TREE MANAGEMENT FOR IMPROVING PEACH FRUIT QUALITY[1]

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Produce buyers are constantly demanding bigger and redder fruit. Other characteristics of high-quality fruit include high sugar levels, an appropriate sugar-to-acid ratio, and adequate flesh firmness to ensure a reasonable self-life. In general, fruit quality improves as harvest is delayed and a tree-ripened peach is truly a remarkable fruit. Unfortunately, we have to sacrifice some quality to have fruit that are firm enough to ship. The emphasis of this talk is to provide some information on improving fruit quality of fruit that can be shipped. I will concentrate on red color firmness because sugars and acids are greatly influenced by environmental conditions, which we cannot control.

Improving Red Color

Genetics. Some varieties develop more red color than others. Although the red color can be maximized for any variety, the potential for red color differs for each variety. Poor coloring varieties like 'Loring' do not possess the genetic potential to develop the same level of red color as 'Redhaven'. Red color is becoming a more important characteristic for fruit breeders; so better coloring varieties should be available shortly.

Stress. In general, any type of stress on the tree, which reduces photosynthesis will, has a negative effect on red color development. Therefore it is important to avoid drought stress and to protect leaves from insects and diseases that damage leaves and reduce whole-tree photosynthesis.

Nitrogen. In general, high levels of nitrogen retard the development of red color in the fruit skin. Part of this may be due to increased levels of chlorophyll in the fruit skin and part may be due to increased shoot growth that shades the tree interior. Therefore, apply nitrogen judiciously to maintain adequate shoot vigor for future cropping, without excess shade.

Light. Light is important for fruit production because all aspects of tree and fruit growth and flower bud development require carbohydrates that are produced by photosynthesis in the leaves. Sunlight provides the energy for photosynthesis. We performed two experiments to determine how much light is needed, and when it is needed to produce high quality peaches. In one experiment entire trees were shaded for varying lengths of time with varying levels of shade cloth. These treatments were too severe because only parts of the tree canopy are usually shaded. So another experiment was initiated to cover scaffold limbs with cloth to provide 100, 45, 23, and 9% full sun during the first half of the final swell, the second half o the final swell, or during the entire final swell. The final swell is the final stage of fruit growth resulting from rapid cell expansion during the last 6 weeks before harvest. Below is a list of critical light levels required for various aspects of fruit quality.

- **Fruit Size** – Fruit sized well during the last 3 weeks before harvest, even when receiving only 9% full sun. At least 30% full sun is needed for the final 6 weeks before harvest for maximum fruit size.

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- **Red Color** – the percentage of the surface colored red is not greatly affected by shade during the last 3 weeks before harvest. Red color development requires at least 23% full sun during the 6 weeks before harvest. Shade for three weeks, followed by full sun during the last 3 weeks resulted in more red color than for fruit that were never shaded. This is also true for apples. Temporary shading probably causes a reduction in green pigment (chlorophyll) in the fruit skin, which can partially mask red color. Therefore, shading early in the season, followed by summer pruning during the last three weeks before harvest will result in maximum red color.
- **Red color intensity** – Intensity red color required more than 23% full sun during the last 3 weeks before harvest.
- **Sugar level** – Soluble solids concentration is the fruit quality characteristic mostly easily altered by stress. Development of high soluble solids required more than 45% full sun during the last three weeks before harvest.
- **Flesh firmness –** In this experiment, flesh firmness was influenced by shade. Fruit receiving less than 45% full sun during the last 3 weeks before harvest were softer than nonshaded fruit, even though the ground color was greener than nonshaded fruit.
- **Flower bud formation –** Shading, even to 9% full sun after harvest did not affect flowering the following spring. However, shading to 9% full sun during the first half of the final swell reduced the number of flowers per shoot the following spring. If one wants to maintain fruiting wood at the tree interior, it is important to improve light levels shortly after pit hardening.

In summary, light was most important during the final three weeks before harvest. Low light levels during the first half of the final swell (6 to 3 weeks before harvest) had little effect of fruit quality if the shade was eliminated during the final half of the final swell. Summer pruning can effectively improve light conditions throughout the tree. However, removal of too much foliage can reduce whole-tree photosynthesis and adversely effect fruit size. Therefore, only remove upright water sprouts at the tree interior that will cause shading on the inside of the canopy.

Relationship between ground color and firmness

As peaches mature, the fruit undergoes a number of changes that may not necessarily be related to each other. During the last 20 to 30 days before harvest, the fruit grows rapidly, the flesh softens, the ground color of the skin and the flesh turn from green to yellow, the side of the fruit facing the sun turns from green to red, the sugars increase and the acid levels decline, and the fruit may become aromatic. Ground color is usually used as an indicator of fruit maturity and firmness. However, more than 60 years ago Professor Blake, at Rutgers University, indicated that ground color should not be used as an index of firmness because fruit with similar ground color, but from trees with varying nitrogen status, had different flesh firmness. Results from our shade experiments indicated that the two characteristics might change independently because shaded fruit remained green, but continued to soften. This led to the question "is the relationship between ground color and flesh firmness affected by light?" If so, then fruit from shaded parts of the tree should be harvested with different ground color than fruit from parts of the tree with high light.

To test this hypothesis we established treatments to provide a range of light levels. About 2 weeks before harvest we applied 3 treatments to one side of a tree. The treatments were: 1. Control; 2. 73% shade cloth to allow 27% full sun; and 3. Reflective mulch under the tree. Fruit from the inside, middle, and outside of the tree canopy were tagged. Light was measured on 6 sides of each fruit (top, bottom, north south, east and west) to estimate the amount of light each fruit intercepted. Starting about 6 days before normal harvest, tagged fruit were harvest from trees every 2 days. These fruit were selected randomly and not on the basis of ground color, so we hoped they would represent the population of fruit on the tree on a given harvest date. Therefore, on each harvest date there would probably be fruit that were more mature than desired and fruit that were less mature than desired, but we wanted to get a large range of fruit maturity.

The amount of light intercepted by the fruit was increased by 15% with reflective mulch, and light interception was reduced by 32% by shade cloth. Light interception by fruit declined, as fruit were located towards the tree interior. Fruit weight and soluble solids concentration (SSC) were positively related to the amount of light intercepted by the fruit, but fruit firmness was negatively related to the amount of light intercepted by the fruit. This indicates that high light may advance fruit maturity. Hue angle on the blush and non-blush sides of the fruit was negatively related to the amount of light interception. T blush side of fruit in high light was dark red and the shaded fruit were reddish orange. The non-blush side of fruit in high light was orange to reddish orange and the shaded fruit were yellow to yellowish orange.

Table 1. The effect of reflective mulch and shade on light interception, and quality characteristics of 'Biscoe' peaches.

Variable	**Full Sun (%)**	**Fruit wt. (mm)**	**Firm. (lbs)**	**SSC (%)**	**Hue angle blush side**	**Hue angle non-blush**
Treatment						
Control	12.1	114	7.6	10.7	33.6	78.9
Refl. Mulch	14.2	121	6.6	10.8	29.9	73.3
73% Shade	8.2	110	7.4	8.0	51.0	87.6
Position						
Inside	6.5	104	9.0	9.3	44.9	86.9
Middle	7.9	112	8.2	9.8	42.7	82.4
Outside	20.1	128	4.5	10.4	26.8	70.6