V МІЖНАРОДНА НАУКОВО-ПРАКТИЧНА ОНЛАЙН КОНФЕРЕНЦІЯ

ТЕНДЕНЦІЇ ТА ВИКЛИКИ СУЧАСНОЇ АГРАРНОЇ НАУКИ В УМОВАХ ВІЙНИ: ТЕОРІЯ І ПРАКТИКА

Присвячена 125-річчю кафедри рослинництва НУБІП України

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Рекомендовано до друку збірник тез доповідей V Міжнародної науково-практичної онлайн конференції: «Тенденції та виклики аграрної науки в умовах війни» Присвяченої 125-річчю кафедри рослинництва НУБіП України вченою радою агробіологічного факультету Національного університету біоресурсів і природокористування України від 16 листопада 2023 року протокол № 11.

Тенденції та виклики сучасної аграрної науки в умовах війни: теорія і практика. **Присвячена 125-річчю кафедри рослинництва НУБІП України** матеріали V міжнародної науково-практичної онлайн конференції (м. Київ, 25-27 жовтня 2023 р.)/НУБІП України, 2023. 339 с.

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У збірнику опубліковано матеріали доповідей учасників V міжнародної наукової інтернет-конференції «Тенденції та виклики сучасної аграрної науки в умовах війни: теорія і практика», яка присвячена 125-річчю кафедри рослинництва НУБІП України. Висвітлено теоретичні і практичні питання сучасної аграрної науки, напрями їх вирішення та впровадження у виробництво.

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EXPRESS DIAGNOSTICS FOR STRESS DETERMINATION IN PLANTS

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Introduction. Plant stress measurement is quantifying the effect of environmental conditions on plant health. When plants are under less than ideal growth conditions, they are considered to be under stress. Stress factors can affect plant growth, survival and crop yield. In the process of crop growth, there are two kinds of stresses: biotic stress and abiotic stress. Biological stress is what we call diseases, pests, weeds and viruses. Abiotic stress includes both physical and chemical aspects. Physical aspects include temperature, water, radiation and mechanical damage. Chemical aspects include air pollution, pesticides, toxins, soil, water pH and salinization. Stress is a complex response that includes primary, secondary, and tertiary stress factors. It may involve visual assessment of plant vitality, but the recent focus has shifted to the use of instruments and protocols to reveal specific processes in plants (especially photosynthesis, plant cell signal transduction and plant secondary metabolism) and determine the best conditions for plant growth, such as optimizing water use in agricultural systems, determining the climatic range of different species or subspecies, and determining which species or subspecies are resistant to specific stress factors.

Scientific and practical significance of the obtained results. The new methods of using different modern electronic devices were studied and compared. The results showed that agricultural crops grow more stable and yield higher, so the optimal conditional was selected.

Conditions and plant stress measurement methods. Field researches were conducted at the research field of NNVK (educational- scientific-production complex) of Sumy National Agrarian University during 2021-2022. Ukraine. Research areas of Sumy NAU are within the city. Sumy (50° 52.742′ N latitude, 34° 46.159′ E longitude and 137.7 m above sea level) and belong to the north-eastern part of the forest-steppe.

Methods and devices of measuring plant stress. The photosynthesis system uses an infrared gas analyzer (IRGAS) to measure photosynthesis. Measure changes in CO2 concentration in the leaf chamber to determine the rate of carbon assimilation by leaves or the entire plant. Studies have shown that the rate of photosynthesis is directly related to the amount of carbon absorbed by plants. Measure the CO_2 in the air before the air enters the blade chamber, and compare it with the CO_2 measured after the air leaves the blade chamber, and use the verified equation to provide this value. These systems also use IRGA or solid state humidity sensors to measure changes in H_2O in the blade chambers. This is done to measure leaf transpiration and correct CO_2 measurements. The combination of these systems and fluorometers is particularly effective for some types of stress and can be used for diagnosis, such as in the study of cold stress and drought stress.

The device for measuring is LCI-SD portable photosynthesis meter is the smallest and portable photosynthesis meter, which measures parameters related to photosynthesis in plant leaves, including the photosynthetic rate, transpiration rate, and stomatal conductance. It can be used in research and is also a good teaching instrument. Its special design allows it to be used in high-humidity and dusty environments. Based on the principle of IRGA (infrared gas analysis), the changes of CO_2 concentration and water content on the leaf surface were precisely measured to investigate the parameters related to leaf and plant photosynthesis. IRGA system. Research shows that IRGA can measure all types of plant stress, so it has become a conventional measuring instrument. The problem is that their costs are high. The combination of IRGA and chlorophyll fluorometer is very helpful for studying different types of plant stress.

Chlorophyll content and fluorescence from plant leaves can provide insight into the health of the photosynthetic system. Chlorophyll fluorometer is designed to measure the variable fluorescence of photosystem II. This variable fluorescence can be used to measure the stress level of plants. The most commonly used protocols include those designed to measure the optical system II (ΔF/Fm') and dark adaptation (Fv/Fm). In most cases, chlorophyll fluorometers are less expensive and more portable than photosynthesis systems, and they provide faster measurements. For these reasons, they have become one of the most important tools for measuring plant stress in the field.

Y(II) is a measurement protocol developed by Bernard Genty and first published in 1989 and 1990. It is a test for adapting to light, allowing the measurement of plant pressure during the photosynthesis process of plants under steady-state photosynthesis light. Like Fv/Fm, Y(II) represents the measurement ratio of plant efficiency, but in this case, it represents the energy used by photosystem II in photochemistry under steady-state photosynthetic lighting conditions. For most types of plant stress, Y(II) is linearly related to plant carbon assimilation in C4 plants. In C3 plants, most types of plant stress are related to carbon assimilation in a linear curve.

The transmittance of the two wavelengths provides the chlorophyll content index, which is called CCI or SPAD index. Chlorophyll content meter is usually used to measure nutrient plant stress, including nitrogen stress and sulfur stress.

The main device of measuring the chlorophyll fluorescence is the PSK plant stress measurement kit. The principle adopts the principle of modulation saturation pulse to measure the chlorophyll fluorescence of plants. Based on the research results of relevant literature, the light quantum yield and the relative electron transfer rate of plants can be calculated. At the same time, environmental parameters such as PAR, leaf temperature and relative humidity can be measured.

The next device is AZ-B0300 Plant Stress Physiology Observation System. The gas exchange parameters and fluorescence parameters obtained by AZ-B0300 plant stress physiology measurement system are used for correlation analysis or principal component analysis with the measured data of various environmental factors or artificial processing conditions. AZ-B0300 Plant Stress Physiology Observation System can simultaneously measure the gas exchange parameters, fluorescence parameters and environmental factors of plants, and can be used to study the stress of various types of environmental factors of plants. So as to analyze the influence mechanism and contribution rate of various environmental factors to plant stress.

The calculation method of **rETR is: rETR=Y(II)×Blade** absorption ratio×Ratio of PSII reaction center to PSI reaction center. In most cases, it is related to the assimilation of photosynthetic carbon. rETR=0.83×0.50 is a relatively common formula. In fact, the absorption ratio of higher plants ranges from 0.70 to 0.90, and the ratio of PSII reaction centers ranges from 0.40 to 0.60. The research shows that when using rETR for comparative measurement, the samples have the importance of the same blade absorption ratio.

OJIP measurement is another measurement that requires dark adaptation, which is used to detect and measure plant stress. If the leaves after dark adaptation are irradiated to observe the increase of chlorophyll fluorescence, a curve with multiple steps and significant differences will be seen at a higher time resolution. With this method, plant stress affecting PSII can be detected. The latest research shows that the O-J segment is mainly caused by photochemical quenching, the J-I segment is mainly caused by photochemical quenching, and the I-P segment is mainly caused by the potential energy of electron transfer caused by PSI cycle electron transfer.

Studies have shown that some types of plant stress affect the OJIP curve of specific parts. Researchers usually use the method of curve superposition to study the effects of stress, and use specific parameters for quantitative analysis of stress. There is a lot of research on herbicides, pesticides and other stresses.

Conclusions. Under modern changes in climatic conditions and intensification of agricultural production, the impact of stressful conditions on the growth and development of plants has dramatically increased. So, there is a clear need for the development of modern methods for determining stress factors using express diagnostics with the best world developments (devices). The study of the nature of stresses and the development of ways to reduce them will ensure the realization of the biological potential of agricultural crops.