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Full Length Research Paper

Effect of seedling management on yield and quality of tomato at Adami Tulu Jiddo Kombolcha District, Central Rift Valley of Ethiopia

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Four different media (red ash, termite tomb, cow dung and course sand) were collected to make good media for tomato seedling and basic theory of good soil (half pore space and half solid materials) that prevent the soil surface from crusting which causes difficulty in water passage and aeration for normal activity of the seedling. Those media were mixed in different proportions to evaluate the best combination that better support tomato seedling with maximum nutrient. At the time of transplanting, the statistical analysis at $p < 0.05$ indicated red ash, course sand, termite tomb and fermented cow dung in the ratio of 4:4:2:1 combination, giving highest stem diameter (4.14±0.09 mm), leaf number (4.25±0.223) and plant height (9.76±0.39 cm) as compared to the rest treatments including those planted with routine farmers practice. As to the placement, media filled with pot and placed on top of bed at waist height gave best performance for stem diamante (4.68±0.249 mm), seedling height (10.09±0.138 cm) and number of true leafs (4.90±0.173), but the average marketable and total yield at time of harvesting contradicts with the vegetative stage, that is, media with ratio of 4 red ash, 3 course sand, 2 termite tomb and 1 fermented cow dung performing better (477±83 q/ha) followed by 469±56 q/ha for 3 red ash, 3 course sand , 3 termite tomb, 1 cow dung and 363±32 q/ha for 4 red ash, 4 course sand, 2 termite tomb and 1 fermented cow dung respectively.

Key words: Average yield, media, seedling management, tomato.

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill), which is cultivated both in backyard for home consumption and commercially for domestic market, processing plants and export, is one of the world's most popular vegetables (FAO, 1989). Cultivation of tomatoes improves diet of the people, as they are a part of every salad in combination with leaf vegetables, green onions, cucumbers, peppers, and other vegetables. As a processing crop, it ranks first among all vegetables grown throughout the world. It also possesses valuable medicinal properties, an excellent purifier of blood and a rich source of vitamins like vitamin A and C than any other vegetables (Villareal, 1978).

It is an important cash-generating vegetable crop to small-scale growers and provides opportunities for employment in the production and processing plants (Lemma, 2003). Its production is more attractive than any other vegetable crops for its multiple harvests, which results in high profit per unit area of land. According to (Lemma, 2003), tomato is the most profitable vegetable with net income of about 11,000 to 14,000 Birr per hectare. Both fresh and processed tomato varieties are popular and economically important vegetable crops produced in the country (Geleta et al., 1995).

In the tropics, tomato is mostly produced by transplanting. Good quality of seedling usually leads to higher yield and earlier maturity. Tomato that mature early not only could receive higher price on fresh market, but also could reduce the risk involved in growing tomatoes in the tropics (AVRDC-TOP, 1987).

The current production of the crop under farmers' conditions is 90 q/ha, which is very low compared to 250 and 400 q/ha at demonstration and experimental research plots, respectively (Lemma, 2002). Increasing production of the crop has a great role to strengthen the growing

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tomato-processing production industries in the country. However, the production and productivity of the crop in the country is influenced by different factors among which over-utilization of irrigable land for vegetable growing result in diseases build up, compaction that leads to poor ventilation as well as infiltration that exposes the crop for different fungal diseases like damping off.

Nursery potting media influence quality of seedlings produced thereof (Baiyeri, 2005; Sahin et al., 2005; Agbo and Omaliko, 2006). The quality of seedling obtained from a nursery influences re-establishment in the field (Baiyeri, 2006) and the eventual productivity of vegetable crops (Baiyeri and Ndubizu, 1994). Therefore, screening of best media combination that best support the seedling for proper growth is paramountly important in meeting the demands of growers and overcoming the various production constraints such as poor water infiltration, ventilation, low yield and quality as well as susceptibility to different diseases/pests. This work aims at introducing improved tomato seedling production technique through identifying ideal media mixing ratio that best support seedling with maximum nutrient.

MATERIALS AND METHODS

The activity was conducted at ATARC on horticultural research field (on station). Cheap and locally available media like red ash, termite tomb, cow dung and course sand was collected from nearby sources to make good soil of plant media in theory with a proportion of half solid and half pore space.

It was suggested that the basic theory of good soil was proposed and implemented to prevent the surface from crusting, causing difficulty in water infiltration and aeration for normal activity of the seedling as well as help to grow healthy and vigor seedling. Those four media were used with the following importance: 1) Volcanic red ash has more pore space and good ability to absorb water; 2) Soil from termite tomb was selected due to its being free from soil borne disease and weeds seeds, also with organic matter and mineral better than ordinary soil; 3)

The course sand from the river has medium particles that create well drainage and aeration; 4) It also protect the surface from crust by silt and clay particle; cow dung can be a source of organic matter and nutrient since it also holds water for long period. In all mixtures, relatively small proportion of cow dung was utilized as a result of short stay of the seedling on nursery (28 – 35 days) so the nutrient supply from it is enough to support the seedling until transplantation period.

Transparent plastic lath house was constructed to prevent the seedling from strong wind and rain. Picture of lath house in which the seedlings were raised inside the house construction of bed at waist (80 cm) and knee height with cheap and locally available materials was made to evaluate easy management practice and performance of seedlings based on different parameters.

Since plastic tray is not affordable and available to majority of farmers in the area, locally available leaf of rubber tree and egg plants were collected and encircled to make its pot using acacia thorn. The four media were mixed at the following ratios in four treatments:

T 1 (3 red ashes: 3 course sand: 3 termite tomb: 1 fermented cow dung)
T 2 (4 red ashes: 3 course sand: 2 termite tomb: 1 fermented cow dung)
T 3 (4 red ashes: 4 course sand: 2 termite tomb: 1 fermented cow dung)
T 4 (4 red ashes: 4 course sand: 3 termite tomb: 1 fermented cow dung)
T 5(Control or farmers practice).

All treatments except control were replicated four times in different experimental unit to evaluate the performance of the seedling and easy management.

Description of the study area

Adami Tulu Agricultural Research Center (ATARC) is located in the mid rift valley (MRV), 167 km south of Addis Ababa on Awasa Road. It lies at latitude 7° 9'N and 38° 7'E longitude. It has an altitude of 1650 m.a.s.l. and a bimodal unevenly distributed average annual rainfall of 760 mm. Rainfall extends from February to September with a dry period in May to June, which separates the preceding ''short'' rains from the following ``long'' rains. The pH of soil is 7.88 fine sandy loams with sandy clay in proportion of 34, 48 and 18, respectively (Adami Tulu Research Center profile, 1998).

Replication (Placement)

R1. Media filled in pot and placed on the ground.
R2. Media filled in pot and placed on the bed at waist height.
R3. Media mixture spread over a bed at knee height.
R4. Media spread over the ground.
R5. Check or farmers practice out of lath house.

For all treatments, seed of tomato variety, Malkashola, was used as a result of high yield and market preference. To provide the technology that is to be used by majority of end users before the beginning of the activity, training was given by different multi-disciplinary team of researchers from the center to representative farmers, development agents (Das) and subject mater specialist (SMS) of Dugda and Adami Tulu J/kombolcha districts. Media mixing and plantation were made together with those three groups by inviting them to the center. Since the seedlings are growing healthily, activities like spraying with chemicals to control pest and fertilizer application was not made before field transplantation. Watering, weeding and other management practice was made as per the recommendation set for the crop. At 35th day, when ready for transplanting, representative farmers were invited to evaluate the stand and performance of the seedling based on their subjective judgment.

Finally, agronomic data was collected on the following points before transplanting and after transplantation at a time of harvesting: Seedling height, seedling diameter, number of true leaves, presence and absence of diseases, general difference among treatments and replications, fruit number/cluster, cluster number/plant, marketable, unmarketable and total weights.

Data analysis

All the collected agronomic data were analyzed by SAS soft ware (SAS 1999 - 2000) using Duncan multiple taste range with 95% confidence interval.

RESULTS AND DISCUSSION

From Tables 1 and 2, T3 performs better in stem diameter, seedling height and number of true leafs (4.1 mm, 9.2 cm

Table 1. Descriptive summary result of average stem diameter, seedling height and average number of true leaves for different treatments.

Treatment	Average stem diameter (mm)	Average seedling height (cm)	Average number of true leaves
T1	3.7745±0.592ab	9.075±0.749ab	4.10±0.311ab
T2	3.7755±0.305ab	9.228±0.566ab	4.45±0.403a
T3	4.1435±0.099a	9.765±0.393a	4.25±0.223a
T4	2.8800±0.567bc	7.180±1.25ab	3.6±0.456ab
T5	2.4460±0c	6.400±0b	3.2±0b

Different letters across column indicate statistical significant difference among treatments with different parameters at P < 0.05. For T5 standard error becomes 0 as a result of non replication

Table 2. Descriptive summary result for average stem diameter, seedling height and average number of true leaves in different replications (placements).

Placement or replications	Average stem diameter (mm)	Average seedling height (cm)	Average number of true leaves
R_1 (PG♣)	3.68±0.261b	8.93±1.108ab	4.25±0.223ab
R_2 (PB♠)	4.68±0.249a	10.09±0.138a	4.90±0.173a
R_3 (MB®)	3.36±0.290bc	8.56±0.601ab	3.60±0.081bc
R_4 (MG□)	2.81±0.504bc	7.67±1.119ab	3.65±0.431bc
R_5 (C^{π})	2.45±0c	6.40±0b	3.20±0c

Different letters across a column indicated significant difference at P < 0.05. For T5, standard error becomes 0, because it was done without replication.

and 4.2 cm) respectively as compared to other treatments and control, that is, increment in termite tomb in case of T1 and T4, which is beyond provision of disease free organic material that hinders normal water infiltration and aeration. As a result, respiration and photosynthesis are not ideal in the case of T3, but a slightly significant difference occurs in the case of T2. This indicates that the highest percentage of red ash and course sand will facilitate aeration, from which the plant benefits much for respiration and photosynthetic processes.

As to plant height, the result indicated that there is highest significant difference among the treatments, but not as strong as stem diameter; but T3 still showed highest significant difference when compared to check and a slightly significant difference when compared with the rest treatments. This finding indicated that height of the seedlings was not maximally affected with different media mixing ratio as in case of seedling diameter, but still, it showed the highest significant difference compared to check or farmers' routine practice in the study area.

Average stem diameter in centimeter

With stem diameter, the highest significant difference occurs statistically among the replications. Media filled in pot and placed on the bed indicates the highest average stem diameter (4.68 mm), followed by pot placed on the ground (3.68 cm) and media placed on the bed (3.36 cm), respectively. Among all, check or farmers practice is very thin and delicate (2.45 cm), followed by media placed on the ground (2.81 cm). The performance of pot on bed is due to the fact that, watering, weeding and other cultural practice are easily performed than the rest placement. Also, during watering, it will reduce the power of water from watering hose, at which it arrives on the seedling as opposed to the rest replication.

Average seedling height in centimeter and number of true leaves

With this parameter, there is high statistical significant difference, but not as strong as stem diameter. Here, seedling also raised from pot placed on the bed performs better than the rest, due to the reason mentioned above. This agrees with the work of (Baiyeri and Mbah, 2006) done in Nigeria on "water stress of African breadfruit", indicating seedlings raised in medium 1:4:3 RHB (Ricehull-based) that resulted in more leaves, longer stem and thicker stem girth at 24 week after planting.

In Table 3, T2 and T1 gave the highest mean yield of 477±83 and 469±56 q/ha respectively as compared to the rest treatments, T3, T5 and T4 that gave 363±32, 351±0 and 310±46 q/ha in decreasing order, respectively. Even though the statistical analysis at harvestable yield indicates non significant difference among these treatments, T2 gave the yield advantage of 23.89% over that of T4.

Table 3. Descriptive summary result of average fruit number/cluster, cluster number/plant, marketable, unmarketable and total yields in quintal/ha for tomato seedling management under different treatments.

Variable (qt/ha)	CV (%)	T1 (3:3:3:1)	T2 (4:3:2:1)	T3 (4:4:2:1)	T4 (4:4:3:1)	T5 (Control)
Fruit number/cluster	20.66	3.6±0.31a	3.9±0.38a	3.9±0.24a	4.8±0.72a	4.5±0a
Cluster number/plant	19.17	13±0.69a	12±1.4a	11±1.5a	14±1.5a	11±0a
Marketable weight	28.36	374±46a	411±73a	313±28a	265±39a	281±0a
Unmarketable weight	62.20	94±37a	66±13a	50±10a	45±12a	70±0a
Total yield	28.6	469±56a	477±83a	363±32a	310±46a	351±0a

Comparing Tables 1 and 3 and different parameters at vegetative and maturity time, treatments performed at vegetative stage did not perform better at the time of maturity. This indicates that good vegetative growth does not always lead to good harvest, unless proper management practices have been conducted as per the recommendation set for the crop; but this has many implications for some farmers who are going to sell their seedlings after raising them in their farm to those who are not able to do so.

The SAS (1999 - 2000) version analysis indicates statistically, that there is a non-significant difference among the treatments, but it showed a clear mean difference in average yield among the treatments. As opposed to T3 that indicates high significant difference compared to the rest treatment at the time of transplanting, T2 gave high amount of yield (477±83) at the time of harvesting as compared to the rest treatments (T4 and T5) with 310 and 351 q/ha, respectively. In general, the vegetative growth and fruit yields for all media except the control are performed well. As to the marketable yield per hectare, T2 and T1, respectively gave high amount of yield (411±73 and 374±46 q/ha). From T1, T3 however showed a high vegetative stage. At a time of transplanting, it performs lower than T1 and T2; therefore, in order to get high amount of yield per a given area of land, it is possible to recommend T2 and T1, respectively. For the replications, R3 (media placed on bed) performs better in market and total yield with 445±47 and 372±47 q/ha respectively, followed by T2 (pot placed on bed) with 389±45 q/ha than the rest treatments. Therefore, R3 (pot placed on bed) gave high amount of yield and better vegetative stage than the rest treatments.

Finally, for farmers and private investors, involved in production of seed, fresh market and processing to get the best promising vegetative and marketable yield, they have to apply T2 (4 red ashes: 3 course sand: 2 termite tomb: 1 fermented cow dung) and use the pot that is placed on the raised bed.

CONCLUSION AND RECOMMENDATIONS

Poor quality seedling will not be improved by any means of management after being transplanted to the field and the genetic inheritance of a given variety will be revealed if and only if it is supplemented by proper seedling management practices. Therefore, in order to get quality seed and harvestable tomato fruit, it is paramount to adopt scientific and proper seedling management practices. Consequently, the above result leads us to recommend to farmers and private investors involved in vegetable seed production to use T2 (4 red ashes: 3 course sand: 2 termite tomb: 1 fermented cow dung) followed by T1 (3 red ashes: 3 course sand: 3 termite tomb: 1 fermented cow dung) in order to get the ideal and firm seedling that will better survive and give good yield after being transplanted to the permanent field.

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