Identifying and Managing New and Old Onion Diseases

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Downy mildew. In 2014, downy mildew was detected in mid-July and was confirmed in two fields in Calhoun and Ottawa Counties, MI. Downy mildew is caused by a water mold, *Peronospora destructor*. The disease can progress rapidly during cool (less than 72°F), wet weather. Optimal conditions for infection are temperatures of 50 to 54°F when there is free water on the leaf for 2 to 4 hours. The spores of the downy mildew pathogen are produced in large masses on the plant tissue and can be disseminated via humid air currents, but are quickly killed during dry conditions. The cycle of infection and spore production can occur multiple times in a season. Sources of disease include infected bulbs, sets, seeds, plant debris, onion cull piles, and volunteers. In addition, overwintering oospores of the pathogen that remain in the soil are able to infect seedlings planted in the following season.

Disease symptoms can be recognized as pale-green yellow to brown elongated patched on leaves. Masses of grayish-purple fuzzy growth usually develop on the older leaves if the environmental conditions are humid (Fig. 1A). Leaf tissue under the pathogen growth turns pale green then yellow. Affected leaves become chlorotic and collapse and die as the disease progresses (Fig. 1B). Yield losses occur as a result of premature death of the onion leaves and bulbs may rot in storage.

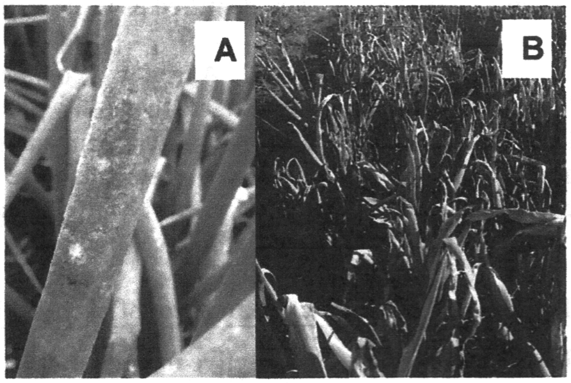

Figure 1. A, Growth of downy mildew pathogen on foliage. **B,** Severely infected onions caused by downy mildew.

Bacterial diseases. Bacterial leaf blight, caused by *Pantoea agglomerans*, and bacterial center rot, caused by *P. ananatis,* have been a limiting factor for Michigan onion growers in recent years. Bacterial diseases were prevalent in all onion fields scouted this summer. The occurrence of bacterial diseases has increased over the last several years and has expanded to onion growing areas in multiple counties. *P. agglomerans* isolated from a field in Ottawa County in 2011 was the first documented case of this species occurring in Michigan. In 2014, it was confirmed that *P. agglomerans* was affecting fields located near Allegan, Calhoun, Eaton, Ingham, Newaygo, and Ottawa Counties. *P. ananatis* was confirmed from a field in Allegan County. The detection of bacterial leaf blight in 2014 was earlier than previous years as it was detected on onion seedlings that were at two-leaf stage (Fig. 2A).

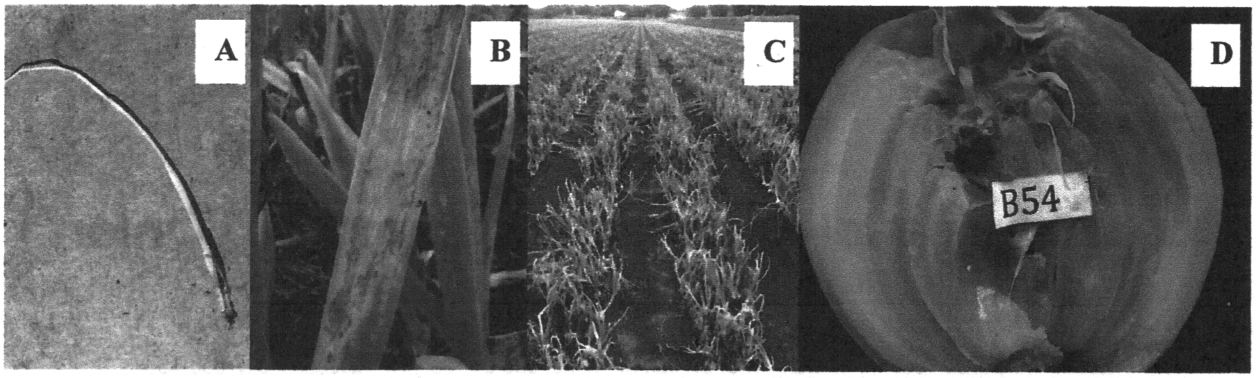

Figure 2. A, Symptoms of bacterial leaf blight on a young seedling. **B,** Leaf lesion caused by the bacterial leaf blight pathogen, *Pantoea agglomerans*. **C,** Onion field with extremely severe bacterial leaf blight symptoms. **D,** Bulb rot caused by bacterial infection.

The pathogens responsible for bacterial leaf blight and bacterial center rot are able to cause disease individually or together as a disease complex. Symptoms appear as irregular or linear streaks of necrotic and bleached areas with water-soaked margins extending along the length of the leaves (Fig. 2B). The pathogens not only cause damage on the photosynthetic tissue of the plants growing in fields (Fig. 2C), but they also result in bulb rot in storage (Fig. 2D). Bacterial diseases are favored by warm, humid, and wet weather. Dissemination of the bacteria generally occurs by wind and splashing water. However, a recent report from Georgia in 2014 showed that tobacco thrips (*Frankliniella fusca*) and onion thrips (*Thrips tobaci*) have been identified as vectors of these pathogens.

Bacterial field trial. A trial was conducted in a commercial field with a grower cooperator in Ingham County, MI to investigate the ability of copper-based and antibiotic products to control bacterial leaf blight (Table 1). Treatments were applied as a foliar spray at 7-day intervals. The first treatment was applied on 2 July and additional treatments were made until 20 August. Disease severity was assessed twice using a scale of 1 to 5; where 1 = no disease, 2 = 1 to 25% of foliage blighted, 3 = >25 to 50%, 4 = >50 to 75%, and 5 = >75% of foliage blighted.

Table 1. Products tested for control of bacterial leaf blight in 2014.

Treatment	Active ingredient	FRAC* code	Rate/Acre	Spray Schedule	App. Type
Untreated control	--	--	--	--	--
Kocide 3000	Copper hydroxide	M1	1.50 lb	7 days	Foliar
Cuprofix Ultra 40	Basic copper sulfate	M1	1.25 lb	7 days	Foliar
Nucop	Copper hydroxide	M1	1.50 lb	7 days	Foliar
Kasugamycin	Kasugamysin	24	2.0 pt	7 days	Foliar

*FRAC stands for Fungicide Resistance Action Committee. Numbers and letters are used to distinguish the fungicide groups based on their mode of action, therefore fungicides with the same FRAC code have similar mode of action.

Kocide 3000 was significantly better in reducing bacterial blight severity on the first disease assessment date in comparison to the other treatments. On the second observation date, both Kocide 3000 and Kasugamycin limited bacterial leaf blight compared to the untreated control (Fig. 3).

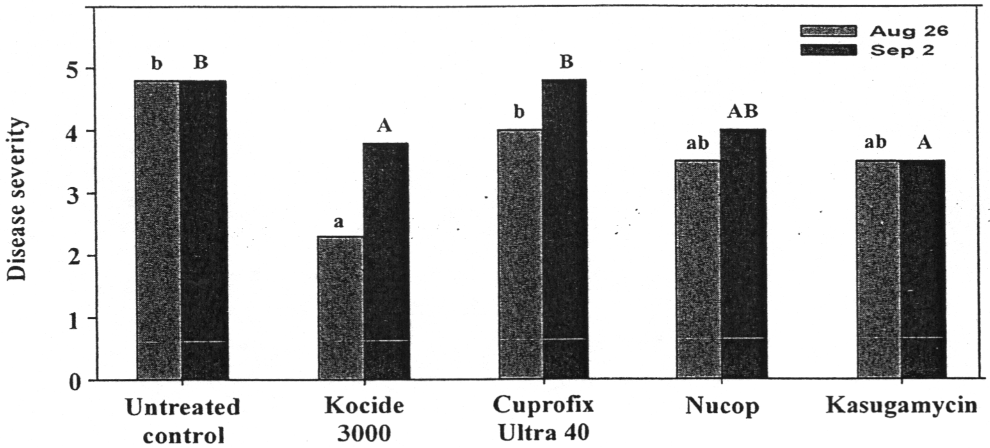

Figure 3. Products tested for control bacterial leaf blight in 2014. Disease severity assessed on 26 August (blue bars) and 2 September (purple bars). Disease severity was rated using a scale of 1 to 5; where 1 = no disease, 2 = 1 to 25% of foliage blighted, 3 = >25 to 50%, 4 = >50 to 75%, and 5 = >75% of foliage blighted. Bars with a letter in common are not significantly different (LSD t test, $\alpha = 0.05$).

Pink root is one of the many diseases which contribute to destruction of onion roots, causing loss of yield. Yield losses can reach as high as 96%, depending on the growth stages of plant when infected and the amount of pathogen inoculum persisting in the planting area. Under favorable cultural conditions, the onion plant may grow fast enough such that the pink root disease is minimized. In Michigan, pink root management relies on cultivar selection and a long crop rotation.

Pink root fungicide trial. In order to propose control strategies for the control of pink root on onions, a fungicide trial was conducted in a research greenhouse at Michigan State University. Approximately 6-week-old 'Highlander' seedlings were transplanted into plastic pots. Plants were inoculated with millet seed infested with the pink root pathogen, *Setophoma terrestris*, followed by drenching with fungicides (Table 2). There were a total of 20 treatments that included healthy and diseased controls and nine fungicide treatments. Fungicides were either applied once (0 day after inoculation) or twice (0 and 14 days after inoculation). Root density and plant fresh weight were measured at 55 days after inoculation.

Table 2. Fungicides tested for control of pink root in greenhouse trial in 2014.

Trade name	Active ingredient (A.I.)	% A.I.	FRAC code*	Rate/acre**
Cannonball	fludioxinal	50.0	3	0.44 lb
Fontelis	penthiopyrad	20.4	7	2.90 pt
Inspire	difenoconazole	23.2	3	0.44 pt
Inspire Super	cyprodinil+difenoconazole	32.5	9, 3	1.25 pt
Quadris Flowable	azoxystrobin	22.9	11	1.19 pt
Quadris Top	azoxystrobin+difenoconazole	29.6	11, 3	0.88 pt
Switch 62.5WG	cyprodinil+fludioxinal	62.5	9, 12	0.88 lb
Vangard	cyprodinil	75.0	9	0.63 lb
Serenade Soil	*Bacillus subtilis*	1.34		8.0 pt

*FRAC stands for Fungicide Resistance Action Committee. Numbers and letters are used to distinguish the fungicide groups based on their mode of action, therefore fungicides with the same FRAC code have similar mode of action.

**Rate/acre was calculated based on % A.I.

Five fungicide treatments, Quadris Flowable, Quadris Top, Inspire, Inspire Super, and Fontelis significantly limited disease as determined by root density; Fontelis had increased plant fresh weight compared to the other treatments (Fig. 4,5). Phytotoxicity was observed for the applications of Inspire Super, Quadris Top, Switch 62.5WG, and Vangard at 0 days after inoculation and with Inspire Super, Quadris Top, Switch 62.5WG, Vangard, and Quadris Flowable applied 0 and 14 days after inoculation.

Overall, Fontelis applied as a drench was the most effective treatment among the other fungicides; however, the severity of pink root was only partially limited with the fungicide treatments as compared with the untreated healthy control. Phytotoxicity was observed on the plants applied with the fungicides that had either azoxystrobin or cyprodinil as an active ingredient. It was also observed that the phytotoxic effect increased with two applications.

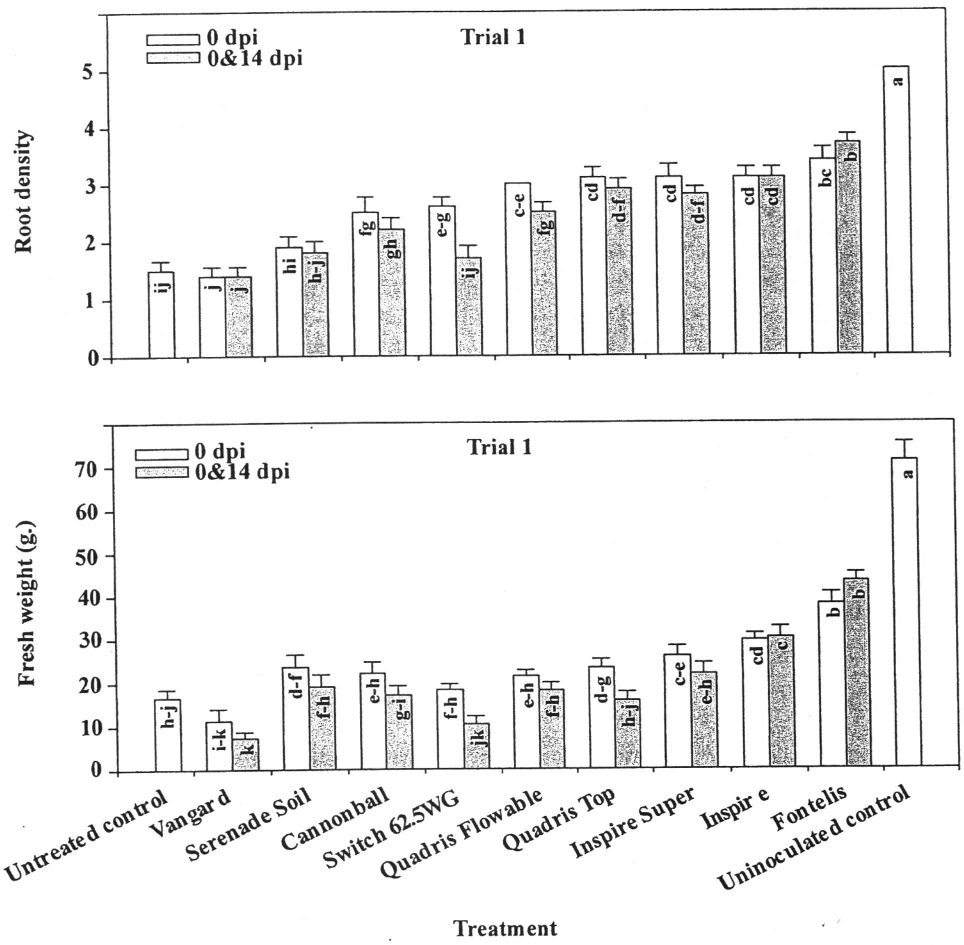

Figure 4. Root density and plant fresh weight of onions treated with fungicides in the greenhouse 0 days after inoculation (yellow bars) or 0 and 14 days after inoculation (grey bars). Root density was rated using a scale from 1 to 5; where 1 = low root density, 2 = low-intermediate, 3 = intermediate, 4 = intermediate-high, and 5 = high root density. Bars with a letter in common are not significantly different (least significant means test, $\alpha = 0.05$).

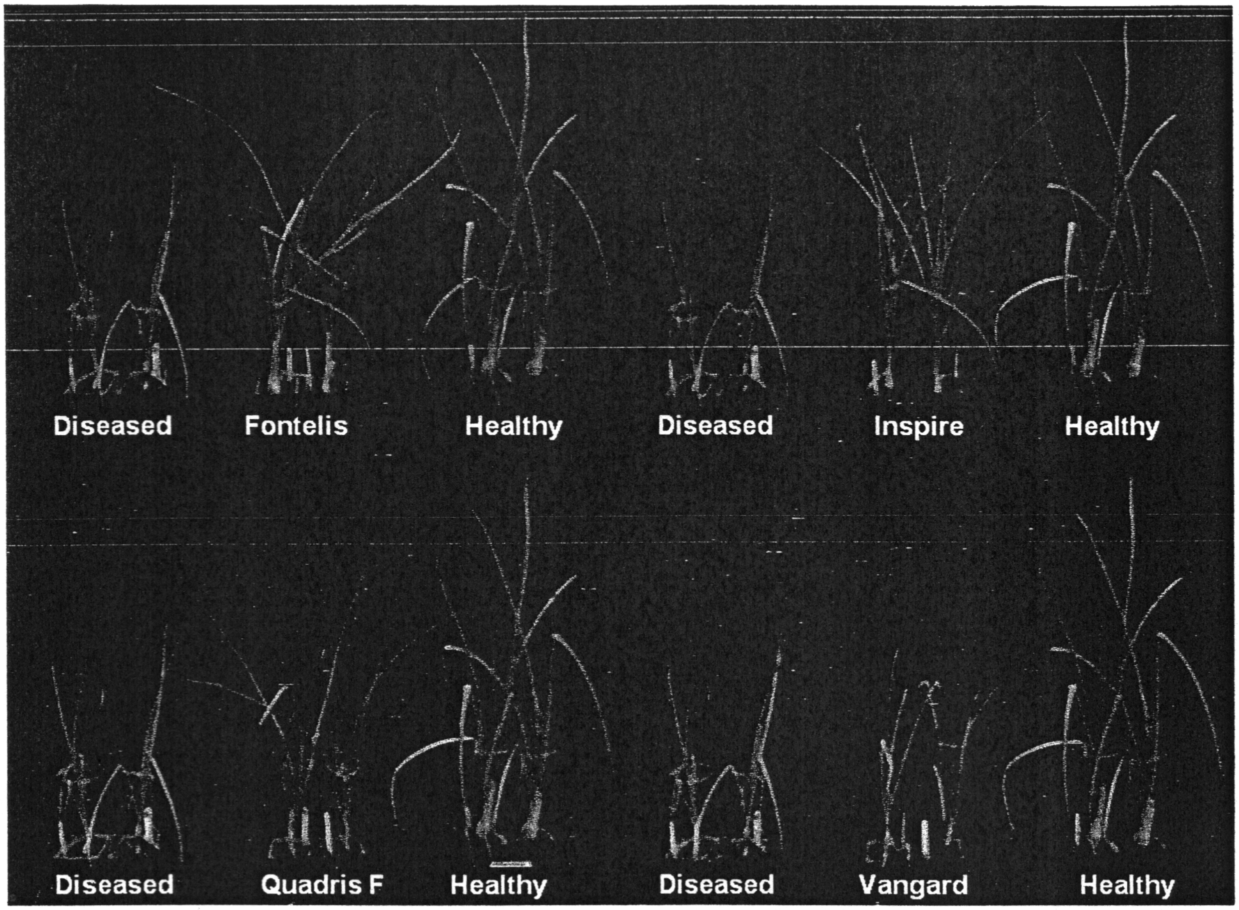

Figure 5. Results of pink root trial comparing a diseased control (left), fungicide treatment (middle), and healthy control (right) of four fungicide treatments. Pictures were taken 55 days after inoculation.

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