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Impact of Organic Manure and Inorganic Fertilizers on Seed Germination of Green Gram (*Vigna radiata* L.)

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ABSTRACT

India is one of the agricultural country and food is very important need for our country because growth of population. Nowadays various inorganic fertilizers used for agriculture for high yield purposes but it affect the soil fertility and living organisms. Chemical fertilizers are very costly and it produced environmental pollution. Organic compost is cost effective and sustainable. In this attempt the effect of various organic fertilizers (farm yard manure, vermicompost and composted coirpith) and inorganic fertilizers (nitrogen, phosphorus and potassium) on germination of green gram (*Vigna radiata* L.). The following parameters were analyzed such as germination percentage, seedling length, fresh weight, dry weight and photosynthetic pigments such as chlorophyll a, chlorophyll b, total chlorophyll and carotenoid. As the result of this study that all above the parameters were increased in vermicompost applicator soil of the plant compared to the other organic and inorganic fertilizers. This study concluded that vermicompost is very used for the crop production.

***Keywords*:** Agriculture; inorganic fertilizer; organic fertilizer; *Vigna radiata* L.

1. INDRODUCTION

India is an agricultural country and it ranks second position by its population in the world. There is a constant pressure on crop production from available cultivable land with

limited water resources in order to keep face with the food requirements for an ever-increasing population. Application of suitable fertilizers is one of the ways to attain the maximum crop yield. The contribution of nutrients by organic amendments had traditionally been considered to be the best to increase the crop yield. Farmyard manure increased the productivity by maintaining the soil health with concomitant nutrient balance, besides minimizing the pollution hazards as well as fertilizer cost (Gayathri and Anburani, 2008). Agricultural scientists are forced to produce more food within limited availability of cultivated land and water resources and particular socio-economic conditions. Over exploitation of vegetation and soil resources and adoption of inappropriate farming systems have resulted in land degradation and reduced crop production.

An efficient plant nutrition management practices need to be identified to ensure both enhanced and sustainable agricultural production and to conserve the natural resources. It is an important to note that even in low-productivity situations, the quantity of nutrients available for recycling *viz.*, plant and animal residues is rarely sufficient to compensate for the amounts removed in agricultural products. Thus, mineral fertilizers have to play a key role in areas with low fertility soils where increased agricultural production is required. Mineral nutrients are the major contributor to enhance crop production and maintaining soil productivity. The chemical fertilizer is the major supplier of nutrients besides organic manures. The continuous and excess use of chemical fertilizers over a longer period of time has resulted in deterioration of soil health and causes less productivity (Yadav and Lourduraj, 2005). The maintenance of the environmental safety and agricultural sustainability is the need of the hour in present system of agricultural production without reducing productivity. Excessive use of chemical is not only detrimental to crop plants in long-period of time but also make soil ecologically fragile, losing its productivity together with its economic implication. Long term application of inorganic fertilizers like high doses of ammonium sulfide and sulfur coated urea has led to soil acidification, decrease in soil aggregate stability decrease in soil respiration, pollution of underground water and decrease in earthworm population. Soil properties have deteriorated due to huge application of inorganic fertilizers and pesticides in order to increase the yield and protect the crop varieties.

Application of chemical fertilizers has boomeranged on man, soil organisms and environment. Modern agriculture is getting more and more dependent on the steady supply of synthetic inputs *i.e.* chemical fertilizers. Use of chemical fertilizers has been the kingpin of modern agriculture over the past 100 years. Consumption of N, P, K fertilizers increased over eight fold from 2647 (1971-1972) to 18070 (1999-2005) thousand tones and application of dose six-fold, through the cost of chemical fertilizers has also increased tremendously. The increase in crops yield in highly developed agricultural systems has been reported to be 60 per cent or more due to the use of chemical fertilizers. Indiscriminate and injudicious use of chemical fertilizers for the crop production has compounded the problem of environmental pollution, such as deterioration of soil health and residue problems. Adverse effects of the chemical fertilizers have compelled the scientific fraternity to look for alternatives in the form of biofertilizer. In this context, the role of organic manures and biofertilizers in sustainable agriculture assumes special significance particularly in the present context of very high cost of chemical fertilizers.

Organic farming is becoming a major tool for sustaining the soil quality degraded by intensive use of synthetic chemicals for increasing crop production. Therefore, the use of bio-agents as biofertilizers or biopesticides is an integral part of organic farming.

The vermicomposts contain plant growth regulating substances including plant growth hormones and humic acids which are probably responsible for increase in germination, growth and yield of plants (Atiyeh *et al.,* 2002; Arancon *et al.,* 2006).

Coirpith is obtained from coconut mesocarp, during the process of coir manufacture. It has a wide C:N ratios and its lignin rich nature does not permit natural decomposition as in the other agricultural wastes. Biodegradation of coirpith is brought about by a variety of microorganisms, such as bacteria, fungi and actinomycetes. The organisms are capable of producing cellulolytic and lignolytic enzymes which are degrading coirpith which is generally measured by the contents of lignin and cellulose. Composted coirpith can be used in different applications such as organic supplements in horticulture, floriculture and also for control of surface erosion and ground water pollution (Senthilkumar and Sekar, 1998). Urea is gaining an important place among the solid nitrogenous fertilizers in world markets. In India, about 85 per cent of total nitrogen consumed is only in the form of urea. When urea or urea containing fertilizer is applied on soil surface, it gets hydrolyzed through enzymatic conversion from amide to ammonium and one or more inorganic carbon forms (Kumar, 1998).

Organic manures are cost effective, eco-friendly and renewable source of plant nutrients to supplement chemical fertilizers and organic manures in sustainable agricultural system in India. They are microbial inoculants which enhance crop production through improving the nutrient supplies and their availability (Wani and Lee, 2002). The use of organic manures undoubtedly boosted not only the food production but also, it shows the positive effects on physico-chemical properties of soil, nitrogen transformation, macro and micronutrient uptake and nutritional composition (Mahesh and Hosmani, 2004). In the present work deals with the impact of organic and inorganic fertilizers on seed germination, growth and photosynthetic pigments of *Vigna radiata* L. (Photos 1-4).

Photo 1. *Vigna radiata.*

Photo 2. *Vigna radiata.*

Photo 3. *Vigna radiata.*

Photo 4. *Vigna radiata.*

2. MATERIALS AND METHODS

2. 1. Seed collection

Vigna radiata L. seeds were procured from Tamil Nadu Rice Research Institute, Aduthurai, Thanjavur district of Tamil Nadu, India.

2. 2. Organic compost

The following organic compost prepared in Botanical garden of Department of Botany, Annamali University. They are farm yard manure, vermicompost and composted coirpith.

2. 3. Inorganic fertilizers

Nitrogen, phosphorus and potassium brought from Government Authorized Agrocentre, Chidambaram, Cuddalore District of Tamil Nadu.

2. 4. Germination studies

The healthy and uniform sized green gram (*Vigna radiata* L.) seeds were selected and surface sterilized with 0.1% $HgCl_2$ for two minutes and then thoroughly washed with tap water. Twenty seeds were placed equidistantly in plastic tray filled with 3 kg sterilized soil mixed with individual application of organic manures (farm yard manure, vermicompost and composted coirpith) and inorganic fertilizers (N, P and K). The combined application were also done within the organic manures and inorganic fertilizers used for laboratory experiment. Three replicates were maintained for each treatment. The germination percentage, shoot length, root length, seedling fresh weight and seedling dry weight were taken and recorded on the 7^{th} day's seedlings.

Germination percentage

The number of seeds germinated in each concentration was counted on the 15th day and the germination percentage was calculated by using the following formula

$$\text{Germination percentage} = \frac{\text{Number of seeds germinated}}{\text{Total numbers of seeds sown}} \times 100$$

Seedling length (cm/seedling)

Five seedlings were taken from each treatment and their seedling lengths were measured by using a cm scale and these values were recorded.

Fresh weight (g/seedling)

Five seedlings were collected from each treatment and their fresh weights were measured with the help of an electrical single pan balance.

Dry weight (mg/seedling)

The same seedlings used for fresh weight were kept in hot air oven at 80 °C for 24 hours. Then, the seedlings were taken from the oven and kept in desiccators for some time. Their dry weights were taken by using an electrical single pan balance.

2. 5. Photosynthetic pigments analyses

The photosynthetic pigments such as chlorophyll a, b, total chlorophyll and carotenoid were analysed in the plants grown both in the laboratory conditions.

Chlorophyll (Arnon, 1949)

Five hundred mg of fresh leaf material was ground with a mortar and pestle with 10 ml of 80 per cent acetone. The homogenate was centrifuged at 800 rpm for 15 minutes. The supernatant was saved and the residue was re-extracted with 10 ml of 80 per cent acetone. The supernatant was saved and the absorbance values were read at 645 and 663 nm in a UV-spectrophotometer. The chlorophyll a, chlorophyll b and total chlorophyll contents were estimated and expressed in mg/g fresh weight basis.

Chlorophyll ‘a’ = (0.0127) × (O.D 663) – (0.00269) × (O.D 645)
Chlorophyll ‘b’ = (0.0229) × (O.D 645) – (0.00488) × (O.D 663)
Total chlorophyll = (0.0202) × (O.D 645) + (0.00802) × (O.D 663)

Carotenoid (Kirk and Allen, 1965)

The same plant extract used for chlorophyll estimation was used for carotenoid estimation. The acetone extract was read at 480 nm in a UV-spectrophotometer. The carotenoid content was calculated by using the following formula and it is also expressed in mg/g fresh weight basis.

Carotenoid = (O.D 480) – (0.114) × (O.D 663) – (0.638) × (O.D 645)

3. RESULTS AND DISSUSION

Germination, the critical phase in the lifecycle of a crop plant is subjected to numerous environmental factors (Cooper, 1979). The natural environment is favoured for growth and development of plant communities (Anamica and Dhaka, 2004). When the seeds are grown to a wide range of environmental factors, it will reflect in the germination performance and the establishment of healthy young seedlings. Germination percentage, shoot length, root length, fresh weight and dry weight of sunflower seedlings as influenced by the application of various fertilizers such as organic compost and inorganic fertilizers. Seed germination and growth are of vital importance for continuation of plant life. Seed germination is defined as the resumption of metabolic activity.

The growth of an embryo starts with the rupture of the seed coat and the emergence of the young seedlings. The time between the seed sowing and seedling establishment is considered to be the crucial period of any plant. The effect of the environment on germination is quite complex because of external and internal factors that modify germination patterns (Rout *et al.,* 2000). The highest germination percentage was observed in vermicompost application of the seedlings (Figure 1). The application of recommended doses of organic manures, inorganic fertilizers and biofertilizers increased the seed germination percentage. Similar increase in germination percentage was recorded in rice sweet flag (Kalyanasundaram *et al.,* 2008), *Zea mays* (Wu *et al.,* 2005), *Abelmoschus esculentus* (Gupta *et al.,* 2008) and *Triticum aestivum* (Ram *et al*., 2014).

Enhancement of seed germination might be attributed to the role of organic compost in increasing the availability of macro and micronutrients in the soil and making of available to the germinating seeds with positive enhancement in the metabolic activity resulting in higher germination (Cooper, 1979). In the present study, the highest seedling length of the green gram was recorded in vermicompost application of the seedlings (Figure 2). Seedling stage is the most sensitive stage in the life cycle of a plant and hence it is susceptible to physical and chemical adversities. The application of the organic manures and inorganic fertilizers improved the growth and development pattern of seedlings. The fresh weight and dry weight are mainly based on their growth performance of a particular crop. A plant can grow vigorously which contain much amount of fresh weight and dry weight. The highest seedling fresh and dry weights were recorded in vermicompost applications of seedlings (Figure 3). Similar results were also recorded in cotton (Vanangamudi *et al.,* 1987), *Albizia labbek* (Kumudha and Gomathinayagam, 2007) and paddy (Rajasekaran *et al.,* 2015). It may be due to the interference of biofertilizer with the seedlings metabolism and increased the biomass of green gram seedlings.

Chlorophyll is an integral component of plant pigments and plays a vital role in the process of photosynthesis. It is the molecule that absorbs sunlight and uses its energy to synthesis carbohydrates from CO_2 and water. It has been proved that chlorophyll play an important role in the ATP generation and prevention of essential plant constituents (Kochot *et al.,* 1998). Chlorophyll analysis is one of the important biochemical parameters, which is used as an index of plant production capacity. Chlorophyll a, b and total chlorophyll content is an indication of photosynthetic and metabolic activity.

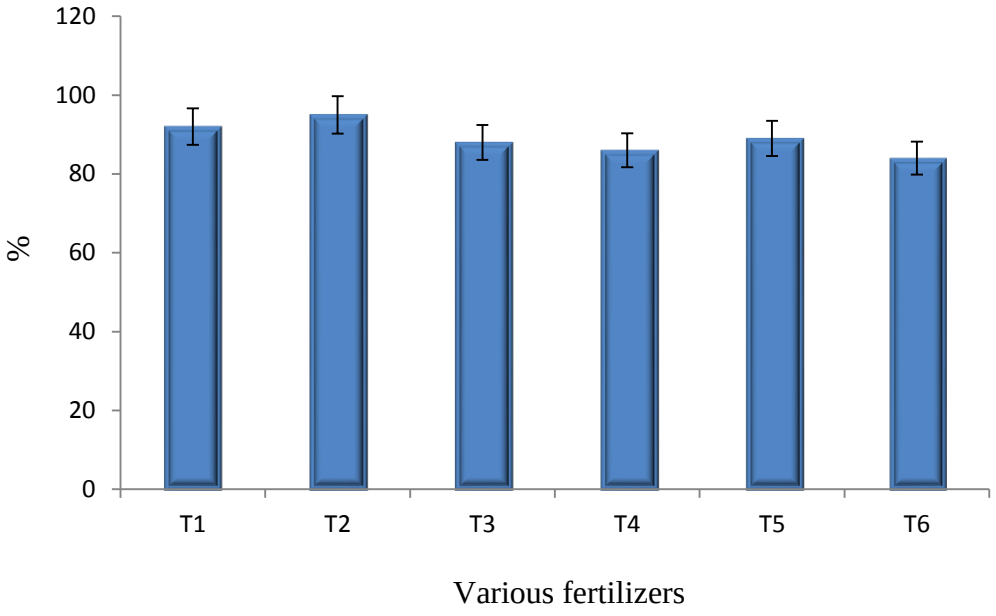

Figure 1. Germination percentage of *Vigna radiata* L. grown under various oraganic and inorganic fertilizers.

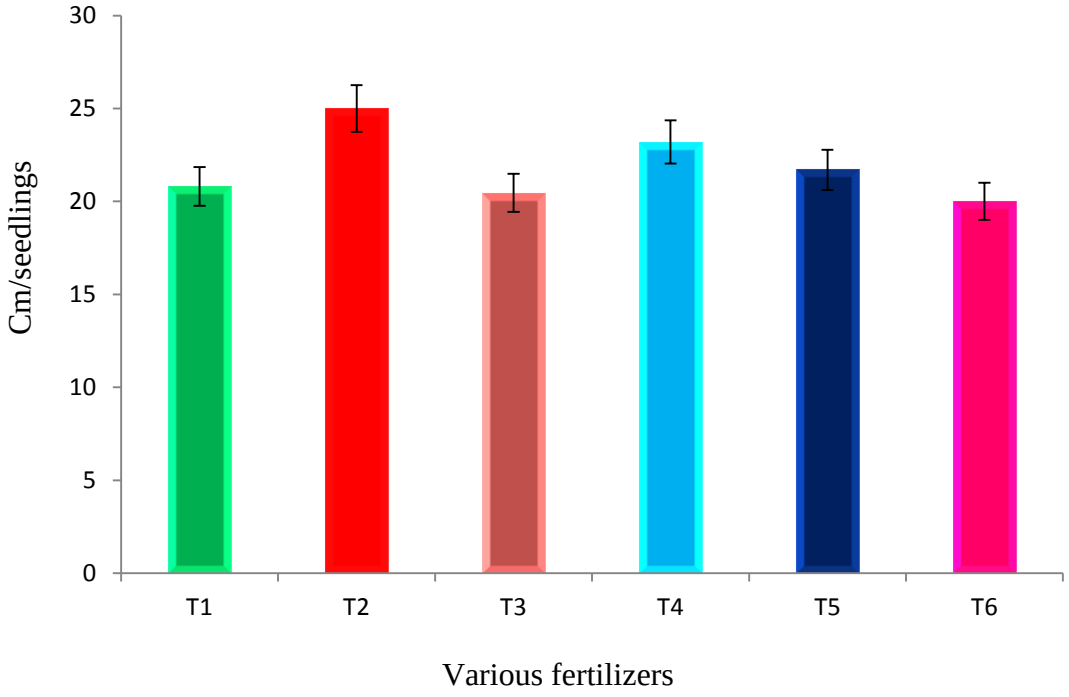

Figure 2. Seedling length of *Vigna radiata* L. grown under various oraganic and inorganic fertilizers.

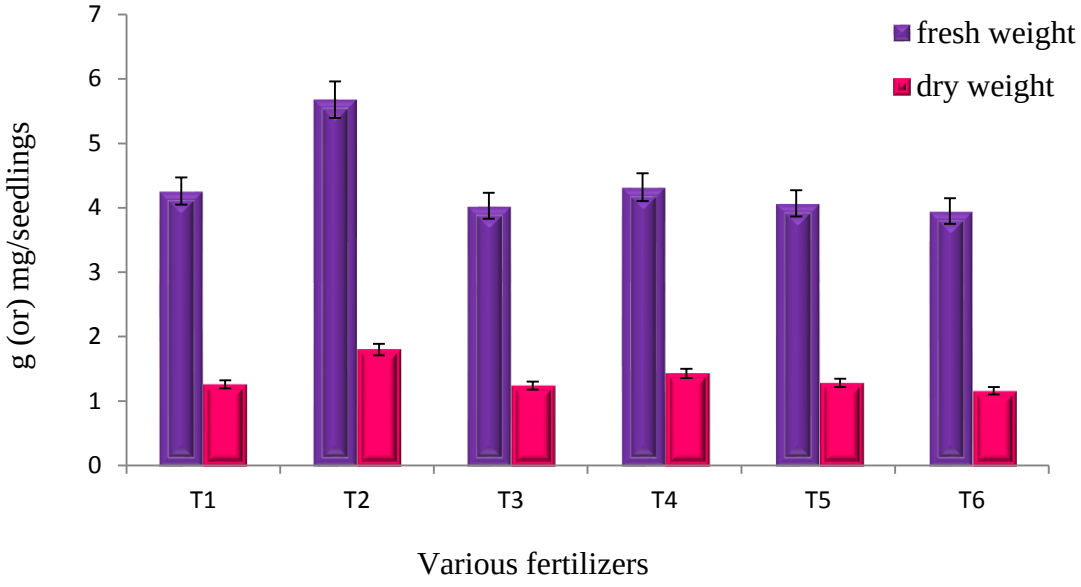

Figure 3. Fresh weight and dry weight of *Vigna radiata* L. seedlings grown under various oraganic and inorganic fertilizers.

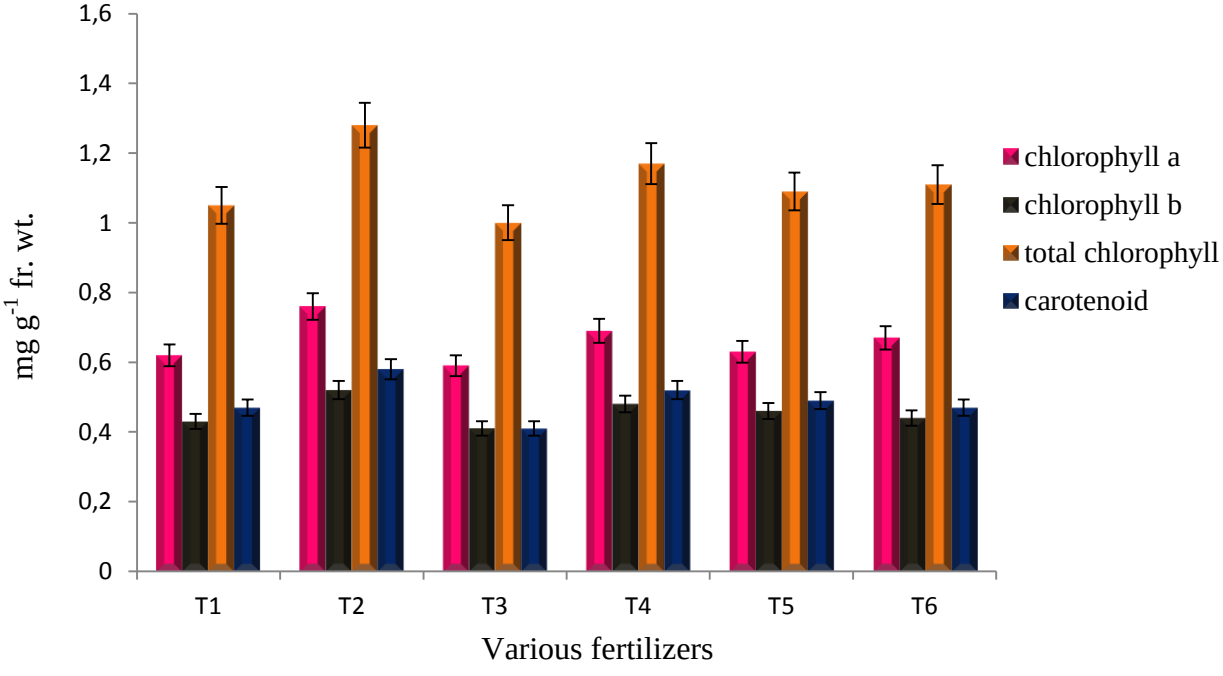

Figure 4. Photosynthetic pigments of *Vigna radiata* L. seedlings grown under various oraganic and inorganic fertilizers.

T1 - farm yard manure; T2 - vermicompost; T3 - composted coirpith; T4 - nitrogen; T5 - phosphours; T6 - potassium.

In the present study, the application of recommended doses of various organic manures and inorganic fertilizers on chlorophyll a, chlorophyll b and total chlorophyll content of green gram crop were estimated in the laboratory studies. The highest chlorophyll content was recorded in vermicompost application of seedlings (Figure 4). It was followed by the crop grown in inorganic fertilizers and organic manures. Similar findings of increased chlorophyll content may be due to fertilizer application was recorded in various plants such as soybean (Thiyageswari and Selvi, 2006), maize (Tejeda *et al.,* 2008). Carotenoid is an accessory pigment in photosynthetic assimilation of plants. The highest carotenoid content was registered in the crop grown in vermicompost followed by inorganic fertilizers and organic manures. The lowest content was recorded in the crop grown without fertilizer. Similar findings were reported in *Acanthus illicifolius* (Ravikumar *et al.,* 2004) and paddy (Rajasekaran *et al.,* 2015).

4. CONCLUSION

Efficient plant nutrition management should ensure both enhanced and sustainable agricultural production and safeguard the environment. In this present study was concluded that the green gram (*Vigna radiata* L.) seedlings were well grow in vermicompost applicator soils compared to other organic and inorganic fertilizers. Required amount of plant nutrient present in this manure which it easily available and eco-friendly. It may be recommended as an effective to boost productivity of green gram.

Statistical analysis

Data were analyzed for one way analysis of variance (ANOVA) for determining the difference between biochemical analysis of African marigold and standard deviations were also calculated with the help of SPSS16.0 and graph formed by MS- Excel.

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