

Determining Optimum Planting Dates for Intercropped Cucumber, Squash, and Muskmelon with Strawberry

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Three field trials were conducted to determine the most appropriate planting dates for cucumber (*Cucumis sativus* L.), summer squash (*Cucurbita pepo* L.), and muskmelon (*Cucumis melo* L.) intercropped with strawberry (*Fragaria xananassa* Duch.), and their effect on 'Strawberry Festival' strawberry yields. 'Straight Eight' cucumber, 'Crookneck' summer squash, and 'Athena' muskmelon were planted 15 days apart on 25 Jan., 9 Feb., 23 Feb., 9 Mar., and 23 Mar. None of the three intercropped species affected strawberry yield up to 60 days before the end of the season on 25 Mar. Cucumber yield responded quadratically to planting dates, rapidly increasing from 25 Jan. to 23 Feb. (approximately 67%), reaching the maximum yield between 23 Feb. and 9 Mar., and declining afterwards. Warmer temperatures seemed to favor summer squash yield, performing better at or after 23 Feb. Planting the crop as early as 25 Jan. reduced yields by 36%, in comparison with those obtained in plots planted on 23 Feb. The opposite tendency was observed with muskmelon, reducing yield as temperatures increased. The largest production was measured when the crop was planted on 25 Jan. and 9 Feb., which was 27% higher than the yield on 23 Feb. In summary, cucumber and summer squash seemed to be favored by planting under warmer temperatures, whereas muskmelon thrives under cooler weather.

Florida is the second largest strawberry-producing state in the United States. The growing season takes place between October and March, with a planted area of approximately 7400 acres and a gross sales value of \$239 million (U.S. Department of Agriculture, 2007). Although market prices usually determine the length of the strawberry season, most growers agree that early yields provide the highest profits per unit, with prices generally declining at the end of February.

The majority of strawberry growers in Florida plant a second crop between 4 and 6 weeks before the end of the season to take advantage of the existing mulch beds, residual fertilizer, drip irrigation lines, and low pest pressure. Among the most frequently intercropped species are cucumber, summer squash, and muskmelon, which are directly seeded between double rows of strawberries. This allows growers to have earlier access to cucurbit markets in comparison with each crop planted separately (Duval, 2005). Previous research showed that when cucumber, summer squash, and muskmelon are planted during the last week in February (31 d before the end of the strawberry season) there is no significant reduction of strawberry yields (Duval, 2005). However, the effect of different planting dates on the yield of the second crops was not addressed.

Another important issue is the weather during January and February in Florida, when freezing temperatures regularly occur. There is a current tendency among growers to intercrop earlier than the last week in February. However, no research has been conducted to address that issue. Early cucurbit planting could expose young seedlings to unfavorable growing conditions. The objective of

this study was to determine the most appropriate planting dates for cucumber, summer squash, and muskmelon intercropped with strawberry, and their effect on strawberry yields.

Materials and Methods

Two field studies were conducted between Oct. and Mar. 2006 and 2007 at the Gulf Coast Research and Education Center of the University of Florida. The soil was a sandy, siliceous, hyperthermic Oxyaquic Alorthod with 1.5% organic matter and pH 7.3. Fields were planted on 6 Oct. 2005 and 4 Oct. 2006 with bare-root transplants of 'Strawberry Festival'. Planting beds were 32 inches wide at the base, 28 inches wide at the top, 8 inches high, and spaced 4 ft apart on centers. Pressed beds were fumigated with methyl bromide plus chloropicrin (67:33 v/v) at a rate of 350 lb/acre, fertilized with 50 lb/acre of a 15N–0P–30K granular formula, and covered with black high-density polyethylene mulch. A single drip irrigation line (T-Tape Systems International, San Diego, CA) was buried 1 inch deep on the bed center. Plant nutrients were supplied to the crop through the drip lines following statewide recommendations (Peres et al., 2006). Strawberry plots were 20 ft long and plants were in double rows with 15 inches between plants. Overhead sprinkler irrigation was used for freeze protection. During 2006, there were two freezing events on 13 and 14 Feb., and the following season freezing temperatures occurred on 17 Feb. Average monthly temperatures surpassed 60 °F after March in 2006 and 2007, steadily increasing over time and reaching a maximum of 95 °F in June during both seasons.

Seeds of 'Straight Eight' cucumber, 'Crookneck' summer squash, and 'Athena' muskmelon were planted 15 d apart on 25 Jan., 9 Feb., 23 Feb., 9 Mar., and 23 Mar. Each species was planted in separate experiments. Cucumber seeds were planted 1 ft apart,

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while summer squash and muskmelon were established 2 ft apart. In all three experiments, the treatments were distributed in a randomized complete-block design with six replications. To determine the effect of the intercropped species on strawberry, strawberry marketable yields were collected on each plot beginning on 25 Jan. (16 harvests), regardless of the planting dates. Marketable fruits of cucumber and summer squash were collected six times, whereas muskmelon plots were harvested four times. Data for each species were examined separately and regression analysis was used to determine the relationship between planting dates and marketable yields of each crop (SAS Institute, 2000). Standard errors were used to separate means of observed values.

Results and Discussion

There was no significant treatment by season interaction; thus data from the two seasons were pooled for analysis. None of the three intercropped species affected strawberry yield up to 60 d before the end of the season on 25 Mar. (data not shown). This confirms and expands previous results, indicating that the competition of these cucurbits against strawberry is negligible when the plants are at least 12 weeks old (Duval, 2005). Planting dates significantly affected cucumber, summer squash, and muskmelon yield. Cucumber yield responded quadratically to planting dates, rapidly increasing from 25 Jan. to 23 Feb. (approximately 67%), reaching the maximum yield between 23 Feb. and 9 Mar., and declining with later plantings (Fig. 1).

Warmer temperatures seemed to favor summer squash yield, performing better at or after 23 Feb. (Fig. 2). Planting the crop as early as 25 Jan. reduced yields by 36%, in comparison with those obtained in plots planted on 23 Feb. There were no significant yield differences among the 23 Feb., and 9 and 23 Mar. planting dates. The opposite tendency was observed with muskmelon, reducing yield as temperatures increased (Fig. 3). The largest production was measured when the crop was planted either on 25 Jan. and 9 Feb., which was 27% higher than the predicted yield for the 23 Feb. planting date.

In summary, planting dates caused very distinctive responses of the three cucurbit species tested in this study. Cucumber and summer squash seemed to be favored by planting under the later warmer temperatures, whereas muskmelon thrives under earlier plantings during cooler weather. It is worth noting that muskmelon growing season is at least 20 d longer than those for cucumber and summer squash, which exposes reproductive vines to excessively high temperatures (>90 °F) in May and June, potentially causing flower abortion and low pollination. Thus, growers would benefit by planting muskmelon early.

Literature Cited

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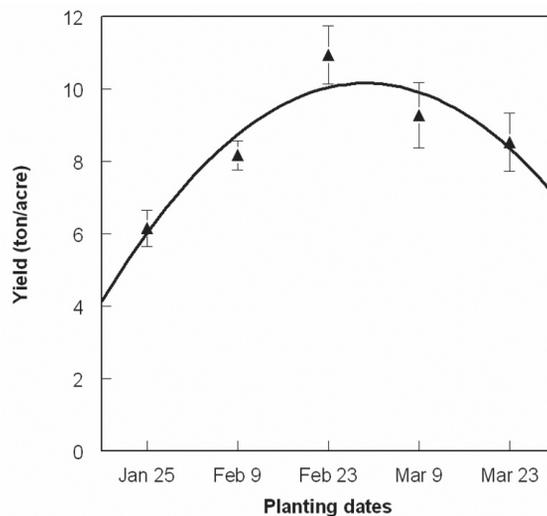


Fig. 1. Effects of planting dates on the yield of intercropped cucumber with strawberry. Regression equation is $y = 6.02 + 0.2288x - 0.0032x^2$.

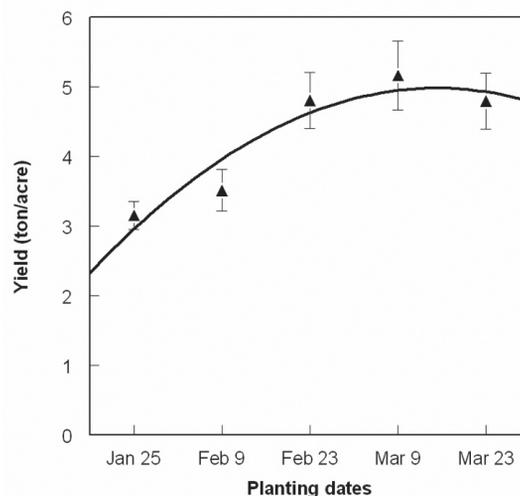


Fig. 2. Effects of planting dates on the yield of intercropped summer squash with strawberry. Regression equation is $y = 2.95 + 0.0784x - 0.0008x^2$.

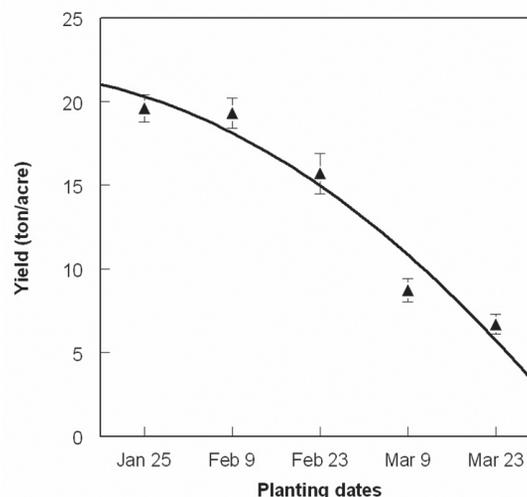


Fig. 3. Effects of planting dates on the yield of intercropped muskmelon with strawberry. Regression equation is $y = 20.31 - 0.1126x - 0.0022x^2$.