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Coffee parchment and NPK 15 15 15 effect on cultivation association of coffee (*Coffea Arabica* L.) and peanut (*Arachis hypogaea* L.) southeast of Gabon

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Key words: Parchment, Coffee tree, Peanut, Fertilization, Crop association.

Abstract

The production of coke through monocropping is a major concern for Gabonese farmers. A test was conducted with a random Fisher block design with four replications. The treatments consisted of coffee hust, NPK 15-15-15 and a combination of coffee husk and NPK applied to monocrop and crop association. Dosages made by micro-plot were: 240 g, 320 g and 400 g for the husk; 5.6 g of NPK; treatment combinations were to combine the NPK at different levels of parchment. The results show that fertilization increased coffee growth and induces production of higher peanut in the case of the witness. The difference compared to the control for parameters: stem diameter, stem height, leaf area, leaves and buds number measured on coffee plants and yield of groundnuts are respectively: 0.158 cm, 1.91 cm; 30.8 cm^2; 12.53; 1.57 and 190 kg/ha. The yield of groundnut monoculture is higher by about 69% compared to the intercropping system that affects 45% average growth of the coffee plant. Most important in this model is the yield, it appears that the combination of coffee-peanut crop was not beneficial to the soil tested. The coffee husk compost, applied alone or in combination especially parchment-NPK, could be considered as fertilizer to improve the growth of the coffee and peanut production, monoculture under the conditions of the southeastern Gabon.

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Introduction

The Gabonese economy is dominated by resources from the oil exploitation in crisis. The agricultural sector should be a palliative to this concern. However, it is relatively undeveloped for several reasons such as rural exodus, the aging of the rural exodus, the poor roads and especially agricultural practices (Ntsama, 2012). Yet the country has a potential for farmland almost 15.2 million relatively fertile hectares, of which only 495,000 ha are operated directly (Sirte, 2008 Ntsama, 2012; FAO, 2015). This under-utilization of the agricultural sector has a negative impact on food security of the population. The country imports foodstuffs for 80% to 85% (AFD, 2013; Saizonou and Mouissi, 2015; ASSECAA, 2015) inaccessible to the most vulnerable households with farmers who are severely affected (FAO, 2015).

The coffee plant (*Coffea arabica*) is the alternative in that, immediately after oil, coffee is the second largest goods market and represents almost 25% of revenue from international trade in Latin America and Africa and more than 80% of revenue for the least developed countries (Ernoult, 2002; ICO, 2015). In Gabon, mainly in the province of Haut-Ogooué, coffee production is steadily increasing. It increased from 23 tons in 2006-2007 to 150 200 tons in 2010-2011 view (Lakoumba, 2011). This production is supported by farmers who are part of the impoverished population. But the coffee is a culture whose entry into production requires 2-6 years depending on the variety. Meanwhile the farmers who often do not have other financial resources pass through difficult times. Thus the conduct of rural coffee is done in monoculture is not beneficial for this segment of the population. It appears wise to practice a coffee-peanut farming association (which is a legume). Plantation, coffee may be associated with several crops including groundnuts (Sanchez, 2002; Camara *et al.,* 2012; Lamah, 2014). The work has produced results that vary from one region to another. Peanut (*Arachis Hypogaea*) chosen for this model is the sixth of the six most important oil crop in the world (Noba *et al.,* 2014). The groundnut production is concentrated in Asia and Africa with 56% and 40% of area and 68% and 25% of global production (Ndjeunga, 2006; Noba *et al.*, 2014.). In Gabon production increased from 16 000 tons in 2002 to 17,000 tons in 2005. Given the degradation in tropical soils tested the model requires the input of inputs, unlike farmers practices. The use of chemical fertilizers by their immediate beneficial effect on crop productivity is one of the solutions but their high cost and their availability make them almost inaccessible to small farmers (N'Goran, 1995; Sanchez, 2002; Muladji, 2011). In addition to the ecological, economic and environmental problems it causes, mineral fertilizer alone cannot maintain soil fertility (Koulibaly *et al.*, 2010; Sester *et al.*, 2015.). Its exclusive use leads to acidity increase, a degradation of the physical status and organic matter decline of soil (Boli and Roose, 2009; Muladji, 2011; Yannick *et al.*, 2014.). In this context, organic fertilization should be an appropriate solution for the restoration of soil fertility (Danho *et al.*, 2010). Many studies have shown that the amendments are important to various soil properties; thereby justifying their use (Lompo *et al.*, 1995; Muladji, 2011; Kasongo *et al.*, 2013.). Ayanlaja *et al.*, (1991). Muladji (2011); Ognalaga *et al.* (2015) have shown that the decomposition of plant residues can significantly improve the level of nutrients and organic matter in soils.

With the foregoing, it seemed appropriate to study, in agreement with the Stabilization fund (CAISTAB), a model of association between a cash crop (coffee) and a food crop (peanuts) supported by fertilization based on the parchment and a soluble mineral fertilizer in water (NPK 15 15 15). The parchment, byproduct of milling coffee is available locally. It decomposes naturally in the open air and constitutes compost whose chemical wealth proved (Ratunga *et al.*, 1994). Its use as organic fertilizer should contribute to improve both soil fertility that the structural stability of degraded soils (Ratunga *et al.*, 1994; Soro *et al.*, 2011) and the reduction of water erosion on cultivated plots. The specific aim of this work is to try to show that this plant crops association grow well and good returns on soils of Haut-Ogooué. Thus, if this model is successful, it could enable farmers to maximize their activity before harvesting and marketing of their coffee.

Materials and methods

Materials

Study site

The trial was conducted from May to October 3th 2014 on the plots of the University of Science and Technology of Masuku (USTM) at Franceville in the province of Haut-Ogooué, the southeast of Gabon. This province is located between parallels 0°25 and 2 of the South Latitude. The geographical coordinates of the site are: 300 meters, 13°36.611 'east longitude, 1°36.394' south latitude.

Biological material

The material is composed firstly of coffee plants (Fig. 1A) and the other of peanut seed (Fig. 1B). The coffee plants were provided by the provincial delegation of the CAISTAB Haut-Ogooué, while peanut seed were purchased at market Franceville, Head instead of the above-mentioned Province.

A B

Fig. 1. Coffee plant (A), peanut seeds (B).

Fertilizers

The fertilizers used are:

- The soluble mineral fertilizer in water (formulation of NPK 15-15-15);

- The parchment coffee (organic soil) composted in piles naturally in the open air. It was then dried, crushed and sieved to 2 mm and brought to a humidity of 15%.

Treatments and experimental device

Table 1 provides the treatment and quantity of the amendments provided for each dose. The study was conducted on an block of Fisher completely randomized. It comprises nineteen (19) treatments and four repetitions.

Table 1. Treatment and constitution of the experimental units.

Treatment	Cropping system	Dose parchment (g)	NPK Dose (g)
To$_a$	Peanut	0	0
To$_b$	coffee	0	0
To$_c$	Coffee + Peanut	0	0
T1	Coffee	0	5.6
T2	Coffee	240	5.6
T3	Coffee	320	5.6
T4	Coffee	400	5.6
T5	Coffee + Peanut	240	0
T6	Coffee + Peanut	320	0
T7	Coffee + Peanut	400	0
T8	Coffee + Peanut	240	5.6
T9	Coffee + Peanut	320	5.6
T10	Coffee + Peanut	400	5.6
T11	Peanut	240	0
T12	Peanut	320	0
T13	Peanut	400	0
T14	Peanut	240	5.6
T15	Peanut	320	5.6
T16	Peanut	400	5.6

Legend : To$_a$; To$_b$ et To$_c$= Control; T1= NPK 5.6g/MP; T2= parchment 240g+NPK 5.6g/MP; T3= parchment 320g+NPK 5,6g/MP; T4= parchment 400g+NPK 5.6g/MP; T5= parchment 240g/MP; T6= parchment 320g/MP; T7= parchment 400g/MP ;T8= parchment 240g+NPK 5.6g/MP ; T9= parchment 320g+NPK 5.6g/MP; T10= parchment 400g+NPK 5.6g/MP; T11= parchment 240g/MP; T12= parchment 320g/MP; T13= parchment 400g/MP; T14= parchment 240g+NPK 5.6g/MP; T15= parchment 320g+NPK 5.6g/MP; T16= parchment 400g+NPK 5.6g/MP. MP= micro-plot.

Methods

Works of implementation

The implementation of the test required a number of works including: Clearing, picketing, the hole digging, planting the seedlings of coffee and peanuts.

The cleared area is 1200 m^2. Then, defining the scope of the orchard was followed by the identification of the location of each of the coffee plant using a pole, according to the spacings of 2.5 mx 3 m. This step was followed by the digging of holes (40 X 40 X 40 cm), the planting that goes with filling holes and fertilization. The plant of the coffee is placed in the planting hole with an inclination of 3O° from the vertical to promote the rapid issue of discards. The cultivated area of each micro-plot is 1.3 m^2.

Sowing of groundnut has been, according to the spacings of 20 x 40 cm, on a one seed per hole. Monitoring crops consisted of extirpation weeds and daily watering of up to 0.83 m^3 of water.

Measured parameters

Parameters measured on coffee, every two weeks during the qualifying period are: stem diameter, stem height, leaf area, leaf number and buds number with the caliper respectively and meter. The yield of the peanut was determined by maturity after weighing in production.

Physico-chemical analysis

Analyses of the substrates used were performed in the laboratory of soil at INSAB on the particle size fraction smaller than 2 mm according to the methods at our disposal (Aubert, 1978; AFNOR, 1994). The analysis package includes: the particle size determined at the Robinson pipette-Khön (clays and silts) and sieving (sands), the pH measured in a solid suspension / solution (1/2.5), total nitrogen by the method Kjeldahl, organic carbon by the modified method Anne; available phosphorus in the soil was extracted by the Olsen-Dabin method. For the extraction of total phosphorus in the parchment, 2 g of previously dried and ground substrate were mineralized at 550 °C for 2 hours. The ashes were taken over by concentrated hydrochloric acid. Each sample was filtered and subsequently homogenized in a 100ml volumetric flask (Lab Procedures, 1970). Phosphorus in solution was determined UV-Visible spectrophotometer at 712 nm (Murphy and Riley, 1962).

The pH of compost was measured in the supernatant of a substrate sample suspended in distilled water after stirring; the solid-solution ratio was 1/5 (Soclo *et al.,* 1999).

Statistical analysis

Data collected during the various observations were analyzed using the software Xlstat 2007. They were then subjected to analysis of variance and a principal component analysis (PCA), the 5% threshold. Newman and Keuls test was used for comparison of means.

Results

Soil analysis

The floor of Clay Silty-Blaster texture has a highly acidic water pH (4.6). By the standards (Wopereis and Defoer, 1998) on the surface horizon: the organic carbon content is good (17 g/kg); available phosphorus, in trace amounts, is very characteristic of lateritic soils that are deficient. The total nitrogen (Nt) is pretty good.

Results of analyzes of soil on the site, conducted in the laboratory of Soil Science at INSAB are presented in Table 2.

Table 2. Physico- chemical characteristics of the soil used.

	pH		Carbon and mineral elements			Particle size		
Physico- Chemical Characteristics	pH_{water}	pH_{KCl}	Assimilable P (mg/kg)	Organic C (g/kg)	Total N (g/kg)	Clay (g/kg)	Silt (g/kg)	Sands (g/kg)
Horizon 0-20cm	4.6	3.7	21.5	17	1.1	141	338	523

Analysis of coffee husk

Results of chemical analyzes performed on the parchment is presented in Table 3. The coffee husks used has a pH close to neutral (7.5). Organic carbon content is high (355 g/kg) while the nitrogen is good because, being of the order of 1.1 g/kg. The content of water soluble phosphorus is 927 mg/kg of parchment made.

Table 3. Chemical characteristics of the compost of parchment used.

	pH		Carbon and mineral elements			
Chemical - Characteristics	pH_{water}	pH_{KCl}	Total P (mg/kg)	Organic C (g/kg)	Total N (g/kg)	C/N
Horizon 0-20cm	7.5	6.4	927	355	1.1	39

Influence of treatments on the growth of the coffee plant

Analysis of variance

The data collected during this test are subject to variance analysis, the results (Table 4) show a highly significant effect of the amendments on all growth parameters.

Stem diameter

Radial growth of coffee is affected positively and highly significantly ($p<0.0001$) by the contribution of fertilizers that produce statistically different effects on the development of this parameter to 14 weeks after planting (Table 4).

Table 4. P-value of the treatments effect on coffee growth.

Source	DDL	Sum of Squares	Mean square	F	P
Stem diameter	11	0.709	0.064	47.153	< 0.0001
Stem height	11	143.127	13.012	74.029	< 0.0001
Leaf area	11	13346.362	1213.306	20.224	< 0.0001
Leaves number	11	8706.917	791.538	96.594	< 0.0001
Buds Number	11	104.229	9.475	5.524	< 0.0001

In all scenarios, the values of the collar diameter obtained (Table 5) with witnesses T0b (0.285 mm) and T0C (0.25 mm) are on average lower than those observed with: the NPK (only on coffee) parchment + NPK (only on coffee) the only parchment (on peanut associated coffee), the parchment + NPK (on peanut associated coffee) in the order of 61% respectively 51% 37% and 28%. For this parameter the collar diameter, NPK produces 0.3 a significant effect superior to other treatments, averaging about 40%. The interaction parchment - NPK (T2 and T3) applied to the only coffee gives a performance that closely follows that of NPK (T1). Furthermore, the interaction parchment - NPK, at doses of 320 g and 400 g produces a depressive effect on the diametrical growth on the order of 30%.

Table 5. Parameters of coffee growth 14 weeks after planting (SAP).

Treatments	Stem diameter (mm)	Stem height (cm)	Leaf area (cm²)	Leaf number	Buds number
T1	0.7±0.05[a]	10.425±0.48[a]	95.7075±5.45[a]	53.5±4.69[a]	7.75±0.96[a*]
T2	0.55±0.02[b]	8.95±0.26[b]	95.415±7.96[a]	44.75±4.43[b]	6.25±1.26[ab]
T3	0.49±0.02[c]	6.125±0.81[c]	93.3675±15.32[a]	42±3.30[b]	6±2.63[ab]
T6	0.43±0.08[d]	5.925±0.42 [cd]	74.2325±3.05[b]	36.5±2.08[c]	5.25±0.96[bc*]
T4	0.385±0.05[de]	5.6C±0.60 [de]	72.4375±3.55[b]	26.25±3.42[d]	4.25±0.96[bc]
T9	0.375±0.01[de]	5.525±0.39 [cde]	70.225±8.83[b]	25.5±2.38[d]	4.25±0.96[bc]
T8	0.345±0.03[ef]	5.4 ±0.45[cde]	70.125±11.67[b]	22±2.22[de]	4±1.41[bc]

Treatments	Stem diameter (mm)	Stem height (cm)	Leaf area (cm^2)	Leaf number	Buds number
T7	0.3375 ± 0.01^{ef}	5.4 ± 0.18^{cde}	66.37 ± 4.12^{b}	19.5 ± 1.71^{e}	3.75 ± 0.96^{bc}
T10	0.33 ± 0.01^{ef}	5.3 ± 0.10^{cde}	62.7375 ± 6.28^{b}	19.25 ± 1.29^{e}	3.25 ± 0.96^{bc}
T5	0.315 ± 0.03^{ef}	5.15 ± 0.39^{de}	58.7175 ± 6.17^{bc}	12.5 ± 1.71^{f}	3.25 ± 1.50^{bc}
Tb	0.285 ± 0.03^{fg}	4.95 ± 0.17^{e}	49.05 ± 4.38^{cd}	12.25 ± 3.37^{f}	3.25 ± 1.41^{bc}
Tc	0.25 ± 0.03^{g}	3.975 ± 0.21^{f}	41.1 ± 6.52^{d}	10.5 ± 0.58^{f}	2.5 ± 0.58^{c}

*Means with the same letters in the same column are not significantly different.

Legend : T0$_b$ et T0$_c$= Control; T1= NPK 5.6g/MP; T2= parchment 240g+NPK 5.6g/MP; T3= parchment 320g+NPK 5,6g/MP; T4= parchment 400g+NPK 5.6g/MP; T5= parchment 240g/MP; T6= parchment 320g/MP ; T7= parchment 400g/MP ;T8= parchment 240g+NPK 5.6g/MP; T9= parchment 320g+NPK 5.6g/MP; T10= parchment 400g+NPK 5.6g/MP; T11= parchment 240g/MP; T12= parchment 320g/MP; T13= parchment 400g/MP; T14= parchment 240g+NPK 5.6g/MP; T15= parchment 320g+NPK 5.6g/MP; T16= parchment 400g+NPK 5.6g/MP. MP= micro-plot.

Stem height

Applied amendments induce a highly significant effect (p <0.0001) on the longitudinal growth and the difference in effect is also significant between the applied inputs (Table 4).

The values of the height of rods obtained (Table 5) with T0b witnesses (4.95 cm) and T0C (3.975 cm) are on average lower than those observed with NPK (only on coffee), the parchment + NPK (on coffee alone), the only parchment (on peanut associated coffee), the parchment + NPK (on peanut associated coffee) in the order of 57%, 50%, 24% and 19%. The T2 and T3 treatments behave similarly to the observations made on the collar diameter. Furthermore, as observed with this diameter, the depressing effect is shown on longitudinal growth when going from 320 to 400 g of parchment. On average the stem height obtained with NPK is higher and significantly superior to other treatments in the order of 35%.

Leaf area

Application of different treatments was highly significant (*p<0.0001*) on the development of coffee leaves (Table 4). Unlike previous settings, treatments T1, T2 and T3 statistically produce the same effect on the leaf surface (Table 5) and the average (95±10 cm^2) of this parameter is greater than that of controls (45±0.03 cm^2) and that of the other treatments (68±5 cm^2) of the order of 53% and 28% respectively.

Leaves number

The number of leaves of coffee plants is affected highly significantly (p<0.0001) by the introduced amendments (Table 4) the effect differs significantly from an amendment to another.

NPK (only on coffee) induces a greater number of leaves of about 78% and 34%, respectively, to witnesses and other amendments (Table 5). Interactions, parchment - increasing doses to NPK generate a decrease in coffee leaf from a given level of manure; However, the dose of parchment made only 320 g (T6) or interaction with NPK (T9) was identified as the maximum threshold above which the production of the number of leaves is affected significantly.

Buds number

Treatments highly significantly influenced (*p<0.0001*) the bud (Table 4). The largest number of buds (Table 5) was obtained with NPK (8 ± 1) and this value is about 3 times greater than that observed on the control plants (2.8±1), or 63%. Apart from T2 and T3, the number of buds produced by other treatments is statistically confused with that of the control.

Influence of treatments on yield of peanut

Yields of peanut pods vary significantly depending on amendments and doses (Fig. 2). The highest yield induced T10 (6.15 t/ha) is superior to other treatments and the witness respectively about 35% and 62.5%. The witness without amendment, based on the association Peanut + coffee (T0C) produced a yield significantly ($p<0.05$) better than 27% relative to control without amendment with peanuts only as a culture (T0a).

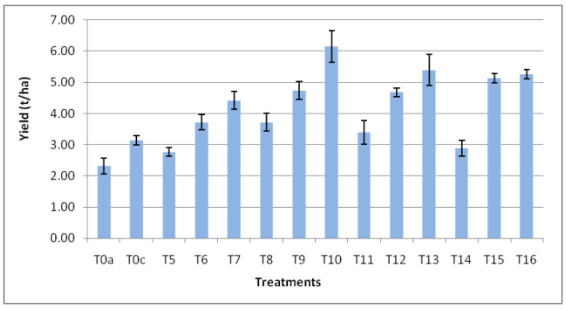

Fig. 2. Fresh yield of peanut.

Legend : T0$_a$ et T0$_c$= Control; T1= NPK 5.6g/MP; T2= parchment 240g+NPK 5.6g/MP; T3= parchment 320g+NPK 5.6g/MP; T4= parchment 400g+NPK 5.6g/MP; T5= parchment 240g/MP; T6= parchment 320g/MP ; T7= parchment 400g/MP; T8= parchment 240g+NPK 5.6g/MP; T9= parchment 320g+NPK 5.6g/MP; T10= parchment 400g+NPK 5.6g/MP; T11= parchment 240g/MP; T12= parchment 320g/MP; T13= parchment 400g/MP; T14= parchment 240g+NPK 5.6g/MP; T15= parchment 320g+NPK 5.6g/MP; T16= parchment 400g+NPK 5.6g/MP. MP= micro-plot.

Outside witnesses (T0a and T0C), examination of Fig. 1 indicates that the yield increases with the dose given. This statement is statistically significant ($p<0.05$) and supported by a Pearson correlation coefficient equal to 0.782 which establishes the relationship between the given dose and induced performance.

Discussion

This study was conducted in order to allow producers to reduce crop cultivating areas, to reduce costs of production factors, increase yields and profitability in the short, medium and long term peasant production units.

Growth of the coffee plant

For all the evaluated parameters (collar diameter, stem height, leaf area, leaf number and number of buds) values were greater than that of untreated plants. This observation is consistent with that of many researchers. Based on the work of Peyraud and Astigarraga (1998) Lemaire *et al.*, (1999), Tendonkeng (2010) fertilization increases the speed of vegetation, increasing production for a given stage of growth or reduced the time needed for achieving a defined yield.

Compost parchment allowed an increase in the biomass of coffee plants. Growth parameters measured (collar diameter, stem height, leaf area, number of sheets and number of buds) are higher on the treated plants relative to untreated plants. These results are in agreement with those of Nyabyenda (2006), who showed that we could increase the coffee yield of more than 20% by restitution of coffee pulps after 3 years decomposition time.

Fertilization with the combination NPK + parchment composted has positively influenced the growth of the measured parameters (collar diameter, stem height, leaf area, leaf number and number of buds). Indeed, the coffee plants treated with parchment compost combination NPK + showed an increase of the higher biomass than untreated plants. Similarly the increase is greater than that observed on the treated plants NPK as well as on plants treated solely compost. It appears that the mineral fertilizer does not act the same role as organic manure on soil fertility. These two types of inputs complement each other (Traore *et al.*, 2002; Tittonell *et al.*, 2008).

In this study, we observed that the biomass increased with the level of fertilization until a threshold beyond which it began to drop. Similar results were reported by Atta *et al.* (2012), Ikeh *et al.* (2012), Ognalaga *et al.* (2014) showing that fertilization with high doses (which exceeds the potential growth needs of the plant) causes a decrease in biomass production due to toxicity.

Cultivation method of effect on growth of the coffee plant

If fertilization has positively affected the production of the biomass of coffee plants, this has not been the case for the cultivation method. Indeed, the results clearly show that coffee plants associated with peanut had an increased in lowest biomass comparatively to plants without association. This result is contrary to reports the literature. Indeed, numerous studies (Akédrin *et al.*, 2010; Nchoutnji, 2010; Attiou, 2014) show a beneficial effect of the combination of legumes with other forage crops on production and improved yields of crops such as maize. In this case the lack of benefit could be the result of a competition water and / or mineral or toxicities root (Diatta *et al.*, 2012). A foliar diagnosis would provide more details on this assumption. (Ognalaga *et al.*, 2014. Nkapnang Djossi, 2016). Naitormbaide (2012) and especially Ndamage (1993) showed that the organic matter could increase the yield of groundnut by 299.6 kg/ha with an average increase of 25.7%.

Performance of peanuts

Results show that the performance of the peanut was positively influenced by the contribution of parchment compost. Indeed, the yield of the plants treated with compost is higher than that of untreated plants. This highlights the role of organic amendments in crop production (Muladji, 2011; Ognalaga *et al.*, 2015. Nkapnang Djossi, 2016). Fertilization with combined treatment NPK + compost parchment influenced positively the performance of peanuts. The treated plants were found to be more productive than controls, with an increase of 17%. These results suggest to us that the mineralization of compost is higher when combined with NPK. Indeed Cobo (2002), Kasongo (2013), Ognalaga *et al.* (2014) showed that the rate of decomposition of organic matter and yield increases were related to the synchronization of the release of nutrients and their consumption by the plant. Through this study we understand that an organo-mineral combination treatment provides more benefits than just mineral or organic treatment.

The method of cultivation has not positively affected the yield of peanut. Indeed, of all the treated plants that monoculture had higher yields than plants associated with coffee plants. The results of this study show that coffee peanut association does not increase yields. According Cissé (1988), the total peanut yield values seem little affected by the fertility level, but especially by the water supply. This fact makes us think that the dry season, characterized by low rainfall 104 mm on average and the number of days of very low rainfall, seven (7) days per month on average during the experimental period were at the origin of low yields observed in the associated plants (Heller, 1998; Durand, 2007). Peanut is a crop demanding in water; it would be appropriate to study the adequate irrigation modes when grown out of season and especially when this plant is in association with another culture.

Conclusion

This study showed that the use of coffee husks compost has been beneficial. The growth parameters measured on the coffee: collar diameter; stem height; leaf area; number of sheets and number of buds had significantly higher values than those observed with the controls. However, it appeared that the treatment combination compost parchment + NPK proved more effective than non combined treatments. These amendments have induced a similar reaction in the production of peanuts. The recorded results show that the growth of the coffee plant and yield of groundnut monoculture are better compared to the system where the two cultures were mixed together on the field. Thus, based on these tests in the soil and climatic conditions in southeastern Gabon, Franceville, the combination of peanut with coffee in order to reduce the cultivated areas is not advised to farmers. However, the combination of a mineral fertilizer NPK and organic amendment (parchment coffee) could help local farmers to improve their production.

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