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Original article

Effect of some plant growth biostimulants on increasing canola (*Brassica napus* L.) tolerance to drought stress

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Extended abstract

Introduction

Canola is known as one of the most important oily plants in the world due to its good composition of fatty acids and oil content. As the first oilseed crop in Iran, Canola is recommended to increase its cultivated area to reduce dependence on oil imports with high oil quality compared to other similar crops. Drought stress is one of the major environmental limiting factors for the successful production of crops, especially canola, in Iran and the world. One effective strategy to reduce the adverse effects of drought stress is to use new nutritional techniques like humic compounds and growth stimuli, including amino acids. Due to the lack of sufficient studies on the effects of growth stimuli on canola, the present study was performed to study the effects of four plant growth biostimulants on increasing canola tolerance to drought stress under Moghan conditions.

Materials and methods

To compare the effects of growth biostimuli on canola yield under drought stress, an experiment was conducted at Moghan Agricultural Research Station in the 2018-2019 crop years. The experiment was conducted as a split-plot in a randomized complete block design with three replications. Treatments included the main factor of irrigation regime at two levels, and the sub-plot included six treatments; control, amino acid foliar application, humic acid with irrigation, fulvic acid foliar application, seaweed extract foliar application, and the combination of second, third, and fifth treatments. In this study, plant height, number of pods per main stem, number of pods per lateral branches, total number of pods per plant, number of seeds per pod, 1000-seed weight and seed yield were measured. Before analysis of variance, the presence or absence of outliers was identified using Grubbs test. Normality of data was then checked by Shapiro-Wilk test. Finally, the analysis of variance was performed and the means were compared using the least significant difference (LSD) method at the statistical level of one and five percent using SAS software version 9.1.

Results and discussion

The results showed that the effect of growth biostimulants could be different in non-stress and drought stress conditions, and biostimulants can reduce the effects of dry stress. in regular irrigation and non-

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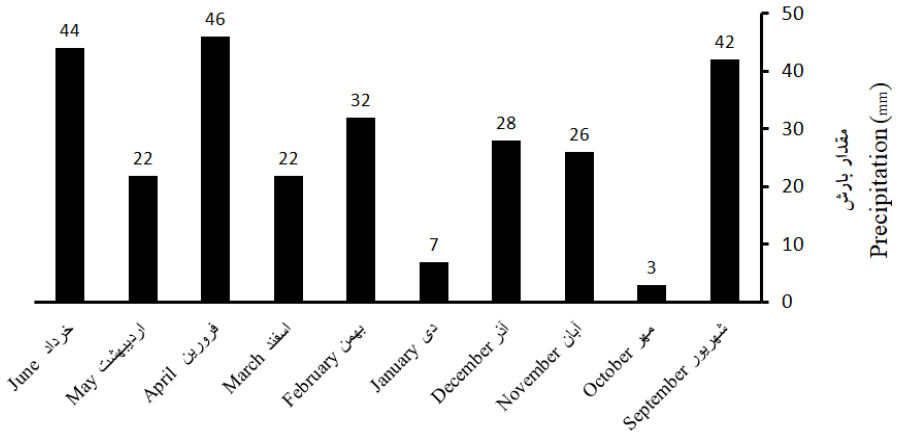
stress conditions, the combined treatment uses of growth stimulants> humic acid> fulvic acid > seaweed extract> amino acid increased by 22.7%, 14.3%, 6.4%, 6.3%, and 3.4%, respectively, compared to the control treatment. In drought stress conditions, the highest effect was related to the combined use of growth stimulants> amino acids> seaweed extract> fulvic acid > humic acid, respectively, with an increase of 31.9%, 21.3%, 15.9%, 11.9%, and 11.1%, respectively, compared to the control treatment.

Conclusions

Under non-stress conditions, the effect of growth stimulants was related to all studied components yield, and the effect of humic acid, fulvic acid, seaweed extract, and amino acid were related to the number of pods. Under stress conditions, other yield components including, number of pods per main stem and lateral branches, plant height and number of seeds per pods had more effect on increasing yield. It can be concluded that the application of growth biostimulants while improving canola yield under normal moisture conditions, can increase its tolerance to drought stress.

***Keywords*:** Drought stress, Fulvic acid, Humic acid, Irrigation regime, Seaweed extract.



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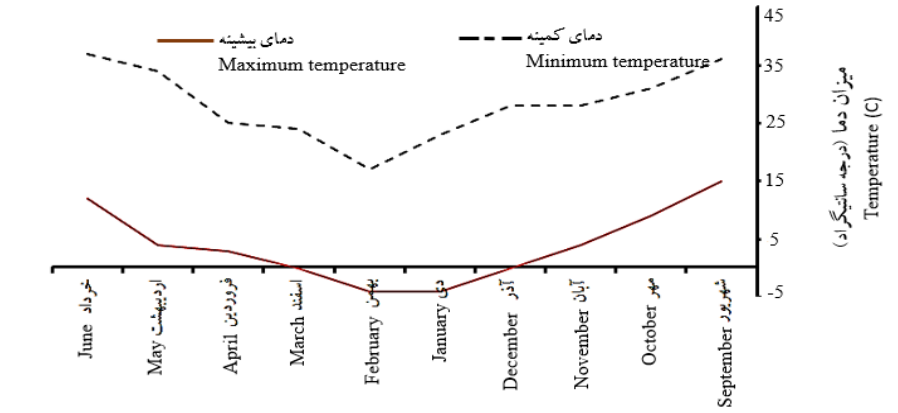

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Fig. 1. Some meteorological features of Ardabil province during the growing period

Table 1. Some soil physical and chemical properties of the soils

Texture	Cu	Mn	Zn	Fe	K	P	O.C	Calcium carbonate equivalent	EC	pH
	----------mg.kg^{-1}----------						----------%----------		dS.m^{-1}	
Clay-loam	1.6	10.6	0.13	3.2	521	15.2	0.9	5.7	1.34	7.8

Table 2. Variance analysis (mean squares) of some characteristics of canola

S.O.V	df	Plant height	Number of pods per main stem	Number of pods per lateral branches	Total number of pods per plant	Number of seed per pods	1000-seed weight	Seed Yield
Replication	2	7.53^{ns}	9.53 ^{ns}	21.4 ^{ns}	57.3 ^{ns}	0.44 ^{ns}	0.02 ^{ns}	27240^{ns}
Irrigation (I)	1	56. 5 ^{ns}	20.2 ^{ns}	69.4 ^{ns}	169^{ns}	0.03 ^{ns}	0.38 ^{ns}	126736^{ns}
Main error	2	17.8 ^{ns}	14.1 ^{ns}	33.4 ^{ns}	13.0 ^{ns}	0.44 ^{ns}	0.08 ^{ns}	48154^{ns}
Growth biostimulants (G)	5	241**	99.9**	251**	650**	10.9**	0.32**	465997**
I × G	5	17.1 ^{ns}	7.12*	29.7 ^{ns}	36.9 ^{ns}	2.89 ^{ns}	0.06 ^{ns}	80579**
Sub error	20	18.8	2.60	19.7	25.5	1.61	0.02	9942
C.V%	-	*2.64*	*4.48*	*4.54*	*3.77*	*4.98*	*4.83*	*2.80*

ns, * and ** indicate insignificance, significant effect at the levels of 5% and 1%, respectively

Table 3. Main effect of irrigation treatments on yield and yield components of canola

Irrigation levels	Plant height	Number of pods per main stem	Number of pods per lateral branches	Total number of pods per plant	Number of seed per pods	1000-seed weight	Seed Yield
	cm					g	kg. ha^{-1}
Normal	165 ^{a}	36.8 ^{a}	99.2 ^{a}	136 ^{a}	25.5 ^{a}	3.3 ^{a}	3620 ^{a}
Drought	162 ^{a}	35.3 ^{a}	96.4 ^{a}	131 ^{a}	25.4 ^{a}	3.1 ^{a}	3502 ^{a}

The means that have common statistical letters in each column, according to LSD test, do not have a statistically significant difference in the level of 5% probability

Table 4. Main effect of growth stimulation treatments on yield and yield components of canola

Stimulants of growth	Plant height	Number of pods per main stem	Number of pods per lateral branches	Total number of pods per plant	Number of seed per pods	1000-seed weight	Seed Yield
	cm					g	kg. ha^{-1}
Control	156 ^{d}	30.7 ^{d}	89.5 ^{d}	120 ^{e}	23.7 ^{c}	2.91 ^{d}	3181 ^{d}
Amino acid	165 ^{b}	35.8 ^{b}	100 ^{b}	136 ^{bc}	25.2 ^{bc}	3.36 ^{b}	3560 ^{bc}
Humic acid	165^{b}	39.7 ^{a}	100 ^{b}	140 ^{b}	25.3 ^{b}	3.18 ^{bc}	3588 ^{b}
Fulvic Acid	159 ^{cd}	35.8 ^{b}	95.0 ^{c}	130 ^{cd}	24.8 ^{bc}	3.26 ^{bc}	3467 ^{c}
Seaweed Extract	163^{bc}	32.7 ^{c}	93.2 ^{cd}	125 ^{de}	26.2 ^{ab}	3.16 ^{c}	3528 ^{bc}
Consolidated consumption	175 ^{a}	41.5 ^{a}	107 ^{a}	149 ^{a}	27.7 ^{a}	3.61 ^{a}	4044 ^{a}

The means that have common statistical letters in each column, according to LSD test, do not have a statistically significant difference in the level of 5% probability