CFPA Canning Fruit Producers' Assoc.	DFPT Deciduous Fruit Producers' Trust	DFTS Dried Fruit Technical Services	Winetech
Submit to: Wiehahn Victor PO Box **426** **Paarl, 7620** **Tel: +27 (0)21 872 1501** **inmaak@mweb.co.za**	Submit to: Louise Kotzé Suite 275, Postnet X5061 Stellenbosch, 7599 Tel: +27 (0)21 882 8470/1 **louise@dfpt.co.za**	Submit to: Dappie Smit PO Box 426 Paarl, 7620 Tel: +27 (0)21 872 1501 **dappies@dtd.co.za**	Submit to: Jan Booysen PO Box 825 Paarl, 7624 Tel: +27 (0)21 807 3324 **booysenj@kwv.co.za**

	X		

Indicate (✓) client(s) to whom this final report is submitted.
Replace any of these with other relevant clients if required.

FINAL REPORT
FOR 2003

PROGRAMME & PROJECT LEADER INFORMATION

	Programme leader	Project leader
Title, initials, surname		Dr SJE Wand
Present position		Senior lecturer
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PROJECT INFORMATION

Project number	DH1P

Project title	Improving red colour development in blushed pears.

Industry programme	**CFPA**	
	DFPT	X
	DFTS	
	Winetech	
	Other	

Fruit kind(s)	Pears

Start date (dd/mm/yyyy)		**End date** (dd/mm/yyyy)	2003

FINAL SUMMARY OF RESEARCH PROJECT

PROGRAMME & PROJECT LEADER INFORMATION

	Programme leader	Project leader
Title, initials, surname		Dr SJE Wand
Institution		University of Stellenbosch
Tel. / Cell no.		021 808 3939
E-mail		Sjew@sun.ac.za

PROJECT INFORMATION

Project number	DH1P

Project title	Improving red colour development in blushed pears.

Fruit kind(s)	Pears

Start date (dd/mm/yyyy)		**End date** (dd/mm/yyyy)	2003

(Give a summary of the *total* project in no more than 250 words).

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 regulation of colour development in pears has not been studied and, in addition, little is known about anthocyanin degradation in attached fruit.

Changes in colour were recorded and phenylalanine ammonia-lyase (PAL) and UDPGalactose: flavonoid-3-o-glycosyltransferase (UFGT) activities assessed in response to cold fronts and during fruit development in order to establish the regulation of colour development in red and blushed pear cultivars. Best red colour was generally attained a month or more before harvest whereafter red colour faded towards harvest. Unlike in some other fruits, UFGT activity apparently did not limit colour development whereas fading of red colour towards harvest might relate to decreasing PAL activity. ‘Rosemarie’ colour fluctuated considerably, increasing with cold fronts and decreasing during intermittent warmer periods, while red colour was more stable in other cultivars. PAL and UFGT activities in ‘Rosemarie’ increased in response to low temperatures, but were unaffected in ‘Bon Rouge’. We concluded that anthocyanin synthesis in ‘Rosemarie’ requires low temperatures while colour development in ‘Bon Rouge’ and probably also other cultivars is primarily regulated by endogenous factors.

Detached pome fruit were used to study temperature and light effects on anthocyanin degradation and fruit colour and to assess the modifying effect of anthocyanin

concentration on colour loss. Anthocyanin degradation and red colour loss increased linearly between 10ºC and 30ºC. Irradiation further increased the rate of degradation and colour loss. The rate of colour loss depended on anthocyanin concentration, being much faster in fruit with high compared to fruit with low pigment levels. This was ascribed to the exponential relationship between anthocyanin concentration and hue at high pigment levels and the linear relationship at lower pigment levels. Anthocyanin degradation and pre-harvest red colour loss in 'Rosemarie' was quantitatively confirmed and corresponded with a warm period during fruit development. Based on these data, we attributed the susceptibility of 'Rosemarie' to pre-harvest colour loss to low anthocyanin concentrations in its peel that allow the visualisation of net anthocyanin degradation at high temperatures.

Overhead evaporative cooling (EC) as measure to improve red colour in blushed pears was evaluated. 'Rosemarie' fruit that received pulsed EC applications from two weeks before harvest at air temperatures exceeding 28ºC were redder than control fruit at harvest. EC had no effect on 'Forelle' colour. 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.

Lastly, we assessed the photoprotective function of anthocyanin in pear peel. Photoinhibition was evident in exposed faces of pears under natural conditions. The extent of photoinhibition increased with decreasing redness of peel and was maintained after photoinhibitory treatment. Although anthocyanin was apparently able to afford photoprotection at 40ºC, we argued against this as a general function. There were indications that photoprotection was associated, but not necessarily due to light attenuation by anthocyanin.

FINAL REPORT

(Relevant publications may replace the final report)

1. Problem identification and objectives

State the problem being addressed and the ultimate aim of the project.

Problem and aims:
Downgrading due to insufficient red colour limits the profitability of blushed pears in the warm production areas of the Western Cape region of South Africa. The objectives of this project are to determine the factors responsible for poor colour development in blushed pears in general and, more specifically, to determine the causes and develop methods to reduce red colour loss in Rosemarie. An improved understanding of the physiology of red colour development in blushed pears should further allow recommendations regarding the cultivation of these pears.

2. Workplan (materials & methods)

List trial sites, treatments, experimental layout and statistical detail, sampling detail, cold storage and examination stages and parameters.

See PhD thesis and publications

3. Results and discussion

State results obtained and list any benefits to the industry. Include a short discussion if applicable to your results.
This final discussion must cover ALL accumulated results from the start of the project, but please limit it to *essential* information.

See PhD thesis and publications

4. Accumulated outputs

List ALL the outputs from the start of the project.
The year of each output must also be indicated.

Technology developed

- Improved understanding of red colour development in pears.
- Guidelines and recommendations for the future production of Rosemarie based on the causes of red colour loss.
- Provisional guidelines for the use of overtree evaporative cooling to improve fruit colour.

Human resources developed/trained

W.J. Steyn (PhDAgric) – graduated April 2003

Patents

Publications (popular, press releases, semi-scientific, scientific)

Scientific:

1. STEYN, W.J., WAND, S.J.E., HOLCROFT, D.M. & JACOBS, G. 2002. Anthocyanins in vegetative tissues: A proposed unified function in photoprotection. *New Phytol*. 155, 349-361.
2. STEYN, W.J., HOLCROFT, D.M., WAND, S.J.E. & JACOBS, G. 2003. Regulation of pear color development in relation to activity of flavonoid enzymes. *J. Amer. Soc. Hort. Sci.* (submitted).
3. STEYN, W.J., HOLCROFT, D.M., WAND, S.J.E. & JACOBS, G. 2003. Anthocyanin degradation in detached pome fruit with reference to pre-harvest red color loss and pigmentation patterns of blushed and fully red pears. *J. Amer. Soc. Hort. Sci.* (submitted).
4. STEYN, W.J. 2003. Red colour development and loss in pear fruit. PhD(Agric) dissertation, University of Stellenbosch.

Semi-scientific:

1. STEYN, W.J., COOK, N.C., HOLCROFT, D.M., WAND, S.J.E. & JACOBS, G., 2000. Dating Rosemarie: How to make her blush. Proceedings of CPA Symposium, Stellenbosch.
2. STEYN, W.J., HOLCROFT, D.M., WAND, S.J.E. & JACOBS, G., 2000. Red colour loss in apples and pears. 9th Congress of the Southern African Society for Horticultural Sciences, Nelspruit.
3. STEYN, W.J., WAND, S.J.E., HOLCROFT, D.M. & JACOBS, G., 2002. Temperature-induced red colour loss in Rosemarie pears. 2002 Combined congress of the Southern African Society for Horticultural Sciences and the South African Society of Crop Production, Cedara Agricultural College.
4. STEYN, W.J., WAND, S.J.E., HOLCROFT, D.M. & JACOBS, G., 2002. Lack of talent to blame for Rosemarie's poor performance. Proceedings of CPA Symposium, Stellenbosch.
5. WAND, S.J.E., STEYN, W.J., MDLULI, M.J., KRUGER, B. & JACOBS, G. 2002. Evaporative cooling: effective technology for a stressful climate? Proceedings of CPA Symposium, Stellenbosch.
6. STEYN, W.J., WAND, S.J.E., HOLCROFT, D.M. & JACOBS, G., 2003. Evidence of increased resistance to photoinhibition with increasing redness of pear peel. 2003 Combined congress of the Southern African Society for Horticultural Sciences, the South African Society of Crop Production and the Soil Science Society of South Africa, University of Stellenbosch.
7. STEYN, W.J., HOLCROFT, D.M., WAND, S.J.E. & JACOBS, G., 2003. Developmental changes in enzymes of flavonoid biosynthesis and temperature-reliance of red colour in pears. 2003 Combined congress of the Southern African Society for Horticultural Sciences, the South African Society of Crop Production and the Soil Science Society of South Africa, University of Stellenbosch.
8. MDLULI, M.J., WAND, S.J.E., STEYN, W.J. & JACOBS, G., 2003. Evaporative cooling: a tool to reduce stress and improve fruit quality. 2003 Combined congress of the Southern African Society for Horticultural Sciences, the South African Society of Crop Production and the Soil Science Society of South Africa, University of Stellenbosch.

Popular:

1. STEYN, W.J., WAND, S.J.E., HOLCROFT, D.M & JACOBS, G., 2001. Climate and red colour development in apples and pears. Part 1. Apples. *Decid. Fruit Grow.* 51 (5): 43-34.
2. STEYN, W.J., WAND, S.J.E., HOLCROFT, D.M & JACOBS, G., 2001. Climate and red colour development in apples and pears. Part 2. Pears. *Decid. Fruit Grow.* 51 (6): 20-21.
3. WAND, S.J.E., STEYN, W.J., MDLULI, M.J., MARAIS, S.J.S. & JACOBS, G. 2002. Overtree evaporative cooling for fruit quality enhancement. *SA Fruit J.* Aug./Sept. 2002, p. 16-19.

Radio:

STEYN, W.J., 2003. Hoekom word plante rooi? Landbou-oorsig, RSG, 30 Junie.

Presentations/papers delivered

Conference presentations:

1. STEYN, W.J., COOK, N.C., HOLCROFT, D.M., WAND, S.J.E. & JACOBS, G., 2000. Dating Rosemarie: How to make her blush. CPA Symposium, Stellenbosch.
2. STEYN, W.J., HOLCROFT, D.M., WAND, S.J.E. & JACOBS, G., 2000. Red colour loss in apples and pears. 9th Congress of the Southern African Society for Horticultural Sciences, Nelspruit.
3. STEYN, W.J., WAND, S.J.E., HOLCROFT, D.M. & JACOBS, G., 2002. Temperature-induced red colour loss in Rosemarie pears. 2002 Combined congress of the Southern African Society for Horticultural Sciences and the South African Society of Crop Production, Cedara Agricultural College.
4. STEYN, W.J., WAND, S.J.E., HOLCROFT, D.M. & JACOBS, G., 2002. Lack of talent to blame for Rosemarie's poor performance. CPA Symposium, Stellenbosch.
5. WAND, S.J.E., STEYN, W.J., MDLULI, M.J., KRUGER, B. & JACOBS, G. 2002. Evaporative cooling: effective technology for a stressful climate? CPA Symposium, Stellenbosch.
6. STEYN, W.J., WAND, S.J.E., HOLCROFT, D.M. & JACOBS, G., 2003. Evidence of increased resistance to photoinhibition with increasing redness of pear peel. 2003 Combined congress of the Southern African Society for Horticultural Sciences, the South African Society of Crop Production and the Soil Science Society of South Africa, University of Stellenbosch.
7. STEYN, W.J., HOLCROFT, D.M., WAND, S.J.E. & JACOBS, G., 2003. Developmental changes in enzymes of flavonoid biosynthesis and temperature-reliance of red colour in pears. 2003 Combined congress of the Southern African Society for Horticultural Sciences, the South African Society of Crop Production and the Soil Science Society of South Africa, University of Stellenbosch.
8. MDLULI, M.J., WAND, S.J.E., STEYN, W.J. & JACOBS, G., 2003. Evaporative cooling: a tool to reduce stress and improve fruit quality. 2003 Combined congress of the Southern African Society for Horticultural Sciences, the South African Society of Crop Production and the Soil Science Society of South Africa, University of Stellenbosch.

Farmers' days and seminars:

1. STEYN, W.J., WAND, S.J.E., HOLCROFT, D.M. & JACOBS, G., 2000. Produksie van blospere met 'n blos. Stargrow nursery day, Citrusdal, 18 April 2000.
2. STEYN, W.J., WAND, S.J.E., HOLCROFT, D.M. & JACOBS, G., 2000. Principles of colour and evaporative cooling. CFG Rosemarie farmers day, Ceres, 2 August 2000.
3. STEYN, W.J., 2000. Fisiologie van kleurontwikkelling en evaporatiewe verkoeling. KROMCO produsentevergadering, 17 September 2000.
4. STEYN, W.J., HOLCROFT, D.M., WAND, S.J.E. & JACOBS G., 2001. Reasons for Rosemarie's colour loss. CPA Blush pear farmers day, 13 March 2001.
5. HOLCROFT, D.M., STEYN, W.J., WAND, S.J.E. & JACOBS G., 2001. Effect of temperature on colour development. CPA Blush pear farmers day, 13 March 2001.
6. WAND, S.J.E., HOLCROFT, D.M., STEYN, W.J. & JACOBS G., 2001. Effect of light on colour development. CPA Blush pear farmers day, 13 March 2001.
7. WAND, S.J.E. & STEYN, W.J., 2001. Fruit production in a changing climate: stress for trees and farmers. Presented at the seminar series of the Botany Dept., US.
8. STEYN, W.J., HOLCROFT, D.M., WAND, S.J.E. & JACOBS G., 2001. Beginsels van kleurontwikkelling in appels en pere. CPA Cripps' Pink Field day, 25 April 2001.
9. WAND, S.J.E. & STEYN, W.J., 2001. Influence of climate on fruit production. Boereverenigingvergadering, Brandvlei, 24 Julie.
10. STEYN, W.J., 2001. Vrugkleur – kernvrugte. Du Toit Boerderye Opleidingskursus, Koue Bokkeveld, 1 Augustus.
11. STEYN, W.J., 2001. Bestuur van kleurontwikkelling by blospere. Op uitnodiging van Piet Niewoudt, Ceres & Koue Bokkeveld, 11 Oktober.
12. STEYN, W.J., HOLCROFT, D.M., WAND, S.J.E. & JACOBS G., 2002. Colour development in bicoloured fruit. Langkloof Farmers' Information Day, Joubertinia, 15 May.
13. STEYN, W.J., 2003. Is rooi net vir die mooi. Stellenbosch VLV, Stellenbosch, 10 April.

4. Total cost summary of project

	Year	CFPA	DFPT	DFTS	Winetech	THRIP	Other	TOTAL
Total cost in real terms for year 1	?		?					
Total cost in real terms for year 2	2002		85 000					
Total cost in real terms for year 3	2003		30 000					
Total cost in real terms for year 4								
Total cost in real terms for year 5								
TOTAL								