



## Report on a cooperative cereal germplasm collection mission in Morocco

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### Abstract

*A cooperative cereal germplasm collection by INRA (Morocco) and Gifu University (Japan) was conducted from June 9 till July 19, 1995. The areas surveyed included the southern coasts, the western part of the Anti-Atlas, the High Atlas, the northern coasts, the Middle Atlas and the Rif. A total of 1,346 seed or spike samples belonging to 46 genera of 16 families and 534 plates of herbarium specimens belonging to more than 20 families were collected. The principal results were summarized as follows : a pure cultivation of einkorn wheat, *Triticum monococcum*, was found in the western foot of the Rif, where spike samples were collected. 143 samples of six *Aegilops* species were collected. Among them, three samples of *Ae. geniculata* ssp. *gibberosa* endemic to the western Mediterranean basin and 16 samples of *Ae. ventricosa*. A large-scaled collection of *Dasypyrum breviaristatum* consisted by 25 samples was made in the Middle Atlas and the High Atlas. The ecological feature of their habitat was analyzed. A total of 237 samples of two cultivated and 13 wild *Avena* species, including endemic ones to Morocco, were successfully collected. The genetic material collected is preserved and evaluated at INRA (all the material), Osaka Prefecture University (*Avena* spp.), Kyoto Prefectural University (herbarium specimens and *Lolium* spp.) and Fukui Prefectural University (*Triticeae* spp.).*

**Key words** : Cereals, collection, germplasm, *Aegilops*, *Avena*, *Dasypyrum*, *Haynaldia*, *Lolium*, *Triticum*, *Triticeae*

## Résumé : Rapport d'une mission de collecte de germoplasme au Maroc

Une mission de collecte de germoplasme de céréales a été effectuée au Maroc par une équipe Maroco-Japonnaise appartenant respectivement à l'INRA et à l'Université de la Préfecture de Gifu, du 9 Juin au 19 Juillet 1995. Les prospections ont eu lieu dans les régions côtières du sud, l'ouest de l'Anti-Atlas, le Haut Atlas, les régions côtières du nord, le Moyen Atlas et le Rif. Au total, 1346 graines et épis appartenant à 46 genres et 20 familles, et 534 planches d'herbier appartenant à plus de 20 familles ont été collectés. Les principaux résultats sont les suivants : une culture pure de *Triticum monococcum* a été trouvée dans la région montagneuse ouest du Rif, où des épis ont été ramassés. Par ailleurs, 143 échantillons de 6 *Aegilops* ont été collectés. Parmi lesquels, trois échantillons de *Ae. geniculata* ssp. endémiques à la région ouest du bassin méditerranéen et 16 échantillons de *Ae. Ventricosa*. En ce qui concerne *Dasypyrum breviaristatum*, 25 échantillons ont été collectés au Moyen Atlas et au Haut Atlas. L'écologie de leur sites de collecte a été étudiée. Un total de 237 échantillons de 2 avoines cultivées et de 13 avoines sauvages, dont certaines espèces sont endémiques au Maroc, a été ramassé. Tout le matériel génétique collecté est conservé et évalué à l'INRA, à l'Université de la Préfecture d'Osaka (*Avena* spp), et à l'Université Préfectoral de Fukui (*Triticeae* spp.)

**Mots clés :** Céréales, collection, germoplasme, *Aegilops*, *Avena*, *Dasypyrum*, *Haynaldia*, *Lolium*, *Triticum*, *Triticeae*

### ملخص : تقرير حول مهمة جمع مصادر وراثية للحبوب بالمغرب

أوهتا س. 1، زين العابدين ف. 2، موريكوات. 3، طوميناكا ت. 4، ملاس ح. 2 وفوروتا ي. 5.

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تمت خلال شهري يونيو ويوليوز 1996 رحلة جمع بعض المصادر الوراثية النباتية في أربع مناطق من المغرب. وقد تعلق الأمر في هذه الرحلة بالقمح والشعير والخرطال والسلالات ذات القرابة الوراثية لهم، وكذلك الأعشاب الضارة المرافقة لهم. وتم التوقف خلال الرحلة في 197 مكانا و جمع 944 مصدرا ينتمون إلى 46 نوعا و 16 عائلة.

ولقد تمّ كذلك خلال هذه الرحلة اكتشاف و جمع *Triticum monococcum* لأول مرة بالمغرب في جنوب شرق وهران. و قد تمّ جمع كل أنواع *Avena* المذكورة سابقا في مقالات أخرى. بالإضافة إلى الأصناف التالية : *Aegilops ventricosa*, *Ae. ovata* var. *latrista*, *Haynaldia hordeacea*

**كلمات مفتاحية :** جمع، احتفاظ، سلالات محلية. *Aegilops*, *Avena*, *Hordeum*, *Haynaldia*, *Triticum*, *Triticea*.

## Introduction

Morocco is well known as one of the diversity centers of the wild relatives of some cereal crops such as wheat, barley and oat (Sauvage, 1975; Baum, 1977; Molina-Cano and *al.*, 1982; Baum and Fedak, 1985a,b). Wild oats have their primary diversity center in Morocco (Baum, 1977). Three wild *Avena* species, *A. maroccana*, *A. agadiriana* and *A. atlantica* are endemic to this country (Baum and Fedak, 1985a,b). For the tribe *Triticeae*, some perennial species such as *Agropyron embergeri* Maire and *Festucopsis festucoides* (Maire) Love, are endemic to the High Atlas Mountains. Because of no living experimental material and few recent herbarium specimens, their phylogenetic position is still open to arguments. In addition to these endemic species, perennial *Dasypyrum* (*D. breviaristatum* (Lindb. f.) Frederiksen) is known to be distributed in two isolated regions: the mountainous regions of western North Africa and Mt. Taygetos in Greece (Maire, 1955 ; Sakamoto and Kobayashi, 1982; Frederiksen, 1991). However, the massive distribution of perennial *Dasypyrum* is restricted to Morocco. Cytogenetically, it comprises diploid and tetraploid cytotypes. The diploid cytotype was reported only once in Morocco by Sarkar (1957). While the tetraploid cytotype is distributed both in North Africa and Greece (Sakamoto and Kobayashi, 1982; Frederiksen, 1991). The tetraploid is an autotetraploid but the genomes are not homologous with those of the annual diploid relative, *Dasypyrum villosum* (L.) Cand. (Sakamoto, 1986). So far, no Moroccan genetic material of *D. breviaristatum* has been involved in cytogenetic works. Samples from Moroccan populations are indispensable to elucidate the phylogeny of the genus *Dasypyrum* (Cosson & Durieu) T. Durand. The genus *Aegilops* L. has its primary diversity center in the Middle East. However, the geographical distribution centers of some *Aegilops* species and intraspecific taxa are located in the western Mediterranean countries where *Ae. ventricosa* Tausch, *Ae. peregrina* (Hackel) Maire et Weiller ssp. *cylindrostachys* (Eig et Feinbrun) Hammer and *Ae. geniculata* Roth ssp. *gibberosa* (Zhuk.) Hammer are found (Eig, 1992 ; Maire, 1995).

In addition to the phylogenetic interest, these wild species have a high potential as a secondary or tertiary gene pool in cereal breeding programs. However, no systematic collection of wild *Triticeae* species has been carried out.

The purpose of the current cooperative botanical mission was to collect land-races of cereals, their wild relatives and weed species associated with crops. Main target plant groups were *Triticum*, *Hordeum*, and other species in the tribe *Triticeae* and *Avena*. This report presents an outline of the current field research and a summarized list of the genetic material col-

lected during the mission. For detailed information about collection sites and all the collected material, see Furuta and Ohta (1996).

## Material and methods

The collection was conducted from June 9 till July 19, 1995 in the following four geographical areas :

- Southern coasts and High Atlas (Provinces of Rabat, Casablanca, El Jadida, Essaouira, Agadir, Taroudant and Marrakech).
- Northern coasts (Provinces of Kénitra, Asilah, Larache, Tangiers and Tétouan).
- The Middle Atlas (Provinces of Meknès, Fès, Ifrane and Khénifra).
- The Rif (Provinces of Taounate, Taza and Al Hoceïma).

The schedule and route of the collection trips are shown in Table 1 and Figure 1.

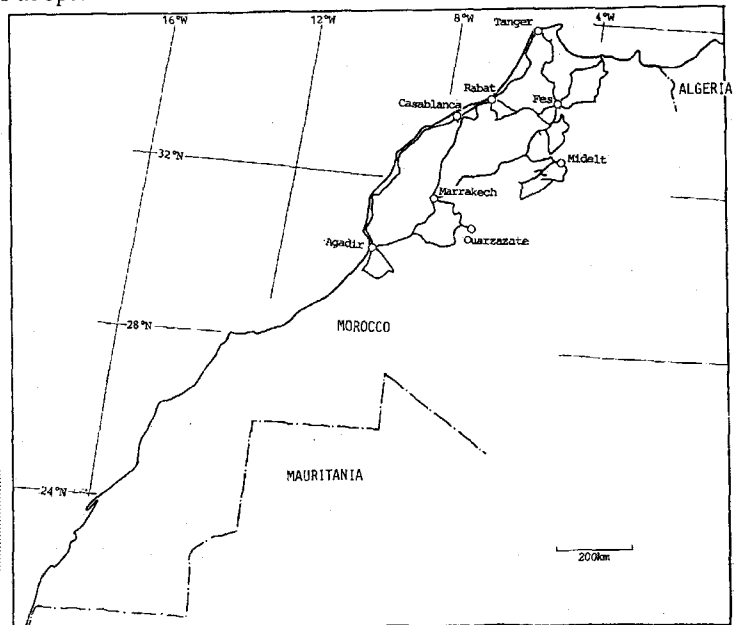
**Table 1.** Schedule and route of the collection trip

Date	Route
Trip 1	
June 9	Rabat - Casablaca - El Jadida
10	El Jadida - Oualidia - Safi - Tleta Sidi Bouguedra - Essaouira
11	Essaouira - Tamri - Agadir - Tiznit - Agadir
12	Agadir - Aït Baha - Tafraoute - Tiznit - Agadir
13	Agadir - Taroudant - Tizi n Test - Asni
14	Asni - Ijoukak - Mzouzite - Asni - Marrakech
15	Marrakech - Settat - Ben Slimane - Bouznika - Rabat
Trip 2	
June 17	Rabat - Tiflet - Khemisset - Rommani - Rabat
18	Rabat - Khemisset - Ifrane - Azrou
19	Azrou - Aïn Leuh - Azrou - Ifrane - Fès
20	Fès - Pont de Sebou - Ouezzane - Chefchaouen
21	Chefchaouen - Tetouan - Tanger
22	Tanger - Larache - Kénitra - Rabat
Trip 3	
June 27	Rabat - Fès - Taza
28	Taza - Aknoul - Al Hoceïma
29	Al Hoceïma - Ketama - Taounate - Fès
30	Fès - Rabat
Trip 4	
July 5	Rabat - Meknès - Ifrane - Azrou
6	Azrou - Timahdit - Boulâajoul - Boulemane - Tazout - Sefrou - Imouzer Kandar - Azrou
7	Azrou - Khénifra - Boumia - Midelt

8	Midelt
9	Midelt - Rich - Tirhibout n Sidi Hmad - Rich - Midelt
10	Midelt - Zaida - Tizi n Zou - Tagoudit - Massou
11	Massou - Tâarâat - Tagoudit - Tounfit - Asaka
12	Asaka - Tagoudit - Imilchil - Lac Tislit - Imilchil
13	Imilchil - Aït Hani - Assoul
14	Assoul - Rich - Zeida - Midelt
15	Midelt - Beni Mellal - Marrakech
16	Marrakech - Tizi n Test - Ouarzazate
17	Ouarzazate - Tazenakht - Taliouine
18	Taliouine - Tizi n Test - Asni
19	Asni - Marrakech - Rabat.

Cultivated species samples were collected in fields, from stacks after harvest, farmer's stocks and seed shops. Farmers were interviewed for information on cultivation and utilization of the crops. Associated weeds were sampled where crop spikes or seeds were collected. Wild species were collected along the roads at intervals of at least 10 to 20 km, as the target species were more or less of weedy or ruderal nature. Stops also were made to collect samples when populations of rare species were found. One spikelet or spike was sampled from each plant selected at random in the wild population or in cultivated fields. All the collected germplasm was divided into two parts, one for INRA and the other for the Japanese team. All the collected accessions in the genus *Avena* L. were identified into species by Morikawa, those in the family Gramineae (Poaceae) were identified by Ohta, and those in the other families were identified by Tominaga and Ohta. For the genus *Aegilops* L. (Gramineae), Hammer's nomenclature (1980) was adopted.

**Figure 1.** Route where collections were conducted



## Results and discussion

The total travel distance was 7,608 km (Fig. 1) and a total of 199 sites were sampled. The collection included 584 samples representing 11 genera of the tribe Triticeae, 557 samples of more than 9 genera in the other tribes of Gramineae, 84 accessions of Leguminosae, 16 of Caryophyllaceae and 50 samples of associated weeds. A total of 1,346 seed and spike samples belonging to 46 genera of 16 families were collected (Table 2).

**Table 2.** A summarized list of the seed material collected

Plant species	Number of samples
Cultivated wheats	230
<i>Triticum aestivum</i>	104
<i>T. durum</i>	125
<i>T. monococcum</i>	1
Aegilops species	143
<i>Aegilops geniculata</i>	64
<i>Ae. lorentii</i>	8
<i>Ae. neglecta</i>	19
<i>Ae. peregrina</i>	3
<i>Ae. triuncialis</i>	33
<i>Ae. ventricosa</i>	16
Barley, rye and their wild relatives	163
<i>Hordeum vulgare</i>	76
<i>H. bulbosum</i>	2
other wild <i>Hordeum</i> species	78
<i>Secale cereale</i>	6
X <i>Triticosecale</i> species	1
wheat and barley seed samples	5
Other wild Triticeae species	48
<i>Agropyron species</i>	6
<i>Crithopsis delileana</i>	1
<i>Eremopyrum orientale</i>	1
<i>Dasypyrum breviaristatum</i>	25
<i>Taeniatherum</i> species	14
X <i>Aegilotricum</i> species	1
Cultivated oats	13
<i>Avena byzantina</i>	1
<i>A. sativa</i>	12
Wild and weedy oats	224
<i>Avena agadiriana</i>	6
<i>A. atlantica</i>	8

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<i>A. barbata</i>	31
<i>A. canariensis</i>	1
<i>A. damascena</i>	20
<i>A. eriantha</i>	4
<i>A. fatua</i>	13
<i>A. hirtula</i>	21
<i>A. logiglumis</i>	3
<i>A. maroccana</i>	7
<i>A. murphyi</i>	1
<i>A. prostrata</i>	1
<i>A. sterilis</i>	99
Not identified	9
Other cereals and their wild relatives	12
<i>Panicum miliaceum</i>	1
<i>Setaria verticillata</i>	1
<i>Sorghum bicolor</i>	4
<i>Zea mays</i>	6
Other wild Gramineae species	308
<i>Brachypodium</i> species	5
<i>Bromus</i> species	129
<i>Lolium temulentum</i>	8
Other <i>Lolium</i> species	57
<i>Trachynia distachya</i>	65
Others	44
Other plant species	200
Caryophyllaceae species	16
Compositae species	7
Cruciferae species	4
Dipsacaceae species	4
Iridaceae species	5
Leguminosae species	84
Liliaceae species	6
Papaveraceae species	5
Weed samples	50
Others	19
TOTAL	1.346

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## Cultivated wheats

During the field trip, 125 samples of *Triticum durum* Desf, 104 of *T. aestivum* L., and one sample of *Triticum monococcum* L. were collected. Cultivation of *T. monococcum* was already reported by Harlan (1992) and Jakubziner (1995). In the current mission, on June 20, a pure

cultivation of the einkorn wheat, *T. monococcum*, was found in a village at the western foot of the Rif Mountains, Aïn -Derej, 40 km southeast from Ouazzane on the way to Fès (collection no. 1995-6-20-5A-1, Fig. 2).

The elevation of the village was 250 m above sea level. In the location where *T. monococcum* was sampled, olive trees, barley and wheat were grown on the slope of both sides of a small river where *Nerium* species. According to a local farmer, it doesn't snow in winter in this village. *T. monococcum* was cultivated in a small plot (10 m x 5 m ) between a barley field and a bread wheat field, and it already ripened as well as barley and bread wheat around it . The local farmer distinguished *T. monococcum* from the other cereals and called it " *chekalia* ". When interviewed, he told us that the crop was sowed last December and would be harvested the following day. As his father and grand father did, he used *T. monococcum* straws to roof a cowshed because of their strength and capacity to stop water from dripping (Fig. 3). This information strongly suggests that the *chekalia* cultivation is a remnant of the past large-scaled cultivation of *T. monococcum* in this area.

**Figure 2.** A cultivated field of *Triticum monococcum* at Ain-Derej, 40 km southeast from Ouazzane on the way to Fes (250m above sea level)



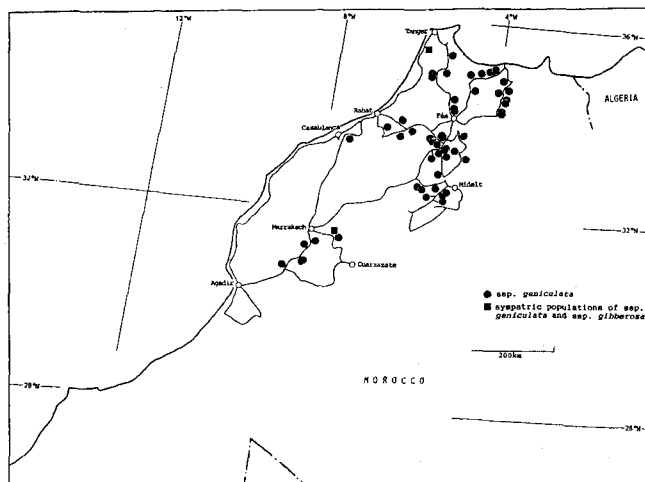
**Figure 3.** A shed for cattle roofed with the stems of *Triticum monococcum* called Chekalia





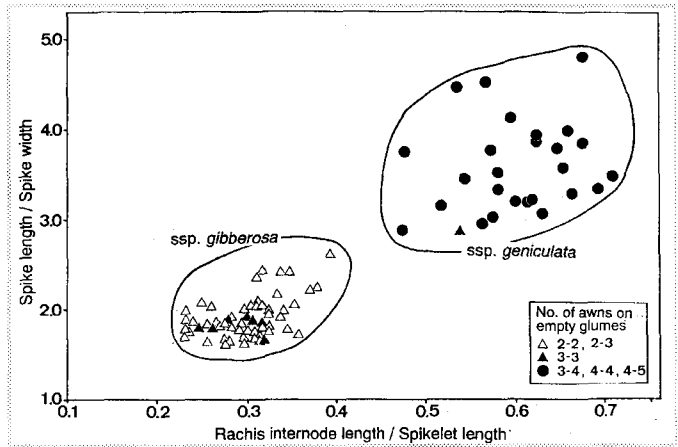
## Aegilops species

A total of 143 samples of six *Aegilops* species were collected. Sixty-four samples of *Ae. geniculata* were collected at 58 sites in the Middle Atlas, the northern part of the High Atlas, the Rif Mountains and the northern coastal provinces. Subspecies *gibberosa* var. *latiaristata* (Lange) Hammer was sporadically found in three sites, where it grew on terra rossa soil in association with ssp. *geniculata* (Fig. 4). Randomly sampled spikes at one of these sites, a margin of a pine plantation at 54 km east from Marrakech on the way to Taddert, were morphologically analyzed (Fig. 5). In fact, two subspecies were clearly identified. Their identification was based on the difference in spike shape (spike length/spike width), density of spikelets on spike (rachis internode length/spikelet length), and the number of awns on empty glumes. This analysis showed that the two subspecies of *Ae. geniculata* were morphologically distinguishable from each other and that no introgression occurred between them. Sixteen samples of *Ae. ventricosa* were collected from 14 sites, located in the Middle Atlas, the High Atlas and the western part of the Anti-Atlas (Fig. 6). Collection site elevation was above 1,200 m (1,270 m to 2,310 m), except one location near Khemisset where it reached only 430 m above sea level. Concerning the other four *Aegilops* species (*Ae. lorentii*, *Ae. neglecta*, *Ae. peregrina* and *Ae. triuncialis*), the collection localities are shown in (Fig. 7). Thirty-three samples of *Ae. triuncialis* L. were collected mainly in the Rif and the Middle Atlas, but not in the High Atlas. However, *Ae. neglecta* Req. ex Bertol. was sampled in 18 sites mainly in the Middle Atlas and the High Atlas. Three samples of *Ae. peregrina* ssp. *cylindrostachys* were collected from Maâmora forest, while *Ae. lorentii* Hochst. was sampled in eight sites in the northern slope of the High Atlas.

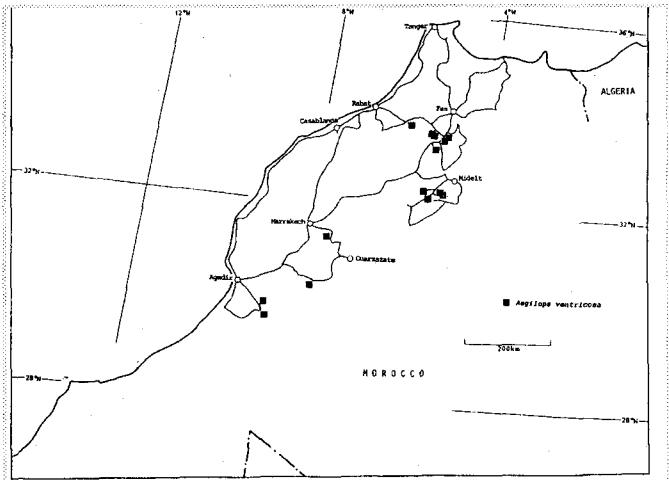


**Figure 4.** Collection sites of the two subspecies of *Aegilops geniculata*

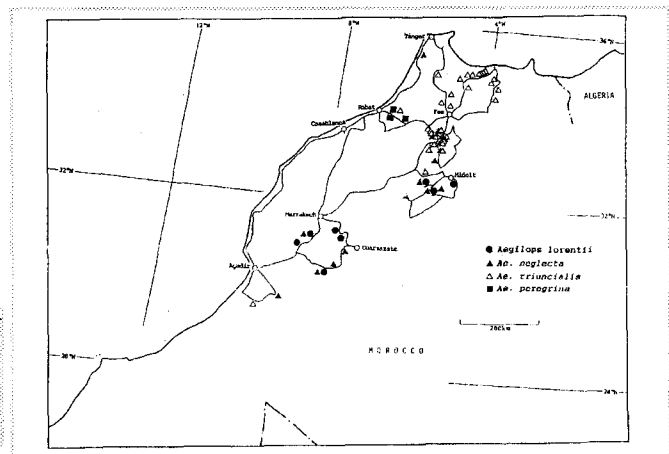
**Figure 5.** Variation in spike morphology of *Aegilops geniculata* collected at a sympatric population of the two subspecies at 54 km east from Marrakech on the way to Taddert.



**Figure 6.** Collection sites of *Aegilops ventricosa*



**Figure 7.** Collection sites of *Aegilops lorentii*, *Ae. neglecta*, *Ae. triuncialis* and *Ae. peregrina*.



## Barley, its wild relatives and rye

A total of 76 spike samples of two-rowed and six-rowed barley, *Hordeum vulgare* L., were collected in the northern coastal region as well as two samples of *H. bulbosum* L. Seventy-eight samples of wild *Hordeum* species were also collected, and their identification into species is now in progress. Rye, *Secale cereale* L., was sampled from two rye fields, two barley fields, a bread wheat field and a durum wheat field. Five of them were found in a mountainous region where elevation is higher than 1.000 m and the other near Rabat at about 400 m above sea level. Besides these samples, a sample of triticale was collected in the southern coastal region. It vigorously grew in spite of winter drought.

## Other wild Triticeae species

Forty-seven samples of the other four triticeae genera were collected from 36 sites in the mountainous regions (Fig. 8). Twenty five samples of perennial *Dasypyrum breviaristatum* were collected from 21 sites in the Middle Atlas and the northern slope of the High Atlas (Fig. 8). Collection site elevation and ecological feature of collection sites are presented in Table 3.

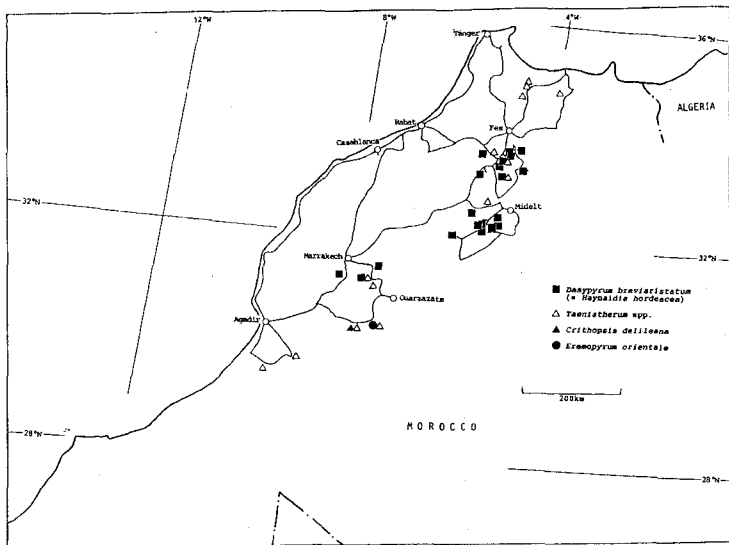


Figure 8. Collection sites of the genera *Dasypyrum*, *Taeniattherum*, *Crithopsis* and *Eremopyrum*.

**Table 3** . Elevation and ecological feature of the 21 sites where *Dasypyrum breviaristatum* was collected.

Site No.	Elevation (m)	Habitat <sup>1</sup>	Soil color	Bed <sup>3</sup> rock	Surrounding vegetation
6-14-7	1,050	a	brown	C	<i>Quercus Pistacia</i>
6-18-7	1,270	a	red	C	<i>Quercus</i>
6-18-10	1,600	b	red	C	<i>Quercus</i>
6-19-3	1,110	a	brown	C	n.d. <sup>2</sup>
6-19-10	1,510	b	brown	C	<i>Quercus</i>
6-30-2	1,300	c	red	C	<i>Quercus</i>
7-5-2	1,600	a	red	C	<i>Quercus</i>
7-6-1	1,750	a	brown	C	n.d.
7-6-7	1,490	a	gray	C	<i>Quercus</i>
7-6-9	1,490	a	brown	C	<i>Quercus, Abies</i>
7-6-10	1,550	b	brown	C	<i>Quercus, Abies</i>
7-7-6	1,920	b	brown	C	<i>Quercus</i>
7-10-2	1,910	a	gray	C	<i>Abies</i>
7-10-4	2,060	a,b	brown	C	n.d.
7-11-1	2,130	a,b	brown	C	n.d.
7-11-3	2,120	a	gray	C	<i>Quercus</i>
7-11-4	1,980	a	gray	C	<i>Quercus</i>
7-12-1	2,310	a	n.d. <sup>2</sup>	C	n.d.
7-12-4	2,250	d	gray	C	n.d.
7-16-2	1,400	a	red	C	<i>Quercus</i>
7-16-5	2,160	d	yellowish	C	n.d.

gray

<sup>1</sup> a : road side or margin of crop fields, b: open lots or abandoned fields

c: open oak forests, d : grasslands.

<sup>2</sup> n.d : no description.<sup>3</sup> C : calcareous rock.

*D. breviaristatum* habitats were different from site to site. However, it occurred at an elevation higher than 1,000 m and on naturally or artificially disturbed terra rossa or loess soil, on calcareous bedrock. Concerning the genus *Taeniatherum* Nevski which has two diploid species, 14 samples were collected in the Rif, the Middle Atlas, the High Atlas and the Anti-Atlas (Fig. 8). For the genera *Crithopsis* Jaub. et Spach and *Eremopyrum* (Ledeb.) Jaub. et Spach, all the collected samples were located in the dry southern foot of the High Atlas (Fig. 8). Two samples of *Agropyron elongatum* (Host) P. Beauv. and of *Ag. junceum* (L.) P. Beauv. were collected, one in wet land in the northern coast and the other one in a sandy seashore in the southern coast, respectively. *Ag. cristatum* (L.) Gaertner was sampled in the southern bank of Lake Tislit in the High Atlas.

## Cultivated and wild oats

Thirteen samples of the two cultivated oat species as well as 224 samples of 13 wild *Avena* species, including those endemic to Morocco, were collected during this research trip. Detailed collection data for the genus *Avena* will be published soon.

## Herbarium specimens

In addition to seed and spike collections, a total of 534 plates of herbarium specimens were made. They belong to more than 20 families and are now under identification.

## Conclusion

Due to the increasing genetic erosion Morocco is suffering from, systematic collections of important plant genetic resources should be carried out. The present collection mission made a great contribution to the conservation of cultivated cereals, their wild relatives and associated weeds in Morocco. The collected genetic material is preserved and evaluated at INRA (all the accessions), Osaka Prefecture University (*Avena* spp.), Kyoto Prefectural University (herbarium specimens and *Lolium* spp) and Fukui Prefectural University (*Triticeae* spp). It will be certainly used by Moroccan national cereal breeding programs to develop outstanding commercial varieties.

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## References

- Baum, BR 1977. Oats: Wild and cultivated. Yale University Press. New Haven. 422 pp.
- Baum, BR, and G. Fedak. 1985a. *Avena atlantica*, a new diploid species of the oat genus from Morocco. Can. J. Bot. 63 : 1057-60.
- Baum, BR, and G. Fedak. 1985b. A new tetraploid species of *Avena* discovered in Morocco. Can. J. Bot. 63 : 1379-85.

- Eig, A. 1929. Monographisch-Kritische Uebersicht der Gattung *Aegilops*. *Repert. Spec. Nov. Regni veg.* 55 : 1-228.
- Frederiksen, S. 1991. Taxonomic studies in *Dasyphyrum* (Poaceae). *Nord. J. Bot.* 11 : 135-142.
- Furuta, Y., and S. Ohta. 1996. A preliminary report of 'The Gifu University Scientific Exploration in the Mediterranean Region in 1995 (GSEM95)'. Faculty of Agriculture, Gifu University, Gifu, 71 pp.
- Eig, A. 1929. Monographisch-Kritische Uebersicht der Gattung *Aegilops*. *Repert. Spec. Nov. Regni veg.* 55 : 1-228.
- Frederiksen, S. 1991. Taxonomic studies in *Dasyphyrum* (Poaceae). *Nord. J. Bot.* 11 : 135-142.
- Furuta, Y., and S. Ohta. 1996. A preliminary report of « The Gifu University Scientific Exploration in The Mediteranean Region in 1995 (GSEM95) ». Faculty of Agriculture, Gifu University, Gifu, 71pp.
- Hammer, K. 1980. Vorarbeiten zur monographischen Darstellung von Wildpflanzensortimenten : *Aegilops* L. *Kulturpflanze* 28 : 33-180.
- Harlan, J.R. 1992. *Crops and man* (2nd ed.). American Society of Agronomy and Crop Science Society of America, Madison, 284 pp.
- Jakubziner, M. M. 1959. New wheat species. In Jenkins, B. C. ed., *Proceedings of the First International Wheat genetics Symposium*, University of Manitoba, Manitoba, pp. 207-220.
- Maire, R. 1955. *Flore de l'Afrique du Nord* 3. Paul Lechevalier, Paris, 399 pp.
- Molina-Cano, J.L., C. Gomèz-Campo, and J. Conde. 1982. *Hordeum spontaneum* C. Koch as a weed of barley fields in Morocco. *Z. Pflanzeng, chtg.* 88 : 161-167.
- Sakamoto, S. 1986. Genome analysis of polyploid form of *Haynaldia hordeacea* in the tribe Triticeae Gramineae. In Li, Z., and M. S. Swaminathan eds. *Proceedings of the First International Symposium on Chromosome Engineering in Plants*, Xian, pp. 52-53.
- Sakamoto, S., and H. Kobayashi. 1982. Variation and geographical distribution of cultivated plants, their wild relatives and weeds native to Turkey, Greece and Romania. In Y. Tani ed., *Preliminary report of comparative studies on the agrico-pastoral people in southwestern Eurasia*, Research Institute for Humanistic Studies, Kyoto University, Kyoto, pp. 41-104.
- Sarkar, P. 1957. A new diploid form of *Haynaldia hordeacea* Hack. *Wheat Inform. Serv.* 6 : 22.
- Sauvage, C. 1975. L'état actuel de nos connaissances sur la flore du Maroc. Dans « *La Flore du Bassin Méditerranéen* ». *Essai de Systématique Synthétique*. pp. 131-42. (CNRS, Paris).