

Using Raman spectroscopy investigate photosynthetic pigments property of maize leaves (*Zea mays* L.) under the influence of thiamethoxam

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Photosynthesis is one of the key processes occurring in the biosphere, thanks to which it became possible to form organic matter by accumulating solar energy into energy of chemical bonds. [1] A key role in the conversion of light energy is played by protein complexes containing photosynthetic pigments - chlorophyll and carotenoids. [2]

Pesticides play an important role in increasing agricultural productivity and have become an essential part of past farming. However, there is evidence that neonicotinoids are toxic to plants. Neonicotinoids reduce seed germination, leading to chlorosis of leaves, necrosis of new leaf edges, and distortion of growth. [3]

The aim of the work was to study the effect of neonicotinoid (thiamethoxam) on photosynthetic pigments of maize genotypes. Two genotypes were used during this experiment. Zppl 225 is inbred lines with high efficiency of photosynthesis, enriched pigment composition and high nutritional value, and Zp 341 is high-yielding hybrid with high quality, yield and cultivation technology (Institute of maize "Zemun Polje, Belgrade, Serbia).

For spraying maize leaves, a thiamethoxam solution with a concentration of 0.2 mg/L was used. With the appearance of the third true leaf (V3), more than 4 cm long, the corn plant was sprayed with thiamethoxam solution (10 days after germination). When the fifth true leaf (V5) size was 12-14 cm (10 days after spraying), measurements were taken. Corn plants grown under similar conditions without spraying with thiamethoxam solution were used as controls.

Ratio of intensity has changed on 24 h measurement (Рис. 1.). For Zppl 225, it decreased after 24 hours thiamethoxam effect. The difference for Zp 341 is not significant. Control group for Zppl 225 on 24 h's intensity is 2.73. The difference of Zppl 225's control group and experiment group are 0.6 which is 22.1% of Zppl 225 control's intensity. Generally, Zppl 225 has larger intensity difference.

With the time passing, until fifth leaf comes up. The difference ratios I1520/I1160 for Zp 341's samples are not big. Zppl 225's intensity has influenced by thiamethoxam notably. Graph (Рис. 2.) shows the big difference between control group and experimental group. This probably indicates the significant conformation change of the carotenoid molecule when exposed leaf tissues under thiamethoxam condition.

The effects of thiamethoxam on the photosynthetic pigments of maize leaves of two genotypes were studied using Raman spectroscopy. It has been established that the state of the main pigments - chlorophylls and carotenoids was changed in maize leaves after spraying with a thiamethoxam solution. The result shows that nature group is more sensitive to thiamethoxam than genetic modified group.

Pesticides like thiamethoxam could influence pigment easily. By the evolve of detection method, it is promising to have new pesticides which is more safety and more effective.

References

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- 2) Gibbons, D., Morrissey, C. & Mineau, P., A review of the direct and indirect effects of neonicotinoids and fipronil on vertebrate wildlife // Environmental Science and Pollution Research, 2015, №22(1). p. 103–118.
- 3) Kuczynska, P., Jemiola-Rzeminska, M. & Strzalka, K., Photosynthetic pigments in diatoms // Marine Drugs, 2015, №13(9). p. 5847–5881.

Illustrations

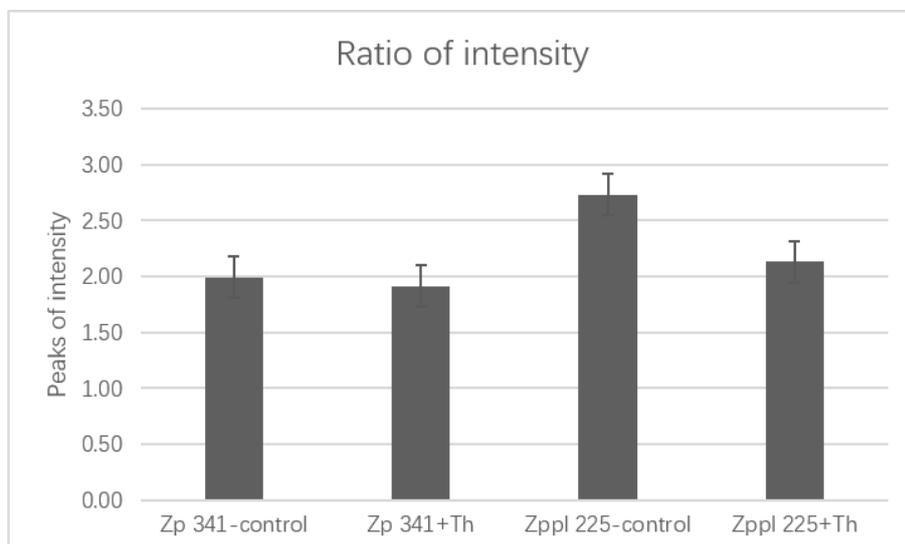


Рис. 1. Comparison of ratio of peaks intensity (I1520/I1160) on different sample which on 3rd leaf (24 h) stage.

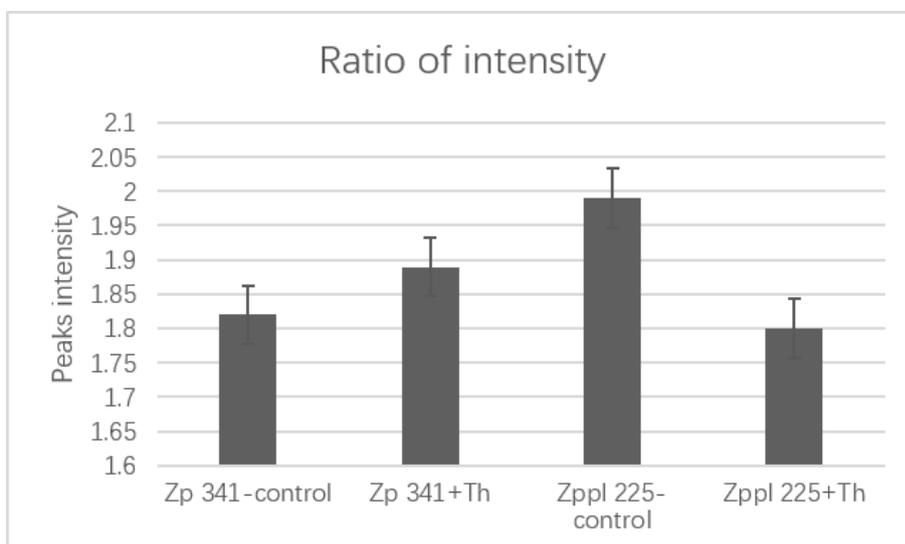


Рис. 2. Comparison of ratio of peaks intensity (I1520/I1160) on different sample which on 5th leaf stage.