FINAL REPORT

Investigation into the fertiliser requirements of heathers.

HNS 96
1998-99

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Background and Objectives

Heather production is, in the main, concentrated with specialist growers. While Heathers are regarded as having a lower nutrient requirement than general hardy nursery stock (HNS) species, they parallel HNS in having species that group into those sensitive to salt level through to vigorous species that are capable of tolerating relatively high salt levels. Whereas a considerable amount of information is available on the nutrition of shrub species, only limited information is available regarding the fertiliser requirements of Heather species.

Discussion with the British Heather Growers Association (BHGA) showed that a wide range of fertilisers and rates were used with little or no information available as to the actual crop requirements. Consequently the group requested that work on rates of CRF suitable for a range of heathers be undertaken and it is to this end that the current trial was designed.

Objectives of the trial were to:

- Examine the effect of a range of different rates of fertiliser on plant growth and quality.
- Compare a selected range of 12-14 month CRF formulations currently available.

Summary of Results

These experiments were undertaken for one year only. Consequently, any findings are for the conditions *under which the experiment was carried out*. To a certain extent, extrapolation to other years is possible, but must be made with a full understanding of the limitations of this work. Additionally, account must be made of irrigation system, incorporation of base fertiliser and geographical location if they differ from those in this study.

As the growing year 1998-99 was not unusually hot and wet, lower rates of CRF would have been able to sustain quality plant growth than would be necessary in a year that was unusually hot and wet. This must be borne in mind when viewing the findings presented here.

1. **Winter flowering, salt sensitive eg: *Erica carnea* 'King George'**: There was no benefit of incorporating a higher rate of Osmocote Plus 12-14 (Autumn) than 1.0 kg/m^3, with plant deaths at 1.5 and 2.0 kg/m^3. Sincrocell 12 at 1.5 kg/m^3 supported growth of a similar quality to Osmocote Plus 12-14 (Autumn) at the same rate but with less plant death. The long release Ficote 270 TE appeared to be inadequate at 2.0 kg/m^3. Vitacote at 1.5 kg/m^3 gave the best plant size and flowering with no plant losses.

2. **Winter flowering, moderate eg: *Erica carnea* 'Myretoun Ruby'**: There was little benefit of increasing Osmocote Plus 12-14 (Autumn) from 1.0 to 1.5 kg/m^3, and plant size reduced at 2.0 kg/m^3. As with King George, Ficote 270 TE appeared to be releasing nutrients too slowly at 2.0 kg/m^3, as did Sincrocell 12 which did not sustain the same quality of growth as Osmocote Plus 12-14 (Autumn) at 1.5 or 1.0 kg/m^3. Vitacote at 1.5 kg/m^3 produced the best plant size and the most new growth.

3. **Late autumn flowering, vigorous eg: *Calluna vulgaris* 'Peter Sparkes'**: Osmocote Plus 12-14 (Autumn) at the lower rates produced the largest plants but 2.0 kg/m^3 has led to reduced growth. Ficote 270 TE and Sincrocell 12, at 2.0 and 1.5 kg/m^3 respectively, again produced smaller plants. Vitacote at 1.5 kg/m^3 produced plants of a similar quality to Osmocote Plus 12-14 (Autumn) at the same rate.

4. **Summer flowering, vigorous eg: *Erica vagans* 'Mrs D F Maxwell'**: With this vigorous variety, no damage was observed at rates up to 2.0 kg/m^3 of Osmocote Plus 12-14 (Autumn). However, similar growth was obtained at 1.0 kg/m^3 and slightly better at 1.5 kg/m^3. As with the other cultivars, Ficote 270 TE produced the smallest plants. Sincrocell 12 at 1.5 kg/m^3 also appeared less able to sustain vigorous growth at 1.5 kg/m^3. Vitacote at 1.5 kg/m^3 produced plants of a similar quality to Osmocote Plus 12-14 (Autumn) at the same rate.

5. Overall, Osmocote Plus 12-14 (Autumn) produced quality plants at 1.5 kg/m^3 for all cultivars but the least vigorous, where 1.0 kg/m^3 gave the best plants. Rates of 1.5 and 2.0 kg/m^3 reduced growth and quality in the least vigorous cultivar. Vitacote performed best, or equal best, with all cultivars, particularly with the salt sensitive 'King George'. Ficote 270 TE and Sincrocell 12 appeared to be releasing inadequate nutrients at their respective rates, compared to the other products (see summary Table 1, below).

6. The cause of the marked response to Vitacote needs is being studied further in HDC project HNS 96a. This may have benefits with other *Ericacea*.

Table 1 . Overall quality summary (size x flower score x plant death) for CRF treatments

(□□□ = best quality, OOO = worst quality)

	Osmocote Plus 12-14 (Autumn)			Ficote 270 TE	Vitacote	Sincrocell 12
Rate (kg/m^3)	**1.0**	**1.5**	**2.0**	**2.0**	**1.5**	**1.5**
Erica carnea 'King George'	□	O	OO	OOO	□□□	□□
Erica carnea 'Myretoun Ruby'	□□	□□□	□□	OO	□□□	O
Calluna vulgaris 'Peter Sparkes'	□□□	□□□	□□	□	□□□	O
Erica vagans 'Mrs D F Maxwell'	□□	□□□	□□	O	□□□	□

Action Points

- Vitacote can produce quality plants of vigorous and salt sensitive cultivars at 1.5 kg/m^3
- Osmocote Plus 12-14 (Autumn) can produce quality plants at 1.5 kg/m^3 for most cultivars, However, with the more salt sensitive cultivars a rate of 1.0 kg/m^3 may reduce plant losses.
- Sincrocell 12 at 1.5 kg/m^3 and Ficote 270 TE at 2.0 kg/m^3 may need to be incorporated at different rates to produce plants of a high quality. The data *suggest* that rates should be increased, but this work is not able to establish the amount the rates need to be changed, or the effect of season.

Practical and Financial Benefits

1. By using the optimum rate of Osmocote Plus 12-14 (Autumn) for each cultivar, plant losses can be reduced in the more salt sensitive cultivars. Additionally, excess application of CRF is wasteful and, under the conditions of this trial, with some cultivars no benefit was observed with the addition of an extra 0.5 or 1.0 kg/m^3 of CRF.

2. Heathers of a range of salt sensitivities can be grown using Vitacote at one rate, allowing one mix to be prepared for most (all?) cultivars on a nursery, saving preparation time and complication

Science Section

Introduction

Heather production is, in the main, concentrated with specialist growers. While Heathers are regarded as having a lower nutrient requirement than general hardy nursery stock (HNS) species, they parallel HNS in having species that group into those sensitive to salt level through to vigorous species that are capable of tolerating relatively high salt levels. Whereas a considerable amount of information is available on the nutrition of shrub species, only limited information is available regarding the fertiliser requirements of Heather species.

Heathers are also an important crop in Holland, but the majority of trial work appears to have been carried out on nutrient requirements in *Erica* and *Calluna* spp. based on liquid feeding, rather than CRFs (Aenderkerk, 1996). Whilst this gives guide-lines as to actual crop requirements, it has limited scope for extrapolation towards recommending CRF rates under UK conditions, where the benefits of using CRFs to help maintain crop quality over winter cannot be matched by liquid feeding, which must cease around September/October.

A number of studies have been previously undertaken looking at the nutrition of heathers. A MAFF funded project carried out from 1996-98 at HRI-East Malling and Efford, and the University of Sussex, looked at countering the aversion of hardy ornamentals to chalk soils (Tobbut and Flowers, 1997). The mechanisms underlying lime chlorosis were studied in *Erica*, at the University of Sussex, and it was demonstrated that the application to the leaves of excess artificial chelates (eg EDTA, EGGHA) led to partial relief of lime chlorosis and could be accounted for by a small proportion entering the leaf cells intact. However, root addition was not studied. The role of phosphate in maintaining heather growth and quality was also investigated in early MAFF funded work carried out at Efford, with the overall conclusion that neither *Calluna* nor *Erica* spp. appeared particularly sensitive to phosphate (Scott, 1981). However, general nutrition has not been studied previously.

This experiment was set up to address two objectives:

- Examine the effect of a range of different rates of fertiliser on plant growth and quality.

- Compare a selected range of 12-14 month CRF formulations currently available.

Materials and Methods

Table 2. Experimental treatments

Treatment	Fertiliser	Rate
		kg/m^3
1	Osmocote Plus 12-14 (Autumn)	1.0
2	"	1.5
3	"	2.0
4	Ficote 270 TE	2.0
5	Vitacote	1.5
6	Sincrocell 12	1.5

Table 3. Analysis of products involved in experiment.

Product	Analysis	UK Supplier
Ficote 270 TE	14:8:8 TE	Scotts UK Ltd.
Osmocote Plus 12-14 (Autumn)	15+9+11+traces	Scotts UK Ltd.
Sincrocell 12	14+8+13+TE	William Sinclair Horticulture
Vitacote	18-6-12+T.E.	Vitax Ltd.

Growing System

Plants were grown outdoors on sandbeds covered with a double layer of Mypex, to prevent capillary action, with overhead irrigation.

Growing media 100% Irish Premium peat
1.0 kg/m^3 Mg Lime

Start material: Plugs potted-on into 9cm containers (Week 23)

Species: *Erica carnea* 'King George' - Winter flowering, salt sensitive
Erica carnea 'Myretoun Ruby' – Winter flowering, moderate
C*alluna vulgaris* 'Peter Sparkes' – Late Autumn flowering, vigorous
Erica vagans 'Mrs D F Maxwell' – Summer flowering, vigorous

Potting date: Week 23 (1/06/98)

Design: Randomised block with three replicates.

Plot size: 24 plants per plot, 12 recorded and 12 guards.
24 plants x 3 reps x 6 treatments = 432 plants

Pest and Disease: Imidacloprid (Intercept) drench, routine fungicide programme: prochloraz (Octave), dichlofluanid (Elvaron), tolclofos-methyl (Basilex)

Assessments

Plants were assessed in October 1998 and after the first flush of growth, in May 1999. The variables recorded differed with species, as appropriate, and are outlined in the results section.

Scoring of size and flowering was subjective; made by visual comparison against selected standards each time. Photographs and measurements of these standards were taken.

Standard plants were selected for each assessed variable as follows: 6 plants displaying the full range of the variable were chosen from within the experimental plots and replaced into the body of plants after all plants had been scored against them. These plants were termed standard 0 to standard 5, with the variable the least for 0 and the greatest for 5; e.g. for size, 0 was the smallest plant and standard 5 was the largest plant. The standards were grown under the same conditions as all the recorded plants and were measured and photographed before being replaced. Standards were selected anew each time plants were scored.

Above ground biomass was recorded for half of all recorded plants (n=6) by destructive sampling after the spring flush of growth.

Photographs Photographs were taken as appropriate throughout trial.

Statistics

Statistical analysis of all variables was carried out by the Biometric department at HRI-East Malling. Statistical analysis can be applied to data derived from a scoring system. There are many examples of this in the literature, especially within microbiology. Recording 5-6 plants per plot leads to a normally distributed population around the mean score value. Consequently, this score was used in ANOVA to derive significance of treatment responses. Least significant differences ($LSD_{(0.05)}$) were calculated to aid interpretation of the data.

Results

Weather data

HRI-Efford

The growing season was unusually wet, especially at the beginning of summer and during October (see Table 4). Rainfall was frequent but periods of low rainfall (<10mm / week) were observed in August and September.

The highest temperatures were recorded week 32 and 33 in 1998 and week 22 in 1999. Over winter there were two cold periods in week 49 and 7 and an unusually cold week in April (wk 14) (Figure 1).

Table 4. Monthly average rainfall, maximum and minimum temperatures at HRI-Efford as a percentage of the 49 year monthly average.

1998	May	June	July	Aug	Sept	Oct	Nov	Dec
first full week no.	*19*	*23*	*28*	*32*	*36*	*41*	*45*	*49*
Rainfall (mm)	44	158	105	36	30	171	52	108
Max °C	119	95	93	101	103	-	100	109
Min °C	128	114	101	91	109	100	92	115

1999	Jan	Feb	March	April	May
first full week no.	*1*	*5*	*9*	*14*	*18*
Rainfall (mm)	128	63	55	166	43
Max °C	-	-	88	110	112
Min °C	178	155	100	136	130

***Erica carnea* 'King George'**

Autumn 1998

By autumn, Osmocote at 1.0 and 1.5 kg/m^3, Sincrocell and Vitacote had all produced plants of a similar size (Figure 2). Ficote and Osmocote at 2.0 kg/m^3 produced the smallest plants; and those grown with Ficote were significantly smaller than those grown with Vitacote.

No significant differences were observed in any aspect of flowering during the winter (Table 5).

Spring 1999

Following the first flush of growth, size was assessed and overall, the treatments displayed a similar pattern to autumn. However, Vitacote produced plants that were significantly larger than both Osmocote at the highest rate and Ficote (Figure 2). Additionally, plants grown with Osmocote at 1.5 kg/m^3 were significantly larger than those grown with Ficote.

Marked differences between treatments were apparent in the number of dead plants per plot (Table 5). On average 1, 4 and 5 plants per plot were dead with Osmocote at 1.0, 1.5 and 2.0 kg/m^3, respectively. These accounted for 8, 33 and 42% of the experimental plants for each treatment. A quarter of plants (3 / plot) grown with Ficote also died, whereas no plant deaths occurred with either Sincrocell or Vitacote.

When half the plants were used to calculate the average plant biomass, only one treatment comparison was significant, with Osmocote at 1.5 kg/m^3 producing an average weight of 3.30 g / 6 plants, which was significantly heavier than Ficote at 1.96 g / 6 plants (Table 5).

Overall

Vitacote at 1.5 kg/m^3 gave the best plant size and flowering with no plant losses. There was no benefit of incorporating Osmocote at a higher rate than 1.0 kg/m^3, with plant deaths at 1.5 and 2.0 kg/m^3. Sincrocell at 1.5 kg/m^3 supported growth of a similar quality to Osmocote at the same rate but with less plant death. The long release Ficote appeared to be inadequate at 2.0 kg/m^3.

Table 5. Erica carnea* 'King George', *HRI-Efford 1998-99
Flower score, above ground dry weight at end of trial and number of plant deaths.

Fertiliser	*kg/m³*	Flower score Winter 1998 (0 = none, 5 = most)	Dry weight Spring 1999 (g / 6 plants)	Number of dead plants / plot
Osmocote plus 12-14 Autumn	1.0	2.72	2.24	1
	1.5	2.58	3.30	4
	2.0	2.14	2.23	5
Ficote 270 TE	2.0	1.86	1.96	3
Vitacote	1.5	2.83	2.72	0
Sincrocell 12	1.5	2.14	2.53	0
	mean	2.38	2.497	-
	d.f.	10	10	-
	SED	0.571	0.486	-
	LSD	1.272	1.080	-

***Erica carnea* 'Myretoun Ruby'**

Autumn 1998

Osmocote at 1.0 and 1.5 kg/m^3 and Vitacote produced similar size plants by autumn (Figure 3). There was an indication that 2.0 kg/m^3 Osmocote was reducing plant growth. Ficote and Sincrocell produced the smallest plants; plants grown with Sincrocell were smaller than those grown using the two lower rates of Osmocote and Vitacote, whereas Ficote produced significantly smaller plants than all other treatments except Sincrocell.

No significant differences were observed in any aspect of flowering during the winter (Table 6).

Spring 1999

Plants responded to treatments in a similar pattern to the autumn record (Figure 3). The differences between the treatments were slightly smaller, and only Vitacote produced plants significantly larger than both Sincrocell and Ficote. All the Osmocote plants were significantly larger than those produced with Ficote.

The dry weights of plants grown in Vitacote and all rates of Osmocote were very close; between 3.65 – 3.67 g / 6 plants, significantly higher than Ficote (Table 6).

Overall

Vitacote at 1.5 kg/m^3 produced the best plant size and the most new growth. There was little benefit of increasing Osmocote from 1.0 to 1.5 kg/m^3, and plant size reduced at 2.0 kg/m^3. As with King George, Ficote appeared to be releasing nutrients too slowly at 2.0 kg/m^3, as did Sincrocell, which did not sustain the same quality of growth as Osmocote at 1.5 or 1.0 kg/m^3.

Table 6. Erica carnea* 'Myretoun Ruby', *HRI-Efford 1998-99
Flower score and above ground dry weight at end of trial.

Fertiliser	*kg/m³*	Flower score Winter 1998 (0 = none, 5 = most)	Dry weight Spring 1999 (g / 3 plants)
Osmocote plus 12-14 Autumn	1.0	2.67	3.65
	1.5	2.86	3.65
	2.0	2.28	3.66
Ficote 270 TE	2.0	1.94	2.50
Vitacote	1.5	2.44	3.67
Sincrocell 12	1.5	2.08	3.03
	mean	2.38	3.36
	d.f.	10	10
	SED	0.563	0.444
	LSD	1.254	0.990

C*alluna vulgaris* 'Peter Sparkes'

Autumn 1998

Osmocote at all three rates and Vitacote produced almost identical sized plants by autumn. Ficote and Sincrocell plants were markedly smaller, significantly so compared to the other four treatments (Figure 4).

Flowering followed a similar pattern to plant size in autumn, with a reduction in flowering with both Ficote and Sincrocell compared to the rest of the treatments, which flowered profusely (Table 7).

Spring 1999

Plants responded to treatments in an identical pattern to the autumn record (Figure 4).

Ficote produced the least biomass of all the treatments, significantly less than Osmocote at 1.0 and 1.5 kg/m^3 and Vitacote (Table 7). There was an indication, as with Myretoun Ruby, that 2.0 kg/m^3 compared to 1.5 $kg/m^3$of Osmocote was leading to a reduction in growth.

Overall

Osmocote at the lower rates produced the largest plants but 2.0 kg/m^3 led to reduced growth. Vitacote at 1.5 kg/m^3 produced plants of a similar quality to Osmocote at the same rate. Ficote and Sincrocell, at 2.0 and 1.5 kg/m^3 respectively, again produced smaller plants.

Table 7. Calluna vulgaris* 'Peter Sparkes', *HRI-Efford 1998-99
Flower score and above ground dry weight at end of trial.

Fertiliser	*kg/m³*	Flower score Autumn 1998 (0 = none, 5 = most)	Dry weight Spring 1999 (g / 3 plants)
Osmocote plus 12-14 Autumn	1.0	4.61	5.13
	1.5	4.67	5.51
	2.0	4.28	4.34
Ficote 270 TE	2.0	3.00	4.20
Vitacote	1.5	4.50	5.14
Sincrocell 12	1.5	2.39	3.45
	mean	3.91	4.63
	d.f.	10	10
	SED	0.314	0.519
	LSD	0.699	1.160

***Erica vagans* 'Mrs D F Maxwell'**

Autumn 1998

The largest plants were produced with Osmocote and Vitacote at 1.5 kg/m^3. Osmocote at 1.0 and 2.0 kg/m^3 produced slightly smaller plants, although not significantly so, whereas markedly smaller plants were grown using Ficote and Sincrocell (Figure 5).

In contrast to the other cultivars, marked differences in flowering were observed between treatments; with the most abundant flowers appearing on those plants grown with Vitacote, significantly more than all other treatments except Osmocote at 1.5 kg/m^3 (Table 8). Osmocote at 2.0 kg/m^3 produced the fewest flowers out of the three rates, and Ficote and Sincrocell flowered the least.

Spring 1999

Plants responded to treatments in an identical pattern to the autumn record (Figure 5).

When the dry weights were calculated as an average of 6 plants, significant differences were present (Table 8). Osmocote at 1.5 kg/m^3 had supported the greatest biomass; Vitacote and Osmocote at 1.0 $kg.m^3$ and 2.0 supported similar growth; Ficote and Sincrocell the least.

Overall

With this vigorous variety, no damage was observed at rates up to 2.0 kg/m^3 of Osmocote. However, similar growth was obtained at 1.0 kg/m^3 and slightly better at 1.5 kg/m^3. Vitacote at 1.5 kg/m^3 produced plants of a similar quality to Osmocote at the same rate. As with the other cultivars, Ficote produced the smallest plants. Sincrocell at 1.5 kg/m^3 also appeared less able to sustain vigorous growth compared to Osmocote and Vitacote at the same rate.

Table 8. Erica vagans* 'Mrs D F Maxwell', *HRI-Efford 1998-99
Flower score and above ground dry weight at end of trial.

Fertiliser	*kg/m³*	Flower score Autumn 1998 (0 = none, 5 = most)	Dry weight Spring 1999 (g / 3 plants)
Osmocote plus 12-14 Autumn	1.0	2.53	3.29
	1.5	3.39	4.21
	2.0	1.75	2.90
Ficote 270 TE	2.0	1.00	2.46
Vitacote	1.5	4.03	3.58
Sincrocell 12	1.5	0.94	2.32
	mean	2.27	3.13
	d.f.	10	9
	SED	0.363	0.342
	LSD	0.809	0.760

Discussion

For the benefit of the discussion, the overall results are summarised in Table 9:

Table 9. Overall quality summary (size x flower score) for CRF treatments

(□□□ = best quality, OOO = worst quality)

	Osmocote Plus 12-14 (Autumn)			Ficote 270 TE	Vitacote	Sincrocell 12
Rate (kg/m^3)	**1.0**	**1.5**	**2.0**	**2.0**	**1.5**	**1.5**
Erica carnea 'King George'	□	O	OO	OOO	□□□	□□
Erica carnea 'Myretoun Ruby'	□□	□□□	□□	OO	□□□	O
Calluna vulgaris 'Peter Sparkes'	□□□	□□□	□□	□	□□□	O
Erica vagans 'Mrs D F Maxwell'	□□	□□□	□□	O	□□□	□

These experiments were undertaken for one year only. Consequently, any findings are for the conditions *under which the experiment was carried out*. To a certain extent, extrapolation to other years is possible, but must be made with a full understanding of the limitations of this work. Additionally, account must be made of irrigation system, incorporation of soluble base fertiliser and geographical location if they differ from those in this study.

The products studied were all controlled release fertilisers. The 'control' of nutrient release is moderated by temperature. At a higher temperature, nutrients diffuse faster from the granule, resulting in a shorter 'life time' for the granule. The opposite is true at lower temperatures. Following prolonged rain, or heavy irrigation (especially overhead), a proportion of the nutrients, that have been already released from the granules, can be leached from the pots. Consequently, nutrient availability to the plant is affected by the interaction of two factors: temperature and moisture (irrigation / rain). When the conditions are warm with heavy rainfall/irrigation the life span of CRFs will be reduced compared to cold and dry conditions. As the growing year 1998-99 was not unusually hot and wet, lower rates of CRF would have been able to sustain quality plant growth than would be necessary in a year that was unusually hot and wet. This must be borne in mind when viewing the findings presented here.

Only Osmocote Plus 12-14 (Autumn) was studied at differing rates. The manufacturer's literature classifies heathers as very sensitive HNS species and recommends a rate of 2.0-2.5 kg/m^3 Osmocote Plus 12-14 (Autumn). The results of the plant growth at 1.0-2.0 kg/m^3 reflected the degree of cultivar salt sensitivity, with 1.0 kg/m^3 sufficient for *Erica carnea* 'King George', but 1.5 kg/m^3 giving the better growth with the more vigorous varieties. The addition of the highest rate (2.0 kg/m^3) did not lead to any further improvement in plant growth or quality.

The results from Sincrocell 12 suggested that release of nutrients was inadequate at 1.5 kg/m^3 in this year. With the salt sensitive 'King George', no plant deaths were observed and quality plants were produced. However, with the more vigorous cultivars plant size was reduced, compared to the same rates of Osmocote Plus 12-14 (Autumn) and Vitacote.

The Ficote 270 TE product was chosen to study plant responses to a longer longevity product at a higher rate, a 'safety' approach taken by some growers with the more salt sensitive cultivars. In this experiment Ficote 270 TE appeared to be releasing the least nutrients, as judged from the size of the plants, with the more vigorous cultivars. This suggests that the plant deaths observed with 'King George' were due to nutrient shortage rather than excess as suggested by the Osmocote Plus 12-14 (Autumn) results.

The outstanding result of this trial was that Vitacote at one rate (1.5 kg/m^3) produced the best, or equal best, plants with all the cultivars studied. This was especially evident with the salt sensitive *Erica carnea* 'King George'; where a third of plants died with Osmocote Plus 12-14 (Autumn) at 1.5 kg/m^3, but no plant deaths occurred at the same rate of Vitacote. This result was not due to a lower rate of nutrient release from Vitacote, as the core granule is an 8-10 month product, which should release faster than Osmocote Plus 12-14 (Autumn), but more importantly, with the more vigorous cultivars Vitacote was as good as, or better than, Osmocote Plus 12-14 (Autumn) at rates of 1.5-2.0 kg/m^3.

There are a number of possible explanations for the improved plant quality with Vitacote:

- It has a coating of iron pigment around the granule
- It has a shorter longevity core granule
- It has a slightly higher N analysis

The results reported here suggest that it is unlikely, though not impossible, that the improved plant growth observed with Vitacote was due to longevity or analysis alone, as 'King George' plants were killed by Osmocote Plus 12-14 (Autumn), even at the lower rates.

The possible role of the iron (Fe) pigment is an intriguing one. Physiological iron deficiency has been observed with ericaceous plants in a number of situations: when there is too much lime in the substrate; when the concentration of HCO^- in the irrigation water is too high i.e. hard water areas; when the levels of certain elements (e.g. copper, manganese, zinc, calcium etc.) are too high; and in a low K : high P environment.

Lime induced chlorosis / iron deficiency is a major problem in world agriculture and as such a wealth of data is available on the role of iron in plant growth and development. Most of this work concentrates on the mechanisms of calcifugy and nutrient accumulation rather than the means to ameliorate symptoms. However, it has been known for some time that the addition of iron salts to the leaves of plants (Gris, 1844), and the soil application of chelated iron (Bould, 1955) can overcome lime induced chlorosis. The mechanisms underlying lime chlorosis were studied in *Erica*, at the University of Sussex (Tobbut and Flowers, 1997), and it was demonstrated that the application to the leaves of excess artificial chelates (eg EDTA, EGGHA) led to partial relief of lime chlorosis and could be accounted for by a small proportion entering the leaf cells intact. However, root addition was not studied.

Although experimental plants were grown in a reduced lime mix, they were irrigated with mains water of pH 7.8-8.2, and for some of the trial the plants may have experienced concentrations of HCO^- sufficient to limit Fe uptake, thus mild lime chlorosis may have been affecting the plants during the trial. This suggests an additional possible benefit; if the addition of Fe was shown to be of advantage, especially with higher pH water sources, then it would provide a low cost, safe alternative to acid dosing irrigation systems. However, further work will be necessary to investigate this response and establish the cause of the improved growth seen with Vitacote.

Conclusions

From one years experimental work:

- Vitacote performed best or equal best with all cultivars, including the salt-sensitive 'King George' at one rate (1.5 kg/m^3).

- Osmocote plus 12-14 (Autumn) produced quality plants at 1.0 kg/m^3 for all cultivars, but 1.5 and 2.0 kg/m^3 reduced growth and quality in the least vigorous cultivar 'King George' and led to plant losses.

- Ficote 270 TE and Sincrocell 12 appeared to be releasing inadequate nutrients at their respective rates, compared to the other products.

- There are a number of potential explanations for the performance of Vitacote: This may be related to the slightly shorter longevity of the core granule, the iron pigment incorporated on the outside of the coating or the higher N analysis. Further work is needed to establish the basis for the improved growth with Vitacote, and any findings may have applications to the production of other ericaceous species.

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