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DETERIORATION IN THE POTATO

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Deterioration in the Potato

It is safe to assume that every potato grower of experience appreciates the fact that seed potatoes from certain districts are more productive than those from others, and that this difference is in some way associated with the soil and climatic conditions of the districts from which such seed originates. Thus in Great Britain crops grown in the southern counties of England degenerate far more rapidly than those grown in Scotland, and this observation has led to an extensive trade in Scottish seed. We have in New Zealand somewhat comparable circumstances in that potato crops grown under the cool summer climatic conditions of Southland, parts of Otago, and the elevated foothills of Canterbruy, deteriorate far less rapidly than crops grown on the plains, and it follows that seed derived from these cooler and elevated districts is likely to be more productive than that raised elsewhere.

A closer examination of the position reveals astonishing differences in productivity even between seed harvested on neighbouring farms. For example, 90 lines of Dakota seed collected from farmers in Canterbury, and grown in one field for comparison, revealed differences in yielding capacity ranging from two tons to 12 tons an acre. The fact that some were profitable and others entirely unprofitable, is a matter of extreme importance to the farmer, and it is vital that he should appreciate the causes which so markedly affect cropping power, and know the means by which he can avoid the purchase of unproductive seed.

Virus Diseases

Degeneration in the potato is almost entirely the result of disease in one form or another. The most serious is a group collectively known as the virus diseases, the economic significance of which is to reduce the yield of tubers. The symptoms of virus disease are to be seen in the foliage. Most of the names of the diseases are descriptive of the symptoms produced on the leaves.

"Leaf roll" causes the leaves to become rigid, and the leaflets roll upwards and inwards, giving them a funnel-shaped appearance. These leaflets are crisp and rustle when the plant is disturbed, while at harvest time the parent tuber has not rotted. All degrees of infection occur. The reduction in yield is in proportion to the degree of infection shown.

In "mosaic" the leaflets are mottled with pale green patches instead of being uniformly green, thus giving rise to the descriptive name "mosaic." The symptoms are recognised most easily in the shade, and, in fact, they are to a very large extent masked in hot, sunny weather. Frequently associated with mosaic is a crinkling of the leaflets, or the margins of the leaflets are waved. In more extreme cases the plant assumes the symptoms of "crinkle," in which the plants are dwarfed and the leaves very crinkled and turned downwards.

In "stipple streak" dark angular spots arise on the leaves and spread down the veins of the leaflets to the mid-rib, while in "spindle sprout" the tuber sprouts are weak and spindly.

Since the classification of these diseases is still a matter of controversy we need not go further into their description. Sufficient has been said, however, to enable an observer to detect them in the field, and since the symptoms are modified by climate, and plants are not infrequently infected by more than one virus, the grower would be wise to regard as virus-infected any plant with abnormal foliage development of the nature described.

Spread of Virus Disease

Virus diseases are not of recent origin, although it is only during the last 10 or 12 years that there has been a full appreciation of their significance and of the drastic effect on yield. As far back as 1778 references are to be found to the losses occasioned by "curl." The agents for the distribution of virus are very widespread.

In the growing crop these agents are certain species of green fly. which. in most crops, may be observed on the under-side of the potato leaves. Allied forms cause the damage known as "blight" in rape and similar crops during a hot, dry summer. They multiply very rapidly and crawl, fly, or are blown from one plant to another. Should these insects have been living on a diseased plant and drawing the sap therefrom, they will, on being transferred to another plant, transmit the infection during the process of feeding. In the absence of green fly there is virtually no transmission in the field. The spread of virus disease may be regarded as directly proportionate to the number of diseased plants serving as centres of infection, the number of insects available to carry out the distribution, and the earliness of the infestation. Late infection may not extend to the tubers in time to be carried over from one season to the next.

The spread from one farm to another may to some extent be caused by insect transmission, but mainly it will be occasioned by the sale and distribution of infected seed tubers. Such infection cannot be determined by an examination of the tubers, and it follows that the purchaser is in complete ignorance as to the degree of infection in any particular line of seed unless he has had an opportunity of inspecting the crop from which such seed originated, and is capable of identifying therein any virus disease that might be present. The certification of seed potatoes undertaken by the Fields Division of the Department of Agriculture removes this responsibility from the farmer and merchant, and gives them what is virtually a guarantee that if they buy certified seed they will at least avoid the pitfalls that in the past have caused such serious loss. The department not only inspects the growing crop, but collects and grows a representative sample of the seed that is to be planted by the grower, and, by certifying only disease-free seed, is playing a very important part in preventing the spread of virus disease from season to season and from farm to farm.

Precautions Against the Distribution of the Virus Disease

There are other factors of importance to be considered in connexion with virus disease. For example, some varieties carry a masked virus, and although showing no symptoms themselves they nevertheless transmit virus to other varieties. It is important to note that the widely distributed variety Aucklander Short Top (Sutton's Supreme) is such a one, and should therefore not be grown alongside a healthy crop of another variety. In fact, there are so many known and unknown factors playing a part in this connexion that it becomes essential in the maintenance of high quality seed to keep varieties some distance apart.

For some years after a crop of potatoes has been grown, odd plants or "ground-keepers" may appear and become a source of virus infection. The small black-fruited tomato (Solanum nigrum), often called black night-

shade, is a common weed that may also be serious in transmitting virus to potatoes.

No varieties at present on the market exhibit any degree of resistance to both leaf-roll and mosaic, although some are fairly resistant to one or the other, and others are tolerant. Thus Iron Duke may carry a high degree of mosaic infection without the yield being greatly affected, but it is extremely susceptible to leaf-roll.

One factor which plays an important part in the spread of virus disease is the practice of planting small tubers of 2-3 ounces in weight. It is granted that this practice must continue, but nevertheless it should be realised that small tubers may be to a very large extent the product of diseased plants which are incapable of producing anything more than a few seed-sized tubers. On the other hand, the practice of planting large tubers, whether cut or whole, is one to be strongly recommended, as these are likely to be the product of healthy plants.

Harvesting seed while still immature is another means of checking the spread of virus. Such seed should be put into hessian bags and left in the field to green and harden. Alternatively, the seed may be put into shallow trays and the sprouting of seed in this manner is strongly recommended. Seed can be handled quite conveniently in the trays, and when stacked in a shed occupies less floor space and comes out in far better condition than when stored in sacks. Properly sprouted seed will normally yield more than the same seed badly sprouted in sacks and pits, and the rogueing of foreign varieties and diseased tubers such as those showing spindle-sprout is greatly facilitated.

Rogueing the growing crop, that is, removing in the field all diseased plants and those not true to name, is the method commonly adopted to keep a line healthy and pure. One must commence, however, with a line that is sufficiently healthy and pure to warrant rogueing, and a grower who is getting disappointing results is recommended to purchase fresh seed. After coming to this decision he will naturally attempt to sell his discarded line, and purchase new seed. But he must realise that there are other growers also trying to dispose of inferior seed. To protect his own interest he should therefore purchase certified seed. Thereafter, rogueing to maintain and even improve this standard may be quite within his ability in districts not subject to a rapid spread of virus. In districts where in spite of severe rogueing reinfection occurs freely, he will be well advised to rely upon purchase of certified seed from more favoured districts. This may be necessary every few years.

Seed Certification

Two standards of certified seed are available—commercial and mother seed. Certified commercial seed is not eligible for re-entry into certification, but can be expected to give satisfaction. It will suit the grower who finds it necessary to purchase fresh seed at frequent intervals and therefore requires a good line at a reasonable price. Certified mother seed, on the other hand, includes only the best lines, and is eligible for re-entry into certification. Those who intend to make a business of growing certified seed are obliged to purchase seed of this standard.

Certification of seed has undoubtedly had a pronounced and beneficial influence on the potato trade. This is realised by growers and merchants alike. Its national aspect has been reviewed by the Government Statistician in the monthly Abstract of Statistics for September, 1936, in which he says:

"The most striking feature of the table is the superior yielding-capacity of certified against uncertified seed. The superiority in yield an acre in the three principal specified varieties, Aucklander Short Top, Dakota, and Arran Chief, is 28 per cent., 30 per cent., and 18 per cent. respectively. In the very large group of "Mixed and minor varieties" (two or more varieties together) certified seed yielded 28½ per cent. more an acre than uncertified seed. Comparison of the Dominion average yields for "certified" and "uncertified" shows a superiority of the former amounting to 1½ tons an acre, or 25 per cent.

. . . the proportion of "pig" potatoes is noticeably smaller in the case of certified seed."

Details of the certification are available on application to the nearest Instructor of the Agricultural Department.

Varietal Purity

The varietal purity of the potato crop is more easily maintained than is its health. In 1927-28 the position was chaotic and certification was introduced. During the first few years from 25-30 per cent. of the crops entered had to be rejected on account of varietal impurities. In 1932-33 this proportion had been reduced to below 1 per cent., and since then virtually no crops have had to be rejected for this reason. There is, however, one phase which offers difficulties. Some varieties throw a variant known as a "bolter" which is taller, later, produces more flowers, and larger and coarser tubers than the normal. Bolters are commonly found in Epicure and Up-to-date varieties. Many lines of these consist entirely of bolters. In an early variety like Epicure this is most undesirable.

Other Diseases

Regarding the deterioration of the potato crop from a somewhat different aspect, it is necessary to consider diseases caused by agencies other than virus, for while virus is caused by a toxic material or poison in the sap, most of the others are caused by fungi and bacteria.

Very common are those diseases which cause a wilting of the plant. The leaves become flaccid and rolled downwards, differentiating them from the upward rolled, crisp leaves characteristic of leaf-roll. In wilt-infected plants a section across the stem end of the tuber will generally reveal a brown circular ring, and in a section across the base of the stem the woody portion is dark. There are several causes of this condition, notably, wilt (Verticillium alboatrum), blackleg (Erwinia atrospetica), and mattery eye (Bacterium solanacearum). Wilt is the most common and causes a decrease in the yield, while mattery eye and blackleg not only reduce the yield but the tubers become affected with a wet rot. In all cases the tubers may carry the disease, and the soil becomes infected, hence the necessity for the double precaution of purchasing certified seed and adhering strictly to crop rotation.

Frequent also are diseases which cause various forms of scab. These disfigure the tubers and may render them unmarketable. The common scab (Actinomyces) is well known to every grower and as a distinguishing feature it will be noticed that the diseased areas are not depressed. In powdery scab (Spongospora subterranea), the disease is first observed as small conical blisters which, on bursting, liberate the powdery spores of the fungus and leave behind a shallow, saucer-shaped depression, which enables it to be distinguished from common scab. Liming induces conditions in the soil favourable for these two organisms, therefore it is inadvisable to apply lime immediately before a potato crop is to be grown.

Corticium (Corticium solani) may also be included in this series, and appears on the tubers as black bodies which may easily be mistaken for adhering particles of soil. They are not washed off in water, although readily lifted off the surface of the tuber with the finger nail. These particles are sclerotia, or masses of the fungus, which, in the spring, become active and cut back the young sprouts, causing delayed growth and misses.

Still another tuber defect is caused by the eel-worm (Heterodera marioni) which during its life-history enters the tuber and causes wart-like growths that disfigure the tubers and reduce their market value.

In all these diseases crop rotation and the purchase of clean seed offer the most hopeful means of control. Neither will prove successful in all cases, but growers must at all times be on guard against introducing on to clean land such diseases as eel-worm, powdery scab and blackleg.

Finally reference might be made to dry-rot caused by species of Fusarium fungi. Dry rot causes so much loss in pit, storage and in transit that it has become one of the major problems of the potato trade. Although the fungus may be suspected of being present on every farm, and in every line of potatoes, it does not attack the tubers until some bruise or wound on the surface permits its entry. Hence the problem is one of careful handling from digging to the time the tubers are consumed. Careless digging with fork and machine, unnecessary bruising during grading and shipping, are the main causes of loss, and growers would be well advised to keep their sheds and surroundings free from diseased tubers which become a fruitful source of contamination in the case of many of the potato diseases.

Conclusion

It will be seen that the prevention of degeneration is a war against disease in which in certain districts the advantage is well on the side of the disease and in others on the side of the grower. By strict attention to rotation and isolation, by the careful handling of the produce, and above all by the use of certified seed, a great deal of improvement may be effected, and an adequate reward awaits those who are prepared to take these necessary precautions.

Copies of this bulletin may be obtained from the Secretary, Canterbury Chamber of Commerce, P.O. Box 187, Christchurch.

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