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Cultural Practices for Vegetable and Small Fruit Crops: Using Kaolin Clay to Reduce Sprinkler Irrigation for Strawberry Transplant Establishment[1]

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Strawberry Transplant Establishment Practices

Strawberry production in Florida uses the annual hill system to supply fresh fruit to the US winter market. Most of the acreage is concentrated in Hillsborough County in West Central Florida, where fast-draining, deep, sandy soils are the norm. Growers rely on bare-root strawberry transplants to establish the crop from late September to late October. To achieve this, sprinkler irrigation is applied from 10 to 14 consecutive days for between 12 and 14 hours a day, which totals approximately 16–24 acre-inch/acre (1 acre-inch = 27,154 gal) of water for that period. The purpose of this practice is twofold: to cool down strawberry crowns to promote new root and shoot development, and to provide some soil moisture to the newly developed roots. Although the former purpose is essential to establish bare-root transplants, the latter might be unnecessary, especially because more than 95% of the water runs off plastic mulch and ends up in field drainage canals and as subsurface water.

Because of the current limitations on water usage for strawberry growers in the Plant City area of Hillsborough County, production practices aimed at minimizing sprinkler irrigation without affecting net income are desirable. At the same time, the environmental impact of applying less water to establish strawberry plants could have a significant positive effect on public perception about water conservation efforts in agriculture.

Crop protectants are mostly naturally occurring substances designed to reduce sun-scalding in fruit crops and vegetables, such as apples, pears, and peppers. Crop protectants form a white film around the target area to reflect light, reduce temperature, and "clog up" leaf stomata, all of which might reduce tissue transpiration. Kaolin clay, calcium carbonate, and wax-derived products are commonly found in commercial crop protectant products around the world. Preliminary observations conducted in strawberry fields located at the UF/IFAS Gulf Coast Research and Education Center (GCREC) indicated that foliar application of crop protectants on

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strawberry bare-root transplants to reduce sprinkler irrigation volumes might result in a potential new use for these materials (Figure 1). This document presents research results on the effect of kaolin clay application on sprinkler irrigation volumes applied to newly transplanted strawberries.

Figure 1. Strawberry field applied with kaolin clay in Balm, Florida. (Credit: B. M. Santos, UF/IFAS)

Small-Plot Studies

Two field studies were conducted at the GCREC in Balm, Florida, in a fine sand soil with very low organic matter content (< 1.5%). Planting beds were 27 inches wide at the base, 24 inches wide at the top, 10 inches high, and spaced 4 ft apart on centers. In mid-September of each season, pressed beds were fumigated with methyl bromide plus chloropicrin (67:33 v/v) at a rate of 350 lb/acre to eliminate soilborne diseases, nematodes, and weeds in the soil. A standard fumigation rig with three knives per bed was used to deliver the fumigant 8 inches deep. Within one minute of fumigation, beds were covered with black high-density polyethylene mulch (0.7 mil thick), and a single line of drip irrigation tubing (25 gal/acre/min) was buried 1 inch deep on bed centers.

'Strawberry Festival' bare-root transplants were set 15 inches apart in double rows in mid-October 2007 and 2008. Double rows were separated 15 inches apart. Seven combinations of number of days of sprinkler irrigation (4 gal/min per sprinkler; 10 hours/day) and timing of kaolin clay (Surround® WP, Tessenderlo Group, Brussels, Belgium) application were established using strawberry plots (80 plants/plot) as follows: 10 days of sprinkler irrigation (control), 8 days of irrigation plus or minus kaolin clay on the 9th day, 6 days of irrigation plus or minus kaolin clay on the 7th day, and 4 days of irrigation plus or minus kaolin clay on the 5th day. Kaolin clay was applied using a backpack sprayer calibrated to deliver 60 gal/acre of water at a rate of 25 gal/acre (Figure 2). The product was applied before 9 a.m. on the day after sprinkler irrigation was suspended. The crop was grown according to current strawberry production practices in West Central Florida.

Figure 2. Strawberry foliage applied with kaolin clay in Balm, Florida. (Credit: P. Huang, UF/IFAS)

Strawberry plant establishment and canopy plant diameter were measured three weeks after transplanting (WAT). Plant establishment was determined as the proportion of actively growing transplants from among all transplants set in the field. Plant diameter was measured perpendicular to the direction of the rows, using five randomly selected plants per plot. Early marketable fruit weight was collected starting at 10 WAT using every plant of each plot. Early marketable fruit weight was defined as the cumulative marketable weight of the first 10 harvests. Treatments were set up in a randomized complete block design with five replications. Means were analyzed with analysis of variance and compared with a Fisher's protected least significance difference (LSD) test at the 5% significance level.

Results showed that the application of kaolin clay on the strawberry foliage the following morning after either 6 or 8 days of sprinkler irrigation had the same plant establishment, plant canopy diameter, and early fruit weight as the 10-day irrigated control (Table 1). Therefore, a 40% reduction of establishment irrigation volumes can be achieved with the application of kaolin clay, which might represent major water savings for strawberry production in West Central Florida. The white film of kaolin clay dissipated within three to five weeks, and it did not show reduction in plant growth, flowering, and yields. No effects on total fruit weight were observed during the seasons (data not shown).

Table 1. Effects of length of sprinkler irrigation and timing of kaolin clay application on the plant establishment and canopy plant diameter at three weeks after transplant, and early marketable fruit weight for the first 10 harvests

Establishment program	Plant establishment[1]	Canopy diameter	Early fruit weight
	(%)	(cm)	(ton/acre)
10 days of sprinkler (control)	99 a	18 a	3.5 a
8 days of sprinkler	88 b	18 a	2.9 b
8 days of sprinkler + kaolin clay on the 9th day	99 a	18 a	3.6 a
6 days of sprinkler	79 b	17 a	2.8 b
6 days of sprinkler + kaolin clay on the 7th day	98 a	17 a	3.5 a
4 days of sprinkler	57 c	13 b	1.6 d
4 days of sprinkler + kaolin clay on the 5th day	81 b	17 a	2.3 c
Significance ($P < 0.05$)	*	*	*

[1]Values followed by the same letter do not statistically differ at the 5% level. Data combined from two seasons in Balm, Florida.

Large-Field Validations

Field validations were conducted in growers' fields in 2009 and 2010 to determine strawberry plant establishment with kaolin clay treatments. In 2009, a 5-acre field was used in Hillsborough County, whereas six growers' fields in Hillsborough, Manatee, and Polk Counties were used in 2010. Fields were treated with either 10 days of sprinkler irrigation or 7 days of sprinkler irrigation followed by kaolin clay on the 8th day. Rates and application procedures were similar to that which was used for the small-plot studies. Kaolin clay was diluted in a water volume of 100 gal/acre and applied on the foliage with a conventional, tractor-mounted sprayer.

The results demonstrated that the application of 70% of the sprinkler irrigation volume traditionally used by strawberry growers followed by foliar application of kaolin clay on the morning of the 8th day could save a significant water volume (30%) while achieving the same plant establishment and early yields (Table 2). If this practice were to be implemented, approximately 40,000 acre-inches of water would be saved in 8,300 acres of strawberries in Hillsborough County.

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Table 2. Effects of irrigation programs on strawberry plant establishment in growers' fields, 2009-10 and 2010-11 seasons, Hillsborough, Polk, and Manatee Counties, Florida

Establishment program	Grower number	Cultivars	Plant number	Plant establishment[1]
				(%)
2009-10				
10 days of sprinkler (control)	1	'Treasure'	1200	99.3 a
7 days of sprinkler + kaolin clay on the 8th day			1200	99.4 a
Significance ($P < 0.05$)				NS
2010-11				
10 days of sprinkler (control)	6	'Treasure', 'Strawberry Festival'	7645	99.2 a
7 days of sprinkler + kaolin clay on the 8th day			7645	98.8 a
Significance ($P < 0.05$)				NS

[1]Values followed by the same letter do not statistically differ at the 5% level. NS = nonsignificant differences.