

JUICE CONTENT IN EARLY RUBY RED GRAPEFRUIT

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INTRODUCTION

Under the Florida Citrus Code of 1949 (2), grapefruit for either fresh fruit market or for processing must meet minimum standards for color break, total soluble solids, and ratio of soluble solids to acid. It must also meet minimum juice requirements for each commercial size of grapefruit. The juice content in naturally maturing Ruby Red grapefruit is generally attained before the passing ratio of Brix to acid. However, fruit from trees receiving lead arsenate spray usually meets the proper ratio standard at an earlier date, often considerably before a passing juice volume is attained.

The new law (3) — passed by the Florida Legislature in 1955 and now in effect — raised juice requirements by approximately 10 percent for the August 1 to October 15 period, and approximately 5 percent for the October 16 to November 15 interval. From November 16 through July 31 of each season, the juice standards of the Citrus Code of 1949 remain in effect. These new higher juice requirements will tend to delay still further the early harvest of Ruby Red grapefruit. At the same time, this delay will lead to better quality fruit being marketed, especially in the early season.

Several factors influence juiciness of grapefruit. Normally, juice content becomes greater as the season advances, being low in unripe fruit early in the season and high in the mature fruit (1). The most rapid changes occur in August and September (4). High rainfall (6) and irrigation (7) tend to increase juiciness, and such factors account for variations in juice volume from year to year. Still other factors affecting juice content are: location, variety, time of bloom, size, shape of the fruit,

and some cultural deficiencies, such as a lack of iron (8).

Spraying grapefruit with lead arsenate in amounts of 0.4 to 1.6 pounds to 100 gallons of spray material to promote early legal maturity is a common practice in Florida. The effect of the spray is to reduce the acid content, thus increasing the solids to acid ratio and making the fruit more palatable. This increase in the ratio is not pronounced early in the season, but is very marked in the ripe fruit late in the season.

The aim of this paper is to provide information on the dates that red grapefruit, produced under various conditions, will meet legal maturity requirements early in the season. Particular emphasis has been placed on juice content in view of the new regulations in effect today. The information is based on a maturity study of early red grapefruit during the past five seasons.

EXPERIMENTAL

Lead-arsenate-spray experiments have been conducted since 1951 on young Ruby Red grapefruit trees on sour orange rootstock in a commercial grove. Plots of similar trees in two other groves were added to these experiments in 1954. Spray treatments consisted of lead arsenate ranging from 0.4 to 1.6 pounds together with 10 pounds of wettable sulfur in 100 gallons of water. Samples of fruit (size 126) were picked at regular intervals from trees in randomized triplicate plots during each season and analyzed for internal juice factors. During 1951-52, juice was expressed on a burr reamer; however, during the other seasons juice was expressed with a commercial "in-line" extractor. Total acidity and soluble solids were found in the usual manner. Juice was weighed after extraction and the content calculated as volume in cc in one fruit. The dates of attainment of legal juice content as well as the ratios on these dates were found by interpolation between the juice or ratio results during appropriate sampling periods.

RESULTS

Juice Content. — A summary of the juice content of Ruby Red grapefruit sprayed with various rates of lead arsenate during four seasons appears in Table 1. As has been shown

Table 1. Summary of Juice Content of Ruby Red Grapefruit (Size 126) Sprayed with Lead Arsenate during Four Seasons.

Season	Lead Arsenate (lb./100 gal.)					
	0	.4	.8	1.0	1.2	1.6
	cc/fruit					
1951-52	159	158	156	159	156	157
1952-53	149	145	149	155	155	146
1953-54	169	171	174	167	171	169
1954-55	160	159	160	154	157	154

in a previous report, there is apparently no significant effect of lead arsenate sprays on juice volume of red grapefruit. Seasonal changes in juice volume are shown in Table 2. Except for differences noted on the January 4 sampling date, the lead arsenate sprays did not appreciably influence the normal seasonal changes in juice content. Table 3 presents the juice content on September 21 for

Table 2. Seasonal Changes in Juice Content of Ruby Red Grapefruit (Size 126) Sprayed with Lead Arsenate during 1954-55.

Date of Sampling	Lead Arsenate (lb./100 gal.)					
	0	.4	.8	1.0	1.2	1.6
	cc/fruit					
August 23	115	111	109	106	110	110
September 28	151	157	151	152	153	154
October 24	154	156	166	157	164	153
November 29	179	180	185	181	181	170
January 4	198	190	190	176	179	182

Table 4. Summary of Time and Ratio of Passing Juice Content of Ruby Red Grapefruit (Size 126) during Five Seasons in One Grove.

New juice requirements cc/fruit	Seasons									
	1951-52		1952-53		1953-54		1954-55		1955-56	
	Date	Ratio	Date	Ratio	Date	Ratio	Date	Ratio	Date	Ratio
165 (Aug. 1-Oct. 15)	Oct. 29	8.92	Nov. 6	7.75	Oct. 8	8.27	Nov. 6	8.19	Oct. 24	8.13
160 (Oct. 16-Nov. 15)	Oct. 20	8.54	Oct. 22	7.41	Oct. 1	8.14	Oct. 28	8.12	Oct. 19	7.91
150* (after Nov. 15)	Oct. 10	8.13	Oct. 4	6.83	Sept. 21	7.92	Sept. 25	7.56	Oct. 11	7.67

*Prior to Aug. 1, 1955, this was the only juice requirement in effect for size 126.

Table 5. Summary of Time and Ratio of Passing Juice Content of Ruby Red Grapefruit (Size 126) Sprayed with Arsenic during 1954-55.

New juice requirements cc/fruit	Lead Arsenate (lb./100 gal.)							
	0		.4		.8		1.2	
	Date	Ratio	Date	Ratio	Date	Ratio	Date	Ratio
165 (Aug. 1-Oct. 15)	Nov. 9	7.36	Nov. 7	7.97	Oct. 24	8.23	Oct. 25	8.21
160 (Oct. 16-Nov. 15)	Nov. 2	7.28	Oct. 30	7.93	Oct. 14	8.09	Oct. 15	8.09
150* (after Nov. 15)	Sept. 27	6.75	Sept. 21	7.16	Sept. 27	7.83	Sept. 25	7.77

* Prior to Aug. 1, 1955, this was the only juice requirement in effect for size 126.

Table 3. Juice Content of Ruby Red Grapefruit on Sept. 21 for Five Seasons. (Size 126)

Season	Juice/Fruit
1951-52	139 cc
1952-53	139 cc
1953-54	150 cc
1954-55	144 cc
1955-56	128 cc

five seasons beginning with the 1951-52 season. Highest juice volume of 150 cc was found during 1953-54, whereas lowest juice of 128 cc was present in September of 1955.

Ratio. — The solids to acid ratios of the juice at the time the new juice requirements are attained differ among seasons. A summary of such data is presented in Table 4 and includes the average results of all treatments for each of five seasons beginning in 1951. The fruit contained the largest ratios in the juice at the three levels during the 1951-52 season. Lowest ratios were found during 1952-53.

Summary of the ratios of Brix to acid for red grapefruit juice from sprayed and unsprayed fruit at the time of passing juice requirements during 1954-55 appears in Table 5. In general, high ratios are present in the fruit at the time of passing 165 cc volume; while low ratios are found in the fruit at the time of passing 150 cc requirements. The sprayed fruit always contained higher ratios than the unsprayed fruit at the date of meeting juice requirements.

DISCUSSION

Grapefruit may not meet all the quality and maturity standards necessary for early harvest. For instance, during 1953-54 red grapefruit was delayed because of low solids although it is usually delayed because of low juice. Moreover, the strict juice requirements will delay picking by approximately three weeks, especially during August 1 through October 15. During this period, much of the red fruit did not meet the high juice requirements. Therefore, harvest was delayed until the period of lower juice standards (October 16 through November 15), at which time the fruit usually attained a sufficient juice volume.

Under the new juice regulations, the early mature red grapefruit in the fresh fruit market will be of better quality, since the fruit will have both high juice and high ratio of solids to acid. Red grapefruit will be sweeter, juicier, more palatable, and consequently, more acceptable to the consumer.

The effect of the 1949 Citrus Code was to subordinate slightly the use of arsenic sprays for early maturity of grapefruit (5). The new juice law goes still further in this respect. Actually, this is accomplished by raising the legal juice standards without increasing the ratio. In the early fruit, it is the juice content that fails to meet requirements, and not the ratio, and it is the ratio that is raised by maturity sprays, and not the juice content. For this reason lower rates of lead arsenate will be satisfactory hereafter for early maturity of red grapefruit. Previously, lead arsenate at 0.8 pound per 100 gallons was recommended for early maturity sprays. But in view of the raised juice standards, a lower rate of 0.6 pound and in some cases, 0.4 pound per 100 gallons is recommended. Fruit sprayed post-bloom with lead arsenate in these amounts will usually have a sufficiently high ratio at the time juice-passing volume is attained. Excessive amounts of lead arsenate are unnecessary, costly, and may be injurious to trees and fruit quality.

SUMMARY AND CONCLUSIONS

Juice content and ratios of total soluble solids to acid of Ruby Red grapefruit in the early fruit season have been studied in one grove during 1951-55, and in two other groves in 1954-55. Young trees on sour orange root-

stock have been sprayed post-bloom with differential amounts of lead arsenate (0.4-1.6 lb. per 100 gal.). Fruit (size 126) was collected at regular intervals during each season and analyses made for total soluble solids, total acidity and juice volume.

Juice increased with maturity, and also varied with seasons. Juice content was not influenced significantly by lead arsenate sprays; that is, the amount of juice in the sprayed or unsprayed fruit on a given date was similar. However, at the time of passing legal ratios, juice content was generally highest in the naturally maturing fruit, as this fruit was usually late in meeting the ratio standard. Fruit sprayed with lead arsenate reached a passing legal ratio at a much earlier date, and consequently had less juice volume at this time.

Increasing juice standards delayed maturity of Ruby Red grapefruit by approximately three weeks. Much of this fruit did not acquire the high juice standards necessary during August 1 through October 15. However, all fruit did attain its legal juice volume during the period from October 16 through November 15. Delaying harvest by maintaining a high juice standard tended to increase the ratio and improve the quality of the grapefruit marketed early in the season.

In the early harvest of red grapefruit, juice and not ratio is the limiting factor. For this reason a lower rate of 0.6 pound per 100 gallons of lead arsenate for early maturity is recommended.

LITERATURE CITED

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