

## *Handling and Processing Section*

### QUALITY CHANGES IN FRUITS OF SOME TOMATO VARIETIES AND LINES RIPENED AT 68°F FOR VARIOUS PERIODS

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#### ABSTRACT

Fruits of three varieties and two lines harvested at the mature-green stage were ripened at 68° F for 6, 9, 12 or 15 days to determine possible varietal differences in ability to retain quality. Firmness, color, soluble solids, dry weight and titratable acidity were determined for each ripening period.

All stocks continued to soften throughout the total ripening period. Although some softened at a slower rate after 9 days, the variety-period interaction was not significant. All increased in color through 9 days and then remained the same or decreased slightly with time.

The dry weight of locular and pericarp portions remained fairly constant through 12 days and then decreased. The stocks differed in dry weight. A significant variety-ripening period interaction was found with the soluble solids contents of both the locular and pericarp portions. Pericarp tissue has a higher dry weight but lower soluble solids content than the locular tissue.

Both portions decreased in titratable acidity but the locular portion much more so than the pericarp with increase in ripening period. All stocks reacted nearly alike although they differed in acidity.

#### INTRODUCTION

Considerable information is available to show that tomato varieties differ in quality factors at a particular stage of ripeness (5) (7). Little information is available on possible varietal differences in ability to retain quality.

Foda (2) found that a firm line, Y 13, had a much lower softening rate than Stokesdale and Rutgers over a 15-day period. He also found a difference in the rate of development of carotenoids between Y 13 and Stokesdale. Hall (3) found a variety-storage period interaction for color in fruits held for 1, 2 and 3 weeks after ripening. Most of the effect was during the third week of storage.

The object of this research was to determine if some of the high quality varieties and lines produced at the Gulf Coast Station would maintain the quality longer than some standard varieties.

#### METHODS

Fruits of three varieties, Manapal, Marion, and Homestead 24, and two breeding lines STEP 461 and STEP 419 were ripened at 68° F for 6, 9, 12 or 15 days beginning the day the fruits showed incipient color at the stylar end (just turned). The fruits were harvested at the mature-green stage at the Gulf Coast Experiment Station, transported to Gainesville, and stored at 68° F on November 24, 1964. Four replications of 10 fruits of each variety or line were used. Replications 1 and 2 were taken from fruits which just turned on November 25 while fruits in replications 3 and 4 just turned on November 26 and 27, respectively. The fruits were stored in covered, 10-pound, fiberboard cartons in the dark during the ripening periods.

Fruit firmness, color, acidity, dry weight and soluble solids were determined for each ripening period. Following the firmness measurement, the fruits were dissected into pericarp (all wall tissue) and locular fractions. Each fraction was blended and filtered through a single layer of cheesecloth to remove skins or seeds. Acidity, dry weight and soluble solids were determined

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for both fractions while color was determined for the pericarp only.

The methods of measuring firmness (Cornell tester), color (Hunter color meter, Rd scale) and acidity were as previously described (4) (6). Soluble solids were determined on filtered juice with a refractometer. The dry weight was determined by drying a 20-gram sample overnight at 70° C in a ventilated oven.

## RESULTS

*Firmness.*—Statistical analysis showed the main effects of variety and ripening period to be highly significant while the variety-ripening period interaction was not significant.

The variety means were 4.2, 4.4, 4.6, 4.6 and 4.8 for Manapal, STEP 419, Homestead 24, STEP 461 and Marion respectively. Manapal was significantly firmer and Marion was significantly softer than the other stocks.

As would be expected, the fruits were softer as the ripening period increased. The linear and quadratic components were highly significant, showing that there was a strong linear trend but that the deviations from linearity were highly significant. Thus the rate of softening decreased with increasing ripening period (Fig. 1). The average ripening period values were 3.8, 4.5, 4.9, and 5.0 for 6, 9, 12 and 15 days respectively.

Although the variety-ripening period interaction was not significant, there were some varietal variations in the rate of softening. The softening rate during 6 to 9 days was similar for all except STEP 419 which had a higher rate. Manapal and STEP 419 had a much slower rate of softening during 9 to 12 days while STEP 461 continued at the same rate as during 6 to 9 days. Homestead 24 and Marion had a softening rate during 9 to 12 days that was intermediate between Manapal and STEP 461. Manapal was firmer than the other four at 12 day and firmer than STEP 461 and Marion at 15 days. STEP 461 was firmer than Marion at 6 and 9 days but similar to Marion at 12 to 15 days. STEP 419 fruits had a "woody" feel when cut at the 12 and 15 day samplings. The flesh was hard, which would explain the great change in rate of softening.

*Color.*—Statistical analysis showed the main effects of varieties and ripening period to be highly significant while the variety-ripening period interaction was not significant.

The variety means were 1.91, 2.03, 2.19, 2.24 and 2.28 for Manapal, STEP 461, STEP 419, Homestead 24 and Marion respectively. Both Manapal and STEP 461 had lower color values than the other three but STEP 461 had a higher value than Manapal.

The average color values increased from 1.80 to 2.32 during 6 to 9 days, decreased to 2.26 during 9 to 12 days, and decreased to 2.15 during 12 to 15 days. Both the linear and quadratic components were highly significant but the quadratic component accounted for most of the variance.

Little varietal variation occurred in the color value curves (Fig. 2). Marion and Manapal fruits did not decrease in color during the 12 to 15 day period.

*Titrateable acidity.*—Statistical analysis of the results showed the main effects of varieties and ripening period to be highly significant for the locular and pericarp fractions. There was no significant interaction with either tissue.

The average acidity values (ml of 0.1 N NaOH per 100 ml of serum) of the pericarp tissue of Marion, Manapal, Homestead 24, STEP 419 and STEP 461 were 55.1, 55.3, 56.4, 60.0

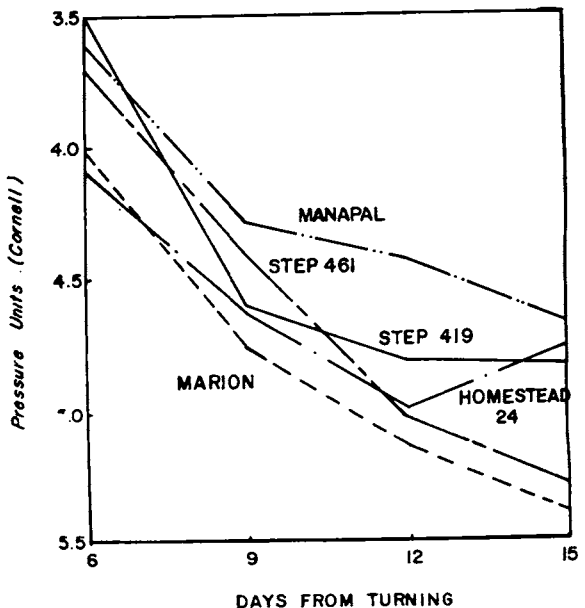


Fig. 1.—The firmness of fruits of some tomato varieties and lines held at 68°F for 6, 9, 12 or 15 days after turning color at the styler end. The lower the value the firmer the fruits.

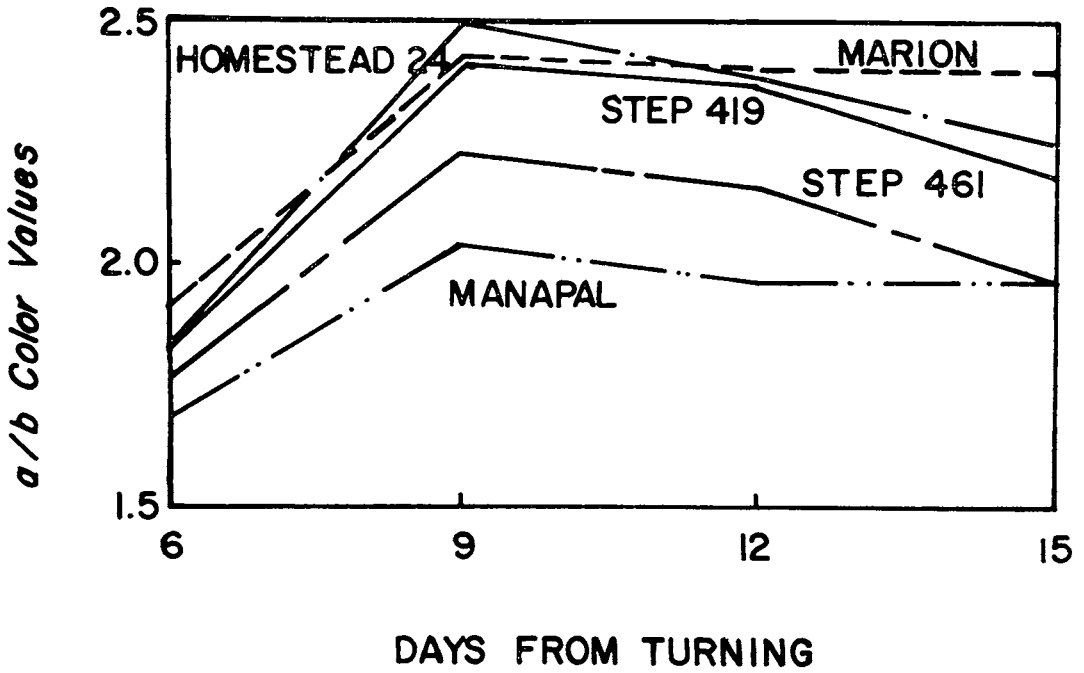


Fig. 2.—The a/b color values of the pericarp tissue of some varieties and lines held at 68°F for 6, 9, 12 or 15 days after turning color at the styler end. The higher the value the redder the fruits.

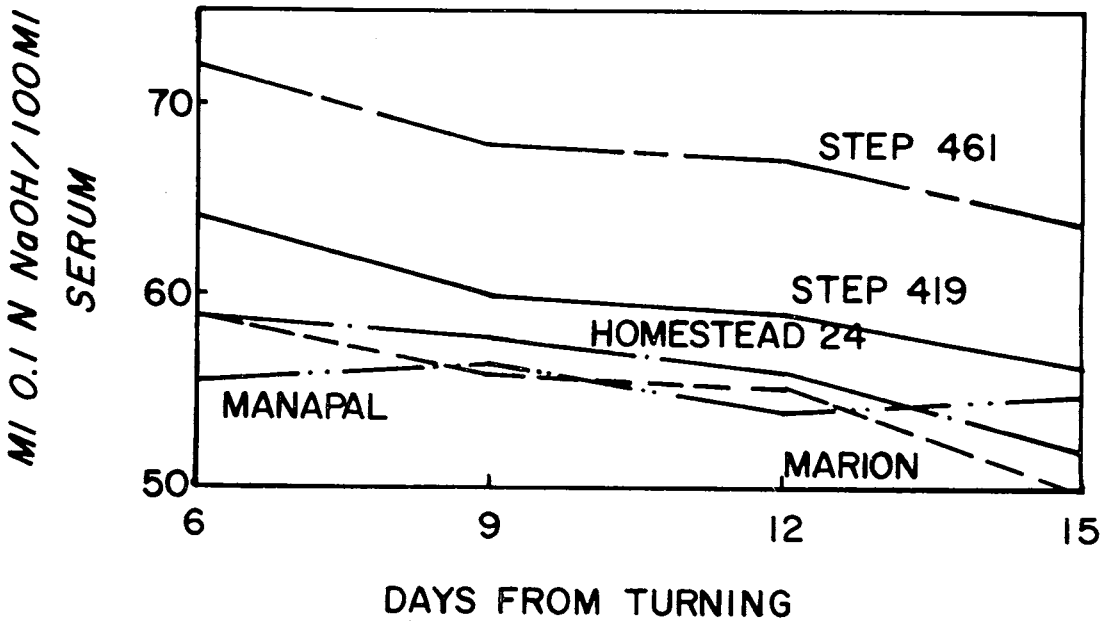


Fig. 3.—The titratable acidity values of the pericarp tissue of some tomato varieties and lines held at 68°F for 6, 9, 12 or 15 days after turning color at the styler end.

and 67.8 respectively. STEP 461 was more acid than STEP 419 which was more acid than the other three varieties.

The average ripening period values for the pericarp tissue were 62.0, 60.0, 58.5 and 55.5 for 6, 9, 12 and 15 days respectively. The decrease in acidity with ripening period increase was linear. The quadratic component was not significant. There were only slight variations between the varietal curves (Fig. 3).

The average acidity values of the locular tissue of Marion, Manapal, STEP 419, STEP 461 and Homestead 24 were 89.4, 95.0, 96.1, 115.9 and 116.2 respectively. STEP 461 and Homestead 24 was much more acid than the other three stocks. There was no difference in acidity between Marion, Manapal or STEP 419. The acidity values of the pericarp and locular tissue are not necessarily related as shown by a comparison of the Homestead 24 and STEP 419 values.

The average pericarp values for ripening periods were 129.7, 106.7, 92.9 and 80.7 for 6, 9, 12 and 15 days respectively. The decrease in acidity with increase in ripening period was primarily linear although the deviations from linearity were significant at the 0.05 level. There were slight variations in the varietal curves (Fig. 4).

The linear decreases in acidity for pericarp and locular tissues are similar to those obtained by Anderson (1) with the Stokesdale variety.

*Dry Weight.*—The main effects of variety and ripening period were highly significant for pericarp and locular tissues. There was no significant interaction with either tissue.

Marion and Manapal had the highest dry weight values for both tissues while Homestead 24 had the lowest (Table 1). The STEP lines were intermediate.

There was a slight linear decrease in dry

Table 1. The percent dry weight of the pericarp and locular tissues of some tomato varieties and lines held at 68°F for 6, 9, 12 or 15 days after turning color at the styelar end.

Days at 68 F	Variety of Line					Days Mean
	Homestead 24	Manapal	Marion	STEP 461	STEP 419	
Pericarp Tissue						
6	4.96	5.60	5.80	5.24	5.31	5.38a <sup>1</sup>
9	4.98	5.39	5.79	5.25	5.30	5.34ab
12	4.98	5.48	5.78	5.14	5.09	5.29b
15	4.69	5.42	5.54	4.91	5.08	5.13c
Variety mean	4.90a	5.47c	5.72d	5.13b	5.19b	
Locular Tissue (minus seeds)						
6	4.56	5.25	5.36	4.81	4.75	4.95a
9	4.54	5.00	5.40	4.91	4.69	4.91a
12	4.49	5.09	5.36	4.76	4.61	4.86a
15	4.11	5.01	4.96	4.64	4.54	4.65b
Variety mean	4.42a	5.09d	5.27e	4.78c	4.65b	

<sup>1</sup>Means with the same letter are not different at the 0.05 level of significance.

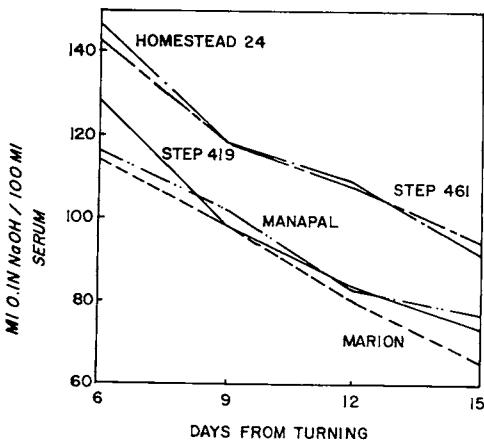


Fig. 4.—The titratable acidity values of the locular tissue of some tomato varieties and lines held at 68°F for 6, 9, 12 or 15 days after turning color at the styler end.

weight during the 6-12 day period for both tissues. During the 12-15 day period a sharper decrease occurred. The deviations from linearity were significant for both tissues. Manapal showed little change throughout which may be a reflection of greater moisture loss as evidenced by shriveling of the shoulders of some fruits.

*Soluble solids.*—The main effect of variety was highly significant for both tissues. The ripening period effect was not significant for either tissue. The interaction was highly significant for the pericarp tissue and significant for the locular tissue.

Marion had the highest soluble solids content followed by Manapal, STEP 461, STEP 419 and Homestead 24, respectively, for both tissues (Table 2).

Marion, Homestead 24 and STEP 461 reacted similarly showing a slight to marked in-

Table 2. The percent soluble solids of the pericarp and locular tissues of some tomato varieties and lines held at 68°F for 6, 9, 12 or 15 days after turning color at the styler end.

Days at 68°F	Variety or line					Days mean
	Homestead 24	Manapal	Marion	STEP 461	STEP 419	
Pericarp tissue						
6	3.92	4.59	4.80	4.40	4.42	4.43
9	4.05	4.45	4.81	4.45	4.32	4.42
12	4.14	4.71	4.89	4.48	4.20	4.48
15	3.90	4.76	4.62	4.31	4.34	4.39
Variety Mean	4.00	4.63	4.78	4.41	4.32	
Locular tissue						
6	4.26	4.91	4.98	4.58	4.42	4.63
9	4.22	4.64	5.01	4.60	4.36	4.57
12	4.29	4.92	5.11	4.61	4.38	4.66
15	4.12	4.99	4.89	4.56	4.41	4.60
Variety Mean	4.22	4.86	5.00	4.59	4.39	

The variety ripening period interaction was significant for both portions at the 0.05 level and for the pericarp portion at the 0.01 level.

crease in soluble solids through 12 days and a decrease during 12 to 15 days. Manapal showed a decrease during 6 to 9 days and increased thereafter. Again, this increase may have been due to loss of moisture as conjectured with the dry weight changes. STEP 419 was somewhat intermediate in soluble solid changes.

The locular tissue had higher soluble solids than the pericarp tissue, which was the reverse of the dry weight situation.

#### DISCUSSION

Based on this experiment, it appears that varieties may differ in rate of softening during the time of ripening. Manapal fruits showed a decrease in softening rate after 9 days while STEP 461 and Marion fruits continued to soften at nearly the same rate. The time of making varietal comparisons is important, since Manapal and STEP 461 fruits were similar in firmness at 6 and 9 days after turning but not at 12 and 15 days.

The results also point out the necessity that each variety be of the some physiological stage of ripeness. For instance, if Homestead 24 fruits 7 days after turning had been compared with Manapal fruits 9 days after turning, no differ-

ence would have been found in color values. Also, if Homestead 24 fruits 7 days after turning were compared with STEP 461 fruits 9 days after turning, the conclusion would have been that the locular tissue of STEP 461 was more acid than that of Homestead 24.

#### ACKNOWLEDGMENT

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#### LITERATURE CITED

1. Anderson, R. E. 1957. Factors affecting the acidic constituents of the tomato. Ph.D. Thesis, University of Illinois, Pp 63.
2. Foda, Y. H. 1957. Pectic changes during ripening as related to flesh firmness in the tomato. Ph. D. Thesis, University of Illinois, Pp 66.
3. Hall, C. B. 1963. Effect of storage temperatures after ripening on the color, firmness and placental breakdown of some tomato varieties. Proc. Fla. State Hort. Soc. 76: 304-307.
4. Hall, C. B. 1964. The effect of short periods of high temperature on the ripening of detached tomato fruits. Proc. Amer. Soc. Hort. Sci. 84: 501-506.
5. Hall, C. B. 1964. Firmness and color of some tomato varieties during ripening and according to harvest dates. Proc. Amer. Soc. Hort. Sci. 84: 507-512.
6. Hall, C. B. 1964. The ripening response of detached tomato fruits to daily exposures to high temperatures. Proc. Fla. State Hort. Soc. 77: 252-256.
7. Thompson, A. E., R. W. Hepler, R. L. Lower, and J. P. McCollum. 1962. Characterization of tomato varieties and strains for constituents of fruit quality. Illinois Agr. Exp. Sta. Bull. 685. Pp 32.

## SUSCEPTIBILITY OF MANAPAL AND GROTHEN'S GLOBE TOMATOES TO ALTERNARIA ROT

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#### INTRODUCTION

It has been recognized that decay of tomato fruit caused by *Alternaria tenuis* auct. follows such defects in the field as sunscald, blossom-end rot, faulty blossom scars, and growth cracks (1). Subjecting tomatoes to "chilling" temperatures also increases the susceptibility of tomatoes to decay by *A. tenuis*. After epidermis injury and inoculation by the causal organism, susceptibility of tomatoes to alternaria rot increased as temperatures were reduced from 50° to 32° F (1). More than 95 hours of temperatures below 60° the week prior to harvest, with-

out postharvest chilling, were found necessary to predispose tomatoes to alternaria rot (2).

In a study on ripening characteristics of tomatoes of varieties grown in Florida, large differences in susceptibility to alternaria rot were found among fruit of the several varieties (3). However, because of inconsistencies in results, relative to season and location, no conclusions could be drawn as to the inherent varietal susceptibility to alternaria rot following field or postharvest chilling. A study was made, therefore, to determine whether the two varieties, Manapal and Grothen's Globe, differ in susceptibility to *A. tenuis*.

#### MATERIALS AND METHODS

Tomato plants of two varieties, Manapal and Grothen's Globe (*Fusarium* wilt resistant strain), were grown in parallel rows in a com-

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