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Improvement of Growth and Productivity of Variety *Arachis Hypogea* (l.) With The Use of Poultry Manure and Phosphate Fertilizers In Degraded Soil of Sudano-Sahelean Area, Cameroon

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Abstract

In Sudano-sahelean area, the crops management on a degraded soils are majority restored by the uses of organic matter mostly in the context that farmers encountered face to the high cost of chemical inputs. The present work is the part of the evaluation of organic and phosphates fertilizers on the growth and yield of the variety peanut “Manipentar” in Sudano-sahelean area. It is conducted at the site of Polyvalente Station of Agricultural Research of North-Cameroon. The experiment consisted initially in evaluating different fertilizers such as the organic and phosphate fertilizer on the growth and yield of variety “Manipentar” of *Arachis hypogea* (L.). Treatments were: **T0** = control; **T1** = poultry manure; **T2** = superphosphate (46 % P); **T3** = poultry manure + superphosphate (46 % P). The experimental setup is a randomized block with 3 repetitions. The parameters evaluated were: the germination rate, the height of the ramification at 90 DAS, the weight of seeds plants. The results show that the germination rate was important with the use of the association of poultry manure + superphosphate. The apply of fertilizers types such as the poultry manure and the combined effect of poultry manure + superphosphate were significant ($P \leq 0.05$) on the height of Peanut variety “Manipentar” compared to control plots. The number of leaves emitted by this variety were significant ($P \leq 0.05$) with the use of poultry manure and the combined effect of poultry manure + superphosphate treatment compared to control plots. The number of ramifications per plants was more significant ($P \leq 0.05$) with the supply of all treatments during the development. Concerning the weight of 100 seeds per plants, the poultry manure and superphosphate treatment were significantly ($P \leq 0.05$) suitable compared to control.

Key words: Arachis hypogea, Fertilizers types, Variety, Yield, Sudano-sahelean zone.

Introduction

Since several years, the intensive management of agriculture has criticized due to degradation causes to environment, particularly on soil (Adjanohoun *et al.*, 2017). Intensive uses of chemical fertilizers have favored the environment pollution (Goalbaye *et al.*, 2016). Face to these different constraints (demographic pressure, soil washing, lack of fallow, lack of use of resistant plants to dryness, absence of polyculture strategies), an improvement of agricultural technology in order to increase productivity of cultures is necessary. As a result, the best perspective allowing to enhance agricultural productivity of cultures comes by the knowledge and use of specific fertilizers to need of plant.

Arachis hypogea (L.)) is an annual plant of the family of Papilionaceae (Fabaceae). Also considered like leguminous plant, it is used as income of resources and food for subsistence in many habits of populations (Betdogo *et al.*, 2015; Wang-Bara *et al.*, 2022). These leguminous is capable to fix atmospheric nitrogen (N_2) of air by symbiosis association with bacteria (*Rhyzobium sp.*) and favor soil restauration (Akanza *et al.*, 2020; Hamidou *et al.*, 2018). Soils quality and productivity of cultures are improved by the decomposition of residues of these cultures. In the same, these residues of cultures are rich in nutrient elements (Akanza *et al.*, 2020; Gbakatchetche *et al.*, 2010). Their leaves considerably rich in phosphorous, are most consumed by animals in dry season (Betdogo *et al.*, 2015; Wang-Bara *et al.*, 2022). Starting from principal idea where our land has been constantly degraded physically at a time due to erosion, biologically due to their bad use and chemically by their overexploitation. Some minerals nutrient elements of cultures as phosphorous, organic carbon are found at a reduced content and we will have acidification phenomenon associated to appearance of toxic elements as aluminum (Chabalier, 2003; Rahajaharitompo, 2004).

However, several researchers observed positive effect of leguminous on availability of phosphorous and biological restauration of degraded soils (Amadji and Aholoukpe, 2008). Roles of roots exudates of leguminous were mostly elucidate for justify their capacity to increase the availability of P in the soil (Subbarao *et al.*, 1997). These roots exudates would be able to solubilize phosphates of calcium and present phosphorous in increasing thus bioavailable of phosphorous (Amadji and Aholoukpe, 2008). But, among the multiples problems that facing agricultural productions: accessibility to phosphorous, efficiency of fertilizers used for food culture, soils poverty in majority acid (aluminums toxicity) and law

content in available phosphorous, it would be important to have a knowledge on good methods of fertilization based on the use of phosphorous fertilizers indispensable for food cultures in degraded soil.

Phosphorous is one of major elements that plants needs during their development (Rahajaharitompo, 2004; Balzergue, 2012). According to the works of Vance et al. (2003), this element is most frequent or as limiting factor for growing and development of plants. Their presence in soil is important for the growth and the productivity of plant, because it is contributed most on a good roots development, fructification and seeds formation (Balzergue, 2012). The needs of plant on phosphorous element are in small quantity, but their presence is important during the start of growth stages of plants (Schiffers, 2011). Near to this important element, we have the organic fertilizers through the poultry manures substrate, which by their presence on soil may easily improve the soil structure, growth of crops and the incorporation of organic matter more or less decomposed. It is playing also an important role in the restoration of degraded soils, improves soils fertility by releasing nutrients element and accelerate the decomposition process (Rahajaharitompo, 2004; Wang-Bara *et al.*, 2022). Nowadays, in the context of the decreases of production on the degraded soils on this locality, climate change which influence on the growth of vegetation and the increase of fertilizers prize, the study focuses on improvement of growth and productivity of the variety of Peanut (*Arachis hypogea* (L.)) by the use of organic fertilizers and phosphate fertilizers. The main objective of this study is to evaluate combined effect of poultry manure and phosphate fertilizers on the growth and yields of the variety of Peanut in a degraded soil of Sudano-sahelean area of Cameroon.

I. Materials and methods

I.1 Description of the site

The study was realized on the site of Polyvalent Station of Agricultural Research of North of Cameroon. The area is covered by the Sudano-sahelean climate type, characterized by 2 seasons: a rainy season from May to September period, with heavy rains from July to August, followed by a cold season (October to January) and a warm dry season (February to April). Temperatures range from 30°C to 40°C. The vegetation in the area is dominated by *Butyrospermum parkii*, *Tamarindus indica*, *Balanites aegyptiaca* and herbaceous. The main cultivated crops are Millet (*Pennisetum glaucum*), Sorghum (*Sorghum bicolor*), Maize (*Zea*

mays), Peanut (*Arachis hypogea*), Fonio (*Digitaria sp*), Cowpea (*Vigna unguiculata*), Bambara groundnut (*Vigna subterranea*).

I.2 Vegetal materials

For this experience, two seeds of peanut were collected from the locality of the north, Cameroon. These varieties are considered like late with the cycle of development around 80 to 100 days (**Figure 1**).

Figure 1: Peanut variety "Manipentar"

I.3 Fertilizers used

The fertilizers used are constituted of recommended superphosphate fertilizers (45 % P) of dose 100 kg and chicken manure in reason of 70g per units of 9 m^2. The application dose of superphosphate fertilizers (46 % P) is 1.2 kg per unit on field for the peanut culture. The organic manure as chicken manure is used on a reason of 70 g per plants for the density of 76 plants per unit. The quantities of 5 kg of chicken manure were applied per unit which receives this substrate.

I.4 Experimental design

The experimental design was a block completely randomized with 3 repetitions and fourth treatments including control (T0), poultry manure (T1), superphosphate (46 % P) and poultry manure + superphosphate at 46 % P (T3). Every block is divided in sub-blocks arranged at the distance of 0.5 and each unit measure 3 m x 3 m= 9 m^2. Before sowing, soil was labor at 25 cm of depth. Sowing process was done two weeks after with 40 cm of distances between lines and 20 cm between pockets. The total number of plants per unit was 76. The seeds were sowed in the soil approximatively at 5 cm of depth and weeds were sprayed in every unit considered.

I.5 Treatments

The applied quantities of different substrates (poultry manure and mineral fertilizers) were measured with a scale and presented on the **Table 1**. Treatments are control without any substrate (T0), poultry manure (T1), superphosphate (T2) and the association of substrates (T3).

Table 1: Applied treatments and control.

Treatments	Doses
Control (T0)	0 kg
Poultry manure (T1)	5 kg
Superphosphate at 46 % P (T2)	1.2 kg
Poultry manure + Superphosphate at 46 % P (T3)	5 kg+1.2 kg

Before sowing, 5 kg of organic manure (poultry manure) were applied on all units which receives poultry manure per pockets. However, phosphate fertilizers types (46 % P) were applied in reason 1.2 kg on units which receives phosphate fertilizers 2 weeks after sowing.

I.6 Parameters assessment

I.6.1 Growth parameters

The growth of plants such as the height of plants and the number of leaves were collected on 15 plants by counting for each treatment at the interval of 10 days, on four sampling campaigns, 40^{th} DAS, 50^{th} DAS and 60^{th} DAS.

I.6.2 Ramification at 90 DAS

The plant ramification was evaluated at 90 DAS by counting number of ramifications on every plant reference of 15 plants for every treatment and control plots during the maturity of plants.

I.6.3 Yields of plants

I.6.3.1 Numbers of pods

The number of pods per plants were counted on 15 plants after harvest process for all treatment and control plots at the maturity of plants.

I.6.3.2 Weight of seeds

For each treatment and control, 100 seeds in total were weighed with an electronic scale (2000*0.1g), in order to determine if the effect of different substrate influence yield of these varieties.

I.6.4 Statistical analysis

Data of growing and yields were performed using ANOVA test with software R-cmdr. Significances average separation were done with the test of Tukey at the probability of 5 %.

II. Results and discussions

II.1 Height of plants

The **Figure 2** indicate the results obtained of three different fertilizers types on the height of plants. Compared to non-amended plots (T0), a significant difference (P≤0.05) was observed on the values of superphosphate supply (T3) and poultry manure (T2). The highest value on height of plants was recorded by the supply of superphosphate (2.05 cm), followed by poultry manure treatment (1.90 cm).

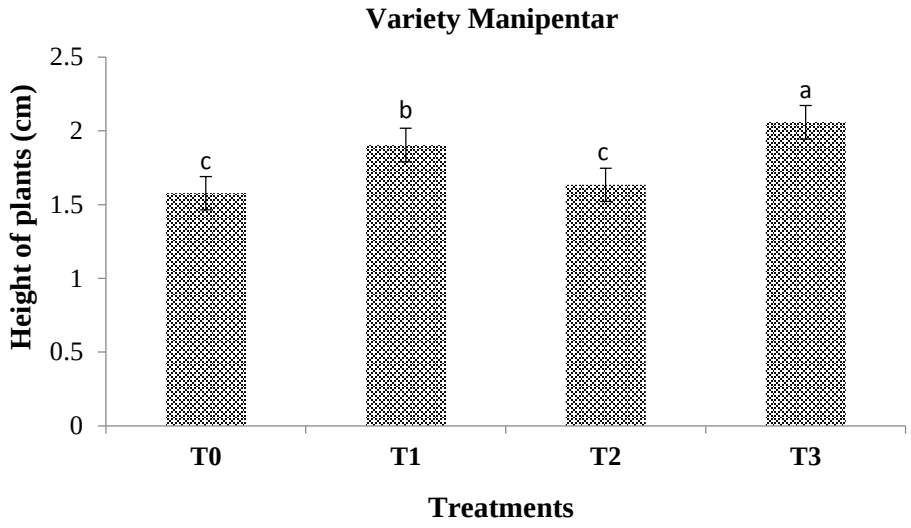

Figure 2: Height of plants during the growth (P≤0.05; **T0** = control; **T1** = poultry manure; **T2** = superphosphate (46 % P); **T3** = poultry manure + superphosphate (46 % P)).

II.2 Number of leaves

The **Figure 3** resume the effect of different fertilizers used on the appearance of the number of leaves of plants. A significant difference (P≤0.05) was observed on the values on superphosphate supply (T3) and poultry manure (T2), compared to the non-amended plots. The highest value of the density of leaves emitted per plants was recorded by the supply of superphosphate (67), followed by the poultry manure treatment (63).

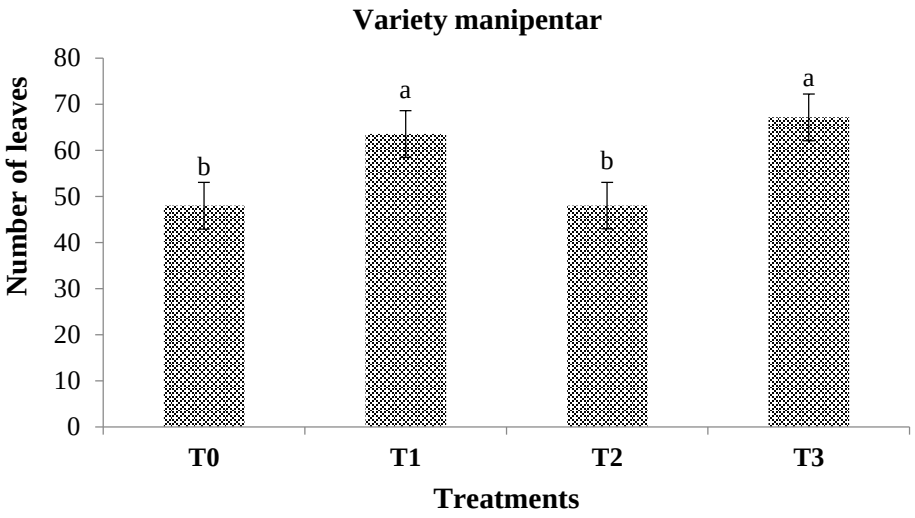

Figure 3: Number of leaves during the growth (P≤0.05; **T0** = control; **T1** = poultry manure; **T2** = superphosphate (46 % P); **T3** = poultry manure + superphosphate (46 % P)).

II.3 Number of ramification at 90 DAS

The **Figure 4** illustrate the results obtained of three different fertilizers on the number of ramification of plants during the development cycle of the variety. A significant difference (P≤0.05) was observed on the value of the use of combined substrates (T3), on superphosphate (T2) and the poultry manure treatment (T1), compared to the non-amended plots (T1). The highest value of the vegetative cover of plants was recorded by the use of the combined effect of both treatment (13) and superphosphate (13), followed by the poultry manure supply (10).

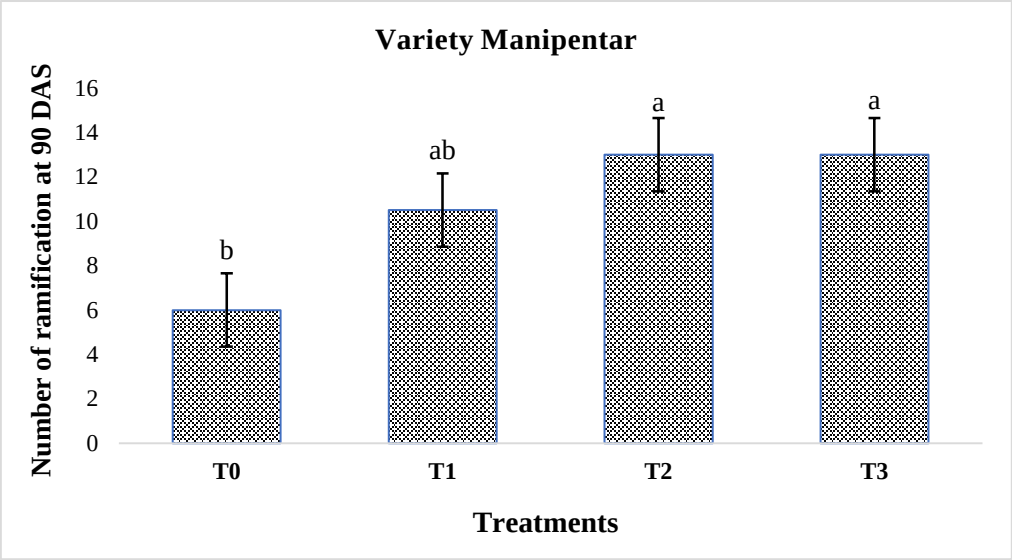

Figure 4: Number of ramifications during the growth (P≤0.05; **T0** = control; **T1** = poultry manure; **T2** = superphosphate (46 % P); **T3** = poultry manure + superphosphate (46 % P)).

II.4 Weight of 100 seeds

The **Figure 5** resume the results obtained of effect of three different fertilizers on the weight of 100 seeds after harvest of plants. Compared to non-amended plots (T0), we recorded a significant difference (P≤0.05) for the use of superphosphate (T2) and the poultry manure treatment (T1). The highest value of the weight rate of 100 seeds was recorded by the use of superphosphate (34 g), followed by the poultry manure treatment (33 g).

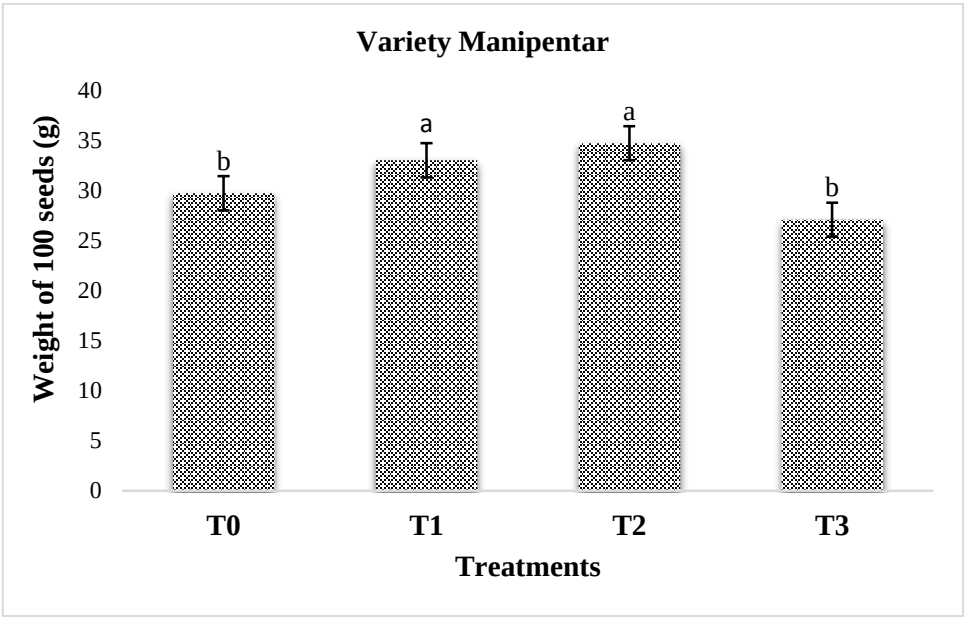

Figure 5: Weight of 100 seeds (P≤0.05; **T0** = control; **T1** = poultry manure; **T2** = superphosphate (46 % P); **T3** = poultry manure + superphosphate (46 % P)).

Discussions

This study demonstrated the effect of organic and superphosphate fertilizers to improve the growth and yield of variety *Arachis hypogea* "Manipentar" on a degraded soil of Sudano-sahelean area. The growing and yield parameters were improved with the use of different types of fertilizers. It is therefore appearing that the poultry manure and the association of poultry manure + superphosphate treatment has a significant influence on the height of plants of this variety. Our works corroborate with the works of Lee et al. (2004) and Metouchi and Yahia (2020) which demonstrated the beneficial effects of organic matter on the vegetative growth of *Lactuca sativa* (L.). That is due to the biological and physico-chemical improvement of soils (Houot *et al.*, 2009). The use of phosphate fertilizers in high proportion on Maize culture significantly improve the height of plants compared to non-amended plots (Nsiku *et al.*, 2019). Also, the results of Metouchi and Yahia (2020) proved that organic fertilizers have a positive effect on vegetative growth of *Phaseolus vulgaris* and suggests that within the sites, where organic matter is present in high proportion, the plants have a good development.

Indeed, the number of leaves emitted were most important with the use of superphosphate and poultry manure compared to non-amended plots. We can suggest that, within the poor soils due to the intensive cultures without rotations of crops, the availability of nutrients elements for plants is low and the productivity of cultures decreases. The aim of phosphate fertilization is to supply the need of plants on P element according to the yield and quality and so to complete soils incomes for a good production (UNIFA, 2005). The works of Tchaniley et al. (2020) showed that the growing of *Lactuca sativa* plants were suitable with the supply of poultry manure associated to the mineral fertilizers. According to Metouchi and Yahia (2020), the Cowpea plant has a good development with the use of organic manure like sources of incomes nutrients elements (Iron, Manganese, Copper, Zinc, Boron).

The ramification of plants was most suitable with the supply of poultry manure, superphosphate and both substrates compared to non-amended plots. The use of different substrate favors a good growth of plants and the vegetative recover. We note that the good effect of fertilizers types on growing of plants. According to the works of Metouchi and Yahia (2020), the supply organic matter favors a good vegetative cover of *Phaseolus vulgaris* (L.). The importance of phosphorous fertilization of cultures could be estimated during the phases of production of plant which is more manifest by the development of plant organ

(Andriamaniraka, 2009). Same results were also found by Tchaniley et al. (2020), which obtained a good diameter and a suitable vegetative recover of plants of *Lactuca sativa* (L.).

The weight of 100 seeds was significantly increased in poultry manure and superphosphate treatment compared to control plots. However, similar studies by Gomez et al. (2006) and Mannix et al. (2001) with high quantities of poultry manure revealed positive effect of poultry manure on peanut yield. According to these authors, the mineralization of organic manure and the activities of telluric microflora favor a good improvement of the productivity of plants. Soils amendments by the high quantities of phosphorous significantly increase the pods weight in maturity (Hamidou *et al.*, 2018). According to the works of Razafindramboa (2015), the fertilization with phosphorous improve the yields of *Phaseolus vulgaris* (L.). In a deficiency of nutrient element such as P and N of soil, the culture of peanut is most beneficial for cereals (Hamidou *et al.*, 2018). The phosphorous element is important for the production of fruits, that mean the incorporation of poultry manure is more suitable in phosphorous which permit a good fructification and maturation of pods (FAO, 2004).

Conclusion

The results of our works on improvement of growth and productivity of the variety *Arachis hypogea* "Manipentar" in degraded soil of the of Sudano-sahelean area showed that the use of poultry manure and superphosphate fertilizers most improves the height of plants peanut compared to control plots. However, the number of leaves were most significant ($P \leq 0.05$) with the use of poultry manure and the combined effect of superphosphate + poultry manure referred to control plots. The vegetative recover of plants (ramification) was more observed with the applied of poultry manure and superphosphate substrates compared to non-amended plots. The weight of 100 seeds was significant with the amendment of poultry manure and superphosphate substrates after harvest processes of cultures.

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