

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
acetamiprid 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	
beta-cyfluthrin 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.
bifenthrin + zeta-cypermethrin Hero <i>RUP</i>	0.04 - 0.10	4.0 - 10.3 fl oz	PHI = 21 days. Do not make applications less than 21 days apart. Do not apply more than 0.2 lb ai per acre per season. Leaves cannot be used for food or feed.
bifenthrin + imidacloprid Brigadier <i>RUP</i>	0.075 - 0.096	4.8 - 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.
clothianidin Belay 2.13SC	Foliar: 0.03 - 0.05 In-furrow or side dress: 0.1 - 0.2	Foliar: 1.9 - 2.8 fl oz In-furrow or side dress: 7.2 - 12.0 fl oz Seed treatment: 0.4 - 0.6 fl oz/cwt depending on seeding rate	Foliar: PHI = 14 days. Do not apply more than 8.4 fl oz per acre per season. Do not apply treatments less than 7 days apart. Soil Application: Apply once at planting or as a side-dress during hilling 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 (12 fl oz) per acre per season (one application).

Potato

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
cyfluthrin 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.
deltamethrin 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.
dimethoate 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.
dinotefuran 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.
esfenvalerate Adjourn 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.
flonicamid 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.
imidacloprid 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.
imidacloprid Mana Alias 4F	0.125 - 0.25	4.0 - 8.0 fl oz or 0.2 - 0.4 fl oz/cwt	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
imidacloprid Mana Alias 4F	0.048	1.52 fl oz	Broadcast or directed foliar spray. PHI = 7 days. Minimum interval between applications = 7 days. Maximum of 6.4 fl oz per acre (0.2 lb ai per acre) allowed per crop season when making foliar applications.
imidacloprid 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.
imidacloprid 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.
imidacloprid 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.
imidacloprid + cyfluthrin Leverage <i>RUP</i>	imidacloprid - 0.047 cyfluthrin - 0.032	3.8 fl oz	PHI = 7 days.
lambda-cyhalothrin Kaiso 24WG <i>RUP</i>	0.02 - 0.03	1.33 - 2 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. Do not apply more than 0.12 lb ai per acre per season. Do not apply within 7 days of harvest.
lambda-cyhalothrin Warrior II <i>RUP</i>	0.02 - 0.03	1.28 - 1.92 fl oz	
lambda-cyhalothrin + chlorantraniliprole Voliam Xpress <i>RUP</i>	0.020 - 0.029 + 0.039 - 0.059	6 - 9 fl oz	PHI = 14 days. Do not apply more than 0.12 lb ai of lambda-cyhalothrin containing products per acre per season or more than 0.216 lb ai of chlorantraniliprole containing products per acre per season. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground application or less than 5 GPA for aerial application.
lambda-cyhalothrin + thiamethoxam Endigo ZC <i>RUP</i>	0.028 - 0.031 + 0.037 - 0.041	4 - 4.5 fl oz	PHI = 14 days. Do not apply more than 0.12 lb ai per acre per season of lambda-cyhalothrin containing products or more than 0.094 lb ai per acre per season of thiamethoxam containing products. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground applications or less than 3 GPA for aerial applications
malathion Malathion 57 EC	0.66 - 1	1.0 - 1.5pts.	PHI = 0 days.
methamidophos Monitor <i>RUP</i>	0.75 - 1	1.5 - 2 pts	PHI = 14 days.
methomyl Lannate LV <i>RUP</i>	0.5 - 1	1.5 - 3 pts	PHI = 6 days. Field re-entry interval is 1 day.
oxamyl 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
permethrin			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>		
phorate			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 oz/1,000 ft of row (heavy or clay soils)	
	<i>RUP</i>		
pymetrozine	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.
Fulfill			
spirotetramat	0.06 - 0.08	4 - 5 fl oz	PHI = 7 days. Minimum of 7 days between applications. Maximum of 10 fl oz per acre per season.
Movento			
thiamethoxam	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 oz per acre per season.
Actara			
thiamethoxam	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			
thiamethoxam	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.
Platinum Ridomil Gold			
thiamethoxam + chlorantraniliprole	0.047	4 oz	PHI = 14 days. Do not exceed a total of 8 oz or 0.094 lb ai of thiamethoxam containing foliar products or 0.2 lb ai of chlorantraniliprole containing products per acre per growing season. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground applications or 5 GPA for aerial applications.
Voliam flexi			
zeta-cypermethrin	0.020 - 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. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.
Mustang Max EC			
Respect			
	<i>RUP</i>		

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
beta-cyfluthrin 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.
bifenthrin + zeta-cypermethrin Hero <i>RUP</i>	0.04 - 0.10	4.0 - 10.3 fl oz	PHI = 21 days. Do not make applications less than 21 days apart. Do not apply more than 0.2 lb ai per acre per season. Leaves cannot be used for food or feed.
chlorantraniliprole Coragen	0.045 - 0.065	3.5 - 5.0 fl oz	PHI = 14 days. REI = 4 hours. Do not apply more than 15.4 fl oz (0.2 lbs ai) per acre per season. Minimum interval between treatments is 5 days. Minimum application volume is 10 GPA by ground and 5 GPA by air.
cyfluthrin 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.
deltamethrin 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 st and 2 nd instar larvae.
esfenvalerate Adjourn Asana XL <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 7 days. Do not feed vines to livestock.
imidacloprid + cyfluthrin Leverage <i>RUP</i>	imidacloprid: 0.0375 - 0.047 cyfluthrin: 0.026 - 0.032	3.0 - 3.8 fl oz	PHI = 7 days. The 3.0 fl oz rate is for ground sprayer application only.
indoxacarb 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.
lambda-cyhalothrin Kaiso 24WG <i>RUP</i>	0.02 - 0.03	1.33 - 2 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. Do not apply more than 0.12 lb ai per acre per season.
lambda-cyhalothrin Warrior II <i>RUP</i>	0.02 - 0.03	1.28 - 1.92 fl oz	
lambda-cyhalothrin + chlorantraniliprole Voliam Xpress <i>RUP</i>	0.020 - 0.029 + 0.039 - 0.059	6 - 9 fl oz	PHI = 14 days. Do not apply more than 0.12 lb ai of lambda-cyhalothrin containing products per acre per season or more than 0.216 lb ai of chlorantraniliprole containing products per acre per season. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground application or less than 5 GPA for aerial application.
lambda-cyhalothrin + thiamethoxam Endigo ZC <i>RUP</i>	0.021 - 0.028 + 0.028 - 0.037	3 - 4 fl oz	PHI = 14 days. Do not apply more than 0.12 lb ai per acre per season of lambda-cyhalothrin containing products or more than 0.094 lb ai per acre per season of thiamethoxam containing products. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground applications or less than 3 GPA for aerial applications
methamidophos Monitor <i>RUP</i>	0.75 - 1	1.5 - 2 pts	PHI = 14 days.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
methomyl 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.
novaluron 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.
permethrin 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.
spinosad (microbial) 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.
spinetoram (microbial) Radiant SC	0.047 - 0.063	6 - 8 fl oz	PHI = 7 days. Do not apply more than 32 fl oz (0.250 lb ai spinetoram) per acre per season. Do not make more than 4 applications per season. Do not make applications less than 7 days apart.
thiamethoxam + chlorantraniliprole Voliam flexi	0.047	4 oz	PHI = 14 days. Do not exceed a total of 8 oz or 0.094 lb ai of thiamethoxam containing foliar products or 0.2 lb ai of chlorantraniliprole containing products per acre per growing season. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground applications or 5 GPA for aerial applications.
zeta-cypermethrin Mustang Max EC Respect <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. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

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
abamectin 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.
abamectin Abamectin E-AG Temprano	See label.	8 - 16 fl oz	PHI = 14 days. Apply at approximately 50% egg hatch. 7 days application interval between repeated applications. Do not apply more than 32 fl oz per acre per season. Do not use with stickers or binder type products (such as Bravo Weather Stik). Do not allow livestock to graze or feed treated foliage to livestock.
acetamiprid 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	
azinphos-methyl Guthion 2L	0.375	1.5 pt	PHI = 7 days. Repeat as necessary. Allow 7 days between applications.
<i>RUP</i>			
beta-cyfluthrin 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>			
bifenthrin + imidacloprid Brigadier		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.
<i>RUP</i>			
bifenthrin + zeta-cypermethrin Hero	0.04 - 0.10	4.0 - 10.3 fl oz	PHI = 21 days. Do not make applications less than 21 days apart. Do not apply more than 0.2 lb ai per acre per season. Leaves cannot be used for food or feed.
<i>RUP</i>			
carbaryl 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.
chlorantraniliprole Coragen	0.045 - 0.065	3.5 - 5.0 fl oz	PHI = 14 days. REI = 4 hours. Do not apply more than 15.4 fl oz (0.2 lbs ai) per acre per season. Minimum interval between treatments is 5 days. Do not apply Coragen more than twice to a generation of Colorado potato beetle or within any 30 day period. Application to the next generation of beetles must be with an effective product with a different mode of action. Minimum application volume is 10 GPA by ground and 5 GPA by air.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
clothianidin Belay 2.13SC	Foliar: 0.03 - 0.05 In-furrow or side dress: 0.1 - 0.2	Foliar: 1.9 - 2.8 fl oz In-furrow or side dress: 7.2 - 12.0 fl oz Seed treatment: 0.4 - 0.6 fl oz/cwt depending on seeding rate	Foliar: PHI = 14 days. Do not apply more than 8.4 fl oz per acre per season. Do not apply treatments less than 7 days apart. Soil Application: Apply once at planting or as a side-dress during hilling 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 (12 fl oz) per acre per season (one application).
cryolite 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.
cyfluthrin 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.
deltamethrin Delta Gold <i>RUP</i>	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.
dinotefuran 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.
esfenvalerate Adjourn 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.
imidacloprid 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.
imidacloprid Mana Alias 4F	0.125 - 0.25	4.0 - 8.0 fl oz or 0.2 - 0.4 fl oz/cwt	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
imidacloprid Mana Alias 4F	0.048	1.52 fl oz	Broadcast or directed foliar spray. PHI = 7 days. Minimum interval between applications = 7 days. Maximum of 6.4 fl oz per acre (0.2 lb ai per acre) allowed per crop season when making foliar applications.
imidacloprid 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.
imidacloprid 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.
imidacloprid 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.
imidacloprid + cyfluthrin Leverage <i>RUP</i>	imidacloprid: 0.0375 - 0.047 cyfluthrin: 0.026 - 0.032	3.0 - 3.8 fl oz	PHI = 7 days. The 3.0 fl oz rate is for ground sprayer application only.
indoxacarb 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.
lambda-cyhalothrin Kaiso 24WG <i>RUP</i>	0.02 - 0.03	1.33 - 2 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. Do not apply more than 0.12 lb ai per acre per season.
lambda-cyhalothrin Warrior II <i>RUP</i>	0.02 - 0.03	1.28 - 1.92 fl oz	
lambda-cyhalothrin + chlorantraniliprole Voliam Xpress <i>RUP</i>	0.020 - 0.029 + 0.039 - 0.059	6 - 9 fl oz	PHI = 14 days. Do not apply more than 0.12 lb ai of lambda-cyhalothrin containing products per acre per season or more than 0.216 lb ai of chlorantraniliprole containing products per acre per season. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground application or less than 5 GPA for aerial application.
lambda-cyhalothrin + thiamethoxam Endigo ZC <i>RUP</i>	0.017 - 0.031 + 0.023 - 0.041	2.5 - 4.5 fl oz	PHI = 14 days. Do not apply more than 0.12 lb ai per acre per season of lambda-cyhalothrin containing products or more than 0.094 lb ai per acre per season of thiamethoxam containing products. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground applications or less than 3 GPA for aerial applications
methamidophos Monitor <i>RUP</i>	0.75 - 1	1.5 - 2 pts	PHI = 14 days.
methyl parathion PennCap-M <i>RUP</i>	0.5 - 1.5	2 - 6 pts	PHI = 5 days. Do not enter treated fields within 48 hours after application.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
novaluron 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.
oxamyl Vydate L	0.5 - 1	2 - 4 pts	PHI = 7 days.
<i>RUP</i>			
permethrin Ambush 2E Arctic 3.2EC Pounce 3.2EC Permethrin 2EC Perm-Up 25 WP Perm-Up 3.2 EC	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.
<i>RUP</i>			
phorate 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.
phosmet Imidan 50 WP	1	2 lbs	PHI = 7 days.
spinosad (microbial) Entrust (formulation approved for Organic crops)	0.05 - 0.1	1 - 2 fl oz	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.
spinosad (microbial) Success	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.
spinetoram (microbial) Radiant SC	0.047 - 0.063	6 - 8 fl oz	PHI = 7 days. Do not apply more than 32 fl oz (0.250 lb ai spinetoram) per acre per season. Do not make more than 4 applications per season. Do not make applications less than 7 days apart.
thiamethoxam 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.
thiamethoxam 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.
thiamethoxam 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, mfenoxam, for control of <i>Pythium</i> seedling disease and pink rot.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
thiamethoxam + chlorantraniliprole Voliam flexi	0.047	4 oz	PHI = 14 days. Do not exceed a total of 8 oz or 0.094 lb ai of thiamethoxam containing foliar products or 0.2 lb ai of chlorantraniliprole containing products per acre per growing season. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground applications or 5 GPA for aerial applications.
zeta-cypermethrin Mustang Max EC Respect <i>RUP</i>	0.020 - 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. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

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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 AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
clothianidin Belay 2.13SC	Foliar: 0.03 - 0.05 In-furrow or side dress: 0.1 - 0.2	Foliar: 1.9 - 2.8 fl oz In-furrow or side dress: 7.2 - 12.0 fl oz Seed treatment: 0.4 - 0.6 fl oz/cwt depending on seeding rate	Foliar: PHI = 14 days. Do not apply more than 8.4 fl oz per acre per season. Do not apply treatments less than 7 days apart. Soil Application: Apply once at planting or as a side-dress during hilling 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 (12 fl oz) per acre per season (one application).
dinotefuran Venom 70 SG (Does not control wireworms)	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.
disulfoton 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.

INSECTICIDE	DOSAGE IN LB	PRODUCT	RESTRICTIONS ON USE
	AI/ACRE	PER ACRE	
imidacloprid Mana Alias 4F	0.125 - 0.25	4.0 - 8.0 fl oz (0.2 - 0.4 fl oz per cwt)	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.
imidacloprid Mana Alias 4F	0.048	1.52 fl oz	Broadcast or directed foliar spray. PHI = 7 days. Minimum interval between applications = 7 days. Maximum of 6.4 fl oz per acre (0.2 lb ai per acre) allowed per crop season when making foliar applications.
imidacloprid Genesis		8 - 16 fl oz (0.4 - 0.8 fl oz per cwt)	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.
imidacloprid Nuprid 2F		8 - 16 fl oz (0.4 - 0.8 fl oz per cwt)	Seed piece treatment ONLY. Maximum of 20 fl oz per acre per season. Do not apply any subsequent in-furrow application of any imidacloprid product.
phorate Phorate 20 G Thimet 20 G		11.3 - 17 oz/1,000 ft of row	Band application at planting. Do not apply Thimet within 90 days of harvest.
<i>RUP</i>			
thiamethoxam 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
acetamiprid 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	
azinphos-methyl Guthion 2L	0.5 - .75	2 - 3 pts	PHI = 7 days. Repeat as necessary. Allow 7 days between applications.
<i>RUP</i>			
beta-cyfluthrin 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>			
bifenthrin Bifenture EC Bridage 2EC Fanfare Sniper	0.033 - 0.1	2.1 - 6.4	PHI = 21 days. Do not apply more than 0.5 lb ai per acre per season, including soil and foliar treatments. Do not make more than 2 foliar treatments per season. Do not make applications less than 21 days apart. Apply in a minimum of 10 GPA by ground and 3 GPA by air.
Flea beetles only	<i>RUP</i>		
bifenthrin + zeta-cypermethrin Hero	0.025 - 0.06	2.6 - 6.1 fl oz	PHI = 21 days. Do not make applications less than 21 days apart. Do not apply more than 0.2 lb ai per acre per season. Leaves cannot be used for food or feed.
<i>RUP</i>			
carbaryl Sevin	1	rate varies by formulation used	No preharvest interval.
clothianidin Belay 2.13SC	Foliar: 0.03 - 0.05	Foliar: 1.9 - 2.8 fl oz	Foliar: PHI = 14 days. Do not apply more than 8.4 fl oz per acre per season. Do not apply treatments less than 7 days apart.
	In-furrow or side dress: 0.1 - 0.2	In-furrow or side dress: 7.2 - 12.0 fl oz	Soil Application: Apply once at planting or as a side-dress during hilling 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 (12 fl oz) per acre per season (one application).
		Seed treatment: 0.4 - 0.6 fl oz/cwt depending on seeding rate	

Potato

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
cyfluthrin Tombstone Tombstone Helios <i>RUP</i>	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.
deltamethrin Delta Gold <i>RUP</i>	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.
dimethoate Digon 400 Dimethoate 400	0.5	1 pt	No preharvest interval. Do not enter treated fields without protective clothing until sprays have dried.
dinotefuran Venom 70 SG	0.050 - 0.2 0.28 - 0.33	FOLIAR: 1 - 4 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.
esfenvalerate Adjourn Asana XL <i>RUP</i>	0.25 - 0.05	5.8 - 9.6 fl oz	PHI = 7 days. Do not feed vines to livestock.
imidacloprid 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.
imidacloprid Mana Alias 4F	0.125 - 0.25	4.0 - 8.0 fl oz or 0.2 - 0.4 fl oz/cwt	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.
imidacloprid Mana Alias 4F	0.048	1.52 fl oz	Broadcast or directed foliar spray. PHI = 7days. Minimum interval between applications = 7 days. Maximum of 6.4 fl oz per acre (0.2 lb ai per acre) allowed per crop season when making foliar applications.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
imidacloprid 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.
imidacloprid 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.
imidacloprid 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.
imidacloprid + cyfluthrin Leverage <i>RUP</i>	imidacloprid: 0.0375 - 0.047 cyfluthrin: 0.026 - 0.032	3.0 - 3.8 fl oz	PHI = 7 days. The 3.0 fl oz rate is for ground sprayer application only.
lambda-cyhalothrin Kaiso 24WG <i>RUP</i>	Potato Leafhopper: 0.015 - 0.025 Flea Beetles 0.02 - 0.03	Potato Leafhopper: 1 - 1.67 fl oz Flea Beetles 1.33 - 2 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 per acre per season.
lambda-cyhalothrin Warrior II <i>RUP</i>	Potato Leafhopper: 0.015 - 0.025 Flea Beetles 0.02 - 0.03	Potato Leafhopper: 0.96 - 1.6 fl oz Flea Beetles 1.28 - 1.92 fl oz	
lambda-cyhalothrin + chlorantraniliprole Voliam Xpress <i>RUP</i>	Potato Leafhopper: 0.016 - 0.026 + 0.033 - 0.052 Flea Beetles 0.020 - 0.029 + 0.039 - 0.059	Potato Leafhopper: 5 - 8 fl oz Flea Beetles: 6 - 9 fl oz	PHI = 14 days. Do not apply more than 0.12 lb ai of lambda-cyhalothrin containing products per acre per season or more than 0.216 lb ai of chlorantraniliprole containing products per acre per season. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground application or less than 5 GPA for aerial application.
lambda-cyhalothrin + thiamethoxam Endigo ZC <i>RUP</i>	0.017 - 0.031 + 0.023 - 0.041	2.5 - 4.5 fl oz	PHI = 14 days. Do not apply more than 0.12 lb ai per acre per season of lambda-cyhalothrin containing products or more than 0.094 lb ai per acre per season of thiamethoxam containing products. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground applications or less than 3 GPA for aerial applications
malathion Malathion 57 EC	0.66 - 1	1.0 - 1.5pts.	PHI = 0 days.
methyl parathion PennCap-M <i>RUP</i>	0.5 - 1	2 - 4 pts	PHI = 5 days. Do not enter treated fields within 48 hours after application.
oxamyl 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
permethrin			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>			
phorate		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.
Thimet 20-G			
phosmet	1	2 lbs	PHI = 7 days.
Imidan WP			
thiamethoxam	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.
Actara			
thiamethoxam	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			
thiamethoxam	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.
Platinum Ridomil Gold			
thiamethoxam + chlorantraniliprole	0.047	4 oz	PHI = 14 days. Do not exceed a total of 8 oz or 0.094 lb ai of thiamethoxam containing foliar products or 0.2 lb ai of chlorantraniliprole containing products per acre per growing season. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground applications or 5 GPA for aerial applications.
Voliam flexi			
zeta-cypermethrin	Potato leafhopper: 0.02 - 0.025	Potato leafhopper: 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. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.
Mustang Max EC			
Respect			
<i>RUP</i>			
	Flea beetle: 0.011 - 0.025	Flea beetle: 1.76 - 4.0 fl oz	

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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.

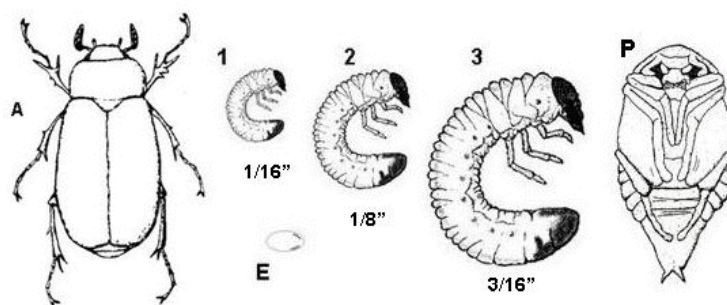
INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
beta-cyfluthrin Baythroid XL <i>RUP</i>	0.0065 - 0.0125	0.8 - 1.6 fl oz	PHI = 0 days. Maximum of 16.8 fl oz per acre per season. Maximum of 2.8 fl oz per acre between 5-day interval. Minimum application volume is 10 GPA by ground and 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.
bifenthrin + zeta-cypermethrin Hero <i>RUP</i>	0.025 - 0.06	2.6 - 6.1 fl oz	PHI = 21 days. Do not make applications less than 21 days apart. Do not apply more than 0.2 lb ai per acre per season. Leaves cannot be used for food or feed.
cyfluthrin 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.
deltamethrin 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.
esfenvalerate Adjourn Asana XL <i>RUP</i>	0.03 - 0.05	5.8 - 9.6 fl oz	PHI = 7 days. Do not feed vines to livestock.
imidacloprid + cyfluthrin Leverage <i>RUP</i>	imidacloprid: 0.0375 - 0.047 cyfluthrin: 0.026 - 0.032	3.0 - 3.8 fl oz	PHI = 7 days. The 3.0 fl oz rate is for ground sprayer application only.
lambda-cyhalothrin Kaiso 24WG <i>RUP</i>	0.015 - 0.025	1 - 1.67 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. Do not apply more than 0.12 lb ai per acre per season.
lambda-cyhalothrin Warrior II <i>RUP</i>	0.015 - 0.025	0.96 - 1.60 fl oz	
lambda-cyhalothrin + chlorantraniliprole Voliam Xpress <i>RUP</i>	0.016 - 0.026 + 0.033 - 0.052	5 - 8 fl oz	PHI = 14 days. Do not apply more than 0.12 lb ai of lambda-cyhalothrin containing products per acre per season or more than 0.216 lb ai of chlorantraniliprole containing products per acre per season. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground application or less than 5 GPA for aerial application.
lambda-cyhalothrin + thiamethoxam Endigo ZC <i>RUP</i>	0.017 - 0.031 + 0.023 - 0.041	2.5 - 4.5 fl oz	PHI = 14 days. Do not apply more than 0.12 lb ai per acre per season of lambda-cyhalothrin containing products or more than 0.094 lb ai per acre per season of thiamethoxam containing products. Minimum interval between applications = 7 days. Do not use less than 10 GPA for ground applications or less than 3 GPA for aerial applications
permethrin 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.

INSECTICIDE	DOSAGE IN LB	PRODUCT	RESTRICTIONS ON USE
	AI/ACRE	PER ACRE	
zeta-cypermethrin Mustang Max EC Respect <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. Apply by air or by ground using sufficient water to obtain full coverage. Use a minimum of 2 gals per acre by air and 10 gals per acre by ground.

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WHITE GRUBS

White grubs that are destructive to field crops in North Dakota have a three-year life cycle. In southeast North Dakota, the most common white grub pest occurs in continuous cropping situations at sites where willow and cottonwood trees are present. In other areas of the state, white grubs are most likely to be found when rotation from grassland, pasture, or grassy weed sites occur. Most root feeding occurs in the second year of the life cycle. In most cases, the number of second-year grubs will only be great enough to justify control once every three years.



Life stages of *Phyllophaga implicita*: A - adult June beetle; E - egg; grub stages with their head width in inches, 1 - first; 2 - second; 3 - third; and P - pupa.

Thresholds:

Treatment is recommended when sampling indicates an average of one or more white grubs per square foot are found. The following sampling procedure provides treatment decisions based on this guideline.

Soil sampling: Fields need to be sampled to determine grub abundance and aid in determining if control is necessary. Sampling in late summer or early fall, before a freeze, provides a more reliable estimate of populations than spring sampling just before planting. Larvae are typically present in the upper 6 inches of soil until a killing frost occurs in the fall. Take soil samples, 1 square foot in size to a depth of 8 inches. Begin taking samples 45 yards from shelterbelts. A total of 30 samples per field, randomly spaced along the shelterbelts, are necessary. If at least a single grub is found in less than 40% of the samples, treatment may be required only out 20 yards from the tree line. If 40% to 60% of the samples are infested, treatment is needed to this distance and maybe as far as 65 yards. If greater than 60% of the samples are infested, treatment may be needed out to 90 yards from the tree line.

INSECTICIDE	DOSAGE IN LB	PRODUCT	RESTRICTIONS ON USE
	AI/ACRE	PER ACRE	
bifenthrin Bifenture EC Bridage 2EC Fanfare <i>RUP</i>	0.3 (at-plant) 0.05 - 0.15 (lay-by)	19.2 fl oz (at-plant) 3.2 - 9.6 fl oz (lay-by)	PHI = 21 days. May be applied in-furrow or as a T-band spray at planting time. May be applied as a lay-by treatment. Do not apply more than 0.5 lb ai per acre per season, including soil and foliar treatments. Apply in 10 GPA spray volume.

INSECTICIDE		DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
bifenthrin Sniper	RUP	0.3 (at-plant)	19.2 fl oz (at-plant)	PHI = 21 days. May be applied in-furrow or as a T-band spray at planting time. May be applied as a lay-by treatment. Do not apply more than 0.5 lb ai per acre per season, including soil and foliar treatments. Apply in 10 GPA spray volume.
		0.05 (lay-by)	3.2 fl oz (lay-by)	
bifenthrin Capture LFR	RUP	0.15 - 0.3 (at-plant)	12.75 - 25.5 fl 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.
		0.15 - 0.3 (lay-by)	12.75 - 25.5 fl oz (lay-by)	

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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 AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
bifenthrin Bifenture EC Bridage 2EC Fanfare	RUP	0.3 (at-plant)	19.2 fl oz (at-plant)	PHI = 21 days. May be applied in-furrow or as a T-band spray at planting time. May be applied as a lay-by treatment. Do not apply more than 0.5 lb ai per acre per season, including soil and foliar treatments. Apply in 10 GPA spray volume.
		0.05 - 0.15 (lay-by)	3.2 - 9.6 fl oz (lay-by)	
bifenthrin Sniper	RUP	0.3 (at-plant)	19.2 fl oz (at-plant)	PHI = 21 days. May be applied in-furrow or as a T-band spray at planting time. May be applied as a lay-by treatment. Do not apply more than 0.5 lb ai per acre per season, including soil and foliar treatments. Apply in 10 GPA spray volume.
		0.05 (lay-by)	3.2 fl oz (lay-by)	
bifenthrin Capture LFR	RUP	0.15 - 0.3 (at-plant)	12.75 - 25.5 fl 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.
		0.15 - 0.3 (lay-by)	12.75 - 25.5 fl oz (lay-by)	
clothianidin Belay 2.13SC			Seed treatment: 0.4 - 0.6 fl oz/cwt depending on seeding rate	Do not use treated seed-pieces for food, feed or fodder. Do not apply subsequent application of Belay (in-furrow or side-dress) following a Belay seed-piece treatment.

INSECTICIDE	DOSAGE IN LB AI/ACRE	PRODUCT PER ACRE	RESTRICTIONS ON USE
imidacloprid Mana Alias 4F	0.125 - 0.25	4.0 - 8.0 fl oz or 0.2 - 0.4 fl oz/cwt	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.
fipronil Regent 4SC	<i>RUP</i>	See label for correct rate. 3.2 fl oz per acre or 0.184 fl oz per 1,000 row feet for 30 inch row spacing	PHI = 90 days. Do not plant small grains or other rotational crops within 12 months following application. Make one in-furrow application at planting time only. Do not apply more than 0.10 lb AI/acre per application. Do not apply this product through any kind of irrigation system.

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