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Period of investigation:	1990-1991
Date of issue of report:	October 1991

CONTRACT REPORT
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PURPLE SPROUTING BROCCOLI: EXTENDING THE SEASON OF PRODUCTION

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PURPLE SPROUTING BROCCOLI: EXTENDING THE SEASON OF PRODUCTION

Summary

Late purple sprouting broccoli, variety BI 87379, were sown in cellular trays at six dates from 8 May to 22 June 1990, and transplanted to the field at corresponding intervals from 13 June to 31 July. Plots were designated for studies of apex development and for yield determination.

In the case of terminal spears, later sowing gave later initiation, whereas on node 20 the reverse was true. The number of nodes to the terminal spear decreased with later sowing.

The marketable yield of secondary spears decreased from 17 t/ha for the first sowing to 10 t/ha for the last. Mean secondary spear weight was about constant for the first five sowings, but was lower from the 22 June sowing. Yields of marketable primary spears were similar (about 0.9 t/ha) for the first five sowings, and fell to 0.4 t/ha for the last. There was little effect of sowing date on size grade of primary spears, nor on the numbers falling into various unmarketable categories. Harvest dates for all sowings were similar, except for a few days' delay in cropping primary spears from the later sowings, and in the start of cropping secondary spears for the last two sowings.

INTRODUCTION

MAFF-funded trials on sprouting broccoli date back to 1970, when work to assess the continuity of production of the then available varieties was conducted at Stockbridge House EHS. The cropping period was February to March, and yields and quality were variable.

Supermarket demand for good-quality, attractively presented sprouting broccoli spears has resulted in increasing public interest. Over 600 ha are grown, but, to meet the existing and potential demand, there is a need to exploit the best of the varieties emerging from the Wellesbourne breeding programme.

A new series of MAFF-funded trials was begun at Kirton in 1988, and varieties and crop spacing were investigated. This provided a useful background for starting the present project, funded by HDC, in 1990. The aim of the project is to study the factors affecting spear initiation and development, finding means of achieving a long season of production for high yielding, good quality crops using a range of varieties and sowing dates. In the initial year of the project, a promising purple sprouting variety, bred at Wellesbourne and coded BI 87379, was used.

MATERIALS AND METHODS

Plant material

Seed of a late purple sprouting broccoli variety coded BI87379, was used throughout. It was sown, one seed per cell, into cellular trays (Hassy 308) of appropriate compost (Bulrush modular) on six dates (8, 17 and 26 May, and 5, 13 and 22 June 1990). Seed was chitted for two days at 21°C before transfer to a Venlo glasshouse heated to give frost protection and ventilated at 10°C. Plants were raised to a good commercial standard (ADAS, 1987) using basic liquid feeds of 100:200 mg/l N:K_2O. Plants were drenched with chlorpyrifos (as 10ml Dursban 4 in 1 litre per 1000 plants) shortly before each individual date of transplanting.

Growing in the field

Plants from the six sowing dates were transplanted to the field on 13, 21 and 28 June and 10, 19 and 31 July 1990, respectively. Transplanting was by hand at spacings of 610 mm (between rows) x 450 mm (within rows). For each of the sowing dates, two plots were planted for sampling and dissection and four plots for harvesting records (see statistical design, below).

Routine husbandry and field information are given in Appendix Table A.

Sampling and dissections

At each of the transplanting dates, samples (10 plants each) were dissected to determine leaf number and state of the apex, and fresh and oven dry weights were determined (from samples of 20 plants each).

From 18 September 1990 to 4 April 1991 samples (ten plants from each of the two sampling plots) were taken from each sowing date at two-weekly intervals. Leaf scars and leaves were counted, recording the total number initiated, and the number of the last leaf scar, the number of the last leaf >10 mm in length, and the number of the lowest leaf with a marketable spear. The apices at leaf 20, 40, 60 and 80 (where present) were dissected, along with

the terminal apex, recording the state of the apex (vegetative, transitional or floral) along with the head diameter (widest and narrowest measurement), length and spear weight (non-trimmed and trimmed) where practical. Total plant fresh and oven dry (80°C) weights were recorded, after discarding the roots by excision at the top of the hypocotyl.

Crop harvest

From 20 March to 16 April 1991 all mature terminal (primary) and side (secondary) shoots were cut from the harvesting plots three times weekly. All spears were trimmed to 150 mm long. For primary heads the number and fresh weight of marketable heads was recorded in diameter grades (0-25 mm, 25-38 mm, 38-50 mm, 50-63 mm and 63-75 mm) along with the number of unmarketable heads in different categories (rotted/frost damaged, senescent, loose and bracted). For secondary heads (where initial cropping was deferred until a reasonable number could be cut per plot), the total number and weight of marketable heads and the number of unmarketable (frost-damaged) heads were recorded. The numbers of healthy plants which lodged and of plants which collapsed and were lost as a result of frost damage were also recorded. As there were marked differences between plots in the numbers of plants with sparse or prolific side shoot development, this was also noted.

Experimental design and data analysis

For the sampling plots, a randomised block design with two replicates was used. Each plot consisted of 11 rows of 21 plants each, with a group of 10 plants for each sampling date allocated and all sampled groups surrounded by non-sampled guard plants.

For the harvesting plots, a randomised block design with four replicates was used. Each plot consisted of three rows of 10 recorded plants each, plus three guard plants at each end of the plot which were not recorded.

Data were subjected to analysis of variance where appropriate.

RESULTS

Apex development

The dates of initiation of terminal spears on nodes 60, 40 and 20 are shown in Table 1. With terminal spears later sowing gave later initiation, while with spears on node 20 the reverse was true. Thus it is not surprising that the spread of initiation was greatest from sowing 1 and least from sowing 6. There was no significant effect of the date of sowing on the time of initiation of spears at nodes 40 and 60.

The number of nodes to the terminal spear decreased progressively from sowing 1 (73) to sowing 6 (49) (see Table 2) so that later sowing resulted in fewer spears. In addition, the dry weight of plants when the terminal spear was initiated decreased with later sowing. Thus it seems that the more nodes plants have, and the heavier those plants are when the terminal spear is initiated, the greater the apparent apical dominance effect of the terminal spear over the lateral spears. This delayed initiation of lateral spears and therefore resulted in greater variability in the time of spear initiation.

Crop performance including yields

Some major differences in plant performance soon became evident towards maturity. The proportion of plants with prolific side shoots decreased with later sowing dates: two-thirds of plants from the first date had many side-shoots, but only one-third of plants from the last two sowing dates, the numbers of plants with prolific or sparse side-shoots being about equal for the intermediate sowing dates. Lodging appeared to be a problem with the crop: plants from the first five sowing dates frequently lodged, but few from the last sowing date did so. Overall, about a quarter of the plants collapsed due to frost damaging the stem (Table 5).

The effect of sowing date on marketable yield is shown in Table 3. For secondary spears, yield decreased more or less progressively with later sowing dates, from over 17t/ha for the earliest sowing to just under 10t/ha for the latest. Numerical yields of secondaries followed the same trend, except that more but smaller secondary spears were produced from the last sowing. Mean secondary spear weight varied between 23 and 25g for the first five sowings, but was only 19g for the last. Unmarketable secondary spears averaged 20.3 per plot overall, and there were no significant effects of sowing date.

The marketable yields of primary spears are also shown in Table 3. These varied little, except for a marked reduction in the last sowing (0.4t/ha compared with 0.8 to 1.0t/ha for the earlier ones). Most primary spears fell into the 25-38mm diameter graded (Table 4), and there was little evidence for an effect of sowing date on grade. The percentage of unmarketable primary spears in different categories is summarised in Table 5. Small percentages (2 to 11%) were lost through being classified as senescent or loose at harvesting, 2 to 18% were bracted, and 10 to 23% were lost through frost damage. Except for a doubling of the number of frosted primaries in the last sowing, and a reduction in bracted primary heads in the later sowings, there was little suggestion of effects of sowing date on these characters.

Total marketable yields of primary and secondary spears are also given in Table 3.

Dates of 50% harvest for primary and secondary spears are given in Table 3, and show that, whereas for primaries later sowing delayed mean harvesting date by six days, there was no significant difference in 50% cropping for secondaries. Table 6 shows a range of percentage harvest dates as well as the duration of the harvest period (10 to 90%). Examination of these figures shows that the start of cropping was delayed by three or four days in the last two sowing dates, compared with earlier ones, resulting in a slightly condensed harvest period.

DISCUSSION

It will not be possible to analyse the dissection data to determine how vernalization occurs until two more years' data are available. Furthermore, any conclusions about the factors controlling spear initiation and development are tentative, being based on only one year's data. Nevertheless some useful preliminary information was obtained which helps to explain effects on yields and the timing of spear development.

It was noticeable that later transplanting under cooler conditions resulted in fewer nodes, presumably because the plants' vernalization requirement was satisfied more rapidly.

Analyses of the rate of spear expansion suggest that the rate of terminal spear growth increased with later sowing. Consistent differences between spear growth rates at other nodes were not so apparent. However, generally the rate of growth of terminal spears was less than that of spears at node 20 which was less than that of spears at node 40.

Plants from the earliest sowing (8 May) produced the heaviest yield of secondary spears, 17t/ha. Later sowings resulted in plants with obviously less side-shooting and falling yields. The last sowing (22 June) produced only 10t/ha of secondary spears, which were much lighter in average weight than those from earlier sowings, and a poor yield of primary spears. Harvest dates and durations were remarkably consistent between the different sowings. Under the conditions of the trial, the cultivar used suffered from lodging (in the heavier yielding treatments) and was insufficiently hardy, overall some 14 per cent of primary spears and 25 per cent of the plants being damaged by frost.

ACKNOWLEDGMENTS

The author thanks the staff of HRI, especially Mrs K van der Heyden (HRI Kirton), for their work in carrying out this trial, A Mead (HRI Wellesbourne) for providing statistical advice and analyses, and A R Gray (HRI Wellesbourne) for supplying the seed.

Table 1 Dates of spear initiation at the terminal node, node 60, node 40 and node 20 together with the spread of initiation across all recorded nodes

Sowing date	Terminal node	Node 60	Node 40	Node 20	Spread (days)
8 May	8 Oct	24 Dec	11 Jan	1 Feb	116
17 May	21 Oct	25 Dec	26 Dec	20 Jan	91
26 May	24 Oct	20 Dec	24 Dec	25 Jan	93
5 June	25 Oct	24 Dec	12 Dec	14 Jan	81
13 June	29 Oct	26 Dec	15 Dec	23 Dec	58
22 June	9 Nov	2 Jan	20 Dec	28 Dec	54

Table 2 The number of nodes to the terminal spear and plant dry weight when the terminal spear was initiated

Sowing date	Number of nodes produced	Plant weight at initiation of terminal spear (g)
8 May	73	288
17 May	63	278
26 May	63	288
5 June	59	231
13 June	53	244
22 June	49	185

Table 3 Effect of sowing date on marketable yield and harvest date of sprouting broccoli BI87379

Sowing date	Marketable yield (t/ha)			Marketable yield (no. of spears/plot)			50% harvest date (days from 1 Jan)	
	Primaries	Second-aries	Total	Primaries	Second-aries	Total	Primaries	Second-aries
8 May	0.8	17.4	18.2	10	602	613	84	95
17 May	0.8	13.7	14.5	9	457	466	84	95
25 May	1.0	15.0	16.0	13	549	562	83	95
5 June	0.9	11.9	12.7	11	436	448	85	94
13 June	1.0	10.1	11.1	12	377	388	86	94
22 June	0.4	9.4	9.9	9	410	420	90	94
SED (df=15)	0.16	2.4	2.4	2.1	69.9	70.6	0.6	1.1
Signif-icance[+]	*	*	*	NS	*	*	***	NS

[+] Significance of sowing date effect: NS, not significant; *, significant at $P \leq 0.05$; ***, significant at $P \leq 0.001$.

Table 4 Effect of sowing date on size of primary spears in sprouting broccoli BI87379

Sowing date	Percentage of marketable primary spears in grades				
	0-25	25-38	38-50	50-63	63-75
8 May	26	24	34	12	3
17 May	11	47	21	21	0
25 May	13	43	27	9	6
5 June	15	49	31	3	3
13 June	43	39	17	0	0
22 June	13	46	29	11	0

Table 5 Effect of sowing date on the percentage of unmarketable primary spears or of frost-damaged plants in sprouting broccoli BI87379

Sowing date	Percentage of plants with primary spears in unmarketable categories or plant collapsed due to frost*				
	Frosted	Senescent	Loose	Bracted	Plant frosted
8 May	14	6	4	16	24
17 May	10	3	5	12	32
25 May	13	5	5	13	21
5 June	13	4	2	18	26
13 June	10	7	11	6	28
22 June	23	8	6	2	16

* Where values (with marketable spears from Table 1) add to slightly less than 100 per cent, this is due to occasional missing (non-established) plants.

Table 6 Harvest date information for secondary spears of sprouting broccoli BI87379

Sowing date	Percentage harvest dates(days from 1 Jan)					Time from 10% to 90% harvest (days)
	10%	25%	50%	75%	90%	
8 May	85	90	95	100	102	18
17 May	84	89	96	100	102	18
25 May	86	90	95	100	102	16
5 June	86	90	94	99	101	16
13 June	87	90	94	98	101	13
22 June	88	90	94	98	100	12

APPENDIX

Table A Outline of cultural and related details in the field

Soil texture:	Mixture of coarse and fine silty marine alluvium ("40 Acres 6" field)
Previous cropping:	1987 Wheat 1988 Brussels sprouts 1989 Grass
Soil analysis	pH 7.6 P_2O_5 index 5 K_2O index 3 Mg index 4
Fertilisers:	77 kg N and 50 kg K_2O/ha (as Kaynitro, 25:0:16 N:P:K) applied in base 12 June 1990 72 kg N/ha (as Ansax, 34.5% N) applied as top-dressing 30 January 1991
Cultivations:	Ploughed 4 December 1989 Cultivated (Lely Roterra) 13 June 1990
Insecticides etc:	Demeton-S-methyl and cypermethrin (as 560ml Metasystox 55 and 250ml Ambush C/ha) applied 18 August 1990 Heptenophos (as Hostaquick 840ml/ha) applied 28 September 1990.
Fungicides:	Mancozeb + metalaxyl (as 1.5 kg Fubol 58 WP/ha) applied 13 and 26 September and 12 October 1990.
Herbicides:	Propachlor and chlorthal-dimethyl (as 9 litre Albrass and 6 kg Dacthal/ha) applied 26 June (first two sowing dates), 13 July (second two sowing dates), 25 July (fifth sowing date) and 3 August 1990 (last sowing date).
Irrigation:	12mm water applied 16 June (first sowing), 28 June (second and third sowings), 20 July (fourth and fifth sowings) and 8 August 1990 (last sowing), and 25mm water applied to whole trial on 13 September 1990.

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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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