

MICROSTRUCTURAL VARIABILITY OF THE LEMMA ABAXIAL EPIDERMIS IN THE GROUP *BROMUS SECALINUS*, *B. COMMUTATUS* AND *B. RACEMOSUS*

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Abstract. A group of closely related species from the section *Bromus*: *B. secalinus*, *B. commutatus* and *B. racemosus* were described by characteristics of the abaxial epidermis of lemma. *B. commutatus* appeared as the most extreme unit against other types. *B. secalinus* exhibited an intermediate nature between *commutatus* and *racemosus* morphs. Many interspecific forms of putative hybrid origin were also put in an ordination space as intermediates.

Key words: *Bromus secalinus* group, lemma epidermis, variation, taxonomy

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Introduction

Genesis of the genus *Bromus* L. has been presented in details by STEBBINS (1981). He considered this genus as an intermediate group between the tribes Festuceae Dumort. and Triticeae Dumort. The genus comprises six sections: *Neobromus* (Shear). Hitchc., *Ceratochloa* (P. Beauv.) Griseb., *Pnigma* Dumort., *Genea* Dumort., *Nevskiella* (Krecz. et Vved.) Tournay and *Bromus*. All three species, *B. secalinus* L., *B. commutatus* Schrad. and *B. racemosus* L. are members of the section *Bromus* Sm. (CVELEV 1976; SMITH 1980). At present, *B. secalinus* is a rare weed in cereal fields. *B. commutatus* has smaller distribution in Europe than *B. secalinus*. *B. racemosus* has a broad geographical distribution in Europe. *B. commutatus* and *B. racemosus* are not easily discriminated. Both species were accurately described by AMMANN (1981). Many intermediate forms between both species have also been described. Ammann considered both as subspecies in *B. racemosus*. Plants expressing more cleistogamic behaviour were noted in *B. racemosus* and recognised as hybrids *B. ×litvinovii* Roshev. ex Nevski (CVELEV 1976). Such a change of mating system can fix them at a specific rank. Species from the section *Bromus* express facultative autogamy. For instance, the level of outcrossing in *B. mollis* L. reaches 4%

(GRANT 1981). A seasonal cleistogamy was also described in *B. carinatus* Hook. et Arn. (HARLAN 1945). KOSINA & SZMIDZIŃSKA (2000) found that *B. arvensis* L. from the section *Bromus* is more allogamic than species from the section *Genea* Dumort., while *B. secalinus* and *B. commutatus* are intermediate in mating behaviour. Are these mating differences reflected in plant microstructure? Abaxial epidermis characteristics were successfully applied in taxonomy of many grasses. For instance, lemma quantitative characteristics clustered together *B. secalinus* and *B. racemosus* and separated both from *B. commutatus* (KOSINA & ZAWERBNA 2002).

Material and methods

The following taxa were cultivated on small plots under equal soil and weather conditions in the grass collection of the first author:

1. *Bromus secalinus*, twelve accessions marked as Bs1 to Bs11 and Bs;
2. *B. racemosus*, two accessions Br1, Br2;
3. Intermediate forms *B. racemosus* - *B. commutatus*, four accessions Brc1, Brc2, Brc3, Brc4;
4. *B. commutatus*, one accession Bc
5. Intermediate forms *B. commutatus* - *B. racemosus*, three accessions Bcr1, Bcr2, Bcr3.

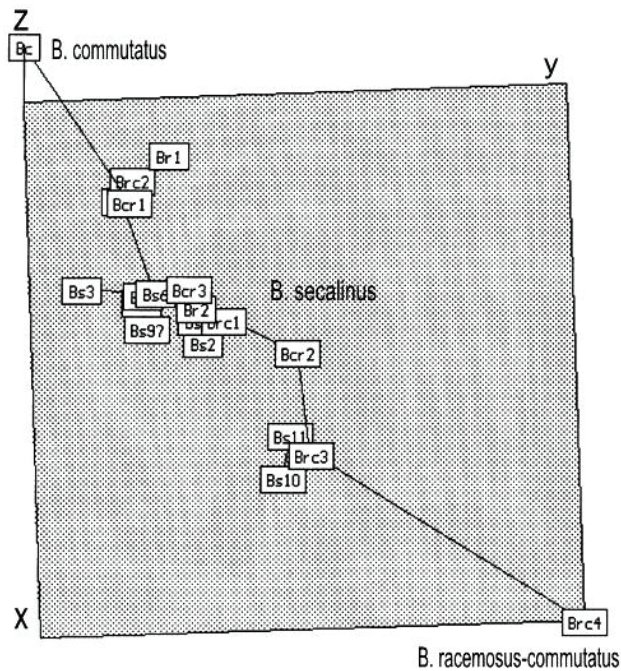


Fig. 1. A minimum spanning tree of the group *Bromus secalinus*, *B. commutatus* and *B. racemosus*. OTUs (species) are scattered in a non-metric multidimensional scaling ordination space (x , y and z axes). OTUs were described by micromorphology of the lemma abaxial epidermis.

The random samples of diaspores ($n = 30$) were treated according to the completely randomised one-way classification. Varnish replicas of the lemma abaxial epidermis were observed under an Amplival microscope. The following types of short cells were counted per a comparable surface of each accession: duplexes (silica and cork cells), papillae, simple short cells and triplexes. Data were elaborated by taxonomic numerical methods including the Kruskal's non-metric multidimensional scaling according to ROHLF (1994). Results are presented in the form of diagram as the minimum spanning tree.

Results and discussion

Characters of lemma epidermis are significantly negatively correlated, as follows (Pearson correlation):

- duplex *versus* papilla, $r = -0.60^{***}$;
- duplex *versus* simple short cell, $r = -0.46^*$.

This means that papillae and simple short

cells are morphogenetically linked *versus* duplexes. The one cytokinesis creating single cell is a different morphogenetic event from that giving duplexes (two cytokineses) and both these kinds of meristemoid activity are interchangeable. The papillae are the main morphogenetic event in the lemma. It was proved that epidermal characteristics of lemma or palea independently discriminate species within the genus *Bromus* (KOSINA 1997). Then, the data of lemma can be applied here for a taxonomic purpose. A matrix of average taxonomic distances was used in the UPGMA clustering method. Numerical results show that maximum epidermal meristemoid events (cytokineses) were detected in *B. commutatus*, while minimum in the accession Brc4. This picture, maximum *versus* minimum, is also well presented in Fig. 1, when the non-metric multidimensional scaling was applied. Many intermediate forms between extreme accessions, including *B. secalinus*, prove that this group of species is biologically complex.

A pattern of scattering of OTUs in the ordination space corroborates results obtained earlier for another set of brome-grasses (KOSINA & ZAWERBNA 2002). Autogamy plus facultative allogamy, natural hybridization creating a pool of recombinants, and natural mutations noted in flower organs (KOSINA, unpubl.), all these influence the variability of the group. ACEDO & LLAMAS (1997) expressed an opinion that an intensive longitudinal growth of epidermal cells decreases frequency of short cells in *Bromus*. In the group of *B. secalinus*, interaccessional differences in frequency of epidermal short cells are of quantitative nature and ranges of variation often overlap (KOCHMAŃSKI 2008). This is also evidenced in gross morphology of spikelet (AMMANN 1981). In the group, many cytogenetic defects such as multipolar anaphases, laggards, bridges and elimination of micronuclei were noted (SKOWROŃSKA 2005). These cytogenetic events also caused disorders in the development of caryopsis. This proves that many studied types are developmentally unbalanced because of hybrid origin.

References

- ACEDO C., LLAMAS F. 1997. Two new brome-grasses (*Bromus*, Poaceae) from the Iberian Peninsula. *Willdenowia* 27: 47–55.
- AMMANN K. 1981. Bestimmungsschwierigkeiten bei europäischen *Bromus*-Arten. *Bot. Jahrb. Syst.* 102: 459–469.
- CVELEV N.N. 1976. *Zlaki SSSR*. Nauka, Leningrad.
- GRANT V. 1981. *Plant speciation*. Columbia University Press, New York.
- HARLAN J.R. 1945. Cleistogamy and chasmogamy in *Bromus carinatus* Hook. & Arn. *Am. J. Bot.* 32: 66–72.
- KOCHMAŃSKI Ł. 2008. Wewnątrzgatunkowa zmienność mikrostrukturalna w grupie *Bromus secalinus* L. MSc Thesis. University of Wrocław, Wrocław.
- KOSINA R. 1997. Zmienność mikrostrukturalna w plemienu Bromeae. *Materiały IV Ogólnopolskiej Konferencji „Genetyka i hodowla traw”*, Poznań: 5.
- KOSINA R., SZMIDZIŃSKA M. 2000. Biologia kwitnienia gatunków sekcji *Genea* i *Bromus* w rodzaju *Bromus*. IV Ogólnopolskie Spotkanie Naukowe „Taksonomia, kariologia i rozmieszczenie traw w Polsce”, Kraków: 14.
- KOSINA R., ZAWERBNA M. 2002. Dyskryminacja mikromorfologiczna sekcji *Genea* i *Bromus* rodzaju *Bromus*. V Ogólnopolskie spotkanie naukowe „Taksonomia, kariologia i rozmieszczenie traw w Polsce”, Kraków: 52.
- ROHLF F.J. 1994. NYSYS-pc v. 1.80. Applied Biostatistics Inc., New York.
- SKOWROŃSKA J. 2005. Mikrostrukturalna i cytogenetyczna analiza grupy *Bromus secalinus* – *B. commutatus* – *B. racemosus*. MSc Thesis. University of Wrocław, Wrocław.
- SMITH P.M. 1980. *Bromus* L. In: *Flora Europaea*. Vol. 5: 182–190. Cambridge University Press, London.
- STEBBINS G.L. 1981. Chromosomes and evolution in the genus *Bromus* (Gramineae). *Bot. Jahrb. Syst.* 102: 359–379.