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STORAGE CHARACTERISTICS OF THREE CULTIVARS OF YELLOW SUMMER SQUASH (*CUCURBITA PEPO* L.)

MARK SHERMAN
University of Florida, IFAS
Vegetable Crops Department
Gainesville, FL 32611
GARY W. ELMSTROM
University of Florida, IFAS
Leesburg Agricultural Research and Education Center
Leesburg, FL 32749
JUDITH J. ALLEN
University of Florida, IFAS
Vegetable Crops Department
Gainesville, FL 32611

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Abstract. **'Multipik', a yellow summer squash cultivar with the gene *B* for precocious yellow fruit pigmentation, has a production advantage when watermelon mosaic virus-2 is a problem. 'Multipik' fruit do not express the streaky or mottled symptoms typical of virus infected fruit. However, buyer resistance to this cultivar developed in some markets because of a reportedly shorter "shelf-life". Experiments in this study compared the storage characteristics of 'Multipik' and 'Goldbar' in 1984 and 'Multipik' and 'Seneca Butterbar' in 1985. 'Goldbar' and 'Seneca Butterbar' are important cultivars that do not have precocious gene *B*. Fruits were stored at 5° or 10°C for up to 17 days in 1984 and 21 days in 1985. Weight loss was determined and fruit were rated for overall appearance on alternate days during storage. 'Multipik' had a higher % weight loss and a lower overall appearance than the other cultivar in both years. Significant differences in % weight loss were evident after as little as two days storage. Generally, ratings for overall appearance were not significantly different until after a week or more of storage. Fruit damage during harvest accelerated weight loss and visual deterioration for all three cultivars.**

Production of zucchini, crookneck, straightneck, scallop, acorn, and butternut squash represented a $30.2 million dollar farm value in Florida during the 1983-84 season (6). The average price per bushel was $10.12 and yields averaged 177 bushels per acre. Potential yields for yellow summer squash are much higher (3, 4). However, virus infections can seriously reduce marketable yields. Adlerz *et al.* (2) reported that the three most common potyviruses in *Cucurbita pepo* L. plantings in Florida were watermelon mosaic virus-1 (WMV-1), watermelon mosaic virus-2 (WMV-2), and zucchini yellow mosaic virus (ZYMV). Symptoms were most severe for ZYMV, intermediate for WMV-1, and least severe for WMV-2.

'Multipik', a yellow summer squash cultivar with the gene *B* for precocious yellow fruit color (12), has a production advantage when WMV-2 is a problem, although it has no advantage when WMV-1 or ZYMV are present (1). 'Multipik' fruit do not express the streaky or mottled symptoms typical of WMV-2 infected fruit. Several growers adopted this cultivar, but buyer resistance developed in some markets because of a reportedly shorter "shelf-life".

The objective of this work was to compare the storage characteristics of the 'Multipik' cultivar with those of other commonly grown yellow straightneck summer squash. The major storage characteristics of commercial importance are appearance and weight loss.

Materials and Methods

Squash were grown as part of the cultivar trials on Apopka fine sand at the Leesburg Agricultural Research and Education Center. In 1984, 'Multipik' and 'Goldbar' were compared. The first harvest was on 27 Apr and the second was on 2 May. In 1985, 'Multipik' and 'Seneca Butterbar' were compared. The first harvest was on 24 Apr and the second harvest was on 29 Apr. 'Goldbar' and 'Seneca Butterbar' are important cultivars that do not have precocious gene B. Fruit from both harvests in both years were of similar physiological age.

Freshly harvested fruit were transported to Gainesville where they were washed and selected for uniformity in size prior to the storage tests. Fruit were stored at 5° or 10°C for up to 17 days in 1984 and 21 days in 1985. There were 3 replications of 10 fruit each, except for the 2nd harvest in 1985 which had 5 fruit per replication. Weight loss was determined and fruit were rated for overall appearance on alternate days during the storage period. Appearance was rated on a 5 point scale with 5 = excellent, no defects; 4 = good, slight defects; 3 = fair, defects definitely detract from salability; 2 = poor, marketable only under unusual conditions; and 1 = not marketable. Experiments were factorials in a split split plot design with storage temperature as the main plot and time of storage as the sub-plot (5). Analyses of variance and linear and nonlinear regression analyses were performed using the Statistical Analysis System (10).

Results and Discussion

'Multipik' was more susceptible to water loss during storage than either 'Goldbar' in 1984 or 'Seneca Butterbar' in 1985 (Fig. 1). Analyses yielded highly significant linear regressions. The addition of a quadratic term did not improve the fit and they were not significantly different from zero. In both years fruit from the second harvest lost water at a faster rate than fruit from the first harvest (Figs. 1 and 2). This difference between harvests can be attributed to the greater physical damage evident on fruit from the second harvest in both years. Whether this damage occurred on the plant or during harvest is unknown, but it underscores the delicate nature of these fruit and the need for careful handling.

Hruschka (7) reported that yellow crookneck squash had an average weight loss of 15% without showing any shrivel symptoms. Average weight loss ranged from 17.6

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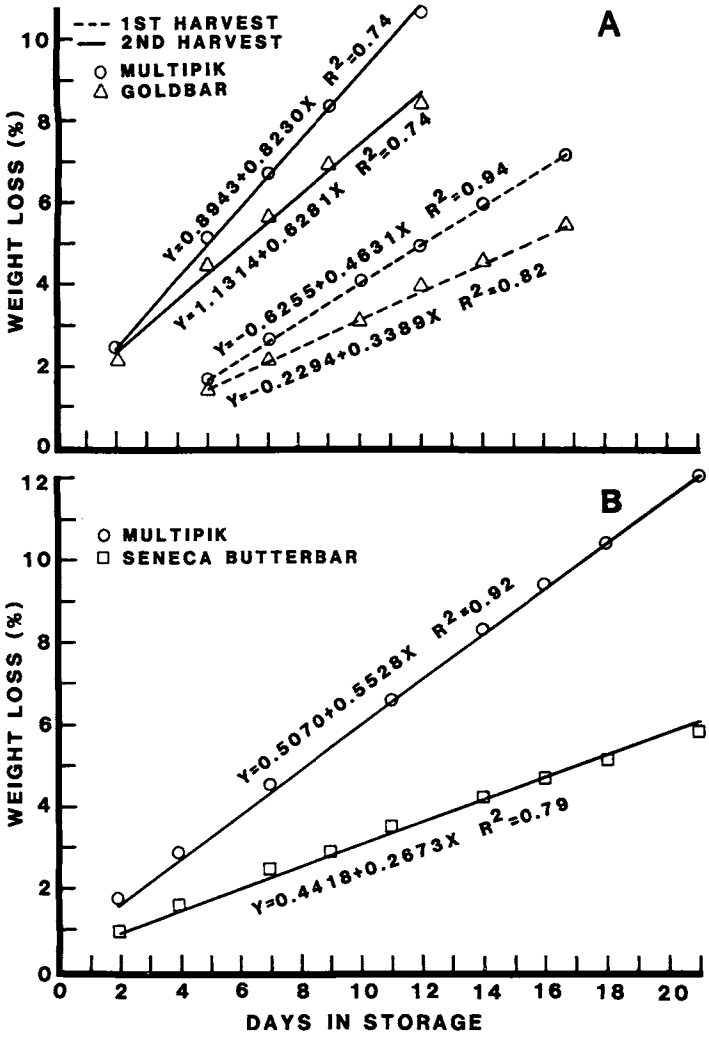

Fig. 1. Regression lines for weight loss of yellow straightneck summer squash during storage. A = 1984, 'Multipik' and 'Goldbar', both harvests. B = 1985, 'Multipik' and 'Seneca Butterbar', second harvest. Each point is the mean of 6 values. Data are combined for temperatures.

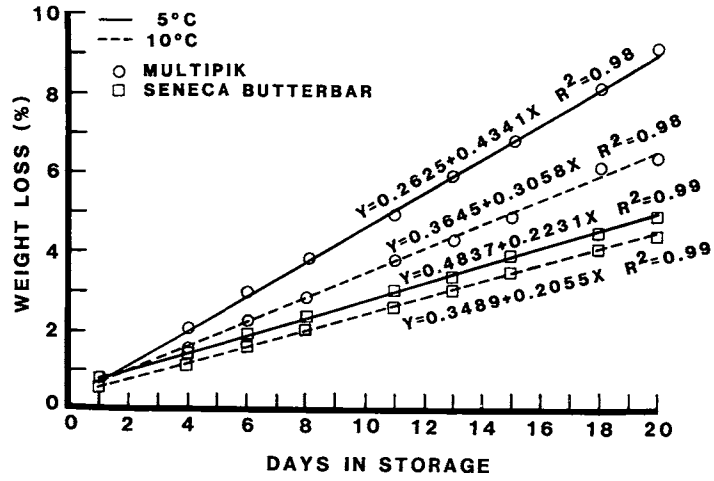

Fig. 2. Regression lines for weight loss of 'Multipik' and 'Seneca Butterbar' during storage at 5° and 10°C. Each point is the mean of three replications. Data are for the first harvest, 1985.

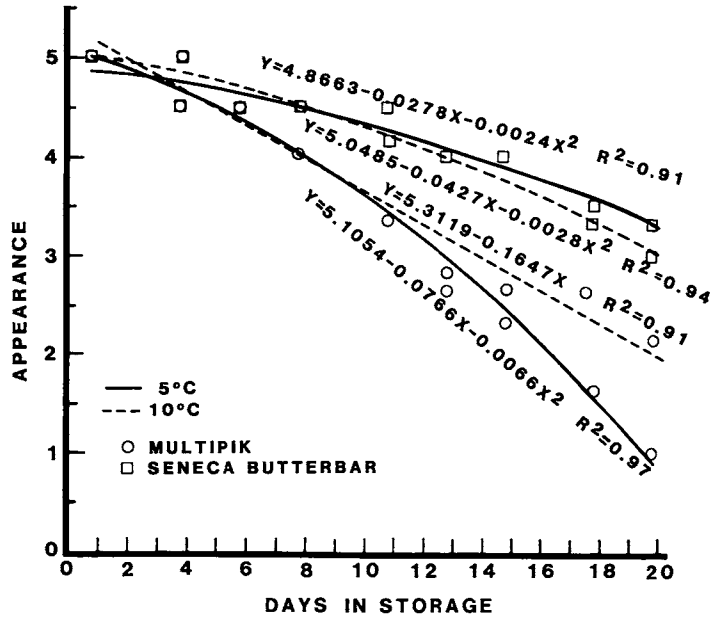

Fig. 3. Regression lines for appearance of 'Multipik' and 'Seneca Butterbar' during storage at 5° or 10°C. Appearance was rated on a 5 point scale with 5 = excellent, no defects; 4 = good, slight defects; 3 = fair, defects definitely detract from salability; 2 = poor, marketable only under unusual circumstances; and 1 = not marketable. Each point is the mean of three replications. Data are for the first harvest, 1985.

to 31.1% for squash having slight to extremely severe shrivel symptoms, respectively (7). In our tests with yellow straightneck squash, fruit exhibited severe shrivel symptoms in the range of 6-8% weight loss. In terms of shrivel, damage during harvest effectively cut the storage life of squash in half even under good storage conditions.

All 3 cultivars lost more water during storage at 5°C when compared to 10°C. This was particularly apparent for 'Multipik' from the first harvest in 1985 (Fig. 2). One reason for this difference was that the vapor pressure deficit (VPD) was greater in our 5° storage room. Relative humidity ranged from 84-96% (mean = 91%) in the 5° storage room. In the 10°C storage relative humidity ranged from 93-99% (mean = 97%). This difference in humidity resulted in a VPD at 5°C that was about double the VPD at 10°C.

The VPD alone cannot account for the differences shown in Fig. 2. If the VPD were the only factor involved then the difference in water loss between 5° and 10°C storage would be the same for both cultivars. One explanation for this may be related to chilling injury. The 'Multipik' cultivar appeared to be more susceptible to chilling injury. 'Multipik' fruit were severely discolored and unacceptable by the end of the 20-day storage at 5°C while 'Seneca Butterbar' fruit still had an acceptable appearance (Fig. 3). Mencarelli *et al.* (8) reported that zucchini squash could be optimally stored at 5°C, a temperature previously thought to be below the critical temperature to induce chilling injury. Our results for yellow straightneck and zucchini (data not shown) indicate that 5°C is too low for Florida grown summer squash.

Overall our results confirm the suspicions of the buyers who resisted 'Multipik' because of a "shorter shelf-life". Squash are rarely handled carefully or stored under optimal conditions in commercial situations. Thus, the differences between 'Multipik' and the other cultivars in our studies may be exaggerated during commercial handling.

It is interesting to speculate on the reason(s) for these cultivar differences. Anatomical differences in cuticle

thickness, stomatal size and frequency, and trichome frequency and structure may all have an influence on water loss (13). We have undertaken microscopic studies to determine if these anatomical factors are involved. The precocious yellow gene *B* in 'Multipik' is known to be highly pleiotropic (11, 12). A number of negative secondary effects have been reported. These include leaf-yellowing, lower yields, and poor seed production (11, 12). These secondary effects may or may not be expressed depending on the genetic background. Paris *et al.* (9) reported that a precocious yellow zucchini cultivar 'Goldy' was capable of producing the yield and yield quality (grade) of green-fruited zucchini cultivars. Schaffer and Boyer (11) found little effect of gene *B* in fruit development in 'Early Prolific' background. Our results limit us to discussion of between-cultivar differences. A comparison of isogenic lines would be worthwhile to determine the possible effects of gene *B* on water loss and storability.

Literature Cited

1. Adlerz, W. C., G. W. Elmstrom, and D. E. Purcifull. 1985. Response of 'Multipik' squash to mosaic virus infection. HortScience 20:892-893.
2. Adlerz, W. C., D. E. Purcifull, G. W. Simone, and E. Hiebert. 1983. Zucchini yellow mosaic virus: a pathogen of squash and other cucurbits in Florida. Proc. Fla. State Hort. Soc. 96:72-74.
3. Elmstrom, G. W. 1981. Summer squash-yellow variety trial results-Leesburg, p. 40. In: M. B. Lazin (ed.) Vegetable variety trial results in Florida for 1981. Circ. S-304. Agr. Expt. Sta., Univ. Fla.
4. Elmstrom, G. W. 1982. Yellow summer squash trial, p. 47. In: J. M. White (ed.). Vegetable variety trial results in Florida for 1978-1979-1980. Circ. S-289. Agr. Expt. Sta., Univ. Fla.
5. Federer, W. T. 1967. Experimental design theory and practice. Oxford and IBH Publishing Co., New Delhi.
6. Florida Crop and Livestock Reporting Service. 1985. Vegetable summary 1984. Fla. Agr. Stat. Orlando, Fla.
7. Hruschka, H. W. 1977. Postharvest weight loss and shrivel in five fruits and vegetables. U.S. Dept. Agr. MRR. 1059.
8. Mencarelli, F., W. J. Lipton, and S. J. Peterson. 1983. Responses of 'Zucchini' squash to storage in low-O_2 atmospheres at chilling and nonchilling temperatures. J. Amer. Soc. Hort. Sci. 108:884-890.
9. Paris, H. S., Z. Karchi, H. Nerson, and Y. Burger. 1983. Yield and yield quality in precocious yellow zucchini cultivars. HortScience 18:724-726.
10. SAS Institute Inc. 1982. SAS user's guide: statistics, 1982 edition. SAS Institute Inc. Cary, NC.
11. Schaffer, A. A. and C. D. Boyer. 1984. The influence of gene B on fruit development in *Cucurbita pepo*. J. Amer. Soc. Hort. Sci. 109:432-437.
12. Shifriss, O. 1981. Origin, expression, and significance of gene B in *Cucurbita pepo* L. J. Amer. Soc. Hort. Sci. 106:220-232.
13. Showalter, R. K. 1980. Postharvest water loss control for vegetables. Vegetable Crops Fact Sheet. VC-28. Fla. Coop. Ext. Ser.

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CALCIUM DETERMINATION IN CITRUS PULP WASH—A COMPARISON OF A COLORIMETRIC PROCEDURE WITH ATOMIC ABSORPTION SPECTROPHOTOMETRY

RICHARD L. COLEMAN, MARY S. SAUNDERS AND ROBERT A. BAKER
U. S. Citrus & Subtropical Products Laboratory[2]
P. O. Box 1909
Winter Haven, Florida 33883-1909

Abstract. **Two methods of calcium determination, a commercial colorimetric procedure and atomic absorption, were evaluated for routine laboratory use on citrus products and other materials. Samples tested included commercial calcium standards, well and process water, and serial dilutions of citrus pulp wash. Satisfactory results on citrus pulp wash samples could not be obtained with atomic absorption without the additional steps of ashing and redissolving in dilute acid. The colorimetric procedure cost less than the atomic absorption method and gave results which were as accurate.**

Some citrus and other drink processors need to carry out a few calcium determinations on various samples intermittently. A comparison of available calcium determination methods was undertaken to find the most practical means for determining calcium content in citrus products. Two methods were selected as least laborious and least costly, yet reasonably accurate. These were atomic absorption spectrophotometry and a colorimetric procedure and they were compared systematically (3). Our experience and results comparing these methods are the subject of this report.

Materials and Methods

The atomic absorption spectrophotometer (AA) was a Perkin Elmer Model 372 using acetylene and air. Samples (3 ml) were prepared by the following methods: 1) unaltered samples were aspirated directly into the AA flame; 2) lanthanum was added to reduce interference from phosphates, and samples were aspirated into the AA flame; 3) samples were ashed at 500°C, extracted with HCl, and treated with lanthanum before aspiration; or 4) samples were ashed at 900°C, extracted with HCl, and treated with lanthanum before aspiration. All AA samples were prepared and analyzed in a commercial analytical laboratory. (Applied Agricultural Research, Inc., Lakeland, Fla.).

Colorimetric determination of total calcium was carried out using a commercial analytical kit (Calcium Determination Kit No. 586, Sigma Chemical Co., St. Louis, Mo.). This determination is based on calcium's reaction with cresolphthalein complexone to form a purple color with a maximum absorption at 575 nm. A Bausch & Lomb Spectronic 20 with standardized test tubes was used to read color intensity as absorbence at 575 nm. Double deionized water, prepared by use of two deionization systems (Mitco Water Laboratories, Inc., Auburndale, Fl., and Cole-Parmer Instrument Co., Chicago, Il.), was used in all standards and dilutions.

[1]Private Consultant. 1102 East Magnolia Drive, Tallahassee, FL 32301
[2]South Atlantic Area, U. S. Dept. Agr., Agr. Res. Serv.
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