



# Development of oat lines differing in the genes of photoperiod sensitivity

V.A. Koshkin, I.G. Loskutov, I.I. Matvienko, E.V. Blinova

E-mail: [koshkin-va@mail.ru](mailto:koshkin-va@mail.ru)

FEDERAL RESEARCH CENTER N.I. VAVILOV INSTITUTE OF PLANT GENETIC RESOURCES (VIR) Sankt-Petersburg, Russia

Most of the oat crops in Russia are located in the areas with unfavorable climatic conditions. For these regions, with their short growing season, early-ripening varieties are required. Growth and development processes in early forms are more intense than in late ones, so the duration of their growing period is shorter. Early maturation is a dominant trait if compared with lateness. The total duration of the growing season depends on the lengths of individual interphase periods: germination – ear emergence and ear emergence – ripening.

In 2007, a cross between the weakly photoperiod-sensitive Mexican variety Chihuahua (Mexico) and highly sensitive cultivar Anatolischer (Turkey) was carried out. The hybrids obtained were tested for photoperiod sensitivity. Under the conditions of a short 12-hour day, from the F<sub>2</sub> hybrid population (Chihuahua x Anatolischer) the most early-ripening weakly photoperiod-sensitive plants as well as the most late-ripening photoperiod-sensitive ones were selected. Selection was performed in a manner that allows you to simultaneously isolate such forms [6]. We selected two early-maturing weakly sensitive lines (VIR-15547, Skorospelyi 1, VIR-15548, Skorospelyi 2), two lines with medium sensitivity (VIR-15549, Srednespelyi 1, VIR-15550, Srednespelyi 2), and a late-ripening highly sensitive line (VIR-15551, Pozdnespelyi), differing in photoperiod sensitivity genes.



Experiments on photoperiodic reaction of plants were carried out in the vegetation and photoperiod testing pavilions at the Plant Physiology Department of the Pushkin Branch of VIR (2010-2015) as well as in the field (2014-2015).

Plants were grown on soddy podzolic soil in plastic 5-liter pots under the natural long (17 h 30 – 18 h 52 min) and short (12 h) photoperiod conditions. Short day (SD) was attained by rolling trolley platforms with pots into an opaque photoperiod testing pavilion where they were kept from 9 PM until 9 AM. Long-day plants (LD) were rolled for the same period of time into a glasshouse. PPS was measured according to the delay of ear emergence in SD plants as compared with the LD plants ( $T_2 - T_1$ ) and with the help of the PPS coefficient proposed by us (CPPS) which is calculated according to the formula ( $CPPS = T_2 / T_1$ ) where  $T_1$  and  $T_2$  mark the duration of the germination – ear emergence phase of oat plants (days) grown respectively under long natural and short 12-hour days [7].



For five years (2011-2015), weakly sensitive early lines 1 and 2 showed a slight delay under the short-day conditions if compared with the long day and had a low CPPS (1.25 and 1.31), while the medium-ripening sensitive lines 1 and 2 significantly delayed their development under the short day and had a higher CPPS (1.53 and 1.55). The highest CPPS (1.84) was observed in the late line.

All lines of oat under the short 12-hour day, if compared with LD, increased their dry weight, length and number of spikelets on the main panicle, whereas the upper internode was shorter. These indicators are influenced by photoperiod and other environmental factors.

In the early lines weakly sensitive to photoperiod the number of grains, grain weight on the panicle, plant weight and economic coefficient (CECON) increased under SD if compared with LD, while in the medium- and late-ripening ones these parameters significantly decreased. Such symptoms are influenced by the genes of photoperiod sensitivity. In weakly sensitive early lines, this effect is produced by dominant alleles of the PPS genes, while in the highly sensitive late line by recessive alleles of the PPS genes.

Thus, we have developed early-ripening weakly photoperiod-sensitive forms and medium-ripening medium-sensitive ones with dominant alleles of the PPS genes which can be used in oat breeding for earliness without the loss of productivity in new cultivars for different regions of Russia.

№ of catalogue VIR	Accession	Pedigree	Germination – heading, days		$T_2 - T_1$	$C_{PPS}$
			$T_1$	$T_2$		
12230	Chihuahua	Скороспелая	35,5±0,48	44,8±0,65	9,3	1,26
14668	Anatolischer	Позднеспелая	44,3±1,15	89,0±0,50	44,7	2,01
15547	Skorospelyi 1	(Chihuahua x Anatolischer) F <sub>4</sub>	37,3±1,59	46,7±0,80	9,4	1,25
15548	Skorospelyi 2	(Chihuahua x Anatolischer) F <sub>4</sub>	35,8±0,25	46,9±0,59	11,1	1,31
15549	Srednespelyi 1	(Chihuahua x Anatolischer) F <sub>4</sub>	40,4±0,34	61,7±0,37	21,3	1,53
15550	Srednespelyi 2	(Chihuahua x Anatolischer) F <sub>4</sub>	37,4±0,31	57,9±0,74	20,5	1,55
15551	Pozdnespelyi	(Chihuahua x Anatolischer) F <sub>4</sub>	48,3±1,54	89,0±3,00	40,7	1,84