CFPA Canning Fruit Producers' Assoc. Submit to: Wiehahn Victor PO Box **426** **Paarl, 7620** **Tel: +27 (0)21 872 1501** **inmaak@mweb.co.za**	DFPT Deciduous Fruit Producers' Trust Submit to: Louise Liebenberg Suite 275, Postnet X5061 Stellenbosch, 7599 Tel: +27 (0)21 882 8470/1 **louise@dfptresearch.co.za**	DFTS Dried Fruit Technical Services Submit to: Dappie Smit PO Box 426 Paarl, 7620 Tel: +27 (0)21 872 1501 **dappies@dtd.co.za**	Winetech Submit to: Jan Booysen PO Box 528 Paarl, 7624 Tel: +27 (0)21 807 3324 **booysenj@kwv.co.za**
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Indicate (X) client(s) to whom this final report is submitted.
Replace any of these with other relevant clients if required.

FINAL REPORT
FOR 2011

PROGRAMME & PROJECT LEADER INFORMATION

	Programme leader	Project leader
Title, initials, surname	Dr N Cook	Dr E Lötze
Institution		Researcher
Tel. / Cell no.	DFPT Research	Dept Horticultural Science
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PROJECT INFORMATION

Project number	EL Soil 2
Project title	Quantifying the effect of compost mulches on the nutrient uptake and fruit quality (b).
Fruit kind(s)	apples

Start date (dd/mm/yyyy)	1/10/2009	**End date** (dd/mm/yyyy)	30/9/2011

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

The higher soil C levels observed at the mulch treatments (3 to 8) compared to the unmulched control treatments (1 and 2) in 2010 was also observed in both 2005 and 2008 (data not shown). No clear trends were observed between the soil mineral concentrations and the rate of plant mineral uptake. However, highest soil Ca levels were observed with treatments 5 and 6, and even though not significant, leaf Ca was the highest at treatment 6 in 2009 and at treatments 5 in 2010. Similarly, with Mg the highest soil levels where observed at treatments 6, even though not

significant, this resulted in the highest leaf Mg levels in both 2009 and 2010 together with treatment 5, and the highest fruit Mg levels in 2009.

Furthermore, the soil pH was significantly lower at the control treatments (treatment 1(average pH 4.42) and treatment 2 (average pH 4.63)) at all depths. The 2007 analyses indicated that the percentage of mycorrhizal colonized roots were significantly higher at the mulched treatments compared to the unmulched (except for treatment 3). Only in 2010 all the mulched treatments resulted in significantly lower fruit N levels, however this was the general trend from 2007, especially with treatments 3, 6, 7 and 8. This however did not correspond with leaf N as no clear trends could be identified in 2009 and 2010. Analysis in 2007 indicated that the unmulched treatments contained a significantly higher number of microbes during spring time (data not shown).

In contrast to the spring analyses, bait lamina analysis during summer resulted in microbial activity being the lowest at the unmulched control treatments (data not shown). Despite the lower yields produced by all the mulched treatments in this trial, fruits size and quality remained unaffected in 2009 and 2010 due to treatments. At treatments 6 and 8, where compost tea was added in addition to the compost/ mulch, no clear trends were found in terms of mineral uptake to the leaves or fruit. Furthermore, no distinguishable trends were evident in terms of soil biota, tree growth, yield or fruit quality throughout this trial period.

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.

In an existing trial, treatments with compost and a straw mulch have been running for a number of years without quantifying the effect of the treatments on fruit quality after storage, or the possible effect of a differential uptake of mineral nutrients on fruit quality. This will be an extension of the existing project to quantify these effects.

2. Workplan (materials & methods)

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

Materials and methods

The trial commenced in 2003 at the Elgin experimental farm in Grabouw on a clay loam soil type. Four-year-old Cripps` Pink apple trees planted on M7 rootstocks were used to form seven tree plots (9 m^2).

Treatments consisted of mulching, mulching with compost tea and the unmulched chemical control in the tree row, which were combined with different combinations of weed control in the inner row to create the different treatments. Treatments were replicated 4 times in a randomized block design. The mulch (50 mm thick) consisted of a compost layer topped with straw spread over the whole plot (1.5 m wide), which was reapplied on an annual basis.

The eight different treatments were as follow:

1. Chemical control of the weeds in the tree row, combined with weeds being slashed during the year in the work row (chemical - slash weeds).
2. Chemical control of weeds in the tree row, combined with a cover crop during the winter in the work row, which will be chemically controlled in the spring, with continuous chemical control during the rest of the growing season (chemical - cover crop & chemical).
3. Mulch in the tree row combined with a cover crop during the winter in the work row, which will be chemically controlled in the spring, with continuous chemical control during the rest of the growing season (mulch - cover crop & chemical).
4. The application of a mulch over the entire area (mulch - mulch).
5. Mulch in the tree row combined with a cover crop during the winter in the work row, which is flattened at spring using a roller (mulch - cover crop & roller).
6. Mulch in the tree row with regular application of compost tea during the growing season combined with a cover crop during the winter in the work row, which is flattened at spring using a roller (mulch & compost tea - cover crop & roller).
7. Mulch in the tree row, combined with weeds being slashed during the year in the work row (mulch - slash weeds).
8. Mulch in the tree row with regular application of compost tea during the growing season combined with combined with weeds being slashed during the year in the work row (mulch & compost tea - slash weeds)

In the unmulched treatments (treatments 1 and 2) fertilizer was supplied at a rate of 65 kg N/ ha at full bloom and in autumn. The mulch treatments (treatments 3 to 8) in which compost was applied a single application was equivalent to 75 kg N/ha; 20.8 kg P/ha and 50 kg K/ha. From 2003 until 2007 the compost/ mulch treatments received a compost application during spring and autumn; however at the end of 2007 the trees were ring barked due to vigorous vegetative growth. In 2008 no compost was applied in spring, however a double application was made in autumn.

In treatments where a cover crop was used, legumes and wheat were rotated on an annual basis. Pest and disease management was conducted on organically acceptable methods. Where symptoms of mineral deficiencies occurred, it was addressed using organically acceptable fertilizing practices.

During this paper our focus would be on the main effect of the treatments in the tree row. Treatments 1 and 2 (chemical control) are seen as the control treatments which are compared to mulch applications (treatments 3, 4, 5 and 7), and mulch application together with compost tea (treatments 6 and 8).

Soil mineral analysis. In 2010, a composite soil sample was taken at 5, 15, 30 and 45 cm soil depth at each plot. The mineral analysis was done by a commercial laboratory (Bemlab Pty Ltd, Strand, South Africa).

Leaf and fruit mineral analysis. Leaf samples (10 leaves / block) were taken annually at the end of January according to standard procedure. A sample of twenty fruit of similar size was randomly taken from each block, at the main harvest, for mineral analyses. The peel was included in the mineral analysis, however, the pips and the fruit core were removed. Both leaf - and fruit mineral analyses were done by a commercial laboratory (Bemlab Pty Ltd, Strand, South Africa).

Fruit maturity and quality. Fruit was harvested during April and May in 2009 and 2010. Multiple harvests occurred due to the specific maturation of Cripps' Pink.

During 2009 and 2010, two samples of 20 fruit were used for fruit quality assessment from each block: one for evaluation at harvest and the other, after cold storage of eight weeks at 0.5°C. The samples were randomly taken from the main harvest. Evaluation was done by the Department of Horticultural Science, University of Stellenbosch.

Fruit size was measured with an EFM (Electronic Fruit Size Measure) and fruit firmness was determined with a FTA (Fruit Texture analyser), using a 7.9 mm tip, on opposite fruit sides. Both instruments are from GÜSS Manufacturing (Pty) Ltd, Strand, South Africa. Fruit mass was determined with an electronic scale.

Fruit colour was determined for background colour and pink over colour (the intensity of the red and the percentage of the fruit covered). This was done by visual inspections and ratings according to colour charts (Background: Unifruco research service (PTY) Ltd. Colour chart for apples and pears. 0.5 = Green and 5 = Yellow), (Pink: Pink Lady colour chart, 1 = Green and 12 = Pink). Starch break down was visually assessed according to a colour chart (Unifruco research service (PTY) Ltd, Starch conversion chart (Pome fruit) circular types), after the fruit was cut in half, painted with an iodine solution (1%) and allowed to dry for one minute.

The total soluble solids (tss) and titratable acidity was measured from juice made of wedges from all 20 fruit. Tss was measured with a digital refractometer (ATAGO CO.LTD, ATAGO

model: PR-32) and the acidity via titration with NaOH (0.1 mol.L^{-1}) in a Metrohm 760 sample changer.

Statistical analysis. Data was analyzed with the Analysing system (SAS) programme (SAS Institute Inc, 2004, Cary, NC) by means of a general Linear Model (GLM). The least square means and standard errors were calculated for treatments. Variance was considered significant at a 5% level.

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.

Results

Soil minerals

The 2010 soil mineral analysis at 5 cm soil depth (Table 1), showed that the pH was significantly more acidic at the control treatments (1 and 2) compared to both the mulch (3, 4, 5 and 7) mulch + compost tea (6 and 8) treatments. Furthermore, the C percentage was significantly lower at the control treatments compared to all the other treatments, whereas P and K concentration was only significantly lower compared to treatments 3, 4, 5 and 6. Sodium (Na) was also significantly lower at the control treatments compared to all the treatments except for treatment 8. Both the mulch and mulch + compost tea treatments resulted in significantly higher Ca and Mg concentration compared to the control treatments.

At 15 cm soil depth (Table 2), the Ph, C, P, Ca and magnesium (Mg) was significantly lower at the control treatments compared to the other treatments. Treatments 4 and 6 resulted in a significantly higher Na concentration compared to the other treatments, and a significantly higher K concentration compared the control treatments.

At 30 cm soil depth (Table 3), the Ph, C, Ca and Mg were significantly lower at the control treatments compared to other treatments. The P concentration was also significantly lower at the control treatments compared to all the other treatments, except from treatment 3. The Na concentration was only significantly higher at treatments 4, 5, 6 and 7 compared to the control treatments. Treatments 3, 4 and 7 contained significantly higher levels of K compared to the other treatments.

At 60 cm soil depth (Table 4), the Ph, Ca and Mg were significantly lower at the control treatments compared to the other treatments. All the treatments, except for treatment 3, contained a significantly higher concentration of P compared to the control treatments. Furthermore, Treatments 3, 4 and 6 contained a significantly higher concentration of K compared to the control treatments, whereas treatments 4, 5, 6 and 7contained a significantly higher Na concentration compared to the control treatments.

Leaf and fruit minerals

Leaf mineral analysis in 2009 (Table 5) indicated that, treatments 5, 7 and 8 contained a significantly lower N percentages compared to the other treatments, however they did not differ significantly from treatment 4. The control treatments contained a significantly lower leaf P compared to all the other treatments. Treatments 1 and 4 contained a significantly higher leaf K percentages compared to treatments 5, 7 and 8. Treatments 1, 2, 7 and 8 contained significantly lower Mg percentages compared to 3, 5 and 6. Na was significantly higher in treatments 1, 2, 3, 4 and 8 compared to the other treatments. Manganese (Mn) was

significantly higher in the control treatments compared to treatments 4, 6, 7 and 8. Copper (Cu) was significantly higher in treatment 6 compared to all the other treatments.
The fruit mineral analysis in 2009 (Table 7) indicated that, treatments 4, 6, 7 and 8 contained significantly higher P levels compared to the control treatments, but did not differ from treatments 3 and 5.
The leaf mineral analysis in 2010 (Table 6) indicated that, treatments 7 and 8 contained a significantly lower N percentage compared to the control treatments, but did not differ from the other treatments. Treatments 1, 2, 3 and 4 all contained a significantly lower P percentage compared to treatments 7 and 8. The K percentage was also significantly higher in treatments 7 and 8 compared to the other treatments. The control treatments contained a significantly higher concentration of Cu compared to the other treatments, whereas treatments 7 and 8 contained a significantly higher concentration of boron (B) compared to the control treatments, however they did not differ significantly from the rest.
Fruit mineral analysis in 2010 (Table 8) indicated significant differences in N, P, Mg, iron (Fe) and zinc (Zn). The control treatments contained significantly higher N and Zn concentration compared to the other treatments. Treatments 7 and 8 contained a significantly higher P percentage compared to treatments 1, 2 and 6, but did not differ significantly from the rest. Treatment 6 contained a significantly lower percentage of Mg compared to all the other treatments, except for treatment 8. The control treatments contained a significantly higher concentration of Mn compared to the other treatments, except for treatments 4 and 7. Fe was significantly higher in treatments 2 and 3 compared to treat 6, 7 and 8 however they did not differ significantly from the rest of the treatments.

Fruit maturity and quality
Fruit maturity results were inconsistent during the 2009 (Table 9) and 2010 (Table 10) evaluations, however some significant differences were observed. In 2009, the starch breakdown percentage was significantly higher at treatment 3 compared to treatments 1 and 8, where starch breakdown at treatment 1 was significantly lower compared to all the other treatments. In 2009, treatment 2 resulted in a significantly higher total soluble solids (tss) compared to the other treatments, whereas both treatments 2 and 3 resulted in a significantly lower tss in 2010. In 2009, the malic acid concentration was significantly lower at treatment 3 compared to treatments 2, 6, 7 and 8, however in 2010 Malic acid was significantly lower at both treatments 2 and 3 compared to treatments 6, 7 and 8. In 2010, fruit from treatments 7 and 8 were significantly firmer compared to treatments 1, 2, 3, 4 and 5, but did not differ significantly from treatment 6.
Treatment differences in fruit quality analyses were inconsistent during 2009 and 2010. In 2009, treatment 7 resulted in a significantly higher malic acid concentration compared to treatments 2, 3, 4, and 5. In 2010, background colour was significantly greener at treatment 8 compared to treatments 1, 2, 3, 4, 5 and 6 furthermore, both treatments 7 and 8 were significantly firmer compared to treatments 2, 4 and 6.

Tables in annexure

4. Accumulated outputs

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

Technology developed

Human resources developed/trained

MSc Agric student should graduate in 2011 – this chapter forms part of his MSc Agric.

Patents

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

Presentations/papers delivered

4. Total cost summary of project

	Year	CFPA	DFPT	DFTS	Winetech	THRIP	Other	TOTAL
Total cost in real terms for year 1	2010		12,000					**12,000**
Total cost in real terms for year 2	2011		15,000					**15,000**
Total cost in real terms for year 3								
Total cost in real terms for year 4								
Total cost in real terms for year 5								
TOTAL			**27,000**					**27,000**