Evaluation of Fruit Quality in *Cucumis sativus* var. *hardwickii* (R.) Alef.-Derived Lines

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Breeding strategies designed to incorporate the sequential fruiting ability of *Cucumis sativus* var. *hardwickii* (R.) Alef. (hereafter referred to as *hardwickii*) into commercially acceptable cultivars (var. *sativus L.*; hereafter referred to as *sativus*) have been a major objective of the U.S.D.A./A.R.S. cucumber project (3). We have developed several high-yielding inbred lines derived from *hardwickii* which could be used in breeding programs to increase the yield of commercial cultivars (4).

We have used the *hardwickii* lines PI 183967 and PI 218889 in pedigree breeding to improve these derived lines for disease resistance. The lines were then random-mated and the resulting population subjected to 2 cycles of recurrent selection for fruit length and fruit number (4). Although the lines approached acceptable horticultural type in some respects, they had short fruits with unacceptably large seedcells.

University of Wisconsin (UW) researchers used 3 cycles of S1 progeny selection to increase fruit number per plant in a population derived from a cross between a gynoecious inbred *sativus* line, 'Gy 14', and a *hardwickii* line derived from PI 183967 (LJ 90430). Inbred line development using 2 cycles of family selection was then conducted, selecting for number of fruits per plant using once-over harvest (1, 2).

Since *hardwickii* confers poor interior fruit quality in *hardwickii x sativus* matings and inbred lines derived from these matings also had unacceptable fruit quality, this study was designed to determine whether *hardwickii*-derived lines could be used in combination with *sativus* inbred lines to produce F1 hybrids with acceptable fruit quality. If fruits of F1 hybrids have acceptable quality, then perhaps they could be commercially useful for once-over mechanical harvest.

Nine genetically distinct cucumber populations, which had been maintained by self-pollination for several generations, were evaluated. Three indeterminate U.S.D.A. processing cucumber breeding lines were selected for crossing with 2 *sativus* lines and 4 lines with *hardwickii* in their pedigrees. The U.S.D.A. gynoecious breeding lines, WI 1701, WI 2712, and WI 2963 were used as females. The inbred WI 2963 resulted from self-pollination of an F1 progeny from a cross between *hardwickii* PI 212289 and WI 1606, an inbred processing cucumber line. Two *sativus* inbred lines (WI 1983 and 13M) along with 4 lines derived from initial *hardwickii x sativus* matings [WI 5098 (USDA), WI 5551 (USDA), 2H1853 (UW), and 4H261 (UW)] were used as males.

To obtain information about F1 fruit quality, a North Carolina Design II mating scheme was used to produce 18 F1 families (3x6). The parents and F1 progenies plus 2 check cultivars, 'Calypso' and 'Fremont', were grown in the field at the UW Experimental Farm, Hancock, WI. The experimental design in each of 2 planting environments was a split-plot treatment arrangement in a randomized complete block design with 2 replications. Single-row plots of 30 plants on 1.5 m row centers were used in each replication. All plots were over-seeded and thinned to 30 plants/plot or about 29,000 plants/ha at a 23 cm plant spacing and about 58,000 plants/ha at a 11.5 plant spacing, thus providing plot lengths of 7 m and 3.5 m, respectively, for each planting density tested.

Data on 3 fruit quality traits were obtained using fruits from the third harvest that were fermented in unpurged brine tanks. Fruit firmness was measured through the pericarp of brined fruits at the stem and shoulder using a Magness-Taylor fruit pressure tester with an 8 mm tip. Measurements were taken on 10 fruits (27 to 38 mm diameter) randomly chosen from one replication at the third harvest. The ratio of seedcell diameter to fruit diameter (interior ratio) was calculated from the middle cross section of 15 brined fruits (27 to 51 mm diameter) also chosen from one replication at third harvest. Twelve experienced processors judged the overall quality of the brined fruit based on internal and external color, internal texture, and shape. Samples were rated using the following scale: 10-9=excellent, 8-7=good, 6-5=fair, 4-3=poor, 2=barely acceptable, 1=not acceptable.

The mean interior (seed cavity diameter/fruit diameter) ratio of nearly-homozygous parental lines and their F1 progenies are given in Table 1. Smaller seed cavities were recorded in sativus lines when compared to *hardwickii* lines or *hardwickii x sativus* (HxS) F1 progenies. Fruit firmness values of *sativus* parental lines were generally higher than those of *hardwickii* parental lines or HxS progenies (Table 2). Curiously, firmness of fruits in the progeny of 13M matings using *sativus* parents (SxS) was lower than parental lines themselves. Fruit firmness in some HxS progeny (WI 1701 X WI 5098, WI 1701 X WI 2H1853, WI 1983 X WI 2963) approached that of the *sativus* parent. Generally, overall quality ratings of *hardwickii*-derived lines and HxS F1 progeny were lower than the *sativus* parents (Table 3). Notable exceptions were WI 1983 X WI 2963, WI 13M X WI 2963, and WI 2712 X 4H261 which demonstrated quality approaching that of the *sativus* parents.

Data from this study indicated that the *hardwickii*-derived lines conferred poor fruit quality on their HxS F1 progeny. Nevertheless, there were F1 hybrids which approached the fruit quality of their *sativus* parents, suggesting that certain *hardwickii*-derived lines may be useful. Undoubtedly, fruit quality characters are quantitatively inherited. The inbred-backcross breeding method is ideal for incorporating quantitative characters from unadapted germplasm into elite lines. Backcrossing to the commercially adapted parent increases the probability of recovering the characters which are horticulturally essential, and provides an opportunity to evaluate the inbred-backcross lines under replication, which enhances the effectiveness of selection for quantitative traits with low heritability. *Hardwickii*-derived lines, such as the ones in this study, will be improved using this method.

Table 1. Mean interior ratio (seedcell diameter/fruit diameter) of nearly-homozygous cucumber lines and their F1 progenies.

Parents	13M	WI 1983	WI 5098*	WI 5551*	2H1853*	4H261*	Mean
WI 1701	0.62	0.54	0.59	0.59	0.61	0.57	0.52
WI 2712	0.60	0.58	0.59	0.58	0.54	0.63	0.55
WI 2963*	0.64	0.56	0.63	0.59	0.55	0.54	0.62
Mean	0.58	0.56	0.57	0.58	0.57	0.60	

LSD(5%) = 0.03

Calypso = 0.54
Fremont = 0.49

[z]Means from middle cross section of 15 brined fruits (27 to 51 mm diameter).
*Contains *Cucumis sativus* var. *hardwickii* germplasm.

Table 2. Mean interior (seed cavity diameter/fruit diameter) ratio of nearly-homozygous cucumber lines and their F_1 progenies.

Parents	13M	WI 1983	WI 5098*	WI 5551*	2H1853*	4H261*	Mean
WI 1701	23.0	25.8	22.5	19.3	23.5	19.1	25.4
WI 2712	21.8	21.8	22.0	21.1	19.3	19.0	22.7
WI 2963*	20.3	23.3	19.3	21.4	22.0	22.8	18.3
Mean	24.1	23.4	21.3	21.3	21.3	20.7	22.1

LSD(5%) = 1.9
Calypso = 23.4
Fremont = 23.7

[z]Means from middle cross section of 10 brined fruits (27 to 38 mm diameter).
*Contains *Cucumis sativus* var. *hardwickii* germplasm.

Table 3. Mean interior (seed cavity diameter/fruit diameter) ratio of nearly-homozygous cucumber lines and their F1 progenies.

Parents	13M	WI 1983	WI 5098*	WI 5551*	2H1853*	4H261*	Mean
WI 1701	6.8	7.8	6.3	5.8	5.4	5.5	7.5
WI 2712	6.2	7.3	4.9	6.0	6.9	6.2	4.8
WI 2963*	6.8	6.5	5.1	4.8	4.4	3.7	6.2
Mean	5.3	6.9	4.7	5.0	4.6	2.4	

LSD(5%) = 1.1
Calypso = 8.3
Fremont = 6.8

*Contains *Cucumis sativus* var. *hardwickii* germplasm.

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