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Original article

Physiological and biochemical responses of transgenic *AtEXPA1* tobacco plants to drought stress

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Abstract

Drought stress is one of the most destructive abiotic stresses. Expansins are one of the cell wall expandable proteins that can expand the cell wall under a pH-dependent pathway. Stomatal opening rate Due to the expression of *AtEXPA1* gene in transgenic plants has been observed. In this study, second generation (T2) of three transgenic tobacco lines with *AtEXPA1* gene were studied for some physiological and biochemical traits under drought stress. Transgenic lines includes 2, 4 and 7 and Non-transgenic commercial cultivar Samson as control were cultivated. RWCL and leaf chlorophyll content has been reduced under drought stress, and ELIL, Lipid peroxidation as MDAL and leaf proline content has been increase. The activity of antioxidant enzymes such as, catalase (CAT), guaiacol peroxidase (GPOX), ascorbate peroxidase (APOX) and polyphenol oxidase (PPO) was increased in leaves under drought stress. In this study, according to biochemical traits Line 2 and Line 7 and according to physiological traits Line4 in compared to the control cultivar, could cope with stress and introduce as tolerate cultivars.

Keywords**:** *AtEXPA1,* Cell wall expansion, Drought stress, Expansin, Transgenic plants

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Table 1. Analysis of variance for physiological traits of transgenic tobacco plants under drought stress in four level and three transgenic lines with control cultivars.

SO.V	df	RWCL	ELIL	MDAL	Cha	Cha+Chb
Drought (D)	3	7778**	6989**	17.9**	720**	1788**
Line (L)	3	533**	228**	1.5**	9.8**	28.1**
D ×L	9	203**	70**	0.6**	6.3**	45.5**
Error	48	1.6	2.8	0.05	0.6	1.14
CV (%)	-	*2.1*	*2.7*	*6.1*	*4.6*	*3.4*

Table 1. Continued

SO.V	df	Fm	Fv	PI	Fm/Fv	Proline
Drought (D)	3	848278**	836686**	20.45**	0.038**	28.3**
Line (L)	3	280229**	317252**	2.98**	0.026**	3.6**
D ×L	9	17351**	18043**	0.37**	0.011**	1.2**
Error	48	25.34	3093	0.055	0.00083	0.03
CV (%)	-	4.5	6.3	14.5	3.7	5.4

Left-to-right traits: Relative Water Content of Leaf, Electrical Leakage Index of Leaf, Malondialdehyde of Leaf of Leaf, chlorophyll content a, chlorophyll a and b, Maximum fluorescence index, Variable fluorescence index, Overall performance index of PSII photochemistry, Maximum photochemical efficiency of PSII and proline content of Leaf.
**: Significance P= 0.01

Table 2. Analysis of variance for biochemical traits of transgenic tobacco plants under drought stress in four level and three transgenic lines with control cultivars.

SO.V	df	CAT	GPOX	APOX	PPO
Drought (D)	1	2361.9**	0.31**	0.03**	0.00013**
Line (L)	3	90.61^{ns}	0.01**	0.009**	0.00002**
D ×L	3	159.10**	0.011**	0.002*	0.000018**
Error	24	32.30	0.00052	0.0006	0.000001
CV (%)	-	*9.097*	*8.907*	*12.287*	*8.321*

Left-to-right traits: Left-to-right attributes: catalase activity, guaiacol peroxidase activity, ascorbate peroxidase activity and polyphenoloxidase activity.
Ns, * and**: represent Non-significance and at a probability level of 5% and 1%, respectively

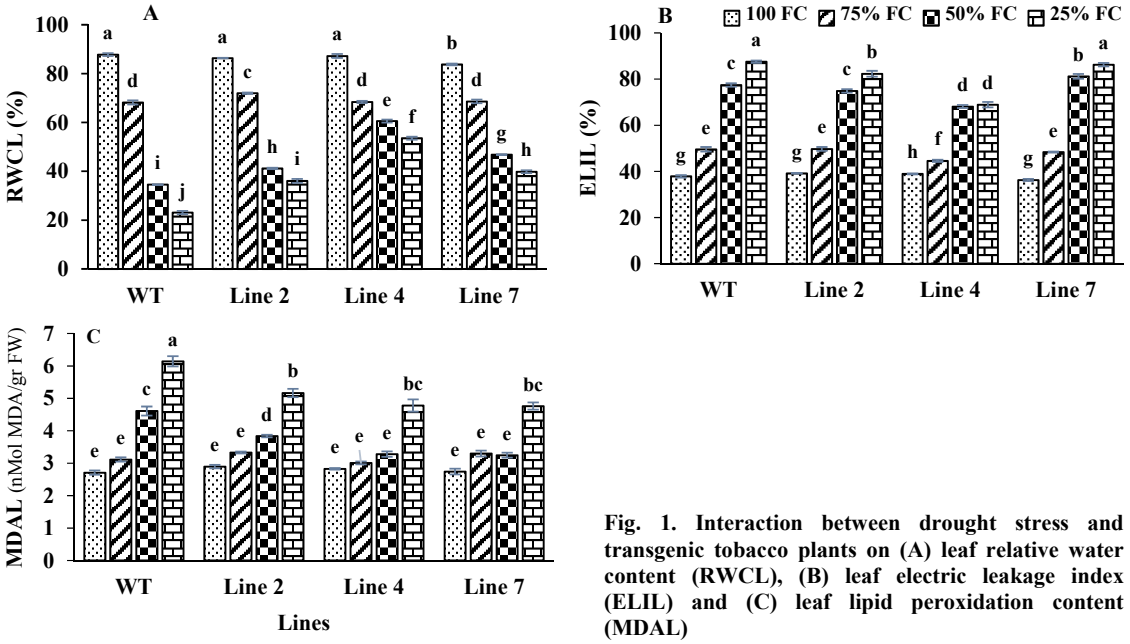

Fig. 1. Interaction between drought stress and transgenic tobacco plants on (A) leaf relative water content (RWCL), (B) leaf electric leakage index (ELIL) and (C) leaf lipid peroxidation content (MDAL)

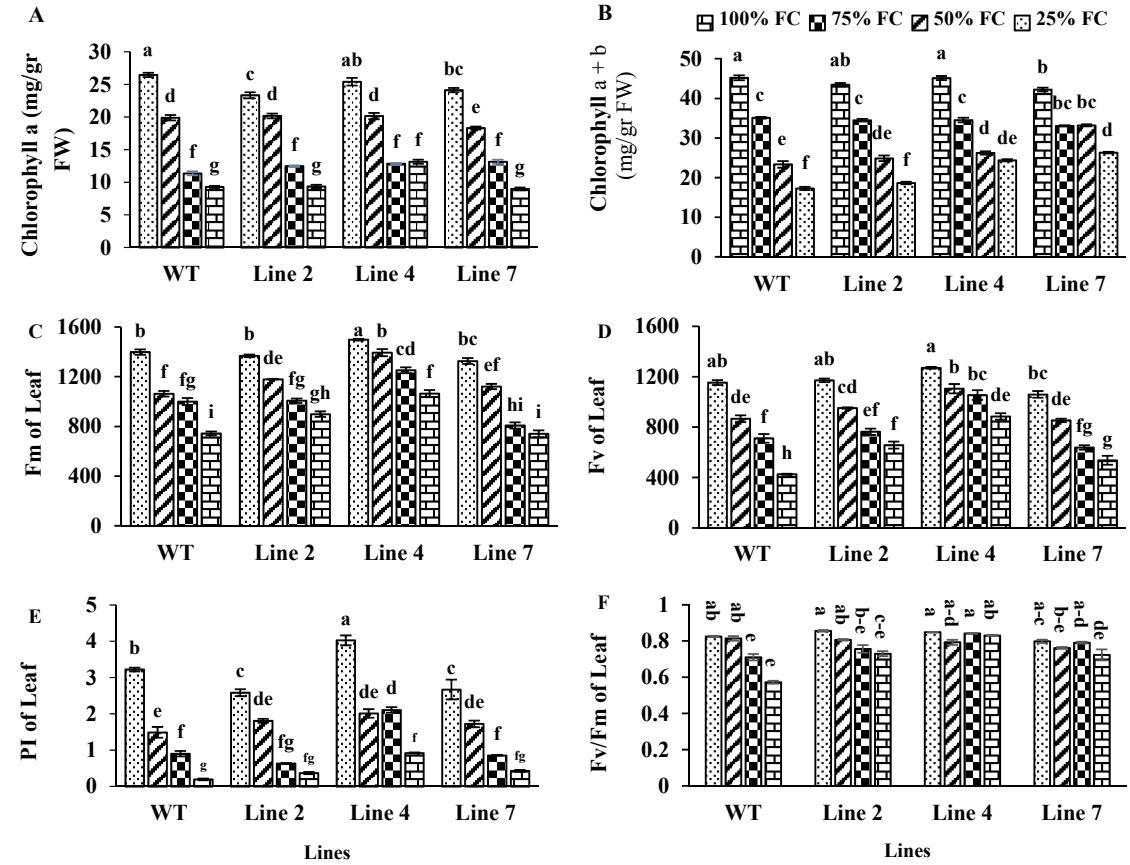

Fig. 2. Interaction between drought stress and transgenic tobacco plants on: of leaf chlorophyll a content (A), total chlorophyll a and b (B), Fm index (C) Fv index (D) PI index (E) and Fv/Fm index (F)

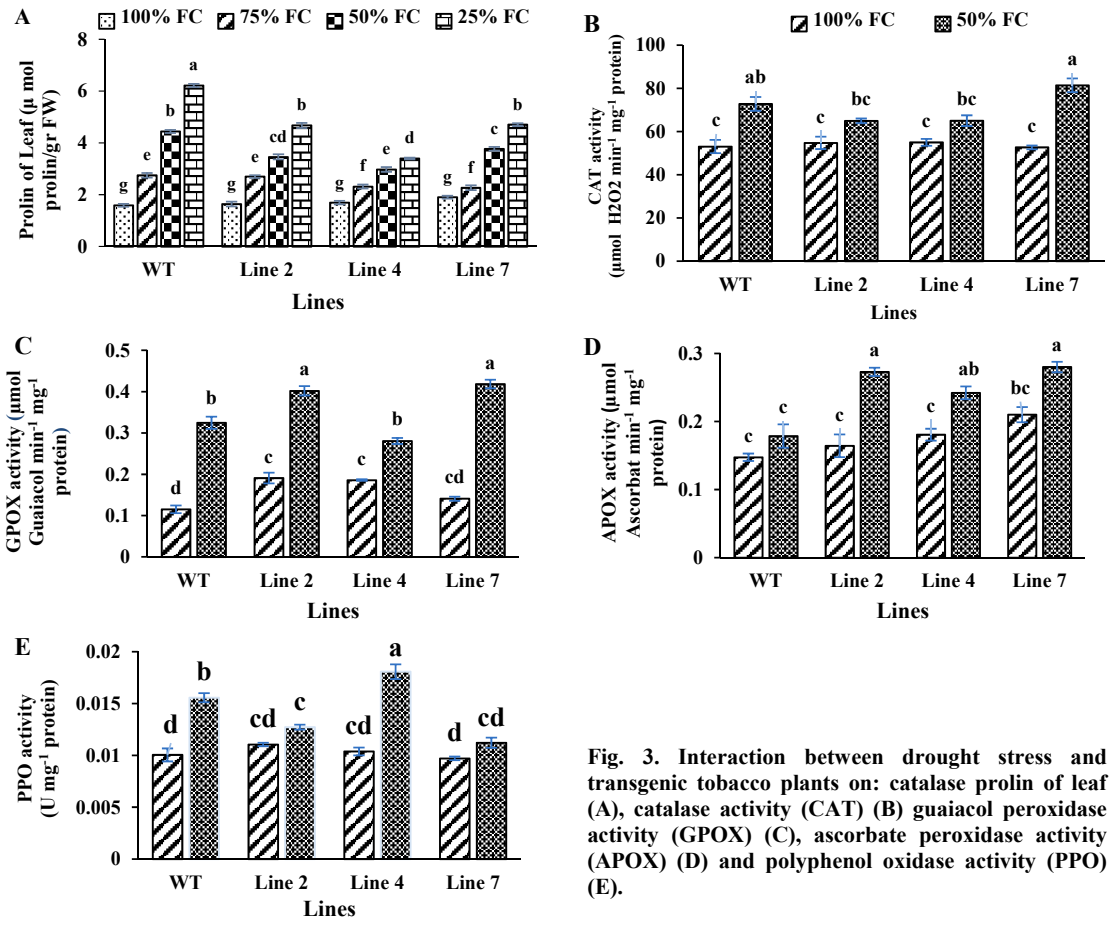

Fig. 3. Interaction between drought stress and transgenic tobacco plants on: catalase prolin of leaf (A), catalase activity (CAT) (B) guaiacol peroxidase activity (GPOX) (C), ascorbate peroxidase activity (APOX) (D) and polyphenol oxidase activity (PPO) (E).