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## PHENOLOGICAL OBSERVATIONS BELONGING TO VEGETATION PERIOD OF SOME NATIVE AND EXOTIC PLANT SPECIES IN KTU KANUNI CAMPUS

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It is possible to determine specific periods in plants during the vegetation period making phenological observations. When making phenological observations, one can collect information about occurrence time of some events, such as sowing, germination and bud bursting. Particularly, this evidence will contribute to the selection of species in site conditions, when making decisions about the species to be left in the field. Therefore, it is important to know blossoming time and lifespan of flowers during the seasons. If coloration of the plants to be used in the landscape design is known to depend on the season, much better compositions with the plants can be created. The aim of the paper is to reveal the differences in the beginning of vegetation of some native and exotic plant species found in the campus of Karadeniz Technical University. In this study, bud bursting times of 19 species of bud bursting dates, including 10 native trees, 5 exotic trees, 2 native shrubs and 2 exotic shrub species were investigated during the 4 phases. Thus, when observations were made for the times from swelling of the buds to the completion of the bud burst, it appeared that the bursting period for *Acer platanoides* L. was completed in the longest time and those for *Carpinus betulus* L. and *Liquidambar orientalis* Mill. – over the shortest time from the native species. The same period for *Wisteria sinensis* (Sims) DC. was completed in the longest time, while for *Prunus serrulata* Lindl. «Kandzan» it was completed in the shortest time for the exotic species.

**Keywords:** *aboriginal and introduced species of woody plants, vegetation, seasoning, bud bursting, landscape design, Trabzon, Turkey.*

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### INTRODUCTION

Phenological observations were made in order to determine the dates of plant life phases under the climatic conditions (Anonymous, 2014). Determination of specific dates within vegetation phases is possible due to phenological observations (Kayacık, 1957). Phenological observations can be made when collecting information on the time of planting, germination, bud bursting, blossoming, change of diameter and height, seed maturation, yellowing of leaves etc. in forest trees. Various branches of science such as silviculture, botany, ecology, entomology and harvesting benefit from this informa-

tion (Firat, Günel, 1973; Kalıpsız, 1982; Carus, Çatal, 2007). Phenology is an important guide in plant breeding, especially when it concerns the origin and seed transfer problems (Ürgenç, 1982). Phenological observations play an important role in the studies of seed gathering, sowing, planting, grafting and controlled pollination (Ürgenç, 1982; Küçük, 1986; Özkurt et al., 1998; Yıldız, 2013).

Slow growth of trees on the background of low temperature can be observed the beginning of the vegetation period (spring). Due to the increase of photosynthesis activity under appropriate weather conditions, rapid growth takes place. In the following period, slowing down and even stopping

of growth can be recorded due to the increase of temperature (Firat, Günel, 1973; Kalıpsız, 1982; Carus, Çatal, 2007). The recording of changes of plant development under the influence of climatic factors and determination of the dates of certain vegetation periods can be made using phenological observations. Taking into consideration year to year changes of climatic conditions, it is important that the phenological observations should be made during several consecutive years (Yıldız, 2013). No equipment or tools are needed for phenological observations. It is detected and recorded by observations of the observers.

The ecological factors, especially climatic, which are effective in the selection of plant species suitable for urban conditions, have an important influence on plant design. As phenological characteristics of plant material change depending on climatic conditions. This impact is especially important in the period of flowering, leaf formation and falling, fruit formation and dropping of plant material. Therefore, emphasizing the effect of color in plant designs is possible if one can tell when plants bloom and how long they stay in bloom depending on the season. If coloring of the plants to be used in the design is known in advance more impressive compositions with the plants can be formed (Gültekin, 1994; Anonymous, 2000; Schwets, Brown, 2000; Önder, Akbulut, 2011; Bilgili et al., 2014). At this stage one should keep in mind vegetation, climate and soil characteristics (Turna, 2010).

The vegetation analysis can suggest ideas for the surrounding areas outside the site to be studied. These results should provide important information on the conditions for growing plants and species selectivity, and help in choosing the species to be left in the study area. Hence, this study is aimed at revealing the differences in the beginning of vegetation of some natural and exotic plant species in KTU campus. The species identified at the campus were photographed with the intervals of 10–17 days starting from March to the end of May. Then attempts were made to determine budding times for the implementation of plant designs in local conditions.

## MATERIALS AND METHODS

Located on the Kanuni Campus of Karadeniz Technical University, 19 broad-leaved species including 18 Angiosperms (*Acer negundo* L., *A. palmatum* Thunb. 'Atropurpurea', *A. platanoides* L., *Robinia pseudoacacia* L., *Carpinus betulus* L., *C. orientalis* Miller, *Cercis siliquastrum* L., *Prunus*

*cerasifera* 'Atropurpurea', *Prunus serrulata* Lindl. «Kandzan», *Fagus orientalis* Lipsky, *Wisteria sinensis* (Sims) DC., *Quercus petraea* (Mattuschka) Liebl., *Q. robur* L., *Liquidambar orientalis* Mill., *Tilia platyphyllos* Scop., *T. tomentosa* Moench, *Ulmus minor* Mill. and *U. glabra* Huds.) and 1 Gymnosperm (*Ginkgo biloba* L.) were selected as sample material. The arrangement of these species are shown in Fig. 1.

Phenological observations were made on 6 different dates on 3, 13 and 23 March, 4 and 16 April and 3 May 2017. In order to make it easier to observe the plants during the study, the photographed shoots were marked. So, the measurements were made at the same place each time.

Budding of some species on the KTU campus was chronologically determined using the acquired photographs and observations in situ. Keeping in mind the time of vegetation onset, budding conditions were arranged in 4 different ways according to D. Güney (2009) and observations were made in agreement with these preparations. The observations are given below.

B–: No budding,

S: The swelling of buds has started,

BB: The burst of buds has just begun,

B+: The burst of buds has completed. On each observation date, budding conditions of 19 different trees were observed and recorded.

The climate of the study area, in Trabzon province, is a typical Black Sea region climate, with temperate climate summers and a rainy season normally lasting from September to April. However, the precipitation regime isn't regular. Although some periods have rare precipitation, some others have long-lasting heavy rains (Reis, Yomralioglu, 2006; Yalcin, 2008). The phenological activities are primarily under the influence of the climate; for that reason, it is important that association of phenological activities in the population should be in agreement with climate data for the research area in the Trabzon Meteorology Regional Directorate. With the help of the obtained temperature values and the results of phenological observations, the data were obtained on the vegetation duration in the research area for the months with phenological observations. The temperature data are given in Fig. 2.

## RESULTS AND DISCUSSION

*The evaluation of findings related to temperature data.* When KTU campus was examined from the viewpoint of geography its distance from Trabzon city center amounted to 3.75 km, and the total

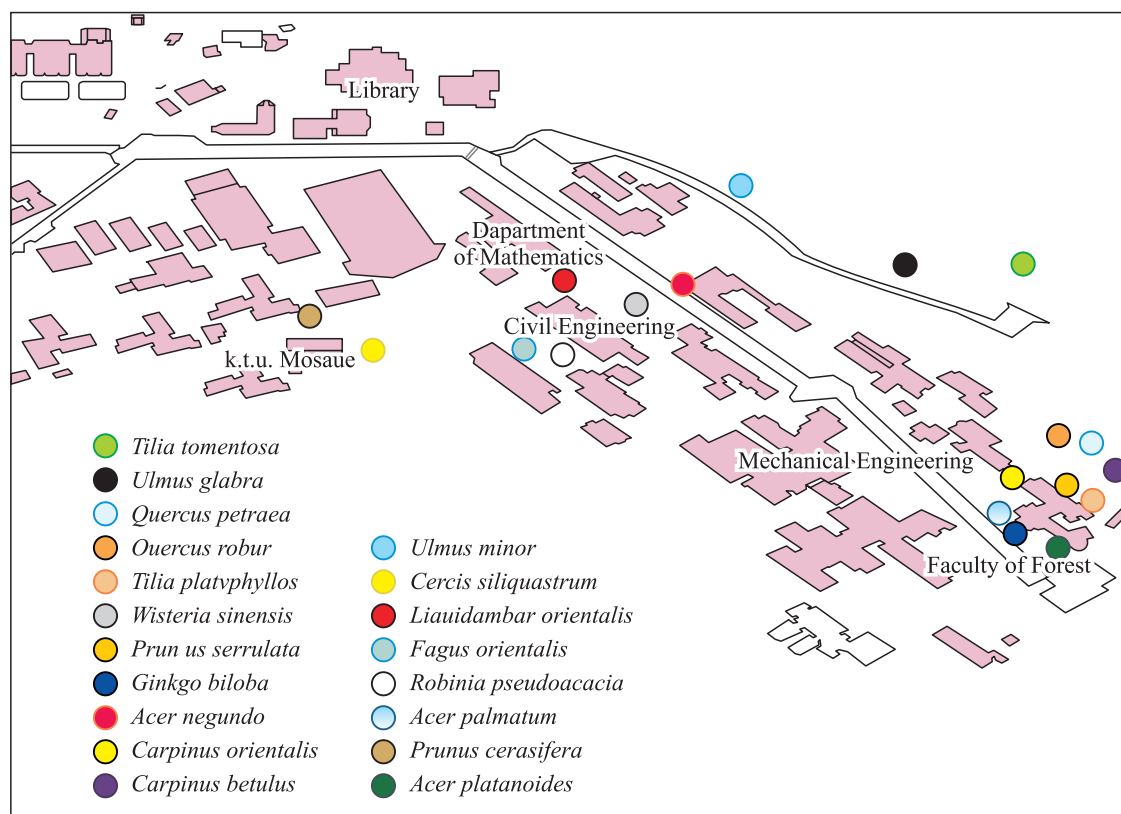


Fig. 1. Sketch demonstration of the species observed on KTU Kanuni campus.

area of the campus made up of 1 492 171 m<sup>2</sup>. Trabzon province is located in the transition zone of the tropical air masses in the South and pole air masses in the North. Changing of precipitation conditions at short distances (microclimate areas) is an important feature of Trabzon. Therefore, there are differences between coastal and interior areas (URL-1).

One of the most important factors for the growth of plants is climate. Since temperature has a more pronounced effect on physiological activities, it is the main climatic factor (Çepel, 1988). In order to

sustain bud bursting and continue to develop up to the growth period with normal conditions of the plants, each of them needs the most suitable conditions in terms of temperature, precipitation and moisture. For that reason, temperature graphs were created to determine the effects before the beginning of vegetation period of temperature data in the months when phenological observations were made. When budding times of plants were investigated, the first bud bursting time was observed in *Prunus cerasifera* 'Atropurpurea' on 3 March. The temperature on that day was 14 °C.

*Findings related to bud bursting times of some broad-leaved species in KTU campus.* A total of 19 species were used in the study, including 10 native trees, 5 exotic trees, 2 native shrubs and 2 exotic shrubs found in Kanuni campus of Karadeniz Technical University. The bud bursting times of these species are given in the Table.

Phenological growth trends of existing species showed some differences between the species. This was an expected result. Because genetic structure of each species and abiotic factors that they need exhibited some differences characteristic of the species. As can be seen in Table, the earliest growing species within the year were *Prunus serrulata* «Kandzan» and *Prunus cerasifera* 'Atropurpurea'. On the other

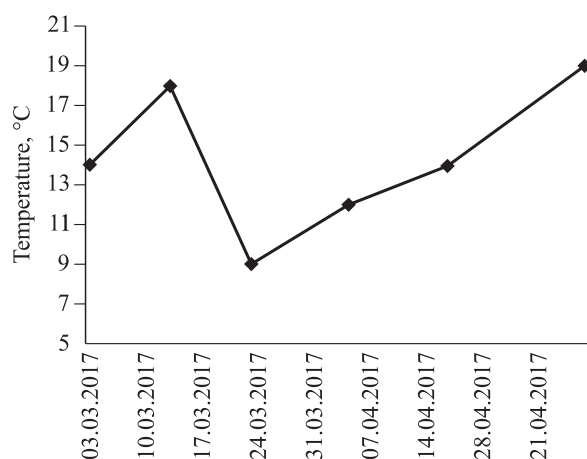


Fig. 2. The temperature data for the months with phenological observations.

Bud bursting times of some species in KTU Kanuni campus

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Note. \* T – tree, E – exotic, N – natural, S – shrub.





**Fig. 3.** Bud bursting stages on different dates: 1 – *Acer negundo* L., 2 – *A. platanoides* L., 3 – *Liquidambar orientalis* Mill.

hand, the growth of *Fagus orientalis* Lipsky and *Ulmus minor* Mill. started and ended later. Differences in the growth and phenology of plants may be related to the photosynthetic pathways they use (Kemp, 1983). The beginning of growth processes within the year of the vast majority of plants were in spring season (March–April–May). According to the results of observations, the earliest-growing species were species that complete their phenological growth at the earliest period (Fig. 3).

As it can be said that higher temperatures in spring caused the plants to develop earlier during the year (Estrella, 2000). The first phenological stage of most of the species was the flowering stage, as it is the most sensitive phase to changes in climate (Spano et al., 1999). The growth courses of species investigated in the research area showed differences. While the species of the earliest bud bursting from

exotic species were *Prunus serrulata* «Kandzan» (March 3) and *Prunus cerasifera* 'Atropurpurea' (March 13), while the species of the earliest bud bursting from native species were *Carpinus betulus* (March 23) and *Liquidambar orientalis* (March 23). The species of the latest bud bursting from exotic species were *Ginkgo biloba* (3 May), *Acer palmatum* 'Atropurpurea' (April 16) and *Wisteria sinensis* (April 16), whereas the species of the latest bud bursting from native species were *Fagus orientalis*, *Quercus petraea*, *Tilia platyphyllos*, *T. tomentosa*, *Ulmus glabra* and *U. minor* (Fig. 4 and 5).

## CONCLUSION

As a result of observations, when the time is examined from the beginning of the bud swelling until the completion of bud bursting; native species

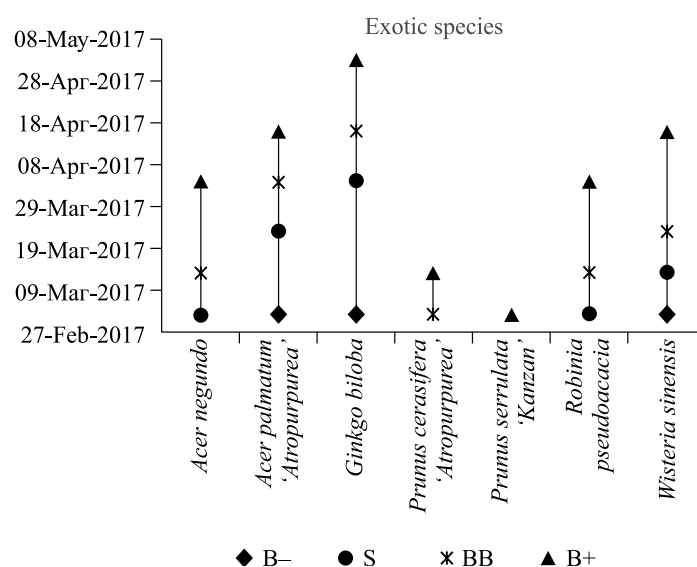


Fig. 4. Bud bursting stages of exotic species.

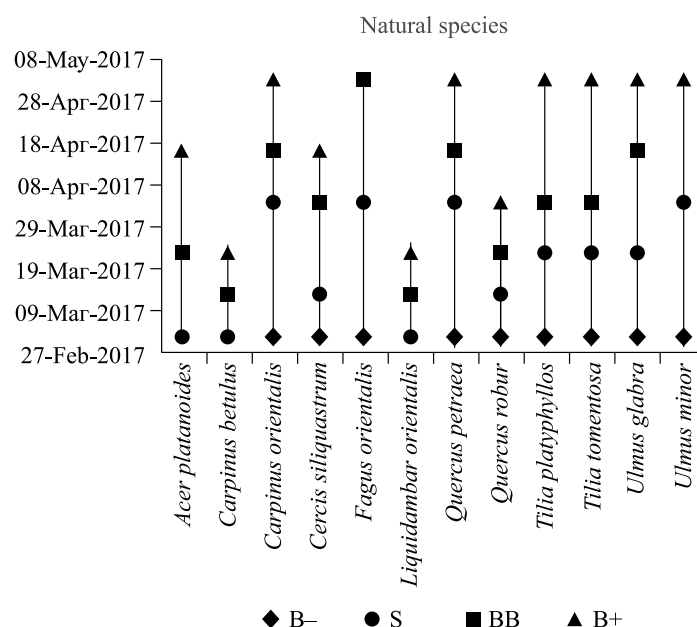


Fig. 5. Bud bursting stages of native species.

that demonstrates the completion in the longest time was *Acer platanoides* L., native species that finishes the process in the shortest time were *Carpinus betulus* L. and *Liquidambar orientalis* Mill. Also, an exotic species that completes the process in the longest time was *Wisteria sinensis* (Sims) DC, an exotic species that accomplishes the phase in the shortest time was *Prunus serrulata* «Kandzan».

Data on phenological activities of tree species (place and time) helped practitioners in the main forestry studies such as, nursery, plantation, rejuvenation and maintenance cutting. Some processes such as collecting grafting material and evidence on grafting time in breeding and genetic studies in ag-

riculture and forestry, success of sowing and planting, determination of harvest times are also studied using knowledge of phenological activities.

These can be temporal variabilities in terms of phenological activities among the different individuals of the same tree species in the same place. They can also take place at different times in phenological processes such as waking, blossoming, foliage growth etc. on different parts of the same tree. The identification of these changes in tree species is beneficial in a variety of contexts. For example, it may be helpful to use seeds or seedlings of these late-onset species in the areas where late frost often occurs.

Planting of bare rooted seedlings is made out of vegetation period in both forestry and landscape afforestation. Determination of vegetation time is very important and requires rigor. As, when differences are considered in two individuals of the same species in the same place, it requires an extremely careful observation. For example, it is not right to give species in a certain recipe to a person who constantly wants to see flowers in his garden. First of all, the phenological changes in the previous years must be regularly followed on the species to be given. Taking seeds or seedlings that are the most suitable species and the most appropriate individual will be important in terms of getting the best result. To achieve the objective, the determination of variations of the species should be made as soon as possible. For this purpose, some qualitative and quantitative characteristics of the species should be measured. With the developing of technology, some methods such as isoenzyme, DNA and others are used to determine genetic structure in recent years. However, these kinds of studies are expensive and require laboratory facilities and attention.

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## ФЕНОЛОГИЧЕСКИЕ НАБЛЮДЕНИЯ В ВЕГЕТАЦИОННЫЙ ПЕРИОД НЕКОТОРЫХ МЕСТНЫХ И ЭКЗОТИЧЕСКИХ ВИДОВ РАСТЕНИЙ В КАМПУСЕ КАМУНИ КАРАДЕНИЗСКОГО ТЕХНИЧЕСКОГО УНИВЕРСИТЕТА

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Проведение фенологических наблюдений за растениями позволяет получить информацию о наступлении времени посева, прорастания и распускания почек. Эта информация способствует, в частности, отбору видов, которые следует оставить для выращивания в условиях конкретного участка. В связи с этим важно знать период и продолжительность цветения растений в течение сезонов. Если известно, что окраска растений, которые будут использоваться в ландшафтном дизайне, зависит от времени года, могут быть созданы гораздо более интересные растительные композиции. Цель работы – выявление различий в начале вегетации некоторых местных и экзотических видов растений, произрастающих в кампусе Камуни Караденизского технического университета в г. Трабзоне, Турция. Изучены временные периоды распускания почек для 19 видов фиников, в том числе десяти местных видов деревьев и пяти экзотических, двух местных и двух экзотических видов кустарников в течение четырех фаз. Таким образом, когда были проведены наблюдения за временем от набухания почек до их раскрытия, оказалось, что период распускания почек у клена остролистного *Acer platanoides* L. был самым продолжительным, а у граба обыкновенного *Carpinus betulus* L. и ликвидамбара восточного *Liquidambar orientalis* Mill. – самым кратким по сравнению с местными видами. Тот же период для глицинии китайской *Wisteria sinensis* (Sims) DC. был самым продолжительным, а для вишни мелкопильчатой «Кандзан» *Prunus serrulata* Lindl. завершен в кратчайшие для экзотических видов сроки.

**Ключевые слова:** аборигенные и интродуцированные виды древесных растений, вегетация, сезонность, раскрытие почек, ландшафтный дизайн, Трабзон, Турция.