FEATURES OF ADAPTATION TO DROUGHT IN ISO AND ANISOHYDRIC PLANTS AND EFFECT OF SALICYLIC ACID

PARTICULARITĂȚI DE ADAPTARE LA SECETĂ A PLANTELOR ISO ŞI ANISOHIDRICE ŞI EFECTUL ACIDULUI SALICILIC

MELENCIUC M.[1]
email: melenciuc79@mail.ru

Abstract*: It has been studied the effect of salicylic acid derivatives of the cations NH_4^+, K^+, Mg^{++} on the physiological processes of the isohydric plant of Zea mays L and anisohydric one of Sorghum bicolor L. Moench in different conditions of soil water content. It was established that the peculiarities of the status of the water, induced by drought, were associated with adaptive morphological characters: reducing surface evaporation by the lower leaf senescence (maize) and adventitious shoots (on sorghum), leaf rolling (maize), cutinization and exudation of silicon oxide (on sorghum). It was shown that salicylates participated in the induction mechanisms of drought tolerance of plants by modulating the absorption, hydraulic conductivity, stomatal resistance and transpiration intensity. Such adaptive changes are geared towards maximum efficiency of water use in the production process. Treatment of seeds and foliage of plants with relevant salicylates increased the organism's tolerance to subsequent bad weather, which in turn affected growth, productivity and plants crop.*
Key words: *isohydric and anisohydric plant, hydraulic conductivity, stomatal resistance, salicylates, growth, productivity, rezistance.*

Rezumat*: S-a studiat efectul acidului salicilic şi a derivaţilor lui cu cationi de NH_4^+, K^+, Mg^{++} asupra proceselor fiziologice a plantelor isohidrice de Zea mays L şi anisohidrice de Sorghum bicolor L. Möench în diferite condiţii de umiditate. S-a stabilit că, particularităţile de autoreglare a status-ului apei, induse de secetă, sunt asociate cu caractere morfologice adaptive: reducerea suprafeţei de evaporare prin senescenţa frunzelor inferioare (la porumb) şi lăstarilor adventivi (la sorg), frunze rulante (la porumb), cutinizare şi exudatii de oxizi de siliciu (la sorg). S-a demonstrat că, salicilaţii participă în inducţia mecanismelor de toleranţă a plantelor la secetă prin modularea absorbţiei, conductibilităţii hidraulice, rezistenţei stomatelor şi intensităţii transpiraţiei. Prin urmare modificările adaptive sunt orientate spre eficientizarea maximă a utilizării apei în procesul de producţie. Tratarea seminţelor înainte de semănat şi a aparatului foliar al plantelor cu salicilaţi relevant majorează toleranţa organismului la intemperiile ulterioare, ceea ce se repercutează asupra creşterii, productivităţii şi recoltei plantelor.*
Cuvinte–cheie: *plante isohidrice şi anisohidrice, deficit de saturaţie, conductibilitate hidraulică, conductibilitatea stomatelor, salicilaţi, creştere, productivitate, rezistenţă.*

[1] Institute of Genetics, Plant Phyisiology and Protection of Academy of Sciences, Chişinău, Republic of Moldova

INTRODUCTION

Study of mechanisms of the formation adaptation and resistance to drought of plants, especially mesophytes, are one of the priority directions of contemporary biology. Production losses caused by unfavorable factors from the environment, entails the need to widen the investigations relating to the elucidation of the mechanisms underlying adaptation and tolerance of plants to environmental conditions, such as suboptimale and search for ways of minimising the negative impact. Property to maintain water plant in the organs under conditions of moderate moisture deficit is at the cellular level and tissue it is codependency of changing water retention capacity (WRC), intensity of osmotic water absorption, coupled with additional energy consumption (Gupta *et al.,* 2000; Jones,. 2007). At the organism maintain fluid balance is conditioned by dimming uptake, translocation through plant transpiration and water consumption in the process (Chavies *et al.,* 2003). Proceeding from the fact that the regulation and coordination of growth, development and productivity of plants under the control of plant hormones, more research in phytophysiology the is oriented to elucidating mechanisms and explore ways of exogenous adjusting plant functional status in moderate drought conditions. Salicylic acid is referred to phytohormones with properties regulating the growth and development of plants ((Gudvin and Mercer, 1983), its effect is associated with the maintenance of the balance of the AIA, ABA and CK (Gupta *et al.,* 2000). It is supposed that AS participates in in regulating hydraulic conductivity (Lp) plant (Moreshet *et. al.,* 1990). In the literature few investigations are subordinate to elucidate the mechanisms of action of AS on components of the water status, growth, development and crop productivity in drought conditions.

MATERIAL AND METHOD

As subjects served isohidric plants of *Zea mays* L cultivar (cv.) P459, and anisohidric plants of *Sorghum bicolor* (L.) Möench, cv. Moldovenesc 40. The experiments were conducted in the greenhouse complex under controlled hydric regime of the IGFPP with plants grown in containers Mitcerlih with 30 kg dry soil. The hydric stress was created by the gradual decline in soil water content range 70 - 60 - 50 to 40 - 30% of total water capacity (TWC) of the soil. Drought stress was modeled on the sixth stage - she organogenesis by reducing water supply plant and maintain the moisture level of 30% TWC. Parallel variants include plants treated with AS. The parameters of the water status in the segment "root-stalk" and "strain - leaves" have been determined by conventional methods (Vasseu and Sharkey, 1989). Hydraulic conductivity plant was determined by inhibiting water channels with $HgCl_2$ (Zhongin and Newmann, 1999) and calculated according to the equation: $F = Lp.\Delta \Psi w / \Delta x$; where F - transpiration rate, or volumetric flow of water; Lp hydraulic -conductibilitatea; Δx - distance between metamerele organ; Ψw - value of the water potential (Jones, 2007). The results were statistically analyzed using the software package "Statistica 7" for computers. Authenticity is true differences in the probability $P \leq 0.05$ and $P \leq 0.01$.

RESULTS AND DISCUSSIONS

Salicylic acid is referred to phytohormones with properties regulating the growth and development of plants (Gudvin and Mercer, 1983), its effect is associated with maintaining the balance of the AIA, ABA and CK (Gupta *et al.,* 2000). Pretreatment with salicylates seed conditioned acceleration of plant growth in the initial stages of ontogenesis (Tab. 1). Salicylates effect is especially evident in plants exposed "physiological drought". Drought physiological root system inhibited the growth of seedlings from seeds treated with 8,7 to 10,00%, while the root system of seedlings treated values did not differ significantly from those of plantlets "martor" unexposed stress. The diurnal rate of accumulation of biomass plantlets "martor" within 5 days after germination amounted to 123,78 mg • pl^{-1}; plantlets treated with AS – 131,8 mg • pl^{-1}. Inaccessibility of to water plantlets from the background "physiological drought" has conditioned a reduction of 147.12 mg biomass accumulation in 24 hours from plantlets treated with 60,54 mg - in those treated (Tab. 1).

Table 1.

Influence salicylates on the growth of the plantlets *Zea mays* L., cv. P459 the a background „ physiological drought ” at the initial stage of ontogenesis.

Variant	Length, mm		Biomass, mg		
	Root	Coleoptile	Roots	Coleoptile	Plantlets
Control	132,1± 0,69	84,52±1,4	373,33±7,2	145,5±1,73	618,92±4,5
Salicylat	156,0± 0,85	98,85±0,4	381,00±5,2	277,9±2,37	658,94±3,8
Martor*Drought	121,56±0,58	77,69±1,2	282,63±3,4	189,1±5,29	471,80±4,3
Salicylat*Drought	132,06±1,67	86,83±0,3	358,05±6,2	200,3±4,87	558,36±5,5

As a result of the effect of SA and increase linearly radicicolei salicylate was two times the mean length of the control plants radicicolei. At the same time coleoptile length was 17,3 percent higher than coleoptile length seedlings from seeds treated with water. It follows that at the early stages of of ontogenesis AS favors the growth of the plantlets in general, but especially to increase the rate of growth of the root system. The dates obtained by us argue indirectly ideas raised by Raskin I. (Raskin, 1992) as the salicylates are able to maintain the balance between IBA, ABA and CK. (Ниловская *et al.,* 1997; Пустовойтова *et al.,* 2000). In all probability AS stimulates biosynthesis because following the data tab. 1 rate of biomass accumulation of plantlets treated with AS exceeded by 1,4 to 1,5 times control plantlets biomass accumulation. A consequence of differences in growth rate of plant organs at the initial stage of of ontogenesis was the change in mass ratio shoot / root mass (m_l / m_r). On the background of accelerating growth processes seedling entirely AS the initial stages of of ontogenesis accelerates especially root system formation. Effect distinctive ofthe AS on the growth of roots and shoots the correlation change allowed to assume that the seed priming with AS could serve as a modulator of growth, development and plant resistance

in wet conditions suboptimal. Just know that one of the causes drought tolerance of plants is to develop a strong root system, deeply penetrating and high absorption activity. Moreover, one of the main factors that determine the size road in conditions in the water supply, is the state of the roots. It was established that plants well supplied with water under the influence salicylate in connection majorarează Lp true "root - leaf" and maintaining its value to a significantly higher level in terms of inadequate water availability.

Table 2.

Influence salicylates on the parameters water status plantlets *Zea mays* L., cv. P459 the a background „ physiological drought ” at the initial stage of ontogenesis.

Variant	Water content , g·100 g^{-1} f. m.		Intensity of transpiration, g · dm^{-2} ·h^{-1}	L_p mg.cm.h
	Root	Coleoptile		
Control	89,67± 0,53	65,37± 0,87	0,68±0,012	4,4375±0,07
Salicylat	90,05± 0,63	96,55± 0,72	0,78±0,009	4,7737±0,13
Martor*Drought	84,53± 0,47	56,67± 1,10	2,87±0,007	1,0249±0,04
Salicylat*Drought	85,65± 0,03	60,40± 0,75	0,89±0,004	2,9541±0,05

Lp under optimum conditions is increased by 9,11% compared to the control. After 24 h of stress ("physiological drought") Lp to the latter decreased 4,9 times, while the plantlets from seeds treated with salicylates - only 1,4 times (tab. 2) and beyond Lp plantlets the treated seed 3,44 times. Arguments about the peculiarities of homeostatare the status of the water by *Zea mays* L. and *plants Sorghum bicolor* (L.) Moench were obtained in the experiences and vegetation moisture controlled fond (Table 3).

Table 3

Influence salicylates on the parameters water status plantlets *Zea mays* L., cv. P459 and *Sorghum bicolor* (L.) Möench cv. Moldovenesc 40 in conditions of insufficiency humidity.

Cultivar	Varianta	Saturation deficiency, % of full saturation	Stomatal conductance, g · dm^{-2}	Intensity of transpiration, mg · dm^{-2} ·h^{-1}	L_p, mg.cm.h
P459	Martor	1,42±0,04 18,70±0,23	44,15 ± 0,86 16,34 ± 0,68	508,7 ± 14,9 201,7 ± 8,45	0,475±0,012 0,235±0,007
	Salmet	1,32±0,03 14,01±0,25	47,54 ± 0,81 24,17 ± 0,71	535,2 ± 15,6 225,6 ± 10,7	0,56±0,009 0,275±0,004
Moldovenesc 40	Martor	0,95 ±0,04 2,72 ±0,07	59,20 ± 1,13 47,42 ± 1,12	844,85 ± 18,4 676,77 ± 16,3	0,855±0,011 0,55±0,008
	Salmet	0,76 ±0,02 1,71 ±0,05	63,85 ± 1,83 53,00 ± 1,49	822,74 ± 9,5 719,36 ± 12,9	0,91±0,006 0,64±0,010

The stabilizing effect of the status of the water produced by the compounds is due to their property AS control hydraulic conductivity and the state of the stomata. Salicylates increase the capacity of the attraction of the water, in particular to the leaves from the top of the plant, inducing redistribution of water bodies. Responding to drought plant sorghum is characterized not so much by reducing water consumption in the process of sweating, as the property

to obtain water due to the increase surface root system and force absorbing water from the soil and preserving conductivity hydraulic plant. Increasing intensity of water delivery stomata allow the plant to keep ajar for longer, facilitating the assimilation of CO_2 and biomass accumulation. Therefore, the drought conditioned prompt changes in the intensity of both the water of perspiration, coupled with the change in conductance of stomata and the potential value of the hydrostatic pressure of the water and foliage of plants. The reduction of the water flow to the leaves (IT) are associated with reduced hydraulic conductivity of the tissues - most significant in sensitive plants as opposed to the typical anisohidrice plants tolerant to a long-lasting drought. The stabilizing effect of the status of the water produced by the compounds of salicylic acid is a consequence of the maintenance of the hydraulic conductivity and the state of the stomates.

Identifying differences of *Zea mays* plant morphophysiological L., cv. P459 and *Sorghum bicolor* (L.) Moench, cv. Pişcevoi 1 (Fig. 1) under controlled humidity, revealed the reaction of different plant maize and sorghum to water

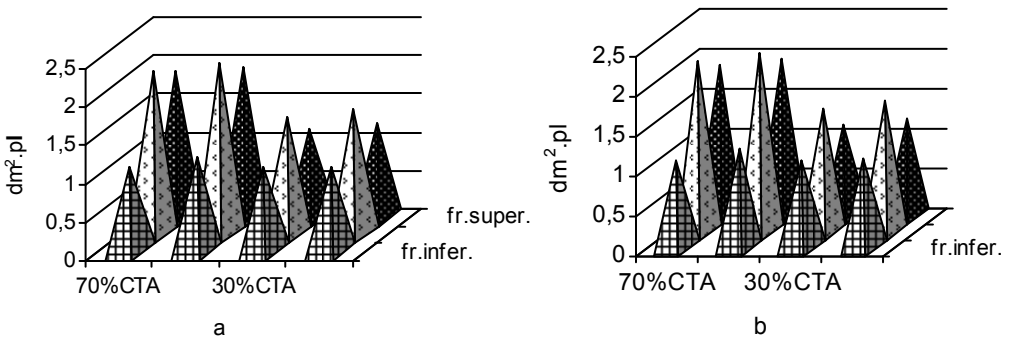

Fig. 1 - The influence of the salicylic acid on formation of the leaf area to different levels insertion, dm^2 plants *Sorghum bicolor*, L. Moench cv. Pişcevoi (a) and *Zea mays* L. cv. P459 (b) under varying humidity.

in the soil and changes in compensatory induced AS-level body, achieved by maintaining growth, the accumulation of biomass , training area, assimilation, etc. Drought leaves its mark on training and assimilation machine by reducing the leaf area metamerelor lower leaves, as a result of drying them, and through halting the growth of leaves and higher levels of employability. Already after 5 days of drought (30% TWC) total leaf area was reduced to *Zea mays* L. plants, cv P459 by 33,0% and those of *Sorghum bicolor* (L.) Moench, cv. Pişcevoi 1-19% compared with control plants exposed to water stress us. The use of AS reduced the negative effect of drought by 6,2 and 5,1 percent respectively maize and sorghum plants. Note that the leaf surface and higher levels decreased under severe moisture 28,1 and 39,4% compared to control plants of sorghum and 30,9 and 40,0% - in the maize. The latter, along with the trend growth inhibition upper leaves, there has been a genuine reduction in lower leaves most significant surface (Fig. 1). A distinctive feature of sorghum plant growth type indeterminate reduce surface evaporation is not so much the main shoot leaves account as partial drying

as a result of adventitious shoots of leaves. AS effect was manifested by mitigating the impact of drought, especially on the leaf area at the bottom and the environment. Therefore, plants treated with foliar AS seminal and easier exceed ancestry stressogenic factors. Its distinctive effect is achieved through better training device assimilate what biomass accumulation undoubtedly reflects on the production process.

CONCLUSIONS

1. Property homeostatare of the water status in the plant induced AS is achieved by enhancing / amplification water uptake by the root system, hydraulic conductivity increases, the degree of hydration of tissues, decrease the saturation deficit and increasing turgidity organs.

2. Salicylates conditioned activation of vital processes already at the initial stages of individual development of plant root and shoot growth stimulation system, the formation of more vigorous plants in hydric suboptimal conditions, lessening the impact on productivity.

3. The phenotype of the plant, comprising the administration of AS is distinguished by improved tolerance to weather during the growing season.

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