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Crops and Cultivation in the Iron Age Near East: Change or Continuity?

Simone RIEHL – Mark NESBITT

Introduction

By the time of the Iron Age in the Near East (c. 1200-500 BC), the essential elements of agriculture were well established. The major cereals, pulses and livestock species had been domesticated in the Neolithic period (11,000-6000 BC). Animal-drawn ploughs and domestication of the main fruits occurred in or just before the Early Bronze Age. Much of the technology and techniques of early twentieth-century agriculture can be traced to the Bronze Age.

This continuity in technology, and the apparently unchanging appearance of the Near Eastern landscape, mask substantial changes in agriculture and diet over the last 3000 years. However, the agricultural (pre)history of these millennia has been remarkably little explored, compared to the attention given by prehistorians to the origins and development of agriculture in the Neolithic, or the role of agriculture in the emergence of city states in the Early Bronze Age.

Our aim is to show that the Iron Age is a period of significant change in agricultural practice that merits further study and, especially, increased sampling of bioarchaeological remains from archaeological excavations. Published archaeobotanical data is used to briefly explore a range of questions; these are intended to stimulate debate rather than to give definitive answers. Explorations of evidence for environmental change, for example through pollen records, or evidence for change in animal husbandry are beyond the scope of this paper. We were unable to attend the meeting, and are aware that some topics discussed there, in particular population migrations, and the role of agrarian failures at the end of the Late Bronze Age, are not covered in this paper.

Data synthesis

Here we do not attempt a detailed re-analysis of data for the period, but have instead summarised published archaeobotanical reports in two simple charts, covering Aegean sites, including those in western Turkey (table 1) and Near Eastern sites (table 2). We have expanded coverage to include Late Bronze Age sites and Aegean sites, as these are necessary to study change through time and space. Arabia and Central Asia are excluded as these have very different climatic regimes and archaeological trajectories. We also exclude sites that have little data or for which the plant identifications are uncertain.

We use English language terms for crops throughout the paper; botanical names are given in table 3. Background information on individual crops is, unless otherwise stated, drawn from Zohary and Hopf (2000).

AEGEAN REGION

Field Crops

Site	Country	Date (cal BC)	samples	context	Wheat: Einkorn	Wheat: Emmer	Wheat: Spelt	Free-t	Hulled barley: 6-row	Hulled barley: 2-row	Naked barley	Rye	Millet: common	Millet: foxtail	Pea	Lentil	Chickpea	Grasspea	Bitter vetch	Horse-bean	Lathyrus clymenum
LATE BRONZE AGE																					
Akrotiri	Greece	1500		storage	+	-	-	-	++	-	-	-	-	-	-	-	-	-	-	-	-
Knossos	Greece	1425	11	storage	+	+++	-	++	+++	-	-	-	-	-		-	-	-	-	-	-
Assiros	Greece	1350			+++	++	+	++	++	-	-	-	-	-	-	+	-	++	+	++	*
Dendra	Greece	1300		imprints	++	+++	-	++	-	-	-	-	+++	-	-	+	-	-	+++	-	-
Gla	Greece	1300-1200	11	storage	+++	?	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aplikli	Cyprus	1300-1200	7	storage	-	-	-	*	++	-	-	-	-	-	-	++	-	-	-	++	-
Ulu Burun (shipwreck)	Turkey	1300-1200	50+	storage	-	-	-	*			-		-	-	-	-	-	-	-	-	-
Troy VIIa	Turkey	1300-1190	16	misc.	++	+++	-	+	++	-	-	-	-	-	-	-	-	-	-	-	-
Iria	Greece	1250	27		-	*	-	-	*	-	-	-	+	-	-	-	++	+	+++	-	-
Iolkos	Greece	1200	11	storage find	-	+	-	-	++	-	-	-	-	-	-	-	-	-	-	*	-
Hala Sultan Tekke	Cyprus	1200		mineralised	-	+	-	*	++	-	+++	-	-	-	-	-	-	-	-	+++	-
Tiryns	Greece	1200-1100	117		++	+++	+	++	+++	+	-	-	+	-	+	++	++	+	+++	+	-
Kalapodi	Greece	1550-1050	5		-	+	-	+++	+++	-	-	-	-	-	-	++	+	+	+	-	-
Kastanas	Greece	1550-1050	53	misc.	+++	++	+	+	+	-	-	-	++	+	+	++	-	++	+++	+	-
IRON AGE																					
Troy VIIb	Turkey	1190-950	28	misc.	++	++	-	++	+++	-	-	-	++	-	-	++	+	+	+++	+	-
Kalapodi	Greece	1050-900	27	misc.	+	++	+	+++	+++	-	-	+	+	+	+	++	+	++	++	+	-
Iolkos	Greece	1025-900	5	storage find	+	++	+	+	++	-	-	-	-	-	-	++	-	+	+++	-	-
Kastanas	Greece	1000-500	129	misc.	++	++	++	+	++	-	-	-	++	++	+	++	-	+	++	+	-
Miletos	Turkey	750-650	52	ashy deposits	+	-	+	+	+++		-	-	-	-	?	+	-	?	+	-	-
Heraion (Samos)	Greece	700-600	55		-	*	-	*		*	-	-	-	-	-	*	-	-	-	-	-
Salamis	Cyprus	600-400	20	funeral pyres		?				?		-	-	-	-	*	*	*	*	*	-
Sardis	Turkey	540	30	storage	-	-	-	++	+++	-	-	-	*	-	-	*	*	*	*	-	-

Horticultural crops and oilseeds

Site	Country	Date (cal BC)	samples	context	Grape	Fig	Olive	Pomegranate	Hazelnut	Almond	Cucumber	Flax	Sesame	Opium poppy	Gold of pleasure
LATE BRONZE AGE															
Akrotiri	Greece	1500		storage	-	-	-	-	-	-	-	-	-	-	-
Knossos	Greece	1425	11	storage	*	*	*	-	-	-	-	-	-	-	-
Assiros	Greece	1350			*	-	-	-	-	-	-	-	-	-	-
Dendra	Greece	1300		imprints	-	-	-	-	-	-	-	-	-	-	-
Gla	Greece	1300-1200	11	storage	-	-	-	-	-	-	-	-	-	-	-
Aplikli	Cyprus	1300-1200	7	storage	*	-	*	-	-	*	-	-	-	-	-
Ulu Burun (shipwreck)	Turkey	1300-1200	50+	storage	*	*	*	*	-	*	-	-	-	-	-
Troy VIIa	Turkey	1300-1190	16	misc.	++	++	*	-	-	-	-	-	-	-	++
Iria	Greece	1250	27		-	*	-	-	-	-	-	-	-	-	-
Iolkos	Greece	1200	11	storage find	+	-	-	-	-	-	-	-	-	-	-
Hala Sultan Tekke	Cyprus	1200		mineralised	++	++	+	*	-	-	-	-	-	-	-
Tiryns	Greece	1200-1100	117		++	+++	++	*	-	-	-	+	-	+	-
Kalapodi	Greece	1550-1050	5		-	*	*	-	-	-	-	-	-	-	+
Kastanas	Greece	1550-1050	53	misc.	++	++	-	-	-	-	-	*	-	+	+
IRON AGE															
Troy VIIb	Turkey	1190-950	28	misc.	++	++	-	-	-	-	-	+	-	+	+
Kalapodi	Greece	1050-900	27	misc.	*	*	*	-	-	-	-	+	-	+	+
Iolkos	Greece	1025-900	5	storage find	-	-	-	-	-	-	-	-	-	-	-
Kastanas	Greece	1000-500	129	misc.	++	++	-	-	-	-	*	+	-	++	+
Miletos	Turkey	750-650	52	ashy deposits	+++	+++	+++	+	+	+	-	-	-	-	-
Heraion	Greece	700-600	55		*	+++	*	*	-	*	*	-	-	-	-
Salamis	Cyprus	600-400	20	funeral pyres	*	*	*	-	*	*	-	-	-	*	-
Sardis	Turkey	540	30	storage	*	-	-	-	-	*	-	*	-	-	-

Table 1 Selective gazetteer of Late Bronze Age and Iron Age archaeobotanical reports from the Aegean, including western Turkey.

Key:

? Identification uncertain

- absent or not yet found

* present; no statement can be made about abundance

\+ Certainly very minor or a contaminant

++ Certainly grown as a pure crop

+++ Dominant crop

NEAR EAST excluding Aegean region																						
Field Crops						Wheat				Hulled barley		Naked	Rye	Millet		Pea	Lentil	Chickpea	Grasspea	Bitter	Horse-	Lathyrus
LATE BRONZE AGE						Einkorn	Emmer	Spelt	Free-t	6-row	2-row	barley		common	foxtail					vetch	bean	clymenum
Site	Country	Period	Date (cal BC)	samples	context																	
Sabi Abyad I	Syria	LBA	1550-1250		misc.	-	•	-	+++	+++		-	-	-	-	-	-	-	-	-	-	-
Hammam et-Turkman	Syria	LBA	1550-1250	11	misc.	+	+	-	++	-	+++	-	-	-	-	-	+	-	+	+	-	-
Hadidi	Syria	LBA	1550-1400	23	misc.	-	-	-	+	-	+++	-	-	-	-	•	•	-	-	-	-	-
Kuşaklı	Turkey	LBA	1500-1200	? of 200	storage	++	+++	-	++	++	+	-	-	-	-	-	++	-	+	+	-	-
Boğazköy	Turkey	LBA	1400-1200	5	storage	++	•	-	-	-	+++	-	-	-	-	-	-	-	-	-	-	-
Boğazköy	Turkey	LBA	1400-1200	2	storage	-	•	-	++	•	-	++	-	-	-	-	-	-	-	-	-	-
Beycesultan	Turkey	LBA	1300-1200	7	storage	++	++		++	++	-	+	-	-	-	-	++	-	-	++	-	-
Deir' Alla	Jordan	LBA	1200-1150	13		-	+	-	+++	-	++	-	-	-	-	++	+	+	-	++	-	-
IRON AGE																						
Timna	Israel	IA	1200-1150	13	hand-picked	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tell Afis	Syria	IA	1200-1000	26	misc.	+	+	-	+++	+++	-	-	-	-	-	•	•	-	-	•	-	-
Deir' Alla	Jordan	IA	1150-500	46		-	++	-	+++	+	++	-	-	-	-	++	++	+	+	+++	+	-
Tell Qasile	Israel	IA	1100-1000	9	storage	-	•	-	-	++	-	-	-	-	-	-	•	-	++	-	++	-
'Ain Dara	Syria	IA	1100-750	35	misc.	-	-	-	++	?	-	++	-	-	-	?	+	-	-	?	-	-
Pella	Jordan	IA	1000-900	16	misc.	-	-	-	++	-	++	-	-	-	-	•	•	•	-	•	•	-
Horbat Rosh Zayit	Israel	IA	1000-800	4	storage	-	+•	-	+++	•	•	•	-	-	-	-	-	-	-	-	++	-
Lachish	Israel	IA	1000-600	3	storage	+	+	-	+++	-	-	-	-	-	-	-	-	•	-	-	?	-
Bastam	Iran	IA	700-600	84	misc.	?	?	-	++	+++	-	-	-	•	-	•	•	•	•	-	-	-
Hasanlu	Iran	IA	800		misc.	•	-	-	•	•		-	-	•	-	-	•	•	-	-	•	-
Tepe Nush-i Jan	Iran	IA	750-550	10	misc.	-	+++	-	•	++		•	•	-	-	•	•	-	-	•	-	-
Nimrud	Iraq	IA	700-600	15	storage	-	+	-	++	++	+++	-	-	++	-	-	++	•	-	-	-	-
Tell Schech Hamad	Syria	IA	700-600	10	storage	-	-	-	•	+++	++	-	-	•	•	-	+++	-	•	•	-	-
Tille Höyük	Turkey (E)	IA	700	17	storage	+	-	-	++	-	++	-	-	-	++	•	•	•	++	++	•	-
Gordion	Turkey	IA	700	18	storage	+	-	-	+++	+++		-	-	++	-	+++	-	+++	-	++	-	-
Kuşaklı	Turkey	IA	1200-700	? of 200	storage	+++	++	-	++	++	-	-	-	-	+	-	+	-	+	++	-	-
Boğazköy	Turkey	IA	1200-700			•	•	-	•	•		-	-	-	-	-	-	-	-	-	-	-

Horticultural crops and oilseeds																
LATE BRONZE AGE						Grape	Fig	Olive	Pome-granate	Hazelnut	Almond	Cucumber	Flax	Sesame	Opium poppy	Gold of pleasure
Site	Country	Period	Date (cal BC)	samples	context											
Sabi Abyad I	Syria	LBA	1550-1250		misc.	-	-	-	-	-	-	-	-	+	-	-
Hammam et-Turkman	Syria	LBA	1550-1250	11	misc.	•	-	-	-	-	-	-	-	-	-	-
Hadidi	Syria	LBA	1550-1400	23	misc.	-	-	-	-	-	-	-	-	-	-	++
Kuşaklı	Turkey	LBA	1500-1200	? of 200	storage	+	-	-	-	-	-	-	+	-	-	-
Boğazköy	Turkey	LBA	1400-1200	5	storage	-	-	-	-	-	-	-	-	-	-	-
Boğazköy	Turkey	LBA	1400-1200	2	storage	-	-	-	-	-	-	-	-	-	-	-
Beycesultan	Turkey	LBA	1300-1200	7	storage	•	-	-	-	-	-	-	-	-	-	-
Deir' Alla	Jordan	LBA	1200-1150	13		•	-	•	-	-	-	-	++	-	-	-
IRON AGE																
Timna	Israel	IA	1200-1150	13	hand-picked	•	-	•	-	-	-	-	-	-	-	-
Tell Afis	Syria	IA	1200-1000	26	misc.	•	-	•	-	-	-	-	-	-	-	-
Deir' Alla	Jordan	IA	1150-500	46		++	++	++	++	-	•	-	+++	++	-	-
Tell Qasile	Israel	IA	1100-1000	9	storage	•	?	-	-	-	-	-	-	-	-	-
'Ain Dara	Syria	IA	1100-750	35	misc.	++	+	-	•	-	-	-	-	-	-	-
Pella	Jordan	IA	1000-900	16	misc.	•	-	•	•	-	?	-	•	-	-	-
Horbat Rosh Zayit	Israel	IA	1000-800	4	storage	•	•	-	-	-	-	-	-	-	-	-
Lachish	Israel	IA	1000-600	3	storage	-	-	+++	-	-	-	-	-	-	-	-
Bastam	Iran	IA	700-600	84	misc.	•	-	-	-	-	•	-	-	•	-	-
Hasanlu	Iran	IA	800		misc.	•	•	-	-	-	-	-	-	-	-	-
Tepe Nush-i Jan	Iran	IA	750-550	10	misc.	•	-	-	-	-	-	-	-	-	-	-
Nimrud	Iraq	IA	700-600	15	storage	•	•	•	•	•	-	•	++	-	-	-
Tell Schech Hamad	Syria	IA	700-600	10	storage	+++	•	-	•	-	-	-	-	•	-	-
Tille Höyük	Turkey (E)	IA	700	17	storage	++	-	-	-	-	-	-	++	-	-	-
Gordion	Turkey	IA	700	18	storage	-	-	-	-	++	-	-	-	-	-	-
Kuşaklı	Turkey	IA	1200-700	? of 200	storage	-	-	-	-	-	-	-	-	-	-	-
Boğazköy	Turkey	IA	1200-700			-	-	-	-	-	-	-	-	-	-	-

Table 2 Selective gazetteer of Late Bronze Age and Iron Age archaeobotanical reports from the Near East

Cereals	
Einkorn wheat	Triticum monococcum
Emmer wheat	T. dicoccum
Spelt wheat	T. spelta
Free-threshing wheat	T. aestivum or T. durum
2-row hulled barley	Hordeum distichum
6-row hulled barley	H. vulgare
Naked barley	H. vulgare var. nudum
Rye	Secale cereale
Common millet	Panicum miliaceum
Foxtail millet	Setaria italica
Pulses	
Pea	Pisum sativum
Lentil	Lens culinaris
Chickpea	Cicer arietinum
Grasspea	Lathyrus sativus
Bitter vetch	Vicia ervilia
Horsebean	Vicia faba
No common name	Lathyrus clymenum
Grape	Vitis vinifera
Fig	Ficus carica
Olive	Olea europaea
Pomegranate	Punica granatum
Hazelnut	Corylus spp.
Almond	Amygdalus communis
Cucumber/Melon	Cucumis sativus/ C. melo
Oilseeds	
Flax	Linum usitatissimum
Sesame	Seasamum orientale
Opium poppy	Papaver somniferum
Gold of pleasure	Camelina sativa

Table 3 Botanical names of crops mentioned in the text.

How representative is the archaeobotanical data?

At first glance tables 1 and 2 appear to be rich in information. However, the number of Iron Age sites (25) is less impressive given that this derives from some four decades of archaeobotanical fieldwork. Furthermore, there are few sites at which the Iron Age samples can be viewed as part of a consistent series of samples spanning earlier and later periods: perhaps just Kastanas and Troy, and potentially a few other sites that are now only part-published. As completing the archaeobotanical analysis of a multi-period site is a slow enterprise, albeit very worthwhile, for the present we will need to look at change through time by combining results from different sites.

Comparison of sites is complicated by the very different sampling and taphonomic circumstances of different archaeological sites. In tables 1 and 2 we are confident of our ability to record presence or absence of crops (albeit at different levels of identification, particularly for the cereals), and in most cases to determine the dominant crops in an archaeobotanical assemblage. The finer gradations, e.g. between main crops and minor crops, or pure crops and crop species that only grow as minor components of other crops, are much more subjective, except for the few sites that are very rich in seed data. Sample numbers are too few, and samples too small, to be sure that a given pattern is truly representative.

Although there is an urgent need for more effective sampling of Iron Age sites, particularly using flotation techniques that guarantee good recovery of seeds, at the same time we should recognise that the data available today is richer than that available to earlier attempts at synthesising data for this region (Hubbard 1980; Miller 1991; Kroll 1991).

Regional patterning

Comparison of the tables immediately suggests some regional differences, which need to be considered before looking at change through time. The most striking is the dominance of hulled wheats (einkorn and emmer) in the Aegean, continuing into the Iron Age period. In the Near East we know that hulled wheats, so important from the Neolithic onwards, virtually disappear from eastern Turkey and northern Syria early in the Early Bronze Age (Nesbitt 1995). Although present at later sites in central Turkey (in areas where einkorn and emmer were grown until the mid 20th century) they are mostly uncommon or virtually absent, having been replaced by increased cultivation of free-threshing macaroni or bread wheats (Nesbitt 1996).

In contrast, in the Aegean both einkorn and emmer are important crops in the Late Bronze Age, and are still widely grown in the Iron Age, though not so often dominant. There is no easy explanation for the continuing role of hulled wheats in the Aegean. Other cases may be explained as cultural preference, as in the case of emmer wheat in the highly distinctive, unified culture of Pharaonic Egypt, or of ecological suitability, as in current day cultivation of hulled wheats in mountainous regions of Europe (Nesbitt - Samuel 1996). Neither explanation suits the geographically diverse Aegean region. Another difference is in the presence of spelt wheat in the Aegean region, in small quantities from the Early Bronze Age onwards. Spelt is virtually absent from the Near East at any period. Its early appearance in the Aegean, and failure to occur in the Near East, supports the hypothesis that spelt emerged as a crop in Bronze Age central Europe (Nesbitt 2001).

Several other crops have a distinctly Mediterranean distribution. Opium poppy is present in the Aegean from the Late Bronze Age. It was eventually to become an important crop in the Near

East, but at some point after the Iron Age (and perhaps as late as the Ottoman period). Gold of pleasure is another oilseed that was not grown as a crop in the ancient Near East, with the exception of one pure find from Late Bronze Age Hadidi. Of the pulses, grasspea was probably domesticated in the Aegean region in the Neolithic period and may not have spread to the Near East until late in the Bronze Age (Kislev 1989; Nesbitt 1996). Another pulse, *Lathyrus clymenum*, has only recently been identified as a domesticate in current day Greece and at Bronze Age sites in the Levant and Greece (Kislev 1993; Sarpaki – Jones 1990). Bitter vetch is well documented in the Near East and Aegean from Neolithic times, but appears most abundant in the Aegean region.

Smaller-scale regional differences are more difficult to detect owing to the small number of site reports. Some differences in distribution have obvious ecological explanations: for example the absence of frost-intolerant olive trees from Iran and central Turkey.

Crop introductions and developments

Turning to change through time, are new crops visible in the Iron Age? In the case of the major cereals, wheat and barley, we see little change in the Near East or Aegean. Six-row hulled barley is the most common form of barley (and probably the dominant cereal overall), while in the Near East free-threshing wheats far outnumber hulled wheats. In most cases, it has not been possible to identify free-threshing wheats to species, i.e. to tetraploid *durum* bread or hexaploid *aestivum* wheat. Identification is only possible using chaff remains, and these are infrequent in the burnt stores that have most frequently been studied at Iron Age sites (cf. Valamoti 2002). Both forms of free-threshing wheat have been grown in the Near East since about 6000 years BC (Nesbitt 2001), so either could be present. The belief that *durum* wheat first appears as a crop in the medieval period (cf. Watson 1983; Sallares 1991) is mistaken.

It is striking that domesticated rye, intermittently present in the Near East since the PPNB period of the Neolithic, continues to be absent from all but two of the surveyed sites. Rye was first domesticated in the Near East, but only developed as a pure crop once it reached Europe (Hillman 1978). Today it is an important crop in the colder parts of the Near East, often as a maslin with wheat, but this role obviously developed after the Iron Age.

The only obvious change in cereals is the introduction of the small-seeded millets to the Near East: mainly common millet, but also rare occurrences of foxtail millet (Nesbitt – Summers 1988). Common millet has been found at Middle Bronze Age sites flanking the main part of the Near East, in Greece and Iran, and is found throughout the Near East in the Iron Age. The importance of the two millet species is that they are summer crops, sown in the spring and harvested in late summer. Another summer crop that becomes more common in the Iron Age Near East is the oilseed sesame, found occasionally in the Near East from the Early Bronze Age onwards (Samuel 2001).

Watson (1983: 123) points out: "The introduction of such summer crops on a wide scale radically altered the rhythm of the agricultural year as land and labour which had previously lain idle were made productive". It is currently unclear, on the basis of these sporadic finds, whether Iron Age summer crops were cultivated on such a scale as to make a real impact on agricultural productivity, or whether sesame was sufficiently widely cultivated as to have become an oil substitute for flax. Overall, flax appears less common at Late Bronze Age and Iron Age sites than in earlier prehistory, hinting at its increasing substitution by olive and sesame oils.

The Near Eastern evidence suggests that horsebean may have become more common in the Iron Age. *Vicia faba* is something of a mystery crop. Its wild ancestor is not yet identified, and finds in the Near East are sporadic and of uncertain identification (Zohary - Hopf 2000: 112-116). As Zohary and Hopf point out, faba beans become abundant in the Mediterranean basin and central Europe before the Near East, hinting at an Iron Age migration of the crop to the Near East. It may have been present earlier in the Near East, but perhaps grown on a small-scale rather than as a field crop.

The main fruits, olive, grape and fig are well established in the Aegean and the Near East before the Iron Age. Two fruits that were probably domesticated in the Early Bronze Age, pomegranate and almond, become more common in the Iron Age, probably reflecting their integration into Near Eastern diet. An indictor of increased trade networks in the Iron Age is the presence of hazelnuts at sites that lie some distance away from the nearest hazelnut trees.

Changes in vegetables and spices are much more difficult to detect, as the seeds of these tend to be carefully husbanded and are less likely to enter the archaeobotanical record. Unsurprisingly, some of the richest finds come from sites with special conditions of preservation: for example the shipwreck of Ulu Burun, or the waterlogged ritual site of the Heraion on Samos. Spices such as garlic and coriander are present at both Late Bronze Age and Iron Age sites. There is no evidence to suggest that spices were as widely available or traded as in, say, the Roman period.

A further problem area is fodder crops, such as vetch (*Vicia sativa*) and lucerne (*Medicago sativa*). These both grow wild in the Near East and, furthermore, are difficult to separate from wild species in archaeological material. There is no reliable evidence for their origin or history prior to the Classical period.

Changes in crop husbandry practice in the Aegean

As suggested by Kroll (1993), there is no evidence to show a general change in the Aegean crop spectrum from Late Bronze Age to the Iron age. There are regionally linked changes in the dominance of various crop species, in so far that in the southern Greek mainland during the Late Bronze Age hulled barley, emmer and lentil seem to be more important than in the north, where einkorn and broomcorn millet belong to the most numerous finds. Also olive belongs to the crop spectrum in the south whereas it is absent in the north. Free-threshing wheat seems to become more important during the Iron Age, which is interpreted by Kroll to be related to differing food preparation (cooking during the Bronze Age, roasting and baking during the Iron Age). There is thus a regional contrast between the Aegean, with little change in the crops between the Late Bronze Age and the Iron Age, and the Near East in which, as argued above, there are significant introductions.

Changes in the weed flora of ancient crops will be better indicators of more subtle changes than the simple introduction of new species, for example in the level of agricultural inputs. As compared to detailed studies of Aegean weed floras by Helmut Kroll and Glynis Jones (Jones 1992; Jones et al. 1999), little comparable work is available for the Near East, and in fact suitable evidence is only available for four sites, all in the Aegean: Kalapodi, Kastanas, Tiryns and Troy.

Ryegrass (*Lolium*, especially darnel, L. *temulentum*) was an important weed during the final phases of the Bronze Age. Its overwhelming presence also seems to occur simultaneously with changes in plant production (either changes in the cultivated species of cereals or general enlargement of the crop spectrum or a shift of the fields). During the transitional phase to the Iron Age the dominance of *Lolium* decreases, maybe as a result of the changes in plant production.

Kalapodi (Greece)

Kroll (1993) detects a strong presence of *Lolium temulentum*, the most important weed in the cereal fields at Kalapodi. It makes up to 4,5% of the whole finds in the samples, and occurs with its highest percentage in the final Late Bronze Age (SH III C) samples.

Kastanas (Greece)

Likewise at LBA Kastanas, high contamination of the wheat harvest with *Lolium temulentum* is striking (Kroll 1983; 1984a). Its grains make up to 1/4 of the sowing rate of the wheats, which is interpreted together with a general decrease in seed sizes as overexploitation of the soil generally causing an increase in weeds (*Galium spurium*, *Fumaria* sp., *Agrostemma githago*, *Convolvulus arvensis*) and leaching out of nutrients from the soil. An increase in millet cultivation is also interpreted as a consequence of the strong wheat contamination with *Lolium*.

Kroll sees the reversal of the exhaustion of the soil during the Iron Age in growing seed sizes (except that of bitter vetch). The contamination with darnel and other weeds has already decreased during the period of transition, although slightly increasing again during the IA (Kroll 1984a). It seems that the landscape and particularly the soils during the transitional period and the IA seems to have recovered from the overuse by the Late Bronze Age population.

Tiryns (Greece)

Lolium temulentum is again one of the most frequent weeds in the LBA material. Assuming it, as the author claims, to have functioned as a wheat weed, the ratio of chaff to Lolium is about 21:1 or the contamination of wheat with Lolium about 4,6% and corresponds almost exactly to that of Kalapodi. Kroll assumes for Tiryns similarly as for Kastanas that the LBA plant production reached its limits, caused by an extreme population density (Kroll 1982; 1984b).

Troy (Turkey)

Various changes become obvious in the botanical material with the transition from Troy VIIa (Late Bronze Age) to VIIb (Iron Age). Besides political and social influences one has also to consider environmental change at the end of the Bronze Age, i.e. soil erosion.

Lolium seeds are very numerous during Troy VIIa and decrease from Troy VIIb onwards, as generally the large-seeded grasses. In Troy VIIb the wild plant flora consists of relatively high amounts of perennials, compared to more abundant annuals during Troy VIIa. Also moisture – and freshwater – indicating plants, mainly associated with barley and einkorn, are more numerous during Troy VIIb. This could indicate an extension of arable fields into areas where perennials were still abundant, probably into the valley area.

In general the specialised economy visible from Troy VI through VIIa seems to have no longer existed in Troy VIIb, not at least for the slightly broader crop spectrum during Troy VIIb (Riehl 1999).

Conclusions

Even a simple analysis of existing archaeobotanical data has shown that significant changes in agriculture, in the form of new crops, occurred in the Iron Age Near East. This is in contrast to the Aegean, where this type of innovation occurred earlier, in the Late Bronze Age.

There are striking differences overall between the Bronze Age/Iron Age crop spectra for the Aegean and the Near East. These differences suggest it would be unwise to extrapolate from the better-studied Aegean case-studies to the Near East. The intriguing hints of resource depletion in the Aegean Late Bronze Age need critical investigation in the Near East.

At the same time, the crop spectrum is far narrower than that recorded in texts and archaeobotanical remains from the early Medieval period (Watson 1983; Samuel 2001). However, the presence of millet and sesame shows that diversification of crops and sowing seasons is a process that starts well before the Islamic period. It is likely, as argued by Samuel (2001: 418-423), that the so-called "Islamic agricultural revolution" was a long-drawn out process that started in the Iron Age. There are hints, in the form of sporadic finds of spices and vegetables (discussed by Powell - Nesbitt, in press), that diet was also becoming more diverse during the Iron Age.

With regard to more subtle indicators of agricultural change, little progress has been made. Recent excavations at sites such as Gordion, Kuşaklı and Boğazköy will eventually result in comparable archaeobotanical material from the Late Bronze Age and Iron Age, with sufficiently rich weed floras as to allow comparisons of agricultural practices. A high priority for such studies would be the detection of irrigation systems outside Mesopotamia. Archaeological evidence suggests that irrigation may have become more widespread in the Iron Age (Belli 1994), perhaps reflecting the needs of summer crops.

We end by emphasising that these interesting and important research questions relating to the most fundamental economic activity of the Iron Age, agriculture, cannot be answered except by intensive sampling (using flotation) at current and future Iron age excavations.

Appendix: bibliographic citations for the site reports (tables 1 and 2)

Aplikli: (Helbaek 1962); 'Ain Dara: (Crawford 1999); Akrotiri: (Sarpaki 1992); Assiros: (Jones et al. 1986; Jones 1981; 1992); Bastam: (Hopf - Willerding 1988); Beycesultan: (Helbaek 1961); Boğazköy: (Neef 2001; Hopf 1992; Dörfler et al. 2000); Deir' Alla: (van Zeist - Heeres 1973, Neef 1989); Dendra: (Hjelmquist 1977); Gla: (Jones 1995); Gordion: Hillman - Nesbitt, unpub.; Hadidi: (van Zeist - Bakker-Heeres 1985); Hala Sultan Tekke: (Hjelmquist 1979); Hammam et-Turkman: (van Zeist 1999); Hasanlu: (Harris 1989); Heraion: (Kucan 1995); Horbat Rosh Zayit: (Kislev - Melamed 2000); Iolkos: (Renfrew 1966; Jones 1982); Iria: (Willerding 1973); Kalapodi: (Kroll 1993); Kastanas: (Kroll 1983, Kroll 1984a); Knossos: (Jones 1990, Jones 1984); Kuşaklı: (Pasternak 1998); Lachish: (Helbaek 1958); Miletos (Kalabaktepe/Zeytintepe): (Stika 1997); Nimrud: (Helbaek 1966); Pella: (Willcox 1992); Sabi Abyad I: (van Zeist 1999); Salamis: (Renfrew 1970); Sardis: Nesbitt, unpub.; Tell Afis: (Wachter-Sarkady 1998); Tell Qasile: (Kislev - Hopf 1985); Tell Schech Hamad: (van Zeist 1999/2000); Tepe Nush-I Jan: (Kyllo - Hubbard 1981); Tille Höyük: (Nesbitt, in press); Timna: (Kislev 1988); Tiryns: (Kroll 1982; 1984b); Troy VIIa: (Riehl 1999); Troy VIIb: (Riehl 1999); Ulu Burun (shipwreck): (Haldane 1993).

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