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IMPACT OF FERTILIZERS APPLICATION ON SEED GERMINATION AND SEEDLING GROWTH OF VIGNA RADIATA

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ABSTRACT

Currently, a real challenge for the workers in the agricultural research field is to stop or reduce the use of expensive agrochemicals/ chemical fertilizers which are hazardous to the environment as well as human health. Present study was aimed to improve the growth and obtain optimum yield of *Vigna* crop with eco-friendly, non-toxic way and to reduce the use of agrochemical/chemical fertilizer application in agricultural activities.

A pot experiment was conducted to study the effect of chemical fertilizer (DAP) and biofertilizer (*Rhizobium* strain) separately and in combination on seed germination and seedling growth (at 30 days) based on morphological parameters such as seedling length (cm), fresh weight (g), dry weight (g) and leaf area $(cm)^2$ of *Vigna radiata* (L.) Wilczek. After one month (30 Days) observations, it was found that seedling length, fresh and dry weights and leaf area were maximum in T_4 and minimum in T_{15}, T_7 and T_8 favored improved seedling length and leaf area whereas T_7, T_8, and T_9 favored improved fresh and dry weights as compared to control.

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KEY WORDS : Biofertilizer, DAP, Germination, Seedling, *Vigna* crop.

Introduction

Today, fertilizer has become essential to modern agricultural practices to get more yield to feed the growing population. Fertilizers are designed to supplement the nutrients already present in the soil. Biofertilizer is a substance which contains living microorganisms, have emerged as a highly potent alternative to chemical fertilizers due to their eco-friendly, easy to apply, non-toxic and cost effective nature. Biofertilizers and biopesticides propose a sustainable solution to the reduction in the use of chemical fertilizers while meeting the demands of growing population. The use of biofertilizers and biopesticides in place of chemicals is likely has the potential to improve human health. Biofertilizers increase the effectiveness of chemical fertilizers by using a carrier material on which microbes are mounted[2].

In the present study, the experimental crop *Vigna radiata* (L.) Wilczek, also known as Mung bean, belonging to the family fabaceae is grown primarily for it's protein rich edible seeds.

Materials and Methods

Present study was carried out to observe seed germination and seedling growth of *V. radiata* influenced by fertilizer application under department of Botany at Dayanand Vedic College (Orai), Bundelkhand region (U.P.), India during kharif season of year 2016. In pot culture, used chemical fertilizer was DAP (Diammonium Phosphate), biofertilizer (BF) was *Rhizobium* strain and experimental crop was mung bean (*Vigna radiata* L. Wilczek, *var.* sweta) belong to fabaceae family which is a short seasonal, annual, self-fertilized herb crop. *Rhizobia* are soil bacteria that fix atmospheric nitrogen after becoming established inside root nodules of legumes.

The study was carried out in a Randomized Complete Block Design with sixteen treatments as T_1, T_2, T_3, T_4, T_5, T_6, T_7, T_8, T_9, T_{10}, T_{11}, T_{12}, T_{13}, T_{14} and T_{15} with a control *i.e.* T_0 in three replications (Table-1). Trial poly pots (10 inches) were filled with prepared soil treated with fertilizers. Undamaged healthy seeds of experimental crop were selected for the study. Before sowing, seeds were first surface sterilized with 0.1% $HgCl_2$ for two minutes and thoroughly washed with distilled water. Then,

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the seeds were sown in poly (plastic) pots with treated soil. The plants were watered daily at specific time and the morphological growth parameters were analyzed and recorded at regular intervals during one month observation for germination and seedling growth.

To estimate seedling length; three plants were randomly selected from each treatment measured by using a centimeter scale and the values were recorded.

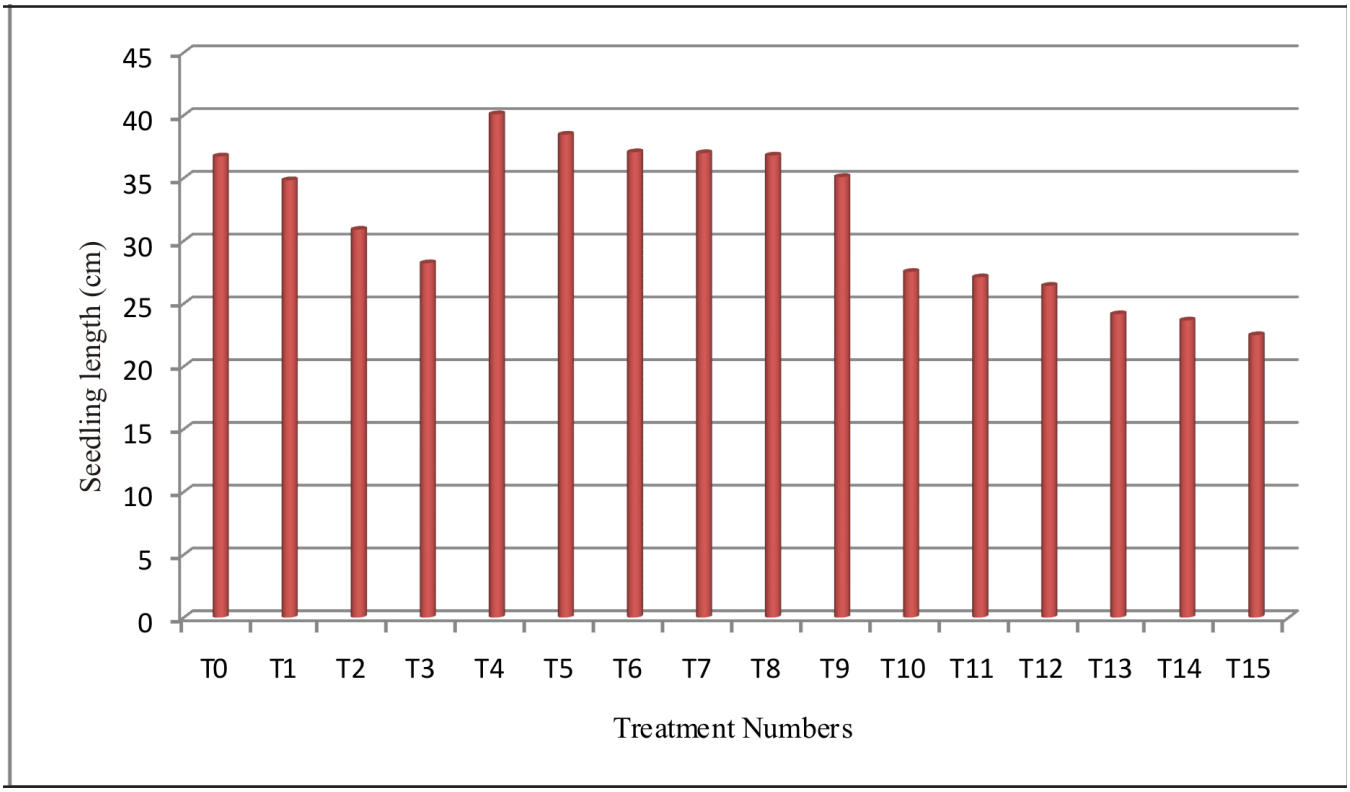

Fig. 1: Seedling length (cm) of *Vigna radiata*

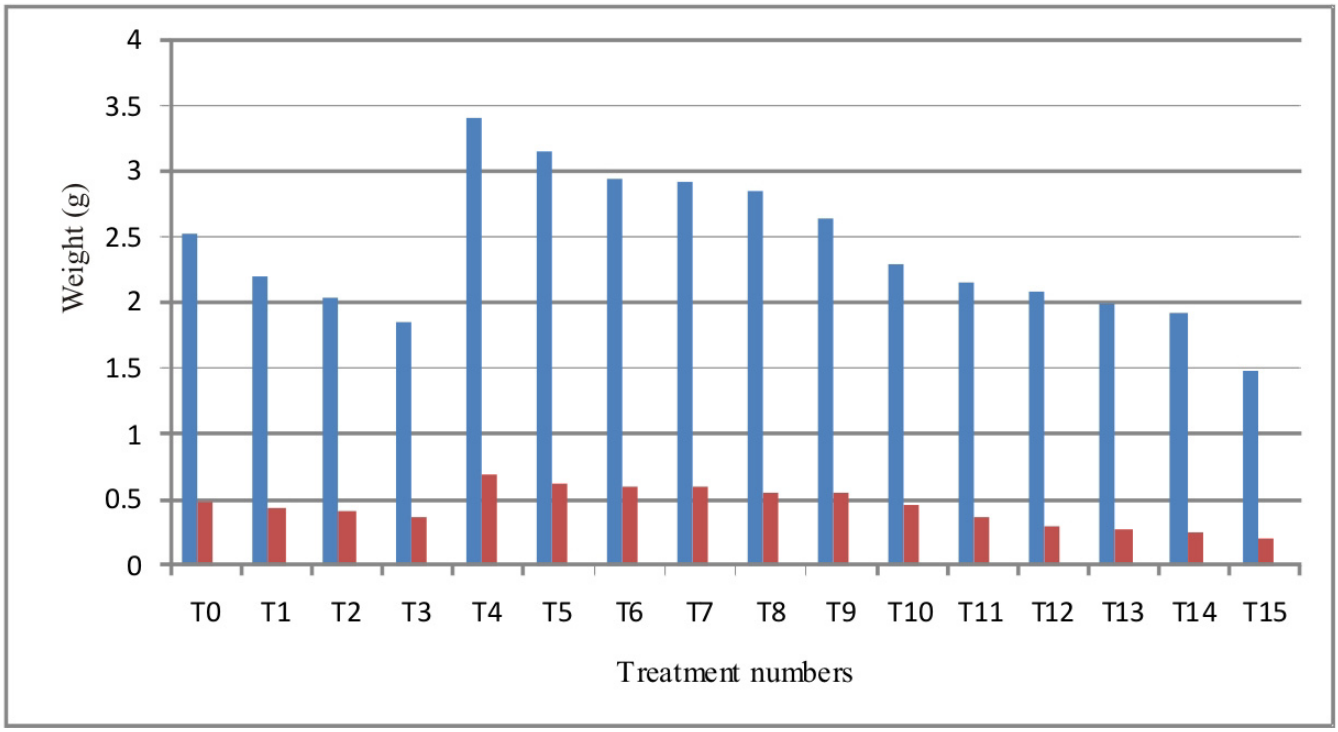

Fig.2: Seedling fresh and dry weights (g) of *Vigna radiata* (Long line= Fresh weight and Short line= Dry weight)

TABLE-1: Treatments with various combinations of chemical fertilizer and biofertilizer

Treatment Number	Doses
T_0	Control (without fertilizer)
T_1	DAP (2g) per kg soil
T_2	DAP (4g) per kg soil
T_3	DAP (8g) per kg soil
T_4	BF (20g) per kg soil
T_5	BF (40g) per kg soil
T_6	BF (80g) per kg soil
T_7	DAP (2g) + BF (20g) per kg soil
T_8	DAP (2g) + BF (40g) per kg soil
T_9	DAP (2g) + BF (80g) per kg soil
T_{10}	DAP (4g) + BF (20g) per kg soil
T_{11}	DAP (4g) + BF (40g) per kg soil
T_{12}	DAP (4g) + BF (80g) per kg soil
T_{13}	DAP (8g) + BF (20g) per kg soil
T_{14}	DAP (8g) + BF (40g) per kg soil
T_{15}	DAP (8g) + BF (80g) per kg soil

To estimate fresh weight and dry weight of seedlings; three seedlings were randomly selected from each treatment. Their fresh weight was recorded by using pan electrical balance. The same seedlings were packed in brown pocket cover and they were kept in a hot air oven at 80^0C for 24 hrs. Then kept them in a dessicator for some time, their dry weight was also taken by using an electrical single pan balance.

Results and Discussion

The results showed that 100% seed germination was found with Treatment number T_0, T_1, T_2, T_4, T_5, T_6, T_7, T_8, and T_9 whereas minimum germination percentage (80%) found in T_{15}. Therefore, it was observed that seed germination percentage was not so much affected by low concentration of chemical fertilizer (DAP) whereas reduced germination percentage occur at high concentration of chemical fertilizer with or without biofertilizer addition.

Maximum seedling length, fresh and dry weights and leaf area attributes in present study were observed in treatment number T_4 whereas, minimum was observed in T_{15} (Fig.: 1, 2 and 3, respectively). Mung bean seeds inoculated with *Rhizobium* strains increased the nodulation and shoot dry weight, and gave better seed yield as compared to uninoculated[5,6,11]. Black gram (*Vigna mungo* L. Hepper) treated with biofertilizer (*Rhizobium japonicum*) showed excellent improvement in morphological and biochemical parameters[17].

Combination of DAP and BF as in treatment number T_7 and T_8 improved the seedling length and leaf

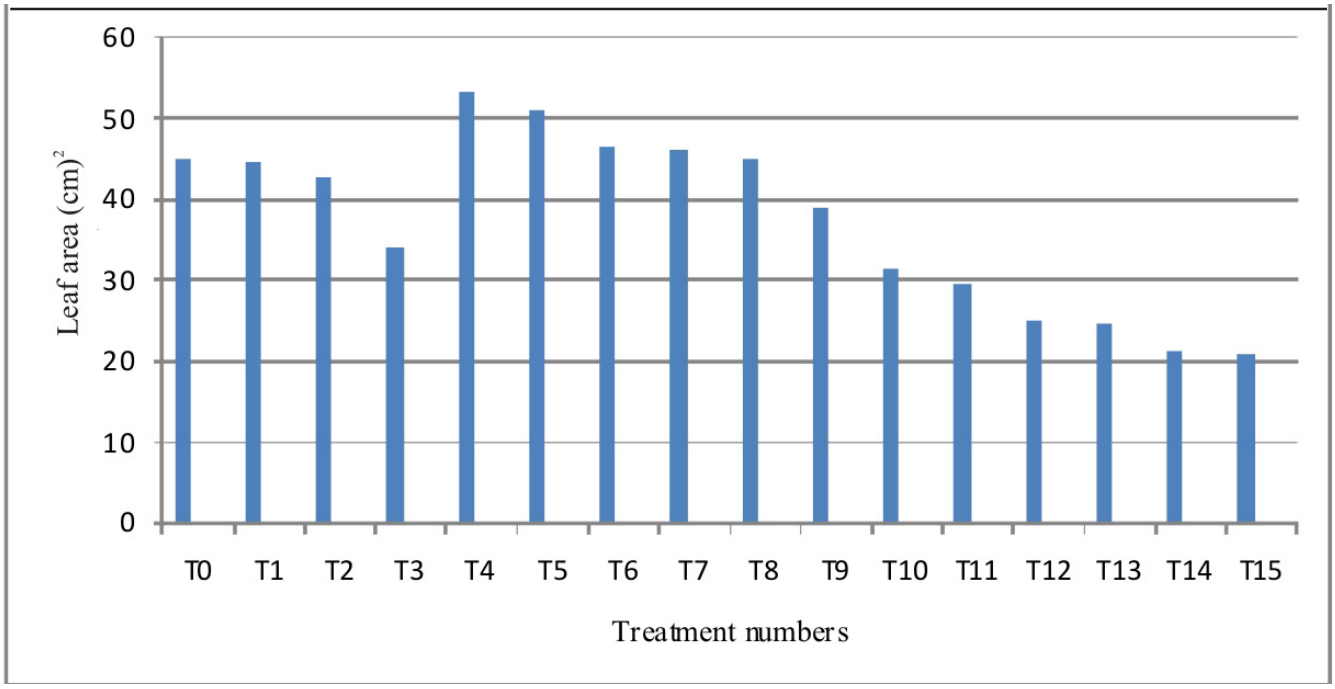

Fig.3: Leaf area of *Vigna radiata*

area in growing seedlings of mung bean as compared to control (Fig.:1 and 3, respectively) whereas T_9 also showed significant improvement in fresh and dry weights than control (Fig.:2). Different levels of phosphorus (control, 20, 40 and 60 kg P_2O_5 ha^{-1}) and biofertilizers recorded that 40 kg P_2O_5 ha^{-1} favoured the highest grain

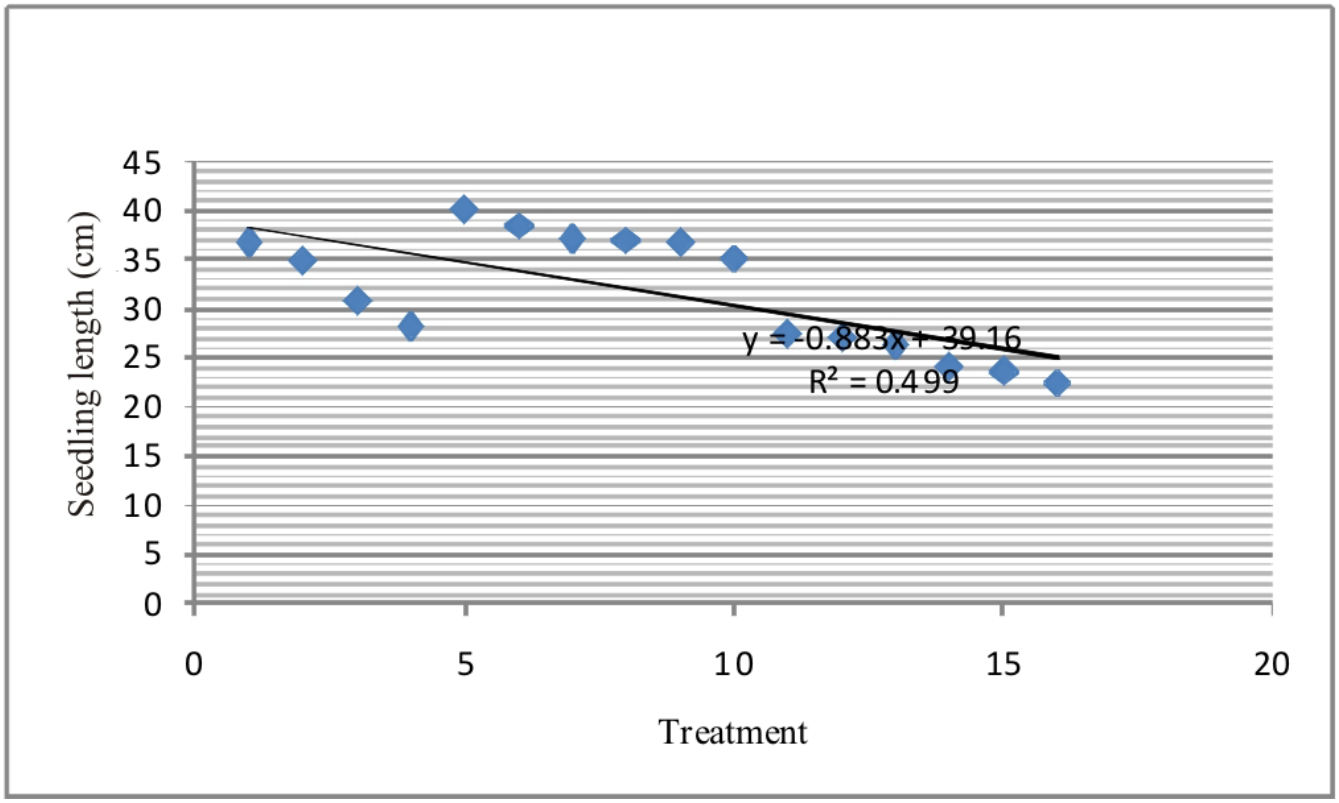

Fig. 4: Correlation and regression equation between different treatments (T_0 to T_{15}) and seedling length of *Vigna radiata.*

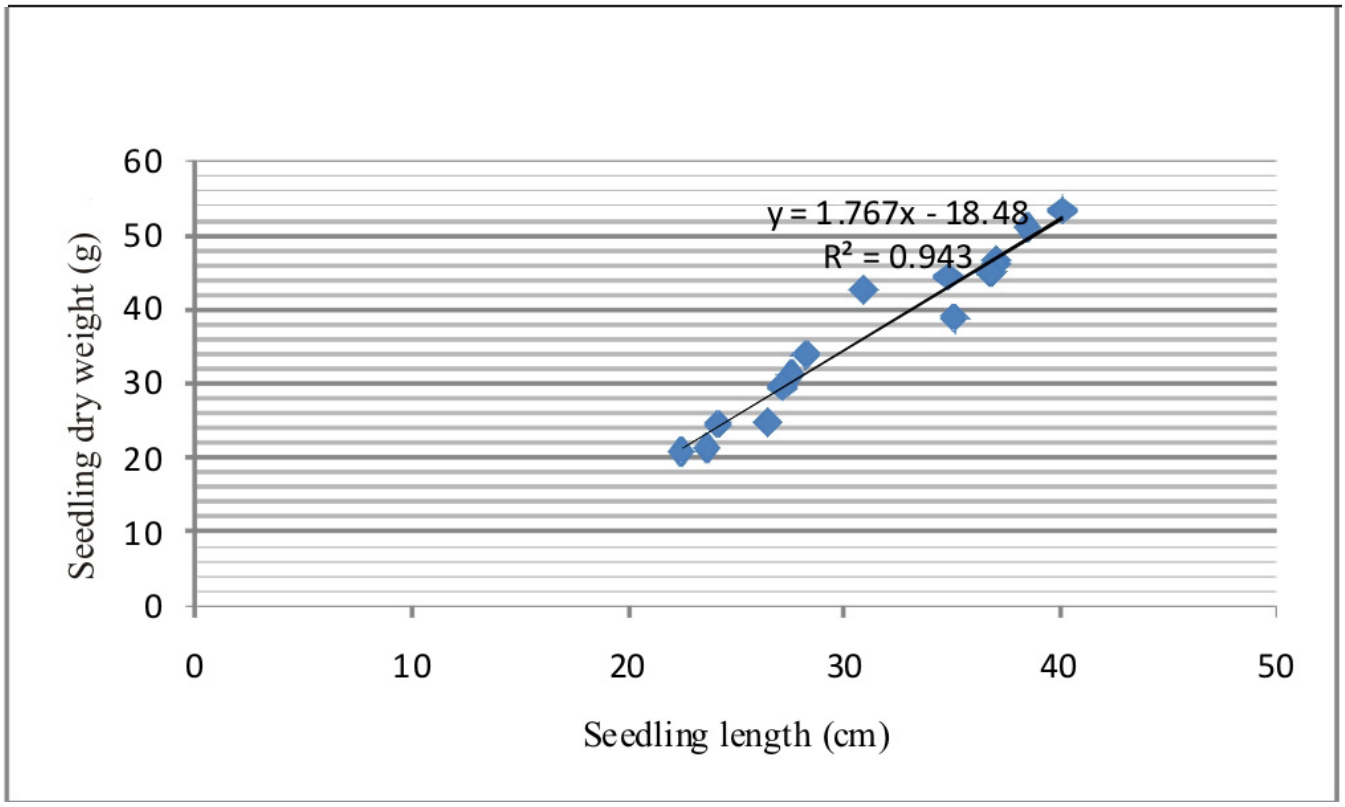

Fig. 5: Correlation and regression equation between seedling length and dry weight of *Vigna radiata*

yield and straw yield which was at par with 60 kg P_2O_5 ha^{-1} and also founded that seed inoculation with combined application of biofertilizers significantly increased highest number of nodules per plant, plant height, leaf area index, total chlorophyll content, grain yield and straw yield[27].

The biofertilizers play an important role in improving soil fertility[12]. *Rhizobium* increases plant growth by various ways such as production of plant growth hormones, vitamins, siderophores by solubilisation of insoluble phosphate, induction of systemic disease resistance and enhancement in stress resistance[10]. This interaction reduce the need of nitrogenous fertilizers during the growth of leguminous crops, which are herbaceous woody plants that produce seeds and are a good source of dietary protein for consumption by humans (vegetable oil) and animals (animal feed)[22,23]. So, rhizobial inoculants have been frequently applied as biofertilizers having antagonistic activity[8]. It was observed by some workers[9] that inoculation with certain plant growth promoting rhizobia (PGPR) may enhance crop productivity either by making the other nutrients available or protecting plants from pathogenic microbes (showing allelopathic effects). 100% RDF+*Rhizobium* 30g/kg was found as the best treatment for plant growth and seed yield of *Pisum sativum* L.which indicated that the process of biofertilizers might be better option for seed growers to achieve seed yield and yield components in pea[13]. Effect of biofertilizer combined with organic or inorganic fertilizer on the growth of *Caesalpinia pulcherrima* and bacterial population in the soil founded plants which were inoculated with biofertilizer (*Azotobacter, Azospirillum*, and *Rhizobium*) showed better growth compared than control treatment[24].

Relationship among different attributes

Positive linear relationships were found among seedling length and fresh weights (R^2= 0.943; fig. 6), dry weight (R^2= 0.943; fig. 5) and leaf area (R^2= 0.943; fig. 7) and negative linear relationship found between seedling length and different treatments (R^2= 0.499; fig. 4).

Conclusion

Biofertilizers are the best modern tools for agriculture which play a key role in the productivity and sustainability of soil and also protect the environment as eco-friendly. It is observed that there is gradual reduction in values of experimental parameters with high concentration of chemical fertilizer with or without combination of biofertilizer. Therefore, it can be concluded that a balanced fertilizer strategy with or without combination of chemical and biofertilizer could be used to achieve maximum crop yield without contaminating the environment.

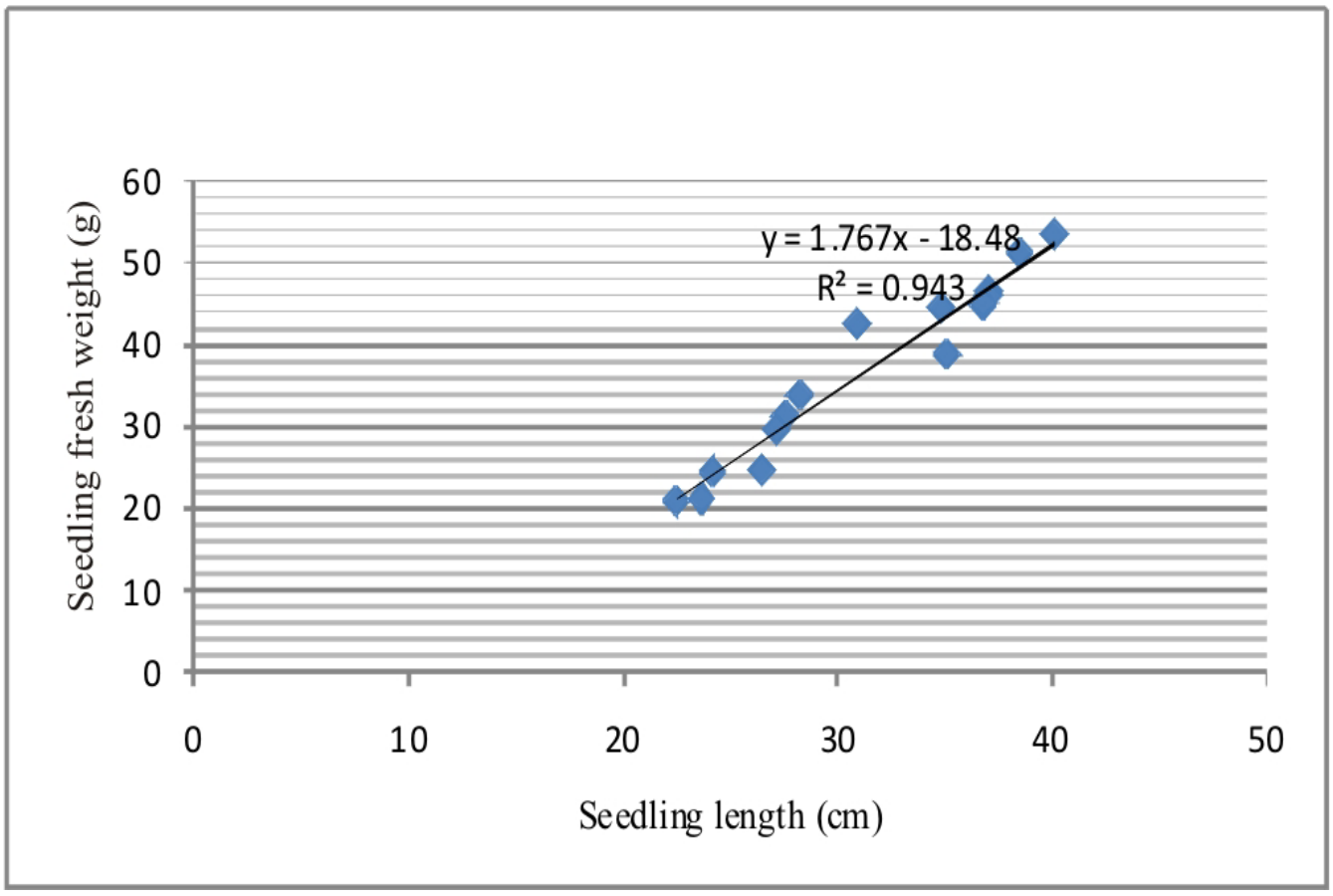

Fig. 6: Correlation and regression equation between seedling length and fresh weight of *Vigna radiata*

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