The Bioscan 11(2): 1251-1254, 2016 (Supplement on Agronomy)
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.com

EFFECT OF INORGANICS, BIOFERTILIZERS AND SPACING ON GROWTH AND YIELD PARAMETERS OF GREEN GRAM CV. KKM-3

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KEYWORDS
Green gram
Fertilizer levels
Green gram rhizobia
Bacillus megaterium

Received on :
17.01.2016

Accepted on :
20.05.2016

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ABSTRACT
A field experiment was conducted to study the effect of inorganics, bio fertilizers and spacing on growth and yield parameters of green gram cv.KKM-3 at Department of Seed Science and Technology, GKVK, UAS, Bangalore during kharif 2014. Experimental results revealed that fertilizer application of 50:100:100 NPK kg ha^{-1} + Green gram rhizobia (200 g ha^{-1}) + PSB-Bacillus megaterium (200g ha^{-1}) with the spacing of 60 × 10cm was recorded significantly higher number of branches $plant^{-1}$(9.89), number of leaves $plant^{-1}$(20.83), plant spread $plant^{-1}$(602.93), number of clusters $plant^{-1}$ (8.33), number of pods $cluster^{-1}$(7.7), number of pods $plant^{-1}$ (64.10), pod weight $plant^{-1}$(g) (64.14), seed recovery per cent (95.34) and processed seed yield (q ha^{-1}) (12.56) as compared to rest of the treatments .Hence, it can be concluded that the application of 50:100:100 NPK kg ha^{-1} + Green gram rhizobia (200 g ha^{-1}) + PSB-Bacillus megaterium (200 g ha^{-1}) with the spacing of 60 × 10 cm would be use full to enhance the productivity of Green gram. The conjunctive use of inorganic fertilizers and biofertilizer may be suggested for higher productivity along with overall betterment.

INTRODUCTION

Green gram (*vigna radiata*) is one of the most ancient and extensively grown leguminous crops of India. According to vavilo (1951) it is a native of India and Central Asia, belongs to the family leguminaceae. It is rich in protein, contains about 48% protein,1% fat and 21% carbohydrate on dry weight basis and it is rich source of magnesium and iron. One of the most important challenges facing humanity today is to conserve/sustain natural resources including soil and water for increasing food production while protecting the environment. As the world population grows, stress on natural resources increases, making it difficult to maintain food security. Long term food security requires a balance between increasing crop production, maintaining soil health and environmental sustainability.

The continuous use of NPK fertilizers under intensive cropping system has caused adverse effects on soil properties such as soil structure, density, pH, quantity and quality of organic matter, nutrient cycle within soil profile(Aulakh and Adhya 2005) and ground water quality (Aulakh *et al*., 2009) causing health hazards and climate change on other hand, nutrient mining has occurred in many soils due to lack of affordable fertilizer sources and where fewer or no organic residues are returned to the soils, soils of Karnataka are inherently poor in organic matter, fertility and water holding capacity. In these soils N, P and S deficiencies are principal yield limiting factors for crop production. INM which entails the maintainenance/ adjustment of soil fertility to an optimum level for crop productivity to obtain the maximum benefit from all possible sources of plant nutrients organics as well as inorganics in an integrated manner (Aulakh and Grant 2008, Sangeeta *et al*., 2014) is an essential step to address the twin concerns of nutrient excess and nutrient depletion INM is also important for marginal farmers who cannot afford to supply crop nutrients through costly chemical fertilizers (Aulakh, 2009). The bio fertilizers have shown encouraging results in sustaining the crop productivity and improving the soil fertility (Govindan and Thirumurugan,2005) Ghosh and Joseph (2008) also reported that pulse crop inoculated with rhizobium culture significantly recorded higher number of pods, number of seeds, test weight and seed yield organic manures on the other side provide a good substrate for the growth of micro-organisms and maintain a favourable nutrient supply environment and improve soil physical properties.

Therefore the aforesaid consequences have paved way to increase the productivity of crops using the combination of inorganic sources and bio fertilizers thus, integrated approach of nutrient supply by chemical fertilizers along with bio fertilizers is gaining importance as this system not only reduces the use of excess inorganic fertilizers, but sustaining crop productivity by improving soil health and is also an environment friendly approach. Integration of inorganic fertilizers and bio fertilizers resulted in better growth, yield and nutrient uptakes in green gram (Mandal and Pramanick, 2014), black gram (Kumpuwat., 2010), rice (Kumar *et al*., 2014) and sesame (Nayek *et al*., 2014) as compared to sole

application of inorganic fertilizers However, information on the conjunctive use of inorganic fertilizers and bio fertilizers is lacking in many crops including green gram.

The optimum plant density can provide congenial conditions to have maximum light interruption right from early growth stage to pod filling stage. By changing the plant spacing, it is possible to achieve optimum vegetative and reproductive growth to boost up crop productivity per unit area (Anil Kumar 2004).The present study was planned with hypothesis that among the factors responsible for low productivity in Green gram, inadequate fertilizer use and emergence of multiple nutrient deficiencies due to poor recycling of organic resources and unbalanced use of fertilizers are important. Keeping above facts in mind the present investigation was undertaken to study the effect of inorganics, bio fertilizers and spacing on growth and yield parameters of green gram cv.KKM-3

MATERIALS AND METHODS

The experiment was conducted at E-6 block,Department of Seed Science and Technology, Gandhi Krishi Vignana Kendra campus, University of Agricultural Sciences, Bangalore during Kharif 2014-15. There were ten treatments with three spacing levels and laid out in factorial randomized block design with three replications. The treatments combinations includes T1 :25:50:25 RDF NPK kg ha^{-1}, T2 :31.25:62.50:31.25 NPK kg ha^{-1}(25% enhanced dosage), T3 :37.50:75:37.50 NPK kg ha^{-1} (50% enhanced dosage), T4 :43.75:87.50:43.75 NPK kg ha^{-1} (75% enhanced dosage), T5 :50:100:100 NPK kg ha^{-1}(100% enhanced dosage), T6 :25:50:25 NPK kg ha-1 + Green gram rhizobia(200 g ha^{-1}) + PSB-Bacillus megaterium (200 g ha^{-1}), T7 :31.25:62.50:31.25 NPK kg ha^{-1}+ Green gram rhizobia(200 g ha^{-1}) + PSB- Bacillus megaterium (200 g ha^{-1}), T8 :37.50:75:37.50 NPK kg ha^{-1}+ Green gram rhizobia(200 g ha^{-1}) + PSB-Bacillus megaterium (200 g ha^{-1}), T9 :43.75:87.50:43.75 NPK kg ha^{-1}+ Green gram rhizobia(200 g ha^{-1}) + PSB- Bacillus megaterium (200 g ha^{-1}), T10:50:100:100 NPK kg ha^{-1}+ Green gram rhizobia(200 g ha^{-1}) +PSB-Bacillusmegaterium (200 g ha^{-1}), S_1:30x10 cm, S_2:45x10 cm and S_3:60x10 cm.The calculated quantity of N, $P_2O_5$and K_2O in the form of urea, single super phosphate and muriate of potash, respectively were supplied as per the treatments at the time of sowing. Green gram cv. KKM-3 seeds were treated with Green gram rhizobia and Bacillus megaterium and sown on 16thof August 2014 at an inter and intra row spacing of 30x10, 45x10 and 60x10 cm respectively. Five plants per plot were selected randomly in the net plot area and tagged for recording growth and yield parameters. The statistical analysis and the interpretation of the experimental data was done by using Fischer's method of Analysis of Variance technique as outlined by Gomez and Gomez (1984) and the level of significance used in 'F' and 't' test was five per cent.

RESULTS AND DISCUSSION

Effect of fertilizer

Significant differences were noticed on growth, seed yield and yield attributing characters of Green gram with the application of fertilizers. Significantly highest plant height (43.26cm),number of branches $plant^{-1}$(8.89), number of leaves $plant^{-1}$(19.40), plant spread $plant^{-1}$(410.64), number of nodules$plant^{-1}$ (7.33) at harvest and days to maturity was recorded with an application of 50:100:100 NPK kg ha^{-1}+ Green gramrhizobia 200 g ha^{-1}+ PSB-Bacillus megaterium 200 g ha^{-1}compared to other treatments (Table 1). More number of branches, leaves and plant spread might be due to less internodal elongation and combine application of inorganic nutrients and bio fertilizers increase the use efficiency of added nutrients and supply it continuously to the plant through out the crop growth period and promoted various physiological activities in plant which are being considered indispensable for proper growth and development. The highest number of nodules might be due to increased nitrogenase activity by Rhizobium and PSB produce growth hormones, i.e. IAA, auxins, gibberellins and vitamins which are conducive to better nodulation. Similar finding was reported by Dusica Delica et al. (2011) in mung bean, Shrikanth Vadgave (2010) in green gram, Bairwa *et al.* (2012) in mung bean.

The less number of days taken to 50 per cent flowering (33.02days) was observed with the application of 25:50:25 RDF NPK kg ha^{-1}(Table 1). Induction of early flowering due to application of bio fertilizers was mainly ascribed to the process of bio regulators which have an influence on early flower initiation. The results are in agreement with findings of Mahesh babu et al., (2008) in soybean and Kathiravan *et al*., (2008) in lablab. Application of 50:100:100 NPK kg ha^{-1}+ Green gram rhizobia 200 g ha^{-1}+ PSB-Bacillus megaterium 200 g ha^{-1} recorded significantly more number of clusters $plant^{-1}$(8.00), number of pods $plant^{-1}$ (56.10), pod weight $plant^{-1}$ (56.10 g), pod length (9.67 cm), Number of seeds pod^{-1} (11.33), seed recovery per cent (94.68 %) and processed seed yield(12.65 q ha^{-1}) as compared to 25:50:25 RDF NPK kg ha^{-1}(5.30, 26.48, 26.64 g, 7.00 cm, 8.89, 80.59 % and 8.60qha^{-1}, respectively) (Table 3). This might be due to enhanced vegetative growth and synergistic effect of combined use of bio fertilizers and inorganic manures. Similar results were reported by Dubay (1998) and Dhage Shubhangi and Kachhave (2010) in soybean. The increased seed recovery per cent might be due to influence of nitrogen, the chief constituent of protein, essential for protoplasm which leads to cell division and cell enlargement given to the parent seed exerted a profound influence on seed filling and relatively high percentage of well filled seeds of largest size. Similar results were reported by Vijaya kumar(2007) in black gram.

Effect of spacing

The number of branches $plant^{-1}$(9.58), number of leaves $plant^{-1}$(18.18),Plant spread $plant^{-1}$(488.39) and Number of nodules $plant^{-1}$ (5.84) were significantly higher in wider spacing 60 × 10 cm at harvest compared to closer spacing 30 × 10 cm (7.21, 17.10, 155.6 and 4.90, respectively) (Table 1). Increase of vegetative growth in wider spacing might be due to less competition for space, mutual shading effect, nutrients and moisture due to reduced plant density per unit area. Similar findings were also reported by Asaduzzaman *et al*. (2010) in black gram.The spacing differed significantly in days to 50 per cent flowering. In wider spacing 60 × 10 cm flowered earlier (33.50days) and matured earlier (63.50 days) than in closer spacing 30 × 10 cm (34.45days and 64.49 days) (Table 1). It

might be related to better vegetative growth, plant canopy area and efficient photosynthetic activity which might have enhanced the reproductive phase in wider spacing compared to closer spacing. These results are in agreement with the findings of Gurusharan and Sharma (2004) in mung bean.

The number of clusters plant^{-1}was significantly higher in wider spacing 60 × 10 cm (6.62) than in closer spacing 30 × 10 cm (6.25). Number of pods plant^{-1}(33.83), pod weight (33.87 g), pod length (5.78 cm) and number of seeds pod^{-1}(8.63) were also higher in wider spacing 60 × 10 cm than in closer spacing 30 × 10 cm (6.62, 39.91,33.87and 5.78 cm, respectively).

Highly significant differences were observed in number of seeds pod^{-1}, seed recovery per cent and processed seed yield ha^{-1}were higher in wider spacing 60 × 10cm (10.78, 88.27 %, and 11.82 q ha^{-1}) than in closer spacing 30 × 10 cm (8.63, 84.86 % and 9.14 q ha^{-1}, respectively)(Table 3). The superior values of seed yield and its components noticed under wider spacing may be attributed to better growth and development of plants under less plant population density and it resulted in to better source to sink relationship due to availability of balanced, adequate nutrients, better light, space and moisture unlike in closer spacing. These results were in conformity with those of Subrata Saha *et al*. (2000) in urd bean, Asaduzzaman *et al*. (2010) and Anupama Kumari *et al*. (2012)

Interaction effect

Interactions due to nutrition and plant density differed significantly for growth, seed yield and yield components. Among the combinations wider spacing of 60x10 cm with an application of 50:100:100 NPK kg ha^{-1}+ Green gram rhizobia(200 g ha^{-1}) + PSB-Bacillus megaterium (200 g ha^{-1}) recorded highest number of branches plant^{-1}(9.89), number of leaves plant^{-1}(20.83), plant spread plant^{-1}(602.93), number of cluster plant^{-1}(8.33.), number of pods cluster^{-1} (7.7), number of pods plant^{-1}(64.14), number of seeds pod^{-1} (13), seed recovery per cent (95.30) and processed seed yield (13.72q ha^{-1}) compared to other combinations(Table 2 and 4). These results are in agreement with findings of Anilkumar (2004) in fenugreek, Singh *et al*., (2009) in black gram and Nazir hussain *et al*., (2011) in black gram. Integration of inorganic fertilizers along with bio fertilizers of plant nutrient elements results in more uptake of them as compared to sole use of in organics alone. This may be due to the fact that the balanced and combined use of various plant nutrient sources results in proper absorption, translocation and assimilation of those nutrients, ultimately increasing the dry matter accumulation and nutrient contents of plant and thus showing more uptake of elemental nutrients. It is also a fact that improvement of physiological efficiencies of different macro and trace elements resulted from the combined application of organic and inorganic sources of nutrients produces crop with superior quality under investigation. Combined application of inorganic fertilizers with Rhizobium + PSB increased nutrient content in soil and nutrient uptake by plant (Ipsita Das and Singh, 2014). Similar findings were reported by Kumpawat (2010), Vadgave (2010), Anandan and Natarajan (2012). Beneficial effects of integration of chemical fertilizers and organic manures along with bio fertilizers on nutrients uptake in black gram wheat, sesame, vegetable soybean and green gram were also noticed by Amruta *et al*. (2015), Sharma *et al*. (2013), Nayek *et al*. (2014), Maruthi *et al*. (2014) and Tyagi *et al*. (2014) respectively.

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