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Short communication

Response of potassium and biofertilizers on growth, yield and quality of lentil (*Lens culinaris* L.)

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Lentil (Lens culinaris L.) is primarily a rabi season crop that belongs to the family Leguminosae. The lentil contains about 25% protein, 10% fat, 55.8% carbohydrates, 3.7% fibre and 3.3% ash (Wang *et al.,* 2009) and is rich in calcium, iron and niacin. In India, the crop is grown in about 14.68 million hectares, contributing to the production of 14.94 million tonnes with an average yield of 1017 kg/ha. In Madhya Pradesh, it is cultivated in an area of 5.42 million hectares with a production of 6.15 million tonnes. However, the productivity of the crop is 1135 kg/ha (Directorate of Economics and Statistics, 2021). A sufficient amount of potassium is required to improve the yield and quality of different crops because of its effect on photosynthesis, water use efficiency, translocation of photosynthates and plant tolerance to diseases, drought and cold as well as for making the balance between protein and carbohydrates. Potassium also plays an important role in optimum symbiotic N-fixation and N-partitioning towards reproductive parts and nodules and also affects parameters such as the height of the plant, size, weight and number of nodules.

Potassium is the most important essential nutrient after nitrogen and phosphorus and plays a vital role in plant cell sap, supporting enzymatic activity, photosynthesis and transportation of sugar, and synthesis of protein and starch but does not bounds with carbon or oxygen. It also develops tolerance to drought conditions and enhances the plant's ability to resist attacks of pests and diseases (Singh *et al.,* 2016). The plant height, branches/plant, dry matter accumulation, pods per plant, test weight, grain and straw yield of lentil and protein content increased significantly up to 90 kg K_2O ha^{-1}. However, yields attributes and yield at 60 and 90kg K_2O ha^{-1} were statistically on par (Sahay *et al.* 2013).

Biofertilisers are gaining popularity as they are Eco-friendly, non-hazardous and non-toxic. Biofertilisers include mainly nitrogen-fixing, phosphate and potassium-solubilizing bacteria and plant growth-promoting micro-organisms. Inoculating pulse crops with rhizobia may help in improved nodulation which ultimately results in higher productivity. The presence of efficient strains of Rhizobium in the Rhizosphere is one of the most important requirements for the proper establishment and growth of grain legume plants. Phosphate-solubilizing bacteria (PSB) solubilizes inorganic and insoluble phosphate and Sahithi, N., Singh, R., Indu, T and Dakshayani, D. (2023). The combined application of 30 kg K/ha + KSB recorded highest the plant height (28.55 cm), pods per plant (49.93) and seeds per pod (1.87) but statistically at par with application of potassium at 30 kg/ha alone. Furthermore, the highest grain yield of 6.81 q/ha was observed with a combined application of 30 kg K/ha + KSB which was at par with potassium application @ 30 kg/ha alone (Bhat *et al.,* 2022).

The experiment was carried out at the Research plot, Department of Agronomy, AKS University, Satna (M.P.) during the Rabi season of the year 2023-24. The experiment was laid out in Randomized block design having a factorial concept (FRBD). The experiment was conducted in a Randomized Block Design. Treatment, combinations of four potassium levels (0, 10, 20 and 30 kg/ha) and three treatments of biofertilizers (Rhizobium, PSB and KSB). Thus, the 12 treatment combinations were laid out in the field in a Factorial Block Design keeping three replications. The gross and net plot sizes were 5.0× 3.0 m = 15 m^2 and 4.5m × 2.4 m = 10.8 m^2 respectively. The experimental plots were fertilizers as per the recommended dose. The nutrient status of the

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experimental plot is available nitrogen 185.4 kg/ha, available phosphorus 12.9 kg/ha and available potassium of field is 215.0 kg/ha.

The result shows that growth, yield, quality and economics were influenced significantly due to lentil potassium levels and biofertilizers.

Plant growth attributes like plant height (cm) (Table 1) are considered to be an important factor in judging the vigour in lentils. Vegetative growth is an essential prerequisite for higher yield. The differences among the various potassium levels and biofertilizers and their interaction were found significant for plant height (cm) at the Harvest stage of lentils.

Table 1: Response of potassium and biofertilizers on growth, yield and quality of lentil

Treatment	Plant height (cm)	Number of branches/plant	Test weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Protein content in seed (%)
K-levels (kg/ha)						
K_0	31.9	15.1	25.3	7.2	10.2	21.5
K_1	32.5	15.5	26.8	8.2	11.2	23.6
K_2	33.7	15.8	28.0	9.3	13.8	24.1
K_3	34.7	16.8	29.0	9.9	15.3	24.5
SEm±	0.09	0.075	0.07	0.05	0.08	0.1
C.D	0.26	0.213	0.191	0.14	0.23	0.3
Biofertilizers (B)						
B_1	33.2	15.6	27.2	8.7	12.7	23.4
B_2	33.7	16.3	28.0	9.1	13.2	24.0
B_3	32.8	15.4	26.6	8.1	12.1	23.0
SEm±	0.08	0.065	0.06	0.04	0.07	0.10
C.D	0.22	0.18	0.165	0.12	0.2	0.28
Interaction effect of potassium levels and biofertilizers						
K_0 B_1	32.1	15.1	25.2	7.3	10.3	21.1
K_0 B_2	32.4	15.4	26.3	7.7	10.7	22.7
K_0 B_3	31.2	\14.8	24.5	6.6	9.8	20.7
K_1 B_1	32.4	15.4	26.9	8.3	11.2	23.7
K_1 B_2	35.9	15.7	27.2	8.8	11.7	24.0
K_1 B_3	32.3	15.3	26.2	7.4	10.8	23.4
K_2 B_1	33.7	15.7	27.9	9.3	14.0	24.2
K_2 B_2	33.9	16.1	28.7	9.7	14.6	24.4
K_2 B_3	33.4	15.4	27.4	8.9	12.9	23.7
K_3 B_1	34.4	16.3	28.7	10.0	15.1	24.6
K_3 B_2	35.5	18.0	29.9	10.2	15.9	24.8
K_3 B_3	34.1	16.2	28.2	9.7	14.8	24.3
SEm±	0.74	0.61	0.55	0.4	0.67	0.93
C.D	2.13	1.77	1.58	1.16	NS	2.7

The plant's height and number of branches per plant were, in general, increased by nearly two-fold in all treatments with the successive growth and development stages of the crop i.e. from 30 days to the harvest stage of observations. Among these growth parameters, plant height, in general, enhanced very fast up to 60 days, thereafter the rise was very shown till the harvest stage of observation. At the harvest stage, plant height on average ranged from 31.86 to 34.67 cm and branches 15.09 to 16.79 /plant under various treatments. The present results corroborate the findings of Singh *et al.* (2016), Chauhan *et al.* (2017), Singh (2017), Ram Lakhan *et al.* (2017) and Sahithi *et al.* (2023).

The yield attributes are directly responsible for grain production. The number of pods/plant number of grain /pod1000-grain weight and seed weight/plant were augmented almost significantly due to an increased supply of potassium up to 30 kg/ha. The probable reason may be ascribed as a result of greater accumulation of carbohydrates, protein and their translocation to the reproductive organs, which in turn, increased the number of pods as well as other yield components. An abundant K^+ supply also leads to an increase in several

stomata on the leaf surface. A greater number of stomata results in higher CO_2 gas exchange, increases the uptake of CO_2 and ultimately higher photosynthetic activity of the plants. These results on lentils are in close agreement with those of (Kumar *et al.* 2015) and Sahithi *et al.* (2023).

The maximum net return per hectare after deduction of expenditure is the ultimate goal of any farm owner or grain producer. The highest level of potassium (K_{30}) brought about the highest average net return up to Rs. 47592/ha. It was higher by Rs. 22583/ha over no potassium (control). This was eventual as the higher net return was directly correlated with the higher grain and straw production per hectare. Amongst the biofertilizer treatments, PSB biofertilizer gave the maximum net return (Rs. 40891/ha) followed by Rhizobium biofertilizer (Rs. 37322/ha) and KSB biofertilizer (Rs. 32764/ha). PSB biofertilizer with K_{30} further raised the average net income maximum to Rs. 49874/ha with a B: C ratio of 2.43. This was but natural as the net return per hectare was directly correlated with the grain and straw production from that piece of land. Based upon this experiment it is concluded that the most accepted lentil variety for the Kymore plateau region of Madhya Pradesh was the Jawhar lentil (JL-3) which responded up to 30 kg K_2O/ha, hence the recommendation to the lentil growers may be made up to this very dose. The maximum grain productivity was 9.94 q/ha with a net return up to Rs. 47592/ha, grain protein 24.54% with application of 30 kg K_2O/ha. Among the biofertilizer treatments, PSB biofertilizer performed the best with the highest grain productivity up to 9.13 q/ha, net return up to Rs. 40891/ha, and grain protein 23.95

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