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Variations among families of *fraxinus ornus* L.

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ABSTRACT

Progeny test is one the most important stages of tree breeding programme to obtain higher quality and quantity forest product per area. It has also valuable contribution for future management practices of forest tree populations. Variations among families, estimate narrow-sense heritability (h_i^2), and correlations were examined in sixth year field test of a progeny test in Manna ash (*Fraxinus ornus* L.) based on seedling height, root collar diameter, and also survival.

Averages of survival, seedling height and root collar diameter were 78.1%, 161.7 cm and 2.3 cm, respectively, while there was large difference among families and within family for the characteristics. Significant differences ($p \leq 0.05$) were found among the families for root collar diameter according to results of analysis of variance. Significant phenotypic correlations ($p \leq 0.05$, $r = 0.644$) were found only between seedling height and root collar diameter according to results of correlation.

The narrow-sense heritability (h_i^2) was 0.382 for seedling height, 0.051 for root-collar diameter.

KEYWORDS

Height;
Diameter;
Progeny trial;
Fraxinus;
Breeding;
Survival.

INTRODUCTION

Turkey has three natural ash species, *Fraxinus excelsior*, *F. ornus* and *F. angustifolia*, which cover 11700 hectares[1]. In these species, Manna ash (*Fraxinus ornus* subsp. *cilicica* L.) occupy in arid zones of Mediterranean region in Turkey. It also occupies in France, Spain, Italy, Syria and Balkan countries[2]. Wood of the species is an important material for such as furniture, ornamental, charcoal and music industries. Besides, oil is extracted from its bark used in medicinal purposes[3]. In addition to the species is very resistance to aridity, forest fire[4], and climate change[5]. These characteristics of the species are getting importance of increasing of present occupation by plantation forestry. Improved seedling material is one of the most important factors in success of biological and economical in plantation forestry. Genetic-breeding studies including progeny test has contributive ways to produce improved seedling. However, studies on its genetic-breeding and other silvicultural practices has very limited on the species[6-10].

This study carried out on progeny trial of Manna ash was based on variation, correlation and heritability for survival, seedling height and root collar diameter of sixth year's result to contribute breeding of the species.

MATERIAL AND METHODS

Data collection

Morphological data (Seedling height, root collar diameter, and survival) was collected in sixth year field test of seedlings belong to 28 open-pollinated families also as genotype planted at an experimental area (latitude 37°452 N, longitude 30°352 E, altitude 1050 m) as three replicates and ten seedlings each replicate at 2x2 m spacing in 2009 (Figure 1). Seedling height (SH), root collar diameter (RCD), and also survival (S) data were measured in all survival seedlings at the end of sixth growth period.

Figure 1 : A view from the field of progeny test

Data analysis

Following model of ANOVA was used for the statistical analysis by SPSS statistical package[11]:

$$Y_{ijk} = \mu + F_i + B(F)_{j(i)} + e_{ijk}$$

where Y_{ijk} is the observation from the k^{th} seedling of the j^{th} genotype in the i^{th} block, μ is overall mean, $B(F)_{j(i)}$ is effect of the j^{th} genotype in the i^{th} block, and e_{ijk} is random error.

Individual heritability (h^2; narrow-sense heritability) for seedling height and root collar diameter was estimated as[12]:

$$h_i^2 = \sigma^2_A / \sigma^2_u$$

where σ^2_A is the additive genetic variance, σ^2_u is the phenotypic variance for the characters.

Correlations between seedling height and root collar diameter were also calculated.

TABLE 1 : Averages of survival in families (%)

Family No	survival (%)	Family No	survival (%)
1	76.2	15	85.0
2	100.0	16	60.0
3	85.7	17	80.0
4	75.0	18	65.0
5	81.3	19	75.0
6	76.2	20	72.2
7	66.7	21	73.7
8	85.7	22	80.0
9	91.7	23	73.7
10	69.2	24	78.6
11	72.2	25	75.0
12	83.3	26	80.0
13	70.6	27	80.0
14	61.1	28	90.0
Total		78.1	

RESULTS AND DISCUSSION

Survival

Average of survival was 78.1% ranged from 65% to 100% (TABLE 1, Figure 2). It was reported 80.8% in fifth year result of progeny test[10]. Survival could be one of the most important criterions in evaluation of successful of plantation biologically and economically[10]. It was also an indication of adaptability to different areas of the species, and large variation in the species. However, the study has six year data. Survival could change from year to year, and it could be early for decision on the best genotype family based on survival[10].

Seedling height

Average of seedling height was 161.7 cm in polled families (TABLE 2). It varied between 146.6 cm and 185.1 cm (Figure 3). Averages of seedling height were 7.05 cm at one year old[6],143 cm at four year[9] and 149.5 cm in at fifth year of the genotypes[10]. Height differences among families were also observed within

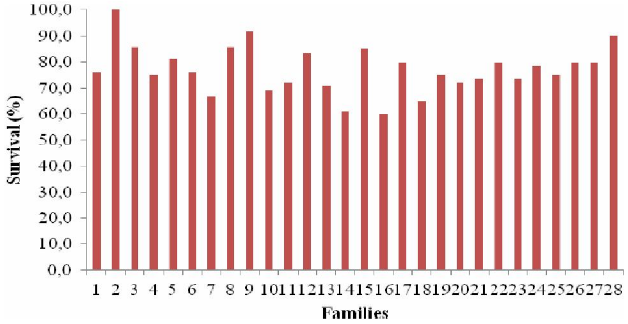

Figure 2 : Survival of the families

TABLE 2 : Averages, ranges and coefficient of variation (%) for seedling height

Family no	average	minimum	maximum	Coefficient of variation	Family no	average	minimum	maximum	Coefficient of variation
1	171.6	125	271	23.5	15	156.8	108	215	20.1
2	156.2	91	214	21.4	16	161.2	112	228	23.6
3	160.3	88	220	25.2	17	156.2	102	220	26.1
4	150.3	105	205	24.2	18	173.8	123	247	21.7
5	172.7	95	233	21.3	19	150.5	97	290	33.6
6	150.3	88	212	26.3	20	133.2	101	171	17.4
7	161.6	123	200	11.8	21	163.3	99	241	27.3
8	175.8	82	261	27.7	22	150.8	92	210	25.7
9	171.1	140	232	14.6	23	185.1	125	263	21.4
10	146.6	77	259	40.7	24	169.5	88	320	40.6
11	161.7	98	282	27.1	25	170.3	68	213	23.7
12	143.4	65	185	23.8	26	172.8	106	243	23.4
13	168.0	111	220	19.5	27	159.5	105	230	26.1
14	168.1	120	240	22.2	28	164.3	131	222	15.6
			Total			161.7	65	320	19.0

family (TABLE 2). The differences among and within family showed large variation of the species as also emphasized in the species[10] and different forest trees[13].

Large differences were also reported among families and within family based on fourth[9] and fifth[10] year results of the species[9], and also one year old seedlings of the genotypes[6]. However, the differences was not significant (*p>0.05*) according to results of analysis of variance. It was opposite to fourth and first year results[6,7,9], while well accordance with fifth year results[10]. It showed

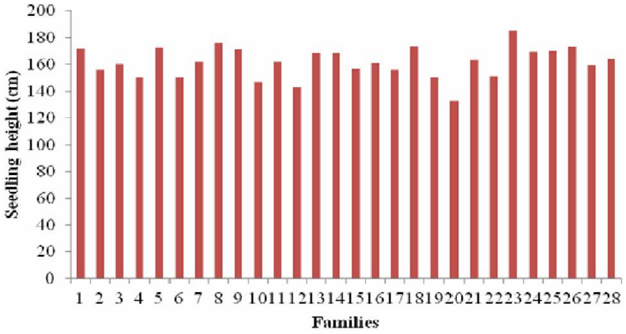

Figure 3 : Averages of seedling height of the families

TABLE 3 : Averages, ranges and coefficient of variation (%) for root-collar diameter

Family no	average	minimum	maximum	Coefficient of variation	Family no	average	minimum	maximum	Coefficient of variation
1	2.6	1.6	4.3	31.5	15	2.2	1.1	3.1	29.1
2	2.2	1.3	3.4	26.4	16	2.6	1.6	4.0	26.5
3	2.5	1.3	3.5	26.4	17	2.5	1.5	3.9	27.6
4	2.1	1.4	3.2	30.5	18	2.1	1.4	3.2	22.9
5	2.4	1.2	3.3	26.3	19	2.1	1.3	3.9	34.8
6	2.0	1.0	3.2	30.5	20	2.0	1.3	3.1	23.5
7	2.2	1.5	2.9	18.6	21	2.1	1.0	3.9	38.1
8	2.1	0.9	3.2	32.9	22	2.2	1.2	3.3	31.4
9	2.7	2.0	4.1	25.2	23	2.7	1.9	3.1	14.1
10	2.1	1.15	3.3	36.7	24	2.3	0.9	4.2	42.6
11	2.1	1.1	4.0	40.0	25	2.5	1.5	4.4	28.8
12	2.0	0.9	3.2	35.5	26	3.1	1.4	5.5	35.2
13	2.2	1.1	3.3	30.0	27	2.2	1.1	3.3	26.8
14	2.4	0.9	3.3	32.5	28	2.2	1.2	3.0	21.8
			Total			2.3	0.9	5.5	30.9

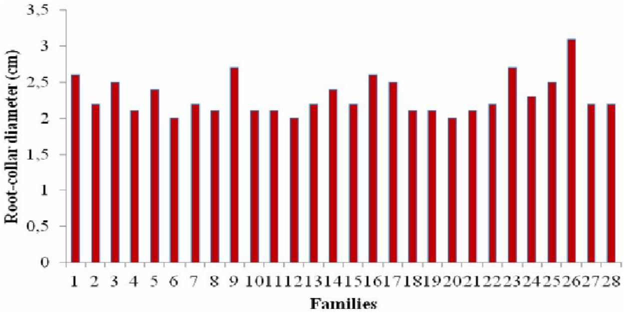

Figure 4 : Averages of root-collar diameter of the families

importance of long period observation.

Root-collar diameter

Average of root-collar diameter in polled families was 2.3 cm, ranged from 2.0 cm to 3.1 cm in families (TABLE 3, Figure 4). Large difference was also found within family. However, the differences was also supported by results of ANOVA ($p<0.05$), opposite to early results in the species[6,7,9,10]. Averages of root collar diameter were 2.95 mm on one year old seedlings of the genotypes[6], and 19 mm on fourth year results of the field test[9]. It showed importance of long period observation to accurate decision on the better family for resistance to arid and semi-arid areas.

Correlations

Statistically significant ($p<0.05$, r=0.644) and positive correlations were found between seedling height and root- collar diameter. The results well accordance with early studies on the species[6,9,10]. The results could be used for selection of genotypes in plantation forestry and other purposes[10]. The relation between seedling height and root- collar diameter were also showed in Figure 5.

Heritability

The heritability in narrow-sense (h_i^2) reflects the share of the variation that depends on the genotypes was very low. It was 0.382 for seedling height, 0.051 for root-collar diameter. The result showed that environment seems to be more important for growth performance of genotypes than their genetic constitution in the species. Low heritability was also reported between characters in the species[6,7,9,10].

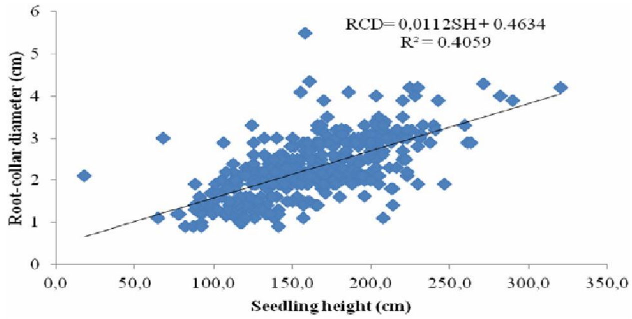

Figure 5 : Relation between seedling height and root- collar diameter

CONCLUSIONS

It was clear that it was needed to collect more data on future years from the experiment to draw accurate conclusions. The studied genotypes were sampled in limited area of the species. New studies should be conducted by large genotypes and seed sources as concluded early studies.

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