INFLUENCE OF TILLAGE, NUTRIENT AND WEED MANAGEMENT ON CHEMICAL PROPERTIES OF SANDY-LOAM SOIL AND YIELD OF SOYBEAN

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ABSTRACT
*Adoption of crop management practices that are directed at achieving a self-sustaining system for soil protection is critical to sustainable crop productions. The influence of four tillage depths (T_1 = Disc plough and disc harrow at 25 cm depth, T_2 = Disc plough at 20 cm depth, T_3 = Double tillage pass of disc harrow (DDH) at 15 cm depth, T_4 =Single pass of disc harrow at 10 cm depth),three nutrient applications (N_1 = No nutrient application (Control),N_2= Farm Yard Manure (FYM) at 0.5 ton/hectare (applied during tillage operation) + 50 kg/hectare of Superphosphate applied 4 weeks after sowing, N_3 = FYM at 1 ton/hectare (applied during tillage operation) + 75 kg/hectare of Superphosphate applied 4 Weeks After Planting) and four levels of weed management (W_1 = No weeding as control, W_2 = 3 litres of pre-emergence at planting + Post-emergence (Fusillade forte) at 2.5 litres (0.14 kg/ha) of post emergence at 3WAP,W_3 = 3 litres of pre-emergence + 3 litres (0.17kg/ha) of post emergence at 5WAP,W_4= 3 litres of pre-emergence + 4 litres (0.23 kg/ha)of post emergence at 7WAP were used for the production soybean in 2018 and 2019 planting seasons. The results showed that tillage systems between 10-15 cm depth of cut favour availability and retention of soil nutrients within the tap root of soybean as in the case of T_3 (DDH at 15 cm) that recorded the highest mean values of Soil Organic Matter (SOM) (1.77), Soil Organic Carbon (SOC) (1.40), total N (0.41%), available P of 4.82 ppm and exchangeable K of 0.22 C mol/Kg. In terms of nutrient application, N_3 had the highest SOM (1.90), Mg^{2+} (1.99), Ca^{2+} (1.28), Total N (0.41), available P (4.48) and exchangeable K (1.32) during harvesting time. T_3 (DDH at 15 cm) had the highest mean values of pod/plant (74.78), 1000 seed weight (134.83g) and highest mean value of grain yield of 2.43 tons/ha, however, it was not significantly different from yield 0f 2.35 tons/ha obtained in T_1 (Disc plough and disc harrow at 25 cm depth).Weed management practices did not significantly influence soil chemical properties soil p^H, soil organic matter, soil organic carbon, Magnesium, Nitrogen and others chemical properties analysed for the soil were uniformly distributed among the treatment at $p\leq0.05$***.** It is important that soybean farmers adopt management practices that are directed at achieving a self-sustaining system of the soil. Hence, tillage depth at 15 cm and minimum application of compost poultry manure are recommended for a sustainable soybean production.*

KEYWORDS: Depth of cut, Reduced tillage, Soil chemical properties, Soil nutrient, Tillage operation

1 INTRODUCTION

Tillage systems are sequences of mechanical operations that manipulate the soil for crop productions. The mechanical manipulation operations include tilling, planting, fertilization, pesticide application, harvesting, and residue chopping or shredding. The manners in which these operations are implemented affect the physical and chemical properties of the soil, which in turn affect plant growth. Several tillage practices have been implemented in agricultural production and a commendable report has been documented by several authors (Olaoye, 2002; Gomez, 2010, Olaoye and Ariyo, 2020). The responses of crops to tillage systems such as conventional, conservation (reduced or minimum tillage) and no tillage show impact of these systems on soil characteristics and nutrients (Košutić *et al.*, 2010; Dorota *et al.,* 2014). In Nigeria, the adoption of conservation tillage systems as alternatives to conventional tillage systems by farmers is gaining popularity because they drive to reduce the time and energy required in crop productions via the use of reduced machinery and labour costs. The tillage system implemented determines the distribution of roots in the soil profile. Roots of plants growing in conservation tillage systems are more concentrated at shallower depths than plant roots grown in other tillage systems (Gomez, 2010). When soil is not adequately mix, nutrients become more concentrated near the soil surface. Such nutrient distribution contributes to the concentration of roots nearer the soil surface. The continuous ploughing of soil at shallower depth results in development of plough pan which restrict nutrient movement and root penetration (Márta, 2014).

The extent of soil tillage may influence weed growth and nutrients uptake by the crops. Hence, researchers noted the necessity to select a suitable tillage practice or having the knowledge of appropriate use of primary tillage implements in order to be able to sustain successful growth of crops in a given environmental condition (Tesfahunegn, 2014). Olaoye (2012) highlighted the challenges of weeding operation in intercropping and mixed cropping systems in Nigeria. Peculiar effects of mechanical weeders were presented in related studies by Olaoye and Adekanye (2011) and Olaoye *et al.* (2012) while it was noted that weeding without application of herbicides could be preferred for quality preservation of the crop products. In many reports, tillage systems had a significant effect on soybean plant height and agricultural mechanization index of farm settlements (Pikul and Asse, 2001; Olaoye and Rotimi, 2010; Dorota *et al*., 2014). In the observation of Dorota *et al*. (2014), plough tillage had more beneficial effect compared to no-tillage by 10.5%. The first pod height was significantly higher by 1.7 cm under conventional plough tillage compared to the no-tillage treatment. Under conventional tillage, plants density was higher by 39.5% after emergence and 31.7% before harvest compared to that obtained under direct seeding. In the experiment, significantly higher seed yield of soybean was obtained under conventional plough tillage. Barrios *et al*. (2006) observed significantly higher yields in soybean crops under conventional tillage than in no tillage system in a rotation of maize/soybean. Buah *et al.* (2017) evaluated the effects of NPK on growth and yield of maize and soybean under no–tillage and conventional tillage using hand hoe. The authors reported that no-tillage with fertilizer resulted in the highest grain yields for both maize and soybean and also gave highest economic return. Seyed *et al.* (2016) studied the effect of tillage system on yield and weed populations of soybean (*Glycin Max* L.). The study reported that the greatest seed yield was recorded for weed control with herbicide + hand weeding (3877 kg ha^{-1}), followed by hand weeding (3379 kg ha^{-1}) and herbicide control (3359 kg ha^{-1}) and lastly by non-weeded treatment (3015 kg ha-1) as averaged across tillage systems. In other words, soybean seed yield was reduced by 22% in un-weeded treatment compared with the weed control with herbicide.

Abebe and Deressa (2017) conducted a study on the effect of nutrient applications (3, 6 and 9 ton/ha of Farm Yard Manure (FYM) and 8, 16 and 24 kg/ha of Phosphorous fertilizer) on the yield of two varieties of soybean followed by finger millet. The authors reported difference in soil chemical properties such as; pH, organic carbon, total nitrogen and available phosphorous before planting and after harvesting of soybean. Both precursor crop and nutrient applications had a positive effect on soil fertility status and hence improved the performance of the subsequent finger millet. Chiezey and Odunze (2009) reported an increase in both growth and yield of two varieties of soybeans (TGX 1019-2GB and TGX 1448-2EB) in the studies conducted in sub-humid Savannah of Nigeria under poultry manure and phosphorous nutrient applications. In the studies, the higher grain yield was obtained at 26.4 kg/ha of P and increased grain yield by 33.7% compared to plots with only poultry manure application. However, the studies reported no interactions between poultry manure and phosphorus fertilizers in any of the years or when weighed over the years.

Information on the tillage practices, nutrient management and weed management practices under mechanized soybean farming are rarely available in the derived guinea savannah (zone) of Nigeria coupled with degradation of arable soils and high energy demand in land preparation. Accelerated mineralization of crop residue also results to loss of soil organic matter (SOM) (especially in warm and moist climate and soil with low clay content) and formation of hard pan that impedes water ingress to root zone of crops thereby hindering crop growth and yield, resulting from excessive tillage practices. Also, in many cases, African farmers, Nigerian inclusive over-estimate tillage requirement for crops that are shallow rooted and this could result to unnecessary soil damage (Niranjan, 2009). The trend of climate change in Nigeria calls for concern on tillage systems and efforts should be focused on how to sustain soil and crop production. Therefore, this study was aimed at investigating the influence of conservation tillage treatments on some selected chemical properties of a sandy-loam soil.

2. MATERIALS AND METHODS

A field experiment was conducted in the growing seasons of year 2018 and 2019 at the research farm site of the Department of Agricultural and Biosystems Engineering, University of Ilorin, Ilorin, Nigeria (Latitude 08° 28’ 54.5” E and Longitude 00 4° 40’ 56.4” N). The land was left fallow for about ten (10) years before the experiment. The percentage slope was between 0.3–2%. The samples for baseline chemical characteristics of the soil were randomly collected (15 samples per season) using zigzag method before land preparations in 2018 and 2019 respectively and mean values are presented in Table 1. Agro-ecological Zone classification shows that the land is within Warm Arid and Semi-Arid Tropics with Length of Growing Period (LGP) of 75-180 days and daily average temperature of greater than 20°C.It has bimodal rainfall distribution pattern that has its peak in June and late September, and dry spell between mid-July and late August, with average monthly maximum temperature of 32.79°C and annual rainfall of 1,271.5 mm (NIMET, 2017). A 4 × 3 × 4 factorial design in Randomized Complete Block Design in three replicates was used for the experiment and factors such as; Tillage systems (Conservation Tillage) (T), Nutrients Applications (N), and Weed management (W) were considered. The treatment levels for both trials are shown in Table 2. The post treatments soil chemical properties were obtained between soil depth 0-30cm (soil manipulation is within 25 cm for this study) during crop harvesting. The chemical properties such as pH in H_2O, Ca^{2+}, Mg^{2+}, Total Nitrogen, Organic Carbon, Organic matter, available P and K were determined in laboratory using United State Department of Agriculture standard. The results were analysed using Statistical Package for Social Sciences (IBM Version 20) to check for variances at a significant level of 5%.
This result is also in line with the findings of the study conducted on *Alfisol* classified as clayey skeletal *Oxic-Paleustalf* soil in the South-West of Nigeria (Nta *et al.*, 2017). The findings further established that tillage operations degrade soil, especially in organic matter, organic carbon, calcium ion, magnesium ion and exchangeable acidity.

Table 1: Baseline Chemical Characteristics of the Soil at the Experimental Site for 2018 and 2019 Seasons

Soil Chemical Properties	**2018 Trial Depth (cm)**		**2019 Trial Depth (cm)**	
	0 - 15	**15 – 30**	**0 – 15**	**15 - 30**
Organic carbon (%)	0.72	0.58	0.84	0.63
Organic matter (%)	0.62	0.61	0.72	0.68
pH (H_2O)	6.40	6.50	6.35	6.50
pH (Kcl)	5.30	5.33	5.30	5.34
Electrical conductivity (U_s/cm)	0.78	0.18	0.82	0.18
Ca^{2+} (mMol/100g)	1.84	2.08	1.76	2.08
Mg^{2+} (mMol/100g)	4.16	2.96	4.21	2.93
Total N (%)	0.22	0.20	0.25	0.21
P (ppm)	4.53	3.10	3.44	3.12
K (mMol/100g)	0.59	0.53	0.82	0.68

Soybean TDX 1448-2EB seeds that is commonly grown in Tropical countries like Nigeria for its ability to withstand drought were sown manually at a spacing of 75 × 25 cm and 2 seeds per hole in mid-June 2018 and 2019 planting seasons. Yield parameters such as number of pods/plant, number of seeds/pod, seed weight per plant and grain yield considered. One hundred and forty four (144) samplings were done at crop maturity on the 2 m² quadrate placed in each plot immediately after sowing.

3. **RESULTS AND DISCUSSION**

The effects of tillage systems, nutrient application rate, and weed management practice on soil chemical properties of the sandy-loam soil shown in Tables 3a - 4b for 2018 and 2019 planting seasons respectively.

3.1 Influence of Tillage Systems on Soil Chemical Properties

The study revealed that tillage system significantly at $p \leq 0.05$ influenced soil chemical properties. Tillage systems have significant effect on the soil organic matter, electrical conductivity of the soil, magnesium, aluminium, total nitrogen, available phosphorous, potassium and soil organic carbon in the trails. Among the tillage treatments, T_3 (DDH at 15 cm) had the highest mean values of soil organic carbon (1.40), electrical conductivity (1.30), total nitrogen (0.41), phosphorus (4.82) and Potassium (0.22) while T_4 (DH at 10 cm) recorded highest mean values of soil organic matter (1.81), magnesium (2.74) and aluminium (1.30). Neugschwandtner *et al.* (2014) also reported an increase in soil organic carbon, total nitrogen, phosphorus and potassium in the uppermost soil layer with reduced tillage intensity. It could be deduced from the results that reduced tillage operations between 10 -15 cm depth of cut favoured the availability and retention of soil chemicals within the tap root of shallow rooted crops such as soybean, as well as root proliferation that may also facilitate nutrient uptake. Also the result reveals that available nutrients are degraded in the soil as the depth of the tillage cut increased.

Table 2: **Experimental factors and levels for 2018 and 2019 planting seasons**

Factors	**Levels**
Tillage system (Conservation tillage)	T_1 = Disc plough and disc harrow at 25 cm depth (Conventional Reduce Tillage practice) (Wlaiwan and Jayasuguya, 2013)
	T_2 = Disc plough at 20 cm depth
	T_3 = Double tillage passes of disc harrow at 15 cm depth
	T_4 = Single pass of disc plough at 10 cm depth
Weed management	W_1 = No weeding as control
	W_2 = Pre-emergence at 3 litres/ha applied at planting + post emergence at 2.5 litres/ha (0.14kg/ha) applied at 3WAP (Dugje *et al.*, 2009).
	W_3 = pre-emergence at 3 litres/ha + post emergence at 3 litres/ha (0.17kg/ha) applied at 5WAP;
	W_4= pre-emergence at 3 litres/ha +) post emergence 4 litres (0.23kg/ha) applied at 7WAP
Nutrient application	N_1 = No nutrient application (Control)
	N_2= FYM at 0.5 ton/hectare (applied at tillage operation) + 50 kg/hectare of Superphosphate applied 4 weeks after sowing
	N_3 = FYM at 1 ton/hectare (applied at tillage operation) + 75 kg/hectare of Superphosphate to be applied 4 weeks after sowing

Pre emergence herbicide used is Pendimethalin while the post emergence is Fusillade forte, WAP = Week After Planting FYM (Farm Yard Manure)

Table 3a: Influence of Tillage Systems, Nutrient Application and Weed Management Practice on Soil Chemical Properties (2018 Trial)

Source of variance	pH in H_2O	SOM (	SOC	EC	Mg^+	Al^+	Ca^+	N	P	K
	P_{value}	P_{value}	P_{value}	P_{value}	P_{value}	P_{value}	P_{value}	P_{value}	P_{value}	P_{value}
T	0.00001*	0.0001*	0.0027*	0.001*	0.0021*	0.000*	0.056^{ns}	0.00001*	0.0001*	0.183^{ns}
N	0.0000*	0.00001*	0.0053*	0.0001*	0.041*	0.001*	0.002*	0.0001*	0.000*	0.021*
W	0.155^{ns}	0.256^{ns}	0.623^{ns}	0.703^{ns}	0.875^{ns}	0.396^{ns}	0.2195^{ns}	0.219^{ns}	0.125^{ns}	0.704^{ns}
T×N	0.729^{ns}	0.0110*	0.990^{ns}	0.143^{ns}	0.870^{ns}	0.0011*	0.0121*	0.022*	0.0033*	0.0001*
T×W	0.021*	0.0022*	0.994^{ns}	0.126^{ns}	0.980^{ns}	0.445^{ns}	0.248^{ns}	0.001*	0.001*	0.113^{ns}
N×W	0.005*	0.0006*	0.155^{ns}	0.949^{ns}	0.890^{ns}	0.430^{ns}	0.386^{ns}	0.0001*	0.005*	0.155^{ns}
T×N×W	0.000*	0.0005*	0.991^{ns}	0.643^{ns}	0.992^{ns}	0.001*	0.0012*	0.000*	0.0011*	0.689^{ns}

T (Tillage systems), N (Nutrient Application), W (Weed management), F* (significant at $p< 0.05$),F^{ns} (non-significant at $p\leq0.05$), SOM (Soil Organic Matter),SOC (Soil Organic Carbon), EC(Electrical conductivity)

Table 3b: Means for the Tillage Systems, Nutrient Application and Weed Management Practice of the Soil Chemical Properties Using DMRT for 2018 Trail

Treatments	pH in H_2O	SOM	SOC	EC	Mg^+	Al^+	Ca^+	N	P	K
Tillage systems(T)										
T_1 (DPH at 25 cm)	6.30[a]	1.53[b]	1.35[a]	1.02[b]	1.54[b]	1.28[b]	1.26[a]	0.33[b]	3.48[c]	0.18[b]
T_2 (DP at 20 cm)	6.00 [ab]	1.21[c]	0.72[c]	0.49[c]	1.21[c]	1.27[c]	1.25[b]	0.29[c]	3.46[c]	0.17[b]
T_3(DDH at 15 cm)	5.80[b]	1.77[a]	1.40[a]	1.30[a]	1.89[a]	1.29[ab]	1.23[c]	0.41[a]	4.82[a]	0.22[a]
T_4 (DH at 10 cm)	5.90[b]	1.81[a]	1.07[b]	1.27[a]	1.74[a]	1.30[a]	1.26[a]	0.29[c]	3.59[b]	0.23[a]
Nutrient Application(N)										
$N_{1(control)}$	5.85	1.24[c]	0.78[b]	0.57[b]	1.60[b]	1.27[b]	1.21[b]	0.21[b]	2.62[b]	0.78[b]
N_2	6.05	1.74[b]	1.31[a]	1.18[a]	1.96[a]	1.30[a]	1.27[a]	0.37[a]	4.39[a]	1.31[a]
N_3	6.10	1.90[a]	1.32[a]	1.31[a]	1.99[a]	1.28[b]	1.28[a]	0.41[a]	4.48[a]	1.32[a]
Weed management (W)										
$W_{1\ (control)}$	6.07	1.61	1.10	1.05	1.88	1.28	1.25	0.33	3.72	1.10
W_2	5.93	1.62	1.15	1.03	1.81	1.29	1.26	0.34	3.84	1.15
W_3	6.04	1.62	1.15	1.01	1.80	1.28	1.26	0.32	3.88	1.15
W_4	5.95	1.61	1.19	1.00	1.90	1.30	1.25	0.33	3.87	1.19

DMRT (Duncan Multiple Range Test), Mean values with same letters are insignificantly different at $p \leq 0.05$, WAP (Week After Planting) SOM (Soil Organic Matter),SOC (Soil Organic Carbon), EC(Electrical conductivity)

Table 4 a: Influence of Tillage Systems, Nutrient Application and Weed Management Practice on Soil Chemical Properties (2019 Trial)

Source of variance	pH in H_2O	SOM	SOC	EC	Mg^+	Al^+	Ca^+	N	P	K
	P_{value}	P_{value}	P_{value}	P_{value}	P_{value}	P_{value}	P_{value}	P_{value}	P_{value}	P_{value}
T	0.0019*	0.000*	0.001*	0.0001*	0.002*	0.0004*	0.044*	0.000*	0.0001*	0.198^{ns}
N	0.001*	0.0001*	0.004*	0.000*	0.041*	0.0001*	0.0016*	0.000*	0.000*	0.040*
W	0.152^{ns}	0.256^{ns}	0.59^{ns}	0.67^{ns}	0.78^{ns}	0.84^{ns}	0.350^{ns}	0.201^{ns}	0.09^{ns}	0.887^{ns}
T×N	0.625^{ns}	0.014*	0.85^{ns}	0.140^{ns}	0.71^{ns}	0.001*	0.013*	0.033*	0.007*	0.000*
T×W	0.011*	0.0014*	0.89^{ns}	0.148^{ns}	0.87^{ns}	0.350^{ns}	0.150^{ns}	0.000*	0.0005*	0.130^{ns}
N×W	0.0041*	0.0003*	0.156^{ns}	0.863^{ns}	0.38^{ns}	0.842^{ns}	0.170^{ns}	0.001*	0.026*	0.107^{ns}
T×N×W	0.0000*	0.0005*	0.751^{ns}	0.735^{ns}	0.83^{ns}	0.001*	0.00018*	0.0001*	0.000*	0.556^{ns}

T (Tillage systems), N (Nutrient Application), W (Weed management), F* (significant at $p< 0.05$),F^{ns} (non-significant at $p\leq0.05$), SOM (Soil Organic Matter),SOC (Soil Organic Carbon), EC(Electrical conductivity)

Table 4b: Means for the Tillage Systems, Nutrient Application and Weed Management Practice of the Soil Chemical Properties Using DMRT (2019 Trial)

Treatments	pH in H_2O	SOM	SOC	EC	Mg^+	Al^+	Ca^+	N	P	K
Tillage systems(T)										
T_1 (DPH at 25 cm)	6.15	1.56^c	1.41^b	1.11^b	1.34^b	1.25^b	1.28^a	0.32^c	3.30^c	0.19
T_2 (DP at 20 cm)	6.12	1.34^d	1.00^d	0.62^c	1.26^c	1.25^b	1.25^b	0.30^d	3.26^c	0.21
T_3(DDH at 15 cm)	6.01	1.80^a	1.52^a	1.34^a	1.80^a	1.40^a	1.22^c	0.45^a	4.26^a	0.22
T_4 (DH at 10 cm)	5.95	1.71^b	1.21^c	1.28^a	1.84^a	1.35^a	1.23^c	0.34^b	4.08^b	0.23
Nutrient Application(N)										
$N_{1(control)}$	6.35^c	1.30^c	0.82^b	0.45^c	1.56^b	1.22^c	1.23^c	0.20^c	2.48^b	0.17^c
N_2	6.05^b	1.86^a	1.25^a	1.21^b	1.90^a	1.28^b	1.26^b	0.35^b	4.20^a	0.19^b
N_3	5.85^a	1.70^b	1.31^a	1.25^a	1.83^a	1.30^a	1.30^a	0.38^a	3.50^a	0.22^a
Weed management (W)										
$W_{1\ (control)}$	5.85	1.55	1.12	1.03	1.86	1.26	1.23	0.30	3.70	0.19
W_2	5.90	1.61	1.15	1.01	1.83	1.30	1.22	0.30	3.68	0.20
W_3	6.00	1.56	1.17	1.00	1.76	1.28	1.23	0.32	3.80	0.20
W_4	6.02	1.59	1.21	1.02	1.86	1.28	1.22	0.31	3.76	0.19
SE	0.042	0.055	0.059	0.071	0.015	0.004	0.012	0.017	0.016	0.002

DMRT (Duncan Multiple Range Test), Mean values with same letters are insignificantly different at $p \leq 0.05$, WAP (Week After Planting) SOM (Soil Organic Matter),SOC (Soil Organic Carbon), EC(Electrical conductivity) , SE (Mean Standard Error)

3.2 Influence of Nutrient Applications on Soil Chemical Properties

The study revealed that nutrient application (N) significantly (at $p \leq 0.05$) influenced pH, organic matter, electrical conductivity, magnesium, aluminium, total nitrogen, available phosphorous, potassium, organic carbon and calcium availability in the soil. The two nutrient treatments were significantly different from the treatment with zero nutrient application in soil chemical availability at harvesting time. Several studies (Maerere *et al.*, 2001; Adeniyan and Ojeniyi, 2003; Agbede, 2010) had also reported a similar trend that poultry manure application improves soil organic matter, macro-nutrient status and micro-nutrient qualities of the soil. This improvement could be attributed to organic nutrient potential to improve soil organic matter content. This however implies that increase in the application of organic matter brings about increase in the soil chemical properties availability.

3.3 Influence of Weed Management Practices on Soil Chemical Properties

The weed management practices considered had insignificant effect on soil pH, soil organic matter, soil organic carbon, magnesium, nitrogen, calcium, potassium and phosphorus. This is in line with the report of Anannya *et al.* (2017), where soil physicochemical properties were not influenced by the herbicide application. This may be due to short half-life (24 – 34 days) of pendimenthalin and fusillade that the herbicide remains active in the soil and the application rates 2-3 lit/ha did not impair the soil (Pal, *et al.*, 2006)

3.4 Influence of Tillage Systems, Nutrient Application and Weed Management on the Yield Components of Soybean

Tables 5a-b and 6a-b present the influences of the treatments on the yield components of soybean for the two trails respectively. Among the tillage systems, T_3 (DDH at 15 cm) had the highest mean values of pod/plant (74.78), 1000 seed weight (134.83g) and highest mean value of grain yield of 2.55 tonne/ha, though not significantly different from the mean values obtained in T_1 (DPH at 25 cm) at $P \leq 0.05$ with pod /plant (68.78), 1000 seed weight (131.72 g) and mean grain yield of 2.50 tonne/ha (Table 6). This result shows that reduced tillage between 15- 25 cm had significant higher yield compared to the treatments with depth of cut of less than 15 cm. This may be as a result of higher weed infestations experienced in the tillage with lower depth of cut.

The fertility status of the soil benefits from poultry manure application since the manure is known to improve soil organic matter and macro-nutrient status and micro nutrient qualities of the soil (Akande and Adediran, 2006). It is ascertained that improved soil nutrient contents caused by poultry manure addition led to increased growth and yield of soybean (Chiezey, 2009)). Increased growths of soybean that resulted from application of 1 ton/ha and 75 kg of SSP/ha nutrient did not translate into grain yield compared to the result of 0.5 ton/ ha and 50 kg of SSP manure treatment. This can be adduced to dilution effect of excess organic matter and high availability of N which led to vegetative growth at the expense of grain filling. This could be explained by the dilution effect of excess N given by 1 ton/ ha of FYM. Ewulo *et al.*, (2008) explained that excessive poultry manure application did not translate into fruit or seed yield of crops. Weed managed before the 5^{th} week after planting performed better by 9.81% in terms of grain yield than weed controlled at 7^{th} week after planting. This implies that early weed management is suitable for higher grain yield of soybean. Soybean may be a poor competitor for moisture content, nutrients and light, at its early growth stages especially with fast growing weeds.

Table 5a : Effects of Tillage Systems, Nutrient Application and Weed Management Practice on the Yield Components and Yield of Soybean (2018 Trial)

Source of variance	Pod/plant (No)	Seed/Pod (No)	100seed weight (g)	Grain yield (ton/ha)
	P_{value}	P_{value}	P_{value}	P_{value}
T	0.0001*	0.618^{ns}	0.030*	0.016*
N	0.000*	0.007*	0.000*	0.000*
W	0.000*	0.012*	0.000*	0.000*
T×N	0.011*	0.609^{ns}	0.000*	0.000*
T×W	0.002*	0.030*	0.000*	0.004*
N×W	0.001*	0.038*	0.000*	0.000*
T×N×W	0.001*	0.031*	0.000*	0.042*

Table 5b: Means for the Tillage Systems, Nutrient Application and Weed Management Practice of the Yield Components and Yield of Soybean Using DMRT (2018 Trial)

Treatments	Pod/plant (No)	Seed/Pod	1000 seed weight (g)	Grain yield (ton/ha)
Tillage systems(T)				
T1 (DPH at 25 cm)	68.78^{ab}	2.3	131.72^{a}	2.50^{a}
T2 (DP at 20 cm)	61.42^{c}	2.3	127.69^{b}	2.27^{c}
T3(DDH at 15 cm)	74.78^{a}	2.3	134.83^{a}	2.55^{a}
T4 (DH at 10 cm)	66.14^{bc}	2.3	131.04^{ab}	2.30^{bc}
Nutrient Application(N)				
$N_{1(control)}$	40.17^{c}	2.21^{b}	92.31^{b}	1.48^{c}
N_2	86.06^{a}	2.40^{a}	150.83^{a}	2.97^{a}
N_3	77.10^{b}	2.34^{a}	149.98^{a}	2.77^{b}
Weed management (W)				
$W_{1\ (control)}$	25.08^{c}	1.10^{d}	60.44^{c}	0.32^{c}
W_2	76.06^{a}	2.38^{b}	143.08^{a}	2.63^{b}
W_3	77.06^{a}	2.40^{a}	142.81^{a}	2.87^{a}
W_4	72.92^{b}	2.31^{c}	137.08^{b}	2.60^{b}
SE	2.44	0.026	3.07	0.41

DMRT (Duncan Multiple Range Test), Mean values with same letters are insignificantly different at $p \leq 0.05$, WAP (Week After Planting)

Table 6a : Effects of Tillage Systems, Nutrient Application and Weed Management Practice on the Yield Components and Yield of Soybean (2019 Trial)

Source of variance	Pod/plant (No)	Seed/Pod (No)	1000 seed weight (g)	Grain yield (ton/ha)
	P_{value}	P_{value}	P_{value}	P_{value}
T	0.000*	0.492^{ns}	0.037*	0.0008*
N	0.000*	0.0012*	0.0001*	0.0001*
W	0.000*	0.0008*	0.00001*	0.000*
T×N	0.005*	0.285^{ns}	0.0019*	0.0009*
T×W	0.033*	0.0011*	0.000*	0.0006*
N×W	0.0005*	0.0028*	0.000*	0.009*
T×N×W	0.0185*	0.015*	0.000*	0.001*

T (Tillage systems), N (Nutrient Application), W (Weed management), * (significant at $p< 0.05$), ^{ns} (non-significant at $p\leq 0.05$)

Table 6b: Means for the Tillage Systems, Nutrient Application and Weed Management Practice of the Yield Components and Yield of Soybean Using DMRT(2019 Trial)

Treatments	Pod/plant (No)	Seed/Pod	1000 seed weight (g)	Grain yield (ton/ha)
Tillage systems(T)				
T1 (DPH at 25 cm)	66.89^{a}	2.25	117.00^{a}	2.19^{a}
T2 (DP at 20 cm)	60.81^{b}	2.31	115.97^{b}	2.04^{b}
T3(DDH at 15 cm)	68.31^{a}	2.33	119.69^{a}	2.30^{a}
T4 (DH at 10 cm)	57.86^{bc}	2.21	115.92^{b}	2.02^{c}
Nutrient Application(N)				
$N_{1(control)}$	42.10^{c}	2.19^{b}	93.77^{b}	1.38^{c}
N_2	76.40^{a}	2.38^{a}	129.13^{a}	2.53^{a}
N_3	74.60^{b}	2.34^{a}	128.54^{a}	2.51^{b}
Weed management (W)				
$W_{1\ (control)}$	20.08^{c}	1.13^{c}	55.56^{d}	0.37^{c}
W_2	70.60^{a}	2.42^{a}	128.61^{a}	2.23^{b}
W_3	70.39^{a}	2.35^{a}	123.22^{b}	2.49^{a}
W_4	69.47^{b}	2.33^{b}	121.31^{c}	2.47^{b}
SE	2.30	0.028	3.02	0.35

DMRT (Duncan Multiple Range Test), Mean values with same letters are insignificantly different at $p\leq 0.05$, WAP (Week After Planting)

4. CONCLUSION

Tillage systems between 10-15 cm depth of cut favours the availability and retention of soil nutrients within the tap root of soybean crops as in the case of T_3 (DDH at 15 cm) that recorded the highest mean values of SOM (1.77), SOC (1.40), total N (0.41 %), available P of 4.82 ppm and exchangeable K of 0.22 C mol/Kg, during the crop harvest. Nutrient application (N) significantly influenced soil chemical properties at $p \leq 0.05$. Nutrient applications at 1 tonne/ha of compost poultry manure had the highest SOM (1.90), Mg^{2+} (1.99), Ca^{2+} (1.28), Total N (0.41), available P (4.48) and exchangeable K (1.32) during harvesting time. Weed management practices did not significantly influence soil chemical properties but has significant effect on the yield of grain with post emergence weed controlled at 5 WAP was 80 % greater in terms of grain yield as compared with the control treatment. It is important that farmers adopt management practices that are directed at achieving a self-sustaining system of the soil. Hence, tillage depth at 15 cm and minimum application of compost poultry manure with early weed management are recommended for a sustainable soybean production.

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