Soil Characteristics of Natural Silver Linden (*Tilia tomentosa* Moench) Populations

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Studies regarding the determination of the ecological characteristics of the natural distribution areas of the silver linden (*Tilia tomentosa* Moench) are limited. It is of great importance to select areas with similar natural cultivation characteristics in the plantations established for flower or timber production. Physiographical factors affecting these forests were explored to determine the physical and chemical characteristics of the soil. The soil samples were collected from three natural populations, and a total of 43 samples were examined in terms of aspect, elevation, declivity position, and slope. It was determined that the natural linden populations expanded between the altitudes of 0 m and 400 m and 88% of the populations were denser in aspects with shadow. It was found that 91% of the soil was in the class of "deep to very deep", 61% showed an expansion in sandy clay loam soils, and 30% showed an expansion in sandy loam soils. Average soil pH ranged between 5.6 and 6.6. The soils were found to be salt-free and slightly limy. In terms of the organic carbon amount, the soils were classified as medium.

Keywords: Tilia tomentosa; Silver linden; Natural expansion; Soil characteristics

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INTRODUCTION

Turkey is comprised of three different plant regions, namely the Mediterranean, Europe-Siberia, and Irano-Turanian. Each one of these regions has its own endemic species and natural ecosystems (Tan 2010). In terms of the variety of species, Turkey has 11,446 natural and 3649 endemic species (Güner *et al*. 2012). The linden (*Tilia* sp.), which is native to the Northern Hemisphere, consists of 30 different species. Four different linden species, namely *T. rubra* subsp. *caucasica*, *T. cordata*, *T. platyphyllos*, and *T. tomentosa* are found in Turkey, and the distribution area of these four species is 12.574 hectares (General Directorate of Forestry (OGM) 2013; Oral 2018). Linden constitutes approximately 0.06% of Turkey's forest area with the majority of it consisting of *T. tomentosa* Moench (Davis 1967; Korkut 2011). *T. tomentosa* is the most common species and is the most known in Turkey (Davis 1967). In addition, *T. tomentosa* is generally found in regions such as Bosnia and Herzegovina, Croatia, Macedonia, Montenegro, Serbia, Slovenia, Bulgaria, Romania, Greece, Turkey, and in parts of China (Mauer and Tabel 1995; Blumenthal *et al*. 1998). *T. tomentosa* has three different ecotypes based on altitude elevation (Kalmukov 1994). The flowers of *T. tomentosa* consist of five petals of yellowish-white color and have an unusually strong smell, which is specific to the flower itself. It is also used as an ornamental plant in parks and gardens in various cities (Uslu 2004; Xie 2018). *T. tomentosa*'s bark is smooth and grey, while its leaves are heart-shaped and covered with white tomentum, especially on the underneath in contrast to the leaves of *Tilia cordata* and *T. platyphyllos*, which are hairless. The flowers are collected in full bloom, dried, and preserved under low-moisture conditions. Since the middle ages, the linden flowers have been used as a diaphoretic to promote perspiration. In addition, the flowers were traditionally used as tranquilizers and to treat headaches, indigestion, and diarrhea. The infusion of the flowers makes a pleasant-tasting tea. Traditionally linden flowers were added to baths to quell hysteria and steeped as a tea to relieve anxiety-related indigestion, heart palpitation, and vomiting (Anonymous 2012). More than half of the production of linden is consumed as tea in winter, making great contributions to the relation between the forest and the public in the cities of Bursa and Yalova (Tuttu *et al.* 2017). According to the General Directorate of Forestry (OGM 2018), the average production of linden for the last 28 years has been 37 tons per year, while the average was 208 tons for 2017. Because the height of the silver linden can reach up to 40 m (Uslu 2004), the flower harvesting is conducted by cutting the thick branches, which in turn heavily damages the tree itself. For this reason, it is suggested to improve the linden's natural distribution areas (Eltan 2012). Thus, it is of great importance to take the linden as cultivar to decrease the damage to the tree and to establish timber plantations to benefit from the flowers in areas in accordance with its ecology. Therefore, it is necessary to determine the cultivation environment of the natural populations and the soil characteristics of the areas. However, the scientific studies conducted in this area are limited. In this study, the soil characteristics of the natural populations of *T. tomentosa* in the Bursa Regional Directorate of Forestry were determined and scientific data were collected for the forestations and the establishment of the plantations.

EXPERİMENTAL

Materials

Introduction of the study area

The material of this study consisted of the pure or mixed *T. tomentosa* forests that have naturally spread in Gökçeören (Bursa), Yeniköy (Bursa), and Esenköy (Yalova), all located in Turkey. The samples were collected in these three regions (Fig. 1).

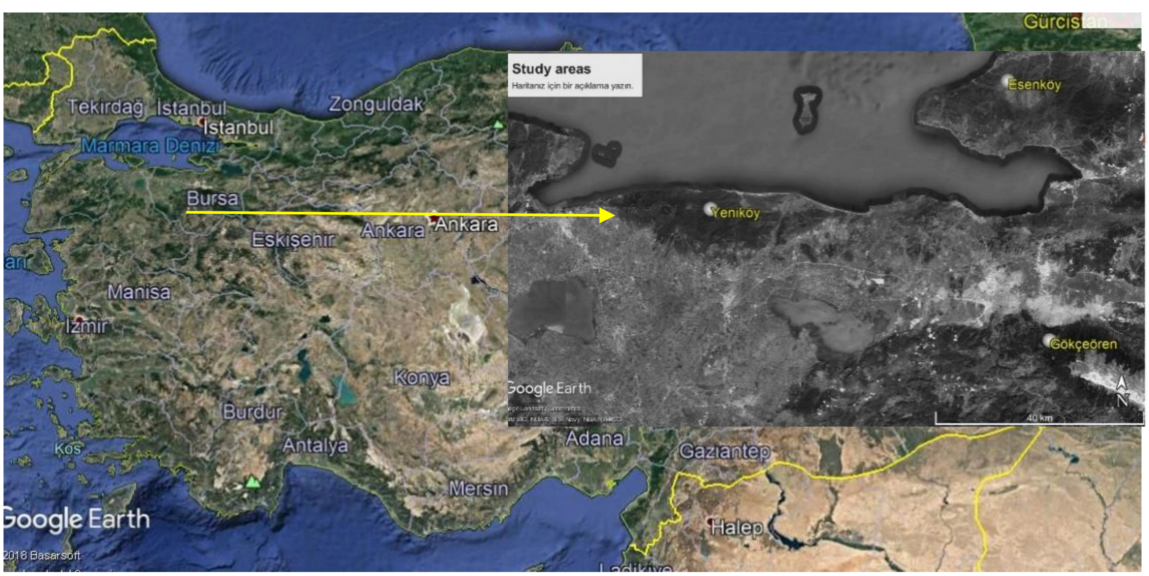

Fig. 1. Geographical position of the study area

A total of 43 soil holes were dug and 90 samples were collected considering the horizon boundaries. Shovels, pickaxes, garden trowels, polyethylene bags, tape measurers, GPSs (Garmin Ltd., Olathe, KS, USA), and camera (Nikon D 3100; Nikon, Tokyo, Japan) were used to obtain the sample data.

Methods

Extraction and analyses of the samples and assessment of the climatic data

The holes in the soil were dug in the regions of the study area. In pedological field studies, the horizon is the basic sampling unit. Therefore soil samples were taken according to the horizon boundaries. In this study a total of 90 samples were investigated; 43 samples were obtained at 0 to 20 cm depth, 29 samples were obtained at 21 to 70 cm depth, and 18 samples were obtained at 71 to 120 cm depth. Approximately 1 kg of soil was collected in polyethylene bags for the samples in consideration with the color difference in the horizons. The absolute and physiological depths of the soil, thickness of the soil horizon, mother rock structure, profile, and surface rocky structure, ground water, and staining status with drainage (Karaöz 1989) were taken note. Using the samples taken from the areas with linden populations, stand parameters, such as closeness, mixture, stand health, and the status of benefit, were determined. Great importance was set on digging the holes in areas where pure *T. tomentosa* are situated. Topography, field position, aspect, elevation, declivity slope, and the coordinates of the areas were measured and recorded on inventory cards to determine the physiographical characteristics of the soil areas. Each soil sample was labelled with the sample's profile number and data before being brought to the lab. The aspect assessments were conducted using the ArcCIS program (ESRI, version 10.5, Redlands, CA, USA) on four main directions. The areas from which the samples were taken were considered in the determination of the slope.

A total of 90 soil samples were brought to the lab and stored in pans until they were air-dried for two months. The samples were then ground in a mortar and sieved with a 2-mm sieve. The thin part of the soil was used in the physical and chemical analyses (0 < 2 mm) (Karaöz 1989). Sand-silt-clay composition of the soil samples were determined according to the hydrometer method (Kroetsch and Wang 2008). The pH, salt, and electrical conductivity (EC) were determined (Richards 1954; Tüzüner 1990). The calcium content was determined based on total $CaCO_3$ content (Çağlar 1949; Tüzüner 1990) using a Schiebler calcimeter (Eijkelkamp Soil & Water, Giesbeek, Netherlands), and organic carbon content was determined following the Walkley-Black wet burning method (Tüzüner 1990). The contents of total nitrogen (N) (Bremner 1965), plant available phosphorous (P), and available potassium (K_2O) were determined using a Perkin Elmer- Inductively Coupled Plasma Optical Emission Spectroscopy (ICP OES) instrument (Optima 7000 DV; Perkin Elmer, Waltham, MA, USA), as shown by Tüzüner (1990).

Slope and aspect were determined based on the obtained data (Ürgenç and Çepel 2001). Soil type was analyzed by the method of International Soil Classification Triangle (Çepel 1960; Atalay 2006). Profile rockiness, surface rockiness, soil depth (Kantarcı 1987), organic carbon amounts (Jackson 1962), calcium contents (Çağlar 1949; Evliya 1964), saltiness (Bernstein 1970; Verhoeven 1980), and pH were also determined (Saatçı *et al*. 1983; Kantarcı 2000).

The data obtained from the meteorology stations of Bursa and Yalova, which were the closest ones to the study areas, were used for the determination of climatic characteristics. The climatic changes and climatic types in the study area were examined according to the Thornthwaite method (Thornthwaite 1948) by using the average precipitation and average temperature values. During the interpolation of the meteorology station data to the study area, the temperature values were decreased 0.5 °C per 100 m and the precipitation values were increased 54 mm per 100 m (Çepel 1988a; Özyuvacı 1999).

RESULTS AND DISCUSSION

Climatologic Findings

According to the meteorological data obtained from the meteorology station of Bursa, the average annual temperature in the study area was 14.6 °C between the years 1926 to 2016, and the annual precipitation average was 707.5 mm. The average annual temperature for the Yalova area between the same years was 14.7 °C, and annual precipitation average was 749.8 mm. According to the findings obtained with the Thorntwaite method (Thornthwaite 1948), Bursa was humid, had medium temperature (mesothermal), was a city in which water deficiency occurred in the summer, and had a climatic type close to an oceanic climate. In contrast, theYalova area was semihumid, had medium temperature (mesothermal), was a city in which water deficiency also occurred in the summer, and had a climatic type close to an oceanic climate.

Floristic Structure

Other species that were present in the study area along with linden were as follows: *Castanea sativa* Mill., *Quercus cerris* L., *Quercus petraea* (Mattuschka) Lieb., *Corylus avellana* L., *Laurus nobilis* L., *Daphne pontica* L., *Hedera helix* L., *Alnus glutinosa* L. Gaertn, *Styrax officinalis* L., *Rubus* ssp., *Erica* ssp., *Arbutus andrachne* L., *Cistus salviifolius* L., *C. laurifolius* L., *Sorbus torminalis* L. Crantz, *Rhus coriaria* L., *Platanus orientalis* L., *Populus tremula* L., *Carpinus betulus* L., *Fraxinus ornus* L., *F. angustifolia* Vahl., *Rosa canina* L., *Cornus mas* L., *Corylus avellana* L., *Diospyros lotus* L., and *Acer campestre* L. In addition to these species, in studies conducted by Özel *et al*. (2017) and Stanescu *et al*. (1997), it was stated that *Euphorbia amygdaloides* L., *Helleborus orientalis* Lam., *Primula vulgaris* Huds., *Rubus hirtus* Waldst. & Kit, *Ruscus aculeatus* L., *Ruscus hypoglossum* L., *Smilax aspera* L., *Smilax excelsa* L., and *Viola sieheana* W. Becker were present.

It was found that the *Tilia tomentosa* were sucessfully mixed with *Q. cerris* and *Q. petraea.* It was also determined that *Castanea sativa*, *Platanus orientalis,* and *Alnus glutinosa* generates a successful mix at high humidity regions. The *Erica* spp, *Arbutus andrachne*, *Cistus* spp, and *Rubus* that are located at south slopes also create succesful mixtures. Once the road-side samples were investigated, it was observed that the successful mix was obtained with *Smilax* spp, *Rubus hirtus*, *Rhus coriaria*, *Populus tremula*, *Cornus mas*, *Corylus avellana*. In the scattered regions *Acer campestre*, *Sorbus torminalis*, *Carpinus betulus*, *Diospyros lotus* generated successful mix. *Laurus nobilis*, *Hedera helix*, *Ruscus* spp, *Smilax* spp created successful mix in the *Linden* stands’ under canopy cover.

Physiographical Characteristics

Elevation from sea level

The soil samples collected from the natural linden population areas in Esenköy and Yeniköy were located between 60 m to 350 m altitude, and the highest altitude reached was measured as 450 m and the average altitude was measured as 266 m. It was determined that 68% of the10554 ha natural expansion area was located between 0 to 400 m, 32% was between 401 m to 800 m, and 0.4% was above 800 m. In a study conducted by Özel *et al*. (2017), it was also stated that the linden expansion in the same area could rise mostly up to 400 m. It has been cited (Davis 1967) that the expansion areas of *T. tomentosa* were between 50 m to 400 m. It was also specified by Şahin *et al*. (2018) that natural linden population areas could rise up to 1000 m in the Marmara region, but the optimal expansion area was between 50 m to 650 m. It was stated that these areas could rise up to 1000 m in Romania (Radoglou *et al*. 2009), but the best development occurred in 150 m to 450 m (Haralamb 1967; Stanescu *et al*. 1997), which shows that the literature is in accordance with the present study.

Aspect-slope

The majority of the linden populations in the study area were more dense in the northern and western aspects. Approximately 7% of the soil samples were taken from the eastern aspect, 23% of them were taken from the western aspect, 65% of them were taken from the northern aspect, and 5% of them were taken from the southern aspect. According to the aspect analysis conducted with the ARC-GIS program, 88% of the populations were more dense in the western and northern aspects, which generally were subject to more precipitation, andwere cooler and more humid (Dirik 2008; Akkemik 2018). Previous studies also support the findings of the present study. For example, in a study conducted by Özel *et al*. (2017), it was determined that 69% of *T. tomentosa* populations were located in areas that receive shade. According to Öner (2009) and Öner and Akbin (2010), the *T. Tomentosa* populations in the Kapıdağ Peninsula were more dominant in declivities with northern aspects and expanded as much as they could in these areas. It was stated by Aksoy (2006) that *T. tomentosa* populations showed expansion in northern, northeastern, northwestern, and southwestern aspects.

The slope in the sampling areas changed between 20% to 40% and the average slope was 32%. When the populations showing expansion within the Regional Directorate were classified according to slope groups, 4% of them were classified as medium slope surfaces (slope between 10% to 20%), 52% of them were classified as high slope surfaces (slope between 20% to 50%), and 37% of them were classified as very high slope surfaces (slope between 50% to 100%). Surfaces with a slope close to steep and with > 100% slope were only 2% (Elibüyük and Yılmaz 2010). No difference was observed among the populations in terms of slope. In the study conducted by Özel *et al*. (2017), while minimum slope was determined as 20%, maximum slope was determined as 100%. Approximately 15% of the areas were classed as steeply inclined hillsides, 23% of them were classed as steep fields, and it was also determined that the linden populations were in the fields with moderately inclined and above the inclined area. These findings (Şahin *et al*. 2018) also indicated that expansion was present in very slopy, steep, and very steep fields.

Physical Characteristics of the Soil

Soil type

Two main soil types were identified in the study area: sandy clayed loam at 61% and sandy loam at 30%. In addition, the loamy sandy soil at 7% and sandy clayed soil at 2% were also determined. It was specified by Atalay (2006) that the soil type of the horizon B in Yenikoy beech forests was sandy loam. When classified by Çepel (1988b), 91% of the soils were medium-level fine-grained soil, 7% were coarse-grained soil, and 2% were fine-grained soil. Özel *et al*. (2017) showed that *T. tomentosa* populations in the Karadağ area showed expansion in loam soil at 61% and sandy loam soil at 15%. It was expressed by Radoglou *et al*. (2009) that the *T. tomentosa* in Europe showed expansion in the sandy loam soil and loamy clay soil, and developed best in the loam, sandy loam, and clayed loam soils. They do not show any development in soils with heavy clay that limit root expansion. It was also emphasized by Kalmukov (1984) and Jaworski (1995) that they conducted their optimal expansion in sandy loam and loamy sandy soils. Additionally, in the study by Şahin *et al*. (2018) it was found that they showed expansion mostly in loam, sandy loam, and clayed loam soils.

It was found that the Yenikoy, Esenkoy, and Bursa areas were different from one another in terms of soil texture (Table 1). No statistically (SPSS Inc., v.15.0, Chicago, IL, USA) meaningful difference could be found among the populations in terms of sand ratios. The silt ratios of the samples taken from Bursa were lower than those of the other populations. While the clay ratios were the same in the Bursa and Esenköy regions, they were lower in the Yeniköy region. Data similar to those of the study conducted by Özel *et al*. (2017) were attained in terms of soil type. No difference was found in the ratios of sand-silt-clay according to the depth stages.

Table 1. Texture, Organic Carbon, pH, and Salt Values According to the Plant Populations

Location	Sample No.	Sand (%)	Silt (%)	Clay (%)	Organic Carbon (%)	pH	Salt (%)
Yenikoy	27	68.61 ± 6.51**a**	16.2 ± 5.14**b**	15.04 ± 7.30**a**	2.32 ± 1.50**a**	5.9 ± 0.54**a**	0.006 ± 0.003**b**
Esenköy	53	64.10 ± 9.62**a**	14.84 ± 6.09**b**	21.06 ± 6.80**b**	2.06 ± 1.12**a**	5.8 ± 0.52**a**	0.0084 ± 0.004**b**
Gökçeören	11	69.21 ± 4.48**a**	11.23 ± 5.78**a**	19.57 ± 3.54**b**	1.03 ± 0.43**b**	6.4 ± 0.61**b**	0.0031 ± 0.006**a**
F-value		3.517	2.968	7.338	4.735	4.220	8.768
P-value		0.057	0.034	0.001	0.011	0.018	0.000

Note: In each column and factor, values followed by the same letter are not significantly different ($P < 0.05$)

Soil depth and profile rockiness

In the present study, it was determined that the absolute soil depth ranged between 55 cm to 150 cm. When the absolute depths of the soils were classified according to Kantarcı (1987), 9% had medium depth, 37% of them were deep, and 54% of them were too deep. Too shallow and shallow soils were also encountered. In this respect, it can be said that *T. tomentosa* shows expansion mostly in deep and too deep soils. The absolute depths of the soil holes that were dug in the study area were 103 cm on average and it was seen that they were in the class of too deep soil (Kantarcı 1987). In the study conducted by Özel *et al*. (2017), 50% of the soils were classed as medium deep and too deep.

The rockiness of the soil has important impacts in terms of water and food capacity. In this respect, when the soil rockiness was classified according to Kantarcı (1987), 46% of the sampling areas were little rocky, 40% were rocky, 7% were medium rocky, and 7% were too rocky. 'Too much rocky' and fully rocky soils were not found in the study area. Furthermore, in the study conducted by Özel *et al*.(2017), 31% of the linden areas were determined as rocky, which is parallel to the findings of the present study.

When an impermeable layer is observed in the soil, the water fills the pores of the soil and it moves horizontally depending on the slope of the impermeable layer or field (Kantarcı 2000), and high ground water affects the physiological depth (Birler 2009). Thus, groundwater examinations were also conducted in the holes dug. However, no staining was observed in any one of the holes depending on groundwater. This showed that the soils lost oxygen and keeping the groundwater in still status was not convenient for silver linden.

Chemical Characteristics of the Soil

Organic carbon, pH, salt (EC), and calcium contents of the soil

The average pH value in natural *T. tomentosa* forests were of mild acidic character with pH 5.96. While the measured minimum pH value was 5.11, the pH was 8.02 only in one soil sample. It was stated by Atalay (2006) that the humid temperate of broadleaf forests are mostly the soils with acidic character. When the findings were assessed according to Kantarcı (2000) and Erşahin *et al*. (2015), it was seen that there was no difference in terms of pH between the populations in the Yenikoy and Esenkoy regions, which had soils with medium-level acidic character. It was seen that the pH in the soil in the Bursa region was of a mild acidic characteristic, which was higher than the other two regions. As the soil depth increased, the pH value also increased and got close to neutral. According to Saatçı *et al*. (1983), while the average pH in 0 to 60 cm depth is 5.6 (medium-level acidic), pH in 60 cm to120 cm stage was 6.6 with mild acid character (Table 1). In the study conducted by Özel *et al.* (2017) in Karadag, it was determined that 23% of the linden populations were in strongly acidic soil, 8% were in medium strong acidic soil, 38% were in mildly acidic, and 31% were in neutral reaction soils. While the minimum determined pH value was 5.2, a value of 7.9 was detected as the maximum value. In terms of the average soil pH, the results of the present study and the results of the studies conducted by Özel *et al*. (2017) and Şahin *et al*. (2018) are close to one another. It was expressed by Radoglou *et al*. (2009) that pH in *T. tomentosa* populations in Europe was between 6.5 to 7.2 and the species showed expansion in the low acidic and neutral areas. Kalmukov (1984) stated that *T. tomentosa* prefers mild acidic or neutral soils (pH 6.2 to 7.2). In the study (Bilgin and Güzel 2017) conducted in *Tilia rubra* subsp. *caucasica*, it was determined that the pH ranged from 6.1 to 6.7 depending on the elevation.

The calcium content of the samples used based on the soil depths was determined as 2.6% and classified as little limy soils (Çağlar 1949; Evliya 1964; Erşahin *et al*. 2015). In the study conducted by Şahin *et al*. (2018), the soil from 87% of the linden populations in Karadag area contained calcium at a medium level. It was asserted by Jaworski (1995) and Radoglou *et al*. (2009) that the species of *Tilia* in Europe generally prefer soil with high calcium content. There is no doubt that a single factor is not effective on the expansion of a plant species. However, it can be said that the *Tilia tomentosa* species in Turkey has shown development in the limeless mother rock and soil.

It was determined in this study that the soil samples taken from the silver linden populations increased in the salt-free class. In the study conducted by Özel *et al*. (2017), all of the soils were determined as salt-free. The difference among the populations in terms of the salt content was found statistically signifigant, and the salt amounts in the samples taken from the Bursa region were determined lower than the soil samples from other regions (Table 1). The reason for this could be the fact that salt condenses in the soil as a result of the evaporation of the sprinkles coming from the sea depending on the direction and speed of the wind (Gustafsson and Franzen 2000). Studies conducted by Reinap *et al*. (2012) have determined that the salt storage occurring near forests is 2 to 3 times more than those near beaches and 50% to 60% higher than in-forest salt storage. Different publications in this subject (Draaıjers *et al*. 1988; Wuyts *et al*. 2008; Dmuchowski *et al.* 2013) support this hypothesis. It was observed in this study that there was no difference in the salt amounts depending on the depth stages.

Organic carbon content of the soil

In the present study, the average organic carbon ratio was 2.01%. When the organic carbon amounts among the populations were compared, the organic carbon content in the samples taken from the Yenikoy and Esenkoy area were higher than those taken from the Bursa area. The organic carbon amounts of approximately 75% of the soils in the Bursa, Yenikoy, and Esenkoy regions were below 3%, 25%, and 2%, respectively. In terms of soil quality, the desired organic carbon content is more than 3% (Saltalı 2014). As classified by Jackson (1962) and Gülçur (1974), the natural linden populations were located in medium class in terms of organic carbon content. According to Kantarcı (2007) and Erşahin *et al*. (2015), 2.01% were in soils with little organic carbon and poor in humus.

When assessed according to the depth stages, it was seen that the organic carbon contents decreased towards the lower layers in the soil samples. The average organic carbon ratio was 2.78% at 0 to 60 cm depth, 1.68% at 60 cm to 90 cm depth, and 0.83% at 90 cm to 120 cm depth (Özel *et al*. 2017). When the organic carbon contents of the soils of the sampling areas of this population were examined, it was determined that 8% of them had low levels of organic carbon, 15% in medium levels, and 77% in high levels of organic carbon contents.

Table 2. Correlation Analyses of Height, Slope and Some Additional Parameters

		Elevation (m)	**Slope (%)**	**pH**	**EC**	**Organic Carbon**
Elevation (m)	Pearson Correlation	1	-0.135	0.032	-0.061	-0.122
	Sig. (2-tailed)		0.202	0.762	0.566	0.251
	N		91	91	91	91
Slope (%)	Pearson Correlation		1	0.067	-0.117	-0.047
	Sig. (2-tailed)			0.525	0.269	0.655
	N			91	91	91
pH	Pearson Correlation			1	-0.142	-0.230*
	Sig. (2-tailed)				0.178	0.028
	N				91	91
EC	Pearson Correlation				1	0.231*
	Sig. (2-tailed)					0.027
	N					91
Organic Carbon	Pearson Correlation					1
	Sig. (2-tailed)					
	N					

*Correlation is significant at the 0.05 level (2-tailed).

There were no correlation between the elevation and slope parameters and pH, EC and organic carbon values. A negative correlation was found between the organic carbon values and pH, whereas a positive correlation was found between organic carbon and EC. (Table 2). The increase in organic carbon amount produced decrease in pH values. The decrease can be explained with the slow decomposition of organic compounds in lower pH values (Kantarcı 2007; Leifeld *et al*. 2008).

CONCLUSIONS

1. The physiographical and soil characteristics of silver linden (*Tilia tomentosa* Moench) populations that naturally expanded into the district of Bursa in Turkey were revealed. It was determined that silver linden populations expanded between the altitudes of 0 m and 400 m, 88% of them were in the aspects with shadow, and the average slope was 32%. It was also seen that the linden populations showed more expansion in Esenköy and Yeniköy regions. Additionally, the humidity from the sea was had an effect in the formation of the pure sands. North-oriented winds blowing from the Marmara Sea provided a humid and cool climate in the northern aspects.
2. Approximately 91% of the soil was in the class of "deep to very deep" and 61% showed an expansion in sandy clay loam soils, while the other 30% showed an expansion in sandy loam soils. Approximately 91% of the soil was in the class of "deep to very deep". No indications were found that there was a problem resulting from the drainage maintenance. It was seen that 86% of the populations were in the class of "rocky to slightly rocky. It was also found that the soil pH of the natural silver linden populations changed from 5.6 to 6.6 and that the soils were in the class of medium acidic and mild acidic soils. In terms of saltiness, it was determined that the soils were in the class of the salt-free type. Average calcium content was 2.6% and belonged to the class of slightly limy nature.
3. The average organic carbon amount was 2.01% in the soil samples, and it was determined that the organic carbon amount decreased as the depth increased. In terms of the organic carbon amount, the soils studied were classified as medium.

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