

The Comparisons Between Root Collar Diameter and Height Growth of Black Pine (*Pinus nigra* Arnold.) and Scots Pine (*Pinus sylvestris* L.) Seedlings in Bolu Forest Nursery

Nuri ÖNER^{1,*}

Figen EREN²

¹ Department of Forest Engineering, Faculty of Forestry, Ankara University, Bademlik mevkii, 18200, Cankiri, TURKEY

² Graduate School of Natural and Applied Sciences, Ankara University, Bademlik mevkii, 18200, Cankiri, TURKEY

* Corresponding Author

e-mail: oner@forestry.ankara.edu.tr

Received: May 24, 2007

Accepted: July 11, 2007

Abstract

In this study, root collar diameter and height growth of bare rooted and containerized Black pine seedlings at 1+0 and 2+0 ages were statistically compared to Scots pine seedlings in Bolu forest nursery. Root collar diameters and height growths of 240 seedlings were measured. The obtained data were compared via "Student's t – test". Results show that containerized seedlings of both Black pine and Scots pine had a better root collar diameter and height growth than the bare rooted seedlings. Black pine seedlings had a better growth of both collar diameter and height growth than Scots pine for both containerized and bare rooted seedlings. Thus, containerized seedlings could be used for plantation. Black pine could be preferred rather than Scots pine in areas which have similar climatic and edaphic conditions of the sample area.

Key words: Black Pine, Scots pine, Bolu, Forest Nursery

INTRODUCTION

Recent studies have indicated that the amount of the forest land defined in Turkey as 20.7 million hectares [1]. Nearly half of this land is degraded forest areas that require reforestation, erosion control, pasture improving practices to be applied. According to the inventory studies, it was reported that intensive cultural practices could be applied in 1.5 million hectares for fast growing species plantation [2]. The total area in the forest regime and subject to the reforestation is 3.8 million hectare. On the other hand, it is stated that total areas which is within and outside the forest regime and needs reforestation nowadays is approximately 18 million hectares and 11-12 million hectares of this area application is possible [3].

While the rapid increase in population continues, the decrease of forest lands will increase the demand for wood in the future [4]. Other than preserving natural forest, in today's afforestation service has various functions such as establishing the natural balance, soil protection, serving the healthy survival possibilities and recreation goals gain importance as well as wood production [5]. It can be found out years later whether afforestation reached its goal or not, and it's impossible to meet efforts and financial loss. So in order to guarantee the level of success, afforestation should be based on scientific techniques. [6].

Nurseries are places which are responsible for producing seedlings constantly and economically whose adaptation ability to the conditions of growing up in main planting areas and relatedly seedling survival and development rates are high [7].

There are plenty of international and national studies on the morphological traits and quality criteria of seedlings of broadleaved and coniferous forest tree species [8-19].

Generally, the afforestation values of seedlings are measured with the quality of seedlings [20]. While evaluating the seedling quality some morphological criteria such as stratum, robust index, quality index, height, root collar diameter, seedling dry weight, root percentage and physiological criteria and some physiological criteria such as root regeneration potential, plant water capacity, root growth potential are used [21-24], however, currently the TSI (Turkish Standards Institute) norms are used in forest nursery practice in Turkey.

Demircioğlu *et al.* [25] have determined the appropriateness of bare rooted Scots pine seedlings at the age of 2+0 grown in Kastamonu-Taşköprü Forest Nursery to both TSI standards and the quality classes they have newly established by using their morphological character.

Genç *et al.* [26] have examined the quality features such as seedlings height, root collar diameter and shoot/root ratio of Black pine seedlings from 9 different origins at the age of 2+0 grown in Eskişehir, Eğirdir and Seydişehir Forest Nurseries.

In a study carried out in Kastamonu-Taşköprü Forest Nursery the morphological differences and TSI appropriateness of Black pine seedlings at the age of 2+0 produced from four different origins have been examined according to origin [27].

Üçler *et al.* [28] have determined the distribution of 2+0 year-old seedling grown in Eğirdir Forest Nursery to seedling quality classes by evaluating them according to TSI norms according to the seeds collected from 24 good phenotyped and normal families of Black and Calabrian pine natural stands in Burdur-Ağlasun region.

Gezer *et al.* [29] have examined the distribution of the seedlings which were originated from the seeds supplied from

3 foreign, 27 native seed sources within the natural expansion borders of Scots pine, according to TSI seedling quality criteria.

11.2 Million hectares of the existing forest lands in Turkey consist of coniferous species. The land that Scots pine forests cover is 757.426 hectares [30]. Its horizontal distribution in Turkey begins from the southeastern part of Marmara Region at Orhaneli thru the southern side of the mountains standing parallel to Black Sea as pure or mixed stands with Oriental Spruce (*Picea orientalis* L. Carr.) and fir (*Abies* sp.); constitutes mostly pure, large forests pure in Bolu or mixed with oriental beech (*Fagus orientalis* Lipsky.) and Bommüller's fir (*Abies bornmülleriana* Mattf.); and large, pure forests stands in Northeast Anatolia; Ardahan, Oltu, Posof and Sarıkamış. The vertical distribution of this wide distribution is quite variable. It is down to sea share in the eastern Black Sea Region, around 700 m in Çoruh, and it constitutes normal canopy forests around Sarıkamış even at 2700 m.

Black pine has got its widest distribution (2.5 million hectares) in Turkey. It constitutes pure or mixed forests in the mountainous parts of all our coastal regions, even goes into steppe. It constitutes forest stands which are pure or mixed with Calabrian pine (*Pinus brutia* Ten.), Scots pine, Lebanon cedar (*Cedrus libani* A.Rich.), juniper (*Juniperus* sp.), oriental beech and oak (*Quercus* sp.) species on the inward slopes of North Anatolian mountains, on the northern slopes of the Western and southern Anatolia. It surrounds the costal areas of Middle and Western Black Sea, Marmara, Aegean and Mediterranean Regions and goes into Central Anatolian steppe. Thus, it may grow naturally in all our geographical regions except Eastern and Southeastern Anatolia. Its vertical distribution is between 1200-2100 m. This is due to the fact that it can grow in places where Scots pine cannot [31-33].

This study has been carried out to compare the root collar diameter and height growth of containerized and bare rooted seedlings of Black pine and Scots pine seedlings in Bolu Forest Nursery.

MATERIAL AND METHODS

The study area

The Nursery Directorate is on Bolu-Karacasu asphalt between Büyükberk and Küçükberk villages dependent on Bolu center; between 40° 44' northern latitudes and 31° 36' eastern longitudes in Western Black Sea Region. The nursery is 2,5 km far from the city center. The elevation of the region is 725 m and its general aspect is in East-West course [34].

According to the data received from Bolu meteorology station which is at 747 m altitude, the average annual temperature is 10,2 °C, the minimum temperature is -4,2 °C (January), the maximum average temperature 27,5 °C (August) and average annual precipitation is 536,4 mm. Vegetation period at area is between May (13,8 °C)-October (11,5 °C) and totally 6 months. The precipitation amount during the vegetation period is 225,7 mm; the fastest wind direction is SW with a speed of 1,8m/sn is in March [35]. When the meteorological data is evaluated according to Thornthwaite method, it has been determined that the area has a climate that is indicated with C₁B₁'wb₃' symbols which means a location "shows close features to oceanic climate that is dry-little dampy mezohermal and has a medium level water shortage in winter" (Table 1, Figure 1).

The land on which the nursery was established is plain and is young alluvial soil with azonal character which has not formed an exact profile. Nursery's soil consists of a heavy texture such as soil rich in clay, muddy clay, sandy muddy clay, dry and with pale brown dark color.

The reaction of soil (pH) is about 7.5 and it is semi-alkali. Lime rate in the soil is between 9,4-13,5 and it's rich in lime. Its organic substance rate is about 1.5%. Total nitrogen level (%) is low due to the organic substances. Phosphorus levels change between 101-424 kg/ha and all plots are rich in phosphorus. There is no detrimental salt problem in the soil [34].

Table 1. Water balance of study area

Element of Balance	MONTHS												Annual Mean
	1	2	3	4	5	6	7	8	9	10	11	12	
Temperature (°C)	0,3	1,6	4,4	9,4	13,8	17,0	19,4	19,5	15,8	11,5	6,9	2,7	10,2
Temperature Index	0,01	2,18	0,82	2,60	4,65	6,38	7,79	7,85	5,71	3,53	1,63	0,39	41,54
Uncorrected PE (mm)	1,28	5,66	18,60	40,70	60,20	82,50	92,70	92,90	73,75	41,42	28,46	10,70	
Corrected PE (mm)	1,08	4,70	19,16	44,48	74,65	103,13	117,73	109,62	76,70	39,76	23,62	8,66	623,29
Precipitation (mm)	58,2	47,8	47,2	48,9	58,5	52,2	27,3	21,5	29,0	37,2	47,7	60,9	536,4
Store Alteration (mm)	23,68	0	0	0	-16,15	-50,93	32,92	0	0	0	24,08	52,24	
To store (mm)	100	100	0	100	83,85	32,92	0	0	0	0	24,08	76,32	
Actual Ev-Tr (mm)	1,08	4,70	19,16	44,48	74,65	103,13	60,20	21,5	29,00	37,20	23,62	8,66	427,38
Water absent (mm)	0	0	0	0	0	0	57,53	88,12	47,70	2,56	0	0	195,91
Extra Water (mm)	33,46	43,10	28,04	4,42	0	0	0	0	0	0	0	0	109,02
Surface flow (mm)	19,73	29,92	28,98	16,69	8,35	4,17	2,08	1,04	0,52	0,26	0,13	0,66	109,02

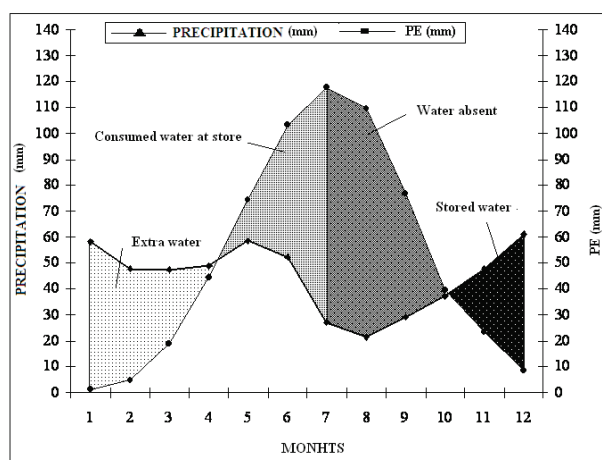


Figure 1. Water balance graphic of study area

Data collection and analyses

In the Bolu Nursery, randomly 30 bare rooted and containerized Black and Scots pine seedlings (a total of 240 seedlings) at the age of 1+0 and 2+0 have been taken.

The measurement of seedling height from root collar level to the level where the terminal bud connects to the bole at 1 mm sensitivity, and root collar diameters were measured at 0.01 mm sensitivity. Descriptive statistics for the obtained height and root collar diameter data have been calculated and Student’s t-test was applied for the evaluation of height and root collar diameter data of Black and Scots pine seedlings at various ages.

RESULTS AND DISCUSSION

Results of the statistical tests for evaluation of root collar diameter and height growth of both Scots and Black pine were given in Table 2-4.

Table 2 shows that there were not any significant difference between height growths of both Black and Scots pine at 2+0 age ($p>0.05$), and Black pine seedlings have a better growth of root collar diameter and height growth than Scots pine at 1+0 age, whereas the Black pine seedlings have only a better

growth of root collar growth than Scots pine seedlings at 2+0 age ($p<0.05$).

According to Table 3; there was a significant difference of both root collar diameter and height growth between Black and Scots pine seedlings at both 1+0 and 2+0 ages in favor of Black pine ($P<0,05$).

Table 4 shows that there was a significant difference of both root collar diameter and height growth between Black and Scots pine seedlings at both 1+0 and 2+0 ages ($P<0,05$).

It’s reported that over the last two decades in England most of the nurseries have been established on sandy or muddy sandy soil of which clay rate is at most 15% [36]. At the same time, the soil of the seedlings which does not contain clay, can create a great growth environment after addition of compost and other organic manures. The soil of this type of nurseries generally has acidic reaction that do not cause any problem about grass and successful and fertile seedlings can be grown on them [5]. Bolu Forest Nursery is rich in clay, so it’s problematic about grass and that is why intense care measures are applied. Although it is an ideal situation for nurseries that the soil is quite light texture soil, soils of the study area consist of heavy soils. For nursery soil that will produce coniferous seedlings, it is ideal for dust and clay content to be between 10–25% and in muddy sand and sandy mud texture; for deciduous species it is ideal that this amount is up to 35% and in sandy mud with clay [37]. These values considered it can be said that the soil of the nursery concerned has appropriate conditions for the deciduous species than coniferous species.

Generally, the suitable soil reaction is 5.0–5.5 pH in production of coniferous seedlings which show the intense acid rate [38]. In Bolu Forest Nursery, soil reaction is medium alkali and about 7.5 pH. That is why the nursery in questions has unsuitable pH value for the production of coniferous species seedlings. The suitable pH levels for Black pine and Scots pine are between 4.5–6.0 [39].

In fertile seedling growth, it is desired that the organic substance amount of the nursery soil should be at least 2% on the upper soil particularly in 0–15 cm depth [5]. The organic substance rate in the research area is 1.5% and it is below the desired rate.

Table 2. Student’s t-test results of species compare at bare rooted seedlings

Compared Feature	Age	Species	N	df	X _{min}	X _{max}	X	S ²	t	P
Root Collar Diameter (mm)	1+0	Black pine	30	58	3,20	4,10	3,86	0,049	2,001	0,000*
	1+0	Scots pine	30		2,76	3,22	2,97	0,019		
	2+0	Black pine	30	58	4,10	5,85	4,90	0,252	2,001	0,000*
	2+0	Scots pine	30		2,95	4,90	4,04	0,233		
Height (cm)	1+0	Black pine	30	48	8,20	9,90	9,19	0,247	2,016	0,002*
	1+0	Scots pine	30		8,10	9,30	8,85	0,091		
	2+0	Black pine	30	58	9,80	13,20	11,75	1,125	2,001	0,936 ^{ns}
	2+0	Scots pine	30		9,20	13,90	11,73	1,410		

* ($P<0.05$, 5% significant to confidence level) ^{ns}($P>0.05$, 5% insignificant to confidence level)

Table 3. Student's t-test results of species compared at containerized seedlings

Compared Feature	Age	Species	N	df	X _{min}	X _{max}	X	S ²	t	P
Root Collar Diameter (mm)	1+0	Black pine	30	55	3,20	4,90	4,21	0,133	2,004	0,000*
	1+0	Scots pine	30		3,00	4,20	3,78	0,220		
	2+0	Black pine	30	58	5,00	6,80	5,85	0,297	2,001	0,000*
	2+0	Scots pine	30		4,20	5,90	5,19	0,220		
Height (cm)	1+0	Black pine	30	58	9,20	11,0	10,15	0,294	2,001	0,000*
	1+0	Scots pine	30		8,20	8,60	9,39	0,408		
	2+0	Black pine	30	36	14,0	20,0	16,51	2,492	2,028	0,000*
	2+0	Scots pine	30		12,0	14,0	11,73	0,299		

* (P<0.05, 5% significant to confidence level)

Table 4. Student's t-test results of compared bare rooted and containerized seedlings to species

Compared Feature	Age	Species	Type of seedling	N	df	X _{min}	X _{max}	X	S ²	t	P
Root Collar Diameter (mm)	1+0	Black pine	Bare rooted	30	48	3,20	4,10	3,86	0,049	2,010	0,000*
	1+0		Containerized	30		3,20	4,90	4,21	0,133		
	2+0		Bare rooted	30	58	4,10	5,85	4,90	0,253	2,001	0,000*
	2+0		Containerized	30		5,00	6,80	5,84	0,298		
Height (cm)	1+0		Bare rooted	30	58	8,20	9,90	9,19	0,247	2,001	0,000*
	1+0		Containerized	30		9,20	11,40	10,15	0,294		
	2+0		Bare rooted	30	36	9,80	13,20	11,73	1,125	2,028	0,000*
	2+0		Containerized	30		14,00	20,20	16,51	2,492		
Root Collar Diameter (mm)	1+0	Scots pine	Bare rooted	30	34	2,76	3,22	2,97	0,019	2,032	0,000*
	1+0		Containerized	30		3,00	4,70	3,79	0,200		
	2+0		Bare rooted	30	58	2,95	4,90	4,04	0,233	2,001	0,000*
	2+0		Containerized	30		4,20	5,90	5,19	0,220		
Height (cm)	1+0		Bare rooted	30	41	8,10	9,30	8,85	0,090	2,019	0,000*
	1+0		Containerized	30		8,20	10,60	9,39	0,408		
	1+0		Bare rooted	30	41	9,20	13,90	11,73	1,410	2,019	0,000*
	2+0		Containerized	30		12,60	14,30	13,52	0,298		

* (P<0.05, 5% significant to confidence level)

In the study area, it is thought that texture, pH and organic substance rates mentioned above have been effective in better development in root collar diameter and height growth of both containerized and bare rooted Black and Scots pine seedlings at the same age groups in favor of Black pine.

CONCLUSION

In the afforestation studies carried out in some of the provinces and villages of Bolu, Black pine and Scots pine seedlings are being used and seedlings are supplied from Bolu Forest Nursery.

As a result of this study, it has been found that Black pine seedling in seedbed and container showed a better root collar diameter and height growth than Scots pine seedlings, and both containerized Black and Scots pine seedlings showed better growth than bare rooted seedlings of Black and Scots pine.

In the nursery; it is thought that any kind of work to improve the physical features of the soil with heavy content, addition of a sufficient amount of stream sand with no salt, organic substance and peat to the plots, application of chemical manure to the plots of land which have insufficient nitrogen and are rich in phosphorus during the vegetations period, application of phosphoric acid and nitric acid to the pool in order to reduce the pH of settled water will increase the quality of seedlings especially the ones with bare rooted.

Higher pH rates make the intake of nitrogen and phosphorus which play a positive role in the growth of seedlings hard and in this sense, weakens their endurance to drought [39]. As the pH of Bolu Forest Nursery is not suitable for coniferous seedling growth, and it should not be ignored that bringing pH to suitable conditions for these species will increase the quality and use of the seedlings grown.

REFERENCES

- [1] Konukçu M. 1997. Statistical Profile of Turkish Forestry. Planning Organization of Government, Ankara.
- [2] Zoralioğlu T. 1990. Research on land preparation methods with machine can be used in afforestation of arid and semiarid area in Eskişehir Territory. Poplar and Fast Growing Exotic Forest Trees Research Institute, Technical Bulletin No: 149:168, İzmit. (In Turkish).
- [3] Anonymous 1988. National afforestation policy of Turkey. Public and Private Sector in Practice, Vision of Chamber of Forest Engineer, Forest Engineering, June 2–11, Ankara. (In Turkish).
- [4] Yahyaoglu Z. 1995. Seed Technology and Nursery Technique. Karadeniz Technical University, Faculty of Forestry, Serial No: 43, Trabzon. (In Turkish).
- [5] Ürgenç S. 1998. Afforestation Technique. İstanbul University, Faculty of Forestry, Publication No: 441:600, İstanbul. (In Turkish).
- [6] Ürgenç S, Çepel N. 2001. Practical Basis of Seedling Planting, Seed Sowing and Species Selection for Afforestation. TEMA Publications No:33-250, İstanbul. (In Turkish).
- [7] Tacenur İA, Efeoğlu İA. 1979. Researches on fertilize requirements and nutrient substances of coniferous seedlings produce in some forest nursery of Turkey. Project No:TÜBİTAK TOAG–237, Ankara. (In Turkish).
- [8] Ayıntaplı P. 1995. Researches on quality classification of Calabrian pine, Black pine and Taurus cedar seedlings produce in Serinyol and Tekir Nursery. Msc Thesis, Karadeniz Technical University, Institute of Science , Trabzon. (In Turkish).
- [9] Anonymous 1990. Forestry of Turkish. Planning Organization of Government, Ankara. (In Turkish).
- [10] Genç M. 1991. Important of seedling quality classification and methods and criterions use to classification. Karadeniz Technical University, Faculty of Forestry, Trabzon. (In Turkish).
- [11] Aslan S. 1986. Researches on nursery techniques of Kazdağı fir. Forestry Research Institute, Technical Bulletin Series: 157, Ankara. (In Turkish).
- [12] Atasoy H. 1986. Effect of nursery elevation on morphology of oriental spruce seedlings. Journal of Forestry Research Institute, Ankara. (In Turkish).
- [13] Aussenac G. 1988. Effect of physiological criterion on forest seedlings depends on quality in before planting (Translation: Suat Tosun-Müjgan Özer). Journal of Forestry Research Institute, Ankara. (In Turkish).
- [14] Cleary BD, Greaves RD, Owston PW. 1978. Seedlings. Oregon State Univ. School of Forestry, By The Forest Service U.S. Department of Agriculture, 97p.
- [15] Eyüboğlu AK, Atasoy HR, Küçük M. 1984. Effects of density on oriental spruce (*Picea orientalis* (L.) link) seedlings. Forestry Research Institute Technical Reports Series No:22, Ankara. (In Turkish).
- [16] Gezer A. 1984. Basis of seedling produces to East Black Sea fir. Journal of Forest Engineering, 21:2, Ankara. (In Turkish).
- [17] Tolay U. 1980. Quality seedling problem in afforestation. Journal of Poplar and Fast Growing Exotic Forest Trees Research Institute, İzmit. (In Turkish).
- [18] Tolay U. 1983. Relations between growing technique and seedling quality and growing success of Uludağ fir in Hendek forest Nursery. Journal of Poplar and Fast Growing Exotic Forest Trees Research Institute, Annual Bulletin No:19, İzmit. (In Turkish).
- [19] Ürgenç S. 1982. Breeding of Forest Trees. İstanbul University, Faculty of Forestry, Publication No: 2836/293, İstanbul. (In Turkish).
- [20] Şimşek Y. 1987. Problems of quality seedling usage in afforestation. Publications of Forestry Research Institute. 33:65, Ankara. (In Turkish).
- [21] Ayan S. 2002. Definition of growing technique and characteristic of seedling growing area in containerized oriental spruce (*Picea orientalis* (L.) Link.). Forest Ministry, Publications of East Black Sea Forestry Research Institute, Ministry Publication No: 179, East Black Sea Forestry Research Institute Publication No:14, Technical Bulletin No:11, Trabzon. (In Turkish).
- [22] Ürgenç S, Alptekin CÜ, Dirik H. 1991. Produce and quality problems in our forest nursery. I. Seedling Symposium in Turkey, Ankara. (In Turkish).
- [23] Görücü Ö, Çağlar S. 1996. Root renovating (regeneration) on deciduous seedlings after replaced. Journal of Poplar and Fast Growing Exotic Forest Trees Research Institute, Publication No: 210, 1996/1 No:23, İzmit. (In Turkish).
- [24] Dirik H. 1993. Relations between some important seedling characteristic and success of planting in Calabrian pine (*Pinus brutia* Ten.). Ph D. Thesis, İstanbul University Institute of Science, Department of Silviculture, İstanbul. (In Turkish).
- [25] Demircioğlu N, Ayan S, Avanoğlu B., Sivacıoğlu A. 2004. Evaluates of 2+0 year-old Scots pine (*Pinus silvestris* L.) seedlings produce in Kastamonu-Taşkoprü forest nursery according to Turkish Standards Institute (TSE) norms. Pamukkale University, Engineering Faculty, Journal of Engineering Science, 10:2, Denizli. (In Turkish).
- [26] Genç M, Güner T, Şahan A. 1999. Morphological researches on 2+0 year-old Black pine seedlings in Eskişehir, Eğirdir and Seydişehir forest nurseries. Turkish Journal of Agriculture and Forestry, 23:2, Ankara.

- [27] Avanoğlu B. 2003. Seedling morphology of some Black pine (*Pinus nigra* Arnold. subsp. *pallasiana* (Lamb.) Holmboe) origins Taşkoprü forest nursery. Msc Thesis. Gazi University, Institute of Science, Ankara. (In Turkish).
- [28] Üçler AÖ, Gülcü S, Bilir N. 2000. Relations between seed source and morphological seedling quality in Black pine and Calabrian pine. II. National Seedling Symposium, 25-29 September 2000, İzmir. (In Turkish).
- [29] Gezer A, Bilir N, Gülcü S. 2000. Quality classification in Scots pine (*Pinus silvestris* L.) seedlings. II. National Seedling Symposium, 25-29 September 2000, İzmir. (In Turkish).
- [30] Genç M. 2004. Principal Basis of Silviculture. Süleyman Demirel University, Publication No: 44, 341p, Isparta. (In Turkish).
- [31] Mataracı T. 2002. Trees. TEMA Publications No: 39, 371p, İstanbul. (In Turkish).
- [32] Yaltırık F, Efe A. 2000. Dendrology. İstanbul University, Faculty of Forestry, Publication No: 465. 382p, İstanbul. (In Turkish).
- [33] Anşin R, Özkan ZC. 1997. Plants with Seed (Spermatophyta) Woody Taxons. Karadeniz Technical University, General Publication No: 167. Faculty of Forestry Publication No:19, 513p, Trabzon. (In Turkish).
- [34] Anonymous 2000. Bolu Nursery Management Plan, Bolu. (In Turkish).
- [35] Anonymous 2003. Climate data belongs to Bolu Meteorology Station. Turkish State Meteorological Service, Ankara. (In Turkish).
- [36] Althous JR.1972. Nursery Practice. Forestry Commission Bulletin No: 43.184p, London.
- [37] Wilde SA. 1958. Forest Soils. The Ronald Press Company, New York.
- [38] Şahin EM. 1989. Seed and seedling produce problems in East Mediterranean forestry. Symposium of East Mediterranean Forestry, Chamber of Forest Engineer Publication No: 15, Mersin. (In Turkish).
- [39] Genç M, Yahyaoğlu Z. 1994. Morphological investigations on 2+0 year-old Black pine seedlings in Eğirdir, Seydişehir and Eskişehir Forest Nursery. Report, VIII. Engineering Week at Süleyman Demirel University, Isparta. (In Turkish).