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FINAL CONTRACT REPORT

An investigation of the use of controlled release fertilizers for spring potting of container nursery stock grown outdoors 1994 - 1996

HDC HNS 43a

This Report has been prepared for the HDC, Levington Horticulture Ltd, and Scotts UK Ltd.

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An investigation of the use of controlled release fertilizers for spring potting of container nursery stock grown outdoors 1994-1996

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RELEVANCE TO GROWERS AND PRACTICAL APPLICATION

Application

The work investigated the use of 8-24 month release formulations of Ficote TE and Osmocote Plus controlled release fertilizers for spring potted hardy nursery stock grown outdoors, on both a Southern (HRI Efford) and Northern (Johnsons of Whixley) site. In addition, the widely recommended use of a 'fast-start' material in the base dressing with the CRF was investigated. Species included the moderate to vigorous *Prunus laurocerasus* 'Rotundifolia', *Weigela* 'Red Prince' and *Chamaecyparis pisifera* 'Boulevard'. Results provided guidelines on longevity of the various controlled release fertilizer formulations, rate of use and potential of the longer-term formulations for maintaining quality over extended periods.

Summary

Nutrition of container nursery stock in the UK continues to rely, in the main, on use of resin-coated controlled release fertilizers (CRF). The shorter-term CRFs, widely used in the 1970s, have generally been superseded by products with 12-18 month release patterns capable, in most cases, of providing sufficient nutrients to maintain quality overwinter and on into a spring sales period from a single application in the base dressing at potting. Both Ficote and Osmocote have given good results provided the correct formulation and rate was matched with species and production method. MAFF-funded screening trials between 1976-87 provided valuable information and guidelines on the use of these fertilizers, many of which were introduced as a result of increased specialism within the industry. Since then a new range of products has been introduced by both Levington Horticulture (Ficote) and Scotts UK (Osmocote), including those with trace elements incorporated and three formulations with extended release capability. This choice of products provides the opportunity of tailoring mixes to species and market requirements, and in the case of long-term materials, enables quality to be maintained, either within the container over an extended period, or during shelf-life and possibly subsequent establishment.

The previous HDC trial HNS 43 made a start in investigating the use of a range of CRF formulations for high value moderate and salt-sensitive indicator species under protection. This work demonstrated the potential of the longer-term products to maintain growth and quality over extended periods. This trial, HNS 43a, investigated the use of 8-24 month release formulations of Ficote TE and Osmocote Plus CRFs for spring potted hardy nursery stock grown outdoors. Plants were grown over the two year period in the same container to enable the point at which nutrient availability became limiting to be identified in the different formulations. Part of the work was also repeated on a Northern nursery site (Johnsons of Whixley) in order to monitor the influence of varying climatic conditions on CRF performance. In addition the widely recommended use of a 'fast-start' material in the base dressing with the CRF was investigated.

Three species were included in the Efford trial, *Prunus laurocerasus* 'Rotundifolia', *Weigela* 'Red Prince' and *Chamaecyparis pisifera* 'Boulevard', with *Prunus* and *Weigela* also used for the Northern trial. Only the *Prunus* at Efford included the eight CRFs at three rates with and without the soluble 'fast-start' fertilizer (KPA). The other species included the recommended rate of CRF, without KPA at Efford, ±KPA for the Northern nursery. Plants were bought in as liners or plugs and potted into 3 litre containers in May-early June 1994. These were grown on outdoor sand beds with overhead irrigation at both sites. The fertilizer treatment details are given in the table on page 5.

The moderate to vigorous species would not normally have been held for two seasons in the same container. However, they were selected as nutrient indicator species representing the deciduous, evergreen and conifer groups, and as such have provided valuable information on the potential longevity of the different CRF formulations.

Growth of *Weigela* was better in the North than in the South. In contrast growth of *Prunus* was advanced in the South compared to the North until the final assessment in the spring 1996, two years after potting. The most striking difference at this time was the increased intensity of foliage colour, especially in the longer-term CRFs on the Northern site. A likely explanation here was that higher reserves of nutrients remained available in the North due to a slower rate of release with the slightly lower average temperatures recorded in that area.

Overall, both Ficote TE and Osmocote Plus formulations produced similar results at recommended rates.

Rate of CRF was only compared in the Efford trial for *Prunus*. Here, a greater response to rate of fertilizer was seen with Ficote TE formulations than with Osmocote Plus, though at recommended rates (medium) results were similar between the two products. This could be due in part to the differences in the rate of release of nutrients from the two types of fertilizer. Based on the analyses done in a complementary trial, HNS 43b, this appeared to be related to a more controlled rate of release of nutrients from Ficote TE, the lowest rate being sub-optimal. A rapid rate of release of nutrients recorded in the first year with Osmocote Plus could have masked effects of rate of application in the early stages.

The shorter-term fertilizers, Ficote 140 TE and Osmocote Plus 8-9 months, maintained good growth over the first growing season, and in this particular year (1994/5) continued to maintain quality over the winter period. In some seasons, however, particularly if there had been periods of heavy rain and leaching, these products have been shown to run out of reserves by the autumn of the first year, especially in the South. It must also be remembered that this trial was relatively late in potting (June 1994) which would have extended the longevity of the shorter-term materials.

The medium-term release fertilizers of Osmocote Plus 12-14 months Spring and 'Midlands' Blend and Ficote 180 TE maintained growth and quality over the winter and into the spring of the second season. Results between the standard and 'Midlands' Blend 12-14 months Osmocote produced similar results in this trial. Where plants needed to be held overwinter for spring sales, Ficote 180 TE appeared to be more suitable than Ficote 140 TE for the South of England. In the North, however, where the growing season is somewhat shorter and cooler and winters colder, similar results were achieved with Ficote 140 TE, which with its lower recommended rate would have been a more cost-effective option than Ficote 180 TE.

Results with the extended release 16-24 month CRFs varied with time. Over the first season growth was significantly slower in Ficote 270 TE and Osmocote Plus 16-18 months, and even more so in Ficote 360 TE, despite rates of fertilizers for these products being increased by up to twofold, compared with the shorter-term materials. By the spring of the second year, whilst still behind, growth in Ficote 270 TE and Osmocote Plus 16-18 months was beginning to catch up, though in Ficote 360 TE was still significantly slower. However, as nutrient levels in the medium-term CRFs ran out, growth in the extended release materials gradually took over and these treatments finished with the best growth and quality, especially foliage colour in *Prunus* and *C.p.* 'Boulevard', and flowering intensity in *Weigela*, where the improvements were striking.

While the potential of the extended release CRFs to maintain growth and quality over two growing seasons was clearly demonstrated, their performance in first year was disappointing, the result no doubt of slower release of nutrients under outdoor conditions, a problem not seen under protection, where the slow release was an advantage for safer use with salt-sensitive species. In order to improve nutrient availability in the first season some blending of a shorter-term CRF with an extended release product could be necessary. Blend and proportions of each fertilizer would need further work.

Other areas where use of extended release fertilizers could be an advantage include improvement in shelf-life potential in the sales area after despatch. All too often rapid deterioration of plants occurs in the garden centres. While part of this could be due to the change in eco-climate from the production nursery to the harsher sales environment, including less frequent watering, nutrient reserves could also be limiting reducing shelf-life potential. Similarly, establishment and early growth after planting can be severely checked by a hard, starved plant. Again, including a proportion of extended release fertilizer at the production stage would ensure some fertilizer reserves were taken over into the planting phase. A further option for extended release formulations could be in association with liquid feeding programmes. Liquid feeding would provide greater precision in application of nutrients, particularly for specialist crops under protection and also outdoors, but has the disadvantage of requiring plants to be top dressed overwinter in order for quality to be maintained. Sub-optimal rates of extended release CRFs would enable liquid feed programmes to be used safely, while providing the nutrients to maintain this quality over the winter period.

Differences in response to the different CRF formulations was less marked in the North compared to the South by the end of the trial, apart from the shorter-term materials which had clearly run out at this stage. Again, this could be accounted for by the somewhat slower rate of release of nutrients in the North due to the lower average temperatures, which would have extended the longevity of the medium-term materials.

Results from the use of the soluble 'fast-start' fertilizer in the base dressing with the CRF at potting were variable. In the South the only advantage seen was where rates of CRF were sub-optimal or releasing too slowly. In the Northern site only a single rate of CRF was used, with rate dependent on whether or not a soluble 'fast-start' fertilizer was used, the recommendation being for a lower rate of CRF incorporation where a soluble base dressing was added. Results over the first season were similar from both lower rate CRF +KPA addition, and the increased rate of CRF -KPA. It had been anticipated that the treatment with the higher rate of CRF (-KPA) would have an advantage in maintaining quality and growth over a longer period than the lower CRF application +KPA. In the event, however, results between the two treatments were not significantly different by the end of the trial. A similar pattern could be seen in the Efford results with *Prunus*, comparing the medium rate of CRF +KPA with the high rate of CRF -KPA. Thus a lower rate of CRF plus 'fast-start' fertilizer appeared to have sufficient reserves at the levels incorporated to maintain growth and quality within its respective longevity, supporting the current recommendation for using a lower rate of CRF in association with a 'fast-start' product, a cost-effective option to increasing the rate of CRF. However, whether this would hold true for a crop potted earlier in the season needs confirmation.

In summary, the extended release CRFs have clearly demonstrated their potential to maintain quality and growth from a single application in the base dressing at potting over an eighteen month to two year period depending on formulation, though their slower rate of release in the first season reduced growth and needs to be addressed. Overall, the current recommended rate of the shorter-medium term formulations of CRFs gave good results. The need for a 'kick-start' fertilizer with CRF appears unnecessary at equivalent rates of fertilizer, though results did suggest that the lower rate of CRF plus 'kick-start' could give similar results to a higher rate of CRF alone. Differences between fertilizer formulations were less in the North, no doubt due to the lower temperatures compared to the South, reducing the need for the longer-term fertilizers required for similar crops in the South.

The trial was jointly funded by HDC, Levington Horticulture Ltd and Scotts UK Ltd, and was done in collaboration with Johnsons of Whixley Ltd, Whixley, York as the Northern Site.

Fertilizer Treatments

Prunus laurocerasus 'Rotundifolia'

CRF	Rate (kg/m³) Efford (±KPA at 0.75 kg/m³) 'Low' Rate	'Medium' Rate	'High' Rate	Johnsons of Whixley +KPA	-KPA
Ficote 140 TE	3.0	4.5	6.0	4.5	6.0
Ficote 180 TE	4.5	6.0	7.5	6.0	7.5
Ficote 270 TE	6.0	8.0	10.0	8.0	10.0
Ficote 360 TE	7.0	9.0	12.0	9.0	12.0
Osmocote Plus 8-9 months	4.0	5.0	6.0	5.0	6.0
Osmocote Plus 12-14 months Spring	5.0	6.0	8.0	6.0	8.0
Osmocote Plus 16-18 months	8.0	9..0	12.0	9.0	12.0
Sierra 'Midlands' Blend 12-14 months	5.0	6.0	8.0	6.0	8.0

CRF	Rate (kg/m³) Efford -KPA	*Weigela* Johnsons +KPA	-KPA	*C.p.* 'Boulevard' Efford -KPA
Ficote 140 TE	6.0	4.5	6.0	4.5
Ficote 180 TE	7.5	6.0	7.5	6.0
Ficote 270 TE	10.0	8.0	10.0	8.0
Ficote 360 TE	12.0	9.0	12.0	9.0
Osmocote Plus 8-9 months	6.0	5.0	6.0	5.0
Osmocote Plus 12-14 months Spring	8.0	6.0	8.0	6.0
Osmocote Plus 16-18 months	12.0	9.0	12.0	9.0
Sierra 'Midlands' Blend 12-14 months	8.0	6.0	8.0	6.0

Action Points

- The range of CRF formulations now available provide the opportunity to tailor mixes more closely to production requirements than in the past. Choice will be dictated by species, markets and system of production, including method of irrigation and use of protection.

- Both the Ficote TE and Osmocote Plus range of CRFs gave good results at recommended rates in this work, with rate of fertilizer required increasing with longevity. Formulation needs to be selected on the basis of their length of release relative to cropping cycles where relying on a single application of CRF in the base dressing.

  * Ficote 140 TE and Osmocote Plus 8-9 months: single season crops

  * Ficote 180 TE and Osmocote Plus 12-14 months: crops held over for spring sales the following year

  * Ficote 270 TE and Osmocote Plus 16-18 months: extended cropping into the second season and beyond

  * Ficote 360 TE: two year crops held in the same container

- Results indicated that nutrient reserves lasted longer in the North, with a shorter term fertilizer capable of producing similar results to a longer term formulation used in the South of England, eg where Ficote 180 TE proved suitable for crops held over for spring sales in the South, similar results were achieved in the North with Ficote 140 TE.

- The extended release products clearly demonstrated their potential for maintaining growth and quality over two seasons, though release of nutrients in the first season appeared to be too slow for the moderate-vigorous species used in this trial. More work is required on response of slower growing species and the possibility of blending formulations to achieve optimal growth early on plus shelf-life.

- The extended release fertilizers can provide reserves of nutrients for taking on into shelf-life in sale areas and/or continued presence of nutrients post planting.

- The use of a 'kick-start' soluble fertilizer with the CRFs did not prove to be necessary in the South where the CRF was used at equivalent rates. However, results did support the current recommendation for using a lower rate of CRF in association with a 'fast-start' product for the late May-early June potted crops in this trial.

INTRODUCTION

Since MAFF-funded work on controlled release fertilizer (CRF) screening ceased in 1987, a new range of products has been introduced by both Levington Horticulture (Ficote) and Scotts (Osmocote), including three with extended release capability. This choice of products provides the opportunity of tailoring mixes to species' and market requirements, and in the case of the long term materials, enables quality to be maintained, either within the container over an extended period, or during shelf-life and possibly subsequent establishment.

The previous HDC trial, HNS 43, made a start in investigating the use of a range of CRF formulations for high value moderate and salt-sensitive indicator species under protection. This work demonstrated the potential of the longer term products to maintain growth and quality over extended periods.

This Project investigated the use of these CRFs outdoors, concentrating on a spring potted crop, and included 8-9 months through to two year extended release formulations. A representative species of the deciduous, conifer and evergreen species was included and information gained included type of formulation and rate of use required for targeting subsequent autumn or following spring sales, as well as shelf-life potential.

As climatic variations influence response of CRFs in different areas of the country, part of the work was repeated on a northern nursery site, with species and mixes common to both sites.

In addition, the possible benefit of the inclusion of a 'kick-start' fertilizer was investigated. The inclusion of a soluble base fertilizer along with the CRF is widely recommended, but benefits might well be related to type and rate of CRF used, geographical location and the species grown.

The trial was jointly funded by HDC, Levington Horticulture Ltd and Scotts UK Ltd, and was done in collaboration with Johnsons of Whixley Ltd, Whixley, York, as the northern site.

This report covers the final period of the trial from November 1995 to April 1996, when shelf-life potential of the extended release materials was monitored.

The 'Grower Relevance' section, however, summarises and discusses results of the whole trial from May 1994-April 1996.

MATERIALS AND METHODS

A. HRI EFFORD

Production System

Plants were grown outdoors on drained sand beds with overhead irrigation.

Controlled Release Fertilizers and Species

Prunus laurocerasus **'Rotundifolia'**

Treatment		Rate (kg/m³)					
		Main Plot Plants *Prunus*			Guard plants *Lavandula rosea*		
Code	CRF	Low	Medium	High	Low	Medium	High
A	Ficote 140 TE	3.0	4.5	6.0	2.0	3.0	4.5
B	Ficote 180 TE	4.5	6.0	7.5	3.0	4.5	6.0
C	Ficote 270 TE	6.0	8.0	10.0	5.0	6.0	8.0
D	Ficote 360 TE	7.0	9.0	12.0	6.0	7.0	9.0
E	Osmocote Plus 8-9 months	4.0	5.0	6.0	2.0	3.5	5.0
F	Osmocote Plus 12-14 months Spring	5.0	6.0	8.0	3.0	4.5	6.0
G	Osmocote Plus 16-18 months	8.0	9.0	12.0	4.0	6.5	9.0
H	Sierra 'Midlands' Blend	5.0	6.0	8.0	3.0	4.5	6.0

Base Supplement: Nil
Kristalon KPA 12+14+24+Micro (0.75 kg/m³)

Design

The trial was set out in a randomised block layout with three replicates, 8 CRFs, three CRF rates for each formulation and two KPA treatments, totalling 144 plots (Appendix I, pages 45 - 47). One plot consisted of six recorded *Prunus* guarded by six *Lavandula* plants.

Weigela 'Red Prince' and *Chamaecyparis pisifera* 'Boulevard'

A reduced number of treatments was used for *Weigela* 'Red Prince' and *C.p.* 'Boulevard' *i.e.* 'standard' rate of CRF for each species with no KPA.

Treatment Code	CRF	Rate (kg/m³) Main Plot Plants *Weigela*	Main Plot Plants *C.p.* 'Boulevard'	Guard Plants *Cytisus*	Guard Plants *Azalea*
A	**Ficote 140 TE**	6.0	4.5	4.5	3.0
B	**Ficote 180 TE**	7.5	6.0	6.0	4.5
C	**Ficote 270 TE**	10.0	8.0	8.0	6.0
D	**Ficote 360 TE**	12.0	9.0	9.0	7.0
E	**Osmocote Plus 8-9 months**	6.0	5.0	5.0	3.0
F	**Osmocote Plus 12-14 months Spring**	8.0	6.0	6.0	4.0
G	**Osmocote Plus 16-18 months**	12.0	9.0	9.0	5.0
H	**Sierra 'Midlands' Blend**	8.0	6.0	6.0	4.0

Design

The *Weigela* and *C.p.* 'Boulevard' were each set out in randomised block layouts with three replicates and 8 CRF treatments, giving a total of 24 plots per species (Appendix I, pages 49-50). Each plot of *Weigela* consisted of six recorded plants guarded by six *Cytisus x praecox*. Plots of *C.p.* 'Boulevard' comprised six recorded plants guarded by six *Azalea* 'Blue Danube'.

B. NORTHERN SITE (JOHNSONS OF WHIXLEY)

Production System

Plants were grown outdoors on sand beds with overhead irrigation.

Controlled Release Fertilizers and Species

A single 'standard' rate of each CRF was used in the Northern trial, with and without the addition of the 'kick-start' fertilizer KPA. Rate of CRF varied according to whether KPA was used, the recommendation being a reduction in rate of CRF if the fast start material was incorporated.

***Prunus laurocerasus* 'Rotundifolia' and *Weigela* 'Red Prince'**

Treatment Code	CRF	Rate (kg/m³) +KPA (0.75 kg/m³)	Rate (kg/m³) -KPA
A	Ficote 140 TE	4.5	6.0
B	Ficote 180 TE	6.0	7.5
C	Ficote 270 TE	8.0	10.0
D	Ficote 360 TE	9.0	12.0
E	Osmocote Plus 8-9 months	5.0	6.0
F	Osmocote Plus 12-14 months Spring	6.0	8.0
G	Osmocote Plus 16-18 months	9.0	12.0
H	Sierra 'Midlands' Blend	6.0	8.0

Design

The two species were set out in separate randomised block layouts with three replicates, eight CRF treatments and two KPA treatments, giving a total of 48 plots per species (Appendix I, page 48). A plot consisted of five recorded plants with two guards which were of the same species as the main plot.

Growing Medium

100% Medium Irish Peat
Appropriate magnesian limestone (see below)
Appropriate CRF (see treatments)
0.75 kg/m³ KPA (according to treatment)
100 ml in 40 litres water/m³ Cudgel

Magnesian limestone: *Prunus, Weigela, Lavandula* and *Cytisus*: 1.5 kg/m³
C.p. 'Boulevard' and *Azalea*: 1 kg/m³.

Growing medium for both sites was mixed at Efford.

Start Material

Plant material for both sites came from the same sources.

The *Prunus* was bought in as 60 mm plugs, *Lavandula*, *Weigela* and *C.p.* 'Boulevard' were bought in as 90 mm liners and *Cytisus* and *Azalea* were from 90 mm liners produced at Efford. All plant material was potted-on into three litre containers.

Start Dates

At Efford, plants were potted between 8 and 15 June 1994 and held under cold glass until laid out on the beds on 5 July 1994.

At Johnsons, plants were potted and laid out on the beds on 26 May 1994.

Records

1. Top growth assessment autumn 1994, conductivity and media fertilizer analyses: ***see first interim report.***

2. Overwintering record: Top growth assessment, percentage root cover and dead plants recorded June 1995, following the spring flush of growth: ***see second interim report.***

3. Top growth assessment summer/autumn 1995: ***see third interim report.***

4. Observation assessment of shelf-life of extended release materials: spring 1996: ***see final report.***

Individual visual plant assessment against selected indicator plants. Both Efford and the Northern trial were recorded against the same score plants to ensure direct comparison of the data could be made.

Prunus:	*Efford*	
	April 1996:	size score 1-5, 5 being the largest number of main branches length of new growth (cm) colour of old growth score 1-5, 5 being the darkest colour of new growth score 1-5, 5 being the darkest
	Northern Site	
	June 1996:	size score 1-5, 5 being the largest number of main branches length of new growth (cm) colour of old growth score 1-5, 5 being the darkest colour of new growth score 1-5, 5 being the darkest
Weigela:	*Efford*	
	June 1996:	new growth score 1-5, 5 being the most foliage colour score 1-5, 5 being the darkest amount of flower score 1-5, 5 being the most quality score 1-5, 5 being the best
	Northern Site	
	June 1996:	new growth score 1-5, 5 being the most foliage colour score 1-5, 5 being the darkest amount of flower score 1-5, 5 being the most quality score 1-5, 5 being the best
C.p. 'Boulevard':	*Efford*	
	April 1996:	size score 1-5, 5 being the largest colour score 1-5, 5 being the darkest

5. Residual analysis (granules): June 1996.

6. Photographs of the score plants and treatment comparisons as appropriate.
(See Appendix III p. 58-65)

Statistical Analysis

The trials were analysed using Standard Analysis of Variance (ANOVA). The degrees of freedom (d.f.), standard error (SED) and least significant difference to 5% (LSD), on which the significance tests were based, are presented in the tables to aid interpretation of the results.

RESULTS

Prunus laurocerasus 'Rotundifolia'

EFFORD

Results for the April assessment are shown in Figures 1-5 (p. 17-21) and Tables 5-6 in Appendix II, pages 51-52.

This spring record, two years from the start of the trial, was essentially to monitor the shelf-life potential of the longer term CRFs, though the shorter term treatments were also included to act as a reference point for estimating the degree of improvement obtained with the extended release formulations.

Plant Growth

The size scores used for this assessment are shown in Plate 1, Appendix III, page 58.

The inclusion of the KPA 'kick-start' fertilizer at the start of the trial appeared to have produced an improvement in final plant size after two years, but these differences did not prove to be significant when analysed. Results are therefore discussed as overall effects of the CRF formulations and rates.

In general, plant size was a reflection of that observed at the previous autumn assessment, with the longer term CRFs (Ficote 270 TE, Ficote 360 TE and Osmocote Plus 16-18 months) continuing to produce the larger plants, the shorter term materials having 'run out of steam' during 1995. These effects were particularly marked at the 'low' rate of CRF inclusion, though it must be remembered that higher levels of extended release CRFs were used, compared with the shorter term formulations, within each of the 'low', 'medium' and 'high' rates. Increasing the rate of the extended release CRFs had little apparent effect on improving overall size, though it did influence quality.

Actual growth in response to reserves remaining in the CRF granules would have been indicated in the length of new shoot growth produced in the spring 1996. A summary of this, averaged across KPA treatments, is shown in Table 1.

Table 1 **Average effects of CRF formulation and rate on length of new shoot growth (cm) at Efford by April 1996**

(figures are a mean across KPA treatments)

CRF	Rate kg/m^3			Length of new shoot growth (cm)		
	Low	Medium	High	Low	Medium	High
Ficote 140 TE	**3.0**	**4.5**	**6.0**	27.6	28.0	27.2
Ficote 180 TE	**4.5**	**6.0**	**7.5**	27.7	31.4	33.5
Ficote 270 TE	**6.0**	**8.0**	**10.0**	35.7	35.7	38.5
Ficote 360 TE	**7.0**	**9.0**	**12.0**	36.8	40.4	40.1
Osmocote Plus 8-9 months	**4.0**	**5.0**	**6.0**	27.7	28.9	28.2
Osmocote Plus 12-14 months Spring	**5.0**	**6.0**	**8.0**	28.5	32.2	33.3
Osmocote Plus 16-18 months	**8.0**	**9.0**	**12.0**	34.6	35.4	44.1
Sierra 'Midlands' Blend	**5.0**	**6.0**	**8.0**	29.5	35.2	34.2

The potential of the longer term formulations in maintaining growth two years after potting was clearly demonstrated.

The main branch framework of the plant was similar regardless of type or rate of CRF.

Foliage Colour

The major influence of CRF formulations/rates after two years was on foliage colour. Both the old and new foliage colour was assessed and these results are summarised in Table 2, again averaging across KPA treatments, since these had no significant influence on final plant colour. Colour scores used in assessment are shown in Plate 1, Appendix III, page 58.

Table 2 **Average effects of CRF formulation and rate on old and new foliage colour at Efford by April 1996**

(figures are a mean across KPA treatments)

CRF	Rate kg/m^3			Foliage Colour (Score of 1-5, 5 = darkest) Old Foliage			New Foliage		
	Low	Medium	High	Low	Medium	High	Low	Medium	High
Ficote 140 TE	**3.0**	**4.5**	**6.0**	2.2	2.8	3.2	3.2	3.7	3.5
Ficote 180 TE	**4.5**	**6.0**	**7.5**	2.7	3.4	2.9	3.1	4.2	3.6
Ficote 270 TE	**6.0**	**8.0**	**10.0**	3.6	3.6	4.0	3.8	3.8	4.2
Ficote 360 TE	**7.0**	**9.0**	**12.0**	4.1	4.1	4.0	4.0	4.0	4.3
Osmocote Plus 8-9 months	**4.0**	**5.0**	**6.0**	2.1	2.6	2.7	2.6	3.1	2.1
Osmocote Plus 12-14 months Spring	**5.0**	**6.0**	**8.0**	2.8	2.9	3.5	2.2	2.8	3.0
Osmocote Plus 16-18 months	**8.0**	**9.0**	**12.0**	3.4	3.7	4.0	3.2	2.8	3.5
Sierra 'Midlands' Blend	**5.0**	**6.0**	**8.0**	2.6	2.9	3.1	2.4	2.9	2.4

Foliage colour was significantly improved by the extended release CRFs, particularly in the older foliage. Ficote 360 TE proved most effective in maintaining good colour, even at the lower rates used (7 kg/m^3). With Ficote 270 TE higher rates were required to maintain as dark a green foliage as Ficote 360 TE after the full two year period (10 kg/m^3). Osmocote Plus 16-18 months produced similar results at the highest rate (12 kg/m^3).

As to be expected the 12/12-14 month CRFs had not been able to maintain quality over the two year period, and while growth and colour was improved at the higher rates, it was not as good as that in the longer term formulations by the end of the trial.

Figure 1

Fourth Growth Record of *Prunus* 'Rotundifolia' at Efford - April 1996

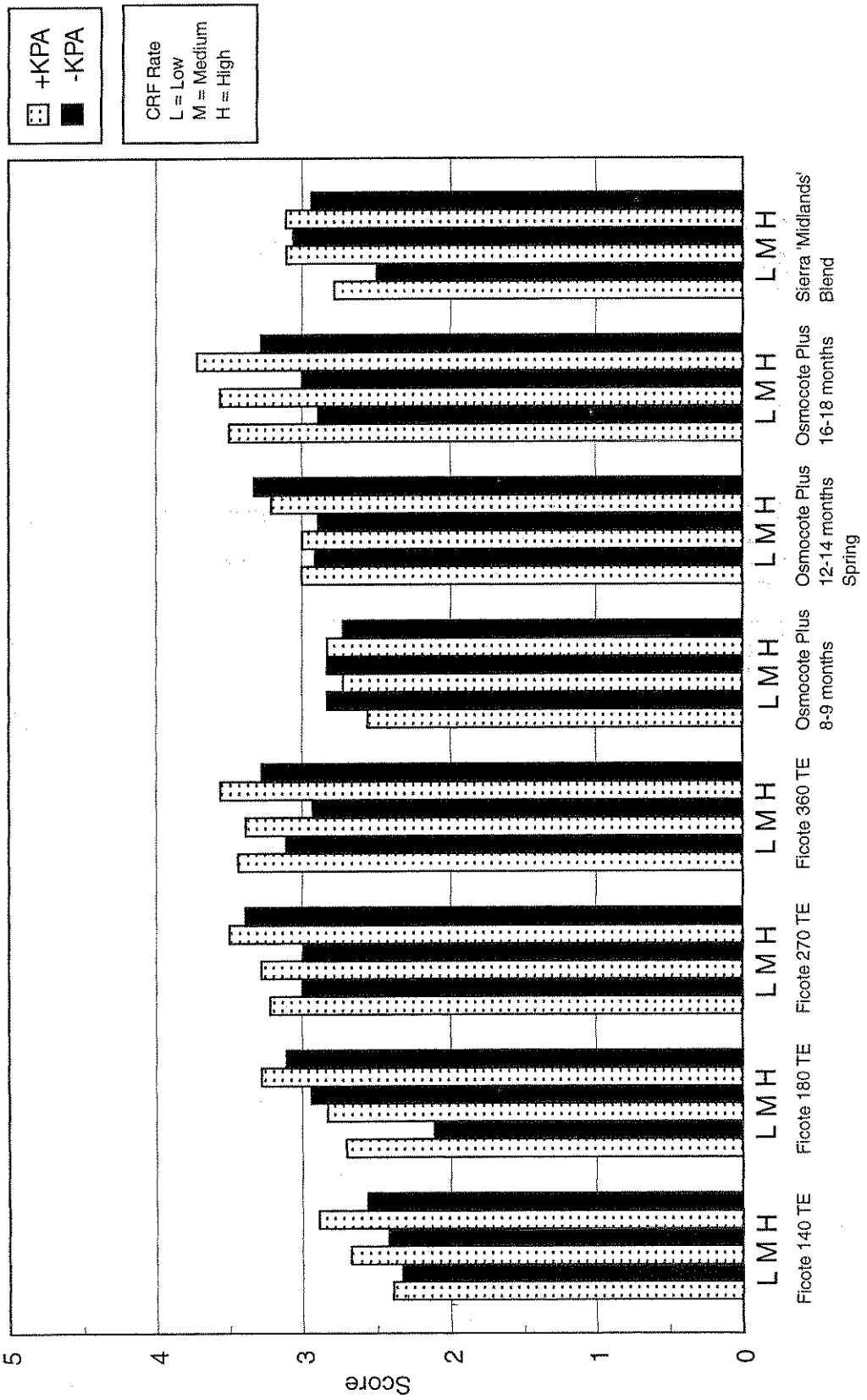


Figure 2

Fourth Growth Record of *Prunus* 'Rotundifolia' at Efford - April 1996

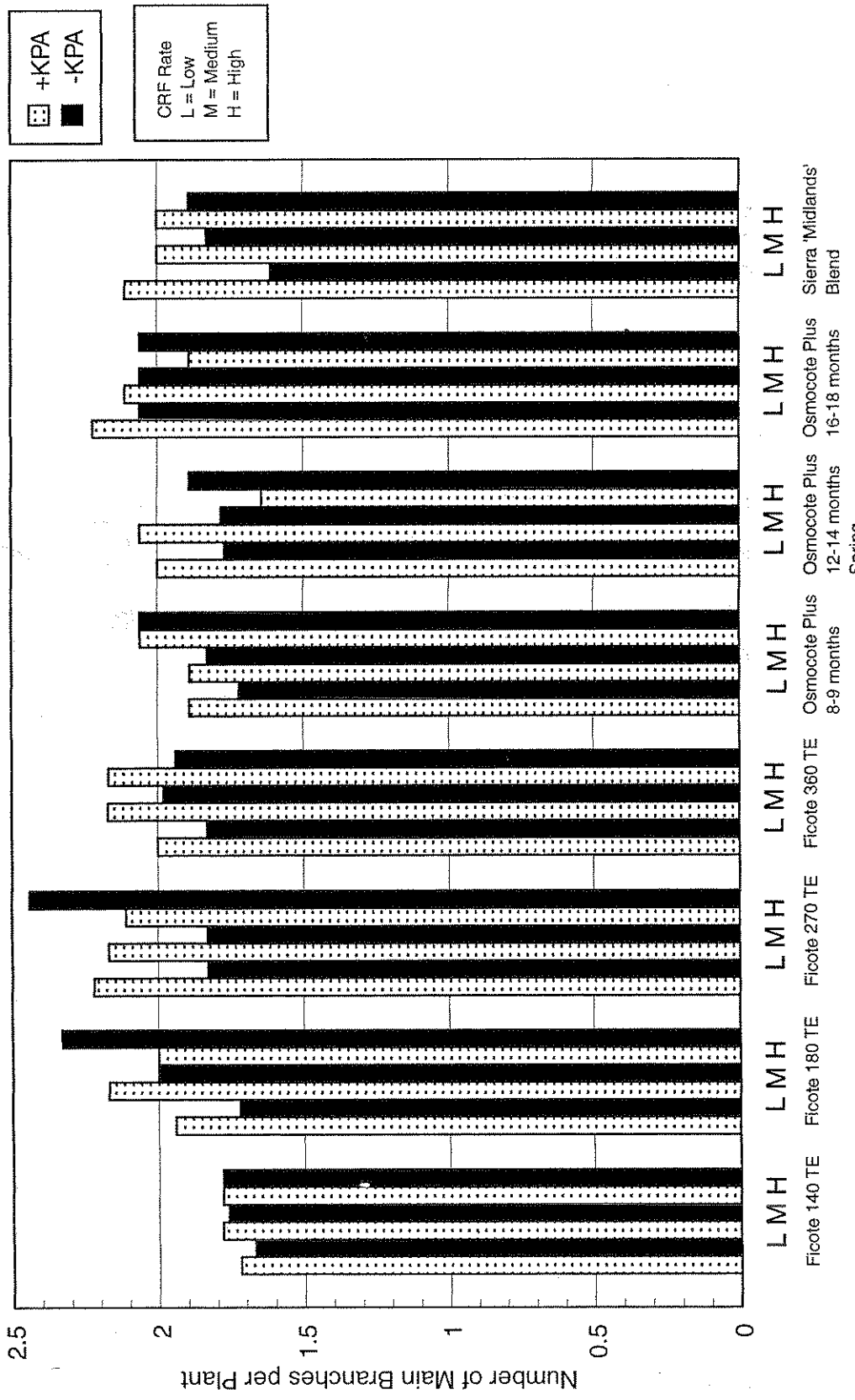


Figure 3

Fourth Growth Record of *Prunus* 'Rotundifolia' at Efford - April 1996

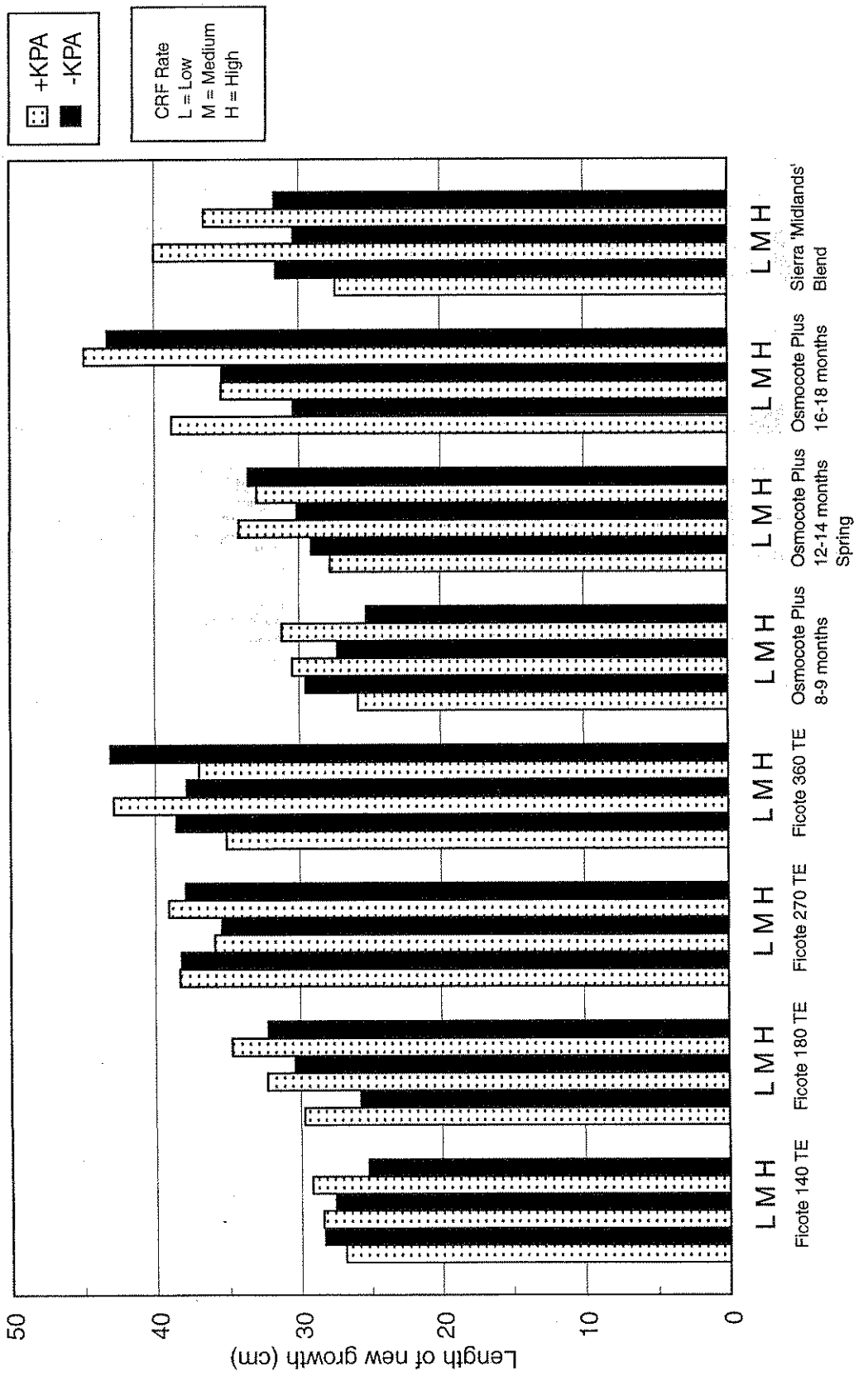


Figure 4

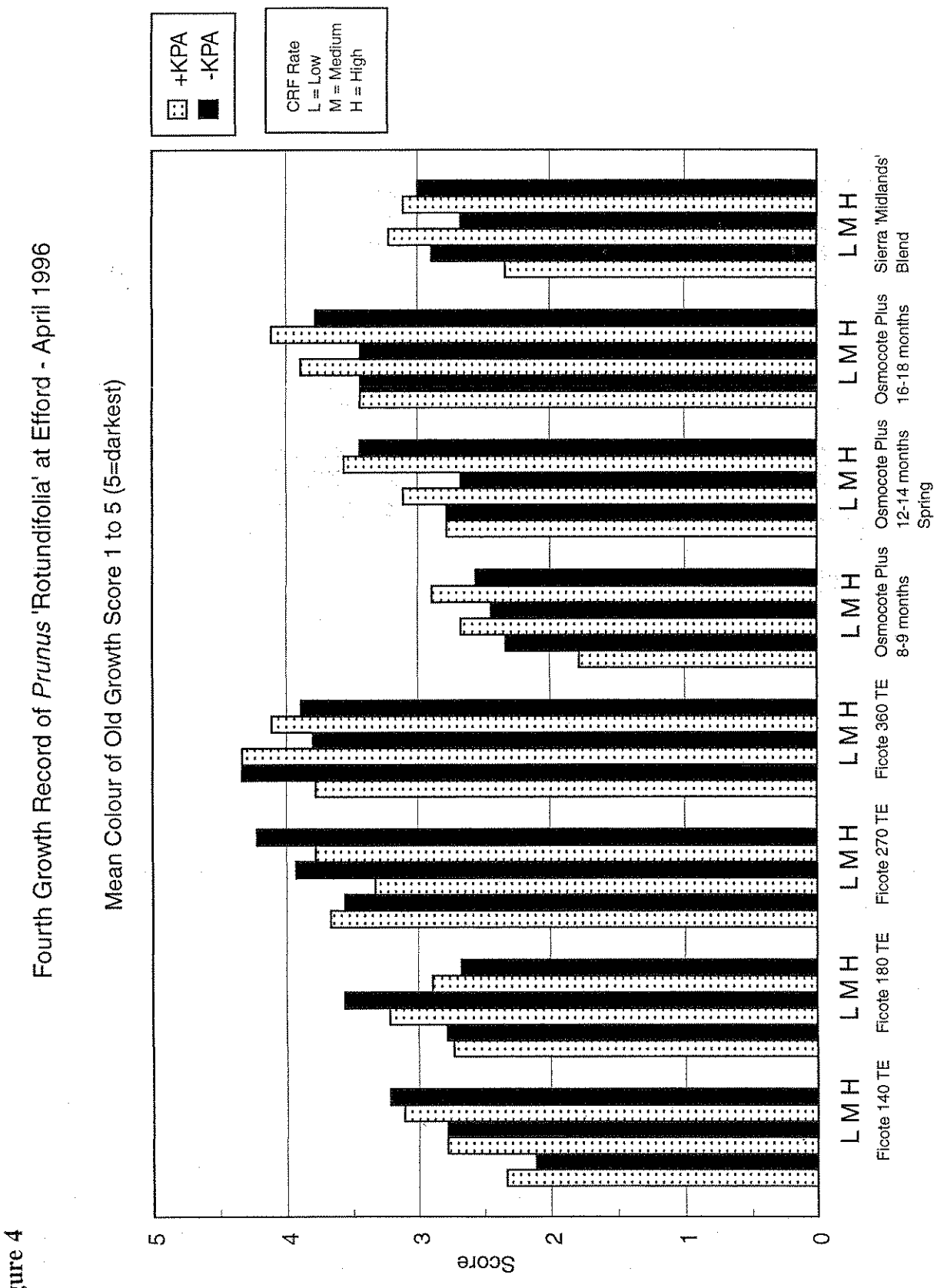
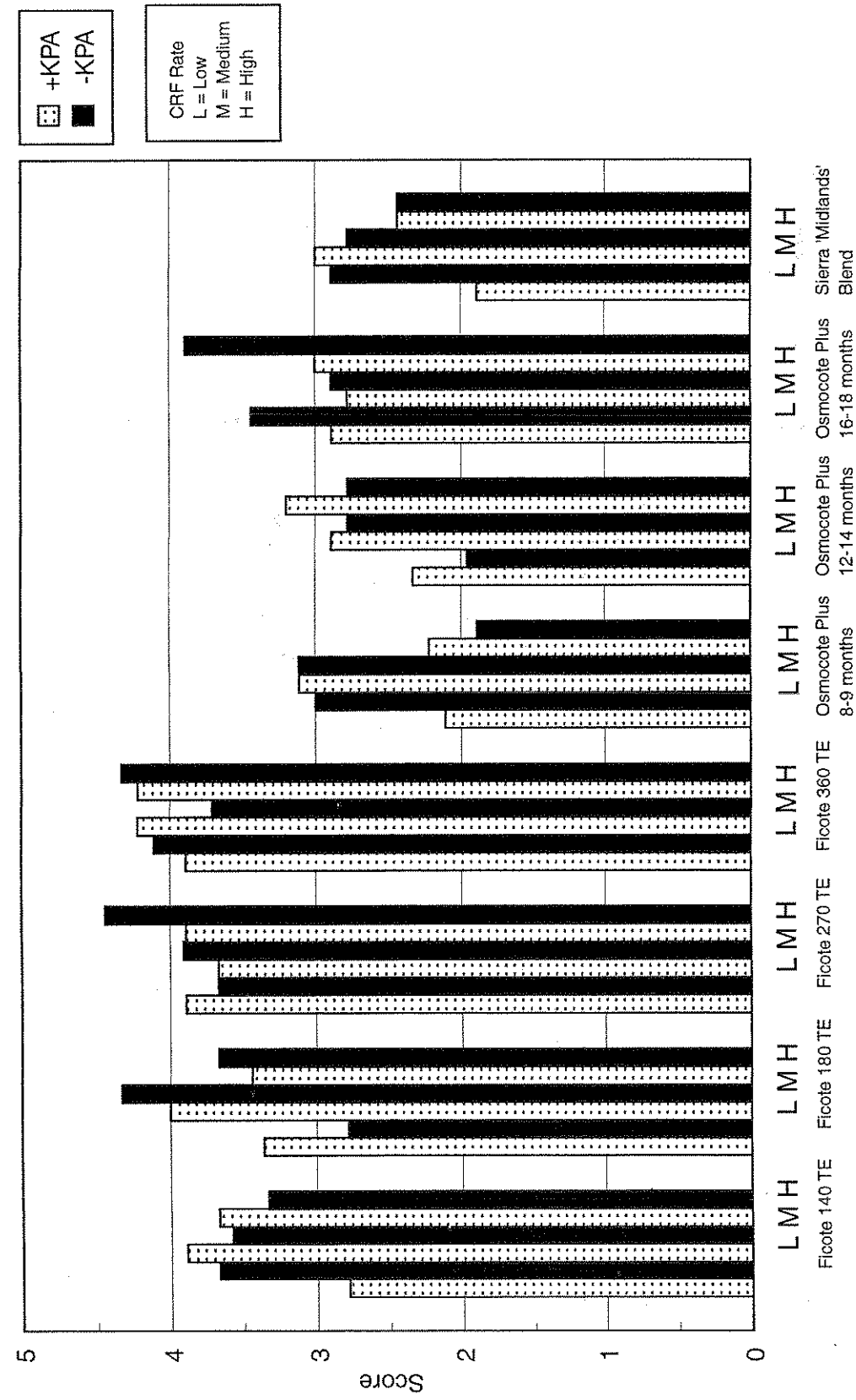

Fourth Growth Record of *Prunus* 'Rotundifolia' at Efford - April 1996
Mean Colour of Old Growth Score 1 to 5 (5=darkest)
+KPA
-KPA
CRF Rate
L = Low
M = Medium
H = High
Score
0
1
2
3
4
5
L M H
Ficote 140 TE
Ficote 180 TE
Ficote 270 TE
Ficote 360 TE
Osmocote Plus 8-9 months
Osmocote Plus 12-14 months Spring
Osmocote Plus 16-18 months
Sierra 'Midlands' Blend

Figure 5

Fourth Growth Record of *Prunus* 'Rotundifolia' at Efford - April 1996

Mean Colour of New Growth Score 1 to 5 (5=darkest)



NORTHERN SITE (Johnsons of Whixley)

These results are presented in Figures 6-8 (p24-26) and Tables 7-8 in Appendix II, pages 53-54. The same indicator 'score' points were used for this northern assessment as at Efford.

Since only one rate of CRF was used in the Northern trial, when checking with Southern results mixes with the addition of KPA need to be compared against the Efford ***medium*** rate +KPA column. Those without KPA had a higher rate of CRF and need comparing with the ***higher*** rate -KPA results at Efford.

Differences in response to the different CRF fertilizer formulations were less marked in the North compared with Southern England in respect to shelf-life, apart from the shortest term materials (Ficote 140 TE, Osmocote Plus 8-9 months), where less growth had occurred, which was hardly surprising after two years. A striking difference between the two sites was the improved foliage colour of the Northern plants, especially with Ficote 270 TE and Ficote 360 TE, but closely followed by Osmocote Plus 16-18 months and Ficote 180 TE.

Only Ficote 270 TE showed a significant increase in size in response to using the higher rate of CRF in the absence of a soluble fast-start fertilizer, but while there was also a corresponding increase in length of new growth in this treatment, it did not prove to be significantly different to the lower rate of CRF + fast start.

Why the +KPA treatments of the shorter term CRFs (Ficote 140 TE, Osmocote Plus 8-9 months) should have significantly darker new foliage than the -KPA mix is difficult to account for, since the reverse would have been expected with the CRF used at a higher rate in the absence of the KPA 'kick-start' fertilizer.

Table 3 summarises the overall effect of CRF formulations on growth achieved in the North, averaging figures across the 'KPA treatments'.

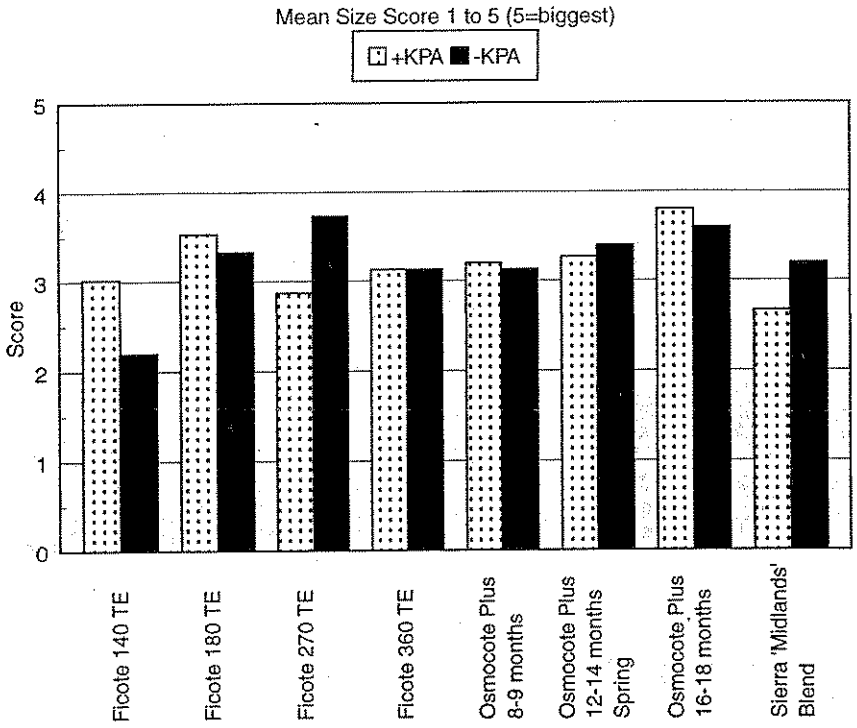
Table 3 Average effects of CRF formulations at 'standard' rates on plant growth at Johnsons of Whixley by April 1996
(figures are averaged across KPA treatments)

CRF	Size Score (1-5, 5 = largest)	Length of new growth (cm)	Foliage colour (1-5, 5 = darkest) Old Foliage	New Foliage
Ficote 140 TE	2.6	23.6	2.7	3.4
Ficote 180 TE	3.4	32.9	4.2	4.3
Ficote 270 TE	3.3	32.9	4.9	4.9
Ficote 360 TE	3.1	32.5	4.9	4.6
Osmocote Plus 8-9 months	3.2	28.1	3.2	3.5
Osmocote Plus 12-14 month Spring	3.3	32.1	3.6	4.3
Osmocote Plus 16-18 months	3.7	37.8	4.2	4.3
Sierra 'Midlands' Blend	3.4	30.6	4.0	3.7

In contrast to the previous assessment dates, by the end of the trial plants in the North had overtaken those in the South in respect of overall size. Taken in conjunction with the improved foliage colour also observed, this suggests that greater reserves of nutrients were available to these plants, a reflection no doubt of the slower rates of release over the preceding months due to lower average temperatures in the North, especially over the winter period.

Figure 6

Fourth Growth Record of *Prunus* 'Rotundifolia' at Johnsons - June 1996



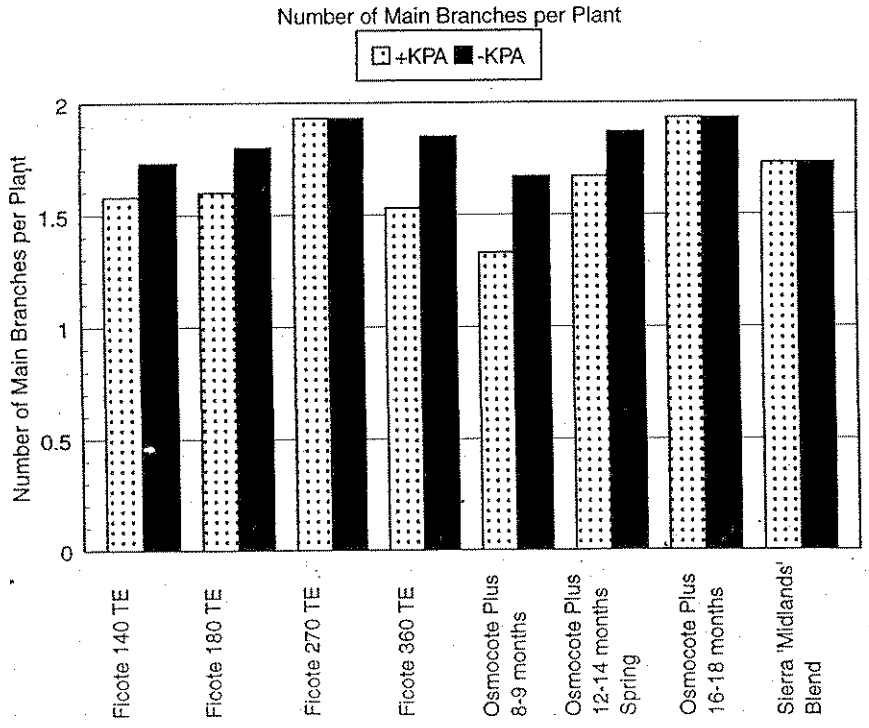


Figure 7

Fourth Growth Record of *Prunus* 'Rotundifolia' at Johnsons - June 1996

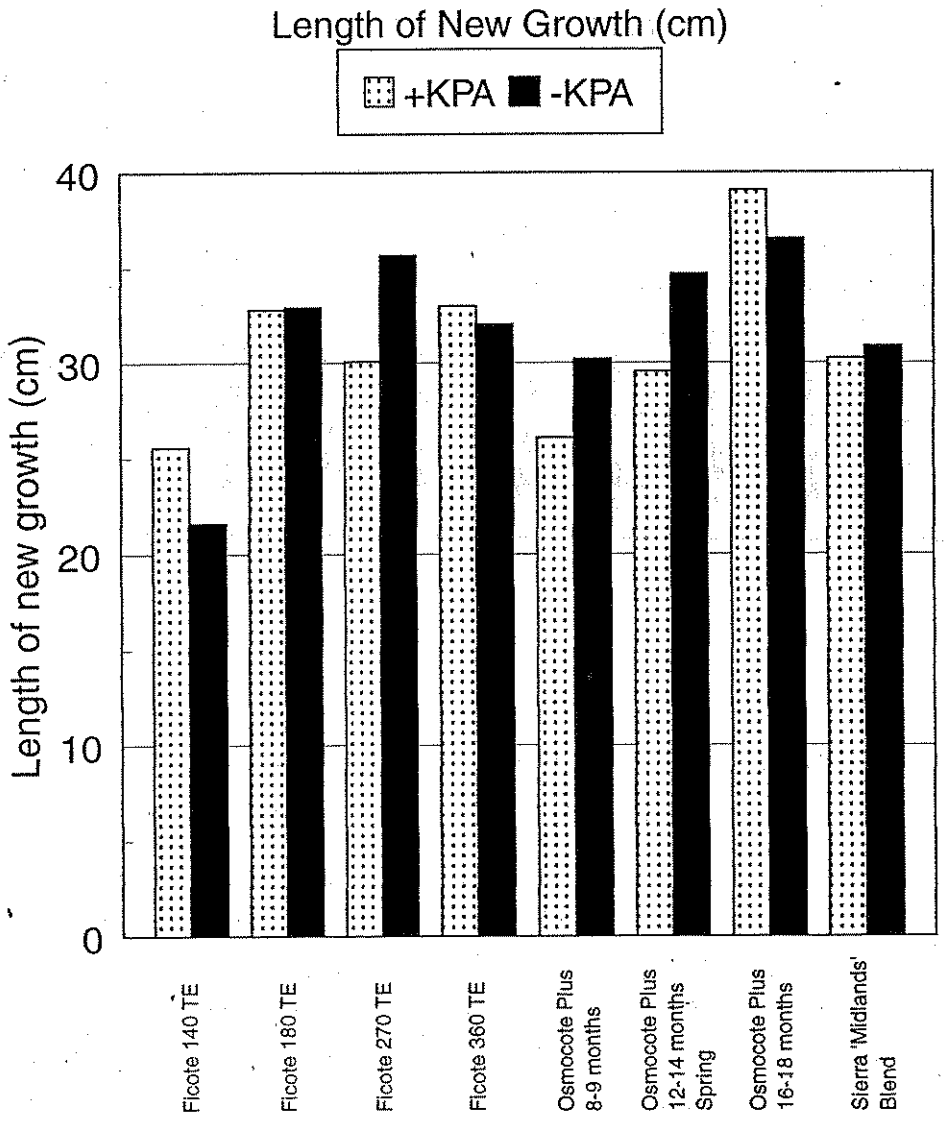
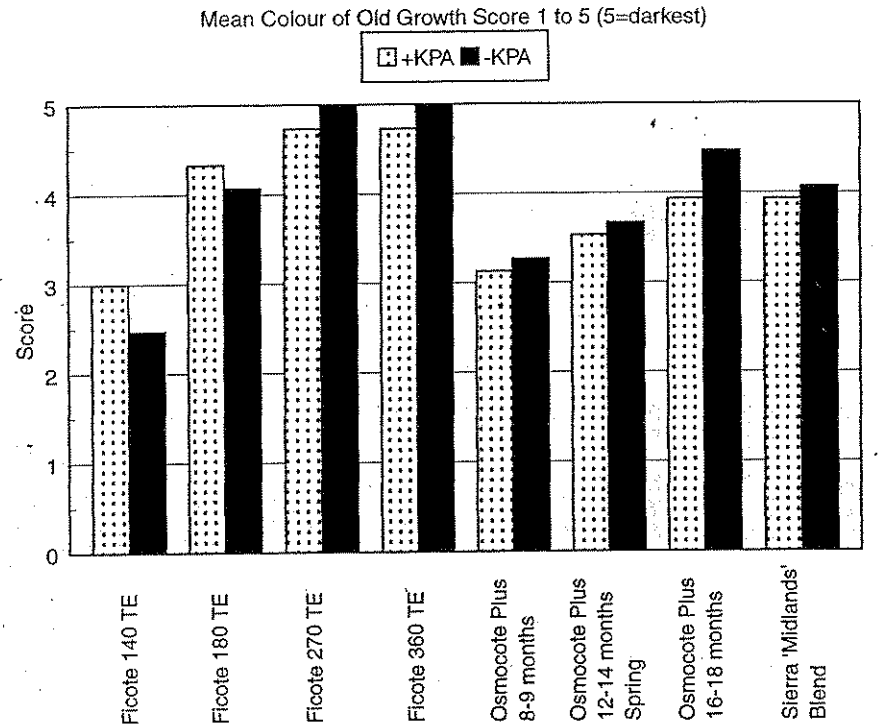
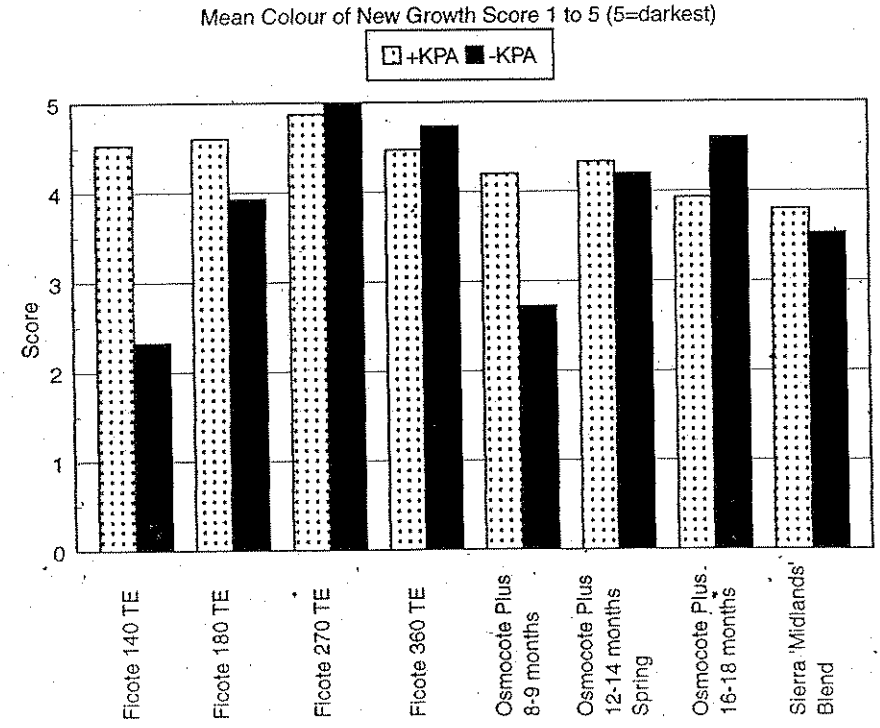


Figure 8

Fourth Growth Record of *Prunus* 'Rotundifolia' at Johnsons - June 1996





Weigela **'Red Prince'**

EFFORD

These results are presented in Figures 9-10 (p 28-29), and Table 9 in Appendix II, page 55. Score grades used and comparison of treatments are shown in Plates 4-6, Appendix III, pages 61-63.

Only one rate of CRF was used with this vigorous species, the highest rate of each formulation used with *Prunus* being selected as a 'standard' for the vigorous category.

As with *Prunus* the potential of the extended release CRFs to maintain growth and plant quality over two growing seasons was clearly demonstrated.

Ficote 360 TE (12 kg/m^3) produced the best results overall, with a significant improvement in general plant quality, amount of new growth, foliage colour and intensity of flowering, compared with the shorter term Ficote 140 TE and Ficote 180 TE products. Ficote 270 TE at 10 kg/m^3 also produced good results, only significantly behind Ficote 360 TE in respect of intensity of flowering.

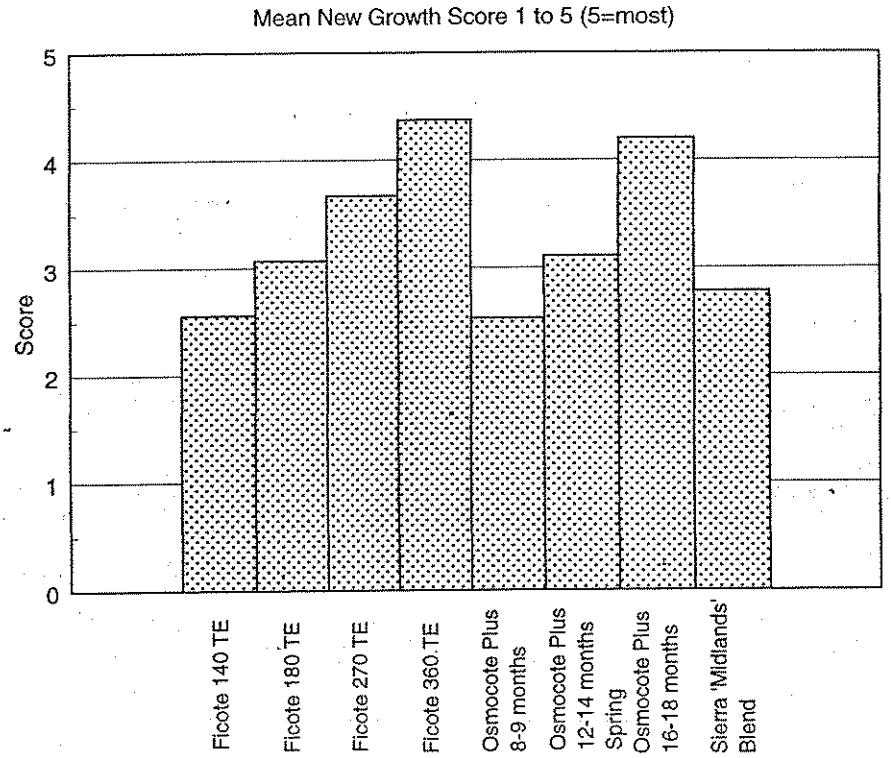
A similar trend was observed with Osmocote Plus, with the 16-18 months formulation producing the best results, though these did not always prove to be significantly different to the shorter term products, especially when compared with those of 12-14 months longevity.

Foliage colour was significantly paler in the Osmocote plants compared to that in the Ficote 270 TE and Ficote 360 TE treatments.

As discussed in previous reports, the high percentage loss of *Weigela* in this trial appeared to be the result of a severe pruning treatment due in Spring 1995 (see Second Interim Report). Very few further plant losses occurred within the surviving plants subsequently.

Figure 9

Fourth Growth Record of *Weigela* 'Red Prince' at Efford - June 1996



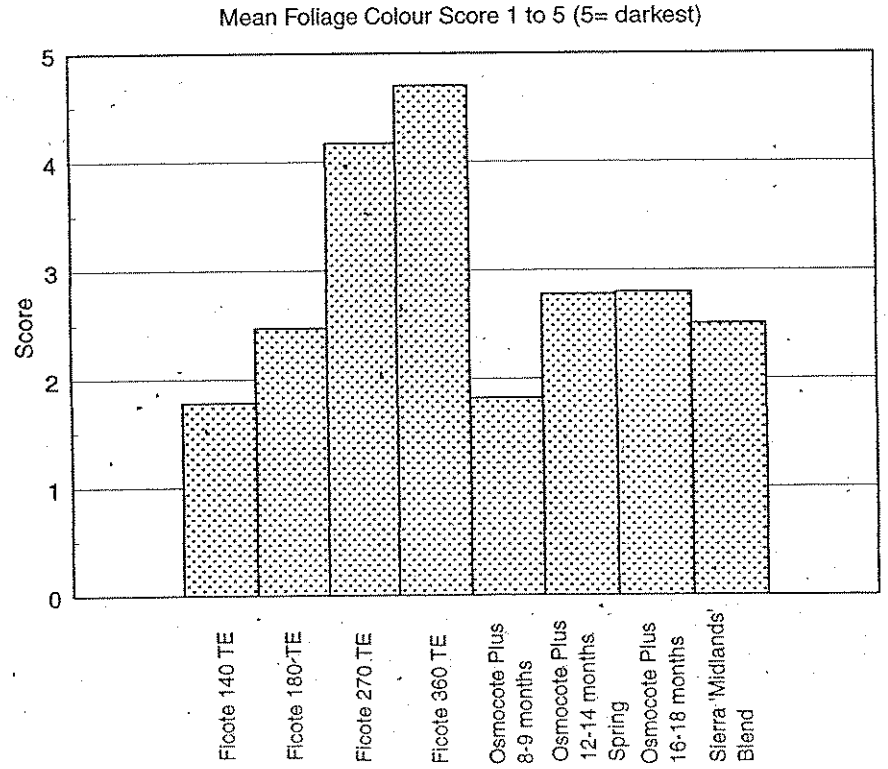
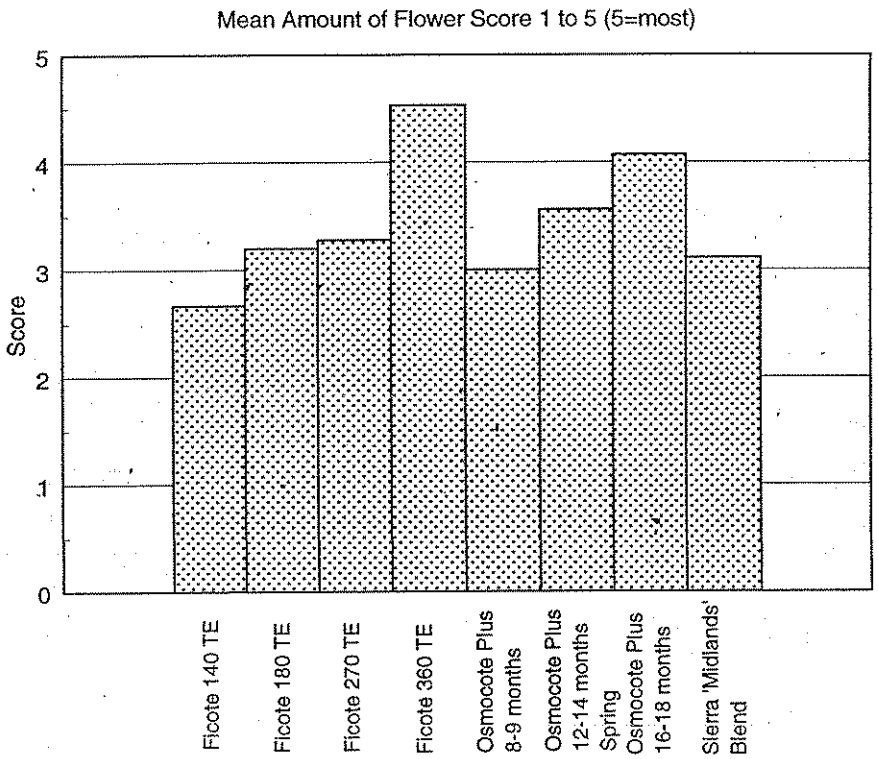
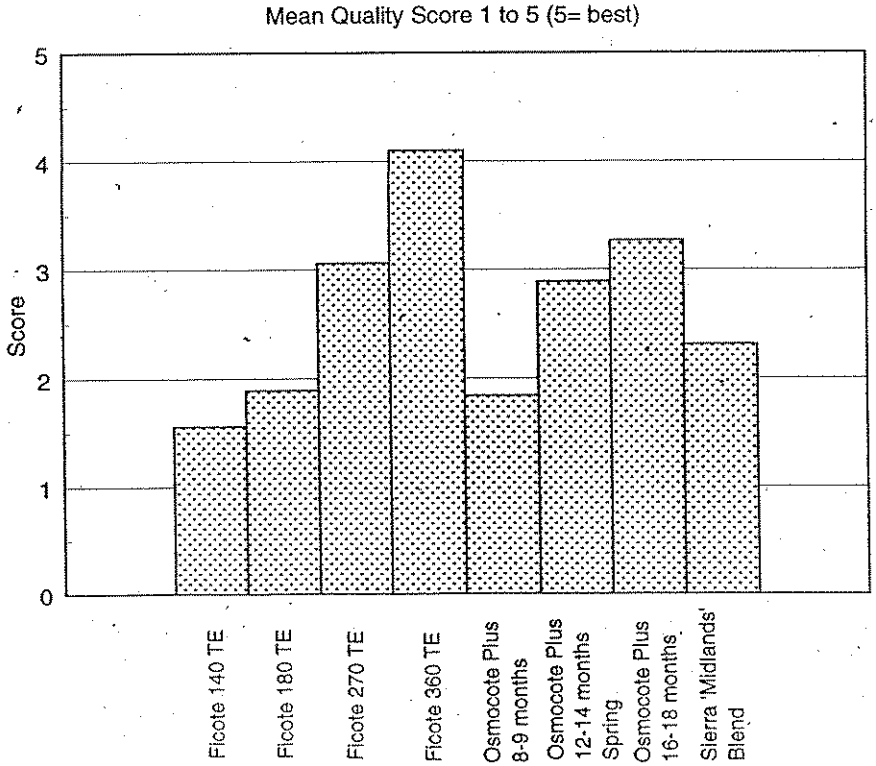


Figure 10

Fourth Growth Record of *Weigela* 'Red Prince' at Efford - June 1996





NORTHERN SITE (Johnsons of Whixley)

These results can be found in Figures 11-12 (p.31- 32) and Table 10 in Appendix II, page 56.

As in previous assessments the Northern site plants were considerably larger than their Southern counterparts.

At the end of the two years there was no significant difference between plants which had received the kick-start fertilizer (KPA) and those without KPA, despite these plants having a lower level of CRF available to maintain quality.

The pattern of results, as at Efford, suggested that amount of new growth, foliage colour and intensity of flowering was improved where longer term CRFs were used, but these differences did not prove significant in the North. However, overall plant quality was significantly better in Ficote 270 TE and Ficote 360 TE compared with the shorter term Ficote formulations.

With Osmocote Plus there was little difference between the 16-18 months and 12-14 months formulation at this time, though, not surprisingly, the quality of the 8-9 months treatment was considerably poorer by this stage.

Figure 11

Fourth Growth Record of *Weigela* 'Red Prince' at Johnsons - June 1996

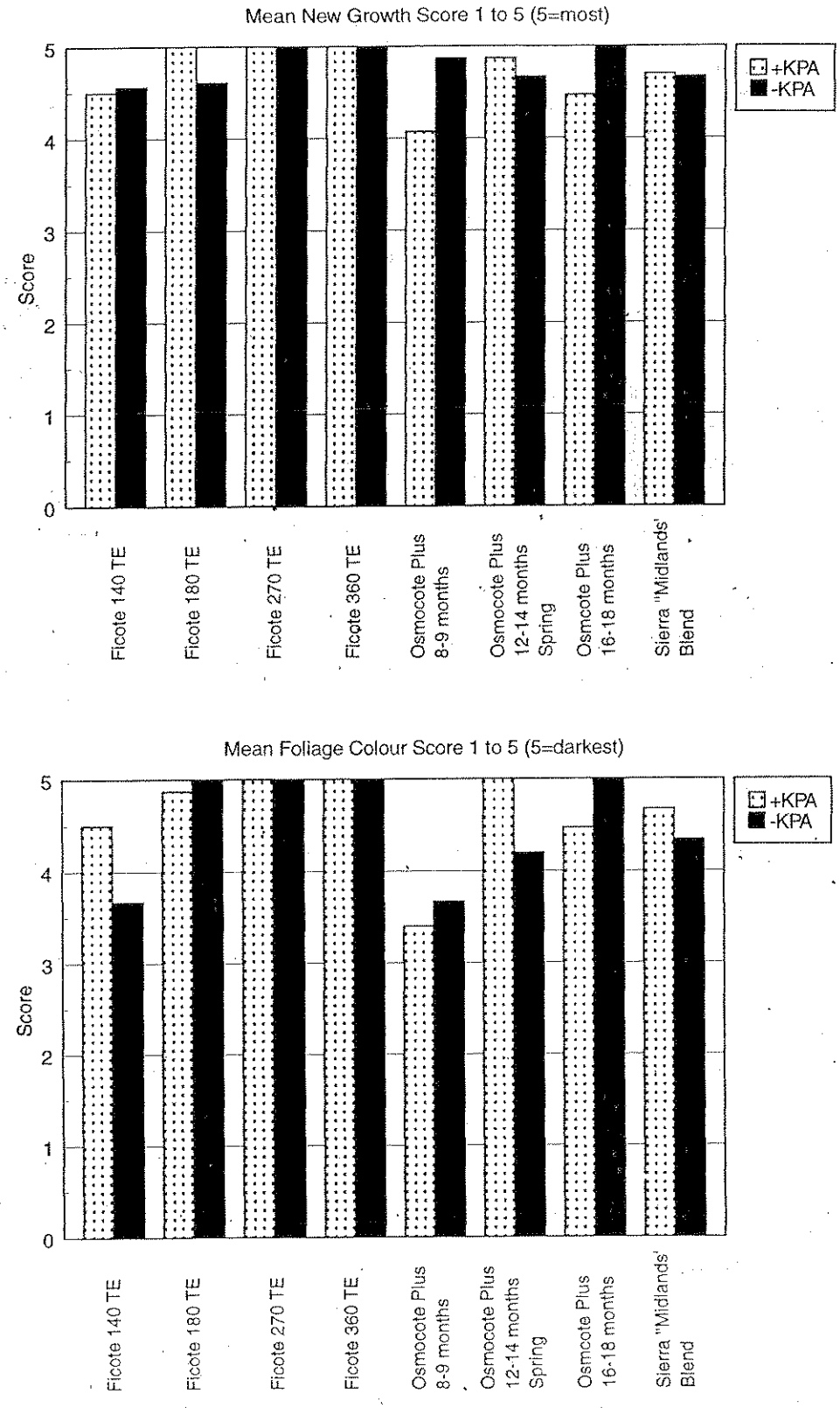
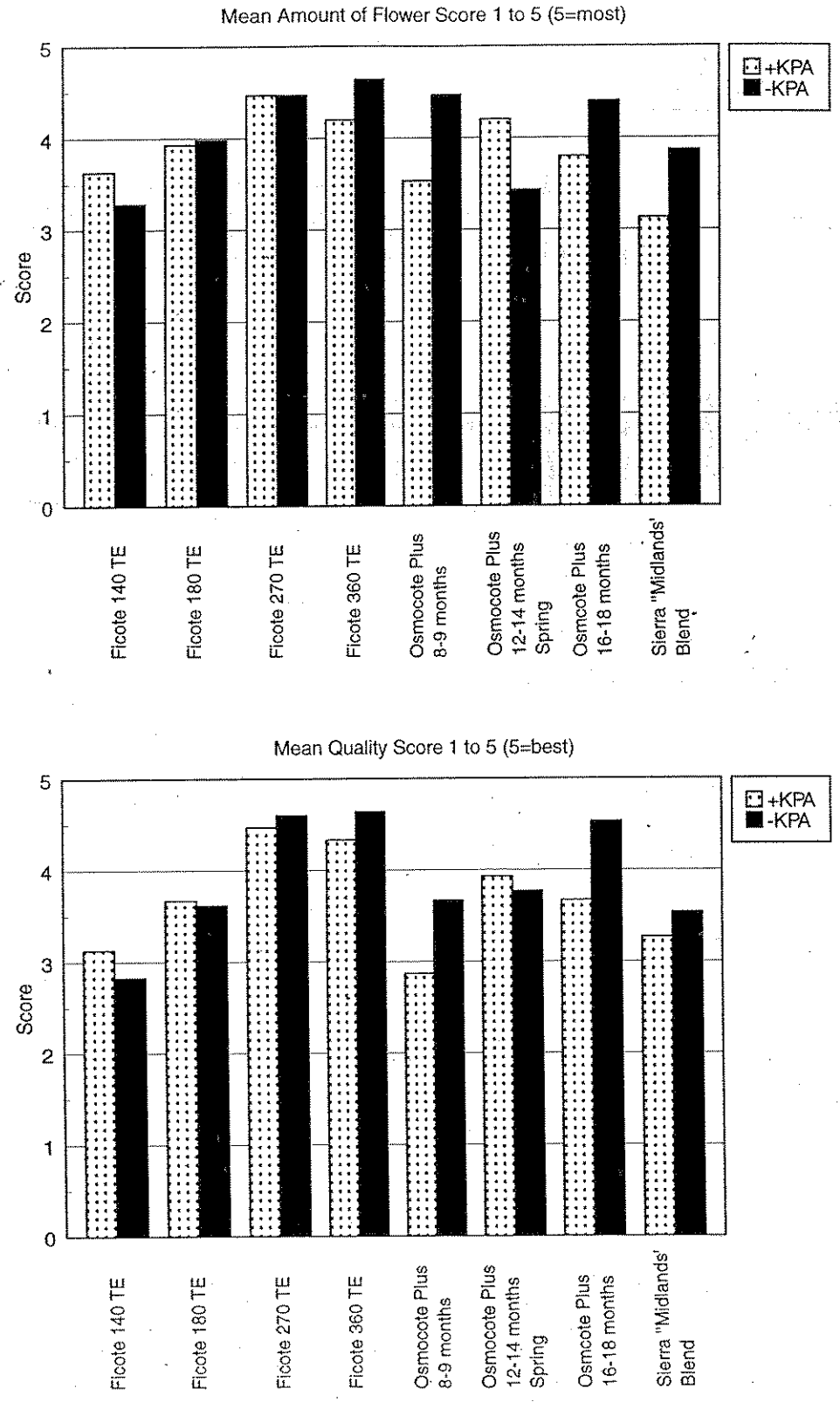


Figure 12

Fourth Growth Record of *Weigela* 'Red Prince' at Johnsons - June 1996



Chamaecyparis pisifera **'Boulevard'**

This species was only included in the **Efford** trial.

Results are shown in Figure 13 (p. 34) and Table 11 in Appendix II, page 57. Score grade used and comparison of treatments are shown in Plates 7-8, Appendix III, pages 64- 65.

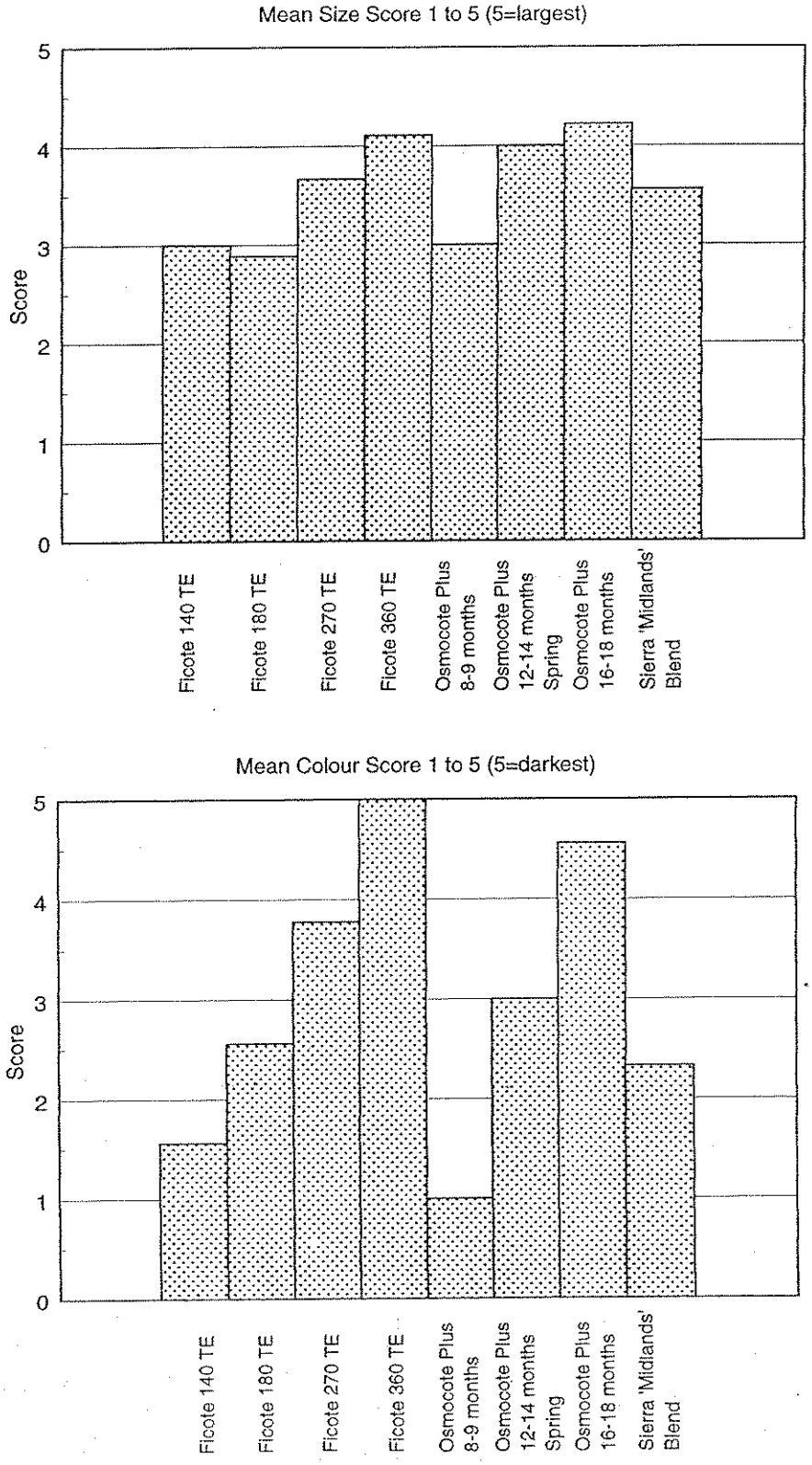
The main difference between treatments was in intensity of colour, with the changes first observed in the summer of 1995 becoming more marked by this final Spring record, 2 years after potting. A significant increase in intensity of foliage colour was observed as the longevity of CRF increased, both in Ficote TE and Osmocote Plus formulation. The colour maintained by Ficote 360 TE was particularly striking, closely followed by Osmocote Plus 16-18 months which was incorporated at an equivalent rate (9 kg/m^3).

By Spring 1996 plants in Ficote 360 TE were also larger than those in other Ficote TE formulations, significantly so when compared with Ficote 180 TE and 140 TE.

Both Osmocote Plus 12-14 months and 16-18 months produced significantly larger plants than Osmocote Plus 8-9 months, and were of similar size to the plants in Ficote 360 TE.

Figure 13

Fourth Growth Record of *C.p.* 'Boulevard' at Efford - April 1996



CRF Granules: Residual Analysis of Longer Term Formulations - Efford

A residual analysis of nutrients remaining in the three longer term CRF formulations (Ficote 270 TE, 360 TE, Osmocote Plus 16-18 months) was done in June 1996. This involved taking a representative sample of 200 granules from the *Prunus* containers, which were then ground and analysed for total nutrients using the liquid feed analysis procedure.

A sample of the original unused granules were also analysed in a similar manner to enable percentage nutrients remaining in the granules to be calculated. Results are presented in Table 4.

Table 4 Controlled Release Fertilizers: Nutrients Remaining in Granules by June 1996 - Efford

(From *Prunus* without KPA)

(200 granules analysed using water extraction method)

	Controlled Release Fertilizer								
		C			D			G	
Element (mg/litre)	Unused Granules	Ficote 270 TE (8 kg/m³) Used Granules	% of orig.	Unused Granules	Ficote 360 TE (9 kg/m³) Used Granules	% of orig.	Unused Granules	Osmocote Plus 16-18 months (9 kg/m³) Used Granules	% of orig.
Nitrate (N)	3234	140	*4.3*	2432	213	*8.8*	2357	80	*3.4*
Ammonium (N)	3288	289	*8.8*	2384	344	*14.4*	2176	170	*7.8*
Potassium	2240	374	*16.7*	1640	354	*21.6*	2420	268	*11.1*
Calcium	178	123	*69.1*	119	79	*66.4*	62	53	*85.5*
Magnesium	437	209	*47.8*	307	171	*57.7*	267	93	*34.8*
Phosphorus	797	237	*29.7*	423	144	*34.0*	542	121	*22.3*
Iron	52.7	7.2	*13.7*	50.6	6.1	*12.0*	24.5	1.2	*5.0*
Zinc	4.7	1.0	*22.2*	3.1	0.9	*29.3*	2.1	0.4	*17.1*
Manganese	23.2	7.6	*32.6*	17.0	5.7	*33.3*	6.2	0.7	*11.7*
Copper	15.7	2.2	*13.9*	11.5	1.6	*14.2*	11.7	2.3	*19.6*
Boron	5.2	0.7	*12.7*	4.8	0.9	*19.7*	5.1	1.0	*19.1*
Sodium	115	10	*8.7*	83	10	*12.0*	52	7	*13.5*
Chloride	76	6	*7.9*	46	2	*4.3*	172	5	*2.9*
Sulphate (as S)	993	415	*41.8*	746	364	*48.8*	850	192	*22.6*

Proportion of nitrate-N remaining in the Ficote 270 TE and Osmocote Plus 16-18 months CRFs was less than 5%, with ammonium-N only slightly more at less than 9%. The levels in the longer term Ficote 360 TE, while still relatively low, were double that of the other formulations analysed, being around 9% and 15% for nitrate-N and ammonium-N respectively.

Phosphorus release was slower with around 30% still available in the Ficote TE granules, 23% in Osmocote Plus 16-18 months.

Of the remaining elements, reserves in Osmocote Plus 16-18 months were, overall, slightly lower than in the two Ficote TE formulations, and especially when compared with Ficote 360 TE. Exceptions were calcium and copper where levels in the Osmocote Plus were higher, and boron and sodium where levels were similar to Ficote 360 TE.

Relatively high proportions of calcium, magnesium and sulphate (as S) were still held in the granules by the end of the trial.

How much of these remaining nutrients would be available to the plant, or speed of release, was not able to be monitored.

DISCUSSION

The trial was set up to investigate the use of 8-24 month release formulations of Ficote TE and Osmocote Plus controlled release fertilizers for spring potted hardy nursery stock grown outdoors. Plants were grown over the two year period in the same container to enable the point at which nutrient availability became limiting to be identified for the different formulations. For the first time part of the work was repeated on a Northern nursery site (Johnsons of Whixley), in order to monitor the influence of varying climatic conditions on CRF performance. In addition, the widely recommended use of a 'fast-start' material in the base dressing with the CRF was investigated. Species used included those of moderate to vigorous growth with *Prunus laurocerasus* 'Rotundifolia', *Weigela* 'Red Prince' and *Chamaecyparis pisifera* 'Boulevard', with liners potted into 3 litre containers in late May-early June 1994 and grown on drained sand beds with overhead irrigation at both sites.

While this report covers the final period of the work from November 1995-April 1996, when shelf-life potential of the CRFs was monitored, the results of the full two years of the trial are discussed here.

The moderate to vigorous species used would not normally have been held for two seasons in the same container. However, they were selected as nutrient indicator species representing the deciduous, evergreen and conifer groups, and as such have provided valuable information on the potential longevity of the different CRF formulations. Further work is needed on use of the extended release CRFs with slower growing species, which could be successfully held in the same container over two growing seasons e.g. *Ilex*, dwarf conifers.

The improved growth of *Weigela* at the Northern site was somewhat unexpected, though perhaps reflects the high plant losses incurred at Efford with this species, and weaker growth of some of the treatments, following a severe spring pruning. As discussed in the second interim report this type of stop was atypical since pruning of this species would normally have been done when the plant was in active growth during the first growing season. This had not been done, apart from a single stop in the early part of the first season, in order to gain information on the influence of fertilizers on total growth. This made it necessary to do the hard prune in the following spring while plants were still semi-dormant, in order to maintain a balanced growth. The increased severity of plant losses could also have been a result of softer growth produced in the South which was more sensitive to the severe prune. Further losses in the plants growing away were few.

With the evergreen *Prunus* growth was advanced in the South compared to the North until the final assessment in spring 1996, two years after potting. The most striking difference at this time was the increased intensity of foliage colour, especially in the longer-term CRFs on the Northern site. One possibility for this was higher reserves of nutrients available in the North

due to a reduction in their rate of release with the slightly lower average temperatures recorded in that area.

Overall, both Ficote TE and Osmocote Plus formulations produced similar results at recommended rates appropriate to formulations of similar longevity.

Rate of CRF was only compared in the Efford trial for *Prunus*. Here, a greater response to rate of fertilizer was seen with Ficote TE formulations than with Osmocote Plus, though at recommended rates (the medium rate) results were similar between the two products. This could be due in part to differences in the rate of release of nutrients from the two types of fertilizer. A complementary trial in collaboration with Dr Ian Burns at HRI Wellesbourne, HNS 43b, was set up to characterise the release patterns of the eight CRFs (medium rate only) in HNS 43a, using *Prunus* grown under the same conditions at Efford, and sampled at intervals during the two year period. Here it was shown that the Ficote released nutrients relatively steadily throughout the trial, while Osmocote released nutrients in two bursts, a more rapid one in the first year and a second more gradually in Year 2. Consequently the increased nutrient availability in Osmocote treatments compared to their Ficote counterparts, could have masked effects of rate of application in the early stages of the trial, while in Ficote the lower rates were obviously sub-optimal.

The shorter-term fertilizers, Ficote 140 TE and Osmocote Plus 8-9 months, maintained good growth over the first growing season, and in this particular year (1994/5) continued to maintain quality over the winter period. In some seasons, however, particularly if there had been periods of heavy rain and leaching, these products have been shown to run out of reserves by the autumn of the first year, especially in the South. It must also be remembered that this trial was relatively late in potting (June 1994) which would have extended the longevity of the shorter-term materials.

The medium-term release fertilizers of Osmocote Plus 12-14 months Spring and 'Midlands' Blend and Ficote 180 TE maintained growth and quality over the winter and into the spring of the second season. Results between the standard and 'Midlands' Blend 12-14 months Osmocote produced similar results in this trial. Where plants needed to be held over the winter for spring sales, Ficote 180 TE appeared to be more suitable than Ficote 140 TE for the South of England. In the North, however, where the growing season is somewhat shorter and cooler and winters colder, similar results were achieved with Ficote 140 TE, which with its lower recommended rate would be a more cost-effective option than Ficote 180 TE.

Results with the extended release 16-24 month CRFs varied with time. Over the first season growth was significantly slower in Ficote 270 TE and Osmocote Plus 16-18 months, and even more so in Ficote 360 TE, despite rates of fertilizers for these products being increased up to twofold. By the spring of the second year, whilst still behind, growth in Ficote 270 TE and Osmocote Plus 16-18 months were beginning to catch up, though that in Ficote 360 TE was still

significantly slower. However, as nutrient levels in the medium-term CRFs ran out, growth in the extended release material gradually took over and these treatments finished with the best growth and quality, especially foliage colour in *Prunus* and *C.p* 'Boulevard', and flowering intensity in *Weigela*, where the improvements were striking.

While the potential of the extended release CRFs to maintain growth and quality over two growing seasons was clearly demonstrated, their performance in the first year was disappointing, the result no doubt of slower release of nutrients under outdoor conditions, a problem not seen under protection, where the slow release was an advantage for safer use with salt-sensitive species. Short of reformulating or increasing rates even further, which would not always be cost effective, the alternative would be to consider blending a shorter-term fertilizer with an extended release formulation to achieve the required release of nutrients in the first year, balanced with longevity to maintain quality over an extended period. The blends and proportions of each fertilizer would need further work.

In addition to the obvious advantages of the extended release formulations in maintaining growth and quality over an eighteen month to two year period from a single application in the base dressing at potting, they could also have a place in other aspects of container production. The first of these would be to provide adequate shelf-life in the sales area after despatch from the nursery. All too often rapid deterioration of plants occurs in the garden centres. Part of this could be due to the change in eco-climate from the production nursery to the harsher sales environment, including less frequent watering, but nutrient reserves can also be limiting reducing shelf-life potential.

Similarly, establishment and early growth after planting can be severely checked by a hard, starved plant. Again, including a proportion of extended release fertilizer at the production stage would ensure some fertilizer reserves are taken over into the planting phase.

A further option for the extended release formulations could be in association with a liquid feeding programme. Liquid feeding would provide greater precision in application of nutrients, particularly for specialist crops under protection, and also outdoors, but has the disadvantage of requiring plants to be top dressed over winter in order for quality to be maintained. Sub-optimal rates of extended release CRFs would enable liquid feed programmes to be used safely, while providing the nutrients to maintain this quality over the winter period.

Differences in response to the different CRF formulations was less marked in the North compared to the South by the end of the trial, apart from the shorter-term materials which had clearly run out by this stage. Again, this could be accounted for by the somewhat slower rate of release of nutrients in the North due to the lower average temperatures, which would have extended the longevity of the medium-term materials.

Results from the use of the soluble 'fast-start' fertilizer in the base dressing with the CRF at potting were variable. In the South the only advantage seen was where rates of CRF were sub-optimal or releasing too slowly. In the Northern site only a single rate of CRF was used, with rate dependent on whether or not a soluble 'fast-start' fertilizer was used, the recommendation being for a lower rate of CRF incorporation where a soluble base dressing was added. Results over the first season were similar from both the lower rate CRF +KPA addition, and the increased rate of CRF -KPA. It had been anticipated that the treatment with the higher rate of CRF (-KPA) would have an advantage in maintaining quality of growth over a longer period than the lower CRF application +KPA. In the event, however, results between the two treatments were not significantly different by the end of the trial. A similar pattern could be seen in the Efford results with *Prunus*, by comparing the medium rate of CRF +KPA with the high rate of CRF -KPA. Thus a lower rate of CRF plus 'fast-start' fertilizer appeared to have sufficient reserves at the levels incorporated to maintain growth and quality within its respective longevity, supporting the current recommendation for using a lower rate of CRF in association with a 'fast-start' product, a cost-effective option to increasing the rate of CRF. However, whether this would hold true for a crop potted earlier in the season needs confirmation.

In summary the extended release CRFs have clearly demonstrated their potential to maintain quality and growth from a single application in the base dressing at potting over an eighteen month-two year period depending on formulation, though their slower rate of release in the first season reduced growth and needs to be addressed. Overall, the current recommended rates of the shorter-medium term formulations of CRFs gave good results. The need for a 'kick-start' fertilizer with CRF appears unnecessary at equivalent rates of fertilizer, though results did suggest that a lower rate of CRF plus 'kick-start' could give similar results to a higher rate of CRF alone. Differences between fertilizer formulations were less in the North, no doubt due to the lower average temperatures compared to the South, reducing the need for the longer-term fertilizers required for similar crops in the South.

CONCLUSIONS

The objective of this trial was to compare the performance of a range of Ficote TE and Osmocote Plus CRFs, with release patterns ranging from 8 to 24 months, for container nursery stock grown outdoors in both Southern England (Efford) and in the North (Johnsons of Whixley). Liners of *Prunus laurocerasus* 'Rotundifolia', *Weigela* 'Red Prince' and *Chamaecyparis pisifera* 'Boulevard' were potted into 3 litre containers in late May-early June 1994, were grown in the same pot on drained sand beds with overhead irrigation over the next two seasons in order to identify the point at which nutrient availability became limiting in the different formulations. The need for a 'fast-start' fertilizer in the base dressing with the CRF was also investigated. The main results can be summarised as follows:

- The species used in this trial were moderate to vigorous in growth and as such would not normally have been held in the same container over two growing seasons. However, valuable information was gained on the potential longevity of the different CRF formulations with these 'nutrient indicator' species. Further work is needed on use of extended release CRFs with slower growing species which could be expected to be held in the same container over two seasons (e.g. *Ilex*, dwarf conifer).

- Growth of *Prunus* was more advanced in the South than in the North for the first 18 months of the trial, but at the final 'shelf-life' assessment in the spring of 1996, two years from potting, growth in the North had overtaken that in the South. A striking difference between the two sites at this time was the improved foliage colour of Northern plants, especially in the long-term CRF formulations. This was attributed to the possibility of increased nutrient reserves remaining in the North due to lower average temperatures reducing their rate of release.

- In contrast, *Weigela* produced markedly better growth in the Northern site at all stages of the trial.

- Overall, both Ficote TE and Osmocote Plus formulations produced similar results at recommended rates.

- A greater response to rate of fertilizer was seen with Ficote TE formulations than with Osmocote Plus in the comparisons at Efford with *Prunus*. Based on the analyses done in the complementary trial HNS 43b, this appeared to be related to a more controlled rate of release of nutrients from Ficote TE, the lowest rate being sub-optimal. A rapid release of nutrients recorded in the first year with Osmocote Plus could have masked effects of rate of application in the early stages.

- The shorter-term CRFs, Ficote 140 TE and Osmocote Plus 8-9 months produced satisfactory growth over the first year, and in the 1994/5 season continued to maintain quality over the winter period.

- Results suggested that Ficote 180 TE was the more suitable Ficote formulation for the South of England where growth needed to be maintained overwinter and into early spring sales. In the North, however, similar results were achieved with Ficote 140 TE.

- Results with the extended release materials varied with the stage of the trial. Over the first season growth was significantly slower in Ficote 270 TE and Osmocote Plus 16-18 months, and even more so in Ficote 360 TE. By the spring of the second year, while still behind, growth in Ficote 270 TE and Osmocote 16-18 months were beginning to catch up, though that in Ficote 360 TE was still significantly slower. However, as nutrient levels in the 8-14 month CRFs ran out, growth in the extended release materials gradually took over, and the improvement in colour in these mixes was striking. The potential of the extended release CRFs to maintain growth and quality over two growing seasons was clearly demonstrated.

- Differences in response to the different CRF formulations was less marked in the North compared to the South by the end of the trial, apart for the shorter-term materials which had clearly run out by this stage.

- Any advantage of using a soluble 'fast-start' fertilizer in the base dressing with the CRF was only seen in the South where rates of CRF were sub-optimal or releasing too slowly.

- In the Northern site only a single rate of CRF was used, with rate dependent on whether or not a soluble fast-start fertilizer was used, the recommendation being for a lower rate of CRF incorporation where a soluble base dressing was added. While no significant advantage was observed from the incorporation of a 'kick-start' fertilizer in the early part of the trial, neither was any major advantage seen in the later stages from the increased rate of CRF in the absence of soluble fertilizer. A similar pattern was seen for the Efford results with *Prunus*, comparing the medium rate of CRF +KPA with the high rate of CRF -KPA. Thus a lower rate of CRF + fast-start fertilizer, appeared to have sufficient reserves at the levels incorporated to maintain growth and quality within its respective longevity, supporting the current recommendation for using a lower rate of CRF in association with a fast-start product, a cost-effective option to increasing the rate of CRF.

- Results are discussed in relation to the options available for using the extended release CRFs to advantage for outdoor container production.

RECOMMENDATIONS FOR FURTHER WORK

1. The work in HNS 43a used moderate-vigorous species and it was shown that nutrient release from the long-term materials was not fast enough outdoors in the first year to achieve the growth required, even at relatively high rates. However, the situation could change with slower growing species, where plants could more reasonably be expected to remain in the same container over two seasons (e.g. *Ilex*, dwarf conifers). This needs further investigation.

2. Monitor effects of improved nutrient reserves in the pot at despatch on quality and shelf-life potential in the garden centre.

3. Examine the influence of adequate nutrient reserves in the substrate on subsequent establishment and early growth following planting.

4. Investigate the potential for blending shorter and extended release formulations to obtain adequate release of nutrients during the first growing season, with reserves to maintain quality overwinter and into the second season as required.

5. Consider the options for using the long-term formulations in combination with liquid feed programmes. This could be particularly useful under protection where greater precision in feeding over the growing season would be obtained by liquid feeds, but again with the option of maintaining quality and shelf-life over the winter period and through to marketing with the CRF.

6. Crop scheduling to target specific markets is becoming more widely adopted, especially with fast maturing crops. Some are potted in the autumn for subsequent spring sales, others at intervals during the growing season. Information on type and rate of CRF (or CRF + liquid feeding) for these cropping schedules is limited.

7. Container production of herbaceous crops is increasing, and while general CRF guidelines on nutrition are available, more detailed information on crop requirements depending on species group, time of year produced and system of production could improve speed and quality of growth.

ACKNOWLEDGEMENTS

The help and collaboration of Johnsons of Whixley in providing the Northern site for this Project was greatly appreciated and added to the value of the work. Thanks are due to John Richardson for agreeing to have the trial on site and Agnes Harbour for her help in the running and management of the work.

APPENDICES

APPENDIX I

Prunus 'Rotundifolia'/Lavender Layout at Efford

Replicate 1

Plot no.	Treatment	Plot no.	Treatment
Guard row of *Prunus*			
1	CM+	25	BH+
2	HH+	26	AH+
3	GL-	27	EH-
4	BL-	28	FM-
5	GM-	29	DM+
6	AL+	30	CM-
7	DH-	31	EL+
8	BM+	32	FH+
9	AM-	33	GL+
10	FL-	34	HM-
11	EM+	35	HL+
12	CH+	36	DM-
13	HL-	37	BL+
14	HM+	38	EM-
15	GH-	39	DH+
16	CL+	40	BM-
17	FM+	41	GM+
18	FH-	42	AL-
19	DL+	43	CH-
20	EL-	44	AM+
21	AH-	45	FL+
22	GH+	46	BH-
23	HH-	47	DL-
24	CL-	48	EH+
Guard row of *Prunus*			

N

Plot layout

Plot 1 Plot 25

X X X X X X X X X X X X

X X X X X X X X X X X X

Lavender Guard *Prunus* Lavender Guard

(6 *Prunus* and 6 lavender per plot)

CRF Treatment
A Ficote 140 TE
B Ficote 180 TE
C Ficote 270 TE
D Ficote 360 TE
E Osmocote Plus 8-9 months
F Osmocote Plus 12-14 months Spring
G Osmocote Plus 16-18 months
H Sierra 'Midlands' Blend

\+ with KPA
\- without KPA

Rate
H high
M medium
L low

APPENDIX I

Prunus 'Rotundifolia'/Lavender Layout at Efford

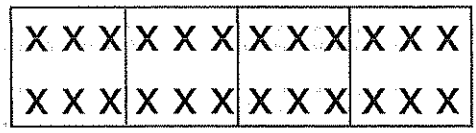
Replicate 2

Plot no.	Treatment	Plot no.	Treatment
Guard row of *Prunus*			
49	GL-	73	AH-
50	CM-	74	EL+
51	AL+	75	GM+
52	EH+	76	DL+
53	BH+	77	FH+
54	HM-	78	BM+
55	EL-	79	HL-
56	GH+	80	CM+
57	EM-	81	FL-
58	AM+	82	HH+
59	CH-	83	BH-
60	HH-	84	GL+
61	DM+	85	AH+
62	GH-	86	DH-
63	BL+	87	CL-
64	HL+	88	FM+
65	DL-	89	EM+
66	FL+	90	AL-
67	FH-	91	DM-
68	BM-	92	CH+
69	CL+	93	HM+
70	AM-	94	EH-
71	GM-	95	FM-
72	DH+	96	BL-
Guard row of *Prunus*			

N

Plot layout

Plot 49 Plot 73



Lavender Guard *Prunus* Lavender Guard

(6 *Prunus* and 6 lavender per plot)

CRF Treatment
A Ficote 140 TE
B Ficote 180 TE
C Ficote 270 TE
D Ficote 360 TE
E Osmocote Plus 8-9 months
F Osmocote Plus 12-14 months Spring
G Osmocote Plus 16-18 months
H Sierra 'Midlands' Blend

\+ with KPA
\- without KPA

Rate
H high
M medium
L low

APPENDIX I

Prunus 'Rotundifolia'/Lavender Layout at Efford

Replicate 3

Plot no.	Treatment	Plot no.	Treatment
Guard row of *Prunus*			
97	BL-	121	HL-
98	GL+	122	CH-
99	DM+	123	EL+
100	HM+	124	AL+
101	BH+	125	FL+
102	GH-	126	AH-
103	EM-	127	GM-
104	HH-	128	BM+
105	EH+	129	CL-
106	AM-	130	DL+
107	FM+	131	FH-
108	HM-	132	CH+
109	CM-	133	GL-
110	HH+	134	DH+
111	BM-	135	AM+
112	EL-	136	FM-
113	GH+	137	BL+
114	CL+	138	DM-
115	HL+	139	EM+
116	DL-	140	GM+
117	EH-	141	AL-
118	FL-	142	CM+
119	AH+	143	FH+
120	DH-	144	BH-
Guard row of *Prunus*			

N

Plot layout

Plot 97 Plot 121

X X X X X X X X X X X X

X X X X X X X X X X X X

Lavender Guard *Prunus* Lavender Guard

(6 *Prunus* and 6 lavender per plot)

CRF Treatment
A Ficote 140 TE
B Ficote 180 TE
C Ficote 270 TE
D Ficote 360 TE
E Osmocote Plus 8-9 months
F Osmocote Plus 12-14 months Spring
G Osmocote Plus 16-18 months
H Sierra 'Midlands' Blend

\+ with KPA
\- without KPA

Rate
H high
M medium
L low

APPENDIX I

Trial Layout at Johnsons of Whixley

Prunus 'Rotundifolia'

Plot no.	Treatment	Plot no.	Treatment
Guard row of *Prunus*			
1	C-	9	F+
2	G+	10	B-
3	A+	11	E-
4	D-	12	A-
5	H-	13	G-
6	B+	14	D+
7	F-	15	H+
8	E+	16	C+
17	G+	25	G-
18	B+	26	C-
19	F-	27	A+
20	C+	28	F+
21	E+	29	D-
22	A-	30	H+
23	H-	31	E-
24	D+	32	B-
33	H+	41	C-
34	D+	42	A+
35	B-	43	E+
36	F+	44	B+
37	E-	45	G+
38	C+	46	H-
39	G-	47	F-
40	A-	48	D-

Weigela

N

Replicate 1

Replicate 2

Replicate 3

Weigela 'Red Prince'

Plot no.	Treatment	Plot no.	Treatment
			Prunus
49	G+	57	B-
50	F-	58	H+
51	B+	59	A-
52	H-	60	E-
53	C-	61	D+
54	E+	62	G-
55	D-	63	C+
56	A+	64	F+
65	G-	73	D+
66	C+	74	E-
67	E+	75	B+
68	H+	76	C-
69	B-	77	A-
70	F-	78	F+
71	A +	79	G+
72	D-	80	H-
81	F+	89	C+
82	A-	90	D-
83	C-	91	A+
84	G+	92	H+
85	B-	93	F-
86	E-	94	B+
87	H-	95	G-
88	D+	96	E+
Guard row of *Weigela*			

One plot

XXXXXXX

7 plants

CRF Treatment

A Ficote 140 TE
B Ficote 180 TE
C Ficote 270 TE
D Ficote 360 TE
E Osmocote Plus 8-9 months
F Osmocote Plus 12-14 months Spring
G Osmocote Plus 16-18 months
H Sierra 'Midlands' Blend

\+ with KPA
\- without KPA

APPENDIX I

Weigela 'Red Prince'/*Cytisus* Layout at Efford

Plot no.	Treatment	Plot no.	Treatment	
Guard row of *Cytisus*				
169	E	181	A	
170	B	182	D	Replicate 1
171	H	183	F	
172	C	184	G	
173	H	185	D	
174	E	186	F	Replicate 2
175	B	187	C	
176	G	188	A	
177	F	189	B	
178	D	190	G	
179	H	191	A	Replicate 3
180	C	192	E	
Guard row of *Azalea*				

N

Plot layout

Plot 169 Plot 181

X X X X X X X X X X X X
X X X X X X X X X X X X

Cytisus Guard — *Weigela* 'Red Prince' — *Cytisus* Guard

(6 *Weigela* 'Red Prince' and 6 *Cytisus* per plot)

CRF Treatment
A Ficote 140 TE
B Ficote 180 TE
C Ficote 270 TE
D Ficote 360 TE
E Osmocote Plus 8-9 months
F Osmocote Plus 12-14 months Spring
G Osmocote Plus 16-18 months
H Sierra 'Midlands' Blend

APPENDIX I

C.p. 'Boulevard'/*Azalea* Layout at Efford

N

Plot no.	Treatment	Plot no.	Treatment	
Guard row of *Azalea*				
145	F	157	B	
146	C	158	E	Replicate 1
147	A	159	G	
148	H	160	D	
149	H	161	D	
150	C	162	A	Replicate 2
151	F	163	E	
152	B	164	G	
153	G	165	D	
154	A	166	F	Replicate 3
155	C	167	H	
156	E	168	B	
Guard row of *Azalea*				

Plot layout

Plot 145 Plot 157

X X X X X X X X X X X X

X X X X X X X X X X X X

Azalea Guard *C.p.* 'Boulevard' *Azalea* Guard

(6 *C.p.* 'Boulevard' and 6 *Azalea* per plot)

CRF Treatment

A Ficote 140 TE
B Ficote 180 TE
C Ficote 270 TE
D Ficote 360 TE
E Osmocote Plus 8-9 months
F Osmocote Plus 12-14 months Spring
G Osmocote Plus 16-18 months
H Sierra 'Midlands' Blend

APPENDIX II

Table 5 — Fourth Growth Record of *Prunus* at Efford - April 1996

Mean Growth Scores

(Figures are a mean of 3 replicates, 6 plants/plot)

Treatment Code	CRF	Rate (kg/m³) Low	Medium	High	Size Score 1 to 5 (5 = largest) Low +KPA	Low -KPA	Medium +KPA	Medium -KPA	High +KPA	High -KPA	Number of Main Branches Low +KPA	Low -KPA	Medium +KPA	Medium -KPA	High +KPA	High -KPA	Length of New Growth (cm) Low +KPA	Low -KPA	Medium +KPA	Medium -KPA	High +KPA	High -KPA
A	Ficote 140 TE	3.0	4.5	6.0	2.39	2.33	2.67	2.42	2.89	2.56	1.72	1.67	1.78	1.76	1.78	1.78	26.8	28.3	28.4	27.6	29.2	25.2
B	Ficote 180 TE	4.5	6.0	7.5	2.70	2.11	2.83	2.94	3.28	3.11	1.94	1.72	2.17	2.00	2.00	2.33	29.7	25.7	32.3	30.4	34.8	32.3
C	Ficote 270 TE	6.0	8.0	10.0	3.22	3.00	3.28	2.99	3.50	3.39	2.22	1.83	2.17	1.83	2.11	2.44	38.3	38.2	35.9	35.5	39.1	37.9
D	Ficote 360 TE	7.0	9.0	12.0	3.44	3.11	3.39	2.93	3.56	3.28	2.00	1.83	2.17	1.98	2.17	1.94	35.1	38.6	42.9	37.9	37.0	43.1
E	Osmocote Plus 8-9 months	4.0	5.0	6.0	2.56	2.83	2.72	2.83	2.83	2.72	1.89	1.72	1.89	1.83	2.06	2.06	25.8	29.6	30.5	27.3	31.2	25.2
F	Osmocote Plus 12-14 months Spring	5.0	6.0	8.0	3.00	2.91	3.00	2.89	3.21	3.33	2.00	1.77	2.06	1.78	1.64	1.89	27.8	29.1	34.2	30.2	33.0	33.6
G	Osmocote Plus 16-18 months	8.0	9.0	12.0	3.50	2.89	3.56	3.00	3.72	3.28	2.22	2.06	2.11	2.06	1.89	2.06	38.8	30.4	35.4	35.4	44.9	43.3
H	Sierra 'Midlands' Blend	5.0	6.0	8.0	2.78	2.50	3.11	3.06	3.11	2.94	2.11	1.61	2.00	1.83	2.00	1.89	27.4	31.6	40.0	30.4	36.6	31.7
d.f. = 94	*SED = ±*				*0.314*						*0.203*						*4.13*					
	LSD (5%) = ±				*0.62*						*0.40*						*8.2*					

APPENDIX II

Table 6

Fourth Growth Record of *Prunus* at Efford - April 1996

Mean Colour Scores

(Figures are a mean of 3 replicates, 6 plants/plot)

Treatment Code	CRF	Rate (kg/m³) Low	Medium	High	Colour of Old Growth Score 1 to 5 (5 = darkest) Low +KPA	Low -KPA	Medium +KPA	Medium -KPA	High +KPA	High -KPA	Colour of New Growth Score 1 to 5 (5 = darkest) Low +KPA	Low -KPA	Medium +KPA	Medium -KPA	High +KPA	High -KPA	Total % Dead Low +KPA	Low -KPA	Medium +KPA	Medium -KPA	High +KPA	High -KPA
A	Ficote 140 TE	3.0	4.5	6.0	2.33	2.11	2.78	2.78	3.11	3.22	2.78	3.67	3.89	3.58	3.67	3.33	0.0	0.0	0.0	0.0	0.0	0.0
B	Ficote 180 TE	4.5	6.0	7.5	2.73	2.78	3.22	3.56	2.89	2.67	3.36	2.78	4.00	4.33	3.44	3.67	5.6	0.0	0.0	0.0	0.0	0.0
C	Ficote 270 TE	6.0	8.0	10.0	3.67	3.56	3.33	3.93	3.78	4.22	3.89	3.67	3.67	3.91	3.89	4.44	0.0	0.0	0.0	0.0	0.0	0.0
D	Ficote 360 TE	7.0	9.0	12.0	3.78	4.33	4.33	3.80	4.11	3.89	3.89	4.11	4.22	3.71	4.22	4.33	0.0	0.0	0.0	5.6	0.0	0.0
E	Osmocote Plus 8-9 months	4.0	5.0	6.0	1.78	2.33	2.67	2.44	2.89	2.56	2.11	3.00	3.11	3.11	2.22	1.89	11.1	0.0	0.0	0.0	0.0	0.0
F	Osmocote Plus 12-14 months Spring	5.0	6.0	8.0	2.78	2.78	3.11	2.67	3.56	3.44	2.33	1.96	2.89	2.78	3.20	2.78	0.0	0.0	0.0	0.0	5.6	0.0
G	Osmocote Plus 16-18 months	8.0	9.0	12.0	3.44	3.44	3.89	3.44	4.11	3.78	2.89	3.44	2.78	2.89	3.00	3.89	0.0	0.0	0.0	0.0	0.0	0.0
H	Sierra 'Midlands' Blend	5.0	6.0	8.0	2.33	2.89	3.22	2.67	3.11	3.00	1.89	2.89	3.00	2.78	2.44	2.44	0.0	0.0	0.0	0.0	0.0	0.0
d.f. = 94	*SED = ±*						*0.447*						*0.630*									
	LSD (5%) = ±						*0.89*						*1.25*									

APPENDIX II

Table 7 Fourth Growth Record of *Prunus* at Johnsons of Whixley - June 1996

Mean Growth Scores

(Figures are a mean of 15 plants)

Treatment Code	CRF	Rate (kg/m^3) +KPA	Rate (kg/m^3) -KPA	Size Score 1 to 5 (5= biggest) +KPA	Size Score 1 to 5 (5= biggest) -KPA	Number of Main Branches +KPA	Number of Main Branches -KPA	Length of New Growth (cm) +KPA	Length of New Growth (cm) -KPA
A	Ficote 140 TE	4.5	6.0	3.02	2.20	1.58	1.73	25.6	21.6
B	Ficote 180 TE	6.0	7.5	3.53	3.33	1.60	1.80	32.8	32.9
C	Ficote 270 TE	8.0	10.0	2.87	3.73	1.93	1.93	30.1	35.7
D	Ficote 360 TE	9.0	12.0	3.13	3.13	1.53	1.85	33.0	32.0
E	Osmocote Plus 8-9 months	5.0	6.0	3.20	3.13	1.33	1.67	26.1	30.2
F	Osmocote Plus 12-14 months Spring	6.0	8.0	3.27	3.40	1.67	1.87	29.5	34.7
G	Osmocote Plus 16-18 months	9.0	12.0	3.80	3.60	1.93	1.93	39.1	36.5
H	Sierra 'Midlands' Blend	6.0	8.0	2.67	3.20	1.73	1.73	30.2	30.9
	d.f. = 30	*SED = ±*		*0.332*		*0.192*		*4.05*	
		LSD (5%) = ±		*0.68*		*0.39*		*8.3*	

APPENDIX II

Table 8 Fourth Growth Record of *Prunus* at Johnsons of Whixley - June 1996

Mean Scores

(Figures are a mean of 15 plants)

Treatment Code	CRF	Rate (kg/m³) +KPA	Rate (kg/m³) -KPA	Colour of Old Growth Score 1 to 5 (5 = darkest) +KPA	Colour of Old Growth Score 1 to 5 (5 = darkest) -KPA	Colour of New Growth Score 1 to 5 (5 = darkest) +KPA	Colour of New Growth Score 1 to 5 (5 = darkest) -KPA	Total % Dead +KPA	Total % Dead - KPA
A	**Ficote 140 TE**	**4.5**	**6.0**	3.00	2.47	4.53	2.33	6.7	0.0
B	**Ficote 180 TE**	**6.0**	**7.5**	4.33	4.07	4.60	3.93	0.0	0.0
C	**Ficote 270 TE**	**8.0**	**10.0**	4.73	5.00	4.87	5.00	0.0	0.0
D	**Ficote 360 TE**	**9.0**	**12.0**	4.73	5.00	4.47	4.73	0.0	6.7
E	**Osmocote Plus 8-9 months**	**5.0**	**6.0**	3.13	3.27	4.20	2.73	0.0	0.0
F	**Osmocote Plus 12-14 months Spring**	**6.0**	**8.0**	3.53	3.67	4.33	4.20	0.0	0.0
G	**Osmocote Plus 16-18 months**	**9.0**	**12.0**	3.93	4.47	3.93	4.60	0.0	0.0
H	**Sierra 'Midlands' Blend**	**6.0**	**8.0**	3.93	4.07	3.80	3.53	13.3	0.0
	d.f. = 30	*SED = ±*		*0.626*		*0.590*			
		LSD (5%) = ±		*1.28*		*1.20*			

APPENDIX II

Table 9 Fourth Growth Record of *Weigela* at Efford - June 1996

Mean Scores

(Figures are a mean of 3 replicates of no. of surviving plants/plot)

Treatment Code	CRF	Rate (kg/m³)	New Growth Score 1 to 5 (5 = most)	Foliage Colour Score 1 to 5 (5 = darkest)	Amount of Flower Score 1 to 5 (5 = most)	Quality Score 1 to 5 (5 = best)	Total % Dead
A	**Ficote 140 TE**	**6.0**	2.56	1.78	2.67	1.56	27.8
B	**Ficote 180 TE**	**7.5**	3.07	2.47	3.20	1.89	22.2
C	**Ficote 270 TE**	**10.0**	3.67	4.17	3.28	3.06	11.1
D	**Ficote 360 TE**	**12.0**	4.37	4.70	4.53	4.10	22.2
E	**Osmocote Plus 8-9 months**	**6.0**	2.53	1.82	3.00	1.84	5.6
F	**Osmocote Plus 12-14 months Spring**	**8.0**	3.11	2.78	3.56	2.89	16.7
G	**Osmocote Plus 16-18 months**	**12.0**	4.20	2.80	4.07	3.27	38.9
H	**Sierra 'Midlands' Blend**	**8.0**	2.78	2.51	3.11	2.31	5.6
	d.f. = 14	*SED = ±*	*0.533*	*0.580*	*0.531*	*0.605*	
		LSD (5%) = ±	*1.14*	*1.24*	*1.14*	*1.30*	

APPENDIX II

Table 10 **Fourth Growth Record of *Weigela* at Johnsons of Whixley - June 1996**

Mean Scores

(Figures are a mean of plants surviving from original 15)

Treatment Code	CRF	Rate (kg/m³) +KPA	Rate (kg/m³) -KPA	New Growth Score 1 to 5 (5= most) +KPA	New Growth Score 1 to 5 (5= most) -KPA	Foliage Colour Score 1 to 5 (5 = darkest) +KPA	Foliage Colour Score 1 to 5 (5 = darkest) -KPA	Amount of Flower Score 1 to 5 (5 = most) +KPA	Amount of Flower Score 1 to 5 (5 = most) -KPA	Quality Score 1 to 5 (5 = most) +KPA	Quality Score 1 to 5 (5 = most) -KPA	Total % Dead +KPA	Total % Dead -KPA
A	Ficote 140 TE	**4.5**	**6.0**	4.50	4.56	4.50	3.67	3.63	3.28	3.13	2.83	6.7	26.7
B	Ficote 180 TE	**6.0**	**7.5**	5.00	4.61	4.87	5.00	3.93	3.98	3.67	3.62	0.0	20.0
C	Ficote 270 TE	**8.0**	**10.0**	5.00	5.00	5.00	5.00	4.47	4.47	4.47	4.60	0.0	0.0
D	Ficote 360 TE	**9.0**	**12.0**	5.00	5.00	5.00	5.00	4.20	4.64	4.33	4.64	0.0	13.3
E	Osmocote Plus 8-9 months	**5.0**	**6.0**	4.07	4.87	3.40	3.67	3.53	4.47	2.87	3.67	0.0	0.0
F	Osmocote Plus 12-14 months Spring	**6.0**	**8.0**	4.87	4.67	5.00	4.20	4.20	3.43	3.93	3.77	0.0	6.7
G	Osmocote Plus 16-18 months	**9.0**	**12.0**	4.47	5.00	4.47	5.00	3.80	4.40	3.67	4.53	0.0	13.3
H	Sierra 'Midlands' Blend	**6.0**	**8.0**	4.70	4.67	4.67	4.34	3.13	3.87	3.27	3.54	6.7	20.0
	d.f. = 30	*SED = ±*		*0.338*		*0.554*		*0.512*		*0.436*			
		LSD (5%) = ±		*0.69*		*1.13*		*1.05*		*0.89*			

APPENDIX II

Table 11 Fourth Growth Record of *C.p.* 'Boulevard' at Efford - April 1996

Mean Scores

(Figures are a mean of 3 replicates, 6 plants/plot)

Treatment Code	CRF	Rate (kg/m^2)	Size Score 1 to 5 (5 = biggest)	Colour Score 1 to 5 (5 = darkest)
A	**Ficote 140 TE**	**4.5**	3.00	1.56
B	**Ficote 180 TE**	**6.0**	2.89	2.56
C	**Ficote 270 TE**	**8.0**	3.67	3.78
D	**Ficote 360 TE**	**9.0**	4.11	5.00
E	**Osmocote Plus 8 - 9 months**	**5.0**	3.00	1.00
F	**Osmocote Plus 12 - 14 months Spring**	**6.0**	4.00	3.00
G	**Osmocote Plus 16 - 18 months**	**9.0**	4.22	4.56
H	**Sierra 'Midlands' Blend**	**6.0**	3.56	2.33
	d.f. = 14	*SED = ±*	*0.418*	*0.565*
		LSD (5%) = ±	*0.90*	*1.21*

N.B. There were no deaths in the *C.p.* 'Boulevard'.

APPENDIX III

Plate 1 *Prunus* 'Rotundifolia': April 1996

Size Scores

5 4 3 2 1

Old Leaf Colour Scores

5 3 1

New Leaf Colour Scores

APPENDIX III

Plate 2 Efford: *Prunus laurocerasus* 'Rotundifolia' Treatment Comparisons

May 1996

Ficote

140 TE	180 TE	270 TE	360 TE
(4.5 kg/m^3)	(6.0 kg/m^3)	(8.0 kg/m^3)	(9.0 kg/m^3)

Osmocote Plus

8-9 months	12-14m Spring	16-18 m	'Midlands' Blend
(5.0 kg/m^3)	(6.0 kg/m^3)	(9.0 kg/m^3)	(6.0 kg/m^3)

APPENDIX III

Plate 3 Efford: *Prunus* 'Rotundifolia' Treatment Comparisons

May 1996

Ficote 270 TE	Osmocote Plus 16-18 months	Ficote 360 TE
(8 kg/m^3)	(9 kg/m^3)	(9 kg/m^3)

APPENDIX III

Plate 4 *Weigela* 'Red Prince': June 1996

Quality Scores

5 3 1

Amount of New Growth Scores

5 3 1

APPENDIX III

Plate 5 Efford: *Weigela* 'Red Prince' Treatment Comparisons

June 1996

Ficote

140 TE	180 TE	270 TE	360 TE
(6 kg/m^3)	(7.5 kg/m^3)	(10 kg/m^3)	(12 kg/m^3)

Osmocote Plus

8-9 m	12-14 m Spring	16-18 m	'Midlands' Blend
(6 kg/m^3)	(8 kg/m^3)	(12 kg/m^3)	(8 kg/m^3)

APPENDIX III

Plate 6 Efford: *Weigela* 'Red Prince' Treatment Comparisons

June 1996

Ficote 270 TE	Ficote 360 TE	Osmocote Plus 16-18 months
(10 kg/m^3)	(12 kg/m^3)	(12 kg/m^3)

APPENDIX III

Plate 7 *Chamaecyparis pisifera* 'Boulevard': April 1996

Size Scores

5 3 1

Colour Scores

5 3 1

APPENDIX III

Plate 8 *Chamaecyparis pisifera* 'Boulevard' Treatment Comparisons

May 1996

Ficote

140 TE (4.5 kg/m^3) 180 TE (6 kg/m^3) 270 TE (8 kg/m^3) 360 TE (9 kg/m^3)

Osmocote Plus

8-9m (5 kg/m^3) 12-14m Spring (6 kg/m^3) 16-18m (9 kg/m^3) 'Midlands' Blend (6 kg/m^3)

Ficote 270 TE Osmocote Plus 16-18 months Ficote 360 TE

APPENDIX IV

HRI Efford Meteorological Data

Table 12 **Rainfall (mm)**

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1996	**58.2**	**95.2**	**46.5**	**36.2**	**58.7**	**26.7**						
1995	143.8	116.8	40.2	27.1	22.2	10.1	26.7	3.4	142.9	38.6	**144.3**	**81.7**
1994	132.2	89.4	57.8	61.3	81.7	23.4	19.6	47.6	70.9	125.8	91.4	116.9
1993	98.0	6.2	45.2	74.7	45.7	61.6	86.2	35.8	120.7	169.3	64.4	185.0
1992	21.7	28.6	51.6	70.4	19.6	32.2	63.1	88.1	78.9	81.5	145.3	81.2
1991	88.5	29.3	77.9	42.3	4.0	113.0	63.3	12.3	48.6	63.0	49.2	33.4
1990	112.7	166.5	6.4	43.9	11.2	55.3	12.2	23.1	28.9	98.6	53.6	62.3
1989	30.6	69.8	74.8	71.7	13.7	34.6	22.5	23.6	37.3	91.0	56.6	242.4
1988	170.9	47.3	82.0	39.5	27.9	34.3	71.8	63.6	41.6	98.4	20.7	20.8
1987	15.8	60.4	89.4	69.1	19.3	54.4	61.4	16.4	37.7	195.6	78.3	43.2
1986	109.9	11.3	61.3	58.9	74.3	25.3	46.6	87.6	33.9	79.2	114.6	102.6
1985	69.5	47.0	51.6	43.8	44.6	61.1	37.8	88.2	24.3	32.4	53.4	88.0
1984	120.5	36.1	81.3	0.3	86.4	18.6	12.0	18.7	62.1	94.6	127.9	96.2
12/13 yr mean	90.2	61.8	58.9	49.2	39.2	42.4	43.6	42.4	60.7	97.3	83.3	96.1
41/42 yr mean	83.9	55.2	59.0	45.3	47.8	54.1	46.9	57.7	70.0	83.8	83.2	88.3

N.B. **Bold** figures in body of table relate to the period of the trial covered by the final report.

APPENDIX IV

HRI Efford Meteorological Data

Table 13 Mean Daily Sunshine Hours

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1996	**1.3**	**3.9**	**2.7**	**5.2**	**6.6**	**9.9**						
1995	1.7	2.7	6.2	6.2	8.7	8.4	8.5	9.9	5.7	3.9	**3.0**	**1.6**
1994	2.5	2.7	3.7	6.3	5.8	9.5	9.0	6.8	5.0	5.7	1.3	2.0
1993	1.1	2.3	4.6	4.5	6.7	8.3	6.0	8.2	4.6	4.3	2.8	1.9
1992	2.4	2.1	2.0	5.5	9.3	8.3	5.4	5.2	4.7	4.2	2.0	1.7
1991	2.2	2.8	3.6	5.8	5.8	5.2	7.2	8.6	6.1	3.0	2.2	1.7
1990	1.5	3.2	5.2	8.1	9.6	4.6	10.2	8.6	6.3	3.5	3.0	2.0
1989	2.2	3.7	3.0	5.7	10.6	9.3	9.8	9.3	4.8	3.6	3.6	1.1
1988	2.0	4.6	3.4	6.5	8.0	6.1	6.7	5.9	3.8	3.5	3.5	1.5
1987	2.1	3.0	4.0	6.7	7.8	5.8	7.2	6.5	5.0	3.5	2.1	1.4
1986	2.0	2.7	3.6	5.6	5.9	7.2	6.2	5.7	5.6	3.4	2.8	2.1
1985	2.5	3.0	4.3	5.7	6.9	6.0	7.9	6.5	5.4	4.1	2.8	1.2
1984	2.8	2.9	3.0	8.2	4.9	9.9	8.9	6.8	4.0	2.9	2.2	1.9
12/13 mean	2.0	3.0	3.8	6.1	7.4	7.6	7.7	7.3	5.1	3.8	2.6	1.7
41/42 yr mean	2.0	2.8	4.1	5.9	7.1	7.3	7.3	6.7	5.3	3.9	2.5	1.8

N.B. **Bold** figures in body of table relate to the period of the trial covered by the final report.

APPENDIX IV

HRI Efford Meteorological Data

Table 14 Mean Maximum Temperature (°C)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1996	**7.2**	**6.6**	**8.0**	**12.2**	**13.5**	**18.9**						
1995	9.2	10.6	10.7	13.6	16.7	20.2	22.8	25.5	18.5	17.2	**12.4**	**6.8**
1994	9.5	8.2	11.5	12.2	14.8	18.7	22.2	21.2	17.5	15.6	13.8	11.3
1993	9.8	7.8	10.4	13.2	16.5	19.5	19.1	19.6	17.1	13.0	9.4	9.7
1992	7.2	9.0	10.9	12.7	18.7	20.6	20.1	19.5	17.6	12.9	12.3	8.2
1991	7.3	5.1	11.0	12.2	15.5	15.5	20.5	21.0	20.0	14.0	10.9	8.5
1990	10.4	11.2	11.8	13.6	18.4	16.9	21.9	22.7	19.1	16.1	10.8	7.9
1989	9.9	10.0	11.5	10.8	19.3	20.2	23.9	21.6	19.5	16.5	11.5	9.5
1988	9.1	8.9	10.2	12.7	16.7	18.8	17.5	19.1	17.7	15.1	10.6	10.7
1987	3.9	7.4	8.1	13.4	15.2	16.6	20.5	20.4	18.1	14.7	10.5	8.3
1986	7.8	2.2	8.3	9.9	13.7	20.0	19.4	17.9	15.9	15.4	12.3	10.0
1985	4.2	5.8	8.4	12.7	15.8	17.2	20.5	18.1	18.4	14.9	8.3	9.8
1984	8.5	7.7	8.6	13.7	14.4	19.5	22.0	22.0	18.0	15.0	12.1	9.8
12/13 yr mean	8.0	7.7	9.9	12.5	16.1	18.7	20.9	20.7	18.1	15.0	11.2	9.2
41/42 yr mean	7.5	7.4	9.8	11.9	15.6	18.4	20.4	20.3	18.3	15.0	10.9	8.7

N.B. **Bold** figures in body of table relate to the period of the trial covered by the final report.

APPENDIX IV

HRI Efford Meteorological Data

Table 15 **Mean Minimum Temperature (°C)**

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1996	**3.5**	**-0.1**	**2.1**	**4.7**	**5.4**	**9.3**						
1995	3.2	5.8	2.6	5.7	7.8	10.2	13.7	13.8	10.5	11.0	**5.1**	**1.2**
1994	4.1	2.1	5.6	4.4	8.6	10.4	13.8	13.7	10.9	7.7	9.6	5.3
1993	5.1	3.3	3.8	6.5	8.8	11.4	12.4	11.3	10.0	7.0	2.8	4.1
1992	1.7	2.8	5.3	5.6	9.2	10.8	13.5	13.4	12.0	5.4	6.2	2.7
1991	3.1	0.5	5.4	4.8	7.0	9.4	12.9	12.8	11.5	8.1	4.8	4.0
1990	5.5	6.3	5.6	4.3	8.6	10.8	12.6	13.5	9.7	10.3	5.8	3.3
1989	4.3	3.3	5.1	3.9	9.4	10.9	14.3	13.0	12.0	10.0	5.6	4.3
1988	4.0	2.5	4.5	4.8	8.8	10.7	12.4	11.9	10.3	7.6	3.0	5.3
1987	0.6	1.7	1.9	6.1	7.0	9.7	12.4	11.9	11.9	8.4	4.8	4.5
1986	1.8	2.2	2.2	2.9	7.8	10.5	12.4	11.5	7.6	8.8	5.9	4.2
1985	1.3	0.2	1.5	4.5	7.3	9.2	11.9	12.5	11.1	8.7	2.2	5.5
1984	2.7	2.1	2.3	3.7	6.7	10.3	11.6	13.3	11.2	9.3	6.6	3.2
12/13 yr mean	3.1	2.5	3.7	4.8	7.9	10.3	12.8	12.7	9.9	8.5	5.2	4.0
41/42 yr mean	2.3	1.9	3.3	4.4	7.5	10.3	12.3	12.3	10.7	8.2	4.9	3.4

N.B. **Bold** figures in body of table relate to the period of the trial covered by the final report.

APPENDIX IV

HRI Stockbridge House Meteorological Data

Table 16 Rainfall (mm)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1996	**50.3**	**49.5**	**23.8**	**40.0**	**31.7**	**29.6**						
1995	87.4	66.0	38.3	17.2	30.9	15.8	15.8	9.0	132.8	14.5	**43.8**	**64.9**
1994	75.3	43.0	28.3	44.1	40.7	15.8	36.9	36.3	75.0	40.7	66.2	70.1
1993	48.4	8.3	7.9	74.8	50.3	38.2	38.2	54.8	89.9	44.4	48.3	71.6
1992	34.9	20.8	54.6	41.7	36.8	38.8	68.6	74.9	80.1	55.6	55.4	35.6
1991	40.3	62.9	51.6	30.2	9.9	43.1	29.7	15.8	22.3	31.9	33.7	26.0
1990	71.2	61.5	7.9	13.9	20.5	70.6	28.7	53.0	27.0	41.5	26.7	96.1
1989	13.1	35.1	44.5	55.6	38.7	66.1	42.3	23.3	10.7	46.9	28.4	70.2
1988	82.2	48.4	76.6	23.1	39.3	68.9	103.3	65.3	19.4	61.8	36.2	25.2
1987	10.8	31.8	78.6	52.7	27.5	77.7	57.5	53.9	41.9	103.5	25.9	37.3
1986	55.6	14.2	48.1	79.9	98.4	40.6	28.1	114.1	7.5	56.8	61.6	69.8
1985	51.0	1.1	48.6	56.5	54.5	32.0	63.3	74.8	21.1	33.0	63.8	55.0
1984	83.6	28.0	53.6	16.1	43.2	20.9	11.0	39.5	73.9	64.8	97.2	27.3
12/13 yr mean	54.1	36.2	43.3	42.0	40.2	42.9	43.6	51.2	50.1	49.7	48.9	54.1
30 yr mean	48.6	38.3	49.2	43.4	49.3	50.2	50.4	51.6	50.2	49.7	53.8	55.4

N.B. **Bold** figures in body of table relate to the period of the trial covered by the final report.

APPENDIX IV

HRI Stockbridge House Meteorological Data

Table 17 Mean Daily Sunshine Hours

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1996	**0.6**	**2.5**	**1.6**	**3.9**	**5.8**	**7.1**						
1995	1.8	2.9	5.1	5.7	6.6	5.8	7.0	7.7	4.1	3.9	**1.9**	**1.2**
1994	2.0	2.0	3.7	5.8	5.0	6.4	6.1	5.6	3.3	2.6	2.0	1.8
1993	1.3	1.5	3.4	3.5	5.9	5.6	5.0	4.6	3.0	2.6	1.0	1.5
1992	1.4	2.6	3.1	4.2	7.5	6.0	5.4	5.4	3.4	2.8	2.3	1.0
1991	2.6	1.8	2.0	4.7	3.8	4.1	6.8	6.7	6.0	2.5	1.9	0.9
1990	1.9	2.5	3.6	6.4	6.9	3.4	7.3	6.0	4.4	2.7	2.1	1.5
1989	2.0	3.8	3.3	3.7	7.9	7.3	7.4	7.0	4.3	2.8	2.1	1.0
1988	1.5	3.9	2.9	3.0	5.6	4.8	3.4	5.4	4.6	2.5	2.9	1.6
1987	1.6	2.2	2.8	4.3	5.8	2.6	4.7	3.6	4.8	3.0	1.4	1.1
1986	2.0	2.3	3.5	3.4	5.7	6.5	4.6	3.5	5.6	3.2	2.6	1.5
1985	1.1	2.7	3.5	3.6	4.4	5.9	5.2	4.5	3.7	2.9	2.9	1.1
1984	1.9	1.7	1.9	6.8	5.9	5.9	7.4	5.7	3.5	2.9	1.4	1.5
12/13 mean	1.7	2.5	3.1	4.6	5.9	5.5	5.9	5.4	4.3	2.8	2.1	1.3
30 yr mean	1.6	2.2	3.1	4.3	5.8	5.7	5.4	5.1	4.0	2.9	2.1	1.4

N.B. **Bold** figures in body of table relate to the period of the trial covered by the final report.

APPENDIX IV

HRI Stockbridge House Meteorological Data

Table 18 Mean Maximum Temperature (°C)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1996	**5.0**	**5.7**	**6.3**	**12.6**	**13.4**	**19.0**						
1995	7.0	9.4	8.9	12.8	16.4	18.5	24.1	24.2	17.6	16.8	**10.3**	**4.3**
1994	7.1	5.2	11.2	12.2	13.9	18.7	23.6	20.6	16.0	12.7	12.0	8.7
1993	8.4	7.6	10.3	13.0	15.3	19.3	19.4	18.6	15.7	11.3	6.4	7.3
1992	6.0	9.1	10.5	12.4	18.3	21.1	20.5	20.4	16.8	10.7	10.5	5.5
1991	5.5	4.6	10.9	11.9	14.6	16.0	22.7	22.9	19.6	13.0	9.3	7.0
1990	9.3	10.2	12.6	13.6	17.9	17.5	21.4	23.4	17.2	14.2	9.2	7.3
1989	9.5	9.9	11.3	9.8	18.5	20.3	22.9	21.6	19.2	15.1	8.9	7.2
1988	7.3	7.5	9.1	11.5	15.7	19.2	18.4	20.1	16.8	13.5	8.7	10.0
1987	3.2	6.4	7.1	13.9	14.1	15.8	19.7	19.6	17.8	12.5	8.7	7.9
1986	5.5	1.2	8.3	9.1	15.4	18.6	20.1	17.3	16.7	14.1	11.0	8.6
1985	3.1	5.4	8.1	11.7	14.3	16.4	20.1	19.0	18.8	14.6	6.5	8.1
1984	6.3	5.8	7.2	12.8	14.0	18.4	22.3	22.8	16.8	14.3	9.6	7.1
12/13 yr mean	6.4	6.8	9.4	12.1	15.5	18.4	21.3	20.9	17.5	13.6	9.3	7.6
30 yr mean	6.2	6.3	9.1	11.7	15.4	18.5	20.4	20.4	17.6	13.5	8.9	7.0

N.B. **Bold** figures in body of table relate to the period of the trial covered by the final report.

APPENDIX IV

HRI Stockbridge House Meteorological Data

Table 19 **Mean Minimum Temperature (°C)**

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1996	**2.2**	**1.1**	**1.6**	**3.7**	**4.7**	**8.9**						
1995	0.4	2.7	1.0	4.1	6.2	8.4	12.8	11.5	9.4	8.5	**4.4**	**0.4**
1994	1.9	-0.2	3.9	4.5	5.7	9.1	11.1	11.2	8.9	6.3	6.2	2.7
1993	1.5	2.3	2.1	5.8	6.8	9.0	10.7	9.5	8.5	4.8	1.7	1.9
1992	0.0	1.8	3.5	4.4	6.9	9.8	11.1	10.7	9.3	4.5	2.8	0.4
1991	-0.8	-2.3	4.4	3.4	6.4	7.3	12.0	11.7	9.0	7.3	3.1	1.2
1990	3.4	4.0	4.6	2.3	6.4	9.8	11.2	12.4	8.4	8.5	4.0	1.7
1989	3.0	2.3	3.2	2.4	6.3	8.1	11.8	10.9	9.7	7.7	3.0	1.4
1988	1.8	1.6	2.4	4.5	6.3	9.7	11.1	11.2	8.6	6.6	1.2	3.9
1987	-1.3	-0.2	0.6	5.1	5.2	8.3	11.3	11.4	8.8	5.3	3.6	3.0
1986	0.4	-3.2	1.4	1.8	7.0	9.1	10.4	8.6	5.3	5.9	4.1	2.4
1985	-2.3	-1.1	0.5	4.5	6.4	7.4	11.0	10.4	9.7	7.5	0.3	2.9
1984	-0.2	-0.6	1.8	2.0	4.1	8.6	9.1	11.0	10.2	6.9	5.6	1.6
12/13 yr mean	0.8	0.5	2.4	3.7	6.0	8.7	11.1	10.9	8.9	6.6	3.3	1.7
30 yr mean	0.7	0.5	2.1	3.5	6.1	8.9	10.8	10.7	8.9	6.4	2.9	1.4

N.B. **Bold** figures in body of table relate to the period of the trial covered by the final report.

APPENDIX V

Contract between HRI (hereinafter called the "Contractor") and the Horticultural Development Council (hereinafter called the "Council") for a research/development project.

1. TITLE OF PROJECT **Contract No: HNS43a**

AN INVESTIGATION OF THE USE OF CONTROLLED RELEASE FERTILISERS (CRF) FOR SPRING POTTING OF CONTAINER NURSERY STOCK GROWN OUTDOORS

2. BACKGROUND AND COMMERCIAL OBJECTIVE

The MAFF funded work on CRF screening ceased in 1987. Since then a new range of products have become available, including products with longer term release patterns. The choice of products available gives the opportunity to tailor CRFs to species' requirements and marketing targets, and in the case of the long term materials enables quality to be maintained, either within the container over an extended production period, or during shelf-life and subsequent establishment.

The previous HDC trial HNS 43 made a start on investigating the use of a range of CRF formulations for high value moderate and salt sensitive indicator species under protection. This work demonstrated the potential of the longer term products to maintain growth and quality over extended periods. This now needs investigating with the outdoor crops.

The current contract concentrates on a spring potted crop and includes 8-9 month through to 2 year extended release formulations. A representative species for the deciduous, conifer and evergreen groups will be included and information will be gained on the formulation and rate of use required for targeting autumn or following spring markets as well as shelf-life potential.

In addition, whether or not the inclusion of a 'kick start' fertiliser would be of advantage needs investigation. The inclusion of a soluble base fertiliser along with the CRF is widely recommended, but its benefit might well be related to type and rate of CRF used, geographical location and species grown. For instance, the inclusion of the soluble fast start fertilisers could be more effective in the shorter season, cooler growing areas than in the south of the country, and climatic differences would also influence response to the various CRFs. The proposal therefore includes the option for part of the work to be done on a northern site, using species and mixes in common with the Efford component of the trial. This would be the first occasion in which the trials with CRFs have been split between north and south sites and will yield valuable information on the potential use of the various formulations under different conditions.

3. POTENTIAL FINANCIAL BENEFIT TO THE INDUSTRY

Information on tailoring CRF use to species and market requirements would help improve market value in terms of quality and shelf-life. Use of the longer term materials could provide savings in reducing or eliminating the need for liquid feeding or top dressing pre sale. Use of the correct fertiliser formulation/rate as influenced

by geographical location could also have cost saving implications.

4. SCIENTIFIC/TECHNICAL TARGET OF THE WORK

To investigate the comparative benefits of a range of the most widely available controlled release fertilisers in the UK for spring potting, including the need for an initial boost from a soluble fertiliser inclusion, and the influence geographical location has on response to the fertilisers.

5. CLOSELY RELATED WORK - COMPLETED OR IN PROGRESS

A two year HDC funded trial investigating a range of CRFs for autumn potting of sensitive species was completed in autumn 1993 (HNS 43).

6. DESCRIPTION OF THE WORK

At Efford *Prunus laurocerasus* 'Rotundifolia' will be used to screen the full range of fertilisers at all rates. A limited number of treatments will be applied to two further species, *Weigela* and *Chamaecyparis pisifera* 'Boulevard'. Plots will be guarded by *Lavendula rosea*, *Cytisus x praecox* and *Azalea* 'Blue Danube' to give further observations of treatment effects. Plants will be grown in all treatments up to the end of October 1995, with an observation of the long term CRF treatments kept until the following spring.

At E.R. Johnson Nurseries, Yorkshire, a limited number of treatments will be applied to *Prunus laurocerasus* 'Rotundifolia' and *Weigela* to give data from a northern site. Source material of plants and media would be the same for both sites, with Efford staff involved in potting, setting up and assessing the trial at the northern site.

Efford

Species 1 *Prunus laurocerasus* **'Rotundifolia'**

	Treatments:		Rate (kg/m³)	(KPA*: 0.75 kg/m³)
A	Ficote 140 14:8:8 TE	L	3	± KPA
		M	4.5	± KPA
		H	6	± KPA
B	Ficote 180 14:8:8 TE	L	4.5	± KPA
		M	6	± KPA
		H	7.5	± KPA
C	Ficote 270 14:8:8 TE	L	6	± KPA
		M	8	± KPA
		H	10	± KPA
D	Ficote 360 14:8:8 TE	L	7	± KPA
		M	9	± KPA
		H	12	± KPA
E	Osmocote Plus, 8-9 months	L	4	± KPA
		M	5	± KPA
		H	6	± KPA
F	Osmocote Plus, 12-14 month Spring	L	5	± KPA
		M	6	± KPA
		H	8	± KPA
G	Osmocote Plus, 16-18 months	L	8	± KPA
		M	9	± KPA
		H	12	± KPA
H	Sierra "Midlands" Blend	L	5	± KPA
		M	6	± KPA
		H	8	± KPA

* KPA = Kristalon KPA 12+14+24+Micro

Design: Randomised block with 3 replicates

8 CRFs x 3 rates x 2 KPA treatments x 3 reps = 144 plots

Plot size: 6 recorded plants per plot
+ 6 guard plants (Lavender)

Species 2 and 3 ***Weigela*** **and** ***Chamaecyparis pisifera*** **'Boulevard'**

Treatments	Rate (kg/m³) *Weigela*	*C.p.* 'Boulevard'
Ficote 140 14:8:8 TE	6	4.5
Ficote 180 14:8:8 TE	7.5	6
Ficote 270 14:8:8 TE	10	8
Ficote 360 14:8:8 TE	12	9
Osmocote Plus, 8-9 months	6	5
Osmocote Plus, 12-14 months Spring	8	6
Osmocote Plus, 16-18 month	12	9
Sierra "Midlands" Blend	8	6

Design: Randomised block with 3 replicates

8 CRFs x 3 reps	=	24 plots
	x	2 species
		48 plots

Plot size: 6 recorded plants per plot
+ 6 guard plants (*Cytisus* and *Azalea*)

Start material: Liners or large plugs potted-on into 3 litre containers

Growing media: 100% Irish Sphagnum peat

System: Outdoor drained sandbeds with overhead irrigation

Assessments:

3 top growth assessments of all treatments: Observation assessment of shelf life of: extended release materials		Autumn 1994, Spring 1995, Autumn 1995, Spring 1996
Root growth assessment:		Autumn 1994 or Spring 1995
Compost analyses:	Available nutrients:	4 weeks post potting (*Prunus* only, bulking across replicates. Recommended CRF rate only ± KPA = 16 samples)
	Conductivity:	monthly measurements of conductivity in pots, all treatments (using loaned PET Havenaar conductivity meter) from May 1994 to October 1994
	Residual analysis:	Late October 1994 and late October 1995. (*Prunus* only, bulking across replicates. Recommended CRF rate only = 8 samples/date)

Photographs as appropriate throughout trial

E.R. Johnson Nurseries

Species: ***Prunus laurocerasus*** **'Rotundifolia' and** ***Weigela***

Treatments	Rate (kg/m³)	
	No KPA	+ KPA (0.75 kg/m³)
Ficote 140 14:8:8 TE	6	4.5
Ficote 180 14:8:8 TE	7.5	6
Ficote 270 14:8:8 TE	10	8
Ficote 360 14:8:8 TE	12	9
Osmocote Plus, 8-9 months	6	5
Osmocote Plus, 12-14 months Spring	8	6
Osmocote Plus, 16-18 month	12	9
Sierra "Midlands" Blend	8	6

Design: Randomised block with 3 replicates

8 CRFs x 1 rate x 2 KPA treatments x 3 reps	=	48 plots
	x	2 species
		96 plots

Plot size: 5 recorded plants per plot
+ 2 guard plants

Assessments:

Top growth assessments: Autumn 1994, Spring 1995, Autumn 1995,

Photographs as appropriate

7. COMMENCEMENT DATE, DURATION AND REPORTING

Start date 25.05.94 ~~01.06.94~~; duration 2¼ years. The first year will monitor treatment effects during production and the second year the shelf life benefits of the products, all the experimental work will be completed by June 1996. Reports will be produced at the end of each assessment period. The results from the autumn 1994 assessments will be included in a report which will be submitted by 01.01.95. The results from the spring 1995 assessments will be included in a report which will be submitted by 01.10.95. The results from the autumn 1995 assessment will be submitted by 01.01.96. The final report detailing the results of the spring 1996 assessment together with the results from all the earlier assessments will be submitted by 01.10.96. Seven copies of each report (1 unbound) should be sent to the HDC, two copies will be sent to each collaborative sponsor by the HDC and the remaining three copies will be retained for internal use.

nb. failure to meet any of the reporting deadlines will result in a financial penalty, detailed in section 10 below.

8. STAFF RESPONSIBILITIES

Dr Liz Davies and Margaret Scott, HRI Efford
(nb. the site at Johnson Nurseries will be managed on a day-to-day basis by Agnes Harbour)

9. LOCATION

HRI Efford & E R Johnson Nurseries, Whixley, Yorkshire

Contract No: HNS43a

TERMS AND CONDITIONS

The Council's standard terms and conditions of contract shall apply.

Signed for the Contractor(s)

Signature.....

Position.....

Date.....

Signed for the Contractor(s)

Signature.....

Position.....

Date.....

Signed for the Council

Signature.....

Position.....

Date.....