

Véronique Zech-Matterne and Girolamo Fiorentino (dir.)

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- 1 While the cultivation of citrus fruits in Egypt is thought to have a long history, there is surprisingly little known about its earliest introduction. It is generally assumed that citron (*Citrus medica*) is the first of the citrus fruits to reach the Mediterranean, probably via Persia and Mesopotamia in the late 4<sup>th</sup> century BC, associated with Alexander's campaigns.<sup>1</sup> Recent pollen evidence from the Mediterranean produces similar dates, such as at the 5<sup>th</sup> or 4<sup>th</sup> century BC Royal Persian garden at Ramat Rehel, near Jerusalem,<sup>2</sup> and at Carthage, Tunisia, in deposits dated to the 4<sup>th</sup> century BC.<sup>3</sup> Citrus pollen finds from the Greek colony at Cumae near Naples are less precisely dated. Indeed, the first citrus pollen in this core derive from an undated deposit (level -641 cm), with radiocarbon dates below this level (at -656 cm) giving an 896-657 cal BC date and above it (at -575 cm) an 38 cal BC-123 cal AD date.<sup>4</sup> According to some scholars, the proximity of the layer containing *Citrus* pollen to the oldest of these two dates suggest an early distribution of citrus into the Mediterranean.<sup>5</sup> We are, however, of the opinion that this record cannot be used to accurately date the earliest introduction of citrus fruits into the Mediterranean, other than to say, as the authors of the original report do, that it was present by the 1<sup>st</sup> century BC. Several radiocarbon dates from layer -641 would be needed to establish the real antiquity of this record. Finally, chemical analyses of organic residues in a 6<sup>th</sup> century BC wine jug at the Punic necropolis of Monte Sirai, Sardinia, identified citrus as one of the components,<sup>6</sup> though this does not prove local cultivation of the tree.

- 2 This raises the question of when the fruit was introduced into Egypt. While Loret<sup>7</sup> suggested the 15<sup>th</sup> century BC (18<sup>th</sup> Dynasty), he offers no convincing evidence for this. Germer,<sup>8</sup> referring to work by Keimer,<sup>9</sup> puts forward a possible Ptolemaic date, on the basis of a description of a complete fruit and longitudinal section thereof from Thebes, which Keimer describes as of uncertain date, but possibly Ptolemaic. Finally, Andrews<sup>10</sup> suggests that the cultivation of citron trees may have been introduced into Italy by gardeners from Alexandria, after the annexation of Egypt into the Roman Empire in 30 BC, and that it was Jewish people who brought the citron to Egypt prior to that (there was a large Jewish colony in Alexandria). Much new archaeological and papyrological evidence has come to light since then, and here we review this evidence in order to determine the likely date for the introduction of citrus species into Egypt and Egypt's possible role in the dispersal of the fruits into the Mediterranean.

## 1. Archaeobotanical remains of citrus

- 3 Due to the arid climatic conditions in Egypt the preservation of botanical remains of foods and other plant material at archaeological sites is extremely good. Unlike most of North Africa, the Middle East and Europe, botanical remains are found in both charred and desiccated form, the latter often including many vegetative parts and looking almost modern. All the remains of *Citrus* found in Egypt to date have been recovered in desiccated state. They were derived from eight archaeological excavation projects, representing eleven chrono-cultural contexts or 'sites', including seeds at seven different sites, rinds at three, fruits at two and leaves at one (table 1, fig. 1).

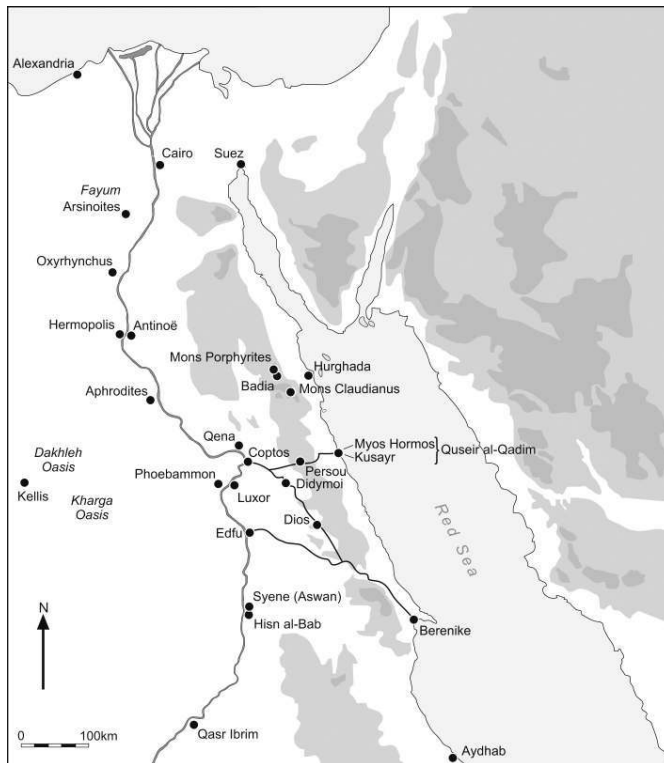
Table 1 - Citrus finds at archaeological sites in Egypt.

Site	Settlement	Dating (AD)	Species	Remains	Preservation	Radiocarbon dates cal AD, 2 sigma, 95%	Ref.
Myos Hormos = Quseir al-Qadim	port	1 <sup>st</sup> -early 3 <sup>rd</sup> c.	<i>Citrus cf. medica</i>	8 seeds	des	1-130 (OxA-20434)	a
			<i>Citrus sp.</i>	4 seeds	des	70-240 (OxA-20435)	
Mons Claudianus	quarry	2 <sup>nd</sup> c.	<i>Citrus cf. medica</i>	23 seeds, 1 fruit	des		b
Mons Porphyrites	quarry	2 <sup>nd</sup> half 2 <sup>nd</sup> c.	<i>Citrus cf. medica</i>	11 seeds	des		c
Antinoë	necropolis	3 <sup>rd</sup> c.	<i>Citrus medica</i>	leaves	des		d
Kellis = Ismant el-Kharab	town	3 <sup>rd</sup> -4 <sup>th</sup> c.	<i>Citrus cf. medica</i>	rinds; 4 large fragm.	des		e
Mons Porphyrites	quarry	4 <sup>th</sup> -5 <sup>th</sup> c.	<i>Citrus cf. medica</i>	3 seeds	des		c
Phoebammon	monastery	5 <sup>th</sup> c.	<i>Citrus medica</i>	1 fruit	des		f
Hisn al-Bab	fort	6 <sup>th</sup> -7 <sup>th</sup> c.	<i>Citrus cf. medica</i>	1 seed	des		g
			<i>Citrus cf. medica</i>	10 seeds, 1 rind	des	1020-1210 (OxA-20436)	
Kusayr = Quseir al-Qadim	port	11 <sup>th</sup> -early 13 <sup>th</sup> c.	<i>Citrus cf. x aurantifolia</i>	38 rinds	des	1020-1210 (OxA-20543)	a
						1020-1220 (OxA-20438)	
						1030-1220 (OxA-20437)	
						1050-1260 (OxA-20497)	
			<i>Citrus cf. x aurantifolia limon</i>	48 seeds, 2 rinds	des		
			<i>Citrus sp.</i>	12 seeds, 1 rind	des		
Kusayr = Quseir al-Qadim	port	14 <sup>th</sup> -15 <sup>th</sup> c.	<i>Citrus sp.</i>	2 seeds	des		a
Syene = Aswan	town	13 <sup>th</sup> -early 16 <sup>th</sup> c.	<i>Citrus cf. medica</i>	rind, 2 large fragm.	des		h

Numbers refer to the minimum number of items present.

References: a) Van der Veen 2011; b) Van der Veen 2001; c) Van der Veen, Tabinor 2007; d) Germer 1988; e) Thanheiser 2002; f) Täckholm 1961; g) Clapham personal communication; h) Thanheiser personal communication.

Fig. 1 - Map of Egypt listing the sites mentioned in the text.



- 4 The earliest archaeological remains recovered so far date to the 1<sup>st</sup> century AD and the latest to the 14<sup>th</sup>-15<sup>th</sup> century AD. The earliest and most common citrus species is citron, *Citrus medica*, recovered from ten sites, while lime, *Citrus cf. x aurantifolia*, was found at only one site, dated to the 11<sup>th</sup>-13<sup>th</sup> century. Possible remains of one or two additional species of *Citrus* are discussed below. Most of the citrus remains originate from three distinct regions, namely the Eastern Desert, the Western Desert and Nubia. Here the sites at which they were found are discussed in chronological order.

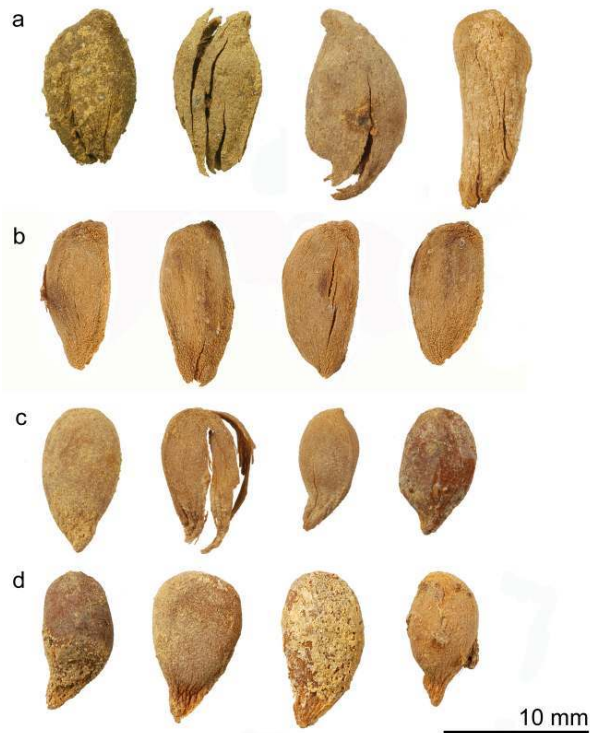
### 1.1. Myos Hormos – Quseir al-Qadim (Red Sea coast/Eastern Desert) - Early Roman

- 5 The archaeological site of Quseir al-Qadim is located on the Red Sea coast of Egypt, some 8 km north of the modern town of Quseir. In antiquity the archaeological site was known as Myos Hormos, one of the two principal ports for Indian Ocean trade. By the medieval Islamic period the site was known as Kusayr, here discussed as a separate site, see below. The harbour was located in an ancient lagoon, created by the drainage of two wadi systems. The site functioned as a transport hub for Eastern trade in spices and other luxury goods coming from India and further afield. An ancient road through the Wadi Hammamat connected the port with Coptos in the Nile Valley, and from there the spices and other goods were transported to Alexandria and onwards to Rome. The site was excavated twice, first by an American team between 1978-1982<sup>11</sup> and, again, between 1999-2003, by a British team from the University of Southampton.<sup>12</sup> The excavations revealed a large settlement, remains of the harbour, as well as a vast array of artefacts, texts (ostraca and papyri), biological remains of foods, textiles, ropes and much more.

The preservation of organics at the site was excellent and an extensive sampling strategy was implemented to recover the botanical and archaeozoological remains.

- 6 During the British excavations 43 samples were collected from the Roman refuse and midden deposits found across the settlement. From each securely dated context two litres of sediment were dry-sieved and subsequently floated over a 0.5 mm mesh and 20 litres were dry-sieved over a 2 mm mesh, the latter to ensure that rarer larger items were recovered. Additionally, botanical remains visible with the naked eye were collected by the workers, the so-called 'handpicked' material.<sup>13</sup> Most of the botanical material represents the left-overs of food and fodder consumed by the people and animals working at the ports. Food and fodder was brought to the site from the Nile Valley on a regular basis (see section 3.2). Most of the imports from India were for onward transport and were not consumed in the port, though small amounts of black pepper (*Piper nigrum*), rice (*Oryza sativa*), mung bean (*Vigna radiata*), coconut (*Cocos nucifera*) and belleric myrobalan (*Terminalia bellirica*) were recovered. The latter four probably represent some of the foods the Indian sailors took with them on the journey. In total some sixty economic plants (mostly food plants) were found, including staples such as cereals, pulses and dates, but also luxuries such as nuts (e.g. *Juglans regia*, *Pinus pinea*), fruits such as peach (*Prunus persica*) and pomegranate (*Punica granatum*), vegetables and herbs such as artichoke (*Cynara cardunculus*), coriander (*Coriandrum sativum*), fennel (*Foeniculum vulgare*), dill (*Anethum graveolens*), cumin (*Cuminum cyminum*) and aniseed (*Pimpinella anisum*).<sup>14</sup>
- 7 The citrus remains from Myos Hormos are composed of twelve desiccated seeds, eight of which have been identified as citron, *Citrus cf. medica* (fig. 2a). The other four seeds were poorly preserved and thus have not been identified beyond genus level, *Citrus* sp. They were found at three separate parts of the site, all containing domestic refuse: in Trench 2D (1<sup>st</sup>-2<sup>nd</sup> century AD), Trench 6GHJ (late 1<sup>st</sup>-mid 2<sup>nd</sup> century AD) and Trench 8 (2<sup>nd</sup>-early 3<sup>rd</sup> century AD). Radiocarbon dates on two of the seeds (from Trenches 2D and 8) gave similar dates of 1-130 cal AD and 70-240 cal AD (Table 1). The seeds are in both shape and size similar to those of the sour and sweet orange (*C. aurantium* and *C. sinensis*), but the presence of *C. medica* rind in a contemporary site nearby (Mons Claudianus, below) and the fact that the sour orange is not thought to have been introduced into the Mediterranean until the medieval period and the sweet orange not until the 16<sup>th</sup> century,<sup>15</sup> makes the identification of citron the most likely. Note that the full identification criteria for remains from this site are listed in Table 2 and discussed below, under section 2.6 Kusayr.<sup>16</sup>

Fig. 2 - Archaeobotanical remains of citrus seeds.



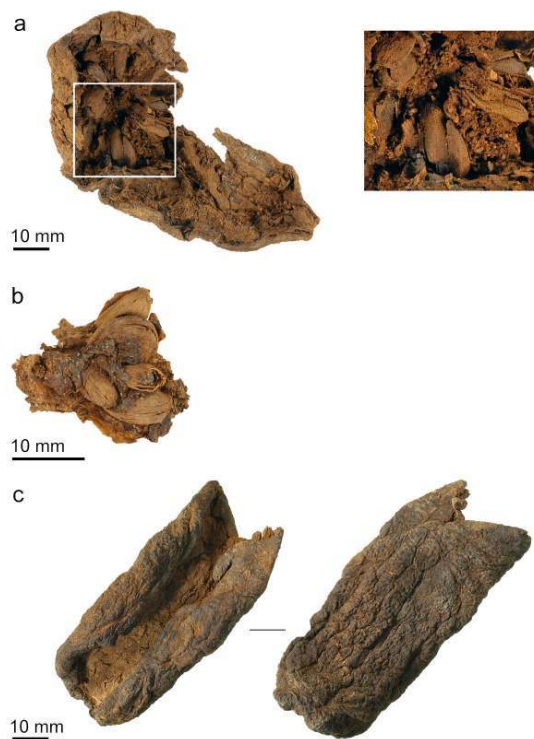
a. Type A - citron, *Citrus cf. medica*, first two from Myos Hormos, 1<sup>st</sup>-3<sup>rd</sup> c. AD, second two from Kusayr, 11<sup>th</sup>-13<sup>th</sup> c. AD (from Van der Veen 2011, fig. 3.4); b. Type A - *Citrus cf. medica* from Mons Porphyrites, 2<sup>nd</sup> century AD (from Van der Veen, Tabinor 2007, fig. 4.9); c. and d. Type B, cf. lime/lemon, *Citrus cf. x aurantifolia/limon* from Kusayr, 11<sup>th</sup>-13<sup>th</sup> c. AD (from Van der Veen 2011, fig. 3.4). See Table 2 for identification criteria (photographs: Jacob Morales).

## 1.2. Mons Claudianus (Eastern Desert) – Early Roman

- 8 Mons Claudianus is located in the heart of the Red Sea mountains, about 700 m above sea level. The site is a quarry settlement occupied from the 1<sup>st</sup> to the 3<sup>rd</sup> century AD, known for its granodiorite, which was used for imperial building projects in Rome (e.g. the Pantheon, Trajan's forum). The site is composed of the quarry field itself, extending over some 750 ha and with 130 individual quarries, as well as a fortified settlement, the main residential and administrative centre, which contained accommodation, a communal kitchen, bath house and temple, stables, a granary and a well. Both inside and outside the settlement were large refuse or midden deposits, full of artefacts, texts (ostraca), biological remains of food, textiles, etc.<sup>17</sup> Both the types of deposits sampled and the sampling strategy are similar to those described above for Myos Hormos. Preservation of the archaeobotanical remains was excellent and some 57 food plants were recovered, comprising a similar range to that found at Myos Hormos. Most of these foodstuffs were brought in from the Nile Valley, in antiquity a journey of ca. seven days, and these include both staples (cereals, pulses, dates), and more expensive items, the latter probably luxuries for the higher ranking officers, such as pine nut (*Pinus pinea*), walnut (*Juglans regia*), hazelnut (*Coryllus avellana*), black pepper (*Piper nigrum*), artichoke (*Cynara cf. scolymus*), etc.<sup>18</sup> Remarkably, there is both archaeobotanical and textual evidence that small gardens were kept near the site for the growing of green vegetables.<sup>19</sup>

- 9 One desiccated fruit and twenty-three seeds were identified as citron remains (*Citrus cf. medica*) according to their size and shape, and they are classified as potential luxury items.<sup>20</sup> The fruit is not complete, but rather represents half a fruit with the seeds visibly embedded in the fruit pulp (fig. 3a). It was not possible to determine with certainty whether it was deliberately cut in half or damaged after deposition. The remains have been found in six separate midden deposits, both inside and outside the main fort. Most of the seeds (N=17) come from a large midden dated to the early 2<sup>nd</sup> century that contained much kitchen waste (onion skin, vegetables, burnt bread), snack foods and table waste (fruit stones) and possible fecal material.<sup>21</sup> Finding fruit as well as seeds indicates that fruits were brought to the site, not dried segments of rind (see discussion in section 4.2 below).

Fig. 3 - Archaeobotanical remains of citrus fruits and rind.



a. near-complete fruit of citron, *Citrus cf. medica*, with seeds still in situ, from Mons Claudianus, 2<sup>nd</sup> century AD (from Van der Veen 2011, fig. 3.5); b. cluster of seeds embedded in fruit pulp, *Citrus cf. medica*, from Mons Porphyrites, 2<sup>nd</sup> century AD; c. rind of half a citron, *Citrus cf. medica*, from Kusayr, 11<sup>th</sup>-13<sup>th</sup> century AD (from Van der Veen 2011, fig. 3.5). See Table 2 for identification criteria (photographs: Jacob Morales).

### 1.3. Mons Porphyrites (Eastern Desert) – Early Roman

- 10 Mons Porphyrites is another quarry complex, this one dedicated to the extraction of purple porphyry, used in imperial sculptures, sarcophagi and small columns. It differs from the Mons Claudianus complex in that it lies deeper into the mountains and is more difficult to reach from the Nile valley than Mons Claudianus (but is closer to the Red Sea), and the spatial organization of the site is more dispersed. The complex was in use during the early 1<sup>st</sup> to late 2<sup>nd</sup>/early 3<sup>rd</sup> century, and again in the 4<sup>th</sup> to early 5<sup>th</sup> century.<sup>22</sup> The

archaeobotanical sampling strategy was identical to that at Mons Claudianus and Quseir al-Qadim. The majority of the samples originate from domestic refuse deposits in some of the rooms, from large midden areas outside the main fort, from an earlier settlement, as well as from a way-station (Badia) on the route to the Nile Valley, and a quarry village high in the mountains.<sup>23</sup> The late Roman remains are discussed below, as a separate chrono-cultural context (or site).

- 11 The plant remains were not as well preserved as those at Mons Claudianus or Myos Hormos, but still mostly preserved by desiccation. Some fifty food plants were recovered, including the usual staples (cereals, pulses, dates), as well as luxuries, in this case including fruits such as persea (*Mimusops schimperi*) and peach (*Prunus persica*), nuts such as hazelnut (*Coryllus avellana*), almond (*Amygdalus communis*) and pine nut (*Pinus pinea*), and vegetables such as lettuce (*Lactuca sativa*). Thus, the more remote location had not affected the range of foods available to the workers, soldiers and officers.<sup>24</sup>
- 12 The citrus remains comprise eleven desiccated seeds and a cluster of seeds still embedded in fruit pulp (figs. 2b and 3b), found in four different rubbish deposits both in and outside of the main fort; all dated to the second half of the 2<sup>nd</sup> century AD. They were all identified as remains of citron, *Citrus medica*.

#### 1.4. Antinoë (Nile Valley) – Mid Roman

- 13 Antinoë, also called Antinopolis or Antinoopolis, was a city founded by the emperor Hadrian in AD 130-132 on the east bank of the Nile, opposite Hermopolis and the modern city of el-Ashmunein. Excavations by Albert Gayet during the late 19<sup>th</sup> and early 20<sup>th</sup> century revealed a necropolis amongst other remains. Fragments of leaves found there were identified by Schweinfurth and deposited in the Botanical Museum in Berlin-Dahlem. They concern two 6 cm long leaf segments of *Citrus medica*, part of a wreath around the head of a 3<sup>rd</sup> century AD mummy.<sup>25</sup> The *Codex of Ancient Egyptian Plant Remains* lists several further finds of leaves of *Citrus medica* from this site, apparently all associated with mummies in the necropolis, some dated as Greco-Roman (not further specified), others as Roman (3<sup>rd</sup> century AD) or Coptic (4<sup>th</sup> century AD).<sup>26</sup> As their authenticity is not secure (they are not listed in Germer 1985), these are not listed in our Table 1.

#### 1.5. Kellis (Western Desert) – Mid-Late Roman

- 14 Kellis or Ismant el-Kharab lies in the centre of the Dakhleh Oasis, and represents a large settlement. Excavations here started in 1986 and have revealed occupation from the 1<sup>st</sup>-4<sup>th</sup> centuries AD, though there is a cemetery dating to the Ptolemaic period, suggesting the site must already have been occupied then. The village (or town) grew up following the introduction of advanced irrigation technology by the Romans, and comprises residential areas, as well as several temples, early Christian churches, Roman baths and extensive industrial areas. It derived its livelihood from agriculture, and traces of ancient fields can still be seen west and south of the settlement. The excavations have yielded a rich archive of ceramics, papyri, textiles, basketry and food remains, as well as two wooden books, including the now famous *Kellis Agricultural Account Book*.<sup>27</sup>
- 15 Archaeobotanical samples were taken within the habitation areas, as well as in the temple complex and the churches. Most of the samples were sieved through a 0.5 mm mesh and



all significant matrices were also screened through bigger meshes to recover rarer items. Approximate 700 samples, representing 10,000 plant remains, have been analysed to date.

- 16 The plant macro-remains found, mainly desiccated, show that the agricultural life during the 1<sup>st</sup>-4<sup>th</sup> centuries was based on various winter and summer crops, including wheat, barley and pearl millet (*Pennisetum glaucum*, ssp. *glaucum*), pulses, especially lentil (*Lens culinaris*), oil and fiber plants, such as safflower (*Carthamus tinctorius*), flax/linen (*Linum usitatissimum*) and cotton (*Gossypium* sp.). The fruit tree production is dominated by olive (*Olea europaea*), fig (*Ficus carica*), grapevine (*Vitis vinifera*), and also includes almond (*Prunus amygdalus*), pomegranate (*Punica granatum*) and peach (*Prunus persica*). Vegetables and herbs include artichoke (*Cynara* cf. *scolymus*), onion (*Allium cepa*), garlic (*Allium sativum*), fennel (*Foeniculum vulgare*) and coriander (*Coriandrum sativum*). The majority of these crops are listed as locally grown in the *Kellis Agricultural Account Book* mentioned above.<sup>28</sup>
- 17 Several desiccated rind fragments of *Citrus* were found in the domestic areas of the last period of occupation, in the 3<sup>rd</sup>-4<sup>th</sup> centuries AD. They are identified as citron (*Citrus* cf. *medica*). Citron is not mentioned in the *Kellis Agricultural Account Book*, and it is thus difficult to prove that citron was locally cultivated in the Dakhleh oasis, though it is certainly likely. There are imported food items at Kellis, e.g. hazelnut (*Corylus avellana*), pine (*Pinus pinea*) and walnut (*Juglans regia*),<sup>29</sup> but these are all nuts that can easily be transported long distances in dry form. This would have been more difficult with fresh fruits of citron.

## 1.6. Mons Porphyrites (Eastern Desert) – Late Roman

- 18 The quarry complex of Mons Porphyrites is described above (section 2.3). During the Late Roman period most of the activity appears to have been concentrated at the small quarry village of Lykabettus, high in the mountains; occupation of the main fort was restricted at that time. Additionally, the first way-station on the road to the Nile Valley, Badia, was still in use, with a high mountain pass connecting it with Lykabettus. The plant assemblage at this time was more restricted than during the heyday of the quarry complex, but with twenty-seven food plants it still suggests the workers and military personnel had access to a varied diet. Apart from the usual staples (cereals, pulses and dates), they had grapes (*Vitis vinifera*), olives (*Olea europaea*), figs (*Ficus carica*), seabest (*Cordia myxa*), linseed (*Linum usitatissimum*), garlic (*Allium sativum*) and coriander (*Coriandrum sativum*).
- 19 While occupation was on a much smaller scale than during the early Roman phase of the complex and while only very small-scale excavations were possible at Lykabettus due to the logistics of reaching the village and bringing samples back down the mountain, three desiccated citrus seeds were found here (none were found at the way-station Badia). They came from three separate rooms/buildings, all dating to the 4<sup>th</sup>-5<sup>th</sup> century AD. All three belong to citron, *Citrus* cf. *medica*.<sup>30</sup>

## 1.7. Phoebammon (Nile Valley) – Late Antique

- 20 The monastery at Phoebammon is located on the west bank of the Nile, more or less opposite Luxor, and ca. 8 km west of the Valley of the Queens. It was excavated in 1948. The monastery was founded in the 4<sup>th</sup> century AD. Botanical remains were collected, but not in any systematic way and no context information for the remains is available. The

plants were identified by Täckholm<sup>31</sup> and include one half fruit of *Citrus medica* dating to the Late Antique period, 4<sup>th</sup> or 5<sup>th</sup> century AD. The precise description made by Täckholm<sup>32</sup> leaves no doubt about the identification:

Half of a young fruit. 8.5 cm long, 4 cm broad, of somewhat pointed shape. Skin blackish-brown with knots of glands. The inside smooth, with the dried-up fleshy part preserved. Two kernels were removed from it. They are 10 mm long, 5 mm broad, obliquely pointed, slightly wrinkled and of brown or blackish colour.

- 21 A second item concerns a fragment of a fruit, “3.5 cm long, 2 cm broad, wrinkled inside. The identification of this piece remains uncertain.” This latter item is not included in our table 1. Surprisingly, the citron from Phoebammon is not mentioned in Germer<sup>33</sup>.

## 1.8. Hisn al-Bab (Nile Valley/Nubia) – Early medieval Islamic period

- 22 The site of Hisn al-Bab is located on the eastern bank of the river Nile, near the first cataract, between the High and Low Dams, ca. 5 miles south of Aswan. The fortifications on a rocky outcrop above the river controlled the main branch of the Nile. The area has always been a frontier zone between Egypt and Nubia and a military presence has been essential through time. The site was occupied during the Late Antique and early medieval period, with at least three phases of fortifications identified, dating from the 5<sup>th</sup> to the 10<sup>th</sup> centuries AD. The most abundant occupation dates to the late 6<sup>th</sup>-early 7<sup>th</sup> century AD, during which time the fort appears to have served as a Nubian frontier post. The site is best known for its role in the *baqt*, a negotiated agreement between Egypt and Nubia shortly after the Arab conquest of Egypt in 651-652 AD. The agreement concerns peaceful relations between the two powers, with exchanges of slaves from Nubia in return for foodstuffs from Egypt. Remains of the earliest fortress comprise stone walls, a tower, a triangular enclosure, traces of structures in a smaller enclosure, as well as midden deposits.<sup>34</sup>
- 23 Botanical remains, charred and desiccated, from the middens are currently under investigation; they include both summer and winter crops. Cereals comprise wheat and barley, sorghum (*Sorghum bicolor* ssp. *bicolor*), pearl millet (*Pennisetum glaucum*), and foxtail millet (*Setaria italica*). Other crops are lentil (*Lens culinaris*), cow pea (*Vigna unguiculata*) and cotton (*Gossypium* sp.). The assemblage is not dissimilar to that from Qasr Ibrim, located about 120 km south of Hisn al-Bab, though no citrus remains were found there.<sup>35</sup> One desiccated seed of citron (*Citrus medica*) was recovered, from a deposit dating to the 6<sup>th</sup>-7<sup>th</sup> century AD.<sup>36</sup>

## 1.9. Kusayr (Red Sea coast/Eastern Desert) – Islamic period

- 24 The Roman occupation of the site of Quseir al-Qadim is described above (section 2.1 Myos Hormos). After a long hiatus the site was reoccupied during the Islamic period and was then known as Kusayr. Occupation spans the 11<sup>th</sup> to 15<sup>th</sup> centuries AD, but the most intense occupation was during the 11<sup>th</sup>-13<sup>th</sup> centuries. The site functioned again as a transport hub for the Indian Ocean trade, but additionally it acted as a disembarkation point for pilgrims and as a transshipment point for grain intended for Mecca and the Hijaz. By this time the lagoon had largely silted up and the harbour consisted of a small bay at the entrance of the former lagoon. A number of residential complexes were excavated as well as some buildings thought to be associated with the trade.<sup>37</sup> Samples

were collected from the many refuse/midden deposits. Sampling was as for the Roman remains, see section 1.1.

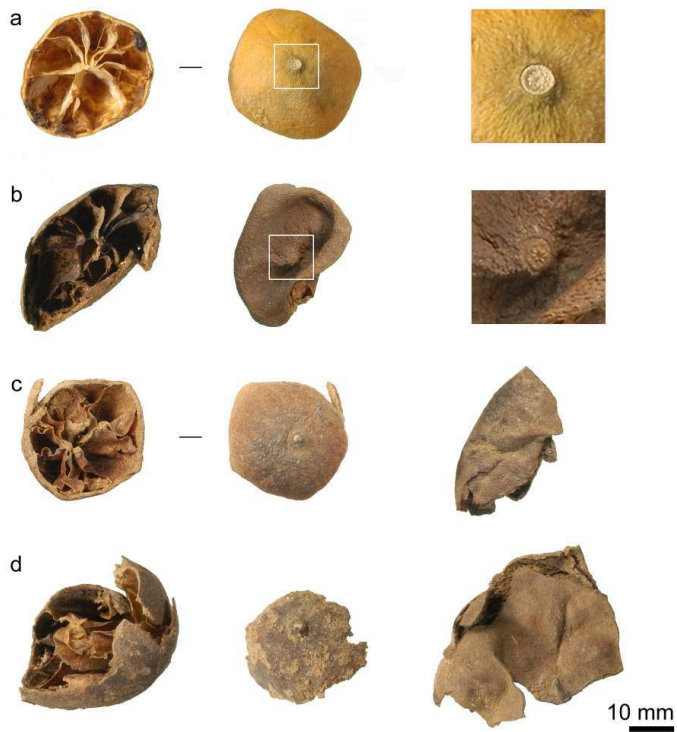
- 25 The botanical assemblage is extremely rich, with remains of 81 food and other economic taxa in the 11<sup>th</sup>-13<sup>th</sup> century assemblage and 49 in the 14<sup>th</sup>-15<sup>th</sup> century assemblage, the latter range possibly affected by the very limited excavations in these later medieval deposits. The most remarkable aspect of the assemblage is evidence for the wide range of spices and other foodstuffs originating from the Indian Ocean world, now consumed in the port. Eastern spices include black pepper (*Piper nigrum*), ginger (*Zingiber officinale*), turmeric (*Curcuma* sp.), and cardamom (*Elettaria cardamomum*). Other new introductions include banana (*Musa* sp.), sugarcane (*Saccharum* sp.), aubergine (*Solanum melongena*), taro (*Colocasia esculenta*) and coconut (*Cocos nucifera*).<sup>38</sup>
- 26 At least two species of *Citrus* were found. A total of 70 seeds and 42 large rind fragments were recovered from the 11<sup>th</sup>-13<sup>th</sup> century AD, as well as two seeds from the 14<sup>th</sup>-15<sup>th</sup> century deposits. Identification criteria are listed in table 2. The seeds could be divided into two types. The first type (seed type A) is identified as citron (*Citrus* cf. *medica*) (fig. 2a), although sour and sweet orange (*Citrus x aurantium* and *C. x sinensis*) cannot be ruled out on morphological grounds. Indeed, the average measurements of the seeds of these three taxa overlap, as observed on modern material.<sup>39</sup> The seeds of type B are in morphology and size closest to those of both lemon (*Citrus x limon*) and lime (*Citrus x aurantifolia*) (fig. 2c and d). Because of the large number of rind fragments of lime in the same deposits, they have been cautiously identified as mostly belonging to lime (*Citrus* cf. *x aurantifolia*).
- 27 The rind fragments are divided into four types, see identification criteria in table 2. Type 1 belongs to a large oblong fruit (ca. 70-x30 mm) with a thick and furrowed skin, tentatively identified as citron (*C. cf. medica*) (fig. 3c). Type 2 (38 specimens) consists of small globular fruits (diameter varying between 25-35 mm) and many of these represent fruits cut in half cross-sectional (fig. 4). These have been identified as belonging to lime (*C. x aurantifolia*). Type 3 rinds (2 specimens) are of similar size to those of type 2, but have a larger pedicel scar and were not cut in half (fig. 5a). These could belong to either lime or a small type of lemon. Finally, type 4 represents one fragment of a much larger fruit (fig. 5b); it could not be identified, though might belong to sour orange (*Citrus x aurantium*), but no secure identification can be offered.<sup>40</sup>

Table 2

Type	Description	Identification	Roman	Islamic
Seed A	Asymmetrical, longer than wide, pointed at both ends. Seed coat rough and sulcate (with grooves or furrows). Mean length=11.9 mm (number of specimen measured, N=16), mean width (taken at widest point) =5.4 mm (N=10)	Citron ( <i>Citrus cf. medica</i> )	x	x
Seed B	Assymmetrically obovate, with one end pointed and the other rounded. Seed coat rough, varyingly pustulate to sulcate. Mean length of 9.1mm (N=37), mean width of 5.3mm (N=31)	Lime ( <i>Citrus cf. x aurantifolia</i> ) or Lemon ( <i>Citrus cf. x limon</i> )	–	x
Rind 1	Large oblong fruit, ca 70x30 mm. Thick (ca 3 mm) and deeply furrowed rind	Citron ( <i>Citrus cf. medica</i> )	–	x
Rind 2	Small globular fruit, diameter ca 25 to 35 mm. No protruding papilla or nipple, small pedicel scar (ca 2 mm wide). Thin rind (ca 1-1.5 mm). Generally preserved as a fruit cut in half (cross-sectional)	Lime ( <i>Citrus cf. x aurantifolia</i> )	–	x
Rind 3	Small globular fruit, similar in size to as Rind 2, though possibly slightly larger. Large pedicel scar (ca 4 mm wide). Possibly representing a complete fruit damaged during deposition.	Variation within the lime group, or a small type of lemon? ( <i>Citrus cf. x aurantifolia</i> or <i>C. cf. x limon</i> )	–	x
Rind 4	Large fruit, at least ca 35 mm long. Medium thickness (2-2.5 mm)	possibly sour orange ( <i>Citrus x aurantium</i> ) ?	–	x

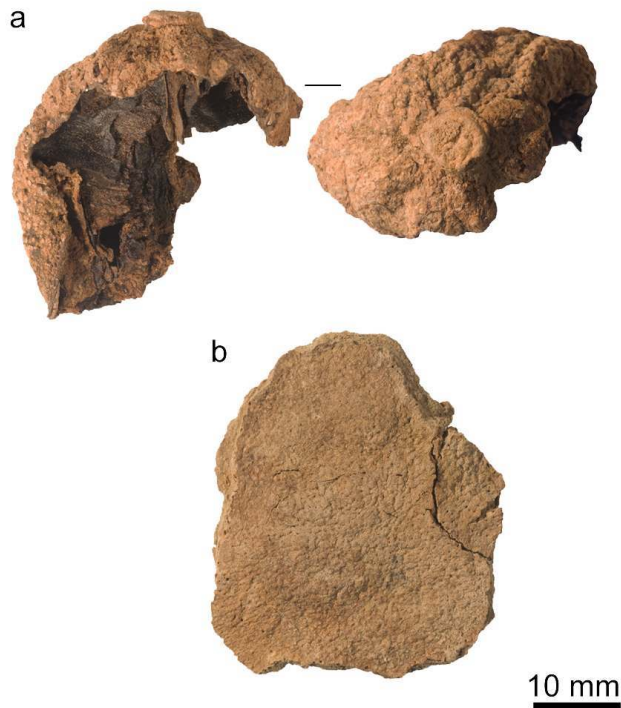
Identification criteria for the citrus remains found at Quseir al-Qadim, i.e. Myos Hormos and Kusayr, from Van der Veen 2011: 83-89. See also figs. 2-5 in this paper.

Fig. 4 - Archaeobotanical remains of citrus rind.



a. modern lime, *Citrus x aurantifolia*; b., c. and d. Type 2 rind, cf. lime, *Citrus* cf. *x aurantifolia*, all from Quseir al-Qadim, 11<sup>th</sup>-13<sup>th</sup> century AD (from Van der Veen 2011, fig. 3.6); central column of rows a, b, and d show the small pedicel scar; row c shows the small nipple. See Table 2 for identification criteria (photographs: Jacob Morales).

Fig. 5 - Archaeobotanical remains of citrus rind.



a. Type 3 rind, cf. lemon/lime, *Citrus x limon/x aurantifolia* (11<sup>th</sup>-13<sup>th</sup> century AD); b. Type 4, indeterminate, both from Kusayr, 11<sup>th</sup>-13<sup>th</sup> century AD (from Van der Veen 2011, fig. 3.6). See Table 2 for identification criteria (photographs: Jacob Morales).

### 1.10. Syene (Nile Valley) – Mamluk period

- 28 The city of Syene is located under modern-day Aswan, situated on the first cataract of the Nile. It was the southern border town of Egypt and an important garrison town. At the frontier with Nubia, Syene was also an important trading centre and famous for its granite deposits. The Swiss Institute started work on documenting and investigating individual monuments in the city of Aswan and nearby area during the 1970s. Since 2000 they have worked together with the Egyptian Supreme Council of Antiquities on systematic rescue excavations across the town. The objective is to understand the history of colonization of the eastern shore of Aswan, where in Greco-Roman times the city of Syene was founded (the twin city of Elephantine), representing the southernmost city of the Roman Empire and the most important city of Upper Egypt between the Greco-Roman and the early Islamic periods.
- 29 Excavations have recovered some prehistoric evidence and occupation of Ptolemaic, Roman and Islamic date. The citrus remains were derived from Mamluk deposits (mid 13<sup>th</sup> -early 16<sup>th</sup> century AD); no systematic archaeobotanical sampling was carried out in these deposits, and only handpicked material is available, amongst which were two large fragments of *Citrus medica* rind, as well as two fragments of cotton balls (*Gossypium* sp.), doum palm (*Hyphaene thebaica*) and date stones (*Phoenix dactylifera*). No citrus remains have been recovered from Ptolemaic or Roman levels.<sup>41</sup>

### 1.11. Finds of uncertain provenance

- 30 There are several further finds of citrus available in the literature, but none of these are precisely dated and are thus not included in table 1. For example, there are several fruits of citron in the Dokki Agricultural Museum at Cairo, ascribed to the Greco-Roman period; one of which is illustrated by Darby,<sup>42</sup> and represents a half fruit with seeds still embedded in fruit pulp. Note that while the text refers to it as of Greco-Roman date, the caption indicates that it comes from Luxor and dates to uncertain period but probably New Kingdom. Similarly, there is one citrus fruit in the Louvre Museum, from Egypt but otherwise of unknown origin and date.<sup>43</sup> There is also a citron fruit and half of one longitudinally cut from a grave near Luxor (Thebes), which are assumed to be of Ptolemaic or Roman date, despite the fact that they were presented by members of the local population without information about the exact spot it was found.<sup>44</sup> In the *Codex of Ancient Egyptian Plant Remains* there is mention of two finds of *Citrus aurantium*, both ascribed to the Pharaonic period, both almost certainly representing medieval or modern contamination. And finally, there is mention of *Citrus* wood from Antinoë, again concerning old finds, never recently corroborated.<sup>45</sup>

### 1.12. Summary of the botanical evidence

- 31 To date, the earliest secure archaeobotanical finds of citrus in Egypt belong to the 1<sup>st</sup> and 2<sup>nd</sup> centuries AD, from three separate sites, i.e. Myos Hormos, Mons Claudianus, Mons Porphyrites, and these all belong to citron, *Citrus medica*. Mid and later Roman evidence comprises leaves of citron which formed part of a 3<sup>rd</sup> century AD funeral wreath from Antinoë, rind fragments from 3<sup>rd</sup>-4<sup>th</sup> century AD Kellis, seeds from the late phase of Mons Porphyrites (4<sup>th</sup>-5<sup>th</sup> century AD) and one fruit from the 4<sup>th</sup>-5<sup>th</sup> century AD monastery at Phoebammon. Medieval Islamic records of citron consist of a desiccated seed from Hisn al-Bab (6<sup>th</sup>-7<sup>th</sup> century AD), seeds and skin/rind fragments from Kusayr (11<sup>th</sup>-13<sup>th</sup> century AD) and rind fragments from Mamluk Syene (13<sup>th</sup>-16<sup>th</sup> century AD).
- 32 One further species of citrus was identified in Egypt, i.e. lime, *Citrus x aurantifolia*, from 11<sup>th</sup>-13<sup>th</sup> century Kusayr, while a further two species (lemon, *Citrus cf. x limon*, and possibly sour orange, *Citrus cf. x aurantium*) may be present (also at Kusayr), though current morphological criteria are not sufficient to offer a definite identification for these. Other scientific methods, e.g. aDNA, may ultimately allow verification.

## 2. Text references to citrus

- 33 The arid conditions in Egypt are also responsible for the excellent preservation of ancient papyri and ostraca, and there is a considerable corpus available, comprising some 25,000 texts spanning the Ptolemaic and Roman periods.<sup>46</sup> Many originate from the early 20<sup>th</sup> century excavations at Oxyrhynchus, an ancient city located on the western edge of the Nile valley, in Middle Egypt, but others were derived from sites in the Fayum and other parts of Egypt. An extensive corpus of texts were recovered at the excavations of Roman sites in the Eastern Desert.<sup>47</sup> While the majority of the Oxyrhynchus texts are papyri, the majority of the Eastern Desert ones are ostraca, the latter used primarily for local communications and documents that do not need to be kept for the longer term.

## 2.1. Greek terms for citrus fruits

- 34 Greek was the principal written language in Egypt during the Ptolemaic and Roman periods, and the Egyptian papyrological documentation contains several Greek terms for the citrus plant, though as discussed below, these differ from those used by classical authors. The papyri use the terms κίτριον (*kitrion*) – also commonly spelled κίτριν (*kitrin*) – referring to either the tree or the fruit, and κίτρον (*kitron*) referring to the fruit; these terms correspond to the Latin equivalents of *citrus*, *citrea* and *citrium*.<sup>48</sup> The term κεδρόμηλον (*kedromèlon*), which is given as a synonym of κίτριον (*kitrion*) by Dioscorides (*De Materia Medica* I.115.5.3),<sup>49</sup> is found in just one, fragmentary, papyrus of the 7<sup>th</sup> century (CPR X 138).<sup>50</sup> Two translations of the Greek terms have been offered: lemon<sup>51</sup> and citron.<sup>52</sup> The latter one, citron, is now the most commonly accepted translation,<sup>53</sup> as is the case for the Latin terms.<sup>54</sup>
- 35 In contrast, Greek writers of the 4<sup>th</sup> century BC to the 1<sup>st</sup> century AD outside of Egypt often refer to the tree with the periphrasis “Median apple” or “Persian apple” (e.g. Theophrastus, *Enquiry into Plants* I.11.4, I.13.4 and IV.4.2). Dioscorides mentions “the Median or Persian apples or *kedromèlon*, called *kitrion* in Latin” (τὰ δὲ Μηδικὰ λεγόμενα ἢ Περσικὰ ἢ κεδρόμηλα, Ῥωμαιστὶ δὲ κίτρια ; Dioscorides, *De Materia Medica* I.115.5.3-4).<sup>55</sup> Similarly, Pliny refers to the fruit as “the citron or Assyrian apple, called by others the Median apple” (*Natural History* XII.7.15-16) and “the Greeks, however, call them Medic [Median] apples” (*Natural History* XV.14.47). As mentioned, these designations referring to the origin of the citron are not encountered in the papyrological corpus from Egypt, but, to highlight the complexity of identifying plants from their ancient names, the term “Persian apple tree” is, in the Greek papyri from Egypt, used to refer to the peach tree.
- 36 Andrews<sup>56</sup> highlights that during the early Empire (late 1<sup>st</sup> century BC) the references to “Persian” and “Median” apple began to be replaced by a specific term for citron: *citreum* and *citrium*, with later variants *citrum*, *cetream* and *cedrium*, and *citrus* for the tree,<sup>57</sup> which matches what we see in the Greek papyri from Egypt. This name change, he suggests, is evidence that only then citron cultivation was introduced into Italy, with the successful acclimatization – meaning the production of flowers *and* fruits – not completed until the middle of the 1<sup>st</sup> century AD. He also points out, following Loret,<sup>58</sup> that these terms may go back to an ancient Egyptian name, with *kitr-* as the root, hence his suggestion that citron may have been introduced from Egypt into Italy.

## 2.2. The earliest Egyptian papyri referring to citrus (1<sup>st</sup>-3<sup>rd</sup> centuries AD)

- 37 The first papyrological evidence of citrus comes from the Eastern desert (table 3).<sup>59</sup> One ostrakon found at the Roman fort of Persou, a way-station in the Wādi Fawākhir, on the route to Myos Hormos, concerns a private letter acknowledging receipt of *syrmadia* (horseradish?) and sending back one *kitrin* (κίτριν), citron, along with some *kolokyntia* (gourds?) (SB VI 9017 Nr. 13 (=O.Faw. 13), line 10).<sup>60</sup> The ostrakon itself is not dated, but it is part of an assemblage of ostraca belonging to the 1<sup>st</sup>-2<sup>nd</sup> centuries AD. There is no indication of the geographical origin of the letter, but while the horseradish is thought to have been grown at Persou, the gourds are listed among the food items mentioned in the



letters from this site as coming from the Nile valley. It is thus likely that the citron did too.<sup>61</sup>

- 38 The as yet unpublished 2<sup>nd</sup> century ostrakon from Dios (inv. 749), another Eastern Desert way-station (on the route to Berenike), refers to *kitrion* (κίτριον) among other food items. It is a fragmentary private letter, containing the text “receive 1 citron”. The indication “from Coptos” is found elsewhere in the text, but it is not clear whether this refers to all or just some food items on the list.<sup>62</sup> Nonetheless, most of the foods consumed at the Roman sites in the Eastern Desert originated from Coptos in the Nile valley, see discussion in section 3.2.
- 39 In addition to the two letters from the Eastern desert, a household account of the late 2<sup>nd</sup> century AD (AD 182), probably coming from Oxyrhynchus in the Nile valley (*P.Mich.* XI 619), twice refers to the citron fruit (κίτριον), the genitive singular form of κίτριον, line 3 and κίτριου, line 27) among other foodstuffs, such as asparagus, fava bean, lupin, leaf beet, bread, meat, etc.<sup>63</sup>
- 40 Finally, a private letter (*P.Warren* 15 (= *P.L.Bat.* I 15)), of unknown origin, dated to the 2<sup>nd</sup> century, concerns a papyrus written by Arsinoos who asks his ‘brother’ Alkimos for an agricultural (?) instrument and tells him that he has dispatched clothes and fruit, namely 1 artaba of dates and 70 citrons (κίτρια, line 15)<sup>64</sup>. Note the unusually large number of citron fruits mentioned in this text.
- 41 At least five 3<sup>rd</sup> century AD records, papyri and ostraca, refer to the citron plant or fruit. Three of them were found at Oxyrhynchus, one of which clearly demonstrates the cultivation of the tree. Indeed, the fruits (κίτριων, the genitive plural form of κίτριον, line 24) are mentioned in a contract established in 280 AD for labour in a vineyard and lease of a fruit garden. While it is clear that the citrons represent only a very small part of the rent compared to the other fruit items, the text confirms that citron was cultivated in Egypt at that time. In it, among other requests, three persons offer:
- to lease for one year the produce of the date palms and all the fruit trees which are in the old vineyard, for which we will pay as a special rent 1½ artabae of fresh dates, 1½ artabae of pressed dates, 1½ artabae of walnut-dates, 1½ artabae of black olives, 500 selected peaches, 15 citrons, 400 summer figs before the inundation, 500 winter figs, 4 large white fat melons (*P.Oxy.* XIV 1631).<sup>65</sup>
- 42 Two other private letters found at Oxyrhynchus refer to the citron plant. The first one, dating to the first quarter of the 3<sup>rd</sup> century, mentions – although the context is not clear – the delivery of “four other citron trees for a total of 42” (*kitria*, κίτρια, accusative plural form of κίτριον, *P.Wash.Univ.* I 29, lines 13-14).<sup>66</sup> The second one, incomplete, from the 3<sup>rd</sup> century, refers to the “sending of a donkey in order to [...] young plants of peach and citron”. Even though the papyrus breaks off and leaves the sentence unfinished, this letter makes clear that the peach (here *persikôn*, περσικῶν, line 18) is well distinguished from the citron tree (κίτριον, line 19) (*P.Oxy.* XIV 1764).<sup>67</sup>
- 43 One ostrakon of the second half of the 3<sup>rd</sup> century AD (*O.Heid.* 396), possibly coming from the Fayum oasis, ca. 100 km north of Oxyrhynchus, corresponds to a list of payments in kind which contains a reference to a large citron (κίτριον μεγάλην, line 20), as well as other foodstuffs such as eggs, chicken, oil, etc.<sup>68</sup> Another 3<sup>rd</sup> century papyrus of unknown origin shows us a list of foods sent or given to a high official (the *hypomnematographus*). Note that the number of citron fruits is modest in this case:
- to the (servant) of the hypomnematographus: 16 eggs, 1 pig, 4 cocks, vegetables, 2 citrons; to Hegoumenos: 2 honey-cakes, 3 duck-eggs; to Phantias: fish, 4 duck-eggs,

2 citrons; to Ioustos: 1 jar, 30 eggs, 4 cocks; to the man from Antaeopolis: 1 jar ( *P.Wisc.* II 60).<sup>69</sup>

- 44 Only one text is dated to the 4<sup>th</sup> century (AD 388). It is a papyrus that describes an offer to lease an orchard at Hermopolis Magna in Middle Egypt (*SB* VIII 9907), containing date palm and citron trees (φύνικες καὶ κίδρια, i. φούνικες; κίτρια).<sup>70</sup> There appear to be no Greek texts referring to citron (or other citrus species) dating to the 5<sup>th</sup> or 6<sup>th</sup> centuries AD. However, it is worth highlighting five mentions of ‘citron-colour’, dated to the 4<sup>th</sup>-7<sup>th</sup> centuries, with two different derived adjective forms, either *kitrinos* (κίτρινον in *P.Heid.* VII 406;<sup>71</sup> *P.Cair.Masp.* I 67006<sup>72</sup> and probably *CPR* X 139)<sup>73</sup> or *kitreos* – which is borrowed from the Latin *citreus* (κίτρεον in *SPP* XX 245<sup>74</sup> and *SB* III 6024).<sup>75</sup> All these references to citron colour are associated with clothing (table 3), which suggests that the fruit is sufficiently well known to be used to name a colour.
- 45 In terms of later texts, at least five Greek texts from the 7<sup>th</sup> and one from the 7<sup>th</sup>-8<sup>th</sup> century refer to the fruit or the tree (table 3). Among them, three leases of orchards or land show that the tree was still cultivated then, in Middle Egypt (*P.Mich* XIII 666)<sup>76</sup> and in the Fayum oasis, together with other fruit trees such as peach, pomegranate, apricot (?) and date palms (*SB* I 4483, line 12 and *SB* I 4485, lines 4 and 5).<sup>77</sup> It is worth mentioning here that there is another 7<sup>th</sup> century papyrus from the Fayum that lists many of these fruits in very large quantities. The text concerns a delivery order for a large estate and it lists several fruits, followed by numbers. Although the edition of the papyrus interprets the numbers as prices, the lack of any monetary unit might, instead, be taken to mean that the numbers refer to quantities. These include 500 apricots, 2000 pomegranates and 1000 citrons (κίτρ(ων), *CPR* X 62, line 5).<sup>78</sup> Unfortunately, the text does not divulge what all these citron fruits were to be used for.
- 46 As for the Coptic texts, several mention citrons and the citron-tree. Here (in table 3) we include three noteworthy ostraca from the Theban region and dating to the 7<sup>th</sup> or first half of the 8<sup>th</sup> century, which derive from a tomb linked to the ascetic Frangé.<sup>79</sup> These three ostraca refer to the fruit (borrowing the Greek words κίτρον or κίτρεά, in Coptic: *k'idre* and *kitra*), which suggest that citron was used there on a regular basis. One of these texts, *O.Frangé* 645, specifically refers to the medical purpose of citron. Indeed, an unknown sender asks for a little bit of citron to be given to his men who are sick.<sup>80</sup> Thus the fruit may join the list of particular foods that were regarded appropriate for people who were ill or poorly, such as wine, honey and maybe fish, according to other ostraca from the same context.<sup>81</sup>
- 47 Finally, we have not been able to determine whether any of the surviving Arabic texts from the period mention citrus fruits, but we do know that the fruit is mentioned by Islamic authors as early as the 7<sup>th</sup> century AD.<sup>82</sup> None of these specifically refer to its cultivation in Egypt, but al-Hamdani (AD 967-1007) mentions that it was available in Egypt in his time.<sup>83</sup>

Table 3 - Papyrological evidence for citrus fruits from Egypt.

Found at	Settlement	Date (AD)	Text	Remains	Document reference	Type and Detail	Ref.
Persou (Eastern Desert)	way-station	1st-2nd c.	κίριβ (l. κίριβ)	ostrakon	SB VI 9017 ( <i>O.Faw.</i> 13)	private letter, incl. foodstuffs, sending of one citron	a, b, u
Dios (Eastern Desert)	way-station	2nd c.	κίριβ	ostrakon	inv. 749	private letter, incl. foodstuffs, delivery of citron	c
unknown	-	2nd c.	κίριβ	papyrus	<i>P.Warren</i> 15 ( <i>PL.Bal.</i> I 15)	private letter concerning sending agricultural instrument, clothes, dates, citrons	a, e
Oxyrhynchus (?)	town	late 2nd c. (ca. 182)	κίριβ(υ), κίριβ(ιου)	papyrus	<i>P.Mich.</i> XI 619	household account, incl. foodstuffs, citron	a, d
Oxyrhynchus	town	early 3rd c.	κίριβ	papyrus	<i>P.Wash.Univ.</i> I 29	private letter, delivery of four citron trees	a, g
Oxyrhynchus	town	3rd c.	κίριβ[υ]	papyrus	<i>P.Oxy.</i> XIV 1764	private letter, young plants of peach and citron	a, f
unknown	-	3rd c.	κίριβ	papyrus	<i>P.Wisc.</i> II 60	list of foods, citron	a, i
Arsinoites (Fayum) (?)	village	2nd half 3rd c.	κίριβ (l. κίριβ)	ostrakon	<i>O.Heid.</i> 396	list, income and expenditure, incl. foodstuffs, one large citron	a, h
Oxyrhynchus	town	late 3rd c. (280)	κίριβ	papyrus	<i>P.Oxy.</i> XIV 1631	contract for labour and lease orchard, citron tree	a, f
Hermopolis Magna	town	late 4th (388)	κίριβ (l. κίριβ)	papyrus	SB VIII 6907	offer to lease an orchard, date palms and citron trees	a, j
unknown	-	4th-5th c.	κίριβ[ov]	papyrus	<i>P.Heid.</i> VII 406	list of clothes, citron-colour mantle	a, s
Hermopolis (?)	town	4th-7th c.	κίριβ (l. κίριβ)	papyrus	SB III 6024	list of clothes, citron-colour tunic	a, h
Aphroditis Kome	village	8th c.	κίριβ	papyrus	<i>P.Cair.Masp.</i> I 67006	marriage contract, citron-colour garment (tunic ?)	a, m, w
unknown	-	8th c.	κίριβ	papyrus	<i>SPP</i> XX 245	list of clothes, citron-colour mantle	a, n
unknown	-	8th c.	κίριβ[ov]	papyrus	<i>CPR</i> X 139	list of clothes, citron-colour hood	a, o
Arsinoites (Fayum)	village	early 7th c. (621)	κίριβ, κίριβ	papyrus	SB I 4483	lease of an orchard incl. peach, pomegranate, apricot(?) trees, citron tree	a, p, l
Arsinoites (Fayum)	village	early 7th c. (630)	κίριβ	papyrus	SB I 4485	lease of an orchard incl. peach, pomegranate trees, citron tree	a, p
Aphroditis Kome	village	1st half 7th c.	κίριβ	papyrus	<i>P.Mich.</i> XIII 666	lease of land incl. date palms, acacia, sycamore fig, olive and citron trees	a, q
Arsinoites/Heraclopolites ?	village	7th c.	κίριβ	papyrus	<i>CPR</i> X 138	list of foods, citron (?)	a, o
Arsinoites (Fayum)	village	7th c.	κίριβ	papyrus	<i>CPR</i> X 62	delivery order incl. peaches, apricots, dates, pomegranates, citrons	a, o, l
unknown	-	7th-8th c.	κίριβ	papyrus	SB XVI 12254	private account, incl. foodstuffs, citron	a, k, v
unknown	-	unknown	κίριβ	papyrus	SB XX 14103	list of foods, citrons	a, l
Theban region	monastic	1st half 8th c.	(κίριβ)	ostrakon	<i>O.Frangé</i> 15	Coptic private letter, delivery of one citron	a, r
Theban region	monastic	628-751	(κίριβ)	ostrakon	<i>O.Frangé</i> 645	Coptic letter, request for citron for medical purpose	z, x
Theban region	monastic	628-751	(κίριβ)	ostrakon	<i>O.Frangé</i> 654	Coptic letter, delivery of eight pomegranates and a little bit of citron	z, y

References: a. <http://papyri.info/search>; b. Bülow-Jacobsen 2003; c. Cuvigny and Bülow-Jacobsen, personal communication; d. Shelton 1971: 57-61; e. David, Van Groningen, Van Oven 1941: 44-45; f. Grenfell, Hunt 1920: *P.Oxy.* XIV 1631 p. 15-25; *P.Oxy.* XIV 1764 p. 183 (descr.); g. Schuman 1980: 42-43; h. Armoni, Cowey, Hagedorn 2005: 368-376, esp. 375; i. Sijpesteijn 1977a: 83-85; j. Lewis 1964: 42-43; k. Pintaudi 1981: 98-99; l. Schram 2014; m. Maspero, 1911: 22-33; n. Wessely 1921: 128; o. Harrauer *et al.* 1986: *CPR* X 62 p. 108-109; *CPR* X 138 p. 164; *CPR* X 139 p. 165; p. Kovarik 2007; q. Sijpesteijn 1977b: 81-87; r. Boud'hors, Heurtel 2010: 46-47; s. Papatthomas 1996: 175-190; t. Daris 1989; u. Guéraud 1942; v. Papatthomas 1994 (*SB* XVI 12254, 8 and 11); w. Russo 1998; x. Boud'hors, Heurtel 2010: 354; y. Boud'hors, Heurtel 2010: 360; z. Boud'hors, personal communication.

## 2.3. Summary of the papyrological evidence

- 48 As far as we know, citron is not mentioned in the Egyptian papyri dating to the Ptolemaic period. Noteworthy is the fact that citron is not found in the Zenon archive, dated to the 3<sup>rd</sup> century BC, in which luxury upper class foods are often mentioned,<sup>84</sup> which might suggest, but does not prove, that it was not yet known in Egypt then. The earliest known records of citrus date to the 1<sup>st</sup>-2<sup>nd</sup> century AD, and these concern sites in the Eastern Desert, that were supplied from the Nile valley (see discussion below). The number of papyrological records increases somewhat during the end of the 2<sup>nd</sup> century/3<sup>rd</sup> century AD and these show clear evidence for the local cultivation of the tree in the Nile valley and perhaps in the Fayum oasis. During the Byzantine and early Islamic periods (4<sup>th</sup>-8<sup>th</sup> centuries), the growing number of records among the Greek and Coptic papyrological corpus suggests wider cultivation and availability of citron by then (table 3).

## 3. Discussion

### 3.1. Limitations of the evidence

- 49 Both archaeobotanical and papyrological data referring to citrus species in Egypt known today are restricted to the Roman and later periods. It is clear, however, that the distribution of the finds reflects the research investment. For example, the number of excavations of Ptolemaic sites where botanical remains have been collected, is extremely limited compared to Roman ones, but even Roman sites with analysed botanical remains

are not numerous, especially in the Nile valley, Delta and Mediterranean coastal strip. In contrast, the size of the Ptolemaic papyrological corpus, while somewhat smaller than that of the early Roman period, might appear to be of sufficient size to allow a good chance of rare foodstuffs to be mentioned (ca. 7,000 texts dating to the 3<sup>rd</sup>-1<sup>st</sup> century BC, compared with ca. 11,000 texts dating to the 1<sup>st</sup>-2<sup>nd</sup> century AD).<sup>85</sup> Nonetheless, while the corpus is substantial, it contains few texts from settlement sites, limiting the chance of finding references to the growing of trees and foodstuffs (see below). Thus, an absence of references to citron does not mean it was not grown then. The discrepancy between the large numbers of papyri from the Ptolemaic period compared with the rarity of botanical remains can be explained by the fact that early excavations tended to focus on the collection of texts, but largely ignored botanical remains.

- 50 A further factor to consider is that of preservation. Citrus remains, like many other fruits, will not normally come into contact with fire, and are thus rarely found in charred form. No charred remains of citrus have been found in Egypt; they are all desiccated. Only one charred seed is reported from the Mediterranean region (i.e. from Pompeii); all the others are mineralized.<sup>86</sup> The lack of desiccated midden deposits in the Delta, the Mediterranean coast of Egypt and some parts of the Nile valley means that the preservation of both the seeds/fruits (and papyri/ostraca) is largely restricted to the Eastern and Western deserts, the dryer parts of the Nile valley and the Fayum.
- 51 Furthermore, the earliest records of citrus in the Mediterranean consist of pollen evidence (at Carthage and Ramat Rehel<sup>87</sup> and possibly at Cuma),<sup>88</sup> but virtually no palynological work has been carried out in Egypt, due to the rarity of suitable deposits. Future excavations of Ptolemaic sites and/or pollen analysis covering the Ptolemaic and earlier periods may, therefore, change the current picture. Pollen analysis of mudbricks and plaster in rural settlements and near gardens may be particularly profitable, as the evidence for citrus pollen from Ramat Rehel was derived from a plaster layer in one of the garden pools.<sup>89</sup>
- 52 Finally, it is worth remembering that the papyrological data also contain biases. This line of evidence records what needed to be written down, not everything that happened. Thus, it does not contain a full list of all the plants that were cultivated or consumed. We can see this in the texts referred to above. Some are letters asking for or promising foods to be delivered to the sites in the Eastern Desert, some are contracts concerning the sale of agricultural land, and others concern transactions of various sorts, that is, all involve activities that require a written record. Government records concerning taxation and property ownership, as well as individual transactions and contracts concerning land, houses, slaves, and animals make up the majority of the papyrological corpus.<sup>90</sup> Additionally, while the papyri from Roman Egypt comprise a wide range of documents, those from Ptolemaic Egypt often concern matters of state; few concern life in ordinary settlements and Bagnall<sup>91</sup> warns that silences in the documentary record from this period should be treated with great caution. Thus, the absence of references to citron in the Ptolemaic papyri cannot be taken to mean that the tree was not cultivated in Egypt.

### 3.2. Local cultivation or import

- 53 One of the key questions to be addressed here concerns the timing of the dispersal of citron and other citrus species into Egypt and the moment they became locally cultivated. In order to correctly interpret the botanical and papyrological evidence, it is, of course,

essential to appreciate the nature of the evidence and the nature of the sites from which the evidence derives. Apart from the limitations on the evidence described above (section 3.1), there are three aspects that need consideration.

- 54 First of all, the sites at which we have found evidence of local citrus cultivation are all located in agricultural regions, that is, Oxyrhynchus and Hermopolis Magna in the Middle Nile valley, the nome of Arsinoites in the Fayum and possibly Kellis in the Dakhleh oasis. All the other sites with citrus remains represent non-agricultural settlements, namely two quarry settlements (Mons Claudianus and Mons Porphyrites), two ports (Myos Hormos and Kusayr), two way-stations (Persou and Dios), one necropolis (Antinoë), one monastery (Phoebammon) and one fort (Hisn al-Bab). Thus, it is precisely at agricultural sites that we find evidence for the local cultivation of citron in Egypt and the earliest evidence we have from such sites dates to the end of the 3<sup>rd</sup> century (Oxyrhynchus). This highlights the need for great caution in interpreting the current evidence as pointing to an absence of citrus cultivation in Egypt before the end of the 3<sup>rd</sup> century AD. Until we acquire more botanical and papyrological evidence from agricultural settlements of Ptolemaic and early Roman date in the Nile valley, Fayum, Delta and Western oases, we are not going to be able to determine definitively when the cultivation of citron started here.
- 55 Secondly, to understand the remains of citrus from the Eastern Desert sites, it is important to realize that the Roman sites in the Eastern Desert concern very specialized settlements, i.e. ports, quarries, and the way-stations that served them. None of them are 'normal' villages or cities and none have an agricultural component. They are all part of a tight and integrated network of industrial and commercial activities providing the Roman Empire with luxuries, such as spices and textiles from India and prestigious building stone and emeralds from the Eastern Desert itself.<sup>92</sup> The importance of these products to the Roman Empire meant that there was a highly organized supply system in place, provisioning these remote settlements with food, water and other essentials. This organization was largely government-controlled, but included some private enterprise. The foodstuffs were brought in from the Nile valley, especially from the Coptos region, the starting point of the roads leading to the ports and quarries. At each of the excavated sites large numbers of ostraca and some papyri describe this organization and these transactions in some detail.<sup>93</sup> Additionally, notwithstanding the fact that most of the foods come from the Nile valley, there is both botanical and textual evidence that some green vegetables were produced in small garden plots associated with the quarries and some of the way-stations, as a private enterprise.<sup>94</sup> While water in the desert was very scarce, small plots could be watered by hand to grow vegetables with short growing seasons providing fresh greens, something difficult to achieve via the routes from the Nile valley. For example, in antiquity the trip from Qena (Kainepolis) to Mons Claudianus would have taken five days when carrying supplies, and that from the Nile to Myos Hormos six or seven days,<sup>95</sup> making delivery of fresh leafy vegetables difficult. Taking these economic considerations and the local conditions into account, we conclude that, in all likelihood, the citrons found at these sites were brought there from the Coptos region, though they could have been grown in the Delta, the Fayum, in the Nile valley or in one of the oases, rather than necessarily near Coptos itself.
- 56 It is, of course theoretically possible that the citron remains we found in the Eastern Desert came directly from the Indian subcontinent, via the ports of Myos Hormos and Berenike. This is implausible, however. Indeed, very few Indian foods were found at the

desert sites (e.g. two peppercorns pepper at Mons Claudianus, one grain of rice at Didymoi),<sup>96</sup> though some were found at the two ports. The latter (rice, mung bean, myrobalan) are interpreted as foodstuffs brought and consumed by Indian sailors that temporarily lived in the ports, rather than by the Roman residents. Concerning citron, there is no reference to this fruit in the mid-1<sup>st</sup> century AD text describing the trade,<sup>97</sup> suggesting that it had already become available in the Mediterranean prior to the writing of that text, something we know to be true from historical texts,<sup>98</sup> as well as from pollen and other evidence.<sup>99</sup> Moreover, the ostraca from Persou and Dios that mention citron, concern lists of foodstuffs coming from the Nile valley, rather than from one of the ports. In fact, the ostraca from these way-stations do not mention the caravan supplying the ports or the one carrying the goods from the ports to the Nile valley.<sup>100</sup>

- 57 Finally, the nature of the finds (fruits, seeds, and rinds) indicates that fruits, not just dried rind segments, were brought to the desert. The journey from India to either Myos Hormos or Berenike, would have taken months, making the survival of whole, fresh fruits on that journey unrealistic. The original introduction of citron into the west would probably have been as seeds or as small plants. The latter is described by Pliny: “[...] importing it [the citron plant] in earthenware pots provided with breathing holes for the roots...” (Pliny, *Natural History* XII.7.15-16), and such pots are, indeed, known from several Mediterranean archaeological sites.<sup>101</sup> The fruits could, of course, have been preserved in brine and transported in ceramic vessels from India, or from other, Mediterranean, regions. However, we currently do not have any evidence of such a practice during the Greco-Roman period, though a section on citrus cultivation and grafting in *Geoponica* – a 10<sup>th</sup> century compilation of earlier Greco-Roman literature – refers to the preservation of the citron fruit (κίτριον). It advises that by covering the fruit with kneaded gypsum it can be ‘kept throughout’, and that ‘citrons stored under barley do not go rotten’ (*Geoponica*, X, 7-10, ed. Beckh; for translation, see *Geoponica* 2011: 204-205). The transportation of dried fruits or dried fruit halves within Egypt, not from India to Egypt, does need consideration (see the discussion in section 3.3).
- 58 To sum up, the evidence from the Eastern Desert can give us no conclusive answer to the question of whether citron was cultivated in Egypt during the 1<sup>st</sup> and 2<sup>nd</sup> centuries AD. What it does indicate though is that citron was available in the Nile valley at that time, but whether it was cultivated in Egypt, or imported from elsewhere in the Mediterranean, will currently remain unanswered. However, even a journey from somewhere in the Mediterranean to Alexandria, from there to Coptos, and from Coptos to Mons Claudianus or Mons Porphyrites, would in all probability have taken too long to allow the survival of fresh fruits, though is possible as dried fruits. Thus, in all likelihood the citron was already cultivated in Egypt by the late 1<sup>st</sup> century AD, but we cannot offer definitive proof at this stage.

### 3.3. Consumption

- 59 Records of citron in Egypt, both archaeobotanical and textual, are modest in number, especially when compared with those of other foodstuffs. This can easily be explained by considering the way citron fruits were used and consumed. The fruits contain a small sour pulp which is very acidic and not eaten raw, but the rind is highly aromatic and rich in essential oil. This oil is used in perfumery and medicines, today and in antiquity,<sup>102</sup> and the quantities of the fruits found should, thus, not be compared with those of fruits

commonly consumed raw. Classical authors suggest that the medicinal use of the fruit was especially connected to its role as an antidote to poisons and as an insect repellent, as the following references highlight:

The 'apple' is not eaten, but it is very fragrant, as also is the leaf of the tree. And if the 'apple' is placed among clothes, it keeps them from being moth-eaten. It is also useful when one has drunk deadly poison; for being given in wine, it upsets the stomach and brings up the poison; also for producing sweetness of breath; for if one boils the inner part of the 'apple' in a sauce, or squeezes it into the mouth in some other medium, and then inhales it, it makes the breath sweet (Theophrastus, *Enquiry into Plants* IV.4.2; 4<sup>th</sup> century BC).

The citron or Assyrian apple, called by others the Median apple, is an antidote against poison. [...] For the rest, the actual fruit is not eaten, but it has an exceptionally strong scent, which belongs also to the leaves, and which penetrates garments stored with them and keeps off injurious insects. [...] Because of its great medicinal value various nations have tried to acclimatize it in their own countries, [...]. It is this fruit the pips of which, as we have mentioned, the Parthian grandees have cooked with their viands [food] for the sake of sweetening their breath... (Pliny, *Natural History* XII.7.15-16; 1<sup>st</sup> century AD).

[...] there are three parts to this fruit: the sharp centre, the fleshy pith and the outer skin. The skin is fragrant and aromatic, not just in smell but also in taste. It is naturally difficult to digest, as it is hard and knobbly. If it is used in medicine, it helps somewhat with the digestion, just like many other things that have a harsh quality. By the same token when a little is eaten it strengthens the stomach, so that after being cut open and squeezed, its juice is combined with medicines taken in pill form that act as a laxative or purge the whole body. Vinegar mixed with the inedible part of the fruit in which the pips are found is used for some other purposes, flat vinegar being made sharper through its addition. The middle of both the parts which give nourishment to the body, whilst containing neither harsh nor sharp qualities, are difficult to digest because of their hardness. Anyone who wants to liven up their dull taste, therefore, eats them with vinegar and fish-sauce. It is quickly found, either through experience or on the advice of a doctor, that they are digested better when taken like this (Galen, *On the Powers of Food* II.37.2; late 2<sup>nd</sup> century AD).

I am well aware, too, that when the citron is eaten before any food, dry or liquid, it is an antidote to every poisonous ingredient; I learned this from a townsman of mine who was entrusted with the governorship of Egypt. He had sentenced some convicted criminals to be the prey of wild beasts, and they were to be thrown among the creatures called asps. As they were entering the theatre assigned for the punishment of the robbers, a peddler-woman in the street gave them in pity some of the citron which she was holding in both hands and which she was eating. They took it and ate, and when, after a short time, they were thrown among those cruel and monstrous creatures, the asps, they received no injury when bitten. Perplexity seized the magistrate, and finally he questioned the soldier who guarded them to see whether they had eaten or drunk anything; when he learned that the citron had been given them, he ordered next day that a piece of citron should be given, exactly as before, to one convict, but not to the other, and the one who ate suffered no injury when bitten by the reptiles, but the other died the moment he was struck. And so, since the same result has been attested in many instances, the citron has been proved to be an antidote to every poison. Again, if one boil a whole citron in its natural state, seeds and all, in some Attic honey, it is dissolved in the honey, and anyone who takes two or three 'fingers' of it in the morning will not be harmed in any way by poison (Athenaeus, *Deipnosophistae or Scholars at the Dinner Table* III.84.D-F - 85.A; early 3<sup>rd</sup> century AD).

- 60 All four texts provide some indication of how the citron was consumed. As a fumigant amongst clothes the fruits were used, though it is not clear from any of the texts whether

these were fresh or dried fruits. As an antidote to poison the fruits were either soaked, boiled and/or dissolved in a liquid (e.g. wine or honey) and ingested as such, with the text by Athenaeus suggesting that the rind still existed within the liquid (reference to 'fingers'), though the 'two or three fingers' may, equally, be a reference to the quantity of liquid to be taken. Also, the juice was squeezed from the fruit and ingested to aid the efficacy of medicines taken in tablet form. And there is the suggestion that the fruit was also consumed without boiling (the pedlar-woman was holding the fruit in her hands and eating it). The text from Athenaeus is particularly interesting in this context, as he was a native of Naucratis in Egypt. His text indicates that citron was easily available in Egypt by the early 3<sup>rd</sup> century AD, as well as highlighting that the magistrate knew the value of scientific methods.

- 61 Finally, there is one reference to citron used in cuisine. In a collection of recipes credited to Apicius (late 4<sup>th</sup>-early 5<sup>th</sup> century AD) there is one mentioning the use of citron peel in a meat stew, not unlike the use of preserved lemons in Middle Eastern cooking today. The cook is instructed to clean the citrons inside and out and then dice them, before adding them to the stew; note that the reference is to complete fruits:

Sweet stew with citrons: In a pot put oil, garum, broth, head of leek; finely chop coriander, cooked pork shoulder, small meat patties. While this is cooking, grind pepper, cumin, coriander or coriander seeds, fresh rue, silphium root; pour on vinegar, defrutum, cooking broth, mix with vinegar. Bring to the boil. When it boils, put into the pot citron that have been cleaned inside and out, diced, and boiled. Break in tracta [thickening agent] and thicken, sprinkle with pepper, and serve ( *Minuta dulces ex citriis*, Apicius *De Re Coquinaria* 169;<sup>103</sup> 5<sup>th</sup> century AD).

- 62 The Greek papyrological corpus from Egypt, unfortunately, does not mention how the fruit was used. The texts mention citron fruits, but none of them indicate whether these are fresh or dried fruits, or how they were consumed. However, one Coptic text, *O.Frangé* 645, from a monastic context in the Theban region dated to the 7<sup>th</sup>-8<sup>th</sup> century, provides us with a specific mention to the medical use of the fruit. Unfortunately, we have no way of verifying whether the citron found at the 5<sup>th</sup> century monastery Phoebammon was also used for medicinal purposes.
- 63 The archaeobotanical evidence does give some clues. Firstly, the presence of seeds at almost all the sites suggests that entire fruits had been present at each. Secondly, the fragments of rind at several sites indicate that citron rinds were used/consumed (see below), and, thirdly, the presence of near-complete fruits at both Mons Claudianus and Phoebammon, as well as at the Louvre, the Dokki Museum and in Keimer's records (see section 1.10 above), suggests that the fruits had a particular role. In fact, remarkably, at least four of these concern half fruits, cut longitudinally, with the seeds still embedded in the fruit pulp (fig. 3a). This might indicate that the fruits were halved and dried, either for use as a fumigant in amongst clothes, in the preparation of an antidote to poison or a breath freshener, or in cuisine. Certainly, one of us (MvdV) has seen dried slices of citrus fruits for sale in herbalist shops in Iran; in this form they would be more easily kept longer term, and transported over long distances.
- 64 At the ports of Myos Hormos and Kusayr (the archaeological site of Quseir al-Qadim) the number of remains of citron and lime was large enough to allow a study of their comparative uses in one location.<sup>104</sup> The remains of citron (*Citrus medica*) at both Roman Myos Hormos and Islamic Kusayr concern mostly seeds, with just one rind fragment found, representing half a fruit, cut lengthwise, but with no seeds or pulp still inside (fig. 3c). In contrast, the remains of lime (*C. x aurantifolia*), only found at medieval Islamic



Kusayr, comprise many seeds, as well as some 40 large rind segments, many representing half fruits cut in cross-section, but without remains of fruit pulp or seeds (fig. 4b, c, and d). As preservation conditions and sampling strategy were identical for both sites/periods, the low occurrence of rind fragments of citron cannot be a product of either preservation or recovery, but, instead, points to differences in the way these fruits were consumed.

- 65 The near absence of citron rind at Myos Hormos and Kusayr suggests that it was the rind that was consumed, which matches some of the uses of the fruit described above, i.e. the boiling of the fruit in a liquid (e.g. wine or honey) to soften or dissolve it before consumption – to counteract the ingestion of poison or improve bad breath –, as well as the consumption of the rind in meat stews. In all these cases the seeds would be discarded, which matches the archaeological findings. Only in the description by Theophrastus is there mention of the use of the fruit pulp (see above).
- 66 In contrast, the lime fragments found at Kusayr comprised mostly fruits from which the juice is extracted, that is, the fruits were cut in half, squeezed and the rinds and seeds were discarded (fig. 4). This matches the use of limes today.<sup>105</sup>
- 67 In terms of social access to the fruit, current evidence from Egypt suggests that citron may have been restricted to the more well-to-do sectors of society in early Roman Egypt. It certainly was found primarily at sites where high ranking officials would have been present, such as at Mons Claudianus, Porphyrates and Myos Hormos, where it was part of a suite of ‘luxuries’, including various nuts (walnut, hazelnut, almond, pine nut), certain fruits (peach, pomegranate, persea), vegetables (artichoke) and herbs (anise, amni, fennel). This is in contrast to the way-stations, where such luxuries were not found and where such officials would not have resided, but only have passed through.<sup>106</sup> Whether the citrons mentioned in the two texts from Persou and Dios, both way-stations, were intended for such personnel is not clear. They may have been intended for high-ranking individuals passing through, such as the *curatores praesidiorum*, in charge of the administration of the way-stations, or a centurion or Decurion.<sup>107</sup>

## Conclusion

- 68 Citrus fruits have been found at 11 chrono-cultural contexts (representing eight archaeological projects) and are mentioned in at least 20 papyri or ostraca from Egypt. In antiquity the only citrus fruit recorded and/or mentioned is citron, *Citrus medica*. By the 11<sup>th</sup> century AD we have evidence for a second species, lime, *Citrus cf. x aurantifolia*, while a further two species (lemon and possibly sour orange) may be present by then as well, though current morphological criteria are not sufficient to offer a definite identification for these rind fragments. Other scientific methods, e.g. aDNA, may ultimately allow verification.
- 69 Thus, despite the fact that citron is present in North Africa and Israel from the 4<sup>th</sup> century BC (pollen evidence from Carthage and Ramat Rehel) and despite the fact that some authors<sup>108</sup> assume the tree was introduced into Italy from Egypt, we have found no evidence for citron in Ptolemaic Egypt. The earliest evidence for citron in Egypt, that we have been able to find, dates to the 1<sup>st</sup> century AD, and the first specific mention of cultivation of citron in Egypt dates to the late 3<sup>rd</sup> century AD. However, as we have argued above, the presence of citron in the Eastern Desert sites indicates that citron was

available at Coptos and the Nile valley more widely by the 1<sup>st</sup> century AD, which is highly suggestive of local, Egyptian, cultivation of citron at that time. It was probably a plant product reserved for the wealthy and officials of high rank, but may have become more widely available by the early medieval period. Historical sources emphasize the medicinal value of citron, including its value as an antidote to snake poison, its role in perfumery and, to a much lesser extent, in cuisine; the Greek papyrological sources are silent on the use of citron, but a Coptic ostrakon mentions the use of citron for medicinal purposes, while the archaeobotanical evidence is suggestive of the consumption of the rind and the use of complete or half fruits, the latter possibly used in dried form, to ease transportation and storage and/or to be used as a fumigant.

- 70 Our evidence may mean that citron was a Roman period introduction into Egypt, rather than the other way round as Andrews<sup>109</sup> had suggested. Certainly, the Romans did introduce many new foodstuffs into Egypt and citron may have been one of them. Caution is needed however. The lack of archaeobotanical assemblages from Ptolemaic sites and the near absence of papyri from ordinary settlements of this period mean that there has been little opportunity to find evidence for citron cultivation in Ptolemaic Egypt. The results from this survey should not be taken to mean that citron was definitely not cultivated in Egypt during the Ptolemaic period; rather that we have, to date, not found evidence for it. Future excavations of Ptolemaic sites, if combined with systematic sampling for archaeobotanical remains and papyri, may recover earlier records.

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## NOTES

1. Amigues 2005; Zohary *et al.* 2012: 146-47.
2. Langgut *et al.* 2013; Langgut 2014.
3. Van Zeist *et al.* 2001.
4. Bui Thi Mai, Girard 2014: 174.
5. Coubray *et al.* 2010; Pagnoux *et al.* 2013.
6. Botto, Salvadei 2005.
7. Loret 1891: 247-249.
8. Germer 1985: 106.
9. Keimer 1984.
10. Andrews 1961.
11. Whitcomb, Johnson 1979; 1982.
12. Peacock, Blue 2006; 2011.
13. For further detail, see Van der Veen 2011.
14. Van der Veen 2011; Van der Veen, Morales 2014.
15. Moore 2001; Watson 1983.
16. See also Van der Veen 2011: 83-89.
17. Maxfield, Peacock 2001a; Peacock, Maxfield 1997.
18. For more details, see Van der Veen 2001.
19. Bülow-Jacobsen 1997; 2003; Van der Veen 1998; 2001.
20. Van der Veen 2001: 220.
21. For more details, see Van der Veen 2001.
22. Maxfield, Peacock 2001b; Peacock, Maxfield 2007.
23. For more details, see Van der Veen, Tabinor 2007.
24. Van der Veen, Tabinor 2007.
25. Keimer 1984: 1-2, and endnote 6, which reads: *Bot. Museum Berlin-Dahlem, Sammlung Schweinfurth, Listen-Nr. 47*; and Germer 1988: 14-20, and figure 11 (the caption of figure 11 reads: *S. Schw. Nr.47*).
26. de Vartavan, Asensi Amorós 2010: 80.
27. *P. Kell.* IV Gr. 96, Bagnall 1997; Thanheiser 2002.
28. For more details, see Thanheiser 2002; Thanheiser *et al.* 2016.
29. Thanheiser 2002.
30. For more details, see Van der Veen, Tabinor 2007.
31. Täckholm 1961.
32. Täckholm 1961: 23-24.
33. Germer 1985.

34. A. Clapham, personal communication; Gascoigne, Rose 2012; Rose, Gascoigne 2013.
35. Clapham, Rowley-Conwy 2009.
36. For further detail, see Clapham unpublished data.
37. Peacock, Blue 2006; 2011.
38. For further details, see Van der Veen 2011; Van der Veen, Morales 2014.
39. Pagnoux *et al.* 2013, appendix 3.
40. For more details, see Van der Veen 2011.
41. Thanheiser, personal communication; see also [http://swissinst.ch/html/forschung\\_neu.html](http://swissinst.ch/html/forschung_neu.html).
42. Darby *et al.* 1977: 704-706, fig. 18.2.
43. Initially identified as lemon, but subsequently identified as citron; Loret, Poisson 1895: 194-196; Darby *et al.* 1977: 704-706; Keimer 1984: 1; Germer 1985: 106.
44. Keimer 1984: 1.
45. de Vartavan, Asensi Amorós 2010: 80.
46. Habermann 1998.
47. E.g. Bingen *et al.* 1992; 1997; Bülow-Jacobsen 2003; Cuvigny 2000; 2003b; 2005; 2012.
48. André 1985: 68; Amigues 2005: 364.
49. I.109.3, ed. Wellmann.
50. Harrauer *et al.* 1986: 164.
51. Daris 1989: 93; Bülow-Jacobsen 2003: 420; Armoni *et al.* 2005: 375.
52. Grenfell, Hunt 1920: 19 and 183; Sijpesteijn 1977a: 83-84.
53. LSJ; Fournet, Magdelaine 2001; Amigues 2005.
54. André 1985: 68.
55. I.109.3-4, ed. Wellmann.
56. Andrews 1961: 41-42.
57. Something also mentioned by Galen (late 2<sup>nd</sup> century AD): “Its fruit is no longer called ‘Median apple’ but *kitrion* by everyone”. Galen, *De Simplicium* VII.12.19.2 (XII, p. 77.4, ed. Kühn). Note that the word κίτρεά, borrowed from the latin *citrea*, and referring to the citron-tree, also appears in the *Geoponica*, a collection of agricultural lore, compiled during the 10<sup>th</sup> century, *Geop.* III.13.6 and X.7.8-11 (ed. H. Beckh; for translation see *Geoponika* 2011: 110; 204).
58. Loret 1891.
59. The papyrological abbreviations follow the *Checklist of Editions of Greek, Latin, Demotic, and Coptic Papyri, Ostraca and Tablets*, available at: <http://papyri.info/docs/checklist>.
60. Guéraud 1942: 168-169, no. 13.
61. Bülow-Jacobsen 2003: 420.
62. H. Cuvigny and A. Bülow-Jacobsen, personal communication.
63. Shelton 1971: 57-61.
64. David *et al.* 1941: 44-45.
65. Grenfell, Hunt 1920: 19.
66. Schuman 1980: 42-43.
67. Grenfell, Hunt 1920: 183.
68. Armoni *et al.* 2005: 375.
69. Sijpesteijn 1977a: 83-84.
70. Lewis 1964: 32-35.
71. Papatomas 1996: 175.
72. Maspero 1911; Russo 1998: 150.
73. Harrauer 1986: 165.
74. Wessely 1921: 128.
75. Armoni *et al.* 2005, see comm. ad l. 20 p. 375.
76. Sijpesteijn 1977b: 81; concerning the date, see Fournet 2016.



77. Kovarik 2007; Schram 2014-.
78. Harrauer 1986: 108-109; Schram 2014-.
79. Boud'hors, personal communication; see also Förster 2002: 417.
80. Boud'hors, Heurtel 2010: 354.
81. Boud'hors, Heurtel 2010: 21.
82. Watson 1983: 45.
83. Müller-Wodarg 1957: 73.
84. H. Cuvigny, personal communication.
85. Habermann 1998.
86. Pagnoux *et al.* 2013: 424.
87. Van Zeist *et al.* 2001; Langgut *et al.* 2013; Langgut 2014.
88. Bui Thi Mai, Girard 2014; papers this volume.
89. Langgut *et al.* 2013.
90. Bagnall 1995: 13-14.
91. Bagnall 1995: 27.
92. Van der Veen *et al.* in press.
93. Sidebotham 1986; Bingen *et al.* 1992; 1997; Cuvigny 1996; 2000; 2003a; 2012; Bülow-Jacobsen 2003.
94. Bülow-Jacobsen 1997; 2003; Van der Veen 1998.
95. Bülow-Jacobsen 2003; Strabo, *The Geography* 17.1.45.
96. Van der Veen 2001; Tengberg 2011; Van der Veen *et al.* in press.
97. I.e. *Periplus Maris Erythraei*, Casson 1989.
98. Theophrastus' *Enquiry into Plants* IV.4.2; Pliny's *Natural History* XII 7.15-16.
99. Pagnoux *et al.* 2013; chapters of this volume.
100. Bülow-Jacobsen 2003.
101. Macaulay-Lewis 2006.
102. André 1981; Andrews 1961; Flower, Rosenbaum 1958; Zohary *et al.* 2012.
103. Giacosa 1992: 95.
104. Van der Veen 2011: 185-187.
105. *Ibidem.*
106. Van der Veen *et al.* in press.
107. Cuvigny 2003a: 314-315, 339-340.
108. E.g. Andrews 1961.
109. Andrews 1961.

## AUTHORS

### CHARLÈNE BOUCHAUD

Archéozoologie, archéobotanique: Sociétés, pratiques et environnements (UMR 7209), Sorbonne Universités, Muséum national d'histoire naturelle, CNRS, CP 56, 55 rue Buffon, 75005 Paris, France

**JACOB MORALES**

Departamento de Ciencias Históricas, Área de Prehistoria, Universidad de Las Palmas de Gran Canaria, Spain (present address)

**VALÉRIE SCHRAM**

École Pratique des Hautes Études; UMR 8167 - Orient & Méditerranée, Paris

**MARIJKE VAN DER VEEN**

School of Archaeology & Ancient History, University of Leicester, UK; mvdv1@le.ac.uk