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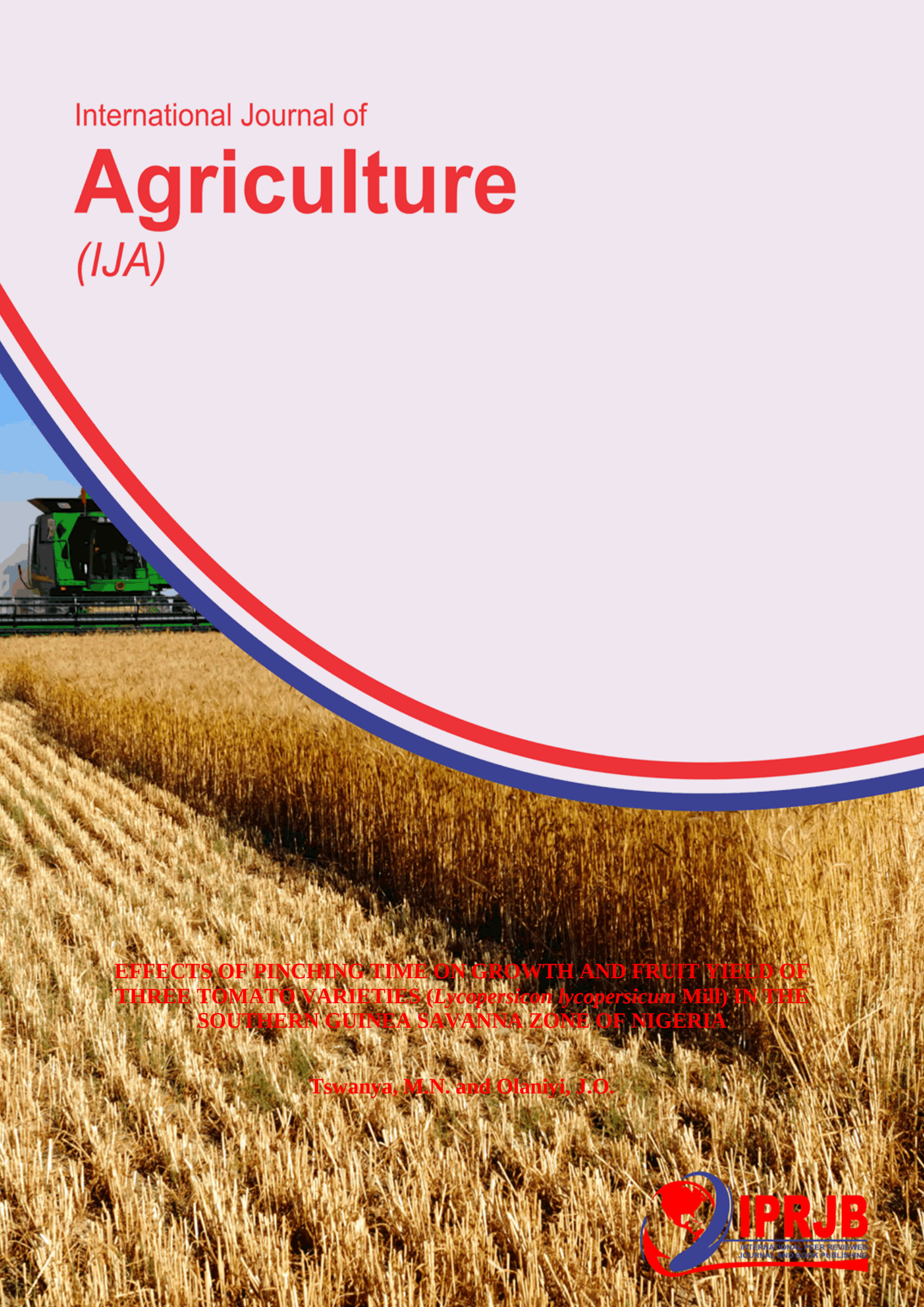

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ABSTRACT

Purpose: Field experiment was conducted at the Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso and Niger State College of Agriculture, Mokwa, in 2012 cropping season to examine the effects of pinching on growth and fruit yield of tomato. The experiment had twelve treatments of three varieties (Ogbomoso Local, Mokwa Local and UC82B) of tomato and four pinching times (0, 2, 4 and 6) weeks after transplanting (WAT) replicated three times. The experiment was laid out in Randomized Complete Block Design (RCBD) and data were collected on plant height, number of leaves, number of flowers, number of fruits and total fruit yield.

Material and Methods: Data was analysed using analysis of variance (ANOVA) SAS package and treatment means compared using least significant difference (LSD) at 5% probability level.

Results: The results showed that un-pinched plants gave the highest plant height (39.5 cm) while pinching at 2 WAT gave the least (33.7 cm). UC82B gave the highest fruit yield (23.10 t ha^{-1}) while Mokwa Local recorded the least (12.00 t ha^{-1}). Plants pinched at 4 WAT gave the highest fruit yield (19.60 t ha^{-1}) and the least (12.5 t ha^{-1}) was obtained from un-pinched plants.

Recommendation: Based on the findings, UC82B and pinching time of 4 WAT may be recommended for the farmers within the study areas.

Key words: *Tomato, pinching time, variety, growth, yield*

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1.0 INTRODUCTION

Tomato (*Lycopersicon lycopersicum*) belongs to the solanaceae family. It originated in Peru and Mexico, in the present day Central and South America from where it spread to other parts of the world (Zeidan, 2005). Tomato reached Europe from Mexico in the 16th century, and was initially used as ornamental plant. Its cultivation for edible fruits started at the end of the 18th century. Tomato was introduced to West Africa and Nigeria in particular, at the end of the 19th century (Villareal, 1980). It is currently considered to be one of the main vegetable crops in the world, and constitutes an economic force that influences the income of many growers in the world (Omar, 2005). In Nigeria tomato also finds its way into almost every kitchen. Tomato crop is very important in terms of diet and economy in Nigeria both during the rainy season (rain fed) and dry season using irrigation facilities. It is used as a condiment in stews and soup or eaten raw in salads. Industrially, the crop is made into puree, sauce, paste and powder (Balarabe, 2012).

Pinching is an horticultural operation in which the terminal growing end of a plant is removed (George, 2004). Pinching consists of removing side shoots when they are 5 cm long by gently breaking off shoot between finger and thumb. This can be done up to one meter or full height of the plant. Pinching makes the control of diseases particularly during wet periods easier. When plants with apical dominance are pinched, lateral buds are encouraged to grow, resulting in full rather than tall, narrow plants (single stem) (Anon, 2006). Pinched plants produce multiple terminal growths that bear flowers and hence increase fruit formation. The side shoots should be removed by pinching them out with the fingers. If allowed to grow they will produce mass foliage but few tomatoes (Guildford, 2009). Pinching and staking increase earliness of fruiting at the expense of yield. Pinching of determinate varieties should be avoided or kept to minimum (Jeffrey, 2004). Pruning tomato plants should begin during early stages of growth, when the plant reaches a height around 30.5 – 45.7 cm. Waiting to prune later on in the development could cause it to go into shock, reducing production. These can occur if you prune a lot of branches at one time (Williams, 2010).

Once tomato plant has developed six or seven trusses it should be stopped by breaking out the growing tip as this would encourage the plant to produce good quality tomatoes rather than an abundance of low quality late-maturing fruit (Michele, 2009). It is necessary to pinch off the growing tip or tips so that the remaining fruits have a chance to ripen. The fruit that is formed on unpinched plant are generally smaller than and not as flavourful as that of a pruned tomato plant, although more fruits are produced. Although pinching can be a tedious chore, it is immensely satisfying to harvest a large crop of juicy, healthy tomatoes all season long (Tonya, 2006).

Despite the popularity of the crop, there is paucity information on the response of tomato to pinching. Many farmers in Nigeria do not practice it for tomato production. This study aimed at determining the appropriate pinching time for tomato production.

2.0 MATERIALS AND METHODS

The experiments were conducted at two locations; Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso ($8^{o}10^{1}$N; $4^{o}10^{1}$E) and Niger State College of Agriculture, Mokwa (9^{o} 18^{1}N and 5^{o} 04^{1}E), during 2012 cropping season. The experimental plot was ploughed and harrowed after which lining out was carried out. There were 36 plots with three replications. Each replicate consisted of 12 plots. Each treatment was in a plot size of 2.5 m x 2.0 m (5.0 m^{2}). A plot contained 30 plants. The total experimental area was 378.00

m^2 (0.038 ha^{-1}). The alley way between replicates plots was 1.0 m and within replicates was 1.0 m. Tomato seedlings were transplanted at a spacing of 50 cm x 50 cm. The treatments consisted of four pinching times; 0 (no pinching) 2, 4 and 6 weeks after transplanting (WAT) and three tomato varieties (Ogbomoso Local, Mokwa Local and UC82B). The treatments were 4 x 3 factorial experiment and fitted into a Randomized Complete Block Design (RCBD), replicated three times.

The seeds were sourced from the Department of Crop Production and Soil Science, Ladoke Akintola University of Technology, Ogbomoso and from the Department of Agricultural Technology, Niger State College of Agriculture, Mokwa. The tomato seeds were sown on nursery beds containing pulverized soil and the seedlings were raised for four weeks before transplanting to the field at the two locations. Watering in the nursery was done as at when needed. Healthy and vigorous seedlings were transplanted into the field in order to ensure uniformity. Watering was done using watering - can to supplement rainfall. Pesticide in form of cypermethrin was applied at the dosage of 25 ml per 15 litres of knapsack sprayer fortnightly to check caterpillars, worms and grasshoppers. Manual weeding was also carried out using hoe at three weeks interval starting from 2 WAT to reduce competition between weeds and plants. Data were collected on growth and fruit yield from six selected plants per plot. Data collected were subjected to Analysis of Variance (ANOVA) using SAS statistical package. Treatment means were separated using the least significant difference (LSD) at 5% probability level.

3.0 RESULTS

The plant heights of the tomato varieties were not significantly ($P \leq 0.05$) different at 2 and 4 WAT but at 6 WAT variety UC82B was significantly shorter than Ogbomoso Local and Mokwa Local which were not significantly different from each other (Table 1). The plants pinched at 2 weeks were significantly shorter (13.0 cm) than the plants from the un-pinched plants and pinched plants at 6 weeks. The un-pinched plants recorded the highest mean value of 39.5 cm at 6 WAT. But the value obtained from un-pinched was not significantly different from the mean value (37.1 cm) obtained from the plants pinched at 6 weeks. The trend was the same at 2, 4 and 6 WAT. The interaction effect of variety and pinching time had no significant ($P \geq 0.05$) effect on the plant height of tomato at all the sampling periods.

The mean number of leaves of tomato varieties were not significantly ($P \geq 0.05$) different at 2, 4 and 6 WAT (Table 2). The number of leaves of the three tomato varieties were significantly ($P \leq 0.05$) influenced by pinching time at 2 and 6 WAT. The plants pinched at 2 weeks with the mean value of 76.8 significantly produced higher number of leaves than the un-pinched plants at 6 WAT but plants pinched at 4 and 6 weeks had similar number of leaves with the mean values of 71.1 and 68.5, respectively. The interaction effect of variety and pinching time was not significant ($P \geq 0.05$).

The number of flowers of UC82B (30.3) was significantly ($P \leq 0.05$) more than that of Ogbomoso Local (22.3) which was not more than that of Mokwa Local (21.3). The mean number of flowers of three tomato varieties were significantly ($P \leq 0.05$) increased by the pinching time in both locations. The plants pinched at 4 WAT recorded the highest mean value of 31.6, followed by the pinched plants at 6 WAT with the mean value of 26.0 which was not significantly different from the plants pinched at 2 WAT (22.3) while the least mean value of 18.7 was obtained from the control plot. But there was no significant difference between the plants pinched at 2 WAT and the control plots (Table 3).

The number of fruits of UC82B (30.5) was significantly higher than that of Ogbomoso Local (22.3) while the varieties of Ogbomoso Local and Mokwa Local had similar number of fruits (Table 4). The number of fruits was significantly ($P \leq 0.05$) increased by pinching time. The plants pinched at 4 WAT recorded the highest mean value of 31.8 which was significantly higher than the mean value of 26.0 obtained at 6 WAT. But there was no significant difference between the mean values received at 6 WAT from the plants pinched at 2 weeks and the control plot. The interaction effect between the variety and pinching time was not significant ($P \geq 0.05$).

The three tomato varieties was significantly ($P \leq 0.05$) different in the total fruit yield (Table 5). The highest fruit yield of 23.10 t ha^{-1} was obtained from UC82B, followed by the mean value of 14.60 t ha^{-1} received from Ogbomoso Local which was not significantly different from the least mean value of 12.00 t ha^{-1} obtained from Mokwa Local. But UC82B significantly performed better than the values obtained from Ogbomoso Local and Mokwa Local varieties, respectively. Pinching time had significant ($P \leq 0.05$) influence on the total fruit yield of tomato. The total fruit yield increased as the pinching time weeks increased with the highest mean value of 19.60 t ha^{-1} recorded from the plants pinched at 4 WAT. This was closely followed by the plants pinched at 6 WAT with the mean value of 18.00 t ha^{-1}. The plants pinched at 4 WAT significantly recorded a higher yield than the plants pinched at 2 WAT and the un-pinched, respectively. Also, the plants pinched at 2 WAT with the mean value of 16.10 t ha^{-1} significantly gave better yield than that of the control plot which had the least mean value of 12.50 t ha^{-1}. The interactive effect of variety and pinching time was not significant ($P \geq 0.05$).

4.0 DISCUSSION

The increased in growth parameters as the plant aged might be due to the increase in the cell number and size. This result is similar to the report of Olaniyi and Akanbi (2008) who reported that there was increase in the plant height and number of leaves of cabbage as the plant aged. The significant reduction in plant height following pinching time as recorded in the current study agrees with the report of Stacey (1983) in which apical bud removal resulted in decreased tomato plant height. The results of the current study revealed that plants in which pinching time of 2 and 4 WAT were done had decreased plant height. This is in agreement with the findings of the above author. Findings in this study also agrees with those of Levent and Sozer (2001) who stated that pinching of the lateral branches and the tips cause reduction in the production of a mass foliage which must have led to plant height reduction observed in the presents study. This is contrary to the reports of Uddin *et al*. (1997) and Ara *et al*. (2007) working in Bangladesh who obtained the shortest heights from unpruned tomato plants. The disagreement might have arisen from varietal and climatic differences. Olasantan (2001) also reported that treatment enhanced in branch production increased young leaf production in okra. According to Williams (2010), pruning tomato plants should begin during early stages of growth, when the plant reaches a height of about 30.5 to 45.7 cm waiting to prune later on in the development could cause it to go into shock, reducing production. This result is in line with Anon. (2006) who reported that when tomato plants with apical dominance are pinched, lateral buds are encouraged to grow, resulting into full rather than tall, narrow plants (single stem).

The superiority of UC82B over the other two varieties in respect of the number of flowers and total fruit yield agrees with the findings of Olaniyi (2009) who stated that tomato

varieties differ in flowering ability due to differences in genetic make-up. This view is also in line with that of Olaniyi and Fagbayide (1999). The significant increase in number of flowers is as a result of more lateral buds that were encouraged to develop when plants tip were pinched. This agrees with George (2004) who revealed that pinched plants produced multiple terminal growths that bore flowers and hence, increased fruit formation and size. Stopping of tomato plants above six or seven trusses is a practice that encourages flowering (Michele, 2009). However, result obtained from this study in which about 30.3 flowers was obtained for UC82B, agrees with Anon. (2008) and Tswanya *et al*. (2012) who stated that average number of tomato flowers ranged between 20 - 35 under normal practice. In okra, work carried out by Olasantan and Salau (2007) also revealed that pruning significantly increased number of pods per plant.

Olaniyi *et al*. (2010) reported that fruit yield per plant and total fruit yield significantly differed among varieties due to genetic differences. The results of the current study showed that UC82B significantly gave the highest total fruit yield of 23.10 t ha^{-1} which falls to the upper value of a range of 26.29 t ha^{-1} of the world as per FAO (2003) and 20 to 30 t ha^{-1} with good management as reported by Uguru (2011). Furthermore, the highest total fruit yield of 19.60 t ha^{-1} and 18.00 t ha^{-1} was recorded when plants were pinched at 4 WAT than the values obtained from the un-pinched plants, which was very close to 20 to 30 t ha^{-1} total tomato yield reported by Uguru (2011). The yield obtained from this study current study agrees with the findings of Tswanya *et al*. (2012) who revealed that plants pinched produces higher fruit yield than the un-pinched plants.

4.1 CONCLUSIONS

The appropriate pinching time for tomato in the southern guinea savanna is 4 WAT. Generally, the values observed from un-pinched plots were lower than the pinched plants. Findings from the results showed that UC82B variety had the highest fruit yield and consistently maintained higher values in other parameters evaluated. It is therefore recommended for the farmers within the study areas.

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Table 1: Effect of variety, pinching time and their interaction on plant height of tomato plants in 2012 cropping season

	Plant Height (cm)				
	Pinching Time (WAT)				
Variety	0	2	4	6	Variety Mean
			2WAT		
OL	16.8	13.8	15.3	15.7	15.4
ML	14.9	12.1	13.5	14.3	14.6
UC82B	15.6	13.2	13.6	14.8	14.5
PT Mean	15.8	13.0	14.1	14.9	
LSD V	ns				
LSD PT	1.21				
V x PT	ns				
			4 WAT		
OL	21.9	19.5	19.8	21.6	20.7
ML	19.8	17.3	18.7	19.4	19.9
UC82B	20.6	17.3	18.7	20.1	19.7
PT Mean	20.8	18.0	19.1	20.4	
LSD V	ns				
LSD PT	1.22				
V x PT	ns				
			6 WAT		
OL	43.0	35.7	38.4	39.9	39.3
ML	39.9	35.4	37.9	38.8	38.7
UC82B	35.6	30.0	31.5	32.5	36.9
PT Mean	39.5	33.7	35.9	37.1	
LSD V	ns				
LSD PT	3.01				
V x PT	ns				

OL = Ogbomoso local, ML = Mokwa local, V = variety, PT = pinching time, NS = not significant ($P \leq 0.05$)

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Table 2: Effect of variety, pinching time and their interaction on number of leaves per plant of tomato plants in 2012 cropping season

	Number of Leaves				
	Pinching time (WAT)				
Variety	0	2	4	6	Variety Mean
			2 WAT		
OL	16.7	19.7	17.8	17.0	17.8
ML	15.8	18.4	17.8	16.8	17.5
UC82B	15.5	18.5	18.1	16.2	17.4
PT Mean	16.0	18.9	17.9	16.7	
LSD V	ns				
LSD PT	1.52				
V x PT	ns				
			4 WAT		
OL	38.7	43.1	41.3	40.1	40.8
ML	33.1	38.1	37.2	35.4	38.6
UC82B	34.8	46.4	40.4	39.3	39.1
PT Mean	35.5	42.5	39.6	38.3	
LSD V	ns				
LSD PT	ns				
V x PT	ns				
			6 WAT		
OL	58.4	85.3	74.2	70.0	72.0
ML	56.4	74.5	71.4	69.2	70.2
UC82B	60.7	70.6	69.4	66.2	69.2
PT Mean	58.5	76.8	71.7	68.5	
LSD V	ns				
LSD PT	9.25				
V x PT	ns				

OL = Ogbomoso local, ML = Mokwa local, V = variety, PT = pinching time, ns = not significant ($P \leq 0.05$)

Table 3: Effect of variety, pinching time and their interaction on number of flowers per plant of tomato plants in 2012 cropping season

Variety	Pinching time (weeks after transplanting)				Variety mean
	0	2	4	6	
OL	16.6	20.1	31.0	21.4	22.3
ML	13.1	15.1	32.6	24.4	21.3
UC82B	26.6	31.6	31.1	32.2	30.3
Pinching time mean	18.7	22.3	31.6	26.0	
LSD 0.05					
Variety	3.89				
Pinching time	4.49				
V x PT	ns				

OL = Ogbomoso local, ML = Mokwa local, V = variety, PT = pinching time, NS = not significant (P≤0.05)

Table 4: Effect of variety, pinching time and their interaction on number of fruits per plant of tomato plants in 2012 cropping season

Variety	Pinching time (weeks after transplanting)				Variety mean
	0	2	4	6	
OL	16.6	20.1	31.0	21.4	22.3
ML	13.1	15.1	32.6	24.5	21.3
UC82B	26.4	31.6	31.8	32.2	30.5
Pinching time mean	18.7	22.3	31.8	26.0	
LSD 0.05					
Variety	4.04				
Pinching time	4.66				
V x PT	ns				

OL = Ogbomoso local, ML = Mokwa local, V = variety, PT = pinching time, NS = not significant, (P≤0.05)

Table 5: Effect of variety, pinching time and their interaction on total fruit yield (t ha-1) of tomato plants in 2012 cropping season

Variety	Pinching time (weeks after transplanting)				Variety mean
	0	2	4	6	
OL	10.9	14.5	17.6	15.2	14.6
ML	8.3	11.1	15.2	13.4	12.0
UC82B	18.2	22.8	26.1	25.4	23.1
Pinching time mean	12.5	16.1	19.6	18.0	
LSD 0.05					
Variety	2.95				
Pinching time	3.40				
V x PT	ns				

OL = Ogbomoso local, ML = Mokwa local, V = variety, P = pinching time, NS= not significant, (P≤0.05)