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Research Article

EFFECT OF SEED PRIMING AND FOLIAR UREA SPRAY ON YIELD AND ECONOMICS IN LENTIL (*Lens culinaris*) UNDER RAINFED CONDITION

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Abstract- A field experiment was carried out during winter (*rabi*) seasons 2005-06 and 2006-07 at Agricultural Research Station, Ummedganj, Kota to study the effect of seed priming and foliar urea spray at different growth stages on productivity and profitability of rainfed lentil. Seed priming (*i.e.*, soaking the seeds in water for 6 hrs) significantly improved higher plant stand/m^2 at harvest was recorded to the tune of 3.5 percent over no seed primed. Maximum taller plant (40.9 cm), branches/plant (5.3), pods/plant (111.3) and seeds/pod (1.8) over no seed primed. It had improved grain yield to the tune of 13.6 per cent and higher net return (₹2352/ha) and B: C ratio (0.22) over no seed primed. Foliar spray of 2 % urea at branching + pod initiation significantly improved plant height (42.2 cm), branches/plant (5.6), pods/plant (123.6) and seeds/pod (1.9) over no spray. Similarly, foliar spray of 2 % urea at branching + pod initiation significantly increased grain yield (1136 kg/ha) to the tune of 25.4 % and fetched maximum return of ₹9772/ha and B: C ratio (0.92) as compared to no spray.

Keywords- Lentil, Productivity, Profitability, Seed Priming, Rainfed, Urea, Yield

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Introduction

Lentil is the second most important *rabi* pulse crop grown over a wide range of environments and has considerable importance as source of protein for majority of vegetarian population in India. However, the productivity is low and unstable as most of the area under lentil cultivation is rainfed. The major constraints are being poor crop establishment and drought in the later stages of crop growth eventually affects the productivity. In India, farmers in rainfed tract are resource poor hence, development of low cost technologies to solve their problems are urgently required. The Rajasthan state has sizeable area 74.5 thousand hectares with annual production of 64.0 thousand tonnes and average productivity was only 859 kg/ha [1]. Lot of technologies tested across in India under rainfed conditions for ensuring proper crop stand, seed priming was found most promising option [2]. Priming process involves simply soaking the seeds in water usually for 6 hrs after shade drying prior to sowing. It hastens germination, enhances crop establishment and promotes seedling vigour hence neglecting the effects of low moisture in early stage of crop growth. Similarly, at later stages of crop growth under moisture stress especially at pod development stage, photosynthesis gets reduced due to depletion of nitrogen in leaves thus lead to acceleration of senescence of leaves [3]. Pods and seeds development are mainly dependent on carbon and nitrogen accumulation, prior to podding [4] as roots fail to absorb nitrogen from dry vertisol soils if applied at that time. Under such situations, nitrogen supply through 2 % urea in the form of foliar applications can be maintained. However, timing of foliar application varied under earlier studies. Therefore, a field study was under taken to evaluate the effect of seed priming and establishing proper time of foliar urea application under sub-tropical climatic conditions prevailing in central India for increased productivity of lentil.

Materials and Methods

A field experiment was conducted during *rabi* (winter) seasons of 2005-06 and 2006-07 at Agricultural Research Station (Agriculture University), Ummedganj, Kota to find out the effect of seed priming and optimum time of urea foliar application for increasing the productivity and profitability of lentil under rainfed situations. The soil of the experimental field was clay loam, slightly alkaline in reaction (pH 7.5), poor in organic carbon (4.1 g/kg), low in available nitrogen (278.5 kg/ha), phosphorus (20.5 kg/ha), sulphur (16.1 kg/ha) and medium in available potassium (292.5 kg/ha). The experiment was carried out in factorial randomized block design comprising treatments of seed priming for 6 hrs and no seed priming and five foliar spray of 2 % urea (no spray, one spray at branching, one spray at flower initiation, one spray at pod initiation and two sprays at branching & pod initiation) with three replications. The recommended dose of fertilizer (20 kg N, 17.5 kg P, 20 kg K/ha and 5 kg Zn) was applied through inorganic sources *viz.*, nitrogen through urea, phosphorus & sulphur through single super phosphate and potassium through muriate of potash and entire fertilizer dose was drilled before sowing. The lentil variety (DPL 62) was used during two consecutive years. Under seed priming treatment, the seeds were soaked in tap water for 6 hrs and then surface dried by placing them on ground floor for 1 hr then used for sowing purpose. The seeds were drilled at 30 cm and 5 cm inter and intra row spacing, respectively by adopting the seed rate of 60 kg/ha. Weeds were managed manually by hand weeding at 30 and 60 days after sowing (DAS). For mitigation of moisture stress, 2 % urea solution for foliar spray was prepared in water on w/v basis and applied as per treatment. The plant protection measures were taken up as and when required. In each plot five plants were randomly selected and tagged to record periodical biometric observations on growth and yield attributes. At maturity data on plant population, plant height, branches/plant, pods/plant, seeds/pod, 1000-seed weight and grain yield were recorded. Net returns as well as B: C ratios were also worked out. Environmental conditions varied considerably during the two consecutive seasons under study period with regards to temperature, rainfall and humidity. Soil moisture content

was recorded at the time of foliar sprays *i.e*., branching, flower initiation and pod initiation. Results of both the years were analyzed statistically and found similar results hence, pooling of data was carried out. All data were subjected to analysis of variance.

Results and Discussion

Growth and yield attributes

A perusal of data [Table-1] further revealed that seed primed practice significantly enhanced the plant stand/m^2, plant height, branches/plant, pods/plant and seeds/pod than the non-primed seed sowing practice. Generally, seed priming with water for 6 hrs enhanced early emergence of lentil and recorded more plant stand at harvest which was higher to the tune of 3.5 per cent over non-primed seed sowing. This might be probably due to faster water uptake, swelling of cotyledons with sufficient moisture and early initiation of metabolic processes. The overall germination counted on 10th day after sowing was found 88 % under seed priming compared to 81 % under non-primed seed sowing. It resulted better crop stand have been evident from higher number of plants/m^2 counted at harvest [Table-1]. Though, seedling vigour was also found faster under seed priming as compared to non-priming. Significantly taller plant (40.9 cm) was recorded under seed priming over non-priming which was higher to the tune of 6.8 per cent. Harris, (2006) also reported that increased enzymatic activity and early events of germination due to priming of chickpea seed [2]. Significantly, higher branches/plant (5.3), pods/plant (111.3) and seeds/pod (1.8) were also recorded under seed priming over non-seed priming. It was registered 12.8, 8.8 and 5.9 per cent higher over non-priming seed, respectively. The results are in line with the findings of Tanwar, *et al*., (2014) [5]. Foliar spray of 2 % urea had positive effect on growth as well as yield attributes of lentil compared to no spray [Table-1]. Irrespective of spray time and frequency, foliar application of 2 % urea solution at branching and pod initiation significantly improved plant height, number of branches/plant, pods/plant and seeds/pod over no spray. The Significantly taller plant (42.2 cm), branches/plant (5.6), pods/plant (123.6) and seeds/pod (1.9) were recorded with 2 sprays of urea at branching and pod initiation over no spray. However, it was remained on par with 1 spray at branching, flower initiation and pod initiation in seeds/pod. Which were higher 15.3, 27.3, 34.1 and 11.8 per cent over no spray, respectively. Similarly, one spray of urea 2 % either at branching, flower initiation or pod initiation had significant improvement in plant height, branches/plant, pods/plant and seeds/pod over no spray. Foliar spray of 2 % urea did not influence the test weight significantly over control. Using 2 % urea solution improved the nitrogen supply to leaf by foliar absorption might be delayed the senescence of leaves and allowed greater total assimilation and carbon remobilization to the seeds of additional pods. The results corroborate the finding of in chickpea [5].

Yield and economics

Sowing of primed seed of lentil showed beneficial effect on grain, protein content as well as economics as compared to no priming [Table-2]. Significantly and maximum grain yield (1088 kg/ha) and protein content (25.13 %) was recorded under seed priming over no seed priming which was 13.6 and 5.2 per cent higher over no priming, respectively. The cumulative effects of growth as well as yield attributes ultimately increased the grain yield of lentil. Kaur, *et al*., (2005) [6] indicated a stimulatory effect of seed priming on enzymatic activity and efficient translocation of photosynthates to the actively growing sink. Maximum and significantly higher gross return (₹19592/ha), net return (₹9123/ha) and benefit: cost ratio (0.87) was fetched under seed priming compared to no seed priming. It was registered higher to the magnitude of ₹2352/ha of net return and 0.22 of B: C ratio over no seed priming. Urea spray at flower initiation, pod initiation and 2 sprays at branching + pod initiation significantly increased grain yield of lentil [Table-2]. Significantly and maximum grain yield was recorded under 2 foliar sprays of 2 % urea at branching + pod initiation (1136 kg/ha) which was 25.4 per cent higher over no spray. However, single foliar spray of 2 % urea at flower initiation and at pod initiation also significantly increased grain yield over no spray and registered 17.0 and 14.7 per cent increased in grain yield over no spray, respectively. This might be due to improvement in branches/plant, number of pods/plant as well as seeds/pod. Whereas, protein content was significantly improved only 2 foliar sprays of 2 % urea at branching + pod initiation which was 6.1 per cent higher over rest of the treatments. The results are in line with the findings of Tanwar, *et al*., (2014) and Palta, *et al*., (2005) [5,7]. He further found that nitrogen taken up from foliar applications at flower initiation and at 50 % flowering was more than twice that from application at pod setting and the recoveries of foliar sprayed nitrogen in seed were higher and consistent with increase in protein content. This improved nitrogen supply to leaf by foliar absorption might have delayed the senescence of leaves and allowed greater total assimilation and carbon remobilization to the seeds of additional pods. Significantly and maximum gross return (₹20442/ha) and net return (₹9772/ha) was fetched under two foliar sprays of 2 % urea at branching + pod initiation to the tune of ₹4141/ha and ₹3740/ha followed by urea 2 % spray at flower initiation (₹8617/ha) and pod initiation (₹8230/ha) over no spray and one spray at branching. Significant improvement in benefit: cost ratio was recorded under two foliar sprays of 2 % urea at branching + pod initiation (0.92) remained on par with at flower initiation and at pod initiation over no spray and at branching. It was registered to the magnitude of 0.33, 0.23 and 0.20 over no spray, respectively. Interaction between seed priming and foliar application of urea were recorded non-significant.

Table-1 *Effect of seed priming and urea spray on growth parameters and yield attributes of lentil (Pooled data of 2 years)*

Treatment	Plant stand/m^2	Plant height (cm)	Branches/plant (Nos)	Pods/ plant (Nos)	Seeds / pod (Nos)	Test weight (g)
Seed Priming						
Primed	32.9	40.9	5.3	111.3	1.8	27.84
No primed	31.8	38.3	4.7	102.3	1.7	27.85
SEm+	0.32	0.53	0.07	1.69	0.02	0.12
CD (P=0.05)	0.91	1.52	0.19	4.86	0.06	NS
Foliar urea spray						
No spray	31.2	36.6	4.4	92.2	1.7	27.79
One spray at branching	31.5	39.8	5.0	96.9	1.8	27.82
One spray at flower initiation	32.6	40.0	5.0	114.4	1.8	27.84
One spray at pod initiation	33.1	39.4	5.0	106.8	1.8	27.84
Two spray at branching & pod initiation	33.3	42.2	5.6	123.6	1.9	27.93
SEm+	0.5	0.83	0.10	2.68	0.04	0.19
CD (P=0.05)	NS	2.40	0.30	7.69	0.10	NS

Table-2 *Effect of seed priming and urea spray on grain yield, protein content and economics of lentil (Pooled data of 2 years)*

Treatment	Grain yield (kg/ha)	Protein content (%)	Gross return (₹/ha)	Net return (₹/ha)	B: C ratio
Seed Priming					
Primed	1088	25.13	19592	9123	0.87
No primed	958	23.89	17240	6771	0.65
SEm ±	19.0	0.34	342	344	0.03
CD (P=0.05)	54.5	0.97	981	988	0.09
Foliar urea spray					
No spray	906	23.76	16301	6032	0.59
One spray at branching	975	24.18	17555	7085	0.68
One spray at flower initiation	1060	24.53	19086	8617	0.82
One spray at pod initiation	1039	24.89	18699	8230	0.79
Two spray at branching & pod initiation	1136	25.21	20442	9772	0.92
SEm ±	30.0	0.45	541	544	0.05
CD (P=0.05)	86.2	1.29	1552	1562	0.15

Conclusion

The present consecutive two years study revealed that the productivity of rainfed lentil can be improved by sowing the seeds soaked in water for 6 hrs and subsequently two foliar spray of 2 % urea at branching + pod initiation definitely improves grain yield.

Application of Research: Generally, pulses are grown under marginal and sub marginal soil having very poof resources like fertilizers and irrigation sources. Therefore, *rabi* grown pulses *i.e.*, lentil, chickpea and fieldpea are adversely affected due to low soil moisture status and terminal heat stress during maturity. Similarly, the productivity of lentil is low and unstable as most of the area falls under rainfed. The other constraints are being poor crop establishment and drought in the later stages of crop growth eventually affects the productivity. In India, farmers in rainfed tract are resource poor hence, development of low cost technologies to solve their problems are urgently required. Hence, the developed production technology of lentil cultivation through adoption of seed priming for proper plant population and vigour and foliar spray of urea 2 per cent at flowering and pod initiation stages in standing lentil crop definitely help for enhancing the reproductive phase and grain development under adverse rainfed conditions eventually for harvest higher grain yield.

Abbreviations:
DAS: Days after Sowing
B: C ratio: Benefit : Cost ratio
MULLaRP: Mungbean, Urdbean, Lentil, Lathyrus, Rajmash & Peas

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