Title: Evaluation of late-dormant applications for control of Exobasidium fruit and leaf spot of blueberry in Georgia

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Public Abstract

As part of their integrated management of pests and diseases, blueberry growers commonly apply various materials during the dormant period. Past work with blueberries has shown that a single application of lime sulfur during the late dormant period can provide excellent control of Exobasidium leaf and fruit spot disease. However, dormant oil applications during the dormant period, which are frequently used to control blueberry pests, can actually exacerbate Exobasidium leaf and fruit spot disease. To enhance our understanding of the impact that dormant applications have on this disease, different application timings and materials were evaluated for their effect on Exobasidium leaf and fruit spot disease control. Utilizing two different timings for single pesticide applications in the late dormant period, a field trial was carried out at a commercial rabbiteye blueberry production site in southern Georgia. Treatments utilized included Damoil (dormant oil), Lime Sulfur Ultra (lime sulfur) and Dormex (hydrogen cyanamide). Based upon disease severity and incidence evaluations, the excellent control of Exobasidium typically provided by late dormant lime sulfur applications was diminished substantially if dormant oil was applied either two weeks prior to lime sulfur or two weeks after lime sulfur. Based upon these results, in order to maximize the effectiveness of late dormant applications of lime sulfur for Exobasidium leaf and fruit spot control, growers should avoid the late dormant period for their dormant oil applications, where possible. Instead, applications of dormant oil earlier in the dormant period may be preferable in sites with a history of Exobasidium disease.

Introduction

Within the past decade, Exobasidium leaf and fruit spot disease, caused by the fungus *Exobasidium maculosum*, has emerged on blueberries in the southeastern U.S. (Brewer et al. 2014; Cline 1998). This pathogen causes lesions that form on leaves and ripening fruit (**Figure 1**). Lesions increase crop losses by making affected fruit unmarketable (Cline and Brewer 2017), and diseased plants are also likely to experience significant fruit drop. The disease has been reported to be so problematic on rabbiteye blueberries in some places that fields have had to be abandoned (Phil Brannen, personal communication). Prior work has indicated that the disease is active in southern Georgia from March through late May, that it is monocyclic, and that initial fruit and leaf infection may occur simultaneously (Ingram et al. 2017). To date, studies on the management of Exobasidium leaf and fruit spot have shown that fungicide applications with Pristine, Elevate, and Captan can reduce disease incidence on both leaves and fruit (Scherm et al. 2014). Furthermore, a single application of lime sulfur or Sulforix (calcium polysulfide) in the late dormant period has been shown to be capable of almost completely controlling this disease (Brannen et al. 2017).

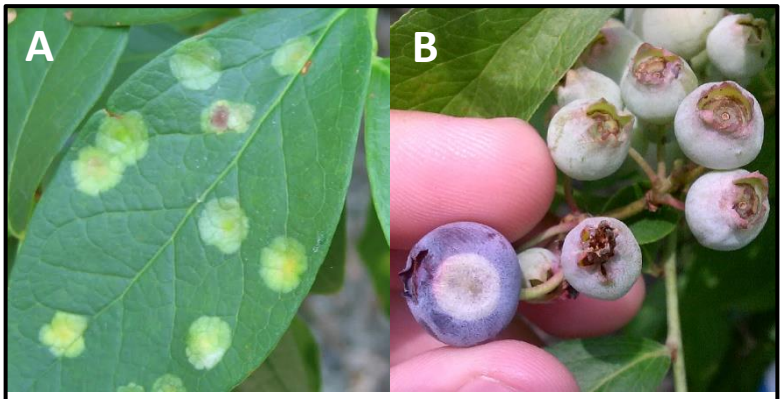

Figure 1. Symptoms of Exobasidium leaf and fruit spot on: (A) leaves and (B) fruit. (Images from MyIPM App)

In addition to lime sulfur, other materials that are frequently applied to commercial blueberries during the dormant period include Dormex (hydrogen cyanamide) and Damoil (mineral oil). Dormex and Damoil are typically applied in the late dormant period to promote earlier bud break and control insect pests, respectively, but they have previously been shown to have an impact on Exobasidium leaf and fruit spot development. In previous trials, it has been noted that Dormex applications consistently result in decreased disease severity and incidence, while Damoil applications are reported to result in increased disease severity and incidence relative to untreated controls (Brannen et al. 2017). In 2018, a spray trial looking at the relative timing of lime sulfur and dormant oil applications suggested that applying both Damoil and Lime Sulfur Ultra (two weeks apart) resulted in poorer Exobasidium leaf and fruit spot control than Lime Sulfur Ultra alone (Oliver et al. 2019). As growers commonly apply multiple materials during the dormant period, the relationship between disease development and the timing of late dormant applications (dormant oil, hydrogen cyanamide, and lime sulfur, respectively) bears further investigation. To understand the impact of materials applied in the late dormant on Exobasidium leaf and fruit spot, as well as the relative spray timings for optimal control, a field trial was conducted in 2019. Accordingly, our objectives with this work were to: (1) determine the effects of late dormant application materials on the incidence and severity of Exobasidium leaf and fruit spot of blueberry, (2) determine the effect of varied spray timings and orders for late dormant application materials on the incidence and severity of Exobasidium leaf and fruit spot of blueberry, and (3) determine the effectiveness of late dormant application materials at reducing the surface populations of *E. maculosum* on blueberry.

Materials and Methods

Field trial design and treatments. Chemicals were evaluated for control of Exobasidium leaf and fruit spot on rabbiteye blueberry cultivars 'Premier' and 'Tifblue' at a commercial site with a history of Exobasidium near Alma, GA. Delayed dormant spray applications were made on 9 Jan (timing 1) and/or on 23 Jan (timing 2). The trial consisted of eight treatments in total (**Table 1**). In one treatment, Dormex was applied with an airblast sprayer (50 gal/A spray volume) at timing 2 with 1 pint/A non-ionic surfactant added. Additional applied treatments included Lime Sulfur Ultra (applied by airblast sprayer at 50 gal/A spray volume) and/or Damoil (applied by airblast sprayer at 100 gal/A spray volume). Five replications of each treatment and the untreated control were applied to a randomized complete block design, with each plot consisting of five sprayed plants, with one unsprayed plant separating each plot and the inner three plants of each plot being utilized for treatment evaluation. All cultural practices were consistent with rabbiteye blueberry production methods commonly observed in the Southeast.

Table 1. Treatments and spray timings of field trial.

	Treatment Description	Rate/Acre	Application Timing[z]
1	Damoil (mineral oil)	3 gal	Timing 1
2	Damoil (mineral oil)	3 gal	Timing 2
3	Lime Sulfur Ultra (calcium polysulfide)	2 gal	Timing 1
4	Lime Sulfur Ultra (calcium polysulfide)	2 gal	Timing 2
5	Damoil (mineral oil)	3 gal	Timing 1
	Lime Sulfur Ultra (calcium polysulfide)	2 gal	Timing 2
6	Lime Sulfur Ultra (calcium polysulfide)	2 gal	Timing 1
	Damoil (mineral oil)	3 gal	Timing 2
7	Dormex (hydrogen cyanamide)	0.75 gal	Timing 2
8	Untreated Control		n/a

[z]"Timing 1" refers to the initial application on 9 Jan and "Timing 2" refers to the second application on 23 Jan.

Assessment of incidence and severity of Exobasidium leaf and fruit spot of blueberry. For both cultivars, leaf disease incidence and severity were assessed on 8 May from ~ 120 leaves per plot. Leaf disease incidence was recorded as the percentage of sampled leaves with Exobasidium spots. Leaf disease severity was recorded as the number of spots per leaf on the sampled leaves. Mature fruit were harvested from the 'Premier' cultivar on 14 May and from the 'Tifblue' cultivar on 4 Jun. Disease incidence on fruit was assessed on ~175-200 fruit per plot. Disease incidence on fruit was recorded as the percentage of collected fruit with spots.

Assessment of surface populations of *E. maculosum* on blueberry. In addition to field disease assessment, the effectiveness of the treatments at reducing fungal inoculum was anticipated to be assessed through examination of surface population levels of *E. maculosum*. Surface population assessment samples were to be taken from treated plants at four timepoints: (1) one day prior to application timing 1, (2) one day prior to application timing 2, (3) two weeks after application timing 2, and (4) eight weeks after application timing 2. Pooled samples consisting of six shoots per plot (one shoot from each side of each bush) were to be collected. Spread-plating on a semi-selective media developed for the isolation of *E. maculosum* was expected to be used to estimate *E. maculosum* surface populations within each treatment plot as previously described (Ingram 2017).

Results

Assessment of incidence and severity of Exobasidium leaf and fruit spot of blueberry. Conditions were adequate for disease development, with nearly 60% of the 'Premier' leaves and 20% of the 'Premier' fruit showing spots in some treatments (**Table 2**). In this trial, Dormex did not appear to impact disease incidence or severity relative to the untreated control. The single late-dormant applications of Lime Sulfur Ultra within this trial resulted in significantly lower disease severity and incidence versus the untreated control and Damoil treatments. Applications in this trial of both Damoil and Lime Sulfur Ultra (two weeks apart) resulted in poorer Exobasidium leaf and fruit spot control than Lime Sulfur Ultra alone. Furthermore, results from this study indicated that spraying Damoil two weeks prior to Lime Sulfur Ultra resulted in Exobasidium leaf and fruit spot control that was poorer numerically than the untreated control. By contrast, spraying Lime Sulfur Ultra two weeks prior to spraying Damoil, did reduce disease numerically as compared to the untreated control; however, these results were not statistically distinguishable from the untreated control, except for leaf spot incidence on the 'Premier' cultivar.

Table 2. Exobasidium incidence and severity assessment results from field trial.

Treatment and amount/A	Application timing[z]	Leaf spot incidence (%)[y]		Leaf spot severity (spots/leaf)[y]		Fruit spot incidence (%)[x]	
		Premier	Tifblue	Premier	Tifblue	Premier	Tifblue
Untreated control	----	47.3ab	45.4ab	0.9b	1.5ab	9.7bc	5.5abc
Damoil 3 gal	1	58.3a	53.1a	2.5a	2.1a	21.2a	9.1a
Damoil 3 gal	2	58.6a	50.9a	2.4a	1.8a	21.0a	6.8ab
Damoil 3 gal Lime Sulfur Ultra 2 gal	1 2	54.6a	46.5ab	1.9a	1.5ab	12.4b	6.1abc
Lime Sulfur Ultra 2 gal Damoil 3 gal	1 2	29.7cd	30.3bc	0.6bc	0.6bc	5.6c	3.4bc
Lime Sulfur Ultra 2 gal	1	16.6de	18.5c	0.2bc	0.3c	3.2c	3.0bc
Lime Sulfur Ultra 2 gal	2	12.5e	21.7c	0.2c	0.5bc	4.0c	2.3c
Dormex 0.75 gal	2	33.5bc	42.6ab	0.8bc	1.1abc	9.9bc	5.4abc

[z]Treatments were single late-dormant applications on either 9 Jan and/or 23 Jan.
[y]Recorded for ~120-150 leaves per plot on average. Means in each column followed by the same letter are not significantly different according to Tukey's test ($\alpha = 0.05$).
[x]Recorded for ~175-200 fruit per plot on average. Means in each column followed by the same letter are not significantly different according to Tukey's test ($\alpha = 0.05$).

Assessment of surface populations of *E. maculosum* on blueberry. Due to earlier than normal bud-break in 2019, this trial commenced (on 9 Jan) prior to notification that this grant had been funded (on 22 Jan). As such, samples for surface population assessment were not collected in time to be assessed during this trial in 2019. It is anticipated that this trial will be repeated in 2020, and surface populations of *E. maculosum* will be assessed at that time.

Discussion

The results of this study reinforce previous findings that a single application of lime sulfur in the late dormant period is the most effective means of controlling Exobasidium leaf and fruit spot. This appears to be true so long as lime sulfur is applied in the absence of Damoil applications. However, the findings of this trial indicate that when Damoil is also applied in the late dormant period, the control of Exobasidium provided by a late dormant application of lime sulfur is greatly diminished. This was true whether Damoil was applied before or after Lime Sulfur Ultra, although

when Damoil applications followed Lime Sulfur Ultra in this trial the negative impact on disease control appeared to be lessened somewhat. Accordingly, growers applying Damoil in the dormant period are advised to avoid the late dormant period to maximize the effectiveness of late dormant applications of lime sulfur for Exobasidium leaf and fruit spot control. Instead, applications should be made earlier in the dormant period, if possible. In situations where late dormant Damoil applications cannot be avoided, previous research has shown that regular applications of Captan can provide control of Exobasidium in-season. This is of particular relevance to growers who are likely to make applications of both materials during the late dormant period.

References

Brannen, P., Scherm, H., Allen, R. 2017. Management of Exobasidium leaf and fruit spot disease of blueberry. *Acta Hortic.* 1180:215-220.

Brewer, M., Turner, A., Brannen, P., Cline, W., Richardson, E. 2014. *Exobasidium maculosum*, a new species causing leaf and fruit spots on blueberry in the southeastern USA and its relationship with other *Exobasidium spp.* parasitic to blueberry and cranberry. *Mycologia*. 106:415-423.

Cline, W. 1998. An Exobasidium disease of fruit and leaves of highbush blueberry. *Plant Dis*. 82:1064.

Cline, W.O. 2014. New and Emerging Diseases of Blueberry. *Acta Hortic*. 1017:45-49.

Cline, W.O. and Brewer, M.T. 2017. Exobasidium Leaf and Fruit Spot. Pages 22-33 in:Compendium of Blueberry, Cranberry, and Ligonberry Diseases and Pests, 2nd Edition. J.J. Polashock, F.L. Caruso, A.L. Averill, A.C. Schilder, eds. APS Press, St. Paul, Minn, USA.

Ingram, R., Allen, R., Scherm, H. 2017. Symptomology and epidemiology of Exobasidium leaf and fruit spot of blueberry. *Acta Hortic.* 1180:205-214.

Oliver, J.E., Allen, R., Ingram, R.J. Evaluation of late-dormant applications for control of Exobasidium leaf and fruit spot of blueberry in Georgia, 2018. *Plant Disease Management Reports.* 13:PF052

Scherm, H., Savelle, A.T., Smith, J.E., and Stanaland, R.D. 2014. Efficacy of fungicides for control of Exobasidium fruit and leaf spot of blueberry in Georgia, 2013. *Plant Disease Management Reports.* 8:SMF024.