STUDY ON SOYBEAN (*GLYCINE MAX*) ROOT GROWTH PERFORMANCE UNDER MICROBIAL INOCULATION, MYCORRHIZAL ASSOCIATION AND CHEMICAL FERTILIZER APPLICATION

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Keywords: Bradyrhizobium, Native forest soil, Mycorrhizae

INTRODUCTION

Recent concerns about cost increases, food safety and quality and environmental protection have prompted plant scientists to re-evaluate the current practices in agriculture. Synthetic fertilizers are known to cause soil acidification and fertility degradation, pollution and generation of greenhouse gases due to inefficient utilization by crops. The alternative is the use of biofertilizers. Inoculant biofertilizers are more environmentally sound and their introduction in agricultural production systems could be one of the means to mitigate the onset of global warming as well as the reduction in fertilizer costs for farmers (Smith and Read 1997). *Bradyrhizobium japonicum*, arbuscular mycorrhizae and native forest soil were used as microbial inoculants in the present trial. Native forest soil also can be considered as a cocktail of helpful microorganisms which can act as a combined microbial inoculum (Mosse *et al.* 1976). Root system of a plant provides much important information about the growth and vigor of the plant. Therefore, the present study was conducted to investigate the effects of microbial inoculums, native forest soil and chemical fertilizers on the growth and nodulation potential of Soybean.

MATERIALS AND METHODS

Soil was collected from a soybean field where chemical fertilizers have been used for more than ten years in the dry zone of Sri Lanka. Native forest soil samples were collected from Ritigala Strict Nature Reserve, Sri Lanka. A pot experiment was conducted in a green house located at the Rajarata University of Sri Lanka. Pots were filled with field soils, to give 10 treatment conditions for Soybean plants: native forest soil, *Bradyrhizobium* inoculum, mycorrhizae inoculum and recommended dose of chemical fertilizer, as individual treatments and combinations of one another. Treatments were: T1- field soil only, T2- forest soil and field soil, T3- forest soil, field soil and fertilizer, T4- forest soil, field soil and mycorrhizae, T5- forest soil, field soil and *Bradyrhizobium* inoculum, T6- forest soil, field soil, mycorrhizae and *Bradyrhizobium* inoculum, T7- field soil and mycorrhizae, T8- field soil and fertilizer, T9- field soil with *Bradyrhizobium* inoculum and T10- field soil, mycorrhizae and *Bradyrhizobium* inoculum. *Bradyrhizobium japonicum* was isolated from the field soil and inoculum was made as a broth culture. Mycorrhizae inoculum was prepared using soybean plants trap cultured on field soil. Each treatment had three replicates and each replicate had four sub samples. After 65 days, plants were uprooted and the roots were washed to get rid of any adhered soil particles. Then the roots were air-dried for 48 hours and the number of root axils, root length, root dry weight and number of nodules were measured. The procedure published by McGonigle *et al.*, (1990) was used for the estimation of percentage colonization of arbuscular mycorrhizae.

RESULTS AND DISCUSSION

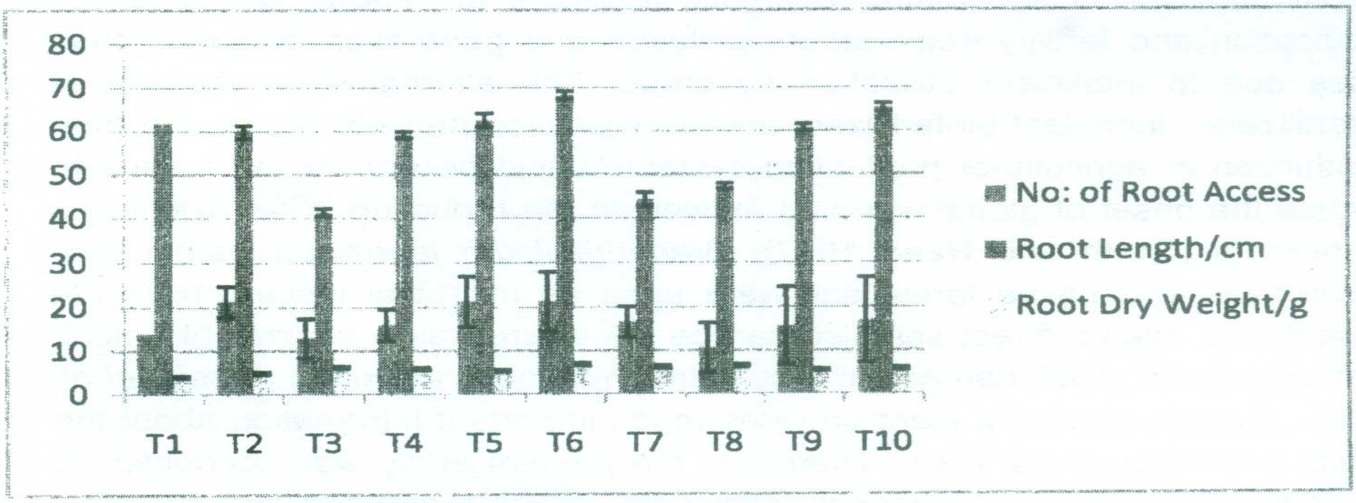

Figure 1- Change of root morphology and dry weight of soybean in different treatments

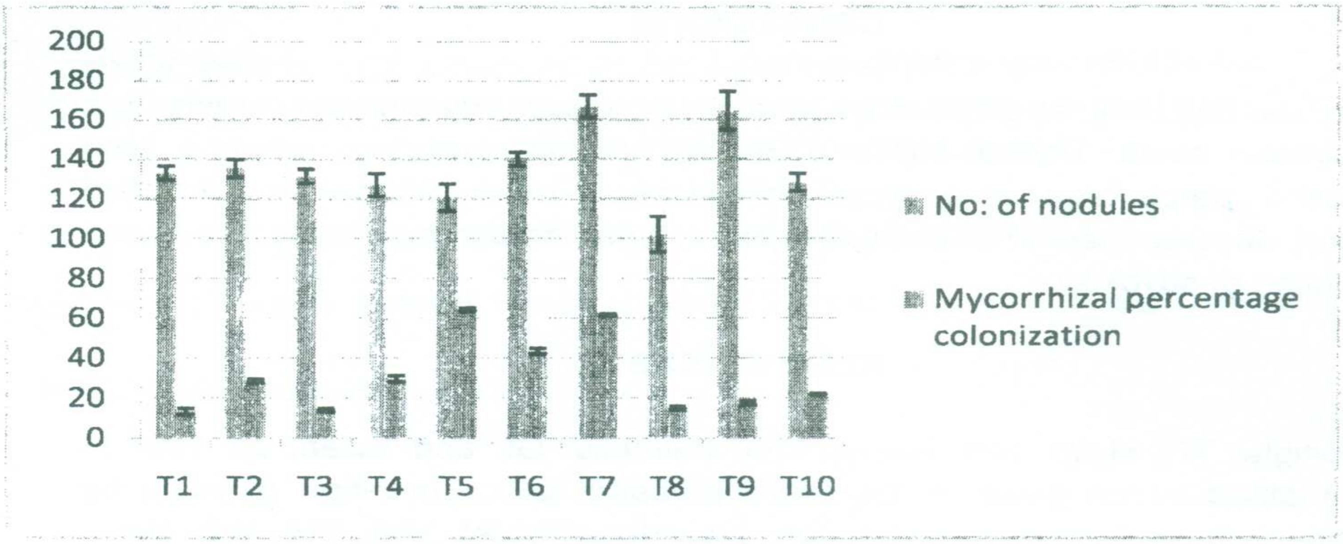

Figure 2 - Change of percentage arbuscular mycorrhizalcolonization and nodulation of soybean

When considering the number of root axils (Figure 1), 2nd , 5th and 6th treatments showed significantly higher number of root axils at $P<0.05$ level. And also the 1st, 3rd and 8th treatments showed significantly lower number of root axils at the same level. This may be due to the higher availability of chemical fertilizers. Generally, plants have higher number of root axils to absorb nutrients from distant places (Ryder *et al.* 1994).

Because of the higher availability of synthetic fertilizers, plants of 1st, 3rd and 8th treatments have less number of root axils. Treatments 7th and 9th had significantly higher number of root nodules (Figure 2) while 8th treatment had the lowest ($P<0.05$). 7th and 9th treatments consisted of arbuscular mycorrhizal inoculum and 8th treatment consisted of chemical fertilizer. Therefore, it can be concluded that the nodulation of soybean roots increased with the addition of mycorrhizae while reduced with chemical fertilizer.

Treatment 6th had the highest root length (Figure 1) and the 3rd had the lowest. This may be the result of the differences in nutrient availability. 5th treatment which had native forest soil, field soil and *Bradyrhizobium* inoculum showed the highest percentage colonization of mycorrhizae and the 1st treatment had the lowest. In the 5th treatment, increased nodulation by *Bradyrhizobium* inoculum may have positively affected mycorrhizal colonization.

6th treatment had the highest value of root dry weight ($P<0.05$) and 1st treatment had the lowest (Figure 1). Production of lengthy roots and large number of root axils may have lead to higher dry weight of total root system.

CONCLUSION

Arbuscular mycorrhizae addition increased percentage mycorrhizal colonization of soybean roots. Forest soil and *Bradyrhizobium* inoculum addition also increased percentage mycorrhizal colonization even without mycorrhizae addition. Mycorrhizae and *Bradyrhizobium* together synergistically enhanced nodulation of soybean.

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