



## Survey of grape cultivate compatibility with kurdistan climate

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### Abstract

One of the major issues of increasing agricultural production, is adaptation of technology to specific climatic variables in cultivated areas. Knowing the weather and climatic condition and periodic yearly and multi-year changes of meteorological phenomena and deviations from normal values are of major requirements of modern agriculture. In this study, daily, monthly and annual weather data of synoptic stations in Kurdistan region was gathered from Iran Meteorological Organization and then, the homogeneity of data were examined by run test method. To study agro-climatic features of viticulture, deviation from optimal conditions and the degree of active days index (GDD) methods are used. Based on the analysis of deviations from optimal conditions at different altitudes in the study area, Marivan station has optimal conditions for planting, among the stations. This is important in terms of development of cultivation areas and commercial production of crops. Based on the agro-climatic analysis, western and central regions (Marivan and Sanandaj stations) are most suitable areas of viticulture in the region. While eastern, northwestern and southern (Bijar, Saghez and Kamyar stations) areas are next in this ranking.

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## Introduction

The increase of global temperature in recent decades and its effect on the environment were confirmed in the latest IPCC report (IPCC 2007).

Several studies have described the impact of climate change on viticulture (Jones & Davis 2000, Duchêne & Schneider 2005, Jorquera-Fontena & Orrego-Verdugo 2010, Malheiro *et al.*, 2010, Urhausen *et al.* 2011).

since climate is one of the key elements influencing grapevine yield and quality (van Leeuwen *et al.*, 2004, Jones *et al.* 2005).

In an earlier study of grapevine phenology in Bordeaux, (Jones & Davis 2000) observed an advance of phenological stages, a shortening of phenological intervals and an increase in potential wine quality, which a later study confirmed for other European wine regions (Jones *et al.*, 2005).

Global warming may also result in a shift in the distribution of grape cultivation, meaning that wine production might become profitable in regions formerly unsuitable or marginal for wine-growing (Lisek 2008).

Most wine-producing regions in Western and Central Europe have benefitted from increasing temperatures, but the impact of global warming obviously varies according to the type of wine produced and the geographical location (Webb *et al.*, 2007, Duchêne *et al.*, 2010, Hall & Jones 2010).

East of the Rhine River, the northern limit of wine production turns gradually southward as the moderating influence of the Gulf Stream and surrounding seas decline. In comparison to other European wine regions, the more continental climate in some parts of Central Europe is characterized by shorter growing seasons, abundant spring and

summer rain and cooler temperatures (Jackson 2000).

Whereas increasing temperatures in these regions could lead to more consistent vintage quality, (Jones *et al.*, 2005).

that they might be at, or close to, their optimum climate for producing the best quality wine with current grape cultivars.

The main wine-producing climate in Europe is found south of 50° N (Mullins *et al.*, 1992), which makes German wine regions among the most northerly in the world. One of Germany's historical wine-producing regions is that of Lower Franconia in the federal state of Bavaria, where production dates back to the 8th century (Robinson 2006).

The vineyards are located along the Main River, which has the effect of moderating temperature, while the steep hills receive maximum heat and light exposure, which enhances ripening (Jackson 2000).

The cool conditions require the use of adapted grapevines (*Vitis vinifera* L.), which include frost resistant, latebudding and early maturing cultivars (Unwin 1991). Grape cultivars most commonly planted are Müller-Thurgau, Riesling and Silvaner. These white cultivars are more suitable for cooler climates with less sunshine and earlier harvest (Robinson 2006).

Approaching harvest, the relative amounts of sugar and acid found in the grapes are the main quality characteristics and are an indicator of grape ripeness.

With an increase in the concentration of sugar, the organic acids decrease (Mullins *et al.*, 1992).

The absence of hot weather during ripening and the cool harvest conditions favour the retention of grape

acidity, result in lower alcohol and promote the development or retention of varietal flavours.

This gives the resulting wine a fresh taste and helps restrict microbial spoilage (Conde *et al.*, 2007).

Thus, the unique character or typicity (the characteristic of a wine that makes it typical for the region or cultivar of origin) is assured (Jackson 2000).

While the majority of the highest quality wine-producing regions in Western Europe and Germany have benefited from an increase in quality ratings (Malheiro *et al.*, 2010), the impact of global warming on Franconian wine and its varietal typicity has received little attention.

Therefore, the objectives of the current work were to undertake a long-term study (1949 to 2010) to evaluate climate effects on grapevines in Lower Franconia using reference vineyard observations.

The main aim of this study is to explain relation between the climatic parameters and grape cultivate in Kurdistan area.

**Materials and methods**

Each scientific reseach requires the application of appropriate methods throughout its scientific proces.

It needs accurate data gathering and application of appropriate analytical methods.

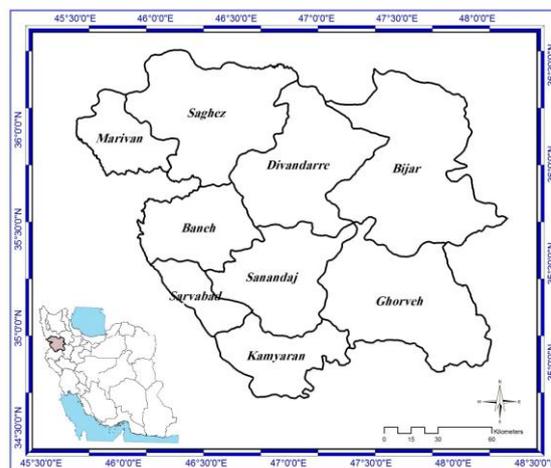
So, in this study, in order to achieve the objectives and find the answers of research questions ,and approve or reject the hypothesis , local climatic elements are analyzed, using methods that would be discussed later.

Next, the methods used in the study has been presented.

In this study, mini and maxi daily temperature parameter of 2011-2001 period in Kurdistan region have been used.

(Meteorological Organization of Kurdistan Region , 2011-2001 ).

*Data gathering*



**Fig. 1.** Study area

*1-Method of deviation from the optimal conditions*

Determination of the optimal time for each area, based on weather stations’ data and daily temperature of crop growth is important. There are four phenological stages for grapes plant and each stage has an optimal temperature, at which the maxi growth rate occurs at this temperature. Identifying and determining the optimal

point for each phenological stage and the mean daily temperature resulted from monitoring mini and maxi daily temperatures; one can determine various optimal times, particularly months of a year, and actually, the time which has the least deviation from the optimal condition, would be considered as the optimal time. In this method, to obtain the optimal of different time intervals, optimal points or optimal temperatures were first determined and then, considering the average of daily data, deviations from the optimal conditions were calculated for 3 decades of each month. For this reason, first, each month was



**Results**

**Discussion**

*1- Deviation from optimal conditions*

Four phenological stages have been considered in grapes plant which are significant in terms of agro-climatic matters; including: germination stage, flowering stage, stem maturation stage, and grapes ripening stage. Each stage has an optimum temperature, in which, the maxi growth rate occurs. In order to study the grapes plant species, phenologically, according to this study, mid-mature plant varieties which are more common in the region, are considered as the basis. Table 2 shows the deviation from the optimal conditions for each phenological stage of sugar beet based on the average daily temperature at selected stations.

According to the results of germination and flowering stage, Marivan station has less deviation and more optimal conditions than the other stations. In the stem-maturation stage, Marivan station has less deviation than the other stations; however, there are not significant differences in terms of deviations from optimal conditions.

The fully ripening stage of grapes plant, Marivan Stations has lower deviations which is followed by Sanandaj and Bijar stations and Saghez and Kamyaran show more deviation; consequently, in all stages, Marivan station has least deviation from optimal condition, this means that this station has the optimum conditions for the grapes plant growth.

**Table 1.** Determining the deviation from optimal condition of grapes plant phenological stages in selected stations.

Total deviations	Grapes ripening		Stem maturation		Flowering		germination		Growth stages station
	Deviation from optimum condition	optimum							
-48.94	-10.66	25-35	-15.34	25-35	-16.13	25-30	-6.82	15-20	Bijar
-51.33	-11.09	25-35	-15.84	25-35	-161.8	25-30	-7.59	15-20	Saghez
-49.76	-10.32	25-35	-15.61	25-35	-16.39	25-30	-7.44	15-20	Sanandaj
-47.85	-9.85	25-35	-15.30	25-35	-15.86	25-30	-6.85	15-20	Marivan
-49.72	-11.05	25-35	-15.64	25-35	-16.05	25-30	-6.98	15-20	Kamyaran

*2- Results of phonological analysis*

Application of thermal coefficients in agricultural problems and the regulation of agricultural calendars in different areas is of significance.

In spite of lack of the extensive phenological studies, using agricultural meteorological studies conducted by Quanta engineers with cooperation of Romanian consultants an applying their methods, active days degree and determination of length of phenological stages were studied according to various thresholds

values are used, but only for the days when the temperature is greater than the average of biological thresholds or zero point of activity. In this study, the basis for calculating the thermal coefficients has two types: one based on a mini threshold of grapes plants at each stage, and the other is zero degrees Celsius. Thermal thresholds of grapes plants in different phenological stages are illustrated in table 2.

*3- Optimal time, based on active days degree method*

Another method to determine the optimal time for agricultural climate, based on the latest incidence of mini thresholds at each phenological stage of grapes plant, is active temperatures' method that it is used in this study. The total daily temperatures with positive

**Table 2.** Temperature thresholds of grapes plants in phenological stages.

Maximum degrees Celsius	Favorable Temperature, degrees Celsius	Minimum Temperature, degrees Celsius	Phonological stages
30	15-20	9	Germination
45	25-30	14-15	Flowering
More than 35	25-30	10	Stem maturation
More than 35	25-35	-5	Grapes ripening

Reference: Quanta, 1974

Since plant species are highly dependent on temperature, the monitored daily mini temperature is used for phenology of the grapes plant. By specifying thresholds of phenological stages of grapes plant and accurate daily temperatures, completion date of each stage is calculated. For all stations, incidence date of mini threshold of grapes plant activation at greater than 0 C° is considered. In order to obtain the completion date of phenological stages of grapes plant in germination stage 320, the flowering stage 475,

stem maturation stage 1200 and fully ripening stage of grapes plant, 3750 thermal units are necessary.

According to Table 3, the date of germination, flowering and stem maturation of grapes plant occurs earlier in Marivan and Sanandaj stations. Completion date of phenological stages of grapes plant in selected stations are shown in Table 4.

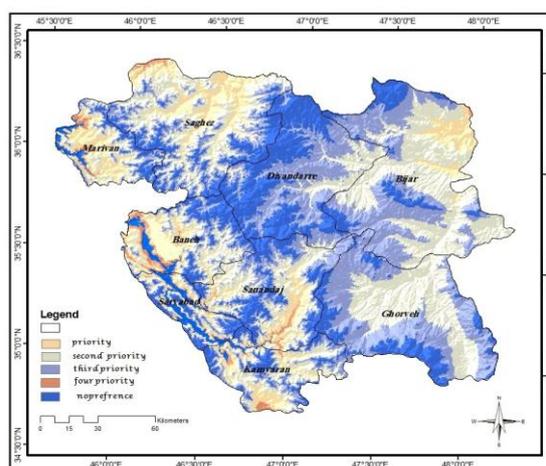
**Table 3.** Completion date phenological stages of grapes plant.

Grapes ripening on	Stem maturation date	Flowering date	Germination date	Minimum threshold incidence date	Altitude	Station
7 October	15 June	6 May	22 April	24 March	1883	Bijar
10 October	18 June	9 May	26 April	26 March	1522	Saghez
27 September	12 June	2 May	21 April	21 March	1373	Sanandaj
23 September	11 June	1 May	19 April	21 March	1286	Marivan
9 October	19 June	11 May	28 April	30 March	1379	Kamyaran

Completion date of each phenological stages is a favorable method to determine the best time of viticulture based on critical threshold, as well. Calculated dates are consistent with the optimum time.

*4- Areas suitable for viticulture*

According to the results, at the germination and flowering stages, Marivan station shows less deviation from optimal conditions than other stations. At stem-maturation stage, Marivan shows less deviation from optimal conditions than other stations, however, a no big difference in deviation from optimal conditions could be observed. At ripening stage of grapes, Marivan has lower deviation, followed by /sanandaj and /kamyaran stations., and Saghez and Bijar stations have higher deviations; therefore, Marivan station has the least deviation from the optimal conditions, at all stations. According to agro-climatic analysis, best viticulture areas are located in the western and central regions (Marivan and Sanandaj stations). While, northwestern, northeastern and southern regions (Saghez, Kamyaran and Bijar stations) are next in the ranking. This means that these stations ( Marivan and Sanandaj ) enjoy the optimal conditions for viticulture.



**Fig. 2.** The total deviation from optimal conditions for grapes plant.

*5- The proposed varieties for viticulture according to climatic conditions*

According to the climatic conditions of each region, suitable grape varieties should be selected for cultivation of grapes plant.

According to the agro climatic conditions of the study area, grapes varieties suitable for the cultivation include yellow and red raisin and Fakhri.

Suitable varieties of grapes for cultivation in Kurdistan region are raisins, Asgari, Fakhri, Khoshnavar and Rah-Shah.

### Conclusions

The environment, in which we live, consists of a series of factors including weather conditions and climatic related phenomena. Weather conditions, is one of the factors determining the type of plants that are cultivated in any region.

Agricultural activities are highly interconnected with natural factors and climate and environmental conditions.

Weather conditions is on top of the natural factors affecting agricultural activities, by which it affect the agriculture, either with a single element or a combination of several elements. Iran, having a special climate in each area, has suitable ground for production of various strategic agricultural crops and climatic parameters, illustrate different types of climates in the territory. Knowing the God-given gifts and the need of the region for researches like this, which shows the local agro-climatic potentials for cultivation of grapes plant, this study is conducted. Based on analysis of deviations from optimal conditions at different altitudes of the stations, Marivan station has the optimum conditions for grapes planting, among selected stations. This is important in terms of development of cultivation areas and commercial crops cultivation, as well. Based on agro-climatic analysis, most suitable viticulture areas are located in western and central regions (Marivan and Sanandaj stations). While eastern, northwestern and southern regions (Bijar, Saghez and Kamyaran stations) are next in this ranking.

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