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WHEATGRASS VARIABILITY (AGROPYRON, SECT. ELYTRIGIA) IN A NATIVE
 COLLECTION FROM TRANSYLVANIA, ROMANIA. I. AGROPYRON INTERMEDIUM
 COMPLEX

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Abstract:

SZABÓ T.A., 1979, Wheatgrass variability (Agropyron, Sect. Elytrigia) in a native collection from Transylvania, Romania. I. Agropyron intermedium Complex. Not. Bot. Hort. Agrobot. Cluj., 1979, X, 89-99. Agropyron intermedium s.l. variability has been studied in 36 populations collected in Transylvania, in order to identify valuable germplasm for erosion control. Open pollination fertility of the samples calculated on seeds per flower basis ranged from 0;0 % to 48.7%. Average values and extremes of some morphological characteristics have also been established. About 20 % of the collected samples belong to ssp. trichophorum (Link.) Volk. and one population with special growth habit and phenotype has been identified as ssp. pulcherrimum (Grossh.) High germination energy and rapid seedling growth have been observed in populations selected for higher OP fertility as compared to A. repens populations.

Index words: Agropyron intermedium, A. repens, taxonomy, variability, OP fertility, germination, seedling growth.

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According to ANGHEL and MORARIU 1972 the Elytrigia (Desv.) Rehb. Section of the genus Agropyron Gaertn. is represented in Transylvania by four species: A. repens (L.) P.Beauv., A. biflorum (Berg.) R. et Sch., A. intermedium (Host.) P.Beauv., A. trichophorum (Link) Richt.

In EHRENDORFER (Ed.) 1973 *A. biflorum* is included in section *Roegneria* K. Koch as a subspecies of *A. caninum* (L.) P. Beauv. and *A. trichophorum* is generally considered as a subspecies or as a variety of *A. intermedium* s.l.

In this paper the results regarding the variability of *A. intermedium* will be reviewed and comparisons between biologically important characters of the two most frequent species, *A. repens* and *A. intermedium* will be made.

The genus *Agropyron* occupies a central position related with the main straw-bearing crops (*Secale*, *Hordeum*, *Triticum*), and this position is assured partly by *A. intermedium*, a species widely used as gene source in hybridisation experiments (2, 5, 10, 11)(Fig.1.)

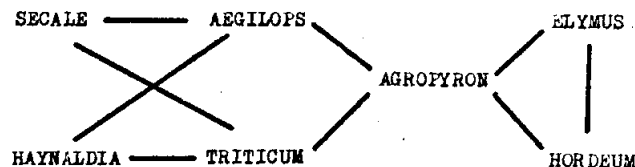


Fig.1. The position of genus *Agropyron* in hybridisation experiments, related to main straw-bearing crops

This species is considered in U.S.A. and Canada as a valuable plant for fodder and soil conservation; it is also a species included in many breeding programmes, with some cultivated varieties (8, 9, 10). In order to enlarge the genetical basis of the breeding work the species has a priority in some plant exploration activities (3, 6).

Material and method

A native collection including 89 *Agropyron* populations originating in Transylvanian Highland has been processed. The samples have been collected along a transect and especially on the north-eastern border of Western Mountains (Munții Apuseni), generally at 350-650 m above sea level. The collection sites have been localized according to the Universal Transvers Mercator (UTM) system accepted for international biochartographical (chorological) representations (6) Fig.2 .

A number of mature spikes and herbarium voucher specimens have been collected from every *Agropyron* population examined randomly along a transect in Transylvania, the collections have been identified taxonomically (Tab.1.) and selected for samples which represented vigorously developed populations, with a large number of mature spikes.

From the selected samples the following data have been registered: (01) = spike length, mm; (03) = spikelet length, mm; (05) = the number of spikelets per spike; (07) = awn length, mm; (09) = pubescence of the spikes; (11) = the number of flowers in spikelets; (13) = the number of caryopses per spikes; (15) = the number of caryopses per spikelets; (17) = rust sensibility; (19) = sensibility to *Claviceps*.

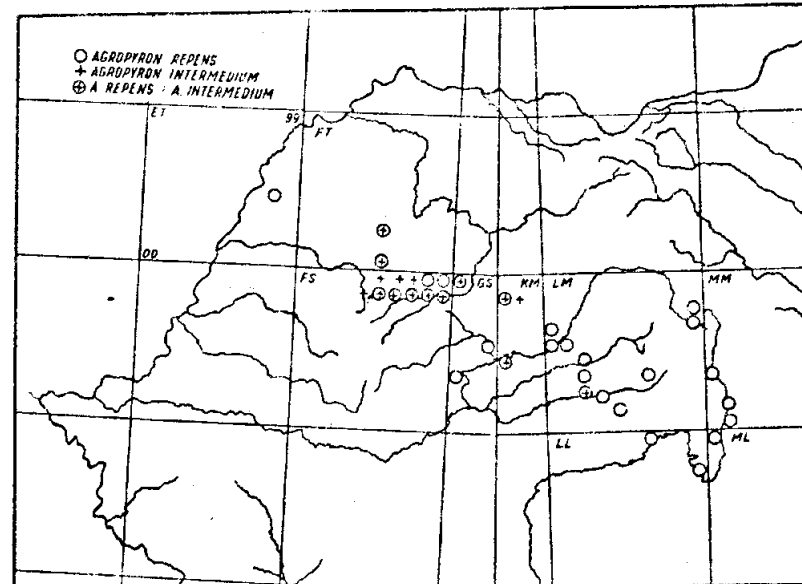


Fig.2. The localization of collection sites (UTM Codes according to Lehrer 1977)

A. *Agropyron repens* (L.) P. Beauv. distr. Alba: GS03 Decea-Mirislău; distr. Bihor: FS24 Olosig-Secuiani; distr. Braşov: LL97 Feldicara, LL89 Horiaz, LM69 Rupea, LM32 Săghioara; distr. Cluj: FS58 Bica, FS78 Căpuşul Mare, FS98 Cluj-Napoca, FS68 Dumbrava, FS66 Gilău, FS89 Gîrbău, GS25 Cîmpia Turzii; KM78 Mociu, GS09 Sumurduc, FS99 Viştea; distr. Covarna: ML09 Bixad; distr. Harghita: LM63 Dealu, LM97 Gheorgheni, MM03 Miercurea Ciuc, LM11 Tugnad, LM36 Voşlobeni; distr. Mureş: LM15 Acătari, KM74 Bogata, LM23 Nadeş, LM24 Tîgmandru, LM05 Recaş-Ungheni, MM06 Săbed, LM14 Saschiz; distr. Sălaj: FT50 Mesteacănu; FT52 Zalău.

B. *Agropyron intermedium* (Host.) P. Beauv. distr. Cluj: Cluj-Napoca FS99; FT50 Bicalat, FS58 Bica-Mănăstireni, FS78 Căpuşul Mare, FS88 Gîrbău, FS68 Dumbrava, FS59 Huedin, KM78 Mociu, FS79 Lechin, KM88 Sărmaşu, GS08 Sumurduc, FS48 Săcuieu; distr. Mureş: KM75 Luduş, LM32 Nadeş; distr. Sălaj: FT60 Gălăşeni-Cuzăplac, FT52 Zalău.

Open pollination fertility has been established on the basis of the total number of analyzed flowers, according to the following formula:

$$OPF = \frac{M(13) \cdot g \cdot 100}{f}$$

where $M(13)$ is the number of cariopses per spike, average value for the analyzed population; g is the total number of the analyzed spikes; f is the total number of the analyzed flowers. In the f values the sterile flowers of the spikelets have been also included.

Germination has been studied in specially adapted germinators, seedling growth have been followed in pots filled with garden soil.

Results and discussions

The taxonomical spectrum of the collected *Agropyron* samples is represented in Tab. 1.

Table 1

Taxonomical classification of the *Agropyron* samples collected in 1978 in Transylvania

Taxon name	Nr. Sample	A %	B
<i>Agropyron repens</i>	51	58.6	100
<i>ssp. repens</i>	26	(29.2)	51.7
<i>ssp. aristatum</i>	25	(28.1)	48.3
<i>A. intermedium</i>	36	41.4	100
<i>ssp. intermedium</i>	26	(29.9)	72.2
<i>ssp. trichophorum</i>	5	(5.8)	13.9
<i>ssp. pulcherrimum</i>	1	(1.2)	2.8
<i>A. apiculatum</i> /X/	2		
T o t a l:	89	100	100

A. Calculated from the total number of *Agropyron* samples

B. Calculated separately for *A. intermedium* and *A. repens*

As the collection followed the principle of random sampling only along the Transylvanian transect and Eastern Carpathians, but not in the north-eastern border region of the Munții Apuseni, the values in table 1 do not represent the real proportions among the sampled *Agropyron* taxa. Most of the *A. intermedium* samples have been collected from the north-eastern part of Munții Apuseni (FS 48-98,

59-99) Fig.2), where the taxonomically problematic phenotypes were more thoroughly searched, but the common types - especially the *A. repens* populations have been neglected.

The overwhelming majority of the collected *A. intermedium* populations belong to *ssp. intermedium* (72.2%), a subspecies characterized according to SOÓ 1973 by glabrous, awnless palea, 15-20 mm long spikelets containing 5-7 flowers; our data are just slightly different from this average values. Populations with awnless, but pubescent, short spikelets have been identified mostly in more xerophytic conditions, for example on gypsic rendzina with high fading coefficient; the pubescence is generally correlated also with lower flower number per spikelets. Based on this findings we consider justified the sepa-

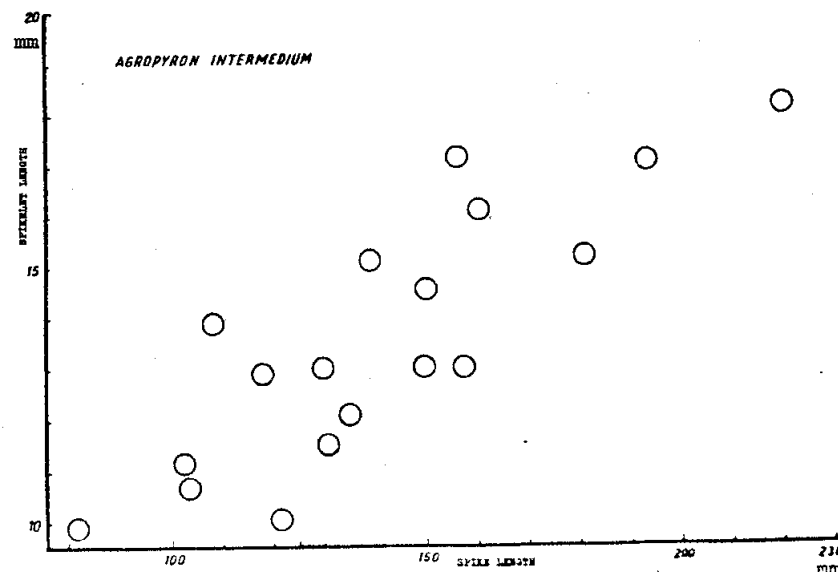


Fig.3. The diagnostic representation (scatter diagram) of the Transylvanian *A. intermedium* populations using the character correlation: "Spike length versus spikelet length"

ration of the taxa on the subspecies level in accordance with SOČ 1973 (12), TZEVELEV 1973, KERGUÉLEN 1975 ap. DEWEY 1978 (3), but we must also mention, that mixed populations (pubescent and glabrous awns) are also not rare in Transylvania. It is worth mentioning, that two populations included in ssp. *intermedium* may represent another problematic taxa - ssp. *baraticum* (Hueff.) Jáv. ap. Thaisz pro sp. - having very long spikelets arranged distantly on a long spike. One of these populations (Huedin 15) have been selected also for further analysis (Table 2).

According to the Middle European botanists (1, 12) the long-awned intermediate wheatgrass populations are considered as belonging to ssp. *intermedium* f. *longiaristatum* (Posp.) Podp. In Soviet and American botanical literature (2, 14) such phenotypes are frequently treated as independent species under the name *A. pulcherrimum* Grossh. syn. *A. popovi* Dobr. Resuming the conclusions of an ample cultivation experiment followed with a large wheatgrass collection from Iran, DEWEY 1978 (3) believes, that "whether this taxon should be separated below species level is a matter of personal taxonomic philosophy" and prefers to view all intermediate wheatgrasses as a single species with no separation below species level. This opinion is perhaps very convenient to plant breeders and geneticists, but not to evolutionary biologists and taxonomists. For many reasons not discussed here in detail, a treatment on subspecies level seems to be a more reasonable solution.

The results of biometrical analysis upon 20 populations selected for high population density are included in table 2. In the table the populations have been arranged according to their OFF values (from OFF = 48.7 to OFF = 0.0 %). The relatively low number of populations analyzed in detail and lack of space do not allow a detailed account and interpretation of data from this table. We just mention that some *A. intermedium* populations with very good open pollination fertility (average cariopsis number per spike may exceed 50!) have been found.

Regarding the character correlations, the correlations "spike length versus spikelet length" and "spike length versus number of spikelets per spike" are more linear in *A. intermedium* as in *A. repens* (Fig. 3., Fig. 4). The intermediate wheatgrass populations are also more resistant to rust and *Claviceps* infections as that of couchgrass populations, but exceptions have been observed for both species.

From the ecological point of view there is an important differential character between the two related species, that is the

Table 2

Average values of some biologically or taxonomically important characters in 20 Transylvanian *Agropyron intermedium* populations selected on the basis of high plant density on the collecting site

Nr.	Population	OFF%	01	03	05	07	09	11	13	15	17	19
1	Bicalat-16	48.7	181.0	15.4	21.4	-	-	5.2	54.2	2.7	++	+
2	Bica-59	35.4	156.0	17.3	13.2	2.1	-	5.3	24.6	1.9	-	-
3	Dumbrava-54	32.8	122.4	10.1	11.5	-	+++	2.9	10.2	0.9	-	-
4	Huedin-15	23.4	222.0	18.8	21.8	-	-	6.0	30.4	1.1	-	+
5	Luduş-46	21.7	154.9	13.2	20.6	2.0	-	4.0	17.9	1.1	+	+
6	Gălăţeni-22	20.9	109.2	13.8	9.8	-	-	4.2	8.6	0.9	-	-
7	Luduş-44	20.7	187.4	16.4	18.4	12.9	-	5.0	19.0	1.0	-	-
8	Gîrbău-81a	15.4	151.0	14.6	15.8	-	-	4.2	10.2	0.7	+++	-
9	Căpuş-53	10.4	150.1	13.1	16.1	-	-	3.0	5.0	0.3	-	-
10	Dumbrava-18	10.3	135.0	12.2	17.4	-	+++	4.2	37.6	2.2	-	-
11	Mociu-21a	10.0	162.0	15.9	13.2	-	-	5.0	6.6	0.4	+	+
12	Leghia-83b	9.9	139.7	15.1	20.0	-	-	3.1	6.2	0.3	-	++
13	Zalău-63b	8.1	194.0	17.2	20.4	-	-	3.9	6.4	0.6	-	-
14	Dumbrava-18a	6.2	131.8	11.5	18.2	-	-	3.4	19.0	0.8	-	-
15	Săcuieu-88	4.5	103.6	11.1	12.1	-	-	3.3	1.8	0.2	+	-
16	Leghia 83a	4.2	85.0	10.6	12.3	-	+++	3.1	1.6	0.1	-	-
17	Căpuş-55	3.3	130.5	13.3	13.4	-	-	5.1	2.3	0.2	-	+++
18	Sărmaşu-23	0.0	116.8	13.4	13.4	-	-	4.8	0.0	0.0	++	-
19	Gîrbău-81b	0.0	103.0	10.8	16.0	-	+++	3.4	0.0	0.0	+++	+
20	Sumurduc-65	0.0	139.0	13.4	14.6	-	-	4.9	0.0	0.0	+	-

Explanations: (01) = spike length, mm; (03) = spikelet length, mm; (05) = the number of spikelets per spikes; (07) = awn length, mm; (09) = pubescence of spikelets; (11) = the number of flowers per spikelets; (13) = the number of seeds per spike; (15) = the number of seeds per spikelets; (17) = rust infection degree on spikes; (19) = *Claviceps* infection degree; OFF = open pollination fertility (%) on seeds per flower basis. + = low; ++ = moderate; +++ = high.

seeds of *Agropyron intermedium* are generally more easy to separate from the palea, the seeds may fall out from spikelets easily and in favourable circumstances may germinate 100% in the first two days.

The germination of different *A. repens* populations is more slower and rarely exceeds in the first germination period more as 50% of the total seeds capable to germinate.

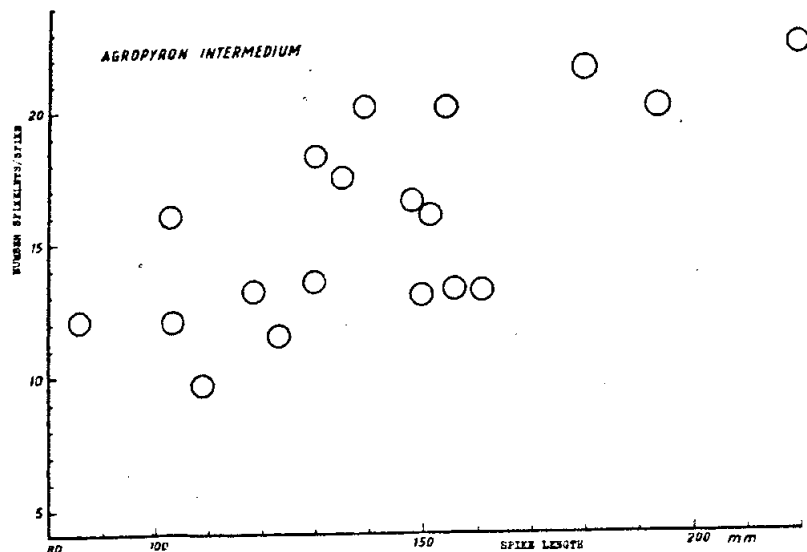


Fig.4. The scatter diagram of Transylvanian *A. intermedium* populations using the character correlation: "spike length versus number of spikelets per spike".

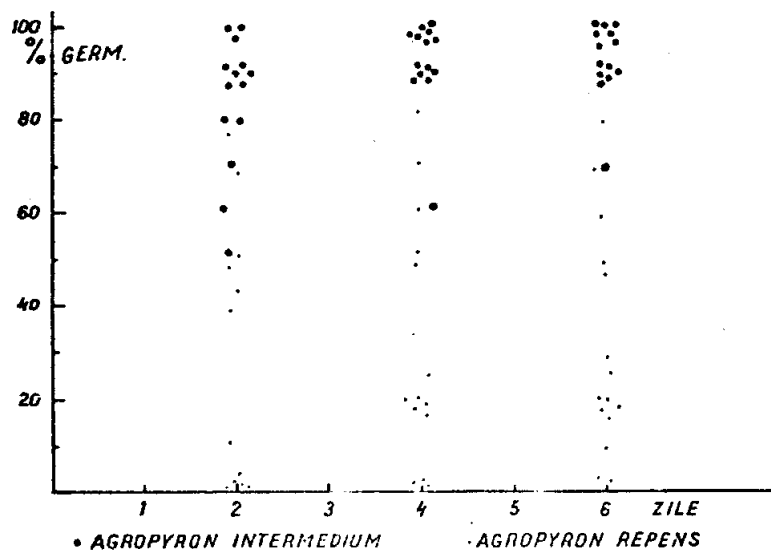


Fig.5. Germination of some *A. intermedium* populations (bold type dots) as compared with *A. repens* populations (small type dots)

The seedling growth of the studied *A. intermedium* populations was also more vigorous than by *A. repens* (Fig. 6) and the average value of the examined populations was more closely attached to the upper limiting values as by *A. repens*.

The large variability observed among intermediate wheatgrass populations in respect to seedling vigour reveals the possibility of a successful selection. For the beginning 6 populations have been selected for high open pollination fertility (Dumbrava 54a, Gălăşeni 22, Bicalat 16, Bica 59, Dumbrava 54b, Luduş 46) in order to examine other characters related to spreading, and related to soil conservation abilities. Some of these populations have a surprisingly high uniformity in respect of seedling vigour (Dumbrava 54a, Bicalat 16), others have a more large variability in respect of this character (Bica 59, Dumbrava 54b).

The sample identified as *A. intermedium* ssp. *pulcherrimum* (Luduş 46) has a distinctly different seedling vigour as compared with the other studied populations.

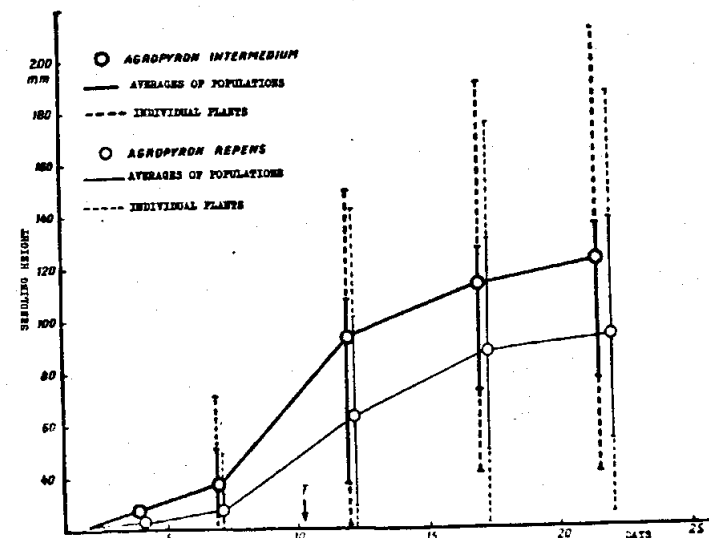


Fig.6. Seedling growth of *A. intermedium* populations as compared with that of *A. repens*; (average values of populations indicated with full lines, individual extremes with broken lines; T = transplantation)

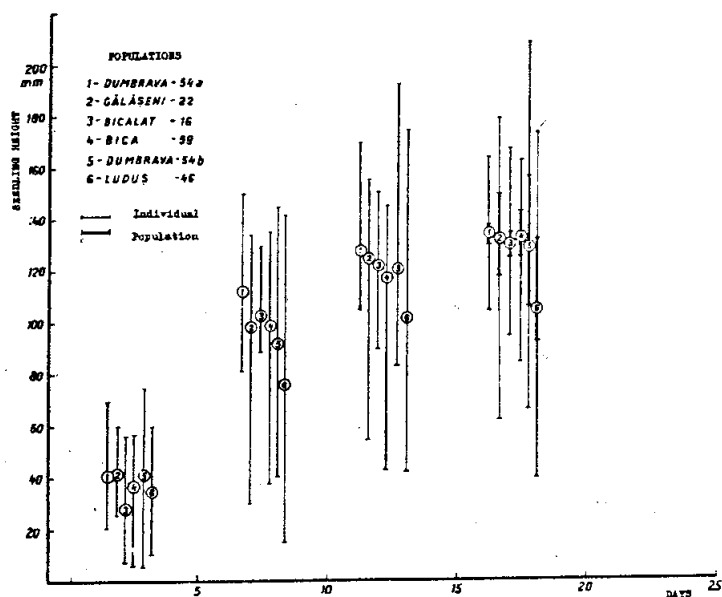


Fig.7. Seedling growth (average and extreme values) of the A. intermedium populations selected for high open pollination fertility (bold lines represent average values calculated for populations)

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