EFFECT OF RHIZOBIAL INOCULATION ON THE GROWTH OF BAMBARA NUT (*Voandzeiasubterranea*L) and SOYBEAN (*Glycine max* L) ON SOIL OF 'YANKWASHI LOCAL GOVERNMENT AREA OF JIGAWA STATE

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Abstract
The effect of Rhizobialinnuculum on the growth of Bambara nut (VoandzeiasubterraneaL) and Soybean (Glycine max L), on the soil of 'Yankwashi L. G. A. were investigated, the experiment was conducted in 2020 at Department of SLT-CST demonstration plot to study the effect of inoculation on the growth, nodulation and nitrogen fixation of Bambara nut and Soybean, The results showed that, the height and chlorophyll content of Bambara nut (VoandzeiasubterraneaL),of the treated plants established better than their corresponding uninoculated plants Control follow by the respond of height and chlorophyll content of Soybean (Glycine max L)of 'Yankwashi Local Government. Again, inoculation resulted in significantly greater nodule numbers, height, and chlorophyll content respectively.

1.0 Introduction

Rhizobium spp is a group of bacteria which has ability of providing nutrients for soybean crops. When symbiotic with legume crops, this group of bacteria is able to infect plant roots and form root nodules. Root nodule serves to take nitrogen in the atmosphere and move it as nutrients needed by host plants. *Rhizobium spp* can donate nitrogen in the form of amino acids to soybean plants (Aminu *et al*., 2015). *Rhizobium spp* fixing nitrogen occurs when atmospheric nitrogen is converted to ammonia by enzyme nitrogenase, and microbial genes are required to fixate nitrogen to be widely distributed in to the environment (Gaby and Backley, 2011). *Rhizobia* can live in plant residues (saprophytes) or in plants (endophytes) or saprophyte related to plant roots (rhizobacteria) (Mohammadi and Sohrabi, 2012). The study of (Aminu *et al*., 2015) showed that the number of nodules formed was high if the soil was inoculated with *Rhizobium*. *Rhizobium spp* can be symbiotic with soybean plants, and capable to fixate air nitrogen to meet the nutrient needs of host plants. The interactions between root nodules and symbiotic bacteria have been studied through proteomics genumes during the signal exchange and symbiotic growth (Simon *et al*., 2014).

Bambara nut (*Voandzeia subterranean (L*) thours*)* is a seed of African origin, used locally as a vegetable. It was first found in West Africa. The plant is leguminous and has nitrogen fixing nodule on the roots. Evidence has shown that, base on the root nodules, the plant supports land care provision in Africa (National Research Council, 2006).

The national botanical name of Bambara nut is *Voandzia subterranean (L)* thours, synonyms of *Vigna subterranean* and belong to the *plantea* of the family of *fabaceae* and sub family of *faboidea*. The common name of bambara nut are okpe (Nigerian Igbo), gurjiya (Nigerian hausa) congo groundnut (Congo) Njugo. bean (South Africa) etc (Abbasi*et al.,* 2008). The plant is distributed in Africa and it's to grow best in presence of sunshine, high temperature, and at least 4 months free frost and frequent rain, however, it is highly adaptable and tolerates harsh weather condition better than most crops. Bambara nut are use locally as food stuff moi-moi (igbo). It can be boiled and eaten as nut and can also be groun into flour for use to fortify maize for pap. The dry seed can last for very long time and serve as farmine food boosting food availability (Furseth*et al.*, 2012).
Bambara plant is also used to sustain the plant habitat as it increases the fertility of soil and bring about the higher yields of other crop (Hungria*et al.*, 2015).

Rhizobia have the ability to change atmospheric nitrogen into ammonia, a form directly used by plants for the synthesis of amino acids and nucleotides. Thus there will be a symbiosis. This symbiotic relationship will benefit both sides. According to Furseth*etal*. (2012), soybeans can fixate 175 kg of nitrogen per year in irrigated areas, while in dry areas it is only able to fix as much as 100 kg of nitrogen per year. Nitrogen is an essential macro nutrient mineral that is needed in the largest amount by plants and is a major limiting factor for plant development, growth and overall harvest (Simon *et al*., 2014). Effective use of nitrogen fertilizer will increase food security (the amount of food produced) and nutritional safety (e.g., food protein content). Sustainable agriculture requires more efficient use of nitrogen. The efficiency of nitrogen use tends to decrease as the available supply of plant nitrogen increases. The need of nitrogen for supplying soybean seeds during seed filling is very high and has been suggested as the cause of nitrogen remobilization and leaf aging (Golparvar *et al*., 2012). In a study conducted by (Flavio *et al*., 2004) fertilization with 80 kg of nitrogen ha-^{1} at the beginning of the seed filling period extended 3 days seed filling period. To produce 1 t ha-1 soybean requires 70 kg N, 7 kg P, and 43 kg K per ha (Manshuri, 2010).

1.1 Statement of the Research Problem

Nitrogen (N) is one of the major agricultural inputs worldwide used to meet the nitrogen requirement of crops (Bohlool *et al.,* 1992). In contrast to expensive chemical nitrogen fertilizer, the use of nodulated legumes in small farming systems is often a more advantage and practical alternative (Sanginga and Woomer, 2009). Their ability to fix atmospheric nitrogen allows them to grow in nitrogen impoverished soils (Giller, 2001). Biological Nitrogen Fixation serves as either a direct source of nitrogen to symbiotic crops, or as an indirect source through decomposition of legume residues (Sanginga and Woomer, 2009). For less developed countries in Asia, Africa, Central and South America, including Congo and Nigeria, inoculant technology has had no significant impact on productivity of the smallholder farmers, because inoculants are not used or are of poor quality (Bashan, 1998). The basic problem in acquiring quality inoculants is the low number of effective rhizobia in terms of nodulation and nitrogen fixation of the host plant. Also, high- quality peat-based inoculant is the most dependable and commonly used especially for small-scale farmers than any other legume inoculants. Unfortunately, good quality peat is not available in many countries (Miličić*et al*., 2006), including Congo and Nigeria. Thus, it is advisable to use an effective rhizobium strain and high quality peat when producing legume inoculants. Therefore, there is need to identify and select an effective rhizobium strain and the best locally available peat material for large scale rhizobia inoculants production in Congo and Nigeria, as an easy and inexpensive way of enhancing soil fertility and productivity of Bambara nut and soybean.

1.2 Significance of the Research work

Bambara nut and Soybean are relatively new crops to many African countries, and over the past 10–15 years, its cultivation and utilization in many sub-Saharan African (SSA) countries is gaining popularity. This is probably as a result of increasing need for protein in food and animal fodder (Sanginga, 2003; Ado *et al.,* 2006). In ‘Yankwashi, Bambara nut and Soybean farming is increasing among smallholder farmers, but their productivity remains low. In order to produce higher yields, larger amounts of nitrogen fertilizer are required. However, the cost of such fertilizer is prohibitive. Thus, very few use it on their farms (Haque and Jutzi, 2011).

1.3 Aim and Objectives

1.3.1 Aim

The aim of this research is to determine the effect of Amarshal crop booster inoculation on the growth of Bambara nut and Soybeans on the soil from ‘Yankwashi Local Government Ares of Jigawa State.

1.3.2 Objectives

I. To enumerate the rhizobial population of the soil under study.
II. To determine the effect of organic matter contents of soils under study on the Bambara nut and Soybeans.
III. To determine the chlorophyll content of the Bambara nut and Soybeans
IV. To determine the effect on the height of Bambara nut and Soybeans on soil samples of different location.

2.0 Materials and Method

2.1Sample Collection and Preparation

Soil samples were collected from farmland at different location of ‘Yankwashi Local Government Areas of Jigawa State. Sixteen samples were collected for the research. Four samples were collected from each Cardinal Point. Sub-sample from bulk soil samples were collected and dried at laboratory condition for five (5) days. The sub-sample was gently crushed with porcelain pestle and mortar and pass through a 2 mm sieved to remove debris and coarse fragments. The fine earth separates (<2 mm soil portion) were labeled and stored in polythene bags for laboratory analysis. Weighing of the soil samples for laboratory analyses was done using an electric weighing balance, (ADP 3100L).

2.2 Physicochemical Analyses of the soil sample

The soil samples were taking to soil science laboratory of Bayero University for the determination of the PH, organic carbon, total nitrogen, available phosphorus, particle size distribution and the exchangeable bases.

2.3 Preparation of Legume Seeds and Development of Seedlings

The legume seeds Bambara nut (*Voandzeia subterranean* L) and Soya bean (*Glycine Max* L) were selected and rinsed in 95% ethanol for 10 seconds to remove wax material and trapped air. Thereafter, the seeds were soaked in a solution of 1% sodium hydrochloride for 4 minutes, followed by rinsing with sterile water five times to remove residual disinfectant (Somasegaran and Hoben 1994). Water agar was prepared by dissolving 14 g of dehydrated medium in 1 litre of water followed by sterilization at 121^0c for 15 minute. The prepared seeds obtained above were planted on the water agar and allowed for 3-5 days germinating. Seedling with good root development and free from contamination were selected and transplanted at 2 cm depth in an experimental pot containing the soil samples obtained 2.1 above. The set up was then watered daily for a period of two months (8weeks). (Somasegaran and Hoben 1985)

2.4 Determination of the Effect of the Inoculums on the Growth of Bambara nut and Soybeans

2.4.1 Sterilization of Pots

One hundred and Ninety two (192) pots were washed with water and detergent. The pots were air dried and then sterilized by vertical air pressure steam sterilizer (LS-B120L) at 121ºC for 15 minutes.

2.4.2 Preparation of the Inoculants, KNO_3 Solution and inoculation

Forty five (45 ml) of Armashal crop Booster was dissolved in 100 ml of distilled water and then used for inoculation. Fifty (50) grams of fertilizer (Nitrogen, Phosphorous and Potassium) was dissolved in 700 ml of sterile distilled water; the content was mixed until the powder was dissolved and 300 ml of distilled water was added to make it 1L (Vance *et al.,* 2000).

The determination of the effects of the inoculation was carried out in the screen house of Science Laboratory Technology (SLT) Kazaure Polytechnic. One hundred and Ninety two (192) pots were filled with raw soil of sixteen different sites. The pots were grouped into eight and each group was filled with one type of soil only. Seedlings of Bambara nut and soybeans with good root development germinated in the laboratory were selected and one seedling was transplanted into each of the pots prepared accordingly. The set up was watered daily and after seven days of transplanting five pots from each ninety six pots were selected and group into five pots each. The first five pots were labeled as plus inoculants (+I), the second five as plus Fertilizer (+F), and the third five pots as inoculants plus fertilizer (+ I+F) and the last as control (C). The first and second were inoculated with 1ml of legume fix inoculants and nitrogen from KNO_3 stock, respectively.

2.4.4 Determination of Chlorophyll Content and Plant height

The SPAD 502 chlorophyll meter was used to measure the chlorophyll contents of the plants by clamping the meter on the leaves and reading appeared on the screen within second which was recorded accordingly. Plant height was measured using a metre rule. This was done by measuring the plant from the ground level to the top of the uppermost and leaf. The reading was recorded accordingly (Morad *et al.,* 2013).

2.5 Data Analysis

The data obtained was analyzed by using statistical analysis and presented in the tables blow.

3.0 Result and Discussion

3.1 Result

Table 3.1 the mean height and chlorophyll content of Bambara nut (*Voandzeia subterranea* L) of 'Yankwashi Local Government

Treatment	Height (cm)			Chlorophyll (1mg/L)	
	HT2	HT4	HT8	CHL4	CHL8
Inoculant	13.43	21.20	28.41	32.45	52.00
Fertilizer	12.30	18.23	29.95	34.10	56.48
Inoc+Fert.	14.22	18.17	32.55	38.93	58.33
Control	11.20	17.00	23.67	29.80	37.34

Table 3.2 the mean height and chlorophyll content of Soybean (*Glycine max* L)of 'Yankwashi Local Government

Treatment	Height (cm)			Chlorophyll (1mg/L)	
	HT2	HT4	HT8	CHL4	CHL8
Inoculant	11.50	15.58	25.44	33.92	43.68
Fertilizer	11.56	15.52	25.26	32.97	47.09
Inoc+Fert	11.18	17.67	24.92	32.87	50.97
Control	11.00	15.00	21.93	30.55	33.89

3.2 Discussion

Growth was measured as crop establishment, result showed that at two (2) weeks of transplanting the height of Bambara nut planted in 'Yankwashi soil treated with fertilizer plus inoculants was found to be the highest (14.22 cm) followed by Bambara nut treated with inoculants (13.43 cm) followed by Bambara nut treated with fertilizer (12.30 cm) followed by the control (11.20 cm). At four weeks of transplanting, the Bambara nut planted in ‘Yankwashi soil treated with inoculants was found to have the highest (21.20 cm) followed by Bambara nut treated with fertilizer (18.23 cm) followed by Bambara nut treated with inoculants plus fertilizer (18.17 cm) followed by the control with (17.00 cm), The height of the Bambara nut at eight (8) weeks of transplanting showed that the Bambara nut treated inoculants plus fertilizer was the highest (32.55 cm), followed by Bambara nut treated with fertilizer (29.95 cm), followed by the Bambara nut treated with inoculants (28.41 cm), and then followed by the control (23.67 cm).

The chlorophyll content of the Bambara nut in ‘Yankwashi local government soil at four (4) weeks, the Bambara nut treated with inoculants plus fertilizer have the highest value (38.93 mg/L), followed by Bambara nut treated with fertilizer (34.10 mg/L), followed by Bambara nut treated with inoculants (32.45 mg/L) and the control have the least SPAD value (29.80 mg/L).
At eight (8) weeks of transplanting, the Bambara nut treated with inoculants plus fertilizer was found to have the highest chlorophyll content (58.33 mg/L), followed by Bambara nut treated with fertilizer (56.48 ml/L), followed Bambara nut treated with inoculants (52.00 mg/L) and the control has the lowest chlorophyll content (37.34 mg/L).

The result showed that at two (2) weeks of transplanting the height of Soybeans planted in ‘Yankwashi soil treated with Fertilizer was found to be the highest (11.56 cm) followed by Soybeans treated with innoculant (11.50 cm), followed by Soybeans treated with fertilizer plus inoculants (11.18 cm), followed by the control (11.00 cm). At four weeks of transplanting, the Soybeans planted in ‘Yankwashi soil treated with inoculants plus fertilizer was found to have the highest (17.67 cm) followed by Soybeans treated with inoculants (15.58 cm) followed by Soybeans treated with fertilizer (15.52 cm) followed by the control (15.00 cm).

The height of the soybeans at eight (8) weeks of transplanting showed that the Soybeans treated inoculants was the highest (25.44 cm), followed by Soybeans treated with fertilizer (25.26 cm), followed by the Soybeans treated with inoculants plus fertilizer (24.92 cm), then followed by the control (21.93 cm).

The chlorophyll content of Soybeans in ‘Yankwashi soil at four (4) weeks, the Soybeans treated with inoculants have the highest value (33.92 mg/L), followed by Soybeans treated with fertilizer (32.97 mg/L), followed Soybeans treated with inoculants plus fertilizer (32.87 mg/L) and the control have the least SPAD value (30.55 mg/L). At eight (8) weeks of transplanting, the Soybeans treated with inoculants plus fertilizer was found to have the highest chlorophyll content (50.97 mg/L), followed by Soybeans treated with fertilizer (47.09 mg/L), followed Soybeans treated with inoculants (43.68 mg/L) and the control has the lowest chlorophyll content (33.89 mg/L). This indicates that inoculants combined with fertilizer influenced the growth of Bambara nut and Soybeans then inoculants only or fertilizer alone. As Ahmad and Mohammad (2007) reported that inoculation plus fertilizer resulted in better growth but the growth could be greatly affected by environmental and genetic factors such as soil temperature and moisture content. Inoculation or application of fertilizer both makes nitrogen available for plant height. Indeed, they have been described as the most limiting nutrient for plants to increase in height (Salisbury and Ross, 1992; Gardner *et al.,* 1985).

Conclusion

Rhizobial inoculante and supplementation has a potential in improving growth, yield, economic benefits, and photosynthesis in legumes. It is recommended to adopt and incorporate these technologies in legumes production. However, the information available demands more research to be done so as to establish the contribution of these technologies in attaining optimal production of legumes grown in different agro ecological zones in Nigeria.

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