Managing *Fusarium* on Ginseng

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Fusarium spp. are soilborne fungi, and can be responsible for damping-off, russeting of the root, and Fusarium root rot. *Fusarium* spp. are part of the fungal complex responsible for preemergence damping-off and postemergence seedling root rot, especially in 1- and 2-year-old ginseng plantings. Damping-off can occur early in production by causing a seed rot and attacking seedlings before they emerge from the soil. Postemergence damping-off is more readily recognized because the damping-off fungus attacks at the soil line after the seedling emerges from the soil. Wilting of the seedling occurs when stems are infected, causing water-soaking and constriction. Seedlings collapse at the point of constriction. *Fusarium* spp. can produce spores on ginseng debris.

Blemishes and lesions caused by infection from *Fusarium* spp.. Although stunted, these roots will often continue to grow until harvest.

Fusarium spp., *Cylindrocarpon destructans* and *Rhexocercospordium panacis* are the fungi that cause russeting of the ginseng root. This disease causes small reddish and brown lesions to develop on the roots. The crowns of the plants may also become infected.

Fusarium root rot can infect the stem, crown, roots and foliage. Red- to orange-colored lesions appear on infected areas of roots. Vascular discoloration is a common symptom of infection and is typically preceded by wilt of the leaves.

Fusarium spp. produce three spore types: large, banana-shaped macroconidia and small microconidia are mass produced. Thick-walled chlamydospores are produced for overwintering. *Fusarium* spp. can be seed-disseminated.

Foliar symptoms of *Fusarium* spp. infection on seedlings. These symptoms are often incorrectly associated as a nutrient deficiency problem.

Cultural strategies recommended for Fusarium root rot management are summarized in the table below.

Cultural Management Strategies
• Choose sites with good soil drainage. • Use treated seed produced in healthy gardens. • Avoid working in the garden when soil is wet to avoid compaction which prevents drainage. • Avoid standing water by digging trenches to drain water away from the garden. • Work in diseased gardens at the end of the day. • Clean equipment used in a diseased garden with a power washer to remove soil and plant debris, then use a detergent. • Use disposable, plastic boots over footwear before entering a garden with *Fusarium*. • Clean hand tools with a disinfestant such as bleach (10% solution) and rinse.

Fungicides, although helpful, will not completely prevent infection of this difficult to control pathogen. See the below table for the best available products.

See table below for list of products.

Product	A.I.	FRAC Group
Products for *Fusarium* spp.		
Maxim 4FS, Spirato 480FS, Dyna-Shield Fludioxonil (seed treatment only)	fludioxonil	12
Cannonball WG	fludioxonil	12
Fontelis SC	penthiopyrad	7
Captan 80WDG	captan	M4

Remember that the pesticide label is the legal document on pesticide use. Read the label and follow all instructions closely. The use of a pesticide in a manner not consistent with the label can lead to the injury of crops, humans, animals, and the environment, and can also lead to civil or criminal fines and/or condemnation of the crop. Pesticides are good management tools for the control of pests on crops, but only when they are used in a safe, effective and prudent manner according to the label.

Visit the IR-4 Project website (http://www.ir4.rutgers.edu) for updates on the registration of new products.