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RESPONSE OF SULPHUR AND ZINC NUTRITION ON YIELD ATTRIBUTES, YIELD OF MUNGBEAN (*VIGNA RADIATA* L. WILCZEK) UNDER PARTIALLY RECLAIMED SALINE-SODIC SOIL IN EASTERN U.P., INDIA

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Abstract

The present study was conducted at the Instructional Farm of N. D. University of Agriculture & Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.) during summer (*Kharif*) season of 2008-2009, to evaluate the response of sulphur and zinc nutrition on yield attributes, yield of mungbean (*Vigna radiata* L. Wilczek). In this experiment the mungbean variety "NDM-1" was shown on 12^{th} April. The treatments were comprised with four sulphur levels i.e. 0, 20, 40, and 60 kg S ha^{-1} and four zinc levels i.e. 0, 5.0, 7.5 and 10 kg Zn ha^{-1}. Elemental sulphur was used as sulphur source and zinc sulphate for zinc. Experiment of laid out in Randomized Block Design (R.B.D.) in factorial arrangement with three replications. The result revealed that the application of 40 kg S ha^{-1} and 10 kg Zn ha^{-1} produced significantly higher yield attributes like fresh weight of nodules $plant^{-1}$, dry weight of nodules $plant^{-1}$, dry matter accumulation $plant^{-1}$, number of pods $plant^{-1}$,number of seeds $pods^{-1}$, weight of seed $pods^{-1}$ and yield like seed yield, stover yield and biological yield of mungbean over control, 40 kg S ha^{-1} and 7.5 kg Zn ha^{-1} and at par with 60 kg S ha^{-1} and 10 kg Zn ha^{-1}, respectively.

Key words : Mungbean, sulphur, zinc, yield attributes and yield.

Introduction

Mungbean (*Vigna radiata* L. Wilczek) is one of the most important pulse crops by virtue of its short duration and higher production per unit area in per unit time.Mungbean is an excellent source of high quality protein. It contains about 25 per cent protein. It also contains 3.3% fat, 5.9% fiber, 51.2% carbohydrate, 3.4% minerals, 0.3% vitamins and 10% moisture. Mungbean is also important for sustainable agriculture as it improves the physico-chemical and biological properties of the soil. Its deep roots also open the soil, which ensure better aeration and heavy leaf drop increase the organic matter in the soil. It has the capacity to fix atmospheric nitrogen through symbiotic nitrogen fixation. It can fix 50-66 kg N ha^{-1} through symbiotic relationship between the host mungbean roots nodules and soil bacteria (Reddy and Reddi, 2005). In India, the total area of mungbean was 2550161 hectare with the production of 1905987 tones having productivity of 747 kg ha^{-1} in 2010-2011. However, in Utter-Pradesh, mungbean is grown on 78 thousand hectare area with production of 45 thousand tones and average productivity of around 577 kg ha^{-1} in 2010-2011 (Source: Agricultural Statistics Division, Directorate of Economics & Statistics, Department of Agriculture & Cooperation).

Sulphur has long been recognized as an essential nutrient element for plant and its ranks in importance with nitrogen and phosphorus. The sulphur requirement of pulses in much higher than that of cereals because it is a constituent of sulphur-containing amino acids in addition to being involved in several metabolic processes. Since mungbean is a legume crop it is likely that it may respond sulphur. The importance of sulphur in agriculture is being increasingly emphasized and its role in crop production is well recognized. Sulphur is a best known for its role in the formation of amino acids methionine (21% S) and cysteine (27% S), synthesis of proteins and chlorophyll, oil content of the seeds and nutritive quality of forages

(Jamal *et al*., 2005; 2006; 2009). The application of sulphur increases the concentration as well as total uptake of N, P, K, Ca, S, Zn, and B at different stages of crop growth (Agrawal *et al*., 2000). Lack of sulphur causes retardation of terminal growth and root development. Sulphur deficiency induced chlorosis in young leaves and decrease seed yield by 45% (Bari *et al*., 2004).

Zinc also an essential plant nutrient for plant growth and development and it is a constituent of several enzymes such as alcohol dehydrogenase, carbonic anhydrase, proteinase and acts as co-factor for several others. It also plays vital role in the synthesis of protein and nucleic acid and helps in the utilization of nitrogen and phosphorus in plant. It is associated with water uptake and retention in plants. Zinc is also known to stimulate plant resistance to dry and hot weather and also bacterial and fungal diseases. It also promotes nodulation and nitrogen fixation in leguminous crops (Demeterio *et al*., 1972). The objective of the study was to evaluate the response of dosessulphur and zinc nutrition on yield attributes, yield of mungbean (*Vigna radiata* L. Wilczek).

Materials and Methods

The present study was conducted at the Instructional Farm of N. D. University of Agriculture & Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.) during summer (*Kharif*) season of 2008-2009, to evaluate the response of sulphur and zinc nutrition on yield attributes, yield of mungbean (*Vigna radiata* L. Wilczek) under partially reclaimed saline-sodic soil in Eastern Uttar Pradesh. In this experiment the mungbean variety "NDM-1" was shown on 12^{th} April using a seed rate of 25 kg ha^{-1} maintaining row to row distance of 30 cm and plant to plant distance 10 cm. The treatments were comprised with four sulphur levels *i.e.* 0, 20, 40, and 60 kg S ha^{-1} and four zinc levels *i.e.* 0, 5.0, 7.5 and 10 kg Zn ha^{-1}. Elemental sulphur was used as sulphur source and zinc sulphate for zinc. Both nutrients were applied at time of sowing. Experiment of laid out in Randomized Block Design (R.B.D.) in factorial arrangement with three replications and net plot size of 4.2 m x 3 m. Fertilizer was applied at 20:50:25 NPK kg ha^{-1} through urea, single super phosphate and mutate of potash, respectively. The data collected from the experiment was statistically analyzed by using Fisher's analysis of variance technique and the difference by employing CD at 5% probability (Cochron and Cox, 1970).

Results and Discussion

The highest fresh and dry weight of nodules $plant^{-1}$ (47.33 and 6.38 mg) was recorded with 40 kg S ha^{-1}, which was significantly higher than untreated plots, 20 kg S ha^{-1} and at par with 60 kg S ha^{-1}. The increased in fresh and dry weight of nodules $plant^{-1}$ under sulphur application might be chiefly due to the improvement in soil properties and also sulphur application could be ascribed to its pivotal role in regulating the metabolic and enzymatic process including photosynthesis and respiration in plants. This might be due to certain of favourable soil ecological condition for growth and development of nitrogen fixing bacteria (*Rhizobium* spp.). Similar findings were also reported by Singh and Yadav (2003), Singh *et al.* (2003), Dey *et al.* (2004), Joshi and More (2004), Singh *et al.* (2004), Srivastava *et al.* (2006) and Patel *et al.* (2010). The fresh and dry weight of nodules $plant^{-1}$ significantly increased upto 10 kg Zn ha^{-1}. The maximum fresh and dry weight of nodules $plant^{-1}$ (47.48 and 6.45 mg) was observed with 10 kg Zn ha^{-1}, which was significantly superior over 5.0 kg Zn ha^{-1}, 7.5 kg Zn ha^{-1} and followed by untreated plots. It is might be due to the application of zinc enhanced and established good root system. This result is in good agreement with results of Singh *et al*. (1997), Mishra *et al*. (2002), Khan *et al*. (2003) and Joshi and More (2004).

The highest dry matter accumulation $plant^{-1}$ was observed with 40 kg S ha^{-1}, which was significantly higher than control, 20 kg S ha^{-1} and at par with 60 kg S ha^{-1}. This may be due to less availability of other nutrients at higher levels (60 kg S ha^{-1}) of sulphur in soil which results in imbalance use of nutrients. Similar findings were also reported by Singh *et al.* (1997), Shivakumar (2001), Mandal *et al.* (2003), Dey *et al.* (2004) and Singh *et al.* (2004). The highest dry matter accumulation $plant^{-1}$ was obtained due to 10 kg Zn ha^{-1}, which was significantly higher than untreated plots, 5.0 kg Zn ha^{-1} and at par with 7.5 kg Zn ha^{-1}. The increase in dry matter accumulation $plant^{-1}$ under increasing zinc treatment may be due to its effect in the metabolism of growing plants which may effectively explain the observed response of zinc application. Favorable responses of zinc application on dry matter accumulation $plant^{-1}$ have also reported by Singh and Badhoria (1984), Enania and Vyas (1994), Singh *et al*. (1997) and Joshi and More (2004).

The number of pods $plant^{-1}$, number of seeds $pods^{-1}$ and weight of seed pod^{-1} of mungbean was significantly increased upto 40 kg S ha^{-1}, which were at par with 60 kg S ha^{-1}. Probably more number of pods may be due to balanced nutrition and proper vegetative growth which later converted into reproductive phase and resulted might in more number of pod per plant. These results were enclose conformity with the findings of Pandey *et al.* (2001), Singh *et al*. (2004), Dey *et al.* (2004), Mitra *et*

Table 1 : Effect of sulphur and zinc levels on fresh weight of nodules plant^{-1}, dry weight of nodules plant^{-1}, dry matter accumulation plant^{-1}, number of pods plant^{-1}, number of seeds pods^{-1}, weight of seed pods^{-1} of mungbean.

Treatments	Fresh weight of nodules plant^{-1} (mg)	Dry weight of nodules plant^{-1} (mg)	Dry matter accumulation plant^{-1} (g)	Number of pods plant^{-1}	Number of seeds pods^{-1}	Weight of seed pods^{-1} (mg)
S levels (kg ha^{-1})						
0	36.65	4.94	8.73	16.14	9.67	0.41
20	39.16	5.28	9.86	17.25	10.33	0.44
40	47.33	6.38	10.54	20.85	12.49	0.53
60	45.45	6.13	9.91	20.02	11.99	0.51
SEm±	0.95	0.13	0.23	0.42	0.22	0.01
CD at 5%	2.75	0.37	0.66	1.21	0.63	0.02
Zn levels (kg ha^{-1})						
0	35.49	4.78	8.86	15.63	9.36	0.40
5.0	40.56	5.47	9.40	17.87	10.70	0.45
7.5	44.70	6.02	10.36	19.69	11.79	0.50
10	47.48	6.45	10.43	21.07	12.62	0.53
SEm±	0.95	0.13	0.23	0.42	0.22	0.01
CD at 5%	2.75	0.37	0.66	1.21	0.63	0.02

Table 2 : Effect of sulphur and zinc levels on seed yield, stover yield and biological yield of mungbean.

Treatments	Seed yield (q ha^{-1})	Stover yield (q ha^{-1})	Biological yield(q ha^{-1})
S levels (kg ha^{-1})			
0	9.21	28.09	37.30
20	9.84	30.13	39.97
40	11.89	36.48	48.38
60	11.42	35.33	46.75
SEm±	0.24	0.64	0.85
CD at 5%	0.69	1.85	2.45
Zn levels (kg ha^{-1})			
0	8.92	27.15	36.07
5.0	10.19	31.55	41.74
7.5	11.23	34.44	45.67
10	12.02	36.90	48.92
SEm±	0.24	0.64	0.85
CD at 5%	0.69	1.85	2.45

al. (2006), Srivastava *et al.* (2006) and Sasode (2008). Zinc application has beneficial effect on number of pods plant^{-1}, number of seeds pods^{-1} and weight of seed pod^{-1}. The highest number of pods plant^{-1}, number of seeds pods^{-1} and weight of seed pod^{-1} were noted with 10 kg Zn ha^{-1}, which was significantly higher than control followed by 5.0 and 7.5 kg Zn ha^{-1}. It may be due to the role of zinc in the formation of more photosynthesis results into development of reproductive parts. This is due to the fact that application of zinc enhanced vegetative and reproductive parts of plants which produced bold seeded grains. The increase in yield attributing characters might be due to application of zinc increased the enzymatic and physiological activities and performance of many catalytic function in plant system, beside transformation of carbohydrates, chlorophyll and protein synthesis. The results obtained are in accordance with findings reported by Enania and Vyas (1995), Sawires (2001), Sangwan and Raj (2004) and Singh *et al.* (2005).

The seed, stover and biological yields increased with increasing levels of sulphur upto 40 kg ha^{-1} and thereafter the yield was decreased (table 2). The maximum seed stover and biologicalyields (11.89, 36.48 and 48.38q ha^{-1}) recorded at 40 kg S ha^{-1} were significantly higher over control (9.21, 28.09 and 37.30 q ha^{-1}) as well as 20 kg S ha^{-1} and statistically at par with 60 kg S ha^{-1}, respectively. The increase in yield was mainly due to enhanced rate of photosynthesis and carbohydrate metabolism as influenced by sulphur application. Similar findings were also reported by Pandey *et al.* (2001), Singh *et al.* (2004), Srivastava *et al.* (2006), Sharma *et al.* (2008) and Patel *et al.* (2010). Decline in yields were observed at higher level of sulphur due to reduced growth of the crop (Sharma and Singh, 1997). Zn application also increased the seed, stover and biologicalyield. The maximum seed, stover and biological yields (12.02, 36.90 and 48.92 q ha^{-1}) observed with 10 kg Zn ha^{-1} application were significantly higher over control (8.92, 27.15 and 36.07 q ha^{-1}), respectively. The increase in yield might be due to role of zinc in biosynthesis of indole acetic acid (IAA) and especially due to its role in initiation of primordial for reproductive parts and partitioning of photosynthesis towards them which resulted in better flowering and fruiting. These results corroborate with the findings of Chaphale *et al*. (1991), Krishna (1995), Prasad *et al*. (1996), Kharche *et al*. (2006) and Singh *et al.* (2008).

Conclusion

Based on the above summary of results it may be concluded that the application of 40 kg S ha^{-1} and 10 kg Zn ha^{-1} is the most suitable and beneficial for getting higher yield of mungbean under partially reclaimed saline-sodic soil in Eastern Uttar- Pradesh.

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