SERİ SERIES SERIE SÉRIE	A	CİLT VOLUME BAND TOME	44	SAYI NUMBER HEFT FASCICULE	2	1994

İSTANBUL ÜNİVERSİTESİ

ORMAN FAKÜLTESİ

D E R G İ S İ

REVIEW OF THE FACULTY OF FORESTRY,
UNIVERSITY OF ISTANBUL

ZEITSCHRIFT DER FORSTLICHEN FAKULTÄT
DER UNIVERSITÄT ISTANBUL

REVUE DE LA FACULTÉ FORESTIÈRE
DE L'UNIVERSITÉ D'ISTANBUL

EFFECT OF SOIL TYPE AND SOWING DEPTH ON GERMINATION AND SEEDLING ESTABLISHMENT OF THREE *Acacia* SPECIES

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Abstract

This study investigated the optimum soil type and optimum depth of sowing seeds of three *Acacia* species; *A. acuminata, A. aneura* and *A. ephedroides*. Three soil types were used; Field soil, pure pine forest soil and mixture of both with five sowing depths; 0.5, 1.0, 1.5, 2.0 and 2.5 cm. The rate of seed germination and survival of germinated seeds were the principal indicators of the suitability of various types of soil and depths. Results indicated that, highest germination percentage of *A. acuminata* seeds was obtained from seeds sown at 1.5 cm depth, and the highest survival of seedlings was reached by 2.0 and 2.5 cm depths in field soil. Highest germination of seeds and highest survival of *A. aneura* seedlings was the best at 1.5 cm in field soil. Whereas sowing seeds of *A. ephedroides* in soil mixture at 0.5 and 1.5 cm depths gave the highest germination percentage of the seeds, and at 2.0 cm depth in field soil gave the highest survival percentage of the seedlings. Generally, results indicated the decreasing of the survival percentage of the seedling with increasing sowing depths. As for the best germination and survival of seedlings, the best soil was found to be the field soil followed by the mixture then the pine forest soil.

1. INTRODUCTION

Acacia species are generally robust, wide ranging plants, easily adapted to harsh environment, and generally very suitable for arid zones. (*HALL, et al.* 1972; FAO, 1989). The species under consideration have been recommended as drought fodder, fuelwood, posts, poles, fencing, turnery, shelter and shade, soil stabilization, ornamental and road side plantations. Therefore, the species are found to be special importance to Jordan. (*HALL, et al.* 1972; *DORAN /TURNBULL/BOLAND/GUNN*, 1983; FAO, 1989).

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Yayın Komisyonuna Sunulduğu Tarih: 12.06.1995

A. acuminata is generally grown in complex or uniform well drained soils. This species is suited to deep sandy loams, excellently suited to deep loams, moderately suited to shallow sands, and completely unsuited to clay profiles, with neutral pH. (NEWBEY 1982).

A. aneura grows most plentifully on flood and erosional plains and in broad valley heads. Soil types vary but the denser stands are usually found on red earths and sands or red clayey sands and sometimes on sandy gravels. (BOLAND et al., 1984). This widespread adatable species on deep loamy soils. (BOOMSMA 1981). Information on *A. ephedroides* was not available.

Mineral soil is a good seedbed because of it's high infiltration rate, adequate aeriation, and close contact between soil particles and seeds. Litter and duft often are less suitable than mineral soil because they warm slowly, inhibit root penetration, prevent seeds from contacting the mineral soil, dry rapidly, and shade small seedlings. (KRAMER/KOZLOWSK, 1979).

Sandy loam and coarse sand all have poor water relations because of their poor available water holding capacity. (BEARDSELL/NICHOLS/JONES 1979).

Seeds sown at a depth of 1-3 times of their diameter, with adequate moisture and optimum temperature will hasten their germination. Excessively deep sowing will impair seedling emergence. (FAO, 1989). Seeds on the surface tended to dry out. The deeper the seed is buried, the less is the likelihood that it will successfully establish a seedling. (JOYCE, 1987). deep burial of the seed produces a long hypocotyl, and the increased tendency for "buckling" tends to reduce the effective axial force of the seedling. A shallow position of the seeds in the soil may teherfore be advantageous to seedling establishment. The depth of sowing also influences aeration, as well as penetration of light. It is possible that beyond a soil depth critical for the plant species, the low temperature may restrict germination (BYWATERS/OSBORNE/FOX 1983).

The aim of this work therefore, is to find out the optimum soil type and optimum depth of sowing seeds of three *Acacia* species.

2. MATERIALS AND METHODS

Seeds of three *Acacia* species *(Acacia acuminata* Benth., *Acacia aneura* F. Muell. ex Benth, and *Acacia ephedroides* Aff) were obtained from the Seed Centre of CSIRO Division of

Table 1 : Origins of seedlots of *Acacia* species
Tablo 1 : Orijinlerin coğrafi ve klimatik karakteristiği

Seed lot Kayıt no.	Species Türler	No of parent treest Ağaç sayısı	Locality of origin Orijin	Latitude Kuzey enlem 0 '	Longitude Boylam 0 '	Altitude Denizden yükseklik M
14098	*A. acuminata*	15	20 Km W Willuna WA	26 34	120 3	550
13718	*A. aneura*	5	MT Wedge Yuendemu NT	22 35	132 17	580
17663	*A. ephedroides*	6	Varley Rock WA	32 36	119 25	260

Forest Research on 7 the August 1991. Seeds of *A. acuminata* and *A. ephedroides* were pretreated with boiling water (100°C immersion for one min.), whereas seeds of *A. aneura* were pretreated with boiling water (pour and soak till cool) as it was recommended by the Centre. Table 1 includes summary of information on these species.

Seeds were sown in three different soils. These were field soil, pure pine forest soil, and mixture of the two soils (equal parts of field soil and forest soil). Table 2 shows some physical and chemical characteristics of these soils.

Table 2 : Information on soils used in the experiment
Tablo 2 : Araştırmada kullanılan topraklara ilişkin bilgiler

a- Soil fertility
a- Toprak verimliliği

Sample no. Numune no.	pH	EC dS/m Elektriki iletkenlik	P ppm	K ppm	Organic matter % Organik madde %	N %	$CaCO_3$ %
Field Soil	7.80	1.76	17.47	229	0.262	0.013	5.97
Forest Soil	7.80	0.50	3.28	535	5.98	0.30	16.70
FSoil+FrSoil 50 % + 50 %	8.05	0.30	12.55	382	3.40	0.17	12.30

b- Particle size distribution
b- Toprak tane boyutu dağıtımı

Sample no. Numune no.	Sand Kum %	Silt Toz %	Clay Kil %	Soil texture Toprak tekstürü
Field Soil	25	22.5	52.5	Clay (Kil)
Forest Soil	25	32.5	42.5	Clay (Kil)
FSoil+FrSoil 50 % + 50 %	22.5	32.5	45	Clay (Kil)

FSoil = Field Soil=Tarım toprağı, FrSoil = Forest Soil Soil=Orman toprağı

Five depths of seeding were selected for the trials : 0.5, 1.0, 1.5, 2.0 and 2.5 cm. A rod bearing markings corresponding to the various depths was used to bore ten holes in each pot. The number of pots bearing holes of each particular depth was two. Thus ten pots were available for each species/depth combination. A seed was dropped to the bottom of each hole, and covered with top soil. The planting of ten seeds per pot created twenty replications per treatment. The experiment was conducted at the experimental field at the Faculty of Agriculture, University of Jordan. The pots were placed on penches in open field situation fully exposed to the weather. Water was applied to maintain suitable germination conditions. After germination water was equally applied when it was necassary for the establishment of the seedlings. The experiment was conducted in Randomized Complete Block Design (RCBD).

The number of seeds germinated in each pot was daily recorded. The number of days to first germination (DF), percentage germination (FG), germination rate (GR), and percentage survival of germinants (Sur) were calculated for each species. The mean germination number quoted for the species 43 weeks after sowing, represents the sum of all the germinations (including deaths) which occurred during that period. Germination rate was calculated using this formula :

$$\text{Rate} = \frac{N_1\,\text{day}_1 + N_2\,\text{day}_2 + \ldots\ldots\ldots N_x\,\text{day}_x}{\text{Total number of seeds germinating}} \quad ;$$

Where N_1 is the number of seed germinating at day_1. This refers to the number of days from the start. Day_x is the last day on which germination occurred. (HARTMANN/ and /KESTER, 1975). All data was statistically analyzed using the MSTAT program, and mean separations were performed using Duncan's Multiple Range Test (DMRT). (LITTLE/HILLS, 1978).

The soil, forest soil and the mixture of both were analyzed for pH and EC (1:1 soil/water suspension), Olsen P, available K, organic matter (Walkley-black method), total nitrogen (micro-kjeldahl), carbonates (Calcimeter method), and particle size distribution (Hydrometer method). The procedures used for all above analyses are described in Methods of Soil Analyses (PAGE 1982).

3. RESULTS

I. Main effects

a- Species

A. aneura was the earliest and fastest germinated species. It gave the second highest germination percentage. *A. ephedroides* gave the highest germination percentage and the lowest survival percentage of seedlings, though it was not statistically significant, and with significantly higher germinatior rate. *A. acuminata* gave the lowest germination percentage, but the highest survival percentage of seedlings (Table 3).

Table 3 : Seed germination and seedling survival of three *Acacia* species.
Tablo 3 : Üç Akasya türünün tohum çimlenme ile fidan yaşama yüzdelerine ilişkin sonuçlar

Species Türler	Df	FG %	GR	Sur %
A. acuminata	15.13 ab	34.00 b	18.18 b	58.29 a
A. aneura	13.47 b	54.33 ab	16.61 b	58.11 a
A. ephedroides	18.33 a	61.67 a	25.61 a	32.78 a

Means within columns having different letters are significantly different at the 5 % level accordig to Duncan's Multiple Range Test (12).

b- Soil type

Seedlings originated from seeds sown in a soil from a cultivated field gave the highest levels of survival. On the other hand, seeds sown in forest soil were the earliest and fastest germinated seeds. However, the differences between the three soil types in all measured characters were not significant (Table 4).

Table 4 : Effect of soil type on seed germination and seedling survival of three *Acacia* species
Tablo 4 : Toprak tipi etkilediği üç Akasya türlerinin tohum çimlenmesi ile fidan yaşama yüzdelerine ilişkin sonuçlar

Soil type Toprak tipi	Df	FG %	GR	Sur %
Field Soil	16.07 a	51.00 a	21.39 a	64.71 a
Forest Soil	15.03 a	48.00 a	18.67 a	37.78 a
FSoil+FrSsoil	15.83 a	51.00 a	20.34 a	46.69 a

FSoil = Field Soil = Tarım toprağı, FrSoil = Forest Soil = Orman toprağı

b- Sowing depth

The 0.5 cm sown seeds and those buried up to 2.5 cm gave similar levels of germination. Seeds germinatied fastest from 0.5 cm burial and starts germination earlier and gave the second higher survival percentage of seedlings. However, no significant differences were found between all sowing depths in the final percentage of germination, germination rate and seedling survival percentage, whereas significant differences were found in the number of days to first germination between 0.5 and 2.0 cm depths only (Table 5).

Table 5 : Effect of sowing depth on seed germination and seedling survival of three *Acacia* species
Tablo 5 : Ekim derinliği etkilediği üç Akasya türlerinin tohum çimlenmesi ile fidan yaşama yüzdelerine ilişkin sonuçlar

Soil Depth (cm) Ekim derinliği (cm)	Df	FG %	GR	Sur %
0.5	14.00 b	52.78 a	18.25 a	53.99 a
1.0	16.44 ab	46.67 a	21.19 a	51.39 a
1.5	14.67 ab	55.56 a	20.22 a	56.25 a
2.0	17.28 a	47.78 a	20.11 a	42.72 a
2.5	15.38 ab	47.22 a	20.90 a	44.29 a

II- Interactions

a- Species x Soil type

A. acuminata and *A*. aneura seeds sown in field soil resulted in the highest percentage of

germination and highest survival of seedlings. However, seeds sown in the field soil were the earliest and the highest germination percentage, but the lower survival percentage of seedlings. However, the differences between the three soil types in all parameters measured were statistically not significant for all species (Table 6).

Table 6 : Interactive effects of species and soil types on seed germination and seedling survival of three *Acacia* species

Tablo 6 : Ağaç türü ile toprak tipi ortak etkilerinin etkilediği üç Akasya türlerinin tohum çimlenmesi ile fidan yaşama yüzdelerine ilişkin sonuçlar

Species Türler	Soil type Toprak tipi	Df	FG %	GR	Sur %
A. acuminata	Field Soil	14.7 a	43 ab	19.27 bc	76.72 a
	Forest Soil	13.7 a	30 b	14.87 c	44.83 ab
	FSoil+FrSoil	17.0 a	29 b	20.40 bc	55.33 ab
A. aneura	Field Soil	13.3 a	63 a	16.28 c	71.60 a
	Forest Soil	13.3 a	48 ab	16.80 c	37.61 ab
	FSoil+FrSoil	13.8 a	52 ab	16.74 c	65.11 ab
A. ephedroides	Field Soil	20.2 a	47 ab	28.61 a	45.80 ab
	Forest Soil	18.1 a	66 a	24.34 ab	30.90 ab
	FSoil+FrSoil	16.7 a	72 a	23.87 ab	21.64 b

FSoil = Field Soil = Tarım toprağı, FrSoil = Forest Soil = Orman toprağı

b- Species x Sowing depth

Earliest and fastest germination was obtained from 0.5 cm depth in seeds of *A. acuminata* and *A. aneura*. Emergence was started earlier at 1.5 cm depth in *A. ephedroides* seeds and fastest germination was in seeds sown at 0.5 cm depth. Highest germinaton percentage was obtained from seeds sown at 0.5 and 1.5 cm depth in seeds of *A. acuminata* and from depths of 1.5 and 2.0 cm in seeds of *A. aneura* and from depth of 2.0 cm in seeds of *A. ephedroides*. Best survival of seedlings was obtained from 1.0 cm depth in *A. acuminata* seeds, and in depth of 0.5 cm in *A. aneura*. Higher survival of *A. ephedroides* seedlings was reached when sowing seeds at 1.5 or 2.0 cm depths (Figure 1).

c- Soil type x Sowing depth

Germination of seeds was started earliest in seeds sown in forest soil at 0.5 cm depth. Seeds sown in soil mixture at 2.0 cm depth needed the longest period to start their germination. Highest germination percentage was reached from soil mixture at 0.5 cm depth. However, lowest germination was obtained from forest soil at 1.0 cm depth. Fastest germination was found in seeds sown in forest soil at 2.0 cm depth. However, lower germination (with higher germination rate) was obtained from seeds sown in soil mixture at 2.0 cm depth. Seedlings from field soil at 2.0 cm depth gave the highest significant survival percentage. Whereas, lowest survival of seedlings was resulted from soil mixture at 2.0 cm depth (Figure 2).

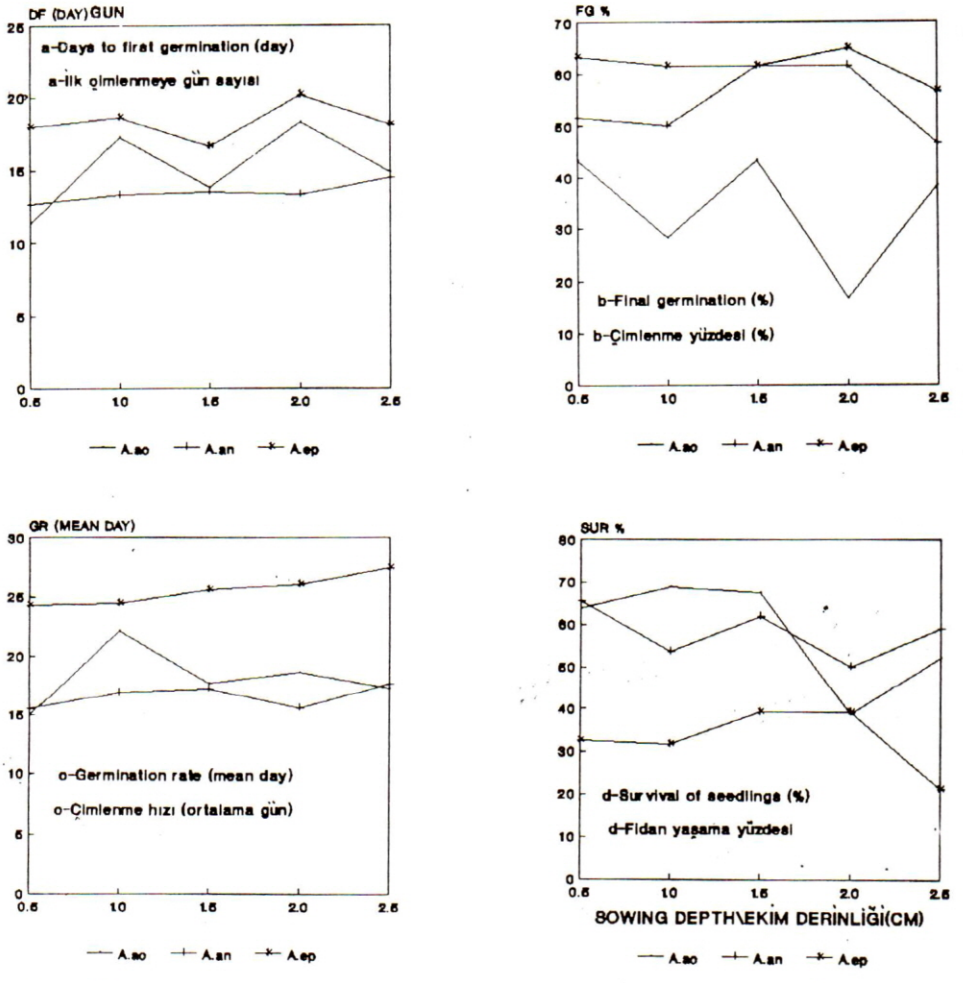

Figure 1 : (a-d) Effects of sowing depth on germination and seedling survival of three *Acacia* species

Şekil 1 : (a-d) Ekim derinliğinin etkilediği üç Akasya tohumu çimlenmesi ile fidan yaşama yüzdesi

d- Species x Soil type x Sowing depth

Earliest germination and highest germination percentage of *A. acuminata* seeds were obtained from seeds sown at (0.5, 2.0 cm) and at 1.5 cm depth in forest soil respectively. However, the lowest germination value was obtained from seeds sown in soil mixture at 2.0 cm depth. Seeds sown in forest soil at 0.5 and 2.0 cm depth. Seeds sown in forest soil at 0.5 and 2.0 cm depth were the fastest germinaed seeds. Highest survival of seedlings was obtained from seedlings originated from seeds sown in the field soil at 2.0 and 2.5 cm depths (Figure 3).

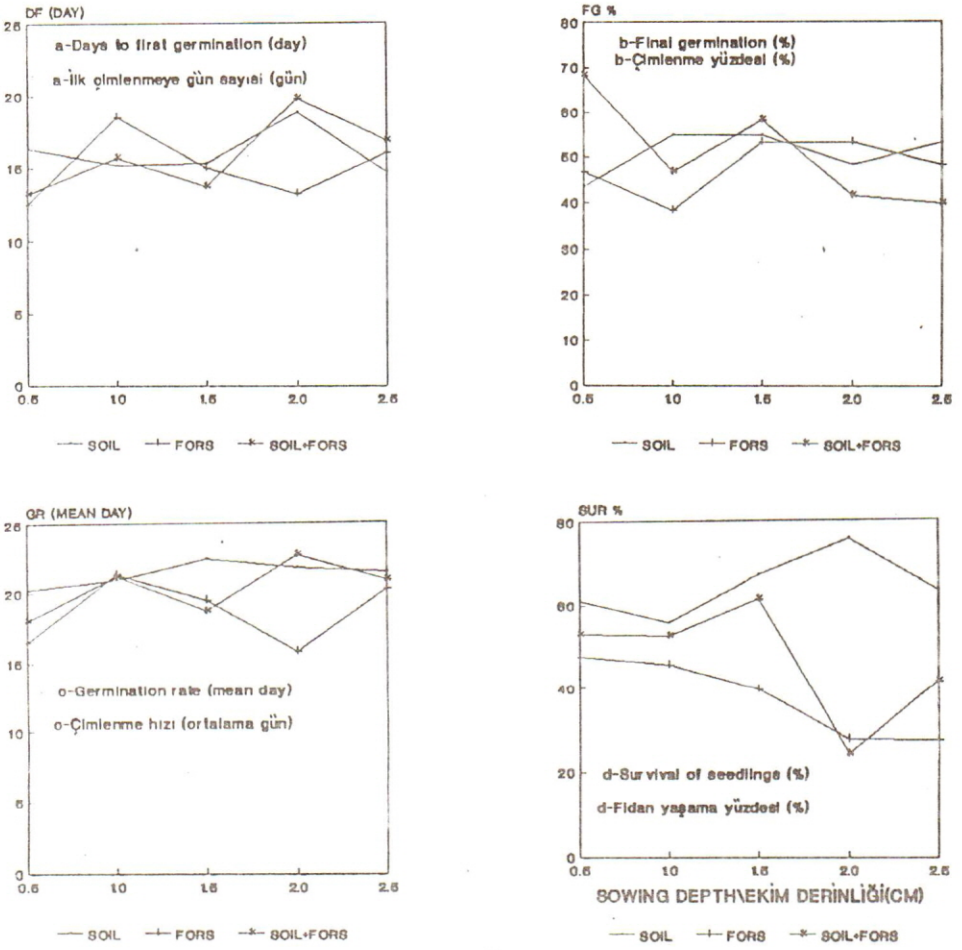

Figure 2 : (a-d) Seed germination and survival of three *Acacia* seedlings from three soil types and five sowing depths

Şekil 2 : (a-d) Üç Askasya tohumu çimlenmesi ile fidan yaşaması etkinlendiği toprak tipi ile ekim derinliği

Germination was started almost after equal periods in *A. aneura* seeds sown in the field soil at 0.5 and 1.0 cm depths and in seeds sown in soil mixture at 1.5, and at 2.0 cm depth in forest soil. Highest germination percentage was reached by seeds sown in te field soil at 1.5 cm depth. Germination of *A. aneura* seeds was fastest in seeds sown in field soil at 0.5 cm and in forest soil at 2.0 cm depth. Seedlings originated from seeds sown in the field soil at 0.5 and 1.5 cm depths, gave the highest survival of seedlings. Whereas, seedlings from forest soil almost gave the lowest percentage of survival (Figure 4).

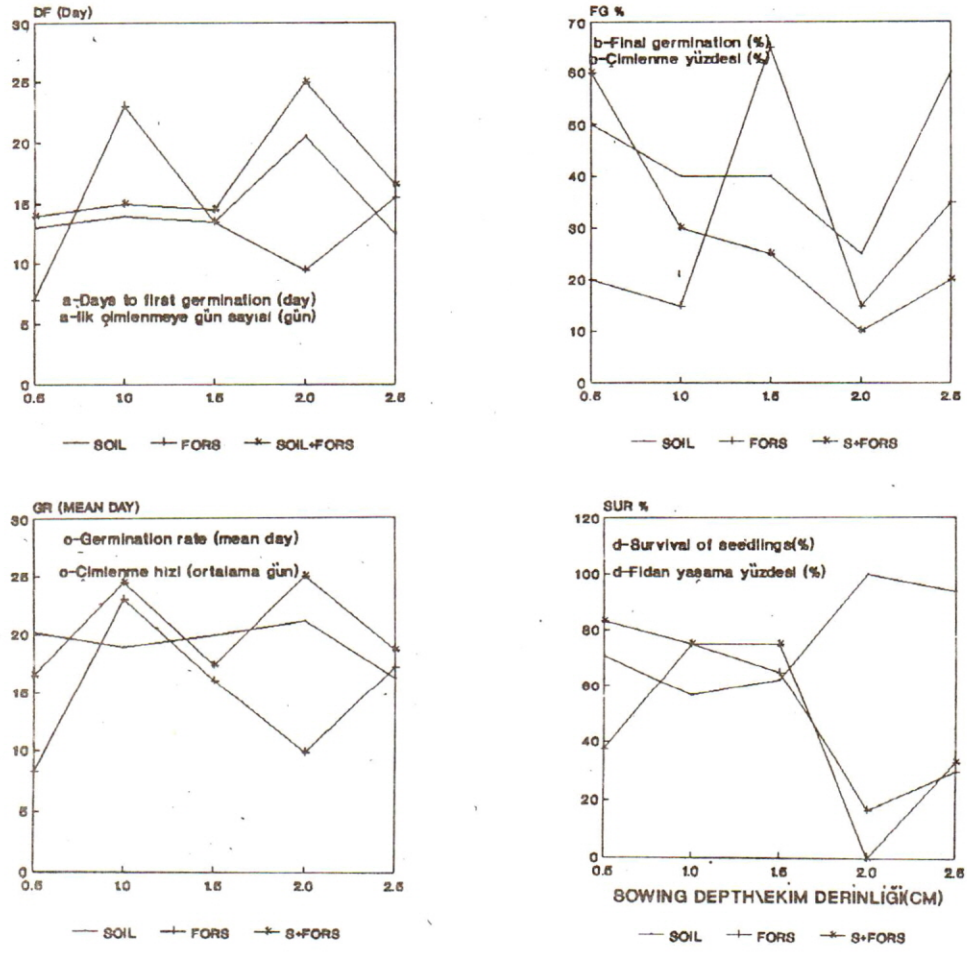

Figure 3 : (a-d) Seed germination and survival of *A. acuminata* seedlings
Şekil 3 : (a-d) *A. acuminata* tohumu çimlenmesi ile fidan yaşaması

Concerning *A. ephedroides* seeds, earliest germination was obtained from seeds sown in soil mixture at 0.5 cm and at 1.5 cm depths. Highest germination percentage of *A. ephedroides* seeds was reached by seeds sown in soil mixture at 0.5 and 1.5 cm dephs, and in forest soil at 2.0 cm depth. However, lowest germination percentage was obtained from seeds sown in field soil at 0.5 and 1.5 cm dephs, gave higher germination percentage as compared to sowing seeds in field soil and forest soil at the same dephts. Fastest germination of seeds was obtained from seeds sown in soil mixture at 0.5 cm. However, lowest germination of seeds with highest germination rate was obtained by seeds sown in field soil at 2.5 cm depth. Highest survival of seedlings was obtained from seeds sown in field soil at 2.0 cm depth, followed by seeds sown in the same media at 1.5 and 1.0 cm depths respectively (Figure 5).

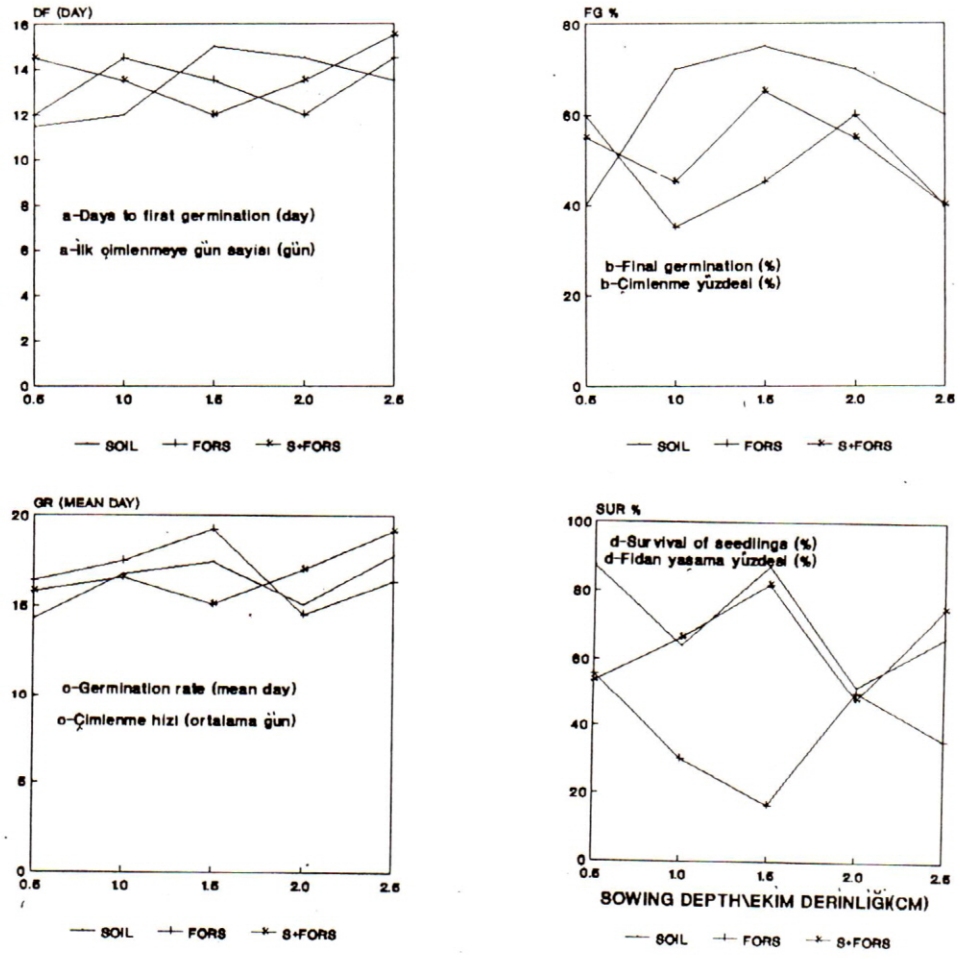

Figure 4 : (a-d) Seed germination and survival of *A. aneura* seedlings
Şekil 4 : (a-d) *A. aneura* tohumu çimlenmesi ile fidan yaşaması

4. DISCUSSION

MAIN EFFECTS

In order of best germination percentage, species were *A. ehedroides* > *A. aneura* > *A. acuminata*. The differences between species could be due to the fact that seeds of various species contain different amounts of storage material and therefore, have different needs for the onset of independent photosynthesisi. (BYWATERS, OSBORNE, FOX, 1983). In order of best survival at the end of the experiment (43 weeks), species were *A. acuminata* > *A. aneura* > *A. ephedroides*. The lower survival of *A. ephedroides* seedlings could be due to the small seeds of this species.

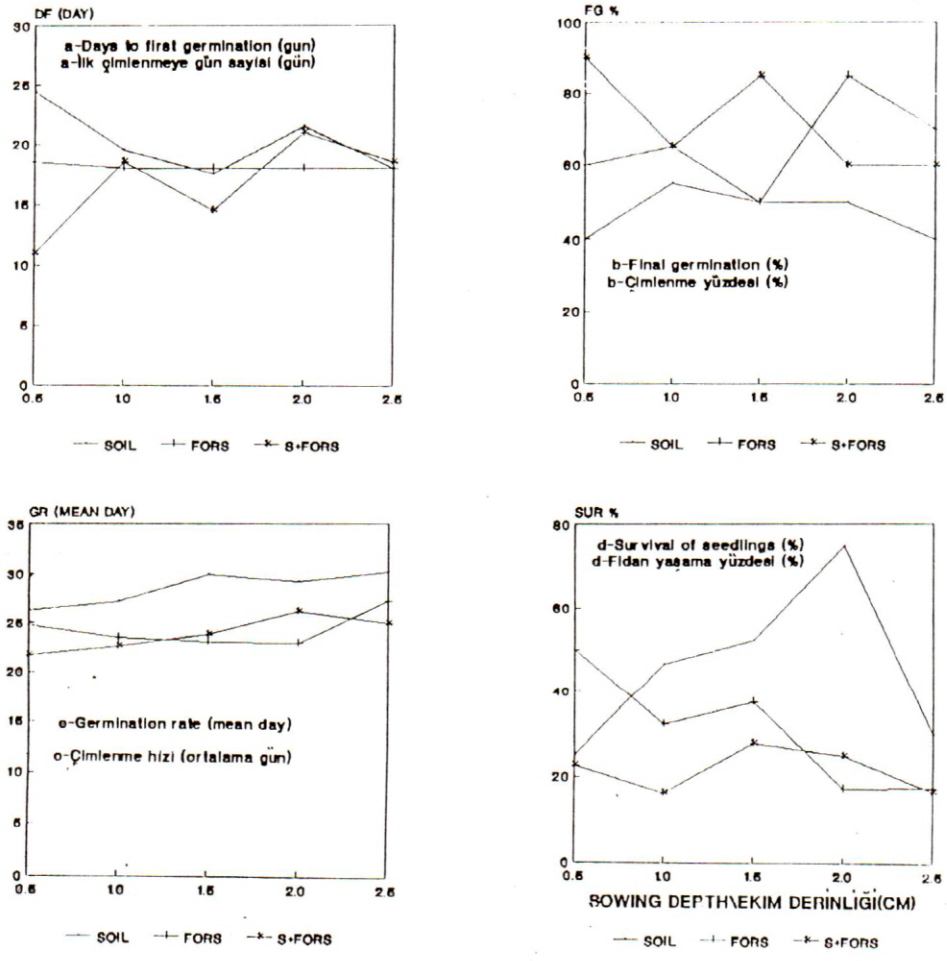

Figure 5 : (a-d) Seed germination and survival of *A. ephedroides* seedlings
Şekil 5 : (a-d) *A. ephedroides* tohumu çimlenmesi ile fidan yaşaması

Corcerning the soil, it seems that the field soil has better physical and chemical characteristics for the growth and development of the seedlings of the three species specially *A. acuminata*. The higher germination and survival percentages in field soil and soil mixture compared to forest soil, could be due to that mineral soil is a good seedbed because of it's low $CaCO_3$, high P, and adequate K content (Table 2), and because of it's high infiltration rate, adequate aeriation, and close contact between soil particles and seeds. Whereas, litter and duft in the forest soil often are less suitable than mineral soil because they warm slowly, inhibit root penetration, prevent seeds from contacting the mieral soil, dry rapidly, and shade small seedlings. (KRAMER and KOZLOWSK, 1979).

Results indicated that increasing sowing depth from 1.5 to 2.5 cm, survival was reduced by 45.49 % (Fig 1). On the other hand, sowing depth exceeding the 2.0 cm reduced the survival of all species. These results agree with the findings of (BYWATERS/OSBORNE/FOX, 1983) in that deep burial of the seed produces a long hypocotyl, and the increased tendency for "buckling" tends to reduce the effective axial force of the seedlings. The depth of sowing also influences aeriation, as well as penetration of light. It is possible that beyond a soil depth critical fort he plant species, the low temperature may restrict germination. A shallow position of the seeds in the soil may therefore be advantageous to seedling establishment and survival (Bywaters, Osborne, Fox, 1983). However, higher survival percentages were obtained from shallow depths ranging between 0.5-1.5 cm compared with those obtained from deeper sowing as 2.0-2.5 cm. As overall treatments shallow sowing of the seeds (0.5 cm) resulted in fastest germination of these seeds. The results are also confirming with FAO reports (FAO, 1989) in that excessively deep sowing will impair seedling emergence.

5. INTERACTIONS

The physical and chemical characteristics of the three soils (table 2) indicate that the cultivated soil is of high P content and low $CaCO_3$ and organic matter. The final germination percentage was higher is seeds of *A. acuminata* and *A. aneura* sown in field soil, except in the case of *A. ephedroides*, the percentage of germination was lower in the field soil. The survival percentage for all species was higher in the field soil than in either the forest soil or mixture. This could be due to the fact that this soil has lower $CaCO_3$ and higher in the field soil than in either the forest soil or mixture. This could be due to the fact that this soil has lower $CaCO_3$ and higher P content that helps in root development resulted in a well developed root system that affected the survival.

As over all treatments, large seeds of *A. aneura* can germinate from deeper depths. This seems to support the view that larger seeds have the energy reserves to germinate from deeper dephs. Small seeds of *A. ephedroides* gave higher germination percentage from deep sowing. These results did not support the general view that small seeds can't germinate from depth. (BYWATERS, OSBORNE, FOX, 1983).

As conclusion, best results of earliest and fastest germination of *Acacia acuminata* seeds were obtained from sowing seeds at 0.5 and 2.0 cm dephts in forest soil, an of highest germination percentage at 1.5 cm depth, and the highest germination percentage at 1.5 cm depth, and the highest survival of seedlings was reached from sowing seeds in field soil at 2.0 and 2.5 cm dephs. In *Acacia aneura*, best results of earliest germination was reached by 0.5 and 1.0 cm depths in soil mixture and by 1.5 and 2.0 cm depths in forest soil. Emergence of seeds was fastest at 0.5 cm depth in field soil and at 2.0 cm in forest soil. Highest germination percentage and highest survival of the seedlings was the best at 1.5 cm in field soil. In case of *Acacia ephedroides*, best results of earliest and fastest germination were at 0.5 cm depth in soil mixture. Highest germination was at 0.5 and 1.5 cm depth ins oil mixture. Highest germination was at 0.5 and 1.5 cm depths in soil mixture, and the highest survival of the seedlings was from 2.0 cm depth in field soil.

TOPRAK TİPİ İLE EKİM DERİNLİĞİNİN ÜÇ AKASYA TÜRÜ TOHUMLARININ ÇİMLENMESİ İLE FİDAN YAŞAMASI ÜZERİNE ETKİLERİ

Dr. M. Ali OMARI
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Abstrakt

Bu araştırmada üç Akasya türü (*A. acuminata* Benth., *A. aneura* F. Muell. ex Benth, ve *A. ephedroides* Aff) tohumlarının değişik toprak tipi (tarım, saf çam ve bu iki toprak tipinin karışımı) ile beş değişik ekim derinliği (0.5, 1.0, 1.5, 2.0 ve 2.5 cm) çimlenmesi ile fidan yaşaması incelenmiştir. Elde edilen sonuçlara göre, en yüksek çimlenme yüzdesi *A. acuminata* tohumlarının ekildiği 1.5 cm derinlik en yüksek fidan yaşama yüzdesi 2.0 ve 2.5 cm derinlikte tarım topraklardan meydana gelmiştir. *A. aneura* tohumları ise, en yüksek tohum çimlenmesi ile en yüksek fidan yaşama yüzdesi, tarım topraklardaki 1.5 cm derinlikten elde edilmiştir. *A. ephedroides* tohumları ise, en iyi çimlenme yüzdesi toprak karışımı, 0.5 ve 1.5 cm derinliklerden elde edilip, ve 2.0 cm derinlik tarım toprağında elde edilen fidan yaşama yüzdeleridir. Aynı zamanda, ekim derinliği arttırıldığı halde, fidan yaşama yüzdeleri artmaktadır. Toprak tiplerine göre, ilk kademede tarım toprağı yer alıp daha sonra toprak karışımı ile saf çam orman toprağı yer almaktadır.

Kısa Özet

Akasya ağaçları genellikle geniş bir alanda dağılıp, özellikle kurak bölgelerde iyi yetişebilen birçok türü görülmektedir (HALL, et al. 1972; FAO, 1989). Bu araştırmada söz konusu türler, birçok önemli kullanış yerlerine; kuru ot, yakacak odunu, telefon direkleri, gölgeleme, toprak erozyonu engelleme, süs bitkisi ve yol kenarı ağaçlandırmaları gibi önemli bulunup, Ürdün koşullarına çok uygun bulunarak önemli olmaktadır (HALL, *et al.* 1972; DORAN/TURNBULL/BOLAND/GUNN 1983; FAO 1989).

Toprak tipi ile ekim derinliğinin tohum çimlenmesi ile fidan yaşaması üzerindeki etkileri ve ağaçlandırma başarısına etkilediğini iyice bilinmektedir (BEARDSELL, NICHOLS, JONES 1979; KROMER/KOZLOWSK, 1979; BYWATERS/OSBORNE/FOX 1983; JOYCE 1987; FAO, 1989). Bu gerçeği ışığında, bahis konusu bu araştırmanın üç toprak tipi ile beş ekim derinliğinin etkilediği üç Akasya türleri tohumlarının çimlenmesi ile fidan yaşamasını inceleyip bulunmaktadır.

Araştırma konusu akasya tohumları CSIRO'dan elde edilip, çimlenme engelleri gidermek için gereken tohum muameleleri yapılmıştır. Tohumlara ait bilgiler tablo 1'de gösterilmiştir. Her Akasya türü için incelenen tohum çimlenme karakterleri şunlardır; ilk çimlenmeye gün sayısı (DF), çimlenme yüzdesi (FG), çimlenme oranı (hızı) (GR) ve çimlenen tohumlardan fidan yaşama yüzdesi (SUR) dir. Toprak tiplerinin verimliliği ile kimyasal analizleri, ilgili standardlara göre yapılmıştır. (PAGE, 1982). Araştırma sonunda bütün sonuçlar statistik analizleri, Duncan's Multiple Range Test (DMRT)'e göre yapılmış bulunmaktadır (LITTLE/HILLS, 1978).

SONUÇLAR

En ileri ve en hızlı çimlenme *A. aneura* tohumundan meydana gelip, çimlenme yüzdesi bakımından ikinci yer almıştır. *A. ephedroides* tohumu ise, en yüksek çimlenme yüzdesi ile en düşük fidan yaşama yüzdesini verirken, çimlenme hızı ise, en yüksek değerde sonuçlanmıştır. Buna karşılık, en düşük çimlenme yüzdesi ile en yüksek fidan yaşama yüzdesi *A. acuminata* tohumundan elde edilmiştir (Tablo 3). En yüksek fidan yaşama yüzdesi, tarım toprağında ekilen tohumlardan ileri gelmektedir. En erken ile en hızlı çimlenen tohumlar, orman toprağında ekilmiş olanlardır (Tablo 4). Genellikle değişik derinlikte ekilen tohumlar birçok sonuçlarda önemli farklar görülmemekle beraber, en erken ve daha hızlı çimlenen tohumlar, 0.5 cm derinlikte ekilen tohumlardır (Tablo 5).

A. acuminata ile *A. aneura* türlerine ait tohumlar, tarım toprağında ekildiğinde, en yüksek tohum çimlenme ile en yüksek fidan yaşama yüzdesi verip, en erken ve en hızlı çimlenen tohumlardır. *A. ephedroides* tohumu ise, toprak karışımında ekildiğinde daha erken ve daha hızlı çimlenip, en yüksek çimlenme yüzdesi ile en düşük fidan yaşama yüzdesine verdiklerini, Tablo 6'daki sonuçlardan anlaşılmaktadır. Şekil 1'den anlaşıldığına göre, en yüksek çimlenme yüzdesi ise, 0.5 ile 1.5 cm derinlikte ekilen *A. acuminata* tohumları, 1.5 ve 2.0 cm derinlikte *A. aneura* tohumları ve 2.0 cm'de ekilen *A. ephedroides* tohumlarından elde edilmiştir. En yüksek fidan yaşama yüzdesi ise, 1.0 cm derinlikte ekilen *A. acuminata* tohumları ile 0.5 cm'de ekilen *A. aneura* tohumları ve 1.5 ile 2.0 cm derinlikte ekilen *A. ephedroides* tohumlarıdır. Toprak karışımında 0.5 cm'de ekilenler en yüksek çimlenme yüzdesi veren tohumlardır. Buna karşılık, en düşük çimlenme yüzdeleri orman toprağında, 1.0 cm derinlikte ekilen tohumlardan meydana gelip, en yüksek fidan yaşama yüzdesi aynı derinlikte fakat tarım toprağında ekilen tohumlardır. En düşük fidan yaşama yüzdesi 2.0 cm derinlik ve toprak karışımında ekilen tohumlardan meydana gelmiştir (Şekil 2).

Orman toprağında 1.5 cm derinlikte ekilen *A. acuminata* tohumları, en yüksek çimlenme yüzdesini verdiklerini sonuçlardan anlaşılmaktadır. Buna karşılık, en düşük çimlenme yüzdesi toprak karışımında, 2.0 cm derinlikte ekilen tohumlardan elde edilip, en yüksek fidan yaşama yüzdesi ise, tarım toprağında ve 2.0 ile 2.5 cm derinlikte ekilen tohumlardan meydana gelmiştir (Şekil 3) *A. aneura* tohumları ise, en yüksek çimlenme yüzdesi 1.5 cm derinlik, ile en yüksek fidan yaşama yüzdesi 0.5 ve 1.5 cm derinlik tarım toprağında ekilen tohumlardan meydana gelerek, şekil 4'den anlaşılmış bulunmaktadır. Şekil 5'ten anlaşılacağı üzere, ekilen *A. ephedroides* tohumları, toprak karışımında 0.5 ve 1.5 cm derinlikten, en yüksek çimlenme yüzdesini vererek, en düşük değeri ise, 0.5 ve 2.5 cm derinlik tarım toprağından elde edilmiştir. En yüksek fidan yaşama yüzdesi, tarım toprağında 2.0 cm derinlikte ekilen tohumlar vermektedir.

TARTIŞMA

Söz konusu Akasya ağaç türlerinin tohumları, farklı çimlenme kabiliyetini göstermiştir. Bu farklılık, değişik ağaç türü tohumların değişik besin maddesi ihtiva ettiğinden ve buna bağlı olarak erken fotosenteze farklı ihtiyaç göstermekten ileri gelmiş olabilmektedir (BYWATER/OSBORNE/FOX 1983). Fidan yaşaması bakımından, Akasya türleri :

A. acuminata > *A. aneura* > *A. ephedroides* sıralamasını göstererek, *A. ephedroides* türü gösterdiği düşük fidan yaşama yüzdesi, tohumun küçüklüğünden ileri gelmiş olabilmektedir. To-

rak tipine göre, tarım toprağı daha iyi fiziksel ve kimyasal karakterleri dolayısıyla, fidan büyümesi ve gelişmesi, özellikle *A. acuminata* türü için, daha elverişli bulunmuştur. Tarım ve toprak karışımından elde edilen yüksek tohum çimlenmesi ile yüksek fidan yaşama yüzdesi, bu gibi toprakların, düşük $CaCO_3$, yüksek P ve yeterli K ihtiva ederek, iyi havalandırma özelliği ve tohuma iyice temas edip, daha elverişli tohum yatağı oluşturmaktadır (Tablo 2). Buna karşılık, orman toprağında bulunan ölü örtü ve bitki artıkları, tohum çimlenmesi ile fidan yaşaması için bu gibi toprakların daha yavaş ısınarak, kök hareketini ve tohumun toprağa temasını engelleyip, daha çabuk kuruyarak ve küçük fidanları gölgelemesinin gibi olaylar, bu toprağın elverişliliğini düşürmektedir (KRAMER, KOZLOWSK, 1979).

Sonuçlardan anlaşılacağı üzere, ekim derinliğinin artması ile, fidan yaşaması düşerek ve 2.0 cm'yi aşan ekim derinliğinin, fidan yaşaması bütün türlerde düşmüş bulunmaktadır. Derin ekilen tohumların yaprakcıkları ile köklerin yassılaşma kabiliyeti artarak, köklerin derin topraklara dağılması engellenmektedir. Buna ilaveten, ekim derinliği, toprağın birçok fiziksel özelliklerini etkileyerek, düşük toprak sıcaklığını tohumun çimlenmesini engellemekte, dolayısıyla daha sığ tohumun ekilmesi fidan yaşaması için bir avantaj olarak söylenebilmektedir. (BYWATER/OSBORNE/FOX 1983). Sonuçların gösterdiği daha sığ ekimlerden elde edilen yüksek fidan yaşama yüzdesi, daha hızlı tohum çimlenmesi. FAO raporlarla uymaktadır (FAO, 1983). Toprak analizleri farklı fiziksel ve kimyasal özellikler göstermiştir (Tablo 2). Tarım toprağı ihtiva ettiği yüksek P ve düşük $CaCO_3$ ve organik madde, buna karşılık orman toprağı daha yüksek $CaCO_3$ ve organik madde ihtiva etmiştir. *A. acuminata* ve *A. aneura* tohumlarının daha yüksek tohum çimlenmesi, tarım toprağında ekildiği halde elde edilmiştir. Buna karşılık, *A. ephedroides* tohumları, daha düşük çimlenme yüzdesi tarım toprağından elde edilmiştir. Fidan yaşama yüzdesi tarım toprağından elde edilmiştir. Fidan yaşama yüzdesi de daha iyi sonuçlar, tarım toprağından meydana gelmiştir. Bu gibi sonuçlar, tarım toprağının düşük $CaCO_3$ ile yüksek P muhtevası nedeniyle, köklerin gelişmesi ve iyi bir kök sistemi gelişmesini olumlu etkileyerek iyi bir fidan yaşamasını temin etmektedir. Genel olarak, büyük *A. aneura* tohumlarının daha derin ekimlerden gösterdiği daha iyi çimlenme kabiliyeti, büyük tohumların ihtiva ettiği besin maddesi dolayısıyla, bu gibi tohumlarda daha derin ekimlerden çimlenebilir, birçok araştırıcıların sonuçlarıyla uymaktadır (BYWATER/OSBORNE/FOX 1983).

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