Table 8. Production of marketable fruit, 'Duke' tomato, AREC-Bradenton, 1983 season expressed on a per plant basis.

Sampling date	Marketable fruit, ring sized				Marketable (total lb. per plant)
	Small (lb./plant)	Medium (lb./plant)	Large (lb./plant)	Ex large (lb./plant)	
18 March	—	—	—	—	—
25 March	—	—	—	—	—
1 April	—	—	—	—	—
8 April	—	—	—	—	—
15 April	—	—	—	—	—
22 April	—	—	—	—	—
29 April	—	—	—	—	—
6 May	—	—	—	—	—
13 May	0.12	—	—	—	0.12
20 May	0.33	.63	.27	.44	1.67
27 May	0.65	1.85	1.96	.56	5.02
3 June	0.88	2.64	3.11	3.51	10.14
10 June	0.95	3.03	3.78	5.73	13.49
17 June	0.84	3.22	4.12	7.89	16.07
24 June	0.68	3.28	4.27	9.51	17.74
Linear	**z	**	*	**	**
Quadratic	**	**	**	**	NS
Cubic	**	NS	NS	NS	NS

zSignificant 5% level (*), 1% level (**), or not significant (NS).

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COLOR AND FIRMNESS OF SELECTED FLORIDA-GROWN TOMATO CULTIVARS

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Additional index words. texture, Hunter Color Meter, *Lycopersicon esculentum.*

Abstract. **Color and firmness are two of the more important factors that affect consumer acceptance of fresh tomatoes** (Lycopersicon esculentum **Mill.). However, quantitative measurements of these quality attributes are not readily available for Florida-grown cultivars, thus plant breeders and physiologists have no point of reference with which to compare possible new releases. In this report we present data that characterize color development and firmness in selected cultivars as they progress from mature-green to table-ripe stage. Color is evaluated with a Hunter Lab Color/Difference Meter and firmness is determined by a non-destructive deformation technique. We suggest that these data may be useful to producers, packers, and researchers in the tomato industry.**

Florida's tomato industry is one of the more dynamic agricultural enterprises in the United States. The 1982-83 shipping season covered a span of 37 wk and included over 14 commercially produced cultivars, most of which were marketed fresh (5). New varieties are available each year and, as a natural consequence, growers may have great difficulty in deciding which one(s) they should plant. In fact, the concerned grower may be confused as to what criteria are being used by breeders to determine which new varieties should be released. Two such criteria that are important for consumer acceptance are color and firmness, both of which have traditionally been determined by subjective methods. There have been occasional reports of objective measurements of these parameters (3, 4), but new releases have come and gone so rapidly that it has been difficult to keep up with quality evaluation. Consequently, much of what we know about tomato quality has come from bits and pieces of research. The primary objective of this work is to evaluate color and firmness of several currently produced cultivars and compare these to some "old-line" varieties. This should give some indication of the progress being made in tomato breeding, in addition to providing a point of reference for other researchers with an interest in these quality characteristics.

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Materials and Methods

Tomatoes were grown in a variety trial at the University of Florida Horticultural Unit north of Gainesville during the spring of 1983. One harvest was made for each variety between June 15 and June 24. Decayed and defective fruit were discarded and the remaining fruit were graded for uniformity in size (4-5.5 oz), shape, and surface quality. From this lot, 10 fruit were selected to represent each of the following 4 stages of development: mature-green, turning, pink and red. These stages were based on comparison of visual color to a U.S.D.A. visual aid for color classification requirements in grades of fresh tomatoes (8). All fruit were washed, surface sterilized with 100 ppm NaOCl, and allowed to dry prior to color and firmness measurements.

Color measurements. Fruit surface color was evaluated with a Hunterlab Color Difference Meter D25D2 calibrated with a white standard plate no. C2-2716. This instrument has been valuable in citrus color studies (7), and a detailed account of the requirements for its use in reproducible measurement of tomato color has been published (6). The Hunter method provides numerical data that closely represent what is actually seen by the human eye (I. Stewart, personal communication). This is possible because the instrument is a tristimulus colorimeter that provides 3 values for each color measurement. These values are derived from 3 scales defined as L, a, and b. 'L' represents brightness on a scale of 0-100, with 0 being perfect black and 100 being perfect white. The 'a' scale progresses from green (negative values) to red (positive values), and the 'b' scale covers the range from blue to yellow, with positive values in the yellow range (1). There are several ways of expressing these data, but the procedure that has gained widespread acceptance is calculation of the a/b ratio. 'L' values are useful in tomato color evaluation if white core is a problem, but in the abscence of white core there is little variation in 'L' values (1). Each fruit in the experiment was subjected to color evaluation in 3 locations; one at the stylar-end and 2 equatorial evaluations. These values were averaged and one a/b ratio calculated for each fruit. Means were separated with Duncan's multiple range test.

Firmness measurements. Tomato firmness was determined by the method of Hamson (4) as modified by Gull (2). The technique basically consists of measuring distance of deformation caused by a 0.6 inch concave contact point under a 2.2 lb. weight for a 5-sec period. Each fruit was subjected to 2 measurements in the equatorial plane over a locular region. Areas overlying the pericarp cross walls are significantly firmer than locular areas and more reproducibility is obtained if cross walls are avoided (4). Means were separated with Duncan's multiple range test.

Results and Discussion

Color. Hunter 'a' values ranged from −0.20 for mature green fruit to almost +50 for table ripe fruit and corresponding 'b' values decreased from almost +30 to about +15. Calculation of a/b ratios resulted in values ranging from −0.15 in mature green to approximately +2.5 in red fruit (Fig. 1). Stages of maturity were significantly different at $\alpha = 0.05$. Comparison of overall color values for varieties showed that 'Flora-Dade', 'Sunny', and 'Hayslip' had significantly higher color scores than all other varieties. The lowest a/b ratio was found in 'Rutgers' a variety that is not grown commercially today (Table 1). All of the varieties in this study had acceptable color for marketing of fresh tomatoes.

Firmness. Deformation in green fruit was less than 0.02 inches for all varieties, but increased to 0.14 to 0.24 inches by the time the red-ripe stage had developed (Fig. 2). Stages of maturity were significantly different at $\alpha = 0.05$. Analysis of overall deformation values showed 'Sunny' to be significantly firmer than all other varieties except 'Duke'. The softest variety was 'Rutgers', which exhibited almost twice the deformation of the new, firmer cultivars (Table 2).

The results of our study indicate that considerable progress has been made in breeding firmer lines of tomatoes that retain the rich color that consumers prefer. In 1952, Hamson (4) observed a negative correlation between color and firmness for all varieties in his study. This indicates that the softest fruit consistently showed the highest color score. Our results are contrary to his conclusions, a particular exception being the variety 'Sunny', which was the firmest selection we observed at the table-ripe stage but also had the highest a/b ratio. This may well be the result of years of breeding efforts to select varieties with good shipping characteristics in addition to acceptable color. Growing conditions in the field may have profound effects upon fruit quality, thus our work may be criticized on the basis that it represents fruit from only one growing location. We acknowledge that a more extensive study is required in order to make state-wide implications regarding tomato quality,

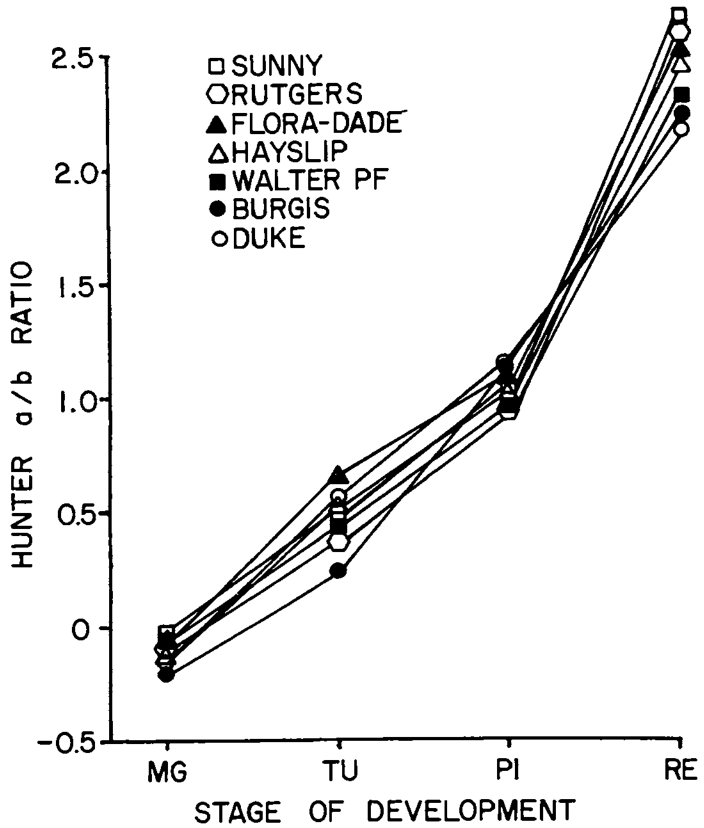

Fig. 1. Color scores for tomatoes at selected stages of development (MG = mature-green, TU = turning, PI = pink, RE = red).

Table 1. Comparison of tomato varieties based on average color readings for four stages of maturity.

Cultivar	Hunter a/b
Flora-Dade	1.08 a[z]
Sunny	1.07 a
Hayslip	1.01 a
Duke	0.99 ab
Burgis	0.92 bc
Walter PF	0.92 bc
Rutgers	0.89 c

[z]Mean separation by Duncan's multiple range test, 5% level.

Table 2. Comparison of tomato varieties based on average firmness measurments for four stages of maturity.

Cultivar	Deformation (inches)
Rutgers	0.114 a[z]
Walter PF	0.099 b
Burgis	0.089 c
Hayslip	0.081 d
Sunny	0.079 d
Flora-Dade	0.074 dc
Duke	0.071 e

[z]Mean separation by Duncan's multiple range test, 5% level.

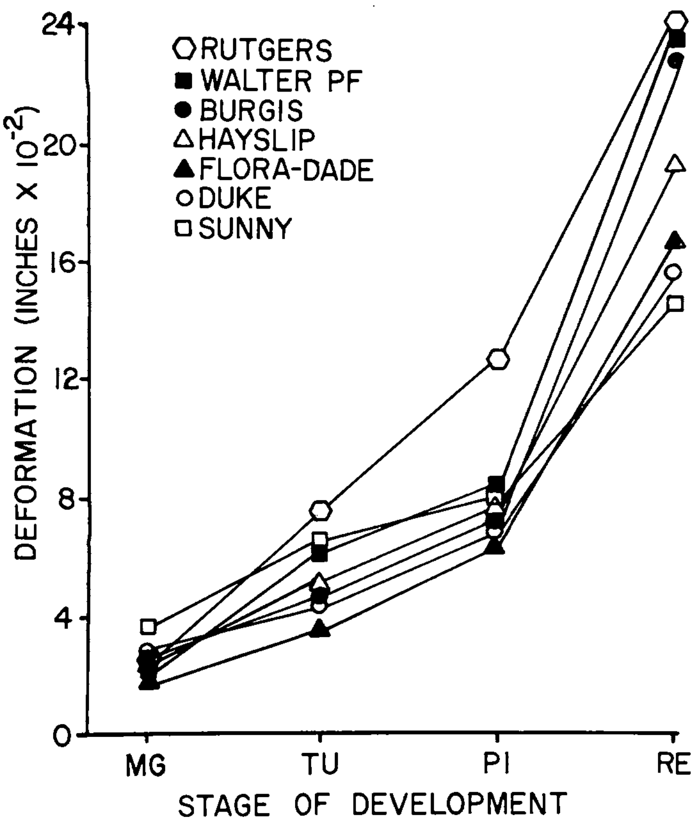

Fig. 2. Firmness evaluation of tomatoes at selected stages of development (MG=mature-green, TU=turning, PI=pink, RE=red).

and we suggest that these measurements may be incorporated into existing programs that emphasize quality evaluation.

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INFLUENCE OF POLLINATION AND CHLORFLURENOL ON FRUIT DEVELOPMENT IN SQUASH[1]

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Additional index words. Cucurbita pepo, Curbiset, Ethrel, ethephon, fruit set.

Abstract. **Yellow crookneck (cv. Dixie) and/or straightneck (cv. Seneca Prolific) summer squash** (Cucurbita pepo **L.) were grown in greenhouse and field experiments at Gainesville. In the greenhouse, 50 ppm methyl-2-chloro-9 hydroxyfluorene-[9]-carboxylate (chlorflurenol) increased fruit set of 'Dixie' when the flowers were not pollinated. When pollination occurred or at a 100 ppm concentartion, chlorflurenol was without effect on fruit set. Fruit shapes from chlorflurenol treated plants were significantly improved when the flowers were not pollinated. In the field 0 to 200 ppm chlorflurenol was applied when 4 to 6 female flowers were visible. Early yields were increased by 25 to 50 ppm chlorflurenol regardless of cultivar. Individual fruit weights were generally less in the chlorflurenol treatments, however more fruit per plant were produced leading to similar total yields in the chlorflurenol treatments as the control. To improve the effectiveness of chlorflurenol, plants were sprayed twice in the seedling stage with 250 ppm 2-chloroethyl phosphonic acid (ethephon) to increase femaleness. Ethephon did not improve the effectiveness of chlorflurenol but did increase overall yields of 'Dixie' squash.**

Parthenocarpy can be induced chemically in cucumber (*Cucumis sativus* L.) by several growth regulators. Most notably, auxin transport inhibitors such as TIBA (2) and chlorflurenol (7) are highly active inducers of multiple fruit set in cucumber. Chlorflurenol effectively induces parthenocarpy in muskmelon (*Cucumis melo* L.) (4) and improves fruit set in tomato (8).

Nitsch et al. (6) reported that the flowering and fruit set patterns of summer squash and cucumber are similar and that both species are capable of setting fruit parthenocarpically. The induction of uniform fruit set promotes earliness, easier harvesting, and, in the case of cucumber, allows the crop to be mechanically harvested.

The objective of this study was to determine the effects of chlorflurenol on fruit set, yield, and fruit size in summer squash.

Materials and Methods

Greenhouse experiments 1 and 2. Effect of chlorflurenol on fruit set in squash. Summer squash (cv. Dixie) seeds were

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