

## Research Report 2015-07 (Final Report)

### Development of practical disease management recommendations for *Exobasidium* leaf and fruit spot of blueberry based on late-dormant and post-bloom practices

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**Objectives:** (1) Determine the potential contribution of late-dormant applications of growth regulators and oils associated with current horticultural and insect management practices, and (2) determine the relative importance of post-bloom and early cover sprays for management of *Exobasidium* leaf and fruit spot disease of blueberry.

#### **Justification and Potential Benefits:**

*Exobasidium* leaf and fruit spot, caused by the fungus *Exobasidium maculosum* (Brewer et al., 2014), is an emerging disease affecting both southern highbush and rabbiteye blueberries. Fruit symptoms (Fig. 1) include circular lesions which may be sunken and tinged with red color, diseased fruit tissue which is generally green and unripe, and sparse white fungal growth on spots. Leaf spots (Fig. 1) are light green on the upper side of the leaf and white on the underside, due to a thin layer of fungal growth, becoming necrotic (dried and brown) with age. Fruit lesions compromise the aesthetic qualities of the fruit, as well as the taste, rendering berries unmarketable. As a result, packing lines have to slow down to allow human sorters time to remove fruit with lesions, thereby increasing production costs. Even with this added effort, affected fruit are still able to make it into the package – increasing customer complaints.

Based on recent research, funded in part by the SRSFC, we know that application of calcium polysulfide products (lime sulfur or Sulforix) at a late-dormant phenology is critical to management of *Exobasidium*. This is most likely due to the destruction of overwintering yeast cells of the pathogen on stem lesions and on buds. In addition to lime sulfur, oil products and growth regulators are sometimes applied to blueberries during the dormant and/or late-dormant periods. Various oil products are utilized for suppression of scale insects, such as horticultural/superior oils. The impacts of these oil applications to the survival of the yeast stage of *Exobasidium* were not known. Dormex (50% hydrogen cyanamide) is used with some varieties to increase leafing, initiate flowering and promote an earlier harvest; it is applied during the dormant season after significant winter chilling has been received, but before significant flower bud swelling occurs. There was also no

information as to whether Dormex might have an antifungal impact on *Exobasidium*, but it could be hypothesized that hydrogen cyanamide, given its caustic nature, would kill the saprophytic yeast state of the fungus on the plant surface. If any of these standard horticultural or insect techniques provided a consequential suppression of *Exobasidium*, this would be of considerable practical interest.

Based on our previous research, late dormant (calcium polysulfide) and bloom (Captan and similar materials) applications are known to be important in suppressing the disease. However, we did not fully understand the contribution of post-bloom and early cover sprays to management of *Exobasidium*. Also, although Sulforix can cause phytotoxicity, there is evidence that cover sprays with this material at reduced rates may not be as dangerous as previously anticipated. In light of the strong efficacy of Sulforix when applied late-dormant, application of this product during the post-bloom and cover-spray timeframe may be of value and should be tested.



**Figure 1.** Symptoms of *Exobasidium* fruit and leaf spot. Fruit symptoms are green, firm spots and blotches that do not mature with the rest of the berry. Leaf symptoms are light green spots on the upper leaf surface which are white or lighter green on the lower surface.

**Methods:** Two studies were conducted to further develop our IPM recommendations for management of this disease. Two field sites with a history of severe *Exobasidium* leaf and fruit spot on ‘Premier’ variety were selected for each study. Treatments were applied to randomized complete block designs through use of producer sprayers (50-70 GPA total spray volume).

The first study incorporated materials that are already utilized for blueberry production, but which might have beneficial activity on *Exobasidium*. Among these, Dormex and superior oil were tested. In addition, Dormex and calcium polysulfide products (lime sulfur) were tested, since there might be an opportunity to apply these at the same phenology. The second study specifically reviewed current disease control options and determined the added contribution of cover sprays (Captan or calcium polysulfide) to management of *Exobasidium*.

#### Treatments (Study 1)

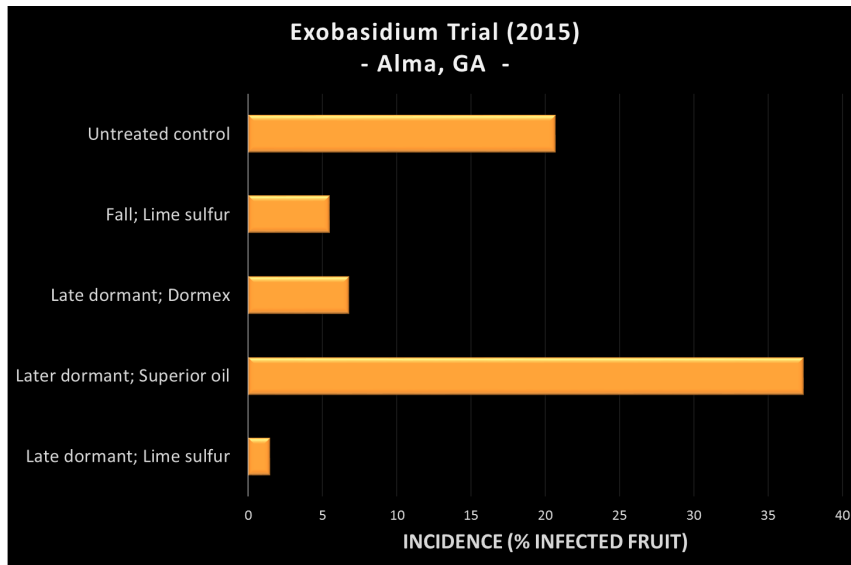
1. Untreated control
2. Dormex (late dormant) @ 0.75 gallons + 1 pint nonionic surfactant in 50 gallons of water per acre
3. Superior oil @ 3 gal/100 gal applied dormant to late dormant
4. Lime Sulfur @ 5 gal/A applied late dormant
5. Lime Sulfur @ 5 gal/A applied in the fall

#### Treatments (Study 2)

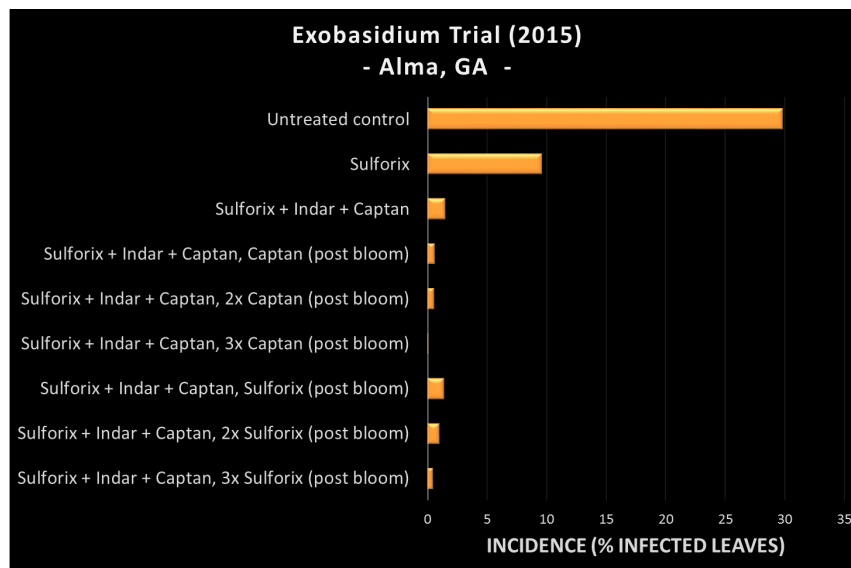
1. Untreated control
2. Sulfurix @ 2 gal/A (late dormant)
3. Sulfurix @ 2 gal/A (late dormant)  
Indar 2F @ 6 fl oz/A + Captan 4L @ 2.5 qt/A (green tip and bloom sprays)
4. Sulfurix @ 2 gal/A (late dormant)  
Indar 2F @ 6 fl oz/A + Captan 4L @ 2.5 qt/A (green tip and bloom sprays)  
Captan 4L @ 2.5 qt/A (post bloom)
5. Sulfurix @ 2 gal/A (late dormant)  
Indar 2F @ 6 fl oz/A + Captan 4L @ 2.5 qt/A (green tip and bloom sprays)  
Captan 4L @ 2.5 qt/A (post bloom)  
Captan 4L @ 2.5 qt/A (first cover)
6. Sulfurix @ 2 gal/A (late dormant)  
Indar 2F @ 6 fl oz/A + Captan 4L @ 2.5 qt/A (green tip and bloom sprays)  
Captan 4L @ 2.5 qt/A (post bloom)  
Captan 4L @ 2.5 qt/A (first cover)  
Captan 4L @ 2.5 qt/A (second cover)
7. Sulfurix @ 2 gal/A (late dormant)  
Indar 2F @ 6 fl oz/A + Captan 4L @ 2.5 qt/A (green tip and bloom sprays)  
Sulfurix @ 2.0 qt/A (post bloom)
8. Sulfurix @ 2 gal/A (late dormant)  
Indar 2F @ 6 fl oz/A + Captan 4L @ 2.5 qt/A (green tip and bloom sprays)  
Sulfurix @ 2.0 qt/A (post bloom)  
Sulfurix @ 2.0 qt/A (first cover)
9. Sulfurix @ 2 gal/A (late dormant)  
Indar 2F @ 6 fl oz/A + Captan 4L @ 2.5 qt/A (green tip and bloom sprays)  
Sulfurix @ 2.0 qt/A (post bloom)  
Sulfurix @ 2.0 qt/A (first cover)  
Sulfurix @ 2.0 qt/A (second cover)

**Results:** Study 1 provided good initial data to support the potential benefit of fall or dormant applications of calcium polysulfide and hydrogen cyanamide as control methods for *Exobasidium* (Fig. 2), but not superior oil. Study 2 provided good evidence that 2-3 post bloom cover sprays with either Captan or Sulfurix may further reduce disease

incidence to near zero (Fig. 3). Both studies will need to be repeated before firm recommendations can be made, but it is encouraging that new IPM methods may be developed if we can repeat the studies in subsequent years. No phytotoxicity was observed with any treatment.



**Figure 2.** Incidence of Exobasidium based on a sample of ~150 ripe fruit per plant (four replications). In this initial study, fall application of lime sulfur (calcium polysulfide) and late dormant applications of either Dormex (hydrogen cyanamide) or lime sulfur provided substantive management of Exobasidium.



**Figure 3.** Incidence of Exobasidium based on a sample of ~300 leaves per plant (four replications). In this initial study, cover sprays added to reduced disease levels, though the late-dormant application of Sulforix (calcium polysulfide) plus Indar + Captan bloom sprays provided substantive efficacy.

**Conclusions:** Initial results indicate that fall applications of calcium polysulfide and dormant applications of a growth regulator (hydrogen cyanamide) may add to management options for Exobasidium leaf and fruit spot. In addition, use of early cover sprays with Captan or Sulforix may further reduce Exobasidium levels to near zero. Whether these additional methods will prove to be cost effective remains to be determined, but in the case of hydrogen cyanamide and Captan, these materials have benefits in addition to Exobasidium control.

**Impact Statement:** Exobasidium leaf and fruit spot, caused by the fungus *Exobasidium maculosum*, is an emerging disease affecting both southern highbush and rabbiteye blueberries. Fruit lesions compromise the aesthetic qualities of the fruit, as well as the taste, rendering berries unmarketable. As a result, packing lines have to slow down to allow human sorters time to remove fruit with lesions, thereby increasing production costs. Even with this added effort, affected fruit are still able to make it into the package – increasing customer complaints. Initial results from 2015 research trials (conducted with funding from the Southern Region Small Fruit Consortium) indicate that fall applications of calcium polysulfide and dormant applications of a growth regulator (hydrogen cyanamide) may add to management options for Exobasidium leaf and fruit spot. In addition, use of early cover sprays with Captan or Sulforix may further reduce Exobasidium levels to near zero. Whether these additional methods will prove to be cost effective remains to be determined, but in the case of hydrogen cyanamide and Captan, these materials have additional benefits other than Exobasidium control. Studies will need to be repeated before firm recommendations can be made, but it is encouraging that new IPM methods may be developed in the next 1-2 years.