FINAL PROJECT REPORT

Project Title: Preservation and retention of green stems

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Total Project Request: Year 1: 15,708 Year 2: 15,708

Other funding sources: None

Budget 1

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Item	**2017**	**2018**	
Salaries	10,000	10,000	
Benefits	5,708	5,708	
Wages			
Benefits			
Equipment			
Supplies			
Travel			
Miscellaneous			
Plot Fees			
Total	15,708	15,708	

OBJECTIVES

Green stems are a good indicator of freshness for the consumer and stems that are retained on the fruit have the longest postharvest life. Deficiencies in the lignification of the five major vascular bundles that supply and connect the developing ovule and flesh lead not only to losses at harvest and postharvest but also defects at the stem bowl connection which provide an opening for moisture loss or absorption and pathogen attack. Reinforcement of these bundles and those throughout the stem with silicate solutions could improve stem retention and stem quality.

SIGNIFICANT FINDINGS

- A single application at shuck fall of silicate compounds modestly increased the stem pull-force and size of sweet cherry at harvest
- Fruit retention on the tree was high for all treatments
- Stem pull-force in silicate treated fruit maintained higher stem-pull force than controls
- Stem color in silicate treated fruit was less brown after 2-4 weeks storage

METHODS

Year 2017

Four orchards, two with Lapins and two with Skeena were used. Six to seven trees near shuck fall were selected for each of four treatments. Treatment solutions (table 1) were prepared in 14 L buffered water and applied to whole trees with a backpack sprayer. Near commercial harvest, 30 spurs from each tree (30-spur method) were collected for the first assessment that included a count of fruit and fruitless stems per spur as an estimate of fruit retention on the tree. For postharvest assessment, a similar amount of spur-fruit were collected, combined among treatment trees, and stored at 1.8 °F in clamshells wrapped in plastic.

Stem-pull force was assessed with fruit at room temperature using a push/pull force gauge (DS2-11, IMADA). Fruit were weighed individually. Stem color was assessed with a chroma meter (CR 410, Konica Minolta). Fruit firmness, diameter, total acidity and soluble solids were assessed with standard procedures.

Sodium and potassium solutions were prepared to contain similar amounts of Si; however, the Ca solution is actually a suspension and the Si content was approximately 50 greater tmes than in the soluble Si solutions (Table 1.).

Methods

Year 2018

Si solutions (Table 1) were prepared and applied similarly to 2017 except CropSil was used in place of Mainstay. CropSil is highly soluble source of Si; whereas, Mainstay is a suspension combined with Ca. Up to three applications were done weekly beginning 1-week after bloom in contrast to the single application at 20 days from bloom in 2017 (Table 2).

Specific gravity was assessed by buoyancy. A basket was hung from the under-hook of a balance and the basket completely submerged in water. The balance was tared then dry cherries were place on top of the balance for the first weight. The cherries were then transferred to the basket, submerged, and weighed again. Specific gravity was determined as first weight / (first weight- second weight) at 20 °C.

New plantings (3-5 years) of Bing/K5 and Rainier/K6 as well as the same older (18yrs) Lapins as 2017 were used.

Table 1. Silicate solutions

Product	Silicate	stock (Si)	dilution	g Si per L	g or mL per 14 L	mL 250ppm KPO4 buffer per 14L
Sodium metasilicate pentahydrate	$Na_2SiO_3 \cdot 5H_2O$	212.14 g/mol	1.7 mMolar	0.0477	5.0489 g	1.4 mL
Armor SI	$K_2O \cdot SiO_2$	10%	1 mL/L	0.046743	14 mL	2.8 mL
Mainstay	$2CaO \cdot SiO_2$	22%	5 mL/L	2.337	70 ml	5 mL
CropSil	proprietary	?	1 mL/L	?	14 mL	6.3 mL

Table 2. Phenology and timing of Si sprays at MCAREC

	Lapins		Bing	Rainier	Skeena
	2017	2018	2018		
Bloom 80%	April 23	April 16	April 14	April 16	April 20
First spray	+ 20	+14	+16	+14	+10
Second spray		+21	+22	+21	+17
Third spray		+28	+30	+28	+24
maturity	+82 days	+76 days	+ 71 days	+69 days	+ 76 days

RESULTS & DISCUSSION

The two late harvest orchards, Lapins or Skeena were far lower in stem-pull force (Fig. 1) and exhibited no significant difference between treatments for stem-pull force, fruit firmness, total acidity and soluble solids (not shown); however, fruit weight was significantly greater in the late harvest orchards (Fig 1.). Among all treatments and orchards, no clear differences in fruit firmness, total acidity and soluble solids showed were observed (not shown). Fruit color was also unaffected (not shown).

In 2018 specific gravity was assessed as an indicator of fruit development and quality. Specific gravity of fruit is directly related to soluble solids, and may be a superior indicator of fruit development than size alone. The ‘lag or resting” phase of growth was clearly evident and coincided well with the pit hardening phase between 30 to 45 days from bloom. Irrigation was started late at MCAREC which affected the mature Lapins block more severely than the young planting of Bing and Rainier. The increase in specific gravity that coincides with final swelling was delayed in Lapins and overall, specific gravity was lower in these tress (fig.6).

A quality aspect of sweet cherry that is sometimes overlooked is the retention of fruit on the tree. Our assessment using a 30-spur method allows a count of fruitless stems. We hypothesized Si could ameliorate losses from the tree before or during harvest. Significant fruit losses however, typically occur in stressed conditions. The 2017 growing season was mild and we observed minimal losses, less than2%, and no differences between treatments (not shown). In 2018 loss from the tree of mature fruit was again minimal.

Stem-pull force at harvest was modestly higher in silicate treatments compared to controls in the two average harvest timing orchards in 2017 (Fig. 2). Interestingly, fruit weight was similarly affected

(Fig. 3). In 2018 no significant difference between Si treatments were observed in stem-pull force (fig. 7) nor in fruit size (fig 8); however, each Si treatment and cultivar showed improvement in fruit quality as assessed by specific gravity (fig. 9).

Stem-pull force after 1 to 3 weeks storage indicated that silicate treatments maintained higher values during storage (Fig. 4).

Stem browning after 2 and 4 weeks storage was assessed for Lapins at MCAREC (Fig. 5). Silicate treatments showed less browning (lower values) than controls.

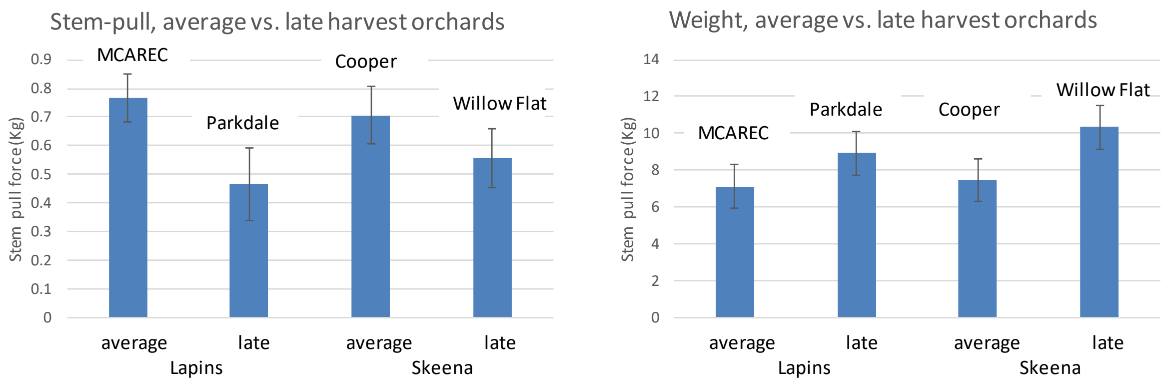


Figure 1. 2017. Lapins at MCAREC and Skeena at Cooper Barn were harvested at average timing from bloom; whereas, Lapins at Parkdale and Skeena at Willow Flat were harvested 7-10 days later. Stem pull-force was assessed with a push/pull force gauge (DS2-11, IMADA). Values are the average and standard deviation of 6-7 trees. Each tree value was the average of fruit from 30 spurs.

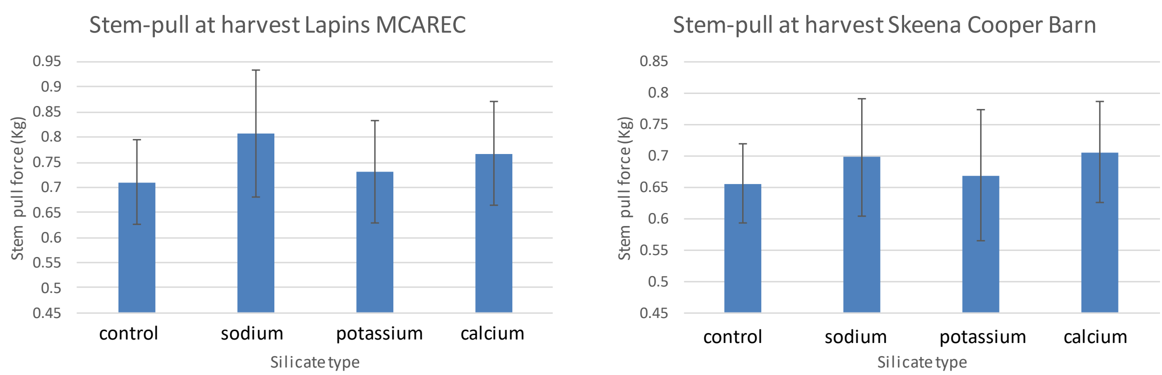


Figure 2. 2017. Stem pull-force was assessed with a push/pull force gauge (DS2-11, IMADA). Values are the average and standard deviation of 6-7 trees. Each tree value was the average of fruit from 30 spurs.

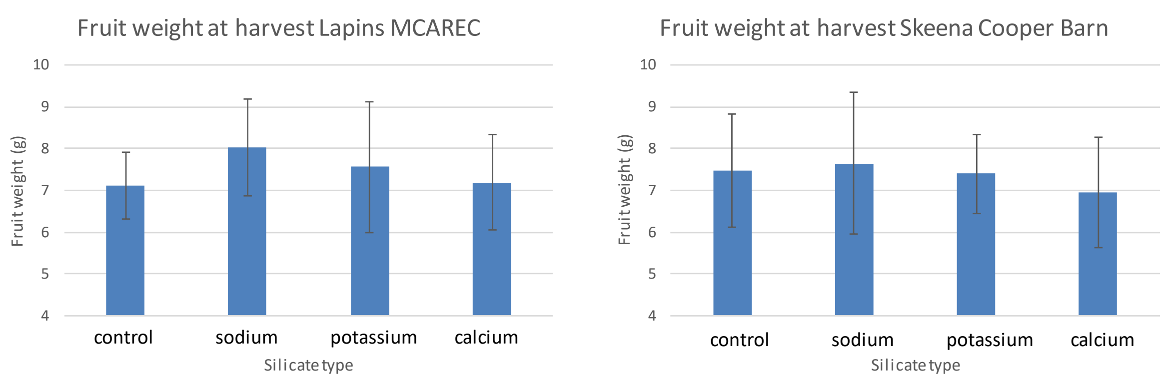


Figure 3. 2017. Individual fruit weights were obtained after the stem-pull force assessment. Values are the average and standard deviation of 6-7 trees. Each tree value was the average of fruit from 30 spurs.

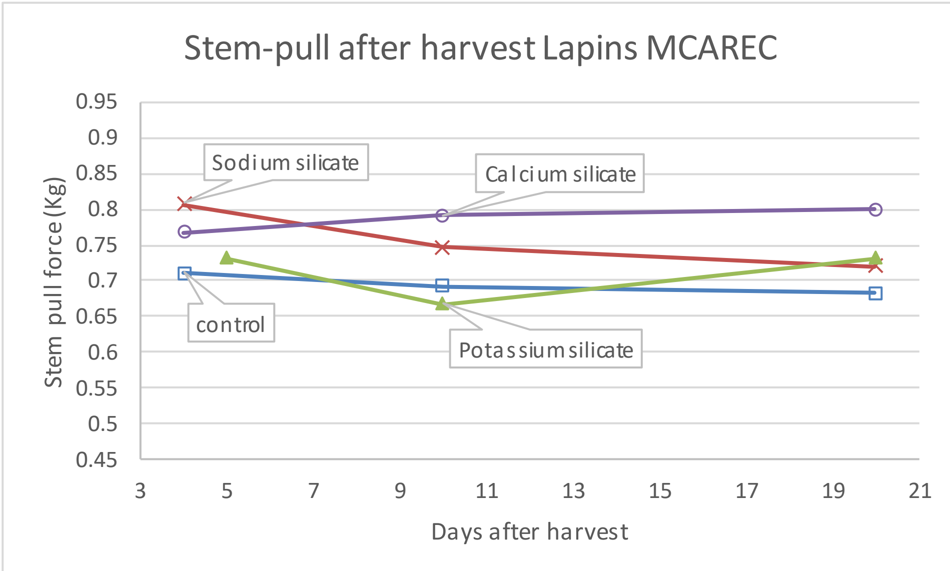
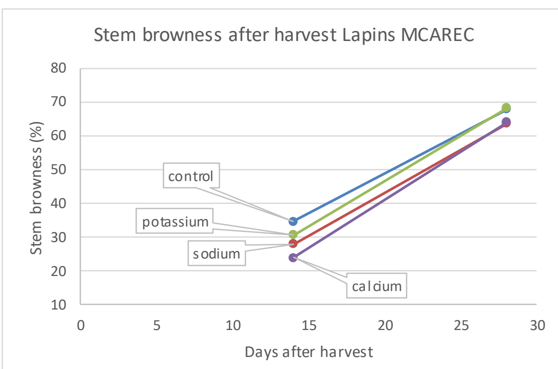


Figure 4. 2017. Stem pull-force was assessed with a push/pull force gauge (DS2-11, IMADA). Values are the average and standard deviation of 6-7 trees. Each tree value was the average of fruit from 30 spurs.



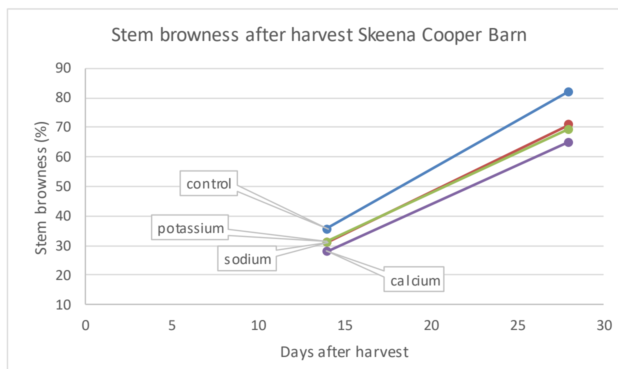


Figure 5. 2017. Browning of stems after harvest was assessed with a chroma-meter (CR 410, Konica Minolta). Greater values indicate that more surface area of the stems are brown.

2018

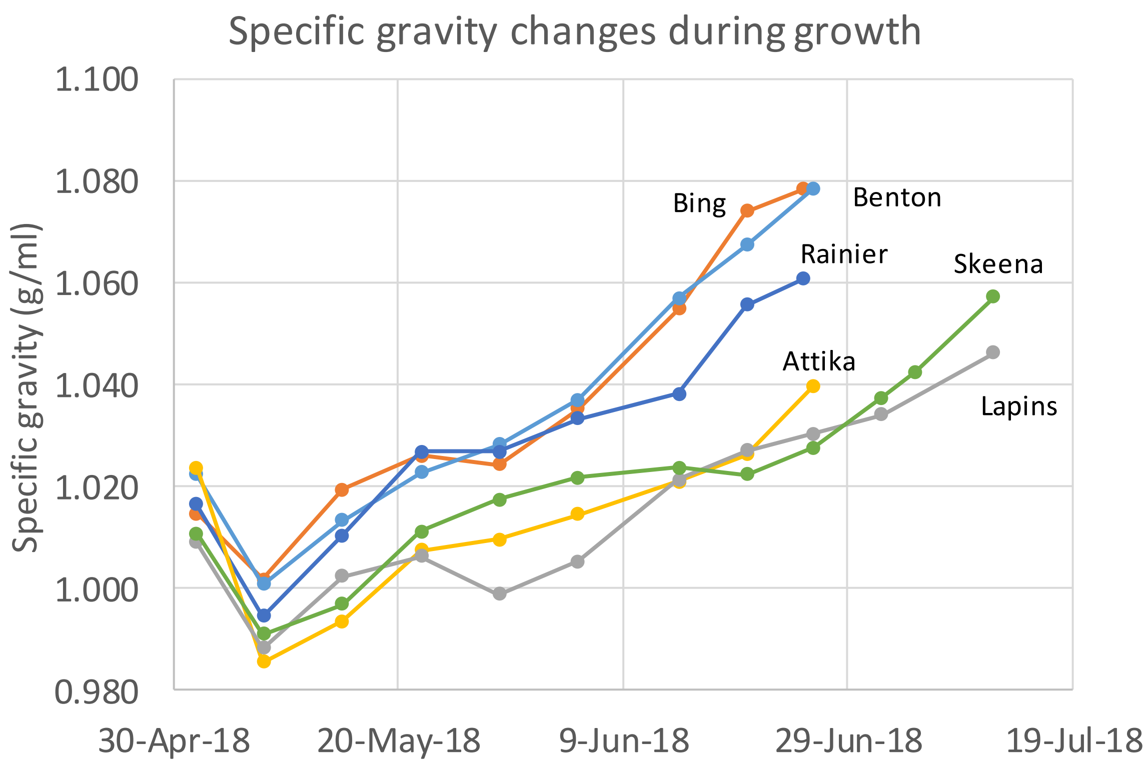


Figure 6. 2018. Specific gravity changes during growth reveal the effects of unintended water stress on Lapins where final swelling was delayed and reduced in magnitude. These trees were not sprayed with Si.

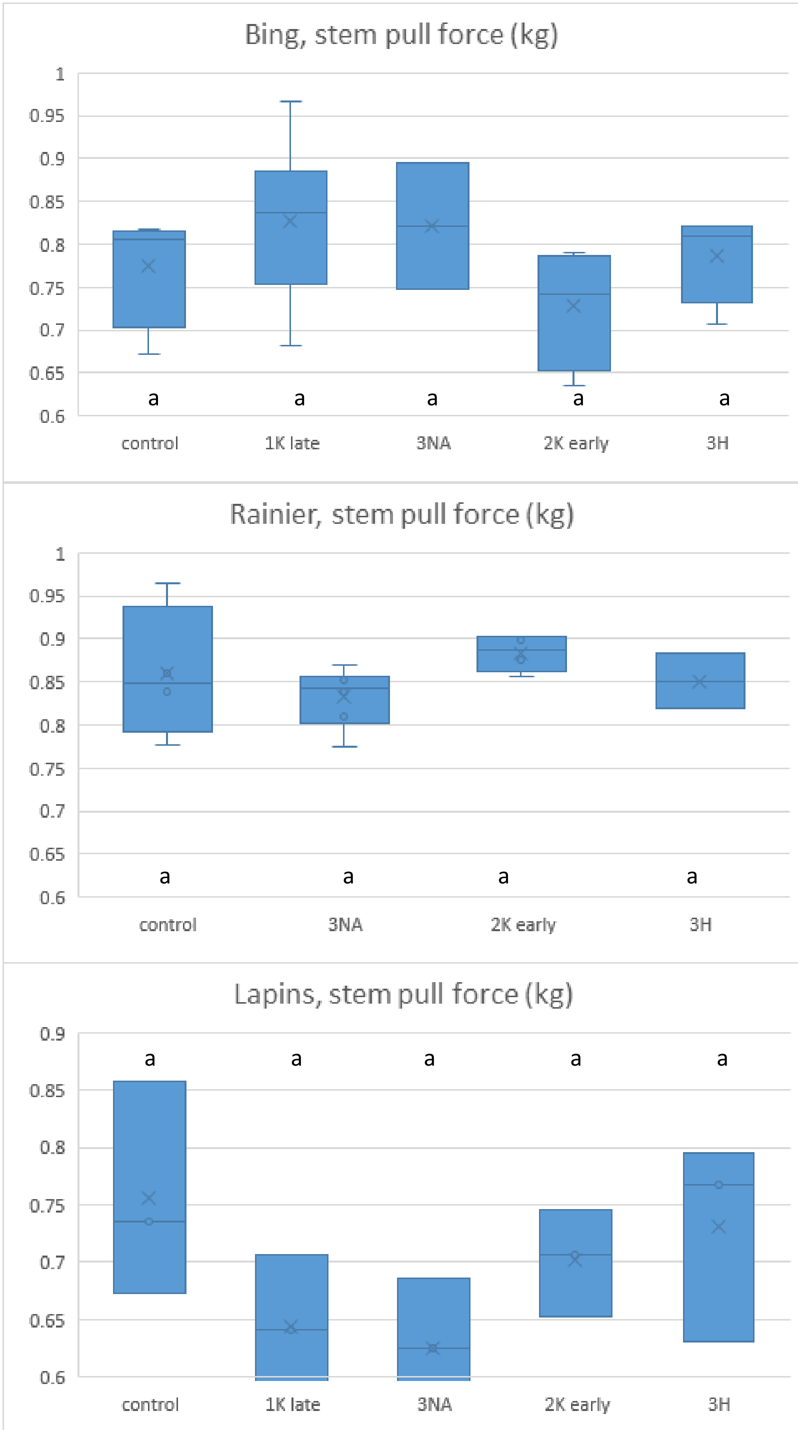


Figure 7. 2018. Stem-pull force showed no significant differences (LSD 95%) between Si treatments. Treatments were as follows; 1K late = potassium form at 21 days post-bloom, 3NA = sodium form at 7, 14 and 21 days post-bloom. 2K = potassium form at 14 and 21 days post-bloom. 3H = humic acid form at 7, 14 and 21 days post-bloom.

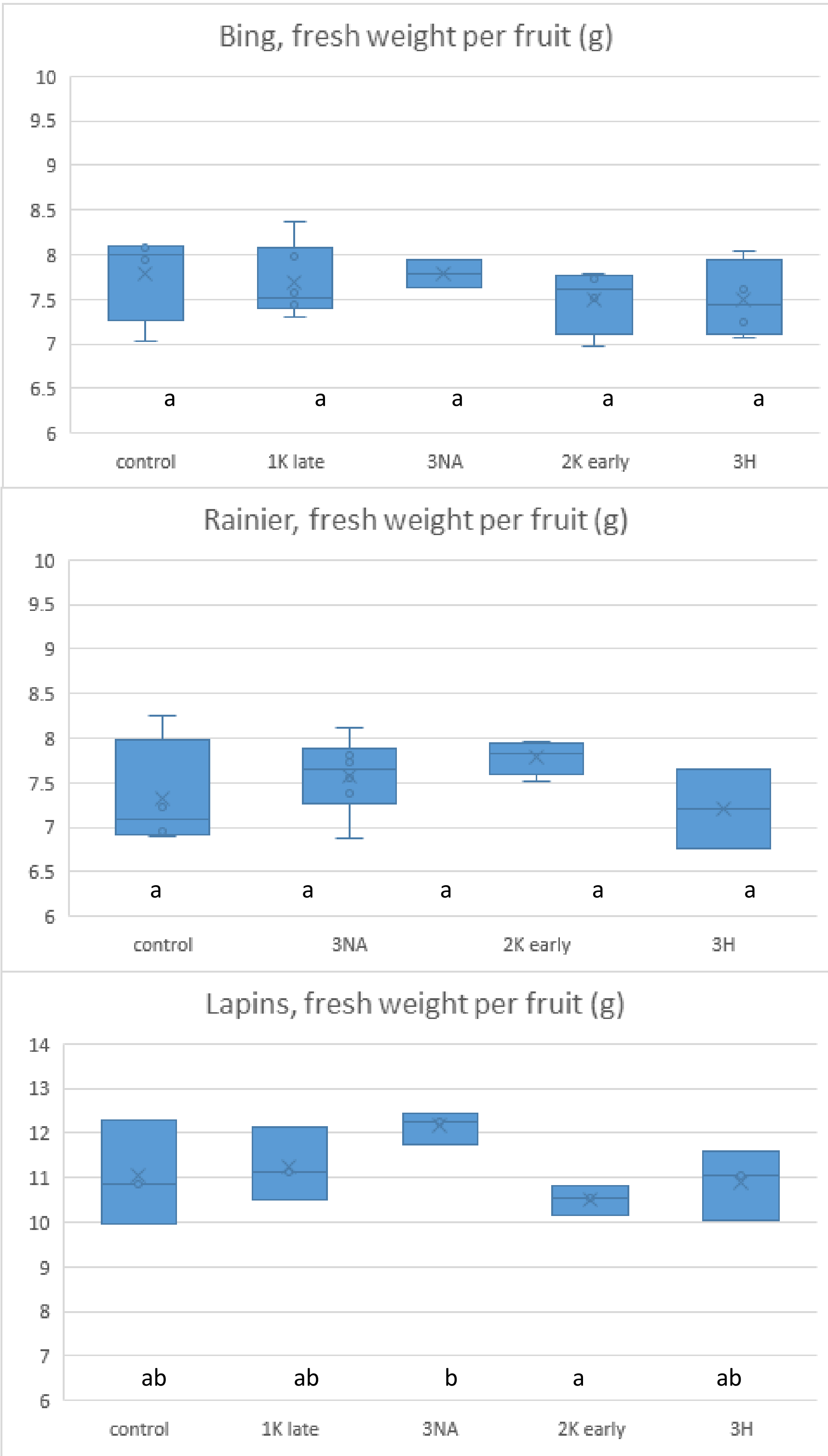


Figure 8. Fruit weight showed no significant differences (LSD 95%) between Si treatments. Treatments were as follows; 1K late = potassium form at 21 days post-bloom, 3NA = sodium form at 7, 14 and 21 days post-bloom. 2K = potassium form at 14 and 21 days post-bloom. 3H = humic acid form at 7, 14 and 21 days post-bloom.

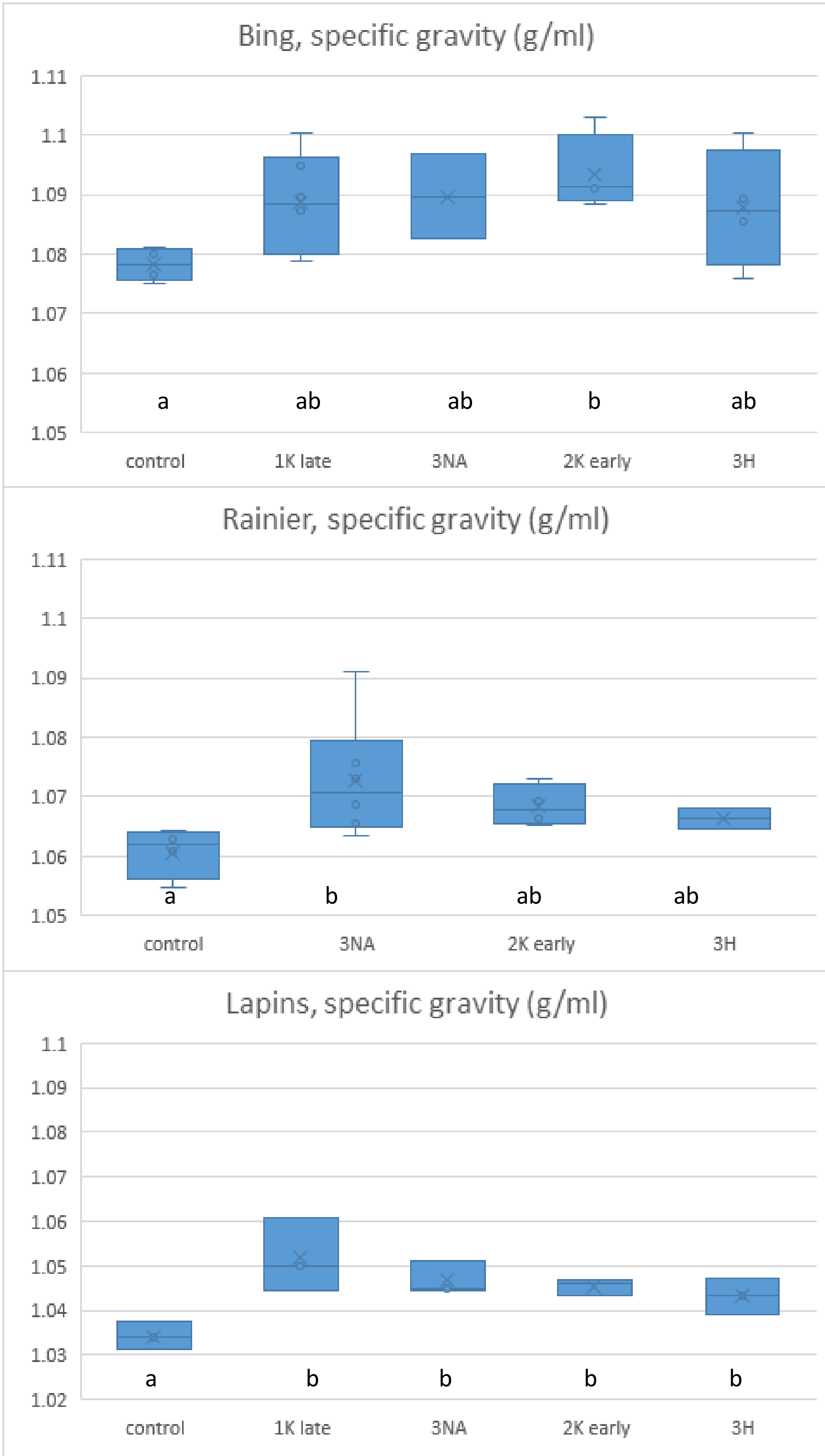


Figure 9. Fruit specific gravity showed some increase (LSD 95%) when Si was applied. Treatments were as follows; 1K late = potassium form at 21 days post-bloom, 3NA = sodium form at 7, 14 and 21 days post-bloom. 2K = potassium form at 14 and 21 days post-bloom. 3H = humic acid form at 7, 14 and 21 days post-bloom.

EXECUTIVE SUMMARY

The effect of Si treatment on stem retention gave mixed results. Only a modest increase was observed 2017 and no positive effect on stem-pull force was observed in 2018.

Post-harvest applications of Si reduced stem browning; however, use of Si solutions in packing-house rinses may create a disposal problem of the alkaline residue.

Silicate supplementation shows promise for improving sweet cherry quality. Effects from a single application near shuck fall (about 14 days after bloom) were modest but indicated an improved vasculature was formed. It is conceivable that improved vasculature could promote fruit size and other quality attributes.

Fruit quality in 2018 was assessed by the specific gravity of bulk samples of fruit (50-300 fruit). Specific gravity is directly related to soluble solids, especially near harvest but may also be used to monitor early fruit development and thereby identify plant stress conditions.

Fruit quality may be improved with Si applications as indicated by a small increase in fruit weight 2017 and by increased specific gravity in 2018.