Bristle Oat (*Avena strigosa* Schreb.) – a weed or an useful plant?

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Summary

The *Avena* genus covers nine species in Poland, including farmed common oat (*Avena sativa*), wild oat (*A. fatua*) – a dangerous spring cereal weed, and bristle (or black) oat (*A. strigosa* Schreb.), a forgotten species. Bristle oat was a valuable component of common oat yield growing on the weakest soils, and it had a status of a crop plant in Poland and in many European countries till 1950s. Chemical analyses of bristle oat caryopses validated the high nutritive value of this species, which had been previously noted by the farmers of the Podhale region. On average, bristle oat contains 27–52% more protein, 14–27% more fat and 38–72% more sugars than common oat. It is good for human consumption in the form of flakes, flour and boiled grains. Bristle oat is witnessing a revival as a valuable farming species, and its crops are subsidized.

Key words: *Avena strigosa Schreb., cultivation of bristle oat, composition of bristle oat caryopses*

INTRODUCTION

The taxonomy of the *Avena* genus undergoes constant change, with 3 to 34 species listed by various authors [1-5]. Nine species have been reported in Poland [6, 7]. The bristle oat discussed in this study (*Avena strigosa* Schreb.), also known as lopsided oat, sand oat, black oat or small oat, originates from West and Northwest Europe with its center of diversity in the Iberian Peninsula [8-10]. Bristle oat was probably farmed already in the Bronze Age. Its caryopses, found at European archeological sites, are older than wild oat and common oat caryopses [11]. Bris-

tle oat was still farmed in many European countries in the 20th century, as a cereal and fodder crop. It was also a valuable component of the common oat yield in the least fertile fields. As many as 14 local oat varieties were grown in Portugal [12]. Today bristle oat grows mostly as a weed infesting spring cereals.

CHARACTERISTICS OF BRISTLE OAT

Avena strigosa is a diploid species (2n=14) reaching a height of 60 cm to more than 150 cm. Its narrow leaf blades (4–8 mm) with dentates margin are long, reaching from 8 cm to 25 cm. The panicle is often one-sided and flagging. Spikelets are two-flowered, with a length of approximately 25 mm. The spikelet axis is not bristle, and caryopses are not shed to the ground as in wild oat. An important characteristic feature of this species is the apex of the lemma which is split and elongated to form two thin awns with a length of about 5–9 mm. The lemma surface is bare with a twisted brown awn growing in the middle. The palea is bent inwards with two veins. Caryopses are not connate with the glumelles. The thousand seed weight is 13–26 g (common oat: 16–47 g) [13, 14]. Bristle oat is a weed infesting spring grain crops. It is most frequently found in common oat stands, in particular in the weakest soil complexes. Until recently, it was very rarely encountered in Poland, and was regarded as a species threatened with extinction [15-17]. Until 1992, the presence of bristle oat as an infesting weed was determined only at 12 localities. As of 1994, the species began to spread in north-eastern Poland. In 1994–1997, Korniak [18] reported the occurrence of *A. strigosa* in 425 villages on 560 crop fields. *A. strigosa* is a speirochoric species which spreads through seed material infested with its caryopses. In experimental treatments, bristle oat was marked by higher productivity than common oat in the weakest soil complexes. Without strain renovation, the percentage share of bristle oat caryopses increases in successive years, thus contributing to higher infestation rates.

PRODUCTION AND UTILIZATION OF BRISTLE OAT

Bristle oat was cultivated in the past. From the end of the 17th century, the majority of oat crops in Ireland and Great Britain most likely belonged to the *A. strigosa* species [12]. Welsh and Scottish farmers grew many local cultivars which probably became extinct [19]. Bristle oat cultivars were also farmed in Germany and Switzerland. Archeological findings have shown that a bristle oat and common oat hybrid was popular in the 13th century in the present territory of Germany [20]. Bristle oat was cultivated on weak soils in Scotland, Portugal, Spain and in northern and western parts of Europe in the mid 20th century [21-23]. In the 1930s, two *A. strigosa* varieties characterized by high resistance to smut, in particular loose smut of oats (*Ustilago avenae*) [24], were found in Great Britain [12].

A. strigosa was also hybridized with *A. brevis* for higher resistance against this pathogen. Bristle oat is used in resistance breeding of common oat as a donor of genes conditioning resistance to black stem rust (*Puccinia graminis* f. sp. *avenae*) [25] and crown rust (*Puccinia coronata* f. sp. *avena*) [26]. In many countries, *A. strigosa* is the main hybridization partner in resistance breeding [27]. A vast number of bristle oat studies are carried out in Brazil where cattle are grazed on extensively used pastures in large farms. In feed production studies, bristle oat is often used as a component of green forage and silage mixtures. Bristle oat is known for its tolerance to low temperatures, drought and various soil types as well as high disease resistance. It can be sown with other grass species and clover. It is recommended for phytomelioration and soil protection against erosion. Bristle oat is widely recognized for its high nutritive value and ease of digestion [28, 29].

Bristle oat was also a crop in the Polish regions of Podhale and Pomorze [30]. Miczyński [31] observed that the species was a crop admixture in the production of common oat. Bristle oat had up to a 70% share of the mixture on the weakest soils. Bristle oat grain was regarded as a valuable feed for poultry and horses in the regions of Orawa and Podhale.

An analysis of the chemical composition of bristle oat caryopses confirmed the high nutritive value of this species. On average, bristle oat contains 27–52% more protein, 14–27% more fat and 38–72% more sugars than common oat [32]. According to data found on the following websites: *The Global Facilitation Unit for Underutilized Species* and *Plants For A Future. Edible, medicinal and useful plants for a healthier world*, bristle oat grain is fit for consumption when boiled, and it may be used for cooking purposes. Bristle oat flour may be used for baking. Fresh leaves can be served in salads. Roasted seeds may be used in the production of a coffee substitute. Similarly to other grain species, the straw of bristle oat has many applications, including the construction of thatched roofs or mulching strawberry patches [40, 41].

Bristle oat grain has similar applications as common oat grain. Oats have a distinctive chemical composition and a high nutritional quality. On average, the protein content of oats is 10–25% higher than in other grains. Oat protein has a high biological value and is a richer source of exogenous amino acids. According to Gąsiorowski [33], oat proteins have the highest biological value, followed by the proteins of rye and maize, while wheat proteins are least nutritionally valuable. This author also demonstrated that the compounds found in oats effectively lower cholesterol levels in the human blood serum. Oat caryopses contain lipids with a valuable chemical composition. Oat fat is a rich source of unsaturated fatty acids with high levels of oleic acid and palmitic acid and low concentrations of linolenic acid [34, 35].

Common oat caryopses contain approximately 15% proteins, 7% fats and 2% crude fiber. Oat proteins are marked by high levels of amino acids and do not contain gluten. Owing to their desirable chemical composition, fatty acids are digested by cattle in 90%. Unsaturated fatty acids are necessary for the proper development

of young organisms and their sustained health throughout life [23, 36]. Oat grain is characterized by a high content of silicic acid, calcium, magnesium, sodium, copper, vitamin E and lecithin. Next to millet, oats are one of the richest sources of minerals among cereals. An oat-enriched diet enhances carbohydrate tolerance which is an important consideration for patients suffering from insulin-independent diabetes [33]. A study investigating the effect of oat glume extract on the treatment of atherosclerosis pointed to its preventive and therapeutic value [37]. Straw and glumes are used in animal feeding. Oat straw is one of the most valuable straw feeds because it contains low quantities of indigestible fiber in comparison with the straw of other cereals. The nutritive value of oat glumes is higher than that of straw, and therefore glumes are used as supplemental feed [38].

RECAPITULATION AND CONCLUSIONS

Formely grown in Poland and many European countries, today bristle oat is a weed infesting cereals, mostly common oat crops on weak soils. In an unfavorable environment for the growth of *A. sativa*, bristle oat may supplement the common oat yield with wholesome grain. *A. strigosa* is best cultivated in combination with other cereal species. Its grain has a higher protein, fat and carbohydrate content than the grain of *A. sativa*. Bristle oat is fit for human consumption in the form of flakes, flour and boiled grains. It may be also used as a component of green forage and silage. Its delicate hay has many applications. The species may be grown without fertilizers as organic food intended for children and allergy sufferers. It may be grown successfully on the weakest soils without occupying areas reserved for more demanding species. Bristle oat may be used for phytosanitary purposes. It is a valuable donor of genes responsible for resistance to common oat diseases. The medicinal properties of bristle oat remains to be investigated. They are probably effects similar to therapeutic ones delivered by *A. sativa* forage and straw which are used in the treatment of kidney diseases, rheumatoid diseases and general fatigue [39]. Bristle oat is witnessing a revival as a valuable cultivates species. Its crops are subsidized as part of variant 6.1 of the agri-environmental package together with emmer wheat, camelina and other alternative species.

REFERENCES

1. Baum BR. Oat: wild and cultivated. A monograph of the genus *Avena* L. (*Poaceae*). – In: Biosistematics Research Institute Monograph. Departament of Agriculture, Ottawa 1977; 14:1-463.
2. Coffman F. Oat history, identyfication and classification. Tech. Bull. 1516, Agric. Res. Services US Dep. Agriculture, Washington DC 1977.
3. Ladizinsky G. Biological species and wild genetic resources in *Avena*. – msc., Hebrew University, Faculty of Agriculture, Rehovot 1990.
4. Jauzein P. Flore des champs cultives. Collection Techniques et Pratiques 1995.

5. Paczos-Grzęda E. Systematyka, ewolucja i cytogenetyka gatunków z rodzaju Avena L. Wiad Bot 2003; 47(1-2):7-17.
6. Mirek Z, Piękoś-Mirkowa H, Zając A, Zając M. Flowering plants and pteridophytes of Poland – a checklist. In: Z. Mirek (ed.), Biodiversity of Poland. Kraków 2002.
7. Rutkowski L. Lowland grasses in Poland. In: L. Frey (ed.), Problem of grass biology. Kraków 2003:83-94.
8. Malzev A. J. Wild and cultivated oats. Sectio Euavena Grseb. Bull Appl Bot Gen Plant – Breed Suppl 1930; 38:1-522.
9. Kropáč Z. *Avena strigosa* – a disappearing synanthropic species in Czechoslovakia. Preslia (Praha), 1981; 53:305-21.
10. Frey L. Distribution of *Avena strigosa* (*Poaceae*) in Europa. Fragm. Flor et Geobot 1991; 36(2):281-8.
11. Nowiński M.. Dzieje upraw i roślin uprawnych. Warszawa 1970.
12. Podyma W. Występowanie gatunku *Avena strigosa* Schreb. sensu lato oraz zmienność cech morfologicznych i biochemicznych w populacjach tego gatunku. Radzików 1994.
13. Rocha AML, Avena L. In: Tutin TG, Heywood VH, Burges NA, Moore DM, Valentine DH, Walters SM, Webb DA. (eds.). Flora Europaea, 5. *Alismataceae* to *Orchidaceae* (*Monocotyledones*). Cambridge University Press 1980:206-8.
14. Korniak T, Kuszewska K, Błocki K. Niektóre taksonomiczne cechy owsa szorstkiego (*Avena strigosa* Schreb.). Acta Univ Lodz, Folia Bot 1998; 13:51-6.
15. Kornaś J. Zmiany roślinności segetalnej w Gorcach w ostatnich 35 latach. Zesz Nauk Uniw Jagiell 834, Prac. Bot. 1987; 15:7-26.
16. Frey L. Rozmieszczenie *Avena strigosa* Schreb. w Polsce. Fragm Flor et Geobot 1989; 34(1-2):43-51.
17. Warcholińska AU. List of threatened segetal plant species in Poland. In: Mochnacký S, Terpo A. (eds.). Antropization and environment of rural setlements. Flora and vegetation. Proceedings of International Conference, Sátoraljaú, hely, Botanical Garden, P. J. Safdrik University, Košice 22-26 August 1994:206-19.
18. Korniak T. *Avena strigosa* (*Poaceae*) in north – eastern Poland. Fragmenta Floristica et Geobotanica 1997; 42(2):201-6.
19. Chater A. O. *Avena strigosa*, bristle oat, and other cereals as crops and casuals in Cardiganshire. Welsh Bulletin Botanical Society of the British Isles 1993; 55:7-14.
20. Wiethold J, Meyer J. Getreidevorräte und Verarbeitungsabfälle aus einer Brandruine des 13. Jahrhunderts auf dem Grundstück Kuhstraße 23 in Greifswald. Bodendenkmalpflege in Mecklenburg-Vorpommern, Jahrbuch 2002; 50:77-118.
21. Ruebenbauer T., Brej S. Hodowla roślin zbożowych. 1957, PWRiL, Warszawa.
22. Hubbard Ch.E. Grasses, a guide to their structure, identification, uses, and distribution in the British Isles. Harmondsworth, Middlesex 1984, England.
23. Tarkowski Cz. Systematyka owsa. W: Mazurek J. (red.) Biologia i agrotechnika owsa. Inst. Upr. Nawoż. i Gleboznaw., Puławy 1993:11-16.
24. Fernandez MR, Santos HP. Contribution of *Avena* spp. used in crop rotation systems under conservation tillage, to the inoculum levels of some cereals pathogens. Canadian Journal of Plant Pathology 1992; 14(4):271-7.
25. Steinberg JG, Fetch JM, Fetch TG. Evaluation of *Avena* spp. accesions for resistance to oat stem rust. Plant disease 2005: 89(5):521-5.
26. Rayapati PJ, Portyanko VA, Lee M. Placement of loci avenins and resistance to *Puccinia coronata* to a common linkage group in Avena strigosa. Ottawa, Ontario, National Research Council of Canada, 1994; 37(6):900-3.
27. Gregory JW, Wise RP. Linkage of genes conferring specific resistance to oat crown rust in diploid Avena. Ottawa, Ontario, Canada: National Research Council Canada 1994; 37(1):92-6.
28. Boller W, Gamero CA, Pereira JO. Evaluation of different tillage systems and soil cover conditions. Engenharia-Agricola, 1997: 17(2):52-63.
29. Basso CJ, Reinert DJ. Variation in aggregation induced by winter cover crops and corn no-tillage in a Hapludalf. Ciencie – Rural 1998; 28(4):567-71.
30. Kluk K. Roślin potrzebnych, pożytecznych, wygodnych, osobliwie kraiowych, albo które w kraiu użyteczne być mogą, utrzymanie, rozmnożenie i zażycie. T.3. Z figurami. O rolnictwie, zbożach, łąkach, chmielnikach, winnicach, y Roślinach gospodarskich. Drukarnia Jego Królewskiej Mci i Rzeczypospolitey u XX. Schol. Piar. Warszawa 1779.

31. Miczyński K. Owies szorstki (*Avena strigosa* Schreb.) – zanikająca roślina uprawna w powiecie nowotarskim. Acta Soc Bot Pol 1949-1950; 20(1):155-6.
32. Korniak T, Kuszewska K. Owies szorstki (*Avena strigosa* Schreb.) – zapomniana roślina uprawna. Zesz Probl Post Nauk Rol 1999; 468:95-103.
33. Gąsiorowski H. (red.). Owies – chemia i technologia. Poznań 1995.
34. Dolnicki A. Cechy form owsa z kolekcji roboczej w warunkach górskich i podgórskich. Biul. Inst. Hod. i Aklimat Rośl 1992; 181-182: 181-8.
35. Bartnikowska E, Lange E, Rakowska M. (2). Ziarno owsa-niedoceniane źródło składników odżywczych i biologicznie czynnych. Część II. Polisacharydy i włókno pokarmowe, składniki mineralne, witaminy. Biul Inst Hod i Aklimat Rośl 2000; 215:223-37.
36. Bartnikowska E, Lange E, Rakowska M. (1). Ziarno owsa - niedoceniane źródło składników odżywczych i biologicznie czynnych. Część I. Ogólna charakterystyka owsa. Białka, tłuszcze. Biul Inst Hod i Aklimat Rośl 2000; 215:209-22.
37. Juźwiak S, Wójcicki J, Tustanowski S, Gonet B, Kałdońska M, Górnik W, Juzyszyn Z, Ceglecka M, Myśliwiec Z, Gorecki P, Mścisz A, Segiet-Kujawa E. Wpływ wyciągu z plew owsa zwyczajnego (*Avena sativa* L.) na przebieg miażdżycy doświadczalnej. Herba Pol 1994; 40(1-2):50-8.
38. Mazurek J. Znaczenie gospodarcze i użytkowanie owsa. W: Mazurek J. (red.) Biologia i agrotechnika owsa. Inst. Uprawy Nawoż. i Gleboznaw., Puławy 1993:7-10.
39. Ożarowski A, Jaroniewski W. Rośliny lecznicze i ich praktyczne zastosowanie. Warszawa. Inst. Wyd. Zw. Zawodowych, 1987:284-6.
40. www.underutilized-species.org
41. www.pfaf.org

OWIES SZORSTKI (*AVENA STRIGOSA* SCHREB.) – CHWAST CZY ROŚLINA UŻYTKOWA?

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Streszczenie

W Polsce występuje 9 gatunków owsa (*Avena*). Wśród nich znajduje się uprawiany owies siewny (*Avena sativa*), groźny chwast zbóż jarych – owies głuchy (*A. fatua*), a także zapomniany w naszym kraju owies szorstki (*A. strigosa*). Gatunek ten był cennym dodatkiem do plonów owsa siewnego na najsłabszych glebach i do połowy XX wieku traktowany w Polsce i w wielu krajach Europy jako roślina uprawna. *Avena strigosa* jest gatunkiem diploidalnym o niełamliwej osi kłoska. Ziarniaki nie są zrośnięte z plewkami, nie osypują się na polu. Owies szorstki występował rzadko jako chwast upraw zbożowych. W ostatnich kilkunastu latach zanotowano jego rozprzestrzenianie się i częstsze pojawienia.

Badania składu chemicznego jego ziarniaków potwierdziły podawane już dawno przez gospodarzy z Podhala pozytywne cechy tej rośliny i jego wysokie wartości pokarmowe. Zawartość białka jest średnio o 27–52% wyższa niż w owsie siewnym, tłuszczu o 14–27%, cukrów o 38–72%. Ziarno nadaje się do spożywania w formie płatków i mąki. Jest rośliną fitosanitarną i udaje się na najsłabszych glebach. Jest cennym dawcą genów odporności na choroby owsa siewnego. Owies szorstki wraca do hodowli jako wartościowy gatunek, a jego uprawa dotowana jest w ramach wariantu 6.1 pakietu rolno-środowiskowego wraz z pszenicą płaskurką, lnicznikiem siewnym i innymi alternatywnymi gatunkami.

Słowa kluczowe: *Avena strigosa Schreb., uprawa owsa szorstkiego, skład ziarniaków owsa szorstkiego*