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Effect of seed priming on growth, physiology and yield of lentil (*Lens Culinaris* Medie) *Cv.* Ndl-1

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Abstract
The present investigation entitled "Effect of seed priming on growth, physiology and yield of Lentil (*Lens culinaris* Medie) cv. NDL-1" was carried out at the experimental site of Department of Crop Physiology, Narendra Deva University of Agriculture & Technology, Kumarganj, and Faizabad-224229 (U.P.) during *Rabi* season 2012-2013 in Complete Randomized Design (RBD) with three replications and seven treatments on variety NDL-1. Observations were recorded at 30, 60 and 90 DAS. Cycocel (100 ppm, 200 ppm), GA_3 (250 ppm, 500 ppm) and IAA (250 ppm, 500 ppm) concentrations were used as treatments. The treatment was comprised of seed priming along with untreated control. The observations had been studied on growth, biochemical, yield and yield attributes parameters of the NDL-1. Seed priming was performed for 8 hours. It is resulted from the study that GA_3 500 ppm significantly increased all the parameters except number of branches and dry weight plant^{-1} followed by GA_3 250 ppm. Cycocel at both the concentration (100, 200 ppm) were found more effective in increasing number of branches and dry weight plant^{-1}. Hence, the use of PGRs in lentil crop enhancing production and productivity by improving responsible traits for growth and yield.

Keywords: Lentil, Physiology, Seed priming, GA_3, Cycocel

Introduction
Lentil (*Lens culinaris*) is a member of the Leguminaceae (Fabaceae) family, recognized as the most nutritious amongst *Rabi* pulses and rank next only to chickpea. It is grown throughout the northern and central India for grains, which are used as dal and other preparation as soups and casseroles. It is generally grown as rainfed crop during *Rabi* season after rice, maize and pearl millet. Lentil ranks fifth in the world production of pulses. Food and agriculture organization statistics indicates that the lentil is grown on about 3.4 million hectares. India produces nearly one-third of the world annual production largely for domestic consumption (Turan *et al*. 2007) [17]. Priming of seed is a physiological pre- conditioning which is widely used in various crops. Which includes subjective of seeds to cycle of wetting, drying and incubation at low temperature? Seed priming is normally practiced with water and can be improved further by selection of inorganic chemicals and growth regulators. Priming of growth regulators may improve the physiological efficiency and may play a significant role in raising the productivity of the crop. Normally lentil produces large number of flowers but most of them drop resulting poor yield. Available literatures suggest that growth regulators can be used as potential tools to enhance the yield of pulses by minimizing the several physiological constraints. Previously some workers have study with the same objectives i.e. Kaur *et al*., (2003) [8], Upadhyay (2004) [18], Das *et al*., (2004) [2], Sultan, (2005), Jafar *et al*., (2007), Jay Kumar *et al*., (2008), Chauhan *et al.*, (2009) [1], Islam *et al*. (2010) [6] and Islam *et al*., (2010) [6], still there are limited studies have been done on the role of growth regulators in overcoming low yield of Lentil and it is therefore considered imperative to study the effect of plant growth regulators on lentil with following aims as effect of PGRs on growth, yield attributes in Lentil and bio-chemical changes due to PGRs.

Material and methods
The present investigation entitled "Effect of seed priming on growth, physiology and yield of Lentil (*Lens culinaris* Medie) cv. NDL-1" was conducted at the experimental site of Department of Crop Physiology, N.D. University of Agriculture & Technology, Kumarganj, Faizabad (U.P.) during *Rabi* season of 2012-2013. The experiment was conducted in earthen pots with lentil variety NDL-1. The physio-chemical properties of soil *viz.*, texture- Sandy loam, pH-7.8, Organic carbon (0.64%), available nitrogen (256.50 kg/ha), available phosphorus (21.25 P_2O_5/ha), available potassium (28.75 K_2O/ha). Seed priming was done by soaking the seeds for 8 hours in distilled water Cycocel 100 ppm, Cycocel 200 ppm, GA_3 250 ppm, GA_3 500 ppm, IAA 250 ppm, IAA 500 ppm.

Afterwards, seeds were taken and then dried under shade for control the seeds soaked in distilled water is used. Each pot was lined with polyethylene bag and filled with 8 kg well pulverized soil.

Five tagged plants were randomly uprooted from fallowing observations; growth characters- plant height (cm), number of branches plant^{-1}, dry matter production plant^{-1}(g), number of nodules plant^{-1}, dry weight of nodules, number of flowers plant^{-1}, yield contributing traits- number of pods plant^{-1}, number of seeds pod^{-1}, number of seeds plant^{-1}, biological yield plant^{-1} (g/plant), 100 seed weight, seed yield plant^{-1}, harvest index (Beedle, 1982). Biochemical parameters- total chlorophyll content (mg/g) (Arnon 1949), nitrate reductase (µ g) (Jaworski 1971), protein content in seed (Lowery *et al.* 1951). The statistical analysis odone by using technique of "analysis of variance" for the complete randomized block design (CRBD) as described by Panse and Sukhatme (1978).

Result and discussion

Effect of PGRs on growth percentage-Effect of plant growth regulators *viz*., Cycocel, GA_3 and IAA had differential effect on growth. The result presented in (Table1), maximum plant height (57.7 cm) was found at 90 DAS with GA_3 (500 ppm) applied as seed priming. The lowest plant height was obtained in control. The increase in plant height may be due to stimulation of cell elongation, division and enlargement as reported by Jafar *et al*., (2007) in cowpea, Chauhan et al., (2009) [1] and Islam *et al*., (2010) [6] in black gram. At 90 DAS, number of branches was found maximum (11.21) with Cycocel (200 ppm) applied as seed priming. Both IAA and Cycocel applied as seed priming produced significantly higher number of branches over control at 30, 60 and 90 DAS of plant growth as reported by Das *et al*., (2004) [2], Sultan, (2005), Jay Kumar *et al*.,(2008) and Islam *et al*., (2010) [6]. It has been observed that application of Cycocel as seed priming produced maximum dry weight of plant & dry weight of nodules plant^{-1} at all the stages of growth. These findings were in agreement with Ogbonna and Abraham (1989) [11] and Kaur *et al*., (2003) [8]. GA_3 applied as seed priming produced maximum number of nodules followed by IAA. Prasad (1990), Beneficial effect of PGRs on flower was also reported by Upadhyay (2004) [18], Tripathi *et al*., (2007) [16] in chickpea.

Effect of PGRs on biochemical activity-The data recorded on total chlorophyll showed (Table 2) that all the treatments applied as seed priming favoured better growth of crop by enhancing chlorophyll content (9.00 mg g^{-1} fresh weight) in GA_3 and (8.16 mg g^{-1} fresh weight) in Cycocel treated plants at 60 DAS. Chlorophyllase enzyme which is responsible for chlorophyll degradation might have been inhibited by plant growth regulators. Similar result also reported by Jaya Kumar *et al.,* (2008) and Senthil (2003) [15]. The stimulated nitrate reductase activity in growth regulators treated plants might be due to the enhancement of nitrogen uptake by plants. Similar finding were also reported by Senthil (2003) [15] and Jaya Kumar *et al*., (2008). Seed protein content was improved with the application of all treatments applied as priming. The higher uptake and mobilization of nitrogen as evidenced by improved nitrate reductase activity might have involved in the enhanced synthesis of amino acids and thereby higher protein content. Similar results were also obtained by Jaya Kumar *et al.,* (2008).

Effect of PGRs on yield and yield component-The number of pods plant^{-1} (Table 1) was most responsive character, especially with GA_3 and Cycocel. These produced significantly higher number of pods plant^{-1} and this enhancement had greater impact on final yield. These results are in accordance to Hoque *et al*. (2002) [5] and Rahman *et al*., (2004) [14]. The application of GA_3 as seed priming was more effective than other PGRs and registered significant increase in number of seeds per pod over control. Similar findings were also reported by Newaj *et al*., (2002) [10] and Islam *et al*., (2010) [6]**.** The effect of seed priming with GA_3 produced highest effect on 100-seed weight. Earlier findings of Newaj *et al*., (2002) [10] in Mungbean and Tripathi *et al*., (2009) in chickpea support the result. The value of biological yield ranged from (14.81) to (15.75 g plant^{-1}). Application of PGRs as priming produced significantly higher biological yield over control. The data revealed that application of PGRs as seed priming favourably influenced seed yield plant^{-1}. The result is in close agreement with those reported by Tripathi *et al*., (2007) [16] and Dawood *et al*. (2012) [3]. Among all applied treatment, GA_3 enhanced harvest index numerically and showed higher value than other PGRs treatments. These findings confirmed the earlier views of Tripathi *et al*., (2009).

Table 1: Effect of Seed priming on growth, penology and germination % in Lentil

	Treatment	Plant height (cm)			Number of branches plant^{-1}			Dry weight plant^{-1} (g) (g)			Number of nodules plant^{-1}		Dry weight of nodules plant^{-1}		Number of flowers plant^{-1}	
		30 Das	60 Das	90 Das	30 Das	60 Das	90 Das	30 Das	60 Das	90 Das	60 Das	90 Das	60 Das	90 Das	60 Das	90 Das
T_1	Control	29.2	36.5	41.9	2.11	3.71	3.71	2.18	3.94	5.90	20.60	29.82	3.71	5.36	47.36	106.50
T_2	Cycocel l00 ppm	31.7	42.6	46.3	2.61	4.17	4.17	2.70	4.88	7.30	22.11	31.98	4.17	5.75	50.92	114.51
T_3	Cycocel 200ppm	32.7	42.6	47.0	2.75	3.98	3.98	2.85	5.15	7.69	23.21	33.58	3.98	6.03	54.30	122.10
T_4	GA_3 250 ppm	33.8	45.8	53.6	2.41	4.39	4.39	2.49	4.51	6.65	25.45	36.85	4.39	6.37	58.01	130.45
T_5	GA_3 500 ppm	35.9	49.5	57.7	2.25	4.83	4.83	2.34	4.23	6.22	26.85	38.85	4.83	6.99	65.35	146.95
T_6	IAA 250 ppm	30.4	38.0	43.7	2.48	4.57	4.57	2.58	4.67	6.98	24.41	35.40	4.57	6.63	49.96	112.35
T_7	IAA 500 ppm	31.0	38.7	44.5	2.35	4.26	4.26	2.45	4.44	6.72	23.51	34.25	4.26	6.14	49.17	110.56
	SEm±	1.20	1.81	1.77	0.10	0.18	0.18	0.09	0.19	0.24	0.86	1.45	0.18	0.26	2.30	4.40
	CD at 5%	3.64	5.51	5.39	0.31	0.54	0.54	0.27	0.58	0.74	2.63	4.41	0.54	0.68	6.98	13.35

Table 2: Effect of Seed priming on bio-chemical and yield parameters in Lentil

	Treatment	Chlorophyll content in leaves (mg g^{-1} fresh weight)			Nitrate reductase in leaves (µg nitrate produced g^{-1} fresh weight)			Protein content (mg/g)	No of pods $plant^{-1}$	No of seeds pod^{-1}	100 seed weight(g)	Biological yield $plant^{-1}$ (g)	Seed yield $plant^{-1}$ (g)	Harvest Index (%)
		30 Das	60 Das	90 Das	30 Das	60 Das	90 Das	-	-	-	-	-	-	-
T_1	Control	4.42	7.36	5.15	134.21	141.31	98.05	21.15	120.21	1.17	2.07	12.91	4.45	34.47
T_2	Cycocel l00 ppm	4.45	7.92	5.55	139.51	146.89	101.92	21.65	134.47	1.31	2.32	14.09	4.95	35.13
T_3	Cycocel 200ppm	4.90	8.16	5.72	141.73	149.22	103.53	21.88	148.72	1.45	2.55	14.81	5.45	36.82
T_4	GA_3 250 ppm	5.30	8.50	6.00	164.53	173.23	120.19	21.75	141.87	1.38	2.44	13.91	5.25	37.77
T_5	GA_3 500 ppm	5.56	9.00	6.36	185.35	195.15	135.40	22.79	157.15	1.53	2.60	15.75	5.85	37.14
T_6	IAA 250 ppm	5.05	7.60	5.32	144.38	152.01	105.57	21.45	137.26	1.35	2.36	14.39	5.08	35.31
T_7	IAA 500 ppm	4.65	7.76	5.30	153.91	162.24	112.43	21.55	128.75	1.25	2.22	13.78	4.81	34.83
	SEm±	0.21	0.30	0.24	5.55	6.87	4.05	0.92	5.39	0.05	0.10	0.56	0.22	1.41
	CD at 5%	0.03	0.91	0.73	16.84	20.84	12.30	NS	16.37	0.17	NS	1.70	0.67	NS

Conclusion

The present field investigation concluded that, the application of Cycocel, GA_3 and IAA as seed priming improve the physiological efficiency of crop and resulted in better growth and yield of lentil cv. NDL-1. The present findings indicate possibility of use of PGRs in enhancing productivity of lentil by improving parameters responsible for growth and yield.

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