



Potentialities of Varieties of Rice (*Oryza sativa* (L.)) Based on the Uses of Two Fertilizers on Sudano-Sahelean Area: Yagoua, Far-Nord Cameroon

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Abstract

Effect of organic manure and mycorrhiza inoculation on responses of Rice increases the productivities. This study was carried out at the SVRA of Yagoua, Far-North of Cameroon. The main objective was to evaluate potentialities of several rice varieties on growth and yields. Treatments were: mycorrhiza (20g) and poultry manure (50g), poultry manure+mycorrhiza (20+50g) and a control without any substrate. The experimental design was a completely randomized blocks with 3 repetitions. The evaluated parameters were: plants growth parameters and yield. Results revealed that the responses of varieties depended on treatments and affected the variety IR 46 and ITA 300 on growth and yields. Plants growths were important in amended plots compared to control. However, the mycorrhiza and poultry manure+mycorrhiza increase height of plants, number of tillers, and numbers of panicle. Statistical analysis showed that not all treatments significantly ($P < 0.05$) affected growing parameters of plants per variety. Heights of plants were positively improved with mycorrhiza treatments for the variety IR 46 and Nerica 60. Organic manure was affected significantly ($P < 0.05$) the height of plants for the variety ITA 300. The numbers of tillers were improved ($P < 0.05$) with apply of organic manures+mycorrhiza and mycorrhiza treatments for the variety ITA 300. However, numbers of seeds per panicle was important ($P < 0.05$) with organic manure and mycorrhiza treatments respectively for the varieties IR46, ITA 300 and Nerica 60.

Keywords: Fertilizers, Mycorrhiza, Rice, Varieties, Yields.

Introduction

Agriculture in Africa remain in decline due to the decrease of soils fertility with a constant decrease of the levels of productivity of culture mainly cereals (Balogoun. *et al.*, 2013). He has recognized the benefits of waste materials as a nutrient and improves the physical and chemical properties of soils (Balkcom. *et al.*, 2003). Nevertheless, it is an inescapable lever for achieve the objective of growing especially in the countries in the process of development like Cameroon. Rice (*Oryza sativa* (L.)) is an annual plant belongs to the family of Poaceae, cultivated in tropical,

subtropical and tempered region for their fruit rich in starch (Folefack, 2014). It is a basic food for the populations and represent one of cereal which is most consumed after maize (Rapport C2D, 2013). Their consumption quickly increase more than others major product on continent due to the higher growth of demographic, urbanization and the evolution of food habit (Seck. *et al.*, 2013).

In Africa, the culture of rice is one of important activity for the populations of

several zone of West Africa and Center Africa insured food security of near of 20 billions of producers (Adrao, 2002). In fact, their culture is practiced almost in all the regions of Cameroon (MINADER, 2009). By elsewhere, local populations have a hurdy-gurdy method of production of rice. It is the cases of the populations of the North, North-west and West (MINADER, 2009). According to the comity of United Nations approximately one people on five is consider on situation of food security in the regions of Far-North, North, Adamawa and East of Cameroon (UN-OCHA, 2016). Where their importance of this culture in diet of the rural and urban populations of the least advanced countries (FAO, 2018).

In Cameroon, the national production average is estimated at 360 thousand ton in 2017 (FAOSTAT, 2018). National request was estimated in 2009 at 300 000 ton cover essentially by the importation (MINADER, 2009; Rapport C2D, 2013). Their culture is considerable and known a highly dependence of international markets (Folefack, 2014), although his culture represent in a recurring way to the perturbation (dryness and inondation) which affect agricultural productions (PAM/PNSA, 2016). Nowadays, uses of chemical fertilizers on agricultural sector remain hypothetical due to the harmful effect of environment in majority (Maodo, 2018). They are inexpensive, contain high nutrients, and are readily available to be taken up by plants (Fatin. et al., 2019). However, excess usage of it results several problems, such as nutrient loss, surface water and groundwater contamination, soil acidification or basification, reductions in useful microbial communities, and increased sensitivity to harmful insects (Fatin. et al., 2019; Chen, 2006). Also problems of food security in the north region destabilize this culture, which involve a strategic of producers to improve production of this cereal (MINADER, 2009). However, climate changes, lost of biodiversity, highly need of consumer are the facts that degrading soils and promote the uses of some fertilizers on minimizing the uses of pesticides (Maodo, 2018). Also socio-

economic constraints, unavailability of qualities of seeds, the bad structuration of this culture, the high cost and unavailability of inputs, biotic (bird) and abiotic stress (toxicity of iron, lower soil fertility) are the mains causes of destabilizing the culture (Rapport C2D, 2013).

Aim of this study is to evaluate the potentialities of varieties of rice by organic and mycorrhiza amendment on growing of plants and yields in degraded soil of Sahelean area of Cameroon.

Materials and Methods

Study Site

The study was conducted at the Valorization Station of Agricultural Research (PSAR) of Yagoua, Mayo-Danay in the Far North region of Cameroon (10°19'45.4" North and 15°15'35.7" East. Altitude of the area is 255 m). Different site were chosen to materialize the experiment. The area is covered by the Sudano-Sahelean climate type, characterized by 2 seasons: The wet season spans the 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 15°C to 35°C. Rain becomes scanty in volume and abundance as one goes further north. Two air masses predominantly influence the area, namely the harmattan and monsoon winds, in the dry season and wet seasons respectively. Low precipitations ranges between 600 mm and 1200 mm/year (MINTP, 2017).

The Vegetation in the area is dominated by *Acacia seyal*, *Butyrospermum parkii*, *Faidherbia albida*, *Anogeissus leocarpus*, *Balanites aegyptiaca*, *Tamarindus indica* and herbaceous like *Andropogon spp*, *Loutedia togoensis*, *Schoenefel diagracilis* (GIZ, 2017). The main cultivated crops are Millet (*Pennisetum glaucum*), Sorghum (*Sorghum bicolor*), Maize (*Zea mays*), Peanut (*Arachis hypogea*), Fonio (*Digitaria sp*), Cowpea (*Vigna unguiculata*) and vegetable crops like Carrot (*Daucus carota*), Watermelon (*Citrullus lanatus*), Tomato (*Lycopersicum esculentum*), Onion (*Allium cepa*), Gombo (*Albelmoschus esculentus*), Lettuce (*Lactuca*

sativa), Black nightshade (*Solanum scabrum*) (GIZ, 2017).

Vegetal Materials

Vegetal materials are constituted of 3 recommended varieties on the North (Garoua) and Far north (Yagoua) regions, such as ITA-300, IR-46 and Nerica 60. These varieties are good quality and with the well productivity in the area.

Methods

Experimental Design

The experimental design for this study is a block completely randomized with 3 replications. The factor is represented by the bio-fertilizers and chicken manure treatments with 4 levels (T1 = control, T2 = mycorrhiza, T3 = chicken manure and T4 = chicken manure + mycorrhiza) with a total of 12 treatments within 3 blocks for each varieties. The experimental design for each variety is described on Figure 1.

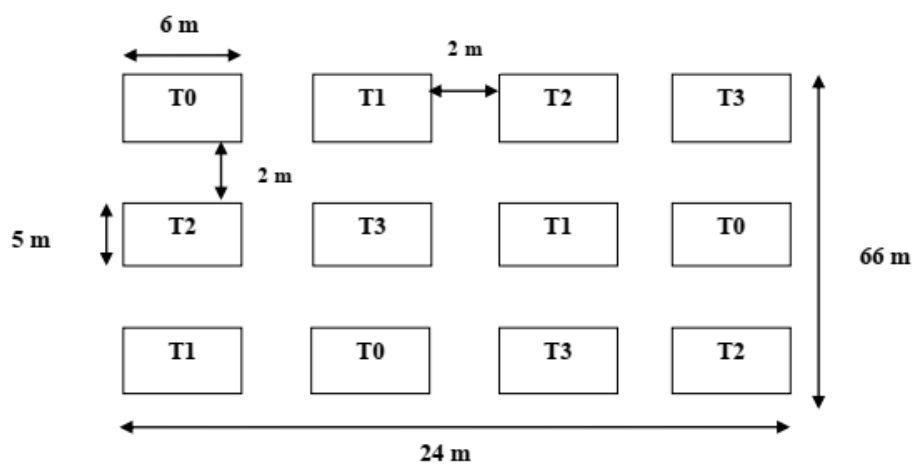


Figure 1: Experimental design

Each block is divided in sub-blocks and they are equal according to a distance of 1m. Experience had started by manual clearing of weeds. A labor of 25 cm of depth have been done in order to mix the soil and remove some grass and arboreous. Sowing was done two weeks after the labor and distances were 40 cm between lines and 25 cm between

pockets. Weeding has been made every two weeks during the period culture.

Inoculants and Organic Manure

The quantities of each treatment were measured with an electronic scale (2000*0.1g). The different doses were defined in the Table 1 as follow:

Table 1: Quantities of doses by treatments applied

Treatments	Doses (g)
Control (T1)	0g
Mycorrhiza (T2)	20g
Chicken manure (T3)	50g
Chicken manure + Mycorrhiza (T4)	20+50g

The inoculation processes was done as describe by GIC AGRO-BIOCAM, which consist to coating each seeds with mycorrhiza before during one hour. Seeds were mixed at 20 g of mycorrhiza with water then sowing after. Organic manure treatments (T2; T3) was

been applied 2 weeks after sowing at the quantities of 50 g per pockets.

Parameters Assessment

Height of Plants

Data of growth were collected. They consist to collect data in 3 repetitions on an interval of

time of 10 days during phenological growth stages of plants. However, 10 plants for each treatment were taken like a reference for collecting data of growth parameter such as height of plants with meter.

Yields Parameters

The plants productivity was evaluated at the end of the crop season. The numbers of tillers and number of seeds per panicle was evaluated on 10 plants referred as a sample for collecting data.

Statistical Analysis

Data analyses were performed using R-cmdr in R software analysis. Analysis of variance (ANOVA) was used and the means have been separated with the test of Tukey for the comparison of average at 5 % of probability.

Results and Discussions

Effect of Treatments on Height of Plants

Height of plant by varieties according to types of treatments is presented on the **Figure 2**. All applied of treatments positively affected plant growth of the variety IR 46. Heights of plants were significantly highest in amended plots with mycorrhiza, organic manures and organic manures+mycorrhiza as treatment compared to the control plots (**Figure 2**). Mycorrhiza and organic manures+mycorrhiza treatments significantly ($p < 0.05$) increased the height of plants respectively for variety IR 46, Nerica 60 and ITA 300 compared to control plots. Within the varieties, organic manures+mycorrhiza treatments responses well for all varieties followed by mycorrhiza on varieties IR 46 and Nerica 60.

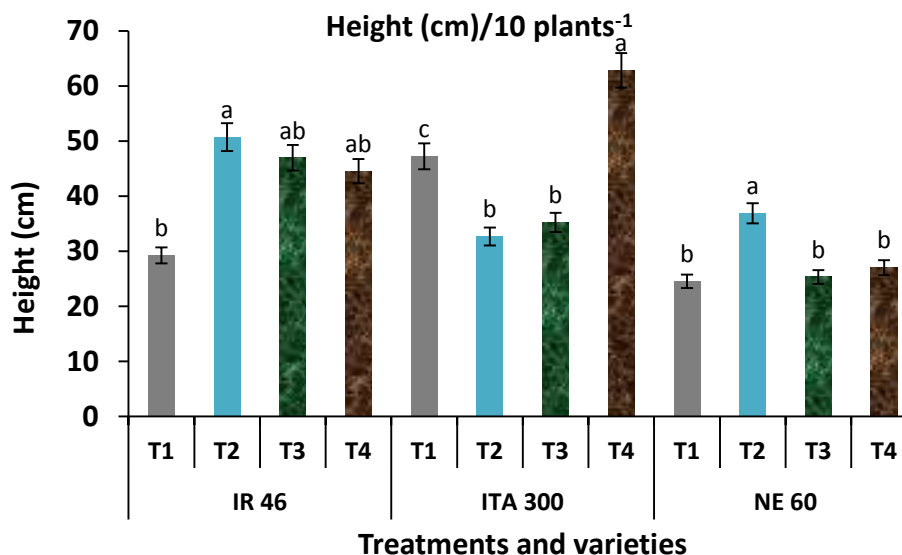


Figure 2: Height of plants for different varieties according to treatments. Treatments with the same letter are not significantly different at the level of probability considered ($P \leq 0.05$). T1 = control; T2 = mycorrhiza; T3 = organic manures; T4 = mycorrhiza + chicken manure.

Effect of Treatment to the Number of Tillers

Numbers of tillers per varieties were presented on the **Figure 3**. Effect of treatments not affect the number of tillers for the variety IR 46 and Nerica 60 excepted for the variety ITA 300 which the number of tillers was relatively higher by mycorrhiza, organic manures+mycorrhiza treatments as treatment compared to the control plots (**Figure 3**). Between varieties organic manures+mycorrhiza and mycorrhiza as treatments react to increase the number of

tillers of the variety ITA 300 compared to the control plots (**Figure 3**). Referred to others varieties, not effect of all treatments were recorded on the variety Nerica 60 compared to control plots, which explain the lower number of tillers for this variety. Within all treatments, organic manures+mycorrhiza and mycorrhiza treatments were significantly affect ($P \leq 0.05$) the variety ITA 300 on the number of tillers compared to others variety.

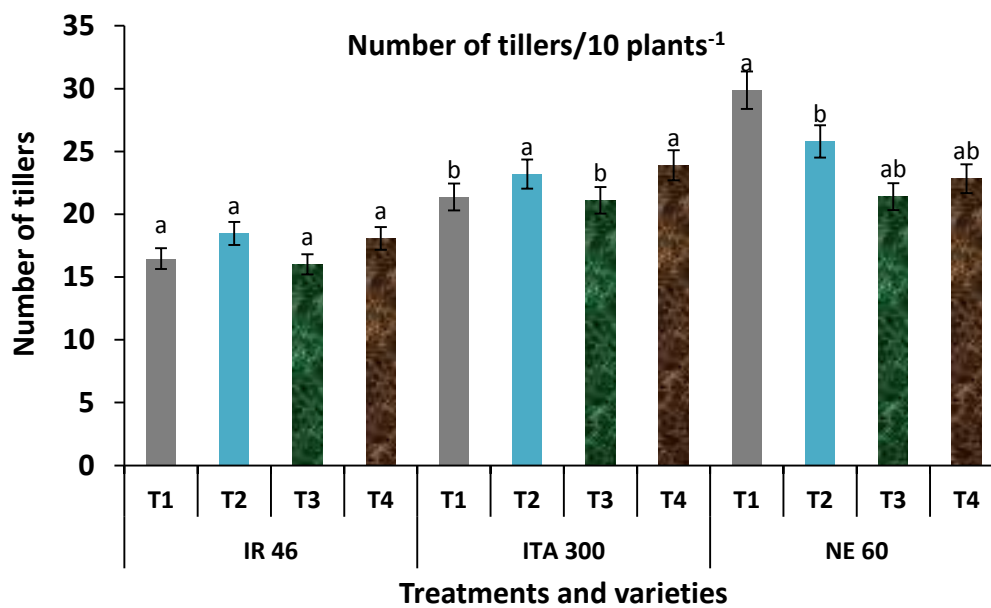


Figure 3: Number of tillers for different varieties according to treatments. Treatments with the same letter are not significantly different at the level of probability considered ($P \leq 0.05$). T1 = control; T2 = mycorrhiza; T3 = organic manures; T4 = mycorrhiza + chicken manure.

Effect of Treatment on the Number of Panicle

The effects of the different treatments on the number of panicle are showed on **Figure 4**. Compared to non-amended plots, mycorrhiza treatment increases the number of panicle for the variety IR 46, followed by variety ITA 300 with mycorrhiza and mycorrhiza+chicken manure as treatment (**Figure 4**). But within

the varieties, mycorrhiza treatment affect number of panicle for the variety IR 46 and ITA 300 compared to others treatments. Comparable to others varieties, not responses effect was recorded on the variety Nerica 60 by the uses of all the treatments compared to control plots. Effects treatments not significantly ($P \leq 0.05$) affect the number of panicle for all the varieties.

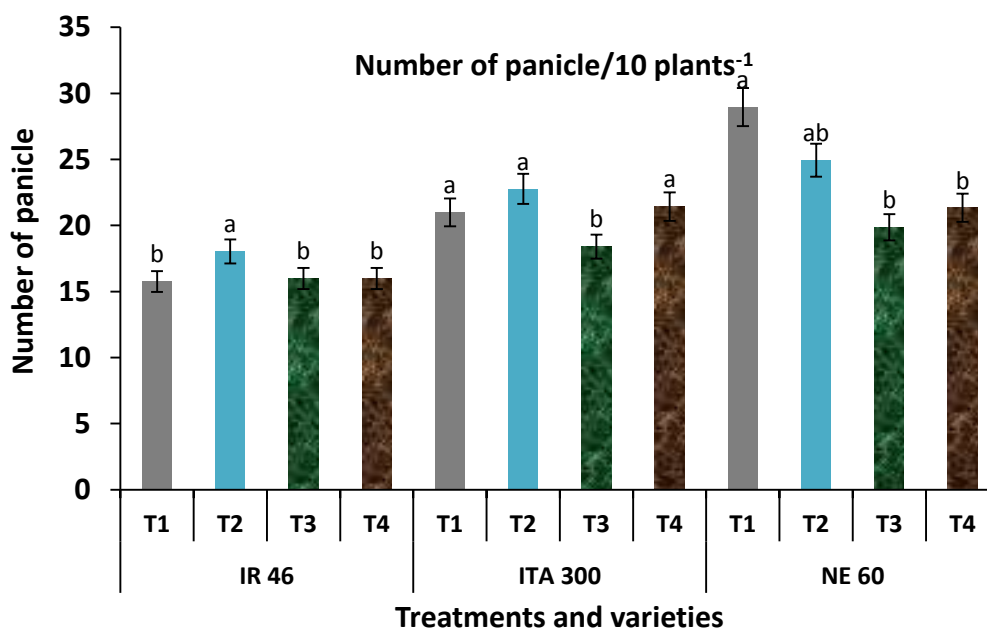


Figure 4: Number of panicle for different varieties according to treatments. Treatments with the same letter are not significantly different at the level of probability considered ($P \leq 0.05$). T1 = control; T2 = mycorrhiza; T3 = organic manures; T4 = mycorrhiza + chicken manure.

Effect of Treatment on the Number Seeds per Panicle

Seeds number per panicle for different variety by treatment was presented on table 5. Numbers of seeds per panicle were higher with organic manures and mycorrhiza treatment for the variety IR 46 and mycorrhiza treatments for the variety ITA 300 compared to non-amended plots (Table 2). Plants response per varieties are suitable respectively by the uses of mycorrhiza as treatments on the variety IR 46 and ITA 300,

followed by organic manures treatments on the variety IR 46 compared to non-amended plots. Referred to others varieties, all treatments not affected on number of seeds per panicle of varieties Nerica 60 compared to control plots. Compared to control plots, organic manure and mycorrhiza treatments affect ($P \leq 0.05$) the number of seeds per panicle respectively for the varieties IR46, ITA 300 and Nerica 60.

Table 2: Number of seeds per panicle for different varieties according to treatments

Treatments	Seeds per panicle/10 plants ⁻¹		
	IR 46	ITA 300	Nerica 60
T1	140.5 ± 30.23b	141.1 ± 32.29b	158.77 ± 34.93a
T2	148.73 ± 25.24ab	168.77 ± 38.51a	148.77 ± 34.01ab
T3	160 ± 48.27a	139.03 ± 30.79b	118.17 ± 24.53b
T4	136.53 ± 29.96b	133.53 ± 21.23b	122.23 ± 20.56b

NB: Values of the column for a variable followed by the same letter are not significantly different at the level of probability considered ($P \leq 0.05$). T1 = control; T2 = mycorrhiza; T3 = organic manures; T4 = mycorrhiza + chicken manure.

Discussions

Objective of this study was to evaluate the potentialities of varieties of rice amended with organic manure and mycorrhiza as treatments on growth parameters and

productivity in Sahelean area with a soil practically poor in organic matter. We evaluated some growth parameters as height of plants, number of tillers, number of panicle and number of seeds per panicle.

Restoration of soil fertility remains important and slow, which require the organic matter as fertilizers. The applied treatments of mycorrhiza, poultry manure and combined effects increased more or less the rice plant heights compared to the non-amended control plots. Applied of treatments positively improve growth of plants with organic manures+mycorrhiza treatments for all varieties followed by mycorrhiza treatment on varieties IR 46 and Nerica 60. Organic manure remains important sources of nutrients elements in soil and their effect favor the growth of rice with increasing of height of plants (Diallo. *et al.*, 2017). They induce the mineralization of organic matter and play an important role to release nutrients elements and water holding. Similar works of Gnamkoulamba. *et al.* (2018) on evaluation of potential of growth and production of rice inoculated on nursery showed the increasing which is more pronounced on height of plants amended compared to non-amended plants. According to Alguacil (2011) artificially mycorrhization with efficient and competitive AMF favor a good growth of plants.

Tillers number per rice plants compared to control plots was more pronounced on the variety ITA 300, which average number of tillers were relatively highest with mycorrhiza and organic manures+mycorrhiza as treatment. Inoculation with AMF has a beneficial effect on growth of plants such as plants size and tillers (Nadjilom. *et al.*, 2020). The number of tillers was most important with the applied of organic manure (Diallo. *et al.*, 2017). Although Fatin. *et al.*, (2019) reported the positive effect of organic manure on plants height, stem girth, and number of leaves compared to control. Theses effect provides to the additional nutrients element to the soil as organic manure. Same results were showed the increase of number of tillers of plants with AMF effect compared to non-amended plots (Gnamkoulamba. *et al.*, 2018; Nadjilom. *et al.*, 2020).

Numbers of panicle were important with mycorrhiza as treatment on the variety IR 46

and ITA 300 compared to control plots. Relationship within treatment and variety showed that these varieties responses well to the uses of mycorrhiza compared to the variety NE 60 which the effects of different treatments not affect growth of plants. Gnamkoulamba. *et al.*, (2018), number of panicle of plants are important on the plots which received mycorrhiza treatment compared to non-amended plots. Also AMF effect significantly increase the number and length panicles of rice (Nadjilom. *et al.*, 2020)

Numbers of seeds per panicle were higher with organic manures and mycorrhiza as treatment on the variety IR 46 and mycorrhiza treatments on the variety ITA 300 compared to non-amended plots. Responses of varieties were favorable respectively by the uses of mycorrhiza as treatments on the variety IR 46 and ITA 300, followed by organic manures treatments on the variety IR 46 compared to non-amended plots. AMF-inoculated rice revealed the improvement of yields which have been attributed to high number of panicles developed by AMF-plants (Nadjilom. *et al.*, 2020). Effect of organic manure also increased yields of spinach (*S. oleracea*) (Dikinya and Mufwanzala, 2010). Gnamkoulamba. *et al.*, (2018), the number of seeds per panicle are more pronounced on inoculated plants compared to control plots. Artificially inoculation by efficient and competitive fungi improves the production of plants compared to naturally mycorrhization (Gnamkoulamba. *et al.*, 2018).

Conclusion

In the actual context where soils are degraded naturally (erosion, lixiviation) or artificially (anthropic factors, chemical fertilizers) and where agriculture are one of major activity for development. It is important to initiated strategies to improve the productivity of culture like uses of Arbuscular Mycorrhizal Fungi (AMF). This study was made to evaluate the potentialities of rice varieties to the effect on organic manure and mycorrhiza, in order to determined best treatment and variety for producers. Ours results revealed that varieties ITA 300 and IR 46 responses

well on mycorrhiza treatments. The numbers of panicle and numbers of seeds per panicle were best by the applied of mycorrhiza and organic manure as treatment on variety IR 46 and ITA 300. These two varieties are potentially suitable and good quality for the production in the Sahelean zone.

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