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(Effect Of The Doses Based On Four Strains Of Arbuscular Mycorrhizal Fungus (AMF) On Pathological Symptoms And The Production Of 3 Varieties Of Bambara Groundnut (Vigna subterranea (L.)) On The Field, Dschang-West Cameroon)

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Abstract: *The study was carried out in the Experimental and Research Farm and in the Phytopathology Laboratory and Applied Zoology of FAAS. Objective is to improve the production of Bambara groundnuts on field based on four strains of Arbuscular Mycorrhizal Fungus (AMF) and identify potential Fungi pathogens of this culture in West Cameroon. For this study, 3 varieties of Bambara groundnuts have been used, the local varieties of Dschang (VL) and two varieties of North Cameroon (V1M et V2M). The doses of mycorrhiza at 10 and 20 g were compared with the control (0 g) in a split-plot design combining two factors (doses and varieties) with 3 repetitions. After doing purity test of seeds, we evaluated the infection rates of each different seeds, types of Fungi species related to seeds, frequency and severity of pathologic symptoms in field, and yield of pods of varieties. Our results showed that variety V2M was most infected among the 3 varieties with the infection rates of 40 %, following by the local variety VL (16 %). However, three types of Fungi belong to the genus of Aspergillus and Mucor were been identified which frequently colonize the varieties. A. niger was been isolated from 3 varieties with a high rate on the variety V2M (8 %) and VL (7 %). A. flavus was isolated from with a high rate on the variety V2M (5 %). Mucor sp was isolated only from the variety V2M at a rate of 7 %. The frequency of dark reddish symptoms on leaves of each variety most appeared on non-inoculated plants and inoculated plants. This symptom was most severe on leaves of the variety V2M at 10g and 20g. According to the table of Horsfall-Barrat, severity rate symptom of dark reddish on leaves from the 3 inoculated varieties varying from the two doses. We recorded the severe evolution of this symptom on the variety V2M during growing. Inoculated plants are less affected compared to plant control. The frequency of whitish symptoms on leaves of the varieties was been observed on non-inoculated and inoculated plants with the two doses. It appears mostly on the variety V2M at 10 and 20g compared to the variety V1M and VL. Generally, plants inoculated were less affected by this symptom for each dose compared to plant control at 0g. This study had shown that direct inoculation with AMF during sowing on-field increases yield pods of the variety VL and improves the production of the variety V1M of North Cameroon. The study permits the conclusion that the variety V1M and VL are capable on the zone at 20g. The variety V2M is susceptible to the symptom of pathology.*

***Keywords**: Mycorrhizal Fungi, Bambara groundnuts, Bio-control, Yields, Plant pathology.*

I. INTRODUCTION

Bambara groundnut (*Vigna subterranea* (L.)) is one of minor leguminous food which their culture is limited in sub Saharian of Africa. It is adapted on several climatic and ecological conditions (IPGRI/BAMNET, 2000; Madou *et al.*, 2018). In Africa, this culture is considered as a third leguminous in terms of production and consumption after Peanut (*Arachis hypogeae* (L.)) and Cowpea (*Vigna unguiculata* (L.)). In West Africa where 70 % of total production provides on cultivated plants, this culture involves like integrated plants on agricultural systems. Seeds serve in human's consumer, only or mixed with others aliment. Leaves rich on phosphorous elements serves on feeding animals. Seeds and leaves of plants are also uses in traditional medicine (Nacoulma-Ouédraogo, 1996). Bambara groundnuts is a plant potentially high in caloric (387 kcal.100 g-1), rich in vitamin, mineral elements and protein (Oniwamo *et al.*, 1998; Diallo *et al.*, 2015; Minka Bruneteau, 2000). They contribute to increase the availability of Phosphorous on a ferralitic soil by their capacity to fix Nitrogen (Andriamananjara, 2011; Amadou *et al.*, 2018). The yield is relatively less by the high rate of soil humidity. However, means yields is situated among 350 to 800 kg/ha-1 on a region where the soil is poor and few rainfalls (Linnemann, 1994).

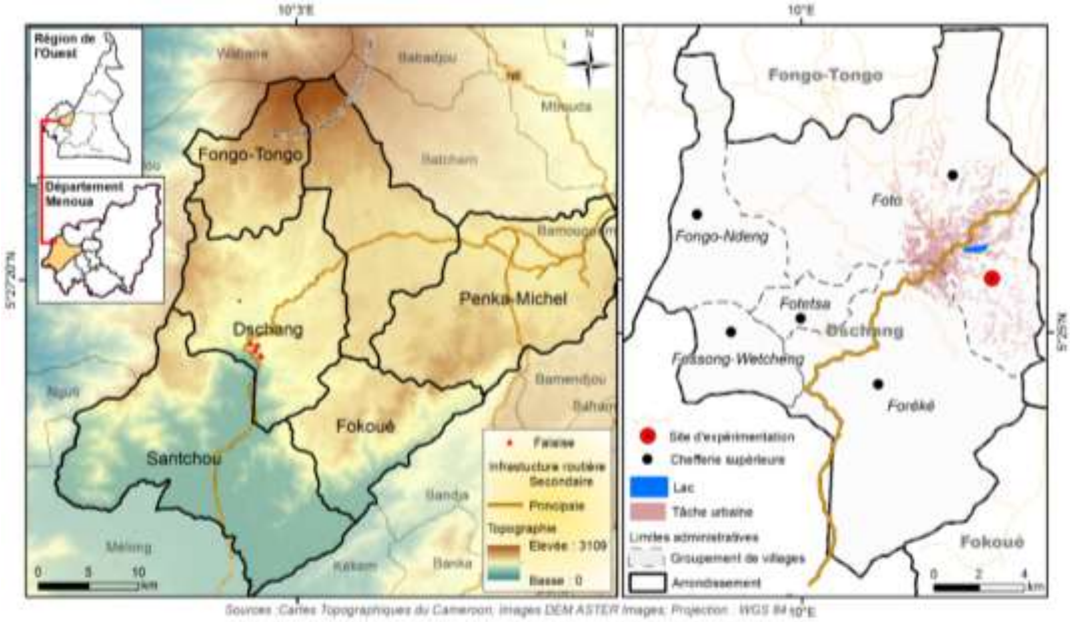
In western Cameroon, this crop is not well known and is considered as a marginal crop in many localities. Production improvement methods are possible to increase crop yields through the use of chemical fertilizers, pesticides and new varieties (Dalgaard *et al.*, 2003). However, the intensive and abusive use of chemical pesticides generates environmental problems (soil and air pollution and the presence of certain waste products on the soil) and affects human health.

Therefore, microorganisms represent promising alternatives to minimize the use of chemicals by replacing them or reducing their rate of application to control plant pathogens (Hajek & Eilenberg, 2018). AMF has been reported to reduce damage caused by pathogens in numerous crops (Plouznikoff *et al.*, 2016). In banana, their beneficial effects have been shown in the control of the nematodes such as *Radopholus similis* (Anene & Declerck, 2016) and Pratylenchus species (Tixier and Quénéhervé, 2008) as well as the soil fungi *Cylindrocladium spathiphylli* (Declerck *et al.*, 2002). Improves of soils fertility by the uses of news strategies is a necessary. Conventional agriculture is necessary to focus on a sustainable agriculture system using less pesticide. Arbuscular Mycorrhizal Fungus (AMF) and bacteria fixing nitrogen which forms a symbiosis with plants appear as important organisms to crop production. This symbiosis induces the formation nodules and by the uses of mycorrhiza on roots of plants of family Fabaceae (Roger *et al.*, 2001; Selosse *et al.*, 2006). Mycorrhizal plants profit from the association by increasing plants roots and biomass which provides to Mycorrhizal Fungus. Plants could better use certain component of soil (Besserer *et al.*, 2006). Uses of mycorrhiza could promote the absorption of Phosphorous and transfer of elements like water, copper, zinc (Johansson *et al.*, 2004). They contribute to protect also plants against fungus diseases (Liu *et al.*, 2007). Biological methods based on the uses of antagonic organisms as phytopathogens agents could constitute one promising solution. One of preventive strategies consists to stimulate natural defenses of plants by mycorrhization. In fact, it knows that the damages cause by some parasites (Fungus, Bacteria or Nematodes) could be reduces to inoculated plants (Whipps, 2004). Arbuscular Mycorrhizal Fungus seems to reduces frequency or severity of effect causes by some fungus phyto-pathogens on roots systems like genus Rhizoctonia, Fusarium, Verticillium, Phytophtora, Pythium and Aphanomyces (Whipps, 2004; St-Arnaud *et al.*, 1995), some bacteria like *Xanthomonas campestris* (Liu *et al.*, 2007) and nematodes as *Meloidogyne incognita* and *Pratylenchus penetrans* (Vos *et al.*, 2012). Unfortunately, few data exist on pathology that affects Bambara groundnuts either on seeds (post- harvest) or on field. In this context, the present work was being motivated in order to identify and evaluate frequency or severity of pathological symptoms of three inoculated varieties of Bambara groundnuts on field. Specifically, this study consists to make purity of seeds by in vitro test based on the methods of ISTA (2005), evaluate frequency and the different pathological fungus symptoms observed on theses varieties of Bambara groundnuts. The objective of this study is to optimize the production of three inoculated varieties of Bambara groundnuts on field based on four strains of Arbuscular Mycorrhizal Fungus (AMF) while identifying and reduces the gravity of fungus pathogens in West Cameroon.

II. MATERIALS AND METHODS

II.1. DESCRIPTION OF STUDY

The study was conducted in the west region of Cameroon, precisely in the Experimental and Research Farm and in the Phytopathology Laboratory and Applied Zoology of FAAS. This region with 13.872 km2 of area, is characterized by 8 departments (Manga et al., 2013). Climate of west region is Sudano-Tropical type with 2 seasons: dry season that take place from October or November to March or April and the rainy season that start from March or April to October or November. The means of annual rainfall varying from 1800 and 2000 mm (IRAD, 2002). The study was carried during the period from December 2017 to May 2018. The average of temperature during dry season was 21.11° C that take place in February. For rainy season, average temperatures begin on February to May with 11.6 mm of precipitation. West is located at 5°0'6°0'N and 10°0'11°0'W with means temperature that varying between 15 to 30°C (25° C during the day). Picture 1 shows the map of the locality of area.



Picture 1: Site study localization

II.2 Agroecological description

Site was cover with the fallow of five months and dominated with herbaceous. The anthropic factors due to human's activities have contributed to the dispersal of perennials shrubs. The vegetation was dominated mostly by the plants of *Tithonia diversifolia*, *Mimosa pudica*, *Ageratum conyzoides, Cyperus esculentus*, *Bidens pilosa*, *Cynodon dactylon.*

III. Materials

III.1. Vegetal material

Vegetal material is constituted of different morphotypes of Bambara groundnuts provides on the north and West region (Picture 2).

North (V1M) **North (V2M)** **West (VL)**

Picture 2: Morphotypes of Bambara groundnuts used (source, WANG-BARA Bertrand, 2018)

IV. Biological material

IV.1 Mycorrhiza

Bio-fertilisant Myco providing from GIC AGRIBIO CAM had used like biological. It's adapted to local sols for nursery culture (legumes, fruit and horticultural plants) and field culture like leguminous, cereals and fruit. This bio-fertilizer is characterized by 4 strains of AMF such as, *Rhizophagus irregularis* (50 %), *Scuttellospora gregaria* (10 %), *Gigaspora margarita* (20 %), *Glomus hoi* (20 %).

Picture 3: Mycorrhiza that contains 4 strains of AMF.

V. METHODS

V. 1 EXPERIMENTAL DESIGN

Experimental design for this study is a split-plot design combining two factors (doses and varieties) with 3 repetitions. The principal factors are doses of mycorrhiza with 3 levels (d0 = control, d1 = 10 g of mycorrhiza and d2 = 20 g of mycorrhiza) and second factors are varieties with 3 levels (Local Variety VL, Mendéo V1M and Mendéo V2M). Each block is divided in three (3) sub-blocks and each sub-blocks have three sub-units that consist on a total of 27 unities. The total surface of design was 230 m2 and each unity was separated from 0.5 m. However, each block was separated from 1m and the experimental unit had 6 plants according to width, 8 from the length. The total plants within the surface of experimental design are 48 plants, with the density of 133.333 plants/ha.

V.2 SITE IMPLEMENTATION

The site had been previously taking place by cereals culture which remains good for the rotation of culture. Plot preparation consisted firstly to make labor of soil at 15 to 20 cm of depth, make an experimental unit and supply water during one week.

V.3 INOCULATION PROCESS

It is consisted to saw each seeds after inoculation process during dry season. Seeds of each morphotypes have been sowed on December 2017 in reason of two seeds hole at 2 to 3 cm of depth. The inoculation processes used is a method describe by GIC AGRO-BIOCAM which consist to apply directly each doses of inoculants) during the periods of sowing. In order to avoid effects of contaminant on mycorrhiza in fields, controls have been firstly sow before.

V.4 PLANT HEALTH PROTECTION

For this study not treatment was carried during growing cycle of plants.

V.5 ASSESSMENT OF THE PATHOLOGY PARAMETERS

In this study, the variables evaluated were: the purity seeds, frequency and severity of pathological symptoms on field.

V.5.1 PURITY OF SEEDS TEST IN LABORATORY

By the methods describe by ISTA (2005), it is consisting for:

1. The infection rate consists to identify and count the infected seeds in each petri dishes for the different varieties in order to evaluate pathogens rate related to seeds according to this formula:

$$Infection\ rate = \frac{\textbf{number of infected seeds}}{\textbf{Total number of seeds tested}} \times \mathbf{100}$$

2. The frequency of fungi consists to identify and count specific fungus of each morphotypes by the formula:

$$Frequency = \frac{\textbf{Number of specific fungi}}{\textbf{Total number of fungus identified}} \times \mathbf{100}$$

V.5.2 OBSERVATION AND IDENTIFICATION OF PATHOLOGICAL SYMPTOMS ON LEAVES

Evaluation of pathology is based on direct observation of types of different symptoms on each leaves of varieties. Observations on field based on the apparition of different symptom were started during growing of plants and the majority of symptoms were appeared at 15th DAS. The Frequency of collect data was at one week on 10 plants taken as reference during vegetative growth. For each different symptom appeared on plants picture were taken in comparison with the main symptoms which affects Bambara groundnuts.

V.5.3 FREQUENCY (IC) AND SEVERITY (G) OF PATHOLOGICAL SYMPTOMS

In each experimental unit, frequency and severity of the pathology was evaluated on each plant taken as reference to collect data by the formula:

$$\text{Ic (\%)} = \frac{\text{Number of infected plants}}{\text{Total Number of plants considered}} \times 100$$

Ic (%) = Frequency of the pathology in percentage.

$$\text{G (\%)} = \frac{\text{Proportion of surface of infected tissue of leaves}}{\text{Total surface considered}}$$

G (%) = severity of the pathology in percentage.

It was noted according to the table of Horsfall-Barrat varying from 1 to 12. **Table 2:** Scales of the severity of the pathology according to the table de Horsfall-Barrat

Code (%)	Rate of severity (%)	Average of severity
1	0	0
2	0-3	1.5
3	3-6	4.5
4	6-12	9
5	12-25	18.5
6	25-50	37.5
7	50-75	62.5
8	75-87	81
9	87-94	90.5
10	94-97	95.5
11	97-100	98.5
12	100	100

Source: Agrios (2005).

V.6 STATISTICAL ANALYSIS

Data collected for each parameter was recorded on a table of Excel de Microsoft. 2017. These data were transferred from the software of SPSS. 21 for analysis of variance (ANOVA) and the means have been separated with the test of Tukey for the comparison of average at 5 % of probability.

VI. RESULTS

VI. 1 INFECTION RATE OF DIFFERENT VARIETIES

The table 3 below shows the infection rate of seeds recorded. On a total of 198 seeds tested on laboratory, the variety V2M of the North was most infected with the infection rate of 40.4 %, follow by the local variety VL with of West (16.67 %). In contrast the variety V1M appear less infected 6.56 %. Results of ANOVA showed a difference ($P \leq 0.05$) on the number of infected seeds for each different variety. In comparison the number of infected seeds was highest on the variety V2M to the varieties VL and V1M.

Table 3: Infection rate of the varieties of Bambara groundnuts.

Variety	Seeds tested	Infection rate (%)	Seeds infected.Petri^{-1}
VL	198	16.67	1 ± 1.34b
V1M	198	6.56	0.39 ± 0.55c
V2M	198	40.40	2.42 ± 1.69a

NB: **VL** = Locale variety of Dschang, **V1M** = variety 1 of North, **V2M** = variety 2 du North.

VI.2 TYPES OF FUNGUS IDENTIFIED FOR DIFFERENT VARIETY

The Figure 1 shows the frequency of infection of fungus recorded on seeds tested. Three main fungus belong to the genus Aspergillus and Mucor were been identified on seeds. Its concern mainly *Aspergillus niger*, *Aspergillus flavus* and *Mucor sp*. *Aspergillus niger* was identified on the variety V2M of North (8.58 %), following by the local variety VL of Dschang (7.57 %) and the variety V1M (4.54 %). This fungus has colonized all the seeds of different varieties. *Aspergillus flavus* was been identified on the variety V2M of North (5.55 %), followed by the variety V1M (1.51 %) and the local variety VL (1.51 %). The three varieties were colonized by this fungus. *Mucor sp* fungi was been identified only on the variety V2M of North with the average of 7.57 % (**Figure 1**).

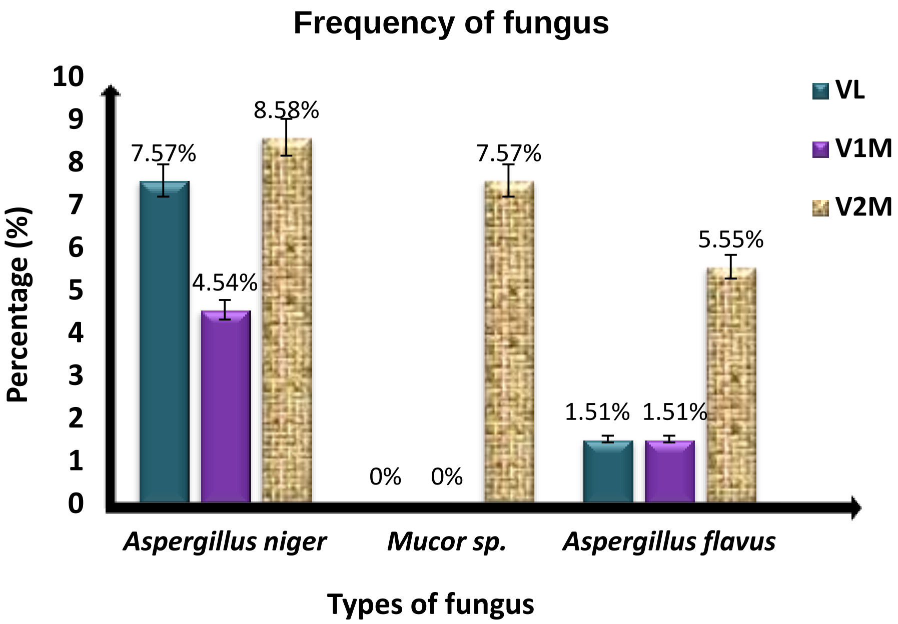


Figure 1: Types of fungus related to seeds.

VI.3 FREQUENCY (IC) OF SYMPTOMS OF DISEASES

During the stages of growing, the observation was made on two types of pathological symptoms frequently identified on leaves of each different variety, mainly dark reddish symptoms and whitish symptom on leaves.

The table 4 shows frequency of dark reddish symptoms similar to the symptoms Cercospora diseases according to the doses and variety. We recorded that at 15th to 22th DAS the rate of symptoms is most important on plant control (0g) for all the varieties compared to inoculated plants. The frequency of symptoms was recorded on the two varieties of north Cameroon with the high rate on the variety V2M varying from 20 to 30 % respectively for the inoculated treatments at 10 and 20 g). The variety V2M appear most affected during this period. However, at 22th au 36th DAS, the variety V2M of North appear most affected by the symptoms with the average rate varying from 60 to 98 % for the dose of 10 g and 60 to 100 % for the dose of 20 g. These results could traduce the vulnerability of this variety with high infection rate recorded on seeds.

Table 4: Frequency of dark reddish symptoms according to the doses and varieties.

		Frequency of dark reddish symptoms (%)			
Var	**Dose**	**15th DAS**	**22th DAS**	**29th DAS**	**36th DAS**
V1M	D0	36.67	66.7	80	100
	D1	13.33	45	57.3	70.3
	D2	16.7	53.3	56.7	64
V2M	D0	23.33	80	83.3	100
	D1	20	60	74	98.7
	D2	30	60	73	100
VL	D0	3	53.3	70	96.7
	D1	0	50	66.3	81
	D2	0	30	70	72.7

NB: **D0** = dose 0g; **D1** = dose of 10g; **D2** = dose of 20g; **VL** = local variety of Dschang; **V1M** = variety 1 of North; **V2M** = variety of North.

Picture 4: Dark reddish symptoms on leaves (source, WANG-BARA Bertrand, 2018)

The table 5 shows the frequency of whitish symptom on leaves comparable to the symptom of Powdery mildew diseases. At 15th DAS, we not recorded incidence of symptom for the doses of 10 and 20g of different variety. At 22th DAS the symptom appears on all the variety at 20 g which traduce the vulnerability of these varieties to the symptom diseases. The averages of this symptom varying for 3.33 % (V1M), 20.67 % (V2M) and 16.7 % (VL). At 29th to 36th DAS the frequency appears highest on the variety V2M of North at the dose of 10g and 20g with the infection rate varying respectively from 73.3 % to 86.67 % and 95, 7 to 83.9 %. That explains the vulnerability of this variety on symptom in field. Additionally, the variety was most infected by fungus on seeds. Nevertheless, the variety is affected by the symptom for the two doses (10 and 20g) with the average low compared to the frequency of the variety V2M varying from 23 to 50 % (29th DAS) and 51.4 to 63.3 % (36th DAS). We recorded also the presence of symptom on the variety VL with the rate varying from 32.2 to 66.7 % (29th DAS) and 56.3 to 75.4 % (36th DAS) respectively for the two doses. The frequency of this symptom on inoculated plants was less recorded compared to control for all the varieties. But we have the decreasing of rate of symptom on inoculated plants 10 and 20g) for the three varieties compared to control (0g).

Table 5: Frequency of whitish symptom on leaves according to doses and varieties.

		Frequency of whitish symptom (%)			
Var	**Dose**	**15th DAS**	**22th DAS**	**29th DAS**	**36th DAS**
V1M	D0	3.33	23.3	46.7	95.6
	D1	0	0	23	51.4
	D2	0	3.33	50	63.3
V2M	D0	0	10	93.3	100

	D1	0	0	86.67	95.7
	D2	0	20.67	73.3	89.3
	D0	0	13.3	43.3	90.5
VL	D1	0	0	32.2	56.3
	D2	0	16.7	66.7	75.4

NB: **D0** = dose 0g; **D1** = dose of 10g; **D2** = dose of 20g; **VL** = local variety of Dschang; **V1M** = variety 1 of North; **V2M** = variety of North.

Picture 5: Whitish symptom on leaves (source WANG-BARA Bertrand, 2018).

Works of Marais and kotze (1976) were showed that mycorrhization associations do not protect totally the plant but contributes to reduce the damaged on plants. Works of Yaya et al. (2013) were showed that certain morphotypes of Bambara groundnuts resist on attacks of insects, diseases and adapted to several conditions of environment. According to Perrin (1985), we have some traits characteristics of natural phenomenal which pathogens agent is present but their activities and impact are limited considerably. It’s difficult that the inoculation process could eliminate completely the pathology, but a substantial reduction characterized by a temporal stability according to the environment conditions.

VI.4 SEVERITY (G) OF SYMPTOM OF DISEASES.

Figure 2 shows the severity of dark reddish symptoms on leaves according to treatments. Referred to the table of Horsfall-Barrat, the frequency of severity is important on inoculated plants compared to control. The severity of the three varieties at 10g varying from 2 à 3 % with the high rate on the variety V2M (3 %). Also at 20g the severity is important on the variety (4 %). The evolution of severity at 10g varying from 4 à 6 % most recurrent on the variety V2M (6 %) compared to the doses of control. we record a severe evolution of this symptom for the variety (V2M) which the average varying from 7 to 8 % at the dose of 10g and 7 % at 20 g.

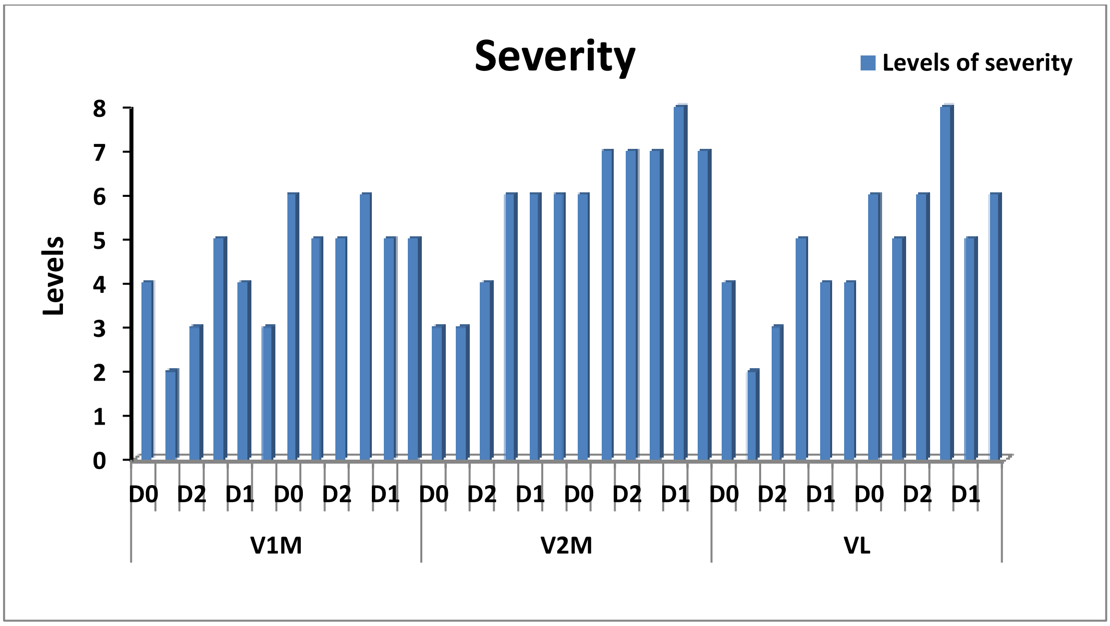


Figure 2: Severity of dark reddish symptoms according to the dose and varieties

By the doses applied of AMF on different morphotypes, the variety V2M appear like most vulnerable to pathological symptoms. This is could be justified by the important infection rate on seeds tested, but also the methods of conservation in post-harvest of seeds, the effect of climate through the humidity of the environment which is favorable to causes the development of the diseases.

Figure 3 shows the evolution of the severity of whitish symptom on leaves according to the treatment. Referring to the table of Horsfall-Barrat, the frequency of the severity of whitish symptom on leaves is constant at 1 % for the dose of 10 and 20g. In contrast the severity on the variety V1M is 2 % at control dose (0g). That traduce the evolution of symptom on this variety. The evolution of severity enhances on all the variety at the dose 0g with the important average varying from 5 to 6 % compared to non-inoculated plant. Contrastly at the dose of 10g the increase of frequency which varying from 2 to 6 % on the variety V2M was most severe on this variety (6 %). The severity at the dose of 10 g of all increases varying from 5 to 6 %. But at the dose of 20g the severity of this symptom is most appear on the variety V2M with 7 %.

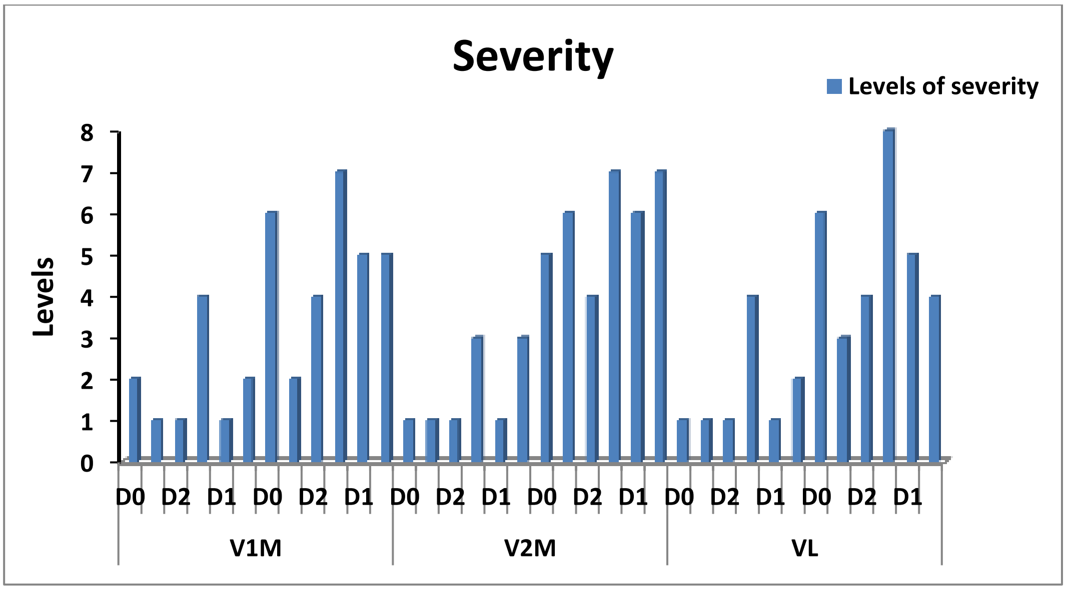


Figure 3: Severity of whitish symptom on leaves according to the dose and varieties.

By this comparison we consider that the evolution of severity is most affected the morphotypes V2M. The rate severity recorded on the local variety could be justified by the methods of storage in post-harvest of seeds which can be affected by the insect's attacks and pathogens related to the environment. Additionally, the origin and the introduction of some varieties on the news agro-ecological zone could affect also seeds through soil and climate.

VI.5. EFFECT OF THE DOSES ON YIELD PODS OF DIFFERENT VARIETIES

The table 6 reveals mean yield pods of different morphotypes according to the treatments. Results of this table showed difference on yields pods among the varieties. We recorded at the level of treatment at 10g, the effect of this dose react on yield pods of the morphotypes VL (1630.66 kg/ha-1), compared to control at 0 g (1302 kg/ha-1). However, the results of ANOVA show a difference ($P \leq 0.05$) among the treatment which received inoculant compared to control treatment. At the dose 20g the morphotypes VL (1682.66 kg/ha-1) and V1M (1599.67 kg/ha-1) show a difference ($P \leq 0.05$) of yield pods compared to control (0g). But in comparison with the doses (10 g and 20 g), average yields pods are significant for the variety V1M (1599.67 kg/ha-1) at 20 g.

Table 6: Yields pods according to the doses and varieties.

	Yields kg.ha^{-1}		
Dose	**VL**	**V1M**	**V2M**
D0	1302 ± 39.66b	1270.33 ± 315.87b	622.33 ± 232.67d
D1	1630.66 ± 81.39a	994.67 ± 330.74c	437 ± 181.51e
D2	1682.66 ± 22a	1599.67 ± 381.6a	537 ± 284.19e

NB: Values followed by the same letter in the same column is not significant at 5% according to the test of tukey ($P \leq 0.05$). The values are the means and standard errors**.** **D0** = dose at 0g; **D1** = dose at 10g; **D2** = dose at 20g; **VL** = Local variety of Dschang; **V1M** = variety of North; **V2M** = variety of North.

VII. DISCUSSIONS

In other to evaluate the effect of doses of AMF on pathological symptoms of three morphotypes of Bambara groundnuts, the purity test of seeds was made for this study. The infection rate of each morphotypes was evaluated. Results showed a difference on infection rate for the three varieties. Infection rate is high for the morphotypes V2M (40.4 %) followed by the local variety (16.67 %). The variety V2M appear most affected by the pathogens. This important rate of infection for the seeds could be justified by the methods of storing seeds in post-harvest, the duration of seeds in storage and the origin of seeds.

Three fungus were identified according to the purity of seeds tested. The fungus which are most dominant on seeds of this three morphotypes are *A. niger*, *A. flavus* and *Mucor sp* On these three varieties used, the variety V2M from the north was most vulnerable to *A. niger*, *A. flavus* and *Mucor sp* which an important frequency of appearance of symptom. In contrast the local variety and the variety V1M were most affected by *A. niger* and *A. flavus*.

However, the prevalence or presence of fungus related to seeds could be justified by several criteria such as the provenance of some morphotypes, quality of seeds, methods of storage in post-harvest and the duration of seeds in storage. Essola (2016) reveal that the presence of some fungus on seeds of *Glycine max* in the locality of Dschang and Foumbot like *Cercospora sp, Colletotrichum sp, Trichoderma sp*, *Aspergillus niger*, *A. flavus*. In this study, fungus *A. niger* and *A. flavus* were colonized seeds of Bambara groundnuts. Additionally, works of Venugopal et al. (2015) explained that the diversity of fungus populations of seeds of *Glycine max* is related to the origin of the provenance. Thus could be justified the diversity of fungus species on seeds of Bambara groundnuts like function to zone. According to Perrin (1985) the protection against some diseases is one of major ability from myccorhiza. It the expression genetic entity determined by the interaction among gene of plant and fungus.

Concerning the frequency and severity of diseases on potentiality of three varieties of Bambara groundnuts two types of pathological symptoms were observed on field. Symptoms of dark reddish and whitish symptoms on leaves were been frequently observed on the variety V2M of the North with the average respectively of 98.7 % and 95.7 % for the inoculated treatment. The severity varying from 7 to 8 % for the dark reddish symptoms and 6 to 7 % for the whitish symptoms in inoculated treatments. However, we encounter also the symptom on variety VL and V1M which are also affected by pathogens symptoms. But on the majority of cases, frequency and severity of symptoms were most recorded on the variety V2M. Additionally the association of AMF enhances the tolerance to dryness and decreases the gravity of plant pathogens (Strullu, 1991) and reduces the effect of infection by pathogens (Duponnois & Cadet, 1994; Abdalla & Abdel-Fattah, 2000).

Yield pods with the applied of AMF are important for the Local variety VL respectively at 10 and 20g, compared to the control. The dose at 20 g was significant for the variety V1M of North, compared to control. The uses of AMF on field increase the productivity of plants (Van der Heijden *et al.*, 1998; Vogelsang *et al.*, 2006).

Concerning the effect of doses of AMF on the gravity of symptoms on the different morphotypes on field, we recorded the decrease of appearance of symptoms on inoculated treatment compared to non-inoculated treatment. Within all the varieties inoculated or none inoculated, the variety V2M was most affected by the pathology of Bambara groundnuts. The important rate of pathology of different variety could be justified by the methods of storage in post-harvest of seeds, the high infection rate on purity test of seeds, the climate through the humidity of the environment which is one a factor that causes the development of diseases on plants. According to Marais and Kotze (1976) uses of AMF not completely protect plant against pathogen agent, but contribute to the decreasing of the gravity of damages and their activities are limited.

VIII. CONCLUSION

This study showed that the uses of doses of AMF on different morphotypes of Bambara groundnuts contribute to the decrease of pathological symptoms of the variety VL and V1M. All the variety were affected by fungus pathogens but on the majority, the damaged is most important on the control treatment compared to inoculated treatment. Concerning harvest, the yield pods is being improved for the local variety VL of West and V1M of North at the dose of 10 and 20g, compared to the control. The variety V2M appeared most vulnerable to pathological symptoms of fungus either on field or laboratory. Study permit to conclude that the uses of doses of AMF not completely protect plant against diseases related to fungus, but we recorded a substantial decreasing characterized by their stability on the environment.

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