

Experimental data on the inheritance of some taxonomic characters in *Hordeum spontaneum* C. Koch emend. Bacht.

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With 4 figures

Since in 1956 the author had published several papers on the fossil form of cultivated barley *Hordeum lagunculiforme* mihi, it has later on been discovered in natural *H. spontaneum* populations in Middle Asia and the Transcaucasus [F. KH. BAKHTEYEV: 1956, 1957, 1958, 1959, 1961, 1962a, 1962b (in collaboration with E. M. DAREVSKAJA), 1962c]. The above-mentioned investigations gave the author ground to deliver a summarizing report on the „Origin and Phylogeny of Barley“ at the First International Barley Genetics Symposium, held at Wageningen (The Netherlands) in 1963 (1964).

Going on with the investigations in this line the author with the assistance of his colleagues (A. P. BELAVSKAJA, E. M. DAREVSKAJA and N. B. SERAFIMOVIČ) carried out a series of experimental trials with a view of eliciting some genetic aspects related to taxonomic peculiarities of the *H. spontaneum* C. Koch emend. Bacht. varieties. In this connection a cycle of crossings of two cultivated barley *H. vulgare* (L.) emend. Vav. et Bacht. varieties was outlined (Table 1).

Table 1. List of varieties of *Hordeum spontaneum* C. Koch emend. Bacht. and *H. vulgare* (L.) emend. Vav. et Bacht. selected as parental forms for cyclic crossings.

Species and varieties	Geographical origin
<i>Hordeum spontaneum</i> C. Koch emend. Bacht.: var. <i>spontaneum</i> var. <i>ischnatherum</i> (Cosson) Thell. var. <i>proskowetzii</i> Nabélék var. <i>lagunculiforme</i> Bacht.	the Turkmenian SSR the Turkmenian SSR the Turkmenian SSR the Turkmenian SSR and the Tajik SSR
<i>Hordeum vulgare</i> (L.) emend. Vav. et Bacht.: var. <i>nutans</i> Schübl. (Viner) var. <i>pallidum</i> Sér. (Pirkka)	the Leningrad reproduction Finland

The planned cycle of crosses was begun as early as in 1961 and continued in 1962. Among the hybridized pairs the following 10 combinations were found to be successful (Table 2). The results of investigating F_1 and F_2 of these combinations were taken as the material for the present report.

Table 2. List of hybrid pairings in which F_1 and F_2 were investigated in 1963–1964.

Cipher	Names of hybrid combinations
h 6	var. <i>spontaneum</i> × var. <i>proskowetzii</i>
h 8	var. <i>spontaneum</i> × var. <i>lagunculiforme</i>
h 9	var. <i>spontaneum</i> × var. <i>pallidum</i>
h 10	var. <i>spontaneum</i> × var. <i>nutans</i>
h 30	var. <i>ischnatherum</i> × var. <i>nutans</i>
h 68	var. <i>lagunculiforme</i> × var. <i>lagunculiforme</i>
h 69	var. <i>lagunculiforme</i> × var. <i>pallidum</i>
h 84	var. <i>pallidum</i> × var. <i>ischnatherum</i>
h 87	var. <i>pallidum</i> × var. <i>lagunculiforme</i>
h 88	var. <i>pallidum</i> × var. <i>lagunculiforme</i>

The results of F_1 and F_2 analysis are summarized in Table 3.

The nature of inheriting the shape of the apex of lateral spikelets in F_1

In intercrossings between *H. spontaneum* varieties a tendency was observed in their dominating in F_1 towards that parental form, of which the apexes of lateral spikelets had less short awn-like formations. This fact is well illustrated in crossing h 6 and h 8, when in both cases F_1 turned to be similar to the typical var. *ischnatherum*, i.e. F_1 was very close to that parental form, which had even no awn-like formation at the lateral spikelets — to var. *spontaneum*, whereas their corresponding second parental forms possessed: comparatively long (var. *proskowetzii*) and long awns (var. *lagunculiforme*).

In var. *spontaneum* and var. *ischnatherum* crosses with the cultivated barley var. *nutans* wild parental forms were dominating in F_1 , i.e. var. *spontaneum* and var. *ischnatherum* (h 10 and h 30).

The hybridization of the same wild forms, i.e. var. *spontaneum* and var. *ischnatherum*, with a six-rowed cultivated barley form var. *pallidum*, gave correspondingly in F_1 : var. *ischnatherum* and var. *proskowetzii*, i.e. the wild-growing varieties (h 9 and h 84) were dominating.

The other four pairings (h 68, h 69, h 87 and h 88) represent combinations of six-rowed wild forms of var. *lagunculiforme* both between themselves and with a six-rowed cultivated variety *pallidum*. In F_1 of all the combinations mentioned a six-rowed wild-growing var. *lagunculiforme* was fully dominating.

The nature of segregation in F_2

The second generation of pairings h 6 and h 8, representing a combination of the extreme *H. spontaneum* varieties, distributed in the first combination (h 6), the parental forms being v. *spontaneum* and v. *proskowetzii*, within the known four varieties of the said wild barley without any new formations, whereas F_2 happened to consist of v. *spontaneum*, v. *ischnatherum* and v. *proskowetzii*. In the second combination (h 8) the F_2 hybrid population consisted of all the four *H. spontaneum* varieties, i.e. of var. *spontaneum*, var. *ischnatherum*, v. *proskowetzii* and v. *lagunculiforme*. At the same time, as was shown by counting corresponding ears, the individuals belonging to the *spontaneum* and *ischnatherum*-type varieties were clearly predominant.

F_2 arising from crosses of wild-growing barley with a two-rowed cultivated barley variety (h 10, h 30) happened to be fully within the variation of a wild-

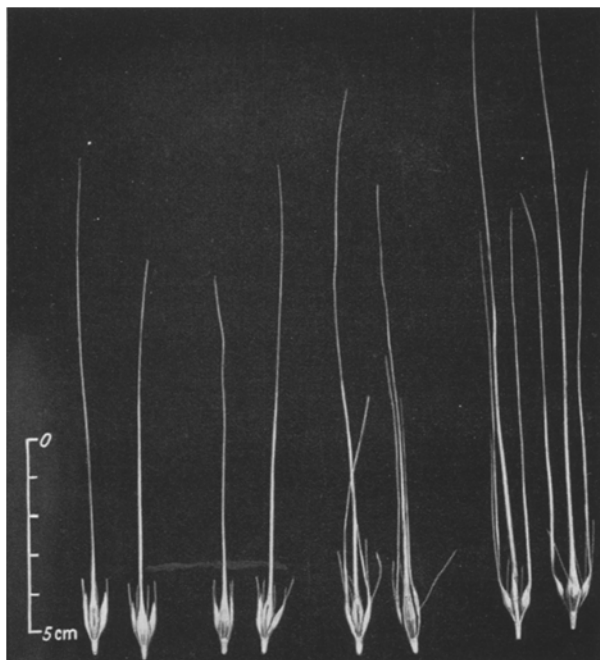


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

growing *H. spontaneum* species; individuals of the cultivated type were not found at all.

The second generation h 9 and h 84 (the crosses of *v. spontaneum* and *v. ischnatherum* with a cultivated six-rowed variety *pallidum*) besides the segregation into varieties, their being comprised by the specific wild-growing *H. spontaneum* population, displayed the appearance of three forms. They were new formations of a wild-growing type, i.e. specimens with rough ears, dividing into spikelets. These were, first of all, individuals similar to *v. ischnatherum*, but differing from the latter by the fertility of all the spikelet triplets. This new hybrid formation was conditionally named „*ischnofertillum*“ (fig. 1). In the second place, the individuals were observed to be similar in all relations to *v. proskowetzii*, but differing from the latter as well, as in the first instance, by the fertility of all the spikelet triplets. This new formation was also conditionally named „*proskowfertillum*“ (fig. 2).

Thirdly, the individuals represented new formations of *H. agriocrithon* E. Åberg type.

Along with the hybrids of a parental type and the *proskowetzii* variety, the combinations h 87 and h 88 showed in F_2 the following three new formations: 1. — individuals fully similar to the cultivated parental form of var. *pallidum*, but differing from the latter by the existence of a „pedicel“ in the lateral spikelets. These forms were conditionally called „*pallipodum*“ (fig. 4). 2. — the hybrid individuals of the *H. agriocrithon* type, and 3. — the hybrid plants similar in all characters to *v. proskowetzii*, but differing from it by the absence of a „pedicel“ in the lateral spikelets, therefore, their lateral sterile spikelets were sessile, as in the six-rowed cultivated barleys. These new formations were conditionally called by us „*sessili-proskowetzii*“ (fig. 3).

F_2 from h 68 and h 69 turned out to be nearly entirely winter forms and up to late autumn of 1964 remained in a vegetative stage, and having left them in the same state in the field during winter, they have formed no ears.

Discussion

The main aim of the conducted investigations consisted in eliciting both the nature of inheriting the „pedicel“ in the lateral spikelets, and the shape of their apex in the wild-growing barley *H. spontaneum* Koch emend. Bacht. The data obtained as regards the „pedicel“ showed this character to be of a clearly dominating nature. F_1 arisen from the forms with a „pedicel“ and without it as well, was always provided with a „spikelet-pedicel“, or, in other words, a „pedicel“. In F_2 the segregation as to the given character proceeded, evidently, in conformity with the monofactorial type. Thus, in the combination h 87 out of the whole number of 485 ears 399 possessed „spikelet-pedicel“ and 86 were without them; in the combination h 88 out of 180 ears, correspondingly, 133 inherited „spikelet-pedicel“ and 47 did not; in the combination h 84 out of 39 ears 33 were with this character and 6 without it.

As to the nature of inheriting the shape of the apex of the lateral spikelets an evident dominance of

Table 3. Results of a morphological analysis of the F_1 and F_2 ears.

Ciphers of combinations	F ₁	F ₂						New formations
		H. vulgare						
		nutans	pallidum	spontaneum	ischnatherum	proskowetzii	lagunculi- forme	
h 6	v. ischnatherum			32	23	1		„ischnofertillum“-1 „proskowfertillum“-1
h 8	v. ischnatherum			79	174	19	112	
h 9	v. ischnatherum		1	33	26	7	15	
h 10	v. spontaneum			22		7	2	All winter sowings did not ear Out of 75 plants only 4 formed ears, but the ears were inferior
h 30	v. ischnatherum			87	158	17		
h 68	v. lagunculiforme							
h 69	v. lagunculiforme							
h 84	v. proskowetzii				9	2	19	
h 87	v. lagunculiforme		37			76	291	„ischnofertillum“-3 agriocrithon-6 „proskowfertillum“-6 „pallipodum“-32 „agriocrithon“-43 „pallipodum“-11 agriocrithon-38
h 88	v. lagunculiforme		9			14	108	

shorter awn-like formations or their rudiments was observed (h 6, h 8, h 9).

Thus, F_2 of the combination h 6 contained on 55 ears with short awn-like formations or their rudiments only 1 ear with comparatively long awn-like formations of the lateral spikelets. In the combination h 8, correspondingly, 253 and 131, in the combination h 9 — 62 and 23. However, in the combination h 84 a reverse phenomenon was established — in F_2 individuals were predominant with longer awn-like formations of the lateral spikelets as compared to the number of those with short awn-like formations (27 ears with long and 12 with short ones).

Conclusion

The obtained data enable us to draw the following conclusions:

1. The opinion is confirmed that the existence of the "pedicel", or "spikelet-pedicel" in the lateral spikelets of the wild-growing barley *H. spontaneum* C. Koch emend. Bacht. is to be considered as an archaic character, displaying its dominating nature in all the crossings with the forms lacking a similar formation, these forms being, in the first place, recent cultivated barley varieties.

2. The statement is also confirmed that the forms similar to *H. agriocrithon* E. Åberg could have arisen and arise only as a result of *H. spontaneum* hybridization with the six-rowed forms of *H. vulgare*, but not in the least within the wild-growing barley population.

3. As regards *H. lagunculiforme* s. str., attributed by the author to one of the *H. spontaneum* varieties, its appearance is due only to the intraspecific population interrelations of the above wild-growing species. However, this fact does not exclude the possibility of receiving experimentally as well the individuals of a *lagunculiforme* type both by intercrossing various *H. spontaneum* forms and by crossing the representatives of the latter with the six-rowed forms of the cultivated barley.

In the latter case, however, the appearance of the hybrid individuals of a *lagunculiforme*-type in F_2 is accompanied, along with the usual Mendelian segregation, by an occurrence of such new formations as *H. agriocrithon*, "*sessiliproskowitzii*", "*pallipodum*", "*proskowfertillum*" and "*ischnofertillum*", which, so far, having been discovered by nobody and nowhere in natural *H. spontaneum* C. Koch emend. Bacht. populations. They are also not known among the cultivated barley populations.

Summary

Hordeum spontaneum C. Koch emend. Bacht. varieties have been both intercrossed and crossed with two cultivated barley varieties of *H. vulgare* (L.) emend. Vav. et Bacht. with a view of eliciting the nature of inheriting "the spikelet-pedicel" of the lateral spikelets and the shape of their apex in the said wild-growing barley. The investigations of F_1 and F_2 showed the inheritance of the "spikelet-pedicel" to have a dominating nature and to segregate in F_2 in

conformity with the Mendelian monohybrid type. In the second case the forms with shorter awn-like formations, or their rudiments, were dominating.

As a result of *H. spontaneum* \times *H. vulgare* hybridization along with already known forms, new formations were received, they have been conditionally named by the author: "*sessiliproskowitzii*", "*proskowfertillum*", "*ischnofertillum*", and "*pallipodum*".

Zusammenfassung

Im Rahmen größerer Untersuchungen über die Abstammung und Phylogenie der Gerste wurden mehrere Varietäten von *Hordeum spontaneum* C. Koch emend. Bacht. sowohl untereinander als auch mit zwei Varietäten der Kulturgerste, *H. vulgare* (L.) emend. Vav. et Bacht., gekreuzt. Es sollte geklärt werden, wie bei den genannten Wildgersten das Stielchen (pedicel) der Seitenährchen sowie die Ausbildung des Apex der Seitenährchen (d. h. ihre Begrannung) vererbt werden. Die Untersuchung der F_1 und F_2 zeigte, daß das Stielchen (gegenüber ungestielten Seitenährchen) dominant und gemäß einer monohybriden Mendelspaltung vererbt wird. Bezüglich der Ausbildung des Apex der Seitenährchen ergab sich im allgemeinen Dominanz der kürzeren oder rudimentären Grannen gegenüber längeren Grannen.

Im Ergebnis der Hybridisation zwischen *H. spontaneum* und *H. vulgare* wurden, neben bereits bekannten, verschiedene neue Formen gefunden, die vom Autor vorläufig wie folgt benannt werden: „*sessiliproskowitzii*“, „*proskowfertillum*“, „*ischnofertillum*“, „*pallipodum*“.

Die Ergebnisse werden im Zusammenhang mit Fragen der Abstammung der Kulturgerste diskutiert.

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