

SCOTTISH SOCIETY FOR RESEARCH
IN PLANT-BREEDING

REPORT

BY THE

DIRECTORS

TO THE

ANNUAL GENERAL MEETING

20th July 1944



1944

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SCOTTISH SOCIETY FOR RESEARCH IN
PLANT-BREEDING.

REPORT.

THE Directors of the Scottish Society for Research in Plant-Breeding have pleasure in submitting the Twenty-third Annual Report to members of the Society.

In looking forward to post-war developments in agriculture and horticulture the Directors appreciate the fact that plant-breeding will be one of the applied sciences expected to make a contribution towards increased efficiency in agriculture by producing improved varieties of crop plants. It is realised that, in order to achieve the desired results as quickly as possible, plant-breeding work must be undertaken on a more extensive scale than has been possible in the past. The Directors are convinced that if more land, more laboratory and storage accommodation, more equipment and more staff were available, the rate of progress would be accelerated. Consideration is therefore being given to the problem of expanding the Society's activities, and a beginning in that direction has already been made by endeavouring to effect a greater degree of collaboration in experimental work with the Agricultural Colleges in Scotland and with the Macaulay Institute for Soil Research. It is well known that a specially urgent problem related to plant-breeding is to devise improved methods of testing new strains of grasses under grazing conditions in different parts of the country, and in demonstrating the value of their special characteristics to farmers. With these important considerations in view the Society's Herbage Sub-Committee recently invited representatives of the three

Agricultural Colleges in Scotland and the Macaulay Institute for Soil Research to attend one of their meetings to discuss problems relating to grass trials. The invitations were readily accepted, and a helpful discussion resulted. Certain grass trials have been arranged on as large a scale as is possible at present, and the Society has agreed to spend a sum not exceeding £450 on these grassland trials.

The question of the Society's acquiring more land at East Craigs has been considered, and it has been decided that additional land at East Craigs should not be acquired during the present emergency, but that the option which the Society holds on land there should be extended until after hostilities cease.

The scarcity of housing accommodation in the district is a factor limiting the amount of labour that can be obtained for the Society's field work, and the question of erecting houses for workmen is receiving attention.

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 in August to assist as temporary inspectors under the Department's scheme for the inspection of growing crops of potatoes.

Dr C. H. Cadman, assistant in the section dealing with virus diseases of potatoes, resigned his post as at 31st October 1943 on his receiving an appointment on the staff of the East Malling Horticultural Research Station.

Financial.

The accounts as audited at 31st March 1944 show that the Society's funds now stand at £47,540, 4s. 8d., as compared with £47,369, 3s. 8d. at 31st March 1943.

The Society's ordinary income in 1943-44 was about £66 less than that of the previous year, which, it may be recalled, showed an increase of about £190. Sales of produce, which, of course, vary from year to year according to the material available for disposal, show a small decrease. For instance, in the 1942-43 accounts sales of vegetables and vegetable seeds amounted to £230, whereas in the year under review—which was not a favourable one for the production of vegetable seeds at Corstorphine—they amounted to only £115. The amount of grant received from the Department of Agriculture for Scotland was £4200.

The total ordinary expenditure shows a slight increase this year of about £148. There were increases in wages, and labour costs were higher by about £115. On the whole, the other items of expenditure do not differ very widely from those of the year ended 31st March 1943. There was no capital expenditure during the year.

On the assets side of the balance-sheet, items I. to VI. represent fixed assets which are valued on the basis of cost, subject to allowance for depreciation each year, and they amount to a total of £11,490, 15s. 2d. Item VII., amounting to £100, 4s. 6d., represents floating assets reckoned at current market valuation. It will be noted that the Society's liquid assets (items VIII. to XI. inclusive) are substantial, amounting to £36,338, 7s. 7d., the investments in item X. being valued at cost price. The market value of these investments at 31st March 1944 showed an appreciation of £14,288, 13s. 9d. on the cost price.

“ Dr Wilson ” Memorial Fund.

This fund now amounts to £359, 16s. 7d. No payments were made from the fund during the year.

Membership.

The Directors regret to report that in the past year eleven members died. They are pleased to record, however, that

ABSTRACT OF

For the year ended

INCOME.

Interest Received		£1,067 6 11	
Recoverable Income Tax		540 16 8	
		£1,608 3 7	
Sales—			
Ordinary, including Stocks on Hand	£1,096 2 7		
Extraordinary—Cocksfoot Account	30 2 0		
		1,126 4 7	
Subscriptions—Annual		83 0 0	
<i>Note.</i> —Annual Subscriptions amounting to £4, 10s. are in arrear.			
Donations—Sums under £10		14 1 9	
	Total Ordinary Income	£2,831 9 11	
Grant received from Department of Agriculture for Scotland for the year 1943-44		4,200 0 0	
Capital Income—			
Life Membership Subscriptions	£105 0 0		
Interest on Donations and Life Membership Subscriptions (£1628, os. 4d. at 3½ per cent, less Income Tax)	£37 1 0		
Recoverable Income Tax	19 18 7		
		56 19 7	
	Total Income	£7,193 9 6	
Funds at 1st April 1943		47,369 3 8	
		£54,562 13 2	

BUILDINGS AND EQUIPMENT

Balance at 1st April 1943		£226 12 8	
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ACCOUNTS.

31st March 1944.

EXPENDITURE.

Salaries—			
Officers, including Sub-Station			£3,421 12 6
Secretary and Office			338 19 3
			£3,760 11 9
Superannuation Contribution			359 4 10
Labour, including Sub-Station			1,564 8 4
National Insurance			36 7 8
Seeds and Roots			11 10 0
Manures			163 14 6
Working Expenses, including renewals of Implements and Tools			202 5 9
Laboratory Expenses			32 1 4
Library Expenses			48 2 1
Rates and Insurances			88 12 3
Printing, Telephone, Postages, and Office Supplies			112 8 5
Heating, Lighting, and Cleaning			121 5 2
Travelling Expenses			49 0 2
Property Repairs			12 13 8
Regional Trials			19 11 1
Special Regional Grass Trials			94 16 0
Sub-Station Maintenance Expenses			119 16 3
	Total Ordinary Expenditure		£6,796 9 8
Depreciation on Temporary Buildings, Implements, Tools, &c.			225 18 10
	Total Expenditure		£7,022 8 6
Funds at 31st March 1944, per Balance-sheet			47,540 4 8
			£54,562 13 2

—FIRE DAMAGE.

Sum on Deposit Receipt at 31st March 1944		£226 12 8	
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DISTRIBUTION OF MEMBERSHIP

As at 31st March 1944.

Aberdeen	15	Linlithgow	7
Angus	22	Midlothian	54
Argyll	8	Moray	2
Ayr	17	Nairn	—
Banff	2	Orkney	3
Berwick	15	Peebles	3
Bute	1	Perth	21
Caithness	1	Renfrew	5
Clackmannan	—	Ross and Cromarty	9
Dumbarton	4	Roxburgh	9
Dumfries	11	Selkirk	1
East Lothian	27	Stirling	6
Fife	23	Sutherland	1
Inverness	2	Wigtown	5
Kincardine	1	England	11
Kinross	4	Abroad	3
Kirkcudbright	3		—
Lanark	31		<u>327</u>

ESTABLISHMENT FOR 1943-44.

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Assistant, Potato-Breeding Sub-Station—WILLIAM BLACK, B.Sc., Ph.D.,
Boghall.
Assistants, Virus Disease Scheme—GEORGE COCKERHAM, B.Sc., Ph.D., and
COLIN H. CADMAN, B.Sc., Ph.D., Craigs House, Corstorphine.
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R E P O R T

BY

DIRECTOR OF RESEARCH

I. Research Programme.

In plant-breeding work many of the problems are of a long-term nature, and although there has been little change in the programme in the year under review, certain developments that have taken place are worthy of mention.

Pasture problems in this country have come prominently to the fore during the war, and they have aroused keen interest. The increase in productivity that can be obtained by ploughing up old worn-out pastures, by adequately manuring the soil, and by re-seeding direct has been demonstrated by various workers on pasture problems. From comparisons of the botanical characters of different strains of herbage plants it would seem that there are possibilities of further improvements being effected by the production of better strains of plants for growing in pastures. Various new strains of grasses are already available, but there are farmers and seedsmen who would like to have some practical evidence that these new strains are more profitable to grow than commercial strains. The comparison of grass strains in a pasture on the basis of financial returns, however, is far from easy. It presents many difficulties, and they are accentuated, under war-time conditions, by the scarcity of staff and labour. Nevertheless, it has been decided that attempts to make further progress in comparing grass strains should be made without further delay. As mentioned in the Report by the Directors, the Society's Herbage Sub-Committee agreed to request the help of the three Agricultural Colleges in Scotland and the Macaulay Institute for Soil Research, Aberdeen, in arranging grass trials, and this request was readily acceded to. A meeting of the Sub-Committee was held in January 1944, and it was

attended by representatives of the Colleges and the Macaulay Institute. In the course of a full and interesting discussion various speakers expressed views to the effect that there was an urgent need for information as to whether the special characteristics of the new strains of grasses had a cash value to the farmer. With a view to getting as much and as accurate information as possible in the present circumstances relative to this point, trials have been arranged in the West of Scotland College area and also in the North of Scotland College area, and seeds mixtures containing the Society's strains and other strains have been sown. It has not been possible to obtain a suitable field in the East of Scotland College area this year, but it is hoped one will be found and made ready for direct re-seeding in 1945. This joint arrangement with the Colleges represents a decided advance, and a very hopeful line of collaboration has been initiated.

The field experimental work at the Plant-Breeding Station is being restricted to some extent by the scarcity of labour, which is, of course, unavoidable at the present time. But the difficulties in securing workmen have been increasing in the last few years through lack of housing accommodation in the district, and before any expansion of the work at Corstorphine or at Boghall Sub-Station can be undertaken the problem of obtaining additional suitable workmen will require to be carefully considered.

A review of the work for the year ended 31st March 1944 follows.

GRAIN CROPS.

WILLIAM ROBE, *Director of Research.*

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

Oats.

Work on the oat-breeding problems referred to in the previous Annual Report was continued; further hybridisations were made, and many individual plants were selected from unfixed progenies for future breeding. The collection of fixed hybrid selections was increased by the addition of several new lines which now appear to be uniform in type. The lack of full-scale multiplication and trial-plot facilities,

on account of war-time conditions, is retarding the comparison of new productions on a field scale. Small nucleus stocks of all the promising fixed selections are being maintained so that they can be multiplied and tested under field conditions as soon as circumstances permit.

As a result of more favourable growing conditions the oat crops at the Plant-Breeding Station in 1943 were heavier than they were in the previous few years. The plants were taller, and those selections which were more susceptible to lodging revealed this defect, and could be eliminated on that account. Several selections showed a high degree of resistance to lodging, and therefore merit further trial for comparison of yields, grain types, and dates of maturity.

Progress is being made in the breeding of an oat of the cultivated type which shows resistance to prompt germination at harvest-time. For example, from certain plants derived from crosses with the wild oat and having the ordinary cultivated form of grain, none of the seeds germinated when, shortly after being harvested, they were placed in moist sand and kept there for a period of thirty days. From other plants of the same cross there were varying proportions of seeds showing prompt germination, thus indicating segregation for this character. In the preliminary stages of selecting plants attention is also being given to shape and size of grain and quality of straw. The wild oat has long, weak straw, and this characteristic, of course, is not desired.

Elite stocks of Early Miller and Bell oats were grown for seed, and the grain met with a ready sale. It would seem that Early Miller oats are being grown in increasing quantities south of the border. There has been a demand from certain parts of England—viz., Yorkshire, Lancashire, and Cheshire—for seed of this oat, and, according to information received, the demand from the South in the last two years has greatly exceeded the supply of Scottish seed available.

Wheat.

In view of the continued favourable reports regarding crops of the Society's selection of Iron III. wheat, the Directors of the Society decided in 1943 that some differentiation should be made in the name of this stock. It was therefore agreed

that this strain should now be known as "Scottish Iron III." A stock of this wheat has been grown at the Plant-Breeding Station for a number of years with satisfactory results.

Barley.

The variety of barley, Reference No. B8(8), selected at the Plant-Breeding Station from an ordinary stock of Common Barley, with the object of obtaining an improved line adapted to conditions in the North of Scotland, continues to give very satisfactory results in that area. A new grower who obtained seed from the Station for sowing in 1943 states :—

"We have now received in the produce from our B8(8) barley. It has grown almost 28 cwt. an acre, which, under the circumstances, we consider very good. We are struck with the proportion of small barley, this being very low. We have only some 6 per cent dressings altogether. The sample is very nice. . . ."

In the earlier trial stages it was observed that this barley had a considerable amount of resemblance to the variety known as "Gold." It was therefore decided, before giving the selection a name, to ask the National Institute of Agricultural Botany, Cambridge, to examine it and say whether it was sufficiently distinct from Gold to be given a different name. The Cereals Synonym Committee of the National Institute of Agricultural Botany agreed to examine the selection, and it has been under observation at Cambridge for two seasons. A report from Cambridge regarding this barley has been received, and it states :—

" . . . The Cereal Synonym Committee has made a close comparison of the barley selection B8(8) with the variety Gold. They are agreed that in view of the definition of a synonym adopted by the Committee, if a new name was to be given to this selection it could not be declared a synonym of Gold."

Following consideration of this report, the Directors of the Society decided that this selection of barley should be known as "Craigs Triumph."

BEANS.

It has become evident that a considerable amount of natural inter-crossing may occur among varieties of field beans when they are grown in small plots in close proximity to each other. In order to reduce the frequency of cross-fertilisation, different selections of beans are now being grown spatially isolated in winter wheat crops, in which the beans grow and pod moderately well.

Two selections from an early maturing Russian variety have been increased in quantity, and they are being tried at the West of Scotland College Farm, Auchincruive, Ayrshire, this year. The earlier ripening selection was ready for cutting at Corstorphine on 6th August 1943, whereas the ordinary crop of a variety of Scottish field bean was not ready for cutting until about a fortnight later.

POTATOES.

(*Breeding—Boghall Sub-Station.*)

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

The potato-breeding work is directed mainly towards producing improved varieties by incorporating as far as possible blight resistance, field immunity from viruses A and X, and resistance to leaf roll with other desirable qualities possessed by the best cultivated varieties.

During 1943 over 8000 new seedlings, obtained from twenty-four hybridisations, were raised and tested for resistance to blight. All the parental combinations contained the blight-resistant character, most of them field immunity from viruses A and X, and a substantial number resistance to leaf roll. The pollen parents used were selected largely from derivatives of the triple hybrids of *S. Rybinii*, *S. demissum*, and *S. tuberosum*. The elimination of blight-susceptible seedlings was effected while the plants were still young, but tests for virus reactions must be delayed until the numbers have been greatly reduced by several years' selection in the field.

The breeding of seedlings, in which blight resistance and field immunity from viruses A and X are combined, presents no unusual difficulties. These characters are, in genetical

terms, inherited in a dominant manner, and, provided they are present in one or other of the parents, a proportion of the progeny will inherit them. But the number of other characters desired in a new variety is large, and practically all of them are obtainable only in a heterozygous condition. It is therefore necessary that large numbers of seedlings should be grown in order that as many as possible of the full range of combinations of characters may have a chance to appear. Progress must necessarily be slow until it is possible to handle the requisite size of progenies.

In the routine test for blight resistance, the common strain prevalent among cultivated varieties was used. For particular purposes other strains have been employed, but it has not been practicable to use them for large-scale testing, concurrently with the common blight. The appearance of different strains of blight presents a problem in the utilisation of new resistant varieties. Much information regarding strains is necessary to ascertain the effect of the introduction into commerce of varieties which are immune from some strains but not from others. It is possible that such varieties might act as host plants for the propagation of new and more virulent strains of blight, which may or may not be detrimental to potato varieties in general.

S. polyadenium, which is blight immune and is very repulsive to greenflies, probably has greater disease-resisting properties than any other potato species. Numerous attempts to use it in hybridisations have failed except in one instance, when it was successfully crossed with a species hybrid plant in 1937. Since then, cultivated varieties and other species have been introduced into the pedigree, but fertility has been low and the characteristics of the seedlings have been mainly wild.

Selections of seedlings raised in previous years were grown in trial and multiplication plots at Boghall and Craigs House. Most of these selections were resistant to blight, and some were also field immune from viruses A and X. The crossing of Craigs Defiance with various blight-resistant seedlings contributed substantially to the numbers in this group. Several seedlings showed considerable promise in the trials in comparison with standard varieties, yielding heavy crops of tubers of good quality.

A number of seedlings were included in the trials at the Midland Agricultural College, Loughborough, in 1943. Several

which are immune from the common strain of blight gave promising results in comparison with standard varieties, and these will be further multiplied in 1944.

Crops of the Alness, Craigs Defiance, and the blight-resistant seedling, Reference No. 653a(99), were grown for stock seed at Boghall.

Further additions were made to the collection of Mexican and South American potatoes maintained at Boghall. The investigations concerning the economic potentialities of the collection, the intercompatibility of the specimens, the genetics of certain characters, and the cytology of species and species hybrids were continued.

Virus Diseases—Craigs House.

GEORGE COCKERHAM, B.Sc., Ph.D.

C. H. CADMAN, B.Sc., Ph.D. (resigned 31st October 1943).

The systematic examination of old and new cultivated varieties, promising seedlings, and South American forms of potato for their reactions to individual potato viruses has been continued. Viruses present in the material have impeded progress in the examination of the collection of South American forms, and it has been necessary to make inquiry into the nature of these viruses, their physical properties, modes of transmission, and their relationships with the common viruses of the potato. Each of these suspected new viruses has been transmitted by graft and by sap inoculation, but no transmission by the aphid *Myzus persicae* has been confirmed. One new virus appears to have close affinities with virus Y, whilst a second is either closely related to virus X or is invariably associated with a strain of virus X.

The study of resistance to leaf roll has been advanced by submitting seedlings which have withstood infection in the field over a number of years to infection through graft unions and infestation with infective aphides. Many seedlings accepted the virus under the more stringent tests, but some emerged from all tests in symptom-free condition. Three new progenies likely to yield seedlings combining field immunity from viruses X and A with resistance to leaf roll were raised and entered into the field trials.

The gene determining hypersensitiveness to, and hence field immunity from, virus X has been used to investigate the nature of polyploidy in the cultivated potato. Correlated cytological work on the same material has been carried out, and the combined data, being complementary, should throw useful light on a complex situation. Other genetical work has been directed towards the elucidation of linkage relationships and the synthesis of virus-resistant breeding stocks.

Fluctuations in aphid populations were again followed throughout the year. A trap for sampling winged populations was erected in spring, and daily collections were taken until 30th September. Winged aphides were first collected on 17th May, coincident with a marked rise in temperature. Thereafter they appeared in moderate numbers, varying with weather conditions, throughout May, June, and July, but from the beginning of August onwards they were relatively few in number. Upon potatoes wingless aphides increased rapidly from the beginning of June, to reach an early but rather low maximum of 700 per 100 leaves in mid-July. This peak was followed by a rapid decline which began during a very warm spell, 25th July to 1st August, and coincided with a marked peak in the numbers of winged potato aphides on the trap. It is clear that a migration from potatoes to alternative hosts was the chief cause of the decline. An increase in the numbers of parasitised aphides during the period of decline suggests that parasites were probably effective in preventing a secondary infestation such as has been observed in previous years. By early September the numbers had fallen to the low value of 12 per 100 leaves.

HERBAGE PLANTS.

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

The time has now arrived when the testing under different agricultural environments of varieties raised by the Society is of no less importance than the breeding work itself. In fact so long as the number of varieties awaiting multiplication and trial remains at its present level it is actually inadvisable, in the absence of artificial isolation, to multiply more nucleus stocks in the open plots.

The growing appreciation that there is no clear line of demarcation between plant-breeding and other grassland improvement operations indicates the advisability of widening the Society's herbage programme, so as to cover some aspects of grassland investigation which have hitherto been left entirely to the agronomist. In initial variety performance trials such as those being conducted by the Society at Dalmahoy, Midlothian, any kind of treatment and sampling technique is permissible, provided it is capable of presenting a picture of varietal potentialities. In ultimate tests, however, the treatments and sampling methods adopted must have as their objects the assessing of varietal performance under the environment of a particular agricultural system. It is at this second or ultimate trial stage that co-operation with other institutes engaged in grassland investigations is so desirable.

Direct Re-seeding of Grassland—Grass as an Arable Crop.—From the upland farmer's point of view there are several fundamental problems awaiting solution. For instance, what are the herbage varieties (including grazing nurse crops) best suited to the technique of direct re-seeding? What herbage varieties give the greatest amount of animal food at the required time in a given district? Are the economic returns from arable grass crops greater or less than those from other arable crops in a given district?

As mentioned in last year's report, the Society has acquired an initial trial area at Dalmahoy for the express purpose of assessing varietal attributes under the conditions of direct re-seeding. This area, a very poor *Fescue-Nardus* grassland, was ploughed in December 1942. On 3rd June 1943 different ryegrass varieties in various combinations were sown with a grazing nurse crop of Bell oats mixed with a variety of winter rye. On 20th July—that is, in less than seven weeks—the nurse crop was ready to graze, and ewes and lambs were admitted to the area, though still having access to the adjoining rough grazing. Following a brief rest in early August for the benefit of the nurse crop, grazing was continued with a maximum stocking of sheep until 22nd October.

The question of appropriate grazing nurse crops for re-seeding purposes is one that requires attention, because not only does the nurse crop influence the rate of pasture establishment, but

the time at which grazing in the re-seeding year can be profitably started is largely dependent on the nature of the nurse crop employed. Moreover, it is suspected that when a cereal nurse crop is used there is an inverse correlation between its seed size and the rate of 'seeds' establishment. For instance, the use of small oat grains (seconds) allows the rapid growth of ryegrass at the critical seedling stage. A feature of last year's grazing was the evenness with which the nurse crop was grazed over the entire area. This is an important point in pasture establishment, though not always achieved, particularly when rape is the nurse crop.

The ryegrass varieties combined in the trial mixtures cannot be identified in the field; accordingly, representative plant samples from the trial plots will be examined in culture at Corstorphine. This technique should allow of the frequencies of the mixture components being assessed with some degree of accuracy, and so provide competition data relating to the quick-developing, early, and the slow-maturing, late varieties under different grazing intensities. Such data is required for correlating varietal frequency with yield. In order to make possible the obtaining of yield data, the Director of the Seed Testing Station has kindly lent the Society a motor mower.

Next year it is hoped to establish jointly with the Edinburgh & East of Scotland College of Agriculture a grassland trial centre in an upland area, where the grazing animal will be used as the criterion of varietal performance.

Trials in the North and West of Scotland.—As a result of the meeting between the Colleges and the Society, the North of Scotland College has undertaken to compare the performance of the Society's Cocksfoot, *Cc 196*, with English-grown Danish, and the Society's Perennial Ryegrass, *Ca 448*, with Ayrshire Perennial. In addition, a comparison is to be made between the production of a commercial 'seeds' mixture and (1) a mixture of bred strains of Cocksfoot and Perennial Ryegrass, (2) a mixture of bred strains of Perennial Ryegrass only, and (3) a plot of Cocksfoot and Ryegrass in which the individual strains have been sown separately in strips.

The West of Scotland College has undertaken to compare the relative merits of a mixture of commercial strains of Cocksfoot and Perennial Ryegrass and (1) a mixture of early, mid-season, and late-bred varieties of Cocksfoot and Perennial

Ryegrass, and (2) a plot of the same bred varieties sown separately in strips.

Seed-borne Diseases of Ryegrass.—Acknowledgment is gratefully made to the staff of the Phytopathology Laboratory of the Department of Agriculture for Scotland for their willing co-operation in attempts to obtain disease-free stocks of ryegrass seed. These investigations are continuing.

Multiplication of Stocks.—14 acres of Cocksfoot, *Cc* 196, have been seeded for the Society by the Essex Seed Growers' Association, and excluding the seed retained for trial and further multiplication, 12 cwt. have been disposed of to members of the Society. Several varieties of Perennial Ryegrass and Timothy now in the 'initial' multiplication plots at Corstorphine will be multiplied for trial as soon as facilities permit.

In addition, 2 acres of Timothy, *Cb* 224, are being grown for seed in Stirlingshire, as well as 1 acre of Perennial Ryegrass, *Ca* 448, 1 acre of Timothy, *Cb* 213, and 1 acre of Cocksfoot, *Cc* 196, in Ayrshire.

ROOT CROPS.

(*Swedes and Kales.*)

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

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. By this means a collection of types approaching true-breeding condition have been obtained, while other material from hybridisations is being examined and selected in an attempt to breed improved strains.

Propagation.—The seed harvest of 1943 was one of the best obtained at the Station. Parent plants grown outside during the mild weather were in very good condition; while those transplanted from frames in the spring made fairly good growth. A gale of exceptional violence in May caused damage by stripping off the bags which are put over the flowering shoots to prevent cross-pollination, but this was later remedied, and a comprehensive stock of seed of all lines was obtained. The

winter of 1943-44 has not been quite so favourable, but the seed parents appear healthy on the whole.

Cultivation.—An infestation of the Station fields by *Phorbia floralis*, the swede root fly, had become so serious in 1940 and 1941 that the trials were removed in 1942 to the sub-station at Boghall, Midlothian. During that season no first-year swedes were grown on the 30 acres of the Corstorphine Station, but crops were raised on neighbouring farms. A longer absence might have been beneficial, but transport difficulties made it necessary to bring the trials back to the Station in 1943. The maggot was by no means absent, though considerably reduced in numbers. In September it was estimated that about 10 per cent of the plants were damaged, but later observations showed that most had been attacked by one or more maggots, though the damage was not great, and really bad infestations were rare.

Swede Pedigree Breeding.—The swede trials were reduced to about one acre to provide space for more important war-time crops, so that only one plot of each of the many experimental lines could be included. Lines are formed by making an original selection of a plant from a commercial crop or from a segregating generation of a cross, and self-fertilising it. A plot of the progeny is grown, and another selection made for propagation. This process is carried out each generation, but as it may often happen that more than one plant is selected, groups of related lines arise which may be regarded collectively as strains. The plots were arranged according to these relationships. The pedigree material originated from plants of commercial varieties, and some of the lines which had been bred for five to ten generations formed part of the collection of types. Others, of most recent origin, had been chosen for their possible value, and two of these were outstanding in 1943—viz., a large soft purple-top, DNe, and a hard purple-top, CHo. The hybrid lines were chosen originally from the second or segregating generation of an intervarietal cross. There were some which had been bred for a number of generations, and were beginning to show uniformity of type. They had been kept to see whether promising characters which they had previously displayed would be inherited. Most of the lines, however, were of recent origin, and were still unfixed. Good plants were selected from the best of these lines. To provide new lines for future examination selections were made

from large plots of the second segregating generation of crosses. Selections were also made from all lines thought worth propagation. In addition to selection for feeding value, various swede characters were still being studied, particularly a type of plant combining the swede bulb with a curly leaf, obtained from a natural cross, probably from one of the kales of the swede family.

Winter Resistance.—At the wish of the Roots Sub-Committee part of the swede trial ground was left unpulled till February for observations of winter resistance. In general, the 'hard' types stood the winter best, but there were cases of poor resistance among lines of both 'hard' and 'soft' types. In some lines the majority of the plants rotted at the neck, though this occurred in small proportions of most of the lines. A few plants suffering from soft rot were found in most plots, more in some than in others. Dry-rot was rarely observed, and there was very little finger-and-toe disease. The bulb weight was large this year, and in consequence the dry-matter percentage, which was estimated on each plot, was very low. The 'hard' lines never exceeded 11 per cent, while the 'soft' types were not much over 9 per cent. Despite the frequent short spells of frost, the winter was fairly mild and did not afford a rigorous test of hardiness.

Breeding of other Root Crops.

The New Zealand Department of Agriculture has, by selection or breeding, produced strains of Brassica crops which have gained considerable attention in that country. Samples of these grown for observation included one swede variety, strains of giant and dwarf rapes and an interesting hybrid between them, and two strains of Marrow-stem Kale, one tall and stemmy and the other shorter and leafy. A few kales of the Station breeding were also observed, particularly strains of the flat-leaved type of Thousand-headed Kale.

Perpetual Kale.—A stock of perpetual kale is kept to provide cuttings. Flowering is evidently very rare, for it has occurred only twice. Plants showing various degrees of vigour were obtained from seed of self-fertilised flowers. Perpetual kale belongs to the cabbage tribe, because seed was readily obtained from crosses with Marrow-stem and curly

kales, which happened to be the only plants flowering at the time. The hybrid with curly kale is certainly very leafy, and is being kept to see whether it has the perpetual characters, or, if it flowers, whether good perpetual types can be obtained from it.

Radish.—An Asiatic form of radish which is potentially capable of forming a heavy-yielding crop was grown under conditions of swede culture. All the plants flowered during the summer, and the 'roots,' when these were formed, were found to be too deep in the soil. Unless more suitable types can be bred from it, there seems little prospect of using this plant as a crop in this country.

VEGETABLE CROPS.

Broccoli.

Breeding.—The breeding has as its object the extension of the range of successful broccoli cultivation northwards into areas where vegetable growing is as yet little developed. Efforts are being concentrated on raising hardy May and June varieties for northern use. So far as Scotland is concerned, the main problem would seem to be one of raising the degree of winter hardiness, although varietal reactions to other climatic factors may also require investigation.

Variety Trials.—The 1942-43 trials were concluded after the 1943 Report went to press. A progeny trial was laid out to test the offspring of certain broccoli plants, which, almost alone, had survived the severe winter of 1940-41 in trials at Cupar and Edinburgh. Broccoli is usually self-sterile, but self-fertile plants can be found. Two of the strains under test were from self-fertile plants, and one yielded well, but was disqualified on account of purple colour which occurred in the curd. Two other strains were grown from the seed obtained by selfing almost self-sterile plants, and these progenies were complete failures. The remainder of the progenies were obtained by hand-crossing pairs of plants of similar maturity, and in most cases of the same variety. One strain, 9:3, derived from two typical Royal Oak plants was out-

standing in the trial. This May maturing strain had large compact heads, and gave the highest yield; the curds were free from purple colour, and the plants resisted the winter well. The other strains in the trial were not outstanding. Some showed very good winter resistance, but were deficient in yield, while others showed purple in the curd which was inherited from certain of the parent plants. Breeding work for winter resistance continues.

Date of Sowing Trial.—Another trial in 1942-43 dealt with dates of sowing broccoli. Seed was sown on 15th April, 15th May, and 15th June, the last sowing being transplanted at the time the early potatoes were lifted. Two varieties were used, an early strain of Late Queen and Midsummer. In both, the April sowing gave the best yields, and the June sowing was a relative failure, with part of the crop forming 'buttons.' When growth slowed down in late autumn the May sowings had not achieved the size of the April sown plant, and the June sowings were definitely undersized. Late Queen headed in March and April, and its May and June yields were reduced to four-fifths and a quarter respectively of the April yield. But Midsummer benefited by eight more weeks of mild weather before heading, and the May sowing was as good as the April, while the June sowing yielded about half.

Regional Trials.—An eight-variety trial has been laid down this year at three centres—Corran Garden, Onich, Inverness-shire; Meadow Croft, Roy Bridge, Inverness-shire; and Corstorphine. Particular attention will be given to winter resistance and to the quality and yield of curds in these three districts. Grateful acknowledgment is made to Mr R. W. Paine of Corran and to Mr Andrew Cree and Mr Murdo Millen of Meadow Croft for their helpful co-operation.

Seed Production.—The strain 9 : 3, a selection of Royal Oak which was outstanding in the 1942-43 trial, was seeded in 1943 in a quarter-acre plot, and another crop of it has been grown for seeding in 1944. In 1943 wet weather set in when the curds were about to break, with the result that *Botrytis* attacked many of the curds. The yield of the crop was thereby considerably diminished. Nevertheless half a hundred-weight of seed, purity 99.2 per cent and germination 95 per cent, was obtained in good condition, and this was sold as Scottish-grown Royal Oak.

Savoy Cabbage.

Savoys were planted in spare pieces of ground among the trials, and, later, others were transplanted to fill vacant land caused by the failure of a carrot crop. The early transplants yielded fair crops, and notes were taken on three strains which were used, but the later transplants failed to head. Thus the results of the 1942-43 sowing date trial were confirmed. Savoys are not being seeded at the Station, because only one member of the cabbage tribe can be seeded there, and preference is given to the broccoli.

Carrots.

The carrot-fly has increased to such an extent on the Station land that crops are seriously damaged when grown in the field. Plants of a red-cored variety were again kept for seeding in 1943, but after making fair growth in the spring they rotted in the root, and very little seed was obtained.

Leeks.

For the third time attempts were made to seed Musselburgh leeks in 1943, and once again the ripening period was spoiled by wet weather, which favoured the spread of fungoid diseases in the flowering heads. The seed crop was practically a failure, only about 2½ lb. of seed being obtained, having a purity of 91.9 per cent and a germination of 58 per cent.

Peas.

The experiment to ascertain the possibilities of growing peas among spring wheat for seed was continued in 1943. Onward peas, reported to be practically free from *Ascochyta pisi*, were sown among Atle wheat. This is a short-strawed wheat which stands well, and the wheat plants supported the peas satisfactorily until the peas began to ripen. At this stage the pea plants began to fall to the ground, and a proportion of the seed was lost. The crop was then cut by the binder before the wheat was ripe, and it was stacked

eighteen days later in excellent condition. Both the wheat and peas kept in good condition in the stack, and they were threshed in January. The yield of peas was low, only $1\frac{3}{4}$ cwt. of peas being obtained from one acre. Although there was wet weather at harvest-time the colour of the peas was tolerably good. After threshing, broken seeds were removed by hand, and a sample of the cleaned seed was submitted to the Plant Pathologist of the Department of Agriculture for Scotland, East Craigs, Corstorphine, to be examined for seed-borne diseases. This examination showed that 36 per cent of the seeds were infected with *Ascochyta pisi* and 10 per cent with *Botrytis*, and consequently they were not suitable for seed. Even although the haulms of most of the plants had been supported and kept off the ground by the wheat plants during the growing season this had not kept the seeds as free from disease as had been expected. Possibly in a more favourable season there would be a smaller amount of seed-borne disease present, but the results of trials in the last three seasons suggest that the growing of peas for seed under the soil and climatic conditions prevailing at Corstorphine is scarcely a practicable proposition.

Tomatoes.

A small field trial to compare hardiness and frost resistance in the Russian tomato varieties Bizon and Stambovoi alpatyev and the variety Essex Wonder was brought to an end by the death of every plant in the trial after exposure to a temperature of 25° F. during the night of September 26-27. Stambovoi alpatyev gave indication of being slightly more hardy during the early stages of growth and of having slightly greater resistance to frost in its fruits than either Bizon or Essex Wonder.

II. Publications and Lectures by Staff for the Year ended 31st March 1944.

Publications (P) and Lectures (L).

W. Black, B.Sc., Ph.D.

"Inheritance of Resistance to Two Strains of Blight (*Phytophthora infestans* de Bary) in Potatoes." Trans. Roy. Soc., Edinburgh, Vol. LXI., Part I., No. 4, pp. 137-147. (P.)

W. Black, B.Sc., Ph.D., and George Cockerham, B.Sc., Ph.D.

"Some modern aspects of Potato Production." Trans. Highland & Agric. Soc., Scotland, 1943. (P.)

C. H. Cadman, B.Sc., Ph.D.

"Nature of tetraploidy in cultivated European potatoes." Nature, Vol. 152, p. 103. (P.)

G. Cockerham, B.Sc., Ph.D.

"Potato breeding for virus resistance." Ann. appl. Biol., Vol. 30, pp. 105-108. (P.)

"The reactions of potato varieties to viruses X, A, B, and C." Ann. appl. Biol., Vol. 30, pp. 338-344.

J. W. Gregor, Ph.D., D.Sc., F.L.S. :—

"The Ecotype." Biological Reviews, Vol. 19, 1944. (P.)

"The application of Agricultural Research: Plant Breeding." Conference of The Association of Scientific Workers, Edinburgh, 4th December, 1943. (L.)

"Ecotypes and subspecies." The Botanical Society of Edinburgh, 16th March 1944. (L.)

A. M. Smith, D.Sc., and William Robb, N.D.A., F.R.S.E. :—

"The Carotene and Protein in Oats and Barley at different stages of growth." Journ. Agric. Science, Vol. 33, pp. 119-121. (P.)

III. Visits.

Director of Research :—

Craibstone Experimental Farm, Aberdeen.

National Institute of Agricultural Engineering, Askham-Bryan, Yorks.

Plant-Breeding Station, Cambridge.

National Institute of Agricultural Botany, Cambridge.

William Black, B.Sc., Ph.D. :—

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V. M'M. Davey, B.Sc., Ph.D. :—

Sugar Beet Demonstrations near Cupar, Fife.

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Findlay, W. M., Craibstone Experimental Farm, Bucksburn, Aberdeen.

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Neptune Mills, Ltd., Leith, Edinburgh.
Runcieman, William, Castleton, King-Edward.

WILLIAM ROBB,
Director of Research.

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