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EFFECT OF AM FUNGI WITH ADDITONAL PHOSPHATE FERTILAZATION ON GROWTH AND NUTRIENT UPTAKE IN *GUIZOTIA ABYSSINICA (L.F) CASS.VAR, RCR-18*

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Abstract

Context: Arbuscular-Mycorrhizal fungi colonization in roots of many plants promotes the increased nutrient uptake especially the phosphorus from phosphorus deficient soil.
Objective: To compare the efficacy of different concentration of recommended dosages of super phosphate fertilizers with inoculation of AM fungi to evaluate growth, nutrients uptake on *Niger* plant *(Guizotia abyssinica (L.f) Cass. var, RCR-18*).
Materials and Methods: The effect of two Arbuscular mycorrhizal fungi *Scutellospora nigra* and *Glomus mosseae* with 4 different dosage (25%, 50%, 75%, 100%) of superphosphate (P_2O_5) was treated on growth yield and nutrient uptake in Niger plant (*Guizotia abyssinica (L.f) Cass. var, RCR-18*) was evaluated under greenhouse conditions. Pots were watered they were harvested once in 30 days intervals. For 90 days the following readings viz., plant height, root length, biomass, grains yield, percent root colonization, spore number macro-micro nutrients contents in shoots and roots were determined.
Results: *Scutellospora nigra* with 50% RDSP/kg showed a significant increase in the plant growth biomass of shoot and root of *Guizotia abyssinica (L.f) Cass. var, RCR-18*. Percent root colonization, seed number and N, P, K and Zn, Mg uptake in shoot and root.
Conclusion: Overall, our results clearly suggest that synergistic and additive mechanisms involved can enhances the plant growth, nutrient uptake and adaptation to unfavorable drought soil conditions.

Key words: Arbuscular mycorrhizal (AM) fungi, Niger plant, Biomass yield, Root colonization, Nutrient uptake, *Scutellospora nigra, Glomus mosseae*.

Introduction

Many good numbers of crop plants fail to absorb the nutrients from the soil which is present beyond the root zone of active absorption. Most land plants form association with Mycorrhizal fungi. Mycorrhizas are mutualistic associations between fungi and plant roots .they are described as symbiotic because the fungus receives photosynthetically derived carbon compounds and plant has increased access to mineral nutrients and sometimes water (Brundrett *et al*.1996). Arbuscular-Mycorrhizal fungi colonization in roots of many plants promotes the increased nutrient uptake especially the phosphorus from phosphorus deficient soil (Bagyaraj 2006, Lakshman 2008). AM fungi could increase the absorption of phosphorous to the host plant and in turn obtain carbon from the host plant (Kapoor *et al.* 1989, Fusconi *et al.* 2005, Tanwar 2012). Ross (1971) has studied the effect of phosphate fertilizer on yield of mycorrhizal and non-mycorrhizal soybean plants. Phosphorus is the major element required by the crop plants and mycorrhizal plants utilize 'P' from organic matter (Jones and Jacobson 1995, Smith 2011). Mosse (1973) have observed that the mycorrhizal onion seedlings grew better in both sterilized soils when compared to non mycorrhizal plants. Recently Tanwar (2013) has studied the effects of AM fungi in the superphosphate fertilization on growth and yield of bell pepper *Capsicum annum* var. California wonder. Hence, this investigation was undertaken in green

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house conditions to compare the efficacy of different concentration of recommended dosages of super phosphate fertilizers with inoculation of AM fungi to evaluate growth, nutrients uptake on *Niger* (*Guizotia abyssinica (L.f) Cass. var, RCR-18*) with an aim to reduce the applications of chemical fertilizers for sustainable system.

Materials and Methods

Guizotia abyssinica (L.f) Cass.var, RCR-18 seeds were surface sterilized in 1% sodium hypo chlorite and rinsed 2-3 times in distilled water and they were sowed in earthen pots, each earthen pots measuring (15 × 20 cm) (breadth × length) filled with four kg sterile phosphorus deficient soil. Chemical composition of this soil consists in the ratio of phosphate- 5.3 ppm/kg, nitrogen =11.7-ppm/kg soil, potassium =14.6 ppm/kg, E.C =0.05 mmhos/cm^2, O.M = 0.19%. The soil in the ratio of 3:1 proportion (3 parts of sandy loam soil and 1 part of pur sand was fumigated and sterilized by using 5% methyl bromide).

Two indigenous strains of AM fungal species viz., *Scutellospora nigra* and *Glomus mosseae* were selected for the present experiments and these were mass multiplied with the host Rhode grass (*Chloris gayana* Munch) 15 grams of mixed inoculums was placed 4 cm below the surface of each experimental pots, except the control pots. The inoculums consisted of 7.5 gm of infected root bits plus 7.5 gm of rhizospheric soil. Approximately 5 gm of rhizospheric soil contained hyphae, sporocarp and spores 135 - 215 chlamydospores. Experimental plants were arranged in completely randomized design with four replications and treated with four different levels of phosphate. The recommended dose (PRD) of super phosphate (P_2O_5) for *Niger* was found to be 40 kg per hectare (ha).

The following treatments were carried out as mentioned below.

1. Zero P O (Control)
2. 25 % PRD P_20_5 (0.20 g per 8 kg soil) + AMF
3. 50% PRD P_20_5 (0.40 g per 8 kg soil) + AMF
4. 75% PRD P_20_5 (0.80 g per 8 kg soil) + AMF
5. 100% PRD P_20_5 (0.160 g per 8 kg soil) + AMF

An application of fertilizers was made as per the standard method proposed by (Kaleem 2000). Pots were watered whenever, it needed and they were harvested once in 30 days intervals. For 90 days the following readings viz., plant height, root length, biomass, and grains yield, percent root colonization, spore number macro-micro nutrients contents in shoots and roots were determined. Percent root colonization; and staining roots was done after washing the roots under tap water and cut in 1 cm pieces and mixed in 10% KOH, autoclaved for 30 minutes and washed in distilled water in 2-3 times, and neutralized in 2N HCl for 2 minutes, later stained in 0.05% tryphan with lacto phenol following the procedure (Phillips and Hayman 1970, Giovennette and Mosse 1980). Plant dry weight was measured after the plant material was oven dried for 72 hours at 70°C. Number of seeds was counted from each flower of the plants. AM fungal spores were isolated according to wet-sieving decanting technique (Gerdemann and Nicolson 1963). Phosphorus content of the shoot was determined calorimetrically by the vanadomolybdate phosphoric — yellow colour method outlined by (Jackson, 1973). Total nitrogen determinations were made by the Microkjeldahal method (Bremmer, 1960). Micronutrients Zn and Mg were determined by using GBS 902 atomic absorption spectocalorimeter.

Results and Discussion

The results of the treatments and growth parameters viz., plants height, biomass yield, per cent root colonization, spore number, macro and micronutrient content of shoot and root is presented in Table 1.

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Guizotia abyssinica (L.f) Cass.var, RCR-18 showed 50% RD sp/kg with mycorrhizal inoculation significantly influenced the increase plant growth, dry weight of shoot and root; percent root colonization, spore number, N.P.K. and Zn, Mg uptake in shoot and roots. Secondly 75% RDSP/kg with mycorrhiza *Scutellospora nigra* influence in biomass yield and nutrient uptake. The seeds production was higher (1610/plant) in *Niger* plants at 75% RDSP/kg with mycorrhiza, followed by 100% RDSP/kg with mycorrhiza inoculation influenced for *Niger* lower number of seeds 501 /plant production. This improvement in *Guizotia abyssinica* plants showed significant results with mycorrhizal inoculation and no such improvement in plant growth, biomass yield, seeds in non inoculated or control plants. Overall *Guizotia abyssinica (L.f) Cass.var, RCR-18* increased biomass when compared to the control plants (Figures 1-5).

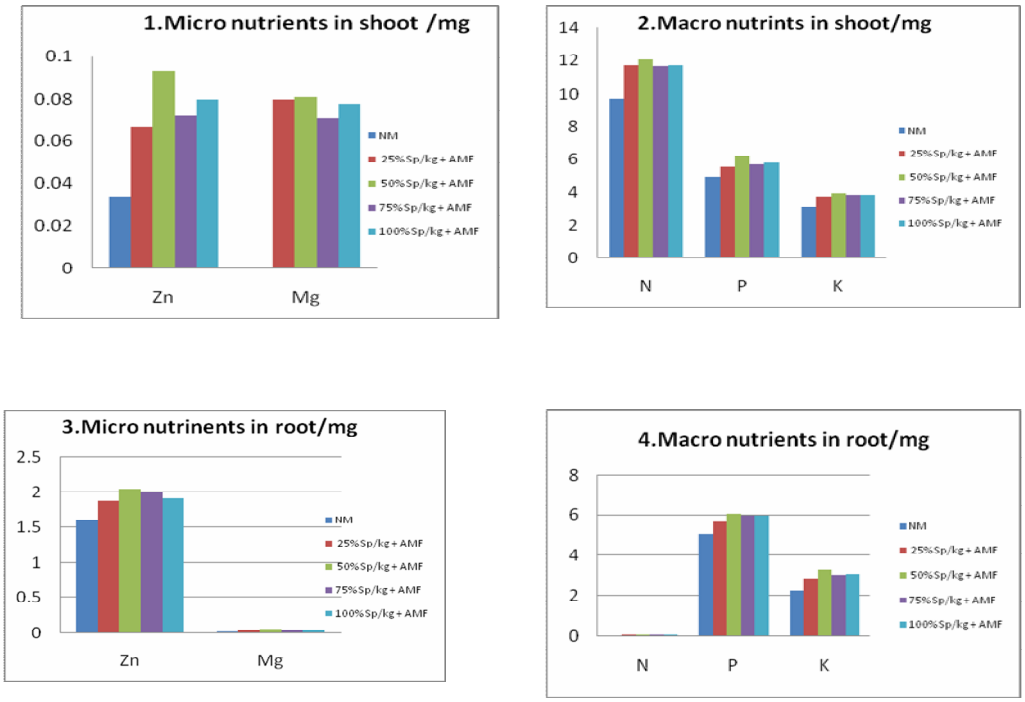

Fig. 1, 2, 3 & 4. : Effect of micro and macro nutrient on growth of *Guizotia abyssinica (L.f) Cass RCR-18 var* at 90 days with different dosages of phosphate and AM fungus *Scutellospora nigra, Glomus mosseae.*

The magnesium (Mg) was found to be higher in control non inoculated plants than the plants treated with phosphate and inoculated with AM fungi. However, increase in concentration of N, K, Zn and Cu was observed in the shoots of *Guizotia abyssinica (L.f) Cass.var, RCR-18* variety when the plants supplemented with AM fungi over the control plants. There was also an increase in the seeds and dry matter of shoots with 50% and 75% of recommended dose of phosphate with AM fungi in *Guizotia abyssinica (L.f) Cass.var, RCR-18*.

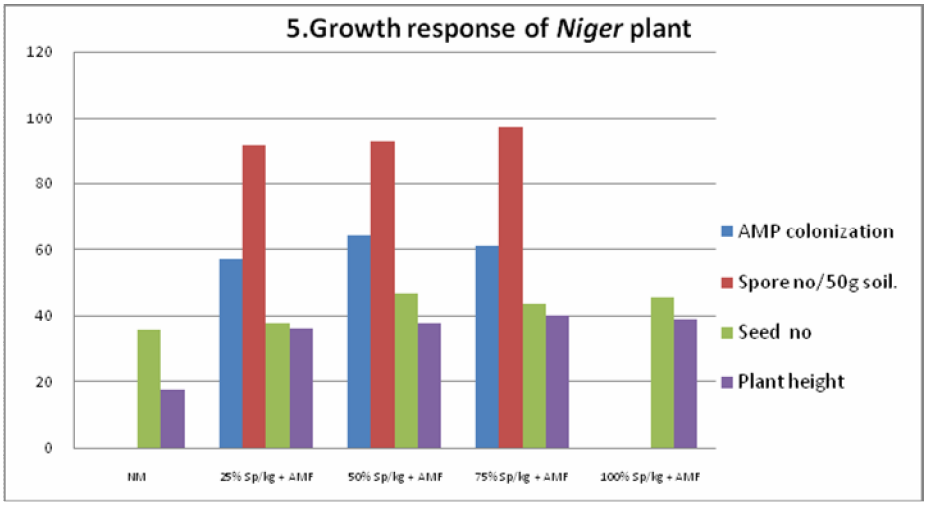

Fig. 5. Effect of different dosages of phosphate and AM fungus *Scutellospora nigra, Glomus mosseae* on growth of *Guizotia abyssinica (L.f) Cass RCR-18 var* at 90 days.

Our findings are in consistent with the earlier works of Srinivasulu, (2002). Lakshman and Kolkar, (2008) showed that 75% of recommended dose of super phosphate was favorable to GPU-45, RAU-8 showed significantly increased in plant height, percent colonization and spore number in *Niger* plant. The present results are in consistent with the findings of earlier workers in other crop plants (Plenechette and Morel-1996, Sreenivasa1994, Kelly *et al*. 2001, Maruthi 2013). This confirms that 25% of recommended dose of phosphate fertilizer could be saved in Niger by inoculating with *Glomus mosse*. Diaz et al., (1946) had reported the uptake of heavy metals (Al, Cu, Pb) and their influence on the growth of *Lygeusu spartna* and *Anthyllis cystisoides* after mycorrhizal inoculation.

Liu *et al.* (2000) had detected acquisition of Cu, Zn, Mn and Fe in mycorrhizal Maize (*Zea may* L). However, further increase in 'P' dose significantly decreased plant height, dry weight of shoot and root, root colonization and spore number in all the two verities of *Niger*. Growth of AM fungus in the host root was better when supplied with lower dose of 'P' fertilizer (Harley and Smith 1983, Sieverding and Howler 1985, Srinivasulu 2002, Lakshman 2009, Tanwar *et al.* 2013). Over all Niger plants supplemented with different levels of phosphate with AM fungal *Scutellospora nigra* as showed maximum plant growth and yield of *Guizotia abyssinica (L.f) Cass.var, RCR-18 at* 50% PD sp/kg with AM fungus *Glomus mosseae* inoculation. Soil microorganisms play a vital role in solubalization of mineral compounds into soluble forms. Liu *et al.* (2000) have showed remarkable increase in growth and P uptake in AM inoculated *Zea mays* plants. Marschner and Dell (1994) reported that high phosphate fertilizer significantly caused decrease in the number of chalmydospores of *Glomus fasciculatum*. AM Fungal spore production can be more or less application of phosphorous rich fertilizers. On the other hand, Roa and Maruthi (2013) have stated that there is reduction in AMF sporulation on application of fertilizers. Similarly Bagyaraj and Manjunath (1980) have conducted investigation on the effect of *Glomus fasciculatum* on growth and nutrient uptake in three crop plants viz., cotton, cowpea and finger millet in soil with low phosphorus content. They found that AM inoculated plants showed significant increase in shoot and root biomass. Further, phosphorus and zinc content was found to be higher when compared to control plants. Reduction in fertilizer in put on application of beneficial microbes has been reported by Soleimanadeh (2010) who have suggested the use of AM fungi with 50% recommended phosphorus to increase seed yield and oil production in sunflower. Influence of mycorrhizal fungi and phosphorus fertilizer was clearly demonstrated by Sieverding and Howler (1985) on cassava. Sreenivasa in (1992) have found that there was an increase in the uptake of micronutrient viz., Zn,

Mn, Ca, and Fe in addition to P, in chilli plants that were inoculated with *Glomus macrocarpum*. Srihari *el al*. (1995) has conducted experiments to study the effect of *Glomus fascicularum* in sunflower plants and they found that AM fungi inoculated plants showed better growth with low dosage of super phosphate treatment.

Conclusion

Decrease in mycorrhizal colonization and AM fungal spore number after the use of 50% RDSP/kg with AM fungi *Scutellospora nigra* and *Glomus mosseae* in *Guizotia abyssinica (L.f) Cass.var, RCR-18*. The use of supplemented 50% RDSP/kg with AM fungus *Scutellospora nigra* can be recommended for *Guizotia abyssinica (L.f) Cass.var, RCR-18.* Overall, our results clearly suggest that synergistic or additive mechanisms are involved in the improvement of plant growth, nutrient uptake and adaptation to unfavorable drought soil conditions

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