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Seasonal variation of collected pollen loads of honeybees (*Apis mellifera* L. *anatoliaca*)

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Abstract
Pollen collected by honeybees foraging in the region of Bursa, Turkey was analysed for a whole year. Pollen loads were collected from the hives of *Apis mellifera anatoliaca* once a week and were classified by colour. Forty-one taxa were identified from the pollen analyses of the loads and 14 of these had percentages higher than 1%. Only 2.05% of the total pollen could not have been identified. Dominant taxa include; Brassicaceae (11.19%), *Helianthus annuus* L. (10.84%), Cichorioideae (8.93%) *Salix* spp. (7.99%), Rosaceae (7.37%), *Centaurea* spp. (7.56%), *Papaver* spp. (7.41%), *Knautia* spp. (6.99%), Fabaceae (6.01%), Asteraceae (5.73%), *Xanthium* spp. (2.65%), *Chrozophora* spp. (2.45%), *Plantago* spp. (1.56%) and *Acer* spp. (1.54%) representing 88.23% of the total. Distinct variations in plant usage are seen through the year with initial use of Rosaceae, *Salix*, and to a lesser extent Brassicaeae. As these groups finish flowering the bees move onto *Helianthus annuus, Centaurea* through the summer followed by Asteraceae in the late summer and Fabaceae in the autumn. There is a strong reliance on crop species for pollen forage but a number of indigenous species are also seen within the samples. The most productive period for collecting various pollen types, and the ideal period to determine pollen preferences of honey bees was June-August.

Keywords: Apis mellifera anatoliaca, *pollen loads, pollen preference, pollen calendar, seasonal variation, Bursa, Turkey*

Pollen is the most important source of proteins for bees particularly at larval stage (Pankiw et al., 1998; Dreller et al., 1999). The decision to collect pollen by honeybee foragers depends on the number of larvae (brood), amount of stored pollen in the colony, as well as forager genotype and available resources in the environment (Camazine, 1993; Pankiw et al., 1998). Various colours of pollen pellets, changing from white to black, including yellow, orange, brown, red, greenish and gray, occur depending on the botanical taxa and the chemical composition of these substances (e.g. Stanley & Linskens, 1974; Winston, 1987; Graham, 1993; Almeida-Muradian et al., 2005). Pollen is collected by honey bee foragers directly from the stamens of flowers, moistened with nectar, saliva, secreted by bees and agglutinated on the hind legs, and called "pollen loads" (García-García et al., 2001).

The beekeeping industry is expanding in Turkey but most of the traditional beekeepers are unaware of the vegetation that shelters the plants used by honey bees. Melissopalynological studies have significant application in the beekeeping industries. Analyses of pollen grains collected from honeybee colonies provide relevant information for the bee visited plant sources of an area. Some studies designating plants used by honeybees as pollen or nectar sources have been used to develop for floral calendars for beekeeping (e.g. Sharma, 1970; Thrasyvoulou & Manikis, 1995; Barth, 2004; Tsigouri et al., 2004; Webby, 2004; Andrada & Tellería, 2005; Bhusari et al., 2005; Terrab et al., 2005; Silici & Gökceoglu, 2007).

Turkey has a great diversity of honey bees with five *Apis mellifera* subspecies (e.g. Kandemir, et al. 2000; Smith, 2002). Honeybee foragers of different subspecies demonstrate flower fidelity or flower colour constancy on natural and artificial flower patches when collecting nectar (e.g. Free, 1993; Cakmak, et al. 2000; Cakmak & Wells, 2001) and also foragers may have preferences of pollen sources of plants when various plants bloom at the same time in the environment. The

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goal of this research has two objectives; first of all, this work was undertaken to determine honeybee foragers' pollen preferences in Bursa, lowlands of north-west Anatolia region. Secondly, to prepare a guide of a year round floral calendar for beekeepers and farmers to have knowledge about the blooming periods of bee pollinated plants.

Material and methods

Study area

Sampling was performed in Bursa lowland area (Nilufer) the north-west part of Turkey, situated at 40° 13.8′ N, 28° 49.8′ E and at an altitude of ca.150 m above sea level. Bursa is the fourth biggest city in Turkey and located near the southwest etc. Marmara Sea at the north-west foot of Mount Uludag (2 543 m). The region is drained by Nilufer River and nearby, there is a big lake named Uluabat. The climate of the area is generally warm during major parts of the year with a Mediterranean climate (Figure 1). We selected this region because it is a frequented by beekeepers in Anatolia. The region is a transitional zone as most of the plants which grow naturally in the study belong to Mediterranean elements but there are also European-Siberian and Irano-Turanian elements. Consequently Mediterranean maquis elements are present in the region. However, whether naturally

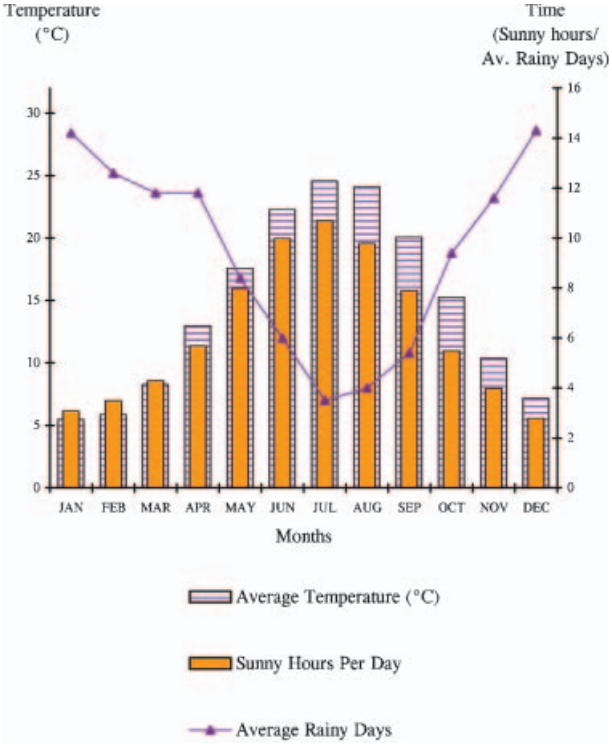

Figure 1.

growing or planted, pine species such as *Pinus pinea* L., *Pinus brutia* Ten. and oak species such as *Quercus infectoria* Olivier, *Q. robur* L. and *Q. pubescens* Willd. populations also occur. The main shrub species include *Crataegus monogyna* Jacq., *Paliurus spina-christii* Mill., *Rubus sanctus* Schreber, *Rubus discolor* Weihe et Nees, *Jasminum fruticans* L., *Ligustrum vulgare* L., *Cistus creticus* L., *Spartium junceum* L., *Pistacia lentiscus* L. and *Rosmarinus officinalis* L., The Asteraceae, Fabaceae, Lamiaceae, Liliaceae, Boraginaceae, Poaceae, Brassicaceae, Apiaceae and Rosaceae are the largest families in the study region. Surrounding the study area are extensive agricultural areas with *Helianthus annuus* L., *Soja hispida* Moench, *Zea mays* L., *Punica granatum* L., *Morus nigra* L., *Morus alba* L., *Malus sylvestris* Miller, *Prunus domestica* L., *Persica vulgaris* Miller, *Amygdalus communis* L., and *Pyrus communis* L. under cultivation.

Sampling and pollen analyses

To obtain pollen loads, we used five colonies of *Apis mellifera anatoliaca* placed in Langstroth-type hives. We started the collection of pollen loads a little after the first heavy pollen loads were brought to the hive by foragers and we continued until pollen foraging decreased. We removed the accumulated pollen loads from the bottom pollen drawers of each hive between the 26 March and 28 October 2005 every 7 days (once a week). In this way we collected 160 samples, which were kept in at refrigerator at +4°C until analysis. To identify pollen foraged and botanical sources used by honeybees in the sampling area, 500 pollen loads were separated randomly from each of the 160 bottles and a total of 80 000 pollen loads were classified according to their colour (Kirk, 1994). A piece of each pollen load from each colour was mixed with glycerin-jelly, and stained using basic fuchsine and the unacetolysed pollen grains were examined (Wodehouse, 1935). Pollen identifications were made using light microscopy and compared with the reference slide collection of the Uludag University Botany department. As the goal of the study was to develop a regional level pollen calendar rather than a detailed species level study samples were unacetolysed. From this data the percentages of the each taxon of pollen grains were calculated.

Results

Total number of 41 different types of pollen grains (excluding unidentified ones) were identified in this study, of which 14 had percentages higher than 1%, and only 2.05% of the total pollen loads were unidentified (Table I). Overall 22 of them are

Table I. Pollen types which collected by honey bee foragers and their weekly percentages in Bursa region in the year 2005.

	MAR.	APRİL				MAY					JUNE				JULY				AUGUST				SEPTEMBER					OCTOBER				NOV.	
Week of the Month	4	1	2	3	4	1	2	3	4	5	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	5	1	2	3	4	1	
Week No. Taxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	**TOTAL**
Acer	0.09	0.29	0.49	0.44	0.20	0.03	0.01																										1.54
Brassicaceae	0.19	0.84	0.56	0.15	0.39	0.97	1.08	0.61	1.15	0.47	1.31	2.17	1.09										0.10	0.11				0.01					11.19
Cichorioideae	0.12	0.20	0.10	0.03			0.11		0.21								0.13			0.19	0.31	0.01			0.13	0.47	0.01	0.81	0.96	1.59	1.94	1.61	8.94
Liliaceae	0.40	0.01	0.38	0.01																							0.08				0.02	0.06	0.95
Lonicera	0.08	0.08																									0.03						0.18
Rosaceae	2.01	1.51	0.13	0.14	0.41	0.66	0.66	0.48	0.08											0.23		0.14		0.15			0.06	0.46	0.13	0.06	0.01	0.07	7.37
Salix		0.21	1.46	2.36	2.13	1.41	0.43																										7.99
Boraginaceae							0.04	0.02						0.16	0.01			0.02	0.01	0.14									0.15	0.23			0.76
Papaver						0.01	0.64	1.69	1.39	1.77	1.06	0.16	0.39	0.29	0.02																		7.41
Pinus						0.06	0.06	0.06	0.08																								0.26
Trifolium pratense							0.10	0.26			0.04		0.17	0.13	0.01	0.01																	0.72
Trifolium repens								0.01		0.10	0.01		0.31																				0.43
Olea									0.06		0.03	0.01																					0.10
Pistacia									0.01	0.06	0.14	0.04		0.01		0.01																	0.26
Vicia									0.15	0.68																							0.83
Artemisia										0.01	0.18																						0.19
Paliurus spina-christii										0.03	0.17	0.23	0.01		0.01		0.01	0.01															0.46
Asteraceae											0.01										0.06	0.22	0.10	1.26	1.32	1.51	1.20	0.01				0.03	5.71
Labiatae											0.08																						0.08
Poaceae											0.01		0.01										0.20	0.06									0.28
Fabaceae												0.09		0.06	0.08			0.18	0.35	0.06			0.05	0.01		0.11	0.01	0.92	1.49	0.61	0.93	1.09	6.01
Helianthus annuus												0.36	0.78	1.45	2.31	2.39	1.45	1.17	0.84	0.10													10.84
Plantago												0.06		0.36	0.26	0.10	0.32	0.03	0.01	0.09	0.16	0.18											1.56
Punica granatum												0.01	0.10	0.28	0.21	0.09	0.08																0.76
Sanguisorba												0.01	0.04	0.01	0.01																		0.06
Jasminum													0.18		0.03																		0.20
Scabiosa													0.06					0.24	0.04	0.48										0.04	0.06		0.92
Malvaceae														0.01		0.04	0.14	0.01	0.02	0.01		0.01											0.23
Onobrychis														0.01	0.01		0.03																0.04
Apiaceae															0.03	0.01	0.23	0.14	0.01	0.09	0.14												0.64
Zea mays															0.14					0.24				0.10									0.48
Amaranth./Chenopod.																0.01		0.01		0.01			0.01										0.03
Centaurea																0.41	0.55	1.16	1.69	1.08	1.78	0.30	0.24	0.15	0.10			0.11					7.56
Xanthium																0.04	0.11	0.04	0.03	0.08	0.06	0.16	0.79	0.24	0.09	0.08	0.49	0.06	0.06	0.26		0.08	2.65
Echinops																	0.01	0.07	0.04	0.03				0.07			0.06						0.28
Ligustrum																	0.01	0.01		0.01	0.01												0.03

Table I. Continued.

	MAR.	APRİL				MAY					JUNE				JULY				AUGUST				SEPTEMBER					OCTOBER				NOV.	
Week of the Month	4	1	2	3	4	1	2	3	4	5	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	5	1	2	3	4	1	
Week No.																																	
Taxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	**TOTAL**
Chrozophora																		0.05			0.29	1.69	0.29	0.13									2.45
Lythraceae																			0.01	0.01		0.01					0.01	0.03	0.03				0.09
Knautia																				0.24	0.32	0.39	1.29	0.86	1.06	0.88	0.83	0.34	0.29	0.31	0.11	0.08	6.99
Convolvulus																								0.01			0.11	0.31				0.01	0.43
Epilobium																									0.01	0.01		0.03					0.05
Unidentified	0.24										0.11			0.37	0.01	0.04	0.07	0.02	0.07	0.05		0.01	0.06		0.41	0.08	0.25	0.06	0.01	0.04	0.06	0.10	2.05

identified to genus, 13 of them to family and 6 to species level. Dominant pollen types are; Brassicaceae (11.19%), *Helianthus annuus* (10.84%), Cichorioideae (8.93%) *Salix* spp. (7.99%), *Centaurea* spp. (7.56%), Rosaceae (7.37%), *Papaver* spp. (7.41%), *Knautia* spp. (6.99%), Fabaceae (6.01%), Asteraceae (5.73%), *Xanthium* spp. (2.65%), *Chrozophora* spp. (2.45%), *Plantago* spp. (1.56%) and *Acer* spp. (1.54%) and these were representing 88.23% of the total.

Pollen types

Acer spp. This genus was the first source for honeybees in spring months. However the pollination period began earlier for this taxon, honey bees' awakening coincided with the latest flowering. Honeybees collected the pollen loads belonging to *Acer* spp. for 7 weeks (from last week of March to 2nd week of May) (Figure 2). *Acer* spp. pollen loads were represented 1.54% of all and they were maximum in the third week of the sampling (2nd week of April) (Table I).

Rosaceae. Rosaceae is represented by many species in the surroundings of the study area that flower in different months (Figure 2). The pollen loads of this family were collected on the 1st–9th, 20th, 22nd, 24th and 27th–32nd weeks of the sampling period by the honey bees (Figure 2). The pollen loads initially collected from the 1st to the 9th week were mostly from fruit trees, and the others in the late sampling periods were mostly from *Rubus, Fragaria* and *Rosa* species. Rosaceae pollen loads represented 7.37% of the total (Table I). They were at a maximum in the first week of the sampling (last week of March) with 2.01%.

Salix spp. Honey bee foragers also use willow trees as a pollen source in the early spring. *Salix* spp. pollen loads began to be collected in the first week of April and continued until the second week of May (Figure 2). The total percentage of *Salix* spp. pollen loads were 7.99% of all (Table I) and they were at a maximum in the 3rd week of April (4th week of sampling) with a percentage of 2.36%.

Brassicaceae. This family represents many crop species and formed the highest pollen percentage (11.19%) in the sampling period. Brassicaceae species are widespread in the study area and most of the species flower in the spring period. The most common species are; *Brassica nigra* (L) Koch., *Sinapis arvensis* L., *Raphanus raphanistrum* L., *Rapistrum rugosum* (L.) All. and *Thlaspi perfoliatum* L. The pollen loads were only identified to the family level because pollen grains within the family are all

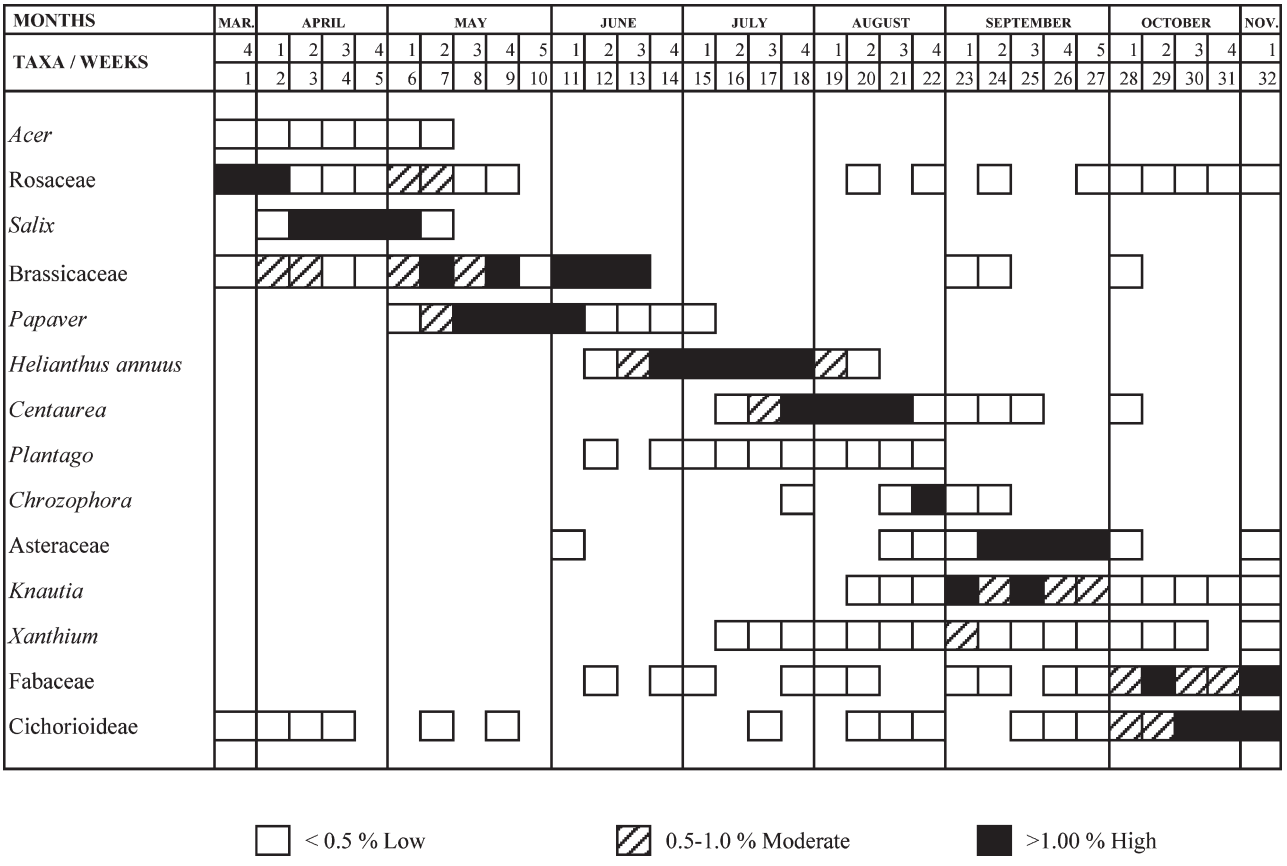

Figure 2. Bee collected predominant pollen types and their seasonal variations in the study area in year 2005.

very similar, and we could not discriminate them at a specific rank. Brassicaceae pollen grains were collected in 1st–13th, 23rd, 24th, 28th weeks by the honeybee foragers (Figure 2). They were at a maximum in the 12th week of the sampling with a percentage of 2.17% (Table I).

Papaver spp. The pollination season started in the first week of May (6th week), and reached to maximum in the last week of May (10th week) with a percentage of 1.77% and ended in the first week of July (15th week) for the honey bees (Figure 2, Table I). The pollen loads of this genus represented 7.41% of the total.

Helianthus annuus. Pollen loads of this species were the second dominant for the study area in summer. They occurred in 10.84% of total pollen loads, which were collected for a whole year (Table I). The pollination season is between the 12th and 20th weeks (from 2nd week of June to 2nd week of August) (Figure 2) and a maximum percentage of 2.39% was recorded in the 16th week (2nd week of July) (Table I).

Centaurea spp. Honey bee foragers use this genus as a pollen source mostly in late summer. Honey bees started to collect *Centaurea* spp. pollen in 16th week (2nd week of July) and continued until the 28th week (1st week of October) (Figure 2). Pollen loads of this genus were at a maximum in the third week of August (21st week) (Table I) when they constituted 7.56% of the total.

Plantago spp. Although the pollen grains of this genus did not reach 1% of the total in any week, pollen foragers of honey bees collect this pollen type regularly in summer. They carried pollen loads to their hives, which belonged to *Plantago* spp. from 12th week (2nd week of June) to 22nd week (Last week of August) (Figure 2). They were at a maximum in the last week of June (14th week) with a percentage of 0.36% and represented 1.56% of the total (Table I).

Chrozophora spp. This genus used by the honeybees from 18th to 24th week (From last week of June to 2nd week of September) (Figure 2). They were represented by 2.45% of the total pollen number of the sampling (Table I) and were at a maximum in the 22nd week with a percentage of 1.69%.

Asteraceae. Like the family Rosaceae, Asteraceae is also a large family and widespread in the study area.

They constituted 5.73% of the total pollen loads (Table I), if we include *Helianthus annuus, Centaurea* sp., *Xanthium* sp. and Cichorioideae to this taxa, it can be said that, Asteraceae is the most utilised by the honey bee foragers as a pollen source. Honey bee foragers used Asteraceae and pollen loads were collected from the pollen drawers of the hive in the first week of June (11th week), 21st–28th weeks (3rd week of August-1st week of October) and 32nd week (1st week of November; last week of sampling) (Figure 2). They were at a maximum in the 26th week of the sampling with 1.51% and Asteraceae pollen grains represented 5.73% of the total (Table I).

Knautia spp. Honey bee foragers use this genus in late summer and autumn as a pollen source. They started to carry pollen loads of *Knautia* spp. to the hives in the 20th week and ended in the last week without any decrease (Figure 2). The maximum value occurred in the 23rd week (1st week of September) with 1.29% and they constituted 6.99% of the total (Table I).

Xanthium spp. Pollen loads were collected from this genus in the 16th week (2nd week of July) and honeybees gathered them until the end of the sampling (Figure 2). The maximum value was 0.79% in the 23rd week (1st week of September), *Xanthium* spp. pollen loads represented 2.65% of the total (Table I).

Fabaceae. Fabaceae family is also a large family and represented by number of species in the study area. They were used as a pollen source by the honey bee foragers between the 12th and 32nd weeks (2nd week of June-1st week of November) (Figure 2). They were maximum in the second week of October (29th week) with the percentage of 1.49% and represented 6.01% of the total (Table I).

Cichorioideae. Pollen loads belonging to this group were collected by the honey bee foragers over the whole bee pollination period of the year. In general, there can be seen an intense foraging activity in the spring and autumn (Figure 2). The maximum value was 1.91% in the 31st week (Last week of October) and total percentage of 8.93% over the whole year (Table I).

In Bursa region most active foraging activity of honeybees started at the beginning of the spring and ended nearly at the end of the autumn. Foraging activity parallels changes in the average temperature and the number of sunny hours per day. In addition to this; precipitation prevents the activity (Figures 1, 2). Our observation suggests that most active pollen foraging in the area occurs after rain.

Discussion

In the study period, the highest pollen diversity in pollen loads occurs between June and August, at the beginning and approximately at the end of the flowering period pollen variation decreased (Table I). In June, honeybee foragers collected mostly Brassicaceae, *Helianthus annuus, Papaver* spp., *Plantago* spp., *Paliurus spina-christii, Punica granatum, Trifolium pretense, T. repens, Pistacia* spp., *Artemisia* spp., *Jasminum* spp., Boraginaceae and Fabaceae pollen grains. In July, *Helianthus annuus, Centaurea* spp., *Plantago* spp., Apiaceae, *Punica granatum*, Fabaceae, *Scabiosa* spp., Malvaceae, *Xanthium* spp., *Zea mays*, and Cichorioideae are the most preferred pollen types by the honey bee foragers. *Centaurea* spp., *Chrozophora* spp., *Knautia* spp., *Helianthus annuus, Scabiosa* spp., Cichorioideae, *Plantago* spp., Fabaceae, Rosaceae, *Xanthium* spp., Asteraceae, Apiaceae and *Zea mays* are the favourite pollen types which attract the foragers in August. Until this main nectar flow period, honeybees generally use early spring flowering plants as a pollen source for their brood like; *Salix* spp., Brassicaceae, Rosaceae, *Papaver* spp., *Acer* spp., *Vicia* spp., Liliaceae, Cichorioideae, *Trifolium pratense, Pinus* spp., *Lonicera* spp. and *Trifolium repens.* Cichorioideae, *Knautia* spp., Asteraceae, Fabaceae, *Xanthium* spp., Rosaceae, *Centaurea* spp., *Convolvulus* spp., *Chrozophora* spp., Boraginaceae, Poaceae, Brassicaceae, Liliaceae, *Echinops* spp., *Scabiosa* spp. are the most preferred pollen types in autumn which is the last periods of the beekeeping season. According to this data it can be said that; the most productive term for collecting various pollen types and preferences of pollen by honeybees is June-August for the region. Even though various pollen types were collected by honeybee foragers, the amount of pollen and brood decreased in colonies in August due to hot temperature in the region.

Honeybees prefer some plant species (up to 1.00% of the total) as pollen source from others, and a pollen calendar prepared from these data can be used by beekeepers of the region (Figure 2). Honeybee foragers collected Cichorioideae pollen loads intermittently during the study period probably reflecting different flowering times for the species lumped within this group (Figure 2). For the Rosaceae, Brassicaceae, Asteraceae and Fabaceae families, pollination and pollen collecting periods by the honeybees are long and discontinuous again reflecting the variation in flowering times of taxa within these families. The pattern of pollen load collection for the Rosaceae reflects the early flowering of fruit trees although the first phase of this period was not recorded by the study as it pre-dated

the data collection period. The autumn collection of Rosaceae probably originates from the wide spread *Rubus sanctus*, *R. discolor* and cultivated *Fragaria* and *Rosa* species. In order to more reliably know what species the honeybees are utilizing a more detailed study is required that can identify pollen to the species level.

In our study, honeybee foragers had a tendency to collect at least one pollen type as a predominant, except in the first week of October. In only five samples, they coincide between the peaks such as in 9th and 11th week between *Papaver* spp. and Brassicaceae, in 18th week between *Helianthus annuus* and *Centaurea* spp., in 25th week between Asteraceae and *Knautia* spp., and in 32nd week between Fabaceae and Cichorioideae. In the 10th week, there can be seen a decrease in preference for Brassicaceae pollen grains by the honey bee foragers, and this is probably due to the interaction between peak flowering times of the two groups.

In general it can be said that, values of collected pollen loads (up to 1.00%) represent the start of and the decline of flowering in the groups recognized. This is well illustrated for *Helianthus annuus* where there is a decrease in the 18th week, and honeybee foragers started to turn towards *Centaurea* spp. as a pollen source. Furthermore, pollen grains of *Acer* spp., *Plantago* spp. and *Xanthium* spp. preferences were always restricted in low levels except the 23rd week and this supports that honeybee foragers prefer some plant species over the others. This case might be a result of nutrition levels of pollen grains offered by some species over others because amino acid composition or protein content of pollen grains has been implicated as a reason of charm (e.g. Kim & Smith, 2000; Pernal & Currie, 2001; Cook et al., 2003).

During the study period the most collected pollen loads in order of abundance were Asteraceae (including all taxa belong to Asteraceae), Brassicaceae, Rosaceae and Fabaceae. This contrasts with the flora where the Asteraceae (14.6%), Fabaceae (12.6%), Lamiaceae (5.3%), Liliaceae (4.7%), Boraginaceae (4.4%), Poaceae (4.4%), Brassicaceae (3.9%), Apiaceae (3.9%) and Rosaceae (3.6%) are the largest families in the study region (Tarımcılar & Kaynak, 1994). Our pollen data mostly show similarity with the flora of the study area but some components of the flora are not well represented in the honey bee collected pollen loads. For example, although being dominant in the flora, Lamiaceae, Liliaceae, Boraginaceae, Poaceae and Apiaceae pollen loads were only seen in low levels ($<1\%$), and the affinity of the honeybees to these families were not representative of the flora. Even though Brassicaceae and Rosaceae are not represented as high as Asteraceae and Fabaceae families in the flora, they are more attractive for honeybee foragers.

According to our data, it can be said that excluding Lamiaceae, Liliaceae, Boraginaceae, Poaceae and Apiaceae families, pollen preference of honey bee foragers reflects the flora of the area. In the other pollen identification studies; Asteraceae and Fabaceae pollen loads were found as predominant in the south part of Turkey (Baydar & Gurel, 1998) and Myrtaceae, Asteraceae, Brassicaceae, Plantaginaceae, Fagaceae and Fabaceae are the most frequent families found in the Mamora (north-west Morocco) forest region (Terrab et al., 2003).

Conclusions

Despite the rich and diverse flora in the study area, the results demonstrate that honeybee foragers concentrate on a few plant species at a time when various plants bloom in summer (June-August). The pollen types which were recorded in high levels are abundant in the surroundings of the hives and they are mostly cultivated species (e.g. *Helianthus annuus*, fruit trees of the Rosaceae, some of the Brassicaceae). The clear preference for some plants as pollen sources has enabled us to develop a pollen calendar (Figure 2) that will aid beekeepers in the Bursa Lowland Region of north-west Turkey. Based on our results it can be said that; Brassicaceae, *Helianthus annuus* and Cichorioideae pollen loads characterize, and are the most frequent ones, for Bursa lowland region north-west Turkey. Knowledge about the species utilized by honeybee from different regions is important for beekeepers, especially where bee keepers move from one region to another.

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