Results of the Field Stage in Third Year of Species and Provenances Trials of *Paulownia* Sieb.&Zucc. in Eastern Black Sea Region

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Abstract

Since it grows fast, suitable for agroforestry, has multi-purpose wood, leaves as feed of animals and useful flowers for bee-keeping, fertilise the soil, etc., *Paulownia* is an important fast growing tree. Turkish Ministry of Forestry has begun a project on *Adaptation of Paulownia Species and Provenances* in 1998, so has four trial sites in Eastern Black Sea Region. They are Samsun-Carsamba (20m), Ordu-Camsan (50m), Ordu-Ulubey (900m) and Ordu-Golkoy (1400m)

Seeds of 16 provenances of 3 *Paulownia* species (*P.tomentosa*, *P.elongata*, *P.fortunei*) and a hybrid (*P.fortunei* x *tomentosa)*, which are imported from China, were sown in Trabzon-Of Forest Nursery in Spring 1999. In Fall 1999, 5 containerized seedlings (1/0 aged) were planted in each plot as 2 blocks, by Randomized blocks method. Torrent degraded the seedlings in Carsamba completely in June 2000. So, a new area was established in Spring 2002 in Samsun-Terme (30m).

Survival and growth performance of the 3-aged seedlings in the field were discussed in this article. All seedlings of provenances and species of *Paulownia* in Golkoy (1400m) were died during the winter 1999. So, it may be said that similar high elevations and sites are not suitable for *Paulownia*.

Keywords: *Paulownia*, Species and provenances trials, Eastern Blacksea Region

1. Introduction

Turkey has generally natural forests and annual increment of which is very low (0.9 m3/ha). Wood import has increased year by year. For example, when it was 6.5 % of annual consumption (11.37 million m3) in 1995, soon it reached to 11.5% in 1995 (ANON. 2000). Knowledge on *Paulownia* is below (ZHU ZHAO-HUA et al. 1986; CETİNER 2002);.

Paulownia is represented by 9 species of fast growing timber trees indigenous to China. It is very adaptable, widely distributed and extremely fast growing both in south and north China; either naturally or cultivated. A 10-year old tree can measure 30-40 cm diameter breast height (dbh) and may have a timber volume of 0.3-0.5 m^3. The timber is light yet strong, dries easily, has a beatiful grain, dos not warp or crack, or deforme easily. The wood is easy to work with, and suitable for carving and has excellent insulation properties. It provides suitable wood for the manufacture of furniture, plywood and musical instruments, and others.

Paulownia has late leaf emergence and leaf fall, and deep root system. Branching is sparce and so also the leaf arrangement. Intercropping with *Paulownia* improves a microclimate for these crops, and their yields increase considerably. For these reasons, it is good for intercropping.

Since leaves and flowers are rich in nitrogen, they are good fertilizer and fodder. They also poss medicinal uses, flowers are important for honey. Flowers are beatiful in spring and trees are green and shaddy in summer. *Paulownia* is suitable for beautifying and enriching the environment, for afforestation, landscaping of urban and industrial areas, for reclamation of mined areas. It is genetically variable and easy to propagate both vegetaively and sexually.

1.1. Growth Characteristics (ZHU ZHAO-HUA ET et al. 1986)

Fast growing is a characteristic. Useful timber trees can be obtained in 5-6 years. The annual breast diameter (dbh) increment of *P.elongata* can be 3-4 cm with average timber volume of 0.05-0.06 m. *P.elongata* and *P. fortunei* grow fast, but *P.tomentosa* grows slow.

Paulownia has well-developed root system; upper roots are thin, sharp, dichotomously branched and grow very densely. The absorbtive roots are long (1-5mm) in thickness and can lead to more than 60 cm. The development and distribution of the root system is greatly influenced by the

underground water level, the physical characteristics of the soil and the nutrition available. *Paulownia* is most suited to loose sandy soils with good drainage. Almost 70-85% of the absorbtive roots of *P.elongata* are spread in a radius of 40-100 cm. This spreading is helpful and provides very suitable conditions for intercropping.

The apical buds of *Paulownia* suffer from frost injury during winter; in the following spring fourth or fifth axillary buds uneffected by frost develop into a new branche. The second to third pairs of buds on newly formed branches are damaged again during the following winter, so on. The growth of the crown progresses in this way year by year. So, tree ages can be calculated from the number of branches formed and the crown morphology.

The two main cultivated species in China are *P.elongata* and *P.fortunei*. The trunk timber volume of *P.fortunei* is 18-36 % larger than of *P.elongata* of the same diameter. The highest increase in timber volume in cultivated *Paulownia* trees is attained much earlier than in wild trees.

According to Boydak (1999), trials on adaptation of *Paulownia* can be resulted the earliest in seven to twelve years. Since ecological features of the two genus are generally similar, *Paulownia* and *Populus euroamericana* I-214 should be studied together. Then, if it is not more economical than the Poplar, *Paulownia* could not be offered for Turkey. Because, poplar has been studied many times, been cultivated and has a market. Aims of *Paulownia* plantations, marketing, silviculture, diseases of clonal propagation, etc. in Turkey should also be studied. *Paulownia* plantations in slopes have better quality timber than in fields. At that time, it may be planted in small (0.5 ha, etc) plots for landscape.

Yavuzsefik et al. (2001), has planted six seedlings of *P.elongata* and *P.fortunei*; three of each. Annual height were 196.3 and 164.0 cm at the end of the first year; and were 297.3 cm and 378.0 cm at the end of the second year, for *P.elongata* and for *P.fortunei*, respectively,

1.2. Ecological Requirements (ZHU ZHAO-HUA et al. 1986)

The northern limit of species' distribution approximately coincides with the mean January isotherm of -5°C; the absolute lowest temperature is around –20°C. Different species vary in their cold resistance. *P.tomentosa* is the hardiest, can withstand around -20°C; *P.elongata* can withstand –15°C to -18°C; and *P.fortunei* can withstand –5°C to 10°C.

The growth of *Paulownia* commences around a temperature of +8°C. The optimum temperature for growth is around 24-29°C of mean daily. The longer the optimum temperature lasts, the better the growth. Thus, the growth tends favourably to respond better under higher temperature (Table 1)

The temperature range at which the various species stop growth varies greatly. Sprouts are usually more cold resistant than saplings in the first year, because they stop heigth growth earlier and wood lignification increases. The time of cessation of diameter growth coincides with the time of leaf fall.

Insufficiently lignified *Paulownia* seedlings and weaker juvenile trees are susceptible to frost injury during winter, especially on the sunny side. After being injured by cold, skin-rot appears on the injured portions. Woodrotting fungi invade, with deleterious effect on tree growth and wood quality. This injury is also caused by the great difference between day and night temperatures. Application of soaked lime on the tree trunk or wrapping the tree with grass bandage may prevent the frost injury.

Table 1. Ecology and distribution of *P.tomentosa, P.elongata* and *P.fortunei* in China

Species	Geography			Temperature (°C)			Ann.Precipitation		Soil	
	Latitu.	Longitude	Altitu.	Max	Mi.	Mea.	(mm)	Drought	pH	Texture
P.tomentosa	28-40N	105-128E	1500m	40	-20	17-11	1500-500	3-9 mt	5-8.5	Light clay sandy
P.elongata	28-36N	112-120E	1200m	40	-15	17-12	1500-600	3-9 mt	5-8.5	He. loam sandy
P.fortunei	18-30N	105-122E	1100m	40	-10	23-15	2500-1200	2-3 mt	4.5-7.5	Light clay sandy

Paulownia has a very large leaf area with a high transpration rate. Sufficient moisture is very important for growth. The annual precipitation of extensive areas vary greatly, from as low as 500mm to a maximum of 2000–3000 mm. During the fast growing period it needs a lot of water. *P.elongata* is

more resistant to drought than *P.fortunei* (Table 1). *Paulownia* is not very sensitive to atmospheric humidity.

It has distinct branches and leaves sparcely arranged which allow light penetration. Natural pruning is very intensive. A slight shade on one side can distort the shape of the tree or damage it completely. *Paulownia* responds well to bright light or light-loving and unsuitable for mixing with other light-demanding fast growing tree species. It is not advisable to have taller of other species around.

Paulownia seeds are light, small and winged, and should make natural regeneration easy. However, both germination and seedling growth require intensive light. So, it can not regenerate naturally within the forest but only exposed areas like abandoned land, felled and burnt sites where it can be considered as a pioneer species. Winged seeds are easily distributed. Seeds can travel 0.5 to 1.0 km away from mother tree by wind. Highly exposed areas with strongly wind are not suitable for afforestation.

Paulownia is found mostly on sandy and clayey soil-heavy earth. The clay content of the soil for *P.fortunei* is 16.3-23.5%; and less than 10% for other species. The extension of the roots needs not only suitable water and temperature, but also deep, loose, moist and well-aerated soil. It needs a total soil porosity above 50%, a non-pore porosity above 10%, soil ventilation above 30% and mean bulk density of 1.031 g/cm^3. On excessively clayey soils, *P.fortunei* and *P.tomentosa* grow better than *P.elongata*.

Paulownia is sensitive to depth of the underground water table and to soil salinity. The water table should be below 1.5 m depth and stagnant water for the three. Growth is seriously impaired if the total salt content of the soil reaches 1%. Soil pH is 5.0-8.9 for *P.elongata* and *P.tomentosa*, and 5.0-8.0 for *P.fortunei*. *Paulownia* is able to absorb selectively calcium and magnesium from the soil. It is tolerant of poor soil. However, it grows much better on fertile soils. Complete fertilzer of nitrogen, phosphate and potassium when the trees are 8-10 years old is the best. Nitrogen is more effective if it is supplied as a single element.

1.3. Afforestation and Management (ZHU ZHAO-HUA et al. 1986)

Selection of suitable sites according to species is a key to success or failure of plantations and to achieve fast growth and high yield. *Paulownia* is very adabtable except for places with too clayey, dry or poor soil, too strong wind, highly saline or alkaline soil, bad drainage, excessively high water table (less than 1.5m) and extreme low temperature (below –20°C). It can be planted on plains and mountains up to 2000m elevations. It is best to plant them in fertile, deep, loose sandy loam or loam soil with good drainage and a water table deeper than 1.5m.

Sides of houses, villages, roads and waterways have usually deep and fertile soil and are convenient for management. *Paulownia* is planted in strips and plots as appropriate beside villages and houses with 5x5m or 5x6m in strips and is thinned in 5 or 6 years. Along roads and waterways they can be planted in rows, one row on each side, 4-5m apart.

The initial planting should be 6x6, 5x5 or 5x4m, with 278, 400 or 500 seedlings/ha, respectively. Trees are thinned at 5-6 years old. Alternate rows are removed. Overall thinning is carried out later when they grow larger. The density should remain flexible and suited to local situations in mountainous regions.

Mixed forest and combinations of trees, bushes and grasses are also effective for preventing serious diseases and insect attacks. As a light-demanding tree, *Paulownia* is not suitable for mixing with fast growing trees such as *Salix, Ulmus, Robinia, Ailanthus altissima, Pterocarya stenoptera* etc. But, it is suitable for raising mixed forest and for intercropping with food or other agricultural crops. Between or under the *Paulownia* trees, *Fraxinus chinensis, Morus sp., Paeonia ssp*., and medicinal plants, and ginger, celery, etc shade tolerant vegetables, *Coriaris sinica, etc.* green manure crops may be cultivated.

As large areas of pure *Paulownia* forest are liable to to be attacked by diseases and insect pests. Primary planting should not be very dense. On the other hand, the sparse planting allows high penetration and encourages the vigorous growth of weeds and bushes and brings difficulties in tending and management. Special consideration should be given for the growth of mixed forests or intercropping in *Paulownia* plantations.

Holes for *Paulownia* seedlings are 70-80 cm wide and 50-60 cm deep. Surface soil and subsoil is seperated when digging the holes and the surface soil is put into the hole first before the seedling is planted**.** Sapling grown in a nursery or root cutting is directly planted in the afforestation area.

High quality sapling should be selected. Tall sapling is not planted in poor soil and place with strong wind. The root should be retained as far as possible. Sapling 4-5 m heigh require root lenght of 40-50 cm. *Paulownia* is planted shallowly. The depth of the planting in field should be 6-10 cm deeper than the sapling in the nursery. After planting, earth is heaped up around the sapling to a height of 15-20 cm. To encourage fast growth and high yield, protection, tending and mangement of the young forest is important, especially during the first three to four years.

The bark of the sapling and young tree is very thin. Injuries heal with difficulty and damage timber quality. So, bark injuries caused by various agencies, physical impact and damage by animals should be avoided after planting. Freeze injury and sunscald should be prevented in 1-2 years old trees. Timely and regular watering is carried out especially in the dry season. Flooding causes most damage. A well-constructed drainage and water run off system is essential.

After planted in the field, according to size of sapling, five to six pairs of lateral buds should be retained in the first year. Pruning begins in the third or fourth year after planting, according to the growth. Nearby branches and unnecessary lateral branches of the same tree are removed. The best of the lateral branches is retained only. Through pruning and tending the tree trunk can extend rapidly. The previously retained branches on the crown are completely removed in winter or spring within less than two years.

The time for thinning *Paulownia* plantations is related to initial planting density. In a plantation with 5x5m or 5x6m initial spacing as well as in avenue and intercropping forests with 3-5m spacing the first thinning should be done five to six years after planting. In an intercropped plantation with 5x10 or 6x12m spacing the first thinning with one row removed and one row retained in fifth or sixth year of planting.

Manipulation with the crown starts with 3-4 year old trees having low stems and, not suitable branches for trunk extension. In spring, around two weeks before active growth, a dormant bud near the trunk is selected. A wound perpendicular to the branch is made with a knife at a position 2-3 cm above the bud, about 1 cm wide, and two-thirds of the way through the branch. The crown should be thinned to prove better nutrition for the remaining branches. All these would help the vigorous growth of the branch normall 4-5 m tall. After the trunk extension comes up, most of the branches on the original crown should be removed before or during the winter of the same year or in the following spring. It should not be assumed that taller trunk is better extension. Under poor site conditions or in strong winds, excessively tall trunk is not good. So, the crown extension method should be chosen according to local conditions, the status of the trees and the level of the management. Occasionally double trunk may sprout out from a single stock.

2. Material and Method

2.1.Material

Seeds of 16 provenances of three *Paulownia* species (*P.tomentosa*, *P.elongata*, *P.fortunei*) and a hybrid (*P.fortunei* x *tomentosa)* were sown (Table 2) into Trabzon –Of Forest Nursery by Eastern Black Sea Forestry Research Institute (AYAN et. al. 2002; ANON 1998).

2.2. Method

Alive seedlings were numbered and height were measured at cm level every year. Heights were analysed by Anayses of Variance and by Newman Keuls Test in TARIST Proggramme. Model 7 were used for Analysis.

Table 2. Species and provenances of *Paulownia* used

Prov. No	Species	Provenance	Altitude	Mean Annual Precip. (mm)	Mean Annual Temp. (C°)	Lowest Temp. (C°)
1	*P.tomentosa*	Shannxi-Xi'an	1200	470	9.3	-15
2	*P.tomentosa*	Henan-Luoyang	100	640	14.2	-10
3	*P.tomentosa*	Shannxi-Taiyuan	750	604	13.3	-10
4	*P.tomentosa*	Shangdong-Chenwu	40	672	14.2	-10
5	*P.tomentosa*	Beijing-Daxin	50	682	11.6	-18
6	*P.tomentosa*	Anhui-Tongling	120	1000	15.7	-7
7	*P.elongata*	Henan-Shanggiu	50	640	14.2	-10
8	*P.elongata*	Shannxi-Xi'an	750	604	13.3	-10
9	*P.elongata*	Anhui-Tongling	120	1000	15.7	-7
10	*P.elongata*	Beijing-Daxin	50	682	11.6	-18
11	*P.fortunei*	Guangxi-Guilin	560	1873	18.8	-2
12	*P.fortunei*	GuiZhaou-Xinren	1100	1200	15.3	-2
13	*P.fortunei*	Zhejiang-Lin'an	650	1200	16.1	-6
14	*P.fortunei*	Hubei-Hunan	20	1260	16.3	-7
15	*P.fortunei*	Anhui-Tongling	120	1000	15.7	-7
16	*P.fortunei* x *tomentosa*	Shen xIhnan				

2.3. Trial Sites

This study is a part of a project called *Introduction and Adaptation of Paulownia spp. in Turkey*. Four trial sites, established in the Eastern Black Sea Region, are Samsun-Carsamba (20m), Ordu-Camsan (50m), Ordu-Ulubey (900m) and Ordu-Golkoy (1400m). Containerized seedlings (1/0 aged) were planted in fall 1999 in 2 blocks, as five seedlings per plot by randomized trial plots method. Since torrent degraded the seedlings all in Carsamba site in June 2000, a new area in the most fertile agricultural sites was established in spring 2002 in Samsun-Terme (30m). It is a poplar cutting area. All seedlings in Golkoy (1400m) were died by frost during the winter 1999. There are actually three trial sites.

Climatic data of the trial sites are given in Table 3.

Ordu-Ulubey (900m): It is in the Sayacabasi Government Plantation area. Where soil depth is 21-40 cm, pH is 5.2-5.4 and acidic; soil type is sandy-clayey-wet clay and sandy-wet clay, salinity (EC) is 0.039 milisimens/cm and no problem, no lime, very less phosphorus, nitrogen is enough, and organic material is medium or high.

Ordu City-Camsan (50m): It is a private agricultural area. Where soil depth is 30-40 cm, pH is 7.6-7.9 and alkalen; soil type is sandy-clayey-wet clay and sandy-clay, salinity (EC) is 0.633-0.933 milisimens/cm and no problem, lime is medium, nitrogen is enough, and organic material is less or medium.

Ordu-Golkoy (1400m): It is is in the Golkoy Government Plantation area. Where soil depth is 21-40 cm, pH is 5.7 and acidic; soil type is sandy-wet clay, salinity (EC) is 0.027-0.037 milisimens/cm and no problem, no lime, very less phosphorus, nitrogen is enough, and organic material is medium or high.

Samsun-Terme (30m): It is in the Golardi Government Plantation area. Poplar (*Populus euroamericana* I-214) trees has been harvested yet. Where soil depth is 40-50 cm, pH is 7.0-7.5 and alkalen; soil type is sandy-wet clay and wet clayey-clay, no salinity problem, and organic material is medium or high.

Samsun-Carsamba: It is (20m) a private agricultural area. Where soil depth is 20-30 cm, pH is 7.2-7.8 and alkalen; soil type is wet clayey-sand and sandy-wet clay, salinity (EC) is 0.282-0.684 milisimens/cm and no problem, fertile by lime (0-9), enough nitrogen, and organic material is medium or high.

Table 3. Some data of three meteorology stations within the project areas

Station Name	Obs. Year	Alt. (m)	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yearly Total
			Monthly Mean Rainfall (mm)												
Ordu	60	4	119	102	103	76	56	73	80	76	102	124	136	130	1177
Mesudiye	24	1050	55	47	52	68	75	44	10	9	28	40	46	65	540
Terme		4	81	70	73	56	44	40	35	31	57	72	89	86	735
			Monthly Mean Temperature (C°)												Ye.Mean
Ordu	27	4	6.5	6.7	7.7	11.3	15.3	19.8	22.2	22.1	19.0	15.3	11.7	8.7	13.9
Mesudiye	18	1050	-1.9	0.2	3.4	7.9	12.3	15.0	17.3	17.1	14.1	9.9	5.5	0.8	8.5
Terme	-	4	6.9	6.9	7.7	11.0	15.6	20.0	23.0	23.2	19.8	16.2	12.9	9.5	14.4
			Monthly Mean Relative Humidity (%)												Ye.Mean
Ordu	27	4	69	72	77	79	80	75	76	76	76	77	72	69	75
Mesudiye	18	1050	69	68	66	64	65	64	64	66	67	68	68	71	66
Terme	-	4	68	70	74	76	78	74	72	72	73	73	69	66	72

2.4. Soil Working, Planting and Tending

Governmental areas were ploughed by a bulldozer and private areas and Terme site were worked by a farm tractor before planting of *Paulownia*. Seedlings were planted into 50x50cm and 30 cm deep holes with 4x4m spacing in fall 1999, but, in spring 2002 at Terme.

Seedlings were cut above ground level in spring 2000 to get healty and quality trunks. Except the best one, double trunks of a single stock were cut in fall 2000 and 2001; at that time some lateral branches were also removed.

3. Findings

Alive seedling was numbered and heights were measured at cm level in fall 2000, 2001 and June 2002. Survival was calculated from number of alive trees. Average heights and survival percentage by provenances in Camsan and Ulubey in June 2002 (third year) are given in Table 4.

Table 4. Average Heights and Survival by Provenances in June 2002

Prov. No	Prov. Name	Altitude	Ulubey Site (900m)		Camsan Site (50m)	
			Height (cm)	Survival (%)	Height (cm)	Survival (%)
1	Shannxi-Xi'an	1200	101,3	70	189,6	50
2	Henan-Luoyang	100	88,3	100	257,4	100
3	Shanxi-Taiyuan	750	126,5	90	231,8	90
4	Shangdong-Chenwu	40	110,6	90	203,1	90
5	Beijing-Daxin	50	133,3	80	205,6	90
6	Anhui-Tongling	120	117,3	80	239,4	100
7	Henan-Shanggiu	50	123,0	90	155,6	60
8	Shannxi-Xi'an	750	145,9	90	195,1	70
9	Anhui-Tongling	120	158,9	50	206,3	70
10	Beijing-Daxin	50	122,2	90	203,2	100
11	Guangxi-Guilin	560	105,8	60	151,6	90
12	GuiZhaou-Xinren	1100	93,7	80	135,4	90
13	Zhejiang-Lin'an	650	140	70	149,6	100
14	Hubei-Hunan	20	124,8	60	180,4	90
15	Anhui-Tongling	120	143,8	90	193,4	90
16	Shen xIhnan		152,5	60	192,8	100

3.1 Height Growth and Seedling Survival in Trial Sites

3.1.1.Results in Ulubey Trial Site

Results of anaysis of variance showed no significant difference by heigth growth between provenances (Table 5). But the provenances number of 9 and 16 has the best average heigth (Table 4).

Table 5. Analysis of variance on average heights of provenances in Ulubey Site

Source of Variance	Degree of Freedom	Sum of Squares	Mean Squares	F Ratio	Alfa type error possbility
Repetition	1	3758,449	3758,449	2,105 ns	0,1647
Origin	15	13044,970	869,665	0,487 ns	0,9124
Error	15	26787,185	1785,812		
Total	31	43590,600	1406,148		

Results of anaysis of variance showed that, there is no significant difference by survival between provenances and blocks (Table 6).

Table 6. Analysis of variance on seeedling survivals of provenances in Ulubey Site

Source of Variance	Degree of Freedom	Sum of Squares	Mean Squares	F Ratio	Alfa Type error possbility
Repetition	1	0,174	0,174	0,000 ns	0,9331
Origin	15	4572,696	304,846	0,661 ns	0,7844
Error	15	6919,780	461,319		
Total	31	11492,650	370,731		

Mean seedling survival percentage at the trial site is 78.1%. Provenance 2 is the best with 100% and provenance 9 is the worst with 50% survival.

3.1.2.Results in Camsan Trial Site

Results of anaysis of variance showed that, there is no significant difference by heigth growth and survival between provenances (Table 7 and 8).

Table 7. Analysis of variance on average heights of provenances in Camsan Site

Source of Variance	Degree of Freedom	Sum of Squares	Mean Squares	F Ratio	Alfa Type error possbility
Repetition	1	17043,195	17043,195	3,867 ns	0,0653
Origin	15	33591,547	2239,436	0,508 ns	0,8992
Error	15	66103,510	4406,901		
Total	31	116738,252	3765,750		

Provenance 2 (with 257.4 cm) and provenance 6 (with 239.4cm) are the best, and provenance 12 is the worst with 135,4 cm by height growth (Table 4).

Table 8. Analysis of variance on seeedling survivals of provenances in Camsan Site

Source of Variance	Degree of Freedom	Sum of Squares	Mean Squares	F Ratio	Alfa Type error possbility
Repetition	1	5,095	5,095	0,013 ns	0,8762
Origin	15	5488,539	365,903	0,928 ns	0,5562
Error	15	5912,348	394,157		
Total	31	11405,982	367,935		

Mean seedling survival in trhe trial site is 86.25%. Provenance 2 is the best with 100% and provenance 7 is the worst with 60% survival.

3.2. Discussion of The Trial Sites Together

Results of anaysis of variance showed significant differences by heigth growth at 99.9 % between provenances (Table 9). So, Newman Keulls test was done (Table 10).

Table 9. Analysis of variance on average heights of provenances in two sites

Source of Variance	Degree of Freedom	Sum of Squares	Mean Squares	F ratio	Alfa Type error possbility
Repetition	1	18302,708	18302,708	5,958 *	0,0195
Trial Site (A)	1	75962,250	75962,250	24,728 ***	0,0001
Origin (B)	15	23090,167	1539,344	0,501 ns	0,9212
A x B	15	23616,662	1574,444	0,513 ns	0,9144
Error	31	95230,627	3071,956		
Total	63	236202,415	3749,245		

General mean seedling survival of the two trial sites is 82.25%. Provenance 2 is the best with 100% and provenance 1 and 9 is the worst with 60% survival.

Table 10. Comparison of average heights by provenaces in two trial sites

Original order	Mean Height (cm)	Arranged order	Mean Height (cm)	Homogenous Groups	
1. Ulubey Site	124,225	2. (Camsan D. S.)	193,128		
2. Camsan Site	193,128	1. (Ulubey D. S.)	124,225		
Hko:3071.956					

General mean heigts of the provenances are better in Camsan trial site in low altitude (50m) than Ulubey site in higher (900m) elevation (Table 10). But, variance analysis on survival of third year in two sites showed that there is no any significant difference.

By observation in spring 2000, it was determined that all seedlings had died during the winter 1999 in very high (1400 m) Golkoy trial site. Torrent in June 2000 degraded the seedlings in Carsamba trial site completely.

Potantintial *Paulownia* sites have generally similar ecological features with *Populus euroamericana* I-214 (Boydak, 1999). To compare them, since Carsamba site was degraded, Terme (30m) trial site was established in Spring 2002.

Three *Paulownia* seedlings planted for landscape into garden of Camsan Factory are good by height and dbhs.

4. Results and Discussion

1. The provenance 2 of *P.tomentosa* has the best height (257.4 cm) in Camsan trial site.

2. Height growth by provenances is very different at two sites. Being the second by heigth in two sites Provenance 9 of *P.elongata* is the best with average and provenance 12 of *P.fortunei* is the worst and being the latest in two sites (Table 4).

3. At nursery stage, the provenances number of 16, 2, 11 and 14 were the best, respectively (AYAN et. al 2002).

4. At the field, provenance 16 seems as good height and being the best in Ulubey, Provenance 2 is the best by height at Camsan, but the latest at Ulubey.

5. Since all seedlings had died during the winter 1999 in (1400 m) Golkoy, it is possible to say that similar very high elevations and sites in the Eastern Black Sea Region are not suitable for *Paulownia*.

6. At that time, there is no any important insect or fungi problem at the trial sites.

7. Strong snow during the winter 2001 damaged the seedlings at Ulubey site. So, seedlings are generally ambiguous.

8. Mean height of three *Paulownia* seedlings that is three aged planted into garden of Camsan Factory is 5.7 m (min-max: 4.8-7.2 m), and mean dbh is 7.9 cm (min-max: 7.0-9.5 cm). So, it is advisable to plant *Paulownia* for landscape in the Region.

9. *Paulownia* tree shold be studied with two very important agricultural crops *Thea* and *Corylus* together in the region.

Acknowlegements

Thanks to Vildane GERCEK and Aysegul SAHIN in nursery stage, and colleagues and others in nursery and plantation stages for their assistance.

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