or equivalent per acre, supplemental fertilizer, particularly nitrate nitrogen, will be needed to produce maximum yields.

In dry seasons one sidedressing with nitrate of soda, supplying 24 pounds of nitrate nitrogen about 15 days after the plants are set, should produce maximum yields of cabbage. In wet seasons with deluges of one or more inches of rainfall, two or three sidedressings may be required to produce maximum yields. Whether or not two or three sidedressings are needed will depend upon the amount of rainfall. When excessive rainfall occurs and the plants show a light green color, they should be sidedressed. If two sidedressings are needed they should be made with nitrate of soda, approximately 15 and 50 days after the plants are set, and each should supply 24 pounds of nitrate nitrogen per acre. If three sidedressings are needed, two of them should be made with nitrate of soda and the last one with nitrate of soda-potash. Each sidedressing should supply 24 pounds of nitrate nitrogen per acre and the last one should supply an additional 22 pounds of potash per acre. These sidedressings should be applied approximately 15, 50 and 90 days after the plants are set.

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THE EFFECTS OF GROWING AREAS AND SEASONS AND PRE-RIPENING TEMPERATURES ON THE QUALITY OF TOMATOES

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There are five major geographical areas of Florida in which tomatoes are grown. The harvesting period for any one area may extend over several weeks; many of the harvest periods overlap at some time, with the harvesting and packing in the state beginning in October and ending in June. Thus many factors of environment may be involved in quality of the tomatoes. There is also some economic competition among areas, with quality, either real or rumored, a basis for price determination.

Hall and Dennison (2) working with specific environmental factors, found an increased incidence of vascular browning under conditions of shading, misting, cool night temperatures and soil compaction. Dennison *et al* (1) studied fruit from the five producing areas and found higher acid content in fruits produced in cooler weather. They also noted that fruits with lower solids content were more firm than those with higher solids. Morris (4) and Workman, *et al.* (7) have pointed out the effects of pre-harvest chilling injury of tomatoes. McColloch (3) has emphasized the effect of chilling injury caused by pre- or post-harvest temperatures on the decay caused by Alternaria. Walford (5) and Wardlaw (6) reported that tomatoes grown at higher temperatures could be handled without damage at lower temperatures than those produced under lower temperature conditions. Thus, it would appear that, under the adverse environments possible during the Florida tomato season, basic differences in quality could occur and different handling conditions might be required.

This work was begun to determine any differences in ripe fruit quality and to study possible modifications in fruit handling practices.

Experimental Procedures[1]

Mature green tomatoes of Homestead variety were taken from one packing house in each of the three areas — Ft. Pierce, Ruskin, and Marion-Sumter. Samples were from three commercial lots, each representing a different grower. Sampling dates were selected to typify early, mid-season, and late production for

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[1]The authors wish to thank the County Agricultural Agents, the growers and packinghouse operators in the various areas for their cooperation and assistance in this work.

each area without regard to the time interval between samples. Sampling dates were also selected insofar as possible, so that two or more areas could be sampled simultaneously. In some areas, by coincidence, the same grower or growers were represented in more than one sampling date. County Agents assisted in obtaining weather data and information concerning grower practices. For each area, season and grower, three identical samples were taken for pre-ripening temperature treatments of 40°, 55° and 70°F. For each sample, U. S. No. 1 fruit, size 6 x 7, as nearly free of blemishes as possible, were taken just prior to final packing and transported to Gainesville. These fruit were held at 70°F. until the following morning (3 to 8 hours) when a final selection of 90 fruit was made. Only 60 fruit were selected for the first sample from Ft. Pierce, but this proved inadequate to supply fruit necessary for analyses, and the number was increased to 90.

After the final selection of fruit was made and fruit arranged in a single layer in trays, samples were placed in storage at 40°, 55° or 70°F. They remained at these temperatures for six days and were then moved to a ripening room at 70°F. At the time of transfer to the ripening room and each three days thereafter, they were examined for amount and severity of decay and scored for color. Five color classes were used and each was assigned a numerical value—mature green, 2; breaker, 3; turning, 4; pink, 5; and firm ripe, 6. Class definitions were based on the appearance and amount of color. A color score for the entire sample was calculated from the sum of the products of the number of fruit in each class and the class value divided by the number of fruit in the sample.

When each fruit reached firm ripe maturity, it was examined in detail and external appearance and, in most cases, internal appearance noted. Other than decay and total color, 11 factors were used to judge external appearance— normal, uneven color, desiccation, black shoulders, grey wall, mechanical damage, uneven whitish areas, stippled areas, pebbly-textured appearance, growth cracks and virus indications. Fruit were scored internally as to normal, bruised, green walls, green jelly, cloudy jelly, grey wall, dark seeds, or other defects which were usually aborted seeds. Any fruit could be scored for more than one defect. The number of fruit which were considered marketable was also recorded. Marketable requirements were exacting; only those fruit which were considered salable to the most discriminating buyer were included. Only very minor color deviations or physical defects were allowed.

Laboratory determinations of dry weight, titratable acidity and crude fiber were made on the first 10 tomatoes which reached the firm ripe stage simultaneously. External and internal observations were recorded prior to these determinations. Samples were also prepared for pectin analyses which have not been completed. When 10 additional fruit reached firm ripe maturity, they were scored externally and were then tested for firmness by measuring the pressure required to force a ½″ rounded tip 3/16″ into the fruit. Usually there were more than 10 fruit available for laboratory and pressure tests and only the most nearly normal fruit were used. Preliminary tests by pressure testing had indicated that firmness was the same for fruit of the same sample reaching firm ripe maturity after 6, 9, 12, 15 or 18 days at 70°F. Thus the 3-day intervals sometimes existing between laboratory determinations and firmness measurements were not considered significant.

Results

Seasonal Effects.—The seasonal effects on quality of tomatoes in the Ft. Pierce area are shown by the data in Table 1. Data on defects which occurred in insignificant quantity

TABLE 1.—The Effects of Season on the Quality of Tomatoes in the Ft. Pierce Area.

Season	Color Score	Percent of Total Sample			Percent of Number of Non-decayed Firm Ripe Fruit							
		Ripened	Marketable	Decayed	Normal Ext.	Normal Int.	Uneven Color	Desiccated	Grey Wall Ext.	Grey Wall Int.	Black Shoulders	Dark Seeds
Early	3.26	74.3	52.6	5.4	31.1	76.3	40.6	20.8	12.5	11.9	14.1	20.4
Mid-Season	4.00	91.0	78.9	5.1	70.2	93.0	21.4	3.5	2.2	0.8	1.3	1.7
Late Season	4.11	94.3	63.4	5.1	52.2	87.7	28.5	15.6	6.6	3.4	4.7	4.2

or which were essentially the same for all seasons have not been included. Data are average percentages for all temperatures of pre-ripening storage. Percentages are based on the number of non-decayed fruit reaching full ripe maturity, with the exception of total ripened, marketable and decay, which are based on the total number of fruit in the sample.

The relatively poor ripening of fruit in early season, indicated by the low color score and ripening percentage, could be due to harvesting at a more immature stage than in other seasons; this in spite of the effort to select fully-mature green fruit in the sample. It is also possible that poor ripening was caused by pre-harvest environmental conditions of a late, cool, wet spring. The fewer marketable fruit in early season also was caused by the ripening behavior, since 73 percent of those which ripened were marketable as compared with 90 percent in mid-season and 69 percent in late season. The great amount of desiccation in early and late season could have resulted from adverse environmental conditions in early season and a declining plant vigor in late season. The amount of desiccation was evenly distributed in grower samples in late season, but came from only two samples in early season. There was no obvious correlation with grower practices or conditions, however.

The amount of black shoulder fruit, which was caused primarily by Alternaria, was greatest in early season fruit and primarily from one grower. It is extremely hazardous to reach conclusions based on a single sample, but it probably should be pointed out that this grower sprayed "as needed," which carries many meanings, and other growers in this sample applied spray in a 5 to 7 day schedule. Fruit from this same grower also showed more dark seeds than that from other growers. There were some apparent differences in amount of fruit with grey wall, depending on season. Reasons are not known. It should be indicated here that the two numbers for grey wall are almost additive, since fruit showing external symptoms of grey wall were rarely examined internally. Grey wall will be discussed again under temperature effects.

Results from the Ruskin area fruit are shown in Table 2. Except for a slight apparent increase in the amount of grey wall as the season progressed, there were few differences in fruit quality in the Ruskin area. The noticeable decrease in marketable fruit was caused by uneven color development which could not be further broken down as to cause. It is, of course, possible that this uneven color was due to virus infections whose symptoms were not enough pronounced to be scored. It was noted that blotchy, virus-like symptoms were often evident before fruit reached firm ripe maturity, but that the characteristic patterns tended to disappear when the full red color developed.

The seasonal effects in the Marion-Sumter area, as shown in Table 3, were very marked in many respects. The most apparent was the reduction in marketable fruit in the mid-season harvest, caused primarily by the increase in black shouders. This big increase in black shoulder fruit was from samples from two growers. Weather during the week preceding this mid-season harvest was characterized by cloudy, overcast skies, but no rain.

None of the fields at any season in any area received rainfall from a week before harvesting began until after all samples were taken.

Results of laboratory determinations are presented in Table 4. There did appear to be a seasonal decline in fruit acidity in Ft. Pierce and Ruskin but not in the Marion-Sumter area. There also seemed to be an increase in firmness of fruit in the Marion-Sumter area as the season progressed. Considering total areas, it was apparent that fruit from the Marion-Sumter area was slightly higher in dry weight and acidity than the other areas, but

TABLE 2.—The Effects of Season on the Quality of Tomatoes from the Ruskin Area.

Season	Color Score	Percent of Total Sample			Percent of Number of Non-decayed Firm Ripe Fruit								
		Ripened	Marketable	Decayed	Normal Ext.	Normal Int.	Uneven Color	Desiccated	Grey Wall Ext.	Grey Wall Int.	Black Shoulders	Dark Seed	Ghosty
Early	4.03	91.1	79.1	4.9	67.1	88.8	24.0	4.0	0.3	0.5	1.1	3.9	7.3
Mid-Season	4.36	95.1	73.5	8.0	63.3	87.4	25.8	2.7	3.6	2.0	1.1	3.7	7.4
Late Season	4.33	93.6	59.6	11.4	50.9	83.2	40.8	5.2	5.7	3.4	1.5	3.9	10.7

TABLE 3.—The Effects of Season on the Quality of Tomatoes in the Marion-Sumter Area.

Season	Color Score	Percent of Total Sample			Percent of Number of Non-decayed Firm Ripe Fruit								
		Ripened	Marketable	Decayed	Normal Ext.	Normal Int.	Uneven Color	Black Shoulders	Grey Wall Ext.	Grey Wall Int.	Ghosty	Growth Cracks	Virus
Early	4.17	96.4	66.2	6.9	55.1	86.2	31.8	7.7	5.0	4.1	9.0	2.2	1.0
Mid-Season	4.56	95.8	45.8	9.9	34.0	88.2	52.9	23.5	1.9	3.6	6.1	5.8	0.2
Late Season	4.47	98.6	59.1	2.7	46.3	89.4	44.2	4.4	3.4	3.4	0.5	4.8	6.7

TABLE 4.--Effects of Season on Laboratory Determinations of Quality of Tomatoes Grown in the Ft. Pierce, Ruskin, and Marion-Sumter Areas.

Area	Season	Dry Weight %	Titratable Acidity ml. 0.1 N NaOH	Crude Fiber %	Firmness Lbs.
Ft. Pierce	Early	4.98	6.07	0.95	3.72
	Mid-Season	5.16	5.61	1.35	3.40
	Late Season	5.48	5.32	1.07	3.75
Average		5.20	5.67	1.14	3.62
Ruskin	Early	5.22	6.86	1.18	3.57
	Mid-Season	4.86	5.36	0.84	3.39
	Late Season	4.99	4.65	0.85	4.13
Average		5.02	5.63	0.96	3.70
Marion-Sumter	Early	5.64	6.61	1.02	2.99
	Mid-Season	5.29	5.33	0.81	3.32
	Late Season	5.50	6.41	0.71	3.62
Average		5.48	6.11	0.85	3.31

TABLE 5.—The Effects of Area on Quality of Tomatoes According to Sampling Dates.

Date	Area	Color Score	Percent of Total Sample			Percent of Number of Non-decayed Firm Ripe Fruit							
			Ripened	Marketable	Decayed	Normal Ext.	Normal Int.	Uneven Color	Desiccated	Black Shoulders	Grey Wall Ext.	Grey Wall Int.	Dark Seed
May 3	Ft. Pierce	3.26	74.3	61.1	5.4	31.3	81.4	39.2	22.8	14.1	11.8	8.8	16.4
May 17	Ft. Pierce	4.02	91.0	78.9	5.1	70.2	93.3	21.4	3.5	1.3	2.1	0.7	1.4
	Ruskin	4.04	91.0	79.1	4.9	67.7	89.0	23.9	3.9	1.1	0.3	0.0	4.1
May 31	Ft. Pierce	4.11	94.3	63.5	5.1	53.0	88.9	28.0	15.6	4.7	5.8	3.2	3.2
	Ruskin	4.36	95.1	73.5	8.0	64.3	88.6	25.0	2.7	1.1	3.2	1.8	3.1
	Marion-Sumter	4.17	96.5	66.2	6.9	56.6	86.8	30.4	4.0	7.6	4.9	3.6	0.3
June 7	Ruskin	4.33	93.6	59.6	11.4	53.1	83.3	38.5	5.6	1.5	4.8	3.3	3.9
	Marion-Sumter	4.56	95.8	45.8	9.9	35.4	88.7	51.8	2.0	22.9	1.6	3.5	0.6
June 14	Marion-Sumter	4.47	98.6	59.4	2.3	46.8	88.8	43.7	5.0	4.3	3.2	3.6	0.3

that fruit were slightly more soft. The high solids and acidity did not adversely affect palatability of the fruit, however. If there was any effect on flavor, it was a slight improvement.

Area Effects. — Data on the effects of the area of production, considered as a whole, on the quality of tomatoes indicate fewer marketable fruit, in general, from the Marion-Sumter area with correspondingly fewer normal tomatoes, more with uneven color and black shoulders. More desiccation and dark seeds appeared in the tomatoes from Ft. Pierce.

Perhaps a more realistic comparison of areas is given in Table 5, in which areas are compared only on the days when simultaneous samples were taken. On this basis a slight difference in ripened quality among areas occurred on May 31 due to the larger amount of desiccated and black shoulder fruit from Ft. Pierce and black shoulder fruit from Marion-Sumter. On June 7 there was a considerable difference in marketable quality between Ruskin and Marion-Sumter due to the amount of black shoulder fruit from the Marion-Sumter mid-season harvest, which has been discussed previously.

Considering all factors of quality, it does not appear that tomatoes from one area are better than from other areas. One area may excel in some factors and be deficient in others. All areas can produce fruit of high ripened quality but, in many cases, some growers could probably improve the tomato quality by increased diligence in production practices, particularly during adverse weather conditions. It should be further stated here that these results indicate the ripened quality that can be produced, not that which is being produced. These were selected samples and it was much more difficult to select this sample in some areas and from some growers.

Temperature Effects. — Temperature was the major factor affecting tomato quality. There were some apparent area-temperature interactions that should be discussed before considering overall temperature effects. From Fig. 1a, an interaction appears likely in percent fruit ripened. In this case such an interaction is quite probable because of the Ft. Pierce area. The seasonal effect for the Ft. Pierce area is shown in Fig. 1b. This indicates that most of the interaction effect resulted from the early season harvest. These results, then, are in agreement with the contentions of Walford (5) and Wardlaw (6) that fruit grown at higher temperatures can be held at lower temperatures and still ripen adequately. This is also indicated by the comparison of fruit from the three areas at the 40°F. temperature, the higher percentage ripening from Marion-Sumter where production was later and temperature higher.

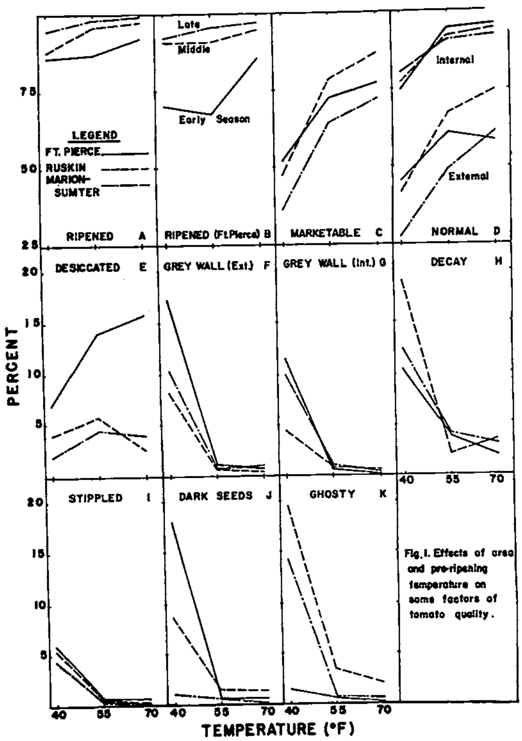

Fig. 1. Effects of Area and Pre-Ripening Temperature on Some Quality Factors of Tomatoes.

There also appears to be an area-temperature interaction in the percent marketable and percent normal fruit shown in Fig. 1c and 1d. This apparent interaction is due almost entirely to the desiccated fruits as presented in Fig. 1e. The reason for the increasing severity of desiccation of Ft. Pierce fruit with increasing temperature in comparison with fruit from other areas is not known. Were it not for this aberration, however, the apparent area-temperature interaction in percent marketable and percent normal essentially would be eliminated.

Temperature had a pronounced effect upon many of the factors of physical quality as shown in all of Fig. 1. Major reduction in quality resulted from exposure to low temperature (40°); however, exposure at 55°F. had a surprisingly deleterious effect on the number of marketable and normal fruit. Since the causes of "ghosty fruit" and dark seeds are unknown, the differences among areas in these figures at 40° cannot be explained. Decay was more prevalent in fruit subjected to low temperature. Most of the decay was of the soft-rot type, however, and not Alternaria. The results on the incidence of grey wall may be of some significance. There were no symptoms of grey wall present at the time samples were taken. The symptoms developed, however, in response to temperature treatments. There were few border-line cases scored; most were serious defects. Most of those fruit showing internal symptoms had not shown external symptoms so the two figures are somewhat additive. At 55° and 70° pre-ripening temperatures, grey wall was almost insignificant. It was severe in all seasons, areas, and growers at 40°F.; however, ranging from 7 to 21 percent of the ripened fruit.

Results of laboratory determinations are shown in Table 6. Indications are that storage at 40° in comparison with 55° and 70° resulted in softer fruit. This is supported by observations on feel of each fruit as it was examined. No other effects of temperature or relationships among determinations are apparent without statistical evaluation.

SUMMARY

Mature-green tomatoes of Homestead variety were selected from one packing-house in three production areas. Samples were from three commercial lots, each representing a different grower. Sampling dates were selected in early, mid- and late-seasons in each area, and, insofar as possible, so that two or more areas could be sampled simultaneously.

Fruits were stored at 40°, 55° and 70° for six days before ripening at 70°F. They were examined each three days thereafter and scored for color and other factors of quality.

Within each area variations in tomato quality occurred among growers and, as the seasons changed. Excessive black shoulder development cause by Alternaria appeared on tomatoes of the early harvest from Ft. Pierce and the mid-season harvest from the Marion-Sumter area.

Temperature effects were most marked. Approximately 12 percent of all tomatoes exposed to 40°F. pre-ripening temperature ex-

TABLE 6.--Effects of Temperature on Laboratory Determination of Quality of Tomatoes Grown in Ft. Pierce, Ruskin and Marion-Sumter Areas.

Area	Temperature °F.	Dry Weight %	Titratable Acidity ml. 0.1 N NaOH	Crude Fiber %	Firmness Lbs.
Ft. Pierce	40	5.04	5.28	1.30	2.88
	55	5.33	5.91	1.03	3.93
	70	5.24	5.81	1.08	4.06
Ruskin	40	5.01	5.67	1.00	3.13
	55	5.02	5.97	0.91	3.87
	70	5.03	5.24	0.97	4.10
Marion-Sumter	40	5.49	5.91	0.86	2.94
	55	5.52	6.58	0.81	3.54
	70	5.42	5.84	0.87	3.46
Temperature Average	40	5.18	5.62	1.05	2.98
	55	5.29	6.15	0.92	3.78
	70	5.23	5.63	0.97	3.87

hibited grey wall while almost none occurred in samples of other temperature treatments. A condition of stippling, uneven color development, ghostly appearance, dark seeds and decay were also accentuated by this low temperature treatment. Somewhat softer fruit also resulted from the exposure to the low preripening temperature.

These data emphasize the extreme importance of temperature in handling tomatoes. The six-day period of pre-ripening storage approximates transit time to terminal markets. The shipper must know the history of the tomatoes, their condition, and the likely results of variations in environment.

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A REPORT ON THE USE OF SYSTEMIC INSECTICIDES ON SOME VEGETABLE CROPS

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Sub-Tropical Experiment Station

Homestead

Systemic insecticides, applied to the soil, have been shown to translocate in a wide variety of plants and to be effective against several insects attacking these plants. Since this type of application does offer some advantages over foliar applications, tests have been conducted at the Sub-Tropical Experiment Station to evaluate the insect control resulting from soil applications of various systemic insecticides on potatoes and pole beans.

The first test on pole beans was put in on December 18, 1959. Plots consisted of 2 rows 3 feet apart and 25 feet in length, replicated 4 times. The McCaslan variety was used. Treatments and rates of application per acre were phorate (Thimet) 1.5, 3.0 and 4.5 lbs; Di-Syston 1.5, 3.0 and 3.4 lbs; Dimethoate, G. C. 3583, G. C. 3582, G. C. 4072 and S. D. 3562 all at 3.0 lbs. All materials were applied in the seed furrow with a Gandy applicator except one phorate treatment, the dimethoate and the S. D. 3562 treatments. These insecticides were mixed with the fertilizer and placed in a band about 4 inches to the side of the seed furrow. Granular formulations were used in all instances except for S. D. 3562 which was a 50% carbon formulation.

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Phytotoxic effects were noted in many plots as soon as the plants started to emerge. The G. C. 3583 and G. C. 3582 plots had more than 90% reduction in stand. Phorate and Di-Syston caused a distortion of the primary leaves and a stunting of the plants, being more severe in the higher dosages and in the phorate plots. No phytotoxicity was evident in the plots in which the insecticide was combined with the fertilizer. The primary leaves were examined for leaf mines on January 4, 1960. Since the population of serpentine leaf miners, *Liriomyza pusilla* (Meig.), was rather low, the results are expressed as per cent of plants infested. Forty-one per cent of the plants in the check plots were infested, 51% in the S. D. 3562 plots, 7% in the G. C. 4072 and 30% in the phorate plots in which the insecticide was combined with the fertilizer. There were not enough plants in the G. C. 3583 and G. C. 3582 plots for evaluation. The remaining plots were free from leaf mines on the primary leaves. This test was destroyed by the freeze of January 22-24, 1960.

A second planting was put in on February 11, 1960. Plot size and operational procedures were the same as in the first test. However, all insecticides were combined with the fertilizer because of phytotoxicity resulting from applying the insecticide in the seed furrow. No phytotoxic effects were noted in any of the