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PHOTOPERIODIC SENSITIVITY AND GENETIC POLYMORPHISM OF *Ppd-1* GENES IN UKRAINIAN WHEAT VARIETIES AND LINES

Solar radiation is one of the main regulator of the various physicochemical and photobiological processes in plants. A huge number of experimental and theoretical works are devoted to the study of wheat photoperiodism − the reaction to the daily rhythm of lighting, expressed in a change in the duration of growth and development of plants.

The successful reproductive cycle of wheat plants largely depends on earing and flowering in favorable conditions. Information about the genetic control of these processes and the molecular interactions in their background is necessary for better understanding of the mechanisms of adaptability of wheat. The reaction to the photoperiod, vernalization (the influence of low temperatures) and ambient temperature are the main exogenous factors that affect the transition to flowering.

The response of wheat to the photoperiod is regulated by the *Ppd-1* system, which includes genes located on the chromosomes of the second homeologues group. Dominant *Ppd-1* genes reduce the photoperiodic sensitivity of wheat plants. *Ppd-D1* is the key gene that determines the photoperiodic reaction of common wheat (*Triticum aestivum* L.). An analysis of the geographical distribution of *Ppd* genes in the world showed that winter wheat varieties that were grown in the more northern latitudes were highly sensitive to the photoperiod, while varieties of southern latitudes reacted poorly on the decrease in daylight hours. Breeders have chosen the *Ppd* genotypes, that were the best adapted for certain environmental conditions, during selection of plants with the most suitable agronomical important traits for the growing region.

The aim of the work was to study genetic polymorphism and photoperiodic sensitivity of modern Ukrainian varieties and lines of bread winter wheat.

The photoperiod sensitivity and genetic polymorphism at *Ppd-1* system were investigated for analogue-lines (BC_7) created in PBGI on two different genetic backgrounds of the well-known Ukrainian varieties “Kooperatorka” and “Stepnyak” and modern winter wheat varieties from The V.M. Remeslo Myronivka Institute of Wheat (MIP; 49°64’ N; 31°08’ E) − Beregynya myronivs’ka (2016), Economka

(2008), Zymoyarka (2007), Kryzhynka (2002), Legenda myronivs'ka (2012), Myronivs'ka zolotovercha (at the varietal testing), Myronivs'ka 65 (2000), Myronivs'ka storichna (2009), Oberig myronivs'ky (2014), Pamyati Remesla (2009), Svitanok myronivs'ky (2014), Juviliyar myronivs'ky (2009). For studies of photoperiodic sensitivity of lines and varieties, experiment was conducted in 2015 and 2019. The sprouted seeds were irrigated for 60 days, planted in vegetable vessels on the open air on April, 16 and grown for natural and artificially reduced (12 hours) photoperiod for 30 plants (2 vegetable vessels) of each grade in each of the experimental variants. The photoperiod was carried out by closing the plants with a box of dark film from 7 to 75 days after discharging. The expiration date of each plant was noted by the label. The data analysis was performed with variation statistics.

By using PCR analysis with molecular markers we have identified the alleles of photoperiod sensitivity genes in the analogue-lines and winter wheat varieties. In the recurrent lines Kooperatorka and Stepnyak 1 we revealed allele *Ppd-D1b*. The allele *Ppd-D1a* was detected in the early analogue-lines Kooperatorka rannya and Stepnyak 1 ranniy. The ratio of dominant and recessive alleles of the *Ppd-D1* gene in MIP varieties was 76% and 34%, respectively. There was no polymorphism at *Ppd-B1* and *Ppd-A1* loci, all lines and varieties were carriers of the recessive alleles *b*.

Lines with the *Ppd-D1b* allele had a strong reaction to shortening of the day light length which manifested in the heading delay for 14.2 days for the Kooperatorka and 11.7 days for Stepnyak 1 on the shortened photoperiod. The presence of the *Ppd-D1a* allele in the genotype significantly decreased the sensitivity to the photoperiod. The difference in the length of the period from germination to heading on a natural and shortened photoperiod in the lines Kooperatorka rannya and Stepnyak 1 ranniy reached 4.6 and 5.8 days, respectively. We also analyzed differences in the length of the period before heading between pairs of lines and between groups of MIP varieties, which differed by the *Ppd-D1* gene alleles, on the natural and shortened photoperiod. The difference in heading time was 2-3 days on a natural photoperiod, on the shorter photoperiod it increased to 8-12.6 days. It should be noted that significant delay in vegetation was observed on the reduced day for plants with recessive alleles: some of the plants remained in the exit into the tube phase, while plants from line Kooperatorka stay on in the tillering phase.