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PERFORMANCE OF SOYBEANS (*GLYCINE MAX L.*) AS AFFECTED BY PLANTING METHODS AND FERTILIZER TYPE IN 2018 AND 2019 RAINING SEASON AT BILLIRI, GOMBE STATE NIGERIA.

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ABSTRACT
A field experiments was carried out during the rainy season of 2018 and 2019 Tal, Billiri in Gombe state, Nigeria. The aim of the experiment is to investigate the performance of soybeans as affected by planting methods and fertilizer type. The planting methods were; Drill (50kg/ha), Dibbling (Transplanted at 25 x 75cm) and Broadcast (50kg/ha). Fertilizer used were; NPK (40kgN, 80kg P, 20kg K), SSP (20kg P) NPK/SSP (Combination of NPK and SSP at 50kg N, 100kg P and 20kg K) and Control. The treatments were laid in a randomized complete block design with three replications. The treatments were combined to have 10 plots in a block with 1 meter between the block and 0.5 meters within the plots. During the research growth characters were measured, other character like days of 50% flower, days of maturity, number of pod per plant, seeds per pod, 1000 seed weight and seed yield were also recorded. All the parameters studies have significantly ($P \leq 0.05$) responded to the both planting methods and fertilizer effects, where dill method was observed to perform higher in both growth character and grain yield. NPK/SSP fertilizer was significant in both growth, yield related character and over-all yield. 2019 rainy season all shows significant difference ($P<0.05$) in growth, yield and related characters when compared to 2018 rainy season. Based on the result obtained it can be suggested that the use of Dibbling methods of planting and the application of NPK at 50kg/ha and NPK/SSP (40kgN, 80kg P, 20kg K) fertilizer will lead to optimum yield for farmers in the study location.

Key words; Planting, Methods, Performance and Fertilizer

INTRODUCTION

Soy bean (Glycine max L.) is a species of legume native to East Asia, widely grown for its edible bean, which has numerous uses. Soybean has been described in various ways. Some call it the "miracle bean" or the "golden bean" because it is a cheap, protein-rich grain. It contains 40 per-cent high quality protein, 20 per-cent edible vegetable oil, and a good balance of amino acids Akunda (2001). t has therefore, tremendous potential to improve the nutritional status and welfare of resource-poor people particularly in a developing country like Nigeria. Soybean can also contribute to enhanced sustainability of intensified cropping systems by improving soil fertility through nitrogen fixation, permitting a longer duration of ground cover in the cropping sequence, and providing useful crop residues for feeding livestock IITA (2000). Soybean is farmed extensively, mainly by small scale farmers, which may account for its low yields. Despite this, Nigeria's experiment in the use of Soya as a food crop offers a lot of promise. Women in Northern Nigeria have come up with the idea of using the beans to make "daddawa", a local condiment which is usually made from the seeds of Locust bean (*Parkia biglobosa*), a leguminous tree from the savannah regions. Soybean was first introduced to Ibadan, Oyo State, Nigeria in 1908 with little or no success in the rainforest ecology of the State (Fennel, 1966). In 1928, it was introduced to the savannah area of Northern Nigeria where the soil and climatic conditions supported its production. The crop was successfully cultivated in 1937 for multiplication and commercial production in Benue State (Nyiakura, 1982). Since then, many small-scale farmers in the south central part of the country have continuously incorporated propagation into their cropping systems. According to a survey report by IITA in 1989, Benue State is the major producer of soybean in Nigeria. The current expansion in the production of soybeans in Nigeria has been attributed to many years of research from the mid-1960s through the 1980s when Scientists adopted a nationally-coordinated approach to Soybean research. In the 1970's, new attempts were made to cultivate the crop in south-western Nigeria through collaborative research initiated between Institute of Agricultural Research and Training (IAR&T) and IITA, Ibadan on soybean variety production trials. Varieties that had those characteristics that made them productive in the moist savannah and forest areas were developed. Nigeria is the largest producer of the crop for human and livestock feeds in West and Central Africa and has great potentials for substituting soy oil for some imported vegetable Oils. The current domestic demand and home consumption have made the crop a versatile and multipurpose agricultural product that could be processed in almost 365 ways for human, livestock and industrial purposes. With the current ban on the importation of vegetable oils, some of the hitherto idle mills across the country are now looking inwards, producing edible oils from soybeans, preventing inefficiency of vegetable oil processing facilities as well as preventing inadequate supply of the oils. At present, the major soybean producing states in the country are Benue, Kaduna, Taraba, Plateau and Niger. Other growing areas include, Nasarawa, Kebbi, Kwara, Oyo, Jigawa, Borno, Bauchi, Gombe, Lagos, Sokoto, Zamfara and FCT. The yield of soybean of 1,700 kg per hectare on research plots in Nigeria compared favourably with the United States (US) yields of 2000 kg/ha and Brazil yields of 1,800 kg/ha. However, there is a gap between the yield on farmers' field and research plots. Seed rate depends on the planting method adopted and variety, most advice about 50-70kg/ha are require to obtained a population of 444,444 plant/ ha, spacing ranging from 25 x75 or 30 x 75 depending on the variety. Application of 4-5tones of Farm yard manure at the time of sowing proved better result. While the application of chemical fertilizer at the rate of 50kg N, 100kg P, 20kg K prove to have yielded much IIAT (2000). Like most other crops, the total output of the soya crop is invariably influenced by the farmer's environment, the genetic potential of the planting material, planting methods, nutrient requirements and the farmer's management/ agronomic practice which is the aim of this work to look at ways of improving soybean production through planting methods and fertilizer requirement or fertilizer type.

MATERIAL AND METHODS

The experiment was carried out in Tal at (9° 50`N 11° 09`) Billiri Local Government of Gombe State in 2018 and 2019 rainy season. The aim of the experiment is to investigate the performance of soybeans as affected by planting methods and fertilizer type. The planting methods

were; Dibbling (50 kg/ha) Hill (25 x 75cm at 50 kg/ha) and Broadcast (50 kg/ha). Fertilizer used were; NPK (40 kg N, 80 kg P, 20 kg K), SSP (20 kg P) NPK/SSP (Combination of NPK and SSP at 50 kg N, 100 kg P and 20 kg K) and Control. The variety used was TGX 1448-2E which is medium maturing, low shattering and Striga resistant. The experiment that was laid in a randomized complete block design (RCBD) with three replicate, a $4m^2$ plot was laid out with 1m between plots and 0.5m between blocks. There were 12 plots each within a block which gave the total number of 45 plots for the study, an inter-row and intra-row spacing of 15cm x 75cm was adopted for the research, Agronomic practice such as weeding was done manually at 2 and 6 weeks after planting to ensure weed free plots, all the data were collected within the net plot of 4m2 /where a total of 10 plants were tagged for data collection within each net plot. The parameters recorded were plant height (was taken with the aid of measuring tape from the base of the plant to the tip), number of leaves (were counted fortnightly) from 10 plants that was tagged and the average used fortnightly and days of flower of 50% flowering (were counted fortnightly), days from flowering to pod filling, days of maturity, yield and yield related characters such as number of pod, number of seed per pod, pod weight and 100 seed weight was recorded. All data collected were subjected to analysis of variance (ANOVA), while least significant difference (LSD) at 5% level of probability was used in separating the means.

RESULTS AND DISCUSSION

Table 1 shows the performance of Soybeans (*Glycine max L.*) as affected by planting methods and fertilizer type on plant height, leaves and number of branches 2018 and 2019 rainy season grown in Billiri. Significant (P≤0.05) difference was recorded in plant height were dill method of planting recorded taller plant than other methods used, this could be due to lack of specific intra row spacing thereby congesting the plant causing the plant to grow tall starving for solar radiation and other environmental resources as suggest by Singh and Shvakumar (2010) in his earlier work on soybean. Same train was observed, were significantly (P≤0.05) difference was observed on number of leaves were dill planting method had higher number of leaves, this will not be far from the facts that plant growth is mostly accompanied by production of leaves to intercept sun light for photosynthetic activities and other metabolic activities as report by Akunda (2001) in addition Calvina (2003a) reported that most crop compete well when in congestion for both climatic resources and soil resources which could lead to production of more leaves. On number of branches it also shows significantly (P≤0.05) difference, with dill planting method having higher number of branches than other planting methods used, this indicate that as plant grows taller more leaves are produces with the enablement of braches as reported by Naeve et al (2002). Haddachi and Gerivary (2009) reported that branches in soybean had direct relationship with planting method and variety which plays an important role in photosynthesis translating such energy to yield.

On fertilizer type Significantly (P≤0.05) difference was recorded with NPK fertilizer on plant height, number of leaves and number of branches when compared with other source of fertilizer type, the application of NPK has proven to supersede all other fertilizer type used in term of vegetative growth. this is not far from the facts that plant such as legumes need NPK fertilizer as started dose at early stage for vegetative growth which is essential for photosynthesis and other metabolic activities as reported by Allen et al (1991) in his work added that plant vegetative growth is affected mostly by nutrients (NPK/ macro- nutrients) and by other environmental condition.

On seasonal effects, the results shows that year 2019 have taller plant, high number of leaves and higher number of branches when compared to year 2018, this could be as results of improvement in agronomical practices, residual effect of such fertilizer, adoptability of the crop to climatic condition of the experimental site, and probably rainfall pattern, this finding is in agreement with the work of Fagam (2018), where he stated that growth related characters can be greatly affected by residual effect of fertilizer used in the previous year, agronomic practices and environmental condition such as rainfall, temperature, distribution of rainfall and relative humidity.

Table 2.Performance of Soybeans (*Glycine max L.*) as affected by planting methods and fertilizer type on 50% days of flower, pod filling and maturity in 2018 and 2019 rainy season grown in Billiri, Gombe State. Significantly (P≤0.05) difference was recorded in 50% days of flowering, where hill planting method produced higher days of 50% flowering, this is because plant population, environmental condition and soil condition affect vegetative growth, delaying flowering and elongating days of maturity which agrees with the finding of Abadian et al (2008). Significantly (P≤0.05) difference was observed on pod filling, were the use hill method of planting had late pod filling days this shows that moderately spaced plant, rainfall pattern and variety could lead to late pod filling days which could also delay days of maturity as reported by Cure et al (1987) the work of Allen and Boote (2000) also collaborate with this finding starting that planting method, nutrients and agronomic practice can prolong days of pod filling in plants. Significantly (P≤0.05) difference was equally observed in days of maturity were hill planting method had late maturing days when compared with the other treatment used, this might be the effects of plant population, environment and probably variety could have delayed maturity days as reported by Morison and Stewart (2002).

On fertilizer type Significantly (P≤0.05) difference was recorded with combination of NPK/SSP fertilizer type having longer days on 50% days of flower, pod filling and maturity compared with other source of fertilizer type, this is not far from the facts that plant such as legumes need NPK fertilizer as started dose at early stage for production of rhizomes to fix atmospheric nitrogen and for vegetative growth so also SSP for flowering, pod filling and maturity which is essential components for photosynthesis translating the assimilate for flowering, pods production, pod filling and affecting yield positively as reported by Springer (2007).

On seasonal effects, 2019 rainy season had higher days of 50% flowering, pod filling days and maturity days when compared with 2018 rainy season, this is not far from the fact that climatic factors play an important role in influencing this. This findings is in conformity with the work of Garba (2015) where he reported that seasonal effects which could be attributed by rainfall, wind, tempreture and relative humidity affect plant positively depending on its distribution. Ali (2017) on the contrary reported a negative influence of weather/climate on the growth and yield of soybean.

Table1 Performance of Soybeans (*Glycine max L.*) as affected by planting methods and fertilizer type on plant height, leaves and number of branches, grown in Billiri, Gombe State

Treatments	**Growth Parameters**		
Planting methods(P)	**P/H**	**N/L**	**N/B**
Hill	66.98	68.21	5.99
Drill	72.09	75.94	6.25
Broadcast	56.90	49.12	4.01
F-LSD (0.05)	8.90	5.01	1.00
Fertilizer (F)			
NPK	70.91	78.23	6.89
SSP	59.45	59.91	5.00
NPK/SSP	61.32	63.91	5.01

Control	50.01	50.19	4.04
F-LSD (0.05)	8.31	9.01	0.91
Season (S)			
2018	71.18	79.91	7.82
2019	75.81	81.71	9.01
F-LSD (0.05)	3.12	2.00	1.03
Interactions			
P x F	NS	NS	NS
P x S	NS	NS	NS
F x S	NS	NS	NS

F= Source of Nutrients, P= planting method, LSD= Least Significant Differences at 5% Level of Probability. PH= plant height, No.L= number of leaves, No.B= number of branches.F-LSD = Fishers' Least Significant Differences at 5% Level of Probability.

Table 2.Performance of Soybeans (*Glycine max L.*) as affected by planting methods and fertilizer type on days 50% of flower and maturity grown in Billiri, Gombe State.

Treatments	**Yield related parameters**		
Planting methods(P)	**50%FL**	**Pod filling**	**Maturity**
Hill	55.98	11.21	105.18
Drill	50.21	12.89	110.98
Broadcast	44.98	10.21	101.17
F-LSD (0.05)	5.08	1.00	5.01
Fertilizer (F)			
NPK	52.89	12.12	110.90
SSP	49.90	11.65	115.95
NPK/SSP	59.09	13.89	120.21
Control	41.09	10.45	105.47
F-LSD (0.05)	6.02	1.01	5.00
Season (S)			
2018	52.91	13.12	119.19
2019	53.86	14.81	112.12
F-LSD (0.05)	2.51	1.04	2.01
Interactions			
P x F	NS	NS	**
P x S	**	NS	NS
F x S	NS	NS	NS

F= Source of Nutrients, P= planting method, LSD= Least Significant Differences at 5% Level of Probability, 50%FL= 50% flowering. .F-LSD = Fishers' Least Significant Differences at 5% Level of Probability.

Table 3 is an interaction between planting method, fertilizer type in 2018 and 2019 rainy season on days of flowering, were hill planting and NPK/SSP had late days of flowering could be attributed to the facts that the plant population is vital in utilizing nutrient and transferring same for yield components coupled with environmental factors delaying flowering as reported by Lotze-campen and Schellnhuber (2009). There was no interaction between planting methods and fertilizer on days of pod filling. Table 4 also recorded an interaction between rainy season and planting methods where 2018 and dill planting method gave early 50% flowering days when compared with 2019 rainy season and hill planting method gave late 50% flowering days, this could be attributed to climatic, agronomic practice and to a large extant rainfall distribution as reported by Kimbell (2011).

Table 3. Interaction between planting method and fertilizer on performance of Soybeans on days of 50% flower grown in Billiri, Gombe State.

Fertilizer (F)	**Hill**	**Drill**	**Broadcast**
NPK	50.12	48.12	45.18
SSP	48.12	45.91	42.19
NPK/SSP	55.98	50.12	48.23
Control	40.91	43.91	38.01
F-LSD (0.05)	2.13	2.00	1.98

LSD= Least Significant Differences at 5% Level of Probability.

Table 4. Interaction between fertilizer and planting seasons on days of 50% flowering of soybean grown in Billiri, Gombe State.

Season (S)	**NPK**	**SSP**	**NPK/SSP**	**Control**
2018	51.92	48.56	46.45	40.92
2019	54.26	51.86	50.34	42.56
F-LSD (0.05)	3.91	2.31	2.01	1.89

LSD= Least Significant Differences at 5% Level of Probability.

Table 5 is an interaction between methods and fertilizer in 2018 and2019 rainy season on days of maturity, where broadcast and the application of SSP had early maturing days when compared with other treatments used, with the application of NPK/SSP and hill planting method having longer days of maturity which could mean that plant population couple with availability of nutrient, translating such nutrients for floral part other than productive part delaying maturity as reported by Calvin (2003b) he also added that when nutrient are readily

available to plant it most times enjoy the nutrient adding to the vegetative beautification and delays maturity period. Looking at the table 6 a perfect interaction was recorded between seasons and planting methods where 2019 rainy season had longer days of maturity in all the planting methods when compared with 2018 rainy season, with dill planting method having the longest days of maturity in 2019 rainy season, this might be due to residual effect of the previous year and probably well distribution in rainy days as reported by Lauter (2003).

Table 5. Interaction between planting method, year and fertilizer on performance of Soybeans on days of maturity grown in Billiri, Gombe State.

Fertilizer (F)	Hill	Drill	Broadcast
NPK	110.11	118.17	105.12
SSP	105.78	115.89	102.98
NPK/SSP	125.12	120.12	110.84
Control	105.34	110.91	101.98
F-LSD (0.05)	2.12	3.88	4.23

LSD= Least Significant Differences at 5% Level of Probability.

Table 6. Interaction between fertilizer and planting seasons on days of maturity of soybean grown in Billiri, Gombe State.

Season (S)	NPK	SSP	NPK/SSP	Control
2018	115.12	119.16	106.91	107.12
2019	120.12	121.91	111.45	110.54
F-LSD (0.05)	3.91	4.91	3.01	2.51

LSD= Least Significant Differences at 5% Level of Probability.

Table 7 is the performance of Soybeans (*Glycine max L.*) as affected by planting methods and fertilizer type on yield and yield related parameters in 2018 and 2019 grown in Billiri, Gombe State. Significantly (P≤0.05) difference was recorded on number of pod per plant, were hill planting had higher number of pod per plant this could be attributed to the facts that well-spaced plant mostly produce high number of pod as supported by the findings of Rameed (2006). Significantly (P≤0.05) difference was recorded by number of pod per seed, where hill planting method had higher seed per pod, this could mean that moderately spaced plant have the tendency of producing more than two seeds per pod giving the needed nutrient as reported by Pederson and Lauter (2004). Significantly (P≤0.05) difference was recorded on 1000 seeds per plant were heavier seeds were recorded when hill planting methods, this could be linked to facts that well-spaced giving the appropriate nutrients crops particularly in soybean tends to produced heaver seeds this work is collaborated by the findings of Ball el al (2000). Significantly (P≤0.05) difference was recorded on planting methods and fertilizer type on seeds yield, were the used of hill planting method recorded the highest yield, this could be attributed to the appropriate plant population couple with environmental factors such as sunlight, rainfall and relative humidity as reported by IPPC (2007) in addition number of flowers, number of pod, number of seeds is directly proportional to crop yield as reported by Zhan et al (2006).

On fertilizer type Significantly (P≤0.05) difference was recorded with combination of NPK and SSP fertilizer on number of pod per plant, number seeds per pod, 1000 seed weight and yield when compared with other source of fertilizer type, this indicate that the combination of NPK and SSP plays an important role not only on vegetative growth at the early stage of growth but also at the later stage of plant growth which aid increase in yield such as number of pod per plant, number seeds per pod, 1000 seed weight and yield of plants as reported by Liv et al (2007).

Year 2019 over weight 2018 rainy season in number of pod, number of seed per pod, 1000 seed weight and the over-all yield. This could be as a result of nutrient residual effect, rainfall distribution, tempreture, relative humidity and improvement in agronomic practises, Ogah (2017) lent support to this finding where he started that it also attribute to higher yield he recorded in his work.

Table 7.Performance of Soybeans (*Glycine max L.*) as affected by planting methods and fertilizer type on yield and yield related parameters grown in Billiri, Gombe State.

Treatments	Yield and yeild Parameters			
Planting methods(P)	**No. of pod/plant**	**No. seeds/pod**	**1000seeds weight**	**Yield (kg)**
Hill	66.23	2.96	19.82	525.09
Drill	58.90	2.41	22.47	499.20
Broadcast	48.21	2.00	17.99	499.20
F-LSD (0.05)	5.00	0.01	1.01	14.91
Fertilizer (F)				
NPK	59.34	2.50	20.82	516.02
SSP	52.90	2.01	19.86	489.21
NPK/SSP	69.65	2.82	22.01	581.09
Control	45.21	2.00	18.21	389.41
F-LSD (0.05)	5.01	0.01	1.00	40.98
Season (S)				
2018	70.10	2.81	22.91	501.26
2019	72.10	3.23	23.34	523.01
F-LSD (0.05)	1.00	0.01	1.01	20.91
Interactions				
P x F	**	NS	**	**

P x S	NS	NS	NS	NS
F x S	**	NS	**	**

F= Source of Nutrients, P= planting method,F-LSD = Fishers' Least Significant Differences at 5% Level of Probability.

Table 8 is an interaction between planting method and fertilizer type and 218 and 2019 rainy season on number of pod, where an interaction was recorded between hill planting method and NKP/SSP fertilizer which gave the highest number of pod, this is not far from the facts that pod initiation /pod production is highly influenced by spacing and nutrients particularly macro-nutrients, this is in conformity with the finding of Egli and Bruening (2000) who reported that NPK plays an important part in the early stage of plant while SSP plays an important role in pod production which in turn increase yield. Table 9 shows Year 2019 rainy season and hill planting method having perfect with higher number of pod than 2018 rainy season, this could be as a result of edafic and agronomic practices as reported by Bello (2018). There was no interaction between planting method and fertilizer type on number of seed per pod.

Table 8. Interaction between planting method and fertilizer on performance of Soybeans on number of pod per plant grown in Billiri, Gombe State.

Fertilizer (F)	Hill	Drill	Broadcast
NPK	61.21	58.12	48.12
SSP	52.09	50.98	45.19
NPK/SSP	66.91	60.73	51.65
Control	46.12	42.90	39.14
F-LSD (0.05)	4.10	3.23	3.14

LSD= Least Significant Differences at 5% Level of Probability.

Table 9. Interaction between fertilizer and planting seasons on number of pod per plant of soybean grown in Billiri, Gombe State.

Season (S)	NPK	SSP	NPK/SSP	Control
2018	59.16	55.61	50.45	47.01
2019	64.91	61.92	52.71	49.91
F-LSD (0.05)	4.91	3.82	3.89	2.56

LSD= Least Significant Differences at 5% Level of Probability.

Table 10 show a perfect interaction between planting method and fertilizer on 1000 seeds weight, were hill plan ting method and the applications of NPK and SSP had heavier seeds than other treatment used, this could be as the result of the well-spaced plants enabling it to utilized the available resources thereby having heavier seeds as suggested by Turgut et al (2005) in his work on soybean, this is not far from the facts that pod initiation and pod production is highly influenced by spacing and nutrients particularly macro-nutrients, this is in conformity with the finding of Egli and Bruening (2000) who reported that NPK plays an important part in the early stage of plant while SSP plays an important role in pod production which in turn increase yield and probably heavier seeds. Table 11 recorded rainy season where 2019 and hill planting method had perfect interaction with heavier seed than 2018 rainy season and other planting methods used, this could be attributed to the facts that rainfall, tempreture, relative humidity and the ability of the crop to adopt to the cultivating environments, this finding is in agreement with table 15.

Table 10. Interaction between planting method and fertilizer on performance of Soybeans on 1000 seeds weight grown in Billiri, Gombe State.

Fertilizer (F)	Hill	Drill	Broadcast
NPK	60.26	17.98	16.24
SSP	18.21	16.65	15.00
NPK/SSP	21.91	19.75	17.01
Control	15.12	13.67	12.89
F-LSD (0.05)	1.81	2.21	1.00

LSD= Least Significant Differences at 5% Level of Probability.

Table 11. Interaction between fertilizer and planting seasons on 1000 seeds weight of soybean grown in Billiri, Gombe State.

Season (S)	NPK	SSP	NPK/SSP	Control
2018	19.62	18.91	17.18	15.12
2019	22.91	21.01	19.14	16.00
F-LSD (0.05)	1.00	1.01	1.00	1.00

LSD= Least Significant Differences at 5% Level of Probability.

Table 12 shows an interaction exists between planting methods and fertilizer type on yield were drill and NPK and SSP had higher yield when compared with other treatments used, this could be as the result of plant population superseding drill methods which is not far from that hill planting methods, in general macro-nutrients, SSP and spacing plays an important role in influencing crop yield as reported by Cure et al (1988)..

Table 12. Interaction between planting method and fertilizer on performance of Soybeans on yield grown in Billiri, Gombe State.

Fertilizer (F)	Hill	Drill	Broadcast
NPK	492.91	501.91	482.81
SSP	500.10	493.84	467.89
NPK/SSP	520.12	560.23	500.01
Control	451.01	459.61	401.01
F-LSD (0.05)	19.81	20.21	21.82

LSD= Least Significant Differences at 5% Level of Probability.

Table 13 is an interaction between fertilizer and season, where season 2019 rainy season had perfectly interacted with drill planting methods having the highest yield when compared with 2018 rainy season and other planting method adopted for the research, this is not far from the fact that residual effects of the previous year had contributed to the yield having in mind also the effects of climate which may have been favourable as reported by table 11

Table 13. Interaction between fertilizer and planting seasons on yield of soybean grown in Billiri, Gombe State.

Season (S)	NPK	SSP	NPK/SSP	Control
2018	490.12	500.12	491.78	450.23
2019	515.01	572.12	505.21	480.11
F-LSD (0.05)	40.01	41.89	42.01	29.41

LSD= Least Significant Differences at 5% Level of Probability.

Table 14 is the physio-chemical properties of the experimental site before and after the experiment, the result indicate there was an increment in the soil nutrient as seen in the table as a result of application of chemical nutrients as reported by Fagam (2000) in his work who started that residual effects of chemical application is mostly felt in a subsequent cropping year.

Table 14. Physicochemical properties of the experimental site at Gombe in the Rainy Season of 2018 and 2019.

	2018		2019	
Soil property	**Before**	**After**	**Before**	**After**
% Sand	58.3	57.06	58.4	57.08
% Silt	14.3	15.54	14.2	15.52
% Clay	27.4	27.4	27.4	27.4
Texture	Sandy loam	Sandy loam	Sandy loam	Sandy loam
Ph	6.11	6.13	6.10	6.12
Organic carbon (%)	0.76	0.79	0.78	0.80
Organic matter (%)	1.53	1.65	1.61	1.62
Total nitrogen (%)	0.28	0.29	0.23	0.30
P(Bray)ppm	11.02	12.98	11.01	13.79
CEC (CmolKg-1)	4.81	5.56	4.91	5.57
Ca2+	3.32	3.41	3.41	3.35
Na2+	0.57	0.58	0.56	0.59
K+	0.24	0.28	0.25	0.27
Mg2+	0.93	0.98	0.94	0.99
Base saturation	74.74	75.95	75.11	76.89

Key; ppm= part per million, CEC= Cation exchange capacity, EC= Exchangeable cation

CONCLUSION

Based on the result obtained the use of Dibbling methods of planting and the application of NPK at 50kg/ha and NPK/SSP (40kgN, 80kg P, 20kg K) fertilizer had lead to optimum yield for farmers in the study location.

Table 15. Meteorological data covering the experimental site during 2018 and 2019 rainy season.

Year	Month	Rainfall	Tempreture		Relative humidity	
			Min	Max	Min	Max
	April	19.11	21	38	20	82
	May	20.12	19	36	32	71
	June	81.27	19	32	35	80
	July	291.81	18	34	37	79
2018	August	321.01	19	36	40	81
	September	401.21	19	35	26	82
	October	251	18	33	38	20
	November	19.19	20	36	29	28
	April	21.81	18	37	34	92
	May	69.81	19	32	31	86
2019	June	281	20	35	40	82
	July	299.81	19	34	41	80
	August	381.42	20	37	38	85
	September	450.71	19	35	30	90

October	281.62	20	36	28	20
November	29.01	19	37	29	25

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