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EFFECT OF BIOFERTILIZER AND PHOSPHORUS ON THE GROWTH AND BIOMASS PRODUCTION OF SOYBEAN (*Glycine max*)

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Abstract

Soybean (*Glycine max*) is one of the most important oil and protein crops of the world. Biofertilizers increases the physicochemical properties of soil structure, texture, water holding capacity, cation exchange capacity and pH by providing natural nutrients and sufficient organic matter. Chemical fertilizers do not produce basic soil health but weaken soil structure. The present study focused on effect of biofertilizers and phosphorus on the growth and biomass production in Soybean (*Glycine max*) were carried out. The results showed that the treatment of T_2 and T_4 showed maximum fresh weight, dry weight, shoot length and root length when compared to control and other treatment were respectively. It can conclude that the treatment T_2 *Rhizobium* individually and combination of biofertilizer (T_4) exhibited maximum plant growth and biomass production. So, it can be recommended that the *Glycine max* seeds can be treated with fungicide and its influence on the nitrogen fixation.

Key words: Soybean (*Glycine max*), Biofertilizer, Chemical fertilizers and Nitrogen fixation.

1. Introduction

Soybean is one of the grain legumes of India which not only helps in maintaining soil fertility but is also a rich source of protein and fats. Growers typically rely on tillage for weed control in organic food grade Soybean production systems. Disadvantages with crop systems that rely on tillage include increased erosion risk, loss of soil structure and decrease in soil organic carbon levels and increases in machinery and fuel costs (Vollmannjohann, 2016).

Biofertilizers are commonly called as microbial inoculants, which are capable of mobilizing important nutritional elements in the soil from non-usable to usable form by the crop plants through their biological processes (Dai *et al.*, 2004). Biofertilzers are used extensively as an eco-friendly approach to minimize the use of chemical fertilizers, improve soil fertility status and for enhancement of crop production by their biological activity in the rhizophere. The bacteria in root nodules of legumes are called *Rhizobium.* They are important agents in the fixation of atmospheric nitrogen. Chemical fixation of nitrogen came to known only several years after our understanding of the implication of biological

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nitrogen fixation (Khosro Mohammadi and Yousef Sohrabi, 2012). The soil contains high organic matter including rich organic forms of phosphorus that comes mainly by way of decaying vegetation. Rock phosphate is one of the basic materials for phosphate fertilizer production. In India, 100 million tonnes of rock phosphate deposits are available. Super phosphate is a common form of phosphatic fertilizer used in India. The present study was carried out to study the effect of biofertilizers and phosphorus on the growth and biomass production in Soybean (*Glycine max*).

2. Materials and Methods

Soil Preparation

All the pots used for the study were filled with 8 kg of soil and treated with phosphorus in the form of super phosphate at the concentrations of 50 kg and 100 kg p/ha. The soil was tested for its nitrogen, phosphorus and potassium. The soil was enriched by the basal application of farmyard manure (FYM) at the rate of 10 t/ha.

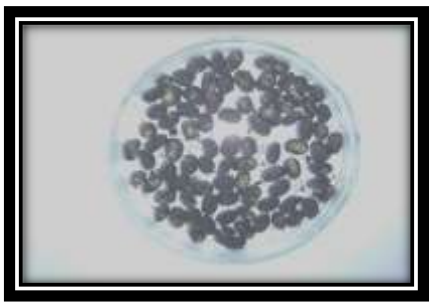
Treatment of seeds

Seeds of Soybean were collected from Tamil Nadu Agricultural University (TNAU), Coimbatore, Tamil Nadu, India. Seeds were soaked in cold water, shade dried and treated with *Rhizobium* sp. and *Phosphobacteria* inoculated with rice gruel as an adhesive agent.

Layout of treatment

The study was carried out as pot culture with four replications for each treatment. The Figure - 1 showed the seeds of untreated and treated of Soybean.

Untreated Soybean



Treated Soybean

Figure - 1: Seeds of Untreated and Treated of Soybean

The Treatments were as follows: T_1 – Control; T_2 - *Rhizobium*; T_3 - *Phosphobacteria*; T_4 - *Rhizobium* + *Phosphobacteria*; T_5 - 50 kg of Phosphorus and T_6 - 100 kg of phosphorus.

Sowing and Watering

About fifteen (Soybean) seeds were sown in each pot and allowed to germinate. After germination of the seeds, water logging condition was maintained.

Harvest Methodology

At the end of the 30th days, the plants were uprooted from the pots without any damage to the root system. The plants were washed gently with water and blotted with filter paper to absorb the water droplets. Then the plants were subjected to biometric and biochemical analysis.

Biometric Parameters

Fresh Weight

The fresh plants after removing the soil particles were weighed immediately and expressed as g/ plant.

Dry Weight

The uprooted plants after recording the fresh biomass were oven dried at 70 ºC for 36 hours. Weighed and expressed as g/plant.

Root and Shoot length

The length of the root and the shoot were measured from the collar region to the tip of the root and shoot respectively and expressed in cm/ plant.

Figure - 2: Growth of Soybean on 30th Day

3. Results and Discussion

The plants were washed gently with water and blotted with filter paper to absorb the water droplets. Then, the plants were subjected to biometric analysis. The results of the study were discussed as follows.

Biometric Parameters

The growth attributes of Soybean such as shoot and root length, fresh and dry weights were recorded on the 30th day after sowing.

Fresh Weight and Dry Weight

The fresh and dry weights of Soybean for various stages of growth were depicted in Table - 1. The Table – 1 clearly indicates that the fresh weight of the treatment T_2 (*Rhizobium*) and T_6 (Phosphorus) was enhanced significantly ($P<0.05$) on the 30th day of growth respectively.

Table - 1: The fresh and dry weights of Soyabean as influenced by the biofertilizer and phosphorus

Treatments	Fresh weight (g/plant)	Dry weight (g/plant)
	30th day after sowing	30th day after sowing
T_1	0.34	0.02
T_2	0.50	0.08
T_3	0.44	0.07
T_4	0.46	0.08
T_5	0.34	0.05
T_6	0.33	0.06

The results revealed that the treatment of T_2 and T_4 showed highest fresh weight on the 30th day when compared to other treatment. The treatment of T_2 and T_4 have recorded the maximum dry weight on the 30th day, when compared to other treatment were respectively.

Shoot Length

The Table - 2 indicate the Shoot and Root length of Soybean on the 30th Day after Sowing.

Table - 2: The Shoot and Root length of Soybean

Treatments	Shoot length (cm)	Root length (cm)
	Days after sowing	Days after sowing
T_1	22.45	3.60
T_2	33.32	7.50
T_3	25.10	5.90
T_4	36.62	6.40
T_5	27.15	4.70
T_6	43.70	5.40

Mary Iwuagwu *et al*. (2013) and Chen (2006) reported the Parameters for growth such as plant height, root length, plant fresh weight, dry weight, stem base diameter and plant chlorophyll content were used to compare the vegetative growth of the seedlings on different treatment applications. The result showed that seedlings treated with microbial inoculants responded greatly when compared to the control. Analysis of variance showed that there was significant increase in height, root length, stem diameter, fresh and dry weight of seedlings on the application of the microbial inoculants. The result suggests that that biofertilizers enhances the growth of *Zea mays* and as such its usage should be encouraged because of it is eco-friendly.

From the above data it was evident that the shoot length increased with the growth period for all the treatments and the increase was found to be significant ($p<0.05$) when compared to the control. Among the treatments T_2 and T_4 were recorded the maximum Shoot length on the 30th day when

compared to other treatment. The combined applications of biofertilizers (*Rhizobium* and *Phosphobacteria*) have enhanced the shoot length very much compared to all the other treatments.

Root Length

Among the treatments, T_2 and T_4 showed increased root length on the 30^{th} day when compared to other treatment. The seeds treated with biofertilizer *Rhizobium japonicum* showed an significant increase in the growth of plant - Mungbean *Vigna radiata* .Their morphological parameters such as Number of leaves, length of leaves, breath of leaves, length of plants, shoot length, root length and Total length of plant showed significant improvements. The effect was also observed in the bio-chemical parameter such as carbohydrate content, protein content and chlorophyll content. Hence, results prove that plants treated with *Rhizobium japonicum* showed better growth in both morphology as well as biochemical parameters (Peter Fernandes and Satish Bhalerao, 2015).

4. Conclusion

From the results summarized above, we can conclude that the treatment T_2 with *Rhizobium* individually as well as the combined application of biofertilizer (T_4) exhibited an improved plant growth and biomass production. It can be recommended that the *Glycine max* seeds can be treated with fungicide and its influence on the nitrogen fixation.

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