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Full Length Research Paper

The effect of sowing time on germination of twenty two Leguminosae species

Cengiz Yücedağ[1]* and H. Cemal Gültekin[2]

[1]Engineering Faculty, Bartın University, Bartın, Turkey.
[2]Poplar Research Institute, 41050, Izmit, Turkey.

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Seeds of twenty two leguminous species were sown without any pretreatment in order to investigate the effect of sowing time on their germination in the forest nursery of Eğirdir, Turkey. The experimental design was completely randomized blocks with four replications. The sowing times were from 1st February to 15th May 2008 with 15 days intervals. According to the analysis results, it was found out that there were significant differences among the sowing times for all the species apart from *Spartium junceum* (p<0.001). Three *Bauhinia* spp., two *Colutea* spp., two *Cytisus* spp., *Gleditsia triacanthus,* two *Robinia* spp., *Sophora japonica, Spartium junceum, Ulex europaeus* and *Wisteria sinensis* seeds germinated successfully on all the studied sowing times. Besides, it was detected the sowing times that *Amorpha fruticosa, Calicotome villosa, Coronilla emerus* and *Genista lydia* seeds had no germination. It could also be concluded that seed sowings in the early spring were more effective on germination percentages of all the species. As a result, provided that there are no sufficient time and proper conditions for applying any pretreatment it would be suggested the seed sowing in the early spring.

Key words: Leguminosae, germination, sowing time, Eğirdir.

INTRODUCTION

Leguminosae family, represented by many species of trees and shrubs in the Mediterranean flora, is characterised by its capacity to actively fix the atmospheric nitrogen (N_2) by means of symbiosis with the nitrogen fixing bacterium Rhizobium. For this reason, they play important role in nature. Besides, woody legume seeds often possess impermable seed coats which require treatment before germination can take place. In other words, their seeds are characterised by extremely tough and impermable seedcoats that hinder germination, since they prevent water entering, gaseous exchanges and radical emission (Baskin and Baskin, 1998).

In this contex, Fordham (1965) indicated that germination would be provided by scarification or by exposing them to hot water or concentrated sulphuric acid. Legumes with hard seedcoats also responded very well to mechanical scarification (Francis and Rodriguez, 1993). Doussi and Thanos (1994), presented that breakage of dormancy for leguminosae is achieved by mechanical scarification of the seed coat though the technique of seed immersion in boiling water for several seconds (optimal duration: 2 to 60 s). Within this scope, it is crucial for the species to determine proper methods and techniques to overcome seed dormancy. But the level of seed dormancy varies both among and within species of this family.

For the afore-mentioned reasons, the present research was conducted to investigate the effects of the sowing times on germination of twenty two leguminosae species.

MATERIALS AND METHODS

Collecting date, location-character and seed storage conditions until sowing belonging to all the species were presented in Table 1. All the seeds were packed in plastic bags and transported to the laboratory. Seeds were randomly sampled for all the experiments. Initial viability was obtained using the cutting method (Saatçioğlu, 1971).

One thousand seed weight is very important to determine both the amount of seed required for each m^2 and the number of seedling obtained in nurseries (Yücedağ, 2008). The average of that for each species was calculated by using International Seed Testing Association (ISTA) equation (ISTA, 1993). This equation is as follows:

*Corresponding author. E-mail: yucedagc@gmail.com.

Table 1. Species, collecting date, location-character, seed storage conditions.

Species	Collecting date, location-character (altitude)	Seed storage conditions
Acacia cyanophylla Lindl.	June of 2007, Antalya-Afforestation Area (40 m)	Seeds were kept within open-jams in the room conditions (at about 20℃)
Albizia julibrissin Durazz	October of 2007, Antalya-Parks and Gardens (30 m)	
Amorpha fruticosa L.	September of 2007, İstanbul-Parks and Gardens (35 m)	
Bauhinia racemosa L.	November of 2007, Antalya-Parks and Gardens (35 m)	
Bauhinia purpurea L.	November of 2007, Antalya-Parks and Gardens (35 m)	
Bauhinia variegata Linn.	November of 2007, Antalya-Parks and Gardens (35 m)	
Calicotome villosa (Poiret) Link.	July of 2007, Antalya-Natural Area (150 m)	
Ceratonia siliqua L.	November of 2007, Antalya-Natural Area (150 m)	
Cercis siliquastrum L.	November of 2007, Sütçüler of Isparta-Natural Area (600 m)	
Colutea arborescens L.	September of 2007, Yenişarbademli of Isparta-Natural Area (1150 m)	
Colutea cilicica Boiss.&Bal.	September of 2007, Alanya of Antalya-Natural Area (1100 m)	
Coronilla emerus L.	July of 2007, Eğirdir of Isparta-Natural Area (1250 m)	
Cytisus laburnum L.	November of 2007, Eğirdir of Isparta-Parks and Gardens (1000 m)	
*Cytisus scoparius (*L.) Link.	August of 2007, Isparta-Afforestation Area (1200m)	
Genista lydia Boiss.	August of 2007, Isparta-Natural Area (1250 m)	
Gleditsia triacanthus L.	November of 2007, Isparta-Parks and Gardens (950 m)	
Robinia pseudoacacia L.	November of 2007, Isparta-Afforestation Area (1300 m)	
Robinia hispida L.	November of 2007, Yalova-Parks and Gardens (45 m)	
Sophora japonica L.	November of 2007, Eğirdir of Isparta-Parks and Gardens (950 m)	
Spartium junceum L.	August of 2007, Isparta-Natural Area (700 m)	
Wisteria sinensis (Sims) DC.	October of 2007, Eğirdir of Isparta-Parks and Gardens (950 m)	
Ulex europaeus L.	August of 2007, İstanbul-Parks and Gardens (70m)	

Table 2. Temperature and rainfall measured by the meteorological station in Eğirdir (Anonymous, 2008).

Month	February	March	April	May	June	July	August
Average temperature (℃)	-0.1	8.8	12.2	15.0	21.5	23.9	24.7
Absolute maximum temperature (℃)	11.1	21.4	28.2	30.1	35.1	36.1	35.5
Absolute minimum temperature (℃)	-10.4	-2.7	0.5	3.2	9.7	12.2	13.0
Rainfall (in mm)	35.4	47.2	80.7	23.6	7.1	3.8	12.9

$$\bar{X} = \frac{\sum_{i=1}^{n} X_i}{8}$$

Where, $\bar{X}$ = Arithmetical mean of measures; X_i = each replication (100 seeds) weight (g) and n= replication number (n=8).

Before sowing, in order to swell seeds, seeds of the species were soaked for 24 h in room conditions (at about 20℃) in running water. The experiment was laid out according to completely randomized design method with four replications. All the species were sown outdoors on eight different sowing times with 15 day intervals (from 1st February 2008 to 15th May 2008) in the forest nursery of Eğirdir, Isparta (37°53́ N, 30°52́ E, 926 m asl). Sowing times in 2008 are as follows: 1) 1st February, 2) 15th February, 3) 1st March, 4) 15th March, 5) 1st April, 6) 15th April, 7) 1st May and 8) 15th May.

Seeds were sown in styrofoam containers in dimension of 10 × 10 cm, in 50% stream mile and 50% forest soil (from Anatolian Black Pine [*Pinus nigra* Arnold. subsp. *pallasiana* (Lamb.) Holmboe]), and at a depth equal to the size of the seed. After sowing, mulching was applied on the sowing lines by means of the lawns. These experiments were intensively watered after sowing. But it was watered once in week commencing the seed sowing during terms not raining. Measurements were taken once a week from the beginning of the germination until emergence was completed.

From the climate point of view, the region where the nursery is located belongs to terrestrial climate with cold winters and frosts. Climatic conditions (temperature and rainfall) that prevailed during the experiments are shown in Table 2.

Germination percentages (GP) were calculated for each experiment. Data was transformed by using arcsin square root and analyzed through one-way Analysis of Variance (ANOVA). Duncan's multiple comparison tests were performed to determine the statistical significance of the differences between means of treatments. A significance level of 5% was used for all the statistical analysis and the results obtained from experiments were separately analyzed. SPSS program was used for statistical analysis.

Table 3. The minimum, maximum and mean±standard deviation of one thousand seed weights by the species.

Species	One thousand seed weight (g)		
	Minimum	Maximum	Mean±Std.
Acacia cyanophylla Lindl.	13.2	16.1	15.1±0.95
Albizia julibrissin Durazz	35	45	41±3.06
Amorpha fruticosa L.	6.5	14.1	9.3±2.41
Bauhinia racemosa L.	110	140	130±10.0
Bauhinia purpurea L.	220	250	236.7±8.82
Bauhinia variegata Linn.	290	320	300±10.0
Calicotome villosa (Poiret) Link.	3.0	4.2	3.7±0.36
Ceratonia siliqua L.	190	225	210±10.4
Cercis siliquastrum L.	17	37	25±6.11
Colutea arborescens L.	10	18	12.2±2.93
Colutea cilicica Boiss.&Bal.	26	35	31±2.65
Coronilla emerus L.	6.1	8.2	6.5±0.89
Cytisus laburnun L.	25	35	27±4.16
*Cytisus scoparius (*L.) Link.	7.0	9.2	8.1±0.64
Genista lydia Boiss.	3.1	6.0	4.3±0.87
Gleditsia triacanthus L.	170	200	186.7±8.82
Robinia pseudoacacia L.	17.0	25.3	20.5±2.48
Robinia hispida L.	16.1	18.1	17.3±0.61
Sophora japonica L.	110	150	130±11.6
Spartium junceum L.	10.2	16.4	13.1±1.80
Wisteria sinensis (Sims) DC.	430	470	450±11.6
Ulex europaeus L.	4.1	7.0	5.6±0.84

RESULTS AND DISCUSSION

One thousand seed weights according to species were determined (Table 3). Results showed that the seeds of the species germinated in the nursery conditions. One thousand seed weights determined for *Acacia cyanophylla, Ceratonia siliqua, Cytisus scoparius,* and *Robinia pseudoacacia* by Saatçioğlu (1971), is similar to those of this study. In contrast Saatçioğlu (1971) found lower one thousand seed weights for *Gleditsia triacanthus, Sophora japonica,* and *Colutea arborescens* and higher for *Cercis siliquastrum* than those reached from the present study. Başbağ and Ayzit (2010) also comfirmed values reached for *R. pseudoacacia* and *G. triacanthus* in the present study.

According to the analysis results in Table 4, it was found out that there were significant differences among the sowing times for all the species apart from *Spartium junceum* L. ($p<0.001$). All the findings and discussion on germination results of the species were evaluated as thus explained.

Acacia cyanophylla Lindl.

The highest GP (64.36%) for this species was determined in the sowing of 1st March 2008 (Table 4). Clemens et al. (1977) stated that manual chipping of the seed gave larger improvements in germination rate in some species. Moreover, the species seeds can survive treatment with concentrated acid, at high temperatures, for a number of hours (Shaybany and Rouhani 1976). The results inferred from these studies disagree with those from the present study, that is, the species seeds germinate well if they are sown without pretreatment in the early spring.

Albizia julibrissin Durazz.

Compared with other sowing times, while the sowing of 1st February 2008 has the highest GP (67.43%), that of 1st May 2008 has the lowest GP (10.96%) in Table 4. The GP gradually decreased from the sowing of 1st February to 15th May 2008. Walters et al. (1974) indicated that species seeds would often germinate without pretreatment, but a 10 min soak in sulfuric acid would increase the percentage and rate of germination.

On the contrary, Gogue and Emino (1979) stated that the germination of the species without pretreatment was very poor. It was reported that germination rates for scrafied seeds ranged 50 to 99% (Franchis and Rodriguez, 1993). Sajeevukumar et al. (1995) stressed

Table 4. Germination results, F-Ratio and homogen groups according to species.

Species	Sowing times								F-ratio
	1	2	3	4	5	6	7	8	
	Germination percentage[1]								
Acacia cyanophylla Lindl.	67.52$^{a, b1}$	69.33^{a}	66.06^{b}	63.1^{c}	59.36^{d}	58.23^{d}	58.2^{d}	58.06^{d}	23.083***
Albizia julibrissin Durazz	67.43^{a}	64.17$^{a, b}$	62.09^{b}	37.4^{c}	29.31^{d}	22.01^{e}	15.78^{f}	10.96^{g}	300.934***
Amorpha fruticosa L.	64.73^{a}	64.35^{a}	37.40^{b}	21.9^{c}	0.00^{d}	0.00^{d}	0.00^{d}	0.00^{d}	985.355***
Bauhinia racemosa L.	73.37$^{a, b}$	72.90$^{a, b}$	75.37^{a}	72.1$^{a, b}$	71.26^{b}	67.16^{c}	64.73^{c}	64.35^{c}	12.268***
Bauhinia purpurea L.	74.77^{a}	73.94^{a}	71.60^{a}	74.45^{a}	70.79^{a}	70.92^{a}	65.17^{b}	65.29^{b}	9.180***
Bauhinia variegata Linn.	72.84^{a}	72.90^{a}	72.40^{a}	74.40^{a}	73.72^{a}	71.45^{a}	68.49^{b}	66.23^{b}	7.766***
Calicotome villosa (Poiret) Link.	73.40^{a}	72.16^{a}	67.84^{b}	64.17^{c}	31.76^{d}	23.05^{e}	0.00^{f}	0.00^{f}	1151.365***
Ceratonia siliqua L.	75.89^{a}	72.58^{b}	71.61^{b}	59.71^{c}	36.55^{d}	28.97^{e}	23.31^{f}	22.34^{f}	587.663***
Cercis siliquastrum L.	74.75^{a}	72.35^{a}	54.51^{b}	48.59^{c}	36.85^{d}	25.26^{e}	16.90^{f}	3.93^{g}	346.787***
Colutea arborescens L.	63.80^{a}	63.99^{a}	64.18^{a}	65.09^{a}	64.74^{a}	63.15$^{a, b}$	61.03^{b,c}	59.20^{c}	6.390***
Colutea cilicica Boiss.&Bal.	64.74^{a}	63.62^{a}	63.62^{a}	63.27^{a}	59.57^{b}	59.02^{b}	53.15^{c}	48.45^{d}	44.449***
Coronilla emerus L.	73.45^{a}	72.84^{a}	48.45^{b}	44.57^{c}	19.03^{d}	0.00^{e}	0.00^{e}	0.00^{e}	1447.094***
Cytisus laburnun L.	71.58$^{a, b}$	71.14$^{b, c}$	70.45$^{b, c, d}$	73.31^{a}	69.10$^{c, d, e}$	68.49$^{d, e, f}$	67.86$^{e, f}$	66.45^{f}	10.239***
Cytisus scoparius (L.) Link.	60.04^{a}	60.35^{a}	60.02^{a}	58.54$^{a, b}$	57.27$^{b, c}$	55.40$^{c, d}$	54.34$^{d, e}$	52.70^{e}	16.620***
Genista lydia Boiss.	66.91^{a}	65.92^{a}	63.98^{a}	59.37^{b}	39.23^{c}	20.66^{d}	9.90^{e}	0.00^{f}	664.363***
Gleditsia triacanthus L.	62.92^{a}	61.36^{a}	62.06$^{a, b}$	59.37^{b}	54.36^{c}	52.09$^{c, d}$	50.77^{d}	46.87^{e}	48.099***
Robinia pseudoacacia L.	68.68^{a}	66.86^{a}	67.64^{a}	68.67^{a}	66.51^{a}	66.96^{a}	61.55^{b}	58.38^{c}	13.303***
Robinia hispida L.	67.66^{a}	66.83^{a}	68.46^{a}	68.27^{a}	65.76^{a}	66.68^{a}	60.72^{b}	59.20^{b}	12.277***
Sophora japonica L.	71.83^{a}	71.65^{a}	71.91^{a}	70.69^{a}	71.15^{a}	69.79$^{a, b}$	67.25^{b}	64.37^{c}	8.163***
Spartium junceum L.	64.17^{a}	65.56^{a}	64.97^{a}	65.60^{a}	64.37^{a}	64.54^{a}	66.04^{a}	63.80^{a}	0.604ns
Wisteria sinensis (Sims) DC.	61.01^{a}	60.52^{a}	60.17^{a}	60.18^{a}	59.04$^{a, b}$	57.60^{b}	54.96^{c}	51.80^{d}	17.220***
Ulex europaeus L.	68.56^{a}	70.45^{a}	69.85^{a}	68.28^{a}	64.74^{b}	64.00^{b}	62.40$^{b, c}$	59.54^{c}	13.745***

***Means with different letters in each species are significantly different ($p<0.001$); ns: Means are not significantly different. [1] Transformed data (logged) was used for mean separations.

that the most effective and practical method of pretreatment to obtain quicker and higher germination in *Albizia* was physical scarification followed by soaking in flowing water for 24 h. Ertekin et al. (2010) indicated that the highest germination rate was obtained by initially soaking the seeds in 100 mg/L PS for 72 h, and then stratification at 30 days. As considered these researchs, if there is no sufficient time and conditions for applying pretreatment it would be suggested the seed sowing in the early spring.

Amorpha fruticosa L.

It was found that the highest GP was 64.73% (Table 4). Increasing the sowing times resulted in a significant decrease in germination percentages. The species had the lowest GP in all the others. There was no germination in four sowing times. Previous studies (Dirr and Heuser, 1987; Martineau, 1996) indicated that species seeds would completely germinate without pretreatment. Beside these, it was reported that stratification at 3 to 4°C for 2 and 8 weeks increased the germination rate; 30 min of scarification in sulfuric acid reduced germination by 50% (Cox and Klett, 1984). Although both the present study and the other studies reported that untreated seeds of *Amorpha* could germinate, application of different

pretreatments would be better to get good germination.

Bauhinia spp.

The highest GPs for *Bauhinia purpurea* (74.77%), *B. racemosa* (75.37%) and *B. variegata* (74.41%) were obtained from the sowing of 1st February, 1st March and 15th March 2008, respectively (Table 4). Francis and Rodríguez (1993) found out excellent germination of *Bauhinia* spp. without scarification, and recorded 77 and 99% germination for *B. variegata* and *purpurea* under laboratory conditions. On the other hand, it was reported that the mechanical scarification and sulphuric acid soak increased the germination of *Bauhinia* spp. seeds (Prasad and Nautiyal, 1996; Lopes et al., 2007).

It was determined that the germination was the highest at 25 to 30°C for *B.variegata* (Akoumianaki-Ioannidou et al., 2004) and *B. purpurea* (Reino et al., 2008). In cont rast to these results, Martinelli-Seneme et al. (2006) put forward that mechanical scarification and immersion in cold water had no effect on seed germination for *B.variegata.* Finally, as it was reached germination over 60% when *Bauhinia* spp. seeds were sown without any pretreatment in spring, all the species seeds could be sown in the whole times studied in the present research.

Calicotome villosa (Poiret) Link.

As presented in Table 4, it was found out that the sowing of 1st February 2008 had the highest GP (75.89%) while that of 15th May 2008 had the lowest one (22.35%). The sowing times outside of the initial three ones resulted in lower germination than 50%. This result was supported by Doussi and Thanos (1994), who determined that germinability of untreated species seeds was generally low. Thus, species seeds ought to be sown in early spring unless any pretreatment was applied.

Ceratonia siliqua L.

The highest GP (75.89%) was obtained from *C. siliqua* seeds sown in 1st February 2008 (Table 1). Frutos (1988) obtained the best germination (99.1%) using sulphuric acid at 80%. Author, however, observed no effects of GA_3 on seed germination. Mitrakos (1988) and Rhizopoulou and Davies (1991) were stated that seeds sown from recently ripened legumes germinated well without pretreatment. The results of these studies agree with those from the present study. Therefore, untreated seeds of the species could be sown as soon as collected or in early spring.

Cercis siliquastrum L.

The sowing of 1st February 2008 had the highest GP (74.75) as explained in Table 4. The GP decreased gradually from the sowing of 1st February to 15 May 2008. Yaşin and Gübbük (2005) indicated that the highest germination ratio was 77.80% at 40°C after keeping in hot water for two hours. Rascio et al. (1998) also found out that *C. siliquastrum* seeds were drawn out from their dormancy state by either a long chilling period or an exogenous GA_3 supply.

Takos and Efthimiou (2003) reported that *C. siliquastrum* seeds sown outdoors on December of 1999 without pretreatment germinated 21% in the spring. Germination from this result was found much lower than that from the present study. The reason of that could be the difference between Eğirdir and Langada meteorological values (Table 2). In addition to these studies, Zencirkıran et al. (2010) reached that eight weeks of moist stratification duration was optimal after 30 min of acid treatment to remove the physical and physiological dormancy of the seeds of the *C. siliquastrum* L. Ertekin (2010) reported that the highest germination (91%) was obtained by soaking the seeds in 500 mg/L PS-A6 + PS-K for 24 h followed by stratification at 4°C for 100 days. Consequently, it could be suggested either seed sowing in early spring or a pretreatment application of for the species.

Colutea spp.

The highest GPs for *C. arborascens* and *C. cilicica* were 65.09 and 64.73% on the sowing of 15th March and 1st February 2008, respectively (Table 4). Both species germinated over 50% on all the sowing times. According to Pijut (2009), species seeds did not germinate easily unless the impermeable seedcoat is ruptured by mechanical or chemical scarification whereas Dirr and Heuser (1987) reported that *Colutea* seeds without any pretreatment could be sown in the autumn, but scarification was required for spring-sowing.

Dirr (1990) stated that species seeds in water that initally brought to 88°C and then allowed to cool 24 h result in good seed germination. Although Ölmez et al. (2007) indicated that *Colutea* seeds applied cold stratification for 20 days under the open field conditions germinated 91.25%, Ölmez et al. (2008) stated that the highest GP (77.19%) were obtained from *C. armena* seeds submersed in sulphuric acid for 30 min and sown in the greenhouse. From the results, *Colutea* seeds sould be sown applying either a cold stratification or scarification instead of spring sowing.

Coronilla emerus L.

As seen in Table 4, untreated seeds sown on 1st February 2008 showed the highest GP (73.45%). When germination of the species seeds was considered, it

could be said that increasing of the sowing time decreased germination percentage. Hence, both cold stratification and scarification would be suitable to be taken into consideration for overcoming the germination obstacles of species seeds.

***Cytisus* spp.**

The highest GPs obtained from *C. laburnum* and *C. scoparious* seeds were 73.31 and 60.35%, respectively (Table 4). Even if Jinadasa (2000) stated that scarification increased significantly the final seed germination of *C. scoparious,* Tarrega et al. (1992) reported that dry-heating the seeds were as effective as mechanical scarification in terms that of. As a matter of fact Abdallah et al. (1989) indicated that alternating the boiling water treatments with freezing treatments (immersion in liquid nitrogen for 15 s) resulted in the highest GPs as well as in complete removal of hard-seededness.

These results were confirmed by Bossard (1993), who found that vigor of seedlings from hot/cold treated seeds was much higher than that of seedlings from seeds subjected to dry heat only. At the same time, initial germination increased as stratification period varied from 0 to 60 days, but final germination after 90 days did not differ significantly among periods (Harrington, 2009). Finally, the species seeds were sown either early spring or applying the combination of heat and cold water.

***Genista lydia* Boiss.**

It was determined that the highest GP (66.91%) was obtained from the sowing on 1st February 2008 (Table 4). Delgado et al. (2006) reported that various heat treatments did not increase germination significantly, but temperatures ≥100°C and 5 min of exposure reduced seed hardness and affected the viability of *G. scorpious* seeds. Tarrega et al. (1992) also stated that temperature did not affect so much on the germination of *G. florida* seeds. Increasing the sowing times resulted in decreasing germination percentages. It should be investigated different pretreatments without heat to overcome the germination obstacles of the species.

***Gleditsia triacanthus* L.**

Sowing on 1st February 2008 showed the highest GP (62.91%) in Table 4. Başbağ and Ayzit (2010) stated that the highest germination (25.5%) for the species was obtained at 50°C for 30 min. Germination of the species was over 50% on all the sowing times. In conclusion, species seeds could be sown without pretreatment in early spring.

***Robinia* spp.**

Both species seeds showed similar germination results (Table 4). Aktaş (2003) suggested that the best way to remove germination obstacle of *R. pseudoacacia* was to soak its seeds firstly into boiling water for five minutes and then to keep them in the room temperature for nine hours. Başbağ and Ayzit (2010) stressed that the highest germination rate (94.5%) was obtained at 90°C for 30 min. Thus, it could be used the methods suggested by these authors instead of spring sowing to overcome the germination obstacles.

***Sophora japonica* L.**

It was found that the highest GP (71.91%) was the sowing of 1st March 2008 (Table 4). The increasing sowing time did not result in the decreasing germination percentage. There was no research investigating the effects of different pretreatments on the germination of the species.

***Spartium junceum* L.**

GP of the species ranged from 63.81 to 66.04% (Table 4). Köse (1998) indicated that the highest germination ratio (96%) for the species was at 40°C after keeping in hot water for 10 s. Doussi and Thanos (1994) and Travlos et al. (2007) stated that untreated seeds of species germinated 44 and 70%, respectively. Travlos et al.(2007) also reported that hot water immersion, dry heat, sulphuric acid treatment and water soak effectively relieved dormancy of the hardcoated portion of the seed population and consequently increased final GP (92, 84, 80 and 78%, respectively).

***Ulex europaeus* L.**

Sowing of 15th February 2008 had the highest GP (70.45%) in Table 4. There were a nonsignificant difference (F-ratio:0.604) among all the sowing times applied this species. *U. europaeus* seeds showed greater GP when they were exposed to dry heat for 2 min (Gutierrez, 1993). Ivens (2006) reported that the germination rate increased linearly with temperature from a minimum near 0°C to an optimum at 18°C.

***Wisteria sinensis* (Sims) DC.**

As seen Table 4, it was found that the sowing of 15thMarch 2008 had the highest GP (60.18%). All the sowing times germinated over 50%. Although the species untreated seeds sown in spring germinated well it should

be examined new pretreatments to remove the germination obstracles of the species.

Conclusions

Of the 22 species investigated, untreated seeds, which included three *Bauhinia* spp., two *Colutea* spp., two *Cytisus* spp., *Gelditsia triacanthus,* two *Robinia* spp., *Sophora japonica, Spartium junceum, Ulex europaeus* and *Wisteria sinensis,* germinated successfully on all the studied sowing times in the nursery. These germinations reduced generally from a sowing time to the other one. Germination of the other species (*Acacia cyanophylla, Albizia julibrissin, Amorpha fruticosa, Calicotome villosa, Ceratonia siliqua, Cercis siliquastrum, Coronilla emerus* and *Genista Lydia*) decreased gradually in the increasing of sowing times. Although *A. fruticosa, C. villosa, C. emerus* and *G. lydia* whose seeds were sown without pretreatment in the early spring germinated well, they also had the sowing times taking place with no germination. Germination varies depending on seed quality, treatment after collection, sowing time, and a host of genetically programmed inhibitors. The data provided in the present study give an indication of the success of germination that can be expected from these species whose untreated seeds were sown in spring. It can also be concluded that seed sowings in the early spring were more effective on germination percentages of all the species studied in this study over nursery conditions.

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