Indian Res. J. Genet. & Biotech. 10(3): 32-37 Nov (2018)

Effect of Staking Method of Planting on Plant Population, Growth Development and yield of Rainy Season Tomato Crop

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(Received : September, 2017 : Revised : September , 2018; Accepted : September, 2018)

Abstract

Effect of Staking Method of Planting on Plant Population, Growth Development and yield of "Red Gold" was studied in the tropical derived Savannah under rain-fed condition at Dhar district.

A population of 40,000 plants per hectare appeared optimim for field grown tomatoes under rain fed conditions, giving an average yield of 89% better than the usual population 37,037 plants per hectare often recommended. Staking of the tomato plants resulted in better fruit set, more total dry matte produced per plant and increased plant height. Percentage of marketable yields were found similar for staked and unstaked plants. The fruit yield advantage of 8% for staked treatment over the unstaked tomato plants would not compensate for the cost of material and labour for staking. There is need for good pest and disease control programmes to avoid fruit damage by insects and fungal leaf diseases.

Key words: Lycopersicon esculentum, early season, staking, plant population.

Introduction

Tomato lycopersicon esculentum mill is the most important word vegetable by production area commercial value and consumed quantity leave both in the, tomatoes are important in maintaining a satisfactory nulritional level both in the temperate and tropical regims. Being a dry natural plant, the crop con be grown at any time of the year provided temperate, humidity, and light conditions are suitable. It requires a moderately and color night temperature of 15-20^0 c high day temperature of 2128^0 c for optimum vegetative growth and good fruit set. Tomato yields in the tropics are lower than in the temperate zone, due to susceptibility to diseases such as bacterial blight and fusarium wilt, root knot nematodes, and low fruit set as a result of heavy rainfall and very high temperatures (vallareal, 1980) the high temperatures of about 0^{0}C in tomato production area of the tropics usually causes blossm drop and failure of fruit set which are physiological phenomena (abdalla and verkerk 1968). Those problems associated with high humidity and temperature, dversely affect the production of rain-fed tomato in southern Nigeria. Use of optimum plant population has a tremendous effect on crop performance largely because of maximum light interception and the use of other resources like fertilizer and soil moisture (janic et al., 1974). However, plant population studies with other crops showed that increasing plant density usually increased yield per unit area, but decerased in per plant. It was therefore the object of this investigation to find out the optimum plant population for field grown tomoto under the early rainy season conditions of Dhar in a Malwa area of India. The advantages that could be derived from staking rainy season field grown tomato as copared with the unstaked crop was also investigated.

Materials And Methods

The field experiments were carried out at research farm of K.V.K., Dhar (M.P.) during the month of April-August, 2011. Dhar. The soil was medium black in texture, slightly alkaline in reaction (pH 7.8) with light 15%, medium 33% and heavy 30%. The experiment was laid out the chemical characteristics of 1.17% total N,0.0001% P,0.14 meq/100g K, 0.096 meq/100g Ca and 0.14meq/100g Mg. The tomato variety used was "Red Gold" the experiment was a 2X8 factorial laid out in a randomized complete

Corresponding author's e-mail:
Published by Indian Society of Genetics, Biotechnology Research and Development,
5, E Biotech Bhawan, Nikhil Estate, Mugalia Road, Shastripuram, Sikandra, Agra282007
Online management by www.isgbrd.co.in

block design (RCBD) with three replications. Treatments consisted of staked and unstaked and eight plant population of 33, 333, 37, 037, 41, 667, 40,000, 44,444, 50,00049,383 and 55,556 plants/ha.

A ground nursery bed where the tomato seeds dusted with Fernasn-D fungicide were drilled into on April, 9 2011 was close to the experimental field. Two days to transplanting, each plot received a basal application of poultry manure at the rate of 10 t/ha on dry basis. Seedlings were transplanted on May 30, and two weeks later each plot received a dressing of urea at the rate of 80kg N/ha, muriate of potash at 111kg K/ha. and single superphosphate at 19kg P/ha. Plants were staked with bamboo sticks five days after transplanting.vetox 85WP was sprayed on all the experimental plot on july 2, 2011. Data was collected on the general plant morphological development yield, and yield components. All the data were subjected to analysis of variance (ANOVA) and means were copared using fisher's least significant difference (FLSD) at 5% level.

Result

Weather records (Table 1) showed that rainfall during crop establishment and vegetative growth periods in April and early May was low. However, it became very heavy from late May to July during flowering, fruit set and fruit filling stages, Relative humidity, The mean maximum day and mean minimum night temperatures were generally high for tomato production. This high mean minimum night temperature caused plant stunting.

Table 1 Summary of Weather Records During the Period of the Experiment

	April	May	June	July	August
Rainfall (mm/month)	115.3	274.0	345.0	221.3	224.1
Rain days (days)	11	13	10	18	25
Mean daily pan evaporation (m1/day)	4004.7	3407.1	3385.0	2056.5	1785.2
Mean max. day temp. (^{0}C)	31.2	30.1	28.9	27.8	26.7
Mean max. night temp. (^{0}C)	21.7	20.7	20.5	20.7	20.7
Mean daily Relative humidity (%)	73.5	76.6	76.9	78.2	78.6
Radiation cal./cm^2/day	535.7	615.0	572.1	435.0	317.0

Table 2 Influence of Plant and staking on Plant Morphological Development at 55 days after transplanting.

Plant population(per ha.)	Number of branches per plant			Height (cm) per plant		
	Unstaked	Staked	Mean	Unstaked	Staked	Mean
33,333	7.9	6.8	7.3	66.7	77.3	72.0
37,037	9.2	6.9	8.0	63.3	75.0	69.2
41,667	7.7	6.7	7.2	62.7	75.2	68.9
40,000	8.6	6.9	7.8	61.7	76.5	69.1
44,444	6.4	7.1	6.8	61.3	79.5	70.4
50,000	7.9	7.3	7.6	71.2	79.2	75.2
49,383	8.1	6.3	7.2	66.7	75.0	70.8
55,556	7.9	6.3	7.1	65.3	76.1	70.7
Mean	8.0	6.8	7.4	65.3	76.1	70.7
$LSD_{0.05}$for staking means			N.S.		4.75	
$LSD_{0.05}$for population means			N.S.			N.S.
$LSD_{0.05}$for staking X population means		N.S.				N.S.

At 55 days after transplanting (DAT) the number of branches of unstaked tomato plants did not differ significantly from those of the stanked ones(Table 2). However, the staked plants were taller than the unstaked. There were no clear differences among plant populations in the number of branches produced, and height. Staking the plants produced a significantly higher leaf dry weight compared with the unstaked plants but mo marked difference in the stem dry weight (Table 3). On e the average, differences in plant population did not produce any major differences in leaf and stem dry weights. Staking resulted in a higher total plant dry matter. At 55 DAT, there were no clear differences among all treatments as regards number of fruits/plant (Table 4). The number of fruits per plant and number of flowers produced in the first three truss positions on The main stem did not differ significantly (Table 5).

The staked tomato plants produced statistically more number of flowers compared with the unstaked plants. For the number of flowers aborted, there was no clear difference between staked and unstaked tomato plants. However, there was an increase in the number of flowers that aborted with higher truss position.

Table 3Influence of Plant Population and Staking on the total Matter of Tops And on Dry Matter Distribution

	Plant Population per Hectare								
	33,333	37,037	41,667	40,000	44,444	50,000	49,383	55,556	Mean
Leaf dry matter (g/plant)									
Unstaked	5.4	9.8	5.0	5.8	6.8	10.3	10.4	6.1	7.4
Staked	19.4	17.5	19.2	9.5	18.3	12.7	13.0	14.4	15.5
Mean	12.4	13.6	12.1	7.6	12.6	11.5	11.7	20.2	11.5
Stem dry matter (g/plant)									
Unstaked	11.4	13.3	11.0	9.1	8.5	9.9	19.5	12.6	11.9
Staked	12.7	14.8	15.3	8.7	17.2	10.0	9.5	10.1	12.3
Mean	12.0	14.1	13.1	8.9	12.9	10.0	14.5	11.3	12.1
Total above ground plant dry matter (g/plant)									
Unstaked	16.8	23.1	15.9	14.7	15.3	20.2	29.9	18.6	19.3
Staked	32.2	32.0	34.5	18.2	35.6	22.7	22.5	24.4	27.9
Mean	24.5	28.0	25.2	16.4	25.4	21.5	26.2	21.5	23.6
						Leaf		Stem	Total
$LSD_{0.05}$for staking means					3.68		N.S.	6.72	
$LSD_{0.05}$for population means						N.S.		N.S.	N.S.
$LSD_{0.05}$for population ^{X} means					N.S.		6.76	N.S.	

Table 4 Influence of Plant Population and Staking on the Number of Fruits Pierced per plant at 55 days after Transplanting

Plant population(per ha.)	Unstaked	Staked	Mean
33,333	17.1	16.3	16.7
37,037	20.6	20.0	20.3
41,667	18.7	16.6	17.6
40,000	16.1	23.8	19.9
44,444	11.2	21.6	16.4
50,000	14.1	26.5	20.3
49,383	18.7	13.1	15.9
55,556	17.9	13.8	15.8
Mena	16.8	19.0	17.9
$LSD_{0.05}$for staking means			N.S.
$LSD_{0.05}$for population means			N.S.
$LSD_{0.05}$for staking ^{X} population means			N.S.

Table 5 Number of Flowers Produced and Flowers Aborted at Different Different Truss Position as Influenced by Staking

Staking	**Truss position on the main stem**			
	1	2	3	Mean
Total number of flowers produced				
Unstaked	6.5	6.6	6.6	6.6
Staked	6.9	7.4	7.1	7.1
Mean	6.7	7.0	6.9	6.9
Flowers Aborted				
Unstaked	2.5	2.9	4.0	3.2
Staked	2.2	3.0	3.7	3.0
Mean	2.4	3.0	3.8	3.1
	Flowers Aborted		**Flowers Aborted**	
$LSD_{0.05}$for staking means	0.43		N.S	
$LSD_{0.05}$for truss means	N.S		0.70	
$LSD_{0.05}$for staking ^{X} truss means	0.75		0.99	

Staking tomato plants results in higher numbers of fruit set compared with the unstaked plants but the difference in the percentage fruit set failed to attain statistical significance (Table 6). Fruit set was more with lower truss position than with the higher truss position. There was no statistically significant difference in the total yield and marketable yield for two plant populations (Table 7). The yield increased from 6.8t/ha for the population of 33,333 plant/ha to 18.0t/ha for the population of 40,000 plants/ha after which it decreased. Neither plant population nor staking of the tomato plants in the rainy season had a significant effect on reducing the number of fruits pierced by fruit boring insects or on the total number of damaged fruits (Table 8). The fruit damage was on the average. 17.8%

Table 6
Number of Fruits Set and Percentage Fruit set at Different Different Truss Position as Influenced by Staking

	Truss position on the main stem			
Staking	1	2	3	Mean
Number of fruits set				
Unstaked	3.9	3.7	2.6	3.4
Staked	4.5	4.4	3.4	4.1
Mean	4.2	4.1	3.0	3.8
Percentage fruits set				
Unstaked	67.7	57.7	39.7	55.0
Staked	69.0	61.0	49.2	59.8
Mean	68.4	59.4	44.5	57.0

	Number of fruits set	Percentage fruits set
$LSD_{0.05}$for staking means	0.53	N.S
$LSD_{0.05}$for truss means	0.65	8.40
$LSD_{0.05}$for staking ^{X} truss means	0.91	11.98

Table 7
Influence of Plant Population and Staking on the total Yield (tones/ha) And Percentage Marketable yield

Plant population(per ha.)	Total yield (t/ha)			Percentage Marketable yield (t/ha)		
	Unstaked	Staked	Mean	Unstaked	Staked	Mean
33,333	6.3	7.3	6.8	77.8	100.0	88.9
37,037	9.8	9.4	9.6	100.0	93.6	96.8
41,667	15.7	16.4	16.1	95.6	64.7	95.1
40,000	14.8	21.3	18.0	92.8	97.8	95.3
44,444	8.0	7.2	7.6	94.9	64.9	79.9
50,000	10.7	15.9	13.3	100.0	93.3	96.7
49,383	18.8	16.4	17.6	78.7	100.0	89.4
55,556	13.6	10.4	12.0	83.3	100.0	91.7
Mean	12.2	13.0	12.6	90.4	93.1	91.7
$LSD_{0.05}$for staking means			N.S.			N.S.
$LSD_{0.05}$for population means			N.S.			N.S.
$LSD_{0.05}$for staking ^{X} population means		N.S.				N.S.

Table 8
Influence of Plant Population and Staking on the Number of Fruits Pierced andPercentage Damage at 55 days after Transplanting

Plant population(per ha.)	No. of fruits pierced per plant			Percentage damage		
	Unstaked	Staked	Mean	Unstaked	Staked	Mean
33,333	2.8	3.2	3.0	15.1	16.7	15.9
37,037	2.7	3.9	3.3	13.6	16.9	15.3
41,667	3.8	3.2	3.5	17.3	20.1	18.7
40,000	3.0	3.8	3.4	16.9	15.6	16.2
44,444	2.1	3.7	2.9	21.2	16.3	18.8
50,000	2.3	5.8	4.1	11.8	23.3	17.6
49,383	3.3	2.7	3.0	17.5	20.2	18.8
55,556	4.1	2.2	3.2	26.6	15.3	21.0
Mean	3.0	3.6	3.3	17.5	18.1	17.8
$LSD_{0.05}$for staking means			N.S.			N.S.
$LSD_{0.05}$for population means			N.S.			N.S.
$LSD_{0.05}$for staking X population means			N.S.			N.S.

Discussion

Irrespective of treatments, tomato yields appeared rather low. This might have been related to rather high temperatures (25.5-30.1^{0}5C), high rainfall and high relative humidity. Good fruit set in tomato is favoured by an optimum day temperature range of 21-28^{0}C. A day temperature>30 ^{0}C will result in impaired fruit set (Went, 1945; Went and cosper,1945). Early in the experiment, the rainfall was torrential and excessive in the months of late May and June, with a rainfall of 616 mm for 23 days. Continuous rainfall through through the subsequent months during fruit filling stage shortened the production span of the crops as a lot of the fruits dropped and many of the flowers aborted. The life span of the crop was 125 days which is lower than 160 days quoted by Grubben (1977). Heavy rainfall which characterizes the tropic resulted in reduced sunshine, greater vegetative growth, and increased incident of diseases (Purseglove, 1968)

Staking tomato plants produced more flowers resulting in more fruit set. It also increased plant height and total dry matter produced per plant, the latter agreeing with the findings of Adelana (1970). The non significant differences of the date on yield and yield components of unstaked compared with staked tomato plants could be attributed to foliar diseases which apparently cut short the life of the plants and greatly limited the realization of the full potential of the crop. The fact that staked tomato plants had nigher number of fruits set but had more fruits pierced per plant drastreally rediced the number of furits harvested from staked plants and consequently the yield. This expanlts why the percentage marketable fruits were not increased significantly by staking. This is contrary to the findings of Wurster and Nganga (1971) which indicate that when leaf diseae is a serious problem, yield of marketable fruits are increased by staking.

There was wide variability in performance of this tomato (variety “Red Gold”) at the different plant populations studied. The yield ranged from 6.8t/ha for 33,333 plants ha to 18.0t/ha for 40,000 plants/ha. In a similar experiment Holliday, (1960) had a yield range of 15t/ha for 4538 plants/ha to 32.8t/ha for 18,150 plants/ha. The yield difference from the result obtained by Holliday (1960) compared with the present experiment could be ascribed to differences in location, environmental conditions, season of growth, plant population used, and the level of management adopted. The yield of 18.0 t/ha form a population of 40,000 plants/ha was similar to the result obtained by willams (1975) using the same tomato variety “Red Gold” .

At an average of 12.6 t/ha, tomato fruit yield was generally low under the rainy season conditions of the experiment compared to the yield range of 15/18 t/ha obtained by Holiday. The incident of Altarnarala leaf spot and high level of flower abortion and fruit drop undoubtedly accounted greatly for the low yields. The population of 40,000 plants/ha appeared optimum for field grown tomatoes under the conditions, since a yielded 88% better than the usual population of 37,037 plants often recommended. There is therefore the need for good pest and disease control programme to avoid fruit

damage by insects and to control fungal leaf diseased which are usually favoured by humid conditions that prevail during the rainy season. This would be economically beneficial for the producers as there are usually high demands for the fruits during this period which is often met with low supply thereby raising the prices.

References

1. Abdalla, A.A and Verkerk, K. (1968), Growth. Flowering and Fruit set of Tomato at High Temperature. Neth. J.Agric.Sci. 16:71-76

2. BBS, 2016, Statistical Year Book, Statistics Division, Ministry of Planing, Government of Peoples Republic of Bangladesh.

3. Gebisa Benti, Gezu Degefa, Alemayehu Biri, Fikadu Tadesse (2017),Performance Evaluation of Tomato (Lycopersicon esculentum Mill.) Varieties Under Supplemental Irrigation at Erer Valley, Babile District, Ethiopia. Journal of Plant Sciences. Vol. 5, No. 1, 2017, pp. 1-5. doi: 10.11648/j.jps.20170501.11

4. M. S. ALAM1 , N. ISLAM2 , S. AHMAD3 M. I. HOSSEN 4 AND M. R. ISLAM5 (2016,), EFFECT OF DIFFERENTSTAKING METHODS AND STEM PRUNING ON YIELD AND QUALITY OF SUMMER TOMATO, Bangladesh J. Agril. Res. 41(3): 419-432, September 2016

5. Villareal, R.L. (1980), Tomatoes in the Tropics. Westview press. Inc Boudle Colorado. Pp531.

6. Went, F.W. (1995), Plant Growth under Controlled Conditions v. The Relation between Age.Light, Variety and Thermoperiodicity of Tomatoes. Amer. J. Bot. 32:469-479.