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Genetic regulation of wheat plant development and architecture

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Motivation and Aim: Wheat is one of the most important food crop in the world; the yield of grains from this crop is largely dependent from plant and, especially, inflorescence architecture. The inflorescence of wheat is a spike with the main axis (spike rachis) carrying lateral sessile spikelets that are directly attached to the rachis and a terminal spikelet. The study of the genetic factors that determine the structural features of the spikelet, a reduced branch bearing the reproductive organs (the florets), is important to understand the mechanisms underlying plant developmental processes and has obvious practical importance. In wheat, difference in the number of fertile florets per a spikelet is genetically determined by the level of ploidy and interspecific variability, but the genes that determine this trait are currently little studied. The aim of our research was to identify genes that control the development of the bread wheat inflorescence and regulate meristem identity and determinacy.
Methods and Algorithms: A set of classical and modern approaches of genetics and developmental biology, including novel methods of plant genome analysis, such as high-throughput genotyping (GBS), as well as light and electron microscopy methods and modern bioinformatic approaches have been used to characterize unique experimental models. The models included wheat accessions with abnormalities in spike development.
Results: It was found that several genes located on chromosomes 5AL, 2AL, and 2AS control the formation of fan-shaped «flabellum» spikelet of bread wheat *T. aestivum*. Results of SEM analysis showed that the formation of the "flabellum" spikelet was associated with the peculiarities of spikelet development. The features of interaction of plant developmental genes and regulation of gene expression, especially those related to determining identity and determinacy of inflorescence meristems have been studied.
Conclusion: Wheat forms with altered plant/spike morphology represent an important genetic tool for research on the development of the wheat spike and for identification of genes that control meristem activities. Further studies on different non-standard morphotypes and wheat lines with altered spike morphology will allow researchers to identify new genes that control meristem identity and determinacy, to elucidate the interaction between the genes, and to understand how these genes, acting in concert, regulate the development of the wheat spike.
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