

# On the trail of the last autochthonous Italian einkorn (*Triticum monococcum* L.) and emmer (*Triticum dicoccon* Schrank) populations: a mission impossible?

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**Abstract** In 1970s it was thought that two species of ‘farro’, namely emmer (*Triticum dicoccon* Schrank) and einkorn (*T. monococcum* L.), were no longer present in Italy, but in 1981, some populations were discovered in a mountain area of the Appennino Sannita (central southern Italy). In 2006/2007 three monitoring missions were carried out to check the current situation of these ancient hulled wheats, specifically in the same areas where they were formerly collected. The same zones were also investigated by both paleo-ethnobotany and agrobiodiversity points of view. The results of this research have shown that nowadays einkorn is completely extinct while emmer is still cultivated in very few traditional farms, mainly as a fodder crop. A strong genetic erosion was detected also for emmer and several nowadays samples were contaminated by

seeds of modern spelt (*T. spelta* L.) varieties. In the present study the causes of this genetic erosion and which safeguarding actions to be undertaken are discussed.

**Keywords** Agrobiodiversity · Central southern Italy · Collecting · Einkorn · Emmer · Genetic erosion · Hulled wheat · Palaeo-ethnobotany · *Triticum dicoccon* · *T. monococcum*

## Introduction

In the last decades, the scientific community has become more and more aware of the problem of safeguarding plant genetic resources threatened by genetic erosion (Scarascia Mugnozza 1974). In Italy ‘farro’, a collective name indicating hulled wheat species (for more information see Perrino 1982), is among the crops to be safeguarded (Padulosi et al. 1996). Over time, in fact, hulled wheats have been gradually replaced by the more productive naked cultivars of durum wheat (*Triticum durum* Desf.) and common wheat (*T. aestivum* L.).

About 30 years ago it was thought that two species of “farro”, namely *Triticum dicoccon* Schrank and *T. monococcum* L., were no longer grown in Italy (Pantaneli 1944, Ciferri and Bonvicini 1959, Vallega 1977). Following a four years research starting 1980 (Perrino et al. 1981, 1982, 1984, Perrino and Hammer

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Dedicated to Dr. Pietro Perrino on the occasion of his retirement (1st May 2008).

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1983), few accessions of these species (seven of emmer and ten of einkorn) were found out in the Daunia and Sannio mountains and in the Napoletano and Lucano Apennines, (central southern Italy). The most frequent races were *T. monococcum* var. *vulgare* Koern. (Fig. 1) and *T. dicoccon* var. *dicoccon* and var.

*rufum* Schuebl.; in rarer cases also *T. dicoccon* var. *atratum* (Host) Koern. was observed (Fig. 2). This re-detection of the “farro” in Italy, after a relatively long time, led to a revival of the interest in this crop, not only in Italy (e.g. D’Antuono 1995) but also on a European scale (e.g. Padulosi et al. 1996).



**Fig. 1** Spikes, spikelets and caryopses of einkorn (*Triticum monococcum* L. var. *vulgare* Koern.) collected in 1981 in a mountain area of the Appennino Sannita (central southern Italy)



**Fig. 2** Black spikes of a rare population of emmer [*T. dicoccon* var. *atratum* (Host) Koern.] collected in Campania region (Italy)

Today, farro is considered a crop with a low environmental impact (Laghetti et al. 1998). Both einkorn and emmer cultivated in Italy showed a high level of resistance to stem rust, leaf rust and powdery mildew (Corazza et al. 1986). Indeed, it is grown in several farms following organic or biodynamic agrotechnique (Tallarico 1990). In Italy, a new flourishing market for products based on farro has emerged

(D'Antuono 1995; D'Antuono and Bravi 1996). These food products are appreciated for their sensorial, nourishing and wholesome qualities, in line with some medical data (Strehlow et al. 1994; Italiano and De Pasquale 1994). Recently an Italian firm has used hulled wheat by-product (i.e. husks) to produce high quality babyhood products (e.g. pillows, mattresses) not causing allergy (<http://www.i-naturali.it/Italiano/>



ethnobotanical information on local traditional hulled wheats was obtained from specialists and through several interviews with the growers. More details on the sampling methods and exploration strategy used are reported elsewhere (Perrino et al. 1981, 1982, 1984; Perrino and Hammer 1983).

## Results and discussion

Einkorn (*Triticum monococcum* L.,  $2n = 14$ , AA) is an hulled wheat and one of the earliest cultivated cereals (Salamini et al. 2002). Caryopses of wild einkorn have been found in Epi-Paleolithic sites of the Fertile Crescent. It was first domesticated in South-West Asia approximately in 10,500 B.C. and, according to Heun et al. (1997), precisely near the Karacadağ mountains in Turkey. Then it was probably introduced to Italy from Asia Minor in 5,000–4,000 B.C. (Zohary and Hopf 2000). Einkorn cultivation decreased in the Bronze Age, and today it is considered a relict crop that is rarely planted. It remains as a local crop, often for bulgur or as animal feed, sometimes as an admixture in emmer and other cereals (Perrino et al. 1981; Perrino and Hammer 1982; Hammer and Perrino 1984) in mountainous areas of France, Switzerland, Romania, the former Yugoslavia, Turkey, Albania, Greece, Morocco, Iran (Salimi et al. 2005) and few other countries (Kimber and Feldman 1987; Perrino et al. 1996b). It often survives on poor soils where other species of wheat fail. A certain variation could be observed during the several collecting missions carried out in Italy (Hammer et al. 1992). The predominant race was var. *vulgare* Koern. but, occasionally, spikes of var. *macedonicum* Papag. could be found (Hammer and Perrino 1984). Other reported races are var. *nigricultum* Flaksb. and var. *tauricum* Drosd. (Dorofeev and Korovina 1979). More variation is reported by D'Antuono and Bravi (1996), Filatenko and Hammer (1997). Additional notes can be found in Szabó and Hammer (1996).

Emmer (*T. dicoccon* Schrank,  $2n = 4 \times = 28$ , AABB), also known as 'farro' in Italy, is a low yielding hulled wheat. This tetraploid wheat was one of the first crops domesticated in the Near East (for a reconsideration of its domestication geography, see Ozkan et al. 2005). It was widely cultivated in the ancient world, but now it is a relict crop in

mountainous regions of Europe and Asia. Wild emmer [*T. dicoccoides* (Koern. ex Asch. et Graebn.) Schweinf.], the wild ancestor of domesticated emmer, grows in the fertile crescent of the Near East. Wild emmer grains were found at the archaeological site of Ohalo II in Israel, with a radiocarbon dating of ca. 19,000 B.C., while domesticated emmer did not appear until around 7,700 B.C. (Zohary and Hopf 2000, p. 46). Emmer and barley were the dominant crops of the ancient Near East, and spread in Neolithic times to Europe and to the Indian subcontinent. In the Near East, in southern Mesopotamia in particular, cultivation of emmer began to decline in the Early Bronze Age, from about 3,000 B.C. (Fiorentino et al. 2008). Today emmer is primarily a relict crop in mountainous areas. Its value lies in its ability to give good yields on poor soils, and in its resistance to fungal diseases. Emmer is grown in Morocco, Spain, the Carpathian mountains, Switzerland, Italy, Albania, Turkey and Ethiopia. Recently it was found in Oman, outside the reported growing area (Hammer et al. 2004). Italy is an interesting unique case, since emmer cultivation is well established and even expanding. In the Garfagnana, a mountainous area of Tuscany, emmer is grown by farmers as a PGI (Protected Geographical Indication) product. Emmer's main use is as a human food, though it is also used for animal feed. Figure 3 shows the distribution of sites with hulled wheats in Neolithic and modern periods. Observing Fig. 3, it is also interesting and clear to note that, over time, the cultivation areas of hulled wheats moved from eastern coast zones to internal western ones.

The survey/collecting missions here presented have shown that nowadays einkorn seems to be completely extinct in centre-south Italy.<sup>1</sup> Few spikelets resembling einkorn were found in the farmers seed stocks, but the analysis of their chromosome number assessed the pertinence of those seeds to *T. dicoccon* species. In some lucky cases the same farmers of the previous collecting missions were found and interviewed. They attributed einkorn extinction to its low yield, to the absence of any

<sup>1</sup> According to our information, only one private company sited in Piedmont region (north Italy) sells einkorn products coming from its own cultivation (<http://www.ilmulinosobrinio.it/ita/>). The genetic characteristics and provenance of that material is not clear.

type of cultivation subsidies similar to those for wheat varieties, to the introduction of modern medicines (in the past, caryopses of einkorn were very effective to cure sheep diarrhoea), and to the selection of new cold resistant wheat cultivars (formerly einkorn was among the most resistant cereals to the low temperatures, a trait very appreciated in the high hilly areas of central southern Italy).

During the 2006/07 missions a strong genetic erosion was detected also for emmer which is still cultivated in very few traditional farms, mainly as a fodder crop. After some very successful years for farro (emmer and spelt) cultivation in central southern Italy (Perrino and Laghetti 1994; Padulosi et al. 1996; Laghetti et al. 1997, 1999), there has been a strong and unexpected decline of its trade, leading to the bankruptcy of the main farmers co-operative societies which produced and traded these crops. After these events the farro market in south Italy is in a state of crisis and also the quality and the genetic purity of the sowing material has decreased. As a matter of fact, several samples collected during these latter missions were contaminated by seeds of modern spelt varieties of foreign origin. While in the traditional areas (Garfagnana, Valnerina, Altopiano di Leonessa, alte Valli del Tronto and dell'Atterno, valle dell'Aniene, alto Molise, Appennino Dauno and Appennino Lucano) emmer cultivation has never been abandoned and landraces are still used, in the new areas emmer varieties are imported either from the traditional areas or modern bred varieties are grown (Buerli 2006). This situation creates an intense market competition that causes loss of competitiveness of traditional areas, favours the replacement of traditional genetic material and doesn't guarantee the product traceability (Porfiri 2004).

According to our opinion and experience farro marketing in central southern Italy is still economically profitable, particularly following initiatives tending to quality or elite markets, or by means of a bettering the organization of agricultural production, trading and transformation, together with geographical identification labels as in Garfagnana. The evidence of this conviction are the many recent requests of expressions of interest to stipulate agreements with IGV by foreign agricultural firms intending to use in their Countries (e.g. Austria, Australia,

Brazil) the patented varieties selected by IGV (Perrino et al. 1996a; Colonna et al. 2001). About the actions aimed at safeguarding the last surviving emmer landraces from central southern Italy, at present only very few initiatives are in progress, as the *ex situ* conservation by IGV (Volpe et al. 2005), some local activities at Monteleone di Spoleto (Umbria region) and in Marche and Molise (by ARSIAM of Campobasso) regions. Of course if the farro market will flourish again, *on farm* conservation by farmers will contribute to the safeguard of this old cereal.

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