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AUTUMN AND EARLY SUMMER CAULIFLOWER: IMPROVING EARLY FIELD GROWTH OF CELLULAR TRAY-RAISED CROPS, ESPECIALLY FOLLOWING OR DURING PERIODS OF STRESS

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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.

.....
Signature

R W P HIRON

Date 21-6-93

Report authorised by:

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Date 21/6/93

COMMERCIAL IN CONFIDENCE

CONTENTS

	Page No.
Relevance to Growers and Practical Application	
Application	1
Summary	1
Experimental Section	
Introduction	2
Materials and methods	3
Site	3
Trial design and treatments	3
Records	5
Trial diaries	6
Results and discussion	9
Conclusions	16
Recommendations for further work	16
Acknowledgements	16
Storage of data	17

AUTUMN AND EARLY SUMMER CAULIFLOWER: IMPROVING EARLY FIELD GROWTH OF CELLULAR TRAY-RAISED CROPS, ESPECIALLY FOLLOWING OR DURING PERIODS OF STRESS

RELEVANCE TO GROWERS AND PRACTICAL APPLICATION

APPLICATION

The work aimed to determine whether nutrient-stressed transplants were slower to establish than non-stressed and to see if this affected crop performance and to investigate remedial nutritional strategies to alleviate the imposed stress.

The results showed that cell-raised transplants were slow to establish, that this was relatively unaffected by the planting stress and that the use of a starter solution had only a slight but significant beneficial effect.

There is no immediate application for this work as the use of starter solution needs to be investigated further, to discover other techniques to enable growers to fully exploit the potential of cell-raised transplants by making them explode into growth post-planting.

SUMMARY

It is known that in the week prior to planting in the field a transplant's treatment can vary considerably, from being cossetted in a propagators glasshouse, to being totally neglected on an exposed headland. Therefore, for two trials, one on autumn cauliflower in 1991, and one on early summer cauliflower in 1992, six different nutritional regimes, from nothing, to full feeding plus an extra 200 mg/l nitrogen feed at planting, were given to plants. The trays of plants were held in two environments, firstly a Venlo glasshouse, and secondly, an exposed concrete standing ground. On the latter, heavy 'rainfall' was simulated equivalent to 15 mm of rain over the week. At transplanting, plants were treated with either of two strengths of starter solution or with a 'water only' control.

The starter solution shortened the time to harvest by 3-4 days and shortened the length of cut by 2-3 days but did slightly, adversely affect quality. Surprisingly, the pre-planting treatments had no effects on field growth, harvest date or yield. But, it was recorded that all plants were very slow to establish and grow away and therefore this field effect could have masked pre-planting advantages or disadvantages of treatments. It is suggested that this slow establishment, which has been observed several times, requires investigation to fully exploit the potential of cell-raised transplants.

EXPERIMENTAL SECTION

INTRODUCTION

Control of growth and development in the cellular tray-raised transplants, prior to planting out in the field, is effected by controlling nutrient supply in the compost and liquid feed. On transplanting there is potential for rapid growth under favourable environmental conditions and consequently a demand for nutrients which may be difficult to meet because of the restricted root system. Although a liquid feed is normally given before transplanting, the amount is limited by the small volume of compost and by the risk of salt damage to the transplant. It is thought that this is usually sufficient to enable roots to grow out of the root ball fairly rapidly and exploit the nutrient reserves of the soil. However, any superimposed stress on the transplants in propagation, during transport or in the field will affect the rate and possible percentage success of establishment. Stress can occur in the propagation phase when there is an interruption to planting schedules which can be followed by inappropriate feeding thereafter, and stress occurs in the field most notably with very early crops.

The project described below investigated these hypotheses in two field trials, firstly an autumn cauliflower crop in 1991 and secondly an early summer cauliflower crop in 1992.

MATERIALS AND METHODS

Site

HRI-Kirton is located in the village of Kirton situated five miles south of the town of Boston. The facilities used include a propagation unit, with adjacent block of modern Venlo glass. The 1991 trial was established by hand in the field designated New Land 3 and the 1992 trial in the field designated Lane 1.

Trial design and treatments

Each trial was designed as a three replicate randomised block for the complete factorial of 12 propagation by three starter solution treatments.

Treatments for 1991 autumn cauliflower trial

Cultivar: White Rock

Propagation treatments

48 trays sown: 32 trays sown on 17/4/91 to be 7 weeks old on 5/6/91, 16 sown on 24/4/91 to be 6 weeks old on 5/6/91.

On 5/6/91 the plants were divided into 12 treatments, 4 trays per treatment.

1. 6-week-old plants in Venlo given 100 mg/l N feed 5, 7 & 10 June, Dursban on 11 June, planted 12 June.

2. 6-week-old plants in Venlo given 100 mg/l N feed 5, 7 & 10 June, Dursban on 11 June, 200 mg/l N prior to planting on 12 June.

3. 7-week-old plants in Venlo given 200 mg/l feed on 5 June then water only on 5, 7 & 10 June, Dursban 11 June, planted 12 June.

4. 7-week-old plants in Venlo given 200 mg/l feed on 5 June then 100 mg/l feed on 7 & 10 June, Dursban 11 June, planted 12 June.

5. 7-week-old plants in Venlo given 200 mg/l feed on 5 June then 100 mg/l feed on 7 & 10 June, Dursban 11 June & 200 mg/l feed prior to planting 12 June.

6. 7-week-old plants in Venlo given 200 mg/l feed on 5 June then water only on 7 & 10 June, Dursban 11 June & 200 mg/l feed prior to planting 12 June.

7-12. Are a repeat of 1-6 but on the standing ground and on the 6, 8 & 11 June simulated heavy rainfall of 5 mm 'rain' (51/sq m) put on with a coarse rose and watering can.

Starter solutions at planting

1. 100 ml/plant Kemira 10:52:17 at 1% solution
2. 100 ml/plant Kemira 10:52:17 at 2% solution
3. 100 ml/plant water

Treatments for 1992 early summer cauliflower trial

Cultivar: Linmont

Propagation treatments

48 trays sown: 32 trays sown on 8/10/91 to be 21 weeks old on 3/3/92, 16 sown on 15/10/91 to be 20 weeks old on 3/3/92.

On 4/3/92 plants divided into 12 treatments, 4 trays per treatment.

1. 20-week-old plants in Venlo given 100 mg/l N feed 4, 6 & 9 March, Dursban on 10 March, planted 11 March.

2. 20-week-old plants in Venlo given 100 mg/l N feed 4, 6 & 9 March, Dursban on 10 March, 200 mg/l N prior to planting on 11 March.

3. 21-week-old plants in Venlo given 200 mg/l N feed on 4 March then water only on 6 & 9 March, Dursban 10 March, planted on 11 March.

4. 21-week-old plants in Venlo given 200 mg/l N feed on 4 March then 100 mg/l N feed on 6 & 9 March, Dursban 10 March, planted 11 March.

5. 21-week-old plants in Venlo given 200 mg/l N feed on 4 March then 100 mg/l N feed on 6 & 9 March, Dursban 10 March & 200 mg/l feed prior to planting on 11 March.

6. 21-week-old plants in Venlo given 200 mg/l N feed on 4 March then water only on 6 & 9 March, Dursban 10 March & 200 mg/l N feed prior to planting on 11 March.

7-12. Are a repeat of 1-6 but on the standing ground and on the 5, 7 & 10 March simulated heavy rainfall of 5 mm 'rain' (5l/sq m) put on with a coarse rose and watering can.

Starter solutions at planting

1. 60 ml/plant Kemira 10:52:17 at 1% solution
2. 60 ml/plant Kemira 10:52:17 at 2% solution
3. 60 ml/plant water

Records

(a) Crop diary

(b) Fresh weight of samples on four occasions after planting. Timing dependent on relative crop growth.

(c) Maturity dates

(d) Yield and quality assessment of produce at harvest.

Trial diaries

1. 1991 Trial on autumn cauliflower

Field/soil type:	New Land 3
Soil analysis:	pH 7.7 Index : N - 0, P - 4, K - 3
Previous cropping:	1990 - Grass
Cultivations;	6/2/91 - ploughed Worked with Lely before planting
Fertiliser:	
In base:	29/4/91 - 60 kg/ha K_20 applied 11/6/91 - 150 kg/ha N applied
Top dressing:	30/7/91 - 100 kg/ha N as Kaynitro applied
Propagation:	17/4/91 - White Rock sown in 308 plastic trays 05/6/91 - propagation treatments started
Planting:	12/6/91 - by hand, with feeds applied as per treatments

Herbicides:	17/6/91 - propachlor as 9 l/ha Ramrod and chlorthal-dimethyl as 6 kg/ha Dacthal
Fungicides:	03/8/91 - mancozeb and metalaxyl as 2 kg/ha Fubol 75 WP and chlorothalonil as 2 l/ha Bombadier
Insecticides:	28/8/91 - cypermethrin as 250 ml/ha Ambush C and pirimicarb as 420 g/ha Phantom 05/9/91 - Cypermethrin as 250 ml/ha Ambush C
Irrigation:	None
Notes:	Samples taken at planting on 12/6 and on 10/7, 1/8 and 8/8 Vigour scores done on 13/8 First harvest date 28/8, final 14/10

2. 1992 Trial on Early Summer Cauliflower

Field/soil type:	Lane 1/Course silty marine alluvial
Soil analysis:	pH 8.0 Index : N - 0, P - 3, K - 2, Mg - 4
Previous cropping:	1990 - grass/barley then grass 1991 - grass
Cultivations:	20/1/92 - ploughed Worked with Lely before planting
Fertiliser:	
In base:	09/3/92 - 150 kg/ha N as 15:8:24 NPK compound

Top dressing:	21/4/92 - 100 kg/ha nitrogen as Kaynitro
Propagation:	8/10/91 & 15/10/91 - Linmont sown in GPG 308 trays. Toclofos-methyl as Basilex drench at 2 g/sq m in 21 applied to sowing 1 on 15/10/91, sowing 2 on 18/10/91. 25/10/91 - fosetyl-aluminium as Aliette at 5 g/sq m in 2.5 l 22/11/91 - molybdate at 7 ml in 5 l applied on 22/11/91. chlorothalonil as Bravo applied on 23/12/91, 06/1/92 & 19/2/92. 04/3/92 - Trial treatments started.
Planting:	11/3/92 - planted by hand, with treatments applied as on plan.
Herbicides:	16/3/92 - propachlor as 9 l/ha Ramrod and chlorthal-dimethyl as 6 kg/ha Dacthal.
Insecticides:	None
Fungicides:	None
Irrigation:	None
Notes:	Three plant fresh wt. samples taken on 26/3, 9/4, 23/4 & 6/5 09/6/92 - First harvest date 29/6/92 - Final harvest date

RESULTS AND DISCUSSION

1. Establishment data

Tables 1 and 2 show the mean fresh weights of samples taken four, seven and eight weeks after planting, and a vigour score assessed nine weeks after planting, for the autumn cauliflower trial. Table 1 shows that, despite the greater stress imposed by holding on the standing ground, transplants for the standing ground treatments grew at similar rates to those taken out of the Venlo immediately before planting. Any observed differences in the growth of the crop in the field do not appear to be consistent with the levels of nutrition applied in the week before, except that treatment 11, which had the most feeds among the 'standing ground' treatments, produced the heaviest plants. However, treatment 8, which received the second highest number of feeds (a program very similar to that for treatment 11), produced the lightest plants. This would suggest that pre-planting treatment has very little effect upon subsequent growth.

Table 2 shows that the starter solution did have a beneficial effect, as seen for both the plant weights and vigour scores, although, surprisingly, the 1% solution appeared to have a greater effect than the 2% solution.

Table 1 Fresh wt and vigour score of samples (3 plants) taken during early growth of the 1991 autum cauliflower trial: means for the 12 pre-planting feeding regimes

Treatment	Fresh wt (g) of samples taken on 3 dates			Vigour score 1=Poor 9=Good
	10 July	1 Aug	8 Aug	on 13 August
Venlo				
1. 6 wo 3x100mg/l feeds	65	1484	2133	6.1
2. 6 wo 3x100+200mg/l feeds	81	1313	1856	5.2
3. 8 wo 1x200mg/l feed	76	1367	1755	5.7
4. 7 wo 1x200+2x100mg/l feed	92	1351	2301	6.5
5. 7 wo 1x200+2x100+ 1x200mg/l feed	85	1150	2019	5.3
6. 7 wo 2x200mg/l feed	65	1259	2157	5.3
Mean	77	1321	2037	5.7
Standing ground				
7. 6 wo 3x100mg/l feeds	84	1404	2185	6.1
8. 6 wo 3x100+200mg/l feeds	72	1169	1848	5.2
9. 7 wo 1x200mg/l feed	73	1318	1856	5.8
10. 7 wo 1x200+2x100mg/l feed	74	1401	1855	5.5
11. 7 wo 1x200+2x100+ 1x200mg/l feed	116	1557	2458	6.3
12. 7 wo 2x200mg/l feed	96	1359	2099	6.6
Mean	86	1368	2047	5.9

Table 2 Fresh wt and vigour scores of samples (3 plants) taken during early growth for 1991 autumn cauliflower trial: means for the three starter solution treatments

Treatment	Fresh wt (g) of samples taken on 3 dates			Vigour score 1=Poor 9=Good
	10 July	1 Aug	8 Aug	on 13 August
1% starter solution	102	1581	2211	6.9
2% starter solution	88	1427	2092	6.0
Water only	55	1025	1822	4.7

In the second trial the measurement times were changed to study early growth and were taken at planting and two, four, six and eight weeks later. A striking feature is the apparent very slow early growth for all treatments, with very little growth in the first four weeks after transplanting. This growth is not affected by preplanting feeding or conditions (Table 3), or

even starter solution (Table 4) and it is only after this time that the starter solution seems to have its beneficial effect.

This slow establishment cannot be attributed to temperature alone as the spring of 1992 was quite warm. The average temperature on site for March, when very little growth occurred, was 7.3°C whilst for April, when growth took off, the average temperature was 8.6°C. There is an indication that the Venlo plants got away slightly faster then those from the standing ground but preplanting feeding had no consistent effect.

Table 3. Fresh weight of samples (3 plants) taken during early growth of the 1992 early summer trial: means for the 12 preplanting feeding regimes

Treatment	Fresh wt (g) of samples taken on 5 dates				
	At planting 11 March	26 March	9 April	23 April	6 May
Venlo					
1. 20 wo 3x100mg/l feeds	6.8	8.0	16.6	55.6	218.9
2. 20 wo 3x100+200mg/l feeds	5.5	10.3	18.7	81.4	280.0
3. 21 wo 1x200mg/l feed	7.8	8.2	15.6	56.5	206.8
4. 21 wo 1x200+2x100mg/l feed	5.6	10.9	19.9	85.8	302.7
5. 21 wo 1x200+2x100+ 1x200mg/l feed	6.6	10.3	18.0	58.0	234.3
6. 21 wo 2x200mg/l feed	7.4	9.3	17.2	65.1	203.5
Mean	6.6	9.5	17.7	67.1	241.0
Standing ground					
7. 20 wo 3x100mg/l feeds	6.6	8.3	14.5	47.2	223.3
8. 20 wo 3x100+200mg/l feeds	7.9	10.0	16.7	68.2	228.5
9. 20 wo 1x200mg/l feed	6.4	9.2	16.7	56.2	218.4
10. 21 wo 1x200+2x100mg/l feed	6.1	9.3	17.8	53.1	199.7
11. 21 wo 1x200+2x100+ 1x200mg/l feed	6.4	8.8	13.7	48.5	207.4
12. 21 wo 2x200mg/l feed	6.2	8.9	16.4	50.8	235.7
Mean	6.6	9.1	16.0	54.0	218.8

Table 4 Fresh weight of samples (3 plants) taken during early growth of the 1992 early summer trial: means for the three starter solution treatments

Treatment	Fresh wt (g) of samples taken on 5 dates				
	At planting 11 March	26 March	9 April	23 April	6 May
1% starter solution	6.6	10.0	19.4	74.2	279.9
2% starter solution	6.6	9.0	16.9	61.4	234.7
Water only	6.6	8.8	14.0	46.0	174.2

2. Harvest data

A summary of the harvest data for the 1991 autumn cauliflower trial is given in Tables 5 and 6. Table 5 shows that neither pre-planting feeding nor holding site had a consistent effect on harvest date, spread of cut or yield. They also had no effect upon any of the other quality characteristics measured. Table 6 shows that the use of starter solutions resulted in a significant, 4-5 day advance in 50% harvest date, and reduced the spread of cut by 2-3 days, compared with the water only treatment. The only other effect of the starter solution treatments was to increase the percentage of curds down-graded to Class II for looseness.

Table 5 Harvest data for 12 preplanting regimes for 1991 autumn cauliflower trial

Treatment	50% harvest date	Length of cut (days)	Yield Cl I (crates/ha)	Total mkble yield (crates/ha)
Venlo				
1. 6 wo 3x100mg/l feeds	7 Sept	19.3	979	2464
2. 6 wo 3x100+200mg/l feeds	7 Sept	16.3	1012	2409
3. 7 wo 1x200mg/l feed	8 Sept	15.3	1023	2431
4. 7 wo 1x200+2x100mg/l feed	6 Sept	15.9	1155	2431
5. 7 wo 1x200+2x100+ 1x200mg/l feed	9 Sept	20.9	847	2486
6. 7 wo 2x200mg/l feed	8 Sept	16.9	1155	2673
Mean	8 Sept	17.4	1028	2482
Standing ground				
7. 6 wo 3x100mg/l feeds	7 Sept	19.4	983	2254
8. 6 wo 3x100+200mg/l feeds	8 Sept	16.9	836	2288
9. 7 wo 1x200mg/l feed	9 Sept	17.0	1078	2431
10. 7 wo 1x200+2x100mg/l feed	7 Sept	17.7	1034	2497
11. 7 wo 1x200+2x100+ 1x200mg/l feed	6 Sept	13.8	1055	2504
12. 7 wo 2x200mg/l feed	7 Sept	15.1	869	2519
Mean	7 Sept	16.6	976	2415
SED treatments (70df) = ±	1.0	2.50	133.5	120.9
LSD (5%) =	2.0	5.00	267.0	241.8
SED mean (70 df) = ±	0.4	1.02	54.5	49.4
LSD (5%) =	0.8	2.04	109.0	98.8

Table 6 Harvest data for starter solution treatments for 1991 autumn cauliflower trial

Treatment	50% harvest date	Length of cut (days)	Yield Cl I (crates/ha)	Total mkble yield (crates/ha)	% loose (Ang trans)
1% starter solution	5 Sept	16.0	1029	2491	38.2
2% starter solution	6 Sept	16.3	921	2420	39.2
Water only	10 Sept	18.8	1056	2435	34.6
SED (70df) = ±	0.4	1.25	66.7	60.5	1.61
LSD (5%)	0.8	2.50	133.4	121.0	3.22

Tables 7 and 8 contain a similar summary of the harvest data for the 1992 early summer cauliflower trial. The results shown in Table 7 are similar to those for the first trial, in that neither pre-planting feeding nor holding site had a consistent effect on harvest date, spread of cut or yield, except that plots held on the standing ground produced a significantly higher yield of Class I heads compared to those held in the Venlo. Table 8 shows that the use of a starter solution again advanced the 50% harvest compared with the water only treatment, this time by 3-4 days, and that the 1% starter solution shortened the length of cut by 2½-3 days compared to the water only treatment and 2% starter solution. However, the use of a starter solution also reduced the yield of Class I heads, and increased the percentage of yellow tinted curds, compared to the water only treatment. This increase in the percentage of yellow tinted curds is odd since in previous trials the use of a starter solution has been shown to reduce the yellowing of curds, this reduction being attributed to the better growth of leaves, and hence better curd protection.

Table 7 Harvest data for 12 pre-planting regimes for 1992 early summer cauliflower trial

Treatment	50% harvest date	Length of cut (days)	Yield Cl I (crates/ha)	Total mkble yield (crates/ha)
Venlo				
1. 20 wo 3x100mg/l feeds	12 June	8.9	405	2407
2. 20 wo 3x100+200mg/l feeds	8 June	5.1	303	2375
3. 21 wo 1x200mg/l feed	12 June	8.1	748	2401
4. 21 wo 1x200+2x100mg/l feed	9 June	5.5	346	2303
5. 21 wo 1x200+2x100+ 1x200mg/l feed	11 June	6.8	471	2443
6. 21 wo 2x200mg/l feed	10 June	5.7	426	2249
Mean	10 June	6.7	450	2363
Standing ground				
7. 20 wo 3x100mg/l feeds	11 June	7.5	602	2603
8. 20 wo 3x100+200mg/l feeds	11 June	8.4	538	2611
9. 21 wo 1x200mg/l feed	11 June	7.5	579	2498
10. 21 wo 1x200+2x100mg/l feed	11 June	6.9	821	2251
11. 21 wo 1x200+2x100+ 1x200mg/l feed	12 June	8.2	604	2436
12. 21 wo 2x200mg/l feed	11 June	6.6	564	2442
Mean	11 June	7.5	618	2473
SED of treatments (70df) = ±	0.9	1.15	150.9	162.4
LSD of treatments (5%) =	1.8	2.30	301.8	324.8
SED of mean (70 df) = ±	0.4	0.47	61.6	66.3
LSD of mean (5%) =	0.8	0.94	123.2	132.6

Table 8 Harvest data for starter solution treatments for 1992 early summer cauliflower trial

Treatment	50% harvest date	Length of cut (days)	Yield Cl I (crates/ha)	Total mkble yield (crates/ha)	% yellow (Ang trans)
1% starter solution	9 June	5.2	318	2365	57.2
2% starter solution	10 June	8.4	381	2408	56.4
Water only	13 June	7.7	903	2482	47.5
SED (70df) = ±	0.5	0.57	75.5	81.2	2.29
LSD (5%)	0.9	1.14	151.0	162.4	4.58

CONCLUSIONS

1. The starter solutions had a beneficial effect on time to cut and length of cut.

2. Surprisingly, pre-planting, quite different nutritional treatments and siting regimes had no consistent effect upon subsequent crop growth, development and yield.

3. One of the supposed advantages of cell-raised transplant is that a pristine transplant, with an actively growing root ball, should 'explode' into growth on being planted. This does not appear to happen, and the problem is not overcome to any great extent by the use of a starter solution. This should, therefore, be the subject for a rather large study which could look at all ways of getting transplants to establish and develop more rapidly.

RECOMMENDATIONS FOR FURTHER WORK

These trials confirmed what had long been felt by some growers, and indicated in previous work, that cell-raised transplants do not establish and develop as fast as would be expected, and that the problem is only marginally improved by the use of a starter solution. This problem needs to be investigated further, to discover techniques which will enable growers to fully exploit the potential of cell-raised plants.

ACKNOWLEDGEMENTS

The author acknowledges the excellent technical assistance of Miss S A Minns of the Station staff.

STORAGE OF DATA

The raw date will be stored at HRI Kirton, Government Buildings, Willington Road, Kirton, Boston, Lincs PE20 1EJ for a period of 10 years. The HDC will be consulted prior to disposal.

RWPH16.REP