# Date-palm (Phoenix, Arecaceae) iconography in coins from the Mediterranean and West Asia (485 BC-1189 AD)

Authors: Diego Rivera1\*, Concepción Obón2, Francisco Alcaraz1, Emilio Laguna3, Dennis Johnson4

1 Depto. Biología Vegetal, Fac. Biología, Universidad de Murcia, 30100 Murcia, Spain.

\*Corresponding author. E–mail: drivera@um.es

### Table 1. Mints of the Mediterranean and West Asia, which issued coins with palm–tree images (485 BC–1189 AD)

| **Mints and references** | **Codes for coin types analysed** | **Coins analysed** | **Present day locality** | **Latitude** | **Longitude** | **Palm–tree coinage period** |
| --- | --- | --- | --- | --- | --- | --- |
| Ace Ptolemais (Galilaea) 8 | (No coins of sufficient quality to be analysed were found) | 0 | Acre, Haifa Bay, North, Israel | 32° 55' 40" N  | 35° 04' 54" E | 47 BC |
| Alexandria (Heraclius I) 50 | Alexandria | 3 | Alexandria, Egypt | 31° 12' 00" N  | 29° 55' 00" E | 629–641 AD |
| Anactorium (Aetolia) 7 | Anactorium | 1 | Aktio Vonitsa, Aetolia–Acarnania, Greece | 38° 55' 20" N  | 20° 50' 29" E | 325–300 BC |
| Antioch (Titus, Gallienus, Gordian III, Valerian) 51 | Antioch shield mid, Antioch shield upper, Antioch Titus | 8 | Near Yalvaç, Isparta, Turkey | 38° 18' 22" N  | 31° 11' 21" E | 79–268 AD |
| Abi’el (Arabia) 52, 71 | Arabia Abi'el | 9 | Al–Hofuf, (Hofuf, Saudi Arabia); Mleiha (Sharjah, UAE); or ed–Dur (Umm al–Qaiwain, UAE) | 25° 23' 00" N  | 49° 35' 00" E | 110–80 BC |
| Arados (Phoenicia) 4, 8, | Arados Alexander III, Arados Silver Drachm, Arados Silver Drachm V | 31 | Arwad, Tartus, Syria | 34° 51' 22" N  | 35° 51' 30" E | 259–147 BC |
| Arles (Constantinopolis commemorative) 53 | Arles Constantinopolis | 2 | Arles, France | 43° 40' 00" N  | 04° 37' 46" E | 330–331 AD |
| Baesuri 65 | Baesuri | 1 | Castro Marim, Algarve, Portugal | 37° 13' 00" N  | 07° 27' 00" W | 120–20 BC |
| Baria5, 38–39, 63, 65 | Baria HEA, Baria UR | 8 | Villaricos, Almería, Spain | 37° 14' 51" N  | 01° 46' 30" W | 205–100 BC |
| Byblos (Alexander III) 69 | Byblos Alexander III | 1 | Byblos, Jbeil District, Lebanon | 34° 07' 25" N  | 35° 39' 04" E | 325–300 BC |
| Carné (Alexander III) 4, 8, | Carné Alexander | 1 | Tell Quarnum, Tartus, Syria | 34° 57' 19" N  | 35° 52' 52" E | 226–137 BC |
| Carthage (Byzantine) 50 | Byzantine Carthage | 4 | Carthage, Tunis, Tunisia | 36° 51' 29" N  | 10° 19' 51" E | 582–602 AD |
| Carthage (Vandals) 62 | Vandals pseudoimp, Vandals Carthage | 8 | Carthage, Tunis, Tunisia | 36° 51' 29" N  | 10° 19' 51" E | 400–440 AD |
| Carthage (Zeugitana, Qart–Hadašt) 7–8, 30, 33, 70 | Zeugitania AE, Zeugitania Wide Palm, Zeugitania Gold, Zeugitania billon, Zeugitania | 53 | Carthage, Tunis, Tunisia | 36° 51' 29" N  | 10° 19' 51" E | 340–146 BC |
| Colonia Nemesia (Nimes) 54 | Colonia Nemesia | 3 | Nimes, France | 43° 50' 10" N  | 04° 21' 40" E | 40–10 BC |
| Cyrene (Cyrenaica) 8, 30, 35 | Kyrenaica | 8 | Near Shahhat, Jabal al Akhdar, Cyrenaica, Libya | 32° 49' 30" N  | 21° 51' 29" E | 321–261 BC |
| Delos (Cyclades) 8, 30 | Delos | 4 | Delos, Cyclades, Greece | 37° 23' 36" N  | 25° 16' 16" E | (300)–166 BC |
| Diocaesareia–Sepphoris (Galilaea) (Judaea s.l.) 8, 47–48 | Galilee Sepphoris | 4 | Tzippori, six km of Nazareth, Israel | 32° 45' 10" N  | 35° 16' 46" E | 98–117 AD |
| Ebusus  65 | Ebusus | 1 | Ibiza, Balearic Islands, Spain | 38° 58' 49" N  | 01° 29' 19" E | 200–100 BC |
| Egypt 7 | Egypt | 1 | Alexandria, Egypt | 31° 12' 00" N  | 29° 55' 00" E | c. 150 AD |
| Ephesos (Ionia) 3, 8, 26 | Ephesos silver drachm, Ephesos silver tetradrachm, Ephesos AE, Ephesos shield, Ephesos Titus | 141 | Three km SW of Selçuk, İzmir, Turkey | 37° 56′ 28″ N | 27° 20′ 31″ E | 394–133 BC |
| Gaza 55 | Gaza | 1 | Gaza, Gaza Strip, Palestine | 31° 31' 00" N  | 34° 27' 00" E | 375–333 BC |
| Gentinos (Troas)  1, 8, 25 | Gentinos | 2 | Tevfikiye, Çanakkale, Turkey | 39° 57' 27" N  | 26° 14' 20" E | 350–300 BC |
| Halieis (Argolis) 8, 27 | Halieis | 3 | Porto Cheli, village in the municipality of Kranidi, Argolis, Greece | 37° 19′ 30″ N | 23° 8′ 31″ E | 360–340 BC |
| Hierapytna (Crete) 8, 29–30 | Hierapytna | 7 | Ierapetra, Crete, Greece | 35° 00' 14" N  | 25° 44' 14" E | 302–286 BC |
| Ios (Cyclades) 8, 30 | Ios Cyclades | 2 | Ios, Cyclades, Greece | 36° 43' 00" N  | 25° 20' 00" E | (300)–166 BC |
| Judaea (Roman administration) 56 | Judaea Agrippa II, Judaea Antonius Felix, Judaea Coponius, Judaea Caesarea Titus, Judaea Caesarea Traian, Judaea Caesarea Domitian, Judaea Caesarea Minima, Judaea Herod III Antipas, Judaea Marcus Ambibulus, Judaea Pontius Pilate, Judaea Titus | 29 | Israel | 32° 30' 00" N  | 34° 54' 00" E | 6–135AD |
| Judaea (First Revolt) 8 | Judaea First Revolt | 4 | Israel | 32° 30' 00" N  | 34° 54' 00" E | 66–70 AD |
| Judaea (Second Revolt) 8 | Judaea Bar Kochba | 11 | Israel | 32° 30' 00" N  | 34° 54' 00" E | 132–135 AD |
| Karystos (Carystus) (Euboea) 5–7 | Karystos | 4 | Karystos, Euboia, Greece | 38° 00' 49" N  | 24° 25' 14" E | 485–360 BC |
| Laelia 57, 64–65 | Laelia | 1 | Cerro de la Cabeza, Sanlúcar la Mayor, Seville, Spain | 37° 23' 01" N  | 06° 12' 20" W | 50–20 BC |
| Lugdunum  58 | Lugdunum | 2 | Lyons, France | 45° 45' 55" N  | 04° 50' 06" E | 71 and 268 AD |
| Marathus (Phoenicia) 8, 30 | Marathos | 1 | Amrit, six km from Tartus, Syria | 34° 49' 48" N  | 35° 54' 00" E | 229 BC |
| Mauretania (Ptolemy) 33 | Ptolemy Mauretania | 2 | Tangier, Morocco | 35° 45' 35" N  | 05° 50' 04" W | 23–40 AD |
| Motya (Sicily) 8–12, 17–20 | Motya | 4 | Mozia (San Pantaleo Island, Sicily, Italy) | 37° 52′ 06″ N  | 12° 28′ 7″ E | 420–397 BC |
| Numidia 8, 33 | (No coins of sufficient quality to be analysed were found) | 0 | Northern Algeria and western Tunisia | 36° 22' 03" N  | 06° 36' 43" E | 202–148 BC |
| Palmyra (Palmyrene, Syria) 8, 42 | (No coins of sufficient quality to be analysed were found) | 0 | Tadmur, Homs Governorate, Syria | 34° 33' 36" N  | 38° 16' 02" E | 200–100 BC |
| Pella (Decapolis) 59 | Pella Decapolis | 1 | Tabaqat Fahl, Irbid Governorate, Jordan | 32° 27' 00" N  | 35° 37' 00" E | 81–96 AD |
| Philadelphia (Arabia Petraea) 46 | Philadelphia Arabia | 1 | Amman, Jordan | 31° 56' 00" N  | 35° 56' 00" E | c. 100–150 AD |
| Phygela (Ionia) 8, 29 | Phygela | 3 | Kuşadası, Aydın Province, Turkey | 37° 51′ 35″ N | 27° 15′ 35″ E | 350–300 BC |
| Priansos (Crete) 8, 29–30 | Priansos | 4 | 11 Km S of Inatos, Arkalochori, Heraklio, Crete, Greece | 34° 59' 06" N  | 25° 17' 06" E | 350–300 BC |
| Pyranthos (Crete) 8, 30 | Pyranthos | 2 | Near Gortyn, Crete, Greece | 35° 00' 00" N  | 24° 58' 00" E | (300)–110 BC |
| Qart Hadašt, Carthago Nova (SE Spain) 8, 17, 30–31, 33, 37–38, 63–65 | Hispano Carthago Nova AE, Hispano Carthago Nova Silver, Spain Carthago Nova Con, Spain Carthago Nova Cyl | 28 | Cartagena, Murcia, Spain | 37° 36' 00" N  | 0° 59' 00" W | 234–210 BC |
| Roman Administration of Palestine8, 45 | (No coins of sufficient quality to be analysed were found) | 0 | Israel; Palestine Authority | 32° 30' 00" N  | 34° 54' 00" E | 6–135 AD |
| Rome86 | Rome Dacica shield, Rome lead tessera, Rome Judaea Nerva, Roscius Fabatus, Rome shield Alexander Severus, Rome shield Commodus, Rome shield Diocletian, Rome shield Lucius Verus, Rome shield Titus, Rome shield Vespasian, Rome Vespasian Judaea, Thrace shield Septimius Severus, Thrace Titus | 46 | Rome, Italy | 41° 54' 00" N  | 12° 30' 00" E | 64 BC–294 AD |
| Samaria  60 | Samaria | 2 | Ramallah, West Bank, Palestine | 31° 54' 00" N  | 35° 12' 00" E | 375–333 BC |
| Sardinia 66–68 | Zeugitania Sardinia | 7 | Sardinia, Italy | 40° 00' 00" N  | 09° 00' 00" E | 300–216 BC |
| Scamandria (Skamandreia) (Troas) 18, 8, 26 | Skamandreia | 4 | Karamenderes, province of Çanakkale, Turkey | 40° 00′ 14″ N | 26° 13′ 25″ E | 350–300 BC |
| Scepsis or Skepsis (Troas) 1, 8, 25 | Skepsis | 7 | Kurşunlutepe, near Bayramiç, Turkey | 39° 51′ 10″ N | 26° 48′ 13″ E | 5th cent. BC |
| Seleucid Empire (Tyre and other Mints) 40–41 | Tyre Alexander I Balas, Tyre Alexander II Zebinas, Tyre Antiochos III Molon, Tyre Antiochos IV, Tyre Demetrios I, Tyre Demetrios II, Tyre Gamala, Tyre Gordian III | 20 | Tyre, South, Lebanon | 32° 55' 40" N  | 35° 04' 54" E | 200–123 BC |
| Sicily (Entella) 2, 11–12, 23, 32–33 | Entella bilobed, Entella regular | 25 | Contessa Entellina, Palermo, Sicily, Italy | 37° 43' 45" N  | 13° 11' 00" E | (410) 345–315 BC |
| Sicily (Guglielmo II) 61 | Sicily Guglielmo II | 2 | Palermo, Sicily, Italy | 38° 06' 57" N  | 13° 21' 37" E | 1190 AD |
| Sicily (Zeugitana) 2, 8–9, 11–18,20– 23 | Uncertain Punic Sicily Wide Palm, Uncertain Punic Sicily HoLyo Palm, Zeugitania Sicily | 25 | Sicily (general), Italy | 37° 30′ 0″ N  | 14°00′ 00″ E | 410–241 BC |
| Sisapo81, 63, 65 | Sisapo | 6 | La Bienvenida, Almodóvar del Campo (Ciudad Real, Spain) | 38° 38' 48" N  | 4° 31' 03" W | 150–100 BC |
| Smyrna (Ionia) 5, 29 | Smyrna | 2 | Izmir, Turkey | 38° 25' 01" N  | 27° 07' 51" E | 280–190 BC |
| Tagilit 63, 65 | Tagilit | 2 | Tíjola, Almería, Spain | 37° 20' 44" N  | 02° 26' 12" E | c. 200–120 BC |
| Tenos (Tinos) (Cyclades) 8 | Tenos | 1 | Tinos, Cyclades, Greece | 37° 32' 00" N  | 25° 10' 00" E | (300)–166 BC |
| Tiryns (Argolis) 8, 27–28 | Tiryns | 5 | Some kilometres north of Nauplion, Argolis, in the Peloponnese, Greece. | 37° 35′ 58″ N | 22° 47′ 59″ E | (421)370–300 BC |
| Tyre (Phoenicia) 4, 8, 43 | Tyre civic issue, Tyre wide palm tree, Tyre Diadumenian Tyre Salonina, Tyre Macrinus, Tyre Julia Aquilia und Elagabalus, Tyre Elagabalus, Tyre Trebonianus, Tyre Volusian | 30 | Tyre, South, Lebanon | 33° 16' 15" N  | 35° 11' 46" E | 126 BC–57 AD |
| Umayyad (al–Ramla) 49 | Umayyad | 8 | Ramallah, Palestine | 31° 54' 20" N  | 35° 12' 00" E | 692–750 AD |
| Umayyad (Dimashq) 49 | Umayyad | 3 | Damascus, Syria | 33° 30' 47" N  | 36° 17' 31" E | 692–750 AD |

References: 1 Wroth (1894), 2 Prag (2008), 3 Head (1880), 4 Hill (1910), 5 Anson (1912), 6 Head (1884), 7 Schwabacher (1944), 8 Head (1887), 9 Breitenstein (1942a), 10 Guzzetta (2008), 11 Hill (1903), 12 Jenkins (1969), 13 Jenkins (1971), 14 Jenkins (1974), 15 Jenkins (1977), 16 Jenkins (1978), 17 Jenkins (1979), 18 Poole (1876), 19 Salinas (1858), 20 Ugdulena (1857), 21 Puglisi (2005), 22 Breitenstein (1942b), 23 Lee (2000), 24 Breitenstein (1945), 25 Breitenstein (1946), 26 Breitenstein (1944), 27 Gardner (1887), 28 Breitenstein (1946), 29 Head (1909), 30 Wroth (1886), 31 Vico (2006), 32 Frey (2000), 33 Alexandropoulos (2008), 34 Manfredi (2009), 35 Christiansen and Kromann (1974), 36 Acquaro (1984), 37 Verdú (2010), 38 Ripollés and Abascal (2000), 39 Ruiz (2010), 40 Gardner (1878), 41 Mørkholm (1961), 42 Wroth (1899), 43 Syon (2008), 44 TBM (2014), 45 Hendin (2007), 46 Spijkerman (1978), 47 Goor (1967), 48 Hill (1914), 49 Bates (1989), 50 Grierson (1982), 51 Milne (1947), 52 Haerinck (1998,1999), 53 Bruun (1966), 54 Puech et al. (2014), 55 Gitler and Tal (2009), 56 Kanael (1963), 57 Akerman (1846), 58 Sydenham (1917), 59 Barag (1978), 60 Gerson (2001), 61 Travaini (1991), 62 Wroth (1911), 63 Alfaro (2004), 64 Vives (1924), 65 Alvarez (2008), 66 Piras (1993), 67 Acquaro (1984), 68 Breitenstein (1942b), 69 Price (1991), 70 Visona (1986), 71 Potts (1991). Note: In coinage period doubtful appear between parentheses.

### Table 2. Palm morphology as represented in coins compared with standardized descriptors for living palms

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Character | States analysed \* | Scored palm age \*\* | Scored realism \*\*\* | Related descriptors (IPGRI 2005*)* | States (IPGRI 2005*)* |
| 1. **Crown shape (L)**
 | Bilobed, Conical, Cylindrical, Cylindrical–Conical, Globose, Hemispheric, None, Obconical, Ovoid, Rhomboidal | 4, 4, 4, 4, 4, 2, 2, 2, 2, 2 |  | Growth habit (6.1.3)  | Erect, Globose, Falling |
| 1. **Length stem / length crown (A)**
 | 0–0.5, 0.5–1, 1–1.5, 1.5–2, 2–2.5, 2.5–3, 3–3.5, 3.5–4, 4–4.5(6) | 0.2, 0.8, 1.3, 1.8, 2.3, 2.8, 3.2, 3.8, 5 |  | None | – |
| 1. **Stem shape (L)**
 | Cylindrical, Cylindrical–Conical, Conical | 4, 2, 0.2 |  | Form of stem (6.1.5) | Cylindrical, Conical, Other |
| 1. **Stem surface (L)**
 | A superposed, Muricate, Fishbone, Verrucose, Muricate–Verrucose, Smooth, Disks superposed, “X” superposed, Irregular |  | 0, 7, 7, 7, 7, 5, 0, 0, 7 | None | – |
| 1. **Remains of the base of leaves that are on the same level on the stem (N)**
 | 0, 1–2, 3–4, 5–10 |  |  | None | – |
| 1. **Basal processes (L)**
 | Disk, Rectangular, Triangular, None |  |  | Presence of aerial roots (6.1.8)? | No, Yes |
| 1. **Stem apex (below crown) (L)**
 | Thickened, Not thickened |  |  | Upper part of the stem furnished with long brown fibres (6.1.9) | No, Yes |
| 1. **Total number of leaves (N)**
 | 1–3, 3–6, 6–9, 9–13, 13–18, 18–24, 24–35 |  | 0, 0, 3, 5, 5, 5, 5 | Aspect of the crown (6.1.4) | Loose, Medium, Dense |
| 1. **Number of curved leaves (N)**
 | 1–3, 3–6, 6–9, 9–13, 13–18, 18–24, 24–35 |  |  | Level of leaf curvature (6.2.1) | In the middle, at 1/3 of the palm, to 2/3 |
| 1. **Leaf outline (L)**
 | Linear, Oblong, Lanceolate, None, Obovate, Spathulate |  | 1, 1, 10, 0, 3, 3 | None | – |
| 1. **Leaf division (although date–palm leaves are always fully pinnate, division is represented in various degrees in coins) (L)**
 | Deeply pinnate, Pinnatisect, Pinnatifid, Dentate, Entire, Entire to pinnatifid |  | 10, 3, 3, 3, 0, 0 | None | – |
| 1. **Leaf apex (L)**
 | Acute, Obtuse |  | 3, 0 | Apical divergence of leaflets (6.2.25) | Low, Mean, Strong |
| 1. **Angle between the basal leaves with the plane transverse to the stem. Left side (N)**
 | –90º to –60º, –60º to –30º, –30º to 0º, 0º to 30º, 30º to 60º, 60º to 90º |  |  | Growth habit (6.1.3)  | Erect, Globose, Falling |
| 1. **Angle between the basal leaves with the plane transverse to the stem. Right side (N)**
 | –90º to –60º, –60º to –30º, –30º to 0º, 0º to 30º, 30º to 60º, 60º to 90º |  |  | Growth habit (6.1.3)  | Erect, Globose, Falling |
| 1. **Maximum number of leaflets per leaf (N)**
 | 0–3, 4–6, 8–9, 10–13, 14–18, 19–24, 25–40 |  | 0, 3, 3, 3, 5, 5, 7 | Average number of leaflets per palm | Counts |
| 1. **Leaflet outline (L)**
 | Linear, Oblong, Lanceolate, None, Triangular, Rounded |  | 0, 5, 10, 0, 3, 0 | None | – |
| 1. **Number of bunches (N)**
 | 0, 1, 2, 3 |  |  | None | – |
| 1. **Peduncle infrutescence (L)**
 | Straight, Recurved, None  |  | 10, 10, 0 | Position of the infructescence (6.4.1) | Erect, Oblique, Nodding |
| 1. **Maximum number of fruits per bunch (N)**
 | 0–1, 2–4, 5–7, 8–10, 11–15, 16–50 |  | 0, 0, 3, 5, 5, 10 | None | – |
| 1. **Fruit shape (L)**
 | Spherical, Ovoid, Sub–Cylindrical, Represented in bulk (without differentiating the form), None |  | 5, 7, 7, 0, 3 | Fruit shape at the "Bser" stage (6.5.1) | Spherical, Sub–Spherical, Ovoid, Cylindrical, Sub–Cylindrical, Piriform, Curved |

Morphological Characters analysed on Palm–tree images in coins, totalizing 20 variables and 112 states, compared with standardized descriptors for describing palm–tree according to IPGRI (2005). Codes: (A) llometric, (L) Qualitative, (N) Quantitative. Note: (\*) For each character, states in this table only with frequencies above 10% are represented in Table 6. (\*\*) Values assigned to each state in a scale from zero to 10 in reason of their frequency in aged living palms. (\*\*\*) Values assigned to each state in a scale from zero to 10. (\*\*\*\*) Other not morphological character analysed is the associated icon, with 18 different states according to the images appearing together with the palm on the same coin face.

### Table 3. Types of palm–tree images, mints, periods and materials

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Type** | **Coinage typess** | **Distinctive characters** | **% Realism** | **% Age** | **% Fertile palms** | **Period** | **Mat.** |
| **1** | Anactorium, Antioch shield mid, Antioch shield upp, Arles Constantinopolis, Entella bilobed, Ephesos shield, Judaea Caesarea Titus, Judaea Caesarea Traian, Judaea Pontius Pilate, Lugdunum, Rome Dacica shield, Rome shield Alexander Severus, Rome shield Commodus, Rome shield Diocletian, Rome shield Lucius Verus, Rome shield Titus, Sicily Guglielmo II, Tenos, Thrace shield Septimius Severus, Thrace Titus | Crown rhomboidal (47%). 2-3 leaves, straight. | 14 to 72 | 26 to 91 | 20 | 320 BC to 1180 AD | AE, AR |
| **2** | Hispano Carthago Nova AE, Hispano Carthago Nova Silver, Zeugitania AE, Zeugitania, Zeugitania Sardinia | Stem surface irregular. 4-6 leaves, lanceolate. Crown obconical (37%), rhomboidal (27%) or hemispheric (34%). | 22 to 54 | 82 to 93 | 87 | 300 to 215 BC | AE |
| **3** | Antioch Titus, Arados Silver Drachm V, Ephesos silver drachm, Ephesos silver tetradrachm, Ephesos AE, Kyrenaica, Phygela, Rome shield Vespasian, Rome Vespasian Judaea | Stem surface muricate | 29 to 60 | 51 to 74 | 80 | 350 BC to 73 AD | AE, AR |
| **4** | Galilee Sepphoris, Judaea Bar Kochba, Judaea Caesarea Domitian, Judaea Coponius, Judaea Marcus Ambibulus, Pella Decapolis, Spain Carthago Nova Con, Spain Carthago Nova Cyl, Tyre wide palm tree | Crown hemispheric. 7-9 leaves. 0-7 dates per bunch. | 49 to 90 | 31 to 64 | 100 | 237 BC to 133 AD | AE, AR |
| **5** | Arados Silver Drachm, Entella regular, Motya, Rome Judaea Nerva, Uncertain Punic Sicily HoLyo Palm, Zeugitania Wide Palm, Zeugitania Gold, Zeugitania billon | Crown cylindrical (40%). Leaves lanceolate. | 49 to 90 | 54 to 100 | 96 | 410 to 155 BC (and 96 AD) | AE, AR, AU, BI, EL |
| **6** | Baria HEA, Baria UR, Byblos Alexander III, Byzantine Carthage, Delos, Ebusus, Egypt, Gaza, Gentinos, Halieis, Hierapytna, Ios Cyclades, Judaea Agrippa II, Karystos, Philadelphia Arabia, Pyranthus, Rome lead tessera, Samaria, Skamandreia, Skepsis, Smyrna, Tagilit, Tiryns, Tyre Gordian III, Tyre Macrinus, Tyre Salonina, Tyre Demetrios II, Umayyad | Crown hemispheric. Stem surface smooth. Leaves mostly entire. Often without fruits (59%) | 12 to 51 | 31 to 92 | 41 | 470 BC to 730 AD | AE, AR |
| **7** | Ephesos Titus, Judaea Antonius Felix, Judaea First Revolt, Judaea Titus, Priansus, Ptolemy Mauretania, Roscius Fabatus, Tyre civic issue, Tyre Alexander I Balas, Tyre Alexander II Zebinas, Tyre Antiochos III Molon, Tyre Antiochos IV, Tyre Diadumenian, Tyre Demetrios I, Tyre Gamala, Tyre Julia Aquilia und Elagabalus, Tyre Elagabalus, Tyre Trebonianus, Tyre Volusian, Vandals pseudoimp, Zeugitania Sicily | Crown hemispheric. Stem surface irregular. 7-9 leaves. | 10 to 63 | 35 to 77 | 98 | 300 BC to 470 AD | AE, AR |
| **8** | Arabia Abi'el , Baesuri, Colonia Nemesia, Judaea Caesarea Minima, Judaea Herod III Antipas, Laelia, Sisapo, Vandals Carthage | Crown cylindrical (37%). Stem surface smooth. Leaves linear, entire. Without fruits. | 18 to 66 | 20 to 72 | 17 | 200 BC to 400 AD | AE, AR |
| **9** | Alexandria, Arados Alexander III, Carné Alexander, Marathos | Crown globose (50%). Stem surface with disks superposed. Leaves entire. | 20 to 41 | 61 to 86 | 100 | 324 BC to 630 AD | AR |
| **10** | Uncertain Punic Sicily Wide Palm | Crown globose. Over 13 leaves, lanceolate, with 6-24 leaflets. Dates globose, 15-50 per bunch. | 89 | 67 | 100 | 410 BC | AR |

**Codes: Mat.** Metal in which the image is coined: AU. Gold. AR. Silver. AE. Bronze (an alloy made of copper and another metal, usually tin). BI. Billon (an alloy made of copper and silver, with more than half copper). EL. Electrum (a naturally occurring alloy of gold and silver, with trace amounts of copper and other metals).

### Table 4. Agricultural, geographical and biological evidence from ancient coins compared to classic Greek and Roman texts

| **Themes** | **Information furnished by Classical authors** | **information available from ancient coins** |
| --- | --- | --- |
|  | Vegetative Characters |  |
| Single stem vs. Multiple stems | Tree with a single undivided stem (Theophrastus EI. 4.2.7.). Double and threefold stemmed palms of Crete, one with five heads in Lapaia (Theophrastus EI. 2.6.9.). Some palms in Syria and Egypt divide into two stems, and in Crete even into three, and some even into five (Pliny NH. 13.8.38). Pythagorean precepts; such, for examples; as these: “Do not lop off the shoots of a palm–tree”… (Plutarch IO. 10.) | Almost all coins represent single–stemmed palms (as usual in most date–palm groves), but a few coins i.e. Egypt lead tessera, also coins of Carystus (Eboea) 369–333 BC, represented two or three palms together emerging from the same point (Anson 1912) (feral and wild individuals) |
| Wood | Wood fibrous (Theophrastus EI. 1.5.3.). The fibres run in every direction (Theophrastus EI. 5.3.6.). Palm–wood is light, easily worked and soft, and it is tough (Theophrastus EI. 5.3.6.). The wood dries while it is being sawn (Theophrastus EI. 5.3.6.). It is strong and bends upwards (Theophrastus EI. 5.6.1.). It curves in a different way to other trees (Pliny NH. 16.81.223.) Why did the palm alone of all trees bend upward when a weight is laid thereupon? (Plutarch QN. 32.) | Palm wood structure is not represented in ancient coins |
| Evergreen leaves | Evergreen (Theophrastus EI. 1.9.3.), Reedy (= feathery) (Theophrastus EI. 1.10.5.). Do not shed their leaves: olive, laurel, palm, myrtle (Pliny NH. 16.33.79.). The leaves of the palm are double (Pliny NH. 16.38.90). | In coins, palms appear with leaves (even a few) except in some of the Victory and shield Roman imperial coinages where represent the shield directly on the top of a palm stem devoid of leaves |
| Crown shape | They tie back the leafy shoots to make them grow upward to a considerable height (Pliny NH. 13.8.36.) | Cylindrical, Cylindrical–conical. Palm types presently grown in Spain and North Africa (Thoory and others) |
| Longevity  | The long–lived palm in Delos (Theophrastus EI. 4.13.2.). Moreover at Delos may be seen a palm–tree dating back to the time of the same deity (Apollo) (Pliny 16.89.240.).  | Numerous Zeugitania coinages (Sicily and Carthage) represent palms with the highest age indices. The average economic life of a date palm is 40 to 50 years, but some are still productive up to 150 years (Chao and Krueger 2007). |
|  | Sterile and male date-palm trees |  |
| Dioecy | Female do not produce “flowers”, male do (Theophrastus EI. 1.13.5.). Some are male, others females (Theophrastus EI. 2.6.8.). A male palm forms a blossom on the shoot, whereas a female merely forms a bud like an ear of corn, without going on to blossom (Pliny 13.7.33). In a palm–grove of natural growth the female trees do not produce if there are no males, and that each male tree is surrounded by several females with … by his pollen; and that when the male tree is felled the females afterwards become barren (Pliny NH. 13.7.35.). | Palms without infructescences are relatively frequent in coins, however these could indistinctly be male or sterile female individuals |
| Short stemmed and sterile | Kinds not larger than a shrub that in some cases is barren (Pliny NH.13.7.28.). | Byzantine coins of Alexandria represent short–stemmed sterile date palms, and alike those of Antioch and Constantinopolis |
| Pollination | They shake the male flower over blooming female flowers (Theophrastus EI. 2.8.4.). Without pollination shed their fruit (Theophrastus EI. 2.8.1.). They fasten the “fruit” of that which the Greeks term the male tree to the one which produces the date; by this means the worm which is contained in the former entering the fruit, ripens and prevents it from dropping immaturely.. (Herodotus H. 1.193.) Mankind has actually devised a method of impregnating them by means of the flower and down collected from the males, and indeed sometimes by merely sprinkling their pollen on the females (Pliny NH. 13.7.35.) | Artificial pollination is not represented in coins |
| Place of the inflorescences | At the top of the palm (Theophrastus EI. 1.14.2.) | When represented in coins appear at the top of the stem below leaf bases (not inflorescences but infructescences) |
|  | Infructescences and fruits |  |
| Seed production, consistence and shape | Solid and dry (Theophrastus EI. 1.11.3.). Some have no seeds, others soft seeds (Theophrastus EI. 2.6.6.). Young it produces its fruit without a stone (Theophrastus EI. 2.6.4.). As long as the trees are young, the fruit has no woody part inside (Pliny NH. 13.8.38.). The seed is oblong in shape and not rounded, and also it is split at the back by a bulging cleft, and in most cases shaped like a navel at the middle of the bulge: it is from here that the root first spreads out (Pliny 13.7.33.). | Coins often represent fruits but do never depict date seeds |
| Fruit setting | High palms, begin to bear fruit as they are four or five years old. Low palms, begin to bear, as they are three years old in Cyprus (Theophrastus EI. 2.6.9.). | Coins of Quart Hadast (Spain) and Guglielmo II (Sicily, Italy) represent fruiting palms with low age index (thus of the age mentioned by Theophrastus)  |
| Fruit size and shape | Remarkable for their beauty and size (Xenophon AN. 2.3.15.). Differ in size and shape, some being round…, others small (Theophrastus EI. 2.6.6.) The *sandalis* date, so called from its resemblance to a sandal… (Pliny NH. 13.9.42.). The finger–date: it is a very long slender date, sometimes curved (Pliny NH. 13.9.46.). In Cyprus the fruit is rounder than it is elsewhere (Pliny NH. 13.7.35.). These too are of several kinds, differing in shape, some rounder and others longer (Pliny NH. 13.9.48.) | Spherical, Ovoid, or Sub–Cylindrical. Fruit shape at the "Bser" stage of different cultivars |
| Fruit colour | Some are white, some black, some yellow (Theophrastus EI. 2.6.6.). With a colour altogether resembling that of amber (Xenophon AN. 2.3.15.) Some being blacker and other reddish; indeed, they are reported to have as many varieties of colour as the fig, though the white ones are the most in favour (Pliny NH. 13.9.48.) | Numerous cultivars coloured at the "Bser" stage from light yellow to orange and red. Colour is not represented in ancient coins. |
| Fruit taste and texture | Much difference in flavour (Theophrastus EI. 2.6.6.). Cyprus, a peculiar kind of palm which does not ripen its fruit, though, when it is unripe, it is very sweet and luscious (Theophrastus EI. 2.6.8.). Cyprus, it has a pleasant sweet flavour even though it does not reach maturity… though people there do not eat the body of the fruit, but spit it out after merely squeezing out the juice (Pliny NH. 13.7.35.). The dates, they would dry and store away for sweetmeats (Xenophon AN. 2.3.15.). Dates of the sort that one can see in Greece were set apart for the servants (Xenophon AN. 2.3.15.). There are two kinds in the Thebaid as well as in Judaea, both the *caryotic* and the other; and the *Thebaic* date is harder, but more agreeable to taste (Strabo GE. 17.1.51.). The date that comes next in sweetness in flavour is the sister of the *caryotae* and consequently is called in Greek the sister–date (Pliny NH. 13.9.45.). All over the Thebaid and Arabia the dates are dry and small, with shrivelled body (Pliny NH. 13.9.47.) Dates please us by their flesh (Pliny NH. 15.34.116.) | Numerous cultivars. “Tendres” of Elche (Spain) present the characteristics of the Cyprus palm. Not in coins. |
| Fruiting peduncle | Hanging in bunches from shoots of its own between the branches, and which has the nature both a cluster and a single fruit (Pliny 13.7.29) Others hang in bunches, for instance dates (Pliny NH. 15.34.115.) The palm–tree alone, has its fruit enclosed in spathes, hanging down in bunches (Pliny NH. 16.48.112.) | Straight or Recurved the fruiting peduncle appears in coins or not (simplified bunches). These may represent different cultivars |
| Harvesting and Conservation of fruits | The fruit is gathered in the autumn (Dioscorides MM. 1.148.). The only dates that will keep are those which grow in the Valley of Syria, while those that grow in Egypt, Cyprus and elsewhere are used when fresh (Theophrastus EI. 2.6.9.). Most liable to lose their fruit before it ripens (Pliny NH. 16.46.109.)  | Depending on water-content ripe dates are classified in dry, semi–dry and soft. Not differentiable in coins, however long and thin ellipsoidal date represented in coins of Judaea recall modern dry dates in shape. |
|  | Western Zones of cultivation |  |
| Italy | It is true that there are also palms in Europe, and they are common in Italy, but these are barren. There are none in Italy not grown under cultivation (Pliny NH. 13.6.26.). In the Temple of Fortuna Primigenia on the Quirinal, a palm–tree sprang up in the temple precint. Reported by T.Marcius Figulus, a palm–tree had sprung up in the inner court of his house (Titus Livius HR. 43.13.). At the time of the Athenian misfortunes in Sicily, the golden dates were dropping from the palm–tree and ravens were pecking off the edge of the shield of Pallas Athena (Plutarch DP. 8.) | One single coinage from Republican Rome (Roscius Fabatus) and several imperial commemorative coinages. |
| Libya s.l.  | *Nasamonian* district and near the temple of Zeus Ammon (Theophrastus EI. 4.3.1.). Deep in the interior above the *Syrtis* and Cyrenaica, being productive of palm–trees and well supplied with water. It lies above *Cyrenaea* to the south (Strabo GE. 17.3.23.). The interior of Africa as far as the Garamantes (*Garama*) and the desert is covered with palms remarkable for their size and their luscious fruit, the most celebrated being in the neighbourhood of the temple of Ammon (Karnak, Egypt?) (Pliny NH. 13.32.112.) | Several coinages of Cyrenaica likely represent Libyan palms |
| Maghreb | *Taeape* (Ghabés), in the middle of the desert… Here underneath palms of exceptional size (Pliny NH. 18.50.188.). The Atlas, and that in the neighbourhood are traces of the land having formerly been inhabited, remains of vineyards and palm–groves (Pliny 5.1.13.) | The scarce coinages from Numidia and Mauretania rarely represent palms and then in an extremely schematic form |
| Sicily | At the time of the Athenian misfortunes in Sicily, the golden dates were dropping from the palm–tree and ravens were pecking off the edge of the shield of Pallas Athena (Plutarch DP. 8.). As a matter of fact most of the Pythagorean precepts do not at all fall short of the writings that are called hieroglyphs; such, for examples; as these: “Do not lop off the shoots of a palm–tree”… (Plutarch IO. 10.) | Numerous coinages from Carthaginian cities in Sicily and Sardinia. |
| Spain | In the coastal regions of Spain they do bear fruit, but it does not ripen, and in Africa the fruit is sweet but will not keep for any time (Pliny NH. 13.6.26.). Canaria also abounds in palm–groves bearing dates (Pliny 6.38.205.) | Several coinages from *Baria* (Villaricos), *Quart Hadast* (Cartagena), and *Sisapo* (Almodovar del Campo), *Laelia* (Olivares). |
|  | Eastern Zones of cultivation |  |
| Arabia | *Arabia Felix* (Strabo GE. 16.4.2.). *Tyros* island (Pliny 12.23.40). The *Minaei* (Pliny 6.32.161.). The land of *Aretas*… a few palm–trees (Strabo GE. 16.4.24.). The island of *Ogyris* lies in the high sea at a distance of two thousand stadia from *Carmania*, and that on it is to be seen the grave of *Erythras*, a large mound planted with wild palm–trees… (Strabo GE. 16.3.5.) | Coinages of Abi’el and *Philadelphia* (Amman) represent palms. Trajan and other imperial coinages represented in the obverse Arabia standing facing with a branch of dates in right hand. |
| Egypt | Egypt (Dioscorides MM. 1.148.). Delta and Alexandria, fruit that is not good to eat; but the palm–tree in the Thebaid is better than any of the rest (Strabo GE. 17.1.51.) The date of the Thebaid is packed into casks at once (Pliny NH. 13.9.47.) | Notwithstanding the evidence of palm groves no coinages with palm images were issued in Egypt. However numerous Ptolemaic coinages were issued with eagle and palm leaf on the obverse. |
| Greece | A young palm–tree seen by Odysseus at Delos by Apollo’s sanctuary (Homer, OD. 6.163, OD. 6.200.). Hellas it does not even ripen its fruit, and in some places it does not even produce any (Theophrastus EI. 1.5.2., EI. 2.2.10., EI. 3.3.5.). Double and threefold stemmed palms of Crete (Theophrastus EI. 2.6.9.). In Crete even three, and some even five stems (Pliny NH. 13.8.38) | Numerous coinages from Argolis, Euboea, Ionia (Ephesos), Cyclades, Troas and Crete. One from Hierapytna (Crete) is single–stemmed, however leaves and stem surface recall those of *P. theophrasti* |
| Judaea | Judaea (Strabo GE. 17.1.51.) But Judaea is even more famous for its palm–trees (Pliny NH. 13.6.26.). The palm–groves are tall and graceful (Tacitus H. 5.6.). Jericho. Here is the *Phoenicon*, though it consists mostly of palm–trees; it is one hundred stadia in length, and is everywhere watered with streams and full of dwellings (Strabo GE. 16.2.41.). The district of Jericho has numerous palm–groves and springs of water (Pliny 5.15.70.). Jericho, is the most fruitful country of Judea, which bears a vast number of palm–trees (Flavius Josephus WJ. 1.138.). On the west side of the Dead Sea is the solitary tribe of the Essenes and has only palm–tress for company. Lying below the Essenes was formerly the town of Engedi. Second only to Jerusalem in the fertility of its land and in groves of palm–trees (Pliny 5.15.73,) | Several Roman coinages and part of those of Bar Kochba’s revolt (132–135 AD), likely represent “*caryotae*” palms |
| Judaea (not Phoenicia) | The *Phoenicon*, which alone has the caryotic palm (referring to Judaea)… (Strabo GE. 16.2.41.) (Palm groves in Phoenicia are not explicitly cited. Therefore it seems that Phoenicians rarely cultivated date–palm although likely commercialized dates and date–wine). | Phoenicians produced coinages with palms at Arados island, and under Seleukid kings at Tyre and other cities but the Phoenicon Valley was in Judaea |
| Mesopotamia | At Babylon palms from Hellas would become fruitful (Theophrastus EI. 2.2.6.). The palm is a very common plant in this country, and generally fruitful (Herodotus H. 1.193.) The dates in Assyria do not keep (Pliny NH. 13.9.49.). The town of Ctesiphon containing not only palm groves but also olives and orchards (Pliny 6.31.131.). The palm is most abundant in Babylonia (Strabo GE. 16.1.5.) Its other needs are supplied by the palm–tree; for this tree yields bread, wine, vinegar, honey, and meal; and all kinds of woven articles are supplied by that tree; and the bronze–smiths use the stones of the fruit instead of charcoal; and when soaked in water these stones are used as food for oxen and sheep which are being fattened (Strabo GE. 16.1.14.) | No coinages with palm images were issued in Mesopotamia neither, surprisingly, in Palmyra (Syria) |
| Persia | The palm is found in abundance in Susa and on the coast of Persis and Carmania (Strabo GE. 16.1.5.).  | No coinages exist with palm images from Persia. However a single palm leaf is included in several scenes on Parthian tetradrachms. |
|  | Cretan palms |  |
| Single stem vs. Multiple stems | Tree with a single undivided stem (Theophrastus EI. 4.2.7.). Double and threefold stemmed palms of Crete, one with five heads in Lapaia (Theophrastus EI. 2.6.9.). Some palms in Syria and Egypt divide into two stems, and in Crete even into three, and some even into five (Pliny NH. 13.8.38). Pythagorean precepts; such, for examples; as these: “Do not lop off the shoots of a palm–tree”… (Plutarch IO. 10.) | Almost all coins represent single–stemmed palms (as usual in most date–palm groves), but a few coins i.e. Egypt lead tessera, also coins of Carystus (Eboea) 369–333 BC, represented two or three palms together emerging from the same point (Anson 1912) (feral and wild individuals) |
| Crete | Double and threefold stemmed palms of Crete (Theophrastus EI. 2.6.9.). In Crete even three, and some even five stems (Pliny NH. 13.8.38) | Coinages from Crete. One from Hierapytna (Crete) is single–stemmed, however leaves and stem surface recall those of *P. theophrasti* |
|  | Cultivar Groups |  |
| Top and Legendary cultivars | The best kind is called the royal palm, it grows hardly anywhere except in the park of the ancient Bagoas, near Babylon (Theophrastus EI. 2.6.7.). The royal palm, used to be reserved for the kings of Persia alone. This garden was always kept within the precints of the ruler’s court (Pliny NH. 13.9.41.). The *Phoenicon*, which alone has the *caryotic* palm, excepting the Babylonian. Accordingly, the revenue derived from it is great… (Strabo GE. 16.2.41.). Judaea, produces also the caryotic, which is somewhat better than the Babylonian. There are two kinds in the Thebaid as well as in Judaea, both the caryotic and the other; (Strabo GE. 17.1.51.). The most famous are the *caryotae*, which supply a great deal of food but also of juice, and from which the principal wines of the East are made. Especially in Jericho, although those growing in the valleys of *Archelais* and *Phaselis* and *Livias* in the same country are also highly spoken of. Their outstanding property is the unctuous juice which they exude and an extremely sweet sort of wine–flavour like that honey (Pliny NH. 13.9.44.).  | Modern legendary date–palm cultivars such as “Barhee”, “Deglet Nour”, “Medjoul” and other were likely not present in this period. Ancient “Caryotae” dates seems to have been long ellipsoidal to cylindrical according to the Bar Kochba’s coinages. |
|  | pruning |  |
| Angle between the basal leaves with the plane transverse to the stem | Not in texts. | Values –90º to–30º, correspond to wild and feral individuals or cultivated with lightly pruned crown, while 26º to 50º and 51º to 90º, correspond with more or less heavily pruned crowns. The whole range is represented in coins. |
| Crown shape | The taller palms make a regular forest, their pointed foliage shooting out from the actual tree all round them like a comb (Pliny NH 13.7.28.)  | Crowns globose or hemispheric belong to wild and feral individuals, or cultivated ones, with lightly pruned crown. Rhomboidal, obconical, or ovoid crowns represent few leaved heavily pruned types. The whole range is represented in coins. |
| Total number of leaves | Not differentiated in texts, leaves account for over 40 in normally developed date palms. This number of leaves is difficult to represent in drawings and coins, thus usually are underrepresented. | Coinages represent from heavily pruned crown (Fig. 8,8) –presumably this pruning is related to ornamental uses– to relatively untouched, cultivated, wild or feral, palm–trees |
| Defoliation tolerance | Palms perish and do not shoot again if they are stripped of their foliage at the top and the crown is cut off (Theophrastus EI. 4.16.1.), Palms shoot again if they are burnt (Theophrastus EI. 4.16.1.) | Not in coins, although several imperial roman coinages represent exclusively the stem without leaves. |
|  | Cleaning of Basal Remains of Leaves |  |
| Stem surface | Palms recover from stripping off the leaf bases (Theophrastus EI. 4.15.2.). The other kinds are rounded and tall, and have compact rows of knobs or circles in their bark which render them easy for the eastern races to climb… (Pliny NH 13.7.29)  | Coinages represent a wide repertory of stems: “Fishbone”, wild or feral palms with leaves naturally broken; “smooth”, petioles cut flush with the stem, for ornamental purposes or to facilitate climbing or “disks superposed”, muricate, verrucose, muricate–verrucose, X superposed, or irregular (petioles cut close to the stem in the form of steps, to facilitate climbing) |
| Stem apex | Not in texts. | Thickened because slight pruning of leaves in order to furnish support to workers (as usual in Elche palm grove, Spain) |
|  | Cleaning Offshoots |  |
| Propagation: seed and clonal | Propagated by seed (Theophrastus EI. 2.2.2.). Most constant when raised from seed (Theophrastus EI. 2.2.6.). Several seeds planted together (Theophrastus EI. 2.6.1.) A single seed produces a weak plant, but four give strong growth (Pliny 13.7.33.). Propagated by offshoots in Babylon (Theophrastus EI. 2.2.2.) Palms are also propagated by layering (Pliny 13.8.36.) (*Phoenix*???) In Assyria the tree itself, too is laid in a moist soil and throws out roots along its whole length, but these grow into shrubs and not into a tree… (Pliny 13.8.37.). “As for the story that at Babylon they plant palm–leaves and produce a tree in that way, I am surprised that *Trogus* believed it” (Pliny 17.9.58.) The “branches” spare the young suckers (Pliny NH. 17.11.65.) | Not in coins. A bulk of clean date seeds was recovered during the excavations 1963–1965 from the Herodian fortress of Masada in the Dead Sea Region, dated 200 BC–128 AD, one of these seeds germinated under particular conditions 2000 years later (Sallon et al. 2008). |
|  | Cultivation, habitat, substrates |  |
| Use of containers | *Citrus medica* is also shown, like date–palms, in pots with a hole in them (Theophrastus EI. 4.4.3.) | Only in one coinage from Ephesos (Roman period) is documented the use of containers presumably in order to ease the transport and protect the palm from severe weather. |
| Irrigation and Manuring | Very fond of irrigation (Theophrastus EI. 2.6.3.). Requires spring water (Theophrastus EI. 2.6.5.). Dew helps to keep alive palms in the land in which no rain falls (Theophrastus EI. 4.3.7.). Dung accompanied with watering (Theophrastus EI. 2.6.3.). It likes running water, and to drink all the year round. A section of the Assyrians think that dung hams the palm if they do not mix it with water from a stream (Pliny 13.7.28.). | Not in coins. |
|  | Commercial practices |  |
| Prices | The Judaeans had invented in the case of palm–tree (Particularly the caryotic palm) … for they do not allow to grow in many places, and because of the scarcity they set a higher price on it and thus increase the revenues (Strabo GE. 17.1.15.). Such is also the case with the *Phoenicon*, which alone has the caryotic palm. Accordingly, the revenue derived from it is great… (Strabo GE. 16.2.41.) | The number of high quality palms was kept small in order to keep date prices high. The *Caryotae* palms are likely those represented in Bar Kochba’s coinages. |
|  | Environmental |  |
| Salt tolerance | Tolerant of sea water (Theophrastus EI. 1.4.3.), Requires salt when transplanted (Theophrastus EI. 2.6.3.). Where date–palm is found (in Libya), the soil is saline and contains water (Theophrastus EI. 4.3.5.). Palms like a salt soil; consequently where the ground is not of that nature they sprinkle salt on it, not at the roots of the trees but a little farther off (Pliny NH. 13.8.37.) The palms get nutriment from salt water (Pliny NH. 17.47.261.). The best kinds for keeping are those that grow in salt and sandy soils, for instance in Judaea and the Cyrenaic district of Africa (Pliny NH. 13.9.49.) | *Phoenix dactylifera* and related species take advantage of brackish waters. Not in coins |
|  | Palm uses |  |
| Crafts, Buildings and Fuel | At Babylon make their beds and other furniture from sterile palms (Theophrastus EI. 2.6.6.). Men now make their images of palm–wood (Theophrastus EI. 5.3.7.). They use the palm–leaf for plaiting (Egypt) (Theophrastus EI. 4.2.7.). A Persian song enumerates three hundred and sixty uses of the palm–tree (Strabo GR. 16.1.14.). The leaves are split up to make ropes and plaited wicker–work and parasols (Pliny 13.7.29.). People used to write on palm leaves (Pliny 13.21.69.). In the east, palm leaves are used for making strong ropes, especially serviceable for use in water (Pliny NH. 16.37.89.). Wood for cutting into layers and for using as a veneer to cover other kinds of wood (Pliny NH. 16.84.231.). They made bridges out of the palm–trees which had fallen and others which they cut down themselves (Xenophon AN. 2.3.10.). The palm–tree beam, it does not, when aged, give way downwards, but curves upwards because of the weight and better supports the roof (Strabo GE. 15.3.10.). Their buildings are finished with beams and pillars of palm–wood (Strabo GE. 16.1.5.). In a number of places this shrub–palm with its dome of leaves serves instead of plaster for the walls of a house, to prevent their sweating (Pliny 13.7.28.). And the bronze–smiths use the stones of the fruit instead of charcoal (Strabo GE. 16.1.14.). Wood makes an evil malodorous smoke (Theophrastus EI. 5.9.5.). Palm wood makes charcoal that lasts a long time and burns slowly (Pliny NH. 13.9.39.).  | Not in coins. Date palm seeds and stem fragments were recovered at the Iron Age copper production site of Khirbat en–Nahas in southern Transjordan (Jordan) (dated 1000–800 BC) in form of charcoal related to copper smelting (Levy et al. 2008). |
| Religious | On whom Apollo shall the palm bestow (Homer, Iliad, 23). A young palm–tree seen by Odysseus at Delos by Apollo’s sanctuary, which he visited on his way to Troy (Homer, OD. 6.163). In Delos, I beheld a palm beside the altar of Apollo, tall, and growing still (Homer OD. 6.200.). Augustus had the palm tree transplanted to the inner court of the adjoining Temple of Apollo on the Palatine and took great pains to make the tree grow (Suetonius DA. 92.1–2). At Rome during the war with Perseus, a palm–tree grew up on the altar of Jove on the Capitol (Pliny NH. 17.88.244.). Where the first–created palm put forth their sacred shoots for dear Latona. And there with the maids of Delos (Euripides Hecuba. 455–456.). “The variety of dates, which we offer, to the honour of the gods is called *Chydaeus* by the Jews” (Pliny NH. 13.9.46.). In the palms the core of the fruit is in some cases of a bony substance, and when polished with the edge of a file is used by superstition as a charm against witchcraft (Pliny NH. 13.9.40.). | Coinages of Delos depict on the obverse a palm and a swan on the crown, linked to the cult of Apollo. |
| Medicinal, Toxic, Perfumery uses | (Fresh fruit) sour and astringent is taken in a drink with hard wine for discharges from tooth sockets and menstrual flows of women. (Dates) stop haemorrhoids and glue wounds together if are rubbed on. Fresh dates are more astringent than dried. Dried dates eaten with meat are good for blood–spitting, the stomach and dysentery. It is pounded into small pieces with cydonium and the waxy ointment Oenanthium (from vine shoots or blossoms) and rubbed on for disorders of the bladder. (Seeds) The *caryotae* heal roughness of the arteries in eaten (Dioscorides MM. 1.148.). Oinos Phoinikites made with common ripe dates… good for discharges because it is astringent. It is fit for gastritis, the abdominal cavity and for blood spitters (Dioscorides MM. 5.40.). Palm wine, which is injurious to the head, and only useful as a laxative and to relieve the spitting of blood (Pliny NH. 23.26.53.). The juice of boiled dates used to be given by the ancients to invalids instead of hydromel to restore their strength and to assuage thirst; especially in food, for the spitting of blood. The dates called *caryotae* are applied with quinces, wax, and saffron to the stomach, bladder, belly and intestines. They heal bruises. The kernels of dates, if they are burnt in a new earthen vessel and the ashes washed, take the place of spodium, are an ingredient of eye–salves and with the addition of nard make lotions for the eyebrows (Pliny NH. 23.51.97.). The palm called elate or spathe gives to medicine its buds, leaves and bark (Pliny NH. 23.53.99.). Serves for producing unguents, which is called by some people an *elate* and by others a palm and by others again a *spathae*. It only has a scent if it grows in regions devoid of water; it has tears of a greasy consistency, which are added to unguents (Pliny NH. 12.52.134.) I also find that aromatic wine is constantly made from almost exactly the same ingredients as perfumes… saffron, dates and Hazelwort, similarly made up in the form of a cake.. (Pliny NH. 14.19.103.) | Not in coins |
| Dates as fodder | The dates in Egypt, Cyprus, Syria and Seleucia in Assyria do not keep, and consequently are used for fattening swine and other stock (Pliny NH. 13.9.49.). When soaked in water these stones are used as food for oxen and sheep which are being fattened (Strabo GE. 16.1.14.). In the east the palm supplies cattle fodder (Pliny NH. 13.6.26.). | Not in coins. |
| Beverages (Juice, Wine and Vinegar) | *Oinos Phoinikites* made with common ripe dates it is exceptionally sweet (Dioscorides MM. 5.40.). (Assyrians) the principal article of their commerce is palm–wine, which they carry in casks... (Herodotus H. 1.194.). In these villages was palm wine and a sour drink made from the same by boiling (Xenophon AN. 2.3.14.) The palm–tree yields bread, wine, vinegar, honey, and meal (Strabo GE. 16.1.14.). (Arabia Felix) the greater part of their wine is made from the palm (Strabo GE. 16.4.25). (Arabia) the tribes extract wine out of palm–trees, as the natives do in India (Pliny 6.32.160.). The wine made from date–palms, which is used by the Parthians and Indians and by the whole of the East, a peck of the rather soft dates called in Greek “common dates” being soaked in water and then pressed (Pliny NH. 14.19.102.). Palm wine is injurious to the head, and only useful as a laxative and to relieve the spitting of blood (Pliny NH. 23.26.53.). The palm–tree yields bread, wine, vinegar, honey, and meal; (Strabo GE. 16.1.14.). The juice of grapes, figs and dates is sweet (Pliny NH. 15.33.109.). | Not in coins. It is difficult to identify specific winemaking tools. |

Sources: Dioscorides (c. 40–90 AD, Osbaldeston 2000), Euripides (c. 480–406 BC, Coleridge 1938), Flavius Josephus (37–c. 100 AD, Whiston 1895), Herodotus (c. 484–425 BC, Beloe 1830, Foster 1942), Homer (c. 750–650 BC, Butcher and Lang 1909, Cowper 1920, Foster 1936, Pope and Buckley 1899), Pliny (23–79 AD, Jones 1961, 1963, 1966, Rackham 1960, 1961a,b), Plutarch (c. 46–120 AD, Cole 1936, Goodwin 1874), Strabo (64/63 BC–c. 24 AD, Jones 1930, 1967), Suetonius (c. 69–after 122 AD, Kellum 1994, Rolfe 1914), Theophrastus (c. 371–c. 287 BC, Hort 1916), Titus Livius (64 or 59 BC–17 AD, Robert 1912), Xenophon (c. 430–354 BC, CAIS 2014, Mather and Hewitt 1962).

### Table 5. Climate proxy series and models used

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Type of proxy | Series analysed | Period Covered | Zone | Latitude | Longitude | References |
| Multiproxy study of sediment cores | Arid and humid phases | 0–4000 14C cal yr BP | Zoñar Lake, Córdoba (Spain) | 37º29’00’’N | 4º41’22’’ W | Martín et al. (2008) |
| 10,000–year–long time series of temperature and humidity/precipitation, reconstruction of glacier advances | Temperature and humidity/precipitation | 0–10,000 14C cal yr BP | Global | – | – | Wanner et al. (2011) |
| Bristlecone pine tree rings and volcanic eruptions | Frost damaged rings | 3000 BC–1997 AD | Western USA | 34º – 41º N | 111 – 119º W | Salzer and Hughes (2007) |
| Multiproxy study of sediment cores, tree rings | Temperature, Arid and humid phases | 1370 BC – 1965 AD | Global | – | – | Davis (1993) |
| Tree ring–based reconstructions | Summer precipitation and temperature variability | 500 BC – 2005 AD | Central European | 40º – 60º N | 0 – 20º E | Büntgen et al. (2011) |
| Ice Core Temperature and Accumulation Data Greenland Ice Sheet Project 2 (GISP2) | Temperature anomalies | 523–2760 14C cal yr BP | Greenland | 73.58º N | 38.4º W | Jouzel et al. (1997) |
| GISP2 Ice Core 4000 Year Ar–N Isotope  | Temperature Reconstruction | 2000 BC – 2000 AD | Greenland | 73.58º N | 38.4º W | Kobashi et al. (2011) |
| Deuterium measurements have been performed on three adjacent cores 3G, 4G and 5G | Temperature change calculated using a deuterium / temperature gradient | 247,000 BP – 2000 AD | Vostok Station, Antarctica | 78.46º S | 106.83º E | Jouzel et al. (1987, 1993, 1997) |
| Solar Variability Over the Last 3000 Years | Modulation potential Climate Forcing (Phi) | 1145 BP – 1945 AD | Global | – | – | Usoskin et al. (2014) |
| North Atlantic Holocene Drift Ice Proxy Data | Composite 18O detrended | 11,600 – 0 yr BP | North Atlantic | 43º58' – 64º47' N | 14º43' – 46º25' W | Bond et al. (2001) |
| North Atlantic Holocene Drift Ice Proxy Data | Detrended 14C production | 11,600 – 0 yr BP | North Atlantic | 43º58' – 64º47' N | 14º43' – 46º25' W | Bond et al. (2001) |
| NE Atlantic region, Western coast of Norway | Average winter precipitation in % of present (1961–1991) S and N Norway | 10,160 – 141 14C cal yr BP | Folgefonna & Lyngen | 60º N & 69º53’ N | 6º17’ E & 20º04’ E | Bakke et al. (2008) |
| NE Atlantic region, Western coast of Norway, pollen transfer functions | Mean July temperature | 10,160 – 141 14C cal yr BP | Øykjamyra | 60º N | 6º17’ E | Bakke et al. (2008) |
|  |  |  |  |  |  |  |

## References (Supplementary for Supplemental tables)

Acquaro, E. 1984. *Arte e cultura Punica in Sardegna.* Carlo Delfine Editore, Rome.

Akerman, J. 1846. *Ancient Coins of Cities and Princes: Hispania – Gallia – Britannia*. John Rusell Smith. London.

Alexandropoulos, J. 2008. *Les monnaies de l’Afrique antique 400 av. J.C.– 40 ap. J.C.* Presses Universitaires du Mirail,Toulouse.

Alfaro, C. 2004. *Sylloge Numorum Graecorum España* Volumen 1. Hispania. Museo Arqueológico Nacional. Madrid.

Alvarez, F. 2008. *La Moneda Hispánica. Desde sus orígenes hasta el Siglo V*. Ediciones Jesús Vivo. Madrid.

Anson, L. 1912. *Numismata Graeca. Coin types classified for immediate identification*. Part 3. Agriculture. Kegan Paul, London.

Bakke, J., Lie, Ø., Dahl, S.O., Nesje, A., Bjune, A. E. 2008. Strength and spatial patterns of the Holocene wintertime westerlies in the NE Atlantic region. *Global and Planetary Change* 60(1): 28–41.

Bakker, J. 2014. Ostia, Topographical Dictionary: Regio II – Insula VII – Piazzale delle Corporazioni (II, VII, 4). [http://www.ostia–antica.org/piazzale/corp.htm](http://www.ostia-antica.org/piazzale/corp.htm) (last accessed 10/12/2014).

Barag, D. 1978, The Palestinian ‘Judaea Capta’ Coins of Vespasian and Titus and the Era on the Coins of Agrippa II Minted under the Flavians. *The Numismatic Chronicle* 18: 14–23.

Bates, M. 1989. *The Coinage of Syria under the Umayyads, 692–750 AD*. In. Bakhit, M., Schick, R. (Eds.). The IVth international Conference on Bilad al–Sham. University of Jordan, Amman. Vol,. 2. Pp. 195–228.

Bond, G.C., B. Kromer, J. Beer, R. Muscheler, M.N. Evans, W. Showers, S. Hoffmann, R. Lotti–Bond, I. Hajdas, and G. Bonani. 2001. Persistent Solar Influence on North Atlantic Climate During the Holocene. *Science* 294 (5549), 2130–2136. DOI: 10.1126/science.1065680.

Breitenstein, N. 1942a. *Sylloge Nummorum Graecorum Copenhagen. The Royal Collection of Coins and Medals.* Part 4: Sicily 1: Abacaenum–Petra. Danish National Museum – E. Munksgaard, Copenhagen.

Breitenstein*,* N. 1942b. *Sylloge Nummorum Graecorum Copenhagen. The Royal Collection of Coins and Medals*. Part 5: Sicily 2: Segesta–Sardinia. Danish National Museum – E. Munksgaard, Copenhagen.

Breitenstein*,* N. 1944. *Sylloge Nummorum Graecorum Copenhagen. The Royal Collection of Coins and Medals.* Part 17: Argolis–Aegean Islands. Danish National Museum – E. Munksgaard, Copenhagen.

Breitenstein*,* N. 1945. *Sylloge Nummorum Graecorum Copenhagen. The Royal Collection of Coins and Medals.* Part 20: Troas. Danish National Museum – E. Munksgaard, Copenhagen.

Breitenstein*,* N. 1946. *Sylloge Nummorum Graecorum Copenhagen. The Royal Collection of Coins and Medals.* Part 22: Ionia 1: (Clazomenae–Ephesos). Danish National Museum – E. Munksgaard, Copenhagen.

Breitenstein*,* N. 1946. *Sylloge Nummorum Graecorum Copenhagen. The Royal Collection of Coins and Medals*. Part 24: Ionia 3: (Smyrna–Teos. Islands). Danish National Museum – E. Munksgaard, Copenhagen.

Bruun, P. 1966. *The Roman Imperial Coinage.* Vol. VII: Constantine and Licinius, AD. 313–337. Spink and Son, London.

Christiansen, E., Kromann, A. 1974. *Sylloge Nummorum Graecorum Copenhagen. The Royal Collection of Coins and Medals*. Part 41: Alexandria–Cyrenaica*.* Danish National Museum – E. Munksgaard, Copenhagen.

Davis, O.K. 1993. Bibliography of Global Climate originally compiled for GEOS 596R – Spring 1991, edited and extended. <http://www.geo.arizona.edu/palynology/geos462/holobib.html> (last accessed 14/10/2015).

Frey, S. 2000. *Ritrovamenti monetale da Entella (Scavi 1984–1997),* in Fantasia, U. (ed.) Terze Giornate Internazionali di Studi sull’Area Elima (Gibellina – Erice – Contessa Entellina, 23–26 ottobre 1997) Atti*.* Pp. 479–498. CESDAE, Pisa.

Gardner, P. 1878. *The Greek Coins of the British Museum. The Seleucid Kings of Syria*. The British Museum, London.

Gardner, P. 1887. *Catalogue of Greek* Coins. Peloponnesus*.* The British Museum, London.

Gerson, S. 2001. Fractional coins of Judea and Samaria in the fourth century BCE. *Near Eastern Archaeology* 64(3): 106–121.

Gitler, H., Tal, O. 2009. More Evidence on the Collective Mint of Philistia. *Israel Numismatic Research* 4, 21–38.

Grierson, P. 1982. *Byzantine Coins*. Methuen and Co., London.

Guzzetta, G. 2008. Prototipi monetali sicelioti e interpretazioni puniche, in: Corrigiu , M. Miccichè, C., Modeo, S., Santogati, L. (eds*.) Greci e Punici en Sicilia*. Pp. 149–172. Salvatore Sciasci Editore, Caltanisetta.

Head, B. 1884. *Catalogue of the Greek Coins. Central Greece (Locris, Phocis, Boeotia, and Euboea)*. The British Museum, London.

Head, B. 1909. *A Guide to the Principal gold and silver coins of the Ancients*. The British Museum, London.

Hendin, D. 2007. Echoes of “Judaea Capta”: The Nature of Domitian’s Coinage of Judea and Vicinity. *Israel Numismatic Research* 2: 123–130.

Hill, G. 1903. *Coins of Ancient Sicily*. Archibald Constable & Co., Westminster.

Hill, G. 1914. *Catalogue of the Greek Coins of Palestine (Galilee, Samaria and Judaea).* The British Museum, London.

Jenkins, G.K. 1969. *Sylloge Nummorum Graecorum Copenhagen. The Royal Collection of Coins and Medals.* Part 42: North Africa. Syrtica–Mauretania*.* Danish National Museum – E. Munksgaard, Copenhagen.

Jenkins, G.K. 1971. Coins of Punic Sicily. Part I. Schweiz. *Numis. Runds.* 50: 25–78.

Jenkins, G.K. 1974. Coins of Punic Sicily, Part 2. Schweiz. *Numis. Runds.* 53: 23–41.

Jenkins, G.K. 1977. Coins of Punic Sicily, Part 3. Schweiz. *Numis. Runds.* 56: 5–65.

Jenkins, G.K. 1978. Coins of Punic Sicily, Part 4. Schweiz. *Numis. Runds.* 57: 5–68.

Jenkins, G.K. Kromann, A. 1979. *Sylloge Nummorum Graecorum Copenhagen. The Royal Collection of Coins and Medals.* Part 43: Spain–Gaul*.* Danish National Museum – E. Munksgaard, Copenhagen.

Jouzel, J., Lorius, C., Petit, J.R., Genthon, C., Barkov, N.I., Kotlyakov, V.M., Petrov, V.M. 1987. Vostok ice core: a continuous isotope temperature record over the last climatic cycle (160,000 years), *Nature* 329: 402–408.

Jouzel, J., Barkov, N.I., Barnola, J.M., Bender, M., Chappelaz, J., Genthon, C., Kotlyakov, V.M., Lipenkov, V., Lorius, C., Petit, J.R., Raynaud, D., Raisbeck, G., Ritz, C., Sowers, T., Stievenard, M., Yiou, F., Yiou, P. 1993. Extending the Vostok ice–core record of paleoclimate to the penultimate glacial period. *Nature* 364: 407–412.

Jouzel, J., Alley, R. B., Cuffey, K. M., Dansgaard, W., Grootes, P., Hoffmann, G., Johnsen, S., Koster, R., Peel, D., Shuman, C., Stievenard, M, Stuiver, M., White, J. 1997. Validity of the temperature reconstruction from water isotopes in ice cores. *Journal of Geophysical Research* *102*: 26,471–26,487.

Kanael, B. 1963. Ancient Jewish Coins and Their Historical Importance. *The Biblical Archaeologist* 26(2): 37–62.

Kobashi, T., Kawamura, K., Severinghaus, J. P., Barnola, J. M., Nakaegawa, T., Vinther, B. M., Johnsen, S., Box, J. E. 2011. High variability of Greenland surface temperature over the past 4000 years estimated from trapped air in an ice core. *Geophysical Research Letters*, 38(21). L21501, doi:10.1029/2011GL049444, 2011

Lee, I. 2000. Entella: The Silver Coinage of the Campanian Mercenaries and the Site of the First Carthaginian Mint 410–409 BC. *The Numismatic Chronicle* 160, 1–66.

Manfredi, L.I. 2009. Monete Puniche da Sabrathamore. Quad. Archeol. Libya 20, 93–118.

Martín, C., Valero, B. L., Mata, M. P., González, P., Bao, R., Moreno, A., & Stefanova, V. 2008. Arid and humid phases in southern Spain during the last 4000 years: the Zonar Lake record, Cordoba. The Holocene 18(6), 907–921.

Milne, J. 1947. The Coinage of Antioch in Pisidia after AD 250. *The Numismatic Chronicle and Journal of the Royal Numismatic Society* 7: 97–107.

Mørkholm, O. 1961. *Sylloge Nummorum Graecorum Copenhagen. The Royal Collection of Coins and Medals.* Part 37: Phoenicia*.* Danish National Museum, E. Munksgaard. Copenhagen.

Piras, E. 1993. *Le Monete Sardo Puniche.* Montenegro S.A.S. Torino.

Poole, R.S. 1876. *Catalogue of the Greek Coins, Sicily.* The British Museum, London.

Potts, D.T. 1991. *The Pre–Islamic Coinage of Eastern Arabia*. The Carsten Niebuhr Institute of Ancient Near Eastern Studies University of Copenhagen, Copnehagen.

Prag, J. 2008. Siculo–Punic Coinage and Siculo–Punic Interactions. Boll. Int. Archeol. on Line. Vol. Spec., 1–10.

Price, A. 1991. *The Coinage in Name of Alexander the Great and Philip Arrhidaeus* Vol. 1. The British Museum. London.

Puech, P., Puech, B., Puech, F. 2014. The “As de Nimes·, a Roman Coin and the Myth of Antony and Cleopatra: Octavian and Agrippa victorious over Antony. *OMNI* 8: 58–66

Puglisi, G. 2005. Distribuzione e funzione della moneta bronzea in Sicilia dalla fine del V sec. a.C. all’età ellenistica, in: Alfaro, C., Marcos, C., Otero, P. (eds*.) Moneda griega arcaica y clásica / Archaic and classical coinages.* Actas del XIII Congreso Internacional de Numismática. Vol. I. Pp. 286–294. Ministerio de Cultura, Madrid.

Ripollés, P., Abascal, J. 2000. *Monedas Hispánicas.* Academia de la Historia, Madrid.

Ruiz, D. 2010. *La circulación monetaria en el sur peninsular durante el periodo Romano–Republicano*. Universidad de Granada, Granada.

Salinas, A. 1858. Su di Alcune monete puniche di Mozia*.* Fr. Lao, Palermo.

Sallon, S., Solowey, E., Cohen, Y., Korchinsky, R., Egli, M., Woodhatch, I., Simchoni, O., Kislev, M. 2008. Germination, Genetics, and Growth of an Ancient Date Seed. *Science* 320: 1464.

Schwabacher, W. 1944. *Sylloge Nummorum Graecorum Copenhagen. The Royal Collection of Coins and Medals.* Part 13: Aetolia–Euboea*.* Danish National Museum – E. Munksgaard, Copenhagen.

Spijkerman, A. 1978. *The Coins of the Decapolis and Provintia Arabia.* Franciscan Printing Press; Jerusalem.

Sydenham, E. 1917. The Mint of Lugdunum. *The Numismatic Chronicle and Journal of the Royal Numismatic Society* 17, 53–96.

Syon, D. 2008. The Bronze Coinage of Tyre: The First Years of Autonomy. *Am. J. Numis. Sec. Ser.* 20: 295–304.

TBM. 2014. Roman Republican Coins in the British Museum. [www.britushmuseum.org/research/publications/online\_research\_catalogues/rrc/roman\_republican\_coins.aspx](http://www.britushmuseum.org/research/publications/online_research_catalogues/rrc/roman_republican_coins.aspx) (last accessed 15/10/2014).

Travaini, L. 1991. Aspects of the Sicilian Norman copper coinage in the twelfth century. *The Numismatic Chronicle* 151, 159–174.

Ugdulena, G. 1857*. Sulle Monete Punico–Sicule Memoria.* Fr. Lao, Palermo.

Usoskin, I.G; Hulot, G; Gallet, Y.; Roth, R.; Licht, A.; Joos, F.; Kovaltsov, G.A.; Thebault, E.; Khokhlov, A. 2014. Evidence for distinct modes of solar activity. Journal\_Name: Astronomy and Astrophysics 562, L10, DOI: 10.1051/0004–6361/201423391. Online\_Resource: <http://www.ncdc.noaa.gov/paleo/study/18475> (last accessed 12/10/2015).

Verdú, E. 2010. Sobre la presencia de monedas púnicas en sepulturas de la necrópolis de l’Albufereta (Alicante). *Mainake* 32: 301–333.

Vico, A. 2006. *Monedas Griegas.* Real Academia de la Historia, Madrid.

Visona, P. 1985. Punic and Greek Bronze Coins from Carthage. *American Journal of Archaeology* 89: 671–675.

Vives, A. 1924. *La Moneda Hispanica*. Vols 1 and 2, Atlas. Real Academia de la Historia. Madrid.

Wanner, H., Solomina, O., Grosjean, M., Ritz, S. P., & Jetel, M. 2011. Structure and origin of Holocene cold events. *Quaternary Science Reviews* 30(21): 3109–3123.

Wroth, W. 1886. *Catalogue of the Greek Coins of Crete and the Aegean Islands*. The British Museum, London.

Wroth, W. 1899. *Catalogue of the Greek Coins of Galatia, Cappadocia, and Syria.* British Museum, London.

Wroth, W. 1911. *Catalogue of the Coins of the Vandals, Ostrogoths and Lombards.* British Museum, London.