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Original Research Article

Response of two cotton varieties on mycorrizal inoculation at Sudano-Sahelian savannah of Cameroon

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Abstract: In the Sudano-Sahelian zone of Cameroon, cotton crop is characterized by low production due to soil poverty and water stress. In this respect, Cameroonian cotton growers are now using chemical inputs to improve plants productivity. With the aim of sustainably increasing cotton growth in Far North Cameroon, study was carried out on effects of mycorrhizae on cotton productivity in two seasons cropping 2016 and 2017. Experimental design used for each of the both cotton varieties studied (Irma Q302 and L457) is split plot; main treatments are localities (Kodek and Mouda) and secondary treatments are fertilizers (unfertilized plants; chemical inputs and mycorrhizal inoculum at 02 levels: 20 and 30 g/plant). Growing and production parameters are evaluated. Results show that cotton productivity varies according to fertilizer, experimental area, year of study and cotton variety. Globaly, Mycorrhizal inoculum increases significantly ($p<0.05$) cotton fibers yield and cotton seeds yield compared to unfertilizer tratement and the application of 20 g of mycorrhizae per plant is more beneficial for cotton productivity. In conclusion, By using mycorrhizae for cotton cropping in Far North Cameroon, we contribute not only to increase cotton plants productivity, but also to limit the use of chemical inputs while ensuring sustainable agriculture.

Keywords: Cotton plants, productivity, mycorrhizae, Far North Cameroon.

INTRODUCTION

Cotton plants present a major economic role in rural areas of Central African. About 2 million farmers produce an average more than two million tonnes of cotton seeds and 830000 tonnes of cotton fibers. This volume of cotton fibers represents more than 15% of international trade, for a turnover between 500 and 700 billon FCFA (CMA/AOC, 2017).

In Cameroon, cotton crop covers about 250 000 ha and it is practiced by about 300 000 farmers. Average area per producer is around 0.8 ha (Ekorong, 2004 cited by Olina *et al.*, 2008). Cotton crop employs about 1.800 peoples for cotton seeds processing and products marketing. Also, it contributes to rehabilitation of approximately 9.000 km of tracks, the granting of credits for foodstuff inputs (about 3 billion FCFA/year) and for livestock development integrated in the farm (30-50 million FCFA/year) (Kadekoy-Tigague *et al*, 2010). Cotton crop is the engine of economy in Soudano-Sahelian zone of Cameroon.

Cotton crop unfortunately presents several difficulties: in particular the fall of cotton seeds prices combined to increasing of inputs; the decline of soil fertility, the multiplication of pests and the global cotton trade which is marked by sharp fluctuations in fiber prices (Yao, 2011, FAO, 2014, CMA / AOC, 2017). Face to declining of soil fertility, cotton growers of Sudano-Sahelian savannahs of Cameroon use chemical fertilizers to improve plants productivity. However, the using of chemical fertilizers exhibites an immediate beneficial effect on crop productivity and provides an immediate solution to declining of soil fertility problem, their high cost make them almost inaccessible to small farmers (Useni *et al.*, 2013 ; Tchuenteu *et al.*, 2018). Furthermore, its exclusive use causes an increase in acidity, a degradation of the physical status and a decrease of soil organic matter (Mulaji, 2011). In this context, it seems necessary to consider in local farming communities, the management methods that allow a rational and sustainable exploitation of bioresources (Manlay, 2000) and also to increase the agricultural production while protecting the

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natural ecosystems (Megueni *et al.*, 2011). In this respect, the use of biofertilizers such as mycorrhizae would contribute to improving cotton productivity in Far North Cameroon region while ensuring sustainable agriculture. Mycorrhizae are symbiotic associations between mycorrhizal fungi and plant roots. Indeed, mycorrhizal inoculum improves plant production by promoting plants hydromineral nutrition (Sheng *et al.*, 2008).

This investigation is designed to contribute to improvement of cotton productivity in Cameroon while limiting the use of chemical imputs as much as possible. Specifically, this work aims to study (1) the physicochemical properties of soils and climate conditions of the both localities Mouda and Kodek of Far North Cameroon; (2) the effect of levels of mycorrhizal fungi on cotton growth. The usefulness of this work is based on the fact that the level of mycorrhizal inoculum which will ensure optimal cotton fibers yield and cotton seeds yield will be popularized.

MATERIALS AND METHODS

Study Site

The study was carried out in two localities (Kodek and Mouda) of Far North Cameroon in two cropping seasons' years 2016 and 2017. Far North Cameroon region belongs to the agro ecological zone I known as the Soudano-Sahelian savannahs with a long dry season (9 months: October - June) and a short rainy season (3 months: July - September). The average annual temperature is 28.3^{o}C (CTFC, 2011). Study site in Kodek area was located at latitude 10°38 '43''; at longitude 14°24'27 " and 378 m elevation. In Mouda locality, Study site was located at latitude 10°37 '79''; at longitude 14°22'48" and 523 m elevation.

Materials

Cotton seeds

Cotton seeds varieties IRMA Q302 and IRMA L457 are used for this work. These seeds were provided by the Institute of Agronomic Research for Development (IRAD) of Maroua Cameroon. Both cotton varieties used present a short life cycle (120 days) and are very used by cotton growers of Far North Cameroon. Using variety presented short reproduction cycle is advantageous for farmers because they may have several harvests per year if they have off-season crops methods. Seeds physical characteristics of the both cotton varieties (IRMA Q302 and IRMA L457) used are presented in table 1.

Table 1: Origin and some characteristics of Irma L457 and Irma Q302 cotton varieties

Cotton varieties	Origin	Crop area	Agronomy	H (cm)	NSP
Irma L457 (ISA784× IrmaB192)	Cameroon (1996)	Nord	Long life cycle, productive, less long fiber	118.43	371.98
Irma Q302 (Irma BLT PF×Irma1466	Cameroon (1999)	Far-Nord and Nord	Very productive ; very long fiber	114.32	388.45

(Viot, 2014) H: Plants height; NSP: Number of seeds per plant

Mycorrhizal inoculum

Mycorrhizal inoculum is provided by Laboratory of Soils from Biotechnology Center of the University of Yaounde I Cameroon. It consists of a mixture of soil (clay, sand grains), root fragments of plants with fungal spores of Glomus and Gigaspora genus at level of 20 spores/g of substrate. According to Jansa et al. (2002), arbuscular mycorrhizal fungi of Glomus spp. and Gigaspora spp. genus are the best known. Glomus is a fungus that is not very host-specific (Bouamri et al., 2006, Wang et al., 2008).

Figure 1 : Mycorrhizal inoculum

Chemical inputs

Chemical fertilizer (NPKBS of formula 21.08.12.3.1.) and chemical insecticide (Trofort 400 EC) are used. They were purchased at Cotton Development Society (SODECOTON) from Maroua Cameroon (figure 2). These chemical inputs are suitable for cotton growing and are commonly used by cotton growers of Far North Cameroon.

a) Chemical fertilizer: NPKBS: 21. 08.12. 3.1

b) Chemical insecticide: Trofort

Figure 2: Chemical inputs

METHODS

Soil samples and soils physico-chemical properties

Soil samples from each study site were collected on the top eighty centimeters of soil using an auger. Soil samples were collected according to a five-point randomization device; in the center and at the four corners of experimental sites, thus constituting composite subsamples, which are then mixed to form a composite sample of 1 Kg per site. The collected soil samples were analyzed at the Laboratory of Research Unit for Soil Analysis and Environmental Chemistry (URASCE) of the University of Dschang (Cameroon). pH, soil contents on organic matter, nitrogen, phosphorus, potassium, calcium, magnesium and sodium was evaluated according to standard methods.

Evaluation of mycorrhizal inoculum on cotton productivity

Land preparation and experimental design

Study field was plowed at 5 cm depth and experimental design used for each of the both cotton varieties is a split plot; main treatments are localities (Kodek and Mouda) and secondary treatments are fertilizers (unfertilized plants ; chemical inputs : (NPKBS of formula 21.08.12.3.1.) and the Trofort (chemical insecticide) ; mycorrhizal inoculum at 02 levels (20 and 30 g/plant). Each experimental unit has 3 seedlings lines and each line has 10 poquets.

Sowing

Sowing took place on July of the both years 2017 and 2018. 03 seeds are placed per poquet at 3 cm depth (SODECOTON, 2015) and unmarking is carried out at 02 weeks after sowing so as to leave 02 plants/poquet. Mycorrhizal inoculum is applied at sowing time and it is put in direct contact with seeds and over entire cavity of hole. Chemical fertilizer is applied on 14^{th} day after sowing (Deschênes, 2010). The chemical insecticide is sprayed on aerial part of cotton plants pre-fertilized with chemical fertilizer using an Ulva brand rotating disc at flowering time (45 days after sowing).

Studied parameters and statistical analysis

During the vegetative phase, cotton plants height and number of leaves per plant are evaluated at regular intervals of 7 days from 17^{th} day after sowing. At fruits maturity, the number of capsules per plant is noted; cotton fibers yield and cotton seeds yield are evaluated. Cotton fibers yield or cotton seeds yield is evaluated according to the following formula: $Rh = (RS \times 10000)/S$ where Rh = yield/ha; RS = Yield on S area and S = sum of areas occupied by an experimental unit (ie 14.4 m^2); 04 experimental units are sampled.

All data were statistically analyzed using theStagraphic plus Program version 5.0. The significance of differences was determined using Duncan test.

RESULTS

Climate characteristics and soils physico-chemical properties

Climate characteristics

Ombrothermal diagram from June to October of the years 2017 and 2018 of Mouda and Kodek localities in Far North Cameroon revealed that precipitation and temperature vary according to study year and experimental area (figure 3). Precipitation was lower (531.5 mm) in 2017 compared to that (552.4 mm) of 2018. In 2017 the highest precipitation (164.6 mm) was observed in September while in 2018 the greatest precipitation value (203.6 mm) was noted in August. Average temperature from June to October of the years 2017 and 2018 were 28.43±1.24 and 31.35 ± 1.28 °C respectively. In 2017 minima (26,81 °C) and maxima (30.28 °C) temperature were observed in August and June respectively while in 2018 average monthly temperature vary from 29.74°C in September to 32.87 °C in October.

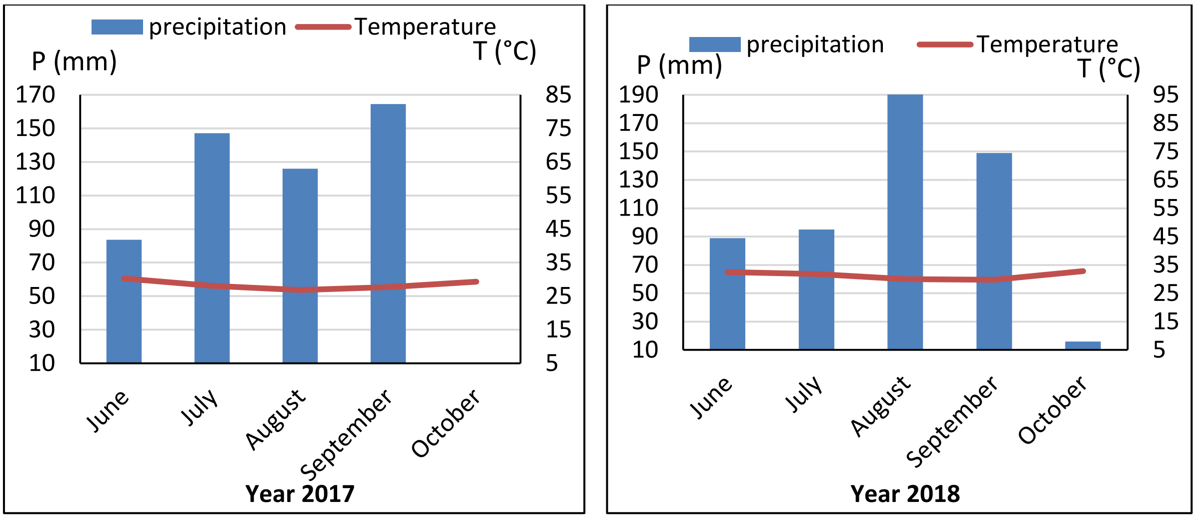


Figure 3 : Ombrothermal diagram depending year and locality

III.1.2. Soils physico-chemical properties

Soil Physico-chemical characteristics vary significantly ($p<0.05$) according to the both studiy sites (Kodek and Mouda) (Table 1). Soil texture from experimental areas indicates that soil from Mouda soil locality is richer in silt (55 ± 1.41%) while soil sand and silt contents from Kodek site are 44 ± 1.41 and 43 ± 2.12% respectively, suggesting that the soil from Mouda has a silty texture while in Kodek locality soil is sandy-loamy. In Mouda locality nitrogen soil content (0.410) and exchangeable base soil content (Ca2 +, Mg2 +, K + and Na +) (16.62 ± 3.27 meq / 100g) are higher while they are no significant difference between soils from the both study area on phosphorus content. Cationic exchange capacity of Mouda soil is 03 folds higher than that from Kodek.

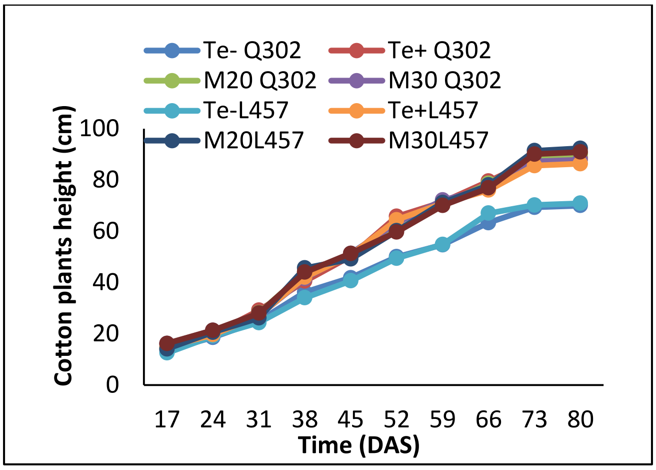
Table-1: Soils physico-chemical properties

Parameters		Localities		P-value
		Kodek	Mouda	
	% S	44.00±1.41^{a}	18.00±1.41^{b}	0.003 (**)
Texture	% L	43.00±2.12^{a}	55.00±1.41^{b}	0.022 (*)
	% A	13.00±0.28^{a}	27.00±2.12^{b}	0.011 (*)
pH		6.60 ±0,70^{a}	6.40 ±0.71^{a}	0.106 (NS)
C mg/g		1.70 ±0,01^{a}	1.82±0.03^{b}	0.033 (*)
MO mg/g		2.93 ±0,63^{a}	3.14 ±0.20^{a}	0.266 (NS)
N (%)		0.04 ± 0.01^{a}	0.04 ±0.01^{a}	0.072 (NS)
C/N		48.00 ±2.83^{a}	45.0 ±1.81^{a}	0.312 (NS)
Ca (meq/100g of DM)		5.92±1.43^{a}	13.52 ±1.39^{b}	0.033(*)
Mg (meq/100g of DM)		0.08 ±0.01^{a}	2.16 ±0.30^{a}	0.010 (**)
K (meq/100g of DM)		0.36 ±0.22^{a}	0.80 ±0.14^{a}	0.145 (NS)
Na (meq/100g of DM)		0.36±0.06^{a}	0.13 ±0.04^{b}	0.044 (*)
S(sum of base) (méq/100g of DM)		6.72 ±1,03^{a}	16.62 ±3.27^{b}	0.048 (*)
T (CEC) (méq/100g of DM)		9.88 ±1,02^{a}	27.04±1.47^{b}	0.005 (**)
P (mg/g of DM)		0.01±0.00a	0.01±0.00a	0.1830 (NS)

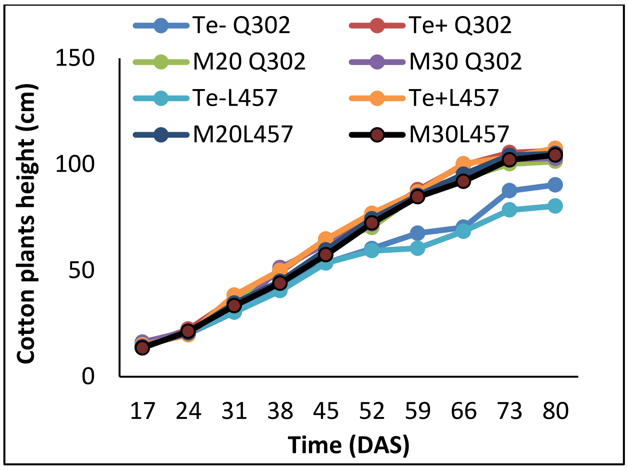
A : argile ; CEC : Cationic exchange capacity ; L : slit ; MO : organic matter ; S : Sand ; DM : Dry matter ; * : Significatif ; ** : Very significatif

Cotton plants height

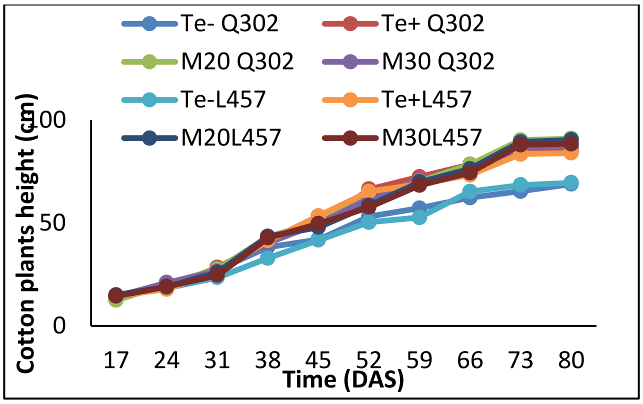
The analysis of variance reveale that at 80 days after sowing (DAS), fertilizers used in this work present a significant ($p<0.05$) effect on cotton plants height (figure 4). Unfertilizer plants exhibited the lowest plants height plants. Plants height ranged from 68.9 ± 9.50 cm for unfertilizer plants of Q302 cotton variety at Kodek locality in season cropping 2018 to 107.54 ± 8.76 cm for plants treated using chemical fertilizers of Irma L457 variety at Mouda area in season cropping 2017. Globally, cotton plants inoculated with 20 g of mycorrhizae are higher than cotton plants from plot treated with 30 g of mycorrhizal inoculum per plant. L457 cotton variety exhibited the highest plants in the both study areas (105.04 ± 9.23 cm and 92.3 ± 7.56 cm respectively in Mouda and Kodek localities) compared to Q302 cotton variety (102.87 ± 8.31 cm and 90.01 ± 7.46 cm respectively in Mouda and Kodek localities). Otherwise, among the both study area the highest plants height are observed in Kodek locality and cotton plants growth in season cropping 2018 exhibited less value of this growing parameter than those cultivated in season cropping 2017.



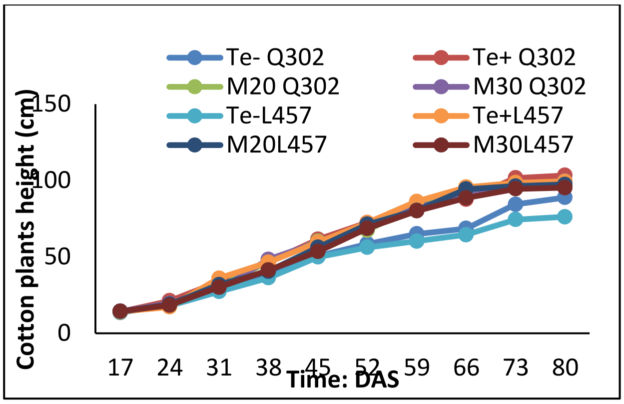
A : Kodek locality in 2017



B : Mouda locality in 2017



C : Kodek locality in 2018



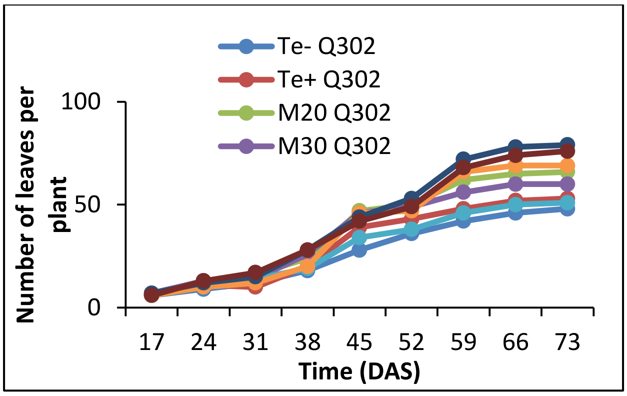
D : Mouda locality in 2018

Figure 4 : Cotton plants height depending time, variety, locality and experimental year

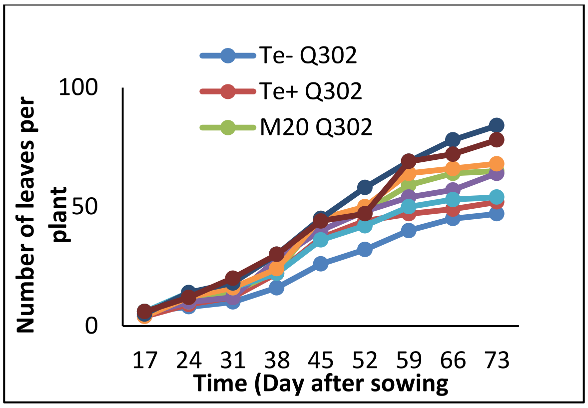
DAS : Day after sowing **; Te- L457** : unfertilized plants of L457 variety ; **Te+ L457** : Plants of L457 variety traited using chemical inputs ; **M20 L457** : Plants of L457 variety inoculated using 20 g of mycorrhizal inoculum per plant ; **M30 L457** : Plants of L457 variety inoculated using 30 g of mycorrhizal inoculum per plant ; **Te-Q302** : unfertilized plants of Q302 variety; **Te+Q302** : Plants of Q302 variety traited using chemical inputs ; **M20Q302** : Plants of Q302variety inoculated using 20 g of mycorrhizal inoculum per plant ; **M30Q302** : Plants of Q302variety inoculated using 30 g of mycorrhizal inoculum per plant

Number of leaves per plant

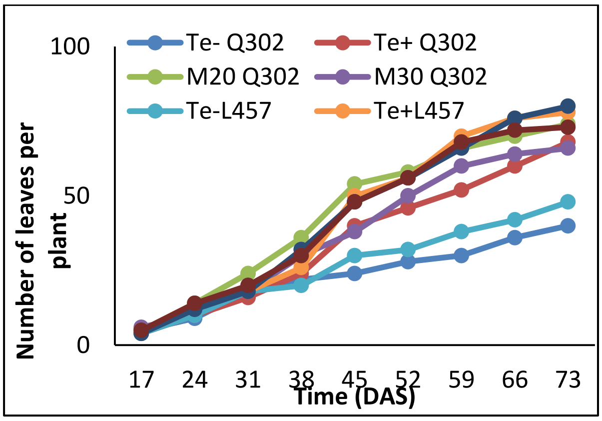
It come on figure 5 that at 73 days after sowing (DAS), fertilizers presented a significant ($p<0.05$) effect on foliar production of cotton plants. Unfertilized cotton plants exhibited the lowest number of leaves per plant. The number of leaves per plant ranged to 40±6.32 for unfertilized plant of Irma Q302 variety growth in Kodek locality in season cropping 2018 to 84±8.43 for Irma L457 fertilized using 20 of mycorrhizal inoculum per plant in Mouda area in season cropping 2017. Among the both levels of mycorrhizae used for the present study, cotton plants inoculated with 20 g of mycorrhizae exhibited the highest foliar production (80±7.54 et 84±8.43 number of leaves per plant for L457 variety in 2018 and 2017 in Mouda experimental farm; 79±8.76 et 80±5.82 number of leaves per plant for Q302 variety in 2018 and 2017 in Kodek study site). L457 presented the greatest foliar production in the both study localities (70 ± 8.54 and 71 ± 7.22 leaves per plant in Kodek and Mouda respectively) compared to Irma Q302 variety whose number of leaves per plant are 56 ± 5.58 and 62 ± 4.57 in Kodek and Mouda localities respectively.



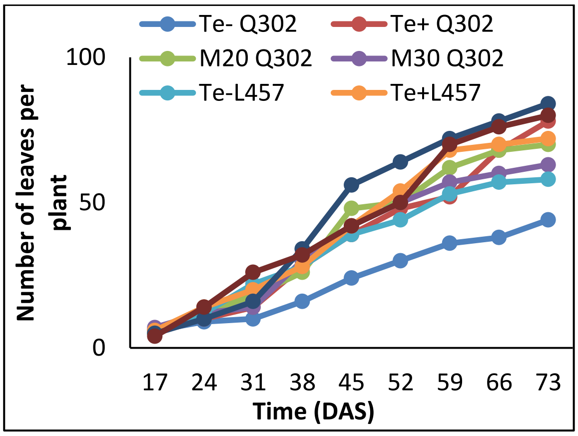
A : Kodek locality in 2017



B : Mouda locality in 2017



C : Kodek locality in 2018



D : Mouda locality in 2018

Figure 5 : Number of leaves per plant depending time, variety, locality and experimental year

DAS : Day after sowing **; Te- L457** : unfertilized plants of L457 variety ; **Te+ L457** : Plants of L457 variety traited using chemical inputs ; **M20 L457** : Plants of L457 variety inoculated using 20 g of mycorrhizal inoculum per plant ; **M30 L457** : Plants of L457 variety inoculated using 30 g of mycorrhizal inoculum per plant ; **Te-Q302** : unfertilized plants of Q302 variety; **Te+Q302** : Plants of Q302 variety traited using chemical inputs ; **M20Q302** : Plants of Q302variety inoculated using 20 g of mycorrhizal inoculum per plant ; **M30Q302** : Plants of Q302variety inoculated using 30 g of mycorrhizal inoculum per plant

Number of capsules per cotton plant

The analysis of variance indicated that the number of capsules per plant vary significantly ($p = 0.0001$) depending on treatments (Figure 6). The number of capsules per cotton plant ranged from 6 ± 0.60 to 12 ± 0.50 capsules per plantcapsules plant for the both cotton varieties cultivated (Irma Q302 and Irma L457) in our two experimental areas. The number of capsules per cotton plant inoculated using mycorrhizae (11 ± 0.80 capsules per plant) is higher than that of unfertilized plant (6 ± 0.60 capsules per plant) in both study sites.

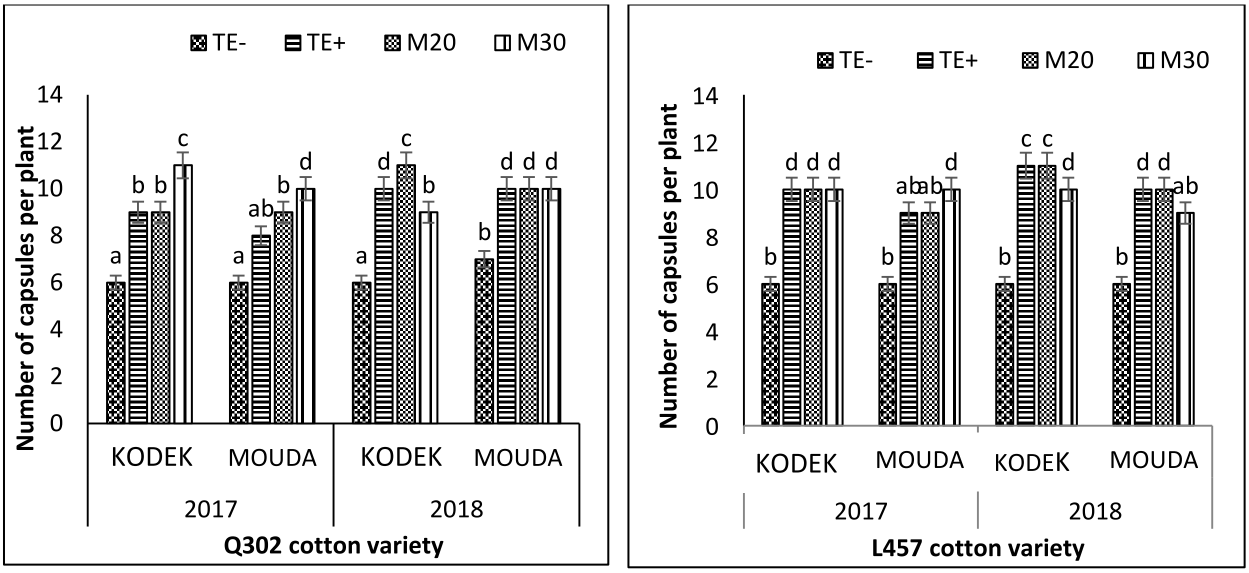


Figure 6 : Number of Capsules per cotton plant

Te- L457 : unfertilized plants of L457 variety ; **Te+ L457** : Plants of L457 variety traited using chemical inputs ; **M20 L457** : Plants of L457 variety inoculated using 20 g of mycorrhizal inoculum per plant ; **M30 L457** : Plants of L457 variety inoculated using 30 g of mycorrhizal inoculum per plant ; **Te-Q302** : unfertilized plants of Q302 variety; **Te+Q302** : Plants of Q302 variety traited using chemical inputs ; **M20Q302** : Plants of Q302variety inoculated using 20 g of mycorrhizal inoculum per plant ; **M30Q302** : Plants of Q302variety inoculated using 30 g of mycorrhizal inoculum per plant ; Value of band with the same color affected by the letter are not significantly different.

Cotton fibers yield

Treatments used in this work presented a significant ($p<0.05$) effect on cotton fibers yield (Figure 7). The lowest cotton fibers yield (569.81 ± 15.83 Kg / ha) was observed on unfertilized plants of Irma Q302 cotton variety at Kodek area. On the other hand, the highest cotton fibers yield (1458 ± 10.01 Kg/ha) was from cotton plants fertilized using chemical inputs of Irma L457 variety in Mouda locality in season cropping 2017. Cotton fibers yield of plants inoculated with 30 g of mycorrhizae is higher than that of cotton plants inoculated using 20 g of mycorrhizae per plant. Levels of 20 and 30 g of inoculum mycorrhizal per poquet increased cotton fibers yield of Q302 variety at 36.22% and 36.32% respectively compared to unfertilized plants in Kodek locality. In Mouda experimental site, 20 and 30 g of mycorrhizal inoculum per plant increased cotton fibers yield at 9.8% and 7.48% respectively compared to cotton plants cultivated on unfertilized plots. In addition, cotton fiber yield is greater in Mouda locality than Kodek area.

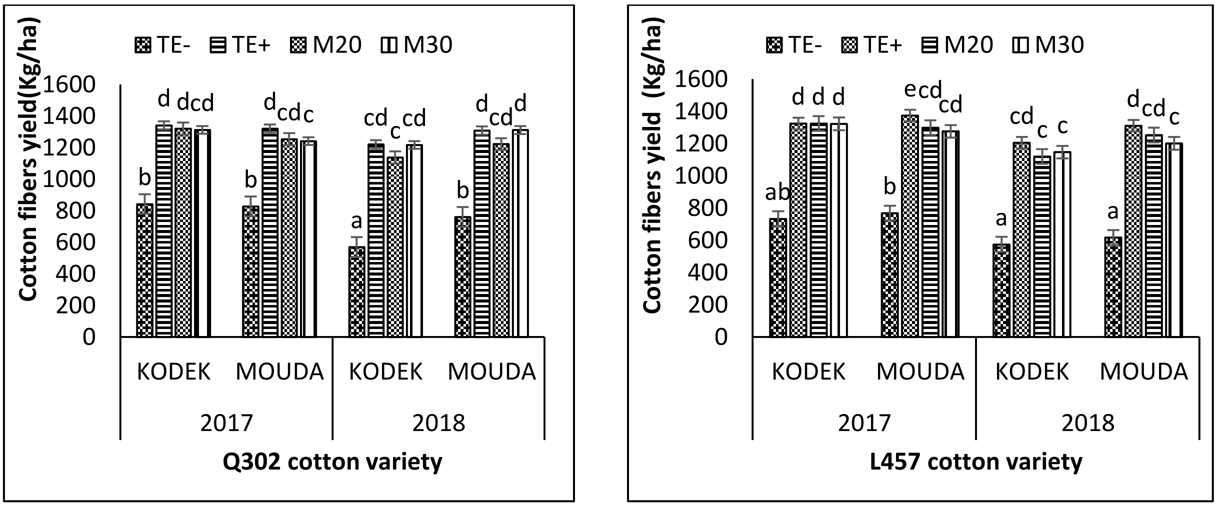


Figure 7 : Cotton fibers yield (Kg/ha)

Te- L457 : unfertilized plants of L457 variety ; **Te+ L457** : Plants of L457 variety traited using chemical inputs ; **M20 L457** : Plants of L457 variety inoculated using 20 g of mycorrhizal inoculum per plant ; **M30 L457** : Plants of L457 variety inoculated using 30 g of mycorrhizal inoculum per plant ; **Te-Q302** : unfertilized plants of Q302 variety; **Te+Q302** : Plants of Q302 variety traited using chemical inputs ; **M20Q302** : Plants of Q302variety inoculated using 20 g of mycorrhizal inoculum per plant ; **M30Q302** : Plants of Q302variety inoculated using 30 g of mycorrhizal inoculum per plant ; Value of band with the same color affected by the letter are not significantly different.

Cotton seeds yield

The analysis of variance shows that there is a significant ($p<0.05$) difference between treatments on cotton seeds yield (figure 8). Cotton plants from unfertilized plots exhibited the lowest value of this production parameter. Cotton seeds yield ranged from 1198.08 ± 25.21 kg/ha for L457 variety in Kodek to 1597.92 ± 13.04 kg/ha for L457 variety in Mouda area. Plots treated with 20 g and 30 g of mycorrhizae increased cotton seeds yield of Q302 variety at 11.9% and 17%, respectively relative to unfertilized plant from Kodek locality. In Mouda site, 20 and 30 g of mycorrhizae per poquet increased cotton seeds yield of L457 variety at 9.8% and 7.48% respectively relative to no fertilized cotton plants.

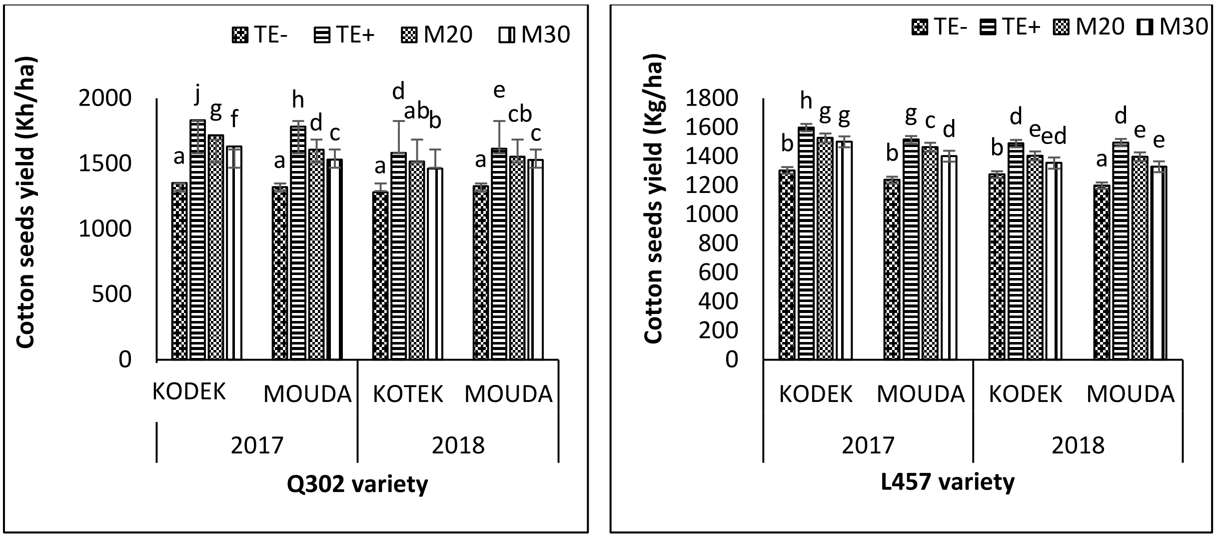


Figure 8 : Cotton seeds yield

Te- L457 : unfertilized plants of L457 variety ; **Te+ L457** : Plants of L457 variety traited using chemical inputs ; **M20 L457** : Plants of L457 variety inoculated using 20 g of mycorrhizal inoculum per plant ; **M30 L457** : Plants of L457 variety inoculated using 30 g of mycorrhizal inoculum per plant ; **Te-Q302** : unfertilized plants of Q302 variety; **Te+Q302** : Plants of Q302 variety traited using chemical inputs ; **M20Q302** : Plants of Q302variety inoculated using 20 g of mycorrhizal inoculum per plant ; **M30Q302** : Plants of Q302variety inoculated using 30 g of mycorrhizal inoculum per plant ; Value of band with the same color affected by the letter are not significantly different.

DISCUSSION

Soils from the bot study sites (Mouda and Kodek) are acidic, which is in conformity to Olina *et al.* (2008) who revealed that average soil pH of Far North Cameroon is 6; in addition Mbonigaba *et al.* (2009) reported that tropical soils are acidic. Soil contents in organic matter and mineral elements vary depending study sites, thus suggesting that Mouda and Kodek localities would influence plants growth; in this respect the study of Mouda and Kodek localities on cotton plants growth is needed. Soil's physico-chemical properties present an important role in plant production as well as on nutrient management (Megueni *et al.,* 2011 ; Tchuenteu *et al.,* 2018).

It is observed in the present work that cotton plants height varies from 68.90 ± 9.50 to 107.54 ± 8.76 cm. This result corroborates to Sekloka (2006) who reported that cotton plants height varies from 53.1 to 100.3 cm. The plant height is an important parameter for the harvesting process. In fact tall plant are not easily subjected to harvesting. In this work, Q302 variety presented the smallest plant height, thus suggesting that the harvesting of fruits of this cotton variety is easier. In addition, study of several authors (Ngakou *et al.,* 2008; Tchuenteu *et al.,* 2013) revealed that there is a positive and significant correlation between plants height and foliar production.

In this work, the numbers of leaves per plant ranged from 40 ± 6.32 to 84 ± 8.43, these data are very higher than those reported by N'goran *et al.* (2016) who reported that the number of leaves per cotton plants ranged between 12 and 20. Leaves are the organs responsible for photosynthesis, increasing of cotton leaf production suggest an increase of photosynthetic activity, consequently an increase of fiber yield and seeds yield. Among levels of mycorrhizae used for this work, cotton plants inoculated with 20 g of mycorrhizae exhibited the highest foliar production In this respect, we expected a greater fibers and seeds yields on plants grown on plots fertilized using 20 g of mycorrhizae per poquet, but this remains to be determined. In addition, it has been reported by our predecessors (Koutroubass *et al.,* 1999, Tchuenteu *et al.,* 2013) that foliar production and seed yield are both proportional parameters.

In this study, cotton fibers seeds ranged from 569.81 ± 15.83 to 1458 ± 10.01 kg/ha and cotton seeds yield ranged betweeb 1198.08 ± 25.21 and1597.92 ± 13.04 kg/ha. These results corroborate data reported by SODECOTON (2013), which reported that cotton fibers yield and cotton seeds yield are 1250 kg/ha and 1400 kg/ha respectively. Cotton fibers and cotton seeds are a source of income for Cameroonian farmers. Cotton fibers are used for clothing manufacture and sanitary products including compresses and cotton. Cotton seeds oil is consumed and it is using for soap manufacture.

In the present study, cotton plants are more productive during the first season cropping 2017 compared to second season cropping 2018.

This variation of cotton growing depending cropping season would be due to climate variations observed between the both cropping year. In fact, these studies were carried out from July to October 2017 and 2018. Average rainfall during the cropping season 2017 is 531.5 mm while they are 552.4 mm in 2018 ; average temperatures vary from 28.43 ° C from July to October 2017 to 31.35 ° C for cropping period of the year 2018. It is observed in this study that climate change affects cotton plants productivity, thus suggesting that fighting against climate chnage is needed in order to maintain the stability of agricultural production.

Experimental sites presented an effect on cotton growth. Mouda locality is more favorable for cotton growing. This variation cotton productivity according to study area must be justified by difference between soils physico-chemical characteristics of study area. Indeed, the soil of Mouda locality resented silty texture whereas in Kodek locality soil texture is silty-sandy. In Mouda region, nitrogen soil content (0.410) and soil exchangeable base content ($Ca2 +$, $Mg2 +$, $K +$ and $Na +$) (16.62 ± 3.27 meq/100g of soil) are greater than those of Kodek ; the soil of Kodek is richer in phosphorus.

L457 cotton variety adapts better in ours both study areas than Q302 variety. Variation observed on cotton productivity according to cotton variety would be justify by the fact that these cotton variety would present different genotypic constitution. Indeed, Irma L57 cotton variety is derived from cross between ISA784 × IrmaB192 while Q302 variety is derived from cross between Irma BLT-PF×Irma1466.

Mycorrhizal inoculum used in this work improved cotton seeds yield and cotton fibers yield. The beneficial effect of mycorrhizae on plants productivity have been demontrated. Mycorrhizae are symbiotic associations between mycorrhizal fungi and plant roots. Mycorrhizae promote the hydromineral absorption of plants and thus improve plant growth and development (Megueni *et al.,* 2011, Hamza 2014, Tchuenteu 2014, Tobolbai *et al.,* 2018). Cotton plants inoculated using 20 g of mycorrhizae per poquet exhibited higher cotton fibers yield and cotton seeds yield than plants grown on plot traited with 30 g of mycorrhizae per poquet, this benefict effect of 20 g of mycorrhizae per plant on cotton plant growth compored to 30 g of this biofertilizer per plant would be justify by competition between mycorrhizal fungi species which constitutes our mycorrhizal inoculum. Substrate used as biofertilizer for this study is composed of fungal spores of *Glomus* and *Gigaspora* genus at level of 20 spores/g of substrate. By using the mycorrhizal innoculum for cotton cropping in the Sudano-Sahelian savannahs of Far North Cameroon, we contribute no only to improvement of cotton plants growth, but also to limit the using of chemical inputs and to ensure sustainable agriculture.

CONCLUSION

The purpose of this study was to contribute to improvement of cotton growth in Mouda and Kodek localities of Far North Cameroon while limiting the use of chemical imputs. Cotton plants growth varies depending cotton variety, experimental area, study year and fertilizer. Mouda locality is more favorable for cotton growing than Kodek area. Unfertilized cotton plants are less productive than plants from fertilized plot. L457 cotton variety adapts better in the both study sites (Mouda and Kodek localities). Application of 20 g of mycorrhizal inoculum per plant is more beneficial for cotton fibers yield and cotton seeds yield than 30 g of this biofertilizer per poquet. By using mycorrhizae for cotton cropping in Far North Cameroon, we contribute not only to increase cotton plants productivity, but also to limit the use of chemical inputs while ensuring sustainable agriculture.

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