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ICEBOX WATERMELON FRUIT SIZE AND YIELD AS INFLUENCED BY PLANT POPULATION

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Abstract. **In 1986 icebox watermelon (*Citrullus lanatus* Thunb. Matsum. and Nakai) cultivar trials, 'Baby Fun' fruit were generally too large when grown at 2.0 feet in-row spacing, whereas 'Minilee' fruit were judged to be optimum size. The effect of in-row spacing on icebox watermelon yield and fruit size was evaluated in 1987. 'Baby Fun' and 'Minilee' icebox watermelon cultivars were grown at 1.0, 1.5, and 2.0 ft in-row spacing on commercial farms in Parrish and Naples and at the Gulf Coast Research and Education Center in Bradenton. Between row spacing varied from 6 to 13 ft depending on location. Highest yields of both cultivars were obtained at 1.5 ft in-row spacing. However, the highest proportion of fruit produced in the desirable 5 to 10 lb. class occurred at 1.0 ft in-row spacing for 'Baby Fun' and 2.0 ft in-row spacing for 'Minilee'.**

Icebox watermelons have been available for more than 30 years, but none of the cultivars available have been commercially successful in the United States. Susceptibility to disease, especially fusarium wilt and anthracnose, poor shipping characteristics, generally inferior quality, and excessive seediness have all contributed to the commercial failure of icebox watermelons.

The icebox watermelon cultivars 'Minilee' and 'Mickylee' were developed recently and have superior disease resistance, shipping characteristics, quality, and very few and small seeds (3). The virtues of these cultivars and their potential for commercial production in Florida were outlined by Crall and Elmstrom (4). In 1986 trials, we found 'Minilee', 'Mickylee' and 'Baby Fun' to be outstanding cultivars (6).

Several plant population/spacing trials have been conducted previously in Florida. In 1958-59, Halsey (7) found that yields of 'Charleston Gray' increased as in-row spacing was reduced from 12 to 3 ft with 10 ft between rows. A decrease in fruit weight was noted in 1959 but not in 1958.

Spacing, in combination with mulch and fertilizer rate, effects on 'Charleston Gray' watermelon performance were evaluated in Gainesville and Leesburg trials in 1977 (1, 2). Maximum yields at both locations were produced with in-row spacings of 2 ft and between row spacing of 5 ft. A linear or quadratic increase in fruit weight occurred with increased in-row and row spacing. Current spacing recommendations for large-fruited watermelon production in Florida are 6 to 9 ft row spacing and 2 to 7 ft in-row spacing (8).

A previous report on spacing of icebox watermelons in Florida (5) indicated that yields of 'Minilee' and 'Mickylee' were not affected by in-row spacings of 16, 24, and 32 inches with 5 ft between row spacing. Although statistical treatment of fruit weight data was not provided, there was a marked tendency for smaller fruit size with closer in-row spacing.

The purpose of these experiments was to evaluate the effects of in-row spacing on yield and fruit weight of 'Baby Fun', a large icebox cultivar, and 'Minilee', a small icebox watermelon.

Materials and Methods

Seed of 'Baby Fun' and 'Minilee' were obtained from Petoseed. Transplants were grown by commercial plant growers in Collier County for the Naples trial and in Hillsborough County for the Bradenton and Parrish trials. In both locations, seeds were planted in 1.5 sq. inch cell flats (No. 150 Todd Planter) containing an amended peat-vermiculite (1:1;V:V) mix. Planting dates and other cultural conditions are shown in Table 1. Specific conditions for each location follow:

Bradenton. This trial was conducted at the Gulf Coast Research and Education Center. Field plots of EauGallie fine sand were prepared in Jan. 1987 by incorporation of 35-194-48 lb. N-P-K/acre. The superphosphate component contained 80 lb./ton minor elements as F503 oxide. Beds were fumigated with methyl bromide:chloropicrin (67%:33%) at 145 lb./acre. Additional fertilizer was applied in shallow bands 9 inches to each side of the plant row on both shoulders of the bed surface at 174-0-201 lb. N-P-K/acre. The 30-inch wide, 6-inch high, black polyethylene-covered-beds were spaced on 9-ft centers with seepage irrigation ditches every 4 beds.

Table 1. Cultural regimes for icebox watermelon evaluations at 3 Florida locations.

Parameter	Location		
	Parrish	Bradenton	Naples
Seeding date	23 Jan 87	23 Jan 87	16 Jan 87
Transplanting date	27 Feb 87	23 Feb 87	25 Feb 87
Row spacing	13 ft	9 ft	6 ft
Plants/acre			
1.0 ft. in-row spacing	3350	4840	7260
1.5 ft. in-row spacing	2233	3226	4840
2.0 ft. in-row spacing	1675	2420	3630
First harvest	29 May 87	26 May 87	22 May 87
No. of harvests	2	3	1

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Table 2. Early yield, mean fruit weight, and soluble solids of 'Baby Fun' and 'Minilee' icebox watermelons at 3 in-row spacings in 3 Florida locations.

Location	In-row spacing (ft)	Baby Fun Early yield/acre[z] No.	Baby Fun Early yield/acre[z] Wt (cwt.)	Baby Fun Mean fruit wt (lbs)	Baby Fun Soluble solids (%)	Minilee Early yield/acre[z] No.	Minilee Early yield/acre[z] Wt (cwt.)	Minilee Mean fruit wt (lbs)	Minilee Soluble solids (%)
Parrish	1.0	1032	104	10.3	12.2	1802	91	5.3	11.8
	1.5	1802	199	11.0	12.2	2255	123	5.6	11.9
	2.0	1417	171	12.1	12.0	1772	107	6.0	11.4
Significance[y]		Q*	L*Q*	L*	NS	NS	NS	NS	NS
Bradenton	1.0	2328	262	11.3	10.9	3722	212	5.7	11.4
	1.5	3678	430	11.7	11.0	4143	258	6.3	11.4
	2.0	2701	303	11.4	11.6	5024	266	5.3	11.4
Significance		Q**	Q**	NS	NS	NS	NS	L**Q**	NS
Naples	1.0	4825	432	8.9	10.2	4199	187	4.5	10.1
	1.5	4061	401	9.9	10.4	3428	179	5.2	10.4
	2.0	3989	413	10.4	11.1	2380	131	5.5	10.2
Significance		L*	NS	L**	NS	L*	NS	L**	NS

[z]One acre was equivalent to 3350, 4840, and 7260 lbf for Parrish, Bradenton, and Naples, respectively.
[y]Linear (L) or quadratic (Q) at the 5% (*) or 1% (**) level or nonsignificant (NS).

Naples. This trial was conducted on a commercial farm. Field plots were prepared of Immokalee fine sand in Jan. 87 by incorporation of 20-52-33 lb. N-P-K/acre. Beds were fumigated with methyl bromide: chloropicrin (98%:2%) at 100 lb./acre. Additional fertilizer was applied in shallow bands on both shoulders of the bed surface at 216-0-249 lb. N-P-K/acre. The 42-inch wide, 9-inch high, polyethylene-mulched beds were spaced on 6-ft centers. Seepage irrigation ditches were spaced 48-ft apart with 6 beds and a roadway between ditches.

Parrish. This trial was conducted on EauGallie fine sand on a commercial farm on beds used the previous fall for tomato production. Supplemental liquid fertilizer was injected into the beds at 50-0-44 lb. N-P-K per acre before the vines covered the beds and dry fertilizer was broadcast over the polyethylene mulched beds at 14-0-10 lb. N-P-K per acre at first fruit set. The 8-inch high, 36-inch wide beds were spaced on 13-ft centers. Each bed was bordered by a seepage irrigation ditch and a drainage ditch.

Plot arrangement. Each plot was 26 linear bed ft (lbf) and had 12, 18, or 24 plants for 2.0, 1.5 or 1.0 feet in-row spacing, respectively. Plots were replicated 4 times and arranged in a randomized, complete-block design. The same arrangement was used at each location.

Harvest. Watermelons to be harvested were cut, counted, and weighed individually from each plot. At each harvest, 2 representative fruit from each plot were sliced longitudinally, and soluble solids were determined on a sample taken from the center of the fruit.

Statistical analysis. The resulting data were subjected to regression analysis to determine linear and quadratic response.

Results and Discussion

Early yields represented 1 of 2, 1 of 3, and 1 of 1 harvests for Parrish, Bradenton, and Naples, respectively (Table 2). 'Baby Fun' watermelon responded in a quadratic fashion to in-row spacings between 1.0 and 2.0 ft at Parrish and Bradenton whereas only a linear response for fruit number was obtained at Naples. Mean fruit weight increased linearly with in-row spacing at Parrish and Naples. With 'Minilee' only a linear response to in-row spacing occurred for fruit number. Average fruit weight responded in quadratic fashion at Bradenton and linearly at Naples. In-row spacing did not affect soluble solids content of early-harvested melons.

Total yield (Table 3) is reported for Parrish and Bradenton, only. A severe outbreak of foliar diseases at

Table 3. Total yield, mean fruit weight, and soluble solids of 'Baby Fun' and 'Minilee' icebox watermelons at 3 spacings in 2 Florida locations.

Location	In-row spacing (ft)	Baby Fun Total yield/acre[z] No.	Baby Fun Total yield/acre[z] Wt (cwt.)	Baby Fun Mean fruit wt (lbs)	Baby Fun Soluble solids (%)	Minilee Total yield/acre[z] No.	Minilee Total yield/acre[z] Wt (cwt.)	Minilee Mean fruit wt (lbs)	Minilee Soluble solids (%)
Parrish	1.0	2449	230	9.7	12.3	3963	204	5.0	11.9
	1.5	3189	360	11.3	12.3	4285	229	5.3	12.0
	2.0	2221	268	12.1	12.1	2546	148	5.7	11.7
Significance[y]		NS	Q*	L**	NS	L*Q*	NS	NS	NS
Bradenton	1.0	4932	520	10.6	11.1	8891	472	5.3	11.5
	1.5	6142	683	11.1	11.2	10101	580	5.8	11.5
	2.0	4283	467	11.0	11.4	8378	444	5.3	11.4
Significance		Q**	Q**	NS	NS	NS	NS	NS	NS

[z]One acre was equivalent to 3350 and 4840 lbf for Parrish and Bradenton, respectively.
[y]Linear (L) or quadratic (Q); 5% (*) or 1% (**) level or nonsignificant (NS).

Table 4. Fruit size distribution of the total yield of 'Baby Fun' and 'Minilee' icebox watermelons at 3 spacings in 3 Florida locations.

Location	In-row spacing (ft)	Baby Fun Fruit wt (lb) 5	5-10	10-15	15-20	20	Minilee Fruit wt (lb) 5	5-10	10-15	15-20	20
		Percentage of fruit					Percentage of fruit				
Parrish	1.0	1	50	41	8	0	46	53	0	0	0
	1.5	0	38	49	11	1	43	57	0	0	0
	2.0	0	27	54	17	2	31	69	0	0	0
Significance[z]		NS	L*	NS	NS	NS	NS	NS	–	–	–
Bradenton	1.0	1	48	42	9	0	45	54	1	0	0
	1.5	2	38	47	14	0	39	62	1	0	0
	2.0	0	37	52	9	2	43	57	1	0	0
Significance		NS	L**	NS	NS	NS	NS	NS	NS	–	–
Naples	1.0	2	77	22	0	0	71	30	0	0	0
	1.5	0	50	51	0	0	42	58	0	0	0
	2.0	0	53	46	2	0	40	60	0	0	0
Significance		NS	NS	L**Q*	NS	NS	L*	L*	–	–	–

[z]Linear (L) or quadratic (Q) at the 5% (*) or 1% (**) level or nonsignificant (NS).

Naples limited production there to a single harvest. A general quadratic yield response to in-row spacing for 'Baby Fun' was obtained whereas a linear response on fruit weight was obtained at Parrish only. For 'Minilee' only a quadratic response to in-row spacing for fruit number was obtained at Parrish. As with early production, there was no effect of in-row spacing on soluble solids content.

The distribution of fruit according to weight for 'Baby Fun' and 'Minilee' is shown in Table 4. A linear response to in-row spacing in the 5 to 10 lb. class occurred at Parrish and Bradenton for 'Baby Fun', i.e. a higher proportion of small melons were produced at close in-row spacing. The reverse situation occurred at Naples where more larger size fruit were produced at the wider in-row spacings. At Naples, more very small (5 lb.) 'Minilee' fruit were produced at 1.0 ft in-row spacing, whereas more small (5 to 10 lb.) fruit were produced at 2.0 ft in-row spacing.

When fruit weight distribution was averaged over the three locations (Table 5), 58% of the 'Baby Fun' fruit grown at 1.0 ft in-row spacing were in the 5 to 10 lb. class compared with only 39% of the fruit grown at 2.0 ft in-row spacing. These percentages should be compared with 35 and 51% of the fruit in the 10 to 15 lb. class at 1.0 and 2.0 ft in-row spacing respectively.

Table 5. Fruit size distribution of the total yield of icebox watermelons at 3 spacings averaged over 3 Florida locations.

Cultivar	In-row Spacing (ft)	Fruit wt (lb) 5	5-10	10-15	15-20	20
		Percentage of fruit				
Baby Fun	1.0	1	58	35	5	0
	1.5	1	42	49	8	0
	2.0	0	39	51	9	1
Significance[z]		NS	L**	L**	NS	NS
Minilee	1.0	54	45	0	0	0
	1.5	41	59	0	0	0
	2.0	38	62	0	0	0
Significance		L**	L**	—	—	—

[z]Linear (L) or quadratic (Q) at the 5% (*) or 1% (**) level or nonsignificant (NS).

A very similar relationship occurred with 'Minilee'. The proportion of melons in the less than 5 lb. class decreased, whereas the proportion of fruit in the 5 to 10 lb. class increased with in-row spacing.

The increased yield of 'Baby Fun' and 'Minilee' icebox watermelons obtained at higher plant population in these experiments is generally consistent with previous results obtained in Florida for 'Charleston Gray' watermelon (1, 2, 7) and for icebox watermelons (5). Likewise, the lower mean fruit weight obtained at high plant populations in these experiments was in general agreement with earlier results.

Highest yields for both cultivars were obtained at 1.5 ft in-row spacing which was equivalent to 2233, 3226, and 4840 plants per acre for 13, 9, and 6 ft row spacing, respectively. 'Baby Fun' fruit weight, however, was not greatly restricted at 1.5 ft as compared to 2.0 ft in-row spacing. A much higher proportion of fruit were in the desirable 5 to 10 lb. class when in-row spacing was 1.0 ft. On the other hand, 'Minilee' fruit size was too small when plants were grown at 1.0 or 1.5 ft in-row spacing. The highest proportion of fruit in the 5 to 10 lb. class resulted from the 2.0 ft in-row spacing.

Yields of both 'Baby Fun' and 'Minilee' icebox watermelons were maximized at 1.5 ft in-row spacing. However, most desirable fruit size was obtained when 'Baby Fun' was grown at 1.0 ft in-row spacing and 'Minilee' was grown at 2.0 ft in-row spacing.

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IMPROVING STAND ESTABLISHMENT OF DIRECT SEEDED VEGETABLES IN FLORIDA

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Abstract. **The emergence of direct seeded vegetables can be reduced by numerous environmental and physical stresses which commonly occur at the time of sowing in Florida. Temperature extremes, heavy rainfall, drought, and soil compaction can greatly alter total plant stands and seedling uniformity. A number of seed priming treatments improved germination and emergence of cabbage (*Brassica oleracea* L.), carrot (*Daucus carota* L.), celery (*Apium graveolens* L.), tomato (*Lycopersicon esculentum* Mill.), pepper (*Capsicum annuum* L.), and lettuce (*Lactuca sativa* L.). An additional improvement in stand uniformity for a number of crops was obtained when seeds were sown with soil amendments. Use of the gel-mix (peat:vermiculite:gel combination) and/or calcined clay amendments (GrowSorb) greatly improved emergence and plant uniformity in pepper, tomato, cabbage, and lettuce sown under temperature stress.**

Seeds for the Florida winter vegetable industry are sown over an extended season, which generally encompasses environmental extremes of temperatures and moisture regimes. Planting of the major vegetable species begins in Aug. and/or early Sept. under excessively high temperatures and, in many cases, continues through or begins again under the low temperature extremes of Jan. and Feb. Plant establishment of most crops becomes limited by high temperatures (above 30°C) resulting in poor stands. Low temperatures, on the other hand, reduce emergence rate, thereby creating uneven plant stands and subjecting the emerging seedlings to soil-borne pathogens for an extended period of time.

Recent technology has led to improved germination and emergence of seedlings after treating the seed by a process called priming (2). The priming treatment consists of imbibing seeds in an osmotic solution such as polyethylene glycol (PEG) or salt, at a concentration that allows the seed to imbibe water and advance through the first stages of germination but which does not permit radicle protrusion through the seed coat. Seed priming has been reported to increase germination rate, total germination, and seedling uniformity, especially under unfavorable environmental conditions (1, 3, 4, 5, 10, 11). 'Slow' and 'fast' germinating seeds of a single lot are brought to the same stage of germination readiness after priming. This is of utmost importance to achieve plant stand uniformity. A major advantage of priming is that seeds can be primed (germination initiated), redried to their original moisture content, and then stored or sown using conventional planting equipment.

Seed with low germination percentage or of generally poor quality cannot be improved by priming (13). Only the highest quality seed gives positive results to seed priming under field stress conditions. Several factors must be considered when priming seed including the osmoticum source and concentration, duration of the soak, temperature, aeration technique, light requirements, redrying procedure, and seed quality (2).

The soil environment can play a key role in regulating emergence, especially under conditions of excessive moisture or high temperature. Soil crusting can occur on Florida's sandy soils and is promoted by heavy rainfall, high radiant energy, and the level of organic material in the soil. Frequent wetting and drying can initiate excessive soil crusting, thus limiting plant stands and uniformity (14, 18, 19). The work reported here, summarizes research on a number of vegetable crops to improve field emergence via seed priming and/or the use of soil amendments.

Materials and Methods

Details for specific information materials, methods, and procedures, including cultivar names, planting dates and priming treatments are referenced directly on the Tables. In order to successfully prime seeds of the various species, several factors were considered including nature of the osmoticum, water potential, duration of the soak, temperature and requirement for high quality seeds. All seeds were primed in the dark in aerated solutions. Typically, 1 g of seeds were placed in a 50 ml test tube along with 30 ml of the priming solution which was aerated through a glass tube connected to an aquarium pump. At the completion of the priming process the seeds were rinsed twice with distilled water to remove the residual osmoticum. Surface water was removed by vacuum filtration, then the seeds were dried at 5°C and 30% relative humidity to their original moisture content. The 5°C-30% relative humidity constituted the long term seed storage conditions used in some studies.

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