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Improvement in Yield Variation in Lentil (*Lens culinaris* L.) Genotypes by Micronutrient Management under Red & Lateritic Soil in Bankura District of West Bengal

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Abstract—*Imbalance in nutrient management is one of the foremost abiotic constraints that limits the productivity in Lentil (Lens culinaris L.). Micronutrient management along with macronutrient is essential for proper growth and higher grain yield of lentil. Genotypes of lentil shows variation in response to their growth under differential micronutrient treatments. Therefore, an investigation was carried out during rabi of 2015-16 and 2016-17 on an inherently poor red and lateritic soil at the extended campus of Bankura, Chhatna, B.C.K.V. to study the effect of three nutrient levels involving Boron (0.5%), Zinc (0.04%) and Molybdenum (0.2%) on the growth and yield attributing parameters of three lentil genotypes (Moitri, Subrata&Asha). These nutrients applied as foliar during 45 and 65 DAS as foliar spray may lead a quick response and increase the nutrient uptake by 8-9 folds higher as compared when applied to soil. Moreover, foliar feeding can enhance yield from 12% to 25% as compared to conventional soil fertilization. B, Zn and Mo were sprayed as foliar by taking their individual treatment concentration as well as combined treatment of them like B+Zn; B+Mo and B+Zn+Mo. From the overall observation, it has been found that combined treatment of all the nutrient play better result regarding all the yield attributing characters than their single treatment. Genotype Moitri recorded the highest grain yield as well as other parameters followed by Subrata and Asha. Finally, conclusion could be drawn that micronutrient alone or in combined mixture can able to improve the growth and yield parameters in lentil.*

Keywords: *Zinc, Boron, Molybdenum,Lentil, Foliar application, Yield attributing characters.*

1. INTRODUCTION

Lentil (*Lens culinaris* L.) is one of the predominant winter pulse crops in India, that is in generally cultivated in poorly fertile and marginal soil almost entirely under rainfed condition with improper management practices. In India, lentil is extensively cultivated (1.4 m ha) in northern, east-central and eastern parts of the country, being the largest lentil-growing country in the world[5].The contribution of India to global lentil area and production is 39.52% and 42.42%, respectively[5].Among the pulses, lentil is of special interest with 23.7% content of grain protein. In addition to protein, its seed is a rich source of minerals and vitamins as human food, while the straw serves as high-value animal feed [11]. Not only that, its cultivation enriches soil nutrient status by adding nitrogen, carbon and organic matter, which promotes sustainable crop production system [8].

Regarding the major constraints that affects the productivity of lentil, lack of proper nutrient management is one of the most key factors. Due to over mining and continuous application of macronutrients for intensive cropping causes unremitting depletion of micronutrients and therefore optimum amounts of nutrients are required for obtaining high grain yield of lentil. The extent and magnitude of nutrient deficiency has aggravated in the recent past due to intensive agriculture and indiscriminate use of plant nutrients [2]. The high intensity cropping through improved production technology and use of high analysis fertilizers has rendered the soils prone to deficiencies of single or multiple micronutrients. Lentil crops respond well to application of micronutrients like Zn, B and Mo. Each micronutrient has an essential role in growth, grain yield and quality (protein content) of pulse crop [14]. Boron play an important role in cell division; in pod and seed formation. Reproductive growth such as flowering, seed and fruit is more sensitive to B deficiency than vegetative growth [9]. In general zinc deficient plant show signs of low levels of auxins such as IAA. It is required for synthesis of IAA [6] and [7] . After flowering, high concentration of zinc in plant will enhance cell differentiation. Zinc plays a greater role during reproductive phase especially during fertilization. Zn play an important role in auxin metabolism, nitrogen metabolism, activation of enzymes like dehydrogenase, carbonic anhydrase, proteinase, peptidase and cytochrome c synthetase etc, stabilize the ribosomal functions and protection against oxidative stress [15] & [10]. Plants emerged from seeds with

low concentrations of Zn could be highly sensitive to biotic and abiotic stresses [10]. Zn enriched seeds can perform better with respect to seed germination, seedling vigour, growth and overall yield advantage [4]. Mo is an important constituent of nitrogenase enzyme that helps in nitrogen fixation and assimilation by the rhizobium in the soil rhizosphere of lentil crops. It can enhance the translocation of photo assimilates and increased enzymatic activities.

Foliar fertilization is a widely used practice to correct nutritional deficiencies in plants caused by improper supply of nutrients to roots. Foliar feeding is an effective method for correcting soil deficiencies and overcoming the soil's inability to transfer nutrients to the plant under low moisture conditions. When fertilizers are foliar applied, more that 90% of the fertilizer is utilized by the plant. When a similar amount is applied to the soil, only 10 percent of it is utilized. The present study was therefore, undertaken (i) to evaluate the response of B, Zn and Mo on the growth and yield contributing characters of lentil; (ii) to search out the standard doses of these micronutrients for maximization of lentil yield and (iii) to find out the location specific and well responsive to micronutrients genotypes of lentil under red and lateritic region soil.

2. MATERIALS AND METHODS:

A field experiment was conducted in the field of Extended Campus of Bidhan Chandra Krishi Viswavidyalaya, Chhatna, Bankura, West Bengal during two successive winter seasons of 2015-16 and 2016-17 to study the effect of foliar treatment of micronutrients (B, Zn & Mo) on growth and yield contributing characters in lentil genotypes (Moitri, Subrata and Asha) that are recommended for dryland areas.The experiment was laid out in RBD design with three replications. The treatments comprised of T1: Foliar application of Boron (0.5%); T2: Foliar application of Zinc (0.04%); T3: Foliar application of Molybdenum (0.2%); T4: Foliar application of Boron (0.5%) combine with Zinc (0.04%); T5: Foliar application of Boron (0.5%) combine with Molybdenum (0.2%); T6: Boron (0.5%) combine with both the Zinc (0.04%) & Molybdenum (0.2%).The sources of B, Zn and Mo are Disodium Octaborate Tetrahydrate (Solu-B) 20%, Zinc Sulphate 33% and Ammonium molybdate respectively. The spraying was done in twice at 45 and 65 days after sowing.

3. RESULTS AND DISCUSSION:

The experimental consequences showed a significant discrepancy among the three high yielding recommended varieties of lentil treated with different levels of nutrient concentrations considering the field observation of all the growth and yield contributing characters in two successive winter seasons. Plant height and number of pods per plant increased with the different nutrient treatments either individual or in combination of two nutrients whereas best enhancement was noticed when treated with three nutrients in combination (Table-1). It was also observed that among the three varieties, Moitri results too much better than Asha and may at par with Subrata regarding both the two characters mentioned above.Other important parameter i.e number of seeds/pod while treated by different nutrients were not influenced significantly as like as plant height and pods/plant in all the three varieties, however Moitri do some extent better than Subrata and Asha (Table-1).

Seed yield enhances 26.53% in Moitri varieties than control when treated with combined treatment of three nutrients whereas seed yielded 21.50% and 18.60% in Subrata and Asha respectively (Table-2). All the treatment plays good beneficial effect than control but in combination of two nutrients do much better than their single treatment, however B+Zn got some better than B+Mo in case all the genotypes. Above all the combination of three always do better than all treatments.[13] found that foliar application with micronutrients either separately or in mixture significantly increased the seed yield of lentil. [16] reported that application of B fertilizer to sandy soil increased the seed yield by 46% compared to control. The combined application of B with Mo or Zn resulted in higher seed yield than their single applications. Based on the findings of test weight that was significantly influenced by nutrients. Maximum (24.5g) and minimum (19.22g) test weight was recorded with T6 and control in Moitri variety whereas in Subrata recorded 24g and 18g test weight in T6 and control. Asha produced 16g and 22.3g test weight in control and T6. Harvest Index also enhances with the interaction of three essential micronutrients.

Results represents that maximum HI (36.7%) recorded in Moitri and 35.4% and 33.2% observed in Subrata and Asha respectively when treated with all nutrients in combination Table-2). [2] reported that balanced application of NPK with B, Zn and Mo significantly increased the yield of lentil over control. The results obtained in this experiment agrees with the findings of [12] and [3]. The combined foliar application of B, Zn and Mo showed positive impact on lentil yield attributing characters viz. plant height, pods/plant, seeds/plant, test weight and ultimately on harvest index % than the single application of nutrients.[1] reported the similar trend with foliar spray of micronutrients in both single or combine treatments.

Table 1: Mean comparison effect of nutrients (single or combined) on plant height (cm), pods per plant and seeds per pod in different lentil genotypes viz. Moitri, Subrata and Asha.

Treatments	Moitri			Subrata			Asha		
	Plant height (cm)	Pods/ plant	Seeds/ pod	Plant height (cm)	Pods/ plant	Seeds/ pod	Plant height (cm)	Pods/ plant	Seeds/ pod
Control	25.9	28	1.22	25.6	26	1.12	23.5	23	1.0
T1	29.6	35	1.48	27.8	31	1.36	25.6	28	1.30
T2	28.7	33	1.4	27.6	28	1.32	25.1	26	1.26
T3	27.6	31	1.37	26.0	28	1.28	24.8	24	1.25
T4	32.5	40	1.59	31.7	37	1.56	28.9	34	1.49
T5	32.0	38	1.58	30	35	1.52	28	31	1.5
T6	38.7	44	1.67	37.3	40	1.61	35.5	35	1.58
CD at 1%	2.453	2.434	6.965	2.462	2.449	31.821	2.473	2.462	31.821
CD at 5%	1.696	1.688	2.92	1.699	1.694	6.314	1.703	1.699	6.314

T1: Boron (0.5%); T2: Zinc (0.04%); T3: Molybdenum (0.2%); T4: Boron (0.5%) + Zinc (0.04%); T5: Boron (0.5%) + Molybdenum (0.2%); T6: Boron (0.5%) + Zinc (0.04%) + Molybdenum (0.2%).

Table 2: Mean comparison effect of nutrients (single or combined) on seed yield (q/ha), test weight (g) and harvest index (%) in different lentil genotypes viz. Moitri, Subrata and Asha.

Treatments	Moitri			Subrata			Asha		
	Seed yield (q/ha)	Test weight (g)	Harvest Index (%)	Seed yield (q/ha)	Test weight (g)	Harvest Index (%)	Seed yield (q/ha)	Test weight (g)	Harvest Index (%)
Control	9.8	19.22	31.1	9.3	18.0	30.5	8.6	16	28.5
T1	10.5	21.1	33.2	10.1	19.3	31.7	9.0	17.7	31.0
T2	10.2	20.9	33.0	10	19.0	31.2	8.8	17.4	30.6
T3	10.0	20.4	32.4	9.6	18.8	31.0	8.6	17.0	29.6
T4	11.5	22.1	34.6	11.0	21.7	33.5	9.8	21.2	32.6
T5	11.1	21.6	34.0	10.6	21.5	33.0	9.4	20.8	32.0
T6	12.4	24.5	36.7	11.3	24.0	35.4	10.2	22.3	33.2
CD at 1%	2.821	2.518	2.441	2.764	2.528	2.449	2.821	2.539	2.473
CD at 5%	1.833	1.721	1.691	1.812	1.725	1.694	1.833	1.729	1.703

T1: Boron (0.5%); T2: Zinc (0.04%); T3: Molybdenum (0.2%); T4: Boron (0.5%) + Zinc (0.04%); T5: Boron (0.5%) + Molybdenum (0.2%); T6: Boron (0.5%) + Zinc (0.04%) + Molybdenum (0.2%).

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