

FIGHTING THE BLIGHT

Part 1: One door opens.... The potato was first brought to Europe about 400 years ago. For the first 200 years, the crop increased in popularity over the whole area, providing a welcome new staple for impoverished peasants. The crop was easy to manage because few of the major diseases had been carried along with the early imports of tubers and seed. But disaster struck in the mid-nineteenth century, when the late blight disease swept through Europe, from west to east. This caused enormous damage to communities that had become dependent on potatoes, but it also boosted the embryonic science of plant pathology. A key question was asked - and answered, that the fungus observed on blighted leaves was the cause, and not the effect, of this major disease.

As a result, plant breeders eventually realised the need to introduce blight resistance genes into the European potato pool from countries such as Mexico, where the potato evolved. Early breeding efforts were directed towards introduction of so-called R genes - single blight resistance genes which gave total disease control. The problem, not fully realised at the time, was that each of these single genes gave resistance only to individuals in the population of the blight fungus that carried the corresponding avirulence gene. Any blight fungus individual lacking that specific avirulence gene could grow unhindered on the potato in question. While the new resistant potatoes were being produced and multiplied in breeder's trials, they remained spectacularly resistant. But, as the area of the new varieties increased, the chances of infection by a rare fungus individual able to sidestep the R gene, also increased. As soon as this happened, the blight pathogen population exploded on the resistant variety and it, and the breeder's fortunes, were lost. Many varieties lasted only one or two seasons in commercial use.

The Hungarian hot potato

Two principal approaches were developed to try to deal with this recurrent problem. One was to search for varieties with durable resistance - the kind of resistance which, on a large field scale, remained effective because the pathogen seemed unable to find the answer. Such varieties are uncommon and difficult to breed from. A second approach was to increase much further the genetic diversity of the crosses used in breeding to try to generate resistances that would be less easily overcome.

The state breeding programme of the USSR took this latter approach, apparently on a very large scale. A considerable contribution to this programme was made by a Hungarian, Dr Istvan Sárvári (who became a 'Soviet Scientist of the Year') and his wife. Some twenty-five years ago the Sárvári family, who now have premises at Zirc in Hungary, started their own potato breeding programme. The family programme, now run by the late Dr Sárvári's two sons, concentrated closely, and successfully, on breeding varieties with exceptionally high resistance to late blight. More recently, it was decided to form an international company, Sárpo Kft, based on the Sárvári's potato breeding programme but with partners from Denmark and Scotland.

New Sárpo varieties have been tested under different conditions in several countries, but, so far, only in small plot field trials. Most have shown outstanding blight resistance, delaying epidemic development by weeks or even months. Interestingly, the leaves in the field frequently show, simultaneously, the characteristics of both R genes, or qualitative, resistance, and also quantitative resistance, which is often observed in varieties with durable resistance.

Laboratory tests in Scotland, Wales and The Hungarian Academy of Sciences, Budapest, have confirmed that much of the resistance is quantitative but that some of this is combined with the qualitative R gene resistance. High resistance to tuber blight has also been observed in all field trials and in laboratory tests in Scotland. Remarkably, in addition, some of the lines appear to have good resistance to viruses, nematodes and slugs.

Crop performance

The next questions are how well do the new lines yield, is the blight resistance effective and durable, and how do they taste? During 2001, we ran a small plot trial at Wakelyns Agroforestry to have a first look at the performance of 12 different selections under organic conditions. The blight resistance was dramatic to the extent that these small plots of vigorous green plants could be seen from hundreds of metres away, surrounded by the blighted (or mown) tops of the commercially available varieties. The most susceptible of the Sárpo lines, which was considerably more susceptible than the remainder, reacted similarly to Cara, normally regarded as one of the best varieties currently available. Part of the

reason for the outstanding resistance is the late maturity of the varieties, though the development process indicates that, if necessary, all of the lines could be harvested early.

The two best lines delivered the equivalent of about 40 tonnes per hectare (Table 1), which was almost twice as much as Cara, Verity, Robinta, Nicola or Sante grown in a neighbouring trial, and better than Stirling and other varieties grown in adjacent plots. We cannot forecast whether the resistance and performance will be durable if the lines are grown on a large scale - but the combination of qualitative and quantitative resistances in the lines looks very promising. Table 1. Yields (t/ha) of 12 lines from the Sárpo programme (means of three replicates; standard error 1.09 t/ha) compared with yields from adjacent, unreplicated plots of a range of common varieties at Wakelyns Agroforestry, 2001.

Weed clover

The low yields of the popular varieties were due partly to the blight infection, but another major reason was competition with clover. Following the white clover ley in the previous season, we had left 30 cm strips of clover between adjacent potato beds, hoping that the nitrogen might continue to be available to the potatoes during the growing season. Unfortunately, when the potatoes were at a sensitive stage of early growth and development, the clover was at its most vigorous and competitive. The trial looked wonderful, but the potatoes were suffering. On the other hand, the best of the Sárpo lines, with their continuous vigorous, vegetative growth, out-competed the clover and, presumably, suffered relatively little from competition. These observations help to underline another great potential advantage of these new Hungarian lines for the organic grower - weed suppression. With hindsight, our clover strips had acted as a valuable, uniform weed competition test.

Recently, the Wakelyns team settled down at lunchtime for a comprehensive taste test of the 12 trial lines. Amidst a remarkable flow of new adjectives to describe steamed potatoes, it emerged, with reasonable consensus, that five of the lines were at least acceptable, and two or three of those were definitely attractive.

The Future

There is a concern in Sárpo that their material should be made available for the development of organic and other forms of sustainable agriculture, in all areas of the potato-growing world. To help with such a development, a number of national and international organisations have agreed that a jointly funded Charitable Trust should be formed. Such a Trust would be able to establish a marketing arm to introduce a continuous supply of the best lines into commercial production. Already, some lines have been entered for National List trialling in the UK. One of these lines is also being incorporated into the EU Blight-MOP project, in which EFRC is in partnership with some 13 partners in 6 countries to develop a systems approach to blight control (EFRC Bulletin 56).

The exciting point is that the breeding programme is still highly active and there are many more improved lines coming along. This is excellent positive news at a time when there is great concern about the gradual withdrawal of copper fungicides, the only support available for those growers trying to produce organic potatoes in conditions conducive to early and severe blight epidemics.

There is one cloud on the horizon. When the blight fungus was first introduced into this country, it came in the form of a single mating type - sexual reproduction was not possible for about 130 years, until the second mating type came into Europe in the 1970's. Since then, there has been evidence of increasing variation in the pathogen population, giving rise to the concern that the fungus might now be better able to overcome resistant varieties. So, the oft-repeated lesson is that we certainly need good sources of resistance but we also need good systems of deployment, long rotations, use of many different varieties and appropriate mixtures. In other words, don't let one or two good resistant varieties tempt us back to monoculture - this would almost certainly fail against the blight fungus, particularly when it is sexually active

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