-514. In: J. Janick and J.N. Moore (eds.), Fruit Breeding. John Wiley & Sons Inc., New York.

Bringhurst, R.S. 1983. Breeding strategy. p.147-153. In: J.N. Moore and J. Janick (eds.), Methods in Fruit Breeding. Purdue University Press, West Lafayette, Indiana.

Falconer, D.S. 1989. Introduction to quantitative genetics. Longman Group UK Limited, Essex, England.

Gilmour, A.R., Cullis, B.R., Gogel, B.J., Welham, S.J. and Thompson, R. 2000. ASReml User Guide. NSW Agriculture.

Hampson, C.R., Quamme, H.A., Hall, J.W., MacDonald, R.A., King, M.C. and Cliff, M.A. 2000. Sensory evaluation as a selection tool in apple breeding. Euphytica 111:90-79.

Hansche, P.E. 1983. Response to selection. p.154-171. In: J.N. Moore and J. Janick (eds.), Methods in Fruit Breeding. Purdue University Press, West Lafayette, Indiana.

Lerner, I.M. 1958. The genetic basis of selection. Wiley, New York.

Simmonds, N.W. 1996. Family selection in plant breeding. Euphytica 90:201-208.

Table 3. GCA effect and ranking for fruit appearance and eating quality of 14 parental genotypes in the 2002 and 2003 seasons, respectively.

Parent	Appearance[1]				Eating quality	
	2002	Ranking	2003	Ranking	2002	2003
			GCA effect			
HW606	-0.154	1	-0.139	8	0.0	0.0
BPM	-0.118	2	0.308	3	0.0	0.0
Eldorado	-0.111	3	0.197	6	0.0	0.0
Guyot	-0.095	4	0.604	1	0.0	0.0
Corella	-0.010	5	0.510	2	0.0	0.0
Josephine	-0.003	6	-0.224	10	0.0	0.0
L'inconnu	-0.003	7	-0.242	11	0.0	0.0
Potamac	0.014	8	0.018	7	0.0	0.0
Howell	0.034	9	0.222	5	0.0	0.0
I11-13B-83	0.040	10	-0.161	9	0.0	0.0
WBC	0.059	11	0.307	4	0.0	0.0
Packham's T	0.080	12	-0.613	13	0.0	0.0
Comice	0.103	13	-0.968	14	0.0	0.0
Winter Cole	0.134	14	-0.552	12	0.0	0.0
			Rank correlation coefficient			
			-0.60*		-	

[1] Due to the different scales used for fruit assessment, in 2002 estimate with negative value indicates better GCA effect, but in 2003 indicates poorer GCA effect for fruit appearance.

* Significant at P<0.05.

Table 4. GCA and SCA variance components and narrow-sense heritability estimates for fruit appearance and eating quality in the 2002 and 2003 seasons, respectively.

	Appearance		Eating quality	
	2002	2003	2002	2003
σ^2_{gca}	0.023	0.319	0.000	0.000
σ^2_{sca}	0.104	0.247	0.015	0.049
h^2	0.10	0.29	0.0	0.0

$h^2 = 4\sigma^2_{gca}/(4\sigma^2_{gca}+4\sigma^2_{sca}+\sigma^2_e)$.

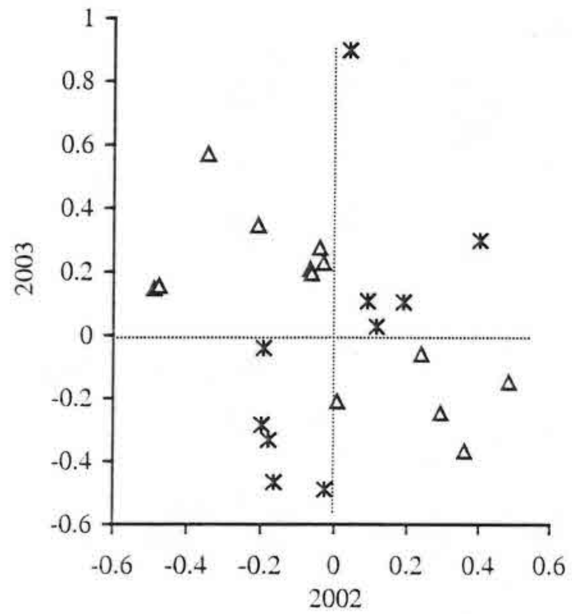


Fig. 1. Variation and relationship of SCA effects for fruit appearance of 23 families assessed in the 2002 and 2003 seasons, respectively.

Due to the different scales used in fruit assessment, in 2002 estimate with negative value indicates better SCA effect for appearance, but in 2003 indicates poorer SCA effect. The points (Δ) indicate the families exhibiting consistency for SCA effects across seasons.

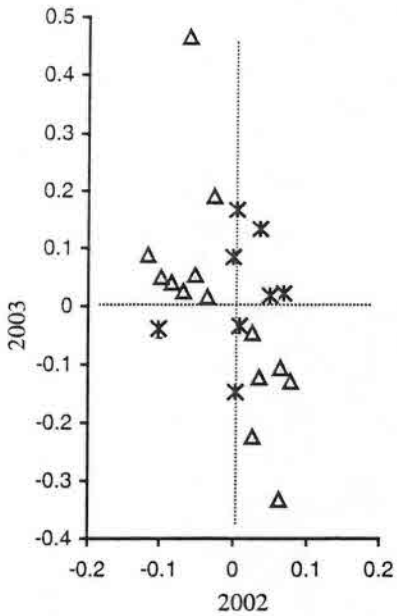
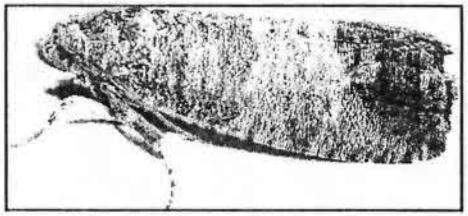


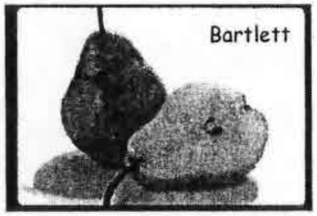
Fig.2. Variation and relationship of SCA effects for eating quality of 23 families assessed in the 2002 and 2003 seasons, respectively.

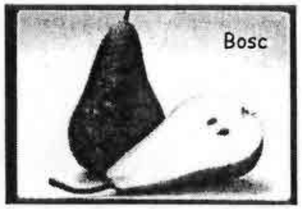
Due to the different scales used in fruit assessment, in 2002 estimate with negative value indicates better SCA effect for eating quality, but in 2003 indicates poorer SCA effect. The points (Δ) indicate the families exhibiting consistency for SCA effects across seasons.

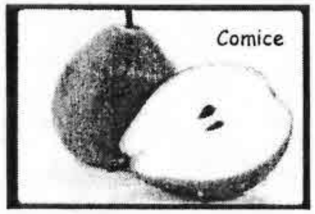
Monitoring Codling Moth in Pear with the Pear Ester

Alan Knight, USDA, ARS, Wapato
Philip VanBuskirk and Rick Hilton,
Southern Oregon Research &
Extension Center, Medford, OR









INTRODUCTION

Codling moth (CM), *Cydia pomonella* L., is the major pest of pear. Management of CM in the western United States relies on both the use of sex pheromones (50% of the acreage is under mating disruption [MD]) and the use of insecticides. MD orchards are typically supplemented with 0 - 2 IGR's or organophosphate (OP) sprays. Conventional orchards usually receive 3 -4 cover sprays of OP, neonicotenoid or synthetic pyrethroid insecticides.

Standard Monitoring of CM

Sex pheromone-baited traps are widely used to monitor CM. Moth catches in these traps establish both the beginning and the peak of moth flight and to establish a threshold for pest pressure. The first insecticide spray is timed at 250 degree days (lower developmental threshold = 50°F) after the start of the male flight. Captures of CM are typically low in managed orchards and the use of MD makes the utility of sex pheromone-baited traps problematic. In particular, the occurrence of 'False Negatives' where traps fail to detect a local CM infestation occurs too often with sex pheromone traps in MD orchards. The revelation that the pear ester, ethyl (2E, 4Z)-2,4-decadienoate, was highly attractive for CM and caught both sexes of moths was a useful step in developing new and improved monitoring systems.

Monitoring CM with the DA Lure

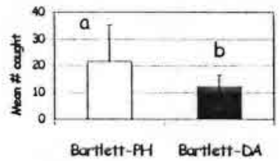
The pear ester is sold as the Pherocon CM DA lure by Trécé Inc. and has been most widely tested in apple and walnut. Traps baited with the DA lure have been useful in detecting the start of female moth flight and have allowed effective timing for sprays (1st female or 1st sustained female moth catch + 155 degree days for the start of egg hatch (Fig. 1). Data from apple has shown that the effectiveness of the lure is impacted by apple cultivar (Fig. 2). The lure appears to be most effective in late-season apples such as Fuji and Granny Smith and least effective in Gala and Golden Delicious. The DA lure has a short-range of activity and has been shown to provide a better predictor of the absence of a local pest population (especially the # of females caught) than a sex pheromone lure in apple (Fig. 3).

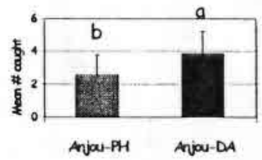
The initial studies with the pear ester in pear were conducted in conventional and MD blocks of Bartlett in California and Washington (Fig. 4). The lure did not perform well in these studies as catches were low in relation to a sex pheromone lure. Subsequent studies have been conducted in blocks of Anjou, Bosc, and Comice under MD in Oregon and Washington. These data are presented here.

Pear Ester - Ethyl (2E, 4Z)-2,4-decadienoate

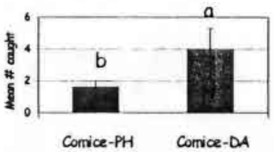
Comice > D'Anjou > Bosc > Bartlett

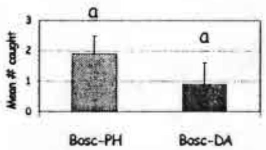
Yakima / Brewster Study 2002





Medford Study 2003





METHODS

Replicated blocks of each pear cultivar were monitored with delta traps baited with either the Biolure 10X pheromone lure or the pear ester DA lure. Traps were checked weekly and lures were replaced after 8 wks.

RESULTS

During 2002 the DA lure caught significantly more moths than the pheromone lure in MD blocks of D'Anjou and significantly fewer moths in MD blocks of Bartlett in Brewster and Yakima, WA, respectively. Moth catches were low in MD pear orchards in Medford during 2003. DA lures caught significantly more moths than the sex pheromone lure in Comice and there was no difference between lures in Bosc.

Fig. 1

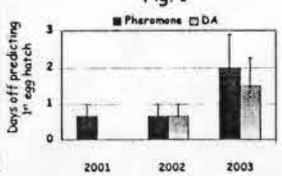


Fig. 2

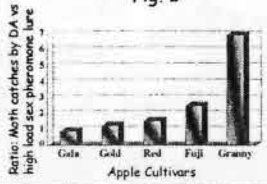


Fig. 3

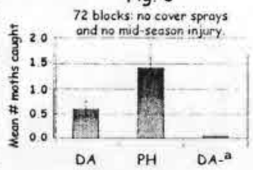
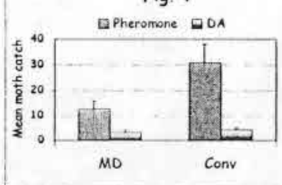


Fig. 4



CONCLUSIONS

The pear ester lure is a powerful new tool for monitoring CM in Comice, D'Anjou, and Bosc pear orchards under MD. Adoption of this lure will likely be greatest in problem blocks and areas of blocks where the performance of the standard pheromone-baited trap has been poor. Further evaluation of the DA lure for other pear cultivars grown in Europe, S. Africa, New Zealand, Australia, Chile,and Argentina are needed.

Consumer Sensory Evaluation of Pear Cultivars in the Pacific Northwest, U.S.A.

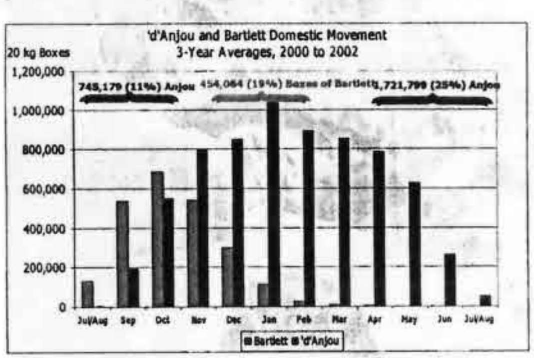
Janet Turner and Jinhe Bai; Oregon State University Mid-Columbia Agricultural Research and Extension Center, Anna Marin, Ann Colonna;
The Food Innovation Center, Portland, OR

The Success of the Hood River Valley Pear Industry is not Competing in a Global Market with Low Cost Fruit, but rather its Ability to Provide an Array of Pears that are Demanded by its Customers and Consumers in the Proper Markets for Exceptional Quality.

This guiding principle for the cultivar trial at MCAREC has been derived in part from the analysis of the 3-year averages of 'd' Anjou' and 'Bartlett' sales of the total boxes sold in the USA. As shown in the graph, about 19% of the 'Bartlett' and 25% of 'd'Anjou' pears are sold after optimal storage for quality fruit. Conversely, 11% of 'd'Anjou' pears are sold prematurely before the pear can ripen to it's optimum quality.

We are not advocating the elimination of the standard commercial varieties, but would encourage growers to produce alternative varieties in seasonal sets:

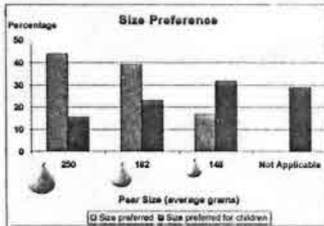
- **Early season (August to mid October),**
- **Mid season (November to mid December)**
- **Late season (Mid December to late Spring).**

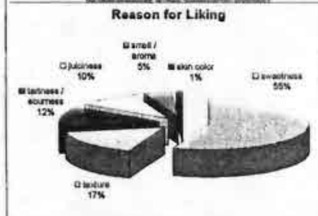


Source: Winter Pear Control Committee annual reports, season summary, 2000-2003.

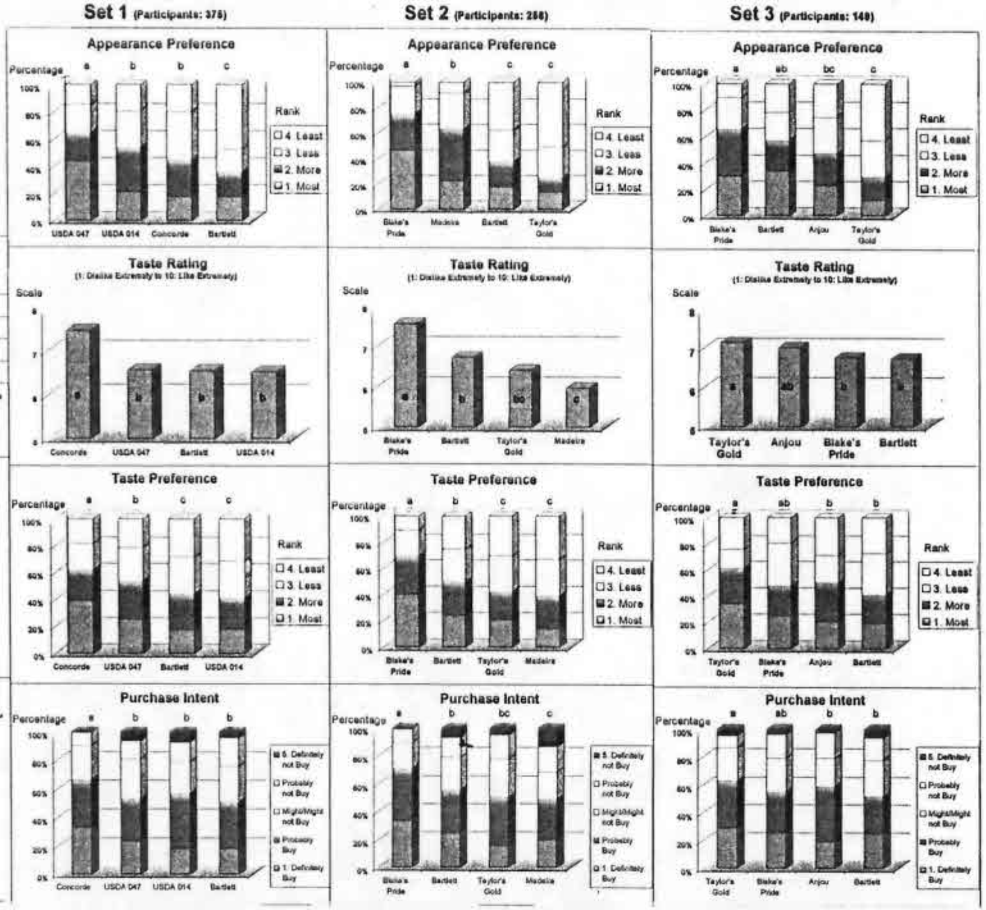
Selected Demographic Attrabutes of Participants for Consumer Sensory Evaluation of Pear Varieties (October 18 & 19, November 1, & November 22, 2003)

Gender	*Percent*
Female	62%
Male	38%
Age, years	
11-17	7%
18-24	7%
25-34	18%
35-44	17%
46-59	34%
60+	16%
Frequency to Eat Pear	
Daily	3%
Once to Several Times a Week	21%
Once to a Few Times a Month	41%
More Frequently, Around the Holidays	18%
Infrequently, a Few Times a Year or Less	18%
Variety Eaten Most Often	
Green Anjou	11%
Red Anjou	5%
Green/Yellow Bartlett	27%
Red Bartlett	7%
Bosc	16%
Comice	10%
Other	10%
Don't Know	14%
Total Number of Participants	780





Based on results from our sensory evaluations, we have learned that consumers want a pear that is Bartlett shaped with a blush. They prefer sweet pears and some choose pears for texture. In order to provide the consumer with the perfect pear for each calendar month, with reduced costs to the grower, it has become imperative to develop alternative pear varieties for the periods when 'Bartletts' and 'd'Anjous' fail to meet optimal storage standards. Instead of pursuing costly treatments to extend the market season for varieties that are marketed past their optimal storage, the industry must diversify with varieties that have customer and consumer acceptance, resistance to diseases and storage disorders, and pack and ship well for the appropriate marketing period, as well as being profitable to Hood River Valley growers and adaptable to the region.



ORFGON STATE UNIVERSITY

ROOTSTOCKS

APPLES

Cultivar	Vigour (% of standard*)	Characteristics	Utilisation of Rootstock	General Comments
MM109	100 - 110%	Precocious and high production	Wide adaptability, low to medium potential soils and warmer areas	Recommended for spur type - poor soils and replant sites
M25	100%	Very precocious and high production	Low to medium potential soils	Good tree structure for light penetration, recommended for medium to poor soils and replant sites, can get collar rot in poorly drained soils, collar rot is controllable with chemical treatment.
M793	80 - 90%	Precocious and high production	Wide adaptability	Recommended for a wide range of soils and cultivars
MM106	60 - 70%	Very precocious and high production	Medium to high potential soils	Produces flat crotch angles, give good fruit size, can get collar rot in poorly drained soils. Collar rot is controllable with chemical treatment.
M7	60%	Precocious and high production	Wide adaptability, not for spur types	Resistant to collar rot. Produce flat crotch angles.
M26	40 - 50%	Precocious and high production	High potential soils and colder climates	Produces burrknots, sunburn can be problem in weak growing conditions.
M9	30%	Very precocious and high production	High potential soils - colder climates and vigorous cultivars	Produce flat crotch angles and large fruit. Can give sunburn in weak growing conditions.

*Standard is apple seedling

PEARS

Cultivar	Vigour (% of standard*)	Characteristics	Utilisation of Rootstock	General Comments
*BP3	100%	Precocious and high production	Wide adaptation. Good on low potential soils. Cold and warm areas	Tolerant to apple stem grooving and apple clorotic leafspot viruses. Recommended for less vigorous and red cultivars.
*BP1	60 - 80%	Precocious and high production	Medium to high potential soils and colder areas	Tolerant to apple stem grooving and clorotic leafspot viruses. Recommended for vigorous and bi-colour cultivars. Require spur pruning in hot climates.
Quince A	50 - 60%	Very precocious and high production	Medium to high potential soils	Recommended for vigorous and bi-colour cultivars. Only compatible with Beurré Hardy and Comice. Needs an interstem for other cultivars.
Quince C51	40 - 60%	Very precocious and high production	High potential soils	Compatibility like Quince A. Recommended for vigorous and bi-colour cultivars.

*Standard is pear seedling -Staking of all rootstocks recommended

STONE FRUIT

Cultivar	Vigour (% of standard*)	Characteristics	Utilisation of Rootstock	General Comments
Kakamas Seedling	Vigorous	Less fertile than Sapo 778, GF677	Well drained soils	Lots of variation due to seedling characteristics. Susceptible to free lime and nematodes.
*GF677	Very vigorous	Fairly drought resistant, lime resistant	Soils with free lime, low potential soils, dry conditions	Recommended for Almonds, Nectarines, Peaches and Plums. Give higher production than Kakamas seedling rootstocks.
*SAPO 778	Vigorous	More resistant than GF677 to nematodes. Very fertile.	Soils with no free lime, medium to high potential soils	Recommended for Almonds, Nectarines, Peaches and Plums. Give higher production than Kakamas seedling rootstocks. Root depth 30-60 cm.
*Viking	Vigorous	Handle wet soils better than GF677	Low and high pH soils	Recommended for peaches, nectarines and plums.
Nemaguard	Vigorous	Nematode resistant, wet susceptible	Well drained soils with high nematode infestations	Recommended for Almonds, Nectarines, Peaches and Plums
Nemared	Vigorous	Nematode resistant, wet susceptible	Well drained soils with high nematode infestations	Recommended for Almonds, Nectarines, Peaches and Plums
Marianna	Vigorous	Handle wet soils well	Recommended for Plums	More vigorous than Maridon.
Maridon	Vigorous	Fairly wet, lime and nematode resistant	Recommended for Plums and Apricots	More tolerant to Bacterial Cancer than Marianna, 7-10 days earlier than Marianna. Rounder fruit than Marianna. Needs an interstem for Apricots. Recommended above Marianna
Apricot Seedling	Vigorous	Wet susceptible. Fiarly lime and nematode resistant	Recommended only for apricots	Need a deep soil 60-90 cm

*Plant Breeders' Rights (royalties payable)

ALMONDS

Cultivar	Full Bloom	Harvest Date	Compatibility	Short Description
*Ferragnes	Late August	2nd week of February	Self-incompatible	Production unshelled - 18 kg per tree in good seasons and 6 kg per tree in poor seasons, taste pleasant, quality moderate, kernel is brown to dark brown
Ne Plus Ultra	Middle August	1st week of February	Self-incompatible	Production unshelled 6 kg per tree, taste good, quality moderate, kernel is light brown to brown
Nonpareil	Middle August	Last week of January	Self-incompatible	Production unshelled 5 kg per tree, taste sweet, quality excellent, kernel a very light brown
Peerless	Middle August	1st week of February	Self-incompatible	Production unshelled 9 kg per tree, taste moderate, quality moderate to poor, kernel is brown
Texas Mission	Late August to early September	3rd week of February	Self-incompatible	Production unshelled 5 kg per tree, typical almond taste, quality good, kernel light brown.
*Volcani 5	Late July to early August	1st week of February	Self-incompatible	Production unshelled 7 kg per tree, taste good, quality good, kernel brown to dark brown.
Volcani 59/4	Early August	1st week of February	Self-incompatible	Production unshelled 6 kg per tree, taste good, quality good, kernel light brown.

*Plant Breeders' Rights (royalties payable)

CHERRIES

CULTIVAR	ORIGIN	TREE	FRUIT	GENERAL
Bing	Seedling of Black Republican	Chilling requirement: high Vigour: strong Growth habit: upright Full bloom date: late September Pollinators: Black Tartarian, Giant Heidelfinger Early Rivers Production: good	Harvest date: middel December Shape; round to heart shaped Skin colour: red Flesh colour: dark red Taste: good Texture: firm Stone: semi-free	Inclined to crack during wet conditions at harvest.
Black Tartarian	Old European cultivar	Chilling requirement: high Vigour: strong Growth habit: upright Full bloom date: middle September Pollinators: Bing, Napoleon Production: good	Harvest date: early to middle December Shape: heart shaped Skin colour: dark red Flesh colour: dark red Taste: good Stone: free	Tree is susceptible to crinkle leaf which will reduce production
Early Rivers	Seedling of Early Purple	Chilling requirement: high Vigour: strong Growth habit: semi-upright Full bloom date: middle September Pollinators: Napoleon, Stella , Bing Production: good	Harvest date: Late Novemer Shape: round to slightly heart shaped skin colour: dark red Flesh colour: red Taste: good Texture:soft Stone: free	Resistant to cracking.
Giant Heidelfinger	Old German cultivar (1850)	Chilling requirement: high Vigour: strong Growth habit: spreading Full bloom date: late September Pollinators: Bing, Napoleon, Stella Production: good	Harvest date: Late December Shape: heart shaped Skin Colour: red Flesh Colour: red Taste: good Texture: firm Stone: semi -free	Fairly resistant to cracking.
Stella	Cross between Lambert and John Innes 2420. Released in 1970.	Chilling requirement: high Vigour: vigorous Growth habit: upright spreading Full bloom date: middle to late September Pollinators: self compatible Production: good	Harvest date: Late November Shape: heart shaped Skin colour: dark purple to red Flesh colour : red Taste: good Texture: very firm Stone: semi-free	First self-compatible sweet cherry to be released. Good general cross pollinator. Fruit crack during wet conditions at ripening.
Napoleon	Unknown	Chilling requirement: high Vigour: strong Growth habit: semi-spreading Full bloom date: late September Pollinators: Black Tartarian, Giant Heidelfinger Rainier Production: good	Harvest date: middle December Shape: round to heart shaped Skin colour: yellow to cream with red blush Flesh colour: cream, clear juice Taste: good Texture: firm Stone: semi-free	Inclined to crack during wet conditions at harvest.

OLIVES			
FRUIT CHARACTERISTICS	**MISSION**	**MANZINILLA**	**KALAMATA**
Fruit Size	4-5 gram when ripe	5 gram	5-6 gram
Shape	Ovate	Oval round	Crescent
Harvest	After May	End of February	Middle April to end May
Use	Black table olives and oil	Oil	Black table olives
Taste	Good	Excellent	Unique
Texture	Medium firm to plump	Excellent	Firm

Mandarin Hybrids

Rating	Selection	Origin & Fruit Characteristics	Production Characteristics	Climatic Suitability	Status and Availability	Economic Prospects
AA	*Afourer	This Murcott type from Morocco is seedless in solid block plantings. Fruit maturity is expected to be June-August. Fruit size is medium (55mm) to large (70mm). Rind colour is deep orange when hung late. Quality is very good. Peelability is easier than that of Nova.	Unknown due to insufficient literature and no trees in production in RSA.	Cool and cold production areas.	By 1996 Morocco had planted in excess of 100 000 trees with future plantings expected to increase sharply. Limited quantities have been planted in California. To be released to the OFB at the end of 1997. A patented cultivar.	This high quality, well coloured, late maturing mandarin type stands to reduce losses overseas for green colour (Clementine Lates) and is a good economic prospect due to the shortage of true easy peelers on the market at that time. This mandarin is considered to be the most significant new discovery and has excellent prospects due to high quality, late maturity, seedlessness and ease of peeling.
A	*Mor	This induced Murcott mutation from Israel is expected to mature July to August. Internal quality is excellent: high sugar and acid content. Fruit size is large and rind thin. In a mixed block seediness ranges from 0-5 seeds/fruit. Expected to be virtually seedless in solid block plantings.	The tree has an upright, vigorous growth habit and is productive. Alternaria could be a problem but not as susceptible as Minneolas and Winolas.	Intermediate to cold production areas.	Approximately 200 ha have already been planted in Israel to date with a sharp increase expected in future. Imported into RSA in 1997. A patented cultivar.	As for Nectar, but even later maturing which increases prospects due to low volumes of easy peelers available at that time.
A	*Or	This Temple X Dancy hybrid from Israel is an induced mutation of Orah. The Orah is seedy in mixed plantings and performance in solid block plantings uncertain. However, the seediness of the Or selection varies from 0-7 seeds/fruit in mixed plantings - expected to be virtually seedless in solid block plantings. Maturity expected to be July-September. Rind colour is initially yellowish orange developing to orange and eating quality excellent. One disadvantage is that acid levels drop in transit. Outside fruit appear to be prone to sunburn.	The growth habit is vigorous and trees productive. Only high quality rootstocks should be used.	Intermediate to cold production areas.	Approximately 100 ha of Or have already been planted in Israel to date with a sharp increase expected in future. The Or was imported into the RSA in 1997 and the Orah is available from the OFB. Experimental plantings of the Orah already established in the RSA. A patented cultivar.	As above for Nectar and Mor, but even later maturing and therefore a good economic prospect.

*Plant Breeders' Rights (royalties payable)

Citrus / Sitrus

Easy Peelers

Production Areas Western Cape - 50%, Eastern Cape - 43%, Zimbabwe - 3%, Other - 4%

Clementine	Some claim that the Clementine originated in Oran, Algeria, but most believe its origins lie in Gwangxi and Guangdong Provinces of China. It is harvested from mid April to beginning July. The Clementine is almost completely seedless. It is easy to peel and segment. Skin colour is bright orange. The flavour is sweet and delicious. Marketing weeks in Northern Hemisphere: 17 - 34.
Minneolas	This fruit originated in Florida in 1931. It is a hybrid of the grapefruit and the tangerine. It is harvested mid May to end June (hot areas) and mid June to end July (cool, inland areas). Minneola tends to have big fruit with a distinctive tip (or nose). The mature fruit is a deep, orange colour. It is juicy, aromatic and has a good tangy flavour. Marketing weeks in Northern Hemisphere: 24 – 36.
Novas	Nova originated in Florida in 1942. It is harvested from end April to end May/beginning July (cool, inland areas). The fruit is medium to large in size. The rind is a reddish-orange colour and the flesh is deep orange. The segments are juicy, tender and sweet. Marketing weeks in Northern Hemisphere: 17 ange. The segments are juicy, tender and sweet. Marketing weeks in Northern Hemisphere: 17 – 34.
Satsumas	Satsuma originated in Japan in the mid 16th century. It is harvested end March to end May. It is an easy-peeler and entirely seedless. The skin colour can be green, even when the fruit is mature. Marketing weeks in Northern Hemisphere: 18 kin colour can be green, even when the fruit is mature. Marketing weeks in Northern Hemisphere: 18 – 26.
Tambor	Tambor originated in Jamaica. It is harvested end June to early August. The pulp is tender and extremely juicy. The fruit is of medium size and slightly flattened at the stylar-end, where a small navel is often formed. Marketing weeks in the Northern Hemisphere: 49 he stylar-end, where a small navel is often formed. Marketing weeks in the Northern Hemisphere: 49 – 06.

Lemons

Production Areas Eastern Cape - 50%, Western Cape - 35%, Mpumalanga 15%

Eureka	This fruit originated in California in 1858. It is harvested mid Feb to mid July (hot areas) and mid March to mid August (cool, inland areas). The rind is smooth and has a thin to medium thickness. This lemon has a high acid level and a high juice content. It rarely has more than 5 seeds per fruit and is often seedless. Marketing weeks in Northern Hemisphere: 12-44.

Grapefruit

Production Areas Swaziland - 35%, Mpumalanga - 35%, Northern Province - 15%, Kwazulu-Natal - 12%, Eastern Cape - 3%

Pummelo	Originated in Southern China and is the parent of modern grapefruit. It is harvested from April through to June. It has a yellow skin; flesh colour can be white or greenish or red. The fruit is very large, minimum 108mm in diameter. An individual fruit can weigh up to 1,5 kg (3lb). Marketing weeks in the Northern Hemisphere: 17-35.
Flame	Originated in Florida in 1973. It is harvested mid April to end June. It has a sweet taste, and a lower acid level than Star Ruby. The skin is yellow with a red blush. The flesh is red and has no seeds. Marketing weeks in Northern Hemisphere: 19-33.
Marsh	The Marsh originated in a Duncan tree in Lakeland, Florida around 1860. It is harvested at the end of March to mid/late June (hot areas). The fruit is large, white and virtually seedless. Marsh is suitable for fresh consumption in segments and for juicing. Marketing weeks in Northern Hemisphere: 17-35.
Rose	Originated in Texas in 1926. Harvested mid April to end June. This fruit has a pale pink flesh with slightly blushing skin. Skin colour is yhellow with a red blush. It is juicy and sweet. Marketing weeks in Northern Hemisphere: 19-33.
Star Ruby	This variety originated in Weslaco, Texas in 1959. Harvested mid April to end June (hot areas). Skin colour is yellow with red background. Flesh is red. It is the most heavily pigmented grapefruit and rarely has more than one or two seeds. It has a thin rind, a very high juice content and a sweet flavour. It is well suited to those who find other grapefruit too sharp in taste. Marketing weeks in Northern Hemisphere: 19-33.

Citrus / Sitrus

Orange Cultivars / Lemoen Kultivars

Production Areas

Navel types: Eastern Cape - 30%, Western Cape - 25%, Northern Province - 25%, Mpumalanga - 20%
Valencia types: Northern Province - 55%, Eastern Cape - 20%, Western Cape - 15%, Mpumalanga - 17%, Kwazulu-Natal - 3%
Midseasons: Northern Province - 70%, Mpumalanga - 30%

Delta Seedless	The Delta Seedless originated near Pretoria, Gauteng, South Africa in 1952. It is harvested mid June to end August (hot areas), mid July to end August (cool, inland areas). The fruit is of good quality and is seedless. It has an attractive smooth rind. Marketing weeks in Northern Hemisphere: 28-49.
Midknights	The origin of this fruit is unknown, but it was first seen as a slightly earlier- maturing tree growing in a Valencia orchard in Addo, South Africa in 1927. Its potential, however, was not recognised until the 1970's.It is harvested from end June to August (hot areas), from mid July to end September (cool, inland areas), and beginning August to end September (cold areas). Midknight has a very high juice percentage and a very good flavour. It has a significantly larger fruit size and is nearly seedless. Midknight tends to be more difficult to peal because it has a thinner rind. Marketing weeks in Northern Hemisphere: 31 - 47.
Navelates	The Navelate is derived from the Navel. It is harvested mid May to end July. The fruit is medium to large in size and has a small navel which is often concealed. It is a top quality orange with a consistent, pleasant, sweet flavour. Marketing weeks in Northern Hemisphere: 22 - 35.
Navels	Navels originated in China. It is harvested, depending on the cultivar and region, between early/mid April and end July/beginning August. Navel oranges have the distinctive feature of having a small secondary fruit embedded in the apex of the primary fruit. The fruit is large and has a deep orange colour. It peels easily and the tender flesh provides a rich and pleasant flavour. The navel is recognised as the primary eating orange throughout the world. Marketing weeks in Northern Hemisphere: 19 - 35.
Shamoutis	The Shamouti originated as a common orange tree in an orchard near Jaffa, Israel. It is harvested beginning/mid June to mid/end July (cool, inland areas). It is medium to large in size and oval shaped. Shamouti is one of the easiest oranges to peel without releasing much rind oil. It has a distinctive fragrance and a unique flavour. Marketing weeks in Northern Hemisphere: 30 - 35.
Tomangos	The origin is not known for certain but the Tomango was first propagated on a commercial scale in the Eastern Transvaal, South Africa in 1916. Harvest date is end April to end May (hot areas) and mid May to end June (cool, inland areas). Fruit is of good quality but is mainly small in size. It is oval in shape with a smooth rind texture and a pale orange colour. The Tomango is largely seedless with tender, juicy flesh and is suitable for juicing or eating fresh. Marketing weeks in Northern Hemisphere: 21 - 31.
Valencia	This orange originated in the Azores in the early 1860's and is of Portuguese origin. Valencia is harvested, depending on the cultivar and region, between mid June and end September (hot areas), and mid July to mid October (cool, inland areas). Fruit size is medium to large. It is roundish-oblong in shape with a well-coloured, moderately thin rind of smooth, sometimes finely pebbled texture. The relatively high acid content combines with a high sugar content to produce a delicious taste. This variety is ideal for juicing. Marketing weeks in Northern Hemisphere: 30 - 49.

PRUNES

Cultivar	Full Bloom	Harvest Date	Compatibility	Short Description
President	Late September	Late February	Self-Compatible	Production moderate, taste moderate, free stone
Prune d'Agen	Late September	Late February	Self-Compatible	Production good, storage ability poor, taste very good - high sugar, free stone, outstanding drying quality.
Van der Merwe	Middle September	Middle January	Self-Compatible	Production good, storage ability poor, taste very good - high sugar, free stone, outstanding drying quality.

APRICOTS

Cultivar	Full Bloom	Harvest Date	Short Description
Bulida	Late August	Late November	Production very good, storage ability poor, little taste, free stone, good canning quality
Cape Babeco	Late August	Late December	Production good, storage ability good, reasonable taste, free stone, good dessert and drying quality, yellow with red blush, good fruit size.
*Grandir	Late August	Late November	Production reasonable, storage ability good for 4 weeks at -0,5°C, fair taste, free stone, orange-yellow with red blush, needs Palsteyn and Supergold as cross-pollinators , good fruit size.
*Ladisun	Late August	Late November	Production very good, storage ability poor, little taste, free sone, good drying quality - recommended for drying only, yellow skin colour.
Palsteyn	Late August	Late November	Production very good, storage ability good for 4 weeks at -0,5°C, taste acid but very good flavour in Little Karee, free stone, orange with red blush, good fruit size.
*Soldonné	Late August	Late November	Production good, storage ability good for 3 weeks at -0,5°C, taste good, free stone, good drying quality, orange-yellow skin.
*Super Gold	Early September	Early November	Production very good, storage ability good for 3 weeks at -0,5°C, taste good, free stone, orange-yellow skin.
*Tri-gems	Late August	Late November	Production good, storage ability good, fair taste, free stone, goodcanning quality, yellow with red blush, suitable for export.

*Plant Breeders' Rights (royalties payable)

NECTARINES

Cultivar	Full Bloom	Harvest Date	Short Description
*Alpine	Late July	Middle to late November	Production very good, storage ability good for 4 weeks at -0,5°C, taste good, bright red skin colour gives a very attractive appearance
*August Glo	Early September	Late January	Production good, storage ability moderate for 4 weeks at -0,5°C, taste good, clingstone, red blushed fruit, better colour than Zaigina
*August Red	Early September	Middle February	Production good, storage ability good for 3 weeks at 0,5°C, taste good, clingstone, red blush on yellow background, late maturing.
*Crimson Giant	Middle August	Middle December	Production good, storage ability variable for 4 weeks at 0,5°C, taste good - slightly acid, semi-clingstone, low chilling requirement, does not crack under wet conditions, dark red skin with specks.
*Donnarine	Late August	Middle December	Production good, storage ability good for 4 weeks at 0,5°C, taste good - slightly acid, free stone, suitable for export, tends to crack under wet conditions prior to harvest.
Fantasia	Middle September	Middle January	Production moderate, storage ability poor, taste good, free stone, good drying quality, local market
*Fiesta Red	Early August	Middle November	Production good, storage very good, taste very good, cling stone. Suitable for export and local markets.
Flamekist	Middle September	Middle February	Production good, storage ability moderate for 3 weeks at 0,5°C, clingstone, taste good - moderately acid, good fruit size, late maturing
*Flavorine	Early September	Early December	Production good, storage ability good, very good taste, clingstone, low chilling requirements
Flavortop	Early September	Early January	Production good, storage ability moderate for 3 weeks at 0,5°C, excellent taste, free stone, good drying quality, full red skin
Independence	Middle September	Middle December	Production inconsistent, storage ability moderate for 3 weeks at 0,5°C, taste moderately acid, free stone, attractive bright red colour
*Margaret's Pride	Late August	Middle December	Production very good, storage ability good for 4 weeks at -0,5°C, taste moderate to good, semi-free stone, large fruit size, good for export, bright red blush
*Mayglo	Late July	Early November	Production very good, storage ability moderate for 3 weeks at -0,5°C, taste fairly acid, clingstone, early maturing
*Nectar	Late August	Middle November	Production good, storage ability very good for 4 weeks at 0,5°C, taste moderate, clingstone, red blush on yellow background colour, less susceptible to Xanthomonas spot than Fiesta Red
Nectared	Late September	Early February	Production very good, storage ability moderate for 3 weeks at 0,5°C, taste good, free stone, low chilling requirements, tends to crack in rainy weather.
*Olympia	Late August	Middle December	Production good, storage ability moderate for 2 weeks at 0,5°C, taste fairly good, stone free, good drying quality, local market
*Red Jewel	Early September	Early January	Production good, storage ability good for 4 weeks at -0,5°C, taste good, clingstone, good full red skin colour, good fruit size
*September Red	Late September	Middle February	Production medium, storage ability good for 3 weeks at -0,5°C, taste moderate to good - firm fruit, clingstone, good fruit size, high chilling requirement, late maturing
Stark Sunglo	Early September	Middle January	Production good, storage ability moderate for 3 weeks at -0,5°C, taste good, free stone, good drying quality
Sunlite	Middle August	Late November	Production very good, storage ability moderate for 3 weeks at -0,5°C, semi-acid taste, free stone, low chilling requirement
*Unico	Late August	Middle November	Production moderate, storage ability good for 5 weeks at -0,5°C, moderate taste, clingstone, unique fruit with yellow skin and flesh colour
*Zaigina	Early September	Late January	Production reasonable, storage ability moderate for 3 weeks at -0,5°C, taste good - slightly acid, clingstone, high chilling requirement

*Plant Breeders' Rights (royalties payable)

PLUMS

Cultivar	Full Bloom	Harvest Date	Compatibility	Short Description
Autumn Giant				
*Flavor King		Middle to late January	Laetitia	Production good, storage ability for 7 days at -0,5°C and 21 days at 7,5 °C, very good taste - Plumcot with good and unique eating quality, clingstone good fruit size, skin colour - bright red
Fortune	Early September	Middle January	Harry Pickstone Souvenir Santa Rosa	Storage ability good, skin colour red, flesh colour yellow.
Gavearli	Early September	Last week December to early January	Self -compatible	Production good, storage ability, good, very good taste, free stone, low chilling requirement.
Gaviota	Late September	Early January	Golden King Santa Rosa Wickson	Production good when chilling requirement has been satisfied, storage ability good for 3 weeks at dual temperature, very good taste, free stone.
Harry Pickstone	Early September	Early January	Self-compatible	Production very good, storage ability good for 3 weeks at dual tempeature, taste reasonable and sweet, clingstone, low chilling requirement.
*Lady Red	Middle September	Middle to late December	Laetitia Songold	Production good, storage ability moderate at dual temperature, taste moderate, semi-lose stone, skin colour: 75° at harvest: full red after cold storage, good fruit size.
*Laetitia	Late September	Middle to late January	Songold Casselman	Production very good, storage ability for 4 weeks at dual temperature, very good taste, semi-free stone, low chiling requirement, attractive bright red skin colour with white lenticells.
Larry Anne	Middle September	Late January to middle February	Songold Laetitia Angeleno	Production good, storage ability good, very good taste, fre stone, dark red colour with prominent lenticells, good fruit size.
*Pioneer	Middle August	Late November	Self-compatible	Production good, storage ability for 5 weeks at dual temperature, sweet flavour, clingstone, low chilling requirements, replacement for Red Beaut (improved colour, taste and storage), incompatible with Marianna rootstock - need interstem, bright red skin colour, early matujring plum.
*Ruby Red	Middle September	Late December	Sapphire Harry Pickstone Laetitia,Songold	Production good, storage ability good at dual temperature, eating quality very good, skin colour red, texture moderate, semi-free stone.
Santa Rosa	Middle September	Middle December	Self -compatible	Production moderate to good, storage ability good for 4 weeks at dual temperature, taste strong flavour, texture melting, skin colour red, clingstone.
*Sapphire	Early September	Early December	Harry Pickstone	Production very good, storage ability good for 4 weeks at dual temperature, very good taste, semi-free stone, purple coloured skin, low chilling requirement.
Songold	Middle September	Early February	Laetitia, Santa Rosa,Casselman	Production good, storage ability good for 4 weeks at dual temperature, taste good, clingstone, large fruit size.
*Southern Belle	Middle September	Middle February	Songold Laetitia	Production good, Storage ability good, eating quality good, skin colour purple, texture fine, semi-free stone
*Souvernir	Early September	Middle to late December	Self-compatible	Production good, storage ability good for 4 weeks at dual temperature, taste good, semi-free stone, skin colour purple on yellow background, taste good, texture firm and melting.
*Sunbreeze	Middle September	Early February	Laetitia, Santa Rosa,Casselman	Good yields every year. Less suspectable to alternative bearing as to Songold. Production good, storage ability good for 4 weeks at dual temperature, taste good, clingstone, large fruit size.
*Sundew	Middle September	Early January	Harry Pickstone Sapphire, Sun Kiss, Laetitia	Production moderate, Storage ability excellent at dual temperature, eating quality very good, skin colour light yellow, texture fine, semi-free stone
*Sun Kiss	Late August	Late December	Harry Pickstone Sapphire, Sundew,Laetitia	Production moderate, Storage ability excellent, eating quality very good, skin colour light yellow, texture fine, semi-free stone
*Suplumsix (Angeleno TM)	Late September	Early February	Santa Rosa Songold Laetitia	Production good, storage ability moderate for 4 weeks at dual temperature, taste moderate - eating quality good - crisp with good flavour, very firm round fruit, semi-free stone, easy handling - don't bruise easily

*Plant Breeders' Rights (royalties payable)

PEACHES

Cultivar	Full Bloom	Harvest Date	Short Description
*Bonnigold	Late August	Late November	Production good, storage ability moderate to good, fair taste,clingstone, good for local market, low chilling requirement
*Catherina	Late September	Early January	Production good, storage ability good for 2 weeks at -0,5'C, good taste, clingstone, good canning quality
*Classic	Late August	Early December	Production moderate, storage ability good for 3 weeks at -0,5'C,good taste, clingstone, red blush on yellow background
*Don Elite	Early August	Middle November	Production good, storage ability moderate for 3 weeks as -0,5'C,moderate taste, clingstone, low chilling requirement
*Excellence	Late August	Late December	Production good, storage ability moderately good for 4 weeks at '-0,5'C, taste moderate to good, semi-free stone, large fruit size, red blushed fruit
Fairtime	Late September	Early March	Production good, storage ability moderately good for 2 weeks at -0,5'C taste good, free stone, local market
*Goudmyn	Early August	Early January	Production good, storage ability moderate, fair taste, clingstone, good canning ability, low chilling requirement
Kakamas	Middle September	Middle February	Production good, storage ability good for 2 weeks at -0,5'C, taste moderately, later yellow clingstone
*Keisie	Late August	Early January	Production good, storage ability moderate, fair taste, clingstone, good fruit size
Malherbe	Early September	Late December	Production good, storage ability good for 2 weeks at -0,5'C, taste good, clingstone, good canning quality
Neethling	Late August	Middle January	Production good, storage ability good for 2 weeks at -0,5'C, taste good, clingstone, good canning quality, low chilling requirement
*Novadonna	Early September	Late November	Production fair, storage ability moderate, good taste, clingstone, local market
Oom Sarel	Late August	Middle December	Production good, storage ability good for 2 weeks at -0,5'C, good taste, clingstone, good chilling requirement, good canning quality
*Oribi	Late August	Late February	Production good, storage ability moderate, good taste, free stone, large fruit size
*Rich Lady	Late September	Middle December	Production good, storage ability good for 2 weeks at -0,5'C, good taste, clingstone, full dark red colour, local market
*Sandvliet	Early August	Early January	Production good, storage ability moderate, fair taste, clingstone, good canning quality, low chilling requirement
San Pedro	Early August	Early November	Production good, storage ability good for 3 weeks at -0,5'C, slightly acid taste, clingstone, low chilling requirement
*Sonnet	Early-mid August	Middle November	Medium size fruit (110g), skin colour light yellow, flesh colour yellow
*Snowcrest	Late August	Early January	Production very good, storage ability very good for 5 weeks at -0,5'C, good taste, free stone, white flesh, 60% red blush on light green background
*Snowhite	Middle August	Early November	Production good, storage ability good for 4 weeks at -0,5'C and 1 week at 10'C, good taste - sweet, clingstone, white flesh, red blush on light green background
Southern Snow	Early September	Middle February	Production good, Storage ability good for 2 weeks at -0,5'C, very good taste, free stone, good appearance - red blush on cream background, large fruit size, white flesh
*Summer Giant	Middle August	Early December	Production good, shelf life of 6 - 10 days, good taste, free stone, summer rainfall areas, low chilling requirements, large fruit size
*Summersun	Late August	Late November	Production good, storage good, taste is good, cling stone, low chilling.
*Sunsweet	Late August	Early January	Production good, storage ability poor, moderate taste, free stone, good drying quality
*Transvalia	Middle August	Middle November	Production moderate, storage ability for 3 weeks at -0,5'C, taste good, clingstone, low chilling requirement, summer rainfall areas, red blush fruit
*Western Cling	Late August	Early December	Production good, storage ability moderate to good, fair taste, clingstone, low chilling requirement
*Western Sun	Middle August	Early to middle January	Production good, storage ability for 4 weeks at -0,5'C and 1 week at 10'C, good taste, clingstone, good for dessert, drying and canning

*Plant Breeders' Rights (royalties payable)

PEARS

Cultivar	Full Bloom Date	Harvest Date	Pollinators	Short Description
Abate Fetel	Middle September	Late January to early February	Forelle Flamingo Rosemarie	Production medium to high, storage ability good, taste good and sweet - good eating quality, bear on spurs, oblong shape.
Beurré Hardy	Late September to middle February	Late January to midde February	Beurré Bosc Bon Chretien Josephine de Malines Doyenne du Comice	Production medium to low, storage ability medium, taste slightly tart, bear on spurs.
Bon Chretien	Early to middle October	Early to late January	Josephine de Malines Beurré Hardy Beurré Bosc Doyenne du Comice	Production medium to high, storage ability average, fragrant and sweet, bear on spurs and shoots, good for drying - dessert - canning, green skin turns yellow with maturity.
Bon Rouge	Early October	Middle January	Packham's Truimph Beurré Bosc Winter Nelis	Production medium to high, storage ability good, taste good, bear on spurs and shoots, full red skin.
Concorde	with Comice	Late September	Comice	Yellow ground colour with an excellent skin finish, upright tree of moderate vigour
Conference	with Packhams	Early - middle February	Packham's Triump	High chilling requirement, yellow-green colour
Doyenne du Comice	Early to middle October	Late February	Bon Chretien Packham's Triump Harrow Delight	Production medium to low, storage ability good, bear on spurs, excellent eating quality - fragrant and sweet, fruit has a thin skin - is marked easily (support limbs to limit rub marks)
Early Bon Chretien	Early to middle September	Late December to early January	Forelle	Production medium to high, storage ability good, fragrant and sweet, bear on spurs and shoots, well adapted to warmer areas, low chilling requirement
Flamingo*	Middle September	Early February	December Abate Fetel Forelle Rosemarie	Production medium to high, storage ability moderate, taste good and sweet, bear on spurs and shoots, attractive blushed pear, light management important for colour development
Forelle	Early to late September	Late February to early March	Kieffer	Production medium, storage ability good, taste sweet, bear on spurs, attractive blushed pear, harvested late, low chilling requirement
Hosui	Middle December	Late January to early February	Chojuro Nijisseki	Production medium to high, stotage ability good, sweet and crisp, bearing habit lateral on 1-year old wood, promising Asian pear, golden brown skin colour and globular shape.
Packham's Triumph	Middle to late September	Middle February	Winter Nelis Rosemarie December	Production high, storage ability very good, slightly sweet but good taste, bear on spurs and shoots, good fruit size.
Rosemarie*	Late September	Early January	December Packham's Truimph	Production high, storage ability medium, taste good, bearing habit standard, yellow pear with bright red blush - light management early in the seison- important for good colour development, thin for good fruit size.
Shinsui	Middle to late September	Middle January	Nijisseiki	Production medium, storage ability good, sweet and crisp, bear on spurs and lateral 1-years shoots, golden brown skin, flat-globular shape, Asian pear.
Starkrimson	Late September to early October	Middle January	Packham's Truimph Ceres Louise Bonne	Production medium to high, storage ability poor, taste good, bear on spurs and shoots, full red pear, low chilling requirement.
Williams Beaut*	Middle September	Middle December	Forelle	Production medium to high, storage ability good, fragrant and sweet, bear on spurs and shoots, well adapted to warmer areas, low chilling requirement

*Plant Breeders' Rights (royalties payable)

APPLES

Cultivar	Full Bloom	Harvest Date	Pollinators	Short Description
African Red (Carmain)*	Early October	Mid-End March	Granny Smith, Spur Winter Banana, Cripps Pink & Red	Production medium to high, very good storage ability, sweet crisp taste.
Atlantic Red*	Middle October	Middle April		Production good. Very good storage ability. Sweet and juicy with good texture.
Autumn Blush*	Middle October	Middle April		Production good. Good storage ability. Tart, juicy and crisp.
Braeburn	Early October	Late March	Golden Delicious Hillieri, Gala Sweet Cornelly	Production high, good storage ability, crisp - sweet-tart taste, bear on spurs and shoots, calcium sprays necessary to prevent bitterpit
Cameo *	Middle October	End March to early April	Granny Smith Cripps Pink	Production good, storage ability good, texture crisp and juicy. Background colour is green at picking - light yellow at eating maturity.
Earligran*				
Early Red One	Middle to late October	Late February to early March	Golden Delicious Granny Smith Hillieri	Production medium, storage ability good, taste good sweet -crisp, red coloured develops at an early stage
Elegant*	Middle October	Middle April	Cripps Pink,Granny Smith, Golden Del.	Production good, very good storage ability, sweet and juicy taste, striped red blush on yellow ground colour.
Fuji B.C.2	Middle October	Late March	Granny Smith Hillieri	Production good, storage ability good, sweet and juicy, bear on spurs and shoots, good eating quality -crisp and sweet, relative long shelf life, firm fruit
Fuji Akifu	Middle October	Late March	Granny Smith Hillieri	Production good, storage ability good, sweet and juicy, bear on spurs and shoots, good eating quality -crisp and sweet, relative long shelf life, firm fruit
Fuji Irriadiated	Middle October	Late March	Granny Smith Hillieri	Production good, storage ability good, sweet and juicy - crisp and firm (same as Akifu), bear on spurs and shoots
Ginger Gold*	Early to mid season	3-6 week prior to Golden Delicious	Golden Delicious-warm areas, RubyGala-colder areas	Production good, Very good texture, crisp, sweet but mildly tart, medium to large fruit.
Golden Delicious NIVV	Early to middle October	Late February to early March	Granny Smith Starking types Royal Gala Hillieri	Production good, storage ability good, fragrant and sweet bear on spurs and shoots, high chilling requirement, smooth skin - less susceptible to russet
Golden Reinders*	Early October	4-6 weeks earlier than Golden Del.	Panorama Pollinator	
Granny Smith	Early to middle October	Late March to early April	Golden Delicious Starking, Hillieri Spur Winter Banana	Production good, storage ability good, bear on spurs, crisp firm fruit -acid/tart taste
Hillwell Braeburn*		Late March	Golden Delicious, Hillieri	Production medium, orange/red striped on a green/yellow background, taste is crisp, juicy, tart/sweet, medium size.
Oregon Spur II*	Middle October	Late February to early March	Golden Delicious Granny Smith Hillieri	Production medium, storage ability good fragant and sweet, bear on spurs
Pacific Gala *	Early to middle October	Early to middle February	Golden Delicious Granny Smith Hillieri, Spur Winter Banana	This is a Gala mutation still under evaluation.
Pinova*	Early - middle October	With Golden Del.	Golden Delicious	Cold hardy and very productive, medium size, outstanding flavor. Good market acceptance. Pleasant exciting flavor.
Royal Beaut*	Early October	Early February	Granny Smith Hillieri Golden Delicious	Production medium, storage ability good, fragant and sweet - good eating quality for an early apple, bear on yellow back-ground (better colour that Royal Gala), thin for good fruit size
Royal Gala *	Early to middle October	Early to middle February	Golden Delicious Granny Smith Hillieri,Sweet Conelly,Spur Winter Banana	Production medium, storage ability good, fragant and sweet - good eating quality for an early apple, bear on yellow background, thin for good fruit size
Ruby Gala *	Early October	Early February	Granny Smith Hillieri Golden Delicious	Production medium, storage ability good, fragant and sweet - good eating quality for an early apple, bear on yellow background (better colour that Royal Gala), thin for good fruit size
Scarlet Spur *	Middle October	Late February to early March	Golden Delicious Granny Smith Hillieri	Production good, texture crisp, good eating quality, sweet taste, skin colour dark red.
Schlect Spur		With other red apples		Large fruit, crisp and juicy.

*Plant Breeders' Rights (Royalties payable)

TABLEGRAPES

CULTIVAR	VINE	BUNCH	BERRY	DESCRIPTION
*Ronelle	Vigour: medium Fruitfulness: good Bud burst: early Sept Full Bloom: early Nov Harvest date: late Jan	Shape: Conical Size: medium/large Density: very dense	Shape: short-oval Colour:purple-black Mass: 8g Texture: medium/firm Taste: neutral Skin: tough	Plant on medium to light soils. Good resistance to berry split. Mainly grown in Summer rainfall areas.
Alphonse	Vigour:strong Fruitfulness:very good Bud burst: early Sept Full Bloom:late Oct Harvest date: late Jan	Shape:conical Size:large Density:medium loose	Shape:round Colour:black Mass:± 9g Texture:frim Taste:sweet to neutral Skin:medium	Not suitable for Summer rainfall areas. Plant on medium to light soil. Good storage ability.
Dan-ben-Hannah	Vigour:strong Fruitfulness: good Bud burst:mid Sept Full Bloom:late Oct Harvest date:late Jan to early Feb	Shape:long-conical Size:medium-large Density:well filled, dense	Shape:oval Colour:black Mass:7-8g Texture:moderate to firm Taste:sweet neutral Skin: tough and slightly tannin like	Does well on most soil types. Good storage ability.
Thompson Seedless	Vigour:very strong Fruitfulness:medium Bud burst:mid Sept Full Bloom:late Oct Harvest date:early Feb	Shape:conical-long Size:large Density:very firm	Shape: round Colour:straw-coloured Mass:3,5g Texture:soft Taste:neutral Skin: medium	Best on medium to heavy soils. Used as drying and table grape. Exported as table grape, but must be treated with plant growth regulators and must be thinned.
*La Rochelle	Vigour: strong Fruitfulness:good Bud burst:mid Sept Full Bloom:mid Oct Harvest date:mid Feb	Shape:oblong Size:medium-large Density:well filled to condense	Shape:round Colour:blue-black with dense bloom Mass:7-8g Texture:firm Taste:neutral Skin:semi-tough	Good resistance to berry split. Sets normally very well. Does well on big range of soils. Very good storage ability.
*Sunred Seedless	Vigour:good Fruitfulness:good Bud burst:early Sept Full Bloom:early Nov Harvest date:mid Feb	Shape:conical Size:large Density:compact	Shape:short elliptic Colour:dark red Mass:6-7g Texture:firm Taste:neutral, high acit Skin:storng, not tough	Reasonably crack resistant. Buches must be well shortened. Suitable for export, keeping quality good.
*Datal	Vigour:good Fruitfulness:good Bud burst:mid Sept Full Bloom:early Nov Harvest date:mid Feb	Shape:conical Size:medium-large Density:good	Shape:oval Colour:green-yellow Mass:10g Texture:soft Taste:sweet to neutral Skin:slightly tough	Best on medium to heavy soils. Very good drying abilities. Does not have a very long shelve life.
Waltham Cross	Vigour:medium Fruitfulness:medium Bud burst:early Sept Full Bloom:early Nov Harvest date:mid Feb	Shape:conical-long Size:medium-large Density:medium loose	Shape:oval-long Colour:green-yellow Mass:8g Texture:medium-firm Taste:neutral Skin:medium	Does best on medium to heavy soil. Fairly resistant to berry split. Suitable for export market.
*Bonheur	Vigour:strong Fruitfulness:good Bud burst:mid Sept Full Bloom:late Oct Harvest date:mid Feb	Shape:conical to round Size:medium Density:good, slightly compact	Shape:slightly short oval Colour:blue-black Mass:10-12g Texture:firm Taste:sweet neutral Skin:medium	Good storage ability.
*Redglobe	Vigour:medium Fruitfulness:good Bud burst:mid Sept Full Bloom:early Nov Harvest date:late Feb	Shape:round Size:large Density:straggly, well filled	Shape:round Colour:red Mass:10-14g Texture:firm Taste:neutral Skin:strong	Does good on medium to heavy soil. Very good berry size. Moderate keeping quality.
Barlinka	Vigour:strong Fruitfulness:reasonable Bud burst:mid Sept Full Bloom:early Nov Harvest date:early March	Shape:oblong with well filled shoulders Size: large Density: dense	Shape:round to oval Colour:black Mass:7,5g Texture:reasonably firm Taste:neutral Skin:tough	Prefer light soil types. Very good storage ability.
Dauphine	Vigour:strong Fruitfulness:good Bud burst:mid Sept Full Bloom:early Nov Harvest date:mid March	Shape:conical Size:large Density:good, slightly dense	Shape:long-oval Colour:white, straw colour Mass:8-10g Texture:firm Taste:sweet to neutral Skin:tough and slightly tannin like	Best on medium to heavy soil. Reasonable resistance to berry split. Good storage ability. Can remain on vine for long time under favourable conditions.
*Sugraone	Vigour:very vigourous Fruitfulness:good Bud burst:early Sept Full Bloom:late Oct Harvest date:early Jan	Shape:conical-oblong Size: medium Density:dense	Shape:oval to slightly obovate Colour:white, straw colour Mass:7.5 g Texture:firm Taste: neutral Skin:medium/tough	Does good on all soil types. Good storage ability. Does very well on Europene markets.

*Plant Breeders' Rights (royalties payable)

WINEGRAPES

KULTIVAR	KLOON	RYPWORDING	BESKRYWING
Cabernet Franc	CF214,CF312,CF1	6-19 Maart	Production:± 3-5 kg / vine, Shoot mass: 3-4 kg / vine, Bunch mass: ± 230 gram
Cabernet Sauvignon	Productive clone CS 15 Qualitative clone CS18,CS20,CS23,CS348 CS163,CS169,CS338,CS341 Old local selections CS 37, CS 46	Late mid season (18 - 26 Mrt)	Production: ± 4- 6 kg / vine , Shoot mass: 1 -2 kg /vine, Bunch mass: ± 218 gram
Chardonnay	Classic white clones CY 3, CY 95, CY 268, CY 277, CY 96, CY 548	Early (1-13 Feb)	Production: ± 2 - 5 kg /vine , Shoot mass: 0, 5 -1 kg / vine Bunch mass: 200 gram
Chenin Blanc	Average production SN 1061, SN 1064 More than average production SN 220, SN 424, SN 481, SN 737	Late mid season (15 Feb - 3 Mrt)	Production: ± 7 -10 kg / vine , Shoot mass: 1- 2 kg / vine Bunch mass: 303 gram
Colombar	Average production CO36 More than average production CO1,CO1098	Late mid season (3 - 11 Mrt)	Production: ± 6 -10 kg /vine. Shoot mass: 1,5 -2 kg /vine Bunch mass: ± 279 gram
Malbec	California - MC 1 Argentina - MC 71	Early mid season (middel - einde Feb)	Production: 5 -6 kg /vine (Big variation between years) Bunch mass:medium size (250g) grape: medium size (2,5g) Malbec are recommended in areas with colder climate and good soils.
Merlot	Clone from Italy MO 3, MO 9, MO 12, MO 192 Clone from Switzerland MO 36 Clone from France MO 314, MO 343, MO 348	Early mid season (middle - end Febr)	Production: ± 6- 8 kg / vine,Shoot mass: 0,8 - 1,2 kg /vine Bunch mass: ± 256 gram
Mouverdere	MT71,MT11	Late mid season	Production: ± 5-7 kg / vine, Bunch mass: 300 gram
Petit Verdot	PR400	Late mid season	Production: 5-7 kg / vine, Bunch mass: 200 gram
Pinotage	PI 48, PI 50, PI45	Late mid season (8 -18 Mrt)	Production: ± 4 -6 kg / vine, Shoot mass:1 - 2 kg / vine Bunch mass: ± 224 gram
Pinot Noir	PN115,PN667,PN777	7-18 February	Production: ± 2-4kg / vine, Shoot mass: 0.5-1.5 kg / vine Bunch mass: ± 180 g
Roobernet	RO 1	Late mid season (18 - 26 Mrt)	Production: 2 - 3 kg / vine , Bunch mass: 220 gram Grapes: 1, 5 gram (red juice), Ave: vigorous growth Wine and growing potential - can be planted in all areas that are suitable for Cabernet Sauvingnon
Ruby Cabernet	RC 1	Late mid season (5 - 20 Mrt)	Production: ± 8 -10 kg /vine , Shoot mass: 2 -3 kg /vine Bunch mass: 240 gram
Sauvignon Blanc	Productive clone SB9, SSB242 Qualitative clone SB11,SB108,SB316,SB317	Early mid season (7 -26 Feb)	Production: ± 4- 6 kg /vine Shoot mass: 1,3 -2,3 kg /vine Bunch mass: ± 229 gram
Shiraz	Argentina - SH 5, SH 9 Local - SH 1, SH 22 France - SH 99	Late mid season (1 -13 Mrt)	Production: ± 5 -7 kg /vine Shoot mass: 0, 9 kg /vine Bunch mass: 260 gram

TABLEGRAPES continue...

Crimson Seedless	Vigour: vigourous Fruitfulness:good Bud burst:mid Sept Full Bloom:early Nov Harvest date: late March	Shape:round Size:medium Density:medium dense	Shape:oval to oblong Colour:dark red Mass:6.5-7g Texture:firm Taste:neutral Skin:crispy	Adapt well to most soils and climate. Very good storage ability.
Flame Seedless	Vigour: medium Fruitfulness:good Bud burst:early Sept Full Bloom:mid Oct Harvest date:early Jan	Shape:oblong Size:large Density:dense	Shape:round Colour:red Mass:6.5-7g Texture:soft Taste:neutral Skin:medium	Very good storage ability. Export market.
*Regall Seedless	Vigour:strong Fruitfulness:very good Bud burst:late Sept Full Bloom:mid Oct Harvest date: mid Jan	Size: medium/large Density: medium to densely filled	Shape:Obovate Colour:green-yellow Mass:7,3g Texture:medium-firm Taste:juicy, neutral flavour	Does well in winter rainfall. Very good storage ability. Export market.
Victoria	Vigour: medium Fruitfulness:good Bud burst:early Sept Full Bloom:late Oct Harvest date:late Jan	Shape:oblong with well filled shoulders Size: medium Density: dense	Shape:Oblong Colour:green-yellow Mass:7g Texture:soft Taste:neutral Skin: medium	Good export quality. Does well on medium to heavy soil.

*Plant Breeders' Rights (royalties payable)

COMPILED BY

CIAMD

CENTRE FOR INTERNATIONAL AGRICULTURAL MARKETING AND DEVELOPMENT FOR

DFPT **SPT**

DFPT • PAARL

CEO: Anton Rabe
258 Main Street
PO Box 163 Paarl 7620

Tel: (021) 870 2900
Fax: (021) 870 2915

E-Mail: anton@deciduous.co.za

CIAMD • PAARL OFFICE

Enquiries: Daan, Suzelna, Jacques
258 Main Street
PO Box 163 Paarl 7620

Tel: (021) 870 2900
Fax: (021) 870 2915

E-Mail: daan@deciduous.co.za

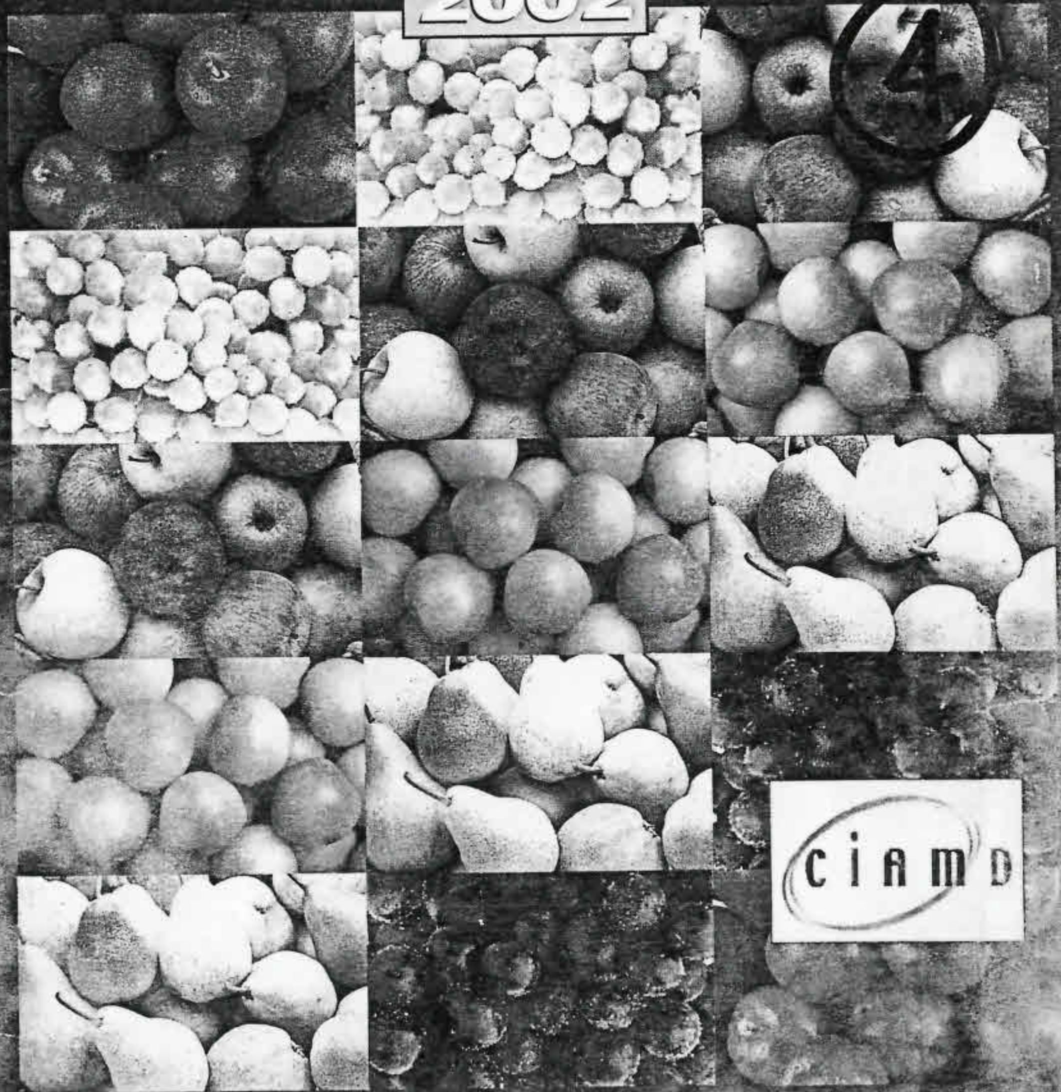
www.deciduous.co.za

(4)

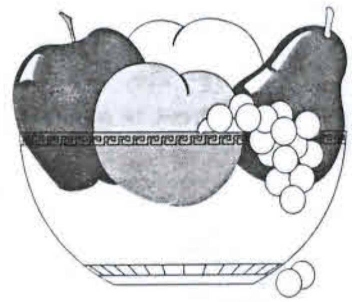
DECIDUOUS FRUIT PRODUCERS' TRUST
SAGTEVRUGTE PRODUSENTE TRUST

KEY DECIDUOUS FRUIT STATISTICS

2002



KEY DECIDUOUS FRUIT STATISTICS



2002

COMPILED BY

CIAMD

CENTRE FOR INTERNATIONAL AGRICULTURAL MARKETING AND DEVELOPMENT

FOR

DFPT SPT

DECIDUOUS FRUIT PRODUCERS' TRUST

PLUMS & PEARS

	PLUMS			PEARS		
	ESTABLISH	NON-BEARING	BEARING	ESTABLISH	NON-BEARING	BEARING
Yield (ton)	**0**	**0**	**25**	**0**	**0**	**35**
Number of trees	**1 480**	**0**	**0**	**1 480**	**0**	**0**
Pre harvest costs	**71 666**	**11 238**	**14 243**	**62 449**	**9 358**	**9 007**
Plant material	27 801	0	0	27 801	0	0
Fertilizer	3 842	1 640	3 067	3 382	1 373	1 561
Herbicides	166	333	333	269	248	231
Pesticides	173	220	2 089	191	802	2 076
Fungicides	169	211	3 410	113	140	727
Land preperation	9 605	0	0	9 605	0	0
Irrigation	12 150	0	0	12 150	0	0
Drainage	5 250	0	0	5 250	0	0
Trelising system	6 792	575	0	0	288	0
Advicers	473	473	473	473	473	473
General	228	0	158	228	0	158
Casual labour	2 016	4 032	1 808	788	2 520	1 197
Fuel	1 382	1 806	893	942	1 769	821
Repair and maintanence	1 096	1 337	1 127	827	1 198	1 080
Electricity	523	612	887	431	547	684
Harvesting costs	**0**	**0**	**5 103**	**0**	**0**	**4 700**
Truck	0	0	754	0	0	942
Machine hire	0	0	204	0	0	204
Packaging	0	0	0	0	0	0
Casual labour	0	0	2 042	0	0	1 452
Fuel	0	0	1 518	0	0	1 517
Repair and maintanence	0	0	586	0	0	586
Overhead expences	**25 307**	**15 256**	**21 415**	**20 912**	**13 750**	**18 668**
Permanent labour	7 904	6 114	10 383	5 230	5 220	8 658
Scheme costs	1 000	1 000	1 000	1 000	1 000	1 000
Licences and insurance	374	405	616	255	191	581
Other overheads *	4 620	4 620	4 620	4 620	4 620	4 620
Interest (Overdraft)	11 409	3 117	4 795	9 807	2 719	3 809
Total Costs	**96 973**	**26 494**	**40 761**	**83 362**	**23 108**	**32 375**

*OTHER OVERHEADS = ADMIN, BANK COSTS, REPAIRS, LOCAL TAXES, POSTAGE, PHONE, AUDITING, SECRETARIAL, ETC.

APPLES & NECTARINES/PEACHES

	APPLES			NECTARINES/PEACHES		
	ESTABLISH	NON-BEARING	BEARING	ESTABLISH	NON-BEARING	BEARING
Yield (ton)	**0**	**0**	**43**	**0**	**0**	**30**
Number of trees	**1480**	**0**	**0**	**1100**	**0**	**0**
Pre harvest costs	**72073**	**12058**	**15188**	**61059**	**12768**	**13856**
Plant material	27801	0	0	18150	0	0
Fertilizer	4193	1917	2048	3504	2783	3928
Herbicides	166	333	212	202	384	328
Pesticides	257	1167	4369	81	1070	3439
Fungicides	140	169	3214	364	165	905
Land preperation	9605	0	0	9605	0	0
Irrigation	12150	0	0	12150	0	0
Drainage	5250	0	0	5250	0	0
Trelising system	6792	575	0	6792	575	0
Advicers	473	473	473	473	473	473
General	228	0	158	228	0	158
Casual labour	2016	4032	1808	2016	4032	1808
Fuel	1382	1655	893	1262	1721	904
Repair and maintanence	1096	1126	1127	831	1160	1064
Electricity	523	612	887	152	406	851
Harvesting costs	**0**	**0**	**5251**	**0**	**0**	**4667**
Truck	0	0	1130	0	0	659
Machine hire	0	0	204	0	0	204
Packaging	0	0	0	0	0	0
Casual labour	0	0	1815	0	0	1702
Fuel	0	0	1517	0	0	1517
Repair and maintanence	0	0	586	0	0	586
Overhead expences	**25361**	**16911**	**20788**	**22930**	**16423**	**19830**
Permanent labour	7904	7504	9702	7622	7468	9574
Scheme costs	1000	1000	1000	500	500	500
Licences and insurance	374	378	616	307	402	624
Other overheads *	4620	4620	4620	4620	4620	4620
Interest (Overdraft)	11463	3408	4850	9881	3434	4512
Total Costs	**97434**	**28969**	**41227**	**83989**	**29191**	**38353**

**PACKAGING = CONTRACT PACKAGING. COST DEDUCTED FROM PRICE.

CANNED PEACHES & APRICOTS

	CANNED PEACHES			APRICOTS		
	ESTABLISH	NON-BEARING	BEARING	ESTABLISH	NON-BEARING	BEARING
Yield (ton)	**0**	**0**	**30**	**0**	**0**	**25**
Number of trees	**1480**	**0**	**0**	**1250**	**0**	**0**
Pre harvest costs	**59288**	**11398**	**11420**	**63514**	**12768**	**11104**
Plant material	25060	0	0	20625	0	0
Fertilizer	3504	2782	3012	3504	2783	2404
Herbicides	203	384	328	203	384	328
Pesticides	81	1078	3164	81	1070	2795
Fungicides	364	165	863	363	165	863
Land preperation	9605	0	0	9605	0	0
Irrigation	12150	0	0	12150	0	0
Drainage	5250	0	0	5250	0	0
Trelising system	0	288	0	6792	575	0
Advicers	473	473	473	473	473	473
General	228	0	158	228	0	158
Casual labour	788	3024	1260	2016	4032	1682
Fuel	848	1721	667	1278	1721	718
Repair and maintanence	614	1160	815	796	1160	834
Electricity	121	324	681	152	406	851
Harvesting costs	**0**	**0**	**4524**	**0**	**0**	**3542**
Truck	0	0	754	0	0	376
Machine hire	0	0	204	0	0	204
Packaging	0	0	0	0	0	0
Casual labour	0	0	1650	0	0	1403
Fuel	0	0	1379	0	0	1107
Repair and maintanence	0	0	538	0	0	453
Overhead expences	**19704**	**14142**	**16839**	**23897**	**14656**	**16069**
Permanent labour	5081	5615	7317	7648	5908	6829
Scheme costs	500	500	500	500	500	500
Licences and insurance	210	402	545	323	402	506
Other overheads *	4620	4620	4620	4620	4620	4620
Interest (Overdraft)	9293	3005	3857	10805	3226	3613
Total Costs	**78992**	**25539**	**32783**	**87411**	**27424**	**30714**

SOURCE: MARIUS SMIT

TABLE GRAPES

	TABLE GRAPES	
	ESTABLISH	BEARING
Yield (4.5kg cartons)	**0**	**4000**
Number of trees	2200	
Pre harvest costs	**99057**	**21677**
Plant material	15400	
Fertilizer	2873	500
Herbicides	250	250
Pesticides	0	446
Fungicides	0	3544
Land preperation	11960	
Irrigation	12500	1565
Drainage	6930	
Trelising system	39099	
Advicers	1500	
General	1250	725
Casual labour	1920	12300
Fuel	1200	555
Repair and maintanence	3775	718
Electricity	400	1074
Harvesting costs	**0**	**38284**
Truck	0	3486
Machine hire	0	
Packaging	0	26978
Casual labour	0	6800
Fuel	0	1020
Overhead expences	**31823**	**12716**
Permanent labour	13217	5632
Water costs	1000	1000
Licences and insurance	250	384
Other overheads *	4500	4500
Interest (Overdraft)	12856	1200
Total Costs	**130880**	**72677**

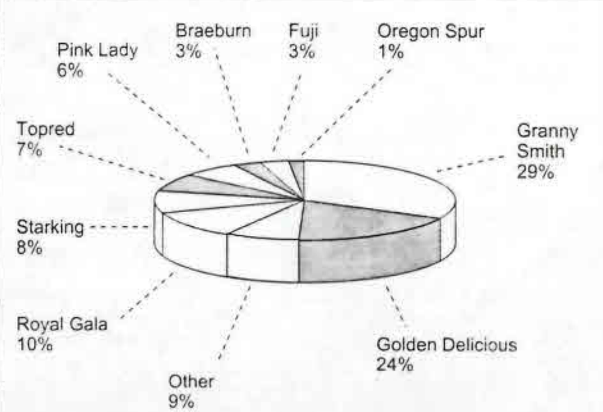
PRODUCTION AREAS

DISTRICT	NO OF TREES	AREA (HA)
Groenland	8,302,413	8,046
Ceres	5,129,600	4,965
Langkloof East	3,187,027	3,869
Villiersdorp / Vyeboom	3,068,338	3,176
Little Karoo	418,214	551
Langkloof West	503,578	517
Piketberg	423,055	384
Southern Cape	271,255	185
Somerset West	200,305	143
Hex Valley	150,270	148
Wolseley / Tulbagh	106,196	90
Berg River	87,390	61
Free State	107,375	89
Cape Town	83,950	70
Eastern Cape	22,267	47
Stellenbosch	43,849	34
Northen Province	40,345	27
Franschhoek	25,833	23
Mpumalanga	40,726	27
Gauteng	1,869	2
Lower Orange River	1,336	1
Total	**22,215,191**	**22,454**

SOURCE: DFPT TREE CENSUS / SADRIN

AREA PLANTED PER CULTIVAR

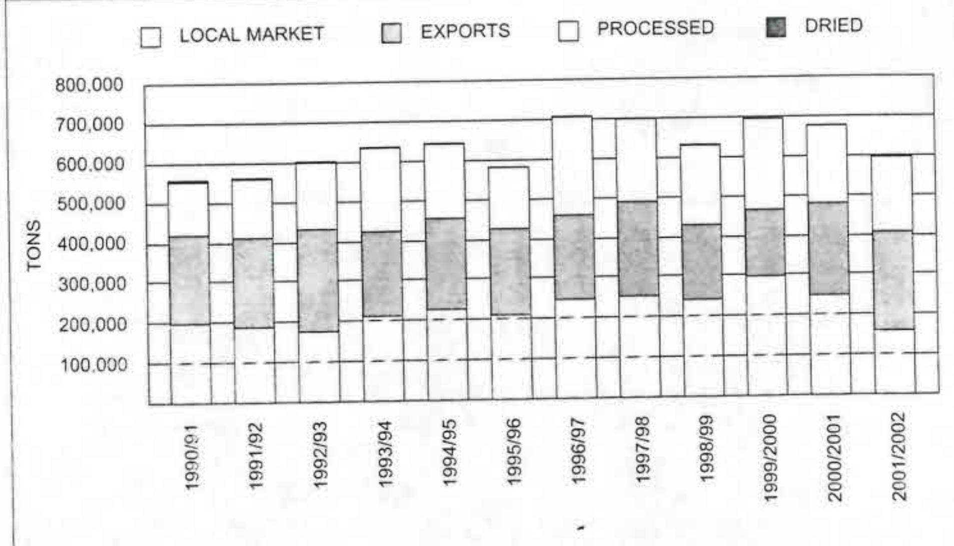
CULTIVAR	HECTARES
Granny Smith	6,555
Golden Delicious	5,340
Royal Gala	2,284
Starking	1,779
Topred	1,528
Pink Lady	1,256
Braeburn	656
Fuji	622
Oregon Spur	313
Other	2,121
Total	**22,454**



SOURCE: DFPT TREE CENSUS / SADRIN

CROP DISTRIBUTION

YEAR OCT-SEPT	TOTAL PRODUCTION (TON)	LOCAL MARKET (TON)	EXPORTS (TON)	PROCESSED (TON)	DRIED (TON)
1990/91	554,777	197,500	218,750	133,750	4,777
1991/92	559,077	187,500	221,250	147,500	2,827
1992/93	599,316	175,000	253,750	167,500	3,066
1993/94	632,835	211,250	210,000	210,000	1,585
1994/95	640,893	226,250	225,000	187,500	2,143
1995/96	578,711	210,000	213,750	153,750	1,211
1996/97	704,157	246,250	208,750	247,500	1,657
1997/98	696,727	251,934	234,573	208,720	1,500
1998/99	628,619	241,267	185,678	199,826	1,848
1999/2000	692,181	296,193	165,879	229,087	1,022
2000/2001	673,848	248,466	228,199	195,571	1,612
2001/2002	594,101	158,684	245,584	188,410	1,423



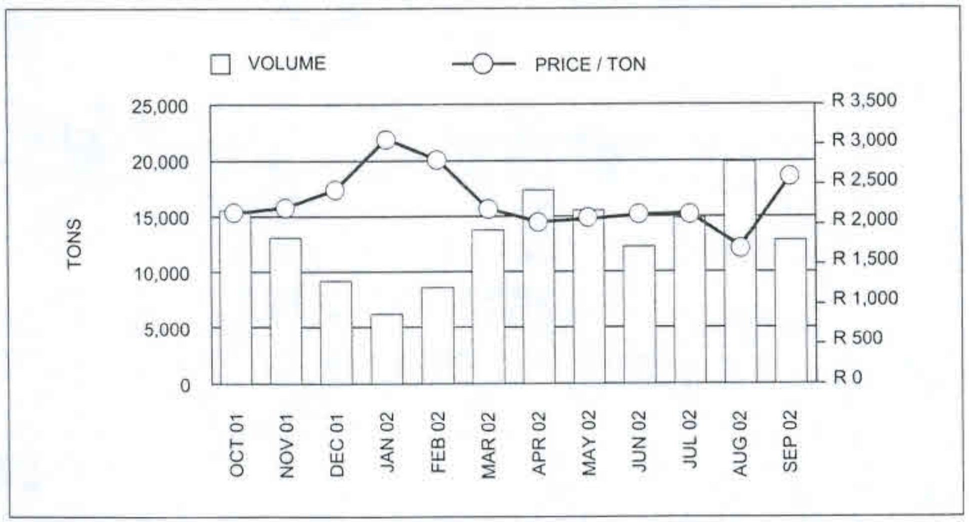
SOURCE: NDA; PPECB; SAAPPA

HISTORICAL PRICE TRENDS

YEAR OCT-SEPT	SALES ON MARKETS AVERAGE PRICE R/TON	EXPORTS NET REALISATION R/TON	PROCESSED AVERAGE PRICE R/TON	GROSS VALUE DRIED R/TON	GROSS VALUE FRESH R/TON	TOTAL VALUE OF PRODUCTION R/TON
1990/91	1,033	1,914	137	3,267,000	557,826,000	561,093,000
1991/92	1,319	1,598	323	2,666,000	571,516,000	574,182,000
1992/93	1,202	928	215	3,832,000	385,632,000	389,464,000
1993/94	1,230	2,130	183	2,330,000	676,156,000	678,486,000
1994/95	1,694	1,721	280	1,511,000	598,387,000	599,898,000
1995/96	1,716	2,598	411	2,245,000	835,611,000	837,856,000
1996/97	1,623	2,192	388	2,874,000	684,450,000	687,324,000
1997/98	1,646	2,420	263	3,367,000	862,282,000	865,649,000
1998/99	1,772	1,468	266	848,000	594,374,000	595,222,000
1999/2000	1,532	2,191	394	2,220,000	711,414,000	713,634,000
2000/2001	1,093	2,159	388	1,410,000	772,201,000	773,611,000
2001/2002	2,197	2,475	571	1,026,000	963,537,000	964,563,000

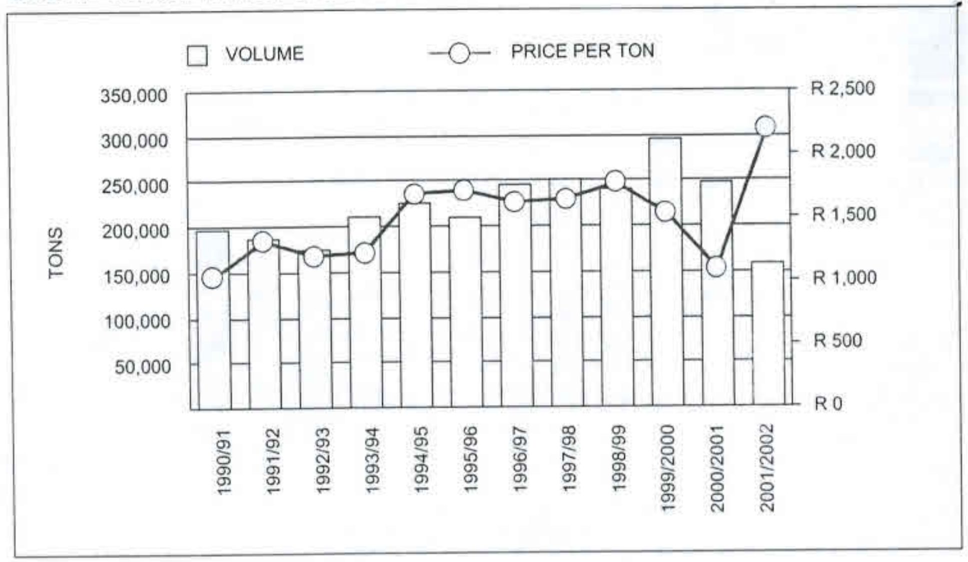
SOURCE: NDA

LOCAL MARKET SALES 2001/2002



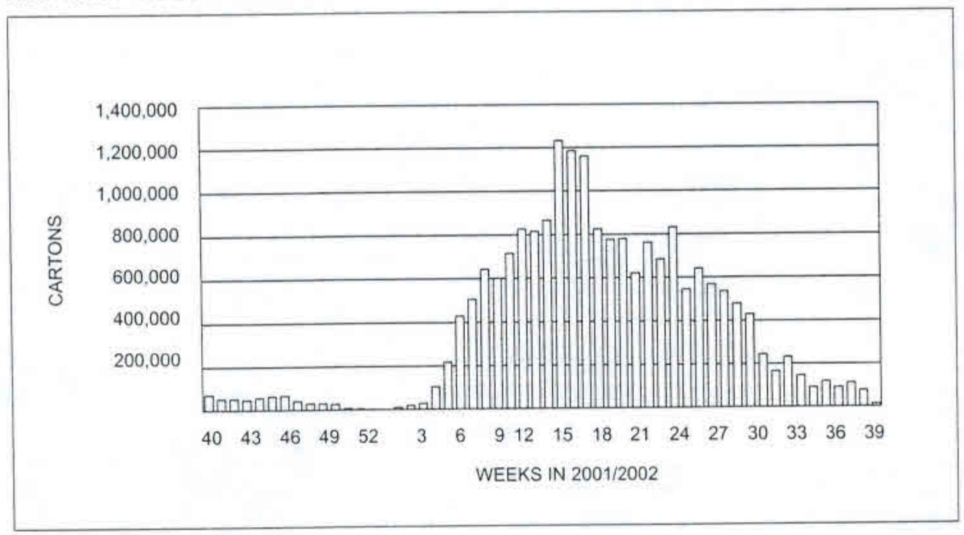
SOURCE: NDA

LOCAL MARKET HISTORICAL SALES



SOURCE: NDA

EXPORT VOLUMES 2001/2002



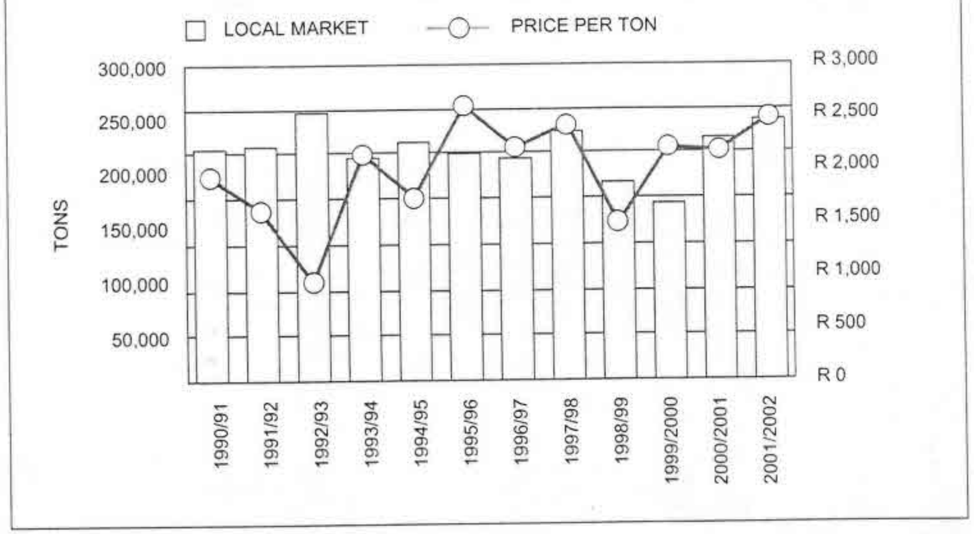
SOURCE: PPECB

EXPORTS IN CARTONS

CULTIVAR	2001/2002	2000/2001	% CHANGE
GOLDEN DELICIOUS	6,734,324	5,727,497	18%
GRANNY SMITH	6,020,849	6,974,218	-14%
ROYAL GALA	1,815,493	1,761,696	3%
TOPRED	864,786	662,411	31%
BRAEBURN	846,586	686,957	23%
GALA	795,954	543,987	46%
STARKING	682,742	534,146	28%
CRIPPS PINK	665,918	508,790	31%
PINK LADY(TM)	477,807	401,769	19%
FUJI	389,377	291,835	33%
SUNDOWNER	121,666	75,240	62%
CRIPPS RED	75,576	22,065	243%
STARKRIMSON	48,186	11,768	309%
GOLDEN GALA	44,805	32,593	37%
EXPERIMENTAL	16,555	16,941	-2%
DELICIOUS APPLES	15,271	630	2324%
JONAGOLD	13,565	436	3011%
OREGAN SPUR APPLES	2,842		
YORK IMPERIAL	2,725		
EMPIRE	2,669	562	375%
SPLENDOUR	2,029	-	
AFRICAN RED/CARMINE	1,801	207	770%
COXS ORANGE PIPPIN	1,344	38	3437%
ROME BEAUTY	1,281		
BLUSHED GOLDEN APPLE	1,183	2,170	-45%
CANVADA	714		
JONAGORED	559		
RED FUJI	56	27,272	-100%
DUNNS SEEDLING	31		
Total	**19,646,694**	**18,255,956**	**8%**

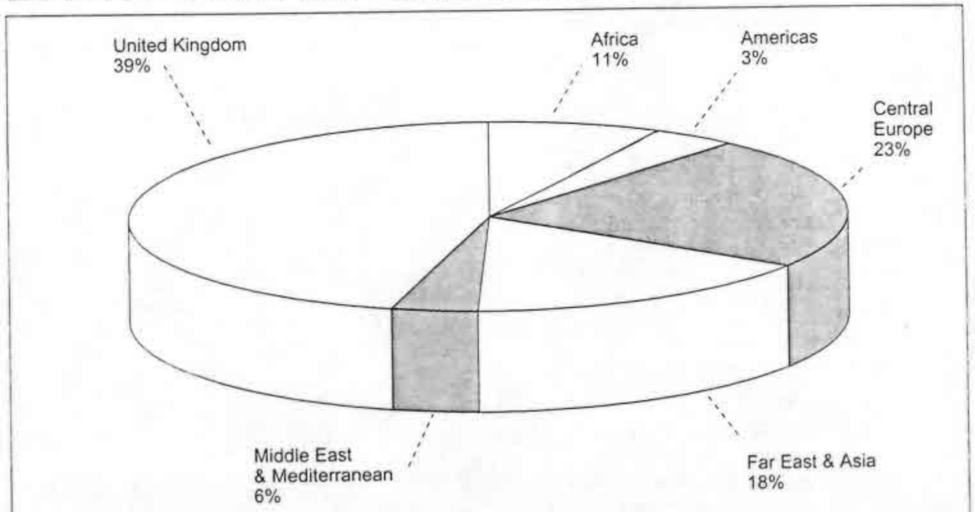
SOURCE: PPECB

EXPORTS HISTORICAL VOLUMES



SOURCE: NDA

EXPORTS PER MARKET SEGMENT: 2001/2002



SOURCE: PPECB

PEARS

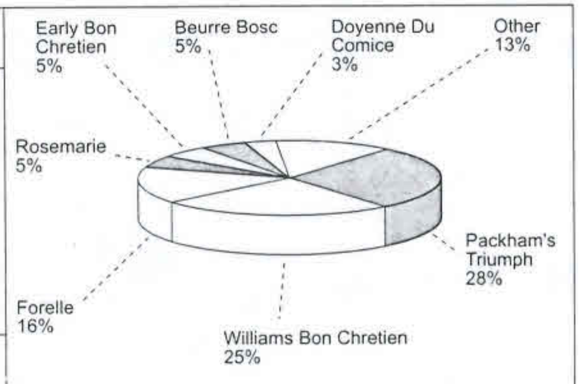
PRODUCTION AREAS

DISTRICT	NO OF TREES	AREA (HA)
Ceres	5,041,249	5,377.01
Groenland	2,469,454	1,868.11
Langkloof East	1,214,011	1,244.89
Wolseley / Tulbagh	1,473,212	1,161.87
Little Karoo	707,378	869.70
Villiersdorp / Vyeboom	955,022	787.38
Berg River	403,380	362.83
Somerset West	357,705	292.50
Stellenbosch	349,277	259.70
Piketberg	195,460	245.94
Langkloof West	118,040	130.79
Hex Valley	139,598	108.05
Southern Cape	108,898	97.58
Franschhoek	69,650	65.59
Cape Town	44,387	25.42
Northern Province	3,222	6.53
Mpumalanga	6,192	3.90
Eastern Cape	1,110	2.08
North West	1100	1.82
Total	**13,658,345**	**12,911.69**

SOURCE: DFPT TREE CENSUS / SADRIN

AREA PLANTED PER CULTIVAR

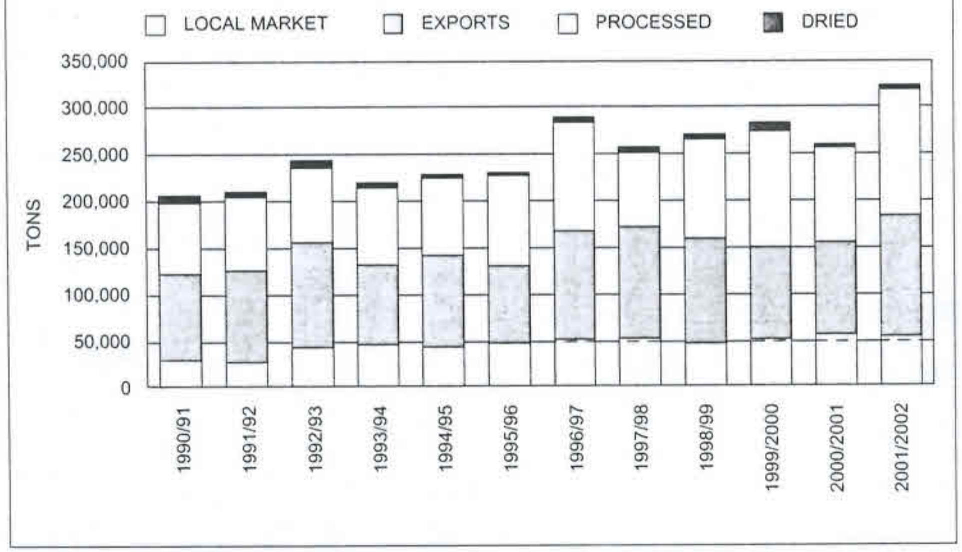
CULTIVAR	HECTARES
Packham's Triumph	3,618
Williams Bon Chretien	3,235
Forelle	2,048
Rosemarie	662
Early Bon Chretien	649
Beurre Bosc	644
Doyenne Du Comice	431
Other	1,624
Total	**12,912**



SOURCE: DFPT TREE CENSUS / SADRIN

CROP DISTRIBUTION

YEAR OCT-SEPT	TOTAL PRODUCTION (TON)	SALES ON LOCAL MARKETS (TON)	SALES ON EXPORTS (TON)	PROCESSED (TON)	DRIED (TON)
1990/91	208,900	28,602	94,445	77,484	8,369
1991/92	212,901	26,302	100,588	80,153	5,858
1992/93	247,460	42,539	115,338	81,457	8,126
1993/94	222,589	45,624	87,796	83,621	5,548
1994/95	231,414	43,044	100,340	83,978	4,052
1995/96	233,305	46,842	85,088	98,208	3,167
1996/97	293,864	50,640	119,159	118,372	5,693
1997/98	261,316	51,703	122,364	81,124	6,125
1998/99	275,032	46,355	115,042	108,059	5,576
1999/2000	287,554	50,640	101,237	126,237	9,440
2000/2001	263,891	55,865	101,228	102,959	3,840
2001/2002	327,900	53,766	132,407	136,959	4,768



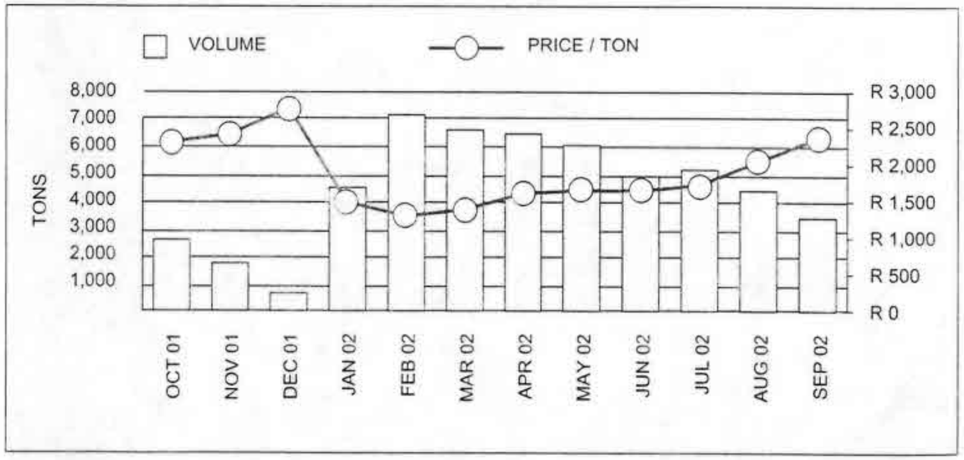
SOURCE: NDA; PPECB, SAAPPA, DFPT

HISTORICAL PRICE TRENDS

YEAR OCT – SEPT	LOCAL MARKET AVERAGE PRICE R/TON	EXPORTS NET REALISATION R/TON	PROCESSING AVERAGE PRICE R/TON	GROSS VALUE DRIED RAND	GROSS VALUE FRESH RAND	TOTAL VALUE RAND
1990/91	1,000.00	1,688.37	266.92	4,435,000	204,055,000	208,490,000
1991/92	1,188.00	2,064.54	347.25	4,095,000	261,809,000	265,904,000
1992/93	972.00	1,113.20	241.88	4,957,000	183,116,000	188,073,000
1993/94	1,119.00	1,881.70	298.97	3,821,000	233,119,000	236,940,000
1994/95	1,505.00	2,218.61	329.52	3,150,000	297,150,000	300,300,000
1995/96	1,454.00	2,783.85	565.14	3,250,000	344,247,000	347,497,000
1996/97	1,314.00	1,663.55	443.24	4,519,000	310,396,000	314,915,000
1997/98	1,497.00	2,532.91	482.77	4,831,000	419,225,000	424,057,000
1998/99	1,428.00	2,438.13	396.63	4,398,000	389,997,000	394,395,000
1999/00	1,329.00	2,863.14	246.04	8,378,000	400,096,000	408,474,000
2000/2001	1,463.00	2,965.25	420.31	2,429,000	390,355,000	393,935,000
2001/2002	1,711.75	3,491.46	607.43	3,015,000	577,178,000	580,193,000

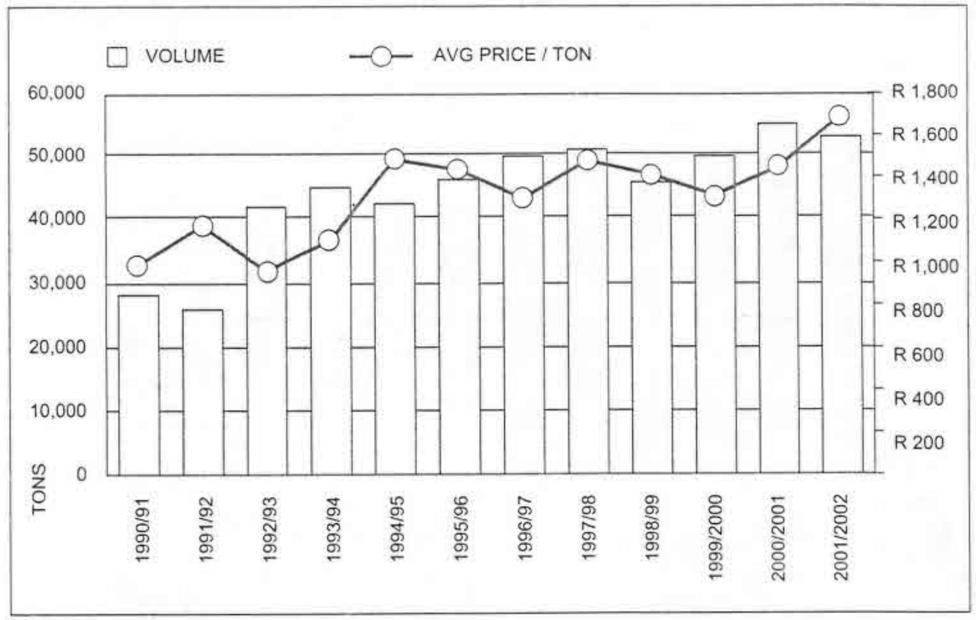
SOURCE: NATIONAL DEPARTMENT OF AGRICULTURE; PPECB

LOCAL MARKET SALES 2001/2002



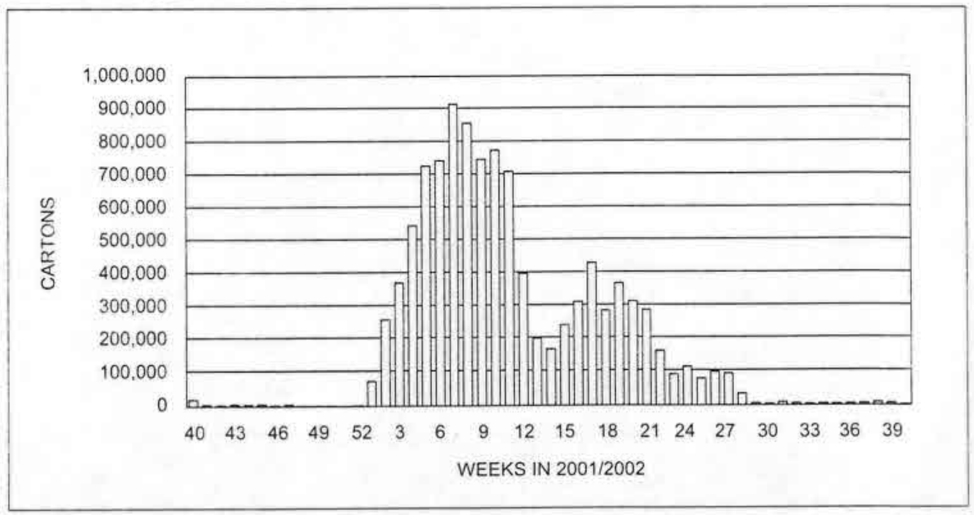
SOURCE: NDA

LOCAL MARKET HISTORICAL SALES



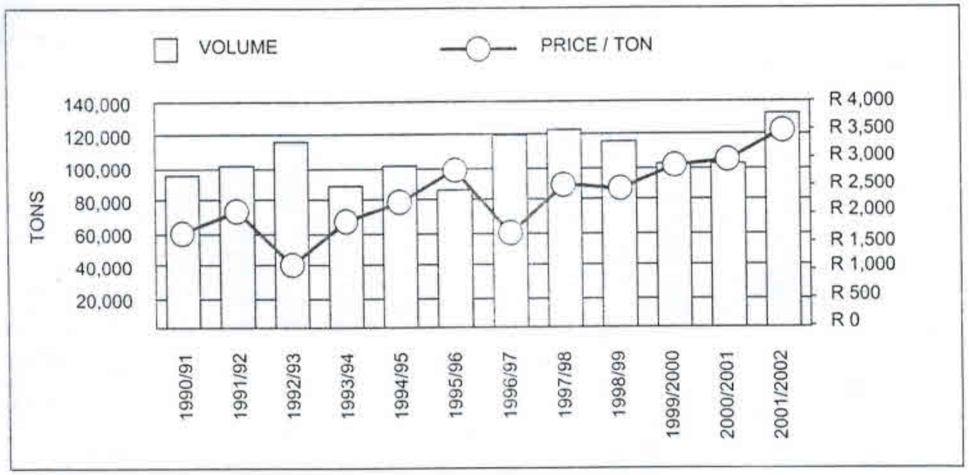
SOURCE: NDA

EXPORT VOLUMES 2001/2002



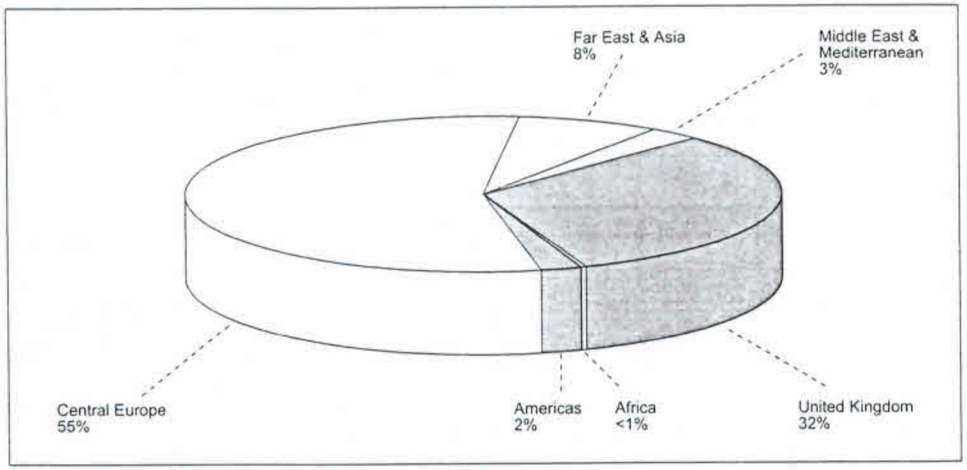
SOURCE: PPECB

EXPORTS HISTORICAL VOLUMES



SOURCE: NDA

EXPORTS PER MARKET SEGMENT



SOURCE: PPECB

EXPORT VOLUME IN CARTONS

CULTIVAR	2001/2000	2000/2001	% Change
PACPACKHAM'S TRIUMPH	5,265,614	4,309,259	22%
WILLIAM'S BON CHRETIEN	1,690,761	1,290,059	31%
FORELLE	1,023,937	922,456	11%
BEURRE BOSC	638,612	405,800	57%
ROSEMARIE	392,072	394,951	-1%
DOYENNE DU COMICE	546,724	210,993	159%
BEURRE HARDY	372,779	185,534	101%
BON ROUGE	114,013	114,636	-1%
FLAMINGO	99,138	108,359	-9%
GOLDEN RUSSET BOSC	127,514	76,586	66%
VERMONT BEAUTY	100,820	12,671	696%
ABATE FETEL	34,156	10,116	238%
VICTORIA BLUSH	5,573	8,328	-33%
CORONA	167	8,099	-98%
HIGHLAND	8,240	7,756	6%
JOSEPHINE DE MALINES	1,259	6,777	-81%
RED D'ANJOU	15,466	4,800	222%
HARROW DELIGHT	20,405	4,016	408%
EXPERIMENTAL	3,150	3,728	-16%
BARTLETT	30,504	3,689	727%
KIEFFER	2,037	2,521	-19%
BLUSHED WILLIAMS		1,206	-100%
FORMOSA		850	-100%
CLAPPS FAVOURITE	5,289	757	599%
CRIMSON	784	720	9%
CONFERENCE	4,682	663	606%
BEURRE DIEL		368	-100%
GLOU MORCEAU		119	-100%
BEURRE CLAIRGEAU	820	-	100%
GENERAL LE CLERC	17,771	-	100%
SEMPRE PEARS	68,275		100%
TOTAL	**10,592,552**	**8,095,817**	**31%**

SOURCE: PPECB

APRICOTS

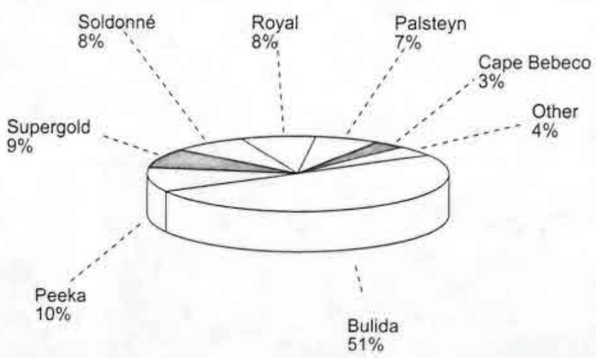
PRODUCTION AREAS

DISTRICT	NO OF TREES	AREA (HA)
Berg River	49,493	70.6
Cape Town	11,909	21.0
Ceres	105,227	147.8
Eastern Cape	2,102	2.8
Franschhoek	1,620	2.0
Groenland	14,604	15.0
Hex Valley	74,493	101.2
Klein Karoo	1,871,955	3233.5
Langkloof East	222,336	406.3
Langkloof West	67,483	135.1
Lower Orange River	48	0.2
Mpumalanga	960	3.2
Namaqualand	7,250	10.7
Northern Province	15,326	18.7
Piketberg	85,664	203.3
Somerset West	12,763	18.5
Southern Cape	26,240	47.4
Stellenbosch	343	0.3
Upper Orange River	70,187	78.0
Villiersdorp / Vyeboom	53,198	60.8
Wolseley / Tulbagh	123,217	172.5
North West	1,315	2.0
Total	**2,817,733**	**4,751**

SOURCE: DFPT TREE CENSUS / SADRIN

AREA PLANTED PER CULTIVAR

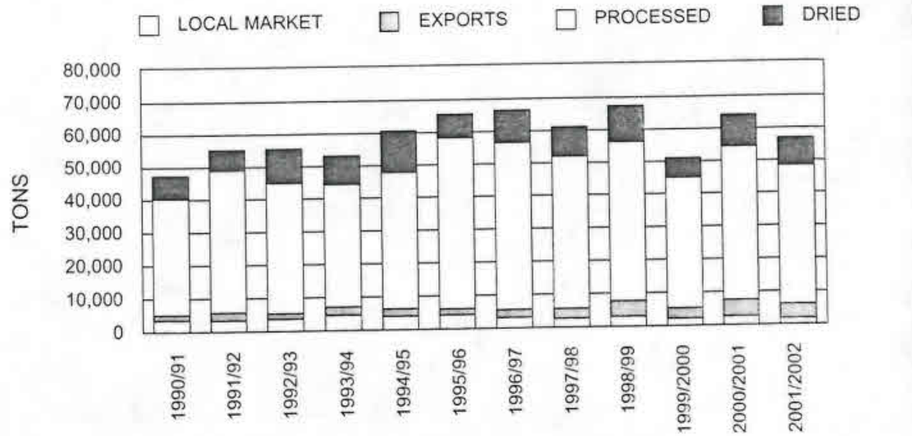
CULTIVAR	HECTARES
Bulida	2,389
Peeka	487
Supergold	407
Soldonné	387
Royal	386
Palsteyn	330
Cape Bebeco	155
Other	211
Total	**4,751**



SOURCE: DFPT TREE CENSUS / SADRIN

CROP DISTRIBUTION

YEAR OCT – SEPT	TOTAL PRODUCTION (TON)	LOCAL MARKETS (TON)	EXPORTS (TON)	PROCESSED (TON)	DRIED (TON)
1990/91	46,983	3,471	1,722	34,803	6,987
1991/92	54,938	3,291	2,512	42,726	6,409
1992/93	55,121	3,634	1,809	39,058	10,620
1993/94	52,791	4,591	2,584	36,728	8,888
1994/95	60,177	4,038	2,340	40,941	12,858
1995/96	65,045	4,208	1,939	51,632	7,266
1996/97	66,006	3,104	2,541	50,419	9,942
1997/98	60,605	2,605	3,108	45,892	9,000
1998/99	66,889	2,986	4,771	48,044	11,088
1999/2000	50,661	2,162	3,209	39,158	6,132
2000/2001	63,679	2,575	5,062	46,370	9,672
2001/2002	56,526	1,817	4,361	41,810	8,538



SOURCE : NDA / PPECB / IPV

HISTORICAL PRICE TRENDS

YEAR OCT - SEPT	LOCAL MARKETS AVERAGE R/TON	EXPORTS NET REALISATION R/TON	PROCESSED AVERAGE PRICE R/TON	GROSS VALUE DRIED RAND	GROSS VALUE FRESH RAND	TOTAL VALUE OF PRODUCTION RAND
1990/91	884	3,990	287.63	9,115,000	20,604,000	29,719,000
1991/92	981	3,078	451.00	9,671,000	30,921,000	40,592,000
1992/93	1,084	4,275	468.67	21,227,000	30,822,000	52,049,000
1993/94	946	2,693	371.74	14,423,000	25,689,000	40,112,000
1994/95	1,261	4,326	424.65	20,148,000	33,303,000	53,451,000
1995/96	1,317	6,758	494.26	12,837,000	46,306,000	59,143,000
1996/97	1,548	5,460	590.67	14,399,000	67,353,000	81,752,000
1997/98	1,658	5,908	448.34	13,002,000	45,969,000	58,971,000
1998/99	1,854	7,267	566.25	16,014,000	68,042,000	84,056,000
1999/2000	1,972	10,901	525.03	9,367,000	63,905,000	73,272,000
2000/2001	2,150	10,184	703.24	20,190,000	90,066,000	110,256,000
2001/2002	2,177	10,099	801.18	17,823,000	91,030,000	108,853,000

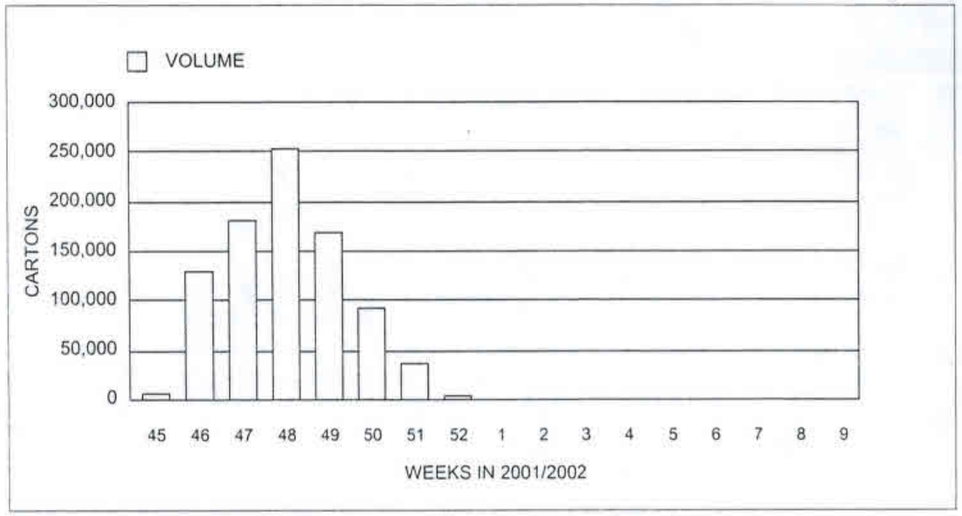
SOURCE: NDA

EXPORTS IN CARTONS

CULTIVAR	2001/2001	2000/2001	% CHANGE
IMPERIAL	432,677	521,162	-17%
SUPERGOLD	230,206	214,322	7%
BEBECCO	83,956	127,824	-34%
SOLDONNÉ	83,523	87,274	-4%
PEEKA	30,758	46,015	-33%
GRANDIR	8,300	8,844	-6%
BULIDA	2,383	3,127	-24%
EMPRESS	-	1,930	-100%
ROYAL	-	1,241	-100%
ALPHA	52	756	-93%
PALSTEYN	484	2	24100%
EXPERIMENTAL	36	-	
Total	**872,375**	**1,012,497**	**-14%**

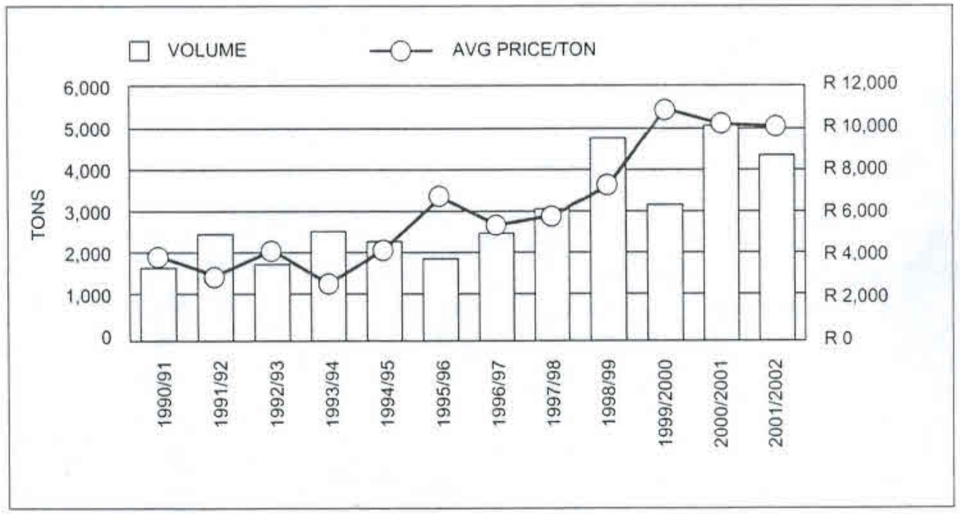
SOURCE: PPECB

EXPORT VOLUMES 2001/2002



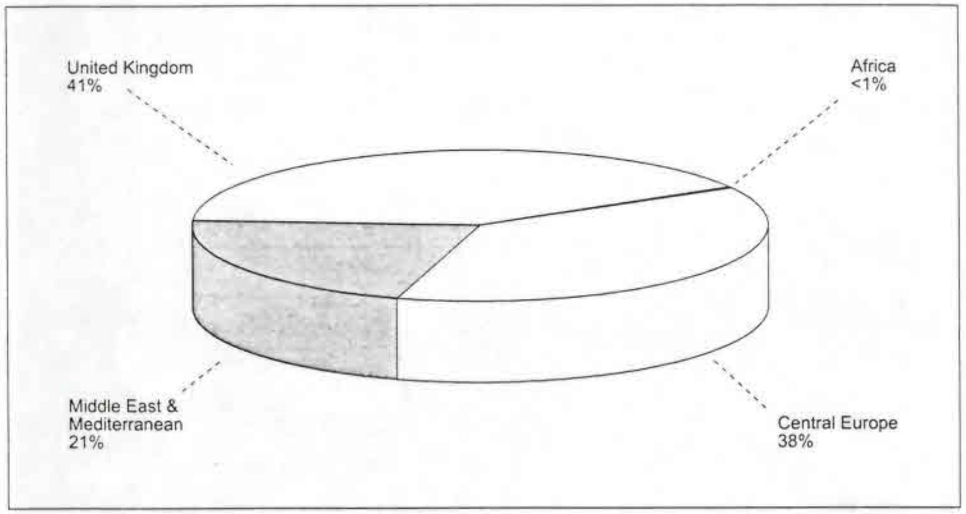
SOURCE: PPECB

EXPORT HISTORICAL VOLUMES



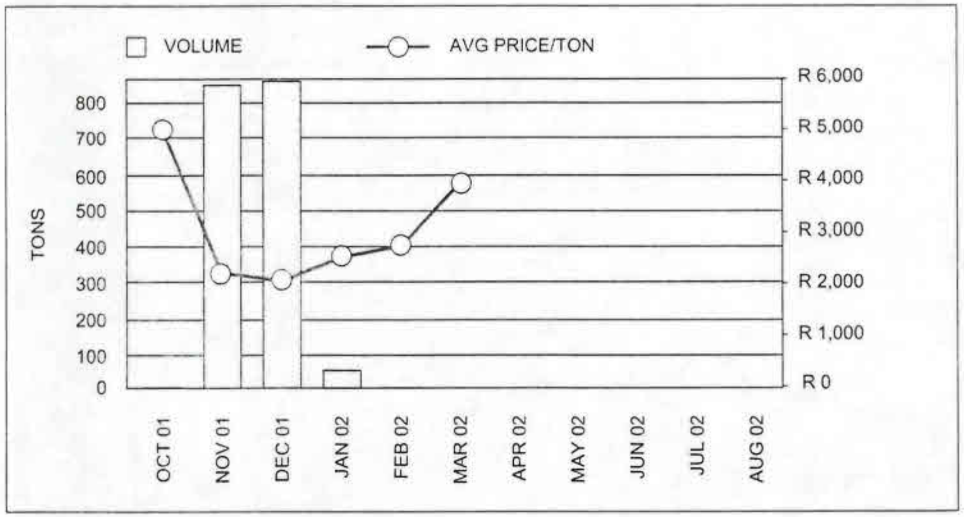
SOURCE: NDA

EXPORTS PER MARKET SEGMENT



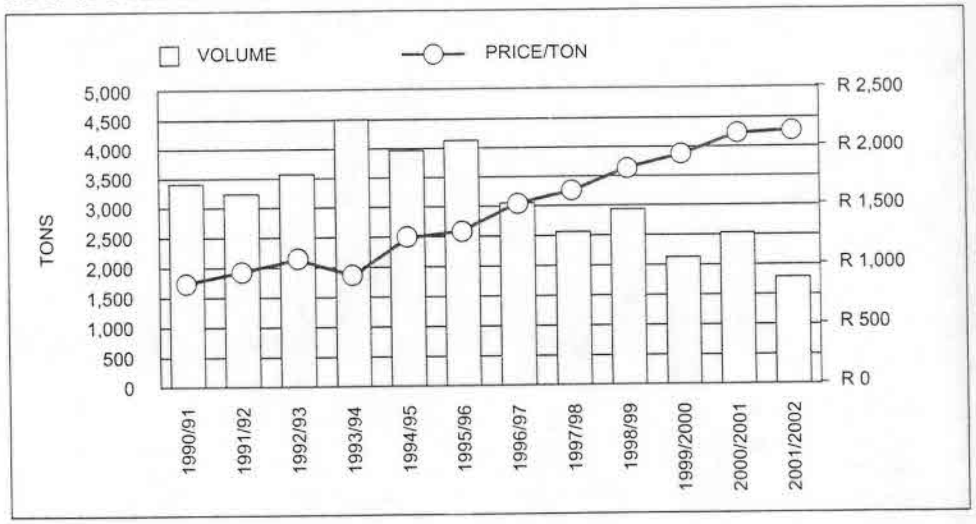
SOURCE: PPECB

LOCAL MARKET SALES 2001/2002



SOURCE: NDA

LOCAL MARKET HISTORICAL SALES



SOURCE: NDA

NECTARINES

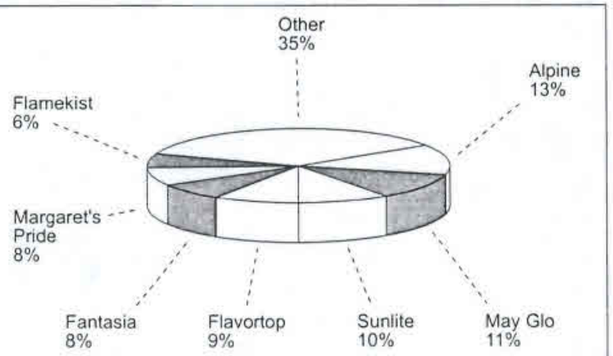
PRODUCTION AREAS

DISTRICT	NO OF TREES	AREA (HA)
Ceres	570,788	378.90
Berg River	168,297	156.20
Wolseley / Tulbagh	205,595	147.99
Piketberg	125,003	106.88
Little Karoo	135,346	147.47
Langkloof East	110,622	90.81
Northern Province	89,941	113.73
Villiersdorp / Vyeboom	59,949	44.51
Groenland	60,280	36.37
Hex Valley	28,378	25.38
Gauteng	11790	17.76
Mpumalanga	10,889	13.76
Stellenbosch	36,141	24.59
Upper Orange River	14,381	12.63
Franschhoek	13,229	12.64
Somerset West	1,118	1.27
Lower Orange River	6,129	5.34
Free State	5,460	13.15
Southern Cape	7,225	4.36
Eastern Cape	8,822	9.31
North West Province	14,837	14.29
Langkloof West	250	0.40
Cape Town	970	1.09
Namaqualand	350	0.35
Total	**1,685,790**	**1379.18**

SOURCE: DFPT TREE CENSUS / SADRIN

AREA PLANTED PER CULTIVAR

CULTIVAR	AREA (HA)
Alpine	181
May Glo	154
Sunlite	137
Flavortop	123
Fantasia	107
Margaret's Pride	106
Flamekist	84
Other	487
Total	**1,379**



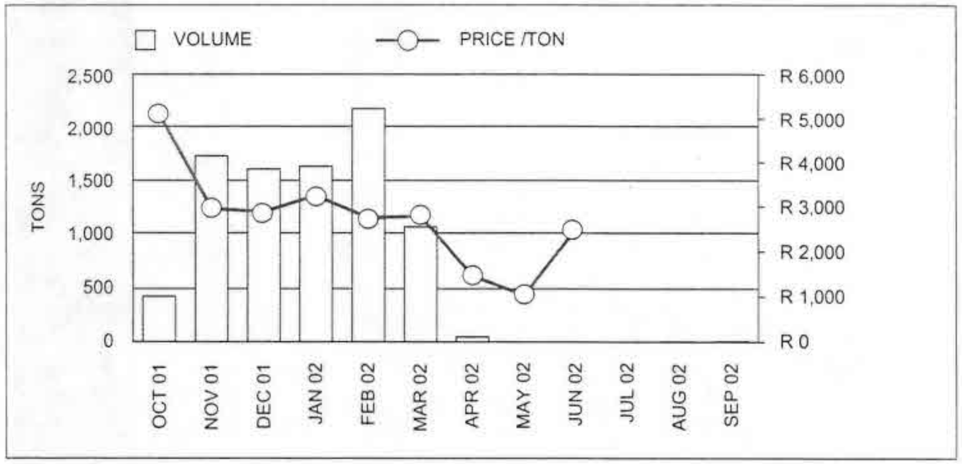
SOURCE: DFPT TREE CENSUS / SADRIN

EXPORTS IN CARTONS

CULTIVAR	2001/2002	2000/2001	% CHANGE
SUNLITE	200,768	166,645	20%
DONNARINE	138,740	139,856	-1%
MAGARET'S PRIDE	135,107	137,282	-2%
FLAVORTOP	116,444	107,115	9%
ZAIGINA	112,679	123,434	-9%
FANTASIA	102,712	171,849	-40%
FLAMEKIST	101,504	108,374	-6%
AUGUST RED	83,113	44,144	88%
MAY GLO	81,983	74,583	10%
ALPINE	62,135	26,069	138%
FIESTA RED	58,173	47,317	23%
OLYMPIA	47,197	27,868	69%
EXPERIMENTAL	37,060	3,806	874%
SUNGRAND	25,093	20,559	22%
CRIMSON GIANT	7,871	2,385	230%
AUGUST GLO	6,531	2,820	132%
EARLY SUNGRAND	5,389	216	2395%
UNICO	4,083	8,378	-51%
INDEPENDENCE	3,979	4,776	-17%
ARMKING	3,330	8,958	-63%
SEPTEMBER RED	2145	-	100%
RED JEWEL	685		100%
NECTARED-9	601		100%
FLAVORINE	586	7,300	-92%
GOLDMINE NECTARINE	157	40	293%
NECTAR	131	120	9%
EARLY RIVER	92	130	-29%
MARINA		24,846	-100%
Total	**1,338,288**	**1,258,870**	**6%**

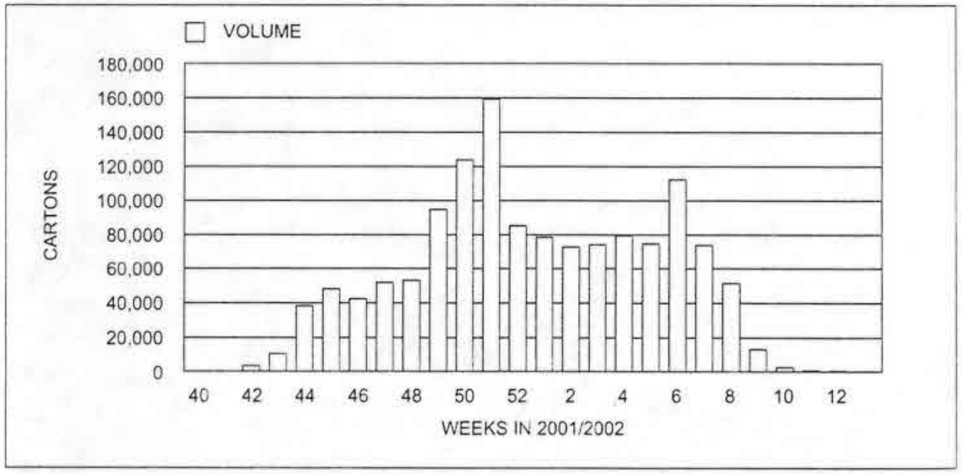
SOURCE: PPECB

LOCAL MARKET SALES 2001/2002



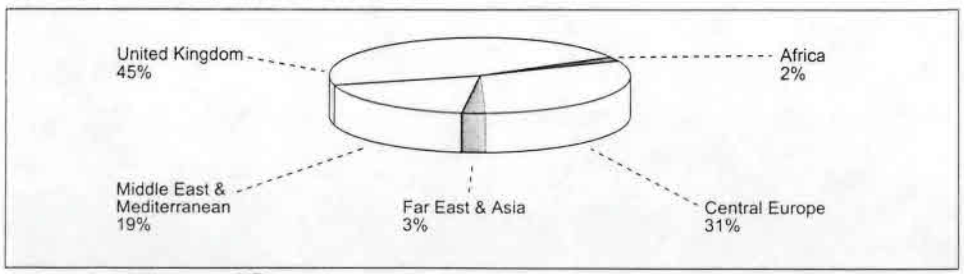
SOURCE: NDA

EXPORT VOLUMES 2001/2002



SOURCE: PPECB

EXPORTS PER MARKET SEGMENT



SOURCE: PPECB

PEACHES

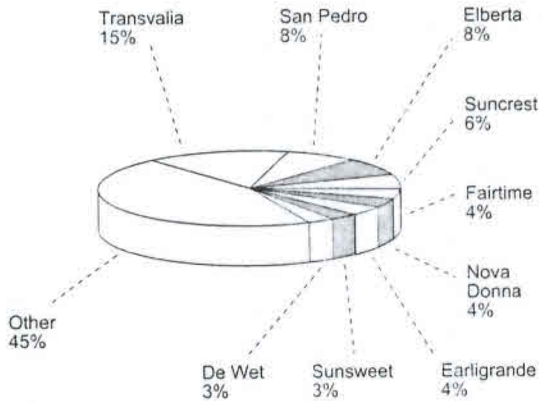
PRODUCTION AREAS

DISTRICT	DESSERT PEACHES NO OF TREES	DESSERT PEACHES AREA (HA)	CLING PEACHES NO OF TREES	CLING PEACHES AREA (HA)
Little Karoo	60,482	78.3	2,123,255	3,554.8
Wolseley / Tulbagh	210,718	190.0	1,138,861	1,444.7
Ceres	156,027	169.7	994,161	1,189.2
Southern Cape	250	0.3	286,342	512.9
Hex Valley	15,068	15.3	347,526	473.9
Villiersdorp / Vyeboom	11,063	8.6	217,731	295.7
Piketberg	154,228	197.8	190,052	224.3
Langkloof East	14,674	22.5	125,347	153.2
Berg River	76,763	79.5	58,790	86.3
Franschhoek	20,588	25.7	39,308	52.6
Mpumalanga	48,692	72.3	25,559	51.0
Stellenbosch	16,633	9.6	49,888	37.5
Langkloof West	1,801	2.7	11,594	32.0
Northern Province	115,811	166.4	17,145	30.8
Groenland	11,279	7.0	19,469	28.6
Free State	59,322	143.3	7,433	19.4
North West	49,301	59.4	6,010	11.5
Somerset West			3,963	8.4
Gauteng	13,101	24.6	3,934	7.5
Eastern Cape	12,625	17.8	6,120	7.4
Upper Orange River	18,510	35.5	4,589	6.2
Cape Town	3,819	5.7	3,150	6.0
Lower Orange River	5,100	5.2	220	0.5
Namaqualand	860	1.1	10	0.01
Kwazulu Natal	1,940	2.3		
Total	**1,078,655**	**1,340.5**	**5,680,457**	**8,234.4**

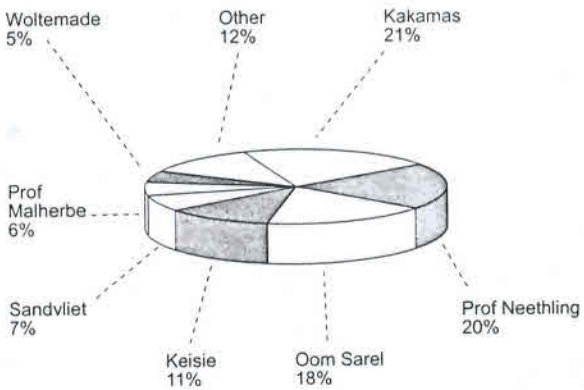
SOURCE: DFPT TREE CENSUS / SADRIN

AREA PLANTED PER CULTIVAR

DESSERT PEACHES	AREA (HA)
Transvalia	203
San Pedro	106
Elberta	104
Suncrest	82
Fairtime	55
Nova Donna	53
Earligrande	51
Sunsweet	41
De Wet	37
Other	608
Total Dessert Peaches	**1,340**



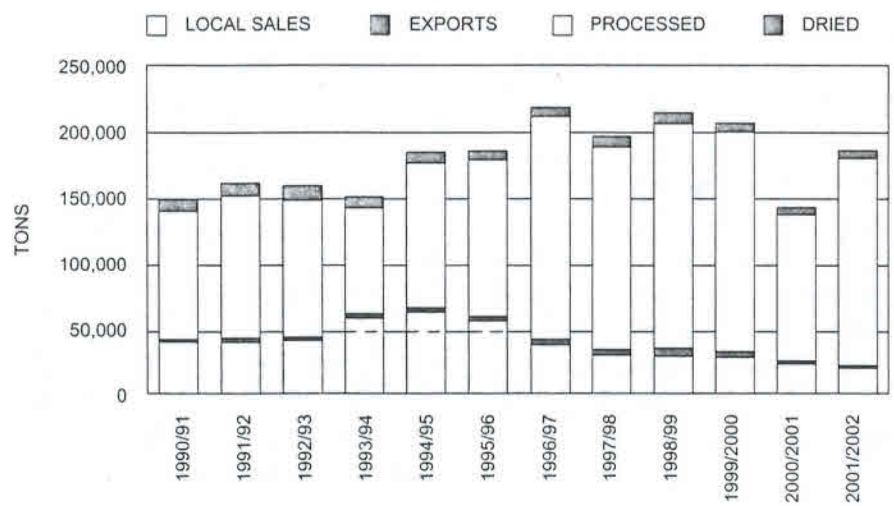
CLING PEACHES	AREA (HA)
Kakamas	1,714
Prof Neethling	1,668
Oom Sarel	1,449
Keisie	945
Sandvliet	584
Prof Malherbe	482
Woltemade	413
Other	978
Total Cling Peaches	**8,234**
Total	**9,575**



SOURCE: DFPT TREE CENSUS / SADRIN

CROP DISTRIBUTION

YEAR OCT - SEPT	TOTAL PRODUCTION (TON)	LOCAL SALES (TON)	EXPORTS (TON)	PROCESSED (TON)	DRIED (TON)
1990/91	148,038	39,505	1,971	97,500	9,062
1991/92	160,197	39,313	3,173	108,116	9,595
1992/93	158,217	40,562	2,507	104,051	11,097
1993/94	149,963	57,593	3,413	80,287	8,670
1994/95	183,983	62,056	3,498	110,213	8,216
1995/96	184,871	55,316	3,532	119,308	6,715
1996/97	217,696	37,129	4,223	169,591	6,753
1997/98	195,901	29,445	4,343	153,824	8,289
1998/99	213,961	28,549	6,277	170,657	8,478
1999/2000	205,986	27,727	4,464	167,051	6,744
2000/2001	141,754	22,723	2,329	111,146	5,556
2001/2002	185,254	19,274	2,395	157,756	5,828



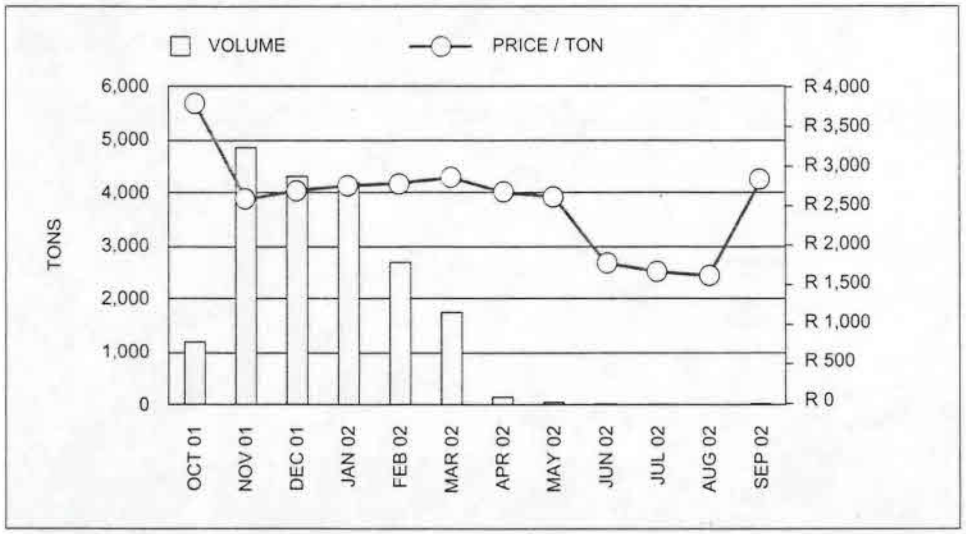
SOURCE: NDA, DFPT, IPV

HISTORICAL PRICE TRENDS

	LOCAL R/TON	EXPORTS R/TON	PROCESSED R/TON	DRIED GROSS VALUE (R)	FRESH GROSS VALUE (R)	TOTAL VALUE OF PRODUCTION (R)
1990/91	1302.00	4660.96	544.72	6,849,000	116,043,000	122,892,000
1991/92	1555.00	4675.38	610.77	8,980,000	145,530,000	154,510,000
1992/93	1557.00	4537.53	615.35	9,742,000	143,759,000	153,501,000
1993/94	1446.00	3287.46	583.59	12,164,000	130,785,000	142,949,000
1994/95	1695.00	5169.91	636.05	8,179,000	178,694,000	186,873,000
1995/96	1978.00	4890.26	782.18	8,662,000	200,120,000	208,782,000
1996/97	2001.00	5739.41	714.53	6,558,000	247,479,000	254,037,000
1997/98	2207.00	7038.59	729.96	8,480,000	232,112,000	240,592,000
1997/98	2619.00	5945.89	1006.61	8,757,000	314,824,000	323,581,000
1999/2000	2644.00	8802.85	939.31	7,947,000	296,945,000	304,892,000
2000/2001	2732.00	8164.34	1041.35	6,232,000	278,535,000	284,767,000
2001/2002	2787.13	8945.31	1154.28	6,537,000	341,505,000	348,042,000

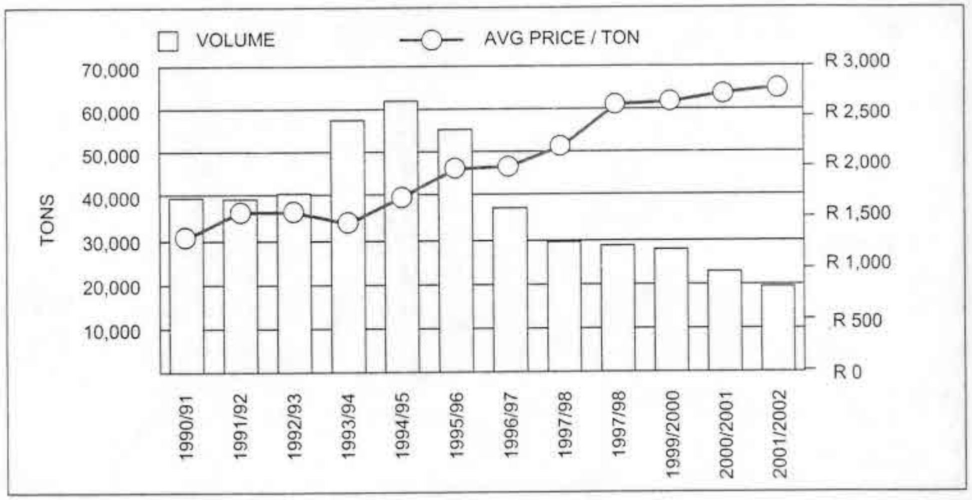
SOURCE: NDA

LOCAL MARKET SALES 2001/2002



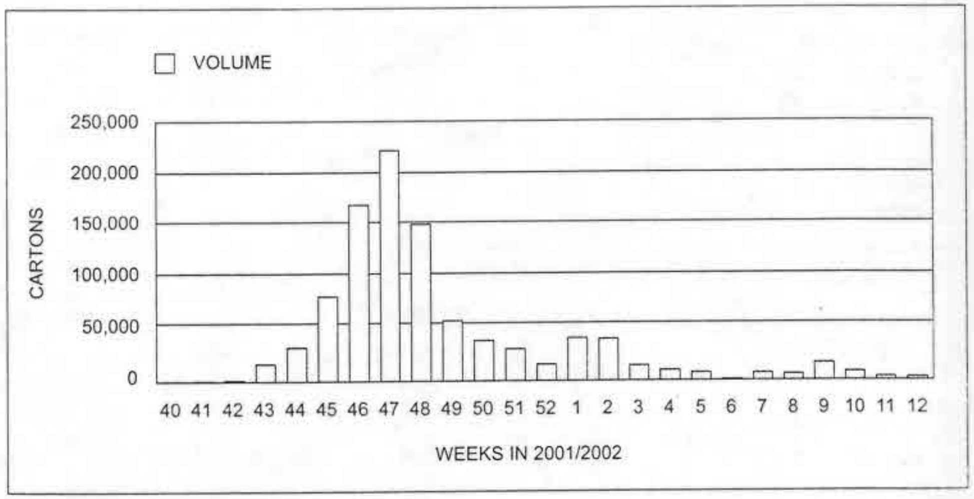
SOURCE: NDA

LOCAL MARKET HISTORICAL SALES



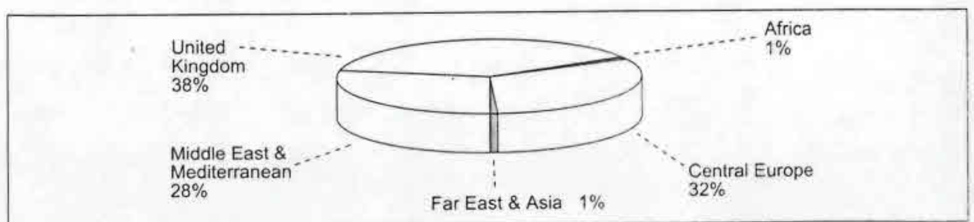
SOURCE: NDA

EXPORT VOLUMES 2001/2002



SOURCE: PPECB

EXPORTS PER MARKET SEGMENT



SOURCE: PPECB

EXPORTS IN CARTONS

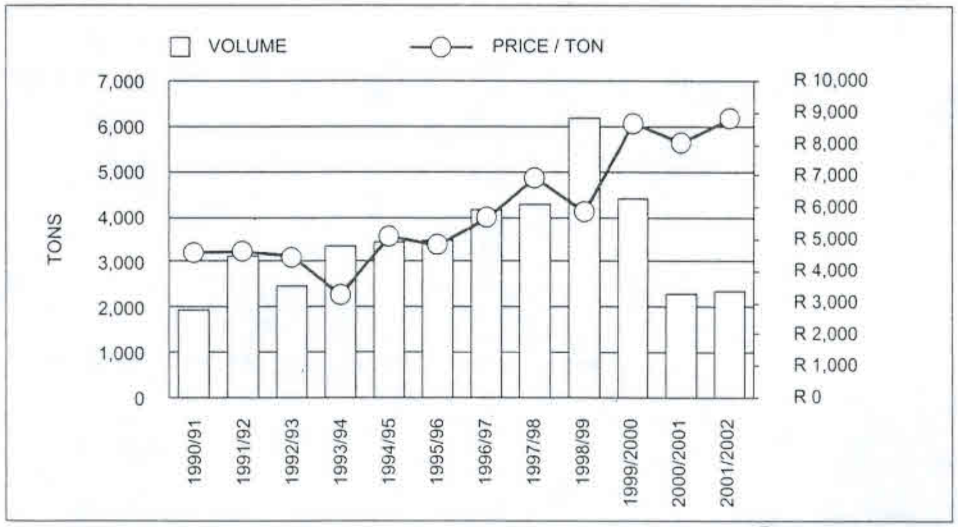
CULTIVAR	2001/2002	2000/2001	% CHANGE
TRANSVALIA	358,147	379,432	-6%
SAN PEDRO	228,143	151,289	51%
NOVA DONNA	58,675	71,738	-18%
BONNIGOLD	37,956	42,000	-10%
CATHERINA	37,046	20,340	82%
FAIRTIME	28,469	23,777	20%
CULEMBORG	23,379	25,477	-8%
EARLIGRANDE	20,980	17,167	22%
OOM SAREL	20,249	25,900	-22%
CLASSIC	16,895	5,934	185%
SUNCREST	16,608	7,686	116%
KEISIE	15,179		
EXCELLENCE	12,317	13,980	-12%
RHODES	11,696	18,015	-35%
KAKAMAS	10,200	4,481	128%
SPRINGCREST	9,927	6,387	55%
YELLOW CLING	7,739	302	2463%
EXPERIMENTAL	6,822	46,799	-85%
SAFARI	3,832	16,747	-77%
WESTERN CLING	3,793	14,358	-74%
ORION	3,371	3,517	-4%
CINDERELLA	3,195	6,393	-50%
DESSERT GOLD	3,150	800	294%
DUNCANS GOLD	3,150		
DESSERT PEARL	3,026	397	662%
SNOWHITE	2,871	1,225	134%
GOLDEN AMBER	1,320	852	55%
SONETTE	1,165	2,519	-54%
BABCOCK	1,051	60	1652%
WESTERN SUN	972	854	14%
GOODMANS CHOICE	971	936	4%
ALBATROS	900		
SUNRAY	836	3,063	-73%
IMPERANI PEACH	730	3,626	-80%
FLORAGOLD	560	1,447	-61%

EXPORTS IN CARTONS (Continued)

CULTIVAR	2001/2002	2000/2001	% CHANGE
SUMMER GIANT	557	115	384%
WOLTEMADE	460	215	114%
DON ELITE	457	509	-10%
BOLAND	450	26	1631%
EARLY ALEXANDER	280	2	13900%
ELBERTA	250		
EARLY DAWN	176		
DE WET	175	5,565	-97%
EARLIBELLE	5	28	-82%
NOOIENS		4,300	-100%
PULLERS CLING		2,216	-100%
SNOWCREST		1,383	-100%
MALHERBE		819	-100%
NEETHLING		533	-100%
CORONET		2	-100%
Total	**958,130**	**933,211**	**3%**

SOURCE : PPECB

EXPORTS HISTORICAL VOLUMES



SOURCE : NDA / PPECB

PLUMS & PRUNES

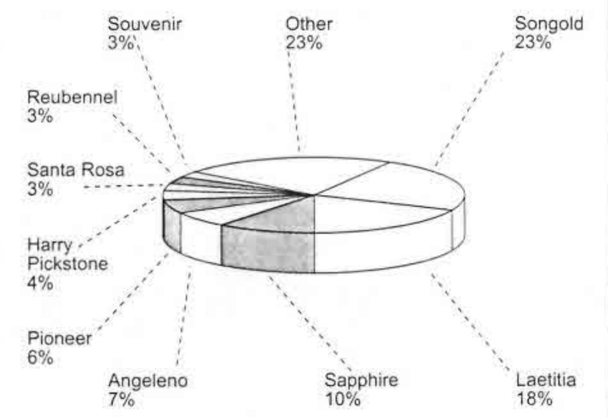
PRODUCTION AREAS

DISTRICT	PLUMS NO OF TREES	PLUMS AREA (HA)	PRUNES NO OF TREES	PRUNES AREA (HA)
Gauteng	34,155	38.93		
Mpumalanga	1,230	4.06		
Lower Orange River	6,793	5.44	12449	7.53
Upper Orange River	56,126	45.90		
Northern Province	67,545	57.52		
North West	33,342	13.88		
Langkloof East	260,489	198.30	1750	2.58
Eastern Cape	39,127	24.54		
Free State	1,550	2.68	1040	2.50
Groenland	676,101	424.78		
Ceres	298,574	143.31	52178	79.65
Villiersdorp / Vyeboom	189,382	137.85	1531	1.91
Little Karoo	1,091,077	914.08	12629	21.75
Langkloof West	8,812	9.66	5	0.01
Piketberg	86,434	65.44	8660	5.43
Southern Cape	161,501	137.42		
Hex Valley	117,821	80.75	7132	13.06
Somerset West	253,329	155.78		
Wolseley / Tulbagh	326,872	193.48	240911	458.59
Cape Town	30,847	19.27		
Berg River	1,500,819	875.60	1285	3.86
Stellenbosch	804,912	530.44		
Franschhoek	392,807	286.15	56	0.07
Total	**6,439,645**	**4,365**	**339,626**	**597**

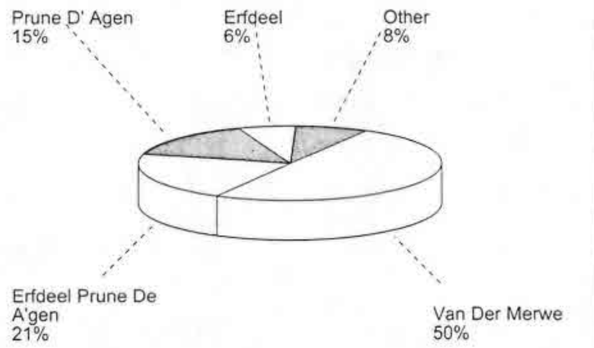
SOURCE: DFPT TREE CENSUS / SADRIN

AREA PLANTED PER CULTIVAR

PLUMS	AREA (HA)
Songold	1,016
Laetitia	805
Sapphire	455
Angeleno	300
Pioneer	249
Harry Pickstone	167
Santa Rosa	142
Reubennel	129
Souvenir	114
Other	990
Total Plums	**4,365**



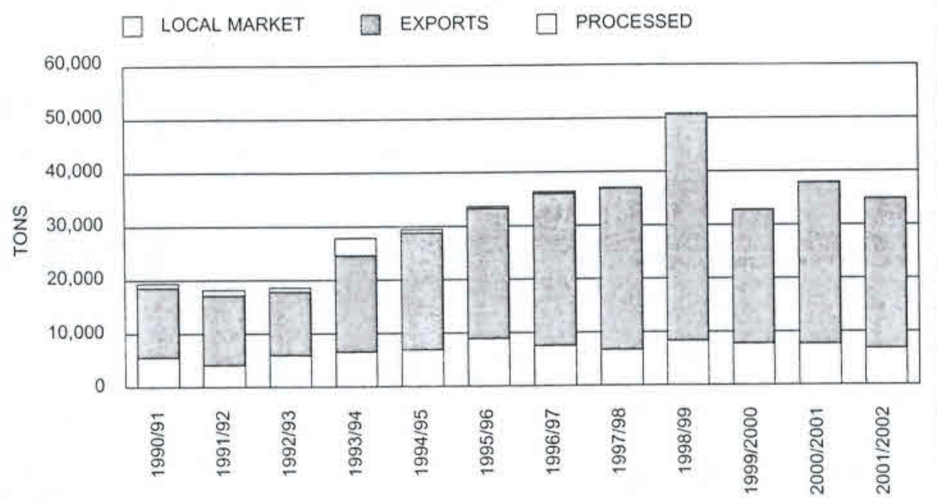
PRUNES	AREA (HA)
Van Der Merwe	297
Erfdeel Prune De A'gen	127
Prune D' Agen	90
Erfdeel	37
Other	46
Total Prunes	**597**
Total	**4,962**



SOURCE: DFPT TREE CENSUS / SADRIN

CROP DISTRIBUTION

YEAR OCT – SEPT	TOTAL PRODUCTION (TON)	LOCAL MARKET (TON)	EXPORTS (TON)	PROCESSED (TON)
1990/91	19,376	5,472	13,102	802
1991/92	18,151	4,050	13,081	1,020
1992/93	18,583	5,886	11,939	758
1993/94	27,862	6,476	18,130	3,256
1994/95	29,417	6,838	22,000	579
1995/96	33,640	8,925	24,358	357
1996/97	36,317	7,551	28,459	307
1997/98	37,011	6,711	30,258	42
1998/99	47,282	8,325	42,429	69
1999/2000	32,832	7,779	25,014	39
2000/2001	37,892	7,700	30,165	27
2001/2002	34,884	6,831	28,053	0



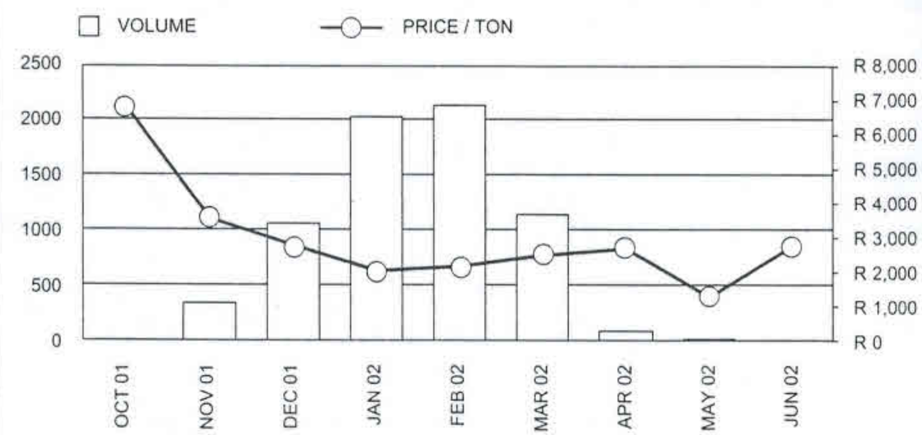
SOURCE: NDA, DFPT

HISTORICAL PRICE TRENDS

YEAR	LOCAL MARKET R/TON	EXPORTS R/TON	PROCESSING R/TON	TOTAL VALUE OF PRODUCTION RAND
1990/91	1,095.00	3,502.98	116.51	51,081,000
1991/92	1,409.00	3,791.76	185.63	54,639,000
1992/93	1,340.00	3,887.88	181.10	53,258,000
1993/94	1,238.00	3,888.43	283.96	78,237,000
1994/95	1,466.00	3,361.70	246.07	82,621,000
1995/96	1,471.00	3,946.80	249.66	107,384,000
1996/97	1,620.00	3,782.79	230.57	118,123,000
1997/98	1,772.00	4,447.66	269.52	144,698,000
1998/99	1,850.00	3,763.63	180.17	174,781,000
1999/2000	2,071.00	8,077.49	379.10	215,761,000
2000/2001	2,154.57	8,077.33	195.70	259,925,000
2001/2002	2,367.81	9,302.04	0.00	276,788,000

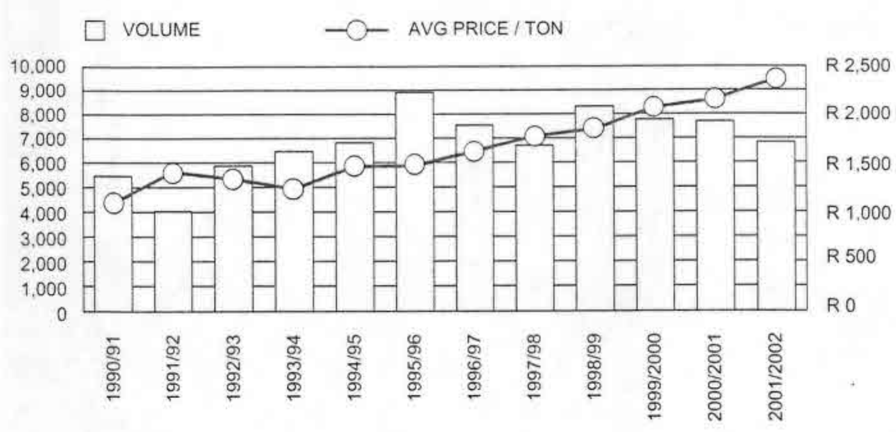
SOURCE: NDA

LOCAL MARKET SALES 2001/2002



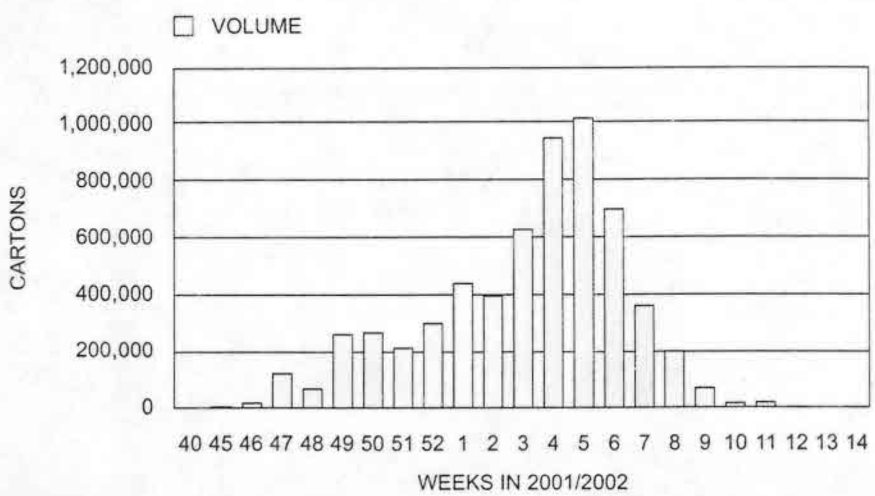
SOURCE: NDA

LOCAL MARKET HISTORICAL SALES



SOURCE: NDA

EXPORT VOLUMES



SOURCE: PPECB

EXPORTS IN CARTONS

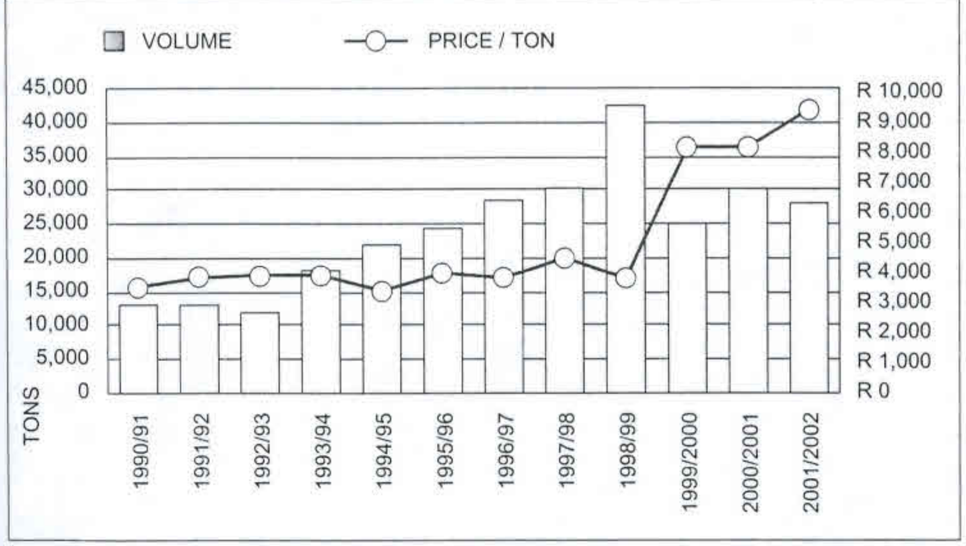
CULTIVAR	2001/2002	2000/2001	% CHANGE
SONGOLD	1,634,475	1,743,686	-6%
LAETITIA	1,595,226	2,076,586	-23%
SAPPHIRE	586,245	608,563	-4%
RUBY NEL	398,029	453,624	-12%
HARRY PICKSTONE	324,750	409,061	-21%
ANGELENO/SUPLUMSIX	312,707	215,952	45%
PIONEER	176,652	176,461	0%
GAVIOTA	167,602	110,550	52%
SOUVENIR	157,869	123,126	28%
LARY ANNE	150,222	86,647	73%
SANTA ROSA	102,011	126,413	-19%
LADY RED	90,198	53,859	67%
FORTUNE	77,074	26,705	189%
CASSELMAN	62,979	88,253	-29%
FLAVOR KING	40,268	12,021	235%
SOUTHERN BELLE	36,700	17,334	112%
EXPERIMENTAL	33,249	11,637	186%
AFRICAN PRIDE	25,817		100%
RED BEAUT	15,094	29,923	-50%
RUBY RED	7,605	3,737	104%
SIMKA	7,468	15,663	-52%
LARODA	6,096	380	1504%
SUN KISS	5,050	10,434	-52%
APPLE PLUMS	4,997	1,463	242%
PRUNES	2,865	1,055	172%
ROYSUM	2,170		100%
RED GOLD	1,138	390	192%
SUNDEW	331	3,817	-91%
MARIPOSA	314	230	37%
BEAUTY	287	2,880	-90%
OCTOBER PURPLE	260		100%
ELDORADO	231	290	-20%
ECLIPSE	50		100%
SATSUMA	30		100%
RED ACE	20	193	-90%

EXPORTS IN CARTONS (CONTINUED)

CULTIVAR	2001/2002	2000/2001	% CHANGE
CHALCOT		717	-100%
GOLDEN KING		391	-100%
KELSEY PLUMS		9	-100%
LADY WEST		486	-100%
METHLEY		15	-100%
MOSTERT		164	-100%
Total	**6,026,079**	**6,412,551**	**-6%**

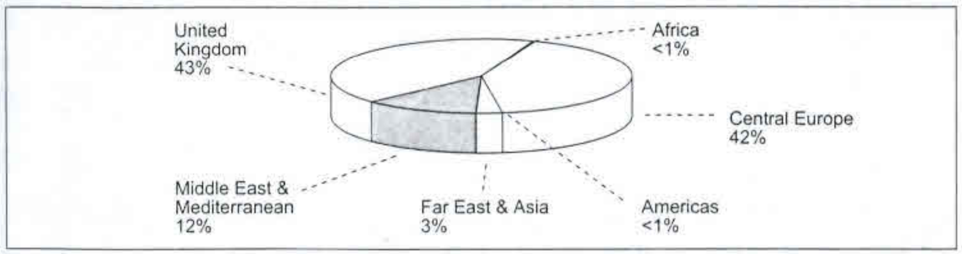
SOURCE: PPECB

EXPORT HISTORICAL VOLUMES



SOURCE: NDA / PPECB

EXPORT PER MARKET SEGMENT



SOURCE: NDA / PPECB

GRAPES

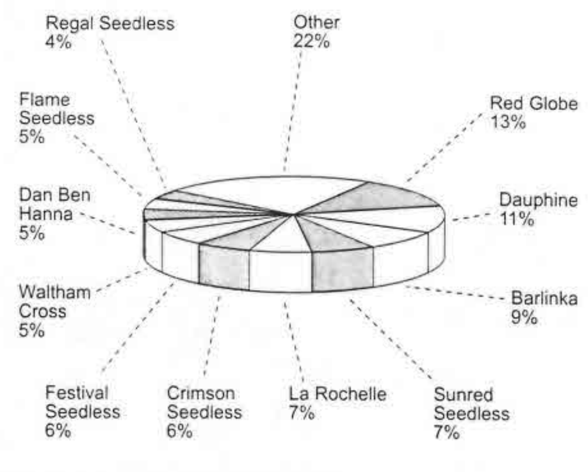
PRODUCTION REGIONS

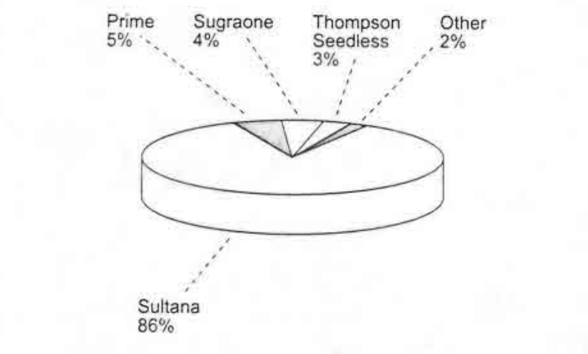
DISTRICT	TABLE GRAPES TREES (NO)	TABLE GRAPES AREA (HA)	DRY GRAPES TREES (NO)	DRY GRAPES AREA (HA)	DRY & TABLE GRAPES TREES (NO)	DRY & TABLE GRAPES AREA (HA)
Hex Valley	10,498,055	4,788.49			667,252	326.08
Berg River	5,273,267	2,711.25			851,189	482.34
Lower Orange River	3,336,428	1,827.88	774,471	468.73	12,117,622	6,872.03
Piketberg	1,254,105	773.86			391,285	249.53
Northern Province	828,666	463.89	8,554	4.16	106,492	62.02
Little Karoo	630,065	329.91	3,595	1.28	237,729	102.61
Namaqualand	335,093	167.10	563,279	186.43	592,854	273.81
Upper Orange River	306,091	160.87	1,000	0.60	21,818	16.54
North West	128,152	78.02	2,000	1.20	8,300	5.17
Wolseley / Tulbagh	121,425	64.82				
Stellenbosch	60,882	34.13	78,678	28.79	27,985	12.14
Gauteng	44,820	24.88	3,000	1.23	58,975	29.93
Mpumalanga	44,526	28.04			20,874	10.27
Langkloof East	13,950	6.32			1,150	0.60
Ceres	9,258	5.82			2,427	1.32
Eastern Cape	8,318	4.98			584	0.54
Groenland	7,037	4.24				
Cape Town	5,598	2.52				
Somerset West	683	0.27			200	0.06
Southern Cape	163	0.08				
Langkloof West	100	0.15				
Free State					45,496	21.70
Villiersdorp / Vyeboom					11,482	6.20
Total	**22,906,682**	**11,478**	**1,434,577**	**692**	**15,163,714**	**8,473**

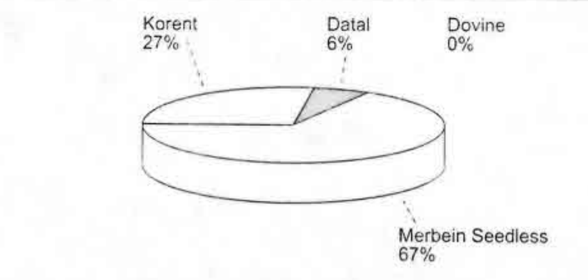
SOURCE: DFPT TREE CENSUS / SADRIN

AREA PLANTED PER CULTIVAR

CULTIVAR	AREA (HA)
TABLE GRAPES	**11,478**
Red Globe	1,476
Dauphine	1,294
Barlinka	984
Sunred Seedless	793
La Rochelle	784
Crimson Seedless	697
Festival Seedless	684
Waltham Cross	613
Dan Ben Hannah	542
Flame Seedless	529
Regal Seedless	483
Other	2,599
DRY- & TABLE GRAPES	**8,437**
Sultana	7,229
Prime	441
Sugraone	375
Thompson Seedless	265
Other	163
DRY GRAPES	**692**
Merbein Seedless	463
Korent	186
Datal	42
Dovine	1
Total	**20,643**



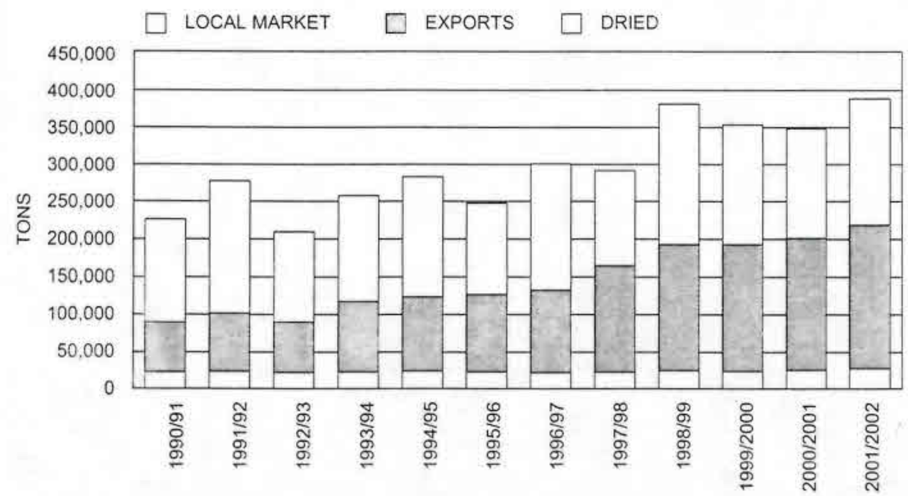




SOURCE: DFPT TREE CENSUS / SADRIN

CROP DISTRIBUTION

YEAR OCT – SEPT	TOTAL PRODUCTION (TON)	FRESH VOLUME LOCAL MARKET (TON)	FRESH VOLUME EXPORTS (TON)	DRIED FRESH VOLUME (TON)
1990/91	224,191	22,172	65,627	136,392
1991/92	275,033	22,632	77,741	174,660
1992/93	207,740	21,472	67,175	119,093
1993/94	255,358	21,964	93,972	139,422
1994/95	280,576	23,088	98,859	158,629
1995/96	245,554	22,229	103,016	120,309
1996/97	298,821	20,972	109,907	167,942
1997/98	289,397	21,659	141,591	126,147
1998/99	379,220	23,767	167,747	187,706
1999/2000	351,452	22,929	168,327	160,196
2000/2001	346,059	24,555	175,164	146,340
2001/2002	386,533	26,578	190,536	169,420



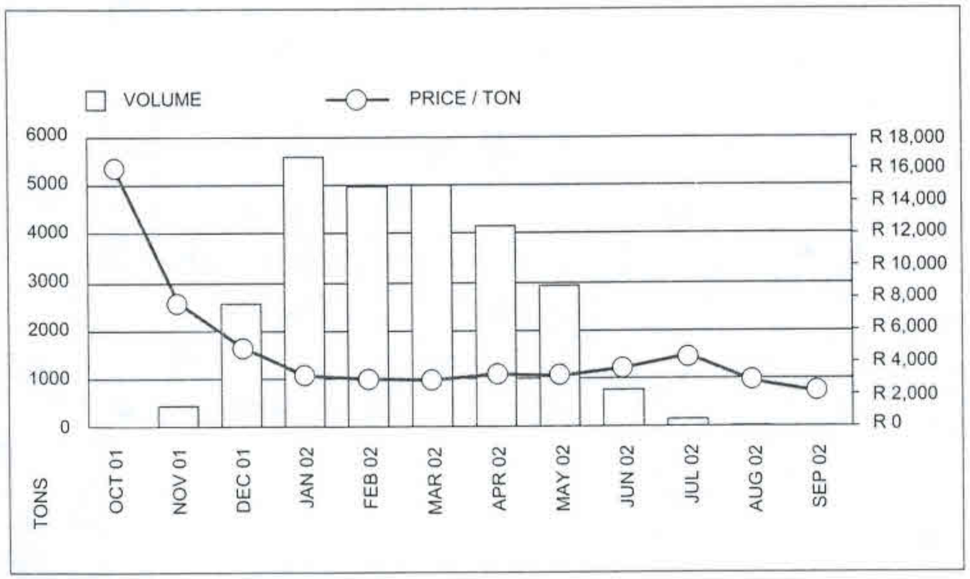
SOURCE : NDA; PPECB

HISTORICAL PRICE TRENDS

YEAR OCT–SEPT	LOCAL MARKET SALES AVERAGE PRICE R/TON	EXPORTS NET REALISATION R/TON	GROSS VALUE GRAPES DRIED R/TON	GROSS VALUE TABLE GRAPES R/TON	TOTAL VALUE OF PRODUCTION R/TON
1990/91	1,539	3,366	67,869,000	270,350,000	338,219,000
1991/92	1,800	3,869	98,293,000	360,465,000	458,758,000
1992/93	1,964	4,496	95,889,000	362,490,000	458,379,000
1993/94	2,024	4,556	101,014,000	489,530,000	590,544,000
1994/95	2,343	4,881	115,215,000	558,288,000	673,503,000
1995/96	2,527	5,021	103,213,000	595,598,000	698,811,000
1996/97	2,321	5,699	136,553,000	703,191,000	839,744,000
1997/98	2,992	6,935	123,044,000	1,071,522,000	1,194,566,000
1998/99	2,937	7,494	231,366,000	1,355,542,000	1,586,908,000
1999/2000	2,781	6,372	190,943,000	1,124,392,000	1,315,335,000
2000/2001	3,151	9,232	135,534,000	1,670,944,000	1,806,478,000
2001/2002	3,357	10,736	134,681,000	2,166,228,000	2,300,909,000

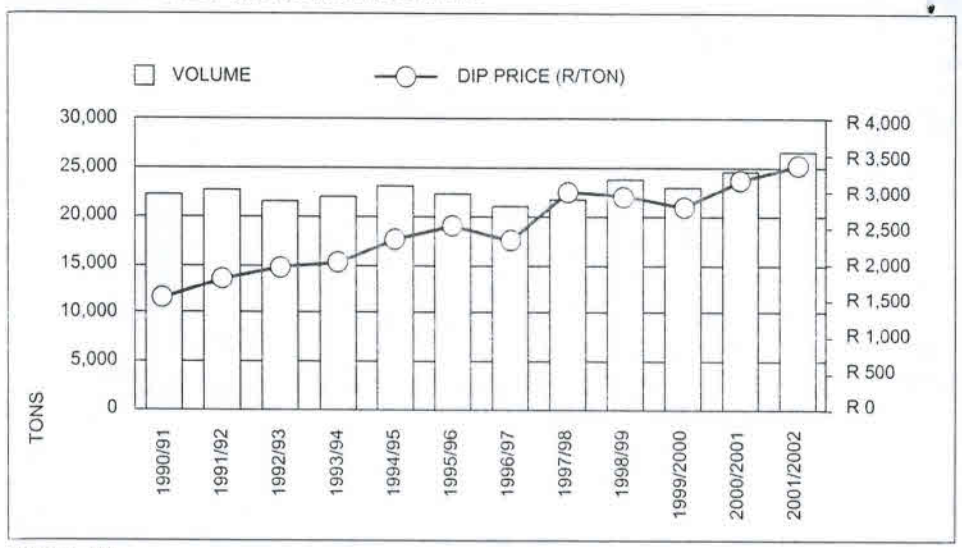
SOURCE: NDA

LOCAL MARKET SALES 2001/2002



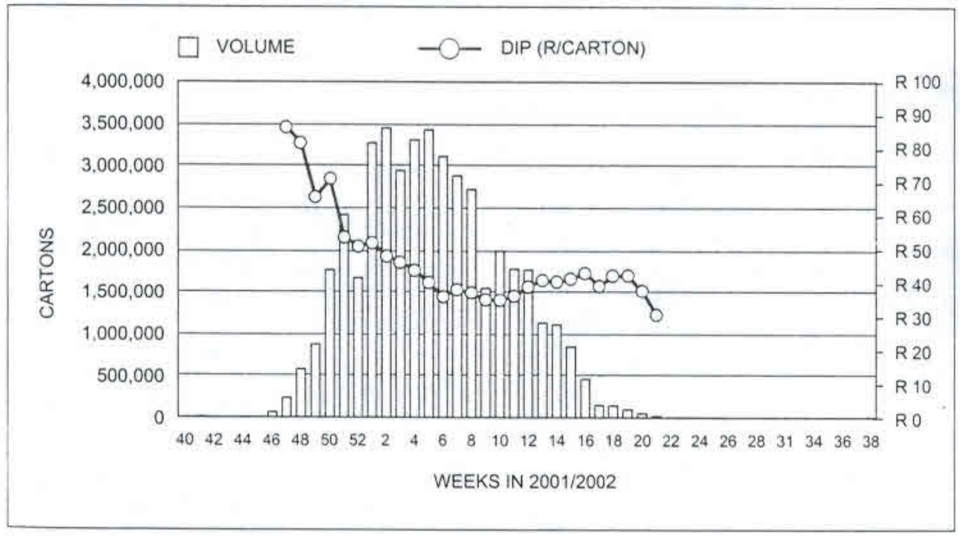
SOURCE: NDA

LOCAL MARKET HISTORICAL SALES



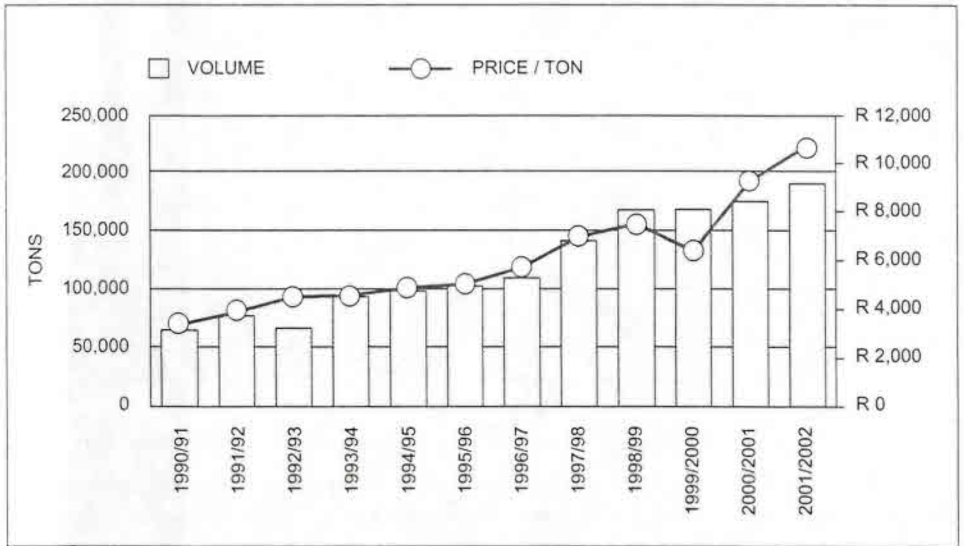
SOURCE: NDA

EXPORT VOLUMES 2001/2002



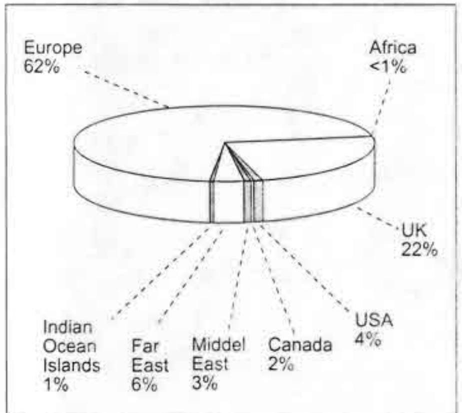
SOURCE: SAT / CIAMD

EXPORT HISTORICAL VOLUMES



SOURCE: NDA / SAT

EXPORTS PER MARKET SEGMENT



SOURCE: PPECB

PRODUCTION PER AREA

AREA	4,5KG CARTONS
Northern Province	1,415,262
Olifants River	1,417,924
Orange River	14,074,446
Hex Rivier & Klein Karoo	17,734,716
Lower Berg River	5,519,627
Upper Berg River	3,593,897
Other	129,883
Total	**43,885,756**

SOURCE: PALTRAC

EXPORTS IN CARTONS

CULTIVAR	2000/2001	2001/2002	%CHANGE
Thompson Seedless	6,014,498	9,286,017	54%
Red Globe	6,198,680	6,090,957	-2%
Dauphine	4,748,492	4,833,789	2%
Sugraone		4,259,984	100%
Barlinka	3,121,353	3,109,163	0%
La Rochelle	2,714,797	2,652,340	-2%
Sunred Seedless	2,411,783	2,597,191	8%
Alphonse Lavallee	2,190,055	1,872,995	-14%
Waltham Cross	2,002,020	1,584,492	-21%
Flame Seedless	663,709	1,461,637	120%
Dan Ben Hannah	2,165,481	1,396,356	-36%
Bonheur	1,425,104	1,280,589	-10%
Regal Seedless	206,009	797,765	287%
Majestic	583,562	506,865	-13%
Victoria	478,940	500,445	4%
Prime Seedless	82,478	348,544	323%
Black Gem	365,341	344,139	-6%
Crimson Seedles	86,938	291,093	235%
Bien Donne	361,004	219,578	-39%
Muscat Supreme	29,696	89,013	200%
Queen o/t Vineyard	94,736	64,702	-32%
Sonita	76,825	52,244	-32%
Datal Grapes	31,463	39,610	26%
Black Emperor	13,271	36,170	173%
Golden Waltham Cross		34,210	100%
Erlihane	20,691	24,463	18%
Barlinka Late Harvest		23,997	100%
Rubistar	27,672	15,200	-45%
New Cross	25,246	14,393	-43%
Super Thompson	30,589	10,370	-66%
Red Globe Late Harvest		9,978	100%
White Seedless Grapes		8,820	100%
Sundance	160	8,729	5355%
Centennial Seeded	11,840	7,520	-36%
White Gem	29,738	7,371	-75%
MUSCAT		6,779	100%
Almeria	11,841	6,560	-45%
Bellevue	45,491	6,160	-86%
Italia	10,720	5,600	-48%
Peridot		3,640	100%

EXPORTS IN CARTONS (CONTINUED)

CULTIVAR	2000/2001	2001/2002	%CHANGE
White Seeded Grapes		1,600	100%
Dauphine Late Harvest		1,448	100%
Crimson Seedles Late Harvest		1,440	100%
Red Sultana		1,166	100%
Mistery Grapes	50	473	845%
Bonheur Late Harvest		320	100%
Sunred Seedless LH		222	100%
Lady Ann Grapes	10,033	160	-98%
Experimental Grapes	7,765	90	-99%
Fantacy Seedless		56	100%
Amber Dawn	65,768		-100%
Barbarossa	320		-100%
Black Empress	19		-100%
Black Prins	720		-100%
Blush Waltham Cross	160		-100%
Canon Hall Grapes	1,280		-100%
Dawn Seedless	540		-100%
Desert Pearl	3,402		-100%
Eclipse Seedless	1,440		-100%
Flaming Tokay Grape	247		-100%
Golden Pearl	80		-100%
Hanepoot	1,159		-100%
Henab Turki Grapes	640		-100%
Muscat Hamburg	37,898		-100%
Muscat Seedless	32,403		-100%
Olivette	3,520		-100%
Pirobella	438		-100%
Red Ruby	155		-100%
Ronelle	7,650		-100%
Rosaki	2,484		-100%
Rosete	350		-100%
Sultana	3,483		-100%
Superior Seedless	2,713,645		-100%
White Cross	16,800		-100%
White Prince	1,627		-100%
Total	**39,194,299**	**43,916,440**	**12%-**

SOURCE: PPECB

PRODUCTION IN SOUTHERN HEMISPHERE 1999 - 2002

SOURCE: FAO

APPLES

COUNTRY	PRODUCTION (METRIC TONNES) 2002	2001	2000	1999
Argentina	1,428,367	1,428,367	833,322	1,116,000
Chile	1,100,000	1,135,000	805,000	1,165,000
Brazil	857,824	722,986	969,085	944,812
South Africa	579,257	557,780	578,369	618,388
New Zealand	536,999	485,000	620,000	545,000
Australia	275,000	290,000	319,652	334,353
Total	**4,777,447**	**4,619,133**	**4,125,428**	**4,723,553**

PEARS

COUNTRY	PRODUCTION (METRIC TONNES) 2002	2001	2000	1999
Argentina	585,249	585,249	513,554	536,549
Chile	345,000	340,000	332,500	350,000
South Africa	304,372	304,372	304,372	289,406
Australia	175,000	175,000	156,369	156,714
New Zealand	36,377	32,855	42,000	44,000
Brazil	18,000	17,000	16,970	16,474
Total	**1,463,998**	**1,454,476**	**1,365,765**	**1,393,143**

APRICOTS

COUNTRY	PRODUCTION (METRIC TONNES) 2002	2001	2000	1999
South Africa	61,488	51,830	56,504	53,017
Chile	44,000	40,500	38,500	35,000
Australia	20,000	20,000	19,875	21,483
Argentina	19,500	19,500	22,135	28,000
New Zealand	7,000	6,000	7,400	7,400
Total	**151,988**	**137,830**	**144,414**	**144,900**

PEACHES AND NECTARINES

COUNTRY	PRODUCTION (METRIC TONNES) 2002	2001	2000	1999
Argentina	252,263	252,263	204,725	240,000
Chile	249,400	250,425	249,262	310,000
South Africa	208,690	160,159	221,373	213,015
Brazil	184,000	183,000	182,460	131,300
Australia	90,000	90,000	86,000	93,459
New Zealand	11,015	11,500	17,000	17,000
Total	**995,368**	**947,347**	**960,820**	**1,004,774**

PLUMS

COUNTRY	PRODUCTION (METRIC TONNES) 2002	2001	2000	1999
Chile	180,000	205,425	163,670	198,000
Argentina	105,475	105,475	74,581	78,000
South Africa	38,329	38,999	33,736	54,828
Australia	22,000	22,000	24,155	28,665
New Zealand	2,000	2,300	2,000	2,000
Total	347,804	374,199	298,142	361,493

GRAPES

COUNTRY	PRODUCTION (METRIC TONNES) 2002	2001	2000	1999
Argentina	2,457,599	2,457,599	2,191,156	2,424,990
Australia	1,851,000	1,551,000	1,342,814	1,265,536
Chile	1,720,000	1,570,000	1,895,000	1,575,000
South Africa	1,350,000	1,350,000	1,530,190	1,554,286
Brazil	1,099,450	1,012,540	998,545	894,965
New Zealand	122,000	71,000	80,100	79,700
Total	8,600,049	8,012,139	8,037,805	7,794,477

WORLD PRODUCTION

APPLES PRODUCTION (MT)	YEAR 2002	PEARS PRODUCTION (MT)	YEAR 2002	APRICOTS PRODUCTION (MT)	YEAR 2002
World	57,982,587	World	17,198,071	World	2,738,601
China	20,507,763	China	9,100,565	Turkey	580,000
USA	4,041,780	Italy	910,000	Iran	282,890
France	2,500,000	USA	856,880	Italy	200,000
Turkey	2,500,000	Spain	626,900	France	186,000
Italy	2,370,000	Argentina	585,249	Pakistan	126,404
Iran	2,353,359	Germany	480,000	Spain	121,800
Poland	1,900,000	Japan	426,300	Morocco	104,350
Russian Fed.	1,800,000	Korea	417,160	Syria	86,015
Germany	1,600,000	Turkey	375,000	China	85,956
India	1,500,000	Chile	345,000	USA	81,370
Argentina	1,428,367	**South Africa**	304,372	Greece	80,000
Chile	1,100,000	France	255,000	Egypt	70,765
Japan	911,900	Iran	190,805	Russian Fed.	70,000
Brazil	857,824	India	188,000	Lebanon	66,000
Spain	711,900	Australia	175,000	**South Africa**	61,488
Korea	650,000	Netherlands	175,000	Algeria	60,000
South Africa	579,257	Belgium-Luxembourg	147,151	Ukraine	50,000
Uzbekistan	550,000	Korea	130,000	Chile	44,000
New Zealand	536,999	Austria	110,000	Afghanistan	37,500
Netherlands	500,000	Portugal	110,000	Romania	25,000
Romania	500,000	Ukraine	105,000	Tunisia	25,000
Mexico	497,327	Switzerland	92,000	Iraq	22,000
Egypt	484,132	Poland	78,000	Australia	20,000
Ukraine	482,000	Algeria	75,000	Tajikistan	20,000
Hungary	470,000	Russian Fed.	75,000	Argentina	19,500
Rest of World	6,649,979	Rest of World	864689	Rest of World	212563

SOURCE: FAO

WORLD PRODUCTION

PEACHES & NECTARINES PRODUCTION (MT)	YEAR 2002	PLUMS PRODUCTION (MT)	YEAR 2002	GRAPES PRODUCTION (MT)	YEAR 2002
World	13,413,343	World	9,141,808	World	62,389,467
China	4,224,267	China	4,234,852	Italy	8.500,000
Italy	1,700,000	USA	585,000	France	7,130,000
USA	1,355,050	Romania	500,000	USA	6,594,600
Spain	1,215,200	Germany	490,000	Spain	5,422,800
Greece	667,000	Yugoslavia	255,579	China	3,885,017
France	483,000	France	227,300	Turkey	3,600,000
Turkey	450,000	Turkey	195,000	Iran	2,516,695
Iran	270,000	Chile	180,000	Argentina	2,457,599
Egypt	256,997	Italy	170,000	Australia	1,851,000
Argentina	252,263	Spain	154,100	Chile	1,720,000
Chile	249,400	Russian Fed.	150,000	Germany	1,550,000
South Africa	208,690	Ukraine	150,000	South Africa	1,350,000
Brazil	184,000	Iran	143,119	Greece	1,200,000
Japan	175,800	Japan	123,700	India	1,140,000
Korea	175,000	Argentina	105,475	Egypt	1,103,840
Mexico	153,336	Poland	102,900	Brazil	1,099,450
India	120,000	Uzbekistan	101,000	Portugal	980,000
Korea	110,000	Hungary	90,000	Romania	895,000
Australia	90,000	India	78,000	Uzbekistan	570,000
Portugal	85,000	Mexico	75,000	Hungary	560,000
Tunisia	82,000	Moldova	66,800	Moldova	520,000
Algeria	60,000	Morocco	63,100	Mexico	475,010
Hungary	55,000	Pakistan	60,119	Korea	460,000
Lebanon	52,500	Bulgaria	60,000	Bulgaria	400,000
Israel	49,760	South Africa	38,329	Ukraine	400,000
Rest of World	689080	Rest of World	742435	Rest of World	6008456

SOURCE: FAO

* COMPETITIVENESS RANKINGS OF MAJOR WORLD APPLE SUPPLIERS, 2002

RANK	OVERALL	PRODUCTION EFFICIENCY	INFRASTRUCTURE & INPUTS	FINANCIAL & MARKETS
1	New Zealand	Netherlands	Chile	New Zealand
2	Chile	Austria	United States	France
3	France	New Zealand	New Zealand	Belgium
4	Austria	Belgium	Argentina	Japan
5	Belgium	**South Africa**	Canada	Italy
6	United States	Brazil	France	Chile
7	Italy	Poland	**South Africa**	United Kingdom
8	Netherlands	France	Italy	Netherlands
9	Japan	Japan	Turkey	Austria
10	Canada	Italy	Australia	Australia
11	**South Africa**	Chile	Brazil	Spain
12	Australia	Canada	Austria	Canada
13	Germany	Turkey	Japan	Germany
14	United Kingdom	Germany	Belgium	United States
15	Argentina	Hungary	Germany	Greece
16	Brazil	Australia	United Kingdom	Portugal
17	Spain	United States	Netherlands	**South Africa**
18	Turkey	Argentina	Spain	Argentina
19	Poland	Yugoslavia	Mexico	China
20	Portugal	United Kingdom	Greece	Hungary
21	Greece	Russian Fed.	Portugal	Poland
22	Hungary	China	China	Mexico
23	China	Spain	Poland	Brazil
24	Mexico	Bulgaria	Hungary	Turkey
25	Russian Fed.	Mexico	Yugoslavia	Russian Fed.
26	Bulgaria	Portugal	Bulgaria	Bulgaria
27	Yugoslavia	Greece	Russian Fed.	Yugoslavia
28	Romania	Romania	Romania	Romania

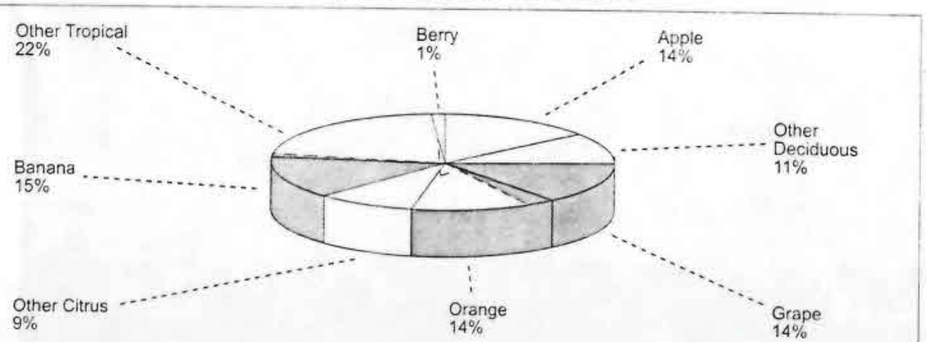
SOURCE: WORLD APPLE REVIEW - 2002

SUMMARY MEASURES OF COMPETITIVE PERFORMANCE, 2002

MEASURE	SCORING METHOD
Production Efficiency	
1. Percent change in Production	1994-96 to 1999-2001
2. Relative Variability of Production	Highets/Lowest, 1991-2001
3. Percent of Acreage Non-Bearing	Actual, 2001
4. Percent New Varieties	Share of Production, 2001
5. Planting Densitiy	Trees per hectare, 2001
6. Average Yield per Hectare	1999-2001, metric tons
Industry Infrastructure and Inputs Available	
7. Adequate Storage	Subjective score, 1-10
8. Modern Packing Facilities	Subjective score, 1-11
9. Efficient Distribution	Subjective score, 1-12
10. Marketing system efficiency	Subjective score, 1-13
11. Land Availability	Subjective score, 1-14
12. Water Availability	Subjective score, 1-15
13. Labor Supply	Subjective score, 1-16
14. Input Costs	Subjective score, 1-17
Financial and Market Factors	
15. Interest rates	Actual, 2001
16. Inflation	Actual, 2002
17. Capital Availability	Subjective score, 1-10
18. Security of Property Rights	Subjective score, 1-11
19. Product Quality Control	Subjective score, 1-12
20. Percent of Production Exported	Actual, 1999-2001
21. Average Export Price	Actual, 1999, US$ per mt
22. Average distance to market (kilometers)	Actual

SOURCE: WORLD APPLE REVIEW - 2002

* THE 2001 WORLD FRUIT PIE (PRODUCTION SLICES)



* MAJOR APPLE VARIETIES: SHARE OF WORLD PRODUCTION (EXCL. CHINA)

ITEM	PERCENT OF TOTAL 2002 ESTIMATE	PERCENT OF TOTAL 2005 FORECAST	PERCENT OF TOTAL 2010 FORECAST
Delicious	17.97	17.53	16.55
Golden Delicious	18.61	18.55	17.87
Gala/Royal Gala	8.77	9.10	10.08
Granny Smith	5.99	5.89	5.57
Fuji	5.96	5.80	6.10
Jonagold	3.18	4.09	4.15
Idared	3.19	3.31	3.42
Jonathan	2.56	2.54	2.47
Braeburn	2.29	2.39	2.63
McIntosh	1.72	1.85	1.78
Rome Beauty	1.64	1.73	1.52
Elstar	1.63	1.70	1.78
Jonagored	0.67	0.87	0.93
Cortland	0.86	0.76	0.76
Boskop	0.52	0.64	0.56
Reinette	0.79	0.50	0.46
Gloster	0.67	0.76	0.73
Cox's Orange	0.49	0.71	0.65
Newton	0.51	0.48	0.44
Empire	0.36	0.51	0.47
Spartan	0.62	0.56	0.54
Tsugaru	0.48	0.46	0.44
Bramley	0.16	0.29	0.27
Pink Lady	0.61	0.70	1.02
York	0.33	0.34	0.30
Melrose	0.18	0.18	0.19
Ohrin	0.69	0.63	0.62
Northern Spy	0.18	0.22	0.21
Stayman	0.21	0.25	0.22
R.I. Greening	0.10	0.12	0.10
Mutsu	0.15	0.17	0.16
Lady Williams	0.03	0.03	0.03
Ingrid Marie	0.06	0.05	0.05
Senshu	0.07	0.09	0.09
Gravenstein	0.06	0.05	0.05
Winesap	0.04	0.04	0.03
James Grieve	0.02	0.03	0.02
Sundowner	0.03	0.05	0.07
Discovery	0.05	0.06	0.06
All other	17.55	15.97	16.61
Total	**100.00**	**100.00**	**100.00**

SOURCE: WORLD APPLE REVIEW - 2002

✓ APPLES PRODUCED, PROCESSED AND FOR CAJ, 2001-2002
(BY WORLD REGION, SELECTED COUNTRIES)

REGION	PRODUCTION OF APPLES (1000 mt)	PROCESSING TOTAL (1000 mt)	PROCESSED FOR JUICE (1000 mt)	CAJ PRODUCED (1000 mt)
European Union	8,812	1,900	1,403	180.4
Eastern Europe	3,348	1,946	1,846	246.6
North America	5,162	2,128	1,097	153.5
Asia + Russia	24,653	3,195	2,553	242.3
S. Hemisphere	4,594	1,443	1,396	152.5
Total	**46,569**	**10,612**	**8,295**	**975.3**

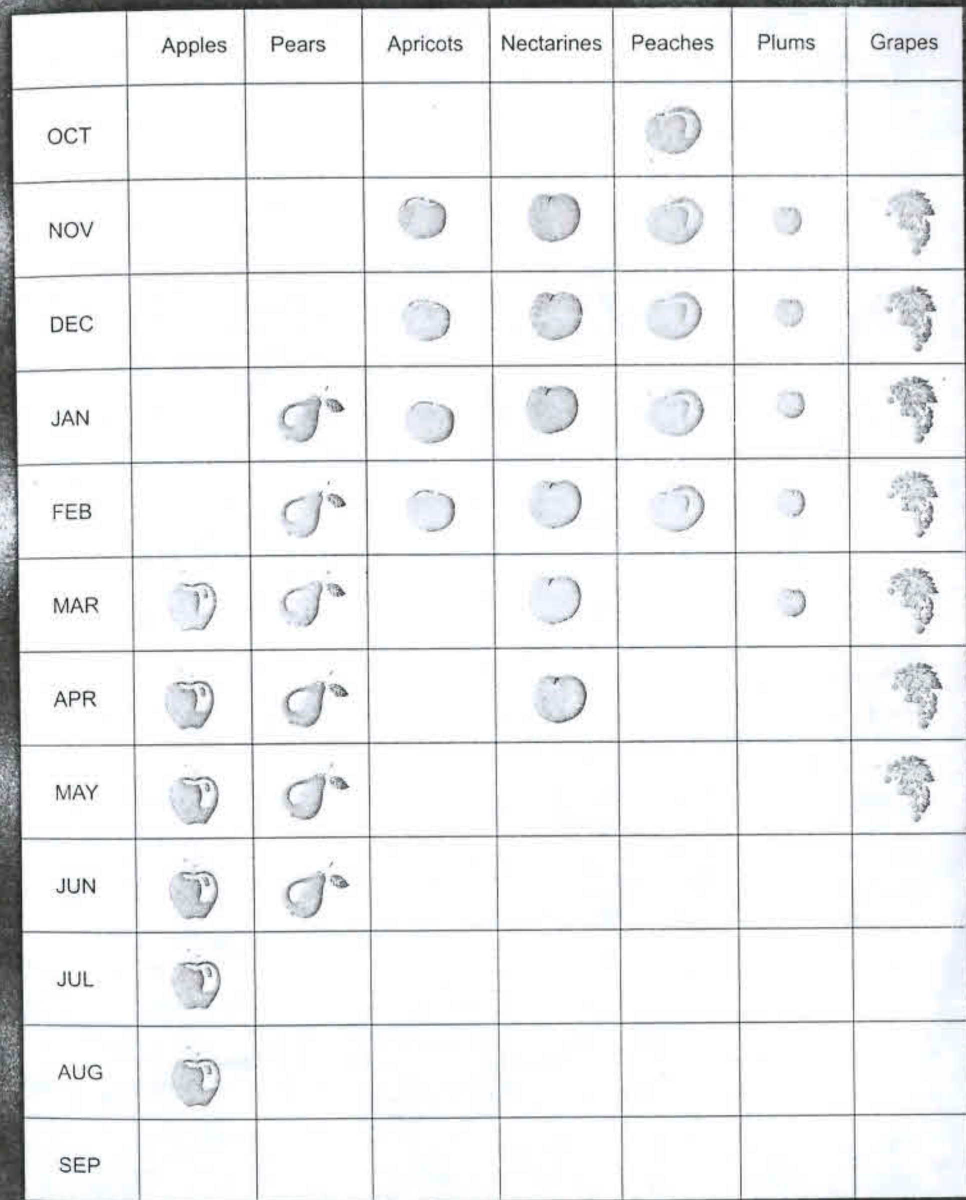
CAJ = CONCENTRATED APPLE JUICE. SOURCE: WORLD APPLE REVIEW - 2002

✗ WORLD APPLE PRODUCTION TRENDS
(ACTUAL 2000, PROJECTED 2005 AND 2010, 1000 METRIC TONS)

COUNTRY OR REGION	2000 ACTUAL	2005 PROJECTED	2010 PROJECTED
Major Producing Countries			
France	2,055	2,300	2,450
Italy	2,267	2,275	2,370
Other EU-15	5,590	5,782	5,880
Other Europe	3,686	3,320	3,645
Total Europe	13,598	13,677	14,345
United States	4,718	5,000	5,200
Other N. America	833	1,050	1,100
Total N. America	5,552	6,050	6,300
China	20,454	25,000	31,000
Other Asia*	4,792	4,750	4,910
Total Asia	25,246	29,750	35,910
South America	2,711	3,660	4,070
South Africa	568	680	700
Oceania	695	950	1,055
Total S. Hemisphere	3,974	5,290	5,825
Russian Federation	1,590	1,200	1,200
Major Producing Countries	49,960	55,967	63,580
Other Producing Countries	9,483	11,300	11,486
World Total	**59,443**	**67,267**	**75,066**

* INCLUDES JAPAN AND TURKEY
SOURCE: WORLD APPLE REVIEW - 2002

SOUTH AFRICA'S DECIDUOUS FRUIT CALENDAR



(3)

Introduction: Stargrow South Africa

HISTORY...

- In 1992, Michiel Prins and Chris Goodman started a rootstock business that produced clonal rootstocks of apples, pears and stonefruits. This would develop into a business that could supply in about 75% of the South African fruit industries' need for clonal rootstocks. Sophisticated propagation facilities and infrastructure for rootstock propagation enables us to quickly multiply and supply rootstock cultivars. Stargrow is also conducting rootstock trials on several sites to supply the industry with accurate information.

In May 1995, Michiel and Chris started a nursery whose main purpose was to supply deciduous fruit trees for the domestic market. At this time, they also started a breeding and cultivar development programme. Between 1995 and 1998 Stargrow diversified into a range of other agricultural crops which has enabled them to supply a wide range of plant material. The citrus cultivar development and management company is an affiliate of Stargrow with co-owner Piet van Rensburg.

MISSION...

Stargrow specialises in the development and supply of high quality plant material, supported by outstanding service.

The experts at Stargrow have extensive technological know-how at their disposal to ensure that the plant material supplied is of the highest quality. The high cost and risk to the producer when establishing a new orchard is precisely why Stargrow takes extra care to ensure that **the quality of our plant material** is always reliable. This encompasses the physical, chemical, genetic and phytosanitary profile of each plant.

Carefully grown plant material that complies with the client's specifications, can be attributed to Stargrow's technological expertise, strengthened by a personal relationship with clients as well as a comprehensive technical back-up service.

NURSERY SITES...

- **SUIKERBOSRAND**
- **MIDDELTUIN**
- **CITRUSDAL CITRUS**
- **ZEVENRIVIEREN**

Suikerbosrand is situated in the Koue Bokkeveld approximately 30 km west of the small town of Op Die Berg, north of Ceres. Suikerbosrand is the Stargrow Nursery site that is responsible for the propagation of Apple and Pear trees. This particular site is ideal for pome fruits because of high chilling units which are necessary for a good hardening off of trees. This site also produces stone fruit, pome fruit and cherry rootstocks.

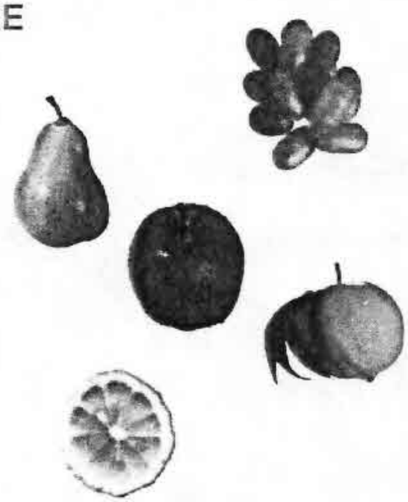
Middeltuin is situated west of the N7, between Clanwilliam (Paleisheuwel turn-off) and Citrusdal (Marcuskraal turn-off). Middeltuin is used mainly for stone fruit and vine (table and wine) propagation. Cherries, berries and olives are also grown at Middeltuin. Apart from normal propagation of plants, we also use this site for the rooting of pear and stone fruit rootstocks, because of the exceptional rooting we obtain, due to a suitable climate and soil. Middeltuin is also the site of our vine rootstock motherblocks for production of vine rootstocks.

Citrusdal Citrus is situated ±5 km north of Citrusdal. As Citrusdal is an area that is totally free from citrus greening and black spot, this Stargrow Nursery site is very well positioned to produce top quality citrus trees.

Zevenrivieren is situated in the Banhoek Valley in the Stellenbosch District, just off the Helshoogte pass. Rootstocks for pome and stone fruit trees are produced here.

PRODUCT RANGE AND MARKET SHARE

Apples	-	48%
Pears	-	50%
Table Grapes	-	20%
Wine Grapes	-	5%
Stone Fruit	-	30%
Cherries	-	50%
Olives	-	20%
Citrus	-	15%
Berries	-	70%



We are currently handling more or less 1.9 million units of the above-mentioned products, as well as about 2.25 million rootstocks. **This makes Stargrow the biggest nursery in the country in terms of volume and diversity.**

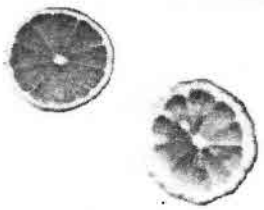
INTELLECTUAL PROPERTY / CULTIVAR DEVELOPMENT...

Stargrow is also **a fruit cultivar development and management company**. Its business is to identify opportunities for new cultivars globally and to breed, acquire, evaluate, control and commercialise these cultivars through a network of Master Agents worldwide. Stargrow is currently commercialising its varieties in countries such as Chile, Brazil, Australia, Argentina, EU, Israel and Africa. The company benefits from the royalty payments made on the sale of plant material and fruit of its exclusively owned cultivars.

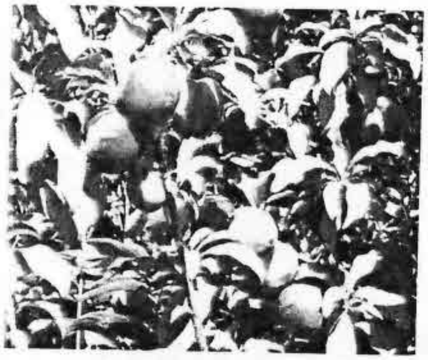
Stargrow is a registered Plant Improvement Organisation (one of only three in South Africa). This means that Stargrow controls the phytosanitary and genetic requirements of our plant material within our government's certification scheme.

We have multiplication and breeding facilities at a number of locations in the Western Cape. **Stargrow is the only private deciduous fruit breeder in South Africa.** Stargrow is a member of an international consortium consisting of leading nurseries (INN), and has license agreements with cultivar development groups in the USA, Canada, Europe, Chile, Australia and New Zealand. The South African Government breeding station has also appointed us as their agent to introduce certain of their cultivars in several countries.

The fact that Stargrow also has its own breeding programme and an ongoing selection of field mutations, ensures that it has continuous access to a wide range of new cultivars developed and released globally for exclusive commercialisation.



The company also employs skilled specialists in the fields of plant breeding, evaluation, plant propagation, plant pathology, plant importation and protection and registration of cultivars.



Plantmaterial Production

It takes from about one year to 18 months for plantmaterial to be released from the South African Quarantine Station. We usually receive ± 50 buds, from which we can produce well over 100 000 nursery trees within 3 years. In the case of berries, we also have the option to bring several thousand plants into open quarantine, which will enable us to produce commercial quantities within one to two years.

The above plants are produced in our nursery and planted out at our test sites. As our nursery sites are located in different climatic regions, the varieties can be tested over a wide range of climates and the right climate for propagation of every fruit type determined. Isolation from pests and diseases and the use of virgin soils enable us to produce plant material of the highest quality. Because they are planted on our own sites, we are able to ensure maximum security of new varieties.

With South Africa being a UPOV member country, adequate legal protection exists for effective control of varieties under the Plant Breeders' Rights Act. This confers the same protection as a USA Plant Patent. If needed, we can also seek trademark protection.

Marketing/Distribution

South Africa

Stargrow has a marketing department that markets its products through:

- newsletters
- advertisements in magazines
- telephone marketing
- the Internet
- personal visits to clients
- nursery and field days
- seminars

International

In foreign countries we are mainly making use of master agents whom we supply on a continuous basis, with a technical back-up service on our products. We also allow them to use trademarks registered on our products.

The price of plant material is determined by free market forces. High quality products and service, as well as availability of new varieties allow us to get a premium price for our products.

CONTACT US:

STARGROW
P O BOX 12536
DIE BOORD
7613
SOUTH AFRICA

TEL :	**+27 21 880 1882**
FAX:	**+27 21 880 1485**
E-MAIL :	**stella@stargrow.co.za**
WEB :	**www.stargrow.co.za**