



(RESEARCH ARTICLE)



Importance of honey bee in cherry species pollination (Kocaeli/Turkey)

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GSC Biological and Pharmaceutical Sciences, 2023, 22(02), 040–048

Publication history: Received on 01 January 2023; revised on 09 February 2023; accepted on 11 February 2023

Article DOI: <https://doi.org/10.30574/gscbps.2023.22.2.0054>

Abstract

This study was carried out in 3 gardens determined in Başiskele, Körfez and Karamürsel districts of Kocaeli province in 2017-2018. A cherry tree was caged and covered with a 4 mm x 4 mm perforated net before flowering to prevent the penetration of honey bees. Before the beginning of flowering, a honey bee colony was placed in 4 decare in each garden and the net was removed at the end of the flowering period. As a result of our study in two field of application gardens aged 10 and 20 (with Ziraat 900 cherry varieties), it was determined that the approximate yield of the caged tree was 1.5 kg in the garden where the bee colony was placed, whereas the other cherry trees which were not caged yielded approximately 50 kg per tree in the same garden. As a result of the study in our third field of application garden aged 7 (with Regina cherry variety), it was determined that the approximate yield of the caged tree was 2.5 kg in the garden where the bee colony was placed, whereas the other cherry trees which were not caged yielded approximately 30-35 kg per tree in the same garden. This situation concretely shows that dependency on honey bee in cherry pollination is even higher than 90%. Consequently, flowers need bees for pollination and bees need flowers for nutrition. The use of honey bees in the pollination of cherry plant should be made widespread.

Keywords: Cherry; Honey bee; Pollination; Yield

1. Introduction

Bees have an important place among pollinator insects for the sustainable ecosystem. In beekeeping activities, the use of bees in pollination, besides the production of bee products, is very common especially in developed countries. Although pollination studies are carried out in Turkey, they are not used efficiently. These studies were mostly performed with annual plants [1-5]. There are limited number of studies on perennial plants (cherry, sour cherry, plum, apple, pear, etc), the production of which is very important. It was first expressed that bees are pollinators of plants by German Koelreuter and Sprengel in 1750-1800s. Bee colonies could be used in the pollination of fruit trees and determined the importance of cross-pollination (xenogamy/external fertilization) in fruit trees. In subsequent studies, it was determined that the presence of bee colonies near orchards yielded good results for the product [6,7]. Bees provide pollination of many plants while collecting pollen and nectar from flowers to obtain nutrients. Pollination is an important factor in the reproduction of flowering plants (Angiosperms) and is defined as the transfer of pollen from the reproductive organs of a flower of the same species or from the male organs of a flower (stamen) from different variety to the female organ (pistil) [8]. In flowering plants, one of the most important factors that provide efficiency for seed and fruit formation is pollination. Inadequate pollination is a limiting factor for efficiency [9]. It has been reported that it is very important to have suitable pollinator varieties in the garden and to take necessary precautions for pollination so that sufficient and quality products can be obtained from cherry trees in particular [10]. In plant production, honey bees are a good pollinator for many plant species. For this purpose, the use of honey bees has many positive effects such

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as increase in yield, quality improvement and maintenance of continuity of natural life [11,12,13,14]. Honey bees constitute the most important pollinator insect group in nature, as they are widely grown all over the world. Honey bees are of great importance both as plant pollinators and to replace the declining wild pollinators. *Apis mellifera* L. is widely used among all honeybee species, especially for commercial pollination of agricultural crops and other plants. Pollination by the honey bee is necessary for fruit setting in fruit species and is also closely related to fruit quality [15]. The pollination of 70% of the plants in the world is done by bees and more than 80% of the pollination done by bees is done by honey bees [16]. It has been reported that 77% of the plant species from which the world's foodstuffs are obtained need pollination by bees, and 1/3 of human food consists of plants that need bee pollination directly or indirectly [17]. In terms of pollination conditions, it is generally recommended to place 2-5 hives in 1 hectare of garden area, and in studies where honey bees are selected as the main pollinators, it is reported that 2.5 colonies per hectare are sufficient [18]. Good agricultural practices are very important from an ecological point of view. This directly affects the life of living things. These applications are very necessary in the lives of bees [19]. Kocaeli, which had outstanding achievements in fruit growing in previous years, has left its place to construction with the increase of industrialization and population and cherry orchards have gradually decreased. In our Körfez District, which is especially famous for Yarımca cherry, the project of 'disseminating modern cherry cultivation and introducing new varieties' has been implemented in order to revitalize cherry cultivation. Although the cherry fields, which are about to disappear with the project, have increased by 2-3 times, there have been problems in pollination and fruiting in the existing gardens in recent years. In addition to climatic conditions, in order to prevent yield loss due to pollination, the project of expanding the use of honey bees in cherry plant pollination was presented to the Ministry of Agriculture and Forestry as a Publication Project and was accepted. In this study, it was aimed to determine the effects of the use of honey bees in the pollination of 0900 Ziraat cherry variety and Regina variety on the basic fruit quality characteristics.

2. Material and methods

2.1. Experimental area

Kocaeli is located between 40 ° 51' 11 " North latitude and 29 ° 52' 53" East longitude of Marmara Region. The surface area of Kocaeli province is 3,418 km². Turkey is an important region in terms of industry. In the research was determined two field of application garden. These garden were in Naip village of Körfez district of Kocaeli province and Kocaeli Provincial Directorate of Agriculture and Forestry, Practice Garden Kullar Nursery in 2017. In addition, an implementation was performed in a field of application garden in Karaahmetli village of Karamürsel district of Kocaeli in 2018. Implementation areas were given in Figure 1-3.



Figure 1 Naip village



Figure 2 Field of application garden Kullar tree nursery



Figure 3 Village of Karaahmetli (Karamürsel)

Information on field of application area where implementations were performed was given in Table1 and Table 2.

Table 1 Field of application area (2017)

Area	Decar and parcel number	Year/Number of trees	Kind used Pollinator in the garden
Körfez /Naip	4.200/543parcel	10/144	0 900 Stark's Gold
Kullar Nursery	249.700/6640 parcel	20/8000	0 900 Stark's Gold

Table 2 Field of application area (2018)

Area	Decar and parcel number	Year/Number of trees	Kind used Pollinator in the garden
Karamürsel/Karaahmetli	21.028 dec. 147/61 parcel	7/1323	ReginaStark'sGold 0 900 Merton Late Kordia

2.2. Establishment of experimentation and practices

Samples of soil were taken from the three practise gardens determined for the research in accordance with the standard techniques and methods. The analyzes of the soil samples taken were carried out in the laboratory according to standard techniques and methods [20, 21]. Average weather for the study period and the physical and chemical properties of the soil samples are given in Table 3 and Table 4.

Table 3 Average weather parameters (<https://www.mgm.gov.tr/>)

Parameters	Naip Village	Kullar tree nursery	Karamürsel/Karaahmetli
Average temperature (°C)	15.9	16.6	16.5
Average number of rainy days	10.24	9.24	9.35
Average monthly total rainfall (mm)	51.3	50.7	50.6

It has been reported that honey bees are not active at temperatures below 12 °C or in rainy weather conditions, and the air temperatures must be at least 13°C and maximum 43°C in order for the bees to collect pollen and nectar [22, 23]. It was determined that the months in which the study was carried out had suitable conditions for bees to collect pollen.

Table 4 Field of application area and soil parameters

Parameters	Naip Village	Kullar tree nursery	Karamürsel/Karaahmetli
pH	7.45	6.65	6.51
Saturation	64	56	57
Salinity %	0.01	0.01	0.03
Organic matter %	0.89	2.18	1.85
Calciumoxide %	3.5	0.01	0.01
Potassium kg/decars	46	24	41.91
Phosphor kg/decars	12	8	15.18

According to the results of soil samples determined for the field of application areas, all cultural techniques needed to be performed in fertilization, hoeing, irrigation, agricultural control, pruning and cherry cultivation were applied. In Kocaeli province, blooming in cherry trees (*Prunus avium*) takes place in April and May depending on the seasonal conditions and beginning and ending period is approximately 8 and 10 days. In the research, before flowering, the trees to be caged were determined and their width and length were measured to determine the size of the cages. As the trees in the gardens established in Naip village and Kullar Nursery in 2017 had a traditional structure, they were caged using a 3x6 meter iron construction material. In order to prevent the penetration of honey bees (*Apis mellifera*), they were covered with a 4 mm x 4 mm perforated net (the maximum size that the honeybee could not penetrate) before flowering. Before the beginning of flowering, a honey bee colony was placed in 4 decars in each garden. Since there was a bee colony in the garden, only the bee penetration to the caged tree was prevented and the other trees continued to pollinate in a normal way. On 21 March 2017, the Provincial Directorate of the field of application garden and on 22 March 2017, Körfez /Naip Field of application area were caged and in both gardens the nets were removed on 28.04.2017 when the flowering period ended. Field implementations are given in Figure 4a - 4c. On 21 March 2018, a similar implementation was performed with semi-dwarf Regina cherry aged 7 in the field of application garden in Karamürsel District. The nets were removed on 26 April 2018.



Figure 4a Net



Figure 4b Construction



Figure 4c Application of net



Figure 5a Flowering in the garden



Figure 5b Trial tree and beginning of flowering



Figure 6a Experimental group full bloom



Figure 6b Placing of beehives

3. Results and discussion

In the study, no problems were encountered in flowering in the caged tree or the other trees around in the flowering period. The caged cherry tree was continuously monitored and its development was recorded. After flowering, the nets were removed. It was determined that problems occurred in fruit transformation as the pollination of the cheery tree, all the flowers of which were shed, with bees did not take place. Fruit sets of the tree used in the study and the other cheery trees was given in Figure 7 - 8.



Figure7a Other cherry trees in the garden



Figure 7b Trial cherry plants

In the garden selected in 2018 in the Karamürsel district of Kocaeli, semi-dwarf Regina cheery trees aged seven were caged and a similar implementation was performed. The development of cheery fruits in this region was given in Figure 8a. At the same time, the farmers in the research area were trained on the subject in the field (Figure 8b).



Figure 8a Cherries from the experiment



Figure 8b Education of farmers

4. Conclusion

Cherry species are important agricultural products which provide income to our country. This research, carried out to determine the effects of the use of honey bees in the pollination of these products in order to increase their market share qualitatively and quantitatively on the basic fruit quality characteristics, is quite important agriculturally. The main goal in fruit growing is to increase the yield and quality. For this reason, pollination and fertilization should be carried out efficiently. In this study, the effects of the use of honey bees in pollination in the gardens where cherry production was made on the quality of the product. The importance of honey bees in cherry pollination has been determined in this study, as is the case in studies conducted in the world. As a result of the study we carried out in the two field of application gardens aged ten (with 0 900 cherry varieties), it was determined that the approximate yield of the caged trees, where bees could not penetrate, per tree was 1.5 kg in the garden where the bee colony was placed (as a the result of the pollination only with wind and small pollinator insects), whereas the other cherry trees which were not caged and pollinated with bees yielded approximately 50 kg per tree in the same garden. As a result of the study in our third field of application garden aged 7 with Regina cherry variety, it was determined that the yield of the caged tree was 2.5 kg as a the result of the pollination only with wind and small pollinator insects , whereas the other cherry trees which were not caged and pollinated with bees yielded 30-35 kg per tree in the same garden. This situation concretely shows that dependency on honey bee in cherry pollination is even higher than 90%. It was determined that this situation is compatible with the pollination studies performed in different regions of our country.

Consequently, it was once again proved that flowers need bees for pollination and bees need flowers for nutrition. A close cooperation should be provided between cherry cultivators and bee keepers concerning this issue. The use of honey bees in cherry plant pollination should be made widespread. For this purpose, theoretical and practical trainings should be given to the farmers regularly by the competent institutions.

Compliance with ethical standards

Acknowledgments

This study was funded by The Directorate of Training and Publication, The Ministry of Agriculture and Forestry, in the scope of Dissemination of Agricultural Innovations Publication Projects (Project Id: EYYDB/2017-2018/5). We would like to thank our Ministry, Ordu Apiculture Research Institute and Kocaeli Provincial Directorate of Agriculture and Forestry for their support.

Disclosure of conflict of interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

Statement of ethical approval

All applicable international, national, and/or institutional guidelines for the care and area were followed. Also, all procedures performed in studies involving plants and bee were in accordance with the ethical standards of the institution or practice at which the studies were conducted.

Author's contributions

E.G.D. designed the research project and supervised the study. A.M. and A. K. wrote the manuscript text and contributed equally in writing the manuscript. All authors read and approved the final manuscript.

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