International Research Journal of Natural and Applied Sciences
Vol. 4, Issue 2, February 2017 Impact Factor- 5.46
ISSN: (2349-4077)

Website: www.aarf.asia Email : editor@aarf.asia , editoraarf@gmail.com

IMPACT OF INORGANIC FERTILIZER AND VARIETY ON GROWTH, SOMEHYDROLOGICAL PROPERTIES AND YIELD OF SOYA BEAN (*GLYCINE MAX. L. MERR.*).

Jibrin, A.D
Graduate School, University of the Philippines Los Banos, Laguna 4031, Philippines.

ABSTRACT

Field experiment were conducted during the 2015 and2016 wet season at the Teaching and Research Farm of Abubakar Tafawa Balewa University, Bauchi (Latitude 10^{0c} 17"N, Longitude 90^{0c} 47"E and 609.3m above sea level) to assess the impact of inorganic fertilizer and variety on growth, some hydrological Properties and yield of Soya bean. The treatment consisted of two Soyabean varieties (TGX 4114-2E and SAMSOY-1) and four levels of NPK 20-10-10 fertilizer (0.0 5.0, 10.0 and 15kg/ha) which were laid out in a randomized complete block design (RCBD) with three replications. Result showed that variety TGX-4114-2E significantly (P=0.05) produced taller plant, number of branches and leaf area in both seasons while variety samsoy-1 significantly gave higher number of leaves, number of seed per plant, 1000 seed weight and grain yield per hectare in the two seasons. Application of Inorganic fertilizer (NPK 20-10-10) significantly (P=0.01) increased Leaf area, number of seed per plant and grain yield per hectare in both seasons. The application of inorganic fertilizer levels significantly decreased dry soil bulk density, increased soil moisture content and porosity rate and 15.0kg/ha produced the highest value in all the parameters observed. Interactions were not significant in both seasons. Therefore, variety samsoy-1 and 15kg/ha of inorganic fertilizer(NPK 20-10-10) could be adopted by farmers in the study area and further research should be conducted to ascertain their superiority.

Keywords: Growth, Hydrological properties, Inorganic fertilizer, Variety, Yield.

Introduction

Soya bean(*Glycine Max. L.Merr.)*belongs to the leguminosae family,sub-family Papilionoideae and genus Glycine (RMRDC, 2004). Soyabean do adopt well to both tropical

and temperate climates (Anthony, 2006). The crop is widely used as an oilseed because it contains above 40percent oil which is rich in important fatty acid, lecithin, vitamin A,D, Phosphorus and Calcium (IITA, 2009). Soyabean was reported to have been domesticated first in the 11^{th} century BC around northeastern part of China (Fisher, 1980) and introduced into Africa by Chinese traders in the 19^{th}century. The global production of the crop as of 2012 was 212.6 MT out of which Nigeria produces only 601,000Mt (FAO,2013). According to Kumawat et al, (2000) soyabean like most legumes performs nitrogen fixation by stashing a symbiotic relationship with the bacterium bradyhizobium japonicum (syn. Rhizobium japonicum). For best resultsan inoculum of the correct strain of bacteria should be mixed with the soyabean (or any legume) seed before planting (Anonymous, 2009). In Nigeria and other countries shortage of edible oil and protein is a factor that contributes to economic importance of soya bean (Akinola et al., 2012).

The low yield per hectare of soyabean obtainable in Nigeria could be due to factors such as the use of poor and interior varieties, poor quality of the inorganic fertilizers, poor agronomicpractices and inappropriateapplication of inorganic fertilizers. The aims of this study were to determine the effects of variety and different dosage of NPK 20-10-10fertilizer on some hydrological properties, growth and yield parameters of soya bean in Bauchi, Nigeria.

Materials and Methods

Field experiment was conducted during the 2015 and 2016 wet seasons at the teaching and research farm of Abubakar Tafawa Balewa University Bauchi located at (Latitude $10^{0}17^{11}$N,Longitude$9^{0}49^{11}$E and 609.3m above sea level) in the Northern Guinea Savannah ecological zone of Nigeria (Kowal and Knabe, 1979). The area has an average rainfall ofabout 1100mm per annum mostly distributed between the months of May – October while the mean monthly temperature and relative humidityrecorded during the experimental periods ranges between 20-30^{0}C and 44.03 -43.97 ,respectively.

Soil Analysis

Surface (0-15cm) and 15-30cm soil samples were taken in both seasons from each plot before the start of the experiment. The samples were bulked and air-dried for routine analysis. Organic Matter (O.M) was determined by Walkley-Black dichromate digestion method. And total soil nitrogen was determined by the kjeldahl method. Available P was determined by Bray-1 method. Exchangeable K^{+}, Ca^{2+} and Mg^{2+} were extracted using ammonium acetate.

Potassium was determined using the flame photo meter and Ca and Mg by EDTA titration. The soil pH in 0.01 M $CaCl_2$ was determined using a glass electrode.

Soil moisture content

Moist soil samples were taken from the field two days after a heavy rainfall in each season with the core sampler and sent to the laboratory where they were weighed to find their initial masses. They were then oven-dried at a temperature of 105°C to a constant mass(MS) The loss of water upon drying constituted the mass of waters(Mw) contained in the sample. The volumetric water content (θv) was determined from the formula: $\theta v = \theta g.p_b/p_w$, where θg = Mw/Ms therefore $\theta v = \theta g.p_b$ (Assuming p_w =1), θv is gravimetric water content. P_b is bulk density of the soil and p_w is the bulk density of water.

Dry bulk density

The dry bulk density was determined from soil cores collected from the field during the two seasons with core sampler. The cylindrical metal sampler (core sampler) with a diameter of 5cm and a height of 5cm was driven into the soil vertically with the aid of wooden plank and a mallet to fill the sampler. The oven dried soils were weighted and the dried bulk densities were calculated by dividing the oven dried mass (mass of solid component of the soil) by the volume of the soil (that is the cylinder).

Porosity

Total porosity was calculated by the formula; $f = i\text{-}P_b/P_s$ where f is total porosity, P_b is bulk density and P_s is particle density ($2.65gcm^{-1}$).Air filled porosity was calculated by the formula, $af = f\text{-}\theta v$ where af is air filled porosity, f is the total porosity and θv is volumetric water content.Some physical and chemical characteristics of the soil prior to sowing are shown in Table 1.

The treatments consisted of two varieties of soyabean (TGX4114-2E and Samsoy-1) obtained at Bauchi central market and Bauchi State Agricultural Development Project (GSADP) respectively and four levels of NPK fertilizer (Urea) (0.0, 5.0, 10.0 and 15.0kg/ha). The various levels of NPK fertilizer were incorporated into the soil of the respective plots each year according to field randomization to a depth of 5cm at planting and twice at three weeks interval.

Prior to planting, the experimental fieldswere ploughed and harrowed using a tractor in order to provide sufficient tilth forsoya bean root growth and development and to destroy weed seeds. Planting was carried out on 11th July of 2015 and 2016 by hand drilling of the soyabean seed into a soil depth of 2cm. The total land area cultivated was $300m^2$which

consist of plot of 27.5X8m with 0.5m borderlines between the plots and 1m borderline between replications.

The plots were kept devoid of weed by manual weeding using a hoe at 3, 6 and 8 weeks after sowing each year. There were no significant incidence of pest and disease observed throughout the experimental period. Data were collected on plant height (cm) number of leaves and leaf area all at 4, 6, 8 and 10 weeks after sowing (WAS), seed pod, pod length (cm), 1000 seed weight (g), number of seed per plant and grain yield (kg/ha) at harvest. These were analyze using the statistical analysis (ANOVA) as described by steel and Torrie (1980). Means were separated using the least significant difference LSD.

Results

Plant height was significantly (P=0.05) affected by the effect of variety at 6, 8 and 10 WAS in both seasons, respectively, (Table 2). Variety TGX4114 -2E produced the taller plant than Sam soy – 1 in all the years of the study. Soyabean number of leaves were found to be influence significantly (P = 0.05) at 6 WAS only during the two years of the experiment,variety TGX4114 – 2Egave higher number of leaves than Samsoy – 1 (Table 3). Similarly, the effect of variety on leaf area was significant (P=0.01) at 4 WAS only in both seasons and TGX4114 – 2E produced the highest leaf area than Samsoy – 1 (Table 4).Table 5 shows the effect of variety on soyabean seed pod, pod length, 1000 seed weight, number of seed per plant and grain yield per hectare during the two wet seasons,respectively.1000 seed weight significantly(p=0.05) , Number of seed per plant and grain yield perhectare were significantly (p=0.01) affected by varietal difference in the two seasons.Variety Samsoy-1 consistently produced the higher value in these parameters in both seasons. However, the effect of variety was not significant on seed pod and pod length during the periods of the study.

Application of NPK fertilizer levels significantly (P=0.05) in 2015 and (P=0.01) in 2016influenced soya bean leaf area (Table 4) application of 15kg NPK/ha produced the highest leaf areacomparedto other levels and control. However,the effect of different NPK fertilizers levels on plant height and number of leaves were not significant during the twoseasons, respectively. (Table 2 and 3).

NPK fertilizer levels significantly (p=0.01) affects soyabean Number of seed per plant and grain yield per hectare in the two seasons, respectively. (Table 5). The application of 15kg NPK/ha consistently produced the higher value than other levels and control. However, the

effect of different NPK fertilizer levels was not significant on seed pod, pod length and 1000 seed weight of soyabean during the two years of the experiment. (Table 5).

Table 6 shows the effects of NPK fertilizer on bulk density, total porosity, aeration porosity and soil moisture content. Application of 5.0kgNPK/ha and control treatment during the two years of the experiment gave the lowest bulk density, while the application of 15.0kgNPK/ha in both seasons gave the highest bulk density. At five percent probability level the application of 5.0 and 10.0kgNPK/ha significantly produced the lowest bulk density than all treatments. However, there were no significant difference between the control and the 5.0kgNPK/ha treatments in both seasons. The application of 15kgNPK/ha significantly produced the highest total porosity followed by the 10.0kgNPK/ha. However, at 5% probability level there were no significant differences between the treatment and the control in all seasons. There were no significant differences among the treatments on aeration porosity in both years of the study, The control recorded the lowest value of 21.4% .The effect of NPK fertilizer levels application on soil moisture content shows thatapplication of 15kgNPK/ha gave the highest value of $0.15gg^{-1}$ for the gravimetric water content (moisture content on mass basis) and 19.6% volumetric wetness. At 5% probability level there were no significant differencesamongst the treatments applied.

Discussion

Plant height was significantly (P=0.05) affected by varietal difference. Variety TGX4114-2E consistently produced taller plant than Samsoy – 1. The difference in plant height could be attributed to the influence of environment and their genetic make-up, this findingsconcurwith that of Anthony (2006)who observed that plant height is one of the growth parameters and is animportant photosynthetic apparatus, hence,the difference in plant height might be due to the differences in genetic factors and environment.

The effect of variety was significantly (p=0.05) on number of leaves at 6WAS only, variety samsoy-1 gave the higher value than the TGX4114-2E. This could be due to best adaptability of variety Samsoy – 1 to the agroecology in which the experiment was conducted. This observation confirmed the work of Pal (2011) who reported that number of leaves of soya bean was significantly affected by varietal difference. Similarly, leaf area per plant was found to be significantly (P=001) increased at 4 WAS,variety TGX 4114 – 2E produced larger leaf area than Samsoy-1. This might be due to the large area occupy by variety TGX 4114-2E which translate to higher quest for photosynthetic apparatus especially at an early stage of growth. Varietal difference significantly (P=0.05) influenced soyabean 1000 seed weight,

number of seed per plant and grain yield per hectare. Variety Samsoy-1 continually gave higher value in these parameters. This may not be unconnected to the difference in genetic composition of the varieties used. Cober et al.,(2000) recorded higher 1000 seed weight and grain yield in soyabean and attributed this to the direct influenced of genetic composition of the varieties and the environment within which the experiment was conducted.

Leaf area of soya beantended to increase by increasing the doses of NPK fertilizer from zero (control) to 5.0kg NPK/ha. This could be ascribed to excessive vegetative growth which resulted to low absorption and growth due to the excessive supply of the NPK fertilizer. This agree with the work of Michael et al., (2001) who reported that most growth parameters of soyabean increased with the application of 5.0kg NPK/ha.

The effect of different NPK fertilizer levels were significant (p=0.05) on the number of seed per plant and grain yield per hectare. Soyabean number of seed per plant and grain yield per hectare increased with increasing application of NPK fertilizer levels from zero up to 15.0 NPK/ha. This finding disagree with the work of Olufajo *et al*., (2000) who reported that applying NPK fertilizer beyond 2kg N/ha resulted in decrease nodulation in soyabean cultivars. However, Tripati *et al*., (2002) observed that NPK fertilizer as a form of inorganic fertilizer has the potential of increasing the fertilizer use efficiency of soils thereby improving the chemical properties of the soil by making better utilization of nutrients, this might also be the reason towards the increased in soyabean seed yield obtained in this experiment.

The results further showed that soil bulk density were significantly improved as a result of the application of varying levels of NPK fertilizer. All the treatment levels significantly produce higher value than the control. This indicates that NPK 20-10-10 fertilizer has the ability to improve soil bulk density, hence increase in crop yield. This finding conform to the earlier studies by Olabode *et al*., (2008) who found that Potassium and Nitrogen are highly mobile and are easily leached especially in sandy soils and that NPK fertilizer application is affected by nutrient status than those with high reserve.

The effect of NPK fertilizer application on total porosity was significant. The application of 15.0kgNPK/ha gave the highest value than other levels and the control. This could be as a result of the reduced bulk density which ultimately led to higher total porosity. Iftikhar et al., (2004) reported that NPK fertilizer significantly increased total porosity in a wheat crop field. In this study it was further observed that application of NPK fertilizer upto 15.0kgNPK/ha significantly gave higher porosity than control and 5.0kgNPK/ha, this showed that NPK fertilizer application to sandy soils has the total positive action on porosity. The result of the

effect of NPK fertilizer application on moisture content suggest that NPK fertilizer has the ability to increased soil moisture contents. This improvement could be attributed to increase in soil nutrients content as a result of the application of NPK fertilizer, this observation is in line with the findings of Basel and Atif (2010) who reported that application of NPK 20-10-10 fertilizer to soils increased the availability of NPK and other essential micro nutrients needed for optimum plant growth.

Conclusion

The result of this experiment showed that variety had a significant effect on some Soyabean growth and yield parameters and variety Samsoy-1 produced higher value in the yield parameters recorded. NPK fertilizer levels significantly affect some hydrological properties, growth and yield parameters recorded and applying 15.0kg NPK/ha gave higher values in bulk density, moisture content, total porosity, aeration porosity, number of seed per plant and grain yield per hectare during the two years of the experiment, hence, farmers in the study area could adopt Variety samsoy-1 in combination with 15.0kg NPK/ha. Further research using NPK fertilizer levels and varieties of Soyabean be conducted to ascertain their superiorities.

Table I: Chemical properties of the soils before the experiment during the 2015 and 2016 wet seasons.

Nutrient	**Soil Depth**	**(0-15cm)**	**(15-30cm)**	
	2015	**2016**	**2015**	**2016**
% Clay	17.19	17.20	10.20	10.20
% Silt	16.01	16.00	14.40	14.39
% Sand	62.99	63.70	60.50	60.51
Textural class	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam
% - organic carbon	0.61	0.60	0.59	0.60
% - total nitrogen	0.11	0.11	0.9	0.90
% - organic matter	0.08	1.09	1.84	1.85
Exchange cations (cmol/Kg)				
Ca	1.90	1.90	2.00	2.00
Mg	0.37	0.33	0.41	0.41
K	0.38	0.37	0.42	0.42
Na	0.12	0.12	0.11	0.11

Available phosphorus (Mg/Kg)	64.67	64.78			56.16	56.17
pH	6.68	6.70			6.00	6.70

Table II: Effect of variety and inorganic fertilizer levels on soyabean plantheight at Weeks after sowing during the 2015 and 2016wet season.

	Week after sowing							
Treatment	4		6		8		10	
	2015	2016	2015	2016	2015	2016	2015	2016
Variety								
TGX4114-2E	6.18	6.3 2	9.63	9.14	10.51	10.01	11.60	13.30
SAMSOY-1	5.91	5.42	8.82	9.49	9.00	9.09	10.25	11.16
LS	NS	NS	*	*	*	*	*	*
LSD(0.05)	-	-	5.41	6.01	7.81	7.86	7.68	8.41
NPK level (kg/ha)								
0.00	3.00	3.27	3.00	3.67	3.43	3.21	6.47	6.50
5.0 0	3.85	3.42	3.15	3.67	3.09	3.02	6.81	6.51
10.00	3.06	3.27	3.17	3.95	4.00	3.89	6.24	5.50
15.00	3.04	3.45	3.21	3.11	4.50	4.01	5.18	5.61
LS	NS	NS	NS	NS	NS	NS	NS	NS
LSD (0.05)	-	-	-	-	-	-	-	-
Interactions								
Var. x NPK	NS	NS	NS	NS	NS	NS	NS	NS

* and ** = significant at 5% and 1% level of probability, NS = Not Significant

Table III: Effect of variety and NPK fertilizer levels on soya bean number of leaves at weeks after sowing during the 2015and 2016 wet season.

	Week after sowing							
Treatment	4		6		8		10	
	2015	2016	2015	2016	2015	2016	2015	2016
Variety								
TGX4114-2E	3.00	3.06	8.64	8.92	3.72	3.21	5.03	5.21
SAMSOY-1	2.14	2.89	5.17	46.17	2.25	3.05	4.92	4.36
LS	NS	NS	•	*	NS	NS	NS	NS
LSD(0.05)	-	5.45	5.45	6.91	-	-	-	-
NPK levels (kg/ha)								
0.0 0	3.61	3.72	3.19	3.39	3.50	3.11	3.28	3.41
5.0 0	3.91	3.61	3.61	3.61	3.95	3.42	3.55	4.01
10.0 0	3.99	3.67	3.72	3.72	3.06	3.28	3.05	3.67
15. 00	3.81	3.89	4.00	4.19	3.43	3.45	4.00	3.89
LS	NS	NS	NS	NS	NS	NS	NS	NS
LSD (0.05)	-	-	_	_	-	-	-	-
Interactions								
Var. x NPK	NS	NS	NS	NS	NS	NS	NS	NS

* and ** = significant at 5% and 1% level of probability, NS = Not Significant

Table IV: Effect of variety and NPK fertilizer levels on soyabean leaf area at weeks after Sowing during the 2015 and 2016 wet season.

	Week after sowing							
Treatment	4		6		8		10	
	2015	2016	2015	2016	2015	2016	2015	2016
Variety								
TGX4114-2E	5.98	6.23	4.11	4.16	3.17	3.42	4.07	4.45
SAMSOY-1	4.99	5.08	4.13	4.57	4.67	2.66	3.17	4.00
LS	•	NS	NS	NS	NS	NS	NS	NS
LSD(0.05)	5.03	-	-	-	-	-	-	-
NPK levels (kg/ha)								
0.00	2.99	2.93	3.11	3.09	3.33	2.25	4.82	4.66

5.00	3.11	2.43	3.61	4.61	4.58	3.22	5.20	5.64
10.00	2.61	3.54	3.99	3.30	4.00	4.00	6.24	6.43
15.00	3.73	4.00	3.63	4.00	3.50	3.67	6.87	7.01
LS	NS	NS	NS	NS	NS	NS	**	**
LSD (0.05)	-	-	_	-	-	-	6.28	6.61
Interactions								
Var. x NPK	NS	NS	NS	NS	NS	NS	NS	NS

* and ** = Significant at 5% and 1% level of probability, NS = Not Significant

Table V: Effect of variety and NPK fertilizer levels on soyabean yield and yield components during the 2015 and 2016 wet season.

Treatment	Seed pod		Pod length (cm)		1000 seed Weight		N/S plant		Grain yield (kg/ha)	
	2015	20 16	2015	2016	2015	2016	2015	2016	2015	2016
Variety										
TGX41414-2E	4.00	5.58	2.88	2.43	7.92	10.01	65.83	89.79	213.20	214.22
SAMSOY-1	4.46	4.67	2.67	2.00	9.73	11.63	98.67	99.62	463.86	487.74
LS	NS	NS	NS	NS	•	*	**	**	**	**
LSD(0.05)	-		-	-	6.84	7.00	12.48	9.67	43.73	43.55
NPK level (kg/ha)										
0.00	5.00	5.33	3.83	3.09	6.30	5.02	30.00	29.99	258.28	261.01
5.00	5.05	4.50	3.71	3.46	6.76	6.01	37.67	32.71	309.72	300.99
10.00	5.02	5.17	2.33	3.00	6.29	6.22	88.33	79.84	365.28	355.14
15.00	5.43	5.50	4.17	4.00	6.36	6.43	95.00	97.57	420.83	422.96
LS	NS	NS	NS	NS	NS	NS	**	**	**	**
LSD (0.05)	-	_	-	-	-	-	14.22	12.51	61.80	62.11
Interactions										
Var. x NPK	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

* and ** = significant at 5% and 1% level of probability, NS = Not Significant

Table VI: Effect of NPK fertilizer on bulk density, total porosity, aeration porosity, soil moisture contents (gravimetric H_20 content (gg^{-1}) and volumetric H_20 Content) during the 2015 and 2016 wet seasons.

Treatments $Kgha^{-1}$	Bulk Density (gcm^{-3}) 2015	2016	Total Porosity (%) 2015	2016	Aeration porosity (%) 2015	2016	Gravimetric water contents (gg^{-1}) 2015	2016	Volumetric water contents (%) 2015	2016
0.00	0.59	0.59	35.30	35.20	21.40	21.41	0.11	0.12	14.00	14.00
5.00	0.79	0.78	37.80	37.30	24.30	24.29	0.12	0.13	15.80	15.80
10.00	1.39	1.38	39.90	39.05	27.80	27.81	0.13	0.13	18.90	18.90
15.00	1.68	1.69	40.60	40.41	28.70	28.72	0.15	0.16	19.60	19.60s
LSD (P<0.05)	0.01	0.02	0.99	0.98	3.06	3.05	0.02	0.03	2.40	2.41
CV (%)	3.02	3.03	3.40	3.41	7.51	7.53	8.37	8.38	3.63	3.63

References

Akinola, M.O., Ojeniyi, S.O. and Amusan, O.A. (2012). Soil Physical Properties and Soya bean Yield as influenced by tillage and ash. *Nigerian Journal of Soil Science*, 22 (2) 2012. 255-259.

Anthony, S.U. (2006). Variety and Nitrogen fertilizer roles insoya bean growth and yield. Apublication of Alabama co-operative extension service of March, 2006. Alabama. 15-21.

Basel, A.O. and Atif, Y.M. (2010). Effect of fertilizers on growth, yield and yield components, Quality and certain nutrient contents in Broccoli (Brassica Oleracea). *International Journal of Agriculture and Biology*. 08-253/HUT/2008/10-6-627-632.

Anonymous (2009). Soyabean as an oilseed: fertilizer N and good variety for optimum yield. Available at: www.http://soyabean/NPK/variety/source.

Cober, E.R., Maill, J. and Voldeng, H.D. (2000). Early tall determinate soya bean – genotype the Sets high bottom pods. *Canadian Journal of Plant Science*. 80(30):527-531.

Fisher, N.M. (1980). Notes on Agricultural Research with soya beans at the Institute of Agricultural Research, Ahmadu Bello University, Samaru, Zaria of the 1st National Meeting of Nigeria Soya beans Scientist 1:34-40.

FAO. Statistic division (2013). atwww.faostart.org.

Institute for tropical Agriculture (IITA, 2009). Response of soyabean and sesame to different N Sources. IITA monthly News Bulletin, May, 2009. 7-16.

Ifullhar, M.H., Shah, S.H., Sajjad, H. and Iqbal, K. (2004). Growth, yield and quality response of Three wheat (Triticum aestivum L.) varieties to different levels of N, P and K. *International Journal of Agriculture and Biology*. 1560-8530/2002/04-3-362-364.

Kowal, J.M. and Knabe, D.T. (1972). An Agro climatologicalatlas of the Northern States of Nigeria. Ahamdu Bello University Press, Zaria.

Kumawat, N.H., Emile, M.G. and Jacques, A. (2000). Effects of Phosphorus, Potassium, Dolomite and Nitrogen Fertilizer on the quality of Soyabean yields, proteins and lipids. *Journal of Agriculture Food Chemistry*. 4:765-769.

Michael, A.S., Lamb, J.A., Randall, G.N., Orfc, J.H. and Rehma, G.W. (2001). In-season Fertilizer Nitrogen Application for soya bean in Minnesota. *Agronomy Journal*, 93:983-988.

Olabode, I.A., Akinyemi, S.O.S., Akinwumi, G.S. and Adelani, A. (2008). Influence of Fertilizer AndPopulation Density on the Growth of Irvingia wombolu (Vermeosen). Proceedings of the 26th Annual Conference of the Horticultural Society of Nigeria (Hortson). Held at Adamawa State University, Mubi, Nigeria. October 26th – 30th, 2008.

Olufajo, O.O., Pal, U.R., Adu, S.K. and Nnadi, L.A. (2000). Nodulation and seed yield of Soya bean as influence by Rhizobia Inoculation and Nitrogen Fertilizer. *Journal of Food and Agriculture* (2): 112-117.

Pal, U.R., Olufajo, O.O. and Adu, S.K. (2011). Recent findings on cultural and nutrient Requirement of soya bean in Northern Guinea zone of Nigeria. In proceedings: V. Annual Workshop of the soya beans scientist on National Coordinated Research Project on Soya bean5: 52-64.

Raw Materials Research and Development Council (RMRCD, 2004). Report on Survey of Agro-Raw Materials in Nigeria. Raw Materials Research and Development Council.

Steel, R.G.D. and Torrie, J.H. (1980). *Principles and Procedures of Statistics: A Biometrical Approach*, 2nd edition. McGraw-Hill: New York.

Tripati, S.A., Morshed, R.G., Rahina, M.M. and Rahman, M.A. (2002). Effect of Nitrogen on Seed Yield, Protein Content and Nutrient Uptake of Soyabean. (Glycine Max. L.). *Journal of Agriculture and Rural Development*. 6 (1 and 2), 13-17.