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Effect of zinc and thiourea application on yield attributes and Yield of greengram [*Vigna radiata* (L.) Wilczek]

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Abstract
A field experiment was conducted at Agronomy farm, S.K.N. College of Agriculture, Jobner (Rajasthan) during *kharif*¸ 2016 on loamy sand soil. The experiment comprising four levels of zinc (0, 2.0, 4.0 and 6.0 kg/ha) and five treatments of thiourea application (control, seed soaking with 500 ppm, foliar spray at branching (500 ppm), foliar spray at flowering initiation (500 ppm) and foliar spray at branching and flowering initiation with 500 ppm) thereby making 20 treatment combinations was laid out in randomized block design and replicated thrice. Results showed that being at par with 6.0 kg/ha zinc fertilization at 4.0 kg/ha significantly increased the yield attributing characters of greengram *viz*., number of pods/plant, number of grains/pod, test weight, maximum seed, straw and biological yields over preceding levels. Foliar spray of thiourea (500 ppm) was found significantly superior among all the treatments with respect to yield determining characters, It produced the grain, straw and biological yields 1253, 2139 and 3392 kg/ha and thus increase these to the extent of 40.3, 35.3 and 37.2 per cent over control.

Keywords: Mungbean, thiourea, zinc, pod, yield, ppm

Introduction
Pulses, also known as grain legumes, are next to cereals in terms of agricultural importance and have been considered best options for diversification and intensification of agriculture across the globe because of their intrinsic values such as nitrogen fixing ability (15-35 kg N/ha), high protein content and ability to thrive well in less endowed environment. Greengram [*Vigna radiata* (L.) Wilczek], also known as mungbean, stands third after chickpea and pigeonpea among pulses. It occupies 29.36 lakh hectare area and contributes 13.90 lakh tonnes in pulse production in the country (Anonymous, 2015-16) [2]. Pulses are the main source of dietary protein particularly for vegetarians and contribute about 14 per cent of the total protein of average Indian diet. The per capita availability of pulses is dwindling fast from 70 g in 1959 to 31.6 g/capita/day in 2011 as against the minimum requirement of 84 g/capita/day prescribed by Indian Council of Medical Research, which is causing malnutrition among the growing population (Anonymous, 2011) [1]. Greengram is an excellent source of protein (24.5%) with high quality of lysine (460 mg/g) and tryptophan (60 mg/g). It also has remarkable quantity of ascorbic acid when sprouted and contains riboflavin (0.21 mg/100 g) with good amount of minerals (Gopalan *et al*., 1995) [5]. Being a short duration crop, it suits well in various multiple and intercropping systems. After picking of pods, greengram plants may be used as green fodder or green manure.

Micronutrients are essential for the normal growth of plants, deficiencies of which adversely affect the growth, metabolism and reproductive phase in plants. In many parts of the country, zinc (Zn) as a plant nutrient stands third in importance i.e. next to nitrogen and phosphorus (Katyal and Sharma, 1991) [8]. In the recent years, zinc is considered as one of the constraint in the optimum production of crops. It plays a vital role in synthesis of chlorophyll, protein and nucleic acid and helps in the utilization of nitrogen and phosphorus by plants as it acts as an activator of dehydrogenase and proteinase enzymes, directly or indirectly in synthesis of carbohydrates and protein. Zinc is constituent of tryptophan which is a precursor of auxin hormone. Besides, it is associated with water uptake and water relations. Zn is an essential component of synthetic and natural organic complexes in plants. It is mainly involved in many enzymatic activities, synthesis of tryptophan and compounds needed for the production of growth hormones.

Since there is little scope for horizontal growth in acreage, the only alternative left is to achieve vertical growth through increasing the existing level of production. This emphasizes to think over for the use of thiourea, bioregulator and micronutrients like zinc to break the stagnation in greengram production. Thiourea plays a vital role in the physiology of plants both as sulphydryl compound and as an amino compound like urea. Foliar applied thiourea improves the CO2 uptake by stomata. Thiourea plays a vital role in maintaining redox state of membrane proteins as it can quench reactive oxygen species (ROS) generated during heat stress. This was also associated with greater total antioxidant activity under heat stress. The foliar spray of thiourea increased the plant photosynthetic efficiency and canopy photosynthesis due to presence of S-H group as an integral constituent of these thiols. Its beneficial effect appears to be due to delayed senescence of both vegetative and reproductive organs as thiourea has cytokinin like activity, particularly delaying senescence (Halmann, 1980) [6].

Material and Methods

A field experiment was conducted during *kharif* season 2016 at Plot No.3-D at Agronomy Farm, S.K.N. College of Agriculture, Jobner (Rajasthan) to find out the "Effect of Zinc and Thiourea Application on Growth and Yield of Greengram [*Vigna radiata* (L.) Wilczek]". Geographically, jobner is situated 45 km west of Jaipur at 26^0 05' North latitude, 75^o 28 East longitude and at an altitude of 427 meters above mean sea level. The average annual rainfall of this tract varies from 400 mm to 500 mm and is mostly received during the months of July to September. Soils are loamy sand with 0.21% organic carbon, 126.3 kg ha-1 N, 19.23 kg/ha P_2O_5 and 150.26 kg/ha K_2O. The experiment comprising four levels of zinc (0, 2.0, 4.0 and 6.0 kg/ha) and five treatments of thiourea application (control, seed soaking with 500 ppm, foliar spray at branching (500 ppm), foliar spray at flowering initiation (500 ppm) and foliar spray at branching and flowering initiation with 500 ppm) thereby making 20 treatment combinations was laid out in randomized block design and replicated thrice. Zinc was applied as per treatment through zinc sulphate (ZnSo4.7H2O) containing 21 per cent zinc. Thiourea treatments were administered as seed soaking and foliar spray. Seed soaking involved dipping the seeds in 500 ppm thiourea solution for 8 hours prior to sowing.

The mungbean RMG-492 was sown at 30 cm row spacing on 13 july 2016. Total number of pods of the five plants selected already for measurement of height and branches were counted and mean value for the number of pods per plant was calculated. At the time of threshing, 10 pods were randomly selected from each of five plants in each plot and their total grains were counted to record the average number of grains per pod. One thousand seeds were counted from the sample drawn randomly from the finally winnowed and cleaned produce of each plot and their weight was recorded as test weight (g). The crop was harvested on 28th September, 2016 to asses the seed, stover and biological yield from net plot area (2.0 m x 1.2 m). The harvested produce of each plot was tied up in bundles, tagged and allowed to sun dry on threshing floor. After drying, the bundles were weighed for biological yield. Threshing and winnowing was done manually. After cleaning, the seed yield per plot was recorded and converted into kg/ha. The straw yield was computed by deducting the seed yield from the biological yield.

Harvest index

Harvest index was computed by using the formula outlined by Singh and Stoskopf (1971) [19].

$$\text{Harvest index} = \frac{\text{Harvest index}}{\text{Biological yield}} \times 100$$

Result and Discussion

Effect of Zinc

Yield attributes and yield

Increasing levels of zinc fertilization up to 4.0 kg/ha significantly increased the number of pods/plant, while the number of grains/pod and test weight increased significantly up to 2.0 kg Zn/ha (Table 1). All their yield attributes registered these maximum values at 6.0 kg Zn/ha. The increase in yield attributes 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 photosynthates towards them. Zinc is also an essential component of enzymes that are responsible for assimilation of N. It also helps in chlorophyll synthesis and plays an important role in N metabolism, thereby resulting into increased uptake of N by the plants. Besides, zinc also enhances the absorption of essential nutrients by increasing CEC of roots. The application of zinc in a soil which was otherwise deficient in its status (Table 3.3), improved overall growth and consequently yield attributes of plant. Similar results were also reported by Sunder *et al.* (2001) [21] and similar Sharma and Jain (2004) [17] in clusterbean and Patel *et al*. (2011) [12], Ram and Katiyar (2013) [13] and Tak *et al*. (2014) [23] in mungbean. Significant increase in grain, straw and biological yields were also recorded in greengram due to increasing levels of zinc fertilization up to 4.0 kg/ha (Table 1). The extent of increase in grain yield was 8.6 and 38.3 per cent over 2.0 kg/ha and control, respectively. The increase in yield with the application of zinc might be due to its important role in regulating the auxin concentration in plants. Zinc deficiency results in a decreased content of auxin. The substantial increase in grain and straw yields with the application of zinc might be also due to better growth and development of plant parts in terms of plant height, number of branches/plant, dry matter accumulation, chlorophyll content, LAI, number and weight of root nodules which might have improved the yield attributes *viz.* pods/plant, grains/pod and test weight and ultimately enhanced the grain and straw yield significantly.

Improvement in straw yield due to application of zinc up to 4.0 kg/ha could be attributed to the higher plant growth and biomass production, possibly as a result of higher uptake of nutrients. The biological yield is a function of grain and straw yields. Thus, significant increase in biological yield is the cumulative effect of improvement in grain and straw yields. Further, higher nutrient uptake and better use of radiant energy led to higher vegetative and reproductive growth, thus enhancing biological yield due to zinc fertilization. Results of the present investigation corroborate with the findings of Saini (2003) [14] in mothbean, Jain (2007) [7] in mothbean, Sammauria (2007) [16] in fenugreek, Singh and Mann (2007) [18] in groundnut.

Effect of thiourea

Yield attributes and yield

Results (Table 1) also indicated that application of thiourea either as foliar spray or as seed soaking significantly increased the yield attributes of greengram like number of pods/plant and number of grains/pod over control. The maximum number of pods and grains/pod were obtained when thiourea was sprayed at both of the branching and flowering initiation stages which was accompanied by branching and flowering stages alone. This brings the role of thiourea, a sulphydryl compound in improving the translocation of photosynthatic for yield formation. Sahu and Solanki (1991) [15] were of the view that probably the photosynthate transport was improved because of improved dry matter partitioning. The partitioning of dry matter in plants depends on its distribution between leaves, stem and pods. In legumes, grain yield is the ultimate aim and therefore, the partitioning of assimilates between grain and vegetative parts is of great importance. These results also reconcile with several workers Meena and Sharma (2005) [10], Bochaliya *et al.* (2011) [4] and Kumawat *et al*. (2014) [9]. Foliar spray of thiourea @ 500 ppm at branching remained at par with thiourea spray at flowering initiation. The increase in yield attributes and yield obtained with another thiourea application was most probably due to increased crop photosynthesis favoured by both improved photosynthetic efficiency and source to sink relationship. Also, the increase in yield due to application of thiourea might be the result of concomitant increase in number of pods/plant, number of grains/pod per plant and growth parameters mainly the dry matter accumulation. These results are in accordance with the findings of Solanki (2002) [20] in clusterbean, Bamaniya (2009) [3] in mungbean and Meena *et al.* (2016) [11] in clusterbean. The highly significant and positive correlation existed between grain yield and yield attributes such as number of pods/plant (r = 0.977), number of grains/pod (r = 0.940), test weight (r = 0.953) and N, P and Zn uptake (r = 0.990, 0.989 and 0.996) also provided an additional support for increased grain yield due to application of thiourea (Table 2). Similar results were also reported Solanki, 2002 [20] and Meena and Sharma, 2005 [10] in clusterbean and pigeonpea.

Table 1: Effect of Zinc and Thiourea on yield attributes and yields

Treatments	Yield attributes			Yields (kg/ha)			Harvest index (%)
	No. of pods/plant	No. of grains/pod	Test weight	Seed	Straw	Biological	
Zinc level (kg/ha)							
Control	27.53	9.45	28.18	853	1485	2338	36.46
2.0	34.33	10.39	30.59	1086	1848	2934	37.03
4.0	38.41	10.85	31.95	1180	2088	3268	36.13
6.0	39.68	11.25	32.55	1020	2157	3353	35.61
SEm±	0.66	0.22	0.61	21	40	64	0.6
CD (P=0.05)	1.90	0.63	1.74	60	113	184	NS
Thiourea application							
Control	30.45	9.04	27.72	893	1580	2473	36.09
Seed soaking with 500 ppm	33.18	10.18	29.77	1020	1824	2844	36.00
Foliar spray at branching (500 ppm)	36.32	10.91	31.72	1125	1974	3099	36.28
Foliar spray at flowering initiation (500 ppm)	35.51	10.74	31.41	1103	1956	3058	36.09
Foliar spray at branching and flowering initiation (500 ppm)	39.48	11.56	33.46	1253	2139	3392	37.06
SEm±	0.74	0.25	0.68	23	44	72	0.7
CD (P=0.05)	2.12	0.71	1.94	67	127	206	NS
CV (%)	7.34	8.18	7.63	7.49	8.10	8.39	6.48

NS= Non- significant

Table 2: Correlation coefficients and linear regression equations showing relationship between grain yield (kg/ha) and independent variables (X)

S. No.	Independent variables (X)	Correlation coefficients (r)	Regression equations (Y = a +byx.X)
1.	Number of pods/plant	0.977**	Y = -26.974 + 31.610 X1
2.	Number of grains/pod	0.940**	Y = -647.017 + 164.613 X2
3.	Test weight (g)	0.9953**	Y = -1087.166 + 70.286 X3

** Significant at 1 % level of significance

References

1. Anonymous, Handbook of Agriculture, ICAR, New Delhi: 2011, 972-973.
2. Anonymous, Crop-wise fourth advance estimates of area, production and yield of various principal crops during 2015-16. Commisionerate of Agriculture, Rajasthan, Jaipur, 2015-16.
3. Bamaniya PK. Effect of thiourea and zinc on productivity of mungbean [*Vigna radiata* (L.) Wilczek]. M.Sc. (Ag.) Thesis, Rajasthan Agricultural University, Bikaner, 2009.
4. Bochaliya GS, Tiwari RC, Ran B, Kantwa SR, Choudhary A. Response of fenugreek (*Trigonella foenum-graecum*) genotypes to planting geometry, agro-chemicals and sulphur levels. Indian Journal of Agronomy. 2011; 56(3):273-279.
5. Gopalan G, Ramasastri BV, Balasubramanian SC. Nutritive value of Indian foods. ICMR, Hyderabad-5000, India, 1995.
6. Halmann M. Synthetic plant growth regulators. Advances in Agronomy, 1980; 43:47-105.
7. Jain S. Effect of sulphur and zinc on growth and yield of mothbean [*Vigna radiata* (Jacq.) Marechal]. M.Sc. (Ag.) Thesis, Rajasthan Agricultural University, Bikaner, 2007.
8. Katyal JC, Sharma. DTPA extractable and total Zn, Cu, Mn and Fe in Indian soils and their association with soil properties. Geoderma, 1991; 49:165-179.
9. Kumawat K, Shivran AC, Kumawat P. Effect of bioregulators and phosphorus on yield, economics, nutrient uptake and quality of mothbean [*Vigna acontifolia* (Jacq.) Marechal]. Annals of Biology. 2014; 30(1):98-101.

10. Meena BS, Sharma DD. Effect of phosphorus sources, solublizers and bioregulators on growth, yield and phosphorus uptake by pigeonpea (*Cajanus cajan*). Indian Journal of Agronomy, 2005; 50(2):143145.
11. Meena H, Meena RS, Rajput BS, Kumar S. Response of bioegulators to morphology and yield of clusterbean [*Cymopsis tetragonoloba* (L.) Taub.] under different sowing environment. Journal of Applied and Natural Science. 2016; 8(2):715-718.
12. Patel MM, Patel IC, Patel RI, Acharya S. Effect of zinc and iron on yield and yield attributes of rainfed cowpea (*Vigna unguiculata* L. Walp). Annals of Arid Zone, 2011; 50(1):17-19.
13. Ram S, Katiyar TPS. Effect of sulphur and zinc on the seed yield and protein content of summer mungbean under arid climate. International Journal of Science and Nature, 2013; 4(3):563-566.
14. Saini RK. Effect of zinc and iron on growth and yield of mothbean [*Vigna aconitifolia* (Jacq.) Marechal] in arid western Rajasthan. M.Sc. (Ag.) Thesis, Rajasthan Agricultural University, Bikaner, 2003;
15. Sahu MP, Solanki NS. Role of sulphydryl compounds in improving dry matter partitioning and grain production of maize (*Zea mays* L.). Journal of Agronomy and Crop Science, 1991; 167:356-359.
16. Sammauria R. Response of fenugreek (*Trigonella foenum-graecum*) to phosphorus and zinc application and their residual effect on succeeding pearlmillet (*Pennisetum glaucum*) under irrigated conditions of north west Rajasthan. Ph.D. Thesis, Rajasthan Agricultural University, Bikaner, 2007.
17. Sharma K, Jain KK. Effect of zinc and thiourea on growth, yield and quality of clusterbean [*Cyamopsis tetragonoloba*]. Annals of Agricultural Research. 2004; 25(1):169-171.
18. Singh YP, Mann JS. Interaction effect of sulphur and zinc in groundnut (*Arachis hypogaea*) and their availability in Tonk district of Rajasthan. Indian Journal of Agronomy 2007; 52(1):70-73.
19. Singh ID, Stoskopf YC. Harvest index in cereals. Agronomy Journal, 1971; 63:224-226.
20. Solanki NS. Effect of thiourea and dimethyl sulphoxide on phosphorus use efficiency, dry matter partitioning and productivity of clusterbean [*Cyamopsis tetragonoloba* (L.) Taub.] Ph. D. Thesis, Maharana Pratap University of Agriculture and Technology, Udaipur, 2002.
21. Sunder S. Effect of phosphorus and zinc on growth, yield and quality of clusterbean [*Cyamopsis tetragonoloba* (L.) Taub.] in north western Rajasthan. M.Sc. (Ag.) Thesis, Rajasthan Agricultural University, Bikaner, 2001.
22. Sunder S, Pareek BL, Sharma SK. Effect of phosphorus and zinc on dry matter, uptake of nutrients and quality of clusterbean. Annals of Agricultural Research, 2003; 24(1):195-196.
23. Tak S, Sharma SK, Reagar ML. Effect of vermicompost and zinc on yield attributes, yield and quality of greengram [*Vigna radiata* (L.) Wilczek] in arid Rajasthan. International Journal of Agricultural Science. 2014; 10(1):138-141.