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Basil (*Ocimum* L.) Genus in Türkiye from Various Aspect

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ABSTRACT

A new comprehensive book is being prepared under the title of 'Illustrated Flora of Turkey'. This article was prepared to introduce the Ocimum L. genus in Türkiye for the book. Studies were carried out in the field and laboratory in 2023-2024. Aim of the study was to reveal the systematic, morphological and some ecological characteristics of Ocimum genotypes in Türkiye. The names of the original genotypes identified and the hybrid numbers are as follows: Bush basil: 4, Top basil: 3, Yediveren basil: 3, Winter basil: 1, Arapgir basil: 2, Purple basil: 2, Variegated purple basil: 3, Başak basil: 1, Hairy basil: 2 and Iridescent basil 1. Exotics: 4. The total number of samples examined is about 50. The distribution of samples by genotypes is as follows:Number of examined specimens of the Fesleğen (Sweet basil) group: Çalı fesleğen(Bush Basil): 13, Top fesleğen (Top basil): 2, Yediveren Fesleğen (Yediveren basil): 7, Kış fesleğeni (Winter basil): 2. Total 24. Number of specimen of the Mor reyhan (Purple basil) group: Arapgir mor reyhanı (Arapgir purple basil): 3, Mor reyhan (Purple basil): 2, Alacalı mor reyhan(Variegated purple basil): 3, Başak reyhan (Başak basil): 4, Tüylü reyhan (Hairy basil): 6, Yanardöner reyhan (Iridescent basil): 1. Total 19. Number of specimen of the exotics: Total 5. The essential oil of the bush basil is black and its oily water is blackish, the oil of the Yediveren basil is light yellow and its oily water is off-whi. Names of these samples could not be scientifically determined. O. basilicum species is registered in Türkiye. The genotype that best fits definition of this species is Çalı(Bush) basil. It does not include Top basil, Yediveren basil and Winter basil and the Purple basil group. The purple basil group is another species in our opinion. The genotypes should also belong to the Purple basil species. Top basil, Yediveren basil and Winter basil should also be subspecies of O. basilicum. Use of these genotypes for economic purposes is also recommended. Since systematics of Ocimum L. genus has not been studied, number of species and total genotypes in Türkiye is unknown. The genotypes have no natural forms in the country. Its purple genotypes are called 'Reyhan', green ones are called 'Fesleğen'. There is a wide variation in Ocimum genotypes both morphologically and chemically. Their odors are diverse. This chemotype diversity varies according to genotype and growing environment(habitat). This difference is due to difference in volatile oil composition. Amount and composition of volatile oil may change according to the harvest period. Amount of odor and its type change in autumn and summer harvests. The odor decreases in autumn. A revision study is needed for Türkiye. In terms of taxonomy, leaf shape, corolla color, hair status, color and branching of the inflorescence are important diagnostic characters. The highest seed germination rate is as follows: Arapgir reyhanı (73%), Alacalı

mor reyhan 78%; Başak reyhan (60%), Çalı fesleğen (69%), Top fesleğen (65%), Yediveren fesleğen (63%) and Kış fesleğen (43%). In the Purple basil and Tülü basil groups, the smell is both low and not very pleasant. Çalı(Bush) basil, Top basil, Yediveren basil and Kış (Winter) basil and Başak basil, groups are deliciously fragrant and have a high amount of smell. These genotypes are the main genotypes of the genus, ancestral lines. Other genotypes have emerged by hybridization of the ancestral lines mentioned here. Amount of smell in the hybrids ones is higher. In hybridization, whichever ancestral line is more dominant, the hybrid genotype is more similar to that genotype.

KEYWORDS: *Ocimum basilicum, Sweet basil, Purple basil, Systematic, Ecology, Economy.*

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INTRODUCTION

The *Ocimum* L. genus is from the Lamiaceae (Labiatae) family. Only one species named *O. basilicum* L. is registered in Türkiye (Davis, 1982). It is estimated that there are 20-30 genotypes cultivated in Türkiye. Since its systematic has not been studied yet. Thus, it is not known certainly how many basil genotypes belong to how many species. It is grown especially in Western and Southern Anatolia regions. It has no natural form in the country. *O. basilicum* originates from South Asia, especially India. It is widespread in tropical and temperate regions. Today, it is cultivated in Türkiye, Iran, India, France, Italy and Spain (Ceylan, 1997). In Türkiye; it is known by names such as 'Fesleğen, Fesliyen, Festikan, Reyhan, İreyhan, Peslan, Rahan' (Özçelik, 1987; 2015). In the food industry, it is used in spices or essential oil-based non-alcoholic beverages (sherbets etc.), bakery products, confectionery, ice cream, vinegar, meat and seasoning products; and also in production of perfumery. Its essential oil content is between 0.3-1% (Akgül, 1993). It is generally fragrant and has an appetizing odor. In some genotypes, odors of the leaf and inflorescence change. That is, chemical composition of the essential oil change. Antioxidant activity of the essential oil was observed in the period close to flowering. While its extract does not have antifungal activity, it has an antibacterial effect (Adıgüzel et al., 2005). Basil genotypes have internal sedative, diuretic and carminative effects. It is also used as a spice. Its seeds have the same effects (Baytop, 1984). It is used as a spice in meals and salads, fresh or dried.

According to what Baydar (2016) quotes from Lee (2010); there is a high and positive relationship between the total amount of phenolic substances and antioxidant capacity in medicinal and aromatic plants. Basil is rich in phenolic substances such as rosmarinic acid, ciscoric acid and gallic acid. For this reason, antioxidant effect of basil is quite high. In addition, ciscoric acid strengthens antiviral effect of basil. There are research findings showing that ciscoric acid is found in basil the most among species of Lamiaceae family. Basil plants are antioxidant depots (Özçelik, 2015). The plants carry antioxidants such as lutein, zeaxanthin, beta-carotene and beta-cryptoxanthin in their essential oils, as well as many vitamins and minerals. Its essential oil helps fight free radicals. It reduces the risk of various health conditions such as cancer, heart disease, arthritis and diabetes. It helps protect against different types of cancer (lung, liver, oral and skin cancer etc.). It helps lower high blood sugar levels. The eugenol in basil blocks calcium channels, which can help lower blood pressure. Essential oils in the plants help lower cholesterol and triglycerides. It can

also help improve blood flow by allowing muscles and blood vessels to relax. This feature comes from the Mg it carries. It contributes to improving mental health. It carries compounds that can help relieve anxiety and depression, increase the ability to think clearly and reduce the risk of age-related memory loss. The essential oils, including eugenol, linalool and citronellol, protect the body against inflammation in the body. It has antibacterial properties. It helps fight bacteria in people with respiratory, urinary, abdominal and skin infections (Faydaoğlu and Sürücüoğlu, 2011). Basil is ideal for fighting against inflammatory diseases, cancers, bacterial infections, viral infections, stress, cardiovascular problems, etc. It also facilitates normal liver functions and acts as a natural aphrodisiac (Anonymous 2023; Özçelik, 2023).

Most of the studies on basil are for agricultural and chemical purposes. It is stated that the yield per decare is higher in dense plantings. However, the yield of essential oil is higher in distance plantings (Ekren et al., 2009). While higher yields are obtained in basil in hot regions depending on the number of cuttings (Nacar, 1997), the yield is lower in cool regions (Havla and Pukka, 1987).

According to Erşahin (2006); total green herb yield was found to be in the range of 1609.1-5345.8 kg/da in different basil genotypes. According to an agricultural study in the Aegean Region; the highest results in terms of green herb yield, drug herb yield and drug leaf yield were obtained at 20 x 10 cm planting density. The highest values in terms of essential oil content were obtained at 40 x 10 cm planting density in first year and at 30 x 10 cm planting density in second year. Herba yields vary according to genotype, ecology and growing techniques. Herba yield decreases as the row spacing widens. Because, as the distance increases, competition in plants decreases (Ekren et al., 2009). In India, green herba yield in basil transplanted to the field at 30 x 45 cm intervals is 3679 kg/da (Verma et al., 1989). Yield in Diyarbakır province (in Türkiye) ecological conditions; it was determined between 1719.2-4450.0 kg/da. In the Aegean region(in Türkiye), 360 kg/da dry herb yield; in Çukurova conditions, 500-750 kg/da drug herb yield was determined (Nacar, 1997). In local basil genotypes cultivated in Türkiye, drug herb yield is stated as 255.7-712.7 kg/da (Telci et al., 2005). According to a study in which local basil (*Ocimum* taxa) genotypes were characterized in Türkiye; there is a wide variation in local basils in terms of both morphology and chemistry. It has been determined that basil, which shows a rich chemical variation, has an important potential in obtaining components used in different areas (linalool, citral, methyl cinnamate, methyl eugenol etc.) and when it comes to commercial production of these substances in Türkiye, existence of genotypes that can meet this need has been determined (Telci et al., 2005). Arapgir Purple Basil is offered for sale as tea, jam and dried plant. Among volatile compounds determined by Gas Chromatography Mass Spectrometry (GC-MS) system in Arapgir Purple Basil, the ones that are in high amounts and stand out are; 2-b-pinene was determined as 1.00-4.90%, 1.8-cineole was determined as 4.00-19.65%, linalool was determined as 20.00-8-65.90%, a-bergamotone was determined as 0.50-5.41%, a-humulene was determined as 0.60-4.45%, methylcinnamate was determined as 4.20-11.35%. The most abundant compounds in the essential oils of dried Arapgir Purple Basil were determined as 1.8-cineole was determined as 1.15-4.80%, linalool was determined as 7.15-24.88%, a-humulene was determined as 1.15-4.18%, methyl cinnamate was determined as 5.24-33.15%, eugenol was determined as 1.70-6.37%, a-cadinol was determined as 1.50-3.90%. According to the literature study; there is no study about economic importance, systematic and ecological characters on *Ocimum* taxa in Türkiye. Generally, agricultural production (Yılmaz and Yılmaz, 2010; Anonymous, 2015), ethnobotanical and antimicrobial researches are intensive (Baytop, 1984; Öztürk and Özçelik, 1991; Tabata et al., 1988; Tonbul and Altan, 1989; Yeşilada and Sezik, 2003). Few studies have been done on botanical properties (Davis, 1982).

A new comprehensive book is being prepared under the title of 'Illustrated Flora of Turkey'. In it, vascular plants of Türkiye are published in their current form. In the scope of this book, an up-to-date revision of the genus *Ocimum* L. is required for Türkiye. During our work on revision of the genus, it was seen that some samples are new taxa. There are between 20-30

genotypes. It is not known to which species or subspecies taxa these genotypes belong. The information available on flora of Türkiye is far from describing the relevant genus. Therefore, this article was prepared for the purpose of preparation for the revision. Notes on field observations are also included.

MATERIAL AND METHODS

This study was conducted in Isparta in 2023-2024. It was carried out under laboratory and field conditions. It has collected basil seeds from various regions in Türkiye. A total of 150 live samples were examined. The origin was estimated by looking at method of acquisition and habitus of the plant; it was estimated to be ancestral or hybrid. The identified genotype samples were collected from various parts of Türkiye. All examined samples are in the GUL Herbarium (Isparta) (Table 1).

The purposes of economic use of members of the genus are based on ethnobotanical studies and our observations in field experiments. Seeds of various genotypes were obtained from local markets and farmers in 2023 and planted in pots in a greenhouse in April 2024. The seedlings germinated from these pots were counted and germination rates were found. The ones grown were thinned and placed in other pots and grown in the open field (Table 1). Herbarium samples were taken from these live samples put into GUL Herbarium, their photographs were taken. Taxonomic, morphological and sensory analyses from the samples were performed. The habitat requirements of the genotypes were estimated. The regions where the species or genotype was produced in Türkiye were revealed according to the geographical situation where it was obtained. Also, herbarium samples were taken from *Ocimum* collection within the MAREM (Fruit Research Institute) Directorate in Eğirdir (Isparta) district and examined.

All samples were examined in the field and in the herbarium, and the genotypes of the *Ocimum* genus in Türkiye were determined, grouped, outlined, named with local names, and their distinctive features were revealed with photographs.

FINDINGS AND DISCUSSION

The ethnobotany: Only *O. basilicum* species of the genus was registered in Türkiye. It has no natural form. The name 'Reyhan' is of Arabic origin and means 'rayiha' or 'pleasant smell'.

Ocimum basilicum is known as 'Purple Basil= Mor reyhan' and 'Sweet Basil= Fesleğen' in Türkiye in general. The purple ones are less fragrant than the green ones. The purple and large-leaved ones are less fragrant than the narrow, small and green-leaved ones. In other words, they have less volatile oil. The chemical compositions of other varieties are different and they have strong aromas. When used internally, it should be preferred to use little amounts. Odors of the genotypes are different. This chemotype diversity varies according to the genotype and the growing habitat. This difference is due to difference in volatile oil composition. The amount and composition of volatile oil also change according to the harvest period. If the harvest in the fall and the summer harvest are compared, the amount of odor and the type of odor change. The odor decreases in the fall.

Every plant with a pleasant smell is called as 'Basil'. For example, the Arab and Maghreb (Tunisia, Algeria, Morocco and Western Sahara) people call the 'Myrtle' tree 'Basil'; while Iraq and Syrian peoples call the 'Yarpuz' 'Basil'. Adding a small amount to oily healing waters extends shelf life and strengthens aroma.

The economy: *O. basilicum* is one from the taxa recorded to be used for medical purposes in ethnobotanical studies in Türkiye. Its use as a food additive is widespread. It is frequently produced in gardens and balconies for landscaping and aroma purposes. It is also seen in pots in offices and workplaces. The most commonly produced in pots are 'Top basil' (*O. basilicum* var. *minutum*) and the 'Yediveren basil' genotype. *Ocimum* products are generally used as food additives and medical purposes in Türkiye as leaves and above-ground parts. Its dry leaf yields are an important element in basil due to the consumption of dry leaves as a spice and the use of essential oil as a source. Dry leaf yield, green herb yield, dry matter ratio also vary

depending on the genotype and growing environment. The odor of some genotypes decreases significantly after drying.

- Autumn harvest is less fragrant than summer harvest, meaning its essential oil decreases. The faster the leaves turn to black after harvest (i.e. deteriorate), the less essential oil and scent they have. Those that rot in a short time have a high water content and a low oil content. Being oily reduces water loss. If the water content is high in the plant, the leaves quickly separate from the stem and quickly become moldy during drying. Molding is also an indication that the oil is acidic. Molds multiply rapidly in acidic environments.
- It was observed that some genotypes died after the first harvest, while others became stunted and tended to become bushier plants, meaning they were resistant to mowing.
- Bush-type basils can have pleasant and unpleasant scents. Here, it is understood that the pleasant and unpleasant-smelling compounds are in balance; at a rate of 45-55%. The change in scent may vary depending on the development period of the plant.

The ones with very nice appearance have landscape value as ground covers. However, the smell of these types is not pleasant. Smells of the leaves and flowers of some types are different, in some whole plant has same smell regardless of the leaves, stems and flowers. While some smell delicious, some secrete an emetic smell. In some, the type and intensity of smell may differ between the organs. It is recommended that this situation be taken into consideration in distillation and that the organs of those with smell differences between their organs be distilled separately. In other words, it is recommended that the varieties be distilled separately. If the varieties are distilled together, their oily water and oil will be of poor quality. Purple basil can be preferred to add color to foods. Since it is low-odor and colorful, its tea can be prepared and drunk. Although it creates a very pleasant aroma when added to small amounts of food, the oily water obtained by distillation does not have the same quality feature when drunk. This shows that the pleasant-smelling compounds are transported less by steam. The most common use is in the production of basil sherbet, tea making, grape molasses, etc. During production, a small amount of basil sprig is added, left for 5 minutes and then removed. The product has a very pleasant smell. If it is left for a long time during boiling, bitter substances also pass into the product. The quality of the product may deteriorate. The oily water produced as a result of distillation is very beneficial for health if drunk as 0.5 cups in a day. It is a culture that is told among the people that it has an effect on completing mineral deficiency in the body, stimulating appetite, eliminating bad breath and increasing sexual power. It is strongly believed that it also increases ability of intestines to absorb nutrients and thus lowers blood sugar. Below is a description of basil sherbet. It is a candidate for an industrial plant species.

Reyhan Şerbet(Basil Sherbet): The most common product in Türkiye is Basil Sherbet. It is made from sugar, cinnamon and purple basil. Some add some herbs from the sweet basil group. In this way, an aroma (pleasant smell) from the basil group and an orange-cherry solution from the purple basil group are obtained. It is drunk glass by glass during or after meals. It is known as an appetite stimulant, calming and digestive aid.

The systematics:

The Ocimum L. genus description: The genus includes annual (or perennial ?) herbaceous and aromatic plant taxa. It is in 2 groups as Purple Basil and Sweet Basil. It can reach (15-)40-60(-100) cm height, 1.5 cm trunk diameter. Generally, trunks are reciprocal (3-branched), rarely alternate branching. Trunks are four-sided, distance between nodes is distinct, hairy or not.

The leaves petiolate, usually ovate, oblong or ellipsoid in shape; rarely linear-lanceolate. Their edges usually coarsely toothed, ranging from yellowish green to purple. Leaf color may vary according to exposure time, light intensity, wavelength of light and development stage of the plant. Color of the lower and upper leaf surfaces may be different. Inflorescence usually branched, dense or loose, narrow or broad, same color as leaves or not. Inflorescence, which is a continuation of main axis, is longer. Verticillate (inflorescence) in terminal racemes with bracts. No bracteoles. The calyx bilabiate, curved in fruit, hairs missing in throat; upper lip larger than lower, ovate-orbicular, entire membranous, with

decurrent margin; lower lip four-toothed, female ovate, acute. The corolla bilabiate, upper lip four-lobed, lower entire or crenate. The stamens four in number and on lower lip in corolla; with upper double filaments projecting from corolla (the genotypes in Türkiye). The style is developed, shortly bifid at tip. The nutlets ovoid or hemispherical, mucilaginous (Davis, 1982). The seed dark brown, sometimes black, oval-elliptical, shiny and mucilage-coated surface structure. The bracts distinct, large and prominent. The corolla white, purple or purple-white mixture; more variable. The seeds usually small, black and numerous, shedding at maturity.

Classification: In Türkiye, genotypes of *Ocimum* genus is divided into two groups. This distinction is possible with the following key:

1. Leaves and stem green; corolla white, strongly aromatic ..... **Sweet basil (Fesleğen) group**

1. Leaves, stems and corolla partially or completely purple, little aromatic, generally smells unpleasant ..... **Purple basil (Mor reyhan) group**

In order to make taxonomy of the genus, determination of genotypic characters is needed. Two pure groups are separated in this key. These two groups may be probably separate to species (genotype groups). However, there is hybridization between species. We have determined 7 varieties in Türkiye. They were newly identified by us, but not named. A total of about 20 genotypes were identified by us, but the total number of genotypes is estimated to be around 30.

- *Sweet basil (Ocimum basilicum) genotypes*: Bush basil (Çalı fesleğen), Top basil (Top fesleğen), Yediveren basil, Başak basil (Başak reyhan) and Winter basil. From these, Top basil is named as *O. basilicum* var. *minutum* in Latin. Fig. 1.

Figure 1a: The some genotypes of Çalı fesleğen (from Sweet basils).

Figure 1b: The some genotypes of Yediveren fesleğen (from Sweet basils).

Figure 1c: The two genotypes of Başak fesleğen (from Sweet basils).

Figure 1d: The genotypes of Top fesleğen (from Sweet basils).

Figure 1e: The two genotypes of Kış fesleğeni (from Sweet basils).

- Genotypes of Purple basil (Reyhan) group: Variegated basil (Alacalı mor reyhan), Hairy basil (Tüylü reyhan) and This group is thought to be another species. The remaining ones among the taxa are hybrid genotypes.Fig. 2.

Figure 2a: The some genotypes of Mor reyhan (from Purple basils).

Figure 2b: The some genotypes of Tüylü reyhan (from Purple basil).

- Purple and green colors in the genotypes are dominant traits. Purple and green colors are seen in the phenotype, even in small amounts. The purple basil group emerged from purple and green basil group emerged from green. In genotypes carrying these characters together, the color appears as a mixture of the two colors. This shows that dominance is codominant. In the cases where each of the green and purple colors is homozygous in a genotype, the colors are seen purely (pure purple or pure green). In cases where it is heterozygous, purplish green phenotypes emerge. The group (Sweet basil or Purple basil) the parent plant is in can be understood from the stem, leaves and flowers of the plant. The inflorescence is greatly affected by hybridization. The Turkish names and distinguishing features of the genotypes detected are given in Table 1.

Table 1: Systematic features and vernacular nomenclature of *Ocimum* genotypes.

Taxonomic varieties	**Number of hybrid genotypes**	**Plant No:**	**Origine**	**Number of seeds planted and germina-tion**	**Systematic and ecological characters**	**Economical use**
Fesleğen (Sweet basil) group						
Çalı fesleğen (Bush Basil)	4	15599, 15601, 15611a, 15617c, 15618, 15620; 15621; 15625; 15626; 15657, 15658, 15659, 15663.	Local	100-69 % 69	The stem and leaves bright or pale green. Stem pale burgundy brown below. Leaf shape somewhat variable, generally large and fleshy, edges toothed and pale green. Inflorescence long, pointed (narrow), hairy or not. Inflorescence large, corolla white. *Covolvulus arvensis* envelops the plant. Insects come a lot. 15657: Classic basil type. Lots of juice, yellowish brown stems, large fleshy leaves. 15658: Purple at the tip, leaves small, bits present. 15659: Branching double, stem brownish below, (pale yellow), odor moderately good, not very pleasant	Leaves fall off in a short time during drought. It has a pleasant smell, sometimes its smell can be undesirable. Strong aromatic. It is frequently produced in homes and gardens in hot regions. It is added to foods. It is suitable for mowing.
	3	15642	Local	50-32 % 65	It is the smallest and shortest genotype. Multiple main stems, thin and much branched stems. Leaves small,	Fragrant and strong scent. A genotype suitable for growing in

Top fesleğen (Top basil)					ellipsoid, ovate, bright green and moist. Late flowering. Inflorescence short. Corolla is white. Seeds very small, black and shedding. Leaves shedding in a short time in case of drought. It is resistant to cold and can flower until the half of October.	offices and balconies. Suitable for mowing. Sensitive to insects.
Yediveren Fesleğen (Yediveren basil)	3	15600, 15611d, 15615 15624; 15627; 15630; 15633; 15634, 15648	Local	50-32 % 63	The plant is bright green throughout. Generally short, rarely tall. Young stems light green and moist. Branches weak (thin). Ellipsoid, ovate, very triangular, with green leaves. The inflorescence, which is the continuation of the main axis, is longer. Corolla is white. Sensitive to aphids and flies. Infested. Leaves fall quickly in drought. It is resistant to cold and can bloom until the end of October	Fragrant and strong. Leaves shedding in a short time. Suitable for growing in offices and balconies. Suitable for mowing.
Kış fesleğeni (Winter basil)	1	15613, 15614 15632, 15653,	Local	15-6 % 43	Old stems thin, long, and later turn from green to brown. Generally, it has a few branches from the base, but no branches at the top. Leaves and stems light green, fall quickly and small. It blooms late or not any. It may not bloom at all in cold regions. The inflorescence is brown in the seed period. The inflorescence green at the beginning of flowering, and may later turn slightly purplish. The inflorescence turns brown in the seed maturation period. The corolla white. Its seeds black and large.	It is added to foods. Strong aromatic. It is quickly shed. Suitable for growing in offices and balconies. Suitable for mowing. It is resistant to insects.

					It is frequently produced in homes and gardens in hot regions. It is preferred to produce cuttings from its branches. It is resistant to cold and can be living until the end of October	
Mor reyhan (Purple basil) group						
Arapgir mor reyhanı (Arapgir purple basil)	2	15610, 15655, 15698	Local	100-73 % 73	The whole plant is purple. A large plant. The stems are branched at the top. The leaves are large and thin, with coarsely toothed edges. It flowering late and the flowering period is short. Inflorescence inflorescence (3-)5-8(-15) branched. The corolla purple. The seeds are small, black and fall off at maturity. There are flies and lice.	It can be used for tea and dye. It is preferred in making sherbet and ice cream. Slightly aromatic or not. Suitable for cutting.
Mor reyhan (Purple basil)	2	15662, 15618	Local	-	The leaves and inflorescence purple. The underside green.	Aromatic and fragrant. Can be used as an additive to foods. Suitable for mowing.
Alacalı mor reyhan (Variegated purple basil)	3	15604 15610, 15618, 15628, 15664	Local	100-78 %78	The stem is dark brown at the bottom, dark brown (khaki color) at the top, the color darkens upwards, only the lower surface of the leaf has the same dark (khaki) color. The leaves fleshy, medium-sized, fleshy, the upper surface khaki green. Its color may be darker purple than Arapgir purple basil. Its success in production is more successful than Arapgir purple basil and Bush basil. It is resistant to cold and can bloom until end of October.	Aromatic and fragrant. Can be used as an additive to foods. Suitable for mowing.
	2	15602,	Local	% 60	Leaves and stems are green, Verticillats	It is produced widely in

Başak reyhan (Başak basil)		15603 15640, 15661			densely branched, purple in color. Strongly aromatic in bloom.	Muğla and Denizli prov. Suitable for mowing.
Tüylü reyhan (Hairy basil)	2	15613, 15614, 15617, 15621, 15622, 15646, 15647, 15654	Local	-	It has the largest habitus. Its leaves broad, partly fleshy, distinctly reticulated veined, not wrinkled. Rough and generally the whole plant, especially in the inflorescence, is coarsely hairy. Hairy, not very pleasant smell.	Its smell is not very pleasant. It is not suitable for use as a food additive. Therefore, its production is rare. It is not suitable for harvesting. It cannot be harvested a second time.
Yanardöner reyhan (Iridescent basil)	1	15660	Local	% 80	Its leaves large, thin, and low in moisture. Leaf color varies depending on season and region.	It has almost no smell. It is produced for ornamental purposes in gardens. It has only been seen in Yatağan (Muğla)
-	2	15618, 15619, 15645	Exotic	-	Stems are khaki-brown. Leaves resemble to pepper leaves. Inflorescence purple; corolla white. An interesting genotype for landscaping purposes, narrow inflorescence, green, stem pilose haired.	It has almost no smell. It is produced for ornamental purposes in gardens and parks.
-	1	15637	Exotic	-	Its stems hairy, inflorescence narrow, long, brown, moldy and infested with insects.	An interesting genotype
-	1	15639	Exotic	-	The verticllates loose and wide. The inflorescence similar to Thlaspi taxa, interesting.	Its economic importance is very weak.
Total genotypes: 26; Local genotypes: 22; Exotic genotypes: 4; Sweet local basils; 11 and Purple local basil: 11.						

Identification key to local *Ocimum* genotypes in Türkiye

1. Leaves, stems and corolla completely or mostly purple colored, inflorescence simple or sparsely branched, plant poor aromatic, generally smells unpleasa

2. Leaves wrinkled, thin, large, edges big dentated, little smelled or no scent plants, verticillates not congested

3. All plant pure purple in every time, weakly scented …… 2.6. **Arapgir mor reyhan**

3. Leaf color changes with age(yellowish in seedling stage, purplish in fruit), odorless ……..…… 2.4. **Yanardöner reyhan**

2. Leaves not wrinkled and thick, medium sized, edges fine-toothed or straight, strongly aromatic plants, verticillates congested

4. Leaves always strongly pure purple, leaf edges finely toothed or smooth, inflorescence simple ..... 2.5. **Mor reyhan**

4. Adult leaves bicolored (purple or purplish green), edges with sparse and coarsely toothed

5. Whole plant long and densely hairy, brects big, smell unpleasant (emetic)…..... ..... 2.3. **Tüylü reyhan**

5. Whole plant sparselly hairy or hairless, strongly aromatic ……..... ..... 2.2. **Alacalı mor reyhan**

1. Leaves and stems completely green, corolla pure white, inflorescence much branched, strongly aromatic, usually smells pleasant ….....……. **1. Sweet basil (Fesleğen) group**

6. Main stem very branched at bottom and upper parts, leaves small, grass green, plants short (20-) 30-40 (-50) cm) tall

7. Inflorescence long and not branched, with many main stems, its habitus length 1-1,5 times longer than its width

8. Leaves ovate, indistinct veined, 10-20x3-8 mm in size, habitus shaped as global, densely branched from base .... 1.3. **Top fesleğen**

8. Leaves elliptical, prominent veined, 20-35 x10-15 mm in size, general appearance of the plant subglobose or long, branched from the base and top ….…. 1.2. **Yediveren fesleğen**

7. Inflorescence short and densely branched, main stem branched in upper parts, with many main, its habitus length 3-5 times longer than its width ……..... 2.1.**Başak fesleğen**

6. With a single main stem, leaves large, grass green or yellowish green, plant height 40-70 (-100), its habitus length 2-5 times longer than its width ……..... 1.1. **Çalı fesleğen**

Its diagnostic characters (in order of importance): Bract shape, size and color. Corolla color. Leaf shape, size, thickness and color; smooth or toothed leaf margin; presence or absence of thick veins. Branching, size and shape of inflorescence. Seed shape, size and color. Indumentum on leaves, stems and inflorescence.

The ecology and physiology: Different shades of purple and green colors vary according to the duration of exposure, intensity of light, and wavelength of light. Yellowish green, grass green, dull green; purple, dusky, brownish colors are formed as a result of color changes in pigments that occur with exposure as well as genotype. Green and purple are the oldest ancestral lineages. The others developed later through hybridization. Arapgir basil is the darkest among purple. In other words, it is the original ancestor. It is widely grown in Arapgir (Malatya) district. Fig. 3.

Figure 3: A view from basil germination and seedling growing activities.

- After October 15, basil in Isparta completes its flowering period, the seed setting process is largely completed, mature seeds are scattered around. Its seeds are generally small black. Arapgir purple basil's leaves decrease towards the end of autumn, fall and fade, turning purplish green. Its color becomes dark purple in August. This shows that the leaf color changes depending on the intensity, wavelength and duration of light. The flowering period is short, it blooms late (in September) and ends early (in early October). It produces many seeds.
- *Ocimum* genotypes generally like sandy soils and hot-humid environments. Their roots are superficial and do not go deep. Therefore, they are not resistant to drought. While it continues to grow and develop until the end of September in Isparta conditions, its physiology weakens from October onwards. Water intake decreases, leaves fall or shrink. Flowering begins in June and continues until the end of October. The order of flowering in genotypes starts with Bush basil and Top basil and Arapgir basil bloom the latest. Arapgir basil blooms later and is the genotype with the shortest flowering period. The water ratio in the plant varies according to the genotype, organ and growing period. Fig. 4.

Figure 4: Effect of light on iridescent genotype.

The general distribution: Asia, Africa and America, Europe and SW Asia. It is produced in pots and gardens. Its production is more intensive in settlements with an altitude of up to 1500 m. It can be grown in closed areas at altitudes above 1500 m. The distribution of the genus in Türkiye; Although it is recorded that it is grown in the Northwest of Türkiye, South and Central Anatolia, namely Istanbul, Hatay, Denizli, Elazığ and Kahramanmaraş (A2, B2, C2, C6), according to our observations; It is an annual, herbaceous cultivated plant with varieties produced all over Türkiye.

The flowering time: It is between 6-10 months

CONCLUSION AND RECOMMENDATIONS

Biodiversity is examined in three groups as species, subspecies and varieties and also habitat diversity. In economic terms, subspecies and varieties of species, habitat diversity from ecological perspective and species diversity from systematic perspective are more important and prioritized. Therefore, it is necessary to give importance to subspecies diversity. Because it is an economic feature.

There are more or less 100 herbarium specimens of *O. basilicum* in GUL Herbarium. About 50 of them were named as *Ocimum basilicum* according to the current criteria (Davis, 1982). According to the literature study; there is no revision of genus *Ocimum* for Türkiye (Davis, 1982). The situation is the same in the updated 'Plants of Turkey' list

(Güner, 2012). The scientific studies conducted on it are focused on its agricultural importance, landscape value and medical importance (Sezik, 2015; Honda et al., 1996; Çubukçu and Özhatay, 1987) and do not cover systematic issues. A serious revision study is needed. The number of examined specimens according to genotypes is as follows:
Fesleğen (Sweet basil) group: Çalı fesleğen(Bush Basil): 4, Top fesleğen (Top basil): 3, Yediveren Fesleğen (Yediveren basil): 3, Kış fesleğeni (Winter basil): 1, Total 11.
Mor reyhan (Purple basil) group: Arapgir mor reyhanı (Arapgir purple basil): 2, Mor reyhan (Purple basil): 2, Alacalı mor reyhan(Variegated purple basil): 3, Başak reyhan (Başak basil): , Tüylü reyhan (Hairy basil): 2, Yanardöner reyhan (Iridescent basil): 1, Total 11.
Exotics: Total 5.

Names of these samples could not be scientifically determined. *O. basilicum* species is registered in Türkiye. The genotype that best fits definition of this species is Çalı(Bush) basil. It does not include Top basil, Yediveren basil and Winter basil and the Purple basil group. The purple basil group is another species in our opinion. The genotypes should also belong to the Purple basil species. Top basil, Yediveren basil and Winter basil should also be subspecies of *O. basilicum*. The genotypes between these taxa were formed by hybridization. The main taxa are determined in Table 1. Hybrids will be determined and named with our ongoing studies.

Local names of the original genotypes identified and the hybrid numbers are as follows: Bush basil: 4, Top basil: 3, Yediveren basil: 3, Winter basil: 1, Arapgir basil: 2, Purple basil: 2, Variegated purple basil: 3, Başak basil: 1, Hairy basil: 2 and Iridescent basil 1. Exotics: 4. The total number of samples examined is about 50.
In the Mor(Purple) basil and Tülü basil groups, the smell is both low and not very pleasant. Çalı(Bush) basil, Top basil, Yediveren basil and Kış (Winter) basil and Başak basil groups are deliciously fragrant and have a high amount of smell. These genotypes are main genotypes of genus *Ocimum*, ancestral lines. Other genotypes have emerged by hybridization of the ancestral lines mentioned here. Amount of smell in the hybrids ones is higher. In hybridization, whichever ancestral line is more dominant, the hybrid genotype is more similar to that genotype. These ancestral lineages should be named systematically, defined as either species or taxa in the species(such as subspecies, variety). The essential oil of the Çalı(bush) basil is black and its oily water(hydrosol) is blackish, the oil of the Yediveren basil is light yellow and its oily water is off-whi.

According to literature study; there is no revision of genus *Ocimum* for Türkiye (Davis, 1982). The situation is same in the updated 'Vascular Plants of Turkey' list (Güner, 2012). Scientific studies on it are focused on its agricultural importance and do not cover systematic issues. All samples are called *O. basilicum* in Türkiye. From a taxonomic perspective, leaf shape and color, corolla color, hair condition, inflorescence color and branching are more reliable characters.

Medicinal and aromatic plants have an important place in the world market. Basil plant and its essential oil are used in areas such as perfume, cosmetics, traditional medicine, aromatherapy, and food. Since odor is low and odor is not very pleasant in purple basil and the basil group is pleasantly scented and has a high oil content, pleasantly scented and colored food products can be developed by bringing the pleasant odor from the basil group and the coloring from the basil group. Solutions can be prepared as emetics for medical purposes from genotypes with unpleasant odors. Basil production is recommended in hot climates and basil group production is recommended in humid, cool or cold climates (for Türkiye). It is thought that if the necessary importance is given to basil cultivation, it will make a significant economic contribution to our country. It is expected that high value-added products will be obtained especially from Arapgir Purple Basil.

Although it was recorded that *Ocimum basilicum* was distributed in the Western and Southern Anatolian regions (A2, B2, C2, C6 squares) in Türkiye (Anonymous, 2024), it was understood that it was produced almost everywhere in Türkiye.

Since *Ocimum* taxa prefer sandy soils and are sensitive to drought, they require care in cultivation. Since the growing environment must be moist, *Cuscuta* and *Convolvulus* species are abundant in the environment and these taxa adhere to *Ocimum* taxa and impair quality of the product. Cuscuta spp. is even more dangerous as it carries poisonous compounds. Weeds should be removed during harvest and those infected with *Cuscuta* should not be harvested.

There is no study on product development from basil plants in any local or foreign literature. Therefore, emphasis should be placed on product development studies. A common and wrong opinion is that basil is an aromatic and ornamental plant. Some ethnobotanical studies have been conducted on some taxa of the Labiatae family, of which basil plants are members (Karadoğan et al., 2000-2003; Tümen, 1989). First of all, it is a genus that needs to be researched. In some regions of Türkiye, very different basil varieties are produced with traditional methods. Despite passing time and developing technology, local people produce basil varieties with great enthusiasm and use them for their domestic needs (Öztürk and Özçelik, 1991; Özçelik, 2023). Therefore, it is recommended to use it within three months after harvest, store it in a dark environment with low humidity, crumble the leaves when used, and keep them whole in other cases.

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