

**EXTENSION OF THE SEASON OF  
PRODUCTION AND QUALITY  
IMPROVEMENT OF A RANGE  
OF VEGETABLE CROPS**

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## SUMMARY

The use of modules for propagation together with growing aids such as plastic covers after transplanting has brought forward significantly the start of the harvest season and improved yield and quality of several important brassicas including swede, cauliflower, broccoli and cabbage. These container grown plants (modules) enables crops to be grown for part of the life cycle under protection in early spring and transplanted outside in March/April when conditions become favourable.

With swedes the season of production has been ‘‘extended back’’ from July to early/mid June with the identification of Magres (bolt resistant cultivar), the use of 19-25cc modules, correct sowing date and plastic covers. Supplementary feeding with nitrogen and potassium during the last 10-14 days of propagation firming, after transplanting and using 6 week old plants also significantly improved yields and overall efficiency of early swede production. Plastic covers after transplanting proved to be an extremely useful aid for early production, enhancing yield and quality and reducing bolting. This enables even earlier sowings to be made in January in early production areas for extra early crops. The earliness and high quality achieved from these trials has led to rapid commercialisation of modular grown swedes. The blueprint resulting from this work has provided growers with an early cash crop and consumers a high quality, very acceptable ‘new swede’ vegetable for this scarce period.

With winter cauliflower wide spacings of 80-90cm apart between the plants doubled the grade of premium class quality curds with both hybrids and open pollinated cultivars maturing in the January/February period - the most difficult period. The optimum time of transplanting (using modules) for the five main groups of winter cauliflower was determined. This varied significantly from June to mid/late July for the various groups and the results provide a reliable proven

transplanting schedule for transplanting the large number of cultivars in commercial winter production programmes.

For the first time ever in over two decades of testing, several new late maturing high quality winter cauliflower cultivars were identified to replace the existing relatively low quality cultivars maturing in May. In addition, several of these extended the season back to early June. The use of plastic covers for early production cultivars such as Nautilus, extended the season back to June, meeting with the last crops of winter cauliflower and providing an all year round supply.

The problem of internal browning (I.B.) in Brussel Sprouts for freezing has been alleviated by the identification of the Dutch hybrid cultivar Philemon which was found to have exceptionally high tolerance to this disorder in both extension trials in Co. Offaly and Kinsealy. In addition this cultivar is high yielding, has superb quality and holds without deterioration in the field for a long period. It can be programmed for November through to December providing a valuable extension of the freezer sprout programme.

The quality of coleslaw cabbage has been significantly increased by means of early transplanting modular raised plants in April. This increased the density of heads which also increases long-term refrigerated storage of the crop. A whole new range of cultivars have been screened with superior quality for coleslaw production. A valuable early extension of the season for coleslaw cabbage back to mid July was gained with the identification of suitable cultivars such as Quisto, raised in modules and given the protection of plastic covers in the field. Similar results were obtained on round and pointed York cabbages, where up to 10 days earliness was obtained.

Earlier research at Kinsealy prior to 1995 had provided a May/December blueprint for green broccoli production. The outstanding hybrids then identified such as Marathon and Shogun have not been superseded in these trials though some new hybrids such as Lord and Flash have, to date, shown promise for late autumn production with tolerance to wet rot one of the biggest problems associated with the production of this crop. Plastic covers have again markedly extended the season by up to 9 days from modular raised plants, and increased both yields and quality of this high value vegetable.

A very valuable extension of the broccoli season was achieved with identification of new purple sprouting broccoli cultivars. In trials completed in 1997 five hybrids produced high quality crops in succession from mid January through to April. These proved to be winter hardy and ringspot tolerant. This new crop had high consumer appeal with purple-coloured heads of exceptionally good flavour.

New hybrids of celeriac have been introduced and a programme for Autumn/Winter production has been successfully developed with identification of correct transplanting time (crucial) and plant spacings.



## INTRODUCTION

Imports of vegetables into Ireland occur mostly out of season (November to April) which is considered the most difficult period for vegetable production. The principal imported vegetables are carrots, onions, winter cauliflower, broccoli and coleslaw cabbage. In addition there is a scarce supply of vegetables for the June period, between late winter production and the start of the new season's vegetables.

Major changes are taking place in the market place. A wider range of high quality vegetables is being demanded and this is being catered for increasingly by the large supermarkets and multiples who now account for around 60% of sales of vegetables. These require a continuous supply all the year round of cheap high quality produce in large volumes. In addition several of these are presently issuing strict growing protocols and integrated crop management strategies with restrictions on pesticide, fertiliser usage and grade of produce required. Growers will have to rely more and more on efficient, low-cost production and continuity of supply to hold their market share against large scale production units in the UK and Europe. New increasing trends in value added preparation of most vegetable lines are taking place and this will provide additional opportunities and challenges to vegetable growers in the future.

A large range of new brassica cultivars are being released by commercial companies making cultivar evaluation an important research objective. Growing aids such as modules and plastic covers to extend the season of production at Kinsealy and in extension trials in growers' holdings were investigated. Planting dates and spacings together with a range of other relevant husbandry factors were evaluated for improvement in crop efficiency, quality and season extension.

The main objectives of this project were to extend the season of production, improve efficiency and quality and provide more consistent continuity of production of winter cauliflower, coleslaw cabbage, swedes, Brussel sprouts and broccoli, to meet with current consumer demands. New crops such as celeriac were also included.

## METHODS AND MATERIALS

New cultivars of swede, winter cauliflower, coleslaw cabbage, broccoli, Brussel sprouts and celeriac were sourced from Dutch, Japanese and U.K sources . All trials except for some direct drilled swede were grown from modular raised transplants varying in size from 13 to 25 ml. Seed was germinated under protection in a glasshouse or polytunnel under gentle heat and grown thereafter in well ventilated conditions; plants were removed outside at the four leaf stage for hardening off prior to transplanting .

Plastic covers when used, were put over the crops immediately after transplanting when the residual herbicides had been applied. These were left on the until early or mid May before temperatures became too high. An irrigation took place after removal when conditions were dry.

Crops were grown according to normal commercial practice with phosphorus (P) and potassium (K) adjustments in the field according to soil analysis . Weed control consisted of trifluralin 48% sc at 2.3l /ha pre-emergence followed by propachlor 48% sc or methazachlor 50% sc at 9l or 2l/ha respectively depending on weed flora. Normal routine precautions were taken against cabbage root fly and other pests.

Trials were undertaken at Kinsealy and on commercial grower holdings .Treatments were laid out in a fully randomised factorial design with 4-6 replications of each treatment or cultivar . Plots consisted of four rows 5-10 m long with guard rows .

Recordings were taken during the growing season . Each plot was separately harvested, produce graded with relevant recordings and results statistically analysed.

## RESULTS & DISCUSSION

### *PURPLE SPROUTING BROCCOLI*

It is not often that new crops are introduced for winter production which offer growers a chance to produce and compete for the first time with imported produce. This maybe now the case with new winter hardy sprouting broccoli. Cultivars have been selected and grown in trials for the first time at Kinsealy in 1997/1998. From sowings in modules and transplantings in late July and early August a succession of high quality crops were produced from mid January to April , with the seven cultivars used (*Tables 1 and 2* ). These proved to be robust and frost hardy as well as having promising yields and outstanding flavour . The purple colour of the heads have a high aesthetic market appeal but obviously promotion would be required if these cultivars continue to perform satisfactorily and the crop is taken up commercially . They had tolerance to ringspot , the main winter disease problem of brassicas. In contrast to green broccoli no soft or bacterial rot affected any of the cultivars in the trials. **Insert slide 1 here**

**Table 1 :** *Yield and maturity of seven winter sprouting broccoli cvs (planting date 21.07.97 ) - Kinsealy 1997/'98*

<b>Cultivar</b>	<b>Market Yield t/ha</b>	<b>Maturity</b>
Rudolph	3.2	late Jan/Feb.
Red Spear	3.6	mid Feb/early March
Red Arrow	2.1	Feb - mid March
Red Head	2.4	late Feb. - mid march
White Star	3.2	April
Early Purple	2.9	March
Late Purple	0.7	April
f - test	NS	
S.E (df=6)	.378	

**Table 2:** *Yield and maturity of seven winter sprouting broccoli cultivars , Kinsealy 1997/1998 ( second planting 05.08.97)*

<b>Cultivar</b>	<b>Market Yield t/ha</b>	<b>Maturity</b>
Rudolph	2.8	end Jan to end Feb.
Red Spear	3.8	end Feb. to early March
Red Arrow	2.6	end Feb. to early March
Red Head	2.4	March
Early Purple	2.5	March
Late Purple	1.2	April
White Star	3.2	April
f - test	***	
S.E (df=6)	.25	

All cultivars except Late Purple the latest to mature produced high yields and excellent quality from January to March over the two transplanting dates .They all required multiple hand harvesting one to two times weekly as side shoots made up to 50% of the yields.

### ***GREEN BROCCOLI - EXTRA EARLY PRODUCTION***

A valuable extension of the early green broccoli season was obtained with the use of a large module cell ( polystyrene 198 tray) and plastic covers (polycrop) in the field , after transplanting . This resulted in significantly higher yields and quality, and extended the harvest season back to early June in the case of the larger cell (*Table 3*).

**Table 3:** *Effect of cell size and plastic cover on yields and harvest date of green broccoli 1995*

<b>Treatment</b>	<b>Mark. Yield - t/ha</b>	<b>Harvest date</b>
Polyst 198 plastic cover	10.9	08.06.95
Hassy 308 plastic cover	11.4	16.06.95
Hassy 308 uncovered	6.7	29.06.95
f -test	*	-
S.E (df=6)	2.3	

### ***BRUSSEL SPROUTS***

Extensive screening trials on 21 cultivars carried out at Kinsealy and on several commercial farms in Co. Offaly identified Philemon as the only cultivar which remained free of internal browning disorder (I.B) over a three year trial period .

The problem of internal browning (I.B.) in Brussel sprouts for freezing has been alleviated by the identification of this Dutch hybrid which was found to have exceptionally high tolerance to this disorder in both extension trials in Co. Offaly and Kinsealy. In spite of repeated pressures on this cultivar with frosts and delayed maturity , it still maintained it's resistance. Lunet, the main standard cultivar for freezing developed a three-fold increase in I.B under similar conditions. In addition Philemon is high yielding, has superb quality and holds without deterioration in the field for a long period. It can be programmed for November through to December providing a valuable extension of the season.

The importance of the trials can be judged by the rigorous standards required for freezing sprouts where crops having over 1% I.B are unacceptable.

## **CAULIFLOWER**

Cauliflower production takes place all year round in Ireland but winter production from November to late winter is the most difficult, with quality and succession often hard to achieve. A survey of winter cauliflower growers in 1995 found that the majority transplant after early potatoes, often in late July and August , at spacings of 50-60 cms apart.

Extensive winter cauliflower cultivar screening trials together with evaluation of spacing and different times of planting were carried out on the main maturing groups of winter cauliflower. These identified methods of improving quality and efficiency. For cultivars grown in the most difficult mid-winter period (January/February) quality was improved significantly by increasing the plant spacings from 40 -50 cms to 80-90 cms apart in 70cm drills. This was accompanied by a significant reduction of inferior grade over the three year trial period (*Tables 4 & 5*) with both the hybrid Medaillon and the open pollinated cultivar - Triskel. Plants from the wider spacings produced larger frames and curds were better protected from the damaging elements of winter weather. They also suffered less from 'tip burn' associated with 'wet feet' and from frost damage. Percentage Class 1 grade curds increased from 45 to 90% using wide spacings. Together with significant reduction in inferior grades such as 'buttons' the wide spacings increased the overall efficiency of winter cauliflower production for this difficult period. **Insert slide 2 here**

**Table 4:** *Effect of spacing on quality (grade) of winter cauliflower ' Medaillon' (1995 - 1997)*

Plant spacing (cm)	Percentage				
	CL 1	CL 2	CL 3	Buttons	Rejects
40 x 70cm	45	18	1	34	3
50 x 70cm	49	26	1	22	1
60 x 70cm	67	23	2	8	0
70 x 70cm	72	19	1	4	5
80 x 70cm	83	10	2	3	3
90 x 70cm	90	7	0	2	1
f-test	***	*	NS	***	NS
S.E (df=20)	4.21	3.44	1.09	3.98	0.71

**Table 5:** Effect of spacing on quality (grade) of winter cauliflower 'Triskel' 1995

Plant spacing (cm)	Percentage			Buttons	Rejects
	CL 1	CL 2	CL 3		
40 x 70cm	22	35	6	33	3
50 x 70cm	26	33	8	27	1
60 x 70cm	47	25	7	16	0
70 x 70cm	53	27	5	12	5
80 x 70cm	63	22	6	7	3
90 x 70cm	70	14	2	11	1
f -test	*	***	NS	***	NS
S.E (df=20)	3.85	2.78	-	3.1	-

Trials to test the effect of transplanting date on cultivars representative of the different maturity groups, showed that specific transplanting dates are required to achieve maximum quality and output, though seasonal variations can be expected (*Table 6*). In general, early winter hybrids maturing from November-December such as Dova, Arbon and Belot performed best by transplanting from early to mid July. Later plantings failed to make sufficient size and suffered badly from downy mildew producing very poor grades. The mid-winter group comprising Janus, Arven, Medaillon and Briac benefited from very early plantings carried from the end of June to early July. Quality deteriorated with plantings from late July onwards. Late winter cultivars Ciren and Florian were not as sensitive in this regard and could be planted later in July. The results of these trials are very important for commercial growers who now have a proper basis for transplanting the various groups of winter cauliflower to achieve maximum quality in their winter cropping production programmes.

**Table 6:** Percentage Grade out and harvest date from four planting dates of eight winter cauliflower, Kinsealy 1995/1996

Cultivar	+Planting treatment	Class I	Class II	Class III	Button	Rejects	Harvest Date	
							From	To

Dova	P1	51.0	27.5	9.8	9.8	2.0	8.11.95	29.11.95
	P2	55.6	37.9	1.9	5.5	0.0	8.11.95	29.11.95
	P3	69.8	23.3	2.3	4.7	0.0	16.11.95	19.12.95
	P4	30.8	40.4	3.8	25.0	0.0	16.11.95	14.12.95
Belot	P1	60.8	33.3	3.9	0.0	2.0	16.11.95	13.12.95
	P2	84.8	10.9	0.0	4.3	0.0	06.11.95	19.12.95
	P3	63.0	31.4	2.9	3.8	0.0	16.11.95	19.12.95
	P4	74.4	12.8	2.6	10.3	0.0	29.11.95	13.12.95
Arbon	P1	75.4	14.0	0.0	10.5	0.0	29.11.95	13.12.95
	P2	67.8	29.0	2.4	3.6	0.0	09.11.95	19.12.95
	P3	72.3	23.4	0.0	4.3	0.0	4.12.95	19.12.95
	P4	61.0	31.7	2.4	4.9	0.0	4.12.95	19.12.95
Janus	P1	38.9	38.9	0.0	22.2	0.0	19.12.95	07.03.96
	P2	23.5	41.2	17.6	14.7	2.9	16.01.96	07.03.96
	P3	15.6	34.4	6.3	31.3	12.5	16.01.96	07.03.96
	P4	18.2	27.3	9.1	22.7	22.7	16.01.96	07.03.96
Arven	P1	57.6	15.2	3.0	18.2	6.1	16.01.95	22.02.96
	P2	56.8	13.5	8.1	21.6	0.0	16.01.96	22.02.96
	P3	32.7	38.8	0.0	24.5	4.1	16.01.96	22.02.96
	P4	24.0	48.0	8.0	12.0	8.0	16.01.96	22.02.96
Medaillon	P1	35.6	22.2	4.4	37.8	0.0	22.02.96	14.03.96
	P2	44.4	25.0	11.1	19.4	0.0	22.02.96	14.03.96
	P3	35.0	17.0	22.5	25.0	0.0	22.02.96	14.03.96
	P4	9.3	34.9	7.0	48.8	0.0	22.02.96	14.03.96
Ciren	P1	20.8	33.3	14.6	31.3	0.0	29.02.96	14.04.96
	P2	25.5	31.9	8.5	34.0	0.0	29.02.96	14.04.96
	P3	51.6	19.4	3.2	25.9	0.0	07.03.96	14.04.96
	P4	17.9	39.3	3.6	39.3	0.0	14.03.96	14.04.96
Florian	P1	31.3	27.0	12.5	29.2	0.0	25.04.96	23.05.96
	P2	39.0	27.2	8.5	22.0	3.4	25.04.96	23.05.96
	P3	30.2	30.2	11.6	27.9	0.0	25.04.96	23.05.96
	P4	22.2	25.0	2.8	50.0	0.0	02.05.96	23.05.96

+P1 = planted 28.06.95

P2 = planted 10.07.95

P3 = planted 17.07.95

P4 = planted 26.07.95

Information on new improved cultivars is an important requirement in determining a growers' programme. The majority of new winter cauliflowers being produced are hybrids. They all require a 'cool period' in their production cycle to crop successfully or various disorders such as bracting and or delayed cropping can result. The screening trial completed in Kinsealy has assessed fifty cultivars for winter production and for reliability to crop to schedule with consistent quality. Over the three year period some outstanding cultivars have been identified which consistently produced very high quality crops. In the early winter group (November-December) Talbot, Belot and Pierot proved to be outstanding. Escale, Dinnet, Pavilion and Liberty were new valuable cultivars identified for late autumn. In these trials the outstanding hybrids previously identified for mid-winter production such as Arven, Briten, Medaillon and Breven have not been superseded by any better cultivar. Luxor and Madiot were two of the most promising hybrids to follow these for succession however (*Table 7*).

A valuable late extension of the season from late spring to June has been achieved with the identification of new high quality cultivars. These included Renoir, Nomad, Invicta for April/early May and Patriot, Brigadoon, Christingle and Evita which produced crops in sequence to the end of May/ June in normal years. This represents an important breakthrough for winter cauliflower growers who had to rely on old cultivars without high quality up until now.

**Table 7:** *Grade and harvest date of 21 cultivars of winter cauliflower - 1997/1998*

Cultivar	Percentage				Maturity	
	CL 1	CL 2	CL 3	Buttons	From	To
Pierrot	47	5	2	3	05.12	18.01
Corboda	19	32	5	15	12.12	06.02
Fontenay	32	25	1	19	20.02	05.04
Asset	42	16	1	21	13.02	20.03
Madiot	80	3	2	2	11.03	26.03
T.G.19	1	10	29	7	02.05	09.06
Cappacio	17	24	4	17	06.02	06.03
Camarino	37	17	0	12	06.02	20.03
Briten	36	17	1	11	13.02	06.03
Breven	49	19	2	8	13.02	20.03
Luxor	52	17	1	5	20.02	20.03
Invicta	70	7	2	8	20.02	05.04
Florian	50	12	2	2	26.03	28.04
Renoir	75	1	0	1	26.03	28.04
Fortroso	78	2	0	1	05.04	18.04
Nomad	75	6	1	0	05.04	18.04
Brigadoon	49	12	0	2	18.04	02.05
Patriot	44	11	0	3	28.04	15.05
Christingle	61	10	1	3	25.04	26.05
Evita	45	22	1	3	28.04	26.05
T.G20	4	17	23	26	12.05	09.06

### **EARLY CAULIFLOWER PRODUCTION**

The use of plastic covers on modular transplants of early summer cauliflower (cv.Nautilus) produced earlier and better crops compared with uncovered crops (*Table 8*). The covers were particularly useful in early extension of the season and in reducing small premature curds (buttons). Plants from the larger polystyrene 198 modules were almost a week earlier in maturity than the traditional Hassy 308 modules.

**Table 8:** *Effect of module cell size and plastic cover on grade and harvest date of early summer cauliflower (c.v Nautilus)*

Treatment	Marketable			Unmarketable	Harvest date
	Class 1 %	Class 2 %	Class 3 %		
Polyst 198 + plastic cover	63	16	0	20	26.6
Hassy 308 + plastic cover	66	18	0	16	2.7
Hassy 308 uncovered	32	5	0.3	62	9.7

### ***CELERIAC***

This is a relatively new crop grown in Ireland for autumn / winter production. The introduction of new hybrids in the mid nineties aroused considerable interest in this crop for dehydration (processing). The crop is like celery and very sensitive to bolting. Trials took place on the most promising hybrid- Brilliant to determine the safest transplanting dates and the optimum plant spacing for Irish conditions . Results from these trials (*Tables 9 and 10*) clearly showed that no transplanting should take place until late May when the risk of bolting was significantly reduced relative to earlier planting dates where up to 95% crop bolted and was unmarketable. **Insert slide 3 here**

The crop was very responsive to spacing. The highest yield was obtained at the closest spacing of 15cm, Table 10. This however produced the smallest root size, having poor quality with over 50% less than 7.5 cm diameter . Root size increased progressively with wide spacing, but was accompanied by a reduction in yield - the greatest reduction was associated with the widest spacing (65cm) used .

These results clearly provide a choice of plant spacings to provide a range of different sized roots for different requirements . As this crop grew well in extension trials in counties Offaly and Cork as well as Kinsealy it could be used as an alternative crop to celery . Unlike celery however it has a much lower nitrogen requirement and is more resistant to black spot disease. An additional advantage is that under Irish conditions it can be stored or will hold over most years until the spring enabling a long succession of crops to be procured.

**Table 9:** *Effect of planting dates on marketable yields and bolting of Celeriac (cv. Brilliant)*

Planting date	Mark. yield t/ha	Bolting t/ha	Percentage			Bolt
			<sup>1</sup> L	<sup>1</sup> M	<sup>1</sup> S	
03.05	1.80	18.10	0	4	7	95
10.05	3.00	22.90	3	5	2	89
17.05	15.10	11.00	14	21	11	48
25.05	25.80	0.20	29	51	18	1
31.05	15.10	1.10	16	36	36	10
f - test	***	***				
S.E (df=12)	4.10	2.00				

<sup>1</sup> L = roots . 12cm diam    M = roots 7-12cm diam    S = roots, 7cm diam

**Table 10:** *Effect of spacing on yield and size of Celeriac (cv. Brilliant)*

Spacing (cm)	Total mark. yield t/ha.	Percentage		
		<sup>1</sup> L	<sup>1</sup> M	<sup>1</sup> S
15 x 60	34.9	5	41	54
25 x 60	31.9	36	37	27
35 x 60	27.9	47	53	0
45 x 60	21.2	61	40	0
55 x 60	19.8	68	32	0
65 x 60	17.5	72	28	0
f - test	*			
S.E (df=5)	3.90			

\* L = roots greater than or equal to 12cm diam    M = roots 7-12cm diam    S = roots , 7cm diam

## **COLESLAW CABBAGE**

Coleslaw cabbage production has increased in Ireland and there is now a demand for year round production. This is one of the main ingredients in coleslaw salads where dense heads are required which will store under refrigerated conditions. Complaints about inferior Irish coleslaw cabbages range from heads being loose to being affected with internal breakdown. An initial trial was laid down at Kinsealy in 1996-1997 and in 1998 in North Cork which is an important production centre and where internal breakdown was known to be a problem in one location.

### **Insert slide 4 here**

The results of an early April versus mid June planting dates on marketable yield are shown in *Table 11*. Apart from Quisto and Piton all other cultivars produced better yields from the earlier date without any bolting. This was most pronounced with Marathon, Junior, Krypton, Marvellon and Ramco where large and significant differences occurred relative to the later transplanting date. In contrast the cultivars Avolon, Kilor and Lion produced almost comparable results from both planting dates. The superior density or firmness achieved from all cultivars from the earliest

planting date was notable. This was carried out by visually scoring and by counting the number of leaves in a cross section of the heads.

Some cultivars were unsuitable for coleslaw production and for long term storage because of looseness. These included Piton, Ramco and Marvellon in spite of their high yield. A number of promising cultivars emerged including Quisto for early production and Kilor, Milford, Lion, Junior and Marathon for main crop production. One cultivar, Robusta had internal breakdown varying from 4% with the earlier planting dates to 2% with the later planting.

**Table 11:** *The effect of planting date on coleslaw cabbage cultivars for yield and density 1996/1997*

Cultivar	<sup>1</sup> Planting Date	Yield t/ha	<sup>2</sup> Rating	Density No. leaves per 2.5cm /head profile
Quisto	P1	51.7	9	-
	P2	63	6	-
Piton	P1	56.0	4	-
	P2	66.6	2.7	-
Avalon	P1	49.7	9	16
	P2	42.7	6	12
Ramco	P1	83.3	4	-
	P2	68.3	4.0	-
Kilor	P1	30.7	9	23
	P2	27.7	9	20
Marvellon	P1	81.3	6	13
	P2	44.3	4.6	11
Milford	P1	46.3	9	17
	P2	48.7	8	14
Krypton	P1	101.2	10	14.3
	P2	31.7	9	13.3
Lion	P1	42.7	10	14.0
	P2	36.7	6	13.7
Junior	P1	56.7	10	14.3
	P2	26.7	8	14.3
Marathon	P2	63.6	9.7	11
	P2	36.7	5	11
Robusta	P1	36.0	9	-
	P2	33.0	8	-
f - test		***	***	
S.E (df=41)		8.90	.483	

<sup>1</sup> P1 transplanted 02.04; sown 20.02 P2 transplanted 16.06; sown 19.03

<sup>2</sup> based on visual rating ; 10 = very dense head; 1= very loose head

### ***CABBAGE - EXTENSION OF THE SEASON***

A valuable 'extension' of the season for fresh market including round headed, york and Coleslaw cabbages was obtained with modular raised transplants and the use of plastic covers ( *Table 12*).

With the round headed Delphi and the coleslaw cv,Quisto , significant yield increases and earliness occurred with the use of plastic covers. Where a larger modular cell size (polystyrene198 cell) was used with the cv. Delphi this further increased yield. No significant yield increases occurred with the two york cabbage cultivars Spirant and Duchy but earliness was again substantially advanced with the plastic covers. **Insert slide 5 here**

**Table 12:** *Effect of plastic cover and modular size on yield and harvest date for early summer cabbages 1995.*

<b>Cultivar / cover</b>	<b>Mark. yield ( t/ha)</b>	<b>Unmark. yield ( t/ha)</b>	<b>Harvest</b>
<b>Delphi</b>			
Polyst 198 plastic cover	48.8	0.2	08.06.
Hassy 308 plastic cover	35.1	3.4	08.06.
Hassy 308 unprotected	7.4	5.0	16.06.
<b>Spirant</b>			
Hassy 308 plastic cover	43.3	1.7	03.06.
Hassy 308 unprotected	32.6	5.0	10.06.
<b>Duchy</b>			
Hassy 308 plastic cover	34.8	3	08.06.
Hassy 308 unprotected	29.9	8	22.06.
<b>Quisto</b>			
Hassy 308 plastic cover	32.0	12.1	13.07
Hassy 308 unprotected	11.8	14.3	03.08
f - test	***	***	
S.E (df=24)	4.0	1.8	

### ***SWEDE (EARLY PRODUCTION)***

The traditional method of direct drilling swedes in early April produced crops for July - too late for the scarce June market. By sowing Magres a cultivar identified in Kinsealy trials with tolerance to bolting in modules, in late February, production was brought forward to June (*Table 13*). Further refinements of sowing dates with other growing aids such as perforated plastic

covers which were put in place after transplanting produced high yields and extended the season of production back to early June (Tables 14 and 15). The best results were obtained using large modules of 19-25 ml capacity such as 160 cell tray. The plastic covers (polycrop and Agryl) advanced earliness, improved quality and significantly reduced bolting. The use of 6 week old plants in modules which received supplementary nitrogen and potassium feeding and firming after transplanting significantly increased quality for early swede production (Table 16). The production blueprint produced from this work has proved reliable and has become widely adopted in commercial practice. This is enabling high quality crops to be produced for the high-priced June market. This is a valuable extension of the season and provides a badly needed cash crop for growers' in the early part of the season. **Insert slide 6 here**

**Table 13:** *Effect of plant raising method on root weight and harvest date of the swede cultivar Magres*

Raising method	Sowing date	Average root (kg)	Harvest date
Module	February	0.5	20.06
Direct drilling	April	0.5	11.07

**Table 14:** *Yields, root size, bolting and harvest date of modular raised Magres sown on two dates*

Sowing date/plastic cover	Mark. yield t/ha	Root weight kg	Percentage				Harvest date
			Mark. Small	Bolters mark.	Bolters unmark.		
<sup>1</sup> Jan 31 Polycrop	50.6	0.7	96	3	0	0.5	12.06
<sup>1</sup> Jan 31 uncovered	17.3	0.2	68	0	30	0	18.06
<sup>2</sup> Feb 28 Polycrop	47.9	0.7	94	0	0	5.5	24.06
<sup>2</sup> Feb 28 uncovered	44.9	0.5	98	0	2	0	02.07
f - test	*						
S.E (df=3)	4.76						

<sup>1</sup>transplanted April 10

<sup>2</sup>transplanted April 24

**Table 15:** *Effect of two plastic covers (Polycrop and Agryl) on yield, bolting and harvest date of swede Magres (sown January 30)*

Treatment	Percentage				Harvest date
	Mark. yield t/a	Mark.	Bolters mark.	Bolters unmark.	
Polycrop	34.8	81	13	6	09.06
Agryl p.17	27.7	75	9	16	09.06
uncovered	16.6	11	40	48	18.06
f-test	NS				

**Table 16:** *Effect of husbandry treatments on yields and root size of swede cv. Magres*

Treatment	Mark. yield t/ha	% Crop Mark.	Size Distribution (%)			
			VL <sup>1</sup>	L	M	S
No firming after planting	42.0	54	7	30	53	10
Firming after planting	51.48	75	12	29	53	6
10 week plants	21.34	32	6	14	29	50
Nitrogen starved	44.52	69	13	43	44	0
N & K feed	54.43	72	25	26	42	4
f-test	***					
S.E. (df=15)	2.98					

<sup>1</sup> root size: VL = roots >135mm; L = roots 110-135mm; M = roots 90-110mm; S = roots 75-90mm.

## CONCLUSIONS

### *Broccoli*

- A valuable extension of the broccoli season from January to April was achieved with new purple sprouting broccoli cultivars.
- Plastic covers significantly increased yield and earliness of early summer green broccoli.

### ***Brussel sprouts***

- A new Dutch hybrid - Philemon has been identified with high tolerance to internal browning .
- This cultivar can be used for November / December production giving a valuable extension of the season for freezer sprout production.

### ***Winter cauliflower***

- Wide spacing of 80-90 cm between the plants for January / February cultivars improved the quality of class 1 curds significantly compared with a spacing of 40 - 50 cm .
- Wide spacings significantly increased quality and the harvest efficiency by reducing ' button' and reject categories.
- Optimum times of transplanting the main groups of winter cauliflower were determined.
- Mid July planting gave best results for November/ December maturing cultivars Arbon, Dova while Belot responded best to late June /mid July planting.
- January maturing cultivars responded best to early plantings carried out from the last week of June to the first week of July.
- March and other later maturing cultivars produced best results from an early to late July planting.
- Late plantings, at the end of July produced greater loss of quality with the November to February maturing groups.
- Several new high quality cultivars were identified which extended the season from early May to early June.

### ***Summer Cauliflower***

- Plastic covers significantly increased earliness, quality and efficiency for the early summer crops.

### ***Celeriac***

- A programme to produce celeriac from October to April was developed.
- Transplanting after May 25<sup>th</sup> was essential to reduce bolting.
- The crop was very responsive to spacing in determining root size and overall yield.
- The optimum spacing for both yield and root size was 35 x60 cm

### *Cabbage*

- Quality of coleslaw cabbage ( density ) was significantly increased from transplanting in April using modular raised plants .
- Plastic covers increased the earliness and yield of early round and york cabbages and also early coleslaw cabbage.

### *Swede*

- Magres is the most bolt resistant cultivar suitable for early production
- End of February sowing in modules under protection, with April transplanting advanced the season from July to late June.
- Plastic covers after transplanting improved yield, quality and gained an additional 6-8 days earliness making crops available for mid June .
- Plastic covers reduced bolting . Polycrop proved superior to the Agryl , P.17 .
- Earlier crops were produced for early June markets by sowing in modules at the end of January and covering with plastic covers in the field ( coastal regions only).
- Six week old transplants gave best results for earliness and quality .
- Firming in plants after transplanting significantly improved yield and quality .
- Supplementary feeding with nitrogen and potassium during the last 10 -14 days of propagation increased quality and yield.
- New cultivars tested to date have not been as reliable as Magres.
- Larger module sizes ( 19- 24 cc) proved superior to the standard module (13 cc) for early production.

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