# THE SPROWSTON FARM

**A Report for Members of the Norfolk Agricultural Station**

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This is a progress report for Station Members, and its contents are **confidential**

## THE FARMING

Weather records at Sprowston show that this has been one of the most protracted winters for a very long time, starting with the early December frosts and continuing right to up the time that this March issue is due to go to press. From the beginning of December seventy-one ground frosts have been recorded, so there has been little or no crop growth during the period, and grass is as backward now as it was immediately after the snow. Not only has the cold spell been protracted but on several occasions more than 25 degrees of frost have been recorded at night during the period.

While from the farming point of view late spring frosts are not very welcome, a season such as this is always valuable in assessing winter hardiness in some of the newer winter cereals, and interesting reactions to cold will almost certainly show up in some of the trial plots this year. At Sprowston last autumn four fields were drilled with Proctor barley, since trial work over the last two years had shown that autumn-sown Proctor outyielded very considerably a comparable spring-sown crop. The early drillings, made in October, have come through the winter well, but the one field drilled in early December was very poor and thin and has now been re-drilled. Nevertheless it is interesting to observe that Proctor is capable of standing a very severe cold spell, provided it is sufficiently well-developed before going into the winter, and once again must stand a very good chance of heavily out-yielding spring-sown crops in a late season such as this.

It is not often that the beet crop reaches near record proportions in two successive years but, following the farm record one in 1960, the 1961 crop yielded very much better than at one time was thought possible. Those fields not complicated by trials averaged nearly 19 tons per acre with an average sugar content of 15.6%, while the overall yield including trials areas was 17¾ tons at the same sugar content. While yields of this order are very encouraging from the financial aspect there must be some concern over low sugar contents, particularly in view of possible changes in the beet contract which may place greater emphasis on sugar per acre at the expense of root weight. In view of the changing trends, the trials programme this year will place some emphasis on the problem of sugar contents, particularly in relation to plant populations. It is hoped that before next season's harvest the Station's tarehouse will be equipped with apparatus for juice purity and noxious nitrogen determinations in a further attempt to elucidate some of the problems connected with " low sugars "—for although the plant breeder may be able to provide more suitable varieties, it will be up to growers to make the most of any changes ultimately written into the beet contract.

## CATTLE

The progress made during last summer by two groups of cattle born in the autumn of 1960 was discussed in the last issue of "The Sprowston Farm". One group received a small amount of supplementary feed throughout the whole grazing season, but gained very little more than a control one which was fed only when grass became short. These animals were yarded on 16th November, each group of twelve being split equally for two levels of feeding during this winter. They were housed and fed in two groups only, according to level of winter feeding. A typical ration per head per day for both groups has consisted of about 56 lb. sugar beet tops (latterly replaced by pea haulm silage and potatoes), 2 lb. hay, 5 lb. dried pulp and 3 lb. of a mixture of two parts cereal and one part decorticated ground nut cake. One group has received in addition to this an extra 2 lb. of a mixture of cereal and dried pulp.

The cattle have been weighed once a month over the whole period of the experiment, and before the first were sold they were all weighed on two successive days. The average weights and gains of the two winter feeding groups were:

| | No. of animals | Live Weights in Pounds | | |
|---|---|---|---|---|
| | | 16th Nov. | 7th Mar. | Gain per day |
| *Standard ration* | | | | |
| Angus x Friesian | 4 | 647 | 941 | 2.65 |
| Friesian ... | 8 | 733 | 1022 | 2.60 |
| Treatment group mean ... ... | 12 | 705 | 995 | 2.61 |
| *Standard ration + 2 lb. cereal* | | | | |
| Angus x Friesian | 4 | 665 | 939 | 2.47 |
| Friesian ... | 8 | 738 | 1044 | 2.76 |
| Treatment group mean ... ... | 12 | 714 | 1009 | 2.66 |

On average the group receiving the extra 2 lb. cereal gained only 5 lb. more per head than the control one over the whole period of 111 days. As in the summer the difference was larger than this for the Friesians, but this was balanced by a negative response in the Angus crosses. These, as we have come to expect, gained less on average than the pure bred Friesians, partly no doubt because they came in off grass in more forward condition. Nevertheless all the gains were very satisfactory and rather above those we might expect from the rations used. The variation in performance between animals within the same treatment group was very large, the best animals gaining nearly 50% more than the worst. This suggests that the small differences between treatment group averages were probably only chance ones. This difficulty is constantly met with in most work with large animals and sufficient numbers can often only be obtained by repeating a given experiment over many years.

Ignoring breeds, we had in this experiment four treatment groups which contained six animals each. One received no supplementary feed in either summer or winter (a), one got it in summer only (b), another in winter only (c), and the fourth during both periods (d). Their total and daily live weight gains in pounds over the whole period, May 1961 to March 1962, were:

| | Winter period | | Averages |
|---|---|---|---|
| | Standard ration | Standard + 2 lb. cereal | |
| Summer period | | | |
| Low ... ... | (a) 606 (1.95) | (c) 606 (1.95) | 606 (1.95) |
| High ... ... | (b) 611 (1.97) | (d) 646 (2.08) | 629 (2.03) |
| Averages ... ... | 609 (1.96) | 626 (2.01) | 617 (1.99) |

At the time of the final weighings each animal was scored by eye and hand for conformation and fatness. Differences between the treatment groups were on average very small; once again the within group variation was considerable, and the only consistent trends showed up the rather better conformation of the Angus crosses and their considerably higher degree of finish.

If the price of the extra feed is taken as £20 a ton, the costs of the amounts given to groups (b), (c) and (d) were respectively £3 11s., £2 and £5 11s., and the advantages in gain apparently due to the feed were 5 lb., nil and 40 lb. per animal. These were of course completely uneconomic, and our conclusions must be, pending another look at the question, that unless grass is short feeding cereals during the summer is not likely to be worth while, and that the ration we normally use for winter fattening for a 7—8 cwt. beast is sufficiently good to require no increase in the concentrate level. Our records are not sufficiently detailed to reveal whether the animals receiving the extra cereal ate less beet tops or silage, but it seems unlikely that this was the case.

## SUGAR BEET TRIALS 1961

*Potash manuring*

For the last three years plots of sugar beet receiving various rates of potash, either in the form of kainit applied in the autumn or as muriate worked into the seedbed, have been compared with plots receiving no potash. Although soil analyses on the fields concerned suggested that potash reserves were generally low there has been little yield response to potash in any form or at any rate. This is undoubtedly due to the policy of heavy manuring over the post-war years having left enough reserves in the soil to mask the treatments applied in any one-year trial. In 1961 the heavy rainfall of the previous winter must have leached out some of the nutrients from the topsoil, as potash—particularly in the form of kainit—greatly improved the colour and early appearance

of the crop. But by harvest the visual effects had quite disappeared and there were only very small differences in yield. Throughout the trial series there has been only a slight insignificant response where potash was applied, even where part of the dressing was in the form of kainit. As this was intended as a purely husbandry trial the salt and trace element constituents of kainit were ignored, and it was compared with muriate of potash on equivalent potash contents alone. The application of salt to the beet crop—either as agricultural salt or as kainit—is generally accepted as good practice, but this trial series indicates that where there is a good reserve of potash in the soil additional applications of potash, as either muriate or kainit, will not necessarily result in an increase in yield.

In these trials a comparison has also been made between 4 and 6 cwt. of Nitro-Chalk per acre; in no year has the higher rate significantly increased the yield, though following the heavy leaching of the 1960-61 winter there was a very slightly heavier yield from the higher level of nitrogen. It would appear that in most years 80 units of nitrogen are sufficient; in the first year of the trial a higher dressing than this depressed the sugar percentage slightly. In this connection it is interesting that in 1961 potash increased the sugar content a little, again more noticeably where kainit was used.

This trial is to be continued for another year, but the results so far suggest that, under our conditions, ploughing down 5 cwt. an acre of kainit in the autumn and supplying a small amount of muriate in the spring more than amply meets the sugar beet crop's demands for potash. It seems hardly worthwhile exceeding 80 units of nitrogen except possibly following a very wet winter, and since there are good reserves of phosphate in our soil 50—60 units of phosphate are probably more than enough for a crop which seldom responds much to this nutrient except on really deficient soils.

*Methods of applying fertiliser*

Broadcasting a heavy dressing of fertiliser during the preparation of the seedbed almost inevitably leaves deep wheelmarks which are a hindrance to the efficient use of precision drills, and to the even emergence of the crop which is a prerequisite of mechanical thinning. Application at some time between ploughing and the initial working of the land would avoid this difficulty, and also ensure that no heavy concentration of fertiliser occurs near the seed. This is important under normal drilling conditions and could be critical when drilling at very low seed rates in an attempt to reduce or elminate hand labour at singling. An alternative approach to this problem would be to apply the fertiliser immediately after drilling or even as late as the first tractor hoeing, either overall or between the rows only.

For the past two years these various ways of applying 6 cwt. an acre of a 16:9:9 compound to beet have been tried. The experiments also included plots where the fertiliser was placed slightly below and to one side of the seed, and others receiving no fertiliser at all. The first year's results were discussed in "The Sprowston Farm" Vol. II, pages 63–64, and showed that in 1960 all the broadcast treatments yielded well above the nil plots, but where the fertiliser was placed scorch damage to the roots lowered the plant populations so that responses on these plots were much smaller.

In the 1961 trial, the placement drilled fertiliser again reduced the plant population, but it produced a very vigorous and healthy crop early in the year; this effect did not last through to harvest, and may have been due partly to the lower plant population resulting in more room for each plant. This point was not obvious until counts were made, and shows the danger of paying too great an attention to eye assessment of the crop.

Fertiliser applied in the autumn after ploughing was subjected to heavy leaching from the winter rains, and yielded a ton an acre less than when a similar quantity was applied immediately prior to seedbed cultivations. Where the fertiliser was broadcast immediately after drilling the crop was only half a ton lighter than where the application had been applied at the normal time, and placement drilling gave the same slight reduction in yield. Delay in applying the fertiliser until the first tractor hoeing resulted in a significant depression in yield of the order of two tons per acre.

The no fertiliser plots gave 17.8 tons of washed beet to the acre, and those where the compound was worked into the seedbed an average of 23.9 tons. The trial suggests that established practice is therefore probably the best—but that in an emergency the fertiliser can be applied much earlier or later than is normal and still produce a large part of its effect.

*Reducing handwork at singling*

Since the war some success has been attained at Sprowston with trials in which various ways have been tried for reducing the peak labour demand for beet singling. The ultimate goal in this work must however be the total elimination of hand hoeing, as it seems highly probable that in a few years' time this operation will be uneconomic even if the labour can be found. Though crops can be grown using mechanical thinners with very little hand trimming it does not appear to be a technique capable of much greater refinement, and in consequence, from 1961 onwards, attention at Sprowston is being directed towards the use of monogerm seed and low seed rates in conjunction with weed-killers—with the object of drilling the seed and leaving it to grow, with no work beyond tractor hoeing and spraying.

The first step towards this ideal was taken last year with a crop grown from monogerm seed which was precision drilled at four inch spacing, with a seedrate of one pound an acre, and left to harvest with no hand work apart from weeding. This area of beet had an average plant population of 30,400 per acre and appeared to have a far better distribution of plants than another large demonstration plot nearby which was drilled with monogerm seed at a higher seed rate and mechanically thinned.

The obvious objection to using very low seed rates is that poor germination can lead to a crop failure. This problem is naturally uppermost in our minds, and this season we are trying ways of avoiding this danger. The problem of weed control has not been completely overcome and unfortunately we were unable to spray the low seedrate plot last year; this will be done in 1962. The most generally useful selective herbicide available is a mixture of endothal and propham which was developed at Sprowston, and though not perfect it should reduce weeds to a level where they become relatively unimportant. The monogerm strains of beet at present available are still inclined towards excessive bolting, yields are not up to the standard varieties, and they are expensive, but the next few years should see great improvements both in field characters and in yield.

At the moment the practicability of producing a clean well-spaced crop without the use of hand labour may seem to be very unlikely, but experience has shown that the use of precision drills and suitable weed-killers can give well spaced stands and weed-free crops. A combination of both techniques must ultimately result in the production of a crop which, while not up to the standards of perfection attainable by the best hand-work, will nevertheless be acceptable in good farming practice.

## WEED CONTROL IN SUGAR BEET

At frequent intervals over the past seven years notes have appeared in "The Sprowston Farm" concerning the current programme of research on chemical weed control. It is intended that the ones in this issue should not be restricted to a contemporary report but should review all the techniques of weed control commercially available and discuss their use; their place in a system of growing satisfactory beet crops without hand labour has been discussed in the previous section.

The chemicals presently available for use in sugar beet may be divided into four categories according to stage of application:

1. *Chemicals applied before sowing the crop*

Two treatments, TCA and propham (or IPC), are used to control wild oats and annual grass weeds. Of the two, TCA is

cheaper and slightly more reliable in its control of wild oats, but propham will in addition control some broad-leaved weeds, notably knotgrass, redshank, chickweed and spurrey.

Propham is best applied within five days of drilling and worked into the soil during the seedbed preparations, which should follow spraying as soon as is practicable. TCA should be applied about two weeks before drilling on to a roughly level surface, but it does not seem to be so important to work it into the soil immediately. Even so this chemical has been criticised on the grounds that it may be inadvisable to work the land so long before drilling, but against this must be set the fact that it is available in a proprietary mixture with a fertiliser which can reduce handling costs.

Both chemicals may cause stunting of the young beet seedlings but experience has shown that this stunting is normally outgrown without loss of yield. Propham is especially active on light sandy soils and on such land no more than 2 lb. per acre should be used. Conversely on heavy clays up to 4½ lb. an acre may be used with safety and, in fact, such a dose may be necessary for adequate weed control. On fen soils propham has virtually no effect at normal doses and TCA should be used, although results are sometimes poor.

Recommended rates of chemicals for wild oat control in sugar beet

| Soil type | Propham *lb/acre (a.i)* | TCA *lb./acre (a.e)* |
|---|---|---|
| Sands and light Sandy Loams | 1½—2 | 7 this could be reduced on the lightest land but wild oats rarely occur on such soils |
| Medium Loam and Light Silt Soils | 3 | 7 |
| Heavy Loams and Clays | up to 4½ | 7 |
| Fen Soils and Others High in Organic Matter | Not Recommended | 7 (better control may be obtained with a higher dose, but "fen" soils vary so widely that prediction is difficult) |

2. *Chemicals applied immediately after drilling the crop*

For control of susceptible broad-leaved weeds, propham may be applied to the soil surface after drilling, but results, particularly against wild oat, are better where it is worked into the soil beforehand as described above.

Members will be familiar with the Station's work on the development of a mixture of endothal and propham, which has given control of a wider range of weeds than is possible with either chemical alone. A proprietary mixture of these two chemicals is now available. Other proprietary soil herbicides, some unfortunately of undisclosed composition, are also being offered.

Certain basic problems are common, to some extent, to all soil acting herbicides. Weed control may be poor where applications are made on to a cloddy or stale seedbed or are followed by a period of drought. With the possible exception of TCA, doses should be related to soil type as most soil acting chemicals are partially adsorbed and inactivated by the clay and organic matter present in the soil. In addition there is some risk of crop damage (broadly speaking this is least with TCA and greatest with propham) so that these materials should be used with a far greater degree of care and precision than is sometimes accorded to cereal spraying. In general then, one is best advised to use the newer chemicals on a small scale until quite confident of the dose suitable for a particular soil, or to make the maximum use of any technical service, such as soil analysis, which may be available to assist in predicting a suitable dose.

3. *Chemicals applied just before the emergence of the crop*

Where a major proportion of the weeds emerges before the crop they can be killed by a wide range of contact pre-emergence herbicides. Only emerged weeds are killed, and these sprays must not of course be used after a significant proportion of the beet has emerged so that the timing of this operation is critical. Chemicals available for this purpose include PCP, which should be applied about two days before expected crop emergence, a proprietary mixture of cresyllic acids, and diquat. T.V.O. was originally used for this purpose and, despite the expense, its use is still occasionally justified by virtue of the fact that it is readily available in large quantities should the need arise urgently.

4. *Chemicals applied after the emergence of the crop*

(*a*) *For the control of wild oats.* Dalapon has been used at 6 lb. of active ingredient per acre when the beet have not more than two true leaves, but this dose can lead to a loss in yield of

up to two tons. The highest level tolerated by beet in trials has been 4½ lb. of active ingredient per acre, but weed control may be slow and inadequate at this dose.

(*b*) *For general weed control.* Chilean nitrate or soda may be used at 2½ 3 cwt. per acre after the beet seedlings have two true leaves. This must be applied in at least 100 gallons of water and a suitable wetting agent should be used. Best results are obtained when spraying is preceded by good growing conditions and followed by humid but rain-free weather. This treatment can be of immense value but many weeds, especially fat hen, become resistant as they grow older and regrowth tends to occur. Where nitrate of soda is to be used the application of an equivalent amount of seedbed nitrogen can be withheld, as it has been established that full benefit can be obtained from nitrogen applied in this way, provided that it is applied in the early stages of the development of the crop.

*Choosing a herbicide*

The use of a mechanical thinner alone can reduce the weed population considerably. Indeed by removing some weeds, by moving stones from the row and breaking the soil crust, and by generally opening up the braird a relatively light thinning treatment can speed up singling considerably. By its very nature, however, the thinner is a strictly non-selective weed killer and the weeds which remain tend to be those in close contact with the beet seedings and, therefore, the most difficult to remove.

Chemical weed control can be used to advantage in any system of husbandry but obviously the benefits are greatest where it is most important to economise on labour. This consideration also affects the choice of which type of herbicide to use in that, where the aim is to increase the efficiency of conventional singling, a chemical effective against a restricted range of species, such as TCA or propham, or one likely to leave a high residual weed population, such as nitrate of soda or the contact pre-emergence herbicides, can be used. On the other hand where it is expected that some of the acreage may be left with little or no hand work it becomes important to use a chemical such as the endothal/propham mixture which is more likely to control a broad range of weeds.

Any comment on the economics of chemical weed control must be of a very general nature; piece work rates can vary by as much as £4 per acre between some of the main beet growing districts, a figure which more than covers the cost of most herbicides. The cheapest materials are TCA and some of the contact pre-emergence types which can be applied with normal

farm machinery for as little as 30/- per acre. On very light land propham or the endothal/propham mixture need cost little more, but on heavy land the cost can be around £5 per acre.

A further point is that two of the chemicals mentioned require the use of machinery not commonly found on farms at the present time. Nitrate of soda needs to be applied at the very high volume rate of at least 100 gallons per acre, and the endothal/propham mixture needs, for economic reasons, to be applied in restricted bands over the rows by means of a specialised type of sprayer. These two methods, therefore, are of most use on farms with a large acreage of beet or in the hands of contractors, where the cost of the machine can be set off against the large acreage.

Chemical weed control is ideally planned well in advance. Indeed, many of the chemicals are applied before the weeds emerge, and those applied after emergence need for best results an accurately timed application, so that the choice of chemical should be made, and the material obtained, well in advance of it being needed.

## POTATO TRIALS 1961

*Number of sprouts per tuber*

The use of artificial lighting for sprouting seed potatoes in converted barns and other buildings is now an established practice, and it has been found that by controlling temperature and the amount of light given it is possible to produce different types of sprout on the seed tubers. A great deal of experimental work remains to be done however on finding exactly what is the most desirable type of sprout and how it can best be obtained. One factor which appears to be of importance is the number of sprouts on the seed tuber, and this is influenced largely by the time when sprouting is commenced. The effect of this was discussed in the last issue of "The Sprowston Farm" (page 75). If the sprouting process is begun in late autumn there is a tendency for the end sprout only to grow, and this appears to inhibit the growth from other eyes on the tuber—an effect known as 'apical dominance'. Preliminary work on this problem has indicated that tubers with only a single sprout may produce a higher proportion of ware so that this could become of direct commercial importance.

In order to investigate this point two experiments were begun in 1961 to compare crops from normal sprouted seed of King Edward and Bintje with those from selected tubers having one, two, three or four sprouts each. At harvest both varieties gave the highest yields from those plots planted with setts having only a single sprout. With Bintje this treatment gave almost 3 tons an

acre more ware than where ordinary unselected seed was used, while in the case of King Edwards the increase was two tons in favour of the 'single sprout' plots.

Yields from seed tubers having two, three or four sprouts were rather variable, with no appreciable trend towards higher yields from fewer numbers of sprouts, but there was an obvious tendency for the crop to produce a greater proportion of ware when setts with few sprouts were used. This was clearly seen with the King Edwards where seed with four or random numbers of sprouts gave 71—75% ware while that having one or two sprouts gave 82—84%. The Bintje gave a regular increase in the proportion of ware—from 74% on plots planted with tubers with random numbers of sprouts to 81% on those where setts with a single sprout each were used.

Though these are the results of only a single year's trials they support work done at the Terrington Experimental Husbandry Farm and indicate that the proportion of ware from a crop can be increased if the seed can be sprouted in such a way that only one or two chits are produced on each tuber.

*Periodic lifting*

Towards the end of the summer when blight may be prevalent it is often difficult to determine when it has become unprofitable to continue spraying the potato crop and when the haulm ought to be destroyed. If there is very little disease on the foliage, and the crop appears to be vigorous enough for the tubers to be still bulking up with some of the seed approaching ware size, then it is obvious that haulm destruction should be delayed. But if blight is prevalent the heavy cost of preventive spraying may not be offset by a continued increase in ultimate yield, and there is always the risk of spores from the blighted foliage infecting the tubers in the ground, in which case there may be great danger of the crop rotting in the clamp or store. Though every season presents a different problem so that no firm recommendation can be made concerning the date of haulm destruction, it would be helpful if more were known about the rate at which yields increase towards the end of the growing season, and so a trial was started in 1961 on King Edwards to examine this question.

The yields were measured in areas of crop from which the haulm had been removed at different dates between August 11th and August 31st, when the tops on the farm crops were finally burned off. Results showed that the yield of ware increased from 12.3 to 15.3 tons per acre between these two dates, with the biggest rate of increase during the latter part of this period. The total yield increased more steadily, and so the proportion of ware

was slightly higher by the end of the month. In 1961, therefore, the three sprays that were necessary to keep the foliage relatively clear of blight during this period were amply covered by the extra 3 tons of ware obtained through not destroying the haulm when blight first became prevalent on August 11th. It is proposed to continue this work over several seasons, and in 1962 a comparison between the rates of bulking of chitted and unchitted seed will be included.

*Source of seed*

For several years now there have been trials at Sprowston concerned with preserving healthy stocks of potatoes on the farm, by spraying against the aphids responsible for introducing and spreading virus diseases causing the so called 'degeneration' of once and twice grown seed.

The results of preliminary investigations carried out in conjunction with Dr. Broadbent of Rothamsted which were discussed in "The Sprowston Farm", Vol. II (page 24), showed reasonable success in the control of leaf roll using DDT emulsion. At the conclusion of this work a further attempt was made to preserve a clean seed stock for one or two years under more practical farming conditions, using a systemic aphicide in place of DDT, which had required very critical timing of the applications. In 1961 there were three stocks of seed available for comparison, including new Scotch Class A, and once grown seed either from the normal farm crop or from a specially sprayed area. The yields of ware were:

| | | |
|---|---|---|
| Scotch seed ... ... | 14.3 | tons per acre |
| Once grown sprayed ... | 11.1 | „ „ „ |
| Once grown unsprayed ... | 10.0 | „ „ „ |

Though the once grown sprayed seed yielded a ton per acre more than the ordinary once grown seed the use of either would have been most unprofitable as their yields were well below the level obtained from comparable Scotch seed.

The general picture emerging from this trial is that it would be very risky for a farmer to save his own seed using this technique, but the basic ideas behind it are quite sound and the introduction of new aphicides may render it far more effective. In these trials much of the aphid infestation and consequent virus infection took place in the very early stages of crop growth before all the plants had emerged and therefore at a time when spraying was hardly practicable. This season a new material—menazon—is to be used on a small area of potatoes and may overcome this difficulty as it is applied to the setts before planting and gives protection over this very critical early period. It is hoped that

this treatment, in combination with a simple spraying programme will produce a virus free crop which can be used for seed next year and possibly the year after.

## N.I.A.B. CROP VARIETY TESTING SCHEME

*Virus tolerance in sugar beet*

The aphids which transmit virus yellows, which can cause serious losses in yield in sugar beet, can now be controlled to a substantial extent by insecticides in both spray and granular forms. As an alternative approach in combating yellows, plant breeders have been investigating the possibilities of breeding for resistance to the virus. While there does not appear to be any genetically controlled resistance there have been found to be considerable differences between varieties in their levels of tolerance. Having produced strains with some measure of tolerance, subsequent observations have shown that some lines remained green after an attack of aphids while others, although remaining vigorous, showed distinct yellowing of the leaves. Severity of yellowing is thus not always associated with intolerance or reduced yield. It has also been found that aphids multiply more slowly on some lines than on others, leading to the later appearance of disease symptoms. In this breeding work it was considered important to select strains with green leaves since it was probable that aphids showed a greater affinity for yellowing foliage. In East Anglia two distinct viruses are responsible for yellows, namely sugar beet yellows virus and sugar beet mild yellows virus. Tolerance to one virus is not always related to tolerance to the other, although useful lines showing tolerance to both have been found.

The selection of strains showing a high level of tolerance to virus yellows is extremely difficult without reliable yield trials. In the 1961 season some thirty-two virus tolerant strains of sugar beet were tested at Sprowston and elsewhere against six commercial varieties, Sharpe's Klein E, Battle's E, Bush E, Cambro, Hilleshog E and Johnsons E as controls. The strains, which were produced in two ways, by inbreeding and by hybridisation, were bred at the Cambridge Plant Breeding Institute, the Dunholme Field Station and Bush-Johnsons. The trial consisted of eight randomised blocks; four were sprayed three times to control aphids while the remaining four were left unsprayed in order to assess the tolerance to yellows possessed by the strains.

The incidence of sugar beet yellows at Sprowston was low during 1961, and as a result the benefit derived from tolerant strains compared with susceptible ones, even in unsprayed areas, was relatively small. A slight increase in yield of sugar was

obtained from replicates which were sprayed, but in a number of cases strains showing a high level of tolerance gave an equivalent and sometimes a slightly higher yield from the unsprayed treatment. High yields of sugar were obtained from two varieties in particular, both from Cambridge, TN.58/235 and VT.26, which, with sugar yields of 87.9 and 84.0 cwt. an acre respectively, gave substantially more than the mean yield for the commercial varieties of 75.7 cwt. Some fourteen other virus tolerant strains also outyielded the controls but by a smaller margin. This testing work is being continued.

*Brussels sprouts*

Varieties specifically for quick freezing have been in trials at Sprowston for some ten years, during which time interest in the crop for processing has grown considerably. Ideally the sprouts should be small, tight, spherical and of good colour. They are now often cut off the stalks in the factory following the current practice of 'on the stalk' harvesting, and ease of picking, once a desirable variety characteristic, is no longer such a critical factor. This method of harvesting has now been adopted in the variety trials and has been compared against the normal picking technique for the past two seasons. Yields are generally slightly lower in the 'on the stalk' harvesting but high labour costs can make picking in the field unprofitable. Uniformity of maturity can, however, be improved by pinching out the growing point in the early autumn thus encouraging the uppermost sprouts to mature more quickly.

At Sprowston the moderately early Cambridge Special outyielded the later maturing but better quality Irish Glacier by a small margin in the 1951 season. A further variety Sanda, although lower yielding, produced sprouts of excellent quality and because of its late maturity it may be useful in extending the picking season. Observation plots of some twenty-eight quick freezing varieties were also grown. Most varieties are maintained merely by selection of the best looking plants for seed production, and as a result are sometimes notoriously heterogeneous. A number of varieties showed considerable promise in the trial, but of particular interest was the very early Japanese hybrid Jade Cross which, because of the way it was bred, showed extreme uniformity in almost all characters.

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