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Study of changes of chlorophyll fluorescence in lime exposed to abiotic stress

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Abstract

In contribution described investigation was focused on possible utilization of additive soil substances Agrisorb, mineral zeolite and lignite in degraded soils. Photosynthetic reaction of lime - Tillia platiphyllos Scop reaction to actual soil and climatic conditions was investigated. Aim of experiment consisted on determination of effect of additive soil substances on photosynthetic processes of experimental plant.

Keywords: *Tillia platiphyllos* Scop, Chlorophyll fluorescence, soil conditions

Introduction

Global change of climate and its possible impacts are presently noticed to be of the most important fulminations of worldwide importance (Intergovernmental Panel on Climate Change). Supposed growth of global temperature will lead to changes in distribution of rainfalls and cloudiness, which will cause significant changes in Earth's ecosystems (Stine 2009).

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In connection with global changes of climate, expanding of arid and semiarid regions can be expected. As consequence of these changes, question, whether presently used agricultural plants will be able to adapt to these extreme soil and climatic conditions, rises. In semiarid and extremely dry ecosystems of moderate climatic zone, stress to seasonal factors limiting physiological efficiency is commonly present. Reduced water availability, which interferes with other factors of dry conditions, presently represents important limitation fight against globally progressing desertification (Mercado 2009).

Additive soil substances (PPL) represent wide group of substrates, which are coming in on focus of interest also in area of recultivation. They present one of the possibilities of reduction of stress conditions for plants and improvement of chemical, physical, and biological properties of soils (Salaš 1996).

Materials and methods

With respect to aim of solving of problem, very extreme locality of agriculturally used countryside of Hodonin region, in very drying area situated on blowing sands (sthenic soil, granularity – class sand, low retention water capacity, extremely high aeration, exchange soil reaction extremely acid, pH/KCl Ah of soil horizon les than 4.5). On experimental area, model recultivation of problem locality was simulated.

For experiment itself, three PPLs were used – synthetic hydro-absorbent – preparate Agrisorb (in applied dose 20g • m^{-2}), natural untreated crushed lignite (applied dose 500g • m^{-2}) and natural mineral zeolite, fraction 2.5-5 mm (applied dose 3l • m^{-2}). As biological material, two-year-old sapling of *Tillia platiphyllos* Scop., which were cultivated on experimental area, were used. They were planted on 1.11.2008. Photosynthetic efficiency of plants was obtained by measuring of chlorophyll fluorescence. For measurement, Chlorophyll Fluorometer OS–30 (Fv/Fm) was used. Measurement itself was carried out from 1. 6. 2009 to 30. 9. 2009 in 10-day period for completely vegetative period.

Results and discussion

Main function of hydro-absorbents consists in water binding in case of its surplus (rainfalls, watering) with subsequent progressive

releasing to plants. Agrisorb is organic polymeric compound, which is able of binding of water into its structure and releasing during vegetative season to roots of plants. Agrosorb is able of creeping and forming of stable gel. Gel established from 1 g of Agrosorb can bond as much as 300g of water (Salaš 1996).

Lignite is able to absorb high amount of water, in mined state contains 50% at least. This ability is reversible during processes of drying and hydratation. Natural mineral zeolite is additive soil substance of volcanic origin (tetragonal sodium aluminosilicate), which contains approximately 70 % of silicon oxide. Zeolite is highly porous with ability of water and ions absorption with subsequent releasing based on ions exchange (Salaš 1996).

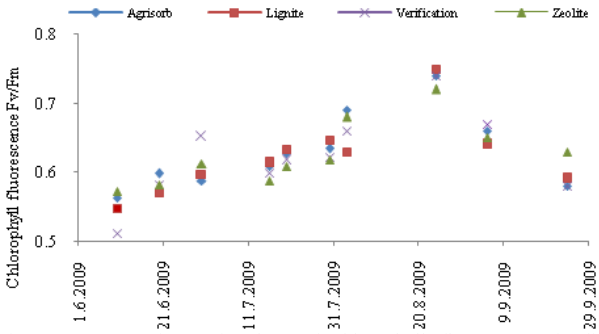

Figure 1: Comparison of values of chlorophyll fluorescence in lime determined during vegetative period on dependence of three PPLs and control area.

In the case of exposition of plant or its photosynthetic system to stress (biotic as well as abiotic), negative influence of photosystem II is recorded. Rate of variable and maximal fluorescence (Fv/Fm) is universal indicator of inhibition of photosystem II function or damage of its reaction centres. Principle of this method consists in simulation of electron excitation with different kinetics of electron exposition (Kyparissis et al. 1995).

Plants cultivated in soils containing additive soil substances demonstrated higher rate of values of variable and maximal fluorescence. Average content of chlorophyll flouorescence (ratio of variable and maximal chlorophyll fluorescence) was 0.64 for lignite, 0.61, for Agrisorb, 0.60 for zeolite and 0.58 for control variante.

Conclusion

Laboratory techniques for determination of chlorophyll fluorescence are time-consuming and destructive. Sample can be only once analysed and changes in chlorophyll fluorescence cannot be analysed during vegetative period or experiment. Described principle of determination of chlorophyll fluorescence values is based on rapid and non-destructive measurement. Due to this fact, method chosen by us proved to be the most suitable for our experiment and for measurement directly terrain.

Acknowledgement

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