

2021



EXTENSION AND ADVISORY TEAM

GUIDE TO PEST MANAGEMENT IN SPINACH

Nova Scotia Vegetable Crop Guide to Pest Management 2021
[SPIN1-21]



GUIDE TO PEST MANAGEMENT IN SPINACH

Nova Scotia Vegetable Crop Guide to Pest Management 2021
[Spin1-21]

Revised March 17, 2021 by
Talia Plaskett, Protected Crop Specialist, Perennia
Jonathan Bent, Research Associate, Perennia

IMPORTANT

This publication was compiled by representatives from Perennia using information from the Pest Management Regulatory Agency of Health Canada, specific pesticide labels, previous Atlantic Provinces Vegetable Pest Guides, and manufacturer's information. **This information is continuously changing and therefore it can cease to be current and accurate. Pesticide labels are the best source of information and should always be consulted prior to using a product.** The label is the best source of information on registered crop uses, rates, days to harvest, compatibility with other pesticides, toxicity, and other special information on its effective and safe use.

By printing this publication, Perennia does not offer any warranty or guarantee, nor do they assume any liability for any crop loss, animal loss, health, safety, or environmental hazard caused by the use of a pesticide mentioned in this publication.

WARNINGS

This publication is meant to be used as a reference for possible pest control options. Where there are multiple brand names of a specific active ingredient registered in Canada, Perennia has only listed a couple for reference purposes and as such does not endorse one brand over another. If you have purchased a generic product not specifically in this guide but has your crop and pest on the label, always follow that product label.

If any information in this or any other publication conflicts with the information on the label, always use the label recommendation. You are legally responsible for the safe use of pesticides you purchase. This means the safe transport and storage of these materials, the label rates used on crops, and the safe disposal of container.

Pest	Group	Active Ingredient	Pesticide Product Name	Rate	Restricted Entry Interval (REI)	Pre-harvest Interval (days)	Remarks
WEEDS:							
Preplant <i>Perennial weeds including quackgrass</i>	9	glyphosate	Roundup WeatherMAX	1.67-8.0 L/ha	12 hours	7	Apply in the fall or spring prior to planting. Annual weed control programs will be necessary to control weeds germinating after planting. For quackgrass control, apply to actively growing quackgrass when at least 4 new leaves are present. The low rate (1.67 L/ha) will provide a minimum of one season control, while higher rates will provide longer term control. The low rate of Roundup should be applied in 50 to 100 L/ha water. If higher water volumes are used add a suitable surfactant. Wait 72 hours before plowing under. Best control of quackgrass is obtained when these herbicides are applied in the fall.
			Touchdown Total	1.6-8.6 L/ha	12 hours	7	
	14	carfentrazone-ethyl	Aim EC	36.5-117 mL/ha	12 hours	1	
Preemergence <i>Stale Seedbed technique</i>	22	paraquat	Gramoxone 200 SL	2.75-5.5 L/ha	24 hours	-	Apply in 300 – 1100 L of water/ha to foliage of emerged weeds but before the crop has emerged.
	22	diquat	Reglone Desiccant, Dessicash	2.3-4.6 L/ha	24 hours	-	
Postemergence <i>Grasses</i>	1	sethoxydim	Poast Ultra plus Merge	0.32 - 1.1 L/ha 1-2 L/ha	12 hours	15	Apply to actively growing grasses. One application per year.

	1	clethodim	Select or Centurion plus Amigo	0.125 - 0.19 L/ha plus 0.5 %v/v	12 hours	14	Apply a maximum of two applications per year.
<i>Inter-row shielded</i>	22	paraquat	Gramoxone 200 SL	2.75-5.5 L/ha	12 hours	-	Avoid spraying crop as damage may occur. Apply in 300-1100 L of water per ha. Do not apply later than 3 days before crop emergence.
	22	diquat	Reglone, Dessicash	2.3-4.6 L/ha	24 hours	-	
	14	carfentrazone-ethyl	Aim EC	36.5-117 mL/ha	12 hours	1	Apply in minimum spray volume of 100 L/ha. Refer to label for target weeds, buffer zones and rates. Use high flow rate nozzles to apply the highest spray volume.

Pest	Group	Active Ingredient	Pesticide Product Name	Rate	Restrictive Entry Interval (REI)	Pre-harvest Interval (days)	Remarks
INSECTS:							
Leaf Miners	4	acetamiprid	Assail 70 WP Aceta 70 WP	86 g/ha	12 hours	7	Max 5 applications/yr. Begin application when insect populations reach recognized economic threshold levels. Consult the provincial extension service, or professional consultants or other qualified authorities to determine appropriate threshold levels for treatment in your area. Adequate spray coverage is essential for optimum control.
	4, 28	Thiamethoxam, cyantraniliprole	Minecto Duo 40WG	750 g/ha	12 hours	-	In-furrow application at the seeding or transplant depth, or a narrow surface band above the seedline during planting. One application per season. Do not use foliar products from groups 4 or 28 following soil application of Minecto Duo.

	28	Cyantraniliprole	Exirel	1-1.5 L/ha	12 hours	1	For optimum control of leafminers, apply Hasten NT Spray Adjuvant* at an application rate of 0.25% v/v or MSO Concentrate with Leci-Tech* at an application rate of 0.5% v/v. Max. 4 applications per season.
	28	Cyclaniliprole	Cyclaniliprole 50SL NEW 2021	1.2 L/ha	12 hours	1	Thorough coverage is essential to achieve best results. Spray volumes of 200-1000L/ha recommended. Avoid applying any Group 28 insecticide consecutively more than 2 times within a 30 day period. Make no more than 3 applications in a year. A minimum of 7 days between treatments.
Aphids	4	acetamiprid	Assail 70 WP Aceta 70 WP	56-86 g/ha	12 hours	7	Max. 5 applications/yr. Begin applications when treatment thresholds have been reached. Thorough coverage is important to obtain optimum control. Use the high rate under heavy pest pressure.
	1B	malathion	Malathion 85E	1345 ml/ha	12 hours	7	Use sufficient spray volume to achieve adequate plant coverage. Max. 1 application per year.
	9B	Pymetrozine	FulFill 50WG	193 g/ha	12 hours	14	Apply when aphids first appear. Do not exceed 2 applications/season. Allow 7 days between applications. Causes feeding cessation shortly after application but aphids may remain on the plant for 2-4 days before they die. The use of a non-ionic surfactant at a rate of 0.25% v/v is recommended to improve performance under drought stress conditions.
	28	Tetraniliprole	Vayego 200 SC NEW 2021	150 mL/ha	12 hours	1	Suppression. Begin applications when treatment thresholds have been reached. Apply as a directed foliar spray ensuring thorough coverage. Allow a minimum of 5 days between applications. No more than 4 applications per season.
	29	Flonicamid	Beleaf 50SG	0.12-0.16 kg/ha	12 hours	0	Thorough spray coverage of plant foliage is essential. Minimum of 94 L of water/ha. Max 3 applications/season; allow 7 days between applications. Avoid overnight storage of spray mixtures, do not use liquid fertilizer as a carrier and do not use adjuvants.

	4	thiamethoxam	Actara 25 WG	105 g/ha	12 hours	7	Apply before aphids reach damaging levels. Max 2 applications/year, with at least 7 days between them. Product is highly toxic to bees, do not apply to blooming crops and wait at least 5 days before placing beehives in a treated field.
	4C	Sulfoxaflor	Closer SC	100-150 ml/ha	12 hours	3	Max. 2 applications/growing season with at least 7 days between them. Do not apply during crop flowering period or when flowering weeds are present in treatment area.
Aphids and Whiteflies	4D	Flupyradifurone	BYI 02960 200SL NEW 2021	Aphids: 500 – 750 mL/ha Whiteflies: 750 – 1000 mL/ha	12 hours	1	Apply as a directed foliar spray ensuring thorough coverage. Minimum application volume of 100 L/ha. Allow 7 days between applications. No more than 2000 mL/ha per season.
	23	spirotetramat	Movento 240 SC	220-365 ml/ha	12 hours	3	Minimum 7-day interval between applications. Maximum of 730 ml/ha of product applied per season. Product is TOXIC to bees through direct contamination of pollen and nectar. DO NOT apply this product during crop flowering period or when flowering weeds are present.
			Movento 150 OD	347-585 ml/ha	12 hours	3	Minimum 7-day interval between applications. Maximum 1.17 L/ha of product applied/season. Product is TOXIC to bees through direct contamination of pollen and nectar. DO NOT apply this product during crop flowering period or when flowering weeds are present.
	28	Cyclaniliprole	Cyclaniliprole 50SL NEW 2021	1.2 L/ha	12 hours	1	Whitefly suppression only. Thorough coverage is essential to achieve best results. Avoid applying any Group 28 insecticide consecutively more than 2 times within a 30-day period. Make no more than 3 applications in a year. A minimum of 7 days between treatments.

	9D	Afidopyropen	Versys	0.1-0.5 L/ha	12 hours	0	<u>Green peach aphid (<i>Myzus persicae</i>), potato aphid (<i>Macrosiphum euphoribae</i>) & lettuce aphid (<i>Nasonovia ribis-nigri</i>).</u> <u>Sweet potato whitefly (<i>Bemisia tabaci</i>) & silverleaf whitefly (<i>Bemisia argentifolii</i>).</u> Allow a minimum of 7 days between applications. Monitor pest population and reapply if necessary once thresholds are reached. Max. 4 applications per year.
	NC	Potassium salts of fatty acids	Kopa Insecticidal Soap	8L in 400L water; 700-1900 L/ha solution	-	0	Do not spray when plants are under stress. Avoid spraying during full sun.
Cabbage looper	5	spinosad	Success 480 SC	0.182 L/ha	When dry	1	Max. 3 applications/yr.
			Entrust 80 W	109 g/ha			Max 3 applications/yr. Allow 7-10 days between applications.
			Entrust SC	364 ml/ha			
	5	spinetoram	Delegate WG	140-200 g/ha	12 hours	1	Time application with peak egg hatch or small larvae. Repeat applications based on population monitoring. Use higher rate for higher infestations or advanced growth stages. Max. 3 applications/year with a minimum re-treatment interval of 5 days.
	11	<i>Bacillus thuringiensis</i>	Dipel 2X DF	275 - 550 g/ha	4 hours	0	Use in a minimum of 200L/ha water.
			Thuricide HPC	2.0 - 4.25 L/ha	-	0	
28	chlorantraniliprol e	Coragen	250 ml/ha	12 hours	1	Begin applications when treatment thresholds are reached. Do not apply more than once every 3 days. Max. 4 applications/season. Do not exceed 1L per ha per season. Apply in a finished spray volume of 100L/ha.	

	28	Tetraniliprole	Vayego 200 SC NEW 2021	225 mL/ha	12 hours	1	Suppression. Begin applications when treatment thresholds have been reached. Apply as a directed foliar spray ensuring thorough coverage. Allow a minimum of 5 days between applications. Max. 4 applications per season.
	28	Cyclaniliprole	Cyclaniliprole 50SL NEW 2021	0.8 – 1.2 L/ha	12 hours	1	Thorough coverage is essential to achieve best results. Avoid applying any Group 28 insecticide consecutively more than 2 times within a 30-day period. Make no more than 3 applications in a year. A minimum of 7 days between treatments.
	18	Methoxyfenozide	Intrepid	0.3 – 0.6 L/ha	12 hours	1	Apply at the first sign of feeding damage or when infestations reach threshold levels as determined by monitoring. Repeat applications after 7-14 days if required based on population monitoring. Use higher rate for heavy infestations, advanced growth stages of the target pest or larger crop canopies.
	11	<i>Bacillus thuringiensis</i> , subsp. <i>aizawai</i> , (Strain ABTS-1857 fermentation solids, spores, and insecticidal toxins)	XenTari WG	500 - 1000 g/ha	4 hours	0	Also for the control of Beet Armyworm. Apply sufficient spray volume to ensure uniform deposition on all plant surfaces; recommend 500 L per ha.
Aster leafhopper	NC	kaolin	Surround WP	12.5 - 25 kg/ha	-	0	An OMRI listed control product suitable for organic production. Apply in 500 L of water at 7-14-day intervals once initial infestation is detected. Use high rate for early applications. Do not exceed 25 kg/ha per application.
Tarnished Plant Bug	4	thiamethoxam	Actara 25 WG	210 g/ha	12 hours	7	Apply before aphids reach damaging levels. Max one application/year. This product is highly toxic to bees, do not apply to blooming crops and wait at least 5 days before placing beehives in a treated field.

	29	Flonicamid	Beleaf 50 SG NEW 2021	0.20 – 0.30 Kg/ha	12 hours	0	Suppression. Apply when tarnished plant bugs first appear in the field and before populations reach high levels. Thorough coverage is essential for optimum control: use a minimum of 94L/ha. Allow a minimum of 7 days between applications. Do not apply more than 0.6 Kg/ha per season.
Onion thrips	5	Spinetoram	Delegate WG	200 - 336 g product/ha	12 hours	1	Max 3 applications/year. Apply when onion thrips first appear targeting egg hatch and small nymphs. Repeat in 7-10 days if needed.
	23	Spirotetramat	Movento 240 SC	365 ml/ha	12 hours	3	Minimum interval between applications: 7 days. Maximum allowed per crop season: 730 mL/ha. Apply when thrips are first identified. Movento should be used during the first half of the season when adult populations are relatively low or building. Reductions in numbers of thrips larvae may take 3 to 4 days after Movento is applied.
Flea Beetles	28	Cyantraniliprole	Exirel	500 - 1000 ml/ha	12 hours	1	Begin applications when treatment thresholds have been reached. Thorough coverage is important to obtain optimum control. Re-application interval: 5 days. Max. 4 applications/season.
	28	Cyclaniliprole	Cyclaniliprole 50SL Or Harvanta 50SL NEW 2021	1.2 L/ha	12 hours	1	Thorough coverage is essential to achieve best results. Avoid applying any Group 28 insecticide consecutively more than 2 times within a 30-day period. Make no more than 3 applications in a year. A minimum of 7 days between treatments.
	28	Tetraniliprole	Vayego 200 SC NEW 2021	150 mL/ha	12 hours	1	Begin applications when treatment thresholds have been reached. Apply as a directed foliar spray ensuring thorough coverage. Allow a minimum of 5 days between applications. Max. 4 applications per season.

Pest	Group	Active Ingredient	Pesticide Product Name	Rate	Restricted -Entry Interval (REI)	Pre-harvest Interval (days)	Remarks
DISEASES							
Anthracnose	9, 12	Cyprodinil and fludioxonil	Switch 62.5 WG	775 - 975 g/ha	3 days	3	Begin applications prior to or at the onset of disease and repeat applications at 7-10-day intervals if conditions remain favourable for disease development. Max. 2 applications per year. Apply in sufficient water to ensure thorough coverage: 175-225 L of water /ha.
Pythium	4	metalaxyl-M and s-isomer	Apron XL LS	20 – 40 ml / 100kg of seed	-	-	One application as a seed treatment. Do not apply to leafy greens that are destined to be grown in the greenhouse.
	28	Propamocarb hydrochloride	Tattoo	1.5 mL product / L of water, at 650-1500 L of solution per hectare	12 hours	2	Apply by directed nozzles to the lower portion of the plants and surrounding soil. <u>Apply as soil application only</u> , mixed in 650-1500 L/ha water. Make the first application when conditions become favorable and continue applications on a 21-40 day interval until threat of disease is over up to 9.2 L/ha.
	BM02	<i>Trichoderma harzianum</i> Rifai strain T22	Trianium P NEW 2021	High crop density: Apply 3 g/m ² of cultivated area. Low crop density or in rows: 30g/1000 plants	-	-	Greenhouse only. Start drench application directly after planting. Use a water volume equal to 10% of substrate volume or 2 – 5 L/m ² . Use a half-rate dose (1.5 g/m ²) if plants have been treated with TRIANUM P previously. Repeat the half-rate booster dose every 10 weeks or after potting-on. Can also be used to suppressed damping off (<i>Rhizoctonia solani</i>) in field grown spinach, see label for directions.

Downy Mildew	11	azoxystrobin	Quadris Azoshy 250SC	1.125 L/ha	12 hours	7	Max. 2 application/yr. Begin applications prior to disease establishment and repeat at 7-day intervals.
	M	copper sulfate	Copper 53W	2.5 kg/ha	48 hours	2 days	Apply at 7-10-day intervals. Max. 5 applications per year.
	40	mandipropamid	Revus plus Non-ionic adjuvant	400-600 ml/ha plus 0.125% v/v	12 hours	1	For control of Downy Mildew and Blue Mold. Applications should begin prior to disease development and continue throughout the season on a 7-10-day schedule, following resistance management guidelines. Max. 4 applications per year.
	49, 40	Oxathiapiprolin, Mandipropamid	Orondis Ultra NEW 2021	0.6 L/ha	12 hours	1	Begin applications prior to disease development and continue on a 7-to-10-day interval. Use shorter interval when disease pressure is high. Make no more than 2 sequential applications before switching to a fungicide with a different mode of action. Max. 4 applications per season.
	7 11	boscalid, pyraclostrobin	Pristine WG	1.6 Kg/ha	24 hours (general) 9 days (hand harvesting and thinning)	0	For suppression of Downy mildew. Apply when disease first appears. Follow 5-7 days later with a fungicide with a different mode of action. Do not make sequential applications of Pristine or other group 11 fungicides. Max. 2 applications per year.
	4	metalaxyl-M and S-isomer	Ridomil Gold 480 EC	1 L/ha	12 hours	-	Apply at planting as a banded application over the row, pre-plant incorporated application. One application per season.

Downy Mildew	43	fluopicolide	Presidio	220-292 ml/ha	12 hours	2	Apply in 200-1000 L/ha. For resistance management, Tank-mix with a labelled rate of another fungicide registered for the target pathogen, but with a different mode of action. Follow the most restrictive use directions of either label. Make foliar applications on a 7-10-day schedule beginning with initial flowering, or when disease conditions are favorable, but prior to disease development. Use the lower rate and longer interval as preventive applications. Use higher rate and shorter interval if disease is present.
	11	Fenamidone	Reason 500 SC	400 ml/ha	-	2	Begin applications prior to onset of disease which typically occurs in humid weather or when rains and heavy dews occur, approximately early to after mid-June. Continue applications on a 7-day interval. Do not make more than one application of Reason 500 SC before alternating with a fungicide from a different group. Apply with sufficient water to ensure thorough coverage of foliage. Max. 4 applications per season.
	U15	Oxathiapiprolin	Zorvec Enicade	0.175-0.35 L/ha	12 hours	0	Begin applications prior to disease development and continue on a 5-14-day interval. Use higher rate and shorter interval when disease pressure is high. Max. 4 applications
	28	Propamocarb hydrochloride	Tattoo	2.3 L/ha	12 hours	2	Make foliar applications when conditions first become favourable for disease development (for example, high moisture and moderate temperature), but before infection. Continue applications on a 7-10-day interval until threat of disease is over, up to 4 applications. Apply as ground application only, mixed in 200 - 400 litres of water per hectare.
White rust (<i>Albugo occidentalis</i>)	NC	<i>Bacillus subtilis</i>	Serenade Opti	0.6-1.1 Kg/ha	-	0	Biopesticide that will only suppress the indicated diseases. Begin applications at the first sign of disease, or when conditions become conducive for disease development. Repeat as necessary on a 7-10-day interval.

White rust (<i>Albugo occidentalis</i>)	21	Cyazofamid	Torrent 400SC Plus Sylgard 309	0.15-0.2 L/ha Plus 0.15 L/ha surfactant	12 hours	1	Suppression only. Max. 5 applications per year. Do not make sequential applications. Apply at 7-day intervals beginning when disease is first seen or when conditions favour disease development. Use the low rate for preventative applications or very low disease pressure; use high rate as disease pressure increases. Spray volume to use varies with the amount of plant growth and will range from 300-500 L/ha. A plant back interval of 30 days is required.
	19	Polyoxin D zinc salt	Diplomat 5SC	463 ml/ha	When dry	0	Apply as a foliar spray in sufficient water to provide thorough coverage of foliage. Begin as a preventative application when conditions favour disease development and continue on a 7-14-day interval as needed to maintain suppression. Do not apply more than 150 g a.i./ha/year.
	M	copper sulfate	Copper 53W	2.5 kg/ha	48 hours	2 days	Apply at 7-10 day intervals. Max. 5 applications per year.
Sclerotinia rot (<i>Sclerotinia sclerotiorum</i> , <i>Sclerotinia minor</i>)	7 11	boscalid, pyraclostrobin	Pristine WG	1.0 – 1.3 Kg/ha	24 hours 9 days for hand harvesting and thinning	0	For suppression of white mold. Apply once per season before disease develops. Max. 2 applications per season.
	7 11	Pyraclostrobin, Fluxapyroxad	Merivon NEW 2021	0.3 – 0.4 L/ha	12 hours; 9 days for thinning; 1 day for scouting/ handset irrigation	1; 9 days for hand harvesting; 1 day for mechanical harvesting	Suppression of Sclerotinia leaf drop. Begin applications prior to onset of disease development. Maximum of 3 applications in a year, with a spray interval of 7-14 days. Use the shorter interval and/or the higher rate when disease pressure is high. Apply subsequent applications if disease persists or weather conditions are favourable for disease development. DO NOT apply to spinach as a tank mix with anything other than water.

	7	penthiopyrad	Fontelis	1.25-1.75 L/ha	12 hours	3	Begin applications prior to disease development, continue on a 7-10-day interval. Use higher rate and shorter interval when disease pressure is high. Max seasonal rate is 5.25 L/ha. Do not make more than 2 sequential applications before switching to another mode of action.
Grey mould (<i>Botrytis cinerea</i>)	7	penthiopyrad	Fontelis	1.25-1.75 L/ha	12 hours	3	Begin applications prior to disease development, continue on a 7-10-day interval. Use higher rate and shorter interval when disease pressure is high. Max seasonal rate is 5.25 L/ha. Do not make more than 2 sequential applications before switching to another mode of action.
	9, 12	Cyprodinil and fludioxonil	Switch 62.5 WG	775-975 g/ha	3 days	3	Begin applications prior to or at the onset of disease and repeat applications at 7 to 10 day intervals if conditions remain favourable for disease development. Make no more than 2 applications per year. Apply in sufficient water to ensure thorough coverage: 175-225 L of water /ha.

Use the following web link to search for any pesticide label mentioned in this guide, or any other pesticide registered in Canada: <http://pr-rp.hc-sc.gc.ca/lr-re/index-eng.php>

PESTICIDE EMERGENCY CONTACT INFORMATION

Poison Control Centres		
Nova Scotia	800.565.8161 or 902.428.8161	IWK, Halifax, NS
New Brunswick	911	Ask for Poison Information
Prince Edward Island	800.565.8161 or 902.428.8161	IWK, Halifax, NS
Newfoundland	709.722.1110	Dr. Charles A. Janeway Child Health Care Centre, St. John's, NF

Environmental Emergencies (Pesticide Spills)	
Transport Canada Regional Operations Centre (24 hours)	
Nova Scotia	800.565.1633
New Brunswick	800.565.1633
Prince Edward Island	800.565.1633
Newfoundland	800.563.9089

ABBREVIATIONS & CONVERSIONS

Formulation and Measurement Abbreviations			
FORMULATIONS		MEASUREMENTS	
DF	Dry flowable	mL	millilitre
EC, E	Emulsifiable concentrate	kPa	kilopascal
L	Liquid	kg	kilogram
Sn / Su	Suspension	g	gram
WP/W	Wettable powder	L	litre
		BIU	Billions of International Units
		ppm	parts per million (1000 ppb)
		ppb	parts per billion (1/1000 ppm)

Helpful Conversions¹	
kPa X 0.14 = pounds per square inch (psi)	millilitres X 0.035 = fluid ounces
hectares X 2.47 = acres	litres X 35 = fluid ounces
kilograms X 2.2 = pounds	litres X 0.22 = imperial gallons
kilograms per hectare X 0.89 = pounds per acre	litres per hectare X 14.17 = fluid ounces per acre
kilograms per hectare X 0.40 = kilograms per acre	litres per hectare X 0.40 = litres per acre
	degree-days C X 1.8 = degree-days F

¹ **Pesticide Units of Measurement**

It is not recommended to convert label rates to imperial units because there is a high probability of mathematical and rounding errors. Present day pesticides are formulated to be more effective in smaller amounts. Therefore, even small conversion errors can lead to the use of incorrect rates (either too high or too low). Use metric – you will be glad you did!