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ORIGINAL ARTICLE

Flax and weld: archaeobotanical records from *Mutina* (Emilia Romagna, Northern Italy), dated to the Imperial Age, first half 1st century A.D.

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Abstract In the city centre of Modena (Emilia Romagna, Northern Italy) a noteworthy amount of carpological remains attributable to flax and weld came to light dated to the Imperial Age (first half 1st century A.D.). Flax remains, i.e. capsules and extremely small seeds, suggest the presence of either immature seeds and fruits of cultivated flax (*Linum usitatissimum* L.) or of a wild flax species (*Linum bienne* Mill.). The quantity of these remains along with the co-presence of seeds of *Reseda luteola*, an important dye plant, leads to the hypothesis of the cultivation of both flax and weld for textile manufacturing purposes, which are attested as important in the economy of the Roman period.

Keywords Northern Italy · Roman period · *Linum* · *Reseda* · Textile manufacturing · Written sources

Introduction

Modena, a town in the centre of the Emilia region (Fig. 1), was founded in the Roman period as *Mutina*, and it has been the subject throughout the years of numerous archaeological excavations dating to the Roman period (Malnati et al. 2009). In particular, from an excavation in the present day city centre (Fig. 2) involving a drainage canal dated to the Imperial Age (A.D. 15–40), many seeds and fragments of flax capsules came to light together with numerous seeds of weld (*Reseda luteola* L.), a plant well-known for its dyeing properties. The present paper, apart from trying to clarify the presence of a significant amount of carpological remains of flax in this context, is an attempt to shed light on the contemporaneous presence of flax and weld, perhaps both traces of practices connected to textile manufacturing and dyeing.

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Materials and methods

The city of Modena (34 m a.s.l.) is located in the Emilian part of the Po plain and is characterized by a rather continental climate with thick fogs and 660 mm average annual rainfall. At present the Modena plain is intensely cultivated and remnants of the original vegetation, particularly oakwoods and wetlands, are extremely scarce (Alessandrini et al. 2010).

Archaeobotanical investigations were made at excavations in the city centre of Modena called "Piazza Grande, area ex Cassa di Risparmio" between 1985 and 1986. This area was excavated during the construction works on the basement level of the Cassa di Risparmio bank (Labate and Malnati 1988; Malnati et al. 2009). The excavation brought to light a drainage canal with amphorae and plant material archaeologically dated to the first half of the 1st century A.D. The canal was part of the canalization system that in the Roman period flowed through the urban and suburban area and that was filled in for the westward development of the town (Labate and Malnati 1988). After a preliminary test survey (Bandini Mazzanti and Taroni 1988), the analyses of the huge amount of carpological material

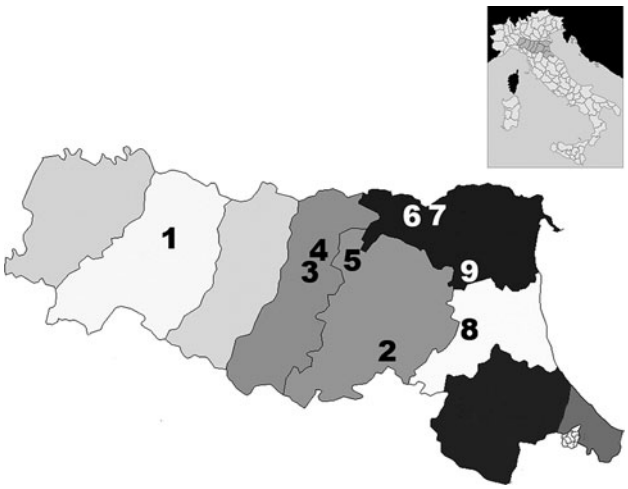

Fig. 1 Map of Italy and Emilia Romagna region with location of sites from ESM Table 1

recovered from the canal in three different stratigraphic units (29, 30 and 31) is now nearing completion (Rinaldi 2010).

The soil samples were floated and sieved in the field by archaeologists with a 0.2 mm final mesh. The soil contained artefacts in various materials, such as plaster, ceramic, glass, bone, metal (Macchioro 1988) and animal remains (De Grossi Mazzorin 1988; Roncaglia 1988), but mainly contained plant remains, including wood and wooden artefacts (Venezia 2003/2004). Analyses on all materials are still in progress.

The identification of the flax remains was made with the aid of reference collections from the Laboratory of Palynology and Palaeobotany of the University of Modena and Reggio Emilia, the Laboratory of the Department of Archaeology and Social Processes of the CSIC of Madrid and the Laboratory of Archaeobiology of the Museums of Como, and advice from Sabine Karg. The length of 100 *Linum* seeds (ESM Table 1) was measured with ImageJ on a Nikon Digital Sight DS-5M (NIS-Element f 2.20).

Fig. 2 Location of site 3 in the centre of Modena and archaeological excavations (by Soprintendenza ai Beni Archeologici dell'Emilia Romagna)

Results and discussion

The tradition of flax cultivation in Italy and the Emilia Romagna region

Among the various forms of cultivation nowadays almost completely disappearing from the Italian agrarian landscape, flax is one of the most tradition-rich. The carpological remains of cultivated flax (*Linum usitatissimum* L.) in Northern Italy (Fig. 1), even if scarce, date back to the Early Neolithic period and become more frequent in the Middle and Late Neolithic (Rottoli and Castiglioni 2009a). They continue to be attested without interruptions from the Bronze Age to the Middle Ages/Renaissance (Castelletti et al. 2001). From the published data for the Emilia Romagna region (Fig. 1, ESM Table 2), the first carpological remains date to the Middle Bronze Age and come from the hand-made ritual basin from Noceto in the province of Parma (1420–1320 B.C.; Rottoli and Castiglioni 2009b) (ESM Table 2, site 1). Interestingly, apart from the great quantity of charred flax seeds found at the Etruscan-Celtic site of Pianella di Monte Savino (ESM Table 2, site 2), some objects with mineralized traces of fabric (maybe linen) were also discovered in the tombs of the Necropolis of Monte Tamburino connected to the settlement (Orsini 2005). There are traces of flax dating back to the Neolithic, but it was during the Roman Period that its cultivation and processing expanded throughout the Empire (Bacci et al. 2007). Classical texts often mention the challenges of this cultivation: *Vergilius Maro P* (37 B.C.) in his *Georgicon Libri IV* recalls that "the cultivation of flax desiccates the fields" ("*urit enim lini campum seges*"—*liber I, 77*) and *Columella* (A.D. 60–65) explains that this is a consequence of the "heating nature" ("*fervidae naturae*") of the plant (*De re rustica*, *liber secundus, 13.3*). The Romans also recognized the enormous economic and social significance of flax: *Plinius Secundus* (A.D. 77) dedicated various

paragraphs to flax in his *Naturalis Historia*, for example "in what context of life does it not occur?" ("*in qua non occurrit vitae parte?*"—*liber XIX, 2 sgg.*); furthermore, even if it ruins the soils and desiccates them flax grows very easily. Pliny, among other things, cites the best European flaxes (including the one from Faenza in the Emilia territory) and illustrates the cultivation and processing techniques. He explains that the maturation of flax is evident from the enlarging of the fruits and the yellowing of the plants; when gathered they should be collected in small bundles and sun-dried so the seeds fall off and can be collected for foodstuffs, drugs or rituals. Next the stems are macerated in water and once again sun-dried; at this point the processing phases of fibre production begin (*liber XIX, 16–18*). With the Middle Ages and the Renaissance, flax becomes widespread in Italy and up to a century ago a tradition remained for Italian brides to have linen garments in their dowry. Cultivation in Italy, however, has ceased for at least 50 years. An attempt to revitalize flax cultivation took place between the two World Wars that gave a great impulse to scientific research. This however did not prevent its new decline starting in the mid-20th century and leading to its almost total disappearance today (Bacci et al. 2007).

The flax and weld remains in Mutina

A large number of carpological remains were recovered in stratigraphic unit 30 (78,309 remains in 2,200 l of soil: Rinaldi 2010). Of these, 5,214 were *Linum* seeds, 163 were *Linum* capsules (almost 7% of total remains in the unit) and 1,367 were *Reseda luteola* seeds, all uncharred. The two taxa were only occasionally recovered from the other two stratigraphic units of the site and in general from other Roman sites in the city, and never simultaneously (Rinaldi 2010). The deposit is clearly anthropic, as is evidenced by the huge amount of cultivated and foodstuff plants (e.g. fig, grapevine, olive, peach, walnut, plum, mulberry, myrtle, juniper, dill, fennel, cornelian cherry, bramble, blackthorn, strawberry) and synanthropic plants (Rinaldi 2010). The significant amount of flax and weld remains in the site and their almost total absence from other coeval sites of the city suggests that in this context these remains are connected to human activity. The morphology of the flax seeds (Fig. 3a and b), found in a good conservation state, hinted at two taxa: *Linum usitatissimum* L., cultivated flax, and *Linum bienne* Mill., considered as the wild ancestor of the cultivated form and a crop species together with it (Zohary and Hopf 2004). The features observed in the capsules (Fig. 3c) confirm this identification. In the present-day floristic lists for the province of Modena 12 taxa of the genus *Linum* are recorded; *L. usitatissimum*, intensively cultivated for a prolonged period in the past, is naturalized but rare and endangered, while *L. bienne* is recorded in the dry meadows of the plain (Alessandrini et al. 2010). Attributing these remains to the presence of the natural vegetation occurring along the canal is in conflict with the present ecology of wild flax that grows in arid habitats, while the remains of the natural vegetation surrounding the canal are mostly attributable to taxa of wet environments and meadows (e.g. *Carex* sp., *Eleocharis* sp., *Ranunculus sceleratus*, *Potentilla reptans*; Rinaldi 2010).

The average length and breadth of the 100 flax seeds (waterlogged archaeological records) measured is 2.6 mm (min 2.3, max 2.9 mm) and 1.4 mm (min 1.3, max 1.7 mm) (ESM Table 1 and Fig. 4), which falls within the range of *L. bienne*; in fact, the minimum length of the *L. usitatissimum* seed is set at 3 mm (Zohary and Hopf 2004). However, one should bear in mind that the small size of the seeds hints at a flax variety used for fibre production rather than for foodstuff (Zohary and Hopf 2004; Herbig and Maier 2011). Granted that evidence of the use of both taxa for fibre is available from Predynastic Egypt (Vogelsang-Eastwood 2000) and that the attribution to *L. bienne* does not exclude the possibility of its cultivation, a further hypothesis can be put forward in light of the various ethnobotanical processes flax undergoes to extract fibre (Andresen Troldtoft and Karg 2011). In fact, we also have to consider that these remains might represent immature harvested *L. usitatissimum*. A well-established technique already used in Ancient Egypt consisted of harvesting the plants just after the appearance of the seeds in order to obtain a more refined fibre (Vogelsang-

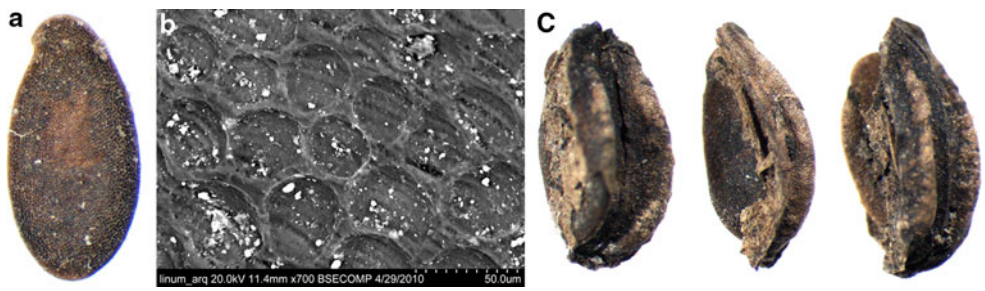

Fig. 3 Carpological records of flax from site 3 in the centre of Modena: **a** uncharred seed (2.5 mm), **b** its surface (SEM), **c** fragments of uncharred capsules (3.5 mm). Photographs by R. Rinaldi and G. Bosi

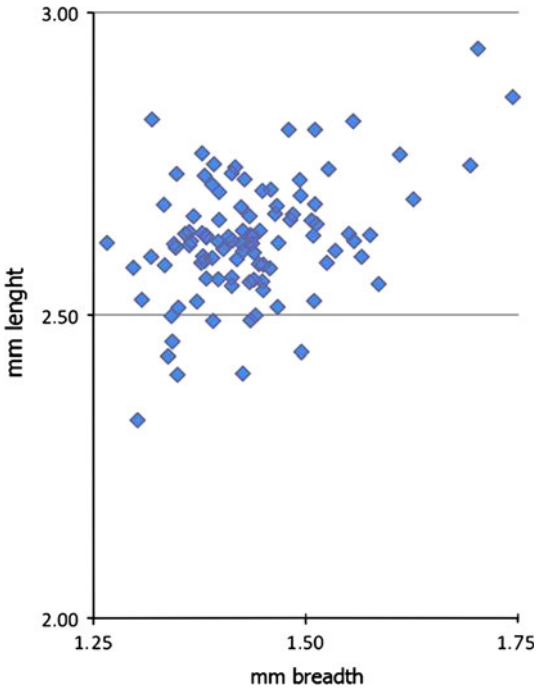

Fig. 4 Dimensions of flax seeds from site 3 in the centre of Modena

Eastwood 2000). Furthermore, the notable amount of seeds and capsule fragments in a canal context is in accordance with practices involving the removal of the seeds/fruits with the help of various techniques once the plants had been macerated and dried (Vogelsang-Eastwood 2000). Today it is estimated that of the harvested product 70% consists of straw yielding the fibre, 18% chaff and the remaining 12% seed (Cremaschi 1999). The technique mentioned by Pliny seems to contrast with the one hypothesized here implying the collection of the plant before maturity to obtain a more delicate fibre. However, it is well-known that the agrarian practices cited by Pliny and Columella for the most part refer to Central Italy (Latium and Umbria regions in particular) rather than Northern Italy and that in consideration of its particular geographical features Italy is still characterized today by a very diverse system of agricultural and craftsmanship traditions from region to region.

The co-presence of numerous seeds of *Reseda luteola* L. (Fig. 5), an Eurasian species naturalized to the Mediterranean region (Pignatti 1982), and presently rare in ruderal areas and along the river banks of the Modena plain and hills (Alessandrini et al. 2010), strengthens the idea that the deposit represents a trace of handicraft activities connected to textile weaving and dyeing. Weld produces flavonoids in all of its aerial parts, the most important being luteolin, a very stable pigment used from ancient times up to the present for dyeing fabrics. The harvest of the plant should preferably happen during fruit maturation when the pigment is more abundant. Weld cultivation and trade, quite

Fig. 5 Uncharred seed (0.9 mm) of *Reseda luteola* from site 3 of the centre of Modena. Photograph by R. Rinaldi

important in Italy and France during the Renaissance period, are now being reconsidered in agriculture to meet the increasing demand for natural dyes (Angelini et al. 2003). In fact, *R. luteola* is considered the classical plant for obtaining the colour yellow (Lundborg 1983) and in Italian ethnobotanical traditions it is indicated as a dye plant (Guarrera 2006); even its species denomination derives from the word *luteus* = yellow (André 1985). In Classical times it was treasured and the Romans used the seeds together with the stalk to dye nuptial and vestal garments (Brunello 1968). In fact, the pigment is particularly suitable for colouring fibres like wool, linen and silk (Angelini et al. 2003).

The possible cultivation of flax and weld in the context of the prosperous economy of Mutina

The Roman colony of *Mutina* founded in 183 B.C. was a centre of great importance from a strategic-military standpoint and for its solid economy. Pomicino Mela in his *Corographia* (II, 60) of the mid 1st century A.D. includes it among the richest cities (*opulentissimae*) of the Adriatic side of the Italian peninsula (Calzolari 2008). Even though it is often renowned for its agriculture and ceramic production, the strongest elements in the economy of *Mutina* were sheep farming and textile manufacturing. Many sources report the dominance of *Mutina* in sheep husbandry. Strabo recalls that the surroundings of Modena supplied "a soft wool and the most beautiful of all" (*Geographia*, V, 1, 12-C 218). Columella evokes the value of the sheep "populating the Campi Macri between Parma and Modena" (*Res rustica*, VII, 2,3), a place near the city where the annual fair took place. This hosted an animal market that was celebrated throughout the entire peninsula (Strabo—*Geographia*, V, 1, 11-C 217). In the Roman period the central part of Emilia was a district specializing in textile industry. *Lanarii* (wool-workers) and *vestiarii* (clothing-makers) were even attested on funerary *stelae* from Modena, proving the diffusion of these activities

through the territory, as in the case of the stele of *C. Purpurarius Nicephor* (end of 1st century A.D.) (ESM Fig. 1), which marks his burial area and that of his family including the slaves. The *purpurarius* (purple-dyer) principally took care of the dyeing process, which followed the scouring and bleaching of the wool (Cardarelli 2002). At the Roman sites in the Po plain near Modena, several smooth and decorative clay loom weights were found (Calzolari et al. 2003). A tangible record of linen fabric derives from a precious Roman sarcophagus of an important person (3rd century A.D.) discovered in the city centre of Modena. This contained linen shrouds (Arias 1948), confirming the use of this fibre.

Conclusions

In the context of a Roman drainage canal in the centre of Modena, various elements lead to the interpretation of the flax remains as traces of agricultural and manufacturing activities connected to fabrics. One important factor supporting this is the large number of small-sized seeds and capsule fragments of either *Linum usitatissimum*, if considered immature, or *L. bienne*, wild flax that can also be used for fibre production. Furthermore, the presence at this site only, amongst several of the Roman period in the city, of remains of flax along with a number of weld seeds, possible traces of dyeing processes, reinforces this idea. Beside this, the textual and archaeological sources testify to a strong involvement of the Modena territory in the textile industry during the Roman period. The cultivation of flax, by methods probably aimed at the production of a particularly fine fibre, and weld are in agreement with both the agrarian and craft preoccupations of the territory, and with the wealth that characterized *Mutina* in the Imperial Age.

Once again archaeobotanical data, along with archaeological and ethnographic information, can shed light, even for historical times, on some aspects of the daily life of the past. This can complete the knowledge built up from other sources and strengthen it through the addition of tangible traces of former living beings.

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