

## POTATO INSECTS

Other resources available through NDSU Extension Service:

Publications	E1001	Potato Leafhopper Biology and Control
	EB No. 26	Potato Production and Pest Management in North Dakota and Minnesota
Video	282	Potato Production in the Red River Valley

### APHIDS

Aphids are major pests of seed potatoes because they transmit viruses which lead to rejection of the seed lot. For this reason, seed producers must keep aphid numbers lower than what can be tolerated on table stock. The most common aphid found on potato is the green peach aphid, an important vector of potato leaf roll virus (PLRV). Many aphids can transmit potato virus Y (PVY). Control measures are targeted specifically against aphids to keep virus spread to a minimum in seed production; control is not as common in normal commercial production.

**Threshold:**

**Seed Stock** . . . To prevent the spread of PLRV, treat when aphid populations reach levels of 10 aphids per 100 leaves. Insecticides will not effectively prevent the spread of PVY.

**Table Stock** . . . To prevent a yield loss from direct feeding by aphids, treat when aphid densities reach 30 aphids per 100 leaves. Sample only middle to lower leaves; aphids will rarely be found on young leaves.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>acetamiprid</b> Assail 30SG	0.028 - 0.075	1.5 - 4.0 oz	Use high rate under heavy pest pressures or dense foliage. Aphid species may differ in susceptibility to this product. If you are unsure of the aphid species present and its susceptibility, use the higher rate. Do not make more than 4 applications per season. Do not apply more than once every 7 days. Do not apply less than 7 days before harvest. Do not exceed a total of 0.3 lb ai (16 fl oz) per acre per season. Apply a minimum of 5 GPA of water by air and 20 GPA of water by ground. Thorough coverage is important to obtain optimum control. There are no rotational crop plantback restrictions.
Assail 70WP	0.044 - 0.075	1.0 - 1.7 oz	
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.022	2.8 fl oz	PHI = 0 days. Maximum of 16.8 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 5-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. If more than 5.6 fl oz per acre is applied, allow at least 14 days between last application and grazing.
<b>bifenthrin + zeta-cypermethrin</b> Hero Pending 2008 <i>RUP</i>	0.05 - 0.103	5 - 10.3 fl oz	
<b>bifenthrin</b> Brigadier Pending 2008 <i>RUP</i>		4.2 - 6.14 fl oz	PHI = 21 days. Allow 7 days between applications. Maximum use rate of 25.6 fl oz total per season. An adjuvant, MSO, NIS, or COC may be tank-mixed.
<b>pymetrozine</b> Fulfill	0.086	2.75 - 5.5 oz	PHI = 14 days. Do not apply more than 11 oz of Fulfill per acre per season. Allow 7 days between applications.
<b>clothianidin</b> Belay 50 WDG	0.031 - 0.047	1 - 1.5 oz	PHI = 14 days. Allow 7 days between applications. Do not apply more than 3 applications per season.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>clothianidin</b> Belay 16 WSG	0.0132 - 0.2	13.2 - 20 oz	Soil Application: Apply once at preplant, preemergence or at ground cracks using one of the following methods: 1) In a narrow band center on the plant row in the bedding operation just prior to planting, 2) In-Furrow spray at planting. Direct spray in the furrow on the seed pieces or potatoes. 3) As a side dress to both sides of the row or as a spray at ground crack directly over the row during hilling. Cover immediately with soil. Do not apply more than 0.2 lb ai (20 oz) per acre per season.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.044	2.8 fl oz  (pest suppression)	PHI = 0 days. Maximum of 16.8 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 5-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. If more than 5.6 fl oz per acre is applied, allow at least 14 days between last application and grazing.
<b>deltamethrin</b> Delta Gold <i>RUP</i>	0.018 - 0.028	1.5 - 2.4 fl oz (suppression)	PHI = 3 days. Allow 3 days between applications. Do not apply more than 12.0 fl oz per acre per season.
<b>dimethoate</b> Digon 400 Dimethoate 400 Dimethoate 2.67 EC	0.38 - 0.75	¾ - 1½ pt	No preharvest interval. Do not enter treated fields without protective clothing until sprays have dried.
<b>dinotefuran</b> Venom 70 SG	0.050 - 0.075  0.28 - 0.33	FOLIAR: 1 - 1.5 fl oz  SOIL: 6.5 + 7.5 fl oz	Foliar Application: PHI = 7. Do not apply more than 4.5 fl oz per acre per season. Soil Application: Apply once at preplant, preemergence or at ground cracks using one of the following methods: 1) In a narrow band center on the plant row in the bedding operation just prior to planting, 2) In-Furrow spray at planting. Direct spray in the furrow on the seed pieces or potatoes. 3) As a side dress to both sides of the row or as a spray at ground crack directly over the row during hilling. Cover immediately with soil. Do not apply more than 12 fl oz per acre per season.
<b>esfenvalerate</b> Asana XL <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 7 days. Do not graze livestock on treated vines.
<b>flonicamid</b> Beleaf	0.036 - 0.089	1.2 - 2.8 fl oz	PHI = 7 days. Use lower rates for building populations and/or up to 7 day residual control. Use higher rates for greater populations, dense foliage, and/or up to 14 days residual control. Do not apply more than 8.4 fl oz per acre per season. Do not apply more than 2.8 fl oz per acre per application. Do not apply more than 3 applications per season. Allow a minimum of 7 days between applications. Use a minimum of 10 GPA by ground and 3 GPA by air. If green peach aphid is present, use higher rates.
<b>imidacloprid</b> Admire Pro	refer to label	0.4 - 0.6 fl oz/1,000 ft of row or 5.7 - 8.7 fl oz	Apply in one of the following methods: 1. In-furrow spray during planting directed on seed pieces or seed potatoes, 2. Subsurface side-dress on both sides of the row covered with 3 or more inches of soil, 3) Narrow band spray at ground cracking directly over the row during hilling covered with 3 or more inches of soil, 4) Narrow band directly below the eventual seed row in a bedding operation 7 or fewer days before planting. There is a 12 month plant-back restriction for all crops not registered.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>imidacloprid</b> Nuprid 2F	0.20 - 0.31	13 - 20 fl oz or 0.9 - 1.3 fl oz / 1,000 row-feet	Maximum amount allowed per season 20 fl oz/acre/season. Apply using one of the following methods: 1) In-furrow spray during planting directed on seed pieces or seed potatoes, 2) Subsurface side-dress on both sides of the row covered with 3 or more inches of soil; 3) Narrow band spray at ground cracking directly over the row during hilling covered with 3 or more inches of soil, or 4) Narrow band directly below the eventual seed row in a bedding operation 4 or fewer days before planting.
<b>imidacloprid</b> Nuprid 1.6F	0.048	3.8 fl oz	PHI = 7 days. Minimum interval between applications = 7 days. Maximum amount allowed per season 15 fl oz/acre/season. May be applied through properly calibrated ground, aerial or chemigation application equipment.
<b>imidacloprid</b> Provado 1.6F	0.047	3.8 fl oz	A total of 16 fl. oz. (0.2 lb active ingredient) per acre per season may be applied as a foliar spray. There is a 12 month plant-back restriction for all crops not registered. PHI = 7 days.
<b>imidacloprid + cyfluthrin</b> Leverage <i>RUP</i>	imidacloprid - 0.047 cyfluthrin - 0.032	3.75 fl oz	PHI = 7 days.
<b>lambda-cyhalothrin</b> Warrior <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 7 days. Apply as required by scouting. When applying by air, apply in a minimum of 2 GPA. When applying by ground, use a minimum of 10 GPA. Will not control mining, tunneling or boring insects once they have entered the plant. Only exposed insects (larvae and/or adults) can be controlled with foliar applications. Do not apply more than 0.12 lb ai (15.36 fl oz) per acre per season.
<b>malathion</b> Malathion 57 EC	0.66 - 1	1.0 - 1.5pts.	PHI = 0 days.
<b>methamidophos</b> Monitor <i>RUP</i>	0.75 - 1	1.5 - 2 pts	PHI = 14 days.
<b>methomyl</b> Lannate LV <i>RUP</i>	0.5 - 1	1.5 - 3 pts	PHI = 6 days. Field re-entry interval is 1 day.
<b>oxamyl</b> Vydate L <i>RUP</i>	0.5 - 1	2 - 4 pts	PHI = 7 days.
<b>permethrin</b> Ambush 2E Arctic 3.2EC Pounce 3.2EC Permethrin 2EC Perm-Up 25 WP Perm-Up 3.2 EC <i>RUP</i>	0.05 - 0.2 0.1 - 0.2 0.1 - 0.2 0.1 - 0.2 0.1 - 0.2 0.1 - 0.2	3.2 - 12.8 fl oz 4 - 8 fl oz 4 - 8 fl oz 4 - 8 fl oz 6.4 - 12.8 fl oz 4 - 8 fl oz	PHI = 14 days. Do not feed vines to livestock. Do not apply more than 1.6 pounds ai per acre per season.
<b>phorate</b> Thimet 20 G <i>RUP</i>		11.3 oz/1,000 ft of row (light or sandy soils); 17 oz/1,000 ft of row (heavy or clay soils)	Band application at planting. PHI = 90 days. Do not apply more than one application of Thimet 20-G per crop season.
<b>thiamethoxam</b> Actara	0.047	3 fl oz	Control may require the use of 2 applications made at 7 to 10 day intervals. PHI = 14 days. Use sufficient water volume to ensure thorough coverage. Do not use less than 10 GPA for ground or 5GPA by air. Actara may be applied by chemigation. Do not apply more than 6.0 oz per acre per season.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>thiamethoxam</b> Platinum	0.078 - 0.125	5 - 8 fl oz	Soil application; see label for complete details. May be applied as: in-furrow during planting; impregnated on dry granular fertilizer before or during planting; or at plant emergence as a direct spray and incorporated into the soil with overhead irrigation within 24 hours. Only 1 soil application per season and do not exceed 0.125 lb AI/acre per season.
<b>thiamethoxam</b> Platinum Ridomil Gold	0.095 - 0.121	2.2 fl oz / 1000 ft row	Product per acre is determined by the row spacing; see label for further discussion. This product includes the fungicide mefenoxam for control of <i>Pythium</i> seedling disease and pink rot.
<b>zeta-cypermethrin</b> Mustang Max <i>RUP</i>	0.02 - 0.025	3.2 - 4 fl oz	PHI = 1 day. Do not apply more than 0.15 lb ai per acre per season. Do not make applications less than 4 days apart.

*RUP* - Restricted use pesticide

## CABBAGE LOOPER

Many different defoliating insects can be found on potatoes. Potatoes are relatively tolerant of some defoliation, especially if the attack is not sustained. The cabbage looper is a light green caterpillar with white or pale yellow stripes down the side. They have only three pair of fleshy prolegs, causing them to loop when moving forward.

### Threshold:

Normal populations seldom reach economically significant levels in North Dakota.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.0125 - 0.022	1.6 - 2.8 fl oz	PHI = 0 days. Maximum of 16.8 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 5-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. If more than 5.6 fl oz per acre is applied, allow at least 14 days between last application and grazing.
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.025 - 0.044	1.6 - 2.8 fl oz	PHI = 0 days. Maximum of 16.8 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 5-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. If more than 5.6 fl oz per acre is applied, allow at least 14 days between last application and grazing.
<b>deltamethrin</b> Delta Gold <i>RUP</i>	0.012 - 0.028	1.0 - 2.4 fl oz	PHI = 3 days. Allow 3 days between applications. Do not apply more than 12.0 fl oz per acre per season. For best control apply to 1 <sup>st</sup> and 2 <sup>nd</sup> instar larvae.
<b>esfenvalerate</b> Asana XL <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 7 days. Do not feed vines to livestock.
<b>imidacloprid + cyfluthrin</b> Leverage <i>RUP</i>	imidacloprid: 0.0375 - 0.047 cyfluthrin: 0.026 - 0.032	3.0 - 3.75 fl oz	PHI = 7 days. <b>The 3.0 fl oz rate is for ground sprayer application only.</b>
<b>indoxacarb</b> Avaunt	0.045 - 0.11	2.5 - 6.0 fl oz	PHI = 7 days. Do not apply more than 24 fl oz (0.44 lb ai) per acre per season. Minimum interval between sprays is 5 days.
<b>lambda-cyhalothrin</b> Warrior  <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 7 days. Apply as required by scouting. When applying by air, apply in a minimum of 2 GPA. When applying by ground, use a minimum of 10 GPA. Will not control mining, tunneling or boring insects once they have entered the plant. Only exposed insects (larvae and/or adults) can be controlled with foliar applications. Do not apply more than 0.12 lb ai (15.36 fl oz) per acre per season.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>methamidophos</b> Monitor <i>RUP</i>	0.75 - 1	1.5 - 2 pts	PHI = 14 days.
<b>methomyl</b> Lannate LV <i>RUP</i>	0.3	1.5 pts	Do not harvest within 6 days. Do not apply more than 4.5 lb ai per acre per crop. REI = 48 hours.
<b>novaluron</b> Rimon	0.05 - 0.0778	9 - 12 fl oz	PHI = 14 days. Do not apply more two applications per crop per season or 24 oz. per acre per season. Re-application on a 7 to 14 days interval will be required to protect new growth.
<b>permethrin</b> Ambush 2E Arctic 3.2EC Pounce 3.2EC Permethrin 2EC Perm-Up 25 WP Perm-Up 3.2 EC <i>RUP</i>	0.05 - 0.2 0.1 - 0.2 0.1 - 0.2 0.1 - 0.2 0.1 - 0.2 0.1 - 0.2	3.2 - 12.8 fl oz 4 - 8 fl oz 4 - 8 fl oz 4 - 8 fl oz 6.4 - 12.8 fl oz 4 - 8 fl oz	PHI = 14 days. Do not feed vines to livestock. Do not apply more than 1.6 pounds ai per acre per season.
<b>spinosad (microbial)</b> Success	0.071 - 0.094	4.5 - 6 fl oz	PHI = 7 days. Do not apply more than a total of 21 fl oz per acre per season.. Do not make applications less than 7 days apart or apply more than 4 times per crop. Treat when pests appear, targeting eggs at hatch or small larvae. Use a higher rate in the rate range for larger larvae or moderate to severe infestations.
<b>zeta-cypermethrin</b> Mustang Max <i>RUP</i>	0.011 - 0.025	1.76- 4 fl oz	PHI = 1 day. Do not apply more than 0.15 lb ai per acre per season. Do not make applications less than 4 days apart.

*RUP* - Restricted use pesticide

## COLORADO POTATO BEETLE

This beetle is the most common and destructive leaf feeding pest of potato. Both adults and larvae feed on foliage. The adult is 3/8 inch long, with oval body and a yellow-brown color with 5 black stripes on each wing cover. The larvae are 1/8 to 3/8 inch long, brick red to light orange in color. Eggs are laid on the underside of leaves in clusters of 10 to 30 and are orange colored when ready to hatch.

In North Dakota, overwintered beetles emerge from May to June. The first-generation larvae are present in the fields from June through July. Beetles from these larvae appear in fields in July, feeding and laying eggs for a second generation.

One of the greatest concerns with management programs for beetles is resistance to insecticides. The best way to manage the development of resistance in an insect population is the reduced use of compounds, limiting the selection of surviving (resistant) individuals. In North Dakota, resistance to the pyrethroid insecticides has been documented and the use of these compounds should be limited to one application per season. If control failures occur following the application of any product, switching to a different class of insecticides is recommended.

### Threshold:

The current recommendation is that spraying be initiated at first egg hatch. Best results have been achieved by flagging the first egg masses that can be located, monitoring these daily, and spraying at 15 to 30% hatch. If the insecticide used is effective but not persistent, a second application should be made 5 to 10 days later. With this approach, the first-generation beetle larvae should be controlled with one or two applications.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>abamectin</b> Epi-Mek 0.15 EC	See label.	8 - 16 fl oz	PHI = 16 days. 7 days application interval between repeated applications. Do not apply more than 32 fl oz per acre per season. Do not allow livestock to graze or feed treated foliage to livestock.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>acetamiprid</b> Assail 30SG	0.028-0.075	1.5 - 4.0 oz	Use high rate under heavy pest pressures or dense foliage. Do not make more than 4 applications per season. Do not apply more than once every 7 days. Do not apply less than 7 days before harvest. Do not exceed a total of 0.3 lb ai (16 fl oz) per acre per season. Apply a minimum of 5 GPA of water by air and 20 GPA of water by ground. Thorough coverage is important to obtain optimum control. There are no rotational crop plantback restrictions.
Assail 70WP	0.025 - 0.075	0.6 - 1.7 oz	
<b>azinphos-methyl</b> Guthion 2L	0.375	1.5 pt	PHI = 7 days. Repeat as necessary. Allow 7 days between applications.
<i>RUP</i>			
<b>beta-cyfluthrin</b> Baythroid XL	0.0125 - 0.022	1.6 - 2.8 fl oz	PHI = 0 days. Maximum of 16.8 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 5-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. If more than 5.6 fl oz per acre is applied, allow at least 14 days between last application and grazing.
<i>RUP</i>			
<b>bifenthrin</b> Brigadier <b>Pending 2008</b>		4.2 - 6.14fl oz	PHI = 21 days. Allow 7 days between applications. Maximum use rate of 25.6 fl oz total per season. An adjuvant, MSO, NIS, or COC may be tank-mixed.
<i>RUP</i>			
<b>bifenthrin + zeta-cypermethrin</b> Hero <b>Pending 2008</b>	0.05 - 0.103	5 - 10.3 fl oz	
<i>RUP</i>			
<b>carbaryl</b> Sevin	1	rate varies by formulation used	First-generation beetles are likely to occur in late June to early July. Treat as soon as larvae appear. No preharvest interval.
<b>carbofuran</b> Furadan 4F	0.5 - 1	1 - 2 pts	PHI = 14 days. (Check label for allowable crops in rotation.)
<i>RUP</i>			
<b>cryolite</b> Kryocide		10-12 lbs	Do not apply more than 96 lbs per acre per season. Apply 5-15 GPA by air and 15-100 GPA. Apply with a minimum of 7 days between applications.
<b>cyfluthrin</b> Tombstone Tombstone Helios	0.025 - 0.044	1.6 - 2.8 fl oz	PHI = 0 days. Maximum of 16.8 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 5-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. If more than 5.6 fl oz per acre is applied, allow at least 14 days between last application and grazing.
<i>RUP</i>			
<b>deltamethrin</b> Delta Gold	0.018 - 0.028	1.5 - 2.4 fl oz	PHI = 3 days. Allow 3 days between applications. Do not apply more than 12.0 fl oz per acre per season.
<i>RUP</i>			
<b>dinotefuran</b> Venom 70 SG	0.050 - 0.075	FOLIAR: 1 - 1.5 fl oz	Foliar Application: PHI = 7. Do not apply more than 4.5 fl oz per acre per season. Soil Application: Apply once at preplant, preemergence or at ground cracks using one of the following methods: 1) In a narrow band center on the plant row in the bedding operation just prior to planting, 2) In-Furrow spray at planting. Direct spray in the furrow on the seed pieces or potatoes. 3) As a side dress to both sides of the row or as a spray at ground crack directly over the row during hilling. Cover immediately with soil. Do not apply more than 12 fl oz per acre per season.
	0.28 - 0.33	SOIL: 6.5 + 7.5 fl oz	
<b>esfenvalerate</b> Asana XL	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 7 days. Do not graze livestock on treated vines.
<i>RUP</i>			

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>imidacloprid</b> Admire Pro	refer to label	0.4 - 0.6 fl oz/1,000 ft of row or 5.7 - 8.7 fl oz	Apply in one of the following methods: 1. In-furrow spray during planting directed on seed pieces or seed potatoes, 2. Subsurface side-dress on both sides of the row covered with 3 or more inches of soil, 3) Narrow band spray at ground cracking directly over the row during hilling covered with 3 or more inches of soil, 4) Narrow band directly below the eventual seed row in a bedding operation 7 or fewer days before planting. There is a 12 month plant-back restriction for all crops not registered.
<b>imidacloprid</b> Nuprid 2F	0.20 - 0.31	13 - 20 fl oz or 0.9 - 1.3 fl oz / 1,000 row-feet	Maximum amount allowed per season 20 fl oz/acre/season. Apply using one of the following methods: 1) In-furrow spray during planting directed on seed pieces or seed potatoes, 2) Subsurface side-dress on both sides of the row covered with 3 or more inches of soil; 3) Narrow band spray at ground cracking directly over the row during hilling covered with 3 or more inches of soil, or 4) Narrow band directly below the eventual seed row in a bedding operation 4 or fewer days before planting.
<b>imidacloprid</b> Nuprid 1.6F	0.048	3.8 fl oz	PHI = 7 days. Minimum interval between applications = 7 days. Maximum amount allowed per season 15 fl oz/acre/season. May be applied through properly calibrated ground, aerial or chemigation application equipment.
<b>imidacloprid</b> Provado 1.6F	0.047	3.8 fl oz	A total of 16 fl. oz. (0.2 lb active ingredient) per acre per season may be applied as a foliar spray. There is a 12 month plant-back restriction for all crops not registered. PHI = 7 days.
<b>imidacloprid + cyfluthrin</b> Leverage <i>RUP</i>	imidacloprid: 0.0375 - 0.047 cyfluthrin: 0.026 - 0.032	3.0 - 3.75 fl oz	PHI = 7 days. <b>The 3.0 fl oz rate is for ground sprayer application only.</b>
<b>indoxacarb</b> Avaunt	0.065 - 0.11	3.5 - 6.0 fl oz	PHI = 7 days. Do not apply more than 24 fl oz (0.44 lb ai) per acre per season. Minimum interval between sprays is 5 days. In situations where Colorado potato beetles are difficult to control, add piperonyl butoxide (PBO), a synergist, at 0.25 lb ai per acre to Avaunt mixture to achieve optimum control.
<b>lambda-cyhalothrin</b> Warrior <i>RUP</i>	0.02 - 0.03	2.56 - 3.84 fl oz	PHI = 7 days. Apply as required by scouting. When applying by air, apply in a minimum of 2 GPA. When applying by ground, use a minimum of 10 GPA. Will not control mining, tunneling or boring insects once they have entered the plant. Only exposed insects (larvae and/or adults) can be controlled with foliar applications. Do not apply more than 0.12 lb ai (15.36 fl oz) per acre per season.
<b>methamidophos</b> Monitor <i>RUP</i>	0.75 - 1	1.5 - 2 pts	PHI = 14 days.
<b>methyl parathion</b> Pencap-M <i>RUP</i>	0.5 - 1.5	2 - 6 pts	PHI = 5 days. Do not enter treated fields within 48 hours after application.
<b>novaluron</b> Rimon	0. - 0.167	9 - 12 fl oz	PHI = 14 days. Do not apply more two applications per crop per season or 24 oz. per acre per season. Re-application on a 7 to 14 days interval will be required to protect new growth. Do not apply more than twice to a single generation of Colorado potato beetle and do not apply to successive generations.
<b>oxamyl</b> Vydate L <i>RUP</i>	0.5 - 1	2 - 4 pts	PHI = 7 days.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>permethrin</b>			PHI = 14 days. Do not feed vines to livestock. Do not apply more than 1.6 pounds ai per acre per season.
Ambush 2E	0.05 - 0.2	3.2 - 12.8 fl oz	
Arctic 3.2EC	0.1 - 0.2	4 - 8 fl oz	
Pounce 3.2EC	0.1 - 0.2	4 - 8 fl oz	
Permethrin 2EC	0.1 - 0.2	4 - 8 fl oz	
Perm-Up 25 WP	0.1 - 0.2	6.4 - 12.8 fl oz	
Perm-Up 3.2 EC	0.1 - 0.2	4 - 8 fl oz	
<i>RUP</i>			
<b>phorate</b>			Band application at planting. PHI = 90 days. Do not apply more than one application of Thimet 20-G per crop season.
Thimet 20-G		11.3 oz/1,000 ft of row (light or sandy soils); 17.3 oz/1,000 ft of row (heavy or clay soils)	
<b>phosmet</b>	1	2 lbs	PHI = 7 days.
Imidan 50 WP			
<b>spinosad (microbial)</b>			PHI = 7 days. Do not apply more than a total of 0.33 lbs a.i. per crop. Do not apply to consecutive generations of CPB and do not make more than 2 applications per single generation of CPB. SpinTor 2SC may be applied by chemigation.
SpinTor 2SC	0.047 - 0.094	3 - 6 fl oz	
Entrust (formulation approved for <b>Organic</b> crops)	0.05 - 0.1	1 - 2 fl oz	
<b>spinosad (microbial)</b>	0.047 - 0.094	3 - 6 fl oz	PHI = 7 days. Do not apply more than a total of 21 fl oz per acre per season.. Do not make applications less than 7 days apart or apply more than 4 times per crop. Treat when pests appear, targeting eggs at hatch or small larvae. Use a higher rate in the rate range for larger larvae or moderate to severe infestations.
Success			
<b>thiamethoxam</b>			PHI = 14 days. Use sufficient water volume to ensure thorough coverage. Do not use less than 10 GPA for ground or 5GPA by air. Actara may be applied by chemigation. Do not apply more than 6.0 oz per acre per season.
Actara	0.023 - 0.047	1.5 - 3.0 fl oz	
<b>thiamethoxam</b>	0.078 - 0.125	5 - 8 fl oz	Soil application; see label for complete details. May be applied as: in-furrow during planting; impregnated on dry granular fertilizer before or during planting; or at plant emergence as a direct spray and incorporated into the soil with overhead irrigation within 24 hours. Only 1 soil application per season and do not exceed 0.125 lb AI/acre per season.
Platinum			
<b>thiamethoxam</b>	0.095 - 0.121	2.2 fl oz / 1000 ft row	Product per acre is determined by the row spacing; see label for further discussion. This product includes the fungicide, mfenoxam, for control of <i>Pythium</i> seedling disease and pink rot.
Platinum Ridomil Gold			
<b>zeta-cypermethrin</b>	0.02 - 0.025	3.2- 4 fl oz	PHI = 1 day. Do not apply more than 0.15 lb ai per acre per season. Do not make applications less than 4 days apart. For control of Colorado potato beetles that aren't pyrethroid resistant.
Mustang Max			
<i>RUP</i>			

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## POTATO INSECT COMPLEX

This grouping of insects refers to aphids, leafhoppers, wireworms, flea beetles and Colorado potato beetle. The at-planting granular treatments provide variable levels of control of these different pests during the early part of the season.

INSECTICIDE	DOSAGE IN LB	PRODUCT	RESTRICTIONS ON USE
	AI/ACRE	PER ACRE	
<b>dinotefuran</b> Venom 70 SG (Does not control wireworms)	0.050 - 0.075	FOLIAR: 1 - 1.5 fl oz	Foliar Application: PHI = 7. Do not apply more than 4.5 fl oz per acre per season.  Soil Application: Apply once at preplant, preemergence or at ground cracks using one of the following methods: 1) In a narrow band center on the plant row in the bedding operation just prior to planting, 2) In-Furrow spray at planting. Direct spray in the furrow on the seed pieces or potatoes. 3) As a side dress to both sides of the row or as a spray at ground crack directly over the row during hilling. Cover immediately with soil. Do not apply more than 12 fl oz per acre per season.
	0.28 - 0.33	SOIL: 6.5 + 7.5 fl oz	
<b>disulfoton</b> Di-Syston 15 G  <i>RUP</i>		15 - 23 oz/1,000 ft of row	Band application at planting. Do not apply Di-Syston within 75 days. Do not plant food or feed crop in rotation after a field treatment with Di-Syston unless it is a registered use for Di-Syston.
<b>imidacloprid</b> Genesis		8 - 16 fl oz (0.4 - 0.8 fl oz per 100 lbs of seed-pieces)	This is a seed-piece application ONLY. Treatments provide protection only to the seed piece, not to daughter tubers. Plant seed pieces as soon as possible after cutting and treating. Do not apply any subsequent application of imidacloprid (Gaucho, Admire in furrow, or Provado) following Genesis seed-piece treatment.
<b>phorate</b> Phorate 20 G Thimet 20 G  <i>RUP</i>		11.3 - 17 oz/1,000 ft of row	Band application at planting. Do not apply Thimet within 90 days of harvest.
<b>thiamethoxam</b> CruiserMAXX Potato		0.19 - 0.27 oz/CWT depending on seeding rate	Seed treatment only. Protects the seed piece only from wireworm, not the daughter tubers. Provides protections from insects and several soil- or seed-borne diseases. Treated seed may be stored for several days provided cool (<60F) and moist (85-90% RH) air is forced through the piles (<6' in height).

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**NOTE:** The lower rate of application is suggested in light or sandy soils and the higher rate is suggested in heavy or clay soils.

## POTATO LEAFHOPPER

Direct feeding damage to foliage is the primary concern with leafhoppers. The potato leafhopper migrates north in the spring, arriving before potatoes emerge. Leafhoppers develop in alfalfa first, moving to potatoes later.

Leafhopper adults are wedge-shaped, 1/8 inch long, and lime green to yellow green in color. The nymphs resemble the adults but are wingless. When disturbed, the nymphs move across the leaf in a sideways fashion.

Damage by leafhoppers is referred to as hopper-burn. Foliage becomes dwarfed, crinkled, and curled. Small triangular brown areas appear at the tips of leaves, gradually spreading around the entire leaf margin. Immature leafhoppers are more destructive than the adults, and generally more numerous than adults.

### Potato Leafhopper Threshold:

Treatments are recommended when potato leafhoppers can be found at a level of 1 nymph per 10 leaves. Sample 35 leaves in each of 5 locations in a field. Pluck leaves from the plants and inspect the underside of the leaf for the presence of nymphs.

## FLEA BEETLE

Flea beetles are small, dull black beetles, about 1/16 inch long, with hind legs adapted for jumping. The adults overwinter in the soil, emerging in the spring to begin feeding on young foliage. Newly emerged plants are most vulnerable. When abundant, flea beetles shot-hole the foliage with numerous small round holes. Severely damaged leaves do not recover.

**Flea Beetle Threshold:**

Thresholds for this pest are not well-defined. Past recommendations have suggested treatment when 10% of the leaf area is lost due to flea beetle feeding. Early season weed control and removal of crop debris make fields less attractive to flea beetles.

**Insecticides Registered for Flea Beetles and Potato Leafhoppers control in potatoes.**

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>acetamiprid</b> Assail 30SG	Flea Beetles: 0.028 - 0.047	Flea Beetles: 1.5 - 2.5 oz	Use high rate under heavy pest pressures or dense foliage. Do not make more than 4 applications per season. Do not apply more than once every 7 days. Do not apply less than 7 days before harvest. Do not exceed a total of 0.3 lb ai per acre per season. Apply a minimum of 5 GPA of water by air and 20 GPA of water by ground. Thorough coverage is important to obtain optimum control. There are no rotational crop plantback restrictions.
	Potato leafhopper: 0.028 - 0.075	Potato leafhopper: 1.5 - 4.0 oz	
Assail 70WP	Flea Beetles: 0.025 - 0.05	Flea Beetles: 0.6 - 1.1 oz	
	Potato leafhopper: 0.025 - 0.075	Potato leafhopper: 0.6 - 1.7 oz	
<b>azinphos-methyl</b> Guthion 2L	0.5 - .75	2 - 3 pts	PHI = 7 days. Repeat as necessary. Allow 7 days between applications.
<i>RUP</i>			
<b>beta-cyfluthrin</b> Baythroid XL	0.013 - 0.022	1.6 - 2.8 fl oz	PHI = 0 days. Maximum of 16.8 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 5-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. If more than 5.6 fl oz per acre is applied, allow at least 14 days between last application and grazing. Use lower rates for leafhopper.
<i>RUP</i>			
<b>bifenthrin</b> Brigadier <b>Pending 2008</b>		4.2 - 6.14fl oz	PHI = 21 days. Allow 7 days between applications. Maximum use rate of 25.6 fl oz total per season. An adjuvant, MSO, NIS, or COC may be tank-mixed.
<i>RUP</i>			
<b>carbaryl</b> Sevin	1	rate varies by formulation used	No preharvest interval.
<b>carbofuran</b> Furadan 4F	0.5 - 1	1 - 2 pts	PHI = 14 days. (Check label for allowable crops in rotation.)
<i>RUP</i>			
<b>cyfluthrin</b> Tombstone Tombstone Helios	0.013 - 0.044	0.8 - 2.8 fl oz	PHI = 0 days. Maximum of 16.8 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 5-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. If more than 5.6 fl oz per acre is applied, allow at least 14 days between last application and grazing. Use lower rates for leafhopper.
<i>RUP</i>			
<b>deltamethrin</b> Delta Gold	0.018 - 0.028	1.5 - 2.4 fl oz	PHI = 3 days. Allow 3 days between applications. Do not apply more than 12.0 fl oz per acre per season.
<i>RUP</i>			
<b>dimethoate</b> Digon 400 Dimethoate 400	0.5	1 pt	No preharvest interval. Do not enter treated fields without protective clothing until sprays have dried.

Potato

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>dinotefuran</b> Venom 70 SG	0.050 - 0.2	FOLIAR: 1 - 4 fl oz	Foliar Application: PHI = 7. Do not apply more than 4.5 fl oz per acre per season. Soil Application: Apply once at preplant, preemergence or at ground cracks using one of the following methods: 1) In a narrow band center on the plant row in the bedding operation just prior to planting, 2) In-Furrow spray at planting. Direct spray in the furrow on the seed pieces or potatoes. 3) As a side dress to both sides of the row or as a spray at ground crack directly over the row during hilling. Cover immediately with soil. Do not apply more than 12 fl oz per acre per season.
	0.28 - 0.33	SOIL: 6.5 + 7.5 fl oz	
<b>esfenvalerate</b> Asana XL	0.25 - 0.05	5.8 - 9.6 fl oz	PHI = 7 days. Do not feed vines to livestock.
	<i>RUP</i>		
<b>imidacloprid</b> Admire Pro	refer to label	0.4 - 0.6 fl oz/1,000 ft of row or 5.7 - 8.7 fl oz	Apply in one of the following methods: 1. In-furrow spray during planting directed on seed pieces or seed potatoes, 2. Subsurface side-dress on both sides of the row covered with 3 or more inches of soil, 3) Narrow band spray at ground cracking directly over the row during hilling covered with 3 or more inches of soil, 4) Narrow band directly below the eventual seed row in a bedding operation 7 or fewer days before planting. There is a 12 month plant-back restriction for all crops not registered.
<b>imidacloprid</b> Nuprid 2F	0.20 - 0.31	13 - 20 fl oz or 0.9 - 1.3 fl oz / 1,000 row-feet	Maximum amount allowed per season 20 fl oz/acre/season. Apply using one of the following methods: 1) In-furrow spray during planting directed on seed pieces or seed potatoes, 2) Subsurface side-dress on both sides of the row covered with 3 or more inches of soil; 3) Narrow band spray at ground cracking directly over the row during hilling covered with 3 or more inches of soil, or 4) Narrow band directly below the eventual seed row in a bedding operation 4 or fewer days before planting.
<b>imidacloprid</b> Nuprid 1.6F	0.048	3.8 fl oz	PHI = 7 days. Minimum interval between applications = 7 days. Maximum amount allowed per season 15 fl oz/acre/season. May be applied through properly calibrated ground, aerial or chemigation application equipment.
<b>imidacloprid</b> Provado 1.6F	0.047	3.8 fl oz	A total of 16 fl. oz. (0.2 lb active ingredient) per acre per season may be applied as a foliar spray. There is a 12 month plant-back restriction for all crops not registered. PHI = 7 days.
<b>imidacloprid + cyfluthrin</b> Leverage	imidacloprid: 0.0375 - 0.047 cyfluthrin: 0.026 - 0.032	3.0 - 3.75 fl oz	PHI = 7 days. <b>The 3.0 fl oz rate is for ground sprayer application only.</b>
	<i>RUP</i>		
<b>lambda-cyhalothrin</b> Warrior	Potato Leafhopper: 0.015 - 0.025	Potato Leafhopper: 1.92 - 3.20 fl oz	PHI = 7 days. Apply as required by scouting. When applying by air, apply in a minimum of 2 GPA. When applying by ground, use a minimum of 10 GPA. Will not control mining, tunneling or boring insects once they have entered the plant. Only exposed insects (larvae and/or adults) can be controlled with foliar applications. Do not apply more than 0.12 lb ai (15.36 fl oz) per acre per season.
	<i>RUP</i> Flea Beetles 0.02 - 0.03	Flea Beetles 2.56 - 3.84 fl oz	
<b>malathion</b> Malathion 57 EC	0.66 - 1	1.0 - 1.5pts.	PHI = 0 days.
<b>methyl parathion</b> PennCap-M	0.5 - 1	2 - 4 pts	PHI = 5 days. Do not enter treated fields within 48 hours after application.
	<i>RUP</i>		

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>oxamyl</b> Vydate L <i>RUP</i>	0.5 - 1	2 - 4 pts	PHI = 7 days.
<b>permethrin</b> Ambush 2E Arctic 3.2EC Pounce 3.2EC Permethrin 2EC Perm-Up 25 WP Perm-Up 3.2 EC <i>RUP</i>	0.05 - 0.2 0.1 - 0.2 0.1 - 0.2 0.1 - 0.2 0.1 - 0.2 0.1 - 0.2	3.2 - 12.8 fl oz 4 - 8 fl oz 4 - 8 fl oz 4 - 8 fl oz 6.4 - 12.8 fl oz 4 - 8 fl oz	PHI = 14 days. Do not feed vines to livestock. Do not apply more than 1.6 pounds ai per acre per season.
<b>phorate</b> Thimet 20-G		11.3 oz/1,000 ft of row (light or sandy soils); 17.3 oz/1,000 ft of row (heavy or clay soils)	Band application at planting. PHI = 90 days. Do not apply more than one application of Thimet 20-G per crop season.
<b>phosmet</b> Imidan WP	1	2 lbs	PHI = 7 days.
<b>thiamethoxam</b> Actara	0.023 - 0.047	1.5 - 3.0 fl oz	PHI = 14 days. Use sufficient water volume to ensure thorough coverage. Do not use less than 10 GPA for ground or 5GPA by air. Actara may be applied by chemigation. Do not apply more than 6.0 oz per acre per season.
<b>thiamethoxam</b> Platinum	0.078 - 0.125	5 - 8 fl oz	Soil application; see label for complete details. May be applied as: in-furrow during planting; impregnated on dry granular fertilizer before or during planting; or at plant emergence as a direct spray and incorporated into the soil with overhead irrigation within 24 hours. Only 1 soil application per season and do not exceed 0.125 lb AI/acre per season.
<b>thiamethoxam</b> Platinum Ridomil Gold	0.095 - 0.121	2.2 fl oz / 1,000 ft row	Product per acre is determined by the row spacing; see label for further discussion. This product includes the fungicide mefenoxam for control of <i>Pythium</i> seedling disease and pink rot.
<b>zeta-cypermethrin</b> Mustang Max <i>RUP</i>	Potato leafhopper: 0.02 - 0.025  Flea beetle: 0.011 - 0.025	Potato leafhopper: 3.2 - 4 fl oz  Flea beetle: 1.76 - 4.0 fl oz	PHI = 1 day. Do not apply more than 0.15 lb ai per acre per season. Do not make applications less than 4 days apart.

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## VARIEGATED CUTWORM

The variegated cutworm is an occasional pest of potato in the region. These larvae are about 2 inches long when full grown. Their color ranges from black to light greenish-yellow or tan. They have a distinctive row of pale yellow spots down the middle of their backs. The variegated cutworm is a climbing cutworm, feeding in the plant canopy at night. Variegated cutworm have been responsible for below-ground feeding that damages tubers. The variegated cutworm overwinters in states to the south of North Dakota, making annual predictions of problems difficult. Moths migrate to the region during the spring and summer months. There are multiple generations of this cutworm, numbering two to three, depending on environmental conditions.

### Threshold:

Treatments would be justified when 4 or more worms per square foot are present.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
<b>beta-cyfluthrin</b> Baythroid XL <i>RUP</i>	0.0065 - 0.0125	0.8 - 1.6 fl oz	PHI = 0 days. Maximum of 16.8 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 5-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. If more than 5.6 fl oz per acre is applied, allow at least 14 days between last application and grazing.
<b>bifenthrin + zeta-cypermethrin</b> Hero Pending 2008 <i>RUP</i>	0.05 - 0.103	5 - 10.3 fl oz	
<b>cyfluthrin</b> Tombstone Tombstone Helios <i>RUP</i>	0.013 - 0.025	0.8 - 1.6 fl oz	PHI = 0 days. Maximum of 16.8 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 5-day interval. Minimum application volume is 10 GPA by ground and 2 GPA by air. If more than 5.6 fl oz per acre is applied, allow at least 14 days between last application and grazing.
<b>deltamethrin</b> Delta Gold <i>RUP</i>	0.012 - 0.028	1.0 - 2.4 fl oz	PHI = 3 days. Allow 3 days between applications. Do not apply more than 12.0 fl oz per acre per season.
<b>esfenvalerate</b> Asana XL <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 7 days. Do not feed vines to livestock.
<b>imidacloprid + cyfluthrin</b> Leverage <i>RUP</i>	imidacloprid: 0.0375 - 0.047 cyfluthrin: 0.026 - 0.032	3.0 - 3.75 fl oz	PHI = 7 days. <b>The 3.0 fl oz rate is for ground sprayer application only.</b>
<b>lambda-cyhalothrin</b> Warrior <i>RUP</i>	0.015 - 0.025	1.92 - 3.20 fl oz	PHI = 7 days. Apply as required by scouting. When applying by air, apply in a minimum of 2 GPA. When applying by ground, use a minimum of 10 GPA. Will not control mining, tunneling or boring insects once they have entered the plant. Only exposed insects (larvae and/or adults) can be controlled with foliar applications. Do not apply more than 0.12 lb ai (15.36 fl oz) per acre per season.
<b>permethrin</b> Arctic 3.2EC Pounce 3.2EC Permethrin 2EC Perm-Up 25 WP Perm-Up 3.2 EC <i>RUP</i>	0.1 - 0.2 0.1 - 0.2 0.1 - 0.2 0.1 - 0.2 0.1 - 0.2	4 - 8 fl oz 4 - 8 fl oz 4 - 8 fl oz 6.4 - 12.8 fl oz 4 - 8 fl oz	PHI = 14 days. Do not feed vines to livestock. Do not apply more than 1.6 pounds ai per acre per season.
<b>zeta-cypermethrin</b> Mustang Max <i>RUP</i>	0.008 - 0.025	1.28- 4 fl oz	PHI = 1 day. Do not apply more than 0.15 lb ai per acre per season. Do not make applications less than 4 days apart.

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## WIREWORMS

Wireworms are most likely to be problems when dry beans follows pasture or grassland. Infestations often are found in coarse textured soils (sandy loam) where moisture is abundant, perhaps in low spots of fields.

### Thresholds:

There is no easy way to estimate wireworm infestations. Two methods are currently used.

**Soil Sampling:** Sample 20, well spaced, 1 square foot sites to a depth of 4 to 6 inches for every 40 acres being planted. If an average of 1 wireworm per square foot is found, treatment would be justified.

**Solar Baiting:** In September, establish bait stations for 2 to 3 weeks before freeze. Place bait stations randomly through the field, but representing all areas of the field. There should be 10 - 12 stations per 40 acre field. Place one cup wheat and one cup shelled corn in a 4- to 6-inch deep hole. Cover grain with soil and then an 18-inch square piece of clear plastic. Dig up the grain. If an average of one or more wireworm larvae are found per station, treatment would be justified.

**Seed Treatment:** Please see the seed treatment section in the introduction for more information.

INSECTICIDE	DOSAGE IN LB		PRODUCT	RESTRICTIONS ON USE
	A/ACRE		PER ACRE	
bifenthrin Capture LFR	0.03 (at-plant)		25.5 oz (at-plant)	Do not apply more than 0.3 lb ai per acre per season as an at-plant application. Do not apply more than 0.5 lb ai per acre per season including at-plant plus foliar applications of other bifenthrin products (such as Capture 2EC). For at-plant, apply in a 8 -12 inch T-band or in furrow. Apply a minimum of 10 GPA in the band. For lay-by, incorporate at hilling for additional wireworm and white grub control.
	0.05 - 0.15 (lay-by)		4.2 - 12.75 oz (lay-by)	

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