

Performance of Heat Tolerant Tomato (*Solanum Lycopersicum* L.) Varieties Under Rain-Fed Conditions of Aliero, Kebbi State, Nigeria .

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Abstract: Six tomato varieties were evaluated at the Kebbi state University of Science and Technology Fruits and Vegetables Teaching and Research Farm, Aliero. The varieties tested were Barreiro, Bernum, Baltyra, Castlebar, Rio-Grande and Ex-Sokoto. Nurseries were established in the first week of June and Transplanting was done in the second week of July. Planting at this time provide an evaluation of the performance of these varieties for heat tolerance. The varieties were evaluated for growth and Yield variables such as plant height , number of leaves per plnt, number of branches ,days to 50% flowering, number of fruits, fruit weight, fruit diameter and fruit yield. Results from analysed data shows that varieties differ in their growth and yield characteristics. Whereas, Castlebar excelled in establishment count and number of leaves, Bernum recorded highest values for number of fruits and fruit yield. It is therefore, concluded that Bernum and Barreiro varieties could be selected for production during rainy season in the study area.

I. INTRODUCTION

Tomato is one of the most widely grown vegetables in the world. Tomato plant is one of the most important vegetable crops grown in Nigeria both in commercial quantity and in subsistent form. It is rich in Vitamins A, C and B complex which helps to prevent eye and skin diseases (Enujeke & Emuh, 2015). It is also rich in potassium which is helpful in controlling the rate of heart beat, heart diseases and stroke (Enujeke, 2013). Tomato is grown for its edible fruits of which when cooked or processed can be used for any of these products:-soup, stew, ketchup, powdered or juice in canning industries (Akanbi *et al.*, 2005). The crop has become widely distributed in Nigeria and indeed all over the tropics and the whole world as an integrated part of human diet commonly consumed in both fresh and raw such as salad making and juice. One good aspect of the crop is that it can be grown in large quantity in any part of Nigeria provided the conditions are favourable . Villa real, (1980) reported that the tomato plant thrive well under a wide range of environmental conditions. The crop requires warm days, well drained soil. moderately cool night temperature and sufficient sunshine for optimum production.. FAO (1993) record, put the average tomato production in Nigeria to be 10t/ha.

The inability of most tomato (*Lycopersicon esculentum*) cultivars to set fruit under high night and day temperatures has been a limiting factor for tomato production in the tropical and the subtropical areas of the world (Alam, *et al.*, 2010). Although tomato plants can be grown under a wide range of climatic conditions, they are extremely sensitive to hot and wet conditions, the type of weather that prevails in the wet season in Nigeria. Fruit setting in tomato is reportedly interrupted at temperature above 26/20°C day/night, respectively, and is often completely arrested above 38/27°C day/night. (Steven and Rudich, 1978; El Ahmadi and Stevens, 1979;).High price of tomato during wet season created a great demand among the farmers for heat tolerant varieties. Varieties differ in their ability to showcase their fruit setting ability under high temperatures Hybrid bred for heat tolerance might have better performance over any open pollinated varieties/lines but should be evaluated under particular situation i.e., hot, humid conditions as the heat tolerant genes are easily influenced by environment (Villereal and Lai, 1979). Ibrahim *et al.* (2000)reported that the differences in growth indices of crops are normally influenced by their genetic constitution. Clark *et al.* (1997) reported that the genotype differences in yield and its components may be due to variation in genetic structure, mineral concentration and potentials to transport photosynthetic materials within plant. Gardner *et al.* (1990) and Zaki *et al.* (1999) attributed yield differences in crop cultivars to stomatal conductance value and to differences between genotypes in partitioning of photosynthetic materials towards economic yield. This experiment was undertaken to evaluate the growth, and yield potentials of six tomato cultivars during wet season in north-western Nigeria.

II. MATERIALS AND METHODS

Five hybrid tomato varieties Barriero, Bernum, Baltyra, Castlebar, Rio-Grande and land race Ex-Sokoto were grown during wet seasons of 2014 and 2015 in a sandy loam soil of Fruits and Vegetables

Teaching and Research Farm of Kebbi state University of Science and Technology, Aliero, Kebbi state, Nigeria. Ground nursery was used to raise the seedlings used for the study. Seeds of the tomato varieties were sown using broadcasting method in the nursery and then covered lightly with sand for easy germination. The nursery seed bed was mulched until germination. The mulch helps to reduce the direct impact of rainfall and sunlight. Routine nursery practices of weeding and shading were maintained. The shading was removed and other hardening process of the seedlings done to acclimatize the seedlings to field condition. On the eve of the transplanting day, the seedlings were watered to field capacity so that the seedlings would be transplanted with ball of the earth the following day at the rate of one plant per stand using a planting distance of 60cm x 40cm at seedling leaf stage of 5 – 7 leaves. Gapping up (replacement of dead seedlings) was done from one week after transplanting of the seedlings.

Weeding was carried out manually by hand and hoe at two weeks interval till maturity.

Composite soil samples were collected from top 0-15cm and 15 -30cm in the study site before application of treatments air dried and analyzed for their nutrients contents.

A randomized complete block design was used with 12 plants in each treatment of 3 replications. Each plot was 2.0 m wide and 2.0 m long. Ten tons of cowdung, 150 kg urea, 60 kg SSP, and 50 kg MP per hectare. Cow dung and entire quantity of SSP and MP were applied during the land preparation. Urea was top dressed in three equal installments at 2, 6, and 8 weeks after transplanting. The data collected from the experiment were those of establishment count, number of branches, days to 50% flowering, number of fruits per plant, fruit weight, fruit diameter and fruit yield. Collected data were analyzed statistically and treatment means were compared by Duncun Multiple Range Test (DMRT).

Description of Varieties

Bernum

Early, high yielding variety for fresh market and processing. Plants are medium large, determinate and vigorous. Fruit weight is 110-120g, square-round in shape, without green shoulders, very firm and jointless. Highly resistant to Verticillium, Fusarium 1+2, Nematodes.

Baltyra

Baltyra-developed by Bakker Brothers is an early hybrid for outdoor crops and highly tolerant to Tomato Yellow Leaf Curl Virus. Plants are determinate, vigorous and good setting under both high and low temperatures. The fruits are medium large (140-160 grms), deep oblate in shape, firm and no green shoulders. Baltyra is resistant to Tomato Mosaic Virus, *Vertihcillium* and *Fusarium* race .

Rio-Grande

Determinate. Large 8cm, blocky, pear-shaped paste tomato deep red in colour. The vigorous plants of Tomato Rio Grande produce heavy crops of tomatoes in clusters. Good disease resistance.

Barreiro

The plants are vigorous, have good cover with very high yields. The fruits are borne in large clusters of 6 to 7 fruits and are semi joint less. A very consistent high yielding variety with resistance to Nematodes.

Table 1: Physical and chemical characteristics of the soil (0-30cm) at the experimental site.

Soil properties		
Soil (texture)		Sandy loam
pH (H ₂ O)		5.4
Total N (g kg ⁻¹)		0.90
Organic carbon (g kg ⁻¹)		6.28
Available P (mg kg ⁻¹)		0.56
Exchangeable bases (cmol kg ⁻¹)		
Ca		0.4
Mg		0.7
K		1.53
Na		0.84
CEC		3.26

III. RESULTS AND DISCUSSION

The results of the study on the growth parameters of the six tomato varieties are presented on Table 2.

Establishment count : The results indicated that, there was significant difference among the varieties used in respect to the establishment count . Barreiro variety recorded the highest value (84.36%) this was statistically similar to that of Bernum and Castlebar. The lowest establishment count(60.46%) was recorded by Ex-sokoto variety. The highest establishment count recorded by these varieties shows their superiority over ex-Sokoto. This clearly portrays the high germination ability of hybrids over other seed materials. Phookan *et al.* (1990) reported variations among the hybrids in establishment when tomato was grown in summer under plastic house condition.

Plant height: There was significant variation on the plant height of the varieties tested. Ex-Sokoto variety recorded the highest value (58.93cm) in terms of plant height while the lowest (43.42cm) was recorded by Rio-Grande. This high value recorded by ex-Sokoto was due the fact that ex-Sokoto is a land race variety which has more vegetative growth than improved varieties. The varietal differences in plant height were due to genotypic make up. Phookan *et al.* (1990) reported variations among the hybrids in plant height.

Number of leaves : There was significant influence ($P < 0.05$) of variety on the number of leaves per plant of Tomato. The highest number of leaves per plant (35.8) was recorded by Castlebar. This was followed by Ex- Sokoto variety (31.10) while the lowest value (27.20) was obtained from Rio-Grande. The higher leaf production by Castlebar was an indication of its superiority over other varieties in terms of vegetative growth which is purely varietal characteristics. Meher *et al.*(1994) also reported variation in the number of leaves among the tomato varieties which he attributed to varietal differences. Ibrahim *et al.* (2000) and Sajjan *et al.* (2002) reported that genetic constitution of crop varieties influence growth characters which they express.

Number of branches: There was no significant difference among varieties in terms of number of branches per plant of tomato. This tend to suggest that have more or less similar pattern of branching.

Days to 50% Flowering: Results on the effects of variety on days to 50% flowering is shown in Table 3 .There was significant effects ($P < 0.05$) variety on the days taken by tomato varieties to attain 50% flowering. Among the varieties, Rio- Grande , Bernum and Barreiro took statistically similar number of days (33.66, 35.00 and 36.66) days respectively to attain 50% flowering that were higher than those recorded by Ex- Sokoto, Castlebar and Baltyra respectively. Baltyra variety took fewer days (21.66) to attain 50% flowering. The early flowering by these varieties

Table 2 : Effects of Variety on growth variables of Tomato (*Solanum lycopersicon*) at Aliero, Nigeria.

Variety	Establishment count (%)	Plant height(cm)	Number of leaves per plant	Number of branches
Barreiro	84.36a	51.89ab	28.30b	4.55
Bernum	83.63a	49.44ab	29.46b	5.55
Baltyra	77.01ab	43.86b	28.05b	5.33
Castlebar	81.80a	50.88ab	35.80a	6.00
Rio-Grande	70.36b	43.42b	27.20b	6.44
Ex-Sokoto	60.46c	58.93a	31.10ab	5.55
Significance	**	*	*	Ns
SE±	4.615	7.01	3.15	

Means in a column followed by same letter(s) do not differ significantly according to DMRT at 5%level of significance

are purely varietal characteristics and shows the early set in of the reproductive phase in these varieties.

Number of Fruits per plant:

There was significant influence of variety on the number of fruits per plant of tomato. The results shows that Barreiro variety produced the highest number of fruits (46..10) which was statistically at par with the (44.72) fruits recorded by Bernum variety. Baltyra and Ex-Sokoto recorded statistically similar number of fruits, while Rio-Grande recorded the lowest (33.70) fruits. The higher number of fruits produced by Barreiro over other varieties indicates the superiority of the variety over others among the varieties tested. Phookan *et al.* (1990) reported significant effect of variety while conducting experiment to evaluate 29 hybrids of tomato on the basis of eight different growth and yield attributing parameters.

Fruit Weight:

There was significant influence of variety on the weight of tomato fruits. The results shows that Baltyra variety recorded the highest (80.01g) fruit weight. This was followed by (62.91g) recorded by Castlebar. The lowest value (39.08g) was recorded by ex-Sokoto variety. This shows that improved varieties have tendency to produce larger and heavier fruits than the landrace. Dane *et al.* (1991) stated that small fruited abundantly

flowering genotypes were less affected by heat stress than larger fruited cultivars, which supports the results of this experiment. Ahmad (2002) also found the range of individual fruit weight to be from 5.25 g to 43.38 g among 25 heat tolerant hybrids which supports the findings of the present study.

Fruit Yield: There was significant effect of ($P < 0.05$) of variety on the fruit yield of tomato as can be seen in Table 2. Bernum variety recorded the highest yield (13.88t/ha) which is not statistically from (13.80t/ha) obtained from Barreiro variety. This was followed by (12.7t/ha) recorded by Baltyra variety. Rio-Grande recorded a yield of (11.09 t/ha). Castlebar and Ex- Sokoto recorded the lowest of 10.37t/ha and 10.57 t/ha respectively. The highest yields recorded by Bernum and Castlebar varieties shows their ability to reproduce efficiently under high temperature and humidity of the rainy season. This suggest that these varieties are more heat tolerant than the other varieties. Alam *et al.*(2010) reported that yield of tomato varied depending on the level of heat tolerance of the hybrids. Findings of Ahmad and Singh(2005) also support the results of this trial. Kabura *et al.* (2009) also reported similar trend in his tomato varietal trial. the findings of this research are in conformity with those of Olaniyi *et al.*(2010).

Fruit Diameter: There was significant ($P < 0.05$) effect of variety on the diameter of tomato fruits. Baltyra variety recorded the highest (6.03cm) diameter . This was followed by Rio-Grande and Bernum respectively. The lowest value (4.26cm) was recorded by Ex-Sokoto. The higher fruit diameter recorded by these varieties (Baltyra, Bernum and Rio-Grande) shows that they have bigger fruit size compared to other varieties. Therefore hybrids are characteristically larger than the land race varieties. Dane *et al.* (1991) stated that small fruited abundantly flowering genotypes were less affected by heat stress than larger fruited cultivars, which supports the results of this experiment.

Table 2 : Effects of Variety on yield variables of Tomato (*Solanum lycopersicon*) at Aliero, Nigeria.

Variety	Days to 50% flowering	Number of fruits /plant	Fruit weight(g)	Fruit yield (t/ha)	Fruit Diameter (cm)
Barreiro	36.66a	46.10a	49.21bc	13.80a	4.63c
Bernum	35.00a	44.72a	56.84bc	13.88a	6.38b
Baltyra	21.66c	40.95ab	80.01a	12.71b	8.03a
Castlebar	23.33c	35.40bc	62.41ab	10.37c	5.60b
Rio-Grande	33.66a	33.70c	47.78bc	11.09b	6.54b
Ex-Sokoto	30.33b	40.17ab	39.08c	10.57c	4.26c
Significance	*	**	**	**	*
SE±	3.00	3.191	7.88	0.296	0.631

Means in a column followed by same letter(s) do not differ significantly according to DMRT at 5% level of significance

IV. CONCLUSION

From the findings of this research, it may be concluded that, Bernum and Barreiro tomato varieties could be selected for production during rainy season in the study area.

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