THE GROWTH OF TOMATO PLANTS IN DIFFERENT POTTING MIXES, UNDER GREENHOUSE CONDITIONS

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ABSTRACT

Tomato variety Money Maker special plants were grown in teh Greenhouse in pots, during August, 1997, at Lincoln University, Canterbury, New Zealand, in several different potting mixes; Pumice, Perlite, Fine peat, Course peat, Pine-bark compost, andf soil as a control. It was then tested for the vegetative growth perjforamnces. Teh highest number of leaves, leaf area, vegetative buds, plant height, stem diameter, shoot and root dry-weight plant-1 were found in Pine bark compost, which were 43, 1592 cm2, 10,27cm, 1 cm, 6 g, and 0 g, respectivley, while the same parameters were found least in soil, which were 15.00, 626.74 cm2, 7.17, 14.82 cm, 0.67 cm, 1.69 g and 0.19g, respectivley. None of the mixes affected root-length. Almost all plants showed maximum vegetative growth in Pine-bark compost.

INTRODUCTION

The growth and production of tomtoes is now based almost entirely on artifical potting-mixes or substrates, rather than soil which was the common practive about fifteen years ago (Wilson, 1986). In some advanced countries, sterilized soils were used as a medium for plants in teh grenehouses, but this practive was very expensive and also there was a the lack fo good soil avialability. Teh potting mixes or aritficial substrates like peat, bark, vermiculite, rockwool and perlite, etc., have the following advantages i.e., disease and weed-free, light in weight, respeive meixes having the same composition, quicker growth and higher yields; so, tomato yields have increased three times more int he last rhity years, mainly due to monocropping systems and growing out of the soil (Silson, 1986).

In advanced countries, different kinds of potting-mixes are available, each of which has its own physical and chemical properties. The present experiment was performed in uniform environmental condiction in a glass house. The potting-mixes available int eh open market of New Zealand are; Pumice, Perlite, Fine peat, Coarse peat, and Pine-bark compost, etc., and so these were used.

MATERIALS AND METHODS

The experiment was laid out in the Greenhouse on 6th August, 1997, which is the normal cropping season in Lincoln University, Canterbury, New Zealand. Six treatments (potting-mixes) were used, i.e. soil (as a control), Pumice, Perlite, Fine peat, Coarse peat, or Pine-bark compost. Each potting-medium was repeated six times (6 replications) and laid in a randomized complete block design. At the initial set up of the experiemnt, three seedlings (50 days ol) were trnasplanted into pots having a diameter of 15 cm, on 6th August 1997. The seed were sown on the media having Clay, Silt and Organic matter with 1:1:1 ratios. The germination fo the seed took 15 days, and the germination was 98 percent. The cultivar chosen for the experiment was “Money-Maker Special’; this is one of the commercial greenhouse varieties grown successfully in New Zealand. Five days after transplanting, sorting was done and only one plant pot-I was left. Slow-release fertilizers were applied to all treatments, as a constant dose i.e. Osmocote was applied at the rate of 24g per 12 liters of media, which contains Nitrogen (N), Phosphorus (P_2O_5) and Potassium (K_2O), in the ratios of 15:4.8:18.8, respectively; Dolomite at 48g per 12 liters of media which contains Calcium and Magnesium. The main reason for using dolomite is to keep the pH level up, and other cultural practices (such as irrigation, weeding, etc) were maintained uniformly. The following data were recorded five weeks after the transplantation of seedlings: Plant height (cm), Leaf number plant-1, Leaf area in cm2, by using Li-Cor model 3100 area meter, Number of all vegetative buds, stem diameter (cm), root-growth (cm) and dry-weight of shoots and roots; by putting them in an oven at 70°C for 48 hours. The reproductive growth data was not recorded.

RESULTS

The mean maximum 27.2 cm plant height was found in pine-bark compost, which is significantly greater ($p<0.05$) than all other potting mixes. The mean minimum 14.8 cm plant height occurred in soil and was significantly different from all other potting mixes.

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Pumice produced plants with an average height of 22.79 cm, which was only significnalty different from pine-bark compost, but was statistically same as with perlite, fine epat and course peat, which were 24.5, 23.7 cm, respectivley. Plant height in perlite was not different fromt he fien peat, course peat and pien bark compost, while fine peat was highly differnt from compost, but not from course peat (Fig.1).

Number of leaves plant-I was significantly different ($p<0.05$) among different treatments. The maximum mean 43.83 leaves were observed in pine-bark compost, while minimum average 15:00 leaves-plant were found in soil media, which was significantly less as compared to pumice, perlite, fine peat, course peat and compost, which were 32.83, 37.67, 36.67, 41.83 and 43.83 plant^{-1}, respectively. Number of leaves in the pumice was not significantly different from course peat and compost, while leaves in perlite, fine peat, course peat and pine-bark compost were not significantly different (Fig., 2).

The mean number of vegetative buds plant-1 were significantly differetn at ($p<0.05$). The mean minimum 7.17 vegetative buds plant-1 were found in soil, which was significantly less than pumice, perlite, fine peat, course peat and pine-bark compost, which were 10.5, 10.5,10.83,10.67 and 10.83, respectively. There were no significant differences observed among the other potting-mixes, except soil (Fig.3). The dimeters of the stem of plants in different potting mixes were found significantly different at ($p<0.05$). The mean maximum 1.05cm stem diameter was found in pine-bark compost potting-mix. Soil media showed the mean minimum stem diameter of 0.67 cm, as compred to pumice, perlite, fine peat, course peat and pine-bark compost, which were 0.80,0.90,0.90,0.86 and 1.05 cm plant-1, respectivley. Pumice showed 0.80 cm stem diameter, which was significantly different from soil and pine-bark compost i.e., 0.67 and 1.05 cm, respectively, but it was not significantly different from perlite, fine peat and ocurse peat, which were 0.90,0.90 and 0.86 cm, respectivley. Stem diameter in perlite was simialr to fine peat, and course peat, but significantly different from pine bark compost. Fine peat was not different from course peat, but was less than pine-bark compost. Course peat was found significantly less than pine bark compost (Fig., 4).

The mean maximum 1592.64 cm^2 leaf area was observed in pinooark compost potting mix, which was significantly different from all other potting mixes. The

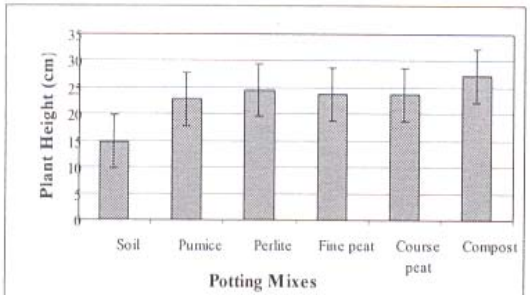

Figure - 1: Plant (Special Money Maker Tomato) height in different potting mixes

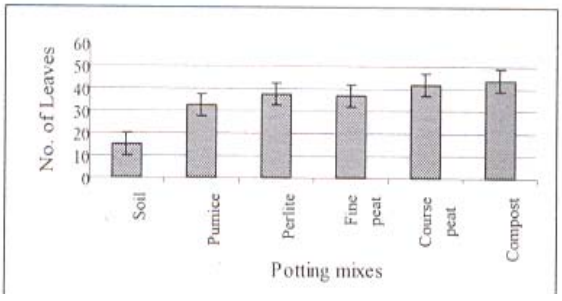

Figure - 2: No. of leaves per plant (Special Money Maker variety of tomato) in different potting mixes

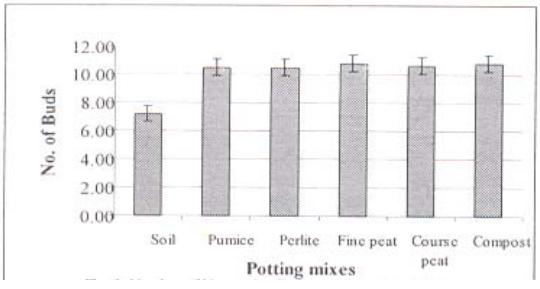

Figure - 3: Number of vegetative buds per plant (Special Money Mker Tomato) in different potting mixes)

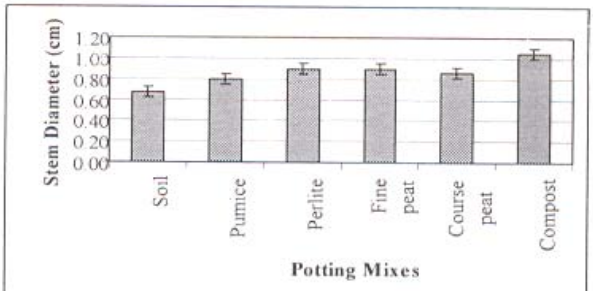

Figure - 4: Stem diameter of plant (Special Money Maker variety of tomato) in different potting mixes

mean minimum 626.74 cm^2 leaf area was observed in soil media, which was significantly less than pumice, perlite, fine peat, course peat and pine bark compost, which were 1045.38,1338.00,1393.73, 1319.17, and 1592.64 cm^2, respectively. Pumice showed 1045.38 cm^2 leaf area, which was significantly less that fine peat, and pine-bark compost i.e., 1393.73 and 1592.64 cm2, respectively. There was statistically no difference found between pumice and course peat, which were *1045.38* and 1319.17 cm^2, respectively. There were also no significant differences in leaf-area found am,ong perlite, fine peat, course peat and pine-bark compost (Fig., 5).

Fresh weight of shoot and root were significantly maximum in compost media, followed by perlite media, and minimum shoot and fresh weight were obtained in soil or check media.(Fig., 6).

The mean maximum shoot dry weight, 6.33g, was found in pine-bark compost, while the mean minimum 1.69 shoot dry-weight plant-1 was found in soil media, which was significantly differnet from all potting mixes i.e., pumice, perlite, fine peat, course epat and pine-bark compost, which were 4.11,5.81,4.8,4.28 and 6.33g, respectively. Pumice showed no significant differences in leaf area from perlite fine peat and course peat, but was signifcantly different from pine-bark compost. Perlite showed no significant differences from fine peat, coarse peat and pine-bark compost. Similarly, fine peat showed no significant differnces from course peat and pine-bark compost, but course peat showed less dry weight than pine bark compost (Fig.7).

The mean maximum root dry weights 0.97 and 0.79g were shown by perlite and pine-bark compost, respectively, while the mean minimum 0.19g root dry weight was shown by soil media, that was significantly less than perlite, fine peat, and pine-bark compost, which were 0.97, 0.64 and 0.79g, respectively, but was not different from pumice and course peat i.e. 0.50 and 0.45g, respectively. Pumice showed less root dry-weight only significantly different from perlite, but not from the other potting mixes. Perlite was significantly different in root dry-weight production from course peat. There were no significant differences in root dry-weight among fine peat, course peat and pine bark compost (Fig., 7).

It is observed in this project that the fresh weight was directly proportional to dry weight in both shoot and root in all the tested media. Moreover, there was no significant root-length difference among different potting mixes.

DISCUSSION

The best plant-height, vegetative buds, number of leaves, leaf-area, stem diameter, shoot and root dry-weight $plant^{-1}$ occurred in pine-bark compost, which may be because this potting mix has a large capacity to keep water and contains more organic matter than the other potting mixes. Nogales, et at (1984) reported that tomato is the most sensitive to compost-addition, showing 10% germination with 10% compost addition. They further reported that in pots, the application of 60 t/ha of compost to soil, with or without N, P, K, S, Ca and Mg fertilizers, promoted the growth of ryegrass. In the compost, the microorganisms' activities in the plant-remains produce heat and transform complex organic materials into forms, which are, later on available to roots. Bark also open up the soil and peat improves aeration and water-holding capacity (Hessayon, 1986). Bark has given good yields of tomatoes, provided proper attention is paid to nitrogenous fertilizing and iron-additions *to* counteract high manganese levels (Wilson, 1983), Solbrae, 1975, 1976). The finding that the poorest plant-growth was observed in soil media, which had the low capacity to keep water and was compact, as compared to other potting mixes. It is because there are some disadvantages of soil, for example it has disease and weeds which should be sterilized before use (Wilson, 1984). Sowan *et al* (1986) also reported that the plant-performance in rice hulls, sand and peat was higher than that of control substrate, which was soil.

Dry weight of shoot and root were both found maximum in pine-bark compost and perlite. Perlite potting-mix is also an ideal rooting medium; it is sterile, chemically inert, physically stable, drains easily, yet has a good capillary action, so it has the ideal physical characteristics especially as regards air and water capacities (Wilson 1984). It was also observed that shoot and root dry-weight in fine peat and course peat was significantly lower than pine-bark compost. Organic potting -mixes or substrates also vary in their physio-chemical properties. Starck and Okruszko (1984) reported that total yield was high in pine bark and peat than that for sawdust. The organic potting-mixes like pine-bark compost, fine peat and course peat.used in this experiment had the following characteristics;

	pH	Nitrate nitrogen	Conductivity
Pine bark compost	5.0	19.0 (ppm)	0.04 (mS/cm)
Fine peat	3.9	03.0 (ppm)	56.4 (mS/cm)
Course peat	4.2	<1.0 (ppm)	0.08 (mS/cm)

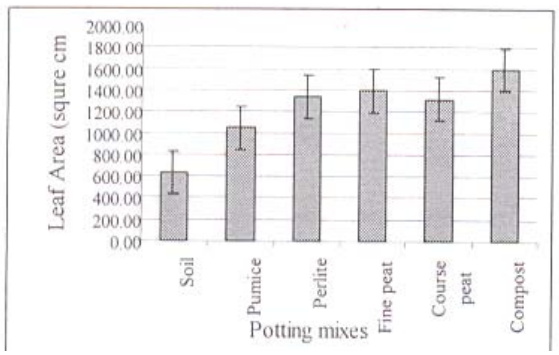

Figure - 5: Leaf Area per plant (Special Money Maker variety of tomato) in different potting mixes)

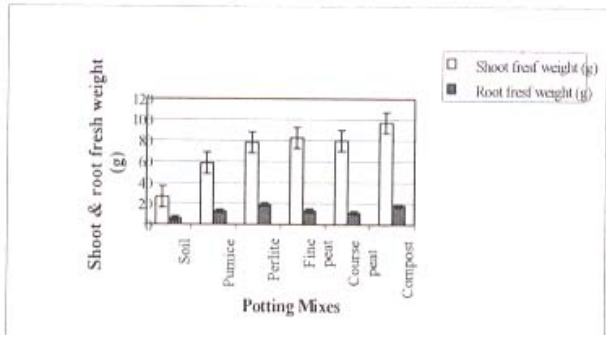

Figure - 6: Fresh weight of shoot and root of Special Money Maker variety of tomato in different potting mixes

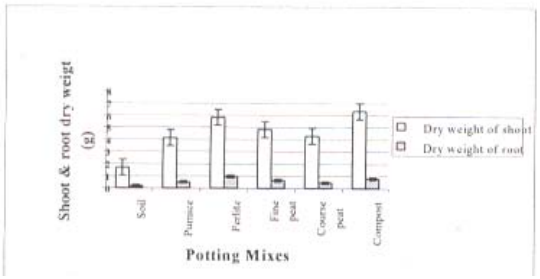

Figure - 7: Dry weight of shoot and root of Special Money Maker variety of tomato in different potting mixes

(These were the recommended analyses provided by the manufacturing companies). So, due to these differences among the potting mixes, it may be readily understand that pine-bark compost showed high shoot and root dry-weight plant^{-1}. Similar trend was noticed in shoot and root fresh-weight. It is observed in this project that the fresh wegith is directly proportional to dry weight, in both shoot and root, in all the tested media.

All potting mixes other than pine-bark compost also showed some signfiicant differences among themselves, but mostly they showed less effect on different vegetative growth parameters.

REFERENCES

1. Hessayon, D. G, Improving your soil by adding humus. In; *The garden expert.* pp 22. (1986).
2. Nogales, R., M. A. Zamora, M. Gomez, and L. F. Gallardo, Fertiliser value of a town refuse compost. Effect on seed germination and yields of sequential harvests. In; Analies de Edafologia y Agrobiologia. 43: 1-2, (1984) 183-194.
3. Sawan, O. N., M. S. El-beltagy, A. Muhammedian, A.S. El-beltagy, and M.A. Maksoud,. A study on the influence of some transplant growing media on flowering and yield of some tomato. In; Horticulture abstracts. 55: 6, (1986) 4453.
4. Solbrae, K, Compo sting bark. Proc. of symp. West German working group on standardisation of bark composts in Horticulture, Ghert, (1974).
5. Solbrae, K., Composting bark. Parts 1-4. Manuscipts Norsk Int. for Skogforskning. (1976)
6. Stark, J. R. and B. Okruszko,. The effect of nitrogen on yield of green house tomatoes grown in peat, pine bark and sawdust. Acta Horticulturae. 145: (1984) 74-80.
7. Wilson, G. C. S., Tomato production in bark substrates. Acta Horticulturae. 150: (1983).
8. Wilson, G. C. S., New perlite system for tomato production. Florentica international. No 2: (1984) 23-36,.
9. Wilson, G. C. S., Tomato production in different growing media. Acta Horticulturae. 178: (1986) 115-120.