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Original Article

Physiological and biochemical changes and calcium-dependent protein kinase expression in canola (*Brassica napus* L.) under salinity stress

H. Ahmadi[1], A.R. Abbasi[2*], A.R. Taleei[3], V. Mohammadi[2]

1. PhD student, Department of Agronomy and Plant Breeding, University of Tehran, Karaj, Iran
2. Associated Professor, College of Agriculture and Natural Resources- University of Tehran Karaj, Iran
3. Professor, College of Agriculture and Natural Resources- University of Tehran, Karaj, Iran

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Abstract

Salinity stress is one of the most important of abiotic stress that affects the yield of oilseed rape. In order to study some physiological and biochemical changes and *Bna*CDPK$_{14}$ transcript expression in rapeseed (*Brassica napus* L.), two tolerant cultivars (Slm046 and Zarfam) and two susceptible cultivars (Okapi and Sarigol) were planted in a growth chamber and were irrigated by water including 100 and 200 mM NaCl and normal water. Relative water content, electrolyte leakage, antioxidant enzyme guaiacol peroxidase (GPOX), antioxidant enzyme catalase (CAT) and the expression of calcium-dependent protein kinase 14 (*Bna*CDPK$_{14}$) were measured. The results indicated the relative water content and electrolyte leakage (200 mM NaCl) decreased and increased under stress respectively. The antioxidant enzyme guaiacol peroxidase (GPOX), catalase (CAT) and *Bna*CDPK$_{14}$ increased by salinity stress, tolerant cultivars showing more increase. Negative correlation was observed between the relative water content of leaves and electrolyte leakage. There was a high positive correlation between the guaiacol peroxidase and catalase contents and the expression of *Bna*CDPK$_{14}$, indicating that by increasing the reactive oxygen species under stress, the plant enzymic antioxidant system helps the plant to cope with it.

Keywords: Antioxidant enzyme, *Brassica napus*, Gene expression, Physiological traits, salinity stress

Table 1. Primers used in this study

Gene name	Accession number	Gene Locus	Primer sequence
*Bna*CDPK$_{14}$	XM_013896624	LOC106454505	For 5′ CGGATTGCGTAAACTAGGAATTGTTG 3′ Rev 5′ CTGCCCATCTTTCTGATGTGTACC 3′
*Bna*actin$_{7}$	XM_013858992	LOC106418315	For 5′ TGGGTTTGCTGGTGACGAT 3′ Rev 5′ TGCCTAGGACGACCAACAATACT 3′

*Correspondent author: Alireza Abbasi; E-Mail: rezabbasi@ut.ac.ir

Table 2. Analysis variance of Leaf relative water content (LRWC), Electrolyte leakage (EL), Guaiacol peroxidase (GPOX), Catalase (CAT) and BnaCDPK14 relative expression ratio in canola cultivars under drought stress

		Mean of square				
S.O.V.	**df**	**LRWC**	**EL**	**GPOX**	**CAT**	**BnaCPK14**
Cultivar	3	204.85**	124**	1.46**	1.39**	0.09*
Salinity stress	2	3992.54**	8158.09**	10.60**	1.77**	1.26**
Cultivar × salinity	6	75.09*	22.55 ^{ns}	0.37**	0.40**	0.027 ^{ns}
Error	24	20.57	25.65	0.1	0.015	0.026
C.V. (%)		*6.54*	*12.77*	*12.44*	*8.15*	*11.92*

Non-significance (^{ns}), Significance P= 0.05 (*) and 0.01 (**)

Table 3. Correlation coefficients (r) for trait means of four canola cultivars for several traits measured in salinity stress. Significance P= 0.05 (*) and 0.01 (**)

	LRWC	**EL**	**GPOX**	**CAT**	***Bna*CPK$_{14}$**
LRWC	1				
EL	-0.97 **	1			
GPOX	-0.67 *	0.79 **	1		
CAT	-0.27	0.44	0.82**	1	
***Bna*CPK$_{14}$**	-0.74 **	0.84 **	0.94 **	0.81**	1

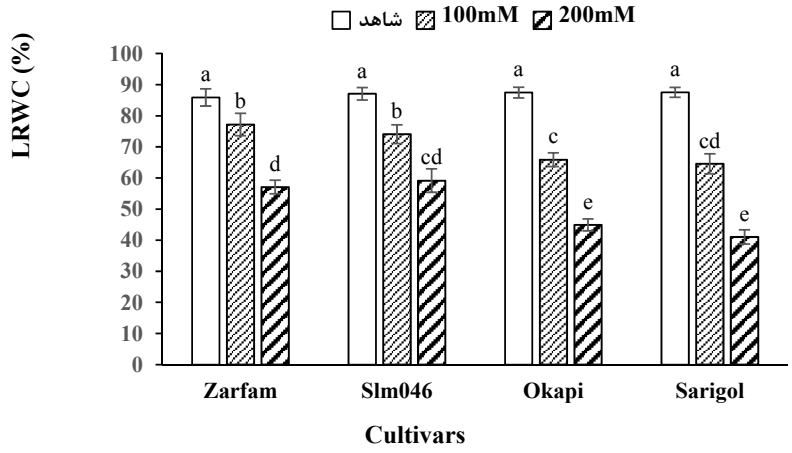

Fig. 1. Effect of salinity stress on Leaf relative water content (LRWC), Vertical bars indicate Means ± SE based on three replicates and different letters above columns indicated significant (P < 0.05) differences.

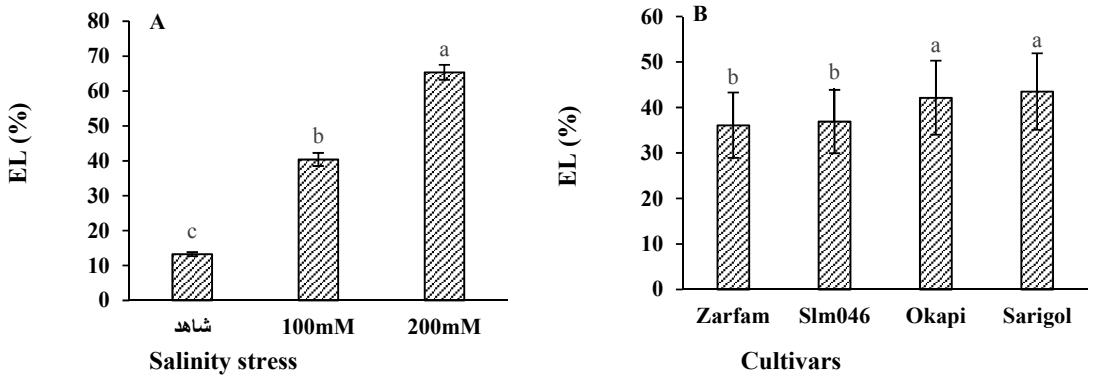

Fig. 2. Effect of different levels of salinity stress and cultivars on Electrolyte leakage (EL) in Canola leaves (A) and (B), respectively. Vertical bars indicate Means ± SE based on three replicates and different letters above columns indicated significant (P < 0.05) differences.

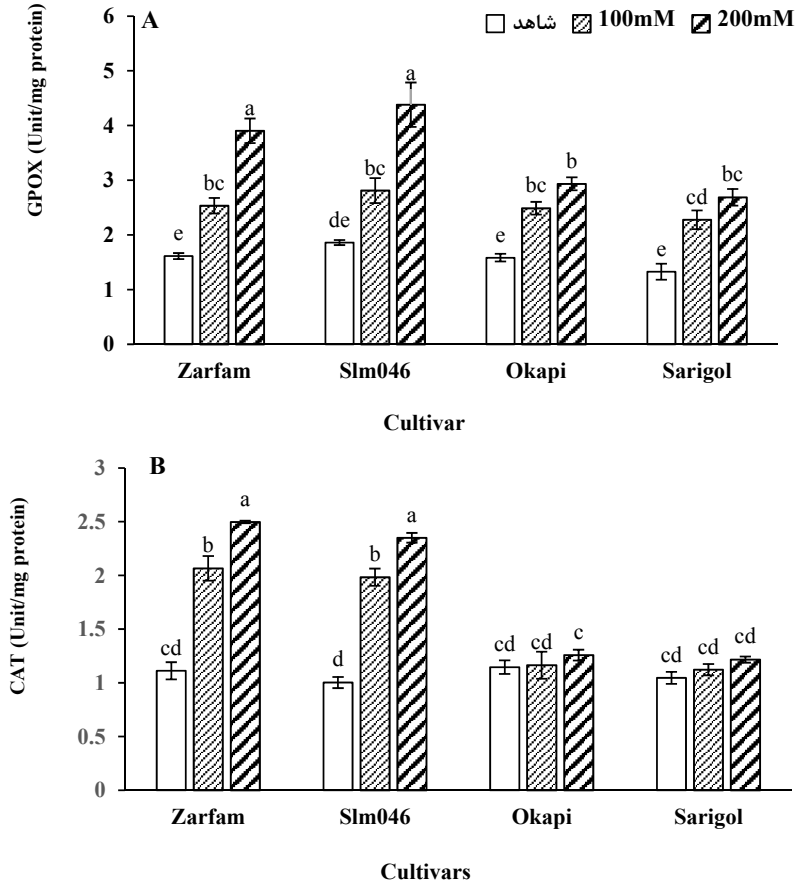

Fig. 3. Effect of salinity stress on GPOX (A) and CAT (B) in canola leaves; Vertical bars indicate Means ± SE based on three replicates and different letters above columns indicated significant (P < 0.05) differences.

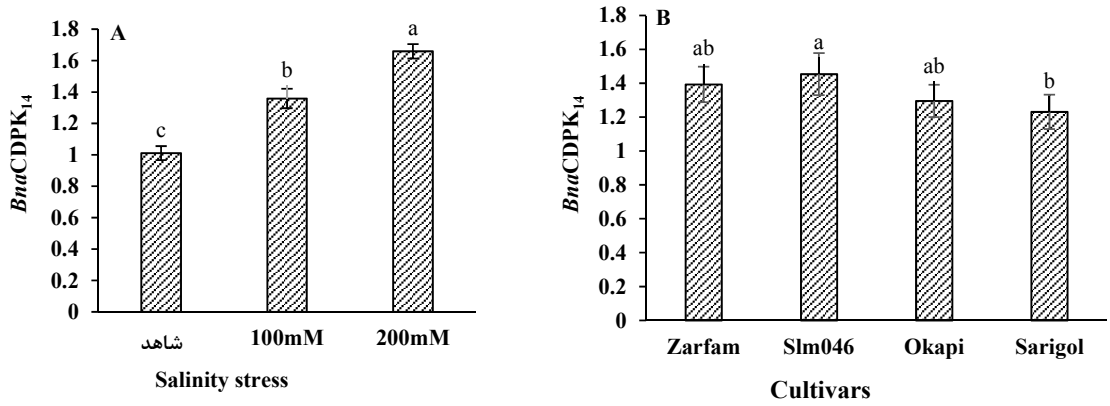

Fig. 4. Effect of drought stress on BnaCDPK$_{14}$ relative expression ratio; Vertical bars indicate Means ± SE based on three replicates and different letters above columns indicated significant ($P < 0.05$) differences.