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To analyse the effect of micronutrients on plant growth and seed yield of green gram (*Vigna radiata* L.)

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Abstract
Applications of 25 kg $ZnSO_4$/ha, 10 kg borax/ha and micronutrients mixture resulted in enhancement of plant growth and yield characteristics *viz*. Field emergence count, plant height, number of branches. The highest seed yield of 1198.41 kg/ha was obtained with application of micronutrients mixture followed by the application of borax @ 10 kg/ha (1098.41 kg). Moderate effects were observed with application of Zn and Mo in respect of these traits. In general, applications of Zn, B and Mo in combinations were found effective in enhancing yield in this crop.

An investigation was undertaken during *kharif* 2017-18 in the Department of Agricultural Botany, Vasantrao Naik Marathwada Krishi Vidyapeeth Parbhani to find out the response of micronutrients application on plant growth and seed yield attributes in green gram cv.BM-2003-2. Five different micronutrients *viz.* zinc, boron, molybdenum, manganese and cobalt were applied in different concentrations, singly and in combination consisting of ten treatments viz., soil application of Zn (10 & 25 kg/ha zinc sulphate, zinc chelate @ 500 g/ha) and B (5 & 10 kg borax/ha), seed treatment of Mo (Ammonium molybdate @ 5 g/kg) and Co (Cobalt nitrate @ 1 g/kg), foliar spray of Mn (Manganese dioxide @ 0.5%), mixture of all micronutrients and a control . were found effective in enhancing yield in this crop.

Keywords: Green gram, micronutrients, plant growth, seed yield

Introduction
Next to cereals, pulses play a vital role in agriculture as these provide proteins, minerals, vitamins rich vegetables and fodder. As the legume crops have self nitrogen fixing capacity, their contribution has an added advantage in the present day of fertilizer crisis in the country. Pulses are second largest source of dietary protein, besides their caloric contribution, not only in India but also in another developing country. Pulses are also considered as important source of minerals, macro and micro nutrients as well as health promoting secondary metabolites and considered poor man's only source of protein. The total cultivated area under pulses in India is estimated to be 33.37 lakh ha and with production pulses is 164.70 lakh tons (DGCI & Ministry of Commerce, Kolkata 2015-2016). Green gram (*Vigna radiata* L.) is one of the oldest pulse crops and is the most nutritious. Apart from high level of protein (25%), green gram also contains fat (1.3%), one of the predominant sources of protein and certain essential amino acids like lysine tryptophan in vegetarian diets. It is also provide 334-334 K Cal. Energy (Shrivastav and Ali, 2004) [6].

Green gram is an excellent source of high quality protein with easy digestibility, consumed as whole grains, dal and sprouted in variety of ways. As value addition, split and dehusked, fried in fat, fetch good value as snacks. After harvesting the pods, green plants are fed to the cattle. The husk of the seed also used as cattle feed. It is suggested that good quality seed and varieties must be available to promote seed production programme (Rout *et al*. 2006) [14]

Materials and Methods
The present investigation was undertaken "To analyse the effect of micronutrients on plant growth and seed yield in green gram" at experimental farm of Dept. of Agril. Botany, VNMKV, Parbhani during *kharif* 2017. The soil was medium deep black and well drained. The topography of the experiment fields was fairly uniform and levelled. BM-2003-2 variety of green gram in a plot size 3.15 m X 2 m² with spacing of 45 cm ×10 cm. The experiment was laid in randomized block design with three replications. Appropriate production technology was adopted to raise the crops. Fertilizer was applied @ 25 kg N, 50 kg P_2O_5. The pods of different treatments stage and seeds after threshing were sun dried.

Observations were recorded on five plant growth characteristics *viz.* days to initiation and 50% flowering, plant height, number of branches, two seed characteristics *viz* number of pods, number of seeds and 1000 test weight, two yield parameters *viz.* seed yield per plant and per hectare. The was analyzed by statistical method used by Panse and Sukhatme (1961) [15].

Table 1: Treatment details

Sr. No.	Treatment symbol	Micronutrients	Name of the salt used	Concentration/dose of application	Mode of application/Stages of application
1	T_1	Control	-	-	-
2	T_2	Zinc (Zn)	Zinc sulphate	10 kg/ha	Soil application (At the time of sowing)
3	T_3	Zinc (Zn)	Zinc sulphate	25 kg/ha	Soil application (At the time of sowing)
4	T_4	Boron (B)	Borax	5 kg/ha	Soil application (At the time of sowing)
5	T_5	Boron(B)	Borax	10 kg/ha	Soil application (At the time of sowing)
6	T_6	Molybdemum (Mo)	Ammonium molybdate	5 g/kg seed	Seed treatment
7	T_7	Cobalt (Co)	Cobalt nitrate	1 g/kg seed	Seed treatment
8	T_8	Manganese (Mn)	Manganese dioxide	0.5%	Foliar spray (20-30 DAS)
9	T_9	Zinc (Zn)	Zinc Chelate	500 g/ha	Soil application (At the time of sowing)
10	T_{10}	Mixture	$T_3 + T_5 + T_6 + T_7 + T_8 + T_9$	*	All the methods

Results and Discussion

A) Plant growth parameters

In the present investigation, observations were recorded on various plant growth characteristics namely field emergence count, number of branches per plant, days to 50% flowering and plant height.

a) Field emergence count

Among all the treatments highest field emergence count was observed in treatment T10 (96.66%) closely followed by T4 (95.55%) also concluded the superior field emergence with boron by Singh, (2011) [12].

b) Number of branches per plant

All the micronutrients were found to have enhancing effect on this character. However, the maximum effect was found with application of borax @ 5.0 kg per hectare (8.33) closely followed by micronutrients mixture (8.00) and manganese (7.33).

Significant increase in number of branches per plant has been reported by application of boron (Basabarajeswari *et al.*, 2008) [1], zinc (Kiran *et al.*, 2010 and Mohanty *et al.*, 2013) [4, 8].

c) Plant height (cm)

As revealed from the results the mean plant height indicating positive effects of all the micronutrients in influencing height of plant in green gram. However, among the treatments, significantly higher effects were observed with the application of zinc (58.72 cm) and molybdenum (57.48 cm) alone or in combinations (57.62 cm) in comparison to the other treatments.

Applications of zinc, boron and micronutrients mixture have been reported to increase the plant height of tomato (Lalit Bhatt, 2004; Tamilselvi, 2005) [6, 13], brinjal (Kiran *et al.*, 2010) [4].

d) Days to appearance and 50% flowering

The days to flowering in 50 percentage plants in different treatments ranged from 53 to 59 days after sowing with an overall mean value of 54.8 days. Among the treatments, application of zinc and molybdenum alone resulted in late flowering while all other micronutrients either singly or in combinations resulted in early flowering in comparison to the control. Application of micronutrients enhanced number of flowers and productive flowers per plant in brinjal (Kuruppaiah, 2005) [5].

B) Pod characteristics

a) Number of pod per plant

Among the treatments except cobalt, application of all other micronutrients had enhancing effect on this character. However, the maximum effect was observed with application of micronutrients mixture (15.33) closely followed by borax @ 10 kg/ha (14.66).

Positive effect of application of micronutrients viz. molybdenum, boron and zinc in increasing the number of seeds per pod has been reported in green gram (Singh, 2011) [12]. The micronutrients might have enhancing role in seed setting that resulted in improvement in number of pod per plant.

C) Seed characteristics and other characters

a) Number of seeds per pod

Among the treatments except cobalt, application of all other micronutrients had enhancing effect on this character. However, the maximum effect was observed with application of micronutrients mixture (9.66) closely followed by borax @ 10 kg/ha (9.33).

b) Days to physiological maturity

Among all the treatments (T_6), (T_3) and (T_2) required more time to attain physiological maturity. Treatment T_7 (62) and T_8 (62) both showed significantly higher yield. Similar results were observed in the study of radish conducted by Deepika, (2015), where she found the more days to mature of crop by application of RDF + $ZnSo_4$ @ 10 kg ha^{-1} + Borax (0.1%) spray at bud initiation stage.

c) Seed yield

The average per plant seed yield ranged from 4.19 g (T1) to 5.04 g (T10) with an overall mean value of 4.64 g. Similarly, the per hectare seed yield values among the treatments ranged from 668.25 kg (T1) to 1198.41 kg (T10) with an overall mean value of 830.24 kg. The results indicated that application of all the micronutrients either singly or in combination had enhancing effect on seed yield in green gram. However, the maximum increase in seed yield was

observed with application of micronutrients mixture followed by borax @ 10 kg per hectare and molybdenum. All other treatments were found to have moderate to low effects in enhancing seed yield in this crop.

The result of the present investigation is in agreement with the findings of a number of workers in a number of crops. (Dordas *et al.*, 2007, Kumar *et al.*, 2007, Ramu *et al.*, 2007, Shil *et al.*, 2007 , Pathak and Pandey, 2010, Nasir *et al.*, 2011, Manna *et al.*, 2013 , Kumar *et al.*, 2013) [3, 10, 11, 9, 7].

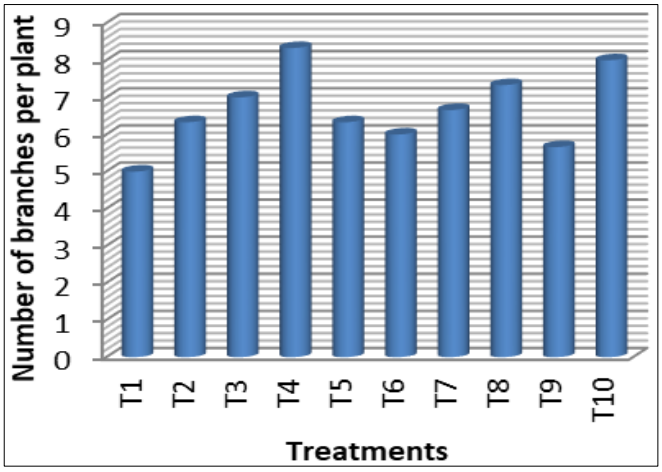

Fig 1: Influence of micronutrients on number of branches per plant in green gram

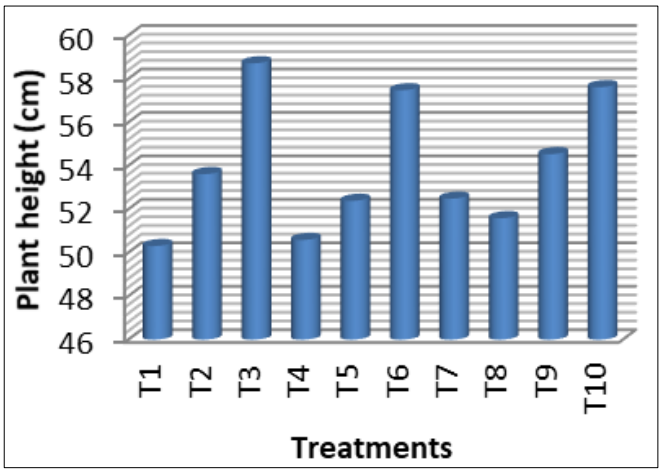

Fig 2: Influence of micronutrients on plant height in green gram

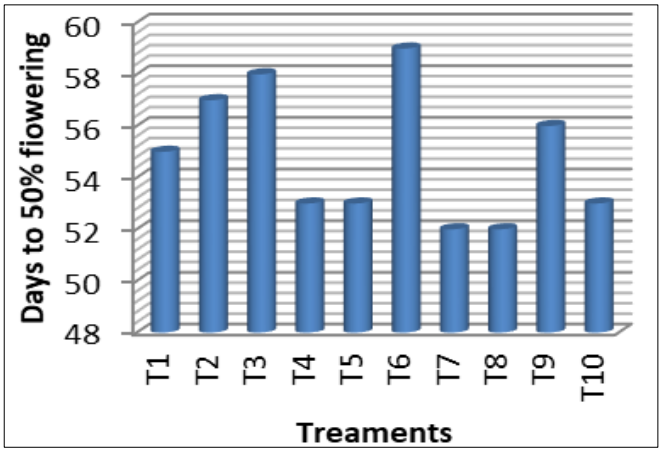

Fig 3: Influence of micronutrients on days to 50% flowering in green gram

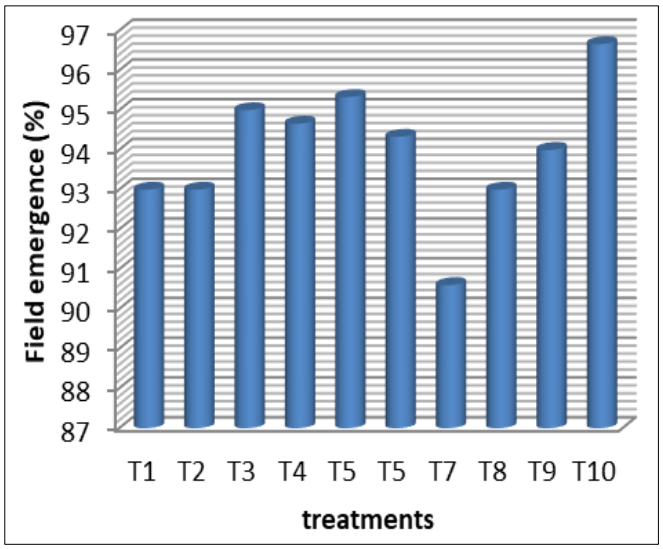

Fig 4: Influence of micronutrients on field emergence count in green gram

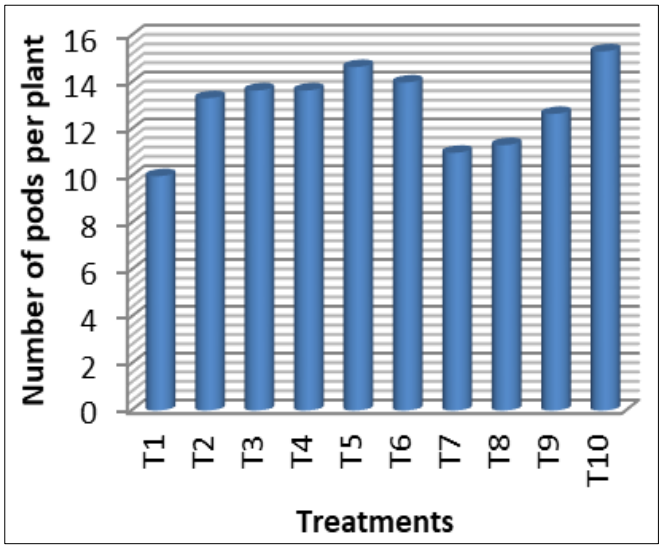

Fig 5: Influence of micronutrients on number of pods per plant in green gram

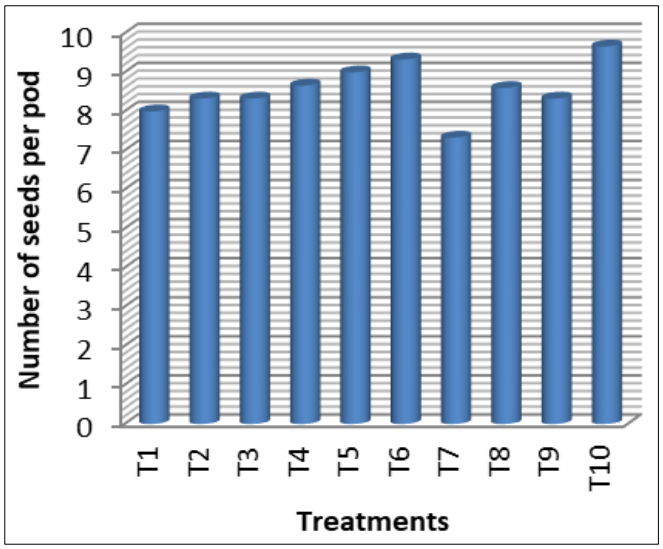

Fig 6: Influence of micronutrients on number of seeds per pod in green gram

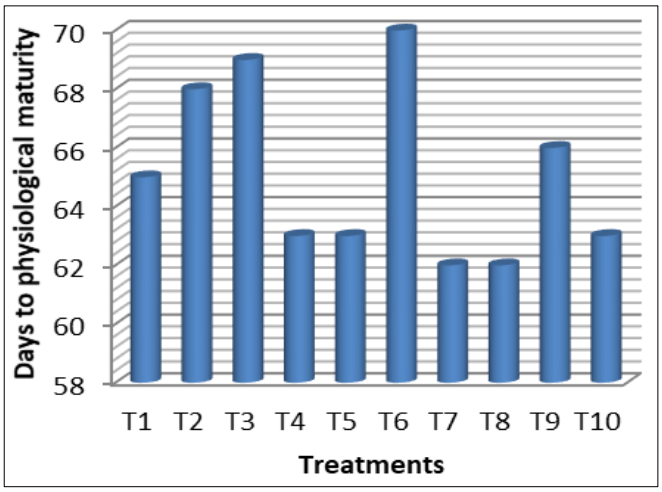

Fig 7: Influence of micronutrients on days to physiological maturity in green gram

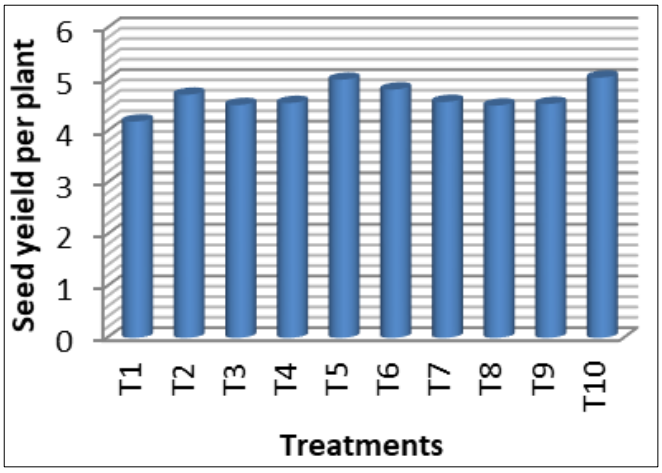

Fig 8: Influence of micronutrients on seed yield per plant in green gram

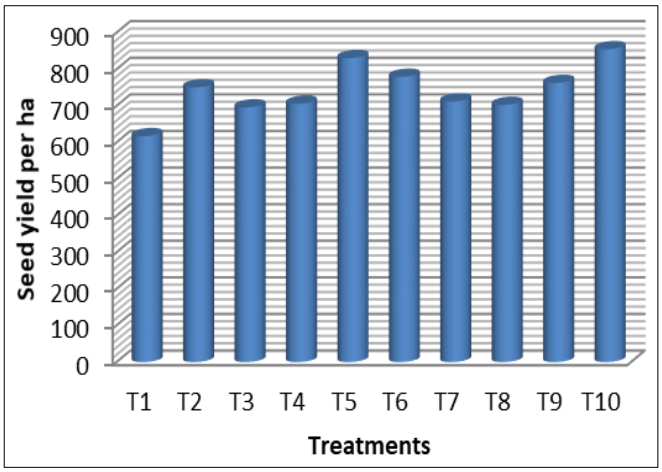

Fig 9: Influence of micronutrients on seed yield per hector in green gram

Conclusion

In the present investigation, it was concluded that application of micronutrients enhanced plant height, number of branches, days to 50% flowering and physiological maturity. Among all the treatments Zn, B, Mo and their mixture had produced significant enhancing effect on yield attributes including seed yield.

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