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# Potato Insect Control

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## ECONOMIC IMPACT OF INSECT PESTS

Insects can cause significant yield and quality losses in North Dakota potato fields. Defoliation and tuber feeding by insects can directly reduce the grade, storability, and harvest weight in all types of potato production. Aphid transmission of viral diseases can reduce seed quality and make potatoes unmarketable as certified seed stock. The 12 most important insects that cause economic damage to North Dakota potato production are discussed in this circular.

## INTEGRATED PEST MANAGEMENT

Development of an effective integrated pest management (IPM) program is the best approach to managing potato pests and reducing the potential for insecticide resistance. An IPM approach to potato production would involve appropriate tillage practices that address weed control, residue management, and sanitation as well as crop rotation, variety selection, and field monitoring. Field monitoring throughout the season will detect the presence of many injurious potato pests and allow the grower time to achieve maximum control. The purpose of an IPM program is not to eradicate insects but to effectively manage their populations at subeconomic levels through the use of chemicals as well as other control techniques.

Recognition of insects and their damage is necessary in order for appropriate control strategies to be applied. Economic thresholds for insects are established for certified seed potatoes as well as for chipping and tablestock production. Growers should take action to control a pest when insect populations reach these economic threshold levels in order to maintain potato yields and quality without economic loss.

Systemic soil insecticides are effective for reducing some early season potato pest populations. Pest monitoring will indicate if additional foliar applications are required to maintain season-long control.

Some potato insects have exhibited evidence of resistance to specific insecticides. Insect resistance can develop if a particular insect species is repeatedly exposed to insecticides that have similar modes of action. Pyrethroids and chlorinated hydrocarbon insecticides appear to have similar modes of action in insects. Having an understanding of the mode of action of a group of insecticides is essential in selecting an alternate class of compounds to minimize the development of resistance.

## STEM AND TUBER FEEDING INSECTS

Certain soil-inhabiting insects can cause potato damage by feeding on the tubers. This type of damage may also predispose the potato plant to secondary infections by microorganisms that can result in tuber rot in either the field or storage.



COOPERATIVE EXTENSION SERVICE

## WIREWORMS (Figs. 1-3)

Wireworms (Fig. 1) can become a problem in areas where potatoes are produced. Wireworms are the immature stage of click beetles (Elateridae) (Fig. 2). These hardened, brownish-orange larvae chew narrow tunnels in developing tubers, seed pieces, and roots causing potatoes to become misshapen and predisposed to invasion by microorganisms (Fig. 3). Heaviest wireworm problems are most likely to occur in sandy fields that were sod the previous season. It is believed they prefer light soils since they burrow deep to escape from the hot sun or cold winters. Heavy feeding by wireworms early in the season can cause significant stand reduction. Wireworms spend up to five years in the immature stage before developing to the pupa and adult stage.

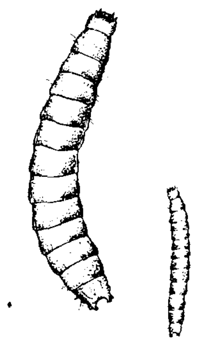

**Figure 1. Wireworm.**

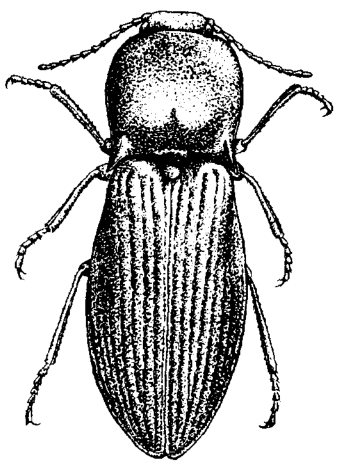

**Figure 2. Click beetle.**

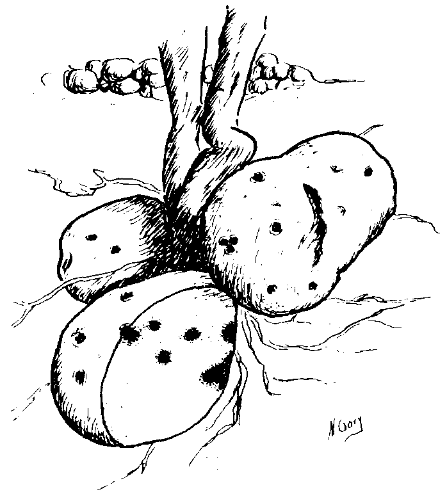

**Figure 3. Tunneling damage to potato tubers caused by wireworms.**

Economic threshold levels for wireworms are determined by sampling 1 square foot of soil at a depth of 6 inches. Twenty well-spaced samples should be taken for every 40 acres of cropland. Soil treatment is warranted if the average wireworm population is greater than one larva per square foot. A granular insecticide applied at planting time will reduce wireworm damage.

## WHITE GRUBS (Figs. 4-5)

White grubs are "C-shaped", soft-bodied larvae (Fig. 4) which are the immature form of June beetles (Scarabaeidae: *Phyllophaga* sp.) (Fig. 5). These larvae cause large, circular cavities in potatoes, which reduce the grade. White grubs require two to three growing seasons for development to adult June beetles. Eggs are usually deposited several inches below the surface in grassland, sod, or weed patches in fields, and larvae hatch to feed upon roots. Most damage from white grubs occurs the second and third year of larval development, and they are most abundant in areas that previously were not in crop production.

If potatoes are to be planted into land that was not cropped the previous two years, the field should be sampled for white grubs

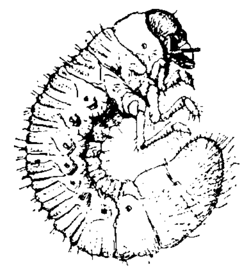

**Figure 4. White grub in typical C-shaped pose.**

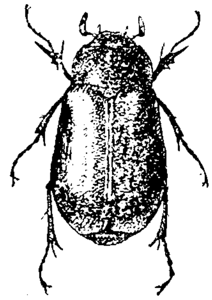

**Figure 5. June beetle.**

to determine if a soil insecticide is necessary. Crop rotation with legumes such as clover or alfalfa, corn, soybeans, or other vegetables can be effective in reducing white grub populations in a field. White grub populations are frequently heaviest in areas of fields adjacent to shelterbelts which served as congregating and feeding areas for the June beetles.

## CUTWORMS, CORN BORER, STALK BORER (Figs. 6-11)

Cutworms, European corn borer larvae, and the common stalk borer are capable of directly affecting stands by cutting and boring into the stem of potato plants. Localized outbreaks of these pests are infrequent but may warrant treatment some seasons.

Cutworms (Fig. 6) can become a serious problem in the spring when potato plants are emerging. Cutworms are night feeders which cut off plants at or near the soil surface and when populations are high can reduce stands dramatical-

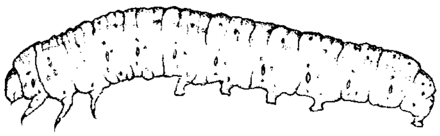

**Figure 6. Larva of the red-backed cutworm.**

ly. Subsoil feeding of cutworms can affect tubers and create circular cavities which reduce potato quality.

Cutworms are the immature form of a moth (Fig. 7) which is commonly seen near lights at night. Economic species of cutworms overwinter as either eggs or larvae and produce one generation per season. In fields damaged by cutworms, larvae are found curled up next to damaged plants just beneath the soil surface or under rocks, litter or soil clumps.

Fallowing, late summer or fall plowing will aid in reducing cutworm populations for the following spring.

The European corn borer, *Ostrinia nubilalis* (Hubner), can become an occasional pest of potatoes. These larvae (Fig. 8) tunnel in stems (Fig. 9), reducing plant vigor or prematurely killing the plant. Corn borer larvae may also produce tuber damage which can reduce the grade of potatoes.

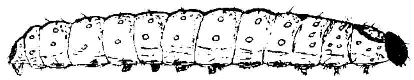

**Figure 8. European corn borer larva.**

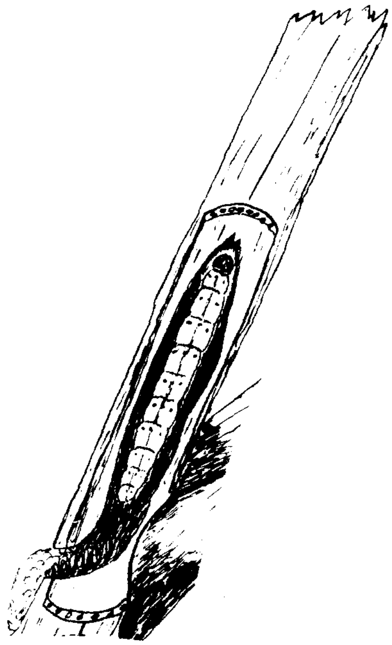

**Figure 9. European corn borer in stem.**

The European corn borer can produce from one to three generations per season, depending upon the climate. Larvae overwinter in crop refuse and develop rapidly during hot conditions. Residue destruction by removal, shredding, or deep plowing can effectively reduce overwintering corn borer populations. Insecticide applications aimed at controlling the adult (Fig. 10) during egg laying may require more than one application. In the Red River Valley, such control measures are not economically justified due to the low incidence of corn borers in potatoes.

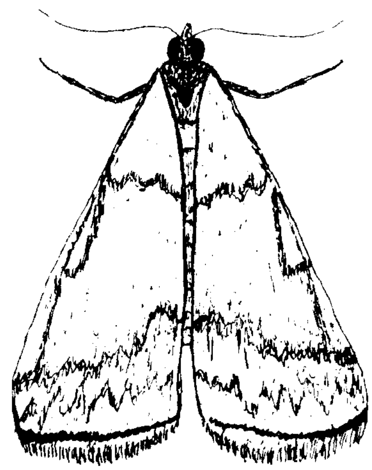

**Figure 10. Female moth of european corn borer.**

The common stalk borer, *Papaipema nebris* (Guen.), also causes feeding damage in potato stems similar to the European corn borer. These larvae (Fig. 11) exhibit a longitudinal white stripe on their backs and broken white stripes on the sides anteriorly and posteriorly. They feed upon a variety of cultivated plants. Often their damage is limited to field margins, but if high populations are present, they can cause significant stand reduction in affected areas.

**Figure 11. Common stalk borer larva.**

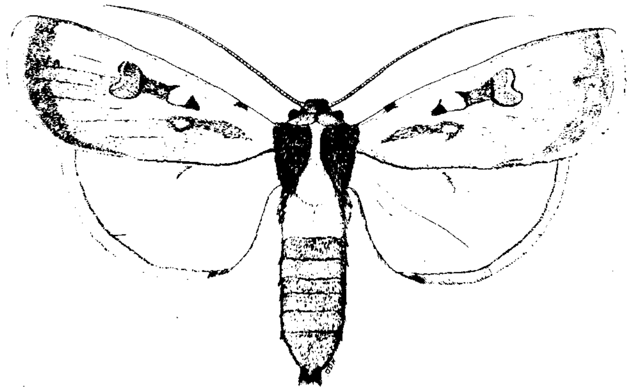

**Figure 7. Red-backed cutworm moth.**

## INSECT DEFOLIATORS

Defoliation of potato plants can be responsible for significant yield reductions. High populations of Colorado potato beetles, flea beetles, or grasshoppers can strip potato plants of their foliage during cirtical growing periods and cause a significant yield reduction. A threshold of 10 percent defoliation during bloom warrants control of these defoliators.

## COLORADO POTATO BEETLE
(Figs. 12-14)

The Colorado potato beetle, *Leptinotarsa decemlineata* (Say), is a native insect of North America which has been a serious pest of potatoes for many decades. Both the larva and adult feed upon potato foliage (Fig. 12) and both populations can completely defoliate a field. The Colorado potato beetle larva (Fig. 13) is a reddish-orange colored grub with black spots on the sides while the adult (Fig. 14) is an oval shaped beetle striped with black and yellow. Adult Colorado potato beetles overwinter in the soil and up to two generations may be produced per year in North Dakota.

Careful monitoring along field margins as well as the center of potato fields is important for determining economic thresholds for control of the Colorado potato beetle. Soil-applied systemic insecticides can provide good early season control, although additional foliar applications may become necessary to maintain season long control. Attempts to control the adult stage of the Colorado potato beetle are rarely cost effective. Controls are most effectivley directed at the larval stage, but effective control requires monitoring since this insect has developed resistance to specific insecticides. (See footnote 2 in control recommendations).

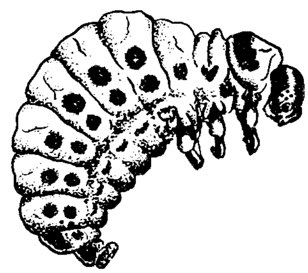

**Figure 13. Larva of Colorado potato beetle.**

**Figure 14. Colorado potato beetle.**

**Figure 12. Defoliation of potato leaves by Colorado potato beetles.**

## POTATO FLEA BEETLE
(Figs. 15-18)

The potato flea beetle, *Epitrix cucumeris* (Harris), is a tiny, dark colored beetle (Fig. 15) with enlarged hind legs which "jumps" when disturbed. These small beetles feed upon potato leaves causing a "shot-hole" appearance (Fig. 16) and are quite active at temperatures above 50°F. Flea beetles lay their eggs in the soil (Fig. 17) and the larvae feed on potato roots (Fig. 18) and the developing tubers. Larval feeding can cause shoot damage and stand reduction.

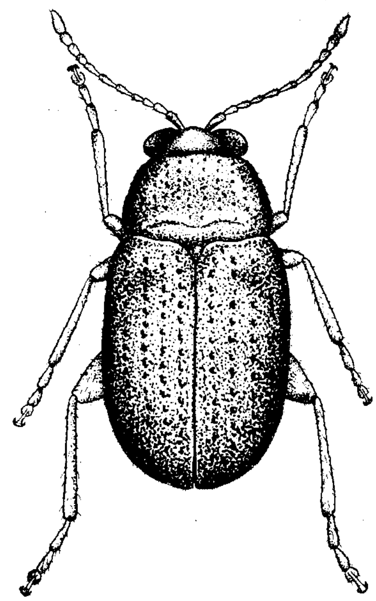

**Figure 15. Potato flea beetle.**

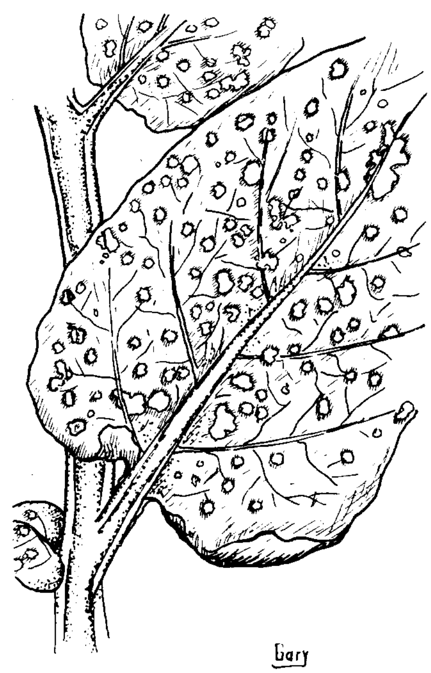

**Figure 16. Shot-hole damage to potato leaves caused by potato flea beetle.**

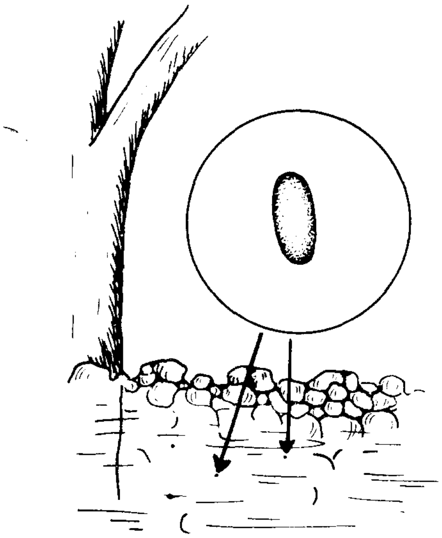

**Figure 17. Potato flea beetle eggs deposited in soil next to potato plant.**

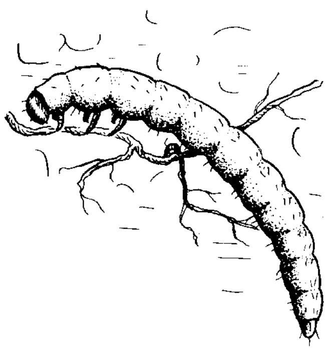

**Figure 18. Potato flea beetle larva feeding on potato roots.**

Flea beetles have one generation per season taking four to six weeks for larval and pupal development. Adult beetles overwinter in crop residue and emerge the following spring to begin feeding. Feeding damage by flea beetles can significantly reduce the vigor of young potato plants.

Good early season weed control and removal of crop debris will make fields less attractive to flea beetles. Foliar sprays may become necessary for flea beetle control if 10 percent leaf area is lost.

### GRASSHOPPERS (Fig. 19)

Grasshopper (Fig. 19) feeding can be destructive to potatoes. When grasshopper populations are high in an area, large numbers can move into potato fields and cause extensive defoliation. Both grasshopper nymphs and adults will feed upon potatoes, but the greatest threat is late season migration of adults into the crop. If possible, direct controls at localized populations of nymphs in hatching areas before they move into the crop. Roadside ditches, waterways through fields, and weedy field margins are potential hatching areas for grasshoppers. These areas should be monitored through late May and early June, and if hopper populations warrant treatment, controls can be applied.

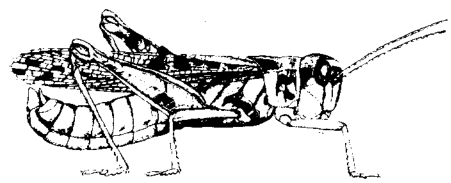

**Figure 19. Adult clear-winged grasshopper.**

## INSECTS PRODUCING TOXICOGENICITY

### POTATO LEAFHOPPER

The potato leafhopper, *Empoasca fabae* (Harris), is a small, pale green insect with piercing-sucking mouthparts capable of withdrawing sap from potato leaves. Leafhoppers have a toxin in their saliva which is introduced into the plant during their feeding, causing a disorder called "hopperburn." Symptoms of hopperburn include browning of leaf tips and margins, leaf rolling, and premature death of heavily infested potato plants.

Potato leafhoppers overwinter in the southern United States, feeding upon various legumes. As the growing season progresses, leafhoppers are carried aloft by strong Gulf air currents and are precipitated out by cold fronts throughout the Upper Midwest. These immigrant hoppers serve as the nucleus of our population and lay eggs in potato plants. Eggs hatch and young leafhoppers undergo five immature stages before becoming adults. There can be two to three overlapping generations per season in North Dakota. Adult leafhoppers appear in early June to feed upon the sugary sap of the potato leaves, and high populations can develop when there is abundant food and warm damp nights. Alfalfa and red clover serve as alternate hosts for leafhoppers and can become reservoirs for large populations of these insects.

Effective controls for leafhoppers must be applied before hopperburn is noticed. Economic threshold levels for leafhoppers are determined by sweeping potato fields with an insect net. Select five locations within the field and at each location take 20 sweeps with the net. Count the number of adult potato leafhoppers and divide that number by 20. This will give the average number of leafhoppers per sweep. If the number of adult leafhoppers exceeds an average of one per sweep, treatment is necessary. A total of 10 nymphs per 100 leaves is also enough to warrant control measures. Careful monitoring of potato fields is necessary for detecting the presence of potato leafhoppers.

Early season leafhoppers can be controlled by systemic soil insecticides applied at planting time. Late season outbreaks may require foliar applications to achieve control.

## DISEASE VECTORS

Viruses and mycoplasma-like organisms (MLO's) can become a serious problem in potato fields designated for certified seed production. Aster leafhoppers and aphids are capable of acquiring and transmitting these disease organisms to potatoes with their piercing-sucking mouthparts. Infected potato plants may exhibit symptoms such as yellowing and lower leaf curling, stunting, or tuber deformation.

**ASTER LEAFHOPPER** (Figs. 20-22)

The aster leafhopper, *Macrosteles fascifrons* (Stål) (Fig. 20), is a primary vector of aster yellows, a mycoplasma-like organism (MLO) which exhibits virus-like symptoms known as purple top (Fig. 21) on potato plants. Aster yellows is not limited to asters but has a wide host range, affecting nearly 200 species of plants. Potatoes can become infected with this disease but do not transmit the disease to uninfected leafhoppers. Infected potatoes frequently develop slender purple shoots and aerial tubers in the axils of the leaves. Excessive branching, stem distortion, vein clearing, yellowing, and stunting are also associated with this MLO. This disease is introduced to potato fields with the leafhopper and there is little spread within the field during the current season. Diseased plants are usually self-eliminating.

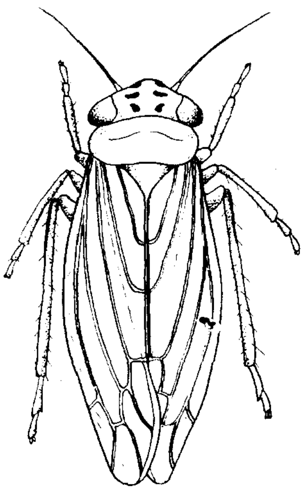

**Figure 20. Aster leafhopper.**

Transmission of purple top by the aster leafhopper can significantly reduce potato seed quality. This leafhopper is capable of transmitting this MLO to potatoes in the adult or nymphal stages following a 10-day incubation period. Aster leafhoppers overwinter as an egg within the tissue of grasses. Nymphs (Fig. 22) undergo five immature stages requiring 16 to 30 days before reaching maturity. To monitor for and control the aster leafhopper, follow the procedures and chemicals previously described for the potato leafhopper.

**GREEN PEACH APHID**

The green peach aphid, *Myzus persicae* (Sulzer), is a small soft-bodied insect which can produce 10 to 25 generations per season. This aphid is one of the two principle vectors of potato virus Y and potato leaf roll virus. Both viral diseases are capable of lowering seed quality and can cause tubers to be unmarketable as certified seed stock. Most green peach aphids seasonally migrate into North Dakota with relatively few overwintering eggs. This aphid also thrives upon many weeds such as wild mustard, smartweed, nettle, and lambsquarters.

**POTATO APHID** (Figs. 23-25)

The potato aphid, *Macrosiphum euphorbiae* (Thomas) (Fig. 23), is another important vector of potato

**Figure 23. Potato aphid.**

**Figure 21. Potato foliage showing symptoms of purple top.**

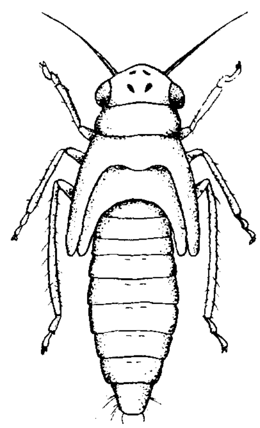

**Figure 22. Nymph of aster leafhopper.**

**Figure 24. Potato leaf rolling symptoms caused by a virus.**

virus Y and potato leaf roll virus (Fig. 24). This tiny insect is green to red colored, with a distinct dark stripe down the middle of its back. Potato aphids are efficient vectors of potato viruses and can multiply rapidly to produce many generations per season. The eggs of the potato aphid overwinter on plants in the rose family where the first generation nymphs (Fig. 25) develop.

The risk of virus spread increases as the season progresses due to the increase in the availability of innoculum and the growing aphid population. Populations of aphids can be effectively managed by wide area elimination of alternate hosts, early season weed control, and protection of beneficial insects such as lacewings, ladybird beetles, and parasitic wasps. Planting certified, disease-free seed will also reduce available sources of virus innoculum in an area.

Economic threshold levels for aphids are determined by examining 100 leaves on the lower third of the potato plant. Seed potatoes require treatment when 10 or more aphids are present while tablestock and chipping potatoes must have 30 or more aphids to warrant control measures. Growers may use a systemic insecticide at planting time to obtain aphid control in seed potatoes but if the aphid populations exceed these thresholds, a foliar treatment is warranted.

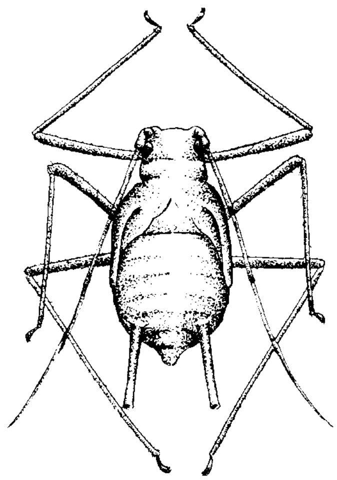

**Figure 25. Nymph of potato aphid.**

## INSECTICIDES

The following insecticides are registered for control of the insect indicated. The dosage and restrictions listed are from product labels. Consult the selected product label for appropriate use and application instructions.

The cost of planting time insecticides can make them impractical for tablestock and chipping production. Planting time applications are more economically practical for seed potato production.

The post treatment to harvest interval (PTHI) is given when this information is presented on the label. Dosage is given in actual toxicant per acre (AI/Acre). The common names of chemicals are used with brand names in parentheses.

| PEST | INSECTICIDE | DOSAGE | REMARKS | PTHI |
|---|---|---|---|---|
| | | **GRANULAR FORMULATIONS** | | |
| **WIREWORMS and WHITE GRUBS:**[1] | fonofos (Dyfonate 10G)* | 2 lbs. AI/Acre | Apply at planting as a subsurface band 3-4 inches on both sides and 2 inches below the seed pieces. | |
| | carbofuran (Furadan 15G)* | 2-3 lbs. AI/Acre | Apply into the bottom of furrow at planting. Check label for allowable crops in rotation. | |
| | phorate (Thimet 20G)* | 2-3 lbs. AI/Acre | Apply evenly in furrow at planting. | 90 days |
| | diazinon (Diazinon 14G) | 1-3 lbs. AI/Acre | Apply as bands 3-6 inches deep on both sides of furrow at planting. | |

[1]White grubs are not listed on the label of the products registered for wireworm control. However these products have demonstrated white grub population suppression in other crops.

*EPA has classified this insecticide as a restricted use pesticide. Restricted use pesticides are to be applied by or under direct supervision of certified pesticide applicators only.

| PEST | INSECTICIDE | DOSAGE | REMARKS | PTHI |
|---|---|---|---|---|
| **CUTWORMS:** | carbaryl (Sevin) | 2 lbs. AI/Acre | | 0 days |
| | Penncap-M* | 2-4 pts./Acre | | 5 days |
| | fenvalerate (Pydrin)* | 0.1-0.2 lb. AI/Acre | Do not feed vines to livestock. | 7 days |
| | permethrin (Pounce)* | 0.1-0.2 lb. AI/Acre | Do not feed vines to livestock. | 7 days |
| **GRASS-HOPPERS:** | dimethoate (Cygon 4E) | 0.25-0.5 lb. AI/Acre | | 0 days |
| | fenvalerate (Pydrin)* | 0.1-0.2 lb. AI/Acre | Do not feed vines to livestock. | 7 days |
| | Penncap-M* | 1-3 pts./Acre | | 5 days |

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| PEST | INSECTICIDE | DOSAGE | REMARKS | PTHI |
|---|---|---|---|---|
| | | **GRANULAR FORMULATIONS** | | |
| **EUROPEAN CORN BORER:** | carbofuran (Furadan 15G)* | 2-3 lbs. AI/Acre | Apply into the bottom of the furrow at planting. Check label for allowable crops in rotation. | |
| | | **SPRAY FORMULATIONS** | | |
| | carbofuran (Furadan 4F)* | 0.50-1 lb. AI/Acre | Check label for allowable crops in rotation. | 14 days |
| | methamidophos (Monitor 4L)* | 0.75-1 lb. AI/Acre | | 7 days |
| | carbaryl (Sevin) | 1-2 lbs. AI/Acre | | 0 days |
| | endosulfan (Thiodan) | 1.5-2 lbs. AI/Acre | | 0 days |
| | azinphosmethyl (Guthion 2F)** | 0.5-0.75 lb. AI/Acre | | 7 days |
| | Penncap-M* | 1-2 qts./Acre | | 5 days |
| | fenvalerate (Pydrin)* | 0.1-0.2 lb. AI/Acre | Do not feed vines to livestock. | 7 days |
| | permethrin (Pounce)* | 0.1-0.2 lb. AI/Acre | Do not feed vines to livestock. | 7 days |

*EPA has classified this insecticide as a restricted use pesticide. Restricted use pesticides are to be applied by or under direct supervision of certified pesticide applicators only.

**Registered under state label in North Dakota.

| PEST | INSECTICIDE | DOSAGE | REMARKS | PTHI |
|---|---|---|---|---|
| | | **GRANULAR FORMULATIONS** | | |
| **COLORADO POTATO BEETLE:** | carbofuran (Furadan 15G)* | 2-3 lbs. AI/Acre | Apply into the bottom of the furrow at planting. Check label for allowable crops in rotation. | |
| Treat at about 10% defoliation with heavy infestations and with damage continuing | aldicarb (Temik 15G)* | 2-3 lbs. AI/Acre | Apply at planting time according to label directions. | 90 days |
| | disulfoton (Di-Syston 15G)* | 2-3 lbs. AI/Acre | Apply in furrow or as a band on each side of furrow at planting. | 75 days |
| Potatoes can tolerate 20-25% defoliation before yield will be affected. | phorate (Thimet 20G)* | 2-3 lbs. AI/Acre | Apply evenly in furrow at planting. | 90 days |
| | | **SPRAY FORMULATIONS** | | |
| | methamidophos (Monitor 4L)* | 0.75-1 lb. AI/Acre | | 14 days |
| | carbofuran (Furadan 4F)* | 0.5-1 lb. AI/Acre | Check label for allowable crops in rotation. | 14 days |
| | phosphamidon (Dimecron 8S)* | 0.5 lb. AI/Acre | | 14 days |
| | carbaryl (Sevin) | 1 lb. AI/Acre | | 0 days |
| | monocrotophos (Azodrin)* | 0.5 lb. AI/Acre | | 7 days |
| | azinphosmethyl (Guthion 2F)** | 0.5 lb. AI/Acre | | 7 days |
| | fenvalerate (Pydrin)* [2] | 0.075-0.1 lb. AI/Acre | Do not feed vines to livestock. | 7 days |
| | permethrin (Pounce, Ambush)* [2] | 0.1-0.2 lb. AI/Acre | Do not feed vines to livestock. | 7 days |

*EPA has classified this insecticide as a restricted use pesticide. Restricted use pesticides are to be applied by or under direct supervision of certified pesticide applicators only.

**Registered under state label in North Dakota.

[2] The University of Minnesota documented in 1985 that resistance to the pyrethroids fenvalerate and permethrin is in populations of the Colorado Potato Beetle in the Red River Valley. Potato growers who have encountered pyrethroid resistance problems in Colorado potato beetle control efforts are advised to switch to a registered organophosphate or carbamate insecticide. Producers who have not, as yet, had problems in achieving good potato beetle control at labeled rates of registered pyrethroids are advised to use the maximum rate recommended for these insecticides in the future. It is suggested that this class of insecticide be used only once per growing season in order to minimize development of resistance.

| PEST | INSECTICIDE | DOSAGE | REMARKS | PTHI |
|---|---|---|---|---|
| | | **GRANULAR FORMULATION** | | |
| **LEAFHOPPERS AND FLEA BEETLES:** | carbofuran (Furadan 15G)* | 2-3 lbs. AI/Acre | Apply into the furrow at planting. Check label for allowable crops in rotation. | |
| | aldicarb (Temik 15G)* | 2-3 lbs. AI/Acre | Apply at planting time according to label directions. | 90 days |
| | disulfoton (Di-Syston 15G)* | 2-3 lbs. AI/Acre | Apply in furrow or as a band on each side of furrow at planting. | 75 days |
| | phorate (Thimet 20G)* | 2-3 lbs. AI/Acre | Apply evenly in furrow at planting. | 90 days |
| | | **SPRAY FORMULATIONS** | | |
| | azinphosmethyl (Guthion 2F)** | 0.5 lb. AI/Acre | | 7 days |
| | oxydemetonmethyl (Meta-Systox-R) | 0.5 lb. AI/Acre | | 7 days |
| | methamidophos (Monitor 4L)* | 0.75-1 lb. AI/Acre | | 14 days |
| | phosphamidon (Dimecron 8E)* | 0.5 lb. AI/Acre | | 14 days |
| | carbaryl (Sevin) | 1-1.5 lbs. AI/Acre | | 0 days |
| | endosulfan (Thiodan) | 1 lb. AI/Acre | | 0 days |
| | monocrotophos (Azodrin)* | 0.5 lb. AI/Acre | | 7 days |
| | carbofuran (Furadan 4F)* | 0.5-1 lb. AI/Acre | Check label for allowable crops in rotation. | 14 days |
| | Penncap-M* | 8-16 oz./Acre | | 5 days |
| | fenvalerate (Pydrin)* | 0.1 lb. AI/Acre | Do not feed vines to livestock. | 7 days |
| | permethrin<br>(Ambush)*<br>(Pounce)* | <br>0.05-0.2 lb. AI/Acre<br>0.1-0.2 lb. AI/Acre | Do not feed vines to livestock. | 7 days |

*EPA has classified this insecticide as a restricted use pesticide. Restricted use pesticides are to be applied by or under direct supervision of certified pesticide applicators only.

**Registered under state label in North Dakota.

| PEST | INSECTICIDE | DOSAGE | REMARKS | PTHI |
|---|---|---|---|---|
| | | **GRANULAR FORMULATIONS** | | |
| **APHIDS:** a) Table stock: 30 aphids per 100 leaves. b) Seed stock: 10 aphids per 100 leaves. | carbofuran (Furadan 15G)* | 2-3 lbs. AI/Acre | Apply into the bottom of the furrow at planting. Check label for allowable crops in rotation. | |
| | aldicarb (Temik 15G)* | 2-3 lbs. AI/Acre | Apply at planting time according to label directions. | 90 days |
| | disulfoton (Di-Syston 15G)* | 2-3 lbs. AI/Acre | Apply in furrow or as a band on each side of furrow at planting. | 75 days |
| | phorate (Thimet 20G)* | 2-3 lbs. AI/Acre | Apply evenly in furrow at planting. | 90 days |
| | | **SPRAY FORMULATIONS** | | |
| | methamidophos (Monitor 4L)* | 0.25-1 lb. AI/Acre | | 14 days |
| | oxydemetonmethyl (Meta-Systox-R) | 6-8 oz. per Acre | | 7 days |
| | dimethoate (Cygon 4E) | 0.5-1 lb AI/Acre | | 0 days |
| | methomyl* (Lannate, Nudrin) | 0.5-1 lb. AI/Acre | | 6 days |
| | endosulfan (Thiodan) | 0.5-1 lb. AI/Acre | | 0 days |
| | monocrotophos (Azodrin)* | 0.5-1 lb. AI/Acre | | 7 days |
| | phosphamidon (Dimecron 8S)* | 0.5 lb. AI/Acre | | 14 days |

*EPA has classified this insecticide as a restricted use pesticide. Restricted use pesticides are to be applied by or under direct supervision of certified pesticide applicators only.

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