Growing Healthy Crops and Healthy Profits
December 6-8, 2005
Grand Rapids, Michigan

Great Lakes EXPO
FRUIT, VEGETABLE & FARM MARKET

Niche Vegetable Opportunities

Wednesday afternoon 2:00 pm

Moderator: Jim Breinling, Mason Co. MSU Extension

2:00 p.m. Marketing Niche Vegetables

Barb Fails, Product Center for Ag & Natural Resources, MSU

2:20 p.m. Okra Production: Is It Possible in Michigan?

Ron Goldy, SWMREC MSU Extension

2:35 p.m. Spinach Production in Michigan: Lessons Learned

Darryl Warncke, Crop & Soil Sciences Dept., MSU

2:55 p.m. Weed Control in Spinach

Bernard Zandstra, Horticulture Dept., MSU

3:10 p.m. Lettuce Production: Knowing the Diseases

Ryan Bounds, Plant Pathology Dept., MSU

3:30 p.m. Pumpkins, Gourds, and Watermelon for Niche Markets

Liz Maynard, Northwest Commercial Hort Program, Purdue Univ.

Lettuce Production: Knowing the Diseases

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I. Diseases

Downy mildew is a foliar disease caused by *Bremia lactucae*, a fungal-like pathogen that requires host tissue to survive. The disease can reduce quality and yield since diseased leaves must be removed prior to packing. The disease is favored by cool, moist conditions which commonly occur during early spring and fall in Michigan. Lettuce plants are susceptible to *B. lactucae* at all stages of growth. Symptoms of downy mildew are characterized by light green to yellow angular lesions which are generally observed on older leaves first. The lesions are variable in size and are often confined by leaf veins. Older lesions turn brown. White, fluffy spores are observed primarily on the underside of the lesions and are produced at temperatures of 41 to 75°F in low light conditions under high relative humidity. The spores are dispersed by wind and can infect other lettuce plants in as little as three hours under optimal conditions. Leaf wetness or high relative humidity is required for infection at optimal temperatures of 50 to 72°F. New lesions can be detected in as few as four to seven days after infection. In Michigan, *B. lactucae* probably survives the winter as thick-walled spores (called oospores) in lettuce debris, but this assumption has not been proven. Disease management tactics include the use of downy mildew-tolerant varieties and/or fungicides. Fungicides should be applied prior to disease development and at regular intervals thereafter if cool, moist weather persists. If overhead irrigation is used, it should be applied late in the day to avoid extended periods of leaf wetness.

Powdery mildew is a foliar disease caused by the fungus *Erysiphe cichoracearum*. It is considered a minor disease in Michigan, although quality and yield can be reduced under certain conditions. Unlike downy mildew, the disease is favored by warm, dry conditions which typically occur in the mid- to late-summer months in Michigan. The disease primarily affects older leaves on plants approaching maturity. Small, white tufts of the fungus are observed on both upper and lower leaf surfaces. Entire leaves may become covered with the talcum powder-like growth and turn yellow then brown. Powdery mildew spores are spread long distances by wind and germinate on host surfaces only in the absence of leaf wetness. Fungicides should be applied prior to disease appearance if conditions are favorable for disease development.

Drop is a soil borne disease caused by *Sclerotinia minor* and/or *S. sclerotiorum*. In Michigan, only *S. minor* has been associated with drop in recent years, although no large scale surveys were conducted. Drop is considered the most important disease of lettuce in Michigan and can result in substantial losses under certain conditions. The initial symptom is the wilting of outer leaves. The entire plant wilts as the infection spreads throughout the plant. Characteristic signs of drop include fluffy, white fungal growth (mycelium) and hard, black overwintering structures (sclerotia) on the underside of lower leaves near the soil surface. The sclerotia of *S. minor* are mostly circular and 1/16 to 1/8 inch in diameter. Sclerotia can survive in the soil for up to 8 to 10 years. The disease is favored by cool, moist conditions and is primarily observed on plants nearing maturity. The top 2 to 3 inches of soil should be kept dry, if possible, to avoid disease outbreaks. Deep plowing buries recently formed sclerotia but may not be an effective practice if the soil is heavily infested. Rotations with non-host small grains may be helpful. Both cultural practices and fungicides are needed to effectively manage the disease in heavily infested

soils. Fungicides may be applied prior to and after thinning and when the soil surface is disturbed by cultivation.

Bottom rot is a soil borne disease caused by the fungus *Rhizoctonia solani*, a common soil inhabitant. Lesions are red to brown and primarily occur on the underside of leaf midribs in contact with the soil. Extensive damage may require additional trimming or render the plant unmarketable. The disease is typically observed on plants approaching maturity and is favored by warm, wet weather. Lesions may develop within two days of infection when temperatures are 77 to 81°F. Lower leaves wilt as the disease progresses. Brown web-like threads (mycelia) of the fungus may be observed without magnification on infected leaves. The fungus survives in infected debris as mycelia or as hardy overwintering structures (sclerotia). Disease management practices include: deep plowing to bury infected debris; planting on raised beds; minimizing irrigation; and properly-timed fungicide applications.

Aster yellows is caused by a phytoplasma which is transmitted to host plants by the aster leafhopper, *Macrosteles quadrilineatus*. Losses to the disease vary year to year, but all lettuce plants showing symptoms are unmarketable. Symptoms of the disease on lettuce include leaf yellowing and twisted growth. The phytoplasma incubates inside the aster leafhopper for two weeks before it can be transmitted to susceptible plants. An infected aster leafhopper carries the phytoplasma for its entire life and transmits it to susceptible plants after several hours of feeding. The phytoplasma overwinters in perennial/biennial plants and weeds. The majority of aster leafhoppers in Michigan migrate from the south in early spring. The threat of aster yellows on susceptible host crops can be based on the proportion of leafhoppers carrying the phytoplasma and the number of leafhoppers present in the field. Insecticide applications are recommended when aster leafhopper numbers reach a predetermined threshold, depending on the proportion of infected leafhoppers. Removal of weed reservoirs may be helpful in reducing sources of the phytoplasma. Carrot, celery, and onion are other important host crops in Michigan.

II. Selected products registered to manage diseases of lettuce in Michigan.

Product*	Active ingredient(s)	Manufacturer	Disease(s)
Acrobat 50WP	dimethomorph	BASF	downy mildew
Aliette 80WDG	aluminum tris	Bayer	downy mildew
Amistar 80WG	azoxystrobin	Syngenta	downy mildew, powdery mildew, bottom rot
Botran 75-W	dicloran	Gowan	drop, gray mold
Champ Formula 2	copper hydroxide	Nufarm	downy mildew
Endura 70WG	boscalid	BASF	drop, gray mold, bottom rot (suppression)
Manex 4F	maneb	DuPont	downy mildew
Microthiol Disperss 80WP	sulfur	Cerexagri	powdery mildew
Phostrol	phosphorous acid salts	Nufarm	downy mildew
Previcur Flex	propamocarb hydrochloride	Bayer	downy mildew
Reason 500SC	fenamidone	Bayer	downy mildew
Rovral 4F	iprodione	Bayer	drop, bottom rot
Tanos 50DF (head lettuce only)	famoxadone + cymoxanil	DuPont	downy mildew

*Consult the product label for other diseases listed, rates, application instructions, precautions, etc.

III. Product Testing

Downy mildew and powdery mildew. This study was conducted at cooperator's farm in Lapeer County, MI on a Houghton muck field previously planted to lettuce in 2004. 'Tall Guzmaine' romaine lettuce seeds were planted on 22 Jul in rows spaced 12 in. apart on two-row raised beds centered 36 in. apart. Treatment plots consisted of one bed 20 ft long. Ten treatments were replicated four times in a randomized complete block design. Fungicides were applied with a CO_2 backpack sprayer equipped with two XR8003 flat fan nozzles spaced 19.5 in. apart and calibrated to deliver 50 gal/A at a boom pressure of 53 psi. Eight applications were made at 3- to 7-day intervals on 16, 23, 27, and 31 Aug; and 3, 7, 13, and 20 Sep. Downy mildew was assessed by counting the number lesions on 10 plants on 27 Sep. Powdery mildew was assessed by visually estimating the percentage of diseased leaf area on 15 plants on 27 Sep.

Cool, wet weather prompted downy mildew infection early in the cropping cycle and symptoms were detected on 24 Aug. Warmer weather in Sep slowed downy mildew advancement, and provided ideal conditions for powdery mildew which was observed on 13 Sep. All fungicide programs reduced the number of downy mildew lesions when compared to the untreated control (Fig. 1). When alternated with Manex 4F, applications of Aliette 80WDG or Acrobat 50WP + Manex 4F significantly reduced the number of downy mildew lesions when compared to the weekly Manex 4F treatment. Powdery mildew was reduced by all treatments (Fig. 2). However, programs that included Pristine 38WG or Amistar 80WG seemed especially effective. Slight phytotoxicity, affecting approximately 1% of the total leaf area, was observed when Aliette 80WDG was alternated with Manex 4F.

Figure 1. Efficacy of products tested to control downy mildew of lettuce, 2004.

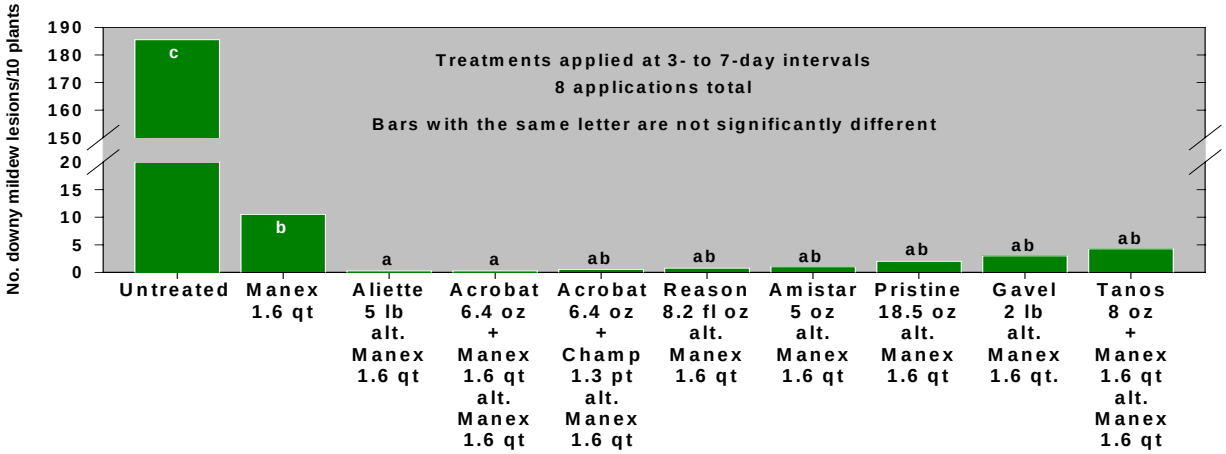
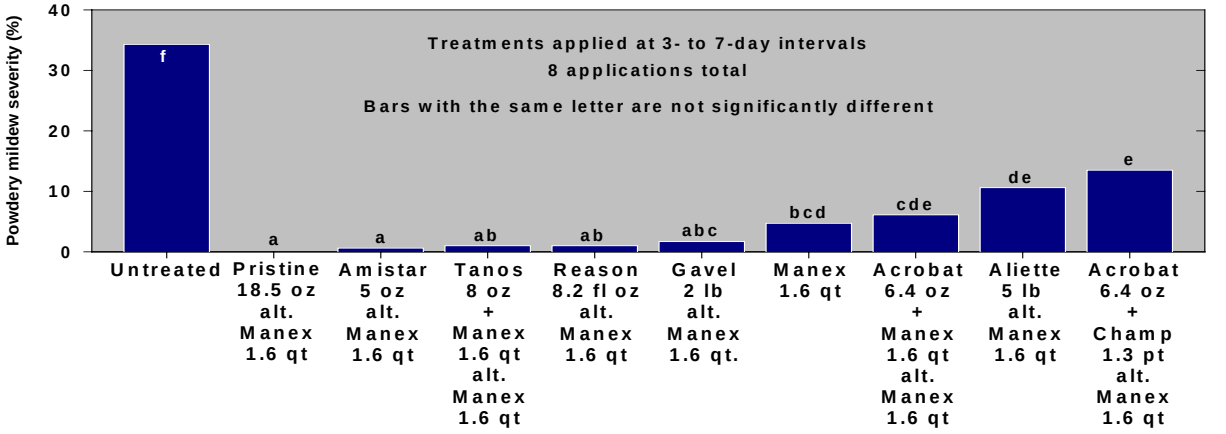


Figure 2. Efficacy of products tested to control powdery mildew of lettuce, 2004.



Drop. This study was conducted at cooperator's farm in Lapeer County, MI on a Houghton muck field previously planted to lettuce in 2004. 'Tall Guzmaine' romaine lettuce seeds were planted on 22 Jul in rows spaced 12 in. apart on two-row raised beds centered 36 in. apart. Plants were thinned to 12-in. spacing on 24 Aug. Treatment plots consisted of one bed 20 ft long. Ten treatments were replicated five times in a randomized complete block design. The field was cultivated on 7 and 17 Aug, and the beds were re-formed on 28 Aug. Fungicides were applied with a CO_2 backpack sprayer equipped with two XR8003 flat fan nozzles spaced 19.5 in. apart and calibrated to deliver 50 gal/A at a boom pressure of 53 psi, unless otherwise noted in the table. Two or three applications were made at 14-day intervals on 16 and 31 Aug; and 13 Sep. The number of healthy and dead or dying plants was recorded on 27 Sep.

Signs of lettuce drop were detected throughout the field on 31 Aug. Four fungicide programs limited drop to < 9% and included: Omega 500F; Contans WG followed by Endura 70WG; Endura 70WG; and Switch 62.5WG (Table 1). Two applications of the biopesticide Contans WG did not significantly reduce disease when compared to the untreated control. All other treatments significantly reduced disease when compared to the untreated control. Omega 500F was the only treatment to limit drop to < 2%; however, phytotoxicity was observed on 12% of the leaf area.

Table 1. Efficacy of products tested to control lettuce drop, 2004.

Treatment and rate/A (application sequence)[z]	% Dead plants[y]	
Untreated control	22.9	d[x]
Omega 500F 1.9 pt (1,2)	1.8	a
Contans WG 6 lb (water incorporation)(1) Endura 70WG 11 oz (2)	7.9	ab
Endura 70WG 11 oz (1,2)	8.8	ab
Switch 62.5WG 14 oz (1,2)	8.8	ab
Rovral 4F 2 pt (1,2,3)	9.7	b
Pristine 38WG 18.5 oz (1,2)	10.0	b
Ronilan 50EG 2 lb (1,2,3)	10.3	b
Botran 75-W 2.7 lb (1,2)	13.3	bc
Contans WG 6 lb (water incorporation[w])(1,2)	19.4	cd

[z] Application sequence: 1 = 16 Aug; 2 = 31 Aug; 3 = 13 Sep.

[y] Percent dead plants determined by counting the number of dead or dying plants on 27 Sep.

[x] Means within a column followed by the same letter are not significantly different according the Waller-Duncan Bayesian k-ratio t-test (k-ratio = 100).

[w] Contans WG treatments were applied between rows in 1 gal of water per plot using a watering can and further incorporated with an additional 1 gal of water.

References

Compendium of Lettuce Diseases. 1997. The American Phytopathological Society, St. Paul, MN.
Integrated Pest Management for Cole Crops and Lettuce. 1985. Univ. of California publication 3307.