EUROPEAN ACADEMIC RESEARCH
Vol. III, Issue 9/ December 2015

Impact Factor: 3.4546 (UIF)
DRJI Value: 5.9 (B+)

ISSN 2286-4822
www.euacademic.org

Vermicompost as Growth Media for Tomato (*Lycopersicum esculentum* L.) Transplants Production

MUHAMMAD JAWAAD ATIF[1]
GHULAM JELLANI
NOOR SALEEM
AHSAN JAVED
ATIF AKRAM
National Agriculture Research Centre
Pakistan Agricultural Research Council, Islamabad
Pakistan

Abstract:

Tomato transplants experiment was conducted using vermicompost as growth media alone and in combination with vegetable waste compost during the year 2014-15. Five experimental treatments were applied. T_0*: Farmyard manure,* T_1*: Vermicompost,* T_2*: Vegetable waste compost,* T_3*: Vermicompost and Farmyard manure (1:1) and* T_4*: Vermicompost and Vegetable waste Compost (1:1). Tomato transplants growth parameters are days to emergence, seedling emergence (%), seedling shoot length (cm), seedling height (cm) and seedling root length. Minimum days to emergence (20) were recorded in* T_4*: Vermicompost and Vegetable waste Compost (1:1). Maximum seedling emergence (91.10 %), seedling shoot length (20.00 cm), seedling height (28.00 cm) and seedling root length (8.00 cm) were recorded in* T_4*: Vermicompost and Vegetable waste Compost (1:1). The objective of the study was to evaluate the potential use of growing media to produce quality seedlings with target morphological and physiological features that guarantee crop success after transplanting.*

[1] Corresponding author: jawaadatif@gmail.com

Key words: vermicompost, tomato transplants production, vegetable waste compost.

INTRODUCTION

Tomato (*Lycopersicum esculentum* L.) is one of the most popular and important vegetable. It is abundantly grown in the tropical regions and become one of the most popular and widely grown vegetables in the world. Out of 15 vegetables listed by the FAO tomato is placed sixth in terms of total annual world production. It is very important vegetable, having much nutritional value at comparatively low prices than other vegetables. It is consumed in every home in different modes, such as vegetables, salad, ketchup and other dishes. Tomato was imported to Indo-Pakistan subcontinent by the Europeans in the second half of 19th century and was consumed in this country only by the Europeans. But later, it became popular among the rich classes of the local population and now almost everybody consumes it in one form or another. That is why it has earned the well deserved title of "Poor man's orange". The early history of tomato is unknown but it is generally believed that this plant originated in the Peruvians and Mexican area of America (Bewley 1946). Tomato cultivars namely Rio-Grande, NARC-1 and F.M. 9 are cultivated during autumn. (Chaudary *et al.*, 1999). The cultivars showing promise during spring season are Roma, Chico III and Tanja, respectively. (Deouk *et al.*, 2000). Ideally, tomato requires a relatively cool, dry climate for optimum yield & quality, but it can also adapt a wide range of environmental conditions. The optimum temperature range for proper growth & development is 21-24 ^{0}C. While fruit set is enhanced below 21^0 C. Tomato grows best in sandy loam to clay loam soils with a pH of 6.0-6.5. Prepare seedbeds 50 cm in width at any convenient length in an area fully exposed to sunlight. Pulverize soil thoroughly and add well decomposed compost or animal manure at the rate of about 1-2 kg m^{-2}. To minimize or prevent damping-off disease and insect pest damage, sterilize the soil by burning rice hull or rice straw on top of the seedbed for 4-5 hours. Alternatively, drench with a combination of fungicide and insecticide following the manufacturer's recommended rates. Water the seedbed thoroughly before sowing. Prepare horizontal rows spaced 5 cm apart. Sow 50-100 seeds/row and cover the seeds thinly with fine soil. A hectare requires 150-200 gm seeds. Cover the seedbed with a thin layer of rice straw mulch to minimize water loss. Water the seed bed daily or when necessary. Seedlings will germinate 3-6 days after sowing depending on the soil temperature. Thin 3-5 days after germination to allow more space between seedlings. Apply starter solution 10 days after germination by dissolving 1 tbsp 910 g of ammonium phosphate (16-0-0) or complete fertilizer (14-14- 14) in 1 gal of water. Alternatively, foliar fertilizers can be used following recommended rates. Harden the seedlings one week before transplanting by gradually reducing the amount and frequency of watering until the seedlings exhibit temporary wilting. Plough the field at least one month before the scheduled date of transplanting. Ploughing and harrowing can be done at one-week intervals to allow weed seeds to germinate between passings. For determinate to semi indeterminate types of tomato, make furrows 0.75 cm – 1.0 m in width. For indeterminate types, prepare furrows at a spacing of 1.5 m between furrows. If the soil is less ideal for tomato, apply a handful (about 500 g) of animal manure or other composted material per hill. Transplant the most vigorous, stocky & disease-free transplants with 3-5 true leaves. Plant 1-2 seedlings/hill at a spacing of 40 cm between hills. To minimize transplanting shock, transplant the seedlings late in the afternoon. Press the soil firmly around the root. Irrigate water the plants lightly immediately after transplanting. Replant missing hills immediately. One to two days before transplanting, apply 1 tbsp (10g) per hill complete fertilizer 914-14-14). Mix thoroughly with the soil. The first side dressing can be done 30 days after transplanting by mixing two parts urea (46-0-0) and one part muriate of potash (0-0-60). Apply 1 tbsp (10 g) per hill of this mixture 6-8 cm away from the base of the seedlings in bands. Water the plants when necessary. It is desirable that the plants receive sufficient moisture from the early stage of growth until the early fruiting stage. For rain fed areas, use rice straw mulch when growing tomatoes during the regular, dry season period. Mulching conserves moisture and suppresses weed growth. For large plantations, the use of black plastic mulch is highly recommended. Tomatoes are being grown in all four provinces of Pakistan. The various varieties tomato is grown over an area of about 17297 hectors. The annual production of tomatoes was around 144675 tonnes in 2012-13. Rise of the fast food industry in the country is also having a significant impact on the demand for tomato based products. It is expected that this trend will continue in the near future and the consumption of tomato will increased further. (GOP 2012-13). Tomato is well established as an important vegetable due to its pleasant flavour, attractive colour and nutritive value. The analytical studies have shown that tomato is an excellent source of vitamin C and vitamin A. It contains from 15 to 25 mg/100 gm of vitamin C and has 4 times the vitamin "A" content of orange juice (Gould, 1971). Besides fair amounts of thiamine, riboflavin niacin and basic ashes; it is a good source of iron, manganese, and copper (Tressler and Joslyn 1971). Vermicompost are products of a non-thermophilic biodegradation and stabilization of organic materials, by interactions between earthworms and microorganisms. They are finely-divided, peat-like materials, with high porosity, aeration, drainage, water-holding capacity and microbial activity which make them excellent soil conditioners (Edwards

& Burrows 1988; Edwards 1998). Substitution of a range of vermicompost, produced from cattle manure, pig manure, food wastes, into a commercial soil-less bedding plant growth medium (Metro-Mix 360) in greenhouse experiments, increased the rates of germination, growth and yields of ornamentals, tomatoes and peppers even when all necessary mineral nutrients were supplied (Atiyeh *et al.* 2000a,b, 2001, 2002). Recently, our laboratory and greenhouse experiments have shown that vermicompost contain plant growth regulating materials such as humic acids and plant growth hormones which may be responsible in part for the increased germination, growth and yield of plants (Atiyeh *et al.* 2002). Moreover, our experiments have demonstrated that vermicompost can suppress *Pythium*, *Rhizoctonia* and *Verticillium* plant diseases (Chaoui *et al.* 2002) and plant parasitic nematodes (Arancon *et al.* 2002). However, experimental investigations into the effects of vermicompost applications on field crop production have been very few. Our main objective was to investigate the effects of different combinations of vermicompost applications on the growth and production of tomatoes in multipot trays.

MATERIALS AND METHODS

The experiment was carried out at the experimental field of Vegetable Crops Research Program, Horticultural Research Institute, National Agricultural Research Centre (NARC) Islamabad during 2014-15. The experimental site is located at longitude 73.08 ^{o} east and latitude 33.42^{0} north on the global scale. Elevation of site was 683 msl (Mean Sea Level). Seedlings of tomato (Riogrande) were raised in multipot trays. The experiment was conducted under plastic tunnel. The experimental treatments were T_0: Farmyard manure, T_1: Vermicompost, T_2: Vegetable waste Compost, T_3: Vermicompost and Vegetable waste Compost (1:1/2), T_4: Vermicompost and

Vegetable waste Compost (1:1). Following parameters were recorded of 5 selected plants from each replication of treatment. 1) Germination Percentage: seeds germinated X 100/total seeds. 2) Days to emergence: Days to emergence was counted from date of sowing to date of seedling emergence for 5 plants. 3) Seedling shoot length (cm): Seedling shoot length was measured with the help of scale for 5 plants. 4) Seedling height (cm): Seedling height was measured with the help of scale for 5 plants. 5) Seedling root length (cm): Seedling root length was measured with the help of scale for 5 plants. Analysis of the data for seed germination and growth of seedlings will be performed according to the Completely Randomized Design (CRD). Means of the examined traits will be ranked according to Least Significant Difference (LSD) Test (Steel *et al.*, 1997). The experiment will comprise of three replications.

RESULTS AND DISCUSSION

Table 1: Vermicompost impact on Days to emergence, Seedling emergence (%), Seedling shoot length (cm), Seedling root length (cm) and Seedling height (cm)

Treatments	Days to emergence	Seedling emergence (%)	Seedling shoot length (cm)	Seedling root length (cm)	Seedling height (cm)
T_0	23.67 a	84.10 e	12.67 e	6.33	19.00 d
T_1	22.33 ab	85.27 d	15.00 d	8.00	23.00 c
T_2	22.00 b	87.07 c	16.67 c	8.00	24.67 bc
T_3	21.00 bc	89.10 b	18.33 b	8.00	26.33 ab
T_4	20.33 c	91.10 e	20.00 a	8.00	28.00 a
LSD value	1.40	0.42	1.40	NS	1.93

All treatments under this study exhibited different germination pattern as there was significant difference was recorded ranges from 84.10 to 91.10 (Table 1). Maximum germination % (91.10) was recorded in T_4: Vermicompost and Vegetable waste Compost (1:1). Different days to emergence pattern were followed by all treatments under this study as there was significant difference was recorded ranges from 23.67 to 20.33 (Table 1). Minimum days to emergence (20.33) were recorded in T_4: Vermicompost and Vegetable waste Compost (1:1). Significant difference was recorded of all treatments in seedling shoot length (cm) under this study ranges from 12.67 to 28.00 (Table 3). Maximum seedling shoot length (20.00 cm) was recorded in T_4: Vermicompost and Vegetable waste Compost (1:1). Non-significant difference was recorded of all treatments under this study as there was no effect of vermicompost as growth media alone and in combination on tomato seedling root length (Table 4). All treatments under this study showed different seedling height (cm) as there was significant difference was recorded ranges from 21.333 to 38.667 (Table 5). Maximum seedling height (28.00 cm) was recorded in T_4: Vermicompost and Vegetable waste Compost (1:1). Some of the increases in growth may have been due to increases in microbial biomass in soils receiving vermicompost which increased nutrient mineralization. Moreover, increases in microbial biomass could have enhanced microbial competition which suppressed plant parasitic nematodes (Arancon *et al.*, 2002) and plant diseases (Chaoui *et al.*, 2002). Increases in growth and yields were more probably due to the production of plant growth regulators by microorganisms or to the effects of humates (Canellas *et al.* 2000) in the vermicompost since we have clear evidence from greenhouse trials that these can produce significant growth effects independent of nutrients. The results of this experiment show that it is possible to substitute peat by compost or vermicompost for the production of tomato plants in nurseries although substantially different effects were observed between these substrates in plant morphology and growth depending on the dose used. Total replacement of peat was only possible when vermicompost was used, while doses of compost higher than 50% caused prompt plant mortality. (Lazcano *et al.*, 2009). Compost and vermicompost have shown to enhance plant growth in several occasions and these growth enhancements have been attributed to an improvement of the physical, chemical and biological properties of the growing substrate. Generally, replacement of peat with moderate amounts of compost or vermicompost produces beneficial effects on plant growth due to the increase on the bulk density of the growing media, and to the decrease on total porosity and amount of readily available water in the pots (Papafotiou *et al.*, 2005; Bachman and Metzger, 2007; Grigatti *et al.*, 2007). Such changes in the physical properties of the substrates might be responsible for the better plant growth with the lower doses of compost and vermicompost as compared to the peat-based substrate. In spite that the amount of nutrients in these amendments varies depending on the parent material from where they are originated, both compost and vermicompost constitute a slow release source of nutrients that supply the plants with the nutrients when they are needed (Chaoui *et al.*, 2003; Nevens and Reheul, 2003). Further, several examples in the literature show that compost and vermicompost are able to enhance the growth of a wide range of plant species further what can be expected because of the supply of nutrients (Edwards *et al.*, 2004; Grigatti *et al.*, 2007). Mycorrhizal colonization (Cavender *et al.*, 2003), microbial activity (Dominguez 2004) and suppressiveness of soilborne plant pathogens (Hoitink and Boehm, 1999; Szczech 1999; Szcech and Smolinska 2001; Scheuerell *et al.*, 2005; Noble and Coventry2005; Termorshuizen *et al.*, 2006) have shown to be enhanced through the addition of compost and vermicompost to a potting media or as a soil amendment. Furthermore, biologically active metabolites such as plant growth regulators (Tomati and Galli, 1995; El Harti *et al.*, 2001) and humates (Atiyeh *et al.*, 2002; Canellas *et al.,* 2002) have been discovered in vermicomposted material.

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