MANAGEMENT STRATEGIES FOR COLORADO POTATO BEETLES AND GREEN PEACH APHIDS

by
K. Duane Biever
USDA-ARS, Yakima, Wa.

The potato industry is plagued by two major insect pests: the green peach aphid (GPA) and the Colorado potato beetle (CPB). Insecticide resistance, lack of suitable replacement insecticides and environmental concerns all contribute to the need to develop control strategies that can be integrated into an effective management program.

The GPA is a serious pest of potatoes because of its role as the primary vector of potato leafroll virus (PLRV) which causes net necrosis and reduces the quality of tubers. It is estimated that this vector costs $125 M in lost yield per year due to PLRV and potato virus Y (PVY). Insecticide treatments applied to potato fields cannot prevent infestations by viruliferous aphids; they can only reduce the rate of within-field spread of the virus. Control strategies are needed to limit the immigration of aphids into potatoes including suppression on non-potato host plants. Effective long-term management of GPA requires extensive knowledge on the structure and function of their habitat. The GPA is known to occur on over 875 plant species thus monitoring programs for aphids in non-potato situations could provide predictions of aphid abundance and virulence.

New control methodologies for management of GPA must effectively integrate with management strategies for CPB. The CPB is a major pest of potato and several other solanaceous plants in North America. It is the single most important defoliating pest of potatoes worldwide as well as in the U.S. The CPB succeeds because it is adaptable and lacks effective natural enemies in the geographic regions it has invaded. Insecticidal resistance is a serious and recurring problem in the control of CPB. The history of insecticidal control of CPB in eastern U.S. shows repeated failures, marked by resistance and environmental contamination. The CPB is the principle limiting factor in potato production in the northeastern and mid-atlantic regions of the U.S. and is becoming a major pest in mid-western and western production areas. At present, in the Northwest, CPB populations are effectively suppressed by insecticides; often by ones that are routinely applied for control of GPA. In the future we will need to use an integrated approach to manage both of these pests. A number of possible control approaches are available and research is in progress on some of them. The CPB is a good candidate for management with biocontrol agents and other alternative control tactics because potatoes can tolerate up to 20% defoliation with no reduction in yield.

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Both chemical and biological insecticides are available and more are being developed. Chemical insecticides will continue to be used and hopefully used only when needed, thus extending their lifetime as the number of replacement materials is likely to be limited. One biological insecticide, Bacillus thuringiensis (B.t) is currently available for CPB and is being used on a limited basis in Eastern North America and Europe. Several companies sell this biological insecticide which is only effective against the larval stages. Timing and coverage are critical in using B.t. as it has limited persistence and CPB larvae must feed on it to be killed.

A number of beneficial agents have the potential of contributing to the control of both GPA and CPB but they are usually eliminated by the routine application of chemical pesticides. Limited research effort is being devoted to beneficial fungi for both pests and nematodes for CPB; more research is needed so these agents can be developed and incorporated into an integrated management system. Research on beneficial parasites needs to be increased to assess opportunities for the introduction of exotic species and to develop techniques to manipulate and enhance the effectiveness of native parasite species. A number of species of predators that attack CPB and GPA are often found in unsprayed potatoes; these include: lady beetles, ground beetles, lacewings, damsel bugs, bigeyed bugs, spiders, assassin bugs and stinkbugs. We have been conducting research on the use of stinkbug predators for controling CPB and have developed procedures to produce them in the laboratory for use in inoculative release programs in early season. Two species have been evaluated and Perillus bioculatus is the best one for field use; in controlled field tests they reduced CPB populations by 65%. Current effort is on integrating inoculative releases of this predator with applications of B.t. and a beneficial fungus. Beauveria bassiana. Fungi are also being evaluated for use against GPA.

Host plant resistance has the potential of serving as an effective first line of defense against CPB and GPA. This is true for both traditionally produced and genetically engineered resistant plants. Single genes such as the endotoxin gene of B.t. have been transferred into potato plants, thus the plants are able to produce the toxin and kill CPB larvae. Field evaluations of genetically transformed B.t.-Russet Burbank potatoes have established that they are very effective. Resistance to transgenic plants can be anticipated if the use of high expression of B.t. transgenic potatoes is widespread, thus making this new and novel strategy useless. A prudent approach may be to incorporate an intermediate or even a low level of B.t. in conjunction with other management strategies making use of plant resistance as one component of the system. We are conducting research on integrating low expression B.t. plants with inoculative releases of the stinkbug predator to control CPB. Transgenic plants with virus resistance are being developed and should significantly reduce the importance of GPA as a vector.

Over 40 traditionally bred potato cultivars have been field evaluated to establish the feeding preference of CPB. We are interested in identifying both the cultivars the CPB most preferred to feed on as well as those that were least preferred.

The least preferred cultivars are of value for breeding programs and the most preferred can be incorporated into programs which utilize trap rows to catch CPB adults for elimination.

A number of cultural techniques offer potential as part of an overall program to reduce both GPA and CPB populations. Several different vacuum systems have been developed to remove CPB adults from potato fields. One we tested removed about 80% of the beetles in one pass. Propane flamers are being used in eastern U.S. to kill adult CPB when the potato plants are 4-8 inches tall. It is currently the best method of control in New York state and a single pass kills 80-90% of the beetles. Plastic lined trenches are also being used to collect and control CPB. Because overwintering CPB adults emerge from the soil (in or near last year's potato fields) in early spring about the time potato plants emerge and usually walk about seeking potato plants, rotation and location of potato fields can be very important. The use of strategically located strip-plantings of potatoes might be used to collect the spring emerging adults so they can be eliminated by spraying, vacuuming or flaming.

Cultural management practices that can significantly limit the importance of GPA as a virus vector include: (1) planting virus free seed, (2) elimination of volunteer potatoes, and (3) elimination of cull piles.

Management of potato insects in the future will most likely involve integrated strategies. These programs will be more knowledge intensive and suppressing CPB will be only one portion of the total crop management system.