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THE INFLUENCE OF ABIOTIC STRESS FACTORS ON LETTUCE

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Summary. This paper presents the influence of non-steroidal anti-inflammatory drugs (diclofenac, ibuprofen, and naproxen), antibiotics (ampicillin, ciprofloxacin), nanomaterials (CNT-COOH, CNT-MnO_2 etc) and heavy metals (Cu, Cd etc) on the lettuce (*Lactuca sativa* L.). The evaluation of the impact of these pollutants on photosynthetic pigments, total polyphenols, antioxidant activity and the variation of multielement content was followed. From these studies it was observed that the VOCs emission rate increase with the increase of the pollutant concentration and the quantity of chlorophylls, carotenoids, polyphenols and flavonoids decrease. In conclusion, these can be employed as a stress signal of the plants or as biomarkers. All these information can be used for assessment the resistance and resilience of plants to environmental stressors and will be applied for plant protection.

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ACTIVITY OF FS 2 IN FLAG LEAF AND DEPTH OF THE TILLERING NODE *Triticum aestivum* L.

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Summary. With the help of BAS Reglalg, it possible to control the depth of the tillering node in the soil. It was found that the experimental variants had higher levels of PS2 flag leaf activity compared to the control variants. In the heading phase, the activity of PS-2 of the flag leaf is the highest. The use of Reglalg contributes to the preservation of PS-2 activity during the period of intensive aging of the leaf blade, this affects the duration of the accumulation of dry matter of seeds in the ear, delaying the death of the leaf by about 1-2 days.

Keywords: *Triticum aestivum L., grain filling, FS-2, tillering node, flag leaf, epicotyl length.*

Introduction. Nowadays, an increase in the activity of the photosynthetic apparatus of plants is considered to be one of the promising approaches in the formation and increase in the yield of grain crops [15]. The assimilation organs of winter wheat are not only the leaves, but also the stem, ear, leaf sheaths, awns [1]. It has been established that in many respects the importance of each of these organs in the process of photosynthesis depends on the stage of plant development. According to studies [6, 13], up to 90-95% of the dry mass of the crop is created due to leaf photosynthesis. In this connection, the size of the assimilation surface of plants is often characterized only by the area of the leaves. Because of the work done, it was possible to establish the presence of a positive conjugacy between the yield and the leaf surface area, from strong (r = 0.95-0.98) to medium (r = 0.45-0.56) [2, 3]. It is important to maintain a high intensity of CO2 assimilation at the late stages of vegetation, which provides the best conditions for grain filling and formation high yield [11]. According to

the work of Lyfenko [4], a large leaf area can lead to a drop in drought resistance and heat resistance. From the data of the work of Maimists [5], it was found that drought-resistant wheat genotypes have increased, but not the highest leafiness indicators. Particular attention should be paid to the correlation component between the leaf area, the weight of the grain in the ear, its lake content and the weight of 1000 seeds (on average it ranges from +0.50 to +0.96). In many ways, the fullness of the seeds depends on the work of the photosynthetic apparatus of the leaves, however, the data of [10, 12] indicate that at the time of the beginning of grain filling, a large contribution belongs to the scales and awns. However, the role of scales and awns is very limited due to their rapid aging, and by the time they dry out, the main source of seed fullness in the ear belongs to the flag leaf. In the process of seed maturation, along with the awns and scales, the flag leaf also ages, in which the photosynthetic apparatus degrades [14]. Therefore, in order to achieve a high and high-quality harvest, it is necessary to preserve the photosynthetic activity of the leaves at the time of grain filling. The possibility of slowing down the aging rate of flag leaves, as it is notes in [8], is achieved using biologically active substances. This paper presents the results of the work of the photosynthetic apparatus of the flag leaf, depending on the depth of the tillering node.

Materials and methods. In the experiment, plants of soft winter wheat (*Triticum aestivum* L.) of the Moldova 5 variety were used, obtained from seeds that were treated with biologically active substance (BAS) Reglalg before sowing. The use of Reglalg allows to control the depth of the tillering node. The measurement of the activity dynamics of the photosystem-2 (FS-2) of the flag sheet was recorded using a fluorimeter PAM–2100 (WALT "Germany"), according to the yield indicator, in the field during the entire period of grain filling. Particular attention was paid to the selection of the studied variants according to common physiological characteristics (plant height, number of leaves, first shoot, leaf illumination, leaf surface dimensions). Wheat plants that were not treated with the preparation before sowing (control) and treated with Reglalg (experiment) served as options. To determine the average length of the epicotyl, plants were counted three times in an amount of at least 100 pcs. For repeatability, plants for pcs were selected to measure the activity of FS-2. Statistical and mathematical processing was carried out in Excel 2013 according to the method of statistical analysis [9].

Results and discussion. To establish the maximum effect of shortening the length of the epicotyle, the seeds were treated with various concentrations of BAS Reglalg (from 1/100 to 1/800) before sowing. Based on the data in Table 1, it can be seen that a high concentration of Reglalg (1/100) does not lead to strong changes in the length of the epicotyls and, on the contrary, contributes to its elongation, compared with control plants. The action of solutions with a lower concentration leads to a decrease in the length of the epicotyls by an average of 1 cm, compared with control plants. Since it is the length of the epicotyls that largely affects the depth of the tillering node, it can be argued that the tillering node and the nodal roots of experimental plants have the advantage of being formed in deeper soil layers, compared with the control variant. The depth of seeding is 5-6 cm, the length of the epicotyle of the control plants has an average of 2.5 cm, and therefore, the tillering node is formed at a depth of 2.5 – 3.5 cm from the soil surface. Experimental plants form a tillering node at a depth of 3.5 - 4.5 cm. Capillary evaporation of moisture has the highest coefficients on the soil surface, where it dries up very quickly immediately after precipitation. In deeper horizons, the effect of capillary evaporation of moisture decreases sharply, and as a rule, moisture condenses in these horizons at the time of severe desiccation of the soil due to temperature changes. This effect allows experienced plants, in particular, it is the nodular roots that use moisture for a longer period under the action of drought, which should certainly affect the duration of the accumulation of dry substances in the seeds of the ear.

Tab. 1.The average value of the length of the epicotyl of plants *Triticum aestivum* L. Moldova 5, the seeds of which were treated with Reglalg of different concentrations before sowing.

Parameter	Variants				
	Control	1/100	1/200	1/600	1/800
Average value, cm.	*2,46*	*2,50*	*1,54*	*1,59*	*1,55*
Standard deviation, cm	*1,27*	*1,18*	*1,07*	*1,09*	*1,11*
Least significant difference 95	0,54				

As can be seen from Table 1, option 1/200 has the best effect on the average length of the epicotyl, and this option is optimal from the point of view

of the concentration of the solution, which does not lead to plant oppression [7]. The activity of FS-2 of the flag leaf was determined starting from the earing phase, when the ear completely emerged from the stem, and up to the phase of the beginning of wax ripeness, when the leaf apparatus retains viability. Subsequently, the leaf dries up and the seeds in the ear no longer gain nutrients, but gradually lose moisture (ripen). Measurements were carried out from 8:00 a.m. to 19:00 p.m., which allowed us to determine the loading speed of the photosynthetic apparatus, its loading level and the speed of recovery. It is worth emphasizing that the determination of the FS-2 activity of the flag leaf throughout the entire maturation period was carried out with the same illumination of about 1000 – 1500 headlights, which made it possible to evaluate the work of the leaf variants with different depths of the tillering node in the soil. Thanks to the optimal illumination of the leaf, it is possible to evaluate the quality of the photosynthetic apparatus.

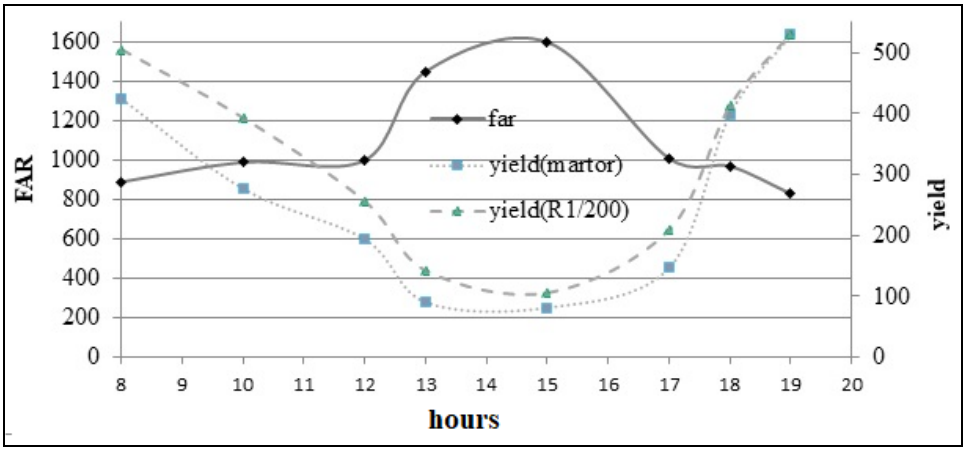


Figure 1. PS-2 activity of the flag leaf of cv. Moldova 5 in the heading phase, control (dotted line) and experiment Reglalg 1/200 (dots).

Figure 1 shows the results of measuring the PS-2 activity of the flag leaf in the heading phase, and, as can be seen, under illumination of about 900 PAR, the photosynthetic apparatus of the leaf begins to gradually load. When the maximum value of PAR is reached (13:00-15:00 hours), the photosynthetic apparatus of the leaf is fully loaded, and only with the beginning of the fall in illumination, the onset of evening (17:00-19:00 hours) does it sharply recover to its initial values.

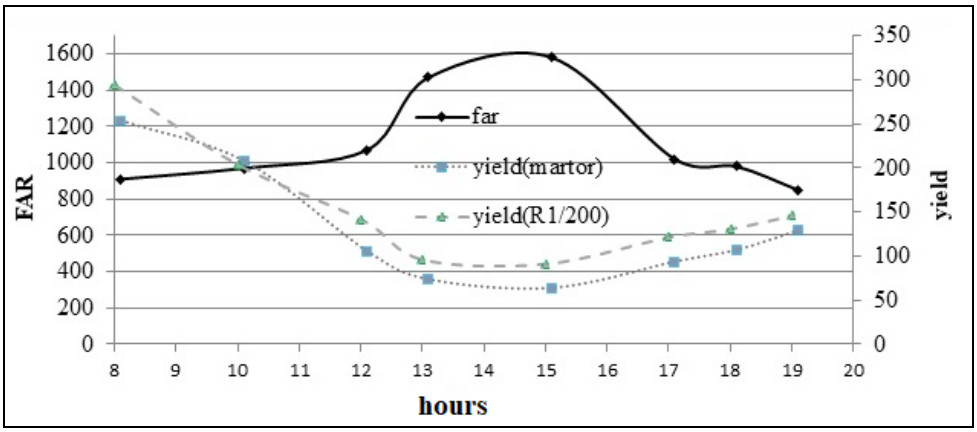


Figure 2. The activity of FS2 of the flag leaf of the Moldova 5 variety in the phase of milk ripeness, control (dotted line) and the experience of Reglalg 1/200 (dots).

Conventionally, the data (Fig.1) can be divided into three groups: the first group represents the state of the photosynthetic apparatus until the moment of intense illumination and displays the work in a stationary state. The second group allows you to estimate the depth of the photosynthetic apparatus during intense lighting and the third group allows to estimate the recovery rate of the photosynthetic apparatus with decreasing illumination. As can be seen from the graph (Fig.1) at the time of earing, when the flag leaf is still young and not subject to intensive aging, the work of the photosynthetic apparatus is active, this is best confirmed by data from the third group, namely the recovery rate. Figure 2 shows the results of measuring the activity of FS-2 at the stage of almost complete leaf aging (milk ripeness). It is noticed that with little illumination in the morning, the photosynthetic apparatus of the leaf is rapidly loaded and with the onset of intense illumination almost reaches zero values, but with the onset of the evening hours, there is no intensive recovery, only a slight upward trend. Special attention should be paid to experimental variants, which, both at the beginning of seed formation and by the end of their maturation, have very distinguishable differences both in workload and in the speed of recovery of the photosynthetic apparatus. Due to the active work of the photosynthetic apparatus, the seeds of experimental plants accumulate more intensively and longer dry substances due to the lifespan of the flag leaf.

Conclusions. The use of BAS Reglalg leads to a decrease in the length of the epicotyle, which ultimately affects the activity of the photosynthetic

apparatus of the flag leaf. As a result, the activity of FS-2 remains at a higher level compared to control plants. This makes it possible to prolong the vital activity of the leaf blade for an additional 1-2 days. By increasing the life span of the leaf apparatus, seeds slowly lose moisture, thereby accumulating dry substances, which certainly affects the average yield of wheat plants. It has been established that the activity of FS-2 in the initial period of seed formation is capable of rapid recovery to initial values in a very short period of time, but by the time of severe leaf aging, seed maturation, the activity of FS-2 decreases sharply. During this period, the photosynthetic apparatus is rapidly loaded with low light and more time is needed without lighting to restore it to its initial values.

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