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

ABSTRACT

Tomato variety Money Maker special plants were grown in the 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, and soil as a control. It was then tested for the vegetative growth performance. The 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, 10,27 cm, 1 cm, 6 g, and 0 g, respectively, 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, respectively. None of the mixes affected root-length. Almost all plants showed maximum vegetative growth in Pine-bark compost.

INTRODUCTION

The growth and production of tomatoes is now based almost entirely on artificial potting-mixes or substrates, rather than soil which was the common practice about fifteen years ago (Wilson, 1986). In some advanced countries, sterilized soils were used as a medium for plants in the greenhouses, but this practice was very expensive and also there was the lack for good soil availability. The potting mixes or artificial substrates like peat, bark, vermiculite, rockwool and perlite, etc., have the following advantages i.e., disease and weed-free, light in weight, resipve mixes having the same composition, quicker growth and higher yields; so, tomato yields have increased three times more in the last thirty 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 condition in a glass house. The potting-mixes available in the 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 setup of the experiment, three seedlings (50 days ol) were transplanted 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 of 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-1 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 (P₂O₅) and Potassium (K₂O), 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.
Pumice produced plants with an average height of 22.79 cm, which was only significantly different from pine-bark compost, but was statistically same as with perlite, fine epat and course peat, which were 24.5, 23.7 cm, respectively. Plant height in perlite was not different from the fine peat, course peat and pine bark compost, while fine peat was highly different from compost, but not from course peat (Fig. 1).

Number of leaves plant-1 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 different 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 diameters of the stem of plants in different potting mixes were found significantly different at (p<0.05). The mean maximum 1.05 cm stem diameter was found in pine-bark compost potting-mix. Soil media showed the mean minimum stem diameter of 0.67 cm, as compared 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, respectively. 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 course peat, which were 0.90, 0.90 and 0.86 cm, respectively. Stem diameter in perlite was similar 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 cm² leaf area was observed in pine-bark compost potting mix, which was significantly different from all other potting mixes. The
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The mean minimum 626.74 cm² 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 cm², respectively. Pumice showed 1045.38 cm² 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 cm², respectively. There were also no significant differences in leaf-area found among perlite, fine peat, course peat and pine-bark compost (Fig., 7).

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 different 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 significantly 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 differences from course peat and pine-bark compost, but coarse 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 because this potting mix has a large capacity to keep water and contains more organic matter than the other potting mixes. Nogales, et al (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 coarse 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;

<table>
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<th>pH</th>
<th>Nitrate nitrogen</th>
<th>Conductivity</th>
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<tbody>
<tr>
<td>Pine bark compost</td>
<td>5.0</td>
<td>19.0 (ppm)</td>
<td>0.04 (mS/cm)</td>
</tr>
<tr>
<td>Fine peat</td>
<td>3.9</td>
<td>03.0 (ppm)</td>
<td>56.4 (mS/cm)</td>
</tr>
<tr>
<td>Course peat</td>
<td>4.2</td>
<td>&lt;1.0 (ppm)</td>
<td>0.08 (mS/cm)</td>
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(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 weight 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 significant differences among themselves, but mostly they showed less effect on different vegetative growth parameters.

REFERENCES