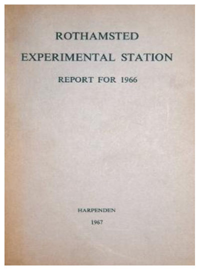
ROTHAMSTED RESEARCH

Rothamsted Report for 1966



Brooms Barn Experimental Station

R. Hull

R. Hull (1967) *Brooms Barn Experimental Station ;* Rothamsted Report For 1966, pp 274 - 302 - **DOI: https://doi.org/10.23637/ERADOC-1-14**

BROOM'S BARN EXPERIMENTAL STATION

R. HULL

W. J. Byford was awarded the Ph.D. degree of London University. R. A. Dunning and R. Hull attended the Winter Congress of the International Institute of Sugar-beet Research in Brussels, and R. Hull also attended the summer meeting in France.

Visitors to the Station from abroad included His Excellency the Ambassador of the Federal Republic of Germany and the Agricultural Attaché, the Hungarian Deputy Minister of Agriculture and Embassy officials, and the Governors of the Laghaman, Badghis and Baghlan Provinces of Afghanistan. We welcomed scientists from several European and American sugar industries, and some of them worked with us for short periods.

The agriculturists of all the British Sugar Corporation factories came for a three-day course of instruction in July. The exchange of ideas on these occasions not only increases the help we receive from the factory agricultural staffs with surveys and field experiments but also keeps the practical problems of growers before us and influences our programme of work. Also, in July we received a Visiting Group from the Agricultural Research Council to examine and report on our programme of work for the period 1966–71.

In our endeavours to improve methods of control of pests and diseases, much effort went into studying the Docking disorder problem, because it seems likely to increase with modern farming methods. Problems of seed production have increased in complexity with developments in sugar-beet breeding, and our work seeks to determine how seed of good quality may be grown most economically, while avoiding spread of pests and diseases between the biennial seed crop and the annual root crop. To devise methods of growing sugar beet without hand labour is the concern of many. Our experiments suggest that, to do this and get good yields, crops must be sown and established as early as possible in the spring, and our cultural, spacing and plant establishment experiments are directed to this end.

Yellows and aphids on sugar beet

Yellows was more prevalent than in any year since 1961, and at the end of August averaged 9·1% infected plants, estimated from the acreage infected to various degrees, and 5·8% when estimated on sample fields. This incidence was less than expected from the mild winter, but greater than expected from the aphid infestation of clamped mangolds (p. 277). The February and March mean temperatures exceeded the average by 3·4° F and 1·1° F respectively, and similar weather has previously resulted in an average incidence of 15–20% yellows.

https://doi.org/10.23637/ERADOC-1-14

Green aphids started to infest sugar beet at the end of May. They increased in bright weather in mid-June when the beet also grew rapidly; stormy, cooler weather at the end of June checked aphids temporarily. In the south-east the sugar factories advised growers to spray sugar beet with systemic insecticide in early June, and in many other areas by the middle of July; 294,000 acres were sprayed with systemic insecticide. This treatment, as well as the continuous efforts to eliminate infection sources and improve cultural practices, has doubtless decreased yellows incidence. Nevertheless, the occurrence of more than 20% yellows on over 30,000 acres of sugar beet, where yield would consequently be appreciably decreased, gives ample scope for improving control. The alternation of green and yellow sugar-beet crops in many districts in September suggests either that spread was very local or that some growers do not take full advantage of existing control measures.

Control by aphicides. Sixteen trials in the English sugar-factory areas and one at Broom's Barn again compared the incidence of yellowing viruses in unsprayed plots, plots sprayed with demeton-S-methyl when the area spray warning was sent to growers, sprayed earlier or sprayed later. On five trials in East Anglia half the plots were sown with menazon-treated seed. The menazon more than halved the green aphid infestation on the plants at the time of the spray warning. At the end of September the menazon-treated plots had an average of 13·0% yellows when unsprayed, 9·2% when sprayed early, 8·8% when sprayed at the warning, and 9·1% when sprayed late. The plots without menazon averaged 24·0%, 11·4%, 7·2% and 13·1% respectively. On the 11 trials in other beet-growing areas an average of only 7·4% of plants had yellows when unsprayed, 2·5% when sprayed early or at the warning and 3·8% when sprayed late.

On the three trials harvested, menazon seed treatment increased root yield by nearly 1 ton/acre on average, but an insecticide spray in addition to the menazon seed treatment did not increase yield further. (Heathcote)

A trial drilled at Broom's Barn on 28 April compared the effect of systemic aphicides applied at the time of drilling with or without foliage spraying in June. The treatments were menazon seed dressing (4·5 oz a.i./acre), and the following granule treatments in the soil above the seed—disulfoton (20 oz a.i./acre); "Fitios" (22), phorate (24) and MX 125 (21). The former three granules produced seedling leaf scorch and decreased seedling vigour, especially "Fitios", which also decreased seedling numbers. Aphid numbers/plant on 23 June and 6 July were: menazon—2·5 and 1·8 green apterae, 36·5 and 73·3 black apterae; phorate—2·2 and 1·1, 2·8 and 102·5; disulfoton—3·3 and 0·8, 2·2 and 69·6; control—6·3 and 3·2, 45·5 and 187·6 respectively; on 23 June MX 125 decreased aphid numbers slightly and "Fitios" markedly. Plants with yellows on 25 August and 19 September averaged 7% on the untreated plots and 8% on the plots sprayed with demeton-S-methyl (3·1 oz a.i./acre on 21 June), but 16% on the granule treatments at drilling and only 5% with granules plus spray.

A 5 × 5 Latin square experiment at Broom's Barn compared effects on aphid populations, virus infection and yield of spraying with DDT or demeton-S-methyl at various times. Before the first spraying on 13 June

https://doi.org/10.23637/ERADOC-1-14

a few plants bore thriving colonies of *Aphis fabae*, and more than half the plants bore a few *Myzus persicae*. On the unsprayed plots *A. fabae* increased and *M. persicae* decreased; at no time were there sufficient aphids to cause damage by feeding. Three sprayings with DDT (13 and 30 June, and 15 July) did not affect *A. fabae*, but halved *M. persicae* numbers, whereas demeton-S-methyl applied on the same dates almost eliminated both species until the end of July. On plots sprayed only on 13 June with demeton-S-methyl, *A. fabae* did not increase until mid-July and *M. persicae* remained few. Spraying with demeton-S-methyl spray on 15 July killed most aphids. Virus yellows incidence reached 25% on the unsprayed plots by 20 September; spraying with demeton-S-methyl spray on 15 July did not affect the infected plant-weeks total, but the early spray and the three sprays decreased it by 79% and the three DDT sprays by 65%. The beet grew vigorously and yielded 67 cwt/acre sugar irrespective of treatment. (Dunning and Winder)

Effect of yellows viruses on yield. Plots of Sharpe's E and of the yellows-tolerant variety Maris Vanguard were infected with BYV or BMYV on 13 June or on 13 July, and others were kept as free from yellows as possible by frequent spraying. Few plants of either variety became infected with downy mildew this year.

The aphids being reared to infect the plots were attacked in the greenhouse by both Hymenopterous parasites and the fungus *Entomophthora*, and infected fewer plants than intended. In September plots of Maris Vanguard inoculated with BYV had 73% of plants infected, and plots with BMYV 37%; Sharpe's E plots had 86% with BYV and 35% with BMYV. About 12% of plants on uninoculated plots had yellows, mainly BMYV. Maris Vanguard yielded 67·8 cwt/acre of sugar on average, and Sharpe's E 61·3 cwt/acre. The earliest infection with BYV decreased yield on average by 32% and BMYV by 11%, but fewer plants were infected with BMYV than BYV.

One of the trials organised by the National Institute of Agricultural Botany to test varieties for tolerance to yellows was at Broom's Barn. Four experimental varieties from the Plant Breeding Institute were compared with Maris Vanguard and Sharpe's E on plots inoculated with BYV and BMYV on 13 June or protected from infection with systemic insecticide. On 25 July 99% of plants had yellows on the inoculated plots and 3·4% on the protected ones. Yellows decreased the sugar yield of Maris Vanguard by 29%, from 48·8 to 34·7 cwt/acre, and of Sharpe's E by 40%, from 51·0 to 30·5 cwt/acre. The other varieties yielded less than the two commercial varieties on the protected plots, but VT 39/HS and VT 54/HS yielded more than Sharpe's E on the inoculated plots. Maris Vanguard and Sharpe's E had similar sugar contents, and yellows decreased it by 1% in both. The root juice of Maris Vanguard contained more impurities, especially potassium and sodium, than Sharpe's E.

Weeds. Aphids occurred on 14 of 50 samples of overwintering weeds from sheltered sites adjacent to either mangold clamps or fields where sugar beet was grown the previous season, a similar proportion to 1965.

https://doi.org/10.23637/ERADOC-1-14

M. ascalonicus was in 11 samples and *M. persicae* in three, all of chickweed. As in 1965, BYV was not recovered from any of the weeds, and BMYV from only few. (Heathcote)

Mangold clamps. Fieldmen again surveyed mangold clamps during late April; of the 2,382 farms in beet-growing areas visited, 827 (33%) grew mangolds, fodder beet or red beet, and 365 (15%) still had clamped mangolds; of the 72 that contained aphids, three had large infestations, 18 moderate and 51 small.

Aphids from 32 samples of shoots were identified and tested for virus. *Rhopalosiphoninus staphyleae* occurred on 27 (84%) of the samples, *M. persicae* on nine (28%) and *R. latysiphon* and *M. ascalonicus* each on one sample (3%). Sixty per cent of the samples examined in early May contained winged aphids and were potential sources of infestation for neighbouring sugar-beet root crops. Aphids from at least four of the clamps were infective with BMYV.

In recent years the incidence of yellows in beet crops at the end of August has been correlated with the number of aphid-infested clamps/sq mile in late April, but in 1966 it was greater than expected from past correlations. The average number of aphid-infested clamps/sq mile was 0·08, and the incidence of yellows at the end of August was 5·8% in sample crops of beet in the same areas as surveyed for clamps. The mangold acreage and number of farms growing mangolds has decreased steadily from the 1945 peak of 300,000 acres to 148,000 acres in 1957 and approximately 40,000 acres in 1966. The percentage of farms in sugar-beet-growing areas that grow mangolds declined from approximately 60% in 1957 to 33% in 1966; in the 1966 survey, 87% of mangold growers also grew sugar beet. (Dunning and Heathcote)

Winged aphids. As in 1965, sticky traps were operated in nine beet crops in eastern England. Similar numbers of aphids were caught in the two years, but whereas in 1965 most were caught during July, in 1966 most were caught during June. More *M. persicae* and *A. fabae* were caught in June 1966 than in June 1965, and in years when these aphids fly early in the season beet viruses often spread widely. In July and August many fewer were caught than in 1965. A migration of *M. persicae* in September was recorded in Bedfordshire. (Heathcote)

Seed crops. Samples of leaves and shoots from one-third of the 262 sugar-beet seed crops grown in England were examined for aphids between the last week of May and the third week of June. On average, 24 crops were sampled each week. Few black aphids were found before the third week of June, but there were considerable infestations of green aphids in Kent during May. Of the potato aphids, *Macrosiphum euphorbiae* was found in addition to the more numerous *M. persicae*. A few of both species overwintered on seed crops in Essex and Huntingdonshire.

Mangold stecklings near Boston had cucumber mosaic in October, but it was less prevalent than in 1965.

When examined in June, 54 sugar-beet seed crops averaged 0·85%

https://doi.org/10.23637/ERADOC-1-14

plants with yellows, and 22 mangold seed crops 3·5%. Steckling beds for the 1967 seed crop showed few plants with yellows when examined in October, but in November some beds in Kent and Bedfordshire had many plants infected with BMYV, seemingly from infection during late August or early September. It was concluded that the menazon seed-treatment had protected the seedlings from aphid infestation at first, but infestations had developed and infected the plants 4–6 weeks after sowing, before the first insecticide spray. Downy mildew was unusually prevalent in seed crops during June, as reported later. (Byford and Heathcote)

Effect of cultural factors on aphid populations. On plots comparing Sharpe's E sown on 16 March, 25 April or 11 May, some with an average plant population of 50·1, and others with 28·4 or 16·4 thousands/acre, the numbers of green and black aphids/plant were inversely proportional to plant populations as in 1965, but, unlike 1965, numbers decreased with lateness of sowing. For example, on 15 June there were 11 black aphids/plant in March-sown plots at 6-in. spacing, nine/plant in April-sown plots at 6 in., and fewer than one/plant in May-sown, whereas there were 36 black aphids/plant in March-sown plots at 24-in. spacing, 19 in April-sown and seven in May-sown.

Percentage of plants with yellowing viruses, mainly BMYV, increased with decrease in plant populations (16·1, 24·4 and 44·5% respectively on 22 September), giving 17·0, 14·0 or 15·1 thousand infected plants/acre. The early-sown plots had the fewest plants with yellows (21·1%), the April-sown had 34·4% and the late-sown 30·1%. In another trial on the same field drilled at the same times, but with a uniform population of 34,000 plants/acre and sprayed with insecticide, yellows incidence was 6·7, 6·9 and 10·6% on the three sowings.

Another trial, drilled on 22 March and sprayed with insecticide to keep the plants free from wingless aphids, had an even greater range of plant populations, 10·1, 16·8 and 35·0 thousand plants/acre in 20-in. rows, and 63·0 thousand plants in 10-in. rows. On 27 September the mean percentages of plants with yellows, mainly BMYV but some BYV, were 50·8, 31·8, 9·9 and 3·0% with increasing plant populations. This trial also compared two rates of nitrogenous fertiliser, and some plots had 2 in. of irrigation water, but these treatments did not influence yellows incidence significantly. (Heathcote)

Cover crops on stecklings. Sugar beet were sown in rows 20 in. apart on 29 April, some without cover, some with two rows of mustard or barley, and others with strips of aluminium foil 2½ in. wide between the rows of beet. Table 1 shows aphids/plant at the peak of infestation, and the final yellows incidence.

The barley provided poor cover because it was damaged by pests, but there were fewer *M. persicae* under this crop, which is not a host for the aphid, than on plots with other treatments and few beet became infested. The mustard plants became heavily infested with *M. persicae*, and more were found on the beet plants beneath them than on other plots, but fewest got yellows. The beet plants beneath the thick mustard cover were

https://doi.org/10.23637/ERADOC-1-14

TABLE 1

Aphids and yellows incidence on sugar beet under cover crops

	Aphids/plant on 14 July		Plants with BMYV(%)
	M. persicae.	*A. fabae*	on 5 October
Barley cover	0·02	0·52	2·0
Mustard cover	1·25	0·20	0·2
Metal strip	0·22	14·47	4·9
Open beds	0·13	33·82	7·2

very small; 98% were less than ½ in. diameter at the crown in early September, compared with 54% beneath the sparse barley cover and 28% in open beds.

The response of winged *M. persicae* to barley and mustard plants was also studied in the glasshouse. Aphids reared on BMYV-infected beet were allowed to fly, then transferred singly to test plants. More aphids probed mustard (60%) than barley (55%), and they stayed longer; within 30 minutes 45% left mustard and 85% left barley. The aphids were then placed singly on *Claytonia perfoliata*, half of which were infected by each. (Heathcote)

Seedling pests

Seedling losses. As in 1965, British Sugar Corporation fieldmen counted plants in spacing experiments on several occasions between emergence and singling, then 1 month after singling. At seven sites the counts were on replicated plots which compared 1½-in. and 6-in. seed spacing; at the other nine sites seed spacing differed by a factor of two; the closest spacing compared 1½ in. with 3 in., and the widest 3 in. with 6 in. Seed variety and drilling dates differed at the various sites. On the replicated plots, with fourfold difference in seed spacing, 1·5-in. spacing gave 145,700 seedlings, of which 9,400 (6·5%) were lost, and 6-in. spacing gave 38,800 seedlings of which 2,600 (6·7%) were lost. Averaging all 16 sites, the close seed spacing was 1·8 in., and 127,300 seedlings emerged of which 7,300 (5·7%) were lost; comparable figures for the wide seed spacing were 4·8 in., 55,600 and 2,600 (4·6%). The percentage of seedlings lost was much the same as in 1965, and the main cause of loss was weedkiller damage, which was severe at two sites. Averaging all sites and all seed spacings, there were 30,900 plants/acre after singling, and only 700 of these were lost in the subsequent month.

At Broom's Barn pelleted Triplex M seed was sown on 17 March at four different spacings, and seedlings were counted on marked lengths of row on seven occasions before singling between 19 April and 18 May. The maximum seedling populations were as in 1965 (*Rothamsted Report* for 1965, p. 263, Table 1) but, as fewer were lost later, the numbers at singling, and the singled plant populations, were greater. Most of the seedlings lost were again attributed to pyrazon damage. Few plants were lost after singling, and these mainly to pheasants and strangles.

The proportion of roots passing through an aperture 4 × 1·75 in., and considered too small to harvest, ranged from 14 to 4% on the plots with

https://doi.org/10.23637/ERADOC-1-14

the densest and thinnest plant populations respectively. Plots sown at 10-in. spacings had most bolters, 19% at harvest.

Defoliation. Several pests defoliate sugar-beet seedlings, and a trial at Broom's Barn tested the effect on yield of two amounts and two times of artificial defoliation. The trial was sown on 5 April with Sharpe's E seed at 2-in. spacing. Two of the treatments were to remove one or both cotyledons on 10 May; the other two treatments were removal of half or all the foliage on 24 May. Sugar yield on 3 October was decreased only by complete defoliation; the 6% and 20% decrease from the 10 and 24 May treatments respectively reflected smaller roots and less sugar content.

Millipedes. In a field of clay loam at Mereside, Hunts, millipedes had reputedly caused severe damage to the previous beet crop in 1963. The 1966 crop was drilled on 3 April, and a trial tested insecticide sprayed in bands on the soil 10 days after drilling, and 3 weeks later, after the seedlings had emerged.

Soil samples taken from the unsprayed plots on 19 May contained 3·8 million millipedes/acre (*Blaniulus guttulatus*, *Brachydesmus superus* and *Macrosternodesmus palicola*), 2·5 million symphylids and very many Collembola and Acarina; in total 80 million arthropods/acre. *Gamma*-BHC applied on 13 April at 3 lb a.i./acre concentrated in a 7-in. band, increased seedling and plant numbers. Other treatments applied at the same time, 1 lb γ-BHC or 1 or 3 lb heptachlor, had no such effect; nor did 1 or 3 lb/acre of γ-BHC or heptachlor applied on 5 May. Numbers of the various arthropod groups were decreased by the heptachlor (1 lb) applied on 13 April, but increased by the γ-BHC (1 lb); the other treatments were not sampled. (Samples extracted with Tullgren-funnel by Entomology Department)

At Broom's Barn, where soil pests are not known to be damaging, 8 oz of γ-BHC applied over the seed-bed before drilling and worked in, increased seedling populations but not final plant populations.

Seed treatment

Insecticides. Trials in 16 factory areas tested the efficiency of dieldrin seed dressing on pelleted Bush Monoplex (genetic monogerm) seed at seven sites, and dieldrin versus γ-BHC on Sharpe's E raw seed at nine sites. A trial at Broom's Barn tested both types of seed. All trials were sown as early as possible with precision drills at $1\frac{1}{2}$–$4\frac{1}{2}$-in. seed spacing, on sites chosen at random where neither wireworm nor other pest damage was specifically expected. Seedlings were counted immediately before singling, and singled plants about 4 weeks later. Mean actual plant populations/acre with, in brackets, populations adjusted for sowing rates, and also for differing density of treated and untreated pelleted seed, for the 8 and 10 sites respectively were: Pelleted seed—untreated 76,210 seedlings and 26,416 plants; dieldrin-treated 69,860 (75,157) and 26,948. Raw seed—untreated 88,441 and 26,286; dieldrin-treated 86,978 (92,271) and 26,805; BHC-treated 90,765 (95,089) and 26,921. Less insecticide-treated pelleted

https://doi.org/10.23637/ERADOC-1-14

and raw seed was drilled/acre but still gave more plants than untreated seed. The pelleted seed carried less than half the dieldrin actually intended, the raw seed more dieldrin and considerably less γ-BHC than intended. The insecticide on the seed was measured by P. H. Needham, Insecticides Department. (Dunning)

Fungicide. To investigate further the causes of the unsatisfactory germination in 1965 when seed was treated with ethyl mercuric phosphate (EMP) in the "Mist-O-Matic" machine, seed was sprayed with a 1·2% EMP solution at 0·5, 1·0 and 2·0% volume of liquid to weight of seed (v/w), and stored in polythene bags for 1–4 months before sowing. Stored, sprayed seed was compared with seed sprayed 11 days before sowing, untreated seed and EMP-steeped seed sown either shortly after treatment or after storage for 3 months. Seed treated with 1% v/w of EMP solution 11 days before drilling gave most seedlings, 33% more than the untreated control, 10% more than EMP steeped seed and 5% more than seed sprayed at 0·5% v/w. After only 1 month's storage seed sprayed at 1·0% v/w gave 10% fewer seedlings than seed sprayed at 0·5% v/w. After 4 months' storage, seedling emergence from seed sprayed at 0·5% v/w was unchanged, but seed sprayed at 1·0% gave only 2% more seedlings than untreated seed. Storage did not affect emergence from EMP-steeped seed. Seed sprayed at 2·0% v/w was damaged after 1 month's storage, and after 4 months gave 86% fewer seedlings than untreated seed.

The percentage germination of samples tested on both sand or paper by the Central Laboratory of the British Sugar Corporation provided a very poor guide to their field emergence. The only consistent effect was that samples badly damaged by treatment gave appreciably fewer normal seedlings on paper than on sand. It is concluded that, although the optimum amount of EMP spray for controlling seedling diseases is 1·0% v/w, it involves some risk of injuring the seed during storage. Using 0·5% v/w gave slightly better emergence than EMP-steep, and the seed had not deteriorated after the severe test of 4 months' storage in a polythene bag. However, the safety margin in a commercial treatment would be small, and seeds overdosed by the treating machine would be likely to die when stored. (Byford)

Downy mildew

On average 3·5% of plants in sugar-beet seed crops had downy mildew (*Peronospora farinosa*) in June, and some crops in south Lincolnshire had 30% of plants infected. However, the disease did not become as widespread in root crops as in 1965, except in south Lincolnshire, where there were unusually early and severe attacks in some root crops near seed crops.

In a seed crop at Chipping Norton, Oxfordshire, five fortnightly sprays of maneb at 2·4 lb a.i./acre (twice the normal rate) beginning in mid-March only halved mildew incidence in June. Five maneb sprays of 1·2 lb a.i./acre, and three sprays at 4-week intervals of 1·2 or 2·4 lb a.i./acre, all failed to control mildew.

https://doi.org/10.23637/ERADOC-1-14

The reaction of new and commercial varieties to downy mildew contracted naturally from infected stecklings was again tested in co-operation with the National Institute of Agricultural Botany at their regional centre at Trawscoed, Cardiganshire. In August the proportion of infected plants ranged in different varieties from 16½ to 47%. The commercial varieties with fewest infected plants were Anglo Maribo Polyploid, Triplex, Amono, Sharpe's Polybeet, Hilleshog Monotri and Zwaanpoly; those with most were Bush Johnson E, Battles E, Zwaanesse III, Hilleshog N and E. A variety trial at Sedgeford, Norfolk, and observation plots sited in the seed-growing area of south Lincolnshire, gave similar results. When seedlings were inoculated in the glasshouse at the cotyledon stage the relative susceptibility of 16 varieties tested in three experiments differed from that determined in the field, confirming other workers' reports that glasshouse tests do not provide a satisfactory guide to field differences between varieties.

A trial at Broom's Barn tested the ability of surviving plants to compensate in yield for loss of plants occurring after singling. When the number of plants was halved by removing alternate plants in the first week of June sugar yield was decreased by 12%, and by 20% when alternate pairs of plants were removed. The corresponding yield decreases when plants were removed in the first week of July were 25% and 22%, and in the first week of August, 36% and 43%. Unless plants with mildew have a similar competitive effect on their neighbours to healthy plants, downy mildew will cause less loss than is calculated by multiplying the percentage of infected plants by the yield loss of individual infected plants. (Byford)

Docking disorder

Survey. Docking disorder was less prevalent than in 1965 or 1964. Although several fields in the York and Brigg factory areas were affected, few were reported from East Anglia. The survey of previous years was not continued, but samples of soil and plants were received from 40 fields where Docking disorder was suspected, in 10 sugar factory areas. All soil samples were examined for ectoparasitic nematodes; there were none or very few in 20, and in these fields poor growth was attributed to acidity, bad drainage or "Barney patch". *Longidorus*, the nematode associated with most of the Docking disorder in East Anglia in the last 2 years, was numerous enough in only one sample to cause root damage. Several samples from patches where beet was stunted in Yorkshire contained up to 3,500 *Trichodorus*/litre, causing fanginess and proliferation of lateral roots, symptoms now associated with this nematode. Fewer (200–300/litre) *Trichodorus* were recovered from occasional samples from fields in the Bury St. Edmunds, Wissington, Cantley, Allscott and Selby factory areas where roots grew poorly. Nematodes were not associated with poor root growth in samples from King's Lynn and Newark.

Crops were examined in the Nottingham, Brigg and Bardney factory areas, which all contain regions of light sandy soil, but from which little Docking disorder has been previously reported. Soil samples collected in June from six fields with patches of stunted beet in the Nottingham area

https://doi.org/10.23637/ERADOC-1-14

all contained a few *Trichodorus* (up to 170/litre) but root damage was mainly from acid soil. More (up to 1,400/litre) *Trichodorus* were found in August causing damage to beet in several fields in the Brigg area. Six fields in the Bardney area all contained a few *Trichodorus*, but the poor beet growth probably reflected unfavourable soil conditions. (Cooke)

Viruses. Tobacco rattle virus (TRV) causing "yellow blotch" disease was found in sugar beet in the Nottingham factory area for the first time. Two crops in Norfolk were surveyed at intervals through the season. Many plants were infected with TRV and tomato blackring virus, and these could not be distinguished by their symptoms from plants infected with one or other virus. Most virus was in the roots, and leaves of many infected plants were symptomless. Leaf symptoms appeared only in plants infected early, and disappeared from many of these by September; symptoms were visible throughout the season in plants sown in infected soil at the beginning of June. (Heathcote)

Herringswell Rotation Experiment. This was the first year of a trial to test how crop rotation, nitrogen dressing and soil fumigation affect sugar-beet yield in a field where beet yielded only 15 cwt sugar/acre in 1965. The failure was attributed to *Longidorus attenuatus*; in June 1965 there were 200/litre in soil adjacent to stunted plants compared with 20/litre around large plants. Treating soil in January with 33·5 gal/acre of dichloropropane–dichloropropene killed 97% of all plant-parasitic nematodes. The N top-dressing was applied in May when plants in the fumigated spring wheat, barley, sugar-beet and ryegrass plots were growing more vigorously than in the unfumigated plots. A chemical analysis of soil from the sugar-beet plots (Table 2) showed more available N in the surface soil of the fumigated plots than the unfumigated, and much of the effect of soil fumigating on plant growth could be attributed to this.

TABLE 2

Mineral nitrogen available in soil in May 1966 at Herringswell

Ammonium + Nitrate Nitrogen (lb/acre-in.)

	Sampling depth		
	0–4½ in.	4½–9 in.	9–24 in.
Fumigated	4·6	5·1	2·6
Unfumigated	1·4	3·6	4·0

In September soil samples showed the effect of cropping on populations of plant parasitic nematodes. From an average of 40/litre in unfumigated plots in March, *L. attenuatus* had increased to 335/litre in ryegrass plots, 180/litre in potatoes, 100/litre in wheat and barley plots and 65/litre in sugar-beet plots. *L. attenuatus* in the fumigated plots remained fewer than 2% of those in the unfumigated plots.

From 1,650/litre in March, *Pratylenchus* increased to 4,200/litre under wheat and barley, and 2,650/litre under potatoes; numbers in the ryegrass and sugar-beet plots decreased slightly. *Pratylenchus* increased relatively fast in the fumigated plots, and by September were about 30% as numerous as in the unfumigated plots.

https://doi.org/10.23637/ERADOC-1-14

Tylenchorhynchus was the only other plant-parasitic nematode abundant in this soil. From about 1,000/litre in March it increased to 9,000/litre under ryegrass, and 2,500/litre under wheat and barley, but decreased to 400/litre under sugar beet and potatoes. Fumigated plots contained about 10% as many as unfumigated plots.

TABLE 3

Yields of dry matter (cwt/acre) from rotation crops at Herringswell in 1966

	Not sterilised	Not sterilised + extra N	Sterilised	Sterilised + extra N
Wheat (grain + straw)	26·8	22·7	45·5	43·0
Barley (grain + straw)	40·7	45·2	61·4	68·3
Grass (3 cuts)	27·0	39·1	51·5	61·5
Potatoes (tubers)	61·6	63·8	66·6	64·8
Sugar beet (roots + tops)	115·4	125·8	139·0	146·6

Drought in June checked the growth of the cereals; regrowth led to uneven ripening, and much of the earliest ripening grain, especially the wheat, was taken by birds. Sugar beet grew well and yielded on average $20\frac{1}{2}$ tons/acre of roots and $3\frac{1}{2}$ tons/acre of sugar. Throughout the season patches of beet were slightly stunted in the unfumigated plots, but the plants did not have numerous *L. attenuatus* around them, or show typical Docking disorder symptoms. Potatoes yielded $15\frac{1}{2}$ tons/acre of tubers.

Soil sterilisation increased the yield of dry matter of all crops (Table 3), particularly the cereals and grass, but the experiment does not show how much of this increase was because parasites were killed and how much was from the extra nitrogen available early in the year on the sterilised plots. The experiment will be modified to investigate this. (Cooke and Hull)

Nematicide trials. At Thornton, York, various nematicide treatments with the seed, and fertiliser treatments, were tested in a field where the beet crop in 1965 yielded little because of Docking disorder. In the root zone of stunted beet plants in October 1965 there were 8,250 *Trichodorus anemones*/litre of soil, but only 650/litre in the seed-bed to 8 in. depth when the trial was drilled on 25 March 1966. The site had been ploughed in late winter and 10 cwt/acre of a 12 : 10 : 8 compound fertiliser applied in mid-March; the seed-bed was loose, and the Sharpe's E seed was sown at $1–1\frac{1}{2}$-in. depth and 2-in. spacing ($4\frac{1}{4}$ lb graded $\frac{8}{64}–\frac{10}{64}$ in. seed/acre). Two seed dressings were tested, "Saphizon" (2·3 oz menazon/acre) and captan (0·25 oz a.i./acre), and five granule treatments, "Nemagon" (16 oz DBCP/acre), "Niran 10G" (6·4 oz parathion/acre), "Thimet" (6·8 oz phorate/acre), "Nemafos" (13·7 oz thionazin/acre) and "Magamp" (118 lb/acre of magnesium ammonium phosphate, equivalent to 8 units N, 47 P_2O_5, 7 K_2O and 14 MgO/acre). All granules were metered with a "Horstine Farmery Microbander" mounted on the "Stanhay" drill, the granules falling in the furrow with the seed. Two further treatments were an extra 100 units N as "Nitro-Chalk", either in the seed-bed or as a top-dressing on 3 June.

The seedlings grew slowly and had to be hand weeded; stems of many were stringy as if affected by soil acidity (but pH $>$ 7·0) or soil fungi. The irregular growth characteristic of Docking disorder developed in June,

https://doi.org/10.23637/ERADOC-1-14

and on 12 October the control plots yielded only 3·9 tons/acre of beet containing 16·4% sugar.

The effects of treatments were assessed by scoring the plants for vigour at intervals between 25 May and 11 October, by counting seedlings on 25 May and 3 June, established plants on 18 July, and small and large beet on 12 October, by scoring the harvested roots for fanginess, and by determining top and root yield and sugar percentage. Captan seed dressing and DBCP granules had no significant effects. Parathion granules increased seedling numbers, as did thionazin granules, which also greatly increased seedling vigour, and the 100 units N topdressing increased plant vigour in August–October. No other treatment showed such effects, and no treatment increased plant population. Table 4 shows measurements made at harvest. Extra seed-bed N gave the greatest root yield, 7·4 tons/acre; no treatment affected sugar percentage.

Many plants on the control plots were fanged, some horizontally, and root fanginess was scored on 30 roots from each plot on a scale 0–5 ranging from none to very severe. It seems especially noteworthy that small amounts of organo-phosphorous materials, especially thionazin, decreased fanginess, presumably by protecting the seedlings from severe damage by *Trichodorus*; parathion and thionazin granules also increased seedling establishment. The additional seed-bed N also decreased fanginess, presumably by encouraging faster root growth in the seedling stage. No treatment affected *Trichodorus* populations (average 1,380/litre) on 28 June and 2 August. Evidently the doses of pesticide were too small, because in pots of Thornton soil containing 400 *Trichodorus anemones*/litre phorate and thionazin granules at 1,340 ppm w/w (1,470 ppm w/v) of moist soil killed nearly all the nematodes within two weeks at 57–63° F, but one-hundredth this rate killed very few. In the field the amounts of active ingredient used were equivalent to approximately 5 and 10 ppm w/v phorate and thionazin, assuming 6 sq in. cross-sectional area of row treated. On 2 August all the N added to the seed-bed in the root zone had disappeared from the soil, but there was more nitrate in the plots topdressed with 100 units N on 3 June than in other plots.

Although several treatments doubled the control yield, at least three- or four-fold yield increase is needed for a satisfactory crop where Docking disorder is severe. The possibility of doing this with a combination of seedling protection by some of these organo-phosphorous nematicides and adequate N needs investigating.

In a field noted for Docking disorder at Gayton Thorpe, Norfolk, there were 55 *Longidorus attenuatus*/litre of soil from the root zone of stunted plants on 21 June. Solutions of various nematicides, or an NPK fertiliser, were injected 6 in. deep into the soil on either side of plants on 21–22 June. Forty ml of solution were applied per plant and the concentration arranged to give 1 and 4 lb a.i./acre of nematicide, or 100 units/acre N, P_2O_5 and K_2O. Nematicides tested were "Berks GC 5940" (coco-1,3-propylene diamine), chlorfenvinfos, DBCP, "Dupont 1179" (methyl O-(methylcarbamyl) thiolacetohydroxamate), phorate and thionazin. Plants made normal growth in July–September, but DBCP damaged the beet, especially at 4 lb/acre; only "Dupont 1179" (4 lb a.i.) consistently

https://doi.org/10.23637/ERADOC-1-14

TABLE 4

Effect of nematicide treatments on sugar beet at Thornton, Yorks in 1966

Treatment	Top yield (tons/acre)	Number of harvestable beet/chain. (>1·75 in. diam.)	% un-harvestable	Sugar yield (cwt/acre)	Root fanginess (0–5)
Control	2·8	49·8	28·7	12·7	3·4
Menazon seed dressing	4·3	58·2	16·5*	22·4*	2·8*
Thionazin granules	4·8	71·3*	16·1*	23·2*	2·4***
Phorate granules	5·0	56·0	13·6**	20·9	2·7**
"Magamp"	5·1*	64·9	10·9**	21·4	3·4
Extra 100 units seed-bed N	5·9*	58·4	14·3**	23·9*	2·8*
Extra 100 units top-dressed N (3 June)	6·1**	54·7	10·0**	23·3*	3·5

*, ** or ***: significantly different from the control at 5%, 1% or 0·1% levels of probability.

improved growth, and it improved yield of roots on 1 November by 41%.

At Herringswell four granular nematicides were tested to see whether they damaged beet when placed either in the furrow with the seed or 3 in. below the seed. Only when placed in the furrow were plants affected and the foliage showed symptoms in May; with DBCP (16·8 oz a.i./acre) they were very slight, with thionazin (19·9) slight and with phorate (9·3) severe. (Dunning and Winder)

Fertiliser trials. Experiments at Barnham and Herringswell, Suffolk, investigated the value of up to 3 cwt/acre N more than the grower's normal dressing for sugar beet on sandy soils prone to Docking disorder. Both crops had to be redrilled in May, the first because of damage from herbicide and the second from wind; the redrilled crops grew well at both sites. Soil was sampled before applying fertiliser, at singling time and in the middle of July, from three depths down the profile: 0–4·5 in., 4·5–9 in. and 9–24 in. The samples were extracted and analysed for ammonium plus nitrate N.

Before fertiliser was applied the soil contained about 1 lb/acre-in. of N at Barnham and 2 lb/acre-in. at Herringswell, distributed fairly uniformly down the profile. At the second sampling the nitrogen fertiliser at Barnham had increased the N in the top 4·5 in. of soil up to 8 lb/acre-in. and there was an even distribution in the three sampling zones irrespective of fertiliser treatment. The results from Herringswell were similar. By mid-July there was considerably less N in the surface zone than at depth, largely because of uptake by the plants. The extra nitrogen did not affect yield of sugar, so in the absence of Docking disorder and leaching of N this year, the farmer's dressing of N was adequate. (Draycott and Last)

Sugar-beet seed crops

Cultural practices. Experiments at Broom's Barn, at Preston Capes, Northants., at Chipping Norton, Finstock and Great Tew, Oxon., at Sutton St. James, Lincs., and at Silsoe and Great Gransden, Bedfordshire, tested various cultural practices. This was the first year that monogerm

https://doi.org/10.23637/ERADOC-1-14

varieties were grown, and some ripened slowly. Multigerm varieties ripened 2 weeks earlier than in 1965.

Method of growing. Three methods of growing monogerm seed were compared at Silsoe; spring-sown under barley with the barley harvested when "binder-ripe" or "combine-ripe"; sown in July or August without a cover crop; and transplanted from a steckling bed in November or February. A thin stand of stunted plants developed under the cover crop, but they grew vigorously when the cover crop was harvested early. More plants established from the August sowing in the open than from the July sowing. The smaller, late-sown stecklings developed slowly after the winter and looked undernourished. Hares damaged stecklings transplanted in autumn. The transplanted and the late-sown stecklings had most downy mildew, and approximately 5% of plants had virus yellows in the second year, most on the undersown plots where cover was removed early. Early, open-drilled plants flowered earliest and transplanted plots latest. Grown-on plants ripened before transplanted ones, and July-sown without cover ripened earliest. Plants sown in July without cover gave the greatest total root and haulm weights at the final harvest; other treatments gave similar yields. Individual plants that had been transplanted weighed nearly three times as much as those grown under barley, and six times as much as those grown without cover.

TABLE 5

The effect of methods of growing and harvesting date on yield of clean seed (cwt/acre) at Silsoe in 1966

	Cover crop removed		Sown without cover		Transplanted	
Harvest date	Early	Late	July	August	November	February
23 August	22·5	23·7	26·1	20·9	27·0	22·7
31 August	14·3	17·4	19·0	19·1	17·9	18·4
6 September	12·0	12·4	16·4	13·7	20·6	17·7

Table 5 gives the yields from plots harvested on three occasions. All straw and impurities were dressed out and seed smaller than $\frac{7}{64}$ in. was discarded. Seed yields were greatest from the first harvest. Most of the loss before the later harvests was to birds. Seed from the densely sown direct-drilled plots with no cover crop was smaller, more germinated and more were monogerm than from transplanted plots.

Time of sowing and harvesting. At Chipping Norton stecklings were sown on 16 July, 6 August and 24 August. The last sowing made little growth in the cold September, and many plants were killed by frost during the winter. Downy mildew was progressively more prevalent with later sowing. As in 1965, plants sown early started to bolt and flower earlier than those sown late, and *Ramularia* leaf spot defoliated plants, especially those sown early. The weight of leaf lamina on plants from the early sowing was no greater on 13 June than on 10 May, but continued to increase in plants of the second sowing and increased greatly on late-sown plants during this period. Leaf laminae of all sowings lost weight after the 13 June, but total haulm weights of the middle and late sowings increased

https://doi.org/10.23637/ERADOC-1-14

until harvest. In August haulm and root weights from the late sowing were still only half those from the early and middle sowings. Seed yields were greater with early sowing and early harvesting (Table 6).

TABLE 6

The effect of sowing and harvesting date on yield of clean seed (cwt/acre) at Chipping Norton, 1966

	Harvest date			
Sowing date	1 September	8 September	15 September	Mean ($\pm$1·10)
16 July	26·7	21·4	19·2	22·4
6 August	20·0	17·9	18·7	18·9
24 August	13·5	13·6	13·3	13·4
Mean ($\pm$0·63)	20·1	17·6	17·1	×

On 1 September the early sowing gave 6·7 cwt/acre more seed than the middle sowing, but then lost so much seed that there was little difference in yield of the first and second sowings on 15 September. The late sowing shed little seed during the harvest period, but gave a small yield. As in 1965, seed from the early sowing was larger and had a greater percentage germination than seed from later sowings; also, harvesting late gave larger seed, with greater germination percentages.

Fertiliser in the second year. Five dressings of ammonium sulphate in the spring giving 0, 0·5, 1·0, 1·5, 2·0 cwt/acre of N were tested at Chipping Norton; also 1 cwt/acre P_2O_5 and 1·0 cwt/acre K_2O was given to half the plots receiving 0, 1·0 and 2·0 cwt/acre N. The crop had received 0·85 cwt/acre N, 0·85 cwt/acre P_2O_5 and 1·25 cwt/acre K_2O in the first year. The mean yields of seed from the five N dressings were respectively 17·1, 20·4, 20·2, 23·4 and 20·3 cwt/acre ($\pm$0·78). The response to N was the same on 10-in. and 20-in. rows. Additional phosphate and potash in the second year did not affect seed yield. Much seed was lost from all plots when harvested late, and there was no evidence that plots with most N gave more seed when cut late. As at Chipping Norton in 1965, germination of the seed was unaffected by N. Plots without N gave the smallest seed, and those with 1·5 cwt/acre N the largest.

An experiment at Sutton St. James, Lincs., on "skirt" land containing much organic matter and clay, tested the same amounts of fertiliser applied in the spring of the second year to stecklings grown under barley that had received 0·7 cwt/acre N, 1·05 cwt/acre P and 0·7 cwt/acre K in the autumn. Mean yields of seed for the five amounts of N were respectively 19·7, 26·5, 27·3, 35·7 and 41·7 cwt/acre ($\pm$1·87). The response to N was much greater on this deep fertile soil than on the less-fertile Oolitic limestone soil at Chipping Norton. Additional phosphate and potash increased the yields of plots given 1·0 cwt/acre N, but not of plots given two. Seed from Sutton St. James was larger than from Chipping Norton. Fertiliser did not affect seed size or germination percentage.

Row width and plant spacing. Experiments at Chipping Norton, Finstock and Preston Capes compared crops direct drilled in rows 10 in. or 20 in. apart. Varieties were multigerm at Chipping Norton and Preston Capes and open-pollinated monogerm at Finstock. Plants averaged 2-in.

https://doi.org/10.23637/ERADOC-1-14

spacing in the rows in the unthinned braird. Two-thirds of the plots were singled to 6-in. spacing in September, and one-third of them were thinned again in the spring to give 12-in. spacing. *Ramularia* leaf spot defoliated the closely spaced plants earliest.

At Chipping Norton and Finstock 10-in. rows produced more seed than 20-in. rows. Seed yield increased with closer plant-spacing on 20-in. rows, but yield was unaffected by spacing on 10-in. rows. At Preston Capes, as at Chipping Norton in 1965, a stand of 100,000 plants/acre obtained by 6-in. spacing in 10-in. rows yielded most seed, but neither the effect of row width nor the interaction between row width and plant spacing was significant.

As in 1965, 10-in. rows produced smaller seed than 20-in. rows. Most of the plants growing 12 in. apart in 20-in. rows lodged, and the secondary growth that developed gave small immature seed. Except for plots that lodged, the closer the plants in the row, the smaller the seed they produced. In most experiments percentage germination of seed was slightly greater from 10-in. rows than from 20-in. rows.

Experiments at Broom's Barn and Great Gransden compared the effect of transplanting in five spacings, 10 × 10 in., 15 × 15 in., 20 × 15 in., 20 × 20 in. and 30 × 30 in. The multigerm variety at Broom's Barn ripened 1 month earlier than the monogerm variety at Great Gransden. Particularly at Broom's Barn, plants in the wide spacings lodged, developed secondary growth and matured late. Plots with dense stands ripened earliest and lost most seed to birds and from natural shedding. Monogerm and multigerm plants at close spacings yielded similarly, but monogerm plants, which were prostrate in habit with many branches, gave more seed than multigerm in the wider spacings. Seed yield at Broom's Barn was greatest from plots spaced 10 × 10 in. and 15 × 15 in. At Great Gransden 20 × 15 in. spacings gave most seed.

Monogerm variety plants spaced 15 × 15 in. gave the heaviest seeds, and those spaced 10 × 10 in. the lightest. With the multigerm variety the closest spacings all gave similar seed cluster sizes, but the secondary growth of plants in wider spacings, particularly 30 × 30 in., gave many small clusters. Germination percentages increased with denser plant stands.

Weed control. Soil taken in November down to 15 in. from plots where pyrazon or lenacil applied in July or August had damaged beets, did not contain any residues injurious to beet or mustard growth in the glasshouse.

Weeds reinfested plots during the spring where chemicals had thinned the beet. Plots with a full stand of beet had few weeds because the sugar beet smothered the weeds. The smallest dose of pyrazon hardly controlled the weeds, and the greatest dose of lenacil killed most of the beet. Other sprayed plots yielded more seed than the untreated plots. Increasing pyrazon up to 6 lb/acre, applied either pre-drilling or post-emergence, increased seed yield, but doubling the dose by applying on two occasions decreased yield. Plots with the smallest amount of lenacil yielded more seed than plots with larger amounts. Plants on the untreated plots were closer together than the optimum spacing for maximum yield, and the plant spacing on the sprayed plots was nearer the optimum, but differences in yield between sprayed and unsprayed plots partially reflected weed

https://doi.org/10.23637/ERADOC-1-14

control, because sprayed plots gave more seed even where spraying did not affect plant density.

An objective of the experiment was to examine whether these herbicides might persist in the plant and decrease the germination of seed produced. The percentage germination of seed from two-thirds of the treated plots was greater than from the untreated, probably because the plants were better nourished with less competition. Post-emergence sprays of both herbicides, particularly with the largest amounts, either alone or in combination with a pre-drilling application, slightly decreased germination.

Seedling emergence in the glasshouse and field. Duplicate samples of natural untreated seed, from plots where treatments had most effect on laboratory germination of seed harvested in 1965, were sown in potting compost in the glasshouse, and also in the field. The number of clusters in different size grades (5·0, 4·0, 3·0 and 2·5 mm) producing one, two and three or more seedlings was scored separately. Invariably the percentage of clusters growing at least one seedling increased with cluster size. Three or more seedlings developed from more than 50% of the largest clusters, and single seedlings from most of the smallest clusters.

Seedling emergence in the glasshouse and laboratory germination of seed from the final harvest were similar, but more clusters from the earlier harvest germinated in the glasshouse than in the laboratory. With this exception, plot-treatment effects on glasshouse emergence were similar to those on laboratory germination. On average, only about half the clusters giving seedlings in the glasshouse produced seedlings in the field.

Pollen liberation in an open-pollinated crop. The effect of weather on the liberation of sugar-beet pollen was again studied in a half acre of seed crop transplanted at Broom's Barn. The "Hirst" trap in the centre of the crop was situated 3 ft above the ground at the level of most of the flowers, but 2 ft lower than in 1965. A second "Hirst" trap in the centre of the crop 6 ft above the ground collected 30% less pollen than the trap at crop level. Both traps were operated from 14 June to 13 August. The first pollen was collected on the 20 June, 1 week earlier than in 1965. The weather during the following week was cool and cloudy, and daily catches increased gradually until the beginning of July, when the weather became bright and sunny with high temperatures and low relative humidity during the day. Most pollen was trapped between 1 and 17 July. Between 18 and 21 July relative humidity remained above 90% and very little pollen was collected. Only small amounts of pollen were collected after 26 July. There was less rain and more sunshine up until the middle of July in 1966 than in 1965, but the weather was predominantly cool and cloudy after the middle of July in both years. Pollen catches were only 40% of those in 1965. Varieties were different, and in 1966 20% of the plants were rogued out because they had downy mildew.

There was a characteristic diurnal periodicity in pollen release. Little pollen was collected between 18.30 and 05.30 G.M.T. Catches increased from 06.30 to 09.30 with decreasing relative humidity as the sun was rising. Usually most pollen was collected between 09.00 and noon, but

https://doi.org/10.23637/ERADOC-1-14

maximum catches were in the afternoons of two days with dull, damp mornings and fine, sunny afternoons.

Seven groups of four plants from different monogerm male sterile lines were grown in pots in buildings where there was little chance of contamination with pollen. Each group was exposed to pollen in the seed crop for a different 24-hour period and returned to the buildings to develop seed. Flowers recently opened when the plants were exposed were marked and later examined for seeds. Neither the proportion of flowers developing complete seeds nor that developing only the testa could be related to the amount of pollen collected while the plants were exposed in the seed crop.

Pollen liberation in crops producing hybrid seed. The pollen catch in a crop where all plants produced pollen was compared with the catch in two crops where most plants were cytoplasmically male sterile and did not produce pollen. To produce hybrid seed it is important to know the minimum proportion and best distribution of pollinator plants to ensure pollination of all the male sterile flowers in the crop. Commercially, the pollinator plants must be as few as possible because they do not bear useful seed.

Two ½-acre crops, one pollinated by the diploid used in the open-pollinated crops and the other by a tetraploid, had two rows of pollinators alternating with five rows of male steriles. The rows ran north to south. Diploid and tetraploid pollinators started to flower at the same time. The male sterile plants, which were monogerm, started to flower later than the pollinators.

The pollen catch from "Hirst" traps in the centre of the five male sterile rows was only 30–40% of the catch obtained where all plants produced pollen. Despite this, seed-set was similar on male-sterile plants exposed for 24 hours in the centres of the three crops. Wind direction during the flowering period was predominantly westerly. The more easterly of the five diploid male-sterile rows yielded less seed, but differences were not significant. Where the pollinator was tetraploid, seed yield decreased in the more easterly of 12 male-sterile rows at the N.E. and S.W. corners of the crop. Mean seed yield from male-sterile plants was similar where alternate rows of pollinators and male-steriles were planted and where two rows of pollinators alternated with five rows of male steriles.

Pollen grains from the tetraploid plants were larger than from the diploid. During the fine sunny period of early July pollen catches from the tetraploid were three times as great as from the diploid, but during the unsettled weather later in the month more pollen was collected from the diploid. Drier air was needed for pollen to be collected from the tetraploid than from the diploid. Relatively more pollen was collected from the tetraploid on windy than on calm days. It seemed to make little difference to the pollen catch in either crop whether wind direction outside the crop was across or down the rows. (Scott)

https://doi.org/10.23637/ERADOC-1-14

Sugar-beet manuring

The Magnesium, Black Fen, NNaDung and Fertiliser Types trials reported below were done in co-operation with the British Sugar Corporation in 1965. The other experiments reported were on Broom's Barn farm in 1966.

Magnesium. Four annual trials, on fields selected by fieldmen as likely to produce magnesium-deficient sugar beet, tested 0, 2·5 and 5 cwt/acre kieserite and 1 ton/acre dolomitic limestone; 0·8 and 1·2 cwt/acre N as ammonium sulphate; 0 and 3 cwt/acre salt, in a factorial design. Dressings of 1·0 cwt/acre of K_2O or of 7 cwt/acre of kainit in addition to the basic fertiliser were also tested. On average, all the magnesium dressings increased yield of beet, and the largest kieserite dressing increased yield by 5·6 cwt/acre of sugar. Magnesium dressings had little effect on root juice purity. Kainit increased yield, but produced no more sugar than did salt. The larger dressing of potassium gave 2·3 cwt/acre of sugar more than the smaller dressing.

A trial near Bury St. Edmunds tested sprays of Epsom salt solution (0·75 cwt/acre in 45 gal and 2 cwt/acre in 120 gal of water) and a top-dressing of kieserite at 2 cwt/acre in July on a magnesium-deficient sugar-beet crop. All the treatments cured the leaf symptoms and increased yield of both beet and sugar.

Three long-term trials were begun in 1964 on sites chosen for a small exchangeable soil magnesium content, where fieldmen thought the deficiency would recur in sugar beet. The sites were cropped with barley in 1964 and sugar beet in 1965. Table 7 shows the treatment plan.

TABLE 7

Treatments on long-term magnesium experiments

	1964 (Cereals)	1965 (Beet)	1968 (Beet)
A	7 cwt/acre kainit	—	—
B	2 tons/acre Mg limestone	—	—
C	2 tons/acre Ca limestone	—	—
D	5 cwt/acre kieserite	—	—
E	—	—	—
F	—	2½ cwt/acre kieserite	—
G	—	5 cwt/acre kieserite	—
H	—	—	5 cwt/acre kieserite
I	—	12 tons/acre dung	12 tons/acre dung

In 1965 magnesium limestone (B) gave 3·4 cwt/acre more sugar than did calcium limestone (C). Applying 5 cwt/acre kieserite in the previous year (D) gave slightly better yields of beet than applying it to the beet seed-bed (G).

NPKNa on Black Fen. The six trials in 1965 completed this 3-year series. There was an economic response to 0·4 cwt/acre N, but no advantage from increasing the dressing to 0·8 cwt/acre. Phosphate dressings up to 1·5 cwt/acre P_2O_5 did not affect yield on average. Potash dressings up to 3·0 cwt/acre K_2O increased yield slightly. These trials confirm that, on this soil, about 0·4 cwt/acre N should be applied for sugar beet, and P_2O_5 and K_2O only to maintain reserves.

https://doi.org/10.23637/ERADOC-1-14

NNa Dung. The object of these trials is to determine how salt (5 cwt/acre) and dung (12 tons/acre) affect response to nitrogen, but the seven done in 1965 gave no definite pattern of response. The dung used in the different trials differed considerably in analysis, and the dressings supplied nutrients within the ranges N, 90–315; P_2O_5, 14–437; K_2O, 160–241; Mg, 13–86; Ca, 65–589; Na, 16–70 lb/acre. On some sites dung, and on others sodium, depressed yield.

Fertiliser types. This trial tested two amounts of N, P_2O_5, K_2O and Na applied as "Chilean Potash Nitrate", as "I.C.I. No. 4. compound", as ammonium sulphate or as "Nitro-Chalk". P, K and Na were made up to a uniform amount with superphosphate, muriate of potash and salt. At both dressings sulphate of ammonia, "Nitro-Chalk" and the compounds gave similar yields.

Fertilisers on rotation crops. In the second year of this experiment wheat followed sugar beet, and yields averaged 10 cwt/acre more than in 1965, when it followed barley (Table 8). Barley and sugar beet yielded as in 1965, but responses to fertilisers were smaller. In contrast to 1965 phosphate depressed the yield of all crops, perhaps because of selective grazing of the plots by pheasants and hares, which caused considerable damage.

TABLE 8

Yield responses of rotation crops to fertiliser treatments in the second year of the long term experiment

(Compound refers to NPK for cereals and NPKNa for sugar beet at the rates given in *Rothamsted Report* for 1965, p. 279, Table 7)

	Wheat grain (cwt/acre at 85% D.M.)	Barley grain (cwt/acre at 85% D.M.)	Sugar-beet sugar (cwt/acre)
Mean yield:	35·0	32·4	58·5
Response to			
N_1	+10·9	+6·4	+ 8·5
N_2–N_1	+ 0·9	+1·0	− 4·6
P_1	− 1·4	−1·6	− 3·9
P_2–P_1	− 4·0	−2·8	− 4·0
K_1	− 1·4	+1·0	+ 5·4
K_2–K_1	− 2·5	−2·0	+ 2·3
Na	− 3·1	−0·8	+ 7·3
Dung	+ 1·4	−3·1	+ 5·4
Compound 1	+ 5·1	+7·4	+15·6
Compound 2–Compound 1	+ 3·5	+3·8	− 2·0

Effect of previous cropping. These trials at Broom's Barn test the effect of previous cropping and nitrogen manuring on the yield and quality of sugar beet. The preparatory crops were grown on Marl Pit field in 1965, and Table 9 shows their off-take of nitrogen.

In 1966 the plots were split for the nitrogen dressings (0, 0·5, 1·0 and 1·5 cwt/acre) for the sugar beet, and the yields are in Table 9.

A further trial was begun in 1966 on Flint Ridge field and will be cropped with beet in 1967. Yields of the preparatory crops were 30 cwt/acre barley grain, 38 cwt/acre winter wheat, 16 tons/acre potatoes (0·5 cwt/acre

https://doi.org/10.23637/ERADOC-1-14

TABLE 9

Quantity of nitrogen removed by preparatory crops in 1965 in Marl Pit Field, and yields of sugar beet in 1966 with different nitrogen dressings

Preparatory crop	N applied (lb/acre)	N offtake (lb/acre)	Yield of sugar (cwt/acre) in 1966, N dressing (cwt/acre) 0	0·5	1·0	1·5
Barley	56	105	43·7	51·8	56·9	51·5
Wheat	90	112	40·0	52·4	51·2	47·1
Potatoes (Low N)	56	75	45·3	47·4	50·6	45·8
Potatoes (High N)	168	95	40·7	53·4	48·0	48·2
Ryegrass	56	68	32·0	51·8	52·1	48·7
Barley (undersown with trefoil)	56	98	43·5	50·3	52·0	53·0

N) and 17 tons/acre (1·5 cwt/acre N). Ryegrass yielded 42 cwt/acre of dry matter.

Deep placement of liquid fertiliser. Four methods of application of a compound liquid fertiliser containing nitrogen, phosphate and potash in the ratio 9 : 9 : 9 was applied at 100 gal/acre, equivalent to 1 cwt/acre each of N, P_2O_5 and K_2O, were compared in microplots by: (1) spraying the fertiliser on the partially prepared seed-bed; (2) after drilling the seed, placing it at 1-ft intervals along the rows at a depth of 0–6 in.; (3) at 0–12 in.; or (4) at 0–18 in., using a "Shell D-D Injector". Sugar yields from the four treatments were similar; 79·8 cwt/acre from the surface dressing; 81·3, 77·1 and 79·9 cwt/acre for the three depths of injection respectively.

Form of fertiliser and time of application. Anhydrous ammonia and liquid fertilisers were tested on sugar beet at Broom's Barn in 1966. Anhydrous ammonia was injected at 6 in. depth on three dates: 4 March on the ploughed land; 21 March on the partially prepared seed-bed; 16 May after emergence of the crop, by injection alongside the rows. These treatments were compared with nitrogen applied to the seed-bed as "Nitro-Chalk", as a liquid fertiliser or as a compound liquid fertiliser. All fertiliser treatments supplied 100 units/acre of N and the same amounts of phosphate, potash and salt.

Applying anhydrous ammonia on 4 March gave a response of 15·9, and applying it on 21 March one of 15·2 cwt/acre of sugar. Injecting the ammonia along the rows of growing beet was less effective and gave a response of only 9·5 cwt/acre of sugar. The liquid fertilisers, like early ammonia, gave responses of 15·0 cwt/acre and 15·5 cwt/acre. "Nitro-Chalk" gave the greatest response, 19·4 cwt/acre. (Draycott)

Plant spacing

Twin-row spacing. There are advantages (see *Rothamsted Report* for 1965, p. 277) from sowing crops to be grown without hand labour in 10 in. rather than wider rows, but harvesting beds of five 10-in. rows by machine seems to be impractical. However, machine harvesting of pairs of narrow rows might be feasible even in wet soils, so an experiment was made to determine the yields of pairs of rows (twins) 20 in. apart and the effect on yield of moving the rows of pairs closer together to give 10-in., 7-in. or

https://doi.org/10.23637/ERADOC-1-14

4-in. twins, or a single row with double the seed rate of the 20-in. rows. The pairs of rows were arranged alongside the tractor wheels so that the adjacent rows of two twins were 20 in. apart. The treatments were replicated in a 5 × 5 Latin square experiment. Sharpe's E pelleted seed was sown at 5-in. spacing in the twins and $2\frac{1}{2}$-in. spacing in the single rows on 7 April, and the area was sprayed with pyrazon. Where two or more seedlings emerged from a seed one was removed by hand to simulate the result to be expected from monogerm seed. A length of 90 ft of twin rows was harvested from each plot by hand and yield/acre calculated using the 20-in. row conversion factor for all row arrangements (Table 10).

TABLE 10

Effect on plant stand and root yield of decreasing the distance between pairs of rows sown with seed spaced at 5 in., or at $2\frac{1}{2}$ in. on the single row. Marl Pit Field, 1966

	Spacing of pairs of rows				Single
	20 in.	10 in.	7 in.	4 in.	row
Yield of roots (tons/acre)	20·63	15·73 (±0·216)	14·83	13·86	13·08
Number of roots (thousands/acre)	36·7	34·1 (±0·55)	34·4	32·6	30·9

The narrower-spaced rows have fewer roots large enough to harvest than the wider-spaced rows because of greater competition. The 10-in., 7-in., 4-in. twins and single rows respectively gave 76, 71, 67 and 63% of the yield of 20-in. rows. By calculation, 10-in. twins would have 20 in. between adjacent rows of the twins, for a crop to give the same yield as a 20-in. row crop. This arrangement would give an average row width across the field of 15 in. This will be tested because the calculation assumes no competition between 20-in. rows; the result indicates that there was competition because the single row yielded more than half that of the two 20-in. rows. Extrapolating the graph drawn from these results indicates that rows would have to be about 32 in. apart not to compete.

In co-operation with the National Institute of Agricultural Engineering, machine harvesting trials were made on adjacent strips of crop drilled with the various twin-row arrangements.

Sowing date and plant population. Plots of Sharpe's E sown on 16 March, 25 April or 11 May in 20-in. rows were singled at 6 in., 12 in. or 20 in. Similar experiments were described in *Rothamsted Reports* for 1965, p. 277, and for 1964, p. 268. Table 11 gives the results for 1966.

TABLE 11

Sugar yields (cwt/acre) from different plant spacings on rows 20 in. apart sown on three occasions. Hackthorn Field, 1966

Plant spacing:	6 in.	12 in.	20 in.	Mean
Plants 1,000/acre:	48	28	17	31
Date sown				
16 March	75·2	73·3	70·3	72·9
25 April	68·4	72·6	57·9	66·3
11 May	60·9	59·9	53·7	58·2
Mean	68·2	68·6	60·6	65·8

https://doi.org/10.23637/ERADOC-1-14

On average, the 6-in. and 12-in. spacing produced the same sugar yield, but 20-in. spacing produced less, especially from the later sowings. Root yield and sugar percentage contributed to the differences, and for the three plant populations they averaged 20·5, 20·7 and 18·8 tons/acre of roots and 16·6, 16·6 and 16·1% sugar. The amounts of impurities in the root juice were considerably greater in the sparser plant stands. (Hull and Webb)

Nitrogen, spacings and irrigation. This experiment investigated the influence of density of plant stand, nitrogen fertiliser and irrigation on yield and rooting depth of sugar beet. Rooting depth was studied in co-operation with J. K. Coulter, and results are in the Chemistry Department report, p. 37.

The four plant spacings of variety Sharpe's E in Marl Pit field were S_1—40 in. apart in 20-in. rows (7,500 plants/acre); S_2—20 in. apart in 20-in. rows (15,000); S_3—10 in. apart in 20-in. rows (30,000); S_4—10 in. apart in 10-in. rows drilled in beds (50,000). "Nitro-Chalk" to give 0, 0·6, 1·2 and 1·8 cwt/acre N was applied in factorial combination with the four spacings. The 16 treatments were replicated in four blocks. A basal dressing of 5 cwt/acre of a 0 : 20 : 20 compound plus 6 cwt/acre kainit was applied to all plots. Irrigation was required on two occasions only: 0·54 in. was given at the end of June and 2·03 in. at the end of August to two of the four blocks. On each occasion heavy rain followed and irrigation did not affect sugar yield.

The mean yield of sugar from the four plant spacings were S_1—54·6, S_2–68·4, S_3—73·0 and S_4—71·6 cwt/acre. Yield increased linearly with plant populations up to 30,000 plants/acre (S_3), but 50,000 plants/acre (S_4) yielded less than S_3. Sugar yields for the N dressings were N_0—54·0, N_1—70·7, N_2—72·7 and N_3—70·3 cwt/acre, and plant spacing did not affect the yield response to N. (Draycott)

Seed spacing and cultivations. To gain experience with growing beet without hand labour, plots were sown on 30 March with pelleted Amono seed at 1½-in., 3-in. or 6-in. spacing, and given different singling, hoeing and pyrazon herbicide treatments. They were harvested by hand or with the "Catchpole Mono-Cadet" harvester. Germination of the seed was inadequate to give a full stand of plants when drilled at 6-in. spacing. Weeds infested these plots, irrespective of herbicide treatments, and had to be hand pulled. Numbers of roots harvested from the 6-in. spacing, were 17 to 21 thousands/acre compared with 30 thousands/acre on plots sown at 1½-in. spacing with hand singling. Plots sown at 3-in. spacing without singling gave 20–32 thousands/acre. On average 1·4 thousand/acre more roots were harvested by hand than by machine. Plots sown at 1½ in. and 3 in. whether or not singled or steerage-hoed gave sugar yields in the range 61–66 cwt/acre. Those sown at 6-in. spacing yielded 56–59 cwt/acre. Sugar yield of plots harvested by machine averaged 60·2 cwt/acre, and those by hand 62·4 cwt/acre. Although the plots grown without hand labour looked rough during the summer, provided there were enough plants, they gave a satisfactory yield and could be harvested by machine. (Church)

https://doi.org/10.23637/ERADOC-1-14

Herbicides

Most of the sugar beet at Broom's Barn was band sprayed at drilling with pyrazon. No part of the crop failed this year, but experiments showed some stunting and loss of seedlings. Weeds were well controlled by the treatment. Numerous samples of seedlings sent by fieldmen from growers' crops showed herbicide damage. Two experiments at Broom's Barn indicate that the position, in addition to the amount of the herbicide in the soil during the early growth of the seedlings, is important in determining damage.

Time of application. Pyrazon at 2 or 4 lb/acre or lenacil at 0·8 or 1·6 lb/acre were applied either 2 weeks before or immediately after drilling Sharpe's E seed on 13 April or 11 May. No treatment severely damaged the seedlings, but the pre-drilling applications made plants less vigorous during the summer. On average, the early sowing treated with either herbicide yielded 22 tons/acre of roots and the late 17 tons/acre. Pyrazon at 2 lb/acre applied before sowing gave 0·45 ton/acre less roots than when applied at drilling, and at 4 lb/acre gave 1·89 tons/acre less; differences on the late sowing were negligible. Corresponding yield differences for lenacil were, early sowing, 0·74 and 1·17 tons/acre and for the late sowing, 0·17 and 0·54 tons/acre. Treatments had negligible effect on sugar percentage, mean 16%, or on plant numbers, mean 33,000/acre.

In the experiments made by Mr. W. E. Bray of Norfolk Agricultural Station pyrazon was tested at 1·5, 3·0 or 6·0 lb/acre applied to the seed-bed and worked in before drilling. Lenacil was also tested at 0·5, 1·0 and 2·0 lb/acre pre-drilling and double these dosages post-drilling. The crop was drilled with Sharpe's E seed on 31 March.

Larger doses of both herbicides at each application time progressively decreased plant numbers. The pre-drilling spray was more damaging than the post-drilling spray. The largest dose of lenacil applied after drilling decreased plant numbers by only 3,000/acre compared with 11,000 for lenacil pre-drilling, 16,000 for pyrazon pre-drilling and 12,000 for pyrazon post-drilling. The smallest doses of both herbicides had little or no effect on root yield and the medium doses only a small effect, but the largest doses of pyrazon pre-drilling decreased yield by 5½ tons/acre; pyrazon post-drilling, 2½ tons/acre; lenacil pre-drilling, 3 tons/acre and lenacil post-drilling, ¼ ton/acre. (Hull and Webb)

Hormone weed-killers. To test the effect of cereal spray drift or contamination, sugar beet were sprayed 8 weeks after sowing, when most were at the 6–8-leaf stage, with MCPA, MCPB or CMPP at $\frac{1}{50}$ and $\frac{1}{200}$ concentration recommended for killing weeds in cereals. Typical symptoms of hormone-spray injury appeared in about 1 week on all plots sprayed with the more concentrated solution, and were most evident in plots sprayed with MCPB, but the plants rapidly recovered. At harvest all the sprayed plots yielded slightly less than the unsprayed, but the greatest loss was less than 8%, and was not related to the severity of visual symptoms. (Byford)

https://doi.org/10.23637/ERADOC-1-14

Time of sowing and harvesting

The effect of three dates of sowing and harvesting on the yield of vars. Sharpe's E and Polybeta was tested on Hackthorn field. The April sowing was delayed by wet weather. Plants numbered about 34,000/acre on all sowings, and bolters were $\frac{1}{2}$%, all on the early sowing. Table 12 shows sowing and harvesting dates and the yields of sugar. The two varieties gave similar root yields, averaging 18·48 tons/acre; the mean yields from the three sowing dates average 20·4, 18·8 and 16·2 tons/acre and from the three lifting dates, 15·8, 19·6 and 20·1 tons/acre respectively. The sugar content of Polybeta averaged 0·9% more than Sharpe's E. The root juice of the early sown beet contained less Na, K and α-amino N than the late sown, but differences with harvest date were erratic. The yields and other attributes of the two varieties changed in the same way with differences in the time between sowing and harvest, which range from 141 to 266 days. (Hull and Webb)

TABLE 12

Yield of sugar from beet sown and lifted on different dates on Hackthorn Field, 1966

Mean of two varieties

Sowing date	Lifting date: 29 September cpa	%	2 November cpa	%	7 December cpa	%	Mean cpa	%
16 March	63·6	18·3	75·8	17·7	76·3	17·1	71·9	17·7
25 April	60·5	18·3	69·4	17·7	70·2	17·3	66·7	17·8
11 May	48·5	17·9	61·8	17·6	60·1	17·1	56·8	17·5
Mean	57·6	18·2	69·0	17·6	68·8	17·2	65·1	17·7

Cereal and rotation experiments

Frequency of beet and barley. This phased rotation experiment, started on Brome Pin field in 1965, tests three rotations with one sugar-beet crop every third year (1 beet, 2 barley; 1 beet, 2 grass; and beet, legume potatoes). These are compared with 1 beet and 5 barley, or continuous sugar beet. When plots are cropped with sugar beet they are split to test fertiliser dressings giving 0, 50, 100 or 150 units N/acre. Each crop is given a recommended dressing of fertiliser, but these dressings will be modified in time to balance the nutrients removed from the soil by crops. The object of the experiment is to determine the productivity of the different crop rotations, and what soil pest and disease problems develop.

The tic beans follow sugar beet, and this year yielded 28·2 cwt/acre of grain: N given to the previous sugar beet did not influence their yield. Majestic potatoes follow beans and yielded 15 tons/acre of tubers. The second-year ley of Italian ryegrass yielded 65·1 cwt/acre of dry matter from two cuts, and the first-year ley 23·9 cwt/acre from two cuts. There was no definite trend of effect on ryegrass from the N dressings to the previous sugar beet. The third successive barley crop yielded only 25·5 cwt/acre of grain, but after one sugar-beet break-crop barley yielded 33·3 cwt/acre. The N dressings on the sugar beet did not affect barley yield.

https://doi.org/10.23637/ERADOC-1-14

Sugar beet yielded more than 3 tons/acre of sugar on average, and previous cropping has not had any obvious effect on yield. Greater N dressings up to 150 units/acre have increased sugar yield, but the yield increment obtained by increasing N from 100 to 150 units/acre is small; after potatoes and legumes, 100 units/acre gives the greatest sugar yield.

Effect of residues from beet on barley. In 1965 sugar beet was grown without N and with 50, 100 or 150 units/acre N, with or without PK fertiliser. N increased sugar yield by about 10 cwt/acre, but the effects of different amounts were erratic. PK increased sugar yield by 2·4 cwt/acre; mean sugar yield was 62·6 cwt/acre. The sugar-beet tops were ploughed in. In 1966 barley, var. Deba Abed, was grown without N or with 33, 66 or 100 units/acre N. These N dressings were applied in all combinations with the fertilisers applied in 1965.

TABLE 13

Yield of barley after sugar beet. Brome Pin Field, 1966

N applied in 1965 (units/acre)	N applied in 1966 (Units/acre) 0	33	66	100	
	Grain, cwt/acre at 15% moisture				
0	24·7	35·8	35·3	35·8	±1·65
50	23·8	34·1	35·8	34·3	
100	28·2	33·8	34·4	34·5	
150	26·1	35·4	35·8	34·9	

Yields (Table 13) were smaller than expected from the appearance of the crop. Applying 33 units/acre N to the barley in 1966 increased yields (range 11·1–5·6 cwt/acre), but there was no advantage from applying more than this. N applied for the sugar beet slightly increased barley yields when no fresh N was applied, but had no effect on yield when it was. The PK fertiliser applied for the beet increased barley yields only a little. (Widdowson)

Manuring of winter wheat. The effect of different fertilisers on the yield of Cappelle wheat, sown on 9 October, was measured on Blackhouse field. No autumn fertiliser was compared with 37·5 units/acre P_2O_5 and 37·5 of K_2O, or these nutrients +15 units/acre N; these dressings were also compared on plots receiving 12 tons/acre of farmyard manure. In the spring each plot was split for 50, 75 or 100 units N/acre. On average, farmyard manure increased grain yield from 34·9 to 38·7 cwt/acre. Without dung the autumn nitrogen increased yield by 1·2 cwt/acre more than the mineral nutrients, which increased yield by 2·2 cwt/acre. On the plots without dung, yields from the three spring N dressings were 33·8, 34·2 and 36·7 cwt/acre; with dung, the effects of N were erratic. (Church)

Nitrogen on grass. On Windbreak field, with a semi-permanent mixed sward, the yield of grass was compared from four amounts of "Nitro-Chalk", giving 0, 1·0, 2·0 and 3·0 cwt/acre of N. These treatments were also applied in the previous year on the same site. One-third of the N was

https://doi.org/10.23637/ERADOC-1-14

applied in spring, one-third after the first harvest and the final third after the second harvest. A basal dressing of 1·0 cwt/acre of P_2O_5 and 2·5 cwt/acre of K_2O was applied. The mean total annual dry matter given by three cuts from plots receiving no nitrogen was 30·6 cwt/acre; responses to nitrogen were: N_1–N_0, +35·7; N_2–N_1, +23·0; N_3–N_2, +13·8 cwt/acre of dry matter. For maximum production at least 3·0 cwt/acre of N is required. (Coulter and Draycott)

Broom's Barn Farm

The concrete to the south of the cattle yard was widened to allow access to vehicles and a wall built to retain the earth bank. In the general-purpose building a high-level platform was built to give access to the two weldmesh silos, and to mount a grain-cleaning plant and movable auger conveyors. An electric drying fan was installed which can be directed into either the silos or a demountable drying platform, used to dry produce from seed-crop experiments and grain in sacks. The beet-loading platform was extended in the autumn to give a paved area of 126 ft by 46 ft.

Ploughing was completed early in 1966, after wet weather had delayed it in December. Little Lane field was deep cultivated in August, levelled and the tile drains extended to the south-west. The Holt was also levelled after harvest. About 35 acres of light land remained unploughed at the end of the year.

Cereals. Ploughing of Brome Pin after sugar beet was not completed until 14 February. In good, drying weather 9 acres of Deba Abed barley was drilled on 18 February. Rain delayed further drilling until 3 March, and the 53 acres of cereals were completed by 12 March. All the fertiliser for barley was combine-drilled; 3 cwt/acre of 20 : 10 : 10 compound was given on Brome Pin and White Patch after sugar beet in 1965, and 3½ cwt/acre on Flint Ridge and The Holt. Winter wheat on Blackhouse received 90 units N as "Nitro-Chalk" in early April, in Dunholme 80 units and in Bullrush 70 units. In spite of more N being given than previously, no crop was lodged at harvest.

Eyespot affected all the barley, and wheat on Dunholme (var. Cappelle) and Bullrush (var. Rothwell Perdix). Rothwell Perdix on Bullrush was also affected by yellow rust.

All the wheat and the grass on Little Lane was sprayed with "Cambilene" on 26 April, and the barley on Flint Ridge, Brome Pin, The Holt and part of White Patch which was not undersown, was sprayed with the same material between 13 May and 20 May. The area of White Patch undersown with Italian ryegrass/clover mixture was sprayed with "Legumex Extra". The Holt and Brome Pin were also sprayed with barban against wild oats.

Cereals were all harvested between 15 and 26 August in favourable weather, and yields are in Table 14. The straw on Dunholme was burnt, and was baled and carted from all other fields.

https://doi.org/10.23637/ERADOC-1-14

Winter wheat on Little Lane established well, although sown when the land was wet.

TABLE 14

1966 cereal yields at 15% moisture

	acres		cwt/acre
Blackhouse	14	Cappelle Wheat	35·1
Dunholme	20·6	Cappelle Wheat	34·7
Bullrush	15	R. Perdix Wheat	37·9
Brome Pin	9	Deba Abed Barley	33·3
Flint Ridge	19·5	Impala Barley	32·8
White Patch	22	Vada Barley	39·1
The Holt	9·3	Zephyr Barley	37·3

Fodder crops. Little Lane was sown with Italian ryegrass in autumn 1965 and cut for silage in early June. After it had been irrigated and fertilised it was cut for hay in late July. On White Patch an area of undersown clover/grass mixture and an area direct sown after harvest established well. An area of Sainfoin failed, and was sown with grass.

Sugar beet. Much of the 30 acres of sugar beet on Hackthorn and Marl Pit fields was occupied with experiments. The basic fertiliser was 6 cwt/acre kainit in the autumn and 6 cwt/acre 20 : 10 : 10 compound on the seed-bed. Sowing started on 16 March, and most of the crop was sown in the next 3 weeks. April sowing were delayed by wet weather, but all except late experimental sowings were completed before the end of the month. Most of the crop was sown with graded seed from precision drills and band-sprayed with the herbicide pyrazon. A good plant stand was established and readily cleaned by hand. No irrigation was given except on a few experiments. The crop was sprayed twice with systemic insecticide to control aphids and yellows. Lifting started in late September, and although the soil was continually wet after the end of October, all was harvested and the undelivered roots clamped by the middle of December. Yields from the 30·6 acres averaged 17·1 tons/acre of clean roots with an average sugar content of 16·1%. This ranged from 17·6 in October to 14·7% in January. Mean dirt and top tare was 14·2 lb/cwt. The country's average yield this year was 15·1 tons/acre of roots at 15·8% sugar.

Livestock. During September and October 1965, 66 Hereford cross and 14 Sussex cross single-suckled calves were bought, average liveweight 544 lb. The cattle were yarded and fed *ad lib* silage plus 2 lb hay/head. The concentrate ration consisted of rolled barley, kibbled beet-pulp nuts and some protein supplement, fed up to a maximum of 10 lb/head from January until slaughter. Liveweight gain averaged 1·69 lb/day over the fattening period, after dropping to 1 lb/day during December and January. All the cattle were sold between 12 April and 6 June.

During September and October 1966, 54 Hereford cross and 28 Friesian steers have been purchased, and put into yards. (Church)

https://doi.org/10.23637/ERADOC-1-14

Weather records

TABLE 15

Monthly means of measurements at Broom's Barn in 1966 and the differences of these from the long-term means at Mildenhall

Month	Mean temperature (° F)	Difference (° F)	Mean daily sunshine (hours)	Difference (hours)	Monthly rainfall (in.)	Difference (in.)
January	35·7	−2·4	1·08	−0·62	1·11	−0·79
February	42·1	+3·1	1·70	−0·81	1·76	+0·35
March	43·0	−0·3	3·97	−0·03	0·43	−0·82
April	45·6	−2·2	3·08	−2·28	1·65	−0·06
May	52·1	−1·3	6·79	+0·29	1·48	−0·14
June	60·1	+1·1	6·38	−0·66	2·27	+0·78
July	58·8	−3·4	5·15	−1·09	2·96	+0·54
August	59·1	−3·0	6·26	+0·30	2·51	+0·48
September	58·1	0·0	5·33	+0·62	0·77	−1·24
October	51·7	+0·4	2·74	−0·72	2·25	+0·33
November	41·1	−3·5	1·71	−0·17	1·78	−0·27
December	40·4	−0·1	1·33	−0·09	3·23	+1·43
Year average	49·0	−1·0	3·79	−0·45	22·20	+0·59

https://doi.org/10.23637/ERADOC-1-14