

NEW POSSIBILITIES FOR RESISTANCE TO EARLY BLIGHT AND SOFT ROT

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Introduction

Early blight is a major problem to Wisconsin potato growers. In a normal year, almost 100% of the production acreage is sprayed for this disease between 4 and 12 times/year. This spraying, although costly in both chemical purchased and application expenses, normally provides adequate control of the disease. However, resistant or tolerant cultivars would provide an alternative which could be much less costly.

Early blight is but one of the disease problems facing potato growers. Late blight control (as discussed by Dr. Fry in these meetings) also requires fungicide application if cool wet years such as 1993 are encountered. Also, potato storage problems such as tuber soft rot caused by *Erwinia* species of bacteria, can cause substantial losses. In these cases, resistant varieties could also be very useful.

Wild relatives of potato which grow in Mexico or in South America are often quite resistant to many of the potato diseases common in Wisconsin. As many of these species cannot be crossed with potato, we have been examining ways of incorporating the genes into breeding lines by alternative procedures such as somatic hybridization. By this technique, cells from leaves are stripped of their cell walls and fused with other wall-less leaf cells. In some cases it is possible to grow whole new plants from these fused cells and these new plants can be tested for disease resistances and for potential fertility. We are now at the point of examining a number of these lines in the field at Hancock. This presentation is a report of progress to date with possible early blight resistant lines. In addition, results with potentially soft rot resistant lines are summarized.

Early Blight Tests

Preliminary tests were made in 1990 with progeny from somatic hybrids between *Solanum brevidens* and Russet burbank, *S. brevidens* and potato line PI 203900, *S. bulbocastanum* and potato line PI 203900, and *S. polyadenium* and a haploid line from Merrimack. Since the hybrids represent the sum of two different species, we are designating them as such for shorthand purposes, e.g. *Solanum brevidens* + Russet Burbank. All of the tested somatic hybrids were more resistant than Norland, the susceptible control. Moreover, three hybrids, *S. brevidens* + Russet burbank, *S. bulbocastanum* + PI 203900 and *S. polyadenium* + Merrimack haploid appeared to be among the most highly early blight resistant lines tested. In addition, several sexual

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progeny of the somatic hybrids appeared to retain resistances, indicating that it might be possible to use these materials for breeding resistant potato cultivars.

The resistance of some of the somatic hybrids and their sexual progeny was confirmed in experiments during the summers of 1991 and 1992. Some lines derived from the somatic hybrid, *Solanum bulbocastanum* + potato line PI 203900, appeared to be particularly resistant and this resistance segregated in sexual progeny obtained by crossing the somatic hybrids with the cultivar Katahdin. For example, two progeny of somatic hybrid #J101 showed only 13% infection on August 10, 1991 whereas two other progeny from the same cross both showed 100% and 98% infection on that date. The same four lines were retested in 1992. On August 10, 1992 the two resistant lines showed 11.6% and 4.6% infection respectively whereas both of the susceptible lines showed 100% infection.

The very high resistances seen in some of the lines and the dramatic differences seen in the progeny have encouraged us to determine if the disease resistances can be coupled with reasonable tuber quality and yields. In 1993, a somatic hybrid and lines from three sexual generations derived from two successive crosses with Katahdin and a final cross with Atlantic were compared. Again, some of the sexual progeny were highly resistant whereas others were highly susceptible. One of the highly resistant lines from the third sexual generation outyielded all other cultivars and test lines in the 1993 early blight trial at Hancock. These results encourage us to believe that a line with excellent agronomic properties which also has the new disease resistance from wild *Solanum* species can be obtained. Future tests of progeny lines are being planned.

Soft Rot Resistance

In addition to tests with early blight resistance, we are continuing our studies on soft rot resistance in the somatic hybrids and their progeny. An observation that tuber pieces of the somatic hybrids did not rot in the field led us to examine the somatic hybrids for resistance to this disease (Austin *et al.*, 1988). In laboratory tests, tubers are inoculated with bacterial suspensions and the inoculated tubers are evaluated three days later to determine the extent of rot. In resistant tubers, the inoculum appears to be walled off and infection stopped. In susceptible lines, infection quickly spreads and the whole tuber becomes involved with soft rot.

This test has been used for two different purposes. In the first instance, we have examined sexual progeny of the resistant hybrids to determine if they are resistant. Segregation of the resistance has been observed in the first generation lines with some materials being as resistant as the original somatic hybrids (Helgeson *et al.*, 1993). This result, as with the early blight tests, indicates that progress with breeding soft rot resistant lines may be possible. Three successive backcrosses have been obtained and some highly resistant lines have been obtained.

A second line of investigation involves attempts to obtain molecular markers to aid us in our attempts to obtain disease resistant plants. We have been examining the successive backcross generations obtained for the retention of DNA from the wild *Solanum* species. The hope is that by doing this we will be able to follow the particular traits being sought by a laboratory test so that our field studies can be focussed on obtaining good agronomic properties in a population known to be highly resistant. Being able to know that one has the resistance genes in the lines before going to the field will be highly beneficial indeed. We have made considerable progress in determining the extent of DNA from the wild species which is obtained at each successive step and will be testing a number of these progeny lines soon for resistance to soft rot.

One particularly encouraging result is finding that the early blight resistant line, which outyielded all other lines in the 1993 trials, is also resistant to soft rot. This result indicates that multiple traits from the wild species can be transferred to potato lines and that superior cultivars with several useful disease resistances may be obtained. This superior line (which yields tubers with very high solids) will be evaluated extensively next year and crosses with this line have already been obtained for further selections.

Summary and Conclusions

Over the last several years, a number of tests of somatic hybrids and their progeny have been made. Lines with good yields, high solids and resistance to both soft rot and early blight have been obtained. In one case, all of these properties have been combined in one line. These results indicate that the new disease resistances may ultimately become highly useful for decreasing losses in the field. In addition, the results with early blight and soft rot resistances suggest that many more resistances from the wild species may be tapped in the future. Since there are indications that resistances to various viruses, nematodes and even to late blight can be found in these wild species, they may ultimately prove to be of considerable value to growers.

References

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