



GRASS INFLORESCENCE MUTATIONS AND THEIR ROLE IN SPECIATION

ROMUALD KOSINA

Abstract. Several examples of natural mutants in the grass family were presented. All appeared as changes in inflorescence structure. In mutated plants chasmogamy was restricted due to anomalous lodicules or compactness of ears. A rare glumeless mutation in *Agropyron pectiniforme* reduced the level of assimilation in the ear. All mutations appear as unfavorable in natural populations.

Key words: grasses, inflorescence, mutation, populational competitiveness

Plant Speciation Group, Institute of Environmental Biology, University of Wrocław, Przybyszewskiego 63-77, 51-148 Wrocław, Poland; kosina@biol.uni.wroc.pl

Introduction

Somatic and generative mutations as well as teratologies induced environmentally are sometimes noted in gross morphology of grasses. Such instabilities were observed in cytogenetic status of the grass plant (NIELSEN & NATH 1961) or in metamers in a spike (KOSINA 2007). Their importance for developmental studies in plants is beyond any dispute. An excessive growth of a spikelet rachilla noted in *Dactylis glomerata* L., *Phleum boehmeri* Wibel, *Lolium perenne* L. and *Cynosurus cristatus* L. is recognized as a photoperiod reaction (KOSINA 1998). The same reaction was also observed more recently by the author in *Brachypodium distachyon* (L.) P. Beauv. CEYNOWA-GIELDON (1997) discovered an anomaly of a spikelet in *Festuca polesica* Zapał. This morphotype analysed in details by KOSINA (1998) was interpreted as a transformation of a single flower into a spikelet. Additional glumes were developed at the base of each flower. Such somatic mutation can be fixed in populations by apomixis. A mutation multiplying the number of spikelets in the ear in *Brachypodium distachyon* was generated by fast neutrons (DERBYSHIRE & BYRNE 2013). A fascinating spectrum of leaf mutants in *Pisum sativum* L. has been presented by GOTTSCHALK (1979). These mutants were caused by various irradiation and chemicals.

Material and methods

Grass mutants were collected during my field study of plant vegetation in various localities in Poland. Some specimens were obtained from other botanists. Other natural mutants were also gained from my grass collection in which many species from the tribes Triticeae Dumort., Aveneae Dumort., Bromeae Dumort. and Brachypodieae (Hack.) Hayek were maintained. When it was possible, mutants were reproduced in the collection. Interpretation of structures was made with the use of a polarising Amplival and Olympus BX60 epifluorescence microscopes.

Results and discussion

Four examples of grass mutants are presented in Fig. 1. Hooded barley is a well-known mutation (Fig. 1 A). STEBBINS & YAGIL (1966) presented a thorough research on its morphogenesis. The hooded tip of lemma is a very complex structure. Its development differs from a normal type of barley by decreased cell elongation and an increased number of cytokineses. This developmental imbalance forms a strange lemma hood. However, such a structure strongly influences flowering behaviour. Flowers in each spikelet cannot be open and the flowers are obligatory cleistogamic. Many species of *Hordeum* L.,

wild and cultivated, are autogamous. However, some level of outcrossing is also documented, in *Hordeum jubatum* L. – 1%, in *H. vulgare* L. – up to 4% (GRANT 1981). The hooded structure isolates the gene pool of this barley. Another type of “cleistogamic” mutation was discovered in *Triticum compactum* Host. Its lodicules are cushionless and also cannot open flowers of this wheat (KOSINA & TOMASZEWSKA 2012). The hood and lodicules determine the specific status of both cereals. Such plants can be active only in a narrow ecological niche, e.g. in cultivated fields.

Fig. 1 B presents the upper part of the spiro-distichous spike of *Lophopyrum elongatum* (Host) Á. Löve. This species is highly allogamic, anthers are exerted and produce many pollen grains. In the lower part of the spike two spikelets instead of one are developed in each segment of the rachis. In the upper part, the spike is very spiral and glumes, glumellae and lodicules are often fused. Morphology of lodicules is very disturbed and highly variable (KOSINA *et al.* 2012). The upper part of the spike does not produce any seeds. A progeny of such a plant, because of its low frequency, will be weaker in the populational competition.

A form of *Lolium perenne* with compact ears is presented in Fig. 1 C. *L. perenne* is also an allogamic species having very active lodicules and distinctly exerted anthers. Its ears are loose and flowers are chasmogamic without any restrictions. A similar mutation is known in wheat. In *Triticum compactum*, chasmogamy is limited by a compact arrangement of flowers in a spikelet and spikelets in a spike. In the population such a plant will be subjected to a selection similar to that of hooded barley and spiro-distichous *Lophopyrum* Á. Löve. The last example presents an extremely rare mutation.

The plant recognised as *Agropyron pectiniforme* Roem. et Schult. has a more compact ear than in regular specimens of the species. Mutation is manifested in the form of lack of glumes. All organs of the ear, rachis, glumes

and glumellae, are important as assimilation structures. Their activity in a green state supports the developing caryopses in starch and proteins. Such a reduced assimilatory potential of the ear diminishes the competitive ability of progeny of the plant in natural populations. Such a mutation is reverse to that found in *Festuca polesica* (Ceynowa-Gieldon 1997).

All the presented mutations would be rather deleterious in natural populations. Such plants, such as hooded barley, can be maintained only in cultivated populations, or can occupy narrow niches in nature.

References

- CEYNOWA-GIELDON M. 1997. Interesting lemmas in *Festuca polesica* fo. *anomala* (Poaceae). *Fragm. Flor. Geobot.* **42**: 233–237.
- DERBYSHIRE P., BYRNE M.E. 2013. MORE SPIKELETS1 is required for spikelet fate in the inflorescence of *Brachypodium*. *Plant Physiol.* **161**: 1291–1302.
- GOITSCHALK W. 1979. Aspects of mutation genetics. *Egypt. J. Genet. Cytol. Suppl.* **8**: 1–87.
- GRANT V. 1981. Plant speciation. Columbia University Press, New York.
- KOSINA R. 1998. O zmienności anomalnej traw. III Ogólnopolskie Spotkanie „Taksonomia, karyologia i rozmieszczenie traw w Polsce”, Kraków: 8.
- KOSINA R. 2007. Some topics on the grass mosaics. In: FREY L. (ed.), Biological issues in grasses: 159–167. W. Szafer Institute of Botany, Polish Academy of Sciences, Kraków.
- KOSINA R., M. FLOREK M., TOMASZEWSKA P. 2012. Lodicule variability in a spiro-distichous spike of *Lophopyrum elongatum*. *Ann. Wheat Newslet.* **58**: 201.
- KOSINA R., TOMASZEWSKA P. 2012. On breeding system in wheat and *Brachypodium distachyon*. *Ann. Wheat Newslet.* **58**: 194–195.
- NIELSEN E.L., NATH J. 1961. Somatic instability in derivatives from *Agroelymus turneri* resembling *Agropyron repens*. *Am. J. Bot.* **48**: 345–349.
- STEBBINS G.L., YAGIL E. 1966. The morphogenetic effects of the hooded gene in barley. I. The course of development in hooded and awned genotypes. *Genetics* **54**: 727–741.

Fig. 1. Examples of grass mutants: **A** – a hooded barley; **B** – a spiro-distichous form of *Lophopyrum elongatum*; **C** – *Lolium perenne* with compact ears; **D** – a glumeless and compact form of *Agropyron pectiniforme*.

