MINT POWDERY MILDEW CONTROL IN CENTRAL OREGON

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Abstract

In 1996, under mild disease conditions prevailing after mid-June fungicide applications, sulfur, propiconazole(Tilt, Ciba-Geigy Corp.), mycobutanil (Rally, Rohm & Haas Co.), and chlorothalonil (Bravo, ISK Biosciences Co.) each controlled powdery mildew in central Oregon. Untreated plots and sulfur-treated plots were harvested in mid-August, and no hay or oil yield differences were found. Oil character was similar for the two treatments, although a trace (0.006%) of mint sulfate was detected in sulfur-treated plots, in contrast to no such detection in untreated plots.

Introduction

Powdery mildew *(Erysiphye chicoracearum)* is common on central Oregon peppermint, but is not chronically severe. The need for routine control is questioned Sulfur is effective against powdery mildew, is relatively inexpensive, and has been regularly applied. Further, sulfur is considered to provide partial control of spider mites. Recently, however, concerns have been raised about the routine use of sulfur. First, sulfur may adversely impact predator mites. Second, concerns have been raised about high sulfur residues in mint oil, although the source of such sulfur residues is not clearly established and may not involve elemental sulfur. Our study was designed to address the impact of powdery mildew, compare several fungicides for its control, and evaluate the impact of sulfur treatments on mites. We cooperated with N. Christensen at Oregon State University and others investigating potential sources of sulfur residues in oil, such as fertilizer, soil, elemental sulfur applied to foliage, etc., and contributed samples for oil residue analyses.

Objectives

1. Determine whether unchecked powdery mildew 'occurrence will result in adverse peppermint performance or, alternatively, whether control of powdery mildew improves peppermint performance
2. Determine relative efficacy of sulfur and other fungicides against powdery mildew.
3. Assess impact of sulfur on spider mites and predator mites.
4. Determine sulfur residues in oil at harvest, as per N. Christensen's study.

Methods

Mildew was rated by visually determining, under a binocular microscope, the proportional leaf area covered by mildew on a third and on a fourth mature leaves from the top of the plant for 20 randomly selected stems from each plot. Numbers of two-spotted spider mites *(Tetranychus urticae)* and predator mites *(Neoseiulus fallacis)* were estimated as the average number of mites and/or eggs per leaf from 30 leaves on 10 stems selected at random from each plot. Plots were 20 ft x 20 ft, replicated 3 times in a randomized block design, in a grower's field north of Madras, OR., in which mildew had built up during late May and early June 1996. Pre-application evaluation of powdery mildew and mites was on June 7 and June 8, respectively. Fungicides were applied to peppermint on June 12, 1996, with 20 gpa water and 1 pt/ac Silgard using a CO2 powered backpack sprayer. Product, active ingredients, and rates per acre are shown in Table 1. Additionally, predator mites were applied 2,000 per acre over the entire trial area. Post-treatment evaluations of mildew were 1, 2, and 4 wk after application. Post-treatment mite estimates were 1, 2, 3, and 4 wk after application.

For each plot and date, verticillium wilt *(verticillium dahliae)* was rated by counting the number of wilt loci per 75 ft^2. Plant growth responses were determined by measuring several features for each date of mildew evaluation; the average stem length, the average number of nodes between the soil and the first retained leaf, average number of nodes per stem, the average number of branches per stem, the dry weight of 20 stems, and the dry weight of all leaves from 20 stems.

Based on lack of growth differences measured earlier, yield differences were not anticipated. Primarily for sulfur determinations, two 3 ft x 20 ft strips were harvested within untreated and sulfur-treated plots on August 15, 1996. Peppermint was placed into burlap bags and weighed in the field. Additional samples were taken for dry weight determinations. Hay was allowed to air dry in central Oregon. Half of the hay was distilled later in August at the OSU-Corvallis research stills, and half was distilled in research stills maintained by L. McKellip in Idaho. Oil yields from the two research stills were added together to calculate the oil yield per plot. Oil character and composition only, from the plot's hay that was distilled in Idaho, was determined by Wm. Leman Co.

Results

Mean pre- and post-application mildew ratings are shown in Table 1. Prior to application, the amount of mildew was abundant and active on peppermint in all plots, as a result of prolonged high humidity prior to mid-June. At that time, some leaf damage had resulted from the effects of mildew. Immediately following application on June 12, normally arid and warmer conditions developed and persisted for two weeks, resulting in inactivation of mildew and development of new, rapid growth on the mint in all plots. During this period, untreated check plots were reduced from nearly 80 percent leaf coverage to less than 30 percent leaf coverage of active mildew on the third and fourth developed leaves. Assisted by the weather, one week after application, all fungicides controlled mildew to a greater extent than the weather alone. All plots treated with fungicides averaged 6.5 percent mildew Vs. 28.1 percent mildew in the untreated control plots ($p<0.05$). Bravo initially seemed less effective than Rally, Tilt, or sulfur.

After two weeks, some ambient humidity returned and the plant canopy thickened, which further promoted humidity within the canopy. Mildew re-activated during this period, but remained less aggressive than during in early June. The untreated check maintained around 30-40 percent leaf coverage by mildew without visible plant damage. During this period of light disease pressure, residual control of mildew was achieved by the initial application of Rally, sulfur, Tilt, and Bravo.

Initially, about 10 verticillium wilt strikes were measured per 75 ft^2. Following application, the number of wilt loci did not increase in any plots ($p<0.05$), suggesting that neither light mildew nor fungicides contributed to increased stress, which might translate into enhanced wilt. Further, no differences were found among any measured plant growth parameters ($p<0.05$), another indicator that neither mildew nor products influenced mint growth. Spider mite numbers prior to the June 12 applications approached the damage threshold, and this level was maintained in all plots, except where populations diminished in plots treated with Comite (propargite) plus sulfur. The impact of lightly but universally-applied predator mites was not easily discerned. Plant growth measurements in plots that had received Comite were not different from those in plots that did not receive Comite ($p<0.05$). A slight reduction in the numbers of mites was seen in plots treated with sulfur alone, although this was not statistically significant ($p<0.05$) compared to other treatments. Impact of various products, including sulfur, on predator mite numbers, was inconclusive. No two-spotted nor predator mite data are shown.

In Table 2, harvest yields in August are shown for untreated plots and for plots treated with sulfur alone on June 12 (nearly two months earlier). Data include the dry hay per acre and the oil yield per acre, for which no differences were seen for the two treatments ($p<0.05$). Partial analysis of the oil is shown in Table 2. Only a selection of the total oil composition is shown, but no statistical differences between untreated and sulfur-treated plots were seen for any component (or for the organoleptic rating) except for mint sulfide ($p<0.05$). Mint sulfide was detected at a trace level in mint oil from all plots treated with sulfur, but none was detected from untreated plots.

Discussion

Mildew was intense prior to mid-June when our applications of fungicides were made, but subsided quickly as the weather became unfavorable for mildew. No sustained plant damage resulted from either mildew or applied materials (although Tilt and Bravo applications turned foliage darker than other treatments for about one week). Most fungicides provided both immediate control of mildew (except for Bravo) and residual action against mildew (including Bravo), at least under mild mildew conditions of late June and early July. Under more severe mildew pressure, this response might be different for some materials. Further testing will be required to evaluate mildew control and impact where applications can be made prior to intense buildup of mildew, and where mildew occurs abundantly at other times of the year, for example on fall re-growth.

Additional testing is required to evaluate these products for activity on spider and predator mites. Our 1996 results were inconclusive.

Plant growth measurements in late June and early July were not different ($p<0.05$) among plots treated with various mildew control treatments, nor were harvest weights and oil yield significantly different ($p<0.05$) for the two treatments that were harvested: untreated plots and plots treated with sulfur. As the only application of foliar-applied sulfur was on June 12, nearly two months prior to harvest, most treated leaves likely would have fallen from the plant by August 15. Thus, sulfur residue would not be expected to contribute much to oil character. No dimethly sulfide was found in oil for either treatment. A positive but negligible amount of mint sulfate (0.006% in all three replications) was found in untreated plots, in contrast to no detection in untreated plots.

Table 1. Percentage of 3rd and 4th leaf area covered by powdery mildew *(Elysiphye chicoracearum)* in the mildew control trial, Madras' OR following a single application of fungicides on June 12, 1996.

Product & Application Rate/Acre	Active Ingredient	Al/Ac	Mildew Rating (% leaf coverage) Pre-Appl.	1 wk Post	2 wk Post	4 wk Post
Tilt 41.8EC, 6 oz	propi-conazole	2.5 oz	80.4 a'	2.3 a	0.3 a	2.0 a
Bravo 720, 1.5 pts	chloro-thalonil	1.13 lb	80.1 a	13.4 c	4.6 a	4.3 a
Micro-Thiol, 51b	sulfur	4 lb	86.3 a	2.8 ab	3.2 a	6.7 a
Micro-Thiol, 5 lb + Comite, 2 pt	sulfur + propargite	4 lb + 1.64 lb	82.1 a	9.5 abc	5.6 ab	6.3 a
Rally 40W, 5 oz	mycobutanil	2 oz	81.7 a	3.0 ab	0 a	1.9 a
Untreated	-	-	78.3 a	28.1 d	42.6 be	30.7 b

1. Means followed by the same letter were not statistically significant, $p<0.05$.

Table 2. Mean.ields and:oil character ratings from peppermint harvested on August 15, in treated plots and in plots treated once with 4 lb AI/Ac sulfur on June 12, 1996[1].

	Harvested Dry Matter lb/ac	Oil Yield lb/ac	Dimethyl Sulfide %	Mint Sulfide %	Menthone %	Menthol %	Mentho-furan %	Organo-leptic rating2
Untreated	7,398 a[3]	35.0 a	04 a	04 a	15.2 a	39.8 a	2.8 a	2.0 a
Sulfur 4 lb AUAc	7,913 a	40.4 a	04 a	0.006 b	16.2 a	38.8 a	3.3 a	2.3 a

1. Data shown are means of three replications from a field trial in a randomized block design. Other treatments, shown in Table 1, were not harvested.
2. Ratings of 1, 2 and 3 were acceptable, acceptable with modification, and unacceptable, respectively.
3. Means followed by the same letter were not statistically significant, $p<0.05$.
4. Not detectable, which was recorded as 0 for this analysis