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Life Angles of Trees

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Abstract: Does every tree have a certain branching angle in itself? Are branching angles of trees determined by genetic factors? Is the branching angle affected by the presence of the tree in the natural environment or in the cultivation? Does branching angle need to be included in identification key for every speciy? Our aims are to find answers to questions.

Previous works on this subject have been examined. As a result of the works investigated, the species of trees to be observed were identified **[Picea orientalis (Oriental spruce), Lagerstroemia indica (Crepe-Myrtle), Cedrus libani (Lebanese Cedar), Hibiscus syriacus (Rose of sharon), Pinus brutia (Calabrian pine)]** and the characteristics of these tree species were studied. The areas where the specified tree species are found have been identified **(Nezahat Gökyiğit Botanical Garden, Atatürk Arboretum, Beykoz Botanical Biodiversity and Geofit Research and Training Center Directorate, Büyükada Natural Forest)** Before carrying into practice, it has been gone to the areas identified with the material **(Protractor, Protractor Application, Tape Measure)** to be used and the measurement was made. The measurements made were tabulated.

We have measured the branching angle that we think is a feature that depends on the genetic material in the light of the hypothesis we create in the tree species. It has been observed that the branching angle of the samples of a specie taken from different places does not change, and the branching angle of different species observed in the same places is different. From this observation, we suggest that the branching angle does not depend on external factors such as soil, climate, humidity etc. but branching angle is a characteristic feature unique to the specie. However, we can suggest that the branching motion may depend on the light. No difference has been observed in the branching angles of the natural and cultivated Pinus brutia trees which we measured. Depending on our observation, we have concluded that the growth of the tree in its natural or cultivated environment is not a factor on the branching angle, and we have supported the hypothesis that the branching angle is a feature of genetic material. Problems such as sidewalk shedding, uncontrolled and unethical cutting of trees, removing them from their areas or mechanical damages in their environment can be eliminated if the branching angles of the tree species planted on the roadsides, parks and gardens are known beforehand.

Also, if the branching angles of the trees in the field of agriculture are known, it shall enable the establishment of healthy distances between the trees.

Key words: Branching, trees, natural, cultivated, environment

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1. Introduction

Does every tree have a certain branching angle in itself?

Are branching angles of trees determined by genetic factors?

Is the branching angle affected by the presence of the tree in the natural environment or in the cultivation?

Does branching angle need to be included in identification key for every speciy? Our aims are to find answers to questions.

The trees that have the ability to produce oxygen and nutrients necessary for our lives do branching to make the leaves they carry to take most advantage of Sun and to get the full efficiency in organic material production. Thus, it gets a large volume and surface area in contact with air. (Megep, 2011) Unethical interventions are being made to this branching done by the tree in order to increase the efficiency of the tree, branching life, durability and creating visually attractive venues by creating variations in the environment. (Turna, İ., 2015) In order to minimize these interventions, we have created the hypothesis that the tree always does branching according to its genetic material. Cedrus libani, Cedrus deodora, Cedrus brevifalia species in the class of Coniferae have been reported to stem at right angles to the trunk, but the branching angle of all species is not specified. And we have aimed to fill this gap in the literature by arguing that it should be specified in all species. (YENER, D. Plant Material 1: Gymnospermae, slide,).

We have set out our work in order to add branching angle to the diagnostic key, which is prepared to be used for the detection of groups of animals or plants that can be found at different stages of field work and which is used to analytically separate living things. (Elçin, E., Erkoç, F., Öztekin, M., Atik, A., Sarıkaya, R., Selvi, M., 2010)

Branching:

It occurs as a result of activities of stigma and side gemmas. If these gemmas stop growing after a short period of activity in a growth season, they form short suckers on the trunk. At Cedrus (cedar) and Pinus (pine), suckers from where needle stems are short. And the gemmas that continue to grow up to the end of the growing season form long suckers. (Toker, C., 2004)

Branching Types:

Each plant species has its own specific branching pattern. Branching patterns can generally be grouped under two headings.

a) Monopidial Branching

Here, the main trunk is dominant as long as the plant lives, and it keeps growing at the end through the activity of the stigma gemma. The branches formed by the lateral meristems make an angle with the trunk

(acute, steep, wide angle). The branches get longer through the activities of the apical meristems at their ends, but their lengthening is partially repressed by the stigma gemma of the main trunk through hormones. Pointed trees such as Populus (poplar) and Cedrus (cedar) have formed a cone shape as a result of monopodial branching.

b) Simpodial Branching

In this type of branching, after the main axis gets longer for a period of time, it ceases lengthening as a result of the atrophy (sometimes turning into sleeping buds or flower buds) of apical meristem. One or more branches take the position of the main axis by vertical lengthening, and the branches lengthening to the side cease lengthening after a while and leave the dominance to other branches in the same order. If the main axis is replaced by a branch, this branching is called “Simpodial-monochasium”. In holding plants such as Vitis (vine), monocasic branching is usually seen. If the main axis is replaced by two branches, this branching is called “Simpodial-dichazium”, if it is replaced by more than two branches, this is called "Simpodial-pleiocazium branching". At the end of the dichazium and pleiocazium branchings, ball trees occur. Shrubs and shrubberies also occur as a result of dicazyium or pleiocathium branching. The trunk leaves the dominance to branches by branching slightly above the soil level in shrubs and at or below ground level in shrubberies. Thus, shrub forms occur. (Ocakverdi, H., Güzel, Y., 2009).

Cultivated Plant: It is the name given to the plants that are improved, developed and produced by natural and artificial means. (Dr. Beşer, N., 2003).

2. Materials and Methods

Previous works on this subject have been examined. As a result of the works investigated, the species of trees to be observed were identified and the characteristics of these tree species were studied. The areas where the specified tree species are found have been identified. Before carrying into practice, it has been gone to the areas identified with the material to be used and the measurement was made. The measurements made were tabulated.

1. Determination of Tree Species

In the selection of plant species to be used on streets, roads and streets; it is important to take into account features such as that they should have a trunk height that can create a clear space of at least 5 m and not have a flabby form, that they usually develop a smooth, unstrained and cylindrical trunk, that they form a symmetrical stigma corolla, that the corolla development is suitable for the width of the track, that their falling fruits do not cause mechanical damages and injuries. (Dirik 2008) Considering that branching angles are also effective in

addition to these features, we have considered the most commonly used tree species in roadside and park and garden landscaping, and we chose five tree species taking into account the tree species to be used in road and street landscaping due to their different size, form, color and texture creating visually attractive spaces by forming moving variations around, and found more common in our environment. (Turna, İ., 2015).

We chose Pinus brutia (calabrian pine) because its natural distribution area can be found in Istanbul.

We have tried to make our research more comprehensive by considering choosing from different sexes.

1.1 Observed Tree Types and Their Features

1.1.1 Picea orientalis (Oriental spruce)

Oriental spruce (Picea orientalis (L.) Link.) The Coniferae class of Gymnospermae belongs to the Pinaceae family and it is a protective, first class forest tree that makes pointed, full and smooth trunks, that can lengthen 40 -50 m and sometimes 60 m and that can reach to 1.5 - 2 m diameter, and that is thick branched (those growing free is branched to the bottom) (KAYACIK 1965, DAVIS 1965, GÖKMEN 1970, ANŞIN 1988). The shell is usually light and smooth in young trunks, dark colored and cracked in old trunks. In general, the branches are settled almost on the whole trunk, and while they are young, they are flabby upwards and later straight or downwards. Young suckers are thin, light brown and hairy.

Oriental spruce is the shortest needle-leaved among the existing spruce species. These needles which vary from 3 to 11 mm in length, are bright-dark green. Needle leaves that stay on tree for many years leave rasp-like protrusions on the trunk when they fall. Horizontal sections of the needles are almost in foursquare. There are few stoma lines on each front. Their ends are not too pointed, cultivated. The gemmas at the ends are angled, with scales in the bottom. The gemmas on the side are egg-shaped or round reddish-brown and nonresinous. (KAYACIK 1965, DAVIS 1965, GÖKMEN 1970, KÜÇÜK 1986, ANŞIN 1988).

1.1.2 Lagerstroemia indica (Crepe-Myrtle)

The Eudicotidae class of Angiospermae belong to the lythraceae family.

Sucker: Suckers are light pink-beige, foursquare and hairless.

Trunk and Shell: The trunk of this plant functions as an aesthetic element, because its gray color, its smooth surface, and its interesting curves are highly decorative. Its homeland, Origin and Natural Distribution Areas in the World: Its homeland is China, Japan, Korea, the Philippines and Australia. There is a tolerance for vandalism, so it is very convenient to use in parks in the city, in refuges, in front of shopping centers, in parking lots. (http://www.agaclar.org/agac.asp?id=1157).

1.1.3 Cedrus libani (Lebanese Cedar)

The Pinopsida class of Gymnospermae belongs to Pinacae family. It is always a green, needle-leaf, pyramidal when young, broad and flattened at stigma when old, tall (40-50m) and long-lived (over 1000 years old).

It naturally grows only in the Taurus Mountains and Lebanon in the world. Thanks to its ability to adapt to different ecological conditions in many regions, it is planted in many regions of Turkey including Central Anatolia, in parks, gardens, and bosket. (Mamıkoğlu, N., 2007).

1.1.4 Hibiscus syriacus(Rose of Sharon)

It belongs to Angiospermae's Eudicotidae class, malvaceae family. It is a small shrub with a round stigma in 2-3 m length, or a small tree 4-5 m in height, it sheds leaf in winter. While its homeland is not known precisely, it is considered to be China, India or Anatolia. It is grown as an ornamental plant. (Mamıkoğlu, N., 2007).

1.1.5 Pinus brutia (Calabrian pine)

Pinus brutia belongs to Pinusaceae family (P. brutia Ten; Syn: P. pityusa Stev.) It is an important rate tree with 20-25 m length and up to 60 cm diameter, with a general appearance and resemblance to Aleppo pine, thick branched and generally with an uneven trunk. On the other hand, there are also pinus brutia stands made up of high, smooth-trunked trees (Dr. Göksin A.1987).

2. Selection of Areas to Work

- We have selected Nezahat Gökyiğit Botanical Garden,
- Beykoz Botanical Biodiversity Geofit Research and Training Center Directorate, and
- Büyükada Natural Forest and Atatürk Arboretum Trees
- where we can get enough information and resources to support our research, and the trees grown in the natural and cultivated environment can be observed

2.1 Nezahat Gökyiğit Botanical Garden

Nezahat Gökyiğit Botanical Garden (NGBB) was established in 1995 by Ali Nihat Gökyiğit to create a memorial park on behalf of his spouse Nezahat Gökyiğit and a planting and afforestation plan for the purpose of 'memorial park' was implemented at the beginning.

First the land whose form ruined due to road construction was reclaimed; then about 50,000 trees and shrub were planted in 32 hectares of the parkland.

Later on, the aim was changed to start a work to become a botanical garden and it was opened to the public in 2002 and changed its name to Nezahat Gökyiğit Botanical Garden in 2003.

It is a research, education and training center in Istanbul's Anatolia Side. (NGBB Official Website: http://www.ngbb.org.tr/tr/)

NGBG; It is a scientific research center with the plant collections at Ertuğrul Island, Meşe Island, Anatolia Island, Thrace Island, Black Sea Garden, Arboretum Island, Herbarium and Central Island. The NGBG helps scientific researches with the resources in its possession.

2.2 Atatürk Arboretumu

Its objectives can be listed as;

- To work on the improvement, introduction, development and adaptation to broad applications of natural and exotic species within the bounds of possibility of microclimate.
- To create a collection of primarily oak and its inclusive fagaceae family.
- To do educational activities to instil nature love to primary and high school students, to contribute to the development of nature consciousness.
- To grow Turkey's endangered plants in order to protect them.

Until today, the Arboretum has been planted with numerous plants of about 2,000 different taxon. Since the first day the plantings have been recorded and these plantings have been labeled.

The arboretum, which is an affiliate of the The General Directorate of Forestry Istanbul Forest District Directorate Bahçeköy Forestry Operation Directorate, is managed by an advisory committee, and the scientific authority in the advisory committee belongs to Forestry Faculty, and the administrative authority belong to the General Directorate of Forestry. Property and financial resources also belong to the General Directorate of Forestry. (Atatürk Arboretum Presentation Handbook).

2.3 Beykoz Botanical Biodiversity and Geophyte Research and Training Center Directorate

The preservation and sustainability of plant biodiversity, obtaining new species through the rehabilitation of geofit species collected from the nature and their registration, making the trials and demonstrations of Turkey GeoFit and ornamental plants. The institution is affiliated to the Ministry of Food, Agriculture and Livestock and located in Istanbul, which is one of the most important metropolis of the world and contributing to tourism in the country. (http://arastirma.tarim.gov.tr/beykozbbgam/Menu/7/Mission-_-Vision).

2.4 Büyükada Natural Forest

It is observed that the vegetation outside the settlement areas in Büyükada are made of needle-leaf forest (Pinus brutia Ten.) and Maki garlic species.

The species of the three with large number enough to form the forests in Büyükada is pinus brutia.

These pinus brutia on the island are present in the natural distribution area in Turkey, in the northern slope, taking root in areas with shallow soil, and they are in interaction with humans for centuries, and they are effective in formation of species that are with bad shapes, not lengthening too much, and trunky. (http://www.buyukadaotelprices.com/buyukada-bitki-ortusu.html).

3. Selection of Measurement Materials

3.1 Protractor

It is a tool for measuring angle. A protractor with a scale of 1 ° and scaled up to 180 ° has been used.

3.2 Protractor application

-Camera angle can be measured.

- With full touch capabilities, the protractor can move easily.
- With the play and stop function, the camera angle can be accurately measured.
- Version: 1.5.1
- Presenter: Android Pandaz (Google Play Store).

3.3 Tape measure

It is a tool used to measure a length of 1.5 meters.

3. Results and Discussion

Table1

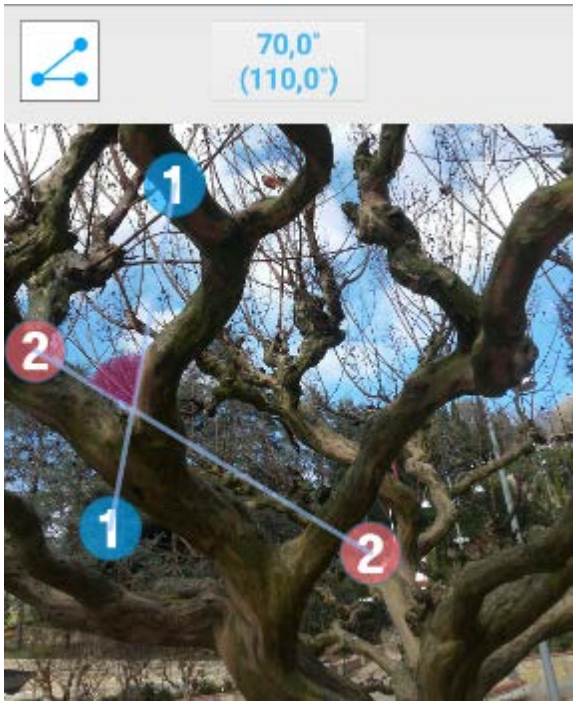
TREE NAME	Cedrus libani										Hibiscus syriecus					Picea orientalis					Logerstroemia indica				
NUMBER OF TREES	20.[1]		20		20		20		20		20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
1.BRANCHING ANGLE	60°	90°	90°	60°	90°	60°	90 °	60°	90°	60°	37°	37°	37°	37°	37°	75°	75°	75°	75°	75°	60°	* -	60°	60°	60°
2.BRANCHING ANGLE	75°	60°	60°	75°	60°	75°	60°	75°	60°	75°	37°	37°	37°	37°	37°	80°	80°	80°	80°	80°	65°	65°	65°	65°	65°
3.BRANCHING ANGLE	75°	75°	75°	75°	75°	75°	75°	75°	75°	75°	-	-	-	-	-	-	-	-	-	-	70°	70°	70°	70°	70°
THE PLACE TAKEN	NG	NG	NG	NG	NG	NG	AA	AA	AA	AA	BB	BB	BB	NG	NG	BB	BB	BB	NG	NG	AA	AA	AA	NG	NG
TRUNK DIAMETER (CM)	90 - 95	90 - 95	75 - 80	75 - 80	50	50	30	30	15 - 20	15 - 20	10 - 15	10 - 15	10 - 15	10 - 15	10 - 15	10 - 15	10 - 15	10 - 15	10 - 15	10 - 15	40 - 45	70 - 75	25 - 30	25 - 30	25 - 30

NG NEZAHAT GÖKYİĞİT BOTANİK GARDEN

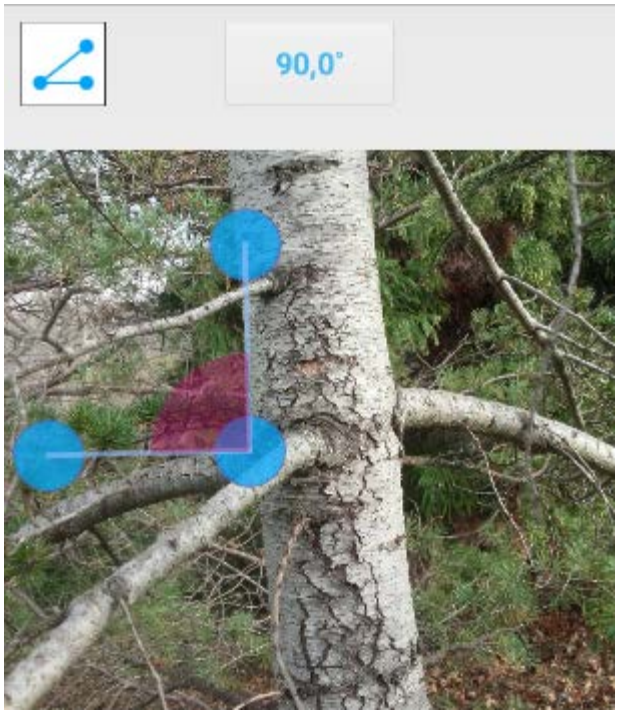
AA ATATÜRK ARBORETUM

BB BOTANICAL BIODIVERSITY AND GEOFIT RESEARCH AND TRAINING CENTER

Lagerstroemia indica



Cedrus libani



Cedrus libani:

As can be seen in **Table 1** , the branches from the measured Cedrus libani trees made two different angles with the trunk. This is a unique feature of the Cedrus libani.

The side branches, which make an angle of 1 90 degree, head upwards when young and extend horizontally when old. (YENER, D., Plant Material 1: Gymnospermae, slide,). These two different results are due to this distinct genetic feature.

Hibiscus syriacus:

As seen in **Table 1**, all branching angles have been determined to be the same. Since the tree is young, there is no 3rd branching angle.

Picea orientalis:

As seen in **Table 1**, no differences have been observed in all branching angles.

Since the tree is young, there is no 3rd branching angle.

Logerstroemia indica:

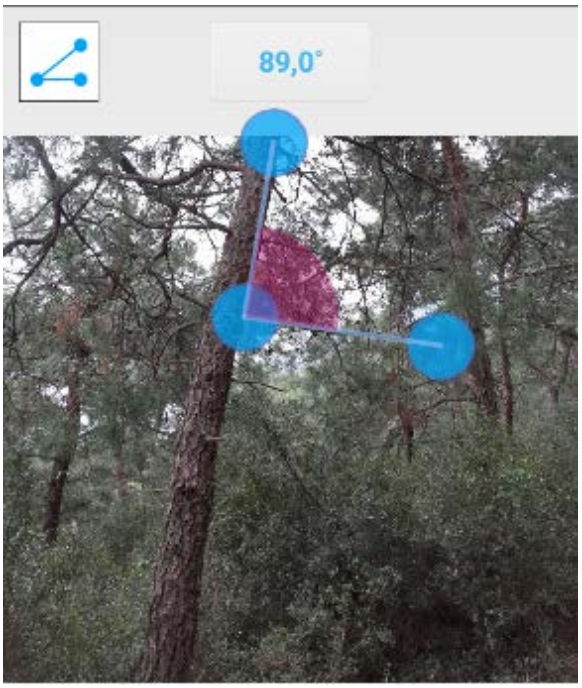
As seen in **Table 1**, no differences have been observed in all branching angles.

Because of the interventions to the measured 2nd Crepe-Myrtle to give an animated and colorful appearance, 1. branching angle has not been determined.

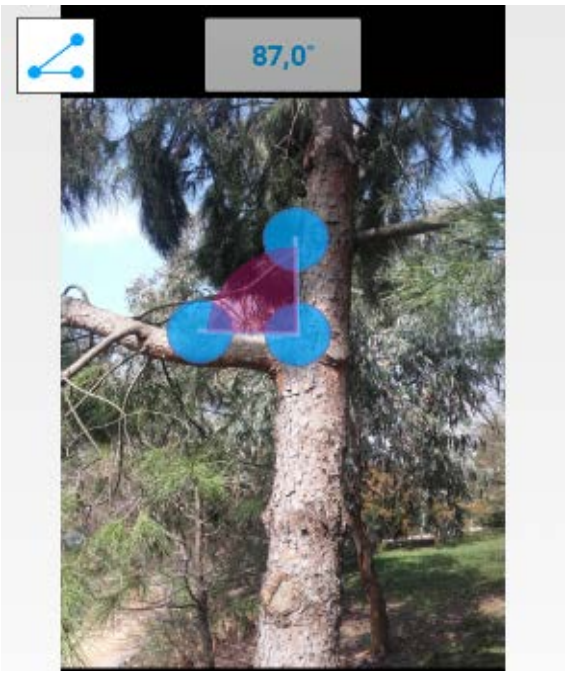
Table2

TREE NAME	NATURAL PINUS BRUTIA (BIGGEST NATURAL FOREST)					CULTURE PINUS BRUTIA (NEZAHAT GÖKYİĞİT BOTANİK GARDEN)				
NUMBER OF TREES	18	22	23	15	22	20	20	20	20	20
1.BRANCHING ANGLE	87°	88°	87°	89°	90°	87°	87°	87°	87°	87°
2.BRANCHING ANGLE	85°	87°	87°	86°	88°	86°	86°	86°	86°	86°
TRUNK DIAMETER (CM)	85-90	85-90	85-90	85-90	85-90	80-85	85-90	90-95	90-95	80-85

NATURAL Pinus brutia
(BUYUKADA NATURAL FOREST)



CULTIVATED Pinus brutia
(NEZAHAT GÖKYİĞİT BOTANİK GARDEN)



As seen in **Table 2** , the branching angles varied between 85-90 °. This result is explained by the non-planned settlement in the natural environment.

As seen in **Table 2** , no difference have been observed in branching angles.

4. Conclusion

We have measured the branching angle that we think is a feature that depends on the genetic material in the light of the hypothesis we create in the tree species. It has been observed that the branching angle of the samples of a species taken from different places does not change, and the branching angle of different species observed in the same places is different. From this observation, we suggest that the branching angle does not depend on external factors such as soil, climate, humidity etc. but branching angle is a characteristic feature unique to the specie. However, we can suggest that the branching motion may depend on the light.

No difference has been observed in the branching angles of the natural and cultivated Pinus brutia trees which we measured. Depending on our observation, we have concluded that the growth of the tree in its natural or cultivated environment is not a factor on the branching angle, and we have supported the hypothesis that the branching angle is a feature of genetic material.

Problems such as sidewalk shedding, uncontrolled and unethical cutting of trees, removing them from their areas or mechanical damages in their environment can be eliminated if the branching angles of the tree species planted on the roadsides, parks and gardens are known beforehand.

Also, if the branching angles of the trees in the field of agriculture are known, it shall enable the establishment of healthy distances between the trees.

The addition of in-specie angles to the identification keys facilitates the use of the identification key as well as facilitating field work. To add more, although they are probably the most convenient and useful key of identification, they should be regarded as directors, not faultless guidelines.

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