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FOR SUSTAINABLE AGRICULTURE

# Developing potatoes with horizontal resistance to the Colorado potato beetle

**Abstract:** Producers who grow potatoes can look to a new variety that features greater resistance to the Colorado potato beetle, the most financially damaging potato pest..

## Question & Answer

**Q: Is it possible to breed for durable resistance to crop pests?**

**A:** Yes, and thus it is not necessary to resort to synthetic chemicals or genetically engineered crops to ensure good yields and quality.

## Background

An effort began in 1998 to develop a new potato variety with natural, durable resistance to the Colorado potato beetle (CPB), the most economically damaging pest threat to potatoes in the United States. The beetle has developed resistance to most pesticides and alternative controls have significant serious drawbacks. In contrast, the durable resistance developed in this project, horizontal resistance (HR), has no known drawbacks and has never been shown to break down. This pilot project resulted in a 62 percent increase in resistance to the CPB compared to parental varieties.

The central question of this project was whether additional resistance to the Colorado potato beetle could be developed in potato genotypes already containing some resistance developed in earlier work.

Broad goals for the project were to:

- Promote biodiversity by greatly reducing/eliminating pesticides that kill non-target organisms,
- Promote crop breeding for pesticide-free pest

management in general, and

- Help to increase crop diversity by promoting revival of Iowa's once-thriving potato industry.

Specific goals were to advance development of a variety of potato with these characteristics:

- Natural, durable HR to leaf feeding by the CPB,
- Adapted to growth in the Midwest, including Iowa,
- Lower costs, easier management, and reduced pesticide exposure for the farmer, and
- Safer for the environment and the consumer.

## Approach and methods

The plan for accomplishing the objectives was to continue using recurrent mass selection to accumulate enough "minor" resistance genes in one potato variety to preserve high yields. This would advance development of the new variety through another one-year cycle of breeding and selection. A typical round of breeding and selection for the project consisted of:

1. Planting tubers of the most resistant plants from the previous year in the greenhouse in January.
2. Cross-pollinating flowers from the resultant plants in February and March.
3. Harvesting seeds from the resultant fruits, planting them in flats, and transplanting the seedlings to the field in May.
4. Testing the field-grown plants for resistance to the beetle by using a detached leaflet bioassay in July and August. Tubers of the most resistant plants were harvested and stored until planting in January, when the next round of breeding and selection begins.

### Principal Investigator:

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### Budget:

\$7,233 for year one  
\$7,233 for year two  
\$7,233 for year three

## Results and discussion

When compared side-by-side in the third year of the project, the final, most resistant genotypes had 83 percent more resistance than parental varieties from which they originally had been developed. This represented a 13 percent increase in resistance over the duration of the project, and a 21 percent increase in resistance over the most resistant genotypes from the 1998 breeding program.

Overall, the project results extended the earlier attempt to breed potatoes with horizontal resistance to the Colorado potato beetle by showing that higher levels of resistance could be achieved with additional breeding, while simultaneously selecting for yield and plant size.

It is probable that plants with 83 percent greater resistance to larval feeding than the parental varieties from which they were developed are good enough to be used commercially, provided genotypes could be found among them that preserve shape, flavor, solids, and other qualities desired in a successful new potato variety.

## Conclusions

The major finding was that it is possible to increase horizontal resistance in potatoes to the Colorado potato beetle with the leaflet bioassay and the first instar beetle larvae. Resistance was increased from the 62 percent previously attained to 83 percent improved resistance in the final year. This level of resistance may well be sufficient to serve as a commercially useful new variety of potato, but only subsequent multiplication and field trials would confirm this finding.

There is little doubt that sufficient germplasm exists in potatoes to develop economically viable resistance to the Colorado potato beetle. New resistance genes from wild potatoes are not needed, nor are genetically engineered genes or chemical treatments.

## Impact of results

The next step, if work were to continue, would be to spend time multiplying tubers from the desirable plants, and then field testing the plants at facilities that experience attacks from adult Colorado potato beetles. The plants that displayed the best endurance in these trials would be available for final quality testing and multiplication for commercialization.

Colorado potato beetles are only one pest that afflicts potatoes. There are at least 20 other threats, of which late blight is probably the most serious. Developing horizontal resistance to all of these pests would require a large, well-funded crop breeding program. Such a program could develop resistance to at least several of the worst afflictions simultaneously, rather than dealing with the individual problems piecemeal.

## Education and outreach

Maharishi University of Management undergraduate students, mainly biology majors, participated in the project as interns. They took part in all phases of the breeding and selection, and it exposed them to ways of conducting scientific research. An Organic Agriculture class also participated in a day of field work when transplanting occurred. High school students occasionally were present for various demonstrations during the research project.

## Leveraged funds

No additional funds were leveraged by this project.

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