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Bee Plants of Van Lake Basin (Turkey)

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Abstract: This study was aimed to determine the apiculturally important plant taxa in Van Lake Basin. The study was carried out between 1993 and 2003 during field excursions. The study area is located in Eastern Anatolia region, Turkey, which is one of the richestest floristic field in the region. In addition to the apiculturally important plants, some agriculturally and horticulturally important plants are propagated in the study area. Therefore, the area is preferred by beekeeper. The biggest problem of the world in the future will be food deprivation due to rapid growing population. According to the results, 251 natural and 31 cultivated, total 282 taxa were determined to be important for apiculture.

Key words: Bee plants, Van Lake basin, Turkey

INTRODUCTION

The biggest problem rapid growing population of the world in the future will be the need of food, depended on nourishment. For this reason, investigation and increasing of vegetation and animal productivity has become necessary. This agriculturally evaluation of the floristic structure and the determination of the suitable agriculture depended on biological richness are needed.

The botanic origin of honey is one of the most important parameters of honey quality (Tucak *et al*., 1998, 2000, 2004). The quality of honey depends on the melliferous plants that bees use in their nourishment. The honey obtained from different melliferous plants has different characteristics and applications, both in medicine and in food industry.

The history of the honey and bee in the world starts in Spain at 7000 BC. In Anatolia as understood from the inscriptions, it began with Sümerler at 3000 BC (Baytop, 1994). Until now from 1950, Turkey is one of the countries increasing, the honey production at the highest level in the world. However, in these years, Turkey's forests and forages have decreased 20%. Turkey is in the third row in the world's honey production and beekeeping.

The life of living organism depends on each other as ecologically. During pollination, some plants need outsider pollination. Their own pollens can inseminate some plants. However, some natural plants and most of the culture plants have tendency to be inseminated by outsider pollens. Honeybees (*Apis mellifera* L.) make most of the pollination in plants. Bees are used widely throughout in the world. Honeybee is an insect that makes the best pollination. In a research made in America, it was found that the pollination by bees was approximately 15-20 times faster than normal pollination (Tutkun, 2000). In agriculture, honeybees should be considered together with culture plants.

Honeybees visit plants to produce honey and take food. Bees collect pollen, nectar or both from plants during their visit to plants. They also collect secreted honey from some plants. While, there is pollen only in flowers, nectar is found in the special parts of some flowers or in organs like trunk, branch and leaf stalk of some plants. In formation and quality of nectar, environment has a vital importance. Bees visit definite organs of some herbaceous and ligneous plants to collect components of honey. For this reason, bee plants can not be determined only by palinological studies in honey (Tew, 1998; Tutkun, 2000).

With its three floral regions, Turkey has a specialty of a continent. In terms of its rich flora, suitable ecology, ideal habitats, colony capacity and genetic variation in the bee populations, Turkey has a big beekeeping potential. The number of species determined as bee plants are about 200 bee plants in Turkey varies according to regions. Moreover, high quality honey is produced in these regions (Kumova and Korkmaz, 2001). The purpose of this study was to contribute to the use of bee plants in the fields of pharmacy, animal sciences, beekeeping, landscape picture, agriculture, also in many other research subjects by the determining plant richness and varieties.

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MATERIALS AND METHODS

The study area and general vegetation: The study was conducted in Van Lake basin, which situated in the Eastern Anatolia region of Turkey (Fig. 1). This region has the greatest density in term of species richness and endemic taxa. The Eastern Anatolia region, which has an important role in Turkey's flora, especially Van, Hakkari, Ağrı, Bitlis and surroundings, have high endemism (Ekim, 1990). Research place of Van Lake basin with 1646-4000 altitude is a closed basin. In the region, there is terrestrial climate affected by Mediterranean climate. Relative humidity in summer increases the quality of honey production. Implanted areas are limited and animal breeding is very popular.

In Van Lake basin, xenomorphic step vegetation is predominant. Occasionally shrub formations, also rarely tree forms are seen. There is no forest formation. Existing forest formation has been transformed into shrub forms by biotic factors. In the research area, herbaceous formations with step characteristic are the predominant vegetation type.

Methods: This study based on the periodic excursion in Van Lake basin between 1993 and 2003. Excursion in the area was made between March-November, because these months are the vegetation period in the basin. In this study, abundance and density of the bee and bee plants populations were observed. Plant samples were collected from the area during these observations. The appropriate drying methods were later applied and identifications of the samples were carried out according to the literature (Davis, 1965-1985; Ekim, 1987; Davis *et al*., 1988; Baytop, 1994; Sorger, 1998; Ekim *et al*., 2000; Güner *et al*., 2000).

The bee plants founds in the area were checked according to the previous floristic studies (Behçet, 1991; Boynukara and Öztürk, 1992; Oğün and Altan, 1992; Behçet and Altan, 1993; Zeyrek and Öztürk, 1993; Altan and Behçet, 1995; Öztürk *et al*., 1998; Koyuncu *et al*., 1999; Özgökçe and Behçet, 1999; Öztürk and Behçet, 1999; Unal and Behçet, 1999; Altan and Uğurlu, 2000; Ilarslan, 2000; Demirkuş *et al*., 2001; Fırat, 2002; Karabacak, 2003; Oztürk, 2004; Turgay and Öztürk, 2003). Furthermore pollen, nectar-pollen and secretion analysis was done in these plant and grouped according to their categories (Ekim, 1997; Tew, 1998).

RESULTS AND DISCUSSION

At the end of this research made in Van Lake basin, 251 natural plants belonging to 44 families and 31 cultures form totally 282 taxa were determined as bee plants. Twenty-eight taxa out of these plants were found to be endemic. The first three families that contain the most taxa were Fabaceae with 42 taxa, Asteraceae with 33 taxa, Lamiaceae with 28 taxa, respectively (Table 1).

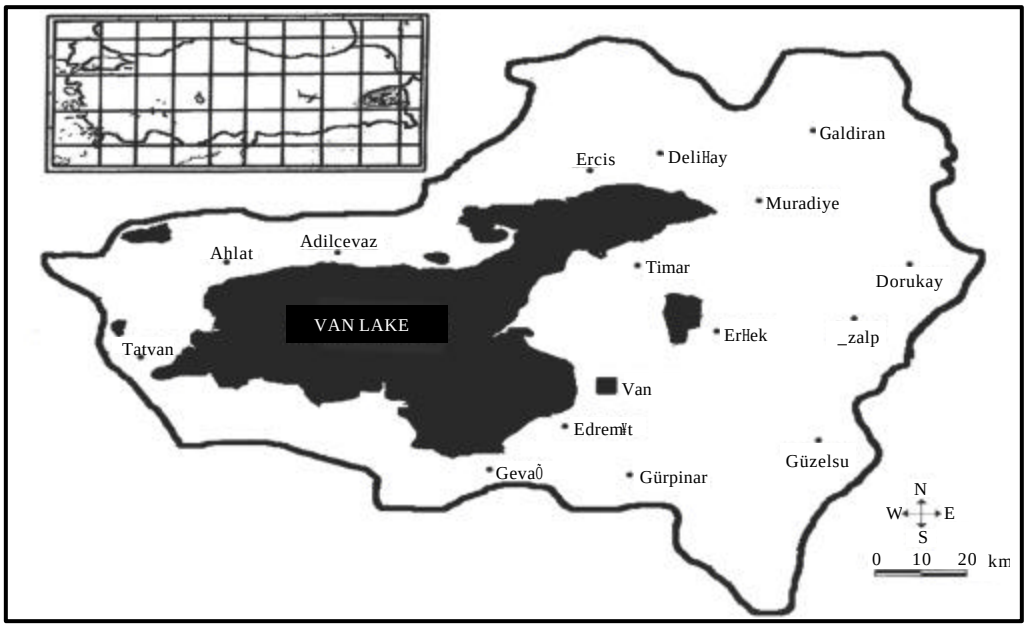

Fig. 1: The study area

Table 1: Bee plants of Van Lake basin

Bee plants of Van Lake basin	N-P-S
Aceraceae	
Acer negundo L., CV.	PS
A. platanoides L.	PS
A. tataricum L.	PS
Anacardiaceae	
Pistacia eurycarpa Yalt.	P
P. khinjuuk Stock.	P
Apiaceae	
Eryngium billardieri Delar.	P
Ferula haussknechtii Wolff ex Rech.	NP
Prangos pabularia Lindl.	P
P. ferulacea (L.) Lindl.	P
Asteraceae	
Achillea biebersteinii Afan.	NP
A. millefolium L. sp. *Millefolium*	NP
A. vermicularis Trin.	NP
Anthemis cretica L. sp. *albida* (Boiss.) Grierson.	P
A. tinctoria L. var. *Tinctoria*	P
Artemisia austriaca Jacq.	P
A. vulgaris L.	P
Carduus nutans L. sp. *Nutans*	NP
C. pycnocephalus L. sp. *albidus* (Bieb.) Kazmi	NP
Centaurea aucheri (DC.) Wagenitz.	NP
C. depressa Bieb.	NP
C. iberica Trev. ex Sprengel.	NP
C. pseudoreflexa Hayek.	NP
C. pseudoscabiosa Boiss. et Buhse. sp. *Pseudoscabiosa*	NP
C. rhizantha C. A. Meyer.	NP
C. saligna (Koch.) Wagenitz. END.	NP
C. solstitialis L. sp. *Solstitialis*	NP
C. spectabilis (Fisch. et. Mey.) Schultz var. *spectabilis*	NP
C. urvillei DC. sp. *hayekiana* Wagenitz.	NP
C. virgata Lam.	NP
Cichorium intybus L.	NP
C. pumilum Jacq.	NP
Cirsium arvense (L.) Scop. sp. *Arvense*	NP
Crepis armena DC.	NP
C. foetida L. sp. *rhocadifolia* (Bieb.) Celak.	NP
C. sancta (L.) Babcock.	NP
Echinops orientalis Trautv.	NP
Scorzonera cana (C.A. Mey.) Hoffm.	NP
Senecio pseudo-orientalis Schischkin.	NP
S. vernalis Waldst.	NP
Taraxacum crepidiforme DC. sp. *crepidiforme*	NP
T. davisii Soest. END.	NP
T. kurdiciforme G. Hagl.	NP
BERBERIDACEAE	
Berberis ottoversis L. CV.	NP
B. thumbergii DC. CV.	NP
Boraginaceae	
Anchusa azurea Miller. var. *azurea*	NP
A. strigosa Labill.	NP
A. arvensis (L.) Bieb.	NP
Echium italicum L.	P
Miyosotis alpestris F. W. Schmidt. sp. *alpestris*	NP
M. olympica Boiss.	NP
Brassicaceae	
Alyssum alyssoides (L.) L.	P
A. contemptum Schott. et Kotschy.	P
A. desertorum Stapf. var. *desertorum*	P
A. ochroleucum Boiss. et Huet. END.	P
Boreava orientalis Jaub. and Spach.	NP
Crambe orientilis L. var. *orientilis*	NP
Isatis aucheri Boiss.	P
I. cappadocica Desev. sp. *cappadocica*	P
I. steveniana Trautv.	P
Sinapis arvensis L.	P

Table 1: Continued

Bee plants of Van Lake basin	N-P-S
Campanulaceae	
Campanula coriacea Davis. END.	NP
C. involucrata Aucher. ex A. DC.	NP
C. stevenii Bieb. sp. *stevenii*	NP
C. stricta L. var. *stricta*	NP
Caprifoliaceae	
Lonicera caucasica Pall.	P
L. nummulariifolia Jaub. and Spach.	P
Caryophyllaceae	
Cerastium anomalum Waldst. et Kit.	NP
C. dubium (Bást.) O. Schwarz.	NP
C. kotschyi Boiss.	NP
Dianthus libanotis Lab.	NP
D. muschianus Kotschy et Boiss. END.	NP
Holosteum umbellatum L. var. *umbellatum*	NP
Silene alba (Miller) Krause	P
S. cappadocica Boiss. Et Heldr.	P
S. capitellata Boiss. END.	P
S. cartilaginea Hub.-Mor. END.	P
S. compactae Boiss.	P
S. marschallii C. A. Mey.	P
Convolvulaceae	
Convolvulus arvensis L.	NP
C. calvertii Boiss.	NP
C. galaticus Rostan et Choisy. END.	NP
Crassulaceae	
Sedum album L.	NP
S. hispanicum L. var. *semiglabrum* Fröder.	NP
S. subulatum (C. A. Mey.) Boiss.	NP
Cucurbitaceae	
Citrullus lanatus (Thunb.) Matsum. Et Nakai	NP
Cucumis melo L. CV.	NP
C. sativus L. CV.	NP
Cupressaceae	
Juniperus excelsa Bieb.	S
J. oxycedrus L. sp. *oxycedrus*	S
Dipsacaceae	
Scabiosa argentea L.	N
S. bicolor Kotschy	N
Elaeagnaceae	
Elaeagnus angustifolia L. sp. *angustifolia*	NP
Euphorbiaceae	
Euphorbia eriophora Boiss.	NP
E. falcata L. sp. *falcata* var. *Falcata*	NP
E. heteradena Jaub. et Spach.	NP
E. orientalis L.	NP
E. virgata Valdst. et Kit.	NP
Fabaceae	
Astragalus bicolor Lam. END.	NP
A. campylosema Boiss. sp. *campylosema* END.	NP
A. caraganae Fisch. et Mey.	NP
A. caspicus Bieb.	NP
A. cinereus Willd. END.	NP
A. comosoides (Chamb.) Mathews.	NP
A. elongatus Willd. sp. *elongatus*	NP
A. fragrans Willd.	NP
A. hyalolepis Bunge.	NP
A. incertus Ledep.	NP
A. kurdicus Boiss. var. *muschianus* (Kotschy and Boiss.) Chamb. END.	NP
A. lagurus Willd.	NP
A. lycius Boiss. END.	NP
A. macrocephalus Willd.	NP
A. odoratus Lam.	NP
A. onobrychis L.	NP
A. persicus (DC.) Fisch. Et Mey.	NP
Colutea cilicica Boiss. Et Bal.	NP
Cronilla orientalis Miller var. *Orientalis*	NP

Table 1: Continued

Bee plants of Van Lake basin	N-P-S
C. varia L. sp. *Varia*	NP
Glycyrrhiza glabra L. var. *glabra*	NPS
Lathyrus boissieri Širj.	NP
L. inconspicuous L.	NP
L. pratensis L.	NP
Lotus cornicilatus L. var. *cornicilatus*	NP
Medicago sativa L. sp. *sativa*	NP
Melilotus officinalis (L.) Desr.	NP
Onobrychis atropatana Boiss.	NP
O. cornuta (L.) Desv.	NP
O. stenostachya Freyn. sp. *sosnowkyi* (Gross.) Hedge. END.	NP
O. sulphurea Boiss. Et Bal. var. *vanensis* Hedge. END.	NP
O. viciaefolia Scop. sp. *sativa* (Lam.) Thellung. CV.	NP
Ononis spinosa L. sp. *Leiosperma* (Boiss.) Širj.	NP
Robinia pseudo-acacia L. CV.	N
Sophora alopecuroides L. var. *alopecuroides*	NP
Trifolium ambiguum Bieb.	NP
T. montanum L.	NP
T. pratense L. var. *pratense*	NP
T. repens L. var. *giganteum* Lag.-Foss.	NP
Vicia alpestris Stev. sp. *Alpestris*	NP
V. cracca L.	NP
V. sativa L. CV.	NP
Fagaceae	
Quercus infectoria Olivier.	PS
Q. libani Olivier.	PS
Q. petraea (Mattusch.) Liebl. sp. *pinnatiloba* (C. Koch.) Menit., END.	PS
Q. robur L. sp. *pedunculiflora* (C. Koch.) Menitsky.	PS
Fumariaceae	
Fumaria asepala Boiss.	P
F. microcarpa Boiss. Ex Hauss.	P
Geraniaceae	
Geranium stepporum Davis END.	NP
Grossulariaceae	
Ribes aureum Pursh. CV.	NP
Hypericaceae	
Hypericum lydium Boiss.	P
H. lysimachioides Boiss. Et Noë.	P
H. scabrum L.	
Iridaceae	
Crocus pallasii Goldb.	NP
C. biflorus Miller	NP
Gladiolus atroviolaceus Boiss.	P
Iris barnumae Baker	NP
I. caucasica Hoffm.	NP
I. iberica Hoffm. sp. *elegantissima* (Sosn.) Takht. Et Fedorov	NP
I. paradoxa Steven.	NP
I. spuria L. sp. *musulmanica* (Fomin.) Takht.	NP
Juglandaceae	
Juglans regia L.	PS
Lamiaceae	
Ajuga chamaepitys (L.) Schr.	NP
Lamium album L.	NP
L. amplexicaule L.	NP
L. garganicum L.	NP
Marrubium parviflorum Fisch. et Mey.	NP
Mentha longifolia (L.) Hudson. sp. *Longifolia*	NP
Nepeta racemosa Lam.	NP
Phlomis armeniaca Willd. END.	NP
P. kurdica Rech.	NP
P. tuberosa L.	NP
Salvia armeniaca (Bordz.) Grossh.	NP
S. brachyantha (Bordz.) Pobed.	NP
S. frigida Boiss.	NP
S. kronenburgii Rech. END.	NP
S. multicaulis Vahl.	NP
S. verticillata L.	NP

Table 1: Continued

Bee plants of Van Lake basin	N-P-S
Stachys annua (L.) L.	NP
S. germanica L.	NP
S. lavandulifolia Vahl.	NP
Teucrium chamaedrys Bentham.	NP
T. orientale L.	NP
T. polium L.	NP
Thymus bornmuelleri Velen. END.	N
T. fallax Fisch. et Mey.	N
T. fedtschenkoi Ronn. var. *handelii* (Ronn.) Jalas. END.	N
T. kotschyanus Boiss et Hohen.	N
T. pubescens Boiss. et Kotschy.	N
Ziziphora capitata L.	N
Liliaceae	
Allium akaka S.G.Gmelin	NP
A. armenum Boiss. et Kotschy END.	NP
A. atroviolaceum Boiss.	NP
A. flavum L.	NP
A. scabriscapum Boiss. et Kotschy	NP
Colchicum szovitsii Fisch. et Mey.	NP
Gagea gageoides (Zucc.) Vued.	NP
G. peduncularis (J. et C. Presl.) Pac.	NP
G. reticulata (Pallas) Schultes	NP
Muscari comosum (L.) Miller.	NP
M. neglectum Guss.	NP
Tulipa humulis Herbert	NP
T. Julia C.Koch.	NP
Linaceae	
Linum persicum Boiss.	P
L. pycnophyllum Boiss. et Heldr. sp. *kurdicum* Davis END.	P
Malvaceae	
Alcea calvertii (Boiss.) Boiss. END.	NP
Malva neglecta Wallr.	NP
Oleaceae	
Fraxinus americana L. CV.	PS
F. excelsior L. CV.	PS
F. syriaca Boiss.	PS
Papareceae	
Glaucium flavum Crandz.	P
G. grandiflorum Boiss. et Huet	P
Papaver arenarium Bieb.	P
P. bracteatum Lindl.	P
Papaver corniculatum (L.) Rud.	P
P. hybridum L.	P
P. macrostomum Boiss et Huet.	P
P. tauricola Boiss.	P
Pinaceae	
Picea orientalis (L.) Link. CV.	PS
Pinus nigra Arn. sp. *pallasiana* (Lamb.) Holmboe CV.	PS
P. pinea L. CV.	PS
P. sylvestris L. CV.	PS
Plantaginaceae	
Plantago lanceolata L.	P
P. major L.	P
P. maritime L.	P
Platanaceae	
Platanus orientalis L. CV.	P
Poaceae	
Triticum dicoccon Schrang. CV.	P
Hordeum vulgare L. CV.	P
Polygonaceae	
Plygonum aviculare L.	NP
P. cognatum L.	NP
P. pulchellum Lois.	NP
Ranunculaceae	
Adonis aestivalis L.	P
A. flammea Jacq.	P
Ceratocephalus falcatus (L.) Pers	P
C. testicularis (Crantz.) Roth.	P

Table 1: Continued

Bee plants of Van Lake basin	N-P-S
Consolida oliveriana (DC.) Schröd.	P
C. orientalis (Gay.) Schröd.	P
Delphinium carduchorum Chow. Et Davis, END.	P
Ranunculus arvensis L.	P
R. cuneatus Boiss.	P
R. damascenus Boiss. Et Gaill.	P
R. dissectus Bieb. sp. *huetii* (Boiss.) Davis, END.	P
R. kotschyi Boiss.	P
R. sericeus Banks. Et Sol.	P
Resedaceae	
Reseda lutea L. var. *lutea*	NP
Rosaceae	
Amygdalus communis L.	NP
A. trichamygdalus (Hand.-Mazz.) Woronow, var. *trichamygdalus*	NP
Armeniaca vulgaris Lam., CV.	NP
Cerasus avium L., CV.	NP
C. microcarpa (C.A.Mey.) Boiss. sp. *Microcarpa*	NP
C. vulgaris L., CV.	NP
Crataegus monogyna Jacq., sp. *monogyna*	NP
C. orientalis Pallas ex Bieb. var. *orientalis*	NP
Cydonia oblonga Miller, CV.	NP
Malus sylvestris Miller, CV.	NP
Prunus cerasifera Ehrh., CV.	NP
P. divericata Ledeb. sp. *Divericata*	NP
P. x domestica L., CV.	NP
P. spinosa L., CV.	NP
Pyrus communis L., CV.	NP
Rosa canina L.	NP
R. dumalis Bechst. sp. *boissieri* (Crépin.) Nilsson var. *boissieri*	NP
R. foetida J.Herrm.	NP
Rubus canescens DC.	NP
Salicaceae	
Populus alba L., CV.	S
P. canescens Smith.	S
P. nigra L., CV.	S
P. tremula L.	S
Salix alba L.	NPS
S. babylonica L., CV.	NPS
S. caprea L., CV.	NPS
S. cinerea L.	NPS
Scrophulariceae	
Lagotis stolonifera (C.Koch.) Maxim.	NP
Linaria kurdica Boiss. and Hohen.	P
L. Piramidata (Lam.) Sprengel	P
Pedicularis comosa L.	P
Scrophularia nodosa L.	N
Verbascum densiflorum Bertol.	P
V. phoeniceum L.	P
V. vanense Hub.-Mor., END.	P
Veronica orientalis Miller sp. *carduchorum* Davis ex Fich. END.	NP
V. orientalis Miller. sp. *orientalis*	NP
Tamaricaceae	
Tamarix tetrandra Pall.	P
Typhaceae	
Typha latifolia L.	PS
Ulmaceae	
Ulmus minor Miller sp. *Minor*	PS

Every index was given in alphabetical order. CV: Cultivated plant, END: Endemic, N: Nectar, P: Pollen, S: Secretion

There is high demand honey that produced in Van Lake basin. The contribution of endemic plants to the quality of the honey is thought to be quite much. In the world, 260 bee plants are known. In Turkey, 75% of bee plants are grown. In the study area, 282 taxa were determined to be bee plants. Twenty-eight of 282 taxa were endemic. It is believed that Van Lake basin is important for beekeeping and quality honey production.

In the study area there is not highway and industry. Therefore, the quality of honey increases. Used for the production of honey plants is important. Honey can be produced toxic effects. Because, it shows some of the pyrrolizidine alkaloid-containing plants that are recorded in the scientific literature as being sources of honey for human consumption (Edgar *et al*., 2002). It has been estimated that 3% of the world's flowering plants contain pyrrolizidine alkaloids (Smith and Culvenor, 1981).

If pyrrolizidine alkaloid ingestion from honey is shown to be substantially above standards for herbal products, but there is no evidence that honeys containing pyrrolizidine alkaloids cause adverse health outcomes then, this should be considered in future risk analysis and in the determination of tolerable daily intakes for pyrrolizidine alkaloids. It may be necessary, in the case of foods such as honey, to set a level for pyrrolizidine alkaloids that is as low as reasonably achievable.

According to results in the study area, two of the 282 plants contain pyrrolizidine alkaloids and 0.7% of the total plants are pyrrolizidine alkaloids plants. Therefore, produced honey in the area is healthy.

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