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ORIGINAL RESEARCH PAPER

Application of jasmonic acid can mitigate water deficit stress in cotton through yield-related physiological properties

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Abstract

Precise and appropriate management of farmland for a cotton crop to reach the highest water use efficiency with a low water supply and an acceptable yield is required in arid- and semiarid regions. This study in Iran aimed to find the most appropriate concentration of jasmonic acid (JA) and the best stage for application to cope with any negative impacts of water deficit stress. A split-plot factorial experiment based on a randomized complete block design with three replications was used in 2 consecutive years (2016–2017). Two irrigation intervals of 10 and 20 days were used, with four concentrations of JA (0, 25, 50, and 100 mg L^{-1}) and applications at three crop stages (vegetative, reproductive, and vegetative and reproductive together). The final results showed that the 20-day interval significantly decreased relative water content, the quantity of cotton, cotton yield and its related traits including boll number per plant, the 1,000-seed weight, seed cotton yield, lint yield, and lint percentage. It also increased the content of proline and soluble sugars. The 50-mg L^{-1} concentration of JA applied at the vegetative-reproductive stages appropriately mitigated the negative effects of water deficit. These results are of practical application for farmers in arid- and semiarid regions with low water supply when irrigating cotton lands in order to reach an acceptable cotton yield.

Keywords

growth stages; lint yield; lint percentage; proline; total soluble carbohydrate

Introduction

Water deficit stress is one of the greatest challenges that agriculture has faced because it results in negative effects on plant growth, development, and so crop yield. Decreasing water table resources and annual precipitation in arid and semiarid areas of Iran, for example, have been even more severe in the last decade. Plant responses to water deficit and drought primarily lead to changes in phytohormone signaling and osmotic homeostasis [1]. Although many studies been have carried out on the effects of water stress and its management, the mechanisms of water deficit response in cotton (*Gossypium hirsutum* L.) have not yet reached advanced levels to allow control. Although cotton is moderately tolerant to drought mainly because of its extensive root system, its growth and development is especially in sensitive stages such as seedling, and the productive stages are severely influenced by water stress [2]. This normally causes reductions in respiration and photosynthesis, flowering and growth, and the quality and quantity of both bolls and fiber resulting in substantial economic yield losses [3].

Drought resistance is significantly associated with the mechanisms and pathways of osmotic regulation. A common mechanism in plants is utilized to confront osmotic stress by the production of osmo-regulators such as proline [3,4]. Furthermore, plant responses to water deficit include different signaling pathways leading to the production of essential phytohormones, such as jasmonic acid (JA), which are involved in many stress responses [5]. Osmotic stress, as an indirect result of drought stress, also affects metabolic and signal transduction pathways of phytohormones [6]. Jasmonic acid production can be induced by a wide range of biotic and abiotic stresses, such as water deficit, salinity, ozone exposure, wounding, and pathogen attack [6]. The JA biosynthetic and signaling pathways have been well studied but the effects of exogenous application on cotton quantity and quality traits remain somewhat unknown [6]. The main aim of the current study was therefore to evaluate the effects of combined water deficit and JA application at different developmental stages on the quality and quantity of cotton yield, and so to determine the best possible practical application for crop management.

Material and methods

The current research was carried out in two consecutive growing seasons (2016 and 2017) in the Zarin-Dasht area, located 337 km from Shiraz in the southeast of Fars Province, Iran. The geographical location of the research site is 25°54′ east latitude and 20°28′ longitude, at 1,150 m altitude and with an annual average precipitation of 250 mm. The experiment was conducted in a split-plot factorial design arranged in completely randomized blocks with three replications for both years. The plots consisted of six 5-m planting lines with a line spacing of 70 cm. The main plot employed two irrigation intervals of 10 and 20 days, and the subplots two factors: (***i***) jasmonic acid application at 0, 25, 50, and 100 mg L^{-1} concentrations and (***ii***), three different stages of vegetative, reproductive, and vegetative–reproductive development. Treflan herbicide was applied at 2.5 L ha^{-1} before sowing the cotton seed in order to control weeds. The soil was ploughed to a depth of 10 cm to mix the herbicide evenly in the soil. After soil preparation, seeds of *Gossypium hirsutum* 'Bakhtegan' (a cultivar commonly grown in the area) were sown in cultivation lines with 20-cm spacing between seeds. In view of the soil analysis for mineral nutrients (Tab. 1), fertilizer additions of 300 kg ha^{-1} urea, 100 kg ha^{-1} superphosphate, and 50 kg ha^{-1} potassium sulfate were applied to the soil. All the superphosphate and potassium sulfate fertilizers were applied before sowing, whereas the urea was applied in three stages at 100 kg ha^{-1}, before sowing, at the four-leaf stage and at the flowering stage.

Tab. 1 Some physicochemical properties of the research station soil.

Sodium absorption quotient		3.4
Magnesium	mg/kg	61.84
Potassium		2.08
Calcium		10.96
Chlorine		40
Sodium		20.5
pH		7.8
Soil depth	cm	0–45
Structure		Sandy loam
Salinity	dS m^{-1}	10.6
Sand	%	54.5
Silt		37.7
Clay		8.7
Field capacity		17.48
Bulk density	g/cm^3	1.428
Sampling depth	cm	0–45

Cotton seed yield and related traits, the 1,000-seed weight, the number of bolls per plant, lint yield, and lint percentage were all measured at the harvest stage. Proline contents of plants were measured according to the method of Bates et al. [7] and total soluble sugars using a method based on that of Yemm and Willis [8] after the reproductive stage. The yield for the whole plot was calculated and reported as kg m^{-2}. For other yield related traits, an area of 0.5 × 0.5 m in the center of each plot was selected and used for measurements. For proline and soluble sugars contents, the final leaf of three randomly selected plants was sampled and two repeats were used to give a final average value for each measurements. Proline and soluble sugars contents were calculated on a dry weight basis. Relative water content (RWC) was also measured to quantify drought effects. Turgid weight, fresh weight, and dry weights of the three samples were measured for each plot using the final leaf of three randomly selected cotton plants, and accordingly RWC calculated using the following formula: $RWC = (Turgid\ weight - Fresh\ weight) / (Fresh\ weight - Dry\ weight) \times 100$.

Data analysis was performed by analysis of variance of the split-plot factorial design. Normality tests were carried out using the Kolmogorov–Smirnov and Anderson–Darling methods on the model residuals. In order to reach normality, arcsine transformation of the square root of lint percentage data was required. Comparison of means was carried out as post hoc analysis by tests of least significant differences (LSD) at the 5% probability level. The statistical package SAS v.9.3 was used for all data analyses [9].

Results

The analysis of variance showed significant effects for irrigation interval, application stage and JA concentrations for all measured traits detailed in Tab. 2. Years showed significant differences for bolls number per plant, 1,000-seed weight, seed yield, and lint percentage. None of the measured traits was affected by the interaction between year and irrigation interval. Except for Concentration × Stage and Irrigation × Concentration × Stage interactions, no interactive effects regarding bolls number per plant were significant. Similar results were apparent for 1,000-seed weight and cotton yield. Irrigation Interval × Stage, JA Concentration × Stage, and Irrigation × Concentration × Stage interactions were significant for lint yield and lint percentage. All the two-way and three-way interactions of irrigation interval, application stage, and JA concentration were significant for proline content and total soluble sugars content. None of the treatment factors related to the measured traits were significant (Tab. 2).

Since the interaction between years and none of the factors was significant, a comparison of means was performed for the combined 2 years. The main effect of the irrigation regime showed that the 10-day irrigation interval had higher boll number per plant, seed cotton yield, 1,000-seed weight, lint yield, lint percentage, and also RWC, whilst it showed a lower content of proline and total soluble sugars. The application of JA at both vegetative and reproductive stages showed the highest values for all measured traits. The lowest values for application of JA for boll number per plant, seed cotton yield, 1,000-seed weight, lint yield, lint percentage, and RWC were at the reproductive stage, but the vegetative stage application had the lowest content of proline and total soluble sugars. The lowest values for boll number per plant, 1,000-seed weight, seed cotton yield, lint yield, lint percentage, and RWC were with the control and the application of 100 mg L^{-1} concentration of JA. The control JA application showed the lowest contents of proline and total soluble sugars with a significant difference from all other JA rates of application. The highest mean values for all measured traits were observed at the 50 mg L^{-1} concentration of JA. The differences between the 50 and 25 mg L^{-1} concentrations were not significant for proline and total soluble sugars contents (Tab. 3).

The three-way interactive effect of Irrigation Regime × Application Stage × JA Concentration modified the results of the main effect (Tab. 4). Apart from proline and total soluble sugars contents, the 10-day irrigation regime showed higher mean values than did the 20-day for all other treatment levels. Application of JA in the vegetative–reproductive stage showed higher values than the two others alone for all other treatment levels, and the 50 mg L^{-1} concentration of JA showed higher values than the other concentrations in the other treatments The highest boll number per plant, 1,000-seed weight, seed yield, lint yield, lint percentage, and RWC were achieved with 50 mg L^{-1} JA in the vegetative–reproductive stage for the 10-day irrigation interval. Differences with applications of 25 mg L^{-1} JA at the same application stages and with the same irrigation regime for seed yield and RWC were not significant. The lowest values for these traits were obtained at 100 mg L^{-1} JA at the reproductive stage only with the 20-day irrigation interval. The difference between control and 100 mg L^{-1} JA at the reproductive stage with the 20-day irrigation interval for lint yield was not significant. Proline and total soluble sugars contents showed their highest values at 50 mg L^{-1} in the vegetative–reproductive stage and the 20-day irrigation interval. The lowest proline contents were in the controls at the reproductive stage for both 10-day and 20-day irrigation intervals. The lowest content of total soluble sugars was in the control and 100 mg L^{-1} JA application at the reproductive stage with 10-day irrigation and in the control at the reproductive stage with a 20-day irrigation interval (Tab. 4).

Tab. 2 Combined analysis of variance for measured traits based on split-plot factorial design.

Source	*df*	Mean squares: Number of bolls per plant	1,000-seed weight	Seed cotton yield	Lint yield	Lint percentage	Proline	Total soluble sugar	RWC
Y	1	18.17**	186.03*	843.03*	26.74 ns	0.0131**	0.00025 ns	0.0001 ns	101.82 ns
R(Y)	4	0.74	22.57	61.98	26.66	0.00053	0.00014	0.0001	16.7
A	1	120.63**	805.2**	3,551.76**	1,725.73**	0.04512**	0.04158**	0.98**	5,634.59**
Y × A	1	0.73 ns	0.26 ns	28.8 ns	0.71 ns	0.00001 ns	0.00002 ns	0.0001 ns	1.04 ns
R × A(Y)	4	1.41	20.64	57.65	26.62	0.00059	0.00044	0.0001	39.42
B	2	414.32**	2,458.85**	62,998**	20,141.72**	0.35379**	0.09674**	2.38**	2,430.67**
C	3	53.81**	244.24**	3,219.63**	1,900.12**	0.05591**	0.02797**	5.39**	241.26**
Y × B	2	0.17 ns	3.39 ns	28.22 ns	1.7 ns	0.00006 ns	0.00005 ns	0.0001 ns	1.73 ns
Y × C	3	0.31 ns	0.45 ns	15.97 ns	0.45 ns	0.00022 ns	0.00051 ns	0.0001 ns	0.29 ns
A × B	2	0.5 ns	3.04 ns	211.42**	175.58**	0.00778**	0.00601**	0.19**	9.79 ns
A × C	3	0.87 ns	24.8 ns	21.45 ns	44.57 ns	0.000132 ns	0.00308**	0.08**	8.93 ns
B × C	6	2.3*	29.56*	127.43**	283.99**	0.01237**	0.0007**	0.59**	20.48 ns
Y × A × B	2	0.06 ns	4.95 ns	4.76 ns	0.5 ns	0.0001 ns	0.00017 ns	0.0001 ns	2.71 ns
Y × A × C	3	0.01 ns	0.55 ns	0.41 ns	0.03 ns	0.0001 ns	0.00015 ns	0.0001 ns	0.29 ns
Y × B × C	6	0.01 ns	1.4 ns	0.77 ns	0.18 ns	0.0002 ns	0.00016 ns	0.0001 ns	0.79 ns
A × B × C	6	2.5*	46.71**	137.19**	117.91**	0.00529**	0.00491**	0.08**	6.97 ns
Y × A × B × C	6	0.02 ns	0.58 ns	1.2 ns	0.04 ns	0.0005 ns	0.00015 ns	0.0001 ns	0.31 ns
Error	88	0.86	11.08	39.17	19.52	0.00047	0.00013	0.0001	13.49
CV%		5.85	3.46	5.82	11.55	3.45	5.84	6.64	5.14

df – degrees of freedom; Y – year; R – replication; A – irrigation; B – time; C – jasmonic acid; *CV* – coefficient of variation.
*, **, ns – significant at 1%, 5% level of probability, and not significant, respectively.

Tab. 3 Main effects mean comparison for measured traits.

Treatment	Number of bolls per plant	Seed cotton yield	1,000-seed weight	Lint yield	Lint percentage	Proline	Total soluble sugar	RWC
Irrigation interval (day)								
10	16.723 ^{a}	112.525 ^{a}	98.696 ^{a}	41.711 ^{a}	35.112 ^{a}	0.177 ^{b}	0.511 ^{b}	77.71 ^{a}
20	14.892 ^{b}	102.592 ^{b}	93.967 ^{b}	34.788 ^{b}	32.034 ^{b}	0.211 ^{a}	0.676 ^{a}	65.2 ^{b}
Application in stage								
Vegetative–reproductive	18.716 ^{a}	139.78 ^{a}	103.467 ^{a}	59.27 ^{a}	42.037 ^{a}	0.242 ^{a}	0.816 ^{a}	78.86 ^{a}
Vegetative	15.866 ^{b}	114.553 ^{b}	96.375 ^{b}	37.132 ^{b}	32.206 ^{b}	0.153 ^{c}	0.371 ^{c}	70.84 ^{b}
Reproductive	12.841 ^{c}	68.344 ^{c}	89.153 ^{c}	18.346 ^{c}	26.475 ^{c}	0.187 ^{b}	0.594 ^{b}	64.67 ^{c}
Concentration (mg L^{-1})								
0	14.836 ^{c}	100.736 ^{c}	93.864 ^{c}	32.801 ^{c}	30.758 ^{c}	0.164 ^{c}	0.24 ^{c}	70.05 ^{bc}
25	16.537 ^{b}	113.678 ^{b}	97.697 ^{b}	42.256 ^{b}	35.441 ^{b}	0.216 ^{a}	0.935 ^{a}	72.96 ^{ab}
50	17.15 ^{a}	117.504 ^{a}	99.311 ^{a}	46.439 ^{a}	37.419 ^{a}	0.22 ^{a}	0.921 ^{a}	74.31 ^{a}
100	14.709 ^{c}	98.317 ^{c}	94.455 ^{c}	31.501 ^{c}	30.672 ^{c}	0.177 ^{b}	0.277 ^{b}	68.49 ^{c}

Means with the same letters are not significantly different (LSD 5%).

Tab. 4 Three-way interaction mean comparison of irrigation regimes by jasmonic acid concentration by application stages related to all measured traits in cotton plants.

Irrigation interval (day)	Application stage	Concentration (mg L^{-1})	Number of bolls per plant	Seed cotton yield	1,000-seed weight	Lint yield	Lint percentage	Proline	Total soluble sugar	RWC
10	Vegetative–Reproductive	0	18.353 ^{cd}	137.478 ^{c}	103.02 ^{cd}	51.99 ^{e}	37.74 ^{e}	0.181 ^{j}	0.415 ^{k}	82.82 ^{b}
		25	20.531 ^{b}	146.603 ^{a}	107.06 ^{b}	72.234 ^{b}	49.232 ^{b}	0.227 ^{de}	0.812 ^{f}	87.533 ^{a}
		50	22.068 ^{a}	151.043 ^{a}	111.948 ^{a}	85.702 ^{a}	56.825 ^{a}	0.245 ^{c}	0.904 ^{e}	91.001 ^{a}
		100	17.923 ^{def}	134.758 ^{cd}	101.673 ^{cde}	49.692 ^{ef}	36.804 ^{ef}	0.198 ^{hi}	0.516 ^{j}	81.137 ^{bc}
	Vegetative	0	16.278 ^{hi}	117.052 ^{gh}	97.44 ^{fgh}	37.187 ^{kl}	31.712 ^{ij}	0.147 ^{no}	0.04 ^{o}	76.125 ^{def}
		25	17.215 ^{efgh}	126.897 ^{ef}	99.96 ^{def}	42.895 ^{hij}	33.746 ^{h}	0.188 ^{ij}	0.999 ^{d}	77.18 ^{de}
		50	17.443 ^{defg}	129.03 ^{def}	99.96 ^{def}	44.036 ^{ghi}	34.062 ^{fgh}	0.159 ^{mn}	0.044 ^{o}	78.54 ^{cd}
		100	15.742 ^{i}	112.54 ^{h}	96.459 ^{ghi}	35.287 ^{l}	31.28 ^{jk}	0.203 ^{gh}	1.09 ^{c}	75.11 ^{def}
	Reproductive	0	13.215 ^{lm}	65.732 ^{lmn}	91.8 ^{kl}	18.071 ^{qr}	27.458 ^{no}	0.141 ^{o}	0.119 ^{lm}	70.04 ^{ghi}
		25	14.55 ^{j}	80.812 ^{k}	92.46 ^{jkl}	22.725 ^{nop}	28.07 ^{mn}	0.153 ^{mno}	0.501 ^{j}	72.36 ^{fgh}
		50	14.695 ^{j}	85.49 ^{jk}	92.46 ^{jkl}	24.271 ^{no}	28.352 ^{lmn}	0.164 ^{lm}	0.584 ^{i}	73.03 ^{fg}
		100	12.662 ^{m}	62.867 ^{mn}	90.115 ^{klm}	16.446 ^{qr}	26.061 ^{op}	0.123 ^{p}	0.109 ^{mn}	67.67 ^{ijk}
20	Vegetative–Reproductive	0	17.088 ^{fgh}	133.96 ^{cd}	99.495 ^{efg}	48.296 ^{efg}	35.992 ^{efg}	0.211 ^{fg}	0.687 ^{h}	70.015 ^{ghi}
		25	18.108 ^{de}	139.4 ^{bc}	101.348 ^{cde}	57.406 ^{d}	41.089 ^{d}	0.27 ^{b}	0.962 ^{d}	73.616 ^{efg}
		50	19.107 ^{c}	144.633 ^{ab}	104.198 ^{bc}	63.299 ^{c}	43.767 ^{c}	0.383 ^{a}	1.475 ^{a}	75.75 ^{def}
		100	16.548 ^{ghi}	130.36 ^{de}	98.993 ^{efgh}	45.542 ^{fgh}	34.854 ^{gh}	0.224 ^{ef}	0.759 ^{g}	69.01 ^{hij}
	Vegetative	0	14.379 ^{jk}	98.455 ^{i}	93.425 ^{ijk}	30.543 ^{m}	31.001 ^{jkl}	0.176 ^{jkl}	0.061 ^{o}	63.967 ^{klm}
		25	15.81 ^{i}	120.02 ^{g}	95.763 ^{hij}	39.159 ^{jkl}	32.566 ^{hij}	0.204 ^{gh}	1.123 ^{c}	65.874 ^{jkl}
		50	16.068 ^{i}	122.74 ^{fg}	95.918 ^{hij}	40.922 ^{ijk}	33.245 ^{hi}	0.237 ^{cd}	1.324 ^{b}	66.313 ^{ijkl}
		100	13.993 ^{jkl}	89.69 ^{j}	92.078 ^{kl}	27.028 ^{mn}	30.038 ^{klm}	0.185 ^{ij}	0.068 ^{no}	63.63 ^{lm}
	Reproductive	0	11.385 ^{n}	59.688 ^{n}	87.411 ^{m}	15.014 ^{rs}	24.999 ^{p}	0.149 ^{no}	0.13 ^{lm}	57.373 ^{n}
		25	13.004 ^{m}	68.335 ^{lm}	89.59 ^{lm}	19.118 ^{pqr}	27.947 ^{mno}	0.165 ^{klm}	0.618 ^{i}	61.2 ^{m}
		50	13.516 ^{klm}	72.087 ^{l}	91.382 ^{kl}	20.404 ^{opq}	28.269 ^{mn}	0.178 ^{jk}	0.749 ^{g}	61.254 ^{m}
		100	9.701 ^{o}	51.74 ^{o}	78.003 ^{n}	10.722 ^{s}	20.645 ^{q}	0.155 ^{mn}	0.158 ^{l}	54.417 ^{n}

Means with the same letters are not significantly different (LSD 5%).

Discussion

Cotton is an important industrial crop both for its lint and seed use and widespread production worldwide. With its extensive and deep root system, cotton is a moderately resistant plant species to water deficit stress [10]. However, drought stress can severely reduce the quality and quantity of the cotton. Furthermore, a lack of a water supply in arid and semiarid regions, as is the case in much of south Iran, makes it necessary to consider different methods to manage irrigation and to make efficient use of the low water supply [11,12]. As reported by Thaler [13], the application of chemical elicitors such as JA having the ability to positively manage plant internal environments when facing drought stress, should be evaluated by cost-benefit analysis. Any advantages induced by the application of phytohormones from exogenous sources must be assessed at different concentrations and different application times to determine the best field management regime to result in lower water use and greater efficiency. There is still a lack of studies regarding the effect of exogenous application of phytohormones under water deficit conditions. These are needed to find the best method to increase water use efficiency using of phytohormones in the cotton plant [14]. In our current study, two different irrigation intervals of 10 and 20 days were evaluated for the application of JA at different concentrations and at different growing stages of the cotton plant. The results indicated that increasing the irrigation interval from 10 to 20 days reduced boll number per plant, 1,000-seed weight, seed yield, lint yield, and lint percentage of cotton plants. Furthermore, the contents of proline and total soluble sugars increased. Water deficit stress usually induces a significant reduction in plant growth and normally brings about smaller and poorly developed vegetative organs leading to a decrease in the photosynthetic apparatus and hence reduced photosynthesis resulting in lower yields [15]. During drought stress, an increase in the accumulation of active solutes, such as free protein and amino acids along with soluble carbohydrates, is claimed to be an effective mechanism to prevent severe damage to plants in the stressed condition [16]. Increased levels of solutes such as proline and carbohydrates in plant tissues cause higher osmotic potentials within cells and hence a greater capacity to absorb water [17]. Such effects in cotton plants under drought stress have been reported by de Ronde, van der Mescht [18], and Chen and Zhang [19]. Sekmen et al. [20] have shown that both the quantity and quality of cotton plant production is negatively influenced by drought stress. Application of JA at an appropriate concentration was shown to be capable of reducing the negative impacts of water deficit on cotton plants in our current study. Applying 50 mg L^{-1} JA resulted in a higher yield and other yield-related traits. It showed a positive trend in these traits, whereas 100 mg L^{-1} showed highly negative effects. The contents of both proline and total soluble sugars showed similar trends. Our results indicated that JA at 50 mg L^{-1} applied under a water deficit condition could be a useful technique to overcome the negative effects of drought stress. The application of JA at different stages of the growth of the cotton plant suggested that the best time is at the vegetative–reproductive stages together. Application of a moderate concentration of JA (25 or 50 mg L^{-1}) at the vegetative–reproductive stage at both irrigation intervals resulted in higher yields and its components. However, its effect at the 20-day irrigation interval was more pronounced, indicating that at these concentrations JA applied at both vegetative and reproductive stages can mitigate the negative effects of water deficit. Jasmonic acid and its related compounds, which can be identified in many plant species, have been regarded as endogenous regulators of both abiotic and biotic stress-induced responses, and also as influential signal molecules in the responses to stresses [3]. The ability of JA to stimulate the expression of proteins putatively involved in plant defense such as peroxidases [21] has been associated with an increase in natural plant resistance to stress conditions. Previous reports have also indicated that exogenous application of JA could be used as a beneficial tool for the control and management of some biotic and abiotic stresses in different plant species such as wheat [22], maize [23], tomato [24], but few studies have highlighted the effect of appropriate concentrations to mitigate drought stress in cotton [25].

Our 2-year study demonstrated that increasing the irrigation interval from 10 to 20 days significantly decreased cotton yield and its related traits whilst increasing the content of proline and total soluble sugars. Application of JA at a precise concentration at both vegetative–reproductive stages can mitigate the negative effects of the water deficit condition. It also emerges that the ideal concentration of JA to diminish the negative effects of water deficit stress is not the highest concentration applied here but a moderate one between 25 to 50 mg L^{-1}.

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Aplikacja kwasu jasmonowego może złagodzić negatywny wpływ deficytu wody na plonowanie i parametry fizjologiczne bawełny (*Gossypium hirsutum* L.)

Streszczenie

Odpowiednie prowadzenie uprawy bawełny, zapewniające optymalne plonowanie i wykorzystanie wody przez rośliny przy niskim nawadnianiu upraw, jest dużym wyzwaniem w strefach klimatów suchych i półsuchych. Celem badań było zbadanie wpływu różnych stężeń kwasu jasmonowego (JA) stosowanego w różnych fazach rozwoju roślin bawełny na zniwelowanie negatywnych skutków stresu suszy. Przeprowadzono czynnikowy eksperyment w układzie *split-plot* metodą losowych bloków w trzech powtórzeniach. Doświadczenie zlokalizowane było w prowincji Zarin-Dasht, Iran. Głównym czynnikiem eksperymentalnym były przerwy w nawadnianiu roślin (10- lub 20-dniowe), dodatkowo analizowano rożne stężenia JA (0, 25, 50 i 100 ppm) zastosowane w trzech stadiach rozwojowych bawełny (stadium wegetatywne, generatywne oraz wegetatywno/generatywne). Wykazano, że 20-dniowe przerwy w nawadnianiu skutkowały istotnym obniżeniem względnej zawartości wody w roślinach, ilości wytworzonych torebek bawełny i redukowały wielkość plonu. Zanotowano spadek liczby torebek/roślina, masy 1000 nasion, liczby nasion, liczby włosków/torebka. Jednocześnie stwierdzono wzrost zawartości proliny i całkowitej puli cukrów rozpuszczalnych w roślinach. Stężenie 50 ppm JA zastosowane w fazie wegetatywno/generatywnej najefektywniej obniżało negatywne skutki deficytu wody. Otrzymane wyniki mają znaczenie praktyczne i mogą być wykorzystane w suchych i pół-suchych rejonach upraw bawełny dla zwiększenia plonowania przy niskim poziomie nawadniania pól.