In summary, the 4 yellow, Everlasting Heritage sweet corns examined appear to have good germination rates and seedling vigor. 'Tendertreat' contains high levels of total sugars, especially at latter stages of development. A comparison of 'Tendertreat' with 'Silver Queen', a variety known to have higher levels of sugar in comparison to other *sugary*-containing sweet corns (5), showed that 'Tendertreat' contained an average of 27% more sucrose during the latter stages of kernel development. Furthermore, 'Tendertreat' is about equal to 'Silver Queen' in WSP content. Although final stand of 'Tendertreat' was almost 2 times that of 'Florida Sweet', the level of sucrose was less than half that found in 'Florida Sweet' at 22 days post-pollination, the stage of normal market maturity.

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CHARACTERISTICS OF ROOT SYSTEMS ASSOCIATED WITH DIRECT-SEEDED AND TRANSPLANTED WATERMELONS[1]

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Additional index words. Citrullus lanatus, irrigation, fertilizer.

Abstract. **Field trials with direct-seeded and transplanted watermelons were conducted on Apopka sand in 1971 and 1972 at the Agricultural Research Center, Leesburg. Direct-seeded watermelons normally have a dominant tap root while transplants have a shallow, branched root system. In order to study the effect of root type and exclude the indirect effects of transplanting and direct seeding, transplants with a tap-root system were compared with transplants having a shallow, branched rooting habit. Direct-seeded plants with a normal single main root were compared with direct-seeded plants with roots that were induced to branch. As surface soil moisture decreased, plants with the shallow, branched root system were affected by moisture stress before plants with a tap root. Neither root type exhibited differences in the efficiency of nutrient absorption. It was concluded that transplants require more frequent irrigation than direct-seeded plants but fertilizer requirements are similar.**

Watermelon, *Citrullus lanatus* (Thunb.) Matsum & Nakai, and muskmelon, *Cucumis melo* L., yields are earlier and usually higher from transplants than from direct-seeded plants (4, 6, 7, 8). Peterson (7) found that transplanting watermelons could be expected to increase early yields over direct seeding unless plants were left too long in the hotbed (30 days or longer) or adverse weather conditions occurred shortly after transplanting.

Direct-seeded watermelons are deep rooted and characterized by a dominant tap root that exhibits positive geotropism. Secondary or lateral roots are generally plagiotropic (geotropically insensitive). Transplanting alters the root system (2, 3, 4, 7) and a shallow, branched root system that lacks a dominant tap root develops. The geotropic growth of the tap root ceases when the developing root reaches the bottom of the container prior to transplanting and geotropic growth of the tap root does not resume upon transplanting.

Relatively shallow root systems are adequate if proper environmental conditions are provided. However, distribution and character of the root system become more important when soil moisture and nutrient conditions are not optimum (1, 5). Plants that lack a dominant tap root may be subject to moisture stress under droughty conditions sooner than those with a well-developed tap root. With adequate irrigation, the lack of a tap root may not be a factor in preventing water stress. In fact, when soil moisture is adequate, water and nutrient uptake might even be greater with a shallow, branched root system than with the tap-root system. The studies reported in this paper were conducted to determine the effect of soil nutrient and moisture levels on yield and leaf tissue composition of watermelon plants with a single main root and of plants with a shallow, branched root system.

Materials and Methods

Experiments were conducted on Apopka sand in 1971 and 1972 at the Agricultural Research Center, Leesburg. Transplants with a tap-root system were compared with transplants having a shallow, branched rooting habit. Direct-seeded plants with a normal, single main root were compared with direct-seeded plants with roots that were induced to branch. For transplants, 'Smokylee' and 'Charleston Gray' watermelon seeds were planted in peat pots (Jiffy 7) which measured approximately 1.8 inches in diameter and 1.5 inches in depth or in wax-coated paper cylinders which were 3.2 inches in diameter and 6.5 inches deep. The cylinders were filled with a sterilized 1:1 sand/peat mixture. Seedlings were grown in the greenhouse for 12 (1972) or 13 (1971) days. For the direct-seeded treatments seed were placed in peat pots which were immediately placed in the field. To assure development of a normal, tap root system, the bottom netting of the peat pots was removed from half of the direct-seeded plants. To induce branching of the other half of the direct-seeded plants, a 2-inch diameter styrofoam disc was placed directly beneath and in contact with the peat pots. Transplants and direct-seeded peat pots were placed in the field on February 23, 1971, and on February 29, 1972. Hills were spaced 4 ft

[1]Florida Agricultural Experiment Stations Journal Series No. 246.

apart in rows 10 ft apart. All treatments were arranged in a randomized complete block design and replicated 3 or 4 times in 20x24 ft plots.

Low soil-moisture trials. To study the influence of low soil moisture on yield from plants with different rooting habits, no irrigation water was applied in these trials during the 1971 and 1972 growing season. In both years the initial fertilizer application was 1,080 lb 1-15-0 (N-P_2O_5-K_2O)/acre placed in a 10-inch band 8 to 10 inches below the center of the bed surface plus 328 lb 15-0-14/acre broadcast over the 40-inch wide bed area and incorporated prior to bedding. Supplemental fertilizer was applied at emergence (100 lb 15-0-14/acre) and at layby (350 lb 15-0-14/acre). In 1971 the first harvest, June 23, was designated as early yield. The second and final harvest was on July 9. In 1972 mature fruit were harvested on June 5, 12, and 22 with the first 2 harvests designated as early yield.

Fertility trials. Various levels of fertilizer were applied in 1971 and 1972 to evaluate the efficiency of the different root systems in removing soil nutrients.

1971			1972		
N	P_2O_5	K_2O	N	P_2O_5	K_2O
		lb/acre			
60	80	55	60	60	60
120	160	110	180	180	180
240	320	220	—	—	—

In these trials adequate soil moisture was maintained with overhead irrigation. All the P (regular superphosphate) and half the N and K (ammonium nitrate and nitrate of potash) were applied over the 40-inch bed area just prior to bedding. The remaining half of the fertilizer was applied at layby. Tissue samples that contained 18 to 20 of the youngest, fully mature leaves were taken for nutrient analysis April 26 and June 1 in 1971 and on April 17 and May 31 in 1972. Mature fruit were harvested June 15 and July 6 in 1971 and June 6 and 12 in 1972.

Results and Discussion

A late frost in 1971 killed the transplants so that only data from the direct-seeded plants were obtained. The styrofoam disc directly beneath the direct-seeded plants interrupted growth of the tap root and induced branching and horizontal growth of secondary roots. Vertical root growth did not resume even after the roots had grown beyond the styrofoam disc. Plants grown without the styrofoam disc beneath the peat pot had a tap root with an average length of 8.2 inches and those grown with the styrofoam disc had a tap root with an average lenth of 3.3 inches. The mature root system of direct-seeded plants grown with the disc obstruction appeared very much like that of systems characteristic of transplanted watermelons (3). In 1972, plants grown in the greenhouse in the 6.5 inch deep cylinders prior to transplanting had tap roots longer than those of the peat-pot transplants but shorter than those of direct-seeded plants which had unobstructed root development. The tap root from the germinating seed grows rapidly and is several inches long before seedling emergence. The main root had reached the bottom of the long cylinder prior to transplanting; therefore, in order to obtain a transplant with a normal tap root a longer cylinder should be used. Plants should probably be set in the field within 10 days of seeding.

Low soil-moisture trials. Rainfall between planting and the first harvest in 1971 was 11.4 inches. However, between April 5 and May 11 there was only 0.2 inch of rainfall. Periods between rains were of long enough duration that the soil dried to a depth of several inches. Growth of all plants was reduced by the lack of moisture, but plants with tap roots were noticeably larger than those without the tap roots.

Early yield from plants grown with no supplemental irrigation in 1971 was higher from plants with the well-developed tap root than from those with the shallow, branched rooting habit (Table 1). The importance of tap root in water absorption increases as the depth from which the plant must obtain water increases. Differences in total yield in 1971 were not significant. Rainfall between the first and last harvest in 1971 was 3.5 inches and was adequate to supply sufficient moisture for all treatments including the shallow-rooted plants.

Rainfall in 1972 for March through May, 10.8 inches, was slightly less than in 1971 but was more evenly distributed. Watermelons in nearby fields were irrigated only twice in 1972, May 2 and June 9. Although the differences in yield were not significant, direct-seeded plants with a tap root had a higher early yield than direct-seeded plants with a branched root system (Table 1). Damping-off of many of the transplants shortly after being set in the field resulted in a lower early and total yields from the transplants than from direct-seeded plants. As in 1971, the differences in total yield due to root system were not significant.

Table 1. Effect of planting method and rooting habit on yield of non-irrigated watermelons.

Planting method[z]		Root habit[y]	Yield (tons/acre) Early	Total
1971				
DS		Tap root	10.6	14.4
DS		Branched	7.1	11.8
	F value[x]		*	N.S.
1972				
DS		Tap root	8.2	13.1
DS		Branched	7.5	13.3
T		Tap root	5.0	11.4
T		Branched	6.6	9.3
	F value[x]		N.S.	N.S.

[z]Plants were direct seeded (DS) or transplanted (T).
[y]For branched root habit on direct seeded plants, a disc was placed beneath a peat pot at time of seeding in the field. Tap roots were maintained on transplants by growing seedlings in 6.5-inch deep cylinders.
[x]F values were not significant (N.S.) or significant at the 5% level (*).

Fertility trials. If plants with shallow, branched root systems were more efficient in nutrient utilization than plants with a tap-root system, yield differences might be apparent at low soil nutrient levels. In 1971 at the low fertility level, yield was only slightly higher from plants with the branched root system than from those with the tap-root system (Table 2). Again in 1972 yield differences were not significant. There was no evidence the branched system was more efficient than the tap-root system. In fact, comparing plants with the same planting method grown at the same fertility level but which differed in rooting habit, the tap-rooted plants had a higher yield than the shallow-rooted plants.

Concentrations of N, P, and K in the plant tissue gave no indication of differences in nutrient absorption by the two root types (Table 2). Comparison of leaf tissue composition did not indicate that the branched root system was more efficient in nutrient absorption than the tap-root system (Table 3). However, since differences between fertility levels were small (Table 2), it is possible that even the lowest fertility level was too high to detect differences in tissue composition.

Table 2. Influence of planting method, root habit, and fertility level on total yield and leaf tissue composition in June of irrigated watermelons.

Planting method[z]	Root type[y]	$N-P_2O_5-K_2O$ (lb/acre)	Yield (tons/acre)	Tissue composition (%) N	K	P
1971						
DS	Tap root	60-80-55	26.2	4.2	1.6	0.26
DS	Branched	60-80-55	28.7	4.2	1.5	0.23
DS	Tap root	120-160-110	32.8	4.4	1.7	0.24
DS	Branched	120-160-110	28.5	4.5	1.6	0.24
DS	Tap root	240-320-220	32.8	4.8	2.2	0.28
DS	Branched	240-320-220	30.2	4.5	1.5	0.25
F value[x]			N.S.	*	N.S.	N.S.
1972						
DS	Tap root	60-60-60	15.4	—	2.0	0.34
DS	Branched	60-60-60	10.3	—	2.1	0.37
T	Tap root	60-60-60	15.9	—	1.9	0.34
T	Branched	60-60-60	15.5	—	2.4	0.36
DS	Tap root	180-180-180	19.7	—	2.1	0.38
DS	Branched	180-180-180	19.0	—	2.0	0.37
T	Tap root	180-180-180	17.8	—	2.2	0.49
T	Branched	180-180-180	15.8	—	2.0	0.36
F value[x]			N.S.		N.S.	N.S.

[z]Plants were direct seeded (DS) or transplanted (T).
[y]For branched root habit on direct seeded plants, a disc was placed beneath a peat pot at time of seeding in the field. Tap roots were maintained on transplants by growing seedlings in 6.5-inch deep cylinders.
[x]F values were not significant (N.S.) or significant at the 5% level (*).

Table 3. Effect of rooting habit on leaf tissue composition of irrigated watermelons.

Root type[z]	Tissue composition (%)[y] N	P	K	Ca	Mg
April, 1971					
Tap root	5.7	0.36	2.7	1.05	0.60
Branched	5.7	0.33	2.8	1.12	0.58
June, 1971					
Tap root	4.5	0.26	1.7	0.82	0.49
Branched	4.4	0.24	1.5	0.91	0.46
April, 1972					
Tap root	—	0.58	2.7	0.72	0.32
branched	—	0.58	2.6	0.81	0.33
June, 1972					
Tap root	—	0.39	2.1	1.29	0.40
Branched	—	0.37	2.1	1.27	0.39

[z]Tap root includes transplants grown in 6.5 inch deep cylinders and direct-seeded plants with no disc. Branched roots include transplants grown in peat pots and direct-seed plants with the disc obstruction.
[y]No F values were significant.

Placement of the styrofoam disc in direct contact with the peat pot induced a rooting habit in direct-seeded watermelons that was quite similar in appearance to the root system characteristic of transplants. For normal tap root development, transplants need to be produced in containers deeper than those utilized in this study which were 6.5 inches in depth. Growth of watermelons under conditions of moisture stress indicated that the normal, tap-root system of direct-seeded plants is more effective in water absorption than the shallow, branched system. Therefore, when transplants are ultilized, more frequent irrigation is desirable. No differences were observed in the efficiency of either root system in nutrient absorption. Thus fertilizer recommendations need not be altered when growing transplants.

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