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PROFICIENCY OF SULPHUR AND IRON FERTILIZATION ON YIELD, YIELD ATTRIBUTES AND ECONOMICAL PARAMETERS OF GREEN GRAM *(VIGNA RADIATA* L.*)* CULTIVAR "SUBH-51".

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Abstract

To evaluate yield, yield attributes and economical parameters of green gram in response to application of different levels of sulphur and iron as individually as well as in combination. The experiment was laid down in randomized block design (RBD), consisting of eight treatments (T_1 control, T_2 1.0% $FeSO_4$ as foliar spray at 25 DAS, T_3 25kg S ha^{-1} as $ZnSO_4$, T_4 25kg S ha^{-1} as SSP, T_5 25kg S ha^{-1} as $ZnSO_4$+1.0% $FeSO_4$ as foliar spray at 25 DAS, T_6 25kg S ha^{-1} as SSP+1.0% $FeSO_4$ as foliar spray at 25 DAS, T_7 12.5kg S ha^{-1} as $ZnSO_4$+12.5kg S ha^{-1} as SSP and T_8 12.5kg S ha^{-1} as $ZnSO_4$+12.5kg S ha^{-1} as SSP+1.0% $FeSO_4$ as foliar spray at 25 DAS). All the above cited treatments were replicated thrice to compare their actual dosage effectiveness on "SUBH-51" cultivar of green gram individually as well as in combination. To supply the required amount of nitrogen, sulphur, iron and others, nutrient management was done through the application of Urea, SSP, $ZnSO_4$ and $FeSO_4$. It was revealed from the present investigation that treatment T_8 that comprises of 12.5kg S ha^{-1} as $ZnSO_4$+12.5kg S ha^{-1} as SSP+1.0% $FeSO_4$ as foliar spray at 25 DAS were far better than rest, which was followed by treatment T_5 (25 kg S ha^{-1} as $ZnSO_4$+1%$FeSO_4$ as foliar spray at 25 DAS). Perusal of the current study indicates that treatment T_8 recorded significantly highest number of pods $plant^{-1}$ (17.75), numbers of grains pod^{-1} (13.00), 1000 grain weight (36.12 g), harvest index (45.39 %), grain yield (7.90 q ha^{-1}), stover yield (8.02 q ha^{-1}) net return (Rupees 44018 ha^{-1}) and B:C ratio (1.89) over rest of the treatments including control. In light of the results obtained from the present investigation. It is concluded that among all the treatments, T_8 was found to be most effective source of sulphur and iron. It results significant improvement in growth parameters, yield attributes grain and stover yield as well as the economical parameters of green gram. The second highest best treatment level as a source of sulphur and iron was treatment T_5 that also significantly enhanced yield and other contributing characters of green gram.

Key words: Green gram, sulphur, iron, yield attributes, yield and economical parameters.

Introduction

Green gram is a warm weather crop and is grown in areas receiving an annual rainfall ranging from 50 to 70 cm. It is mainly cultivated in a cereal-pulse cropping system primarily to conserve soil nutrients and utilize the left over soil moisture particularly, after rice cultivation. Although, it can be grown in all the seasons, In north India, it is grown mostly as *kharif* season crop while as in peninsular India majority of green gram cultivation falls in either *rabi* or late *rabi* seasons. Green gram can be used in both sweet and savoury dishes. Green gram seeds are highly digestible and cause less flatulence than seeds of other pulses. Green gram contains 1.2g fat, 15mg sodium, 62g carbohydrates, 16 g fiber, 24g protein, 15% vitamin C and vitamin A, 20% calcium and 80% iron (Infonet biovision). Being rich in quality protein, minerals and vitamins, green gram or mungbean is inseparable ingredients in the diets of vast majority of Indian populations. When supplemented with cereals, they provide a perfect mix of essential amino acids with high biological value.

Sulphur and iron are one of the most important nutrients for all the plants and animals. Sulphur is considered as the fourth major nutrient in increasing agricultural crop production after nitrogen, phosphorus and potassium. As being rich source of proteins, green gram needs to be judiciously fertilized with sulphur as this element plays a key role in protein synthesis and chlorophyll development. Sulphur is a constituent of essential amino acids *viz*., methionine, cysteine, homo-cysteine and taurine -the building blocks of protein. Therefore, sulphur fertilization is considered as critical for seed yield, protein synthesis and for the quality improvement of economic produce in legumes through their enzymatic and metabolic effects (Bhattacharjee *et al.,* 2013). In addition, sulphur is required by the rhizobia bacteria for fixation of atmospheric nitrogen. The sulphate ion, SO_4, is the form primarily absorbed by plants. Sulphate is soluble and is easily lost from soils by leaching. As sulphate is leached down into soil, it accumulates in heavier (higher clay content) subsoil's. For this reason, testing for sulphur in topsoil is unreliable for predicting sulphur availability during a long growing season. Sulphur deficiency symptoms show on young leaves first. The leaves appear pale green to yellow. The plants are spindly and small with retarded growth and delayed fruiting. For a rapid correction of a deficiency, use one of the readily available sulphate sources. There are many sources of sulphur available. One of the source of sulphur is the organic matter that helps in enriching the sulphur in soils naturally. Other sources of sulphur are rainfall and some. Some readily available sources include ammonium sulphate (24% S), potassium sulphate (17.6% S), gypsum (16.8% S), and zinc sulphate (17.8% S) McCauley *et al.,* (2009).

Iron (Fe) is one of the essential micronutrient that enhances plant growth and reproduction (Welch, 1995). Iron was the first nutrient element discovered as essential for plant life. In the plant system, iron plays an important role in a series of metabolic activities involving respiratory enzymes and various photosynthetic reactions. Iron also plays an important role in legumes including green gram for nodule formation and nitrogen fixation. It is not only essential element that is required by both, the host legume and the rhizobium. Iron has been considered to be associated with chlorophyll formation because any of its deficiency in the plant system results in foliar chlorosis. The iron deficiency results in yellowish green discolorations in newly born leaves. But veins remain green in colour (interveinal chlorosis). Finally whole leaves turn to yellow in colour this is called sogai disease. Foliar application of Fe solutions is one of the most widely used methods for correcting Fe deficiency in many crops. This method of application usually circumvents the problems associated with Fe application to the soil. Bera, M. and Ghosh, G.K. (2015), reported that foliar sprays of Fe significantly reduced iron-deficiency chlorosis and increased seed yield in soybean. Therefore, balanced fertilization of macro and micro nutrients particularly in combination is very important for proper growth, development and high yield production of crop plants including green gram (Atul and Singh (2017)).

Materials and Methods

The present investigation was carried out at Crop Research Farm, Department of Agronomy, School of Agriculture, Suresh Gyan Vihar University, Jaipur (Rajasthan) during *kharif* season of 2018. The experimental site is situated in the eastern boundary of Thar Desert, a semi-arid land of Rajasthan situated at an elevation of 431 meters above sea level with 26.90 North latitude and 75.70 East longitudes. The experiment consists of eight treatments including control which were tested under three replications by using randomized block design (RBD). Different sources of sulphur and iron nutrients were used to test the performance of green gram cultivar "SUBH-51". To supply the required amount of nitrogen, sulphur, iron and others, nutrient management was done through Urea, SSP, $ZnSO_4$ and $FeSO_4$. Half dose of nitrogen in the form of inorganic source i.e., urea was applied after first irrigation and the second split dose at the time of pod formation whereas full dose of inorganic source of sulphur in the form of $ZnSO_4$, SSP were applied as basal dressing, Iron in the form of $FeSO_4$ as foliar spray at 25 DAS.. The data on yield, yield attributes and economics were recorded in all the treatments and were analysed statistically.

Results and Discussion

Yield attributing Characters

Perusal of data presented in Table 1 revealed that all the yield contributing characters under study showed significant variation when treated with different sources of sulphur and iron nutrients that were either applied individually or in combination. The maximum number of pods plant^{-1} (17.75), number of grains pod^{-1} (13.00), 1000 grain weight (36.12 g) and harvest Index (45.39%) was recorded in treatment T_8 that (12.5kg S ha^{-1} as $ZnSO_4$+12.5kg S ha^{-1} as SSP+1.0% $FeSO_4$ as foliar spray at 25 DAS) against minimum recorded in treatment T_1 (control). The increased number of pods plant^{-1}, number of grains pod^{-1}, 1000 grain weight and harvest Index observed in T_8 may be due to increased metabolic process in plants with sulphur application through $ZnSO_4$ and SSP which may have promoted meristematic activities resulting in higher apical growth and expansion of photosynthetic surface, which led to higher photosynthesis and hence higher photosynthates accumulation Meena and Kumuwat, (2013). On the other hand, increased availability of iron in the form of $FeSO_4$ helps in absorption of nutrients, which are expected to have efficient photosynthetic mechanism and better equipped for efficient translocation of photosynthates from source to sink, consequently resulting into higher number of pods plant^{-1} Karpagam and Rajesh (2014).

Grain yield

Table 1: Response of sulphur and iron on yield attributes of green gram (*Vigna radiata* L.).

	Treatments	Number of pods plant^{-1}	Number of grains pod^{-1}	1000 grain weight(g)	Harvest Index (%)
T_1	Control	8.48	10.33	26.13	30.06
T_2	1% $FeSO_4$ as foliar spray at 25 DAS	15.26	10.66	30.02	31.23
T_3	25 kg S ha^{-1} as $ZnSO_4$	15.48	11.42	31.73	33.59
T_4	25 kg S ha^{-1} as SSP	15.36	11.33	30.61	33.06
T_5	25 kg S ha^{-1} as $ZnSO_4$+1%$FeSO_4$ as foliar spray at 25 DAS	16.38	12.42	35.48	43.98
T_6	25 kg S ha^{-1} as SSP +1%$FeSO_4$ as foliar spray at 25 DAS	15.55	12.00	32.07	35.89
T_7	12.5 kg S ha^{-1} as $ZnSO_4$+12.5 kg S ha^{-1} as SSP	17.36	12.67	33.77	39.38
T_8	12.5 kg $ZnSO_4$ ha^{-1}+12.5 kg S ha^{-1} as SSP+1% $FeSO_4$ as foliar spray at 25 DAS	17.75	13.00	36.12	45.39
F- test		S	S	S	S
S. Ed.(±)		0.98	0.73	1.63	2.51
C. D. (P = 0.05)		2.10	1.56	3.51	5.39

It was revealed from the present investigation that application of both S and Fe through different sources ($ZnSO_4$, SSP and $FeSO_4$) significantly affected grain yield of green gram. Significantly maximum grain yield was obtained in plots where 12.5kg S ha^{-1} as $ZnSO_4$ in combination with 12.5kg S ha^{-1} as SSP along with 1% FeSO4 as foliar spray at 25 DAS was applied. The treatment that secured second in respect to highest grain yield was T5 (25kg S ha^{-1} as $ZnSO_4$+1.0% $FeSO_4$ as foliar spray at 25 DAS), which was statistically at par with T7 treatment (12.5kg S ha^{-1} as $ZnSO_4$+12.5kg S ha^{-1} as SSP). On the other side, significantly minimum grain yield was observed from the plots with zero application of both sulphur and iron (control). The findings are in conformity with the work reported by Khorgamy and Farin, (2009) and Valenciano *et al.,* (2010) who reported that maximum grain yield obtained in green gram may be due to increased metabolic process in plants due to sulphur application through $ZnSO_4$ and SSP. In addition to sulphur, availability of zinc in zinc sulphate and iron in ferrous sulphate also helps in absorption of nutrients, which are expected to have efficient photosynthetic mechanism and better equipped for efficient translocation of photosynthates from source to sink, consequently resulting into increased grain yield Pingoliya *et al.,* (2014), Prajapati *et al.,* (2013).

Stover Yield

From the table 2, it was observed that stover yield of green gram cultivar "SUBH-51" when treated with different sources of sulphur and iron nutrients showed significant variation. Significantly maximum stover yield (8.02 q ha^{-1}) was found with treatment T_8 (12.5kg S ha^{-1} as $ZnSO_4$+12.5kg S ha^{-1} as SSP+1.0% $FeSO_4$ as foliar spray at 25 DAS) against significantly minimum in control (5.88 q ha^{-1}). Similar results were also reported by Patel and Acharya, (2011) and Kokani *et al.,* (2014). Sulphur nutrition enhances cell multiplication, elongation, expansion and is known to impart a deep green colour to leaves due to better chlorophyll synthesis, which in turn increases

Table 2: Response of sulphur and iron on yield and economic of green gram (*Vigna radiata* L.).

	Treatments	Grain yield (qha^{-1})	Stover yield (qha^{-1})	Net Return (Rs. ha^{-1})	B : C Ratio
T_1	Control	4.73	5.88	18937	0.87
T_2	1% $FeSO_4$ as foliar spray at 25 DAS	5.43	6.53	23052	1.03
T_3	25 kg S ha^{-1} as $ZnSO_4$	6.45	6.97	25041	1.32
T_4	25 kg S ha^{-1} as SSP	5.47	6.86	22569	1.05
T_5	25 kg S ha^{-1} as $ZnSO_4$+1%$FeSO_4$ as foliar spray at 25 DAS	7.79	7.72	41686	1.81
T_6	25 kg S ha^{-1} as SSP +1%$FeSO_4$ as foliar spray at 25 DAS	6.79	7.20	28830	1.50
T_7	12.5 kg S ha^{-1} as $ZnSO_4$+12.5 kg S ha^{-1} as SSP	7.17	7.29	36697	1.60
T_8	12.5 kg $ZnSO_4$ ha^{-1}+12.5 kg S ha^{-1} as SSP+1% $FeSO_4$ as foliar spray at 25 DAS	7.90	8.02	44018	1.89
F- test		S	S	-	-
S. Ed. (±)		0.34	0.38	-	-
C. D. (P = 0.05)		0.74	0.81	-	-

the effective area for photosynthesis and thus resulting increase in stover yield of a plant. In addition to sulphur, availability of iron also helps in absorption of nutrients, which are expected to have efficient photosynthetic mechanism and better equipped for efficient translocation of photosynthates from source to sink, consequently resulting into increased stover Bera and Ghosh (2015).

Economic

Data pertaining to economics of green gram in terms of net return and benefit cost ratio differed significantly due to application of different levels of sulphur and iron through various sources of fertilization ($ZnSO_4$, SSP and $FeSO_4$). The net return (Rs. 64,862) as well as benefit cost ratio (1.89) was recorded in T_8 treatment (12.5kg S ha-^{1} through ZnSO4 in combination with 12.5kg S ha^{-1} as SSP and 1.0% $FeSO_4$ as foliar spray at 25 DAS), against minimum recorded in control Similar results Similar observations were also stated by Ram and Katiyar, T.P.S. (2013).

References

Banik, N.C. and K. Sengupta (2012). Effect of Sulphur on growth and yield of green gram (*Vigna radiata* L.) *Journal of crop and weed,* **8(1):** 109-110.

Bera, M. and G.K. Ghosh (2015). Efficiency of Sulphur Sources on green gram (*Vigna radiata* L.) In Red and Lateritic Soil of West Bengal. *International Journal of Plant, Animal, Environmental sciences,* **5(2):** 109-116.

Bhattacharjee, A., M.J. Lehtinen, T. Kajander, A. Goldman and T.S. Jokiranta (2013). Both domin 19 and domin 20 of factor H are involved in binding to complement C3b and C3d. *Mol. Immunol.,* **47:** 1686-1691.

Karpagam, J. and N. Rajesh (2014). Iron Application for Enhancing Growth, Yield and Soil Health on green gram (*Vigna radiata* L.) *American-Eurasian J. Agric. and Environ. Sci.,* **14(12):** 1378-1381.

Kokani, J.M., K.A. Shah, B.M. Tandel and P. Nayaka (2014). Growth, Yield Attributes and Yield of Summer black gram (*Vigna mungo* L.) as Influenced by FYM, Phosphorus and Sulphur. *The Ecoscan Special issue,* **6:** 429-433.

Khorgamy, A. and A. Farina (2009). Effect of phosphorus and zinc fertilization on yield and yield components of chick pea cultivars. *African Crop Science Conference Proceedings*, **9:** 205-208.

Meena, K.K., R.S. Meena and S.M. Kumuwat (2013). Effect of sulphur and iron fertilization on yield attributes, yields and nutrient uptake of green gram (*Vigna radiata* L.) *Indian journal of Agriculture Science,* **83(4):** 472-476.

McCauley, R.J., E. Strand, G.L. Lof, T. Schooling and T. Frymark (2009). Evidence based systematic review.

Patel, M.M., I.C. Patel, R.I. Patel and S. Acharya (2011). Effect of Zinc and Iron on Yield and Yield Attributes of Rainfed Cowpea (*Vigna unguiculata* L.) *Annals of Arid Zone,* **50(1):** 17-19.

Pingoliya, K.K., M.L. Dotaniya and M. Lata (2014). Effect of Iron on yield, quality and nutrient uptake of chickpea (*Cicer arietinum* L.) *African Journal of Agricultural,* **9(37):** 2841-2845.

Prajapati J.P., R.P. Singh, Santosh Kumar, I.K. Kushwaha and P.K. Yadav (2013). Yield and nutrient uptake of green gram (*Vigna radiata* L.) influenced by Phosphorus and Sulphur. *Agriculture for sustainable development,* **1(1):** 49-51.

Ram, S. and T.P.S. Katiyar (2013). Effect of Sulphur and Zinc on the seed yield and protein content of summer green gram (*Vigna radiata* L.) Under arid climate. *I.J.S.N.,* **4(3):** 563-566.

Valenciano, J.B., J.A. Boto and V. Marcelo (2010). Response of Chick pea (*Cicer arietinum* L.) yield to Zinc, Boron and molybdenum application under pot conditions. *Spanish Journal of Agricultural Research,* **8:** 797-807.

Welch, M. (1995). Micronutrient Nutrition of Plants *Critical Reviews in Plant Sciences,* **14(1):** 49-92.