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Full Length Research Paper

The impact of propiconazole (Tilt 250 EC) on the growth and the breathing of hard wheat isolated roots (*Triticum durum, GTA and Vitron varieties*)

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Fungicides are recognized as non-toxic compounds, or have a weak ecotoxicological risks. The use of these products is responsible for an important part of the increase of the cereals output. However, the exhibition of the consumers to residues in food remained especially preoccupying with regard to some metabolites that put more problems in relation with the human health. In our work we investigate the effects of the propiconazole (Tilt 250 EC) at three concentrations 35, 70, 140 and 280 µM, on some parameters of the growth and on the respiratory metabolism of roots isolated from two varieties of wheat: the Vitron and GTA variety. Our results show that Tilt 250 EC inhibits strongly the number and the length of the roots of GTA variety, but there are no effects on Vitron variety roots. The respiratory metabolism results of isolated roots show that in Vitron variety there is an enhancement of breathing (about 25%), contrarily in GTA variety where we observe a reduction in respiration rate (about 100%).

Key words: Propiconazole, tilt 250EC, wheat; *Triticum durum*, GTA, vitron.

INTRODUCTION

The intensification of the cereal cultures is accompanied with the apparition of damaging illnesses. These illnesses are largely caused by the micro and macroscopic fungi which make an important damage to wheat, barley and to other cereals on the quantitative or qualitative plan. We remedied these cryptogamic infections with fungicides products, classically definite like the chemical or biologic substances that kill or neutralize the pathogenic mushrooms (Adrian, 1987). However, this struggle was not as beneficial, because on one hand, the synthetic fungicides permit the control and the elimination of the harmful fungal agents, they also generate some toxic problems to the plants that they are destined to protect and even at the non-targeted plants and animals (Berova et al., 2002; Bouraoui et al., 1998; Rouabhi et al., 2006a,b). These substances inhibit the roots growth of the gramineous, (Djebar and Djebar, 2000; Di Martino et al., 2005), this inhibition is generally less marked that the one of the aerial parts (El Jaafari et al., 1995; Fernie et al., 2004).

The defoliation causes the reduction of breathing and elongation of the apex roots. The glucides and reduced sugar contents in roots control the respiration intensity and the growth of roots (Klink and Meale, 2003). So the roots under stress conditions present a dominant breathing: it is a generating breathing of indispensable energy to the maintenance of the cellular structures and ionic transportation (Kaur and Diffus, 1989).

The triticale presents a considerable tolerance to several types of xenobiotics; the roots keep - in situation of stress- a good faculty to assure the mineral nutrition of the plant (Millar et al., 1998). To understand better the behavior of the root system of the triticale exposed to a xenobiotic, we studied the effect of a fungicide the Tilt 250 EC on the growth and the respiratory activity of the isolated roots during the first 03 days that follow germination, corresponding stage to the setting up of the vegetative system.

MATERIAL AND METHODS

Vegetal material and culture conditions

Little plants of triticale (*Triticum Desf durum*, GTA variety and vitron) of 03 days (1 leaf stage), are cultivated and watered by a nourish-

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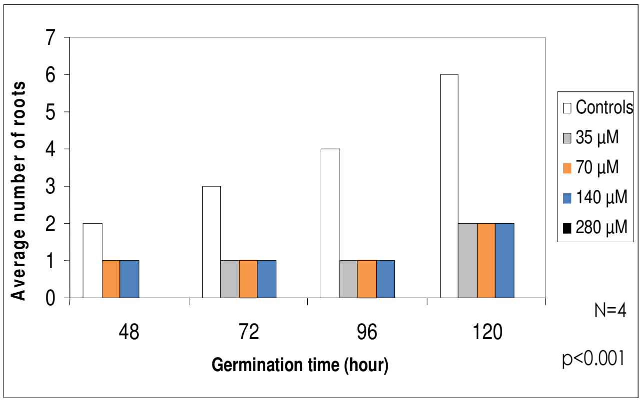

Figure 1. Variation of GTA variety roots average number under treatment of different concentrations of Propiconazole ($p<0.001$).

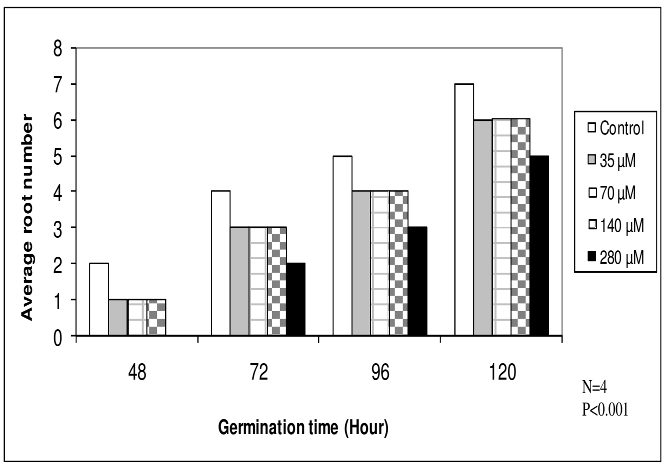

Figure 2. Variation of vitron variety roots Average number under the treatment by different concentrations of Propiconazole ($p<0.001$).

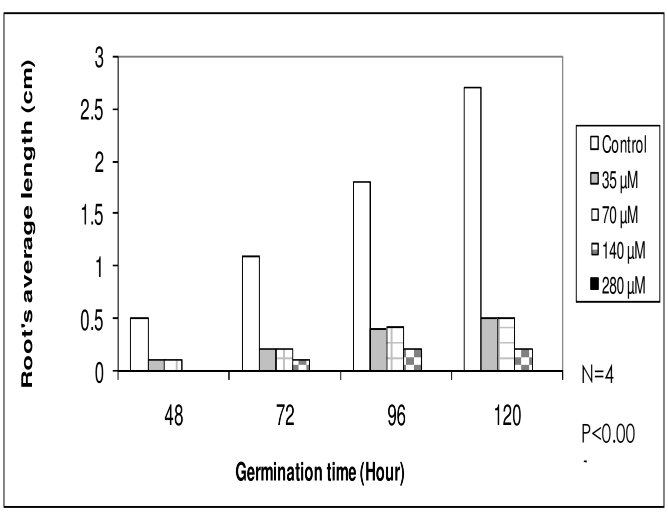

Figure 3. Variation of GTA variety root average length in presence of different concentrations of propiconazole ($p<0.001$).

ing liquid solution. The culture medium is composed of macro-elements (mmol): K^+(1,5); Ca^{2+}(1,75); Mg^{2+}(0,5); NO_3^-(4); $H_2PO_4^-$(0,5); HPO_4^{2-} (0,25); SO_4^{2-}(0,5); and of trace elements (ppm): Fe(1,4); Mn(0,25); B(0,16); Cu(0,03); Zn(0,03); Mb (0,01). Fungicide [Tilt 250 EC, systemic fungicide, chemical name 1-(2-(2, 4-dichlorophenyl)-4-propyl-1,3-dioxolan-2-methyl)-1H-1,2,4-triazol] was provided by the *Syngenta* farm Crop Protection. It is added in the culture medium in order to get concentrations order between 0 and 280 µM. The photoperiod is of 16 h with a luminous intensity of 40 W/m2, a humidity and a temperature averages of 55% and 30℃ the day, and 90% and 22℃ the night. The culture mediums are aired permanently and renewed every 03 days.

Measure of the growth

The roots elongation parameters are determined in Petri boxes on 2 to 3 days germinations in presence or no of Tilt 250 EC. The number and the average length of the roots are followed during 4 days by marking using the China ink. The different used concentrations of fungicide are 35, 70, 140 and 280 µM.

Measurement of the isolated roots breathing activity

The respiration activity is released by polarography technique on isolated roots, using Clark's cell (Hansatech). The samples are introduced in the cell of measurement containing 2 ml of culture witness medium added or no of Tilt 250 EC in different concentrations (0 to 280 µM). The cell of measurement is maintained to constant temperature (25℃) grace an external circulation of water. The medium of measurement is constantly agitated with a magnetic bar maintained aside from the isolated roots. The respiration speeds of oxidization are expressed in “n” mole oxygen in relation to the fresh matter.

RESULTS

The impact of Tilt 250EC on growth

We determined the average number of young plant root aged 03 to 04 days of the GTA and vitrons varieties, cultivated in presence of Tilt 250 EC at different concentrations. The Figure 1 shows how the treatment of the GTA variety by the Tilt 250 EC at 35, 70 and 140 µM, affect appreciably the average number of roots. For the highest concentration (280 µM), a light increase of this number is observed (this number passes from 01 root to 02), but remains very low according to the control samples (06 roots). The gotten results with the Vitron variety are presented in the Figure 2, we show that the average number of gotten root in presence of the different concentrations of Tilt 250 EC rest very close to the control roots. The vitron variety roots seem to present a good tolerance against fungicide.

The measurements of the isolated roots lengths are represented in Figure 3 for the GTA variety and at Figure 4 for the vitron variety. The treatment by the different concentrations of Tilt 250 EC lead a strong reduction of the average lengths recorded in the GTA variety. Indeed, these hardly pass 0.5cm of length. At the vitron variety it notes that the used concentrations of Tilt 250 EC remain without effect on the variations of the average lengths of

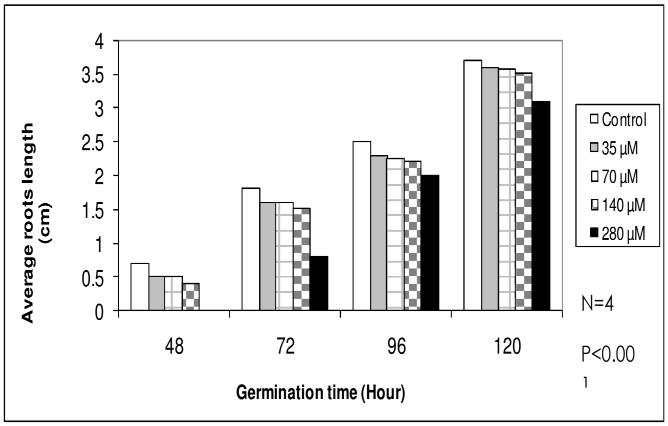

Figure 4. Variation of vitron variety roots length in presence of different concentrations of Propiconazole (p<0.001).

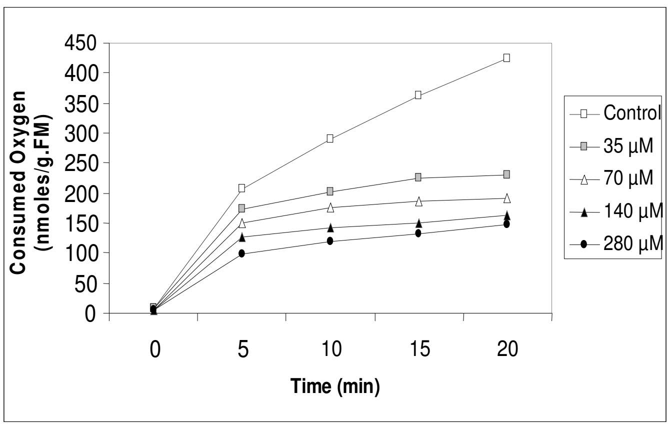

Figure 5. Respiration activity kinetic of GTA variety isolated roots under the treatment of different concentrations of propiconazole.

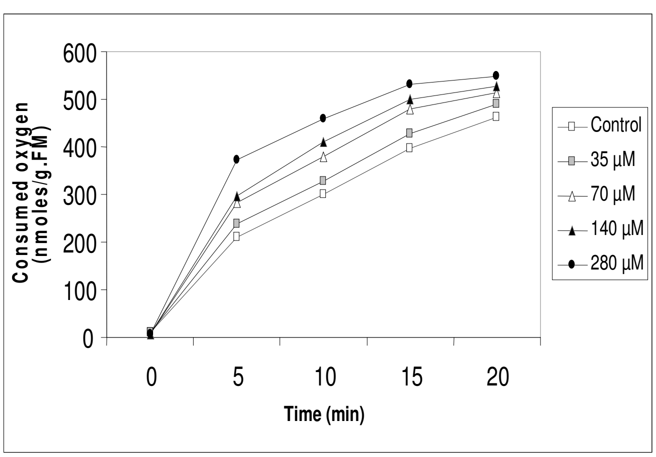

Figure 6. Respiration activity kinetic of Vitron variety isolated roots under the treatment of different concentrations of Propiconazole.

the young plants. The average values remain very near to the witnesses roots.

Respiration

The measurement of the GTA variety breathings intensities is done on control medium (Figure 5), we show a strong respiratory activity varying from 0 nmoles to approximately 450 nmoles O_2/g of fresh matter. In presence of Tilt 250 EC, we observe a strong decrease of 40 to 45% of the breathing of isolated roots in the strongest used concentration (280 µM). The effect of the Tilt 250 EC is observed since the 5 first minutes of respiretory activity registration. This effect puts in evidence a phase of sensitivity in the development of the young plants. The recorded respiratory activity in presence of the other concentrations of Tilt 250 EC is weak and constant. Concerning the vitron variety (Figure 6) we note that the respiratory intensities recorded in presence of the different concentrations of Tilt 250 EC are raised more than those gotten in cultivated controls root. So the increase of the respiratory activity observed at the vitron variety underlines the strong tolerance/resistance of the isolated roots of this variety against the used fungicide.

The respiratory intensity of the GTA variety isolated roots is very sensitive to the treatment by the Tilt 250 EC, contrary to the one observed at the vitron variety that seems rather stimulated.

DISCUSSION AND CONCLUSION

The Tilt 250 EC inhibits strongly the average number of GTA variety root, but remains without effect on the roots of the vitron variety. In the presence of the increasing concentrations of Tilt 250 EC the values of the average lengths of the GTA variety roots are very weak in relation to those of the witness roots of the same variety. In the same way, no difference is observed in the vitron variety roots where the values even gotten at the strongest concentration of Tilt are neighboring of the one gotten in the control roots. It could translate a disruption of the growth and the elongation of the roots led by the different metabolites coming from the transformation of the Tilt 250 EC in the plants, particularly Triazolylalanine (Minta et al., 2004).

From the concentration 35 µM of Tilt 250 EC, the breathing is less than the control roots of about 10% after 5 min of root’s breathing and 65% after 20 min of respiretory activity. This slowing of the respiratory activity becomes even more important at the strongest concentration (280 µM) and the noted respiratory oxidization speed is practically the same to that recorded after 5 min of breathing. The passage of the roots cells from the division stage to the stage of elongation was accompanied with a respiratory metabolism modification (28 C. Agr).

At the vitron variety the results show that the recorded speeds of respiratory oxidizations are in constant increase. Indeed, after 5 min of respiration activity and at the most elevated concentration of Tilt 250 EC (280 µM), we note a speed of respiratory oxidization, two times more elevated than the recorded in controls root, this difference after 20 min stay constant. These observations are explained by an increase of the energetic cost of the ionic regulation (Siddiqui et al., 2001; Zarn et al., 2003). This energy expense linked to the transportation seems to be marked especially in the roots, which have direct contact with soil facilitates the losses of ions that must be continually reabsorbed [this process represents 25 to 50% of the respiratory cost of the ions transportation (Zhou et al., 2002)]. The increase of the breathing in the roots of triticale (vitron variety) in presence of Tilt 250 EC can correspond either to an increased energetic need of the mineral and water nutrition, either to an availability increased of respiratory substrata freed by the slowing of the growth of the aerial parts (that is translated by a decrease of the report of the aerial parts biomass to the roots biomass) (Wang and Zhou, 2005). In our case, we can suppose that the maintenance of the elongation speed of the triticale root (the Vitron variety) in presence of Tilt 205 EC was caused by the increase of the root energetic consumption. The maintenance of the root's growth and the stimulation of the breathing in presence of Tilt 250 EC seem in according to vitron variety tolerance factors relating to the GTA variety.

REFERENCES

Adrian C (1987). The propiconazole Fungicide. Food Production, Canada. D87-05: p.17.

Berova M., Zlatev Z, Stoeva N (2002). Effect of paclobutrazol on wheat seedlings under low temperature stress. Bulg. J. Plant Physiol. (28): 75-84.

Bouraoui N, Grignon C, Zi A (1998). Effet du NaCl sur la croissance et la respiration racinaire de triticale. Cahiers Agriculture. (7): 372-376.

Djebar MR, Djebar H (2000). Bioénergétique: Les mitochondries végétales. Synthèse. 8: 141.

Di Martino C, Pizzuto R, Luigia Pallotta M, De Santis A, Passarella S, (2005). Mitochondrial transport in proline catabolism in plants: the existence of two separate translocations in mitochondria isolated from durum wheat seedlings. Planta. 10: 1-5.

El Jaafari S, Lepoivre P, Semal J (1995). Implication de l'acide abscissique dans la résistance du blé à la sécheresse. UREF: pp. 141-148.

Fernie AR, Carrari F, Sweetiove LJ (2004). Respiratory metabolism: glycolysis, the TCA cycle and mitochondrial electron transport. Curr. Opin. Plant. Biol. (7): 254-261.

Klink KJ, Meale BJ (2003). Dermal exposure to 3-amino-5-mercapto-1,2,4-triazole (AMT) induces sensitization and airway hyper-reactivity in BALB/C Mice. Toxicol. Sci. (75): 89-98.

Kaur J, Diffus C (1989). The effect of Naf on cereal germination and seedling growth. Plant Cell and Environ. (12): 154-161.

Millar AH, Atkin OK, Menz RI, Henry B, Farquhar G, Day DA (1998). Analysis of respiratory chain regulation in roots of soybean seedlings. Plant. Physiol. (117): 1083-1093.

Minta M, Wilk I, Zmudzki J (2004). Embryotoxicity of carbendazin in rat and hamster micromass cultures. Bulg. Vet. Inst. Pulawy. 48: 481-484.

Rouabhi R, Berrebbah H, Djebar MR (2006a). Toxicity evaluation of flucycloxuron and diflubenzuron on the cellular model, Paramecium sp. Afr. J. Biotechnol. 5(1): 045-048.

Rouabhi R, Djebar-Berrebbah H, Djebar MR (2006b). Toxic Effect of a Pesticide, Diflubenzuron on Freshwater Microinvertebrate (Tetrahymena pyriformis). Chin. J. App. Environ. Biol. 12(4): 514-517

Siddiqui ZS, Ahmed S, Zaman A (2001). Effects of methyl thiophenate (Systemic fungicide) on germination, seedling growth, biomass and phenolic content of resistant and susceptible varieties of T*riticum aestum* (L). Pakistan J. Biol. Sci. 4(10): 1198-1200.

Zarn JA, Brüschweiler BJ, Schlatter JR (2003). Azole fungicides affect Mammalian steroidogenesis by inhibiting sterol 14α-demethylase and aromatase. Environ. Health Perspect. 111(03): 255-261.

Zhou QX, Ren LP, Sun TH (2002). Contaminative and interfacial processes of soil cadmium in a lead-zinc mining area. Chin. J. Soil. Sci. 33: 300-302.

Wang ME, Zhou QX (2005). Single and joint toxicity of chlorimuron-ethyl cadmium and cooper on wheat (Triticum aestum). Ecotoxol. Environ. Saf. 60: 169-175.