Alexey Doroshkov
THE INSTITUTE OF CYTOLOGY AND GENETICS The Siberian Branch of the Russian Academy of Sciences
e-mail: ad@bionet.nsc.ru
Mikhail Genaev
Tatyana Pshenichnikova
Dmitry Afonnikov

Analysis of leaf hairiness in wheat Triticum Aestivum L. using image processing technique

Leaf hairiness in wheat is of great importance for adaptation to environmental factors including protection from pests. For example, this trait is the characteristic of a number of drought resistant wheat cultivars referred to the steppe ecological group. Study of leaf hairiness morphology and identification of the corresponding genes will allow obtaining the varieties which are resistant to hard climatic conditions and certain pests. To identify the genes responsible for the leaf hairiness, mass analysis of a great number of plants belonging to different hybrid populations is needed, accompanying with a laborious manual job. Furthermore, the more accurate description of the morphological properties of the trait for correct determination of phenotypic classes is timely. We developed the computerbased technology for descriptions of quantitative traits of leaf hairiness. It contains the LHDetect program with the feature of image processing [1,2]. Using the LHDetect one can count the trichome number, the mean length of the trichomes, and evaluate the trichome length distribution vector for each leaf sample. In the investigation, we used the LHDetect program for determining the morphological properties of leaf hairiness on a number of wheat genotypes. The technology appeared to be the effective approach for a large scale analysis of leaf hairiness morphological peculiarities in individual plants. In according with genotyping this approach can be useful for quantitative trait loci (QTL) mapping. In this study we carried out the detailed morphology analysis of leaf hairiness in 8 wheat cultivars: Golubka, Saratovskaya 29, Rodina (almost glabrous leaf), Rodina introgression line 102/00i (genome contains Aegilops speltoides gene, responsible for trichomes, line has well-haired leaf), Houng mang may, Janetzkis probat, Chinese synthetic and Diamant 2. Chosen cultivares represent a wide range of leaf hairiness morphology: the trichome density, length and distribution pattern greatly varied. Golubka cultivar plants was grown in the various conditions. It was shown that drought stressed Golubka plants form more trichomes on the leaf surface, but they are significantly shorter than those from plants grown in a favourable conditions. There are at least two possible explanations of the observations. First, much more trichomes are needed to form the microclimat in the drought conditions. Second, plant cells cant produce enough turgor pressure to form a long trichomes while the drougt stress.

References

[1] Using the computer-based image processing technique in genetic analysis of leaf hairiness in wheat Triticum aestivum L./ A.V.Doroshkov, M.A.Genaev, T.A.Pshenichnikova, D.A.Afonnikov //the 7-th international conference on bioinformatics of genome regulation and structure/ systems biology, june 20-27 2010 Novosibirsk, Russia.

[2] WheatPGE system for analysis of the relationships between phenotype, genotype and environment in wheat/ M.A.Genaev, A.V.Doroshkov, D.A.Afonnikov //the 7-th international conference on bioinformatics of genome regulation and structure/ systems biology, june 20-27 2010 Novosibirsk, Russia.