Final Project Report – SRSFC Research Grant 2013-10
Southern Region Small Fruit Consortium

Proposal Category: ____X_____**RESEARCH**

PROJECT TITLE: Eriophyid Mite Management for Suppression of Blueberry Necrotic Ring Blotch Disorder: An Emerging and Significant Disease of Southern Highbush Blueberries

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Objective: 1) Determine whether mite management programs will reduce the level of blueberry necrotic ring blotch virus (BNRBV) observed in southern highbush blueberry plantings, 2) indirectly test the premise that eriophyid mites are vectors of a virus that causes BNRBV.

Justification: The blueberry industry in Georgia, Florida, North Carolina, South Carolina and other southeastern states has experienced considerable growth during the past 30 years due to improved cultivars and marketing opportunities. This expansion will likely continue in the near future, since consumer demand has increased due to the widely publicized health benefits of blueberries, and producers are seeking alternatives to traditional crops that have become less profitable, such as tobacco and citrus.

Recently, a new problem was observed on southern highbush blueberries (*Vaccinium corymbosum* interspecific hybrids). Initially observed in 2006, plants with symptoms reminiscent of a viral-induced disease were found scattered among four locations in Appling and Bacon Counties in southeastern Georgia. The disease has now been observed extensively in Florida, Mississippi, South Carolina, and North Carolina as well. Leaves of susceptible cultivars develop irregular red or brown spots that may or may not have green centers, depending on the cultivar (Fig. 1). Eventually the spots may coalesce to cover the entire leaf. *Blueberry necrotic ring blotch virus* (BNRBV) can result in defoliation of the plant. Since severe defoliation results, negative yield impact is assumed to be equivalent to that observed with fungal leaf spot diseases or mechanical defoliation, both of which have been studied extensively.

This disease is caused by a unique plant virus; based on relatedness to other viruses and newly-conducted research, it is likely a local-lesion virus, as opposed to a systemic virus. More information needs to be obtained to better understand the disease and to develop management strategies for controlling the disease.

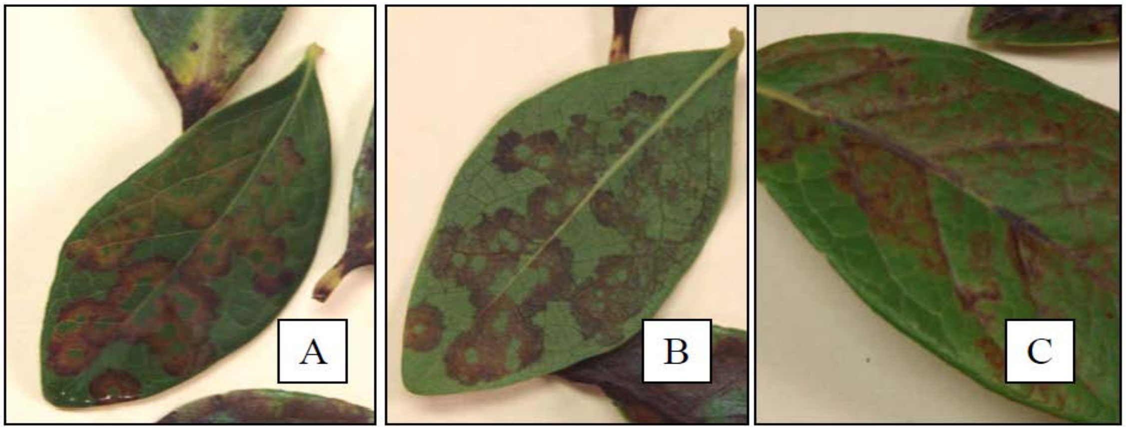

Figure 1. Symptoms of BNRB are visible on the top (A) and bottom (B) surfaces of the leaf. A variant of this symptom, often observed on the same plant, is a greasy or oily appearance on the leaves, which greatly resembles a chemical burn injury (C).

Recently, an eriophyid mite was identified in both Florida and Georgia that is closely associated with symptom development in the greenhouse and field (Fig. 2). It is a presumptive vector of the virus. Tissue-cultured plants, free of virus, have obtained the virus within a short period of time in both the greenhouse and field when the mites are present – guilt by association. Definitive transmission studies have not yet been conducted, but the need for field management is immediate. As such, we proposed that field trials be conducted to determine whether mite management would result in less BNRBV disease symptoms and subsequent plant health reduction.

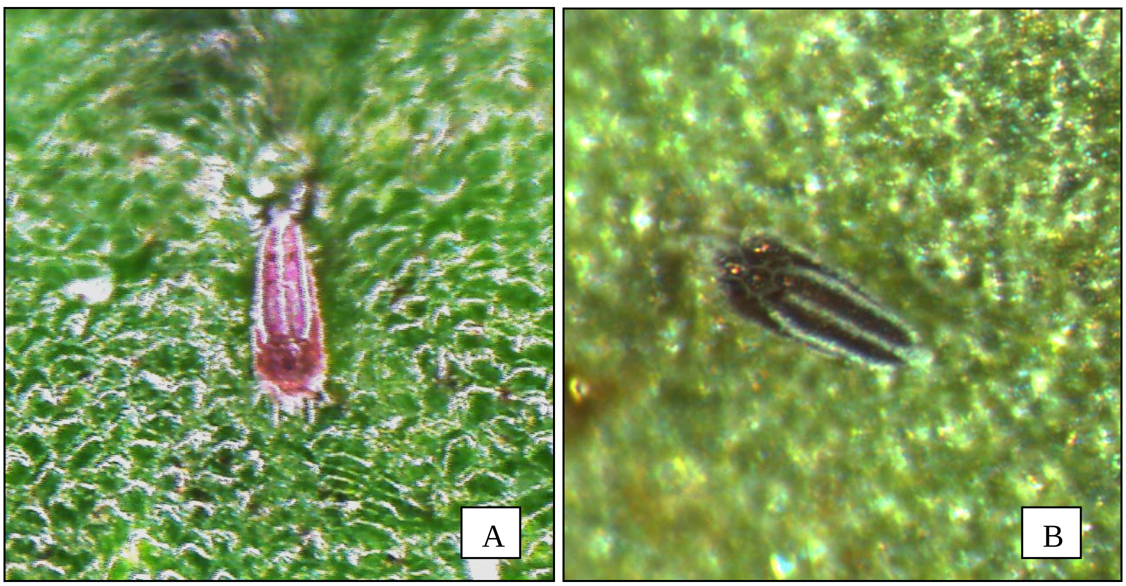

Figure 2. The eriophyid mite shown above has been found in Georgia (A) and Florida (B) in association with blueberry necrotic ring blotch virus infected plants. It is a presumptive vector of the virus, and to date, it has not been identified to species.

<u>Materials and Methods</u>: Seven field sites with a history of severe BNRBV epidemics were selected from multiple counties (Appling, Bacon, Berrien, Brantley and Ware). Treatments were applied to randomized pairs; treatments were untreated (grower standard insecticides) and treated with mite-management materials applied to large blocks (~1 acre minimum). Disease incidence and severity were assessed in July and September. The mite spray program utilized three chemicals with purported eriophyid mite activity: Hero EW**, (**Bifenthrin + Zeta-Cypermetrin, FMC Corp.), Malathion 57% **(**Malathion, Cheminova, Inc.), and Admire Pro **(**Imidacloprid, Bayer CropScience). Producers were instructed to use insecticides other than the 4 chemicals selected if possible for control of blueberry maggot, spotted-wing drosophila, etc. when spraying untreated plots for this trial. Weekly applications of the treatments were started at post-bloom on split plots of the southern highbush variety 'Star' and were continued as per the spray guidelines presented in Table 1.

Table 1. Producer guidelines for applications of insecticides with mite activity.

Week	Treatment	Rates
1	**Malathion 57%**	2 pints/Acre
2	**Hero EW**	11.2 oz./Acre
3	**Malathion 57%**	2 pints/Acre
4	**Hero EW**	11.2 oz./Acre
5	**Malathion 57%**	2 pints/Acre
6	**Hero EW**	11.2 oz./Acre

Results and Discussion: Though sites were selected based on severe disease levels observed in 2012 (see notes in Table 2), only one site had significant disease levels in 2013 (Table 2; site 6), and disease levels were significant on the organic portion of the trial only. All other sites developed either low or no disease. There are two possible reasons for the lack of disease development: (1) environmental conditions that impacted the host, virus and/or vector, and (2) the sheer number and types of insecticides and number of applications applied to all blueberries, including the producer standard. We have noted that the disease is not as prevalent in wet years, and 2013 was one of wettest observed in the last 100 years. Therefore, this could have contributed to the low levels of disease observed. However, significant disease levels were observed in site number 6, which also experienced intense rainfall conditions. As one will note from the insecticides that were applied to the producer checks, producers utilized many of the same active ingredients that were applied in our test plots; this was in large part due to the need to control spotted-wing drosophila (SWD). The impact of this insect on BNRBV incited disease may be important, as secondary management of mites may be instrumental to reduction in BNRBV.

Any statistical analysis with the collected data would be futile due to the confounding aspects of producer applications, but anecdotal evidence indicates a substantive difference in disease levels, and this may be based on insecticide applications. The results from the organic site were particularly compelling, since the nonorganic side of the field was sprayed with our insecticides, while the organic side did not have these same materials applied; the level of disease developed rapidly in the organic plot (Fig. 3), whereas no disease was observed with our program. In addition, a substantial infestation of *Brevipalpus* spp. mites were observed in association with the BNRBV infected plants (Fig. 4); this is a new find in Georgia blueberries, and this mite is known to transmit *citrus leprosis virus*, a virus that is related to BNRBV. As a side-by-side comparison, this site provided good evidence that use of certain insecticides will have a likely influence on BNRBV; with the intense use of insecticides for management of SWD, insect and/or mite vectored diseases, such as is the likely case with BNRBV, will be impacted as well. As with BNRBV, blueberry leaf scorch, which is vectored by leaf hoppers, may also be reduced in importance; over the last two years, this disease has decreased substantially, and this might be in part related to an increase in insecticide use against SWD.

As a result of this research, we cannot definitively conclude that insecticide or miticide use will decrease BNRBV through management of the vectors, but the information gained does support the premise that this may be the case.

Table 2. Disease results by site and treatment.

Site	BNRBV Symptoms (Incidence %) 7/13/2013		BNRBV Symptoms (Incidence %) 9/11/2013		Notes	Insecticides applied to the producer check
	Untreated	Mite Control	Untreated	Mite Control		
1	Trace	0	Trace	Trace	Occasional symptom on a leaf or two. Usually a single spot found in a long stretch of the row. Pressure has been strong in some years.	Malathion; Mustang Max (Zeta-Cypermethrin)
2	0	0	0	0	Tremendous pressure in the past.	Hero (Zeta-Cypermethrin + Bifenthrin), Malathion
3	0	0	0	0	Extreme pressure last year, "looked like Paraquat damage on the 'Stars'."	Malathion,Spintor (Spinosad) , Mustang Max (Zeta-Cypermethrin), Alias (Imidochloprid),
4	Trace	Trace	10	10	Producer was considering removing 'Star' plants after damage last year. Occasional damage on 1-10 leaves.	Unknown
5	0	0	0	0	Strong pressure in the past.	Malathion, Danitol (Fenpropathrin), Delegate (Spinetoram), Spintor (Spinosad)
6	10-20	0	50	0	Untreated is organic (directly next to a non-organic which is the mite treated). Initial infections found only on older leaves (prior to hedging; infection likely occurred prior to June. Very compelling evidence of impact of the value of miticides. Additional infections observed on second site visit.	Entrust (Spinosad) and Pyganic (Pyrethrins)
7	0	0	0	0	No disease observed	Unknown

Figure 3. Blueberry necrotic ring blotch virus symptoms. These severe viral symptoms were observed in an organic blueberry production site. An adjacent site was treated with insecticides that have purported activity against eriophyid mites, and no disease was observed. The sites are separated by an open distance of ~50 yards.

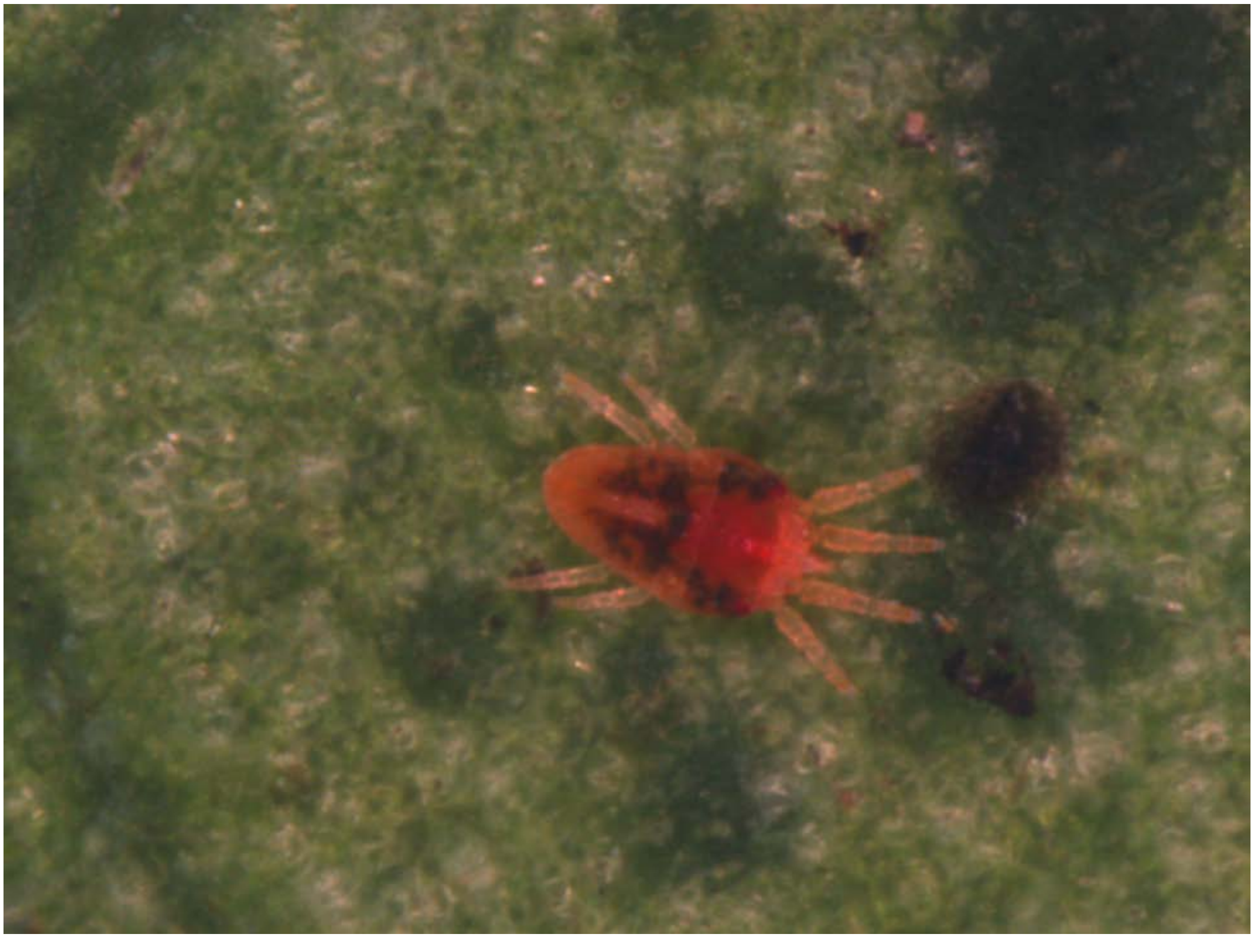

Figure 4. Brevipalpus spp. mites found in association with BNRBV infected plants. In addition to eriophyid mites, this is another potential vector of BNRBV, since it is a known vector of *citrus leprosis virus*, a virus which is related to BNRBV.

Conclusions: As a result of this research, we cannot definitively conclude that insecticide or miticide use will decrease BNRBV through management of the vectors, but the information gained does support the premise that this may be the case.

Impact Statement: The objectives of this stude were to: (1) Determine whether mite management programs will reduce the level of blueberry necrotic ring blotch virus (BNRBV) observed in southern highbush blueberry plantings, and (2) indirectly test the premise that eriophyid mites are vectors of a virus that causes BNRBV. The blueberry industry in Georgia, Florida, North Carolina, South Carolina and other southeastern states has experienced considerable growth during the past 30 years due to improved cultivars and marketing opportunities. This expansion will likely continue in the near future, since consumer demand has increased due to the widely publicized health benefits of blueberries, and producers are seeking alternatives to traditional crops that have become less profitable, such as tobacco and citrus. As a result of this research, we cannot definitively conclude that insecticide use will decrease BNRBV through management of the vectors, but the information gained does support the premise that this may be the case. Where insecticides with purported mite activity were applied, the disease was reduced substantially over levels observed in the previous growing season. In addition, a substantial infestation of *Brevipalpus* spp. mites were observed in association with the BNRBV infected plants; this is a new find in Georgia blueberries, and this mite is known to transmit *citrus leprosis virus*, a related virus to BNRBV.

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