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Effects of Stem Pruning and Weeding Frequency on Tomato (*Lycopersicon lycopersicum* Mill.) in Zuru, Northern Guinea Savanna, Nigeria

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ABSTRACT- Field trials were conducted during the 2007 and 2008 rainy seasons on the Teaching and Research Farm of the College of Agriculture, Zuru, (Lat 11° 26'N, Long. 5° 16'E) Kebbi State, Nigeria. The objective was to determine the growth and yield response of Tomato (var. UC82B) to stem pruning and weeding frequency. Treatments consisted of three pruning levels (three-stem, two-stem and unpruned) and four weeding frequencies (weedy-check, three-weeding, two-weeding and weed-free) with a factorial combination, laid out in a Complete Randomized Block Design and replicated three times. Results obtained showed that plant height and mean fruit weight were significant ($P<0.05$) higher in two-stem pruned plants; Leaf Area Index (LAI) and fruit number per plant were favored by unpruned treatment, while the highest yield was recorded by three-stem pruned plants in both 2007 and 2008 and the combined years. In terms of weeding frequency, plant height, LAI, fruit number per plant and mean fruit weight of tomato were significantly ($P<0.05$) higher in all the treatments than the weedy-check (zero-weeding); weed-free treatment produced the highest yield compared with both three and two-weeding which had comparable result in the two seasons and the combined years. However the interaction between pruning and weeding revealed that two-stem pruning combined with two-weeding produced the heaviest fruits while three-stem pruning combined with any of the weed-free, three or two-weeding produced the highest yield. The study therefore concluded by recommending three-stem pruning at two-weeding frequency for higher tomato production in the study area.

Key-Words: Tomato, Pruning, Weeding, Northern Guinea Savanna

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INTRODUCTION

Tomato (*Lycopersicon lycopersicum* Mill.) are one of the most important vegetables in the northern part of Nigeria. It is relatively easy to grow and is an important source of nutrition and income for small holders and large commercial producers [1]. Tomato can be processed and canned as paste, juice, saucer powder, or eaten raw, a lone or in combination with other foods.

About 70 million tons of tomato is grown in the world on more than 2 million hectares of land, but less than 20% of the produce comes from the tropics [2]. The average yields are 9.9 t ha^{-1} in Thailand, 8.8 t ha^{-1} in Phillipines, 15 t ha^{-1} in India, 25.3 t ha^{-1} in China, 52 t ha^{-1} in Japan and 63 t ha^{-1} in USA. In Africa, highest yield was obtained in South Africa (76.25 t ha^{-1}) and the least was from Angola (3.7 t ha^{-1}). In Nigeria, the average yield is about 7.0 t ha^{-1} [3] where it is widely cultivated in Guinea savanna in the wet

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season and Sudan in the dry season through irrigation [4]. The low yield of tomato in Nigeria (7.0 t ha^{-1}) could be attributed to poor production practices.

Tomato yield could be increased through improved agronomic techniques like pruning (removal of side and lower shoots) and appropriate weeding. [5-7] recommended pruning as a cultural practice that improves the yield and quality of tomato. Critical period and frequency of weed control in tomato have been reported as 6-8 weeks after transplanting (WAT) and 2–3 times respectively [8]. While pruning diverts nutrients to flower clusters and fruits on the main stem and allows more efficient air circulation, weeding reduces the crop competition for growth factors like moisture, nutrients, air and to some extent sunlight [9,10]. The objective of this study, therefore was to determine the appropriate pruning level and the weeding frequency for good growth and yield of tomato variety UC82B.

MATERIALS AND METHODS

Field experiments were conducted during the 2007 and 2008 rainy seasons on the Teaching and Research Farm of the College of Agriculture, Zuru (Lat 11° 26'N, Long. 5° 16'E). The area lies within the Northern Guinea Savanna zone of Nigeria in therainfall range of 690-885 mm per annum, distributed over a period of 4–6 months (April-October). A mean monthly temperature range of 18–32° C was recorded between 2007 and 2008 cropping seasons. The physic-chemical characteristics of the experimental area are presented in table 1. The soil of study area was sandy loam; average in total nitrogen, available phosphorus and organic carbon; and was slightly acidic in nature (pH=5.6). Treatments consisted of factorial combination of three-stem pruning levels (three-stem, two-stem and unpruned) and four weeding frequencies (three-weeding, two-weeding, weed-free and weedy-check) laid out in Randomized Complete Block Design replicated three times. Certified seed of tomato (var. UC82B) was obtained from Kebbi State Agricultural Supply Company (KASCOM). Seedlings were raised in nursery beds using nursery management techniques (thinning out and hardening off were carried out before transplanting). Seedlings were transplanted at about 30-35 days after sowing. Transplanting was at inter and intra-row spacing of 50 cm and 40 cm, respectively. Fertilizer was split-applied at transplanting and at 4WAT at the rate of 300 kg NPK (15:15:15) ha^{-1} and 140 kg urea ha^{-1} respectively.

Pruning was carried out from 4WAT and continued 2-weekly up to 10 WAT. Depending on the pruning level, one or two shoots just below the first flower cluster was left to grow as the second and third shoots, respectively, while the rest were removed. Weeds were controlled manually using hoe according to treatment. The first weeding was carried out at 3WAT where all plots were weeded except the weedy-check plots. The same pattern was followed for the second weeding at 6WAT. At 9WAT, only plots with three-weeding and weed-free were weeded, others were left as weedy-check and two-weeding treatments respectively. The plots were sprayed against insects at an interval of 3 weeks using Karate (*Lambda cyhalothrin*) at 4ml L^{-1} concentration. Fruits were harvested at regular intervals at physiological maturity (skin turns yellowish orange).

Data were collected on plant height, leaf area index (LAI), fruit number per plant, mean fruit weight and fruit yield. [11] model was used to estimate the leaf area (LA) using plant height (H) and leaf width (W) [LA= 19.8 x H – 23.7 x W + 1.56 x HW] $R^2 = 0.958$. Data were subjected to analysis of variance procedure and significant differences were further analyzed using Duncan's Multiple Range Test (DMRT) using statistical analysis system SAS.

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Table 1: Physical and chemical properties of soil of the experimental site in 2007 and 2008 rainy seasons

Soil Test	2007	2008
Chemical Properties		
pH (water)	6.29	5.81
pH ($CaCl_2$)	5.60	5.95
Organic carbon g kg^{-1}	6.00	7.85
Total Nitrogen	0.45	0.68
Available Phosphorus	2.10	2.12
Physical Properties		
Sand g kg^{-1}	561	530
Silt g kg^{-1}	314	312
Clay g kg^{-1}	120	150
Textural class	Sandy loam	Sandy loam
Exchangeable Cations (Cmol/kg)		
Ca	0.93	0.80
Mg	0.55	0.45
K	0.95	1.00
Na	1.13	1.13
CEC	33.4	33.6

RESULTS AND DISCUSSION

Plant height (cm)

Table 2 shows that stem pruning had significant ($P<0.05$) effect on plant height at 10 WAT. Two-Stem pruning produced the tallest plants of 62.34 cm and 63.78 cm compared to three-stem and unpruned plants had comparable plant height. Taller plants recorded in two-stem pruning could be due to reduced competition for photosyn-thate among the branches [12], which were fewer than in three-stem or unpruned, plants. This result agreed with the findings of [5,13], who reported a significant plant height response to pruning, and that one-stem pruning produced the tallest plant compared to no pruning treatment.

Plant height in weedy-check was significantly ($p<0.05$) lower than the other weeding treatment (three-weeding, two-weeding and weed-free), which were comparable in both 2007 and 2008 (Table 2). This may be attributed to intense competition between weeds and crop for space, moisture and nutrients. According to Melifonwu [14] weed invasion in the early growth of tomato depressed growth and overall yield.

Table 2: Plant height of Tomato as influenced by Stem pruning and Weeding frequency at Zuru in 2007 and 2008 rainy seasons

Treatment	Plant height (cm) at 10WAT	
	2007	2008
Stem pruning		
Three-stem	54.8b	57.09b
Two-stem	62.34a	63.78a
Unpruned	56.71b	54.14b
SE±	0.41	1.42
Significance	S	S
Weeding frequency		
Three-weeding	51.60a	53.44a
Two-weeding	53.40a	52.89a
Weed-free	56.90a	55.31a
Weedy-check	33.90b	30.67b
SE±	1.41	1.23
Significance	S	S

Within treatment, means followed by same letter(s) are not significantly different at 5% using DMRT

Leaf Area Index (LAI)

Leaf area index defined, as the ratio of the total leaf area of the soil area occupied per plant was significantly ($P<0.05$) influenced by stem pruning at 10 WAT in both 2007 and 2008 (Table 3). Unpruned plants had the highest LAI compared to the three-stem and two-stem which were comparable. Since LAI depends on growth in leaf area [15,16] the LAI in unpruned plants would, at any time during the growth of the plants, be higher than the plants that were pruned. However, the comparable LAI of three-stem plants and two-stem plants could be due to the fact that although

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the three-stem plants had higher number of leaves than the two-stem plants, the two-stem plants might have had larger single leaf area. This was possible because the assimilate that could have been used in the growth of the third shoot in the three-stem plants might have been used for leaf expansion in the two-stem. In that case, the larger number of leaves in the three-stem plants was counteracted by the larger sized leaves in the two-stem plants, making the difference in LAI of the two treatments comparable [17].

Weedy-check treatment showed significantly (P<0.05) lower LAI than the other weeding frequency. The result could also be attributed to the growth depression due to intensive competition between the tomato crop and the weeds, which might have resulted in smaller and fewer numbers of leaves.

Table 3: Leaf Area Index (LAI) of Tomato as influenced by Stem pruning and Weeding frequency at Zuru in 2007 and 2008 rainy seasons

Treatment	LAI at 10WAT	
	2007	2008
Stem pruning		
Three-stem	0.8b	0.82b
Two-stem	0.75b	0.78b
Unpruned	0.98a	1.12a
SE±	0.45	0.07
Significance	S	S
Weeding frequency		
Three-weeding	0.82a	0.78a
Two-weeding	0.81a	0.81a
Weed-free	0.84a	0.80a
Weedy-check	0.63b	0.59b
SE±	0.32	0.40
Significance	S	S

Within treatment, means followed by same letter(s) are not significantly different at 5% using DMRT

Total Number of Fruits Plant^{-1}

Stem pruning had significant (P<0.05) effect on the total fruit number per plants on both trial as presented in table 4. Unpruned plants produced the highest number of fruits per plants followed by three-stem and then two-stem being the least, in both 2007 and 2008 seasons. The high number of fruits per plants in unpruned plants may not be unconnected with the availability of more undisturbed fruit-producing shoots in the unpruned treatments than the other pruned treatments [13,18]. All the weeding frequency treatments had comparable number of fruits per plants and significantly greater than the control (weedy-check) in both trials (Table 4). Number of fruits, as a yield component, was most critically reduced when the crop was weed infested. This result is corroborated by [14], who observed that for optimum fruiting, weeds need to be removed as often as necessary within 6 WAT.

Table 4: Total Number of Fruits per Plant as influenced by Stem pruning and Weeding frequency at Zuru in 2007 and 2008 rainy seasons

Treatment	Number of Fruits Plant^{-1}	
	2007	2008
Stem pruning		
Three-stem	32.21b	03.23b
Two-stem	29.51c	26.45c
Unpruned	36.81a	38.15a
SE±	0.44	0.82
Significance	S	S
Weeding frequency		
Three-weeding	35.05a	34.06a
Two-weeding	34.99a	35.12a
Weed-free	35.39a	36.00a
Weedy-check	13.50b	11.47b
SE±	0.93	1.22
Significance	S	S

Within treatment, means followed by same letter(s) are not significantly different at 5% using DMRT

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Mean Fruit Weight (g)

Stem pruning had significant (P<0.05) effect on mean fruit weight of tomato (Table 5) in both trials and the two years combined years. Highest mean fruit weight was recorded in two-stem (55.33 g, 54.03 g, 54.68 g), followed by three-stem (50.17 g, 48.84 g, 49.51 g) and the least was in the unpruned (38.43 g, 32.48 g, 35.46 g) plants in 2007, 2008 the combined years, respectively. Higher mean fruit weight recorded by pruned plants could be attributed to less photosynthate-demanding shoots of the pruned plants which resulted in partitioning of more dry matter to the fruits. Similar results were earlier reported [5,13,18]. Weeding frequency had no significant (P<0.05) effect on mean fruit weight except for the control in both seasons and the combined years (Table 6). However, mean fruit weight was significantly influenced by the interaction of stem pruning and weeding frequency (Table 6). Two-stem pruning combined with two-weeding produced the heaviest fruits (55.40 g).

Table 5: Mean Fruits Weight (g) of Tomato as influenced by Stem pruning and Weeding frequency at Zuru in 2007 and 2008 rainy seasons

Treatment	Mean Fruit Weight (g)		
	2007	2008	Combined
Stem pruning			
Three-stem	50.17b	48.84b	49.51b
Two-stem	55.33a	54.04a	54.68a
Unpruned	38.43c	32.48c	35.46c
SE±	0.62	0.71	0.67
Significance	S	S	S
Weeding frequency			
Three-weeding	51.50a	50.11a	50.81a
Two-weeding	51.00a	49.23a	50.11a
Weed-free	52.04a	49.81a	50.92a
Weedy-check	32.53b	30.47b	31.50b
SE±	0.60	1.24	0.92
Significance	S	S	S

Within treatment, means followed by same letter(s) are not significantly different at 5% using DMRT

Table 6: Mean Fruit Weight (g) as influenced by Pruning and Weeding interaction for the combined years

Weeding frequency	Stem pruning		
	Three-stem	Two-stem	Unpruned
Three-weeding	50.16c	52.71b	43.14d
Two-weeding	49.81c	55.40a	42.79de
Weed-free	50.22c	52.80b	43.19d
Weedy-check	40.51e	43.09ds	33.48f
SE±		**0.80**	

Means followed the same letter(s) across rows and columns are not significantly different at 5% using DMRT

Fruit Yield (t ha^{-1})

Three-stem plant produced the highest fruit yield than two-stem and unpruned plants (Table 7). The fruits yield in two-stem plants was not significantly higher than the unpruned, suggesting that increased fruit size and mean fruit weight due to pruning had no advantage over the high number of fruits obtained from unpruned plants. However, the moderately pruned (three-stem) plants had higher fruits size, mean fruit weight and relatively comparable number of fruits to the unpruned, as a result, the three-stem plants out yielded both the unpruned and two-stem plants significantly [7].

Weed-free treatment produced significantly highest tomato fruit yield followed by three and two-weeding frequencies, which produced similar yield differences. The least yield was recorded in the control (weedy-check) plots. Many researchers reported similar results [14,19]. Interaction between stem pruning and weeding frequency showed that three-stem pruning and any weeding frequency, except weedy-check, produced the higher tomato fruit yield.

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Table 7: Fruit Yield of Tomato as influenced by Stem pruning and Weeding frequency in 2007 and 2008 rainy seasons

Treatment	Fruit Yield (t ha^{-1})		
	2007	2008	Combined
Stem pruning			
Three-stem	55.86a	57.32a	56.59a
Two-stem	50.87b	52.18b	51.53b
Unpruned	49.92b	50.95b	50.44b
SE±	0.85	1.25	1.05
Significance	S	S	S
Weeding frequency			
Three-weeding	50.50b	53.24ab	51.87b
Two-weeding	49.55b	52.70b	51.13b
Weed-free	52.02a	54.85a	53.44a
Weedy-check	12.47c	14.87c	13.67c
SE±	0.57	0.70	0.64
Significance	S	S	S

Within treatment, means followed by same letter(s) are not significantly different at 5% using DMRT

Table 8: Fruit yield as influenced by Stem pruning and Weeding frequency interaction for the combined years

Weeding frequency	Stem pruning		
	Three-stem	Two-stem	Unpruned
Three-weeding	54.23ab	51.70c	51.16c
Two-weeding	53.86ab	51.33c	50.79c
Weed-free	55.02a	52.49bc	51.94c
Weedy-check	35.12d	32.60de	32.06e
SE±		0.85	

Means followed the same letter(s) across rows and columns are not significantly different at 5% using DMRT

CONCLUSIONS

Based on the findings of this study, pruning tomato (cultivar UC82B) to three-stem could be practiced for improved yield. Since keeping field weed-free is not economically feasible, two-weeding could conveniently be adopted for enhanced and economical production of tomato in the study area. Therefore three-stem pruning combined with two-weeding frequency is recommended for tomato production in Zuru area.

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