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ACTIVITY OF PHYTOHORMONES IN AXIAL ORGANS OF *PISUM SATIVUM* L. SEEDLINGS DUE TO ACTIVATION OF PHOTORECEPTOR SYSTEMS

АКТИВНІСТЬ ФІТОГОРМОНІВ У ОСЬОВИХ ОРГАНАХ ПРОРОСТКІВ *PISUM SATIVUM* L. ЗА АКТИВАЦІЇ ФОТОРЕЦЕПТОРНИХ СИСТЕМ

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It is known that light acts as a factor that regulates the processes of plant photomorphogenesis with the participation of various signaling systems, including the phytohormonal system [1, pp. 1423–1425]. The photoreceptors of plants are represented by receptors of red light (RL) and far red light (FRL) – phytochromes; receptors of ultraviolet A radiation, blue (BL)

and green (GL) light – cryptochromes, phototropins, proteins of the ZEITLUPE family, as well as a UV-B receptor – protein UVR8 [2, pp. 163–167]. One of the mechanisms of plant growth and development regulation by light is the influence on the synthesis and activity of phytohormones [1, p. 1427]. Phytohormones are low-molecular organic substances synthesized by plants and perform regulatory functions [3, pp. 15–20]. Unlike animals, plants do not have special organs that synthesize phytohormones. At the same time, there is a greater saturation of hormones in some of their organs compared to others. For example, the apical meristems of the stem and root are enriched with auxins (IAA), and abscisins (ABA) usually act at the point of synthesis, spreading only a short distance [4, pp. 115–117]. It is also believed that it is not the influence of a single phytohormone that is important, but the hormonal status of plants, in other words the activity levels of phytohormones and the ratio between them [5, pp. 56–57]. IAA and ABA are antagonistic hormones in the regulation of plant growth and development [6, p. 13–19]. Interaction of photoreceptor and phytohormonal systems ensures control and regulation of plant growth and development processes [4, pp. 107–109]. Hormonal status in connection with the activation of photoreceptor systems of plants is actively studied. The aim of the work was to analyze the effect of selective light on the activity of IAA and ABA in the above-ground and underground parts of pea seedlings.

As a plant material in the work a long-day plant of pea (*Pisum sativum* L.) of the Metsenat variety was used. The seeds were sterilized in a 15% solution of sodium hypochlorite and 70% ethanol, after which 10–15 seeds were germinated in Petri dishes on moistened filter paper at a temperature of 22 °C in the dark in a thermostat for 3 days to stabilize the growth reaction. Then activation of the photoreceptor systems of the studied seedlings was carried out by irradiation with light of a different spectrum. Etiolated seedlings in an isolated box in the dark were irradiated daily for 30 minutes for 5 days using a Korobov LED matrix with red light (RL 660 nm), green (GL530 nm) and blue (BL 450 nm). Control plants were cultivated under the same conditions without activation of photoreceptor systems by selective light. Plant material was fixed on the 10th day of the experiment. Phytohormones were extracted from fixed plant material, followed by purification and chromatographic separation of the mixture of hormones by thin-layer chromatography. The activity of PH was determined by the method of biotests: IAA – by the growth of wheat coleoptiles, ABA – by the inhibition of mustard seed germination.

According to the results of the analysis in the control seedlings, the activity of IAA in the above-ground part is significantly higher than in the underground part (Table 1). Irradiation with selective light leads to a decrease in activity in the above-ground part of seedlings: it is insignificant in the case of RL irradiation and almost twice in the case of BL and GL irradiation, which may be related to the different content of phytochromes and cryptochromes, which participate in photoreception, in the above-ground part of seedlings. The activity of IAA in the root part is affected by selective light in a different way. Irradiation of the GL leads to an increase in the activity of IAA almost twofold, while irradiation of the BL leads to inhibition of the activity. Irradiation of RL does not lead to a significant effect, which may be related to the absence or insufficient concentration of activated phytochromes that perceive RL in the underground part of etiolated seedlings.

Table 1

The influence of selective light on the activity of IAA in the above-ground and underground parts of etiolated seedlings of seeded pea *Pisum sativum* L.

Factors	IAA activity,%	
	Aboveground part	Underground part
Control (w/r)	215±32,31	107,6±26,5
RL (660 nm)	176±15,57	107±23,07
GL (530 nm)	123±20,53*	215±45,8*
BL (450 nm)	85±12,66*	77±16,17

*) note – the difference with the control is significant for $P \leq 0.05$

According to the results of the experiment, a significant difference between the activity of ABA in the above-ground and underground parts is not observed in all variants (Table 2). But the effect of selective light on the activity of ABA in different parts of seedlings is somewhat different. The activity of ABA in the above-ground part has the greatest influence on GL: there is a decrease in ABA activity compared to the control. In the case of irradiation of GL and BL in the root part, stimulation of ABA activity is observed compared to the control.

Table 2

The effect of selective light on the activity of ABA in the aboveground and underground parts of etiolated seedlings of *Pisum sativum* L.

Factors	ABA activity,%	
	Aboveground part	Underground part
Control (w/r)	88,51±3,57	75,53±8,07
RL (660 nm)	90,63±14,02	77,5±17,61
GL (530 nm)	77,63±14,07*	86,11±5,09*
BL (450 nm)	88,1±7,8	92,11±1,31*

*) note – the difference with the control is significant for P≤0.05

In the above-ground and underground parts of the control seedlings, the dominance of IAA over ABA is observed by approximately 2,5 and 1,5, respectively (Table 3), that may be associated with active growth in length, which is one of the signs of etiolation. But irradiation with selective light leads to a change in the phytohormonal balance. In the above-ground part, irradiation with selective light leads to a change in the balance towards ABA. BL and GL have the greatest effect. In turn, in the underground part, the irradiation of RL and BL also leads to a decrease in the IAA/ABA ratio, while GL, on the contrary, changes the phytohormonal balance in the direction of IAA.

Table 3

The effect of selective light on the phytohormonal balance in the above-ground and underground parts of etiolated seedlings of *Pisum sativum* L.

Factors	Phytohormonal balance of IAA/ABA	
	Aboveground part	Underground part
Control (w/r)	2,44	1,43
RL (660 nm)	1,95	1,39
GL (530 nm)	1,69	2,51
BL (450 nm)	0,97	0,83

Thus, the activity of phytohormones is affected by the activation of photoreceptor systems, which is associated with the crossing of their signaling pathways [1, p. 1427]. Above-ground and underground parts

of seedlings differ in their response to selective light, because of which we can assume that the root system contains a slightly different composition of photoreceptors than in the above-ground part of seedlings. GL has the greatest influence on the phytohormonal status of a long-day pea plant both in the above-ground and underground parts, although the direction of its action in the axial organs is opposite.

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