Original Research Article

Productivity of lentil as affected by micronutrient application at Old Alluvial Zone of West Bengal, India

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ABSTRACT

Field trial was conducted to optimize the micronutrient application in lentil crop (Variety-WBL-77) at Regional Research Station (Old Alluvial Zone), Uttar BangaKrishi Viswavidyalaya, Majhian during 2019-20 and 2020-21. Foliar application of Fe, Zn and B (at 50 and 100 ppm each) were applied twice, first at pre anthesis stage and second at pod development stage. Parameters such as plant height (cm), dry matter (g/m^2), number of nodules per plant and number of pods per plant were observed highest with T_8(RDF+50 ppm Zn+Fe+B foliar spray) treatment whereas the T_1 (RDF) showed the lowest value for each parameter. T_3 (RDF+100 ppm Zn foliar spray) resulted with maximum 1000 seed weight (g). T_8 (RDF+50 ppm Zn+Fe+B foliar spray) was also recorded with the highest seed yield (kg/ha), stover yield (kg/ha). Both T_7 (RDF+100 ppm B foliar spray) and T_8 (RDF+50 ppm Zn+Fe+B foliar spray) treatments were resulted with the same value of harvest index followed by the rest of the treatments. Therefore, the treatment T8 (RDF+50 ppm Zn+Fe+B foliar spray) proved best among the treatments selected and can be recommended for lentil (Variety-WBL-77).

Keywords: lentil, micronutrient, foliar spray, growth parameters, yield

1. INTRODUCTION

Lentil (*Lens culinaris*) is one of the most important consumable edible legumes of Indian subcontinent. Loaded with high protein along with carbohydrate and micronutrients, lentil contributes a huge portion to the pulse production of the country. Among the *Rabi* season crops of the country, lentil is the most important one from the nutrition and soil health enrichment point of view. Mostly grown after the aman rice, lentil in West Bengal as well as Indo Gangetic plains, may substitute the practice of growing long duration exhaustive winter crop in large extent. As grown in rice fallows, generally with residual moisture of soil, lentil requires very less amount of irrigation water [1]. This way it can also fulfil the demand of the hour to raise crop with less water. But the late harvesting of the *Kharif* rice mostly cause delay in the sowing of the lentil in Old Alluvial zone of West Bengal also just like the other part of IGP. This delay sowing compels the crop to be exposed in harsh and severe cold of North India hampering its growth and development for a certain duration. Therefore the reproductive phase of the crop get less time to complete and thus yield is reduced.

In Indo Gangetic Plains, rice-wheat and rice-lentil growing zones has a widespread and common problem of micronutrient deficiency. It was reported that in soybean application of micronutrients in leaves were better than applying them in soil [2]. Another report stated that in wheat, foliar spraying of micronutrient at particular growth stage resulted with better performance of crop [3]. Also the soil of Old Alluvial Zone is normally deficient in micronutrients. Among the micronutrients, zinc has role in formation of auxin, carbonic anhydrate and dehydrogenate enzyme activation and stabilization of ribosomal tractions [4,5]. Also zinc plays important role in chlorophyll formation, protein synthesis and carbohydrate metabolism [6]. In reproductive phase, also zinc has many roles to play, especially during fertilization making the seed enriched with at specific physiological growth stage is undoubtedly of great importance, especially in case of micronutrient deficient soils. Also pollen grain usually has a higher content of protein. At this stage, the zinc supplied through foliar spray helps in seed development [7,8,9]. Another report concluded that micronutrients had direct effect on physiological activities like photosynthesis; respiration etc, therefore absence of any one of them during specific plant growth period may disturb the plant growth by hampering metabolic processes [10]. It was reported that Zn was responsible to displace Fe from chelate complexes and forming corresponding heavy metal chelates in soil, this phenomenon may be important either for limiting Fe uptake or reducing Fe-chelate translocation [11]. According to another group of scientists, treatment with zinc increased lentil yield but reduced Mn content in lentil plants [12]. It was observed that zinc application on lentil resulted in higher number of yield contributing characters like branches/plant, pods/plant and increased 1000-seed weight, seed yield/plant and seed yield/ha except straw yield/ha [13]. The foliar application of Zn also significantly increased Zn content in grain [14]. Fe, Mn and Zn fertilization resulted increase in concentration and total uptake in plant tissue [15]. Boron worked as a growth-promoting nutrient by enhancing length and weight of both shoot and root tissues [16]. Foliar spray of both B @ 0.1% and Zn @ 0.25% twice at 40 and 60 days after sowing recorded with the highest number of pods/plant and seed yield [17]. Iron is an important element for all the organisms in the planet. It takes part in different metabolic activities of the living organisms. In reactions like photosynthesis, respiration, DNA synthesis etc., iron takes an important role. Like other crops, lentil also shows the deficiency symptoms of lentil [18]. Yield loss due to iron deficiency may go upto 25% in case of vulnerable varieties. Iron is a part of nitrogenase enzyme, lehaemoglobin and ferrodoxin and used by the rhizobium bacteria at the time of fixing biological nitrogen. Due the deficiency of iron, nodule formation, leghaemoglobin production and nitrogenase activity may go down which may result in low concentration of nitrogen in aerial plant part [19]. Iron serves as prosthetic group constituent for many enzymes [20]. Also it was found that if iron is applied from different source, it can improve the iron concentration in beans [21]. Due to the low solubility of the oxidized ferric form of iron, it has been considered as the third most limiting nutrient for the growth and development of plant [22, 23]. Foliar application may not completely replace the soil application of nutrients was, but can result better with nutrient uptake by the plants and their availability to the plants compared to soil application [24] . It was reported that in soil application, leaching of nutrient may cause their unavailability to crops. But in foliar application the effectiveness of micronutrient is better than any other means [25]. This was observed that foliar nutrition is one of the important methods as the spray of micronutrients and fertilizers facilitate easy and quick utilization of nutrients both by osmotic diffusion and penetration through stomata in to the leaf cells [26]. So either solely or in an integrated manner applying these micronutrients may help in improvement of growth and yield parameters in lentil in Old Alluvial Zone of West Bengal. Keeping these points in mind, the current study was taken to assess the growth and yield parameters of lentil as affected by micronutrient like zinc, iron and boron spray at Old Alluvial Zone of West Bengal.

2. MATERIALS AND METHODS

The field experiment was conducted during the *Rabi* season of 2019-20 and 2020-21 at the Regional Research Station (Old Alluvial Zone), Uttar Banga Krishi Viswavidyalaya, Majhian, Dakshin Dinajpur. The range of maximum temperature was 19.2-34.7^{o}C and range of minimum temperature was 8.4-17.8^{o}C. The rainfall received in two seasons is 63.6 mm and 0.8 mm in 2019-20 and 2020-21, respectively. The soil data from the study site reveals that the soil is of sandy loam type with 5.58 pH, available nitrogen, phosphorus and potassium levels of 185.36 kg/ha, 22.12 kg/ha and 295.78 kg/ha, respectively. With this, the latitude, longitude and altitude of the place are 25^{0}19' N, 88^{0}46'E and 43m respectively. The experiment was laid out in randomized complete block design (RCBD) with eight treatments

[T_1- Recommended Dose of Fertilizer (RDF), T_2- RDF+ Zn 50 ppm, T_3-RDF+ Zn 100 ppm, T_4-RDF+ Fe 50 ppm, T_5-RDF+ Fe 100 ppm, T_6-RDF+ B 50 ppm, T_7-RDF+ B 100 ppm and T_8-RDF+ 50 ppm Zn+ 50 ppm Fe+ 50 ppm B]. Here RDF stands for recommended dose of fertilizer N: P_2O_5: K_2O @ 20:40:20 kg/ha. Each treatment replicated thrice. The spaying of micronutrient was done at 45 Days After Sowing (DAS) at anthesis and pod development (65 DAS) stage of crop growth. The certified seeds of lentil variety WBL-77 (Moitree) were collected and sowing was done at spacing of 30 cm with a seed rate of 30 kg/ha. The experimental plots were of 20 m^2 (5 m X 4m) size and sowing was completed on 1st of December, 2019. The chemicals used for spraying are commercial grade Zinc sulphate, Boric acid and Ferrous sulphate. For recording the observation like, plant height (cm), productive branches per plant, pod per plant, seed yield (kg/ha), 1000 seed weight (g), stover yield (kg/ha) five numbers of plants from each sides (total ten numbers of plants) leaving the border row are selected and sampled. For dry weight of shoots per m^2 and number of nodules/plant, five plants from each plot were dugged out at 90 DAS. The dry weight of shoots was recorded by drying samples in an oven at 60^o C for 72 hours. The crop was grown with two light irrigations. For early stage weed control one spray of pendimethalin as pre emergence @ 0.5 kg *a. i* applied after sowing. At 30 DAS one hand weeding was done for controlling the next weed flush. Soil information like physical and chemical parameters (pH, EC, organic carbon%, available N, available P and exchangeable K) were recorded before sowing and after harvest of the crop. The analysis of variance (ANOVA) was done in RCBD for each parameter. For the process of analysis, outline followed from Statistical Procedures for Agricultural Research [27]. Pooled data of both years are used for analysis as the trend was same.

3. RESULTS AND DISCUSSION

3.1 GROWTH PARAMETERS

The recorded data from two seasons showed that the foliar spraying of Zn, B and Fe (50 ppm each) with RDF (*i.e* T_8) resulted maximum plant height (47.2 cm) at the time of harvest (Table 1). The result was significantly higher than T_1, T_2, T_3 and T_4 but was at par with T_5, T_6 and T_7. For dry matter accumulation (g/m^2), at harvest, following the previous pattern, T_8 treatment (i.e foliar spraying of Zn, B and Fe 50 ppm each) resulted with the significantly higher value (106.3 g) over the rest of treatments except T_5 (106.2 g) which is statistically at par with T_8 (Table 1). Difference in accumulation of dry matter (g/m^2) may be because of the effect of the different micronutrient spray treatment. The T_1 treatment *i.e* recommended dose of fertilizer only recorded with the lowest plant height as well as dry matter accumulation (g/m^2). This result was in accordance with the other results [28, 29].

3.2 NUMBER OF NODULES /PLANT

The T_8 treatment i.e the combination of all the three micronutrient spray with recommended dose of fertilizer, recorded significantly higher number of nodules per plant (28.7) followed by T_7, T_6, T_5, T_4, T_3, T_2 and T_1 (Table 1). Application of zinc at later stage may influence the nodule count per plant at 90DAS. Similar result was observed by other scientists [30,31,32]. Number of productive branches per plant was not significantly affected by any of the foliar spray of micronutrients. This result was in accordance with other results [28].

Table 1. Effect of foliar spray of Zinc, Iron and Boron on growth parameters of lentil

	Treatments	Plant height (cm)	Total dry matter (g/m^2)	No. of nodules /plant	No. of pods/plant
T_1	RDF (N:P:K-20:40:20 kg/ha)	43.30	102.63	22.83	79.23
T_2	RDF+ Zn 50 ppm	44.20	103.07	23.70	82.17
T_3	RDF+ Zn 100 ppm	45.30	103.70	24.03	85.57
T_4	RDF+ Fe 50 ppm	46.07	105.27	24.50	84.57
T_5	RDF+ Fe 100 ppm	46.67	106.20	24.80	87.53
T_6	RDF+ B 50 ppm	46.43	104.20	25.23	86.10

T_7	RDF+ B 100 ppm	46.87	104.63	25.60	90.50
T_8	RDF+Zn+Fe+B(50ppm each)	47.17	106.33	28.77	91.50
	CD	1.01	0.77	1.26	2.08

3.3 YIELD AND YIELD ATTRIBUTES

Foliar application of Zn, Fe and B in addition to recommended dose of fertilizer had significant effect on number of pods per plant, grain yield, stover yield and 1000 grain weight (g) of lentil (Table 2). The T_8 treatment, following similar pattern of response of growth parameters recorded significantly higher number of pods per plant (91.5) over rest of all the treatments except T7 (90.5). The T_7 treatment was statistically similar with the T_8 treatment. While analyzing the data of 1000 grain weight (g) from both the years, pooled data showed that treatment T_8 was found with highest 1000 grain weight (g) also. This treatment was significantly higher over T_1, T_2, T_4, and T_6 treatment. The rest three treatments were found to be statistically similar with the highest one. Grain yield (kg/ha) and stover yield (kg/ha) followed similar pattern in both seasons. The pooled data reveals that T_8 treatment recorded the highest grain yield (1084 kg/ha) which was significantly higher than the rest of all the treatments. Also in case of stover yield, highest value was recorded with the same treatment (3611.3 kg/ha). But harvest index calculated from economic yield and biological yield was found with non significant values among the each others. This result was similar to another result [32] in which also iron application increased lentil seed yield. Also it was reported that the harvest index, seed yield per plant, pods per plant and biological yield were correlated with grain yield. In addition, harvest index, seed yield per plant, pods/plant and biological yield were the most important traits that have a relationship with grain yield [33].

Table 2:Effect of foliar spray of Zinc, Iron and Boron on yield attributes and yieldof lentil

	Treatments	1000 grain weight (g)	Grain yield kg/ha	Stover yield (kg/ha)	Harvest index
T_1	RDF (N:P:K-20:40:20 kg ha^{-1})	18.77	691.667	2,791.667	0.197
T_2	RDF+ Zn 50 ppm	19.33	723.000	2,925.00	0.19
T_3	RDF+ Zn 100 ppm	20.57	753.67	3,074.33	0.19
T_4	RDF+ Fe 50 ppm	19.03	793.33	3,064.00	0.20
T_5	RDF+ Fe 100 ppm	20.13	808.67	3,134.33	0.20
T_6	RDF+ B 50 ppm	19.33	797.00	3,017.33	0.20
T_7	RDF+ B 100 ppm	20.37	818.00	3,063.33	0.21
T_8	RDF+ Zn+ Fe+ B (50 ppm each)	20.60	1,084.00	3,611.33	0.21
CD		1.10	21.90	63.23	NS

4. CONCLUSION

Based on the result of the study, it can be concluded that with recommended dose of fertilizers, application of micronutrients such as zinc, iron and boron (@50 ppm) in foliar form can be applied to lentil for higher yield. These treatments were found to be statistically superior over the other treatment-combinations. Therefore, it is recommended for the old alluvial zone of WestBengal and other related ecologies of the world.

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ABBREVIATIONS

1. RDF-Recommended Dose of Fertilizer
2. DAS- Days After Sowing