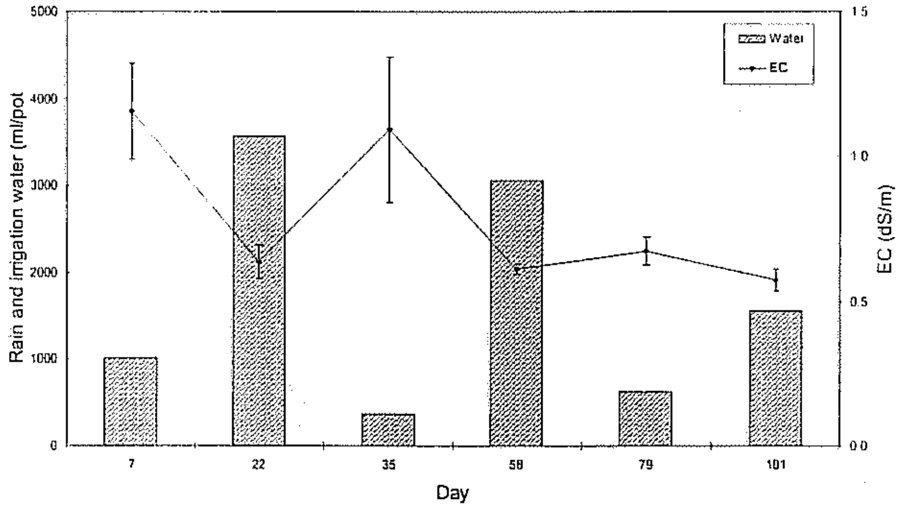
Figure 13 Relationship between water application and EC - Tibouchina
Mean and standard deviation for all treatments

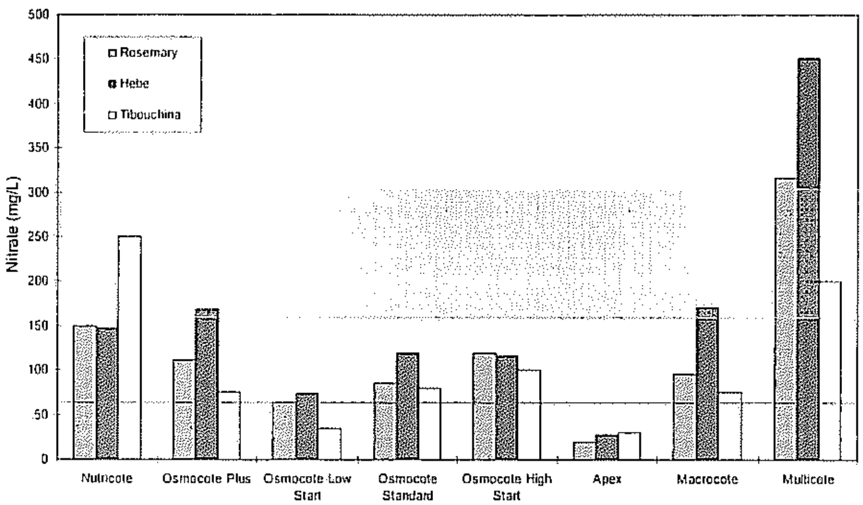


PT nitrate

The concentration of nitrate in the PT extract 7 days after planting was quite variable indicating the early release of nitrogen from the fertilizers was different (Figure 14).

In most cases, the level detected was above the 50mg/L considered acceptable for plants fertilized with a CRF (Handreck and Black, 1994).

Figure 14 Concentration of nitrate in the PT extract - Day 7

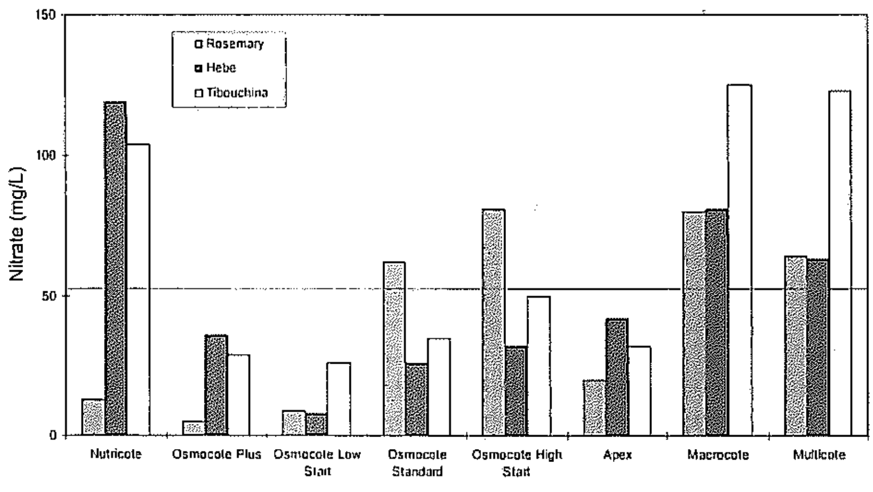


The low nitrate in pots fertilized with Apex is at least partly explained by the use of urea as a nitrogen source in this product. Nitrogen supplied in this form cannot be successfully monitored using nitrate test strips or even EC.

At this early stage, there was no consistent species effect on solution nitrate.

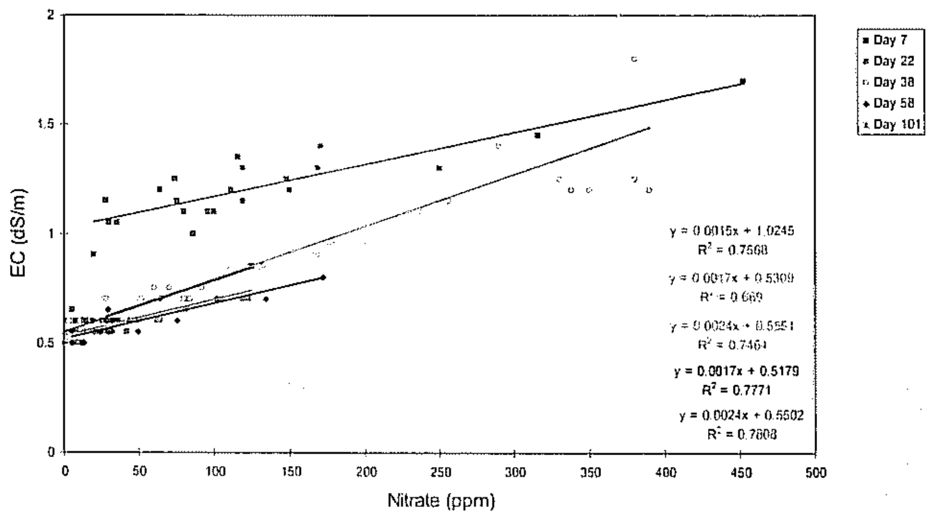
By day 22, the PT nitrate had fallen below 50mg/L in some treatments (Figure 15).

Figure 15 Concentration of nitrate in the PT extract - Day 22



EC was closely correlated with nitrate at individual sampling dates but the relationship changed with time reducing the reliability of EC as a guide to nitrogen supply (Figure 16).

Figure 16 Relationship between nitrate and EC in PT extract

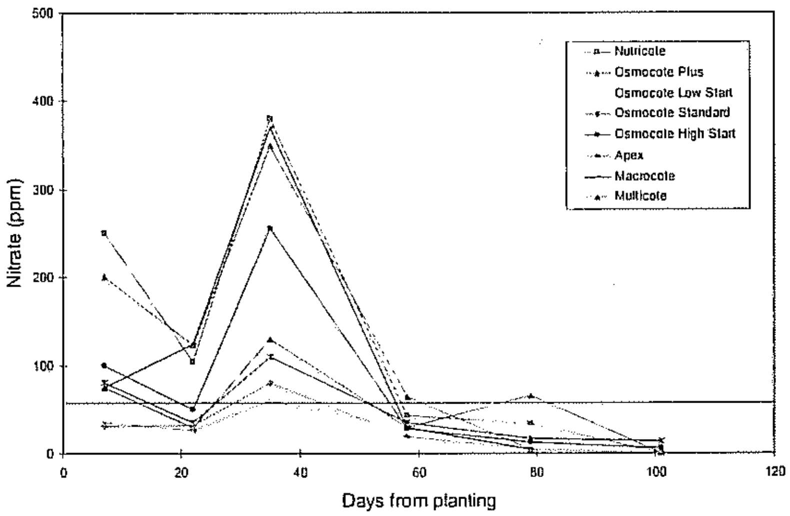


At day 7, the EC of the PT extract at any given nitrate concentration was higher than at other times. This indicates that salts other than nitrate contributed more to the EC in the first week than later in the trial.

Once these soluble salts had been leached from the potting mix, EC became a more reliable measure of nitrate.

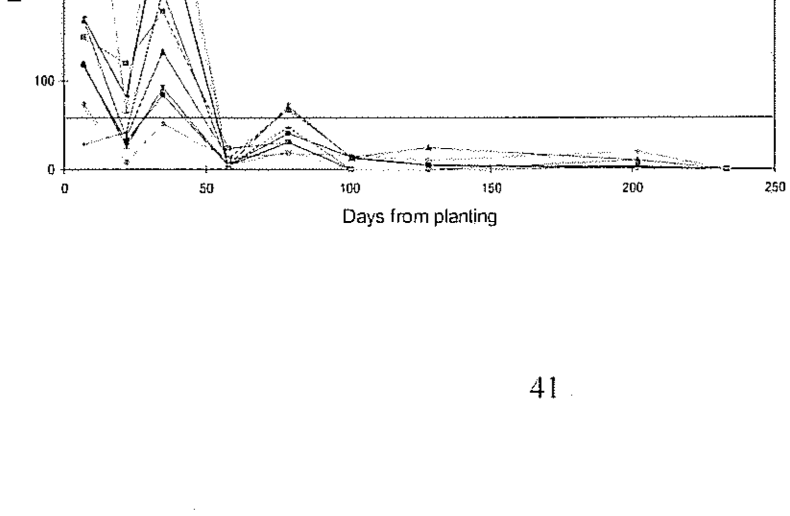
The trends for tests done after day 7 show that at an EC of 0.5dS/m there was little if any nitrate in the soil solution.

Figure 17 Trend in PT nitrate for trial period - Tibouchina



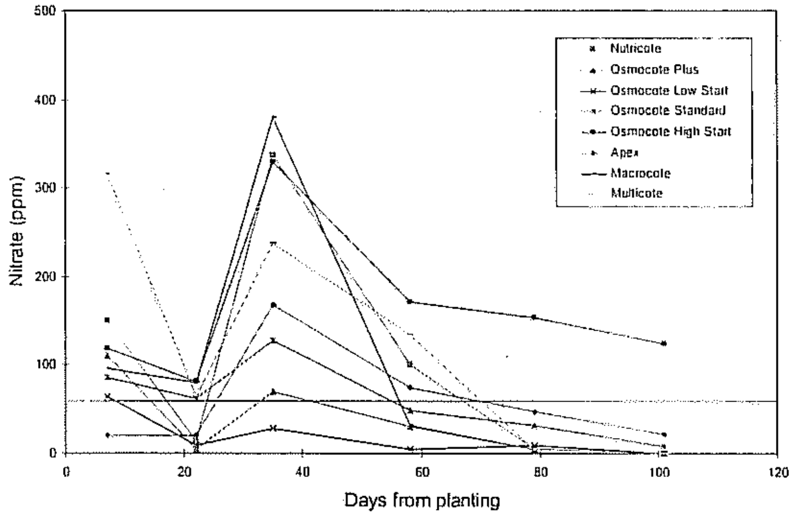
PT nitrate fluctuated wildly but generally decreased with time from planting (Figures 18-20). It fell below the critical 50ppm (Handreck and Black, 1994) for most fertilizers after 60 days and by day 233 could no longer be detected in any fertilizer treatment.

Figure 18 Trend in PT nitrate for trial period - Hebe



PT nitrate increased markedly on day 35 in all fertilizer treatments. This parallels the trend for EC and was probably due to the higher temperatures and lower leaching fraction in the period preceding the test.

Figure 19 Trend in PT nitrate for trial period - Rosemary



The concentration of nitrate in the PT extract was inversely related to the water application rate (Figures 20-22). At high rates of application, solution nitrate fell and at low rates, solution nitrate rose. This trend can be explained by nutrient leaching.

Figure 20 Trend in water application and PT nitrate - Rosemary
Mean and standard deviation for all fertilizers

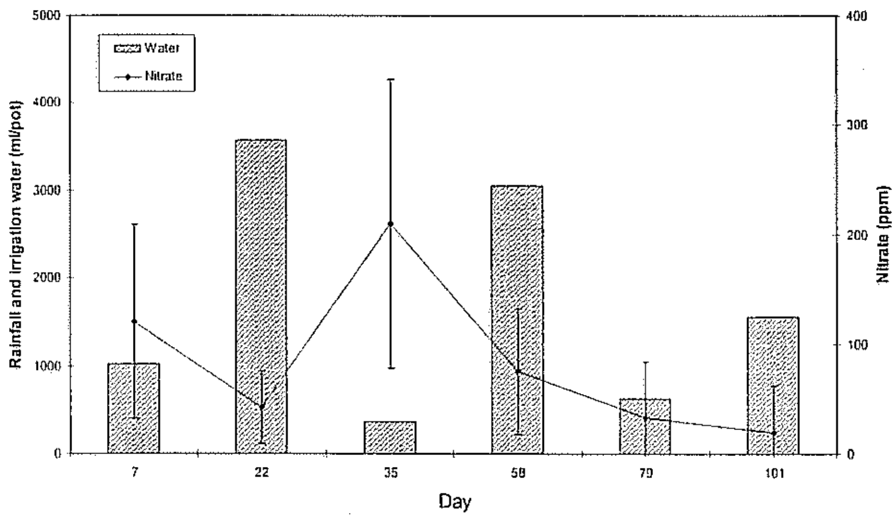
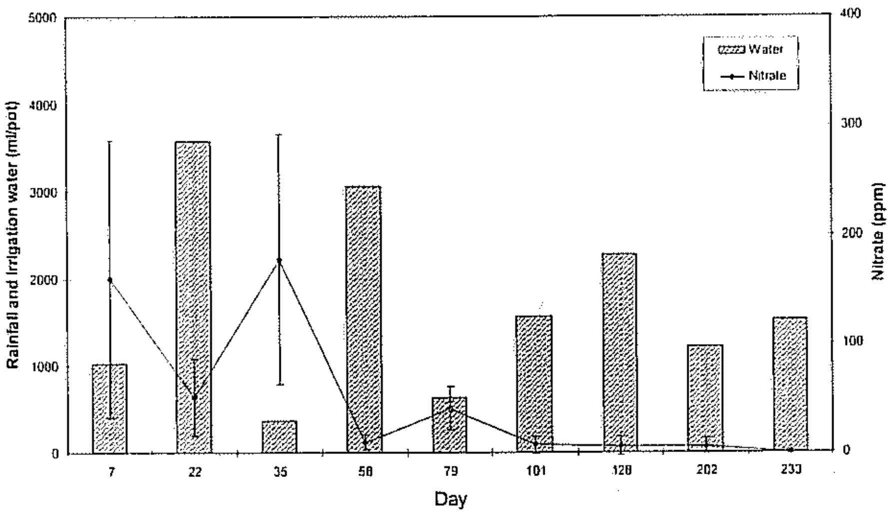
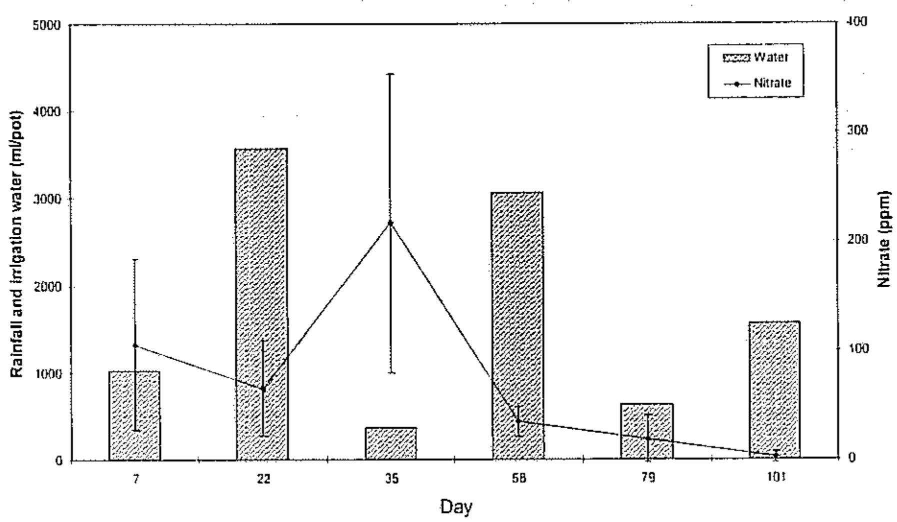


Figure 21 Trend in water application and pour-through nitrate - Hebe
Mean and standard deviation for all fertilizers



The standard deviations for treatment means indicate that fertilizer differences were larger at the end of a dry period than at the end of a wet period. This points to differences in release rates for the fertilizers. Average daily nitrogen release rates for the fertilizers ranged from 0.87 – 2.8mgN/day.

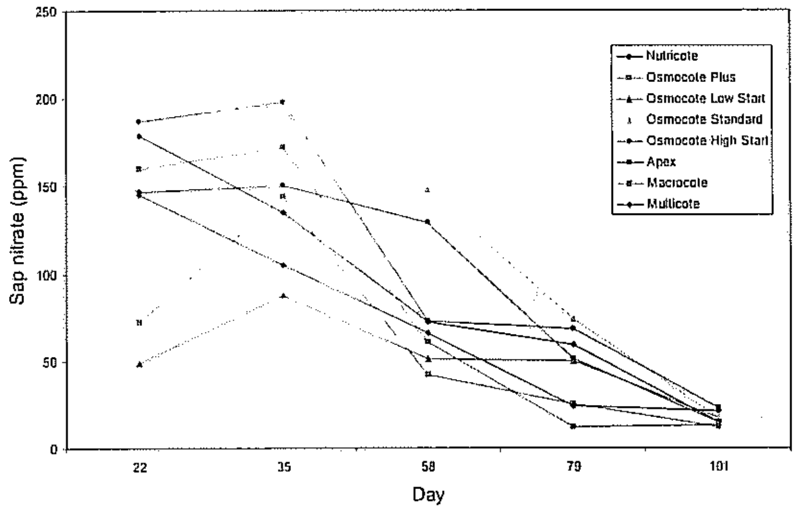
Figure 22 Trend in water application and pour-through nitrate - Tibouchina
Mean and standard deviation for all fertilizers



Sap nitrate

Sap nitrate fell rapidly over the trial period indicating that root uptake was not keeping pace with the plants requirement for nitrogen (Figure 23). Since the trend for nitrate in sap and PT extract were similar it would seem that the supply of nitrogen was inadequate.

Figure 23 Trends in sap nitrate for trial period - Rosemary



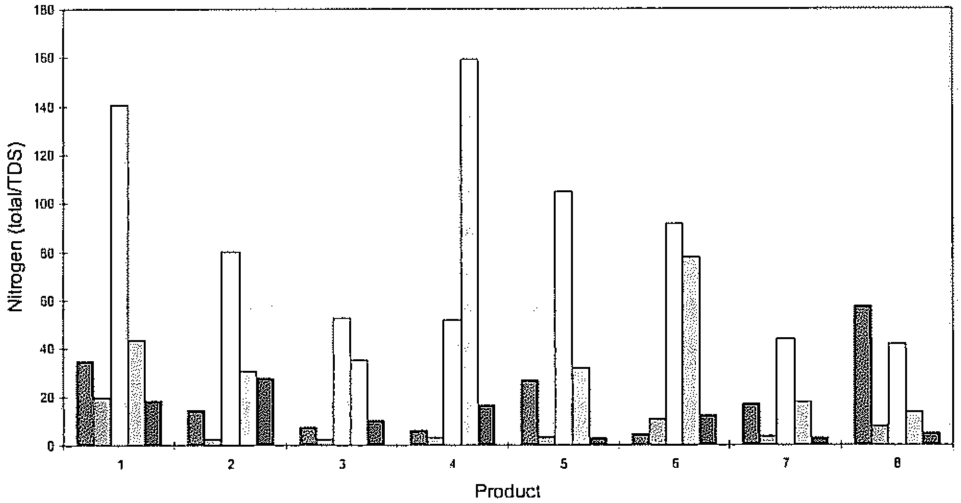
There are no published sap nitrate standards for rosemary plants. However, the measured concentration is low compared to the >1000ppm nitrate required by most ornamental plants (Table 1), even allowing for the dilution during the extraction.

Nitrogen release

The EC of the PT extract is a measure of the total salts dissolved in the soil solution. For EC to be a reliable indicator of nitrogen availability, the proportion of nitrogen in the solution must remain constant with time. There are several factors which make this an unlikely possibility including high contribution of soluble fertilizer salts and liming materials to the leachate in the first few irrigations and uneven release of nutrients from CRFs.

Results from the leachate study (Figure 23) demonstrate that the proportion of nitrogen can change considerably over the release period.

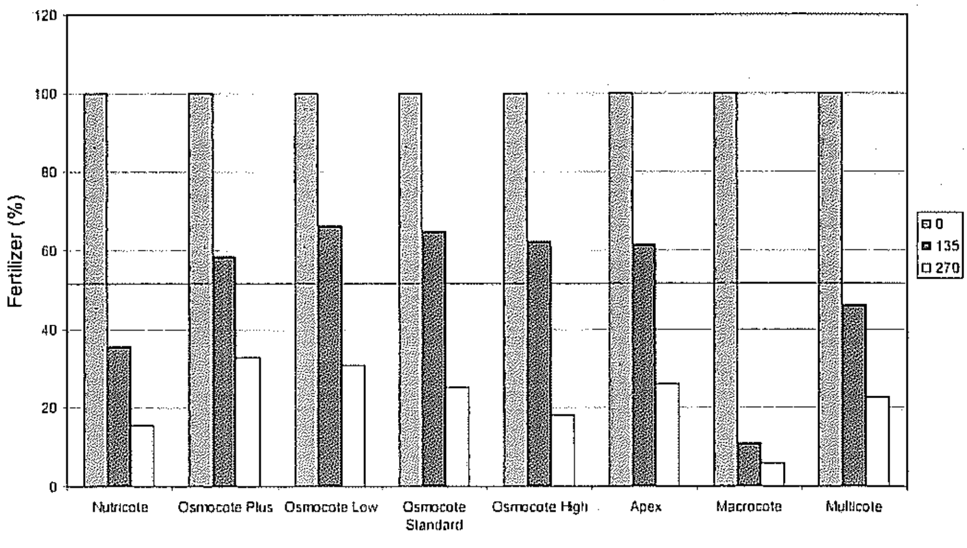
Figure 23 Nitrogen release as proportion of soluble salts
Day 22, 79,128, 202 and 232



Nutrient release

Nutrient release rates were also different between fertilizers.

Figure 24 Fertilizer remaining in prills estimated from EC
Day 0, 135 and 270



The data in figure 24 shows the percentage of soluble fertilizer remaining in each product at days 0, 135 and 270. The analysis is based on the EC of a solution made by crushing and dissolving 50 pellets in 100ml of water.

By midway through the nominal release period (8-9 months), some products were above and some below the 50% line. Those above, Apex and all Osmocote products had released slower than the nominal rate. However, this is to be expected given the low temperatures during most of the growing period.

Those products below, Nutricote, Macrocote and Multicote had released faster than the nominal rate. By day 135, less than 20% of the total soluble nutrient salts in Macrocote remained. In warmer weather, these products would release faster which could reduce the longevity further.

This statement needs some qualification because the results for day 270 show that all products had some fertilizer salts remaining at the end of the release period. Therefore, all products had technically achieved the stated longevity. The main difference between fertilizers is in the way the release rate changes with time.

The differences between products need not be considered undesirable. Problems arise only when the release pattern does not coincide with expectations.

When the release patterns of individual fertilizers are known, the differences should allow closer matching of nutrient supply to crops.

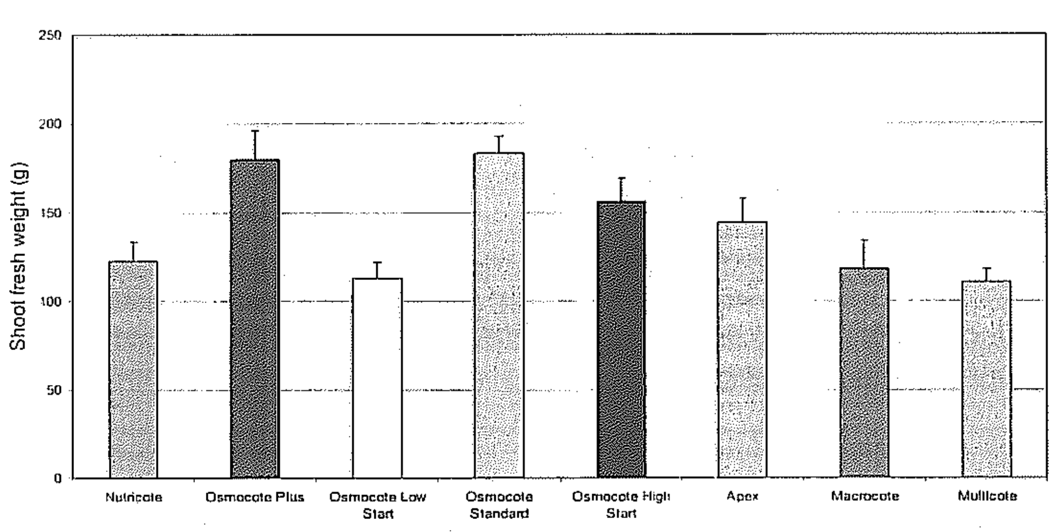
Plant responses

A bacterial infection caused large losses of Rosemary plants. There was no obvious fertilizer effect on susceptibility and no meaningful growth measurements were possible.

Nitrogen deficiency symptoms were expressed by Tibouchina and Hebe plants late in the growing period. Under the conditions, the rate of nitrogen release from all fertilizers was clearly inadequate for these plants.

There was no observable fertilizer effect on flowering or on final shoot weight of Tibouchina or Rosemary plants. However, differences in shoot weight of Hebe were significant (Figure 25).

Figure 25 Influence of fertilizer on Hebe shoot growth



General conclusions

The main findings from this section that relate to the use of quick tests for nutrient management are:

- The pH of the PT extract is possibly higher than would be obtained with a SME and is also influenced inversely by the leaching volume. This latter effect could be due to particles of lime washing out of the potting mix, a process that will eventually acidify the medium.
- The trend in PT EC was not stable as would be expected if nutrient supply was matched to losses. Rather the EC was higher at the beginning than at the end of the production period.
- EC was influenced by leaching volume and by temperature. EC was lowest during periods of heavy rain or irrigation and increased when the weather was dry and warm.
- The trend for PT nitrate was similar to that for EC.
- During winter, all fertilizers failed to release enough nitrogen to sustain maximum growth of the test crops. Rather than reducing fertilizer rates in winter, the results show that higher rates or shorter term products could be beneficial.
- PT EC was a good indicator of nitrate supply from these fertilizers over most of the monitoring period. However, in the first week after the fertilizer was applied the EC was higher at any given nitrate concentration. This was due to the contribution of salts in the potting mix that are normally leached away in the first few weeks.

- Nitrogen was not released from the CRFs at a consistent rate relative to the other nutrients. This reduced the reliability of EC as an index of nitrate.

- No nitrate was detected at an EC of 0.5dS/m. From this study, nitrate testing appears necessary when the EC falls below 1dS/m as the salinity of the irrigation water can mask a deficiency.

- Sap nitrate testing confirmed the diagnosis of nitrogen deficiency made from symptoms and from the trends for PT EC and PT nitrate. Sap nitrate decreased consistently over the monitoring period indicating that root uptake and plant reserves were declining.

As a general comment, the results clearly show that the failure of these fertilizers to provide adequate nitrogen under the growing conditions could have been predicted from the trends in PT EC and nitrate.

SECTION 2 - CASE STUDIES

The information in this section of the report was obtained with the generous cooperation of six nurseries in and around Sydney.

Fertilizer references are not intended to imply endorsement. The reader should keep in mind that the trials reported here were not conducted by the author. They are grower trials with objectives specific to that nursery. In most cases, the fertilizer treatments were not balanced for the nitrogen they provided and so the comparison of products is difficult.

The purpose of this section is to illustrate the practical benefits that can be obtained from on farm testing of potting mixes and plants.

Nursery 1

Dam water

Water from the second dam had a pH 10.1 an EC 0.4 dS/m and no detectable nitrate.

The water is not saline but the pH is a very high. A complete chemical analysis of the water is recommended to determine the nature of the dissolved salts particularly in relation to alkalinity.

Alkaline irrigation waters with a pH of this order can be detrimental to plants and to equipment.

Fertilizer trial

<u>Young citrus in 200mm bag</u>
Composted pine bark mix with incorporated Greenjacket CRF.
Top-dressed with 2 tablespoons 8-9 month CRF 8 weeks ago

Fertilizer	pH	EC dS/m	Nitrate ppm
Multicote 8	6.5	0.9	250
Greenjacket	6.5	0.55	50

Comment

All plants were growing satisfactorily and there was no visual difference between plants in the two fertilizer treatments. This may be because the plants have used nitrogen stored in the wood for the early growth.

If the differences in nitrogen release from the fertilizers continue, the plants given Multicote should outgrow those given Greenjacket.

By published standards, the EC of the pour-through extract is low in both instances. The US experience suggests that an EC of 1 – 1.5dS/m is desirable.

I would not be concerned about the supply of nitrogen to the Multicote plants as the nitrate values fall within the desirable range according to US standards. However, the nitrate level in the pour-through extract from the Greenjacket treated pots is well below the satisfactory range of 288-377ppm (It is borderline according to Handreck and Black, 1994). This may be because the fertilizer contains urea (only Formula 5) which will not be detected by a nitrate test or because the release rate is inappropriate. Do the two products have the same longevities and similar nitrogen levels?

If the nitrate release does not increase in the next few weeks as the weather warms up and the plant requirement increases, growth of the Greenjacket treated plants may be limited by nitrogen.

This is a situation where it would be helpful to monitor the mixes. If the low nitrogen trend continued for a few weeks, it would be worth reapplying fertilizer to these pots.

3 year old citrus

Composted pine bark mix with base Greenjacket now fully expended.
Top-dressed with Osmocote 7 – 8 months earlier. Lime was also applied at this time to raise the pH of the potting mix.

Plants were judged from their visual appearance to need top dressing with fertilizer. Iron and magnesium deficiency symptoms were observed.

Fertilizer	pH	EC dS/m	Nitrate ppm
3 YO citrus	6.6	0.5	60

Comment

The low nutrient status of this mix was confirmed by the test results for EC and nitrate.

In future, it would be better to decide when more fertilizer is needed from the results of testing than from the appearance of plants. Visual symptoms appear too late to be any use for predicting disorders. They only show when growth rate and sometimes quality have been irreversibly reduced.

Mini standard roses 1 year old +

Composted pine bark mix with base Greenjacket now fully depleted. Thick layer of sugar cane mulch on the surface. Pots top-dressed with one tablespoon of Multicote, 2 months earlier.

Plants have been slow to get away. Lower leaves have yellow veins.

Fertilizer	pH	EC dS/m	Nitrate ppm
Mini standard rose	6.6	0.5	10

Comment

The values for EC and nitrate are very low. This would suggest that the poor early growth of these plants was because of nitrogen deficiency.

The yellow veins and the premature shedding of lower leaves (symptoms of nitrogen deficiency for many plants) support this interpretation.

The low nitrogen supply could be because the fertilizer was applied to the surface of the cane mulch. This could reduce the nitrogen availability in two ways:

1. Nitrogen release from the CRF is slower because the prills dry out between irrigations. A more consistent release would be expected if the fertilizer prills were under the mulch layer where the conditions remain moist.

2. Nitrogen from the CRF is retained in the decomposing mulch layer. This is a form of nitrogen drawdown.

Large standard roses 1 year old +

Composted pine bark mix with base Greenjacket now fully expended. Top-dressed with two tablespoons of Multicote 2 months earlier. Sugar cane mulch applied to surface.

Plants have been quicker to get away than the smaller plants. Lower leaves showing vein clearing.

Fertilizer	pH	EC dS/m	Nitrate ppm
Large standard rose	6.6	0.6	40

Comment

EC and nitrate are also low for these plants.

More nitrogen is available than for the mini standards, which explains the faster growth but supply is still inadequate.

The sugarcane mulch may have played a part.

The concentration of nitrate in the leachate is higher simply because more fertilizer was used (2 tablespoons versus 1 tablespoon).

Nursery 2

Dam water

A sample of water collected from the dam had the following properties: pH 9.3, EC 0.5 dS/m and <5 ppm nitrate.

EC and nitrate are both relatively low indicating only minor fertilizer contamination. A full analysis is needed to establish whether the concentration of phosphorus or any other element is higher than the environmental standard.

The pH of the water is very high and so the bicarbonate concentration should be established. Alkaline waters can cause problems for plants and equipment if the bicarbonate content is not reduced.

Outdoor and indoor stock

All plants except Fuchsia have been potted into composted bark and green waste mix. Multicote 8 was incorporated at 4 kg/m^3. Plants were sprinkler irrigated.

The Fuchsias were potted into a mix containing vermiculite, perlite and peat. Multicote 6 was incorporated at 3 kg/m^3. These plants were sub irrigated and occasionally hand watered.

Plant	Pour-through extract pH	EC dS/m	Nitrate ppm	Sap Nitrate ppm
Zantadeshia	6.8	0.55	0	nd
Cupressus sempervirens	6.3	1.8	600	
Murraya	6.7	1.9	500	
Agapanthus	6.6	1.35	500	nd
Lavender	7.4	0.5	50	250
Rosemary officinalis	7.3	0.55	100	2000
Fuchsia	6.9	2.1	400	2500

nd Not detectable

Comments

High concentrations of nitrate were found in the pour-through leachate from most of the pots tested. 288-377ppm nitrate is considered desirable in the US.

In most cases, these tests were done just before an irrigation, which means the soil moisture was low, concentrating the solution. Pots should be tested an hour or so after an irrigation.

Further testing is needed to establish whether too much nitrogen is being supplied. This is very important because the conditions could deteriorate as the weather warms up and the fertilizer releases faster.

The rate of fertilizer used is not high by normal nursery standards. However, there were more prills on the surface of the mix than might be expected suggesting that the actual rate was higher than 4 kg/m^3. A simple count of prills from a few pots would answer this question. The rate used is equivalent to 4 g of fertilizer in a litre of mix.

The high sap nitrate recorded for the Fuchsia could be partly due to the method of irrigation. These pots are sub-irrigated and therefore do not experience the low soil solution levels after an overhead irrigation caused by leaching.

Notice that the EC was higher in the sub-irrigated pots. The salinity was not excessive but should be monitored as a precaution. This is especially important in hot drying conditions. It may be possible to reduce the fertilizer rate for sub-irrigated crops.

Other plants tested may be getting too little nitrogen. The Zantadeshia crop had a low EC and no nitrate was detected in the leachate or the sap. This crop had been irrigated less than 15 minutes before the testing was done and so the mix may have been thoroughly leached of nitrate and other fertilizer salts. However, this does not explain the absence of nitrate in petiole sap which would be unaffected by the recent irrigation. A retest of the pots an hour after an irrigation would help to establish whether the crop is truly nitrogen deficient.

The lavender and rosemary plants also tested low in nitrate according to the available standards. In the case of the lavender, the sap nitrate was also low. However, this was not true for the rosemary.

No nitrate was detected in petiole sap from the Agapanthus. However, the sap produced by this plant is gelatinous and this property may have interfered with the test. EC and nitrate measurements on the pot leachate indicate that the crop presently has adequate nitrogen.

Nursery 3

Testing was done at this nursery as part of a general survey of the nutrient status of plants. A small number of plants appeared from symptoms to be nitrogen deficient while others could have been affected by excess fertilizer.

Representative pots were tested using the pour-through technique for EC and nitrate (See following table). Some of these were too dry and so had to be rewet before the extraction could be done. These pots were tested within the hour and so the results may underestimate the available nutrients.

Plant	Potting date	Time months	EC dS/m	NO_3 mg/L	NO_3-N mg/L
Westringia brevi	20/12/00	9	0	<5	<1
Acacia binervia	16/1/01	8	0.35	50	11
Grevillea Pink Lady	9/2/01	7	0.9	250	57
Grevillea Coconut Ice	9/2/01	7	0.5	100	23
Grevillea molongolo	24/4/01	5	1.3	400	90
Banksia paludosa prostrate	26/4/01	5	1	500	113

Testing showed that the nutritional conditions were quite variable and that this was largely attributable to the different lengths of time the plants had been growing.

Westringia brevi and *Acacia binerva* were judged from the testing and from symptoms to be nitrogen deficient. The reason for this was revealed by the potting date which indicated that the CRFs were at the end of their 9 months release period.

The nitrate concentration in the PT extract was high for *Banksia paludosa* which had fertilizer burn like symptoms. As the fertilizer was already 5 months into the 9 month release period, it was likely that the soil solution levels had been higher earlier.

The result for *Grevillea molongolo* was also high which could also have placed this species at risk of fertilizer damage.

Action

The testing made it abundantly clear that plants held beyond 7 months would need top dressing. A system had to be put in place for recording planting dates and for alerting the production manager that a top dressing was needed.

The question of whether the fertilizer rate was too high for some species needed to be investigated either by trialling or by nutrient charting a crop from planting.

Nursery 4

At this nursery, representative plants from a fertilizer trial were tested. All plants were apparently healthy and without obvious nutritional symptoms.

Tests were done on the potting mix and plant sap. Sap was expressed from petioles and the nitrate concentration determined using the Merckoquant test strip.

Crop	Planting date	Duration days	Nitrate Leachate mg/L	Nitrate Sap mg/L
Marguerite daisy				
Variety 1	12/4/01	70	10	0
Variety 2	24/5/01	28	1000	5000
Variety 3	31/5/01	21	1500	4000
Compacta daisy	25/4/01	57	10	30
Lavender	11/4/01	71	30	4000

The concentration of nitrate in the PT extract proved either excessive or inadequate by the available standards (See above table).

The highest concentrations were found in the most recently potted plants. According to Yeager *et al* (1994), >665ppm nitrate is very high. The absence of symptoms on leaves indicates that these varieties are very tolerant of high nitrate although growth may have been inhibited.

High concentrations of nitrate were also found in the sap of these plants.

PT nitrate fell dramatically from 57 days after planting. By the available standards, nitrate was inadequate for optimum growth. 57 days was within the release period of the fertilizer.

Sap nitrate was also low in two of the three plants which had low PT nitrate. This is proof that the PT result was an accurate indication of supply rather than an aberrant reading.

In the case of the lavender, a high sap nitrate was obtained even though the PT nitrate was low. This could be a species effect. One explanation is that the plant is able to draw from reserves in roots and stem when external supply diminishes.

Conclusions

The tests revealed that the nutritional conditions provided by the fertilizer program are potentially excessive early on. Furthermore, the release period for the fertilizer appears to be much shorter than expected from the nominal longevity. This may not be a problem in a short term crop.

Nursery 5

Background

Leachate and petiole sap tests were conducted to understand the reasons for observed growth differences in two fertilizer trials.

The trials and fertilizer programs were:

<u>Potted colour</u>

1. Multicote 4 kg/m^3 Special blend Prilled potassium nitrate + Multicote NK and NP + Multicote N 4m.

2. Standard program

<u>Shrubs</u>

1. Multicote 16:3:13 +Mg 6m 5 kg/m^3

2. Standard program

All fertilizers were incorporated before potting up.

Testing of the potted colour was done at the end of the growing period when the fertilizer had largely expired.

Results

Potted colour

The form, foliage colour and flowering of all three plants grown with Multicote was superior to that achieved with the standard program. Celosia gave the largest difference.

All plants on the standard program were smaller and had nitrogen deficiency symptoms including pale foliage and yellowing of old leaves. This diagnosis was supported by the leachate and sap tests (Tables 1 and 2).

The EC and the concentration of nitrate in the pour-through extract from pots fertilized with the standard program was generally lower than from Multicote treated pots. However, except for the Snapdragon, the nitrate levels for all treatments were lower than desirable for maximum growth. This is simply a reflection of how late the sample was taken, as all plants were ready for sale. At least for the Multicote treated plants, sufficient fertilizer had been used.

Testing of petiole sap nitrate approximately one week later, revealed large differences between the two fertilizer treatments in plant nitrogen reserves. In every instance, the concentration of sap nitrate was acceptable for the Muticote plants but grossly deficient for plants on the standard program (Table 2). Most plants require >1000ppm nitrate in petiole sap for optimum growth. The 50ppm nitrate found in the poorer plants is clearly inadequate and is consistent both with the visual symptoms and the low leachate test results.

Table 1 Results of leachate testing based on pour-through extract

Test	Multicote	Standard program
Snapdragon		
EC (dS/m)	0.95	0.5
Nitrate (ppm)	228	<5
Alyssum		
EC (dS/m)	0.35	0.3
Nitrate (ppm)	21	8
Celosia		
EC (dS/m)	0.3	0.3
Nitrate (ppm)	<5	<5

Table 2 Results of petiole sap testing for nitrate (ppm)

Test	Multicote	Standard program
Snapdragon	3000	50
Allysum	2000	50
Cellosia	4000	50

Shrubs

At the time of testing, there were no clear visual differences between treatments.

However, leachate tests reveal that the standard program is again supplying less nitrogen than the Multicote program.

If 50ppm is taken as an acceptable target for nitrate in the pour-through extract, it is apparent that plant growth may be limited by nitrogen in several of the treatments.

Additional leachate tests are needed to follow the release pattern over the next few weeks.

Leaf analysis should be used to establish the reason for any growth differences that may develop as the trial progresses. This information would be very helpful when readjusting the fertilizer blend to improve plant performance.

Table 3 Results of leachate testing based on pour-through extract

Test	Multicote	Standard program
***Pittosporum* - Silver sheen**		
EC (dS/m)	0.5	0.4
Nitrate (ppm)	55	25
Viburnum tinus		
EC (dS/m)	0.75	0.65
Nitrate (ppm)	190	76
Coprosma repens		
EC (dS/m)	0.65	0.5
Nitrate (ppm)	118	39

Nursery 5

Background

Leachate testing was conducted on pots in a fertilizer trial designed to compare the effectiveness of a Multicote based program against the standard practice.

The treatments were:

1. Multicote 18:2.6:10 + me 2.5 kg/m^3 8m + 2.5 kg/m^3 12m 15:3:12 + Supergrow 1 kg/m^3

2. Standard practice

All fertilizers were incorporated into the potting mix prior to planting.

Testing was done approximately 5 months after potting up.

Results

<u>Plant growth</u>

At the time of sampling, plants grown with the two fertilizer regimes were not visually different with the clear exception of the Gardenias. In that case, the plants receiving the program based on Multicote were dramatically larger and more advanced (See photo). These plants were ready for sale 3-4 weeks earlier than plants on the standard program.

<u>Plant nutrition</u>
A snap shot of the current nutrient conditions was obtained by testing the leachate from two representative pots from each treatment.

The electrical conductivity (EC) and the nitrate content of the pour-through extract are shown in the following table.

Results of leachate testing based on pour-through extract

Test	Multicote	Standard practice
Abelia grandiflora		
EC (dS/m)	0.45	0.75
Nitrate (ppm)	92	1312[a]
Euonymus japonica		
EC (dS/m)	0.45	0.65
Nitrate (ppm)	115	260
Gardenia magnifica		
EC (dS/m)	0.35	0.55
Nitrate (ppm)	56	181

[a] This unusually high reading was based on a pooled sample of leachate from two pots. It is possible that one or both pots were not truly representative of the nutrient status of the group even though the plants were typical in size and appearance.

The EC and nitrate results suggest that the standard program is currently providing more nutrients. This must reflect a higher release rate from the fertilizers because the total N, P and K in the standard program is less than in the Multicote program.

At this stage, the strategy has not provided a clear advantage in plant performance. In fact, the higher nitrogen supply in this treatment may explain the poorer growth of the Gardenias (See following leaf analysis results). Plants in this treatment are an unusually dark green colour.

Leaf analysis

Leaf analysis was done to establish the reason for the dramatic difference in the growth of Gardenia plants in this trial (See table below).

Results of Gardenia leaf analysis

	MULTICOTE	STANDARD	OPTIMUM
Nitrogen (N)%	2.10	3.20 SH	1.5 - 3.0
Phosphorus (P)%	0.22	0.30	0.16 - 0.4
Potassium (K)%	1.96	2.34	1.0 - 3.0
Calcium (Ca)%	0.64	0.58	0.5 - 1.3
Magnesium (Mg)%	0.29	0.24 SL	0.25 - 1.0
Sodium (Na)%	0.03	0.05	
Sulphur (S)%	0.24	0.33	0.2 - 0.4
Zinc (Zn) mg/kg	36	43	20 - 150
Iron (Fe) mg/kg	72	100	60 - 250
Copper (Cu) mg/kg	8	12	6 - 40
Manganese (Mn) mg/kg	32 SL	38 SL	50 - 250
Boron (B) mg/kg	33	37	25 - 70

Consistent with the leachate test results, the Gardenias on the standard program had higher concentrations of most nutrients in leaves. The lower concentrations in the Multicote treated plants could be partly attributable to growth dilution of tissue levels.

Leaf manganese (Mn) was slightly low in plants from both treatments and could have been limiting. The main symptom of Mn deficiency is an interveinal chlorosis of young and middle leaves on shoots. The symptom can easily be confused with Fe deficiency. There were no other imbalances for the Multicote plants.

Leaf magnesium (Mg) was slightly low in the standard treated plants but the imbalance is not serious and could not possibly explain the observed growth inhibition.

The most likely explanation for the inferior growth of plants on the standard regime was that the early release of nitrogen was excessive. Evidence for this is provided by the leachate data (discussed above) and by the leaf N result, which is in the high range according to available standards.

Recent leachate testing (4 weeks after the initial results) shows that nitrate has fallen dramatically in both treatments (Multicote 13ppm and Standard 116ppm). The fall may in part be due to heavy rain on the night before the test was done and the active uptake of nitrogen by the now larger plants. At face value, the results suggest that the supply of N is now within an acceptable range for the standard program but is low for the Multicote program. It is possible that the more generous supply of N from standard could provide a growth advantage as the trial continues.

Nursery 6

Background

In this nursery, nutrient charting is being used to examine the nutrient conditions experienced by five different plant species normally grown with a fertilizer program based on short and longer term CRFs.

The study was motivated by a desire to improve fertilizer use efficiency. This was not a case of addressing an obvious problem as crops in the past have performed adequately. An important reason for doing the work was to see whether nutrient charting had anything to offer as a management tool.

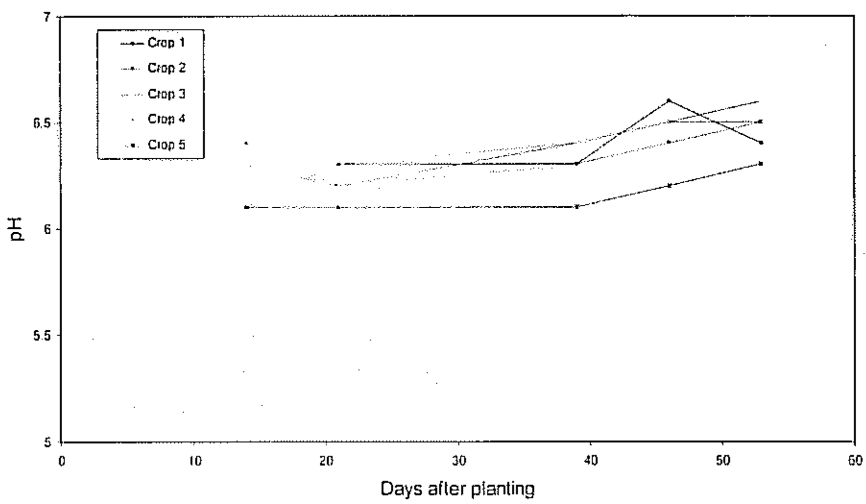
Findings

The results presented in this report, cover the time from planting until midway through the production period. During this time, the crops grew satisfactorily and had no obvious symptoms of nutritional disorder.

pH

The pH increased slightly over the monitoring period (Figure 1). If the trend continues, nutrients such as iron and manganese could conceivably become limiting.

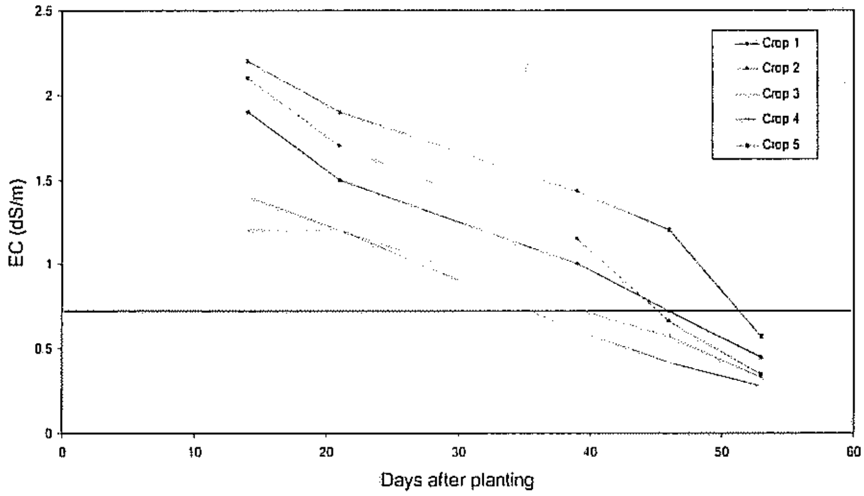
Figure 1 Change in PT pH with time



EC

The EC has fallen steadily since potting up and the last test results suggest that nutrition is suboptimal for maximum growth (figure 2). This is particularly worrying given that the crops are only half way through the production period.

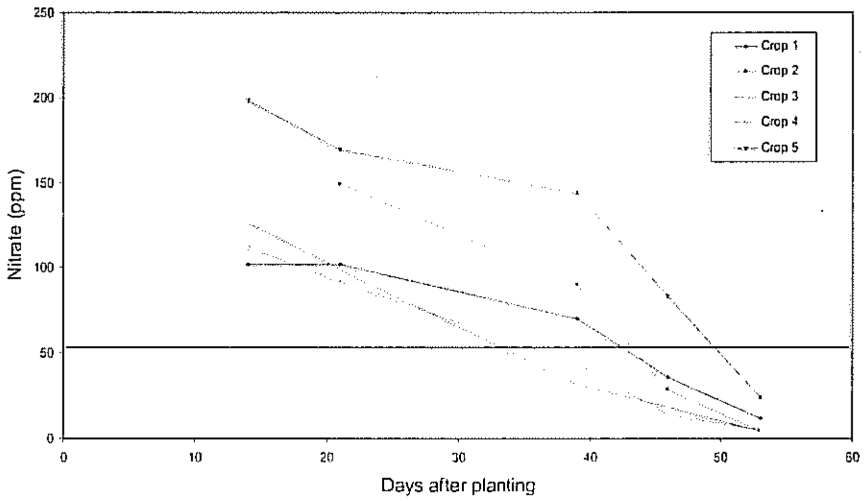
Figure 2 Change in PT EC with time



Nitrate

The trend for nitrate closely follows that for EC (Figure 3). Even the differences between crops are similar. According to the available standards, nitrate was inadequate for optimum growth by day 50.

Figure 3 Change in PT nitrate with time

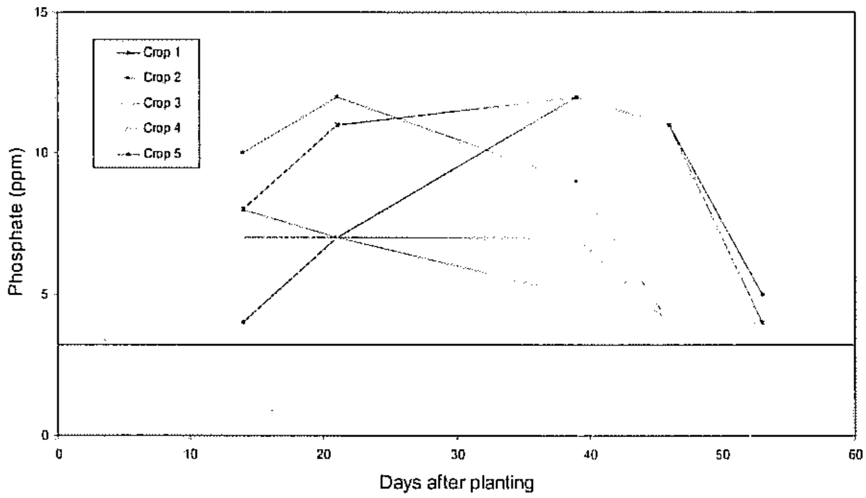


Phosphorus

The trend for phosphorus is different to that for EC and nitrate (Figure 4).

For four of the five crops, phosphorus initially increases before it falls rather abruptly in the later samples. The trends suggest that phosphorus may become limiting within a week. These crops are grown at a low level of phosphorus to avoid excessive vigor.

Figure 4 Change in PT phosphorus with time

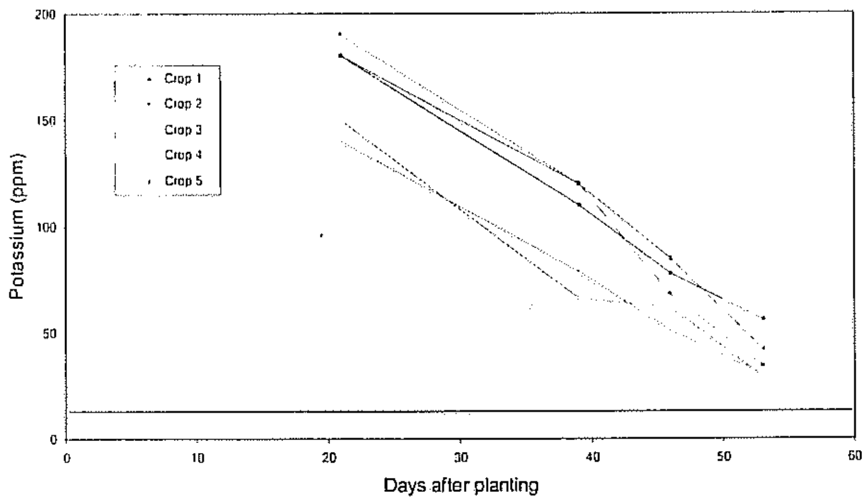


Potassium

The trend for potassium is similar to that for EC and nitrate (Figure 5). If soil solution potassium continues to fall, this nutrient will also become limiting in about two weeks time.

The Reflectoquant test for potassium seriously underestimated the concentration in the soil solution. Organic residues in the solution appear to have interfered with the colour reaction. Accurate readings were subsequently obtained using a Cardimeter.

Figure 5 Change in PT potassium with time



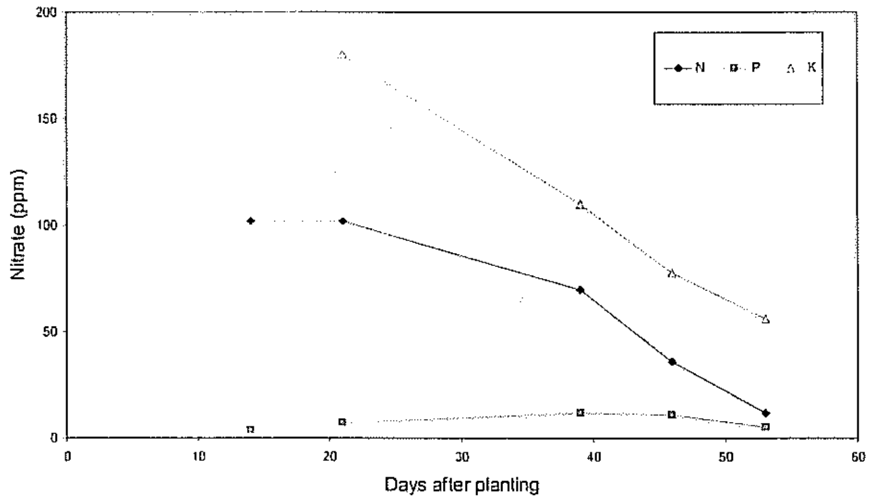
Conclusions

The value of nutrient charting for predicting nutritional disorders before they affect growth is readily apparent in these results.

There can be little argument that the trends for nitrate, phosphorus and potassium point to some future crisis in supply (Figure 6). Whether this will have a significant commercial impact is unknown. These nutrients are mobile in plant tissues and so the plant may subsist for some time on internal reserves. Furthermore, the conditions could improve as the weather warms up as this will promote faster release from the CRFs. Regardless; it is difficult to escape the conclusion that the present fertilizer program is not ideal for these crops grown in a greenhouse at this time of year.

An important lesson from this study is that the visual appearance of the plants gives no clue about the problem that is developing. Of course, strong symptoms may not show until the plants have left the nursery but this could be even more damaging to the business.

Figure 6 Crop 1 - Leachate N, P and K vs time



Nutrient charting of these crops has raised several important questions.

1. Can the fertilizer program be altered to provide more stable nutritional conditions?

2. Will this give a commercial benefit – faster production, better quality, lower losses?

3. Could other crops also be disadvantaged by the fertilizer program?

Trials are already underway at this nursery to find answers to these questions. Even if the answers are all no, the process has been worthwhile because the nursery manager will have a better understanding about the width and the turns in the nutritional path he must tread to produce a crop of consistent quality.

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