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Soil Preparation Effects on Compaction, Carrot Yield, and Root Characteristics in Organic Soil[1]

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Abstract. **Rolling organic soil after plowing and drag disking resulted in significantly lower marketable yields, more forks (branching) and less stubbed (premature blunting resulting in an unmarketable root) carrots (*Daucus carota* L.) than not rolling. Using a rotary tiller before bedding had no significant effect on yield or other characteristics measured. Bed making with a tilrovator or bed shaper did not significantly affect yield, root length, number of forked, crooked or split carrot roots. Compaction, as measured with a penetrometer, did not have a linear relationship between the eight tillage treatments used in preparing beds and any of the root characteristics measured such as yield, length or number of misshapen roots.**

The most desirable type of carrot root for fresh market is uniform, smooth, slender, and long tapering (7). The tapering should be appropriate to the carrot type. Considerable variation in shape and size is found in carrot roots. A number of environmental conditions have been shown to have a marked influence on the shape and size of carrot roots (1, 6). Cultural practices such as nutrition (1, 2, 6), soil structure as affected by land preparation and tillage (3, 6, 11), length of growing season (1, 4, 9), and plant density (2, 8, 9, 10) affect the size and shape of carrot roots. Plant refuse in the soil, injury to the young root, or any impediment to its downward growth causes branching or forking (6). Chipman (4) found lengthening the growing season resulted in poor root shape with more cracking, but with no increase in forking. DeLeenheer (5), found the number of forked sugar beets was usually not correlated with the number of plants per hectare. His results suggested root forking to be associated with a compact soil condition.

A general practice on Florida muck land is to use large, heavy drum rollers following a turn plowing and drag disking operation to firm the loose muck. An alternate land preparation technique is to use large power driven rotary tillers followed by rollers to firm the muck. If rollers were not used, the freshly plowed or rotary tilled muck would be too loose for planting.

The purpose of this study was to determine the influence of soil compaction resulting from various land preparation practices on the marketable yield, root length, and forking of carrot roots.

Methods and Materials

An Everglades mucky peat soil averaging about 61 cm in depth was prepared by turn plowing and then working with a disk harrow. The eight tillage treatment combinations used were: 1-rolled (R), rotary tilled (T), tilrovator beds (B); 2-rolled (R), rotary tilled (T), bed shaper beds (b); 3-rolled (R), not rotary tilled (t), tilrovator beds (B); 4-rolled (R), not rotary

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tilled (t), bed shaper beds (b); 5-not rolled (r), rotary tilled (T), tilrovator beds (B); 6-not rolled (r), rotary tilled (T), bed shaper beds (b); 7-not rolled (r), not rotary tilled (t), tilrovate beds (B); and 8-not rolled (r), not rotary tilled (t), bed shaper beds (b). Beds were 51 cm across the top and 91 cm apart. Two rows of carrots were planted on each bed. A spring and fall planting of 'Hicolor 9' and 'Dominator' carrot were made in 1975. The fall crop was harvested in 1976. Three weeks after emergence, plants were hand thinned to 7 to 8 plants per 30 cm of row length. Each main plot was 4 beds wide (2 for each cultivar), and 36.6 m long. Sub-plots were 2 beds (1.8 m) wide and 9.1 m long. Four replications were used in the split plot design.

A penetrometer (Model CL-700, Soil Test, Inc.) was used 30 days after planting to measure soil compaction in 2.5 cm increments to a depth of 30 cm.

The carrots were graded according to the suggested standards by the USDA (7). U.S. Fancy and U.S. NO. 1 were combined and called marketable. Carrots less than 1.9 cm in diam or more than 3.8 cm, or with a length less than 12.7 cm were considered culls. Defective roots such as forks, stubs, crooks, and splits were separated from the culls after weighing and counted, but not re-weighed.

Table 2. Effect of 3 land preparation practices on marketable yield and root characteristics for 'Hicolor 9' and 'Dominator' carrot grown on organic soil at Zellwood, Florida, in 1975 and 1976.

Treatment	Yield ($kg/16.7 m^2$) marketable	culls	Root length (cm)	Avg no./16.7 m^2 Forks	Stubs	Crooks	Splits
Rolled	61.8	17.6	18.0	41	30	108	16
Not rolled	71.3	18.9	18.8	26	50	70	22
Significance	*	NS	NS	*	*	NS	NS
Rotary tilled	67.8	15.1	18.7	26	40	87	21
Not tilled	65.3	21.4	18.0	41	40	91	17
Significance	NS	NS	NS	NS	NS	NS	NS
Tilrovator bed	70.5	17.7	18.3	31	55	100	21
Bed shaper	62.6	18.8	18.4	36	25	78	17
Significance	NS	NS	NS	NS	*	NS	NS
Hicolor 9	68.8	18.2	19.3	29	35	78	28
Dominator	64.3	18.2	17.7	38	45	100	10
Significance	NS	NS	*	NS	NS	NS	NS

NSNot significant.

*Significant at 5% level.

Results and Discussion

The 1975 spring planting had a lower yield and higher number of culls than the 1975 fall planting. A 6.4 cm rain one week before harvest and higher growing temperatures may have contributed to the lower spring planting yield. More rotten roots were noted in the spring planting, but very few in the fall planting. The rotten roots accounted for most of the yield difference. The treatment results for yield and root length followed a similar trend in both plantings and for both cultivars. 'Hicolor 9' produced slightly higher marketable yields in both the spring and fall plantings. Because the data obtained was similar for both plantings and cultivars, the average for both are summarized in Table 1. Treatments RTB and RTb were significantly lower in marketable yield than rTB, rtB, and rtb. The rTB treatment had the longest average root length at 19.7 cm while RTB had the shortest average root length at 17.1 cm. Not rolling the land resulted in significantly higher yields, less forks (branching), and more stubs (blunted carrot roots too short to be marketable) than rolling the land (Table 2). Rotary tilling had no significant effect on yield or any characteristic measured. Making beds with a tilrovator or a bed shaper did not significantly affect marketable yield, root length, forks, crooks or splits (Table 2). Tilrovator made beds had significantly more stubs than bed shaper made beds. 'Hicolor 9' had a significantly longer average root than 'Dominator', but yield and other measured characteristics were not significantly different. The longer root length for 'Hicolor 9' was expected and was in the range found in previous cultivar evaluations. These 2 cultivars were selected to determine if a general response of just a cultivar response to the treatments were observed.

Correlation coefficients were not significant for penetrometer values at the 10 cm depth when a linear regression was tested on marketable yield, average root length or the number of misshapen roots (Table 3). There was a significant r value for the depth at which the penetrometer value exceeded 4.5 kg/cm^2 unconfined strength and marketable yield (Table 3). These data suggest that there is no linear relationship between the compaction caused by the 8 treatments used in preparing beds and carrot root length compaction and the number of misshapen roots (forks, stubs, crooks, and splits). There was a linear relationship between the depth of compaction value of 4.5 kg/cm^2 and marketable yield (Table 3). The 4.5 kg/cm^2 value was selected because considerable pressure was required to obtain higher readings with the penetrometer and there seemed to be a visible difference in the compaction of the soil between 4.5 and higher readings. Less compact beds (those in which the 4.5 kg/cm^2 value was obtained at a greater depth from the top of the bed) had significantly higher marketable yields, but no significant effect on root length, number of forks, stubs, crooks, or splits. Rolling was the only tillage practice used which contributed to compaction.

Table 1. Average marketable yield and root characteristics for 'Hicolor 9' and 'Dominator' carrot grown on organic soil under 3 land preparation practices at Zellwood, Florida, 1975 and 1976.

Treatment[z]	kg/16.7 m^2 marketable	culls	avg marketable root length (cm)	Root no./16.7 m^2 Forks	Stubs	Crooks	Splits
RTB	60.4 b[y]	21.4 ab	17.1 c	22 c	43 bc	118 a	18 a
RTb	58.5 b	20.1 b	18.9 ab	53 a	14 d	105 a	13 a
RtB	65.2 ab	20.4 b	18.2 bc	54 a	37 cd	106 a	19 a
Rtb	63.0 ab	18.7 bc	17.6 c	46 ab	25 cd	92 ab	12 a
rTB	71.4 a	14.0 d	19.7 a	11 c	66 ab	40 cd	21 a
rTb	68.6 ab	15.3 cd	19.1 ab	19 c	36 cd	72 bc	30 a
rtB	72.6 a	25.2 a	18.1 bc	47 ab	72 a	123 a	27 a
rtb	72.7 a	11.1 d	18.1 bc	28 bc	24 cd	33 d	11 a

zR = rolled; r = not rolled; T = rotary tilled; t = not rotary tilled; B = tilrovator; b = bed shaper.

yMean separation, within columns, by Duncan's multiple range test, 5% level.

Table 3. Land preparation tillage treatment effects on penetrometer values by treatments and linear corrleations for depth, marketable yield, average root length, and number of misshapen carrot roots.

Treatment[z]	Penetrometer kg/cm^2 at 10 cm	Depth[y] (cm)	Marketable yield ($kg/16.7\ m^2$)	Avg root length (cm)	No. misshapen roots/ $16.7\ m^2$
RTB	6.69	5.7	60.4	17.1	201
RTb	4.44	8.3	58.5	18.9	185
RtB	4.69	8.3	65.2	18.2	216
Rtb	6.25	5.1	63.0	17.6	175
rTB	2.56	12.7	71.4	19.7	138
rTb	4.50	9.5	68.6	19.1	157
rtB	3.81	10.2	72.6	18.1	269
rtb	1.94	14.6	72.7	18.1	96
r value		.7988*	.1444 NS	.1264 NS	.1272 NS

[z]R = rolled; r = not rolled; T = rotary tilled; t = not rotary tilled; B = tilrovator; b = bed shaper.

[y]Depth at which 4.5 kg/cm^2 was exceeded.

*Significantly different, 5% level.

[NS]Not significantly different.

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Interspecific Hybridization between Rice Bean [*Vigna umbellata* (Thunb.) Ohwi & Ohashi] and Adzuki Bean [*V. angularis* (Willd.) Ohwi & Ohashi][1]

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Additional index words. embryo culture, mung group

Abstract. **Interspecific hybridization between *Vigna umbellata* and *V. angularis* is reported for the first time. Hybrids were obtained from immature embryos cultured on artificial medium. The hybrids showed normal meiosis (11_{II}) and fertility only slightly reduced from that of the parental species. Viable seeds were produced by self-pollination and by backcrosses to both parents. It appears that these species are closely related and gene transfers in both directions should be possible once embryo abortion is overcome by embryo culture.**

Vigna umbellata and *V. angularis* along with *V. radiata* (L.) Wilczek (mung bean) and *V. mungo* (L.) Hepper (black gram) comprise the mung group of related oriental bean species. These beans are major pulse crops in parts of Asia and Africa, but are little known in the U.S. These beans are distinguished from other beans by their Asian origin and their yellow flowers. Their separation from *Phaseolus* to *Vigna* by Verdicourt (19) has generally been accepted.

Interspecific hybrids between these 4 species are not generally easy to make, except in the case of crosses between mung

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