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Bell Pepper Production under Protective Structures: Evaluation of Soilless Media and Container Types

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Bell pepper (*Capsicum annuum*) production in Central America and the Caribbean has become one of the main agricultural activities for exporting into the U.S. and Europe. To guarantee constant supply and quality, small and medium-size growers could use structures, such as greenhouse and high tunnels. Crop irrigation and fertilization are influenced by the growing media and the wrong selection of the media may increase fruit and flower abortion, lower fruit number and size, and thus increase postharvest losses. This study was conducted to assess the performance of three media and three container types on the growth and yield of bell pepper under a net house. The media used were pine bark, coconut coir, and potting mix (Fafard Mix 2) combined with boxes (2.6 gal/plant), bags (2.7 gal/plant), and pots (2.5 gal/plant). Marketable yields were measured for four harvests. The results showed that there was significant interaction between media and containers. Potting mix in pots, bags, and boxes, pine bark in bags, and coconut coir in boxes, and bags had the highest marketable fruit weight followed by coconut coir in pots and pine bark in pots, pine bark in boxes had the lowest yields.

In the U.S., bell pepper (*Capsicum annuum* L.) sales were around $634 million and production reached 786,950 tons in 2010. In the state of Florida, bell pepper production was 203,550 tons and the revenues were $295 million (USDA, 2011). High value, colored bell peppers should be grown inside greenhouses to improve quality and color. Greenhouses are generally used to protect the crop from rain, wind, and excessive solar radiation. On the other hand, they help controlling pests while keeping beneficial insects within the structure. Finally, depending on weather conditions, greenhouses may help regulating the temperature of the soil or the growing medium (Jovicich, 2004). Nethouses are structures with a comparable functionto that of a greenhouse, aiming to reduce the incidence of sunlight during the day and moderate temperatures during cold nights through the use of white, black, or colored nets (Santos, 2010). A common practice inside the greenhouses is the use of non-mineral growing media or substrates. The advantages of substrates range from better use of water and fertilizer, due to its greater holding capacity and reduction of soilborne diseases (Ansorena Miner, 1994; Rodriguez, 2006). The container shape also may influence water movement, which will affect water retention of the medium-container combination (Ansorena Miner, 1994). The objective of this study was to determine the effect of media and container types on the growth and yield of bell pepper under a protective structure.

Materials and Methods

A field study was conducted between Feb. and June 2011 at the Gulf Coast Research and Education Center of the University of Florida in Balm. The media used were pine bark, coconut coir, and potting mix. Pine bark was 1 inch in diameter (Elixson Wood Products, Starke, FL). Potting mix no. 2 mix (Fafard, Agawam, MA), which is a combination of sphagnum peat moss (65%), perlite, vermiculite, and dolomitic limestone, with a pH ranging between 5.5 and 6.5 after medium hydration. Fine-grade coconut coir was used (Botanicoir, London, UK). The container types were wooden boxes with a volume of 42 gal, plastic bags of 10.8 gal, and plastics pots of 2.5 gal. All these containers provided between 2.5 and 2.7 gal of medium per plant. Transplants of 'Revolution' determinate bell pepper were set on 23 Feb. 2011 in double rows with 9 inches between plants.

The irrigation was adjusted to the crop requirement, stage of growth, and evaporative demand in terms of the reference evapotranspiration (ETo) from the historical daily averages determined with the Penman method for west-central Florida (Simonne et al., 2011). The amount of water applied during the season was 23.1 gal per plant. This water volume was applied in four daily frequencies between 8 AM and 6 PM. There was no irrigation of the treatments during raining days. The irrigation emitters had a flow of 0.0417 gal per emitter and the uniformity coefficient of the system was 74%. Drip fertilization, irrigation and pest control followed current guidelines for the crop (Olson et al., 2011). The first flower blossom in all treatments occurred at 2 weeks after transplanting (WAT). Plants were tied at 4 WAT.

Nine treatments resulted from the combinations of three containers and three media: 1) potting mix in bags, 2) potting mix in boxes, 3) potting mix in pots, 4) coconut coir in bags, 5) coconut coir in boxes, 6) coconut coir in pots, 7) pine bark in bags, 8) pine bark in boxes, and 9) pine bark in pots. Treatments were arranged in a randomized complete- block design with four replications. Experimental units had 16 plants per plot in a 16.5-ft^2 plot. Pepper marketable weight was recorded from four harvests from 10 May to 2 June 2011. Fruit were harvested when more than 50% of the skin color started changing from dark green to red. Desirable marketable fruit characteristics were "boxy" shape

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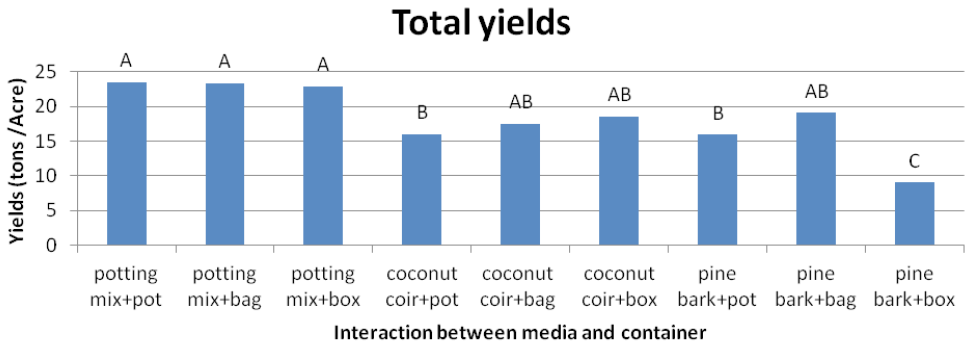

Fig. 1. Effect of the interaction of media and containers on bell pepper yields. Balm, FL, 2011. Values followed by the different letters were different at the 5% significance level based on Fisher's protected LSD test.

with no deformations and no insect, disease, or mechanical damage. Marketable fruit weight was collected weekly from each plot and a total of four harvests were done. Data were analyzed with analysis of variance ($P < 0.05$) and treatment means were separated with Fisher's-protected least significant (LSD) difference test.

Results and Discussion

There was significant interaction between media and containers on pepper fruit weight. There were no fruit weight differences in treatments with potting mix in pots (12.8 ton/acre), potting mix in bags (12.7 ton/acre), potting mix in boxes (12.4 tons/acre), pine bark in bags (10.4 ton/acre), and coconut coir in boxes (10.1 ton/acre), and coconut coir in bags (9.5 ton/acre). Treatment of pine bark in boxes had the lowest yields with 4.9 ton/acre (Fig. 1).

The differences among treatments could be related to the water retention capacity and water movement within each system. Ansorena Miner (1994) indicated that the water retention of a medium was related to the height of the container, with shallower containers tending to retain more water than deep ones given the same medium volume. In pine bark, lateral water movement was restricted due to the large openings that reduce capillarity in comparison with coconut coir and potting mix. This condition probably affected water and thus nutrient availability for the plant on the first stages of the crop, which could cause a delay in plant development and low yields. Further research should be conducted to evaluate the water movement within pine bark, coconut coir, and potting mix and the effects of container size and configuration on crop growth and yields.

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