

ORIGINAL ARTICLE

## Effect of Trichokonins on the Growth Characteristics of *Paeonia ostii* 'Fengdan' Seedling Roots

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### Abstract

The growth characteristics of *Paeonia ostii* 'Fengdan' seedlings roots in response to trichokonins-spray treatment were investigated in this study. One-year-old seedlings of *P. ostii* 'Fengdan' were potted in plastic cups containing garden mold and grown under field conditions. The results showed that application of trichokonins significantly promoted root growth in *P. ostii* 'Fengdan' seedlings. The total root projection area, total root surface area, total root volume, total root length, root number and root diameter of seedlings treated with 0.25 mg/L trichokonins were higher by 141.70, 116.59, 119.44, 55.97, 348.88 and 127.78%, respectively, than that of the control. Thus, the results supported the hypothesis that good growth condition for roots could directly improve their nutrient absorption and utilization efficiency, promoting plant growth and development.

**Key words** : *Paeonia ostii* 'Fengdan', Trichokonins, Root characteristics

### 1. Introduction

*Paeonia ostii* 'Fengdan', which is called in Moran in Korea, the widely cultivated tree peony variety in China with traditionally medicinal and ornamental value, has become the emerging oilseed crop in recent years on account of high oil yielding rate and good oil quality. The low-quality seedling has been considered as a strong barrier for seed production in *Paeonia ostii* 'Fengdan' (Cheng and Du, 2008), so effective cultivation approaches need to be adopted to enhance seedling

quality. It was reported that gibberellic acid (GA<sub>3</sub>) or *Arbuscular mycorrhizal* fungi was beneficial for seedling growth of *Paeonia ostii* 'Fengdan' (Cheng and Du, 2008; Chen et al., 2010).

*Trichoderma* spp. are free-living fungi that are well known as important biological control agents of plant diseases (Song et al., 2006). However, a growing literature confirms that *Trichoderma* spp. play an important role in plant growth regulation. *Trichoderma* HT-03 spores had positive effects on the photosynthetic capacity and the activities of POD, PPO and SOD, consequently a remarkably

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promotion in the growth of tomato seedlings (Chen et al., 2007). Huang et al. (2003) found that the effect of *Trichoderma harziaiarum* H-13 in promoting rice growth had a relation to enhance of nitrate reductase activity and the increase of N, P, K absorption. Metabolites produced by *Trichoderma* spp. play essential roles in plant growth promotion, such as organic acid and peptaibols. Trichokonins are a kind of peptaibols isolated from *Trichoderma pseudokoningii* SMF2 (Li et al., 2014). Previous studies revealed that Trichokonins was involved in promoting plant growth. Treatment with Trichokonins resulted in increased root-shoot ratio, stem length and leaf area of *Sophora japonica* seedlings (Zhu Yanjie et al., 2014). Dong (2014) analyzed the growth characteristics of roots in *phalaenopsis* spp. seedlings in response to Trichokonins root-irrigating treatment. The results showed that the total root length, total root surface area, root volume and root number were increased significantly in the presence of Trichokonins.

Up to now, the relationship between seedling growth of tree peony and Trichokonins treatment has not been reported. Herein, the effect of trichokonins on the roots growth characteristics of *Paeonia ostii* 'Fengdan' seedlings was explored. This work provides a new method for improving seedling quality of *Paeonia ostii* 'Fengdan' and a basis for application of Trichokonins in the seedling cultivation.

## 2. Materials and methods

### 2.1. Materials

One-year-old seedlings of *Paeonia ostii* 'Fengdan' were potted in plastic cups (height 23 cm, upper circumference 17 cm) containing garden mould and grown under field condition in the East Campus of Liaocheng University. Healthy plants with uniform size were prepared for experiments.

### 2.2. Methods

Each plant was sprayed with 2 mL Trichokonins (0.0025, 0.025, 0.25, 2.5 and 25 mg L<sup>-1</sup>) or 2 mL deionized water (control solution). Treatments were conducted once a week. After 4 weeks of treatment, plants were grown at common condition for 2 weeks for recovery. Three replicates of each control or treated sample consisting of 10 plants each were collected. Roots of seedlings were flushed by distilled water, and then cleaned by ultrasonic cleaner for 5 minutes. After drying surface with filter paper, the root characteristics were scanned and analyzed using WinRHIZO root analysis system (Canada).

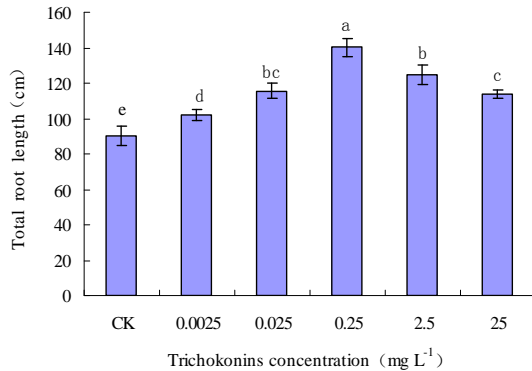
### 2.3. Statistic Analysis

Data representing the mean±standard error (SE) of three replicates were analyzed by one-way ANOVA procedures using the SPSS version 13.0 (SPSS Inc., Chicago, IL, USA). Significant differences between the treatment means were evaluated by Duncan's multiple range test at  $p < 0.05$ .

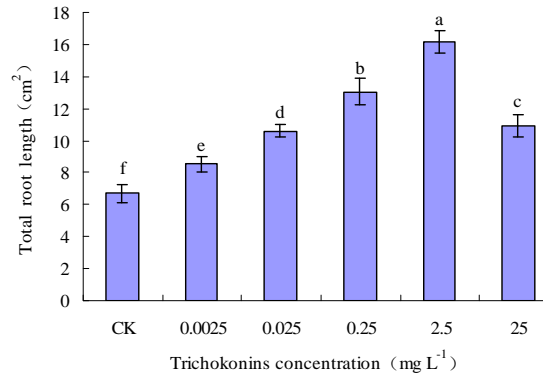
## 3. Results

### 3.1. Effects of Trichokonins treatment on the total root length of *Paeonia ostii* 'Fengdan'

The total root length of *Paeonia ostii* 'Fengdan' seedlings in response to Trichokonins treatment was assayed (Fig. 1). Compared to control, application of Trichokonins improved the total root length significantly. The total root length increased at lower concentrations (0.0025 or 0.025 mg L<sup>-1</sup>), peaked at 0.25 mg/L Trichokonins and then decreased at higher concentrations (2.5 or 25 mg/L). The highest total root length was 140.11 cm at 0.25 mg/L Trichokonins which was 50.28 cm longer than the control.



**Fig. 1.** Effects of Trichokonins treatment on the total root length of *Paeonia ostii* 'Fengdan'. The different lower case letter are significantly different at  $p < 0.05$ , according to Duncan's multiple range test.



**Fig. 2.** Effects of Trichokonins treatment on the total root projection area of *Paeonia ostii* 'Fengdan'. The different lower case letter are significantly different at  $p < 0.05$ , according to Duncan's multiple range test.

### 3.2. Effects of Trichokonins treatment on the total root projection area of *Paeonia ostii* 'Fengdan'

The total root projection area of *Paeonia ostii* 'Fengdan' seedlings in response to Trichokonins treatment was evaluated. As shown in Fig. 2, the total root projection area showed significant increase after Trichokonins treatment in comparison with control. The total root projection area dose dependently increased with Trichokonins concentration, reaching the maximum of 16.17 cm<sup>2</sup> at 2.5 mg/L Trichokonins, which was increased by 141.70% compared with the control.

### 3.3. Effects of Trichokonins treatment on the total root surface area of *Paeonia ostii* 'Fengdan'

The total root surface area of *Paeonia ostii* 'Fengdan' seedlings in response to Trichokonins treatment was measured. The results showed that the total root surface area of seedlings treated with Trichokonins was significantly higher than that of the control (Fig. 3). With the increase of Trichokonins concentrations, the total root surface area showed a trend of first increasing and then decreasing. The best concentration for Trichokonins was 0.25 mg

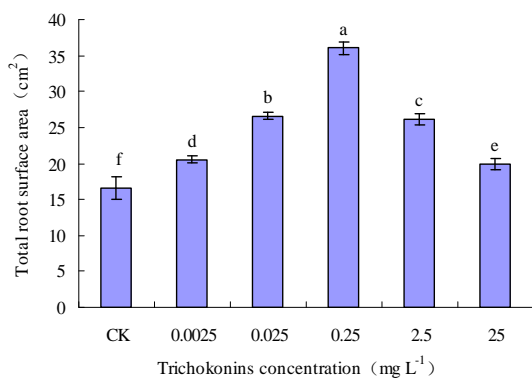
L<sup>-1</sup>, by which the total root surface area reached the maximum levels (36.04 cm<sup>2</sup>) that was 2.17 times as large as the control.

### 3.4. Effects of Trichokonins treatment on the average root diameter of *Paeonia ostii* 'Fengdan'

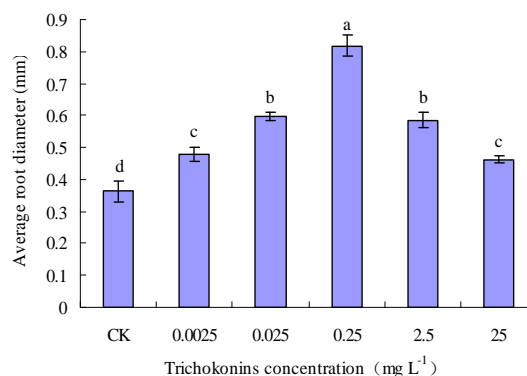
The average root diameter of *Paeonia ostii* 'Fengdan' seedlings in response to Trichokonins treatment was analyzed. Compared with the control plants, treatment with Trichokonins resulted in significant increase in the average root diameter. A 2.28-fold increase in the average root diameter was found in the presence of 0.25 mg/L Trichokonins as compared to control ( $p < 0.05$ , Fig. 4).

### 3.5. Effects of Trichokonins treatment on the total root volume of *Paeonia ostii* 'Fengdan'

The total root volume of *Paeonia ostii* 'Fengdan' seedlings in response to Trichokonins treatment was tested. As shown in Fig. 5, the total root volume of plants treated with Trichokonins was much higher than that of the control ( $p < 0.05$ ). The highest volume of root was 0.79 cm<sup>3</sup> with 0.25 mg/L Trichokonins treatment, which was



**Fig. 3.** Effects of Trichokonins treatment on the total root surface area of *Paeonia ostii* 'Fengdan'. The different lower case letter are significantly different at  $p < 0.05$ , according to Duncan's multiple range test.



**Fig. 4.** Effects of Trichokonins treatment on the average root diameter of *Paeonia ostii* 'Fengdan'. The different lower case letter are significantly different at  $p < 0.05$ , according to Duncan's multiple range test.

1.19-fold larger than the control.

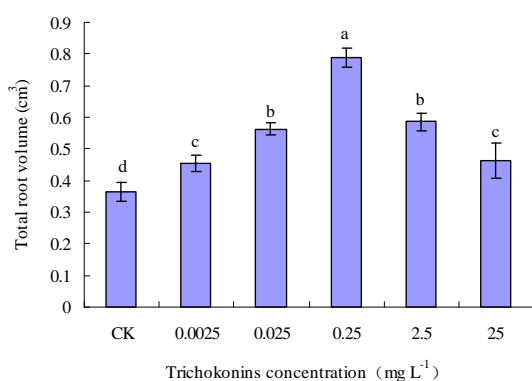
### 3.6. Effects of Trichokonins treatment on the root number of *Paeonia ostii* 'Fengdan'

The root number of *Paeonia ostii* 'Fengdan' seedlings in response to Trichokonins treatment was detected. The results demonstrated that Trichokonins treatment was superior to the control in improving the root number. Treatment with 0.25

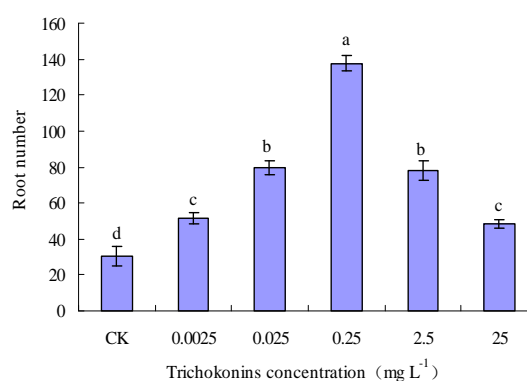
mg/L Trichokonins resulted in the highest number of root, with the value for 137.67 which was 107 more than the control (Fig. 6).

## 4. Conclusion and discussion

The test results show that after spraying on the coming azithromycin treatment "Fengdan" peony seedling root growth condition is good, the seedling



**Fig. 5.** Effects of Trichokonins treatment on the total root volume of *Paeonia ostii* 'Fengdan'. The different lower case letter are significantly different at  $p < 0.05$ , according to Duncan's multiple range test.



**Fig. 6.** Effects of Trichokonins treatment on the root number of *Paeonia ostii* 'Fengdan'. The different lower case letter are significantly different at  $p < 0.05$ , according to Duncan's multiple range test.

root total length, total projection area, total volume, total surface area, as well as the root number, branch number, form index has improved significantly. Among them, in conring toxin concentration is 0.0025 ~ 25 mg/L range of root total root length, total surface area, average diameter, volume and the number root root number, root bifurcate increased at first, then decrease, had the highest concentration of 0.25 mg/L. Seedling root total projection area is reduced after rising first, had the highest concentration of 2.5 mg/L. Show that conring after spraying processing, "Fengdan" peony seedling root growth, enlargement, root surface area and volume increase, lateral root and root number increased. And root good growth condition can directly improve plant for nutrient absorption and utilization efficiency, to promote the growth and development of plants.

The findings of the present study and the previous study showed the consistent results of plant growth substances and plant root growth. In recent years, many researches proved that trichoderma viride class can promote plant root growth. Zhu Yanjie et al. (2014) study found such as conring toxin can promote a degree of the pagoda tree seedling root of total root length, total surface area, volume, and root tip count. Wang et al. (1997) study found that the use of trichoderma viride T2 can promote the growth of plants and root, after processing of seedling increased plant height, leaf blade thick, fibrous root increased. Wang et al. (1997) study found that the use of trichoderma viride T2 can promote the growth of plants and root, after processing of seedling increased plant height, leaf blade thick, fibrous root increased. Trichoderma could reduce damage plants, and promote plant lateral root formation (Naseby et al., 2000). Li et al. (2014) study found that such as trichoderma viride can promote the

reproductive growth of peanut, improve the efficiency of its absorption of nutrients, promoted the peanut root growth, so as to promote the growth of the whole peanut plant. Chen et al. (2010) found in the sunlight greenhouse tomato after yellow green trichoderma viride T1010 treatment, its root, stem and leaf of fruit growth and development are significantly increased, the main root and lateral root of tomato growth and lateral root number increased. Trichoderma viride plant root growth promotion may good application in prospect.

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