

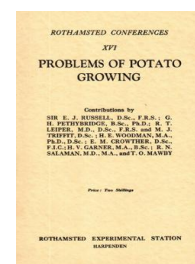
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The Raising of Blight-resistant Varieties and Virus-free Stocks

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THE RAISING OF BLIGHT-RESISTANT VARIETIES AND VIRUS-FREE STOCKS

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Blight-Resistant Varieties

THE possibility of raising potato varieties which shall be resistant to *Phytophthora infestans* has interested me for a great many years. In 1910 I showed that such resistance was to be found in the hybrid species *S. edinense*, and that it behaved as a Mendelian recessive factor. One of these seedlings retained its immunity to blight for 21 years, during which time it was allowed to grow without disturbance in a kitchen garden. In 1914 I introduced the species *S. demissum* into the breeding experiments, and found that it exhibited a complete resistance to blight. Crosses were made with domestic varieties, but the war put an end to the work. In 1922 crosses were again made between *S. demissum* and domestic varieties, and the generations derived from those original crosses are being bred to-day in the Potato Virus Research Station, Cambridge, under the care of Miss C. O'Connor who has taken over the greater part of the practical side of the work. As a result of prolonged breeding and selection from these original crosses, we have obtained seedlings which exhibit a very high resistance to the common blight of the field and at the same time possess good economic qualities. In this connection it should be remembered that *S. demissum* is everything that a potato should not be: in our climate it bears no tubers, it has stolons 6-10 feet long, and it is so late that it flowers right on into the winter, hence selection and back-crossing to suitable domestic varieties with continuous testing for susceptibility has been essential in order to combine resistance and economic worth.

In 1931 we found, as did Müller and others in Germany, that the blight fungus *Phytophthora infestans* can itself develop strains whose power of infectivity may be different from that of the parent fungus. We have, in fact, encountered a strain which so far is not prevalent in the potato fields, but which will attack certain of our resistant seedling varieties. This of course is disappointing, but Miss O'Connor has countered it by finding a Peruvian variety which is immune both to the new and the original strains of *Phytophthora infestans*. We are now interbreeding the two resistant stocks and have obtained a fresh set of seedlings some of which are resistant to both strains of *Phytophthora infestans*. Whether they will be resistant to others which may yet be evolved, waits to be seen. The difficulty which

may arise from the possible existence of manifold strains of the invading fungus should not be exaggerated, for it by no means follows that in this climate all these new forms will be able to thrive and spread as has the common form against which our stocks are already resistant.

We have found that the ordinary domestic varieties and their seedlings exhibit no resistance to artificially produced attacks of blight, and very little if any to attack in the field, so that it is essentially amongst wild varieties that we must seek for the gift of resistance. That potato varieties resistant to the common strain of blight can be produced is an indisputable fact ; that we shall produce in the near future a variety resistant to such other strains of *Phytophthora infestans* as are likely to become widespread in nature is, I think, highly probable.

The work necessary for the achievement of this goal is arduous and has already involved considerable private expenditure. The Potato Trade, which one would imagine might be interested in the problem, has neither assisted nor encouraged those who are striving to counter its attacks, and the Government is unprepared to risk even a couple of hundred pounds a year to insure against a scourge which not only costs the country on the average something like £5,000,000 a year, but to whose action most of our political troubles in Ireland may be directly traced.

Virus-Free Stocks

The production of stocks of potato varieties which should be free of virus disease was one of the original tasks of the Potato Virus Research Station, and one which has been successful to a greater degree than was anticipated when the work started.

It should be noted that not all varieties respond in the same manner to the attacks of the various virus diseases we know of. Thus an attack of the "X" virus kills an Epicure straightway, seriously affects a King Edward, but has little—often no—effect on most other varieties. Paracrinkle, which is present in a latent condition in every King Edward, produces in such varieties as Arran Victory and Arran Chief an almost fatal disease. The "Y" virus, which is the most widely destructive and easily communicated of all the viruses, will ruin more or less completely nearly every variety grown in this country ; yet there is a variety called Kathadin which can to a great extent retain its vigour, notwithstanding its infection. Thus we see that the potato is a plant which on the one hand is peculiarly liable to virus infection, and on the other exhibits in a remarkable degree the capacity to act as a "carrier," i.e., plants of certain varieties which, though impregnated throughout their tissues with a potentially virulent disease germ, display no clinical symptoms suggestive of its presence.

The aim of the Potato Virus Research Station has been to secure

stocks of varieties which are entirely free from virus infection ; in this it has succeeded in great measure.

Thus we have stocks of the following varieties in which no critical tests, so far known, have demonstrated the presence of any virus :

Abundance	Arran Victory	Great Scot
Arran Banner	British Queen	International Kidney
Arran Cairn	Catriona	Kerr's Pink
Arran Chief	Champion	King George
Arran Comrade	Di Vernon	Majestic
Arran Consul	Duke of York	May Queen
Arran Crest	Eclipse	Ninetyfold
Arran Pilot	Epicure	Sharpe's Express
Arran Scout		

In some varieties, after testing a very large number of sources, we are obliged to content ourselves with stocks which, though vigorous and healthy in their appearance, nevertheless, do " carry " a virus ; such are :

King Edward	..	which carries the Paracrinkle virus
Irish Chieftain	..	" " " " " A " virus
Golden Wonder	..	" " " " " A " "
The Baron	" " " " " X " "
Uptodate	" " " " " X " "

In order to secure a clean stock of any variety, immature tubers are taken from the healthiest-looking plants on which no sign of disease can be observed, grown in the best seed-producing areas of Scotland and Ireland, during the month of June. The tubers are kept till the next season and cut in halves, one half is grown outside in an observation plot, the other in a pot in an insect-proof house. If the former displays definite disease before the end of June, then the whole unit is discarded ; if it does not, then the glasshouse plant is tested for the presence of virus infection by grafting scions to a number of healthy test varieties, and also by inoculating its sap into tobacco and *Datura* seedlings. If the tuber unit reacts negatively to all these tests, then the glasshouse pot is harvested and the seed tubers preserved throughout the winter in an insect-free store, and in the following season sufficient pots are planted to establish an adequate glasshouse stock and the remainder is planted in isolation in the field.

Testing of each proved variety is repeated each season, nuclear stocks of which never leave the shelter of the insect-proof glasshouse and store ; in this manner the virus-free stocks, once won, are maintained indefinitely.

The outside plots are grown in complete isolation in cornfields ; they are never planted nearer than half a mile to any other potatoes, and the individual plots are separated by 120 yards one from another. These plots are visited several times in the season and rigorously rogued if necessary, but as the seed is virus-free, no infection is eve:

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seen till late in the season and such plants are removed at the earliest possible moment.

Seed from the outside plots is available for farmers and seed-producers and should be used for raising further seed under similar conditions of isolation. In this way we have raised in the neighbourhood of Cambridge and Barley, stocks of potatoes which have left the protection of the glasshouse two, three and four years. The stocks acquire some virus disease in the second and subsequent years, but very little, if any, in the first year. A large number of statistically planned yield tests of the material grown outside have been made as against best Scotch seed, and in nearly every case the Cambridge stocks, even in their third year from the glasshouse, have proved themselves superior.

There is no doubt that seed which is virus-free gives a healthier stand and a far higher yield than ordinary commercial seed. If seed raisers were to avail themselves of the material that the Potato Virus Research Station can offer them, and use it in the manner advised, they would most certainly raise larger and better crops. The ideal which is being aimed at is that the best seed-growing area, whether in Scotland or elsewhere, should be planted with the best available seed, and such seed we possess in Cambridge. It should not be difficult to effect a co-operative arrangement of this nature but, in fact, few if any raisers appear ready to take the trouble to renew their stock seed and work it up to the necessary bulk in the manner advocated.

POTATO GROWING IN LINCOLNSHIRE

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THE first thing to consider in planning an acreage of potatoes is the crop after which the potatoes are to be grown. There are various rotations of cropping, here are some of them :

Wheat—Sugar Beet—*Potatoes*. Wheat—Peas—*Potatoes*. Oats—Wheat—Sugar Beet—*Potatoes*. Wheat—Mustard—Winter Tares—*Potatoes*. Wheat—Winter Beans—*Potatoes*.

The land has now to be cultivated. As soon as the corn crop is in the stack it is usual to work the stubble in order to destroy any weeds. The land is left in this state until the middle of November. (In some cases where the field needs it a dressing of about 12 loads of farmyard manure is applied per acre.) The field is now deep ploughed to a depth of between 10 in. and 12 in. and sub-soiled a further 6 in. to 8 in.

The land is then left in this form until the spring. If the winter has been mild or wet, it is probably necessary to drag the land before levelling with the harrows, but usually and particularly after a severe winter, it is only necessary to use heavy harrows before