Vol.12 No. 1, Page No. 178–181 (2023)
Received: May, 2023; Accepted: June, 2023

Response of Nano Zinc and Nano Iron Fertilization on the Yield and Economics of lentil (*Lens esculenta)*in Mandsaur Region of Madhya Pradesh

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Abstract

Due to nutrient toxic effects, soil health become the main concern in Malwa region, consequently affecting the mineralization of nutrients in soil. Keeping in view in mind the present investigation entitled "Response of Nano Zinc and Nano Iron Fertilization on the yield and economics of lentil (Lens esculenta)in Mandsaur region of Madhya Pradesh" carried out in Mandsaur (Madhya Pradesh) by using F test. Mandsaur is situated at latitude 24o C 4'36.61" N, longitude 75° 4'9.46" E and at an altitude of 442.16 meters above the mean sea level. The experiment was laidout with different fertilizer treatments [Control, 50%RDN (@10kg N/ha)+ 100% PK(40kg P_2O_5: 20kg K_2O / ha) +50% FYM, 75% RDN(@15kg N / ha) +100%PK(40kg P_2O_5: 20kg K_2O / ha) +25% FYM, 100% RDF (@20kg N: 40kg P_2O_5: 20kg K_2O / ha), 100%RDF(@20kg N: 40kg P_2O_5: 20kg K_2O / ha)+Rhizobium(@20gm/kg seed), 100% RDF(@20kg N: 40kg P_2O_5:20kg K_2O / ha)+PSB(@20gm/kg seed), 100% RDF(@20kg N: 40kg P_2O_5: 20kg K_2O / ha)+ Nano zinc, 100% RDF(@20kg N: 40kg P_2O_5: 20kg K_2O / ha)+ Nano iron, 100% RDF(@20kg N: 40kg P_2O_5: 20kg K_2O / ha) +zinc +Iron, 100% RDF (@20kg N: 40kg P_2O_5: 20kg K_2O / ha)+ zinc + iron + Rhizobium(@20gm/kg seed)] in Randomized Blocks Design replicated thrice.

Moreover, the result revealed that all the treatments showed significant differences for most of the traits under study. Further, lentil grown under 100% RDF (@20kg N: 40kg P2O5: 20kg K_2O / ha)+ zinc + iron + Rhizobium(@20gm/kg seed) recorded the highest yields (q/ha) (Grain yield, straw yield, biological yield), harvest index (%), and economics (Rs/ha) (cost of cultivation, gross return, net return) and Benefit-Cost ratio (B:C ratio). Thus, lentil proved better in terms of performance and economic feasibility when fertilized with 100% RDF (@20kg N: 40kg P_2O_5: 20kg K_2O / ha)+ zinc + iron + Rhizobium(@20gm/kg seed). Apart, it also improved soil health of Malwa region.

Keywords : Nano zinc, Nano iron, economics, lentil.

Introduction

The Fabaceae family includes the major annual leguminous crop known as lentil (*Lens esculenta* L.), sometimes known as "Masoor" in local dialects. Vegetable protein is a significant component of the human diet. In 2022, the size of the world lentil market was 14.2 million tonnes. Looking ahead, IMARC Group projects that the market will increase at a CAGR of 10.96% from 2023 to 2028, reaching 26.7 million tones. In the nation, lentils are grown on an area of around 1.51 million acres, producing 0.95 million tonnes annually with an average yield of 629 kg/ha. With an output of 263 million tonnes and an average yield of 520 kg/ha, lentil cultivation in Madhya Pradesh takes up around 0.056 million hectares of land. This is a relatively small area. The Vidisha, Sagar, Raisen, Jabalpure, and Damoh districts have the highest concentration of land used for this crop. In

the state's Keymore hills and gird, the area planted with lentil has grown (IMARC 2022).

Studies have shown that adding nano Zn and nano Fe to RDF has a good impact on the growth and production of lentil crops. For instance, the addition of nano Zn to RDF greatly boosted lentil plant height, branch count, pod length, and seed output. In another study that the application of nano Fe and RDF together boosted the nutritional content, enzyme activity, and chlorophyll content in lentil plants, resulting in better growth and yield indices. The effectiveness of lentil crops in absorbing nutrients may also be improved by using nano Zn and nano Fe in combination with RDF. Due to their tiny size, nanoparticles may easily pass through the root system and reach the cellular level, improving nutrient uptake and translocation within the plant. This increased nutrient availability can reduce nutritional shortages and increase the production of lentil crops.

This is very important because lentils are well-known for having high levels of important micronutrients like iron and zinc. Additionally, it has been demonstrated that adding nanoscales of zinc and iron to lentil crops may successfully alleviate nutritional shortages. The production of lentils frequently faces problems with zinc and iron deficiency, which reduces crop output.

Materials and Methods

The present investigation entitled “Response of Nano Zinc and Nano Iron Fertilization on Performance on lentil (*Lens esculenta*) and Soil Health in Mandsaur region of Madhya Pradesh” was carried out at the at Research Farm, of Mandsaur University, Mandsaur Madhya PradeshIndia during Rabi season 2022-23.The soil was dark brown to pink coloured lateritic soil with pH-7.8having organic carbon 0.44%, available N 140 kg/ha-1, $P_2O_5$7 kg/ha and K_2O 316 kg/ha. The experiment consisted of ten treatment combinations of nutrient management [Control, 50%RDN (@10kg N/ha)+ 100% PK(40kg P2O5: 20kg K2O / ha) +50% FYM, 75% RDN(@15kg N / ha) +100%PK(40kg P2O5: 20kg K2O / ha) +25% FYM, 100% RDF (@20kg N: 40kg P2O5: 20kg K2O / ha), 100%RDF(@20kg N: 40kg P2O5: 20kg K2O / ha)+Rhizobium(@20gm/kg seed), 100% RDF(@20kg N: 40kg P_2O_5:: 20kg K_2O / ha)+PSB(@20gm/kg seed), 100% RDF(@20kg N: 40kg P2O5:: 20kg K2O / ha)+ Nano zinc, 100% RDF(@20kg N: 40kg P2O5:: 20kg K2O / ha)+ Nano iron, 100% RDF(@20kg N: 40kg P2O5:: 20kg K2O / ha) +zinc +Iron, 100% RDF (@20kg N: 40kg P2O5:: 20kg K2O / ha)+ zinc + iron + Rhizobium(@20gm/kg seed)]. The experiment was laid out in Randomized Blocks Design, allocating nutrient management was replicated three times. Seeds of lentil were dibbled according to recommended spacing i.e., 10 cm. plant to plat and 30 cm. row to row observations recorded during the course of investigation along with sample size and recording time. Data collected during the course of investigation ware statistically analyzed.

Results and Discussion

Effect of nutrient management on yield

Application of nutrient management significantly influenced the grain yield, straw yield, biological yield and harvest index during the experimentation. Highest grain yield (23.85 q ha-1), straw yield(46.69 q ha-1), biological yield (50.83q ha-1) and harvest

index (70.54) was recorded with 100% RDF (@20kg N: 40kg P2O5:: 20kg K2O / ha)+ zinc + iron + Rhizobium(@20gm/kg seed)which was significantly higher over all other treatment[3].

Effect of nutrient management on economics

Nutrient management treatments significantly influenced the gross returns and netreturns per hectare and benefit: costratio during the experimentation (Table 1).Significantly the highest cost of cultivation(Rs 34795 ha^{-1}) gross return (Rs149851ha-1), net return ha-1(Rs115056ha-1) and benefit: cost ratio (3.31) were recorded in treatment 100% RDF (@20kg N: 40kg P2O5:: 20kg K2O / ha)+ zinc + iron + Rhizobium(@20gm/kg seed)over all other treatments during the study period and in pooled data respectively (Table 1)[1,2,4].

Conclusion

Based on the investigation held at Mandsaur University, Mandsaur (M.P.), it can be concluded that lentil received 100% RDF coupled with nano zinc, nano iron and Rhizobium proved to be better in terms of performance, production, and economics.

Table 1 Effect of nutrient management on yield and economics

Treatment	Yield and economics							
	Grain yield (q/ha)	Straw yield (q/ha)	Biological yield (q/ha)	Harvest index	Cost of cultivation (□/ha)	Gross returns (□/ha)	Net returns (□/ha)	Benefit cost ratio (B:C ratio)
Control	12.78	22.20	34.98	36.53	29,895	79170	49,275	1.65
50%RDN + 100% PK+50% FYM	13.54	28.11	41.65	32.51	42,445	85714	43,269	1.02
75% RDN+100%PK+25% FYM	14.86	31.33	46.19	32.17	38,232	94262	56,030	1.47
100% RDF	15.57	33.09	48.66	32.00	34,020	98871	64,851	1.91
100%RDF+Rhizobium	20.99	37.76	58.75	35.73	34,344	130549	96,205	2.80
100% RDF+PSB	17.92	33.64	51.56	34.75	34,720	112016	77,296	2.23
100% RDF+ Nano zinc	21.41	40.78	62.19	34.42	34,171	134067	99,896	2.92
100% RDF+ Nano iron	19.23	33.69	52.92	36.34	34,317	119241	84,924	2.47
100% RDF +zinc +Iron	22.65	44.75	67.40	33.60	34,471	142475	1,08,004	3.13
100% RDF + zinc + iron + Rhizobium	23.85	46.69	70.54	33.82	34795	149851	1,15,056	3.31
SEm+	1.379	2.666	4.043	0.012	-	-	-	-
CD at 5%	4.129	7.982	12.107	0.036	-	-	-	-

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