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USE OF SPECTRAL REFLECTANCE METHOD FOR MONITORING OF PLANT TRAITS AND DROUGHT STRESS EFFECTS IN WHEAT

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The drought stress represents one of the main environmental factors affecting growth and yield of crops in a global and regional scale. The non-invasive methods enable fast and efficient way to monitor the drought stress effects. The aim of the study was to test the application of spectral reflectance method and select the proper parameters to evaluate the main leaf traits in various wheat genotypes in genebank. The results enabled to indicate the parameters showing a good link to observed traits and an appropriate sensitivity to drought stress effects. The study represents the initial step of the program aimed at stress tolerance screening and monitoring of wheat germplasm.

Keywords: stress monitoring, wheat, spectral reflectance, genotypes, hyperspectral analysis.

Spectral reflectance analyses represent a promising technology for field environmental monitoring of stress effects in plants. Drought stress is another key environmental factor responsible for the reduction of growth and yield of plants. Drought stress adversely affect plants, including the reduction in leaf water contents, photosynthesis [1], nutrient uptake, growth, and yield of plants [2]. There are numerous methods and protocols for non-invasive assessment of stress effects with a different level of labor costs [3]. One of the most promising is hyperspectral monitoring using the broadband spectral reflectance records, which was successfully used in different crops and various stresses [4]. Previous studies over the past decades have successfully used hyperspectral data to quantify the canopy characteristics of crops. It was found that leaf spectral reflectance increases in portions of the visible and very-near infrared range as a plant experiences physiological stress [5]. These methods are well established in the remote sensing, including the satellite or plane applications. It is well documented that the wheat germplasm is characterized by an enormous phenotypic diversity, including the morphological traits of aboveground biomass determining the optical properties of the crop canopy. The open question is the reliability of the methods for monitoring the physiological status of the diverse accessions of wheat differing in various leaf traits. To answer this, the hyperspectral field records as well as the subsequent leaf analyses were made in 100 wheat genotypes from the collection of Slovak Genebank. Moreover, the automated phenotyping of 25 wheat genotypes grown in pots were performed at a PlantScreen phenotyping facility of SUA. The traits of the fully developed flag leaves (chlorophyll content, leaf area, leaf thickness, etc.) were correlated with >100 hyperspectral indices developed to estimate different properties of crop aboveground biomass. The genotypes provided high diversity in all observed traits, providing good background for correlation analyses. We identified a group of parameters with a high correlation (MCARI, red edge parameters), which can be useful for the automated field phenotyping of wheat genetic resources. The RGB analyses enabled to collect the phenotyping data related to the plant height, leaf area, but also the color characteristics of plants and leaves. The study represents the initial step of the program aimed at stress tolerance screening and monitoring of wheat germplasm, including local landraces, towards developing the methodological approaches to assess the genotype. This effort may contribute to efficient utilization of crop genetic resources, their protection and increase of genetic and biological diversity of cultivated cultural plants. The study was supported by the grants VEGA 1-0589-19, APVV-18-465, and APVV-15-0562.

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FORMATION, ACCUMULATION AND DISPOSAL OF POLYMER WASTE IN THE REPUBLIC OF BELARUS

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This paper analyses the existing situation in the field of polymer waste management in the Republic of Belarus; and a comparative analysis of recycling processing methods (disposal) in Belarus and Western European countries is given.

Keywords: polymer waste, chlorinated plastic, biodegradation of plastics, bisphenol, polystyrene particles, accumulation, sorting, recycling.

One of the results of anthropogenic activity is the formation of waste, polymer waste occupying a special place. Plastics account for 18-30% of municipal waste in industrialized countries. They form about 260 million tons of waste with an annual increase of 5-6%. Polymer waste consists of 34, 20, and 7 per cent of polyethylene, polystyrene, and polypropylene respectively.

Chlorinated plastic can release harmful chemicals into soil, which can then leak into groundwater or other nearby water sources.

Landfill areas are constantly heaped up with many different types of polymer waste. They have a lot of microorganisms that accelerate plastic biodegradation. Considering biodegradable plastics, decaying process proceeding, methane (a greenhouse gas) is released. This has a significant negative impact on the environment.

A considerable amount of polymers enters the oceans, it has also been estimated that they make up about 10 % of the beach cover worldwide. Plastics in the oceans usually decompose within a year, and the process implies that toxic chemicals such as bisphenol and polystyrene can get into the water. According to 2016 estimates, there are 268,940 tons of plastic on the ocean surface, and the total amount of plastic debris is 5.25 trillion tons.

Polymer waste contamination can cause animal poisoning, which, in turn, can negatively affect the supply of food to humans. Polymer pollution has been described as having very detrimental effects on large marine mammals [1].

In the composition of waste generated in our country, the share of polymers is growing; and only a few types of plastics are actually processed. According to experts, the content of plastic in household waste of the residents of Belarus is 7 % of the total weight. According to some data only 17 to 30 % of total plastic waste is recycled in Belarus.

Food packaging is the main source of plastic waste. The attempts to reduce the amount of packaging when shopping convince us that the bulk of its share falls on food, where the proportion of polymers can reach up to 90 %. It should be noted that recycling of “food” polypropylene and polyethylene; polystyrene; and Tetra Pak packaging is the most problematic.

Polyethylene and polypropylene bag recycling is difficult due to the complexity of sorting. Recycling of "food" polyvinyl chloride (PVC) and polystyrene is also difficult as they crumble during transportation, pressing and washing; they are sensitive to organic impurities, which can provoke their decomposition during the processing. Food containers made of these polymers have difficult-to-separate labels and often heavily contaminated with food residues. No more than 20 % of polypropylene which ends up in recycling bins is recycled.

The analysis of plastic waste recycling methods shows that there are quite a lot of technological solutions of the problem. The recycling can be mechanical, chemical and thermal. Thermal methods include pyrolysis, hydrolysis, glycolysis, methanolysis) [2].