Effects of CPPU, a synthetic cytokinin, on fruit set and yield

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CPPU (common name forchlorfenuron) is a synthetic cytokinin which may be used in the production of some table grape varieties where it is applied after fruit set to increase berry size and firmness. It was registered for use in table grapes in 2005 and received a Supplemental Label for Seeded Wine Grapes the following year. It is marketed as Prestige®.

The effect of CPPU on table grape clusters is timing and rate dependent. There are also variety affects. Fruit set, berry growth and development are all impacted (1). When applied after shatter near fruit set, berry size is increased due to an increase in cell division and elongation. Fruit maturity (soluble solids accumulation) is also delayed which can be advantageous in fresh market fruit. CPPU has been shown to delay color development in sensitive varieties such as Flame Seedless when applied at >6 g/ac (1, 2). In that variety the material is used with gibberillic acid and rates and timing of both materials are adjusted to maximize effects on berry size and minimize effects on color development (1).

When applied at bloom, CPPU will cause an increase in fruit set in seeded and seedless grapes. The effect is rate and timing dependent. As rates increase, berry size increases and there is a delay in accumulation of soluble solids. Low rates (<4 g/ac) may promote color development.

We investigated the effects of bloom applications of CPPU on fruit set, berry size and composition in winegrapes in Sonoma County. In 2006, it was applied by hand to small plots in a Merlot vineyard that had fanleaf degeneration disease. In 2007, growers from three ranches applied the material with conventional sprayers at bloom; at a fourth location, single-vine plots were established and CPPU was applied with a hand sprayer.

2006

A 10-year old block of Merlot clone 181 on 110R rootstock was selected as the trial site because it was infected with Grapevine Fanleaf Virus (GFLV). Disease symptoms expressed every year; fruit set was historically variable within the block; crop load differences on adjacent vines ranged from “normal” to 50% of normal.

At 90% bloom, 2 g/ac and 4 g/ac of CPPU (8 and 16 fluid ounces/ac Prestige® respectively) were each applied to 10 replications of 3-vine plots, thus each rate was applied to a total of 30 vines. The material was applied with a backpack sprayer at the equivalent of about 100gpa.

A single 100-berry sample was collected from each plot on 8 September, 10-days prior to harvest. Average berry weight per plot was found. Berries were crushed by hand, and the juice was filtered through cheesecloth. Soluble solids (Brix), pH and total acidity were found on the juice. Due to the high variability of berry size and color within plots, we decided to do a visual assessment of fruit color and berry size per plot. Vines were ranked 1 - 4 based on the proportion of berries that reached full

color (% color) and the proportion of berries that reached full size (% full sized). At harvest, total cluster number and vine yield were found.

Results.

1. Vines that received an application of 4 g/ac CPPU set a significantly greater number of berries compared to the 2 g/ac rate or the unsprayed vines (p=0.0003).
2. The 4 g/ac CPPU application rate delayed ripening: juice pH was reduced and total acidity increased compared to the untreated control.
3. The 2 g/ac rate resulted in fruit with more color than untreated fruit or fruit that received a higher rate of CPPU.
4. Vines treated with 2 g/ac CPPU were not consistently intermediate in yield and fruit maturity parameters between vines that received the higher rate and untreated vines.

2007 - Trial 1

An 11 year old vineyard of Pinot Noir located in the Sonoma Coast AVA (clone 31 on 5C) was selected as a trial site to determine the effect of a CPPU application on berry size uniformity. During bloom on May 25, 2 g/ac CPPU was applied to four sets of five contiguous vineyard rows (of equal length) with an Andros 5-row sprayer (high volume; 133 gpa). A set of five contiguous vineyard rows between each treatment set were left untreated, creating 8 plots - four replications of two treatments. Clusters were collected from treated and control vines on September 24, 2007. One cluster was removed from each of 10, randomly selected vines within the center row of each five-row plot.

Clusters were weighed individually then all berries were clipped off the rachis to remove the pedicles. Berries were then sorted into four size classes by using a series of three 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 “tiny” (< 3/8-inch). After berries from each cluster were sorted, they were counted and weighed. To obtain a maturity assessment within a plot, all berries within a size class were combined into one composite sample. In this manner the average berry weight and berry composition (Brix, pH, titratable acidity) of the ten clusters collected per plot was analyzed for each of the four berry size classes. The block was hand harvested on October 15, and crop weights were obtained for each five-row plot.

Results

1. Vines that received an application of 2 g CPPU did not significantly increase average total berry number or average cluster weights.
2. When four size classes of berries were examined separately, there were no significant differences in average berry number between treated and untreated fruit. Although not significant, there were slightly more mid-sized and tiny-sized berries and fewer small-sized berries in the clusters sampled from CPPU treated vines. Again not significant, the large berries were slightly heavier in clusters sampled from rows treated with CPPU than in clusters sampled from untreated rows.
3. The application of CPPU did not affect juice soluble solids, pH or titratable acidity.
4. The average yield of the 5-row plots that were treated with CPPU was slightly greater than in untreated plots, but the differences were not significant (p=0.2380). Harvested crop in the five-row plots that had been treated with 2 g/acre CPPU averaged 8,195 pounds (standard error 486); five-row plots containing untreated vines averaged 7,880 pounds (standard error 428).

2007 – Trial 2

A 9 year old vineyard of Pinot Noir located in the Sonoma Coast AVA (clone 777 on 101-14) was selected as a trial site to determine the effect of a CPPU application on berry set. Set is often reduced by very cool and foggy conditions during the bloom period. The trial contained 12 replications of single-vine plots. There were 6 treatments: An "early" bloom application of 2 g/ac and 4 g/ac CPPU with an untreated control; and a "late" bloom application of the same 3 rates. The applications were made by hand. The early application was made on May 24, 2007 at about 20% bloom; the late application was made 10 days later on June 3. On that date, clusters ranged from less than 50% bloom to 100% bloom and occasionally past bloom (set).

On October 1, a single cluster per treated vine was collected using a described sampling strategy (3). Clusters were weighed individually, and then the berries clipped off the rachis and sorted into berry size classes as previously described. In each size class of berries from each cluster, berries were counted and weighed. For juice analyses, all berries from a cluster were recombined, then crushed and process as previously described to measure soluble solids, pH and total acidity. On October 4, 60 berries per vine were sampled and weighed and juice analysis was also performed on these berries. The data vines were harvested on October 6, and cluster counts and vine yield was found.

Results.

1. CPPU application (regardless of rate or time) significantly increased average cluster weight ($p = 0.0000$). At harvest, average cluster weights were 96 grams and 133 grams for untreated and treated fruit respectively (the latter over both application rates and timings).
2. Clusters sampled from untreated vines had significantly fewer small-sized berries and more tiny-sized berries than clusters from vines that were treated with CPPU.
3. No treatment differences were observed in average berry weight within any of the berry size classes.
4. In the berries collected just prior to harvest on October 4, those from vines treated with 2 g/ac CPPU at early bloom were slightly lighter than berries from vines treated with either rate at late bloom.
5. Juice from both the whole cluster sample and the berry sample had significantly higher soluble solids and higher pH in untreated vines than in any vines that received an application of CPPU.
6. Total vine yields from untreated vines were significantly less than yield from vines treated with CPPU. At harvest, average yield of untreated vines was 7.5 pounds per vine; average yield of treated vines (over both application rates and timings) was 10.7 pounds per vine. Among the CPPU treated vines, the early bloom application of 2 g/ac resulted in less crop weight per vine than the 4 g/ac applied at the same time.

2007 - Grower Trials

Two growers applied CPPU to small acreages to learn if they could see the effect of the material on fruit set under their own site conditions.

- A portion of two small blocks of young Malbec vines was treated with 2 g / ac CPPU at bloom on May 18. One block had cordoned trained vines which were planted as benchgrafts in 2004 (clone 595 on Riparia gloire); a second block of Riparia gloire rootstock was field budded in 2005 (clone 596). About half of the vines in each age group were treated with CPPU.

On August 28, a total of 70 clusters were sampled from the treated and untreated cordoned trained vines using a described sampling strategy (3). Cluster weights were found and berries per cluster were counted. The average weight of clusters taken from vines that had been treated with CPPU was greater than the average weight of clusters taken from untreated vines. The average number of berries per cluster was also larger in fruit sampled from treated vines. On August 29, berry samples were collected from each of 10 treated and untreated rows of vines in the field budded block; berry weights were significantly larger in samples collected from treated rows ($p=0.0001$). There were no significant differences in berry composition.

On September 4, vines were hand harvested and fruit was kept separate by block and treatment. In the cordoned trained block, vines that had been treated with CPPU averaged 4.0 pounds per vine; untreated vines averaged 3.7 pounds per vine. In the field budded block, vines that had been treated with CPPU averaged 0.6 pounds per vine; untreated vines averaged 0.4 pounds per vine.

- Two small areas in a Sauvignon blanc vineyard were treated with 2 g/ac of CPPU to determine the affect of fruit set on vines that were infected with GFLV. Disease symptoms expressed every year; fruit set was historically variable within the block. In 2007, GFLV symptoms were more severe in the north area than in the south area of the block. In each these areas, CPPU was applied with a Gearmore sprayer to one-half of a pair of adjacent rows; an equal number of vines in each row pair were treated and untreated. On August 23, fruit was hand harvested by treatment within each area. In the north area (more severe disease symptoms), crop weight totaled 690 and 410 pounds in the treated and untreated vines respectively. In the south area (less severe disease symptoms), crop weight totaled 665 and 805 pounds in the treated and untreated vines respectively.

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