The Effect of Pruning on Blueberry Stem Gall Wasp

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SUMMARY. The influence of commercial pruning regimes on the survival of wasps inhabiting stem galls of lowbush blueberry (*Vaccinium angustifolium* Ait.) was studied in 1999 and 2000. Three commercial fields in Nova Scotia were used to examine the effect of mow pruning on wasp survival. Galls were removed from blueberry stems in fall 1999 and placed either above or within the leaf litter in a small blueberry plot or held at 2°C over the winter. Another group of galls was collected in spring 2000 from within and above leaf litter. Wasp emergence was not

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affected by any treatment showing that mow pruning has no effect on wasp survival. In a second study, mowing was compared to mowing plus burning in either fall or spring. Burning did not affect gall number, but did affect wasp emergence. The poorest emergence from galls was seen in spring burning and those burnt in the fall had lower emergence than from galls that were only mowed. Thus, a spring burn is recommended if growers are concerned about stem gall populations in their fields.

KEYWORDS. Blueberry stem gall, *Hemadas nubilipennis*, lowbush blueberry, *Vaccinium angustifolium*, pruning, cultural control

INTRODUCTION

Galls, abnormal plant tissue growth, on the stems of wild blueberry (*Vaccinium angustifolium* Aiton) are caused by a small wasp, the blueberry stem gall wasp (Hymenoptera, Chalcidoidea, Pteromalidae, *Hemadas nubilipennis* Ashmead) (Shorthouse et al., 1986). Some six other species of chalcid wasps, which may be inquilines or parasitoids, also have been found inhabiting the galls (Brooks, 1993; Driggers, 1927; Hayman, 1998; McAlister and Anderson, 1932; Shorthouse et al., 1990).

Within wild blueberry fields in Nova Scotia, stem gall numbers appear to be increasing possibly due to changes in management strategies (MacKenzie, unpublished data). While growers are concerned that high levels of stem galls may reduce crop yields, the biggest problem with galls is that they have been found to contaminate both fresh and processed product. Even though concerns have been raised about gall populations, no control tactics have been developed for this insect (Crozier, 1997). Lowbush blueberry crop management involves a two-year cropping cycle. After harvest the fields are pruned by either mowing or burning to encourage vegetative growth the following year (McIsaac, 1997). While it has been suggested that pruning may reduce the numbers of stem galls by affecting blueberry stem gall wasp survival (Crozier, 1997), the issue has never been scientifically examined. This study was set up to determine if pruning reduces the survival of wasps inhabiting blueberry stem galls.

MATERIALS AND METHODS

Removal of galls from stems. This study was done in three commercial fields in Nova Scotia. Thirty galls, collected from each field on 5 October 1999, were randomly divided into three groups. These were (1) held at 2°C, or put into mesh bags and placed (2) above or (3) within the leaf litter of a wild blueberry plot located in Kentville, Nova Scotia. On 4 May 2000, 10 galls from within and from above the leaf litter were collected from the three fields. The five treatment groups were then incubated at 21°C, 50%RH and constant fluorescent light with an average photosynthetic photon flux of 72.3 ± 3.6 μmoles $m^{-2}s^{-1}$. All emerged wasps were removed from cups daily. The wasps were identified to species. After emergence was completed the galls were dissected and all dead inhabitants counted.

For each field, the proportion of emerged wasps that were blueberry stem gall wasps was calculated. To examine the effects of treatment on wasp survival (includes all wasp species), survival [(emerged + 0.5)/(total − emerged + 0.5)] was log transformed and subjected to a one-way ANOVA. Means were then back transformed.

Pruning technique. Five commercial fields in Nova Scotia were used for this study. After commercial mow pruning was completed in October 1999, the experiment was set up. Six parallel 100-meter transects each separated by 7 m were staked off, and two of these were randomly assigned to each of three treatments: mow only, mow and fall burn, and mow and spring burn. A small diesel-fueled plot burner was used to apply the burn treatments with fall burning done in November and December 1999, and spring burning in April 2000.

In May 2000, all galls above and within the leaf litter in a 0.5 m^2 quadrat were collected at five meter intervals along each transect. One randomly selected gall formed in 1999 from each quadrat where galls were present was incubated and evaluated as described above with the exception that emerged wasps were removed weekly rather than daily.

The effect of treatment on the total number of stem galls per quadrat were tested using a split plot ANOVA. For each field, the proportion of emerged wasps that were blueberry stem gall wasps was calculated. Data analyses was the same as the previous section except that a split plot ANOVA was performed.

RESULTS AND DISCUSSION

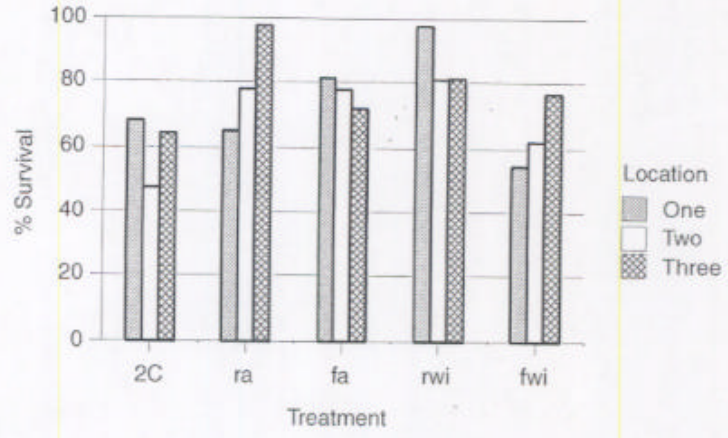
Removal of galls from stems. It was common for more than one species to emerge from a single gall with a total of six species (*H.*

nubilipennis, *Eurytoma solenozopheriae* Ashmead, *Sycophila vacciniicola* Balduf, *Orymus vacciniicola* Ashmead, *Eupelmus vesicularis* Ritzius and an unidentified species of *Pteromalus*) present in this study. Blueberry stem gall wasps emerged from 46%, 26%, and 28% of the incubated galls from the three sites. In terms of community structure, blueberry stem gall wasps made up 27%, 15%, and 17% of all wasps in the three sites, respectively.

Wasp survival was significantly affected by treatment ($p < 0.05$) (Figure 1). The poorest survival was seen in galls that were held at 2°C and greatest survival was from galls wintered at Kentville within the leaf litter. Emergence was high in this study at 80% for galls wintered in the field plot at Kentville and 70% for those wintered in the fields. Differences in survival are likely due to climatic conditions as Kentville has milder winter temperatures than the commercial blueberry fields. This work shows that removal of galls by mow pruning is likely to have little affect on Blueberry stem gall wasp populations.

Pruning technique. The six species of chalcid wasps mentioned

FIGURE 1. The effect of gall removal from lowbush blueberry stems on survival of wasps inhabiting blueberry stem galls. Treatments are designated as follows: 2C–removed from stems in fall and held at 2°C over winter, ra–removed from stems in fall and placed in field above the leaf litter at Kentville, N.S., rwi–removed from stems in fall and placed in field within the leaf litter at Kentville, N.S., fa–wintered in field above leaf litter, and fwi–wintered in field below leaf litter.

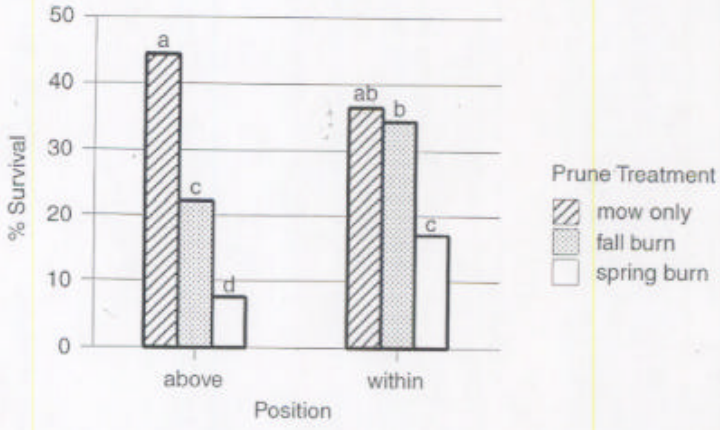


above were also collected in this study. In the five fields, the Blueberry stem gall wasp made up 24%, 27%, 28%, 51%, and 70% of the wasps that emerged from the incubated galls. Differences in co-inhabitant levels as large as this suggest that parasitoids may be involved in regulating Blueberry stem gall wasp populations and it would be interesting to further examine this issue.

There were no significant differences in the effect of treatments in the five fields, and thus, data was pooled for analysis. The total number of galls was similar for the three pruning treatments indicating that the burning treatment did not physically destroy galls. Wasp survival was greatest in the mowed only plots, with fall burning intermediate and spring burning showing the lowest survivor rates ($p < 0.05$) (Figure 2). Galls above the leaf litter tended to have poorer survival than those within it.

The wasp community associated with mature blueberry stem galls from this study is similar to that seen in other research. Similar species were reared from galls collected from *V. angustifolium*, *V. atrococcum* (Gray), and *V. corymbosum* L. (Brooks, 1993; Hayman, 1998; Judd, 1959; McAlister and Anderson; 1932, Shorthouse et al., 1990). Except for two fields where it dominated, *H. nublipennis* made up a small proportion of the wasps emerging from galls in this study. Similar high

FIGURE 2. The effect of pruning method on survival of wasps inhabiting blueberry stem galls. For each prune treatment and position, letters above the bars indicate statistically significant differences in means ($p < 0.05$).



parasitism was seen by Shorthouse et al. (1990). They felt that the parasitoids delay their development until after blueberry stem gall wasp larvae have almost completed development and the gall is near maturity. Thus, although parasitoids may influence stem gall populations in the future by reducing gall wasp populations, the presence of galls that contaminate the berries could still remain a problem.

The removal of galls from stems in the fall had no effect on survival as compared to galls removed from the plant the following spring. Blueberry stem gall wasp larvae mature in mid-August and survive the winter as prepupae (West and Shorthouse, 1989). Thus, this insect has reached the prepupal wintering stage well before the time of fall pruning and is able to survive removal from the plants. Burning reduced survival as compared to mowing. This was an effect of high temperature as wasps in galls within the leaf litter had better survival than those on the top of the litter that were directly exposed to the burn. Other work has also found that insects living within or near the ground are not as affected by fire as those in the above ground vegetation (Seastedt and Reddy, 1991). While the switch to mow pruning has been on-going within the lowbush blueberry industry due to better land-leveling and the higher costs of burning (Kinsman, 1993), it now appears that other problems such as increasing numbers of blueberry stem galls could be exacerbated by this management change. Other benefits of the use of a burn prune every three or four production cycles could include reductions in other insect pests such as blueberry leaftier (Ponder and Seabrook, 1994) and blueberry spanworm (DeGomez et al., 1990), and some diseases and weeds (DeGomez et al., 1990).

CONCLUSIONS

This research has shown that the survival of wasps inhabiting blueberry stem galls is not affected by the removal of galls from the stem by mow pruning in the fall. The pruning practice of burning, especially in the spring, significantly reduced wasp survival. However, the fact that the number of galls was not affected means that the temperatures reached above and within the leaf litter by burning was sufficient to kill the insects without destroying gall tissues. It is recommended that lowbush blueberry producers consider burn pruning as a pest management strategy for the management of blueberry stem gall populations.

GROWER BENEFITS

Lowbush blueberry growers have concern about the number of blueberry stem galls within their fields. This research shows that it is possible to reduce gall wasp populations by using a spring burn for pruning. Growers should monitor populations within their fields, and if levels are of concern, they should plan their pruning treatments accordingly.

LITERATURE CITED

Brooks, S. 1993. Geographic variation of the parasitoid complex associated with galls induced by *Hemadas nubilipennis* (Hymenoptera: Pteromalidae). Honours Thesis, Laurentian Univ., Sudbury, Ont.

Crozier, L. 1997. The blueberry stem gall. Lowbush blueberry fact sheet. N.S. Dept. Agric. Mktg., Truro, N.S.

DeGomez, T., D. H. Lambert, H. Y. Forsythe, Jr., and J. A. Collins. 1990. The influence of pruning methods on disease and insect control. Wild blueberry fact sheet No. 218. Univ. Maine Coop. Ext., Orono, Maine.

Driggers, B. F. 1927. Galls on stems of cultivated blueberry (*Vaccinium corymbosum*) caused by a chalcidoid, *Hemadas nubilipennis* Ashmead. J. N. Y. Entomol. Soc. 34:253-259.

Hayman, D. I. 1998. Species composition, development and dispersal of wasps in lowbush blueberry stem galls. Thesis for the Certificate of Honours Equivalency. Saint Mary's Univ., Halifax, N.S.

Judd, W. W. 1959. Studies of the Byron bog in southwestern Ontario. vii. Wasps reared from the blueberry stem gall on *Vaccinium atrococcum*. Trans. Amer. Microsc. Soc. 78:212-214.

Kinsman, G. 1993. The history of the lowbush blueberry industry in Nova Scotia: 1950-1990. Blueberry Producer's Assoc. N.S., N.S. Dept. Agric. Mktg., Truro, N.S.

McAlister, L. C. and W. H. Anderson. 1932. The blueberry stem gall in Maine. J. Econ. Entomol. 25:1164-1169.

McIsaac, D. 1997. Growing wild blueberries in Nova Scotia. Lowbush blueberry fact sheet, N.S. Dept. Agric. Mktg., Truro, N.S.

Ponder, B. M. and W. P. Seabrook. 1994. The effect of pruning of *Vaccinium angustifolium* on the *Croesia curvalana* larval population. J. Small Fruit Viticul. 2(2):57-64.

Seastedt, T. R. and M. V. Reddy. 1991. Fire, mowing and insecticide effects on soil Sternorrhyncha (Homoptera) densities in tall-grass prairie. J. Kansas Entomol. Soc. 64:238-242.

Shorthouse, J. D., I. F. Mackay, and T. J. Zmijowshiyj. 1990. Role of parasitoids associated with galls induced by *Hemadas nubilipennis* (Hymneoptera: Pteromalidae) on lowbush blueberry. Environ. Entomol. 19:911-915.

Shorthouse, J. D., A. West, R. W. Landry, and P.D. Thibideau. 1986. Structural damage by female *Hemadas nubilipennis* (Hymenoptera: Pteromalidae) as a factor in gall induction on lowbush blueberry. Can. Entomol. 118:249-254.

West, A. and J. D. Shorthouse. 1989. Initiation and development of the stem gall induced by *Hemadas nubilipennis* (Hymenoptera: Pteromalidae) on lowbush blueberry, *Vaccinium angustifolium* (Ericaceae). Can. J. Bot. 67:2187-2198.