IJIRR

International Journal of Information Research and Review
Vol. 06, Issue, 01, pp.6051-6054, January, 2019

RESEARCH ARTICLE

BIOPESTICIDE AND BIOFERTILIZER EFFECT ON SOME GROWTH PARAMETER OF INDIAN SPINACH AND SOIL PHYSICAL PROPERTIES

***Chime E. U. Nweke I. A., Ibeh C.U. and Nsoanya L.N**

Department of Soil Science, Faculty of Agriculture Chukwuemeka Odumegwu Ojukwu University, Igbariam Campus, Nigeria

ARTICLE INFO

Article History:
Received 17th October, 2018
Received in revised form
29th November, 2018
Accepted 20th December, 2018
Published online 30th January, 2019

Keywords:
Biopesticide, Biofertilizer,
Soil physical properties,
Basella alba and crop production.

ABSTRACT

A potted experiment was carried out on the faculty of Agriculture growth chamber of Chukwuemeka Odumegwu Ojukwu University Igbariam, to evaluate the effects of two biopesticides and Pennisetum biofertilizer on the physical properties of Igbariam sandy loam soil cropped to Basella alba. The experiment was laid out in complete randomized design (CRD) with four treatments and three replications. The treatments were as follows: control soil (Ct), Ginger biopesticide (Gb), Pawpaw biopesticide (Pb), and Pennisetum biofertilizer (PF), with Indian spinach (I).The treatments generally increased total porosity compared with the control. Bulk density and dispersion ratio significantly decreased in all treatments. There was significant inecrease in aeration porosity. Field capacity and plant available water were significantly increased ($p = 0.05$).The treatments generally increased germination percentage compared with the control. Basella alba fresh biomass was significantly increased in all treatments with highest percetage value (341%, 280% and 206%) in treated Pennisetum biofertilizer, ginger and pawpaw leaf biopesticide with lowest value (100%) in control respectively. According to this study using Pennisetum biofertilizer, ginger and pawpaw leaf biopesticide contributed immensely in improving physical properties of soil and also increased plant biomass and biomass component of Basella alba significantly.

INTRODUCTION

Indian Spinach (*Basella alba*) is an edible perennial vine, fast growing which belong to the family Basellaceae (Rathee *et al.,* 2010).The stem is very long, slender, succulent and much branched. Leaves are broadly ovate in shape thick entire with cordate base. Flowers are white or red in colour, sessile in few lax pendunculate spikes. The fruit is small and red or black in colour (Alnieida, 2003). It is an important green leafy vegetables found commonly in the tropical regions of the world. The plant is used as a substitute for true spinach. The plant is an extremely heat tolerant (Grubben and Denton, 2004).it is commonly known as Malabar spinach, Indian spinach, Ceylon spinach, vine spinach, climbing spinach (Sen *et al.,* 2010). Different studies have proved that the plant is rich in vitamin A, C, and folic acid along with flavonoids, saponins, calcium, magnesium, iron, amino acids and medicinal potential (Palada and Crossman, 1999). In Nigeria the leaves are used extensively in the preparation of stew and soups (Olgorite, 2006). Deep coloring matters are obtained from the ripened fruits and it is used for food coloring, pastries or sweets (Rajasab and Mahamad, 2004).

Corresponding author: **Chime E. U.**
Department of Soil Science, Faculty of Agriculture Chukwuemeka Odumegwu Ojukwu University, Igbariam Campus, Nigeria.

Recent studies showed that the increased use of pesticides is responsible for the vanishing population of bees and several other useful insects involved in pollination of flowers of agriculturally important crops (Gill *et al.,* 2012). In a similar study, pesticide exposure raised question on global decline of frog population (Brühl *et al.,* 2013). Even several species of birds have become extinct or are on the verge of it because of the pesticides. It can also be concluded that the negative impact of pesticides is much more than what is visible by the aid of the present technology. Bio-control is the best method to cope with the losses done by the chemicals. Biopesticide is a formulation made from naturally occurring substances that controls pests by non-toxic mechanisms and in ecofriendly manner. Biopesticides are derived from animals, plants and microorganisms which can be harnessed for the management of pests (Mazid *et al.,* 2011). Biopespicides and biofertilizer maintain the health of the soil and promote its life by increasing soil organic matter content. They are biodegradable, economical and biorenewable resources (Radhakrishna, 2010, Akpheokhai *et al.,* 2012, Taye *et al.,* 2012). Biopesticides are not toxic and safer to the beneficial microorganism, human and environment. Thus, the main objective of the study was to examine the effects of two biopesticides and Pennisetum biofertilizer on soil physical properties and growth seedlings of indian spinach (Basella alba).

MATERIALS AND METHODS

Site Location: Potted experiment was conducted at the faculty of Agriculture growth chamber of Chukwuemeka Odumegwu Ojukwu University, Igbariam Campus. The potted experiment was established to evaluate the effect of two biopesticide and *Pennisetum* biofertilizer on the physical properties of Igbariam sandy loam cropped to *Basella alba*. The study area is located at latitudes $5^0$40' and $6^0$46' north, longitude $6^0$40' and $7^0$20' east.the rainfall distribution is bi-modal with a high period of precipitation. The mean temperature is between 28˚C – 37˚C as maximum relative humidity is 78.2% while sunshine stood at 2.8 hours (Igbariam Meteorological Station, 2012).

Potted experiment preparation/ Experimental design and treatment application: Elephant grass *Pennisetun purpurum* was freshly harvested and chopped into pieces. 8kg of pieces grass weighed out and mixed with 8kg of fresh pig dropping at the ratio of 50:50 on weight basis. The two mixed thoroughly together incubated in an airtight container for 2weeks after which it was aerated for 3-4days.The two biopesticides was prepared using fresh pawpaw leaf and ginger rhizome. 1kg pawpaw leaf and 500g of ginger rhizome was grinded respectively. The filtrate was then mixed thoroughly with 5liter of cow urine incubated in two different airtight container of 10liter capacity for 7days after which it was diluted at the rate 1:3 liter of water.4kg of sieved subsoil was weighed out in 12 plastic pots. The dimension of the pot is 17cm × 19cm. The bottom sides of the pot were uniformly perforated to allow adequate aeration and drainage. 350g of treated *Pennisetum* biofertilizer was added and 500ml of pawpaw leaf extract and ginger rhizome extract was added for biopesticides pot and with 500ml of water for control soil.

The potted experiment was laid out in complete randomized design (CRD) with four treatments and three replications. The treatments were as follows:Ct + Bs = control soil + *Basella alba*, G + Bs = ginger biopesticide + *Basella alba*, P + Bs = pawpaw biopesticide + *Basella alba*, F+ Bs = Pennisetum biofertilizer + *Basella alba*. 10seeds of *Basella alba* was uniformly planted at initial and later thinned down to 2plant per stand after 10days of planting. The two plants were monitored for 30days before it was finally harvested. The agronomic parameters studied were plant germination percentage and plant biomass production. At the end of the study, soil samples were collected from each pot, air dried and sieved thoroughly with 2mm mesh, after which physical properties of the soil were determined. Field capacity, Plant wilting point and plant available water was determined by the method of Grewal *et al.,* (1990), Bulk density was determined by the method of McKenzie *et al.,* (2004), Total porosity and Aeration porosity was determined by the method of Flint and Flint (2002). Data generated from the study were subjected to one way Analysis of variance using SPSS version 20, and the mean difference of the effects of the biopesticide and biofertilizer on soil properties and plant biomass were compared using the least significant difference ($LSD_{0.05}$) as described by Obi (2002).

RESULTS

Table 1 shows some physical properties of Igbariam soil at the start of the experiment. The soil was found naturally deficient in soil nutrients and sandy loam. Due to all these deficiencies the soil of this class needs serious improvement which can be actualized by application of biofertilizer and biopesticides. From the data in (Table 2), there is significant effect among the treatments ($P < 0.05$).

Table 1. Some Physical properties of Igbariam soil at the start of the Experiment

Soil Properties	Values
Sand (%)	80.8±6.1
Silt (%)	3.2±0.2
Clay (%)	16.0±3.6
Textural Class	Sandy Loam
Dispersion Ratio (%)	36.0±1.6
Aeration Porosity (%)	11.1±2.3
Total Porosity (v/v)	33.7±4.3
Bulk Density (g/cm^3)	1.9±0.0
Field Capacity (%)	11.9±5.4
Plant Available Water (%)	6.2±0.3

Table 2. Effect of pawpaw leaf biopesticide, ginger biopesticide and *pennisetum*Biofertilizer on physical properties of Igbariam Sandy loam soil cropped to *Basella alba*

Treatments	TP(v/v)	BD (g/cm^3)	DR(%)	AP(%)	FC(%)	PAW(%)	WP(%)
Ct+Bs	33.1±1.4	1.9±0.0	15.3±1.4	11.7±1.9	21.2±0.5	17.0±1.3	4.2±0.5
G+Bs	56.2±1.8	0.9±0.0	8.5±0.1	21.6±1.7	26.2±1.5	22.5±0.5	3.7±0.3
P+Bs	61.1±0.4	0.9±0.0	10.9±0.6	25.7±1.5	34.3±1.2	32.1±1.4	2.3±1.2
F+Bs	75.4±1.2	1.3±0.0	6.8±0.4	29.3±1.3	47.7±1.5	46.2±0.4	1.5±1.1
$LSD_{0.05}$	3.1	0.2	2.6	2.3	3.4	2.8	1.8

Key: Ct = Control, Bs = *Basella alba*, G = ginger Biopesticide, P = pawpaw leaf Biopesticide, *F = pennisetum* bioferticide, TP= Total Porosity, BD= Bulk Density, DR= Dispersion Ratio, AP= Aeration Porosity, FC= Field Capacity, PAW= Plant Available Water, WP= Wilting Point.

Table 3. Effect of pawpaw leaf biopesticide and Pennisetum biofertilizer on the growth of *Basella alba*

Treatment/crop	Germination Percentage (%)	Fresh Biomass @ 30 DAP (g)	Dry Biomass @ 30 DAP (g)
Ct + Bs	67.4±1.7	28.9±1.0	1.0±0.0
G + Bs	71.7±2.2	72.6±0.4	3.2±0.2
P +Bs	83.4±1.3	64.7±0.7	5.2±0.1
F +Bs	88.5±0.5	98.1±0.6	9.4±0.3
LSD0.05	3.2	2.8	1.3

Key:Ct = Control, Bs = *Basella alba*, G = ginger Biopesticide, P = pawpaw leaf Biopesticide, *F = pennisetum* bioferticide.

Ginger biopesticide, Pennisetum biofertilizer and pawpaw leaf biopesticide, cropped to *Basella alba* increased soil total porosity when compared with the result obtained under were no biofertilizer and biopesticide was used. However, ginger biopesticide, and pawpaw leaf biopesticide, cropped to *Basella alba* tend to show greater reduction in dispersion ratio when compared with the control. This indicate that the treated Pennisetum biofertilizer and the two biopesticides increased soil organic matter which help in aggregating the soil colloidal particles together, thereby causing erosion resistance. Generally, the pots with treatments tended to show higher total porosity values compared to the control. Pennisetum biofertilizer, pawpaw leaf and ginger biopesticide generally reduced bulk density in potted experiment which favors early growth of *Basella alba*. Field capacity, aeration porosity and plant available water was significantly increased among the treatments. The result indicates that the two biopesticides and pennisetum biofertilizer greatly influenced field capacity which is very useful for plants growth. Also the result revealed the ability of the amended soil to retain water and make them available for plant growth (Table 3) shows Effect of pawpaw leaf biopesticide, ginger biopesticide and treated Pennisetum biofertilizer on the growth of *Basella alba.* The results revealed that soil treated with pawpaw leaf biopesticide, ginger biopesticide and treated Pennisetum biofertilizer shows significant increased in plant biomass and percentage germination when compared to the control soil ($P<0.05$). The percentage increased in fresh biomass of Basella alba and order of increase with regard to individual treatments were; 341.08% (F+Bs) > 292.911% (G+Bs) > 2713.44% (P+Bs) >100% (Ct+Bs) respectively. Thus, the significant increased of fresh and dried biomass of Basella alba crop in this study help exploring the possible roles of treated Pennisetum biofertilizer and biopesticides on promoting plant growth and productivity.

DISCUSSION

Total Porosity and Dispersion Ratio: Total Porosity and Dispersion Ratio of the soil under different treatments is presented in (Table 2). There was significant effect among the treatments ($P > 0.05$). It is clearly observed that the total porosity was low (100%) for control soil compared to the treated pennisetum biofertilizer, ginger and pawpaw leaf biopesticide treatments: (268.27%), F+Bs (288.67%) G+Bs, (269.91%), P+Bs, respectively. The control soil has the highest percentage of dispersion ratio (100%) whereas pennisetum biofertilizer, ginger and pawpaw leaf biopesticide induced 26.72% and 23.75% reduction of the dispersion ration (Table 2). Suggesting that the treatment enhanced soil aggregation and aggregate stability, According to Brown and Cotton, (2011) showed that application compost resulted in significant increase of structural stability, with the compost treatment being the most efficient. Their results also indicated that the application of pennisetum biofertilizer, ginger and pawpaw leaf biopesticide improved better the structural stability when compared with control. Such behavior might be the result of elevated organic matter content and important microbial activities (Amlinger et al., 2007).

Field Capacity, Aeration porosity and Plant Available Water: Field capacity, aeration porosity and plant available water was significantly different among the treatments. The result indicates that the two biopesticides greatly influenced field capacity which is very useful to plants growth. Noah *et al*. (2010) has also evaluated the effect of compost and inorganic fertilizer on water use efficiency of maize crop. The higher and significant difference that was revealed in crop water demand satisfaction under compost and its related treatment as compared to inorganic fertilizer treated soil indicate that compost media contain more available water than soil treated with inorganic fertilizer. This is because compost and its related treatments increased the organic matter content of the soil and this increased the soil available water-holding capacity (Brown and Cotton, 2011).

Germination Percentage and Plant Biomass: The table shows Effect of pawpaw leaf biopesticide, ginger biopesticide and treated pennisetum biofertilizer on the growth of *Basella alba.* The results revealed that soil treated with pawpaw leaf biopesticide, ginger biopesticide and treated pennisetum biofertilizer shows significant increased in plant biomass and percentage germination when compared to the control soil ($P<0.05$). Thus, the significant increased of fresh and dried biomass of *Basella alba* and *Moringa oleifera* plants in this study help exploring the possible roles of treated pennisetum biofertilizer and biopesticides on promoting plant growth and productivity. According to Laila, 2011, marketable yields of maize were significantly increased by 107 and 124 % due to application of compost at the rates of 5 and 7 ton fed^{-1}, respectively, over that of control treatment. Moreover, compost increases available form of nutrients for plant in soil and then increases root growth and nutrient uptake by plant that results in plant stem height and dry weight rise up. Gamal (2009) also reported that application of 5 ton ha^{-1} compost increased sorghum grain yield by 45% as compared to no compost plots, while the grain yield was higher at composted plots (10 ton ha^{-1}) by 19% than no compost plots in different sites. Suggesting that the treatments promoted growth production and germination rates. These indicate their efficacy in mobilization of plant nutrient in the soil.

Conclusion

Although the use of pesticides has been proven beneficial for crops but decrease the overall fertility of the soil, and has also polluted the environment (Arora *et al.,* 2010). In turn, biofertilizer and biopesticides, like treated pennisetum biofertilizer, ginger rhizome extract and pawpaw leaf extract have not only found to enhanced total porosity, aeration porosity, field capacity, plant available water and maintenance of high aggregate stability and desirable level for soil microbial activity. Ginger, pawpaw leaf biopesticide and treated pennisetum biofertilizer serves as a good source of soil amendments which accounts for *Basella alba* germination percentage increased and growth.

REFERENCES

Akpheokhai, I.L., Cole, A.C. and Fawole, B. 2012. Evaluation of some plant extracts for the management of *Meloidogyne incognita* on soybean (*Glycine max*). *World J. Agric.Sci.* 8(4): 429-435.

Almeida MR. 2003. Flora of Maharashtra Vol. 4.Blatter Herbarium, St. Xavier's College, Mumbai.

Amlinger F, Peyr S, Geszti J, Dreher P, Karlheinz W &Nortcliff S. 2007. Beneficial effects of compost application on fertility and productivity of soils.Literature Study, Federal Ministry for Agriculture and Forestry, Envi.and Water Management, Austria.

Arora, N.K., Khare, E., Maheshwari, D.K. 2010. Plant growth promoting rhizobacteria: constraints in bioformulation, commercialization, and future strategies. In: Maheshwari DK (ed) Plant growth and health promoting bacteria. Springer, Berlin, pp 97–116

Brown S and Cotton M. 2011. Changes in soil properties and carbon content following compost application: results of on-farm sampling. *Compost Science and Utilization*, Vol. 19, No. 1, 88-97.

Brühl, C.A., Schmidt, T., Pieper, S., Alscher, A. 2013. Terrestrial pesticide exposure of amphibians: Anunderestimated cause of global decline? *Sci Rep*3:1135

Flint, L. E and. Filint, A.L. 2002. Pore size distribution. *In:* Dane, J. H. andTopp, G. C. (Co-Eds), Methods of Soil Analysis. Part 4 Physical Methods. Soil Science Society of America, Madison, Wisconsin, USA, Pp. 246-253.

Gamal Abdel-Rahman 2009. Impacts of Compost on Soil Properties and Crop Productivity in the Sahel North Burkina Faso.*American- Eurasian J. Agric. and Envi.Sci,* 6(2): 220 -226.

Gill, R.J, Rodriguez, O.R, Raine, N.E. 2012. Combined pesticide exposure severely affects individual and colony level traits in bees. Nature 491:105–108

Grewal, K.S., Buchan, G.D. and Tonkin, P.J. 1990. Estimating of field capacity and wilting point of some New Zealand soils from their saturation percentages. New Zealand, *Journal of Crop and Horticulture Sci.* 18:-241-246.

Grubben, G.J., & Denton, O.A. 2004. Plant Resources of tropical African Vegetables.Wageningen, Backhuysleiden (CTA). Prota foundation.

Laila K M Ali. 2011. Significance of Applied Cellulose Polymer and Organic Manure for Ameliorating Hydro-physico-chemical Properties of Sandy Soil and Maize Yield.Australian *Journal of Basic and Applied Sciences*, 5(6): 23-35.

Mazid, S., Kalita, J.C, Lul. and Paul,S.K. 2011.A review on the use of biopesticidesin insect pest management.*Int J Sci Adv Technol* 1:169–178

McKenzie NJ, Jacquier DJ, Isbell RF, Brown KL (2004) Australian Soils and Landscapes An Illustrated Compendium**.** CSIRO Publishing: Collingwood, Victoria.

Noah A, Olufunke C, K G Ofosu-Budu, J Ofosu-Animc, K B Laryea & Dionys F. 2010. Effect of N-enriched co-compost on transpiration efficiency and water-use efficiency of maize (Zeamays L.) under controlled irrigation. *Agricultural Water Management*. 97: 995–1005.

Obi, I.U, 2002. Statistical Methods of Detecting Differences between Mean and Research Methodology Issues in Laboratory and Field Experiments 2nd edition. Enugu: *SnaapPress (Nig) Ltd*. 117pp

Olgorite, A. 2006. Genetic relationship between *Basella alba and Basella rubra.WARA Newsletter*, pp. 9: 9-10.

Palada, M.C & Crossman, M.A 1999. Evaluation of tropical leaf vegetables in the virgin Islands. *Perspectives on new crops and new uses, ASHS press, Alexandria, V.A*.pp. 388-393.

Radhakrishnan, B. 2010. Indigenous botanicals preparations for pest and disease control in tea*. Bul. UPASI Tea Res. Found.* 55: 31-39.

Rajasab, A.H, & Isaq, M. 2004. Documentation of folk knowledge on edible wild plants of North Karnataka.*Indian Journal of traditional knowledge,* pp 3:419-429.

Rathee, S, Ahuja, D., Rathee, P, Thanki, M, Rathee, D. 2010. Cytotoxic and antibacterial activity of *Basella alba* whole plant: A relatively unexplored plant. *Pharmacology online*, 3: 651-658.

Sen, K, Goel A, Rawal S, Mahajan N, Baboo S, Alak, S. 2010. Antimicrobial activity of basella alba leaves, *International journal of Research in pharmaceutical and biological sciences,* 1:88-91.

Taye, W., Sakhuja, P.K. &Tefera, T. 2012. Evaluation of plant extracts oninfestation of root-knot nematodes on tomato (*Lycopersicon esculemtum* Mill). *J.Agric. Res. Develop.*2(3): 86-91.

****