



Efficacy of triazole compounds on the growth and development of *Raphanus sativus* L.

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Abstract

In the current investigation, a pot culture experiment was conducted to analyze the effect of drought stress with triazole compounds (hexaconazole and uniconazole) response on growth parameters of *Raphanus sativus* L. (Raddish). The triazole compounds (hexaconazole and uniconazole) was sprayed in the *R. sativus* seed sowing pot applied as regular 7 days interval and maintained one pot without spraying triazole compound as serve as control. The experiments to examine the effect of triazole compound on growth characteristics of *R. sativus*. The plant was grown in the drought stressed condition and analyzed the parameters in every 20th days interval of tuber length, tuber width, leaf length, leaf width, no. of hairy roots and no. of leaves. The uniconazole compound treated pot observed the stunt of leaf count and leaf width. Tuber length and tuber width was increasing order. The maximum tuber length and tuber width was recorded in hexaconazole + uniconazole + DAP treated pot (Pot D) than compared to other treatment.

Keywords: hexaconazole, uniconazole, *Raphanus sativus*

Introduction

Radish belongs to the family Brassicaceae, genus *Raphanus* and species *sativus*. It is one of the most important and popular root vegetable grown in tropical, subtropical and temperate regions of the world. It is grown both as an annual and a biennial vegetable crop depending upon the purpose of which it is grown. Radish is predominantly a cool season vegetable crop. But, Asiatic types can tolerate higher temperature than European varieties. In the mild climate, radish can be grown almost all year round except for few months in summer (PCARRD).

Plant growth regulators have been successfully used to increase the yield in many vegetable crops and particularly in tuber crops. Triazole compounds like triadimefon (TDM), hexaconazole (HEX), paclobutrazol, and uniconazole are mainly used as systematic fungicides and also have growth regulating properties (Fletcher and Hofstra, 1990; Fletcher *et al.*, 2000) [5, 6]. Triazole compounds are used mostly as systemic fungicides and have plant growth regulating properties (Fletcher *et al.*, 2000) [6]. Triazole compounds, like triadimefon, triadimenol, propiconazole, uniconazole and hexaconazole have growth regulating properties and can induce many morphological and biochemical changes, like reduction in shoot elongation; stimulation of rooting, changes in stem length and weight of seedlings; inhibition of gibberellin synthesis, increase in chlorophyll and carotenoid content; improvement of the carbohydrate status, lipid peroxidation changes in membrane permeability, ascorbic acid, alpha tocopherol, total phenols and nucleic acid contents increase in cytokinin synthesis; improvement

of photosynthetic activity and water balance increase in the content of proline and soluble sugars, stimulation of antioxidative enzyme systems and enhancement in carbohydrate metabolism.

Plant growth regulators have been reported to play important roles in stress responses and adaptation (Sharma and Dubey, 2005; Vineeth *et al.*, 2016) [15, 16]. Triazole compounds have plant growth regulating features and are called as plant multistress protectants, because of their innate ability to induce abiotic stress tolerance by increasing antioxidant enzymes and molecules in stress affected plants (Jaleel *et al.*, 2007) [8, 11].

They can protect plants against various stresses, including water deficit, chilling and high temperatures, salinity and flooding.

Materials and Methods

Collection of Rhizome of *Raphanus sativus* and triazole

Healthy *Raphanus sativus* seed was collected from Agricultural department, Thanjavur, Tamilnadu, India. The triazole compound (hexaconazole and uniconazole) was purchased from Agricultural market, Thanjavur, Tamilnadu.

Pot culture experiments

The pot culture experiment was carried out Indian Biotrack Research Institute, Thanjavur, Tamilnadu, India. The pots were filled with the mixture of red soil + sand + farm yard manure in 1:1:1 ratio and each pot were filled with 25 kg mixture. 5 *Raphanus sativus* seeds were sown in each pot and triplicates were maintained under shade net.

Treatment combination

Pot A-Control

Pot B-Foliar spray of Hexaconazole @ 25mg/L

Pot C-Foliar spray of Uniconazole @ 25mg/L

Pot D-Foliar sprays of Hexaconazole + Uniconazole + DAP @ 25:25:25 mg/L

Every 20th day interval was analysed and the morphometric parameters of tuber length, tuber width, leaf length, leaf width, no. of leaves, no. of hairy roots.

Results and discussion

In the present investigation the morphometric parameters was analyzed the treated and untreated triazole compounds of *Raphanus sativus* plants. Every 20th day recorded the parameters data of tuber length, tuber width, leaf length, leaf width, no. of leaves and no. of hairy roots. The maximum quantity observed in Pot D (hexaconazole + uniconazole + DAP 1:1:1) as 7.50±0.09cm tuber length, 1.23±0.20cm tuber width, 8.50±0.06cm leaf length, 4.00±0.00 cm leaf width, 6.00±0.00nos of leaves and 15.0±0.03 nos of hairy roots than compared to control and other treated pot (Table 1).

In tuber crops like radish, triazoles increased the partitioning of assimilates to the economically important plant part such as roots or tubers, and thus indirectly improved the yield per unit land (Fletcher *et al.*, 2000) [6]. The number of roots showed a progressive increase in treated plants, and the highest number of roots was observed for a hexaconazole concentration of 25 mgL⁻¹. The fresh and dry weight of tuber increased in treated plants. Nevertheless, the higher number of tubers in treated plants was recorded for a 25 mgL⁻¹ concentration of hexaconazole (Lakshmanan *et al.*, 2007) [10, 11]. The increase in the tuber yield to weight ratio after initiation in treated plants depended on the ability of aerial parts to synthesize the needed assimilates for the rapid development of tubers, which act as 'sinks'. Increased root growth was previously reported in *Catharanthus* plants under plant growth regulator treatments (Jaleel *et al.*, 2007) [8, 11]. Triazoles are known to shift assimilate partitioning from leaves to roots, and they could also alter mineral uptake and plant nutrition (Yelenosky *et al.*, 1995) [17].

In the current investigation the leaf length and leaf width were recorded in every 20 days interval. The Pot A, Pot B and Pot D observed the leaf was increase in day to day but Pot C Uniconazole treated pot the leaf number was decreasing order because the uniconazole compound was inhibit the development of leaf numbers (Table 1, 2, 3). Uniconazole reduced the leaf number in *Pyreantha* species (Norcini and Knox, 1989) [13]. Application of ABA at room temperature results in reduced leaf production in many plants. The leaf production is reduced in strawberry and soybean by triazole treatment. Uniconazole reduce the leaf number in *Pyreantha* species (Norcini and Knox, 1989) [13]. The total leaf area of the plant decreased with the age in all the treatments. The more decrease was prominent in HEX treated plants and it was 103.41 per cent on 60 DAP when compared to TDM treated plants. TDM and HEX treatments were reducing total leaf area when compared to control in *Raphanus sativus* plants. Triadimefon reduced the leaf area in wheat (Gao *et al.*, 1988). Triazoles increased the leaf thickness by inducing additional layers of palisade mesophyll cells which has a smaller diameter as in soybean, wheat and chrysanthemum (Burrows *et al.*, 1992) [2]. The effect of Triadimefon and Hexaconazole on plant total leaf area of *Raphanus sativus* on different growth stages (Sridharan and Raja, 2015).

The root length increased in drought stressed sunflower plant when compared to control. Drought stress increased the root length in sunflower (Manivannan *et al.*, 2007) [8, 11], olive (Bacelar *et al.*, 2007) [1], parsley (Petropoulos *et al.*, 2008) [14], *Triticum aestivum* (Dickin and Wright, 2009) [4], and in chickpea (Ceylan *et al.*, 2013) [3]. The development of root system may increase the water uptake under drought stress. The root length increased in triazoles treatment under drought stress when compared to control. Triazole treatment increased the root growth in rose (Jenks *et al.*, 2001) [9] under drought stress. Triazoles increased the diameter and length of fibrous roots and enhanced the lateral root formation in tomato plants (Mohamadi and Rajaei, 2013) [12]. The present studies the no. of hairy roots are increasing order especially pot c (Table 1, 2, 3).

Table 1: Morphometric analysis of *Raphanus sativus* after the treatment of 20th day

S.No	Parameters	Treatments			
		Pot A	Pot B	Pot C	Pot D
1	Tuber length (cm)	4.80±0.05	5.70±0.02	6.00±0.08	7.50±0.09
2	Tuber width (cm)	1.00±0.06	0.80±0.09	1.20±0.10	1.23±0.20
3	Leaf length (cm)	6.02±0.02	6.90±0.06	7.40±0.01	8.50±0.06
4	Leaf width (cm)	2.90±0.03	3.00±0.00	3.60±0.01	4.00±0.00
5	No of leaves (nos)	3.00±0.00	4.02±0.05	4.00±0.03	6.00±0.00
6	No. of hairy roots (nos)	14.2±0.03	15.0±0.04	12.0±0.03	15.0±0.03

Pot A-Control, Pot B -Hexaconazole, Pot C-Uniconazole, Pot D-Hexacomozole + Uniconazole + DAP

Table 2: Morphometric analysis of *Raphanus sativus* after the treatment of 40th day

S.NO	Parameters	Treatments			
		Pot A	Pot B	Pot C	Pot D
1	Tuber length(cm)	9.40±0.05	11.5±0.00	12.4±0.02	15.4±0.02
2	Tuber width (cm)	3.20±0.10	4.50±0.21	4.54±0.32	6.64±0.41
3	Leaf length(cm)	13.0±0.04	14.0±0.05	14.4±0.05	17.4±0.05
4	Leaf width(cm)	6.03±0.05	6.80±0.05	7.50±0.06	8.08±0.05
5	No of leaves (nos)	6.00±0.00	8.70±0.05	10.5±0.03	12.2±0.02
6	No. of hairy roots (nos)	25.0±0.05	27.0±0.00	21.0±0.05	30.0±0.03

Pot A-Control, Pot B-Hexaconazole, Pot C-Uniconazole, Pot D-Hexacomozole + Uniconazole + DAP

Table 3: Morphometric analysis of *Raphanus sativus* after the treatment of 60th days

S.No	Parameters(cm)	Treatments			
		Pot A	Pot B	Pot C	Pot D
1	Tuber length(cm)	20.6±0.01	25.3±0.07	27.2±0.08	30.8±0.02
2	Tuber width (cm)	14.5±1.20	16.7±1.91	23.4±1.31	27.6±1.26
3	Leaf length(cm)	28.6±0.06	30.8±0.00	31.6±0.09	33.2±0.07
4	Leaf width(cm)	13.2±0.05	14.9±0.00	16.5±0.07	19.3±0.08
5	No of leaves (nos)	10.0±0.00	10.0±0.01	13.0±0.04	16.0±0.04
6	No. of hairy roots (nos)	31.0±0.09	29.4±0.02	26.0±0.00	35.6±0.04

Pot A-Control, Pot B-Hexaconazole, Pot C-Uniconazole, Pot D-Hexacomozole + Uniconazole + DAP

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