

DRIP IRRIGATION LEVELS AFFECT PLANT GROWTH AND FRUIT YIELD OF BELL PEPPER

Juan C. Diaz-Perez

AUTHOR: Associate Professor, UGA – Horticulture, 4604 Research way UGA Tifton Campus, Tifton, Georgia 31793-0748, 229-391-6861
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Abstract Bell pepper (*Capsicum annuum* L.) plants have a high demand for water and nutrients and are particularly sensitive to water stress during the establishment period and fruit setting. High levels of irrigation are often applied in order to maximize yields. However, field observations suggest that excessive irrigations may negatively affect bell pepper plants. The objective of this study was to evaluate the effects of irrigation rate on plant growth and fruit yield. The trial was conducted the Coastal Plain Experiment Station, Tifton, Ga. Drip-irrigated bell pepper (“Stiletto”) plants were grown on black plastic mulch in 1-m wide beds (1.8 m- centers). Plants were irrigated with an amount of water that ranged from 33% to 167% the rate of evapotranspiration (ET), adjusted by crop stage of development. Soil moisture content (% by volume) over the season was continuously monitored with time domain reflectometry sensors connected to a datalogger. The results showed that the average soil moisture content for the season increased with increasing rates of irrigation. Vegetative top fresh wt. and marketable fruit yield were reduced at both, low (33% ET) and high (166% ET) rates of water application. However, irrigation rate had a stronger effect on fruit yield than on top fresh weight. Plants supplied with high irrigation rates appeared to be more chlorotic compared to plants irrigated at medium rates (100% ET). There was a tendency for higher incidences of soil borne diseases (*Pythium* spp., *Phytophthora capsici*) in plants receiving higher rates of irrigation. The conclusion is high irrigation rates ($\geq 166\%$ ET) are not recommended since they waste water and may result in both, higher incidences of soil-borne diseases and reduced bell pepper yields.

INTRODUCTION

The Vegetable industry in Georgia is rapidly growing and had a farm gate value of about \$900 million in 2007. Bell pepper was produced in about 5,900 acres and had a value of \$100 million. About 75% of the total bell pepper acreage is under plastic film mulch and drip irrigation.

The use of drip irrigation and plastic film mulch has been associated with increases in yield and quality of vegetables. Bell pepper (*Capsicum annuum* L.) plants have a high demand for water and nutrients and are par-

ticularly sensitive to water stress during the establishment period and fruit setting. High levels of irrigation are often applied in order to maximize yields. However, field observations suggest that excessive irrigations may negatively affect bell pepper plants. The objective of this study was to evaluate the effects of irrigation rate on plant growth and fruit yield.

MATERIALS AND METHODS

The experiment was conducted at the Coastal Plain Experiment Station, Univ. of Georgia, Tifton, Georgia. The soil was a Tifton Sandy Loam (a fine loamy, siliceous thermic Plinthic Paleudults) with a pH of 6.0-6.5. Before laying the plastic film mulch (black, PlastiTech , Canada) with a tractor and a mulch layer, the soil was fertilized with 900 kg/ha of 10-10-10 fertilizer and fumigated with a mixture of 67 methyl bromide: 33 chloropicrin (by weight) at 336 kg/ha. Drip irrigation tape (Roberts Ro-Drip, 20-cm emitter spacing and a flow rate of 0.49 L/h per emitter) was placed 5 cm below the soil surface.

Bell pepper (*Capsicum annuum* L. cv. Stiletto) seedlings from Lewis Taylor Farm (Tifton, Georgia, USA) were planted in the spring on beds formed on 1.8-m centers, with two rows per bed and 30 cm spacing between plants. The cultivar Stiletto was used because of its resistance to Tomato spotted wilt, an important viral disease in Georgia. Starting two weeks after transplanting, plants were fertilized weekly for 11 weeks. Total major nutrients applied were 250 kg/ha (N), 111 kg/ha (P), and 243 kg/ha (K).

Bell pepper plants were irrigated with an amount of water that ranged from 33% to 167% the rate of evapotranspiration (ET), adjusted by crop stage of development. Soil moisture content (% by volume) over the season was periodically (every 10 min) monitored with time domain reflectometry sensors (CS-610, Campbell Scientific, Logan, Utah) connected to a datalogger (CR-10X, Campbell Scientific, Logan, Utah). The moisture sensors had three metallic 30-cm rods and were inserted vertically within the row between two plants. Fruit were graded according to USDA grading standards as marketable and cull.

Statistical analysis. Data were analyzed using the General Linear Model Procedure of SAS (SAS Institute Inc., 2000), using the Duncan's multiple range test to separate the treatment means.

RESULTS AND DISCUSSION

The average soil moisture content for the season increased with increasing rates of irrigation (data not shown). This is an indication that the sensors were able to detect the differences in irrigation water applied. The average soil moisture content was 8% (at 33% ET) and 14% (at 166% ET). These results suggest that bell pepper may be able to tolerate mild levels of water stress without reductions in fruit yield. A study showed that bell pepper growth without supplemental irrigation over the first part of the vegetative cycle does not impair plant growth and may even be useful to improve yield of early fruit {Delfine, 2001 #548}.

Fresh weight of the vegetative plant top (data not shown) and marketable fruit yield (Fig. 1) were reduced at both, low (33% ET) and high (166% ET) rates of water application. However, irrigation rate had a stronger effect on fruit yield than on vegetative top fresh weight. Plants supplied with high irrigation rates were visually more chlorotic compared to plants irrigated at medium rates (100% ET). There was a tendency for higher incidences of soil borne diseases (*Pythium* spp., *Phytophthora capsici*) in plants receiving higher rates of irrigation. In a study in Florida it was found that bell pepper yields were highest at 133% the rate of evapotranspiration (Simonne et al., 2006).

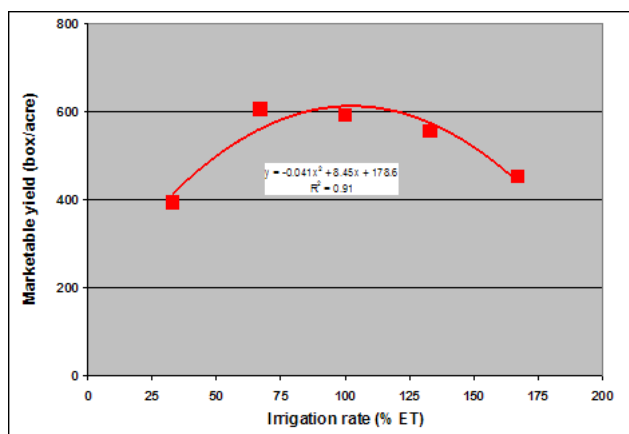


Figure 1. Relationship of marketable yield of bell pepper with irrigation rate

CONCLUSIONS

Highest bell pepper yield were found in plants irrigated between 66% and 133% the rate of evapotranspiration. High irrigation rates ($\geq 166\%$ ET) are not recommended because they result in reduced water use efficiencies, diminished bell pepper yields, and in increased incidences of soil-borne diseases.

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