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Evaluation of Lentil (*Lens culinaris* Medikus) varieties under varying seed rates in Low-hills of Uttarakhand

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ABSTRACT
A field experiment was conducted during winter season of 2017-18 at Agriculture Research Block, School of Agricultural Sciences, Shri Guru Ram Rai University to evaluate the performance of lentil (Lens culinaris Medikus) varieties with varying seed rates. There were six treatments comprising combinations of two varieties (V 1 : Pant L 234 and V 2 : Pant L 639) and three seed rates (S 1 : 30 kg, S 2 : 40 kg and S 3 : 50 kg) were tested in factorial randomized block design with four replications. The Grain yield was found to be non-significant with respect to variety. However, Pant L 234 gave 10% higher grain yield than Pant L 639. The Seed rate of 40 and 50 kg/ha resulted 6 and 11% higher seed yield than that at seed rate of 30 kg/ha and 40 kg/ha, respectively. The highest net returns and net B: C ratio was observed with variety Pant L 234 at seed rate of
50 kg/ha.
Key words: Lentil, Seed rate, Varieties, Grain yield, Seed yield, Net return

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Lentil is an important pulse legume grown during winter season throughout Indian sub-continent under varied agro-ecoloical conditions, soil types and cropping systems. In areas where winters are extremely cold, it is preferred over chickpea and pea owing to its tolerance to frost [5]. In low hills areas of Uttarakhand, lentil could follow rice or finger millet crop thereby increasing a substantial area under lentil if high yielding varieties of lentil are available for such conditions. Being a photo and thermo sensitive crop, choice of suitable variety or varieties in these conditions gets prime importance. Lentil is used as inter or mixed crop in wheat [1] and in brown sarson and oat [5] in mid hills of Uttarakhand and Kashmir. Due to various reasons improper crop establishment with optimum plant population is an area of concern. Further due to adverse environmental conditions, resulting lower plant productivity. To compensate the reduction in per plant productivity, maintenance of higher plant population by using higher seed rate, may be one of the ways, to get maximum yield. Further seed requirement of different varieties is variable due to variation in their growth and development behaviour and also in 1000-seed weight. The present investigation was therefore undertaken to find out suitable bold-seeded lentil variety or varieties and their optimum seed requirement in normal sowing conditions.

A field experiment was conducted during winter season of 2017-18 at Agriculture Research Block of School of Agricultural Sciences, Shri Guru Ram Rai University, Dehradun, Uttarakhand (29°58' N, 77°34' E with 650 m above mean sea level). The area has a typical subtropical climate, with severe cold winter and hot and dry summer and rainy season. Soil at the experimental site was sandy loam, pH 7.1 and medium in fertility for available nitrogen and phosphorus and rich in available potassium. Six treatments, comprising combinations of 2 varieties (V_1: Pant L 234 and V_2: Pant L 639) and 3 seed rates (S_1: 30 kg, S_2: 40 kg and S_3: 50 kg) were tested in factorial randomized block design with four replications. Lentil seed was sown on 18 November. Crop was sown at 25 cm row spacing. Total rainfall received during the crop season was 88.5 mm. Lentil was sown after pre-sowing irrigation using seed rates as per the treatments. Entire dose 20, 17.6 and 8.3 kg of NPK/ha for lentil crop were applied at the time of field preparation. One irrigation was given at the time of flowering. One hand hoeing was given at 5 weeks after sowing to control weeds. The crop was harvested on 15 April. For economic evaluation of the system, prevailing

market price was used for different outputs and inputs. The prices of different produce per kg used for calculation were: Rs 20 for lentil grains and Rs 0.50 for lentil straw. The inputs costs used for calculation of net returns were: Rs 115/manday, Rs 11/kg N, Rs 23/kg P, Rs 8/kg K and Rs 6,000/ha for land preparation, whereas the prices of plant-protection chemicals and seed were based on actual market price. For treatment comparisons, F-test was used following the procedures of factorial randomized block design.

Variety significantly influenced the plant height, plants/m row, 1000-grain weight (Table 1). Grain yield was found to be non-significant with respect to variety. However, Pant L 234 gave 10% higher grain yield than Pant L 639. This might be due to higher plant population at maturity and lower mortality as compared to Pant L 639. Singh and Singh [2] also reported that variations in seed yield of different lentil varieties. Increase in seed rate resulted in increase of plant height and plants/m row. However, branch/plant and pods/plant decreased with increase in seed rate. Similarly, increase in seed rate resulted in increase in seed yield/ha, though the difference was non-significant. Seed rate of 40 and 50 kg/ha resulted 6 and 11% higher seed yield than that at seed rate of 30 kg/ha and 40 kg/ha, respectively. No advantageous effect of increasing seed rate beyond 30 kg/ha in relation seed yield/ha might be owing to severe intra-row competition to the extent that it's adverse effect on seed yield/ha could not be proportionally counteracted by increase in plant population. Singh and Verma [4] reported significantly higher seed yield with 45 kg seed/ha over 60 kg seed/ha. Singh *et al.* [3] also reported higher seed yield at 37.5 kg seed/ha than those of 45 and 50 kg seed/ha. Interaction effect of variety and seed rate was found to be significant. All the growth and yield parameters were found to be significant except plant height. The highest grain yield was recorded with Pant L 234 (1679 kg/ha) sown at seed rate of 50kg/ha, however, it was at par with Pant L 234 sown at seed rate of 40 kg/ha. Similarly, the grain yield of Pant L 639 (1388 kg/ha) at seed rate of 30 kg/ha gave similar yield with that of Pant L 234 (1545 kg/ha) at 40 kg/ha indicating greater intra-row competition among plants particularly at higher seed rates.

The highest net returns and net B: C ratio was observed with Pant L 234 at seed rate of 50 kg/ha followed by 40 and 30 kg/ha (Table 2). At 30 kg seed/ha and 50 kg seed/ha Pant L 639 resulted similar net B:C ratio. Increase in seed rate of Pant L 234 resulted in increase of gross return, net returns and ultimately net benefit: cost ratio.

Thus, with respect to net returns and B: C ratio Pant L 234 at 50 kg seed/ha and Pant L 639 at 30 kg seed/ha found to be best in low hills region of Uttarakhand.

Table 1: Effect of varieties and seed rate on growth, yield and yield attributes of lentil

Treatment	Plant height (cm)	Plant/m row	Biological yield (kg/ha)	Grain yield (kg/ha)	1000-grain wt (g)	Branch /plant	Pods /plant	HI* (%)
Variety (*V*)								
Pant L 234	41.0	28.0	7255	1493	33.8	13.9	46.6	20.7
Pant L 639	34.1	26.2	6444	1358	39.8	13.6	45.9	21.1
SEm±	0.89	0.59	103	79	0.6	0.4	0.8	0.4
CD (P=0.05)	2.8	1.9	326	NS	2.0	NS	NS	NS
Seed rate (*kg/ha*) *(S)*								
30	37.4	24.4	6923	1321	36.0	16.2	48.7	19.1
40	39.1	28.4	6904	1400	37.8	12.4	47.6	20.3
50	36.3	28.7	6723	1556	36.6	12.7	42.5	23.2
SEm±	1.1	0.73	126	96	0.76	0.42	0.9	0.5
CD (P=0.05)	3.5	2.3	NS	NS	NS	1.4	3.0	1.5
Interaction (*V* x *S*)								
$V_1 S_1$**	41.1	25.0	7267	1255	34.1	16.1	49.5	17.3
$V_2 S_1$	33.6	23.7	6579	1388	37.8	16.3	47.9	21.1
$V_1 S_2$	42.0	28.7	7787	1545	33.1	12.3	48.2	19.8
$V_2 S_2$	35.0	28.0	6021	1255	42.4	12.4	47.0	20.8
$V_1 S_3$	39.9	30.3	6712	1679	34.1	13.3	42.2	25.0
$V_2 S_3$	32.6	27.0	6733	1433	39.1	12.1	42.7	21.3
SEm±	1.5	1.03	179	78	1.1	2.0	1.6	0.7
CD (P=0.05)	NS	3.2	565	242	3.4	0.62	4.6	2.0

*HI: Harvest index; **V_1: Pant L 234 and V_2: Pant L 639; S_1: 30 kg/ha, S_2: 40 kg/ha and S_3: 50 kg/ha

Table 2: Effect of varieties and seed rate on net returns and net B: C ratio

Treatment	Cost of cultivation (x 10^3 Rs/ha)	Net returns (x 10^3 Rs/ha)	Net B:C ratio*
V_1 S_1**	17.81	10.29	0.58
V_2 S_1	17.81	12.55	0.70
V_1 S_2	17.99	16.03	0.89
V_2 S_2	17.99	9.49	0.53
V_1 S_3	18.17	17.93	0.99
V_2 S_3	18.17	13.14	0.72

*Net B:C ratio – Net Benefit: Cost ratio; ** V_1: Pant L 234 and V_2: Pant L 639;
S_1: 30 kg/ha, S_2: 40 kg/ha and S_3: 50 kg/ha

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