2008 Update on effects of CPPU on fruit set in Merlot

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CPPU (common name forchlorfenuron) is a synthetic cytokinin which affects fruit set, berry growth and development in grapevines. The effects on fruit are dependent on rate and timing. It was registered for use in selected table grape varieties in the US in 2005 and in seeded wine grapes the following year. It is currently marketed to table and wine grape growers as Prestige® and CPPU® respectively.

When applied at bloom, CPPU will cause an increase in fruit set in seeded and seedless grapes. As rates increase, berry size has been reported to increase and there is a delay in accumulation of soluble solids.

We investigated the effects of early and late bloom applications of CPPU on fruit set, berry size distribution and juice composition in selected vines in a block of Merlot in Bennett Valley AVA in 2008. Vines were planted at a density of 1555 per acre and were head trained, cane pruned on a VSP trellis. The trial consisted of 12 data vines and each vine had been pruned to 2 fruiting canes and two spurs.

Six treatments were utilized consisting of 2 g a.i. and 4 g a.i. CPPU per acre applied at early and late bloom stages to different clusters. In addition, there were untreated clusters designated as "early" and "late" control treatments. All treatments were established on each of 12 data vines. Prior to bloom 3 shoots were selected on each fruiting cane and 6 treatments were randomly assigned to those shoots. The base of each selected shoot was flagged to identify timing and rate of CPPU application. Shoots assigned as controls were also flagged. All flagged shoots had 2 flower clusters.

Early and late applications were made 1 June and 8 June 2008 respectively. On each date, CPPU applications were directed to both flower clusters on flagged shoots designated to receive either 2 g a.i. or 4 g a.i./acre. A spray bottle applicator was used and treated clusters were isolated to prevent material contact with flower clusters or leaves on adjacent shoots. On 1 June, flower clusters receiving early bloom CPPU treatments ranged from 0-50% bloom; flowers were present on just under half of the treated clusters. On 8 June, flower clusters receiving late bloom CPPU treatments ranged from 80-100% bloom; only 3 clusters had less than 100% cap fall.

Data vines were harvested over a 3 week period; all treated clusters on each vine were harvested on the same day and kept separate by treatment and by location on the shoot (basal or apical). With significant assistance provided by the grower, berries were clipped off each cluster. In the lab, berries from each cluster were separated into 4 size classes by using a series of 3 trays that had been drilled with progressively smaller holes. The four resulting size classes were "large" (> 5/8-inch), "medium" (> ½-inch; < 5/8-inch), "small" (> 3/8-inch; < ½-inch), and "very small" (< 3/8-inch).

After sorting, berries were counted either manually or by taking a digital photograph and counting using ImageJ® digital photograph processing software. Berries in each size class were weighed then combined and crushed for juice analysis. Soluble solids, pH and titratable acidity were found on a per cluster basis.

For all analyses, significance was tested at $\alpha=0.05$, and Tukey's HSD test was used as the mean separation test.

Cluster weight

All CPPU applications caused a significant increase in cluster weight compared to untreated clusters with the exception of the late 2 g/acre treatment at α=0.05 (p=0.000). There was no significant difference in cluster weight between any of the CPPU treatments (Table 1). There was no significant difference in cluster weight between designated control clusters and other non-treated clusters within the same vine thus it is unlikely product translocation occurred from treated to untreated clusters (Data not shown).

Table 1. Cluster weight at different CPPU rates and application timing

Treatment	Mean Cluster Weight (g)	Standard Error	Tukey's HSD
Early Control	175.0	11.74	a
Early 2 g a.i.	243.2	13.87	b
Early 4 g a.i.	242.9	17.26	b
Late Control	162.3	10.90	a
Late 2 g a.i.	201.5	12.78	ab
Late 4 g a.i.	243.3	14.40	b

Fruit Set

Cluster weight differences caused by CPPU application were attributed to improved fruit set (Table 2). All CPPU applications significantly increased the number of berries per cluster compared to untreated clusters at α=0.05 (p=0.000). Although there was no significant difference in cluster weight between CPPU treatments (Table 1), the early 4 g/acre, and both late application rates had significantly more berries than the early 2 g/acre rate.

Table 2. Increase in fruit set at different CPPU rates and application timing

Treatment	Mean Berries per Cluster	Standard Error	Tukey's HSD
Early Control	120.2	7.69	a
Early 2 g a.i.	226.5	15.81	b
Early 4 g a.i.	305.1	21.82	c
Late Control	117.5	8.50	a
Late 2 g a.i.	304.7	23.68	c
Late 4 g a.i.	331.2	31.00	c

Mean berry weight

Both CPPU rates at both application timings significantly lowered the average berry weight (Table 3). A significantly higher mean berry weight for the early 2 g/acre treatment compared to other CPPU treatments explains why this treatment had similar mean cluster weights with significantly fewer berries per cluster (Table 1 and 2). Although the early 2 g/acre treatment resulted in the greatest mean berry weight of all CPPU treatments, it had significantly lighter berries than the untreated controls.

Table 3. Mean berry weight at different CPPU rates and application timing

Treatment	Mean Berry Weight (g)	Standard Error	Tukey's HSD
Early Control	1.42	0.04	a
Early 2 g a.i.	1.06	0.05	b
Early 4 g a.i.	0.78	0.05	c
Late Control	1.37	0.05	a
Late 2 g a.i.	0.67	0.05	c
Late 4 g a.i.	0.77	0.04	c

Berry Size Distribution

Smaller mean berry weight in treated clusters arose from a distinct difference in berry size distribution. While significant differences in berries per cluster existed between treatments within the large, medium and small size classes, the most notable treatment effects were the abundant very small berries in clusters treated with CPPU (Figure 1). Increases in cluster weight for three CPPU treatments, early 4 g/acre and both late applications, were primarily attributed to the weight of very small berries (Figure 2). The early 2 g/acre CPPU treatment resulted in a number and total weight of very small berries per cluster that was not significantly different than the untreated controls.

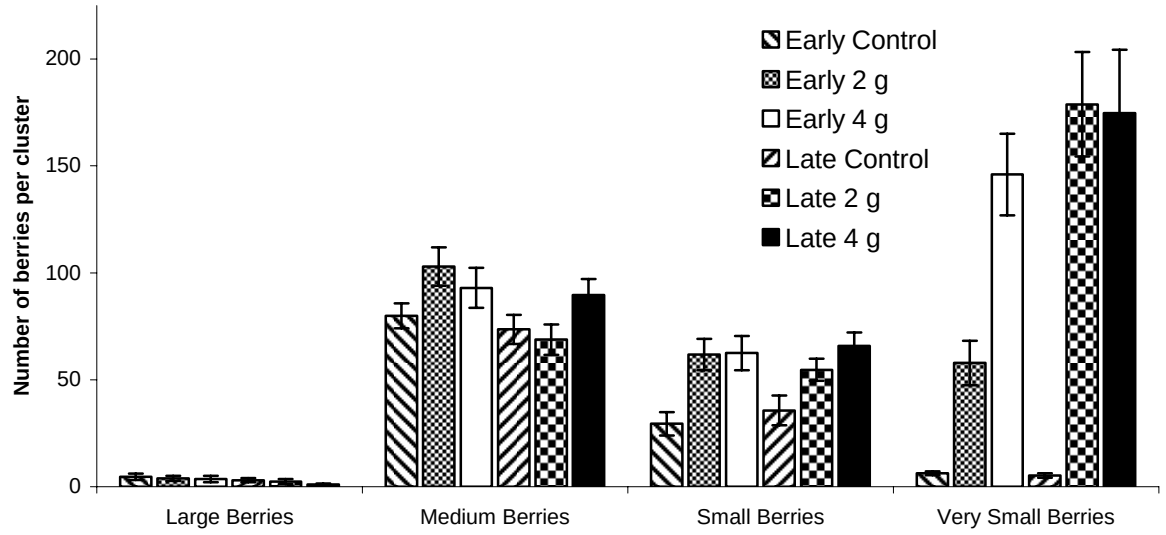

Figure 1. Number of berries per cluster in four size classes

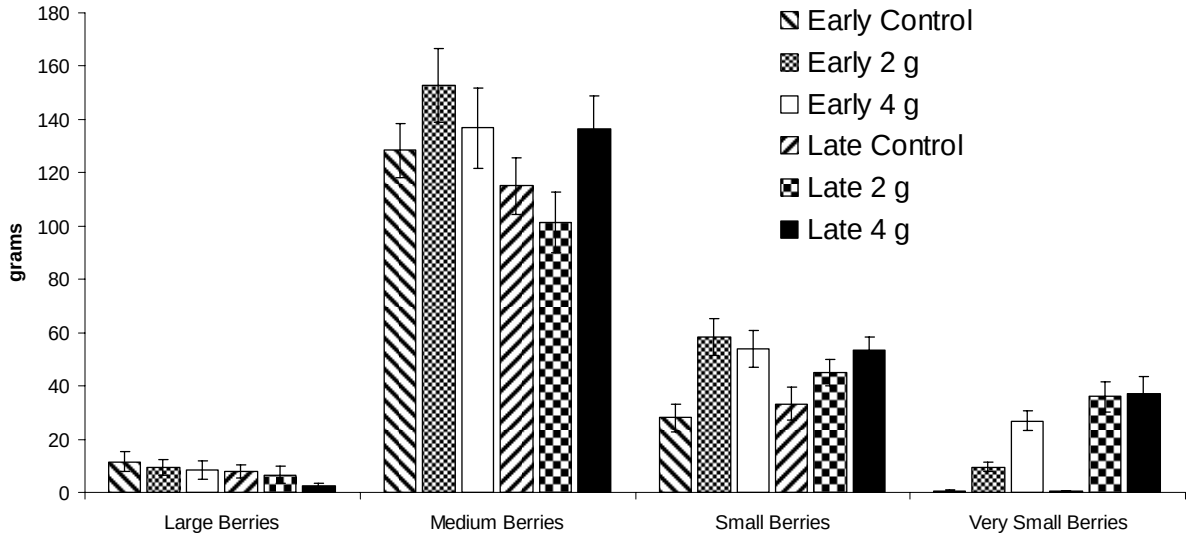

Figure 2. Weight of berries per cluster for four size classes

Berry Composition

Juice pH was lower and titratable acidity (TA) was higher for all CPPU treatments than controls (Tables 4). Soluble solids for both early and late 2 g/acre treatments were not significantly different from the control, but early and late 4 g/acre treatments were significantly lower. There was no significant difference in °Brix, TA and pH between designated control clusters and other non-treated clusters within the same vine thus it is unlikely product translocation occurred from treated to untreated clusters (Data not shown).

Table 4. Juice composition of CPPU treated clusters and controls.

Treatment	°Brix				Titratable Acidity (g/L)				pH			
Early control	22.18	±	0.277	a	6.67	±	0.211	a	3.27	±	0.016	a
Early 2 g a.i.	21.86	±	0.238	abc	7.23	±	0.168	b	3.18	±	0.015	b
Early 4 g a.i.	21.53	±	0.294	c	7.55	±	0.174	bc	3.13	±	0.010	c
Late control	22.20	±	0.279	a	6.52	±	0.181	a	3.28	±	0.018	a
Late 2 g a.i.	22.10	±	0.218	ab	7.59	±	0.108	bc	3.10	±	0.012	c
Late 4 g a.i.	21.76	±	0.277	bc	7.91	±	0.188	c	3.10	±	0.014	c

Conclusion:

CPPU application resulted in increased cluster weight due to an increase in berry set. In some treatments, the mean number of berries per cluster more than doubled. Cluster weight increase was not proportional to the increase in berry set because treated clusters had smaller mean berry weights.

Yield increases in the early 2 g/acre rate were mostly due to increased total weight of medium sized berries and to a lesser degree, small sized berries although these increases were not significantly different from all other treatments. Berry size distribution in clusters treated with early 2 g/acre CPPU was not altered as much as in other CPPU treatments; this rate had a mean of only 9.5 g/cluster of very small berries compared to 26.9 – 37.0 g/cluster for other CPPU treatments.

Juice composition of clusters treated with CPPU tended to indicate delayed fruit maturity as compared to untreated clusters. This may be related to greater fruit set. Juice from treated clusters had significantly lower pH and higher TA than juice from untreated clusters. Juice °Brix in clusters treated with 2 g/acre CPPU in early or late bloom was not significantly different than untreated fruit.