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学 位 論 文 要 旨
Dissertation Abstract

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学位論文題目：
Title of Dissertation **Tebuconazole and Trifloxystrobin-Mediated Abiotic and Biotic Stress Regulation in Plants: In Relation to Reactive Oxygen Species and Antioxidant Defense Systems (テブコナゾールとトリフロキシストロビンに媒介された植物における非生物的および生物的ストレス制御:活性酸素種と抗酸化防御システムについて)**

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Dissertation Abstract

Plants are always suffered by various abiotic (such as salt, drought, metal, extreme temperature, etc.) and biotic stresses (such as fungi, bacteria, viruses, and insects), thus altered plant physiology and caused significant yield losses. Proper management can ameliorate dysfunction in and improve the plant growth and productivity under stress condition. Here, five experiments had been conducted to investigate the role of tebuconazole (TEB, triazole group) and trifloxystrobin (TRI, strobilurin group) fungicides as phytoprotectants on plant physiology under abiotic and biotic stress conditions. The main focus was on incorporating reactive oxygen species metabolism and antioxidant defense systems in plants and pathogens.

In the first experiment, it has been studied the effect of TEB and TRI to mitigate salinity-induced damage on moderately salt tolerant crop wheat (*Triticum aestivum* L. cv. Norin 61). Seedlings were pre-treated for 48 h with fungicide (1.375 µM TEB + 0.5 µM TRI) and then subjected to salt stress (250 mM NaCl) for five days. Results found that the application of TEB and TRI significantly alleviated salt-induced growth inhibition and improved photosynthetic pigments and leaf water status. Application of TEB and TRI also decreased malondialdehyde (MDA), hydrogen peroxide (H_2O_2), and electrolyte leakage (EL) by modulating the ascorbate (AsA) and glutathione (GSH) contents and enzymatic antioxidant activities. In addition, TEB and TRI regulated K^+/Na^+ homeostasis by improving the K^+/Na^+ ratio under salt stress. After findings these results, the second experiment was conducted to investigate and justify our previous results for mitigating salt toxicity on salt sensitive crop cucumber (*Cucumis sativus* L. cv. Tokiwa) by TEB and TRI. The cucumber plants were grown semi-hydroponically in a glasshouse and exposed to two different doses of fungicides (1.375 µM TEB + 0.5 µM TRI and 2.75 µM TEB + 1.0 µM TRI) solely and in combination with NaCl (60 mM) for six days. Similarly, the exogenous application of TEB and TRI reduced oxidative stress by improving antioxidant defense systems. Ion

homeostasis also regulated by reducing Na^+ uptake and enhanced K^+ accumulation and the K^+/Na^+ ratio after application of TEB and TRI. In the third experiment, observed the protective role of TEB and TRI in wheat seedlings to tolerate cadmium (Cd). Five-day-old hydroponically grown seedlings were allowed to mild (0.25 mM $CdCl_2$) and severe (0.5 mM $CdCl_2$) Cd stress separately and with the fungicides (2.75 µM TEB + 1.0 µM TRI) for the next four days. Applying TEB and TRI reduced H_2O_2, MDA, EL, MG, and LOX activity by preventing uptake of Cd in the shoots and roots of wheat.

Afterwards, the fourth and fifth experiments were conducted to explore the role of TEB and TRI to improve plant stress tolerance under biotic stresses. In the fourth experiment, it has been studied the potential of TEB and TRI to improve antioxidant defense systems in *Ceratocystis fimbriata* infected sweet potato as well as the inhibitory effects on the growth and antioxidant activity in *C. fimbriata*. Four days after inoculation of *C. fimbriata* in cut surface of sweet potato disks observed TEB and TRI reduced the H_2O_2, MDA, EL, and LOX activity in *C. fimbriata*-inoculated sweet potato by enhancing antioxidant defense systems. However, *in vitro* condition TEB and TRI application increased H_2O_2, MDA, EL, and LOX activity in *C. fimbriata*, where AsA and GSH content reduced. Therefore, TEB and TRI improved black rot disease tolerant in sweet potato by by inhibiting *C. fimbriata* growth. The fifth experiment, was conducted to investigate the role of propiconazole (PRO, triazole group) and combined effect of TEB and TRI on antioxidant defense systems in citrus and *Alternaria citri*. The citrus peel segments were inoculated by *A. citri* solely and in combination with different doses of triazole and strobilurin fungicides. After five days of inoculation, triazole and strobilurin fungicides improved antioxidant defense systems and reduced oxidative damage in *A. citri* infected citrus peels. Fungicide treatment also inhibited the mycelial growth of *A. citri* by increasing oxidative damage under *in vitro* condition.

Considering the above results, the possible mechanisms of TEB and TRI was explored which is closely associated with the modulation of the antioxidant defense systems to improve plant tolerance under both abiotic and biotic stresses. Therefore, the findings suggested that the exogenous application of TEB and TRI might be a promising approach to improve plant stress tolerance.