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Research Article

STUDY ON THE PERFORMANCE OF DIFFERENT SEED RATE AND SEED PRIMING TREATMENTS ON GROWTH AND YIELD OF LENTIL (*Lens culinaris* M.)

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Abstract: The field experiment was conducted during *Rabi* 2017-2018 to study on the performance of different seed rate and seed priming treatments on growth and yield of lentil (*Lens culinaris* M.). The experiment consisted of 12 scheduling treatments *viz*, seed rate (40,45,50 kg ha^{-1}) and seed priming (no priming, hydro priming, osmo priming, hormone priming) using factorial randomized block design with three replications. A keen observation of the data revealed that different seed rates sowing of lentil crop with seed rate of 50 kg ha^{-1} resulted in significantly higher growth and yield followed by seed rate of 45 kg ha^{-1}. Among different seed priming treatments hormone primed seed (GA_3) produced significantly superior plants with higher productivity. Application of 50 kg ha^{-1} seed rate and hormone primed seed (GA_3) also realized significantly higher gross returns, net returns and B:C ratio and it was followed by seed rate of 45 kg ha^{-1} with osmo- primed seed (KNO_3).

Keywords: *GA_3, Lentil, Seed rate, Seed priming*

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Introduction

Lentil (*Lens culinaris* M.) is an important grain legume crop in the world, belongs to Fabaceae family and papilionidae subfamily. Lentil is rich in protein and contains high concentration of essential amino acids like isoleucine and lysine, as well as other nutrients like dietary fiber, folate, vitamin B1 and minerals. Lentil is very nutritious and its protein content is usually between 23-27% and its digestion is easier than other pulses [1]. In India, lentil is cultivated over an area of 1.28 million ha with total production of 0.98 million tonne [2]. In Punjab, it covers about 0.9 thousand ha area with total production of 0.6 thousand tonne [3]. Seed rate plays an important role in maintaining plant population of the crop. Higher seed rates may show to be a benefit in some areas, depending on conditions and disease risks. Thus, optimum seed rate is pre-requisite for better growth and achieving higher yield. Several causes are responsible for low yield of lentil of which the use of traditional local cultivars, low plant density unit-1 area weed infestation and poor crop management practices constitute the major ones. Use of the high yielding lentil cultivars and maintenance of proper plant density unit-1 area would thus help in increasing the yield from unit-1 area. Optimum spacing can also effect proper growth of the aerial and underground parts of the plant through efficient utilization of solar radiation, nutrients, water, land as well as air spaces [4]. High quality seeds play a major role in successful crop production. Seed priming could play an important role to increase germination, reduce seedling emergence time, improve stand establishment and yield. Seed priming is a pre-sowing strategy for seedling growth by regulating pre-germination metabolic activity. The priming is enabling to be hydrated enough so that the early stages of germination will be done, but roots don't come out. Seed priming can be accomplished in different ways and with specific goals that can include hydro-priming, osmo-priming and hormonal priming *etc*. These treatments enhance germination, seedling growth rate and increase crop yield under normal and stress conditions [3]. During priming, seeds are partially moisturised, so that pre-germinative metabolic activities advance, while radical protrusion is obviated and then seeds are dried back to the original moisture level.

The productive effects of seed priming have been demonstrated for many field crops such as lentil, mung bean *etc*. The main effects on lentil crop is to increment the yield attributes and shelf life of seeds [6]. Priming of growth regulators may help the physiological efficiency and may play a significant role in raising the productivity of the crop. Usually lentil produces large number of flowers but most of them drop resulting in poor yield [7].

Materials and Methods

The field experiment was conducted during Rabi season of the year 2017-18 at Campus for Research and Advanced Studies, Dhablan, Post Graduate Department of Agriculture, General Shivdev Singh Diwan Gurbachan Singh Khalsa College, Patiala. The experiment was laid out with twelve treatments and three replications, in Factorial Randomized Block Design (FRBD). The gross and net plot size were 4.00 x 3.00 m^2 and 3.55 x 2.55 m^2 respectively. The following treatments were applied: T_1: No primed seed @ 40 kg ha^{-1}; T_2: Hydro primed seed @ 40 kg ha^{-1}; T_3: Osmo- primed seed (with KNO_3) @ 40 kg ha^{-1}; T_4: Hormone primed seed (GA_3) @ 40 kg ha^{-1}; T_5: No primed seed @ 45 kg ha^{-1}; T_6: Hydro primed seed @ 45 kg ha^{-1}; T_7: Osmo- primed seed (with KNO_3) @ 45 kg ha^{-1}; T_8: Hormone primed seed (GA_3) @ 45 kg ha^{-1};T_9: No primed seed @ 50 kg ha^{-1}; T_{10}: Hydro primed seed @ 50 kg ha^{-1}; T_{11}: Osmo- primed seed (with KNO_3) @ 50 kg ha^{-1}; T_{12}: Hormone primed seed (GA_3) @ 50 kg ha^{-1}. All the mentioned treatments were applied to lentil cultivar- LL 931.During the trail, there was no use any kind of herbicides/weedicides. The recommended package of practices was followed for other cultural operations.

Results and Discussions

Growth attributes

Various growth parameters *viz*., plant height (cm), number of leaves plant-1, number of branches plant-1, dry weight (gm^{-2}). Among different seed rates, significant difference was observed at various growth stages.

Table-1 *Effect of different seed rates and seed priming treatments on plant height (cm), number of leaves plant-1and number of branches plant-1 at harvest of lentil*

Treatment	Plant height at harvest (cm)	Number of leaves plant^{-1} at harvest	Number of branches plant^{-1} at harvest
Seed rate (kg ha^{-1})			
40	14.46	1292.83	463.50
45	16.03	1634.31	773.58
50	19.08	1810.58	709.58
SE(m) ±	0.81	76.39	13.70
CD (P=0.05)	1.67	158.44	28.42
Seed priming			
No priming	15.91	1092.00	561.78
Hydro primed seed	15.08	2102.11	743.11
Osmo- primed seed (with KNO_3)	19.07	1809.50	666.00
Hormone primed seed (GA_3)	16.04	1313.36	624.67
SE(m) ±	0.93	88.21	15.82
CD (P=0.05)	1.28	182.95	32.82

Table-2 *Effect of different seed rates and seed priming treatments on no. of pods plant-1, no. of seeds pod-1 and test weight (g) of lentil*

Treatment	No. of pods plant^{-1}	No. of seeds pod^{-1}	Test weight (g)
Seed rate (kg ha^{-1})			
40	22.96	1.19	21.58
45	23.84	1.26	21.33
50	24.29	1.25	21.50
SE(m) ±	0.61	0.05	0.99
CD (P=0.05)	NS	NS	NS
Seed priming			
No priming	23.71	1.26	21.00
Hydro primed seed	24.62	1.24	21.22
Osmo- primed seed (with KNO_3)	23.49	1.22	22.00
Hormone primed seed (GA_3)	22.96	1.21	21.67
SE(m) ±	0.70	0.06	1.14
CD (P=0.05)	NS	NS	NS

Table-3 *Effect of different seed rates and seed priming treatments on grain, biological and straw yield; and harvest index of lentil*

Treatment	Grain yield (q ha^{-1})	Biological yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvest index
Seed rate (kg ha^{-1})				
40	9.18	25.35	16.17	36.21
45	10.08	28.40	18.33	35.48
50	12.03	32.90	20.88	36.55
SE(m) ±	0.23	0.58	0.63	1.34
CD (P=0.05)	0.48	1.20	1.31	NS
Seed priming				
No priming	8.37	21.83	13.47	38.32
Hydro primed seed	9.47	28.87	19.40	32.80
Osmo- primed seed (with KNO_3)	11.68	31.80	20.12	36.72
Hormone primed seed (GA_3)	12.20	33.03	20.83	36.93
SE(m) ±	0.27	0.67	0.73	1.55
CD (P=0.05)	0.56	1.39	1.52	3.20

Further with the advancement of growth stages, significant taller plants were observed with 50 kg ha^{-1} seed rate at harvest and it is might be due to more competition for light under dense population which resulted in the enhancement of plants. Among different seed priming treatments at harvest, the significant increase in plant height with hormone priming is owing to reason that (GA_3) stimulates rapid stem and root growth whereas, osmo- priming (KNO_3) makes nitrogen rapidly available which enhanced the plant height. Osmo- priming which supported the early emergence resulting in faster growth and ultimately more plant height of the lentil crop. These results are in agreement with the findings of Singh (2017) [8]. Similar results were also observed by Senthil (2003) [9] and Jaya, *et al*., (2008) [10].

Among different seed rates, significant higher number of leaves were observed with 50 kg ha^{-1} seed rate at harvest which is might be due to increased seed rate which resulted in the enhancement of leaves per plant. Among different seed priming treatments, the higher number of leaves with hydro priming is might be due to increased enzymatic activities which ultimately led to a greater number of leaves of lentil crop. With the advancement of growth stages, significant higher number of branches were observed with 45 kg ha^{-1} seed rate at harvest which is owing to increased seed rate which resulted in significantly a greater number of branches. At harvest, hydro primed seed treatment produced significantly highest number of branches due to increase the enzymatic activities which ultimately increased a greater number of branches of the lentil crop. Singh and Singh (2002) [11] also corroborated the similar findings.

Yield attributes and yield

Among different seed rate and seed priming treatments, no significant difference was observed in number of pods of lentil crop due to different seed rate and seed priming treatments. Hoque (2002) [12] obtained similar findings in number of pods plant-1.The data presented in [Table-2] revealed that among different seed rates and seed priming treatments, no significant difference was observed at each yield attributes as no significant difference was observed in number of seeds pod-1 of lentil crop due to different seed rates and seed priming treatments. This result is quite similar to the findings of Parveen and Bhuiya (2010). No significant difference was observed in test weight of lentil crop due to seed rates treatments. Newaj, *et al*., [13] and Tripathi, *et al*., (2007) [14] corroborated similar findings in lentil crop.

Further with the advancement of yield attributes, significant highest grain yield was observed with 50 kg ha^{-1} seed rate due to increased seed rate; as it increased various growth and development parameters i.e. plant height (cm), number of branches plant-1, number of pods plant-1 and number of seeds pod-1.

The maximum grain yield with hormone priming is might be due to the cell division and enlargement character of (GA_3) hormone priming which support the grain yield of lentil crop. The result is in close agreement with those reported by Lhungdim, *et al*., (2014) [15]. The highest straw yield was observed with 50 kg ha^{-1} seed rate which might be due to increased seed rate. The increase in straw yield with hormone primed seed (GA_3) is might be due to the reason that it increases the elongation of stem of hormone priming which supported the straw yield of lentil crop. Iliger and Alagundagi (2017) [16] reported similar findings in lentil crop. With the advancement of yield attributes, significantly highest biological yield was observed with 50 kg ha^{-1} seed rate owing to increased seed rate as the optimum plant population is an important factor to realize the potential yields as it directly affects plant growth and development. When plants are widely spaced, biological yields tend to increase linearly with increase in plant density.

The maximum biological yield with hormone priming is might be due to the cell division and enlargement character of (GA_3) hormone priming which support the grain yield of lentil crop. This result is quite similar to the findings of Tripathi *et al*., (2007) and Singh (2017). Among different seed rates, no significant difference was observed in harvest index of lentil crop due to different seed rates. The maximum harvest index with no priming is might be due to reason that seed was not treated with any chemicals so that harvest index was higher in lentil crop.

Conclusion

Among different seed rates sowing of lentil crop, seed rate of 50 kg ha^{-1} resulted in significant higher growth and yield followed by seed rate of 45 kg ha^{-1}. Among different seed priming treatments, hormone primed seed (GA_3) produced significantly superior plants with higher productivity.

Application of research: Application of 50 kg ha^{-1} seed rate and hormone primed seed (GA_3) also realized significantly higher gross returns, net returns and B:C ratio and it was followed by seed rate of 45 kg ha^{-1} with osmo- primed seed (KNO_3).

Research Category: Agronomy

Abbreviations: DAS: days after sowing, CD: Critical difference, GA_3: gibberellic acid, q: quintal

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Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
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