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Fertility variation and effective number of parent in a Taurus cedar (*Cedrus libani* A. Rich.) population

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ABSTRACT

Fertility variation and effective number of parent were estimated based on mature cone production in a natural population of Taurus cedar (*Cedrus libani* A. Rich.). Interactions between cone production and growth characters were also investigated in the present study. Average of number of cones per tree was 57, while there were large differences among individuals within population. The fertility variation estimated proportion of the numbers of cone counted from individuals in the population was 1.52. The effective number or parents was 32.8 (65.6% of census number) in the population. Age, height, diameter at breast height and crown diameter have no significant ($p>0.05$) effect on cone production. Results of the study were discussed based on silvicultural and genetic-breeding practices of the species. © 2014 Trade Science Inc. - INDIA

KEYWORDS

Cedar;
Coancestry;
Growth;
Reproductive;
Sibling coefficient.

INTRODUCTION

Taurus cedar (*Cedrus libani* A. Rich), which has the largest natural distribution mainly on the Taurus Mountains in southern Turkey Figure 1[1] is classified as one of the most economically important species for Turkish forestry and the "National Tree Breeding and Seed Production Programme"[2].

It is known that fertility data have important roles in economical and biological success of plantation forestry and breeding programme. Variation in fertility is also one of the major factors in the evolution and genetic management of population[3], and fertility variation of trees has important implications in forest tree breeding[4,5,6,7], and gene conservation programs[8]. However, genetic studies included fertility variation are very limited in Taurus cedar.

The purposes of this study are to estimate the fertility variation and effective number of parent, and to examine the interactions between cone production and growth characters in a natural population of Taurus cedar to contribute silvicultural and genetic-breeding strategy of the species.

MATERIAL AND METHODS

The numbers of mature cone Con, Figure 2 and growth data (Age, A; three height, H; diameter at breast height, DBH; crown diameter, CD) were assessed from 50 trees chosen randomly in a natural population of Taurus cedar at the end of October 2013. The population is located at latitude 38°06'

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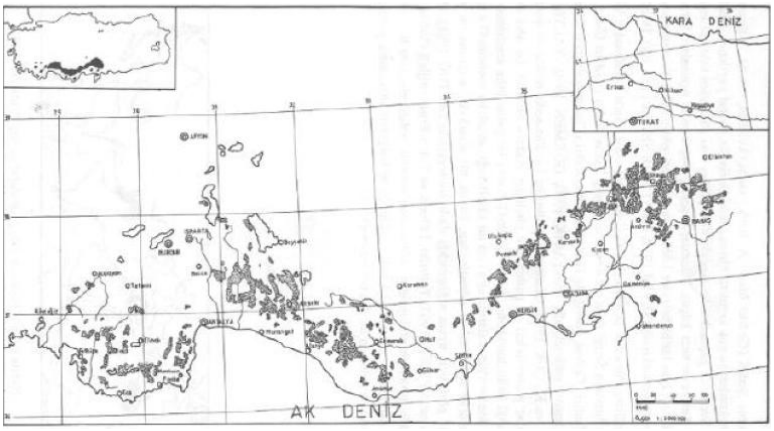

Figure 1 : Natural distribution of the species in Turkey

Figure 2 : Mature cones of the species

N, longitude 30°40' E, and average elevation 1650 m.

Fertility variation as the proportion of the number of cones counted from individuals in the population was estimated based on the number of cones (Ψ_c) as[9]:

$$\Psi_c = N\sum_{i=1}^{N} Con_i^2 \quad (1)$$

where N is the census number, c_i is the fertility for cone production of the individual i.

The effective numbers of parent (N_p) was estimated based on census number (N) and fertility variation (Ψ_c) as[10]:

$$N_p = N/\Psi_c \quad (2)$$

Correlations among cone production and growth characters were also calculated by Pearson's correlation using SPSS statistical package program.

RESULTS AND DISCUSSION

Cone production and growth characters

Averages of cone production and growth characters were presented in TABLE 1. Average of cone production was 57. However, individual trees showed large differences for cone production in the population TABLE 1. It was known that the differences could be genetic[11], as well as influenced by environmental factors[12] and management of strategy[13].

In the present study, cone and growth data were collected from only one year and one population. Therefore, it was needed to collect more data on fertility variation to draw accurate discussion. Large differences in fertility among trees were reported in populations[14-20], and also among years[21].

Fertility variation and effective number of parent

Cone fertility variation (Ψ_c), effective numbers of parent (N_p), and relative effective numbers of par-

TABLE 1 : Averages, standard deviation and ranges of cone production, and averages of growth characters in the population

Cone Production			
Average	**Standard deviation**	**Minimum**	**Maksimum**
57	43.2	10	245
Growth Characters			
H (m)	**DBH (cm)**	**CD (cm)**	**A (year)**
16.3	28.9	606.6	49.2

TABLE 2 : Fertility variation (Ψ_c), effective number of parents (N_p) and relative effective number of parent (N_r) in the populations

Ψ_c	N_p	N_r*
1.52	32.8	65.6

*; $N_r = N_p/N$

TABLE 3 : Relations between cone production and growth characteristics

	H	DBH	CD	A
Cone production	-0.65 (*p>0.05*)	0.204 (*p>0.05*)	0.124 (*p>0.05*)	0.015 (*p>0.05*)

ent (N_r) were presented in TABLE 2.

The fertility variation was 1.52 (65.6% of census number) in the population TABLE 1. Estimated fertility variation in the present study could be acceptable level for typical natural populations. However, it is expected to close to 1 for ideal population. Thus, Ψ=1 means that there is an equal contribution of individual to gamete gene pool in the population (*CV* = 0). It was suggested that the sibling coefficient (Y) of natural stands as a heuristic rule of thumb could be set to three (Ψ = 3)[22]. It could be balanced by traditional or genetical forest tending (e.g. removing of unproductive tree) or equal cone harvesting each individual seed tree, when the populations were selected seed collection or gene conservation area.

Interaction of cone production and growth characters

Studied growth characters had no significant (*p>0.05*) effect on cone production TABLE 3. This result was well in accordance with the results of some studies[23], correlations changed in populations, tree species and also years in many studies[24-29]. For instance, while positive correlations among growth and reproductive characters were reported in *Pinus sylvestris*[30] and in *Picea abies*[31], while negative correlations were reported in *Pinus sylvestris*[32] and in *Pinus taeda*[33].

CONCLUSION

It is needed to collect more data on fertility variation from different populations to draw accurate conclusion. However, cone and growth data were collected from only one year in the present study.

Large differences for cone production among individual trees emphasized importance of individual selection in higher cone production. Fertility variation was close to ideal population. It could be balanced by forest tending.

Nonsignificant effect of the growth characters on cone production showed importance of environmental factors (i.e., altitude) effect on selection of seed collection area.

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