# EXPERIMENTAL BOTANY

DOI https://doi.org/10.30525/978-9934-26-111-4-6

## EFFECTS OF PRE-SOWING TREATMENT WITH DL-N-HEXANOYL-L-HOMOSERINE LACTONE ON PHYSIOLOGICAL AND BIOCHEMICAL CHARACTERISTICS OF WINTER WHEAT

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Acylhomoserinlactones (AHL) are a class of mediator molecules of bacterial origin involved in the remote transduction of signals between phytosphere colonizing bacteria and bacteria and the host plant [1, p. 605–612]. These compounds belong to the signaling systems of autoreception of quantitative parameters of the bacterial population, which is called «quorum sensing» (QS). QS expresses bacterial genes that play an important role in plant-bacterial relationships [2, p. 3–19]. Since bacteria and eukaryotic organisms have evolved together over millions of years, host plants have developed a QS signaling perception system [3, p. 1–14]. The molecular mechanisms by which plants respond to bacterial signaling have

not been fully studied. It is shown that the phenomenon of QS and the related components are involved in the regulation of prokaryotic-eukaryotic interactions, including the formation of biofilms, phytohormone synthesis, plasmid transfer, production of virulence factors, bioluminescence, sporulation, nodule formation, stress resistance [2, 3-19].

Climatic conditions significantly affect the quality of the crop, and adverse changes in temperature and water regime reduce the resistance of plants to bacterial and fungal invasions. An effective biotechnological approach to the formation of resistance to biotic and abiotic stressors is pre-sowing treatment of seeds with compounds of the AHL class [3, p. 1–14; 4, p. 463–474; 5, p. 106–1188; 6, p. 92–100; 7, p. 1–17].

We analyzed the effects of pre-sowing treatment of seeds with aqueous solution of DL-$C_6$-AHL (150 and 300 ng/ml) on the physiological and biochemical characteristics of winter wheat (*Triticum aestivm* L. 'Podolyanka') at different phases of vegetation. Field experiments were performed in 2019-2020 on research center «Feofania» of the M.G. Kholodny Institute of Botany of the National Academy of Sciences of Ukraine (Kyiv).

It is known that photosynthesis plays a key role in crop formation. The pigment system converts solar energy into the energy of chemical bonds. Leaves with a higher concentration of photosynthetic pigments absorb more solar energy and have a higher intensity of photosynthesis [8, 463-483; 9, 1799-1823]. A gradual increase in the chlorophyll content from the tillering phase to the flowering phase and a subsequent decrease to the milk-wax ripeness phase was determined during the vegetation of winter wheat of the Podolyanka variety. The total content of chlorophylls in wheat leaves after treatment of seeds with DL-$C_6$-AHL at a concentration of 150 ng/ml and 300 ng/ml varied in the range of 1.35-1.41 mg/g of fresh weight (FW) and 1.28-1.59 mg/l FW, respectively, whereas in the control – in the range of 1.18-1.26 mg/g FW. An increase in the amount of chlorophyll *b*, especially at the flowering stage, was detected. Thus, the pigment content in wheat leaves after treatment of seeds with DL-$C_6$-AHL solution at a concentration of 150 and 300 ng/ml was 24% and 30% higher compared to the control.

Selection of modern wheat varieties is aimed at the screening of genotypes with a large area of leaf blades to increase the photosynthetic surface, which contributes to the formation of more grains in the ear [8, p. 463–483]. Treatment of seeds with an aqueous solution of DL-$C_6$-AHL induced an increase in the area of the assimilation surface of wheat leaves of Podolyanka variety. Thus, after seeds treatment with DL-$C_6$-AHL at a concentration of 300 ng/ml, the total area of four leaves at the stage of

tillering increased by 13%, the area of flag and pre-flag leaves at the stage of flowering increased by 50 and 25%, respectively, while the area of flag leaf at the stage of milk-wax ripeness – by 40%.

It was shown that an additional source of assimilates required for grain filling are non-structural carbohydrates deposited in the stem ([10, 4647-4670]. Since an outflow of assimilates from the stem to the ear occurrred in the phase of grain filling, the deposit capacity of the stem is characterized by a decrease in the number of non-structural carbohydrates in the phase of full maturity compared to the flowering phase [11, p. 285–293]. Abnormal weather conditions in 2019-2020 in some way affected the metabolism and redistribution of non-structural carbohydrates. We have showed that the content of non-structural carbohydrates in winter wheat plants of the Podolyanka variety reached a maximum in the flowering phase and decreased to a minimum in the phase of full maturity. In control plants, the share of nonstructural carbohydrates accounted for 28% -7.5%, while in primed with DL-$C_6$-AHL at a concentration of 300 ng/ml – 35.5% -9.8%.

An important identifier of plant tolerance is the content of total phenols [12, p. 5–18]. We determined that in the tillering phase the amount of total phenols reached maximum values, after which it gradually decreased in the phase of milk-wax ripeness. During the tillering phase, the content of phenols in the shoots after seeds treatment with DL-$C_6$-AHL at a concentration of 300 ng/ml increased by 30% compared to the control. Among the secondary metabolites of phenolic nature, flavonoids have the greatest antioxidant and radical-neutralizing potential phenols [12, p. 5–18]. The maximum content of total flavonoids in the shoots and roots of Podolyanka wheat was detected in the tillering phase. The minimum content of flavonoids was recorded in the flowering phase in the roots of control and primed plants. However, after priming with DL-$C_6$-AHL at a concentration of 300 ng/ml, this value increased by 58%. In our opinion, the nature of the accumulation of total phenols and flavonoids could be influenced by hydrothermal conditions, which in autumn 2019 and spring and summer 2020 differed significantly from the normal and were not favorable for plant growth and development.

Plants are characterized by a pronounced dependence on environmental conditions. With rigid static position, they survive solely due to internal defense mechanisms. Our studies showed that seeds treatment with DL-$C_6$-AHL induced an increase in the assimilation surface area of leaves and an enhance in photosynthetic pigments, total phenols and flavonoids, as well as intensified the deposition of non-structural carbohydrates in the stem of winter wheat Podolyanka during the vegetation, contributing to better grain

filling. The improvement in the indicators of the crop structure elements, including productive bushiness and the amount and weight of grains in the ear and the weight of 1000 grains was found.

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