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Identification of a New Sign for the Date Palm in Proto Elamite Texts and its Reflection on the Economic System of Susa

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Abstract

The earliest evidence of human exploitation of the wild date palm in the Middle East dates back to the sixth and fifth millennia BCE. Despite the scarcity of archaeological data, it is commonly assumed that by the end of the Late Uruk period (ca. 3300–3100 BCE), the Sumerians founded the earliest date palm orchards. However, this hypothesis has thus far not been substantiated by scientifically verified and documented evidence, rendering the matter a subject of scholarly controversy. To date, since the Proto-Elamite script has not yet been fully deciphered, our knowledge of agricultural activities within Proto-Elamite society remains considerably limited. What has been learned so far regarding the structure of this society's economic system is derived mainly from comparisons between signs found on Proto-Elamite clay tablets and comparable examples in Late Uruk Mesopotamian Proto-cuneiform tablets from the late fourth millennium BCE; signs that primarily pertain to labor activities, animal husbandry, and livestock products. This study outlines the phenotypic characteristics of the date palm that can be identified, and examines their similarities to known Proto-Elamite examples. The authors suggest signs representing date palms in the Proto-Elamite script and consider them as key resources for a better understanding of the subsistence economy of the Proto-Elamite period, an issue previously absent from the scholarly literature on this era. Employing a comparative approach, the article correlates the signs for palms in Proto-Elamite texts with contemporaneous and later Iranian, as well as Mesopotamian, visual motifs. By introducing these signs into the archaeological discourse of the Proto-Elamite period, the research enables a more accurate reconstruction of the economic system and assessment of the level of date-palm horticultural knowledge in southwestern Iran during the late fourth millennium BCE.

Keywords: Date Palm, Proto Elamite, Susa, Early Cuneiform, Late Fourth Millennium BCE, Horticulture.

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Introduction

The date palm (Phoenix dactylifera L.) is among the oldest known cultivated plants in southwestern Asia. Archaeological evidence, along with the study of historical texts and agricultural history, attests to its enduring presence and foundational role in the economy, subsistence, and culture of Near Eastern societies and in particular those of Iran from prehistoric times through historical periods (Amiet, 1980; Burrows, 1935; Dowson, 1923; Goor, 1967; Heimpel, 2011; Landsberger, 1967; Postgate, 1980; Potts, 1997; Sarton, 1936; Tengberg, 2012; Zohary & Hopf, 1994). The date palm, a dioecious plant, was not only of high economic importance within the agricultural production systems of ancient societies but also held a prominent place in many cultural traditions and religious symbolism (Giovino, 2007; Hassett, 1911; Nixon, 1951). From a phytogeographical perspective, the date palm is native to the botanical region known as the "Sind Desert," a desert or semi-desert zone extending from the Indus Valley in the Indian subcontinent to southern Mesopotamia and North Africa (Gauba, 1953). This natural range provided a favorable environment for the species' growth and served as the initial setting for its domestication in antiquity. Despite its vast-ranging importance in agricultural history, questions about the precise origin and domestication trajectory of the species remain topics of scholarly investigation. Unlike many other cultivated plants[1], no wild species has yet been definitively identified as the direct ancestor of the cultivated date palm, and its pre-agricultural distribution pattern remains shrouded in uncertainty (Tengberg, 2012). Multiple hypotheses have been advanced regarding the date palm's origin. Some researchers have suggested that the Persian Gulf region, particularly the borderlands between Iran, Iraq, and the Arabian Peninsula, served as its probable homeland. In contrast, others have traced its ancestry to the wild or "sugar" date (Phoenix sylvestris) of western India (Zargari, 1990). More recent genomic studies, based on analyses of genetic diversity in native date palm populations, present a new hypothesis suggesting that domestication likely began in the eastern parts of the Arabian Peninsula (Gross-Balthazard *et al.,* 2017). While these findings are not yet definitive, they represent an essential step toward understanding the historical trajectory of domestication and the species' diffusion within the cultural sphere of the ancient Near East.

Many archaeologists maintain that large-scale commercial date palm groves first appeared in Mesopotamia during the Late Uruk period (i.e., approximately 3300–3100 BCE), (e.g., Nixon, 1951; Postgate, 1980). This development is typically linked to the emergence of organized Sumerian civilization, in which temple administrations managed labor forces, irrigation systems, and the flow of resources, forms of control that constituted a principal source of revenue for the city-states (Potts, 1997). The date palm played a central role in the agriculture of Proto historic societies in Iran and

Mesopotamia (Powell, 1987), as it not only produced a very high yield (between 30 and 200 kg of dates per tree), (Zohary & Hopf, 1994) but also provided a wide array of secondary products and was exceptionally well suited to the hot, dry climates of southern and southwestern Iran and southern Mesopotamia, as well as to the particular properties of their soils (Potts, 1997: 69; Schwab, 1983: 149; Van de Mieroop, 1992: 158).

Objectives

This article aims to identify and analyze signs associated with the date palm tree and its products in Proto-Elamite texts, with particular emphasis on signs recognized within the Mesopotamian scribal tradition, especially the sign (ZATU 230)[2]. Given the fundamental role of the date palm in the economies of societies in southwestern Iran and the southern Zagros region, areas that culturally overlap with the geographical domain of the Proto-Elamite period, this study seeks to identify and interpret motifs related to this plant in the era's written records. Focusing on the Proto-Elamite sign list published online by Jacob Dahl through the "Cuneiform Digital Library Initiative", and especially on those signs appearing in the earliest tablets of this writing system, the research conducts etymological, semantic, and graphical analyses of these signs. The objective is to trace the visual evolution of these signs and compare them to their analogues in Mesopotamian writing traditions, thereby providing a more precise representation of the place of the date palm in the linguistic and economic systems of Proto-Elamite societies (Dahl, 2005). Since this topic has not previously been examined directly and systematically, the findings of this study have the potential to fill a significant gap in research on agriculture, subsistence economy, and the semiotic analysis of Proto-Elamite texts.

Evidence of the Date Palm in the Archaeological Record of Iran

The earliest known depictions of the date palm in Iran are found in rock carvings in the "Teymareh" region of Golpayegan County (Farhadi, 1996). In one such panel, the date palm is clearly portrayed alongside several wild goats and a carnivorous animal resembling a feline. This scene, which combines vegetal and animal elements within a symbolic space, reflects the deep-rooted link between the date palm and the cultural lifeworld of the inhabitants of the central Iranian plateau (Fig. 1: A). During the Susa II period, representations of the date palm gradually assume a prominent place in the art and symbolic system of cylinder seal impressions. On several cylinder seals from this period, a human figure is shown climbing the trunk of a date palm; a gesture likely alluding to the process of harvesting fruit or tending the tree (Roach, 2008). This visual pairing of the date palm and the human figure holds particular semantic and symbolic

significance. In these depictions, the date palm is typically rendered in a simplified, abstract manner, often positioned at the margin or edge of the scene. Botanical details are seldom represented, and the iconography focuses more on the schematic form than on precise morphological realism (Fig. 1: B).

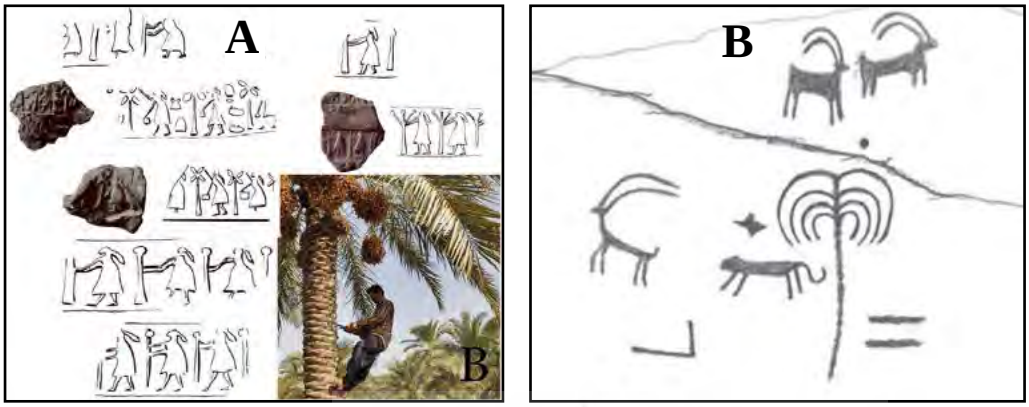


Fig. 1: A) The earliest known representations of the date palm in Iran in the rock carvings of the Teymareh site. B) Early representation of the date palm on cylinder seals from the Susa II period; examples of the enduring association between the palm's vegetal element (Roach, 2008).

In the Proto-Elamite period, the use of cylinder seals adorned with representations of the date palm constituted a distinctive and noteworthy phenomenon (Fig. 2). In specific examples, particularly those impressed on the reverse of clay tablets, a symbolic composition emerges in which animals such as goats, cattle, or lions are observed alongside the date-palm motif. This visual arrangement, significant not only from an aesthetic perspective but especially within the framework of the semiotic system and the socio-economic relations of the Proto-Elamite era, carries multiple interpretive implications (Palarde, 2022; Kelley, 2024; Kelley *et al.,* 2025). The date palm in these seals is typically rendered in a highly simplified, abstract manner, at times resembling the common logographic sign used in administrative texts of the same period. The placement of this symbol at the margin or edge of the scene's composition is a recurring and meaningful feature in Proto-Elamite iconography. Such positioning may indicate both an intrinsic or implicit sanctity attributed to the tree within the socio-economic context of the time and a direct linkage between the image, the sign system, and the bureaucratic function of seals and documents. Indeed, this imagery, beyond affirming the economic importance of date palm products, reveals the interconnection between administrative systems and the symbolic worldview of Proto-Elamite society (Kelley 2024). The convergence of significant function (in accounting and economic texts) and artistic symbolism (in glyptic art) illustrates the transfer of meaning from the written sphere to the visual and even ritual domain. The visual consistency of the date palm motif across both spheres, seals, and clay tablets thus lays the foundation for a deeper

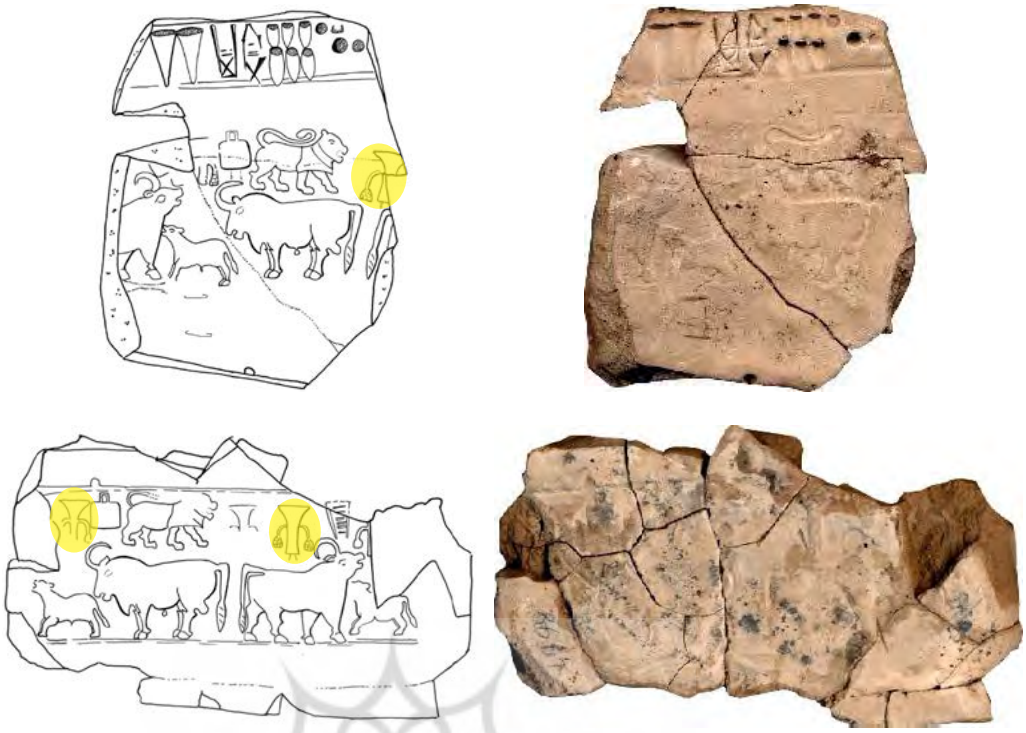


Fig. 2: Impressions of Proto-Elamite seals on the reverses of two tablets, depicting an abstract representation of the date palm (Phoenix dactylifera L.), (Paladrde, 2022).

understanding of the socio-economic standing and symbolic cosmology of the Proto-Elamite world (Kelley, 2024).

In the Middle Elamite period, the date palm was one of the fundamental pillars of the agricultural economy in Elam and Khuzestan, holding a distinguished position within the production systems and subsistence strategies of the communities of that era. Diverse evidence attests to this importance, including inscriptions and administrative seals dedicated to recording and regulating the harvest and distribution of date palm products. Furthermore, in the decoration of the temple of "Shutruk Nahhunte" in the Acropole mound of Susa, the date palm is prominently depicted in the form of molded and relief-fired bricks; a portrayal reflecting the symbolic role and economic function of this plant within both ritual spaces and the architectural expressions of royal authority (Fügert & Gries, 2020). The apex of the combined visual and documentary representation of the date palm is clearly evident in the art, administrative records, and architectural works of the Achaemenid period. At Persepolis, numerous reliefs depict the date palm, illustrating the plant's prominent presence in the symbolic imagination and economic framework of the Achaemenid era. These motifs, together with Elamite clay tablets, administrative records, and the many seals identified at the sites of Susa and Persepolis, serve as compelling testimony to the continuity and intensification of the palm's status within the bureaucratic rationing systems and economic relations of the time (Hallock 1960; 1978). From the perspective of external written sources, Greek texts also play a

decisive role in describing the status of the date palm in ancient Iran. Xenophon, in the Anabasis, and Theophrastus, in his botanical treatises, explicitly mention the existence of extensive date orchards and even the diversity of their cultivars in Iran, providing evidence of the coherence and efficiency of a palm-based agricultural system and natural resource management within the Achaemenid bureaucratic structure (Fig. 3). Thus, the continuity of the date palm's role from the Middle Elamite to the Achaemenid periods can be traced not only in administrative records but also in art and architecture, an enduring linkage that reveals the deep interconnection between the agricultural economy, administrative practices, and symbolic expression throughout the historical trajectory of the Iranian plateau, thereby enabling comparative interpretations of this plant's place in the transformations of socio economic structures across different eras. Thus, the continuity of the date palm's role from the Middle Elamite to the Achaemenid periods can be traced not only in administrative records but also in art and architecture, an enduring linkage that reveals the deep interconnection between the agricultural economy, administrative practices, and symbolic expression throughout the historical trajectory of the Iranian plateau, thereby enabling comparative interpretations of this plant's place in the transformations of socio economic structures across different eras.

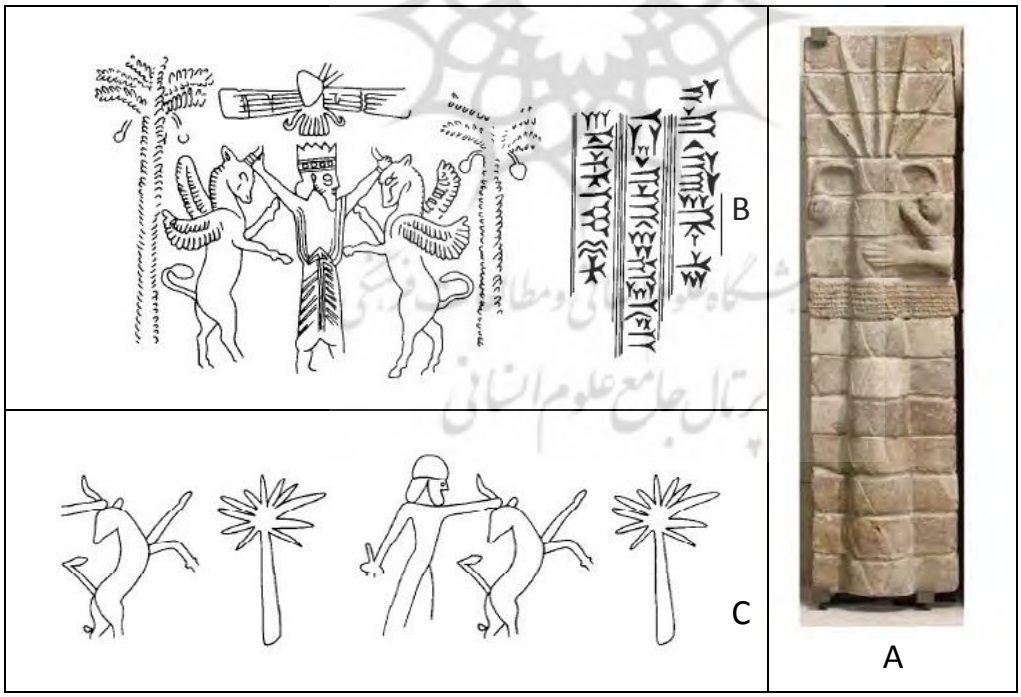


Fig. 3: A) Moulded Brick from the Middle Elamite Period Depicting a Date Palm Motif; B) Impression of Seals from the Achaemenid Period Bearing the Date Palm Design; C) Impression of a Cylinder Seal from the Neo Elamite Period (Roach, 2008).

Furthermore, the frequent depiction of the date palm tree on Jiroft stone vessels, as one of the principal themes and decorative motifs, attests to the considerable economic, symbolic, and perhaps even ritual importance of this species in the socio-cultural

landscape of the late third millennium BCE (Piran & Hessari, 2005; Majidzadeh, 2003). These recurring visual representations suggest that the date palm was more than a utilitarian crop; it likely functioned as a central element in local identity formation, artistic canon, and possibly in ceremonial or religious practice, thereby reinforcing its dual role as both a staple resource within the agricultural economy and a potent emblem within the visual and ideological repertoire of the Jiroft cultural complex (Fig. 4).

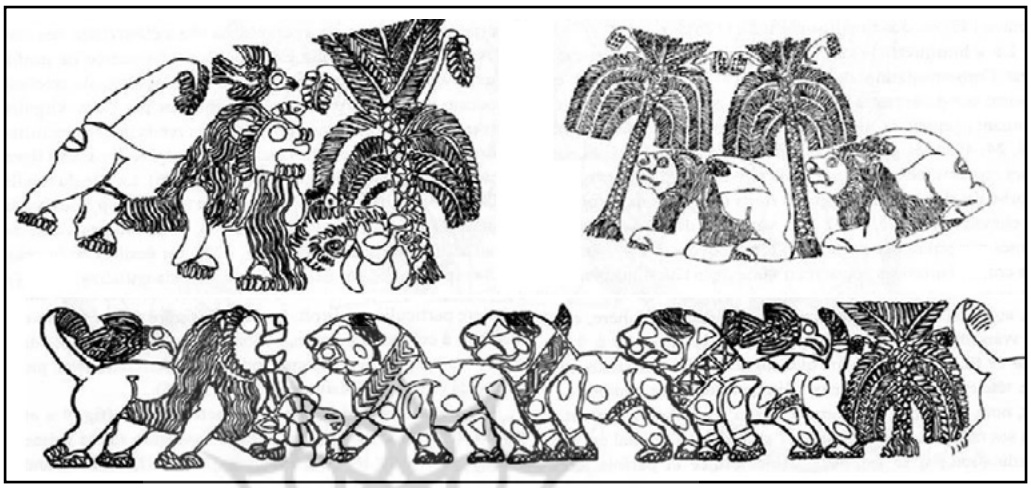


Fig. 4: Date palm motifs on Jiroft stone vessels, reflecting the plant's economic, symbolic, and ritual significance in the late third millennium BCE (Majidzadeh, 2003).

The Proto-Elamite Period

The term "Proto Elamite period" refers to one of the key phases in the formation of early polities with indigenous administrative structures in Iran, spanning approximately from the late fourth millennium to the early third millennium BCE. This era is characterized by the emergence and spread of ideographic writing systems, the development of organized administrative frameworks, the art of cylinder seals, and the appearance of signs indicating the earliest local states in southwestern and parts of central Iran (Damerow & Englund, 1989; Pittman, 1997). The designation "Proto Elamite" was first introduced by "Vincent Scheil" to refer to clay tablets bearing ideographic imagery (Scheil, 1905: 60). Although these tablets were initially attributed to an unknown and hypothetical language, subsequent expansion of archaeological research and the discovery of similar finds in areas such as Tepe Sialk (Ghirshman, 1938) broadened the scope of the term, transforming it into a marker for identifying an independent cultural and managerial tradition. This tradition was distinguished by features such as the use of script, the emergence of rudimentary accounting systems, and an efficient bureaucratic apparatus (Englund, 2004; Damerow & Englund, 1989; Dahl, 2012). Recent studies, especially those examining cylinder seals, the structure of documents, and systemic administrative signs, indicate that Proto-Elamite society was not merely influenced by its neighbors but possessed indigenous innovations in writing, economy, and social organization

(Pittman, 1997). This period is often regarded as the connecting link between the era of proto-literate communities in Iran and the formation of larger historical states such as Elam and the eastern civilizations of the Iranian Plateau (Desset, 2018). From a research perspective, one of the most significant legacies of this period is the corpus of economic and administrative texts. Examination of these documents not only illuminates the processes of technological development and script evolution but also contributes to understanding the interactions between the Iranian Plateau and neighboring civilizations at both regional and intra-regional scales (Dahl, 2012). Nevertheless, due to uncertainties in the precise dating of these materials and limitations in the archaeological record, the chronological boundaries and defining features of the Proto-Elamite period remain subjects of specialized scholarly debate. In sum, the "Proto Elamite period" is now recognized as a pivotal turning point in ancient Iran's civilizational trajectory, an age encompassing the rise of local states, the composition of the earliest texts, advanced glyptic art, and the establishment of economic and administrative systems retaining a central place in archaeological research and in studies of the history of writing and bureaucracy in the ancient world.

Morphological Characteristics of the Date Palm

The date palm, belonging to the family "Arecaceae", is a perennial tree with a sturdy, upright stem that can reach a height of up to 25 meters and a diameter of 40 to 50 centimeters. Its trunk is covered with the bases of old leaves and is brown. The tree bears only one terminal bud at its apex, which plays a critical role in the plant's growth and survival (Zargari, 1990). Annual pruning of the dry leaves results in a characteristic decorative pattern on the trunk. Propagation of the date palm occurs via two methods: sexual (from seed) and asexual (through offshoots). Offshoots generally grow at the base of the tree, close to the stem, and play an essential role in commercial production. Depending on the cultivar, some leaf bases remain attached to the trunk throughout the tree's life, while in other cases they weather away over time, leaving the trunk smooth. The crown of a date palm typically comprises about 50 leaves, each up to 4.5 meters in length, although in specific cultivars this number can reach as high as 120 leaves. The leaf axes are relatively rigid and bear narrow filaments up to 40 centimeters long along their length. Between the leaves, conical inflorescence clusters appear, which, after development, form hanging clusters bearing date fruits (Hussain, 1989). Fruit yield and quality depend largely on the ratio of green leaves in the crown to the number of floral clusters. The date palm is a dioecious plant, that is, male and female flowers occur on separate trees. Both male and female inflorescences are cylindrical clusters (spadices) located among the leaves, each with distinct structural and growth patterns. The prophyll

and the scale-like bracts of the clusters contribute to the structural differentiation of the inflorescences. The root system of the date palm consists mainly of adventitious, fibrous roots arising from a zone at the base of the trunk. These roots generally grow to a depth of around 30 centimeters in the soil and can spread laterally over several meters, providing vital stability and water absorption in hot, arid regions.

Pictographic and Semanto-graphic Representations of the Date Palm in Uruk Clay Tablets of the Late Fourth Millennium BCE in Mesopotamia Compared with the Proto-Elamite script, the Proto-Cuneiform writing system, owing to its more clearly traceable trajectory of development toward classical cuneiform, offers greater possibilities for the decipherment and semiotic analysis of vocabulary and symbols (Damerow, 2007). One of the most prominent examples in this regard is the sign listed in the (ZATU) catalogue as number 230. This sign, whose documented evolution from pictographic representation to cuneiform script is well established, is semantically linked to the concept of the "date palm" (Fig. 5). Structural and semantic analysis of this sign not only advances our understanding of the lexical and conceptual framework of Proto Cuneiform texts but also provides a basis for identifying equivalent or cognate signs within the Proto Elamite script. Such comparative work meaningfully deepens our comprehension of agricultural patterns and the management of orchard resources within two parallel writing traditions.

Fig. 5: Sign ZATU 230 from the Uruk III period and its morphological development into cuneiform script in later periods (Paszke, 2019).

Compared with the Proto-Elamite script, Proto-Cuneiform, owing to its more clearly delineated trajectory of development toward classical cuneiform, provides a richer foundation for the decipherment and semiotic analysis of vocabulary and symbols (Damerow, 2007). One notable example in this regard is the group of signs catalogued as (ZATU 230), whose transformation from pictographic imagery to cuneiform writing is thoroughly documented and analyzed, and which, from a semiotic perspective, exhibits a clear connection to the concept of the "date palm" (Green & Nissen, 1987). According to the studies of Green and Nissen (1987), this sign group is divided into two principal types, (ZATU 230a) and (ZATU 230b), both identified in Uruk layers IV and III. The (ZATU 230a) group predominantly represents the entire date palm tree, incorporating morphological elements such as a smooth trunk, a dense crown, vertical or diagonal

lines indicating young or pruned leaves, and occasionally additional lines suggesting upright leaves or pollen (Fig. 6).

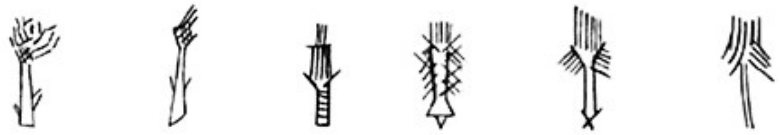


Fig. 6: Grapheme ZATU 230a from the Uruk IV and Uruk III periods (Paszke, 2019).

Attention to the detailed rendering of the trunk, employing lozenge-shaped or zigzag motifs, which are also repeated in Akkadian seals, reflects the artists' sensitivity to the regular pattern of pruned leaves and its codification as a visual convention (Nissen *et al.,* 1993). Furthermore, the conical, triangular, and swollen form of the basal trunk region demonstrates careful observation of the biological features of the date palm and the direct transfer of these characteristics into the sign system, an element visible in both the Proto-Cuneiform and later cuneiform traditions. Conversely, the group of signs classified as (ZATU 230b), with its morphological diversity, indicates a focus on specific organs and parts of the date palm, particularly the inflorescences. These signs generally comprise three principal components: an open inflorescence cluster, an inner fibrous covering, and a short, truncated stalk, which, in specific variants, is accompanied by two split geometric coverings and decorative diagonal lines (Fig. 7).

Fig. 7: Grapheme ZATU 230b from the Uruk IV and Uruk III periods (Paszke, 2019).

The most distinctive feature of this group is the depiction of inflorescences as upright spadices emerging among the palm leaves, with pictographs often shown with a truncated stalk and a bract enclosing the immature inflorescence. This twofold distinction namely, the representation of the entire tree in (ZATU 230a) and of significant biological components such as the inflorescence in (ZATU 230b), not only highlights the scientific and environmental attentiveness of scribes and artists of the period, but also holds fundamental importance for tracing the pictorial origins of the signs and identifying their equivalents in Proto Elamite script. In turn, this serves a crucial role in the analysis of agricultural patterns and orchard resource management within administrative and economic texts (Green & Nissen, 1987; Nissen *et al.,* 1993).

Materials and Methods

This study focuses primarily on the extraction, analysis, and evaluation of script signs associated with the concept of the date palm in texts from the Proto-Elamite period.

First, drawing upon motifs from cylinder seals of the Susa II period, the semiotic and lexical data contained in Proto Cuneiform texts of Uruk IV and III, and comparable Proto Elamite signs from both pictographic and semiotic perspectives, a set of potential date palm-related signs was identified and extracted from the Proto Elamite sign list. Additionally, motifs relating to the date palm from later historical periods were used as comparative resources, thereby creating a contextual basis for the analysis of the signs. In the next stage, to assess the validity of these attributions, the texts in which these signs appear were subjected to rigorous linguistic, semantic, and structural analysis. This was undertaken to evaluate the semantic coherence of the signs within their textual contexts and to examine their potential applications in horticulture and in products derived from the date palm. Based on the results obtained, the preliminary list of proposed date palm-related signs was refined and reduced to those for which sufficient and credible evidence existed regarding their association with agricultural activities, particularly date palm cultivation during the Proto-Elamite period.

In total, twenty-five Proto-Elamite signs and their equivalents in Proto-Cuneiform were examined comparatively to enable the identification of morphological similarities between Proto-Elamite written signs and cognate examples in the Mesopotamian writing system (Fig. 8). This comparative analysis provides insight into how the physical characteristics of the date palm were integrated into the graphic and semantic structures of the signs, thereby establishing a more profound connection among the written records.

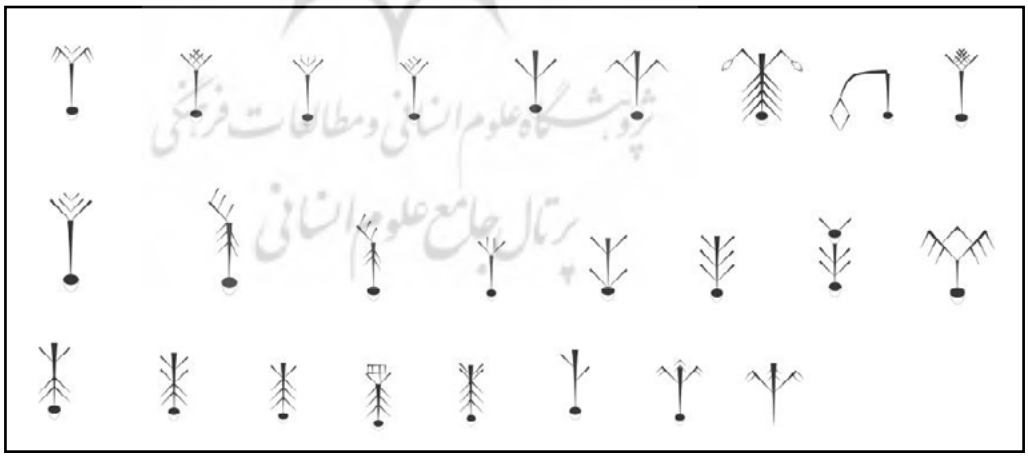


Fig. 8: Proposed Candidate Signs for the Date Palm in the Proto-Elamite Sign List (Authors, 2024).

Following the examination of all date palm-related signs in Proto-Elamite tablets, several fundamental points emerge. First, in all texts in which these signs appear, the numerical system employed is predominantly of the "capacity System". The capacity system, based on volumetric measurement, is specific to the description and accounting of agricultural products and raw materials. Given the nature of agricultural production and its importance within the subsistence economy of the period, the use

of this numerical system reflects a distinct managerial administrative logic. This systematic linkage between script signs and volumetric measurement strengthens the validity of the selected candidate signs for identifying the date palm symbol, as the correlation between numerical data and the accounting logic of orchard products in administrative records reveals both the functional application and the economic value of these commodities. Another notable point is the meaningful proximity and convergence between the signs selected for the date palm and sign (M288). This correlation is significant in terms of textual usage and the position of this sign within the set of symbols associated with agricultural products. Such a correspondence indicates that the process of candidate sign selection and its potential decipherment, based on comparative analysis with cognate signs and interdisciplinary studies, rests on a robust methodological foundation and can effectively trace the lexical and pictorial origins of these symbols. Nevertheless, it must be acknowledged that many Proto-Elamite signs remain only partially identified or undeciphered, and the overall script system still requires further comprehensive research. Accordingly, from among the proposed signs, four signs (M088, M077, M086, and M075~g), which exhibit the highest degree of graphic, semantic, and textual affinity with the concept of the date palm, were selected for deeper contextual and content analysis. Evaluating these signs not only clarifies the place of the date palm within the Proto-Elamite economic administrative system, but also facilitates a more precise reconstruction of the processes by which symbolic language and orchard accounting practices emerged in southwestern Iran during the late fourth millennium BCE (Fig. 9).

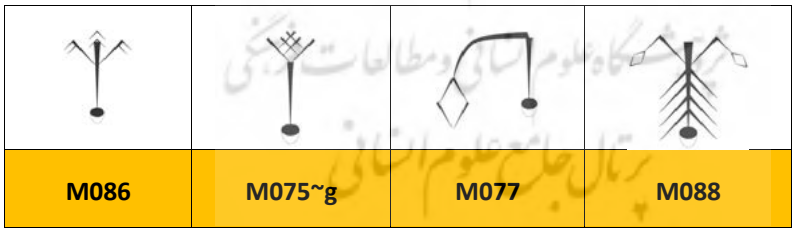


Fig. 9: Four selected Proto-Elamite signs exhibiting the highest graphic and semantic similarity to the concept of the date palm (Authors, 2024).

Pictorial Indicators of Date Palm Motifs in Proto-Elamite Signs

To identify the date palm in Proto-Elamite script signs, it is necessary to display all signs in their natural orientation, rotated 90° to the right, which contrasts with the conventional writing direction of Proto-Elamite. The study of these signs, based on the Proto-Elamite Sign List published by Jacob Dahl (Cuneiform Digital Library Initiative), was re-examined and analyzed in detail. From among the Proto-Elamite signs in Dahl's list, sign (M088), () clearly corresponds morphologically to the date palm. This sign depicts the upright trunk of the palm together with two short broken lines,

likely indicating either the outer crown boundary or fruit clusters extending laterally. Graphically, it shows the closest resemblance to sure signs, ( )and ( ) from the subgroup (ZATU 320a) dating to Uruk III and IV. A significant diagnostic feature of the date palm is its root system.

Because the palm's roots are shallow, they appear as a swollen mass at the base of the trunk, a trait consistently represented in all Proto Cuneiform variants as two short intersecting lines connected to the tree trunk, ( ), and in Proto Elamite signs associated with the date palm as a corresponding graphic form attached to the lower end of the trunk ( ). The palm trunk itself in both writing systems follows the same pattern: diagonal strokes slanting upward or downward connected to the trunk, seen in Proto Cuneiform signs (, ,) and in Proto Elamite signs (,), suggesting older leaves. In Proto Cuneiform pictographs, the crown of the tree is rendered as two diverging diagonal lines filled with interior strokes reminiscent of crown leaves (,), whereas in the Proto Elamite signs the early forms emphasize two hanging clusters of date fruits ( ). In later Proto Elamite examples, the crown is depicted similarly to Proto Cuneiform ( ). Indeed, this graphic modification has enabled the recognition of other forms and meanings of Proto-Elamite pictographs in later exemplars (Fig. 10).

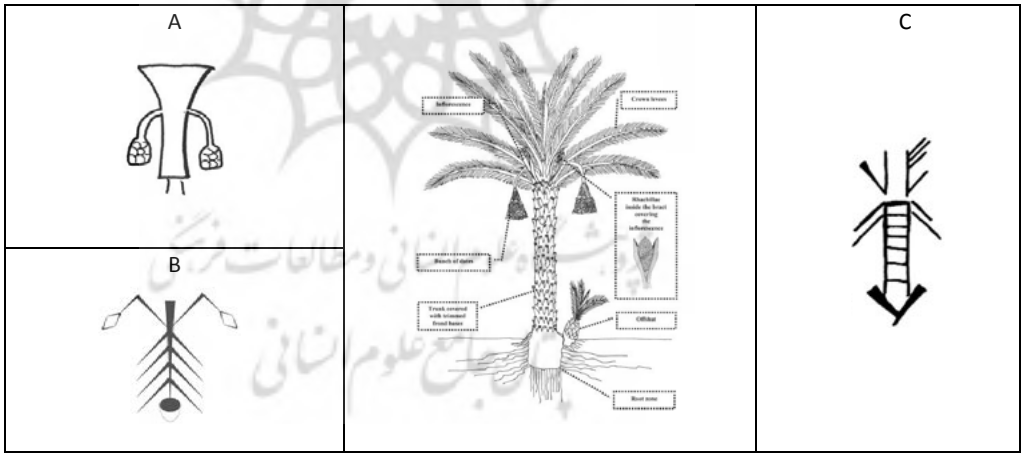


Fig. 10: Morphological features of the date palm and their comparison with graphical date palm signs in the A) Proto Elamite Seal Impressions, B) Proto Elamite scripts and C) Proto Cuneiform Sign list (Authors, 2024).

In the variants associated with sign (M088), the swollen root section is included in almost all examples. It constitutes one of the primary criteria for identifying date palm-related signs within the Proto-Elamite sign list. The variation in forms attributed to the date palm reflects a gradual process of standardization and graphic simplification of the signs over time, such that the distinctive and diagnostic swollen root element has been preserved as a key feature in all subsequent variants. This pattern underscores the role and importance of representing the morphological characteristics of the date palm in the conceptual framework of Proto-Elamite scribes, as well as their efforts to achieve

greater compatibility between the pictograph and its intended concepts. The continued use of the swollen root element in these signs may further reflect functional, visual, and semantic considerations in the scribal strategy, whereby, in transitioning beyond the initial stage, scribes sought to optimize and enhance the efficiency of the Proto-Elamite writing system.

Semantic Signs Attributed to the Date Palm in the Proto-Elamite Period

Sign M088 ( )

In this tablet (MDP 17, 066), the pictorial sign (M088) corresponds to the date palm, depicted by means of short diagonal strokes forming a segmented trunk, with branches protruding from it (Scheil, 1923; MDP 17, 66). Based on the corpus of Proto-Elamite texts, only one tablet has been identified that contains this sign. Archaeologists have generally attributed this sign to the date palm; however, no dedicated study has yet been conducted specifically on this sign, and the attribution has so far relied primarily on its visual similarity to the form of the date palm tree (Dahl, 2009; Kelley, 2024; Palarde, 2022). Given the tablet's physical form and script style, it belongs among the earliest examples within the Proto-Elamite textual record. Comprehensive analysis of this corpus indicates that the sign in question does not recur in other contemporary texts. Such evidence suggests that, during the transformation and transmission of the writing system, scribes tended to simplify and abstract signs, eventually producing simpler forms and multiple variants derived from the original (Fig. 11).

Image	Drawing	Transliteration
		Obverse 1. Mx, M088, 1(N30D) 2. |M136+M365|, M088 ,1(N30D) Reverse Top 1. 1(N34)#

Fig. 11: Pictographic sign M088 on clay tablet MDP 17, 066, depicting a date palm with short, slanted lines and branches protruding from the trunk, one of the few documented instances of this symbol in Proto-Elamite texts (Scheil, 1923), Image courtesy of the Cuneiform Digital Library Initiative (CDLI), (Drawing and Transliteration by: Authors, 2024).

This tablet, due to its simple structure and limited use of signs, can serve as a baseline for a better understanding of texts related to horticulture and agriculture, particularly in identifying the date-palm sign. In the present text, two independent entries are identified, each bearing its own separate heading. It appears that, in each entry, the

first sign plays a decisive role in defining and explaining the second sign from the perspective of ownership. This assumption is reinforced by the fact that, in the second entry, the hairy triangle sign (M136+M365), ( ) precedes the mention of the date palm sign (M088). In both entries, the numerical valuation of the sign (M088) with the numerical sign (N30D), ( ), has been carried out within the capacity-counting system (Capacity System C). One noteworthy feature of this tablet is the absence of capacity signs such as (M288) for harvested products or for other derivatives of the tree. In this text, the scribe, instead of using a separate sign for the product, has taken the tree sign itself as the basis for measuring and assessing the yield. This approach not only reflects the primitive and simplified nature of the text's writing system but also shows that, at this stage in the evolution of writing, no clear distinction had yet been made between the source (tree) and the harvested product, something that, in later texts, evolved with the addition of intermediary signs to separate these concepts. Another critical point is that the aim of this record was not to count the trees themselves; if that had been the case, the counting system would have used a different model and employed symbols appropriate for enumerating individual entities. In the current text, however, a capacity-based numerical system is used for valuation, a system mainly employed to calculate and record quantities of consumable products such as cereals (Fig. 12). This probably indicates that the focus of the record was more on the amount of product harvested from each tree or collection of trees, rather than on counting the trees themselves. Overall, the structure and recording method in this tablet provide valuable grounds for studying the early stages in the emergence of a form of agricultural accounting thought, as well as how scribes in the Proto-Elamite period abstracted and conceptualized resources and products. Analyzing such texts significantly contributes to our understanding of the development of written language, the process of sign simplification, and the formation of specialized recording systems in Proto-Elamite economic documents.

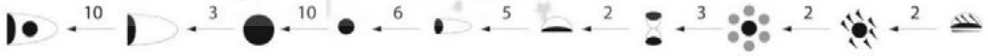


Fig. 12: Structure of the capacity numerical system (Capacity System C) as recorded on clay tablet MDP 17, 066 (Authors, 2024).

Sign M077 ( )

In this tablet (MDP 17, 406), the pictorial sign (M077) is presented as a sign of the date palm. The sign is drawn with a broken, asymmetrical line and depicts a drooping branch extending downward from the top of the palm's trunk (Scheil, 1923). One notable element of this pictograph is the presence of a root knot connected to the trunk; a feature also observed in other signs associated with the date palm, an element likely reflecting a more naturalistic image of the plant in the scribe's mind. Based on the corpus of Proto-Elamite texts, only one tablet has so far been identified that contains the sign (M077). In

terms of the tablet's morphology and writing style, this text belongs among the earliest examples of Proto-Elamite writing and, as such, holds particular significance for the study of sign evolution and the writing system of this period. Examination of the limited and unique occurrence of this sign indicates that, in the course of Proto-Elamite script transformation, writing style and the use of symbols were subject to a trend toward simplification and abstraction. It appears that the initial complexities of certain pictorial signs gradually gave way to simpler and more abstract forms, thereby allowing scribes to record information more quickly and efficiently (Fig. 13).

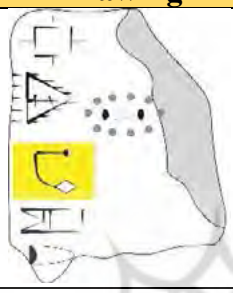
Image	Drawing	Transliteration
		obverse 1. M195#, M136~i *header* 2 M077, M288#, 1(N01) 3. M387~l#?, [...] *rest broken*

Fig. 13: Depiction of pictographic sign M077 on clay tablet MDP 17, 406, representing a rare instance of date palm symbolism characterized by an asymmetrical form, a drooping branch, and a root knot motif (Scheil, 1923), Image courtesy of the Cuneiform Digital Library Initiative (CDLI), (Drawing and Transliteration by: Authors, 2024).

This tablet, due to its simple structure and basic writing elements, belongs among the earliest examples of agricultural texts related to the date palm. However, compared with the previous example, it exhibits greater complexity, as evidenced by the presence of a heading and the recording of at least two distinct entries, indicating the beginnings of administrative organization within agricultural texts. The header of this tablet appears as a binary combination of the signs (M195#, M136~i), (,), a pairing recognized in the Proto-Elamite sign lexicon as a recurrent combination that seems to have held a specific semantic or functional role in classifying or thematically organizing texts. In the first entry, a new, simplified sign relative to (M088) is employed, consisting of a root, a trunk, and a drooping date-palm branch (M077). This choice of sign clearly reflects scribal tendencies toward abstraction and simplification of plant motifs, aligning them with the increasing demands of the economic recording system. One particularly significant feature of this text is the use of one of the variants of the sign (M288), ( ) a sign associated explicitly with a container for storing or holding agricultural products. In Proto-Elamite accounting practice, this sign denotes the use of the capacity-counting system, a method by which the quantity of product is determined not as an absolute number but according to the volume or capacity of the container. On this tablet, the sign (M288) occurs in conjunction with the numeral (1N01), representing the measurement of product quantity using a defined unit of container capacity. However, the nature and size of this unit remain unknown.

Of the second entry, only the sign (M387~l), ( ) survives, and the breakage in the text renders it unreadable and unanalyzable. Among Proto-Elamite tablets, a total of 41 examples explicitly contain the sign (M387~l). Structural analysis of these tablets shows that this sign is directly associated with signs which, based on this study, very likely refer to "date palm" or to one of its related derivatives. This semantic association arises not only from the co-occurrence of these signs side by side, but also from the fact that in most analyzed tablets (M387~l) appears consistently in combination or proximity with other proposed signs linked to the concept of the date palm (such as M077, or different combinations indicating species, parts, or products of the palm). This systematic repetition suggests that (M387~l) likely refers to a product, production process, or specific economic activity directly connected to the date palm. Therefore, inter-sign analysis and the observed frequency of co-occurrences reinforce the probable special role of this symbol within the financial and administrative system of the early writing stage in relation to date-palm products. This aspect can guide future research in interpreting the meanings and functions of similar signs. Overall, this tablet, in addition to being a valuable example for analyzing the process of simplification and standardization of agricultural signs in the Proto-Elamite period, provides a clear picture of the early phases in the formation of administrative and economic systems based on the qualitative and quantitative recording of products.

Sign M086 ( )

The sign (M086), which textual and comparative evidence suggest was probably used as a sign for the date palm, appears in five tablet examples (MDP 06, 222; MDP 17, 292; MDP 26, 020; MDP 26S, 4786; TCL 32, 035), (Scheil, 1905; 1923; 1935; Dahl, 2019). This sign displays a marked similarity to (M088), with the essential differences that, in(M086), the drooping date clusters are not depicted as diamonds; instead, the palm tree crown is prominently added above the trunk, and the diagonal lines on the trunk, observed in (M088), are omitted here. Nevertheless, the tree's root, which in earlier pictographs is usually rendered as a swollen mass at the base of the trunk, is still preserved in the new sign. This semiotic continuity allows tracing the gradual evolution of date-palm symbolism in the Proto-Elamite script. Moreover, given the tablet's morphological structure and script style, this example belongs among the later texts of the Proto-Elamite period. This feature is of particular research value, as it enables not only the analysis of graphic changes and the overall sign structure, but also the study of how these tablets reflect the progressive standardization of signs and the gradual shift of visual elements from pictograph to symbol within the Proto-Elamite writing system. The chronological position of this example toward the end of the period indicates that the link between the date palm sign and the writing system was grounded not only in

picto-ideogram and aesthetic features, but also in the communicative and accounting needs of that era. Therefore, a detailed examination of the components and subtle distinctions of this sign, alongside analysis of the archaeological and economic context of these tablets, can yield valuable information about the integration of indigenous cultural elements with the functional requirements of early administrative organization in Iran, as embodied in the structure of the Proto-Elamite script (Fig. 14).

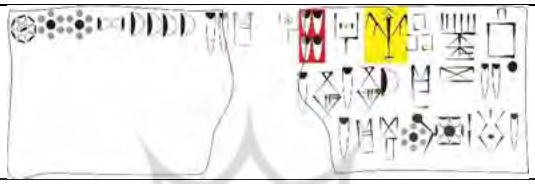
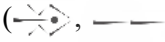
IMAGE	
DRAWING	
Transliteration	Obverse 1.M157~a, (*header*) 2. M038~i? M141 M086 |M036+1(N24)| , 4(N01), 3. |M036+1(N30C)| , 1(N14) 2(N01), 4. M140~a M288, 1(N39B), 5. M262~b, 1(N01), 6. M262~ba, 1(N01)#, 7. […], 1(N01), 8. M248~a M002, 1(N30D), 9. M343~h, 1(N30C), 10. M037 M288, 1(N01) 1(N39B)# Reverse 1. M288, 1(N14) 5(N01) 4(N39B) 1(N24) 2(N30C) 1(N30D)

Fig. 14: Representation of sign M086 on tablet MDP 26S, 4786, illustrating the gradual transformation of the date palm depiction within the Proto-Elamite script structure, marked by the omission of the trunk's diagonal lines, emphasis on the tree crown, and the retention of the root element (Scheil, 1923), Image courtesy of the Cuneiform Digital Library Initiative (CDLI), (Drawing and Transliteration by: Authors, 2024).

This tablet contains a heading and several distinct accounting entries, each of which appears to relate to a process or unit within the production of dates. For each row, except for the second entry following the main header, the numerical system employed is the capacity system (Capacity System C), which typically denotes the amount of product or an agricultural accounting unit. The numerals are generally expressed in capacity format (N01, N14, N30C, N39B, N24, N30D), indicating varying volumes or weights. The total quantity for all entries except the first is recorded, on the reverse of the tablet, most likely with the sign (M288) or one of its variants. The heading in this text is (M157~a), one of the most well-known signs in Proto Elamite texts, generally attributed to an economic or familial unit under whose supervision the recorded economic activity was conducted. The first entry begins with a sequence of four signs (M038~i? M141 M086 |M036+1(N24)|), which, in combination, appear to represent the primary subject of the accounting and auditing activity. This four-sign chain is defined by (4N01). Given the presence of (M086) in this sequence, this entry probably records four date-palm trees, counted using a different numerical system from the capacity system. The second entry

employs the composite sign (M036+1(N30C)), (), which is probably associated with a portion of the harvest or the secondary processing of date palm products. The recorded amounts (2N01, 1N14) are in the capacity numerical system. The third entry begins with the combination (M140~a M288), (). The sign M288 is among the most recognized and frequently used signs in the Proto-Elamite lexicon; in most cases, it denotes a container for cereals and agricultural products, and also functions as a unit of measure for the disbursement of rations (Dahl *et al.*, 2018). This combination is quantified by the numeral (1N39B) using the volumetric numerical system. In the fourth recorded entry, the sign (M262~b), () is used, valued at (1N01). The fifth entry contains the sign (M262~ba), () probably recorded with (1N01), and likely refers to a product similar to the previous entry but with minor details. In the sixth entry, the product type sign falls within a broken portion of the tablet, with only its numerical valuation (1N01) preserved in the following line. The seventh entry combines (M248~a M002), (), and is probably related to a portion of the harvest or secondary processing of date-palm produce; the amount recorded is (1N30D) in the capacity system. The eighth entry, consisting solely of (M343~h), ( ) appears in the last row and is quantified as (1N30C), (). The final recorded row uses the composite (M037 M288) sign, valued at (1N39B, 1N01)#.

On the reverse of the tablet, all entries recording products, likely derived from date palms, are probably consolidated under the sign (M288), totaling (2(N01) 4(N39B) 1(N24) 2(N30C) 1(N30D)). The unification of multiple distinct signs, each bearing quantitative values, into a single comprehensive sign (M288) on the reverse reflects a simplifying, standardized approach within the Proto-Elamite accounting system. This approach demonstrates, on the one hand, a tendency to employ diverse signs in the detailed recording of production processes, and, on the other hand, a practice whereby, during final aggregation and administrative verification, the total production or end product is registered under a general, overarching sign. This indicates an accounting perspective in which detail matters only at the production stage, while in the final report, only the total quantity and overall valuation are deemed sufficient. Such a pattern itself signals the existence of a rudimentary yet efficient accounting system in the agricultural and horticultural economy of the Proto-Elamite period.

In its first entry, this tablet records four date-palm trees; this number corresponds to four units (N01) and is understood as the initial capital or primary asset (i.e., the number of trees). In the subsequent rows, rather than counting trees, the entries record only the amount of product harvested from these trees, expressed in various numerical units. When the first row (4N01) is excluded from calculations, and only the product-related rows are considered, the total quantity recorded on the tablet, converted to the base

numerical value (N01), equals (12.6N01), (8+0.2+1+1+1+0.06+0.13+1.2=12.60 N01). On the reverse of the tablet, considering the first broken section, the total is (3.0665 N01), which likely represents the lost values (1N14) and (5N01). If these amounts are added, the total quantities from the obverse and reverse of the tablet become nearly identical (6+5+0.8+0.4+0.2667+0.0667=12.5334 N01). This close numerical correspondence between the totals from the reverse and obverse after removing the count of four trees clearly shows that the structure of the text rests on distinguishing capital (trees) from yield (product), with all recorded data organized accordingly. Such numerical harmony strengthens the validity of the initial hypothesis: namely, that this tablet is an account that first records the number of date-palm trees as the orchard's asset, then, separately and precisely, reports the harvest from those same trees. By removing the asset quantity (trees), the sums of the product measures on the obverse and reverse match almost exactly, thereby confirming the accuracy of both the quantitative and interpretive analyses of the text. This is clear evidence of a rudimentary yet systematic accounting framework in the Proto-Elamite period, one in which a deliberate and precise distinction is maintained between the base asset (trees) and the economic yield (product).

Sign M075~g ( )

The sign (M075~g), which was probably used as a sign for the date palm, appears in ten tablets (MDP 06, 217; MDP 06, 5009; MDP 17, 051; MDP 26, 071; MDP 26, 229; MDP 26, 273; MDP 26, 349; MDP 26, 415; MDP 26, 419; MDP 26S, 5227), (Scheil, 1905; 1923; 1935). This sign shows a strong resemblance to (M086), differing only in lacking the drooping date clusters; instead, the palm tree's crown is rendered with intersecting hatching. Nevertheless, the tree's root, depicted as a swollen mass in earlier examples, remains visible in this sign as well (Fig. 15). In terms of tablet morphology and writing

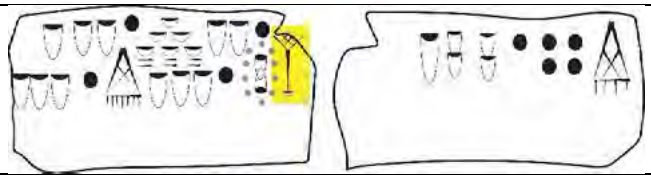
Image	
Drawing	
Transliteration	Obverse: 1. M075~g#, 1(N14) 2(N01), 2. M384~ab, 1(N14) 3(N01) 3. M387~l, 1(N14) 3(N01), 4. M122, 1(N14) 3(N01) Reverse;1. M122#, 5(N14) 5(N01)

Fig. 15: Sign M075~g on tablet MDP 26, 419, exemplifying the depiction of the date palm with a hatched crown and the omission of hanging clusters, featuring a prominently rendered root element (Scheil, 1935), Image courtesy of the Cuneiform Digital Library Initiative (CDLI), (Drawing and Transliteration by: Authors, 2024).

style, examples featuring this sign occur in both early and later forms of Proto-Elamite tablets. This makes (M075~g) especially important for the study of signs related to the date palm and the semantic system of the period. In the following section, two selected tablets containing (M075~g) are examined, each providing distinctive information for analysis.

This tablet, based on its structure and writing style, belongs to the early texts of the Proto-Elamite period. The text lacks a heading and comprises four entry records, each associated with specific numerical values expressed in accordance with the Capacity System C, with the total recorded on the reverse. In the first entry, the sign (M075~g), most likely representing the date palm, is given. Following this sign are two numerical values: (1N14) and (2N01). This entry appears to refer to a specific share or product from the date palm with defined quantities that have been formally recorded in the administrative system. The second entry contains the well-known sign (M384~ab), depicted in classical proto-Elamite seal impressions. This sign occurs in thirteen Proto-Elamite tablets: in five instances as a heading, in seven cases as one of the recorded entries, and in a single case as the totalizing sign on a tablet's reverse. Symbolically, this may indicate either a distinct figure/persona or a type of product, possibly linked to the date palm. Alongside it appear the common numerical combinations (1N14) and (3N01), which conform to standard capacity notation for product or receipt recording. This suggests a potential diversity of product types or differentiated roles in harvest/ownership, each accounted for separately. The third entry follows a similar numerical combination to the second but begins with the sign (M387~l), ( ). This change in sign likely indicates a specific secondary product type, one that is habitually correlated with variants of the date-palm sign. The fourth entry features the sign (M122), ( ) as the recorded subject, with the same numerical combination as the second and third entries: (1N14) plus (3N01). This likely represents either a more general product category or a grouped share intended for a larger administrative objective than those in previous lines. On the tablet's reverse, there is only one line. In this line, the sign (M122#) probably functions as a summarizing or totalizing marker for all quantities recorded on the obverse. The total calculated is five units (N14), equivalent to thirty units (N01), plus an additional five units (N01), yielding a total of thirty-five units (N01). According to the capacity numerical system, the value of each N14 equals six units (N01), (i.e., each N14 = 6 N01), while N01 equals one unit (N01). In the first entry, one-unit (N14) equals six units (N01); adding two units (N01) results in a total of eight units (N01). In the second entry, one unit (N14), (six units N01) plus three units (N01) gives a total of nine units (N01). The third entry has the same numerical combination and thus also totals nine units (N01). The fourth entry, with one unit (N14) plus three

units (N01), again sums to nine units (N01). The aggregate quantity recorded on the obverse, therefore, is exactly thirty-five units (N01), perfectly matching the total on the reverse. This numerical correspondence demonstrates the precision and rationality of the Proto-Elamite accounting system, as well as the rigorous application of closing and balancing procedures. Such accuracy reflects the structured nature of administrative control and resource allocation within this system. Within the documentary structure of the present tablet, it is observed that on the reverse, all recorded data are consolidated under the sign (M122). This method of aggregation reflects a unified accounting approach based on the standardization of quantitative entries. Regardless of the variety of signs employed on the obverse, all are gathered and registered under a single sign on the reverse. Given that (M075~g), according to current comparative studies and available sources, is a strong candidate for representing the date palm tree, it follows that all other signs used in the front side rows of the tablet are likewise in some way connected to the products or derivatives of the date palm. This assumption gains further validity when considering that the numerical system employed is capacity-based (Capacity System C), a format in which subsidiary and primarily economic products, ranging from fruits and sap to other date palm derivatives, were consistently recorded using capacity measures. Consequently, the presence of multiple distinct signs in the obverse entries indicates not merely a diversity of product types; instead, it suggests a classification of secondary products, different exploitation processes, or possibly various stages of production associated with the date palm tree. All these datasets, from a managerial and economically focused perspective, are brought together on the reverse beneath the overarching sign (M122) as the general total for the product or overall yield.

This logic not only demonstrates the precision and efficiency of the Proto-Elamite accounting system but also reveals the deep understanding of the era's administrators regarding the principles of standardization, categorization, and data consolidation in agricultural management, a factor holding a key position in the evolution of auditing and administrative systems in the early civilizations of the Iranian Plateau. Building on the examination of signs associated with the depiction of the date palm in Proto-Elamite administrative tablets, the present example represents another stage in the graphic transformation of this motif. The preceding analysis of sign (M075~g) demonstrated that the omission of drooping fruit clusters and the adoption of a hatched crown, combined with the retention of the root component, formed part of a broader trend toward simplification and functionalization of the date palm motif within the writing system. The new tablet, through its distinctive combination or variation of these elements, not only reflects the continuity of the pictorial tradition but also incorporates evidence of stylistic diversity, possibly linked to administrative or regional differences.

This diversity provides an essential basis for assessing the relationship between writing styles and administrative functions, and it contributes to reconstructing the internal logic of the sign system in the Proto-Elamite period.

Sign M075~g ( )

The header of this tablet consists of a combination of the sign (M218 + M218), ( ) rendered in double form within a lined (bordered) frame. As in many Proto-Elamite tablets, this section probably functions as the sign of an owner or family responsible for the recorded entries, serving as an identifier for the type of document or, perhaps, the thematic domain of the subsequent records. It contains no numerals and has no direct computational role, but it plays a decisive part in defining the tablet's classification (Fig. 16).

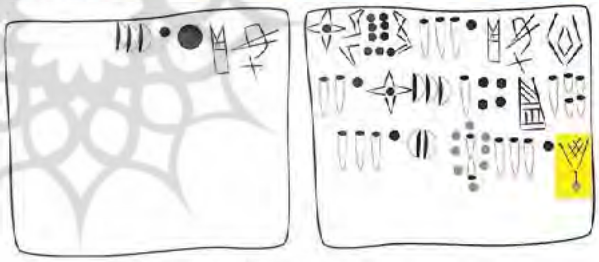
Image	
Drawing	
Transliteration	Obverse: 1. |M218+M218|, *header,* 2. M056~f M288, 1(N14) 3(N01), 3. |M054+M384~i+M054~i| M365, 5(N01) 4. M111~e, 4(N14) 1(N01) 3(N39B), 5. M365, 1(N14) 3(N01), 6. M075~g, 1(N14) 3(N01), 7. M387~l M348, 1(N14) 3(N01) Reverse: 1. M056~f M288, 1(N45) 1(N14)# 3(N39B)

Fig. 16: Sign M075~g on tablet MDP 6, 217, exemplifying the depiction of the date palm with a hatched crown and the omission of hanging clusters, featuring a prominently rendered root element (Scheil, 1905), Image courtesy of the Cuneiform Digital Library Initiative (CDLI), (Drawing and Transliteration by: Authors, 2024).

In the second entry, a combination of two signs (M056~f + M288), (,) appears, which may represent a specific product or a particular segment of production or exploitation. The sign (M056) is one of the symbols frequently used in Proto-Elamite tablets and was first identified by Meriggio in 1974 (Meriggi, 1974). This sign closely resembles the (APIN) sign of Proto Cuneiform and the Babylonian word (epinnu), meaning "to plough" (Green & Nissen, 1987). It derives from a traditional agricultural implement, the plough, which is still used in some local communities today. The subsequent use of (M288) refers to a container used to store or hold agricultural

products. In the Proto-Elamite accounting tradition, (M288) implies the application of the capacity-based counting system. This method expresses product quantities not as absolute numbers but in terms of the container's volume or capacity. Immediately following this combination, numerical values (1N01) and (3N14) are entered, indicating a record of part of the product or receipt according to the capacity system. The third entry contains a complex chain of combined signs (|M054 + M384~i + M054~i| M365), (), which probably denotes a product or a subordinate process connected to the production chain introduced in the heading of the first row. This entry is quantitatively valued at (5N01), indicating the recorded amount of a product. In the fourth entry, the individual sign (M111~e), () is recorded, followed by a detailed numerical combination ((4N14), (1N01), (3N39B)), which likely represents a more specific categorization of the product or possibly denotes quotas or minor allocation estimates. The fifth recorded entry consists of the standalone sign (M365 ), with its quantity following the same pattern ((1N14), (3N01)) that is often encountered in similar rows of Proto Elamite texts. In this row, the key sign (M075~g), (), previously introduced as a strong candidate for the date palm, appears together with its standard numerical combination (1(N14) 3(N01)).

The presence of this sign, alongside other signs related to agricultural activity, reinforces the diversity of products and associated derivatives. In the final line, a combined sequence of two signs (M387~l + M348), () is recorded; this combination has a direct correlation with known variants associated with the date palm tree. On the reverse of the tablet, the same sign combination found in the second row of the obverse, (M056~f M288), () is repeated, this time serving a summarizing and concluding role. To evaluate the degree of correspondence and integration between the numerical values recorded on the obverse and the aggregated total inscribed on the reverse, careful attention to the internal metrical logic and the chain of equivalences in the numeration system of the Proto-Elamite period is essential. Within the value structure of the capacity-based numerical system, all amounts can be converted back into the base unit (N01): each unit (N39b) equals one-fifth (N01), each unit (N14) equals six (N01), and each unit (N45) equals sixty (N01). Applying these equivalences, the algebraic sum of the obverse entries can be calculated, resulting in a total of (66.6 N01). On the reverse side, the final aggregated value is presented as a combination of (1 N45, 1 N14, 3 N39b), which, when each is converted into the N01 unit, also totals (66.6 N01). This precise numerical equivalence between the detailed line-by-line entries on the obverse and the consolidated figure on the reverse clearly demonstrates accounting consistency, adherence to the logic of capacity measurement, and the absence of any error or contradiction in the numerical record of this Proto-Elamite text. In other words,

this exact correspondence reflects managerial accuracy and the operational efficiency of the administrative system of the period. In this tablet, a step-by-step differentiation and documentation of products or items from the primary branch of farming and horticulture can be observed. Each line, marked by a specific sign and capacity value, records a segment of the production or exploitation flow in positive form. The key feature of this model lies in the final aggregation on the reverse of the tablet, where specific entries from the obverse are repeated verbatim, and the sums match precisely with the final reverse side total.

Conclusion

Archaeological evidence indicates that human exploitation of wild date palm fruit in the Middle East has a very ancient history, extending back to the sixth and fifth millennia BCE. However, conclusive proof of organized horticulture and dedicated date-palm plantations has, until recently, relied mainly on hypotheses and limited datasets from Mesopotamia and southern Iraq, with no definitive documentation for Susa and southwestern Iran. Moreover, the incomplete decipherment of the Proto-Elamite script and the scarcity of textual evidence have also restricted our understanding of the agricultural culture, economic system, and subsistence structure of this society in the fourth millennium BCE. This study, through a comparative and semiotic analysis of several Proto-Elamite tablets, including those containing the signs (M088, M077, M086, and M075~g) in their accounting contexts, has taken an essential step toward reconstructing an overlooked chapter in the agricultural economic history of southwestern Iran. The signs under consideration, previously unexamined or assumed to be only hypothetically linked to the date palm tree and its related products, were carefully evaluated using morphological criteria, comparison with graphic motifs, and cross-reference to Proto Cuneiform signs from Mesopotamia, as well as artistic evidence such as seal impressions from Susa and Chogha Mish. The conducted analyses demonstrate that features such as trunk curvature, the arrangement of fronds in a shoulder-like pattern, and the representation of the tree crown closely correspond to the phenotypic characteristics of the date palm and its artistic depiction in the proto-historic Iranian tradition. The recurrent presence of these signs in tablets, especially within a standardized capacity-based accounting system, provides strong evidence for the existence of a managed structure for the exploitation, allocation, and distribution of date palm products and their derivatives. A comprehensive examination and numerical calculation of line-by-line entries in the studied tablets, along with the recording of final totals on some tablet reverses, confirm the coherence and maturity of bureaucratic and accounting practices during this period. The significance of this achievement lies

in the fact that, for the first time, it is possible to speak of a precise accounting system employing dedicated signs for specific agricultural products, such as dates, in Susa. These findings reveal that Susa not only kept pace with Mesopotamian innovations in this domain but also possessed its own distinctive managerial and supervisory model for documenting production, ownership, and consumption of date products. In addition to affirming the advanced level of economic organization in Susa during the Proto-Elamite period, they open new horizons for research into ancient agriculture, food resource management, and administrative mechanisms in protohistoric Iran. Indeed, identifying and introducing the signs (M088, M077, M086, M075~g) as written reflections of the date palm within the semiotic corpus of Proto-Elamite not only broadened the scope of tablet analysis but also opened a new avenue for reconstructing the region's horticultural system and subsistence economy. The key point is that documenting these pictorial signs and incorporating them into scholarly study is a significant step toward recovering the date palm's role as one of the pillars of agriculture and the economy in southwestern Iran in the late fourth millennium BCE. The continuation of comparative and semiotic analyses in this field will undoubtedly lead to a more precise and scientifically grounded reconstruction of Iran's administrative and agricultural systems and of Susa's pioneering role in the history of Iranian civilization.

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Author Contributions

All authors contributed equally to the writing of this article.

Conflict of Interests

The authors declare no conflict of interests.

Endnote

1. For extensive discussions on plant domestication see: Riehl, 2012; 2013; Takahashi, 1995.

2. The term ZATU in studies of proto-cuneiform signs refers to an early system for classifying and coding signs, derived from the German phrase "Zeichen aus Tafeln Uruk" meaning "Signs from the Tablets of Uruk". This system was first employed in the works of scholars such as Falkenstein and Damerow, and its primary purpose was to facilitate the identification and referencing of signs found on texts from Late Fourth Millennium BCE Uruk and Mesopotamia, many of which lack a definitive phonetic reading or clear meaning (Nissen et al., 1993). Within this framework, each sign is designated by a specific number, for instance, (ZATU 659), so that cross-referencing and comparison among inventories, glossaries, and various texts become possible. Although more comprehensive classification systems such as the CDLI have become prevalent in contemporary research, the ZATU system still retains its significance in preliminary, historical, and classical studies as a foundational reference tool.

References

- Amiet, P., (1980). "The Mythological Repertory in Cylinder Seals of the Agade Period (c. 2335-2155 B.C.)". *Ancient Art in Seals,* 35–59. https://cdli.earth/publications/1776208

- Burrows, E., (1935). Ur Excavations Texts. II: Archaic Texts. British museum.

- Dahl, J. L. (2019). *Tablettes et fragments proto-élamites = Proto-elamite tablets and fragments*. Éditions Khéops, Louvre éditions. https://cdli.earth/publications/148123?artifacts%5Bsort%5D=Periods.period&artifacts%5Bdirection%5D=asc

- Dahl J., Hawkins L. & Kelley, K., (2018) Labor Administration in Proto-Elamite Iran, in: A. Garcia-Ventura (éd), *What's in a Name? Terminology related to the Work Force and Job Categories in the Ancient Near East* [Alter Orient und Altes Testament Band 440], Münster, Ugarit-Verlag, 15-44. https://ocb.uni-tuebingen.de/Record/KEI00131843?lng=de#details

- Dahl, J. L., (2005). "Complex Graphemes in Proto-Elamite". *Cuneiform Digital Library Journal,* 2005(3): https://cdli.earth/articles/cdlj/2005-3

- Dahl, J. L., (2009). "Early writing in Iran, a reappraisal". *Iran,* 47(1): 23-31. https://doi.org/10.1080/05786967.2009.11864757

- Dahl, J. L., (2012). "The marks of early writing". *Iran,* 50 (1): 1-11. https://doi.org/10.1080/05786967.2012.11834709

- Damerow, P., (2007). "The material culture of calculation (A Theoretical Framework for a Historical Epistemology of the Concept of Number)". In: Gellert, U. & Jablonka, E., (pp. 19-56), *Mathematisation and demathematisation: Social, philosophical and educational ramifications,* BRILL. https://doi.org/10.1163/9789460911439_003

- Damerow, P. & Englund, R. K., (1989). "The proto-Elamite texts from Tepe Yahya. American School of Prehistoric Research". Cambridge, MA: Peabody Museum of Archaeology and Ethnology, Harvard University. http://catalogue.bnf.fr/ark:/12148/cb35565589b

- Desset, F., (2018). "Linear Elamite Writing". In: Álvarez-Mon, Javier, Gian Pietro Basello, and Yasmina Wicks, eds. (pp. 397-415), *The Elamite world,* Routledge. https://doi.org/10.4324/9781315658032-21

- Dowson, V. H. W., (1923). *The varieties of date palms of the Shatt Al'Arab.* Printed and published for the Agricultural Directorate of Iraq by W. Heffer & Sons.

- Englund, R., (2004). "The state of decipherment of Proto-Elamite". In: S. Houston (Ed.), (pp. 100–149), *The first writing*: Script invention as history and process. https://cdli.earth/files-up/publications/englund2004c.pdf

- Farhadi, M., (1996). "Museums in Wind: Introducing the Vast New - Found Rock Engravings of Teimareh". *Social Sciences*, 4(7.8): 13-61. DOR: 20.1001.1.17351162.1374.4.7.8.1.7.6 (In Persian).

- Fügert, A. & Gries, H., (2020). "'I had baked bricks glazed in lapis lazuli color' – A Brief History of Glazed Bricks in the Ancient Near East". In: A. Fügert & H. Gries (Eds.), *Glazed Brick Decoration in the Ancient Near East: Proceedings of a Workshop at the 11th International Congress of the Archaeology of the Ancient Near East* (Munich) in April 2018 (pp. 1–15). Archaeopress. https://doi.org/10.2307/jj.15136077.4

- Gauba, E., (1951). "Botanische Reisen in der persischen Dattelregion (Fortsetzung)". *Annalen Des Naturhistorischen Museums in Wien,* 58: 13–32. http://www.jstor.org/stable/41768534

- Ghirshman, R. (1938). *Fouilles de Sialk. Près de Kashan. 1933, 1934, 1937*. Librairie Orientaliste Paul Geuthner. https://cdli.earth/publications/1786156

- Giovino, M., (2007). *The Assyrian sacred tree: a history of interpretations* (Vol. 230). Saint-Paul.

- Goor, A., (1967). "The history of the date through the ages in the Holy Land". *Econ Bot,* 21: 320–340. https://doi.org/10.1007/BF02863157

- Green, N. W. & Nissen, H. J., (1987). *Zeichenliste der archaischen Texte aus Uruk*. Ausgrabungen der Deutschen Forschungsgemeinschaft in Uruk-Warka 11 (ZATU). Gebr, Mann Verlag. https://cdli.earth/files-up/publications/englund1987a.pdf

- Gross-Balthazard, M., Galimberti, M., Kousathanas, A., Newton, C., Ivorra, S., Paradis, L., Vigouroux, Y., Carter, R., Tengberg, M., Battesti, V., Santoni, S., Falquet, L., Pintaud, J.-Ch., Terral, J.-F. & Wegmann, D., (2017). "The discovery of wild date palms in Oman reveals a complex history of domestication involving centers in the Middle East and Africa". *Current Biology,* 27(14): 2211–2218. https://doi.org/10.1016/j.cub.2017.06.045

- Hallock, R. T., (1960). "A new look at the Persepolis Treasury Tablets". *Journal of Near Eastern Studies,* 19: 90–100. https://doi.org/10.1086/371570

- Hallock, R. T., (1978). "The use of seals on the Persepolis Fortification Tablets". In: Gibson, M., (pp. 127–133) *Seals and sealing in the ancient Near East*. Undena Publ.

- Hassett, M., (1911). "Palm in Christian symbolism". *The Catholic Encyclopedia*, 11.

- Heimpel, W., (2011). "Twenty-eight trees are growing in Sumer". In: D. I. Owen (Ed.), *Garšana studies* (pp. 75–152). CDL Press.

- Hussain, A. A., (ʿA.-A. Ḥosayn). (1974). *Date palms and dates with their pests in Iraq*. Baghdad: Publisher: University of Baghdad. https://www.cabidigitallibrary.org/doi/full/10.5555/19750521499

- Kelley, K., (2024). "Images hidden in script. The invention of writing in ancient Iran". In: Ferrara, S., Cartolano, M. & Ottaviano, L. (pp. 71-94). *Talking Images: The Interface Between Drawing and Writing, Taylor & Francis*. https://doi.org/10.4324/9781032712970-6

- Kelley, K., Cartolano, M. & Ferrara, S., (2025). "Seals and signs: tracing the origins of writing in ancient South-west Asia". *Antiquity,* 99(403): 64-82. https://doi.org/10.15184/AQY.2024.165

- Landsberger, B., (1967). "The date palm and its by-products, according to the cuneiform sources". *Archiv für Orientforschung,* 17: 1–70. https://cdli.earth/publications/1696104

- Majidzadeh, Y., (2003). *Jiroft: Kohantarin tamaddon-e shargh; Jiroft – asar-e tarikhi.* Tehran: Sherkat-e Chap va Entešarat-e Sazman-e Oqaf va Omur-e Kheyrieh.

- Meriggi P., (1971). *La scrittura proto-elamica* [3 volumes], Roma, Accademia Nazionale dei Lincei.

- Nissen, H. J., Damerow, P. & Englund, R. K., (1993). *Archaic bookkeeping: Early writing and techniques of economic administration in the ancient Near East.* University of Chicago Press. https://cdli.earth/publications/1657148

- Nixon, R. W., (1951). "The date palm: "Tree of life" in the subtropical deserts". *Economic Botany,* 5(3): 274–301. https://doi.org/10.1007/BF02985151

- Paladre, C., (2022). "Les sceaux-cylindres proto-élamites: Productions d'un phénomène revisité". Unpublished doctoral dissertation. Université Paris 1 Panthéon-Sorbonne. https://hal.science/tel-03910211/

- Paszke, M. Z., (2019). "Date palm and date palm inflorescences in the Late Uruk Period (c. 3300 B.C.): Botany and archaic script". *Iraq,* 81: 221–239. https://doi.org/10.1017/irq.2019.15

- Piran, S. & Hessari, M., (2005). *Catalog of the exhibition: The culture of Halilrud and Jiroft margin.* Tehran: National Museum of Iran. (In Persian)

- Pittman, H., (1997). "The administrative function of glyptic art in proto-Elamite Iran: A survey of the evidence". In: R. Gyselen (Ed.), *Res Orientales X. Les sceaux d'Orient et leur emploi* (pp. 133–161). Bures-sur-Yvette: Groupe pour l'Étude de la Civilisation du Moyen-Orient.

- Postgate, J. N., (1980). "Palm-trees, reeds, and rushes in Iraq, ancient and modern". Dans M. T. Barrelet (dir.), *L'archéologie de l'Irak du début de l'époque néolithique à 333 avant notre ère. Perspectives et limites de l'interprétation anthropologique des documents. Colloques Internationaux du Centre National de la Recherche Scientifique 580* (pp. 99–109). Éditions du Centre National de la Recherche Scientifique. https://vergil.uni-tuebingen.de/keibi/Record/KEI00076834#details

- Potts, D. T., (1997). *Mesopotamian civilization: The material foundations.* Athlone Press. https://dokumen.pub/mesopotamian-civilization-the-material-foundations-0485930013.html

- Powell, M. A., (1987). "The tree section of ur5 (=HAR)-ra = hubullu". *Bulletin on Sumerian Agriculture,* 3: 145–151.

- Riehl, S., Benz, M., Conard, N. J., Darabi, H., Deckers, K., Nashli, H. F. & Zeidi-Kulehparcheh, M., (2012). "Plant use in three Pre-pottery Neolithic sites of the northern and eastern Fertile Crescent: A preliminary report". *Vegetation History and Archaeobotany,* 1(2): 95-106. https://doi.org/10.1007/s00334-011-0318-y

- Riehl, S., Zeidi, M. & Conard, N. J., (2013). "Emergence of agriculture in the foothills of the Zagros Mountains of Iran". *Science,* 341(6141): 65-67. https://doi.org/10.1126/science.1236743

- Roach, K. J., (2008). "The Elamite cylinder seal corpus, c. 3500-1000 BC". Ph.D. Dissertation, The University of Sydney. http://hdl.handle.net/2123/5352

- Sarton, G., (1936). "Third note on date culture in ancient Babylonia". *Isis,* 26(1): 95–98. https://doi.org/10.1086/347129

- Scheil, V. (1905). "Documents archaïques en écriture proto-élamite". Paris, (MDP, 6): 83 - 114.

- Scheil V., (1923). *Textes de comptabilité proto-élamites. Mémoires de la Mission archéologique de Perse Tome XVII (MDP 17)*. Paris, Ernest Leroux. https://cdli.earth/publications/4629

- Scheil, V., (1935). *Textes de comptabilité proto-élamites et Supplément. Mémoires de la Mission Archéologique de Perse, Tome XXVI et XXVIS (MDP 26 et 26S)*. Paris, Ernest Leroux. https://cdli.earth/publications/5109

- Schwab, E., (1983). "Some agricultural and metrological terms in Akkadian: A Reconsideration of the Basic Source Material". *Sumer,* 39(1/2): 146–149. https://ocb.uni-tuebingen.de/Record/KEI00062271/Description#details

- Takahashi, R., (1955). "The origin and evolution of cultivated barley". In: M. Demerec (Ed.), *Advances in genetics,* Vol. 7, (pp. 227–266) Academic Press. https://doi.org/10.1016/S0065-2660(08)60097-8

- Tengberg, M., (2012). "Fruit growing". In: D. T. Potts (Ed.), *A companion to the archaeology of the ancient Near East,* Vol. 1, (pp. 181–200), Wiley-Blackwell. https://doi.org/10.1002/9781444360790.ch10

- Van De Mieroop, M., (1992). "Wood in the Babylonian texts from Southern Babylonia". *Bulletin on Sumerian Agriculture,* 6: 155–161. https://vergil.uni-tuebingen.de/keibi/Record/KEI00041442

- Zargarī, ʿA., (1990). *Gīāhān-e dārūʾī* (4th ed., Vol. IV). Tehran, Iran (In Persian).

- Zohary, D. & Hopf, M., (1994). *Domestication of plants in the Old World: The origin and spread of cultivated plants in West Asia, Europe, and the Nile Valley.* Oxford University Press.

۳۳

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شناسایی نشانه‌های جدید از نخل خرما در متون آغازایلامی و بازتاب آن بر نظام اقتصادی شوش

روح اله یوسفی‌زشک [I]، خلیل‌الله بیک‌محمدی [II]، سعید باقی‌زاده [III]، حسن افشاری‌سالکی [III]

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چکیده

قدیمی‌ترین شواهد مربوط به بهره‌برداری انسان از میوه‌های درخت خرمای وحشی در خاورمیانه به هزاره‌های ششم و پنجم پیش‌ازمیلاد بازمی‌گردد. باوجود کمبود داده‌های باستان‌شناختی، معمولاً چنین پنداشته می‌شود که در پایان دورهٔ اوروک متأخر، سومریان نخستین باغ‌های خرما را بنیان نهادند و این فرضیه تاکنون به اثبات نرسیده و مسئله را به موضوعی بحث‌برانگیز تبدیل کرده است. همچنین، به‌دلیل آن‌که خط آغازایلامی به‌طور کامل رمزگشایی نشده، اطلاعات فعالیت‌های کشاورزی در جامعهٔ آن بسیار محدود است. آن‌چه تاکنون از ساختار نظام اقتصادی این جامعه دریافته‌ایم، برمبنای مقایسهٔ نشانه‌های گِل‌نبشته‌های آغازایلامی با نمونه‌های مشابه در گِل‌نوشته‌های آغازمیخیِ بین‌النهرینی است؛ نشانه‌هایی که بیشتر به فعالیت‌های کارگری، دامداری و محصولات دامی اختصاص یافته‌اند. فرضیهٔ اصلی پژوهش، درخصوص برخی نشانه‌هایِ تاکنون ناشناخته یا به‌درستی تفسیر نشدهٔ متون آغازایلامی است که درحقیقت بازنمایی‌هایی از درخت نخل خرما و میوهٔ آن هستند؛ درنتیجه، خرما و باغداریِ نخل، برخلاف تصور پیشین، بخش قابل‌توجهی از اقتصاد معیشتی شوش در اواخر هزارهٔ چهارم پیش‌ازمیلاد را تشکیل می‌داده‌اند. در همین‌راستا، پرسش‌های پژوهش عبارتنداز: ۱) آیا در گِل‌نبشته‌های آغازایلامی می‌توان نشانه‌هایی قابل‌اتکا از نخل خرما شناسایی کرد؟ ۲) این نشانه‌ها در مقایسه با نمونه‌های تصویری هم‌زمان یا متأخرتر چه جایگاهی دارند؟ ۳) شناسایی این نشانه‌ها چه تأثیری بر بازسازی نظام اقتصادی و سطح دانش باغداری جامعهٔ آغازایلامی دارد؟ این پژوهش با رویکرد تطبیقی و نشانه‌شناختی، نخست ویژگی‌های فنوتیپی قابل‌تشخیص نخل خرما را استخراج و سپس آن‌ها را با نشانه‌های موجود در گِل‌نبشته‌های آغازایلامی مقایسه می‌کند و در ادامه، با نمونه‌های تصویری هم‌زمان و متأخرتر ایرانی و بین‌النهرینی تطبیق داده شده و ازطریق تحلیل مقایسه‌ای، امکان همسان‌سازی آن‌ها، سنجیده می‌شود. نتایج پژوهش نشان می‌دهد که چند نشانهٔ شاخص در متون آغازایلامی با ویژگی‌های فنوتیپی نخل خرما هم‌خوانی دارد و می‌توان آن‌را به‌عنوان کهن‌ترین بازنمایی‌های شناخته‌شده از نخل خرما در جنوب‌غرب ایران معرفی کرد. این گزاره، افق تازه‌ای برای بازشناسی اقتصاد معیشتی و دانش باغداری در شوشِ آغازایلامی می‌گشاید و نشان می‌دهد که خرما و فرآورده‌هایِ آن، احتمالاً نقشی بنیادین در اقتصاد این دوره داشته‌اند.

کلیدواژگان: درخت نخل، خرما، آغازایلامی، شوش، آغازمیخی، نیمهٔ دوم هزارهٔ چهارم پیش‌ازمیلاد، باغداری.

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