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RELATIVE EFFICACY OF AM FUNGI ON *GUIZOTIA ABYSSINICA* (L.F) CASS., (NIGER)

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ABSTRACT

Experiments were conducted to understand the relative efficacy of AM fungi on Niger under experimental conditions. Plants were inoculated with three AM fungi in different factorial combinations. The plants inoculated with three AM fungi as triple inocula (*Glomus macrocarpum, Gigaspora margarita and Sclerocystis clavispora*) brought significantly increase in plant growth growth parameters and biomass yield. Hence inoculation with *Glomus macrocarpum*+*Gigaspora margarita* + *Sclerocystis clavispora* was found to be better than the single or dual inoculated AM fungi and also over the non-inoculated plants.

KEY WORDS: ***Guizotia abyssinica*** **(L.f) Cass., (Niger), biomass yield, triple inocula,** ***Glomus macrocarpum***

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INTRODUCTION

Guizotia abyssinica (L.f) Cass., (Niger) is an oilseed crop cultivated in Ethiopia and India. The niger oil is used for cooking, lightning, anointing, painting and cleaning of machinery[1]. In addition to its oil, niger offers an important source of seed proteins, carbohydrates, vitamins and fiber that significantly contribute to the human dietary intake[2]. Niger based agar medium can be used to distinguish *Cryptococcus neoformans*, (a fungus that, causes a serious brain ailment), from other fungi. There are reports that, niger oil is also used for birth control and for the treatment of syphilis[3]. Thus, use of microbial inoculants play an important role in sustainable agriculture. Among the microbial inoculants, Arbuscular mycorrhizal fungi (AMF) are known to improve plant health and growth. These are ubiquitous group of soil fungi colonizing the roots of plants belonging to more than 90% of plant families[4]. They are integral part of terrestrial ecosystems[5]. AM benefits the plants by improving the supply of nutrients, particularly phosphorus and other nutrients such as Zn, Cu, S, K and Ca[6-8], and the plant supplies the fungus with photosynthetic sugar[9,10]. This has gained momentum in recent years because of the higher cast and hazardous effects of heavy doses of chemical fertilizers. The association creates an intimate link between plant roots and the soil and plays a pivotal role in the acquisition of mineral nutrients. Moreover, AMF may protects plants against environmental stresses such as salinity[11,12], drought[13], mine spoil[14]. Therefore, present study was undertaken to select the potential AM fungal combination as potential inocula to improve growth and yield niger under experimental conditions.

MATERIALS AND METHODS

The rhizospheric soil samples were collected during June 2013, from Niger growing areas of different localities of North Karnataka. Arbuscular mycorrhizal fungal spores were recovered from the same soil by adopting the wet-sieving and decanting technique[15]. The recovered AM fungal spores were mass multiplied by using *Sorghum vulgarae* L., as a host plant in separate earthen pots measuring 30 cm diameter containing sterilized soil: sand mixture in the ratio of 3:1.Single or multiple AM fungal inoculum containing dry soil, hyphae, spores (215-250/ 50 g soil) and root bits was mixed with the soil in the top of 4 cm of the each experimental pot. Each pot measuring about 12x15 cm (length and breadth) contained 4 kg of sterilized soil having pH 6.8, Electrical conductivity (EC) 0.11, Organic carbon (OC) 0.97%, Calcium (Ca) 32.02mg/g, 1.76 mg/g phosphorus (P), 0.83mg/g Nitrogen (N). The control plants are not provided with any AM fungal inoculum. The amount of AM fungal inoculum for each treatment was so adjusted that the equal amount of single and combined soil inoculum could be added to each pot. The different treatments were maintained as mentioned below:

T1: Soil without inoculum (control).
T2: Soil with inoculum of *Glomus macrocarpum* (10 g).
T3: Soil with inoculum of *Gigaspora margirata* (10 g).
T4: Soil with inoculum of *Sclerocystis clavispora* (10 g).
T5: Soil with inoculum of *Glomus macrocarpum* (10g) + *Gigaspora margarita* (10g).
T6: Soil with inoculum of *Glomus macrocarpum* (10g) +*Sclerocystis clavispora* (10g).
T7: Soil with inoculum of *Sclerocystis clavispora* (10 g) + *Gigaspora margirata* (10 g).
T8: Soil with inoculum of *Glomus macrocarpum* (10 g) + *Gigaspora margirata* (10 g)
+ *Sclerocystis clavispora* (10 g)

Seeds surface sterilization was done by dipping seeds in 1% mercuric chloride for three minute then the seeds of Niger (*Guizotia abyssinica* (L.f) Cass.) were sown in each pot above the soil inoculum and pots were arranged in random block design. Each treatment was maintained in triplicate under green house conditions. Plants were uprooted periodically and per cent colonization of the roots was assessed by micro slide technique[16]. The spores were isolated from rhizospheric soil of niger and spore count was recorded. The growth parameters of niger plant such as plant height, dry weight of shoot and root, number of grains / plant, phosphorous content in shoot in terms of µg/mg tissue were measured[17]. Each treatment was carried out in triplicates and the recorded results were arithmetic mean. Data were analyzed by one way ANOVA using SPSS software.

RESULTS AND DISCUSSION

The different AM fungi such as *Glomus macrocarpum, Gigaspora margarita* and *Sclerocystis clavispora* were inoculated to test the relative efficacy of single and multiple inocula for the growth and yield of the *Guizotia abyssinica* (L.f) Cass., (niger). All the AM fungal treated plants showed increased growth parameters. The experimental results also revealed that, not only the growth parameters of niger plant but also the nutrient up take_also influenced by AM fungi. However, all the three used AM fungi behave differently in different combinations and as well as in single.

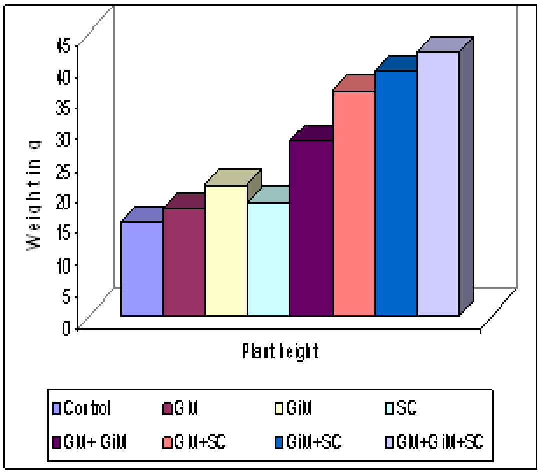
Table 1
Effect of AM fungi on the growth of Guizotia abyssinica (L.f) Cass., at 90 days.

Sl. No.	Treatments	Fresh weight of shoot (g)	Fresh weight of root (g)	Dry weight of shoot (g)	Dry weight of root (g)	Spore number/50 g soil
1	Control	13.6 ba	2.7a	2.5a	0.24c	0
2	GM	24.2 b	4.9	3.7b	1.2bc	142b
3	GiM	19.5d	4.6	3.9c	1.3a	159c
4	SC	34.3bd	6.9d	4.4d	1.7c	146b
5	GM+ GiM	27.4c	5.2c	4.5cd	1.8a	123ad
6	GM+SC	32.8cb	7.3b	5.8bd	2.2b	121bd
7	GiM+SC	28.6c	5.4a	6.1c	2.3a	99c
8	GM+GiM +SC	37. 6d	9.1a	6.8a	2.5ad	96a

GM: Glomus macrocarpum, GM: Gigaspora margirata and SC: Sclerocystis clavispora

Experimental plants inoculated with triple inocula showed a significantly increased plant height compared to uninoculated plants (Fig. 1). Dual inoculation with combination of *Glomus macrocarpum* and *Gigaspora margirata* had shown a maximum increase in plant height when compared to the dual inoculation with other combinations. There was significant increase in plant height was observed with all dual inoculation over the unioculated control plants. *Glomus macrocarpum* was found to be the efficient fungus. Plants treated with *Glomus macrocarpum* has shown more plant height than the plants treated with *Gigaspora margirata* and *Sclerocystis clavispora*.

Figure 1
Effect of AM fungi on the plant height and seeds per plant of Guizotia abyssinica (L.f) Cass., (Niger).



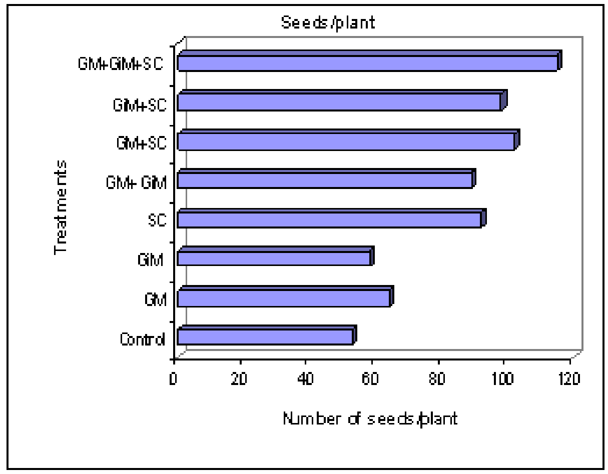
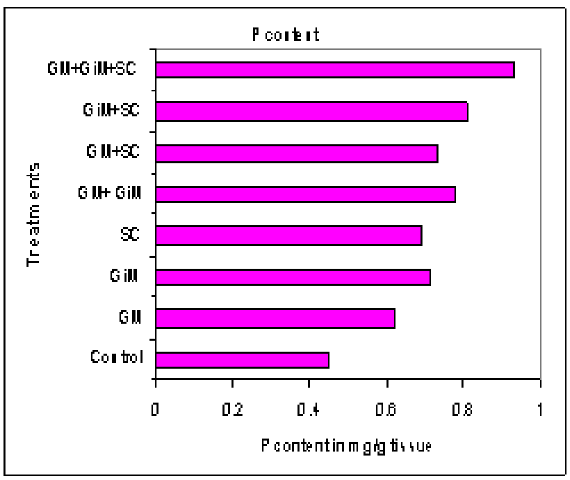
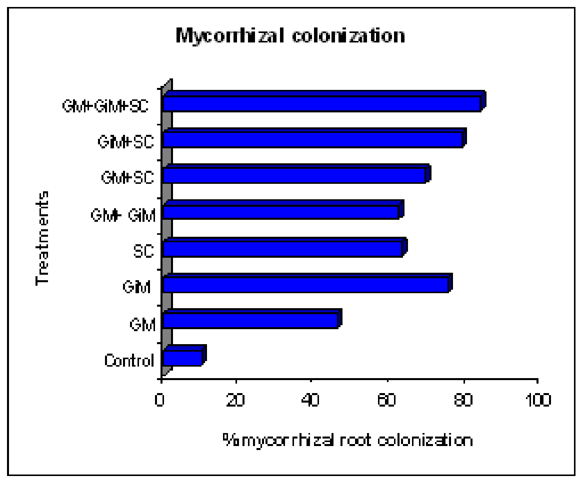


Figure 2
Effect of AM fungi on the percent of 'P' content in shoot and percent of root colonization of Guizotia abyssinica (L.f) Cass., (Niger).





Highest biomass yield was observed in plants inoculated with three AM fungi *Glomus macrocarpum, Gigaspora margarita* and *Sclerocystis clavispora* compared to control plants. The experimental plants grown with dual inoculation also showed increased biomass, particularly inocula of *Glomus macrocarpum* and *Gigaspora margirata* had maximum increased biomass compared to other dual inocula of AM fungi and control plants. Among the single AM fungal inoculation, increased biomass production was recorded with *Glomus macrocarpum* inoculation compared to other single inoculum and un-inoculated plants. Niger inoculated with AM fungus *Sclerocystis clavispora* do not influence much on the biomass value compared to all other treatments, but it was significantly over the control.Niger plants inoculated with AM fungi had high number of grains per plant and differed significantly with each treatment. Plants inoculated with triple inocula showed maximum increased number of grains per plant (Fig.1) compared to the uninoculated ones. Results also revealed that the plants inoculated with dual inocula of *Glomus macrocarpum* and *Gigaspora margirata* had significantly increased number of grains/ plant over other dual inocula and uninoculated experimental plants.Increased growth and biomass production in mycorrhizal plants strongly depends on their ability to access minerals from the soil[18]. Therefore, positive effects of tested AM fungi on P content could be related to the ability of symbiotic fungi to enhance soil P depletion zones around roots[19-21]. In the present study plants inoculated with triple inocula of AM fungi was showing increased P content in shoots. The improvement of plant growth and P with inoculation of AM fungi has been reported in a number of tree species and crop plants[22-24]. The main effect of mycorrhizal fungi in improving plant growth is through improved uptake of nutrients especially phosphorus, the content of phosphorus in shoot has been recorded highest in case of plants treated with triple inocula, due to the exploration by the external hyphae beyond the root hair zone when phosphorous is depleted[25,26]. Increased phosphorous uptake has been attributed not only to increase in surface area of absorption[27], but also to enhance hyphal translocation[28,29]. Increased plant growth due to AM fungal inoculation is mainly through improved uptake of diffusion limited nutrients such as 'P'. AM fungi improving plant biomass were also good in increasing the 'P' content of the experimental plants significantly highest being in plants inoculated with triple inocula. Such higher 'P' content in AMF inoculated plants is attributed to the higher influx of 'P' into plant system through AM fungi which explores the soil volume beyond depletion zone[30,31]. The enhancement in growth and nutritional status was also related to mycorrhizal root colonization and spore numbers in the root zone soil. This statement upholds the observations made by earlier workers contribution on other plants[32,33]. It can be concluded that the growth parameters in niger, was increased when they were treated with triple inocula of AM fungi with a combination of *Glomus macrocarpum, Gigaspora margarita* and *Sclerocystis clavispora* over the all other treatments and the uninoculated plants. Therefore, the inoculation of triple inocula is better than the single and dual inocula for the better growth and yield of the niger.

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