

The effect of high temperature during growing season on chlorophyll *a* fluorescence parameters in potato leaves

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Introduction

Potato (*Solanum tuberosum* L.) is a plant typical mainly of temperate climate. The limits and optimal values for the growth of the above-ground part of the potato plant and for the tubers are different. Haulm growth is fastest in the temperature range of 20-25 °C whereas the optimal range for tuberization and tuber growth is 15-20 °C. Under high-temperature conditions tuberization is significantly inhibited.

Chlorophyll *a* fluorescence kinetics is an informative tool for studying the effects of different environmental stresses on photosynthesis. In the research work these techniques are used for assessment of potato genotypes tolerant and sensitive to environmental stresses. The aim of this work was to study the response of selected potato cultivars to high temperature during the subsequent periods of growing season under drought conditions and favourable soil moisture conditions using chlorophyll *a* fluorescence parameters.

Methods

The pot experiment was carried out in 2014. The following early cultivars were tested: Lord, Milek (very early), Gwiazda, Hubal (early), Oberon, Tetyda (medium early). The impact of high temperature (HT) day/night 38 °C/25 °C on potato plants was tested in a growth chamber in four periods: I – May 16-31, II – June 1-15, III – June 16-30 and IV – July 1-15. In these periods half of the plants were watered to a level close to optimal (Favourable Soil Moisture - FSM), while the other half remained without irrigation (Soil Drought - SD). After the end of high temperature periods, measurements of chlorophyll *a* fluorescence were performed with a Pocket PEA (Hansatech, UK). Determined parameters were: F_v/F_m - the ratio of variable to maximal chlorophyll fluorescence and PI - the performance index of photosystem II.



Fig.1. Control plants of cultivar Lord on May, 31

Results

High temperature negatively influenced PI and F_v/F_m parameters in tested plants, and its effect was dependent on the period of stress application and on the cultivar. The value of PI was reduced on average by 68% in the case of high temperature under Favourable Soil Moisture conditions and by 99% under Soil Drought conditions. The value of the parameter F_v/F_m decreased respectively by 9% and 68%. Evaluation of tolerance / sensitivity of cultivars to high temperature stress will be performed after the next year of the study

References

Rykaczewska K (2015) The effect of high temperature occurring in subsequent stages of plant development on potato yield and tuber physiological defects. *Am. J. Pot. Res* 92: 339-349.



Fig. 2. Plants of cultivar Lord just after the I period of HT stress
HT-FSM stress– on the left; HT-SD stress – on the right

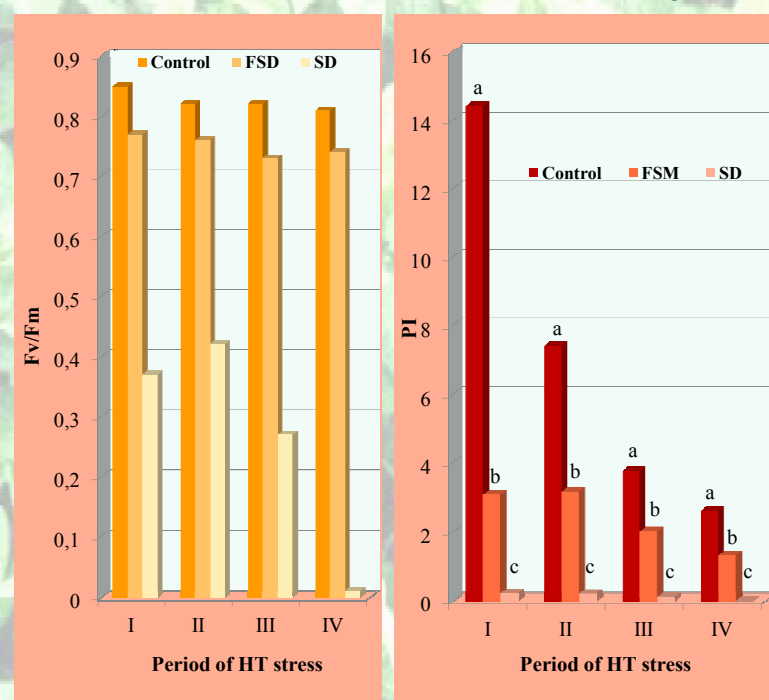


Fig. 3. Parameters of chlorophyll *a* fluorescence depending on the period of HT stress and soil moisture

Conclusion

Based on presented investigations and literature review it can be stated that chlorophyll fluorescence is a very sensitive probe of the physiological status of leaves, which can provide very rapid assessment of plant performance in a wide range of situations. However, in the case of potato, the assessment of plant responses to the stress, the period of measurements is very important. In the earlier period of the growing season, when plants are physiologically younger, high values of PI parameter can be relatively high, despite the impact of stress on them. Therefore, before the implementation of discussed non-invasive techniques for potato genotype screening, it is necessary to conduct more studies.