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Investigation of Pollen Preferences of Honeybee

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Abstract: This study was established in Agriculture Faculty of Ordu University Campus in test field area. Most of the bee visitings were to phacelia plant by 71.8 number m^{-2}. The second visiting rate was to sainfoin plant by 55.9 number m^{-2}. Alfalfa plant visiting was the least preferred visiting by 1.5 number m^{-2}. In this study honeybee collonies gathered 10 pollen packages from sainfoin plant and phacelia plant followed that by 4 pollen packages by chosen randomly among 200 pollen packages. There was no alfalfa plant pollen in measured pollen packages. Alfalfa plant had the maximum flower quantity by 9317 flowers/number in m^2, phacelia had 7038.2 flowers m^{-2} and sainfoin had 4312.7 m^{-2} flowers. Although, alfalfa plant was in the first place due to flowers in m^2 honey bees did not prefer it as a nectar source.

Key words: Honeybee, phacelia, sainfoin, alfalfa, pollen, Turkey

INTRODUCTION

The presence of living things are connected to plants directly or indirectly and strong common organic links established over time among them. Generally, the partnership is reciprocal. The one of the best example to this is the relationship between honeybee and plant flowers. The flowers need the bees for the pollination, the bees need the flowers to feed.

In order to provide high efficiency in beekeeping is depend on the efficiency of the colony, the colonial power and hard work, the abundance of nectar and pollen sources. Therefore, determined of suitable production areas and capacities provide us to take advantage of using plant source. This will affect the efficiency of production directly Dogaroglu and Genc (1995). In addition, during the periods of good flow of nectar in bees, their sarcasm feature declines (Yucel and Koseoglu, 2011).

Nectar and pollen are found in nature which are the basic food for honeybees. This is the most important factor that affects the quality and quantity of products that are the result of mutual benefit for honeybees and plants. Therefore it is possible to prefer plants on the basis of genus or species by honeybees. In this case honeybees prefer the plants according to it's quality of nectar and pollen (Free, 1992).

Although, honeybees visit many plant species for a season, they tend to make a choice through populations. This relationship is a feature of physiological and behaviour between bees and flower species. If a honeybee can not take advantage from a plant, it will have the feature of leaving the plant and may adapt to another. This situation can change depend on structure, shape, color, smell of flower and also sugar concentration in nectar which is more important. Bees preference changes according to average of sugar concentration in nectar in same plant genus or species (Kumova *et al*., 2001).

Sainfoin is a good honey extract plant. It is important for beekeeping with the features of secreting large quantities of nectar having richer honey extract with sucrose, glucose and fructose having big flowers with eye-catching colors and having the event of tripping on its flowers.

Alfalfa is the most cultivated forage plant on the earth. According to other legume plants, it can easily adapt to different environmental conditions. For this reason, it is farmed in different agricultural areas. Alfalfa is a long-lasting and a perennial forage plant. It can live for many years if appropriate environmental conditions are provided.

Phacelia is farmed in order to increase honey production. It enriches the soil with N and it prevents to leave N from soil. It protects the soil from erosion and also it controls the nematode infection and aphid intensity. These are the other purposes of farming phacelia (Cooke, 1985).

In this study, the main purpose is investigating the flowering density and phenology of alfalfa, phacelia and sainfoin that grown in the ecological conditions of the province of Ordu and investigating the preferences of honeybees to different plant species during their nectar flowing time.

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MATERIALS AND METHODS

This study was established in 2008 in Agriculture Faculty of Ordu University in test field area by using split-split plot design with three replication. In the study, phacelia, sainfoin and alfalfa were planted to three separated 100 m^2 parcels, respectively. Local bee that obtained from Ordu was used with Turan 82 in phacelia, Vela in alfalfa, Ozerbey-03 in sainfoin.

Sowing time was planned to be in same period with flowering in plants. Alfalfa and sainfoin were sowed in suitable times in order to coincide the phacelia with the beginnings of flowering in plants. Three pieces of bee colony were located next to parcels before flowering. Before flowering bushes had been maken equally for puppy area, number of frames and the mothers with the same ages (Guler, 2006).

Counts in plants about bee visiting, were made in flowering period 1 day in a week with three different times: 09:00, 12:00 and 15:00. Iterations which are on the counting parcels had been determined and secured with small stakes and then 80×50 cm mobile frames were put on the stakes. Measurements were calculated with determine the visiting honeybees in 5 min on the area (Williams and Christian, 1991). Results were evaluated in 1 m^2 area.

Counts related to visiting of the bee have been done on five different times. It started on 31 May, 2008 that the beginning of flowering in plants continued on 7, 14, 21 and 28 June in 2008.

Pollen traps installed to hives 1 day in a week in order to determine what concentration of pollen source was used by honeybees from plant groups that researchers studied. After weighing collected pollens, 200 pollens palette were selected randomly which was collected from traps. Pollens that supplied from sainfoin, alfalfa and phacelia were prepared with reference preparations. These preparations were compared with the other pollens that supplied from traps as microscobic analysis (Sawyer, 1988). Thus when we compared reference preparation and sample preparation, researchers could identify which plant, trap attached pollens belong to.

Phenological observations were made in the research period. About 1 m^2 area was selected and 10 plants were marked for determine the agricultural properties of plants. Plant height, number of major branches and number of side branches were determined in those 10 plants. The statistical package program JAMP applied to the obtained data. LSD test were maken and groups were determined when the application differences were important.

RESULTS AND DISCUSSION

Some agricultural features and phenological observation of plants: The dates of plantation, output, starting of flowering, full flowering and final flowering which were found from phenological observations of phacelia, sainfoin and alfalfa plants and average number of main branches, side branches and heights of plants were shown in Table 1.

The plants which honey-bees preferred: In terms of bee visits in this study, no statistically significant differences were determined between plants ($p>0.01$). The honeybees visited the phacelia plants at the most with average 71.8 units m^{-2} within 5 min. Also the honeybees visited the sainfoin plants secondly with average 55.9 units m^{-2} while they were visiting to alfalfa plant rarely with average 1.5 units m^{-2} within 5 min. According to dates and plants, the visits of honeybees were shown in Table 2.

The plants which honey-bees preferred in flowering time: In terms of visits of bees, the significiant differences were determined between plant history interactions in this study ($p<0.01$). According to Fig. 1, the honeybees visited the sainfoin plant frequently at start of flowering and visited to phacelia plant frequently at middle times of flowering period. Despite the fact that the honeybees visited to alfalfa plants partially at start of flowering period, alfalfa plants were not found attractive by honeybees.

The plant choice of honey-bees according to pollen: The particular pollen sources of honeybees are natural flora. The pollen value of a flora depend on diversity, density and flowering period of plant kinds with pollen in flora. If

Table 1: Phacelia, sainfoin and alfalfa plants on same of the agricultural features of the phenological observations

Plants	Phacelia	Sainfoin	Alfalfa
Date of plantings	26 March, 2008	22 Oct., 2007	27 Oct., 2007
Date of output	21 April, 2008	20 Nov., 2007	24 Nov., 2008
Starting of flowering date	30 May, 2008	27 May, 2008	31 May, 2008
Final flowering date	29 June, 2008	30 June, 2008	5 July, 2008
Ortalama bitki boyu (cm)	98.6	100.5	104.6
Average number of main branches	1	19.83	26.16
Average number of side branches	3.53	6.42	4.13

Table 2: Date in terms of the number of honey bees visit plants (units m^{-2})

Observation dates	Phacelia	Sainfoin	Alfalfa	Average
31 May, 2008	6.8^{g}	109.4^{c}	3.3^{g}	39.8^{c}
07 June, 2008	121.8^{b}	69.0^{d}	3.3^{g}	64.7^{b}
14 June, 2008	148.4^{a}	64.3^{de}	0.4^{g}	71.0^{a}
21 June, 2008	58.1^{e}	30.9^{f}	0.2^{g}	29.7^{d}
28 June, 2008	24.2^{f}	6.2^{g}	0.4^{g}	10.2^{e}
General average	71.8^{a}	55.9^{b}	1.5^{c}	43.0

LSD (5%) plants: 3.79; LSD (5%) observation dates: 4.89; LSD (5%) observation dates and plants: 8.47

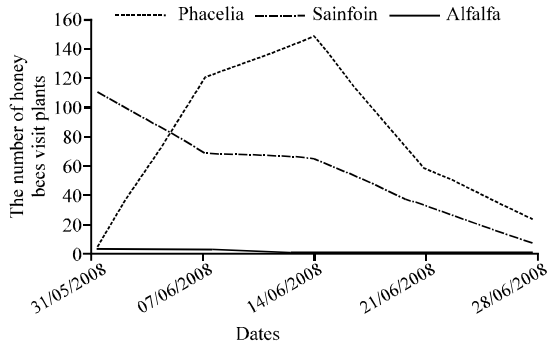

Fig. 1: Phacelia, sainfoin and alfalfa plants on visits od the bee

Table 3: Phacelia, sainfoin and alfalfa plants on honey bee colony in trems of polen brought the number (Pcs)

Observation dates	Phacelia	Sainfoin	Alfalfa	Average (B×T)
31 May, 2008 (1)	2.3^{f}	12.6^{b}	0^{f}	5.0^{b}
07 June, 2008 (2)	8.6^{c}	17.6^{a}	0^{f}	8.7^{a}
14 June, 2008 (3)	6.3^{cd}	14.0^{b}	0^{f}	6.7^{b}
21 June, 2008 (4)	1.6^{ef}	3.3^{de}	0^{f}	1.6^{c}
28 June, 2008 (5)	1.3^{ef}	2.6^{ef}	0^{f}	1.3^{c}
Average	4.0^{b}	10.0^{a}	0^{f}	4.6

plant kinds which have high pollen value are much among plant kinds with flower in flora, bees will have high pollen accumulation activity. It is known that the honeybees do not use all the phanerogam plant species as pollen source and select plant species. The pollen amounts which bees carried to bee colonies from phacelia, sainfoin and alfalfa plants were researched in this study and findings were shown in Table 3.

According to the results of this study in Table 4, the significiant differences were determined between pollen palletes which the honeybees carried to colony from phacelia, sainfoin and alfalfa plants ($p<0.01$). The honeybees collected the most pollen palletes with 10 units pollen palletes from sainfoin plants. Also, according to this study, the honeybees collected 4 units pollen palletes from phacelia plants and did not prefer pollens of alfalfa plants.

According to Fig. 2, it is determined that the honey-bees collected pollens from sainfoin plants with 71% rate and phacelia plants with 29% rate. There were not pollen palletes of alfalfa plants among pollen palletes which were got from pollen traps.

Flowering of plants: The datas about flower density of phacelia, sainfoin and alfalfa plants which was raised in ecologic conditions of Ordu were shown in Table 4. According to flower amounts on per square meter, the significiant differences were determined between phacelia, sainfoin and alfalfa plants ($p<0.01$) (Table 4). The alfalfa plants had the most flowering value with 9317.1 units m^{-2} while the phecelia plants were having

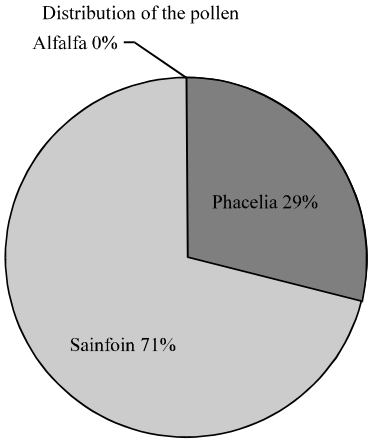

Fig. 2: Phacelia, sainfoin and alfalfa plants on distribution of the pollen

Table 4: Phacelia, sainfoin and alfalfa plants flower square meter as of the dates the amounts (units m^{-2})

Observation dates	Phacelia	Sainfoin	Alfalfa	Average
31 May, 2008	1667.3^{gh}	4529.6^{ef}	355.3^{h}	2184.1^{d}
07 June, 2008	9641.6^{c}	6354.3^{de}	1083.3^{gh}	5693.0^{c}
14 June, 2008	13010.6^{b}	7475.6^{d}	9723.3^{c}	10069.8^{a}
21 June, 2008	8124.6^{cd}	2760.3^{fg}	13109.3^{b}	7998.1^{b}
28 June, 2008	2747.0^{fg}	444.0^{h}	22314.3^{a}	8501.7^{b}
General average	7038.2^{b}	4312.7^{c}	9317.1^{a}	6889.3

LSD (5%) Plants: 926.23; LSD (5%) observation dates: 1195.77; LSD (5%) Observation dates and plants: 2071.13

7038.2 units m^{-2} flowering value. Also the sainfoin plants had the least flowering value with 4312.7 units m^{-2} (Table 4).

It can be thought that the plant choices of bees were affected by nectar qualities of plants. The nectars were divided three groups according to sugar contents. These were nectars with intensive sucrose, balanced nectars with equal glucose, sucrose and fructose contents and nectars with high fructose and high glucose. The bees choose nectars according to sugar contents and they choose the most balanced nectars (Dogaroglu, 2004).

Celik (1988) determined that the honey-bees prefer sainfoin plants rather than alfalfa plants at similar bees activities which were in at alfalfa and sainfoin grounds and continued activities normally at flowering period.

In the study, it was investigated about using as bee feeding ground of phacelia which was used as feed plant in Cukurova region, it was determined that average 90-201 units m^{-2} honeybees were in per parcel of land at the best time of flowering (Tansi *et al*., 1995). In the study which was examined about phacelia in Kahramanmaras, average 7.3 units m^{-2} bees visited the flowers in normal conditions and average 119 units m^{-2} bees visited the flowers at the most intensive flowering period (Kizilsimsek and Ates, 2004).

Bakoglu and Kutlu (2006) stated that the honeybees leastly visited with average 2 units m^{-2} at start of flowering and had visited mostly average 102 units m^{-2} at the most intensive flowering period on sainfoin plants. In the study of Ozbek (2003), the honeybees visited the sainfoin plants with high rate. Also in this study, it was determined that the honeybees visited to alfalfa plants with low rate.

The honeybees which were seen extensively in nature did not have any effect on pollination of alfalfa plants. The honeybees usually collect nectar. If the honey-bees do not find suitable flowers, they visit the alfalfa plants. Thus this situation will be help to pollination and fertilization (Acikgoz, 2001). The findings which were found in studies about this topic were parallel to results of this study.

Sorkun (2008) stated that sainfoin and alfalfa plants were secondary and phacelia plants were dominant according to potentials of pollen production. Fewell and Winston (1992) examined that the honey-bees collected pollens with high protein when pollen stock at shells was enough but they collected pollens with low protein when pollen stock at shells was not enough. Celik (1988) stated that the honeybees preferred greatly pollens of other plants addition to alfalfa plants. The findings of this study were parallel to findings of studies about this topic.

The differences which were determined could be arised from plant choices of honeybees according to pollen amount and quality, collecting pollens which adhered to honeybees' body during collecting pollen, pollen requirements and stocks of bees colonies which was researched.

Bakoglu and Kutlu (2005) determined that average flower numbers were 62-4719 units m^{-2} in study which they emphasized that sainfoins were important for apiculture. Kumova *et al.* (2001) determined that average flower numbers on parcels where three different plants were raised were 1077.6-971,10 and 1021.1 units m^{-2} in their study about flower densities of honeybees among phacelia species. The significant difference was not determined between phacelia plant kinds ($p<0.05$).

Kizilsimsek and Ates (2004) examined that flower numbers were 61.7-1662.8 units m^{-2} in their study about flowering process at different planting times and using as bee field of phacelia plants at Kahramanmaras conditions. Bakoglu and Kutlu (2006) investigated that flower numbers were 1.7-8982 units m^{-2} in their study regarding effects on some agricultural features and using as bee field of different row separation which was performed on phacelia plants which were produced on watery land of Bingol. The many findings of this study were parallel to findings of other studies regarding this topic. The causes of differences which were determined can be different climates of research regions, adaptation of phacelia plants, soil structure of trying region, maintenance and feed conditions of plants. According to flower numbers at per unit, alfalfa plants were at first place. Alfalfa plants were at last place in terms of honey-bees visits because of deficiency of nectar amount. The contents of nectar and pollen of flowers are more important than flower number at per unit for apiculture.

CONCLUSION

As consequence of this study, it was determined that phacelia and sainfoin plants were produced successfully in Ordu ecologic conditions. Also, it was determined that phacelia and sainfoin plants were used as bee field with suitable planting times because of the rich nectar contents. The alfalfa plants were produced in study region but the honeybees did not prefer alfalfa plants when plants with nectar and pollen as phacelia and sainfoin were available in region.

According to bee visits in this study, phacelia plants were at first place. Sainfoin plants were at first place in terms of pollen numbers which were collected from pollen traps of colonies. The phacelia plants were richer than sainfoin plants while phacelia and sainfoin plants were comparised according to nectar amount. The sainfoin plants were richer than phacelia plants according to pollen amount. The visits and flowering of plants in this study lasted for 30-35 days. This long flowering time is too important for apiculture.

As a consequence of this study, the phacelia and sainfoin plants could be produced successfully in Ordu ecologic conditions also these plants could be used as bee fields with suitable planting planning when pollen and nectar deficiency is available for apiculture.

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