



Studies on the influence of triazole compounds and minerals on the growth and development of *Solanum lycopersicum* L.

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Abstract

A pot experiment was conducted the effects of two different triazole compounds, hexaconazole and paclobutrazol on the growth and mineral contents in *Solanum lycopersicum* L. (tomato) plants. Soil were treated with hexaconazole (25mg/100ml), Paclobutrozele (25mg/100ml) and Hexaconazole 25mg + Paclobutrozele 25mg (50mg/100ml) in separate treatments. Finally observed following parameters like shoot length, root length, plant height, leaf length, leaf width, number of leaves, number of flowers and number of fruits observed in each interval of 30, 60 and 90 days and mineral contents such as Ca, Fe, Mg, K, Se, Pb and Zn found to be investigated respectively. Combined effect of hexaconazole with paclobutrozele treatments increased when the parameters influencing on the extraordinary performance. Thus, the results of the present study indicated that the application of different triazole compounds reduced the detrimental effects in *Solanum lycopersicum* (tomato) plant.

Keywords: hexaconazole, paclobutrozele, morphometric, minerals and trace elements

Introduction

Domesticated tomato (*Solanum lycopersicum* L.) is the most important horticultural crop worldwide. Low polymorphism at the DNA level conflicts with the wealth of morphological variation. Fruits vary widely in size, shape, and color. In contrast, genetic variation between the 16 wild relatives is tremendous. Several large seed banks provide tomato germplasm for both domesticated and wild accessions of tomato (Dietmar *et al.*, 2014)^[18].

Originating in the Andes, the tomato (*Solanum lycopersicum* L.) was imported to Europe in the 16th century. At present, it is an important crop plant cultivated all over the world, and its production and consumption continue to increase. This popular vegetable is known as a major source of important nutrients including lycopene, β -carotene, flavonoids and vitamin C as well as hydroxycinnamic acid derivatives. Since the discovery that lycopene has anti-oxidative, anti-cancer properties, interest in tomatoes has grown rapidly (Aneta *et al.*, 2015)^[2].

Plant growth regulators are organic substances produced naturally in higher plants, controlling growth or other physiological functions at a site remote from its place of production and active in minute amounts (Kumari *et al.*, 2018)^[18].

Triazole compounds are systemic fungicides having plant growth regulating properties and are called as stress protectants, because of their innate ability to induce abiotic stress tolerance by increasing antioxidant enzymes and molecules in stress-affected plants (Bizuyehu and Getachew, 2021)^[4].

A part of the fungicides used in foliar treatment penetrates into the soil. The triazoles presence has substantially affected the bioavailability of Fe, Cu and Zn in soil (Michal *et al.*, 2021)^[13].

Trace metals (TMs) constitute one group of known hazardous substances: in some cases, these elements are naturally present in soils (David *et al.*, 2020)^[7]. There is worldwide concern about some metals, such as cadmium (Cd), iron (Fe), and zinc (Zn), because they have the capacity to translocate into plant shoots: other metals like arsenic (As), chromium (Cr), and lead (Pb) bioaccumulate in most plant organs: roots, stem, leaves, and fruits.

In crop cultivation, organic waste is commonly used as a source of nutrients, but long-term application can increase TM concentrations in soils (Da *et al.*, 2018)^[6].

Materials and Methods

Collection of *Solanum lycopersicum* seed

For the present investigation, seeds of *S. lycopersicum* were procured from Department of Agriculture, Thanjavur, Tamil Nadu, India. Collected seeds are identical in size and shape were segregated manually by visual appearance. The collected seeds were washed and surface sterilized into of 0.1% HgCl₂ for 10 minutes and three times rinsed into sterile distilled water.

Collection of triazoles

Hexaconazole (hexoplus) and Paclobutrozele (packstar) were purchased from Prakash Agrotech, RR Nagar, Thanjavur.

Seed Treatment combination (Michal *et al.*, 2021)^[13]

- USRV 1- Control
- USRV 2- Hexaconazole (25mg/100ml)
- USRV 3- Paclobutroazole (25mg/100ml)
- USRV 4- Hexaconazole 25mg + Paclobutroazole 25mg (50mg/100ml)

USRV

U.Suresh, R.Velayutham *Solanum lycopersicum* were planted in the pot experiment and foliar application by treated monthly with the same total triazoles per plant.

Pot experiment (Piscitelli *et al.*, 2020)^[15]

Seeds of *Solanum lycopersicum* L., were soaked for 15 minutes in tap water and sterilized with sodium hypochloride (5%) for 15 min. Then, they were washed three times with sterile water and sown in glass beakers with sterile soil. Seeds were exposed to sunlight and germinate at the greenhouse. After 30 days the seedlings were transferred into open air to grow in four different experimental pots containing 2 kg of the selected soil. The pot culture experiments was carried out in the year of 2019-2020 by Indian Biotrack Research Institute, Thanjavur, Tamil Nadu, India.

Morphometric Analysis (Evy *et al.*, 2021)^[9]

The cultivated plant has observed on its morphological characters such as shoot length, root length, plant height, leaf length, leaf width, number of leaves, number of flowers and number of fruits in three different intervals of 30, 60 and 90 days were investigated respectively.

Analysis of minerals (Paul and Srivastava, 2007)^[14]

Solanum lycopersicum leaf samples was carried out for the estimation of Ca, Fe, Mg, K and Zn while, dryashing was done for determined by Ramesh *et al.*, (2021)^[16], Se (Fick *et al.*, 1976)^[10] and Pb (Abou *et al.*, 2000)^[11].

Table 1: Effect of triazole compounds on the growth and development of *Solanum lycopersicum*

| Parameters | USRV 1 | USRV 2 | USRV 3 | USRV 4 |
|-------------------|-----------|-----------|-----------|-----------|
| 30 days | | | | |
| Shoot length(cm) | 9.33±0.03 | 12.6±0.05 | 15.4±0.06 | 19.2±0.05 |
| Root length (cm) | 3.46±0.03 | 3.76±0.03 | 5.81±0.00 | 6.13±0.03 |
| Plant height (cm) | 12.7±0.05 | 16.4±0.03 | 21.1±0.06 | 25.0±0.08 |
| Leaf length (cm) | 1.81±0.05 | 2.23±0.06 | 2.83±0.03 | 3.46±0.03 |
| Leaf width (cm) | 1.06±0.03 | 1.70±0.05 | 2.06±0.03 | 2.33±0.03 |
| No of leaves | 9.01±0.57 | 11.0±0.57 | 15.0±0.57 | 21.1±0.57 |
| 60 days | | | | |
| Shoot length(cm) | 22.8±0.03 | 30.4±0.06 | 35.5±0.00 | 43.6±0.03 |
| Root length (cm) | 7.50±0.05 | 7.63±0.26 | 8.31±0.05 | 8.66±0.03 |
| Plant height (cm) | 30.2±0.35 | 38.1±0.14 | 42.8±0.60 | 52.2±0.32 |
| Leaf length (cm) | 2.33±0.12 | 3.01±0.08 | 3.43±0.08 | 3.53±0.12 |
| Leaf width (cm) | 1.73±0.08 | 2.33±0.12 | 3.11±0.11 | 3.23±0.06 |
| No of leaves | 17.3±0.88 | 23.1±1.15 | 31.0±0.57 | 38.1±0.57 |
| 90 days | | | | |
| Shoot length(cm) | 29.6±0.17 | 37.5±0.17 | 52.2±0.24 | 63.2±0.17 |
| Root length (cm) | 10.5±0.14 | 10.5±0.23 | 12.3±0.11 | 13.4±0.20 |
| Plant height (cm) | 39.6±0.28 | 48.4±0.26 | 64.9±0.64 | 75.1±0.89 |
| Leaf length (cm) | 2.63±0.17 | 3.46±0.20 | 4.61±0.15 | 5.21±0.05 |
| Leaf width (cm) | 1.53±0.14 | 2.36±0.14 | 3.21±0.05 | 3.43±0.16 |
| No of leaves | 24.3±0.33 | 32.1±0.57 | 46.6±0.33 | 54.3±0.33 |
| No of flower | - | 2.03±0.01 | 2.55±0.52 | 4.12±1.11 |
| No of fruits | - | - | - | 1.66±0.33 |

The values are expressed in mean ± standard deviation

USRV1-Control USRV 2-Hexaconazole USRV 3 – Paclobutroazole
USRV 4 - Hexaconazole + Paclobutroazole

Table 2: Analysis of minerals from triazole treated and untreated *Solanum lycopersicum* soil

| Name of the minerals | Quantity (µg/g) | | | |
|----------------------|-----------------|-----------|-----------|-----------|
| | USRV 1 | USRV 2 | USRV 3 | USRV 4 |
| Calcium | 1.48±0.00 | 1.59±0.00 | 1.53±0.00 | 1.62±0.00 |
| Iron | 2.12±0.00 | 2.34±0.00 | 2.22±0.00 | 2.38±0.00 |
| Lead | 2.74±0.00 | 2.84±0.00 | 2.80±0.00 | 2.96±0.00 |
| Magnesium | 0.83±0.00 | 0.89±0.00 | 0.85±0.00 | 0.92±0.00 |
| Potassium | 2.72±0.00 | 5.63±0.00 | 4.90±0.00 | 5.89±0.00 |
| Selenium | 2.42±0.00 | 2.18±0.00 | 2.22±0.00 | 2.12±0.00 |
| Zinc | 1.99±0.01 | 2.20±0.00 | 2.13±0.00 | 2.17±0.00 |

The values are expressed in mean ± standard deviation

Result and Discussion

The hexaconazole and paclobutroazole was treated at every 30, 60 and 90 days. And this study was conducted with combined effect of fungicide and untreated soils. In the 30th day have to observed morphological characters like shoot length (19.2±0.05cm), root length (6.13±0.03cm), plant height (25.0±0.08cm), leaf length (3.53±0.12cm), leaf width (2.33±0.03cm), number of leaves (38.1±0.57cm), no number of flowers and no number of fruits were recorded in USRV 4, 60th day has observed above the parameters like, shoot length (43.6±0.03cm), root length (8.66±0.03cm), plant height (52.2±0.32cm), leaf length (3.53±0.12cm), leaf width (3.23±0.06cm), number of leaves (38.1±0.57cm), no number of flowers and no number of fruits were recorded in USRV 4, 90th day measurements of shoot length (63.2±0.17cm), root length (13.4±0.20cm), plant height (75.1±0.89cm), leaf length (5.21±0.05cm), leaf width (3.43±0.16cm), number of leaves (54.3±0.33cm), number of flowers (4.12±1.11ns) and number of fruits (1.66±0.33ns) were recorded in USRV 5 (Table – 1).

Vijee *et al.*, (2016)^[18] was studied about the morphology variations of *Solanum lycopersicum* phenotypic characterization and significantly in our studies were correlated with the leaf width (6.3%), or leaf size (10.24%) was seen.

Increased plant height and root length by 40 and 30%, respectively, as compared to the control plants. The highest plant height and root length were recorded with T1M1 and T2M0, respectively, whereas the lowest counts were obtained in the untreated plants (Bombiti *et al.*, 2011)^[5].

Aye *et al.*, (2013)^[3] was stated the depressed root growth was observed in both young and old plants. Younger plants showed reduction in root growth earlier than older ones but for a shorter duration. Comparison of root length and emergence (relative to the control plants) between the two growth stages suggested that plants better compensated for a loss of resources when ozone was applied at the younger stage, and this could be linked with the absence of fruits at this time.

Nineteenth day of in this study was conducted for the analysis of minerals and heavy metals, such as calcium (1.62±0.00), iron (2.38±0.00), lead (2.96±0.00), magnesium (0.92±0.00), potassium (5.89±0.00), zinc (2.20±0.00) are highly presented in USRV 4 and selenium (2.42±0.00) was highly occurred in USRV 2 were recorded (Table-2).

David *et al.*, (2020) was reported the highest quantification were 14.7 % and 2.9 % for Cd and Pb *Solanum lycopersicum* and *Lactuca sativa* cultivated soil.

Vagn *et al.*, (2001) was stated the harvest times different levels ($p < 0.05$) were shown for Ca, Cd, Fe, Mn Na, Ni, Sr, Zn Cu, K, Mg, P, Sn, and V. The concentration of Cd was >15 times higher and the concentration of Ca was 50–115% higher in soil.

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