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Performance of Hydro-Primed *Brassica napus* L. Seeds Under Different Saline Regimes, A Preliminary Approach

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Abstract. In the present study effect of hydro-priming on some primary parameters (germination, radicle/plumule length and biomass) of canola seed was investigated that were subjected to various saline doses. The experiment was based on 3 factorial complete randomized design with salinity levels (0, 20 mM, 30 mM, 40 mM and 50 mM) as a first factor, priming (non-primed and hydro-primed) levels as second factor and canola cultivars (Abasin-95, Dur e Nifa and Nifa Gold) as third factor. Results confirmed significant (Alpha = 5 % probability level) effects of salinity on radicle/plumule growth and fresh biomass of *Brassica napus* L, whereas data related to germination displayed non-significant variations (Alpha = 5 % probability level). Subsequently, studied parameters recorded significant variations for priming levels and canola cultivars. In the same way, first order interaction (salinity doses × priming levels) induced significant effects on plumule size and fresh weight of *Brassica napus* L. in contrast to other parameters (radicle growth and germination). The 2nd order interaction (priming levels × cultivars) was proved to cause highly significant effects on all the selected parameters of *Brassica napus* L. In case of 3rd order interaction (salinity doses × cultivars) the response of *Brassica napus* L. was significant for plumule and radicle growth only. Consequently, the 4th order interaction (salanity doses × priming levels × cultivars), instigated non-significant effects on all the studied parameters of *Brassica napus* L. except radicle growth. The increase in seedling growth and fresh weight of *Brassica napus* under most of salinity doses confirmed canola as a salt tolerant plant as shown by previous studies. Furthermore, present study justified better performance of non-primed seeds over hydro-primed canola seeds. Among the tested canola cultivars, Nifa Gold proved to be more adapted to salinity than other cultivars and is advisable for growing on saline land in Pakistan.

Keywords: canola cultivars, saline regimes, hydro-priming

Introduction

Salinity is considered as the most important cause of low seed germination and plant yield. There are many causes behind soil salinity which is low quality of irrigation water, transpiration and evapouration is most notable. About 950-million hectare land of the world is saline (Farhoudi *et al*., 2015). To convert this large area of the globe cultivable, the hazards of salinity must be broken and techniques must be searched out by which we become able to inculcate large vigour in plants. Pre-sowing seed treatment is believed to be good and in expensive method of improving plant growth and germination under saline conditions. It is a common belief that priming bring about some biochemical and physiological changes within the seed, which ultimately results in maximum germination and plant growth. Now-a-days, many compounds are being used for seed priming (Jisha and Puthue 2014; Patade *et al*., 2009). The simple and easily applicable of which is water for sure. Seeds treated with water have lesser side effects on plants raised from them than other compounds. The reason is behind selecting water as a priming agent for this study. Many workers have studied the effects of priming on numerous plants grown in saline conditions (Jia *et al*., 2020; Wu *et al*., 2019; Hu *et al*., 2018; Guo *et al*., 2018; Khalaj *et al*., 2017; Song and Farhoudi *et al*., 2015; Wang, 2015; Aymen *et al*., 2014; Shoor *et al*., 2014; Younesi and Moradi, 2014; Abbasdokhta and Edalatpishehb 2013; Begum *et al*., 2013; Benincasa *et al*., 2013; Maher *et al*., 2013; Soughi *et al*., 2013; Farhoudi *et al*., 2007). Besides, searching out techniques that help in breaking hazards of salinity, we must find salt tolerant plants which could be grown on these barren areas. Canola (*Brassica napus* L.), oil seed crops, is one of the salt tolerant plants. That's why it is the central focus of many workers (Alishavandi *et al*., 2014; Nasibi *et al*., 2014; Yosef 2013; Saber *et al*., 2013;

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Shabani *et al*., 2013; Shahbaza *et al*., 2013; Abdollahi and Jafari, 2012; Kandil *et al*., 2012). The present study is another effort to check and find a pre-sowing technique that helps canola plants to overcome the salinity stress.

Materials and Method

The study was carried out in the laboratory of Govt. Degree College, Tangi, Charsadda, KPK. Pakistan. Seeds of Canola cultivars were obtained from Nuclear Institute for Agriculture (NIFA) Peshawar. The experiment was based on 3 factors factorial randomized complete block design. Five salinity doses (0, 20, 30, 40 and 50 mM of NaCl) were selected as first factor. The second factor was two priming levels (non-primed and hydro-primed canola seeds). The third factor was canola cultivars (Abasin-95, Dur e Nifa and Nifa Gold). Each treatment was replicated 3 times with 10 seeds in each replicate (Muhammad and Hussain, 2012). Prior to start the study, four salt solutions of different concentrations were prepared in sterilized beakers. 10 mL of each salt solution was poured in the properly labeled petri dishes with two folded Whataman # 1 paper as seeds beds excluding the control that was moistened with distilled water. Some seeds of Canola cultivars were soaked in tape water for 3 h and then brought to normal conditions whereas other was taken in dry form. To half of the experimental set up dry seeds were added, while to other water soaked seeds were put. Data regarding germination and early seedling growth (radicle/plumule growth and plant fresh weight) was recorded after 7 days. Fisher analysis of variance technique (1985) and LSD test (alpha = 5 % probability level) was applied on the recorded data to compare the differences among means (Steel and Torie, 1984).

Results and Discussion

Effect on plumule growth (cm). Salinity doses (A), priming levels (B) and canola cultivars (C) exhibited significant variations for plumule growth. In the same way, data related to 1st (A×B), 2nd (B×C) and 3rd (A×C) order interactions were highly significant for plumule growth. On the contrary, 4th order interaction (A×B×C) displayed non-significant differences for plumule growth (Table 1).

Most of the salinity doses brought significant increase in plumule growth except 30 mM (2.81 cm). Maximum increase in plumule growth was recorded in seeds subjected to 40 mM (6.13 cm) salinity dose. Differences among plumule growth recorded from seeds subjected to 20 mM (5.37 cm), 30 mM (2.81 cm), 40 mM (6.13 cm) and 50 mM (5.12 cm) were highly significant ($\propto$ = 5 % probability level). Seeds exposed to 30 mM salinity dose recorded significant depression in plumule growth as compared to other salinity treatments.

Non-primed seeds showed maximum plumule growth (5.16 cm) in saline regimes as compared to hydro-primed seeds (4.39 cm).

Variations in plumule growth demonstrated inter-varietal differences among the selected genotypes.

In case of 1st order interaction (A×B), dry seeds subjected to 40 mM (6.21 cm) salinity dose recorded maximum plumule growth. At the same time, hydro-primed seeds germinated in 30 mM (2.50 cm) dose showed reduction in plumule growth.

In case of 2nd order interaction (B×C), seeds of cultivar Nifa Gold pre-soaked with water produced seedlings with larger plumule length (5.73 cm). On the contrary, seedling raised from seeds of cultivar Abasin-95 pre-soaked with water showed minimum plumule growth (2.56 cm). In case of 3rd order interaction (A×C), cultivar Nifa Gold subjected to 20 and 40 mM salinity doses recorded maximum plumule growth (6.34 cm). Whereas, seeds exposed to 30 mM salinity doses reduced plumule length of cultivar Abasin-95 to 1.81 (Table 2 and Fig. 1-3).

The increase in plumule growth is seemed as adaptation of plants under stress as to provide maximum surface for absorption of water vapours from atmosphere. Hydro-priming of seeds reduced plumule growth of Canola. Review of literature revealed that many plants are sensitive to salinity stress. With contrast to our results, (Jia *et al*., 2020; Wu *et al*., 2019; Khalaj *et al*., 2017; Farhoudi *et al*., 2015; Aymen *et al*., 2014; Shoor *et al*., 2014; Soughi *et al*., 2013; Abdollahi and Jafari 2012) and reported ill effects of salinity on growth of canola, fenugreek, safflower, cumin and soyabean respectively. Furthermore, these workers reported positive effects of priming on plant growth in saline regimes over non primed seeds negating our results.

Effect on radicle growth (cm). Radicle growth was significantly affected by the factors (A, B, C) under trial. Similarly, all the interactions induced significant effects on the subject parameter except salinity × priming levels (Table 1).

Seeds treated with 40 mM NaCl solution showed maximum radicle growth (6.75 cm), followed by the 20, 50 and 30 mM salinity doses. On the other hand, untreated seeds recorded lowest radical growth (3.36 cm).

Table 1. Table for mean squares of plumule growth (cm), radical growth (cm), germination % and fresh weight (g).

Source	Degree of freedom	Plumule growth	Radicle growth	Germination %	Fresh weight
Replication	2	0.045	0.148	7.778	0.007
Salinity levels (A)	4	28.223^{S}	28.279^{S}	96.111^{NS}	0.313^{S}
Priming levels (B)	1	13.456^{S}	53.546^{S}	2777.778^{S}	0.117^{S}
A×B	4	0.985^{S}	1.686^{NS}	169.444^{NS}	0.034^{S}
Canola cultivars (C)	2	19.147^{S}	31.218^{S}	1337.778^{S}	0.110^{S}
A×C	8	0.866^{S}	2.323^{S}	146.111^{NS}	0.007^{NS}
B×C	2	21.330^{S}	26.228^{S}	2151.111^{S}	0.321^{S}
A×B×C	8	0.683^{NS}	3.220^{S}	126.111^{NS}	0.009^{NS}
Error	58	0.387	1.025	143.410	0.006

S = Significant; NS = Non-significant; A×B = 1st order interaction; B×C = 2nd order interaction; A×C = 3rd order interaction; A×B×C = 4th order interaction

Table 2. Effect of pre-sowing seed treatment (non-primed and hydro-primed) on plumule growth (cm) of three canola cultivars under different saline regimes.

Salinity doses × Priming levels × Canola cultivars interaction

A×B×C		Abasin-95	Dur e Nifa	Nifa Gold
Control	Non-primed	5.23	4.77	4.32
20 mM		6.12	6.11	5.95
30 mM		2.79	3.23	3.35
40 mM		6.19	6.34	6.13
50 mM		5.64	5.71	5.61
Control	Hydro-primed	2.71	4.63	5.04
20 mM		2.44	4.89	6.71
30 mM		0.83	2.95	3.73
40 mM		4.93	6.67	6.55
50 mM		1.90	5.25	6.61

Salinity levels × Priming levels interaction (A×B)

	Non-primed seeds	Hydro-primed seeds	Doses means
Control	4.77^{b}	4.14^{c}	4.45^{c}
20 mM	6.06^{a}	$4.68b^{c}$	5.37^{b}
30 mM	3.12^{d}	2.50^{e}	2.81^{d}
40 mM	6.21^{a}	6.05^{b}	6.13^{a}
50 mM	5.65^{a}	4.59^{bc}	5.12^{b}

Priming levels × Canola cultivars interaction (B×C)

	Abasin-95	Dur e Nifa	Nifa Gold	Priming means
Non-primed seeds	5.20^{b}	5.23^{b}	5.07^{b}	5.16^{a}
Hydro-primed seeds	2.56^{c}	4.89^{b}	5.73^{a}	4.39^{b}

Salinity levels× Canola cultivars interaction

	Control	20mM	30mM	40mM	50mM	Cultivars means
Abasin-95	3.97^{def}	4.28^{cde}	1.81^{h}	5.56^{b}	3.77^{efg}	3.88^{c}
Dur e Nifa	4.72^{c}	5.50^{b}	3.09^{g}	6.50^{a}	5.82^{b}	5.06^{b}
Nifa Gold	4.68^{cd}	6.33^{a}	3.54^{fg}	6.34^{a}	6.11^{ab}	5.40^{a}

LSD value at 5 % probability level of significance for salinity doses = 0.4151; priming levels =0.2625; cultivars =0.3215; salinity doses × priming levels = 0.5870; priming levels × cultivars = 0.4547 and salinity doses × cultivars = 0.7189. Values bearing similar letters in rows and column are statistically non-significant.

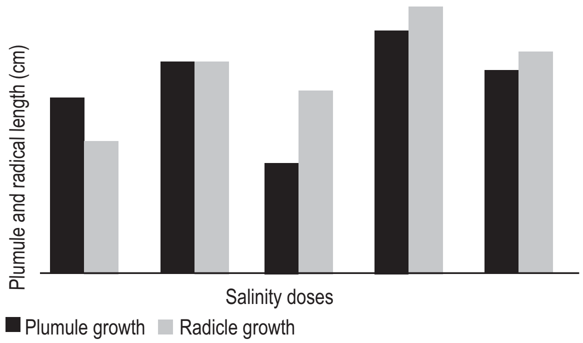

Fig. 1. Effect of salinity doses on radicle/plumule growth (cm) of canola.

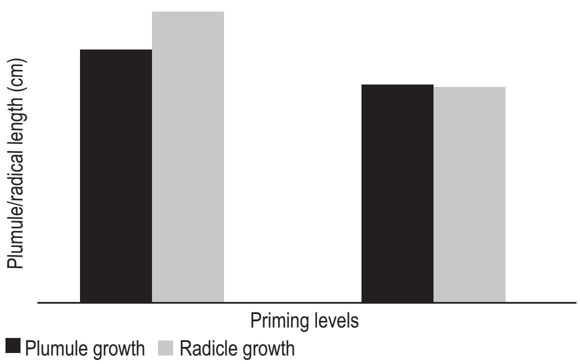

Fig. 2. Effect of priming on radicle/plumule growth (cm) of canola.

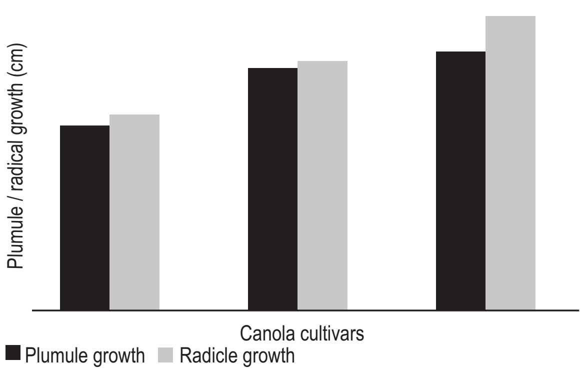

Fig. 3. Inter varietal variations among three canola cultivars for radicle/plumule growth (cm).

Furthermore, differences among the treatment levels were highly significant for the subject parameter.

Dry seeds showed maximum radicle growth (5.90 cm) as compared to hydro-primed seeds (4.36 cm).

Inter cultivars variations were prominent and maximum radicle growth was recorded by cultivar Nifa Gold (6.11 cm), Dur e Nifa (5.20 cm) and Abasin-95 (4.08 cm) respectively.

In case of 1st order interaction (A×B), maximum value recorded for radicle growth was 8.7 cm and minimum was found to be 0.50 cm. This maximum value for radicle growth was obtained from non-primed seeds of cultivar Nifa Gold in the presence of 40 mM NaCl. On the other hand, the minimum value was obtained from hydro-primed seeds of cultivar Abasin-95 in 30 mM NaCl. In the priming levels × cultivars interaction, non-primed seeds of cultivar Nifa Gold showed maximum value of 6.35 cm for radicle growth. While hydro-primed seeds of cultivar Abasin-95 represented the minimum value (2.23 cm). In the interaction of salinity × cultivars, seeds of Nifa Gold gave the highest value (7.23 cm) for radicle growth in 40 mM and 50 mM NaCl, while seeds of cultivar Dur e Nifa showed minimum value (2.87 cm) for radicle growth in non-saline regime (Table 3 and Fig. 1-3). The cause of maximum radicle growth of canola seeds in salinity treatment than control may be due to the same reason of physiologic drought mentioned earlier. Radicles of Canola embryos were in search of free waters that molded the radicals long comparatively. Similarly, poor radicle growth in hydro-primed than un-primed Canola seeds may be attributed to the embryonic arrest in germination between the break of pre-sowing seed treatment and then growing it again in test salinity levels probably. On contrast to our results, (Farhoudi *et al*., 2015; Aymen *et al*., 2014; Nasibi *et al*., 2014; Shoor *et al*., 2014; Saber *et al*., 2013; Shahbaza *et al*., 2013; Soughi *et al*., 2013; Maher *et al*., 2013; Abdollahi and Jafari 2012; Kandil *et al*., 2012) reported positive effects of pre-sowing seed treatment on radicle growth of Canola, fenugreek, safflower, cumin and soya bean respectively.

Effect on germination (%). Priming levels (B), Canola cultivars (C) and priming levels × cultivars interaction induced highly significant variations in germination %. On the other hand, salinity doses (A) and rest of the three order interactions exhibited non-significant variations for the same parameter (Table 1).

Non-primed seeds of Canola showed maximum germination (95 %) as compared to hydro-primed seeds (85 %). Among cultivars, Dur e Nifa showed maximum germination (96 %) followed by Nifa Gold (87 %) and Abasin-95 (83 %). Similarly, non-primed seeds of cultivar Abasin-95 showed maximum germination (98

%), while hydro-primed seeds of the same cultivar showed the minimum (67 %) (Table 4 and Fig. 4-6). Comparing our results with other authors, pre-sowing treatment reduced salinity hazards in most of halo sensitive plants (Farhoudi *et al*., 2015; Alishavandi *et al*., 2014; Shoor *et al*., 2014; Younesi and Moradi 2014; Yosef 2013; Maher *et al*., 2013; Abdollahi and Jafari 2012; Kandil *et al*., 2012).

Table 3. Effect of pre-sowing seed treatment (non-primed and hydro-primed) on radical growth (cm) of three canola cultivars under different saline regimes.

Salinity levels × Priming levels × Canola cultivars interaction						
A×B×C				Abasin-95	Dur e Nifa	Nifa Gold
Control		Non-primed		3.82^{ijkl}	3.03^{klm}	4.37^{ghijk}
20 mM				6.21^{bcdef}	6.35^{bcdef}	5.45^{defghi}
30 mM				5.33^{efghi}	4.91^{fghij}	5.65^{defgh}
40 mM				7.58^{abc}	7.65^{ab}	8.47^{a}
50 mM				6.69^{bcdef}	5.23^{efghi}	7.79^{ab}
Control		Hydro-primed		2.65^{lm}	2.71^{klm}	3.65^{jkl}
20 mM				1.88^{mn}	5.21^{efghij}	7.09^{abcd}
30 mM				0.50^{n}	5.08^{efghij}	6.21^{bcdef}
40 mM				4.31^{hijk}	6.50^{bcdef}	5.99^{cdef}
50 mM				1.79^{mn}	5.36^{efghi}	6.55^{bcdef}
Salinity levels × Priming levels interaction						
		Non-primed seeds		Hydro-primed seeds		Salinity levels means
Control		3.74		2.97		3.36^{d}
20 mM		6.00		4.73		5.37^{b}
30 mM		5.30		3.93		4.61^{c}
40 mM		7.90		5.60		6.75^{a}
50 mM		6.57		4.56		5.57^{b}
Priming levels × Canola cultivars interaction						
			Abasin-95	Dur e Nifa	Nifa Gold	Priming levels means
Non-primed seeds			5.93^{ab}	5.43^{bc}	6.35^{a}	5.90^{a}
Hydro-primed seeds			2.23^{d}	4.97^{c}	5.88^{ab}	4.36^{b}
Salinity levels× Canola cultivars interaction						
	Control	20^{mM}	30^{mM}	40^{mM}	50^{mM}	Cultivars means
Abasin-95	3.24^{ghi}	4.05^{fgh}	2.92^{hi}	5.94^{bcd}	4.24^{efg}	4.08^{c}
Dur e Nifa	2.87^{i}	5.7^{cd}	4.99^{def}	7.08^{ab}	5.29^{cde}	5.20^{b}
Nifa Gold	3.96^{fghi}	6.27^{abc}	5.93^{bcd}	7.23^{a}	7.17^{a}	6.11^{a}

LSD value at 5 % probability level of significance for salinity doses = 0.6755; priming levels = 0.4272; cultivars = 0.5233; salinity doses × priming levels × cultivars = 1.655; priming levels × cultivars = 0.7400 and salinity doses × cultivar = 1.170. Values bearing similar letters in rows and column are statistically non-significant.

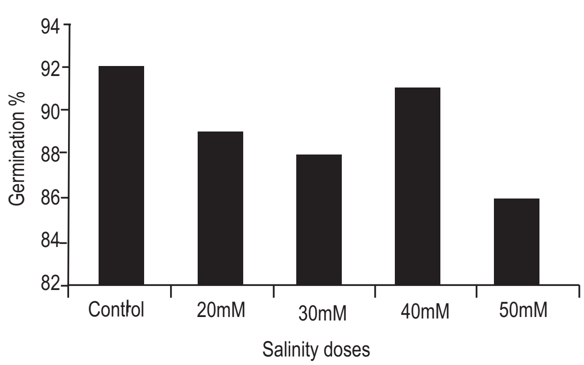

Fig. 4. Effect of salinity doses on germination (%) of canola.

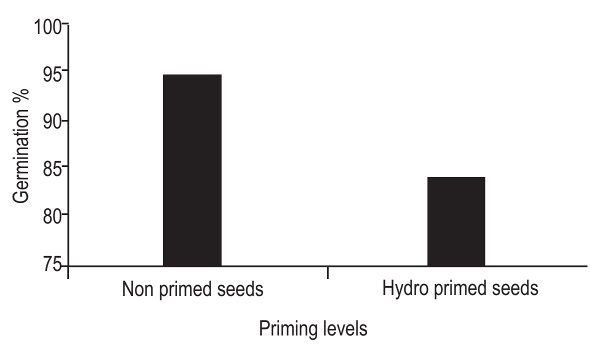

Fig. 5. Effect of priming on germination (%) of canola.

Table 4. Effect of pre-sowing seed treatment (non-primed and hydro-primed) on germination of three canola cultivars under different saline regimes.

Salinity levels × Priming levels × Canola cultivars interaction

		Abasin-95	Dur e Nifa	Nifa Gold
Control	Non-primed	100	93	87
20 mM		100	97	90
30 mM		100	97	87
40 mM		97	97	90
50 mM		93	57	90
Control	Hydro-primed	87	97	87
20 mM		60	97	90
30 mM		53	97	93
40 mM		80	97	87
50 mM		57	90	83

Salinity levels × Priming levels interaction

	Non-primed seeds	Hydro-primed seeds	Salinity l evels means
Control	93	90	92
20 mM	96	82	89
30 mM	94	81	88
40 mM	94	88	91
50 mM	96	77	86

Priming levels × Canola cultivars interaction

B×C	Abasin-95	Dur e Nifa	Nifa Gold	Priming levels means
Non-primed seeds	98[a]	97[ab]	89[ab]	95[a]
Hydro-primed seeds	67[c]	95[ab]	88[b]	84[b]

Salinity levels× Canola cultivars interaction

	Control	20mM	30mM	40mM	50mM	Cultivars means
Abasin-95	93	80	77	88	75	83[b]
Dur e Nifa	95	97	97	97	95	96[a]
Nifa Gold	87	90	90	88	88	87[b]

LSD value at 5 % probability level of significance for priming levels = 5.054; cultivars= 6.189 and priming levels × cultivars = 8.753. Values bearing similar letters in rows and column are statistically non-significant.

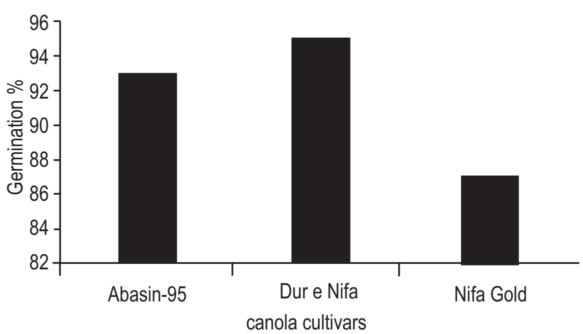

Fig. 6. Inter varietal variations among three canola cultivars for germination.

Effect on fresh weight (g). All the three factors had highly significant effects on fresh weight of canola plants. Similarly, 1st (A×B) and 2nd (B×C) order interactions induced significant variations in fresh weight. At the same time, 3rd (A×C) and 4th (A×B×C) order interactions were failed in instigating significant variations for the subject parameter (Table 1).

Seedlings raised from seeds exposed to 40 mM (0.58 g) and 50 mM (0.54 g) salinity doses showed maximum fresh weight as compared to 20 mM (0.38 g) and 30 mM (0.30 g) salt solutions. Seedlings in control showed the least fresh weight of 0.29 g. Seedlings rose from unprimed seeds recorded maximum fresh weight (0.45 g) as compared to hydro-primed seeds (0.38 g). Among genotypes, cultivar Nifa Gold showed maximum fresh weight (0.47 g) followed by Dur e Nifa (0.44 g) and Abasin-95 (0.35 g) respectively. In case of 1st order (A×B) interaction, seedlings rose from unprimed seeds exposed to 50 mM and 40 mM salinity doses showed maximum fresh weight (0.64 g) as compared to other treatment levels. Whereas, seeds pre-soaked with water give rise to seedlings with least fresh weight. In case of 2nd order (B×C) interaction, priming had non-significant effects on fresh weight (0.50 g) of cultivars Dur e Nifa and Nifa Gold (Table 5 and Fig. 7-9). The

Table 5. Effect of pre-sowing seed treatment (non-primed and hydro-primed) on fresh weight (g) of three canola cultivars under different saline regimes.

Salinity levels × Priming levels × Canola cultivars interaction

		Abasin-95	Dur e Nifa	Nifa Gold
Control	Non-primed	0.31	0.16	0.35
20 mM		0.46	0.34	0.45
30 mM		0.35	0.30	0.36
40 mM		0.66	0.49	0.66
50 mM		0.68	0.56	0.67
Control	Hydro-primed	0.20	0.37	0.37
20 mM		0.18	0.43	0.44
30 mM		0.11	0.36	0.31
40 mM		0.40	0.70	0.55
50 mM		0.16	0.64	0.50

Salinity levels × Priming levels interaction

	Non-primed seeds	Hydro-primed seeds	Salinity levels means
Control	0.27^{c}	0.31^{c}	0.29^{c}
20 mM	0.42^{abc}	0.35^{bc}	0.38^{bc}
30 mM	0.34^{bc}	0.26^{c}	0.30^{c}
40 mM	0.61^{a}	0.55^{ab}	0.58^{a}
50 mM	0.64^{a}	0.43^{abc}	0.54^{ab}

Priming levels × Canola cultivars interaction

	Abasin-95	Dur e Nifa	Nifa Gold	Priming levels means
Non-primed seeds	0.49^{a}	0.37^{ab}	0.50^{a}	0.45^{a}
Hydro-primed seeds	0.21^{b}	0.50^{a}	0.43^{a}	0.38^{a}

Salinity doses × Canola cultivars interaction

	Control	20^{mM}	30^{mM}	40^{mM}	50^{mM}	Cultivars means
Abasin-95	0.26	0.32	0.23	0.53	0.42	0.35^{a}
Dur e Nifa	0.27	0.39	0.33	0.60	0.60	0.44^{a}
Nifa Gold	0.36	0.45	0.34	0.61	0.59	0.47^{a}

LSD value at 5 % probability level of significance for salinity doses = 0.1634; priming levels = 0.1034; cultivars = 0.1266; salinity doses × priming levels = 0.2311 and priming levels × cultivars = 0.1790. Values bearing similar letters in rows and column are statistically non-significant.

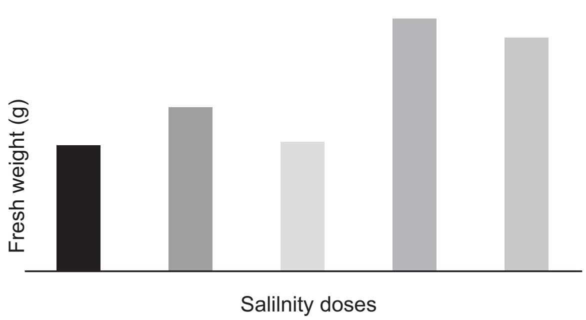

Fig. 7. Effect of salinity doses on fresh weight (g) of *Brassica napus* L.

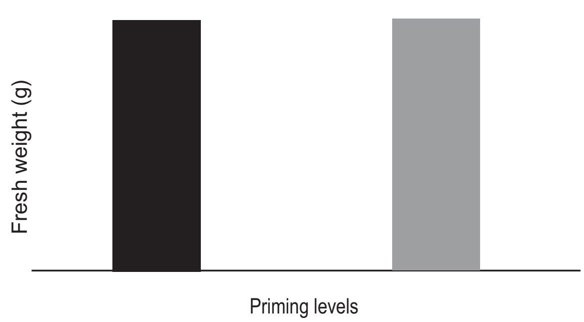

Fig. 8. Effect of priming on fresh weight (g) of *Brassica napus* L.

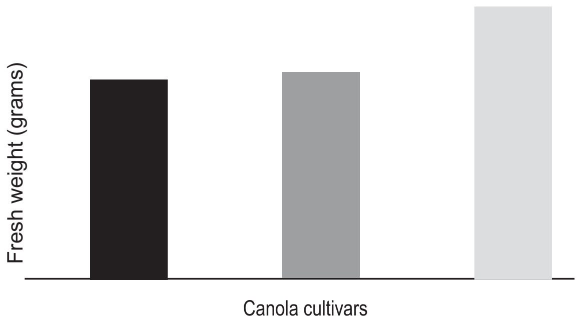

Fig. 9. Inter varietal variations among three canola cultivars for fresh weight (g).

increase in biomass of canola seedling over control clearly demonstrated that salinity stress turned on many otherwise suppressed genes and systems in the Canola plant to produce additional necessary compounds required to grow in unfavoUrable conditions. The poor performance of hydro-primed Canola seeds could be attributed to the failure of adaptation of embryos in the saline conditions as these were exposed to two different conditions (normal and saline) consecutively. On the contrary, results of other studies confirmed significant effects of seed priming on means of fresh and dry weight (Jia *et al*., 2020; Farhoudi *et al*., 2015; Aymen *et al*., 2014; Shoor *et al*., 2014; Abbasdokhta and Edalatpishehb, 2013; Shahbaza *et al*., 2013; Soughi *et al*., 2013; Abdollahi and Jafari, 2012; Kandil *et al*., 2012). On the same side, these workers reported decrease in biomass of plants with increase of salinity dose, unlike our findings.

Conclusion

From the present study, it could be easily deduced that canola plant is tolerable to salinity. It could also be deduced that for better growth and germination, pre-sowing seed treatment may not be required. Among the tested canola cultivars, Nifa Gold was proved to be more efficient in all the studied primary growth parameters (plumule growth, radical growth, germination % and fresh weight) and hence it is expected to show the same trend in the field conditions. Our study provides sufficient guide line to test the effect of more doses of salinity on the same plant in future.

Conflict of Interest. The authors declare they have no conflict of interest.

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