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Effect of Nutrient and Weed Management Practices on Weed Dynamics and Chlorophyll content of lentil (*Lens culinaris* L.)

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ABSTRACT: Weeds are undesirable and unwanted plants that absorb faster and greater quantities of nutrients than crop plants, reducing crop yield even at maximum fertilizer rates. So, promising weed management methods are required to enhance lentil quality. Keeping this in mind, afield experiment was conducted at Research Farm, Division of Agronomy, MPUAT, Udaipur during *Rabi* season of 2021-22 and 2022-23 to study the effects of nutrient and weed management practices on weed dynamics and chlorophyll content of lentil (*Lens culinaris* L.). The experiment was laid out in factorial Randomized Block design comprising five nutrient management practices *viz*., 100% RDF, 75% RDF + one spray of each 2 ml/l nano DAP and nano Zn at flowering initiation, 50% RDF + one spray of each 2 ml/l nano DAP and nano Zn at flowering initiation, 75% RDF + two spray of each 2 ml/l nano DAP and nano Zn at flowering and pod initiation and 50% RDF + two spray of each 2 ml/l nano DAP and nano Zn at flowering and pod initiation as factor A and four weed management practices *viz*., Weedy check, Two hand weeding at 20 and 40 DAS, Pendimethalin 30 EC @ 1.0 kg/ha PE and Imazethapyr 35% + imazamox 35% WG @ 70 g/ha PoE at 20 DAS as factor B. The weed density and chlorophyll content were recorded at 30 DAS. Application of different nutrient management treatments, 100% RDF recorded significantly increased chlorophyll content of lentil followed by 75% RDF + two spray of each nano DAP and nano Zn as compared to rest of the treatments during both the years of study. Among weed management practices, two hand weeding at 20 and 40 DAS observed significantly reduce weed density followed by pendimethalin 30 EC @ 1.0 kg/ha over to rest of the treatments during both the years. Hence, it concluded that use of 100% RDF and pendimethalin as is promising options for management of weeds and realizing higher chlorophyll content of lentil.

Keywords: Nutrient management, lentil, chlorophyll, weed management, weed density.

INTRODUCTION

At the global level, even though India accounts for 30% of the world's output of lentils, its production (15.06 lakh tone) and productivity level (1008 kg/ha) are noticeably low (Govt. of India, 2019). Dehulled lentil grains have a protein content (24-26%) fat content (1.3%), ash content (2.2%), fibre content (3.2%) and carbohydrate content (57%). It is a rich source of calcium (68 mg 100 g^{-1} grain), phosphorus (300 mg 100 g^{-1} grain) and iron (7 mg 100 g^{-1} grain).

The low average yield may be the result of insufficient weed control, producing lentils on marginal areas with minimal fertilizer inputs, and poor crop management practices. Fertilizers have a significant role in today's crop production and productivity. Many factors including genotype, ambient conditions, soil fertility

and cultural practices, influence seed yield and its components (Golzarfar *et al*., 2012). The residual minerals may seep to deeper layer causing irreversible damage to the soil structure, mineral cycles, soil microbial flora and plants (Solanki *et al*., 2015). Microelements are essential for crop development and quality. They play important role in plant growth and metabolic processes related with photosynthesis, chlorophyll formation, cell wall development and respiration, water absorption, xylem permeability, disease resistance and enzyme activities.

Weeds have been reported to diminish lentil output by 73% (Phogat *et al*., 2003) and at extreme weed densities, losses can even exceed 100%. Due to its sluggish initial development, small height and shallow root structure, lentil has a high weed infestation rate. Hand weeding is the most efficient way to controlling weeds in lentil. However, this method can only be used successfully on small farms where there is an adequate supply of labour. Herbicide usage as a substitute to hand weeding may be practical and more cost-effective (Bijarnia *et al*., 2023). Pre-emergence herbicides, such as pendimethalin, are only effective for the first 30 days after application; beyond that, the crop becomes infected with weeds. Therefore, it is necessary to promote the use of post-emergence herbicide in lentil. To increase quality and profitability, the most efficient and cost-effective weed control and fertilizer management techniques must be developed. In light of these factors, the current experiment was created to identify the ideal fertilizer and weed control method for lentil crops.

MATERIALS AND METHODS

Field experiment was conducted during rabi season of 2021-22 and 2022-23 at Research Farm of Department of Agronomy, Rajasthan College of Agriculture, MPUAT, Udaipur, India to examine the performance of lentil under varying nutrient and weed management practices. The experimental site is situated at 24°35′N latitude, 72°42′E longitude and at altitude of 581.13 metre above the mean sea level (MSL) in the Sub-Humid Southern Plain and Aravali Hills. The experimental soil was clay loam with slightly alkaline reaction (pH 8.2 and 8.1), organic carbon (0.54 and 0.56%), medium available nitrogen (278 and 278.2 kg/ha) and phosphorus (18.90 and 19.20), and rich potassium (370.8 and 372.6 kg/ha). The experiment was replicated thrice in Factorial Randomized Block Design (FRBD) with nutrient management practices as factor A viz., 100% RDF, 75% RDF + one spray of each 2 ml/l nano DAP and nano Zn at flowering initiation, 50% RDF + one spray of each 2 ml/l nano DAP and nano Zn at flowering initiation, 75% RDF + two spray of each 2 ml/l nano DAP and nano Zn at flowering and pod initiation and 50% RDF + two spray of each 2 ml/l nano DAP and nano Zn at flowering and pod initiation and four weed management practices viz., Weedy check, Two hand weeding at 20 and 40 DAS, Pendimethalin 30 EC @ 1.0 kg/ha PE and Imazethapyr 35% + imazamox 35% WG @ 70 g/ha PoE at 20 DAS as factor B. A uniform dose of 20, 40, 20 kg N, P_2O_5, K_2O/ha was applied to different plots as per the treatment requirements through urea, DAP and Muriate of potash respectively. Lentil variety Kota masoor-4 was sown on 19 November in 2022 and 22 November in 2023, respectively using a seed rate of 40 kg/ha at row spacing of 30 × 10 cm and following all standard package and practices. Hand weeding was done with the help of khurpi at an interval of 20 and 40 DAS. As per treatments, pendimethalin was sprayed one day after sowing "as pre-emergence" while, imazethapyr + imazamox was applied twenty days after sowing "as post-emergence". The herbicides were sprayed with a knapsack sprayer fitted with flat fan nozzle using 500 litres of water per hectare after calibration. In the earmarked plots the weeds were removed manually at 20 and 40 days after sowing (DAS).

Weed density was counted from two randomly selected area of 0.25 m^2 using 0.5 m × 0.5 m quadrate at 30 DAS and expressed as numbers m^2. The mean data was subjected to square root transformation $\sqrt{x+0.5}$ to normalize their distribution (Gomez and Gomez 1984). Chlorophyll content of fresh leaves samples from each experimental plot was analysed at 30 DAS following the procedure laid down by Arnon (1949) using 80% acetone. The total chlorophyll content was determined by the following formula and content expressed in mg/g fresh weight of leaves.

Total chlorophyll content (mg/gfresh weight)

$$= \frac{20.2\,(A\,645) + 8.02\,(A663)}{a \times 100 \times W} \times V$$

chlorophyll 'a' (mg/gfresh weight)

$$= \frac{12.7\,(A\,663) - 2.69\,(A645)}{a \times 100 \times W} \times V$$

chlorophyll 'b' (mg/gfresh weight)

$$= \frac{22.2\,(A\,645) - 4.68\,(A663)}{a \times 100 \times W} \times V$$

where,

A = absorbance specific wave length

A = length of light path in the cell (usually 1 cm)

V = volume of extract (ml)

W = fresh weight of leaf sample (g)

RESULTS AND DISCUSSION

A. Weed density (no./m^2)

The perusal of data described in Table 1 reveal that nutrient management practices was found to be non-significant effective in reduction of total weed population (no./m^2). Among weed management practices, two hand weeding at 20 and 40 DAS brought the significantly reduction in the density of grassy, broad-leaved and total weeds over all the other treatments during both years as well as pooled basis. Hand weeding twice removed the weeds completely and created condition more favourable for crop growth and ultimately resulted in the lowest density of later emerged weeds during the crop growth period. Our results are similar the findings of Poonia and Pithia (2013); Chavada *et al.* (2017).

Table 1: Effect of nutrient and weed management practices on weed density at 30 DAS.

Treatments	Weed density (m^{-2})								
	Grassy			Broad-leaved			Total		
	2021-22	2022-23	Pooled	2021-22	2022-23	Pooled	2021-22	2022-23	Pooled
Nutrient management practices									
100% RDF	2.67 (7.63)	2.75 (8.08)	2.71 (7.85)	5.01 (29.85)	5.07 (30.54)	5.04 (30.20)	5.65 (37.48)	5.74 (38.62)	5.69 (38.05)
75% RDF + one spray of each 2 ml/l nano DAP and nano Zn at flowering initiation	2.59 (6.93)	2.64 (7.18)	2.62 (7.05)	4.92 (28.81)	4.97 (29.60)	4.95 (29.21)	5.52 (35.74)	5.60 (36.77)	5.56 (36.26)
50% RDF + one spray of each 2 ml/l nano DAP and nano Zn at flowering initiation	2.64 (7.27)	2.71 (7.55)	2.68 (7.41)	4.95 (29.16)	5.01 (30.22)	4.98 (29.69)	5.58 (36.43)	5.67 (37.78)	5.63 (37.10)
75% RDF + two spray of each 2 ml/l nano DAP and nano Zn at flowering and pod initiation	2.54 (6.79)	2.60 (7.08)	2.57 (6.94)	4.75 (27.40)	4.89 (27.96)	4.82 (27.68)	5.35 (34.19)	5.50 (35.04)	5.42 (34.62)
50% RDF + two spray of each 2 ml/l nano DAP and nano Zn at flowering and pod initiation	2.54 (6.87)	2.63 (7.23)	2.58 (7.05)	4.85 (27.99)	4.93 (28.42)	4.89 (28.20)	5.44 (34.86)	5.56 (35.65)	5.50 (35.26)
SEm±	0.09 (0.44)	0.08 (0.44)	0.06 (0.31)	0.07 (0.62)	0.09 (0.98)	0.06 (0.58)	0.09 (0.82)	0.10 (1.10)	0.07 (0.68)
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS
Weed management practices									
Weedy check	3.89 (14.64)	3.94 (15.04)	3.91 (14.84)	8.68 (74.82)	8.75 (76.18)	8.71 (75.50)	9.48 (89.45)	9.57 (91.22)	9.53 (90.34)
Two hand weeding at 20 and 40 DAS	1.47 (1.67)	1.56 (1.95)	1.52 (1.81)	2.73 (7.01)	2.91 (8.03)	2.82 (7.52)	3.02 (8.68)	3.22 (9.98)	3.12 (9.33)
Pendimethalin 30 EC @ 1.0 kg/ha PE	2.77 (7.32)	2.82 (7.61)	2.80 (7.47)	3.92 (14.99)	3.95 (15.20)	3.94 (15.09)	4.76 (22.31)	4.82 (22.81)	4.79 (22.56)
Imazethapyr 35% + imazamox 35% WG @ 70 g/ha PoE at 20 DAS	2.26 (4.75)	2.35 (5.09)	2.30 (4.92)	4.26 (17.76)	4.28 (17.99)	4.27 (17.88)	4.78 (22.51)	4.84 (23.09)	4.81 (22.80)
SEm±	0.08	0.07	0.05	0.06	0.08	0.05	0.08	0.09	0.06
CD (P=0.05)	0.23	0.21	0.15	0.18	0.23	0.15	0.22	0.25	0.17

Table 2: Effect of nutrient and weed management practices on chlorophyll content at 30 DAS.

Treatments	Chlorophyll content (mg/g f.w.)									
	Chlorophyll "a"			Chlorophyll "b"			Total chlorophyll			
	2021-22	2022-23	Pooled	2021-22	2022-23	Pooled	2021-22	2022-23	Pooled	
Nutrient management practices										
100% RDF	1.317	1.326	1.321	0.597	0.606	0.601	1.914	1.932	1.923	
75% RDF + one spray of each 2 ml/l nano DAP and nano Zn at flowering initiation	1.290	1.302	1.296	0.570	0.582	0.576	1.860	1.884	1.872	
50% RDF + one spray of each 2 ml/l nano DAP and nano Zn at flowering initiation	1.261	1.272	1.266	0.546	0.555	0.551	1.807	1.827	1.817	
75% RDF + two spray of each 2 ml/l nano DAP and nano Zn at flowering and pod initiation	1.297	1.309	1.303	0.577	0.589	0.583	1.875	1.897	1.886	
50% RDF + two spray of each 2 ml l^{-1} nano DAP and nano Zn at flowering and pod initiation	1.277	1.289	1.283	0.557	0.569	0.563	1.834	1.859	1.846	
SEm±	0.009	0.011	0.007	0.009	0.010	0.007	0.018	0.020	0.014	
CD (P=0.05)	0.027	0.030	0.020	0.026	0.028	0.019	0.052	0.059	0.039	
Weed management practices										
Weedy check	1.275	1.290	1.283	0.555	0.570	0.563	1.830	1.861	1.845	
Two hand weeding at 20 and 40 DAS	1.303	1.306	1.305	0.583	0.589	0.586	1.887	1.894	1.891	
Pendimethalin 30 EC @ 1.0 kg/haPE	1.287	1.303	1.295	0.571	0.583	0.577	1.857	1.886	1.872	
Imazethapyr 35% + imazamox 35% WG @ 70 g/ha PoE at 20 DAS	1.289	1.299	1.294	0.569	0.579	0.574	1.857	1.878	1.868	
SEm±	0.008	0.010	0.006	0.008	0.009	0.006	0.016	0.018	0.012	
CD (P=0.05)	0.024	0.027	0.018	0.023	0.025	0.017	0.047	0.052	0.035	

On pooled basis, application of pendimethalin 30 EC @ 1.0 kg/ha PE and imazethapyr 35% + imazamox 35% WG @ 70 g/ha PoE at 20 DAS resulted in 28.56 & 41.16 and 54.83 & 50.99 and 49.77 and 49.51 per cent reduction in density of grassy, broad-leaved and total weeds as compare to weedy check (3.91, 8.71 and 9.53/m^2). This might be due to the fact that pre-emergence herbicide controlled early flushes of weeds, while post-emergence herbicide and hand weeding destroyed late flushes of weeds. Therefore, following pre-emergence application and during the important period of crop-weed competition in the event of post-emergence, the crop maintained its weed-free status for a much longer period of time than weedy check. (Tariq *et al.*, 2022). Due to its soil action, pendimethalin initially prevented weed seed germination. Barla and Upasani (2022); Rana *et al.* (2019) also reported lower weed density and dry weight under application of pendimethalin and imazethapyr + imazamox in lentil. Shiv *et al.* (2023) ; Dubey *et al.* (2018) have reported that pre-emergence pendimethalin and post-emergence imazethapyr + imazamox were superior over weedy check in lowering total weed density and dry matter.

B. Chlorophyll content

Recommended dose of fertilizer had a significant impact on the chlorophyll content: a, b and total at 30 DAS (Table 2). Data reveal that application of 100% RDF significantly increased chlorophyll "a", "b" and total content in leaves during both the years. On pooled basis, application of 75% RDF + two spray of each 2 ml/l nano DAP & nano Zn at flowering and pod initiation, 75% RDF + one spray of each 2 ml/l nano DAP & nano Zn at flowering initiation and 50% RDF + two spray of each 2 ml/l nano DAP & nano Zn at flowering and pod initiation was recorded significantly increased chlorophyll "a" (1.303, 1.296 and 1.283 mg/g fresh weight), "b" (0.583, 0.576 and 0.563 mg/g fresh weight) and total content (1.886, 1.872 and 1.846 mg/g fresh weight), respectively, in leaves over 50% RDF + one spray of each 2 ml/l nano DAP & nano Zn at flowering initiation.

The two main pigments in plant photosystems are chlorophyll a and chlorophyll b. These chemicals' concentrations reveal details about plant vigour, production, and environmental quality (Geetanjali, *et al*., 2023). In addition, chlorophyll a has a concentration that is 2-3 times greater than chlorophyll b and is the main pigment involved in photosynthetic activity in plants (Saha *et al*., 2022). It is well known that using the right crop nutrition may improve a variety of physiological and metabolic processes in plants. As it is required for the creation of proteins, chlorophyll, and other organic molecules in the plant system, nitrogen is the most important mineral nutrient (Sarwar *et al*., 2019).

Phosphorus is the main ingredient of the coenzymes ATP and ADP, which are used by plants as a form of storehouse for energy (Singhal *et al*., 2015). Application of phosphorus affects cytoplasm streaming, membrane transport and the synthesis of proteins, phospholipids, nucleic acids, and proteins (Yadav *et al*., 2023). As a cofactor or activator for several enzymes involved in the metabolism of proteins and carbohydrates, potassium helps with osmotic and ionic regulation. Similar results were attained by Khan *et al*. (2021); Kristiono and Muzaiyanah (2021), namely an improvement in chickpea growth characteristics as a result of the use of organics.

CONCLUSIONS

The highest value of chlorophyll a, b and total content was observed under 100% RDF followed by 75% RDF + two spray of each 2 ml/l nano DAP & nano Zn at flowering and pod initiation. Among herbicidal treatments, application of pendimethalin 30 EC@ 1.0 kg/ha was the best treatment with respect to weed control. Based on two-year research findings, it is recommended that application of 100% RDF to achieve higher chlorophyll content of lentil and maximum weed control with pendimethalin 30 EC@ 1.0 kg/ha under agro-climatic condition of Rajasthan.

FURTHER SCOPE

Based on the results of present investigation, effect of nutrient and weed management through different source of nutrients and weed control method on crop should be sequence needto be studied for improving yield and quality of crop to minimized environmental pollution due to more use of traditional fertilizer.

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Conflict of Interest. None.

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