Effect of Tillage Practices on the Growth & Yield of Maize *(Zea mays)* on an Alfisols in Northern Guinea Savannah of North-Eastern Part of Nigeria

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D.O.I: 10.56201/ijaes.v10.no2.2024.pg23.38

Abstract
The present study aimed to assess the effect of tillage practices on the growth and yield of maize (zea mays) on an Alfisols in northern Guinea Savannah of North-eastern part of Nigeria. The research was conducted in Teaching and Research Farm School of Agricultural Technology, Modibbo Adama University, Yola where four (4) treatments of tillage operations namely Minimum tillage (MT), Ridge Tillage (RT), Disc Tillage (DT) and Zero Tillage (ZT) respectively. These treatments were replicated three times (3) and laid out in a Randomized Complete Block Design (RCBD) making twelve plots accordingly. Each plot was measured as 5m x 5m with spacing of 1 m between replicates and 0.5 m between plots in the same replicate. This will give a total plot size of 17 m x 27 m (459 m^2). Maize crop was planted (25 cm × 75 cm) where data on morphological growth were collected at 3 WAS, 6 WAS and 9 WAS and yield data were measured accordingly. The obtained data were subjected to Analysis of Variance (ANOVA) after which significant means were separated using Least Significant Difference (LSD) at P <0.01 %. The results revealed that there were significant difference among the tillage treatments in all the periods of measured growth parameters and yield variables. The growth parameters were affected by treatments in order of RT>MT>DT>ZT while increase in GYPH of maize was in order of RT>ZT>DT>MT with the following corresponding mean values of 17166.67 kg, 11000.00 kg , 10731.25 kg and 9716.67 kg respectively. To realize optimum growth and yield of maize conventional tillage (RT) and conservation tillage (MT) practices should adopted in the area.

Keywords: *Alfisols, Growth, Maize, Tillage and Yield*

INTRODUCTION

Tillage, undoubtedly, is one of the most crucial practices to ameliorate crop productivity and maintain soil health (Shahbaz, *et al.*, 2017). It is well defined as the mechanical manipulations of soil to keep it loose for plant growth and free from weed during the growth of plant while its fundamental purposes include: preparing suitable seed bed for plant growth, destroying competitive weed and, improving the physical condition of soil. Soil is a key natural resource and soil quality is the integrated effect of management on most soil properties that determine crop productivity and sustainability (Anikwe and Ubochi, 2007; Franzluebbers, 2002; Aikins and

Afuakwa, 2012). Tillage systems create an ideal seedbed condition for plant emergence, development, and unimpeded root growth (Licht and Al-Kaisi, 2005). Soil tillage is among important management practices affecting soil quality and crop yield (Odunze, *et al.*, 2014). It contributes up to 20% of all crop production factors (Khurshid et al., 2006).

Tillage methods influence soil physical, chemical and biological characteristics, which in turn may alter plant growth and yield (Rashidi and Keshavarzpour, 2011). Different tillage methods may affect the growth and yield of maize due to different soil conditions created. Farmers in the study areas adopted different tillage operations without being aware of the effect of these operations on the growth and yield of maize cultivation while others uses no tillage. It is imperative to note that reducing tillage positively influences several aspects of Thus, despite this adopted tillage operations in the area there is inadequate information on the effect of tillage methods on maize growth and yield in the region. There is need therefore to understand the effects of tillage operation on maize production and ensure food security in the region. It is based on the assertion that the present research work saddled in assessing the effect of tillage practices on the growth and yield of maize *(Zea mays)* on an Alfisols in Northern Guinea Savannah of North-eastern part of Nigeria.

MATERAILS AND METHOD

The Study Area

The research work will be conducted at Teaching and Research Farm School of Agriculture and Agricultural Technology, Modibbo Adama University, which is located in Gerie Local Government Area of Adamawa State Nigeria.

Experimental Treatments and Design

Experimental treatments were consisted of four (4) namely Minimum tillage (MT), Ridge Tillage (RT), Disc Tillage (DT) and Zero Tillage (ZT) respectively. These treatments were replicated three times (3) and laid out in a Randomized Complete Block Design (RCBD) making twelve plots accordingly. Each plot was measured as 5m x 5m with spacing of 1 m between replicates and 0.5 m between plots in the same replicate making total plot size of 17 m x 27 m (459 m^2) of land for this research work accordingly.

AGRONOMIC PRACTICES

Land Preparation

All land operations were conducted before making the treatments.

Planting

Planting were done at a depth of 2.3 cm with a recommended of spacing 25 x 75 cm giving an approximate plant population of 35,000 plants/hectare.

Weeding and pest control

Due to the size of the plots weeding was done achieved using manual method when required and also pest control was achieved using chemical method respectively.

Fertilizer application

Recommended doses of N, P and K (60, 120 and 180 kg /ha) were applied. Doses of nitrogen, phosphorous and potassium were applied using urea, di-ammonium phosphate and sulphate of potash (SOP). All the doses of phosphorous and potassium were applied at the time of sowing while nitrogen was applied in three splits respectively.

Data Collection for the Crop Growth and Yield Parameters

Data Collection for Crop Growth

The following morphological data were collected

1. Plant height was measured at 3, 6 and 9 weeks after sowing (WAS). This was done by measuring with a measuring tape from the base of the plant to the tip of the highest shoot/leaf of the plant.
2. Leaf area was determined at 3, 6 and 9 WAS using the leaf area meter. Each leaf was divided into two and then placed into the leaf meter machine. The appropriate mask number was used (20 cm^2 or 50 cm^2 depending on size of leaf). The machine was then set to full scale and the leaf and glass mask inserted into the machine again. After pulling the shuttle, the reading of the leaf area was obtained.
3. Stem girth was measured using caliper in millimeters
4. Number of leaves were done by counting the number of leaves
5. Leaf Area Index was done by dividing the leaf area with the canopy covered area

Data Collection for Crop Yield

The following yield data were collected;

1. Cob length,
2. Number of cob/plant,
3. Weight of grains cob (g)
4. Grain Weight kg (100)
5. Grain yield per hectare (GYPH)

DATA ANALYSIS

Data collected for the growth and yield parameters of maize were subjected to the Analysis of Variance (ANOVA) after which significant means were separated using Least Significant Difference (LSD) at P <0.01 %(Steel *et al.*, 1997).

RESULTS & DISCUSSIONS

Effects of Tillage Practices on Growth Parameters of Maize (*Zea Mays*)

Effects of Tillage Practices on Plant Height (PH) of Maize (*Zea Mays*)

The results on the effect of tillage on the plant height of maize (*Zea mays*) are presented on Table 1.The result revealed that at 3 WAS the plant height of 16.66 cm (15.68-18.00 cm) under MT was recorded, under RT was found to be 17.96 cm (17.11-18.90 cm), DT recorded an average mean of 17.31 (16.91-17.88 cm) and under ZT the PH was observed to 17.07 (16.14-17.88 cm) respectively. There was significant difference among the tillage practices on the PH of maize at 3 WAS at P-value < 0.01. It could be noted that the PH increases in order of RT>DT>ZT>MT at 3 WAS. This results agreed with Aikin *et al.,* (2012) and Kayode and Ademiluyi (2004) who observed that the tallest plant was located in the disc harrowing only plots while the shortest plant was found in the No Tillage plots in some alfisol of Southwestern Nigeria. This is to explain that the maximum PH of the maize was found with RT which might be attributed to high level of ridges above the ground that may be allow faster growth due to high draining capacity with moderate moisture condition and free from water logging. Ridge sowing also produce higher germination percentage as compare to flat sowing (Altuntas *et al.*, 2009). Thus, conventional tillage decreases bulk density of soil (Khan *et al.,* 1999) and soil penetration resistance and also improves porosity and water holding capacity of the soil as was reported by Rashidi and Keshavarzpour (2007)

At 6 WAS the PH had increased to 43.96 cm under MT (39.5-48.12 cm), 48.80 cm (47.15-50.12 cm) with RT while DT was found to have 47.10 (46.12-48.19 cm) and 43.51 cm (39.19-49.17 cm) was observed under ZT practices accordingly. There was significant difference among the tillage practices on the PH of maize at 6 WAS at P-value < 0.01. Moreover, it is imperative to note that at 6WAS the PH had increased in order of RT>DT>MT>ZT. This result is not in conformity with of Karunatilake *et al.* (2000) who obtained that there is no statistical significant of results in plant height in tilled soil as compare with no tilled treatments. Karuma *et al.*, (2016) have reported increasing soil loosening effects created by Disc Ploughing plots created an ideal seedbed condition which influenced the growth of the crop resulting in the tallest plants in all the seasons. Khurshid *et al.* (2006) in the semi-arid Faisalabad, Pakistan, found a mean increase in maize plant height of 11.28 % and 9.59 % in the case of conventional tillage (use of a rigger in ridge tillage) and deep tillage (use of a cultivator in deep tillage plots), respectively, over minimum tillage (dibbling) treatments

In addition, at 9 WAS there were increased of PH of maize (*Zea mays*) plant to 183.82 cm (173.11-190.25 cm) with MT practices, 190.47 cm (189.15-192.14 cm) was recorded under RT meanwhile 184.80 cm (182.11-187.88 cm) was observed with DT and ZT practice recorded an averaged 182.50 cm (174.15-191.19 cm) of PH of the maize in the area. There was significant difference among the tillage practices on the PH of maize at 9 WAS at P-value < 0.01. The increase in PH was at 9 WAS is in order of RT>DT>MT>ZT. Similar finding was reported by Agber *et al.*, (2017) who explained that the tallest plant was found in the ridge tillage treatment at 8 weeks after planting while shortest plant was found in the no tillage plots. This might be due to proper root penetration due to that of Kayode and Adenileuyi (2004) who observed the shortest maize plant in the no tillage plots in comparison with that in the tilled plots on a sandy clay loan Alfisols in south western Nigeria.

Generally, it is clear to explain that the PH performs better under RT and DT practices than MT and ZT respectively. This could be linked to high level of the soils surface created by ridges and disc that permit moderate moisture status, ventilation among plants and improve high draining capacity of the soil. Thus, maize does not required water logged soils with low raining capacity. These findings agreed with the report of Nath *et al.,* (2020) who explained that deep tillage promoted better root growth and thus facilitated the plants for better absorption of water and nutrients, which in turn increased the plant height.

Table 1. Effects of Tillage Practices on Plant Height (PH) of Maize (*Zea Mays*)

Tillage Practices	3 WAS	6 WAS	9 WAS
Minimum Tillage			
Mean	16.66	43.96	183.82
Stand Dev	1.179	4.32	9.33
Min – Max	15.78 – 18	39.5 - 48.12	173.11 - 190.25
S.E+	0.393	1.439	3.112
C.V %	7.079	9.822	5.078
Ridge Tillage			
Mean	17.96	48.80	190.47
Stand Dev	0.898	1.51	1.53
Min – Max	17.11 - 18.9	47.15 - 50.12	189.15 - 192.14
S.E+	0.299	0.504	0.509
C.V %	4.999	3.099	0.801
Disc Tillage			
Mean	17.31	47.10	184.80
Stand Dev	0.509	1.04	2.90
Min – Max	16.91 - 17.88	46.12 - 48.19	182.11 - 187.88
S.E+	0.170	0.346	0.968
C.V %	2.939	2.205	1.572
Zero Tillage			
Mean	17.07	43.51	182.50
Stand Dev	0.876	5.12	8.52
Min – Max	16.14 - 17.88	39.19 - 49.17	174.15 - 191.19
S.E+	0.292	1.707	2.842
C.V %	5.133	11.771	4.671
P-value	0.002**	0.001**	0.001*

Effects of Tillage Practices on Leaf Area (LA) of Maize (*Zea Mays*)

The results on the effect of tillage on the leaf area of maize (*Zea mays*) are presented on Table 2. Leaf area is important for crop light interception and therefore has a large influence on crop yield (Dwyer and Stewart, 1986). At 3WAS the results shows that the LA was maximum under RT with an average value of 96.20 cm^2 (91.17-102.11 cm^2) followed by MT having a mean value 82.20 cm^2 (80.17-87.18 cm^2), while ZT had 81.14 cm^2 (75.15-88.12 cm^2) and the lowest LA of 73.45 cm^2 was recorded under DT practices respectively. It could be noted that the increased of LA was in order of RT>MT>ZT>DT. Thus, there was significant difference among the tillage practices on the LA of maize at 3 WAS at P-value < 0.01. These findings are similar to those observed by Karuma *et al.,* (2016) and Carlesso *et al.* (2002) who reported higher LAI values in maize cultivated under conventional tillage and attributed that to improved access to soil moisture as compared to no-till

In addition, similar trends were observed at 6 WAS where RT was found to be maximum with a mean value of 201.43 cm^2 (190.18-219.11 cm^2), then MT having 18.48 cm^2 (181.-190.20 cm^2), while DT was recorded with 173.41 cm^2 (170-177.11 cm^2) and the lowest LA was found under ZT practice 159.75 cm^2 (140.41-178.13 cm^2). There was significant difference among the tillage practices on the PH of maize at 6 WAS at P-value < 0.01. Therefore, the differences in maize LAI under the different tillage practices can also be attributed to the differences in exploration of the maize roots for soil moisture as was also explained by Karuma *et al.,* (2016). Aikins *et al.*, (2012) also observed that No tillage plots produced the smallest leaf area index

Similar trends were observed at 9 WAS where the LA was maximum under RT with a mean value of 303.45 cm^2 (290.12-315.11 cm^2), followed by MT practice with 280.80 cm^2 (279.12-295.17 cm^2) while DT was recorded with 257.08 cm^2 (211.12-283 cm^2) and ZT had the lowest LA of 204.43 cm^2 (199.11-211.00 cm^2) respectively. There was significant difference among the tillage practices on the PH of maize at 3 WAS at P-value < 0.01. Nath *et al.*, (2020) reported similar finding that the leaf area per plant of maize crop was significantly affected by different tillage and earthing up practices at 30, 60 and 90 DAS respectively.

At 6 and 9 WAS maintained similar order in LA increase of the increased of LA was in order of RT>MT>DT>ZT, with RT produces the maximum LA while the lowest was with ZT respectively. This might be attributed to low water logging effect of soil treated by RT when compared with ZT having more possibility of retaining water making the soil highly saturated which may affect the respiration and other biochemical processes of the maize plant. Agber *et al.*, (2017) also narrated that among the tillage systems, ridge tillage produced the largest leaf area compared to the other systems of tillage in Makurdi, Benue State, Nigeria.

Table 2. Effects of Tillage Practices on Leaf Area (LA) of Maize (*Zea Mays*)

Tillage Practices	3 WAS	6 WAS	9 WAS
Minimum Tillage			
Mean	84.2	185.48	284.80
Stand Dev	3.606	4.56	8.99
Min – Max	80.17 - 87.18	181.1 - 190.2	279.12 - 295.17
S.E+	1.202	1.520	2.997
C.V %	4.284	2.458	3.157
Ridge Tillage			
Mean	96.20	201.43	303.45
Stand Dev	5.522	15.50	12.58
Min – Max	91.17 - 102.11	190.18 - 219.11	290.12 - 315.11
S.E+	1.841	5.167	4.193
C.V %	5.740	7.695	4.145
Disc Tillage			
Mean	73.45	173.41	257.08
Stand Dev	7.500	3.56	39.91
Min – Max	66.12 - 81.11	170 - 177.11	211.12 – 283

S.E+	2.500	1.188	13.303
C.V %	10.212	2.055	15.524
Zero Tillage			
Mean	81.14	159.75	204.43
Stand Dev	6.541	18.88	6.04
Min – Max	75.15 - 88.12	140.41 - 178.13	199.11 – 211
S.E+	2.180	6.293	2.015
C.V %	8.062	11.817	2.956
P-value	0.00**	0.001**	0.001**

Effects of Tillage Practices on Leaf Area (LAI) of Maize (*Zea Mays*)

The results on the effect of tillage on leave area index (LAI) of maize (*Zea mays*) are presented on Table 3.The results revealed that the LAI was maximum at 3WAS under RT with an average value of 3.2 cm^2 (3.03-3.40 cm^2), followed by MT with 2.8 cm^2 (2.67-2.90 cm^2) while 2.7 cm^2 (2.5-2.93 cm^2) was observed under ZT and the lowest value of LAI was recorded at DT having mean value of 2.44 cm^2 (2.2-2.7 cm^2) respectively. The LAI increases in order of RT>MT>ZT>DT. Thus, there was significant difference among the tillage practices on the leaf area index of maize at 3 WAS at P-value < 0.01.

At 6 WAS the maximum LAI was found at RT practice with a mean value of 3.35 cm^2 (3.16-3.65 cm^2) under RT, followed by 3.13 cm^2 (3.01-3.30 cm^2) at MT, 2.89 cm^2 (2.83-2.95 cm^2) was recorded under DT and ZT had the lowest value of 2.66 cm^2 (2.34-2.96 cm^2) correspondingly. The order of increase was in order of RT>MT>DT>ZT. There was significant difference among the tillage practices on the leaf area index of maize at 6 WAS at P-value < 0.01. Similar trends were observed at 9 WAS where the LAI of maize was maximum under RT with an average value of 3.37 cm^2 (3.22-3.5 cm^2), then MT having 3.16 cm^2 (3.1-3.27 cm^2) followed by 2.85 cm^2 (2.34-3.14 cm^2) and the lowest value of LAI was observed under ZT 2.27 cm^2 (2.21-2.34 cm^2) respectively. Similar order of LAI increase was observed (RT>MT>DT>ZT) at 9 WAS as was observed in 6 WAS respectively. Hence, there was significant difference among the tillage practices on the leaf area index of maize at 9 WAS at P-value < 0.01. it could be noted that conventional tillage produced maiximum LAI than other tillage practices. Shahbaz *et al.*, (2017) had reported that during maize growth period the highest value for leaf area index (7.18) was obtained from those plots where the conventional tillage practices were exercised followed by deep tillage practices while lowest leaf area index (6.47) was recorded from minimum tillage practiced plots. Leaf area index was enhanced up to 9.89% by deep tillage practices as compared to minimum tillage. Tillage is an effective farm activity to improve soil tilth and soil physical conditions (Khan *et al.,* 2010), which increased nutrient use efficiency of crop and eventually leads to good crop yield (Bahadar *et al.*, 2007).

Table 3. Effects of Tillage Practices on Leaf Area (LAI) of Maize (*Zea Mays*)

	3 WAS	6 WAS	9 WAS
Minimum Tillage			
Mean	2.8	3.13	3.16
Stand Dev	0.118	0.15	0.10
Min – Max	2.67 - 2.9	3.01 - 3.3	3.1 - 3.27
S.E+	0.039	0.050	0.032
C.V %	4.211	4.835	3.019
Ridge Tillage			
Mean	3.2	3.35	3.37
Stand Dev	0.187	0.26	0.14
Min – Max	3.03 - 3.4	3.16 - 3.65	3.22 - 3.5
S.E+	0.062	0.087	0.047
C.V %	5.838	7.778	4.186
Disc Tillage			
Mean	2.44	2.89	2.85
Stand Dev	0.250	0.06	0.44
Min – Max	2.2 - 2.7	2.83 - 2.95	2.34 - 3.14
S.E+	0.083	0.020	0.148
C.V %	10.243	2.088	15.546
Zero Tillage			
Mean	2.7	2.66	2.27
Stand Dev	0.217	0.31	0.07
Min – Max	2.5 - 2.93	2.34 - 2.96	2.21 - 2.34
S.E+	0.072	0.103	0.022
C.V %	8.021	11.677	2.937
P-value	0.029**	0.02**	.001**

Effects of Tillage Practices on Stem Girth (SG) of Maize (*Zea Mays*)

The results on the effect of tillage on stem girth (SG) of maize (*Zea mays*) are presented on Table 4. Stem girth is an expression of vegetative growth (Squire, 1990). At 3 WAS the SG of maize was maximum under the RT with a mean value of 1.8 cm (1.17-2.22 cm) while MT was observed as next with 1.78 cm (1.74-1.84 cm) of SG, followed by DT 1.65 cm (1.55-1.74 cm) and ZT practice was found to be 1.54 cm (1.44-1.65 cm) respectively. At 3 WAS the SG increases in order of RT>MT>DT>ZT. There was significant difference among the tillage practices on the LAI of maize at 3 WAS at P-value < 0.01. Similar report was made by Anjum *et al.*, (2019) who revealed that various tillage practices significantly affected stem diameter of maize plant
Furthermore, at 6 WAS it was also recorded that RT practice had the maximum SG of 2.80 cm (2.74-2.88 cm) followed by DT with a mean value of 2.45 cm (2.11-2.77 cm) while MT was

observed with a mean value of 2.40 cm (2.35-2.45 cm) and ZT practice had the lowest value of 2.38 cm (2.11-2.55 cm) correspondingly. The SG of maize plant increases in order of RT>DT>MT>ZT. There was significant difference among the tillage practices on the LAI of maize at 6 WAS at P-value < 0.01. Aikins *et al.*, (2016) have reported that the biggest *Akposoe* maize variety plant stem girth was observed in the disc harrowing and disc ploughing while the smallest stem girth was found in the No Tillage plots. Similar results were obtained by Aikins and Afuakwa (2010) experiment on different tillage practices on maize performance. In addition, at 9 WAS the RT was found to be maximum having a recorded value of 4.88 cm (4.64-5.11 cm), 4.35 cm (3.66-4.78 cm) was recorded with MT practices while DT had a mean value of 4.22 cm (3.67-4.78 cm) and 3.84 cm (3.55-4.00 cm) was observed under ZT accordingly. It could be observed that an increase in SG of maize at 9 WAS is in order of RT>MT>DT>ZT. There was significant difference among the tillage practices on the PH of maize at 9 WAS at P-value < 0.01. Anjum *et al.*, (2019) reported that statistically maximum plant stem diameter of (1.58 cm) was obtained in deep tillage treatment whereas statistically minimum plant stem diameter (1.28 cm) was observed in zero. The results obtained from this present study contradicted with Aikins et al. (2012) and Anjum *et al.* (2014), stated that stem diameter was not significant in tilled and no tilled treatments.

Generally, it is imperative to note that RT produced the maximum SG of maize plant in all the observed (3, 6 and 9 WAS) weeks after sowing while the lowest was recorded under ZT practice which concord with the report of Anjum *et al.*, (2019).

Table 4. Effects of Tillage Practices on Stem Girth (SG) of Maize (*Zea Mays*)

Tillage Practices	3 WAS	6 WAS	9 WAS
Minimum Tillage			
Mean	1.78	2.40	4.35
Stand Dev	0.051	0.05	0.60
Min – Max	1.74 - 1.84	2.35 - 2.45	3.66 - 4.78
S.E+	0.017	0.017	0.200
C.V %	2.878	2.094	13.837
Ridge Tillage			
Mean	1.80	2.80	4.88
Stand Dev	0.554	0.07	0.24
Min – Max	1.17 - 2.22	2.74 - 2.88	4.64 - 5.11
S.E+	0.185	0.024	0.078
C.V %	30.821	2.575	4.819
Disc Tillage			
Mean	1.65	2.45	4.22
Stand Dev	0.095	0.33	0.56
Min – Max	1.55 - 1.74	2.11 - 2.77	3.67 - 4.78
S.E+	0.032	0.110	0.185
C.V %	5.772	13.484	13.141
Zero Tillage			
Mean	1.54	2.38	3.84

Stand Dev	0.100	0.23	0.25
Min – Max	1.44 - 1.64	2.11 - 2.55	3.55 – 4
S.E+	0.033	0.078	0.083
C.V %	6.490	9.862	6.492
P-value	0.031**	0.010*	0.012**

Effects of Tillage Practices on Number of Leaves (NL) of Maize (*Zea Mays*)

The results on the effect of tillage on number of leaves (NL) of maize (*Zea mays*) are presented on Table 5. Leaves are the site of photosynthetic activities of crops through which biomass are produced, partitioned among various parts of crops and stored for crop productivity (Asare *et al.*, 2011).The result indicates that at 3 WAS the NL was found to be highest under RT with 7.33 (7-8), followed by DT 6.67(6-7) and 6.33 (6-7) was observed under MT and ZT practices. There was significant difference among the tillage practices on the number of leaves of maize at 3 WAS at P-value < 0.01. The increasing order of RT>DT>MT and ZT was observed at 3 WAS. Similarly, at 6 WAS RT was highest 11.67 (11-12), followed by DT 10.67 (10-11) while MT had a mean value of 9.67 (9-10) and the lowest value of 9.33 (9-10) was recorded under ZT correspondingly. The NL increases in order of RT>DT>MT > ZT. There was significant difference among the tillage practices on the number of leaves of maize at 6 WAS at P-value < 0.01.

Moreover, at 9 WAS the NL was highest with a mean of values of 13.33 (13-14) under RT practices, followed by 12.33 (12-13) with ZT while 12 (12-12) NL was observed under DT and the lowest value of 11.67 (11-12) was recorded with MT accordingly. There was significant difference among the tillage practices on the number of leaves of maize at WAS at P-value < 0.01. The increase of NL at 9 WAS is in order of RT>ZT>DT>MT which is not in conformity with that of 3 and 6 WAS respectively. Similar significant effect of tillage practices was reported on maize number of leaves per plant except for the first, second and fourth weeks after planting as was reported by Aikins et al., (2012). In contrast, there was no significant effect of tillage practices on maize number of leaves per plant (P=0.05) by Bongomin *et al.*, (2020) in Uganda.

Table 5. Effects of Tillage Practices on Number of Leaves (NL) of Maize (*Zea Mays*)

Tillage Practices	3 WAS	6 WAS	9 WAS
Minimum Tillage			
Mean	6.33	9.67	11.67
Stand Dev	0.577	0.58	0.58
Min – Max	6 - 7	9 – 10	11 – 12
S.E+	0.192	0.192	0.192
C.V %	9.116	5.973	4.949
Ridge Tillage			
Mean	7.33	11.67	13.33
Stand Dev	0.577	0.58	0.58
Min – Max	7 - 8	11 – 12	13 – 14
S.E+	0.192	0.192	0.192
C.V %	7.873	4.949	4.330
Disc Tillage			
Mean	6.67	10.67	12.00
Stand Dev	0.577	0.58	0.00
Min – Max	6 - 7	10 – 11	12 – 12
S.E+	0.192	0.192	0.000
C.V %	8.660	5.413	0.000
Zero Tillage			
Mean	6.33	9.33	12.33
Stand Dev	0.577	0.58	0.58
Min – Max	6 - 7	9 – 10	12 – 13
S.E+	0.192	0.192	0.192
C.V %	9.116	6.186	4.681
P-value	0.001**	0.02**	0.001**

Effects of Tillage Practices on Yield Parameters of Maize (*Zea Mays*)

The results on the effect of tillage on the yield parameters of maize (*Zea mays*) were presented on Table 6. It was revealed that the ear length of maize was highest under RT, followed by DT, MT and ZT with corresponding values of 19.39 cm (18.12-20.17 cm), 17.07 cm (16.89-17.18 cm), 16.45 cm (14.18-18.17 cm) and 15.83 cm (14.17-18.17 cm) respectively. There was significant difference among the tillage practices on cob length of maize at P-value < 0.01. The conventional tillage (RT and DT) produces high cob length than the conservation tillage (MT and ZT) this would be due to maximum vegetative growth and leaf area index to capture sunlight and food reserves in deep tillage than no till treatments. This result was not in conformity with the report of Agber *et al.*, (2017) who reported that the highest dry cob length (cm) was obtained in flat bed than ridge-tillage plot. However, they also reported that the lowest dry cob length (cm) was obtained in no tillage systems. But the results agreed with the results of Anjum *et al.*, (2019) indicated that cob length was significantly influenced under different tillage practices. Meanwhile, our results are contradictory to Pabin *et al.* (2006), who indicated that different tillage practices failed to influence maize cob length.

In addition, RT practice was found to highest number of cob per plat with a mean value of 1.67 than other tillage practices which recorded similar value of 1.33 accordingly. There was no significant difference among the tillage practices on number cob per plant of maize at P-value < 0.01. Anjum *et al.*, (2019) reported similar findings indicating that tillage practices influence number of grains per cob.

Similarly, maximum weight of cob was observed under RT practice having a mean value of 1210.40 g (180.11-3070.17 g), followed by MT with 254.47 g (233.11-270.18 g), then ZT having an average value of 205.35 g (120.11-292.13 g) and DT recorded the lowest value of 186.80 g (180-11-192.16 g) accordingly. There was significant difference among the tillage practices on weight of cob of maize at P-value < 0.01. Aikins *et al.*, (2012) also found out that the lowest dry cob weight obtained in the No Tillage plots may be due to the lack of soil loosening for providing conditions favourable to crop growth and yield.

Furthermore, grain weight is considered as most important component of grain yield. It is also called as seed index, an important yield contributing component. For the grain weight results shows that RT had recorded that maximum mean weight of 27.27 kg (23.11-30.11 kg), followed by ZT having 17.60 kg (15.11-19.87 kg), then DT 17.17 kg (16.22-18.11 kg) and 15.55 kg (14.41-17.12 kg) was the lowest observed under MT respectively. There was significant difference among the tillage practices on grain weight of maize at P-value < 0.01. In Similar report of Agber *et al.*, (2017) weight of 1000grains and grain yield (t/ha) was highest under ridge-tillage plot which might be due to proper soil loosening which led to deep rooting ability, water utilization and nutrient uptake for crop growth and yield. These results were compatible with studies conducted by Wasaya *et al.* (2011), who manifested that tillage operations meaningfully influenced 1000-grain weight in deep tilled plots. In the same way Khurshid *et al.* (2006) and Khan *et al.* (2001) elucidated that1000-grain weight of maize significantly increased in conventional till plots rather than no tilled plots.

Similar trend was observed on the grain yield per hectare (GYPH). Gain yield is final objective of farmers. The results shows increase in GYPH of maize in order of RT>ZT>DT>MT with the following corresponding mean values of 17166.67 kg (14443.75-18818.75 kg), 11000.00 kg (9443.75-12418.75 kg), 10731.25 kg (10137.5-11318.75 kg) and 9716.67 kg (9006.25-10700 kg) respectively. There was significant difference among the tillage practices on GYPH of maize at P-value < 0.01. This results agreed with the findings of Anjum et al (2019) and Vijaya, *et al.*, (2022) who reported that tillage practices significantly influenced the grain yield . These results are in agreements with that of Videnovil *et al.*, (2011) who observed higher maize yield in conventional tillage plots in comparison with that of the no-tillage plots in comparison with that of the notillage plots in the chenozen soil type in Cemunpolje, Serbia. Generally, These results are in agreement with those of Khan *et al.* (1999), Khan *et al.* (2001), Yusuf (2001), Khurshid *et al.* (2006) and Yusuf (2006), who concluded that tillage practices significantly affects crop yield and growth. However, in this study conservation tillage (ZT) was the second to had produced high

GYPH. Thus, no-tillage (NT) is considered to be one of the potentially efficient strategies (Six *et al.,* 2004). No tillage practice is a type of conservation tillage that simultaneously conserves soil and water resources, reduce farm energy and increase or stabilize crop production. Zhang *et al.* (2015) found that grain yield was (4.4%) higher in no tilled soils over tilled soil.

Table 6. Effects of Tillage Practices on Yield Parameters of Maize (*Zea Mays*)

Parameters	Cob Length (cm)	No. of Cob/ Plant	Weight of Cob (g)	Grain weight (Kg)	Grain Yield Per Hectare (Kg)
Minimum Tillage					
Mean	16.45	1.33	254.47	15.55	9716.67
Stand Dev	2.05	0.58	19.17	1.41	879.24
Min – Max	14.18 - 18.17	1 – 2	233.11 - 270.18	14.41 - 17.12	9006.25 - 10700
S.E+	0.6832	0.1925	6.3900	0.4689	293.0794
C.V %	12.463	43.301	7.533	9.049	9.049
Ridge Tillage					
Mean	19.39	1.67	1210.40	27.47	17166.67
Stand Dev	1.11	0.58	1613.74	3.80	2375.96
Min – Max	18.12 - 20.17	1 – 2	180.14 - 3070.17	23.11 - 30.11	14443.75 - 18818.75
S.E+	0.3698	0.1925	537.9118	1.2672	791.9855
C.V %	5.721	34.641	133.323	13.841	13.841
Disc Tillage					
Mean	17.07	1.33	186.80	17.17	10731.25
Stand Dev	0.16	0.58	6.14	0.95	590.65
Min – Max	16.89 - 17.18	1 – 2	180.11 - 192.16	16.22 - 18.11	10137.5 - 11318.75
S.E+	0.0524	0.1925	2.0451	0.3150	196.8833
C.V %	0.921	43.301	3.284	5.504	5.504
Zero Tillage					
Mean	15.83	1.33	205.35	17.60	11000.00
Stand Dev	2.08	0.58	86.02	2.39	1492.26
Min – Max	14.17 - 18.17	1 – 2	120.11 - 292.13	15.11 - 19.87	9443.75 - 12418.75
S.E+	0.6950	0.1925	28.6735	0.7959	497.4196
C.V %	13.171	43.301	41.890	13.566	13.566
p-value	0.001**	0.061	0.001**	0.003**	0.000**

CONCLUSION

Based on the results obtained from this research work after comparing various tillage practices it is cleared that the growth and yield of maize was maximum with an increasing order of RT>ZT>DT>MT. The conventional tillage of RT is considered as the best method followed by conservation tillage of ZT in parameters regarding growth and yield of maize in the study area respectively.

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