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Effect of seed priming on growth parameters and yield of lentil (*Lens culinaris* Medic.)

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Abstract
An experiment was conducted to study the "Effect of seed priming on growth and yield of lentil (*Lens culinaris* Medic.) at New Dairy Farm, Kalyanpur, during Rabi season of 2016-17 & 2017-18 on lentil variety KLS-218. The experiment was comprised ten seed priming treatments *viz.*, T_0- Control, T_1- Seed priming with *Trichoderma harzianum* @ 1.5%, T_2- Seed priming with GA_3 @ 50ppm, T_3- Seed priming with Vitavax power @ 0.25%, T_4 - Seed priming with GA_3 @ 50ppm + seed coating with *Trichoderma harzianum* @ 15g/kg seed, T_5- Seed treatment with Bavistin @ 3g/kg seed, T_6- Seed priming with sodium molybdate @ 500 ppm, T_7- Seed priming with sodium molybdate @ 500ppm + seed coating with *Trichoderma harzianum* @ 15 g/kg, T_8- Seed priming with water, T_9- Seed priming with leaf extract of *Lantana camara* @ 10% .The present investigation revealed that seed priming with sodium molybdate @ 500 ppm + seed coating with *T. harzianum* @ 15g/ kg seed was significantly highest to improved the growth and seed yield parameters over unprimed (control) with highest field emergence (93.66%), number of plants per square meter (237.66), number of pods per plant (137.49), number of seeds per pod (1.81), seed yield per plot (1.22 Kg) & seed yield (12.20 q/ha). Treatment T_7 was the best priming treatment as it showed highest benefit cost ratio (1:2.49) which increase growth, yield and seed quality parameters and enhance to the farmer's income. T_1 (seed priming with *Trichoderma harzianum* @ 1.5%) was found second best priming treatment.

Keywords: seed priming, growth parameters, lentil, *Lens culinaris*

Introduction
Lentil is one of the important and most nutritious rabi pulse. The dal is made by splitting the grain in 2 cotyledons, which are deep orange red or orange yellow in colour. It is also rich in calcium (560 ppm), iron, and niacin. It has the lowest content of lectins and trypsin inhibitors among legumes. Since it is a leguminous crop, it improves the fertility of soil biological nitrogen fixation. In priming, seeds are soaked in different solutions with high osmotic potential. This prevents the seeds from absorbing in enough water for radicle protrusion, thus suspending the seeds in the lag phase (Taylor *et al.,* 1998) [13]. Seed priming has been commonly used to reduce the time between seed showing and seedling emergence and to synchronise emergence (Parera and Cantliffe, 1994) [10].

Seed priming is a controlled hydration technique where seeds are partly hydrated to allow metabolic events to occur without germination and are then re-dried to permit routine handling. Primed seeds usually have higher and synchronized germination (Farooq *et al*., 2009) [3] owing to simply a reduction in the lag time of imbibition taking place (McDonald, 2000) [8] buildup of germination-enhancing metabolites, metabolic repair during imbibition and osmotic adjustment. To control hydration seeds are placed in solutions with high osmotic potential. This prevents seeds from entering Phase III of hydration by extending and holding seeds within the lag phase (Phase II). As seeds are metabolically active during this period, they convert stored reserves for germination such that membrane and genetic repair is better than under normal imbibitions. Seeds are then removed from the priming solution, rinsed with water and dried. Such seeds germinate faster than non-primed seeds. Ghassemi-Golezani *et al.* (2013) observed that hydro-priming treatments to lentil seeds increased the plant height, number of pods and number of seeds per plant, the biological yield, the grain yield and the harvest index when compared to the control. The aim of this study was to research the effects of hormo-priming, bio-priming, and hydro-priming treatments to lentil seeds, to analyse the influence of such treatment over seed germination properties and some plant characteristics,

yield components and grain yield in an experiment conducted with field conditions.

Materials and Methods

The present investigation entitled "Effect of seed priming on growth and seed yield parameters of lentil (*Lens culinaris* Medic.). An experiment was conducted at New Dairy Farm, Kalyanpur, during rabi season of 2016-17 & 2017-18 on lentil variety KLS-218 with objectives, to find out the effect of seed priming on growth, yield attributing characters. The seed priming was done by soaking of required quantity of seeds of lentil variety KLS 218 in tap water and various chemicals concentration for 12 hours. Then the seeds were shade dried to obtain the seed moisture content of 11-13%. Ten tagged plants were randomly uprooted from following observations; growth characters- Field emergence (%), Plant height (cm), number of root nodules/plant, number of plants/m^2., number of pods/plant, number of seeds/pod, Incidence of diseases and pests, Seed yield (kg/plot), Seed yield (q/ ha). It was carried out according to the procedure of Randomized Complete Block Design for each character as per methodology advocated by Panse and Sukhatme (1967).

Result and Discussion

seed priming treatment T_7 (Seed priming with Sodium molybdate @ 500ppm + seed coating with *Trichoderma harzianum* 15g/kg seed) showed significantly highest values 93.66%, 237.66 plant, 137.49 pods, 1.81 seed, 12.20 q/ha & 1:2.49 B C ratio over control for most of the parameters with percent improvement viz. field emergence (9.76%), number of plants in $1m^2$ (18.83%), number of pods per plant (127.14%), number of seeds per pod (20.66%) & seed yield (q/ha) (19.60%) as shown in table-1, 2. 1% of sodium molybdate solution was as equally effective as soil application in improving growth and yield. The efficiency of seed priming with molybdate may be further enhanced by adding *Trichoderma harzianum* to the priming solution. Seed priming in sodium molybdate and *Trichoderma harzianum* significantly improved nodulation, N fixation, nutrient uptake, plant growth and seed yield. The present findings supported by earlier researchers, Mummigatti *et al.* (2013) [9] and Buts *et al.*, (2013).

Next priming treatment was T_1 (*Trichoderma harzianum* 1.5%) that exhibited 2nd position with values 92.99 %, 228.16 plants, 131.30 pods, 1.78 seeds & 11.90 q/ha, respectively and percent improvement for most of the parameters viz. field emergence (8.97%), number of plants in $1m^2$ (14%), number of pods per plant (116.91%), number of seeds per pod (18.66%) & seed yield (q/ha) (16.66 %), respectively. *Trichoderma harzianum* are endophytic plant symbionts that are widely used as seed treatments to control diseases and to enhance plant growth and yield. It enhances tolerance to abiotic stresses during plant growth, improvement in water holding capacity of plants and enhancement in nutrient uptake. The present findings supported by earlier researchers, Mummigatti *et al.*, 2013 [9]; Kumar *et al.* 2014 [5].

A part from the above treatment T_5 – Bavistin stood on 3rd rank by exhibiting 92.49 %, 12.50 cm, 9.93 nodules, 127.49 pods, 1.76 seeds, 11.70 q/ha & 1:2.38 B:C & its percent improvement for field emergence (8.39%), plant height (13.63%), number of root nodules per plant (9.93%), number of pods per plant (110.62%), number of seeds per pod (17.33%), seed yield (q/ha) (14.70 %) & benefit cost ratio respectively. The optimum amount of bavistin is treated before sowing which field emergence, number of pods per plant, weight of the seed, seed yield and decrease in many fungal diseases. The present findings supported by earlier researchers Buts *et al.*, (2013).

Table 1: Mean table for the effect of effect of seed priming treatments on seed quality parameters of lentil on pooled basis.

Treatment		Field emergence (%)	Plant height (cm)	No. of root nodules / plant	No. of plants / sq. m.	No. of pods / plant	No. of seeds / pod	Incidence of diseases and pests	Seed yield (kg / plot)	Seed yield (q / ha)
Control	T_0	85.33	11.00	6.05	199.99	60.53	1.50	12.00	1.02	10.20
Trichoderma harzianum (1.5 %)	T_1	92.99	11.66	12.05	228.16	131.30	1.78	8.72	1.19	11.90
GA_3 (50 ppm)	T_2	86.66	23.51	6.38	219.16	66.16	1.67	9.70	1.04	10.40
Vitavax power (0.25%)	T_3	91.99	11.24	6.60	217.16	95.91	1.71	7.84	1.09	10.90
GA_3 (50 ppm) + *Trichoderma harzianum* (15 g)	T_4	89.33	22.61	6.82	226.49	72.83	1.69	8.96	1.06	10.60
Bavistin (3g)	T_5	92.49	12.50	9.93	222.83	127.49	1.76	8.31	1.17	11.70
Sodium molybdate (500 ppm)	T_6	90.83	11.32	7.55	217.83	121.49	1.73	8.72	1.14	11.40
Sodium molybdate (500 ppm) + *Trichoderma harzianum* (15 g)	T_7	93.66	12.36	11.88	237.66	137.49	1.81	8.25	1.22	12.20
Tap water for 8 hours	T_8	86.99	11.73	7.27	216.66	107.66	1.75	10.60	1.13	11.30
Leaf extract of lantana camara 10%	T_9	87.66	11.39	6.49	213.50	77.99	1.67	9.32	1.07	10.70
$S.E_{(diff.)}$		1.79	0.30	0.22	4.38	2.33	0.03	0.21	0.02	0.19
$C.D_{(P=0.05)}$		3.80	0.65	0.48	9.28	4.93	0.07	0.45	0.05	0.42

Table 2: Mean table for the cost of seed priming per unit area (ha.) & B C ratio

Treatments	Cost of seed priming per unit area (ha.) & B C ratio					
	Cost of cultivation 2016 - 18 mean		Avg. Treatment cost	Gross mean	Net benefit	B C ratio
1	2		3	4	(4-2)	6
Control	T_0	40042	0.00	83600	43558	1:2.08
Trichoderma harzianum (1.5 %)	T_1	40057	15	97400	57343	1:2.43
GA_3 (50 ppm)	T_2	40067	25	85200	45133	1:2.12
Vitavax power (0.25%)	T_3	40073	31.25	89400	49327	1:2.23
GA_3 (50 ppm) + *Trichoderma harzianum* (15 g)	T_4	40127	85	86900	46773	1:2.16
Bavistin (3g)	T_5	40132	90	95900	55768	1:2.38
Sodium molybdate (500 ppm)	T_6	40087	45	93400	53313	1:2.32

Sodium molybdate (500 ppm) + *Trichoderma harzianum* (15 g)	T_7	40147	105	100000	59853	1:2.49
Tap water for 8 hours	T_8	40042	0.00	92600	52558	1:2.31
Leaf extract of lantana camara	T_9	40042	0.00	87700	47658	1:2.19

Conclusion

The present field investigation concluded that, the application of Sodium molybdate (500 ppm) + *Trichoderma harzianum* (15 g) as seed priming improve the physiological efficiency of crop and resulted in better growth and yield of lentil cv. KLS-218. Seed priming in enhancing productivity of lentil by improving parameters responsible for growth and yield. Treatment T_7 was the best priming treatment as it showed highest benefit cost ratio (1:2.49) which increase growth, yield and seed quality parameters and enhance to the farmer's income. T_1 (Seed priming with *Trichoderma harzianum* @ 1.5%) was found second best priming treatment.

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