Application of Hydrogen Cyanamide to Increase Bloom Uniformity in Low-Chill Peaches: A Preliminary Report

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Hydrogen cyanamide (HC) is an important tool for growers of low-chill fruit crops in subtropical production regions. This chemical can help plants break dormancy to enhance the emergence of leaves shortly after bloom and fruit set. Leaf emergence is important for the production of sugars, structural carbohydrates and volatile flavor components in low-chill fruit that often have a compressed fruit developmental period. The objective of this preliminary study was to observe the application of two rates of hydrogen cyanamide (HC; Dormex®) on ‘UFSun’ and ‘UFOne’ peach varieties. Two rates were applied (2% or 3%; v/v + surfactant) in ‘UFSun’ while only 3% was applied in ‘UFOne’. Controls were included in which no chemical was applied. HC was effective at increasing lateral budbreak in both peach varieties, and there was no difference between the 2% and 3% rate in ‘UFSun’. Terminal budbreak was not affected in ‘UFSun’; however application of HC did increase terminal budbreak in ‘UFOne’. Neither variety exhibited phytotoxicity symptoms at either rate when applied three to four weeks before anticipated budbreak. This preliminary study has shown that when applied before bud swell, HC can improve terminal and lateral budbreak in low-chill peaches. However, timing of the application can do severe damage to flower and leaf buds and must be considered to avoid crop loss.

In subtropical areas of the southeastern United States (U.S.), growers growing low-chill peach (Prunus persica L.) varieties have been fortunate to take advantage of an early market window. These low-chill varieties developed at the University of Florida and Texas A&M University ripen just as imported fruit from Latin America is declining, and domestic production in the southeastern U.S. increases. Winter temperatures in the subtropical southeastern U.S. are dominated by mild temperatures, resulting in non-uniform flower and vegetative budbreak. Warm, mild temperatures can cause extended bloom periods (> 3 weeks), resulting in irregular ripening of the crop and multiple harvest periods, creating both labor and economic strains.

Peach trees originate from temperate areas of the world, specifically China (Hedrick, 1917) and require a certain amount of chill unit accumulation during the dormant period to resume normal growth in the spring. This chill unit requirement is unique to each cultivar and can be tracked using various models for chill accumulation. In peach production, a modified Utah Chill Model is used to track accumulated chill units determined by specific ranges of temperatures (Richardson et al., 1974; Table 1), which correspond to an entire chill unit or portions thereof that are accumulated during these ranges. Peach cultivars that do not receive the necessary chill unit accumulation can result in poor or uneven budbreak, sporadic flowering, delayed leaf emergence and poor fruit set (Erez, 1987; Saure, 1985). In growing areas with low-chill unit accumulation, various chemicals have been examined to aid in the process of overcoming this chill unit requirement (Dozier et al., 1990; George et al., 1992; Shulman et al., 1985).

Hydrogen cyanamide has been successfully used to induce budbreak in grape (Dokoozlian et al., 1995), blueberry (Williams et al., 2002), apple (Bound and Jones, 2010), kiwi (Linsley-Noakes, 1989) and peach (Dozier et al., 1990) when inadequate chilling is received during the course of the dormant period. The use of hydrogen cyanamide is an effective chemical in the release of dormancy, provided a minimum number of chill units have been received (Dozier et al., 1990; Siller-Cepeda et al., 1992). However, hydrogen cyanamide is highly toxic with severe side effects if proper protection and caution is not exercised (de Haro, 2009; Settimi et al., 2005).

The objective of this preliminary study was to examine the effect of two different rates of hydrogen cyanamide in two low-chill peach varieties, ‘UFSun’ and ‘UFOne’ on flowering and budbreak percentage in central and south central Florida peach production areas.

Materials and Methods

This experiment was conducted on 5-year-old trees of ‘UF-Sun’ (125 chill unit requirement) and ‘UFOne’ (250 chill unit requirement) both grafted to ‘Flordaguard’ rootstock, located in Vero Beach, FL. Hydrogen cyanamide (Dormex®, AlzChem, Germany; 50% a.i.) was applied at two rates, 2% and 3% (v/v) in ‘UFSun’, while only 3% (v/v) was applied in ‘UFOne’. A surfactant was used (Silwet L-77, Helena Chemical Company, Collierville, TN) and trees were sprayed at a rate of 125 gpa. A control was also included in which no chemical was applied. Treatments were applied on 4–5 Jan. 2014, approximately 3 weeks before anticipated budbreak. No additional information about temperature or presence of dew was recorded. Lateral and terminal budbreak and shoot dieback (%) were tracked on February 7, 2014 (N=5).

Data were statistically analyzed using JMP (v. 11, SAS Institute, Cary, NC). Least square means were used to determine differences

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using Tukey’s HSD (P < 0.05). Error bars were determined by using the standard error of the mean.

Results and Discussion

Application of hydrogen cyanamide was effective at improving lateral budbreak in both ‘UFSun’ and ‘UFOne’ peach varieties (Fig. 1, Fig. 2). The higher rate used in this study (3% v/v) did not result in significant phytotoxicity to flower buds as reported in other studies (Linsley-Noakes, 1989; Siller-Cepeda et al., 1992); however in this experiment, there was no benefit to using a higher rate for both peach varieties. Neither rate of hydrogen cyanamide significantly affected shoot dieback percentage (> 0.05), indicating that there was no significant phytotoxicity associated with the higher rate (3% v/v) at the particular timing of application (3–4 weeks before anticipated budbreak). This is surely to be variety dependent, as preliminary reports of hydrogen cyanamide use with other low-chill varieties in Florida have delayed budbreak, leafing and fruit harvest (M. Olmstead, pers. comm.). In addition, with the high toxicity classification labeled by the U.S. Environmental Protection Agency, application of the lowest effective amount would be a best management practice.

Terminal budbreak (%) was not affected by hydrogen cyanamide application in ‘UFSun’; however, ‘UFOone’ trees treated with either 3% v/v had significantly greater terminal budbreak (77.8%) than those that did not receive hydrogen cyanamide (1.3%; P < 0.001). It has been reported that terminal buds do not have as great a chilling requirement as lateral buds (Scalabrelli and Couvillion, 1986); however, since ‘UFOone’ has a higher chill requirement, it was not surprising that low percentages of terminal budbreak was observed without applications of hydrogen cyanamide in this south Florida location.

Timing of hydrogen cyanamide applications are important to coordinate well before bud swell and bud break in peaches, as significant phytotoxic effects to the floral buds can occur. In blueberry, hydrogen cyanamide applications before any chilling was recorded resulted in lower vigor, higher flower bud mortality and overall reduced yields when compared with plants receiving some chill (Williamson et al., 2001). Flower buds can be monitored to examine the development of pollen grains by dissecting flower buds and examining under a microscope (Powell, 1999). The change in pollen grain color from light green to yellow-green indicates increasing sensitivity of the flower buds to hydrogen cyanamide and applications after this stage can result in overthinning of flower buds (A. Powell, pers. comm.).

This preliminary data on improving budbreak of under-chilled peach varieties is encouraging, and growers that have used hydrogen cyanamide in central and south Florida have reported compressed bloom periods, resulting in shorter harvest periods with more uniform ripening. A significant drawback to growing low-chill peach varieties in years when the minimum chill unit requirement is not satisfied is an extended bloom period (up to 4 weeks) which then translates to prolonged harvest periods. This in turn, can significantly reduce the profit realized by growers as additional expenses are allocated to labor and fruit transportation to packing houses. Thus, use of hydrogen cyanamide or other rest-breaking compounds could result in increased economic gain for growers of low-chill stone fruit in Florida.

Table 1. Chill unit accumulation for ‘Redhaven’ and ‘Elberta’ peaches at various temperature ranges as determined by the modified Utah chill model (Richardson et al., 1974).

<table>
<thead>
<tr>
<th>Temperature (°F)</th>
<th>Chill Units Contributed</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 34 °F</td>
<td>0.0</td>
</tr>
<tr>
<td>35 – 36 °F</td>
<td>0.5</td>
</tr>
<tr>
<td>37 – 48 °F</td>
<td>1.0</td>
</tr>
<tr>
<td>49 – 54 °F</td>
<td>0.5</td>
</tr>
<tr>
<td>55 – 60 °F</td>
<td>0.0</td>
</tr>
<tr>
<td>61 – 65 °F</td>
<td>-0.5</td>
</tr>
<tr>
<td>&gt; 65 °F</td>
<td>-1.0</td>
</tr>
</tbody>
</table>

Fig. 1. Effect of hydrogen cyanamide at 0 (control), 2%, or 3% rates on lateral budbreak of ‘UFSun’. Letters denote mean separation as determined by Tukey’s HSD (P < 0.001). Error bars indicate the SE of the mean.

Fig. 2. Effect of hydrogen cyanamide (3% rate) and a control (no chemical applied) on lateral budbreak of ‘UFOone’. Letters denote mean separation as determined by Tukey’s HSD (P < 0.001). Error bars indicate the SE of the mean.

Literature Cited


