International Journal of Agriculture, Environment and Bioresearch

Vol. 3, No. 04; 2018

ISSN: 2456-8643

THE EFFECTS OF MORINGA (Moringa Oleifera Lam.)LEAVES AND NITROGEN, PHOSPHORUS AND POTASSIUM (15:15:15) FERTILIZER ON THE GROWTH PARAMETERS AND YIELD OF SOYBEAN (Glycine Maxl. Merrill)) IN OBUBRA, SOUTHEASTERN REGION OF NIGERIA

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ABSTRACT

A field experiment was conducted at Obubra region in the forest belt of South-eastern Nigeria during the growing seasons of 2014 and 2015 to study the effects of incorporating Moringa (MoringaoleiferaLam.) leaves and NPK (15:15:15) fertilizer on the growth, yield and protein content of soybean plant. Experiment was adopted in the Randomized Complete Block Design (RCBD) with three replicates in two factors. First four rates of Moringa leaves i.e. (0, 5, and 15) t. ha-1. Second and four levels of NPK fertilizers (15:15:15) i.e. (0, 50, 100 and 150) kg. ha-1. Means were compared by using the least significance difference (L.S.D.) test at probability 0.05. Results showed that added Moringa leaves or fertilization with NPK fertilizer significantly increased plant, number of pods per plant, weight of 100 seeds and grains yields. Meanwhile there are no significant results between interactions of two factors.

Keywords: Moringa leaves, NPK (15:15:15) fertilizer, Soybean.

1. INTRODUCTION

Soybean (Glycin max. L. Merrill) is one of the most widely cultivated grain legumes in the world (Tukamuhabwa, 2000). Soybean is a leguminouscrop high protein and oil content in the seeds and very important in the human nutrition and the forage of the livestock. content both of which are adapted to the nourishment of man and livestock (Ojikpong and Olufajo, 2005). Soybean constitutes more than 50% of the edible crop oil rich in essential fatty acid and devoid of cholesterol (Ogundipe and Weingarther, 1992). The oil extracted is used as supplement in animal feeds. It is a source of calcium, iron and Niacin (Mijindale, 1987). Soybean is a very important crop in soil Nitrogen nutrition for crop production. The need for finding ways to supply the necessary proteins to feed the rapidly growing population in the last decade, has revealed new opportunities of exploring nature's unlimited nitrogen resources for agriculture through the cultivation of soybean crop

Literature/Theoretical underpinning

Soybean productivity is often limited by the low availability of nutrients in the soil which is forming one of the major constraints to soybean productivity. The long term use of inorganic fertilizers without organic supplements caused some damages to the soil physical, chemical and biological properties and environmental pollution. The incorrect and random uses of chemical fertilizers contribute largely to the deterioration of the environment also. It leads to loss of soil fertility due to imbalanced use of fertilizers that has adversely impacted agricultural productivity and caused soil degradation. There is a growing realization on the fact that the adoption of ecologically friendly and sustainable farming practices can reverse the declining trend in the global low crop productivity and environmental degradation. (Aveyard, 1988; Wani, Rupela, and Lee, 1995). Organic matter helps to improve physiochemical properties of the soil and provide a good substrate for the growth of microorganisms and maintain a favorable nutrition balance. Lourduraj (2000) reported that application of organic manures significantly enhances the growth attributes and yield of soybean.

Moringa (*MoringaOleifera*) is a fast growing multipurpose tree plant which has made much effects in the agriculture and human health. It has high forage yield which may amount to 120 metric tons' dry matter ha. $^{-1}$yr.$^{-1}$(Makkar and Beckar, 1999). Research findings revealed that all kinds of nutrients and amino acids needed for human body are available in Moringa leaves. Its production cost is low and can be grown with minimum care and without fertilization.The possession of many valuable properties has made it of great scientific interest. These include the high protein in leaves, twigs and stems, high protein and oil content of the seeds, (Fordl; Makkar and Becker, 2001). Moringa has been reported to provide crop nutritional benefits where it has been used to promote growth and yield of crops, (Fugile, 2001).Moringabiomass promoted growth of the plants, improves the tolerance of plant to, pests and diseases, increases number of the roots, stem and leaves, produces more and larger fruits and generally increases growth and yield of crops. Moringa has also been reported to significantly improve soil fertility if used as green manure when Moringa seedlings are ploughed into the soil (Davis, 2000).

Protein formation in the seeds is affected by many factors such as fertilizers, bio fertilizers, and organic inclusion (Khajounei; Kazem; Alyari;Javanshie, and Arvin, 2004). Nitrogen has remarkable influence on protein content of soybean because nitrogen is required for the synthesis of amino acid such as cysteine, and methionine which are essential components of protein (Tisdale; Nelson; Beaton; and Havlin; 1999).

In Nigeria soil fertility is the major problem faced by many farmers at all levels of agricultural practices. The continuous use of inorganic fertilizers has been shown to be detrimental to the soil and the environment. The incorporation of Moringa biomass (leaves, twigs and stems as manure could act as double advantage in improving the soil and soybean protein content through its inherent rich mineral resource base. In spite of its numerous advantages, research work on the uses of *MoringaOleifera* in the Southern part of Nigeria still remains scanty despite its acclaimed economic values and importance (Odeyinka; Torimiro; Oyedele and Asaolu; 2007).

The present study is therefore aimed at evaluating the effect of *MoringaOleifera* biomass as a promoter of growth, yield and protein content of soybean.

2. METHODOLOGY

This study was conducted at the teaching and research farm in the Faculty of Agriculture and Forestry, Cross River University of Technology, Obubra region, Nigeria in the growing season of 2014 - 2015 to study the effect of Moringa biomass and NPK (15:15:15) fertilizer on the growth, yield and protein content of soybean plant. Obubra land altitude is above 148m sea level and had two distinct seasons.wet season (April-November) and the dry season (December-March). A composite soil sample of the experimental site was taken to the laboratory for pre-cropping physicochemical analyses. The soybean variety used was (TGX 1835-10 E), obtained from National Root Crop Research Institute (NRCRI), Umudike, Nigeria. Experiment was adopted in the Randomized Complete Block Design (RCBD) with three replicates in two factors. The treatments comprised; 0, 5, 10 and 15 tons/ha (first factor) and 0, 50, 100 and 150 kg. ha^{-1} (second factor) of NPK (15:15:15) fertilizer. There were 16 treatment combinations and 3 replicates making a total of 48 plots. Each plot measured 2 m x 3 m. The treatments were allocated at random to each of the blocks using a table of random numbers. The total experimental area was 19.5 m x 21.5 m (419.25 m^2). The site was cleared of the existing vegetation on the 04/05/2014. Plot sizes of 2 m x 3 m (6 m^2) were demarcated, with 1m pathway between blocks. Moringa biomass (leaves) was ploughed into various plots on the 16/05/2014 and allowed for two weeks before planting. Soybean seeds were sowed on the 30/06/2014. Prior to planting, soil samples to a depth of 20 cm were taken from different representative locations of the site with a soil auger. These were bulked into composite sample, air-dried, sieved through a 2 mm sieve for the determination of their physical and chemical properties. Two seeds were planted per hole at the planting distance of 75 cm x 10 cm inter-row and intra-row, respectively. This was later thinned to one plant per hole two weeks after sowing. Fertilizer application was done to the various plots using the side banding method at two weeks after sowing. (**Ojikpong and Olufajo, 2005).**

2.1 Soil Analysis

The soil sample was subjected to routine analysis. Particle size distribution was determined by the Bouyuocos (Hydrometer) method as described by (Udoh;Ibia; Ogunwale; Ano; and Esu; 2009). Soil pH was determined in water in a ratio of 1:1 soil: water. Organic matter was determined by the Walkley – Black wet oxidation method as outlined by [16]. Total nitrogen was determined by the Macro Kjeldahl digestion method as described by (Udoh; Ibia, Ogunwale, Ano; and Esu, 2009). While available phosphorus was determined by Bray 1 method as outlined by (Page; Miller and Keeney, 1982). Exchangeable cations were determined by the Ammonium Acetate extraction method as described by (Udoh, Ibia; Ogunwale; Ano; and Esu; 2009).

Soybean Parameters: 100 g of soybean seeds were oven-dried at 68^{o}C for 48 hours. The oven-dried seeds were milled into powder using a laboratory blender and subjected to routine chemical analysis using standard procedures as outlined by (Juo, 1979). The nitrogen in the samples was determined by the micro Kjeldahl method. The total nitrogen values were converted into crude protein (%) by multiplying by 6.25 and multiplied by 100. (Brady and Weil, 2008).

2.2 Crop Service Operations

ISSN: 2456-8643

Manual weeding was carried out using the West Indian hoe and machete. This was done on a regular basis to keep the field clean and free of weed. Prophylactic control of pod sucking insect pests with Attacke 2.5 EC (Lambdacyhalothrin 2.5 EC) bi-weekly proved effective.

2.3 Data Collection and Analysis

Data were collected number of leaves at 6, 8 and 10 weeks after planting (WAP), plant height (cm) at 6, 8 and 10 (WAP), number of pods per plant, seeds yield (kg. ha^{-1}), protein content of soybean. The data were subjected to statistical analysis using the analysis of variance (ANOVA) procedure for a factorial experiment according to (Steel and Torrie, 1980), while mean separation for significant differences (F-LSD) as described by(Obi, 1986).

3. RESULTS AND DISCUSSION

Physical and Chemical Properties of Soil Used for the Experiment	
Parameters	**values**
Sand (%)	80.3
Silt (%)	9.4
Clay (%)	10.3
Textural class	Sandy loam
Chemical properties	
pH (H_2O)	6.00
Organic Carbon (%)	0.55
Total nitrogen (%)	0.080
Available P (mg/kg)	33.0
Exchangeable base (Cmol /kg soil)	
Magnessium (Mg)	3.451
Potassium (K)	0.23
Sodium (Na)	0.58
Cation Exchange Capacity (CEC)	6.32

Base saturation (%)	68.07

Result of the physico – chemical properties of the soil of the experimental site as presented in Table 1 indicates that, the soil was sandy loam with a high sand particle. The soil was mildly acidic with a pH of 6.0 and low in organic matter. The soil total nitrogen and available phosphorus were low as well as the exchangeable cations of calcium, magnesium, potassium and sodium. The low total nitrogen, available phosphorus and low organic matter content of the experimental site soil is a clear indication of the poor fertility status which is the features of tropical soil as reported by (Ojeniyi,2010).

Table 2: Plant height (cm) and Number of leaves/Plant of soybean as influenced by Moringa biomass and NPK Fertilizer

Treatment	**Number of leaves/Plant**	**Plant height (cm)**
Moringa (t/ha)		
0	56.5	26.81
5	52.0	28.31
10	56.0	30.26
15	62.0	32.30
LSD (0.05)	**NS**	**3.15**
NPK (kg/ha)		
0	48.0	27.07
50	54.0	28.80
100	57.3	30.17
150	59.0	34.64
LSD (0.05)	**NS**	**3.15**
Moringa x NPK	**NS**	**NS**

In Table 2, Moringa biomass and NPK fertilizer did not influence the number of leaves produced by soybean plant but. Plant height was significantly ($p < 0.05$) influenced by Moringa biomass only (Table 2). Plant height increased with increasing levels ofMoringa biomass and was tallest in plots applied with biomass at the rate of 10 tons/ha and shortest in the control or zero applied plots. The application of Moringa biomass at the rate of 10 t/ha and 15 t/ha produced the tallest plants (30.26cm and 32.30cm) respectively. This was closely followed by plants applied with 5 t/ha of Moringa biomass and the least plant height was obtained from the control where no manure was applied. This result agrees with the findings of (Lourduraj, 2000), who reported that application of organic manures significantly enhances the growth attributes and yield of soybean. Meanwhile the results showed that interaction between Moringa biomass and NPK fertilizer had no significant effect on the number of leaves per plant and plant height.

Table 3: Number of Pods per plant and 100 seed weight of soybean as influenced by Moringaleaves and NPK Fertilizer

Treatment	No of Pods/plant	100 seed wt (g)
Moringa (t/ha)		
0	42.5	10.06
5	64.2	11.88
10	74.9	13.87
15	52.7	15.82
LSD (0.05)	**10.13**	**1.96**
NPK (kg/ha)		
0	37.8	11.10
50	68.4	12.27
100	61.7	13.33
150	66.4	14.93
LSD (0.05)	**10.13**	**1.96**
Moringa x NPK	**NS**	**NS**

Moringa biomass and NPK fertilizer significantly influenced the number of pods produced per plant and 100 seed weight of soybean (Table 3). Application of Moringa biomass at the rate of 10 t/ha and NPK fertilizer at the rate of 50 $kg.ha^{-1}$ produced the highest number pods per plant to 74.9 and 68.4 pods per plant, respectively. This was followed by 5 t. ha^{-1} of Moringa biomass to (64.2) and 100 kg/ha of NPK fertilizer (61.7), respectively. The least value was recorded in 0 t/ha of Moringa (42.5) and 0 kg. ha^{-1} NPK fertilizer (37.8), respectively. The result obtained in this experiment agrees with the findings of Fugile,(2001), who reported that Moringa biomass accelerated growth of young plants, increases number of roots and leaves, meanwhile the results showed that interaction between two factors had no significant effect on the number of pods per plant and 100 seed weight.

ISSN: 2456-8643

Table 4: Protein content and 100 seed weight of soybean as influenced by Moringa leaves and NPK Fertilizer.

Treatment	Crude Protein Content (%)	Grain yield (kg/ha)	
Moringa (t/ha)			
0	21.19	1599	
5	31.66	2170	
10	55.59	2524	
15	52.23	2496	
LSD (0.05)	**9.42**	**267.3**	
NPK (kg/ha)			
0	21.88	1363	
50	25.41	2014	
100	32.26	2111	
150	32.12	2032	
LSD (0.05)	**9.42**	**267.3**	
Moringa x NPK	**NS**	**NS**	

Crude protein content of soybean was also significantly influenced by Moringa biomass and NPK fertilizer (Table 4). The highest crude protein was obtained with the application of 10 $t.ha.^{-1}$Moringa (55.59) and 100 kg. ha^{-1} NPK (32.26). No further significant increase in crude protein content with corresponding increase in NPK fertilizer rates was obtained.

Grain yield of soybean was also enhanced by application of Moringa biomass and NPK fertilizer. The highest grain yield was obtained in 10 t/ha and 50 kg. ha^{-1} of Moringa biomass (2524 kg/ha) and NPK fertilizer (2014 kg. ha-1), respectively. The most beneficial effect of the nutrient on crude protein content and grain yield was obtained by incorporating 10 t. ha^{-1} of Moringa biomass in plots that were applied with 50 kg. ha^{-1} of NPK (15:15:15) fertilizer. The depression in crude protein content and grain yield obtained in higher rates of NPK fertilizer application could be attributed to excessive foliage production, prolonged vegetative growth and increased competition for light. The result showed also that the interaction between two factors had no significant effect on the crude protein content and grain yield of soybean.

The decline of crop yields in the traditional farming systems has been attributed largely to soil-related constraints (Juo, 1979). However, enhanced growth and increased productivity obtained in manure plots underscore the importance of organic resources in soil fertility management. The non-significance of the interactions between the factors could be attributed to the fact that Moringa biomass may not have completely be decomposed in order to release the nutrients to the soil due the short period of incorporation of the organic matter into the soil.

4. CONCLUSION

Moringa biomass improved the grain yield and protein content of soybean. Grain yield and protein content of soybean increased with increasing levels of Moringa biomass and NPK fertilizer and maximized at 10 t. ha^{-1} and 100 kg/ha, respectively. Moringa leaves and NPK at a recommended rate supports the grain yield and improves the protein content of soybean.

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