



## Effect of Seasonal Winds On the Pistachio Trees Productivity of Sirjan in the Last ten Years

Farshid Rafati<sup>1</sup>, Saman Hajmohamadi<sup>2</sup>, Sohrab Hajmohamadi<sup>3</sup>

1. Department of agriculture, Islamic Azad University, Sirjan, Iran

2. Department of Chemistry, Islamic Azad University, Sirjan, Iran

3. Young Researchers and Elites Club, Sirjan Branch, Islamic Azad University, Sirjan, Iran

### Abstract

Pollination is the mechanical transfer of male pollen of a flower on the female stigma. This process has a fundamental role to survive the plants species. Since this process is invisible, its importance has been ignored. Insufficient pollination can be harmful for the farmer instead of being useful. Pollination can be done via some ways. The most important ways are done by insects and wind. Pistachio tree because of different sorts of its pollination is significant. To implant the pistachio trees in a 100-meter row, thirty female trees and just one male tree is needed that the male one is put in the front of the row. Spring season (April) is the season of pistachio tree pollination. Wind speed and direction are basic factors for pistachio pollination. In this paper, the speed of seasonal wind of Sirjan has been researched during ten years (2002-2012) and the pistachio gardens productivity were compared. (The gardens which were in front of wind direction).

**Key words:** Pollination, Pistachio, Productivity, Sirjan

### Introduction

Pollination has a fundamental role to survive the plants species. Since this process is invisible, its importance has been ignored. Insufficient pollination can be harmful for the farmer instead of being useful [1]. Pollination is a complicated process that various factors interfere in it such as heat, moisture, plant nutrition and pollinators. Although some of these factors are uncontrollable, but some of them can be controlled by the farmers [2]. Pollination is the mechanical transfer of male pollen of a flower to the female stigma [3]. This function can be done via some ways that the most important ways are done by insects and wind [4]. In cross-pollination, the variety of a male pollen transfers to the variety of different female pollen [5], but in self-pollination, the variety of a male pollen transfers to the variety of the same female pollen or the same flowers and plants [6]. The economical significance of cross-pollination had identified before its biological importance many years ago [7]. Farmers and ranchers in the United States continuously find out that their only properties are not their lands and water, but the wind is their another property, as well [8]. Among the plants, pistachio tree, because of its different sort of

pollination, is significant. In a 100-meter row, there are thirty female trees and just one male one that is located in the front of the row and it is the pollinator. Also, Spring (the end of March month) is the season of pistachio pollination. Due to climate, the speed and direction of seasonal winds, pollination of pistachio is various in arid and semi-arid regions especially in Sirjan.

### **Introducing the pollination & crop productivity**

Pollination is the transfer of pollen seed from anther to the stigma. This transfer factors are different depending on plant species. The most important factors include:

**1. Wind:** Wind is the factor of pollination in these plants: Corn, rye plant, Sugar cane, Sugar beet, date, Pistachio, olive, spinach, and hemp.

**2. Insects:** Pollination of the plants such as gladiolus, spearmint, clover, trefoil, onion, cherry, apple, pear, cocoa, carrot, sunflower, cabbage, and caoutchouc tree is done by insects.

**3. Birds:** In some plants the factor of pollination is birds. They transfer the pollen from one flower to another, or from a root stock to another one, e.g. hummingbird transfers pollen in pineapple tree and sometimes in tobacco.

**4. Water:** Pollination by water is fairly rare. In some aquatic plants, the movement of pollen seed is the factor of pollination. In anemone, when the water is collected in the corolla, and pollen is floating on water and reaches on the sigma surface, the self-pollination takes part. In black pepper plant, the rain drops cause the distribution of pollen and cross-pollination occurs.

**5. Gravity:** In wheat and barely, pollen transfers directly to the stigma due to its weight. These kinds of plants mostly are self-fertile.

By this introduction, we review two kinds of pollination in the nature. I mention once more that pollination mechanism is the first step of this functional program. In plant inbreeding with sexual reproduction, mostly there are two types, self-pollination and cross-pollination groups [9].

a) Cross-pollination plants :

Transfer of pollen seed from another of a flower to the stigma of another flower or root stocks is called cross-pollination. The plants with 95% of self pollination are called self-pollination plants, and the plants with 5% of cross-pollination are called cross-pollination plants. The rate of self or cross pollination is changeable based on these factors: Variety, race, environmental and climatic conditions, speed, wind direction and the insects population.

b) Natural self-pollination plants

The population of these plants are self-pollination: Wheat, barley, oat, soybean, apricot, peach, eggplant, tomato, and celery. The rate of cross-pollination of these plants often changes from 0% to 5% [10].

### **Artificial pollination in the Pistachio Gardens:**

Pistachio is a dioecious plant. Dioecious plants are the plants whose male and female flowers are put on different root-stocks. In this sort of plants, pollination is very vital to produce the crops and fruits. Usually, the male pistachio plants give fruit earlier than females in spring

season. Studies have showed that the flowers in female plants of pistachio open gradually, so the female pistachio plants that are opened earlier, have more opportunity for inoculation than the others. Unfortunately, the female pistachio plants that open later or never, have no chance for inoculation, since the male plants do not have any pollen in the air and have stopped their pollinations. In addition to unbalanced activity between male and female pistachio plants in spring season, there is another complicated case. It is related to the number of male plants which are less than female one.

Of course, in California, the number of male pistachio plants are normal due to more attention to them. To set the male pistachio plants between the females, there is a special form of pollination that is completely paid attention to it in developed countries such as the United States. The standard ratio of male to female plants is normally estimated 1 to 8, or 1 to 14. Unfortunately, in Kerman of Iran, pistachio planting, there is no such ratio, and number of male plants are much less than females. This problem has a lot of reasons.

To solve the first problem i.e. unbalanced activity between male and female plants and also decreasing the fertilization output, a lot of studies and efforts have been done in the world that unfortunately, in Iran (the biggest world pistachio exporter) none of these actions have been done, and it is very astonishing. One of the solutions to solve this problem is artificial pollination. Artificial pollination increases the fertilization and inoculation in female plants. Artificial pollination help approximately all plants to fertilize, and it is a very useful mechanism. According to studies, artificial pollination increases the number of clusters, the number of grains in clusters, and decreases the porosity of pistachio as well. Researches show that the pollination of pistachio plants is done by wind i.e. the more blowing of wind, the more fertilization in female plants [12].

Electrostatic pollination is a new method of pollination that does not have a long background. Electrostatic pollination have been so effective in many fruit gardens like apple, almond, hazelnut, olive, and recently in pistachio gardens of California. In electrostatic pollination, pollens are examined by a special test before they are used for pollination. In this way, it is understood that either they have the ability to fertilize or not. Putting the pollens in the machine and splashing them by electrostatic pollinator in an appropriate time helps the female plants to fertilize [13].

### **Traditional Form of Artificial Pollination**

The activities that have been done by Sirjan Farmers show that artificial pollination has had a significant effect on the pistachio productivity. According to Scientific theories, appropriate and sufficient pollination triples the rate of trees productivity. In the applied traditional method, the pollens of male flowers are gathered, then in the ratio of 1 to 3, are mixed with flour. After that they are put in a pair of stockings and are twisted in the air by a worker. The pollens of male flowers are scattered in the air and in this way they are able to touch the female trees in a closer distance. Thus, the fertilization will be performed more completely.

### **Pollination by Generating the Artificial Wind**

The artificial wind was generated by making a big 3 in 3 meter fan which could create the speed of monsoons. The speed of monsoons are at least 15 Km/h, of course, this rate is variable. In the time of pistachio pollination (March), the highest speed of monsoon is 14.4 Km/h, and the

direction of their blowing is from South to North. According to experimental results, the sufficient speed of pollination of pistachio trees is 10-14 Km/h. This wind speed with the direction of it was examined for the pistachio gardens of three regions in Sirjan. The following results are given:

**Table 1.** Tested villages of Sirjan and the rate of wind effect on production of the gardens

Region	Wind speed (m/s)	Gardens area (m <sup>2</sup> )	The difference between pistachio harvest compared with the other parts of garden (ton)
Mahmudabad	3	5000	1
Fakhrabad	3	3000	1.5
Dasht-e-Zar	3	10000	1

It is necessary to mention that the wind direction has been performed by the direction of male and female trees. And the harvest contains fresh pistachio.

### The Comparison Between Harvests and the Wind Last Years

As it was mentioned before, the time of pistachio pollination is in March every year. The wind speed in this period of time in Sirjan is between 7.2-14.4 Km/h, and the wind direction mostly is from 120 to 140 degrees (southeast). Table 2 shows the speed of monsoons and their directions and also the average harvest of pistachio in March.

**Table 2-** Monsoon speed and direction, the rate of harvest during recent 10 years.

Year	Monsoon (Km/h)	Speed (Km/h)	Production Rate (ton)
2004	10.8	122	25000
2005	10.8	115	37000
2006	7.2	102	30000
2007	10.8	113	43000
2008	10.8	132	40000
2010	10.8	100	5000
2011	10.8	146	37000
2012	14.4	131	35000
2013	14.4	138	25000
2014	14.4	142	45000

\*Year 2009 is not mentioned in the table because of cold temperature injury, the rate of production has had a significant reduction.

According to mentioned data, the most rate monsoons blows from South and Southeast of Sirjan. Based on this data, the amounts of pistachio harvest in South of Sirjan have been collected which are presented in table 3.

Table 3. The rate of pistachio harvest in the gardens of South Sirjan (direction 165 degrees)

Year	Monsoon speed(Km/h)	Production rate (ton)
2006	7.2	5800
2007	10.8	10000
2008	10.8	11000
2010	10.8	1600
2011	10.8	11500
2012	14.4	14000
2013	14.4	13500
2014	14.4	16500

### Conclusion

Wind speed increasing with monsoon direction has a great effect on the pistachio fertilization. According to the directions mentioned in table 2, it is observed that most of the monsoon directions are from south and southeast of Sirjan. Therefore, the gardens that are located in the direction of such winds/monsoons, have produced suitable crops, of course, they should be planted in an appropriate condition especially the male ones.

According to table 3, we can see the crops increasing because of the wind speed increasing. That is why, the data of table 3 refers to the south part of Sirjan which is influenced directly by the monsoon direction. The other factors have not had any effect on pollination. Naturally, the speed of wind is effective on pollination but if it increases, it can reduce the probability of pollination.

### Recommendation

Based on the direction of monsoon in spring season in Sirjan, the farmers can be guided to plant the male and female trees (the male trees can be changed into female trees by transplant). In this way, the wind blowing can have the most influence on trees pollination. Generating artificial wind at the speed of 10-14 Km/h can be influential in trees pollination as well.

### References

1. Polman. J.M. and Sliper. D.A. 2002. Crop development. translated by Ahmad Arzani, Isfahan Polytechnic University Press.
2. Fahr. W.R., 2003. Crops principles, Translated by Reza Sadrabadi et al, Mashhad Ferdosi University Press.
3. Karimi. H., 1981. Alfalfa, Tehran University Press.
4. Karimi. H., 1981. Cultivation and forage crops development, Tehran University Press.

5. Anonymous. 1998. Excerpted from Beekeeper's Handbook, Sammataro /Avitable©1998. Pollination and Bee plants.  
[www.gears.tucson.ars.ag.gov/beeclass/Pollination](http://www.gears.tucson.ars.ag.gov/beeclass/Pollination).
6. McGregor, S.E. 1976. Insect Pollination of Cultivated Crop Plants. USDA.
7. Kvasona, E. V. 1998. Pollen Tube Growth and Fertilization in Tripped and Untripped Flowers of Alfalfa (*Medicago sativa*) Inbred Plants. Proceedings of the 36<sup>th</sup> North American Alfalfa Improvement Conference bozeman, MT August 2-6.
8. Palmer-Jones, T.; Forster, I.W. 1972. Measures to Linn.). New Zeal. Jear. Agr. Res. 15(1):186-193.
9. Peterson, S.S., and et.al. 1992. Current Status of the Alfalfa Leafcutting Bee, *Megachile rotundata*, as a Pollinator of Alfalfa Seed. Bee Science 2:135-142.
10. M.P Browse,. 1994 .propagation Plan. London .Limited Book International. P191.
11. M. R. Pordel , R. Ebadi , M. Mobli , B. Hatami . Effect of Pollination on Seed Quantity and Quality of Three Winter Cultivars of Canola (*Brassica napus* L.) in Isfahan. JWSS - Isfahan University of Technology. 2007; 11 (40) :267-276 .
12. Agrawal V, Prakash S, Gupta SC (2002). Effective protocol for *in vitro* shoot production through nodal explants of *Simmondsia chinensis*. Biol. Plant. 45: 449-453.
13. Apostolo NM, Llorente BE, Princen LH, Rossi C (1996). Rooting and acclimatization of micropropagated jojoba seedlings (in Spanish). Proc. 9th Int. Conf. Jojoba and Its Uses, Catamarca, Argentina, 25 - 30 September 1994, pp. 47-49.