Effect of application of iron and zinc on growth and yield of Cluster bean (*Cyamopsis tetragonoloba* L.)

Abstract:

A field experiment was conducted during *Zaid* 2023 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The soil of the experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), low in organic carbon (0.36 %), available N (171.48 kg/ha), available P (15.2 kg/ha) and available K (232.5 kg/ha). The experiment was laid out in Randomized Block Design with nine treatments each replicated thrice based on one year of experimentation. The application of Iron at 15000 ppm + Zinc 20 kg/ha, recorded significantly higher Plant height (102.80 cm), number of nodules per plant (47.57) Plant dry weight (55.04 g/plant). Significantly maximum pods/plant (44.50), Seeds/pod (14.31) were recorded with the treatment of Iron at 15000 ppm + Zinc 20 kg/ha.

Keywords: Sulphur, Iron, Zinc, cluster Bean.

Introduction:

Cluster bean [*Cyamopsis tetragonoloba* (L.)Taub] popularly known by its vernacular name ‗Guar' is an important legume crop mainly grown under rainfed conditions in arid and semi-arid regions of Rajasthan during the kharif season. It is a very hardy and drought-tolerant crop. Its deep penetrating roots enable the plant to utilize available moisture more efficiently and thus offer better scope for rainfed cropping. The crop also survives even at moderate salinity and alkalinity conditions. There is no other legume crop so hardy and drought tolerant as cluster bean, which is especially suited for the soil and climate of Rajasthan. Among dry land crops, guar occupies an important place in the national economy because of its industrial importance mainly due to the presence of gum in its endosperm (35 to 40%). Cluster beans are grown for different purposes from very ancient times viz., vegetables, green fodder, green manure and the production of seeds. Besides, all these, it provides nutritional concentrate and fodder for cattle and adds to the fertility of the soil by fixing a considerable amount of atmospheric nitrogen. Cluster bean seed is also used as a concentrate for animals and extraction of gum. The seed of cluster bean contains 28 to 33 per cent gum. Guar gum has its use in several industries viz., textiles, paper, petroleum, pharmaceuticals, food processing cosmetics, mining explosives, oil drilling etc. Cluster bean is a leguminous crop and can fix 37-196 kg N/ha/ year.

Zinc deficiency has been reported to be the most widespread micronutritional disorder of food crops in India. The magnitude of zinc deficiency varied widely among soil types and within the

various states. Coarse textured, calcareous, alkaline or sodic soils having sandy texture, high pH and low organic matter are generally low in available zinc. Calcareous soils of Bihar, vertisols and Inceptisols of Andhra Pradesh, Tamil Nadu and Madhya Pradesh and Aridisols of Haryana showed extensive deficiency of zinc resulting in low crop yields. Zinc is a crucial component of the package of practices recommended for sodic soil reclamation. Deficiencies of Fe, Mn and Cu are much less extensive than that of zinc. Though the marked response of crops to Zn application has been noticed, Zn deficiency is a major nutritional constraint for successful crop production in Tamil Nadu. The available Zn content of Indian soils varied from traces to 22 mg kg-1 and 47 per cent of Indian soils were found to be deficient in Zn. (Mishra *et al*. 2009).

Iron is a structural component of porphyrin molecules, cytochromes, heme, non-heme, ferrichrome and leghaemoglobin. These substances are involved in oxidation-reduction reactions in respiration and photosynthesis. It is also an important part of the enzyme nitrogenase. Which is essential for nitrogen-fixation by nitrogen-fixing microorganisms. Iron in chloroplasts reflects the presence of cytochromes for performing various photosynthetic reduction processes and ferredoxin as an electron acceptor. The ferredoxins are Fe-S proteins and are the first stable redox compound of the photosynthetic electron transfer. Chemical fertilizers, no doubt, are important source which can meet the nutrient requirement but their imbalance and continuous use has led to environmental pollution and deterioration of soil health. Furthermore, the availability of fertilizer at economic prices is another problem for the farmers. In the last few years, the price of cluster bean remained quite high and farmers realized high profit by producing cluster bean seed because the guar gum demand has increased substantially abroad. Despite the maximum area of cluster beans in Rajasthan, the average productivity is only 0.48 t/ha compared to 1.27 and 0.84 t/ha in Haryana and Gujarat (Anonymous 2016-17).

Material and Methods:

The experiment conducted to know the Effect of foliar application of iron and zinc on the growth and yield of Cluster bean (Cyamopsis tetragonoloba L.) was carried out at Crop Research Farm of Sam Higginbottom University, Prayagraj, Uttar Pradesh in 2022. The experiment was laid out in an RBD (Randomized Block Design) consisting of Ten treatments including Control with 3 replications, with the treatment combinations The treatments which are T_1: Iron at 5000 ppm + Zinc 10 kg/ha, T_2: Iron at 5000 ppm + Zinc 20 kg/ha, T_3: Iron at 5000 ppm + Zinc 30 kg/ha, T_4: Iron at 10000 ppm + Zinc 10 kg/ha, T_5: Iron at 10000 ppm + Zinc 20 kg/ha, T_6: Iron at 10000 ppm + Zinc 30 kg/ha, T_7: Iron at 15000 ppm + Zinc 10 kg/ha, T_8: Iron at 15000 ppm + Zinc 20 kg/ha, T_9: Iron at 15000 ppm + Zinc 30 kg/ha, T_{10}: Control (RDF) 20:40:20 kg NPK/ha are used.

Results

Plant height: At 80 DAS, there was a significant difference among the treatments. However, highest plant height (102.80 cm) was recorded with the application of Iron at 15000 ppm + Zinc 20 kg/ha, whereas minimum plant height (94.70 cm) was recorded with the treatment Control (RDF) 20:40:20 kg NPK/ha and Iron at 15000 ppm + Zinc 10 kg/ha (101.70 cm), Iron at 15000 ppm + Zinc 30 kg/ha (102.50 cm) which were statistically at par with T8.

Dry weight: At 80 DAS, there was a significant difference among the treatments. However, highest plant dry weight (55.04 g) was recorded with the application of Iron at 15000 ppm + Zinc 20 kg/ha, whereas minimum plant dry weight (52.47 g) was recorded with the treatment Control (RDF) 20:40:20 kg NPK/ha and Iron at 15000 ppm + Zinc 10 kg/ha (54.14 g), Iron at 15000 ppm + Zinc 30 kg/ha (54.00 g) which was statistically at par with T8.

Number of Pods/plants: Significantly Maximum Number of Pods/plant (44.50) was recorded with the treatment of the application of Iron at 15000 ppm + Zinc 20 kg/ha over all the treatments, and the minimum was recorded in Control (RDF) 20:40:20 kg NPK/ha (35.12). However, the treatment Iron at 15000 ppm + Zinc 10 kg/ha (43.81), was found to be statistically at par with T8.

Number of Seeds/Pod: The perusal of the data of some seeds/pods recorded at harvest, is presented in Table 1. The data reveals that there was a significant effect among different treatments on the number of seeds/pods. The maximum number of seeds per pod (14.31) was recorded with the treatment of the application of Iron at 15000 ppm + Zinc 20 kg/ha over all the treatments. However, for the treatments Iron at 15000 ppm + Zinc 10 kg/ha (14.00), which was found to be statistically at par with T8, the minimum was recorded in Control (RDF) 20:40:20 kg NPK/ha (10.00).

Seed index (g): Seed index (34.36 g) was recorded higher with the treatment application of Iron at 15000 ppm + Zinc 20 kg/ha over all the treatments, and the minimum was recorded in Control (RDF) 20:40:20 kg NPK/ha (32.45 g) and there was no significant change in between the treatments.

Discussions:

The application of mineral nutrients significantly increased the available content of Zn and Fe nutrients in the soil at the harvest of the crop. The increase in available content of Zn and Fe may also be due to the direct addition of these nutrients in the experimental soil. Synergism between nitrogen and iron, phosphorus and molybdenum and Mo and Zn may also be responsible for an increase in the available content of these nutrients. Similar results were also reported by Mishra *et al*. (2011) and Sharma and Jain (2012).

The application of micronutrient fertilizers alone might supply one nutrient only but conjoint use of micronutrient fertilizers would provide two nutrients in proper ratio to plant and soil and also reduces the possibilities of multiple micronutrient deficiencies in particular. The responses of some of the micronutrients viz, Fe and Zn have also been found promising in increasing the productivity of the soils (Masood Ali and Mishra, 2000). The significant response of pulses to micronutrients has also been reported by several workers (Teotia *et al*., 2000; Chavan *et al*. (2012) and Gupta and Ganagwar (2012). The stimulating effect of Zn and Fe on total and effective nodules might be due to the increased availability of these nutrients to the crop and the microorganisms responsible for enhanced nodulation. The balanced supply of Zn and Fe might have improved the overall development of the crop plant and the total and effective nodules of the crop. Similar findings were also reported by Gupta and Gangwar (2012) and Singh *et al*. (2008).

Conclusion:

It is concluded that the application of Iron at 15000 ppm + Zinc 20 kg/ha recorded significantly higher growth and yield attributes, as compared to other treatments. Since, the finding based on the research done in one season.

Table 1: Response of iron and zinc on growth and yield attributes of Cluster bean.

Treatments	Plant height	Dry weight	Pods/plant (No)	Seeds/pod (No)	Seed index (g)
T1	95.50	38.78	37.00	10.30	32.50
T2	95.70	40.45	37.24	10.50	32.55
T3	96.70	37.54	36.57	10.00	32.45
T4	97.40	40.68	38.64	12.00	32.91
T5	100.00	42.09	39.40	12.47	33.45
T6	100.20	40.12	38.32	11.00	32.60
T7	101.70	47.39	43.81	14.00	33.79
T8	102.80	47.57	44.50	14.31	34.36
T9	102.50	44.32	41.20	13.00	33.65
T10	94.70	36.81	35.12	10.00	32.45
Sem(±)	0.71	0.62	0.53	0.24	0.50
CD (p=0.05)	2.11	1.86	1.59	0.72	-

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