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Melon Cultivation in Sand and Hardwood Sawdust

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ABSTRAK

Pertumbuhan dan daya pengeluaran tembikai, kultivar 'Polidor' ditaksir dalam 2, 4 dan 8 liter pasir dan abuk kayu keras yang diairi sehingga melimpah dengan larutan nutrien sepenuhnya. Tanaman tersebut dibesarkan dalam rumah kaca yang di set siang dan malam pada suhu 18°C/15°C dengan ventilasi 26° C. Jumlah min jirim batang dan daun kering adalah tidak berbeza samada semasa penjagaan ataupun selepas buah dipetik. Min hasil buah-buahan (bilangan dan berat) tidak dipengaruhi oleh isipadu substrat tetapi ternyata (P<0.01) lebih tinggi daripada tanaman yang ditanam dalam pasir. Begitu juga min tarikh memetik untuk buah yang pertama ternyata (P<0.01) lebih awal bagi tanaman yang ditanam di dalam pasir berbanding dengan yang ditanam di dalam abuk kayu.

ABSTRACT

The growth and productivity of melons, cultivar 'Polidor', were assessed in 2, 4 and 8 litres of sand and hardwood sawdust irrigated to excess with a complete nutrient solution. The plants were grown in a glasshouse set at day/night temperatures of 18°C/15°C with venting at 26°C. Mean total stem and leaf dry matter after the fruits were harvested were not significantly different between treatments. Mean fruit yield (number and weight) was not affected by substrate volume but was significantly (P<0.01) higher from plants grown in sand. Similarly, mean harvest date for the first fruit was significantly (P<0.01) earlier from plants grown in sand compared with sawdust.

INTRODUCTION

The initial capital cost of setting up a deep-culture recirculating nutrient solution system, as described by Lim and Wan (1985) is prohibitively high. Some amount of experience and technical expertise are also needed in managing a recirculating nutrient solution system. These factors have discouraged growers from adopting this method of hydroponic culture.

The use of rockwool and perlite as growing media, with complete nutrient solution supplied via drip lines, is less costly than recirculating solution systems and is preferred in Europe (Vaughan 1989). With nutrient solution not being recirculated, there is reduced risk of disease spread in the root system. However, horticultural rockwool and perlite may be too expensive for a short-term crop such as melon. The present investigation compares the use of an alternative inorganic substrate (sand) and an organic substrate comprising sawdust from temperate hardwood species.

MATERIALS AND METHODS

Plant culture

Single, month-old melon seedlings, cultivar 'Polidor', propagated in rockwool cubes (7.5 cm × 7.5 cm × 7.5 cm) were planted on 25 May 1990 into two different substrates, namely sand and hardwood sawdust (comprising 90% oak, 5% ash and 5% chestnut). These unlimed and unfertilised substrates were contained in 2, 4 and 8 litre black polythene bags with a common depth of 20 cm to ensure similar drainage rates and air-filled porosities (AFP).

The experiment was carried out in a glasshouse set at day/night temperature of 18°/15°C with venting at 26°C. A total daily volume of 2.7 litres/plant of complete nutrient solution at an

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electrical conductivity of 2.5 mS/cm and a pH of 5.5 (Hitchon *et al.* 1990) was applied by drip irrigation at hourly intervals between 0400 hrs and 2200 hrs. Approximately 20 per cent of the total amount applied drained to waste. The treatments were randomised into three blocks with seven single-plant plots per treatment within each block.

The plants were trained as single-stemmed plants by the removal of all side-shoots except those at 9th to 12th internodes, each of which was retained to produce two female flowers. All the eight female flowers were hand-pollinated on the day of anthesis. The plants were stopped after producing 24 leaves. Three weeks after pollination, a maximum of two fruits per plant was selected and allowed to develop and ripen.

Data Collection

Ripe fruits were harvested when they were just beginning to become detached from their stalks and weighed immediately. When all the fruits had been harvested, the main shoots, excluding the side shoots which bore the fruits, were cut just above the cotyledons. Stem and leaves were dried in a forced draught oven at 105°C for 16 hours and weighed. Data obtained were statistically analysed with two-factor ANOVA using GENSTAT.

Air-filled porosities of sand and sawdust were determined prior to use by the method of Bragg and Chambers (1988).

RESULTS

No differences in plant growth were observed between treatments from transplanting until fruit harvest. Total stem + leaf dry matter (Table 1a) did not significantly differ between any of the treatments.

The production of female flowers commenced three weeks after transplanting and lasted for a further three weeks. Fruit set of the eight, hand-pollinated flowers/plant was poor and most plants carried only one or two fruits and a very few three. A maximum of two fruits/plant was therefore selected, within three weeks of setting, to develop to maturity.

The mean date of harvest of the first fruit (Table 1b) from plants grown in sand was 94 days after transplanting, i.e. four days earlier (significant at $P<0.01$) than from plants grown in sawdust. The mean dates of harvest of the second fruit were two days later than the first fruit but these did not differ significantly betwen treatments.

Mean fruit number per plant (Table 1c) was 20 per cent higher (significant at $P<0.01$) from plants grown in sand compared with plants grown in sawdust. Total fruit weight per plant (Table 1d) was 14 per cent higher (significant at $P<0.05$) in sand than in sawdust.

In both media, shoot weight, fruit number and fruit yield were similar whether grown in 2, 4 or 8 litres of substrate nor was there significant rooting volume x substrate interaction.

DISCUSSION

Air-filled porosity in sawdust (15.7 per cent) was above the value of 10 per cent considered critical for organic substrates which are irrigated to excess (Bunt 1988). Despite the lower measured AFP in sand (2.7 per cent) plants grew equally well in this medium. In the method of Bragg and Chambers (1988) AFP is measured in containers with a height of 12 cm. The greater depth of substrate used in the present experiment would have provided a greater AFP than that measured. Moreover, the low microbial population in sand would not compete strongly with the roots. Oxygen availability, therefore, was unlikely to limit root function in sand despite the lower measured AFP.

Two litres of medium per plant were found to be adequate for either substrate when frequently irrigated with complete nutrient solution to prevent water and nutrient stress from developing. Hall *et al.* (1988), in a similar experiment using perlite, observed that 5 litres of substrate were sufficient for the cultivation of tomatoes.

At two litres/plant, the total amount of sand required per hectare would be 50 tonnes when melons are planted at a modest planting density of 20,000 plants/ha. This is a considerable reduction from the 200 tonnes/ha when 8 litres of sand per plant is used. Although sawdust has a lower bulk density than sand and hence a lower labour requirement to handle it, there is a yield penalty of 14 per cent compared with sand (Table 1e).

It is likely that the yield penalty from growing in sawdust was due to the pH of the unlimed substrate. The pH of water extracts from sawdust averaged 5.2 over the period from transplanting until harvest, despite frequent irrigation with complete nutrient solution at a pH of 5.5.

Raja Harun *et al.* (1992, in preparation) reported that the possible presence of toxins in sawdust reduced percentage germination of melon seedlings. However, toxins did not reduce shoot growth of mature plants if the root systems of the

TABLE 1
The effects of substrate and substrate volumes on growth and productivity of melons.

	1a			1b			1c			1d			1e		
	Leaf + Stem dry wt. g/plant			First Fruit days after sowing			Second fruit days after sowing			Fruit number/plant			Fruit kg/plant		
Volume (litres)	Sawdust	Sand	Volume means	Sawdust	Sand	Volume means	Sawdust	Sand	Volume means	Sawdust	Sand	Volume means	Sawdust	Sand	Volume means
8	112.0	118.0	110.0	96.0	93.6	94.8	99.5	98.8	99.2	1.5	1.9	1.7	2.13	2.36	2.25
4	108.8	110.9	109.9	98.9	94.6	96.8	99.7	95.4	97.5	1.5	1.9	1.7	1.99	2.32	2.16
2	104.9	111.6	108.3	98.8	93.8	96.2	99.6	99.7	99.6	1.6	1.6	1.6	2.00	2.28	2.14
Substrate means	108.6	110.2		97.9	94.0		99.6	98.0		1.5	1.8		2.04	2.32	
Vol. (V) Signif.		NS			NS			NS			NS			NS	
Substr(S) Signif. and S.E.d.		NS			** 1.25			NS			** 0.10			* 0.11	
V x S Signif.		NS			NS			NS			NS			NS	

NS = not significant * = P<0.05 **P = <0.01

seedlings were very well developed at transplanting. Similarly, Nichols (1981) observed that well-rooted cuttings and seedlings established well in fresh bark and sawdust. In the present experiment, any toxic effects of the sawdust may have influenced plant productivity only during the reproductive stage, resulting in reduced fruit set and fruit development. Further work is needed to identify sawdusts from various species which are not toxic to plant growth and productivity. The identification of toxins present and methods to eliminate them need to be investigated. In soft wood bark, volatile toxins present are known to be eliminated by composting, making the bark suitable for use as a growing medium (Aaron 1973, 1982; Still *et al.* 1976).

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