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ASSESSING THE NITROGEN FIXATING ABILITY OF ANIDASO AND NANGBAAR VARIETIES OF SOYBEAN *(Glycine max)* IN THE SOIL

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Abstract

The experiment was conducted at the research field of crop science department, University of Cape Coast, Kwadaso College of Agriculture. The main objective of the research was to assess the nitrogen fixing ability of Nangbaar and Anidaso two newly released varieties of soybean, to know how much of nitrogen each variety would contribute to the soil with depth ranging from (0-10) cm and (10-20) cm. Randomize Complete Block Design with two treatments with two replications. Nitrogen fixing ability and other growth parameters such as plant height, number of leaves and leave broadness were assessed. The result indicated that there was no significant difference between T1 (Nangbaar) and T2 (Anidaso) in terms of plant height, number of leaves and leave broadness. However , there was a significant difference notice with T1 (6.196)(6.057) and T2 (6.737)(6.522) in terms of nitrogen fixed at depth (0-10)cm and (10-20)cm. with respect to plant height, number of leaves and leave broadness Nangbaar performed far better than Anidaso but had the least mean N-fixed. It was therefore recommended that farmers should use Anidaso as intercrop during cultivation or as fallow but use Nangbaar as a cover crop in checking erosion

Key words: GenStat software package,, Analysis Leguminous, Nitrogen Fixing, Soils samples, Treatments, Soybean, Microclimate, Rhizobium, Nodulation, Symbiosis, Bacteria and Nutrient.

Introduction

Legumes play an important role in natural ecosystems, agriculture, agro-forestry and industries. Soybean (Glycine max L. Merrill) is among the important legumes cultivated in Ghana. The crop is used in the livestock industry to prepare feeds for livestock. Soybean is regarded as the most valuable grain in the world because of its source of oil and protein (Keyser and Li, 1992). Grain legumes are cheap sources of protein especially to the poor (Ennin et al., 2004). Soybean contains 40% protein, 30% carbohydrate and 20% oil (Teferai8, 2010), and therefore has the potential for alleviating malnutrition problems. In sub Saharan Africa, cowpea is usually included in rotations and intercrops to fix atmospheric nitrogen but Soya bean has the ability to grow fast and more importantly the spreading type is able to control weeds and erosion (Harrison et al., 2007).

Objective

The main objective of this work is to assess the nitrogen fixing ability of Anidaso and Nangbaar, two new varieties of soybeans (Glycine max) released by CSIR in the soil. Specifically, to analyze the nitrogen levels of the field before planting of the soybeans**.** Secondly to analyze the nitrogen level of soil after plant maturity of the soybean and determine the impart of N-fixed on growth parameters of the varieties. And it was conceived that, the soybean used in the study could lead to the betterment or enrichment of the soil as well as increase in yield of the crops

Methodology

Soil was sampled with soil augur from depth of 0-10cm ans 10-20cm, the soil pH was determined using Eutech 510 Ph meter in a 1;2.5 soil to distilled water ratio. A 10g air-dried soil was weighed into 100ml beaker. 25ml distilled water was added and stirred thoroughly for 20 mintes. The soil-water suspension was allowed to stand for 15 minutes. After calibrating the pH meter with buffer solution at pH 4.0 and 7.0 and was read by immersing the electrode into the upper part of the suspension

Unless otherwise stated, all soil sampling and laboratory analysis reported in this section were carried out on soybean field. Ten core samples were taken from each plot at a depth of 0-10 and 10-20 cm using an augur. The soil samples were then bulked and thoroughly mixed to obtain composite samples from which subsamples were taken for chemical analysis. The samples were sieved with a 2 mm mesh sieve to remove broken sticks and other debris before the chemical analyses were carried out. The Kjeldahl method involving digestion and distillation method as described by Bremner and Mulvancy (1982) was used to determine the initial total nitrogen. Ten grams of soil sample was weighed into a Kjeldahl digestion flask and 10 ml distilled water was added to it. After 30 minutes, 5 ml concentrated sulphuric acid and selenium mixture were added, mixed carefully and digested for 3 hours until a colourless solution was observed. The digest was diluted with 50 ml distilled water and allowed to cool. The digest was made to 100 ml with distilled water and mixed well. A 10 ml aliquot of the digest was transferred to the reaction chamber and 20 ml of 40% NaO solution was added followed by distillation. The distillate was collected over 4% boric acid. Using bromocresol green as an indicator, the distillate was titrated with 0.02 N HCl solution. A blank distillation and titration was also carried out to take care of traces in the reagents as well as the water used.
Calculation:

14g of N contained in one equivalent weight of NH3

Weight of N in the soil= (14*(A-B)*N)/1000

Where:

A = volume of standard HCl used in the sample titration
B = volume of standard HCl used in the blank titration
N = Normality of standard HCl

Mass of soil sample used, considering the dilution and the aliquot taken for distillation
=(10g -10ml)/100ml
= 1g
Thus, the percentage of nitrogen in the soil sample is,
% Total N= (14*(A-B)*N*100)/(1000*1)

Note: When N = 0.1 and B = 0
% Total N = A x 0.14

Field size with dimension 6m x 9.5m was used randomly for the work, The soya beans seeds were sown at 60cm between rows and 10cm within plants for each plot. The seeds were sown between 2.5-5cm deep. Soybean seeds were sown at four seeds per hill and thinned to two seed per hill two weeks later. The Kjeldahl method involving digestion and distillation method as described by Bremner and Mulvancy (1982) was used to determine the final total nitrogen. Data were sujected to Analysis of Variance (ANOVA) using Genstat statistical software version 12. Significant difference were assessedat 5% (p = 0.05) level and means seperated using least significant difference (LSD) procedure

Results

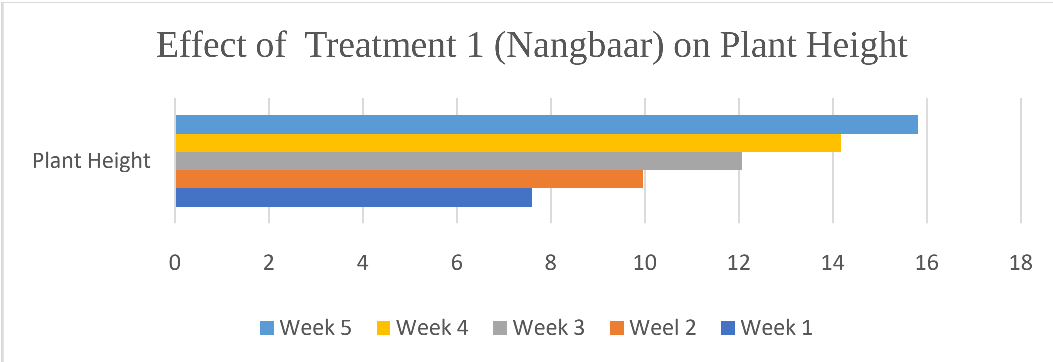

Figure (A)

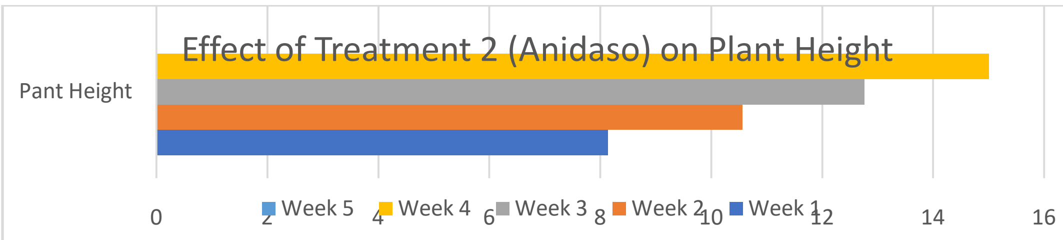

Figure (B)

Figure (A) and (B) shows the results from the effect weeks on plant height of the treatments. Treatment did not show any significant difference between each other from the weeks. There were no significant between T1 (15.80) and T2 (15.40) at week 5. However, T2 recorded the highest mean value for plant height for the five weeks followed by T1 (iigure A and B). this showed that, treatment T2 had high N-fixing ability which contributed to the growth of plant height. Biological N-fixing is brought about by free-living soil microorganisms and by symbiotic association of microorganisms with higher plants. Anidaso (T2) might have being a good breed of soybean. Nitrogen fixing depends on the interaction effect of the legume genotype, the rhizobium strain, the environment and management of the after mention (Giller, 1995). Breeding for improved cultivars of legumes may enhance the genetic potential of plant in fixing nitrogen; this can cause 10% increase in nitrogen fixed relative to existing cultivar (Giller and Cadisch, 1995). Good growth of the legume is required for symbiosis as it supplies nutrient to the rhizobia (Keyser and Li, 1992)

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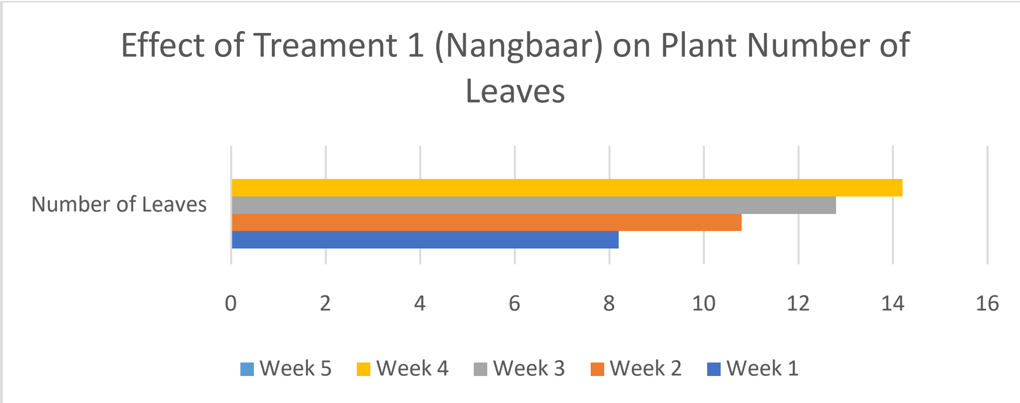


Figure (C)

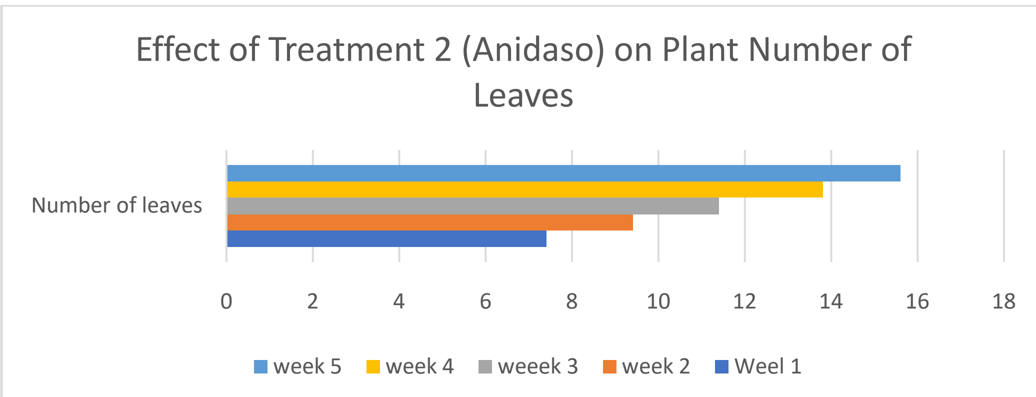


Figure (D)

Figure (C) and (D) represent the effect weeks on plant number of leaves of the treatments. There was no significant difference between ($p>0.05$) various treatment according to the weeks. However, during week 1 Nangbaar recorded the highest mean value of 8.20. More so, it consistently recorded the highest number of leaves in the subsequent weeks. Follow by Anidaso which recorded 7.40 and increased to week 5. The result shoes that, treatment T1 has high nitrogen fixing content which might have contributed to the vegetative growth of the crop. Rhizobia infect root hairs of the leguminous plant and produce the nodules. The nodules become the home for bacteria where they obtain energy from host plants and take free nitrogen from the soil air and process it into combine nitrogen, in return the plant receive the fixed N from the nodule and produce food and forage protein (Herridge, 1989).

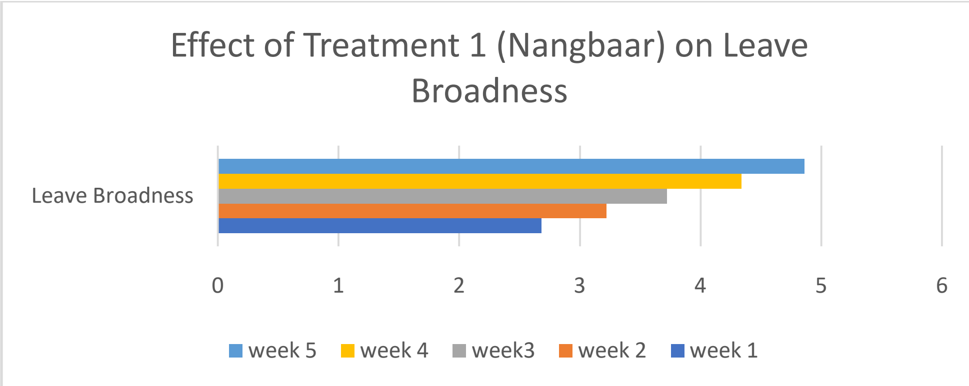


Figure (E)

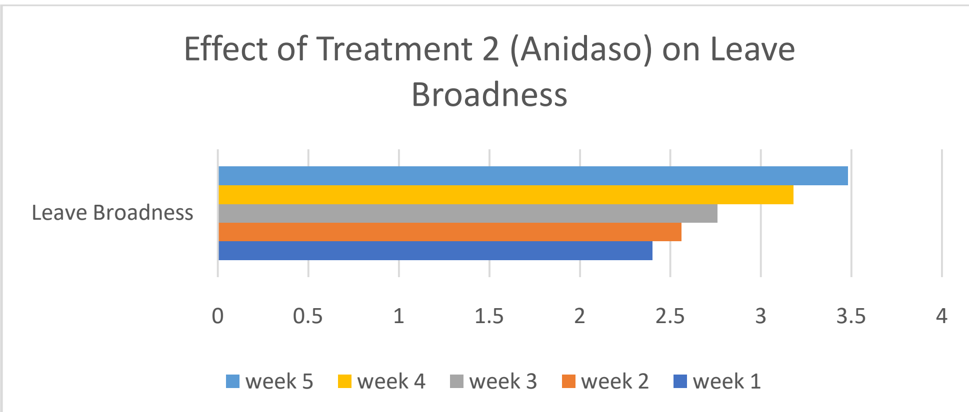


Figure (F)

Figure (E) and (F) represent the effect weeks on plant leaves broadness of the treatments. There was significant difference between treatments according to weeks as shown from the figure E and F above. T1 recorded the highest mean leave broadness value of (4.86), followed by treatment T2 (3.48) at week 5. The significant difference was evident from week 1 to week 5 but was not significant with T2 in week 1(figure F). The high leave broadness can be attributed to the fact that there was available nitrogen which influenced the rapid vegetative growth of the leaves (Pingali, 2001). The Rhizobium bacteria that lives in the root nodules of legume fix atmospheric nitrogen into the soil. The underlying principle is based on the fact that nitrogen from (T1) can be transported to the leaves in the form of nutrient to increases plant leave sizes (Pingali, 2001). However, it has been shown that when mineral N is depleted in the root zone of the legume component by the non-leguminous intercrops, N_2 fixation of legumes may be promoted

Figure (G)

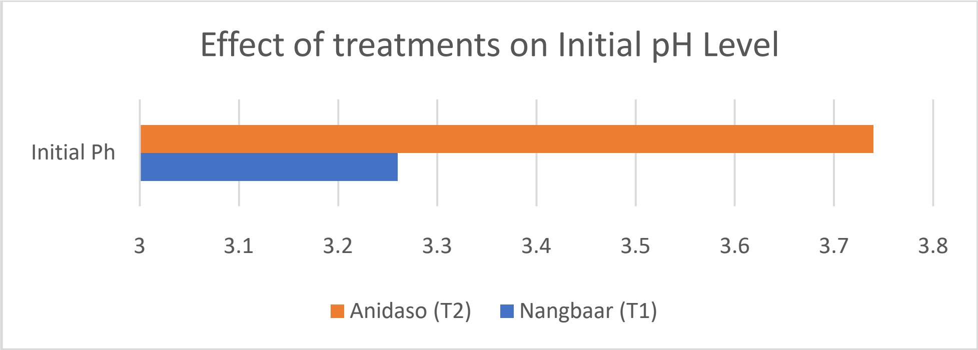
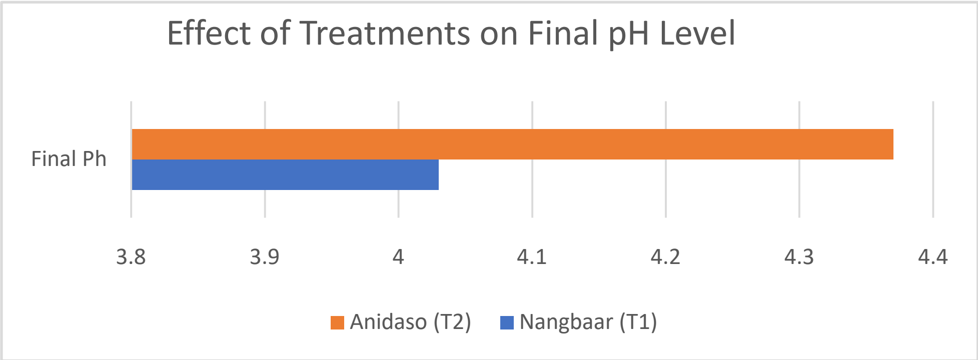


Figure (H)



The graph represents the effect of treatments (N-fixed) on soil pH levels. There was no significant difference between various treatments ($p>0.05$). Treatments were not significant concerning the initial levels of pH of T1 recording (3.26) and T2 recording (3.74). However, T2 recorded the highest pH in the final analysis of 4.34 as shown in figure G and H. T1, recorded the least pH in both the initial and final results. This shows that, treatment T1 introduced high level of acidity into the soil as compared to T2. The nitrogen cycle is a biologically influenced by prevailing microclimate, climatic conditions along with the physical and chemical properties of a particular soil. Both climate and soil varies greatly affecting the nitrogen transformation at different areas (John A Lamb et.al 2014)

Figure (I0

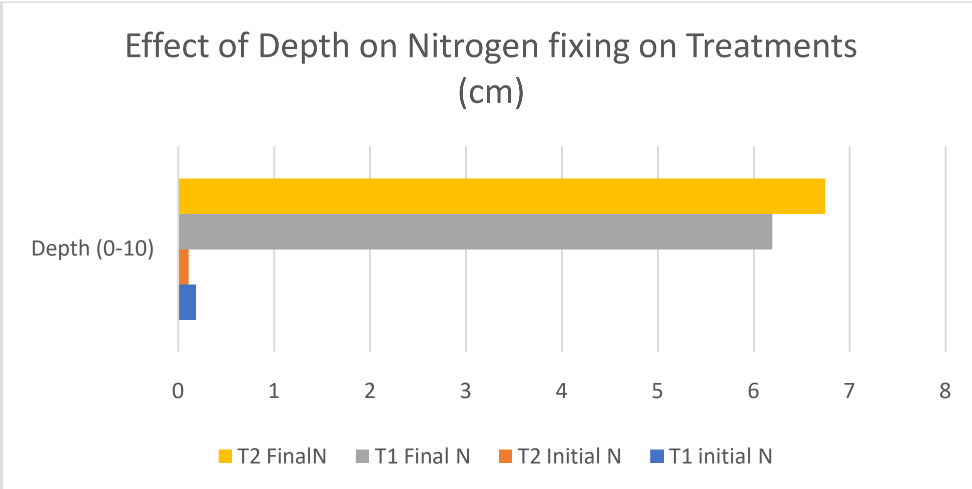
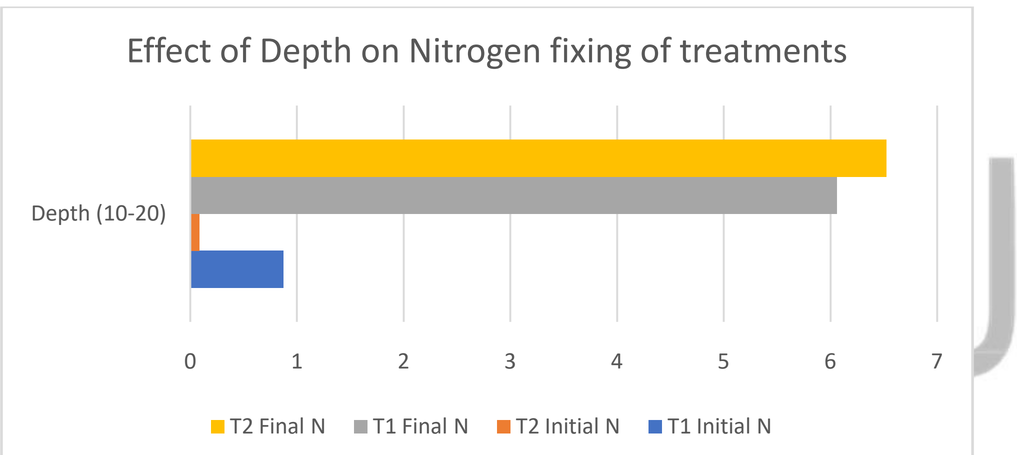


Figure (J)



The graph represents the Nitrogen-fixed in the soil by the treatments according to depth of the soil samples. According to figure I and J there was no significant difference at P>0.05 between N-fixed by various treatments at depth (0-10) cm and (10-20) cm. However, T1 recorded the highest of initials at 10-20cm depth, followed by 0-10cm depth. T1 recorded the least initial and final values on depth 0-10cm and 10-20cm respectively.

Conclusion

It was concluded from the research that, the treatment T2 (Anidaso) had the highest mean values 6.737 and 6.522 in terms of Nitrogen fixed with depth from 0-10cm and 10-20cm as well as most of the growth parameters and showed significant difference from T1 (Nangbaar) which recorded (6.196) and (6.522) respectively. In view of the results, it was recommended that the experiment should be research using different varieties of treatment 1 to ascertain the results. And farmers can use T1 (Nangbaar) as intercrop during cultivation

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