Effect Of Different Nitrogen Sources On Nodulation, Nutrient Compostion, Growth And Yield Of Soybean (Glycine Max L.) In Southern Guinea Savannah, Kogi State, Nigeria

Ogundare, S. K and Mohammed, S. A

[1]Department of Agronomy, Ahmadu Bello University, Zaria, Kaduna State, Nigeria
[2]Division of Agricultural Colleges, Ahmadu Bello University, Zaria, Kaduna State, Nigeria
Email: drogundarekayode@yahoo.com

Abstract: The experiment was carried out at Agronomy Section of Kabba College of Agriculture to investigate the effect of different nitrogen sources on nodulation, nutrient composition, growth and yield of soybean. The treatment consists of two nitrogen fertilizer (urea and N P K 15:15:15) and three animal manures (poultry manure, cow dung and pig manure). All these materials were applied at 20kgN/ha at planting. The growth character observed were plant height, number of leaves, stem girth, leaf area, fresh weight of plant and dry weight of plant. Yield characters observed were pod length, pod number, 1000seed weight, and number of grains per plant, grain weight per plant and yield per land area. Nodule characters observed were fresh weight of nodule and number of nodule produced per plant. Data were also collected on nutrient composition of soybean seed such as N P K, S, protein, oil, and carbohydrate. All the data collected were subjected to Analysis of Variance and treatments mean were separated using Least Significant Difference. The result shows that plots treated with N P K fertilizer at 20kgN per ha gave highest yield of soybean. It is therefore recommended to the farmers in the study area.
[Ogundare, S. K and Mohammed, S. A. **Effect Of Different Nitrogen Sources On Nodulation, Nutrient Compostion, Growth And Yield Of Soybean (Glycine Max L.) In Southern Guinea Savannah, Kogi State, Nigeria.** *Researcher* 2016;8(6):59-63]. ISSN 1553-9865 (print); ISSN 2163-8950 (online). http://www.sciencepub.net/researcher. 10. doi:10.7537/marsrsj080616.10.

Keywords: Nitrogen, Nodulation, Nutrient composition, Soyabean, Manure and Fertilizer

Introduction

Soybean (Glycine max L.) is called a miracle golden bean because of its nutritive value, especially as a substitute or complement of protein. Soybean is an excellent source of protein and therefore, can supplement protein in human diet; the approximate composition of soybean is 40-45% protein, 18-20% edible oil, 24-26% carbohydrate and a good amount of vitamins (Kaul and Das, 1986). It thus can play an important role in supplementing oil – protein deficiency. Soybean has one of the highest nitrogen requirements among the most agronomic crops.

Nitrogen is an integral component of many compounds including chlorophyll and enzymes, essential for plant growth processes. It is an essential component of amino acids and related proteins. Nitrogen is essential for carbohydrate use within plants and stimulates root growth and development as well as the uptake of other nutrients. This element encourages above ground vegetative growth and gives a deep green colour to the leaves (Brady, 1990). It is recognized that nitrogen is one of the key elements of soil fertility. Most of the developed countries are harvesting high yields and maintaining the soil nitrogen level by the application of chemical nitrogenous fertilizer. Soybean, being a leguminous crop, is capable to fix atmospheric nitrogen through symbiosis. However, several studies have shown that the symbiotic N – Fixation is not able to meet high N – requirement of this crop particularly under the Nitrogen deficient conditions. A number of workers (Duraisami and Mani, 2011; Kumawat *et. al.,* 2000; Bachhau and Sabale, 1996; Sharma and Misra, 1997) reported the positive role of nitrogen in increasing yield, protein content and nutrient uptake of Soybean.

Soybean is a leguminous crop; there is need to plant leguminous plant in other to improve soil fertility. Nodule production determines the availability of nitrogen to crop at later stage of crop life. The crop has the ability to convert atmospheric nitrogen to the form that can be used by the plant. It also, determines nitrogen content of soybean seed. The work will examine the rate of nodule formation in soybean in Southern Guinea Savannah of Nigeria. Objectives of the study are to determine the effect of different nitrogen sources on nodulation, nutrient composition on soybean seed and on growth and yield of soybean.

Materials And Methods

Area of the Study

The field experiment was conducted at Kabba College of Agriculture student experimental field during 2015 cropping season. Kabba is located in the Southern Guinea Savanna Ecological Zone of Nigeria. (07^0 53'N, 06^0 08'E). It has an average rainfall of about 1,570mm per annum with an annual temperature range of 18^0c – 32^0c. The mean relative humidity

(R.H) of about 59% and four hundred and twenty seven meter (427m) above sea level.

Field work

The Soybean seeds were source from Agricultural Development Project Office, Aiyetoro, Kogi State, Nigeria. The experiment was conducted using single field of dimension 14.5m x 11m which consisted of six treatments and were replicated three times. The experiment was laid out in a Randomized Complete Block Design (RCBD).

The treatments consisted of the followings: The experiment consists of six nitrogen sources apply at 20kgN/ha, T1= Urea (43.48kg urea/ha), T2= NPK (133.3kgNPK/ha), T3=Poultry manure (555.6kg pm/ha), T4=Cow dung (714.3kg cwd/ha), T5= Pig manure (1250kgpgm/ha) and a Control (No fertilizer).

Sites were cleared manually using cutlass and later ridged with hoes and in the field, Seeds of Bambara nut were sown on a flat bed. Organic manure were uniformly spread on the flat beds and incorporated with hoes two weeks before planting. Urea and NPK fertilizer was applied at planting. The seeds were planted at the rate of two - plant-per-hole at a spacing of 50cm by 30cm which make up forty-nine stands per plot. Plots were weeded manually at three weeks intervals.

Data analysis

Data were statistically analyzed using GENSTAT. The analysis of variance (ANOVA) was performed to find out the significance of variation among the treatments while the significant difference between mean treatments were separated using least significance Difference at 5% level of probability.

Results And Discussion

Pre-planting soil analysis and composition of animal manure used

The result of the pre-planting soil analysis showed that the soil was dominated by sand fraction at the surface at 60%, followed by clay at 21.6% and silt at 18.1%. The soil was therefore classified as sand clay loam, by this classification, it could be inferred that the soil used for the study was of good drainage and well aerated for good root penetration. The soil pH showed that the soil was slightly acidic in reaction with pH value of 6.2. The organic matter content was low (2.14%) the low organic matter content could be attributed to the effect of erosion and seasonal burning that was very common in the area in early January and March annually. The total N was quite low at 0.19%. The low total nitrogen could also be attributed to low organic matter content (Nnaji et al, 2005). The available phosphorus was quite high at 31.4ppm. This could be as a result of low fixation of P in the study area by sesquioxides or as a result of the parent material. The exchangeable cation of Ca, Mg, K and Na were low. The cation exchange capacity (CEC) was low. Generally the percentage of base saturation was 23.3% and this infers that the soil had low fertility.

Plant height

Nitrogen sources influenced plant height of soybean significantly over control. 1norganic fertilizer influenced plant height better than organic nitrogen sources. Among the inorganic fertilizer tested NPK fertilizer produce taller plant. Plots treated with NPK were not significantly better than plots treated with urea. Animal manure plots were statistically inferior to plots treated with inorganic fertilizer except in plots treated with poultry manure. Similar results were reported by Varon et al. (1984), Manral and Saxena (2003). The result also corroborate the finding of L1 and Mahler (1995) who obtained better vegetative development in wheat, most especially when soil was amended with poultry manure. N P K and poultry compete favorably in terms of growth characters of soybean. This could be as a result of many nutrients in both nitrogen sources. Among the animal manure, poultry manure produced tallest plant, followed by cow dung and the shortest plant occurred in plots treated with pig manure.

Number of leaves and leaf area were significantly affected by the different nitrogen sources applied. Plot treated with N P K produced the widest leaf area ($4.8m^2$). All the plots amend either with inorganic or animal manure were better than the control plot, there was no significant difference on stem girth.

Animal manure was significantly inferior to N P K fertilizer in this experiment but, compete favorably with urea. The result is in line with the finding of Ogundare et al (2015).

Table 4.3 presented the result of yield and yield components of soybean. Significant difference were observed in pod length, pod number , 1000seed weight (g) , number of grains weight of grains and grain yield per hectare due to different nitrogen sources, plots amend with inorganic fertilizer (urea and N P K) show better performance in yield and yield characters compared with plots amend with animal manure (poultry manure, cow dung and pig manure). Though, N P K recorded higher pod number (66.8), grain number (148), grain weight per plant (43.4) and yield per hectare 4840kg (4.8 t/ha) which was not significantly better than plots treated with urea. Among the organic residues (animal manure) cow dung recorded greatest yield which was statistically different from plots treated with poultry manure and pig manure. Control plots were highly statistically

inferior to plots amended with either organic or inorganic fertilizer in this study. Poultry manure performs better than either cow dung and pig manure. The better performance of poultry manures in all the growth characters observed infers that the plant response to poultry which agrees with earlier finding of Olatunji and Oboh (2012). They reported increase in growth of tomato with the use of poultry manure. The better performance of the inorganic fertilizer in this study could be a result of nutrient released immediately into soil and crop. The findings of smith et al (1986) who reported that legumes crop do not need nitrogen, N P K treated plots perform better than urea treated plots. This observation could result from leaching and volatilization effect of urea that make the nutrient unavailable to the crop, cow dung was the best animal manure in the experiment and significantly better than either poultry manure or pig manure in terms of yield. The result could be attributed to the effects of phosphorus in cow dung which is a major nutrient in seed or grain production. Plots with no amendment produce the least yield and yield characters in this study. The results confirm that soybean response to nitrogen apply at planting.

Nodule characters in soybean

Fresh weight of nodules, dry weight of nodules and number of nodules per plant were significantly affected by the different nitrogen sources applied. Plots treated with poultry manure had largest number of nodules which was followed by N P K fertilizer plots, urea applied plots and cow dung plots, pig manure plots had least number of nodules. However, unamend plots control show remarkly low number of nodules. Nodule number increased in all the amended plots over the control. The findings of Senerirantue et al, (2000) have shown that inoculation and fertilizer use promote plant growth and increase grain yield in soybean. Incorporating 23kg N/ha as the primary fertilizer application and adding 23kg N/ha at the end of flowering does not inhibit soybean nodulation. This show the importance of nitrogen fixation in the tropic even with fertilizer incorporation included. Nitrogen affects nodulation of legume (soybean). Yashima (2003) grain legume in nutrient solution containing 0 – 100 ppm nitrogen in the form of urea and found that maximum number of nodules was obtained at 25ppm nitrogen.

Table 4.5 presents the result of fresh weight of plants (g) and dry weight of plant (g). There was significant difference in fresh weight of plant and dry weight of soybean due to treatment. The results were not consistent.

Nutrient composition of soybean seed

Significant difference was observed in nitrogen, protein and oil due to different nitrogen sources. However, P, K, S and carbohydrate were not statistically affected by treatments. Though, the result on nutrient composition was inconsistent. Plots amended with urea had highest percentage of nitrogen and oil while plots treated with cow dung had highest percentage of protein. However, unamend plot had the least percentage of nitrogen, protein and oil.

Table 4. 1a: Physical and Chemical Properties of Soil of soil used for the experiment

PROPERTIES Values	
Sand (%)	60.3
Clay (%)	21.6
Silt (%)	18.1
Soil texture	Sand clay loam
pH	6.2
Bulk density (g/cm^3)	1.38
Total porosity (%)	40.0
Organic matter (%)	2.14
Total N (%)	0.19
Available P (mg/kg)	3.11
Exchangeable K (Cmol/kg)	0.21
Exchangeable Ca (Cmol/kg)	2.67
Exchangeable mg (Cmol/kg)	1.57
Base saturation (%)	23.3

Table 4.1b composition of animal manure used

Nutrient (%)	Poultry manure	Cow dung	Pig manure
Organic carbon	**38.3**	**43.4**	**46.2**
Total N	**3.6**	**2.8**	**1.6**
C:N ratio	**10.6**	**15.9**	**28.9**
phosphorus	**1.3**	**1.1**	**2.28**
Potassium	**3.1**	**0.8**	**1.5**
Calcium	**1.23**	**1.2**	**1.1**
Magnesium	**0.32**	**0.24**	**0.6**

Table 4.2: Growth characters of soyabean as affected by application of different nitrogen sources.

Treatment	Plant height(cm)	Stem girth	Number of leaves	Leaf area(m2)
Urea	96.4	2.54	39.4	4.1
NPK	96.7	2.77	63.6	4.8
Poultry manure	95.4	2.34	45	4.6
Cow dung	86.6	2.87	45.1	3.9
Pig manure	80.4	2.6	71.6	4.2
Control	43.6	2.01	26.7	2.6
LSD	4.27	Ns	13.4	4.96

Table 4.3: Yield parameters of soyabean as affected by application of different nitrogen sources

Treatment	Pod length	Pod number	1000seed weight(g)	Grain number	Grain weight per plant	Yield (kg/ha)
Urea	6.41	65.1	7.6	134	42.6	4641
NPK	7.63	66.8	7.4	148	43.4	4840
Poultry manure	5.62	56.1	6.8	136	49.8	4210
Cow dung	6.34	63.4	5.6	127	48.3	4314
Pig manure	6.61	56.8	5.3	131	46.8	3724
Control	2.21	43.9	3.8	96	25.45	1360
LSD	1.22	6.81	1.44	10.66	6.28	26.44

Table 4: Nodule characters of soyabean as affected by application of different nitrogen sources

Treatment	Fresh weight of nodule (g/plant)	Dry weight of nodule (g/plant)	Number of nodule per plant
Urea	0.89	0.26	36.8
NPK	0.74	0.24	37.6
Poultry waste	0.64	0.18	39.4
Cow dung	0.73	0.21	36.8
Pig manure	0.58	0.23	31.4
Control	0.56	0.18	24.13
LSD	0.21	0.02	3.75

Table 4.5: Shoot fresh and dry weight of soybean plant as affected by application of different nitrogen sources

Treatment	Fresh weight of plant (g)	Dry weight of plant (g)
Urea	14.56	4.69
NPK	13.44	3.87
Poultry manure	13.08	3.94
Cow dung	14.48	4.11
Pig manure	14.69	3.95
Control	8.68	2.84
LSD	3.60	1.11

Table4.6: Nutrient composition of soybean seed as affected by application of different nitrogen sources

Treatment	N (%)	P (%)	K (%)	S (%)	Protein (%)	Oil (%)	Carbohydrate (%)
Urea	8.41	0.42	0.60	0.44	36.78	21.66	23.81
NPK	7.73	0.46	0.64	0.43	37.23	20.44	22.64
Poultry manure	7.56	0.44	0.61	0.41	41.14	20.13	22.83
Cow dung	8.31	0.42	0.62	0.48	42.82	19.46	23.46
Pigmanure	7.44	0.47	0.66	0.46	38.61	20.13	21.81
Control	6.36	0.46	0.61	0.40	36.42	17.64	22.63
LSD	0.56	Ns	Ns	Ns	1.21	2.40	Ns

Conclusion

Soybean responses to both inorganic and organic nitrogen source irrespective of the type of the soil. N P K fertilizer influenced growth and yield of soybean better than urea and among the organic sources poultry manure was the best. Nodule formation in soybean was also influenced by application of nitrogen irrespective of the sources. Growth and yield of soybean was positively influenced by inorganic and organic manure used as nitrogen sources. NPK fertilizer at 20kgN/ha applied at planting influenced yield of soybean better than other sources, it is there recommend to the farmer for optimum yield. Further research should be carried out on other agronomy characteristics influence soybeans production.

References

1. Bachhav, P.R. and Sabale,R.N (1996). Effect of Different Source of Nitrogen on Growth Parameter, Yield and Quality of Soyabeans. *J. Maharashtra Agric univ*.21 (2), 244-247.
2. Brandy, N.C. (1990). The Nature and Properties of Soil (Tenth edu.). Macmillian Publishing Company, New Jersey. USA. 315pp.
3. Dualism, V.P and Mani, A,K, (2001) Residual Effect of Inorganic N,Componted Cropith and Biofertilizer on Yield and Uptakes of Soyabean in an Inceptisol Madras Agric J. 88 (4/6) 277-280
4. Kaul, A.K and Das M.L (1986) Oil Seed in Bangladesh" Bangladesh Canada Agricultural Sector Team, Ministry of Agriculture, Government of the Republic of Bangladesh, Dhaka Pp.324.
5. Kwmawat, S.M. Dhaka L.L. and Mallwal, P.L. (2000), Effect of Irregulation Regime and Nitrogen on Yield, oil content and Nitrogen Uptake of Soyabeans (*Glycine max*) *India \Jounal of Agron*. 45 (2) 361-366.
6. Li,G.C and Mahaler, R.L. (1995) Effect of Plant Material Parameters on Nitrogen Mineralization in a Moilisol. Common Soil Sci. Plant *Anal*. 26(11-12) 195-198.
7. Manral, H. S and Saxena, S. C. (2003). Plant Growth, Yield Attributes and Grain Yield of Soyabean as Affected by the Application of Inorganic and Organic Sources of Nutrients. *Bioresour. Technol.* 92: 110-118.
8. Nnali, G.U. Mbagun, J.S.C and Amalu C.L.A. (2005) Changes in Physical Properties of Soil and in Cassava Monograph and Organic Amendment in Proceeding of the 19th Annual Conference of Farm Management Association of Nigeria Pp374-377.
9. Ogundare S.K. Babatunde, I.J and Etukudo O.O (2015). Responds of tomato variety (Roman F.) Yield to Different Mulch Material and Staking in Kabba, Kogi state *Journal of Agricultural Study vol. 3, No.2.Pp 61-70.*
10. Olatunji, O. and V.U Oboh (2012). Growth and Yield of Okro and tomato as Affected by Pig Manure and Other Manure Issue for Economic Consideration in Benue state. *Nig.J. soil sci.* vol.22 (1): 103-107.
11. Seneuiratne, G; L.H.J Van Holm, E.M.H.G.S. Ekanyake. 2000, Agronomic Benefits of Rhizobia Inoculants use. Over Nitrogen Fertilizer Application in Tropical Soyabean. *Field Crops Research* 68,199-203.
12. Sharma, R. A. and Misra, O. R. 1997. Crop residues, FYM and fertilizer use in relation to growth, yield and nutrient uptake by soybean. *Crop Res Hisar* **13**(1), 51-57.
13. Smith, DR. R.J. Bula, R.P. Walagenbach, 1986. Forage Management 5th ed Kandall Hunt Publishing Company, Dubuque, IA.drought Stress and Pod Position. *Agron.J.* 84:166-170.
14. Varon RCA, Munoz BD, Covaleda Zf, Medina UD (1984). Effect of Level and Stage of N Fertilizer Application and Rhizobium Inoculation on Soyabean Field in Ibague. *Revista Institute colambian Agropecuarion.* 19(3): 291-295.
15. Yashima, H., Fujikake, H., Sato, T., Tewari, K., Ohtake, N., Sueyoshi, K., & Ohyama, T.(2003). Systemic and local effects of long term application of nitrate on nodulegrowth and N2 fixation in soybean (*Glycine max* (L.) Merr.). *Soil Sci. Plant Nutr.,* 21, 981-990.

6/22/2016