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Response of weed management practices and phosphorus levels on growth and yield of lentil (*Lens culinaris* Medik. L.)

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Abstract

A field experiment was conducted during 2024-25 at Agricultural Research Farm, School of Agricultural Sciences, Jaipur National University, Jaipur, Rajasthan to evaluate the Production of Lentil (*Lens culinaris* Medik. L.) as influenced by weed management practices and phosphorus. The experiment was laid out in Factorial Randomized Block Design with three replications. The experiment comprised four levels of phosphorus viz.; control, 15 kg P₂O₅ ha⁻¹, 30 kg P₂O₅ ha⁻¹ and 45 kg P₂O₅ ha⁻¹ and three weed management practices viz; weedy check, Hand weeding once 30 DAS and Pendimethalin@ 0.75kg a.i. ha⁻¹. The significantly higher growth parameters viz., plant height, number of branches, DMA, weed dry matter accumulation and maximum yield attributes and yield viz., pods plant⁻¹ (119.53), number of seeds pod⁻¹ (2.07), seed yield plant⁻¹ (2.10 g), test weight (31.04 g), seed yield (1400 kg ha⁻¹), stover yield (4406.67 kg ha⁻¹) and harvest index was obtained with the application of 45 kg P₂O₅ ha⁻¹ followed by 30 kg P₂O₅ ha⁻¹. Among the weed management practices, the application of pendimethalin @ 0.75kg a.i. ha⁻¹ gave significantly higher growth parameters viz., plant height, number of branches, DMA, weed dry matter accumulation; maximum yield attributes and yield viz., pods plant⁻¹ (115.51), number of seeds pod⁻¹ (2.00), seed yield plant⁻¹ (2.03 g), test weight (29.95 g), seed yield (1350.83 kg ha⁻¹), stover yield (4354.58 kg ha⁻¹) and harvest index.

Keywords: Lentil, phosphorus, weed management, growth and yield

Introduction

Pulses are the important world food crops providing more plant protein than cereals. Human daily diet may be augmented by supplementation with protein rich pulse grains. Pulse grains also provide a source of rich protein to communities preferring vegetable protein in their diet. The total world acreage under pulses as recorded during 2022 is about 959.68 lakh ha with production at 973.92 lakh tones and productivity 1015 kg ha⁻¹. It reveals that the India ranked first in area and production with 38% and 28% respectively of world area and production (DES, 2024) ^[1].

Lentil (*Lens culinaris* Medikus) is one of the major cold season winter legume crops in India, which is the second major legume sown in winter after chickpea. Lentil is an essential food legume grown during the winter season across the Indian continent under many agroecological conditions, soil types and cropping systems, in areas with extremely cold winters. It is considered the meat of the poor and the cheapest source of protein for a group of disadvantaged people who cannot afford animal protein (Gaud *et al.*, 2021) ^[2]. The product obtained from cultivated lentils is the seed, which is a valuable food for humans containing an excessive amount of protein (22-34.5%), carbohydrates (65%) and various minerals and vitamins (Kumari *et al.*, 2024) ^[3]. The seeds are commonly eaten as dal in soups and the flour can be combined with cereal flour and used in cakes, breads and some baby foods (Singh and Pandey 2017) ^[4]. India ranked second in the area (14.12 lakh ha) and in production (12.69 lakh tonnes) with 26% and 19% of world area and production respectively. The highest productivity is recorded in Australia (1738 kg ha⁻¹) followed by Bangladesh (1320 kg ha⁻¹). Canada rank first in production (35%) due to high level of productivity (1341 kg ha⁻¹) as compared to India (899 kg ha⁻¹) (DES,

2024)^[1].

The production of pulses has virtually stagnant with production and area over the last 25 years (450 kg ha⁻¹) in Rajasthan. The reason beyond for this is that pulses are mainly grown on marginal soil as a residual crop and less application of the fertilizers (Ayalew *et al.*, 2015)^[5]. Phosphorus is an important macro element for growth of legumes. It has important role in formation of root nodules and this opinion has an important role in nitrogen fixation. Phosphorus (P) is a non-renewable and second most important macronutrient which is required for young tissues and performs several functions related to growth, development, and metabolism of the plant and also regulates many metabolic activities of the plant life (Khare *et al.*, 2017)^[6]. Lentil is usually grown on unproductive marginal and sub-marginal lands of Supaul district under rainfed conditions. The modern lentil varieties give good yield under the umbrella of good agronomic management practices. Weed infestation is one of the limiting factors in achieving optimum yield of lentil. Among the different crop management practices, weed management is of key importance as 20 to 30% losses in grain yield are quite usual and may increase even 50%, if the weed management practices are not properly followed (Yadav *et al.*, 2013)^[7]. Mechanical/manual weeding is normally tedious, labour consuming and costlier. Increased cost of manual weeding, its poor labour efficiency and scarcity during critical periods when labour utilization is diverted to other priority crops made herbicides very attractive in lentil. Herbicides have revolutionized agriculture all over the world and have played key role in enhancing productivity. They are accepted as an essential tool in weed management as they reduce labour requirement enormously and are easy and convenient to use (Rao and Nagamani, 2010)^[8]. Herbicides have come as a big boon to farmers in areas where the labour supply is limited and wages are high. Application of herbicide can minimize weed infestation if the field can be kept weed free during the critical growth period. Pendimethalin (N-(1-ethylpropyl)-2, 6 dinitro-3, 4-xylidine) is a selective herbicide used to control most annual grasses and certain broadleaf weeds in field crops and pulses. It is used both pre-emergence and early post emergence. The control of most annual grasses weed and fair control of small-seeded annual broadleaves weed. Pendimethalin's herbicidal action lies in its inhibition of the steps in plant cell division responsible for chromosome separation and cell wall formation (Singh *et al.*, 2018)^[9].

Among the different factors influencing crop production, weed management practices and phosphorus levels play a vital role and require careful consideration to achieve the maximum yield potential of lentil. With this understanding, the present field experiment was carried out.

Materials and Methods

The field experiment was conducted during *rabi* seasons of 2024-25 at Agricultural Research Farm, School of Agricultural Sciences, Jaipur national University, Jaipur, Rajasthan. Soil of the experimental field was sandy in texture having pH 7.58, organic carbon (OC) (0.43%), available nutrient (nitrogen 217.30 kg ha⁻¹; phosphorus (P) 20.28 kg ha⁻¹ and potassium (K) 219.20 kg ha⁻¹). The experiment was laid out in Factorial Randomized Block Design with three replications. The field trial consisted 12 treatments combinations viz., four phosphorus levels viz., (i) control, (ii) 15 kg P₂O₅ ha⁻¹, (iii) 30 kg P₂O₅ ha⁻¹ and (iv) 45 kg P₂O₅ ha⁻¹, while three weed management practices viz., (i) weedy check, (ii) hand weeding once 30 DAS and (iii) Pendimethalin @ 0.75 kg a.i. ha⁻¹. The lentil variety

'KM 3' was sown @ 50 kg seed/ha with spacing of 30 cm x 5 cm. The three irrigations are applied. All agricultural practices were kept uniform in all the plots.

Results and Discussion

Growth Parameters

Effect of phosphorus Levels

The different levels of Phosphorus significantly enhanced the growth parameters viz. plant height (cm) at 30 DAS and at harvest, number of branches plant⁻¹ at harvest, DMA (g plant⁻¹) at 30, 60, 90 DAS, at harvest of the lentil (Table 1).

The significantly maximum plant height (10.85 cm at 30 DAS and 44.49 cm at harvest), number of primary branches plant⁻¹ (7.10 at harvest) and number of secondary branches plant⁻¹ (4.60 at harvest) were recorded with the application of 45 kg P₂O₅ ha⁻¹ and it was found statistically at par with 30 kg P₂O₅ ha⁻¹ (Table 1). The plant height, number of branches depends on the supply of nutrients; more supply of nutrients stimulates the plant to increase the growth parameters. The progressive increase in plant height, number of branches might be due to the cumulative effect of phosphorus on the process of cell division. These results were in agreement with the findings of Singh *et al.* (2011)^[10], Zafar *et al.* (2003)^[11] and Rasheed *et al.* (2010)^[12].

Moreover, the DMA (1.30 at 30 DAS; 2.58 at 60 DAS; 7.32 at 90 DAS and 16.50 at harvest) significantly higher with the application of 45 kg P₂O₅ ha⁻¹ and it was found statistically at par with 30 kg P₂O₅ ha⁻¹. The increase in DMA might be due to enhanced in plant height and primary and secondary branches that provided the more leaf area its increased the photosynthetic rate of plant that's result in increased the DMA by the plant. Phosphorus application improves nodulation in lentil (Singh *et al.*, 2008), which might have resulted in higher nitrogen fixation and consequently higher dry matter production. These results are also in close agreement with the finding of Singh *et al.* (2017)^[13]; Gaud *et al.* (2021)^[12]; Kumari *et al.* (2024)^[3]; Singh *et al.* (2016)^[14].

Effect of weed management practices

The different weed management practices significantly enhanced the growth parameters viz. plant height (cm) at 30 DAS and at harvest, number of branches plant⁻¹ at harvest and DMA (g plant⁻¹) at 30, 60, 90 DAS, at harvest of the lentil (Table 1). The significantly maximum plant height (10.47 at 30 DAS and 42.93 at harvest), number of primary branches plant⁻¹ (6.85 at harvest), number of secondary branches plant⁻¹ (4.44 at harvest) and DMA (1.25 g plant⁻¹ at 30 DAS, 2.50 g plant⁻¹ at 60 DAS, 7.08 g plant⁻¹ at 90 Das and 16.10 g plant⁻¹ at harvest) were recorded with the application of pendimethalin@ 0.75 kg a.i./ha over other treatments. This might be due to lower weed infestation for longer period of time and lesser nutrient removal by weeds. A similar result also reported by Bahera *et al.* (2005)^[15], Manjunath *et al.* (2010)^[16]; Punia *et al.* (2011)^[17] and Younesabadi *et al.* (2013)^[18].

Yield attributes and yield

Effect of phosphorus Levels

The different levels of phosphorus significantly enhanced the yield attributes and yield viz. number of pods plant⁻¹, number of seeds pod⁻¹, test weight (g), seed yield plant⁻¹ (g) and seed yield (kg ha⁻¹), stover yield (kg ha⁻¹) and HI (%) of the lentil crop (Table 2). The maximum number of pods plant⁻¹ (119.53), number of seeds pod⁻¹ (2.07), seed yield plant⁻¹ (2.10 g), test weight (31.04 g), seed yield (1400 kg ha⁻¹), stover yield (4406.67 kg ha⁻¹) and harvest index (24.11) were significantly

recorded with the application of 45 kg P₂O₅ ha⁻¹ and it was found statistically at par with 30 kg P₂O₅ ha⁻¹. Several authors reported that increment in grain yield, the most important character regarding the economic value of crop, might be due to improvement in various parameters i.e. plant height, branches plant⁻¹, dry matter accumulation (Togay *et al.*, 2008^[19]; Singh *et al.*, 2011^[10]; Biswas *et al.*, 2015^[20] and Rasheed *et al.*, 2010)^[12].

Effect of weed management practices

The different weed management practices significantly enhanced the yield attributes and yield viz. number of pods plant⁻¹, number of seeds pod⁻¹, test weight (g), seed yield plant⁻¹ (g), seed yield (kg ha⁻¹), stover yield (kg ha⁻¹) and HI (%) of the lentil crop (Table 2). The maximum number of pods plant⁻¹

(115.51), number of seeds pod⁻¹ (2.00), test weight (29.95 g), seed yield plant⁻¹ (2.03 g), seed yield (1350.83 kg ha⁻¹), stover yield (4354.58 kg ha⁻¹) and HI (23.56%) were significantly recorded with the application of pendimethalin @ 0.75 kg a.i. ha⁻¹ over other treatments. This might be due to the fact that the luxuriant growth of many weed species with greater nutrient removal from the soil, thus, reduced the crop yield considerably. The efficient weed control measures reduced weed density and biomass resulting in improvement of yield-related traits and ultimately crop yield. Many reports support such role of herbicide application in improving the yield-related traits and yield of several crops through efficient weed management (Chander *et al.*, 2014; Sagvekar *et al.*, 2015)^[21, 22].

Table 1: Effect of phosphorus levels and weed management practices on growth parameters of Lentil

Treatments	Plant height (cm)		No. of Branches plant ⁻¹ at harvest		DMA (g plant ⁻¹)			
	30 DAS	At harvest	Primary branches	Secondary branches	30 DAS	60 DAS	90 DAS	At harvest
Phosphorus levels								
Control	9.27	38.00	6.06	3.93	1.11	2.22	6.29	14.84
15 kg P ₂ O ₅ ha ⁻¹	9.69	39.73	6.34	4.11	1.16	2.32	6.57	15.28
30 kg P ₂ O ₅ ha ⁻¹	10.72	43.93	7.01	4.54	1.28	2.55	7.23	16.35
45 kg P ₂ O ₅ ha ⁻¹	10.85	44.49	7.10	4.60	1.30	2.58	7.32	16.50
S.Em±	0.07	0.30	0.05	0.03	0.01	0.02	0.05	0.08
CD (p=0.05)	0.26	1.05	0.17	0.11	0.03	0.06	0.17	0.27
Weed Management Practices								
Weedy check	9.78	40.10	6.40	4.15	1.17	2.34	6.62	15.37
Hand weeding once 30 DAS	10.14	41.58	6.64	4.30	1.21	2.42	6.86	15.75
Pendimethalin @ 0.75kg a.i. ha ⁻¹	10.47	42.93	6.85	4.44	1.25	2.50	7.08	16.10
S.Em±	0.04	0.15	0.02	0.02	0.005	0.01	0.02	0.04
CD (p=0.05)	0.11	0.46	0.07	0.05	0.014	0.03	0.07	0.12

Table 2: Effect of phosphorus levels and weed management practices on yield attributes of Lentil

Treatments	Yield attributes				Yield		
	No. of pods plant ⁻¹	No. of seeds pod ⁻¹	Test weight (g)	Seed yield plant ⁻¹ (g)	Seed yield (kg ha ⁻¹)	Stover yield (kg ha ⁻¹)	Harvest index
Phosphorus levels							
Control	102.80	1.77	26.51	1.81	1195.56	4103.00	21.90
15 kg P ₂ O ₅ /ha	107.26	1.85	27.71	1.89	1250.00	4297.78	22.49
30 kg P ₂ O ₅ /ha	118.07	2.04	30.64	2.08	1382.22	4376.67	24.03
45 kg P ₂ O ₅ /ha	119.53	2.07	31.04	2.10	1400.00	4406.67	24.11
S.Em±	0.78	0.01	0.21	0.01	9.53	7.98	0.12
CD (p=0.05)	2.70	0.05	0.73	0.05	32.98	27.62	0.41
Weed Management Practices							
Weedy check	108.21	1.86	27.97	1.90	1261.67	4235.17	22.71
Hand weeding once 30 DAS	112.03	1.93	29.01	1.97	1308.33	4298.33	23.12
Pendimethalin @ 0.75 kg a.i./ha	115.51	2.00	29.95	2.03	1350.83	4354.58	23.56
S.Em±	0.40	0.01	0.11	0.01	4.87	18.64	0.07
CD (p=0.05)	1.19	0.02	0.32	0.02	14.60	55.88	0.20

Conclusion

Based on a one-year field study on lentil, it may be concluded that: The application of 45 kg P₂O₅ ha⁻¹ with pendimethalin @ 0.75kg a.i. ha⁻¹ was suitable to attain the higher growth parameters, yield attributes and yield, quality, nutrient content and their uptake, maximum net returns and B: C ratio of lentil.

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