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An Examination Into The Effects Of Salicylic Acid (Sa) On The Morphological Characteristics Of Wheat And Drought Conditions Following Each Foliar Spray

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Abstract
To investigate the effects of salicylic acid on wheat by foliar spraying at various doses. An experiment in pots with three replications was carried out in India during the rabi season of 2021-2022. Plant was treated with foliar spray at the tillering, extension, and heading stages, with concentrations of 0.5mM, 1mM, and 2mM. The results reveal that foliar sprays of 1mM and 2mM salicylic acid aim to maintain shoot length under drought stress conditions. As the concentration of salicylic acid on wheat increases, the number of leaves increases in drought stress. Overall, salicylic acid treatment has a favourable effect on wheat plants under drought stress conditions.
Key words: Drought Condition, Salicylic Acid, Foliar Spray, Grain quality, nutrition value

Introduction

Wheat is considered Egypt's first strategic food crop. During that period, it remained the core staple meal in urban areas and was blended with maize in rural regions for bread manufacturing. Wheat straw is also an essential feed [1]. Wheat plants in Egypt are occasionally subjected to drought at various stages of development. Foliar spraying of chemical desiccant to wheat plants is one method for reducing crop losses caused by drought [2]. Salicylic acid (SA) occurs naturally in very low concentrations in plants and participates in the regulation of physiological processes such as stomatal closure, nutrient uptake, chlorophyll synthesis, protein synthesis, ethylene biosynthesis inhibition, transpiration, and photosynthesis [3]. It has been discovered as an essential signalling factor involved in the establishment of plants' local and systemic disease resistance response following pathogen attack [4]. Plant responses to abiotic and biotic stress factors are regulated by Salicylic acid (SA), Jasmonic acid (JA), and ethylene-dependent signalling pathways [4]. Furthermore, SA treatments at 0.5 mM reduced the Cd-induced up-regulation of antioxidant enzyme activity in barley[5]. SA has a direct physiological effect through altering antioxidant enzyme activity. SA treatment activated some enzymes while inhibiting others, such as catalase. Catalase appears to be an important enzyme in salicylic acid-induced stress tolerance because it has been found to bind SA in vitro [6] and to be inhibited by SA in numerous plant species [7]. SA promotes flowering, prolongs floral life, slows senescence, and boosts cell metabolic rate. Sustained salicylic acid levels may be required for the synthesis of auxin and/or cytokinin [8]. Ascorbic acid (AA), on the other hand, is an organic molecule that is necessary in trace amounts in higher plants to ensure normal growth [9]. AA affects phytohormone-mediated signalling pathways throughout the transition from the vegetative to the reproductive phase, as well as the last stage of development and senescence in plants [10]. Furthermore, AA influences the activity of the nutritional cycle in higher plants and is vital in the electron transport system [11]. It is also necessary as a cofactor for many essential enzymes in plants [12]. The powerful effects of salicylic acid and ascorbic acid on various aspects of plant structure and function have prompted many researchers to apply them to a

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variety of crop plants in order to control growth and development patterns while also increasing systemic resistance to various harmful agents that may appear in the surrounding environment. Salicylic acid enhances some physiological processes while inhibits others, depending on concentration, plant species, developmental stage, and environmental factors [13]. SA improved soybean flowering, pod yield, and seed yield [14]; wheat growth ; and maize growth [15]. Salicylic acid, on the other hand, decreased plant development and chlorophyll content in tomato, lupine, and wheat[16]. Ascorbic acid, on the other hand, has been shown to improve growth and productivity in lemongrass [17], cotton [18], sugar beetroot[19], cucumber[20], sweet pepper[21], and wheat. As well as on sunflower plants[22]. As a result, salicylic acid and ascorbic acid could be expected to influence wheat plant growth and yield. As a result, the current study was carried out to investigate the effect of spraying salicylic acid, ascorbic acid, individually or in combination on some morphological criteria, yield, and biochemical constituents of wheat (Triticum aestivum L.) cv. Gemmiza 10 plants in order to improve growth, yield, grain quality, and nutritional value.

Materials and Methods

At the net house, an experiment was carried out in loamy soil pots with three replications. Seven seeds were placed at a depth of 5 cm in each pot. Normal irrigation is provided for 15 days after seeding. At 25-day intervals, three foliar sprays of 0.5mM, 1mm, and 2mM salicylic acid were applied to normal watered and drought stress wheat plants at the tillering, extension, and heading stages. Drought stress is applied for 7 days. At the tillering stage, bind one well-grown plant in each pot with thread for parameter monitoring. Shoot length and the number of leaves on each plant in each pot were measured. After recording the data in Excel, a graph was created to analyse the results.

Results and Discussion

Salicylic acid treatment had an effect on wheat in both normal watered and drought stressed conditions. Plants treated with SA demonstrate a favourable benefit in drought situations. The table shows that branch length/plant is greater in SA-treated plants than in controls (no SA treatment). The shoot length is also increased in normal conditions by foliar spray of SA compared to the regular irrigated plant with no treatment. Shoot length is practically maintained in drought plants compared to normal watered plants by the first foliar spray of 0.5 mM SA, 1 mM SA, and 2 mM SA. Shoot length was increased in plants under drought conditions by foliar sprays of 1 mM and 2 mM SA compared to plants under normal watered conditions. Shoot length is practically maintained in drought plants after the second and third foliar sprays compared to typical watered plants. Shoot length increased in plants under drought conditions by foliar spraying with 0.5 mM SA compared to plants under regular watered conditions. Foliar sprays of 1 mM and 2 mM SA virtually maintain shoot length/plant in drought circumstances. The number of leaves on each plant falls in drought circumstances. The graph shows that in drought conditions, the number of leaves/plants is greater in SA-treated plants than in the control (no SA treatment). The number of leaves is enhanced in normal conditions by foliar spray of SA compared to the normal irrigated plant with no treatment. The number of leaves in drought plants is practically maintained in comparison to normal irrigated plants by the first foliar spray of 0.5 mM SA, 1 mM SA, and 2 mM SA. The number of leaves is enhanced in plants under drought conditions by foliar sprays of 1 mM and 2 mM SA compared to plants under normal watered conditions. The number of leaves in drought plants is practically maintained after the second and third foliar sprays of 0.5 and 2 mM SA, compared to normal watered plants. The number of leaves increased in plants under drought conditions by foliar spraying with 1 mM SA compared to plants under regular watered conditions. This demonstrates that SA has a good effect on drought-stressed wheat plants, and the plants are attempting to overcome the stress by maintaining the number of leaves per plant.

Foliar spray	**Concentrations**	**Normal**	**Drought**

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1st	Control	20.667±0.577	15.667±0.289
	0.5 mM SA	20.1± 1.931	19.833±4.368
	1 mM SA	20.833±2.309	21.933±0.404
	2Mm SA	21.833±2.754	22.967±1.762
2nd	Control	42.03±0.577	37±1.732
	0.5 mM SA	38.133±2.579	39.33±4.04
	1 mM SA	43.333±4.619	41.833±1.457
	2Mm SA	45.067±2.747	44.667±2.309
3rd	Control	42.3±3.2	37.5±1.732
	0.5 mM SA	39.067±2.386	43.533±4.5
	1 mM SA	43.5±4.678	42.333±1.793
	2Mm SA	46.167±2.926	46.367±2.312

Table 1: Plant shoot length with varied SA treatments in normal and drought circumstances after each foliar spray Plant length/Shoot length (cm)

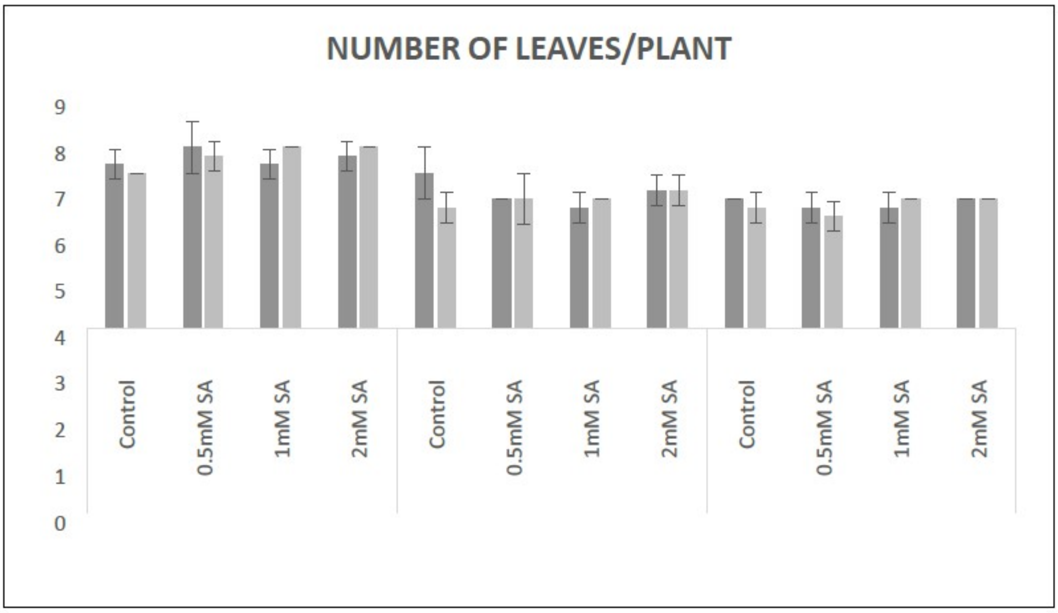

Figure 1: Graphical representation of Shoot length/plant in sample plants which were given the treatment of 0.5mM, 1mM and 2mM Salicylic acid (SA) and control (no SA) in both normal irrigated and drought conditions after each foliar spray.

Foliar spray	Concentrations	Normal	Drought
1st	Control	6.333±0.577	6±0
	0.5 mM SA	7±1	6.667±0.577
	1 mM SA	6.333±0.577	7±0
	2Mm SA	6.667±0.577	7±0

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2nd	Control	6±1	4.667±0.577
	0.5 mM SA	5±0	5±1
	1 mM SA	4.667±0.577	5±0
	2Mm SA	5.333±0.577	5.333±0.577
3rd	Control	5±0	4.667±0.577
	0.5 mM SA	4.667±0.577	4.333±0.577
	1 mM SA	4.667±0.577	5±0
	2Mm SA	5±0	5±0

Table 2: The number of leaves in the plant after each foliar spray with different SA treatments in normal and drought circumstances.

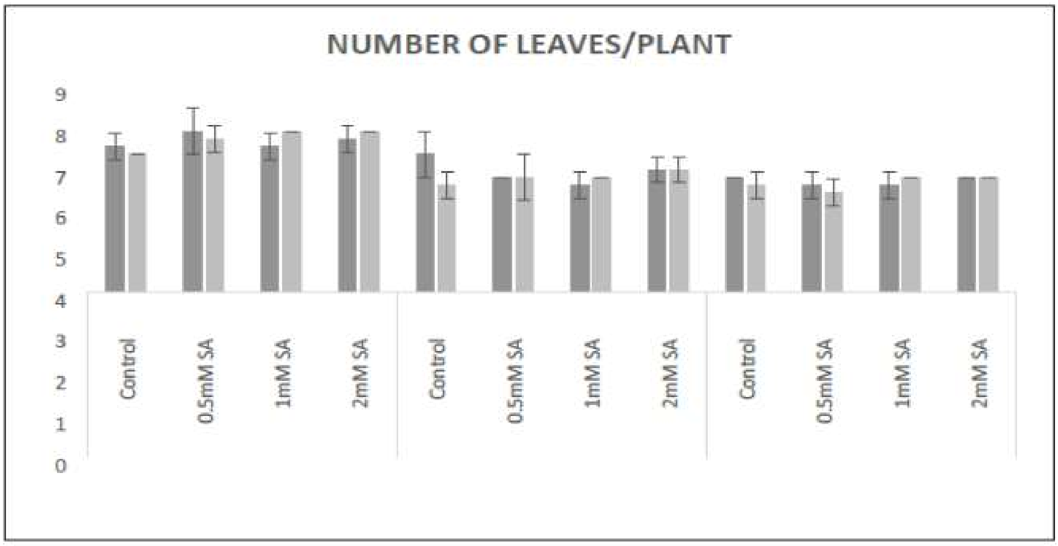

Figure 2: Graphical representation of the number of leaves per plant in sample plants treated with 0.5mM, 1mM, and 2mM Salicylic acid (SA) and control (no SA) after each foliar spray in both normal watered and drought circumstances.

The number of leaves, dry/fresh weight, and shoot/root length all influence plant growth rate. Wheat plant branch length is decreasing as a result of drought stress. Shoot length is reduced in drought-stressed plants compared to irrigated plants because elongation of cells can be suppressed by disrupting water supply to surrounding elongating cells via the xylem. As demonstrated in table 1, the first spray of 0.5 mM SA, 1 mM SA, and 2 mM SA almost maintains shoot length in drought plants compared to normal watered plants. While in the second and third sprays, 0.5 treatment boosted shoot length in plants under drought conditions compared to plants under regular watered conditions. Foliar sprays of 1 mM and 2 mM SA virtually maintain shoot length/plant in drought circumstances. It was the cell extension growth stage of wheat plants when the second spray was applied. Exogenous administration of SA to wheat plants at any growth stage results in increased shoot length relative to untreated drought plants. These findings are congruent with Prabha and Negi's study, which found that 0.5 mM salicylic acid treatment increased morphological characteristics such as plant height per plant under drought stress conditions in capsicum [23]. The number of leaves was practically maintained in drought plants compared to normal watered plants by the first foliar spray of 0.5 mM SA, 1 mM SA, and 2 mM SA. The number of leaves was practically maintained in drought plants after the second and third foliar sprays of 0.5 and 2 mM SA compared to irrigated plants. A foliar spray of 1 mM SA increased the number of leaves in plants under drought conditions compared to plants under regular watered conditions. The number of leaves per plant might be reduced in drought stress due to a decrease in soil water potential. The number of leaves increases during the tillering stage but reduces during the extension and heading stages because spike formation begins during these stages and the nourishment is distributed. Exogenous foliar SA attempted to sustain the number of leaves under drought stress. This finding is confirmed by a study that found that externally applying 1.5 mM salicylic acid to mung plants under water deficit circumstances improved plant height and number of branches/plants [24]. At lower concentrations, SA by spray had a favourable effect on shoot length and leaf number.

Conclusion

According to the findings of this study, foliar application of SA increases the various morphological characteristics of wheat plants in drought conditions. The following results were found when three foliar sprays of SA were administered to wheat plants at three different growth stages. In drought plants, 0.5 mM and 1 mM SA applications result in an increase in shoot length and leaf number.

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