Early Defoliation Reduces Flower Bud Counts on Rabbiteye Blueberry

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Abstract. Vigorous, upright shoots on mature *V. ashei* Reade cv. Aliceblue plants growing in a commercial field planting were used to study the effects of premature defoliation on flower bud formation. Three treatments (total shoot defoliation, alternate-node defoliation, and no defoliation) were applied on each of three dates (20 Aug., 17 Sept., and 15 Oct. 1987). For the August defoliation, the number of flower buds present per shoot on 6 Jan. of the following year averaged 1.3 for shoots that were totally defoliated, 3.7 for shoots on which alternate nodes had been defoliated, and 4.2 for control (nondefoliated) shoots. Shoots treated on 17 Sept. averaged 2.6 buds per shoot for total defoliation, 4.1 for alternate-node defoliation, and 4.8 for controls. Defoliation on 15 Oct. did not reduce flower bud formation. Reduction in flower bud formation due to defoliation was localized at the defoliated nodes. For shoots on which alternate nodes were defoliated on 20 Aug., 59.8% of the apical five nodes that were not defoliated produced flower buds compared with 1.4% of the defoliated nodes.

Mature rabbiteye blueberry plants in North Florida often are partially defoliated months before the first killing freeze, which normally occurs in late November. Defoliation is most extensive on plants that have not been pruned, are being fertilized at low rates, or are growing on marginal soils. Florida's long growing season, frequent summer rains, and long periods of high humidity are conducive to defoliation by fungal pathogens. Rabbiteye cultivars vary in susceptibility to premature autumn defoliation.

Observations over several years of many rabbiteye clones in test blocks at the Univ. of Florida Horticulture Unit in Gainesville suggested that premature defoliation was associated with reduced flower bud differentiation (Lyrene, 1989). This study was designed to determine the effects of late-summer to early fall defoliation on flower bud formation on vigorous shoots of 'Aliceblue' rabbiteye blueberry.

Twenty vigorous 4-year-old 'Aliceblue' plants growing consecutively in one row of a commercial blueberry farm near Gainesville were used in the experiment. The plants ranged from 2.5 to 3.5 m tall. On 20 Aug. 1987, 288 shoots (32 blocks, nine shoots per block) were selected for use in the experiment. Vigorous shoots that had ≥ 10 leaves in the last flush and appeared to have ceased elongation were selected. Shoots within each block were selected for maximum uniformity but were not necessarily on the same plant. Only 10 of the 288 shoots had a visible flower bud at the time the shoots were selected, and each of these 10 had only a single flower bud. Little or no natural defoliation had oc-

curred by 20 Aug. on the shoots used in the experiment.

The nine shoots in each block were randomly assigned to three defoliation dates, each of which had three treatments: 1) a control, in which no leaves were removed; 2) alternate-node defoliation, in which every other leaf was removed; and 3) total shoot defoliation. In the alternate-node defoliation, the basal node on the last growth flush of the shoot was always defoliated, and alternate-node defoliation progressed toward the apex, so that the terminal node was either defoliated or not, depending on how many nodes were in the growth flush. Care was taken in defoliation that the axillary buds were not damaged. Because the plants were large and only a small fraction of the shoots on each plant were used in the experiment, <2% of the total leaves were removed from any plant by the defoliation treatments.

The three defoliation dates were 20 Aug., 17 Sept., and 15 Oct. On 2 Nov., data were collected on the 96 shoots treated on 20 Aug. so that defoliated and nondefoliated nodes could be distinguished before natural leaf drop became widespread. Each node from the apical node (node no. 1) basipetally to the 15th node from the apex (if the shoot had that many nodes) was scored for presence or absence of the leaf and presence or absence of a visible inflorescence bud. Some natural defoliation had occurred by this date (15% of the control nodes).

On 6 Jan. 1988, the number of nodes having visible inflorescence buds was counted for all shoots. Randomized complete-block analysis of variance showed the block effect to be insignificant; therefore, the experiment was analyzed as a completely random design. Percentage of flower bud initiation was compared for treatments within particular sets of nodes by χ^2 tests for proportions using Yates' correction for single-degree-of-freedom comparisons (Cochran and Cox, 1968; Steel and Torrie, 1980).

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Table 1. Number of inflorescence buds produced per blueberry shoot following three defoliation treatments applied on each of three dates.*

Defoliation	Defoliation dates ^y					
	20 Aug.		17 Sept.		15 Oct.	
	Mean	SE ^x	Mean	SE	Mean	SE
<i>Inflorescences (no.)</i>						
Total	1.3	0.17	2.6	0.24	4.5	0.27
Alternate node	3.7	0.16	4.1	0.21	5.3	0.29
None	4.2	0.20	4.8	0.31	4.8	0.37
LSD 0.05 ^w	0.5		0.7		0.9	

*Data were collected 6 Jan. 1988.

^y1987.

^xMeans and standard errors. Each mean is based on 32 observations.

^wWithin columns, means differing by more than the LSD are significantly different at $P < 0.05$.

Table 2. Percentage of nodes producing inflorescence buds on blueberry shoots of three defoliation treatments for nodes 1-5, 6-10, and 11-15.*

Node position ^z	Nodes with leaves ^x		Nodes without leaves ^x	
	No.	With flower buds	No.	With flower buds
		(%)		(%)
<i>Total defoliation^y</i>				
1-5	0	---	161	11.2
6-10	0	---	159	1.3
11-15	0	---	118	0.9
Total	0	---	438	4.8
<i>Alternate-node defoliation^y</i>				
1-5	87	59.8**	73	1.4**
6-10	71	42.3**	88	1.1**
11-15	65	20.0**	80	0.0**
Total	223	42.6**	241	0.8**
<i>No defoliation</i>				
1-5	140	48.6 ^{NS}	20	30.0 ^{NS}
6-10	145	16.6 ^{NS}	15	6.7 ^{NS}
11-15	99	5.1 ^{NS}	35	0.0 ^{NS}
Total	384	25.3**	70	10.0**

*Node 1 = apical node.

^yAll defoliation treatments administered on 20 Aug. 1987 and data collected 2 Nov. 1987.

^zOn 2 Nov.

^{NS}Within rows, the percentages differ (**, $P < 0.01$) or do not differ (^{NS}, $P > 0.05$) according to χ^2 tests for analysis of proportions calculated using Yates' correction for continuity (Cochran and Cox, 1968).

Complete defoliation of shoots on either 20 Aug. or 17 Sept. greatly reduced flower bud formation (Table 1). Shoots totally defoliated on 20 Aug. produced only 30% as many flower buds as the control shoots. Shoots totally defoliated on 17 Sept. produced only 54% as many flower buds as the controls. Defoliation on 15 Oct. had no significant effect on the number of flower buds formed.

The effect of defoliation was highly localized at specific nodes (Table 2). For the five apical nodes in the treatment in which alternate nodes were defoliated on 20 Aug., only 1.4% of the defoliated nodes produced flower buds compared with 59.8% of the nodes that were not defoliated ($\chi^2 = 58.51$; $P < 0.01$). The data for alternate-node defoliation reveal a degree of compensation in flower bud formation, in that the defoliation of some nodes increased the probability that other nodes not defoliated on the same shoot would form flower buds. For example, on shoots where alternate nodes were artificially defoliated on 20 Aug., a mean of 42.3% of nodes in positions 6 to 10 of nondefoliated

nodes had developed flower buds by 2 Nov. (Table 2). The mean for comparable nodes on shoots receiving no artificial defoliation was only 16.6% (χ^2 for the contrast = 15.45; $P < 0.01$). For nodes 11-15, twigs receiving alternate-node defoliation produced flower buds at 20.0% of the nondefoliated nodes compared with only 5.1% of the comparable nodes on twigs that had received no artificial defoliation (χ^2 for the contrast = 7.49; $P < 0.01$). Overall (nodes 1-15), alternate-node defoliation resulted in 42.6% of the nondefoliated nodes producing flower buds compared with 25.3% for comparable nodes with no artificial defoliation (χ^2 for the contrast = 18.84; $P < 0.01$).

Reducing (by defoliation) the number of flower buds formed near the shoot apex stimulated nodes farther down the stem to produce flower buds. A similar phenomenon was observed in an earlier experiment in which shoots that were pruned to remove the apical flower buds midway through the season of flower bud formation increased flower bud production below the pruning cut (Lyrene, 1984).

Short photoperiods have been shown to greatly stimulate flower bud initiation in both lowbush (*V. angustifolium* Ait.) and highbush (*V. corymbosum* L.) blueberry (Hall and Ludwig, 1961; Hall et al., 1963). At 21C in the greenhouse, for example, nine lowbush clones all initiated flower buds after 6 weeks of 11- or 13-h photoperiods, but no flower buds were formed under a 15-h photoperiod (Hall and Ludwig, 1961). With the highbush cultivars Coville, Earliblue, and Jersey, 6-week photoperiod treatments of 8, 10, or 12 h all induced numerous flower buds, whereas relatively few flower buds formed at a 14-h photoperiod (Hall et al., 1963). In the field in Nova Scotia, however, lowbush blueberry clones that ceased shoot growth were able to initiate flower buds under 16-h days in late June, suggesting that factors other than photoperiod may also affect flower bud initiation (Aalders and Hall, 1964). Darnell (1991) found that reducing the photoperiod from ≈ 11.5 to 8 h for 40 days starting 30 Sept. increased the number of flower buds formed on *V. ashei* 'Beckyblue' in Florida. The importance of short days in stimulating blueberry flower bud differentiation, especially at high temperatures, suggests that early defoliation of rabbiteye blueberry plants in Florida could reduce flower bud initiation by eliminating the receptors of the short-day stimulus. Removal of a nearby source of carbohydrates could also affect the potential of an axillary bud to be transformed into a flower bud.

In commercial rabbiteye blueberry fields in Florida, defoliation is commonly caused by leaf pathogens, usually fungal, and leaves are often damaged by disease long before they abscise. Whether a severely damaged leaf that has not yet abscised is capable of stimulating flower bud differentiation is unknown.

Premature defoliation can reduce fruit yield on rabbiteye blueberries in Florida. Early leaf drop can be reduced by the use of disease-resistant cultivars, maintenance of high soil fertility levels, control of foliar diseases with fungicides, and postharvest pruning, which promotes summer growth of new leaves and shoots. In addition, cultivars could be selected that differentiate flower buds earlier in the fall, before defoliation becomes severe.

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