INSECT PESTS AND THEIR MANAGEMENT

Juan M. Alvarez, Robert L. Stoltz, Craig R. Baird, and Larry E. Sandvol

GENERAL PRINCIPLES OF INSECT MANAGEMENT

Avoiding Insecticide Resistance

Two of the major insect pests of potatoes, Colorado potato beetle and green peach aphid, are infamous for the ability to develop resistance to commonly used insecticides. The repeated use of the same insecticide or other insecticides from the same chemical class in the same year or in successive years will accelerate the development of resistance. By doing the following, the development of resistance can be avoided:

1. Keep good records insecticide applications and changes in insect population.
2. Rotate insecticides used.
3. Use insecticides at labeled rates.
4. Use some of the new insecticidal chemistries.
5. Scouting and make insecticide applications only as needed.

MAJOR PESTS FOR POTATOES

Successful grower management of pests, using any method, depends on being able to reliably identify and monitor pest populations at each life stage. In taking an IPM approach, this section provides information on insect identification, action thresholds, control decisions, conservation of natural enemies, and provides options for avoiding pesticide resistance.

COLORADO POTATO BEETLE

The Colorado potato beetle (CPB), *Leptinotarsa decemlineata,* larvae cause most of the defoliation and consume about four times more leaf mass than do the adults. Leaf feeding has the greatest impact on yields when it occurs within 2 weeks of flowering. Potato plants can tolerate some defoliation without a yield reduction; up to 30 percent before flowering, between 10 and 15 percent when tubers are beginning to bulk, and up to 20 percent for the last 3 weeks of the growing season.

Identification

The adult CPB is ⅜ inch (10 mm) long, with yellow rounded and convex wing covers (elytra) marked with 10 black stripes. The larvae are ⅛ to ½ inch long and have slug-like, soft-skinned, brick red to orange, humped bodies with two rows of black spots on each side, six legs, and a black head.

Adult Colorado potato beetle.

Biology

In Idaho, the adult CPB lives year round. Adult beetles spend the winter buried 4 to 10 inches deep in the soil. Adults emerge in the spring just as the first volunteer potatoes appear. Colonizing beetles first feed for up to a week, then lay eggs. Females lay up to 800 eggs over a 4- to 5-week period. In Idaho, the eggs begin to hatch at the

end of May or first week of June and hatch in 4 to 9 days. The larvae pass through four growth stages in as little as 8 to 10 days. The mature larvae drop from the plant and burrow into the soil where they pupate and transform into adults in 1 to 2 weeks. The new summer generation of adults emerges and lays eggs within the same field or in an adjacent field and then migrates to an overwintering site.

Management
Several methods are effective for dealing with CPB.

Cultural Control
1. Rotate crops.
2. Control volunteer potatoes and weeds.
3. Other control methods include the use of plastic-lined trenches, propane flamers, and vacuums.

Chemical Control
1. **Selecting an Insecticide:** In most cases, the choice of an insecticide is based on price, effectiveness, and ease of application. Insecticides should be rotated with each application to avoid development of resistance to any one compound. Mixtures of insecticides in general are not recommended.
2. **When to Apply*:*** Insecticides should only be used when needed. Where damaging infestations of CPB are not an annual occurrence, the best option for control is to scout the crop after emergence and apply foliar insecticides as needed.
3. **How Much to Apply:** While providing complete coverage of the plants, products should be applied at the full recommended effective dose.
4. **Where to Spray:** When growers follow good crop rotation practices, beetles coming into a field will concentrate at the edge of fields. In such a situation, growers may need only to spray the edge of the potato field.
5. **Which Stage of Growth to Target:** Young larvae are the most susceptible to insecticides. The best time for foliar application is when 15 to 30 percent of the beetle eggs have hatched.

Biological Control
Not all the CPB eggs seen in the field early in the spring (end of May in Idaho) will become adults. Several beneficial insects that feed on CPB eggs and young larvae will reduce the number of adults in the first spring generation. This biological control effect of predators and parasitoids is easily recognized in the field by marking several CPB egg masses, counting the number of eggs that hatch, and following the fate of the resulting larvae.

GREEN PEACH APHID

The green peach aphid (GPA),*Myzus persicae,* is a European native that occurs throughout the world on a diverse host range of over 875 species of plants. It is the most common and abundant aphid in North America. GPA is considered one of the most difficult insect species to control primarily because of its high reproductive potential and diverse range. Aphid numbers may occasionally be high enough to cause damage to potato crops by excessive removal of sap, but losses mainly occur through transmission of the potato leafroll virus (PLRV).

Wingless green peach aphids.

Identification

The green peach aphid has many forms. Wings may or may not be present in the adults. Winged green peach aphids are pale or bright green with a dark head and thorax. The irregular dark patches on the abdomen are characteristic but not unique. One distinctive characteristic of GPA is the presence of small, inward pointing structures located at the base of the antennae called tubercles (head bumps). Tubercles appear similar on both the winged and wingless forms. Wingless GPA adults are light yellowish-green to pinkish, teardrop shaped, and about 2 to 3 mm long.

Biology

The life cycle of aphids in general is unusual and complicated. It includes several body forms, and a sexual and an asexual mode of reproduction. Asexual reproduction occurs during the growing season when females give birth to live females (they do not lay eggs, as is common with most insects), with most species producing 10 to 25 generations. Sexual females produce eggs in the fall. *Please refer to* ***Potato Production Systems*** *book for more detailed information* (Order Potato Production Systems).

Management of GPA

A successful integrated pest management program for GPA should include methods aimed at breaking the life cycle of this aphid, such as applying insecticides to control the aphid and eliminating or treating overwintering and secondary hosts.

Cultural Control

Reducing Overwintering GPA Populations on the Primary Host: The common means of overwintering in most parts of Idaho is on the winter host in the egg stage. Peach trees are the most common winter hosts, although apricots and other species of *Prunus* are infested on rare occasions. Removing and replacing peach and apricot trees and spraying insecticides on commercial peach orchards are effective ways to prevent aphid buildup in Idaho.

Eliminating GPA Populations on Bedding Plants: Significant numbers of winged aphids can be produced in home gardens after plants have emerged. Aphids moving directly from home gardens to potato plantings often transport viruses since home garden potato plants often have a high rate of disease infection.

Eliminating Secondary Hosts: Many winged aphids migrating from peach trees and other sources appear before crops are available for colonization. Early infestations

commonly occur on several weeds, including species of mustards, nightshades, and ground cherries. It is important to keep nightshades under control, especially in seed potato-growing areas where disease prevention is essential.

Scouting for Aphids

When scouting, it is important to keep in mind that GPA prefers to infest the undersides of leaves in the lower portions of potato plants. After periods of cool, cloudy weather, tops of plants may also be infested. Colonies will also develop on upper portions of plants where crowding occurs.

When to Scout: In Idaho, aphids usually start to land on potato plants by the first week of June in the western part of the state and by the first week of July in southeastern Idaho. At this time, it is important to scout fields for GPA twice a week to ensure quick detection. Detection of winged aphid and timely application of insecticides will minimize the formation of colonies.

Biological Control

Predators (example of such a predator is the Ladybird beetle larva shown below), parasitoids, and pathogens affect aphid populations and, together with other natural control factors, may keep aphids below economic levels in particular situations. The sudden decline of aphid population late in the season is associated with several factors of which the action of predators is often dominant. Several fungi in the family Entomophthoraceae are known to cause infections that kill GPA and other aphids. Applications of fungicides against foliar diseases, such as late blight, eliminate these fungi. Typically, 75 percent of Idaho's commercial potato acreage receives four or more fungicide sprays each season.

Ladybird beetle larva.

Chemical Control and Management of Insecticide Resistance

The green peach aphid is difficult to control because of the high reproductive capacity and because it has developed resistance to at least 69 different insecticides representing all major classes.

Selecting an Insecticide: Some systemic insecticides give adequate aphid control and also reduce Colorado potato beetle, wireworm, or nematode numbers.

When to Apply: Aphids can be effectively controlled by applying systemic insecticides to the soil at the time of planting. At high elevations where mid- to late-season pressure from winged aphids is light, these applications may provide season-long protection. At lower elevations, one or more foliar applications of insecticide may be necessary after midseason. Application of foliar insecticides should begin when one to three wingless aphids per 100 leaves are detected. This is a low threshold for detection with confidence and, therefore, most growers choose to use a no-gap program. That means that application of foliar insecticides should begin just before the expected time of decline of the residual control of the systemic insecticide applied at planting.

Relationships of Green Peach Aphid to PLRV Transmission

Aphids transmit potato viruses in two ways—nonpersistent transmission and persistent transmission:

Nonpersistent Transmission

Viruses transmitted in this way are located in the surface layer (epidermal tissues) of plant leaves. The mouthparts of the aphid get contaminated with virus particles in the brief process of probing or feeding on the surface layer of leaves of infected plants. Then they transmit these viruses usually within a few seconds while feeding on other plants. The virus will remain on the aphid for a short time (less than 2 hours), and the aphid must again feed on an infected plant to reacquire the virus.

Persistent Transmission

Viruses persistently transmitted are located in the phloem tissue of plants. Aphids must consider the plant as a host and stay on the plant for 20 or 30 minutes. PLRV infects the phloem tissue of potato plants and is the most important example of a persistently transmitted potato virus. Only aphids that colonize potatoes transmit this virus. The GPA, the most efficient PLRV vector, picks up the virus when it feeds on infected plants. A “latent” period, between feeding and transmission, is needed before the virus can be transmitted to healthy plants and cause infections. During the latent period, the virus moves from the gut of the aphid into the blood and then into the salivary glands and finally into the salivary fluid. When the aphid feeds, virus particles move with the salivary fluid into the plant tissue. The minimum time required for the virus to complete the circulative route and, therefore, to be transmissible, is about 6 hours. Most aphids require a longer period, and in some individual aphids the process may require up to 48 hours. Winged aphids coming into a field that are already carrying the virus can probably transmit PLRV within a few minutes. Once PLRV is picked up it is retained and transmitted through the life of the aphid. The virus does not pass from the mother to the young aphids. Only feeding on an infected plant infects each aphid.

PLRV Symptoms: In commercial potato crops the main reason to control GPA is to avoid tuber symptoms known as “net necrosis” See Disease Management section for a description of PLRV symptoms on plants and net necrosis symptoms in tubers.

Factors Affecting Spread of Net Necrosis

1. **Aphid Age:** Some evidence indicates that efficiency of transmission varies with aphid age or stage of growth. Winged forms are obviously more important in transporting the virus into fields and moving the virus relatively long distances within fields. Wingless forms may move the virus from plant to plant, especially when crowded.
2. **Potato Variety:** Some varieties, although susceptible to infection, are not prone to the tuber net necrosis symptom.
3. **Age of Potato Plants:** The green peach aphid transmits the virus more efficiently after feeding on a young, infected plant. Therefore, plant conditions for the transmission of PLRV are most favorable just after plant emergence and decrease through the growing season.
4. **Numbers of Source Plants:** Any practice that reduces the number of virus-source plants will also reduce need for insecticide treatments. Severity of problems with PLRV depends on the relationship between numbers of green peach aphids in the crop area and number and distribution of virus-infected plants.

PLRV/GPA Control Recommendations

Because of its PLRV susceptibility, control measures on the Russet Burbank variety are aimed at keeping green peach aphid numbers low. To help minimize spread of PLRV:

1. Plant clean, certified seed and remove ALL volunteer.
2. Use a systemic insecticide at planting, or plant virus-resistant or genetically-modified varieties.
3. Do not spray to control winged aphids.
4. Soon after plant emergence sample for aphids every 3 to 4 days.
5. Maintain a no-gap policy for aphid control.
6. Spray late-season, susceptible varieties at detection of surviving, wingless aphids.
7. Control aphids on late-season, susceptible varieties until vine kill, or as close to vine kill as possible while observing application to harvest intervals of chemicals.
8. Do not extend the growing season past normal vine kill, if possible.
9. Consider controlling aphids in early harvest fields (before winged forms develop) to prevent migration to long-season, susceptible varieties.

WIREWORMS

Identification

Wireworm larvae are hard-bodied, slender, cylindrical, shiny, small-legged, yellow-to-brown worms that feed upon potato seed pieces and underground stems during the spring. Wireworms also burrow into developing tubers.

Wireworm larva.

Biology

The life cycle of our most common wireworms requires 3 to 4 years to complete under favorable conditions. Wireworms spend the winter in the soil either as partially grown larvae or as new adults. Adults work their way up to the soil surface in the spring when soil temperatures are 55°F or above. The female mates soon after emerging from the soil, then burrows back into the soil and lays eggs in several locations at depths of 1 to several inches. Wireworm larvae cause the most sever e feeding damage during their second and third years. In the spring when soil temperatures are 50°F or above, the larvae move toward the soil surface from overwintering depths of 6 to 24 inches. When soil surface temperatures reach 80°F or higher, they move downward again. In irrigated fields with complete foliage cover, the soil may remain below this temperature. During the third or fourth season, mature larvae transform to fragile pupae in earthen cells. In 3 to 4 weeks the pupae change to adults, which remain in the soil until the following spring. Wireworms in all stages may be present during any growing season.

Management

All wireworms common to Idaho have similar biology, and the same management approaches apply to all three species.

Wireworm Detection

Detecting wireworm infestations and determining size of wireworm populations are not easy. Baiting gives a poor estimate of population size but is a quick way to determine if wireworms are present. Baits must be buried in the ground for 1 month before planting to determine if insecticide treatment is required. *Please refer to* ***Potato Production Systems*** *book for more detailed information* (Order Potato Production Systems).

Control

Because wireworm populations are spotty and erratic, there are no reliable economic thresholds. The most accurate way to assess the need for control is to look at historical problems with wireworms in potato fields. If past crops in a field have sustained economic damage, there may be a need to treat.

Chemical Control: Wireworms can be controlled by broadcast or band treatments of insecticides, by fumigation, or with seed treatments. Usually controlling wireworms in one crop of a 2- to 4-year rotation will reduce wireworm damage in the other crops. For broadcast treatments granules or emulsifiable concentrates should be applied evenly over the soil and incorporated immediately. Granular insecticides may be used as band treatments at planting time. Fumigants, such as Telone®, may be used to control high wireworm populations, but a combination of broadcast and band treatments may be more economical to use. Seed treatment insecticides used to control Colorado potato beetle and green peach aphid have also proven effective at reducing wireworm damage. Growers need to keep in mind that even the best insecticides will not kill all wireworms, and a small percent of a large population can still cause economic damage.

Cultural Control: Certain cultural control practices can effectively reduce wireworm populations. One practice is to avoid rotations that include clovers and grasses. Alfalfa in the rotation is especially effective for reducing wireworms. Because soil dryness can kill many wireworms in an infested field, fallowing a field will reduce wireworm numbers but the control achieved must be weighed against the income lost from missing a crop year. If wireworm populations are high, it may be necessary to avoid planting potatoes in a particular field.

Biological Control: Known natural enemies of wireworms include birds, carabid and staphylinid beetles, entomopathogenic nematodes, and pathogenic fungi, such as Beauveria sp. and Metarhizium sp. However, not much information is available on the real impact of these natural enemies

SECONDARY PESTS FOR POTATOES

Blister Beetles

Four species of blister beetles commonly damage potatoes. They are long beetles (⅝ to 1⅛ inches) with conspicuous heads and necks. The wing covers are soft and do not completely cover the tip of the abdomen. The beetles cluster and feed on the tips of plants, causing leaf ragging and stunted plants. Severe damage, however, is not common. The adults first appear in June and July and live about 45 days. They are usually abundant only in areas adjacent to rangeland where the larval stages are parasitic on grasshopper eggs.

Nuttal blister beetle.

Management

Field edges should be scouted in years of heavy grasshopper infestations. The beetles are strong flyers and often fly from an area before damage is detected and controls can be applied. If beetles remain in the field and continue to defoliate field

edges, border sprays will eventually alleviate the problem. If defoliation remains below 10 to 15 percent, controls are probably not needed.

Cutworms and Armyworms

Cutworms are soil-dwelling caterpillars that have a smooth appearance, three pairs of legs, and five pairs of prolegs. Some species may be up to 2 inches long when mature. Cutworm and armyworm species common in Idaho include: Black cutworm *(Agrotis ipsilon),* Variegated cutworm *(Peridroma saucia),* Spotted cutworm *(Amathes c-nigrum),* Army cutworm *(Euxoa auxiliaris),* and Red-backed cutworm (Euxoa ochrogaster)..

During the day cutworms and armyworms can be found under clods of soil or in cracks in the ground near injured plants. The western yellowstriped armyworm (Spodoptera praefica) feeds during the day, and like the army cutworm, may migrate in large numbers into potato fields from adjacent crops.

Cutworms either cut off stems at or below ground level or strip the foliage during the growing season. They also feed on tubers that are exposed to the surface or are accessible through cracks in the soil.

Management

Control programs are aimed only at seriously damaging infestations because chemical control is difficult and natural enemies generally hold the populations in check. If chemical control is necessary, numerous effective broadcast granular or foliar-applied insecticides are available. Some defoliation from cutworms can be tolerated. Keeping defoliation under 10 to 15 percent will generally prevent yield loss. Weed control in previous crops and along field edges also aids in reducing cutworm damage.

Other Secondary Pests

Other secondary pests of potatoes include: flea beetles, garden symphylan, grass hoppers, leafhoppers, leather jacket, loopers, lygus bugs, potato aphid, thrips, and white grubs. *Please refer to* ***Potato Production Systems*** *book for more detailed information concerning description, damage incurred, and management of these other secondary potato pests* (Order Potato Production Systems).