



Spinach: Disease, Insect & Nutrition Management

When planning your next crop of spinach in field, greenhouse and high tunnel, give them a healthy start and keep them clean throughout production with the BioWorks family of products.

Root Disease Control

RootShield® PLUS⁺ WP and Granules (OMRI Listed)

- Provides long-term (12 weeks) root protection for all stages of growth
- Grows on the roots “shielding” them against root damaging fungi such as *Fusarium*, *Pythium*, *Rhizoctonia* and *Phytophthora*
- Active ingredients: *Trichoderma harzianum* strain T-22 and *Trichoderma virens* strain G-41
- WP: Apply as a drench to transplants or larger plants, used in a suspension to dip transplants into before transplanting in the high tunnel, greenhouse or field, or applied through drip irrigation systems
- Granules: Apply at seeding, transplanting or to established crops as a side dress and incorporated into soil
- Cost effective: Reduces or eliminates chemical root fungicide applications
- Grows on the roots within a pH range of 4–8 at soil temperatures of 48° to 97°F
- 8–10 week residual. 4-hour REI, 0-day PHI

T-22 HC (OMRI Listed)

- *Trichoderma harzianum* strain T-22 wettable powder preventative biological fungicide for control of *Pythium*, *Rhizoctonia*, *Fusarium*, *Cylindrocladium* and *Thielaviopsis*
- Can be used for commercial seed treatment of spinach seed

Product and Application	Rates
RootShield® PLUS⁺ WP, RootShield® PLUS⁺ Granules – OMRI-Listed (controls <i>Rhizoctonia</i> , <i>Pythium</i> , <i>Fusarium</i> , <i>Rhizoctonia</i> , <i>Phytophthora</i> and more)	
RootShield PLUS+ Granules growing mix: 1.5-3 lb/cu yd	
<u>Field production in furrow:</u> Apply Granules using a metering devise mounted to deliver granules into the furrow just behind the furrow opener. Apply at seeding, transplanting or to establish crops as a side dress and incorporate into soil, OR WP in-furrow spray equipment or in transplanting equipment, including water wheels, OR	5-12 lb/acre (Granules) 16-32 oz/acre (WP)
<u>Drench</u> immediately after seeding/planting with RootShield PLUS+ WP. Apply at the rate of 50 gal to 800 sq. ft. of transplant trays. For plants in 4-inch square or larger rockwool blocks, use 100 gal of drench suspension per 800 sq. ft. For plants in large pots, drench at the rate of 10-12 fl oz/gal of pot size.	6 oz/100 gal 10-12 fl oz/100 gal of pot size
<u>Transplant dip:</u> Maintain agitation of the dip suspension. Submerge for 30 seconds. The whole transplant or plug tray can be dipped, if desired. Change out dip solution as it is used up or becomes difficult to use because of fouling with organic matter. Can be tank mixed with ON-Gard® for dipping of transplants.	1.6 oz suspended in 20 gal water
<u>Drip irrigation application:</u> Ensure that all filters are in place. Run RootShield PLUS+ towards the end of the irrigation cycle, flush irrigation lines with clear water after application.	6 oz/100 gal or 1-2 lbs per acre
T-22 HC (controls <i>Pythium</i>, <i>Rhizoctonia</i>, <i>Fusarium</i>, <i>Cylindrocladium</i> and <i>Thielaviopsis</i>) Commercial seed treatment:	1-3 oz per hundred weight (CWT) of seed



Foliar Disease Control

BotryStop® (*Ulocladium oudemansii* U3 strain; 4-hr REI, 0-day PHI, OMRI Listed)

- Biofungicide used to prevent *Botrytis* and *Sclerotinia* diseases
- Active component is a non-pathogenic saprophytic fungus that aggressively competes for the same physical space as the plant pathogens, preventing crop damage; highly unlikely that resistance will develop
- Non-invasive and causes no harm to live plant tissue
- Storage and Shelf Life: Product must be stored refrigerated. Do not freeze. During storage, keep the bag closed, with excess air removed and away from non-compatible products. Under proper storage conditions, shelf life is 12 months

CEASE® (*Bacillus subtilis* strain QST 713; 4-hr REI, 0-day PHI, OMRI Listed)

- Prevents both fungal and bacterial disease; controls *Botrytis*, powdery mildew, *Erwinia* and *Xanthomonas*
- Add to a program for enclosed space production (greenhouse and high tunnel)
- Can be applied to foliage or soil for control of a broad spectrum of diseases
- Compatible in a tank mix with MiiStop for foliar applications

MiiStop® SP (Potassium Bicarbonate; 1-hr REI [4-hr REI if tank mixed with CEASE], 0-day PHI, OMRI Listed)

- Broad-spectrum foliar fungicide that can prevent powdery mildew and other foliar diseases
- Cost effective, pre-formulated with surfactants
- Excellent tank mix partner with CEASE for greenhouse and high tunnel cucurbits to increase disease prevention effectiveness
- For outdoor cucurbits, Serenade ASO can be used in place of CEASE

Product and Application	Rates
<p>BotryStop® – OMRI-Listed (controls <i>Botrytis</i> and <i>Sclerotinia</i> diseases)</p> <p>Foliar Spray: The most commonly used rate is 3 lb/acre. Use sufficient water volume to provide good coverage, wetting and saturation of the plant. Fill tank halfway, begin agitation, add desired amount of BotryStop and then add a compatible non-ionic surfactant for proper product wetting and spreading. (Refer to “BotryStop Compatibility Sheet” for product compatibility). Use spray mixture immediately. Do not allow spray mixture to stand overnight or for prolonged periods.</p> <p>For spinach, begin applications when conditions are conducive to disease development and repeat on 7-10-day intervals as needed</p>	<p>2-4 lbs/acre in at least 50 gal of water every 7-10 days</p>
<p>CEASE® – OMRI-Listed (controls <i>Botrytis</i>, powdery mildew, <i>Erwinia</i>, <i>Pseudomonas</i>, <i>Xanthomonas</i> and more)</p> <p>Can be applied as often as 3-day intervals. Recommended to spray at 7-day intervals for prevention when conditions are optimum for disease. For downy mildew, CEASE should be used as part of an overall control program for prevention. Under conditions conducive to downy mildew, CEASE applications should be increased to twice a week. While the rate range for CEASE is from 2-8 quarts/100 gal, the most commonly used rate is 4 quarts.</p>	<p>2-8 qts./100 gal every 3-7 days</p>
<p>MiiStop® – OMRI-Listed (controls Powdery mildew, <i>Botrytis</i> and other diseases)</p> <p>Outdoor Foliar Spray: Curative application rates between 2.5 lbs and 5 lbs per 100 gal/acre; Preventative rates up to 5 lb/100 gal/acre.</p> <p>Enclosed Space Application: Rates as low as 1.25 lb/100 gal for preventative applications. Apply weekly during periods of high disease potential. Use up to 3 lb/100 gal for curative applications to eradicate powdery mildew</p>	<p>Outdoor Preventative: 2.5 lbs/100 gal/acre Outdoor Curative: up to 5 lbs/100 gal/acre Enclosed Space Preventative: 1.25 lbs/100 gal</p>
<p>TANK MIX: MiiStop & CEASE</p> <p>For an effective 1 – 2 punch combine MiiStop and CEASE as a tank mix to control powdery mildew and other foliar diseases. Use recommended preventative rate, increasing rate for curative control of powdery mildew.</p>	<p>Preventative: 1.25 lbs (M) + 2 qt per gal/acre (C) Curative: 3.0 lbs (M) + 6 qt per gal/acre (C)</p>



Insect & Mite Control

BotaniGard® / Mycotrol® (*Beauveria bassiana* strain GHA; 4-hr REI, 0-day PHI)

- Biological insecticide to control aphids, early stage caterpillars, thrips and other pests.
- BotaniGard 22WP or Mycotrol WPO (WSDA Certified Organic) for organic use – also reliable options for enclosed space production, such as greenhouse or high tunnel

BotaniGard® MAXX (*Beauveria bassiana* strain GHA and natural pyrethrins; 12-hr REI, 0-day PHI)

- Unique combination product representing the latest generation of biorationals for insect control. The dual active ingredient formulation offers both synergy and multiple modes of action that work to kill damaging insect and mite pests.
- Excellent rotation partner with BotaniGard: When insect pressure is high, use BotaniGard MAXX for quick knockdown, then follow up with typical BotaniGard use.

Product and Application	Rates
<p>BotaniGard® ES / Mycotrol® ESO (controls aphids, early stage caterpillars, thrips, & more)</p> <p><u>Outdoor Foliar Spray:</u> At first detection of target pest, spray recommended solution to wet, trying to avoid runoff. Repeat application at 5-10 day intervals. *Shorten interval to 3-5 days when populations are high, especially with whiteflies and aphids. Repeat applications for as long as pest pressure persists.</p> <p><u>Enclosed Space Production (greenhouse or high tunnel) Foliar Spray:</u> At first detection of target pest, spray solution to wet, but avoid runoff. Repeat applications at 5-10 day intervals. **Shorten interval to 3-5 days when populations are high, especially with aphids and whiteflies. Repeat applications for as long as pest pressure persists.</p>	<p>¼ - 1 qt/acre in 5-100 gal of water 5-10 day intervals*</p> <p>½ - 2 qt/100 gal of water**</p>
<p>BotaniGard® 22WP / Mycotrol® WPO (controls squash bugs, aphids, thrips, whiteflies & more)</p> <p><u>Enclosed Space Production (greenhouse or high tunnel) Foliar Spray:</u> At first detection of target pest, spray solution to wet, but avoid runoff. Repeat applications at 5-10 day intervals. ***Shorten interval to 3-5 days when populations are high, especially with aphids and whiteflies. Repeat applications for as long as pest pressure persists.</p> <p><u>Transplant Dip:</u> Maintain agitation of the dip suspension. Submerge for 30 seconds. Transplants or whole plug tray can be dipped if desired. Change out dip solution as it is used up or becomes difficult to use because of fouling with organic matter. Can be tank mixed with ON-Gard® and RootShield PLUS+ WP. NOTE: DO NOT USE BotaniGard ES or Mycotrol ESO for dipping.</p> <p>TANK MIX OR ROTATION: BotaniGard/Mycotrol & Molt-X</p> <p>Both BotaniGard and Mycotrol formulations can be tank mixed with Molt-X as an effective combination on labeled pests. Use the recommended rates of BotaniGard/Mycotrol indicated above and add Molt-X at 4 fl oz/100 gal. When tank mixing, include Molt-X in every other application.</p> <p><u>In Rotation:</u> Use the 8-10 fl oz rate of Molt-X, 5-7 days after a BotaniGard/Mycotrol application</p>	<p>½ - 1 lb/100 gal of water per acre 5-10 day intervals***</p> <p>1.5 oz suspended in 5 gal of water (or 6 oz/20 gal)</p>
<p>BotaniGard® MAXX (controls squash bugs, aphids, thrips, whiteflies and other pests)</p> <p><u>Enclosed Space Production:</u> Whiteflies, aphids, thrips and other labeled pests; Apply recommended solution – DO NOT WET PLANTS TO POINT OF RUNOFF OR DRIP.</p> <p><u>Field Spinach Production:</u> Mix in sufficient water to thoroughly cover foliage infested with insects, typically 5-100 gal of water per acre. Final spray volume can be up to 400 gal/acre. Water volume depends on spray equipment, crop canopy and target pest. DO NOT WET PLANTS TO POINT OF RUNOFF OR DRIP. Apply BotaniGard MAXX up to a maximum of 2 qt/acre for extreme insect pressure or high plant density. Can be applied aerially at ¼ - 1 qt/acre. See label for more details. Apply at 5-10 day intervals. High insect populations, especially aphids and whiteflies may require application at 2-5 day intervals.</p>	<p>½ - 1 qt/100 gal spray volume (depending on insect population and foliage density)</p> <p>¼ - 2 qt/acre (typically 5-100 gal water/acre)</p>



Insect & Mite Control (continued)

Molt-X® (Azadirachtin; 4-hr REI, 0-day PHI, OMRI Listed)

- Insect growth regulator; slows or disrupts the development process which can increase insect susceptibility to either a tank mix partner or the next rotated insecticide(s)

SuffOil-X® (Mineral oil); 4-hr REI, 0-day PHI, OMRI Listed)

- Provides a different mode of action to provide knock down activity to control aphids, spider mites, whiteflies, thrips and other pests.
- Light summer oil will suffocate the insects, resulting in a rapid response
- Excellent rotational partner with BotaniGard and Molt-X

NemaShield® (*Steinernema feltiae*; No REI; No human toxicity; Exempt from EPA labeling requirements)

- Beneficial nematode ideally suited to control root-damaging fungus gnat larvae (commonly *Bradysia* species) in greenhouse production
- Also controls thrips species that spend a portion of their life cycle in the soil or potting media.
- Properly applied, NemaShield will kill fungus gnat larvae that are feeding on plant roots
- Compatible with many pesticides, including insecticides

Product and Application	Rates
<p>Molt-X® – OMRI Listed (controls foliar and soil borne pests)</p> <p>Maintain tank solution pH between 5.5-6.5. Repeat application for as long as pest pressure persists. When tank mixing Molt-X, reduce rate to 4-5 fl oz/100 gal.</p>	<p>8-10 fl oz/100 gal/acre (If tank-mixing, reduce rate to 4-5 fl oz/100 gal)</p>
<p>SuffOil-X® – OMRI Listed (controls aphids, spider mites, whiteflies, thrips, and other pests)</p> <p>Apply as a foliar spray at recommended rate. If reducing water volume per acre, keep concentration at 1-2%. Repeat application for as long as pest pressure persists, but keep interval one week apart. No limit to the number of applications.</p>	<p>1-2 gal/100 gal (maintain 1-2%)</p>
<p>NemaShield® (controls fungus gnat larvae and thrips (WFT) pupae and pre-pupae)</p> <p>One unity of NemaShield containing 100 million infective stage <i>Steinernema feltiae</i> on a clay/gel carrier will treat 1100-3400 sq ft, depending on insect pressure. NemaShield is available in 100 million, 500 million and 2 billion nematodes per unit. See the NemaShield label for more details on proper rates and usage.</p>	<p>One 1100 million packet/1100-3400 sq ft (depending on insect pressure)</p>



Nutrition Management

ON-Gard® 5-0-0 (OMRI Listed)

- 100% plant-derived; 100% water soluble, and consistent in composition
- Provides a broad array of plant-based amino acids for increased plant health

Verdanta® EcoVita® 7-5-10 / N-Vita® 9-4-3 (Organic Fertilizers; OMRI Listed)

- EcoVita: general purpose organic fertilizer suitable for many crops
- N-Vita: higher nitrogen mix (9-4-3)
- Derived from 100% organic sources; provide slow but continuous release of nutrition to vegetable crops
- Produced using proprietary MINIGRAN® Technology which creates a uniform composition in each granule, consisting of the same amount of N, P and K for precise nutrient distribution and availability to plants

Product and Application	Rates
<p>ON-Gard® – OMRI Listed (provides plant-based amino acids)</p> <p><u>Transplant Dip</u>: Can be used alone or in combination with RootShield <i>PLUS</i>+</p> <p><u>Foliar Spray or through drip irrigation</u>: Use as a foliar spray during production or mixed with fertilizers run through a drip system.</p> <p>Tank mixable with most crop inputs. Test (jar test) to ensure physical compatibility.</p>	<p>0.25% v/v (1.6 fl oz/5 gal) as a dip solution</p> <p>0.25%-0.5% v/v (1-2 qt/100 gal) as a foliar spray</p>
<p>Verdanta® Eco-Vita® 7-5-10 – OMRI Listed (general purpose fertilizer)</p> <p>Field Spinach</p> <p>Greenhouse/High Tunnel Spinach</p>	<p>870-2,180 lb/acre</p> <p>435-1,745 lb/acre</p>
<p>Verdanta® N-Vita® 9-4-3 – OMRI Listed (general purpose fertilizer with higher nitrogen)</p> <p>Spinach – Base fertilization</p> <p>Top dressing</p>	<p>435-1,350 lb/acre</p> <p>435-870 lb/acre</p>

Refer to product labels for complete application details. Additional technical information is available on our website (bioworksinc.com) or from your BioWorks Biological Solutions Advisor. Always read and follow label directions.