Progress Report on Late Blight Research/Activities by the USDA, ARS, Vegetable Crops Research Unit

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The USDA, ARS Vegetable Crops Research Unit received special funding from ARS in 1995 to conduct late blight research based on a joint proposal they had submitted. Brief reports were solicited from each scientist and are compiled here. Clearly, a broad base has been laid for further research in this area. This report encompasses the creation of new hybrids of difficult to use Mexican species through the use of embryo rescue, the evaluation of wild species for late blight resistance, the identification of resistant clones, the import of resistant germplasm, setting up of an electronic information network, study of taxonomic relationships among two diploid Mexican species, and a collecting expedition to Guatemala. This has created a spring board for additional research and support activities for the future.

New Hybrids by Embryo Rescue (Robert E. Hanneman, Jr.)

Last spring, embryo rescue procedures were worked out using a modified procedure based on that reported by Singsit and Hanneman. MS media with sucrose added was purchased as a prepared media. This worked well for rescue of embryos. The procedure was tested both on crosses which were expected to set normal progeny and on those which would not. Over 300 hybrids were obtained in all. With these tools in hand we were ready to launch into a major crossing and embryo rescue project this summer.

Approximately 120 late blight resistant accessions (PIs) were grown at UW Agricultural Research Stations at Hancock and Rhinelander. Haploids, varieties and pollinators necessary for double pollination were also grown at these locations. Pollinations have been made using many of these as males and

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as females. Most of the crossing did not occur until August so there is little to
report other than that embryo rescue has been undertaken for a number of
promising crosses. We are optimistic that we may have the unique hybrids of
the Mexican diploid species that we are hoping for. No one has been able to
generate these hybrids successfully on any significant scale. If we are
successful, we will be the first to do this. This material is highly resistant to
late blight and to several other diseases and pests and should be an excellent
new source of germplasm—a new germplasm pool to be tapped. Numerous
crosses that are expected to succeed were also made with resistance PIs, so
these should generate potentially useful materials as well. We have also used
some of the clones that Dr. Havey was able to identify as being resistant as
parents. They will form the core of our crossing and embryo rescue efforts
this fall and winter.

Once we are sure that we have the unique hybrids sought, Dr. Havey will
evaluate them for late blight resistance. The resistant hybrids will form the
essential materials for use in the molecular studies for mapping and marker
assisted selection work as well as for enhancement. We are optimistic about
the success of the project based on these preliminary results.

Evaluation of Wild Species (Michael J. Havey)

Potato lines were evaluated for resistance to the potato late blight fungus
(Phytophthora infestans) using a technique modified from Tooley. Isolates of
P. infestans were obtained from W. R. Stevenson, Department of Plant
Pathology, University of Wisconsin. Both the A-1 mating type (US 1 isolate)
and the A-2 mating type (US 8 isolate) of the fungus were used. The abaxial
(bottom) surface of an 18 mm leaf disc was inoculated with 2000 sporangia
(spores) applied in a 10 ul droplet. In some experiments less than the desired
amount of sporangia was applied due to poor sporulation of the fungus. The A-
2 isolate produces fewer spores than the A-1 isolate. In a test of three
commercial cultivars the two susceptible to A-1 were 96 to 100 percent
infected, the three susceptible to A-2 were 34 to 65 percent infected.
Twenty-three plant introductions (PIs) were evaluated for resistance to the A-1 mating type and 22 PIs to the A-2 type. The fungus did not sporulate on any of the PIs. Evaluations were from three experiments. In the first experiment, four PIs were tested for A-1 resistance. The four lines used as controls were 25 to 50 percent infected. The second experiment checked 19 PIs for A-1. The three cultivars used as controls were 75 to 83 percent infected. Resistance to A-2 was checked in the third experiment with 0 to 25 percent of the three controls infected. Inoculum used was 75, 50, and 15 percent of desired level, respectively, in the three experiments.

The PIs tested for resistance to the A-1 mating type were 243505, 243504, 243506, 243508, 243510, 243512, 275192, 225661, 275236, 161158, 161178, 195166, 205510, 230490, 239410, 283064, 283065, 283095, 184774, 186553, 186554, 275233, 275234. The same PIs were tested for the A-2 type, except 283095 which died.

Collection and Characterization of Accessions of Promising Resistant Species (David M. Spooner)

Molecular characterization of diversity in the U. S. germplasm collection of *Solanum bulbocastanum* and *S. cardiophyllum*. These two diploid Mexican species have natural resistances to late blight. There is much diversity among them, however, that led to confusion regarding their taxonomic treatments and phylogenetic relationships. Fifty-two accessions of these species, and *S. pinnatisectum* (outgroup), were characterized for variation in chloroplast DNA, single copy nuclear RFLP's, RAPD's and morphology. It was discovered that each species has three natural groups of diversity within them that correspond to traditionally recognized subspecies. One of these subspecies, however, *S. cardiophyllum* subsp. *ehrenbergii*, is very distinct. It has the chloroplast DNA of *S. pinnatisectum* and its close relatives, yet nuclear DNA more similar to *S. cardiophyllum* than to *S. pinnatisectum*. These results suggest that this species is the product of hybridization between these two species, with backcrossing to *S. cardiophyllum*. A comparison of RFLP and RAPD results showed that within the context of these diploid outbreeders, RAPD's have the ability to more cheaply and thoroughly discriminate among accessions. Although RAPD's have potential problems in such analyses because of their typically dominant inheritance, they were concordant with