EVALUATION OF VERDESOIL™ FOR MANAGEMENT OF TOMATO PATHOGENS

E.N. Rosskopf, N. Kokalis-Burelle, and J.C. Hong
USDA-ARS, U.S. Horticultural Research Lab, Ft. Pierce, FL

Verdesoil™ is a commercially-available soil amendment product composed of glycerin, urea, phosphorous, potassium, and propionic acid. Field research trials in Florida and California were conducted in strawberry production systems in which yields resulting from Verdesoil treatments were significantly higher than yields derived from untreated plots and from 79-133% of the yields achieved using soil fumigation (Savage et al., 2017).

A greenhouse trial was conducted using field soil from a commercial farm with a heavy infestation of root-knot nematode (*Meloidogyne arenaria*). Verdesoil (7480 l ha^{-1}) was compared to a non-treated check and treatments were replicated 10 times. Verdesoil was applied in the equivalent of one acre inch of water and the non-treated controls were treated with water only. Pots were covered with 0.03-mm black/white VaporSafe® totally impermeable film (Raven Industries, Sioux Falls, SD) and treated pots were undisturbed for three weeks prior to plastic removal and establishment of three tomato transplants per pot. Home garden tomato variety 'Florida Lanai' was used due to its rapid growth, compact size (Rajabu et al. 2018), and susceptibility to *M. arenaria* (Kokalis-Burelle, unpublished). Plants were watered daily and fertilized weekly using a water-soluble 20-10-20. Vigor and foliar disease development was rated weekly. Fruit were harvested upon ripening until the final assessment at which time all remaining fruit were harvested regardless of size or ripening stage. Tomato plant biometric assessments were conducted ten weeks after planting and included plant height, fresh top biomass, stem diameter, stem vascular necrosis (+/-), root condition (0-5, 5 being necrotic roots), root gall rating (1-10, Bridge and Page, 1980) and root weight. Soil and root nematodes were extracted using the Baermann funnel technique and *Meloidogyne* spp. and free-living microbivorous and predatory nematodes were identified after extraction using the methods of Kokalis-Burelle et al., 2016. Soil and tissue nutrient analysis was conducted to determine the contribution to measured plant growth parameters.

Greenhouse temperatures during the study were on average 18C night temperature and 33C day temperature. Plant height, fresh biomass, stem diameter, fruit count, fruit weight, root weight, galling, and root condition were significantly different between plants grown in the Verdesoil treatment and the non-treated check ($p<0.0001$). All plant growth parameters were significantly greater in the Verdesoil treatment than in the non-treated check. Root galling and condition were significantly lower in the Verdesoil treatment (Table 1). Interestingly, there was no difference between numbers of root-knot nematodes in soil ($p=0.7018$), but there were significantly fewer root-knot ($p=0.0022$) and reniform ($p=0.0239$) nematodes extracted from roots derived from the Verdesoil treatments. Conversely, there were more non-pathogenic nematodes in the Verdesoil treatment than in the non-treated soil ($p=0.0026$), but no difference between treatments for roots ($p=0.2807$, Figure 2).

While this experiment was limited in scope, Verdesoil provided a level of root-knot nematode control in tomato that warrants additional studies to confirm field efficacy for the production of nematode-susceptible vegetable crops in the southeast.

Bridge, J. and Page, S.L.J. 1980. Estimation of root-knot infestation levels in roots using a rating chart. Topical Pest Management 26:296-298.

Kokalis-Burelle, N. Rosskopf, E.N., Butler, D.M., Fennimore, S.A., and Holzinger, J. 2016. Evaluation of steam and soil solarizaton for *Meloidogyne arenaria* control in Florida floriculture crops. Journal of Nematology 8:183-192.

Rajabu, C.A., Kennedy, G.G., Ndunguru, J., Ateka, E.M., Tairo, F., Hanley-Bowdoin, L., Ascencio-Ibáñez. 2018. Lanai: A small, fast growing tomato variety is an excellent model system for studying geminiviruses. Journal of Virological Methods 256:89-99.

Savage, S., Taylor, C., Bejarano, C., Ashby, E., and Sharingson, J. 2017. Verdesoil, a glycerol-based pre-plant soil amendement for strawberries. Proceedings of the Annual International Research Conference on Methyl Bromide Alternatives and Emissions Reductions, MBAO, 32-1-32-2.

Table 1. Average plant biometric values for three plants per replicate and ten replications for each treatment.

Treatment	Height (cm)	Fresh Weight (g)	Stem Diameter (mm)	Root Weight (g)	Fruit Count #	Fruit Weight (g)
Verdesoil™	45.7a	57.2a	14.0a	57.2a	8.8a	82.7a
Nontreated	37.1b	14.2b	9.7b	14.2b	1.8b	22.2b

Values with different letters are significantly different based on Fisher's protected LSD (0.05).

Table 2. Average root condition and galling values and soil and root nematode counts per gram of root and per 100cc of soil for three plants per replicate and ten replications for each treatment.

Treatment	Root Condition (1-5)[¥]	Root Galling (1-10)[£]	Root-knot nematode (soil)	Root-knot nematode (root)	Reniform nematode (root)	Non-pathogenic (soil)	Non-pathogenic (root)
Verdesoil™	0.88a	0.27a	4.2a	0a	0a	64.0a	34.4a
Nontreated	1.32b	5.16b	4.9a	20.6b	7.2b	15.6b	25.3b

Values with different letters are significantly different based on Fisher's protected LSD (0.05). [¥] Root condition was used as a general indicator of root health and was assessed using a subjective scale of 0 to 5 with 0 to 1.0 = 0% to 20% discolored roots, 1.0 to 2.0 = 21% to 40%, 2.0 to 3.0 = 41% to 60%, 3.0 to 4.0 = 61% to 80%, and 4.0 to 5.0 = 81% to 100%. [£] Root gall rating was assessed based on a gall index scale of 1-10, with one representing no galls and 10 representing severe (100%) galling (Bridge and Page, 1980).