



## Effect of salicylic acid and fluconazole on the growing development analysis of *Zea mays*

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### Abstract

Maize is an important food, feed and industrial crop that is severely affected by adverse climatic conditions, especially heat stress. In the present study the analysis of maize plants are inoculated in Foliar spray of Salicylic acid and Fluconazole dissolved in treated plants. The effect of salicylic acid and fluconazole on the growth and stress condition of the maize plants with different intervals of 30, 60 and 90 days were analysed. The measurement of morphological characters were analysed with different treatment of maize (T1, T2, T3 and T4). The T4 treated pot showed maximum shoot length was  $98.66 \pm 0.19$  cm in 90<sup>th</sup> days than compared to other treated pot. The maximum plant height recorded in T4 pot (Foliar spray of Salicylic acid and Fluconazole @ 30mg/L) as  $119.33 \pm 0.88$  cm in 90 days interval than compared to control.

**Keywords:** maize seeds, salicylic acid and fluconazole

### Introduction

Maize (*Zea mays* L.) is a monoecious species which has separate staminate and pistillate flowers on the same plant. The male inflorescence (tassel) arises from the shoot apical meristem, while the female inflorescences (ears) originate from the axillary bud apices. The use of higher plant density to maximize yield and therefore the grain yield potential per unit area is increased. In the past, improvement of crops and agricultural techniques has mainly focused on increasing shoot biomass and grain yield and the relevance of the root system for food production has often been overlooked. The root is a crucial plant organ that contributes to yield because root morphology determines the ability of the plant to acquire soil resources (Costa *et al.*, 2000).

Root length, root absorbing area and root activity (as TTC reducing capacity) is used as important physiological parameters for evaluation of ion and water uptake. To acquire adequate water and nutrient, plants may increase root length density and surface area to explore a larger soil volume and/or increase nutrient uptake activity. In maize, plants responded to N deficiency by increasing root to shoot ratio, total root length, the elongation of individual axial roots, and enhancing lateral root growth.

Triazole-based plant growth regulators are extensively used in plants for growth, stress, and disease management in plants. They modulate molecular, physiological, and biochemical processes in plants for growth promotory and induction of tolerance against a range of biotic and abiotic stresses. They generally control the endogenous level of phytohormones and other compounds like gibberellins, cytokinins, auxins, abscisic acid, and ethylene for their aforesaid role in plants. The nanocarrier-based controlled release formulations of triazoles do strengthen the practical

basis of sustainable agriculture. In recent years, there has been a target-oriented shift for the development of novel triazoles that target strigolactones to control growth and induction of stress tolerance in plants (Arruje and Tahir, 2021) [1]. Here in, we present some note worthy examples of recent developments regarding the applications of triazoles in plant growth regulation and stress management.

### Materials and methods

#### Collection of *Zea mays* seed (Sabihah *et al.*, 2020)

The seeds of *Zea mays* were procured from Department of Agricultural Thanjavur, Tamil Nadu, India. Collected seeds are identical in size and shape was segregated manually by visual appearance. The collected seeds were washed and surface sterilized into of 0.1% HgCl<sub>2</sub> for 10 minutes and three times rinsed into sterile distilled water.

#### Collection of chemicals

Salicylic acid chemical were purchased from Techno Scientific, Thanjavur and fluconazole fungicide was collected from local market, Thanjavur.

#### Pot culture experiments (Gabriel *et al.*, 2014) [3]

The pot culture experiments was carried out by Indian Biotrack Research Institute, Thanjavur, Tamilnadu, India Treatment combination:

T1 - Control

T2- Foliar spray of Salicylic acid and Fluconazole @ 10mg/L

T3- Foliar spray of Salicylic acid and Fluconazole @ 20mg/L

T4- Foliar spray of Salicylic acid and Fluconazole @ 30mg/L

Sampling and measurements were recorded.

### Morphological characterization (Hardacre and Turnbull, 1986) [5]

The morphological characteristic of maize plants were measured at shoot length, root length, plant height, leaf length, leaf width, number of leaves, number of hairy roots, shoot girth, number of flowers and number of seeds. It measured at different days of intervals (30, 60 and 90) in different treatment of pots (T1, T2, T3 and T4) respectively.

### Result and Discussion

The result on the effect of foliar spray of salicylic acid and fluconazole on the growth and development of *Zea mays* plants include shoot length, root length, plant height, leaf length, leaf width, number of leaves, number of hairy roots, shoot girth, number of flowers and number of seeds of maize plants at various stages of its growing (30, 60 and 90 days) are shown in table 1, 2 and 3. The treatments of maize plants were planned and treated plants are T2, T3, T4 and untreated maize plants are T1. The highest shoot length, root length, plant height, leaf length, leaf width, number of leaves, number of hairy roots, shoot girth and number of flowers measured at  $98.66 \pm 0.19$ ,  $21.66 \pm 0.66$ ,  $119.33 \pm 0.88$ ,  $38.66 \pm 0.33$ ,  $04.06 \pm 0.03$ ,  $42.72 \pm 0.36$ ,  $19.66 \pm 0.33$ ,  $64.18 \pm 0.33$ ,  $5.33 \pm 0.16$  and  $63.01 \pm 0.57$  and absence of seed were recorded in T4 (foliar spray of salicylic acid and fluconazole) pot found that drought stress reduced plant height and leaf area of garlic and salicylic acid application ameliorated these features in drought and normal conditions. Plant growth reduction under drought condition was ascribed to the adverse effect of drought on the pressure of cell turgor, expansion rate of cell, reduction in the activity of plant cells metabolic decrease in photosynthesis and disturbance in the nutrients accumulation. The doses of salicylic acid which enhanced plant height in drought and normal conditions could have better performance since the amounts of sugar shoot which is translocated at seed filling stage to compensate for limited photosynthesis in drought condition depends on plant height and having a shorter height can limit this case. This information will be useful for modulating rhizosphere processes and soil fertility and for guiding and recommending residue management practices in crop production with relatively larger yields (Suna *et al.*, 2020). The lowest growing in shoot length, root length, plant height, leaf length, leaf width, number of leaves, number of hairy roots, shoot girth, number of flowers and number of seeds measured at  $14.05 \pm 0.05$ ,  $02.05 \pm 0.26$ ,  $16.66 \pm 0.33$ ,  $13.07 \pm 0.15$ ,  $01.40 \pm 0.20$ ,  $02.01 \pm 0.00$ ,  $15.33 \pm 0.33$ ,  $0.06 \pm 0.03$  cm and absence of flower and seeds were recorded at various stages of its growth (30, 60 and 90 days) in the crop grown without any fertilizer application (Table 1, 2 and 3). Maize is an important food, feed and industrial crop that is severely affected by adverse climatic conditions especially heat stress. An experimental study was

designed and characterized maize hybrids of different origin for morphological and phenological traits under heat stress. The research material consisted of 21 maize hybrids of different origin. Data were recorded for different plant traits related to heat tolerance and days to 50% tasseling, days to 50% silking, plant height, cob height, plant harvested, cob harvested, cob length, number of grains per cob, thousand grain weight, shelling percentage and grain yield per hectare (Muhammad *et al.*, 2017) [9].

Morphological and physiological characteristics of the root systems of the higher-yielding corn variety Deng Hai 661 (DH661) and the commonly grown corn variety for northern China Zheng Dan 958 (ZD958). The results clearly showed that DH661 consistently yielded higher than ZD958 in both years. (Wen *et al.*, 2012) [14]. Correlation and regression analyses revealed that approximately 63 % of the breaking force was explained by the average dry weight per unit length (DWUL) of the basal three internodes, ear height and fresh weight of the basal three internodes at silking. At 35 d after silking, approximately 88 % of the difference in breaking force was explained by the plant height, ear ratio, crush strength (CS) of the fourth internode, average DWUL and fresh weight per unit volume (FWUV) of the basal three internodes. The main indicator affecting VRPR was the ratio of root depth to width at 35 d after silking. Therefore, an important strategy for increasing maize lodging resistance is to breed cultivars with high internode DWUL, low ear position and deep roots (Xue *et al.*, 2020) [15]. The highest and lowest kernel yield was recorded for stress in 10-12 leaf stage (7.13 ton/ha) and stress in flowering (4.76 ton/ha). Means comparison revealed that the effect of salicylic acid spraying on the growth of morphological traits and increasing in the corn yield was considerable and significantly inhibited of decreasing in plant height, ear height, leaf area of the main ear, row no/ear, kernel no/ row and ear length (Mahdi *et al.*, 2013) [8]. The SA, Zn, or GB spray increased the plant height by 7.32%, 5.50%, and 10.07%. The maximum growth parameters, yield, and its components were recorded from the plants treated with GB followed by SA and Zn spraying treatments under two soil water conditions (Ramadan *et al.*, 2021). The yield reduction varied with species, with wheat having lower yield reduction (20.6%) compared to maize (39.3%) at approximately 40% water reduction (Daryanto, *et al.*, 2016) [2]. Increased the grain abscisic acid (ABA) content at 5–20 days after pollination and decreased the indole acetic acid (IAA), zeatin riboside (ZR), and gibberellin (GA) contents ( $P < 0.05$ ). The grain-filling rate decreased under shading conditions. Meanwhile, the grain volume, grain weight, and yield all decreased; the yields in 2013 and 2014 decreased by 61 and 60% (Jia *et al.*, 2018) [6]. Control was having Grain yield and biomass reduced 66, 36, and 93 % compared to the control by shading treatments of S1, S2, and S3, respectively (Haiyan *et al.*, 2015) [4].

**Table 1:** Effect of salicylic acid and fungicides on the morphometric analysis of *Zea mays* (30<sup>th</sup> DAYS) The values are expressed in terms of (Mean  $\pm$  Standard deviation)

S. No	Growth Parameters	Treatments			
		T1	T2	T3	T4
1	Shoot length(cm)	14.05 $\pm$ 0.05	16.03 $\pm$ 0.46	18.01 $\pm$ 0.96	20.73 $\pm$ 0.14
2	Root length (cm)	02.05 $\pm$ 0.26	04.03 $\pm$ 0.26	05.04 $\pm$ 0.25	04.04 $\pm$ 0.26
3	Plant height (cm)	16.66 $\pm$ 0.33	18.33 $\pm$ 0.66	23.33 $\pm$ 0.66	24.66 $\pm$ 0.33
4	Leaf length (cm)	13.07 $\pm$ 0.15	15.04 $\pm$ 0.15	20.46 $\pm$ 0.23	23.53 $\pm$ 0.14

5	Leaf width (cm)	01.40±0.20	03.33±0.16	02.13±0.13	02.66±0.33
6	Leaf area (cm)	14.47±0.35	18.37±0.31	22.59±.36	26.19±0.47
7	No of leaves	02.01±0.00	02.06±0.33	02.03±0.66	03.01±0.14
8	No of hairy roots	15.33±0.33	17.66±0.33	16.66±0.33	18.33±0.33
9	shoot girth (cm)	00.06±0.03	00.28±0.05	00.96±0.03	01.06±0.06
10	No of flower	-	-	-	-
11	No of seeds	-	-	-	-

T1 – Control, T2 - Foliar spray of Salicyclic acid and Fluconazole @ 10mg/L, T3 - Foliar spray of Salicyclic acid and Fluconazole @ 20mg/L, T4 - Foliar spray of Salicyclic acid and Fluconazole @ 30mg/L

**Table 2:** Effect of salicyclic acid and fungicides on the morphometric analysis of *Zea mize* (60<sup>th</sup> DAYS)

S. No	Growth Parameters	Treatment			
		T1	T2	T3	T4
1	Shoot length (cm)	20.33±0.28	26.33±0.45	28.63±0.36	30.21±0.33
2	Root length (cm)	06.16±0.06	09.26±0.13	35.01±0.13	08.63±0.31
3	Plant height (cm)	26.33±0.33	35.66±0.36	89.65±0.33	38.32±0.66
4	Leaf length (cm)	14.00±0.57	18.06±0.03	24.01±0.57	20.09±0.57
5	Leaf width (cm)	01.66±0.06	03.53±0.06	03.06±0.06	03.36±0.05
6	Leaf area (cm)	15.66±0.63	21.59±0.09	27.07±0.63	23.45±0.62
7	No of leaves	04.00±0.57	06.06±0.33	06.00±0.57	09.03±0.33
8	No of hairy roots	23.33±0.45	29.66±0.33	36.09±0.57	24.01±0.57
9	Shoot girth (cm)	02.56±0.03	03.16±0.05	02.83±0.03	03.23±0.08
10	No of flower	-	-	-	-
11	No of seeds	-	-	-	-

The values are expressed in terms of (Mean ± Standard deviation)

T1-Control, T2 - Foliar spray of Salicyclic acid and

Fluconazole @ 10mg/L, T3 - Foliar spray of Salicyclic acid and Fluconazole @ 20mg/L, T4 - Foliar spray of Salicyclic acid and Fluconazole @ 30mg/L.

**Table 3:** Effect of salicyclic acid and fungicides on the morphometric analysis of *Zea mize* (90<sup>th</sup> DAYS)

S. No	Growth parameters	Treatments			
		T1	T2	T3	T4
1	Shoot length(cm)	53.86±3.71	101.66±0.88	99.66±0.81	98.66±0.19
2	Root length (cm)	09.83±0.21	14.36±0.31	19.33±0.33	21.66±0.66
3	Plant height (cm)	62.08±1.15	115.33±0.38	118.02±0.58	119.33±0.88
4	LEAF length (cm)	35.16±0.44	38.46±0.26	41.03±0.54	38.66±0.33
5	Leaf width (cm)	01.90±0.05	05.66±0.33	05.00±0.57	04.06±0.03
6	Leaf area(cm)	37.06±0.49	44.12±0.59	46.03±0.11	42.72±0.36
7	No of leaves	09.66±0.33	14.66±0.33	24.66±0.33	19.66±0.33
8	No of hairy roots	49.66±0.33	61.28±0.33	66.45±0.57	64.18±0.33
9	Shoot girth (cm)	02.03±0.03	03.33±0.16	4.00±0.57	5.33±0.16
10	No of flower	-	54.66±0.33	59.33±0.33	63.01±0.57
11	No of seeds	-	-	-	-

The values are expressed in terms of (Mean ± Standard deviation)

T1 – Control, T2 - Foliar spray of Salicyclic acid and Fluconazole @ 10mg/L, T3 - Foliar spray of Salicyclic acid and Fluconazole @ 20mg/L, T4 - Foliar spray of Salicyclic acid and Fluconazole @ 30mg/L

#### Acknowledgment

The authors extend sincere thanks to the principal, M.R. Govt. Arts College, Mannargudi and the Director, Indian Biotrack Research Institute, Thanjavur for the laboratory facilities provided.

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