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Evaluation of soils fertility, growth, nutrient uptake and yield traits of peanut under indigenous and effective microorganism fertilizers in sandy ferralitic soils in Douala, Cameroon

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Soil fertility, growth, nutrient uptake and yield traits of peanut (*Arachis hypogaea* L. var. JL24) were investigated under two organic fertilizers (indigenous microorganisms (IMO) or effective microorganisms (EM) with three replications. Application of IMO or EM fertilizers had significant effects on soils fertility compared to untreated soils. Total nitrogen, organic carbon, total phosphorus, calcium and magnesium led to a significant increase under organic fertilizers. IMO fertilizer supply at 20 g significantly increased the shoot length and the number of leaves compared to the EM fertilizer and untreated plants. In contrast, the highest values of stem diameter and leaf area were recorded at 40 g of EM supply. The highest values of pod (1.25 and 1.18 t/ha) and grain yield (0.96 and 0.98 t/ha) were recorded at 10 and 20 g for IMO and EM, respectively. Application of EM and IMO at 10 or 20 g led to a significant increase in nitrogen and phosphorus contents in leaves and roots with the highest accumulation of nitrogen at the roots level of treated plants. Nitrogen and proteins contents of peanut seeds were positively influenced by IMO and EM supply at 10 and 20 g, respectively. The use of IMO and EM fertilizers could enhance peanut growth performance in sandy ferralitic soils.

Key words: Field performance, plant growth, fertilizers, yield traits, *Arachis hypogaea.*

INTRODUCTION

Peanut (*Arachis hypogaea* L.) plays an important role in human and animal nutrition (Briend, 2001). In fact, its

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seeds consist of approximately 45-50% of lipids, 25-30% of proteins, 5-2% of carbohydrates and 3% of fibers (Griel et al., 2004). These nutritive values have been used in the composition of foods with high nutritional value (Briend, 2001). In addition, it would also reduce the risk of cardiovascular disease (Fraser 2000; Albert et al., 2002). The world's twelfth crop production, peanut is a legume grown on all five continents, and in about 120 countries (Ntare et al., 2008). It is the sixth most important oilseed crop in the world (FAO, 2003a). It occupies a total area of 24.6 10^6 ha for a production of 38.2 10^6 t. Africa, although the second largest continent in terms of peanut production, has the lowest yields per ha with an average of 1 t/ha, compared to Asia (1.8 t/ha) and America (3 t/ha) (Foncéka, 2010). In Cameroon, peanut in 2006 covered an area of more than 236 951 ha for an annual production of 414 046 t, with a yield of 1.74 t/ha (FAO, 2003b), compared to an area of 455 692 ha with an annual production of 635 947 t for a yield of about 1.4 t/ha in 2014 (FAO, 2015). Despite its importance, the peanut sector is experiencing a persistent decline in production due to the decline in soil fertility (Meguekam, 2016).

The development of soil fertility management options in order to increase the productivity of stable food crops is a challenge in most parts of sub-Saharan Africa, where soils are constrained by nitrogen, phosphorus and potassium deficiencies (Taffouo, 1994; Manu et al., 1991; Jemo et al., 2010). Adequate soil supply of nitrogen is beneficial for carbohydrates and protein metabolism, and it promotes cell division and cell enlargement of plants (Shehu et al., 2010). The availability of nitrogen is the primary limiting factor of productivity in most natural and managed soils (Aerts and Chapin, 2000). Although some plants rely on nitrogen organic form (Ohland and Nasholm, 2004), most nitrogen is supplied to plants through ammonification and nitrification (Chapin et al., 1987). Nitrification plays a major role in cultivated soil. NO_3^- is mobile and circulates with the solution of the soil towards the roots of the plant (Mantelin and Touraine, 2004). Protein biosynthesis occurs as a result of direct transfer of N from the roots towards the leaves of plants (Taffouo et al., 2014). However, phosphorus is one of the least available nutrients in many aquatic and terrestrial ecosystems, and plant-available phosphorus deficiency is a main feature of many soils in Sub-Saharan Africa (Buresh and Smithson, 1997). Under these conditions, many farmers lack the means to purchase adequate amounts of fertilizers to either correct low levels of soil phosphorus or replace the phosphorus depleted by plant harvest at maturity (Gweyi-Onyango et al., 2005).

Chemical fertilizers have long been considered as a necessary solution capable of replacing the natural fertility of the soil. Although they are effective, they are difficult to access, with many constraints such as being very expensive to purchase, pollution, and the increased resistance of many pathogens to commonly used doses of chemical fertilizers (Janny et al., 2003). For sustainable development, it is necessary to change behavior and innovate by proposing new ways of producing new cropping systems based primarily on natural processes to meet both the need for food security and the need for a more balanced management of natural resources. Much research has focused on the biology of microorganisms that influence rapid mineralization of organic matter (Higa, 1996). Indigenous microorganisms (IMO) and effective microorganisms (EM) constitute a nutritive reserve source. Their roles as mineralizers increase soil fertility, while making them less subject to compaction and erosion (Narasimha et al., 2012). IMO consists of indigenous microorganisms trapped in the culture zone composed mainly of bacteria, fungi and yeasts. EM is a commercial solution of effective microorganisms consisting mainly of bacteria and yeasts (Helen et al., 2006). Data to justify their use in crops in Cameroon are deficient.

The objective of this study was to evaluate the impact of organic fertilizers based on indigenous microorganisms on peanut productivity in the coastal region of Douala. In addition, the objective is to analyze the physico-chemical characteristics of the soil before and after application of fertilizers in order to determine the fertility of the soil, and evaluate the impact of the inoculation of these microorganisms on the growth and yield of peanut in the field.

MATERIALS AND METHODS

Description of the study site

The study was conducted in the coastal region of Cameroon in the experimental field of the University of Douala during 2018 and 2019 cropping seasons. The study site (Figure 1) is located on the geographic coordinates of 4°01’ North latitude and 9°44’ East longitudes. The altitude is about 13 m. The rainfall of the zone is of the equatorial type of a particular type called "Cameroonian". It is characterized by two seasons with a long rainy season (about 9 months) that runs from March to November and a short dry season that runs from December to February. The average monthly rainfall varies from 55 mm in December to 800 mm in August with an annual average of 4 129 mm. The monthly temperature ranges from 24.8°C in July and August to 27.7°C in February with an annual average of 26.4°C. Relative humidity ranges from 62.3% in May to 88.6% in August with an annual average of 78.3% (Meguekam, 2016).

Experimental design and procedures

One selected variety of peanut (JL24) and two organic fertilizers with Indigenous microorganism (IMO) and Effective microorganism (EM) manures were used in a randomized completely block design with three replications. This drought tolerant variety was provided by IRAD Maroua, Cameroon. Before sowing, the seeds were sorted, only healthy and homogenous seeds were chosen. The seeds were then sterilized with 5% sodium hypochlorite solution by soaking for 5 min. Then, they were thoroughly rinsed with sterile distilled water under aseptic conditions. Seeds were sown at a

Figure 1. Map showing location of the study area.

Table 1. Physical properties of the soil (0-20 cm).

Parameter	Units	Value
Texture	-	Sandy loam
Clay	%	14.20 (1.20)[a]
Coarse sand	%	27.90 (2.10)
Fine sand	%	25.60 (1.80)
Coarse lime	%	26.00 (1.60)
Fine silt	%	6.30 (0.50)

[a]Values in parenthesis represent the standard error of the mean.

depth of 3-5 cm, and one seed per hole. IMO was prepared according to the method of Park and Du Ponte (2008) using local materials while EM was prepared according to the method of Higa (1991). A piece of land 20 m by 20 m was cleared, raked and ridges of 5 m by 0.75 m were formed. The experimental plots were enriched with 0, 10, 20, 40g of EM and IMO fertilizers. The main factor was the variety of peanut used (JL24) and the secondary factor was the treatments (doses). The size per plot was 4 x 2 m. The spacing between plots was 1 m and 0.5 m between sub-plots and 0.4 m between peanut plants. The weeds were removed manually to avoid nutritional competitions.

Determination of soil physical and chemical properties

Soil samples were taken using auger from the experimental site from a depth of 0 to 20 cm. Twenty sub-samples were chosen to get a composite sample for the analysis of soil physical (Table 1) and chemical properties before and after application of both IMO and EMO (Table 2).The sampling technique used was zigzag sampling. Twenty subsamples were collected and carefully mixed to form a composite sample. These soil samples were analyzed in the soil and plant laboratory of IRAD Nkolbisson. Samples of soil were collected at a depth from 20 to 30 cm of soil from the study site,

Table 2. Chemical properties of soil before and after organic fertilizers application (0-20 cm).

Parameter	Units	T0	T1	IMO	EM
Nitrogen	%	0.32 (0.01)[a]	1.82 (0.05)	2.76 (0.07)	2.01 (0.02)
Organic C	%	0.75 (0.05)	2.69 (0.09)	2.92 (0.06)	4.24 (0.08)
ratio C/N	-	2.34 (0.02)	1.47 (0.04)	1.06 (0.03)	2.10 (0.06)
Phosphorus	ppm	4.60 (0.10)	19.07 (2.16)	24.90 (3.10)	58.00 (4.01)
Ca^{2+}	(g/kg)	0.23 (0.01)	0.68 (0.03)	1.49 (0.07)	1.83 (0.06)
Mg^{2+}	(g/kg)	0.17 (0.01)	0.14 (0.01)	0.27 (0.03)	0.38 (0.05)
pH - water		6.45 (0.10)	5.98 (0.12)	5.86 (0.09)	5.89 (0.11)

[a]Values in parenthesis represent the standard error of the mean. T0: Control before application of organic fertilizers; T1: Control after application of organic fertilizers.

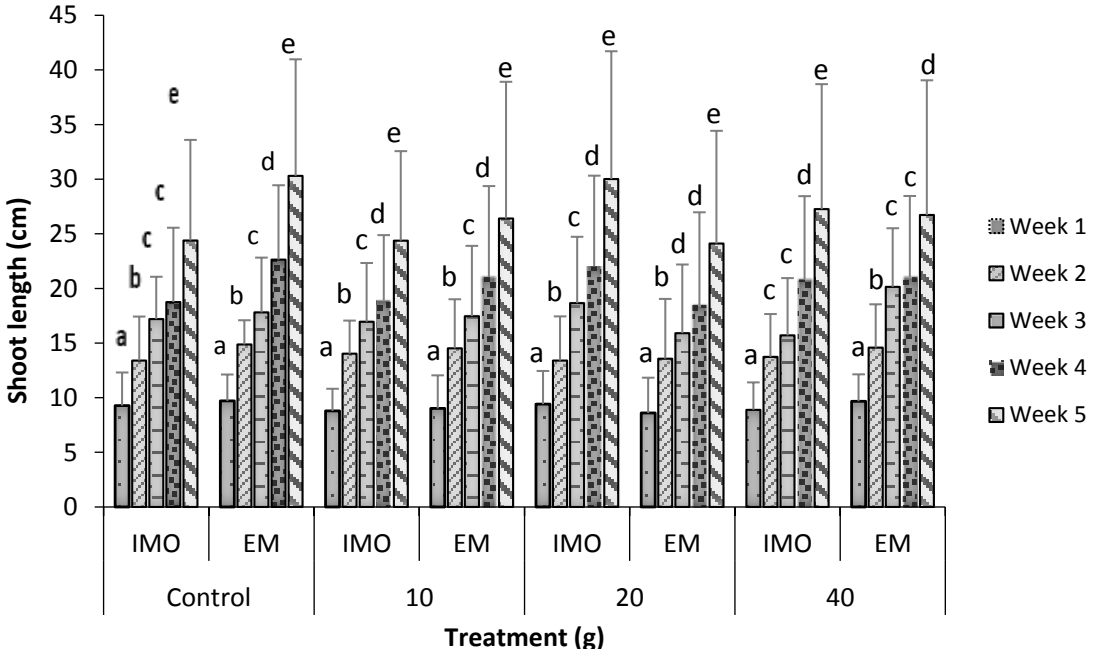

Figure 2. Effect of IMO and EM fertilizers on shoot length of *Arachis hypogaea* (10 WAS). Means followed by the same letter are not significantly different (P <0.05) as determined by Duncan test. Bars indicate standard deviation.

recovered in sterile plastics and then it was taken to the laboratory, dried using ambient temperature for 72 h. It was sieved using 2 mm sieve. The sample was ready for the physical and chemical analyses. The physical properties were basically the soil texture which was constituted essentially by determining the rate of clay, fine silt, coarse silt, fine sand and coarse sand according to the relative proportion of clay, silt and sand. The following chemical analyses were done to the soil: Organic carbon (C) was determined using humid oxidation procedure (Walkley and Black, 1934) and total nitrogen (N) by Kjeldahl method. Magnesium (Mg) was extracted using Mehlich 3 method and determined by Technicon autoanalysers (Technicon 2). Total available phosphorus (P) was determined by Okalebo et al. (1993) method. The pH of the soil was measured potentiometrically in the supernatant suspension of a 1:2.5 soil to water ratio using a pH meter. Calcium (Ca) was determined using a flame photometer (JENWAY) as described by Taffouo et al. (2017) and Cation Exchange Capacity (CEC) using standard procedure of Gregorich and Carter (2007).

Plant sampling and determination of growth and yield characteristics, nitrogen, phosphorus and protein contents

The plants were sampled at complete maturity 10 weeks after sowing (WAS), for their shoot length, stem diameter, number of leaves per plant, leaf area, number of nodules and yield components such as number of pods per plant, 100 seeds weight, pod yield and seed yield (Figures 2, 3, 4, 5 and 6; Table 3). Ten plants from which measures of shoot length, stem diameter, number of leaves per plant and leaf area were taken periodically 4, 8 and 10 WAS were identified randomly per plot. The shoot length and stem diameter were measured using a tape and vernier caliper, respectively. The leaf area (S) of the seedling was determined by measuring the length (L) and width (l) of the leaves with a ruler and

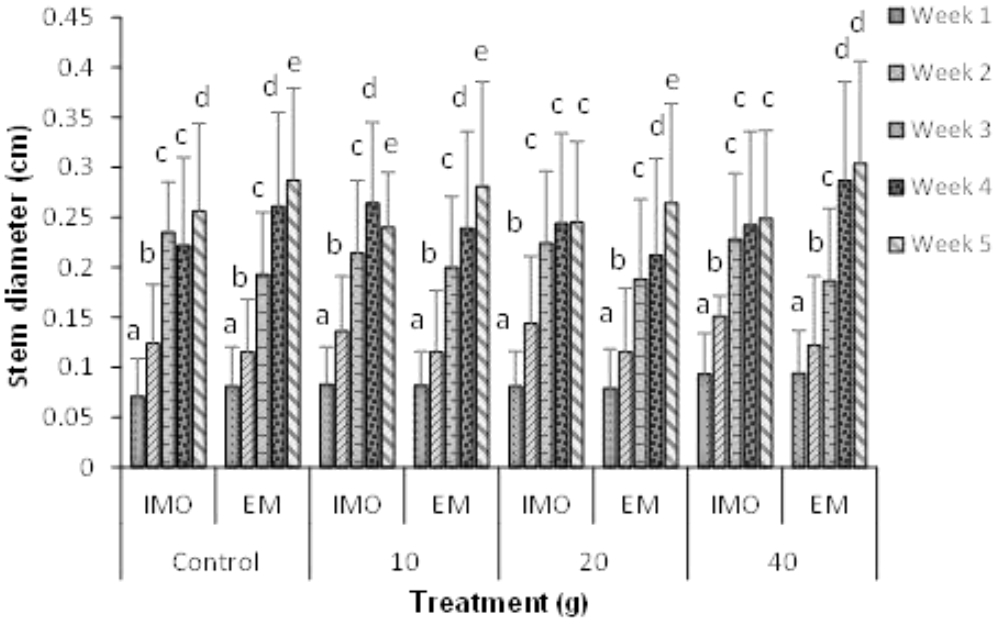

Figure 3. Effect of IMO and EM fertilizers on stem diameter of *Arachis hypogaea* (10 WAS). Means followed by the same letter are not significantly different (P <0.05) as determined by Duncan test. Bars indicate standard deviation.

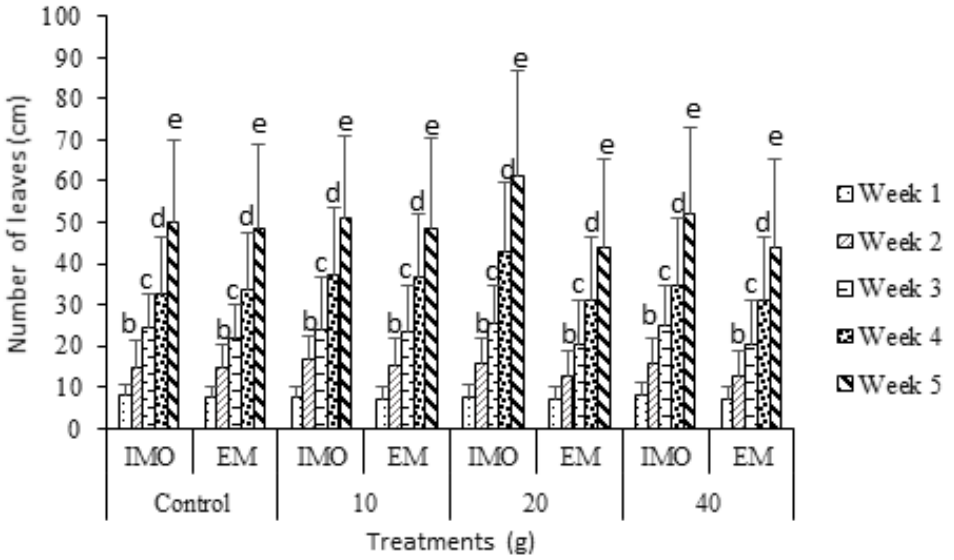

Figure 4. Effect of IMO and EM fertilizers on the variation of the number of leaves of *Arachis hypogaea* (10 WAS). Means followed by the same letter are not significantly different (P <0.05) as determined by Duncan test. Bars indicate standard deviation.

calculated according to the formula described by Kumar et al. (2002) where S = L x l x 0.80 x N x 0.662 (cm^2) with N the total number of leaves. The number of nodules was counted after uprooting one groundnut plant on each plot 10 WAS. At harvest, the yield parameters such as number of pods per plant, 100 seeds weight, pod yield and seed yield were recorded. For quantifying leaf and root nitrogen, phosphorus and protein contents, ten plants were also randomly selected in each plot, and their leaves and roots were cut; their fresh weight was registered. A representative sub-sample of about 1000 g per plot was dried in an oven at 70°C for 72 h in order to determine its dry weight. The determination of nitrogen (N) content in the roots and leaves was carried out according to the

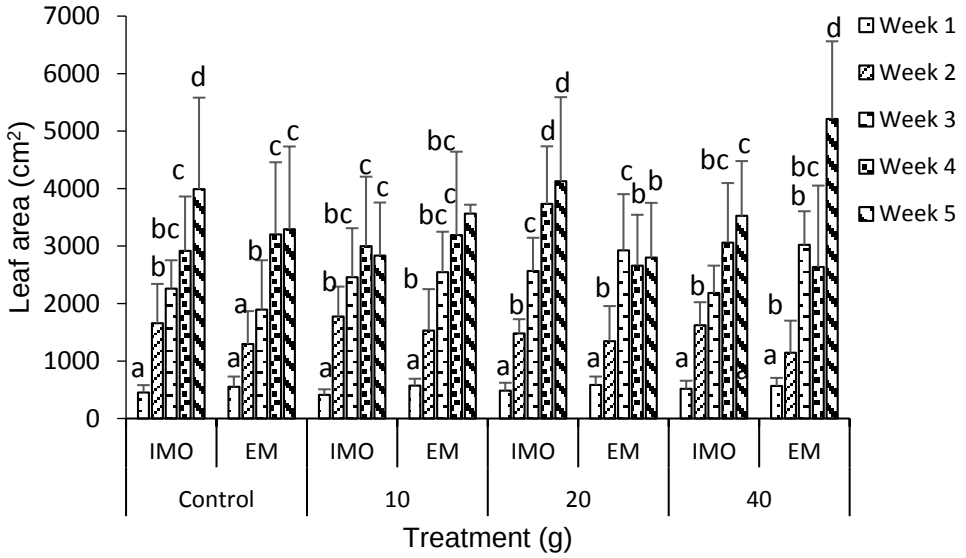

Figure 5. Effect of IMO and EM fertilizers on the variation of the leaf area of *Arachis hypogaea* (10 WAS). Means followed by the same letter are not significantly different (P <0.05) as determined by Duncan test. Bars indicate standard deviation.

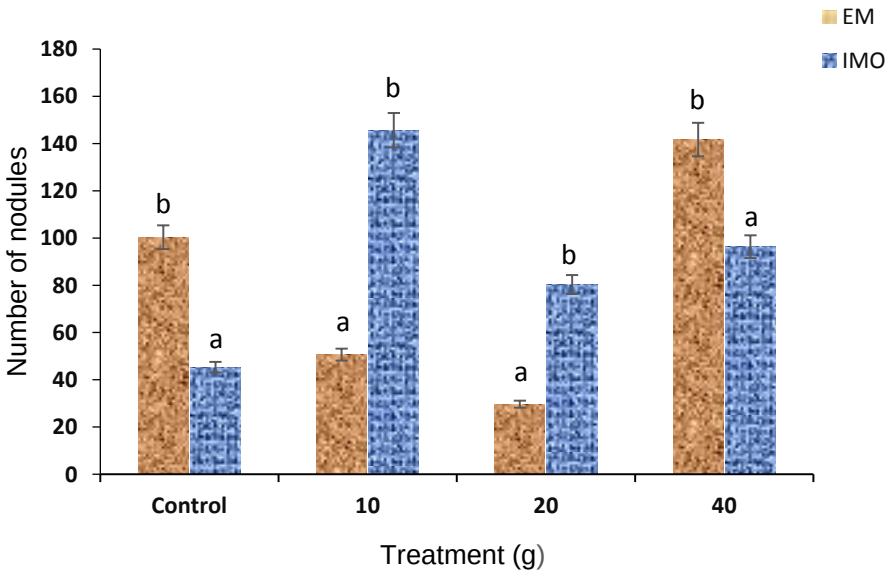

Figure 6. Effect of IMO and EM fertilizers on the number of nodules (10 WAS). Means followed by the same letter are not significantly different (P <0.05) as determined by Duncan test. Bars indicate standard deviation.

colorimetric method described by Devani et al. (1989), while phosphorus was determined according to the method used by Okalebo et al. (1993).

Statistical analysis

Results obtained are expressed as mean ± standard deviation, and were analyzed using statistical package for social sciences (SPSS) software. Statistical differences between treatment means were established using the Fisher least significant difference (LSD) test at p values<0.05. Analysis of variance (ANOVA) was used to determine whether variety and fertilization type had a significant influence on the measured parameters. The multiple comparisons of data in experimental groups compared to those recorded in the control group were done using Dunnett's procedure (Sigma Stat

Table 3. Effect of EM and IMO fertilizerson yield parametersof peanut plants (10 WAS).

Organic fertilizer	Treatment (g)	Number of pods per plant	100 seeds weight (g)	Pod yield (t/ha)	Seed yield (t/ha)
IMO	0	10.30± 3.74[a]	52.32 ± 0.00[a]	0.73 ± 0.00[a]	0.69 ± 0.00[a]
	10	15.86 ± 8.03[d]	58.58 ± 0.00[b]	1.25 ± 0.00[d]	1.18 ± 0.00[d]
	20	15.26 ± 7.77[b]	51.11 ± 0.00[a]	1.1 ± 0.00[c]	1.06 ± 0.00[c]
	40	15.33 ± 8.03[c]	51.29 ± 0.00[a]	1.01 ± 0.00[b]	0.72 ± 0.00[b]
EM	0	9.3± 4.05[a]	55.12 ± 0.00[a]	0.76 ± 0.00[b]	0.77 ± 0.00[a]
	10	12 ± 4.67[b]	58.69 ±0.00[b]	0.73 ± 0.00[a]	0.81 ± 0.00[b]
	20	13.76 ±7.24[c]	60.80 ± 0.00[b]	0.96 ± 0.00[d]	0.98 ± 0.00[d]
	40	14.46 ± 10.03[d]	56.68 ± 0.00[a]	0.92 ± 0.00[c]	0.88 ± 0.00[c]

Values with the same letter are not significantly different at significance level p <0.05.

2.03 software).

RESULTS AND DISCUSSION

Soil fertility

In the present study, Indigenous microorganism (IMO) and Effective microorganism (EM) manures supply singly had significant effects on soil fertility compared to untreated soils (Table 2). Chemical analyses showed a significant (P <0.05) decrease in pH in soils treated with organic fertilizers compared to untreated soils. It decreased from 6.45 to 5.86 respectively for the control and the soil treated with IMO. This decrease of soil pH could be explained by the fact that soil organic matter is rapidly degraded by the microorganisms contained in EM and IMO (Trisdall and Oades, 1982). Consequently, it leads to the production of susceptible substances such as organic acids capable of inducing an increase in soil acidity while making the soil minerals bioavailable (Kinsey, 1994). These results are in agreement with those obtained by Muyang et al. (2016) who worked on *Solanum tuberosum* in the northwestern region of Cameroon. These authors have shown that the soil pH decreases after application of fertilizers EM and IMO. However, they emphasized that the pH of this soil increases over time by depletion of organic matter in the medium. In contrast, total nitrogen, organic carbon, total phosphorus, calcium and magnesium increased significantly (P <0.05) after organic fertilizers application (Table 2). For total phosphorus, Ca^{2+}, Mg^{2+}, organic carbon and nitrogen, increasing the availability of these elements in fertilizer-treated soil (IMO and EM) compared to untreated plants is the result of the mineralization of organic matter by the microorganisms present in these fertilizers. In addition, N is more available in the IMO fertilizer treated plants than in the EM fertilizer treated plants. These results could be explained by the fact that IMO is made of indigenous microorganisms. In fact, the latter adapt more easily to mineralization processes of organic matter which could justify the lower pH value in the plot treated with IMO. These results are in agreement with those of Zuraihah et al. (2012) who, through their studies of *Brassica alboglabra*, *Brassica chinensis* and *Lactuca sativa*, showed that the mineralization of organic matter was more at the level of the soil treated with IMO, thus acidifying the soil more. In this study, the C/N ratio was less in the plot treated with IMO (3, 28) followed by the one treated with EM (5, 52), both were lower compared to the control (11, 35) (Table 2). The C/N ratio is an important parameter for measuring the biological activity of microorganisms during the degradation process of organic matter (Leonard, 2001). This ratio is even lower when there is a strong presence of organic matter in the soil or also by the strong presence of nitrogen in IMO. These results are in agreement with those of Anyanwu et al. (2015) on the application of IMO for the bioconversion of agriculture. The cation exchange capacity (CEC) is low for both fertilizers compared to the control (Table 2). This low content indeed reflects a low level of trade and therefore low plant nutrition. The average values of the CEC are between 10 and 15 g/kg of soil. However, these low CEC levels do not necessarily reflect the low level of fertility in the area, but could be explained by the quality of the clay-humic complex, which guides the transfer of minerals between the soil solution and crops.

Plant growth

The present study showed that IMO and EM fertilizers had a positive impact on the growth parameters compared to untreated plants (Figures 2, 3 4, 5 and 6; Table 3). Similar results were obtained by Xu et al. (2000), Mbouobda et al. (2013) and Muyang et al. (2014) on several vegetable crops. However, IMO fertilizer supply at 20 g significantly (P < 0.05) increased the shoot length, the number of leaves and nodules compared to the

Table 4. Effect of EM and IMO fertilizers on nitrogen and phosphorus contents of peanut plants.

Organic fertilizer	Treatment (g)	Nitrogen content (mg/g)		Phosphorus content (µg/g)	
		Leaves	Roots	Leaves	Roots
IMO	0	1.10 ± 0.38[a]	7.67 ± 0.11[a]	4.15 ± 4.50[a]	7.23 ± 1.82[a]
	10	1.37 ± 1.09[a]	21.05 ± 5.54[b]	6.56 ± 1.30[a]	5.33 ± 1.92[a]
	20	3.50 ± 2.01[b]	12.27 ± 5.41[a]	9.05 ± 1.31[a]	8.21 ± 2.69[a]
	40	0.47 ± 0.11[a]	25.02 ± 5.54[b]	3.60 ± 2.39[a]	5.66 ± 0.96[a]
EM	0	2.65 ± 0.59[a]	25.05 ± 5.01[a]	5.16 ± 0.02[a]	4.54 ± 0.32[a]
	10	2.19 ± 0.76[a]	8.54 ± 0.72[b]	6.09 ± 1.21[a]	5.38 ± 3.06[a]
	20	3.73 ± 1.12[a]	11.98 ± 1.004[a]	5.98 ± 2.08[a]	6.16 ± 1.07[a]
	40	1.79 ± 0.49[a]	33.84 ± 16.05[a]	6.46 ± 0.99[a]	7.28 ± 2.38[a]

Values with the same letter are not significantly different at the significance level $p < 0.05$.

fertilizer EM and untreated plants (Figures 2, 4 and 6). These results could be explained by the fact that IMO consists of beneficial indigenous microorganisms that rapidly degrade organic matter while increasing nutrient availability, suppression of soil-borne pathogens, and therefore increase the plant's ability to withstand pathogenic microorganisms (Helen et al., 2006). IMO consists of indigenous microorganisms trapped in the culture zone composed mainly of bacteria, fungi and yeasts. The role of IMO as mineralizers increases soil fertility, while making them less subject to compaction and erosion (Narasimha et al., 2012). In contrast, the higher values of stem diameter and leaf area were recorded at 40 g of EM supply (Figures 3 and 5).The improvement observed could be due to the fact that the application of EM in soil is generally associated with the growth of microbial biomass (Mbouobda et al., 2013). In addition, inoculation of EM in the soil could improve the nutritional quality of the roots, which would promote good photosynthesis of the leaves (Muthaura et al., 2010).

Yield traits

Means of the growth traits of the peanut (10 WAS) are depicted in Table 3. Inoculation of IMO and EM fertilizers significantly ($P < 0.05$) influenced the yield traits such as number of pods per plant, 100 grain weight, pod yield and grain yield (Table 3). These results are consistent with the results obtained by Anyanwu et al. (2015), Mbouobda et al. (2013) and Taffouo et al. (2018) on several crops. These results could be explained by the fact that EM and IMO are organic fertilizers and each of them has an important role in maintaining and improving the physicochemical and biological properties of the soil (Muyang, 2016). According to Hosner and Juo (1999), organic matter increases soil capacity to buffer pH changes, increases cation retention capacity (CEC), reduces phosphate fixation and serves as a reservoir for secondary nutrients and oligoelements. The improved yield traits observed in this study could be related to the availability of nitrogen, phosphorus and potassium for crops and the mode of dispersion of organic residues (Kilinc et al., 2005; Edema et al., 2007; Leconte et al., 2011).

Nutrient partitioning

Application of EM and IMO at 10 or 20 g led to a significant ($P < 0.05$) increase in nitrogen and phosphorus contents in leaves and roots of peanut compared to untreated plants (Table 4). However, the highest accumulation of nitrogen was registered at the roots level of treated plants. These results could be due to the migration of photosynthetic assimilates such as the amino acids of the leaves to the reserved organs (Taffouo, 1994) and also by the fact that nitrogen once in the leaves would have been distributed in the parts in the process of growth (Heller, 1989, Taffouo et al., 2014). Nitrogen, phosphorus and potassium are among the essential elements required for plant metabolism and the improvement of soil water-holding capacity (Wamba et al., 2012). Nitrogen is largely needed during leaf formation and then for increasing tuber growth and size, when it ensures optimal photosynthate production in the leaves (Taffouo, 1994). Nitrogen fed at an early stage of crop development will help build the overall size of the leaf canopy, whereas at later stage of growth, nitrogen helps maintain the greenness of the canopy and maximize yield (Mark et al., 1983). The availability of nitrogen is the primary limiting factor of productivity in most natural and managed soils (Aerts and Chapin, 2000). Although some plants rely on nitrogen organic form (Ohland and Nasholm, 2004), most nitrogen is supplied to plants through ammonification and nitrification (Chapin et al., 1987). Nitrification plays a major role in cultivated soil. NO_3^- is mobile and circulates with the solution of the soil towards the roots of the plant (Mantelin and Touraine, 2004). However, phosphorus is one of the least available nutrients in many aquatic and terrestrial ecosystems, and plant-available phosphorus

Table 5. Effect of EM and IMO fertilizers on nitrogen and total protein contents of seeds.

Organic fertilizers	Treatment (g)	Nitrogen content (mg/g)	Protein content (mg/g)
IMO	0	11.36±0.12[a]	71.00 ±6.82[a]
	10	16.28±0.20 [d]	101.75±5.05[d]
	20	12.89±0.40[c]	80.56±4.95[c]
	40	11.70±0.10b	73.12±2.01[b]
EM	0	10.34±0.30[a]	64.62±5.22[a]
	10	15.43±0.40[d]	96.43±0.70[d]
	20	12.72±0.20[c]	79.5±0.56[c]
	40	11.19±0.15[b]	69.93±0.31[b]

Means followed by the same letter are not significantly different (P <0.05) as determined by Duncan test. Bars indicate standard deviation.

deficiency is a main feature of many soils in Sub-Saharan Africa (Buresh and Smithson, 1997).

Proteins and nitrogen contents of peanut seeds

In this study, nitrogen and protein contents of peanut seeds were significantly (P <0.05) increased at 10 and 20 g of EM and EMO supply, respectively compared to untreated plants (Table 5). According to Shehu et al. (2010), an adequate supply of nitrogen to plants is beneficial for carbohydrate and protein metabolism resulting in higher yields while nitrogen deficiency may result in the reduction of total dry weight, in lower intake of nitrogen into fruits, and in less protein content and grain yield (Mark et al. 1983). Taffouo et al. (2014) reported that nitrogen is directly transferred from the roots towards the leaves of leguminous plants where the nitrogen compounds are used for protein biosynthesis. Leaf protein content of sweet potato varieties was positively influenced by inorganic-NPK (Taffouo et al., 2017). In cowpea, the nitrogen requirements for developing pods are not only covered by root uptake or biological nitrogen fixation, but also by mobilization of nitrogen in vegetative tissues (Douglas and Weaver, 1993).

Conclusion

The shoot length, number of leaves, stem diameter, leaf area, pod and grain yield, nitrogen and phosphorus contents, and soil fertility were positively influenced by the IMO and EM fertilizers supply. However, the use of IMO fertilizer could be considered more to the extent that the mineralization of organic matter is more accentuated in IMO. The optimal fertilization rates for growth and yield traits of the JL 24 peanut variety studied were 10 g for IMO fertilizer and 20 g for EM fertilizer. The pod and grain yield were estimated at 1.25 and 1.18 t/ha respectively for IMO; 0.96 and 0.98 t/ha for EM. IMO fertilizer can be considered as an efficient fertilizer that can serve as a suitable alternative to chemical fertilizers in sandy ferralitic soils. The use of IMO and EM fertilizers could enhance peanut growth performance in sandy ferralitic soils.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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