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Date of Planting on Tomato Fruit Production under Irrigation Condition in Humbo District, Southern Ethiopia

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Abstract

An experiment was conducted in 2018 and 2019 to evaluate effect of planting date on tomato fruit production under irrigation at Humbo District in Wolaita Zone, Ethiopia. Five planting dates with fifteen days intervals were evaluated for tomato fruit production such as planting at mid of September, at end of September, at mid of October, at end of October and at mid of November. The study was carried out using RCB design with three replications. Analysis of variance showed that there were significant differences among treatments. Planting at mid of September in 2018 yielded higher total fruits (22.58t ha^{-1}) and low diseases pressure than other treatments, where as in the case of 2019, planting at end of September produced better fruit yield (51.11t ha^{-1}) and low diseases pressure than other treatments. Based on this study, it can be concluded that planting tomato starting from mid to end of September yielded better than other planting times in the study area. Hence, farmers in the study area as well as in others with similar environmental conditions can be advised to adjust their planting practice of tomato to period of mid to end of September so as to get better tomato fruit yield.

Keywords: Planting date; Tomato; Growth; Fruit yield

Introduction

Tomato (Lycopersicon *esculentum* L.) is a fruit producing annually cultivated vegetable fruit crop under the family of Solanaceae. It is native to Western South America and use as a nutritious edible fruit throughout the planet that is grown in both greenhouse and field conditions [**1**]. Tomato is rich in nutrients such as vitamins, minerals and antioxidants, which are important to well-balanced human diets. Tomato is also an important dietary component because it contains high level of lycopene, an antioxidant that reduces the risks associated with several cancers and neurodegenerative diseases [**2**].

Tomato is a warm season crop that requires very stable temperature ranges with minimums and maximums not being too wide apart. Temperature variation might result in poor fruit quality or reduced yield. Extreme temperatures cause flower drops and poor fruit set. A temperature range between 21 and 27^{0}C day and 10- 20^{o}C night is favorable for plant development, and fruit set in the Rift Valley region in Ethiopia. Timing of planting date is therefore important so that every developmental phase may occur at times when temperature is favorable for crop performance and high yields can be obtained [**3**].

The best planting date for tomato in the Humbo area under irrigation had not been determined yet. Farmers in the study area had been planting tomato starting from September to the beginning of month December. Therefore, the current study was carried out in order to investigate the effect of planting date on tomato fruit production and diseases under the existing climatic conditions of Humbo District, Woliata Zone, Ethiopia.

Objective

To determine appropriate planting time period for tomato fruit production under irrigation in Humbo District, Wolaita Zone, Ethiopia.

Materials and Method

Description of study site

The study was carried out in Wolaita zone, Humbo district between September to November in 2018 and 2019. Wolaita zone is located between 06°30' –07°12' N 037°14' –038°7' E [**4**]. It covers an altitude range of 700–2900 m above sea level, having a bimodal rainfall [**5**]. Mean annual rainfall of the study area is 1001 mm with the lowest and highest record in January and August, respectively. The mean monthly maximum and minimum temperature is 27^{0}c and 14^{0}c, respectively. The last twenty two years' monthly mean values of rainfall and temperature are shown below **(Figures 1 and 2)**.

Soils of the zone are varying due to its diverse topography. The dominant soils of the zone are reported to be Nitisols with clay loam texture [**6**]. It is derived from a multistory ignimbrite substratum, deep and has a good general porosity, a high capacity to absorb rainfall, water and a high infiltration speed [**7**].

An improved tomato variety named Roma VF was used as a test crop. Urea (46%N) and NPS blended (19%N: 38%$P_2 0_5$:7%S) fertilizers with recommended rates (100kg urea and 200kg NPS) were used as the sources of Nitrogen and Phosphorus, respectively. Irrigation water was applied as per farmers' practice uniformly for all treatments. All other cultural operations like nursery rising, main field preparations, transplanting, weeding, diseases management (application of Mancozeb) etc. were carried out as per the recommendations in order to obtain a successful crop [**8**].

Treatments and experimental design

Five treatments of various planting dates were used with fifteen days

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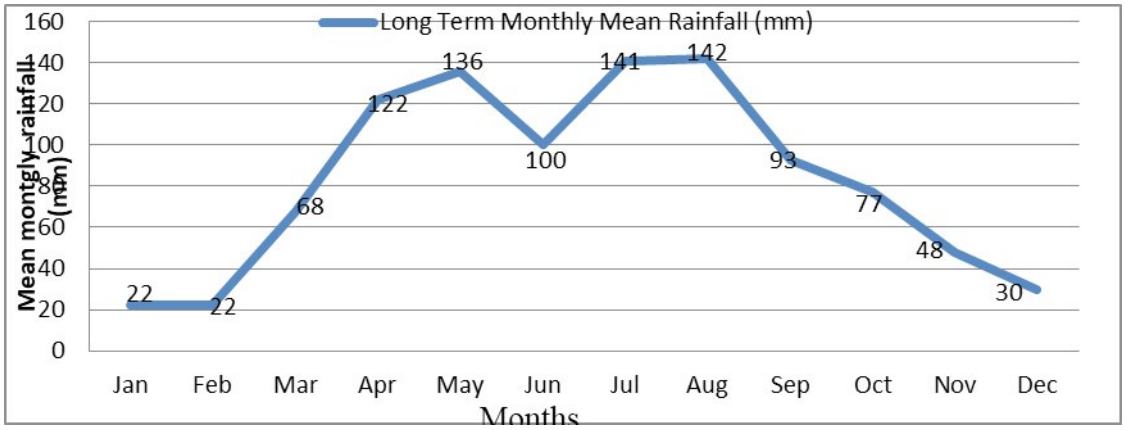

Figure 1: Long term (1996-2018) monthly mean rainfall amount (WMS, 2018).

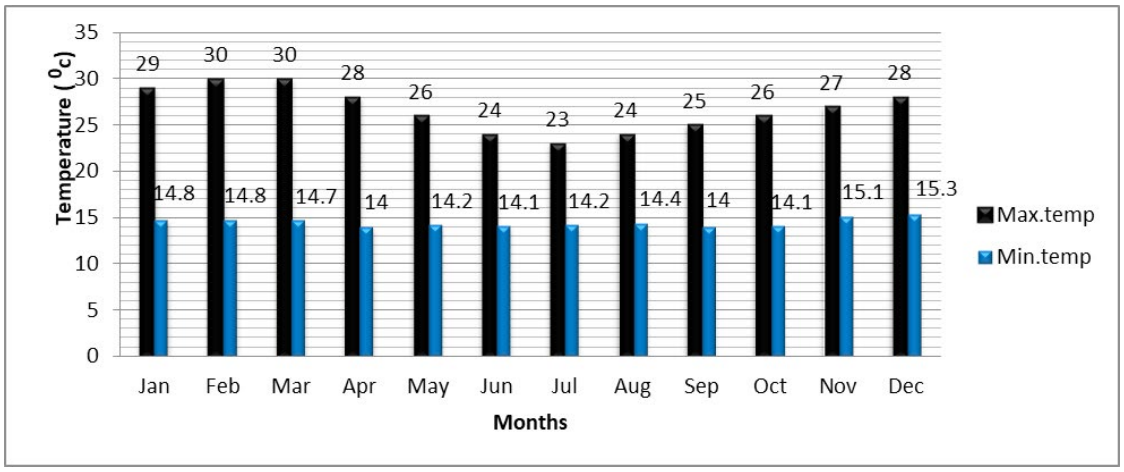

Figure 2: Long term (1996-2018) monthly mean maximum and minimum temperature (WMS, 2018).

intervals: **Treatment 1**: Planting at mid of September; **Treatment 2:** at end of September; **Treatment 3:** at mid of October; **Treatment 4:** at end of October and **Treatment 5:** at mid of November. The experiment was laid out as RCB design with three replications.

Data collection and analysis

Fruit yield, numbers of unmarketable, marketable and total number fruits per plot data were taken by using sensitive balance and diseases data was also recorded. The collected data were subjected to analysis of variance (ANOVA) for RCB Design using the SAS software by the command PROC GLM version 9.2 (SAS Institute, 2009). Least Significant Difference (LSD) test at 5% probability was used to separate means when the F test was significant.

Results and Discussion

Effects of planting date on growth of tomato crop

It is usual that the effect of planting time in relation to change of temperature of the environment is reflected primarily in plant growth. Both tomato plant height and number of primary branches were significantly ($p<0.05$) affected by planting date. The longest plant height (75.5cm) and more primary branches (7.7) were observed with tomato planted at the end of month September. There were no statistically significant differences observed in both plant height and number of primary branches of tomato planted starting from mid-October to mid-November. In general, late planting showed a significant reduction in plant height and number of primary branches of tomato (Table 1). This may be due to the existing temperature differences of the respective months. More than optimum temperatures were recorded in growth period of tomato planted in other treatments expect September (Fig 2).Therefore, the presented results are consistent with other previous findings published. It agrees with Srivastava and **[9]** who reported that planting time had great effect on the regulation of plant architecture as well as plant height of tomato. Similarly, **[10]** reported that among dates of planting, early planting recorded the highest vegetative growth. While **[11]** stated that number of branches per plant was found to be gradually decreased with the late transplanting dates.

Effects of planting date on tomato fruit yield

Planting date highly significantly ($p<0.05$) influenced the marketable fruit number, marketable fruit yield and total yield of tomato in the study area in both years of 2018 and 2019. In the year 2018, the highest marketable fruit number, marketable fruit yield and total yield were observed from planting tomato at mid and endof September whereas in the year 2019,planting tomato at end of Septembergave highest fruit yield. The lowest fruit number and yields were observed from other planting dates in both years (Table. 2 and Table 3). In other words, planting tomato within month Septembergave better yield than planting in October and/or November. This result was consistent with the growth parameters analysis of variance such as plant height and numbers of branches per plant of the year 2019. Moreover, the simple linear correlation coefficientsfor major parameters measured

Table 1: Effects of planting date on plant height and numbers of primary branches of tomato in Humbo district,Wolaita Zone, Ethiopia, 2019.

Planting date	Plant height (cm)	Number of primary branches
Mid-September	69.8b	5.6b
End September	75.5a	7.7a
Mid October	63.6c	6.0ab
End October	63.2c	4.6b
Mid November	63.7c	4.9b
LSD(0.05)	4.7	1.8
CV (%)	3.7	16.9

Table 2: Effect of Planting Date on Number of Marketable Fruits (NMF), Marketable Fruit Yield (MFY) and Total Fruit Yield (TFY) of Tomato in Humbo district,Wolaita, Ethiopia, 2018.

Planting date	NMF	MFY (t ha^{-1})	TFY (t ha^{-1})
Mid-September	360,185a	15.52a	22.58a
End September	236,852b	11.72ab	17.51ab
Mid October	131,852c	6.94c	10.55c
End October	168,056b	9.31bc	14.34bc
Mid November	137,870c	7.33bc	12.81bc
LSD(0.05)	94,268	5.92	7.72
CV (%)	3.1	9.1	7.9

Table 3: Effect of Planting Date on Number of Marketable Fruit (NMF), Marketable Fruit Yield (MFY) and Total Fruit Yield (TFY) of Tomatoin Humbo district, 2019.

Planting date	NMF per ha	MFY (t ha^{-1})	TFY (t ha^{-1})
Mid-September	670,667b	33.73b	41.42c
End September	714,889a	40.84a	51.11a
Mid October	558,889c	36.09b	45.02b
End October	385,333e	22.20d	29.69e
Mid November	435,333d	25.40c	33.09d
LSD(0.05)	28,990	2.460	3.513
CV (%)	2.8	4.1	4.6

were significantly different from zero at the 1% probability level. The significant high r values indicated that there was strong evidence that the growth and yield parameters were highly associated with one another in a linear way. Numberof marketablefruits (r = 0.78**), marketable fruit yield (r = 0.67**) and total fruit yield(r = 0.63**)all were positively and strongly correlated with plant height. Similarly, number of marketable of fruits (r = 0.73**), marketable fruit yield (r = 0.75**) and total fruit yield (r = 0.76**) were positively and strongly correlated with number of primary branches. Furthermore, both marketable fruit yield (r = 92**) and total fruit yield (r = 87**) were positively and highly correlated with number of marketable of fruits. These resultssuggest that Septemberplanting time is more favorable to produce highest plant height and branch number as a result higher flower produced which enhance the higher fruit set and development which in turn contribute to maximum yield than late transplanting. Furthermore, theresultof this study agrees with other researchers' results. **[5].** Reported the results of studies carried out at different areas in Ethiopia that planting in month September provided higher marketable mean yield than other months. **[12]** also showed a declining trend in fruit yield and other yield attributing characters when planted lately. Similarly, **[13]** reported that early planting of tomato gave increased yield [14].

Conclusions

The results of the experiment revealed highly significant responses of growth and yield parameters of tomato to planting date. Both plant height and number of primary branches were significantly influenced by planting date. The highest plant height and primary branches were recorded from tomato planted in month September. Similarly, number of marketable fruits, marketable yield and total yield were highly significantly influencedby planting date. Higher number of marketable tomato fruits, marketable yield, total yield and low diseases pressure were obtained from planting tomato at mid and end of month September in the 2018, while in the year 2019 planting at end of September resulted in higher number of marketable tomato fruits, marketable yield and total yield and low diseases pressure. Based on the results found, in general, it can be concluded that planting tomato within month September provided higher yield than other months tested in the study area.Therefore, it is better advising tomato growing farmers to plant tomato in between mid to end of September so as to obtain higher yield inthe prevailing environmental conditions of the study area, Humbo, Wolaita, Ethiopia. Future research should be directed studying more agro-ecology are needed to establish the correlation between fruit yield and weather factors.

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Competing Interest

The authors declare that they have no competing interests.

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