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Prestigious early Roman gardens across the Empire: the significance of gardens and horticultural trends evidenced by pollen

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ABSTRACT

The present study has two main goals. The first is to reconstruct the botanical components that grew in the impressive garden of Villa Arianna (Stabiae). The garden, which was extensively destroyed and covered by tephra ash in 79 CE, is considered the largest peristyle garden in the Vesuvian region. Its plants were revealed based on a unique palynological-archaeological method involving the extraction of pollen from plaster attached to structures that faced the garden. The second aim is to compare this prestigious garden with other early elite Roman gardens, located in the eastern part of the Empire, to trace the importation of plants, horticultural trends, etc. For this purpose, gardens of Herod the Great, the client king of Judaea, which the author recently studied palynologically (in Caesarea, Herodium and Jericho), were compared with the new pollen results of Villa Arianna. The comparison between the gardens' botanical components and their different landscapes led to the following conclusions: (1) Plants were imported from both ends of the Empire as elite products (rather than cash crops). Hazelnut (*Corylus*) and cedar (*Cedrus*) were introduced from west to east, while the date palm (*Phoenix dactylifera*) was introduced along an east-west axis. (2) The gardening trend of tree dwarfism was observed both at Villa Arianna and Jericho. (3) The gardens flourished in challenging habitats. At Villa Arianna and Caesarea, efforts were devoted to sustaining splendid gardens in the relatively harsh, saline Mediterranean Sea environment; at Herodium and Jericho, special efforts were required for the success of Mediterranean plants in semi-arid climate. (4) Herod's mausoleum garden in Herodium, whose dark evergreen trees on the whitish slopes of the artificial tumulus could be seen from the Temple in Jerusalem, may have been inspired by the architectural arrangement of the Pantheon and the Mausoleum of Augustus, the patron of Herod.

KEYWORDS

Roman gardens; pollen-plaster; Stabiae; Roman Empire; King Herod; Villa Arianna; ancient gardens

1. Introduction

Lavishly planted gardens, a feature of royal palaces in antiquity, attest to their owner's ability to both control the natural environment and sustain exotic plants in a man-made environment (Foster 2004; Conan 2007; Amrhein 2015). During the Roman period, the elite class practiced highly developed horticulture, not only in the hub of the Roman Empire (Figure 1) (Jashemski 1979–1993; Farrar 1996; Hartswick 2004; Landgren 2004, 2013; Jashemski et al. 2017), but also in distant provinces (e.g. Bedal et al. 2013; Langgut and Gleason 2020).

Different archaeobotanical remains are used to reconstruct the plants that grew in ancient gardens: macrobotanical remains, such as wood, charcoal, seeds and fruits; as well as microbotanical remains, mainly phytolith and pollen. Unfortunately, the ability of most of these proxies to reconstruct the exact ornamental botanical component that grew in historical gardens is limited. Wood and charcoal remains may also have originated from the gardens' furniture, fences, pergolas and fertilization of the garden soil. Remains of fruits

and seeds may also derive from fertilizer or from food eaten in the garden (Jashemski 1979–1993; Miller and Gleason 1994, pp. 27–31). Phytolith, an inorganic remain, tends to preserve well in garden soils (Russo Ermolli and Messenger, 2013); yet the identification of phytolith to a detailed systematic level is highly restricted (Pearsall 1982); therefore, the ability of this proxy to address the question of what grew in a garden is very limited. Though pollen can be very helpful with the reconstruction of cultural vegetation (Bryant 1989; Mercuri et al. 2013a, 2013b; Vignola et al. 2022), it should originate from secure archaeological contexts and preferably be extracted from good pollen traps (Bryant and Holloway 1983; Langgut et al. 2016; Mercuri et al. 2019). For instance, while reconstructing an ancient Persian royal garden in Judaea (Figure 1), the plaster attached to the garden's structures proved to be an exceptional pollen trap since (1) the plaster's alkaline environment contributed to the good state of preservation of the pollen grains; (2) pollen captured in the plaster acts as a time capsule, since pollen contamination from earlier or later periods cannot occur (Langgut et al.

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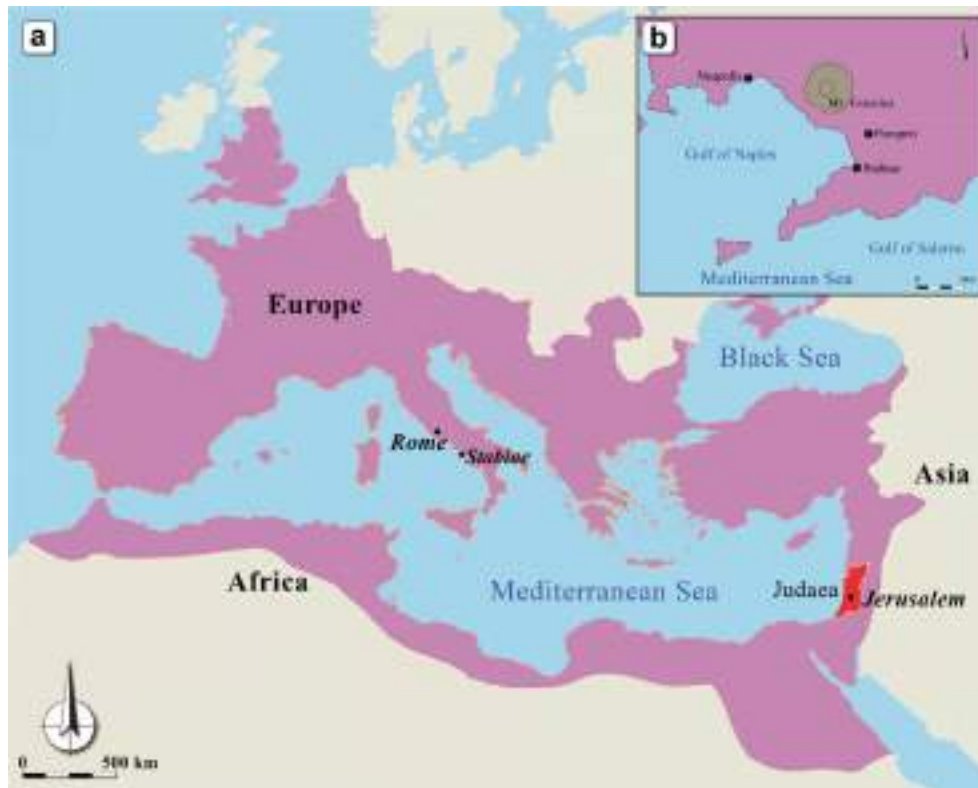


Figure 1. (a) The Mediterranean Basin depicting Roman Empire territory during the 1st century BCE–early 1st century CE, including Stabiae (Italy) and Herod’s realm in Judaea. (b) The location of the seaside resort town, Stabiae, where Villa Arianna is situated. Source: M. Cavanagh.

2013). The pollen-plaster extraction method is helpful in two scenarios while investigating ancient gardens: when there are no other preserved botanical remains in the relevant archaeological context (garden soil, planting pots), or when the garden has already been long-exposed or even destroyed. For example, most of the gardens known at Pompeii fall under one or both of these categories (Barrett et al. 2020). Additionally, some of the Pompeiian ancient gardens are ‘contaminated’ by recent flora that was planted by the park authority. Therefore, the pollen-plaster technique has the potential to provide much new information about the paleo-vegetation of the Vesuvius area, as well as about other ancient gardens. Pollen grains could have penetrated the plaster in two ways: (1) if any of the garden-facing plaster layers were applied when the garden was blooming, the wet surface of the plaster could have trapped airborne pollen grains; (2) if water from the garden (e.g. water channels, pools, reservoirs) was used to mix the plaster, pollen would have become incorporated into the subsurface plaster layer (Langgut et al. 2013, 2015). In order to distinguish between the two sources, a separation of the outer part of the plaster from its inner filling material (=subsurface) is recommended (Langgut et al. 2013, 2015). The division may also provide insight into whether the pollen originates from a distant source or from the garden itself. This study demonstrates application of the unique pollen-plaster technique, including the plaster’s separation, on the Great Peristyle Garden of Villa Arianna. This luxurious villa is located in Stabiae, an ancient Roman seaside resort in the Vesuvius area. The garden, which was extensively destroyed and covered by tephra ash in 79 CE, is considered the largest peristyle garden in the

Vesuvian region. It offers the most detail and potential for interpretation of any large Roman garden in the Empire.

Gardens have been noted at Stabiae since the earliest excavations. The Bourbons, working from 1757–1762 under the direction of Swiss engineer Karl Jacob Weber, prepared the first plan of the town, the villas and some of the gardens (Pagano 1997). Though Villa Arianna had been excavated by several expeditions already since the 18th century, its courtyard garden remained largely unexcavated until the investigation of the latest expedition (Howe 2016). This expedition collected the plaster samples for the pollen study presented here. The first aim of this research was to reveal the exact component that grew in the splendid Great Peristyle Garden of Villa Arianna. The second aim was to trace evidence for the importation of plants across the Roman Empire as elite products, to explore horticultural trends of the period, and to expose the hidden significance of these luxurious gardens. In order to address these issues, the pollen results of Villa Arianna were compared to other Early Roman elite gardens, located at a distance from the Empire’s hub. Four gardens of King Herod the Great (73–4 BCE) in Judaea (Figures 1 and 2), whose botanical components have been recently studied palynologically by the author (Langgut et al. 2015; Langgut and Gleason 2020; Langgut et al. in press), were chosen to implement this comparison.

2. The archaeological sites

2.1. Villa Arianna (Stabiae), Italy

The area surrounding the Vesuvius volcano in southern Italy was one of the most important regions of the Roman Empire;

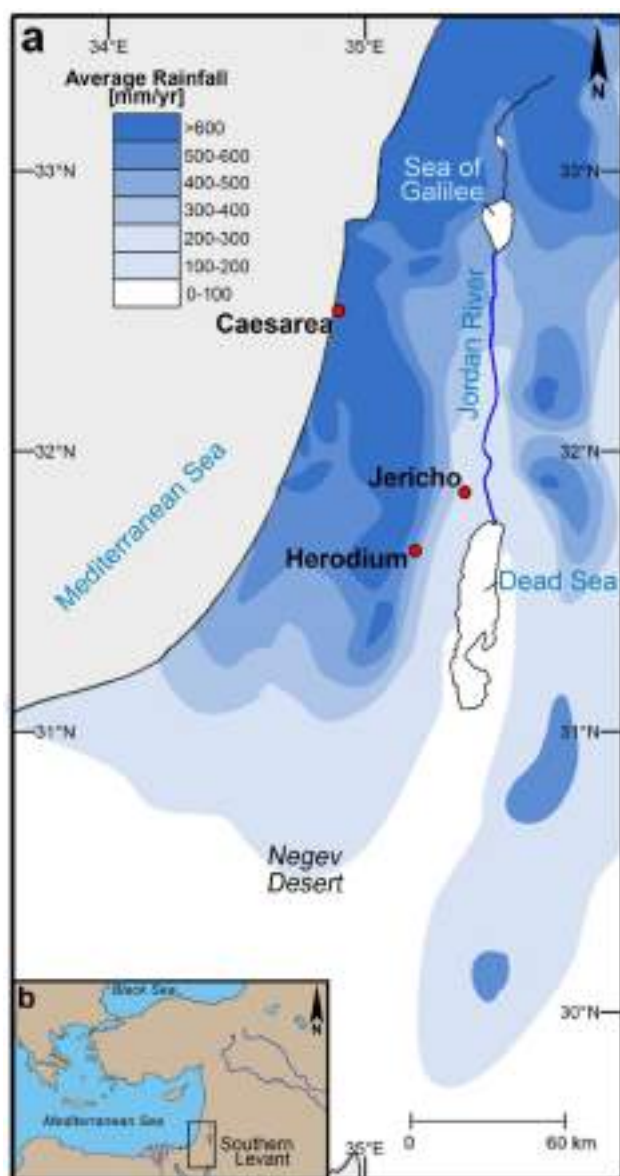


Figure 2. (a) Map of the Herodian sites investigated in this study: Caesarea, Herodium, and Jericho, presented with mean annual rainfall in mm (modified after Srebro and Soffer 2011). (b) The position of the southern Levant.

the fertility of its volcanic soil, proximity to the sea, and mild climate made it a favored place for settlements (D'Arms 1970). Stabiae, an ancient Roman seaside resort town located 16 kilometers from Mount Vesuvius (Figure 1b), was extensively destroyed and covered by tephra ash in 79 CE. One of the most impressive Roman villas discovered in Stabiae is Villa Arianna, renowned for its frescoes, and containing one of the largest peristyle gardens in the Vesuvian region (Gleason 2010; Howe 2016). It is situated on the western hills of Varano, at a cliff-top position overlooking the Bay of Naples. The villa's structure, wall paintings, pavements, and garden beds remained buried until their rediscovery in the 18th century. The courtyard garden offers the most detail and potential for interpretation of any large Roman garden in the Empire.

Prior to this study, the botanical components of the Villa Arianna's peristyle garden were a mystery. Studies from the Vesuvius area demonstrated that the 79 CE volcanic eruption resulted in the preservation of a huge quantity of

archaeobotanical material (e.g. Borgogno 2006; Moser et al. 2013). Several palynological examinations of the flora of the ancient gardens in the region have been conducted (Ciarallo and Mariotti-Lippi 1993; Mariotti-Lippi 2000; Dimpleby and Gruger 2002; Mariotti-Lippi and Bellini 2006; Russo Ermolli and Messager 2013). The pollen grains studied were extracted mainly from the garden soil, limiting the results due to poor preservation and/or by long-distance airborne pollen transportation, among other causes (Jashemski 2002, p. 3). None of these studies employed the method of pollen recovery from plaster facing the garden.

During the excavation of the Great Peristyle Garden, no unusually well-preserved archaeobotanical evidence—such as nuts, seeds, or impressions in the earth or volcanic debris—was observed to indicate the species of the garden plants (Gleason 2010). Wood charcoal remains were interpreted as evidence of fuel material (Challinor 2016). Nonetheless, deposits of carbonized remains among the root cavities of the garden beds provided insight into meals, perhaps by nearby workers repairing the paintings (Gleason and Langgut, in press). The phytolith investigation produced evidence of only one ornamental plant—date palm (Ryan 2016). Systematic collection of land mollusks enabled a mapping of the moisture and sun/shade conditions, as well as relative heights of planted areas, as different mollusk species have specific habitat requirements (Pinto-Guillaume 2016). Following these examinations, it was therefore determined that in order to reveal the garden botanical components the extraction of pollen grains from plaster installations facing the garden could be the key to resolving the enigma of what grew in this exclusive garden.

2.2. Royal gardens of Herod the Great

King Herod, the Roman client king of ancient Judaea, was perhaps the greatest builder in Jewish history. He was responsible for several colossal building projects throughout Judaea. Indeed, archaeological excavations have revealed the existence of elaborate gardens surrounding Herod's palaces and monumental buildings (Netzer 1981, 2001, 2008; Gleason 1993, 1998; Evasaf 2010; Netzer et al. 2010; Gleason and Bar-Nathan 2013; Porat et al. 2018). Yet, the exact type of plants that grew in Herod's royal gardens remained an enigma until pollen was recovered and identified from various contexts. Among these gardens are (Figure 2): the courtyard of Herod's Promontory Palace at Caesarea (Langgut et al. 2015), the peristyle garden of Herod's Third Palace at Jericho (Langgut and Gleason 2020) and two gardens at Herodium—the peristyle garden of the Mountain Palace-Fortress and the garden that was built around Herod's mausoleum (Langgut et al. in press).

2.2.1. Herod's royal gardens at Herodium

Rising above the Judean Hills, the artificial conical mountain of the Herodium still bears witness to the building prowess of its namesake, Herod. At this barren site southeast of Jerusalem (Figure 2), in the last three decades of the 1st century BCE, Herod constructed a spectacular palace/fortress

atop the mountain and a lavish palatial resort in the valley below (Netzer et al. 2010). The importance of Herodium to the king is clear, as it is his only building site to which he gave his name. The discovery of Herod's tomb complex in 2010 (Netzer et al. 2010; Netzer 2011; Porat et al. 2018) strengthens the theory that Herod had an exceptional attachment to this site. From atop the Herodium, there is an impressive 360° panoramic view that takes in Jerusalem, Bethlehem, the Judean Desert and the Mountains of Moab. The complex contains three royal gardens (Figure S1): (i) at the foot of the mountain (=Lower Herodium) (Netzer 1981, 2008; Evyasaf 2010); (ii) in the courtyard of the palace/fortress on top of the mountain (Corbo 1967, pp. 88–90; Netzer 2008, pp. 179–201); and (iii) circling the mausoleum, where the natural surroundings were reshaped into a terraced formal garden (Netzer 2011; Porat et al. 2015, pp. 116–128). All three gardens were characterized by the presence of thick brown-black soil, brought to Herodium from elsewhere.

Herodium is located along the western perimeter of the rain shadow of the Judean Desert, about 12 km south of Jerusalem. The region is characterized by a semi-desert environment—a transitional zone between the Mediterranean and the desert climate zones (Figure 2). Floral elements are scarce and belong primarily to the semi-arid steppe Irano-Turanian and the arid Saharo-Arabian vegetation. The site was provided with a constant supply of spring water via an aqueduct Herod had built 'at great expense' (Josephus, *The Jewish Wars* 1.21.10). This water system enabled Herod to construct a remarkable complex of gardens featuring Mediterranean flora alongside thermae and impressive water installations at the threshold of the Judean Desert (Netzer 2008: 190). Plaster samples collected from different structures in the three royal gardens yielded no pollen grains. Pollen was not detected due to preservation issues and/or low pollen concentrations in the air (perhaps due to the preparation of plaster outside of the blooming season, or if the plastering had been done before the garden was planted; Langgut et al. in press). Therefore, the identification of the plants that grew in the gardens was based on pollen extracted from the cultivation layer of the garden soil (Table S1 and Figures S2–S8). The reconstruction was accomplished by soil sifting and by the identification of other botanical remains, mainly charcoals. Since at Lower Herodium the garden soil had been exposed for several decades and washed away, analysis there was not possible, unfortunately.

2.2.2. The promontory palace at Caesarea

In 22 BCE, Herod began building the city of Caesarea Maritima with its massive artificial harbor (Sebastos) and a palace (Herod's Promontory Palace), a colossal project on the Mediterranean coast of his territory (Figure 2). Herod dedicated a major portion of his personal and kingdom wealth and resources to the project (Burrell 1996, 2009; Netzer 1996). Caesarea Maritima was King Herod's showcase to the wider Greco-Roman world; the design of the city, harbor, and palace was the greatest accomplishment of this cosmopolitan king (Burrell 2009). The 'most magnificent palace', in the words of Flavius Josephus (*Jewish Antiquities* 15.331), was

constructed on a promontory in two stages (Figures S9 and S10). The 'Lower Palace' was built around a large rock-cut decorative pool, probably between 22 and 15 BCE (Levine and Netzer 1986); and the 'Upper Palace' was built for the inaugural festivities of the city in 10 BCE (Gleason et al. 1998). The craftsmanship of the palace stonework, frescoes and mosaics is excellent (Gleason et al. 1998). The palace courtyard (42 × 65 m) was surrounded by a colonnade with plaster-coated columns made of crushed local Kurkar, a Calcareous sandstone common in Israel (Gleason et al. 1998; Patrich 2011). Plaster samples collected for palynological investigation from these columns revealed the botanical components that grew in this magnificent peristyle garden (Langgut et al. 2015; Figure S11 and Table S2). The garden provided shade, color, scent and greenery, for additional prestige (Figure S12).

2.2.3. Herod's winter palace in Jericho

King Herod continued the tradition established by the Hasmonaeans and built a winter palace in Jericho, less than 20 kilometers east of Jerusalem (Figure 2). The palace was designed for use during the winter months when Jerusalem, at ~700 m above sea level, was quite cold while Jericho, at ~400 m below sea level, was warm and the wadi flowed with water. The palace was built in three stages. The third stage, which took place around 15–10 BCE, was the most elaborate (Netzer 1977; Gleason 1987; Netzer and Laureys-Chachy 2004). Dozens of perforated ceramic vessels interpreted as planting pots (named by Pliny the Elder *Ollae Perforatae*; *Natural History* 17.64, 1st century CE) were found *in situ* in the garden soil (Gleason 1993; Gleason and Bar-Nathan 2013). The fortunate discovery of these buried planting pots enabled the reconstruction of the basic design of Herod's gardens in Jericho (Gleason and Bar-Nathan 2013; Figure S13). The majority of the planting pots were located in the small courtyard garden of Herod's Third Palace, arranged in seven rows of as many as eleven pots each. This garden is also known as the peristyle courtyard of the palace (area B64; Figure S14) (Netzer 1977; Gleason and Bar-Nathan 2013), and it displays some of the finest garden remains known in the Roman world (Netzer 2001; Rozenberg 2008).

The planting pots provide evidence of impressive gardens in a particularly harsh environment, since Jericho receives only 100–200 mm of rainfall annually (Figures 2, S15, and S16). Beyond doubt, the planting pots would have helped conserve water. The exact type of plants that grew in Herod's pots was an enigma until recently, when Langgut and Gleason (2020) conducted a detailed pollen investigation at the peristyle courtyard of the Third Palace. Sifting of the pots' sediments yielded no macro-botanical remains. Since the identified pollen grains mainly belong to naturally large plants, Langgut and Gleason (2020) suggested that the garden at Area B64 featured dwarf trees (Figures S17 and S18). It was not possible to study other gardens in Jericho since the excavation took place about three decades ago, and the only garden samples collected for archaeobotanical

investigation at that time were from the peristyle courtyard of Area B64.

3. Methods

3.1. Palynology

Using sterile equipment, twelve plaster samples were collected from colonnades, drains, and a pool facing the Great Peristyle Garden of Villa Arianna during the excavation. The exact archaeological context of each sample is detailed in Table 1. To assess whether the pollen grains were trapped within the plaster's wet surface while it was drying, or whether the grains had penetrated the plaster in a different way, a previously designed method was employed (described in Langgut et al. 2013). This procedure includes plaster sub-sampling prior to pollen extraction. Each plaster sample, usually smaller than 10 mm wide, was divided into two sub-samples: the outer part (<0.1 mm), peeled away using a sharp razor blade; and the inner filling material. Prior to this subdivision, the sample surfaces were cleaned with compressed air to prevent contamination by recent pollen. A sample of modern plaster prepared for conservation purposes served as a control. A total of 26 samples were analyzed palynologically.

The physical-chemical pollen extraction process was executed as follows: one *Lycopodium* spore tablet was added to each sample as a tracer (Stockmarr 1971; Bryant and Holloway 1983). Next, the samples were treated with 10% HCl for three days in order to remove the calcium carbonates within the sample, to loosen the different particles and to dissolve the *Lycopodium* spores. Samples were then rinsed with distilled water several times, until pH 7 was achieved. Next, a density separation was carried out using a ZnBr₂ solution with a specific gravity of 1.95. After stirring well and vortex, samples were placed in an ultrasonic water bath for three minutes. After sonication, samples were centrifuged for 20 minutes at 3,500 RPM (all other steps were followed by only five minutes of centrifuging with the same RPM). The floated suspension was then sieved through a 150 µm mesh screen with distilled water. Then, samples were subjected to an acetolysis process so as to dissolve cellulose, chitin and other organic materials, thereby concentrating the pollen. Later, unstained residues were homogenized and mounted onto microscopic slides using glycerin. A light microscope with magnifications of 200×, 400×, and 1,000× (immersion oil) was used to identify the pollen grains. For pollen identification, a comparative reference collection of recent pollen of Tel Aviv University (deposited at the Steinhardt Natural History Museum) was used, in addition to pollen atlases (Reille 1995, 1998, 1999; Beug 2004). For each sample, all the extracted pollen grains were counted and identified to the most detailed systematic level. The ratios of each pollen taxon were calculated from the total pollen sum.

3.2. Botanical comparison

The comparison between the garden of Villa Arianna and the gardens located in the eastern part of the empire (in

Caesarea, Herodium and Jericho) is qualitative rather than quantitative. Table 2 summarizes the presence/absence of Villa Arianna's pollen taxa identified in this study, in comparison to the published data of the eastern gardens (Langgut et al. 2015, in press; Langgut and Gleason 2020). While palynological studies involving paleo-climate and paleo-environmental reconstruction necessitate the counting of hundreds of pollen grains for statistical reliability (e.g. Faegri and Iversen 1989; Langgut et al. 2021a), in palynological-archaeology the qualitative approach is often used. Pollen concentrations in archaeological samples may differ from one site to another. The concentrations depend on a combination of taphonomical processes and human behavior (Mercuri 2014). In both palynological-archaeological and environmental-palynological studies, a site's ecological niche can also influence pollen concentrations (Bryant 1989; Faegri and Iversen, 1989). Accurate interpretation of archaeological pollen data requires the analysis of several samples from the same archaeological context, alongside the use of control samples as well as nearby surface pollen samples (Bryant and Holloway 1983; Russo Ermolli and Messenger 2013; Mercuri et al. 2019; Langgut and Gleason 2020).

4. Results

4.1. The pollen spectrum of Villa Arianna

The palynological assemblages of Villa Arianna were characterized by a good state of pollen preservation. Pollen was preserved in all analyzed samples, except sample no. 9 (Table 1). Pollen grains could have penetrated the plaster in two ways: (1) if any of the garden-facing plaster layers were applied when the garden was blooming, the wet surface of the plaster could have trapped airborne pollen grains; (2) if water from the garden (e.g. water channels, pools, reservoirs) was used to mix the plaster, pollen would have become incorporated into the subsurface plaster layer. The samples of the outer part of the plaster are typified, in most cases, by higher pollen concentrations and higher numbers of pollen taxa. This is most probably because pollen penetrated the outer part of the plaster by two agents—wind and the water. Pollen grains seem to have penetrated the inner filling material of the plaster (=subsurface) only by the latter agent (water). In only a few samples, the opposite results were found; namely, higher numbers of taxa were documented in the inner filling material (samples nos. 7, 8 and 13). In two cases, pollen grains of both olive and *Castanea* (chestnut) appeared in clumps (that is, several pollen grains remained still attached to each other, as in the flower source). The control sample was dominated by a pollen spectrum deriving mainly from the natural environment.

4.2. Comparison between gardens

The comparison between the gardens with the presence/absence of the pollen taxa is presented in Table 2. Unfortunately, the pollen grains were extracted from the gardens based on different methods and contexts. Though I

Table 1. Palynological results from the Great Peristyle Garden of Villa Arianna (Stabiae), based on the pollen-plaster technique.

Archaeological context	Northeast corner of garden edge of outer wall		Room N, exterior wall, below window		South east corner of water tank		Pillar next to column opposite S, southeast corner		Concrete basin in PB1		Gutter north of west end of PB1 near setting basin		From column at west end of garden across from C and G		Room C exterior wall facing east		Interior wall room E		Exterior wall room R		Corner of blew pillar		Room C exterior wall facing east (interior plaster)		Column outside room A, Side facing garden		Summary		Control—modern plaster sample	
	no. 1 inner plaster	no. 1 outer plaster	no. 2 inner plaster	no. 2 outer plaster	no. 3 inner plaster	no. 3 outer plaster	no. 4 inner plaster	no. 4 outer plaster	no. 5 inner plaster	no. 5 outer plaster	no. 6 inner plaster	no. 6 outer plaster	no. 7 inner plaster	no. 7 outer plaster	no. 8 inner plaster	no. 8 outer plaster	no. 9 inner plaster	no. 9 outer plaster	no. 10 inner plaster	no. 10 outer plaster	no. 11 inner plaster	no. 11 outer plaster	no. 12 inner plaster	no. 12 outer plaster	no. 13 inner plaster	no. 13 outer plaster	Total pollen inner part	Total pollen outer part	no. 14 inner plaster	no. 14 outer plaster
<i>Pinus</i> (pine)		1	1		15	27		3	10	13		21	2	1				1	2		2		1	4	11	33	82		4	
Cupressaceae (cypress/juniper)		4	1	1	8	1		1		4		10			1			1		2	2		3	2	4	15	30	9	5	
<i>Olea europaea</i> (olive)	1	4	17	24	44	74	5	18	16	35	2	6	1	2	3			12	9	2	7	11	19	30	5	144	203	6	8	
<i>Platanus orientalis</i> (oriental plane)					1	1																			2	1				
<i>Myrtus communis</i> (true myrtle)					2																			2		4			1	
Rosaceae (rose type)					7																					7				
<i>Juglans regia</i> (Persian walnut)		1		1	9	1		2		2										2		1			5	14	10	2	1	
<i>Vitis vinifera</i> (grapevine)					6								3											3		12			1	
<i>Tilia</i> (linden)										2																0	2			
<i>Cedrus</i> (cedar)					1																			3		4				
<i>Alnus</i> (alder)		19	8	32	28	30	1	3	13	24		3	8		2	1			1	5	1	2	2	6	30	5	94	130	6	9
<i>Corylus</i> (hazel)		6	1	1	11	1		2	2			1		2					1					2	5	21	18	1		
<i>Castanea</i> (chestnut)		4			9	2		3	1	8									1	1			2	3	3	16	21			
<i>Carpinus</i> (Hornbeams)				1						1					6				1				3	3	4	8	11	1		
<i>Ulmus</i> (elm)			3	1						1				1									1			2	4	5		
<i>Picea</i> (spruce)		3		2	1	2			3		1									1			1			3	4	9		
<i>Abies</i> (fir)				3	1	2			3	7																4	12			
<i>Betula</i> (birch)		4		18	7	17				5	1	4							2						3	19	29	51	1	2
Ericaceae (heath)		1		1	2																				4	6	2			
<i>Salix</i> (willow)		1		1	8	8																				8	10			
<i>Quercus</i> evergreen type		4			7	7					7									1		1	1	3	4	1	12	24	1	
<i>Quercus</i> deciduous type		29		7	2			3	5		1														9	19	37	3	1	
Asteraceae Asteroideae type (aster-like)			1	6	1	3		1		1									1	1					2	5	12	3	1	
Asteraceae Cichorioideae type (dandelion-like)		1		2	2	3			1	1																3	24			
<i>Artemisia</i> (sagebrush)				2				2												1				3		2	6		1	
Poaceae (grasses)		2			5	11	1	1	1	10		3	1		1										1	11	36		1	
Cerealia type				1	2																				1	3	1			
Caryophyllaceae (pink family)						3		1																1		5	1			
Chenopodiaceae (goosefoot family)		3	1	4	7	17		7	3			1	2	1											2	1	15	34	3	4
Plantaginaceae (plantain family)		2	6	2	12	19		6	11	9	2	8	3		3				6	20		4		5	8	3	51	78	3	3
<i>Ephedra</i> (Mormon tea)							1	1																		1	1			
Brassicaceae (cabbage family)				6	1	7		1	2	1														1	2	5	16	2	2	
Urticaceae (nettle family)		1	1	2			1	4	3	4		1	3		245	7			1	6		4	12	445	1	267	474		1	
Fabaceae (legumes)		1			4	5				2																4	8	1		
Ranunculaceae (crowfoot family)		2	4			1								1												5	3			
<i>Cannabis</i>		1	5	6	8			2		3			2													9	18		1	
Apiaceae (umbellifers)			1		9	9	1		1	4														1		13	13		1	
<i>Thymelaea</i> (Sparrow-worts)													1													1				
<i>Rumex</i>																														1
Cyperaceae (sedges)					1				1																	2				
Total counted	2	98	58	121	211	250	11	57	76	142	7	66	26	3	259	14	0	0	28	67	6	33	33	498	144	38	861	1387	43	48

Table 2. A comparison of the botanical components of the splendid Great Peristyle Garden of Villa Arianna (Stabiae), with Herod's royal gardens at Judaea.

Plants of the natural environment	Caesarea	Herodium (palace)	Herodium (mausoleum)	Jerico	Stabiae
Site (Figures 1 and 2)	Caesarea—the courtyard of the Promontory Palace	Herodium—the garden of the Mountain Palace-Fortress	Herodium—Herod's mausoleum garden	Jericho—the peristyle garden of the Third Winter Palace (B64)	Stabiae—The great peristyle garden of Villa Ariana
Ecology (Figure 2)	Mediterranean with partially saline characteristics (due to their proximity to the Sea)	Semi-desert	Semi-desert	Desert	Mediterranean with partially saline characteristics (due to their proximity to the Sea)
Archaeological context	Plaster samples from the garden's structures	Garden soil (plaster samples were pollen barren)	Garden soil (plaster samples were pollen barren)	Sediments of planting pots (plaster is not available)	Plaster samples from the garden's structures
Possible ornamental trees and shrubs	<i>Pinus</i> (pine)	+	+	+	+
	Cupressaceae (cypress/juniper)	+	+	+	+
	<i>Olea europaea</i> (olive)	+	+	+	+
	<i>Platanus orientalis</i> (oriental plane)			+	+
	<i>Myrtus communis</i> (true myrtle)			+	+
	<i>Laurus nobilis</i> (bay tree)			+	
	<i>Phoenix dactylifera</i> (date palm)	+	+	+	a
	Rosaceae (rose type)	+	+		
	<i>Juglans</i> (Persian walnut)				+
	<i>Vitis vinifera</i> (grapevine)				+
	<i>Salvia</i> (sage)	+	+		
Trees and shrubs non-native to the Israeli flora	<i>Tilia</i> (linden)				+
	<i>Cedrus</i> (cedar)			+	+
	<i>Alnus</i> (alder)				+
	<i>Corylus</i> (hazel)	+	+		+
	<i>Castanea</i> (chestnut)				+
	<i>Carpinus</i> (Hornbeams)				+
	<i>Ulmus</i> (elm)				+
	<i>Picea</i> (spruce)				+
	<i>Abies</i> (fir)				+
	<i>Betula</i> (birch)				+
	<i>Cannabis/Humulus</i>				+
Plants of the natural environment	<i>Salix</i> (willow)				+
	<i>Quercus</i> evergreen type	+		+	+
	<i>Quercus</i> deciduous type	+		+	+
	<i>Pistacia</i> sp. (terebinth)	+			
	<i>Phillyrea</i> (broad-leaved Phillyrea)	+			
	<i>Tamarix</i> (tamarisk)	+		+	
	Asteraceae Asteroideae type (aster-like)	+	+	+	+
	Asteraceae Cichorioideae type (dandelion-like)	+	+	+	+
	<i>Centaurea</i> (knapweeds)			+	
	Poaceae (grasses)	+	+	+	+
	Cereal type	+	+	+	+
	Caryophyllaceae (pink family)	+	+	+	+
	Liliaceae		+	+	
	Chenopodiaceae (goosefoot family)	+	+	+	+
	Plantaginaceae	+	+	+	+
	<i>Mentha</i> type (mint)	+		+	
	Geraniaceae (Geraniales)			+	
	<i>Ephedra</i> (Mormon tea)	+	+	+	+
	Brassicaceae (cabbage family)	+	+	+	+
	<i>Limonium</i> (sea-lavender)			+	

(continued)

Table 2. Continued.

Plants of the natural environment	Caesarea	Herodium (palace)	Herodium (mausoleum)	Jericho	Stabiae
Urticaceae (nettle family)					
Crocus (croci)			+		+
Malvaceae		+		+	
Polygonaceae (knotweed family)	+			+	
Valerianaceae (valerian family)				+	
Carthamus (distant thistle)		+			
Artemisia (sagebrush)	+	+			
Fabaceae (legumes)	+	+			
Cistus (rock rose)	+	+			
Campanulaceae (bellflower family)					
Ranunculaceae (crowfoot family)					
Cannabis (hemp)					
Apiaceae (umbellifers)	+				
Solanaceae (nightshades)		+			
Cyperaceae (sedges)		+			
Nimphaea (water lilies)					
Typha (reed)		+			

^aPhytolith analysis revealed that date palm was grown at Villa Arianna's garden (Ryan, 2016).

had sought to apply the pollen plaster technique to all gardens, this method was only successful at Villa Arianna and Caesarea. In the case of the gardens at Herodium, all plaster samples were barren of pollen; this was perhaps due to the preparation of plaster outside of the blooming season, the plastering taking place prior to the planting of the garden, or the type of plaster used and the technique used to prepare it. In contrast, the soil samples from the cultivation layer of the gardens soil at Herodium (garden of the Mountain Palace-Fortress and the mausoleum garden) were productive (Langgut et al. *in press*). For Jericho, plaster samples were not available; therefore, sediments from the planting pots were analyzed palynologically.

For the purpose of the comparison, the palynological spectra of the gardens were divided into three main categories: (1) possible ornamental trees and shrubs; (2) trees and shrubs that are not native to the Israeli flora; and (3) plants of the nearby natural environment (also termed in palynological studies 'background noise' or 'background spectrum'; see Bryant 1974; Dimbleby and Gruger 2002, p. 183; Mariotti-Lippi and Bellini 2006). The highest taxa diversity was found in the great peristyle garden of Villa Arianna, probably due to its humid Mediterranean environment with relatively close proximity to a Mediterranean forest.

Two interesting observations emerged regarding the group of plants not indigenous to Israel: the identification of *Corylus* (hazel) pollen at Caesarea and the presence of *Cedrus* (cedar) pollen at Jericho. Interestingly, in the garden of Villa Arianna these two pollen taxa, native to the Vesuvius area, were also detected. While it is clear that in Caesarea and Jericho these non-native trees were used as ornamental plants, at Villa Arianna the interpretation of the pollen assemblages is more complicated, due to the relative abundance of local windborne pollen. Pollen from wind-pollinated plants might have blown into the garden from sources of considerable distance, so the pollen assemblage is less useful for identifying the plants of the Villa Arianna's garden. However, the presence of airborne pollen of trees such as *Pinus* (pine) and Cupressaceae (cypress/juniper), native to the Mediterranean vegetation zone, in gardens located in semi-arid and arid environments (Herodium and Jericho) probably point to their use as ornamental plants. The same explanation also applies to the presence of *Platanus orientalis* (oriental plane) and *Laurus nobilis* (bay tree) at Jericho. The appearance of the wind-pollinated *Olea europaea* (olive) at gardens situated in coastal Mediterranean environments (Caesarea and Stabiae) may indicate origination from the nearby natural Mediterranean forest, from olive orchards (Mercuri et al. 2013b; Langgut et al. 2014a, 2019) or from the gardens themselves. However, finding olive pollen in the harsh environments of Jericho and Herodium may suggest the use of olive as an ornamental tree. On the contrary, pollen of *Phoenix dactylifera* (date palm), a common natural and cultivated tree of oasis desert environments, appears only in Jericho and Herodium.

Pollen from insect-pollinated plants typically does not travel far from its source, so these taxa are more likely to have actually grown in the gardens. For example, the

presence of pollen of *Vitis* (grape), *Myrtus* (myrtle), *Salvia* (sage) and rose type, all insect-pollinated taxa, may suggest that they were cultivated in the gardens. The same can be concluded regarding *Juglans regia* (Persian walnut); albeit a wind-pollinated species, it is characterized by very low pollen dispersal efficiency (Bottema 2000; Langgut 2015).

5. Discussion

5.1. The great peristyle garden of Villa Arianna comes alive

Though pollen was well preserved in most of the plaster samples, the results of this study are difficult to interpret due to the challenges of ascertaining the exact source of the pollen grains; on one hand, the palynological spectrum may represent what actually grew in the garden, and on the other hand, pollen grains could originate from the surrounding natural or cultivated environment (Tables 1 and 2). A mix of both sources (nearby vegetation and garden plants) is also a possibility, especially in the case of air-pollinated taxa (Mariotti-Lippi 2000; Dimbleby and Gruger 2002, p. 183; Mariotti-Lippi and Bellini 2006; Langgut et al. 2015; Barrett et al. 2020; Vignola et al. 2022).

The pollen-plaster technique may solve some of this complexity. In this study, samples of the outer part of the plaster are found to be characterized by higher pollen concentrations and higher numbers of pollen taxa than those characterizing the inner plaster (Table 1). The higher values may indicate that the outer layer is composed of pollen from both sources, water and wind, while the inner layer contains pollen which originated only from the local water which was used to mix the lime. Based on this observation, it can be determined that at least some of the plants originated from the garden and were not blown from a distance by the wind. Among these taxa are: cedar, Persian walnut, myrtle, hazelnut, *Ericaceae* (heath), rose and grape. The latter is a common fruit tree in Pompeian gardens (e.g. Mariotti-Lippi 1998), and was even interpreted as evidence of a pergola in a garden of a Roman villa in Sicily (Montecchi and Mercuri 2018). The occurrence of both olive and chestnut in clumps is another strong indicator of their origin from the garden. Even for wind-pollinated species, large flower clumps must have fallen close to the plant that formed them.

While excavating the garden of Villa Arianna, a central feature comprising a set of four walks (*ambulationes*) crossing the courtyard was identified. The walks, separated by planting beds and stake holes for light fencing, are seen at each end of the beds. These beds contain nearly two hundred root cavities, ranging from tiny herbaceous plants to trees and shrubs (Gleason 2010). Such a configuration is unprecedented among the Pompeii area gardens and might point to varied vegetation that existed in the garden (Gleason et al. 2020). Due to limitations in pollen identification, herbaceous plants are usually difficult to trace to the genus/species level. For example, the various plants within the Brassicaceae (cabbage) family are difficult to distinguish based on morphological pollen grain criteria. The Brassicaceae family in Italy is very diverse and contains many

genera and species. Some *Brassica* sp. plants are used as crops, others as ornamentals, and others are merely common weeds. In addition, some of the herbs identified in the palynological spectrum (Table 1), such as members of the nettle family, may represent ruderal plants that grew in the garden (Mercuri et al. 2013a; Langgut et al. 2014b).

Other botanical remains collected from the garden, such as wood and charcoal remains, were interpreted as evidence for fuel material (Challinor 2016). Some deposits of carbonized remains and charcoal among the root cavities of the garden beds provided insight into meals, perhaps by nearby workers repairing the paintings (Gleason and Langgut in press). The phytolith investigation produced evidence of only one ornamental plant—the palm tree (Ryan 2016). The fine path system, which was exposed by using LiDAR scan in the garden, suggests that the garden was meant for recreation rather than purely for agricultural use (Gardelli and Howe 2016).

In summary, while the phytolith investigation indicates that date palms were grown in the prestigious Great Peristyle Garden of Villa Arianna, this pollen study suggests that cedar, Persian walnut, myrtle, hazelnut, grape, rose, heath, olive and chestnut were probably also cultivated in the garden. Some herbaceous plants, such as members of the cabbage family, may have also been grown in this luxurious garden.

5.2. Challenging ecologies and the importation of plants throughout the Empire

Due to the proximity to the Mediterranean Sea, at both gardens—the one of Villa Arianna and the one at Caesarea, efforts were devoted to planting and sustaining splendid gardens in relatively harsh, saline environments. The palace at Caesarea was built on the only promontory other than those used for the harbor, and could be used to inspect it from the south. This magnificent palace demonstrates King Herod's ability to design for the particular demands and ambitions of his reign, while creating a structure of exceptional splendor. Thus, it is not surprising that attempts were also made to plant and sustain a lavish garden in the courtyard of this palace complex. Villa Arianna is among a few luxurious *villae maritimae* in Stabiae, the resort town for senatorial elite from Rome. Ancient Stabiae is situated across the Sarno River along the edge of a 50 m cliff overlooking the Bay of Naples. This magnificent location offered spectacular views out across the bay towards Mt. Vesuvius, while cradled by the verdant Verano hill and the Latteri hills on the landward side. The Great Peristyle of the Villa Arianna not only provided a view of the water, but an array of interior landscapes was integrated into the villa's architecture as well. Currently, it is the largest extensively exposed prestigious garden in the Vesuvian region (Howe 2016).

At both the Caesarea and Villa Arianna gardens, pollen of pine, cypress and hazelnut was identified (Table 1). All of these trees are typical features of gardens of the early Roman period and may show that King Herod was inspired by planted spaces that he might have seen during his travels

to Rome. While cypress and pine are native to the Israeli flora, the non-indigenous hazelnut was probably imported. It is not surprising that King Herod made efforts to import trees and to 'defy nature' by sustaining a garden in saline, windy coastal environment. The desire to present trees from the distant parts of the Roman Empire in his gardens probably comprised part of King Herod's propaganda and display of power. The same can be said of the presence of cedar pollen in Jericho. This magnificent tree is not a member of the Israeli flora. In ancient Israel, the cedar symbolized strength, dignity and splendor, and was considered the prince of trees (Zohary 1982). Its use as an ornamental tree is suggested by archaeobotanical evidence originating from Iron Age Megiddo (Benzaquen et al. 2019), from the Persian royal garden near Jerusalem (Lipschits et al. 2012; Langgut et al. 2013) and from a desert Byzantine ornamental garden (Langgut et al. 2021b). In the western part of the Empire, cedars were also used as ornamental trees, as shown by their distinctive silhouettes rising above villas in frescos of maritime scenes.

In addition to the Mediterranean Sea, semi-desert and desert environments are also challenging environments in which to sustain royal gardens. This hardship is demonstrated by the gardens of Herodium and Jericho, both of which receive less than 200 mm of annual rainfall (Figure 2). An intensive and controlled irrigation system was necessary to grow the typical Mediterranean trees that were identified palynologically in these gardens (Table 1). The further need to sustain the trees in their unnatural habitat probably demanded expert cultivation. The cedar pollen found in Jericho is a case in point, since it is challenging to cultivate this tree in a desert environment. The location of these lush, verdant gardens amidst the semi-arid and arid landscapes demonstrated Herod's power and affluence, not only in ruling his subjects but also in mastering and controlling the environment.

While hazelnut and cedar were probably imported to Herod's gardens from the north/north-western parts of the Roman Empire, we have evidence that the popular date palms were imported to the Empire center from its eastern periphery. Pollen, as well as other botanical remains of this desert oasis tree, were found in the two gardens at Herodium (Langgut et al. *in press*) and at Jericho (Langgut and Gleason 2020). At Villa Arianna, no date palm pollen was found, but Ryan (2016) suggested that palm phytolith were present in the garden soil. Recently, date palm pollen was identified at two gardens adjacent to Villa Arianna—Villa San-Marco and the garden of Domus Panoramica (Gleason and Langgut *in press*). Date palm trees were also popular in other western Roman Empire gardens (Jashemski et al. 2002, pp. 140–141 and references therein), where they were used only for ornamental or symbolic purposes, since palms cannot bear fruit in the temperatures and humidity typical of this part of the world. Indeed, Pliny the Elder had described the barrenness of the palm trees growing in this area of Italy and noted the popular practice of importing many varieties of palm fruit (*Natural History* XIII.6: 27). Augustus enjoyed a Judean date named for Nicholas of Damascus, a member of

Herod's court, who brought these dates as a gift to the emperor (Athenaeus, *Deipnosophists* XIV.651f; Pliny the Elder, *Natural History* XIII.9: 42–46). Flavius Josephus records that Mark Anthony gave Cleopatra the 'palm grove of Jericho where the balsam grows' (*The Jewish Wars* I.361). Josephus also cites Jericho and its dates in connection with Salome, wife of Herod, and with Julia, daughter of Augustus—citations that indicate the fame and popularity of Jericho's dates (*The Jewish Wars* II.167; Goor 1967). Pliny the Elder discusses the Judean palm (*Natural History* XIII.6: 16)—specifically, the dates from Jericho—calling them the most famous (*Natural History* XIII.9: 44). In addition to its economic importance and its use as an ornamental tree, the date palm tree also had symbolic value, both in Judean culture and in the Roman world, where it was used in triumphal processions to symbolize victory and pacification (Fine 1989; Jashemski et al. 2002).

5.3. Gardening trends

While the desire of King Herod to present in his gardens trees from the distant parts of the Roman Empire, such as hazelnut and cedar, was probably a part of his propaganda and display of power as discussed above, the importation of date palm trees to the Empire's heartland probably resulted from the elites' interest in following the latest trends in gardening. Whereas it is quite easy to follow the movement of flora as an elite product on a west-east axis and vice versa (based on the plants' natural distribution, botanical remains and contemporaneous texts; e.g. Langgut 2017), it is much more difficult to trace the origin of the fashion of the miniaturized garden during the Early Roman period. Simultaneous evidence for the dwarfing of trees was found in Judaea and in the Empire's center (Langgut and Gleason 2020). This gardening trend was part of the Roman art known as *ars topiaria*, the art of elite ornamental gardening (*topia* = ornamental landscape gardening), which comprises the source of our modern term 'topiary'. *Ars topiaria* encompasses all manner of cut effects: grafting, clipping trees into dwarf forms, pruning and training trees to fit into planters and/or to climb walls, arranging them into scenes, and ultimately (by the 1st century CE), the creation of the kind of shapes and arrangement familiar to us as 'topiary' today (Landgren 2013; Gleason and Palmer 2018, p. 376).

Indications that the size of plants was controlled at the gardens of Jericho come through the discovery of dozens of perforated ceramic vessels (*ollae perforatae*) found *in situ* (Gleason 1993; Gleason and Bar-Nathan 2013). Archaeological excavation in the courtyard garden of Herod's third Winter Palace exposed seven rows of as many as 11 planting pots each (Gleason 1993; Gleason and Bar-Nathan 2013). The pollen finds from the garden soil and the planting pots include pine, cypress/juniper, cedar, olive, oriental plane, myrtle, bay tree and date palm. All of these trees and shrubs are well-known ornamentals in elite gardens of the western Roman world. Since these naturally large plants were grown in planting pots, it has been suggested that the garden featured dwarf trees (Langgut and Gleason 2020).



Figure 3. Planting pot from Oplontis with cast of large root cavity within the vessel. Courtesy of the Wilhelmina and Stanley Jashemski Archives, University of Maryland.

Sources from the western Roman world pointing to the dwarfing of trees derive from texts, paintings and archaeological evidence (mostly the presence of planting pots that still contain woody remains, [Figure 3](#)). Pliny the Elder mentioned that this practice was introduced by Gaius Matius during the reign of Augustus (*Natural History* 12.6). Ancient texts record plants with the prefix *chamae*, which includes dwarf plants for garden use. Some of the ornamental plants identified in the Jericho courtyard have such a prefix: *Chamaeplatanus* (dwarf oriental plane), *Chamaezēlos* (dwarf date palm) and *Chamaedaphne* (suggested as dwarf laurel; [Gleason 2019](#) and references therein). Interestingly, evidence for the presence of the oriental plane and the date palm was also found in Villa's Arianna garden. Following the evidence in ancient literature and wall paintings, it was recently suggested that dwarf trees were used in the garden of Villa Arianna, based on the close spacing and size of root cavities ([Gleason 2019](#)). As a decorative amenity, myrtle, whose pollen has also been uncovered in both Jericho and Villa Arianna, is often clipped to form decorative hedges. Together with its deep evergreen color and appealing odor, myrtle was (and is) an indispensable feature in ornamental gardens.

In addition to the evidence from Jericho, plentiful amounts of *ollae perforatae* were also used in the royal gardens of Herod's contemporary, Augustus ([Klynne and Liljenstolpe 2000](#); [Zachos 2003](#)). Abundant planting pots in elite gardens have been exposed elsewhere as well—in the garden of the imperial villa of Poppaea at Oplontis ([Figure 3](#)), where a total of 85 planting pots were recovered, and in the garden of the House of the Ship Europa in Pompeii ([Jashemski 2018](#), pp. 443–444).

The question of who was the trendsetter behind the gardening fashions of the time, such as dwarfism of trees, is difficult to answer. Was it Augustus, the most powerful ruler of the Mediterranean? Or Herod the Great? Though Augustus set the trends of his time, not all practices necessarily originated only in Italy. Augustus drew inspiration from his own travels and those of his predecessors around the Mediterranean. Therefore, various gardening practices may have originated in Italy, Alexandria, Pergamon, or other notable centers of garden art, such as Judaea. Indeed, though

located far from the western Roman world, the miniaturized garden at Jericho is no less impressive than any other elite peristyle garden of the period ([Langgut and Gleason 2020](#)). Allocation of trained gardeners (= *topiarii*) was essential, especially if the trees at this desert oasis were to be pruned to miniature proportions. Special knowledge was required for the success of plants outside their natural habitat. There are ample textual and archaeological indications showing that Herod was inspired by architectural and artistic trends of the royalty of the western Roman Mediterranean ([Netzer and Laureys-Chachy 2004](#); [Gleason and Bar Nathan 2013](#); [Berlin 2014](#); [Peleg-Barkat 2014](#)), including the arboricultural and horticultural trends attested to in the textual sources ([Langgut and Gleason 2020](#)). While comparing the finds from Judaea with those from adjacent regions, it is evident that Herod preceded other local monarchs and vassal kings in introducing Roman trends into local architecture and art, making him one of the central figures involved in the importation of Roman culture into the East ([Peleg-Barkat 2014](#)). [Netzer \(2008\)](#) proposed that Herod had sent teams of building staff from Rome to Judaea by Agrippa—mostly artists who did the wall paintings and masons who introduced the distinctive Roman stonework, *opus reticulatum*, to Jericho and Caesarea ([Gleason and Palmer 2018](#)), but possibly *topiarii* as well ([Langgut and Gleason 2020](#)). Notably, Herod was often in direct dialogue with Augustus and his son-in-law Agrippa during travels and state visits. Herod's architecture and art bore a local distinctiveness but were clearly eclectic, combining traditions from the Graeco-Roman East and the Western Roman Empire ([Peleg-Barkat 2014](#); [Weiss 2014](#)). Herod's gardens are thus amongst the earliest examples of gardens of the moment of transition from the late Hellenistic to the early imperial Roman period ([Langgut and Gleason 2020](#)).

Four of the five gardens examined in this study are colonnaded gardens: the great peristyle in Villa Arianna, the courtyard of the Promontory Palace in Caesarea, the peristyle garden of the Third Winter Palace in Jericho, and the courtyard garden of the Mountain Palace-Fortress in Herodium. Both sides of the Empire have large gardens framed by colonnades; in its eastern part, the Petra Garden is the largest and most beautiful among these ([Bedal 2004](#); [Bedal et al. 2013](#)). In the western part of the Empire, colonnaded gardens were exposed at several *villa maritima* around the Bay of Naples—at Villa San Marco in Stabiae ([Jashemski, 1979–1993](#), pp. 305–307) and Villa Poppaea in Oplontis ([Jashemski, 1979–1993](#), pp. 289–314)—in addition to Villa Arianna. Larger public examples in Rome are also valuable, particularly those that would have been seen by Herod himself, such as the Porticus Pompeiana ([Gleason 1994](#)). The specific combination of a large garden surrounded by colonnades and a pavilion/tholos (along with other leisure facilities) likely had its origins in Hellenistic palatial architecture ([Bedal 2004](#), pp. 157, 168). By combining Eastern and western Roman gardening trends and garden architecture elements, Herod was ahead of his time, creating innovative landscape architectural formats that, in turn, influenced other gardens in the Roman world, from the Petra Garden ([Bedal](#)

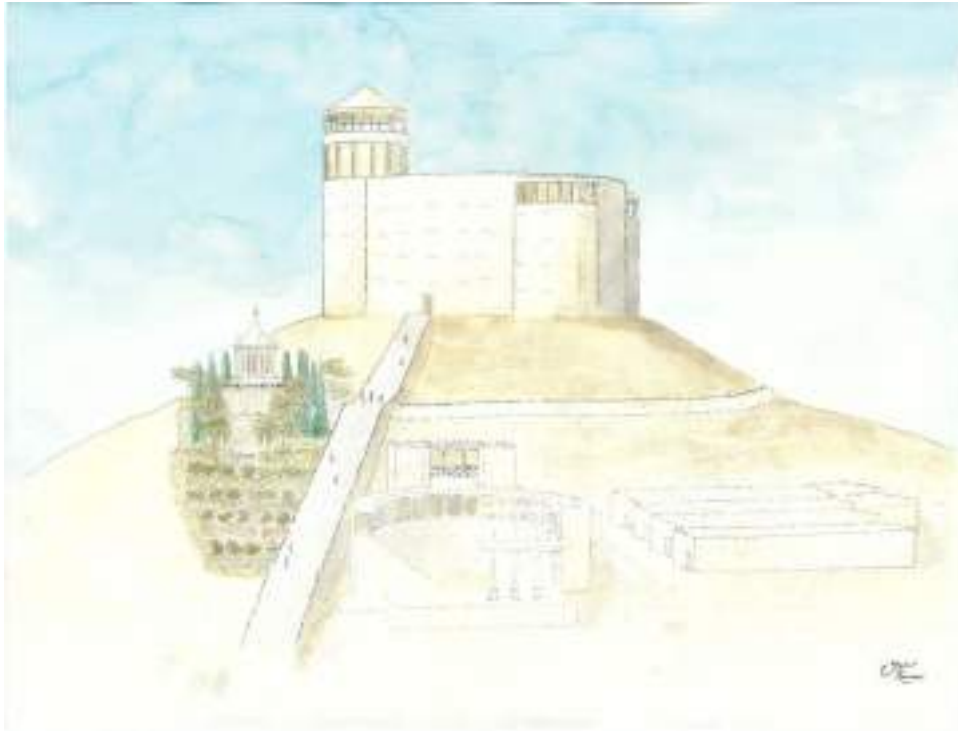


Figure 4. Reconstruction of the mausoleum garden during its early period, around 15 BCE (drawing by Y. Korman).



Figure 5. A view of Herodium from Armon Hanatziv during the late 1st century BCE (Jerusalem hills, <10 km northwest of Herodium) (drawing by Y. Korman).

2004; Ramsay and Bedal 2015) to gardens and landscapes in Italy, such as Hadrian's Villa (MacDonald and Pinto 1995, pp. 85–88). Debates about the eastern versus western origins of early Roman garden trends and garden architectural elements are likely to continue until more Early Roman gardens are well excavated, including the identification of the exact botanical components of these gardens.

5.4. Visibility

Herod's mausoleum garden at Herodium differs from the other gardens investigated in this study. All the other gardens are colonnaded gardens that are mostly used for pleasure, strolling, and status symbols, while the mausoleum garden is smaller and difficult to access. Herod's decision to be buried in the middle of the slope of the artificial



Figure 6. A view from the Temple Mount towards Armon Hanatziv (=the Commissioner's Palace in Hebrew; the site is also known as the British Mandate Governor's House). The artificial mountain of Herodium can be seen on the horizon. Courtesy of the Israel Antiquities Authority.

mountain of Herodium (Figure 4) and not on top of the *tumulus* at his outstanding Palace-Fortress or at its foot, at the remarkable Lower Herodium, is an enigma. Considering the components that were planted in the garden (Table 1), I hereby propose a solution to the mystery. All the ornamental plants identified in the garden are evergreen Mediterranean trees and shrubs: pine, cypress, olive and rose. The date palm, which is a green desert oasis tree and a popular garden tree, was also present within the assemblage. The predominant use of evergreen trees presents a dramatic contrast to the whitish slopes of the imposing artificial conical hill (Figure 4). Beyond doubt, the choice of these evergreen trees contributed to the visibility of the mausoleum from a distance, and specifically emphasized its presence from as far as the hills of Jerusalem (Figure 5). For example, while standing today at Armon Hanatziv hill in Jerusalem (<10 km northeast of Herodium), the artificially elevated mountain of Herodium is clearly notable (Figures 6 and 57). The addition of a dark green patch in the middle of its northeastern slope increases its visibility from afar, particularly to people looking southwest from Jerusalem. The case of Armon Hanatziv is interesting as it seems to be an important location in Jerusalem since antiquity. Recent discoveries indicate that already during the 7th century BCE, Armon Hanatziv was home to very wealthy residents who owned a palace with extraordinary architectural and artistic elements (Langgut 2022). The views from the Armon Hanatziv ridge are breathtaking; to the north, the City of David, and to the south, the Judean Desert. This may explain why even the British commissioner chose it as his residence during the British Mandate. I argue that the visual connection between elevated locations in Jerusalem (such as Armon Hanatziv and the Temple Mount) and the whitish burial monument (Figures 5 and 6) with its dark evergreen garden in the

desert was intentional, probably aimed to manifest power, devotion and awe. Herod wanted to be seen and remembered even after his death by the people of Jerusalem and its famous temple (the 'Second Temple', also known in its later years as Herod's Temple). Such an architectural arrangement of a temple and tumulus-like burial structure aligned along one visual axis (Figure 6) was also found in Rome, between the Pantheon and Mausoleum of Augustus, constructed by Herod's patron, Emperor Augustus. The funerary monument that was surrounded by gardens and the temple may have served as a source of inspiration for the client king, by which Herod manifested his affinity to the Caesar.

6. Summary and conclusions

The use of the pollen-plaster extraction method enabled the identification of the botanical components that grew in the Great Peristyle Garden of Villa Arianna, a luxurious *villae maritimae* at Stabiae. The garden, which was extensively destroyed and covered by tephra ash from the Vesuvius eruption in 79 CE, offers the most detail and potential for interpretation of any large Roman garden in the Empire. This pollen study suggests that in addition to date palms (evident from the phytolith study), cedar, Persian walnut, myrtle, hazelnut, grape, rose, heath, olive and chestnut were probably cultivated in the garden. Some herbaceous plants, such as members of the cabbage family, may have also been grown in this super garden.

The pollen results of Villa Arianna were compared to four other Early Roman gardens of monumental contexts, located at a distance from the hub of the Empire. The gardens belonged to Herod the Great, the client king of Judaea (an eastern province of the Empire), in Caesarea, Jericho and

Herodium. The comparison between these contemporaneous gardens' botanical components and their varied landscapes led to the following conclusions:

1. Plants were imported from both ends of the Roman Empire as elite products (rather than cash crops). Hazelnut (*Corylus*) and cedar (*Cedrus*) were introduced from west to east, while the date palm (*Phoenix dactylifera*) was introduced along an east-west axis.
2. There is ample evidence to suggest that Emperor Augustus, the most powerful ruler of the Mediterranean, was the trendsetter of his time, and provided the inspiration for Herod's feats in architecture and art. But who set the trends in garden design of the era? Evidence shows that Herod integrated a unique combination of architectural elements from the Graeco-Roman East (e.g. a colonnaded garden with a pavilion) and the Western Roman Empire in his royal gardens. Therefore, Herod may have introduced other unique gardening fashions, such as dwarfism of trees, which were later adopted by the elite in the Empire's heartland—maybe even by Augustus himself, who was known to draw inspiration from his travels around the Mediterranean. However, present evidence shows that the miniaturization of trees and shrubs occurred simultaneously across the Empire, impeding the identification of the origin of this trend until more Early Roman gardens will be explored in detail.
3. The gardens investigated in this study flourished in challenging habitats: at Villa Arianna and Caesarea, efforts were devoted to planting and sustaining splendid gardens in the relatively harsh, saline environment of the Mediterranean Sea; at Herodium and Jericho, special knowledge and efforts were required for controlled irrigation and for the success of the plants outside of their natural habitat, in the semi-arid environment of the Judean desert. Herod was well known for his skills in challenging the limitations of the surrounding environment so as to create astonishing locations that defied Roman norms of landscape architecture. From the surf of Caesarea to the oasis of Jericho and through the artificial mound of Herodium, Herod's garden-building endeavors were designed to delight viewers from near or far. This is especially true of Herod's mausoleum garden in Herodium, whose dark evergreen garden on the whitish slopes of the artificial mound could be seen from the high peaks of Jerusalem, including that of the Second Temple. The use of such contrast was probably aimed as a manifestation of Herod's power, by inspiring devotion and awe even after his death. A parallel architectural arrangement of a temple and tumulus-like burial structure aligned along one visual axis was also found in Rome, between the Pantheon and Mausoleum of Augustus. The Caesar's funerary monument surrounded by gardens and able to be seen from the temple, may have served as a source of inspiration for the client king, by which Herod manifested his affinity to Augustus.

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Data availability statement

All data generated or analyzed during this study are included in this article (Tables 1 and 2).

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