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The influence of salicylic acid on 1000 grain weight, germination percent and biological yield of wheat in the sistan region

Mehdi Mazraei[1], Hamid Reza Ganjali[1]*, Mohammad Reza Narouei Rad[2]

[1]Department of Agriculture, Islamic Azad University, Zahedan Branch, Zahedan, Iran
[2]Agriculture and Natural Resources Research Center of Sistan, Iran

Abstract Salicylic acid (SA) (*o*-hydroxybenzoic acid), which belongs to a group of plant phenolics, is widely distributed in plants and is now considered as a hormone-like substance, which plays an important role in the regulation of plant growth and development. Exogenous SA alters the activities of antioxidant enzymes and increases plant tolerance to abiotic stress by decreasing generation of ROS. It has been found that SA has different effects on stress adaptation and damage development of plants that depend on plant species, concentration, method and time of SA application. The field experiment was laid out factorial with randomized complete block design with three replications. Treatments included varieties (a1: Bam, a2: Sistan, a3: Hirmand, a4: Hamun) as factor a and factor b consisted of salicylic acid (b1: 0 µM, b2: 900 µM, b3: 1800 µM, b4: 2700 µM). Analysis of variance showed that the effect of varieties on all characteristics was significant. Analysis of variance showed that the effect of salicylic acid on all characteristics was not significant.

Keywords 1000 grain weight, germination percent, biological yield

Introduction

Salicylic acid (SA) (*o*-hydroxybenzoic acid), which belongs to a group of plant phenolics, is widely distributed in plants and is now considered as a hormone-like substance, which plays an important role in the regulation of plant growth and development [1-2]. During the last 20 years this substance has drawn the attention of researchers because of its ability to induce systemic acquired resistance (SAR) in plants. At the present, considerable interest has been aroused by the ability of SA to produce a protective effect on plants under the action of stress factors of different abiotic nature. Salicylic acid (SA) is a signaling or messenger molecule in plants and induces plant tolerance against various biotic and abiotic stresses [3]. SA also plays an important role in the regulation of some physiological processes in plants such as effects on growth and development, ion uptake and transport and membrane permeability [4]. Salicylic acid (SA) or ortho-hydroxy benzoic acid and other salicylates are known to affect various physiological and biochemical activities of plants and may play a key role in regulating their growth and productivity [5]. Salicylic acid is considered to be an endogenous growth regulator of phenolic nature that enhanced the leaf area and dry mass production in corn and soybean [6]. Enhanced germination and seedling growth were recorded in wheat, when the grains were subjected to pre-sowing seed-soaking treatment in salicylic acid [7]. Fariduddin et al. (2003) reported that the dry matter accumulation was significantly increased in Brassica juncea, when lower concentrations of salicylic acid were sprayed. However, higher concentrations of salicylic acid had an inhibitory effect [8]. Khodary (2004) observed a significant increase in growth characteristic, pigment contents and photosynthetic rate in maize, sprayed with salicylic acid [9]. It was also reported that exogenous application of

salicylic acid, enhanced growth, physiological process and antioxidant activity of carrot plants grown under salinity stress. Flowering is another important parameter that is directly related to yield and productivity of plants. Salicylic acid has been reported to induce flowering in a number of plants. Different plant species including ornamental plant Sinningia speciosa flowered much earlier as compared to the untreated control, when they received an exogenous foliar spray of salicylic acid [10]. In cucumber and tomato, the fruit yield enhanced significantly when the plants were sprayed with lower concentrations of salicylic acid [11]. It was reported that the foliar application of salicylic acid to soybean also enhanced the flowering and pod formation [12]. Exogenous SA alters the activities of antioxidant enzymes and increases plant tolerance to abiotic stress by decreasing generation of ROS. It has been found that SA has different effects on stress adaptation and damage development of plants that depend on plant species, concentration, method and time of SA application [13]. Furthermore, SA is a potential non-enzymatic antioxidant and an important signal molecule for modifying plant responses to environmental stressors. Some earlier reports display that exogenous SA can ameliorate the impairing effects of drought stress in different species [14]. SA has obtained particular attention because of inducing protective effects on plants under NaCl salinity [15]. Several studies have shown that the effects of cytotoxicity induced by salt stress can be ameliorated by the exogenous application of SA [4]. Thus considerable data have been obtained concerning the SA induced increase in the resistance of wheat seedlings to salinity [16], and water deficit [17], of tomato and bean plants to low and high temperature [18], as well as the injurious action of heavy metals on rice plants [19].

Material and Methods

Location of experiment

The experiment was conducted at the zabol which is situated between 30° North latitude and 61° East longitude.

Composite soil sampling

Composite soil sampling was made in the experimental area before the imposition of treatments and was analyzed for physical and chemical characteristics.

Field experiment

The field experiment was laid out factorial with randomized complete block design with three replications.

Treatments

Treatments included varieties (a1: Bam, a2: Sistan, a3: Hirmand, a4: Hamun) as factor a and factor b consisted of salicylic acid (b1: 0 μM, b2: 900 μM, b3: 1800 μM, b4: 2700 μM).

Data collect

Data collected were subjected to statistical analysis by using a computer program SAS.

Results and Discussion

1000 Grain Weight

Analysis of variance showed that the effect of varieties on 1000 grain weight was significant (Table 1). The maximum of 1000 grain weight of treatments a2 was obtained (Table 2). The minimum of 1000 grain weight of treatments a1 was obtained (Table 2). Analysis of variance showed that the effect of Salicylic acid on 1000 grain weight was not significant (Table 1). The maximum of 1000 grain weight of treatments b2 was obtained (Table 2). The minimum of 1000 grain weight of treatments b3was obtained (Table 2).

Germination Percent

Analysis of variance showed that the effect of varieties on germination percent was significant (Table 1). The maximum of germination percent of treatments a2 was obtained (Table 2). The minimum of germination percent of treatments a1 was obtained (Table 2). Analysis of variance showed that the effect of Salicylic acid on germination percent was not significant (Table 1). The maximum of germination percent of treatments b4 was obtained (Table 2). The minimum of germination percent of treatments b1was obtained (Table 2).

Table 1: ANOVA analysis of the wheat affected by varieties and salicylic acid

S.O.V	df	1000 Grain Weight	Germination Percent	Biological Yield
Varieties (V)	3	78.2**	12.07**	113.6**
salicylic acid (SA)	3	15.43ns	5.35ns	4.7ns
R	2	7.49ns	1.52ns	23.9**
V*SA	9	20.2ns	12.3**	7.08**
Error	30	20.1	1.8	2.09
CV (%)	-	14.9	1.44	27.08

*, **, ns: significant at $p<0.05$ and $p<0.01$ and non-significant, respectively.

Biological Yield

Analysis of variance showed that the effect of varieties on harvest index was significant (Table 1). The maximum of harvest index of treatments a3 was obtained (Table 2). The minimum of harvest index of treatments a2 was obtained (Table 2). Analysis of variance showed that the effect of Salicylic acid on harvest index was not significant (Table 1). The maximum of harvest index of treatments b3 was obtained (Table 2). The minimum of harvest index of treatments b4 was obtained (Table 2).

Table 2: Anova analysis of the wheat affected by varieties and salicylic acid

S.O.V	Treatment	1000 grain weight	Germination percent	Biological yield
Varieties (V)	a1	28.2b	93.6b	3.08a
	a2	33.8a	96a	2.5c
	a3	28.7b	95.4a	9.1a
	a4	29.4b	95.3a	6.5b
Salicylic acid (SA)	b1	29.1a	94.2b	5.1ab
	b2	31.3a	95.5a	5.9a
	b3	29a	94.9ab	5.8ab
	b4	30.6a	95.7a	4.5b

Any two means not sharing a common letter differ significantly from each other at 5% probability

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