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Research Article

Honey Plants of Düzce University Ornamental and Medicinal Plants Botanical Garden

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ABSTRACT

In this study, melliferous plants that the honey bee (*Apis mellifera* L.) can benefit from among the taxa planted in Düzce University Ornamental and Medicinal Plants Botanical Garden, are presented. Among the 451 taxa planted in the botanical garden, those with these characteristics were determined by reviewing studies on the subject. Of the 165 taxa (36.58%) included in the honey plant class; 119 contain both nectar and pollen, 25 contain pollen, 13 contain nectar, 4 contain both pollen and insect secretion (IS) or sweet sap (SS), 2 contain pollen, nectar and IS or SS, 1 contain both nectar and SS, 1 contain only IS. In order to prevent the decrease in pollinator and pollinator insects, whose numbers are decreasing due to global climate change, a "Bee and Insect Hotel" was placed in the botanical garden. For this reason, the majority of the plants selected for planting were chosen from taxa with honey plant properties. The main purpose here is both to pollinate the plants in the botanical garden and to show and explain the effects of insect species on pollination through nature education.

Keywords: *Botanical garden, Honey plants, Nectar, Pollen, Bee and insect hotel.*

Düzce Üniversitesi Süs ve Tıbbi Bitkiler Botanik Bahçesinin Ballı Bitkileri

Öz

Bu çalışmada Düzce Üniversitesi Süs ve Tıbbi Bitkiler Botanik Bahçesi'ne dikilen taksonlardan bal arısının (*Apis mellifera* L.) yararlanabileceği ballı bitkiler sunulmuştur. Botanik bahçesine dikimi gerçekleştirilen 451 taksondan bu özelliklere sahip olanlar konuyla ilgili çalışmalar incelenerek belirlenmiştir. Ballı bitki sınıfına giren 165 taksondan (%36,58); 119'u hem nektar hem de polen, 25'i polen, 13'ü nektar, 4'ü hem polen hem de böcek salgısı (BS) veya tatlı özsu (TÖS), 2'si polen, nektar ve BS veya TÖS, 1'i hem nektar hem de TÖS, 1'i yalnızca BS içerir. Küresel iklim değişikliği nedeniyle sayıları azalan polen ve polen taşıyıcı böceklerin azalmasını önlemek amacıyla

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botanik bahçesine bir "Arı ve Böcek Oteli" yerleştirildi. Bu nedenle dikim için seçilen bitkilerin büyük çoğunluğu ballı bitki özelliği taşıyan taksonlardan seçildi. Buradaki temel amaç hem botanik bahçesindeki bitkilerin tozlaşmasını sağlamak hem de böcek türlerinin tozlaşma üzerindeki etkilerini doğa eğitimi yoluyla göstermek ve anlatmaktır.

Anahtar Kelimeler: *Botanik bahçesi, Ballı bitki, Nektar, Polen, Arı ve böcek hoteli*

I. INTRODUCTION

Animal pollination plays a vital role as a regulating ecosystem service in nature. Most of the world's wild flowering plants (87.5%) are pollinated by insects and other animals. The importance of animal pollination varies substantially among crops, and, therefore among regional crop economies [1]. The vast majority of pollinator species are wild, including more than 20,000 species of bees, some species of flies, butterflies, moths, wasps, beetles, thrips, birds, bats and other vertebrates [2].

A few species of bees are widely managed, including the western honey bee (*Apis mellifera*), the eastern honey bee (*Apis cerana*), some bumble bees, some stingless bees and a few solitary bees [3]. However wild pollinators have declined in occurrence and diversity (and abundance for certain species) at local and regional scales in North West Europe and North America [4]. The abundance, diversity, and health of pollinators and the provision of pollination are threatened by direct drivers that generate risks to societies and ecosystems [5].

The ranges, abundances, and seasonal activities of some wild pollinator species (e.g., bumble bees and butterflies) have changed in response to observed many of our pollinators are currently suffering declines due to land use changes, land management, pesticides, disease, invasive species, and climate change [6]. Ecological infrastructure needed to improve pollination includes patches of semi-natural habitats distributed throughout productive landscapes, providing nesting and floral resources [7].
Providing artificial habitats for pollinators can significantly increase their number and diversity. It is known for certain that more nectar and pollen sources will help increase their health and numbers. For this reason, it is known that efforts to develop and create alternative habitats for pollinators continue in some countries [8, 9, 10].

Currently, in the context of biodiversity losses, Botanical gardens have assumed a new role as repositories for the conservation of the plant biological diversity at global level. The Botanical Gardens are habitats that highly structured with many very different biotope types and a permanently high flower diversity, for bees [11].

Düzce University Ornamental and Medicinal Plants Botanical Garden was established in order to protect the plant biological diversity of Düzce province and the Western Black Sea Region, to transfer it to future generations by ensuring its sustainability, and to serve integrated nature conservation and education. While selecting species for the botanical garden, care was taken to plant species that contain nectar and pollen in order to provide food for pollinators, as well as species that have visual appeal that can attract the attention of visitors.

In this study, it was aimed to determine food plants for bees in Düzce University Ornamental and Medicinal Plants Botanical Garden, which is a living nature museum, and to give information about the application that will attract bees.

II. MATERIAL METHOD

A. STUDY AREA

Euro-Siberian (Euxine) Flora, Mediterranean Flora and Irano-Turanian Flora are dominant in the northwestern Black Sea region in Düzce province. Thus, biodiversity is very high in Düzce.
Düzce flora has 102 families, 471 genera, 1200 species and subspecies taxa. On the north-facing slopes of the region, there is forest vegetation consisting of beech, chestnut, oak, hornbeam, linden, maple, ash and other leafy trees belonging to the Black Sea vegetation. On the south-facing slopes, there is a pseudo-macchia vegetation consisting of shrubs such as laurel (*Laurus nobilis* L.), Oak (*Quercus* sp.), and heather (*Erica arborea* L.) belonging to the local Mediterranean vegetation. Duzce's rich flora is habitat for various pollinators. Chestnut (*Castanea sativa* Miller), linden (*Tilia* spp.), thyme (*Thymus* spp.) and heather (*Ericaceae*) are the main species of honey forests. The study area is located within the borders of Düzce University Konuralp Campus, located in the north of Düzce province (Fig. 2).

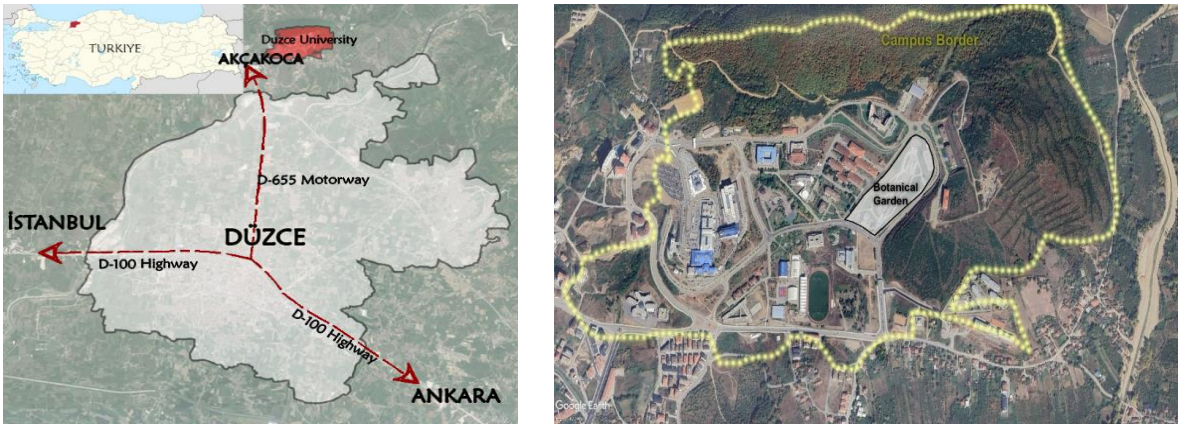


Figure 1. *Location of study area*

The botanical garden is a valley located within the borders of Düzce University, with an area of approximately 51,450 m², from the bottom of which a weak water flows, and the amount of green area consists of a total of 38293 m².

The Botanical Garden is a rectangular area extending from the north-northeast direction to the south-southwest axis and is surrounded by internal roads. The Black Sea climate is generally dominant in the project area.

Düzce University Ornamental and Medicinal Plants Botanical Garden is a living nature museum built on 43 main consisting of terraced gardens, rock gardens, waterfalls, streams, streams, pond ecological systems, amphitheater, nature and botanical museum education systems, collections and garden exhibitions where living biomes on earth are defined: arboretum and recreation area, medicinal aromatic plants garden, *Ex-situ* Düzce plants, Central Anatolian steppe plants, rock garden, Mediterranean plants, herbaceous-woody plants, geophyte garden, exotic species, pond and aquatic plants, moist stream vegetation and welcome gardens (Fig. 3).

Figure 2. *Plant collections of Düzce University Ornamental and Medicinal Plants Botanical Garden*

B. DETERMINING HONEY PLANTS PLANTED IN THE BOTANICAL GARDEN

Among the plants planted in the botanical garden, taxa that can provide food sources for various pollinators by containing nectar, pollen, insect secretions and sweet sap were determined by examining various literature on the subject (Figs. 7 and 8) [12, 13, 14, 15, 16, 17, 18, 19, 20, 21].

C. BEE AND INSECT HOTEL DESIGN

A bee and insect hotel has been designed to host various pollinators, especially solitary wild bees, that will benefit from the honey plants in the Botanical Garden. Log pieces, timber and briquette bricks were used as materials in the design of the Bee Hotel (Fig. 4).

Figure 3. *Bee and insect hotel located in Düzce University Ornamental and Medicinal Plants Botanical Garden*

III. RESULT

Aromatic- medicinal gardens plants in the botanical garden, are a type of garden designed with the intent of growing used as natural medicines also specific nectar and pollen-producing plants. This designed garden is approximately 80 meters long and 2 m wide. 18 different species were preferred in this garden. Each parcel is approximately 4 m.

18 different species were preferred in this garden. Most of these species attract bees with their scent and flower characteristics. For the planting project carried out in the Botanical Garden, 13852 plants belonging to 451 taxa were procured through purchases and grants from various nurseries in Turkey. In this context, approximately; Grant from 4444 Nezahat Gökyiğit Botanical Gardens and Eskişehir and Bolu Regional Directorates of Forestry, 9408 plants were procured through purchasing. Seeds of medicinal plants obtained by donation from Afyonkarahisar Medicinal and Herbal Plants Center and Zeytinburnu Medicinal Plants Garden are stored in the seed bank until the germination process begins. Among the taxa planted in the botanical garden, the life forms of 165 taxa determined to be honey plants were determined. Accordingly, 147 taxa (89.09%) are Phanerophyt (Trees and shrubs), 9 taxa (5.45%) are Chamaephytes (woody plants with perennating buds), 5 taxa (3.03%) are Lianas (climbing woody plants), 4 taxa (2.42%) are Hemicryptophytes (rosette plants) (Fig. 5).

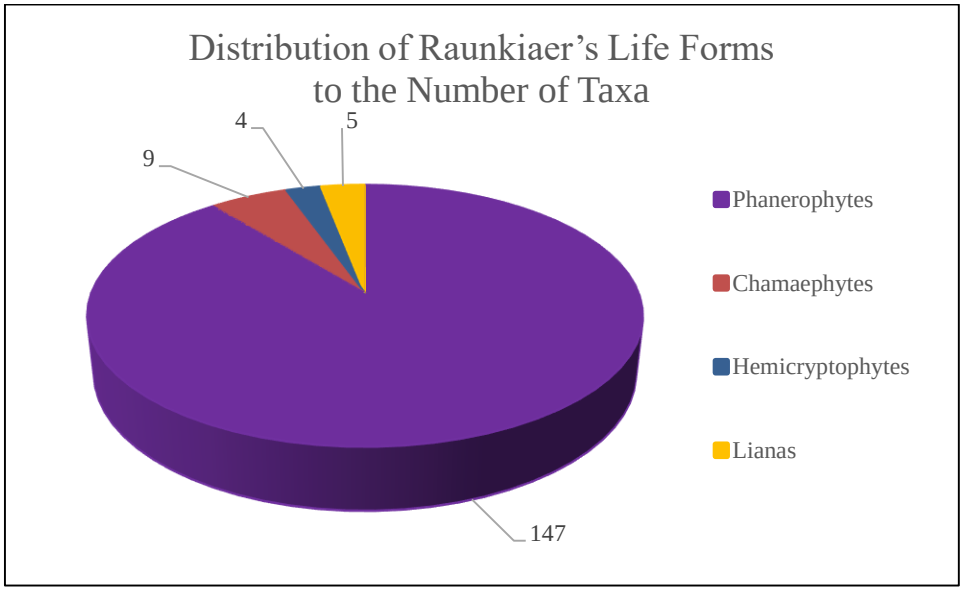


Figure 4. *Distribution of Number of Taxa according to Raunkiaer's Life Forms*

The majority of the plants selected for planting were chosen from taxa with honey plant properties. The main purpose here is both to pollinate the plants in the botanical garden and to show and explain the effects of insect species on pollination through nature education.

Melliferous plant characteristics of 451 taxa planted in the Botanical Garden were determined. Accordingly, 165 taxa (36.58%) are important for beekeeping. 119 contain both nectar and pollen, 25 contain pollen, 13 contain nectar, 4 contain both pollen and insect secretion (IS) or sweet sap (SS), 2 contain pollen, nectar and IS or SS, 1 contain both nectar and SS, 1 contain only IS (Table 1), (Fig. 6).

Table 1. *Honey Plants Planted in Düzce University Ornamental and Medicinal Plants Botanical Garden*

Family	Takson	Nectar	Pollen	IS/SS	Life Form
Caprifoliaceae	*Abelia* × *grandiflora* (Rovelli ex André) Rehder	N	P		Phanerophyt
Caprifoliaceae	*Abelia* × *grandiflora* 'Compacta Nana'	N	P		Phanerophyt
Caprifoliaceae	*Abelia* × *grandiflora* 'Kaleidoscope'	N	P		Phanerophyt
Fabaceae	*Acacia dealbata* Link	N	P		Phanerophyt
Sapindaceae	*Acer buergerianum* Miq.	N			Phanerophyt
Sapindaceae	*Acer campestre* L.	N	P		Phanerophyt
Sapindaceae	*Acer negundo* 'Flamingo'	N	P		Phanerophyt
Sapindaceae	*Acer negundo* L.	N	P		Phanerophyt
Sapindaceae	*Acer palmatum* 'Dissectum'	N	P		Phanerophyt
Sapindaceae	*Acer platanoides* 'Crimson King'	N	P		Phanerophyt

Sapindaceae	*Acer platanoides* 'Drummondii'	N	P		Phanerophyt
Sapindaceae	*Acer platanoides* 'Fairview'	N	P		Phanerophyt
Sapindaceae	*Acer platanoides* 'Globosum'	N	P		Phanerophyt
Sapindaceae	*Acer platanoides* L.	N	P		Phanerophyt
Sapindaceae	*Acer platanoides* 'Royal Red'	N	P		Phanerophyt
Sapindaceae	*Acer pseudoplatanus* L.	N	P		Phanerophyt
Sapindaceae	*Acer pseudoplatanus* 'Leopoldii'	N	P		Phanerophyt
Sapindaceae	*Acer pseudoplatanus* 'Spaethii'	N	P		Phanerophyt
Sapindaceae	*Acer rubrum* L.	N	P		Phanerophyt
Sapindaceae	*Acer saccharinum* L.	N	P		Phanerophyt
Sapindaceae	*Acer saccharinum* 'Laciniatum Wieri'	N	P		Phanerophyt
Sapindaceae	*Acer tataricum* L.	N	P		Phanerophyt
Sapindaceae	*Aesculus* × *carnea* Hayne	N	P		Phanerophyt
Sapindaceae	*Aesculus hippocastanum* L.	N	P		Phanerophyt
Ericaceae	*Arbutus unedo* 'Compacta'	N	P		Phanerophyt
Berberidaceae	*Berberis* × *media* 'Red Jewel'	N	P		Phanerophyt
Berberidaceae	*Berberis juliana* C.K.Schneid.	N	P		Phanerophyt
Berberidaceae	*Berberis ottawensis* 'Superba'	N	P		Phanerophyt
Berberidaceae	*Berberis thunbergii* 'Coronita'	N	P		Phanerophyt
Berberidaceae	*Berberis thunbergii* DC.	N	P		Phanerophyt
Berberidaceae	*Berberis thunbergii* f. *atropurpurea*	N	P		Phanerophyt
Berberidaceae	*Berberis thunbergii* f. *atropurpurea* 'Nana'	N	P		Phanerophyt
Berberidaceae	*Berberis thunbergii* 'Maria'	N	P		Phanerophyt
Berberidaceae	*Berberis thunbergii* 'Tinny Gold'	N	P		Phanerophyt
Berberidaceae	*Berberis vulgaris* L.	N	P		Phanerophyt
Betulaceae	*Betula pendula* Roth		P	IS	Phanerophyt
Scrophulariaceae	*Buddleja davidii* Franch.	N			Phanerophyt
Fagaceae	*Castanea sativa* Mill.	N	P	SS	Phanerophyt
Cannabaceae	*Celtis australis* L.	N	P		Phanerophyt

Fabaceae	*Ceratonia siliqua* L.	N	P	Phanerophyt
Fabaceae	*Cercis siliquastrum* L.	N	P	Phanerophyt
Cistaceae	*Cistus creticus* L.	N	P	Chamaephyt
Cistaceae	*Cistus salviifolius* 'Crispus'	N	P	Chamaephyt
Ranunculaceae	*Clematis vitalba* L.		P	Lian
Fabaceae	*Colutea arborescens* L.	N	P	Phanerophyt
Cornaceae	*Cornus alba* 'Aurea'	N		Phanerophyt
Cornaceae	*Cornus alba* 'Sibirica'	N		Phanerophyt
Cornaceae	*Cornus* florida L.	N		Phanerophyt
Cornaceae	*Cornus kousa* Bürger ex Hance	N		Phanerophyt
Cornaceae	*Cornus mas* L.	N	P	Phanerophyt
Cornaceae	*Cornus sanguinea* L.	N	P	Phanerophyt
Rosaceae	*Cotoneaster dammeri* C.K.Schneid.	N	P	Phanerophyt
Rosaceae	*Cotoneaster dammeri* 'Evergreen'	N	P	Phanerophyt
Rosaceae	*Cotoneaster franchetii* Boiss.	N	P	Phanerophyt
Rosaceae	*Cotoneaster frigida* 'Cornubia'	N	P	Phanerophyt
Rosaceae	*Cotoneaster horizontalis* Decne.	N	P	Phanerophyt
Rosaceae	*Cotoneaster microphyllus* Wall. ex Lindl.	N	P	Phanerophyt
Rosaceae	*Cotoneaster salicifolius* Franch.	N	P	Phanerophyt
Rosaceae	*Crataegus lavallei* 'Carrierei'	N	P	Phanerophyt
Cupressaceae	*Cupressus sempervirens* L.		P	Phanerophyt
Cupressaceae	*Cupressus sempervirens* subsp. *horizontalis*		P	Phanerophyt
Cupressaceae	*Cupressus sempervirens* subsp. *pyramidalis*		P	Phanerophyt
Hydrangeaceae	*Deutzia gracilis* Siebold & Zucc.		P	Phanerophyt
Ebenaceae	*Diospyros kaki* L.f.	N	P	Phanerophyt
Elaeagnaceae	*Elaeagnus angustifolia* L.	N	P	Phanerophyt
Escalloniaceae	*Escallonia rubra* (Ruiz & Pav.) Pers.	N	P	Phanerophyt
Fagaceae	*Fagus orientalis* Lipsky		P	Phanerophyt
Oleaceae	*Forsythia* × *intermedia* Zabel	N	P	Phanerophyt

Oleaceae	*Fraxinus excelsior* 'Altena'	N	P		Phanerophyt
Oleaceae	*Fraxinus excelsior* 'Diversifolia'	N	P		Phanerophyt
Oleaceae	*Fraxinus excelsior* 'Jaspidea'	N	P		Phanerophyt
Oleaceae	*Fraxinus excelsior* L.	N	P		Phanerophyt
Oleaceae	*Fraxinus excelsior* 'Westhof Glorie'	N	P		Phanerophyt
Fabaceae	*Genista tinctoria* 'Royal Gold'	N	P		Chamaephyt
Araliaceae	*Hedera helix* 'Alba Marginata'	N	P		Lian
Araliaceae	*Hedera helix* 'Aurea Variegata'	N	P		Lian
Araliaceae	*Hedera helix* L.	N	P		Lian
Araliaceae	*Hedera hibernica* Poit.	N	P		Lian
Hydrangeaceae	*Hydrangea macrophylla* (Thunb.) Ser.	N	P		Phanerophyt
Hydrangeaceae	*Hydrangea quercifolia* Bartram	N	P		Phanerophyt
Juglandaceae	*Juglans regia* L.		P	SS	Phanerophyt
Lauraceae	*Laurus nobilis* L.	N	P		Phanerophyt
Lauraceae	*Laurus nobilis* 'Pyramidalis'	N	P		Phanerophyt
Lamiaceae	*Lavandula angustifolia* Mill. subsp. *angustifolia*	N			Chamaephyt
Lamiaceae	*Lavandula dentata* L.	N			Chamaephyt
Lamiaceae	*Lavandula stoechas* subsp. *cariensis* (Boiss.) Rozeira	N	P		Chamaephyt
Oleaceae	*Ligustrum vulgare* L.	N	P		Phanerophyt
Caprifoliaceae	*Lonicera etrusca* Santi	N	P		Phanerophyt
Caprifoliaceae	*Lonicera japonica* Thunb.	N	P		Phanerophyt
Caprifoliaceae	*Lonicera nitida* E.H.Wilson	N	P		Phanerophyt
Caprifoliaceae	*Lonicera pileata* Oliv.	N	P		Phanerophyt
Caprifoliaceae	*Lonicera tatarica* L.	N	P		Phanerophyt
Magnoliaceae	*Magnolia grandiflora* 'Gallisoniensis'		P		Phanerophyt
Magnoliaceae	*Magnolia grandiflora* 'Pyramidalis'		P		Phanerophyt
Magnoliaceae	*Magnolia* × *soulangeana* 'Nana'		P		Phanerophyt
Magnoliaceae	*Magnolia* × *soulangeana* Soul.-Bod.		P		Phanerophyt
Berberidaceae	*Mahonia aquifolium* (Pursh) Nutt. (≡ *Berberis aquifolium* Pursh)	N	P		Phanerophyt

Berberidaceae	*Mahonia aquifolium* 'Charty'	N	P		Phanerophyt
Rosaceae	*Malus sylvestris* Mill.	N	P		Phanerophyt
Lamiaceae	*Melissa officinalis* L.	N	P		Hemicryptophyt
Lamiaceae	*Mentha* × *piperita* L.	N			Hemicryptophyt
Moraceae	*Morus alba* L.		P		Phanerophyt
Moraceae	*Morus alba* 'Pendula'		P		Phanerophyt
Lamiaceae	*Origanum onites* L.	N	P		Chamaephyt
Oleaceae	*Osmanthus* × *burkwoodii* (Burkwood & Skipwith) P.S.Green	N	P		Phanerophyt
Oleaceae	*Osmanthus heterophyllus* (G.Don) P.S.Green	N	P		Phanerophyt
Oleaceae	*Osmanthus ilicifolius* 'Tricolor'	N	P		Phanerophyt
Hydrangeaceae	*Philadelphus coronarius* L.	N	P		Phanerophyt
Oleaceae	*Phillyrea latifolia* L.		P		Phanerophyt
Pinaceae	*Pinus brutia* Ten.			IS	Phanerophyt
Anacardiaceae	*Pistacia lentiscus* L.	N	P		Phanerophyt
Platanaceae	*Platanus orientalis* L.		P	SS	Phanerophyt
Rosaceae	*Prunus avium* (L.) L. (≡ *Cerasus avium* (L.) Moench)	N	P		Phanerophyt
Rosaceae	*Prunus laurocerarus* L. (≡ *Laurocerasus officinalis* M.Roem.)	N	P		Phanerophyt
Rosaceae	*Prunus laurocerasus* 'Nana'	N	P		Phanerophyt
Rosaceae	*Prunus laurocerasus* 'Otto Luyken'	N	P		Phanerophyt
Rosaceae	*Prunus laurocerasus* 'Rotundifolia'	N	P		Phanerophyt
Rosaceae	*Pyracantha coccinea* 'Aurea'	N	P		Phanerophyt
Rosaceae	*Pyracantha coccinea* M.Roem.	N	P		Phanerophyt
Rosaceae	*Pyracantha coccinea* 'Mohave'	N	P		Phanerophyt
Rosaceae	*Pyracantha coccinea* 'Nana'	N	P		Phanerophyt
Rosaceae	*Pyracantha coccinea* 'Navaho'	N	P		Phanerophyt
Rosaceae	*Pyracantha coccinea* 'Orange Glow'	N	P		Phanerophyt
Rosaceae	*Pyracantha coccinea* 'Soleil D'or'	N	P		Phanerophyt
Rosaceae	*Pyrus communis* L. subsp. *communis*	N	P		Phanerophyt
Rosaceae	*Pyrus elaeagrifolia* Pall.	N	P		Phanerophyt

Fagaceae	*Quercus brantii* Lindl.		P		Phanerophyt
Fagaceae	*Quercus ilex* L.		P		Phanerophyt
Fagaceae	*Quercus macranthera* subsp. *syspirensis* (K.Koch) Menitsky		P		Phanerophyt
Fagaceae	*Quercus palustris* Münchh.		P		Phanerophyt
Fagaceae	*Quercus robur* 'Fastigiata'		P		Phanerophyt
Fagaceae	*Quercus robur* L.		P		Phanerophyt
Fagaceae	*Quercus virgiliana* (Ten.) Ten.	N		SS	Phanerophyt
Fagaceae	*Quercus vulcanica* Boiss. & Heldr. ex Kotschy		P		Phanerophyt
Ericaceae	*Rhododendron ponticum* 'Grazella'	N			Phanerophyt
Rosaceae	*Rosa canina* L.	N	P		Phanerophyt
Rosaceae	*Rosa* L.		P		Phanerophyt
Rosaceae	*Rosa multiflora* Thunb.	N	P		Phanerophyt
Salicaceae	*Salix babylonica* L.	N	P		Phanerophyt
Salicaceae	*Salix babylonica* var. *matsudana* (Koidz.) H.Ohashi & Yonek.	N	P		Phanerophyt
Lamiaceae	*Salvia officinalis* L.	N	P		Hemicryptophyt
Lamiaceae	*Salvia rosmarinus* Schleid. (≡ *Rosmarinus officinalis* L.)	N	P		Chamaephyt
Lamiaceae	*Salvia sclarea* L.	N	P		Hemicryptophyt
Viburnaceae	*Sambucus nigra* L.	N	P		Phanerophyt
Rosaceae	*Sorbus aucuparia* L.	N	P		Phanerophyt
Rosaceae	*Sorbus torminalis* (L.) Crantz	N	P		Phanerophyt
Oleaceae	*Syringa vulgaris* L.	N	P		Phanerophyt
Tamaricaceae	*Tamarix africana* Poir.	N			Phanerophyt
Tamaricaceae	*Tamarix smyrnensis* Bunge	N	P		Phanerophyt
Taxaceae	*Taxus baccata* 'Compacta'		P		Phanerophyt
Taxaceae	*Taxus baccata* 'Fastigiata'		P		Phanerophyt
Taxaceae	*Taxus baccata* L.		P		Phanerophyt
Taxaceae	*Taxus baccata* 'Media Hillii'		P		Phanerophyt
Malvaceae	*Tilia cordata* Mill.	N	P		Phanerophyt
Malvaceae	*Tilia dasystyla* subsp. *multiflora* (Ledeb.) Pigott	N	P		Phanerophyt

Malvaceae	*Tilia platyphyllos* Scop.	N	P		Phanerophyt
Malvaceae	*Tilia platyphyllos* subsp. *corinthiaca* (Bosc ex K.Koch) Pigott	N	P		Phanerophyt
Malvaceae	*Tilia tomentosa* Moench	N	P	SS	Phanerophyt
Ulmaceae	*Ulmus minor* Mill.		P	SS	Phanerophyt
Ericaceae	*Vaccinium myrtillus* L.	N	P		Phanerophyt
Plantaginaceae	*Veronica odora* Hook.f.	N	P		Phanerophyt
Plantaginaceae	*Veronica* × *andersonii* Lindl. & Paxton	N			Phanerophyt
Rhamnaceae	*Ziziphus jujuba* Mill.	N	P		Phanerophyt

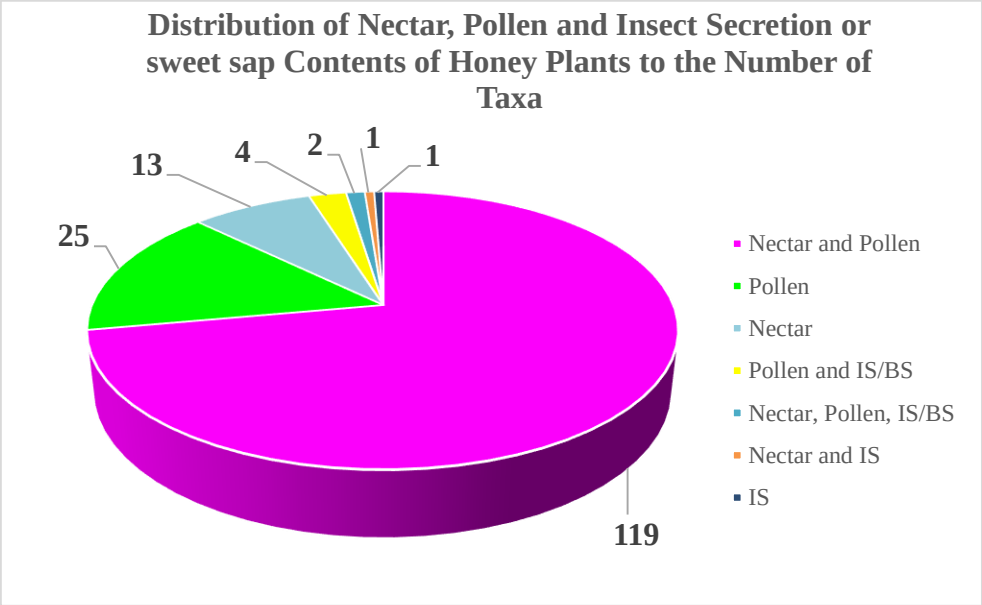
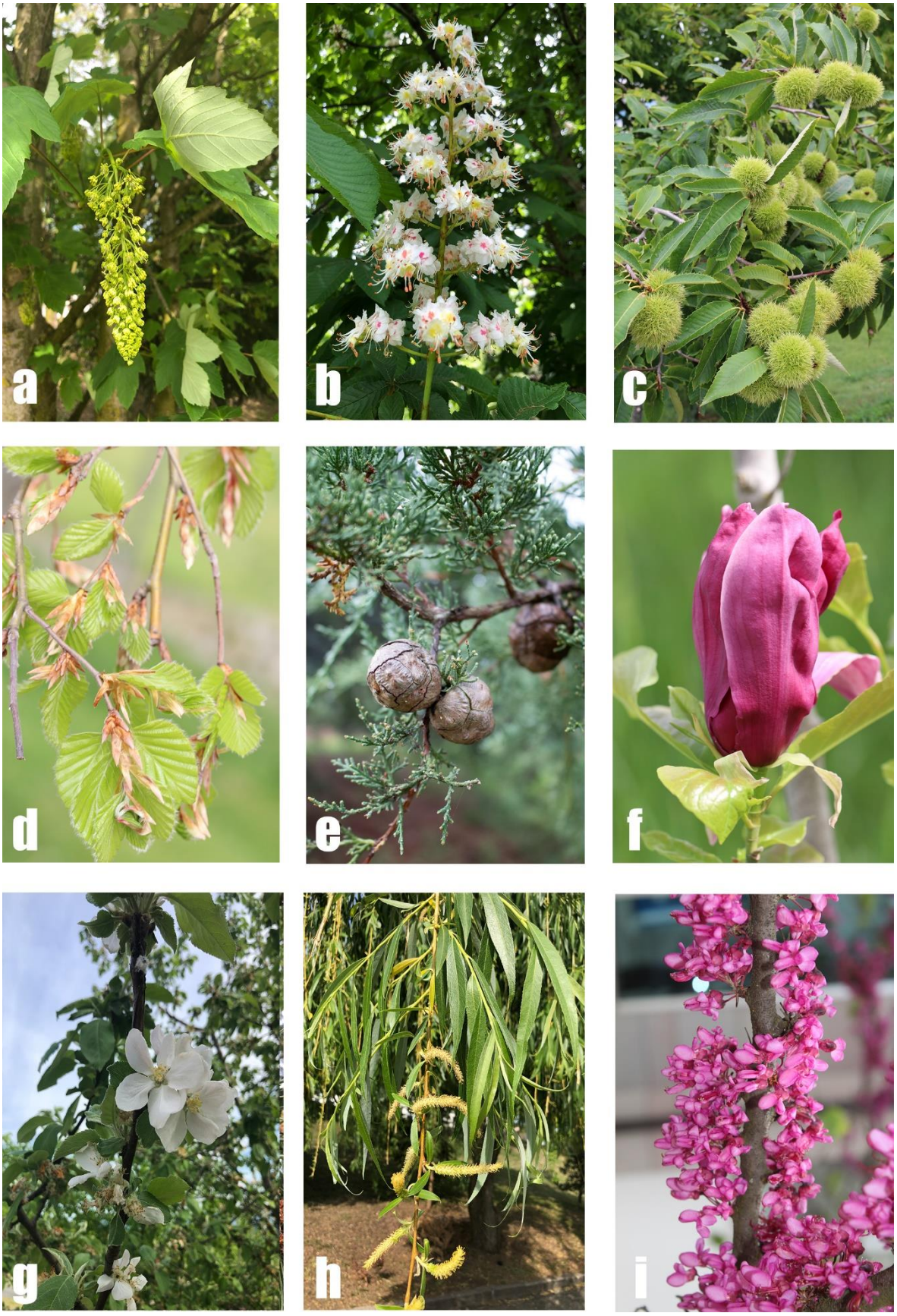
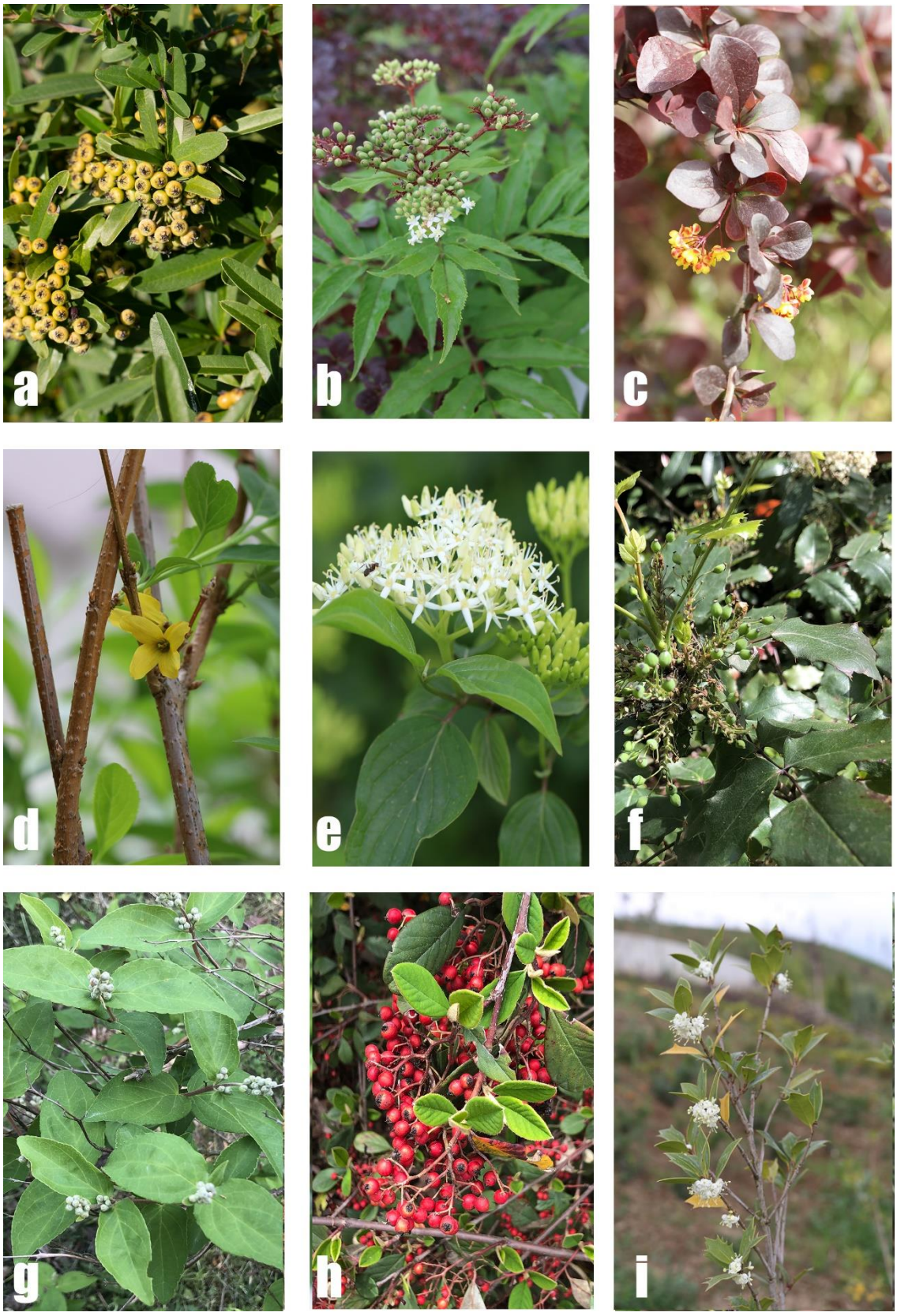


Figure 5. *Distribution of Nectar, Pollen and Insect Secretion or Sweet Sap Contents of Honey Plants to the Number of Taxa*



a- *Acer pesudoplatanus*, b- *Aesculus hippocastanum*, c-*Castanea sativa*, d-*Fagus orientalis*, e-*Cupressus sempervirens*, f-*Magnolia* × *soulangeana*, g- *Malus sylvestris*, h- *Salix babylonica*, i- *Cercis siliquastrum*

Figure 6. *Some tree plant species used for pollen in the botanical garden.*



a-*Pyracantha coccinea*, b- *Sambucus ebulus*, c-*Berberis thunbergii*, d-*Forsythia* × *intermedia*, e-*Cornus sanguinea*, f-*Mahonia aquifolium*, g- *Deutiza gracilis*, h- *Cotoneaster franchetii*, i- *Osmanthus heterophyllus*

Figure 7. *Some shrub plant species used for pollen in the botanical garden.*

IV. CONCLUSION

Many functions of botanical gardens emphasize the scientific basis of botanical gardens, focusing on research, education, and conservation. Botanical gardens responded to the necessary habitat for wildlife. Because botanical gardens have a rich floristic diversity.

Botanical gardens provide for and facilitate the pollinators continuing their lives in disintegrated urban habitats through applications that increase the richness of natural and endemic species (such as fragrance garden, rock garden, water garden, roof and terrace garden) [22]. Botanical gardens evaluate, improve, and maintain effective pollinator breeding practices to improve genetic diversity and maintain traits. Botanical gardens help to Identify and address spatiotemporal gaps in forage, habitat, and nutrition and their relation to the health and sustainability of managed and wild pollinators.

Depending on what sorts of pollinators a gardener is hoping to attract, be it birds, bees, or butterflies, nectar, pollen, and larval-host plants appropriate for these species should be chosen [23, 24]. Decision makers are also encouraged to choose native plant species. A plant is considered to be a native species if it occurs naturally in a particular region or habitat without human introduction. Native plants have evolved to be best adapted and suited for the particular climate and growing conditions in which they are found and have often developed pollinator-specific relationships [25]. Additionally, choosing native plants ensures that surrounding native plant populations will not be outcompeted by introduced species. Garden maintenance, such as mulching, weeding, and clearing, should also be timed appropriately so as not to interrupt particular pollinator life stages. Further, it is important that pollinator gardens include structural elements such as nesting boxes and water sources to further support the complex life cycle of pollinators.

Nectar and pollen characteristics of 451 taxa planted in the Botanical Garden were determined. Accordingly, 165 taxa (36.58%) are important for beekeeping. 119 contain both nectar and pollen, 25 contain pollen, 13 contain nectar, 4 contain both pollen and insect secretion (IS) or sweet sap (SS), 2 contain pollen, nectar and IS or SS, 1 contain both nectar and SS, 1 contain only IS. It is important for the integrity of the ecosystem that the taxa planted in the botanical garden have honeyed plant characteristics. Attracting pollinators to the area is important for the pollination of the plants in the area, as well as providing nutrients to the pollinators.

Bees are a very diverse group with very different lifestyles and nesting habits. Some bees live in society, while some bees live alone. Solitary bees build their nests on their own and lay their eggs in tunnels such as dead trees or hard soil. In nature, solitary species often nest in hollow plant trunks, holes in dead wood, or other natural crevices. Man-made cavities can also easily provide nesting habitat [10, 26, 27]. Bee hotels provide nesting sites for certain solitary bumblebee and wasps. A bee hotel is designed with hollow reeds, stems or perforated wooden blocks, aiming to simulate a nesting environment. These nesting tunnels can be protected from weather and predators by using a variety of guards [10, 26]. For this goal, a bee hotel was placed in the botanical garden and a poster was prepared to inform visitors about the bee hotel and placed in front of the bee hotel (Fig. 9).

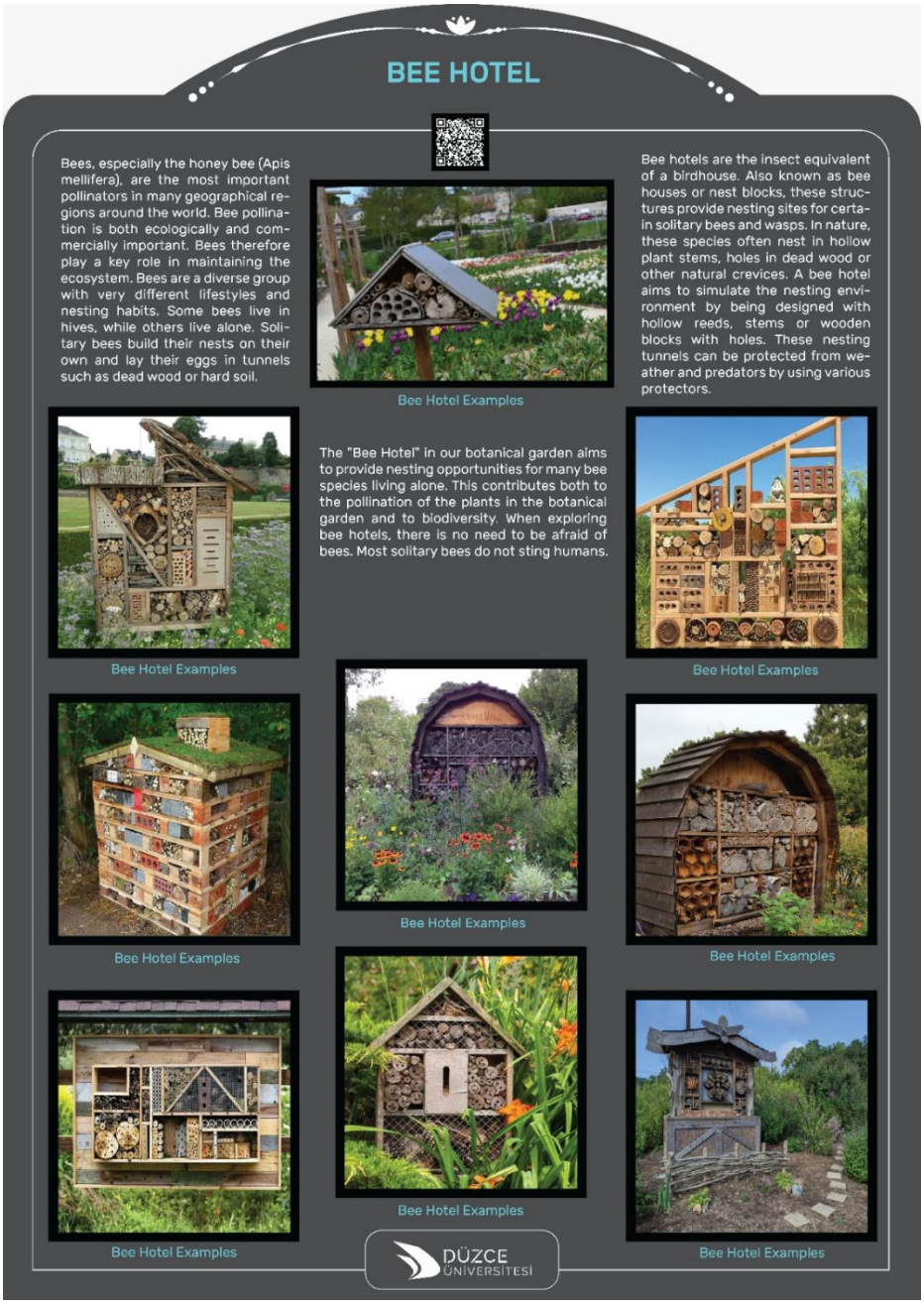


Figure 8. *Information poster about the bee hotel placed in the Botanical Garden*

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