

**TITLE:** Occurrence of white pine blister rust on cultivated “resistant” varieties of *Ribes* species and the impact to local white pine resources

**LOCATION:** New Hampshire (with implications to all regions with cultivated *Ribes*)

**DATE:** September 2012

**DURATION:** FY 2013 **FUNDING SOURCE:** Base

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**PROJECT OBJECTIVES:** (i) Evaluate incidence and severity of white pine blister rust (WPBR) on cultivated resistant *Ribes* varieties.

(ii) Determine incidence and severity and white pine blister rust on neighboring eastern white pine and wild *Ribes* species.

(iii) Verify presence of WPBR with DNA-based molecular diagnosis techniques.

#### **JUSTIFICATION:**

**a. Linkage to FHM program.** In 1996-98 an FHM “focus funding” project supported a survey to quantify WPBR incidence in New Hampshire as part of a statewide analysis to determine whether to maintain or modify the State’s quarantine all *Ribes* species planting. Results showed very low (0.3-7.2% per county) WPBR rust incidence statewide and helped guide officials to allow the planting of several resistant *Ribes* varieties. Results from a 2012 preliminary survey indicate that these resistant varieties are potentially infected with WPBR (Figs. 1-3) and a complete survey of these plantings and the impact on local white pine forests is needed.

**b. Significance/Impact of forest health issue.** The breakdown in of WPBR immunity in cultivated *Ribes* could have potential deleterious effects on the white pine resource. Increased cultivation of currants no longer immune to WPBR can increase the risks of WPBR by increasing spore loads, spreading more virulent races of the pathogen, or facilitating the development of new *C. ribicola* race (3). WPBR was the most significant forest damage causing agent in New Hampshire for more than 60 years. From 1917 to 1970 millions of man hours were spent eradicating *Ribes* throughout the state to protect the white pine timber industry. It was not uncommon to find stands of pine with infection levels above 50%. White pine is still the most economically important timber species in New Hampshire. New Hampshire is 84% forested and the forests are estimated to provide 4.9 billion dollars to the state economy annually from timber and recreation combined. White pine is the most important and abundant of the timber species helping to contribute these dollars. White pine timber volumes are estimated at 1.9 billion cubic feet statewide and this is 30% higher than the next closest species group. It’s also critically important to note that 90% of this volume of timber is owned by private landowners

with modest sized parcels. Any pine health issues contributing to a decline of volume or value would be both economically and socially detrimental to all of New Hampshire's forest-centric society.

**c. Scientific basis.** Our collaborative team has extensive experience conducting field surveys and diagnosing WPBR on *Ribes* (1). In addition, preliminary data has been generated from a pilot study conducted in 2012 (Fig. 1). Consequently, because of our collective experience we are positioned well to successfully complete all aspects of the project.

**d. Cost/Economic efficiency.** If this project is carried out *Ribes* varieties that have overcome immunity will be identified and the impact to the white pine resource will be assessed. To accomplish these objectives, modest funds (\$18,611 total) are requested to cover cost of field surveys and PCR diagnoses. Products resulting from this project will be management guidelines, WPBR distribution maps, extension and research publications, and data that may be used by States to assess current status of *Ribes* quarantines. Implications of these results might affect both forestry and agricultural industries. Consequently the cost of this project is minimal in comparison to the benefits obtained.

**e. Priority Issues.** By sampling *Ribes* during two consecutive years (one year of sampling has already been completed) we will determine if the 2012 WPBR epidemic on *Ribes* was favored by **unusual weather events**. This year's warm and humid spring has favored many rust diseases including ash rust, apple-cedar rust, and WPBR. Data obtained in this project will be used to **validate or fill data gaps in insect & disease risk models**. Although the breakdown in WPBR immunity on *Ribes nigrum* cv Titania has been reported recently (1), the impact of this breakdown in immunity on native white pines has not been assessed. The ability of WPBR to cause widespread **tree mortality** had been extensively documented (2).

## **DESCRIPTION:**

### **a. Background:**

White pine blister rust has been a threat to both forest resources and agricultural commodities since its introduction in the early 1900s to eastern North America (2, 3). Since the enactment of the Federal Plant Quarantine Act in the early 1900s, the interstate movement of *Ribes* was controlled to limit the incidence of WPBR. After the lifting of the Federal quarantine and the more recent availability of developed resistant varieties of black currants and gooseberries, States in the Northeast have amended or eliminated their restrictions, in part to allow for commercial plantings and homeowner requests. The restrictions vary as some relate to the varieties of *Ribes* and others also to location. New Hampshire currently allows the planting of designated resistant varieties after obtaining a permit. New York allows planting of resistant varieties with a certification and also non-resistant varieties in certain areas of the State. Rhode Island and Massachusetts prohibit black currants and allow certain other species with a permit, while Massachusetts also prohibits all import to specific municipalities. Maine continues to ban the planting of *Ribes* in designated areas and prohibits black currants Statewide. There are also specific restrictions in New Jersey, Delaware, and West Virginia; however, no quarantines are currently in place regarding *Ribes* plants in Vermont, Pennsylvania, or Connecticut. States could change these various quarantines if there is evidence that certified resistant varieties are found to be infected.

There is evidence that abundance of susceptible *Ribes* leads to greater risk of WPBR mortality. In Maine, 70 years of *Ribes* eradication program resulted in a consistent difference in WPBR disease incidence on white pine between treated and untreated areas (4). *Ribes* eradication program resulted in 50% reduction in WPBR infected trees in treated areas. In untreated areas, 50% of white pine mortality was caused by WPBR compared to 14% in treated areas (4).

**b. Methods:**

Ribes survey: New Hampshire residents who wish to plant approved resistant *Ribes* must submit a permit (<http://www.nhdf.org/forest-health/white-pine-blister.aspx>). The website also lists the resistant *Ribes* varieties that can be planted in New Hampshire. The State of New Hampshire maintains these records and consequently has a database of sites where *Ribes* have been planted. Approximately 25% of the 100 sites statewide were visited during a preliminary survey in 2012. A subset of these sites will be revisited in late July-early September of 2013 when WPBR telia develop. Site selection will be stratified by county, size of *Ribes* planting, and number of *Ribes* varieties. At least 10 sites per county will be surveyed. At each site, WPBR incidence and severity will be assessed up to 5 plants per variety. Severity ratings will include crown defoliation and a measure of the degree of damage per leaf which will be estimated by obtaining a subsample of 5 leaves per plant. Heavily infected leaves of each variety of the 15 *Ribes* varieties will be collected for PCR analyses. During these surveys, an area of up to 1000 ft surrounding the cultivated *Ribes* will be scouted for presence of wild *Ribes*, eastern white pine, and symptoms of WPBR. Distance and direction to nearest white pines will be recorded. If during this scouting effort wild *Ribes* are found, the same methods will be used to assess WPBR incidence and severity in these plants as for cultivated *Ribes*.

Eastern white pine survey: A subset of sites where white pine was spotted growing next to cultivated *Ribes* during 2013 will be surveyed in May-July of 2014, when aecia are most visible. WPBR incidence and severity will be recorded for trees with symptoms of WPBR or in the absence of symptoms, in the nearest stand adjacent to cultivated *Ribes*. To obtain data for pine stands closest to cultivated *Ribes*, a 20 BAF prism will be used to select sample trees.

PCR diagnostics: Samples will be collected from each of the approved resistant *Ribes* varieties and wild *Ribes* species found in the vicinity of cultivated *Ribes*. Up to 5 samples per variety or species will be collected, bagged, labeled, and kept cool until shipment. Each sample will consist of 10 infected leaves per *Ribes* plant. Samples will be FedExed to Cornell for PCR diagnoses where samples will be processed as described by Frederick (2011).

**c. Products:**

- 1) Confirmation in breakdown of WPBR immunity in *R. nigrum* vc. *Titania* and other resistant *Ribes* varieties
- 2) First assessment of the impact of WPBR on eastern white pine after the breakdown of resistant *Ribes* immunity to WPBR
- 3) Maps of current cultivated *Ribes* distribution, and current WPBR distribution in cultivated *Ribes* and adjacent white pines and wild *Ribes* in New Hampshire.
- 4) Management guidelines for *Ribes* and white pine.
- 5) Pest alert, final report, extension publications, and peer-reviewed journal publications.
- 6) Presentations in FHM meeting, forestry, and agricultural professional meetings.

d. Schedule of Activities:	Year	Season	2013				2014		
			Jan	May	July	Sept	Jan	May	July
<b>Activity</b>									
Notify land owners & plan field season			_____				_____		
Survey <i>Ribes</i> sites collect samples					_____				
PCR analyses					_____				
Survey pines and wild <i>Ribes</i> adjacent to cultivated <i>Ribes</i> sites with WPBR							_____		
Data analyses, progress report, & publications							_____		

**e. Progress/Accomplishments:** A preliminary survey was conducted during 2012 during which 23 sites were visited. Signs and symptoms of WPBR were observed in most sites. Symptomatic *Ribes* leaves were collected at the sites and inspected by the Plant Disease Diagnostic Lab in the University of New Hampshire. Samples from several *Ribes* varieties were sent to Cornell for PCR diagnoses. Samples of gooseberry 'Clark' and black currants 'Consort' and 'Willoughby' were positive for *C. ribicola*.

**f. Relevant Citations:**

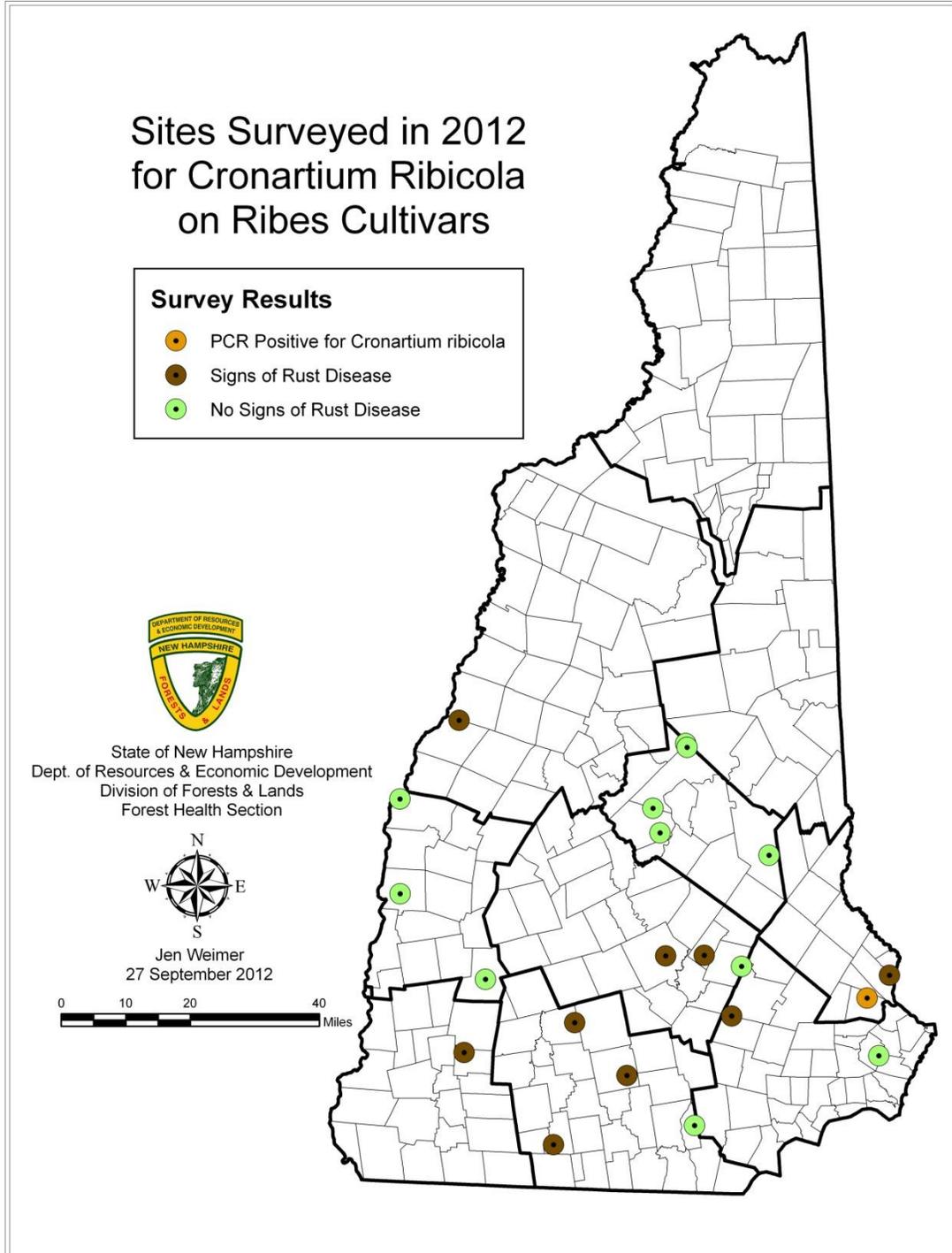
1. Frederick, Z. A., Los, L., Allen, J., and Cox, K. 2011. First report of white pine blister rust caused by *Cronartium ribicola* on immune black currant *Ribes nigrum* cv. Titania in Preston, Connecticut. Plant Disease.
2. Geils, B. W., Hummer, K. E., and Hunt, R. S. 2010. White pines, *Ribes*, and blister rust: a review and synthesis. Forest Pathology 40:147-185.
3. Muir, J. A., and Hunt, R. S. 2000. Assessing potential risks of white pine blister rust on western white pine from increased cultivation of currants. HortTechnology 10:523-527.
4. Ostrofsky, W. D., Rumpf, T., Struble, D., and Bradbury, R. 1988. Incidence of white pine blister rust in Maine after 70 years of *Ribes* eradication program. Plant Disease 72:967-970.

**COSTS:**

Categories	EM Request	Cooperator's Share	Total
Personnel	\$8,000	\$ 18,611	\$23,429
Fringe benefits	\$500		\$500
Equipment	\$1,000		\$1,000
Supplies/Materials	0		
Contract Services	\$8,000		\$8,000
Other (Audit Fund)	\$186		\$186
Indirect Costs	\$925		\$925
<b>Total:</b>	<b>\$18,611</b>	<b>\$18,611</b>	<b>\$18,611</b>

**APPENDIX**

**Figure 1.** Map of sites with cultivated *Ribes* surveyed in 2012 indicating sites containing *Ribes* with signs of rust and with positive PCR confirmation of *Cronartium ribicola*.



**Figure 2.** Eastern white pine (A) adjacent to cultivated *Ribes* with WPBR signs (B & C).



**Figure 3.** Eastern white pine sapling with WPBR symptoms growing next to cultivated *Ribes*.

