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The effect of different salinity levels on germination characteristics of canola (*Brassica napus* L.) cultivars

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Introduction: Soil salinity is a critical issue in agriculture, with far-reaching implications for food security and environmental sustainability. The improper use of irrigation water containing high levels of salts, combined with faulty agronomic practices such as unbalanced fertilization and the impacts of climate change, exacerbates this problem. Salinity affects soil and plant systems in various ways (Atta et al., 2023). In arid and semi-arid regions, soil and water salinity serves as a key limiting factor that significantly impacts crop yield and productivity. Salt tolerance during germination is particularly crucial, as it influences subsequent stages of plant growth and development (Irik and Bikmaz, 2024). Thus, addressing soil salinity is essential for improving agricultural resilience and ensuring sustainable food production. Increasing salinity levels caused a significant decrease in the percentage and speed of germination, as well as the length and weight of roots and stems. However, the percentage reduction in each parameter varied. The cultivar × salinity interaction had a significant effect on all measured parameters (Eslami et al., 2009). The different salinity stress levels had a significant effect on the germination percentage, germination speed, and shoot and root length of canola cultivars (Bybordi, 2010).

Materials and methods: In order to investigate the effect of different levels of salinity on the germination indices of canola varieties, a factorial experiment based on a completely randomized design with three replications was conducted in the seed breeding laboratory of the Kermanshah Agricultural Research and Training Center in 2024. The first factor included nine rapeseed cultivars (Aram, Asa, Baharan, Poror, Delgan, Roshana, Safar, Mafa, RGS005), while the second factor included four levels of salinity stress using sodium chloride (0, 40, 70, and 90 mM). First, the seeds were disinfected with 5% sodium hypochlorite in 100 cc of distilled water for 5 minutes and then rinsed thoroughly three times with distilled water. The seeds were cultivated in sterilized Petri dishes with a diameter of 9 cm. Inside each Petri dish, 25 canola seeds were placed on filter paper and moistened with 10 ml of the desired salt concentrations. The seeds were kept at a temperature of 25/15 degrees Celsius (day and night) inside the germinator for 10 days. At the end of 10 days, germination percentage, stem and root length, and seedling length were measured. After data collection, normality was checked using SPSS (Version 16). Data analysis of variance was performed using MSTATC and SAS (Version 9.4). Duncan's method was applied for mean comparison at the 5% significance level.

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Results and discussion: The effect of cultivar, salinity, and their interaction on germination percentage, stem and root length, and canola seedling length was significant (Table 1.). The results of the average data comparison (Table 2.) showed that all salinity concentrations reduced the investigated traits of canola cultivars compared to the control. The reactions of the studied traits varied for each variety under the influence of different salinity levels. With the increase in salinity concentration, the studied traits in all cultivars decreased significantly. The lowest values for germination percentage, root length, stem length, and total seedling length were observed in the Aram cultivar under the effect of 90 mM salinity. Additionally, the results indicated that the highest germination rate (100 percent) was associated with the Mafa variety, while the highest root length (8.5 cm), stem length (6.03 cm), and total seedling length (16.25 cm) were related to the Baharan variety. The highest germination rate (85.5%) was observed at the 0% EC salinity level for the DK EXTORM variety, while the lowest rate (1.5%) occurred at the 25% EC level for the NK LINUS variety. As salinity levels increased (from 0% to 25% EC), decreases in germination, seedling length, and fresh and dry weights were observed. The highest root length (64.1 mm) and fresh weight (125.9 g) were recorded at the 5% EC level for NK LINUS; however, some varieties showed no growth at higher salinity levels (Osman & İlbaş, 2023).

Conclusion : This study showed that salinity concentration and its interaction with variety have a significant effect on the germination percentage and growth traits of rapeseed. The cultivar Mafa exhibited the best germination percentage (100%), while the cultivar Baharan had the highest root length, stem length, and total seedling length. Conversely, the cultivar Aram showed the lowest values under the influence of 90 mM salinity.

Key words: Abiotic stress, Variety, Oil plants, Salinity.

Table 2. Interaction effect of salinity levels and rapeseed cultivars on germination traits

Treatment		Traits			
Cultivars	Salinity (mM)	Stem length (cm)	Root length (cm)	Seedling length (cm)	Germination (%)
Aram	0	4.725^{cde}	5.725^{fg}	10.13^{ghi}	86.67^{a-h}
	40	2.233^{jkl}	4.133^{i-m}	7.017^{mno}	73.33^{f-j}
	70	1.650^{klmn}	2.500^{no}	4.200st	71.67^{g-j}
	90	0.767^{n}	1.450^{op}	2.067^{tu}	31.67^{l}
Asa	0	4.421^{def}	7.675^{cd}	12.55^{cd}	88.28^{a-g}
	40	3.194^{hij}	4.825^{g-j}	8.125^{klm}	84.98^{a-i}
	70	2.530^{j-l}	1.200^{p}	4.025st	75.00^{e-j}
	90	1.993^{klm}	1.500^{op}	3.850^{t}	81.67^{b-i}
Baharan	0	6.031^{ab}	8.500^{bc}	14.75^{b}	93.33^{a-d}
	40	6.389^{a}	9.750^{a}	16.25^{a}	98.68^{ab}
	70	1.806^{lm}	4.067^{j-m}	6.100^{op}	90.01^{a-f}
	90	1.661^{lmn}	2.521^{no}	4.467^{rst}	78.98^{c-i}
Pishro	0	5.622^{abc}	8.775^{ab}	14.52^{b}	95.86^{abc}
	40	4.804^{cde}	7.375^{de}	12.25^{cde}	88.30^{a-g}
	70	3.067^{hij}	5.225^{f-i}	8.925^{i-k}	93.62^{a-d}
	90	1.942^{klm}	3.675^{klm}	5.800^{opq}	93.50^{a-d}
Dalgan	0	4.242^{d-g}	5.00^{g-j}	9.500^{hij}	88.33^{a-g}
	40	5.009^{cd}	5.650^{fg}	10.70^{fgh}	91.41^{a-e}
	70	5.100^{bcd}	5.753^{fg}	10.89^{fg}	93.73^{a-d}
	90	4.827^{cd}	5.445^{fgh}	10.31^{gh}	88.33^{a-g}
Roshana	0	3.833^{e-h}	4.500^{h-k}	8.750^{jkl}	93.00^{a-d}
	40	5.469^{abc}	7.750^{bcd}	13.50^{bc}	88.33^{a-g}
	70	2.070^{klm}	5.825^{fg}	7.935^{klm}	88.44^{a-g}
	90	1.891^{lm}	3.225^{lmn}	5.525^{pqr}	86.75^{a-h}
Safar	0	3.169^{hij}	4.00^{j-m}	7.500^{lmn}	73.33^{f-j}
	40	4.651^{cde}	6.30^{ef}	11.06^{efg}	69.99^{h-k}
	70	2.876^{h-k}	5.350^{fgh}	8.510^{jkl}	61.67^{jk}
	90	1.993^{klm}	3.06^{mn}	5.310^{p-s}	53.33^{k}
Mafa	0	4.804^{cde}	7.80^{bcd}	12.20^{cde}	100.0^{a}
	40	4.191^{d-g}	7.410^{cd}	11.62^{def}	100.0^{a}
	70	2.326^{jkl}	5.05^{g-j}	7.600^{lm}	98.4^{ab}
	90	1.150^{mn}	3.201^{lmn}	4.600^{q-t}	97.03^{ab}
RSG003	0	3.578^{fgh}	7.750^{bcd}	11.75^{def}	76.70^{d-j}
	40	3.322^{ghi}	7.600^{cd}	11.35^{d-g}	68.33^{ijk}
	70	2.913^{h-k}	4.975^{g-j}	8.175^{klm}	68.33^{ijk}
	90	1.7121^{lmn}	4.22^{i-l}	6.250^{nop}	68.33^{ijk}

each columjs, means having difference less than LSD provided are not significantly different ($p \leq 0.05$)