ALTERNATIVES FOR POWDERY MILDEW CONTROL ON LILAC

by David L. Clement, Stanton A. Gill and William Potts[1]

Abstract. As part of an effort to develop biorational materials that can be easily incorporated into current nursery and landscape integrated pest management (IPM) strategies we evaluated two horticultural oils, a fatty acid based insecticide (insecticidal soap), sodium bicarbonate, an antitranspirant, and a conventional fungicide for the control of powdery mildew on field grown lilacs. In field trials both horticulturaloils (SunSpray Ultra-Fine and Saf-T-Side), performed as well as the standard fungicide (Bayleton). Horticultural oil combined with sodium bicarbonate in our trials was not significantly different from oil alone. Applications of sodium bicarbonate without oil failed to control powdery mildew and this treatment appeared similar to the control plants sprayed with water. The insecticidal soap (M-pede) was not significantly different from the horticultural oils in our evaluations. The antitranspirant (Cloud Cover) gave only slightly better results than the water treated plants.

Powdery mildew is a persistent problem of lilacs in landscapes and nurseries. Under severe disease conditions this disease can cause leaf browning, leaf distortion, chlorosis, premature leaf drop and subnormal growth rates. Powdery mildew on lilac is caused by the fungus *Microsphaera syringae* (10). In Maryland, the primary infection symptoms are evident on lilac foliage in early July. Early symptoms are found on older leaves toward the base of the plant. The initial inoculum comes from overwintered ascospores that are carried by air currents to the current season leaves from leaf litter (10). Once initial infection is established, symptoms of powdery mildew can develop rapidly throughout the plant. Under ideal conditions *M. syringae* can produce sporulating lesions within 4 - 6 days after infection. Secondary infections are caused by wind borne conidia. By August, lilac foliage can be heavily infected and unsalable to nursery customers.

Although plant breeders have introduced lilacs resistant to powdery mildew to the nursery trade, very few nurserymen and landscapers sell these resistant species in their nurseries or utilize them in landscape installations. Most of the lilac plantings in Maryland are still comprised of the mildew susceptible French lilac, *Syringa vulgaris*. Lilacs resistant to powdery mildew include: *S. diversifolia*, *S. emodi*, *S. julianae*, *S. meyeri*, *S. x persica* and *S. yunnanensis*.

As part of an effort to develop integrated pest management (IPM) strategies for the green industries in Maryland we evaluated several biorational materials for powdery mildew prevention on lilacs. These materials were selected on the basis of compatibility with existing IPM protocols developed for nurseries and landscapes in Maryland by the Cooperative Extension Service. The criteria used in the selection of chemicals for IPM programs are: a) low toxicity to applicators, b) short residual on plants, c) low toxicity to beneficial insects, d) relative safety to non-target sites and ,if possible, e) combined insecticidal and fungicidal activity.

Horticultural oil has been reported to control powdery mildew on azaleas, monardia, phlox. crapemyrtle, hydrangea, euonymus and rose (2,7,14,15). In addition, oils have been used for control of greasy spot on citrus and black spot on roses (1,6). Fatty acid based insecticides (insecticidal soaps) have been reported to have fungistatic action against powdery mildew on *Zinnia elegans* (11). Punja and Grogan found that carbonate and bicarbonate salts of ammonium, potassium, lithium and sodium had fungicidal effects on germination of *Sclerotium rolfsii* sclerotia on water agar plates (9). Sodium or potassium bicarbonates combined with horticultural oil have effectively controlled powdery mildew on pumpkin. The combination also gave significant control of gummy stem blight, Alternaria leaf blight of

1. Statistician, USDA-ARS, Beltsville Agricultural Research Center, Beltsville, MD

muskmelon and Ulocladium leaf spot of cucumber in greenhouse trials (13). The antitranspirant products Wilt Pruf and Vapor Gard have been reported to protect garden roses from powdery mildew infection for about 30 days (5).

Based on the success with the above biorational materials, we evaluated two horticultural oils, an insecticidal soap, sodium bicarbonate, an antitranspirant, and a conventional fungicide for the control of powdery mildew on lilac.

Materials and Methods

Field trials. During 1991 and 1992 field trials were conducted at a nursery in central Maryland. The products used in our study were sodium bicarbonate (Church and Dwight Co.), SunSpray Ultra-Fine oil (Sun Company, Inc. R+M), Saf-T-Side horticultural oil (Brant Chemical Co.), M-Pede fatty acid based insecticidal soap (Mycogen Corp.), Cloud Cover antitranspirant (Easy Gardener) and the fungicide Bayleton (Mobay, Inc.). Treatment rates were: 2% (v/v) SunSpray Ultra-Fine oil; 2% (v/v) Ultra-Fine oil plus 0.5% (w/v) sodium bicarbonate; 0.5% (w/v) sodium bicarbonate alone; 2% (v/v) Saf-T-Side oil; 2% (v/v) M-Pede;1:10 (v/v) Cloud Cover; and Bayleton at the labeled rate of 1 oz per 50 gallons (0.15 g/l).

The lilacs treated in this field trial were planted 3 meters on center in the nursery row and were 2 - 3 meters tall. The plants had filled in within the row so that the branches were either touching or close to touching. This field had restricted air drainage which created ideal humidity conditions for maintaining powdery mildew infection (Table 1). In 1991, the plants were sprayed up to 5 times between July and September at intervals of either 2 or 4 weeks. In 1992, the plants were sprayed twice between July and September at an interval of 4 weeks. Evaluations of the treatments were made in October 1991 and September 1992. Sprays were applied with a Birchmeyer 9 liter, interchangeable spray tank, backpack sprayer. Treatment materials were mixed with 6 liters of well water and the plants were sprayed to runoff. Treatments were applied between 10 am and 2 pm. Temperature and humidity were measured with an Omega RH portable humidity/temperature sensor.

Table 1. Temperature and humidity readings for 1991 and 1992 lilac powdery mildew spray trials.

Date	Temperature, °C	Relative humidity, %
1991		
12 July	32	34
25 July	26	65
16 Aug	29	51
29 Aug	29	45
9 Sept	28	54
1992		
8 July	30	46
3 Aug	29	52

Statistical analysis. Both 1991 and 1992 field trials were arranged as a randomized complete block design. In 1991, there were 9 treatments and 4 blocks. In 1992 there were 7 treatments and 5 blocks (Table 2). The plants were evaluated for percentage of the whole plant infected and leaf severity rating. Ratings for each year were fitted to an analysis of variance modeled by weighted least squares. Weighted least squares estimation was used to account for variance inequality. The variance of the severity rating response was assumed to be proportional to the square of the product of the mean of the response minus one and five minus the mean of the response. The mean responses were estimated by their fitted values and weighted least squares estimation was iterated twice. Pairwise comparisons among the treatment means were made with the appropriate *t* tests.

Results and Discussion

Since there were no significant differences between 2 and 4 week treatment intervals in 1991 we decided to reduce the number of sprays and lengthen the spray interval to 4 weeks in 1992. No phytotoxic responses to any of the treatments were noted on the treated lilacs. Temperature and humidity readings during the 1991 and 1992 seasons were conducive for powdery mildew development. Powdery mildew disease pressure was similar for both the 1991 and 1992 trials. In 1991 the rainfall was 18.8 cm for July through September and in 1992 the rainfall was 24.3 cm

for this period. In our 1992 field trial both horticultural oils performed as well as the standard fungicide (Table 2). The results of the horticultural oil applications support previous efficacy investigations for the control of powdery mildew on ornamental plants (7). In field trials conducted in New York, Bayleton provided control of powdery mildew on lilacs comparable to horticultural oil but was inferior to either 2 or 3% horticultural oil treatments on azalea and phlox (2). In field trials conducted with cut flowers in 1991 - 1993, both 2% horticultural oil and 2% insecticidal soap gave control for powdery mildew on zinnias that was equal to Bayleton (11).

Horticultural oil combined with sodium bicarbonate in our trials was not significantly different from oil alone. Applications of sodium bicarbonate without oil failed to control powdery mildew and this treatment appeared similar to the control plants sprayed with water. Possible explanations for the failure of sodium bicarbonate without oil to control powdery mildew might be a combination of poor leaf adhesion and accelerated weathering on the lilac foliage. Ziv and Hagladi (14) had significant control of powdery mildew on euonymus with combinations of horticultural oil and sodium bicarbonate. They reported that the combination gave improved control over oil alone. They found that sprays containing sodium bicarbonate and 1% horticultural oil gave better protection against spread of powdery mildew on euonymus foliage than did various commercially available polymer coatings or Bayleton. Horst et al (6) obtained control of powdery mildew on rose with sodium bicarbonate plus 1% horticultural oil plus Tween 20. The found that this combination was significantly more effective than Tween 20 or Tween 20 plus oil.

In the 1991 trial, the polymer coating (Cloud Cover) gave only slightly better results than the water treated plants. Daughtery et al (2) reported that another polymer coating, Vapor Guard, was not as effective as horticultural oil in suppressing symptoms of powdery mildew on lilac and azalea. Although not labeled for disease control, natural waxes and polymer films have provided protective barriers to infection by Botrytis and other fungi (4,8). Ziv and Frederiksen found that Wilt Pruf was as effective against powdery mildew as the fungicide benomyl (16). Ziv and Hagiladi found that the antitranspirants, Vapor Guard and Wilt Pruf, effectively controlled powdery mildew on hydrangea and crapemyrtle (15). Reasons for these differing levels of disease control might be that the various anti-transpirants formulations vary in their protective qualities and also vary in leaf adhesion and weathering properties on different plant species.

Table 2. Effectiveness ratings of biorational compounds against powdery mildew on lilac.

Treatment	Whole plant*	Individual leaf*
1991		
Bayleton 2 week interval	1.0 c**	1.1 c
Bayleton 4 week interval	1.0 c	1.1 c
M-Pede 2 week interval	2.0 bc	2.1abcd
M-Pede 4 week interval	1.1c	1.6 bcd
SunSpray oil 2 week interval	1.0 c	1.0 d
SunSpray oil 4 week interval	1.0 c	1.0 d
Cloud Cover 4 week interval	2.8 abc	2.9 abc
Water control 2 week interval	4.0 ab	3.6 a
Water control 4 week interval	4.1 a	3.5 ab
1992		
Bayleton	1.0 b	1.0 b
SunSpray + sodium bicarbonate	1.2 b	1.0 b
Saf-T-Side	1.0 b	1.0 b
SunSpray oil	2.2 ab	2.6 ab
M-Pede	2.6 ab	2.5 ab
Sodium bicarbonate	3.7 a	3.8 a
Water control	4.0 a	4.1 a

* Disease ratings based on a 1 - 5 scale: 1 = 0 - 20%; 2 = 21 - 40%; 3 = 41 - 60%; 4 = 61 - 80%; 5 = 81 - 100% infection.
** Means within columns and years with at least one letter in common are not significantly different.

Although not currently labeled for disease control, there has been interest in expanding the EPA labeling for horticultural oils and insecticidal soaps, which could offer an alternative to conventional fungicides for powdery mildew control on selected plants. Our field trials support the results of previous efficacy investigations of horticultural oil for powdery mildew control on horticultural crops (2,8,12,15). The insecticidal soap that we tested was not significantly different from the horticultural oils. Biorational materials can be easily incorporated into current nursery and

landscape IPM strategies. In addition, biorational materials are relatively safe for the pesticide applicator and have a minimal impact on non-target organisms. Horticultural oils and insecticidal soaps have a proven record in IPM strategies for control of many common nursery pests including aphids, scales, and spider mites.

Literature Cited

1. Bailey, J.B. and J.G. Morse. 1991. Citrus treatment guide. Univ. Calif. Agric. Nat Res. Publ. 2903. Oakland, CA. 100pp.
2. Daughtrey, M., M. Clark, and M. Macksel. 1992. *Effect of scheduled applications of horticultural spray oil for control of powdery mildew on lilac, azalea, monardia and phlox.* Fungicide & Nematocide Tests 48: 378.
3. Davidson, N.A., J.E. Dibble, M.L. Flint, P.J. Marer, and A. Guye. 1991. Managing insects and mites with spray oils. IPM Education and Publications, Div. Agric. Nat. Res. Publ. 3347. Oakland, CA. 45pp.
4. Elad, Y., N. Ayish, O. Zin, and J. Katan. 1990. *Control of grey mould, Botrytis cinerea, with filming polymers.* Plant Pathology 39: 249-254.
5. Hagiladi, A. and O. Ziv. 1986. *The use of antitranspirants for the control of powdery mildew of roses in the field.* J. Environ. Hort. 4: 69-71.
6. Horst, R.K., S.O. Kawamoto, and L.L. Potter. 1992. *Effect of sodium bicarbonate and oils on the control of powdery mildew and black spot of roses.* Plant Disease 76: 247-251.
7. Locke, J.C. 1990. Activity of certain oils against foliar fungal pathogens. Phytopathology 80: 978.
8. Martin, J.T., R.F. Batt, and R.T. Burchill. 1957. *Defense mechanisms of plants against fungi.* Nature 180: 796-797.
9. Punja, Z.K. and R.G. Grogan. 1982. *Effects of inorganic salts, carbonate bicarbonate anions, ammonia, and the modifying influence of pH on sclerotial germination of Sclerotium rolfsii.* Phytopathology 72: 635-639.
10. Sinclair, W.A., H.H. Lyon, and W.T. Johnson. 1987. Diseases of Trees and Shrubs. Cornell University Press, Ithaca N.Y. 574pp.
11. Sharp, D. and S.A. Gill. 1993. *Evaluation of biorational pesticides for control of powdery mildew on zinnias.* ASCFG Quarterly 5(4): 13-14.
12. Smith-Fiola, D.C. 1991. Pest resistant ornamental plants. Rutgers Coop. Exten. Ser. Leaflet. Toms River, NJ.
13. Zitter, T.A. and O. Ziv. 1991. Control of cucurbit foliar diseases with conventional fungicides and bicarbonates. Cornell Pest Control Proceedings.
14. Ziv, O. and A. Hagiladi. 1993. *Controlling powdery mildew in Euonymus with polymer coatings and bicarbonate solutions.* HortScience 28(5): 124-126.
15. Ziv, O. and A. Hagiladi. 1984. *Controlling powdery mildew on hydrangea and crapemyrtle with antitranspirants.* HortScience 19(5): 708-709.
16. Ziv, O. and R.A. Frederiksen. 1983. *Control of foliar diseases with epidermal coating materials.* Plant Disease 67(2): 212-214.

Regional Specialists
Cooperative Extension Service
University of Maryland
11975 Homewood Road
Ellicott City MD 21042