EFFECT OF EARLY SOWING ON THE GROWTH, YIELD AND QUALITY OF SUGAR BEET

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Teagasc acknowledges the support of Irish Sugar plc
and Sugar Beet Levy Farmer Funds
in the financing of this project

ISBN 1 84170 080 0

December 1999

Teagasc
The Science of Farming and Food

EUROPEAN UNION
European Agricultural Guidance and Guarantee Fund

Teagasc, 19 Sandymount Avenue, Dublin 4

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SUMMARY

Experiments have shown that yield of sugar is closely related to the amount of solar radiation intercepted by a sugar beet crop. Early sowing increases leaf area from May onwards when radiation is at its maximum and provides a basis for increasing yields. In the past, bolting has been an undesirable consequence of early sowing but some modern cultivars have good bolting resistance and can be sown early with a limited risk of bolting.

This study, conducted from 1994 to 1998, compared the performance of two cultivars, Celt and Monofeb, at three sowing dates and three harvest dates. In replicated experiments, plant establishment, crop development, and root yield and quality were assessed. The effect of sowing date on solar radiation interception was studied. Effects of in-furrow pesticide application on pest numbers and plant damage were also measured.

Plant establishment was influenced by sowing date with the early sowings generally giving lower plant numbers than the later ones. The cultivar Celt produced higher populations than Monofeb at all sowing dates.

Early sowing increased the leaf area index (a measure of the ratio of leaf to land area) and consequently the amount of solar radiation intercepted. This was particularly so in June when solar radiation levels are highest. Early crop establishment provides the opportunity to exploit good weather conditions which may occur in April or May.

Pest numbers generally were small at all the sites. Insecticide had a greater effect on pest numbers and plant damage than it had on plant establishment; the beneficial effects of pesticide were slightly more pronounced for the early and mid-season sowings than for later-sown beet.

Seedling diseases were not a problem at any time of sowing. Poor emergence, where it occurred, was not associated with pre-emergence disease.

Early to mid-March sowings produced significantly higher yields of roots and sugar than the early or late April sowings over the period of the experiment. Even in years when plant populations from the first sowings were much lower than subsequent sowings, yields tended to be at least equal to those of later sowings.

Monofeb produced a slightly higher root yield than Celt, but because it had lower sugar contents there was no difference in sugar yields.

Harvesting extended over the period from early October to mid-November and root growth and sugar production increased over that period irrespective of sowing date.

Bolting was a problem in 1996 on the early-sown plots, particularly with the cultivar Celt.

INTRODUCTION

Experiments in the UK have shown that: (i) there is a close relationship between solar radiation intercepted by a sugar beet crop and the yield of sugar, and (ii) the basis of a good crop is created early in the season (1). The implication from this work was that the aim should be to ensure that more of the energy falling on land devoted to sugar beet is intercepted by green, healthy leaves.

Early sowing and plant establishment is one way by which the leaf area from May to July can be increased. However, there are limitations to the benefits of early sowing; little germination or emergence occurs while air and surface soil temperatures remain below 5^{o}C, a situation which is more likely after early sowing. Beet seed or seedlings may, therefore, be vulnerable to pest or disease attack for longer and plant establishment may be reduced. Heavy rainfall within a few days of sowing may reduce seed vigour and plant establishment (2).

Bolting has been a major drawback of early sowing in the past, not only from the loss of sugar yield (1% bolted has been estimated to reduce sugar yield by 0.5%) but also as a potential source of weed beet. Bolting percentage is related to the number of days after sowing on which the maximum daily temperature does not exceed 12^{o}C, so early-sown beet is more likely to be exposed to a greater number of these days than later-sown beet (3, 4). Beet cultivars vary in their resistance to bolting. Bolting-susceptible cultivars are expected to bolt significantly (0.5%) after a total of 20 days <12^{o}C; bolting-resistant cultivars need about 35 days.

The availability of cultivars with a high degree of bolting resistance has provided the opportunity for a fresh look at the effects of different sowing and harvest dates on establishment, development and yield of sugar beet.

METHODS

Experiments were conducted annually from 1994 to 1998 comparing the effects of different sowing and harvest dates on growth and development of two sugar beet cultivars. There were three sowing dates each year, spaced at approximately three-week intervals, with the first sowing at the earliest date in March on which soil conditions were considered suitable for cultivation. The target interval between the three harvest dates was also three weeks, starting in mid- to end-October. Site, and sowing and harvest date details are given in Table 1.

Table 1: Details of sites, and sowing and harvest dates

Year	Site	Soil type	Sowing dates	Harvest dates
			14/3/94	3/10/94
1994	Oak Park	Sandy	7/4/94	24/10/94
			27/4/94	11/11/94
			23/3/95	13/10/95
1995	Oak Park	Loam	8/4/95	4/11/95
			26/4/95	28/11/95
			8/3/96	16/10/96
1996	Park, Carlow	Sandy loam	1/4/96	6/11/96
			26/4/96	14/11/96
			12/3/97	7/10/97
1997	Chapelstown, Carlow	Sandy loam	2/4/97	29/10/97
			22/4/97	13/11/97
			21/3/98	5/10/98
	Oak Park	Loam	15/4/98	27/10/98
			4/5/98	16/11/98
1998				
			19/3/98	9/10/98
	Camolin, Co. Wexford	Loam	17/4/98	29/10/98
			1/5/98	18/11/98

Two cultivars were used throughout the experiment: 1. Celt – a diploid with an upright growth habit, and 2. Monofeb – a triploid with a more spreading leaf growth habit. Both cultivars were bolting resistant.

Most of the sites were located close to Carlow town and all were on light to medium free-draining soils, which could be worked reasonably early.

Date of ploughing varied from November to February. Cultivations were similar on all sites; they consisted of one pass, approximately 15 cm deep, with a Lely Roterra rotary cultivator at a slow forward speed on the ploughed ground, aiming to produce a fine moist seedbed. Cultivations were done immediately before sowing at each sowing date.

The experimental layout was a randomised block with six replications; each plot corresponded to a sowing date with six subplots for cultivar and harvest date within each main plot. Each subplot was five rows wide, corresponding to one seeder width. Row width was 56 cm and target seed spacing 15.2 cm for the first two years and this was increased to 16.5 cm for the remainder. Plot length was 24 metres; each plot was subdivided into two 12-metre lengths, one of which was used for establishment and yield measurements, and the other for solar radiation/crop development and pest assessments.

The effects of pesticide on plant establishment, pest numbers, damage to root and hypocotyl and capsid damage to aerial growing points were assessed in plots treated with carbofuran-isofenphos (Yaltox Combi) granular insecticide and compared with untreated beet. The carbofuran-isofenphos was applied to the three centre rows of plots as an in-furrow treatment, at 9 kg/ha. The two remaining outer plot-rows represented the untreated controls. Comparisons were made for each of the three sowing periods in each season. All plots were sown with commercially available seed, which included the standard pellet-incorporated insecticide, Mesurol (0.5% methiocarb).

Plant establishment was calculated by counting all plants in insecticide-treated and untreated rows. Where emergence was poor, unemerged seedlings and/or pellets were recovered from blank spaces in the two outside rows of each subplot in an effort to establish the cause of non-emergence. Seedling pest numbers represented the mean in five soil cores (6.35 cm diameter and 15 cm deep) from these rows. Plant damage was expressed as the mean number of bites per plant and was based on the examination of five plants from treated and untreated rows when plants were at the 2 – 3 leaf stage of growth.

The effect of sowing date on leaf growth (leaf area index), radiation interception and partitioning of photosynthate between leaf and root were also measured.

Plant establishment, root yield, sugar content and impurity levels were measured, from which plant population, root and sugar yield, and sugar extractability were calculated.

On most sites, a basic PK dressing (0N.7P.30K) was applied onto the ploughed ground shortly before the first sowing, and the nitrogen was applied in two splits after the crop had emerged. A complete beet compound was applied on the Carlow and Wexford sites in 1996 and 1998, followed by a single nitrogen application. The nitrogen applications were delayed to prevent possible leaching in the period between the first and last sowings. Boron was applied in liquid form where the beet compound was not used. Weed control measures were based on regular observation and each sowing date was assessed and, if required, sprayed independently. A fungicide was routinely applied in August to prevent foliar diseases.

RESULTS AND DISCUSSION

Plant establishment

Plant establishment figures varied between sowing dates in each year. In 1994 and 1995, when the target spacing was 15.2 cm, 100% establishment would give a population of 117,733 plants/hectare, while from 1996 to 1998, when the spacing was increased to 16.5 cm, 100% establishment would give 108,306 plants/hectare. The generally accepted target population for commercial beet crops is 75,000 plants/hectare, corresponding to establishment percentages of 63.7% and 69.2% for the two seed spacings used for this experiment.

Recovery of unemerged seedlings or pellets showed that seed germination was always greater than 95%, though subsequent seedling emergence varied. In 1994, the first sowing produced lower plant stands than either the second or third (Fig. 1a). In 1995, all three sowings produced excellent plant stands, and the first sowing was as good as the other two. The first sowing in 1995 was on March 23 and soil temperatures were relatively high after sowing. Conditions in 1996 were less favourable after the first sowing (March 8) and emergence was slow; final populations after the first sowing were significantly lower than those from the second and third sowings. In 1997, the first sowing produced a full and rapid emergence, with about 87% established after four weeks; the final establishment was similar to the second sowing but plant establishment was very low after the third sowing, averaging about 68% (Fig. 1b). Although the seedbed was dry at the time of the third sowing, there was heavy rain within two days of sowing which, combined with a fine seedbed, may have caused waterlogging around the seed and impaired seed vigour and reduced subsequent establishment (4). There was no evidence of pest or disease problems.

Weather conditions played a significant part in determining plant establishment, particularly in 1998 when a very cold and windy spell in early April killed many seedlings on the early-sown plots and reduced establishment to less than 40% at Oak Park and 50% in Camolin. The second sowing, which had not yet emerged avoided the worst effects of this unusual weather. In 1994 and 1996, while the weather was mild after the first sowing, the soils were wet and this may have had an adverse effect on emergence. The standard seed dressings gave good control of seedling diseases and poor emergence was never attributed to pre-emergence disease. Celt produced significantly higher plant populations than Monofeb at all sowing dates in each year of the experiment (Figs. 1a and 1b).

Final plant populations at harvest are given in Table 2. In 1996, populations on the first sowing treatment were slightly below the figure considered necessary for a full yield. In 1998, populations on the first sowing treatment at the Oak Park and Camolin sites were very low and those on the second sowing were barely adequate.

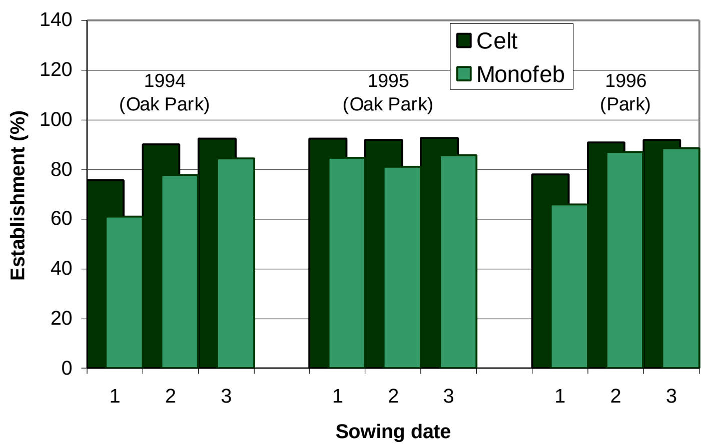

Fig. 1a: Comparison of plant establishment for cultivars Celt and Monofeb at three sowing dates, 1994-96

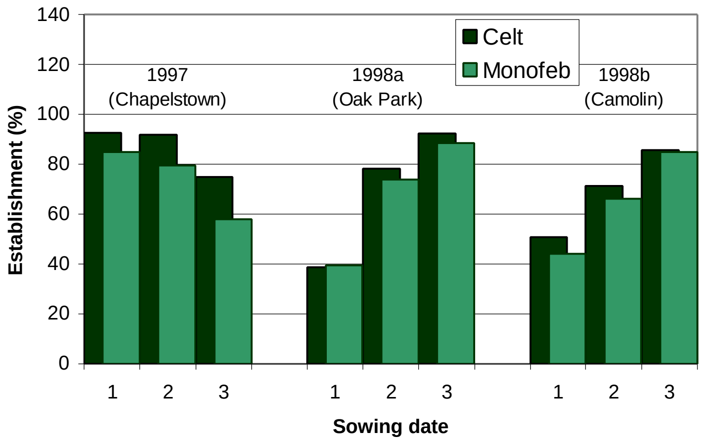

Fig. 1b: Comparison of plant establishment for cultivars Celt and Monofeb at three sowing dates, 1997-98

Table 2: Plant populations at harvest for two cultivars and three sowing dates, 1994-98

	1994	1995	1996	1997	1998a	1998b
Cultivar						
Celt	99,666	103,951	87,879	90,586	70,463	70,340
Monofeb	82,171	91,528	76,678	74,707	65,833	62,469
s.e.d.	920.2	1079.1	973.9	1064.9	1405.9	1468.5
Significance	***	***	***	***	***	***
Sowing						
1st	79,286	97,801	71,926	91,296	42,708	49,259
2nd	94,907	95,694	87,918	85,949	74,954	67,037
3rd	98,563	99,722	83,992	70,694	86,782	82,917
s.e.d.	1186.2	1894.0	1914.7	1617.1	1721.9	1798.5
Significance	***	NS	***	***	***	***

Leaf development

As yields are influenced mainly by the amount of solar radiation intercepted by the leaf canopy, it is important to promote as early leaf development as possible. The amount of leaves on any crop is expressed as the leaf area index (LAI) which is the ratio of leaf to land area. The effect of LAI on the total amount of radiation intercepted is illustrated in Fig. 2. This shows the importance of achieving a leaf canopy with an LAI of about 3 early in the season if a high level of radiation interception is to be obtained.

The effect of time of sowing on LAI in 1997 is illustrated in Fig. 3, where the earliest sowing date gave the earliest leaf development and the highest radiation interception by the leaves. It can be seen from Fig. 4 that the levels of sunshine utilised by crops sown in early March was 80% compared to 59% and 22% for early April and late April sowings, respectively. The close relationship between these factors and final yield is illustrated in a later section of this report.

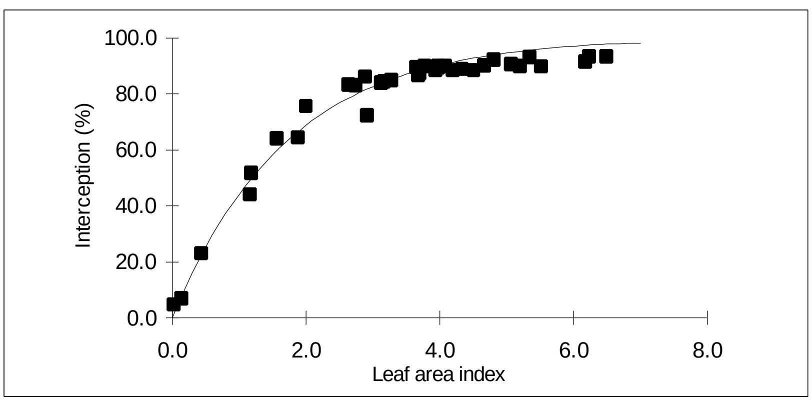

Fig. 2: Radiation interception vs leaf area index (Oak Park trials)

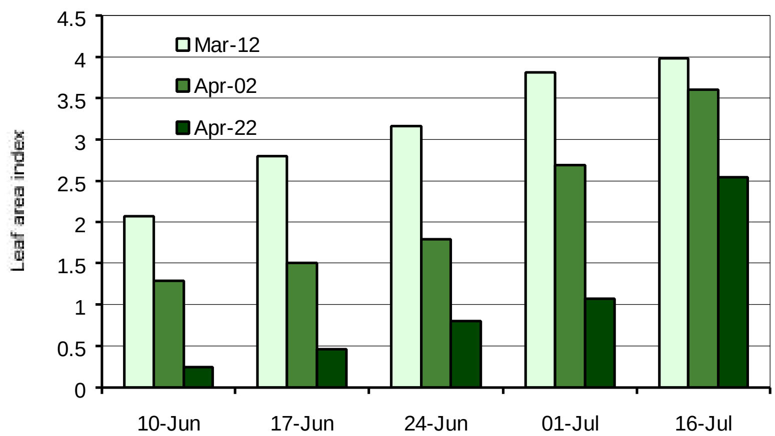

Fig. 3: Effect of sowing date on leaf area index for cultivar Monofeb at 3 sowing dates, 1997

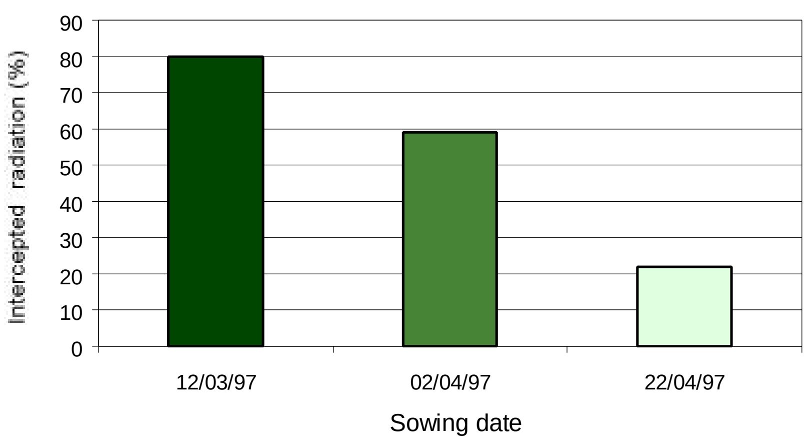

Fig. 4: Effect of sowing date on radiation interception, 10 June 1997

Pests

The number of beet seedling pests in the six sites investigated was low. The most abundant of the soil pests in each season were the *Onychiuridae* (Springtails). Relative to earlier trial sites, however, onychiurids in these sites were unusually scarce. The lowest infestation, 0.08 onychiurids/soil sample, was recorded at the Oak Park site in 1998 and the highest, 3.7/sample, was found at the Camolin site, also in 1998. Pygmy beetles (*Atomaria linearis*) were found damaging seedlings of the late-sown beet (23 April) in 1995 but otherwise these beetles were not encountered. The small pest-induced reduction in plant establishment at the Oak Park site in 1998 was due to leatherjackets (*Tipula paludosa*). This was the only infestation of leatherjackets recorded during this investigation. Some seedling damage by capsids (*Lygus rugulipennis*) occurred each season. The maximum mean seasonal damage by capsids ranged from a low of 2.4% of plants damaged in 1995 to a peak of 11.1% damaged in 1998.

The effects of granular insecticide on plant establishment, pest abundance and pest damage over the period 1994 to 1998 are given in Table 3. The use of insecticide resulted in a significantly higher plant establishment in treated, relative to untreated, plots in three of the six trials. The maximum increase in plant establishment, due to insecticide, was only 3.7% and was indicative of the low number of pests in the sites investigated. The number of onychiurids per soil sample was reduced, due to insecticide, in each trial but only in three trials was the reduction significant. The maximum reduction in the number of these pests was from 3.4 per sample in untreated plots to 1.3 per sample in treated plots. The insecticide reduced the number of pest bites on roots and hypocotyls of treated plants in each trial and the difference was significant for four trials. The maximum reduction in damage recorded was from 6.4 bites/plant in untreated beet to 1.8 bites/plant in treated plots.

The effect of granular insecticide on plant establishment, pest number and pest damage on two cultivars of beet sown early, mid and late season in the period 1994 to 1998 is given in Table 4. The use of insecticide increased plant establishment, reduced the number of onychiurids per soil sample and reduced the number of pest bites per plant in each of the three sowing periods. The beneficial effects of insecticide were somewhat greater for early and mid-season sown beet. The differences in plant establishment (Fig. 5) between treated and untreated beet were small (maximum 2.7%) and were significant for early and mid-season sown beet but were not significant for late-sown beet.

Table 3: The effect of granular insecticide on plant establishment, pest numbers and pest damage (means for two cultivars and three sowing dates) over five seasons, 1994-98

Treatment	Season	Plant establishment (%)	No. onychiurids per soil sample	No. pest bites per plant
Granules	1994	81.40*	1.33*	0.93
No granules		78.40	3.37	4.09
Granules	1995	87.58	0.33	1.83*
No granules		87.30	0.62	6.39
Granules	1996	85.25	0.88	0.47*
No granules		83.08	2.41	1.53
Granules	1997	80.45	0.25*	0.05*
No granules		80.82	1.20	0.64
Granules	1998a	69.10*	0.06	0.03
No granules		65.43	0.08	0.07
Granules	1998b	67.82*	1.98*	0.48*
No granules		64.47	3.70	1.89

*=Significant differences between insecticide treated and untreated ($P \leq 0.05$)
1998a = Oak Park; 1998b = Camolin

Table 4: The effect of granular insecticide on plant establishment, pest number and pest damage on two cultivars of beet sown early, mid and late season, in the period 1994-98

Early season		Mid season		Late season	
Insecticide	No insecticide	Insecticide	No insecticide	Insecticide	No insecticide
Per cent plant establishment					
67.74*	65.61	81.37*	78.69	85.83	84.79
Number of onychiurids per soil sample					
1.01*	2.44	0.62*	1.72	0.68*	1.23
Number of pest bites per plant					
0.57*	2.48	0.16*	1.05	0.43*	1.19

*=Significant difference within season between insecticide treated and untreated ($P \leq 0.05$)

The use of insecticide significantly reduced the number of onychiurids per soil sample for each of the three sowing periods (Fig. 6). The reductions in pest numbers in early, mid and late-season sown beet were 59%, 64% and 45%, respectively.

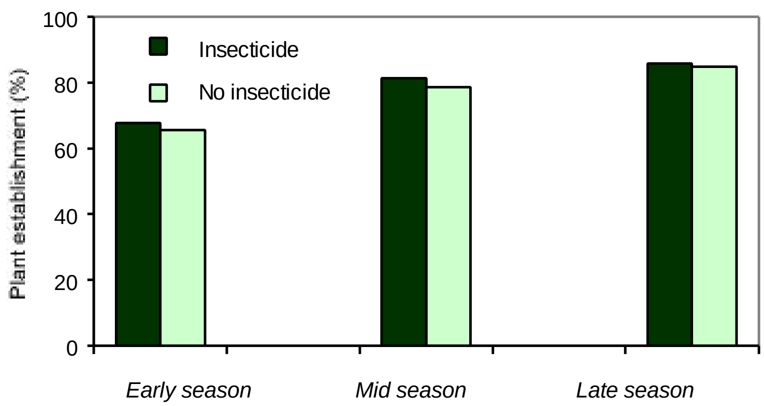

Fig. 5: Plant establishment in sugar beet treated and untreated with granular insecticide in the period 1994-98

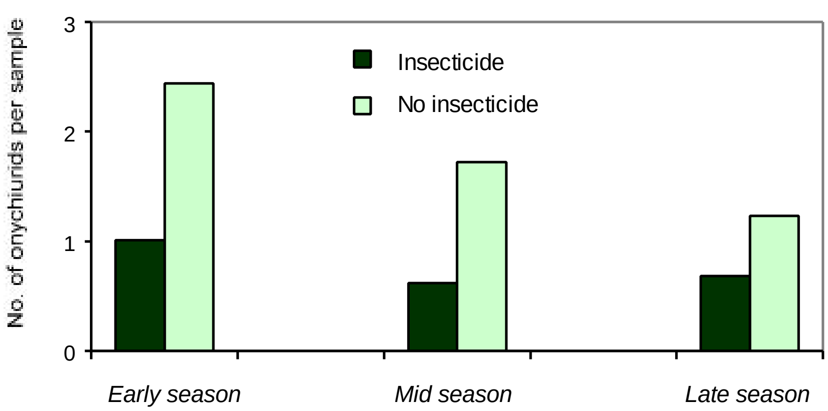

Fig. 6: The number of onychiurids per soil sample in sugar beet treated and untreated with granular insecticide in the period 1994-98

Corresponding with the low numbers of soil pests in these trials the extent of plant damage, in terms of pest bites on roots and hypocotyls, was also low. However, the insecticide treatment significantly reduced the number of pest bites on plants, (Fig. 7). The reduction in pest bites/plant for early, mid and late-season sown beet was 77%, 85% and 64%, respectively.

The effect of granular insecticide in reducing capsid damage in these trials is given in Table 5. With the exception of one trial in 1998, capsid damage was not a serious problem. The insecticide significantly reduced capsid damage in the mid and late-season sown beet but not in the early-sown beet. The mean maximum level of plant damage by these insects was 11% recorded in 1998 at Oak Park. There was 5.3% damage in the 1997 trial while each of the four remaining trials had less than 4%. The greatest incidence of capsid damage, and significant reduction in damage due to insecticide, was recorded in beet sown at Oak Park on 15 April 1998. Damage in the untreated plots of the cultivar Monofeb was 11.1% while in treated plots there was 4.7%. The respective values for the cultivar Celt, also sown at Oak Park on this date, were 9.8% and 3.1%.

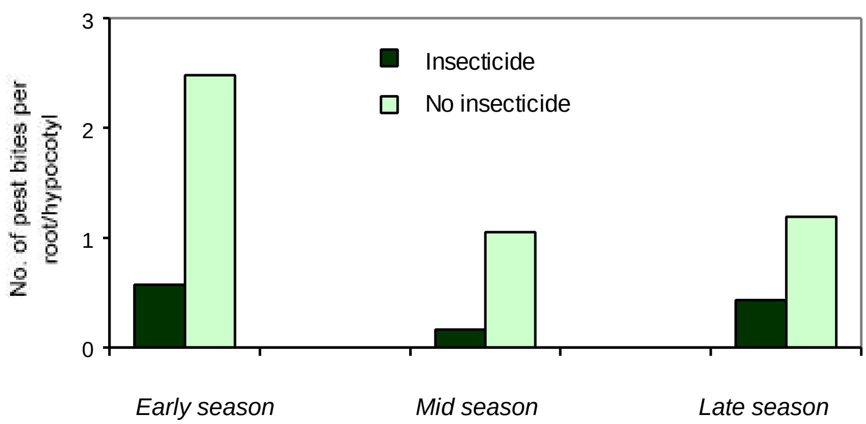

Fig. 7: The number of pest bites per plant in sugar beet treated and untreated with granular insecticide in the period 1994-98

Table 5: Capsid damaged plants in beet sown early, mid and late season with and without the granular insecticide carbofuran-isofenphos (% of total plants). The data are aggregated for the two cultivars Celt and Monofeb for the period 1994-98

	Sowing period		
	Early season	Mid season	Late season
Granules	2.2	1.8*	1.0*
No granules	2.6	3.6	1.6

*=Significant difference within season between insecticide treated and untreated ($P \leq 0.05$)

The aphid-transmitted disease, virus yellows, occurred only in the 1994 season when the maximum infection was 6.5% of total plants. Differences in the level of disease between sowing periods were not significant. The effect of insecticide on virus incidence was not recorded.

Overall, the numbers of soil pests (onychiurids, symphlids and millipedes) in the six trial sites were low. The maximum mean number of onychiurids per soil sample, at the 2/3 leaf plant growth stage, in untreated plots of either Celt or Monofeb and sown either early, mid or late season was 5.2 per sample. In previous experiments, where these pests were found causing serious crop damage more than 20 onychiurids per soil sample could be expected. The low number of pests is attributed to the long sequence of tillage crops grown on these sites. In Ireland, onychiurids are the most widely distributed and important of the soil pests that damage seedling beet. Populations of onychiurids build up in soils growing perennial ryegrass and are also plentiful in cultivated mineral soils having high organic matter or a plentiful weed flora. These pests are usually more numerous in the cultivated soil layer in early spring and it would seem reasonable, therefore, to expect that damage to seedlings by these pests would be greatest in early-sown crops. Data on the effect of non-lethal pest damage, at the seedling stage of growth, on root yield is limited but some studies indicate that such feeding can result in yield loss. In contrast to onychiurids, damage by symphylids and pygmy beetles is more likely to occur in late-sown beet.

Root yields

There was no significant difference in yield between the cultivars Celt and Monofeb in the first four years of the experiment. In 1998, Monofeb yielded

Table 6: Root yields for cultivars Celt and Monofeb (t/ha), 1994-98

	1994	1995	1996	1997	1998a	1998b
Cultivar						
Celt	54.568	49.269	63.891	57.807	65.582	59.203
Monofeb	54.270	50.907	64.068	58.579	67.766	60.988
s.e.d.	0.4795	0.9215	0.6210	0.5207	0.7050	0.7591
Significance	NS	NS	NS	NS	**	*

slightly better at the two sites, although Celt had a significantly higher plant population; this increase occurred at all sowing and harvest dates (Table 6).

In 1994, the first sowing had a significantly lower plant population than either the second or third, but it produced the highest root yields. The largest root yields were obtained at the final harvest but a rather anomalous result was obtained at the second harvest when the yields were lower than those at the first harvest (Fig. 8a).

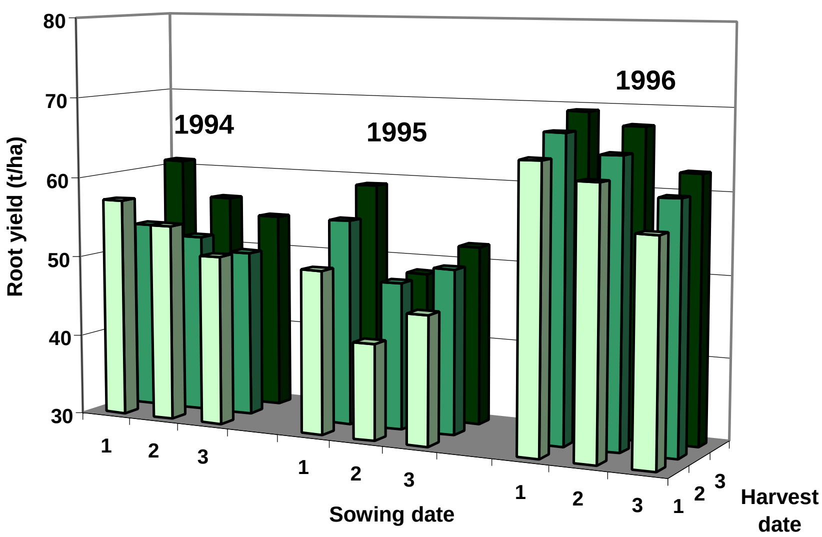

Fig. 8a: Effect of different sowing and harvest dates on root yield (t/ha), 1994-96

In 1995, there were large variations in yield from individual plots across the experiment as a result of a combination of a prolonged warm, dry spell and soil type variations which caused severe wilting on parts of the site. The effects were worst on the light, gravelly areas where the wilting was more severe and prolonged than on the sandy loam areas. The earliest sowing date produced the highest yields at all three harvests, but the second sowing yielded less than the third, although the difference was not significant. The high degree of non-treatment variability made it difficult to draw conclusions from the experiment in 1995.

Highest yields were obtained on the early-sown plots in 1996, although the differences between the first and second sowings were not statistically significant. These high yields were obtained in spite of the fact that the first sowing had the lowest plant populations. Delaying harvesting from mid-October to mid-November gave consistent root yield increases for all sowing dates.

In 1997, when plant establishment was relatively poor from the third sowing, there were clear-cut differences in root yields between sowing dates and also between harvest dates. Earlier sowing and later harvesting gave improved yields (Fig. 8b).

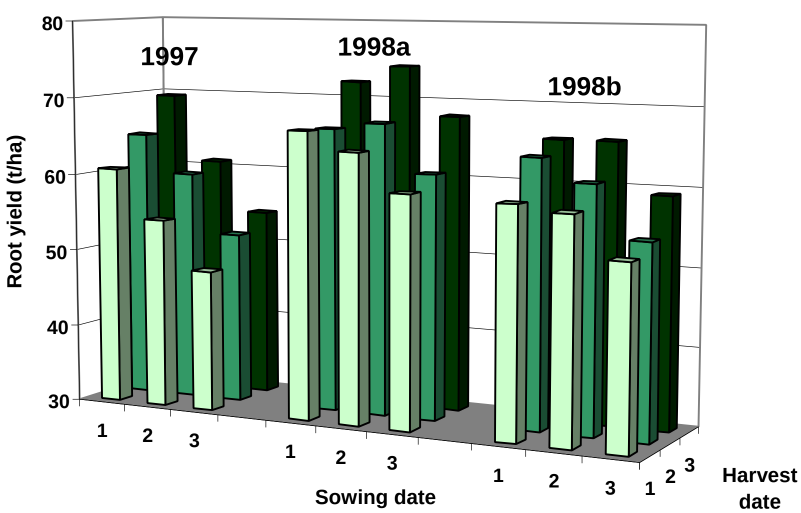

Fig. 8b: Effect of different sowing and harvest dates on root yield (t/ha), 1997-98

Experiments were conducted at two sites in 1998 and establishment was very poor in the first sowing at both sites. In spite of this, root yields from the early treatment were not significantly different from the second sowing and were better than the third. As in previous years, the later harvests gave higher yields.

Sugar content

There were significant differences in sugar content between the cultivars Celt and Monofeb at all sites except Oak Park 1995 but the differences were not consistent. Celt had higher sugars on four of the six sites (Table 7).

Table 7: Sugar contents for cultivars Celt and Monofeb (%), 1994-98

	1994	1995	1996	1997	1998a	1998b
Cultivar						
Celt	18.81	16.13	18.56	18.13	17.35	17.40
Monofeb	18.45	16.08	18.68	17.98	17.14	17.16
s.e.d.	0.056	0.081	0.057	0.058	0.063	0.055
Significance	***	NS	*	**	***	***

Sugar contents in the first sowing were usually lower than the second or third, although they were higher in 1995 and 1997 (Figs. 9a and 9b). Differences between the second and third sowings were less clear-cut; the second sowing gave higher sugar contents in 1996, 1997 and at the Oak Park site in 1998, while the third was higher in 1994. There was no significant difference in 1995 or at Camolin in 1998. Over the five years of the experiment there was no significant difference in sugar content between sowing dates.

There were significant differences between harvest dates at all sites but the differences were inconsistent, with early harvesting proving best in 1995; the later harvest (mid-November) was best in 1996 and 1998 (Camolin) but worst in 1995, 1997 and 1998 (Oak Park). The sugar contents were slightly higher at the second harvest over the period of the experiment. Weather and growing conditions prior to harvest in individual years obviously had a big effect on sugar contents.

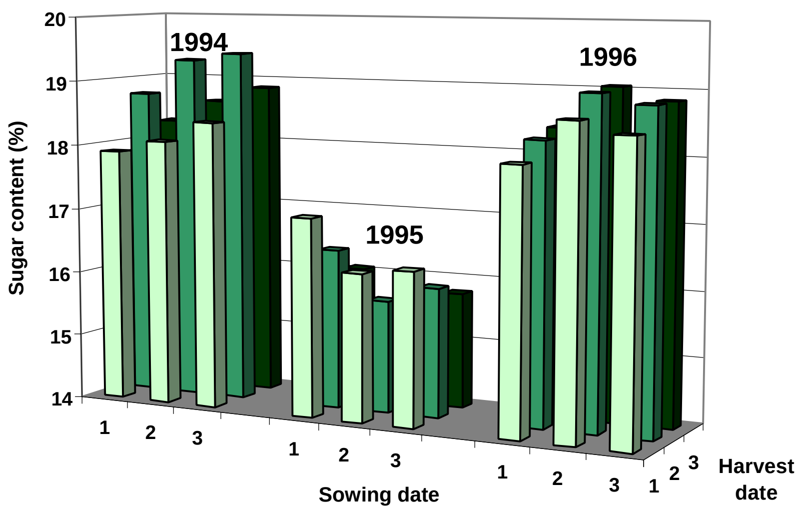

Fig. 9a: Sugar content of beet sown and harvested on various dates (%), 1994-96

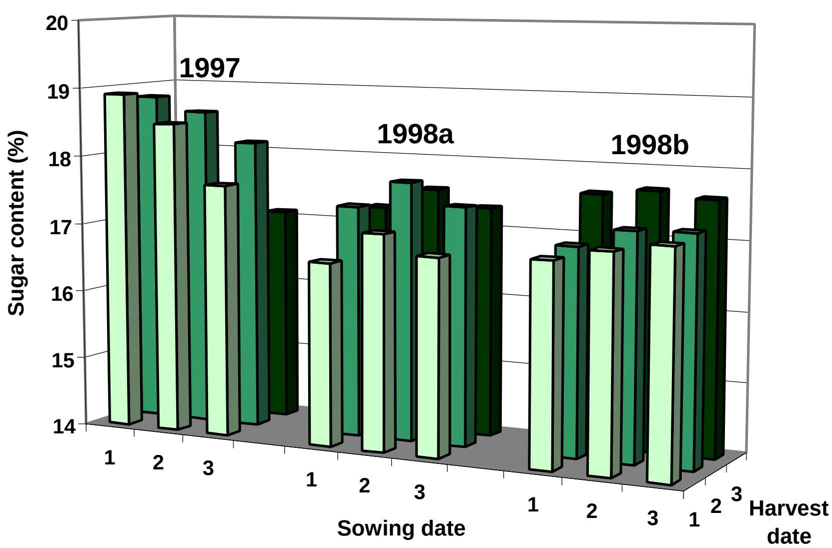

Fig. 9b: Sugar content of beet sown and harvested on various dates (%), 1997-98

Sugar yield

When root yields and sugar contents were combined to give sugar yields, the net effect on the comparison between the cultivars Celt and Monofeb was a significant difference in one year only (1994) when Celt outyielded Monofeb by about 0.3 t/ha (Table 8).

There was no significant difference in sugar yield between sowing dates in 1994 and 1995 (Fig. 10a). While there appeared to be a trend towards increased sugar yields from early sowing, a significant difference between the first and second sowings occurred only in 1997. The third sowing produced the lowest yields from 1996-98 (Fig. 10b). Taking average sugar yields over the six sites from 1994 to 1998, early sowing produced approximately 0.5 t/ha more sugar than the second sowing, which in turn yielded 0.7 t/ha more than the third sowing. The differences for the combined years were highly significant ($P < 0.001$).

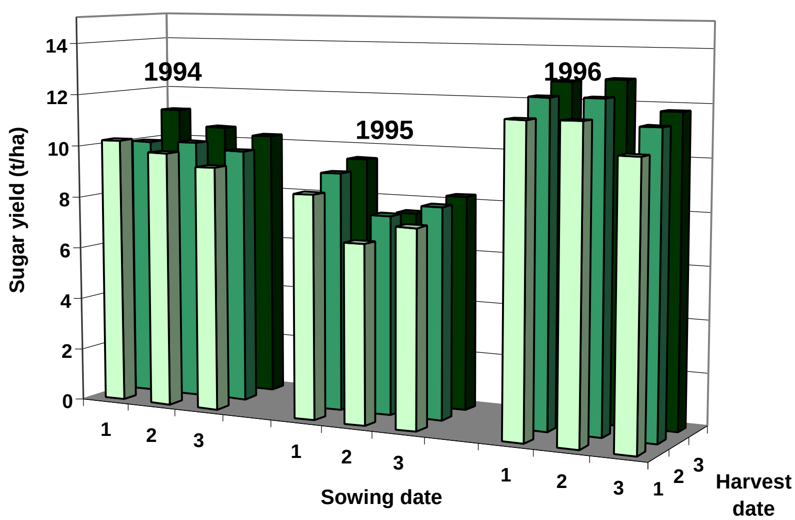

Fig. 10a: Effects of different sowing and harvest dates on sugar yields (t/ha), 1994-96

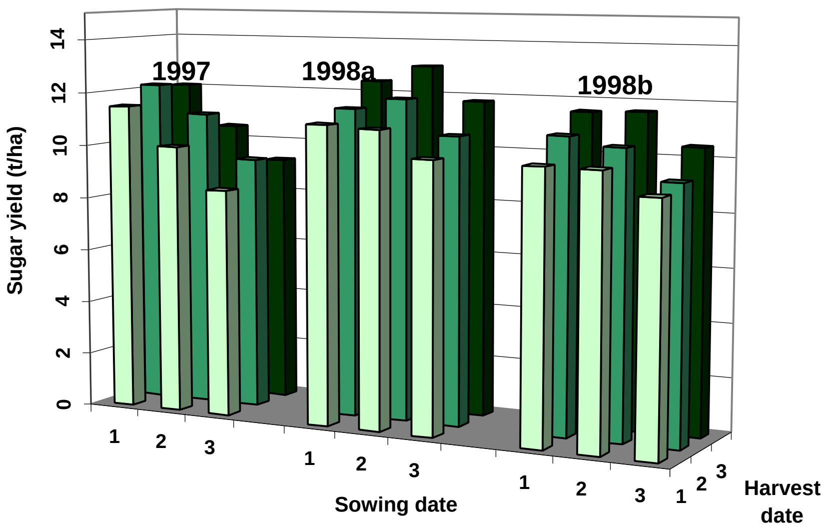

Fig. 10b: Effects of different sowing and harvest dates on sugar yields (t/ha), 1997-98

Table 8: Sugar yields for cultivars Celt and Monofeb (t/ha), 1994-98

	1994	1995	1996	1997	1998a	1998b
Cultivar						
Celt	10.257	7.993	11.855	10.477	11.383	10.299
Monofeb	10.002	8.239	11.964	10.532	11.614	10.467
s.e.d.	0.1014	0.1738	0.1198	0.0989	0.1227	0.1289
Significance	*	NS	NS	NS	NS	NS

Table 9: Extractable sugar yields for cultivars Celt and Monofeb (t/ha), 1994-98

	1994	1995	1996	1997	1998a	1998b
Cultivar						
Celt	9.771	7.473	11.353	10.141	10.748	9.829
Monofeb	9.490	7.651	11.433	10.154	10.941	9.948
s.e.d.	0.096	0.1690	0.1156	0.0966	0.1168	0.1250
Significance	**	NS	NS	NS	NS	NS

Sugar yields were consistently lower at the first harvest than the subsequent ones and nearly always lower at the second than the third. The beet plants continued to produce dry matter and sugar up to the last harvest dates (mid-November) and over the 5 years of the experiment the sugar yields continued to rise significantly from harvest to harvest.

Yields of extractable sugar (net sugar yield taking extractability factors into account) tended to follow the same pattern as sugar yield, i.e. earlier sowing and later harvesting giving increased yields (Figs. 11a and 11b).

Bolters

There were very few bolters at any of the sites except in 1996 at the site near Carlow. The first sowing at this site (8/3/96) produced a significant number of bolter plants (Table 10). The cultivar Celt produced almost twice as many bolters as Monofeb.

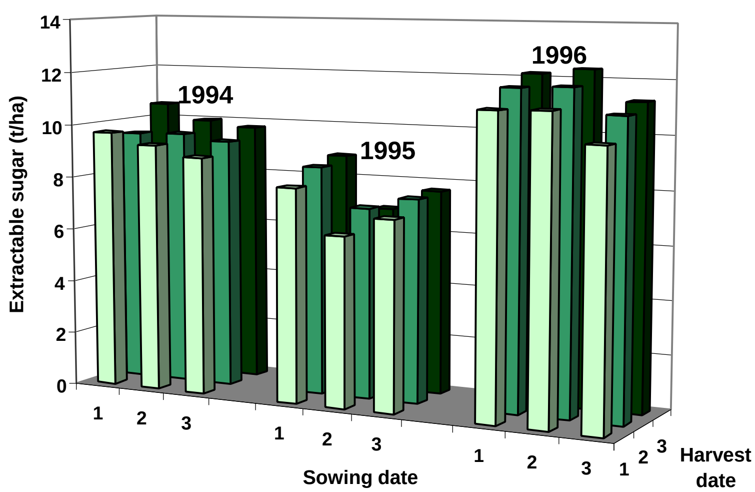

Fig. 11a: Yield of extractable sugar from beet sown and harvested on various dates (t/ha), 1994-96

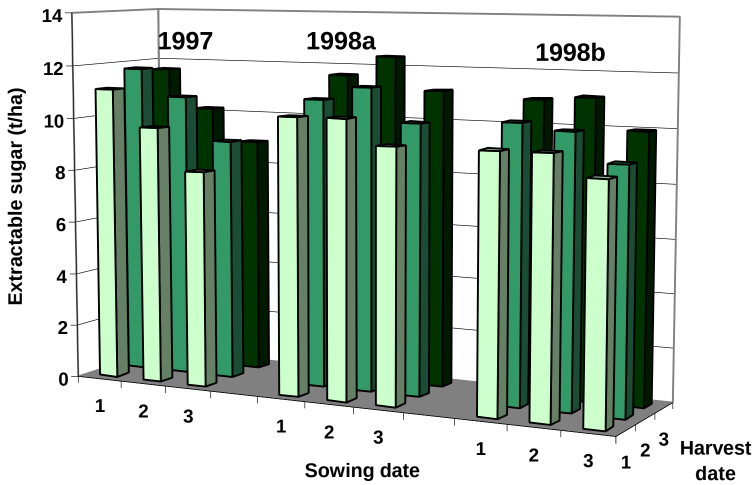

Fig. 11b: Yield of extractable sugar from beet sown and harvested on various dates (t/ha), 1997-98

Table 10: Effect of cultivar and time of sowing on bolting (%)

Date of count	1st sowing		2nd sowing		3rd sowing	
	Monofeb	Celt	Monofeb	Celt	Monofeb	Celt
29/7/96	1.09	1.70	0.01	0.09	0.00	0.03
12/9/96	3.45	6.38	0.03	0.15	0.00	0.05

CONCLUSIONS

- Early sowing (mean sowing date 16 March) significantly reduced plant establishment over the five-year experiment compared with early or late April sowings. It would, therefore, be advisable to increase seed rates, i.e. reduce seed spacing by about 15% compared with April sowings to ensure a full population from early planting.

- Early sowing increased the leaf area index (a measure of the ratio of leaf to land area) and consequently the amount of solar radiation intercepted. This was particularly so in June when solar radiation levels are highest.

- In spite of having lower plant populations, beet sown up to the third week in March produced significantly higher yields of roots and sugar over the period of the experiment.

- While sugar contents were usually lower in the early-sown beet there was no significant difference between the three dates over the five years and six sites. There was no difference in sugar extractability over the experimental period.

- The cultivar Celt gave consistently better plant establishment at all three sowing dates and a small but significant increase in sugar content over Monofeb but lower root yields so that there was no significant difference in sugar yields between the two. Celt had a slightly higher extractability percentage.

- Irrespective of sowing date the beet continued to grow up to the final harvest date in mid-November, so that root and sugar yields continued to increase with the extended growing period. Over the 5 years, sugar contents at the second harvest (~20 October) were slightly but significantly higher than those at the earlier and later harvests.

- The benefit from using granular insecticide, in respect of plant establishment, was marginally better for early- and mid-season sown beet than for late-season sown beet.

- Over the six trials, the improvement in plant establishment due to insecticide was less than 3% and was consistent with low pest numbers. This result suggests that fields having a long sequence of tillage crops are not likely to harbour high populations of sugar beet pests and may not require granular insecticide at sowing.

- The differences between insecticide-treated and untreated beet were substantially greater for onychiurid numbers and pest damage per seedling than for plant populations. The effect of insecticide on pest number and damage was slightly greater for early- and mid-season sown beet than for late-sown beet.

- The number of onychiurids and their damage decreased with lateness of sowing. This trend concurs with previous results.

- Capsid damage was low (< 4%) in four of the six trials and was moderate (5 – 10%) in two trials. Based on these trials, therefore, it is reasonable to conclude that capsids are not a major pest of seedling beet and the use of granular insecticide for their control is not warranted.

- Virus yellows is not a frequent or major disease of sugar beet. The only season in which the disease occurred was 1994 when, unexpectedly, the incidence of virus yellows was not influenced by the date on which plots were sown.

- Standard seed dressings gave good control of seedling diseases and poor emergence was never attributed to pre-emergence disease.

- Bolting was a problem in the early-sown plots in 1996 only (sowing date 8 March). This would suggest that there is a risk of significant bolting with Celt if weather conditions (low maximum daily temperatures over an extended period) are conducive.

- Weed population differences between sowing dates were not assessed critically but it would appear that an extra herbicide application would be necessary on the early-sown plots.

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