

Research Article

Identification of the effect of optimal climatic elements on Khansar county apiaries' performance

Maedeh Beigi^{1*}, Hamideh Beigi² and Mansour Nejati³

^{1*}M.S Student in Watershed Management, Faculty of Natural Resources,
Islamic Azad University, Meybod Branch, Iran.

E-mail: Beigimaede1987@yahoo.com

²Assistant Professor, Management Department, Faculty of Literature and Humanities Science, University of
Guilan, Iran. E-mail: h.beigi@guilan.ac.ir

³Veterinary physician, Therapist and counselor in Honey Bee, Isfahan, Iran. E-mail: dr.nejati110@yahoo.com

ABSTRACT

Conditions governing the weather, type of climate and beekeeping industry, are three effective and important factors that receive attention in a global level. All human activities are directly or indirectly influenced by climatic elements. Beekeeping industry is an important agricultural production field that is closely related to optimal climatic conditions because thousands of urban and rural households earn a living from it. Khansar county is of the country's important honey production centers, and by paying attention to the quality of its apiaries' honey production, the country will be developed more. In the present paper, by investigating Khansar's synoptic station's meteorological statistics in a 12 year climatic period, it was revealed that there's much association between the climatic elements and the quality of the honey produced. Among the elements, the temperature and total rainfall have proven to be most influential.

Keywords: Weather; climatic factors; apiary; Khansar County.

INTRODUCTION

Climate is one of the most important factors that has received attention throughout history from mankind and the reason of it is the important role of climatic elements on human life and particularly agricultural productions (Mohammadi and Moghtaderi, 2006:340 and Golchin and Jalali, 2010). Today, beekeeping is recognized as an agricultural field in most countries around the world (Rastgar et al. 2005:3) and since agricultural activities depend on natural environment, human has always tried to minimize natural limitations (Dehghaniyan et al, 2000:75). Evaluations show that the share of honeybee in increasing agricultural productions, is 69 to 143 times the amount of its direct production (Tahmasbi and Purgharai, 2000:131). In addition to its indirect productions, honeybee

has created the foundation for the occupation of a majority of population by direct productions including (honey, pollen, royal jelly, poison and etc) and using them in various industries including food, pharmaceutical, paper, etc. industries (Golchin and Jalali, 2010). Not much study concerning the effect of climatic elements on honey production has been done in Iran, nevertheless, with its suitable climatic conditions; Iran has long been a center for beekeeping. This has also been the case in the county of Khansar, it has various apiaries and vast pastures with a potential for beekeeping that has a significant share in the income of a group of the city's population. By investigating the activity of various honeybees to identify their pollination capability

over plants around the city of Riyadh, Saudi Arabia, Al Ghomdi (2003), concluded that there's a correlation between honeybee activities and temperature and relative moisture during different seasons of a year. Such that during spring and winter, the correlation between honeybee activity and environmental temperature, is positive and weak and with relative moisture the correlation is of negative and weak type. But during summer, the effect of the climatic elements changes, such that honeybee activity, shows a weak and negative correlation with environmental temperature, and positive and weak correlation with relative moisture. Also, the relation between temperature and relative moisture with honeybee activity has been weak.

Al Kahtani (2003) and Al Gharni (1995), analyzed the effect of climatic conditions on honeybee hives and evaluated the effect of high temperature on queen's egg-laying and bees' larvae laying performances, and also evaluated the method for sap collection and concluded that the beehives in the Riyadh area, begin their activities before dawn (Golchin and Jalali, 2013). They realized that native bees have higher temperature tolerance capability and lose less weight compared to other bees.

(Kontera et al, 2004), studied the effects of different times of a day, temperature, moisture level and air pressure on stingless bees' flight, and concluded that flight activities in this type of bees, are influenced by atmospheric conditions, daytime elements, temperature, moisture and pressure.

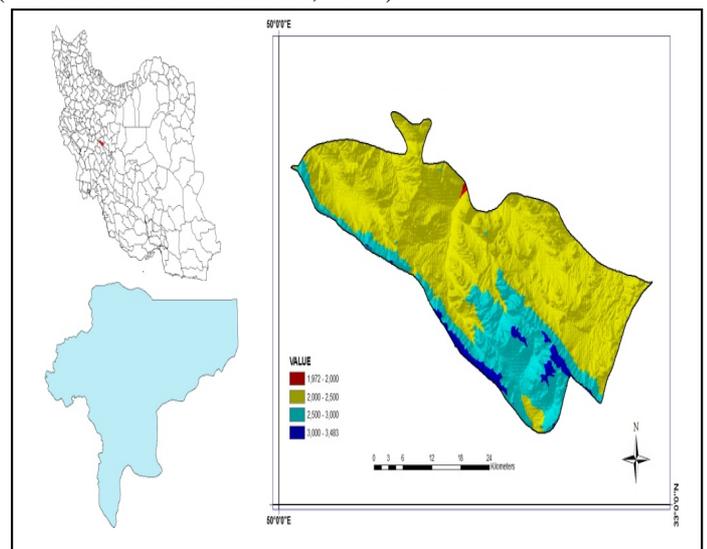
By studying the effect of geographical and climatic conditions on the separation of Iran's small honeybee colonies, Tahmasbi et al, (2001) concluded that the features related to the body and size of a small honeybee is not correlated with some climatic variables such as wind, minimum annual temperature and the number of frost days, but the amount of areas' rainfall is significantly and positively correlated with physical features such as foot length, front wing length, front wing width, rear wing length, rear wing width, height, and honeybees trunk length. Also areas covered by small honeybees' distribution, like productive and more humid

areas, have bigger bees. In brief, differential climates of different regions, distinguish Iran's small honeybee colonies in the east and west of the country's southern strip (Golchin and Jalali, 2013).

Given the position of Khansar in the country's honey production, it seems important to evaluate the effects of optimal climatic elements on the apiaries performance. The present research has been carried out to find the relations between each of the climatic elements of temperature, rainfall and etc. with honey production of the study area, based on statistical analyses and measurement of the ideal amount of these elements on honeybee activities.

MATERIALS AND METHODS

Khansar county: is located in northwest of Esfahan, and leads to Golpayegan to the north, and to Tiran - Karvan and Najaf Abad to the east and Ferydan to the south and the west. With a 900 km² area, it is located in the central part of Iran in the mountainside of Zagros (Mount Khansar). This county is located at 33 degrees latitude and 13 minutes north latitude and 50 degrees longitude and 19 minutes east longitude. Khansar is located in a mountainous area and is 2250m higher than the sea level (Moosaiebi and Moosaiebi, 2012).



Picture (1), The geographical Map and height status of the area.

Due to the great height of this city from the sea level, its climate is moderate during summer and relatively cold during winter, and for this reason,

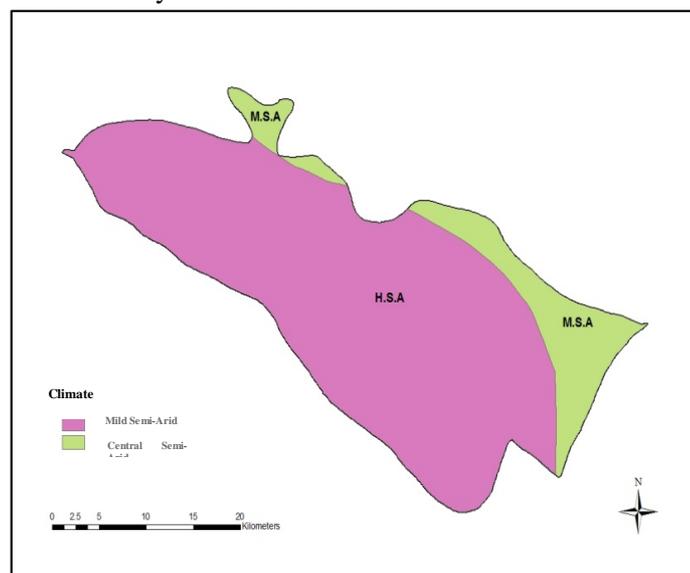
it has up-country conditions. The existence of abundant water wells and green gardens has provided proper conditions for tourism attraction. During the cold seasons of a year, the air temperature reaches down to 20 degrees below zero, and during the hottest days of summer, the temperature increased up to 38 C, and the relative moisture degree is 32.2. The average annual rainfall is 375 mm, and during the past 10 years, the lowest and highest rainfall levels were reported as 198 and 525mm, respectively (National meteorological organization, 2014).

Climatic factors:one of the most fundamentals factors in the earth's structure is climate, and doubtlessly, the nature, human and all other life manifestations are greatly influenced by climatic conditions (Jafarpur, 1987). The climate of any territory is considered as a very important factor in the division of biological and environmental areas of that region and vegetation , animals and soils distribution depend on climatic conditions. The study area, that is a small part of Iran, is one of the general surface factors of the planet, and it's an influential countrywide factor and is of local factors. The aforementioned elements will create meso-climate of the region and cause diversity in its microclimate.

Generally, the area climate is under the influence of two general regional flows. The dependence of the region on the Eastern frontal mountains of Zagros has a decisive role in the regional rainfalls. On the other hand, closeness to desert areas such as Qom and Kashan, contribute to the dryness and low rainfall of the region, such that as we move towards the west and southwest from the north and east of the region, that means, as we get further away from the desert lands and approach Zagros, atmospheric rainfalls increase. Such that, the level of rainfall in the east is about 200mm while it reaches over 450mm in the western part of the area.

The influence of the rainfall can be clearly seen in the density of vegetation, such that the pastures of the western part of the region, are of countries rich pastures whereas only 50km to the east, the pastures lose their richness and

vegetation density. Also, due to approximately sufficient rainfalls in the western parts of the area, despite the mountainous being of the region, the lack of soil and the existence of transportation problems, the human habitats there are more concentrated than the eastern part. And the reason for that is the triple rainfall level of the western area compared to the eastern area. Picture (2), shows the climatic categorization of Khansar county. Based on this map, the study area is located at a semi-arid area that is mainly moderate semi-arid.

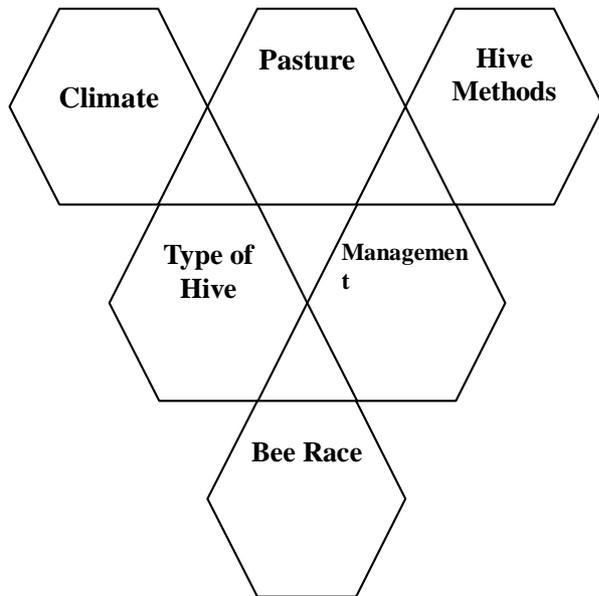


Picture (2), Map of Climatic classification of Khansar County

Apiary: is the location of bee colonies. Good management of an apiary, is a prerequisite for beekeeping, and it turns it to a beneficial work. Beekeeping is not difficult and doesn't need as much effort as farming, but there are many delicate points in keeping any colony alive, the knowing of which is necessary for any beekeeper. One of these points is the climatic condition of an apiary. The following conditions are not suitable for the location of an apiary: unbearable temperature conditions for the bees, continuous and excessive rainfall, and cloudy weather during most periods of a year, heavy winds, humid or foggy weather, and sudden change in weather temperature and weather pollution. In addition to the points above, the following tips should be considered when establishing a permanent apiary:

- **Establishment of necessary facilities:** for the ease of work related to an apiary, all the required facilities of the apiary should be constructed and the necessary tools should be provided. Necessary apiary facilities include: summer and winter location, work room workshop, stock, shelter, frames disinfection room, shower and drinking place.
- **Fencing around the apiary:** It's advised to draw a fence around the apiary to prevent intrusion from different people and animals into the facilities.

Based on Picture (3), the factors influencing apiary and beekeeping activities are shown. Among the mentioned factors, climate and optimal climate conditions, are recognized as the most important factors for honeybee activity.



Picture (3), Factors in beekeeping

DISCUSSION

In order to identify the optimal climatic factors influencing Khansar county apiaries, initially, meteorological data were collected from a complementary synoptic station in Khansar in a 12 year statistical period (2005 to 2016). The synoptic station of Khansar is located at 50 degrees longitude and 19 minutes east, and 33 degrees latitude and 14 minutes north. Also the data related to honey production, in this same period, were provided from the Department of Animal Agriculture Organization. Then, with the

use of the Excel software, the statistical data were analyzed and the corresponding climatic statistical maps were drawn, also with the use of the ArcGis 9.3 software, the size of the maps of Khansar were extracted. The primary evaluations showed that the factors of temperature and rainfall have a higher influence compared to other climatic factors such as sunny hours, relative moisture, wind and etc.

*** Investigation of temperature in the study area**

Temperature is the measuring of a thermal energy that can be measured in soil, air and other materials. All organisms are directly influenced by heat. The study about energy balance shows that temperature changes as a result of radiant energy changes (Jafarpur, 1987).

Temperature is a climatic factor that is studied as one of the main environmental variables because it directly influences vital processes, and accuracy in its process, is important for economic-social planning and agricultural activities and land preparation. In beekeeping industry, attention to climatic points and issues including sensitive temperatures for a honeybee is necessary. This sensitivity varies in different races. Such that tropical native bees, are more resistant towards higher temperatures and are more sensitive towards cold, and conversely, cold climate native bees are more resistant towards lower temperatures and more sensitive to higher temperature (Shahrestani, 1995). Sensitive temperature conditions for a honeybee are:

- A human body senses one tenth the amount of a change in temperature compared to a honeybee. Such that if we put a human in a room and change the temperature of the room by +/- 2 degrees, then he/she won't sense it, but it only takes 0.2 degrees of change in the temperature for a honeybee to sense it.
- The temperature inside a beehive is 35centigrade degrees. This temperature is ideal for the growth of the newborns, evaporation of honey water and also the

body activities of honeybees. In this temperature, the bees neither need fuel to warm up the hive nor do they need water to cool it down. In other words, if the temperature is below this level, the bees will try to consume honey and rub their bodies against one another to create heat and increase the temperature to 35 centigrade degrees, and the temperature is below this, then they will bring water and spray it in the hive and flap their wings to cool the temperature down to 35centigrade degree. This temperature is the ideal for the growth of the newborns. In lower temperatures, the larvae will grow slowly. If the temperature is high, not only the larvae will be suffocated, but by reaching to the melting point of the wax (70 centigrade degrees), the hexagon construction of their wax, softens and if it's heavy enough (full of honey, pollen or pupa), there's a chance the hive will collapse. But during winter, sometimes the temperature inside a hive reaches to zero and or even below. But due to the clustering of the bees, this temperature does not kill them. But if a honey bee is exposed to this temperature alone, then its wings and legs will be paralyzed. If we place the bee in a place with a temperature of +8, then the bee will continue to live again. But if the bee

remains in this paralyzed status, then its death will be certain.

- In temperatures below 8 centigrade degrees and above 49, the wing muscles of honeybees are paralyzed and cannot fly. For this reason, the bee won't be able to fly but can still walk.
- Whenever the temperature inside a hive reaches below 8, the bees will form clusters (Samataro and Avitabile, 2010). Honeybees can survive temperatures as low as -30 centigrade degrees during winter.

By investigating temperature parameters of Khansar county in a 12 year statistical period that included average minimum temperature, average maximum temperature and average temperature, it was discovered that in the statistical period of 2005 to 2016, the coldest month of the year was January with an average temperature of -0.1 centigrade degree, and the absolute minimum of -12.6 centigrade degrees happened in the same month. The hottest month of the year was July with an average temperature of 12.7 centigrade degree and an absolute maximum of 34.2 degrees. Therefore, there's 26.3 degrees of difference between the warmest and coldest months of the year and the temperature difference between the absolute minimum and the absolute maximum is 46.8. Table (1) and diagram (1), show the temperature parameters of Khansar in the 12 year statistical period.

Table (1)-Temperature parameters of Khansar in the 12 year statistical period (2005 to 2016)

Station Month	Khansar		
	Minimum	Maximum	Mean
January	-12.6	10.2	-0.1
February	-11.8	12.3	2.1
March	-5.7	17.5	7.3
April	-0.7	21.3	11.7
May	4.8	26.3	17.1
June	9.3	32.3	23.4
July	14.7	34.2	26.7
August	13.6	33.6	25.2
September	8.9	29.8	21.4
October	2.6	24.5	14.8
November	-3.9	17.2	6.8
December	-10.4	13.7	2.3

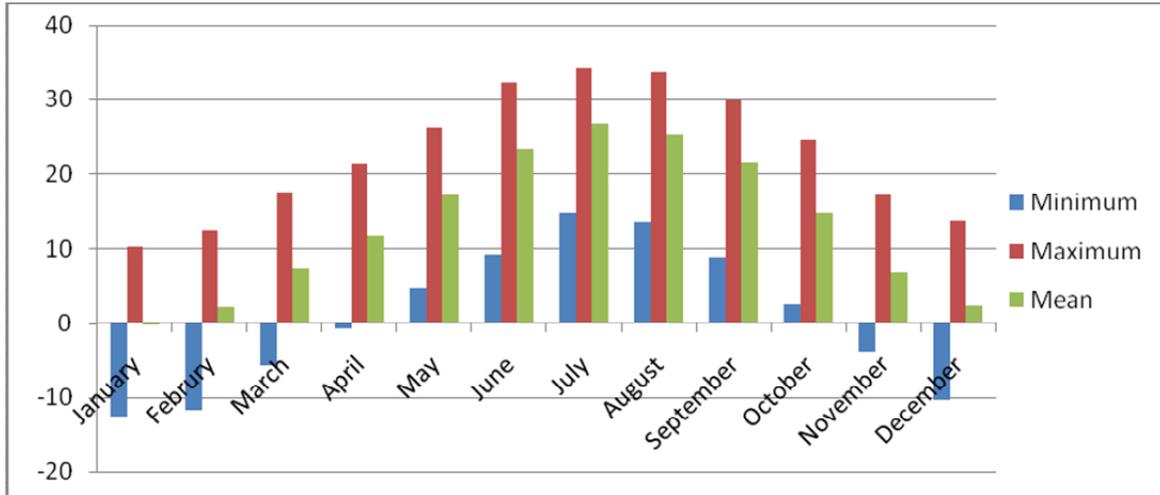


Diagram (1)-temperature parameters of Khansar in the 12 year statistical period (2005 to 2016)

***Investigation of rainfall in the study area**

Rainfalls in the Khansar region like other regions of Iran start simultaneously with the activation of Mediterranean and Atlantic streams and their movement in the western bands towards Iran begins in cold seasons. In autumn, simultaneous with the retreat of subtropical jet stream towards the south and stopping on Africa, the possibility for the coming of west winds towards Iran raises and the rainfalls begin. Naturally, as we move towards the west, the starting time for rainfalls falls forward and the rainfalls are intensified. Rainfall in west of the region, begins in October, but sometimes, no rain comes until near November 20th. The area rainfall, given the weighted average of the regional rainfall, was calculated as approximately 375mm. Table (2), shows the monthly and annual rainfall of the study station during the statistical period of 2005 to 2016. Diagram (2), shows the changes in rainfall during different months of the year of the Khansar station during the statistical period. In this period, December has the highest level of rainfall that is 60.5 mm, and July, has the lowest rainfall level that is 2.1mm.

Table (2) . The monthly and annual rainfall of the Khansar station in the 12 year statistical period

January	February	March	April	May	June	July	August	September	October	November	December	Annual
31.3	51	56.9	59	27.4	2.7	2.1	2.9	3.1	23.9	54.4	60.5	375

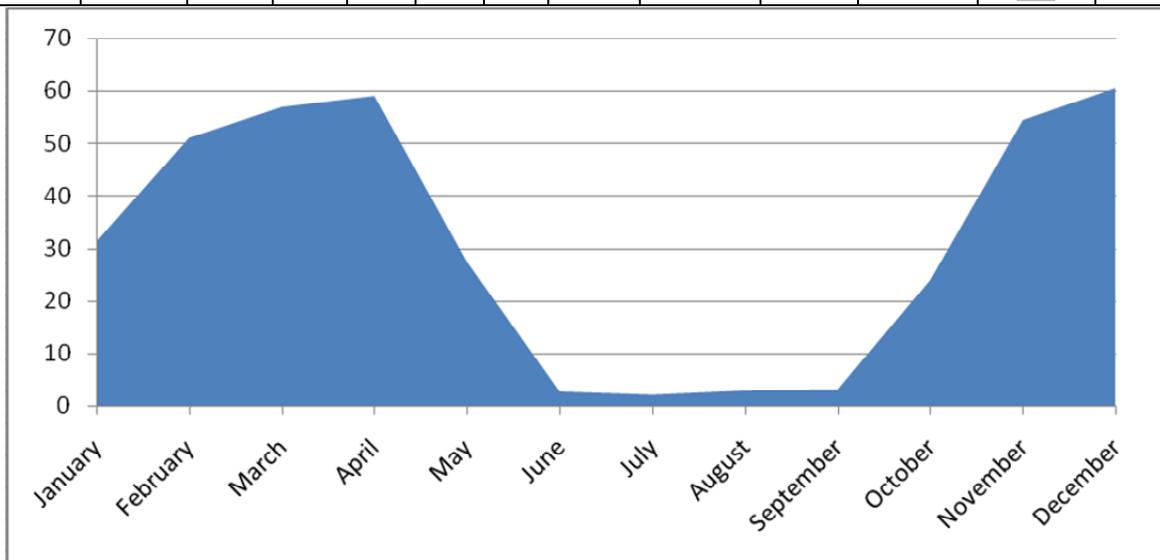


Diagram (2). The rainfall changes during different months of the year in Khansar in the 12 year statistical period of 2005 to 2016.

***Investigation of relative moisture in the study area**

Relative humidity (relative moisture) is the proportion of the existing absolute moisture in any volume of air with a certain temperature to maximum absolute moisture that can exist in that volume of air. In other words, the mass ratio of water vapor in any volume of air to that same volume of air in a saturated mode is called, relative moisture. Therefore, the level of relative moisture equals or is less than one unit, but to express it, its percentage is considered. The average for relative annual moisture in the Khansar station is 47.8 percent, and during an observation in the station, the minimum annual moisture was 36.8% and the maximum annual moisture was 60.2%. The maximum of relative moisture was registered in January that was 64.5% for Khansar. The minimum relative monthly moisture of 30.4% for the station was registered in July. Table (3), shows the relative moisture level of the study area. The relative moisture is reduced during the cold months of the year and simultaneous with the increase in temperature, and it restarts to go up with the beginning of the cold season.

Table (3)- Monthly relative moisture of Khansar's synoptic station

January	February	March	April	May	June	July	August	September	October	November	December
64.5	60.9	54.8	45.7	41.3	32.7	30.4	30.7	39.7	51.7	58.9	62.3

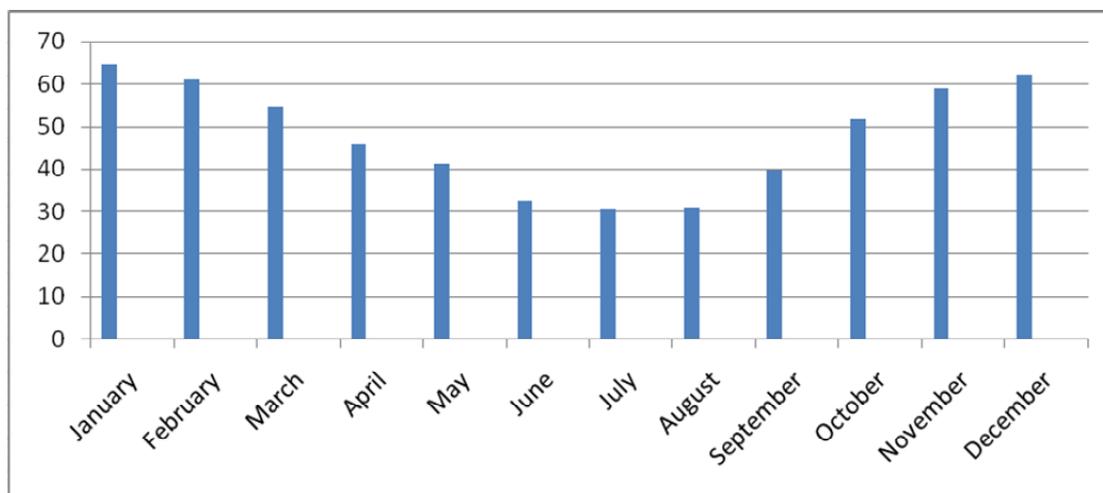


Diagram (3). The - Monthly relative moisture during different months of the year in Khansar in the 12 year statistical period of 2005 to 2016.

***Apiary performance timing**

The queen bee, starts to lay eggs in the optimal climatic conditions of Khansarin February, and increases the number of the eggs every day, until in early June, she lays 2500 eggs per day and the weight of the eggs laid, exceeds the weight of the queen (the weight of each queen egg equals 0.5 milligram) (Haji Sharifi, 2013). The rate of egg-laying and the honey consumption of the bees of an 8 frame hive are given in table 4.

Table (4)-Beekeeping calendar

Month	The number of eggs	Honey consumption(gr)
January	-----	500
February	-----	1000
March	15000	2000
April	30000	5000
May	35000	
June	40000	
July	30000	
August	20000	
September	15000	
October	10000	500
November	5000	500
December	15000	500
Total	200000	

CONCLUSION

The aim of this research was to investigate the effect of the optimal climatic elements on Khansar apiaries and identify the most important climatic elements, and in order to do that, the meteorological data of the Khansar station for a 12 year statistical period were collected and analyzed. The analyses of this research showed that the climatic elements of temperature and rainfall are important criteria in the performance of apiaries. Since a honeybee's performance hits its maximum in temperatures of 20-25 centigrade degrees, during the months of June, July, August and September, due to the optimal temperature conditions, the amount of honey produced from beehives is multiplied, and due to the role of rainfall in pasture enrichment, the period between November 20 to January 20, despite the high level of rainfall, has the lowest honey production rate because the activities of bees are limited due to raining.

REFERENCE

1. Jafarpur, A. (1987), *Climatology*, Tehran university publications.
2. Haji Sharifi, A. (2013), "Encyclopedia of Honey Therapy in Iran", Hafez Novin Publications.
3. Dehghaniyan, S. Kuchaki, A. and KallahiAhari, A. (2000). "Agricultural geography", second publication, Mashhad, Ferdosi University Publications.
4. Rastegar, Sh. Barani. H. Sepehri, A. and Akbarzade, M. (2008). "Determining the attractiveness of pastures plants used by bees, and providing a beekeeping supplies calendar in rangelands of Polur". Magazine of agricultural science and natural resources, No. 1, pp 1-12.
5. Samataro, D. & Avitabil, A. (2010). "Practical guide for beekeeping". Translated by MazaherSeyedi and Mohammad BagherFarshineAdl, Zayanderud Publications.
6. Shahrestani, N. (2014), "Honeybee and honeybee keeping", Sepehr Publications.
7. TahmasbimGh. Ebadi, R. Tajabadi, N. Akhundi, M. and Faraji, S. (2002). "The effect of geographical and climatic conditions in the separation of small honeybee clusters of Iran", *Journal of agriculture and natural resources science and techniques*, No. 2, oo-169-175.
8. Tahmasebi, Gh. And Purgharayi, H. (2000). "Investigation of the role of honeybee in pollination and increase of Iranian agricultural productions, agriculture and development economy, No. 30, pp -131-144.
9. Golchin, M. and Jalali, A. (2009), "Investigating the effect of weather elements in the performance of modern beehives of Ahar city", *science and research magazine of geographical space*, tenth year, No. 29, pp181-197.
10. Golchin, M. and Jalali, A. (2013). "Investigating the effects of weather elements in the production of native beehive of Ahar city". *Magazine of geography and planning*, No. 45, pp 183-202.
11. Mohammadi, H. and Moghtaderi, Gh. (2007). "The relation between climatic parameters and the problem of the dehydration of date clusters". *Biyaban magazine*, No. 2, pp339-346.