MINT POWDERY MILDEW CONTROL, 1997

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Abstract

Fungicides were applied to plots located in three central Oregon peppermint fields in 1997. Objectives were to determine whether mildew affected mint performance and to further evaluate efficacy of sulfur and nonlabeled fungicides of interest. Fungicides were applied with 20 gpa water and 1 pt/ac Silgard using a CO zpowered backpack sprayer. Mildew ratings were based on the percentage of leaf area covered by the mildew fungus for 16 leaves, using the third and fourth mature leaf Average ratings represent a wide range of actual leaf ratings per plot. A 30% rating is composed of a moderate proportion of leaves that are individually rated above 80%. For fields A and B, treatment was imposed after ratings had increased. For field A, fungicides improved hay yields and trended toward improving oil yields. No such trends were seen for Field B. Mint was quite weak in Field C, and mildew was treated at a lower mildew rating. There was strong, positive fungicide response in hay yield and a positive trend in oil yield in this field. Anecdotal information suggests that mildew impact is greater for weak or stressed mint, and these data support this contention. Leaf damage was greater with sulfur and no treatment (fields B and C). A simpler, quicker rating system will be developed in 1998, and the impact controlling the initial buildup of mildew will be addressed.

Introduction

Powdery mildew *(Erysiphe chicoracearum)* is common on Central Oregon peppermint Whether powdery mildew commonly damages peppermint in this region, and is worth exerting control measures against, is controversial. Mildew develops most rapidly and extensively during prolonged periods of warm, humid, and cloudy weather and with dense foliage. These conditions encourage sporulation and infection. In general, mildew fungi do not kill plant cells outright but instead grow on living plant cells. They poke holes in plant leaves which causes higher transpiration rates, and their feeding reduces leaf growth and photosynthetic activity. Highly infected leaves may become dysfunctional, while still losing water, and eventually may die.

Black Mitcham peppermint and Scotch spearmint are more susceptible than other commercial mint varieties, but neither is much grown in Central Oregon. In Central Oregon, the more tolerant Todds and Murray sometimes become damaged. Damage is of most concern during the month before harvest, because it is the leaves which develop during this month that are harvested for oil or tea leaves. High levels of mildew earlier in the year might effect growth and development but later in the year might impact fall and spring vigor and winter survival.

The criteria for determining when control is necessary to protect foliage are not clear. For highly susceptible varieties, and in regions such as the Columbia Basin which are conducive to long periods of high mildew activity, control may be easily justified. In Central Oregon, conditions for mildew rarely persist, and mildew activity is sporadic. Ultimately, there is need for an integrated pest management program for powdery mildew that considers current incidence of mildew, stage of plant development, weather and climate information, anticipated harvest dates, cost and efficacy of control products available, and other factors.

Sulfur is effective against powdery mildew, is relatively inexpensive, and has been regularly applied in central Oregon. Further, sulfur is considered to provide partial control of spider mites. Recently, however, concerns have been raised about the routine use of sulfur: Sulfur may adversely impact predator mites more than spider mites, causing rapid resurgence of spider mites even if partial control is directly achieved (Mark Morris, A.M. Todd Co., personal communication, 1996). Further, at least one major end user of mint oil wishes to receive no sulfur residues in mint oil. In 1996 and 1997, Christensen (1998) showed that sulfur residues were directly attributable to sulfur fungicide usage, rather than other sources of sulfur. Currently, the only registered fungicide for mildew is sulfur, but newer and more expensive fungicides such as Tilt and Rally are in the process of being registered for rust and mildew. Our study was designed to measure the impact of high powdery mildew levels in central Oregon, to compare several fungicides for its control, and to contribute samples for oil-residue analyses. We used this opportunity to learn how to measure and monitor current incidence, toward development of IPM tools. This is our second year of this project; 1996 results were published in the previous annual report (Crowe and Butler, 1997).

Methods

In 1997 as in 1996, fungicides (See Table 1 for products used) were applied to peppermint in several commercial fields in central Oregon in which mildew was progressing. Fungicides were applied with 20 gpa water and 1 pt/ac Silgard using a CO_2-powered backpack sprayer. Plots were 20' x 20', replicated 3 times.

Pre- and post-treatment evaluations of mildew were rated by visually determining the proportional leaf area covered by powdery mildew on the third and on fourth mature leaves from the top of the plant, for 15 to 20 randomly selected stems from each plot. At some dates, estimates were made of leaf damage using a 0 (no damage) through 5 (death) scale.

In 1997, plots were harvested on August 12-14, 1997, just prior to commercial harvest. A gas-powered mechanical mower was used to cut mint, which was bagged as long-stemmed (i.e., not chopped) hay and air dried until distilled in research stills.

Mildew estimates and yields were compared using analysis of variance.

Results

FALL 1996, SPRING 1997: Two fields with substantially mildewed fall regrowth were treated in the early fall of 1996. Treatment was late enough that no differences in mildew incidence were observed prior to fall dormancy. No mildew recurred in the spring on these trials. Relatively high levels of mildew recurred by mid-summer, with no carryover effects of fall treatment measurable. Plots were harvested, but no carryover effects of 1996 treatments were seen with respect to either 1997 mildew incidence or mint yields. Data from these treatments are not shown.

SPRING/SUMMER 1997: Four fields were identified with moderate to high levels of mildew appearing in early to mid-July. The expectation was that some or all of the affected foliage after this period would be harvested. Treatments of Tilt, Rally and Sulfur (Microthiol), and untreated checks, were made to all fields in replicated field trials. Pre- and post-treatment mildew levels, leaf damage ratings and harvest data are shown in Table 1 for three of the four fields — the fourth was commercially over sprayed with sulfur and was eliminated from the study.

In Field A, the 3rd and 4th leaves averaged about 30% mildew coverage on July 11, 1997. An average of 30% leaf coverage represents individual leaf coverage of 0 through 100%, so at least some leaves are highly involved. On August 5, the mean mildew rating was near zero for all treatments, and no leaves showed any leaf damage from mildew or applied products. The zero rating for untreated mint indicated that weather alone killed or inactivated mildew from the plots, along with promoting rapid mint growth so that the 3rd and 4th leaves present at the later sampling were free of mildew. Inspection of the older leaves indeed suggested that mildew which had been active on those leaves was no longer active. Mean mint hay yields were significantly higher ($p<5\%$) for mint treated with each fungicide, compared with untreated mint, although oil yields were not statistically separable at a 5% statistical significance level. Assuming hay yields were affected by mildew, this suggests that weather-induced reduction of mildew in the untreated plots proceeded slowly in comparison to rapid control of mildew in fungicide treated plots. We should have rated the mildew sooner than August 5 in this case.

In Field B, the mean mildew rating again averaged about 30% on July 11, 1997, and was reduced again to near zero about 3 weeks later. In this case, neither hay nor oil yield advantage was gained with fungicide application. However, mean leaf damage ratings were higher for both sulfur treated and untreated plots. This suggests that the mildew did some damage, and it is likely that the sulfur too was somewhat damaging to foliage. It also suggests that either the growth rate was slower in this field, so that some previous leaves were still at the 3rd or 4th level, or that damage occurred on younger foliage in the earlier period. This effect perhaps should be clarified in later studies.

In Field C, average mildew level on July 3 was about 4 to 10%, much lower than in Fields A and B. An average of 5% leaf coverage represents individual leaf coverage of 0 through perhaps 50%, but only a few of the later. On July 18, mildew was absent from fungicide treated plants, but remained at about 6% on untreated plants. This field was treated earlier than Fields A and B, and the weather most conducive to active mildew occurred later in July. A mildew rating of 6% was not enough mildew to result in leaf damage observed later, so it seems likely that higher levels of mildew developed on at least the untreated mint at some point later in July. We did not take additional mildew ratings later than July 18, but we probably should have as the harvest data suggests a strong difference in yields related to products used. Leaf damage rating on July 18 was greater in the sulfur treated and untreated plots than for Tilt and Rally treated plots. The mint in Field C was under greater stress from other factors, and the 3rd and 4th leaves probably were not fully replaced by the second rating. Similarly, hay and oil yields on August 13 were lower for sulfur treated and untreated plots. In the case of sulfur, it is possible that leaves were damaged by the product, and this directly resulted in yield.

Discussion

Our method of measuring the incidence of mildew on mint leaves under a high-powered binocular microscope is time-consuming Using this method, mildew incidence even at trace levels can be determined rather precisely. The area covered by active mildew is estimated and averaged for all leaves per plot. In the long run, a more expedient, in-the-field method is needed. Development of a climate model might better predict likely period of mildew buildup.

In 1997, we measured diverse responses of plants and mildew to applied products. There seems to be evidence that sulfur itself can be damaging, probably related to hot weather or some prior mildew damage. Clearly, mildew itself can result in leaf damage. Yields were affected in several cases, irrespective of whether leaves showed damage on the days we observed them. In the field showing the greatest yield response to fungicides (Field C), the mint was weak from other factors. It may be that mildew damage is worse on mint which is not growing vigorously. If growth was retarded by other factors, newer leaves would be less likely to replace mildewed leaves within the canopy. For example, there is an industry impression that under-fertilized mint may be more susceptible to mildew (E. Fairchild, Eugene Farmers Coop, Eugene OR, personal communication, 1998). Crop stresses are something to consider in future investigations.

We earlier believed mildew to be only occasionally damaging, and it is likely that our three fields in 1997 were not representative of most fields in the region; nevertheless, we did have mildew impact in all three fields. In most case, we believe cloudy, humid, warm weather does not usually persist long enough to allow mildew to reach damaging levels, but in 1997 it apparently did this. In the case of Field B, weather alone eliminated moderate-to-high levels of mildew, but apparently not before an impact on yield occurred.

We have not been able to invest the time to monitor fields as frequently as was needed in 1997 to assess mildew activity and control at all the stages necessary. In order to determine the true impact of mildew, research spray trials should be started well before mildew intensifies in order to preclude any mildew buildup, and fields should be assessed weekly thereafter. This would not likely be an optimal commercial program, so additional applications likely would be needed at those times of the season when mildew intensifies.

Literature Cited

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Crowe. F. and M. Butler. 1997. Mint powdery mildew control in central Oregon. Pp. 13-15 *In* Central Oregon Agricultural Research Center Annual Report, 1996. Special Report 969, Agricultural Experiment Station, Oregon State University, Corvallis, OR.

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Table 1. Mean powdery mildew incidence and damage ratings, and mean yield responses of peppermint to seasonal fungicide applications in three central Oregon commercial peppermint fields, 1997[1]

Treatments		Pre-treatment			Harvest Data	
Product	Amount/Ac	% Leaf Infection[2]	Post-Treatment % Leaf **Infection**	Leaf Damage Rating	Fresh Hay Wt (lb/Ac)/1,000	Oil Yield lb/Ac
Field A		**7/11197**	**8/5197**	**8/5197**	**8/14/97**	**8/14/97**
Tilt	6.0 oz	31.7	0	0	12.4 ab[3]	40.3
Rally	5.0 oz	29.5	0.2	0	15.7 a	42.6
Sulfur	5.0 lb	34.3	0.1	0	14.0 a	37.6
Untreated	N.A.	32.7	0.1	0	10.4 b	36
F-Test Observed		0.87	0.4	0	6.67	2.89
F-Test 5%		3.49	3.49	3.49	3.49	3.49
Field B		**7/11/97**	**8/8/97**	**818/97**	**8/14/97**	**8/14/97**
Tilt	6.0 oz	33.8	0	1.0 a	12.4	40.8
Rally	5.0 oz	37.2	0.3	0.9 a	13.4	47.6
Sulfur	5.0 lb	31.5	0	2.1 b	14.9	45.3
Untreated	N.A.	36.5	0.1	1.9 b	13.8	51.2
F-Test Observed		3.22	0.72	5.09	2.35	1.78
F-Test 5%		3.49	3.49	3.49	3.49	3.49
Field C		**7/3/97**	**7/18/97**	**7/18197**	**8/13197**	**8113/97**
Tilt	6.0 oz	4.8	0	0.6	11.5 a	46.1
Rally	5.0 oz	5.4	0	0.5	9.6 ab	36.1
Sulfur	5.0 lb	5.7	0	1.8	6.2 b	29.1
Untreated	N.A.	10.9	6.3 b	1.3	7.4 ab	28.6
F-Test Observed		1.23	4.66	1.6	4.15	2.44
F-Test 5%		3.49	3.49	3.49	3.49	3.49

[1] Trials were randomized complete block experimental designs with 4 replications. Data analyzed by analysis of variance.

[2] Average of 15 measurements per plot; percentage of 3rd mature leaf covered by mildew. Fungicides were applied the day in which leaves were sampled for mildew rating, or the next day.

[3] Means with similar letters are considered similar statistically, 5% level. N.A. = Not Applicable.