

Performance muskmelon

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harvest for commercial muskmelon production. The larger fruit size of hybrids would naturally reduce numbers and percentages of smaller sized fruits. Hybrid vigor for average fruit size was not rated as either desirable or undesirable in table 3. An average size of 900 to 1100 grams (36 size) is desirable, but fruit size from this study was expected to be larger than would have resulted from the closer,

more competitive plant spacing common in commercial plantings. Hybrid vigor evident from these muskmelon crosses will continue to be evaluated in this research project on muskmelon breeding.

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TABLE 1. PERFORMANCE OF 45 BIPARENTAL HYBRIDS AND THE 10 PARENT VARIETIES FOR ONE FRUIT APPEARANCE TRAIT (NET, ABOVE DIAGONAL) AND ONE FRUIT QUALITY TRAIT (PER CENT SOLUBLE SOLIDS, BELOW DIAGONAL). VALUES REPRESENT AVERAGE OF 3 FRUITS FROM EACH OF 15 PLANTS GROWN AT EL CENTRO

PER CENT SOLUBLE SOLIDS	MELON NET RATING*	Campo	Del. 51	Hale's Best	Honey Rock	PMR 45	Pride Wisc.	Spart. Rock	SR 91	Schoon's	Tip top
		3.67	0.37	3.67	2.27	3.60	1.53	2.30	3.23	2.13	0.27
Campo	12.5										
Del. 51	13.1	13.8 ¹	1.73	3.80 ¹	2.50	3.77 ¹	2.03	1.93 ³	1.97 ³	3.13 ²	1.67
Hale's Best	12.3	12.7 ¹	13.7 ¹	2.00	2.77 ¹	1.43	1.77 ¹	1.57 ²	2.00 ²	1.83 ²	0.80 ¹
Honey Rock	12.1	13.4 ¹	13.3 ¹	13.1 ¹	2.57	3.83 ¹	2.40	2.73	2.47 ²	3.80 ¹	1.93
PMR 45	12.8	13.3 ¹	14.1 ¹	13.2 ¹	13.2 ¹	2.40	2.20 ²	2.63 ¹	2.27	2.07 ²	1.97 ²
Pride Wisc.	13.6	13.3 ¹	13.8 ¹	13.5 ²	14.0 ¹	13.7 ¹	2.27	2.53	2.17 ³	3.80 ¹	2.27 ²
Spart. Rock	13.6	13.2 ²	13.7 ¹	13.5 ²	13.5 ²	13.7 ¹	14.6 ¹	2.27 ²	2.43	2.17 ¹	1.60 ¹
SR 91	8.9	13.3 ¹	13.9 ¹	13.9 ¹	13.4 ¹	13.6 ¹	14.0 ¹	13.9 ¹	2.33	2.43 ¹	1.67 ²
Schoon's	13.1	13.2 ¹	14.1 ¹	12.6	13.2 ¹	12.9	14.1 ¹	14.2 ¹	13.4 ¹	2.30	2.00 ²
Tip Top	12.0	12.8 ¹	13.7 ¹	12.9 ¹	13.2 ¹	13.5 ¹	13.4 ²	12.8 ²	13.0 ¹	12.9 ²	1.23 ²

TABLE 2. PERFORMANCE OF 45 HYBRIDS AND 10 PARENT VARIETIES FOR ONE YIELD TRAIT (TOTAL NUMBER OF FRUIT PER PLANT, ABOVE DIAGONAL) AND ONE MATURITY TRAIT (DAYS FROM TRANSPLANT TO FIRST FRUIT HARVESTED, BELOW DIAGONAL), VALUES ARE AVERAGES FROM 15 PLANTS GROWN AT EL CENTRO

DAYS TO FIRST FRUIT	TOTAL FRUIT NUMBER	Campo	Del. 51	Hale's Best	Honey Rock	PMR 45	Pride Wisc.	Spart. Rock	SR 91	Schoon's	Tip Top
		9.4	8.5	9.2	5.9	8.4	4.6	9.3	9.1	4.1	5.9
Campo	129.4										
Del. 51	123.5	118.9 ¹	9.1 ²	9.5 ¹	8.1 ²	10.5 ¹	6.6	7.4 ³	9.7 ¹	9.5 ¹	9.4 ¹
Hale's Best	124.7	124.9 ²	116.3 ¹	8.9	8.2 ²	10.5 ¹	7.1 ²	6.3 ³	10.7 ¹	9.9 ¹	9.3 ¹
Honey Rock	123.3	123.3 ¹	122.4 ¹	119.7 ¹	7.5	10.3 ¹	9.1 ²	7.5 ²	9.5 ¹	9.6 ¹	7.7 ²
PMR 45	128.1	135.5 ²	114.8 ¹	131.4 ²	114.4 ¹	8.5 ¹	8.4 ¹	6.5	7.5	9.3 ¹	7.8 ¹
Pride Wisc.	129.7	120.0 ¹	122.3 ¹	128.8	120.0 ¹	128.0 ¹	7.7 ²	9.9 ¹	11.3 ¹	9.9 ¹	9.3 ¹
Spart. Rock	126.8	123.6 ¹	123.7 ²	119.9 ¹	116.8 ¹	122.4 ¹	124.4 ¹	5.3	8.5 ²	8.7 ¹	6.5 ¹
SR 91	129.8	120.7 ¹	117.5 ¹	119.3 ¹	121.5 ¹	119.1 ¹	115.7 ¹	7.3 ³	7.3 ³	6.8 ²	5.6 ²
Schoon's	129.3	125.2 ¹	122.7 ¹	128.4	120.3 ¹	128.0 ¹	128.3 ¹	127.5 ²	115.9 ¹	10.5 ¹	9.1 ¹
Tip Top	127.1	121.1 ¹	123.7 ²	121.5 ¹	112.8 ¹	120.7 ¹	126.0 ¹	126.1 ¹	121.0 ¹	125.4 ¹	7.2 ¹

* Melon net rating scored visually as a combined rating of net density and net thickness on a scale of 0 to 4 with 4 the best rating.

¹ Hybrid crosses which exceed best parent in cross.

² Crosses which were better than the midparent or average of two parents.

³ Crosses which were below the low or poor parent.

TABLE 3. SUMMARY OF HYBRID PERFORMANCE FOR 15 TRAITS IN MUSKMELON—NUMBER OF HYBRIDS WHOSE VALUES EXCEEDED HIGH PARENT IN CROSS (>HP), EXCEEDED MIDPARENT (>MP) OR WERE LESS THAN LOW PARENT (<LP) ARE INDICATED FOR EACH TRAIT

Characters evaluated	Number of crosses:			Mean of parents	Mean of hybrids	Avg. % hybrid vigor
	>HP	>MP†	<LP			
Quality and appearance traits:						
Net appearance (0-4 score)	12	23	5	2.31	2.30	- 0.17 -‡
Scruble solids (%)	35	43	0	12.40	13.44	+ 8.39**+
Rind thickness (mm)	6	13	24	2.85	3.26	+ 14.31**+
Suture appearance (0-4)§	5	14	14	2.46	2.25	- 8.40**-
Flesh (%)	5	19	14	44.27	43.81	- 1.04 -
Shape index (length/width)	10	18	17	1.101	1.124	+ 2.10**-
Maturity and yield traits:						
Days to first harvested fruit	37	41	2	127.2	122.1	- 3.99**+
Days—1st to 3rd fruit harvested	8	15	20	9.5	11.7	+ 23.72**-
Avg. wt. 1st 3 fruits (gm)	25	30	6	1244	1428	+ 14.79**+
Total wt. fruit/plant (gm)	34	38	3	7791	9456	+ 21.38**+
Total number fruit/plant	25	34	5	7.4	8.5	+ 14.52**+
No. fruit harvested/plant	15	27	9	5.0	6.7	+ 35.27**+
Early fruit harvested (21 day harvest period)	24	29	4	1.6	2.0	+ 27.76**+
No. fruit in 45 and 36 sizes	7	18	17	2.5	2.2	- 13.82 -
% fruit in 45 and 36 sizes	6	14	22	37.8	30.5	- 19.27**-

† Includes >HP crosses.

‡ + and - designates desirable or undesirable direction of average hybrid vigor.

§ 0-4 scale; 4 = smooth fruit void of sutures.

** Differences between parents and hybrids which are significantly different from zero at 1% level of probability.

THE PURPOSE of plant breeding is to combine in a single individual or variety a desirable level of expression of all important traits. This can be difficult to achieve because the various desirable traits are often distributed among different plant types. Population improvement can be accomplished by simultaneous incorporation of several types into a composite population, followed by selection for maximum expression of the various traits within the offspring. Evaluation and selection of parent materials to combine into such a population to permit this accumulation of traits, therefore, becomes important.

Diallel cross

The diallel cross involves all possible two-way crosses among several parents, and provides a method for evaluating parental entries by comparing their performance in combination with each other parent in the diallel. The average performance of a line in hybrid combinations is termed "general combining ability," (GCA) and relates to additive gene action. The performance of specific hybrid crosses, after taking into account the GCA of the two parents, is termed "specific combining ability" (SCA) and measures the dominance deviation from the additive model. Information of GCA and SCA—or the types of gene action influencing various traits—enables the plant breeder both to evaluate parental entries, and to select the best breeding system for maximum character improvement.

A diallel cross was established to evaluate 10 muskmelon varieties for their combining abilities, and to provide a basis for selection of varieties to be incorporated into a breeding population for muskmelon improvement in desert areas. The 10 varieties in the table were crossed in all possible combinations to provide 45 F₁ hybrids. These hybrids, along with the parent varieties, were grown at three locations in southern Cali-

and combining ability of varieties in a diallel cross

fornia: El Centro, Riverside and Santa Ana. Plants were individually spaced at 7 x 7 ft intervals with five plants per plot. Plots were replicated three times at each location. At maturity, fruits were harvested at two- or three-day intervals, and were recorded on the fruit appearance, quality, yield, and maturity characteristics listed in the table.

Among variety

The "among variety crosses" source of variation in the statistical analysis of data from the diallel cross was divided into components according to GCA and SCA. These combining ability variances are presented in the table for each of the 15 traits. Both GCA and SCA were significant for each of the quality and appearance traits as well as for days-to-first-fruit-harvested, the average weight of first three fruits, and percentage of fruit in the 45 and 36 sizes. In a comparison of combining-ability values for each trait, the variability accounted for by GCA is three or more times the variability accounted for by SCA. Therefore, without exception, additive gene action was important in the inheritance of each of these traits among these 10 muskmelon varieties. SCA is also important, however, in

the evaluation of specific hybrid combinations formed in this study.

Cumulative performance

GCA effects for each parent variety were calculated for each trait by comparing the cumulative performance of crosses involving a given parent with the average performance of all parents. GCA effects distribute around a zero mean for each trait, so that large positive or negative values indicate a large deviation from the average performance for these 10 varieties. Positive GCA effects in the table all relate to a desirable deviation from average performance. A comparison of GCA effects among parents in this diallel cross permits identification of the best varieties for selection and recombination into future breeding populations.

The four commercial varieties (Campo, Hale's Best, PMR 45 and SR 91), along with Schoon's Hardshell, recorded the best performance in crosses. Each of these varieties exceeded the average for net and suture appearance, total number of fruits per plant, number of fruits harvested and number and per cent of fruits in the 45 and 36 size classes. SR 91 was also superior for shape and days to first fruit harvested, but ranked below

average in flesh percentage. In contrast, the other four varieties mentioned above recorded high for flesh percentage, days between first and third fruits harvested, and total weight of fruits per plant, but were below average for per cent soluble solids, shape index, days to first fruit, and number of early fruits harvested. The other varieties were generally inferior in performance for most of the traits considered.

Four varieties

Based on the combining ability values from this diallel study, four varieties, Campo, Hale's Best, PMR 45 and Schoon's Hardshell, were selected and mated to form a breeding population. This population will be subjected to improvement by recurrent selection, a breeding method which utilizes the additive-type gene action indicated to be important in the inheritance of these muskmelon traits.

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COMPARISONS OF GCA AND SCA VARIANCES, AND GCA EFFECTS FOR EACH MUSKMELON VARIETY, FOR CHARACTERS EVALUATED IN THE DIALLEL CROSS

	Combining-ability variances		General combining ability effects for varieties									
	GCA	SCA	Campo	Del. 51	Hale's Best	Hcney Rock	PMR 45	Pride Wisc.	Spartan Reck	SR 91	Schoon's Hardsh.	Tip Top
Quality and appearance												
Net appearance	9.93**	2.18**	0.32**	-0.54**	0.51**	-0.08	0.45**	-0.25**	-0.12	0.10	0.28**	-0.47**
Soluble solids	4.99**	1.34**	-0.35*	0.39*	-0.32*	-0.23	-0.09	0.40**	0.14	0.10	-0.04	-0.10
Rind thickness	10.00**	1.74**	-0.14	-0.17	0.58**	0.05	0.09	-0.31**	-0.68**	0.19	0.49**	-0.10
Suture appearance	20.18**	0.44**	0.34**	-0.33**	0.39**	0.20**	0.46**	-0.41**	-0.55**	0.61**	0.26**	-0.96**
Flesh percentage	142.14**	9.93**	2.12**	-0.80**	0.79*	-1.25**	1.15**	0.75*	-0.57	-1.06**	1.23**	-2.37**
Shape index	0.0970**	0.0113**	-0.03**	0.04**	-0.02*	0.00	-0.03**	-0.02*	-0.01	0.08**	-0.03**	0.02*
Maturity and yield												
Days to first fruit harvested	280.95**	32.80*	-0.98	2.48**	-1.81*	1.70*	-1.10	0.94	0.11	1.95*	-2.25**	0.84
Days—first to third fruit	124.28	15.18	0.39	-0.97	1.61	-2.76*	0.98	-0.39	-1.31	-0.33	3.00*	-0.22
Avg. wt. first 3 fruits	1792 x 10 ³ **	75 x 10 ³ **	-34.6	43.1	-104.2**	-49.0	-131.2**	96.2	240.5**	-256.4**	-41.3	236.7**
Total wt. fruit/plant	16 x 10 ⁶	6 x 10 ⁶	551	-170	222	-510	589	-1014*	-437	-315	191	889*
Total no. fruit/plant	165.32	11.15	0.54	-0.79	2.24	-0.77	2.18*	-1.93	2.70*	2.26*	0.72	-1.75
No. fruit harv./plant	16.79**	1.59	0.52*	-0.37	0.63*	-0.32	1.23**	-0.77*	-1.49*	0.60*	0.59*	-0.61
Early fruit harvested	66.24	12.05	-1.00	1.95*	-0.23	0.47	-0.33	-1.52	-1.00	1.68	-0.80	0.80
Number 45 & 36 sizes	60.20	8.20	1.04	-0.95	1.08	-0.14	1.11	-0.79	-1.97*	0.51	1.07	-0.97
Per cent 45 & 36 sizes	3248.7**	358.5**	0.14	-4.48*	8.72*	3.39	6.35*	10.07**	-15.32**	23.64**	0.81	-13.23**

*,** - values significantly different from zero at the 5% and 1% level of probability, respectively.