

**Effect of soil amendments, climate and rootstock on tree
performance and fruit quality of 'Valencia' orange used
for processing**

by

Tanith Freeman

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Department of Plant Production and Soil Science

Faculty of Natural and Agricultural Sciences



University of Pretoria

Pretoria

Republic of South Africa

Supervisor: Prof P.J. Robberste

Co-supervisor: Prof P.J.C. Stassen

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Dedicated to all who have left an impression on my life



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DECLARATION

I declare that this thesis, for the degree of MSc (Horticulture), has never been submitted for any degree at any university. The research work reported is the result of my own original investigation, except where acknowledged.

A handwritten signature in black ink that reads "Freeman".

Tanith Freeman

NOTE TO READERS

This thesis represents a compilation of manuscripts that were prepared over a period of three years. Each chapter is an individual entity and some redundancy between chapters has therefore been unavoidable.

Each chapter consists of an abstract, an introduction, materials and methods, results, discussion and references. Tables and figures of the relevant chapter follow text in the appropriate chapter.



SUMMARY

Effect of soil amendments, climate and rootstock on tree performance and fruit quality of 'Valencia' oranges used for processing

by

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Supervisor: Prof P.J. Robberste

Co-Supervisor: Prof P.J.C. Stassen

Department of Plant Production and Soil Science

Magister Scientiae in Agriculture

In the deregulated market environment fruit quality is important for both fresh consumption and processed juices. In the processing industry the main quality criteria is soluble solid per metric ton. Soluble solids per metric ton is determined by juice percentage and soluble solids. Other quality parameters such as titratable acid and the ratio of solids to acid are also important. The objective of this study was to manipulate soluble solids per metric ton and other internal quality parameters by means of cultural practices.

The internal quality of 'Valencia Late' was investigated with regard to fruit position in the canopy and effect of winter girdling of branches. Fruit from exposed canopy positions generally had higher soluble solids while no real differences were found for soluble solids per metric ton due to lower juice percentages. Girdling of branches late in the season did not improve soluble solids. Quadratic trends were best fitted to the data indicating an increase of soluble solids over the season peaking in late August 1999, and then decreasing.

Ten cultural practices were evaluated in two non-adjunct orchards. White reflective plastic increased yield and soluble solid production per hectare above control trees. Aldicarb increased fruit weight and kilogram soluble solids per metric ton. The addition of organic mulch increased fruit size, soluble solids per metric ton and per hectare and yield although nematode counts were highly comparable with the control at harvest. In both treatments of bark chips and manure and molasses in single application, nematode counts were not significantly suppressed in comparison to the addition of aldicarb and PI Plus® in combination treatments.

The fruit of two orchards were compared for differences in chemical composition over two seasons. During the first season of the study the fruit differed in physical and chemical characteristics. Soluble solid content, titratable acid and kilogram soluble solids per metric ton differed while the solid to acid ratio was comparable between the orchards throughout the first season. Fruit from the second season did not indicate any differences. Variation in subsoil layers enhanced differences between orchards in the first season due to high rainfall not found present in the second.

Three rootstocks (Rough lemon, Swingle citrumelo and X639) were evaluated. Juice percentage and titratable acid decreased over time while soluble solids, the solid to acid ratio and soluble solids per ton increased between sample dates. Highest soluble solids per fruit and ton was achieved by fruit grafted on Swingle citrumelo. Fruit from Rough lemon rootstock yielded the highest solid to acid ratio and lowest titratable acid.

Fruit quality data as influenced by the weather over the last three years was evaluated. Soluble solids per fruit and per metric ton were annually compared to rainfall. Heat units for the years 1999 and 2000 were correlated to the soluble solids per metric ton for fruit delivered. A high correlation was found between the internal quality and rainfall indicating a decrease in fruit quality within years of high downpour. Although no high correlation coefficient was found for heat units, soluble solids per ton increased linearly over time, plateaued towards the end, before decreasing.

SAMEVATTING

Die invloed van grond behandelings, klimaat en onderstam op boomprestasie en vrugkwaliteit van 'Valencia' lemoene bestem vir prosessering

deur

Tanith Freeman

Leier : Prof P.J. Robberste

Mede-leier: Prof P.J.C. Stassen

Department Plantproduksie en Grondkunde

Magister Scientiae in Landbou

Binne die vrymarkstelsel is vrugkwaliteit belangrik vir vars sowel as geproseseerde vrugte. In die versappingsbedryf is oplosbare vastestowwe per ton die hoof kriterium vir sapkwaliteit. Ander kwaliteitsparameters byvoorbeeld suurgehalte en die verhouding van opgeloste vastestowwe is ook belangrik. Die doel van die studie was om die opgeloste vastestowwe per ton en ander interne kwaliteitsparameters te manipuleer met behulp van verbouingspraktyke.

Die interne kwaliteit van 'Valencia'-vrugte ten opsigte van die posisie in die blaredak en die invloed van winterringuleering in Junie is ondersoek. Blootgestelde vrugte het oor die algemeen hoër opgeloste vastestowwe bevat terwyl daar geen verskille gevind is vir opgeloste vastestowwe per ton weens laer sappersentasie nie. Die ringulering van vrugdraende takke laat in die 2000 seisoen het geen invloed op die oplosbare vastestowwe gehad nie. 'n Kwadratiese regressie van die data toon 'n toename in opgeloste vastestowwe met 'n maksimum in laat Augustus 1999, waarna waardes afneem.



Tien verbouingspraktyke is in twee nie-aangrensende boorde geëvalueer. Opgeloste vastestowwe per hektaar geproduseer sowel as die opbrengs was hoër by bome waarvan wortels met 'n wit plastiekdeklaag bedek is as by kontrole bome. Verhoogde vrugmassa en kilogram opgeloste vastestowwe is in vrugte van bome wat met aldicarb behandel is gevind. Toedienings van organiese deklae het vruggrootte, opgeloste vastestowwe per ton asook per hektaar, en opbrengs laat toeneem. In beide behandelings, houtsaagsels en 'n enkel behandeling met mis plus molasse, was daar geen betekenisvolle onderdrukking van nematodes in vergelyking met behandelings met molasse in kombinasie met aldikarp en PI Plus nie.

Die produksie van oplosbare vastestowwe is tussen twee, nie-aangrensende boorde vergelyk. Gedurende die eerste seisoen van die studie is daar betekenisvolle verskille tussen fisiese en chemiese eienskappe vir die vrugte gevind. Tydens die tweede seisoen is daar egter geen verskille waargeneem nie. Die afwesigheid van positiewe resultate in die tweede seisoen kan toegeskryf word aan die invloed van verskille in die grondprofiel wat 'n groter invloed in die eerste seisoen gehad het, aangesien die eerste seisoen gekenmerk is deur hoë reënval.

Drie onderstamme (Groweskilsuurlemoen, Swingle citrumelo en X639) is t.o.v. interne vrugkwaliteit by die proefplaas van die Universiteit van Pretoria ondersoek. Sappersentasie en die suurgehalte van vrugte het afgeneem terwyl die opgeloste vastestowwe, die verhouding van opgeloste vastestowwe tot suur, en kilogram opgeloste vastestowwe per ton tussen Junie en Augustus toegeneem het. Swingle citrumelo het die hoogste opgeloste vastestowwe per vrug en ton opgelewer. Vrugte van Groweskilsuurlemoen het die hoogste opgeloste vastestowwe en verhouding van vastestowwe tot suur gelewer.

Vrugkwaliteitdata, soos beïnvloed deur die weer vir die laaste drie seisoene is ontleed. Opgeloste vastestowwe per vrug en per ton is jaarliks vergelyk met reënval. Hitte-eenhede is vir 1999 en 2000 gekorreleer met kilogram opgeloste vastestowwe per ton. 'n Hoë korrelasie is gevind tussen die interne



kwaliteit van vrugte en reënval. Geen goeie korrelasie kon gevind word tussen hitte-eenhede en kilogram opgeloste vastestowwe nie, alhoewel 'n kwadratiese neiging oor tyd, gevind is vir vastestowwe.



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