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"In This Issue"

VELUM® PRIME Nematicide/Fungicide label expanded via Minor Use Program to help manage stem and bulb nematode in Garlic

J. MOSIONDZ, Minor Use Coordinator, OMAFRA

The Pest Management Regulatory Agency (PMRA) recently announced the approval of a minor use label expansion registration for VELUM® PRIME Nematicide/Fungicide for control of stem and bulb nematode (*Ditylenchus dipsaci)* on garlic in Canada. VELUM® PRIME Nematicide was already labeled for management of nematodes and diseases on a wide range of crops in Canada. This minor use proposal was submitted by the Ontario Ministry of Agriculture, Food, and Rural Affairs as a result of minor use priorities established by growers and extension personnel.

The following is provided as an abbreviated, general outline only. Users should be making disease management decisions within a robust integrated disease management program and should consult the complete label before using VELUM® PRIME Nematicide/ Fungicide.

Crop	Pest Suppressed	Rate	PHI	Use Information
Garlic	Stem and bulb nematode (*Ditylenchus dipsaci*)	500 mL/ha or 3.75 mL / 100 m row (based on 75 cm row spacing)	30 days	One application at planting in the fall OR in the spring. Spray specified dosage in a 10-15 cm band in-furrow at planting and cover with soil. For best results, direct the in-furrow spray to the seed and soil. Apply in 50-300 L of water per hectare.

Toxic to aquatic organisms and non-target terrestrial plants. Observe buffer zones specified under DIRECTIONS FOR USE. Toxic to birds. This product demonstrates the properties and characteristics associated with chemicals detected in groundwater. The use of this product in areas where soils are permeable, particularly where the water table is shallow, may result in groundwater contamination. To reduce runoff from treated areas into aquatic habitats avoid application to areas with a moderate to steep slope, compacted soil, or clay. Avoid application when heavy rain is forecast. Contamination of aquatic areas as a result of runoff may be reduced by including a vegetative filter strip between the treated area and the edge of the water body.

Follow all other precautions, restrictions, and directions for use on the VELUM® PRIME Nematicide/Fungicide label carefully.

VELUM® PRIME Nematicide/Fungicide label expanded via Minor Use Program to help manage stem and bulb nematode in Garlic…con't

For a copy of the new minor use label contact Travis Cranmer, Vegetable Crops Specialist, OMAFRA, Guelph (519) 835-3382, your regional supply outlet, or visit the PMRA label site http://www.hc-sc.gc.ca/cps-spc/pest/registrant-titulaire/tools-outils/label-etiq-eng.php

Note: This article is not intended to be an endorsement or recommendation for this particular product, but rather a notice of registration activity.

A New Strategy for Managing Garlic Stem and Bulb Nematode

Travis Cranmer, Vegetable Crop Specialist, OMAFRA

The bulb and stem nematode (*Ditylenchus dipsaci*), is a major pest of garlic that has destroyed hundreds of acres of garlic in Canada over the past decade. The nematodes survive in the soil as well as in garlic cloves that are being used to plant subsequent crops. Cloves with low numbers of nematodes are asymptomatic-, and it may not be until the third or fourth year of growing the crop that rot is observed just above the basal plate (**Figure 1**).

Figure 1. Bulb and stem nematode causing rot above the basal plate.

Female nematodes can lay up to 500 eggs during their lifespan and can start producing eggs in as few as 19 days at an average temperature of 15°C. The fourth juvenile life stage of the nematode can resist dry environments and freezing temperatures allowing it to survive the winter in cloves or soil (Yuksel, 1960).

Symptoms of the stem and bulb nematode include premature senescence prior to harvest and the yellowing of the lower leaves moving upwards. As the root plate rots, infected plants can be easily pulled, and the plants appear to have no roots attached. Symptoms can be easily confused with Fusarium basal rot. Garlic infected by a subspecies of *Fusarium oxysporum* are also easily pulled, but some roots typically remain attached to the bulb. Both stem and bulb nematodes and *Fusarium oxysporum f. sp. capae* can colonize the bulb at the same time.

The best management practice is preventing the introduction of nematodes into the crop. Testing planting stock for stem and bulb nematode prior to planting is the most effective way to avoid this pest. Bulbs can be submitted to a pest diagnostic lab qualified for nematode extraction, identification and count. Soil from fields prior to planting can also be sampled. Stem and bulb nematodes are most prevalent in the top 5 cm (2 inches) of the soil profile (Blauel *et al.*, 2021). Avoid allowing samples to dry out and keep in a cool place prior to submitting to the lab. Submit soil samples within two days of sampling to help avoid false negatives. Before planting, growers should consider sending their poorest looking cloves to determine whether stem and bulb nematode is present in their planting stock.

Many growers have started clean, with nematode and virus-freed roundels from the Garlic Growers Association of Ontario / SPUD Unit or planted bulbils in nematode-free soil. Both strategies can result in a nematode-free crop that can be multiplied and phased into production in 2-4 seasons. These methods are effective at reducing the pathogens present in the crop, but it can take several years to reach the number of plants desired. In addition, it takes careful planning to avoid contamination from infested fields.

Once stem and bulb nematodes are present in the crop, it is difficult to manage. The *Ditylenchus* nematode genus has an extensive host range that includes over 450 plant species (Mckenry and Roberts, 1985). According to studies conducted at the University of Guelph and University of Manitoba, the specific nematode species that is found in to infect garlic in Canada reproduces well in alfalfa, peas, beans, and onion. Crops that reduce the population of stem and bulb nematode after garlic include soybean, wheat, canola, corn, barley, potato, carrot, and lettuce (Hajihassani *et al.*, 2016; Ives 2019). Once the bulb and stem nematode is introduced to a field, utilizing a four-year crop rotation with a non-susceptible crop can help suppress this nematode.

A hot water treatment (soak) of cloves at 49°C for 20 minutes prior to planting has shown to be an effective method of suppressing nematodes; but it can be difficult to implement. Temperatures below 49°C may not kill the nematodes, and temperatures above 50°C may damage the germination rate of the planting stock.

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It's also important to prevent soil moving from infested fields to a nematode-free field. Clean machinery, boots, tools and other equipment of all soil between fields to help prevent nematodes from establishing in a new field.

Several crop protection products have been evaluated for their potential to manage this nematode in Canada. Multiple field trials conducted by the University of Guelph and OMAFRA have shown fluopyram (FRAC group 7) to be effective at reducing nematode levels thus improving yields.

Trials conducted by Ives in 2016 and 2017 showed a drench application of fluopyram to infested planted stock in muck or mineral soil significantly decreased- nematode survival resulting in a greater marketable yield compared to other treatments. Work conducted by Celetti in 2017 and 2018 showed fluopyram drenched over infested planting stock in open furrows resulted in reduced nematode damage, fewer nematodes in the harvested bulbs, and -marketable bulbs when harvested the following year. In a trial conducted by Blauel *et al*.; in 2019, a fluopyram drench provided a significant increase in the percent marketability and yield in planting stock that had both low and high levels of nematodes.

Velum Prime (fluopyram) has since been recently registered on garlic via the Minor Use Program for the management of stem and bulb nematode. This registration is the result of an URMULE submission and as of March 10, 2022, the PMRA has approved a use pattern of Velum Prime on garlic as outlined below. This product provides a new management strategy that will be useful for managing nematode populations in lightly infested planting stock, or on planting stock that was harvested from a field with a history of stem and bulb nematode. This label expansion was made possible due to past work conducted by Michael Celetti, Lilieth Ives, Mary Ruth McDonald and Jim Chaput.

Summary;

- Always test new planting stock for stem and bulb nematode by sending a sample to a lab prior to planting
- Obtain clean seed roundels from the Garlic Growers Association of Ontario / SPUD unit or plant bulbils in nematode-free soil
- Implement a four-year crop rotation using non-hosts to stem and bulb nematode
- Clean machinery prior from nematode-infested fields prior to entering a new field
- Rogue out symptomatic plants throughout the growing season
- When Velum Prime is applied as a soil application for control of stem and bulb nematode, use another FRAC mode of action (not a group 7) for the first foliar fungicide application of the season, if applicable

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Figure 2. Use pattern for Velum Prime on garlic at planting.

- Blauel, T., Celetti, M.J., Jordan, K.S., and McDonald, M.R. 2021. Optimizing methods to sample and quantify stem and bulb nematode, *Ditylenchus dipsaci*, in garlic, *Allium sativum*, field soil. Canadian Journal of Plant Pathology. *In press*.
- Blauel, T., Vander Kooi, K., and McDonald, M.R. 2019. Evaluation of nematicides for control of stem and bulb nematode in garlic, 2018-2019. 42-44.
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- Hajihassani, A., Tenuta, M., and Gulden, R.H. 2016. Host Preference and Seedborne Transmission of *Ditylenchus weischeri* and *D. dipsaci* on select pulse and non-pulse crops grown in the Canadian prairies. Plant Disease. 100:1087-1092.
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- McKenry, M. V., and Roberts, P. A. 1985. Phytonematology Study Guide Publication 4045. University of California, Division of Agriculture and Natural Resources. 1-56.
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Now Hiring – Summer Research Assistant Position in Ridgetown

There are still positions available to gain experience working with the Ontario Ministry of Agriculture, Food and Rural Affairs in Ridgetown this summer. The vacant positions include a wide variety of projects involving vegetable production, soil quality, insect and disease management, and research skills. Application deadline is March 25, 2022.

2022-OMAFRA-Ridgetown-Summer-Field-Research-Assistant-Job-Ad2

Anthracnose management in peppers – the old and the new

Katie Goldenhar, Pathologist (Horticulture) and Amanda Tracey, Vegetable Crop Specialist, OMAFRA

Anthracnose in Ontario field peppers has been historically caused by the fungal pathogens *Colletotrichum coccodes* and *C. dematium*. These are endemic to Ontario and mainly infect ripe fruit. The disease has typically been controllable through use of fungicides applied on a 14-day interval starting after fruit set. In 2020, a severe anthracnose outbreak occurred in one processing pepper field. Samples were taken from the field, sent for diagnosis and subsequently identified as *Colletotrichum scovillei*, a new species to Ontario. In 2021, anthracnose in peppers was seen in late July in multiple pepper fields. The disease spread quickly and was extremely aggressive with more than 80% of fruit (immature and mature) infected with at least one lesion by late August.

Colletotrichum scovillei has been reported in South Carolina, Brazil, China, Indonesia, Japan, Malaysia, South Korea, Taiwan and Thailand. *Colletotrichum scovillei* is part of the *C. acutatum* species complex, which can cause symptoms on immature fruit. *Colletotrichum scovillei* hosts are primarily within the *Capsicum* (pepper) family.

Biology and Spread

Colletotrichum species may overwinter on infected pepper fruit left in the field or on infected plant material at the end of the production season. Additionally, if crop debris remains on equipment, this may serve as an overwintering source for the disease. Pepper anthracnose usually starts out as a 'hot spot' in the field and then fans out directionally with the prevailing wind and driving rain. The spores of *Colletotrichum* species are spread through splashing water, rain or irrigation, driving winds and equipment/people. Hot weather along with afternoon and evening showers are ideal conditions for anthracnose development.

Symptoms

Colletotrichum species are known to have latent infection periods, where they infect flowers or developing fruit and do not show symptoms until weeks after. *Colletotrichum scovillei* can cause lesions on small, immature fruit as well as mature fruit. Samples of asymptomatic fruit were collected and fruit without any visible lesions (between 1-5 cm) were found to already be infected. Infected fruit can have one or more soft, sunken lesions covered with salmon-colored spore masses (Figure 1).

Figure 1. Anthracnose caused by *Colletotrichum scovillei* on banana, bell, and jalapeño peppers.

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Management

Cultural controls for anthracnose should include starting with clean transplants. Scout regularly and remove infected plants, including plants surrounding the diseased one as soon as symptoms are seen. Rotating away from peppers, ideally a 3-year rotation or more, can help reduce inoculum pressure. Avoiding the use of overhead irrigation can help reduce the leaf wetness period needed for infection. Remaining plant debris should be mulched/mowed and then incorporated into the soil as soon as harvest is finished to allow for the soil microorganisms to break down the residue. Clean and disinfect equipment including irrigation hoses, baskets, tractors, trucks, wagons, etc. before storage.

Fungicide applications targeting anthracnose should start at flowering and continue on a 7-to-10-day interval until harvest. Make sure the sprayer is well calibrated and the fruit is receiving adequate coverage. Table 1 outlines the fungicides registered in Canada for pepper anthracnose. Group 11 fungicides (Cabrio and Quadris Top) are heavily relied on for anthracnose control. When using group 11 (QoI) fungicides, the Fungicide Resistance Action Committee (FRAC) recommends that in programs in which applications of QoI are made with both solo products and mixtures, the number of QoI containing applications should be no more than 50% of the total number of fungicides applied per season. Table 2 gives an example of a spray program for *C. scovellei* including the new Emergency Use Label for captan. A spray program beginning at flowering could have 10 or more fungicide applications.

Table 1. Fungicides registered on field peppers for the 2022 field season for anthracnose. Note that captan is an Emergency Use Label for one year.

Active ingredient	Product	FRAC Group	Maximum # of applications per year	Pre-Harvest Interval (days)
copper sulphate	Copper 53W	M1	10	2
captan	Catan 80 WSP	M4	3	3
pyraclostrobin	Cabrio	11	6	0
azoxystrobin/ difenoconazole	Quadris Top	11 & 3	3*	1
difenoconazole/ benzovindiflupyr	Aprovia Top	3 & 7	4*	1
difenoconazole/ pydiflumetofen	Miravis Duo	3 & 7	2*	0
fludioxinil/cyprodinil	Switch	12 & 9	3	0

Table 2. Fungicide programs with captan for the season. More than 12 applications may be needed. All fungicides with difenoconazole (Quadris Top and Aprovia Top) max 4 apps per year, Switch max of 3 apps per year, Cabrio max 6 apps per year and Captan max 3 apps per year.

Week	With captan
1 (first flowering)	Quadris Top
2	Switch
3	Captan + Cabrio
4	Aprovia Top
5	Switch
6	Captan + Cabrio
7	Aprovia Top
8	Switch
9	Quadris Top
10	Captan + Cabrio

Other management strategies could include host resistance. Based on a report from South Carolina, Table 3 outlines some cultivars that showed reduced disease development. None of these cultivars are suitable to Ontario production, however it does demonstrate that there may be some genetic resistance in commercial cultivars that could be incorporated into northern cultivars.

Table 3. Cultivars tested in South Carolina against *Colletotrichum scovillei*

Resistant (0% incidence)	Tolerant (2-5% incidence)	Susceptible (>10% incidence)
Roulette	Mexican Sunset	Cornito Giallo
Red Ember	Mexican Sunrise	Escamillo
Aiji Rico	Chili Pie	
	Just Sweet	

Anthracnose management in peppers – the old and the new…con't

Pepper growers should keep anthracnose at the top of their mind as planning continues for the 2022 field season. Reach out to myself (katie.goldenhar@ontario.ca) or Amanda Tracey (amanda.tracey@ontario.ca) for any questions or concerns regarding this disease.

References

- A.P. Keinath, S.H. Zardus, and V.B. Dubose, and G. Rennberger. (2021) Evaluation of All-America Selections peppers, 2020. *Plant Disease Management Reports* 15: V040.
- Farr, D.F., & Rossman, A.Y. Fungal Databases, U.S. National Fungus Collections, ARS, USDA. Retrieved March 2, 2022, from https://nt.ars-grin.gov/fungaldatabases/
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