Original Research Article

Impact of zinc and thiourea application on growth and yield of summer green gram (*Vignaradiata* L.)

ABSTRACT

Aims: To find out the Impact of zinc and thiourea application on growth and yield of summer green gram (*Vigna radiata* L.).
Study design: The experiment was laid out in Randomized Block Design (factorial concepts) with three replications.
Place and Duration of Study:A field experiment was conducted during summer season of 2020 at Agronomy Instructional Farm, SDAU, Dantiwada (Gujarat). The soil of experimental plot was loamy sand in texture.
Methodology: The experiment comprising three levels of zinc (1.5, 3.0 and 4.5 kg ha^{-1}) and five treatments of thiourea application (control (no spray), seed soaking with thiourea @ 500 ppm, foliar spray of thiourea @ 500 ppm at 30 DAS, foliar spray of thiourea @ 500 ppm at 45 DAS and foliar spray of thiourea @ 500 ppm at 30 and 45 DAS).
Results: Almost all the growth and yield attributes as well as yield were significantly influenced due to various treatments. The plant height (47.02 cm and 46.60 cm, respectively), total number of pods $plant^{-1}$(15.92 and 19.82, respectively) and number of seeds pod^{-1}(7.91 and 8.26, respectively) and seed yield and stover yield were also found significantly higher in the application of either 4.5 kg Zn ha^{-1} or foliar sprays of thiourea @ 500 ppm at 30 and 45 DAS.
Conclusion: On the basis of experimental results, it can be concluded that higher yield of green gram crop responds positively to the application of zinc and thiourea with enhancement in the agronomical performance and productivity.

***Keywords:** Green gram; Soil application; Foliar application; Thiourea and Zinc*

1. INTRODUCTION

Pulses are agriculture's lifeblood since they play a distinct role in every system as the primary crop, catch crop, cover crop, green manure, intercrop and mix crop. One of India's principal pulse crops is greengram, often known as moong. Along with fibre and iron, it provides a rich source of protein. Green gram has extremely little cholesterol and is low in sodium and saturated fat. Along with being a very good source of dietary fibre, vitamin C, vitamin K, riboflavin, folate, copper, manganese, and protein, it is also a good source of 1adiate1, niacin, vitamin B_6, pantothenic acid, iron, magnesium, phosphorus and potassium. Additionally, 100 g of dry green gram seeds contain 104.5% copper, 84% iron, 45% manganese, 45% phosphorus, 52% selenium, 15% calcium, and 24% zinc [1].

Such limiting conditions are brought about by the alkaline reaction, low organic matter, high calcium carbonate, low soil moisture and coarse texture of soils. Crops develop slowly and have very low Zn concentrations under these Zn-limiting conditions, especially in edible sections[1].One of the main causes of the prevalent Zn deficits in human populations is low dietary intake of Zn. The yield of green gram (*Vigna radiata* L.) decreases when cultivated in Zn-deficient soils. Zn application to the soil is effective in addressing their shortages, but it may be less effective at boosting its concentration in edible components, which is the main goal in addressing micronutrient deficiency [2].

Thiourea is an essential component of plant physiology, both as a sulphydryl molecule and as an amino compound similar to urea. Thiourea, a fertilizer that belongs to the SH group and has a variety of biological actions in plants, is one of the fertilizers with 36.8 and 42.1% of N and S, respectively [3]. It has been observed that thiourea foliar spray and seed soaking boost plant growth and development as well as dry matter partitioning for higher grain production [4]. Sulphydryl compound thiourea (NH_2-CS-NH_2) is well known for promoting germination and breaking dormancy [5]. Use of thiourea, recognized as plant growth regulator may be helpful in this regard.The exogenous supply of growth regulators also affects essential physiological processes such carbon and nutrient assimilation, partitioning of photosynthates and utilisation efficiency in addition to hormonal regulation, differentiation and morphogenesis[6].Keeping the above things in mind a study was carried out to Impact of zinc and thiourea application on growth and yield of summer green gram in loamy sand soils of Dantiwada (Gujarat).

2. MATERIALS AND METHODS

Geographically, Sardarkrushinagar is situated at 240° 19' North latitude and 72° 19' East longitude with an elevation of 154.52 meter above the mean sea level and situated in the North Gujarat Agro-climatic region. The current study was carried out at the Agronomy Instructional Farm, C. P. College of Agriculture, Sardarkrushinagar, during summer of 2020. The standard week wise meteorological data for the period of this investigation recorded at the Meteorological Observatory at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, SardarkrushinagarDantiwada Agricultural University, Sardarkrushinagar (Banaskantha).Climate of this region is sub-tropical monsoon type and falls under semi-arid region. In general, the monsoon is warm and moderately humid, winter is fairly cold and dry, while summer is largely hot and dry.The experimental soil was loamy sand with 7.5% clay, 8.3% silt and 84.2% sand. The soil exhibited a low available N content (157.8 kg ha^{-1}), a medium available P_2O_5 content (33.8 kg ha^{-1}) and a medium available K_2O content (259.7 kg ha^{-1}) and available Zn (0.38 mg kg^{-1}).

Green gram was sown in field plots on first fortnight of March. With four replications, fifteen treatments were laid up in randomised block design (with factorial concept).The experiment included three levels of zinc (1.5, 3.0 and 4.5 kg ha^{-1}) and five treatments of thiourea application (control (no spray), seed soaking with thiourea @ 500 ppm, foliar spray of thiourea @ 500 ppm at 30 DAS, foliar spray of thiourea @ 500 ppm at 40- 45 DAS and foliar spray of thiourea @ 500 ppm at 30 and 45 DAS). The variety of the crop was *Gujarat Mung 4*. The plant to plant and row to row spacing was maintained at 10× 45 cm.The RDF *i.e*nitrogen (20 $kgha^{-1}$) was applied as Urea, while phosphorous (40 kg ha^{-1}) was applied as DAP. Plant height and number of branches were measured on five randomly selected plants in a plot of each treatment during harvest in order to analyse the crop's growth pattern. According to established protocols, observations on yield parameters such as number of pods $plant^{-1}$, number of seeds pod^{-1}, seed index, seed yield, and stover yield $hectare^{-1}$ were recorded.

The data on different aspects of green gram crop were subjected to statistical analysis by adopting analysis of variance [7] as per the procedure of randomized block design with factorial concept by computer system at the computer centre, Department of Agricultural Statistics, Chimanbhai Patel College of Agriculture, Sardarkrushinagar. The value of calculated 'F' was worked out and compared with the value of table "F" at 5% level of significance. The value of S.Em.±, C.D. at 5% and coefficient of variation (C.V. %) were also calculated.

3. RESULTS AND DISCUSSION:

3.1. Effect of zinc

3.1.1. Growth attributes

The number of branches $plant^{-1}$ is a key morphological feature that is directly associated to yield in green gram. With the application of 4.5 kg Zn ha^{-1} along with the recommended dose of NPK (20-40-00 kg ha^{-1}), the maximum plant height (47.02 cm) and number of branches $plant^{-1}$ (7.25) were measured (Table 1). The positive effects of zinc application on these traits can be attributed to its catalytic or stimulatory effects on the majority of plant physiological and metabolic processes [6]. Similarly,Kuniyaet al.reported that application of 5.0 kg Zn/ha gave significantly higher plant height and number of branches $plant^{-1}$ of clusterbean. [8].

3.1.2. Yield attributes

Plant yield is directly correlated with yield attributing variables such pods $plant^{-1}$, seeds pod^{-1} and seed index. The results showed that the application of 4.5 kg Zn ha^{-1} along with recommended dose of NPK (20-40-00 kg ha^{-1}) resulted in the highest pods $plant^{-1}$ (15.92), seeds pod^{-1} (7.91) and seed index (4.40) (Table 1).Application of Zn encouraged greater root growth and sink size development (number of pods $plant^{-1}$), which ultimately led to increased seed yield [9]. Ram and Katiyar also concluded that application of 10 kg Zn/ha significantly increased number of nodules and pods per plant, seeds per pod, test weight over preceding levels[10].

3.1.3 Yield

With the application of 4.5 kg Zn ha^{-1} together with the recommended dose of NPK (20-40-00 kg ha^{-1}) significantly increased seed yield (873 kg ha^{-1}) and stover yield (1378 kg ha^{-1}) (Table 1).Th,e higher yields with zinc application could be ascribed to accelerated nutrient uptake helped the plant to put optimum growth. As these growth and yield attributes as well as nutrients uptake showed significant increase in seed yield, evidently resulted in higher yields with zinc fertilization [9].Pooja and Sarawadfound that application of 4 kg Zn/ha increased seed yield (2065 kg/ha) and straw yield (1734 kg/ha)[11], which was slightly higher value.

3.2. Effect of thiourea

3.2.1. Growth attributes

In green gram, the number of branches $plant^{-1}$ is a crucial morphological characteristic that is closely associated to yield. With the application of foliar sprays of thiourea @ 500 ppm at 30 and 45 DAS along with the recommended dose of NPK (20-40-00 kg ha^{-1}), the maximum plant height (46.60 cm) and number of branches $plant^{-1}$ (7.75) were recorded (Table 1). This favourable changes in the crop may be attributed to improved growth and development of the crop with thiourea treatment action potentially targeting the meristematic activity of apical tissues with stimulatory effects on cell division which promotes growth in shoot length and cell number for improved leaf area (mainly by higher sulphur and nitrogen nutrition).Thiourea boosted net photosynthetic rates as well as total chlorophyll and starch concentrations in the leaves, resulting in maximum plant height and branches[12].Singh and Singh also reported that application of thiourea @ 500 ppm at pre-flowering and pod initiation stages significantly increased plant height and branches than the control treatments [13]

3.2.2. Yield attributes

Plant yield is directly correlated with yield-attributing variables such pods plant^{-1}, seeds pod^{-1} and seed index. The application of foliar sprays of thiourea @ 500 ppm at 30 and 45 DAS, combined with the recommended dose of NPK (20-40-00 kg ha^{-1}), resulted in the highest pods plant^{-1} (19.82), seeds pod^{-1} (8.26), and seed index (4.48)(Table 1). This could be related to the crop's accelerated nitrogen metabolism and extended moisture retention, particularly during the moisture stress stage, which may have contributed to a higher number of pods plant^{-1} and seeds pod^{-1}at harvest. Sarita et al. also observed that application of thiourea @ 500 ppm at flower initiation recorded significantly higher number of podsplant^{-1}, seedspod^{-1} and test weight over rest of treatments. [14].

3.2.3. Yield

Significantly higher seed yield (868 kg ha^{-1}) and stover yield (1438 kg ha^{-1}) were recorded with application of foliar sprays of thiourea @ 500 ppm at 30 and 45 DAS along with recommended dose of NPK (20-40-00 kg ha^{-1}) (Table 1).The increased photosynthesis and effective transport of photosynthates towards the sink, which ultimately results in more seed yield, may be the cause of the improved yield through thiourea. The increase in yield observed in this study could be a reflection of thiourea's impact on growth and development.The increased number of branches plant^{-1} resulted in more pods and consequently more seeds. Additionally, the rise in photosynthetic activity could have increased photosynthesis, which would have increased the amount of assimilates transferred to the seeds and increased their weight. Deviet al.also observed that application of thiourea @ 500 ppm increased the seed and stover yield of greengram by 58 and 84 per cent, respectively over control [15].

4. CONCLUSION

In conclusion the results of experiment indicated that the application of 4.5 kg Zn ha^{-1}and foliar sprays of thiourea @ 500 ppm at 30 and 45 DAS along with recommended dose of NPK (20-40-00 kg ha^{-1}) were significantly improved the growth and the yield of green gram.

Table 1:Effect of zinc and thiourea on plant height, branches plant^{-1}, pods plant^{-1}, seeds pod^{-1}, seed index, seed yield and stover yield of green gram

	Treatments	Plant height (cm)	Branches plant^{-1}	Pods plant^{-1}	Seeds pod^{-1}	Seed index (g)	Yield (kg ha^{-1})	
							Seed	Stover
[A] Zinc (kg ha^{-1})								
Zn_1	1.5	41.17	6.60	14.84	7.29	4.27	722	1234
Zn_2	3.0	42.63	6.67	15.26	7.59	4.36	816	1306
Zn_3	4.5	47.02	7.25	15.92	7.91	4.40	873	1378
	S.Em.±	0.92	0.15	0.30	0.13	0.05	18	34
	C.D. (*p*≤ 0.05)	2.65	0.44	0.86	0.38	NS	54	100
[B] Thiourea								
TU_0	Control	40.84	5.90	12.52	6.89	4.23	739	1165
TU_1	Seed soaking with thiourea@ 500 ppm	41.70	6.30	13.16	7.22	4.29	786	1263
TU_2	Foliar spray of thiourea @ 500 ppm at 30 DAS	43.48	6.75	14.93	7.66	4.32	798	1305
TU_3	Foliar spray of thiourea @ 500 ppm at 45 DAS	45.40	7.49	16.27	7.97	4.39	827	1359
TU_4	Foliar spray of thiourea @ 500 ppm at 30 and 45 DAS	46.60	7.75	19.82	8.26	4.48	868	1438
	S.Em.±	1.18	0.20	0.39	0.17	0.06	24	44
	C.D. (*p*≤ 0.05)	3.42	0.57	1.11	0.49	NS	69	129
Interaction								
	(Zn × TU)	NS	NS	NS	NS	NS	NS	NS
	C. V. %	8.11	8.51	7.49	6.59	4.10	8.93	10.20

NS: Non-Significant

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