North American Bramble Growers Research Foundation (NABGRF) Grants
Research Proposal Report

Evaluation of algicides for management of orange felt and fungicides for control of cane blight diseases of blackberry

Principal Investigator
Phillip M. Brannen
Extension Plant Pathologist – Fruits
Department of Plant Pathology
2106 Miller Plant Sciences
University of Georgia
Athens, GA 30602
Phone: (706) 542-1250
FAX: (706) 542 4102
Email: pbrannen@uga.edu

Collaborator
Jeremy Taylor
Agricultural Extension Agent – Lanier County
162 West Thigpen Avenue
Lakeland, GA 31635
Phone: (229) 482-3895
FAX: (229) 482-2654
Email: jeremyt@uga.edu

Collaborator
Justin Shealey
Agricultural Extension Agent – Echols County
P.O. Box 186
109 Courthouse Street
Statenville, GA 31648-0186
Phone: (229) 559-5562
FAX: (229) 559-9436
Email: justin1@uga.edu

Objectives: (1) Compare algicides for management of orange felt of blackberries; (2) Determine fungicidal efficacy for cane blight management in commercial blackberries.

Justification: The acreage and value of commercial blackberries has increased dramatically over the last 10 years, with large-scale production centered in both Georgia and North Carolina. Cane diseases are among the limiting factors to blackberry production. One of these is orange felt (also known as orange cane blotch) disease of blackberry, caused by the parasitic alga *Cephaleuros virescens* (Fig 1). Orange felt is especially prevalent on blackberries grown in very hot, wet, and humid environments, such as those encountered in much of the Coastal Plain areas of the Southeast. Where colony formation (i.e. the degree of coverage of the cane) is limited, it has been stated that this alga does not limit blackberry production. Where ideal environmental conditions occur, this alga may girdle canes or exacerbate other cane diseases, causing subsequent decline and death. Since stem cracking accompanies infection, this may also account for death of blackberry canes, due to secondary attack by opportunistic fungi such as *Botryosphaeria* species and cane blight.

The *C. virescens* colonies form where zoospores (mobile swimming spores) settled the prior summer. In the case of blackberries, spread has to occur from floricane to primocane in each year of continued colony production. Algal filaments spread to form a colony. As the colonies develop and mature in early to mid-summer, they form hair-like stalks (sporangiophores), which subsequently produce multiple zoosporangia. Under wet conditions, the zoosporangia in turn release multiple zoospores (swimming spores), each of which is capable of forming a new colony. Spores can actually swim to a new spot on a cane, but spread from floricane to primocane is

likely through splashing water from summer rains. The disease cycle can be continuous for 8-9 months under favorable environmental conditions.

Copper sprays have been traditionally utilized to suppress this disease; though many copper products are registered for control of blackberry diseases, the labeled use times for most copper materials may not be sufficient to cover all infection periods. Also, copper injury can occur with prolonged use or under certain environmental conditions, such as very hot or prolonged moist periods (poor drying conditions). Mid-summer copper applications are not generally allowed under most current labels, and once again, plant tissue damage may possibly occur under hot conditions. Likewise, Bordeaux mixture has been utilized for control of algal pathogens on other commodities, but it may be phytotoxic, and other formulations of coppers have generally replaced Bordeaux as the product of choice. Additional materials are needed for management of orange felt, and efficacy data will be required to determine which algicides and/or fungicides (some impact algae as well) will be of value for management of this disease.

B

Figure 1. Clusters of *Cephaleuros virescens* sporangiophores (A) and yellow to orange velvet-like colonies formed by *C. virescens* on a thornless blackberry cane (B). When actively sporulating, the zoosporangia are borne on stalks which give the "orange felt" appearance associated with the disease. Orange felt forms yellow to orange spots, starting on the base of the canes in the late spring or early summer. Spots become more pronounced each fall.

Cane blight can also be a major disease of blackberry in the Southeast, resulting in severe losses – sometimes resulting in the complete destruction of fruiting canes in any given year. As with orange felt, wet, humid conditions observed in Georgia and other southeastern states allow for significant losses following pruning or other injuries to the primocane. Cane blight is caused by *Leptosphaeria coniothyrium*, a common fungus which also causes stem canker on roses and other ornamentals (Fig 2). The fungus produces two types of fruiting structures (pseudothecia and

pycnidia), both of which are largely buried in the dead bark tissue. Likewise, the fungus produces two respective spore types (ascospores or conidia).

The fungus overwinters on dead tissue of old floricanes (fruiting canes). If not removed, dead canes or cane tissue can serve as a ready source of inoculum. Spores are produced from the spring through the fall, and spores infect injured primocane tissue. Therefore, the risk of cane blight is greatly increased when primocanes are injured or improperly pruned. Though pruning cuts provide a major infection site, insect damage, herbicide damage, freeze injury, or injury from farm machinery or other mechanical operations will likewise provide sites for infection to occur. If rainfall immediately follows any injury, this furthers the likelihood of pathogen infection and establishment in the vascular tissue. Once primocane infection has occurred, the pathogen continues to invade plant tissue during the fall and winter, resulting in floricane bud failure and cane dieback in the following spring, completing the disease cycle.

In the summer, fall, and winter following the initial wound-site infection, cane blight lesions may develop on the primocanes; these lesions are generally dark red to purple with irregular purple borders – similar in appearance to those of Botryosphaeria cane canker. In some cases, lesions may extend for only a few inches, but canes can also be girdled by larger lesions or cankers, resulting in their death and complete loss of production the following year. Floricane lesions become brittle in the spring and summer, and released spore masses dry on the canes, often resulting in a silvery to gray surface appearance on dead tissue. With a hand lens, the fruiting structures will appear as small, black, pimple-like bumps which are largely buried in the blackberry tissue.

Numerous fungicides could be brought to bear on cane blight, but efficacy data for management of cane blight is lacking as well. Efficacy trials are greatly needed to help us address both cane blight and orange felt.

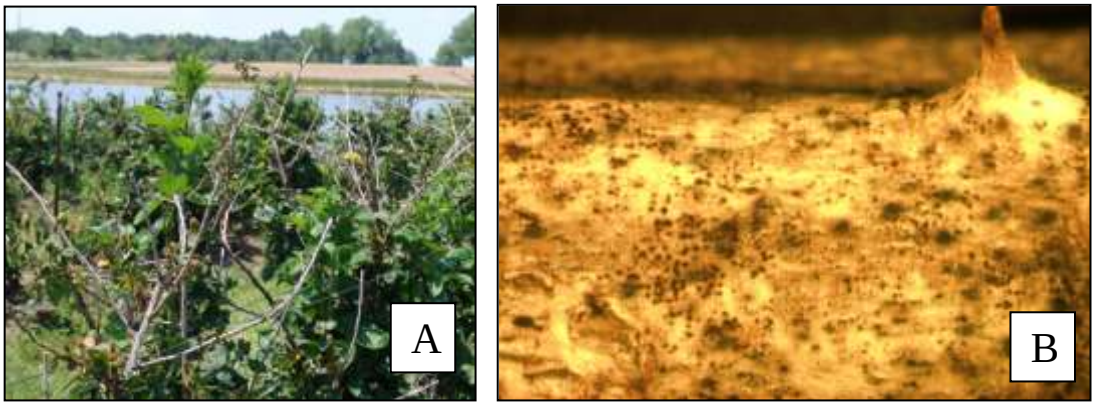

Figure 2. Symptoms (A) and signs (B) of cane blight. Following infection, dead and dying floricanes are observed in the spring and summer. Dead canes may have a silvery to gray appearance. Damage is generally associated with pruning cuts, especially large ones. With a hand lens, small, black, pepper-like specks can be seen on the surface of the dead tissue. These are the fruiting structures for the fungus (pseudothecia and/or pycnidia).

Methodology: The following treatments were designed to address the efficacy of fungicides and/or algicides for cane blight and orange felt management. Treatments were applied to a randomized complete block design. Five replications of each treatment were conducted, and each

replication consisted of a single plant. Fungicide applications were made with a backpack sprayer to runoff at multiple application dates. A minimum of one plant was skipped between spray plants to minimize plot-to-plot spray drift. Variables measured were severity of both diseases.

Results:

Orange felt. Rainfall was more than adequate for disease development. Copper application has been generally recommended for suppression of *Cephaleuros virescens* diseases of fruit plants in the Southeast, but it was not effective in this trial. Possibly due to its systemic activity, Prophyt was the only efficacious treatment, providing substantial suppression of orange cane blotch. Phytotoxic effects were present in both the Prophyt and potassium sorbate treatments, each causing marginal leaf burn. Potassium benzoate caused severe phytotoxic damage to the plant, as indicated by a more general leaf burn.

Treatment and rate/A	Orange cane blotch severity (%)[x]
1. Non-treated control	48.0 ab
2. Potassium benzoate 10% a.i.[w]	66.0 a
3. Potassium sorbate 10% a.i.	40.0 b
4. Oxidate 64 fl oz	42.5 b
5. Bravo Weather Stik 4 pt	52.0 ab
6. Kocide 3000 1.75 lbs	43.0 b
7. Lime sulfur 6 gal	50.0 ab
8. Prophyt 4 pt	9.5 c
9. Sulforix 1qt	42.5 b
10. Dithane 4.8 qt	38.5 b
11. Junction 3.5 lbs	50.0 ab
12. Omega 500 1.25 pt	48.0 ab
13. Bleach 10%	43.5 ab

Cane blight. Rainfall was sufficient for cane blight establishment as well. Though Pristine has shown efficacy in previous trials, the only fungicide that provided significant control of cane blight was the DMI fungicide Rally. Cane blight is mainly a disease that follows pruning, so timing of Rally applications to pruning should reduce the development of disease, especially when chemical control is combined with good cultural management recommendations. It is surprising that the broad-spectrum, dual-component treatments such as Pristine, Switch, and Topsin M + Captan were not more efficacious. Additional fungicides are needed, as Rally alone will likely develop resistance over time without good alternation partners. With this said, other DMI fungicides should be tested in the future, as some may be even more efficacious than Rally.

Treatment and rate/A	Cane blight severity (%)
1. Untreated control	56.0 a
2. Pristine 23 oz/A	48.2 ab

3. Rally 2.5 oz.....	32.0 b
4. Topsin M 70WSB 1.5 oz + Captan	55.2 a
5. Switch 14 oz	45.8 ab

Conclusions: Fortunately, an efficacious fungicide (Prophyt) was found to be active on the algal disease, orange felt. Likewise, another fungicide (Rally) was determined to provide suppression of cane blight. Both of these findings are new, so based on this research, blackberry producers now have two registered materials that can help with these diseases. Additional research needs to be conducted to optimize timing of both fungicides for disease control. In addition, more fungicides from diverse classes are needed to prevent resistance development in these algal and fungal diseases. For now, overall cane health should be increased by incorporation of both Prophyt and Rally into IPM programs for management of these and other diseases.

Impact Statement: Based on this research, two critical cane diseases of blackberry now have known chemical controls. Though additional chemical fungicides are needed in order to prevent resistance development in these pathogens, Prophyt and Rally can now be incorporated into IPM programs for control of orange felt and cane blight.

Selected References:

1. Chapman, R.L., Henk, M.C. 1985. Observations on the habit, morphology, and ultrastructure of *Cephaleuros parasiticus* (chlorophyta) and a comparison with *C. virescens*. J. Phycol. 21:513-522.
2. Ellis, M. A., Kuter, G. A., and Wilson, L. L. 1984. Fungi that cause cankers on thornless blackberry in Ohio. Plant Disease 68:812-815.
3. Holcomb, G.E. 1986. Host of the parasitic alga *Cephaleuros* virescens in Louisiana and new host records for the continental United States. Plant Disease 70:1080-1083.
4. Holcomb, G.E., Vann, S.R., Buckley, J.B. 1998. First report of *Cephaleuros virescens* in Arkansas and it occurrence in cultivated blackberry in Arkansas and Louisiana. Plant Disease 82:263.
5. Joubert, J.J. and Rijkenberg, F.H.J. 1971. Parasitic green algae. Annual Review of Phytopathology 9:45-64.
6. Sinclair, W.A., Lyon, H.H., Johnson, W.T. 1987. Diseases of Trees and Shrubs. Comstock Publishing Associates, Ithaca, NY. 575 pp.
7. Williamson, B. 1991. Cane blight. Pages 5-7 in: Compendium of Raspberry and Blackberry Diseases and Insects. M. A. Ellis, R. H. Converse, R. N. Williams, and B. Williamson., eds. APS Press, St. Paul, MN.