Response of Muskmelon to Within-row Plant Spacing

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Introduction

The yield response of muskmelons to plant spacing has been investigated in Arizona (3), California (2,6) and Florida (5), but very little research, if any, has been conducted in other areas of the United States

Davis and Meinhert (2) and Frazier (3) reported that the total yield and number of marketable fruits were the greatest when Powdery Mildew Resistant (P.M.R.) No. 45 cantaloupe plants were spaced 30 cm apart in rows 1.8 m apart. Lazin and Simonds (5) found that increasing distance between plants (decreasing plant population) increased the number of fruits per plant and mean fruit weight but decreased the total number and weight of muskmelon cvs. Earli-Dew and TAM-Dew Improved. Holliday (4) explained the relationship between plant population and crop yield for fruiting crops as a parabolic curve. With this type of curve, a certain plant population gives a maximum yield, while larger or smaller populations give lower yields (4).

This study evaluated the effects of 25, 50, 75, and 100 cm within-row plant spacings in rows 2.7 m apart on stem length, leaf area, dry matter, soluble solids, marketable yield, number of culls and marketable fruit, yield per plant, fruits per plant, fruit weight, and nutrient content of muskmelon cvs. Burpee Hybrid and Classic on a southwestern Indiana sandy loam, mixed, mesic Typic Hapludalf soil in 1982 and 1983.

Materials and Methods

Field investigations were conducted in 1982 and 1983. The 15 cm of soils had a pH of 5.7 to 6.5, 155 to 220 kg/ha available P (Bray P-1), and 260 to 335 kg/ha available K (1N ammonium acetate extractable), as determined by the Purdue soil testing laboratory (1). The preplant fertilizer application consisted of 112, 25, and 140 kg/ha of N, P, and K, respectively. Plots were sidedressed with 50 kg/ha N five weeks after transplanting. Granular furadan (Carbofuran) and prefar (Bensulide) were applied preplant at the recommended rates for insect and weed control, respectively. Black plastic mulch, 120 cm wide by 32 μ m thick, and drip irrigation hose (3.55 1/hr/m Tri-Wall® 0.15 mm) with orifices 31 cm apart were simultaneously applied.

The experimental plots were established in a complete randomized block design with 4 replications and each of the 4 treatments, e.g., 25, 50, 75, and 100 cm distance between plants, was randomly assigned to a 16 x 2.7 m plot. Three-week-old greenhouse raised plants (three-leaf-stage) of muskmelon cvs. Burpee Hybrid in 1982 and Classic in 1983 were transplanted on May 13 each year. Guard rows were planted on both ends of the experimental area.

A 7-10 day spray schedule was followed throughout the growing period for disease and insect control. Plots were kept weed free by hand hoeing. All plots were trickle irrigated until tensiometer readings at 30 cm depth reached 33 kPa.

Surface soil samples (0 to 15 cm) and petioles of first fully-expanded leaf near the growing point were sampled 5 weeks after transplanting in 1983 and analyzed (1).

Harvest data on weight and number of marketable muskmelons were collected daily. The muskmelons were analyzed for total solids using Bausch and Lomb refractometer. Unmarketable muskmelons were culled and no data on culling were recorded in 1982. During the 1983 growing season, data on number of culls were recorded.

Results and Discussion

Stem length. Total stem length per vine measured 32 days after transplanting for 'Classic' muskmelon in 1983 increased from 215 to 368 cm with the increase in within-row plant spacing from 25 to 100 cm. Stem length response to within-row competition was expressed by the equation $Y = 175 + 2.019X$ (Figure 1A) or quadratic equation $Y = 132 + 3.708X - 0.0136X^2$, which suggests that muskmelon stem growth is a function of within-row plant spacing.

It is interesting to note that the quadratic equation predicts a maximum stem growth of 384 cm at 130 cm within-row plant spacing. Since the maximum was outside the parameters of this study, the quadratic equation cannot be meaningfully extrapolated.

Leaf area. A highly significant relationship was observed between leaf area and within-row plant spacing in 1983 (Figure 1B). This relationship was expressed by the equation $Y = 118.5 + 0.204X$. This positive relationship indicates that muskmelon leaf area was directly influenced by within-row plant spacing.

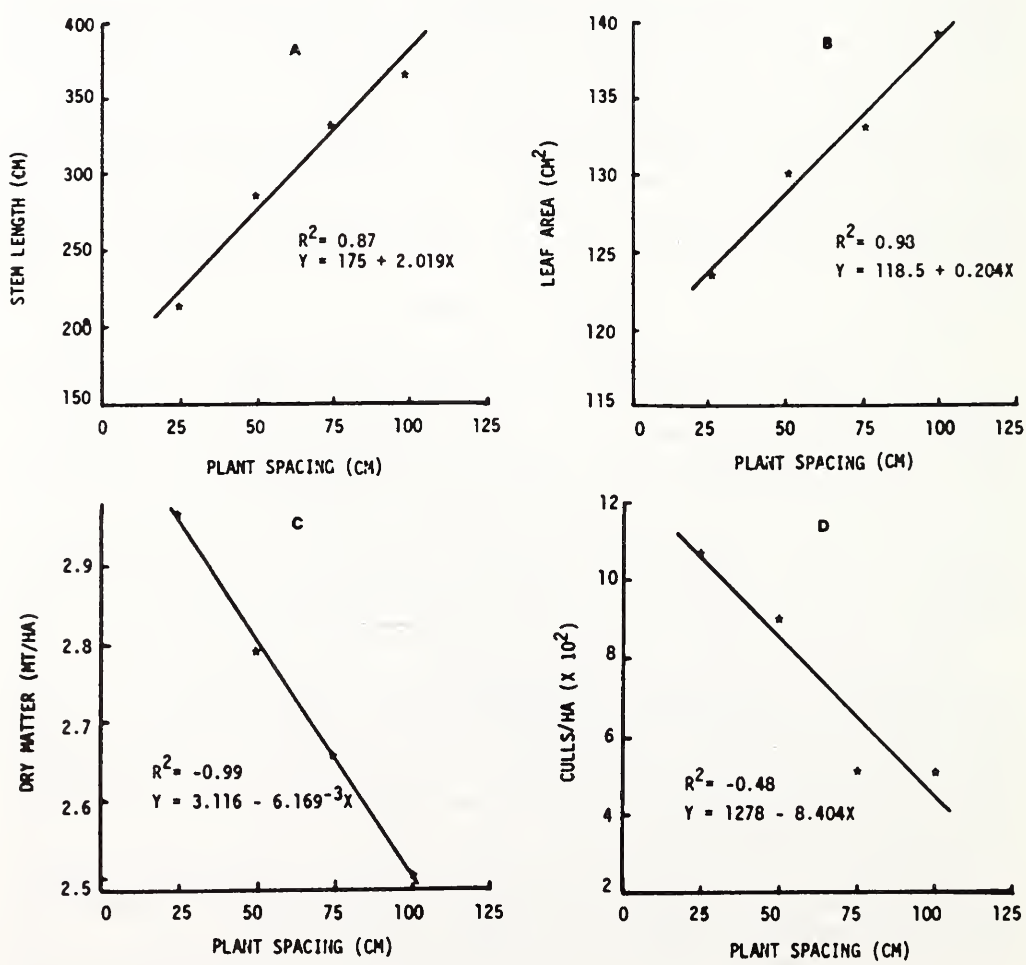

FIGURE 1A-D. *Relationship between within-row plant spacing and A) stem length; B) leaf area; C) dry matter per hectare; and D) culls per hectare in muskmelon cv. Classic.*

TABLE 1. *Effect of Within-row Plant Spacing on Muskmelon Petiole Nutrient Content.*[1]

Plant spacing (cm)	N	P	K	Ca	Mg	Mn	Fe	B	Cu	Zn	Al	Na
	Percent					PPM						
25	3.3	0.27	2.73	4.93	0.51	683	174	20	10	41	124	212
50	2.6	0.30	3.06	4.72	0.47	614	156	22	9	42	107	242
75	4.5	0.29	3.14	4.90	0.47	637	166	22	10	43	117	205
100	3.1	0.26	2.84	5.31	0.48	642	164	19	10	42	130	217

[1]Values reported are means of two replications.

Dry matter. Total above ground dry matter, excluding fruit, decreased linearly with increased within-row plant spacing, e.g., 2.5 mt/ha at 100 cm and 3.0 mt/ha at 25 cm within-row plant spacing. This highly significant linear relationship was expressed by the equation $Y = 3.116 - 6.169^{-3}x$ (Figure 1C).

Nutrient content. Data on muskmelon petiole and soil nutrient content for the 1983 growing season are reported in Tables 1 and 2.

Yield. Total marketable yields (mt/ha) was not affected by plant spacing in either year. These results differ from those reported by Lazin and Simonds (5), who reported a highly significant decrease in yield from 19.9 to 15.1 mt/ha as within-row plant spacing increased from 30 to 90 cm under Florida conditions. It is interesting to note that yield of cv. Classic was 23 percent more than that of cv. Burpee Hybrid.

Culls. Number of culls (unmarketable fruits) per hectare for 'Classic' muskmelon was highest at the closer spacings and lowest at the wider spacings (Figure 1D). These results are in agreement with Zahara (6).

Number of fruits. As plant spacing increased from 25 to 100 cm, the number of marketable fruits per hectare decreased (Figure 2A). Furthermore, highly significant negative coefficients of determination (R^2) between plant spacing and number of marketable fruits per hectare suggest that number of fruits per hectare is closely related to plant spacing. These results agree with those of Davis and Meinert (2) and Frazier (3). Zahara (6) found that as plant spacing increased from 25 x 25-cm to 75 x 75-cm, the number of marketable fruits per 15.2 m row increased from 0 to 27. In his study, Zahara (6) was dealing with much higher plant populations (18,000 to 160,000 plants per hectare) and the increased competition with increased plant population resulted in yield decreases (4). My studies, however, dealt with plant populations of only 3,600 to 14,500 plants per hectare and only within-row competition. Holliday (4) concluded that a certain plant population gives a maximum yield, while larger or smaller populations give lower yields. Zahara's study was probably at the "larger" population according to Holliday's parabolic curve.

TABLE 2. *Effect of Within-row plant spacing on soil nutrient content.*[1]

Plant spacing (cm)	P	K	Ca	Mg	Mn
	ppm				
25	78	58	310	24	72
50	66	80	370	36	45
75	82	80	340	33	69
100	73	85	350	23	40

[1]Values reported are means of two replications.

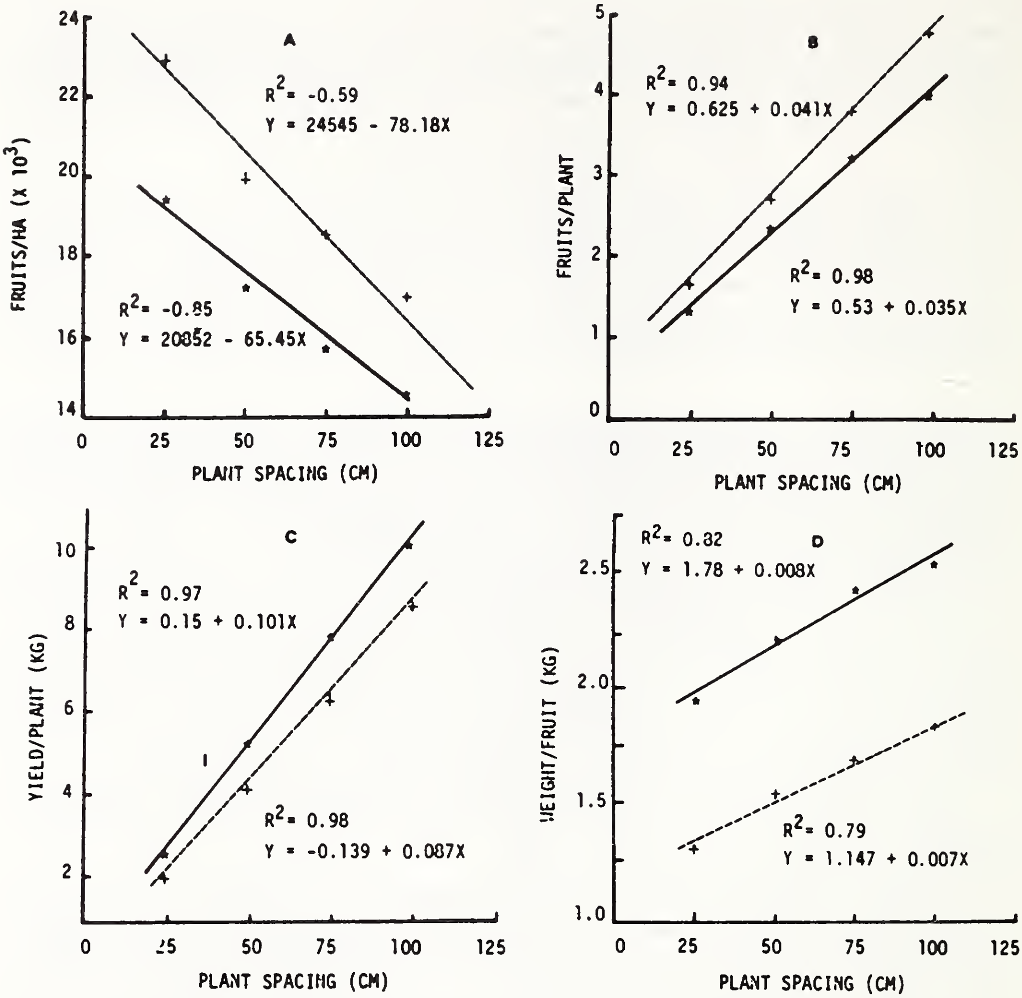

FIGURE 2A-D. *Relationship between within-row plant spacing and A) fruits per hectare; B) fruits per plant; C) yield per plant; and D) weight per fruit in muskmelon cvs. Burpee Hybrid* (+-----+) *and Classic* (*___________*).

Number of fruits per plant. Highly significant linear relationships were established between fruits per plant and plant spacing during both the years, the coefficient of determination being 0.94 and 0.98 in 1982 and 1983, respectively (Figure 2B). These results are in agreement with those of others (2,5).

The quadratic equation for number of fruits per hectare (x 1000) in relation to within-row plant spacing was $Y = 26.375 - 0.153X + 0.0006X^2$ for 'Burpee Hybrid' and $Y = 22.325 - 0.1302X + 0.00052X^2$ for 'Classic' muskmelon. Based on these equations maximum fruits were predicted for 125 cm within row plant spacing. According to these equations, competition ceased at 125 cm within-row plant spacing.

Yield per plant. The mean yield (kg) per plant was highly correlated with plant spacing each year, increasing significantly as spacing between plants increased from 25 to 100 cm (Figure 2C).

Fruit weight. The mean fruit weight increased significantly as plant spacing increased from 25 to 100 cm (Figure 2D). Lazin and Simonds (5) reported that as distance between plants increase from 30 to 90 cm, mean muskmelon weight increased from 1.36 to 1.53 kg. The highly significant coefficient of determination between plant spacing and fruit weight (Figure 2D) suggests that fruit weight is a function of plant spacing and can be manipulated to meet consumer and/or market demand.

Soluble solids. Within-row plant spacing had a significant effect on soluble solids. The highly significant linear relationship showed that soluble solids increased as the within-row plant spacing increased from 25 to 100 cm (Figure 3). Davis and Meinert (2) and Zahara (6) also reported similar results.

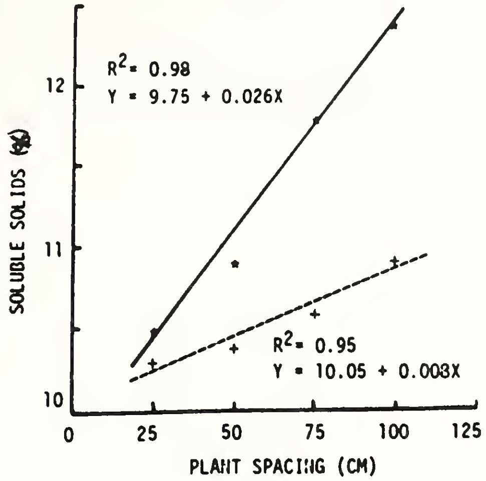

FIGURE 3. *Relationship between within-row plant spacing and soluble solids in muskmelon cvs. Burpee Hybrid* (+-----+) *and Classic* (*____________*).

Summary

The effects of within-row plant spacings of 25, 50, 75, and 100 cm with row spacing of 2.7 m on 'Burpee Hybrid' and 'Classic' muskmelons were evaluated in field studies conducted on a southwestern Indiana sandy loam, mixed, mesic Typic Hapludalf soil in 1982 and 1983. With increased plant spacing from 25 to 100 cm, stem length, leaf area, yield (kg) per plant, number of fruits per plant, fruit weight, and soluble solids increased linearly, whereas dry matter, number of culls, and marketable fruits per hectare decreased linearly. Plant spacings had no significant effect on soil and petiole nutrient content and total marketable tonnage.

Note

Joint contribution from USDA-ARS, and Department of Horticulture, Purdue University, West Lafayette, Indiana. Mention of firm names or trade products does not imply endorsement or recommendation by the USDA or Purdue University over other firms or similar products not mentioned.

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