Pak. J. Bot., 33(2): 133-141, 2001.

A MORPHOLOGIC AND TAXONOMIC STUDY OF *HORDEUM MURINUM* SENSU LATO (POACEAE: TRITICEAE) IN IRAN

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Abstract

Quantitative, qualitative and multi-state morphological characters on 350 herbarium specimens from 35 Iranian populations of *Hordeum murinum* s.l. were examined. Based on the results of this study, the followings were chosen as diagnostic characters: fresh leaf colour, inflorescence density, inflorescence colour at anthesis and maturity, pedicel presence in central spikelet and central floret, ratio of the length of the central spikelet (excluding awn) to that of the lateral ones, shape and colour of the lateral spikelets rachilla prolongation, central spikelet lodicules margin vestiture, ratio of the anther length of the central floret to those of the lateral ones, central and lateral florets anther colour, central floret anthers situation at anthesis, and lateral florets palea vestiture. Regarding morphological diversity, the idea that this group has three distinct species is confirmed. Moreover, *Hordeum murinum* L., is recorded for the first time from Iran from Bandar-e Abbas and Bandar-e Lengeh. Using morphological characters, two taxonomic keys are provided for the taxa in *Hordeum murinum* s.l.

Introduction

Taxonomically, the taxa belonging to *Hordeum murinum* s.l. (*H. murinum* L., *H. glaucum* Steud., and *H. leporinum* Link) have been treated in different ways. Nevski (1941) recognized *H. murinum* and *H. leporinum* as two distinct species and considered *H. glaucum* as a synonym of *H. leporinum*. Parsa (1950) recognized *H. murinum* and *H. leporinum* as two distinct species in his Flore de l'Iran; however, his description for *H. murinum* is similar with *H. glaucum*. Bor (1968, 1970) recognized *H. leporinum* and *H. glaucum* as two distinct species, the spike of *H. glaucum* is compact, whereas that of *H. leporinum* is loose. In *Flora Iranica* according to Bor (1970) *H. glaucum* has a vast distribution in Iran, while *H. leporinum* is restricted to Gorgan, Mazanderan, East Azerbaijan. Isfahan, Chaharmahal va Bakhtiari and Khuzistan and *H. murinum* does not occur in Iran. Humphries (1980), Baum & Bailey (1984a, 1984b) recognized three subspecies in *H. murinum* s.l.: subsp. *murinum*, subsp. *leporinum* (Link) Arcang., and subsp. *glaucum* (Steud.) Tzevelev. Bothmer *et al.*, (1991) recognized three subspecies in *H. murinum* s.l.. They demonstrated that subsp. *murinum* is a tetraploid (2n=4x=28), and distributed from the Atlantic to southwestern U.S.S.R. and usually not reaching the Mediterranean region. The subsp. *leporinum* with two tetra and hexaploid cytotypes (2n=4x=28 and 2n=6x=42) has a distribution from Mediterranean region to Afghanistan. The third subsp. i.e., *glaucum* is a diploid (2n=2x=14) and occurs from southern Mediterranean region and eastwards to Iran, Afghanistan and Kashmir. According to Shewry (1992), *H. murinum* L. subsp. *murinum* is the only taxon of the genus *Hordeum* has pedicellated central spikelet while Bothmer *et al.*, (1991) described it as a taxon with sessile to subsessile central spikelets.

The object of this study was to evaluate the status of *H. murinum* s.l. in Iran.

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Table 1. Geographic origin of *Hordeum murinum* s.l. collections from Iran (HL=*H. leporinum*, HG=*H. glaucum* and HM=*H. murinum*).

Collection site	Population number	Species
C: Isfahan; 10 km W Najafabad towards Tiran, 51° 15′E, 32° 40′N, elev. c. 1800m	28	HG
C: Isfahan; Naein towards Anarak, , 53° 42′E, 33° 18′N, elev. c. 1450 m	29	HG
C: Isfahan; Zayand-e Rud river banks, 51° 38′E, 32° 38′N, elev. c. 1550 m	30	HG
C: Qom; 25 Km SW Qom, Tollab, 50° 40′ E, 34° 35′N, elev. c. 1050 m	31	HG
C: Tehran; Shahriar, 51° 03′ E, 35° 40′ N, elev. c. 1250 m	32	HG
C: Tehran; Tajrish, 51° 26′ E, 35° 45′N, elev. c. 1450 m	33	HL
E: Korasan; Mashad, Torghabeh, 59° 20′E, 36° 17′N, elev. c. 1050 m	1	HG
N: Mazandaran; Sary, 53° 05′E, 36° 35′N, elev. c. 112 m	2	HG
S: Bushehr; 5 Km S Borazjan, Sarkuh, 51° 13′E, 29° 12′N, elev. c. 55 m	17	HG
S: Bushehr; between Konartakhteh and Dalaki, 51° 19′E, 29° 28′N, elev. c. 470 m	18	HG
S: Busher; between Ahram and Khormoj, 51° 19′E, 28° 46′N, elev. c. 45 m	19	HG
S: Fars; Shiraz, 20 Km N Kazerun, 51° 35′E, 29° 47′N, elev. c. 1760 m	14	HG
S: Fars; Shiraz, 5 Km N Perspolice, 52° 54′E, 29° 56′ N, elev. c. 1580 m	15	HG
S: Fars; Shiraz, 8 Km E Pasargad, 53° 13′E, 30° 11′N, elev. c. 1750 m	10	HG
S: Hormozagan; Bandar-e Abbas, Hajyabad, 55° 52′E, 28° 19′N, elev. c. 1070 m	20	HM
S: Hormozgan; 10 Km E Bandar-e Lengeh towards Bandar-e Abbas, 55° 56′E, 26° 37′N, elev. c. 15 m	21	HM
S : Kerman; 15 Km W Baft towards Syrjan, 56° 28′E, 29° 18′N, elev. c. 1980 m	22	HG
S : Kerman; Mahan, Jopar, 57° 06′ E, 30° 04′N, elev. c. 1730 m	23	HG
SW: Chaharmahal va Bakhtiari; 5 Km W Sarkhuon towards Dehdez, 50° 27′E, 31° 43′N, elev. c. 1940 m	3	HL
SW: Chaharmahal va Bakhtiari, Shalr-e Kord, Lordegan, 50° 48′E, 31° 31′N, elev. c. 1870 m	4	HG
SW: Chaharmahal va Bakhtiari, 50 Km SE Lordegan, Meymand, 51° 15′E, 31° 09′N, elev. c. 1670 m	5	HG
SW: Chaharmahal va Bakhtiari, Lordegan, 25 Km W Nagan towards Dehdez, 51° 32′E,31° 35′N, elev. c. 1920 m	6	HL
SW: Kohgiloyeh va Boyerahmad; Yassudj, 25 Km NW Yassudj, Biareh, 51° 28′E, 30° 50′N, elev. c. 1690 m	34	HG
SW: Kohgiloyeh va Boyerahmad; Yassudj, 20 Km SW Yassudj towards Gachsaran, Morka, 51° 28′E, 30° 24′N, elev. c. 1830 m	35	HL
W: E. Azerbaijan; 15 Km E Ahar towards Meshginshahr, Tazehkand, 47° 13′E, 38° 26′N, elev. c. 1650 m	26	HL
W: Hamadan; Ganjnameh, 48° 28′E, 34° 48′N, elev. c. 1750 m	27	HG
W: Hamadan; 45 Km Hamadan towards Malayer, Aliabad, 48° 40′E, 34° 33′N, elev. c. 1680 m	24	HL
W: Hamadan; 5 Km N Malayer, 48° 50′E, 34° 17′N, elev. C. 1780 m	25	HG
W: Khuzistan; 5 Km NE Khorramshahr, 48° 11′E, 30° 30′N, elev. c. 10 m	7	HG
W: Khuzistan; Andimeshk, 48° 19′E, 32° 28′N, elev. c. 200 m	8	HL
W: Khuzistan; 30 Km W Bandar-e Mahshahr towards Abadan, 48° 52′E, 30° 33′N, elev. c. 20 m	9	HG
W: Khuzistan; Ramhormoz, 10 Km Ramhormoz towards Bandar-e Abbas, 49° 30′E, 31° 11′N, elev. c. 100 m	16	HG
W: Khuzistan; Eizeh, 49° 54′E, 31° 48′N, elev. c. 800 m	11	HL
W: Lorestan; Khorramabad, Pol-e Dokhtar, 47° 43′E, 33° 07′N, elev. c. 1650 m	12	HL
W: Lorestan; Khorramabad, Tang-e Malavi, 47° 54′E, 33° 16′N, elev. c. 1670 m	13	HL

Materials and Methods

The materials used in the present study were collected from the field from different parts of Iran (Table 1). Using 35 populations and 10 plants from each population, 48 quantitative and 2 qualitative and multi-state morphological characters in each specimen were studied. Besides specimens present in the herbarium of Tehran Botanical Garden (TARI), the herbarium of the Plant Pests and Diseases Research Institute of Ewin (PPDRIE) and the herbarium of the University of Tehran (UT) were also examined. The morphological terminology used in this study is based on Stearn (1992). Voucher specimens are deposited in the herbarium of Isfahan University.

Results and Discussion

The present study showed that several morphological characters could be used for distinguishing *H. murinum* group (Table 2).

The results of this study, indicates that *H. murinum* s.l. in Iran contains three distinct species: *H. glaucum* Steud., *H. leporinum* Link, and *H. murinum* L. Of these *H. murinum* is recorded for the first time from Bandar-e Abbas and Bandar-e Lengheh, Iran. Because of its pedicellated central spikelet, *H. murinum* is clearly distinguishable from the other *Hordeum* species, especially from *H. leporinum* and *H. glaucum*. *H. glaucum* has a widespread distribution in Iran as compared to other members of the genus (Table 1). In order to facilitate the distinction among the taxa belonging to *H. murinum* group, two taxonomic keys and figures 1-4 are provided.

Table. 2. Diagnostic characters and states in *Hordeum murinum* s.l. study (HL=*H. leporinum*, HG=*H. glaucum* and HM=*H. murinum*).

No.	Character	HL	HG	HM
1.	Fresh leaf colour	Green	Glaucous	Light green
2	Inflorescence density	Loose	Dense	Loose
3	Inflorescence colour at anthesis	Green	Green to glaucous	Light green
4	Inflorescenc colour at maturity	±Purplish	Usually brownish	Yellowish
5	Pedicel presence in central spikelet	Absent	Absent	Present
6	Pedicel presence in central floret	Present	Present	Absent or Present
7	Length of the central spikelet (excluding awn) to that of the lateral ones	Unequal	± Equal	± Equal
8	Lateral spikelets rachilla prolongation shape	Slender	Stout	Slender
9	Lateral spikelets rachilla prolongation colour	Light green	Orange-brown	Light green
10	Central spikelet lodicules margin vestiture	Hairy	Not hairy	Hairy
11	Anther length of the central floret to those of the lateral ones	± Equal	Unequal	± Equal
12	Central and lateral florets anther colour	Yellowish	Yellowish with small purple spots	Yellowish
13	Central floret anthers situation at anthesis	Excluded	Included	Excluded
14	Lateral florets palea vestiture	Scabrous	Hairy	Almost glabrous

Fig. 1. *Hordeum leporinum* Link, Habit. (W: Lorestan; Khorramabad, Pol-e Dokhtar, 47° 43′E, 33° 07′N, elev. c. 1650 m).

Fig. 2. *Hordeum glaucum* Steud., Habit. (S: Kerman; 15 Km W Baft towards Syrjan, 56° 28'E, 29° 18'N, elev. c. 1980 m).

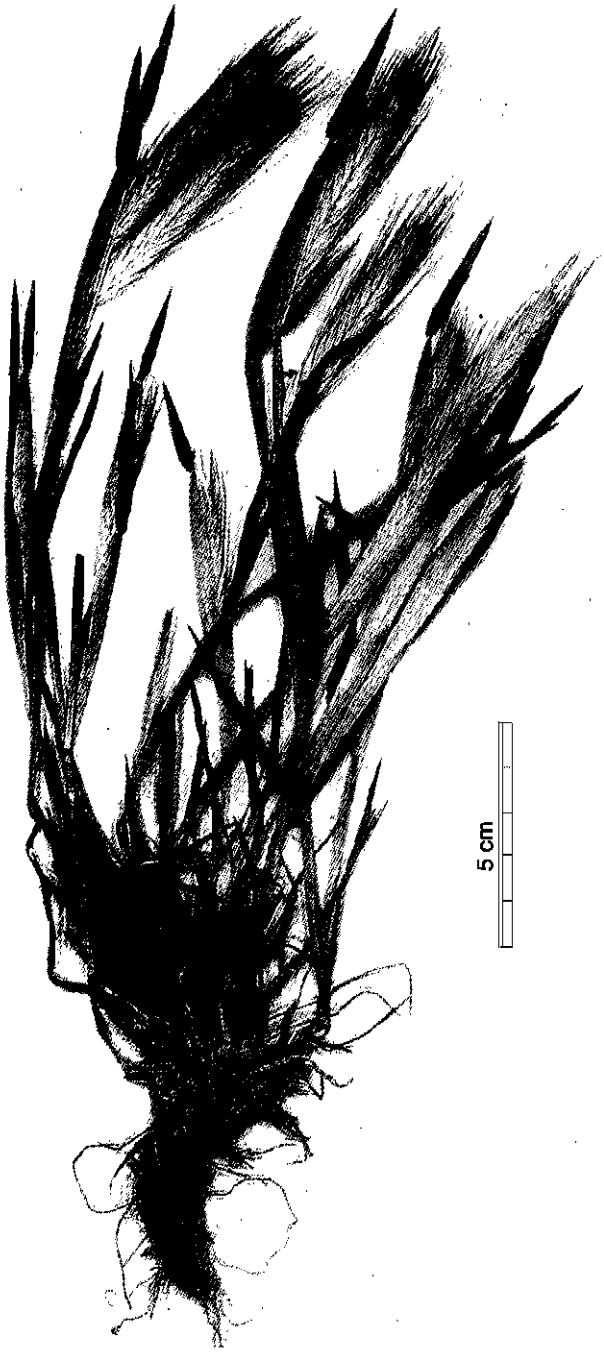

Fig. 3. *Hordeum murinum* L., Habit. (S: Hormozgan; 10 Km E Bandar-e Lengeh towards Bandar-e Abbas, 55° 56′ E, 26° 37′ N, elev. c. 15 m).

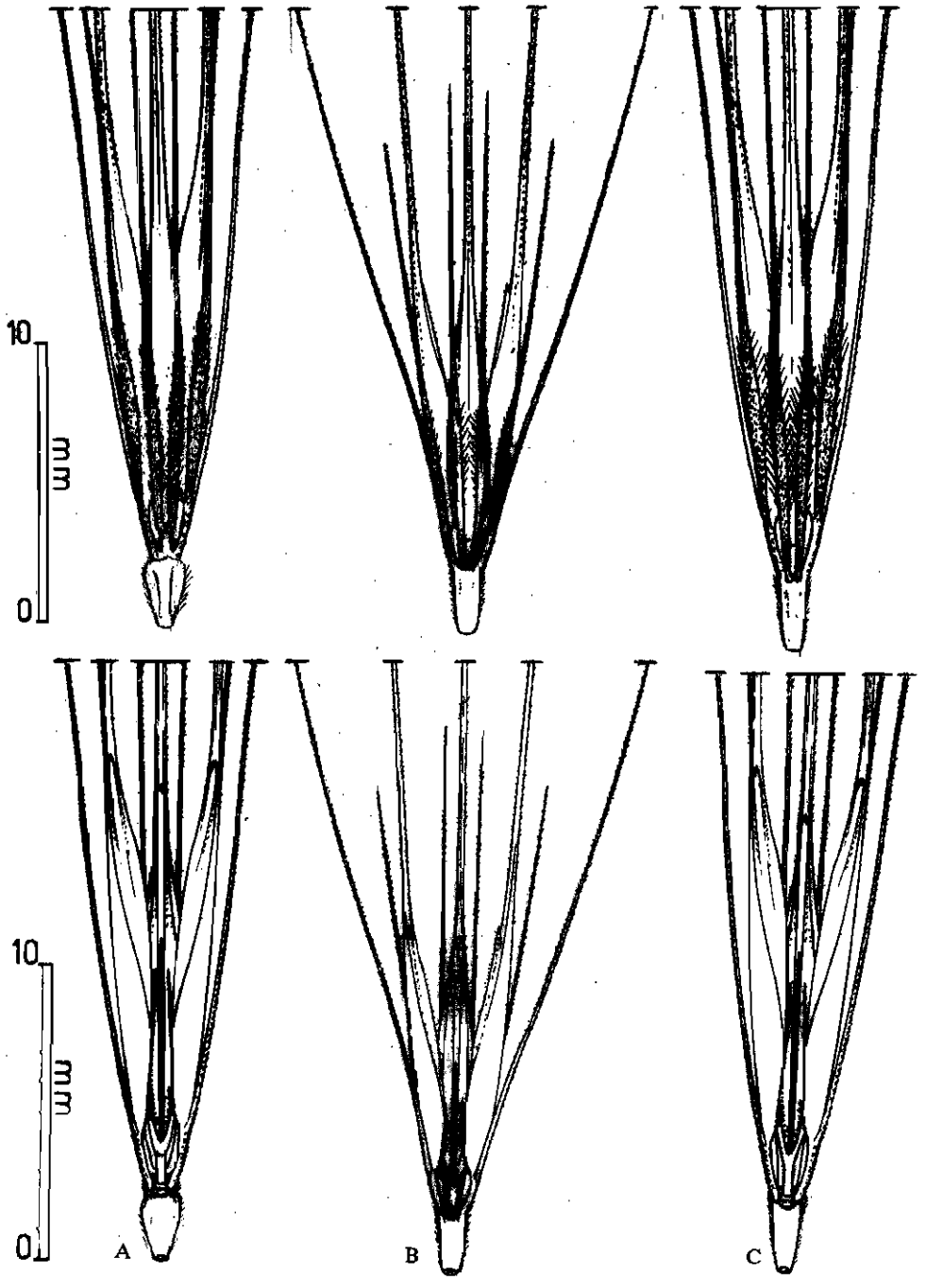

Fig. 4. Triplet of spikelets of *Hordeum murinum* s.l. seen from the abaxial side (above) and adaxial side (below).- A, *H. murinum* .- B, *H. glaucum*.- C, *H. leporinum*.

Key I to the taxa in *Hordeum murinum* s. l. based on five morphological characters: spike colour, pedicel presence in central floret, lateral spikelets rachilla prolongation shape and colour, and lateral florets palea vestiture.

1. Spike light green at anthesis, yellowish at maturity. Central floret sessile to subsessile. Rachilla of the lateral spikelets slender, light green; palea of the lateral florets almost glabrous ..... *Hordeum murinum* L.
   Spike green to glaucous at anthesis, ± purple or brownish at maturity. Central floret distinctly pedicellate. Rachilla of the lateral spikelets slender or stout, light green or orange-brown; palea of the lateral florets scabrous or hairy 2

2. Spike glaucous at anthesis, brownish at maturity. Rachilla of the lateral spikelets stout, orange brown; palea of the lateral florets hairy ..... *Hordeum glaucum* Steud.

   Spike light green at anthesis, ± purple at maturity. Rachilla of the lateral spikelets slender, light green; palea of the lateral florets scabrous ..... *Hordeum leporinum* Link

Key II to the taxa in *Hordeum murinum* s.l. based on four morphological characters: pedicel presence in central spikelet, anthers length of the central floret to those of the lateral ones, central and lateral florets anthers eolour, central floret lodicules margin vestiture.

1. Central spikelet distinctly pedicellate. Anthers length of the central and lateral florets almost equal; anthers in both florets yellowish. Lodicules margin of the central floret ciliate ..... *Hordeum murinum* L.

   Central spikelet sessile. Anthers length of the central and lateral florets equal or unequal; anthers in both florets yellowish, with or without small purple spots. Lodicules margin of the central floret ciliate or glabrous 2

2. Anthers length of the lateral florets much longer than those of the central ones; anthers both florets yellowish, with small purple spots. Lodicules margin of the central floret glabrous ..... *Hordeum glaucum* Steud.

   Anthers length of the central and lateral florets ± equal; anthers in both florets yellowish, without small purple spots. Lodicules margin of the central floret ciliate ..... *Hordeum leporinum* Link

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(Received for publication 18 November 2000)