Impact of Spacing, Sources of Nutrient and Methods of zinc Application on yield Attributes of Green Gram (Vigna Radiata L.)

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Abstract*: The research was conducted during Zaid season of 2014 at Experimental Farm, Annamalai University, Annamalainagar to find out the experiment consisted of two different spacings (30 cm × 10 cm and 45 cm × 6.7 cm), three sources of nutrient (100% Organic, 50% Organic + 50% Inorganic and 100% Inorganic on the basis of N and K) and three methods of Zn application (No application, Soil application at 12.5 kg ZnSO4 ha-1 and foliar spray at 0.5% ZnSO4) which was laid out in Factorial Randomised Block Design (FRBD) with three replicates. Thus, there were 18 treatment combinations in total. The result revealed that greengram grown during zaid season with the spacing of 30 cm × 10 cm along with nutrient sources 50% Organic (1.50 tonnes of Farmyard Manure ha-1 + 83.35 kg Bone meal ha-1) + 50% Inorganic (55.56 kg Diammonium phosphate ha-1 + 12.50 kg Muriate of Potash ha-1) and Soil application of Zn at 12.5 kg ZnSO4 ha-1, recorded highest number of seeds pod-1 which attributed in obtaining highest grain yield. In addition, highest net return as well as benefit to cost ratio was evaluated for the same treatment.

***Index Terms*: Bone Meal and Economics, Farmyard Manure, Integrated sources of nutrient, Organic, Summer green gram, Spacing**

I. INTRODUCTION

In India, pulses are consumed secondary to cereals. The year of 2016 was declared as the "International Year of Pulses" by UN in order to increase awareness among the mass on consumption of pulses, its health benefits, and its sustainable production aiming at meeting the future needs. Green gram [Vigna radiata (L.)] or Mung bean is a self-pollinated leguminous crop which is grown during the Kharif and summer seasons in the arid and semiarid regions of India. The mung beans are grown without any proper density of planting the plantlets, because of which the production gets reduced to around 20-40%, as the closely spaced plants compete with each other for food, sunlight, nutrition and water. For the plants to get optimum sunlight and nutrients, the spacing has to be maintained (Miah et al. 1990). The most limiting factor that has affected the production of crops and productivity of Indo Gangetic plain is fertilizer through imbalanced and indiscriminate use on one hand and withdrawal of organic matter from the schedule of inputs on the other (Kumar et al., 2008). Therefore integrated nutrient management (INM) has been an increasing necessity especially for the sub-tropical Indian soils. Using mixture of organic manure with that of the fertilizers is believed to increase productivity of the crop plants. Thus, to achieve higher efficiency, the awareness needs to be spread on use of organic manure in the farms. Even though there has been a marked increase in the production due to use of NPK fertilizers; however, this has led to a number of issues, such as causing micronutrient deficiency in plants, like that of the Zn.

Lack of zinc causes deficiency in formation of RNA and protein. Therefore, the plant with lack of zinc is poor in amount of protein. Hence, the present study was undertaken to examine the integrated impact of spacing, sources of nutrient and method of zinc application on yield attributes, productivity and economics of green gram.

II. MATERIALS AND METHOD

The experiment was carried out during year of 2014 at Experimental Farm, Annamalai University, Annamalainagar. The soil was sandy loam with pH 7.4, organic carbon 0.43%, available nitrogen 235.25 kg/ha, phosphorus 15.60 kg/ha, potassium 345.22 kg/ha and Zn status of 0.84 ppm. The treatments comprised of two different spacings (30 cm × 10 cm and 45cm × 6.7 cm), three sources of nutrient (100% Organic, 50% Organic + 50% Inorganic and 100% Inorganic on the basis of N & K) and three methods of Zn application (No application, Soil application at 12.5 kg ZnSO4 ha-1 and foliar spray at 0.5% ZnSO4) which was laid out in Factorial Randomised Block Design (FRBD) consisting of eighteen treatment combinations with three replications; plot size was 2.5 2.7 m for crop seed rate is 25 kg ha-1 (Vigna radiata L.) Cv. VBN 2. Green gram was sown and the recommended dose was 20 kg N + 50 kg P2O5 + 15 kg K2O/ha. Full dose of nitrogen, phosphorus and potassium applied as Di-ammonium phosphate and Muriate of potash for inorganic sources of nutrient and Farm yard manure + Bone meal for organic sources of nutrient on the basis of N and K was applied at the time of sowing of green gram. Zn is applied in the form of ZnSO4 as basal at the time of sowing and as foliar spray at 25 and 45 DAS in defined plots according to treatment combinations. The rainfall during the crop season was 9.4 mm in five rainy days occurred from sowing to harvesting during 2016. A periodical observation of

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growth was carried out at a 15 days interval, with harvesting done 9th June. At harvest, grain and straw yield of crop were recorded. The modified Kjeldahl's method was applied to determine the nitrogen content in the crop (Jackson, 1973). Economics and system productivity were evaluated based on the market value.

III. RESULTS AND DISCUSSION

A. Yield Attributes

The data revealed insignificant interaction effects in case of pods plant-1 and seeds pod-1. The highest number of pods plant-1 was observed in treatment T14 [45 cm × 6.7 cm + (50% Organic + 50% Inorganic) + ZnSO4 at 12.5 kg ha-1 (as basal)]. Whereas, the highest number of seeds pod-1 was found with the treatment combination T5 [30 cm × 10 cm + (50% Organic + 50% Inorganic) + ZnSO4 at 12.5 kg ha-1 (as basal)]. The interaction effect was found to be significant for test weight. The highest value of test weight was found with the treatment combination T8 [30 cm × 10 cm + 100% Inorganic + ZnSO4 at 12.5 kg ha-1 (as basal)]. However, treatments T14 [45 cm × 6.7 cm + (50% Organic + 50% Inorganic) + ZnSO4 at 12.5 kg ha-1 (as basal)] and T5 [30 cm × 10 cm + (50% Organic + 50% Inorganic) + ZnSO4 at 12.5 kg ha-1 (as basal)] were found statistically on a par with T8 [30 cm × 10 cm + 100% Inorganic + ZnSO4 at 12.5 kg ha-1 (as basal)]. The possible reason for increasing yield attributes may be due to integrated use of organic with inorganic fertilizers, thus leading to efficient activity of the roots and absorption of nutrients.

Similar finding was reported by Thakur et al. (2011) in case of soybean-wheat cropping system. ZnSO4 might have enhanced the micronutrients availability to the plants, which resulted in efficient photosynthesis process on part of the plant. This result is similar to those reported by Keerthi et al. (2015) in green gram.

B. Yields and Harvest Index

The interaction effect was found to be non-significant for grain yield. However, the highest grain yield was observed in treatment T5 [30 cm × 10 cm + (50% Organic + 50% Inorganic) + ZnSO4 at 12.5 kg ha-1 (as basal)]. The interaction has significant effect on stover yield. Highest stover yield was observed in treatment T1 [30 cm × 10 cm + 100% Organic + Fertilized Control (Recommended NPK)]. However, treatment T6 [30 cm × 10 cm + (50% Organic + 50% Inorganic) + ZnSO4 at 0.5% (as foliar)] was statistically at par with T1 [30 cm × 10 cm + 100% Organic + Fertilized Control (Recommended NPK)]. The interaction effect was found to be non-significant for harvest index. However, the highest harvest index was observed in treatment T5 [30 cm × 10 cm + (50% Organic + 50% Inorganic) + ZnSO4 at 12.5 kg ha-1 (as basal)].

The credible reason for increasing grain yield may be due to under 45 cm ☐ 6.7 cm the less intra row spacing increases competition for solar radiation that ultimately stunt growth of some intra row plants in vegetative phase and they were unable to reach reproductive phase, even though the yield contributing variables were high when compared to the recommended spacing, the productivity was low due to lesser plant population reached to reproductive phase. According to Sarkar et al. (2004). Green gram planted at a spacing of 30 ☐ 10 cm significantly produced the highest seed yield. Integration of inorganic fertilizers and organic manures resulted in better yield in green gram may be due to organic manures provide a good substrate for the growth of microorganisms and maintain a favourable nutrient supply environment and improve soil physical properties. Similar findings were reported by Mandal and Pramanick (2014).

C. Economics

The highest net return and benefit cost ratio was recorded in treatment T5 [30 cm × 10 cm + (50% Organic + 50% Inorganic) + ZnSO4 at 12.5 kg ha-1 (as basal)]. The feasible reason for increasing net returns and benefit cost ratio may be organic sources in a combination with inorganic sources proved vital in attaining economical harvests that emphasize the need to adopt integrated nutrient management. This will result into increasing farmer's premiums as well as maintain soil nutrition. Similar finding in mungbean was reported by Aslam et al. (2010).

It is concluded that spacing at 30 cm ☐ 10 cm in combination with 50% organic (1.5 tonne FYM ha-1 + 83.35 kg Bone Meal ha-1) + 50% Inorganic (55.55 kg DAP ha-1 +12.5 kg MOP ha-1) with ZnSO4 at 12.5 kg ha-1 (as basal), recorded highest number of seeds pod-1 (10.40) which attributed in obtaining highest grain yield (893.83 kg ha-1) in greengram. Also, highest net return (¬ 26617.50) and benefit cost ratio (2.21) was recorded in same treatment.

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Table 1. Integration effect of spacing, nutrient sources and methods of zinc application on yield attributes, yields, harvest index and economics of greengram at harvest stage

	Treatments	Number of pods plant^{-1}	Number of seeds pod^{-1}	Test weight (g)	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Harvest Index (%)	Net return* (□ ha^{-1})	B: C Ratio*
1.	30cm × 10cm + 100% Organic + Fertilized Control (Recommended NPK)	11.89	8.93	37.50	711.11	2896.30	19.68	17264.00	1.76
2.	30cm × 10cm + 100% Organic + $ZnSO_4$ at 12.5 kg ha^{-1} (as basal)	13.11	8.87	39.44	770.37	2523.46	23.31	18904.50	1.81
3.	30cm × 10cm + 100% Organic + $ZnSO_4$ at 0.5% (as foliar)	10.89	9.07	36.68	750.62	2553.09	22.64	18149.50	1.78
4.	30cm × 10cm + (50% Organic + 50% Inorganic) + Fertilized Control (Recommended NPK)	10.56	9.07	38.63	780.25	2533.33	23.52	21589.50	2.02
5.	30cm × 10cm + (50% Organic + 50% Inorganic) + $ZnSO_4$ at 12.5 kg ha^{-1} (as basal)	13.22	10.40	40.14	893.83	2585.19	25.63	26617.50	2.21
6.	30cm × 10cm + (50% Organic + 50% Inorganic) + $ZnSO_4$ at 0.5% (as foliar)	10.78	9.27	39.24	839.51	2748.15	23.43	24312.00	2.11
7.	30cm × 10cm + 100% Inorganic + Fertilized Control (Recommended NPK)	12.56	8.53	36.37	745.68	2402.47	23.77	21113.00	2.07
8.	30cm × 10cm + 100% Inorganic + $ZnSO_4$ at 12.5 kg ha^{-1} (as basal)	14.22	9.40	41.28	834.57	2427.16	25.54	24850.50	2.21
9.	30cm × 10cm + 100% Inorganic + $ZnSO_4$ at 0.5% (as foliar)	12.56	9.33	38.50	800.00	2385.19	24.91	23187.50	2.14
10.	45cm × 6.7cm + 100% Organic + Fertilized Control (Recommended NPK)	11.78	9.07	36.20	681.48	2409.88	22.03	15035.00	1.66
11.	45cm × 6.7cm + 100% Organic + $ZnSO_4$ at 12.5 kg ha^{-1} (as basal)	14.33	9.27	38.15	740.74	2555.56	22.45	17504.00	1.75
12.	45cm × 6.7cm + 100% Organic + $ZnSO_4$ at 0.5% (as foliar)	12.89	9.20	37.02	725.93	2491.36	22.54	16806.50	1.72
13.	45cm × 6.7cm + (50% Organic + 50% Inorganic) + Fertilized Control (Recommended NPK)	13.78	9.40	37.13	730.86	2491.36	22.67	19076.50	1.90
14.	45cm × 6.7cm + (50% Organic + 50% Inorganic) + $ZnSO_4$ at 12.5 kg ha^{-1} (as basal)	17.78	9.87	40.18	834.57	2545.68	24.68	23609.00	2.08
15.	45cm × 6.7cm + (50% Organic + 50% Inorganic) + $ZnSO_4$ at 0.5% (as foliar)	17.00	9.40	39.87	795.06	2607.41	23.35	21850.50	2.00
16.	45cm × 6.7cm + 100% Inorganic + Fertilized Control (Recommended NPK)	13.56	9.33	36.64	716.05	2501.23	22.20	19761.50	2.00
17.	45cm × 6.7cm + 100% Inorganic + $ZnSO_4$ at 12.5 kg ha^{-1} (as basal)	16.44	9.67	39.43	800.00	2590.12	23.54	23345.00	2.14
18.	45cm × 6.7cm + 100% Inorganic + $ZnSO_4$ at 0.5% (as foliar)	14.89	9.60	37.48	775.31	2466.67	23.87	22060.50	2.08
	F test	NS	NS	S	NS	S	NS	-	-
	SEm (±)	0.77	0.29	0.45	54.48	61.67	1.25	-	-
	CD (P = 0.05)	-	-	1.28	-	177.24	-	-	-

* Data was not subjected to statistical analysis

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