Alternative Methods for Controlling the Colorado Potato Beetle

West Virginia University
Extension Service

Center for Sustainable
and Alternative Agriculture

For more than a hundred years, farmers and gardeners have endured damage to their potato crops by the Colorado potato beetle. The beetles feed on the leaves of plants in the Solanacea family, which includes tomatoes, peppers, and horse nettles as well as potatoes. When populations of the beetle are high, entire plants can be defoliated. This reduces plant energy reserves and therefore productivity and yield. Resulting economic losses force potato growers to adopt insect control measures.

In the early years, control methods for the Colorado potato beetle included hand picking, planting varieties less preferred by the beetle, trap cropping, and crop rotation. By the late 1800s, arsenic-based insecticides were developed for use against the Colorado potato beetle, and by the 1930s, DDT was commonly used. In the post-World War II period, chemical research has provided an array of insecticides for the potato grower to use against this agricultural pest.

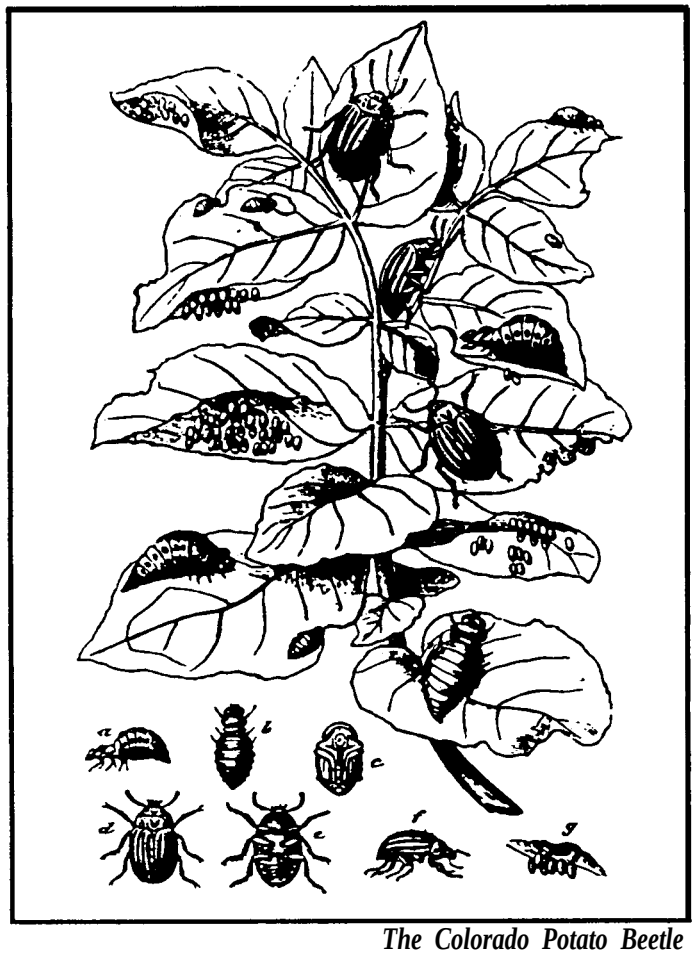
The problem, however, with the use of modern insecticides is the beetle's remarkable ability to develop resistance to each new insecticide. Currently, potato growers find it necessary to change insecticides every few years in order to continue obtaining good results. This resistance factor, combined with an increasing concern with environmental, food safety, and farm workers' health issues, has prompted farmers and researchers to experiment with alternative methods of controlling the Colorado potato beetle.

Life Cycle of the Colorado Potato Beetle

Colorado beetles spend the winter months several inches below the soil surface. In the spring these adults emerge, feed, and mate. Females lay twenty to sixty bright orange eggs on the underside of leaves on early planted potatoes. Over a lifetime, a female may lay as many as 3500 eggs. When the larvae hatch, they begin feeding on potato plant leaves, stopping only to molt (shed their skins in order to grow). They undergo four larval stages or "instars" in ten to twenty days, depending on the temperature.

Mature larvae drop off the leaves and enter the soil for pupation, a stage in the beetle's development lasting five to ten days. During this inactive stage in the ground, the larvae transform into adults. In West Virginia, the adults from this first generation emerge during the potato growing season, mate, and lay eggs, thus beginning a second generation of larvae with voracious appetites. The adults that result from this second generation of larvae are the ones that overwinter. The following spring, the cycle repeats.

Therefore, control measures for limiting Colorado potato beetle damage must account for the fact that West Virginia growers see two generations in a typical growing season.



The Colorado Potato Beetle

Alternative Strategies for Managing the Colorado Potato Beetle

Crop Rotation. The single most important Colorado potato beetle management technique is to plant in new ground every year because adults overwinter in sites near last year's crop. Crop rotation not only avoids depletion of certain soil nutrients in a growing area, but also disrupts the Iife cycle of the Colorado potato beetle. In the spring, emerging adults will have to travel farther to reach the host potato plants, thereby delaying egg laying and feeding on leaves by larvae.

Additional available nutrients in the new beds will benefit the potato plants, which can put on vigorous growth before Colorado potato beetle populations are established.

Removing Plant Vines. If a grower destroys and removes the plant vines before harvest, Colorado potato beetle larvae cannot survive the subsequent loss of food. The potatoes also develop tougher skins, reducing the possibility of bruising during harvest.

Mulching. Besides its other benefits, mulch helps to control the Colorado potato beetle by providing a barrier to beetles moving into the field. Studies have shown that a mulch of 4 inches significantly reduces the number of overwintered adult beetles, egg masses, and larvae. The mulch should be applied when the first potato shoots emerge.

Floating Row Covers. Floating row covers are large pieces of lightweight clothlike material placed directly on plants to provide a barrier to insects. These covers allow sunlight and rain to penetrate, but not insects. Potatoes do not need to be pollinated so they may remain covered the entire growing season, protecting them from the egg-laying females. Floating row covers are expensive but can be used for three or four years if handled properly. (The cost for covering an acre, at 1992 prices, was approximately $860.)

Flame Thrower. In the spring of 1989, a flame thrower was built and tested on Long Island to control the Colorado potato beetle. The rig consisted of four 3-inch weed burning heads attached to a 3/4-inch gas pipe that was mounted to the front of the tractor. The burning heads were 12-18 inches above the ground and spaced 34 inches apart, covering four rows. A gas line ran to the back of the tractor and was connected 10 a series of four 100-pound household LP tanks.

The most effective control was obtained when the plants were just emerging to 4-6 inches tall. Overwintered adults are killed when exposed to the flame as they feed on young plants. Potato plants receive initial damage from the flame but recover in a few days. In addition to destroying adult beetles, the flame thrower reduced egg hatch by 35% on test plots. The estimated cost to treat one acre was $6 to $7, excluding labor and machine costs.

Testing of this new control technique was not completed at this writing. It is discussed here only to show the range of alternatives being considered to control the Colorado potato beetle.

Defoliation and Potato Yields

Potato plants can tolerate leaf loss without significant yield reduction. For example, young plants can tolerate 20% defoliation (or loss of leaf surface) before yield is affected. Plants in early bloom to post bloom can tolerate a level of 40% defoliation. For the remainder of the season a 60% level of defoliation can be tolerated.

When Preventive Measures Fail

Bacillus Thuringiensis. *Bacillus thuringiensis* or *Bt* is a bacterium that is toxic to specific insects but harmless to other forms of life. Larvae that feed on a potato plant treated with these bacteria stop feeding and soon die. Only small larvae are effectively controlled with *Bt,* however, so inspections of the potato field should be made early in the season. The *Bt* used for control of the Colorado potato beetle is the San Diego strain sold under the trade names of "M-One" and "Foil." (It should not be confused with the *Bt* commonly used in home gardens, sold as "Dipel" or "Thuricide.")

A recent three-year study conducted by entomologists at the University of Massachusetts showed that both of these *Bt* products were economically feasible when compared to conventional insecticides. In fact, during the second and third years of the study, the Bt-treated fields produced yields as high as, or higher than, yields in conventionally treated potato fields. Net profits per acre were also higher with *Bt.*

Using *Bt* Effectively. Careful timing and frequent field visits are critical for effective use of *Bt,* especially at the beginning of the season. Fields should be visited once or twice a week to determine the arrival of adult potato beetles.

When the first egg masses are found on the underside of leaves, mark those leaves with bright surveyor's tape so that you can find them again. Mark at least ten egg masses with the tape and then return to these plants every day or two to determine when the eggs hatch. **When one-third to one-half of the masses have hatched, apply *Bt* within the next one to three days.**

The goal is to control small larvae. Once they have grown beyond the first and second instars, *Bt* is not very effective.

It is also important to keep in mind that temperature is an important factor affecting the amount of feeding the Colorado potato beetle larvae do and, therefore, influences the effectiveness of a *Bt* spray. For example, one laboratory study showed that only half as many larvae are killed by *Bt* at a temperature of 70 degrees as at 82 degrees. It is suggested that *Bt* be applied in the morning when daytime temperatures are expected to be above 70 degrees.

Potato fields have to be monitored frequently, even after the first spraying of *Bt*, to determine the number of eggs hatching and the number of small larvae present. When the average number of small larvae exceeds four per plant, *Bt* should be applied. As long as new eggs are being laid in high numbers, you must watch for small larvae, and expect to treat on a five- to seven-day schedule.

The type of spraying equipment used also influences the number of Colorado potato beetle larvae killed by *Bt*. Research in potato fields on Virginia's Eastern Shore showed that spray nozzles that reach the lower canopy of leaves (i. e. "drop" nozzles) are much more effective than top nozzles that cover only the upper, exposed leaves of the potato plant.

Natural Enemies. There are other insects you might find in your potato field which do not feed on the plants, but on the Colorado potato beetle. These friends of the grower include the lady beetle *(Coleomegilia maculata),* a ground beetle *(Lebia grandis),* and occasionally the granddaddy long legs *(Phalaguim opilio)* and the spined soldier bug *(Podisus maculiventris).* There is also a fly *(Doryphorophaga doryphorae)* that can parasitize as much as 75% of the second generation of Colorado potato beetle larvae. The female fly lays her eggs on the Colorado potato beetle larvae. The fly larvae hatch from their eggs, burrow into the bodies of the beetle larvae and begin feeding on internal tissues and organs.

Other predators and parasites of the Colorado potato beetle can be seen over the course of the growing season.

For information on buying and using natural enemies of the Colorado potato beetle, consult your West Virginia University county extension agent.

It should be remembered that traditional control methods, especially commercial insecticides other than *Bt*, often kill beneficial insects in addition to the target insects.

Future Research

A new and promising area of research involves finding ways to develop resistance to the Colorado potato beetle in the potato plant itself. Glandular trichomes in wild potato species from Bolivia release a sticky substance that entraps small insects and covers the legs and wings of larger ones. Crosses of the wild potato and the common potato show reductions in the number of adults as well as reductions of 90% and 87%, respectively, of small and large instar larvae densities. These hybrids one day may fit well into a Colorado potato beetle control program.

Conclusion

No one alternative management technique discussed in this fact sheet will completely control the Colorado potato beetle. Research and demonstration efforts have shown that effective control of this common agricultural pest can be obtained with an integrated program that includes crop rotation, early planting of potatoes, use of early-maturing varieties, early vine killing, weed control, mulching, the use of *Bt*, and a management program providing an environment that does not harm natural enemies.

Research on control of the Colorado potato beetle continues at several universities. In the meantime, there is sufficient evidence that alternative measures will yield profitable results for the potato grower.

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