Crop Profile for Potatoes in Delaware

General Production Information

- Acres of white potatoes planted in Delaware were 5,300 (1996), 4,300 (1997) and 4,600 (1998).
- Acres of white potatoes harvested were 5,200 (1996), 4,200 (1997) and 4,600 (1998).
- Production figures were 1,248,000 CWT (1996), 966,000 Cwt. (1997), and 1,012,000 Cwt. (1998).
- Production values were $9,922,000 (1996), $7,970,000 (1997), and $8,501,000 (1998).

Production Regions

Potatoes can be grown in all three Delaware counties.

Cultural Practices

Potatoes are produced in greater quantities worldwide than any other vegetable. Members of the nightshade, potatoes are related to tomatoes, peppers and eggplants. The edible portion of the potato plant is the underground tuber that serves as food storage. Potato setting, or tuberization, occurs six to eight weeks after planting, or when the plant is in the early bud stage. In Delaware approximately 5,000 acres of potatoes are grown annually and shipped throughout the eastern United States and Canada. Many good varieties do well in Delaware:

Round Whites - Superior, Kennebec, Haig and Katahdin

Red Potatoes - Norland and Red LaSoda

Russets - Russet Burbank and Belrus

Planting

Plant potatoes any time the weather permits after March 15 until April 15. If potato tubers (which are
used as seed) are cut, seed pieces should be blocky and average about 2 ounces. Seed pieces should be
cut the day before planting to allow healing. Plant them in 36-inch rows with the seed pieces dropped
every 9 to 12 inches. Maintain soil pH at 5.5 to 6 to control scab, although many varieties are now scab
resistant.

Potatoes respond to high fertilization and frequent watering. Apply 3 to 4 pounds of 10-10-10 per 100
square feet. Sidedress when the plants are 6 inches high with 1/2 pound of ammonium nitrate per 100
foot of row. Cultivate weeds when they are young, before rows close in.

Insect Pests

Colorado Potato Beetle (CPB)

Damage and Life Cycle

The Colorado potato beetle, *Leptinotarsa decemlineata*, is the most important insect pest in potatoes in
the Northeast. Uncontrolled populations can completely devastate a potato field by late July (5). Adults
overwinter in the soil and emerge from late April through May, when they invade host crops. Adults
mate after they are established on the plants (8). This first generation of adults feeds on the foliage of
emerging plants and can do considerable damage when populations are high, although young plants
usually can outgrow the damage (5, 8). Females deposit eggs in clusters on the underside of leaves. A
single female can produce about 500 eggs in a 3 week period before she dies. The larvae hatch in 4 to 8
days and feed on foliage for about 3 weeks, often stripping plants of leaves and leaving only the main
branches. Because eggs are laid in clusters, larvae are distributed in clumps throughout the field (8).
Larvae grow through several stages, all of which feed on the foliage (5). When mature, they construct a
small spherical cell in the soil at the base of the plants, where they pupate. The second generation of
adults emerges in 5 to 10 days, and beetles mate to produce a second generation of larvae. Adult beetles
and larvae continue feeding on potato plants, but damage in midsummer is less severe because plants are
larger and because beetle egg production is inhibited at temperatures above 80°F. In Delaware, beetles go
through 2 generations and a partial third each growing season (8).

Frequency of Occurrence

The Colorado potato beetle is the most economically important insect pest of potatoes in the mid-Atlantic
and throughout the Northeast (5). It is an important management issue every year in Delaware. The
proximity of a field to overwinter sites is an important factor affecting the severity of early season
infestations (8).

Management
A variety of strategies are used in combination by Delaware growers to manage Colorado potato beetle populations. Crop rotation is critically important, and the growers plant potatoes as far as possible from fields previously planted in potatoes or other solanaceous crops. Scouting and treatment thresholds, as well as careful insecticide selection are also important (6).

When potatoes are planted in fields adjacent to beetles overwintering sites, a preplant or planting application of Imidacloprid (Admire) may be used (6). Fields are scouted twice weekly following plant emergence, and the number of colonizing adults is noted. Often adult numbers are not numerous enough to justify insecticide treatment and growers delay spraying until after the first generation of eggs have hatched (8). In Delaware, approximately 70% of the potato acreage is scouted for CPB. Throughout the season thereafter, fields are scouted weekly for CPB to determine the need to spray. At least 10 sites per field are inspected along a V- or W-shaped path. At each site, one stem from each of five adjacent plants are examined, and the number of CPB adults, large larvae and small larvae are counted. As a general guideline, if more than 50 adults or 75 large larvae or 200 small larvae are counted per 50 stems, an insecticide treatment is applied (6).

Chemical Controls

If Colorado potato beetle populations are expected to be high, as in situations where crop rotation is limited, a preplant or at-planting application of imidacloprid (Admire 0.9-1.3 fl oz 2F/1,000 row ft) is used as a preventative measure (6). According to the label, Admire is applied as a banded application during seedbed preparation, or in the furrow at planting, or is sidedressed on either side of the potato row at planting.

Foliar treatments are applied on an as-needed basis, based on scouting and established thresholds. Choice of insecticide is influenced by local adaptation of Colorado potato populations, which have developed varying levels of resistance to a number of products. The following foliar products are labeled for use on potatoes in Delaware:

**abamectin** (Agri-Mek 8-16 fl oz 0.15EC/A)- used on < 2% of the acres; best used on small to medium size larvae

**cryolite** (Kryocide, Prokil cryolite 10-12 lb 96WP/A) - used on 5% of the acreage; still provides very good control of larvae, not readily available

**Ecozin** (Azadiractin 11-21 fl oz EC/A)- Not used in DE

**azinphos-methyl** (Guthion 1.5 pt 2L/A)- Not used in DE

**phosmet** (Imidan 1 1/3 lb 70WP/A)- used on < 2% of the acres; only fair control

**imidacloprid** (Provado 3.75 fl oz 1.6F/A.)- Provado is not used in fields treated with Admire at
planting.]

**Endosulfan** (Thiodan 1.33-2.67 pt 3EC/A)- used on 2% of the acreage

**oxamyl** (Vydate L 1-4 pt 2L/A)- Not used in DE

**Bt: Bacillus thuringiensis tenebrionis** (Novodor)- Used only for small larvae. The first application is made when eggs begin to hatch and treatment is repeated at 5 to 7 day intervals for as long as small larvae are present. Not used in DE

**spinosaid** (Spintor - 4-6 oz/acre)- labelled in 1999 - used on 80% of the DE acreage in 1999 - good CPB control

**Insecticide Resistance Management**

The Colorado potato beetle has proven to be quite adaptive, and in some areas of the U.S. beetle populations have developed resistance to all major classes of insecticides. Insecticide management to slow the development of resistance is critical to insuring the continued effectiveness of the available chemical insecticides (9). Growers use all available management strategies for this pest, including crop rotation, scouting, following established treatment thresholds, and alternating insecticides with different modes of action (6). When insecticides are used, proper timing, rates, and good spray coverage are important. The same insecticide is not used for subsequent generations of beetles in the same field. Piperonyl butoxide is a chemical used by some growers in combination with organophosphates or pyrethroids to slow resistance. It works by blocking one of the beetle’s resistance mechanisms and thereby increases insecticide effectiveness. Further, it is important to be mindful of Colorado potato beetle resistance when managing other insect pests in potato (6).

**Alternative Controls**

Genetically engineered varieties of potatoes which express the toxic *Bacillus thuringiensis tenebrionis* protein are available and provide season-long control of Colorado potato beetles (6). These are very resistant to Colorado potato beetle damage (3).

**Cultural Practices**

Crop rotation is a critically important means of reducing or delaying Colorado potato beetle infestations (9). Potatoes are not planted in fields where solanaceous crops were planted the previous year, so that overwintering adults have a longer dispersal route to find potato hosts (8). The resulting reduction or delay in colonization affects the rate of resistance development in the beetle population and can greatly influence the overall success of a Colorado potato beetle management program (9).

**Natural Enemies**
Colorado potato beetles have several natural enemies, but these do not normally provide sufficient control of the pest (9).

**Potato Leaf hopper**

**Damage and Life Cycle**

Potato leafhopper is an annual serious pest of potatoes that causes significant crop damage, even when populations are low (9, 11). It also attacks beans and a range of other vegetable crops. Adults overwinter in the South and move into the mid-Atlantic area each spring (11). Adults insert eggs singly into stems or leaf veins of susceptible plant species. Eggs hatch in 7 to 10 days, and nymphs develop into adults over a period of 2 to 3 weeks (9). Both adults and nymphs feed by piercing the underside of leaves and sucking plant juices. As they feed, they inject a toxin into plant tissues which is taken up by the plant and inhibits normal development by disrupting the flow of nutrients from photosynthetic tissues to the rest of the plant (9, 11). Early symptoms of leafhopper feeding include a rolling and yellowing of the leaves. Leaves later turn brown and die (9). High levels of leafhoppers in potatoes can cause extensive leaf-yellowing known as "hopper burn," although many varieties show few symptoms of hopper burn and yet can incur significant yield losses (6, 9). Yield losses from potato leaf hoppers can be substantial (9).

**Frequency of Occurrence**

Potato leafhopper is a serious annual pest of potatoes in Delaware. Even relatively low numbers of leafhoppers can cause a significant yield reduction (9). Because nymphs are susceptible to desiccation, populations tend to be lower during very dry summers (11).

**Management**

Fields are monitored from early June through early August for the buildup of potato leafhoppers (6). Sweep net samples are used to monitor adult populations and leaves are inspected for the presence of nymphs (11). Growers make a foliar insecticide application when adult counts exceed 1 per sweep or if more than 1 nymph per 10 leaves is found (6). Admire applied at planting and foliar insecticides applied on as an needed basis are the only means of controlling potato leafhoppers.

**Chemical Controls**

The following insecticides are labeled to control leafhoppers on potatoes in Delaware:

**Preventive Applications:**

**imidacloprid** (Admire 0.9-1.3 fl oz 2FS/1,000 row ft) [According to the label, Admire is applied as a banded application during seedbed preparation or in the furrow at planting or sidedressed on either side}
of the potato row at plating.] used on 30% of the acreage, providing good control.

Rescue Treatments:

**imidacloprid** (Provado 3.75 fl oz 1.6F/A.)- [Provado is not used in fields treated with Admire at planting.] used on 60% of the acreage, provides good control

**permethrin** (Permethrin 4-8 fl oz 3.2EC/A) - used on 30% of the acreage; good control

**esfenvalerate** (Asana XL 5.8-9.6 fl oz 0.66EC/A) - used on 5% acreage; good control

**dimethoate** (0.5-1 pt 4EC/A) - used on 2% of the acreage

**phosmet** (Imidan 1 1/3 lb 70WP/A) - used on 5% of the acreage

**methomyl** (Lannate-1.5-3 pt LV/A) - Not used in DE

**endosulfan** (Thiodan 1.33-2.67 pt 3EC/A) - Not used in DE

**oxamyl** (Vydate L 1-4 pt 2L/A) - Not used in DE

Alternative Controls

No alternative controls are used in the management of this pest.

**Aphids:**

Green Peach Aphid, Potato Aphid, and Melon Aphid

Damage and Life Cycle

Several species of aphids feed on potatoes, and all inflict similar types of injury to plants. Aphids overwinter as eggs on a variety of host plants. Green peach aphids overwinter in the south and migrate into our area, or overwinter in greenhouses and are introduced with bedding plants. Potato aphids overwinter as eggs on wild and cultivated rose plants, and certain weed species including lambsquarters, yellow mustard, and redroot pigweed (5) Aphid nymphs hatch in spring and feed until they mature. Adults of this first generation reproduce sexually, bearing live young which mature into winged adults and migrate onto crops. This generation feeds on plants and rapidly reproduces asexually, with a generation time of 5 to 7 days. Many overlapping generations occur, and populations can increase rapidly. Most species of aphids produce a winged, sexually reproductive generation near the end of the growing season (9).
Green peach aphids and potato aphids are the most important of several aphid species that attack potatoes in Delaware. The melon aphid can also cause significant damage. All three aphid species attack plants throughout the growing season, but damage is usually worst in May and June, and again in the fall. Aphid infestations commonly begin in small scattered areas over the field. Aphids are found primarily on the underside of the leaves, where they suck sap from the plant. Green peach aphids favor mature lower leaves while potato aphids are found primarily on terminal leaves and young stems (8). Infested leaves curl downward and may turn brown and die (9). When infestations are heavy, aphid damage can reduce plant vigor, size and yield, and may kill the plants. (8).

Frequency of Occurrence

The green peach aphid is a major pest of potatoes everywhere they are grown (10). The green peach aphid and the potato aphid are the most common species of aphids found on potatoes grown for the fresh market in the Northeast (5). The melon aphid is also found on potatoes in our area (6). Aphids are present every year, but typically affect potato yields only when their populations reach very high levels.

Management

Fields are scouted for the presence of aphids 2 or 3 times during the growing season, in May and early June for the potato aphid, and in late June for the green peach aphid (8). Scouting is done by looking for wilting and curled leaves throughout the field. When aphids are detected, more intense sampling is done to determine infestation levels and natural enemy activity. An insecticide is applied to control potato aphids and green peach aphids if combined counts exceed 2 per leaf prior to bloom, 4 per leaf during blooming, or 10 per leaf within 2 weeks of vine killing. For melon aphids, the thresholds are lower: 1 per leaf prior to bloom, 2 per leaf during blooming, or 5 per leaf within 2 weeks of vine killing (6).

Chemical Controls

The following insecticides are labeled to control aphids on potatoes in Delaware:

imidacloprid (Admire 0.9-1.3 fl oz 2FS/1,000 row ft)- [According to the label, Admire is applied as a banded application during seedbed preparation or in the furrow at planting or sidedressed on either side of the potato row at plating (Label).] used on 30% of the acreage; very good control

imidacloprid (Provado 3.75 fl oz 1.6F/A.)- Provado is not used in fields treated with Admire at planting. Used on 10% of the acreage

dimethoate (0.5-1 pt 4EC/A)- [Potato aphid only] not used in DE.

methomyl (Lannate--1.5-3 pt LV/A)- [The most effective product against melon aphid] not used in DE

methamidophos (Monitor 1.5-2 pt 4 Liquid Insecticide/A)- [Potato aphid and green peach aphid only]
used on 5% of the acres in recent years in DE

**endosulfan** (Thiodan l.33-2.67 pt 3EC/A)- [Potato aphid and green peach aphid only] None in DE

**oxamyl** (Vydate L 1-4 pt 2L/A)- [Potato aphid and green peach aphid only] None in DE

**Natural Enemies**

Aphids may be controlled naturally by parasitic wasps and a variety of predators, including lady beetles and their larvae, lacewing larvae, and syrphid fly larvae. When making a treatment decision, natural enemy populations are considered (8). During periods of high humidity, fungal diseases may also help reduce aphid populations.

**European corn borer**

(Ostinia nubilalis)

**Damage and Life Cycle**

The European corn borer feeds on a wide variety of crops, including potatoes. It overwinters as a mature larva in its burrow in the sweet corn stalk or in the stem of a different host plant (5). Larvae pupate in late April or early May, and adults emerge in late May or early June (11). Female moths lay their eggs on the underside of leaves or on stems (9). A single female can produce as many as 500 eggs during her lifetime (5). Eggs hatch in 4 to 7 days (depending on temperature) and young larvae feed on plant foliage for 7 to 12 days before boring into the stems (11). Stem damage weakens the plant by interfering with translocation of water and nutrients. This insect produces 2 to 3 generations a year in the mid-Atlantic area (11). The stem boring activities of the first larval generation cause the most damage to potatoes in Maryland (9). Insecticide sprays made to control other potato pests in July and August, and the availability of preferred hosts, prevent later generations from causing extensive damage to potatoes (5).

**Frequency of Occurrence**

European corn borer is a major pest of field corn and sweet corn throughout the United States and Canada, and feeds on a large range of other host plants, including potato (5). The timing and extent of damage to the potato crop can fluctuate from year to year and from region to region (12). Moth populations can fluctuate considerably annually as well (13).

**Management**

A degree-day system has been established for predicting the life stages of the first generation. Scouting begins at 500 degree days and continues through 700 degree days or when egg masses are less numerous. Scouts count egg masses on the undersides of leaves on the bottom half of the plant. More than 1 egg mass per 25 leaves may indicate a problem. Black light traps are also used to monitor populations of
adults. Catches exceeding 25 adults per night indicate that adult may produce enough eggs to justify an insecticide treatment (9).

Chemical Controls

Proper timing of foliar insecticide sprays is critical for successful control. Growers apply the first spray when 10-25% of the terminal tips have entry holes. A total of 2 or 3 applications are made on a 5 to 10 day schedule. If a pyrethroid (Asana XL, Baythroid or Permethrin) is used, the first application is made when 8 to 10 European corn borer moths are being trapped in local pheromone or blacklight traps. Two to 3 additional applications are then made at 5 to 7 day intervals, based on moth activity (6).

The following insecticides are labeled to control ECB on potatoes in Delaware (6):

Rescue Treatments:

azinphos-methyl (Guthion 1 qt 2L/A)- None used in DE

methamidophos (Monitor 1. 5-2 pt 4/A)- used on 2% of the acreage- effective control

methyl parathion (Penncap-M 2-4 pt 2FM/A) ) used on < 2% of the acreage in DE; provides effective control

permethrin (Permethrin 4- 8 fl oz 3.2EC/A)- used on 40% of the acreage ; very good control

esfenvalerate (Asana XL 5.8-9.6 fl oz 0.66EC/A) used on 2% of the acreage- poor corn borer control

spinosaid (Spintor 4 - 6 oz/acre)- used on 30% of the acreage -good control

Alternative Controls

Resistant Varieties: none available that are commercially used in Delaware.

Natural Enemies

There are several natural enemies of European corn borer, but these rarely provide sufficient control. Also, enemy populations are often depleted by the use of insecticides to control European corn borer and other pest species in potatoes (5).

Wireworms

Damage and Life Cycle
Wireworms, the larvae of click beetles (Elateridae), feed on a variety of crop and non-crop plants. Several species of wireworms attack potatoes and can damage seed pieces, roots, and tubers. Most species spend 2 to 4 years in the larval stage, so adults and immatures may be present during the growing season (10). Adults emerge in May or June. Eggs are deposited in the soil in late spring (5). Larvae infest the soil, hollowing out seed pieces, pruning roots, and feeding on developing shoots. This damage makes plants more susceptible to fungal infection and other diseases. Damaged tubers have round entry holes. After 2 to 4 years of development and feeding, mature larvae pupate in the soil before emerging as adults to continue the cycle. Larvae and pupae overwinter deep in the soil (10).

Frequency of Occurrence

Wireworms are considered a major pest problem in potatoes. Populations are often greater in fields previously planted in cereal crops (10). Wireworm populations are also favored by planting into situations with heavy amounts of crop residue, continuous small grains, or a rotation with field corn with no soil insecticide at planting.

Management

Soils can be sampled for wireworms prior to planting in fields that have a history of infestation, or fields previously planted in cereal or sod (10). As a general guideline, a soil insecticide is needed if 5 or more wireworms are found in 20 soil samples.

Chemical Controls

Soil insecticides are the only chemical means for controlling wireworms. They are applied in the spring when the soil temperature at the 6-inch depth is at least 50° F (10° C) and soil moisture is equivalent to that desired for planting. Frequently, the insecticide is applied immediately before or at planting.

The following products are labeled for use in Delaware. (6):

Preplant Application:

- **diazinon** (Diazinon AG500), broadcasted and incorporated into soil just before planting) to be used on 10% of the acreage in 2000

- **ethoprop** (Mocap 40-60 lb l0G/A, broadcasted and incorporated just before planting) method not used in DE

At Planting Application:

- **ethoprop** (Mocap 30 lb l0G/A, in the row)- used on 30% acres in DE; fair - good control
**phorate** (Thimet 15 oz 15G/1,000 ft of row)- used on 30% of the acreage; fair control

**Alternative Controls**

Crop rotation or frequent cultivation of the soil may help to reduce wireworm populations in the soil. Growers avoid planting in fields high in organic matter (5).

**Cutworms**

**Damage and Life Cycle**

A number of cutworm species attack crop plants. They are active mainly at night, and hide in soil or debris during the day (5). Variegated cutworms feed primarily on potato foliage on lower stems. Black cutworms feed mainly on stems at or below the soil surface, but will also feed on foliage (6). First generation larvae may attack young seedlings, often snipping stems near the soil surface (5, 6). Most cutworm species overwinter as late instar larvae (5). Adults emerge in early to mid summer, and are present in our area during July and August (6). Some species, possibly the black cutworm, overwinter farther south and adults migrate into our area (15). Females deposit eggs on debris, grasses, or weed leaves and stems (5). Weedy or minimum-tillage fields are favored egg-laying sites (6). Eggs hatch in 5 to 14 days, depending on species (5, 15). Larvae develop through several instars, feeding on plants for weeks before pupating in the soil. Cutworms may also attack exposed tubers through cracks in the soil, leaving shallow feeding holes (5, 6). One to three generations occur each year, depending upon species (5).

**Frequency of Occurrence**

Cutworms are a minor pest of potatoes in Delaware (14). There is considerable variation in this pest regionally. Moth populations can fluctuate considerably from year to year as well (13). In dry years, low lying areas of the field are more subject to attack than other areas (6).

**Management**

For cutworms that feed below the ground, neither foliar nor systemic insecticides are effective. In fields where high cutworm populations are expected, a broadcast incorporated insecticide may be applied and worked into the soil immediately prior to planting. Whether or not this strategy is used, fields are scouted for cutworm damage after plant emergence. Protective sprays are applied if more than 6 variegated cutworms are found per plant, or if more than 10% feeding damage is incurred. Also, if cutworms are actively cutting plants, a contact insecticide is applied at the base of plants at night (6).

**Chemical Controls**
Insecticides should be applied at the base of plants at night, with a high volume of water, to achieve the best possible control (5). The following insecticides are labeled to control cutworms on potatoes Delaware (6). In 1999, damage was significantly higher however, no sprays have been applied for this pest in Delaware

**Esfenvalerate** (Asana XL 5.8-9.6 fl oz 0.66EC/A)

**Methomyl** (Lannate 1.5-3 pt LV/A)- [variegated cutworm only]

**permethrin** (Permethrin 4-8 fl oz 3.2EC/A)

**carbaryl** (Sevin 2.5 lb 80S/A)

**carbaryl** (Sevin bait 40 lb 5% bait/A)

**Alternative Controls**

A number of predators and parasites help to reduce cutworm populations, including birds, ground beetles, parasitic wasps and flies, and diseases (5, 10). Plowing in the fall may be used to destroy some life stages (5). Good weed control is important, since moths often favor weedy sites to deposit eggs (6).

**Potato Flea Beetle**

**Damage and Life Cycle**

Potato flea beetle (*Epitrix cucumeris*) is common throughout the Northeast and is known to transmit early blight and bacterial ring rot. It feeds on a variety of crops including eggplant, tomatoes, peppers, and potatoes. Adult beetles overwinter in crop debris or weedy areas near fields and become active in early spring. They feed on a variety of herbaceous plants until potatoes emerge. Eggs are deposited on the soil at the base of plants, about 100 eggs per female. Larvae emerge after about 10 days and burrow into the soil, where they feed on roots, sprouts, and tumors, weakening plants and sometimes killing seedlings. They pupate in the soil. Adult beetles emerge and burrow to the surface. They climb onto plants and chew small holes in the foliage which can facilitate the entry of plant pathogens. Beetles may also spread diseases from plant to plant as they feed. The life cycle takes 4 to 6 weeks to complete. There are two to three generations per year in Delaware. Young plants attacked early in the season suffer the most damage (5).

**Frequency of Occurrence**

Potato flea beetle is an occasional pest in our area, but it is usually controlled by insecticide applications made to control other insect pests (3).
Management

Chemical control specifically for flea beetles is not needed every year, probably due to inadvertent control of beetles by insecticide applications made for other insect pest species (3). Chemical control may be utilized when the first generation population is high, to reduce the potential for disease transmission and prevent later populations from reaching economic levels.

Chemical Controls

The following insecticides are labeled to control flea beetles on potatoes in Delaware (6)

Preventive Applications

**imidacloprid** (Admire 0.9-1.3 fl oz 2FS/1,000 row ft)- [According to the label, Admire is applied as a banded application during seedbed preparation or in the furrow at planting or sidedressed on either side of the potato row at plating.] -mainly used for CPB, aphid and PLH control but will also provide very good flea beetle control.

Rescue Treatments:

**permethrin** (Permethrin 4-8 fl oz 3.22EC/A)

**esfenvalerate** (Asana XL 5.8-9.6 fl oz 0.66EC/A)

**phosmet** (Imidan 1 1/3 lb 70WP/A)

**methomyl** (Lannate--1.5-3 pt LV/A)

**endosulfan** (Thiodan l.33-2.67 pt 3EC/A)

**oxamyl** (Vydate L 1-4 pt 2L/A)

Alternative Controls

Control of early spring weeds near potato fields and cultivation are used to reduce overwintering and reservoir populations of flea beetles (5).

White grubs

(Scarabidae)

Damage and Life Cycle White grubs are the larval stage of beetles in the scarab family. They have a
broad host range, feeding on over 200 species of plants, including most vegetable crops (5). Females prefer to lay their eggs in fields which have extensive weed growth during mid-summer (16). Larvae hatch during late-summer and move through the soil where they feed on developing tubers, leaving large, shallow, round holes. Since there are no foliar symptoms of grub feeding, beetles may do extensive damage to tubers before the grower is aware of a problem. Damage is usually worst in fields previously planted in sod or pasture (5). White grubs feed and develop as larvae for 1 to 4 years, depending upon the species (16).

Frequency of Occurrence

White grubs are a minor pest of potatoes (14). Like wireworms, white grubs are most commonly found in fields where the preceding crop was sod or other grasses (16). They thrive best in cool, wet soils (9).

Chemical Controls

No insecticides are labeled to control grubs in potatoes. However, insecticides labeled for wireworm control provide some degree of white grub suppression.

Weeds

Weeds cause economic loss in potatoes in several ways. These include competition for nutrients, space, water and light, which will reduce yields; and a reduction in the efficiency of harvesting. Weeds may also act as reservoirs for insect pests and diseases. Most weeds produce numerous seeds, many of which can remain in the soil and increase weed populations for years. Therefore, proper weed management is essential not only for this years crop, but for years to come (7)

Weed Management

Non-chemical Controls

Herbicides are used in conjunction with cultivation and cultural control practices to achieve good weed control in potatoes. Where possible, growers select cultivars that compete well with weeds, and plant rows close together to discourage weed growth (5). Weeds carried over from previous crops in the rotation are reduced through use of certified seed for all crops in the rotation. The spread of weeds from one field to another is minimized by cleaning farm equipment between uses in different fields. Maintaining good weed control around field borders and fence rows is important, as these are a potential source for insect pests and disease as well as weed seeds. Growers do this by planting competitive grasses at field borders and keeping these areas free of weeds. Well-planned crop rotations are also an important strategy growers use to reduce weed pressure (7). Cultivation is a critical part of weed management in potatoes, but it must be done with great care to avoid damage to the plants and yield loss.
Fields must be cultivated while the target annual weeds are small to achieve effective control (7).

**Scouting**

Fields are scouted to identify the weeds in each field and select recommended herbicides that control those weeds (6). Scouting is done within 4 weeks of crop emergence to determine the effectiveness of preplant incorporated and preemergent herbicides. Scouting can determine if a postemergent product is needed, what products should be used, and assure that the application is made while weeds are still small and susceptible. Fields are scouted again 4 or 5 weeks before vine kill to increase harvest efficiency and to plan weed control strategies for the next cropping season (5).

**Chemical Controls**

**I. Preplant Incorporated and Preemergent Herbicides**

Preplant incorporated and preemergence herbicide selection is based on the mixture of weeds present in the field, soil type, and the percent of organic matter in the soil (6).

**EPTC** -- Growers apply 3 - 4.5 lb ai per acre (3.4 - 5.1 pt/A of Eptam 7E or 30 to 45 lb/A of Eptam 10G) at one of three times: (1) immediately before planting and disking (this treatment is used for early season control of nutsedge and other weeds, but on plantings before April 1, it may reduce early vigor and yields slightly); (2) immediately after drag-off cultivation, incorporated into sod; (3) just prior to the first or second cultivation (this treatment is best for late-season control of nutsedge and other weeds). EPTC is not applied within 45 days of harvest. This herbicide primarily controls annual grasses, yellow nutsedge, and a few broadleaf weeds (6).

**Linuron** -- Growers apply 0.4 - 1 lb ai per acre (0.8 - 2 lb/A Lorox 50DF) after planting or before potatoes emerge, but after final drag-off and before grasses are 2 inches tall and before broadleaf weeds are 6 inches tall. Linuron mainly controls broadleaf weeds, and is tank-mixed at low rates with metolachlor or pendimethalin, or used in addition to EPTC for preemergence annual grass control. Lower rates of linuron are used if tank-mixed (6).

**Metolachlor** -- Growers apply 1.25 - 3 lbs ai per acre (1.25 - 3 pt/A of Dual 8E) before potatoes emerge, but after final drag-off. This product will primarily control annual grasses. Nutsedge control may be adequate if weed pressure is light. Metolachlor is tank-mixed with linuron or metribuzin for broadleaf weed control (6).

**Metribuzin** -- Growers apply 0.38 - 0.5 lb ai per acre (0.5 - 0.66 lb/A of Sencor or Lexone 75DF or comparable rates of liquid formulation) just prior to emergence. If drag-off is practiced, then the application is made after drag-off. Metribuzin primarily controls broadleaf weeds, and is tank-mixed with metolachlor or pendimethalin, or used in addition to EPTC for preemergence annual grass control. Metribuzin is not applied within 60 days of harvest (6).
**Pendimethalin** -- Growers apply 0.5-1.5 lbs ai per acre (1 to 3 pts/A of Prowl 4EC) before potatoes emerge. Pendimethalin controls certain broadleaf weeds, including velvetleaf, and early-season annual grasses, but does not control yellow nutsedge. This product is combined with linuron to improve velvetleaf control, or with linuron or metribuzin to improve the control of most other broadleaf weeds (6).

II. Postemergence Herbicides

Growers apply postemergence herbicides when crop and weeds are within the recommended size and/or leaf stage to maximize weed control and minimize crop damage (6).

**Rimsulfuron** -- Growers apply 0.0156 lb ai per acre (1 oz/A of Matrix 25DF) soon after emergence to control many weeds including foxtail species, pigweed species, wild mustard, and wild radish. Common lambsquarter, common ragweed, jimsonweed, morningglory species, and yellow nutsedge may only be suppressed by rimsulfuron. This product is tank-mixed with reduced rates of metribuzin to increase the spectrum of weeds controlled. A second application 2 to 4 weeks after the initial spray is used to improve the suppression or control of common purslane and perennial weeds, such as field and hedge bindweed. Results tend to be most effective when used following a preemergence residual weed control program. To improve weed control, growers add nonionic surfactant to be 0.25 percent of the spray solution (1 quart per 100 gallons of spray solution). Growers do not exceed 2 ounces of Matrix 25DF per acre per year. Rimsulfuron is an ALS inhibitor and is always used in combination with other herbicides with different modes of action to prevent the development of resistant weed populations (6).

**Metribuzin** -- Growers apply 0.25 - 0.5 lb ai per acre (0.33 - 0.66 lb/A of Lexone or Sencor 75DF) before weeds are 1 inch tall. Metribuzin mainly controls broadleaf weeds. It is applied only if there have been at least three successive sunny days prior to application. It is not used on red-skinned or early maturing, smooth, white-skinned varieties. Treatment can cause some yellowing or minor burn (6).

**Sethoxydim** -- Growers apply 0.2 - 0.4 lbs ai per acre (1 - 2 pts/A Poast 1.5EC with oil concentrate added to be 1 percent of the spray solution) after emergence to control annual grasses and certain perennial grasses. For best results, growers treat annual grasses when they are actively growing and before tillers are present. Control may be reduced if hot, dry weather or drought conditions occur. Repeated applications may be needed to control certain perennial grasses. Yellow nutsedge, wild onion, or broadleaf weeds will are not controlled by sethoxydim. Growers do not tank-mix with or apply within 2 to 3 days of any other pesticide unless labeled, as the risk of crop injury may be increased, or reduced control of grasses may result. No more than 5 pints per acre of Poast is applied during the growing season, and a minimum preharvest interval of 30 days is observed (6).

III. Postharvest

**Glyphosate** - Growers apply 2 - 5 lbs ai per acre (2 - 5 qts/A of Roundup Ultra 4SC) in the fall after harvest to control perennial grasses and broadleaf weeds, including quackgrass, field bindweed, Canada
thistle, and others. (Rate varies depending on the weed population.) Application is delayed after harvest (but applied prior to the first frost) to allow for adequate weed regrowth to intercept the spray. Growers do not till or mow for 1 week after application (6).

Chemical Control Issues for Herbicides

Table 2. Potato herbicides for grasses and sedges.

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Barnyard-grass</th>
<th>Crabgrass, Large</th>
<th>Fall Panicum</th>
<th>Foxtail sp.</th>
<th>Goosegrass</th>
<th>Johnsongrass (seedling)</th>
<th>Yellow nutsedge</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Preemergence or Preplant Incorporated:</strong></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EPTC</td>
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<td>G</td>
<td>G</td>
<td>G</td>
<td>G</td>
<td>G</td>
<td>N</td>
</tr>
<tr>
<td><strong>Preemergence:</strong></td>
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</tr>
<tr>
<td>linduron</td>
<td>F</td>
<td>P/F</td>
<td>P</td>
<td>F</td>
<td>P/F</td>
<td>-</td>
<td>N</td>
</tr>
<tr>
<td>metolachlor</td>
<td>G</td>
<td>G</td>
<td>G</td>
<td>G</td>
<td>G</td>
<td>G</td>
<td>F/G</td>
</tr>
<tr>
<td>metribuzin</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>-</td>
<td>N</td>
</tr>
<tr>
<td>pendimethalin</td>
<td>G</td>
<td>G</td>
<td>G</td>
<td>G</td>
<td>-</td>
<td>G</td>
<td>N</td>
</tr>
<tr>
<td><strong>Postemergence:</strong></td>
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</tr>
<tr>
<td>rimsulfuron</td>
<td>G</td>
<td>F</td>
<td>F/G</td>
<td>G</td>
<td>P</td>
<td>-</td>
<td>F</td>
</tr>
<tr>
<td>metribuzin</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>-</td>
<td>-</td>
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<tr>
<td>sethoxydim</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>

Herbicide performance is affected by weather, soil type, herbicide rate, weed pressure and other factors. These ratings indicate ONLY relative effectiveness in tests conducted by the University of Delaware, University of Maryland System, The Pennsylvania State University, Rutgers, The State University of New Jersey, and Virginia Polytechnic Institute and State University. Actual performance may be better or worse than indicated in this chart (*). (Table modified from 1999 Commercial Vegetable Production Recommendations, University of Maryland Cooperative Extension Bulletin 236)

**Key:** G = good, F = fair, P = poor, N = no control, I = insufficient data

Table 3. Potato herbicides for broadleaf weeds
<table>
<thead>
<tr>
<th>Preemergence or Preplant Incorporated:</th>
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</thead>
<tbody>
<tr>
<td>EPTC</td>
</tr>
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<tr>
<td>linduron</td>
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<tr>
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<tr>
<td>pendimethalin</td>
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**Vine Killing and Storage**

**Vine Killing**

Potato vines must be killed prior to harvest. Vine death signals an end to tuber growth and promotes the formation of the outer skin. Timing is important. Tubers harvested too soon after vine kill will be more prone to injury and early and late blight infection during harvest. Tubers left in the ground too long after vine kill may be damaged by frost or may have excessive *Rhizoctinia* sclerotia on the tuber surface. For most cultivars, a period of 10 to 14 days after vine kill is sufficient to allow tubers to mature (7).

The following desiccants are used for vine killing (6):

**Endothall** – Growers apply 0.75 to 1 lbs per acre (1.5 - 2 qts/A of Desicate II), mixed with ammonium sulfate and a surfactant, 10 to 14 days before harvest. Higher rates are applied if vine growth is vigorous or if weather is cool and cloudy.

**Diquat** – Growers apply 0.25 lbs per acre (1 pt/A of Diquat 2SC in 20 to 100 gallons of water) with a nonionic surfactant. Application is repeated after 5 days if needed. Tubers are harvested 7 days post-treatment.
Paraquat – Growers apply 0.4 to 0.6 lb ai/A (1 to 2 pts/acre of Gramoxone Extra 2.5SC) with 50 to 100 gallons of water at least 3 days prior to harvest. Paraquat works well on grassy fields, but is not used on vigorously growing vines if potatoes will be stored or used for seed.

Storage

Vines of potatoes going into storage are killed 14 to 21 days before harvest. Tubers are maintained at a temperature of 50° to 60°F for the first 2 to 3 weeks, to promote healing of cuts and bruises. After this, the storage temperature for table stock or seed potatoes is lowered to 40°F. If the potential for rot is high, the curing period is eliminated a storage temperature of 45°F is used until the crop is sold (6).

Sprout inhibitors are applied directly to tubers after cuts and bruises from harvesting have healed. Growers use chlorpropham (Chloro IPC or Sprout-Nip) (6).

Contacts

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Authors:

- Joanne Whalen - INSECTS
- Mark Van Gessel - WEEDS
- Susan Whitney - General Information

Portions of this crop profile were adapted from the draft potato crop profile written by Al Fournier, University of Maryland.

References


10. Integrated Pest Management for Potatoes in the Western United States. University of California, Division of Agriculture and Natural Resources. Publication 3316. 1986.


[1] FOOTNOTES:

Imidan 50WP has been changed to Imidan 70W at 1 1/3 lb/acre for control of Colorado Potato Beetle, Potato leaf hopper, and Potato Flea Beetle. Raven is no longer available for insect control and has been deleted for use on Colorado Potato Beetle. The only BTt product available for potatoes is Novodor Ambush 2EC and Pounce 3.2 EC have been changed to Permethrin 3.2EC for use against Cut Worms, Potato Flea Beetle, Potato Leafhopper, and European Corn Borer. Di-Syston (disulfoton) is not labeled for potato and has been deleted from this crop profile for use against Potato Leafhopper, wireworms, and Potato Flea Beetle. Monitor LV has been changed to Monitor 4 Liquid Insecticide (1.5-2 pt /A) for use against Potato aphid, green peach aphid, and European Corn Borer Delaware has a 24C label for Diazinon AG500 (3-4 qt/acre at planting; PHI 35 days) from Maketism Agan as of 2006 for wireworm control.