The Effect of UV-Reflective Mulching on Yield and Quality of Cantaloupes

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Abstract

Three trials, one during Fall 2003 season and two during the spring 2004, were conducted at the Yuma Agricultural Center to investigate the influence of UV reflective mulching on yield and quality of cantaloupes. We report here results from the first two trials. The results showed that reflective mulching increased the total number of fruits by over 25%. The silver film allowed early harvesting, it produced fruits with higher content of soluble solids (°Brix), pulp with more intense color, and early-harvested fruits with higher content of vitamin C. This technique seems promising for the production of melons and probably other cucurbits but the grower is ultimately the one who needs to determine whether the economical return, associated with the mulch, compensates the costs of implementing it in their fields.

Introduction

Mulch technology for vegetable production has been studied and commercially used for several decades with diverse results. UV-reflective mulches are one of the most recent additions of the mulch industry. It is thought that plants grown with reflective films have higher CO_2 fixation and larger amount of assimilation products translocated to roots and leaves than in regular mulches. Currently, in western Arizona and southern California UV-reflective mulches are not used, and mulches in general are rarely observed in the fields. In other areas, reflective mulches are used to enhance color of fruits, accelerate plants' growth, and repel insects.

Most of the research in the Southwest has been done to evaluate reflective mulches as an insect repellent. Very little has been done on the effect of brilliant silver mulches on quality of melons. With this study we aimed to fill that lack of information, especially considering that light conditions in Arizona could be ideal to enhance benefits of light-reflective mulches. The main objective was then to evaluate the effect of UV reflective films on cantaloupes yield and quality.

Materials and Methods

Melons were grown at the Yuma Agricultural Center. In two of the trials the cantaloupes were cultivated on beds of approximately 50 ft using drip irrigation. In a third study the cantaloupes were grown in a 1-acre field, on beds of approximately 600 ft and using furrow irrigation.

Timing of drip irrigation was determined according to soil conditions. The beds with reflective mulches used only 2/3 of the water compared to that used by the control beds. The plants were directly seeded in the furrow-irrigation trial, whereas transplants were used for the drip irrigation trials.

At first harvest, the plots were evaluated for: 1) weight; 2) number of fruits; 3) number of ripe fruits; 4) number of non-ripe fruits; 5) soluble solids using a digital refractometer; 6) resistance to penetration using a penetrometer with pounds force (lbf) as units; 7) color using the L*, a*, *b units of a Minolta chromameter, were L* indicates dark (0) to light (100) color, a* indicated green (negative) to red (positive) and b* indicates blue (negative) to yellow (a*) and; 8) Vitamin C. The analysis of ascorbic acid content (Vitamin C) was conducted at the Vegetable Quality Lab of the Yuma Agricultural Center. Each sample was carried out in duplicate on tissue pulp homogenized using a pestle and mortar. Twenty grams of homogenate was mechanically stirred in 60 ml of a 5%

solution of metaphosphoric acid for 15 minutes. The mixture was filtered (Whatman No 541), and the filtrate was diluted to 100 ml with HPLC grade water. An aliquot of the acid extract was then filtered through 0.45 um PTFE membrane prior to injection into the HPLC. The HPLC apparatus used was a Reverse Phase Shimadzu liquid chromatograph equipped with KC-10Atvp pump system and a UV-Vis detector. The column was a Restek C_{18} (150 x 4.6 mm) of 5 um particle size. The mobile phase consisted of solvents A: HPLC grade water brought to pH 2.2 with metaphosphoric acid and B: 100% methanol. Isocratic gradient at 100% solvent A was kept during the first 10 minutes, changing to 100% methanol in two minutes and maintained at this level for four minutes; the gradient was back to 100% solvent A in one minute, remaining at this point for three minutes to complete 20 minutes. Flow rate was 0.8 ml/min and the detection wavelength was 245 nm.

Each experiment was arranged in a completely randomized design. Data were subjected to analysis of variance (ANOVA) at $p \leq 0.05$ to determine statistical significance. Mean comparisons were conducted using Fisher's Protected LSD Method at $p \leq 0.05$.

Results and Discussion

In the first trial the mulch treatment had nearly 25% more fruits than the control (Figure 1). It was also evident that the mulch system accelerated growth, since at an early harvest we recorded over 30% more weight per fruit in the mulch treatment than in the control (data not shown).

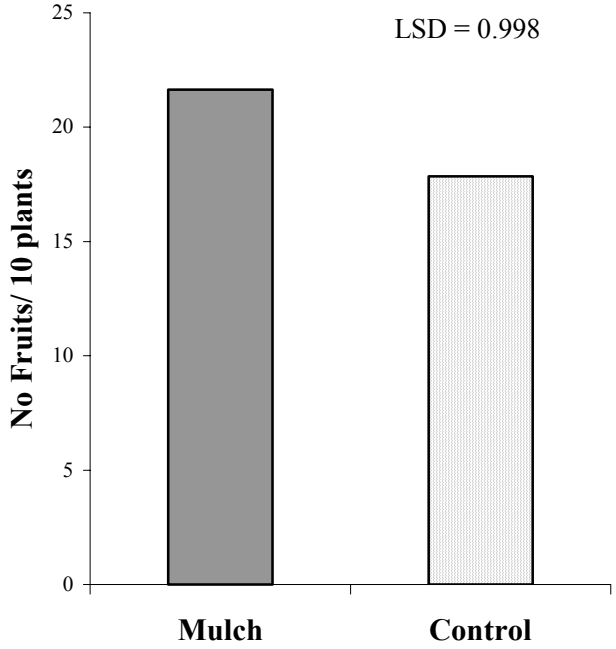

Figure 1. Effect of reflective mulching on yield of cantaloupes (number of fruits) in a trial conducted during Fall 2003.

In the second trial, the number of fruits in the mulch treatment was also higher than that in the control. The mulch treatment showed over 35% more fruits than the control. Interestingly, the difference in the number of fruits was essentially with fruits that were ready to harvest at an early date. At first harvest, the number of ripe fruits in the mulch treatment was 4 times that in the control. This confirmed previous findings that showed that reflective mulching accelerates plants' growth, resulting in early harvesting. The fruits from the mulched plots were also sweeter (higher ºBrix), and had higher content of Vitamin C. It was also interesting to observe that the pulp color

of the control was lighter (L*) and more yellow (b*) than that of the treatment, indicating that the mulched fruits had a more intense pulp color at harvest. No differences were found in resistance to penetration and fruit weight (Table 1)

Table 1. Effect of UV-reflective mulch on yield and quality of cantaloupes at harvest.

Parameter of Evaluation	**UV Reflective Mulch**	**Control**
Number of Fruits (Average/30 ft)	70.2 a	50.5 b
Number of Ripe Fruits (Average /30 ft)	21.8 a	5.0 b
Number of Non-ripe Fruits (Average/30ft) ns	48.4	45.5
Weight per Fruit (g) ns	1543.8	1415.8
Soluble Solids (ºBrix)	11.7 a	10.5 b
Resistance to Penetration (lbf) ns	4.4	5.5
Minolta L* (dark to light)	57.4 a	59.5 b
Minolta a* (green to red) ns	12.6	13.2
Minolta b* (blue to yellow)	32.3 a	33.7 b
Vitamin C (mg Ascorbic Acid/100 g Fresh Weight)	38.4 a	24.9 b

ns indicates no significant differences among treatments (P=0.05)

The effect of reflective mulch on the number of fruits was consistent in the first two trials. Some researchers have suggested that UV light repels some insects, but it can be alluring to others such as bees and wasps, which could partially explain the higher number of fruits obtained with the mulch. These trials were conducted without placing bee hives in the fields, thus, the pollination was dependant on bees from surrounding farms. This factor will be considered for future trials.

Early harvesting seems to be a clear result of using UV-reflective mulches. Moreover, the fruits in the first harvest showed higher quality, in terms of sweetness, pulp color and vitamin C content. The fact that the pulp color was more intense, or more "orange", may be an indicative of a higher content of Beta carotene, a parameter that will be evaluated in future experimentation. Although vitamin C content was higher in the mulch treatment, our preliminary results with melons stored in a cool room for one week showed similar content (data not shown). This has also been observed in tomatoes and could be due to the fact that as more sugars, such as D-mannose and L-galactose, are formed, more ascorbic acid can be synthesized in the pulp.

Our results indicate that reflective mulching could be economically feasible for the growers of this area. Although the costs of implementing this technology is high, ranging between $350 and $500 per acre (including installation and removal of the mulch), our preliminary results suggest that the economical benefit could surpass those numbers. Other potential benefits could be the reduction in water, herbicide and pesticide usage. At the time this

report was written, results from: 1) the postharvest storage evaluation in the second experiment and 2) a third experiment evaluating different types of UV-reflective films compared to a black mulch and a control, had not been processed. These and future results from a study planned for this 2004 fall will help determine with more accuracy the benefits of UV-reflective mulching under the Yuma conditions.

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