THE VARIABILITY OF NATURAL POPULATIONS OF BRACHYPODIUM PINNATUM AND B. SYLVATICUM BASED ON MORPHOLOGICAL FEATURES

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ABSTRACT

The morphological diversity in 25 populations of two native species of Brachypodium occurring in Poland, was studied. Principal component analysis and cluster analysis of morphometric data segregate specimens or populations of Brachypodium into two groups, corresponding to the two species. In most of morphological characters, B. pinnatum and B. sylvaticum are similar to each other. However, in terms of characteristics, such as the hairiness of culms and leaf-sheaths both can also vary much within a single population. In comparison with B. pinnatum, B. sylvaticum always has pubescent abaxial pala surfaces. Apparent differences were not detected between the two ecotypes of B. pinnatum named “Grassland” and “Woodland”.

KEY WORDS: Brachypodium pinnatum, B. sylvaticum, morphological variability, Poaceae, Poland.

INTRODUCTION

Brachypodium Beauv., one of the oldest genera of the family Poaceae, commonly known as False-brome with regard to its brome-like appearance, includes grasses with a simple spike-like racemose inflorescence and spikelets that are not strongly flattened and often have awned lemmas. The common name of False-brome indicates that Brachypodium species are often misidentified or mistaken for a brome (Bromus). According to Schippmann (1991), there are currently nine species and subspecies in the genus Brachypodium, which occur in temperate areas of Europe. The two commonest species, the only ones that occur in Poland (Mirek et al. 2002), are Chalk False brome Brachypodium pinnatum (L.) P. Beauv. and Slender False-brome B. sylvaticum (Huds.) P. Beauv. The Eurosiberian B. pinnatum, a long-lived extensively rhizomatous perennial grass, is a characteristic species of the Festuco-Brometalia class. It is a frequent, locally abundant and dominant grass species of semi-natural chalk xerothermic grassland communities of the lowlands and submontane regions in Poland, although it is also a frequent member of chalk scrub, wood margins and open woodlands. The woodland B. sylvaticum, a perennial bunchgrass, is indigenous to Europe, temperate Asia and northwest Africa. It is a characteristic species of the Querco-Fageta class and is most commonly found in Poland in lowland, submontane and lower montane woods, copses, along hedgerows, and in other shady places, but may grow in grassland and along roadsides in originally woodland areas (Hultén and Fries 1986; Zając and Zając 2001; Matuszkiewicz 2002; Mirek and Pękoś-Mirkowa 2002). Both can occur in close proximity, for instance in thermophilous oak forests.

B. pinnatum and B. sylvaticum overlap with one another in most of their morphological characters (Smith 1980). Therefore, Saint-Yves (1934) earlier recognised only one species – B. pinnatum (L.) Beauv. including B. sylvaticum Hudson (Beauv.) as a variety, var. sylvaticum St-Y. According to Hubbard (1968), B. pinnatum is distinguished from B. sylvaticum by its form of growth, presence of rhizomes, usually hairless culms and leaf-sheath, stiffer racemes and especially by the shorter-awned lemmas. According to Johnson (2004) the most distinctive feature in identifying B. sylvaticum in the USA is the single row of ciliate-pilose hairs fringing the leaf blade and similar hairs covering the leaf-sheath and accentuated at the collar.

B. pinnatum and B. sylvaticum are species complexes that have different variants or cytotypes in Europe. These variants have very similar morphological characters, the same chromosome base numbers (x=7 and 9), and similar seed-protein electrophoretic band pattern (Smith 1980; Khan 1984; Schippman 1991). B. pinnatum (L.) P. Beauv. occurs in Europe as two forms, which are recognised as species (B. pinnatum (L.) P. Beauv., B. raupstre (Host) Römer and Schultes; Smith 1980, Schippman 1991, Khan 1992, Shi et al. 1993, Catalán and Olmstead 2000), subspecies of B. pinnatum (subsp. pinnatum, and subsp. raupstre (Host) Schübner and Martens, Smith 1980), or varieties of
B. pinnatum (var. pinnatum M.A. Khan and var. rupestre (Host) Reichenb.; Khan 1992). B. sylvaticum (Huds.) P. Beauv. occurs in Europe as two morphologically similar, but cytologically distinct forms. These forms are recognised as species (B. sylvaticum (Huds.) P. Beauv., B. glaucovirens (Murbeck; Shi et al. 1993), subspecies of B. sylvaticum (subsp. sylvaticum and subsp. glaucovirens Murb.; Smith 1980, Khan 1992, Murbeck 1891) or one of them even as another variety of B. pinnatum (var. glaucovirens (Murbeck) St.-Yves; Saint-Yves 1934). Schippman (1991) recognised within B. sylvaticum two subspecies (subsp. sylvaticum and subsp. creticum Scholz & Greuter). B. glaucovirens is located in the Mediterranean area, whilst B. rupestre is found in West, Central and South Europe. B. sylvaticum subsp. creticum is recorded only on Crete at high altitude (Schippman 1991).

Based on RAPD data (Catalán et al. 1995), B. pinnatum and B. sylvaticum are the most recently evolved species in the RAPD tree. The latest studies disagree on the placement of B. sylvaticum. This species is placed in a sub basal position of the clade of rhizomatous perennial in the ndhF tree (Catalán et al. 1997). Evolutionary reconstruction based on the sequences of the chloroplast and nuclear genomes is congruent with topologies obtained from the analysis of RAPD data (Catalán and Olmstead 2000).

The B. pinnatum is largely self incompatible, whereas B. sylvaticum is highly self compatible (Khan and Stace 1999). B. pinnatum is an example of clonal grass which regenerates by both sexual reproduction and vegetative propagation. Despite the low proportion of sexual recruitment, clonal diversity within the population of B. pinnatum was higher than reported for other clonal plant populations (Schläpfer and Fischer 1998). In the USA, where B. sylvaticum is an invasive plant, genetic analyses indicate that both guerilla dispersal (on vehicles, boots, clothes, and forestry equipment), and simple diffusion are taking place (Dobberstein and Cruzan 2004/2005).

Some workers have mentioned the occurrence of hybridisation in the genus Brachypodium. All knowledge accumulated so far is based on morphological studies of wild plants and artificial hybrids. Camus (1958) reported natural hybrids between B. pinnatum and B. sylvaticum on the basis of morphological characters. Stace (1975) stated that putative hybrids of B. pinnatum x B. sylvaticum had been recorded from Denmark, Czechoslovakia, France and Ireland. The result of Khan and Stace’s (1999) studies of Brachypodium show that, despite their apparent ancient and relict status, the European species have mostly retained the ability to interbreed and produce viable F1 hybrids. Success in raising hybrids, and the degree of fertility of such hybrids, partly agrees with the closeness of taxonomic relationships as measured by morphological, anatomical, biochemical and molecular characteristics (Mühlberg 1970; Schippmann 1991; Khan 1992; Shi et al. 1993; Catalán et al. 1995; Khan and Stace 1999; Catalán and Olmstead 2000).

To date, there have been no detailed studies in Poland on any variability of B. pinnatum and B. sylvaticum. The main aim of this study, which is introductory to further investigations, was to determine the true extent of the morphological variability of B. pinnatum and B. sylvaticum in Poland.

![Map of Poland with geographic locations of the sampled populations of Brachypodium pinnatum (black dots) and B. sylvaticum (black triangles).](https://example.com/map.png)

**Fig. 1.** Map of Poland with geographic locations of the sampled populations of Brachypodium pinnatum (black dots) and B. sylvaticum (black triangles).

**MATERIAL AND METHODS**

Plant material included 13 population samples of B. pinnatum (320 individuals) and 12 population samples of B. sylvaticum (275 individuals) collected in Poland from different habitats (Fig. 1, Appendix 1). The plants of B. pinnatum growing under the tree canopy and in the unshaded grassland were named “Woodland” and “Grassland”, respectively. Two population samples of B. pinnatum (P-12, P-13) differing as regards the hairiness, and one population sample of B. sylvaticum (S-20) from the Świetlista Dąbrowa reserve were collected. Due to the rhizomatous habit of B. pinnatum, plants were collected a few metres apart to avoid sampling from the same vegetative clone. Each accession consists of between 11 and 25 plants (usually 25) (Appendix 1). The material was deposited in the herbarium of the Institute of Botany in Kraków (KRAM).

Twenty-eight characters (13 quantitative and 15 qualitative (Tables 1 and 2)) were counted or measured with a ruler or Nikon stereoscopic zoom microscope. The assessment of palea glabrousness or pubescence is without regard to stiff-cilia on keels and at the apex. A palea that is glabrous except for cilia on the keel and at the apex is called glabrous. Small differences could be observed in the intensity of pubescence among the accessions, but they are very hard to score. Uninformative and consistent characters, such as the length of the culm, the hairiness of the uppermost, middle and lowest node of the stem and the length of culms, as well as racemes and some other features, were excluded from the analysis.

For the phenetic analysis, univariate and multivariate methods were used. In the univariate methods, descriptive statistics of quantitative characters were calculated for each taxon, based on the entire data set. Box-and-whisker plots were used to display this data. Differences among means of characters were tested using a one-way ANOVA.

Multivariate methods of analysis were carried out using version 5.1 of the STATISTICA PL programme (StatSoft 1997). Principle component analysis (PCA), and cluster analysis (CA) were performed (Sokal and Rohlf 1981).
TABLE 1. The range for the 13 quantitative characters and the results of ANOVA. Differences between species were considered significant at the level of p<0.05.

<table>
<thead>
<tr>
<th>Character</th>
<th>$F$ (p&lt;0.05)</th>
<th>B. pinnatum range</th>
<th>B. sylvaticum (for S-20) range</th>
</tr>
</thead>
<tbody>
<tr>
<td>*ratio: length of lemma awn/length of lemma</td>
<td>8171.17</td>
<td>0.22-0.63</td>
<td>0.72-1.45</td>
</tr>
<tr>
<td>*length of lemma awn [mm]</td>
<td>7280.67</td>
<td>2.0-5.9</td>
<td>6.7-14.0 (11.0-16.0)</td>
</tr>
<tr>
<td>**length of lemma awn [mm]</td>
<td>7242.50</td>
<td>0.0-2.6</td>
<td>4.0-10.0 (2.6)</td>
</tr>
<tr>
<td>*number of nerves on lower glume</td>
<td>764.06</td>
<td>3.7</td>
<td>4-8</td>
</tr>
<tr>
<td>*length of lower glume [mm]</td>
<td>591.02</td>
<td>3.3-8.0</td>
<td>5.5-9.8</td>
</tr>
<tr>
<td>length of pedicel of fourth spikelet [mm]</td>
<td>568.00</td>
<td>0.9-4.2</td>
<td>0.5-1.5</td>
</tr>
<tr>
<td>*length of upper glume [mm]</td>
<td>388.04</td>
<td>5.0-9.8</td>
<td>6.5-11.3</td>
</tr>
<tr>
<td>width of penultimate leaf [mm]</td>
<td>264.99</td>
<td>2.3-10.0</td>
<td>5.0-12.0</td>
</tr>
<tr>
<td>number of florets in the fourth spikelet</td>
<td>229.19</td>
<td>6-19</td>
<td>4-16</td>
</tr>
<tr>
<td>length of penultimate leaf ligule [mm]</td>
<td>208.68</td>
<td>0.8-3.7</td>
<td>1.4-3.5 (3.1-5.5)</td>
</tr>
<tr>
<td>*length of upper glume awn [mm]</td>
<td>165.37</td>
<td>0.0-1.0</td>
<td>0.0-2.0</td>
</tr>
<tr>
<td>number of spikelets per raceme</td>
<td>163.86</td>
<td>6-16</td>
<td>5-10</td>
</tr>
<tr>
<td>length of penultimate leaf [mm]</td>
<td>29.5</td>
<td>5.2-37.0</td>
<td>10.1-34.0</td>
</tr>
</tbody>
</table>

* measured at the fourth floret in the fourth spikelet
** measured at the first floret in the fourth spikelet

TABLE 2. Descriptions, abbreviations and attributes of qualitative characters and their frequencies in Brachypodium pinnatum and B. sylvaticum. r= characters used in PCA.

<table>
<thead>
<tr>
<th>Description of character</th>
<th>Abbreviation of character [attributes]</th>
<th>B. pinnatum (N=320)</th>
<th>B. sylvaticum (N=275)</th>
</tr>
</thead>
<tbody>
<tr>
<td>culm: hairiness of upper internodes</td>
<td>[hairless/hairy]</td>
<td>300/20</td>
<td>243/32</td>
</tr>
<tr>
<td>culm: hairiness of middle internodes</td>
<td>[hairless/hairy]</td>
<td>235/85</td>
<td>214/61</td>
</tr>
<tr>
<td>r: culm: hairiness of lower internodes</td>
<td>[hairless/hairy]</td>
<td>124/196</td>
<td>149/125</td>
</tr>
<tr>
<td>r: uppermost leaves: hairiness of sheaths</td>
<td>[hairless/only margins hairy/hairy]</td>
<td>43/158/119</td>
<td>22/171/82</td>
</tr>
<tr>
<td>r: middle leaves: hairiness of sheaths</td>
<td>[hairless/only margins hairy/hairy]</td>
<td>30/109/181</td>
<td>10/120/145</td>
</tr>
<tr>
<td>r: lowest leaves: hairiness of sheaths</td>
<td>[hairless/only margins hairy/hairy]</td>
<td>23/81/216</td>
<td>5/95/174</td>
</tr>
<tr>
<td>r: penultimate leaf: hairiness on adaxial side</td>
<td>[hairless/hairy]</td>
<td>30/289</td>
<td>5/267</td>
</tr>
<tr>
<td>penultimate leaf: hairiness on abaxial side</td>
<td>[hairless/hairy]</td>
<td>153/166</td>
<td>165/107</td>
</tr>
<tr>
<td>r: margins of penultimate leaf: hairiness</td>
<td>[hairless/hairy]</td>
<td>43/276</td>
<td>156/118</td>
</tr>
<tr>
<td>r: penultimate leaf: shape of ligule</td>
<td>[truncate/obtuse]</td>
<td>295/25</td>
<td>44/231</td>
</tr>
<tr>
<td>middle raceme: hairiness of 4th internode from below</td>
<td>[hairless/hairy]</td>
<td>18/302</td>
<td>34/241</td>
</tr>
<tr>
<td>lower glume: hairiness on abaxial surface**</td>
<td>[hairless/hairy]</td>
<td>16/304</td>
<td>43/232</td>
</tr>
<tr>
<td>upper glume: hairiness on abaxial surface**</td>
<td>[hairless/hairy]</td>
<td>17/303</td>
<td>42/233</td>
</tr>
<tr>
<td>lemma: hairiness on abaxial surface of lemma**</td>
<td>[hairless/hairy]</td>
<td>5/315</td>
<td>6/269</td>
</tr>
<tr>
<td>r: palea: pubescence on abaxial surface of palea**</td>
<td>[glabrous/short-ciliate hairs]</td>
<td>229/91</td>
<td>3/272</td>
</tr>
</tbody>
</table>

* penultimate = second from the top
** estimate at fourth floret in fourth spikelet from

PCA was used to detect groups of specimens and to estimate the contribution of each variable to the analysis. PCA was based on correlation matrices of the whole set of quantitative characters (Table 1), and eight qualitative characters (Table 2). Cluster analysis was used to assess the groupings among Brachypodium populations based on 12 quantitative characters, excluding penultimate leaf length (Table 1). Standardised data were used to compute the distance matrix based on average taxonomic distance, and this was subjected to the unweighted pair-group method, arithmetic average (UPGMA) clustering algorithm.

RESULTS

Qualitative characters

All individuals of the Brachypodium species examined have hairy culms at and near their nodes, hairy spikelets and floret pedicels. Most of the Brachypodium specimens studied have hairy: adaxial (upper) side of the penultimate leaf blade, raceme internodes, abaxial (lower) surface of the lemma, abaxial surface of lower and upper glume, and sheath margin. About half of the lowest and middle leaf-sheaths are covered with long scattered or dense hairs. Lowest sheaths of most of Brachypodium individuals are more likely to be hairy than upper leaf-sheaths. Most of the Brachypodium plants examined have hairless culm internodes, though the lowest ones are hairy frequently in B. pinnatum individuals (Table 2).

Almost all B. sylvaticum individuals have a short-ciliate abaxial surface of palea (272 of 275) and most of B. sylvaticum plants have obtuse ligules (222 of 275). These characters are not species-specific, because the part of B. pinnatum individuals also have these attributes (Table 2). The penultimate leaves of most B. pinnatum individuals usually (85%) have hairy margins, whereas only 40% of B. sylvaticum plants have the same attribute (Table 2).

Twelve of 15 individuals of B. sylvaticum (S-20) accessed from the Swietlińska Dąbrowa reserve have shorter-ciliate abaxial surface of palea and all individuals from the two
population samples of *B. pinnatum* (P-12, P-13) from this locality also share this attribute (Table 2). What is of interest, is that the penultimate leaves of all *B. pinnatum* as well as *B. sylvaticum* individuals from the Świetlista Dąbrowa have margins fringed with hairs.

**Quantitative characters**

The results of ANOVA analysis showed a significant variation (P<0.05) between species of *Brachypodium* for the morphological characters (Table 1). However, the most useful characteristic for discriminating between the studied species of *Brachypodium* is lemma awn length. The lateral lemma awn length (at the fourth floret in the fourth spikelet) in *B. pinnatum* (N=320) is less than 6 mm, whereas *B. sylvaticum* (N=265) has a lateral lemma awn of 6.5-14 mm in length (Table 1, Fig. 2). The remaining quantitative characters overlapped between Polish species of *Brachypodium*.

There was no apparent difference between two ecotypes of *B. pinnatum* named “Grassland” and “Woodland”. The examination of the variation in traits for these two ecotypes revealed that plants of the “Woodland” ecotype are similar to the woodland *B. sylvaticum* as regards the length of the penultimate leaves, and have an intermediate appearance regarding the width of penultimate leaves and the number of spikelets in the raceme (Fig. 3).

The UPGMA dendrogram for the *Brachypodium* accessions (Fig. 4) shows two major clusters. The first major cluster contains four sub-clusters of *B. pinnatum* accessions. Two of these are most numerous, the first containing accessions of *B. pinnatum* from grassland habitats and the other, accessions of *B. pinnatum* from woodland habitats. Both ecotypes of *B. pinnatum* appear to be very similar and are placed very close to each other in a single cluster. The second cluster contains accessions of *B. sylvaticum* at some distance. It is interesting to note that the accession of *B. sylvaticum* (S-20) from the Świetlista Dąbrowa reserve is distinct. The examination of trait ranges for this accession revealed that S-20 is unusual compared to other *B. sylvaticum* populations in having longer penultimate leaf ligules, longer lemma awn (at the fourth floret in the fourth spikelet) (Table 1) and abundant pubescence of leaves, leaf-sheaths, culms, and spikelets. The outlying values for these traits are likely to have resulted in the separation of this population into unique cluster.

There are some morphological differences between plants of different habitats within *B. pinnatum*, however those differences are too inconsistent and imprecise to allow for the recognition of two intraspecific taxa within *B. pinnatum*. One would expect that under such circumstances, a significant degree of morphological diversification would have occurred, making it possible to visually distinguish plants of different habitats.

**Quantitative and qualitative characters**

Output from the PCA (Fig. 5) showed the pattern of morphological variation of Polish *Brachypodium* accessions based on 21 morphological characters (13 quantitative and eight qualitative) (Tables 1 and 2). PCA axis 1 is most highly influenced by (presented in decreasing order of loadings): (1) length of the lemma awn at the fourth floret, (2)
length of the lemma awn at the first floret, (3) ratio: length of lemma awn/length of lemma at the fourth floret, (4) length of the lower glume, (5) number of nerves on the lower glume, (6) the shape of the ligule, (7) hairiness of the abaxial surface of palea, (8) length of the upper glume. In this axis the traits with the most important contribution were related to lemma awn length in the first and fourth floret at the fourth spikelet. PCA axis 2 by: (1) hairiness of the middle leaf-sheaths, (2) hairiness of the lowest leaf-sheaths, (3) hairiness of the lowest culms, (4) hairiness of the abaxial surface of the penultimate leaves, (5) hairiness of the uppermost leaf-sheaths. The second principal component is interpreted as a factor of hairiness. Two distinct groups are evident. One group consists of *B. pinnatum*, and the other includes *B. sylvaticum* (Fig. 5). Both species show the same pattern of variation as regards the hairiness of leaf-sheaths, culms, and penultimate leaves. Most specimens of *B. pinnatum* and *B. sylvaticum* have more or less hairy penultimate leaves, leaf-sheaths, lower culm-internodes, and spikelets.

**DISCUSSION**

**Differences and similarities between species**

The results revealed that *B. sylvaticum* differs from *B. pinnatum* by the following combination of characters: (1) longer awn of the lemma of the fourth flower (6.7-14.0 mm vs. 2.0-5.9), (2) always short-ciliate hairy vs. glabrous palea abaxial surfaces, (3) the racemes, which tend to have less spikelets (5-10 vs. 6-16), (4) the lower glumes, which tend to have more nerves ((4)5-7-nerved vs. 3-5 (6)-nerved), (5) the penultimate leaves, which tend to be wider (5-10 mm vs. 2-8), (6) longer lower glumes (5.5-10 mm vs. 3-8). The most remarkable differences between *B. pinnatum* and *B. sylvaticum* are the length of the lemma awn, its form habit, presence of rhizomes and stiffer racemes. Awn length is the best single character for identifying the two studied species (Table 1, Fig. 6).

*B. pinnatum*, according to the author’s observations, is similar to *B. sylvaticum* as regards: (1) the length of the culm and the number of culm nodes, (2) the length of the
spike-like raceme, (3) the length of the spikelet and inter-node between the third and fourth spikelet, (4) the hairiness of culm nodes, (5) hairiness of leaves and leaf-sheaths (6) hairiness of culm internodes, and (7) hairiness of glumes and lemmas. The morphological variation for most culm and spikelet characters is continuous with a high degree of overlap across both studied species of *Brachypodium*.

According to Hubbard (1968), *B. pinnatum* is distinguished from *B. sylvaticum* by its usually hairless culm and leaf-sheath. However, according to my observations, the pattern of variation within both the Polish *Brachypodium* species is very similar as regards the culm and leaf-sheath pubescence. When analysing leaf-sheaths, those on the lower half of the culm, 90% and 63% of individuals of *B. pinnatum* and *B. sylvaticum* respectively, have hairy leaf-sheaths. Leaf-sheath pubescence, especially on the middle and lower part of the culm, has a dominant character in both native species of *Brachypodium* in Poland. However, glabrousness is a dominant characteristic on the upper half of the culm, 63% and 71% of individuals of *B. pinnatum* and *B. sylvaticum*, respectively, have glabrous uppermost leaf-sheaths (Table 2). Both studied species of *Brachypodium* consist of many forms as regards the hairiness of leaf-sheaths and leaves, from almost glabrous types, through a multitude of intermediate forms, to abundant hairy types. Within both species almost glabrous types are rather rare, most frequent are largely hairy individuals or plants of intermediate appearance as regards the hairiness. A certain pattern of variation can be found as regards the hairiness of leaf margins, but this characteristic is not specific to any of both *Brachypodium* species. This has been confirmed by Stace’s (1991) opinion that pubescence is generally of a very limited value.

The disagreement between the results presented here and those obtained by Hubbard (1968), is explained by the fact that two different species were compared. Hubbard’s concept of *B. pinnatum* included *B. rupestre*, which is much more common than *B. pinnatum* in Britain (Stace, pers. comm.). The distinction between *B. pinnatum* and *B. rupestre* was not determined until after the publication of the New Atlas (Preston et al. 2002) and as such, precious little mapping data are available (Cheffings and Farrell 2005). This confusion also explains the erroneous statement by Stace (1975) that hybrids between *B. pinnatum* and *B. sylvaticum* occur in several European countries. Such plants are almost certainly *B. pinnatum*, which appear to be more or less intermediate between *B. sylvaticum* and *B. rupestre*, but have the same chromosome number as the latter, and are fertile (Stace, pers. comm.). Nevertheless, wild hybrids should be expected also in Poland.

**Ecotypes of B. pinnatum**

It is interesting that ecological segregation among accessions of *B. pinnatum* was detected based on morphological characters. Furthermore, the author’s analyses indicate that *B. pinnatum* cannot be subdivided in any meaningful way. The results of both CA and PCA can only be interpreted to support the recognition of a single species in *B. pinnatum*. The degree of morphological similarity among the populations is too high to justify the recognition of more than one species, while the lack of pronounced gaps in the pattern of variation renders recognition impractical (Fig. 5).
Hybridisation

Despite the apparent morphological similarity of three populations in the Świetlista Dąbrowa reserve (P-12, P-13, and S-20), plants from this area do not form a uniform group with respect to other populations of *B. pinnatum* and *B. sylvaticum* (Table 1, Figs 2 and 3). It is interesting, however, that all individuals of *B. sylvaticum* from the Świetlista Dąbrowa reserve (S-20) have longer lemma awns and leaf ligules than other *B. sylvaticum* individuals (Table 1) and three of the 15 individuals have a glabrous abaxial surface of palea, such as most individuals of *B. pinnatum*. *B. pinnatum* individuals from the P-13 accession have a slightly longer lemma awn than other *B. pinnatum* plants and have profusely hairy culms, leaves, leaf-sheaths, and spikelets (Fig. 3). Both Brachypodium species grow there in close proximity, which renders hybridisation possible. Thus, the area sampled for specimens P-12, P-13 and P-20 (Table 1, Figs 2 and 3) may represent a hybrid zone. Hybrid zones may confound morphological characters alone; therefore, other markers – preferably chromosome count – would be needed in the further assessment of these populations. I cannot suggest any taxonomic status for the False-brome in the Świetlista Dąbrowa reserve at this time and continue to refer to them as *B. pinnatum* (individuals from the P-12 and P-13 accessions) and *B. sylvaticum* (S-20), respectively. Further investigation and confirmatory chromosome count in regions where both Brachypodium species sympatrically appear, are needed to throw light on this interesting issue.

ACKNOWLEDGEMENTS

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LITERATURE CITED


APPENDIX

Appendix 1. Sampled populations of Brachypodium pinnatum (P) and B. sylvaticum (S) collected by B. Paszko. The number of plants measured in each population sample is given in brackets.

B. pinnatum


B. sylvaticum