

## COMPOSITIONAL AND ORGANOLEPTICAL DIFFERENCES BETWEEN CELERY GROWN IN FLORIDA AND CALIFORNIA

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The Florida celery industry has shown considerable interest recently in the comparison of the quality of celery grown in Florida and California because in some markets California celery has sold at a premium over Florida celery. The reasons given by the buyers for the lower prices for the Florida product are not unanimous but include poor appearance, bitter flavor, and toughness.

Little work has been reported on the composition of celery and none on varietal comparisons between production areas. Hall (2) has summarized the more important work and reports the variation in composition of the stalk. Geraldson (1) has reported that celery grown in solutions with a high potassium content has a strong flavor. Increasing the sodium content and decreasing the potassium lessened the strong celery flavor.

The work was directed toward determining the differences between celery grown in Florida and California in constituents that might be related to quality. Constituents determined were dry weight, chlorophyll, alcohol-insoluble solids, crude fiber, reducing sugar, sucrose, potassium, sodium, and total nitrogen. Organoleptic evaluations were made by a taste panel on flavor, bitterness, toughness, and fibrousness.

Samples of celery from the two production areas were compared in April and again in May of 1957. Each harvest date is considered separately since a different number of varieties were compared at each date and a different method of organoleptic evaluation used.

### METHODS

**A. April Harvest:** The varieties from California, 52-70 and Short-Top, were harvested April 15, shipped April 16 (air express), and arrived the afternoon of April 17. The samples, consisting of 12 stalks of each variety, were wetted and stored overnight at 40°F. The

varieties from Florida, 52-70 and 259-19, were harvested at Belle Glade on April 16, and placed in 40°F. storage at Gainesville that evening. Four replications chosen at random from each variety were sampled April 18. Outer and inner petioles were sampled separately.

Only the portion of the petioles from just above the winged basal portion to the first node was used. Petioles were washed, dried, diced finely and well mixed before sub-sampling.

The taste panel consisted of six members. Samples were rated one replication at a time on the basis of one to ten. The larger the value the better the flavor or the more bitter, tough, or fibrous the sample.

**B. May Harvest:** The varieties from California, 52-70 and Slo-Bolt No. 12, were harvested and shipped on May 15. Upon arrival May 16 the samples, consisting of 12 stalks of each variety, were wetted and placed at 40°F.

The Florida celery (varieties 52-70, 259-19, and 148C) was harvested May 17 at Plymouth and stored at 40°F. at Gainesville.

The celery was judged for organoleptic characteristics by 12 persons and for appearance by 19 persons May 20. Samples were taken for chemical composition May 21, as outlined for the April harvest. Three replications were chosen at random for each variety.

The system used for organoleptic judging differed from that used in April in that a ranking system was used. The taste panel ranked the varieties on a basis of one to five with one being the most preferred and five the least.

### RESULTS

**A. April Harvest:** Only the 52-70 variety from each location are compared, since it is not possible to be sure that the values for the other varieties were due to location or variety although all varieties are included in the tables.

The inner petioles of 52-70, grown in Florida, contained less dry weight, reducing sugar, sucrose, sodium, and total nitrogen but more potassium than the same variety grown in California (Table 1). There was no difference

**TABLE 1 - The content of certain constituents of inner and outer petioles of celery grown in Florida and California. Sampled April 18, 1957.**

Variety	State	Dry Wt. %	Chloro- phyll (mg/100g)	AIS (% F.W.)	Crude Fiber (% D.W.)	Reducing sugar (% F.W.)	Sucrose (% F.W.)	Potassium (mg/100g)	Sodium (mg/100g)	Total Nitrogen (% D.W.)
<b>INNER PETIOLES</b>										
52-70	Cal.	3.44	1.61	1.47	13.8	0.88	1.11	199	223	1.54
52-70	Fla.	2.94	1.65	1.49	15.8	0.54	0.74	317	151	1.11
259-19	Fla.	3.26	1.75	1.64	16.2	0.64	0.78	256	176	1.28
Short-Top	Cal.	3.42	1.75	1.55	14.2	0.87	1.22	193	226	1.81
L.S.D.	0.05	0.37	N.S.	0.10	N.S.	0.08	0.20	23	13	0.29
	0.01	N.S.		0.12		0.11	0.28	32	19	0.41
<b>OUTER PETIOLES</b>										
52-70	Cal.	3.43	2.43	1.58	15.0	0.50	0.62	232	252	1.25
52-70	Fla.	3.28	1.97	1.60	15.9	0.44	0.52	308	165	0.97
259-19	Fla.	3.69	1.89	1.76	15.6	0.57	0.85	256	187	1.02
Short-Top	Cal.	3.77	3.11	1.66	13.8	0.79	1.02	196	253	1.51
L.S.D.	0.05	0.30	0.55	0.09	N.S.	0.10	0.32	31	13	0.20
	0.01	N.S.	0.77	0.12		0.13	N.S.	44	18	0.28

in the chlorophyll, alcohol-insoluble solids (AIS), and crude fiber contents.

The outer petioles of 52-70 from Florida were higher in potassium but lower in sodium and total nitrogen than the California sample. There was no difference in the dry weight, chlorophyll, AIS, crude fiber, or sugar contents of the samples from the two locations.

The inner petioles of both varieties grown in Florida contained less sugars, sodium, and total nitrogen but more potassium than the varieties grown in California.

The taste panel judged the inner petioles

of the Florida-grown 52-70 to be of better flavor but more fibrous and tough than the California-grown sample (Table 2). The two samples did not differ in bitterness.

The outer petioles of the two samples did not differ in bitterness, toughness, or fibrousness. The sample from Florida was judged to be of better flavor than the sample from California.

**B. May Harvest:** The inner petioles of 52-70 grown in Florida contained more dry weight, chlorophyll, AIS, and potassium but less reducing sugar, sucrose, and sodium than that

**TABLE 2 - The organoleptic ratings\* of the inner and outer petioles of celery grown in Florida and California. Sampled April 18, 1957.**

Variety	State	Flavor	Bitterness	Toughness	Fibrousness
<b>INNER PETIOLES</b>					
52-70	Cal.	3.7	2.7	2.4	2.7
52-70	Fla.	4.5	2.4	3.1	3.1
259-19	Fla.	5.0	2.6	3.2	3.1
Short-Top	Cal.	2.9	3.7	2.5	3.0
L.S.D.	0.05	0.7	N.S.	0.3	0.3
	0.01	1.0		0.5	N.S.
<b>OUTER PETIOLES</b>					
52-70	Cal.	2.2	6.0	4.0	4.9
52-70	Fla.	3.7	5.2	4.4	4.6
259-19	Fla.	3.8	4.6	4.8	5.0
Short-Top	Cal.	1.6	6.1	4.3	4.6
L.S.D.	0.05	1.1	N.S.	0.6	N.S.
	0.01	1.5			

\*Rated on a basis of 1 to 10. The larger the value the better the flavor or the more bitter, though or fibrous the sample. Six persons were on the taste panel.

TABLE 3 - The contents of certain constituents of inner and outer petioles of celery grown in Florida and California. Sampled May 21, 1957.

Variety	State	Dry Wt. (%)	Chlorophyll (mg/100g)	AIS (% F.W.)	Fiber (% D.W.)	Reducing Sugar (% F.W.)	Sucrose (% F.W.)	Potassium (me/100g)	Sodium (me/100g)	Total Nitrogen (% D.W.)
INNER PETIOLES										
52-70	Cal.	3.71	1.20	1.48	13.9	0.75	1.23	266	133	1.67
52-70	Fla.	4.34	1.83	1.91	14.4	0.60	0.75	289	116	1.60
259-19	Fla.	4.14	1.80	2.18	16.5	0.80	0.99	284	121	1.72
148 C	Fla.	4.12	1.31	1.84	15.1	0.66	0.80	284	126	1.80
Slo-Bolt	Cal.	4.13	1.52	1.74	13.9	0.92	1.45	226	144	1.56
L. S. D.	0.05	0.31	0.40	0.29	1.6	0.11	0.33	18	11	N.S.
	0.01	N.S.	N.S.	0.41	N.S.	0.15	0.46	26	16	
OUTER PETIOLES										
52-70	Cal.	3.66	1.55	1.64	16.4	0.68	1.09	280	151	1.60
52-70	Fla.	4.71	2.23	2.07	14.4	0.49	0.65	280	127	1.18
259-19	Fla.	5.08	2.09	2.20	15.0	0.64	1.25	251	124	1.27
148 C	Fla.	4.44	1.52	2.01	15.1	0.50	0.66	294	133	1.54
Slo-Bolt	Cal.	4.23	1.50	1.73	15.4	0.72	1.06	246	158	1.57
L. S. C.	0.05	0.40	0.33	0.23	N.S.	0.04	0.39	25	13	0.16
	0.01	0.58	0.54	0.32		0.05	N.S.	36	18	0.22

from California (Table 3). There was no difference in the crude fiber and total nitrogen contents of the two samples.

The outer petioles followed the same pattern as the inner except that there was no difference in potassium content and the California-grown 52-70 had a higher total nitrogen content.

The taste panel rankings indicated that the California-grown 52-70 had better flavor, less bitterness, and better appearance but was tougher and more fibrous than the 52-70 grown in Florida (Table 4).

Representative stalks of each variety are shown in Fig. 1. Bleaching of the foliage of 52-70 from California can be noted in the photograph which was taken two weeks after harvest. The stalks of the varieties from California were more compact with wider petioles.

#### DISCUSSION

The only consistent differences between constituents of 52-70 grown in the two areas

were those of potassium, sodium, and sugars. In general, Florida-grown 52-70 had a higher potassium content and lower sodium and sugar content than the California-grown variety.

Comments by the taste panel at the April sampling were that the California-grown 52-70

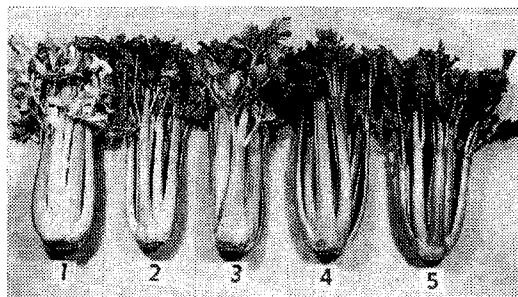


Fig. 1. Typical stalks of 1. 52-70 (Cal.) 2. 52-70 (Fla.) 3. Slo-Bolt No. 12 (Cal.) 4. 148 C (Fla.) 5. 259-19 (Fla.)

lacked celery flavor and was tasteless and bland. These comments coincide with Gerald-

TABLE 4 - Organoleptic rankings\* for inner petioles of celery produced in Florida and California. Sampled May 20, 1957.

Variety	State	Flavor	Bitter-ness	Tough-ness	Fibrous-ness	Appear-ance	Prefer-ence
52-70	Cal.	3	3	5	5	2	3
52-70	Fla.	5	5	2	3	3	4
259-19	Fla.	4	4	4	1	5	5
148 C	Fla.	1	2	1	3	1	1
Slo-Bolt	Cal.	2	1	3	2	4	2

\*Ranked on a basis of 1 to 5 with 1 being most preferred and 5 least. Twelve persons made the rankings except for appearance where 19 persons were used.

son's observations of the effects of potassium and sodium on flavor. A comparison of the ratio of potassium to sodium on a milliequivalent basis shows that the inner and outer petioles of the California-grown variety had ratios of 0.89 and 0.92 respectively, while the same ratios for Florida-grown 52-70 were 2.10 and 1.87. A low potassium-sodium ratio was associated with a bland flavor.

In the May sampling the potassium-sodium ratios did not differ markedly, 2.00 and 1.85 for inner and outer petioles of the 52-70 from California and 2.20 and 2.49 for inner and outer petioles of the Florida-grown 52-70. The preference for the flavor of the California-grown 52-70 at this sampling may be due to the higher (about 66%) sucrose content of this sample as compared to the Florida-grown sample. Sugar content appears to be an important part of the total flavor if the other flavor constituents are somewhat equal.

#### SUMMARY

Celery air-expressed from California was compared with freshly harvested Florida celery in April and May of 1957. The samples were rated organoleptically and analyzed chemically for several constituents. Four varieties were

studied in April and five in May but only 52-70 was grown in both locations.

In general, Florida-grown 52-70 had a higher potassium content and lower sodium, nitrogen, and sugar contents than the California-grown variety. The two samples did not differ in fiber content. There was no consistent difference between the samples in dry weight, chlorophyll, or alcohol-insoluble solids.

The Florida-grown 52-70 was considered of better flavor at the April sampling and the California sample better in May. The potassium-sodium ratio (milliequivalents) appeared to be associated with intensity of celery flavor.

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## EFFECTS OF SPACING BETWEEN ROWS AND BETWEEN PLANTS ON GROWTH AND YIELD OF THREE CELERY VARIETIES

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Celery grown in the Everglades area in recent years has been usually grown in either 24- or 28-inch rows and plants spaced 5 to 7 inches in the rows. Recent changes in celery types from strictly summer pascal types to Utah 52-70 and Emerald with their more upright and compact growth habits have resulted in a need for consideration of cultural practices in this area that make for the best yield and type in these two new celery varieties.

The literature furnishes little information on spacing studies with celery, although many spacing studies have been done with other crops. Ruprecht and Westgate (2) reported that total yields of Celery were not affected by plant spacing at 4.5 and 6 inches in the row, although plant size was greater at wider spac-

ings. Wittwer et al. (3) found that increasing plant spacings with Utah 15 and Cornell 19 varieties from 6 to 9 inches in 36-inch rows greatly decreased yields and increased culls. Davis (1) noted that with plant spacings of 4, 6, 8, and 10 inches in 32-inch rows at two fertility levels, plant size increased as spacing increased. Plant size at all spacings increased from the lowest to highest fertility rate.

#### MATERIALS AND METHODS

Two experiments were conducted on Everglades peat soil, one grown largely under fall conditions of 1957, conducted at the Everglades Experiment Station, the other grown under winter 1958-59 conditions conducted on the farm of a grower-cooperator.

Seed for the first experiment were sown on the seedbeds of a grower-cooperator July 7, 1957. Plants were brought to the Experiment Station and set in the field September 26 and 27, 1957. The test was harvested December

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