



THE EFFECT OF SUPPLEMENTAL LIGHT ON MANGO GROWTH

Lindsey Okumura, Aimee Taniguchi, Jensen Uyeda, Josh Silva, Gerardo Spinelli, and Jari Sugano

University of Hawai'i at Mānoa

College of Tropical Agriculture and Human Resources

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(Notes from an observational field trial)

Mango is a popular fruit grown in tropical and a few subtropical regions of the world. Originally grown in Southeast Asia, unmanaged mango trees can grow to heights ranging from 30-40 feet tall (Shah, Patel, Parmar, 2010). Quality mango can reap a high price in the marketplace (Nelson, 2008). The farm gate value of mango was estimated at \$290,000 with 26,000 trees in 2016 (USDA Hawaii Tropical Fruit and Crops Report, 2017). Mango fell behind longan and lychee in tropical fruit crop sales. Longan had the highest farm value at 1.2 million dollars in 2016. The increase in longan production maybe due to the ability to force flowering via products such as potassium chlorate.

We conducted an informal field trial to evaluate the effect of supplemental lights on mango growth. The field trial used the mango variety, Rapoza (*Magnifera indica L.*), a high-quality mango variety developed by researchers at UH CTAHR. The trial was installed at the Waimanalo Research Station in March 2017. LED lights were installed in May 2018 to provide supplemental lighting to the orchard crop due to frequent cloud cover and low light conditions. Lights were spaced about 15 feet apart from one another on the border of the field.

A total of 21 fruit trees were planted at the Waimanalo Research Station. The trial was initially a spacing trial to evaluate the high-density planting technique used in countries like India, Israel, etc. Plants were spaced 10, 12, 15 or 20 feet apart (Figure 3). A control plot was established at the back of the research station with trees spaced 20 feet apart. Fifty-watt, LED flood lights were installed around the existing field plot, three on each side of the field (Figure 3). The 12-volt, DC lights were powered by three solar panels, 12V, 275 watt each (Chaori SunPerfect model CRM275S156P-72) with a timer set to go on for 6 hours after sundown.



Photo1: Fifty-watt LED floodlights connected to of 3 solar panels, donated by Ili'iili Farms.

Hawaii's day length is relatively consistent being in the tropics. According to the Atlas of Hawaii (1983), Hawaii's longest days are about 13.5 hours compared to the shortest days ranging around 11 hours, respectively. Two years after transplanting, Okumura and Taniguchi (UH CTAHR NREM students) took measurements to assess if the lights had any effect on the trees; height and diameter. Height measurements were taken at 2 different points: 1) ground to the graft, and 2) ground to the crotch. Diameter measurements were taken from the ground and measured at 1' intervals until the crotch of the tree. We defined the crotch of the tree to be the point in which the trunk of the tree splits into multiple branches.

There were five treatments: 1) 10 foot spacing with lights, 2) 12 foot spacing with lights, 3) 15 foot spacing with lights, 4) 20 foot spacing with lights, and 5) control or 20 foot spacing with no supplemental lights.

Overall, the results of this experiment showed that the supplemental lighting had no positive effect on tree growth (Table 1&2). Data was analyzed using an analysis of variance (ANOVA). There were significant differences between the height from the ground to the crotch when spacing varied as well as with the addition of lighting. However, for high density plantings to be a success in Hawaii, we aim to keep the crotch of the tree low vs high.

Tighter spaced trees produced higher crotch levels than trees spaced farther apart (Figure 1). Similarly, trees planted closer together with a row spacing of 10 and 12 feet had higher crotch levels than the control trees which received no supplemental light (Figure 2).

Table 1. Results of statistical analyses for growth parameters measured in the experiment.

There were five treatments: 1) 10 foot spacing with lights, 2) 12 foot spacing with lights, 3) 15 foot spacing with lights, 4) 20 foot spacing with lights, and 5) control or 20 foot spacing with no supplemental lights.

Parameter	Analysis	n	P-Value	Significance
Height to grafting point	ANOVA	21	0.544	NS
Height to crotch	ANOVA	21	0.00955	**
Diameter at 1 ft from ground	ANOVA	21	0.653	NS
Diameter at 2 ft from ground	ANOVA	19	0.284	NS

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table 2. Results of statistical analyses for growth parameters measured in the experiment.

There were two treatments: 1) with lights and 2) without lights.

Parameter	Analysis	n	P-Value	Significance
Height to grafting point	ANOVA	21	0.469	NS
Height to crotch	ANOVA	21	0.0052	**
Diameter at 1 ft from ground	ANOVA	21	0.346	NS
Diameter at 2 ft from ground	ANOVA	19	0.0236	*

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

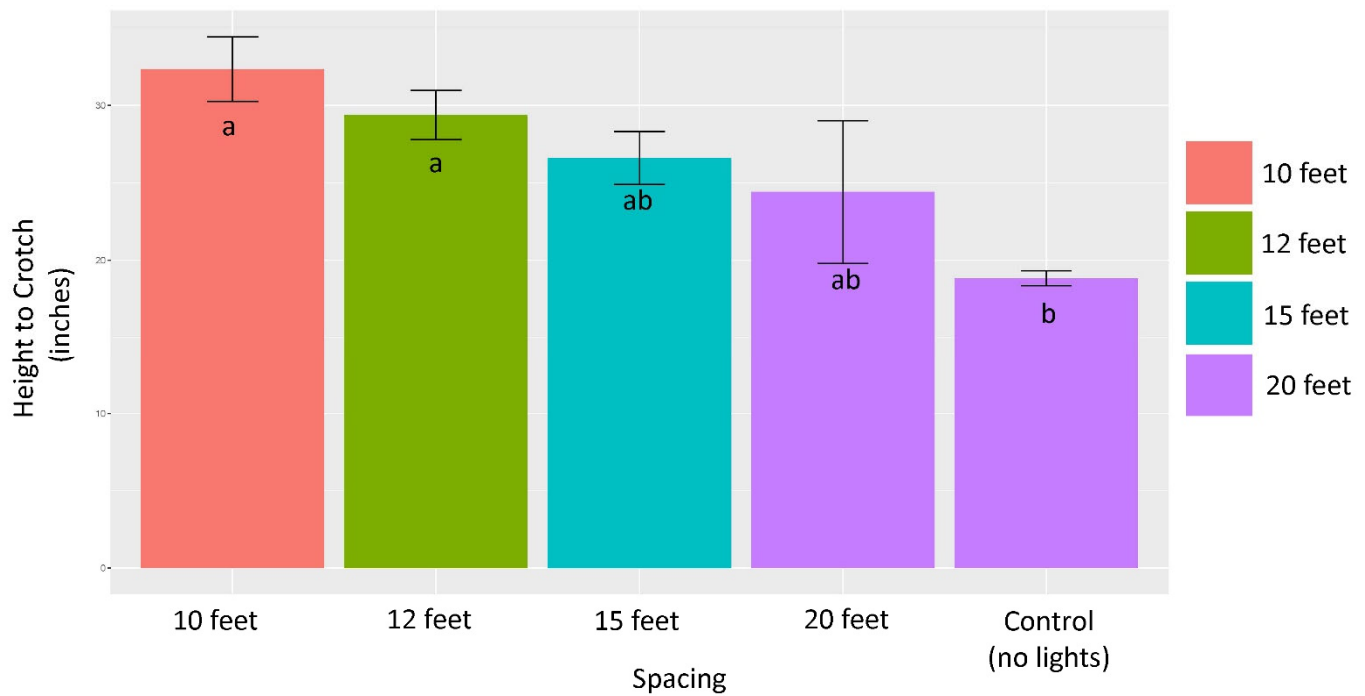


Figure 1. The effect of spacing on the height from ground to crotch (inches).

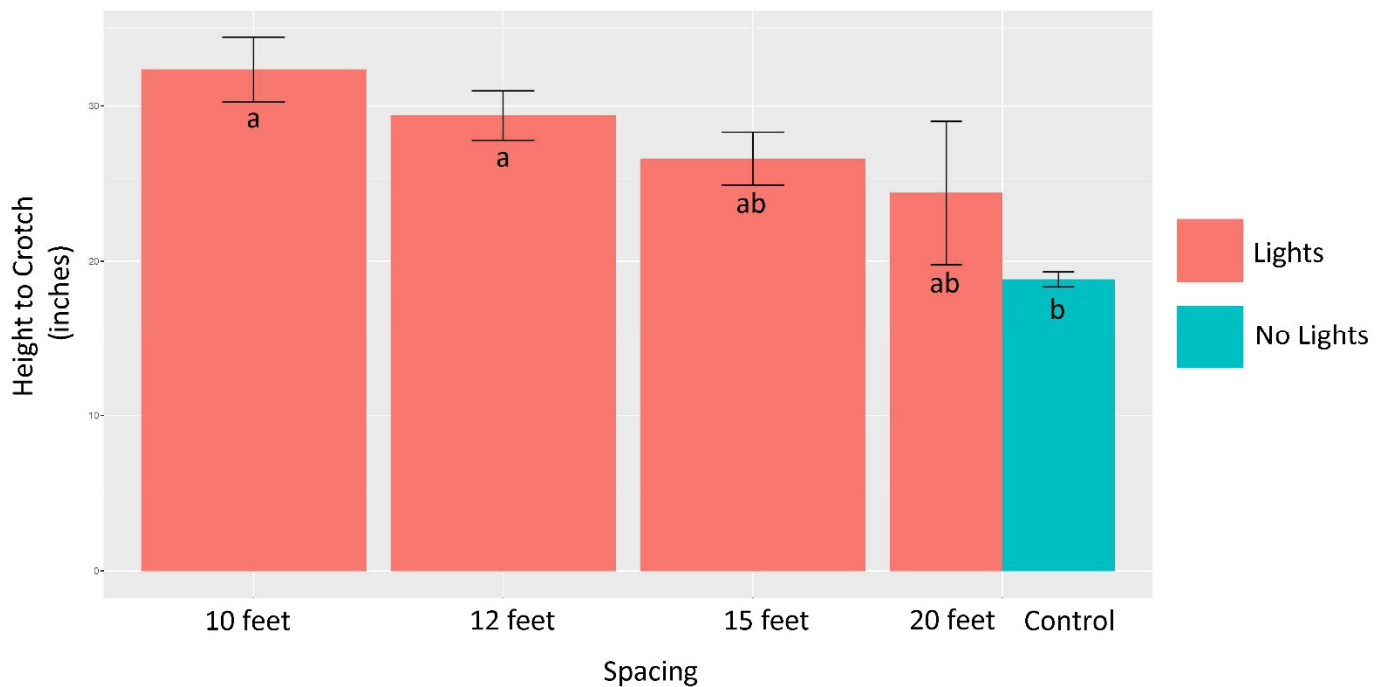


Figure 2. The effect of lighting on the height from ground to crotch (inches).

Mango Orchard with Supplemental Lighting

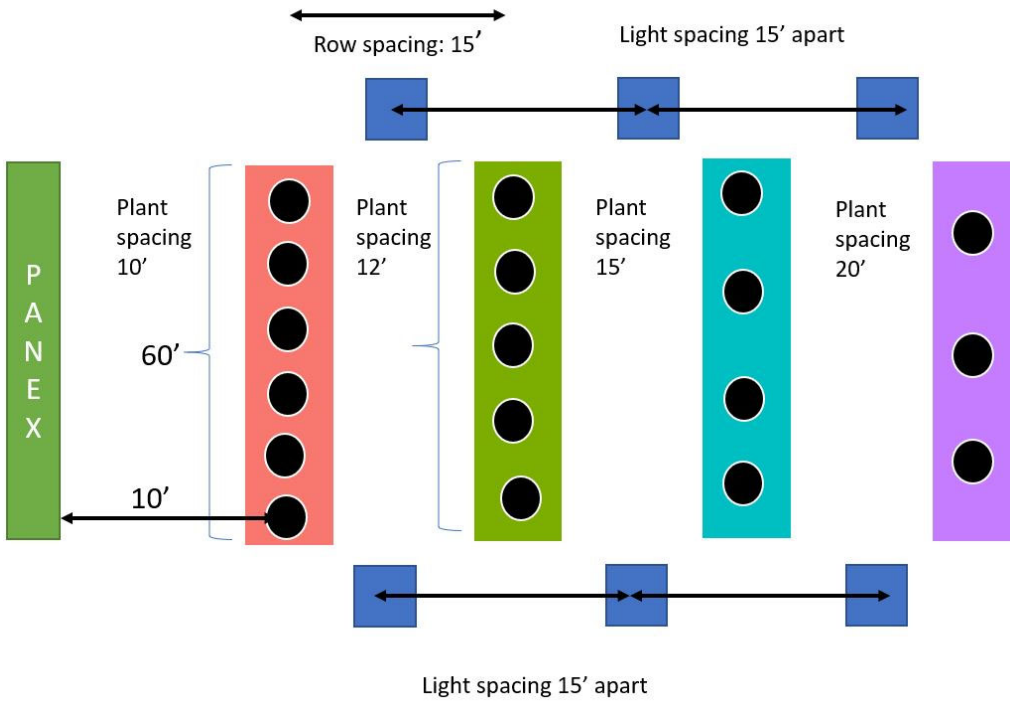


Figure 3: Illustration of LED light placement (blue squares) in relation to mango trees.



Photo 2: LED lights supplied 6 additional hours of light to mango trees grown at the Waimanalo Research Station.

Ultimately, the challenge in successfully executing high density mango plantings in Windward, Oahu is managing plant diseases. Anthracnose (*Colletotrichum gloeosporioides*) and powdery mildew (*Oidium mangiferae*) continues to affect our ability to produce quality fruit on a commercial scale. Anthracnose and powdery mildew affect the flower panicles and flowers, as a result, fruit set has been difficult due to the excessive amount of rains in 2017-2019.

Future work includes modifying the flowering season of mangoes in windward, Oahu. Flowering in Hawaii usually starts in January with fruit maturation ranging from May to September (Nagao and Nishina, 1993). Due to diseases like powdery mildew and anthracnose, Hawaii mango production is not as high as other tropical regions in the world (Nelson, 2008). By modifying the flowering season of mangoes by way of using potassium nitrate (4%) to initiate off season flowering, we anticipate increasing fruit set, productivity and reducing fungicide applications during the winter season.



Photo 3: Flowers and panicles damaged by anthracnose and powdery mildew.

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