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Effect of sulphur and molybdenum on the growth and yield of cowpea

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Abstract
A field experiment titled "Effect of Sulphur and Molybdenum on the growth and yield of cowpea" was conducted during *kharif* 2023 at Crop Research Farm. Department of Agronomy, Naini Agriculture Institute SHUATS, Prayagraj Uttar Pradesh. The experiment was laid out in Randomized Block Design with ten treatments which are replicated thrice. The treatments combination are T1: Sulphur 15 kg/ha + Molybdenum 1%, T2: Sulphur 15 kg/ha + Molybdenum 1.5%, T3: Sulphur 15 kg/ha + Molybdenum 2%S, T4: Sulphur 20 kg/ha + Molybdenum 1%, T5: Sulphur 20 kg/ha + Molybdenum 1.5%, T6: Sulphur 20 kg/ha + Molybdenum 2%, T7: Sulphur 25 kg/ha + Molybdenum 1%, T8: Sulphur 25 kg/ha + Molybdenum 1.5%, T9: Sulphur 25 kg/ha + Molybdenum 2%, T10: Control – 25:50:25 (N:P:K) Kg/ha are used. Results obtained that combined The application of Sulphur 25 kg/ha + Molybdenum 1.5% recorded significantly maximum Plant height (52.6 cm), Plant dry weight (33.14 g/plant), Number of nodules per plant (19.8), Significantly maximum number of pods per plant (19.7), number of seeds per pod (8.8), Seed yield (1.60 t/ha), stover yield (3.68 t/ha).

Keywords: Cowpea, sulphur, molybdenum, growth parameters, yield attributes and economics

Introduction

Cowpea [*Vigna unguiculata* (L.) Walp.], popularly known as chowli, is one of the most important legume plants and plays an important role in Indian nutrition because it contains about 23.1% protein; This is more than twice the protein of Indian cereals. The cowpea area in Gujarat is 8.29 million hectares with annual production of 5.22 million tonnes and productivity of 576 kg/ha (DOA, 2011) [3]. It is grown in Banas kantha, Sabarkantha, Mehsana, Patan, Ahmadabad and Kheda districts of Gujarat. Additionally, the value of cowpea as a good food, green manure, croptolerant cover crop, and fertility restorer is well known. Despite the importance of this crop, commercial production is very low in India and Gujarat because this crop is rarely fertilized and hence productivity is low. Cowpea is a legume plant that fixes nitrogen in the air and increases soil fertility. The importance of phosphorus application to cowpeas has been known for a long time (Singh *et al*., 2006) [10]. It increases nodulation, symbiotic nitrogen fixation, photosynthesis, early flowering, increases the number of flowers. Phosphorus deficiency is often one of the most important problems for weak crops in all types of soil, because in addition to playing an important role in root growth, phosphorus is also necessary for the growth of rhizobia bacteria, which are responsible for nitrogen fixation and enhance legumes as a healing agent. conclusion. Land transfer efficiency and function. In addition to essential nutrients, secondary nutrients (especially sulfur) should also be obtained from beans. It also promotes nodulation of beans (Tandon, 1991) [11]. Legumes are known to be sensitive to molybdenum deficiency. Molybdenum is involved in many enzymatic processes during the growth of plants, especially legumes. Mo is a component of nitrogenase and is also required by rhizobia during hardening. Therefore, thanks to this study, molybdenum has a positive effect on growth, yield, nitrogen content of leaves and roots and the formation of root nodules in legume plants. In other aspects of nutrition, molybdenum enzymes are involved in nitrogen metabolism and improve ascorbic acid, soluble sugar and chlorophyll content. Therefore, its deficiency will appear as a decrease in plant growth, stunting of pod and/or grain development, and exposure of plants to insect damage.

Although there is a large literature describing the beneficial effects of lime, molybdenum, and rhizobia inoculations on legume growth in other parts of the world, sitespecific conditions may produce different benefits. (Caesar *et al*., 2005) [8].

Materials and Methods

The experiments on the effect of Sulphur and Molybdenum on the Growth and Yield of Cowpea were conducted at *Kharif* season of 2023 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj which is located at above the mean sea level. This region is located approximately 5 kilometers from Prayagraj city on the right bank of the Yamuna River beside Prayagraj Rewa Road. A composite soil sample was taken between 0 and 30 cm down. It was crushed, let to air dry, and its chemical and physical qualities examined. The soil reaction of the sandy clay loam was 7.2, the organic matter content was 0.69 (0.72%), the available nitrogen was 181.7 kg/ha, the phosphorus was 32.74 kg/ha, the potassium was 120.0 kg/ha, the sulfur content was 7.2 mg/kg, the zinc was 0.81 mg/kg, and the available Boron was 0.66 mg/kg. Cow pea variety YLB Sabarmati were selected for sowing. Seeds were sown in line manually on 2023. Seeds were covered with the soil immediately after sowing. The spacing adopted was plant to plant 10 cm and row to row 30 cm according to the treatment details and the seeds were drilled at 5 cm depth. All the treatments were applied by balancing to the initial soil test values and crop requirements to justify the cropresponse to the supplied nutrients in both years.

Results and Discussion

Plant height: At 75 DAS there was significant difference among the treatments. However, highest plant height (52.6 cm) was recorded with the application of Sulphur 25 kg/ha + Molybdenum 1.5%, Sulphur 25 kg/ha + Molybdenum 1% (49.8 cm) was statistically at par with Treatment (8) Sulphur 25 kg/ha + Molybdenum 1.5% and minimum was reported in Control (RDF) 25:50:25 NPK kg/ha (43.8 cm).

Plant dry weight: there was significant difference among the treatments. However, highest plant dry weight (33.14 g) was recorded with the application of Sulphur 25 kg/ha + Molybdenum 1.5%, Sulphur 25 kg/ha + Molybdenum 1% (31.69 g) was statistically at par with Treatment combination Sulphur 25 kg/ha + Molybdenum 1.5% and minimum was reported in Control (RDF) 25:50:25 NPK kg/ha (25.51 g).

Number of nodules per plant: At 75 DAS there was no significant difference among the treatments. However, highest number of nodules (9.0) was recorded with the application of Sulphur 25 kg/ha + Molybdenum 1.5%, and minimum was reported in control (6.1).

Number of pods per plant

There was significant difference among the treatments, however, higher number of pods per plant (19.7) was recorded with the application of Sulphur 25 kg/ha + Molybdenum 1.5%, Sulphur 25 kg/ha + Molybdenum 1% (19.3) was statistically at par with Treatment (8) Sulphur 25 kg/ha + Molybdenum 1.5% and minimum was reported in Control (RDF) 25:50:25 NPK kg/ha (13.5).

Number of seeds per pod

There was significant difference among the treatments, however, higher number of pods per pod (8.8) was recorded with the application of Sulphur 25 kg/ha + Molybdenum 1.5%, Sulphur 25 kg/ha + Molybdenum 1% (8.2) was statistically at par with Treatment (8) Sulphur 25 kg/ha + Molybdenum 1.5% and minimum was reported in Control (RDF) 25:50:25 NPK kg/ha (5.7).

Seed yield (t/ha)

Higher seed yield (1.60 t/ha) was recorded with the application of Sulphur 25 kg/ha + Molybdenum 1.5%, Sulphur 25 kg/ha + Molybdenum 1% (1.59 t/ha) was statistically at par with Treatment (8) Sulphur 25 kg/ha + Molybdenum 1.5% and minimum was reported in Control (RDF) 25:50:25 NPK kg/ha (1.40 t/ha).

Stover yield (kg/ha)

Higher stover yield (3.68 t/ha) was recorded with the application of Sulphur 25 kg/ha + Molybdenum 1.5%, Sulphur 25 kg/ha + Molybdenum 2% (3.59 t/ha) was statistically at par with Treatment (8) Sulphur 25 kg/ha + Molybdenum 1.5% and minimum was reported in Control (RDF) 25:50:25 NPK kg/ha (3.20 t/ha).

Discussion

Chandra and Kothari (2002) [2] reported that the soil application of 1.0 1.0kg Mo/ha and seed treatment with 3.5 g sodium molybdate kg seed increased the grain yield by 13.13% and 16.76% over the yields (24.4 and 24.5 q ha-1, respectively) at lower doses, while it was on par with yields at higher doses of Mo. Halmagean *et al*. (2003) [7] investigated the effects of molybdenum (Mo) as sodium molybdate at 210 kg/ha, applied by pulverization and dusting during the seed stage, 15 cm seedling height stage, flowering, bean (pod) formation, and seed formation of bean [Phaseolus vulgaris]. Biotrofin at 10 l/ha was supplied to the rhizosphere of the rhizosphere of the plants. The length and width of fresh and dry roots, as well as the root nodule weight, were maximum with Mo application during the 15 cm height and pod formation stages. Leaf area was maximum when Mo was applied by pulverization at the 15 cm height stage. Mo treatment during the flowering stage negatively affected the production parameters. Nautiyal and Chatterjee (2004) [12] observed that the leguminous plants were very sensitive to Mo deficiency, but excess Mo might impair growth, decrease biomass and seed yield, and deteriorate the quality of production. Lalitlanmawia *et al*. (2005) [9] reported that phosphorus and molybdenum applications increased the growth of the plants at 60 and 90 DAS, which increased the yield of the soybean crop. They also found a significantly increased number of pods with a plant maximum and a number of pods with 1.0 kg molybdenum/ha. Adkine *et al*. (2011) [1] reported the maximum and significant increase in number of branches, number of leaves, dry matter accumulation, leaf area,number of pods, weight of pods per plant, and test weight of soybean observed with RDF + boron @ 1 kg/ha + molybdenum @
0.5 kg/ha soil application at the time of sowing. Gupta and Gangwar (2012) [6] stated that the application of all micronutrients as well as inoculation significantly increased the nodule and total plant dry weight at 45 days of sowing. Grain yield was significantly increased by the application of molybdenum through ammonium molybdate at 1 kg/ha, which was 42.9% higher than the recommended dose. Gad and Kandil Hala (2013) [5] carried out two field experiments to evaluate the effect of different levels of molybdenum on nodule efficiency, growth, yield quantity, and quality of cowpea plants.

Molybdenum enhanced cowpea root nodule efficiency, growth, mineral composition, yield quantity, and quality compared with control plants.

Table 1: Effect of Sulphur and molybdenum on growth and yield attributes of cowpea.

S. No	Treatments	Plant height	Plant dry weight	Number of nodules per plant	Number of pods per plant (no.)	Number of seeds per pod (no.)	Seed yield (t/ha)	Stover yield (t/ha)
1.	Sulphur 15 kg/ha + Molybdenum 1%	44.8	26.34	6.0	15.2	5.9	1.42	3.34
2.	Sulphur 15 kg/ha + Molybdenum 1.5%	46.8	27.66	6.2	15.4	5.8	1.43	3.36
3.	Sulphur 15 kg/ha + Molybdenum 2%	46.4	27.95	6.6	16.0	6.9	1.44	3.39
4.	Sulphur 20 kg/ha + Molybdenum 1%	47.6	28.62	7.3	16.7	6.6	1.45	3.38
5.	Sulphur 20 kg/ha + Molybdenum 1.5%	47.7	30.99	7.0	17.2	6.9	1.46	3.35
6.	Sulphur 20 kg/ha + Molybdenum 2%	47.9	30.21	7.2	17.3	7.1	1.50	3.40
7.	Sulphur 25 kg/ha + Molybdenum 1%	49.8	31.69	8.0	19.3	8.2	1.59	3.48
8.	Sulphur 25 kg/ha + Molybdenum 1.5%	52.6	33.14	9.0	19.7	8.8	1.60	3.68
9.	Sulphur 25 kg/ha + Molybdenum 2%	49.4	31.26	7.6	18.2	7.5	1.54	3.59
10.	Control(RDF): 25:50:25 NPK kg/ha	43.8	25.51	6.1	13.5	5.7	1.40	3.20
	SE m (±)	0.77	0.89	0.61	0.56	0.43	0.04	0.10
	CD (p=0.05)	2.28	2.66	-	1.68	1.28	0.13	-

Conclusion
The study demonstrated that the application of Sulphur 25 kg/ha + Molybdenum 1.5% significantly enhanced various growth parameters and yield components of soybean compared to other treatments, including plant height, dry weight, number of pods per plant, seeds per pod, seed yield, and stover yield. These findings corroborate previous research indicating the positive impact of molybdenum on leguminous crops, particularly in improving nodulation and overall productivity. However, further research could explore optimal application rates and timings to maximize these benefits without adverse effects, ensuring sustainable agricultural practices for soybean cultivation.

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