Agricultural Development and Advisory Service

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CONTRACT REPORT

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Nutrition and transplanting dates for module raised subjects

Undertaken for HDC

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PRINCIPAL WORKERS

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AUTHENTICATION

I declare that this work was done under my supervision according to the procedures described herein and that this report represents a true and accurate record of the results obtained.

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Summary

Small (15 mm) modules filled with a low nutrient, peat based compost were direct seeded with Marigold, Petunia, Salvia and Verbena. Liquid feeds containing nitrogen at 100, 200 and 300 mg/litre N and potassium at 100 or 300 mg/litre K_2O (in factorial combination) were applied at every watering once germination was complete. Transplantings were made from the modules at weekly intervals once the trays were half covered with foliage and the transplants grown on to marketing stage. Records were taken of the plants both at transplanting and marketing stage.

The rate of nitrogen used greatly influenced plant size at transplanting stage, whereas potassium had no effect. Neither nutrient influenced either production time or plant quality at marketing stage.

Introduction

The use of small modules for the propagation of bedding plants is increasing rapidly in the UK. Whilst there are many advantages (faster production, less labour intensive) there are concerns about the effects on the quality of the end product and how this may be influenced by the cultural practices followed whilst the plants are growing in the modules. Previous trials investigated nutrition (ECT 556, 479) module size (ECT 535, 480), growth regulants (ECT 554, 478) and compost structure (ECT 484).

This trial is intended to complete studies on the nitrogen and potassium nutrition of plants growing in modules. In ECT 556 and 479 it was shown that the rate of nitrogen applied as a liquid feed was the main influence on plant size at transplanting stage when plants were grown in a compost of low nutritional status. Increasing potassium from 100 to 200 mg/litre had no effect on plant growth at this stage. Increasing the rate of either or both nutrients had no effect on plant size or quality at sale stage.

The objectives of this trial are:

1 To test the response of module raised bedding plants to potassium over a wider range of rates (100 and 300 mg/litre K_2O)

2 To confirm the response of bedding plants to nitrogen

3 To investigate whether optimum transplanting stage is influenced by nutritional regimes

Treatments

1	Nitrogen (liquid feed at every watering)	100 mg/litre 200 " " 300 " "
2	Potash (liquid feed at every watering)	100 mg/litre 300 " "
3	Transplanting date	50% tray cover " " " plus 1 week " " " plus 2 weeks
4	Species:	Marigold cv Inca Gold Petunia cv Ultra Burgundy Salvia cv Red Riches Verbena cv Derby Coral

Design

3 nitrogen x 2 potash x 3 transplantings x 2 replicates = 36 plots/species
10 recorded plants/plot. Full factorial arrangement of treatments, analysed by analysis of variance following a log transformation (data and SED's quoted in report are log transformations) where necessary.

Materials and Methods

Sowing: seed was direct sown into 15 mm (diameter) module trays (PG 432) filled with a peat based compost (Fison's Propagation, conductivity ADAS Index 0 - 1, less than 120 mg/litre). A covering of vermiculite was given and the trays placed into a germination cabinet (temperature 21°C) with a low level of illumination from fluorescent tubes.

Growing on: once emergence was well under way the trays were placed in a glasshouse set to give a minimum temperature of 12°C venting at 20°C. Module trays were placed on plastic mesh supports to ensure that air pruning of the roots took place and to prevent cross contamination of the liquid feed treatments.

Liquid feed: six liquid feeds were prepared from ammonium nitrate and potassium nitrate (Appendix I). These were applied at every watering, giving sufficient to run through the bottom of the module.

Transplanting: after recording, the plants were transplanted into 70 mm square pots (FP 7) filled with a peat based compost. These were then grown on alongside the modules in the same house. Liquid feed (200 ppm N + K_2O) was given at every watering once roots had explored all the compost. Salvias were additionally fed immediately after the final transplanting with 100 ppm N + K_2O to improve the foliage colour.

Crop Diary

		Transplanting dates recorded at			
species	sown	1	2	3	marketing stage
Marigold	14 April	1 May	5 May	11 May	26 May
Petunia	24 March	21 April	28 April	5 May	25 May
Salvia	10 March	7 April	14 April	21 April	20 May
Verbena	19 March	28 April	1 May	5 May	16 June

Recording

Transplanting stage: recording and transplanting took place once 50% of the tray was covered with foliage in the most advanced trays and at weekly intervals thereafter (rapid growth of some species forced shorter intervals to be used). Plant height, leaf size and leaf number were recorded. At the final transplanting date compost samples were taken for analyses.

Marketing stage: plants were recorded for a second time when 50% of the plants in a tray had one or more open flowers.

Growth regulants: daminozide (Alar) was applied as follows:

29 April	-	5000 ppm	-	Salvia
8 May	-	5000 ppm	-	Salvia
15 May	-	2500 ppm	-	Verbena
15 May	-	2500 ppm	-	Petunia
15 May	-	2500 ppm	-	Marigold

Statistical Analysis

All results were subjected to analysis of variance. Strictly speaking, leaf number and production time are not ideally suited to this type of analysis (the data being discontinuous). The analyses presented are good indicators of crop responses but should not be interpreted in too much detail. For statistical reasons much of the data at transplanting stage showed no significant effects and transformation was not considered worthwhile.

Results

Transplanting stage: nitrogen had a considerable effect on plant size at transplanting stage (Tables 1 and 2). Those given the higher rates of nitrogen being taller and with larger leaves (except Salvia). Only in the case of Marigold did the nitrogen treatments have a significant effect on leaf number, although leaf number tended to increase with the rate of nitrogen (Table 3). There was no significant difference in height, leaf size or leaf number between the two potash treatments. Neither was there any interaction between potassium and nitrogen. There was no interaction between nutrition and transplanting stage.

Marketing stage: without exception, nutritional regime had no influence on the time taken to produce a marketable plant or its final quality.

Compost Analyses

The results of the analyses of the module composts at the third and final transplanting date are shown in tables 4a, 4b and 4c (potassium, conductivity and nitrate respectively). Most of these data equate with ADAS indices 0 - 2 and are on the low side for bedding plants. Petunia and Salvia composts had the lowest levels of nutrient, Verbena the highest. The analysis figures do not reflect the liquid feeding treatments which had been applied. This is probably due to the small volume of compost relative to the size of plant at the final transplanting date and to the policy of watering to excess to avoid an accumulation of salts in the module. The conductivity figures indicate that this policy was successful. Overall, the compost analyses data suggest that liquid feeding is essential to avoid nutrient deficiency.

Table 1: Effect of nitrogen on height, log mm (recorded mm) at transplanting stage (means over all transplanting treatments)

	nitrogen mg/litre N			
species	100	200	300	LSD
Marigold	3.70 (42.1)	3.80 (47.2)	3.78 (46.1)	0.049
Petunia	1.32 (25.6)	1.37 (30.2)	1.37 (30.6)	0.036
Salvia	1.68 (52.1)	1.69 (52.9)	1.65 (49.6)	0.038
Verbena	1.56 (38.4)	1.62 (44.3)	1.67 (49.8)	0.036

Differences significant to P = 0.05 are indicated (log mm)
LSD's are quoted to P = 0.05

Table 2: Effect of nitrogen on leaf size (log mm, recorded mm) at transplanting stage (means over all transplanting treatments)

	nitrogen mg/litre N			
species	100	200	300	LSD
Marigold	3.41 (37.4)	3.70 (42.5)	3.92 (42.5)	0.058
Petunia	1.61 (41.1)	1.63 (43.4)	1.66 (47.3)	0.026
Salvia	1.30 (33.1)	1.31 (20.8)	1.31 (21.1)	0.021
Verbena	1.51 (33.1)	1.58 (39.6)	1.61 (41.7)	0.023

Table 3: Effect of nitrogen on leaf number at transplanting stage (means over all transplanting treatments) (non-continuous data - analysis regarded as approximate)

species	100	200	300	LSD	SED
Marigold	3.33	3.57	3.53	0.067	0.14
Petunia	6.93	7.15	6.91	0.196	0.42
Salvia	5.23	5.28	5.44	0.093	0.20
Verbena	6.53	6.72	6.80	0.134	0.29

Table 4: Compost analyses at the final transplanting

4a

N	K_2O		potassium K_2O (mg/l) [ADAS index] Marigold	Petunia	Salvia	Verbena
100	100	1)	76 [2]	22 [0]	19 [0]	1 13 [3]
200	100	2)	65 [2]	7 [0]	5 [0]	1 72 [2]
300	100	3)	43 [1]	10 [0]	7 [0]	1 46 [3]
100	300	4)	30 [1]	47 [1]	22 [0]	1 57 [3]
200	300	5)	90 [2]	50 [1]	12 [0]	50 [1]
300	300	6)	86 [2]	61 [2]	17 [0]	1 40 [3]

4b

N	K_2O		conductivity (microsiemens [ADAS index] Marigold	Petunia	Salvia	Verbena
100	100	1)	1 50 [0]	1.00 [0]	85 [0]	1 80 [1]
200	100	2)	1 45 [0]	80 [0]	70 [0]	1 55 [1]
300	100	3)	1 15 [0]	80 [0]	80 [0]	1 80 [1]
100	300	4)	85 [0]	100 !0]	80 [0]	145 [0]
200	300	5)	155 [1]	115 [0]	100 [0]	160 [1]
300	300	6)	170 [1]	115 [0]	100 [0]	195 [1]

4c nitrate - N (mg/l) [ADAS index]

N	K_2O		Marigold	Petunia	Salvia	Verbena
100	100	1)	17 [1]	12 [0]	10 [0]	43 [2]
200	100	2)	29 [2]	12 [0]	7 [0]	36 [2]
300	100	3)	14 [0]	19 [1]	14 [0]	80 [3]
100	300	4)	<1 [0]	12 [0]	10 [0]	26 [2]
200	300	5)	31 [2]	22 [1]	17 [1]	55 [3]
300	300	6)	36 [2]	12 [0]	14 [0]	55 [3]

Discussion

The trial confirmed that the type of transplant of bedding plants in modules can be regulated by control of the amount of nitrogen given as liquid feed. There was no evidence that any of the regimes was especially suited to growing the plants in modules for prolonged periods. None of the regimes tested had any influence on the quality of the finished plants. This suggests that the rate of nitrogen used will be selected by the grower in order to produce young plants which will be robust and easily transplanted. It is likely therefore that a low rate of nitrogen will be adequate under most circumstances.

There was no evidence that the rates of potassium used had any influence on plant growth. The use of high levels of this nutrient reputed to produce 'hard' or compact plants appears to be unfounded. High rates of potash may increase conductivities which can result in root damage, especially if compost is permitted to become dry. It would seem preferable to use the lowest rate of potassium consistent with the prevention of nutrient deficiencies.

Conclusions

1 Within the range tested, increasing the strength of nitrogen in liquid feeds increases the growth rate of bedding plant seedlings growing in modules

2 Within the range tested, increasing the strength of potassium in liquid feeds does not affect the growth rate or appearance of bedding plant seedlings growing in modules

3 Within the range tested, varying the strength of nitrogen and/or potassium in liquid feeds applied to bedding plant seedlings growing in modules does not have a residual effect at sale stage

Recommendations

For the species tested, a feed consisting of 100 ppm N & K_2O applied to excess at every watering appears suitable for the nutrition of bedding plant seedlings growing in modules.

Future work

Further work on nutrition in modules does not warrant a high priority. Areas for further investigation include:

1 Defining the lower limit for liquid feeding

2 Testing the response to liquid feeding of phosphate

3 Testing the interaction of nitrogen and the growth regulator daminozide which have some conflicting effects

APPENDIX I

Liquid feeds

quantity of stock	mg/l N	mg/l K_2O	g in stock solution potassium nitrate	g in stock solution ammonium nitrate	cf*
20	100	100	860	820	1200
10	200	100	430	1000	1600
10	300	100	430	1590	2100
10	100	300	1300	60	1400
10	200	300	1300	650	1900
10	300	300	1300	1240	2400

Above stock solutions diluted 1:200 before use

* Lee Valley water supply = 550

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