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# Screening the Cucumber Germplasm Collection for Fruit Storage Ability

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***Abstract.*** **All available cucumber (*Cucumis sativus* L.) cultigens were tested for combining ability for fruit storage ability by crossing them with the gynoecious inbred Gy 14. Fruit weight and firmness were measured before and after storage, and fruits were rated for water loss after storage. The cultigens with the lowest percentage of fruit weight loss during storage were PI 172839, PI 344067, PI 264667, PI 171612, PI 339245, PI 220171, PI 279469, and PI 368550; those with the lowest percentage of loss in fruit firmness were PI 379284, PI 339241, PI 414159, PI 422177, 'Regal', PI 109483, 'Addis', PI 285603, PI 257486, and 'Calypso'. The cultigens demonstrating the least fruit shriveling were 'Dasher II', 'Sprint 440', 'Texas Long', PI 390255, PI 432870, 'Pacer', PI 419078, PI 390247, PI 321011, and PI 414158. The 10 best cultigens from the initial screening study, along with the four worst cultigens and six checks, were retested directly (not as $F_1$ progeny) for fruit keeping ability in two storage conditions and at two harvest dates. No significant differences were detected between the two harvest dates and storage conditions.**

The cucumber fruit is botanically classified as a pepo (an inferior berry) and is nonclimacteric (Biale and Young, 1981). Because cucumbers are often harvested and stored for several weeks before use by the consumer, keeping ability is an important trait. According to Buescher (1986), the fruits can be stored for 1 or 2 weeks under optimal conditions [i.e., 4 °C, 100% relative humidity (RH), and 1% $O_2$ and 30% $CO_2$] without loss of quality. Both environmental and genetic factors are involved in keeping ability; a large genetic component is the fruit type. Commercial types of cucumbers include american pickling (processing), european pickling, american slicing (fresh market), european greenhouse (parthenocarpic), oriental trellis (burpless), middleeastern cucumbers (Beit Alpha), and schalgurken (german pickling) (Wehner and Horton, 1986).

Cucumber breeders have developed cultivars that are white-spined rather than black-spined because of the linkage or pleiotropy between genes *B* and *R* (Hutchins, 1940). Large, immature fruits that would be green in the northern parts of the United States turn yellow to orange in the southern states if they have the *R* gene. Therefore, cucumber breeders have developed white-spined cultivars since the 1940s to keep the fruits green longer (Wehner and Robinson, 1991).

Keeping ability in pickling cucumbers is critical and is related to the method of processing—brining (fermentation), fresh-pack (pasteurization), or cold-pack (refrigeration). Pickling cucumbers often are shipped from remote locations for fresh-pack operations; the time from harvest to processing usually lasts up to a week (Miller and Wehner, 1989). Fresh-pack processing of cucumbers has been widely accepted because of the high quality of the final product (attractive color and improved crispness). Refrigerated products are gaining in consumer popularity. Although they have a limited shelf life, they offer high quality. The perishable nature of cucumbers prevents the economical storage of fresh fruits for longer than 1 month. The advantages of brining over the other two pickling processes are that large quantities of fruits can be stored until needed for processing, and the finished product has a longer shelf life (Lower and Edwards, 1986).

The shelf life and pickling quality of cucumbers can be enhanced by spraying the plants with 100 $mg \cdot L^{-1}$ K and 5000 $mg \cdot L^{-1}$ Ca. Further improvement can result when fruits are packaged in perforated polyethylene bags and stored under refrigerated conditions (5 °C and 85% ± 5% RH). This reduces weight loss and fruit decay (Bakr and Gawish, 1993). Fruits treated with thiabenzadole [2-(4-thiazolyl) benzimidazole] (a postharvest fungicide) and held in perforated polyethylene bags at room temperature for 9 d lost less weight, had less decay, and were firmer than nontreated controls (Shanan et al., 1978). Keeping quality of greenhouse-grown cucumbers was negatively influenced by certain energy-saving measures (i.e., thermal screens and glasshouses with double roofing) (Janse and Welles, 1984). The removal of field heat immediately after harvest can enhance the postharvest fruit quality of produce (Kays, 1991), and hydrocooling of cucumbers has been recommended to enhance keeping ability. Navazio and Staub (1994) and Thomas and Staub (1992) reported that the most effective treatment was hydrocooling immediately after harvest followed by optimum storage conditions (15 °C and 85% RH).

Optimum storage conditions rarely can be attained in the first few days after harvest. Improved keeping ability of cultivars held at ambient summer temperatures (25–40 °C in North Carolina) would help reduce postharvest losses of fresh-market and pickling cucumbers, and would improve the yield of greenstock purchased and shipped to consumers and processors.

The objective of this study was to evaluate the U.S. Dept. of Agriculture (USDA) cucumber germplasm collection, along with additional cultivars, for keeping ability using rapid methods of measurement. The "best" and "worst" cultigens (cultivars, breeding lines, and plant introduction accessions) identified in the germplasm collection screening study were further retested using more elaborate methods.

## Materials and Methods

All experiments were performed at the Horticultural Crops Research Station at Clinton, N.C., using recommended horticultural practices (Hughes et al., 1983; Schultheis, 1990), and optimized field plot trials. Three replications of once-over harvest have been recommended for maximum efficiency to determine which cucumber lines have commercial potential for multiple-harvest trials (Wehner, 1986; Wehner and Miller, 1984). A plot size of $1.2 \times 1.5$ m was optimum for yield evaluation for once-over harvest of pickling cucumbers (Swallow and Wehner, 1986). Wehner and Miller (1987) recommended the use of small single-row plots without end borders rather than large, multiple-row, bordered plots. Small-plot, single-harvest trials were more efficient than large-plot, multiple-harvest trials, which require more time and labor (Wehner, 1986, 1989; Wehner and Miller, 1984). Swallow and Wehner (1989) reported that maximum information (1/variance) was obtained by allocating test plots of cucumber lines to different seasons and years instead of using different locations and replications. Field plots at Clinton were the best for yield evaluation in North Carolina (Wehner, 1987).

### Germplasm tested

*Germplasm screening study*. A total of 756 cultigens from a total of 44 countries were evaluated in the experiment, including 15 checks. Most of the cultigens were plant introduction accessions; also included were 47

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breeding lines (old cultivars, current cultivars, or experimental inbreds and hybrids). Cultigens designated with a PI number were obtained from the USDA germplasm collection at Ames, Iowa. Old cultivars were obtained from the National Seed Storage Laboratory (NSSL) in Fort Collins, Colo. Countries with the largest number of entries were Turkey, People's Republic of China, Iran, Yugoslavia, India, Japan, and Czechoslovakia. To make them gynoecious, all cultigens were crossed with Gy 14, a gynoecious pickling cucumber inbred, under controlled greenhouse conditions at the Horticultural Science Greenhouses at North Carolina State Univ., Raleigh; this assured fruit set under local field conditions. The cultigens designated "checks" were the cultigens per se (not the $F_1$ resulting from a cross with Gy 14). Cultigens with high combining ability for keeping quality should be good genetic sources for direct use in a breeding program. However, cultigens that performed poorly for combining ability might still be good sources for direct use if their superior keeping ability was due primarily to recessive genes. Recessive genes for keeping ability might not be expressed in the hybrid if Gy 14 had dominant genes at the loci involved. Gy 14 was intermediate (212 of 756) in performance for keeping ability, as indicated by loss in fruit weight. Some of the best and worst cultigens were retested as hybrids with Gy 14 and as the cultigen per se, so we were able to measure in part the importance of recessive genes in keeping ability.

*Retest study.* A total of 20 cultigens were tested for this study. Cultigens in the top 10% for fruit weight loss from the germplasm screening study (Gy 14 x PI220171, Gy 14 x PI279469, Gy 14 x PI321006, Gy x PI211962, Gy 14 x Producer, Gy 14 x PI422177, Regal, PI 220171, Producer, and PI 422177) were chosen to represent cultigens for good keeping ability. Four cultigens in the worst 10% range for fruit loss in the screening study (Wautoma, Gy 14 x PI339244, Gy 14 x PI255934, and PI 339244) were chosen to represent cultigens with the worst keeping ability. Six standard commercial checks were added to the study ('Sumter', 'Wisconsin SMR 18', 'Calypso', 'Poinsett 76', 'Marketmore 76', and 'Dasher II').

Table 1. Keeping ability of fruits of 756 cultigens tested at Clinton, N.C.[z]

| Cultigen | Seed source[y] | Wt loss (%) | Firm. loss (%) | Shriveling[x] |
|---|---|---|---|---|
| PI 172839 | Turkey | –52[w] | 21 | 6.7 |
| PI 344067 | Turkey | –24[w] | 19 | 7.3 |
| PI 264667 | Germany | –11[w] | 11 | 6.3 |
| PI 171612 | Turkey | –2[w] | 6 | 7.0 |
| PI 339245 | Turkey | 3 | 24 | 6.0 |
| PI 220171 | Afghanistan | 8 | 14 | 4.3 |
| PI 279469 | Japan | 9 | 16 | 5.7 |
| PI 368550 | Yugoslavia | 9 | 24 | 7.7 |
| PI 263047 | USSR | 10 | 14 | 6.3 |
| PI 326597 | Hungary | 10 | 13 | 6.7 |
| PI 343452 | USSR | 10 | 16 | 7.0 |
| Check–Gy 5 | Check | 10 | 14 | 5.0 |
| PI 264230 | France | 10 | 6 | 6.0 |
| PI 344439 | Iran | 11 | 14 | 5.7 |
| PI 277741 | Netherlands | 11 | 11 | 5.7 |
| PI 167197 | Turkey | 11 | 14 | 6.0 |
| PI 182192 | Turkey | 11 | –3[w] | 5.0 |
| PI 263083 | P.R. China | 11 | 1 | 6.0 |
| PI 419079 | P.R. China | 11 | 10 | 5.3 |
| PI 175696 | Turkey | 12 | 13 | 7.0 |
| Ansansky | NSSL | 12 | 22 | 6.0 |
| PI 357851 | Yugoslavia | 12 | 13 | 6.3 |
| PI 392292 | USSR | 12 | 16 | 5.7 |
| PI 137836 | Iran | 12 | 14 | 6.3 |
| PI 432894 | P.R. China | 12 | 16 | 5.0 |
| PI 321006 | Taiwan | 12 | 10 | 4.7 |
| PI 432895 | P.R. China | 12 | 13 | 5.0 |
| PI 164950 | Turkey | 12 | 9 | 6.0 |
| PI 211962 | Iran | 12 | 25 | 4.3 |
| Producer | NSSL | 12 | 23 | 6.7 |
| PI 172848 | Turkey | 12 | 16 | 6.0 |
| PI 288993 | Hungary | 12 | 12 | 5.7 |
| PI 376063 | Israel | 12 | 7 | 5.7 |
| PI 204568 | Turkey | 12 | 11 | 5.3 |
| PI 288995 | Hungary | 12 | 12 | 5.3 |
| PI 343451 | USSR | 12 | –1[w] | 6.3 |
| PI 357862 | Yugoslavia | 12 | 15 | 7.0 |
| PI 351139 | USSR | 12 | 7 | 6.7 |
| PI 137839 | Iran | 12 | 6 | 5.7 |
| PI 257487 | P.R. China | 12 | 20 | 6.0 |
| PI 326594 | Hungary | 12 | 12 | 5.7 |
| PI 264666 | Germany | 12 | 17 | 6.3 |
| PI 422177 | Czechoslovakia | 12 | –6[w] | 4.5 |
| Check–Regal | Check | 13 | –6[w] | 4.3 |
| PI 175691 | Turkey | 13 | 17 | 6.0 |
| PI 288994 | Hungary | 13 | 21 | 5.7 |
| PI 288996 | Hungary | 13 | 6 | 5.3 |
| PI 344349 | Turkey | 13 | 11 | 7.0 |
| PI 209065 | U.S.–Ohio | 13 | 14 | 6.0 |
| PI 222243 | Iran | 13 | 8 | 6.3 |
| PI 209068 | U.S.–Ohio | 13 | 9 | 6.3 |
| PI 267747 | U.S.–Oklahoma | 13 | 12 | 6.7 |
| PI 172849 | Turkey | 13 | 18 | 5.7 |

Table 1. Continued.

| Cultigen | Seed source[y] | Wt loss (%) | Firm. loss (%) | Shriveling[x] |
|---|---|---|---|---|
| PI 422191 | Czechoslovakia | 13 | –1[w] | 5.3 |
| PI 137856 | Iran | 13 | 4 | 5.7 |
| PI 355053 | Iran | 13 | 0 | 5.3 |
| PI 171606 | Turkey | 13 | 12 | 6.0 |
| PR 27 | NSSL | 13 | 14 | 5.3 |
| PI 264665 | Germany | 13 | 11 | 6.0 |
| PI 422198 | Czechoslovakia | 13 | 14 | 6.5 |
| PI 169387 | Turkey | 13 | 18 | 6.0 |
| PI 324239 | Sweden | 13 | 11 | 5.7 |
| PI 279464 | Japan | 13 | 27 | 5.0 |
| PI 390954 | USSR | 13 | 4 | 6.3 |
| PI 205995 | Sweden | 13 | 18 | 7.3 |
| Check–Gy 4 | Check | 13 | 18 | 4.7 |
| PI 234517 | U.S.–S.C. | 13 | 5 | 4.0 |
| PI 314425 | USSR | 13 | 6 | 5.7 |
| PI 197086 | India | 13 | 30 | 7.0 |
| PI 280096 | USSR | 13 | 13 | 6.3 |
| PI 432888 | P.R. China | 13 | 28 | 5.0 |
| Check–Gy 2 | Check | 13 | 8 | 5.0 |
| PI 321009 | Taiwan | 13 | 15 | 5.3 |
| PI 292012 | Israel | 13 | 13 | 6.0 |
| PI 279465 | Japan | 13 | 11 | 5.7 |
| PI 211982 | Iran | 13 | 15 | 6.3 |
| PI 267197 | P.R. China | 14 | 2 | 5.0 |
| PI 172851 | Turkey | 14 | 18 | 5.7 |
| PI 164952 | Turkey | 14 | 9 | 6.3 |
| PI 211985 | Iran | 14 | 7 | 5.3 |
| PI 209067 | U.S.–Ohio | 14 | 15 | 5.0 |
| PI 281448 | Korea | 14 | 8 | 5.0 |
| WS Davis Perf. | NSSL | 14 | 5 | 5.0 |
| PI 368554 | Yugoslavia | 14 | --- | 6.0 |
| PI 419214 | Hong Kong | 14 | 15 | 4.7 |
| PI 109481 | Turkey | 14 | 20 | 5.3 |
| PI 248778 | Iran | 14 | 13 | 5.7 |
| PI 212233 | Japan | 14 | 12 | 4.7 |
| Shamrock R | NSSL | 14 | 20 | 5.3 |
| PI 432870 | P.R. China | 14 | 22 | 3.0 |
| PI 176951 | Turkey | 14 | 19 | 5.3 |
| PI 368551 | Yugoslavia | 14 | 5 | 6.0 |
| PI 176952 | Turkey | 14 | 10 | 7.0 |
| PI 183224 | Egypt | 14 | 14 | 5.7 |
| PI 357836 | Yugoslavia | 14 | 7 | 5.7 |
| PI 263084 | P.R. China | 14 | 2 | 5.0 |
| PI 302443 | P.R. China | 14 | 9 | 5.7 |
| PI 357852 | Yugoslavia | 14 | 14 | 4.0 |
| Check–Sprint 440 | Check | 14 | 4 | 3.0 |
| Cubit | NSSL | 14 | 10 | 4.0 |
| PI 308916 | USSR | 14 | 10 | 6.3 |
| PI 196289 | India | 14 | 15 | 7.0 |
| PI 285603 | Poland | 14 | –5[w] | 4.7 |
| PI 267088 | USSR | 14 | 12 | 7.0 |
| PI 257494 | Iran | 14 | 23 | 6.7 |
| PI 193497 | Ethiopia | 14 | 27 | 7.0 |

**Cultural practices**

*Germplasm screening study*. Seeds were planted on raised, shaped beds 1.5 m apart. Plots were 1.2 m long and 1.5 m wide with 1.2-m alleys at each end. Fourteen seeds were planted in each plot on 12 May and the plants were thinned to a uniform stand of 10 plants per plot on 29 May 1987. No significant disease problems were observed. The guard rows were planted around the field, and at the end of each row. 'Sumter', a monoecious inbred, was planted in border rows and at the ends of each row (62 m long) to provide competition and pollen. Fertilizer was incorporated before planting at a rate of 90N–39P–74K kg·ha$^{-1}$, with an additional 34 kg·ha$^{-1}$ N applied at vine tip-over stage. A tank mix of 2.2 kg·ha$^{-1}$ of naptalam {2-[(1-naphthalenylamino) carbonyl] benzoic acid} and 4.4 kg·ha$^{-1}$ of bensulide {*O,O*-bis (1-methylethyl) *S*-[2-[(phenylsulfonyl) amino] ethyl] phosphorodithioate} was applied preplant for weed control. Irrigation was applied when needed for a total of 25–40 mm per week. Four fruits were harvested from each plot and evaluated for keeping ability following storage in brown paper bags at room temperature (23 ± 2 °C) and 55% ± 7% RH.

*Retest study*. Twenty cultigens identified during the initial screening study were planted in the spring season (Table 2). The plots (2.8 × 1.5 m) were separated by 0.3-m alleys at each end, and had 20 plants each. 'Sumter' was planted at each side of the field, and at each end of the row, to provide competition and pollen. Two harvest dates (1 and 13 July 1988) and two storage environments (an air-conditioned laboratory at 22 ± 2 °C and 55% ± 7% RH and a storage building at 25 ± 3 °C and 79% ± 11% RH without air conditioning) were used in the study. Fruit having a diameter of 40–50 mm were harvested from each plot and three were placed in each of five brown paper bags. Four of the bags were placed in either the laboratory or the storage building for 7 or 14 d. Fruit in the fifth bag were measured immediately upon harvest and were designated the day 0 control.

Table 1. Continued.

| Cultigen | Seed source[y] | Wt loss (%) | Firm. loss (%) | Shriveling[x] |
|---|---|---|---|---|
| PI 177361 | Turkey | 14 | 17 | 5.5 |
| PI 169389 | Turkey | 14 | 0 | 7.0 |
| PI 257486 | P.R. China | 14 | –5[w] | 6.3 |
| PI 338236 | Turkey | 14 | 20 | 5.0 |
| PI 422181 | Czechoslovakia | 14 | 6 | 4.3 |
| PI 222783 | Iran | 14 | 27 | 6.7 |
| PI 113334 | P.R. China | 14 | 22 | 6.3 |
| PI 092806 | P.R. China | 14 | 4 | 6.0 |
| PI 218036 | Iran | 14 | 15 | 5.3 |
| PI 226510 | Iran | 14 | 6 | 5.7 |
| PI 176526 | Turkey | 14 | 6 | 6.0 |
| PI 188749 | Egypt | 14 | 18 | 6.0 |
| PI 432889 | P.R. China | 14 | 15 | 6.3 |
| PI 326595 | Hungary | 14 | 16 | 6.0 |
| PI 358814 | Malaysia | 14 | 24 | 6.7 |
| PI 267086 | USSR | 14 | 26 | 7.0 |
| PI 344435 | Iran | 14 | 13 | 6.0 |
| PI 169398 | Turkey | 14 | 16 | 6.5 |
| PI 451975 | Canada | 15 | 19 | 5.7 |
| PI 114339 | Japan | 15 | 12 | 5.0 |
| PI 169386 | Turkey | 15 | 18 | 6.3 |
| York State Pickle | NSSL | 15 | 11 | 5.7 |
| PI 432860 | P.R. China | 15 | 13 | 5.0 |
| PI 370448 | Yugoslavia | 15 | 11 | 6.7 |
| PI 183231 | Egypt | 15 | 21 | 5.3 |
| PI 206954 | Turkey | 15 | 24 | 6.0 |
| PI 285609 | Poland | 15 | 19 | 6.3 |
| PI 283900 | Czechoslovakia | 15 | 11 | 6.7 |
| PI 172845 | Turkey | 15 | 13 | 6.0 |
| PI 419183 | P.R. China | 15 | 18 | 5.0 |
| PI 137857 | Iran | 15 | 11 | 5.3 |
| PI 422176 | Czechoslovakia | 15 | 2 | 5.0 |
| PI 249561 | Thailand | 15 | 3 | 6.3 |
| PI 183677 | Turkey | 15 | 23 | 6.0 |
| PI 211589 | Afghanistan | 15 | 16 | 7.0 |
| PI 419010 | P.R. China | 15 | 23 | 4.0 |
| PI 172847 | Turkey | 15 | 13 | 6.0 |
| PI 344437 | Iran | 15 | 19 | 5.3 |
| PI 175679 | Turkey | 15 | 15 | 6.7 |
| PI 174177 | Turkey | 15 | 22 | 5.7 |
| Calypso | N.C. State Univ. | 15 | –4[w] | 4.7 |
| PI 175695 | Turkey | 15 | 11 | 6.3 |
| PI 200818 | Burma | 15 | 15 | 5.7 |
| Tiny Dill | NSSL | 15 | 11 | 6.0 |
| PI 167358 | Turkey | 15 | 8 | 5.7 |
| PI 487424 | P.R. China | 15 | 14 | 5.0 |
| Check–Dasher II | Check | 15 | 10 | 2.3 |
| PI 288332 | India | 15 | 0 | 5.3 |
| PI 339241 | Turkey | 15 | –12[w] | 6.3 |
| PI 285606 | Poland | 15 | 14 | 5.7 |
| PI 368558 | Yugoslavia | 15 | 20 | 6.3 |
| PI 344347 | Turkey | 15 | 4 | 6.7 |
| PI 178887 | Turkey | 15 | 18 | 6.3 |

Table 1. Continued.

| Cultigen | Seed source[y] | Wt loss (%) | Firm. loss (%) | Shriveling[x] |
|---|---|---|---|---|
| PI 357850 | Yugoslavia | 15 | 11 | 6.3 |
| PI 211728 | Afghanistan | 15 | 7 | 5.7 |
| PI 229309 | Iran | 15 | 44 | 7.0 |
| PI 209064 | U.S.–Ohio | 15 | 7 | 6.0 |
| PI 356809 | USSR | 15 | 16 | 6.7 |
| Check–Calypso | Check | 15 | 14 | 4.0 |
| PI 174170 | Turkey | 15 | 4 | 6.0 |
| Snows Pickling | NSSL | 15 | 18 | 4.3 |
| PI 275411 | Netherlands | 15 | 9 | 6.3 |
| PI 222099 | Afghanistan | 15 | 13 | 6.7 |
| National Pickling | NSSL | 15 | 12 | 5.3 |
| PI 169304 | Turkey | 15 | 21 | 6.7 |
| PI 288237 | Egypt | 15 | 3 | 5.7 |
| PI 227209 | Japan | 15 | 18 | 7.0 |
| PI 227664 | Iran | 15 | 20 | 6.0 |
| PI 283902 | Czechoslovakia | 15 | 25 | 6.3 |
| Check–M 21 | Check | 15 | 13 | 4.0 |
| PI 174173 | Turkey | 15 | 14 | 5.3 |
| PI 321008 | Taiwan | 15 | 25 | 6.3 |
| PI 172852 | Turkey | 15 | 13 | 6.3 |
| PI 314426 | USSR | 15 | 15 | 6.0 |
| PI 339247 | Turkey | 15 | 13 | 6.7 |
| PI 264226 | France | 15 | 17 | 6.0 |
| PI 279463 | Japan | 15 | 18 | 5.7 |
| PI 344348 | Turkey | 15 | 12 | 6.7 |
| PI 436609 | P.R. China | 15 | 6 | 6.0 |
| PI 369717 | Poland | 15 | 27 | 6.5 |
| PI 418964 | P.R. China | 15 | 15 | 4.0 |
| PI 177360 | Turkey | 15 | 13 | 6.0 |
| PI 390257 | Japan | 15 | 14 | 4.3 |
| PI 419078 | P.R. China | 15 | 17 | 3.3 |
| PI 172844 | Turkey | 15 | 5 | 6.0 |
| PI 169315 | Turkey | 15 | 16 | 7.0 |
| PI 414158 | U.S.–Hawaii | 15 | 9 | 3.7 |
| PI 169397 | Turkey | 16 | 6 | 6.7 |
| PI 211980 | Iran | 16 | 5 | 6.3 |
| PI 288238 | Egypt | 16 | 26 | 5.7 |
| M 21 | N.C. State Univ. | 16 | 5 | 4.3 |
| PI 264668 | Germany | 16 | 5 | 6.0 |
| PI 179921 | India | 16 | 13 | 7.0 |
| PI 466922 | USSR | 16 | 7 | 4.7 |
| PI 458853 | USSR | 16 | 0 | 6.5 |
| PI 220790 | Afghanistan | 16 | 27 | 7.0 |
| PI 105340 | P.R. China | 16 | 9 | 6.0 |
| PI 211975 | Iran | 16 | 19 | 6.3 |
| PI 419017 | P.R. China | 16 | 15 | 3.7 |
| PI 321011 | Taiwan | 16 | 4 | 3.5 |
| PI 344353 | Turkey | 16 | 7 | 7.7 |
| PI 227208 | Japan | 16 | 23 | 3.7 |
| PI 165499 | India | 16 | 3 | 7.0 |
| PI 432893 | P.R. China | 16 | 19 | 6.0 |
| PI 211978 | Iran | 16 | 15 | 4.7 |
| Gy 14 | N.C. State Univ. | 16 | 29 | 4.5 |

Table 1. Continued.

| Cultigen | Seed source[y] | Wt loss (%) | Firm. loss (%) | Shriveling[x] |
|---|---|---|---|---|
| PI 211117 | Israel | 16 | 23 | 4.7 |
| PI 172838 | Turkey | 16 | 16 | 6.3 |
| PI 175120 | India | 16 | 20 | 7.0 |
| PI 172846 | Turkey | 16 | 3 | 6.3 |
| PI 432883 | P.R. China | 16 | 7 | 4.7 |
| PI 338234 | Turkey | 16 | 20 | 7.0 |
| PI 458852 | USSR | 16 | 12 | 5.0 |
| PI 478367 | P.R. China | 16 | 12 | 5.3 |
| PI 233932 | Canada | 16 | 14 | 7.3 |
| PI 135123 | New Zealand | 16 | –2[w] | 7.3 |
| PI 251519 | Iran | 16 | 26 | 7.0 |
| PI 109483 | Turkey | 16 | –6[w] | 4.7 |
| Texas Long | NSSL | 16 | 18 | 3.0 |
| Clinton | N.C. State Univ. | 16 | 6 | 5.0 |
| PI 211979 | Iran | 16 | 14 | 5.7 |
| Model | NSSL | 16 | 9 | 5.3 |
| PI 344351 | Turkey | 16 | 18 | 6.3 |
| PI 176517 | Turkey | 16 | 4 | 6.3 |
| Early Green Cluster | NSSL | 16 | 7 | 7.0 |
| PI 357844 | Yugoslavia | 16 | 13 | 7.0 |
| PI 432866 | P.R. China | 16 | 2 | 5.3 |
| PI 103049 | P.R. China | 16 | 19 | 5.3 |
| PI 344444 | Iran | 16 | 17 | 4.0 |
| PI 211977 | Iran | 16 | –4[w] | 6.7 |
| PI 174172 | Turkey | 16 | 6 | 5.7 |
| PI 206425 | Turkey | 16 | 4 | 6.3 |
| PI 171611 | Turkey | 16 | 25 | 7.0 |
| PI 222985 | Iran | 16 | 15 | 5.7 |
| PI 169402 | Turkey | 16 | 13 | 5.7 |
| PI 257286 | Spain | 16 | 16 | 5.7 |
| PI 344445 | Iran | 16 | 25 | 5.3 |
| PI 344441 | Iran | 16 | 26 | 5.3 |
| PI 175693 | Turkey | 16 | 18 | 6.0 |
| PI 357859 | Yugoslavia | 16 | 14 | 7.0 |
| PI 432850 | P.R. China | 16 | 21 | 6.3 |
| PI 264664 | Germany | 16 | 13 | 5.7 |
| PI 271753 | Netherlands | 16 | 14 | 5.0 |
| PI 432892 | P.R. China | 16 | 21 | 5.7 |
| PI 390255 | Japan | 16 | 20 | 3.0 |
| PI 171605 | Turkey | 16 | 5 | 7.0 |
| PI 269480 | West Pakistan | 16 | 17 | 6.3 |
| PI 342950 | Denmark | 16 | 15 | 6.7 |
| Early Fortune | NSSL | 16 | 5 | 6.3 |
| PI 432867 | P.R. China | 16 | 25 | 5.7 |
| PI 169392 | Turkey | 16 | 23 | 6.0 |
| PI 326598 | Hungary | 16 | 2 | 5.7 |
| PI 292011 | Israel | 16 | 28 | 5.7 |
| Sprint 440 | Asgrow | 17 | 17 | 4.7 |
| PI 172843 | Turkey | 17 | 29 | 7.3 |
| PI 137853 | Iran | 17 | 12 | 5.7 |
| PI 264229 | France | 17 | 22 | 4.0 |
| Delcrow | NSSL | 17 | 14 | 4.5 |
| PI 401733 | Puerto Rico | 17 | 10 | 4.0 |
| PI 179676 | India | 17 | 21 | 4.3 |
| PI 436610 | P.R. China | 17 | 20 | 4.3 |
| PI 379282 | Yugoslavia | 17 | 11 | 8.0 |
| PI 427090 | P.R. China | 17 | 25 | 5.0 |
| PI 137848 | Iran | 17 | 20 | 6.7 |
| PI 357845 | Yugoslavia | 17 | 10 | 6.3 |
| PI 432879 | P.R. China | 17 | 19 | 6.0 |
| PI 435946 | USSR | 17 | 16 | 5.7 |
| PI 167134 | Turkey | 17 | 5 | 6.0 |
| PI 478365 | P.R. China | 17 | 17 | 4.7 |
| PI 432865 | P.R. China | 17 | 8 | 4.3 |
| PI 354952 | Denmark | 17 | 12 | 6.0 |
| PI 357841 | Yugoslavia | 17 | 8 | 6.3 |
| PI 175686 | Turkey | 17 | 26 | 6.7 |
| PI 263082 | P.R. China | 17 | 20 | 5.7 |
| PI 401734 | Puerto Rico | 17 | 11 | 4.3 |
| PI 109484 | Turkey | 17 | 2 | 6.0 |
| PI 418963 | P.R. China | 17 | 11 | 4.3 |
| PI 204692 | Turkey | 17 | 19 | 4.7 |
| PI 167079 | Turkey | 17 | 18 | 5.0 |
| PI 285604 | Poland | 17 | 14 | 4.7 |
| PI 293432 | Lebanon | 17 | 19 | 6.3 |

Table 1. Continued.

| Cultigen | Seed source[y] | Wt loss (%) | Firm. loss (%) | Shriveling[x] |
|---|---|---|---|---|
| PI 288992 | Hungary | 17 | 16 | 5.3 |
| PI 285605 | Poland | 17 | 37 | 6.7 |
| PI 171604 | Turkey | 17 | 9 | 6.7 |
| PI 419108 | P.R. China | 17 | 23 | 5.0 |
| PI 283899 | Czechoslovakia | 17 | 15 | 5.7 |
| PI 226461 | Iran | 17 | 17 | 6.3 |
| PI 169353 | Turkey | 17 | 18 | 6.0 |
| PI 357865 | Yugoslavia | 17 | 7 | 6.0 |
| PI 422186 | Czechoslovakia | 17 | 11 | 5.0 |
| PI 432853 | P.R. China | 17 | 14 | 4.3 |
| PI 182190 | Turkey | 17 | 14 | 6.0 |
| PI 169383 | Turkey | 17 | 17 | 7.0 |
| PI 390246 | Japan | 17 | 18 | 4.0 |
| PI 246930 | Afghanistan | 17 | 11 | 5.3 |
| PI 167050 | Turkey | 17 | 8 | 4.5 |
| PI 489754 | P.R. China | 17 | 27 | 4.0 |
| PI 390951 | USSR | 17 | 60 | 7.5 |
| PI 357860 | Yugoslavia | 17 | 11 | 6.3 |
| PI 172841 | Turkey | 17 | 5 | 5.7 |
| Boston Pickling | NSSL | 17 | 17 | 6.7 |
| PI 222987 | Iran | 17 | 10 | 6.3 |
| PI 263080 | USSR | 17 | 13 | 6.7 |
| PI 326596 | Hungary | 17 | 19 | 5.3 |
| PI 357837 | Yugoslavia | 17 | 9 | 6.7 |
| Arlington WS | NSSL | 17 | 21 | 5.0 |
| PI 181756 | Lebanon | 17 | 6 | 5.7 |
| PI 171600 | Turkey | 17 | 14 | 7.0 |
| PI 379278 | Yugoslavia | 17 | 5 | 6.3 |
| PI 169381 | Turkey | 17 | 19 | 6.3 |
| PI 422168 | Czechoslovakia | 17 | 14 | 4.7 |
| PI 458849 | USSR | 17 | 16 | 6.3 |
| PI 204690 | Turkey | 17 | 11 | 5.7 |
| PI 357839 | Yugoslavia | 18 | 11 | 5.3 |
| PI 422185 | Czechoslovakia | 18 | 9 | 5.3 |
| PR 39 | NSSL | 18 | 16 | 4.7 |
| PI 321007 | Taiwan | 18 | 23 | 5.7 |
| PI 192940 | P.R. China | 18 | 19 | 6.3 |
| PI 226509 | Iran | 18 | 21 | 6.7 |
| PI 390247 | Japan | 18 | 31 | 3.3 |
| PI 344432 | Iran | 18 | 13 | 6.3 |
| PI 355055 | Iran | 18 | 4 | 6.7 |
| PI 356833 | GBE | 18 | 26 | 4.3 |
| PI 175690 | Turkey | 18 | 9 | 5.7 |
| PI 176957 | Turkey | 18 | 6 | 6.0 |
| PI 177363 | Syria | 18 | 14 | 5.7 |
| PI 275412 | Netherlands | 18 | 21 | 5.3 |
| PI 167052 | Turkey | 18 | 14 | 6.7 |
| Favor II | NSSL | 18 | 11 | 6.7 |
| PI 432859 | P.R. China | 18 | 12 | 4.7 |
| PI 169391 | Turkey | 18 | 7 | 6.3 |
| PI 296387 | Iran | 18 | 15 | 7.0 |
| PI 261608 | Spain | 18 | 8 | 5.0 |
| PI 169401 | Turkey | 18 | 0 | 6.7 |
| PI 368549 | Yugoslavia | 18 | 18 | 7.0 |
| PI 181910 | Syria | 18 | 20 | 5.3 |
| PI 267743 | P.R. China | 18 | 12 | 5.0 |
| PI 227210 | Japan | 18 | 26 | 5.3 |
| PI 182188 | Turkey | 18 | 20 | 5.7 |
| PI 357831 | Yugoslavia | 18 | 21 | 7.0 |
| PI 357868 | Yugoslavia | 18 | 17 | 5.7 |
| PI 344352 | Turkey | 18 | 1 | 6.7 |
| PI 212599 | Afghanistan | 18 | 13 | 7.0 |
| PI 174167 | Turkey | 18 | 20 | 5.0 |
| PI 181940 | Syria | 18 | 23 | 4.7 |
| PI 390256 | Japan | 18 | 14 | 6.0 |
| PI 197087 | India | 18 | 18 | 6.7 |
| PI 178884 | Turkey | 18 | 31 | 7.3 |
| PI 222782 | Iran | 18 | 25 | 6.0 |
| PI 249550 | Iran | 18 | 15 | 5.7 |
| PI 137835 | Iran | 18 | 21 | 6.0 |
| PI 218199 | Lebanon | 18 | 25 | 7.0 |
| PI 344438 | Iran | 18 | 15 | 6.0 |
| PI 179260 | Turkey | 18 | 21 | 6.0 |
| PI 172840 | Turkey | 18 | 18 | 5.0 |
| PI 172842 | Turkey | 18 | 24 | 6.3 |

**Traits measured**

*Germplasm screening study*. Data were collected on: fruit weight loss (%), firmness loss (%), and a visual rating for appearance (fruit shriveling). Fruit weight was measured before storage and after 2 weeks, when the fruits were rated for shriveling and firmness. Shriveling was rated subjectively on a 0–9 scale with 0 = none (no appearance of shriveling of fruit skin), 1–3 = slight, 4–6 = moderate, and 7–9 = severe (skin very shriveled). Firmness was the amount of force (N) required to penetrate the exocarp (skin) and mesocarp (flesh) with an 8-mm-diameter tester head (McCormick Fruit Tech, Yakima, Wash.) on the top carpel of the blossom end of the fruit.

*Retest study*. Data were recorded 0, 7, and 14 d after harvest. The traits measured were fresh weight, firmness, percentage of shriveling, degree of yellowing, incidence of postharvest diseases, fresh taste, seedcell wateriness, placental hollows, and carpel separation.

Quality traits (taste, seedcell, placental hollows, and carpel separation) were rated subjectively on a 1–9 scale (1–3 = poor, 4–6 = intermediate, 7–9 = excellent). Taste ratings of 1–3 indicated a bad flavor or bitter taste, 4–6 a slightly off-flavor, and 7–9 a good flavor and sweet taste. Seedcell wateriness was rated based on the degree to which the firm, crisp seedcell became soft and watery; ratings of 1–3 indicated that the seedcell was very watery, and a rating of 7– 9 indicated that it was firm and crisp. Placental hollows rating was based on the length of placental hollows in the fruit. A rating of 1–3 indicated two or three hollows running most of the length of the fruits, 4–6 indicated one or two placental hollows running less than the entire length of the fruit, and 7–9 indicated that there was no defect (or no more than one placental hollow running less than half the length of the fruit). Carpel separation was rated based on the degree of carpel separation. A rating of 1–3 indicated carpels separated, and the center of the fruit hollow, 4–6 indicated carpels obviously separated, and 7–9 indicated that there was no defect (or carpels slightly but not obviously separated). Average quality, damage index, percentage loss in fresh fruit weight, and percentage of

Table 1. Continued.

| Cultigen | Seed source[y] | Wt loss (%) | Firm. loss (%) | Shriveling[x] |
|---|---|---|---|---|
| PI 176956 | Turkey | 18 | 12 | 5.7 |
| Straight 8 | NSSL | 18 | 23 | 4.3 |
| PI 109482 | Turkey | 18 | 13 | 7.0 |
| PI 306785 | Canada | 18 | 22 | 3.7 |
| PI 274902 | Great Britain | 18 | 10 | 5.7 |
| PI 249562 | Thailand | 18 | 15 | 4.0 |
| PI 163217 | India | 18 | 5 | 6.3 |
| PI 357867 | Yugoslavia | 18 | 9 | 6.0 |
| Everbearing | NSSL | 18 | 2 | 5.7 |
| PI 227207 | Japan | 18 | 22 | 5.0 |
| PI 135122 | New Zealand | 18 | 40 | 7.0 |
| PI 174164 | Turkey | 18 | 30 | 6.7 |
| PI 478364 | P.R. China | 18 | 9 | 5.0 |
| PI 414159 | U.S.–Hawaii | 18 | –8[w] | 4.7 |
| PI 458848 | USSR | 18 | 6 | 7.0 |
| PI 262990 | Netherlands | 18 | 16 | 6.7 |
| PI 137846 | Iran | 18 | 8 | 6.0 |
| PI 379285 | Yugoslavia | 18 | 8 | 5.3 |
| PI 390265 | Japan | 18 | 38 | 7.0 |
| PI 251520 | Iran | 18 | 18 | 7.3 |
| PI 178886 | Turkey | 18 | 19 | 6.0 |
| PI 379287 | Yugoslavia | 18 | 2 | 6.7 |
| PI 271331 | India | 19 | 19 | 7.0 |
| PI 169403 | Turkey | 19 | 17 | 5.7 |
| PI 271754 | Netherlands | 19 | 15 | 6.0 |
| PI 432857 | P.R. China | 19 | 47 | 5.7 |
| PI 379284 | Yugoslavia | 19 | –13[w] | 5.0 |
| PI 400270 | Japan | 19 | 24 | 7.0 |
| PI 223437 | Afghanistan | 19 | 7 | 6.3 |
| PI 165506 | India | 19 | 22 | 7.0 |
| PI 458855 | USSR | 19 | 6 | 6.5 |
| PI 206952 | Turkey | 19 | 18 | 6.0 |
| PI 169388 | Turkey | 19 | 22 | 6.3 |
| PI 489752 | P.R. China | 19 | 20 | 5.7 |
| PI 422172 | Czechoslovakia | 19 | 18 | 4.7 |
| PI 390953 | USSR | 19 | 10 | 7.0 |
| PI 175683 | Turkey | 19 | 6 | 6.3 |
| PI 171601 | Turkey | 19 | 22 | 5.7 |
| PI 308915 | USSR | 19 | 18 | 6.7 |
| PI 355052 | Israel | 19 | 8 | 6.0 |
| PI 368548 | Yugoslavia | 19 | 16 | 6.7 |
| PI 357857 | Yugoslavia | 19 | 23 | 7.0 |
| PI 339246 | Turkey | 19 | 19 | 7.0 |
| PI 179259 | Turkey | 19 | 6 | 6.0 |
| PI 267087 | USSR | 19 | 6 | 6.3 |
| PI 176516 | Turkey | 19 | 16 | 6.0 |
| PI 482464 | Zimbabwe | 19 | 22 | 4.0 |
| PI 255936 | Netherlands | 19 | 34 | 6.7 |
| PI 165029 | Turkey | 19 | 19 | 6.7 |
| PI 175680 | Turkey | 19 | 9 | 7.0 |
| PI 171602 | Turkey | 19 | 22 | 6.3 |
| PI 267942 | Japan | 19 | 11 | 6.7 |

Table 1. Continued.

| Cultigen | Seed source[y] | Wt loss (%) | Firm. loss (%) | Shriveling[x] |
|---|---|---|---|---|
| PI 267746 | India | 19 | 7 | 7.0 |
| PI 183445 | India | 19 | 23 | 6.7 |
| PI 220789 | Afghanistan | 19 | 16 | 5.7 |
| Shogoin | NSSL | 19 | 27 | 5.7 |
| PI 304803 | U.S.–New York | 19 | 21 | 5.3 |
| PI 357854 | Yugoslavia | 19 | 9 | 6.5 |
| PI 169380 | Turkey | 19 | 14 | 6.3 |
| PI 181753 | Syria | 19 | 14 | 5.7 |
| PI 175694 | Turkey | 19 | 27 | 6.3 |
| PI 106063 | P.R. China | 19 | 7 | 6.3 |
| PI 391569 | P.R. China | 20 | 11 | 5.5 |
| PI 344350 | Turkey | 20 | 27 | 6.7 |
| PI 356832 | Netherlands | 20 | 3 | 5.3 |
| PI 285607 | Poland | 20 | 3 | 6.7 |
| PI 344433 | Iran | 20 | 13 | 5.7 |
| PI 179678 | India | 20 | 12 | 4.7 |
| PI 339250 | Turkey | 20 | 25 | 6.7 |
| PI 177359 | Turkey | 20 | 23 | 4.7 |
| PI 173889 | India | 20 | 20 | 5.7 |
| PI 436673 | P.R. China | 20 | 31 | 4.7 |
| Check–WI 2757 | Check | 20 | --- | 4.0 |
| PI 390952 | USSR | 20 | 11 | 5.3 |
| PI 164734 | India | 20 | 1 | 6.7 |
| PI 401732 | Puerto Rico | 20 | 26 | 5.7 |
| PI 422180 | Czechoslovakia | 20 | 31 | 4.5 |
| PI 489753 | P.R. China | 20 | 18 | 5.7 |
| PI 211988 | Iran | 20 | 8 | 5.7 |
| PI 209069 | U.S.–Ohio | 20 | 24 | 6.3 |
| PI 271334 | India | 20 | 18 | 6.7 |
| PI 436648 | P.R. China | 20 | 26 | 5.0 |
| PI 422196 | Czechoslovakia | 20 | 30 | 4.0 |
| PI 458847 | USSR | 20 | 14 | 5.7 |
| PI 269482 | West Pakistan | 20 | 14 | 6.3 |
| PI 292010 | Israel | 20 | 8 | 5.0 |
| PI 165046 | Turkey | 20 | 24 | 6.5 |
| PI 135345 | Afghanistan | 20 | 21 | 6.3 |
| PI 217644 | India | 20 | 29 | 7.3 |
| PI 321010 | Taiwan | 20 | 13 | 6.7 |
| PI 262974 | India | 20 | 24 | 6.3 |
| PI 435947 | USSR | 20 | 19 | 6.3 |
| PI 267935 | Japan | 20 | 16 | 7.0 |
| PI 458850 | USSR | 20 | 6 | 7.0 |
| PI 169394 | Turkey | 20 | 19 | 5.7 |
| PI 390259 | Japan | 20 | 7 | 6.3 |
| PI 171610 | Turkey | 20 | 19 | 7.0 |
| PI 418989 | P.R. China | 20 | 8 | 7.5 |
| PI 169351 | Turkey | 20 | 27 | 7.7 |
| PI 390252 | Japan | 20 | 18 | 6.7 |
| PI 175111 | India | 20 | 1 | 6.0 |
| PI 263081 | P.R. China | 21 | 26 | 6.7 |
| PI 211967 | Iran | 21 | 9 | 6.7 |
| PI 319216 | Un. Arab Repub. | 21 | 11 | 6.3 |

Table 1. Continued.

| Cultigen | Seed source[y] | Wt loss (%) | Firm. loss (%) | Shriveling[x] |
|---|---|---|---|---|
| PI 338235 | Turkey | 21 | 8 | 6.0 |
| PI 179263 | Turkey | 21 | 31 | 7.0 |
| PI 169396 | Turkey | 21 | 17 | 6.7 |
| PI 164819 | India | 21 | 20 | 7.7 |
| PI 169393 | Turkey | 21 | 12 | 6.7 |
| PI 212059 | Greece | 21 | 15 | 5.3 |
| PI 390258 | Japan | 21 | 46 | 6.7 |
| PI 357849 | Yugoslavia | 21 | 14 | 7.0 |
| PI 422190 | Czechoslovakia | 21 | 21 | 4.3 |
| PI 250147 | W. Pakistan | 21 | 8 | 6.7 |
| PI 263049 | USSR | 21 | 17 | 6.3 |
| PI 357835 | Yugoslavia | 21 | 3 | 6.5 |
| PI 163214 | India | 21 | 23 | 7.3 |
| PI 263079 | USSR | 21 | 26 | 4.7 |
| PI 174166 | Turkey | 21 | 33 | 7.0 |
| PI 169400 | Turkey | 21 | 11 | 6.7 |
| PI 176954 | Turkey | 21 | 34 | 7.0 |
| PI 164670 | India | 21 | 11 | 5.0 |
| PI 206043 | U.S.–Puerto Rico | 21 | 37 | 6.7 |
| PI 418962 | P.R. China | 21 | 27 | 5.0 |
| PI 137847 | Iran | 21 | 45 | 7.7 |
| PI 422170 | Czechoslovakia | 21 | 28 | 5.3 |
| PI 178888 | Turkey | 21 | 29 | 7.3 |
| PI 419136 | P.R. China | 21 | 16 | 5.3 |
| PI 432890 | P.R. China | 21 | 19 | 5.3 |
| PI 357840 | Yugoslavia | 21 | 31 | 7.0 |
| PI 209066 | U.S.–Ohio | 21 | 29 | 7.0 |
| PI 263048 | USSR | 21 | 16 | 7.0 |
| PI 176953 | Turkey | 21 | 45 | 7.0 |
| PI 267943 | Japan | 21 | 23 | 7.3 |
| PI 419009 | P.R. China | 21 | 11 | 4.7 |
| Muronium | NSSL | 21 | 57 | 7.0 |
| PI 171609 | Turkey | 21 | 36 | 6.7 |
| PI 390262 | Japan | 21 | 34 | 4.5 |
| PI 357847 | Yugoslavia | 21 | 25 | 5.0 |
| Polaris | NSSL | 21 | 41 | 5.5 |
| PI 306180 | Poland | 21 | 17 | 6.0 |
| Check–Addis | Check | 21 | –6[w] | 6.0 |
| PI 483342 | Korea | 21 | 24 | 5.0 |
| PI 221440 | Afghanistan | 22 | 12 | 6.0 |
| PI 390269 | Japan | 22 | 15 | 7.0 |
| PI 370449 | Yugoslavia | 22 | 18 | 8.0 |
| PI 344434 | Iran | 22 | 17 | 6.0 |
| White Wonder | NSSL | 22 | 3 | 6.3 |
| PI 422188 | Czechoslovakia | 22 | 31 | 6.0 |
| Pacer | Harris–Moran | 22 | --- | 3.0 |
| PI 181874 | Syria | 22 | 20 | 6.0 |
| PI 206953 | Turkey | 22 | 18 | 7.0 |
| Long of Keschmet | NSSL | 22 | 27 | 7.0 |
| PI 344440 | Iran | 22 | 12 | 5.7 |
| PI 432873 | P.R. China | 22 | 38 | 6.3 |
| PI 390253 | Japan | 22 | 20 | 7.0 |
| PI 137844 | Iran | 22 | 18 | 7.5 |
| PI 422173 | Czechoslovakia | 22 | 10 | 6.0 |
| PI 167389 | Turkey | 22 | 36 | 7.0 |
| PI 391568 | P.R. China | 22 | 26 | 6.7 |
| PI 173892 | India | 22 | 28 | 6.0 |
| PI 344443 | Iran | 22 | 15 | 6.7 |
| PI 357863 | Yugoslavia | 22 | 16 | 6.0 |
| PI 169385 | Turkey | 22 | 27 | 7.7 |
| PI 207476 | Afghanistan | 22 | 19 | 5.3 |
| PI 304805 | U.S.–New York | 22 | 17 | 6.5 |
| PSI | NSSL | 22 | 20 | 4.3 |
| PI 174174 | Turkey | 22 | 18 | 6.3 |
| PI 173674 | Turkey | 22 | 35 | 7.3 |
| PI 391573 | P.R. China | 22 | 33 | 5.0 |
| PI 368556 | Yugoslavia | 22 | 36 | 7.7 |
| PI 289698 | Australia | 22 | 5 | 6.3 |
| PI 211984 | Iran | 22 | 12 | 5.0 |
| PI 211943 | Iran | 22 | 14 | 6.3 |
| PI 109275 | Turkey | 22 | 18 | 6.7 |
| PI 414157 | U.S.–Oregon | 22 | 20 | 6.7 |
| PI 360939 | Netherlands | 22 | 15 | 6.7 |
| PI 279468 | Japan | 23 | 24 | 7.0 |
| PI 193496 | Ethiopia | 23 | 13 | 6.7 |

Table 1. Continued.

| Cultigen | Seed source[y] | Wt loss (%) | Firm. loss (%) | Shriveling[x] |
|---|---|---|---|---|
| PI 164816 | India | 23 | 2 | 7.7 |
| PI 181942 | Syria | 23 | 24 | 5.3 |
| PI 296121 | Egypt | 23 | 12 | 7.0 |
| PI 293923 | U.S.–S.C. | 23 | 35 | 7.0 |
| Check–Sumter | Check | 23 | 20 | 6.7 |
| PI 264231 | France | 23 | 22 | 7.3 |
| PI 390266 | Japan | 23 | 24 | 6.5 |
| PI 182189 | Turkey | 23 | 13 | 5.7 |
| PI 163213 | India | 23 | 22 | 6.0 |
| PI 390248 | Japan | 23 | 31 | 7.5 |
| PI 176924 | Turkey | 23 | 32 | 7.7 |
| PI 357834 | Yugoslavia | 23 | 29 | 7.0 |
| PI 390240 | Japan | 23 | 34 | 8.0 |
| PI 181752 | Syria | 23 | 39 | 7.0 |
| PI 211983 | Iran | 23 | 27 | 6.0 |
| PI 370450 | Yugoslavia | 23 | 58 | 7.5 |
| PI 255933 | Netherlands | 23 | 23 | 5.3 |
| PI 339248 | Turkey | 23 | 21 | 5.3 |
| PI 357830 | Yugoslavia | 23 | 53 | 7.0 |
| PI 432877 | P.R. China | 23 | 19 | 6.5 |
| PI 373918 | England | 23 | 21 | 6.3 |
| PI 275410 | Netherlands | 23 | 13 | 6.3 |
| PI 372898 | Netherlands | 23 | 26 | 5.3 |
| PI 255937 | Netherlands | 24 | 23 | 6.0 |
| PI 357843 | Yugoslavia | 24 | 26 | 8.0 |
| Chicago Pickling | NSSL | 24 | 15 | 7.0 |
| PI 357848 | Yugoslavia | 24 | 18 | 7.0 |
| PI 204567 | Turkey | 24 | 28 | 6.7 |
| Palmetto | NSSL | 24 | 40 | 6.3 |
| PI 436672 | P.R. China | 24 | 18 | 6.3 |
| PI 422171 | Czechoslovakia | 24 | 35 | 6.7 |
| PI 481617 | Bhutan | 24 | 15 | 4.0 |
| PI 214049 | India | 24 | 18 | 7.7 |
| PI 222720 | Iran | 24 | 42 | 7.5 |
| PI 390250 | Japan | 24 | 35 | 6.3 |
| PI 432861 | P.R. China | 24 | 30 | 6.7 |
| PI 169378 | Turkey | 24 | 22 | 7.7 |
| PI 164743 | India | 24 | 15 | 6.7 |
| PI 432875 | P.R. China | 24 | 34 | 7.0 |
| PI 357855 | Yugoslavia | 24 | 11 | 7.3 |
| PI 175688 | Turkey | 24 | 25 | 5.0 |
| PI 175689 | Turkey | 24 | 19 | 5.7 |
| PI 164173 | India | 24 | 14 | 6.7 |
| PI 264227 | France | 25 | 31 | 6.3 |
| PI 422174 | Czechoslovakia | 25 | 45 | 7.0 |
| PI 267741 | Japan | 25 | 12 | 6.7 |
| PI 432858 | P.R. China | 25 | 15 | 6.7 |
| PI 174160 | Turkey | 25 | 22 | 7.3 |
| PI 357833 | Yugoslavia | 25 | 41 | 8.7 |
| PI 200815 | Burma | 25 | 36 | 5.7 |
| PI 176521 | Turkey | 25 | 27 | 7.3 |
| PI 169395 | Turkey | 25 | 31 | 8.3 |
| PI 344442 | Iran | 25 | 22 | 6.3 |
| Pixie | NSSL | 25 | 1 | 4.3 |
| PI 175681 | Turkey | 25 | 11 | 7.5 |
| PI 306179 | Poland | 25 | 34 | 7.7 |
| PI 227013 | Iran | 25 | 47 | 7.3 |
| PI 422169 | Czechoslovakia | 25 | 61 | 7.3 |
| PI 357832 | Yugoslavia | 25 | 24 | 6.7 |
| Wautoma | USDA–Wis | 25 | 31 | 5.0 |
| PI 217946 | Pakistan | 25 | 31 | 7.0 |
| PI 204569 | Turkey | 25 | 44 | 7.7 |
| PI 432848 | P.R. China | 26 | 43 | 6.7 |
| PI 263078 | USSR | 26 | 29 | 6.7 |
| PI 432855 | P.R. China | 26 | 32 | 8.5 |
| PI 264228 | France | 26 | 5 | 6.7 |
| PI 177364 | Iraq | 26 | 30 | 6.7 |
| PI 183127 | India | 26 | --- | 9.0 |
| PI 206955 | Turkey | 26 | 19 | 7.3 |
| PI 390241 | Japan | 26 | 26 | 4.0 |
| PI 284699 | Sweden | 26 | 35 | 7.3 |
| Delicatesse | NSSL | 26 | 8 | 6.7 |
| PI 370447 | Yugoslavia | 26 | 6 | 6.5 |
| PI 267742 | P.R. China | 26 | 31 | 7.3 |
| PI 175950 | Turkey | 26 | 9 | 6.7 |

loss in firmness were calculated from the data. Average quality was the mean of the ratings for taste, seedcell wateriness, placental hollows, and carpel separation.

Damage traits (shriveling, fruit yellowing, and postharvest diseases) were rated subjectively on a 0–9 scale (0 = none, 1–3 = slight, 4–6 = moderate, 7–9 = severe), and damage index was calculated as the mean of the three values. Percentage of loss in fruit weight and fruit firmness were calculated based on the formulas described for the germplasm screening study.

### Data analysis

*Germplasm screening study*. The experiment was a randomized complete-block design with 761 cultigens and three replications. Data were analyzed using the GLM and CORR procedures of SAS (SAS Inst., Cary, N.C.).

*Retest study*. The experiment was performed using a factorial treatment arrangement in a randomized complete-block design with two replications of nine fruits per treatment combination [two harvest dates (1 and 13 July) × two storage locations × 20 cultigens]. Data were analyzed using the GLM and CORR procedures of SAS (SAS Inst.).

## Results and Discussion

*Germplasm screening study*. Differences among cultigens in percentage of fruit weight loss, percentage of fruit firmness loss, and degree of fruit shriveling during storage were highly significant. Cultigens were ranked based on the mean values for the percentage of fruit weight loss over the three replications (Table 1). Correlation analysis revealed that there were only moderate associations for percentage of fruit weight loss vs. fruit firmness loss ($r = 0.60$), percentage of fruit weight loss vs. shriveling rating ($r = 0.44$), and fruit firmness loss vs. shriveling rating ($r = 0.45$) (Table 1).

Cultigens with the lowest percentage of fruit weight loss (<10%) were PI 172839, PI 344067, PI 264667, PI 171612, PI 339245, PI 220171, PI 279469, and PI 368550 (Table 1), and the cultigen with the highest percentage (70%) was PI 357864. Cultigens with the lowest percentage of loss in fruit firmness

Table 1. Continued.

| Cultigen | Seed source[y] | Wt loss (%) | Firm. loss (%) | Shriveling[x] |
|---|---|---|---|---|
| PI 171608 | Turkey | 26 | 39 | 7.3 |
| PI 224668 | Korea | 27 | 39 | 6.7 |
| Earliest of All | NSSL | 27 | 19 | 5.7 |
| Nappa 63 | NSSL | 27 | 2 | 6.5 |
| MR 200 | NSSL | 27 | 21 | 6.0 |
| PI 267745 | Brazil | 27 | 28 | 6.7 |
| PI 169377 | Turkey | 27 | 14 | 7.0 |
| PI 432862 | P.R. China | 27 | 26 | 6.0 |
| PI 478366 | P.R. China | 27 | 36 | 7.0 |
| PI 269481 | West Pakistan | 27 | 20 | 7.7 |
| Robin | NSSL | 27 | 19 | 6.3 |
| PI 458851 | USSR | 27 | 31 | 7.7 |
| PI 390244 | Japan | 27 | 29 | 8.0 |
| PI 137845 | Iran | 27 | 32 | 6.3 |
| PI 263046 | USSR | 27 | 25 | 6.0 |
| PI 211986 | Iran | 28 | 18 | 7.0 |
| PI 390239 | Japan | 28 | 38 | 7.0 |
| PI 419041 | P.R. China | 28 | 29 | 8.0 |
| PI 176523 | Turkey | 28 | 47 | 7.3 |
| PI 357869 | Yugoslavia | 28 | 33 | 7.3 |
| PI 176525 | Turkey | 28 | 13 | 7.7 |
| PI 212985 | India | 28 | 28 | 8.0 |
| PI 432886 | P.R. China | 28 | 36 | 6.7 |
| Sunny South | NSSL | 28 | 12 | 5.7 |
| PI 372587 | Netherlands | 28 | 26 | 6.0 |
| PI 261609 | Spain | 28 | 26 | 6.3 |
| PI 163221 | India | 28 | 45 | 6.5 |
| PI 379283 | Yugoslavia | 28 | 0 | 7.0 |
| PI 372893 | Netherlands | 29 | 37 | 7.0 |
| PI 422167 | Czechoslovakia | 29 | 21 | 7.0 |
| PI 432851 | P.R. China | 29 | 52 | 8.0 |
| PI 105263 | Turkey | 29 | 25 | 6.7 |
| Staygreen | NSSL | 29 | 10 | 5.0 |
| PI 357842 | Yugoslavia | 29 | 42 | 6.0 |
| PI 228344 | Iran | 29 | 24 | 6.3 |
| PI 296120 | Egypt | 30 | 31 | 7.0 |
| PI 255938 | Netherlands | 30 | 24 | 8.0 |
| Check–SMR 58 | Check | 30 | 22 | 7.7 |
| PI 176524 | Turkey | 30 | 10 | 6.0 |
| PI 169319 | Turkey | 30 | 5 | 6.0 |
| PI 137851 | Iran | 30 | 12 | 5.7 |
| PI 220860 | Korea | 31 | 17 | 6.0 |
| PI 458846 | USSR | 31 | 33 | 7.0 |
| PI 422192 | Czechoslovakia | 31 | 19 | 6.7 |
| PI 175692 | Turkey | 31 | 42 | 7.0 |
| PI 271328 | India | 31 | 26 | 7.7 |
| PI 267744 | P.R. China | 31 | 37 | 6.3 |
| PI 164284 | India | 31 | 19 | 7.7 |
| PI 255935 | Netherlands | 31 | 20 | 5.7 |
| PI 379280 | Yugoslavia | 31 | 65 | 8.0 |
| PI 419135 | P.R. China | 31 | 47 | 7.3 |
| PI 169328 | Turkey | 32 | 41 | 8.3 |

Table 1. Continued.

| Cultigen | Seed source[y] | Wt loss (%) | Firm. loss (%) | Shriveling[x] |
|---|---|---|---|---|
| PI 390264 | Japan | 32 | 40 | 6.7 |
| PI 357856 | Yugoslavia | 32 | 62 | 8.5 |
| PI 279466 | Japan | 32 | 27 | 7.5 |
| PI 265887 | Netherlands | 32 | 56 | 7.0 |
| PI 169384 | Turkey | 32 | 45 | 7.3 |
| PI 432871 | P.R. China | 33 | 65 | 7.0 |
| PI 220169 | Afghanistan | 33 | 27 | 7.0 |
| PI 390260 | Japan | 33 | 42 | 7.3 |
| PI 212896 | India | 33 | --- | 5.0 |
| PI 390261 | Japan | 33 | 21 | 7.0 |
| PI 483344 | Korea | 33 | 66 | 8.0 |
| PI 339243 | Turkey | 33 | 24 | 8.3 |
| PI 422200 | Czechoslovakia | 33 | 25 | 7.0 |
| PI 169334 | Turkey | 33 | 47 | 7.7 |
| PI 164951 | Turkey | 33 | 41 | 7.7 |
| PI 227235 | Iran | 33 | 21 | 6.3 |
| PI 173893 | India | 34 | 31 | 8.0 |
| PI 432864 | P.R. China | 34 | 48 | 8.3 |
| PI 368560 | Yugoslavia | 34 | 16 | 6.7 |
| PI 169350 | Turkey | 34 | 41 | 7.7 |
| PI 279467 | Japan | 34 | 23 | 7.7 |
| PI 169352 | Turkey | 35 | 44 | 7.3 |
| PI 169390 | Turkey | 35 | 50 | 6.7 |
| PI 357858 | Yugoslavia | 35 | 39 | 6.7 |
| PI 368552 | Yugoslavia | 35 | 30 | 7.7 |
| PI 368559 | Yugoslavia | 35 | --- | 8.0 |
| PI 171613 | Turkey | 35 | 8 | 5.3 |
| PI 422182 | Czechoslovakia | 36 | 13 | 4.3 |
| Check–M 27 | Check | 36 | 46 | 7.7 |
| PI 432882 | P.R. China | 37 | --- | 9.0 |
| PI 205181 | Turkey | 37 | 37 | 8.5 |
| PI 288991 | Hungary | 38 | 41 | 6.7 |
| PI 458856 | USSR | 38 | 60 | 6.3 |
| PI 285608 | Poland | 38 | 22 | 8.0 |
| PI 342951 | Denmark | 38 | 39 | 7.7 |
| PI 202801 | Syria | 38 | 34 | 8.0 |
| PI 165509 | India | 38 | 24 | 8.3 |
| PI 368557 | Yugoslavia | 38 | 6 | 8.0 |
| PI 283901 | Czechoslovakia | 39 | 30 | 6.0 |
| PI 197085 | India | 39 | 58 | 8.0 |
| PI 368555 | Yugoslavia | 39 | 47 | 8.5 |
| PI 390267 | Japan | 40 | 44 | 6.0 |
| PI 223841 | Philippines | 40 | 37 | 7.3 |
| PI 379281 | Yugoslavia | 40 | 62 | 8.0 |
| PI 436608 | P.R. China | 41 | 30 | 5.5 |
| PI 271326 | India | 41 | 22 | 8.0 |
| PI 222244 | Iran | 41 | 31 | 6.3 |
| PI 422179 | Czechoslovakia | 41 | 28 | 6.0 |
| PI 167043 | India | 42 | 46 | 6.7 |
| PI 169382 | Turkey | 42 | 62 | 7.7 |
| PI 176519 | Turkey | 42 | 41 | 6.0 |
| PI 432896 | P.R. China | 43 | 67 | 7.7 |

Table 1. Continued.

| Cultigen | Seed source[y] | Wt loss (%) | Firm. loss (%) | Shriveling[x] |
|---|---|---|---|---|
| PI 220791 | Afghanistan | 43 | 39 | 7.3 |
| PI 118279 | Brazil | 43 | 59 | 8.0 |
| GiantWtArnstadt | NSSL | 44 | 58 | 9.0 |
| PI 171607 | Turkey | 44 | 44 | 7.0 |
| PI 271327 | India | 44 | 75 | 6.7 |
| Davis Perfect | NSSL | 46 | 61 | 7.0 |
| Stono | NSSL | 46 | --- | 9.0 |
| PI 167198 | Turkey | 46 | 41 | 6.0 |
| PI 390251 | Japan | 46 | 26 | 6.0 |
| PI 391570 | P.R. China | 47 | 63 | 8.0 |
| PI 288990 | Hungary | 47 | 43 | 6.3 |
| PI 176522 | Turkey | 47 | 47 | 7.3 |
| PI 222986 | Iran | 48 | 65 | 8.3 |
| Redlands | Australia | 48 | 38 | 8.3 |
| PI 432863 | P.R. China | 50 | 61 | 8.3 |
| PI 197088 | India | 50 | 59 | 8.0 |
| Magnolia | NSSL | 51 | 58 | 8.5 |
| Check–Wautoma | Check | 51 | 50 | 8.5 |
| PI 285610 | Poland | 52 | 48 | 7.3 |
| PI 357838 | Yugoslavia | 52 | 48 | 8.0 |
| PI 163223 | India | 52 | 54 | 8.7 |
| PI 422184 | Czechoslovakia | 53 | 7 | 8.5 |
| PI 339244 | Turkey | 53 | 77 | 8.0 |
| PI 432885 | P.R. China | 55 | 11 | 6.5 |
| PI 255934 | Netherlands | 56 | 73 | 7.7 |
| PI 432874 | P.R. China | 58 | --- | 9.0 |
| PI 368553 | Yugoslavia | 60 | 100 | 9.0 |

Table 1. Continued.

| Cultigen | Seed source[y] | Wt loss (%) | Firm. loss (%) | Shriveling[x] |
|---|---|---|---|---|
| PI 357864 | Yugoslavia | 70 | --- | 9.0 |
| LSD (5%) | | 21 | 32 | 1.9 |
| Mean | | 20 | 20 | 6.2 |
| CV (%) | | 64 | 101 | 19 |
| Range | | 122 | 113 | 7 |
| Range/LSD | | 6 | 4 | 4 |

*Correlations*

*r* (% weight lost vs. % firmness lost) = 0.60[**]
*r* (% weight lost vs. shriveling rating) = 0.44[**]
*r* (% firmness lost vs. shriveling rating) = 0.45[**]
*r* (keeping rating vs. shriveling rating) = –0.50[**]
*r* (keeping rating vs. % weight loss) = –0.85[**]
*r* (keeping rating vs. % firmness loss) = –0.94[**]

[z]Data are means for three replications of three fruits each. Cultigens listed were used as the male parent to produce a hybrid with Gy 14 (with the exception of those listed as checks, which were the actual cultigens). Cultigens designated with a PI number came from the USDA germplasm collection in Ames, Iowa. The NSSL seed source is the National Seed Storage Laboratory in Fort Collins, Colo.
[y]Some countries listed now no longer exist as political units (Czechoslovakia, USSR, Yugoslavia).
[x]Rated from 0 to 9 (0 = no shriveling, 1–3 = slight shriveling and discoloring, 4–6 = moderate shriveling and discoloring, 7–9 = severe shriveling and discoloring).
[w]Negative values are due to sampling error.
[**]Significant at $P = 0.01$.

Table 2. Mean keeping ability of 20 cucumber cultigens over two locations after storage for 0 and 14 d.[z]

| Cultigen | Seed source | Avg quality[y] | Damage index[x] | Wt loss (%) | Firm. loss (%) | Fruit Taste[w] | Seed-cell[w] | Plac. hollow[w] | Carpel sep. rating[w] | Shriveling | Fruit yellow rating | Disease rating[v] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Control (0 d storage)** | | **8.5** | **0.0** | **0** | **0** | **8.0** | **9.0** | **8.0** | **9.0** | **0.0** | **0.0** | **0.0** |
| Calypso | Petoseed | 6.5 | 1.8 | 17 | 12 | 4.0 | 4.0 | 8.8 | 9.0 | 2.5 | 3.5 | 0.0 |
| Regal | N.C. State Univ. | 6.2 | 1.5 | -8 | 8 | 3.8 | 3.3 | 8.6 | 9.0 | 1.9 | 2.9 | 0.1 |
| Gy 14 x PI422177 | N.C. State Univ. | 6.1 | 1.5 | 15 | 10 | 3.7 | 3.4 | 8.6 | 8.7 | 2.7 | 2.3 | 0.7 |
| Wautoma | USDA–Wis. | 6.0 | 1.6 | 6 | 5 | 3.2 | 3.0 | 9.0 | 9.0 | 1.8 | 3.2 | 0.0 |
| Gy 14 x Producer | N.C. State Univ. | 6.0 | 2.0 | 16 | 12 | 4.2 | 2.8 | 8.7 | 8.5 | 2.2 | 4.0 | 0.0 |
| Gy 14 x PI255934 | N.C. State Univ. | 6.0 | 1.6 | 22 | 13 | 2.6 | 3.5 | 9.0 | 9.0 | 3.6 | 2.9 | 0.4 |
| PI 339244 | Turkey | 6.0 | 1.5 | 30 | 27 | 3.0 | 3.0 | 9.0 | 9.0 | 3.5 | 3.0 | 0.0 |
| Gy 14 x PI339244 | N.C. State Univ. | 6.0 | 3.1 | –5 | 10 | 3.0 | 3.3 | 8.8 | 8.9 | 2.9 | 5.4 | 0.8 |
| Gy 14 x PI211962 | N.C. State Univ. | 6.0 | 2.4 | 8 | 11 | 3.7 | 3.4 | 8.1 | 8.6 | 2.1 | 4.1 | 0.7 |
| Sumter | Asgrow Seed | 5.9 | 2.4 | 9 | 15 | 2.7 | 2.9 | 9.0 | 9.0 | 3.9 | 4.1 | 0.6 |
| Dasher II | Petoseed | 5.9 | 0.6 | 26 | 10 | 3.3 | 3.0 | 8.5 | 8.8 | 1.1 | 1.1 | 0.1 |
| Marketmore 76 | Asgrow Seed | 5.9 | 0.9 | –5 | –1 | 2.8 | 2.8 | 9.0 | 9.0 | 1.8 | 1.8 | 0.0 |
| Gy 14 x PI279469 | N.C. State Univ. | 5.9 | 3.9 | 33 | 21 | 3.2 | 3.0 | 8.4 | 8.8 | 4.6 | 6.6 | 1.2 |
| Poinsett 76 | Petoseed | 5.8 | 0.9 | –8 | 9 | 3.5 | 3.2 | 8.3 | 8.2 | 1.7 | 1.8 | 0.0 |
| Gy 14 x PI321006 | N.C. State Univ. | 5.8 | 1.4 | –6 | 6 | 3.6 | 3.9 | 7.6 | 8.0 | 2.4 | 2.7 | 0.0 |
| PI 220171 | Afghanistan | 5.8 | 1.8 | --- | --- | 2.5 | 2.5 | 9.0 | 9.0 | 2.0 | 3.5 | 0.0 |
| PI 422177 | Czechoslovakia | 5.8 | 2.4 | 16 | 4 | 2.8 | 2.6 | 9.0 | 8.6 | 3.0 | 3.8 | 1.0 |
| Gy 14 x PI220171 | N.C. State Univ. | 5.7 | 2.3 | 10 | 18 | 2.8 | 2.9 | 8.5 | 8.5 | 3.0 | 4.0 | 0.6 |
| Wis. SMR 18 | Northrup King | 5.6 | 2.9 | 10 | 9 | 3.4 | 3.3 | 7.8 | 8.1 | 3.1 | 5.9 | 0.0 |
| Producer | NSSL | 5.1 | 3.3 | 2 | 10 | 3.0 | 2.1 | 7.1 | 8.0 | 3.3 | 5.6 | 1.0 |
| *Statistics* | | | | | | | | | | | | |
| LSD (5%) | | NS | 1.0 | NS | NS | NS | NS | NS | NS | 1.2 | 1.3 | NS |
| Mean | | 5.9 | 2.0 | 8.6 | 10.5 | 3.3 | 3.1 | 8.5 | 8.6 | 2.6 | 3.7 | 0.4 |
| CV (%) | | 10 | 59 | 345 | 125 | 30 | 34 | 16 | 11 | 45 | 37 | 345 |
| *Means for harvest date (d)* | | | | | | | | | | | | |
| 7 d | | 7.3 | 1.5 | –4.7 | 3.0 | 6.7 | 5.6 | 8.5 | 8.5 | 1.2 | 2.8 | 0.3 |
| 14 d | | 5.9 | 2.0 | 8.6 | 10.5 | 3.3 | 3.1 | 8.5 | 8.6 | 2.6 | 3.7 | 0.4 |
| *Location (14 d only)* | | | | | | | | | | | | |
| Shed | | 5.8 | 2.0 | 12.3 | 14.4 | 3.1 | 3.1 | 8.4 | 8.6 | 3.0 | 3.5 | 0.5 |
| Lab | | 6.0 | 2.0 | 6.7 | 6.8 | 3.5 | 3.1 | 8.7 | 8.7 | 2.4 | 3.8 | 0.2 |

[z]Data are means for two replications, two harvests, two locations, and six fruits.
[y]Mean of ratings for taste, seedcell, placental hollows, and carpel separation.
[x]Mean of ratings for shriveling, fruit yellowing, and fruit disease.
[w]Traits rated subjectively on a 1 to 9 scale (1–3 = poor, 4–6 = intermediate, 7–9 = excellent).
[v]Traits rated subjectively on a 0 to 9 scale (0 = none, 1–3 = slight, 4–6 = moderate, 7–9 = severe).
[NS]Nonsignificant.

were PI 379284, PI 339241, PI 414159, PI 422177, 'Regal' (check), PI 109483, Addis (check), PI 285603, PI 257486, and 'Calypso' (check), and the cultigen with the highest percentage of loss was PI 368553. The cultigens with the least degree of fruit shriveling during storage were 'Dasher II' (check), 'Sprint 440' (check), 'Texas Long', PI 390255, PI 432870, 'Pacer', PI 419078, PI 390247, PI 321011, and PI 414158, and those with the greatest degree of fruit shriveling were PI 368553, PI 183127, PI 432882, 'Stono', PI 432874, and PI 357864.

*Retest study*. No significant differences were detected between the two harvest dates and the two storage locations for the 20 cultigens tested in the study (Table 2). However, differences among cultigens were greater at 14 than at 7 d after harvest. Therefore, data are reported as means over two locations at 14 d after harvest.

The traits of greatest value in distinguishing keeping ability were ratings for shriveling and fruit yellowing, based on their low CV and high range/LSD (Table 2). Differences in all other traits measured were inconsistent or were not statistically significant. Cultigens with the best keeping ability (based on damage index) were all slicers: 'Dasher II', 'Marketmore 76', and 'Poinsett 76' (Table 2). The worst cultigens were 'Producer' (an obsolete cultivar) and 'Wis. SMR 18' (a black-spined cultivar).

In general, the tough skin of modern slicing cultigens and the white-spine trait of most new cultigens contributed to superior keeping ability. However, there were differences in keeping ability among the thin-skinned, white-spined cultigens (Table 2). 'Regal' was one of the best and 'Producer' was one of the worst for keeping ability. These two cultigens would make good check lines (positive and negative checks) for future tests of keeping ability among thin-skinned cultigens.

Other traits were too variable to provide significant differences among cultigens. Different sets of fruits had to be measured after 0, 7, and 14 d of storage, since the fruit were cut for evaluation of seedcell wateriness, placental hollow, carpel separation, and taste. Future studies could be done using the same fruits if seedcell wateriness, placental hollows, carpel separation, and taste were not evaluated. Since the cultigens did not differ for those quality traits, they could be ignored in favor of obtaining better data for weight loss. Negative values for percentage of loss of fruit weight and firmness were a result of sampling error (Table 2). If a nondestructive test were conducted, firmness after 14 d would have to be used instead of percentage of loss in firmness, since no initial measurement for fruit firmness can be made (to calculate the percentage of loss in firmness) without damaging the fruits.

Differences between the cultigens per se and their hybrids were nonsignificant for shriveling and fruit yellowing of PI 220171 and for fruit shriveling of PI 422177. However, differences for fruit yellowing between the hybrids and cultigens per se for PI 422177 were significant (Table 2).

Future studies should examine more closely the association between skin toughness, spine color, and keeping ability. Keeping ability should be routinely measured on potential new cultivars by measuring weight loss, firmness, degree of shriveling, and fruit yellowing after storage for 14 d under uniform conditions. Check lines could include 'Marketmore 76', 'Regal', 'Wis. SMR 18', and 'Producer'.

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