Original Article
DOI: https://doi.org/10.70749/ijbr.v3i4.971

INDUS JOURNAL OF BIOSCIENCE RESEARCH
https://induspublishers.com/IJBR
ISSN: 2960-2793/ 2960-2807

# Salicylic Acid Mediated Modulation of Maize Germination under Induced Drought Stress

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## ARTICLE INFO

**Keywords**

Abiotic Stress, Drought, Salicylic Acid, Germination Attributes, Maize Cultivar.

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**Declaration**

**Authors' Contribution:** All authors equally contributed to the study and approved the final manuscript.
**Conflict of Interest:** No conflict of interest.
**Funding:** No funding received by the authors.

**Article History**

Received: 10-01-2025, Revised: 18-03-2025
Accepted: 31-03-2025, Published: 08-04-2025

## ABSTRACT

This study aimed to assess the effects of varying concentrations of salicylic acid (SA) on the morpho-agronomic traits of maize (Zea mays L.) under induced drought stress. The evaluated morphometric parameters included germination percentage, germination index, germination rate index, root length, shoot length, and leaf count. A factorial experiment was conducted using a completely randomized design (CRD) with three replications to determine the influence of SA on the germination percentage of maize under drought conditions. The maize cultivar 'Afsan' was subjected to controlled drought stress. The findings demonstrated significant variations among different SA treatments under drought stress imposed for 5 and 10 days. Drought-induced dehydration in maize leaves was associated with reduced shoot and root growth. However, SA application alleviated the detrimental effects of drought stress by enhancing root length, shoot length, and leaf number. The study concludes that foliar application of SA at a 2% concentration is a cost-effective and efficient strategy for mitigating drought stress in maize.

## INTRODUCTION

Stress is an altered physiological situation because of factors that tend to disrupt the equilibrium [1]. Plants are exposed to certain abiotic stresses like drought, salinity and extreme temperature stresses. These stresses directly influence plant growth, development and productivity [2]. Drought stress is a perilous environmental challenge that effect agriculture productivity, ecosystem vigor and water resources universally. It occurs when extended period of below average precipitation leading to significant reduction in soil moisture. This phenomenon not only impact crop yield and quality but also threatens biodiversity and the sustainability of natural territories.

## MATERIALS AND METHODS

### Site Description

The pots experiment was conducted to study the growth parameter of Zea mays L. as affected by Salicylic acid and various level of drought stress at the Department of Botany Government degree College No2 Bannu Khyber Pakhtunkhwa Pakistan during the period from March to April 2023. Temperature ranges from 25°C (in March) to 30°C (in April).

### Experimental Design

Cultivar of Zea mays L. (var; Afson) were collected from (Naurang Agriculture Research Centre) Lakki Marwat Pakistan in the month of March 2023. Eight pre germinated seed of cultivar (Afson) were sown per pot at a depth of 3cm in pots. The pots experiment was arranged in a randomized complete block design (RCB) in three replications with spacing of 10cm between the rows and 5cm between the plants following [3,4]. All the recommended cultural measures namely, irrigation, weeding and plant protection methods were carried out during the growth period of the crop. After sowing 9 pots were taken into control/untreated and 18 pots were subjected into different Drought stress condition. Drought stress was given in the form of direct induction

to the pots. The specimens were collected after 30 days of germination.

**Seed Treatment**

Prior to sowing Zea mays L. seeds of homogeneous, identical in size and color, free of wrinkle be preferred for the plan pot experiments were sterilized by washing with distilled water for Three time.

**Hydropriming with Distilled Water**

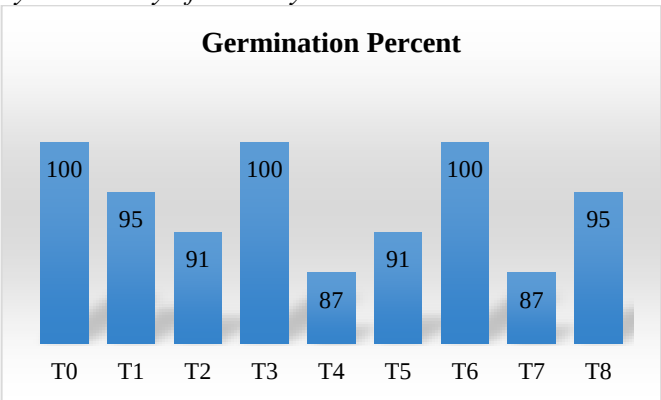
For hydropriming the seeds of Zea mays L. were sinked in 100 ml of distilled water for 2 hours. After priming with distilled water, the seeds were dried in shade at room temperature i.e. 25°C.

## RESULTS

Effect of induced drought stress reduced the germination percent of (T4), (T7) of Zea mays L. as compared to control (To). While the other show no response to drought stress. (Fig. 1)

**Figure 1**

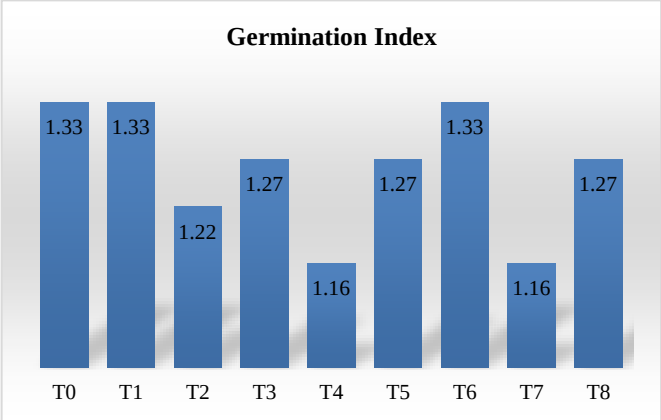
*Effect of induced drought stress on germination% on hybrid variety of Zea mays L.*




Effect of induced drought stress highly reduced the germination index of (T4) and (T7). While (T2), (T5) and (T8) lawyerly affected as compared to control (To). Similarly, the others were non-significant to reduce germination index. (Fig. 2)

**Figure 2**

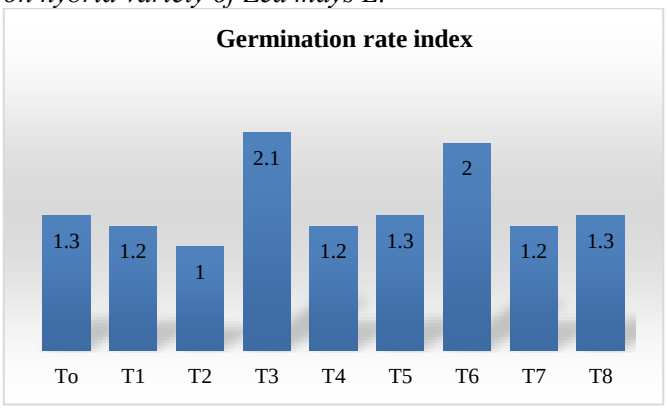
*Effect of induced drought stress germination index on hybrid variety of Zea mays L.*




The effect of drought on the germination rate index shows highest germination rate index in (T3) and (T6) While the show lowest germination rate index. (Fig. 3).

**Figure 3**

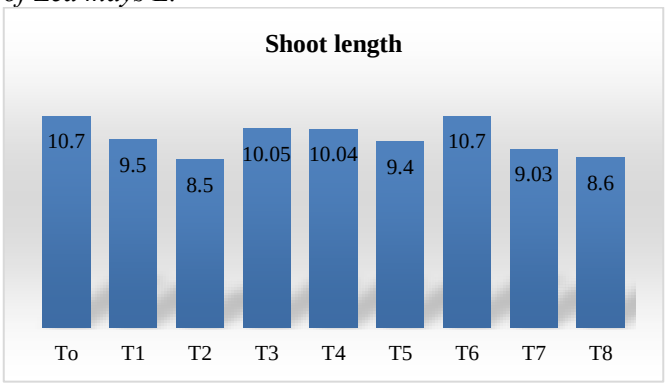
*Effect of induced drought stress germination rate index on hybrid variety of Zea mays L.*




Effect of foliar application of S.A significantly increase the shoot length of (T3), (T4) and (T7) as compared to control (To). While that of others were not remarkable. (Fig. 4)

**Figure 4**

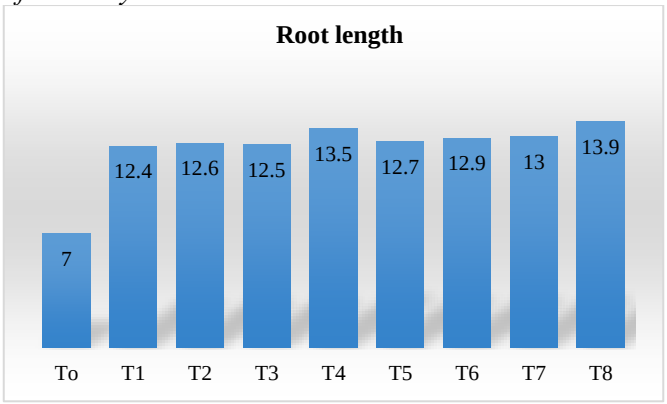
*Effect of Salicylic acid on Shoot length of hybrid variety of Zea mays L.*




Effect of foliar application of salicylic acid (S.A) increased the root length of (T4) , (T6) , (T7) and (T8) While the other show no remarkable effect. (Fig. 5)

**Figure 5**

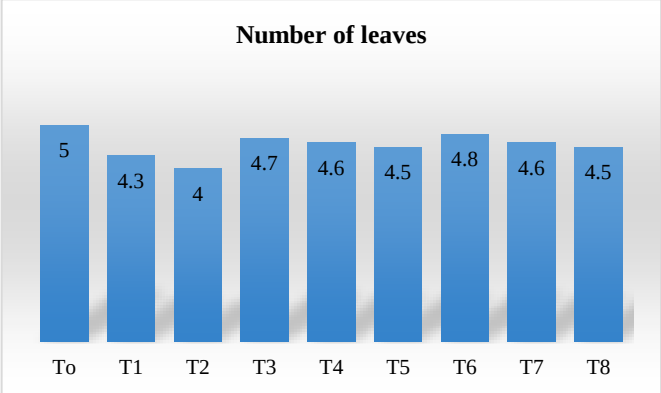
*Effect of Salicylic acid on Root length of hybrid variety of Zea mays L.*



Effect of foliar application of salicylic acid enhance the number of leaves in (T3), (T6) and (T7) as compared to control (To). (Fig. 6)

**Figure 6**

*Effect of Salicylic acid on Number of leaves of hybrid variety of Zea mays L.*




**Keys**

To= control. T1= 5 days drought. T2= 10 days drought. T3= 1% S.A control. T4= 5days drought+ 1% S.A. T5= 10 days drought+ 1% S.A. T6= 2% S.A control. T7= 5 days drought+ 2% S.A. T8= 10 days drought + 2 S.A.

## DISCUSSION

Among the various abiotic stresses such as salinity, drought, high and low temperatures and oxidative stress drought stress adversely affects every aspect of plant growth and development. [1,2] Plants experience water stress either when the water supply to their roots becomes limited or when the transpiration rate becomes intense. Water stress is primarily caused by the water deficit, that is, drought or high soil salinity. [8,11]

**Germination percent: (G%)**

Effect of induced drought stress reduced the germination percent of (T4), (T7) of Zea mays as compared to control (To). While the other show no response to drought stress. From morphological results, that 2.0 mM of salicylic acid treatment may be helpful in seed germination and seedling growth of the beet. [5]

**Germination index: (GI)**

Effect of induced drought stress highly reduced the germination index of (T4) and (T7). While (T2), (T5) and (T8) lawyerly affected as compared to control (To). Similarly, the others were non-significant to reduce germination index.

**Germination rate index: (GRI)**

The effect of drought on the germination rate index shows highest germination rate index in (T3) and (T6) While the show lowest germination rate index. The seedling raised under water stress showed relatively poor growth as compared to water sufficient plants at the time of application of S.A.

**Shoot length: (SL)**

Effect of foliar application of S.A significantly increase the shoot length of (T3), (T4) and (T7) as compared to control (To). While that of others were not remarkable. [7]

**Root length: (RT)**

Effect of foliar application of salicylic acid (S.A) increased the root length of (T4), (T6), (T7) and (T8) While the other show no remarkable effect. Foliar spray of SA maintained a better rooting system and thus improved drought tolerance of maize plants. These results are confirmatory with previous findings of [9,10] who found significant increases in root growth when groundnut plants were applied with exogenous SA.

**Number of leaves: (NL)**

Effect of foliar application of salicylic acid enhance the number of leaves in (T3), (T6) and (T7) as compared to control (To). Drought stress adversely affects the meristematic activity, cell elongation, results in premature abscission of leaves and roots, and reduces the photosynthetic activity and accumulation of dry matter. [16] The beneficial effect of SA on LRWC under drought stress has been reported. [12, 13]

## CONCLUSION

It has been concluded that under various level of salicylic Acid (S.A) induce Drought stress germination of Zea mays L. were of maximum. Salicylic acid enhances seedling establishment and field capacity. 2hour hydro priming is also helpful to some extent. Our results simply indicate that priming is a useful technique for agriculture industry by improving seed quality and more affective results could expected by increasing the period priming and by use of Salicylic acid as an enhancer during stress condition.

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