Comparison of Root Substrates, Depth and Solution Concentration

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A short term experiment was started in July, 1976, to compare the relative merits of soil, gravel and rockwool as growing media at two depths and irrigated with three different nutrient soution concentrations. There were no statistically significant differences as to total yield and flower quality between the different treatments. There was a 27% difference in yield between soil and a 6-in depth as compared to gravel 6-in deep, using a normal solution concentration, soil outproducing gravel. Gravel and rockwool generally produced less than either 6-in deep media. On the other hand, gravel 6-in deep produced the highest quality. Again, these differences were not significant.

Materials and Methods

These treatments were devised, and 'Elliott White' carnations planted on July 6, 1976, at a 3.8 plant per sq. ft. density, 28 plants per plot, in a glass covered greenhouse:

1. Soil, 6 inches deep.
2. Gravel, washed chip, 6 inches deep.
3. Gravel, washed chip, 1½ inches deep.
4. Rockwool, 1½ inches deep.

All plots were irrigated with Chapin double wall tubing, the soil watered on demand, 6-in gravel one to six times daily, depending upon season, and the 1½ inch media every 30 minutes regardless of season. The shallow media had a capillary mat beneath it which was laid over black plastic.

The normal solution concentration fed to the plots followed Holley and Hartman's recommendation. This consisted of:

13 milliequivalents per liter NO_3^-
6 milliequivalents per liter K^+
6 milliequivalents per liter Ca^{++}
3 milliequivalents per liter Mg^{++}
3 milliequivalents per liter $SO_4^=$
1 milliequivalents per liter NH_4^+
1 milliequivalents per liter $H_2PO_4^-$

A standard trace solution was fed equally to all plots. Solution treatments consisted of irrigating with normal concentration, one-half normal and two times normal concentration. Each treatment was repeated once, or two plots of 48 plants, completely randomized.

Results and discussion

There was a general trend toward lower production in the shallow media (Table 1), with maximum production in soil and at the normal solution concentration. However, neither the differences in Table 1 or Table 2 (Mean grade) were statistically significant when a two-way analysis of variance was applied. There was considerable variation between individual plots due to location in the house which probably accounted for lack of significance. Highest mean grade (fancy = 5.00, standard = 4.00, short = 3.00 and design = 2.00) was in 6 inch gravel and a normal solution concentration. There appeared to be a tendency toward lower flower quality at higher solution concentrations. The crop began

production the first part of December, 1976, and peaked the middle of January.

Table 1: Yield per plot (28 plants) of 'Elliott White' carnations planted July 6, 1976. Records stopped March 16, 1977.

	Root substrate				
Solution concentration	Soil 6-in deep	Gravel 6-in deep	Gravel 1½-in deep	Rockwool 1½-in deep	Mean
One-half normal[a]	146	139	118	95	124
Normal concentration	205	162	131	122	155
Twice normal concentration	135	136	130	154	139
Mean	162	146	126	123	139

[a] Normal concentration: 13 meq/l NO_3, 6 K, 6 Ca, 1 NH_4, 3 Mg, 3 SO_4 and 1 H_2PO_4. Trace elements added.

Northern European growers have been using rockwool successfully as a cheap growing medium in recent years, and we were approached by the Rockwool Industries, Inc. of Colorado to test this material for them. The shallow medium (1½ inches) was chosen in order to reduce the cost of replacement. Previous experience with shallow gravel has indicated no reduction in yield or quality if the medium is watered and fertilized at a frequent enough interval. The method also has advantages in that it might be cheaper to replace 1½ inches, disinfect the bench, and refill rather than to steam. Growers experiencing disease problems in ground beds could use the system in lieu of raised, conventional benches by leveling the ground and covering it with polyethylene. One by two inch firring strips are adequate to contain the medium. Such a system does require a more sophisticated irrigation timing device to ensure adequate water, and nutrients must be applied at each irrigation.

It appears from this short study that carnations could be grown adequately in shallow rockwool as supplied to us by Rockwool Industries, Inc. The system of shallow, artificial media requires further testing, for the literature indicates that solution concentration should be increased slightly as the volume of the root substrate is reduced. While we did not test the moisture holding capacity of rockwool, it was our observation that its ability to retain water was similar to peat moss.

Table 2: Mean grade of 'Elliott White' carnations planted July 6, 1976. Records stopped March 16, 1977.

	Root substrate				
Solution concentration	Soil 6-in deep	Gravel 6-in deep	Gravel 1½-in deep	Rockwool 1½-in deep	Mean
One-half normal[a]	3.69	3.66	3.54	3.70	3.65
Normal concentration	3.42	3.74	3.67	3.64	3.62
Twice normal concentration	3.48	3.71	3.64	3.52	3.59
Mean	3.53	3.70	3.61	3.62	3.62

[a] Normal concentration: 13 meq/l NO_3, 6 K, 6 Ca, 1 NH_4, 3 Mg, 3 SO_4 and 1 H_2PO_4. Trace elements added.

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