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Varietal Evaluation of Tomato (*Lycopersicon lycopersicum* (L.) H. Karst) Varieties Resistance to Root-Knot Nematode (*Meloidogyne* spp.) in the Sudan Savanna of Nigeria

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ABSTRACT
Nineteen entries consisting of seven parental lines plus twelve F_1 hybrids derived from a line x tester mating design were evaluated in a randomized complete block design (RCBD) with three replications in two locations (Gashua and Maiduguri) during the dry season of 2013/2014 under irrigation. The study identified the following parents. Nematex, Atkinson, Rossol, Dansyria and hybrids Nematexx Ex-Gashu'a, Atkinson xDansyria, and Rossol xDansyria as the best in yield and yield attributing characters and resistance to root-knot nematode (*Meloidogyne* spp.) with average mean yield higher than the other genotypes across locations. These parents and hybrids discovered could further be evaluated across years and locations to ascertain their resistibility and yield potentials.

Key Words: Hybrids, Parents, Nematode, Resistance, Tomato

INTRODUCTION
Tomato (*Lycopersicon lycopersicum* (L.) H. Karst) is one of the most widely consumed vegetables in the world. The popularity of the crop stems from its acceptable flavour, nutritive value, the short life cycle and high productivity (Adil *et al*., 2003). It is a versatile health product and due to its equally versatile preparation option, there is really no reason to neglect the tomato as part of a healthy diet. In the recent decades the consumption of tomatoes have been associated with the prevention of several diseases (Wilcox *et al.*, 2003; Sharoni and Levi, 2006) mainly due to the content of antioxidants including carotenes, ascorbic acid and phenolic compounds (Periago *et al.*, 2009). The fruit is highly nutritious and contains high levels of lycopene, a powerful antioxidant associated with lower risk of cancers, heart and age related diseases, Hanson (2003).

In Nigeria the major producing areas lie between latitudes 7.5^{o} $11^{''}$ and 25^{o} to $30^{''}$ (Umeh *et al*., 2002). Global production estimate is put at approximately 130 million metric tonnes annually on 118.71 million hectares of land (FAO, 2010).In Nigeria, it is mostly cultivated in the semi-arid region during the cool dry season using irrigation. High temperature limits the production of tomato to the cooler period of the year (Rodriguez, 2007). When available the use of nematode resistant germplasm is the best nematode management option for resource poor farmers (Usman, 2012). Thus, there is the need for developing nematode resistant and high yield tomato varieties to minimize yield loss due to root knot nematodes pest. The objective of the present study was to determine the performance of some tomatoes varieties among the genotypes selected for nematode resistant, yield improvement and adaptation. Tomato is mainly constrained by biotic and a biotic pests which limits its production. However root-knot nematode (*Meloidogyne* spp.) pest causes high economic losses if not properly checked and treated at appropriate

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time through soil treatment and breeding for resistant varieties. Despite effective and sustainable nematode management techniques through the use of nematicides, cultural practices, biological and physical techniques high losses are still recorded from nematode pest. Soil treatment using chemical control and soil amendments for the control of *Meloidogyne* have been found to be costly and ineffective due to its high mobility, wide lost range and boring activities (Izge and Garba, 2012). When available the use of nematode resistant germplasm is the best nematode management option for resource poor farmers (Usman, 2012). Thus, there is the need for developing nematode resistant and high yield tomato varieties to minimize yield loss due to root knot nematodes pest. The objective of the present study was to determine the performance of some tomatoes varieties among the genotypes selected for nematode resistant, yield improvement and adaptation. The use of resistant varieties adapted to the environment is the most promising method of controlling the spread and damage causes by root-knot nematode.

Nematodes have been recognized as one of the major pest of tomato throughout the world, particularly in the tropical and subtropical regions including Nigeria (Fawole, 1992; Sikora *et al*., 2003). Many different species of nematodes are known to cause damage on tomato, but the most destructive species are root-knot nematode belonging to the genus *Meloidogyne*. According to Amosu *et al*. (1993) infestation of tomato by *Meloidogyne* species accounts for about 40 – 60 percent in yield reduction in Western Nigeria.

MATERIALS AND METHODS

Two sets of tomatoes were chosen for the experiment. The first set consisted of three improved varieties (resistant to *Meloidogyne* spp.) obtained from certified seed marketers in Maiduguri. The second sets consisted of four farmer's cultivars that are susceptible to root knot nematode (*Meloidogyne* spp.) and were predominantly grown by the farmers in Sudano-sahelian zone of tomato producing areas. Line x Tester mating design was used for the formation of the hybrids. Three tomato resistant's varieties were used as lines while four susceptible varieties were used as testers. The material comprised of seven parental lines and 12 hybrids which were evaluated in two locations, Gashua (latitudes $12^0 54^1$N and longitude $11^0 05^1$E) andMaidugurilatitudes 11^0 14^1N and longitude 13^0 04^1E) during 2013/2014 dry season.

Initial population level of nematodes were determined by taking three core samples with a soil auger to a depth of 20 cm in a zigzag pattern from each experimental plot, bulked, leveled and transported to the laboratory for extraction of nematodes. The bulked sample for each plot was thoroughly mixed and a 250 g sub-sample was taken, for extraction of nematodes using White and Hemming (1965) tray method. To identify and count nematodes, nematodes suspension was poured into Doncaster (1962) counting dish for counting under the stereomicroscope and nematodes observed, identified and counted according to their genera. Nematode identification was done under the compound microscope by picking nematodes from the counting dish into slides which were placed under 10x magnification of a compound microscope. The treatments were laid out in a randomized complete block design (RCBD), replicated three times in both locations. Each plot size was 2.5 x 2.5m^2, with three rows 2.5m long of sunken beds of soil spaced 75 x 50cm intra-row spacing. There were 18 plants per plot in each replication; all cultural practices in relation to tomato production were carried out. Data were collected on five randomly selected plants in respect of the following characters: plant height per plant (cm), number of leaves per plant, number of flower clusters per plant, number of flower drops per plant, number of fruits per plant, number of fruits dropped per plant, weight of fruits per plant (g) and weight of fruits per plot (t/ha).All data collected were subjected to analysis of variance (ANOVA) at 5% levels of significance and the differences among the means were separated using Duncan Multiple Range Test (DMRT) (Duncan, 1955). The analysis was done according to the model suggested by Kempthorne (1967).

RESULTS AND DISCUSSION

Analysis of Variance

Mean squares from the analysis of variance for eight yield characters in tomato combined across locations are presented in Table 1. The results presented indicated that the means squares were statistically difference among all the characters evaluated across locations except number of leaves. In the interaction between parents and hybrids in all did not show any significant difference in their mean squares. Almost all the remaining characters also show significant differences in their mean squares. On the other hand locations x parents-hybrids interactions had significant difference only in weight of fruits per plant among all the characters evaluated. According to Falconer (1989), the amount of genetic improvement obtained by selection among a number of hybrids is dependent on the amount of variability between the crosses and the intensity of selection applied. Hence, in this study, the significant differences observed among the genotypes for most of the characters indicated that an appreciable amount of genetic variability existed in the genotypes used. Significant mean squares were observed among the parental lines and hybrids for different yield components characters, implying that both the parents and the hybrids derived from them would most likely respond to selection. Hannan *et al*. (2007) and Haydar *et al*. (2007) had also reported significant difference in plant height at 60 days after planting, number of fruits per plant and number of flower clusters in tomato.

Table 1: Mean squares of analysis of variance for tomato parental lines and their hybrids for eight characters across locations

Source of variation	DF	PHT	NLV	NFC	NFLD	NFP	NFD	WFPL	WFP
Rep (within location)	4	169.09**	424.16	169.01**	147.66**	138.70*	124.67*	13269.11**	145614665.20**
Location	1	585.42**	432.64	3169.11**	2019.02**	2810.11**	173.41*	43711.20*	1325416.03**
Genotypes	18	480.29**	61.53	3169.11**	41.67	147.32**	142.87**	193471.10**	418191.08*
Parents(P)	6	694.12**	87.44	42.41	33.15	138.31*	131.32*	34118.92*	451585.47*
Hybrids(H)	11	518.92**	64.37	61.32*	37.67	50.91*	20.36	279981.67**	481578.06*
Parents Vs Hybrids	1	103.00	32.84	23.62	20.61	20.62	19.76	76229.17	99823.99
Location x Genotypes	18	91.74*	90.66	50.33	42.33	48.34	27.41	741167.93**	370744.00*
Location x Parents	6	89.63*	63.41	67.81*	58.14*	52.09*	36.12*	43741.20*	42185.98*
Location x Hybrids	11	83.91*	91.23	52.01*	40.96*	46.62	28.61	489671.19**	456634.31*
Location (P Vs H)	1	43.67	15.99	24.11	20.83	20.01	18.99	89354.2**	56364.11
Error	72	696.83	23.41	54.61	47.56	43.67	30.11	291671.01	209793.71
Total	**149**								

Key: PHT: Plant height (cm), NLV: Number of leaves, NFC: Number of flowers clusters, NFLD: Number of flowers drops, NFP: Number of fruits/plant (g), NFD: Number of fruits drops, WFPL: Weight of fruits/plant (g), WFP: Weight of fruits/plot (t/ha).

Performance of Parents and Hybrids

The mean performance of parents and hybrids for eight agronomic characters in tomatoes across locations are presented in Table 2. Variations exist among the parents and hybrids in relation to growth characters. These were significant variation in all the characters studied. Variation among tomato cultivars in growth characters have been reported by several researchers. Mehta and Asati (2008) and Olaniyi *et al*. (2010) have reported variation among tomato cultivars and have attributed that to the genetic potential of the plant. Parent Dansyria appeared to be taller than all the parents, while many hybrids such as Nematex x Dansyria, Nematex x Roma VF, Atkinson x Danbaga, Atkinson x Roma VF, Rossol x Dansyria and Rossol x Danbaga generally appeared vegetatively vigorous, taller with much leaves compared to all other entries. Similarly, Kayum *et al.* (2008) working with three cultivars of tomato observed significant variations in the number of leaves, leaf area and leaf area index.The superiority parents (Nematex, Atkinson, Rossol, and Dansyria) and hybrids (Nematex x Ex-Gashua, Atkinson x Dansyria, Rossol x Danbaga, and Rossol x Danbaga) tomatoes observed manifested significant ability to produce very high levels of number of flower clusters, low number of fruits drops, high levels of number of fruits per plant and low number of fruits dropped. The low number of fruit drops and weight of fruits dropped indicated their ability to resist root-knot nematode (*Meloidogyne*) infestation. Parents Nematex, Atkinson, and Rossol and hybrids Nematex x Ex-Gashua, Atkinson x Dansyria, Atkinson x Danbaga and Rossol x Dansyria recorded the highest yield per plant and in tones per-hectares in across locations (Table 2).

These genotypes had better establishment across locations indicating that the parents and crosses could be explored for root-knot nematode resistant cultivars. The hybrids could be further evaluated to root-knot nematode infested area to ascertain their resistance. Ex-Gashua and Danbaga parents consistently had the lowest yield in the combine location, however their hybrids among the best in terms of yield and resistant to root-knot nematode infestation. Izge *et al.* (2007) and Kadams (2000) both reported that performance of a variety per se is not always a good indicator of their superior parents (General combining abilities). However, poor parent gave good hybrids when cross with one of the best parent (general combiner) (Aminu and Izge, 2013).

Table 2: Mean performance of tomato parental lines and their generations for eight characters across locations

S/No.	GENOTYPES	PHT	NLV	NFC	NFLD	NFP	NFD	WFPL kg	WFP t/ha
1.	NEMATEX	64.12[bc]	163.42[a]	57.28[a]	10.12[c]	190.24[a]	12.21[e]	12.96[a]	3.88[a]
2	ATKINSON	70.43[b]	149.69[ab]	52.48[a]	12.40[c]	189.32[a]	14.02[e]	10.38[a]	3.11[a]
3	ROSSOL	60.72[bc]	143.47[ab]	60.92[a]	15.24[c]	187.54[a]	13.31[e]	11.19[a]	3.26[a]
4	EX-GASHUA	57.34[c]	91.59[bc]	39.07[bc]	40.49[a]	102.80[c]	46.22[a]	4.32[c]	1.43[c]
5	DANSYRIA	94.35[a]	109.29[bc]	50.54[a]	41.10[a]	169.49[a]	39.20[b]	7.65[b]	1.99[c]
6	DANBAGA	62.67[bc]	134.40[ab]	47.72[ab]	40.61[a]	89.70[c]	40.29[b]	5.13[bc]	1.02[c]
7	ROMA VF	71.30[b]	130.17[ab]	29.31[c]	38.15[a]	74.12[c]	42.91[ab]	6.64[b]	1.12[c]
8	NEMATEX x EX-GASHUA	68.56[ab]	177.71[a]	63.82[a]	11.40[c]	207.76[a]	16.51[d]	13.87[a]	4.43[a]
9	NEMATEX x DANSYRIA	82.09[a]	130.36[a.b]	49.74[ab]	22.60[ab]	156.92[ab]	26.38[cd]	8.15[b]	2.79[ab]
10	NEMATEX x DANBAGA	69.39[ab]	104.47[bc]	36.06[c]	21.29[ab]	120.81[b]	28.73[cd]	6.91[b]	2.30[ab]
11	NEMATEX x ROMA VF	68.68[a]	125.42[b]	31.47[c]	27.43[ab]	88.72[c]	30[c]	7.54[b]	2.41[ab]
12	ATKINSON x EX-GASHUA	67.98[bc]	124.85[b]	27.28[c]	19.58[b]	73.09[c]	19.66[d]	7.46[b]	2.41[ab]
13	ATKINSON x DANSYRIA	78.20[ab]	156.81[a]	65.94[a]	10.37[c]	181.56[a]	16.59[d]	12.86[a]	3.89[a]
14	ATKINSON x DANBAGA	81.53[a]	110.57[bc]	32.20[c]	18.23[b]	77.29[c]	29.04[c]	10.90[ab]	3.10[a]
15	ATKINSON x ROMA VF	89.05[a]	136.49[ab]	30.67[c]	21.17[ab]	113.03[b]	30.31[c]	9.53[ab]	2.81[ab]
16	ROSSOL x EX-GASHUA	63.34[bc]	121.15[b]	27.99[c]	22.43[ab]	131.81[b]	34.50[c]	8.64[b]	2.73[ab]
17	ROSSOL x DANSYRIA	87.80[a]	161.40[a]	52.79[a]	9.21[c]	173.40[a]	20.88[d]	10.71[ab]	3.11[a]
18	ROSSOL x DANBAGA	68.17[a]	157.70[a]	54.86[a]	8.14[c]	169.11[a]	21.76[d]	9.24[ab]	2.82[ab]
19	ROSSOL x ROMA VF	59.89[c]	119.87[b]	24.36[cd]	32.55[a]	92.21[c]	41.87[a]	5.72[bc]	2.04[b]
SE ±		**5.32**	**25.75**	**5.31**	**10.66**	**21.56**	**2.32**	**1.22**	**0.61**

Key: PHT: Plant height (cm), NLV: Number of leaves, NFC: Number of flowers clusters, NFLD: Number of flowers drops, NFP: Number of fruits/plant (g), NFD: Number of fruits drops, WFPL: Weight of fruits/plant (g), WFP: Weight of fruits/plot (t/ha).

CONCLUSION

Clear variations exist among the genotypes evaluated in relation to various characters studied. The results showed that root-knot nematode resistant varieties and some of their hybrids evaluated at two locations gave appreciated yield even under *Meloidogyne* infestation areas. However, some hybrids appeared to be superior to some parental lines. Parents such as Nematex, Atkinson, Rossol and Dansyria and hybrids Nematex x Ex-Gashua, Atkinson x Dansyria, Atkinson x Danbaga and Rossol x Dansyria gave high yield and resistant to root-knot nematode *Meloidogyne* infestation showing their inherent genetic potential for root-knot nematode (*Meloidogyne* spp.) resistance.

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