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# 8.2

# Wild wheats in southern Italy

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The conservation of wheat genetic resources, both cultivated species and wild relatives, has been given high priority by the International Board for Plant Genetic Resources (IBPGR) because of the worldwide importance of the crop and the threat of genetic erosion (Croston and Williams, 1981). The importance of wild relatives in wheat research and breeding is well known (Feldman and Sears, 1981; Chapman, 1986). In order to collect adequate and representative diversity, priorities per country and per species were established by IBPGR (Chapman, 1985).

In Italy, the germplasm of cultivated wheats has been adequately collected. However, until the late 1980s little exploration had been done for the wild wheats (Yamashita, 1959; Perrino et al., 1982, 1984). IBPGR sought to encourage national programmes to collect the germplasm of wild wheats throughout the peninsula (Laghetti et al., 1992) and during the summers of 1989 and 1990 three expeditions were carried out in southern Italy and Sicily to collect germplasm of wild wheats and related genera and species.

## COLLECTION STRATEGY

On the basis of the species distribution area which has been reported in several floras of Italy (Fiori, 1923; Tutin, 1980; Pignatti, 1982) and additional information obtained during previous collecting missions, the regions of southern Italy which were visited were Apulia, Basilicata, Calabria and Campania. As ecological factors are a major determinant of genetic diversity, the collecting strategy was defined on an ecogeographical basis. Environmentally distinct areas were identified according to temperatures, rainfall, elevation, soil type and vegetation (Milone, 1956; Colamonico, 1960; Rossi Doria, 1963; Ruocco, 1970). A large grid was then adopted and sites to be visited were randomly selected within ecologically homogeneous regions. The sampling, however, was biased towards collecting material near main roads, for ease of access. This sampling strategy was chosen to gain first-hand information from a large geographic region where highly diversified micro-environments are present.

## SPECIES COLLECTED

In total, 315 samples of 21 species belonging to seven genera were collected (*see* Table 1).

**Table 1** **Number of samples of wild wheats and related genera collected from sites in southern Italy and Sicily**[a]

| Species | Apulia | Basilicata | Calabria | Sicily | Total |
|---|---|---|---|---|---|
| *Aegilops* | | | | | |
| *Ae. geniculata* | 25 | 9 | 6 | 51 | 91 |
| *Ae. neglecta* | 6 | — | 11 | 2 | 19 |
| *Ae. triuncialis* | — | — | 6 | 5 | 11 |
| *Ae. biuncialis* | 3 | — | — | — | 3 |
| *Ae. ventricosa* | — | 1 | — | — | 1 |
| *Ae. uniaristata* | 1 | — | — | — | 1 |
| *Aegilops* species | — | 2 | 2 | 11 | 15 |
| Total *Aegilops* | 35 | 12 | 25 | 69 | 141 |
| *Agropyron* | | | | | |
| *Ag. elongatum* | 15 | 6 | — | — | 21 |
| *Ag. junceum* | 7 | 4 | — | 3 | 14 |
| *Ag. pungens* | 5 | 4 | 1 | — | 10 |
| *Ag. repens* | 5 | 3 | — | — | 8 |
| *Ag. intermedium* | 1 | 1 | — | — | 2 |
| *Agropyron* species | 2 | — | — | 3 | 5 |
| *Ag. repens* x *Ag. pungens* | 1 | — | — | — | 1 |
| Total *Agropyron* | 36 | 18 | 1 | 6 | 61 |
| *Hordeum* | | | | | |
| *H. murinum* | nc[a] | nc | nc | 18 | 18 |
| *H. bulbosum* | nc | nc | nc | 13 | 13 |
| *H. marinum* | nc | nc | nc | 1 | 1 |
| *Hordeum* species | nc | nc | nc | 1 | 1 |
| Total *Hordeum* | nc | nc | nc | 33 | 33 |
| *Aegilotricum* | 3 | — | 1 | 2 | 6 |
| *Dasypyrum villosum* | 32 | 10 | 4 | 23 | 69 |
| *Secale strictum* | — | — | 2 | 3 | 5 |
| Total samples | 106 | 40 | 33 | 136 | 315 |
| Collection sites | 47 | 19 | 24 | 62 | 152 |

Note: a Not considered.

### *Aegilops* species

A total of 141 samples of six different species of *Aegilops* were collected. *Ae. geniculata* Roth (syn. *Ae. ovata* auct. non L.) and *Ae. neglecta* Req. ex Bertol. (syn. *Ae. triaristata* Willd.) were the only species of Italian origin; they were already present in germplasm collections, as was one sample of *Ae. uniaristata* collected in 1980 (Perrino et al., 1981). *Ae. geniculata* is very common in all the regions visited, particularly on untilled and barren lands but also in disturbed areas; *Ae. neglecta* grows in similar habitats but is less common and was not found in Basilicata.

*Ae. triuncialis* L. is not widespread in southern Italy; it was collected only in Calabria and Sicily where it occurred in natural pastures. *Ae. biuncialis* Vis. (syn. *Ae. lorentii* Hochst.) and *Ae. uniaristata* Vis. are very rare in Italy (Bianco et al., 1988; Bianco et al., 1989); three samples of the former and one of the latter (only two spikes) were collected in Apulia at four new sites. It was observed that *Ae. biuncialis* always grew near *Ae. geniculata*. A small population of *Ae. ventricosa* Tausch. was gathered in Potenza, along a little path near an oak wood. Its presence in southern Italy is not reported in the floras cited earlier. The spikes were characterized by fragile rachides.

### *Aegilotricum wagner*

Six samples of the rare *Aegilotricum wagner* were found in Apulia, Calabria and Sicily but only one had fertile spikes. The specimens show characteristics intermediate between *Aegilops geniculata* and *Triticum aestivum*. Only in one case were the probable parents present on the same site where the hybrid was found. In one sample, plants showing different degrees of resemblance to wheat and *Aegilops* were included. Vavilov (1951) observed similar cases of natural hybridization between hard wheats and species of *Aegilops* in Sicily. More recently, other researchers have found *Aegilotricum* specimens during collecting missions in the Mediterranean area Perrino et al., 1976a, 1976b; (Perrino and Porceddu, 1990). According to preliminary observations, *Ae. geniculata* appears to be the female parent.

### *Agropyron* species

For this genus, 60 samples of five *Agropyron* species were collected. *Ag. elongatum* (Host) Beauv. was found on clay and coastal saline soils in Apulia, Basilicata and Campania, but it was not found in Sicily, which contrasts with reports in several Italian floras. *Ag. junceum* (L.) Beauv. was collected on coastal sandy dunes of the Ionian and Thyrrenian seas, where it thrives because of its high salt resistance. However, in Sicily, building activities and the expansion of coastal settlements have destroyed the natural habitat of the species, greatly reducing its growing area. *Ag. pungens* (Pers.) R. and S., which has shorter internodes than *Ag. junceum* but is phenotypically very similar, was gathered both on sandy dunes and clay soils; the collected samples were characterized by polymorphic leaves, spikes and spikelets, and few genotypes had bearded lemmas. *Ag. repens* (L.) Beauv. was common in all the visited regions apart from Sicily where, again, human activity has brought about a fast genetic erosion of the species; variation was observed for plant colour (from green to almost blue) and awn length (some plants were beardless). Samples of *Ag. intermedium* (Host) Beauv., a species more frequent in north-central Italy, were gathered at two collecting sites in Basilicata and in Apulia. A possible hybrid between *Ag. pungens* and *Ag. repens* was also collected, but the presumed parents were not present in the vicinity.

### *Dasypyrum villosum*

A total of 69 samples of *Dasypyrum villosum* (L.) Borb's were collected. This species is common in all the explored regions except in the central part of Calabria on the Thyrrenian side. The preferred habitats were untilled and dry lands, roadsides and ruins. The germplasm collected had varying plant height, spike length, degree of tillering and spike colour (yellow, white, black and dark red).

### *Hordeum* species

*Hordeum murinum* L. is the most widely distributed species of wild barley in Italy; 18 samples were collected, together with 13 of *H. bulbosum*, less common than the former species and found most often in association with it. A population of the rare *H. marinum* Huds. was also found.

## EVALUATION OF SPECIES COLLECTED

All this genetic material is stored in Bari. The *Aegilops* collection was also duplicated and stored at the University of Basilicata (Potenza) and is ready for distribution. Evaluation of *Ae. geniculata* has been completed, while that of *Agropyron* species is still in progress. An analysis of variance for 10 traits on 20 accessions of *Ae. geniculata* is shown in Table 2; there were significant differences for all traits between regions of origin and between the accessions within each region. The simple correlations between the 10 traits previously considered are reported in Table 3. As expected, flag leaf length and width were significantly and positively correlated (r = 0.31); correlation coefficients among flag leaf length and spike and seed characteristics were all significantly different from zero; flag leaf width showed the same trend, apart from its correlations with spikelets per spike, spike and seed length, and seed width. Flag leaf size is an important trait; in bread wheat it has provided a useful parameter for selection of high yielding plants (Volden and Simpson, 1967; Briggs and Aytenfisu, 1980) or for a

**Table 2** **Analysis of variance for 10 traits in 20 accessions of *Aegilops geniculata* from southern Italy**

| Trait | Error df | Mean square | | |
|---|---|---|---|---|
| | | Error | Regions[a] | Accessions (region)[b] |
| Flag leaf width (mm) | 1372 | 0.08 | 1.87[c] | 0.55[c] |
| Flag leaf length (mm) | 1372 | 1.84 | 364.11[c] | 29.73[c] |
| Seed width (mm) | 462 | 0.00 | 0.02[c] | 0.03[c] |
| Seed length (mm) | 443 | 0.01 | 0.11[c] | 0.06[c] |
| Spike length (mm) | 443 | 0.13 | 3.80[c] | 1.42[c] |
| Seeds/spike (no.) | 443 | 3.75 | 162.41[c] | 24.04[c] |
| Spikelets/spike (no.) | 443 | 0.22 | 3.85[c] | 0.69[c] |
| Weight of seeds/spike (g) | 443 | 0.00 | 0.13[c] | 0.01[c] |
| Spike weight (g) | 443 | 0.01 | 0.91[c] | 0.11[c] |
| Heading time (days) | 935 | 8.38 | 6700.68[c] | 2452.88[c] |

Note: a = 3 df; b =16 df; c = signifcant variations ($p < 0.001$).

**Table 3** **Simple correlation between 10 traits in *Aegilops geniculata* (minimum of 374 and maximum of 1392 observations used in each correlation analysis)**

| | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Flag leaf width | -0.05 | 0.15[a] | 0.12[a] | 0.09 | 0.15[a] | 0.07 | 0.09 | 0.06 | 0.31[c] |
| 2 | Flag leaf length | -0.32[c] | 0.46[c] | 0.39[c] | -0.19[c] | 0.29[c] | 0.27[c] | 0.18[c] | 0.16[c] | |
| 3 | Seed width | 0.02 | 0.17[c] | 0.22[c] | -0.07 | 0.13[a] | 0.03 | -0.12[b] | | |
| 4 | Seed length | -0.15[a] | 0.42[c] | 0.47[c] | 0.17[c] | 0.23[c] | 0.34[c] | | | |
| 5 | Spike length | -0.40[c] | 0.62[c] | 0.58[c] | 0.63[c] | 0.54[c] | | | | |
| 6 | Seeds/spike | -0.45[c] | 0.75[c] | 0.76[c] | 0.54[c] | | | | | |
| 7 | Spikelets/spike | -0.25[c] | 0.46[c] | 0.41[c] | | | | | | |
| 8 | Weight of seeds/spike | -0.45[c] | 0.91[c] | | | | | | | |
| 9 | Spike weight | -0.58[c] | | | | | | | | |
| 10 | Heading time | | | | | | | | | |

Note: a = significant at p = 0.01; b = significant at p = 0.05; c = significant at p = 0.001.

larger number of seeds per spike (Simpson, 1968; Joshi et al., 1982). Correlation coefficients above 0.60 were obtained only for spike weight with spike length, seeds per spike and weight of seeds per plant, spike length with spikelets per spike, and seeds per spike with weight of seeds per plant. Heading time was significantly and negatively correlated with all traits, apart from flag leaf and seed width.

The accessions of *Ae. geniculata* considered in this study were also significantly correlated with the elevation of the collection sites, but with relatively low values and only for three traits: flag leaf length (-0.07), spike weight (-0.15) and heading time (0.11) (*see* Table 4).

The regions of origin of the material and the relative coefficient of variation (CV) for each trait are shown in Table 5 (*overleaf*). The most variable characters were weight of seeds per plant (CV = 41.54) and spike weight (CV = 36.77), while the lowest variability was observed in heading time (CV = 5.29).

**Table 4** **Correlation coefficients between means of morphological traits and altitude of the collection sites in *Aegilops geniculata***

| Code | Traits | (No. of observations) | Altitude |
|---|---|---|---|
| FLW | Flag leaf width | (1392) | -0.05 |
| FLL | Flag leaf length | (1392) | -0.07[a] |
| SDW | Seed width | (463) | -0.03 |
| SDL | Seed length | (463) | -0.01 |
| SPL | Spike length | (463) | 0.04 |
| SDP | Seeds/spike | (463) | -0.04 |
| SKS | Spikelets/spike | (463) | -0.06 |
| WSS | Weight of seeds/spike | (463) | 0.02 |
| SPW | Spike weight | (463) | -0.15[a] |
| HET | Heading time | (955) | 0.11[b] |

Note: a = significant at p < 0.01; b = significant at p < 0.001.

**Table 5** Coefficients of variation (CV) for 10 traits in *Aegilops geniculata* from southern Italy[a]

| Regions | FLW | SDW | FLL | SDL | SPL | SDP | SKS | WSS | SPW | HET |
|---|---|---|---|---|---|---|---|---|---|---|
| Apulia | | | | | | | | | | |
| MG | | | | | | | | | | |
| 95443 | 17.46 | 19.49 | 23.33 | 11.84 | 13.21 | 21.02 | 8.19 | 32.56 | 20.88 | 0.63 |
| 95436 | 20.28 | 13.97 | 22.38 | 8.62 | 17.85 | 19.85 | 11.48 | 24.78 | 18.73 | 1.32 |
| 95439 | 18.35 | 20.79 | 24.89 | 13.97 | 14.70 | 20.29 | 16.14 | 32.14 | 27.91 | 0.00 |
| 95416 | 22.37 | 20.76 | 38.24 | 9.51 | 10.30 | 26.51 | 13.08 | 45.45 | 32.39 | 2.87 |
| 95418 | 27.52 | 18.56 | 9.82 | 9.82 | 11.10 | 23.78 | 14.42 | 27.70 | 25.77 | 1.29 |
| Subtotal | 23.78 | 22.05 | 30.83 | 12.50 | 16.63 | 23.17 | 13.83 | 33.97 | 26.97 | 3.90 |
| Basilicata | | | | | | | | | | |
| MG | | | | | | | | | | |
| 95441 | 17.37 | 15.26 | 23.00 | 11.14 | 13.72 | 21.19 | 14.59 | 37.87 | 30.46 | 0.00 |
| 95480 | 16.97 | 16.11 | 23.21 | 14.62 | 11.79 | 27.54 | 8.90 | 41.42 | 32.92 | 4.39 |
| 95430 | 22.70 | 13.93 | 31.46 | 17.82 | 14.43 | 17.57 | 9.09 | 37.43 | 29.04 | 0.63 |
| 95428 | 21.59 | 14.65 | 31.04 | 12.55 | 10.93 | 17.31 | 11.57 | 26.15 | 19.86 | 2.05 |
| 95408 | 15.48 | 20.84 | 25.70 | 11.84 | 17.19 | 19.47 | 10.94 | 25.60 | 30.69 | 1.11 |
| Subtotal | 19.69 | 19.33 | 28.51 | 15.23 | 15.01 | 27.24 | 11.59 | 38.54 | 37.41 | 6.73 |
| Calabria | | | | | | | | | | |
| MG | | | | | | | | | | |
| 95457 | 20.77 | 23.61 | 25.95 | 10.97 | 12.39 | 15.73 | 12.33 | 27.77 | 22.72 | 1.13 |
| 95692 | 18.57 | 20.76 | 23.18 | 10.61 | 10.39 | 21.97 | 8.69 | 33.45 | 19.07 | 0.84 |
| 95471 | 19.11 | 13.61 | 18.52 | 4.91 | 11.53 | 19.02 | 11.73 | 18.80 | 16.14 | 0.00 |
| 95691 | 19.41 | 0.00 | 21.27 | 7.82 | 10.32 | 20.35 | 13.06 | 41.91 | 29.21 | 0.00 |
| 95458 | 19.42 | 8.99 | 22.31 | 9.81 | 13.52 | 16.14 | 9.80 | 27.35 | 26.32 | 2.49 |
| Subtotal | 19.50 | 19.35 | 25.50 | 9.66 | 15.29 | 19.80 | 11.35 | 32.07 | 28.17 | 3.78 |
| Sicily | | | | | | | | | | |
| MG | | | | | | | | | | |
| 95671 | 18.55 | 14.72 | 18.31 | 9.29 | 12.99 | 17.91 | 11.54 | 15.20 | 11.76 | 2.21 |
| 95667 | 20.37 | 10.11 | 23.20 | 11.30 | 10.70 | 27.45 | 10.67 | 36.53 | 28.77 | 1.72 |
| 95682 | 18.08 | 17.45 | 16.04 | 10.35 | 15.76 | 18.15 | 10.00 | 31.08 | 17.78 | 1.62 |
| 95747 | 19.74 | 15.86 | 21.51 | 8.26 | 13.28 | 22.53 | 11.56 | 36.22 | 28.00 | 2.12 |
| 95683 | 17.16 | 19.13 | 23.50 | 8.91 | 13.46 | 25.57 | 12.69 | 30.33 | 25.27 | 1.60 |
| Subtotal | 21.28 | 18.30 | 22.37 | 12.26 | 14.30 | 23.57 | 11.19 | 33.64 | 28.39 | 2.58 |
| Total | 21.26 | 20.02 | 30.98 | 13.08 | 16.39 | 25.93 | 12.69 | 41.54 | 36.77 | 5.29 |

Note: a FLW = flag leaf width; FLL = flag leaf length; SDW = seed width; SDL = seed length; SPL = spike length; SDP = seeds/spike; SKS = spikelets/spike; WSS = weight of seeds/spike; SPW = spike weight; HET = heading time.

The regions had more or less the same CVs for each trait. The means and ranges of variation for the 10 traits for each region of origin, along with the overall mean, was calculated. This data could be used to identify phenotypically divergent sources for traits of interest in breeding programmes.

More detail on these results will be reported in a special paper on the characterization of *Aegilops* species when the analyses on molecular markers are completed.

## CONCLUSION

As a result of this collection work, more wild genetic resources of wheat are now available at the Germplasm Institute of the Consiglio Nazionale delle Ricerche (CNR) in Bari, Italy. Useful information is also available on the presence and distribution of wild wheats in southern Italy, especially of *Dasypyrum villosum*, *Agropyron* and *Aegilops* species. Future collection missions should cover other areas of Italy. During the expeditions reported in this chapter, germplasm was collected mainly along the main roads; work is now needed to identify more remote sites using available ecological parameters. This systematic approach may increase the chances of collecting larger amounts of genetic variation, which in turn would provide a better description of the distribution of rare species. The results of similar surveys could provide information for selecting areas suitable for *in situ* conservation.

## Discussion

*K. Hammer:* Where did you find *Secale strictum* in Italy?

*G. Laghetti:* We found this species growing on the slopes of Mount Etna.

*M. van Slageren:* The natural hybrid between *Aegilops geniculata* and bread wheat that you mention may be *Ae. neglecta* x *T. aestivum* which, in my opinion, is very rare. Also, the report of *Ae. ventricosa* from southern Italy (Potenza) represents an extension of its distribution since it has previously been reported in the flora only in the north, particularly from Sardinia and Corsica.

*G. Laghetti:* It is possible that it is *Ae. neglecta* and not *Ae. geniculata*, since the spikelets in the two species are very similar.

*A. Mujeeb-Kazi:* Was the *Agropyron pungens* that you mentioned collected from a saline environment near the coastal areas?

*G. Laghetti:* No. It was found in the interior on sandy but not saline soil.

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# 8.3

# *Aegilops* s and distril

M. ZAHARIEVA

The genus *Aegilops* genus in Bulgaria is seven *Aegilops* spe Willd., *Ae. ovata* L., commonly found i *umbellulata* Zhuk.

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Bulgaria is divided explored and 299 se *cylindrica*, *Ae. triun umbellulata* and *Ae.*

The country is n tively small area the territory is at an elev reaching up to 3000 situation and the div Black Sea exerts a