

1943

SCOTTISH SOCIETY FOR RESEARCH IN  
PLANT-BREEDING,

ABRIDGED

REPORT BY THE DIRECTORS.

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THE Directors of the Scottish Society for Research in Plant-Breeding have pleasure in submitting the Twenty-second Annual Report to members of the Society, and in indicating the progress and development of the Society's work.

As mentioned in the previous Report, certain parts of the programme of experimental work were of necessity curtailed in 1941, and in the year under review experiments were continued on lines similar to those of the preceding year. Some work on the seeding of vegetables was also undertaken again.

Elite stocks of Early Miller and Bell oats and small stocks of grasses (Perennial Ryegrass, Cocksfoot, Timothy, and Meadow Foxtail) were grown for seed at Craigs House. Stockseed crops of Craigs Defiance and Alness potatoes and a small area of barley (Ref. No. B8(8)) were grown at Boghall.

Consideration is being given by the Directors of the Society to the question of expanding the Society's activities, particularly with grasses, and to the need for securing more land and equipment for the experimental work. The two acres of old worn-out pasture on an upland area near Balerno which, as reported last year, the Society obtained for the purpose of conducting grazing trials, have been ploughed and limed, and progress has been made in laying out the grass trials. As arrangements for ploughing could not be made until near the end of 1942, it was not possible to start any experimental work there in the spring or summer of 1942 as had been hoped.

On account of the acute scarcity of labour at Boghall sub-station at certain busy periods of the year, it was decided that a small tractor with suitable equipment should be obtained so as to facilitate the work of cultivating the experimental plots there. An Anzani Iron Horse Tractor was recently purchased, and labour difficulties should now be considerably reduced by having this machine at our disposal. It has been arranged that the tractor may be hired, when this can be conveniently done, to the Manager of the Edinburgh and East of Scotland College of Agriculture Farm at Boghall for use in his experimental plots there.

#### **Staff.**

In response to a request from the Department of Agriculture for Scotland two members of the Society's staff, Dr William Black and Dr George Cockerham, were again granted leave of absence for four weeks in August 1942 to assist as temporary inspectors under the Department's scheme for the inspection of growing crops of potatoes. It is felt that the experience gained in this work has been of benefit to these members of the staff who are engaged in potato breeding, by bringing them into closer contact with potato growers and in enabling them to see problems in the field as they affect potato cultivation in Scotland.

Mr J. M. S. Lang, B.S.A., Temporary Assistant at the Station, resigned his post as at 12th December 1942 on his receiving an appointment with the Ministry of Aircraft Production.

#### **Visit of Inspection.**

Members of a Committee of the Agricultural Research Council paid a visit of inspection to the Plant-Breeding Station at Corstorphine in June 1942. The visitors were received at Craigs House by the Chairman of the Board of Directors of the Society, Sir John H. Milne Home, and the

party was thereafter conducted round the buildings and the experimental plots by members of the Society's staff.

### Library.

A list of publications which are known to be out of print, and which it is desired to acquire, is subjoined. If readers of this Report have any of these for disposal the Director of Research would be glad to have particulars regarding them.

#### *Welsh Plant-Breeding Station Bulletins—*

- Series H. No. 1. Preliminary investigations with herbage plants.  
 No. 3. Further investigations with herbage plants.  
 No. 5. The animal complex and the pasture complex.  
 No. 7. Red clover investigations.

*Journal of the National Institute of Agricultural Botany*, Vol. I., No. 1. 1922.

*Scottish Journal of Agriculture*, Vol. 19, No. 4. 1936.

"Wheat Breeding Investigations." By Biffen and Engledow.

"Balliere's Encyclopædia of Agriculture" (two volumes). Edited by Hunter.

"The Barley Crop." By Hunter.

"Wheat in Great Britain." By Percival.

Gifts to the Library of publications which are out of print have been received from James H. Elder, Esq., B.Sc., Cregganore, North Berwick, and Dr Alexander Nelson, Royal Botanic Garden, Edinburgh. These gifts are highly appreciated and are gratefully acknowledged.

### Membership.

The Directors regret to report that in the past year four members died. It is worthy of note, however, that forty-six new members—more than double the number enrolled in

1941-42—were elected during the year ended 31st March 1943. Of these 46, 10 became life members. At 31st March the membership numbered 308, and consisted of 142 life members and 166 annual members (20 at the 5s. rate and 146 at the 10s. rate of subscription). A list of members appears on pages 25 to 33 hereof.

Donors of £10 and over are entitled to become life members without further payment. Donors of £5 may become members of the Society by payment of an annual subscription of 5s., and others by payment of an annual subscription of 10s.

The Directors have decided that members on Military Service shall be allowed the privileges of membership, without payment of subscription, for the duration of hostilities, on the understanding that they resume payment after the war. In view of this it would be helpful if members who are serving with the Forces would notify the Secretary to this effect.

JOHN STIRTON,

*Secretary.*

**List of New Varieties of Crop Plants raised or selected by the Society and introduced into Commerce.**

		Date of Registration.
<i>Oats—</i>		
Elder	} Registered by the Department of Agriculture for Scotland as new- varieties.	1930
Bell		1932
Early Miller		1934
<i>Wheat—</i>		
Scottish Iron III.		
<i>Barley—</i>		
Unnamed (as yet) selection, Ref. No. B8(8).		
<i>Potatoes—</i>		
The Alness	} Registered by the Department of Agriculture for Scotland as new varieties.	1934
Craigs Defiance		1939
<i>Grasses—</i>		
Cocksfoot—Ref. No. Cc 180.		
Timothy—Ref. No. Cb 191.		

# R E P O R T

BY

DIRECTOR OF RESEARCH

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## I. Research Programme.

Many of the problems in the approved programme of work are of the long-range type, and although war conditions have necessitated some modifications from time to time, most of the important plant-breeding investigations have been continued. Since Mr C. A. Lyall joined H.M. Forces in 1941 the work with barley and wheat that was in progress has had to be considerably reduced. Some additional work has been undertaken by the staff in the saving of seed of certain vegetable crops. With the unavoidable curtailment of facilities for field trials of cereals, potatoes, and grasses in different localities, promising new varieties or strains of these crop plants which have reached the field trial stage are increasing in number. Small foundation stocks of these are, of course, being maintained so that increased quantities of seed may be available for trials as soon as possible after field experiments can again be arranged.

A review of the work for the year ended 31st March 1943 follows.

### GRAIN CROPS.

WILLIAM ROBB, *Director of Research.*

CHARLES A. LYALL, B.Sc., *Assistant.* (At present on Active Service.)

#### *Oats.*

The chief oat-breeding problems on hand are: (1) to produce new varieties having an increased amount of resistance to lodging in combination with high grain-yielding capacity and

other desirable grain characteristics; (2) to produce some early-ripening and hardy varieties for the more upland areas in Scotland; (3) to see how far resistance to prompt germination of the grain at harvest-time can be combined with other desirable characters of grain and straw; (4) to produce an improved oat to replace the Bristle-Pointed oat in those areas in the West of Scotland where that type is still grown in preference to those which give better results in other districts.

In the first-mentioned problem the aim is to breed for shorter straw, and the Semi-Dwarf oat has been largely used as a parent to introduce this characteristic. Other oats such as Elder and Early Miller, varieties which do not lodge very readily, have also been used for breeding. Many unfixed hybrid progenies were again grown, and these have been subjected to rigorous selection as regards grain characters and type of straw. Some attractive short-strawed plants still produce variable progenies, and selection of individual plants is being continued. In the Semi-Dwarf and Early Miller crosses there frequently occur apparently useful straw types which have too high a proportion of barren or empty grains. This is an undesirable feature, and an endeavour is being made to eliminate it.

In the second of the oat problems the collection of early-ripening types has been increased, and further comparison of this group of varieties was made in small plots in 1942.

In the third problem the objective is to obtain a strain of oat of the cultivated (*sativa*) type the seed of which will not germinate during wet weather when the grain is in the stook. As mentioned in previous reports, the wild oat (*Avena fatua*) has been used to introduce this character of delayed germination. It is a well-known characteristic of the wild oat that its seeds do not germinate at harvest-time, but may readily do so some months later. Seeds from selected crosses between the wild oat and cultivated oats were sown in moist sand immediately after the plants were harvested, and notes were made regarding germination. Wide variation in the dates of germination was evident; some grains germinated in nine days, while others did not germinate for several weeks after sowing, although they were kept moist all the time. Seeds from the selected plants (*sativa* grain type) showing this characteristic of delayed germination have been sown for further selection and breeding.

The fourth breeding problem has been undertaken in order to see whether an improved variety can be produced to replace the hardy but low grain-yielding Bristle-Pointed oat, *Avena strigosa*, which is still grown in some areas on the West Coast of Scotland, where the soil is alkaline and where modern varieties (*A. sativa* types) do not seem to thrive. The suggestion has been made that an improved oat might be obtained by crossing the Bristle-Pointed oat with one or other of the more widely cultivated and higher grain-yielding *sativa* varieties. This cross has been tried repeatedly, but without success. Failure is doubtless due to the wide difference in chromosome constitution between the Bristle-Pointed oat and the other larger-grained cultivated varieties. There is reason to believe that another species of oat, *Avena byzantina*, one of the *sterilis* type, has shown some tolerance of alkaline conditions, and one of the ordinary (*sativa*) oats has been crossed with it. This cross was secured a few years ago, and second-generation hybrid plants have been grown for comparison and selection.

About two acres each of Early Miller and Bell oats were grown, and all the grain was sold for seed.

#### *Barley and Wheat.*

Only one variety of barley was grown—viz., the Society's unnamed selection, Reference No. B8(8). This variety has not yet been named in view of its close resemblance to Gold barley. A sample was sent to the National Institute of Agricultural Botany, Cambridge, for examination, and only a few very slight differences were found between the varieties Gold and B8(8); but further comparisons are to be made in 1943, and a report will be received in due course. When a selection of a crop plant resembles a named variety very closely in its morphological characters it is not desirable that it should be given a new name unless there is some distinct difference physiologically; for instance, higher grain-yielding capacity or better quality of grain.

A few named varieties of winter and spring wheats were grown for observation and to maintain small reference stocks. Opportunity may be taken here to mention that the Society's selection of Iron III. wheat (now known as Scottish Iron III.)

continues to give encouraging results. Last year a grower in East Lothian reported having obtained a yield of 49½ hundredweights (11 quarters) per acre from three acres. This wheat generally grows well at the Plant-Breeding Station, and it is the only winter wheat which is grown in quantity there at the present time. All the available grain grown at the Station in 1942 was sold for seed.

#### BEANS.

The work with beans was continued. About an acre of a selection of Scots Tick Beans and a collection of unfixed types were grown.

#### POTATOES.

*(Breeding and Genetics—Boghall Sub-Station.)*

WILLIAM BLACK, B.Sc., Ph.D.

*(Virus Diseases—Craigs House.)*

GEORGE COCKERHAM, B.Sc., Ph.D.  
C. H. CADMAN, B.Sc., Ph.D.

The productive capacity of potatoes is already high, but losses incurred through the ravages of diseases remain heavy. In attempting to effect varietal improvement it is apparent that progress can be made by breeding into new forms any inherent resistance which is available and thus prevent much of these losses. Consequently the immediate object of the potato-breeding investigations is to combine in good quality varieties a high degree of resistance to blight, field immunity from viruses A and X, and resistance to leaf roll.

True blight resistance is unknown in our commercial varieties, but this desirable quality exists in several wild species indigenous to Mexico. Field immunity from viruses A and X, on the other hand, is present in several well-known varieties, and the nature of its inheritance makes it readily available for incorporating into new types. By utilising these varieties in the experimental breeding for blight resistance, a combination of the characters has been effected. A considerable number of new seedlings in the initial stages of trial have proved to be resistant to blight, field immune from



viruses A and X, and otherwise have shown promise of fulfilling the general requirements of agricultural practice. As regards leaf roll, no absolute immunity has yet been found, but several varieties possess some degree of resistance. Such varieties have been used as parents in the experiments, but so far special tests for leaf-roll resistance in respect of this material have not been initiated.

In previous years a fungus culture of blight taken from a commercial potato crop was used for testing seedlings for their blight reaction. Apparently the fungus is not entirely stable, since a distinct and more virulent strain was developed and isolated from it. The two strains are readily recognised by the reaction of certain potato varieties which are immune from the original or A strain, but which succumb to the more virulent or B strain. Both strains were used in the 1942 series of tests, involving about 5000 plants, and it is significant that all the seedlings which were immune from the B strain were also immune from the A strain. Resistance to the two strains A and B was found to be controlled by two dominant genes designated Ra and Rb respectively.

A satisfactory proportion of the experimental material proved to be resistant to both strains of the disease. This material included progenies bred from *S. tuberosum* varieties and a 48-chromosome hybrid derived with difficulty from *S. Rybinii* ( $2n = 24$ ) and *S. demissum* ( $2n = 72$ ). A feature of these progenies was the exceedingly high degree of fertility encountered, reaching 100 per cent in some cases, which should prove invaluable for future breeding purposes.

The economic potentialities of the wild and cultivated Andean species have been further investigated. Much information has been accumulated regarding their cytological behaviour and their intercompatibility, as well as their reaction to the A and B strains of blight. Various hybrid progenies were raised, bringing the total of new seedlings raised in 1942 to over 7000.

Seedlings raised in previous years were grown in trial and multiplication plots at Boghall and Craigs House, and some were also included in the trials at the Midland Agricultural College, Loughborough. In addition, two blight-resistant seedlings were grown in comparative trials in Lincolnshire, where their cropping capacity proved to be high. One of these seedlings will be further multiplied in 1943.

Tests of tubers of a number of blight-resistant seedlings were carried out in co-operation with the National Federation of Fish Friers Ltd. Reports received were very encouraging, most of the samples when fried comparing favourably with those of Kerr's Pink and Golden Wonder. Certain members of the Federation have taken an enthusiastic interest in the breeding of improved varieties of potatoes, and they have emphasised the need for high-quality varieties possessing resistance to blight.

One acre of Craigs Defiance was grown for seed at Boghall in 1942, and the crop gained a Stock Seed Certificate. From this crop 4 tons 6 cwt. of tubers were sold as seed. About half an acre will be grown for seed in 1943.

A Stock Seed Certificate was also obtained in respect of the quarter-acre crop of Alness grown in 1942.

#### *Virus Diseases.*

The search for characters of virus resistance among the collection of wild species in the custody of the Station forms an increasingly important part of the work on virus diseases. In the current year 118 clones of 29 species have been submitted to infection with virus Y and the leaf-roll virus, and a number of clones have been re-examined for their reactions to grafting with scions carrying viruses A, B, C, and X. The existence of positive resistance to each of these viruses is suggested by the repeated failure of certain clones to accept one or other of them. A third unrecorded but suspected virus has been located within the wild material. Indication has been obtained that one of the earlier suspected viruses is transmissible by the aphid *Myzus persicae*.

The genetical study of leaf-roll resistance and the attempt to combine this resistance with field immunity from viruses A, B, C, and X was continued by the exposure of seedling progenies to attack with the leaf-roll virus. Foundation breeding for the addition of blight resistance to this combination has been carried out.

The genetics of field immunity from viruses A and X have received continued attention through the collection of data from some 1800 seedlings, many of them replicated by cuttings, upon the amount of recombination between the genes Na and Nx. In further studies upon the inheritance of field immunity

from viruses B and C it has been found that the variety President is duplex for the gene Nc.

The nature of polyploidy in the cultivated potato raises a problem of fundamental importance in the interpretation of genetical data and in the synthesis of breeding stocks for special purposes. Two aspects of this problem are being followed, the genetical aspect in a close study of the inheritance of the Na, Nb, Nc, and Nx genes, and the cytological aspect in correlated work upon the same material on the behaviour of the chromosomes at germ-cell formation. This latter work has been greatly facilitated by the provision of essential equipment by the Agricultural Research Council, to whom thanks are due. Other genetical work in this connection has dealt with chlorophyll deficiencies, and plant and tuber colours. Three types of chlorophyll deficiencies have been found among sixteen seedling progenies. Their segregations have given indication of tetraploid inheritance. Studies of plant and tuber colours have been begun in the hope that selection for field immunity on the basis of linked phenotypic characters may eventually be possible.

Aphis populations throughout the season have been the smallest so far recorded. The arrival of winged spring migrants was observed in mid-June, but the subsequent increase of apterous forms was exceedingly slow. A population maximum of 200 aphides per 100 leaves was reached in mid-August, at which time the autumn migration began. A preliminary study of the influence of predators and parasites on aphis populations has been initiated.

Seedling progenies were raised for test in 1943, and breeding requisite to the needs of the various investigations was carried out with moderate success.

#### HERBAGE PLANTS.

J. W. GREGOR, Ph.D., D.Sc., F.L.S.

J. M. S. LANG, B.S.A. (*resigned 12th December 1942*).

It is believed that, even in districts little suited to the usual forms of arable cropping, the cultivation of grass as an arable crop ought still to prove a practical proposition, and, as reported in 1941, emphasis has been transferred from the breeding of 'permanent' pasture components to the relatively

less expensive and more productive constituents of arable grassland.

In the preliminary reclamation trials conducted by the Society at Ainville, Midlothian, the use as a grazing nurse crop of the oat variety 'Sandy' gave very satisfactory results. On the other hand, a small trial carried out last year at Inveroran, Argyll, has shown that, where conditions are less favourable to the growth of oats, rye can be used with advantage. Investigations, however, indicate that the choice of the rye variety is important. For instance, 'winter' varieties when spring-sown tend to produce more herbage than do 'spring' varieties—that is, plants which remain in the vegetative stage throughout the seeding year will, in all probability, make the best grazing. By no means all 'winter' varieties are pure for this desirable characteristic, and efforts are accordingly being made to obtain races of the required type.

Another plant which may prove useful as a grazing nurse crop is Missouri Early Beardless barley. When autumn sown it makes rapid vegetative growth, and has proved to be winter-hardy at Corstorphine; its employment as a nurse crop for autumn-sown 'seeds' is certainly worth a trial. Seed for trial purposes is being multiplied this year by the Society. Some late varieties of oats are also being examined. For instance, a small sample of a very late variety received from Dr Carson of the Cambridge Plant-Breeding Institute was grown at Corstorphine last summer. Sown on the 24th March, it produced a large amount of leafy herbage and did not flower. The plot was left over the winter in the hope that a seed crop would be obtained in the following season, but all plants succumbed before the spring. Although possessing the characteristics of a good grazing nurse crop this variety unfortunately cannot be multiplied on a commercial scale in Scotland.

A feature of the Society's direct re-seeding trials at Ainville in 1939 was the competitive superiority of the seedlings of ryegrass over those of other sown species. Since that date a number of ryegrass varieties, ranging in their maturity times from very early to very late, have been bred. Not all of these have as yet been multiplied in sufficient quantity to allow of their inclusion in field trials. The further breeding of ryegrasses has been limited temporarily, and in the meantime all available facilities are being utilised for the multiplication of those varieties already obtained.

Arrangements have now been made for carrying out the necessary trials under the conditions of direct re-seeding on two acres of derelict pasture land near Balerno, which have been kindly lent to the Society for the purpose by Mr William Crawford, Mid-Calder. The importance of variety trials as part of the breeding programme is obvious, and hardly needs to be emphasised.

One of the most serious hindrances to the introduction of late varieties of perennial ryegrass at a cost comparable to that of early varieties is the relatively low yields of viable seeds obtained per acre. That these low yields are not necessarily a matter of the late varieties having a low flower production is evident from the results of flower counts. At Corstorphine seed yields are adversely influenced by attacks of *Helminthosporium* spp. fungi which over-winter on the leaves, and may in certain circumstances break out in epidemic intensity at the time the spikes appear. The result is that flowering stems are ringed, and seed production accordingly suffers. Moreover, many of the seeds which do develop are themselves infected, and are thus potential carriers of the disease. Another disease which affects seed yields and viability, though usually to a less extent, is the one known as 'Blind-seed Disease.' So far no varieties of ryegrass are known to be immune from either of these diseases. The life-histories of both these disease organisms, and possible control measures, are being studied at the Phytopathological Laboratory of the Department of Agriculture for Scotland, and acknowledgment is gratefully made to the staff of the laboratory for their willing co-operation with the Society in trying to solve these seed-production problems.

*Multiplication of Stocks.*—Perennial Ryegrass: *Ca* 457 (early), *Ca* 448 (2nd-early), and *Ca* 434 (late); Cocksfoot: *Cc* 196, a re-selected stock of the variety *Cc* 180; Timothy: *Cb* 213 (pasture-hay), *Cb* 224 (hay), and *CbA* 141 (pasture); and Meadow Foxtail (a stock from Blythe, Lauder) are in process of multiplication. The following varieties of ryegrass will be multiplied for trial purposes as soon as facilities permit: *Ca* 457(a), *Ca* 458, *Ca* 460, and *Ca* 462.

*Experimental Taxonomy.*—The experimental study of the hereditary constitution of wild populations (of *Plantago maritima* mainly) in relation to environment has been suspended for the duration of the war. An endeavour will,

however, be made to keep alive some of the experimental material. The results of work done at the Plant-Breeding Station and at other institutes, especially in America, Russia, and Sweden, in connection with the ecotypic differentiation of populations (*i.e.*, heritable differentiation occasioned by the selective action of the environment) are believed to have, in addition to their interest from a purely theoretical point of view, a definite application to grass breeding. It is now recognised that ecodemes—*i.e.*, populations occurring under specified habitat environments, have, as a rule, hereditary constitutions specially adapted to these habitats, and accordingly are valuable sources of breeding material. One of the most significant features of this work from the practical standpoint is the unpredictable reactions of ecodemes when transferred from one kind of environment to another. This emphasises, as stated by Clausen, Keck, and Hiesey, California, "the need for test stations located in environments generally similar to those in which the crop is to be grown."

With the temporary limitation of the breeding work with grasses, and as the new grazing trials are not yet established, it was found possible for the members of the staff engaged on herbage work to continue the broccoli investigations started two years ago. An account of the progress of this work is given elsewhere in this report.

## ROOT CROPS.

(*Swedes and Kales.*)

V. M'M. DAVEY, B.Sc., Ph.D.

J. M. S. LANG, B.S.A. (*resigned 12th December 1942*).

Various methods of selection and propagation of root crop plants are being examined. Swedes, which are unusual in being potentially self-fertile, have been bred for a number of generations by seeding plants singly in pollen-proof bags in order to determine whether the method is of practical value for obtaining new or improved strains or varieties.

*Propagation.*—Methods of storing swede plants intended for breeding have received attention during the unusual winters of the last few years. Selections were made in duplicate, and one of each pair was transplanted in autumn into

the propagation plot, while the other was set in sand in a cold frame. In the winters of 1939-40 and 1940-41 the outdoor plants were mostly destroyed or badly damaged by frost. The winter of 1941-42 was also severe, but nearly all the swedes in the propagation plot survived, though they looked extremely unhealthy in the spring. The duplicate set from the frames had large shaws when transplanted in March, and for a while they made more vigorous growth and commenced flowering earlier than the others. During a dry period in the summer, however, the tables were turned in favour of the autumn-planted swedes, which had evidently established better root systems. They flowered steadily and gave good yields of well-ripened seed, but those planted in spring began to fail, and many died before their seed was fully formed. After the mild winter of 1942-43 the autumn-planted swedes looked very healthy, with only 1 per cent loss, whereas dry-rot caused damage to some of the plants in the frames. It may be concluded, therefore, that planting in autumn is the more satisfactory method of wintering, except in unusually severe winters.

*Cultivation.*—In 1940 and 1941 the swede crops at Craigs House had suffered the full force of the ravages of the Swede Root Maggot (*Phorbia floralis*). It was therefore decided to transfer the swede trials to Boghall Experimental Farm, Midlothian, in the hope that the pest had not reached that area, and that it might be reduced at Craigs House by the absence of swedes there. An acre was sown out with swedes at Boghall, and good crops were obtained, but *Phorbia* was found to be present, though not in overwhelming numbers. The light stony soil and higher elevation of Boghall afforded instructive contrasts with the cultural conditions of Craigs House. The shaws were larger on the whole, and some lines usually considered deficient had adequate foliage, but this may have been a seasonal effect. The bulb shapes were rather poorer than usual, and the amount of colour was in general different, though lines still showed the relative differences in intensity that was expected of them. Selections were made at the end of the season and brought back to Craigs House for propagation.

*Swede Pedigree Breeding.*—A group of Purple-top strains of swede derived from intervarietal crosses was grown in 1/44 acre plots. They were examined by members of the Roots

Sub-Committee, and it was decided to continue work on about half a dozen of them. Pedigree lines bred by self-fertilisation of single plants from original selections taken from commercial varieties were also grown. This material embraces most of the types found in cultivation, and has been used for crossing.

Attempts to breed swedes resistant to finger-and-toe disease were continued, using seedlings grown in trays of infected soil. Slight differences have been noted between strains, but so far no plant showing a high degree of resistance has been isolated.

*Other Root Crops.*—Small plots of Thousand-headed Kale were grown at Corstorphine, and observations were made. Kales are not at present being propagated at Craigs House, in order to avoid contamination of the Broccoli crop. Two strains of mangold obtained by seeding groups of selected plants in natural isolation were grown in small plots. The roots conformed to the types selected, but bolting was so pronounced that they were not considered worth further breeding.

*Hybridisation.*—Interspecific crosses were made between Kale, Rape, Swede, and Turnip with various degrees of success. Marrow-stem Kale  $\times$  Rape proved highly incompatible, and only aborted seeds were obtained from a considerable number of hybridisations.

## VEGETABLE CROPS.

### *Broccoli.*

The particular importance of the broccoli crop lies in its ability to mature at a time when other vegetables are scarce—namely, in the spring and early summer. In our view the main problems requiring attention are: (1) to determine which of the numerous varieties of heading broccoli are most capable of yielding reliable crops in Scotland; and (2) to determine whether it is necessary to investigate the possibility of raising the degree of winter resistance of the hardiest varieties now available.

*Variety Trials.*—Samples were arranged in replicated plots, and the data obtained from records taken throughout the growing season were treated statistically. The 1941-42 trials



covered eighteen commercial varieties. The heterogeneous nature of some of them was very marked; indeed, in respect of some characters the variability within varieties actually exceeded that between varieties. Moreover, strains of the same variety from different sources differed very considerably not only in appearance but also in winter resistance. The method adopted for estimating winter resistance was to assign to each plant one of five grades, Grade 1 indicating no apparent damage, Grade 2 slight damage, and so on up to Grade 5 denoting dead or very severely damaged plants. Plants in Grades 1 and 2 were considered for practical purposes to be winter resistant, and on this basis very striking varietal differences occurred. For instance, all plants of the variety Royal Oak, 28 per cent of plants of Late Angers, and none of the plants of the variety British Roscoff were placed in Grades 1 and 2. St George and May Blossom, two varieties which mature earlier than Royal Oak and Late Angers, also proved to be relatively winter hardy, with, respectively, 83 per cent and 96 per cent of plants in the two resistant grades. It is interesting to note that in Mr Hall's broccoli trials at Cupar, Fife, where winter conditions are as a rule more severe than those at Corstorphine, Royal Oak, St George, and May Blossom headed the list for winter resistance. Of 320 plants planted, Royal Oak had 9 per cent deaths, St George 12 per cent, and May Blossom 21 per cent.

*Breeding.*—Through the co-operation of Mr Hall some of the very few plants of Royal Oak and St George which survived the exceptionally severe winter of 1940-41 with comparatively little frost damage were transferred for breeding purposes from the Cupar trial grounds to Corstorphine. Several selfed and crossed lines have been obtained from this material, sixteen of which were included in the Society's 1942-43 trials. Commercial samples of Royal Oak and Late Angers were used as controls. Although differing considerably in their economic value all the lines withstood the winter without damage. Notwithstanding the mildness of last winter Late Angers showed appreciable frost injury—injury which was later accentuated by the spread of *Botrytis* from the damaged leaf surfaces. The best of these lines have provided parent plants for further breeding work.

*Seed Production.*—Last autumn a seed crop of Late Queen was successfully harvested at Corstorphine. From less than

a quarter of an acre a yield of 1.25 cwt. of seed (germination 96 per cent) was obtained. This season a similar area of a line bred from the Cupar 1940-41 Royal Oak selections is being grown for seed.

### *Savoy Cabbage.*

Savoys are not at present being seeded on a field scale, because only one member of the cabbage tribe can be seeded in isolation at the Station and preference has been given to broccoli. A small trial was laid out, however, to determine the most suitable times for sowing savoy cabbage in this district. Three varieties were used which had proved winter-hardy in the varietal trial of 1941-42, and each was sown on (1) 15th April, (2) 15th May, and (3) 15th June. About 150 plants of each variety were transplanted on (1) 5th June, (2) 15th June, and (3) 23rd July. All three sowings matured at the same time in spring, but there were marked differences in yield. The diameter of the closed head was measured in November, when Ormskirk Late Green averaged (1) 12.2 cm., (2) 11.0, and (3) 6.0; Ormskirk Extra Late (1) 13.1 cm., (2) 11.8, and (3) 6.6; and Alexander's No. 1 (1) 10.7 cm., (2) 10.8, and (3) 6.5. Thus the third sowing gave very small plants, and the first sowing was best, except in Alexander's No. 1. In February the diameters had increased evenly by one or two centimetres, but many of the third sowing plants which had not formed solid heads had by then opened out, and indeed most of this sowing was unmarketable.

### *Carrots.*

About 1000 roots of Early Market (red-cored) carrots were grown for seed in 1942. The core colour in this stock is not completely fixed, and a small proportion of yellow-cored plants is found. As there appears to be no way of determining the core colour without damaging the plant, a number of suitably shaped roots had the tips cut off, and from these 100 were selected to provide a better stock for future seeding. Damage due to rotting during winter storage was more frequent in these, but a number survived, and this lot was seeded in a separate plot. The main selections were made on outward

appearance, and they yielded twenty-eight pounds of dressed seed, while one and a half pounds were obtained from the specially selected plants. The seed was carefully rubbed and dressed, and the results of the official tests were respectively: (1) purity 98.7 per cent, germination 82 per cent; and (2) purity 99 per cent, germination 85 per cent.

About a quarter of an acre was sown with Early Market (red-cored) carrots. The carrot-fly, however, caused much damage in the crop, and only a comparatively small quantity of roots (about 200) was suitable for selection as seed parents.

#### *Curled Cress.*

A small plot of curled cress was grown and seeded. The cabbage-root fly caused some damage, but about thirty pounds of seed—99 per cent purity and 74 per cent germination—was obtained.

#### *Leeks.*

Three thousand leek plants of the variety 'Musselburgh' were seeded in 1942. The experiences of 1941 were repeated. The plants flowered freely and showed promise, but seed set slowly, and fungous diseases caused many of the fruits to abort and shrivel up. The heads were harvested about the end of September, and they were dried during the winter in a heated and well-ventilated room. The seed when threshed and dressed amounted to about three pounds, with purity 91 per cent and germination 56 per cent. Climatic conditions had again been unfavourable, and this made the seed crop practically a failure.

Seedling leeks were raised in quantity, some being transplanted for seeding and the remainder sold.

#### *Onions.*

On about a quarter of an acre White Lisbon onions were grown for seed. The plants survived the winter satisfactorily and produced flower heads freely. Weather conditions, however, in late summer and early autumn were unfavourable

for the setting of seed, and at the end of the season it was evident very little had been formed. Some of the heads which had the appearance of bearing a few seeds were harvested and carefully dried, but examination later revealed that only small shrivelled seeds had been produced, and that none of them was fit for sowing.

### *Peas.*

An acre was sown with Peter Pan peas. Seed from the previous crop raised at the Plant-Breeding Station was used, and it was treated with a disinfectant dust. A good crop was obtained, and the plants were harvested early in August so as to prevent, as far as possible, the germination of the seeds in the pods during wet weather. The crop was secured in good condition by drying on tripods before stacking, and the peas were ready for threshing about the end of December. A yield of 16 cwt. of apparently good seed was obtained. Since weather conditions prior to harvesting were favourable to the spread of *Ascochyta*, a fungus causing 'foot-rot,' a sample of the threshed peas was sent to the Plant Pathology Service, Department of Agriculture for Scotland, for examination. The pathologist's report showed that infection had been heavy, amounting to 65 per cent. The percentage germination of the seed was only 54. The peas were therefore unfit for use as seed, and they were sold for feeding.

The experiment on the growing of peas amongst spring wheat was repeated. Although the peas were treated with a disinfectant dust before sowing, many of the plants failed to develop, and the amount of seed obtained was just about equal to that which had been sown. While the yield was low it was of interest to find that in this crop there was only 12 per cent *Ascochyta*.

## II. Publications and Lectures by Staff for the Year ended 31st March 1943.

Publications (P) and Lectures (L).

C. H. Cadman, B.Sc., Ph.D. :—

"Autotetraploid inheritance in the potato: Some new evidence." *Journal of Genetics*, Vol. 44, pp. 33-52, 1942. (P.)

George Cockerham, B.Sc., Ph.D. :—

"Potato breeding for virus resistance." *Association of Applied Biologists*, London. 9th October 1942. (L.)

J. W. Gregor, Ph.D., D.Sc., F.L.S. :—

"The units of experimental taxonomy." *Chronica Botanica*, Vol. VII., September 1942. (P.)

"The future of sub-marginal arable land." *Scottish Journal of Agriculture*, Vol. 24, No. 1, 1942. (P.)

J. M. S. Lang, B.S.A. :—

"A trial of broccoli varieties in Scotland." *Scottish Journal of Agriculture*, Vol. 24, No. 2, 1943. (P.)

## III. Visits.

Director of Research and V. M'M. Davey, B.Sc., Ph.D. :—  
Sugar Beet Demonstrations at Boarhills, Fife.

C. H. Cadman, B.Sc., Ph.D. :—

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