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Growth Performance of Tomato (*Lycopersicon Esculenta* L.) as Affected by Different Sowing Depth at Jimma, Southwestern Ethiopia

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ABSTRACT

Tomato (*Lycopersicon esculenta* L.) is one of the commercially cultivated vegetable crops in most part of the Ethiopia. It is mainly grown for its fruits and consumed both as fresh or cooked form. The crop is very important as a cash crop and earning income to the small scale farmers. However, seedling growth performance of the crop in the dry season is limited by soil moisture, firmness of soil and water deficiency. Therefore, a field experiment was conducted in 2016 cropping year at JUCAVM horticulture and plant science research site during dry season by using irrigation with the objectives of determining the effect of different sowing depth on the seedling emergency and growth performance of local tomato variety. The experiment consists of four different types of sowing depth 2.5, 5.0, 7.5, and 10.0cm laid out in Randomized Complete Block Design with three replications. Data were collected on growth performance of tomato. Among different sowing depth the highest growth performance of tomato were recorded from sowing depth 2.5cm whereas the lowest was observed from deep sowing. Farmers around JUCAVM and similar areas can use those sowing depth which increases growth performance of tomato. However, similar field and economic feasibility studies need to be carried out for number of season and location.

Keywords: Growth performance, Seedling emergency, Sowing depth and Tomato

INTRODUCTION

Tomato (*Lycopersicon esculent* L.) belongs to *solanaceae* family known as night shade family and genus of *Lycopersicon*. It is originated in narrow strip along pacific coast of South America, majority centered in the mountainous area of modern day of Peru and Galapagos Islands (Basset, 1986, Culter, 1997, Male, 1999, Cox, 2000).

It is cultivated in back yard for home consumption, commercially for market, processing and export. It is one of the world most known vegetables for fresh use as well as processing. It ranks first among all vegetables grown through out of the world (FAO, 2008). It also process valuable medical properties and rich source of vitamin "A", "B" and "C" than any other vegetables (Basset, 1978). It also a cash generating crop to small scale grower and provide opportunities for employment. Its production is more attractive than any other vegetables for it is multiple of harvesting, which result high profits per unit area.

In Ethiopia it is one of the most widely grown vegetables. Fresh and processed products are very common. Small scale farmers produced the bulk of fresh market tomatoes, while processing type are largely produced by private farms (Lemma, 2003).

There are different factors that affect seedling emergency and growth performance of tomato. Among them sowing too deep and too shallow, unsuitable weather condition and poor agronomic practices are the most common. It requires optimum sowing depth to germinate and grow properly. If tomato seed is sowed too deep they may be damaged by decaying and damping off and if it is sowed too shallow it affected by insect and dry condition which result evaporation from the soil surface (William *et al.*, 1995).

Farmers around Jimma they use different sowing depth which is not fixed to maximize the growth and yield of tomato. This unfixed sowing put problem on the production of tomato and cause drastic yield

reduction. The use of optimum sowing depth together with other improved technologies to increase yield is the main issues by the farmers. With millions of seeds sowed only a few will emerge and grow into successful plants. If you improperly sow the seed, it has a higher chance of emergency failure. With this point the research is designed to investigate the effect of sowing depth on seedling emergency and growth performance of tomato at Jimma southwestern Ethiopia.

MATERIALS AND METHODS

Description of the Study Area

The experiment was conduct under field condition at Jimma University College of Agriculture and Veterinary Medicine (JUCAVM) horticulture and plant science research field in the year 2016 cropping season. It is geographically located at about 7^0, 33^0 N latitude and 36^0, 57' E longitude at an altitude of 1710 meter above sea level. The mean maximum and minimum temperatures are 26.8°c and 11.4°c respectively, and the mean maximum and minimum relative humidity are 91.4% and 31.2% respectively. The annual rainfall of the area is 1500mm.The soil of the experimental site is well-drained clay to silt clay with P^H of 4.51(Essubalew *et al.,* 2015).

Experimental Design and Treatment

The experiment was laid down in Randomized Complete Block Design with three replications and four level of sowing depth (2.5cm, 5.0cm, 7.5cm, and 10cm) under filed condition at Jimma University College of Agriculture and Veterinary Medicine horticulture and plant science research filed. The total area was 4.5m x13.5m (60.75m^2) and one block were having an area of 1m x13.75m (13.75m^2) and single plot area was 1m x 3m (3m^2). The path between each plot was 0.5m and between each block was 0.75m. On each row would have three seedling of tomato and in each plot would have nine seedling of tomato**.**

Experimental Materials

The material was used as local tomato seed, fertilizer, shovel, rack, spade, hoe, rope, meter, string, peg, hammer, watering cane, calculator, pen, pencil, note book measuring cylinder, sensitive balance, plastic bag, marker and oven.

Data Collected

Data on the growth performance of tomato were recorded from each plot by taking three random plants from the middle. These quantitative traits includes: days to 50% emergency, plant height (cm), leaf area (cm^2), stem girth (cm), leaf length (cm), leaf width (cm) and number of branch per plant.

Data Analyzed

The raw data of each parameter from each plot and replication were collected and data was analyzed using SAS software. The treatment mean separation was done using Least Significant Difference at 5% level of probability (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Days to 50% Emergency

Data depicted in Table 1 showed that the highest 50% emergency was observed when tomato grown under 2.5cm sowing depth which is statistically similar with 5.0 and 7.5 cm sowing depth, respectively. While, the lowest days to 50% emergency was observed when tomato planted at 10cm sowing depth. This might be the fact that to deep sowing soil temperature is lower and unsuitable for germination since, tomato and other solanaceae family vegetables seeds highly require optimum temperature for good germination (Gan *et al*., 1996). Environmental factors such as temperature, light, p^H and soil moisture are known to affect seed germination of tomato (Rizzardi *et al*., 2009). This work in line the work of Halsey (1969) plants emerged faster in one inch depth than the one-half inch depth of sowing.

Table1. Effects of sowing depth on days to 50% emergency of tomato at Jimma

Sowing depth (cm)	Days to 50% emergency
2.5	70.40[a]
5	63.00[a]
7.5	55.60[a]

10	0.00[b]
Mean	47.25
CV (%)	21.08
LSD (0.05)	19.90

Means followed by the same letter are not significantly different from each other at P=0.05.

Plant Height

Data presented in Table 2 showed that the tallest plant height was observed when tomato grown under 2.5 cm sowing depth which is statistically similar with 5.0 and 7.5 cm sowing depth, respectively. Whereas, the shortest plant height was observed under 10cm sowing depth. These could be due to as seeds germinated as early start produced more leaf and food through photosyentsis and it used for growth and development. In other side as the depth of the soil increase soil macro and micro porosity become to decrease in density and size due to these facts level of nutrients availability and soil moisture become decrease with this translocation of food form the seed stop. According to Broome (2003), pore space is occupied by air and water so the amount of air and water are inversely proportional to the amount of oxygen in the soil.

Table2. *Effects of sowing depth on days to plant height of tomato at Jimma*

Sowing depth (cm)	Plant height (cm)
2.5	27.43[a]
5	26.70[a]
7.5	23.83[a]
10	0.00[b]
Mean	19.49
CV (%)	6.84
LSD (0.05)	2.66

Means followed by the same letter are not significantly different from each other at P=0.05.

Number of Leaf per plant

Data obtainable in Table 3 showed that the uppermost leaf number was observed when tomato grown under 2.5 cm sowing depth which is statistically similar at 7.5 cm sowing depth respectively. Whereas the lowest leaf number was observed when tomato planted under 10cm sowing depth. This could be due to the fact that there is variation soil temperature. This result in line with the findings of NCRFC (2011) described in its national weather service page, a frozen soil limits infiltration of water thereby generating more runoff from rain, snowmelt and hamper seed germination than soil that is not frozen.

Table3. *Effects of sowing depth on the leaf number of tomato at Jimma*

Sowing depth (cm)	Leaf number
2.5	76.99[a]
5	55.32[b]
7.5	43.20[a]
10	0.00[b]
Mean	19.49
CV (%)	6.84
LSD (0.05)	2.66

Means followed by the same letter are not significantly different from each other at P=0.05.

Leaf Length

Data depicted in Table 4 showed that the longest leaf length was observed when tomato grown under 2.5 cm sowing depth which is statistically similar to 5 and 7.5 cm sowing depth. Whereas the lowest leaf length was observed when tomato planted under 10cm sowing depth. The main reason of this would be likely more sowing depth, the lower the temperature and it could results limit up take of water and nutrients from the soil. In other side as the depth of the soil increased, un-aerobic microorganisms of the soil will be increased which is the main reason of tomato plant roots to up take excess amount of phosphorus nutrient which can interfere up take and function of Fe, Mn and Zn which enhance production of chlorophyll, growth regulation and photosynthesis respectively (Jones, 1999; Echochem 2015).

Table4. *Effects of sowing depth on the leaf length of tomato at Jimma*

Sowing depth (cm)	Leaf length (cm)
2.5	2.30[a]
5	2.23[ab]
7.5	1.96[b]
10	0.00[c]
Mean	1.62
CV (%)	9.91
LSD (0.05)	0.32

Means followed by the same letter are not significantly different from each other at P=0.05.

Leaf Area

The result indicated in Table 5 showed that the maximum leaf area was observed when tomato grown under 2.5 cm sowing depth which is followed 5 cm sowing depth. The mini mum leaf area was observed at 10cm sowing depth. This difference mainly due to the fact there is variation in sowing depth and unfavorable environmental conditions in different sowing depth. Seedlings emerging from greater depth are also weaker and tiller poorly. Extension of the coleoptiles is directly related to soil temperature. Soils that are too cold or too hot shorten the coleoptiles length (PROCROP, 2007).This study agreed with the finding of (Yang *et al*., 2006).

Table5. *Effects of sowing depth on the leaf area of tomato at Jimma*

Sowing depth (cm)	**Leaf area (cm^2)**
2.5	8.57[a]
5	8.29[ab]
7.5	5.52[b]
10	0.00[c]
Mean	5.59
CV (%)	25.76
LSD (0.05)	2.88

Means followed by the same letter are not significantly different from each other at P=0.05.

Stem Girth

Data presented in Table 6 showed that the highest stem girth was observed when tomato grown under 2.5 cm sowing depth followed by at 5 and 7.5 cm sowing depth. While, the lowest stem girth was observed when tomato planted under 10cm sowing depth. Crop yield and plant growth are closely related to root system development (Westesen *et al*., 1987) as the root of plants exposed to un-favorable soil condition, the rate and amount of water and nutrients need to move from soil to plant become decline, which can result limited increments of stem girth of tomato. This result is in line with work (Pavek and Thornton, 2009).

Table6. *Effects of sowing depth on the stem girth of tomato at Jimma*

Sowing depth (cm)	Stem girth (cm)
2.5	3.03[a]
5	2.73[a]
7.5	2.35[a]
10	0.00[b]
Mean	2.03
CV (%)	17.81
LSD (0.05)	0.72

Means followed by the same letter are not significantly different from each other at P=0.05.

SUMMARY AND CONCLUSION

Tomato (*Lycopersicon esculenta* L.) is the one of the most important vegetable crops in Ethiopia and widely used as a fresh, home consumption, processing. Growth and yiled of tomato impaired by several factor out of these emergency and seedling growth tomato plants were significantly affected by different sowing depth. Among different sowing depth 2.5cm, 5.0cm, 7.5cm, and 10.0cm sowing depth were contributed to know the optimum sowing depth of tomato.

There are different factors that affect emergency and seedling growth of tomato. Among them sowing too deep and too shallow are the most one and also environmental condition (light, temperature and moisture etc) and cultural practices. Tomato requires optimum sowing depth to emerge and grow properly. If tomato seed is sowed too deep they may be damaged by decaying and damping of organism. If it sowed at too shallow planting deep they affected by some insect and dry condition.

To solve the above listed problem the experiment was designed in randomized complete block design in three replications at JUCAVM horticulture and plant science research filed. In this study effect of different sowing depth on the emergency and seedling growth performance tomato was investigated. The finding of the study revealed that tomato significantly responses to a different sowing depth. The results of the experiment indicated that effects of different sowing depth showed significant variation on tomato seedling emergence and seedling growth performance.

The result revealed that an optimum sowing depth showed better seedling and growth performance of tomato seedling was observed at 2.5cm sowing depth. However, the results of the experiment are only morphological parameters and did not include yield components due to limitation of budget. Thus the results would be assured, if similar research is going to be conducted in multi locations across seasons.

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