depend on impact velocity or the square root of drop height rather than on velocity squared or drop height gives more relative importance to minimizing the height of drops. If drop height is halved, the incidence of damage is likely to be decreased only to 71% of the original damage incidence.

The results of this work have shown the importance of cv. selection and maturity in minimizing impact damage to tomatoes. Also, peak impact force is essentially proportional to the square root of the drop height. Overall damage of a particular cv. and maturity resulting from impact was best represented as a linear function of drop height. When damage combined for all cvs. and maturities was fit by power functions the exponents indicated that impact damage was proportional to impact velocity and not the energy of the fruit upon impact. Damage was found with all treatments except mature green 'MH-1's' at drop heights as low as 4 in. (10 cm.).

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ASCORBIC ACID CONTENT OF TOMATO VARIETIES

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Abstract. **The ascorbic acid content of 41 tomato varieties and breeding lines is reported. The analyses were made on red ripe fruit grown at Bradenton, Florida in the spring of 1973. The mean value for all 41 varieties was 15.0 mg/100g, and individual varieties ranged from 10.7 to 20.9 mg/100g, wet weight basis. There was a positive correlation between the year of variety release and the ascorbic acid content. Twelve strains of the variety Walter had ascorbic acid values ranging from 13.3 to 17.8 mg/100g.**

Recent nutritional labeling regulations have been enacted by the Food and Drug Administration making it possible to label foods for their nutritional composition. If so labeled, the nutritional value must be stated accurately or the food will be considered mislabeled and is subject to seizure. Fresh fruits and vegetables are also included in this regulation, and if nutritional claims are made for them, the fresh food must be labeled to indicate the nutritional composition.

Tomatoes are a good dietary source of ascorbic acid (Vitamin C), hewever the ascorbic acid content varies greatly. Many factors contribute to this variation, and environmental growing conditions have been reported as having major effects on the ascorbic acid composition (4, 5, 9).

Most researchers have found less than 100 percent variation in ascorbic acid content between different varieties for a single season and growing location (2, 8, 16, 17). However, some researchers have reported more than 100 percent variation between varieties (3, 10).

Hamner et al (5) found that when the same tomato variety was grown in different areas of the country the ascorbic acid composition could vary more than 100 percent. The variety Marglobe had a value of 14.4 mg/100g when grown at Knoxville, Tennessee, and 30.6 mg/100g at Wenatchee, Washington. The variety Rutgers had a low value of 8.4 mg/100g when grown at Kingston, Rhode Island, and a high value of 19.7 mg/100g when grown at Lafayette, Indiana. The variety Pritchard had a value of 10.7 mg/100g when grown at Kingston, Rhode Island, and 29.0 mg/100g when grown at Fresno, California. From controlled experiments with temperature, humid-

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ity, length of photoperiod, and sunshine and shade, they concluded that the light intensity just prior to harvest had the greatest influence on the tomato ascorbic acid content. McCollum (9) had previously shown that shaded tomato fruits contained less ascorbic acid than unshaded fruit and that fruit wall tissues with the greatest exposure to light had the highest levels of ascorbic acid.

The USDA Agricultural Handbook No. 8, Composition of Foods, cites the year-round average for ascorbic acid in ripe raw tomatoes as 23 mg/100g. Samples marketed from November through May average around 10 mg/100g; and from June through October, around 26 mg.

The published ascorbic acid values for Florida-grown tomatoes are fragmentary. Mustard (12) reported the ascorbic acid content of Florida-grown Marglobe, Rutgers, and cherry tomatoes as 19.7, 19.2 and 51.5 mg/100g respectively. French and Abbott (3) analyzed 29 tomato varieties grown at Bradenton, Florida during the 1942 season. Their ascorbic acid values ranged from 10.8 to 27.2 mg/100g, with a mean value of 19.5 mg/100g. Ten tomato varieties were also analyzed in the 1943 and 1944 seasons. There was considerable season to season variation for some varieties. The variety Valiant which had the highest ascorbic level in 1942 (27.2 mg/100g) had only 18.5 mg/100g in 1944. The variety Grothen's Globe had 24.5 mg/100g in 1942 and 14.5 mg/100g in 1944.

The mean value for all tomato varieties analyzed was 19.5 mg/100g in 1942, 18.6 mg/100g in 1943, and 19.0 mg/100g in 1944.

Janes (6) reported the Florida-grown tomato varieties Pan America and Rutgers, had ascorbic acid contents of 26.0 and 25.9 mg/100g, respectively. Kuhn and Dennison (7) reported the ascorbic acid content of canned Florida tomatoes, variety unknown, ranged from 11.4 to 17.4 mg/100g. None of the varieties analyzed by these authors are currently in commercial production.

The objective of this work was to obtain information on the ascorbic acid content of current Florida-grown commercial tomato varieties and breeding lines. Some very old varieties for which seed was available were grown for comparison.

Methods and Materials

A total of forty-one varieties and breeding lines were evaluated for their ascorbic acid content as developed under Florida growing conditions during the 1973 spring season.

Ten plants of each variety or breeding line were grown on stakes at the IFAS-AREC, Bradenton. At harvest, all pink and red ripe fruit were picked from these plants at one time for a single composite sample. The tomatoes were transported to Gainesville and held at 70°F until the fruit reached the red ripe stage.

Ten red ripe fruit were sliced into wedges and divided into three composite samples. Replicate analyses were made for ascorbic acid by the AOAC 2,6 dichloro-indophenol method (1). Results are reported as mg ascorbic acid/100g fruit on a fresh weight basis. The sampling procedure was designed to eliminate within fruit and between fruit variation.

Twelve separate strains of the tomato variety Walter were grown in ten-plant plots to determine variation between strains. Growing conditions and analysis procedures were the same as for the other varieties.

Results and Discussion

The ascorbic acid values for the forty-one varieties ranged from 10.7 to 20.9 mg/100g Table 1). This range between varieties is less than that previously reported by French and Abbott (3) and Maclinn and Fellers (10) for a single season. However, Currance (2), Scott and Walls (16), and Tripp et al (17) reported less than 100 percent difference between varieties they studied.

The mean value for the 41 varieties was 15.0 mg/100g.

Florida releases include Homestead-24, Manasota, Manalucie, Indian River, Manapel, Floradel, Tropi-Gro, Tropi-Red, Walter, Tropic and MH-1. The mean ascorbic acid value for these Florida releases is 14.2 mg/100g.

The major varieties in current commercial Florida production are Walter, Florida MH-1, Homestead-24, and Floradel. The value of each of these varieties exceeds the mean ascorbic acid value for all Florida releases.

The human Recommended Daily Allowance (RDA) for ascorbic acid set by the FDA is 60 mg, one medium tomato (150 g) would provide at least one-third of the RDA.

The twelve strains of the Walter variety grown in separate ten-plant plots, had ascorbic acid values ranging from 13.3 to 17.8 mg/100g. A similar variation between strains of a single variety

Table 1. Ascorbic Acid Content and Release Date of Tomato Varieties

Variety	Release Date	Ascorbic Acid mg/100g
Ponderosa	1891	11.4 ± .50
Ms. Corbett's Sp.	ca1891	13.9 ± .20
Bonny Best	1908	16.5 ± .25
Oxheart	ca1920	17.2 ± .32
Manasota	1949	15.5 ± .53
Homestead-24	1952	14.4 ± .26
Ace	1952	12.3 ± .23
Manalucie	1953	13.3 ± .38
Indian River	1961	15.2 ± .12
Manapal	1961	12.1 ± .28
Chico III	1961	14.3 ± .23
Floradel	1964	14.8 ± .50
Atkinson	1966	17.1 ± .17
Tropi-Gro	1967	13.3 ± .38
Tropi-Red	1967	10.7 ± .32
Strano-Sp.	1967	13.3 ± .36
Walter	1969	16.3 ± .26
Tropic	1969	14.3 ± .16
Royal Ace	1969	13.6 ± .42
VFN Bush	ca1970	13.6 ± .50
Campbell 28	1971	18.9 ± .32
MH-1	1971	16.0 ± .61
Panase F	1972	16.1 ± .32
Saturn	1972	13.4 ± .44
Ohio MR-12	1972	14.3 ± .20
Red Rock	1972	20.9 ± 1.06
Merit	1972	16.8 ± .16
Dorchester	1972	18.0 ± .17
Caroline	1972	17.1 ± .17
Enza	1972	16.9 ± .72
Cuautla 70	UN*	17.0 ± .58
Chanasy Early	UN	13.4 ± .42
Subarctic Delite	UN	14.8 ± .61
Super Sioux	UN	20.7 ± .71
Schencks-1	BL**	12.4 ± .58
Schencks-2	BL	13.2 ± .10
White Walter	BL	13.4 ± .21
Sweet Cherry	BL	12.0 ± .26
71120	BL	14.2 ± .10
2432	BL	16.9 ± .21
6120	BL	17.3 ± .65
Mean		15.04 ± 2.36

* UN — Unknown
** BL — Breeding Line

Table 2. Ascorbic Acid Content of Twelve Strains of the Tomato Variety Walter

Line	Ascorbic Acid mg/100g
W-1434	13.3 ± .45
W-1046	14.5 ± .40
W-1052	14.6 ± 2.14
W-1053	15.0 ± .12
W-1043	15.3 ± 1.72
W-1435	15.3 ± .46
W-1054	15.6 ± .00
W-1055	16.2 ± .57
W- 790	16.3 ± .26
W-1432	16.3 ± .53
W-1044	17.5 ± .53
W-1045	17.8 ± .26

was reported by Maclinn and Fellers (10) who found that seven strains of the Marglobe variety varied from 23 to 31 mg/100g.

There has been some speculation that recent variety releases have less nutritional value than the tomatoes of olden days. The 41 varieties are plotted against the year of release in Figure 1. When the linear regression is evaluated for ascorbic acid content versus the year of release, the equation of best fit has a slight positive slope. Therefore, for the tomato varieties analyzed, there is a slight increase in the ascorbic acid content between 1950 and 1972. The mean ascobic acid value for releases between 1950 and 1960 was 13.3 mg/100g and between 1960 and 1972 was 15.3 mg/100g. The mean value for releases prior to 1950 was 14.9 mg/100g.

Future research will include selected varieties evaluated for ascorbic acid over several seasons at different locations.

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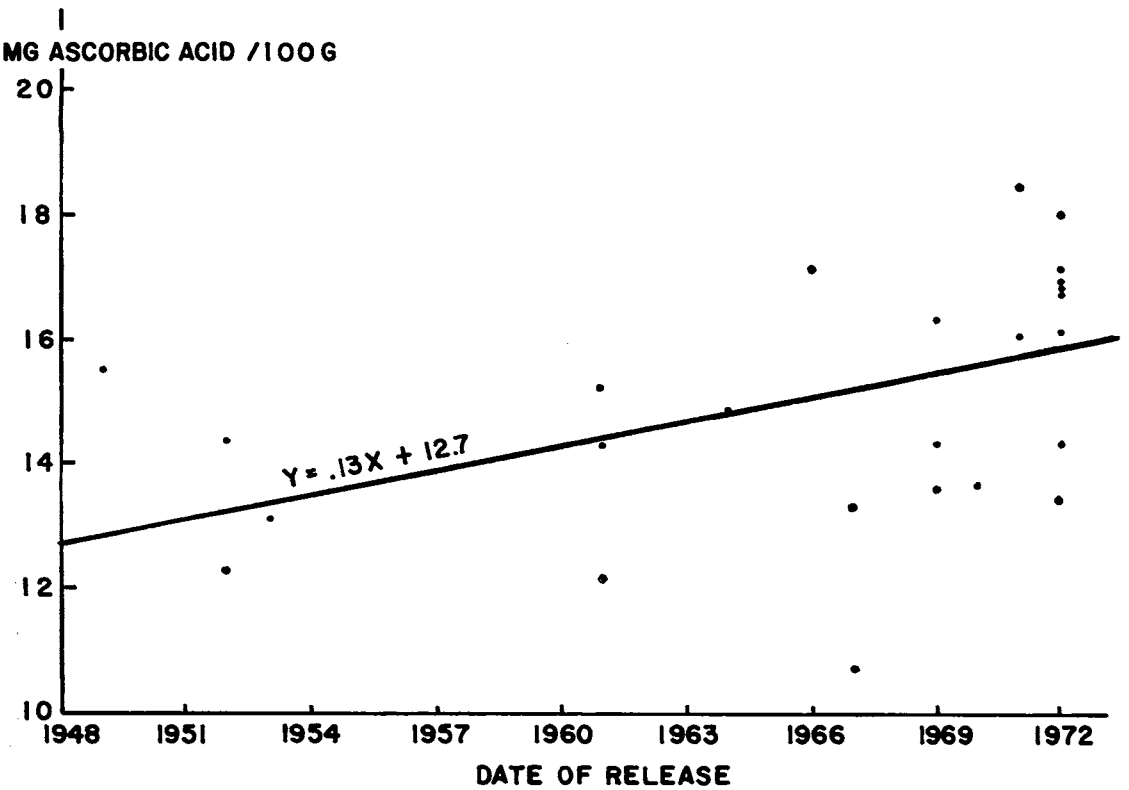

Fig. 1. Ascorbic Acid Content of Tomato Varieties Versus Release Date.