Ecological Properties of *Pinus nigra* ssp. *pallasiana* var. *şeneriana*

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Abstract

In this study, the ecological properties of *Pinus nigra* ARN. ssp. *pallasiana* (LAM.) HOLMBOE var. *şeneriana* (SAATÇIOĞLU) YALTIRIK, one of the endemic plants in Turkey, has been studied. To determine the biological characters, needle, cone and seed morphology of the plant were used as main characters. Bioclimate, soil, dead layer characters and floristic composition of the distribution area were used to determine the ecological characters.

P. nigra ssp. *pallasiana* var. *şeneriana,* shows a distribution in Bolu, Manisa and Kütahya at an altitude of 800 m to 1250 m. It is a tree that has many stems branching from the base, with rounded or spherical, wide top and also close branches. Average needle length is 82.2 mm with 1.3 mm width. Average cone length is 51.2 mm with 26.8 mm width. The annual precipitation is 487.1 mm to 702.7 mm and annual temperature is 10.2°C to 16.9°C in the area. In the whole distribution area, rendsina soil type is dominant, besides this, Braunerde, Calc braunerde, Meridional braunerde and Terra Rossa of soils exist as well. Almost 65% of the determined plants showed wide distribution, 11.2% of them are Euro-Siberia, 12.9% is Mediterranean, 11.2% are Irano-Turanian element and the endemical ratio is 9.5%. In seed germination experiments, it was found that there is no inhibition on germination. Germination ratio decreased in the dark period. Low concentration (0.5%) of NaCl, HCl and KNO_3 did not have any effect on seed germination percent, however at high concentration of these solutions, seed germination is inhibited, and at all concentration of H_2SO_4, germination is inhibited.

Key words: Pinus, Pinus nigra, ecology, endemic, seed, germination.

1. Introduction

Pinus nigra ARN. has a very wide distribution in two small areas of Algeria and Morocco in the Northwest of Africa; in Europe, beginning from South and East Spain it is seen in south France Corsica and North east of Italy, in Austria, Yugoslavia, the Balkans, Crimea, Cyprus and Turkey are other distribution areas. It therefore is divided to five sub-species (MIROV, 1967; RICHARDSON, 1998). *P. nigra* ARN. ssp. *pallasiana* (LAMB.) HOLMBOE which is one of these five sub-species known, shows a natural distribution in the Balkans, Crimea, South Carpathian mountains, Syria, Cyprus and Turkey (*Fig. 1*) (RICHARDSON, 1998).

Total forest area, in Turkey, is 20.2 million hectares. *P. nigra* ssp. *pallasiana* is native to the 2.2 million hectares of this area. Due to this widespread distribution, it has been divided into four varieties in Turkey; var. *pallasiana*, var. *pyramidata,* var. *şeneriana*, var. *yaltırıkiana* (YALTIRIK, 1988) and has many geographical variations (RÖHRIG, 1966; YÜCEL et al., 1999). Additionally, there is one more questionable variety (var. *columnaris-pendula*) which was introduced by BOYDAK (1989), however, the morphological characters have yet to be determined completely. *P. nigra* ARN. subsp. *pallasiana* (LAMB.) HOLMBOE var. *şeneriana* (SAATÇIOĞLU) YALTIRIK is endemic for Turkey and determined by the name of "*P. nigra* ARN. var. *şeneriana* SAATÇIOĞLU", being found for the first time in Bolu (Çaydurt) by SAATÇIOĞLU (1955). Later it is attached to the sub-species of "subsp. *pallasiana*" by YALTIRIK (1988).

P. nigra subsp. *pallasiana* var. *şeneriana* (Ebe Black Pine) is naturally found in Turkey often individually but sometimes in small communities around Bolu (Çaydurt) Manisa (Alaşehir) and Kütahya (Tavşanlı, Domaniç, Aslanapa, Aydıncık). In general, the tree has the appearance of a wide topped compact tree having many stems branching from the base with a round and spherical shape. Crown shape studies made had about its some biological properties and natural distribution (ALPTEKİN, 1986; YÜCEL and ÖZTÜRK, 1998), pollen morphology (YAMAN and SARIBAŞ 1999), properties of seed germination (YÜCEL, 1997) and there is no study about its ecological properties.

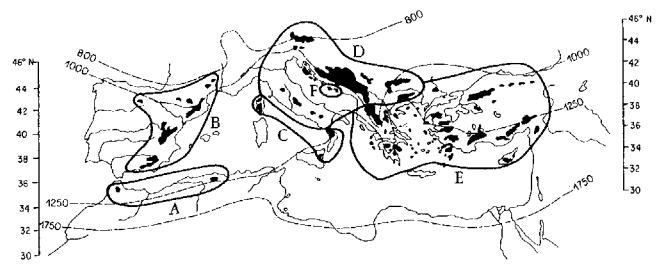
In this study, the aim is to determine ecological features of var. *şeneriana.*

2. Materials and Methods

This study considers only var. *şeneriana* as a material and the distribution area of it is accepted as the area. Firstly, the natural distribution areas was determined and then the study concentrated on 25 sample areas representing natural range (*Table 1*).

Data collected in Bolu, Alaşehir, Kütahya, Tavşanlı and Domaniç meteorology stations (Anon., 1990) represented the ecological features of the research area. Climatic and bioclimatic properties were scrutinised relying on the methods of WALTER (ÖZTÜRK et al., 1997).

Soil profiles were studied at each site and soil samples from each horizon were collected. The analysis of soil samples were done according to the followings methods; BOUYOUCOS, (1962) Hydrometer method for texture, Munsell Soil Colour Charts for colour, glass and calomel/combined electrode method for soil reaction, SCHEIBLER type calsimeter for total calcium carbonate, digestion method for amount of organic substance (WAKLEY-BLACK, 1934), semi-micro kjeldal method for nitrogen,



Pinus nigra
A: subsp. *mauretanica*
B: subsp. *salzmannii*
C: subsp. *laricio*
D: subsp. *nigra*
E: subsp. *pallasiana*
F: subsp. *dalmatica*

Figure 1. – The distribution of five subspecies of *Pinus nigra* (RICHARDSON, 1998).

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Table 1. – Sample areas.

Sample area no.	Locality name	Slope %	Aspect	Altitude (m)	Latitude Longitude
1	Bolu, Çakmaklar Village, Susuz	40	West	1000	40° 46' 03" N 31° 34' 12" E
2	Bolu, Güney Village	35	South	1070	40° 45' 19" N 31° 50' 70" E
3	Bolu, Güney Village	20	North	1070	40° 45' 44" N 31° 50' 66" E
4	Bolu, Güney Village	15	Northeast	1090	40° 45' 66" N 31° 51' 04" E
5	Bolu, Yakabayak Village, Guz	10	North	900	40° 42' 70" N 31° 43' 52" E
6	Kütahya, Aydıncık, Otharmanı	10	East	1150	39° 19' 42" N 29° 32' 47" E
7	Kütahya, Çavdarhisar, Çamköy Tavagediği	45	East	1110	39° 07' 99" N 29° 43' 38" E
8	Kütahya, Domaniç, Aksu Village	45	North	830	39° 65' 61" N 29° 73' 42" E
9	Kütahya, Domaniç, Aksu Village	45	North	860	39° 68' 24" N 29° 72' 43" E
10	Kütahya, Domaniç, Aksu Village	15	West	1000	39° 75' 20" N 29° 68' 36" E
11	Kütahya, Gürağaç Village	20	South	970	39° 80' 03" N 29° 53' 34" E
12	Kütahya, Ilıca Village	30	South	950	39° 35' 46" N 30° 02' 98" E
13	Kütahya, Tavşanlı, Aliköy Village	20	North	1110	39° 30' 94" E 29° 39' 46" N
14	Kütahya, Tavşanlı Dulkadir Village	10	North	1030	39° 28' 39" N 29° 42' 57" E
15	Kütahya, Tavşanlı, Şahmelek, Gölyeri	5	West	1050	39° 30' 49" N 29° 36' 97" E
16	Kütahya, Tavşanlı, Şahmelek, Kargaçamı	10	East	1060	39° 39' 42" N 29° 38' 09" E
17	Kütahya, Yenice Village, Burçaklı Tarla	10	South	1250	39° 19' 43" N 30° 03' 26" E
18	Kütahya, Yenice Village, Çöğürler	25	East	1100	39° 19' 56" N 30° 03' 22" E
19	Kütahya, Tavşanlı Vakıf Village	25	East	1110	39° 27' 05" N 29° 40' 60" E
20	Kütahya, Tavşanlı Karakişi Village	15	West	1240	39° 27' 05" N 29° 40' 60" E
21	Kütahya, Tavşanlı Vakıf Village	35	North	1125	39° 27' 16" N 29° 40' 45" E
22	Manisa, Alaşehir, Bahadır Village	20	North	815	38° 17' 18" N 28° 31' 61" E
23	Manisa, Alaşehir, Bahadır Village	20	North	1000	38° 17' 18" N 28° 31' 59" E
24	Manisa, Alaşehir, Bahadır Village	20	North	1000	38° 16' 28" N 28° 31' 31" E
25	Manisa, Alaşehir, Evrenli, Kuru Kiraz	15	East	1030	38° 16' 63" N 28° 29' 71" E

ammonium-acetate method for potassium, OLSEN method for phosphorus (P_2O_5). Measurement, were repeated three times for each (OLSEN and SOMMERS, 1982; KLUTE, 1986). In determining soil types the study of KUBIENA (1953), was considered substantially.

In excavated soil profiles, different samples were taken from each of the humus horizon for analysis. One-year-old needle samples were collected from five to ten trees, nearest to the excavated soil profiles. Needles have collected 3 m to 4 m above the ground, on the south face, taking sun light directly, and at the tip of branches. In analysing the needle samples and organic horizons, semi-micro kjeldal was applied for nitrogen, ammonium-acetate for Ca^{2+}, Mg^{2+}, K^+ and Na^+, OLSEN for phosphorus. Procedures were repeated three times for each (BEUTON and WALSH, 1973). The sheath, length, width, weight and moisture percentage were measured of the needles.

To determine the properties of the plant communities in the distribution area, herbarium samples were collected from the flora in the sample areas. Having been described according to DAVIS (1965 to 1988), the collected plants were reserved in

Herbarium of Biology Department at Anadolu University, Faculty of Science (ANES).

Between December 10 to 20, cones were collected from 5 different localities (Bolu / Güney, Manisa / Alaşehir, Kütahya / Domaniç, Kütahya / Aydıncık, Kütahya / Yenice), from (at least 25 different trees) individual trees. To determine cone and seed properties. Width and length of randomly selected 100 cones were measured. The weights of randomly selected 1000 cones were weighed by a digital balance. The assessment of results were made by means of ANOVA using SCHEFFE F-test with 95% reliability. Additionally, regression analysis were carried out to determine the width, length and weight relations of cones. By leaving the cones in an ordinary room conditions, individual seeds were released. Then, the 1000 grain weight was established through separating dark and light coloured. Cones were collected in December and the germination experiments were carried out March. Germination experiments were carried out in plant growth cabinets (MLR-350 Model Sony, Japan). Using temperature (+25 °C, ±1 °C) with white light source (8-hour-light, 16-hour-dark daily photo period). In each experiment series and for each concentration, 100 dark coloured seeds were utilised. Each of the germination experiments were repeated for times (4x100) (WILLAN, 1985). Experiments were carried out in germination bed was formed on filter paper in petri-dishes (9 cm in diameter). During germination period, treatments applied to, each experiment series, in the same way and at the same time. Although the experiments lasted for 50 days, the germination was completely ceased on the 36th day in all series and this was accepted as the final day of experimentation. In the germination experiments 6 main experiment treatments (NaCl, H_2SO_4, KNO_3, HCl dark milieu and Control group) for each origin were arranged. In these experiment series, the seeds were incubated in NaCl, H_2SO_4, KNO_3 and HCl in 0.5%, 1%, 2%, 3% concentrations respectively. However, distilled water was only used in control group. In order to consider that the seed to be germinated, it was necessary that the radicula to touch the germination bed. The ANOVA FISHER PLSD test was applied in evaluating the results related to germination experiments.

3. Results

3.1. Natural distribution

The var. *şeneriana* shows distribution in Bolu, Manisa, Eskişehir and Kütahya in Turkey, and, in general, consist of individual trees and also rarely in small communities (*Fig. 2*). They are seen in Çaydurt county of Bolu (between Akdoğan and Avşar hills) North of Güneygidriş village, Kırka, Kayı, Avşar, Muratlar, Ericek, Rüzgârlar, Börünük and around Dörtdivan county at 900 m to 1100 m altitudes. It shows distribution in Manisa around county of Alaşehir and its district of Alakıraç at the altitudes of 800 m to 1250 m. They are in Aydıncık, Örencik, Emet, Aslanapa, Tunçbilek, Yeniköy and Domaniç in Kütahya at the altitudes of 800 m to 1250 m. In such a widespread distribution area, it is found densely around Bahadır village of Alaşehir (Manisa), Güney village of Çaydurt (Bolu), Yeniceköy (Çöğürler region) in Kütahya and Domaniç/Aksu village (Akyar region).

3.2. Morphological traits of Ebe black pine

The var. *şeneriana* is one of the endemic plants of Turkey and a forest tree that has many stems, branching from the base, round or long spherical, wide topped, densely branched and has the height up to 17 m. Generally it does not have a main stem, but has many sub-stems originating at the soil surface or 30 cm to 50 cm above it. Stems grow at with a 10 at 20 degrees angle.

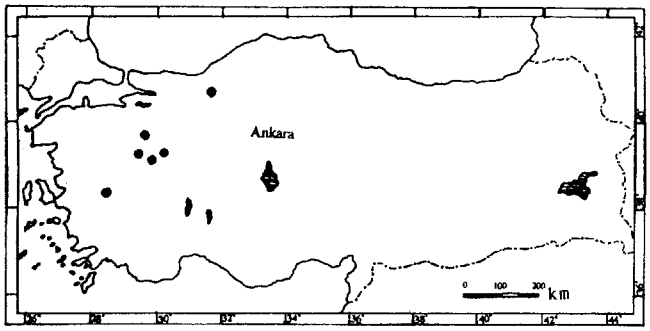

Figure 2. – The distribution of five subspecies of *Pinus nigra* ssp. *pallasiana* var. *şeneriana*.

Rarely are there some round topped forms arising up as one stem up to 1.0 meters to 1.5 meters but after this point they have no main stem. The var. *şeneriana* are generally 6 meters to 10 meters tall but some of them may grow up to 17 m. The tallest ones are found around Bolu/Güney and Manisa/Alaşehir; the best formed and the most decorative ones are found around Kütahya. They branch compactly with short sprouts at a 10 to 30 degree angle. The ones surrounding Alaşehir have generally wider branching angles and thick sub-branches. In forest areas where there is a competition with other species for light absorption, some of its numerous stems die out by natural pruning and the close branched compact form is partially deformed. However, among deformed *P. nigra* ssp. *pallasiana* and *Quercus* sp. groups or in open areas, the canopy of the tree well spread up to 12 meters in diameter, but the height remains 4 to 6 meters.

3.3. Needle properties

Needles are gathered at the apex of shoots like dense rosette, in a brush and are green in colour. The shortest sheath length (4.6 mm ± 0.63 mm), was detected in the 4th sample area, the longest one (7.9 mm ± 0.9 mm) in the 10th sample area. For this reason, the sheath mean length was 5.8 mm ± 1.0 mm. The shortest needle (47.9 mm ± 8.81 mm) was found in the 24th sample area and the longest (110.8 mm ± 11.51 mm) in the 10th sample area, thus, the needle mean length was 82.17 mm ± 9.67 mm. The narrowest needle (1.06 mm ± 0.09 mm) was measured in the 5th sample area and the widest needle (1.56 mm ± 0.07 mm) was seen in the 10th sample area, the needle mean width was 1.2 mm ± 0.09 mm. The lightest 100 needle weight (2.6 gr, 46.2% moisture) was measured in the 24th sample area, the heaviest (12.2 gr, 52.3% moisture) in the 10th area and the needle mean height was 6.13 gr (47.6% moisture).

3.4. Cone and seed morphology

It was observed that there are differences in cone width and length among the cones collected from 5 different areas (*Table 2*). The following characteristics were observed in the

Table 2. – Seed-collection localities (in Turkey).

Origin No.	Locality name	Slope %	Aspect (%)	Altitude (m)	Latitude Longitude
1	Bolu, Güney Village	20	North	1070	40° 45' 44" N 31° 50' 66" E
2	Kütahya, Aydıncık, Otharmanı	10	East	1150	39° 19' 42" N 29° 32' 47" E
3	Kütahya, Domaniç, Aksu Village	45	North	860	39° 35' 56" N 30° 03' 23" E
4	Kütahya, Yenice Village, Çöğürler	25	East	1100	39° 19' 56" N 30° 03' 22" E
5	Manisa, Alaşehir, Bahadır Village	20	North	1000	38° 17' 18" N 28° 31' 59" E

Table 3. – Differences among origins *Pinus nigra* ssp. *pallasiana* var. *şeneriana* of cone length, width, weight and seed weight.

Origin No.	Cone Width (mm)		Cone Length (mm)		Cone Weight (gr)		Seed Weight (gr)	
1	34.10±4.49	d	63.29±8.35	d	22714.31±7.29	c	23.24±1.55	d
2	23.85±1.44	a*	44.60±3.54	a*	6833.32±2.91	a*	14.66±0.36	a
3	25.38±1.29	bc	47.73±3.72	b	7634.26±3.07	a	17.86±0.74	b
4	24.67±2.15	ab	46.15±5.36	ab	6900.84±4.22	a	13.78±0.36	a*
5	26.16±1.98	c	54.44±4.87	c	14924.24±4.03	b	19.89±0.79	c

*) Within each column, means with the same letter are not significantly (P = 0.05); Annova SCHEFFE F-test.

data; the narrowest cone width was measured in Kütahya/Aydıncık (23.86 mm ± 1.44 mm) and the widest ones were in Bolu/Güney (34.10 mm ± 4.5 mm) originated cones, mean cone width was 26.84 mm ± 4.15 mm; the shortest cone length was in Kütahya/Aydıncık (44.608 mm ± 3.548 mm), the longest was in Bolu/Güney (63.296 ± 8.356mm), the cone mean length was 51.246 mm ± 7.71 mm; the lightest cone weight was in Kütahya/Aydıncık (6.833 gr ± 2.913 gr), and the heaviest was in Bolu/Güney (22.714 gr ± 7.29 gr) originated cones (*Table 3*). From statistical point of view, the cone width, length and weight differences were found to be significant between origins.

When the data obtained from all origins are evaluated, it was found that the relation between cone width and length is significance (r^2 = 0.78) and the cone width makes clear the cone length as can be seen in y = 1.7252 x + 4.9475 related to the regression equation of F = 1780.4321 and p = 0.0001. A positive correlation was found between cone length and weight (r^2 = 0.989). Considering the figures of y = 900.253 x – 34333.457 regression equation F = 264.778 and p = 0.0005 it can be said that the cone length is corelated to cone weight. Additionally, there is a positive significance in terms of cone length and weight (y = 0.477 x – 6.548, r^2 = 0.901, F = 27.27, p = 0.0137).

It was determined that seeds clearly consisted of light and dark coloured seeds and these show differences regarding germination percentages, length and morphological properties. Light coloured seeds are 5.7 mm ± 0.5 mm in length, 2.2 mm ± 0.2 mm in width; dark coloured seeds are 5.6 mm ± 0.5 mm in length, 2.2 mm ± 0.2 mm in width. 23% of light coloured seeds are full, 77% of them are empty. Also 98% of dark coloured seeds are full but 2% of them are empty. It was found out that mean 1000 seed weight of light coloured seeds was 9.97 gr and mean 1000 seed weight of dark coloured seeds was 17.9 gr. 1000 dark coloured seed weight was found as the lowest in Kütahya/Yenice (13.8 gr ± 0.36 gr) originated seeds; the heaviest in Bolu/Güney originated (23.2 gr ± 1.55 gr). When the origins of which their seeds were collected in terms of weights (1000 dark coloured seeds), the difference between Kütahya/Aydıncık and Kütahya/Yenice originated seeds indicated in significance at the 0.05 level, but the difference between other origins was also significant (*Table 3*).

A positive relationship was found out (r^2 = 0.87) between the weight of 1000 dark coloured seeds and the weight of 1000 cones. As it was observed from the data F = 20.39, p = 0.02 and related to y = 0.0005 x + 11.769 regression equation, the 1000 seed weight justifies 1000 cone weight.

3.5. Properties of climate and bioclimate

Annual average temperature was measured as follows; the highest in Alaşehir (16.9°C), Tavşanlı (11.4°C), Domaniç (10.9°C), Kütahya (10.6°C) and Bolu (10.2°C) respectively. The highest annual mean temperature was measured as 42.0°C in Alaşehir, 39.4°C in Bolu, 36.8°C in Kütahya, 36.5°C in Domaniç and 36.5°C in Tavşanlı. The lowest annual mean temperature was measured as –31.5°C in Bolu, –26.3°C in Kütahya, –19.7°C in Tavşanlı, –16.5°C in Domaniç and –7.5°C in Alaşehir. The highest annual mean relative humidity was measured 73% in Bolu, the lowest 57% in Alaşehir and it was 68% in Kütahya, 67% in Tavşanlı and 65% in Domaniç. The maximum annual precipitation was measured in Domaniç (702.7 mm), Kütahya (579.7 mm), Bolu (533.7 mm), Alaşehir (513.8 mm) and Tavşanlı (487.1 mm). The average snow covered days is mostly seen in Bolu (39.0 days), Kütahya (30.3 days), Domaniç (25.0 days), Tavşanlı (14.9 days) and Alaşehir (2.2 days) respectively. There are arid periods in which areas are lack of water having differing periods, in Bolu from July to the end of September (*Fig. 3),* in Alaşehir from the mid May till mid October (*Fig. 4*), in Kütahya from the end of June to the end of September (*Fig. 5*), in Domaniç from the mid June until mid September (*Fig. 6*), in Tavşanlı from June until October (*Fig. 7*).

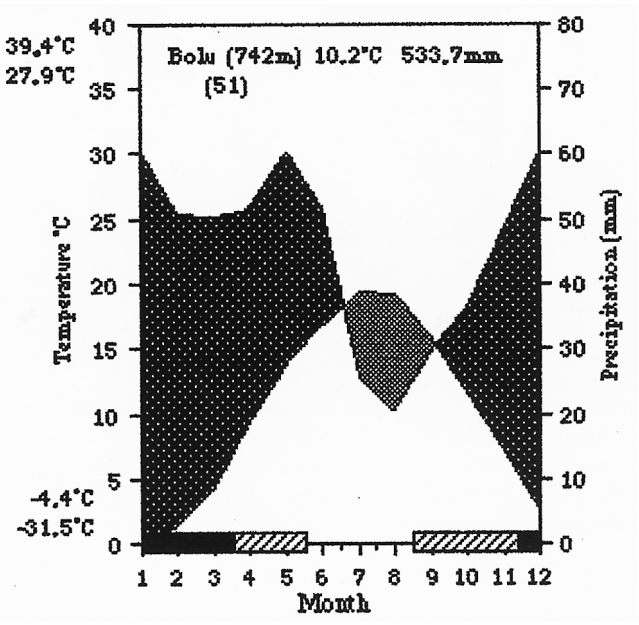

Figure 3. – Omrotermic diagram of Bolu region.

3.6. Properties of soil

Although the Rendsina soil type is the most widespread one in the research area, there are Calc Braunerde, Meridional Braunerde, Braunerde and Terra Rossa as well (*Table 4*).

Soil reaction between pH 6.0 and pH 7.8 indicated the following differences; total $CaCO_3$ amount between 0.00% to 89.47%,

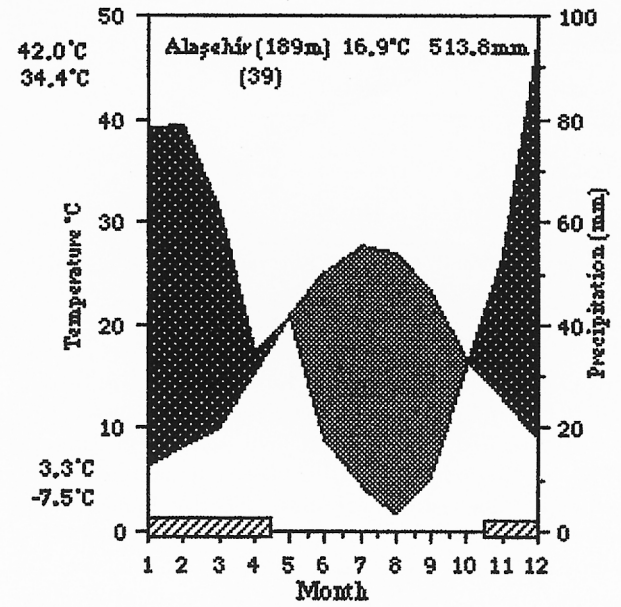

Figure 4. – Omrotermic diagram of Alaşehir region.

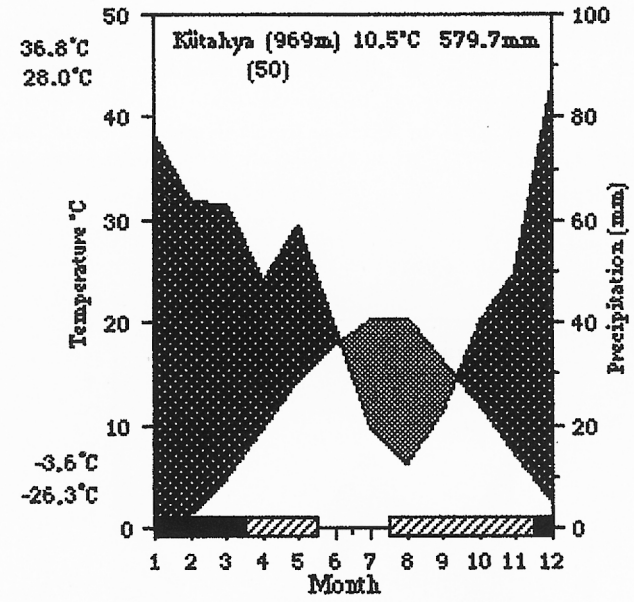

Figure 5. – Omrotermic diagram of Kütahya region.

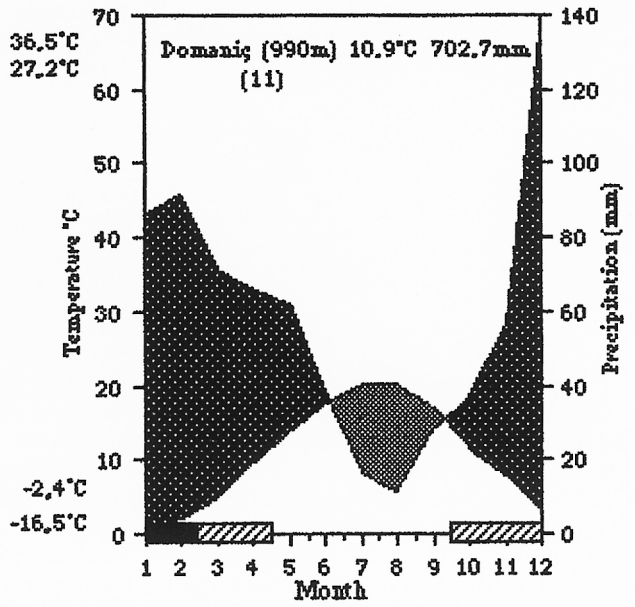

Figure 6. – Omrotermic diagram of Domaniç region.

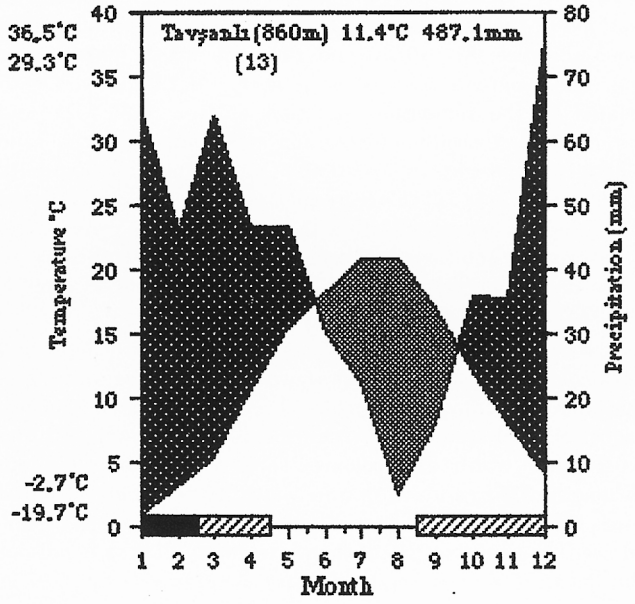

Figure 7. – Omrotermic diagram of Tavşanlı region.

amount of organic substance between 0.57% to 29.67%, nitrogen between 0.03% to 0.96%, calcium 0.07% to 1.96%, magnesium 0.02% to 4.75%, potassium 0.01% to 0.11%, sodium 0.002% to 0.020% and phosphorus (P_2O_5) 0.001% to 0.023% (*Table 4*).

3.7. Humus forms and its chemical features

It was found that there was Mull type humus in the whole sample areas. In the humus were found out between the values of pH 5.3 to pH 7.6, nitrogen 0.51% to 1.07%, calcium 0.05% to 1.93%, magnesium 0.01% to 0.45%, potassium 0.01% to 0.40%, sodium 0.01% to 0.03% and phosphorus 0.01% to 0.08% (*Table 5*).

3.8. Nutritive elements determined in needle

Values in needle samples were found between the following percentage; nitrogen 0.84% to 1.42%, calcium 0.14% to 0.67%, magnesium 0.10% to 0.23%, potassium 0.42% to 1.52%, sodium 0.01% to 0.02% and phosphorus 0.05% to 0.16% (*Table 6*).

3.9. Correlation between amounts of nitrogen, calcium, magnesium, potassium, sodium and phosphorus in soil, humus and needle

Using the data collected and results of chemical analysis, elements of nitrogen, calcium, magnesium, potassium, sodium and phosphorus amounts were tested at 0.05 reliability level by regression analysis to determine whether there is a correlation between the amounts of elements in soil, needle and humus samples. A slightly positive relation was discovered between the amount of nitrogen in the needle and the amount of organic substance ($r^2 = 0.28$). As it is seen in $F = 8.891$ and $p = 0.0067$ related to $y = 0.318x + 0.355$ regression equation, the amount of nitrogen in needle was correlated with the amount of nitrogen in the humus. A negative relation was found out be-

Table 4. – Physical and chemical properties of sample area soils.

no.	Horizon name	Soil types depth (cm)		Soil colour	Sand %	Loam %	Clay	pH %	$CaCO_3$ total	Organic matter	N %	Ca^{++} %	Mg^{++} %	K^{+} %	Na^{+} %	P_2O_5 %
1	A1	0-3	Calc	2.5Y-4/2	28.1	35.9	36.0	7.6	21.63	11.47	0.57	0.86	0.28	0.04	0.004	0.003
	A2	3-13	Braunerde	2.5Y-4.3	27.1	35.4	37.6	7.6	31.38	6.67	0.33	0.61	0.19	0.03	0.003	0.005
	(B)	13-28		2.5Y-5/3	25.8	37.0	37.2	7.8	42.45	4.51	0.22	0.67	0.10	0.01	0.003	0.001
	Cv	28-		2.5Y-7/3	37.2	34.4	28.4	7.8	55.02	1.52	0.08	0.57	0.07	0.01	0.003	0.001
2	A1	0-2	Calc	10YR-3/1	48.4	35.3	16.3	7.3	12.03	17.54	0.71	1.16	0.60	0.11	0.006	0.023
	A2	2-5	Braunerde	10YR-4/3	40.5	29.3	30.2	7.3	22.19	7.61	0.38	0.74	0.37	0.06	0.005	0.004
	A2/(B)	5-18		10YR-6/3	29.1	32.9	38.0	7.5	30.70	3.45	0.17	0.59	0.14	0.03	0.003	0.001
	(B)	18-36		10YR-5/4	42.1	30.5	27.4	7.8	49.07	1.44	0.07	0.47	0.06	0.01	0.003	0.001
	Cn	36-														
3	A1	0-4	Meridional	10YR-3/3	39.8	31.0	29.2	7.6	3.15	13.82	0.69	0.98	0.59	0.06	0.006	0.010
	A2	4-29	Braunerde	10YR-4/3	37.3	27.7	35.0	7.5	3.87	6.83	0.34	0.80	0.53	0.04	0.005	0.003
	(B)	29-45		10YR-6/3	49.2	29.1	21.7	7.6	31.77	3.13	0.16	0.79	0.20	0.01	0.005	0.001
	Cv	45-		10YR-7/4	47.3	29.0	23.7	7.6	31.84	1.22	0.06	0.79	0.09	0.01	0.004	0.001
4	A1	0-2	Calc	10YR-3/3	45.2	34.5	20.3	7.4	20.46	16.30	0.70	0.81	0.12	0.03	0.003	0.010
	A2	2-26	Braunerde	10YR-4/3	42.7	29.2	28.1	7.7	31.84	8.00	0.40	0.76	0.10	0.01	0.002	0.003
	(B)	26-56		10YR-6/3	54.5	26.2	19.3	7.5	48.33	4.27	0.21	0.61	0.04	0.01	0.002	0.004
	Cv	56-		10YR-6/4	52.6	33.0	14.4	7.8	50.73	0.83	0.04	0.50	0.02	0.01	0.002	0.001
5	A1	0-4	Calc	10YR-2/2	54.9	28.6	16.5	7.2	5.06	29.67	0.86	1.96	0.89	0.10	0.007	0.017
	A	4-17	Braunerde	10YR-3/2	36.4	29.9	33.7	7.3	15.30	12.42	0.62	0.98	0.29	0.07	0.004	0.011
	(B)	17-37		10YR-4/2	34.1	30.0	35.9	7.5	39.03	7.72	0.38	0.81	0.19	0.05	0.003	0.002
	Cv	37-		10YR-7/3	35.0	31.7	33.3	7.7	64.44	2.43	0.12	0.58	0.10	0.01	0.003	0.001
6	A	0-20	Rendsina	10YR-6/2	35.1	26.9	38.0	7.6	56.34	4.58	0.23	0.53	0.57	0.04	0.007	0.003
	Cn	20-														
7	A	0-13	Braunerde	7.5YR-4/2	42.9	35.5	21.6	6.9	0.01	13.88	0.69	0.57	0.34	0.04	0.005	0.008
	(B)	13-28		7.5YR-5/3	25.7	24.9	49.4	7.5	15.39	2.85	0.14	0.40	0.08	0.01	0.005	0.001
	Cv	28-		7.5YR-6/3	29.9	51.3	18.7	7.5	19.03	1.73	0.09	0.37	0.05	0.01	0.005	0.002
8	A1	0-5	Meridional	10YR-4/3	34.1	23.9	42.0	7.7	1.62	3.20	0.16	0.67	2.29	0.10	0.004	0.002
	A2	5-17	Braunerde	10YR-4/4	42.8	19.6	37.6	7.8	0.01	1.87	0.09	0.71	2.28	0.05	0.005	0.003
	(B)/Cv	17		10YR-5/4	67.7	19.4	12.9	7.8	0.01	1.04	0.05	0.66	2.65	0.02	0.005	0.001
9	A1	0-2	Calc	10YR-5/3	22.8	29.9	47.3	7.6	36.21	7.92	0.39	0.63	2.12	0.08	0.006	0.002
	A2	2-18	Braunerde	10YR-6/2	23.6	23.1	53.2	7.8	43.34	3.69	0.18	0.59	1.60	0.07	0.006	0.001
	(B)	18-35		10YR-7/1	22.6	18.6	58.8	7.7	43.62	1.92	0.10	0.51	0.87	0.06	0.006	0.001
	Cv	35-69		10YR-8/1	17.5	16.7	65.8	7.8	43.26	0.60	0.03	0.53	1.29	0.04	0.009	0.001
10	A	0-30	Rendsina	10YR-3/2	42.1	29.9	27.9	7.6	20.08	12.85	0.48	0.94	1.80	0.05	0.007	0.010
	Cn	30-														
11	A	0-10	Rendsina	7.5YR-5/3	32.5	31.6	36.0	7.5	39.41	12.42	0.62	1.13	1.38	0.06	0.005	0.008
	A/Ca	10-33		7.5YR-5/2	28.5	25.1	46.5	7.5	37.08	5.19	0.25	0.80	1.13	0.02	0.005	0.002
12	A	0-17	Rendsina	10YR-2/2	33.2	15.7	51.1	7.5	24.86	9.714	0.69	0.71	2.01	0.07	0.015	0.005
	Ca	17-		10YR-4/3	52.4	18.9	28.7	7.6	66.84	1.52	0.65	0.55	1.20	0.04	0.003	0.003
13	A	0-16	Rendsina	10YR-2/2	26.3	26.5	47.2	7.5	17.54	11.09	0.55	0.78	4.75	0.05	0.010	0.006
	A/Ca	16-		10YR-4/1	30.3	11.5	58.2	7.7	23.92	4.00	0.20	0.75	2.59	0.02	0.007	0.001
14	A	0-4	Rendsina	10YR-2/2	27.5	29.7	42.9	7.4	8.85	14.64	0.73	1.14	0.96	0.07	0.006	0.007
	A/C	4-17		10YR-3/2	35.4	17.6	47.0	7.5	9.57	4.52	0.23	1.01	0.31	0.03	0.009	0.004
	Cn	17-														
15	A	0-8	Meridional	10YR-3/1	49.5	15.2	35.3	7.6	8.62	3.55	0.18	0.70	1.67	0.05	0.006	0.001
	A/(B)	8-28	Braunerde	10YR-4/2	54.0	13.1	32.9	7.8	13.31	1.57	0.08	0.74	1.51	0.02	0.006	0.001
	(B)	28-		10YR-5/2	24.8	51.0	24.2	7.8	0.01	0.57	0.03	0.65	1.01	0.01	0.006	0.001
16	A	0-19	Rendsina	2.5Y-5/2	23.4	21.7	54.9	7.4	20.30	5.38	0.29	0.75	2.60	0.01	0.006	0.004
	Cn	19-														
17	A	0-18	Rendsina	10YR-5/3	36.4	31.4	32.2	7.4	38.85	6.85	0.34	0.68	0.34	0.06	0.006	0.002
	Cn															
18	A	0-12	Rendsina	10YR-5/2	44.5	29.5	26.0	7.7	35.00	7.00	0.35	0.73	0.40	0.06	0.007	0.004
	Cn															
19	A	0-20	Calc	5Y-3/1	22.1	26.6	51.3	7.0	36.42	8.07	0.58	1.02	1.76	0.04	0.007	0.006
	(B)	20-37	Braunerde	5Y-8/1	30.4	27.3	42.3	7.3	69.10	4.08	0.39	0.75	1.80	0.03	0.008	0.002
	Ca	37-		2.5Y-8/1	45.4	25.1	29.5	7.6	67.69	2.82	0.64	0.63	1.89	0.03	0.012	0.002
20	A	0-12	Rendsina	10YR-3/2	15.6	57.9	26.5	7.5	4.43	12.45	0.88	0.80	2.08	0.04	0.007	0.004
	Ca/Cn	12-		2.5YR-8/2	54.9	20.5	24.6	7.7	89.47	2.77	0.42	0.34	1.70	0.01	0.006	0.001
21	A	0-28	Rendsina	2.5Y-4/1	42.5	22.1	35.4	7.4	37.30	9.38	0.87	0.87	1.76	0.04	0.020	0.005
	Ca	28-		2.5Y-8/1	44.8	36.8	18.4	7.5	84.20	2.88	0.19	0.40	1.55	0.01	0.010	0.002
22	A1	0-1	Braunerde	10YR-5/2	62.9	21.6	15.5	6.3	0.00	13.99	0.70	0.38	1.34	0.04	0.007	0.004
	A2	1-17		10YR-5/4	55.5	23.2	21.3	6.7	0.00	3.10	0.15	1.57	1.00	0.02	0.006	0.001
	A2/(B)1	17-54		7.5YR-4/4	50.5	15.2	34.3	7.0	0.00	1.69	0.08	0.12	2.86	0.02	0.006	0.001
	(B)1	54-103		7.5YR-4/3	40.2	20.0	39.8	7.0	0.00	2.64	0.13	0.13	3.31	0.02	0.009	0.001
	(B)2	103-107		7.5YR-4/4	46.2	19.5	34.3	7.0	0.00	0.92	0.05	0.08	3.14	0.02	0.007	0.001
	Cv	107-		7.5YR-4/6	45.6	23.9	30.5	7.3	0.00	0.88	0.04	0.10	4.01	0.02	0.007	0.001
23	A1	0-3	Terra Rossa	7.5YR-3/3	56.4	33.9	9.7	6.7	0.00	26.93	0.96	0.78	2.96	0.06	0.007	0.003
	A2	3-16		7.5YR-4/3	58.7	17.4	23.9	7.1	0.00	6.35	0.32	0.37	1.56	0.04	0.006	0.001
	(B)	16-49		7.5YR-4/4	60.5	17.6	21.9	7.3	0.00	2.13	0.11	0.07	2.90	0.02	0.006	0.001
	Cv	49-		7.5YR-5/6	67.0	16.1	16.9	7.5	0.00	0.67	0.03	0.09	2.48	0.01	0.003	0.001
24	A1	0-5	Braunerde	7.5YR-4/4	41.8	30.7	27.5	6.0	0.00	5.21	0.26	0.18	0.67	0.07	0.003	0.001
	A2	5-24		7.5YR-4/3	41.8	26.6	31.6	6.5	0.00	4.31	0.21	0.38	0.61	0.08	0.003	0.001
	A2/(B)	24-66		7.5YR-4/4	37.5	26.6	35.9	6.8	0.00	2.15	0.11	0.34	0.58	0.02	0.003	0.001
	(B)	66+113		7.5YR-3/6	41.2	18.3	40.5	6.5	0.00	1.47	0.07	0.39	0.73	0.02	0.004	0.002
	(B)/Cv	113-		7.5YR-4/6	18.1	12.6	69.3	6.4	0.00	1.30	0.06	0.62	1.39	0.02	0.004	0.004
25	A1	0-3	Terra Rossa	7.5YR-3/3	71.2	20.2	8.6	6.5	0.00	17.44	0.86	0.69	0.49	0.05	0.003	0.022
	A2	3-13		7.5YR-5/3	72.2	17.5	10.3	6.9	1.47	2.36	0.12	0.20	0.22	0.03	0.002	0.009
	(B)	13-28		7.5YR-5/4	58.2	30.5	11.3	7.0	0.73	0.76	0.04	0.12	0.19	0.03	0.002	0.010
	(B)/Cv	28-		7.5YR-4/6	66.1	17.5	16.4	7.0	0.73	1.37	0.07	0.17	0.23	0.03	0.003	0.009

tween the amount of magnesium in the needle and the amount of nitrogen in humus (r^2 = 0.28). According to the values of F = 4.5704 and p = 0.0219 related to y = – 0.1096x + 1.014 regression equation, the amount of magnesium in the needle correlated with the amount of magnesium in the humus. A positive correlation was indicated between the amount of sodium in the needle and in the humus (r^2 = 0.2103). Values of F = 0.2103 and p = 0.0219 correlated to y = 0.4357 x + 0.0053 regression

Table 5. – Amounts of N, Ca, Mg, K, Na, P and pH in humus horizons.

Sample area no.	Humus horizon name	high (cm)	N %	Ca %	Mg %	K %	Na %	P %	pH (1/2 H_2O)
1	O1	3	0.75	1.77	0.15	0.08	0,02	0,04	–
	O2	2	0.69	1.44	0.07	0.01	0,01	0.01	6.0
	O3	2	0.61	1.55	0.07	0.01	0,01	0.01	6.8
2	O1	3	0.61	0.78	0.06	0.08	0,01	0.03	–
	O2	3	0.79	0.79	0.04	0.06	0,01	0.04	5.5
	O3	3	0.88	1.32	0.07	0.07	0,02	0.02	5.9
3	O1	4	0.62	1.31	0.17	0.07	0,02	0.02	–
	O2	4	0.61	1.21	0.08	0.04	0,01	0.01	6.9
	O3	3	0.72	1.42	0.06	0.02	0,01	0.01	7.5
4	O1	2	0.99	1.33	0.12	0,13	0,03	0.01	–
	O2	2	0.65	0.05	0.01	0.01	0,01	0.01	6.7
	O3	1.5	0.81	0.93	0.02	0.03	0,01	0,01	7.3
5	O1	4	0.76	1.93	0.28	0.06	0,02	0.01	–
	O2	3	0.76	0.60	0.05	0.01	0,01	0.03	6.4
	O3	3	0.99	0.97	0.06	0.06	0,01	0,01	6,6
6	O1	3	0.60	1.07	0.17	0.08	0,02	0.04	–
	O2	2	0.51	1.07	0.10	0.09	0,01	0.01	7.3
	O3	2	0.60	1.04	0.10	0.09	0,01	0.01	7.4
7	O1	2	1.07	1.00	0.15	0.11	0,02	0.04	–
	O2	1.5	0.76	0.75	0.08	0.05	0,01	0.02	5.3
	O3	2	0.78	0.77	0.07	0.05	0,01	0.01	6.5
8	O1	3.5	0.54	0,94	0.22	0.10	0,02	0.03	–
	O2	2	0.52	0.73	0.22	0.08	0,01	0.01	6.6
	O3	2	0.60	0.69	0.22	0.08	0,01	0.01	7.0
9	O1	2	0.63	1.09	0.24	0.15	0,02	0.04	–
	O2	2	0.60	1.11	0.24	0.09	0,01	0.02	6.9
	O3	1.5	0.64	0.94	0.29	0.08	0,01	0.01	7,2
10	O1	5	0.52	0.88	0.20	0.08	0,02	0.05	–
	O2	3	0.52	1.05	0.17	0.05	0,01	0.02	6.8
	O3	3	0.56	1.03	0.17	0,05	0,01	0.02	7.1
11	O1	2	0.53	1.17	0.16	0,13	0,02	0.03	–
	O2	3	0.51	1.19	0.13	0.08	0,01	0.01	7.0
	O3	2	0.63	1.18	0.13	0.08	0,01	0.01	7.2
12	O1	4	0.80	1.12	0.34	0,09	0,02	0,01	–
	O2	3	0.75	0,80	0.18	0,09	0,01	0.01	6.4
	O3	2	0.71	0.77	0.19	0.09	0,01	0.01	7.5
13	O1	2	0.76	1.31	0.15	0.08	0,02	0.03	–
	O2	3	0.71	1.17	0,42	0,09	0,01	0.03	6.8
	O3	3	0.80	1.04	0.43	0.09	0,01	0.02	7.5
14	O1	2	0.71	0.76	0.20	0.09	0,02	0.05	–
	O2	1	0.7	1.29	0,11	0.06	0,01	0.02	6.2
	O3	1	0.72	1.16	0.12	0.07	0,01	0.02	7.3
15	O1	3	0.64	0.20	0.14	0.08	0.03	0.04	–
	O2	2	0.61	0.97	0.41	0.09	0,01	0.02	6.8
	O3	2	0.69	0.98	0.42	0.09	0,01	0.02	7.2
16	O1	4	0.65	1.45	0.15	0.07	0,02	0.02	–
	O2	3	0.67	0.90	0.40	0.08	0,01	0.02	6.6
	O3	3	0.75	0.97	0.40	0.09	0,01	0.02	7.0
17	O1	4	0.61	1.17	0.19	0.08	0,02	0,03	–
	O2	2.5	0.62	1.18	0.16	0.07	0,01	0.01	7.1
	O3	2	0.75	1.40	0.17	0.06	0,01	0.01	6.6
18	O1	2	0.65	1.24	0.13	0.05	0,02	0.02	–
	O2	2	0.65	1.01	0.13	0.06	0.01	0,01	7.6
	O3	1	0.68	1.15	0.16	0.07	0,01	0.01	7.6
19	O1	4	0.85	1.10	0.16	0.40	0,03	0.08	–
	O2	3	0.98	0.79	0.18	0.04	0,02	0.01	6,9
	O3	3	1.05	0.85	0.20	0.05	0,02	0.01	7.0
20	O1	4	0.75	0.56	0.20	0.40	0,03	0.04	–
	O2	3	0.69	0.60	0.16	0.04	0,02	0.02	6.9
	O3	2	0.85	0.60	0,19	0.04	0,02	0,02	7.2
21	O1	3	0.74	1.15	0.10	0.20	0,03	0.04	–
	O2	3	0.69	0.97	0.18	0.05	0,03	0.01	6.8
	O3	2	0.99	0.99	0.20	0.06	0,02	0,01	7.0
22	O1	3	0.73	0.89	0.22	0.08	0,02	0.05	–
	O2	1.5	0.71	0.50	0.07	0.06	0,01	0.03	5.9
	O3	2	0.71	0.26	0.09	0.05	0,01	0.01	6.0
23	O1	3	0.60	1.10	0.28	0.08	0,02	0.06	–
	O2	2	0.77	0.45	0.21	0.06	0,01	0,03	6.0
	O3	3	0.99	0.61	0.28	0.05	0,01	0,01	6.1
24	O1	3	0.68	1.28	0.10	0.07	0,02	0,05	–
	O2	1.5	0.64	0.59	0.06	0.05	0,01	0.01	5.9
	O3	1.5	0.67	0.65	0.08	0.07	0,01	0,01	6,1
25	O1	3	0.80	0,95	0,13	0,11	0,02	0,04	–
	O2	3	0.76	0,78	0,09	0,06	0,01	0,02	5.9
	O3	3	0,88	0.72	0.09	0.05	0,01	0.02	6.2

equation predicted that the amount of sodium in the needle justifies the amount of sodium in the dead covering. A part from above values, the correlation found out in terms of the amount of nitrogen, calcium, magnesium, sodium and phosphorus in the needle, dead covering and soil were not found to be significant, thus, it was concluded that r^2, 'F' and 'p' data, related to regression equation, given completely in *table 7*, are not in quality of justifying these correlation alone.

Table 6. – Amounts of N, Ca, Mg, K, Na and P in *Pinus nigra* ssp. *pallasiana* var. *şeneriana* needles.

Sample area No.	N %	Ca %	Mg %	K %	Na %	P %
1	1.16	0,20	0.12	1.00	0,02	0.09
2	1.32	0,25	0.12	1.16	0.01	0.05
3	1.26	0.26	0.10	0.89	0.01	0.13
4	1.15	0.29	0.13	0.95	0.02	0.11
5	1.15	0.27	0.14	1.37	0.02	0.12
6	1.27	0.20	0.11	1.05	0.01	0.09
7	1.21	0.17	0.11	1.26	0.01	0.11
8	0.98	0.32	0.16	0.84	0.02	0,06
9	0.90	0.32	0.19	0.95	0,02	0,05
10	0.88	0,65	0.17	0,63	0,02	0,06
11	0.85	0.33	0.15	0.89	0,02	0.11
12	0.87	0.27	0,21	1.05	0,02	0.07
13	1.26	0.23	0,13	1.00	0.01	0,09
14	1.33	0.19	0.14	1.31	0,01	0,08
15	1.15	0.21	0.13	1.00	0.01	0.15
16	1.33	0.14	0.14	1.31	0,01	0.16
17	0.84	0.27	0.11	1.16	0.01	0.09
18	1.00	0.67	0.23	0,42	0.01	0.05
19	1.42	0.25	0.17	1.05	0.02	0.11
20	1.34	0,42	0.19	0.63	0.02	0,05
21	1.32	0.54	0,14	0,68	0,02	0,07
22	1.04	0,31	0,19	1.37	0,01	0,06
23	1.14	0.16	0,14	1.37	0,01	0.13
24	0.99	0.48	0.11	1.52	0,01	0,15
25	1.04	0,29	0.16	1.47	0,01	0.05

Table 7. – The correlation and statistics that indicate N, Ca, Mg, K, Na and P amounts included in needles, humus and soil.

	Regression Coefficient	Intercept	Determination Coefficient		
	A_1	A_0	r^2	F	p
Needle (N) – Humus (N)	0,318	0.355	0,27	8,891	0.0067*
Needle (N) – Soil (N)	0.1632	0,168	0,03	0.8343	0.3705
Needle (Ca) – Humus (Ca)	–0.1096	1.014	0.004	0,098	0.7571
Needle (Ca) – Soil (Ca)	0.1024	0.6425	0,004	0.1077	0.7457
Needle (Mg) – Humus (Mg)	0,5775	0.0826	0,05	1.4589	0,2394
Needle (Mg) – Soil (Mg)	–0.1096	1.014	0,29	4.5704	0.0219
Needle (K) – Humus (K)	–0.0295	0,1112	0,08	2.015	0.1692
Needle (K) – Soil (K)	0.0032x	0,037	0,002	0.0595	0.8095
Needle (Na) – Humus (Na)	0,4357	0,0053	0,21	6.124	0,0211
Needle (Na) – Soil (Na)	0,0921	0.0049	0,03	0.7709	0.389
Needle (P) – Humus (P)	–0,0296	0,0239	0,02	0,4793	0,4957
Needle (P) – Soil (P)	–0.0199	0.0057	0,06	1.4743	0.237

* Significant at 0.05 level.

3.10. Floristic composition

To determine the plant communities in Ebe black pine region samples were collected, identified and the results presented in *table 8*. It shows a distribution in 3 different phytogeographical regions of Bolu, Manisa and Kütahya. Depending on this, floristic composition was analysed under three sub-titles:

a) Floristic composition of Bolu

Pinus nigra ssp. *pallasiana* comprises the tree layer around Bolu distribution. However, in several places, *Abies nordmanniana* ssp. *bornmuelleriana* and *P. sylvestris* ssp. *hamata*, *Fagus orientalis* and *Acer campestre* ssp. *campestre* exist in the composition either individually or in small communities. As for shrub layer, the widespread taxons are *Juniperus oxycedrus* ssp. *oxycedrus*, *Cornus mas*, *Ligustrum vulgare*, *Corylus avellana* var. *avellana*, *Rosa canina*, *Quercus ithaburensis* ssp. *macrolepis*, *Q. pubescens*, *Q. robur* ssp. *robur*, *Q. virgiliana*, *Cotoneaster nummularia*, *Viburnum lantana*. In the herb layer, the members of Lamiaceae (Labiatae) (13.6%), Fabaceae (Leguminosae) (9.9%), Compositae (7.4%) are the most wide spread taxons of their families. Of the flora discovered in the sample area around Bolu consists 25.9% Euro-Siberian, 8.6% Mediterranean, 1.2% Irano-Turanian elements.

Table 8. – Phytosociological table.

Sample area no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
Altitute (m)	1000	1070	1070	1090	900	1150	1110	830	860	1000	970	950	1110	1030	1050	1060	1250	1100	1110	1240	1125	815	1000	1000	1030	
Aspect	W	S	N	NE	N	E	E	N	N	W	S	S	N	N	W	E	S	E	E	W	N	N	N	N	E	
Slope (%)	40	35	20	15	10	5	45	45	45	15	20	30	20	10	5	10	10	25	25	15	35	20	20	20	15	Pre-
Sample area width (m^2)	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	sence
Parent rock	CH	CH	CH	CH	SR	LM	CH	SN	CH	CH	CH	LM	LM	CH	LM	LM	CH	CH	LM	CH	CH	SN	SN	CH	CH	
TREES																										
Pinus nigra ssp. pallasiana	5.4	5.5	5.5	4.5	4.5	4.4	5.5	3.3	2.3	5.5	3.4	4.4	2.2	4.4	5.5	4.5	3.3	3.3	5.5	2.3	4.4	2.3	2.2	4.4	5.5	V
Pinus nigra ssp. pallasiana var. şeneriana	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	V
Quercus cerris var. austriaca							+1	1.1	1.1	+1	1.2	1.2		1.2	+1	+1	1.2	1.2			1.1					III
Quercus cerris var. cerris		+1						1.1	1.2	+1		2.2							+1	1.1		+1	+1	+1		II
Pinus nigra ssp. pallasiana var. pyramidata						+1								+1		+1			3.3	2.2	2.2					II
Quercus robur ssp. robur	+1	+1									1.2				+1	+1		1.1								II
Pinus brutia																						4.4	4.4	2.2		I
Acer campestre ssp.campestre				+1	+1																					I
Quercus ithaburensis ssp. macrolepis		+1	+1																							I
Carpinus betulus				+1																						I
Fagus orientalis					+1																					I
Abies nordmanniana ssp. bornmuelleriana					2.2																					I
Pinus sylvestris ssp. hamata	+1																									I
Sorbus torminalis var. orientalis				1.1																						I
SHRUBS																										
Juniperus oxycedrus ssp. oxycedrus	1.1	2.2	+1		1.1	+1					2.3	1.1	2.2	+1	+1	+1	2.2	1.2	+1	1.2	1.1	+1	+1	+1	+1	IV
Quercus pubescens	+1		+2	1.2				1.2	2.3		2.2	2.3		1.2			2.3	2.3	1.2		1.2					III
Ligustrum vulgare	+1	+1	1.1	+1	1.1				1.1	+1		1.1							+1		1.1					II
Rosa canina	+1		+1	+1			+1		1.1	1.1	+1					+1										II
Viburnum lantana				+1	+1					+1		+1							+1		+1					II
Cornus mas			+1	+1	+1					2.2		+1			1.2				+1							II
Quercus infectoria ssp. boissieri		1.2						1.2	1.2					+1							1.2	1.2				II
Cistus laurifolius							+1															2.2	2.2	1.2	2.3	I
Corylus avellana var. avellana			+1	+1						1.2					+1						+1					I
Quercus trojana											1.2				+1		2.2	1.2			1.1					I
Cotoneaster nummularia	+1		1.1								1.1								+1	1.1						I
Rubus sanctus		1.2										1.2							1.2	1.2	1.2					I
Juniperus foetidissima														+1			1.2	1.1		1.2						I
Pistacia terebinthus ssp. palaestina																			+1			2.2	2.2			I
Lonicera periclymenum												1.1							+1	+1						I
Cistus salviifolius																						1.2	1.2	2.2		I
Juniperus excelsa												1.1		+1					+1							I
Colutea cilicica										1.1	+1								+1							I
Quercus coccifera																						3.3	3.3		2.2	I
Rhus coriaria									1.2	1.1																I
Lonicera etrusca var. etrusca																	+1	+1								I
Quercus virgiliana	+1				+1																					I
Prunus divaricata												1.2							+1							I
Pyracantha coccinea			+1	+1																						I
Rosa iberica													2.2								1.1					I
Hedera helix																			+1							I
Buxus sempervirens	+1																									I
Lonicera caucasica ssp. orientalis				1.1																						I
Rhododendron ponticum ssp. ponticum			2.2																							I
Genista lydia var. lydia																				+2						I
Spartium junceum																								2.2		I
Quercus petraea ssp. iberica										+1																I
Laurus nobilis																			+1							I
Clematis viticella																				+1						I
Crataegus monogyna																					1.1					I
Crataegus pentagyna					+1																					I
Crataegus tanacetifolia				+1																						I
Pyrus elaeagnifolia ssp. elaeagnifolia										+1																I
Taxus baccata					+1																					I

Continued

CH=Chalk; LM=Limestone, SN= Sandstone, SR=Serpentine. West, W; North, N; East, E; South, S.

HERBS																									
Dorycnium pentaphyllum ssp. herbaceum	+1		1.1	1.2	1.1	+1	+1		+1	+1					+1				1						II
Onobrychis gracilis		+1	+1					+1		+1			+1	+1	+1	+1				+1	+1					II
Globularia trichosantha		1.2				1.1			1.2	+1	+1	1,2		+1			1.2	1.2	+1							II
Dactylis glomerata ssp. hispanica	1.1	1.2	1.2					+1	1.2						+1				+1			2.2		1.2	1.2	II
Anthemis tinctoria var. discoidea	1.1	+1			1.1	+1	+1						1.1	+1							+1				+1	II
Coronilla varia ssp. varia	+1	+1	+1			+1								+1			1.1	+1		+1					+1	II
Teucrium polium	+2							1.2	1,2	+1			1.2	+1			2.2	1.2			1.2					II
Centaurea virgata								+1		+1	+1			+1	+1	+1					+1			+1		II
Clinopodium vulgare ssp. vulgare		+1	+1	+1	+1									+1						+1					+1	II
Alyssum borzaeanum								+1	+1	+1	+1				+1	+1					+1					II
Alyssum sibiricum						+1	+1		+1	+1	1.2		2.2							1.2						II
Euphorbia macroclada						+1	+1	+1		+1	+1	+1		+1												II
Trifolium pratense var. pratense		1.2	1.2	1.1	+1														+1			1.2			2.3	II
Hypericum perforatum	1.2	+1	+1																		+1		+1	+1	1.2	II
Salvia candidissima ssp. occidentalis						+1									+1	+1	1.2	+1				+1	+1			II
Briza media	1.1	1.1	1.1				+1				+1			+1						+1						II
Polygala anatolica	+1	+1	+1	+1	+1	+1												+1								II
Galium subuliferum	+1					+1	+1						+1		+1		1.2	+1								II
Helianthemum canum						1.1								+1	+1	+1		1.2		1.1						II
Lotus corniculatus var. corniculatus					+1	+1									+1					1,2			1.2	1.2		II
Paronychia angorensis						+1							+1		+1	+1		+1			+1					II
Teucrium chamaedrys ssp. chamaedrys		1.2		1.2						1.2	+1	1,1							+1							II
Cichorium intybus			+1					+1	+1		+1									+1						I
Sideritis montana ssp. remota						+1	+1			+1							+1	+1								I
Linum hirsutum ssp. anatolicum var.anatolicum						1.1	+1						1,2		+1			1.2								I
Laser trilobum	+1		+1	+1	+1																					I
Campanula lyrata ssp. lyrata												+1							+1			+1	+1			I
Anthemis cretica ssp. tenuiloba												+1					+1	+1	+1							I
Inula ensifolia	+1					+1						+1							+1							I
Leontodon crispus ssp. asper var. asper		+1												+1			+1	+1	+1							I
Senecio vernalis			+1	+1	+1																				+1	I
Xeranthemum annuum								+1	+1	+1	+1															I
Convolvulus holosericeus ssp. holosericeus	1,2					1,2											1.2	1.2								I
Sedum acre													2.2		+2	+1		+2								I
Alyssum murale ssp. murale var. murale								+1						+1	+1				+1							I
Iberis taurica												+1					+1	+1	+1							I
Scabiosa argentea								+1	+1	+1	+1															I
Astragalus strictispinis								1.2					1.2	+1						1.2						I
Medicago sativa ssp. sativa							+1						2.2	+1					+2							I
Vicia cracca ssp. stenophylla															+2	+1					1.2				1.2	I
Globularia orientalis						1.2	+1						1.2					+2								I
Stachys cretica ssp. anatolica		+1	+1	+1	+1																					I
Thymus leucostomus var. leucostomus						1,2	+1																	1.2	1.2	I
Thymus longicaulis ssp. longicaulis	1,2												2.3		+2	+1										I
Muscari weissii												+1			+1	+1				+1						I
Viscum album												1,2								1.2	1.1	1.1				I
Aegilops umbellulata ssp. umbellulata						+1	+1										1.2	1.1								I
Consolida hellespontica						+1										+1			+1	+1						I
Falcaria falcarioides															+1	+1				+1						I
Cerinthe minor ssp. auriculata						+1				+1	+1															I
Dianthus leptopetalus								+1	+1		+1															I
Anthemis tinctoria var.tinctoria																						+1	+1	+1		I
Echinops ritro								+1	+1	+1																I
Picris strigosa								+1		+1	+1															I
Convolvulus lineatus	1,2	+2											1.2													I
Anthyllis vulneraria ssp. boissieri				+1		+1														+1						I
Astragalus microcephalus ssp. finitimus							+1					1,1							+1							I
Astragalus vulneraria											+1							+2			+1					I
Chamaecytisus supinus	+1	+1	+1																							I
Hedysarum varium													1,1					+			+1					I
Medicago rigidula var. rigidula															+2	+2				+1						I
Psoraleae bituminosa								+1		+1	+1															I
Trifolium arvense var. arvense																						1.1	+1		1.2	I
Origanum vulgare ssp. vulgare									+1	+1										+1						I

Continued

Salvia cadmica																		+1				+1			1,1	I
Salvia candidissima ssp. candidissima					+1												+1	+1								I
Salvia tomentosa	+1													+1					+1							I
Ziziphora capitata																	+1	+1	+1							I
Ziziphora taurica ssp. cleonioides				+1														+1						+1		I
Allium cupina ssp. hirtovaginatum																	+1	+1			+1					I
Orchis anatolica							+1						+1							+1						I
Phleum montanum ssp. montanum															+1	+1			+2							I
Helleborus orientalis			1,2	1,1	2,2																					I
Sanguisorba minor ssp.muricata				+1											+1						+1					I
Echinophora tenuifolia ssp. sibthorpiana									+1	+1																I
Onosma isauricum																	1,2	+1								I
Asyneuma virgatum ssp. virgatum									+1	+1																I
Dianthus micranthus						+1								+1												I
Dianthus zonatus																			+1		+1					I
Minuartia anatolica var. anatolica										+1								+1								I
Fumana aciphylla																	+2	+1								I
Helianthemum nummularium ssp.lycaonicum			+1		+1													+1								I
Cirsium hypoleucum				+1	+1																					I
Filago pyramidata																						+1	+1			I
Convolvulus compactus																	+2	+1								I
Astragalus angustifolius ssp. angustifolius												+1							+1							I
Astragalus lydius														+1							+1					I
Dorycnium pentaphyllum ssp. anatolicum						+1								+1												I
Trigonella spicata																						+1			+1	I
Hypericum aviculariifolium ssp. depilatum																		+1		+1						I
Marrubium parviflorum ssp. parviflorum						+1	+1																			I
Scutellaria orientalis ssp. pinnatifida								+1	+1																	I
Stachys byzantina								+1			+1															I
Ziziphora tenuior																	+1	+1								I
Allium flavum ssp. flavum var. flavum												+1							+1							I
Allium pseudoflavum																							+1	+1		I
Allium scorodoprasum ssp. rotundum		+1																		+1						I
Muscari tenuiflorum																	+1			+1						I
Ornithogalum comosum														+1						1,1						I
Linum nodiflorum		+1		+1																						I
Orobanche caryophyllaceae															+1	+1										I
Papaver rhoeas						+1	+1																			I
Chrysopogon gryllus ssp. gryllus						+1	+1																			I
Hordeum murinum ssp. glaucum													2,2						+1							I
Phleum exaratum ssp. exaratum														+2							1,2					I
Poa bulbosa																						1,2			1,2	I
Rumex acetosella																						1,2			1,2	I
Reseda lutea var. lutea						+1	+1																			I
Potentilla inclinata												+1							+1							I
Asperula involucrata														1,2				+1								I
Galium verum ssp. verum					+1																+1					I
Haplophyllum buxbaumii ssp. buxbaumii						+1	+1																			I
Verbascum cheiranthifolium var. cheiranthifolium									+1	+1																I
Daucus carota										+1																I
Anchusa leptophylla ssp. leptophylla						+1																				I
Anchusa pusilla				+1																						I
Onosma echioides																					+1					I
Onosma roussaei																			+1							I
Asyneuma limonifolium ssp. limonifolium						+1																				I
Campanula persicifolia				+1																						I
Campanula rapunculoides ssp. rapunculoides				+1																						I
Dianthus lydus																			+1							I
Minuartia hybrida ssp. hybrida													1.1													I
Minuartia juniperina																		+1								I
Myosoton aquaticum		+1																								I
Saponaria glutinosa																			+1							I
Silene otites																					+1					I
Stellaria media ssp. media															+1											I
Fumana procumbens																					+1					I

Continued

Helianthemum nummularium ssp. nummularium	+1																I
Achillea millefolium													2,2				I
Carlina vulgaris							1,2										I
Hieracium lasiochaetum										+1							I
Scariola viminea																+1	I
Taraxacum officinale						1,2											I
Tussilago farfara												+1					I
Sedum album													1,2				I
Sedum confertiflorum														+1			I
Sedum pallidum var. pallidum			+1														I
Alyssum minus														1,2			I
Cardaria draba ssp. draba												+1					I
Sinapis arvensis				+1													I
Euphorbia amygdaloides													+1				I
Chamaecytisus hirsutus														+1			I
Galega officinalis		+1															I
Ononis adenotricha var. adenotricha																+1	I
Trifolium alpestre														1,2			I
Trigonella aurantiaca											+1						I
Trigonella rostrata									+1								I
Centaurium erythraea ssp. turcicum	+1																I
Gentiana asclepiadea			+1														I
Geranium lucidum													1,1				I
Origanum sipyleum														1,2			I
Origanum vulgare ssp. hirtum	1,2																I
Phlomis armeniaca											+1						I
Salvia glutinosa			+1														I
Salvia sclarea													+1				I
Thymus longicaulis ssp. chaubardii var. alternatus								2,2									I
Allium paniculatum ssp. paniculatum													+1				I
Asphodelina damascena ssp. damascena											+1						I
Muscari armeniacum			+1														I
Muscari neglectum												+1					I
Ornithogalum narbonense														+1			I
Linum bienne														+1			I
Linum hirsutum ssp. pseudoanatolicum														+1			I
Arceuthobium oxycedri														+1			I
Cephalanthera damasonium												+1					I
Cephalanthera rubra														+1			I
Orobanche alba			+1														I
Aegilops biuncialis												+1					I
Aegilops comosa ssp. comosa													1,2				I
Aegilops cylindrica																1,2	I
Briza humilis														+1			I
Bromus danthoniae													1,1				I
Bromus sterilis														1,2			I
Festuca callieri													2,2				I
Poa alpina ssp. fallax														1,2			I
Polygala supina													+1				I
Polygonum aviculare												+1					I
Adonis flammea								+1									I
Agrimonia eupatoria		+1															I
Cerasus mahaleb var. mahaleb						+1											I
Fragaria vesca												+1					I
Potentilla recta									+1								I
Asperula rumelica													1,2				I
Asperula lilaciflora ssp. phrygia														+1			I
Gallium tricornutum			+1														I
Viola odorata												+1					I
Viola parvula													1,2				I

b) Floristic composition of Manisa

Although *P. nigra* ssp. *pallasiana* is the dominant tree species around Manisa (Alaşehir) distribution area, *P. brutia* scarcely exist in this composition. In the shrub layer there are *Cistus laurifolius, C. salviifolius, J. oxycedrus* ssp. *oxycedrus, Q. cerris* var. *cerris, Q. coccifera, Q. infectoria* ssp. *boissieri, Spartium junceum, Pistacia terebinthus* ssp. *palaestina*. As for the herb layer, taxons belonging to following families are seen; the most widespread one is Fabaceae (19.4%), Compositae (16.7%), Lamiaceae (13.9%) respectively. In the region, 19.4% of the flora Mediterranean and 5.6% it are Irano-Turanian elements.

c) Floristic composition of Kütahya

Although *P. nigra* ssp. *pallasiana* is the dominant species forming tree layer around Kütahya, *J. excelsa, J. foetidissima, Q. cerris* var. *cerris* and *P. nigra* ssp. *pallasiana* var. *pyramidata* are included in the composition. The shrub layer consists of the widespread families of Fagaceae, Cupressaceae, Rosaceae and Cistaceae. Among these, especially *Quercus* sp., *Juniperus sp.* and *Cistus laurifolius* comprise the main texture of the shrub layer. In some occasions, *Viburnum lantana, Cotoneaster nummularia, Rosa canina, Rubus sanctus* and others exist in the composition. As for herb layer, the most widespread families are; Fabaceae (18.9%), Lamiaceae (11.5%) and Compositae (7.3%). The most widespread taxon in the herb layer are; *Onobrychis gracilis, Teucrium polium, Centaurea virgata, Alyssum borzaeanum, A. sibiricum* and *Helianthemum canum*. The flora in Kütahya consists of elements of 7.8% Euro-Siberian, 13.0%, Mediterranean and 11.5% Irano-Turanian.

3.11. Seed germination features

a) Effects of different salt (NaCl) concentrations on germination

The 0.5% NaCl use resulted as 93% to 97%, 1% NaCl use resulted as 80% to 97% germination; 2% NaCl use in Manisa / Alaşehir and Kütahya / Domaniç originated seeds resulted no germination at all, but 1 to 3 of germination was observed in others. There was no germination in the use of 3% NaCl. Although the germination percentage of the series in which 0.5% NaCl was used was lower than the control group, the difference indicated insignificance at 0.05 level (*Table 9*). Therefore, it can be said that, NaCl inhibits the germination at a 1% and higher concentrations. When origins are correlated with the sensitivity to NaCl, there is significant difference among origins (*Table 10*).

b) Effects of different potassium nitrate (KNO_3) concentrations on the germination

In 0.5 KNO_3 experiment series germination was 91% to 100%, in 1% KNO_3 series the result was 71% to 100%, in 2% KNO_3 series germination was 5% to 80% and in 3% KNO_3 application resulted as 0% to 31% germination. The difference between the germination percentage of KNO_3 series and control group was found to be statistically significant (*Table 9*). It was found to be significant when all origins were compared in terms of the sensitivity to KNO_3; it was revealed that the difference of germination percentage between the origins are significant at 0.05 level (*Table 10*).

Table 9. – The total average effect of darkness and NaCl, KNO_3, H_2SO_4, HCl over germination of five origins.

	Concentration	Germination percentage, %	
NaCl	0.5%	96	i
	1%	87	f
	2%	1	a
KNO_3	0.5%	94	h
	1%	90	g
	2%	52	d
	3%	17	b
H_2SO_4	0.5%	67	e
HCl	0.5%	90	g
	1%	35	c
	2%	1	a*
Dark	–	84	f
Control	–	97	i

*) Within each column, means with the same letter are not significantly; 95% significant; Annova FISHER PLSD test.

c) Effects of different Sulphuric Acid (H_2SO_4) concentrations on the germination

While 66% to 83% germination was observed in 0.5% H_2SO_4 series, there was no germination in other series. In series where germination occurred the percentage was lower than that of control group and the difference was statistically significant (*Table 9*). For this reason, it can be said that the germination was inhibited by H_2SO_4. It inhibited germination completely when H_2SO_4 concentration was over 1%. The difference was significant when different origins were compared with in terms of their sensitivity to H_2SO_4 (*Table 10*).

d) Effects of different Hydrochloride Acid (HCl) concentrations on the germination

In 0.5% HCl use resulted 80% to 96% germination, 1% use of HCl resulted 9% to 80% germination, while 2% use of HCl in series of Kütahya / Domaniç resulted as 1%, other seeds were not germinated in other series, 3% of HCl use hindered germination. Though germination percentage in 0.5% HCl series was lower than that of control group, the difference was insignificance (*Table 9*). However, the effect of other concentrations was found to be insignificant of control group and the dif-

Table 10. – The total average effect of darkness and NaCl, KNO_3, H_2SO_4, HCl over germination of different concentrations (0.5%, 1%, 2%, 3%).

Origin No.	NaCl Germination %		KNO_3 Germination %		H_2SO_4 Germination %		HCl Germination %		Dark Germination %		Control Germination %	
1	46	b	72	b	17	b	28	a	71	a*	97	b
2	49	c	42	a*	18	b	25	a	84	c	99	c
3	43	a*	52	a	17	b	44	c	91	d	96	b
4	44	a	73	b	12	a*	23	a*	71	a	94	a*
5	50	c	77	b	21	b	38	b	98	e	98	b

*) Within each column, means with the same letter are not significantly; 95% significant; Annova FISHER PLSD.

ference was insignificant (*Table 10*). When the origins were compared with their sensitivity to HCl, the difference was insignificant at 0.05 level as well.

e) The effects of light on germination

Although the germination in continuous dark took place (71% to 98%) was lower than that of control group (8-hour-light, 16-hour-darkness photo period) (*Table 9*), and the difference was significant (*Table 10*).

Including the control group, when all the origins were compared with each other by using the averages of the results of experiment series, the highest germination was found in Bolu / Güney (70.7 ± 37.6) and the lowest germination was observed in Kütahya / Yenice originated seeds (50.2 ± 39.8) (*Table 10*).

4. Discussion

In the distribution area of Ebe black pine the annual mean precipitation fluctuates between 487.1 mm to 702.7 mm; the annual mean temperature is between 10.2°C and 16.9°C, the lowest temperature is between -7.5°C and -31.5°C, the highest temperature fluctuates between 36.5°C and 42.0°C. In above regions an arid period which begins on May and June and ends on September and October.

Fortyfour percent of the soil in the research area is Rendsina, of the 12% is Braunerde, of the 24% is Calc Braunerde, of the 12% is Meridional Braunerde and of the 8% is Terra Rossa types of soils.

Humus reaction severe acid and light acid (pH, 5.3 to 7.6). Although the humus reaction has similar values of (pH, 5.9 to 7.4) the humus which exists under the *P. nigra* ssp. *pallasiana* var. *pyramidata* (YÜCEL, 1995), it is higher than the values reported for *P. nigra* ssp. *pallasiana* (pH, 4.9 to 5.5) (KANTARCI, 1987).

In the needle samples the following elements are found between the values of; nitrogen 0.84 to 1.42, calcium 0.14% to 0.67%, magnesium 0.10% to 0.23%, potassium 0.42% to 1.52%, sodium 0.01% to 0.02% and phosphorus 0.05% to 0.16% (*Table 6*). Although the calcium and nitrogen amount found in Ebe black pine needles are about similar to the values found in *P. nigra* ssp. *pallasiana* (IRMAK and ÇEPEL, 1959) and in var. *pyramidata* have the lowest value of phosphorus and the highest value of potassium (YÜCEL, 1995) (*Table 11*).

Table 11. – Nutrition concentration amounts in *Pinus nigra* ssp. *pallasiana* and varieties.

Taxon name	Ca %	N %	P %	K %	Literature
Pinus nigra ssp. *pallasiana*	0.35	1.40	0.11	0.68	Irmak and Çepel, 1959
var. *pyramidata*	0.29	1.36	0.49	0.70	Yücel, 1995
var. *şeneriana*	0.31	1.13	0.09	1.05	In this study

In the *P. nigra* ssp. *pallasiana* var. *şeneriana* communities, 145 species and 242 taxons are found belonging to 46 families were found. In these communities, in general widespread and phytogeographic the region of which are not known (56.2%), are prevalent and followed by the Mediterranean elements in above communities. Three families which include the largest taxon are Fabaceae (12.0%), Lamiaceae (9.9%) and Compositae (7.9%). Families which include fewest taxons with 0.4% proportion are Aceraceae, Araliaceae, Buxaceae, Cornaceae, Dipsacaceae, Ericaceae, Geraniaceae, Illecebraceae, Lauraceae, Oleaceae, Papaveraceae, Resedaceae, Rutaceae, Scrophulariaceae and Taxaceae. Taxons (43.8%) the phytogeographic distribution of which are known and 9.1% of it is endemic for Turkey are the elements of 12.0% Euro-Siberian, 12.8% Mediterranean and 9.9% Irano-Turanian. However, there are significant phytogeographical differences among Bolu, Manisa and Kütahya. The existent ratios of Euro-Siberian elements in Bolu and Irano-Turanian elements in Kütahya are higher than other phytogeographic region elements. While there are no Euro-Siberian elements in Alaşehir, the Mediterranean elements are of the highest ratio. Though the Irano-Turanian elements are abundant in Kütahya, the Mediterranean and Euro-Siberian ones are found rather low in ratios. When we consider Bolu, much of the flora of it is consisted of Euro-Siberian elements. Such results indicate relevance to the phytogeographic regions of Turkey (ATALAY, 1994). Families including the most endemic taxon in the research area are; Lamiaceae (Labiatae) (2.1%), Fabaceae (1.7%), Caryophyllaceae (1.2%) and Pinaceae (0.8%). When compared with the endemical ratio, they were found as 8.7% Kütahya, 2.5% Bolu and 1.7% Alaşehir. The sample area including the most endemic taxon is Yenice village of Kütahya called Çögürler region.

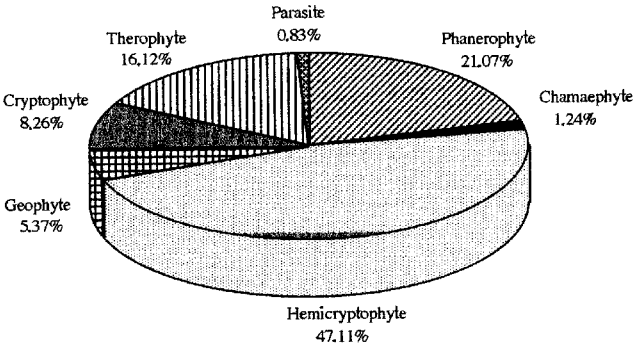

Figure 8. – Biologic spectrum of the *Pinus nigra* ssp. *pallasiana* var. *şeneriana* communities.

These communities, in general, have three-layer structure where tree, bush and grass layers are separated from each other distinctly. In these communities the hemicriptophytes (47.1%) are in majority (*Fig. 8*). However, phanerophytes are widespread as well. Yet, in some anthropogen areas, when the layered structure disappears and the tree level is represented by a few trees, the characteristics of bush-level communities of *Quercus* sp. and *Juniperus* sp. species become prevalent in such areas.

Only the dark coloured seeds were used in this study, due to the fact that there are large differences in germination percentages, weight and morphological properties of light and dark coloured seeds. As a result of the germination experiments, it was found out that the salt (NaCl) was not effective for germination in low concentrations (0.5%), but inhibited the germination in high concentrations. Data obtained from this study goes hand in hand with the literature (MOORING, 1971) that high salt concentrations hinder the germination. Although it is reported that KNO_3 is a growth organiser and stimulates the germination for some plants (ÖZTÜRK et al., 1984), in this study it was discovered that all concentration it was inhibited the germination. As it is known, the acid rain has been an important environmental problem, and it was reported that there is a close relation with acid rain and the bad growth of *P. rigida* MILL., *P. echinata* MILL., and *P. taeda* L. species (JOHNSON et al., 1981). When acid rain has higher pH than 3, growth and germination of *P. sylvestris* L. and *P. strobus* L. were affected adversely (EVANS, 1982; PERCY, 1986). On the other hand, even low H_2SO_4 concentrations hinders germination of *P. nigra* ssp.

pallasiana var. *pyramidata* (YÜCEL, 1999). In this study, in accordance with the literature, the germination was inhibited by H_2SO_4 in all concentrations and concentrations of 1% and grater hindered the germination completely. HCl was seen to have inhibited germination at all concentrations, and stopping at 3% concentrations.

Among origins there was difference in terms of sensitivity towards NaCl, KNO_3 H_2SO_4 and HCl (*Table 10*). Whether the seed and cone weight have effect on seed germination percentages was tested through regression analysis. According to this analysis, these is no significant relation between 1000 grain seed weight and seed germination percentage (r^2 = 0.07). In relation to y = 0.1319 x + 94.4416 regression equation and as it is observed from F = 0.2276 and p = 0.6659 values, 1000 grain seed weight justifies the seed germination percentages. Similarly, according to y = 0.0001 x + 96.0699 regression equation, the cone weight does not justify the germination percentage (F = 0.1592, p = 0.7166, r^2 = 0.05).

Preserving the plant gene resources is of great importance both for the continuation of biological variety and for economy. For this reason, Ebe black pine, which is under extinction, should be urgently put under protection through a program.

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Factors Influencing Rooting in Cutting Propagation of Cypress (*Cupressus sempervirens* L.)

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Abstract

Some aspects related to the rooting of cuttings of *Cupressus sempervirens* were examined in this work. They are of both scientific and practical relevance, dealing with the genetic variability of the rooting ability, the expression of this character in different periods of the year and the efficiency of the modality of hormone supplying.

A greater efficiency of indole-butyric acid given to the cuttings in the form of either potassium salt solution or talcum dispersion were found, compared to the alcoholic solution. The

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