Defoliation as a cold acclimation strategy for blackberry
Identifying effective defoliants of 'Ponca'

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Background

Winter temperatures are increasingly variable in western North Carolina (NC), delaying and/or reducing cold acclimation of fruit crops including blackberry. Cold injury of blackberry buds and canes reduces yield, delays fruiting, and limits the health and longevity of plantings. Applying defoliants in the fall may accelerate leaf senescence and dormancy, thereby improving cold hardiness. Incomplete defoliation of the cultivar 'Ponca' commonly observed in western NC. Prior research found that Ponca is less cold hardy than many widely grown cultivars. Potentially, leaf retention is related to cold sensitivity.

Conventional defoliants of blackberry and other fruit crops are caustic products (e.g. urea, copper chelate, and lime sulfur) that function by physical burning of leaf tissue. Foliar applied plant growth regulators (PGRs) are an alternative with potential benefits that include enhanced nitrogen remobilization and improved hardiness. Abscisic acid (ABA) has been shown to defoliate and advance cold hardiness of apple, but to our knowledge has not been evaluated on blackberry.

Objectives

- Determine main effects and interactions of a conventional defoliant and PGR on blackberry defoliation.
- Identify optimal rates and application timing of defoliant products.
- Determine the effects on leaf spectral indices as indicators of leaf senescence.
- Identify the effects of defoliation on cold hardiness, cold injury, and bud break.

Materials and Methods

- Commercial planting of mature 'Ponca' floricane-fruiting blackberry (*Rubus* L. subgenus *Rubus* Watson)
- **Experimental design**: 2x3 factorial with 5 replicate plots of 10 plants.
- **Treatments**: Urea at 0% and 10% and ABA (ProTone®, Valent BioSciences) at 0, 500, and 1000 ppm with 0.125% (v./v.) organosilicone surfactant added to all treatments.
- Foliar application on October 27 applied with a research sprayer calibrated to apply 100 gallons per acre.
- Measurements on 3 canes/plot: 1) leaf counts to determine % defoliation 2) chlorophyll fluorescence and stomatal conductance and 3) leaf spectrometry
- Measurements started 3-6 days after treatment (DAT) and continued weekly for 7 weeks plus a final leaf count at week 14.

Results

Table 1. The effects of urea and abscisic acid (ABA) on percent defoliation at 3, 20, 25, 35, 50, and 95 days after treatment (DAT) (+/-1 day). Means are the average of 3 canes per plot replicated 5 times.

Treatments	3 DAT	20 DAT	25 DAT	35 DAT	50 DAT	95 DAT
			% defoliation			
0 % urea	1.5 a[1]	3.5 b	16.9 a	32.6 a	62.2 a	90.1 a
10% urea	2.7 a	7.6 a	16.9 a	33.5 a	63.1 a	90.7 a
0 ppm ABA	2.6 a	3.0 b	5.9 c	16.8 c	49.7 b	86.0 b
500 ppm ABA	1.9 a	6.5 ab	17.5 b	35.1 b	68.2 a	91.6 ab
1000 ppm ABA	1.9 a	7.2 a	27.3 a	47.3 a	70.1 a	93.5 a
Significance[2]	*P-value*					
urea	0.22	*0.01*	0.98	0.79	0.75	0.80
ABA	0.74	*0.05*	*0.00*	*0.00*	*0.00*	*0.03*
ABA*urea	0.09	0.45	0.17	0.30	0.56	0.14

[1] Mean separation by Tukey's honestly significant difference (P = 0.05).
[2] Factor main effects and interactions by a two-way ANOVA (P = 0.05).

Results

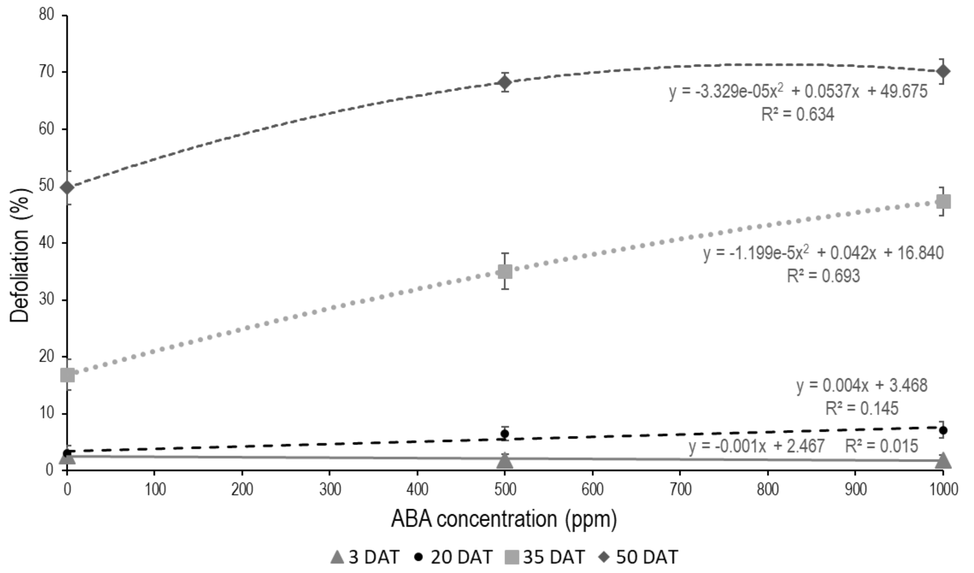

Figure 1. The relationship between percent defoliation and ABA concentration. The equation and R^2 value for the line of best fit are presented at 3, 20, and 35 and 50 days after treatment (DAT).

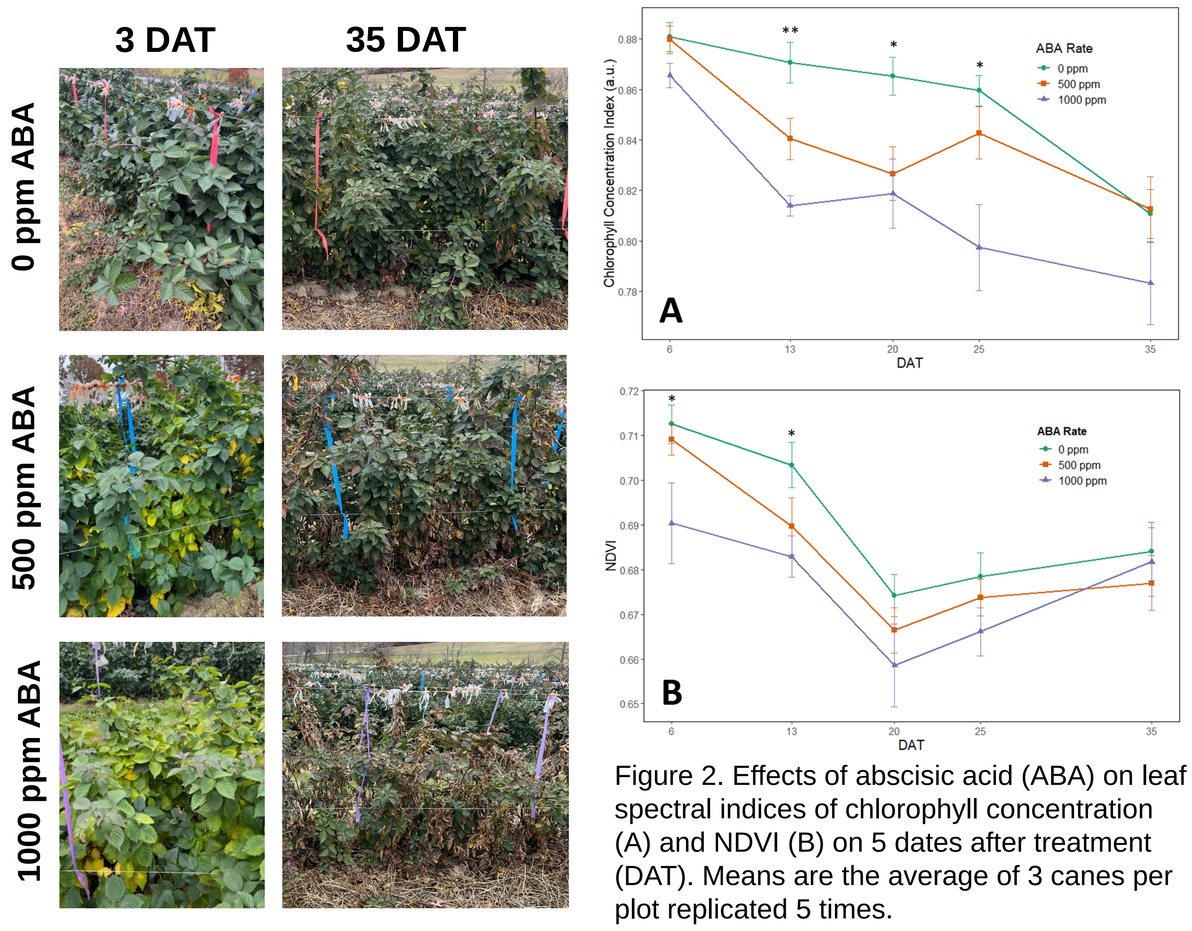

Figure 2. Effects of abscisic acid (ABA) on leaf spectral indices of chlorophyll concentration (A) and NDVI (B) on 5 dates after treatment (DAT). Means are the average of 3 canes per plot replicated 5 times.

Highlights

- ABA improved defoliation, and 100 ppm ABA increased % defoliation by 4.2 to 30.5 % advanced early leaf abscission by ~15 days relative to untreated plants.
- Urea increased defoliation at one time point (20 DAT), and there was no interaction of ABA and urea.
- A significant linear relationship between ABA rate and % defoliation occurred 20 DAT, becoming curvilinear at later time points until 50 DAT.
- For up to 30 DAT, ABA treatments reduced leaf spectral indices related to greenness, chlorophyll concentration and NDVI, suggesting that ABA advanced leaf senescence, dormancy onset, and associated cold acclimation.

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