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RESEARCH ARTICLE :

Effect of different organic manures, inorganic fertilizers and growth regulator on yield attributes and yield of greengram (*Vigna radiata* L.)

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SUMMARY : The experiment was conducted during *Kharif* 2014-15 at Crop Research Farm, Department of Agronomy, SHAITS, Allahabad to study the effect of organic manures (farm yard manure, vermicompost and polutry manure), inorganic fertilizers (Nitrogen, Phosphorus and Potash) and growth regulator (Gibberellic acid) on yield attributes and yield in green gram, *Vigna radiata* (L.). The experiment was laid out in Randomized Block Design with thirteen treatments in three replications. Application of 10-40-20 NPK kg/ha+10 kg/ha N through poultry manure+GA3 75+75 ppm was recorded significantly maximum number of pods per plant, number of grains per pod, test weight(g), grain yield and straw yield in greengram as compared to the all other treatments .

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KEY WORDS :
Greengram, Inorganic fertilizers, Farm yard manure, Vermicompost, Polutry manure, Gibberillic acid, Yield

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BACKGROUND AND OBJECTIVES

Greengram *Vigna radiata* (L.) is an important pulse crop and an excellent source of high quality protein. It consists of about 25% protein which is almost 2.5-3.0 times more than the cereals. Greengram also known as mungbean is consumed as whole grain and as well as dal. Sprouted greengram whole seed is used in South India for preparing curry or a savory dish. India is the largest producer and consumer of pulses in the world. India primarily produces Bengalgram (chickpea), redgram (tur), lentil (masur), greengram (mungbean) and blackgram (urad). Pulses are the major source of protein for vegetarians and the crop residues are a major source of high quality livestock feed.

Per capita consumption of pulses in India is decreasing from 60g in 1960-61 to 40g in 1997-98 as against 80g recommended by World Health Organization and Food and Agricultural Organization. Mungbean is cultivated in an area of 3.38 M ha, with a production of 1.61 m tonnes, an average productivity is 474 kg/ha (CMIE, 2015) in India. Madhya Pradesh, Maharashtra, Rajasthan, Uttar Pradesh and Karnataka are the major pulses producing states in India. In Uttar Pradesh cultivation of greengram is 0.78 M ha with a production of 0.39 m tonnes and

an average productivity is 500 kg/ha (CMIE, 2015). Average yield of pulses are very low in India compared to other countries due to poor spread of improved varieties and technologies, abrupt climatic changes, substandard methods of cultivation, poor crop stand, imbalanced nutrition and vulnerability to pests and diseases.

The integrated plant nutrient system helps in improving and maintenance of soil fertility for sustaining crop productivity. Cultivation of pulses benefit of the succeeding crop to the extent of 40 kg N/ha (Witham *et al*., 1971). Organic manures contain both macro and micronutrients whose application into soil, it results in improved soil condition and thereby significantly increases the level of N fixation.

Use of organic manures alone, as a substitute to chemical fertilizers is not profitable and will not be enough to maintain the present levels of crop productivity of high yielding varieties. Use of organic manures along with inorganic fertilizers leads to increase in productivity and also sustain the soil health for a longer period (Gawai and Pawar, 2006). Organic manures although not useful as sole sources of nutrients, however, acts as good complementary nutrient sources with inorganic fertilizers (Chaudhary *et al*., 2004), which have carryover effect on succeeding crops. About less than 30% of N and small fraction of P and K in organic manures may become available to immediate crop and rest to subsequent crops (Sharma and Vyas, 2001). Use of organic manures alone or in combination with chemical fertilizers will help to improve physico-chemical properties of the soils, efficient utilization of applied fertilizers for improving seed quality and quantity. Organic manures provide a good substrate for the growth of micro-organisms and maintain a favourable nutritional balance and soil physical properties. It is recognized that combined source of organic matter and chemical fertilizers play a key role in increasing the productivity of soil. Mungbean yield and quality can be improved by the balanced use of fertilizers and also by managing the organic manures properly.

Farmyard manure is known to play an important role in improving the fertility and productivity of soils through its positive effects on soil physical, chemical and biological properties and balanced plant nutrition (Kumar *et al*., 2011). Fertilizers play vital role in maintaining/ improving soil fertility as the source of readily available nutrients to plants. The increasing cost of chemical fertilizer, growing environmental concern and energy crisis have created considerable interest for search of alternative cheap sources of plant nutrients.

The use of vermicompost as a source of organic manure increase crop growth, yield and soil nutrient status (Vasanthi and Kumaraswamy, 1996) and nutrient uptake (Sansamma and Raghavan Pillai, 1996). Vermicompost is not only rich in plant nutrients but also improves the physical, chemical properties of the soil and enhances the microbial activity in soil. Vermicompost is rich in microbial populations and diversity, particularly fungi, bacteria and actinomycetes (Edwards and Burrows, 1988; Tomati *et al*., 1987). Generally, after vermicomposting the organic material is ground upto a more uniform size which gives the final substrate a characteristic earthy and more heterogeneous appearance (Ndegwa and Thompson, 2001; Tognetti *et al*., 2005) and increase the dry weight (Edwards, 1995).

Plant growth regulators are known to play a positive role in enhancing yield potential in plants. Foliar application of plant growth regulators are influences the plant architecture and yield potential. The application of Naphthalene Acetic Acid at 50 ppm significantly increased the grain yield in greengram (Kalita, 1989). However, information on integration of organic manures, inorganic fertilizers and growth regulators is lacking. Hence, in the present study was carried out to optimize the use of available resources of organic manures, growth regulators and inorganic fertilizers and their integrated approach to boost the green gram yields.

RESOURCES AND METHODS

The experiment was conducted during the *Kharif*, 2014-15, at the Crop Research Farm, Department of Agronomy, Allahabad School of Agriculture, Sam Higginbottom Institute of Agriculture Technology and Sciences, Allahabad, Uttar Pradesh, India. The Crop Research Farm is situated at 25° 572' N latitude, 87° 192' E longitude and at an altitude of 98 m from the sea level. The soil was sandy loam in texture, low in organic carbon (0.28%) and medium in available nitrogen (225 kg ha^{-1}), phosphorus (21.50 kg ha^{-1}), low in potassium (87 kg ha^{-1}) and with soil pH of 7.4. The experiment was laid out in Randomized Block Design with thirteen treatments in three replications. The treatments were comprised of T_1: 20-40-20NPK/kg/ha (Recommended Dose of Fertilizer), T_2:10-40-20 NPK/kg/ha+10 kg N through FYM, T_3:10-40-20 NPK/kg/ha+10 kg N through

FYM+GA_3 25+25 ppm (25 ppm at two leaf stage and 25 ppm at 20 days after first spraying), T_4:10-40-20 NPK/kg/ha+10 kg N through FYM+GA_3 50+50 ppm, T_5:10-40-20 NPK/kg/ha+10 kg N through FYM+GA_3 75+75 ppm, T_6: 10-40-20 NPK/kg/ha+10 kg N through vermicompost, T_7:10-40-20 NPK/kg/ha+10 kg N through vermicompost+GA_3 25+25 ppm, T_8:10-40-20 NPK/kg/ha+10 kg N through vermicompost+GA_3 50+50 ppm, T_9:10-40-20 NPK/kg/ha+10 kg N through vermicompost + GA_3 75+75 ppm, T_{10}:10-40-20 NPK/kg/ha + 10 kg N through poultry manure, T_{11}: 10-40-20 NPK/kg/ha+10 kg N through poultry manure + GA_3 25+25 ppm, T_{12}:10-40-20 NPK/kg/ha+10 kg N through poultry manure+GA_3 50+50 ppm and T_{13}:10-40-20 NPK/kg/ha+10 kg N through poultry manure + GA_3 75+75 ppm was replicated thrice each treatment. Recommended dose of fertilizer (RDF) for green gram is 20-40-20 kg/ha of nitrogen, phosphorus and potash. Nitrogen and potash were applied in all the plots as per the recommended dosages of SHAITS, Allahabad to greengram. Farm yard manure, vermicompost, poultry manure and phosphorus were applied as basal dose as per the treatments. The growth regulator, gibberellic acid was sprayed two times, at the time of two leaf stage and at an interval of 20 days after first spraying. The green gram variety, *Vigna radiata* (L.) Var. *Samrat* 8 was selected for sowing with a maturity period of around 70-75 days. Seeds were soaked in normal water for half an hour before sowing and were sown manually in a line on 23rd July, 2014 at a depth of 3-4 cm. The size of the plot was 3×3 m with a spacing of 15 cm in between the plants and 45 cm in between the rows. All the recommended agronomic and plant protection practices were followed in the experimental plots. Data were recorded on five randomly selected plants from each plot which were tagged for observations on number of pods per plant, number of grains per pod, test weight (g), grain yield (kg/ha) and straw yield. Data were analyzed by using Gen Stat14 software. Significance difference between treatments mean was tested through 'F' test, against the critical difference at 5% level of significance.

OBSERVATIONS AND ANALYSIS

Number of pods per plant:

The numbers of pods per plant and among treatments were non-significant due to effect of different organic manures, inorganic fertilizers and growth regulators. Numerically, the maximum number of pods per plant were recorded with the application of T_{13} (10-40-20 NPK kg/ha+10kg N through poultry manure+GA_3 75 ppm+75 ppm) (73.2) (Table 1) as compared to the all other treatments. The lowest number pods were noticed in T_1 (20-40-20 NPK kg/ha) (68.9) (Table 1). Patel and Patel *al*. (1994) reported that application of recommended dose of fertilizers (role N) recorded maximum number of pods per plant in greengram. The combination of NPK, poultry manure and GA_3 increased number of pods per plant of the green gram. Application of 10-40-20 NPK/kg/ha+10 kg N through poultry manure+GA_3 75ppm+75ppm may be recommended for increasing number of pods per plant of green gram, might be spraying of growth regulator (GA_3) increased pod length in green gram. Wasma Arwin *et al*. (2016) stated that maximum number of pods per plant was recorded on vermicompost 7 tonnes per ha and 100% of optimum dose of inorganic fertilizers. It might be combination of organic manures, inorganic fertilizers and growth regulator, it improves soil physical properties which provide health and favourable soil conditions to enhance nutrient use efficiency and improves vegetative growth. Application of DAP at 124 kg per ha and 10 tonnes of poultry manure recorded higher number of pods per plant (Abbas *et al*., 2011).

Number of grains per pod:

The number of grains per pod were non-significant among the treatments. The highest number of grains per pod were noticed with the application T_{13} (10-40-20 NPK kg/ha+10 kg N through poultry manure+GA_3 75 ppm+75 ppm) (8.8) as compared to the all other treatments. Lower number of grains per pod were recorded with the application of T_1 (20-40-20 NPK kg/ha) (RDF) (7.6) (Table 1). Samiullah *et al*. (1982) obtained that higher grain yield with application of 20 kg N/ha, produced more number of seeds per pod and increased the pod length of greengram. The poultry manure, NPK and GA_3 helped for plant to availability of nutrients and enhancement in nutrient uptake; translocation and synthesis of photosynthesis assimilation which results into increased plant growth characters and economic yield per plant. The application of 100 mg Z^{-1} seeds pre-soaking and 100 mg L^{-1} as foliar application of GA_3 in green gram, significantly increased number of pods per plant and biological mass (Akbari *et al*., 2008). The higher number of grains per pod was recorded on vermicompost 7 tonnes per ha and 100% of optimum dose of inorganic fertilizers.

It might be combination of organic manures, inorganic fertilizers and growth regulator, it improves soil physical properties which provide health and favourable soil conditions to enhance nutrient use efficiency and improves vegetative growth (Wasma Arwin *et al*., 2016). Application of DAP at 124 kg per ha and 10 tonnes of poultry manure recorded maximum number of grains per pod (Abbas *et al*., 2011). Upadhayay (2002) reported that maxmum number of seeds/pod, pods/plant, 1000-seed weight and seed yield was recorded spraying of 30 ppm NAA in Chickpea.

Test weight (g):

The maximum test weight was recorded significantly with the application of T_{13} (10-40-20 NPK kg/ha+10 kg N through poultry manure + GA_3 75 ppm+75 ppm) (38.3), followed by T_9 (10-40-20 NPK kg/ha+10 kg N through vermicompost + GA_3 75 ppm+75 ppm) (37.3) which was on par with as compared to the all other treatments (Table 1). The lowest test weight was observed with application of T_1 (20-40-20 NPK kg/ha) (RDF) (32.3). Application of nitrogen significantly increased the grain yield and test weight (Sawhney and Moolani, 1967). Khurana *et al*. (1988) reported that increasing levels of nitrogen and P_2O_5 increased the test weight and grain yield. Abbas *et al*. (2011) noticed that application of DAP at 124 kg per ha along with 10 tonnes of poultry manure recorded maximum seed test weight. Organic manures contain plant nutrients, growth promoting substances and beneficial micro flora which in combined with inorganic fertilizers provide favourable soil conditions to enhance nutrient use efficiency. Wasma Arwin *et al*. (2016) noticed that maximum seed test weight was recorded on vermicompost 7 tonnes and 100% of optimum dose of inorganic fertilizers.

Grain yield :

The statistical analysis of data showed that there were significant differences between treatments and grain yield. Significantly maximum grain yield was recorded on treatment T_{13} which was applied 10-40-20 NPK kg/ha+10 kg N through poultry manure+GA_3 75 ppm+75 ppm (1704 kg/ha) as compared to the all other treatments (Table 1). Significantly increased grain yield in green gram because application of organic manures, inorganic fertilizers and growth regulator (GA_3) could

Table 1: Effect of organic manures, inorganic fertilizers and growth regulators on yield components and grain yield of green gram

Treatments	No. of pods per plant	No. of grains per pod	Test weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
T_1:20-40-20 NPK kg/ha (RDF)	68.9	7.6	32.3^{a}	1259.0^{a}	2185.0^{a}
T_2:10-40-20 NPK kg/ha+10 kg N through FYM	70.4	7.8	33.3^{ab}	1222.0^{a}	2296.0^{ab}
T_3:10-40-20 NPK kg/ha+10 kg N through FYM+`GA3 25 ppm+25 ppm	69.9	8.1	34.3^{abc}	1296.0^{a}	2296.0^{ab}
T_4:10-40-20 NPK kg/ha+10 kg N through FYM+GA3 50 ppm + 50 ppm	70.7	8.5	33.7^{ab}	1296.0^{a}	2333.0^{ab}
T_5:10-40-20 NPK kg/ha+10 kg N through FYM+GA3 75 ppm + 75 ppm	70.1	8.5	33.0^{ab}	1270.0^{a}	2296.0^{ab}
T_6:10-40-20 NPK kg/ha+10 kg N through Vermicompost	70.9	8.5	35.7^{bcd}	1304.0^{a}	2593.0^{b}
T_7:10-40-20 NPKkg/ha+10 kg N through Vermicompost +GA3 25 ppm + 25 ppm	69.3	8.1	34.3^{abc}	1194.0^{a}	2600.0^{b}
T_8:10-40-20 NPK kg/ha+10 kg N through Vermicompost +GA3 50 ppm + 50 ppm	71.1	8.1	34.7^{abc}	1296.0^{a}	2500.0^{ab}
T_9:10-40-20 NPK kg/ha+10 kg N through Vermicompost +GA3 75 ppm+75 ppm	72.4	7.7	37.3^{cd}	1430.0^{a}	2593.0^{b}
T_{10}:10-40-20 NPK kg/ha+10 kg N through poultry manure	70.9	8.6	34.3^{abc}	1407.0^{a}	2444.0^{ab}
T_{11}:10-40-20 NPK kg/ha+10 kg N through poultry manure +GA3 25 ppm+25 ppm	70.9	8.7	33.7^{ab}	1370.0^{a}	2370.0^{ab}
T_{12}:10-40-20 NPK kg/ha+10 kg N through poultry manure +GA3 50 ppm+50 ppm	71.4	8.5	35.0^{abc}	1370.0^{a}	2463.0^{ab}
T_{13}:10-40-20 NPK kg/ha+10 kg N through poultry manure +GA3 75 ppm+75 ppm	73.2	8.8	38.3^{d}	1704.0^{b}	3000.0^{c}
Fpr	0.4	0.4	<0.001	<0.001	<0.001
Vr (12, 24)	25.7	3.6	8.04	6.3	10.7
S.E.±	1.1	0.36	0.6	51.6	66.1
LSD (P=0.05)	NS	NS	1.7	150.5	192.9
CV (%)	2.7	7.4	3.0	6.7	4.7

NS= Non-significant

be ascribed to their direct influence on dry matter production at successive stages by virtue of increased photosynthetic efficiency. While indirect influence seems to be due to increase in plant height. The profound influence of nutrient application on biological yield seems to be an account of its influence on vegetative (straw) and reproductive growth (grain). Rana and Singh (1988) recorded that the application of 120 kg N/ha and 100 kg P_2O_5/ha significantly increased growth attributes, grain yield and straw yield. Singh *et al*. (1999) found that grain yield was increased with the application of phosphorus in green gram. Nitrogen is an essential plant nutrient, it has a directly influenced on the green gram yield. Nitrogen and phosphorus is very essential for a good vegetative growth and grain development in green gram production. Abbas *et al*. (2011) was found that application of DAP 124 kg per ha and 10 tonnes of poultry manure was obtained maximum seed yield in greengram. Jeyakumar *et al*. (2008) observed that application of salicyclicacid @125ppm increased seed yield in blackgram. Venkata Reddy *et al*. (2009) noticed that application of tricontanol at 1ml/l recorded maximum yield in soyabean.

The increases in protein content may be due to higher availability of nitrogen throughout the growth period due to application of fertilizer at basal dose and also supply of foliar nutrients and growth regulators at critical periods of crop growth.(flowering and development stage). Spraying of growth hormone increase the uptake of nutrients from soil and also increases metabolic activity in the plant cell. The higher soil available N and P may be due to higher microbial activity and higher root activity in the rhizospher and improved soil physical and chemical properties. The organisms during mineralization convert organically bound nutrients to inorganic form resulting in higher availability of nutrients. The increasing N uptake might be due to increased availability of nitrogen to the crop and higher biomass production and retarded the loss of chlorophyll and leaf nitrogen with increased photosynthesis and increase N supply during flowering and pod filling stages.

Straw yield :

The statistical analysis of data showed that there was a significant difference between treatments and straw yield. The maximum straw yield was recorded in T_{13} (10-40-20 NPK/kg/ha+10kg N through poultry manure+GA_3 75ppm+75ppm) (3000 kg/ha) (Table 1). The straw yield of green gram was significantly increased with increasing levels of growth regulator GA_3. The overall improvement in crop growth under the influence of optimum nutrition involving combination of all organic manures, nutrients and increasing role of fertility level could by ascribed to the potential role in modifying soil and plant environment conducive for better development of both morphological and biochemical component of the plant growth that increase efficiently of physiological processes of plant system. The grain and straw yield of green gram was increased with the application of Nitrogen and phosphorus (Srivastava and Verma, 1981).

In the present study, concluded that the application organic manures, combination with inorganic fertilizers and growth regulator (GA_3) will helps increase the nutrient uptake through various of organic nutrients and growth regulator helps cell division and elongation of cells in plants. The application of 10-40-20NPK kg/ha+10 kg/ha N through poultry manure+$GA_3$75+75 ppm was recorded maximum number of pods per plant, higher number of grains per pod, maximum 1000-seed test weight, and grain yield per ha and straw yield per ha.

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