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Photosynthetic Alterations in *Amorphophallus campanulatus* with Triazoles Drenching

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Abstract: In the present investigation, an attempt was made to study the effect of different triazole compounds viz., triadimefon, paclobutrazol and propiconazole on photosynthetic characteristics of *Amorphophallus campanulatus*. The results indicated that in *Amorphophallus campanulatus* the triazole compounds increased the total chlorophyll and carotenoid contents, inter cellular CO_2 concentration, net photosynthesis rate (P_N) and water use efficiency (WUE) while decreased the transpiration rate (T_R) rate and stomatal conductance. Among the triazole compounds, paclobutrazol showed better results than the other two triazole compounds.

Key words: Chlorophyll, Carotenoid, Inter cellular CO_2 concentration, Net photosynthesis rate, Water use efficiency, Transpiration rate, Stomatal conductance

INTRODUCTION

The triazole compounds are the largest and most important group of systemic compounds developed for the control of fungal diseases in plants. The triazole compounds are mainly used as growth retardants and also stress protectants in many crop plants [1-5]. They tend to be much more effective than many other plant growth regulators and they generally require at relatively low rate of applications [6]. The influence of triazoles as plant growth regulators to hormonal changes, photosynthetic rates, enzyme activities and yield components has been reported by various workers [7-9].

Besides cereals and legumes, the tuber crops are regarded as an important food crop with highest dry matter production [8,10]. *Amorphophallus campanulatus* (Elephant Foot Yam) is rich source of starch, essential amino acids and used as vegetable. It is cultivated and utilized in various regions of south India. *Amorphophallus campanulatus* is one of the very high yielding tuber crop used in certain ayurvedic medicinal preparations recommended for piles and dysentery [11].

The triazole compounds are widely used systemic fungicides to control diseases in plants and animals. Many of the triazole compounds have both fungi toxic and plant growth regulating properties [11]. However, work on the use of these triazole compounds to increase the yield of tuber crops is scanty. Hence, the present study becomes essential to ascertain the effect of triazole compounds on photosynthetic characteristics of the *Amorphophallus campanulatus* cv.pidikarani.

MATERIALS AND METHODS

Amorphophallus campanulatus is a robust herbaceous plant with an erect long pseudo stem arising from the underground corm apex bearing a tripartite leaf which is deeply dissected. The root system is fibrous and confined to the top layers of the soil. The corms produced at 60 to 80 DAP. Fresh corms of uniform size were selected and surface sterilized with 0.2% $HgCl_2$ solution for 3minutes with frequent shaking and thoroughly washed in tap water. The field experiments were laid in CRBD with 7 replicates. The pit size of 60x60x45cm were dug at a spacing of 90x90cm. The pits were filled with soil mixture containing FYM, red soil and sand in 1:1:1 ratio. The plot was 5 X 4m with 20 pits in each plot. One cormel was planted in each pit and irrigated with bore well water at 10 days interval. The EC of the soil was 0.10 dsm^{-1} and pH was 6.8. Each plant treated separately with one liter of

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aqueous solution containing 20mg triadimefon, 20mg paclobutrazol and 20mg propiconazole on 30, 70 and 110 DAP. The treatment was given by soil drenching. During the study the average day and night temperatures were 30±2°C and 22±2°C and the average RH was 70-80%. The plants were harvested randomly on 80, 160 and 200 DAP for the determination of photosynthetic pigments.

Estimation of Photosynthetic Pigments

Estimation of Chlorophyll and Carotenoid Contents: Chlorophyll and carotenoid were extracted from the leaves and estimated by the method of Arnon [12].

Extraction: Five hundred milligrams of fresh leaf material was ground with 10 ml of 80 per cent acetone at 4°C and centrifuged at 2500 rpm for 10 minutes at 4°C. This procedure was repeated until the residue became colourless. The extract was transferred to a graduated tube and made up to 10 ml with 80 per cent acetone and assayed immediately.

Estimation: Three milliliters aliquots of the extract were transferred to a cuvette and the absorbance was read at 645, 663 and 480 nm with a spectrophotometer (U-2001-Hitachi) against 80 per cent acetone as blank. Chlorophyll content was calculated using the formula of Arnon.

Total chlorophyll (mg/ml) = (0.0202) × (A.645) + (0.00802) × (A.663)
Chlorophyll 'a' (mg/ml) = (0.0127) × (A.663) – (0.00269) × (A.645)
Chlorophyll 'b' (mg/ml) = (0.0229) × (A.645) – (0.00468) × (A.663)

and expressed in milligram per gram fresh weight.

Carotenoid content was estimated using the formula of Kirk and Allen [13] and expressed in milligrams per gram fresh weight.

Carotenoid = A.480 + (0.114 × A.663 – 0.638 × A.645).

Gas Exchange Measurements: Net photosynthesis rate (P_N), transpiration rate (T_R) and inter cellular CO_2 concentration (C_i), stomatal conductance were measured on fully expanded leaves of three individual plants for each treatments at respective intervals. Gas exchange measurements were determined using IRGA (ADC makes model LCA-3). The P_N, T_R, C_i and stomatal conductance were measured for control and treated plants and CO_2 concentration (Ca) of 340 μ mol^{-1} a leaf to air vapor pressure difference of 2.5 to 3.5 KPa and photo synthetically active irradiance was 1400±50 μ mol CO_2 $m^{-2}s^{-1}$. Water use efficiency (WUE) is the ratio of carbon assimilated to water lost by transpiration and it was calculated by dividing P_N by T_R [14].

RESULTS AND DISCUSSION

The treatment with triazoles increased the chlorophyll and carotenoid contents with untreated plants (Fig. 1). TDM treatment increased the chlorophyll contents in leaves of *Catharanthus roseus* [15]. PBZ increased the chlorophyll content, fresh weight and leaf area basis and this may due to in part to the observed increase in mass of the root system indicated by triazoles which are the site of cytokinin biosynthesis [16]. The increase in cytokinin level was associated with stimulated chlorophyll biosynthesis [17].

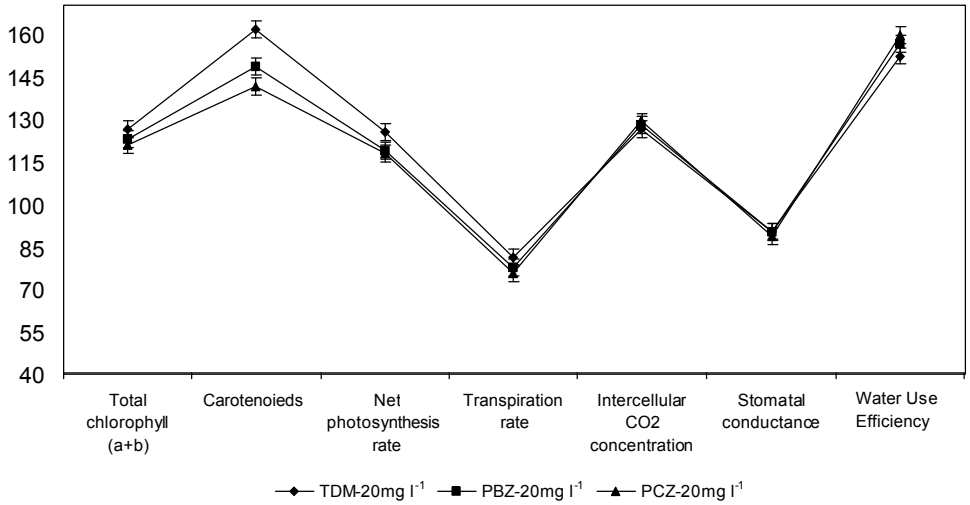

Fig. 1: Effect of triazoles percentage changes in photosynthetic parameters of *Amorphophallus campanulatus* on 100 Days after planting

The net photosynthetic rate was increased by the triazole treatments (Fig. 1). Similar results were observed in triazole treated plants [18]. The increased intercellular CO_2 concentration and stomatal conductance may be the reason for the increase P_N in *Amorphophallus* plants. The increased chlorophyll content and photosynthesis by triazole treatment in *Withania somnifera* seedlings [3] was reported.

The rate of transpiration was lowered in triazole treated plants in all the stages of growth (Fig. 1). Triadimefon treatment increased the level of ABA content in various plants [7]. This in turn induced the stomatal closure, thereby decreasing the transpiration rate. Decrease in transpiration rate may have increased the moisture content in the *Amorphophallus campanulatus* plants. Similar results were observed in triazole treated plants [19,20]. Triadimefon treatment increased the ABA content in *Catharanthus roseus* [7].

Triazole treatments increased the intercellular CO_2 concentration (Fig. 1). Similar results were observed in triazole treated plants [21,22]. Triazole treatments decreased stomatal conductance in *Amorphophallus* plants (Fig. 1). Triazole caused partial closure of stomata thereby reduced the T_R [23,24]. Triazole treatments increased WUE in *Amorphophallus* plants (Fig. 1). Similar observation was made in TDM treated plants [23,24]. PBZ increased the WUE in *Psendotsuga menziesisi* and *Pinus cornata* seedlings [25]. Triazole induced partial closure of stomata and increased inter cellular CO_2 concentration and it may be the reason for increased WUE in treated plants.

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