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Evaluation of canola germination characteristics under priming condition

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Abstract

This study performed to evaluation of priming and priming duration effects on some germination' characteristics of two canola cultivars (Zurika and Talayeh) as factorial randomized complete design with three replications at the Besat Research Center, Fars Province, Iran. The first factor treatments included cultivars and second factor was salicylic acid in 3 levels (750, 1500 and 2250 M), ascorbic acid in 3 levels (200, 400 and 600 ppm), polyethylene glycol on 2 levels (-2 and -4 bar), potassium chloride 2 level (-5 and -10 bar) Brassinosteroid on 2 levels (20 and 40 micrograms per liter), gibberellic acid on 2 levels (100 and 200 mg), nano zinc chelate and nitrogen each at two levels (1 and 2 mg) and priming water, also third factor included priming duration at 3 levels (3, 6 and 12 h). Totally, according to result it was founded that priming had positive effect on germination characteristics also it was determined that gibberellic acid, salicylic acid and Ascorbic acid had highest effects in compared to other priming, with increasing of concentration and duration of priming, studied traits increased in responses to treatments. According to interaction between priming and duration, it was founding that highest radicle length (6.13 mm) and plumule weight (0.172 g) were obtained by BR20 for 3h duration, also KCL-5 treatment with 12h duration showed highest means for plumule length (4.19mm) and seedling length (52.37mm). The results showed that highest seedling weight (0.315 g), allometric coefficient (1.074) and weight vigor index (0.218) were obtained by GA100 for 3h.

Keywords: canola, cultivar, priming

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INTRODUCTION

Canola (*Brassica napus* L.) is an important agricultural crop, grown commonly for oil or biofuel production. After oil extraction, the high protein seed residue can be used as animal feed (Zare and Pakniyat 2012). Rapeseed is mainly cultivated in Europe, Asia, North America and Australia, in recent decades, winter oilseed rape production has a rapid increase. Oil seeds are known as one of the best protein and energy sources. Canola is an annual plant from Brassica family. The last released cultivars by FAO in 1999 showed that the most important oil sources in the world are soybean, oil palm and canola, respectively. At present, China and Canada are the greatest canola producers in the world. The use of canola between other oils is continuously increased because of its low saturated fatty acid content and effectiveness in human health. The germination is first step and one of the critical stages in the plant growth and life cycle of plants, in the last years great efforts is done to improve germination and seed vigor and seedling in special environments. One of the new methods is the use of priming. Seed priming could be caused to increasing of percentage of germination, seedling establishment, to accelerate flowering and maturity, drought tolerance and etc. (Harris et al. 2008). Also priming induces some biochemical necessary processes to begin the process of germination, such as breaking dormancy, hydrolysis or metabolism of inhibitors, water absorption and enzymatic activities. Kubbala et al. (2015) showed that improved germination of primed seeds was associated with higher abundance of proteins involved in the management of oxidative stress during post-priming germination. Also, Nasibi et al (2014) resulted that the adverse effects of salt stress on canola can be alleviated by the arginine pre-treatment through modulating activities of antioxidant enzymes. Noor-Un-Nisa et al. (2013) concluded that seed priming with boron is beneficial to improve germination and other growth related attributes of the

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seedlings. There are different types of priming includes priming, osmopriming, Halo priming, matric priming, thermo-priming, bio-priming and priming with plant growth hormones (Ashraf and Foolad 2005). Priming appropriate times have been reported between a few hours to a few weeks depending on species, Entesari et al. (2012) evaluated seed priming (salicylic acid and potassium nitrate) effect on mungbeen (*Vigna radiata*) cultivars with salicylic acid and potassium nitrate under salinity stress, Totally, they concluded that salicylic acid and potassium nitrate pretreatment results in improvement germination properties of mung bean seeds under salt stress condition which in turn increases the resistance of mung bean against salt stress in germination phase. The results of Rajhou et al. (2006) revealed several processes potentially affected by SA. This molecule enhanced the re-induction of the late maturation program during early stages of Arabidopsis seed germination, thereby allowing the germinating seeds to reinforce their capacity to mount adaptive responses in environmental water stress, Other processes affected by SA concerned the quality of protein translation, the priming of seed metabolism, the synthesis of antioxidant enzymes, and the mobilization of seed storage proteins (Rajjou et al. 2006). Giri and Schillinger(2003) determined seed priming effects on winter wheat germination, emergence, and grain yield., seed primed in potassium chloride (KCl), polyethylene glycol (PEG), and water led to enhanced emergence, compared with checks. Shariatmadari et al. (2017) concluded that priming with appropriate concentration of gibberellin plays an important role in the induction of tolerance to drought and overcome limitations created by the environmental stress such as osmotic effects, ion toxicity and nutritional imbalance in chickpea. At this relation, Mosavian et al. (2016) reported that the length of hydro-priming solutions improved the performance of seeds and seedlings of rapeseed. Higher levels of hydro priming duration reduced negative effects of sever salinity stress. Mohammadi et al. (2011) evaluated laser priming on canola yield and its components under salt stress, the results showed that 45-min laser priming had the strongest effect on yield and yield components and reduced significantly the adverse effects of salinity. The aims of this study were evaluation of priming and priming duration' effects on some germination' characteristics of Neptun cultivar Canola.

MATERIALS AND METHODS

This study performed as Factorial randomized complete design with three replications at the Besat Research Center, Fars Province, Iran.

The first factor treatments included cultivars Zurika and Talayeh, Also second factor was salicylic acid in 3 levels (750, 1500 and 2250 M), ascorbic acid in 3 levels (200, 400 and 600 ppm), polyethylene glycol on 2 levels (-2 and -4 bar), potassium chloride 2 level (-5 and -10 bar) Brassinosteroid on 2 levels (20 and 40 micrograms per liter), gibberellic acid on 2 levels (100 and 200 mg), nano zinc chelate and nitrogen each at two levels (1 and 2 mg) and priming water, third factor included priming duration at 3 levels (3, 6 and 12 h). The seeds sterilized with sodium hypochlorite for 2 minutes, Then, seeds were washed with distilled water and 50 seeds were moved in dishes with a diameter of 9 cm, 10 mg of distilled water or the priming solution were added to each petri dish. The van't Hoff formula (1) was used to produce different osmotic potential (Michel 1983).

$$\Psi S = -miRT \qquad (1)$$

ΨS: osmotic potential in terms of time, m: morality solution, i: ionization coefficient, R: overhead gases, T: temperature in degrees Kelvin

Seeds were counted at regular intervals, Seeds with root length of 2 mm or more were considered as germinated seeds (Isna 2010).

Evaluated Traits

Radicle and plumule length: Measuring the length of Radicle and plumule were done with a millimeter ruler accurately.

In this experiment to measure the germination rate (GR) method (Maguire 1962) and germination percentage (GP) (Penalosa and Eira, 1993), vigor length and weight index (Abdul-Baki and Anderson 1973) (VI) and Allometry factor (ISTA 1979) (CA) will be calculated by the following formula

$$GR = \sum_{i=1}^{n} Si/Di$$

GR = germination rate (the number of germinated seeds per day)

Si = number of germinated seeds per count

Di = the number of days to n-th count

$$\mathrm{GP} = 100(N'/\mathrm{N})$$

GP = percentage of germination

N'= number of germinated seeds

N = the total number of seeds per Petri dish

Vigor Index

$$\mathrm{VI} = \frac{(\mathrm{R}+\mathrm{S})100}{\mathrm{GP}}$$

R = average of radicle dry weight (mg)

S = average plumule dry weight (mg)

CA = coefficient of allometric

$$CA = Wr/Ws$$

Wr = radicle dry weight

Ws = plumule (Stem) dry weight

To determine the dry weight of radicle and plumule, Samples were placed for 24 hours at 75 ° C in the oven (ISTA 1985) and then weighed by the sensitive balance 0.0001 carefully.

Table 1. Analysis of variance for studied traits

	d.f	Radicle length	Plumule length	Radicle weight	Plumule weight	Seedling length	Seedling weight	Allometric coefficient	Longitudinal vigor index	Weight vigor index
Cultivar	1	0.414	2.422**	0.0012	0.000032	468352.6**	0.00013	0.018	80410.02**	0.55**
Priming	19	3.707**	2.041**	0.004**	0.000474**	247.953**	0.005579**	0.21**	504.082**	0.004**
Cultivar*Priming	19	0.368	0.239	0.000158	0.000158	163.974**	0.000211	0.01	414.218**	0.002*
Priming duration	2	3.584**	0.014	0.001	0.0005	191.42*	0.002	0.05	671.568**	0.004*
Cultivar* Priming duration	2	0.579	0.722	0.001	0.0002	175.88*	0.001	0.048	453.316	0.0005
Priming* Priming duration	38	1.644**	0.81**	0.001	0.000289*	140.072**	0.001289	0.049	299.022**	0.001
Cultivar* Priming* Priming duration	38	0.88	0.335	0.002**	0.000368**	116.572**	0.002579**	0.125**	229.138	0.002**
Error	240	0.72	0.27	0.001	0.000179	54.971	0.000946	0.042	161.317	0.001
C.V		17.35	15.89	5.86	8.5	16.7	15.11	6.89	22.39	24.19

Table 2. Means comparison between cultivars for studied traits

	Radicle length		Plumule length		Radicle weight		Plumule weight		Seedling legth		Seedling weight		Allometric coefficient		Longitudinal vigor index		Weight vigor index	
Zurika	4.85	a	3.18	b	0.046	a	0.158	a	84.1	a	0.204	a	0.292	a	71.67		0.182	a
Talayeh	4.92	a	3.35	a	0.047	a	0.156	a	82.7	b	0.203	a	0.306	a	41.78		0.103	b

Means with the same letters in each column don't show significant differences at 5% statistical level (Duncan 5%)

Table 3. Means comparison between priming duration treatments for studied traits

	Radicle length		Plumule length		Radicle weight		Plumule weight		Seedling legth		Seedling weight		Allometric coefficient		Longitudinal vigor index		Weight vigor index	
3h	4.953	A	3.271	A	0.05002	A	0.1577	A	45.44	A	0.2078	A	0.3216	A	58.51	A	0.1483	A
6h	5.019	A	3.279	A	0.04476	A	0.1583	A	44.62	AB	0.2031	A	0.2822	A	57.63	A	0.1423	AB
12h	4.692	B	3.257	A	0.04498	A	0.1551	A	42.96	B	0.2	A	0.293	A	54.05	B	0.137	B

Means with the same letters in each column don't show significant differences at 5% statistical level (Duncan 5%)

Table 4. Means comparison between priming treatments for studied traits

	Radicle length		Plumule length		Radicle weight		Plumule weight		Seedling legth		Seedling weight		Allometric coefficient		Longitudinal vigor index		Weight vigor index	
Control	4.19	GH	3.48	B-F	0.048	B	0.154	A-F	42.6	C-F	0.202	BC	0.300	B	55.0	B-G	0.146	BCD
water	4.25	GH	3.01	G-J	0.040	B	0.150	DEF	39.7	DEF	0.190	BC	0.261	B	52.3	EFG	0.137	CD
GA100	4.34	E-H	3.20	E-I	0.109	A	0.163	ABC	39.9	DEF	0.272	A	0.745	A	49.5	G	0.188	A
GA200	4.94	B-F	3.23	D-I	0.052	B	0.160	A-D	45.5	BCD	0.212	B	0.326	B	54.8	B-G	0.141	BCD
SA750	4.83	C-G	2.97	HIJ	0.045	B	0.153	B-F	42.6	C-F	0.197	BC	0.290	B	53.5	C-G	0.135	CD
SA1500	4.32	FGH	2.88	IJ	0.040	B	0.161	A-D	39.2	EF	0.200	BC	0.246	B	52.0	FG	0.146	BCD
SA2250	4.95	B-F	3.07	G-J	0.045	B	0.152	C-F	45.3	BCD	0.197	BC	0.293	B	54.5	B-G	0.133	CD
SC200	5.01	A-D	3.13	F-I	0.040	B	0.155	A-F	45.4	BCD	0.196	BC	0.260	B	62.3	A-E	0.149	BCD
SC400	5.15	A-D	3.39	C-G	0.043	B	0.155	A-F	45.9	ABC	0.197	BC	0.278	B	58.4	A-G	0.136	CD
SC600	5.12	A-D	3.59	B-E	0.044	B	0.148	EF	46.6	ABC	0.192	BC	0.309	B	59.9	A-F	0.133	CD
ZN1	5.32	ABC	3.61	BCD	0.043	B	0.160	A-D	49.3	AB	0.203	BC	0.266	B	62.7	A-D	0.143	BCD
ZN2	5.41	ABC	3.70	ABC	0.041	B	0.159	A-D	47.6	ABC	0.200	BC	0.256	B	56.0	A-G	0.127	D
KCL-5	5.66	A	4.00	A	0.047	B	0.163	AB	51.2	A	0.210	BC	0.283	B	65.0	A	0.142	BCD
KCL-10	5.52	AB	3.79	AB	0.047	B	0.161	A-D	50.0	AB	0.207	BC	0.289	B	64.5	AB	0.145	BCD
PEG-2	4.80	C-H	3.09	F-J	0.034	B	0.158	A-E	43.0	C-F	0.192	BC	0.216	B	63.0	ABC	0.153	BC
PEG-4	5.05	A-D	3.09	F-J	0.039	B	0.159	A-D	44.5	B-E	0.198	BC	0.245	B	52.9	D-G	0.127	D
N1	4.56	D-H	3.24	D-I	0.047	B	0.158	A-D	41.8	C-F	0.206	BC	0.294	B	49.8	FG	0.134	CD
N2	4.98	B-E	3.33	C-H	0.045	B	0.162	ABC	46.8	ABC	0.208	BC	0.279	B	55.2	A-G	0.137	CD
BR20	5.24	ABC	2.89	IJ	0.045	B	0.164	A	42.7	C-F	0.209	BC	0.278	B	63.9	AB	0.164	B
BR40	4.16	H	2.71	J	0.039	B	0.147	F	37.5	F	0.185	C	0.264	B	49.5	G	0.134	CD

Means with the same letters in each column don't show significant differences at 5% statistical level (Duncan 5%)

RESULT AND DISCUSSION

According to analysis of variance, there were significant differences between cultivars for Plumule length, Seedling length, Longitudinal vigor index and Weight vigor index traits, Talaye cultivar showed higher Plumule length (3.35 mm) in compared to Zurika but highest Seedling length (8.41 cm), Longitudinal vigor index (71.6) and Weight vigor index (0.182) were observed by Zurika cultivar.

According to **Table 1**, priming had significant effects on all studied traits at 1%statistically level. KCL5 showed highest means of radicle length (5.66 mm), plumule length (4 mm), seedling length (51.2 mm), longitudinal vigor index (65) in compared other treatments,

Interaction between priming and duration showed significant effect on Radicle length, Plumule length, Seedling length, Longitudinal vigor index ($P<0.01$), and Plumule weight ($P<0.05$).

According to interaction between priming and duration, it was founding that highest radicle length (6.13 mm) and plumule weight (0.172 g) were obtained by BR20 for 3h duration, also KCL-5 treatment with 12h duration showed highest means for plumule length (4.19mm) and seedling length (52.37mm).

The results showed that highest seedling weight (0.315 g), allometric coefficient (1.074) and weight vigor index (0.218) were obtained by GA100 for 3h, in this order, Jamil and Rha (2007) reported that gibberellic acid priming led to water uptake of sugar beet primed seed, also water uptake increased with increasing

Table 5. Means comparison of interaction treatments on studied traits

		Radicle length		Plumule length		Radicle weight		Plumule weight		Seedling legth		Seedling weight		Allometric coefficient		Longitudinal vigor index		Weight vigor index	
Control	3h	4.37	E-K	3.50	A-K	0.057	B	0.167	A-D	49.13	A-E	0.224	C	0.319	C	53.3	C-I	0.158	B-F
	6h	4.15	G-L	3.42	C-L	0.043	B	0.149	C-H	41.63	A-J	0.192	CD	0.291	C	58.3	A-H	0.148	B-G
	12h	4.05	IJKL	3.51	A-K	0.044	B	0.146	E-H	37.08	G-K	0.189	CD	0.291	C	53.3	C-I	0.132	D-G
water	3h	5.03	A-I	3.26	C-M	0.042	B	0.152	A-G	44.85	A-J	0.194	CD	0.269	C	59.5	A-G	0.139	C-G
	6h	3.64	JKL	2.70	LMN	0.036	B	0.148	D-H	34.89	JKL	0.184	CD	0.246	C	46.2	F-I	0.135	D-G
	12h	4.07	H-L	3.08	F-M	0.041	B	0.151	B-G	39.34	D-K	0.192	CD	0.269	C	51.3	D-I	0.138	C-G
GA100	3h	4.55	D-K	3.43	C-L	0.153	A	0.162	A-F	43.49	A-J	0.315	A	1.074	A	54.9	C-H	0.218	A
	6h	4.07	H-L	2.94	H-M	0.058	B	0.169	ABC	37.62	F-K	0.226	C	0.341	C	49.6	E-I	0.162	B-E
	12h	4.40	E-K	3.22	C-M	0.118	A	0.157	A-G	38.45	E-K	0.275	B	0.819	B	44.1	GHI	0.184	ABC
GA200	3h	4.59	D-K	3.29	C-M	0.054	B	0.166	A-D	46.18	A-I	0.220	C	0.325	C	54.1	C-I	0.150	B-G
	6h	5.28	A-I	2.85	J-M	0.050	B	0.156	A-G	43.62	A-J	0.206	CD	0.319	C	53.3	C-I	0.134	D-G
	12h	4.93	A-I	3.56	A-J	0.053	B	0.157	A-G	46.56	A-I	0.209	CD	0.336	C	57.1	B-H	0.140	C-G
SA750	3h	4.90	B-I	2.79	KLM	0.052	B	0.158	A-G	42.80	A-J	0.210	CD	0.324	C	55.2	C-H	0.149	B-G
	6h	4.86	B-I	3.32	C-M	0.045	B	0.151	B-G	45.63	A-I	0.196	CD	0.296	C	54.2	C-I	0.127	D-G
	12h	4.72	C-K	2.79	KLM	0.037	B	0.148	D-H	39.41	D-K	0.185	CD	0.251	C	51.1	D-I	0.129	D-G
SA1500	3h	4.21	F-L	2.78	KLM	0.037	B	0.167	A-D	37.06	G-K	0.204	CD	0.222	C	52.7	C-I	0.156	B-F
	6h	4.41	E-K	2.62	MN	0.038	B	0.152	A-G	40.34	B-K	0.190	CD	0.250	C	52.5	C-I	0.142	C-G
	12h	4.34	E-K	3.26	C-M	0.044	B	0.163	A-E	40.19	C-K	0.207	CD	0.266	C	50.8	D-I	0.139	C-G
SA2250	3h	4.91	A-I	2.87	I-M	0.041	B	0.152	A-G	44.69	A-J	0.193	CD	0.267	C	56.9	B-H	0.139	C-G
	6h	5.12	A-I	3.40	C-L	0.056	B	0.161	A-F	47.67	A-G	0.218	C	0.345	C	57.6	A-H	0.148	B-G
	12h	4.81	C-J	2.93	H-M	0.038	B	0.144	FGH	43.41	A-J	0.182	CD	0.266	C	49.0	E-I	0.112	FG
SC200	3h	5.09	A-I	3.12	E-M	0.040	B	0.155	A-G	51.41	A	0.195	CD	0.254	C	62.7	A-G	0.144	B-G
	6h	5.42	A-F	3.45	B-L	0.042	B	0.152	B-G	48.81	A-E	0.193	CD	0.275	C	63.0	A-F	0.136	D-G
	12h	4.53	D-K	2.82	J-M	0.040	B	0.159	A-F	35.93	IJK	0.199	CD	0.252	C	61.1	A-G	0.168	BCD
SC400	3h	5.28	A-I	3.63	A-I	0.046	B	0.161	A-F	49.15	A-E	0.207	CD	0.290	C	68.8	A-D	0.161	B-E
	6h	5.56	A-E	3.21	D-M	0.045	B	0.156	A-G	45.90	A-I	0.201	CD	0.287	C	54.9	C-H	0.127	D-G
	12h	4.61	D-K	3.32	C-M	0.037	B	0.147	D-H	42.56	A-J	0.184	CD	0.258	C	51.4	D-I	0.121	D-G
SC600	3h	5.20	A-I	3.97	ABC	0.053	B	0.139	GH	46.53	A-I	0.193	CD	0.404	C	66.0	A-E	0.139	C-G
	6h	5.49	A-E	3.49	A-K	0.041	B	0.159	A-F	44.08	A-J	0.200	CD	0.254	C	57.6	A-H	0.132	D-G
	12h	4.68	d-k	3.31	C-M	0.039	B	0.145	E-H	49.28	A-E	0.183	CD	0.271	C	56.0	C-H	0.128	D-G
ZN1	3h	5.93	abc	3.69	A-H	0.042	B	0.161	A-F	51.35	A	0.203	CD	0.260	C	60.3	A-G	0.130	D-G
	6h	5.16	a-i	3.61	A-I	0.044	B	0.160	A-F	50.14	A-D	0.203	CD	0.270	C	65.7	A-E	0.151	B-F
	12h	4.87	b-i	3.52	A-K	0.043	B	0.160	A-F	46.42	A-I	0.203	CD	0.267	C	62.2	A-G	0.149	B-G
ZN2	3h	5.29	a-i	3.39	C-L	0.039	B	0.158	A-G	46.51	A-I	0.196	CD	0.244	C	54.0	C-I	0.124	D-G
	6h	5.76	A-D	3.96	A-D	0.049	B	0.164	A-E	47.22	A-H	0.214	C	0.302	C	56.7	C-H	0.132	D-G
	12h	5.18	A-I	3.73	A-G	0.035	B	0.157	A-G	49.04	A-E	0.191	CD	0.222	C	57.4	B-H	0.124	D-G
KCL-5	3h	5.57	A-E	3.62	A-I	0.041	B	0.159	A-F	49.47	A-D	0.200	CD	0.253	C	64.3	A-F	0.141	C-G
	6h	5.68	A-D	4.18	AB	0.053	B	0.166	A-D	51.68	A	0.219	C	0.319	C	60.5	A-G	0.135	D-G
	12h	5.71	A-D	4.19	A	0.046	B	0.164	A-E	52.37	A	0.209	CD	0.279	C	70.2	ABC	0.150	B-G
KCL-10	3h	5.69	A-D	3.87	A-E	0.054	B	0.163	A-F	51.12	AB	0.217	C	0.329	C	63.9	A-F	0.150	B-G
	6h	5.32	A-H	3.73	A-G	0.040	B	0.157	A-G	48.69	A-E	0.197	CD	0.252	C	60.0	A-G	0.132	D-G
	12h	5.55	A-E	3.78	A-F	0.046	B	0.161	A-F	50.13	A-D	0.207	CD	0.286	C	69.5	A-D	0.154	B-F
PEG-2	3h	4.88	B-I	3.12	E-M	0.039	B	0.159	A-F	43.96	A-J	0.197	CD	0.244	C	60.4	A-G	0.148	B-G
	6h	4.58	D-K	3.02	G-M	0.037	B	0.160	A-F	41.78	A-J	0.197	CD	0.233	C	64.8	A-F	0.167	BCD
	12h	4.93	A-I	3.13	E-M	0.027	B	0.155	A-G	43.11	A-J	0.182	CD	0.171	C	63.8	A-F	0.145	B-G
PEG-4	3h	5.09	A-I	3.08	F-M	0.033	B	0.157	A-G	44.91	A-J	0.190	CD	0.213	C	64.0	A-F	0.148	B-G
	6h	5.73	A-D	3.49	A-K	0.044	B	0.164	A-E	49.96	A-D	0.208	CD	0.268	C	58.0	A-H	0.129	D-G
	12h	4.33	E-K	2.71	LMN	0.040	B	0.156	A-G	38.57	E-K	0.196	CD	0.254	C	36.6	I	0.104	G
N1	3h	4.37	E-K	3.02	G-M	0.049	B	0.158	A-G	39.65	D-K	0.207	CD	0.306	C	50.8	D-I	0.142	C-G
	6h	4.10	HIJKL	2.98	G-M	0.041	B	0.164	A-E	36.65	H-K	0.205	CD	0.250	C	47.6	E-I	0.142	C-G
	12h	5.21	A-I	3.74	A-G	0.052	B	0.154	A-G	49.22	A-E	0.205	CD	0.328	C	51.1	D-I	0.117	EFG
N2	3h	4.87	B-I	3.47	A-K	0.052	B	0.159	A-F	49.10	A-E	0.211	CD	0.325	C	57.1	B-H	0.144	B-G
	6h	5.38	A-G	3.35	C-M	0.036	B	0.160	A-F	48.03	A-F	0.196	CD	0.224	C	57.5	A-H	0.128	D-G
	12h	4.69	D-K	3.16	E-M	0.048	B	0.168	ABC	43.14	A-J	0.217	C	0.288	C	51.1	D-I	0.140	C-G
BR20	3h	6.13	A	3.68	A-H	0.045	B	0.172	A	50.78	ABC	0.217	C	0.259	C	75.3	AB	0.168	BCD
	6h	6.06	AB	2.89	I-M	0.050	B	0.170	AB	46.32	A-I	0.220	C	0.300	C	75.7	A	0.188	AB
	12h	3.52	KL	2.10	NO	0.041	B	0.149	C-H	30.93	KL	0.190	CD	0.275	C	40.7	HI	0.138	D-G
BR40	3h	3.13	L	1.87	O	0.033	B	0.132	H	26.71	L	0.165	D	0.253	C	36.3	I	0.120	EFG
	6h	4.61	D-K	2.98	G-M	0.048	B	0.149	D-H	41.76	A-J	0.197	CD	0.325	C	59.1	A-H	0.154	B-F
	12h	4.73	C-K	3.29	C-M	0.034	B	0.160	A-F	44.11	A-J	0.194	CD	0.213	C	53.2	C-I	0.129	D-G

Means with the same letters in each column don't show significant differences at 5% statistical level (Duncan 5%)

concentration of GA as compared to control. Afzal et al., (2002) evaluated of priming and growth regulator treatments effect on emergence and seedling growth of hybrid Maize, but BR20 for 6h had highest Longitudinal vigor index (75.7) in compared to other treatments. Kagale et al. (2007) mentioned brassinosteroids (BRs) appear to have the ability to protect plants against various environmental stresses, they demonstrated that treatment with 24-epibrassinolide (EBR), a BR, increases the basic thermotolerance of Brassica napus and tomato seedlings. Also they demonstrated that EBR treatment enhances seedling tolerance to drought and cold stresses in both Arabidopsis thaliana and *B. napus*, and helps to overcome a salt-stress-induced inhibition of seed germination.

Ansari et al. (2013), in relation to priming effect mentioned that the highest germination percentage (53%) and normal seedling percentage (23.5%) were attained from hydro priming for 16h at 15◦C and the highest coefficient of velocity of germination (0.21) and coefficient of allometry (0.49) were attained from hydro priming for 8h at 10◦C, also hydro priming for 8h at 15◦C increased seedling length (3.15) as compared to the unprimed. Osmo priming with concentration of -15 bar PEG for 24h at 15◦C increased GP (80.5 %), GI (17.9), normal seedling percentage (45 %), seedling vigor index (257.85) and seedling length (5.73 cm) and decreased MTG as compared to the unprimed and other treatments of osmo priming.

The results of Zhang et al. (2007) showed that germination percentage, germination index, and vigour index of lucerne seeds primed with brassinolide were significantly higher than those of the non-primed seeds.

It seems that priming with different solutions, with increasing the mean stem and root dry weight or mean germination rate at suitable priming times, can cause better and faster seedling establishment in the early season and thus can improve the plant tolerance against unfavorable environmental conditions.

CONCLUSION

Totally, according to result it was founded that priming had positive effect on germination characteristics also it was determined that gibberellic acid, salicylic acid and Ascorbic acid had highest effects as compared to other priming, with increasing of concentration and duration of priming, studied traits increased in responses to treatments.

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