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A Naturel Heritage in Erzincan: Karaerik (Cimin) Grape

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Abstract
Viticultural activities in Erzincan are among the earliest agricultural practices in the region, with a history tracing back to the Neolithic Age. Although Erzincan viticulture has evolved from wine grape production to table grape production over time, the fundamental grape production methods have remained largely unchanged. The Üzümlü District is the primary production center that comes to mind when Erzincan viticulture is mentioned, and the standard grape variety is the Karaerik (Cimin) grape, recognized as one of the region's significant national values. While the vineyard area in Üzümlü has experienced slight fluctuations in the last two decades, no significant increase or decrease is noticeable. The limited production area and unique taste of the Karaerik grape variety have made it one of the most commercially valuable grape varieties in the Türkiye. Transferring this grape variety to future generations is crucial for preserving a historical value, cultural heritage and a unique genetic resource. However, it is anticipated that vineyards in the plains will shift towards the hillsides due to the frequent frost events experienced in recent years, which have a greater impact on vineyards in the lower-lying areas.
Evaluation of hawthorn genotypes growing naturally in Malatya (Türkiye) in terms of some morphological characteristics

Erzincan'da Doğal Bir Miras: Karaerik (Cimin) Üzümü
Özet
Erzincan'da bağcılık faaliyetlerinin, yörede yapılan ilk tarımsal faaliyetlerden biri olduğu ve tarihinin neolitik çağa kadar dayandığı değerlendirilmektedir. Erzincan bağcılığı, tarihsel süreç içerisinde şaraplık üzüm üretiminden sofralık üzüm üretimine evrilmesine rağmen üzüm üretim yöntemi esasen değişmeden kalmıştır. Erzincan bağcılığı denilince akla gelen üretim merkezi Üzümlü İlçesi, standart üzüm çeşidi ise yörenin en önemli milli değerlerinden biri olan Karaerik (Cimin) üzümüdür. Son 20 yılda Üzümlü'de bağ alanı varlığı hafif dalgalı olarak seyretmesine karşın önemli bir artış veya azalış göze çarpmamaktadır. Karaerik üzüm çeşidinin sınırlı bir alanda üretilmesi ve eşsiz tadı ticari olarak ülkenin en değerli üzüm çeşitlerinden biri olmasını sağlamıştır. Bu üzüm çeşidinin gelecek nesillere aktarılması; tarihi bir değerin yaşatılması, kültürel bir mirasın ve eşsiz bir genetik kaynağın korunması adına önem arz etmektedir. Ancak son yıllarda sıklıkla yaşanılan don hadiselerinin taban arazilerdeki bağları daha fazla etkilemesinden dolayı ovadaki bağların yamaç arazilere doğru kayacağı düşünülmektedir.

1. Introduction

History of Erzincan Viticulture

Grape production is economically carried out between 20°-52° north and 20°-40° south latitudes on Earth. In addition, grape production is possible in high altitude regions close to the equator outside these latitudes (Saglam and Saglam, 2018a). Located at the intersection of the Mediterranean and Near East gene centers, Türkiye is the genetic source of many of the world's most significant fruit species and cultivars and is located in the world's most suitable climate zone for viticulture (İlim Serhat et al., 2017; Taskesenlioglu et al., 2022). For this reason, it is reported that grapes have been grown in this geography for many years and have a deep-rooted viticulture culture (Küpe et al., 2021). Türkiye's grape production, with 3,400,000 tons cultivated across 3,845,365 decares, positions the nation as the 7th largest global producer. This places Türkiye behind China (13,500,000 tons), Italy (6,668,830 tons), France (6,205,260 tons), the United States (5,361,010 tons), Spain (4,822,760 tons), and India (3,740,000 tons) as depicted in Figure 1.

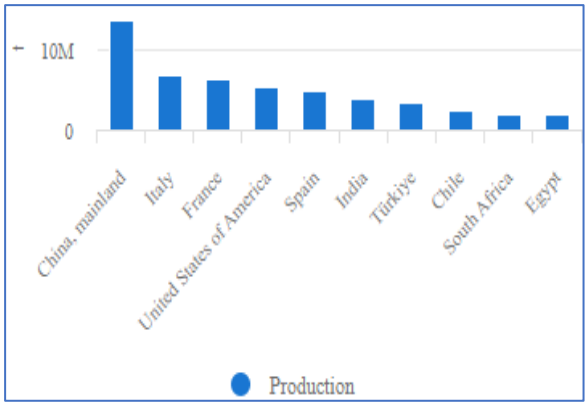

Figure 1. Production of Grapes top 10 producers (FAO,2023)

Archaeobotanical and archaeological investigations provide evidence indicating that the practice of viticulture in Anatolia, the Caucasus Mountains (including Transcaucasia), and the Zagros Mountains in northern Iran dates back as far as 6000 BC. The region's long-standing association with grape cultivation, legends such as Noah's Ark and references to Mount Ararat in the Bible, supported by scientific findings, suggest that Anatolia is among the original homelands of grapes and one of the earliest centers of viticulture (Türker and Alaeddinoğlu, 2016).

The Eastern Anatolia Region, characterized by a dominant continental climate, exhibits significant climatic variations compared to other Turkish geographical regions. This is primarily attributed to its high altitude, mountainous terrain, and constricted topographic structure. However, the Erzincan Plain presents a notable exception, displaying a comparatively high annual average temperature within the Eastern Anatolia Region. This thermal characteristic is closely linked to the plain's morphological features and its surrounding topography. Specifically, the encompassing mountain ranges, reaching elevations of up to 3500 meters in certain areas, act as a barrier against the intrusion of cold air masses into the plain during winter. Conversely, in the summer, these same mountain ranges impede the dissipation of heat generated by favorable radiation conditions at the plain's base, thereby contributing to an increase in temperature. The climate of Erzincan represents a transitional zone between the prevailing Eastern Anatolian and Central Anatolian climate patterns. Notably, in comparison to other centers within the Eastern Anatolia Region, Erzincan exhibits microclimatic characteristics distinct from its immediate surroundings (Polat and Altınbilek, 2021). Historical records indicate a long-standing tradition of grape production in Erzincan, attributed to its favorable climatic conditions, suggesting a viticulture culture with deep historical roots (Taskesenlioglu et al., 2022; Özoğul, 2024)

While some tools discovered by Kökten (1971) during his research in Tunceli and Erzincan are believed to date back to the Paleolithic Age, the plant and animal remains found in the strata of Pulur and Tepecik provide evidence of settled life. This suggests the presence of a significant agricultural culture in this region from approximately 5000 BC onwards, with the history of agriculture in the area reportedly extending back to the Neolithic Age (Erzen, 1992).

Historical accounts from Xenophon, a soldier in the Assyrian army, provide insights into the prominence of grapes and wine within the Anatolian civilizations, particularly among the inhabitants of the Eastern Anatolia Region. During his return to Iran in the early 4th century BC, following an expedition to Eastern Anatolia, Xenophon noted the hospitality encountered in the region between Erzincan and Van. His narrative describes the local populace offering his troops "a strange drink," alongside provisions such as livestock, grain, aged wines with a notable aroma, dried grapes, various types of beans, and an abundance of other provisions (Belli, 2011; Alaeddinoğlu and Türk, 2015). This account underscores the significant role of

viticulture and its products in the daily life and hospitality of the people in this geographical area during that historical period.

Archaeological evidence indicates the significant role of viticulture in the Eastern Anatolian region, encompassing present-day Erzincan, during the Urartian period. Notably, excavations at Urartian sites have unearthed vessels suggestive of wine libations. Among these findings at Erzincan/Altıntepe, tomb number 3, was a bronze cauldron featuring a bull's head attachment, measuring 51 cm in height and 0.72 m in diameter, with a capacity of 300 liters (Özgüç, 1969). This discovery underscores the potential cultural and ritualistic importance of wine, derived from grapes, within this historical context.

Furthermore, archaeological findings at Altıntepe, situated within the boundaries of Üzümlü, Erzincan, have revealed the presence of cellars and storage areas containing hieroglyphic pithoi (Özgüç, 1961). The Üzümlü region is renowned for its distinctive Cimin grape, believed to have been utilized for wine production from the Urartian period through the Middle Ages. Notably, a cavity carved into the bedrock within the garden of a long-cultivated house in the Üzümlü region is hypothesized to be a "wine press." However, the absence of definitive archaeological data currently prevents precise dating of this potential winemaking structure (Karaosmanoğlu et al., 2014). This suggests a potentially continuous tradition of viticulture in the Üzümlü area.

Throughout history, grapes and wine have retained their significance in Anatolia. Wine, acquiring religious connotations particularly during the prevalence of Christianity, held considerable importance. However, with the expansion of Islam, the prominence of wine diminished or ceased in regions under Muslim dominance. Nevertheless, grapes and grape motifs continued to hold cultural value and remained prevalent in artistic expressions (Çiğdem, 1996; Sağlam and Sağlam, 2018b; Taşkesenlioğlu et al., 2022).

Erzincan's strategic location along historical trade routes connecting Europe and Asia has consistently drawn the attention of travelers and historians, particularly concerning its agricultural richness. Throughout history, the region has been lauded with evocative descriptions such as "Irem Garden," "Gül-i Gülistan Vineyard and Garden," "Land of Heaven," "City of Belkıs," "Çemenistan and Bülbülistan," and "Mountainous surroundings, vineyards in the middle" (Kara, 2016). Notably, the Spanish traveler Clavijo, who traversed Erzincan between 1403 and 1406, documented the city's establishment on a plain adjacent to a river, widely recognized as the Euphrates, which he described as originating from paradise. He further noted the Erzincan Plain's encirclement by a mountain range, observing the snow-capped peaks contrasting with the absence of snow on the plain itself. Clavijo also remarked on the ubiquitous presence of villages with gardens and the extensive cultivation of wheat fields and vineyards across the entire plain. Similarly, both Katip Çelebi in his Cihannüma and Evliya Çelebi in his Seyahatname make specific mention of the abundant vineyards and the delectable quality of the grapes cultivated within the Erzincan Plain (Karadeniz and Altınbilek, 2016). These historical accounts underscore the long-standing significance of viticulture and agriculture in shaping the perception and description of the Erzincan region.

The enduring history of viticulture in Erzincan, spanning millennia, is clearly substantiated by historical evidence. A crucial ecological factor underpinning this sustained tradition is the sandy soil composition characteristic of the region. This soil type has historically conferred a natural resistance to phylloxera, a devastating grapevine pest, thereby providing a significant and inherent advantage for the long-term viability of viticulture in Erzincan (Keskin, 2015; Gökbayrak, 2016).

2. MATERIAL AND METHOD

2.1. Grape Production of Erzincan

In Erzincan, the local grape variety, Karaerik (also known as Cimin grape), constitutes approximately 99% of the cultivated grapes. This variety has historically dominated grape production in the region due to its favorable fruit characteristics. Notably, the grape cultivation methods employed have remained largely consistent since 800 BC. The Karaerik grape exhibits a high degree of adaptation to the specific soil and climatic conditions of Erzincan, allowing for production with comparatively lower input requirements, such as pesticides and fertilizers, when contrasted with other grape varieties (Karadoğan et al., 2018; Küpe et al., 2021; Taskesenlioglu, 2022).

Table 1. Erzincan Grape Production (Anonymous, 2024 a)

Year	Grape Area (da)	Total Fruit Area (da)	Yield (kg/da)	Total Production (ton)
2005	8790	34760	662	5822
2006	8690	34620	647	5625
2007	8640	34971	580	5008
2008	8540	35047	651	5561
2009	8650	34555	661	5720
2010	8650	34712	658	5690
2011	8900	35739	680	6055
2012	8920	35330	669	5970
2013	8920	35718	669	5967
2014	9000	35415	475	4278
2015	9000	35295	352	3166
2016	9200	33834	609	5607
2017	9240	33398	398	3682
2018	9533	34515	458	4369
2019	9503	36657	533	5064
2020	9453	37745	663	6272
2021	9495	38633	569	5402
2022	9478	38672	654	6202
2023	9426	38466	421	3965

Table 2. Grape Production of Üzümlü District and Its Share in Erzincan (Anonymous, 2024 a)

Year	Vineyard Area of Üzümlü (da)	The Rate in Erzincan (%)	Grape Production of Üzümlü (ton)	The Rate to Total Production in Erzincan (%)	Yield (kg/da)
2005	5300	60,3	3975	68,3	750
2006	5300	61,0	3900	69,3	736
2007	5300	61,3	3491	69,7	659
2008	5300	62,1	3922	70,5	740
2009	5300	61,3	3975	69,5	750
2010	5300	61,3	3875	68,1	731
2011	5500	61,8	4125	68,1	750
2012	5500	61,7	4125	69,1	750
2013	5500	61,7	3988	66,8	725
2014	5500	61,1	2189	51,2	398
2015	5500	61,1	1620	51,2	295
2016	5500	59,8	3688	65,8	671
2017	5500	59,5	1981	53,8	360
2018	5699	59,8	2753	63,0	483
2019	5700	60,0	3340	66,0	586
2020	5700	60,3	4275	68,2	750
2021	5700	60,0	3578	66,2	628
2022	5700	60,1	4190	67,6	735
2023	5691	60,4	2561	64,6	450

Examining the total grape production in Erzincan Center and its districts over the past two decades reveals a fluctuation in the cultivated area, ranging between 8540 and 9533 decares, with peak production reaching 6272 tons in 2020 (Table 1). Notably, the Üzümlü district alone accounts for approximately 65% of Erzincan Province's total grape production (Table 2). In Üzümlü, viticulture encompasses diverse applications beyond table grape production. The predominant standard variety in the region, Karaerik grape, is primarily consumed fresh; however, its must is also processed into valuable by-products such as molasses, fruit pulp, and vinegar. Furthermore, a traditional product known as "Saruç" is produced by halving Cimin grapes, removing their seeds, inserting walnuts, and then drying and stringing them, resembling rosary beads, for consumption as dried nuts. Additionally, the young vine leaves harvested early in the growing season are extensively utilized both fresh and pickled (Kalkan et al., 2017).

2.2. Training System in Local Vineyards

While the Karaerik grape variety (Cimin grape) is the defining characteristic of viticulture in Erzincan and the sole standard table grape variety cultivated extensively in the Üzümlü District (Table 2) (Ekinci, 2008), several other local grape varieties, including Ağrazakı, Kabuğuyufka, Kirlişerife, Hacıtesbihi, and Sarıgolot, are also cultivated in limited quantities. These minor varieties are currently facing the risk of extinction within the region and lack commercial significance. The Karaerik grape, belonging to the Vitis vinifera species, is distinguished by its thin skin and a unique epicuticular wax layer (Karadeniz and Altınbilek, 2016).

The Karaerik grape variety is cultivated using a training method unique to the region, known as the "baran system." This system involves burying the main grapevine trunk underground, while the branches and canes are left above the soil surface, with the soil mounded in a herringbone pattern (Figure 3; Figure 4). However, recent years have witnessed a decline in snow cover in the region, attributed to global warming and climate change. Consequently, the Karaerik grape variety is now increasingly susceptible to damage from winter frost (Küpe, 2012). A recent study conducted by Özoğul (2024) investigated frost damage in Karaerik vineyards situated at varying altitudes within the Erzincan region. The findings of this study indicated that the vineyard located at an altitude of 1500 meters experienced less frost damage compared to vineyards at 1200 and 1300 meters. This observation suggests a potential correlation between the extended duration of snow cover at higher elevations and a reduced incidence of frost damage (Figure 2). In Üzümlü, the primary center of grape production in Erzincan accounting for 65% of the province's total (Table 2), a shift towards a modified grapevine system has been observed in recent years, coexisting with the traditional baran system. The modified system is characterized by the installation of a wire approximately 30 cm above the grapevines. One-year-old vine shoots are then trained onto this wire, allowing the grape bunches to hang freely. This modification enhances the efficacy of spraying and fertilization practices (Figure 5). This adaptation likely reflects efforts to optimize vineyard management and potentially mitigate some of the challenges posed by changing climatic conditions in the region, as noted in previous studies.

Figure 2. Grapevines in the dormant period

Figure 3. Grapevines in the awakening period

Figure 4. Grapevines during the vegetation period

Figure 5. Modified baran training system

2.3. Topographic Structure of Local Vineyards

The topographical and soil characteristics of the Üzümlü District are highly conducive to viticulture and fruit cultivation, defining the landscape of Erzincan's grape production. The gently to moderately steep slopes with permeable colluvial soils facilitate effective viticultural practices, complemented by the favorable climatic conditions. The primary areas for

Karaerik grape cultivation are concentrated in the Üzümlü town center and the villages of Pişkidağ, Göller, Karakaya, and Avcılar, as well as the plains situated on the foothills of the mountains where slopes range from 5-10%. Alluvial fans represent the most significant accumulation landforms in the context of Erzincan viticulture, with notable examples including the Üzümlü Fan, which is segmented by volcanic cones, and the Pişkidağ and Demirbağ Fans. Furthermore, a substantial portion of the Sansa Gorge, an area significant for viticultural activities in the region, lies within the administrative boundaries of the Üzümlü District (Ardos, 1985). This geological and geographical context underscores the natural advantages that have historically supported and continue to shape viticulture in Üzümlü and Erzincan.

2.4. Phenological Stages and Pomological Characteristics of Karaerik Grape Variety

The Karaerik grape (Vitis vinifera L.), also known locally as the Cimin grape, stands as the sole standard table grape variety cultivated extensively in the Üzümlü District of Erzincan. This variety is characterized by its black color, flat oval shape, an average berry weight ranging from 3 to 4 grams, and typically contains 1 to 4 seeds per berry. The Karaerik grape exhibits medium skin thickness, a dense texture, and an average cluster weight of 300 to 500 grams (Ekinci, 2008).

Phenological observations are indispensable as they provide information on the real condition of the plants, frost warnings and important recommendations for pest control (Koch et al., 2007). Considering the land structure and frequent frost events in the Üzümlü region of Erzincan, where viticulture is intensive, it has become essential to follow the phenological development course of the vines. In the Karaerik grape variety, which is the only standard table variety in the province, the first bud break in the vineyards is generally seen in the end of March-beginning of April, although it varies according to the years. In the Üzümlü district, where the bud break time has shifted to a later period due to the increase in altitude, the first flowering occurs in the 1st and 2nd weeks of June, while veraison occurs in the 1st and 2nd weeks of August. The Karaerik grape variety, highly valued in the Erzincan center and neighboring provinces, is harvested starting in early September and continuing through the end of October (Özoğul, 2024).

2.5. Cultural Practices in Erzincan Viticulture

2.5.1. Pruning in Vineyards

Yield pruning in grapevines is done to regulate growth and development, productivity and quality in a balanced way, and to maximize the benefit obtained from the vines. Pruning intensity is the number of buds left on the vine, and the number of buds to be left varies according to the position of the productive buds of the variety, the development power of the vine, the training system and maintenance conditions (Çelik et al., 1998). In Karaerik, a table grape variety widely grown in the Erzincan region and with a high market value, pruning is usually done in March. However, some farmers in the region prune after harvest in the fall to reduce the workload in the spring. Karaerik grape variety, which has more productive bottom buds, is usually pruned short over 3-4 buds

2.5.2. Irrigation in Vineyards

The Limited Liability Üzümlü Irrigation Cooperative, operating in the Üzümlü district center, uses underground water (drilling) belonging to the State Hydraulic Works and meets the water needs of approximately 2500 acres of vineyards (for a fee). In addition, this water, known as hourly water in the region, coming from the foothills of Keşiş Mountain, forms the source of Cimin Stream and is used in agricultural irrigation with the free service provided by Üzümlü Municipality. Farmers use this water freely until June 21, and after this date, they irrigate it with the ‘‘minutes’’ determined according to the size of the land. There are irrigation cooperatives in the villages of Karakaya, Pişkidağ and Göller, where grape growing is intensive, and the water needs of the vineyards are met by the spring water coming from Kureyşlisarıkaya Village through these cooperatives. The vineyards in the region are generally irrigated 3 times, and it is known that no problems are experienced in irrigation during viticulture activities. Although flood irrigation is generally preferred as an irrigation method, in recent years there has been an increase in the number of vineyards with drip irrigation due to grants from the Ministry of Agriculture and Forestry and Bank Loans (Figure 6).

Figure 6. Vineyards with flood irrigation and drip irrigation

2.5.3. Spraying and Fertilizing in Vineyards

In Üzümlü vineyards where Karaerik grapes are grown, powdery mildew (Erysiphe necator (Schw.) Burr.) and downy mildew (Plasmopara Viticola) diseases are frequently encountered. In a study, it was reported that the rate of some grape varieties, including Karaerik grape variety, to be infected with powdery mildew varied between 67.3-96.7% (Bozkurt et al., 2023). It has been determined that vineyard mildew also causes significant economic losses in Üzümlü vineyards. It was observed that grape production decreased by 38.87% in 2023 compared to the previous year, and the yield per decare decreased from 735 kg to 450 kg (Table 2). It is considered that an important reason for this loss of yield is downy mildew and powdery mildew diseases. In fact, in 2024, Üzümlü District Governorship distributed 2000 boxes of plant protection products with a 50% grant to farmers who produce grapes in order to prevent yield losses caused by downy mildew and powdery mildew diseases and to raise awareness among farmers about these diseases (Anonymous, 2024 b). Again, the District Directorate of Agriculture and Forestry frequently organizes farmer training against these diseases. (Anonymous, 2024 c). The most common pest in grape vineyards is the grapevine moth (Lobesia Botrana). Erzincan Provincial Directorate of Agriculture and Forestry has carried out projects aimed at creating awareness and reducing the amount of chemical pesticides used against this pest by distributing pheromone traps used against grapevine moth to farmers within the scope of integrated management (Anonymous, 2024 d).

The most common application in fertilization in local vineyards is the application of burnt farm manure, which is applied at an average of 2-3 tons per decare every 3 years. In addition to farm manure, nitrogenous and potassium synthetic fertilizers and foliar fertilizers containing microelements have also been applied in recent years, but the number of farmers who have soil analysis done is quite low.

2.5.4. Weed Control in Vineyards

Due to the topographic structure and training system of the local vineyards, the use of machinery in the vineyards is quite limited. Weed control in the vineyards is generally carried out physically with human labor in the spring after pruning, without using herbicides (weed killers). This process is called "vineyard digging" in the region and causes a great time and economic loss for farmers. This process is generally carried out twice a year in the spring months. In the advanced stages of vegetation, weed control is carried out by directly pulling out the weeds by hand rather than digging the vineyard. In recent years, it has been observed that local vineyard growers cover their grape vines with mulch in order to save time and carry out this process more economically (Figure 6).

2.6. Marketing of Grapes

Grapes cultivated by farmers in the Üzümlü district center are typically harvested, crated, and transported to the local wholesale fruit and vegetable market. In contrast, grapes produced in the surrounding villages are often marketed through brokers who purchase directly from the farmers within the village, or alternatively, the farmers themselves transport and sell their produce to neighboring provinces (Figure 7). In a study conducted in Üzümlü, it was reported that the best way to market grapes according to producers is to sell to a broker in the village market (61.29%), sell directly to the consumer in the local market (17.74%), sell to a broker where the agricultural enterprise is located (17.74%) and sell wholesale while the product

is in the field (3.23%) (Gözener et al., 2014). Grapes produced in Erzincan generally do not face significant marketing challenges, and they command favorable prices in the Eastern Anatolia and Black Sea Regions (Küpe, 2013). The geographically indicated Cimin Grape has established a strong reputation, extending its reach across Türkiye as a popular gift item (Figure 8), thus indicating a well-established and geographically diverse market for this local specialty.

Figure 7. Transporting table grapes by the farmer

Figure 8. Grape boxes sent as gifts

Figure 9. Second quality grapes prepared for juice

Rainfalls occurring during the harvest season trigger fungal diseases in the vineyards and cause quality losses in the product. Another issue that causes quality losses in the product is the physical damages in the grape berries due to hail. Due to these damages, the products whose market value decreases are evaluated as industrial and are sent to fruit juice factories in Erzincan or Elazığ provinces (Figure 9).

2.7. Türkiye's First Geographically Indicated Grape: Karaerik (Cimin Grape)

The Karaerik grape variety was registered by the Üzümlü Municipality in 2002 and received a Geographical Indication (Origin) registration certificate, becoming the first registered grape variety in Türkiye (Kalkan and Keskin 2018). In 2022, the Üzümlü Center and Villages Service Union received a Geographical Indication Registration Certificate (Source) for Saruç, which is produced by processing the grape. As of 2024, there are a total of 10 products

with geographical indications in Erzincan, and the fact that two of them are related to the Karaerik grape variety is an indication of the importance of this grape in Erzincan geography and culture (Anonymous, 2024 e).The grape figures positioned on the right and left of the two Turkish flags in the Üzümlü District Governorship show the value given to the Karaerik (Cimin) grape by public institutions. In addition, there is a 3.5 m high grape statue at the entrance of the Municipality Building in the district, which takes its name from the product that is intensively cultivated. The grape-figured lamps used in the lighting of the main streets in the district center show that the grape is used as the symbol of the district (Figure 10).

Figure 10. Some grape figures in Üzümlü district

3.Conclusion

In the Üzümlü District of Erzincan, the cultivation of Karaerik grapes is characterized by a constrained vegetation period and a high frequency of frost events. These frost occurrences result in significant economic losses for the Karaerik grape variety, which, as the sole standard variety in the region, commands premium prices in adjacent provinces due to its distinctive taste and appearance (Küpe, 2019). Research indicates that the formation of frost lakes plays a substantial role in the incidence of this damage, with vineyards situated on the valley floor being more susceptible to frost damage compared to those located on slopes (Khanizandeh et al., 2005; Korkutal et al., 2012). Compounding the challenges posed by winter frosts, the agricultural importance of the plain land for the cultivation of field crops and vegetables necessitates the establishment of future vineyards on sloping and hillside terrains. This strategic land allocation reflects a need to balance diverse agricultural practices within the region, acknowledging the limitations and opportunities presented by the varied topography. Furthermore, certain legal regulations stipulate that agricultural subsidies will not be available for the establishment of new vineyards and orchards on land with a slope of less than 6%, effectively prohibiting such new plantings on flatter terrain. Concurrently, the Ministry of Agriculture and Forestry has been offering substantial grants for greenhouse farming initiatives, resulting in a notable increase in greenhouse investments within Erzincan and Üzümlü. Consequently, it appears probable that existing vineyards located on flatter lands, particularly in Üzümlü, may be progressively replaced by greenhouse agricultural enterprises.

Another significant factor posing a future risk to viticulture in Üzümlü is the occurrence of sudden and intense hailstorms. Hail events, particularly those occurring during the critical months of May, June, and July, can severely impede viticulture, causing irreparable physical damage to the vines and substantially diminishing both fruit quality and yield. Indeed, a recent hailstorm on July 7, 2024, reportedly resulted in an estimated 80% damage across 2510 decares of vineyards.

Despite the anticipated emergence of certain climatic and legal constraints on viticulture in Üzümlü in the coming years, it is projected that the overall production volume will not be negatively impacted. Rather, producers are expected to adapt by shifting their vineyard location preferences towards higher altitudes and steeper slopes. This adaptation strategy is anticipated to have positive implications for the long-term sustainability of viticulture in the region. Viticultural practices possess a deeply entrenched history within the Erzincan region, an area distinguished by its microclimatic characteristics within the predominantly continental climate of the Eastern Anatolia Region. The economic viability and sustainability of the geographically indicated Karaerik (Cimin grape) variety are of significant importance, both for enhancing the living standards of local farmers and for ensuring the transmission of this ancient cultural heritage to future generations. In Erzincan, the ongoing cultivation and management of the Karaerik grape represent a contemporary

continuation of this historical tradition, with its economic and cultural significance remaining pertinent to the local community.

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