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SEED GERMINATIONS OF 20 WILD SPECIES GROWING IN ANTALYA (TURKEY) WITH OUTDOOR ORNAMENTAL PLANT POTENTIAL

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Abstract

Among the very rich plant genetic resources of Turkey, many plant species have the potential of outdoor landscape usage due to their aesthetic and functional characteristics. However, this diversity could not be evaluated well and cultivated enough. This study was carried out in Batı Akdeniz Agricultural Research Institute in Antalya (Turkey) between 2007 and 2009, under the project of TUBITAK-KAMAG-105G068-106G020. It was aimed to cultivate 20 wild plant species (some of them are endemic) via generative production method. For this aim, the seeds of the species of *Crataegus monogyna, Daphne sericea, D.gnidioides, D.oleoides, Erica manipuliflora, E.sicula* subsp. *libanotica, Ferula communis, F.tingitana, Iberis attica, Limonium angustifolium, L.gmelinii, L.sinuatum, Rosularia sempervivum* subsp. *sempervivum, Smilax aspera, Vaccaria hispanica, Vitex agnus-castus* and the endemic species of *Conringia grandiflora, Erica bocquetii, Gypsophila bitlisensis* and *Ricotia carnosula* were sown in different times without pretreatment, except than soaking them in tap water for 6 hours. According to the results of 35 germination trials tested in 20 species, 6 species (*Crataegus monogyna, Daphne sericea, D.oleoides, Erica sicula, Rosularia sempervivum, Smilax aspera)* did not germinated under the present germination conditions, whilst 14 species germinated at different ratios ranging from 2% to 98%. Among the germinated species, *Conringia grandiflora, Gypsophila bitlisensis, Ricotia carnosula, Vaccaria hispanica and Vitex agnus-castus* were determined to be the most regenerative species germinating above 85% when their fresh seeds were sown. The germination results of this work were found quite promising for the cultivation and domestication of most of the focused wild plant species. Also, it is possible to increase the germination rates by different pretreatment applications in the forthcoming studies in particular non-germinated species.

Keywords: *Genetic resource, Outdoor ornamental plant, Endemic plant, Domestication, Cultivation*

Introduction

In the recent landscape designs in Turkey, mostly imported plants have been used due to their contibutions to the designs in terms of the aesthetic image and the species diversity. It is not possible to predict exactly today how these extremely demanded plants will have influence upon the flora and fauna of the country in the future. However, some emerging problems in the recent times proved that imported plants should be used in the controlled manner. In this case, to tend to the existing natural plants with outdoor ornamental plant potential in Turkey's rich flora and to evaluate them seems to be a correct approach (Arı et al., 2010). However, the success of this approach is closely related with the domestication of the targeted plants.

As known, cultivation of wild plants is an essential step for domestication of new crops. As the current stage of our extensive studies on domestication of new ornamental plants from the wild plants naturally grown in Antalya (Turkey) conducted since the year of 2000, we have now aimed to screen 20 plant species (*Conringia grandiflora, Crataegus monogyna* subsp.

monogyna, Daphne sericea, D.gnidioides, D.oleoides subsp. *oleoides, Erica bocquetii, Erica manipuliflora, E.sicula* subsp. *libanotica, Ferula communis* subsp. *communis, F.tingitana, Gypsophila bitlisensis, Iberis attica, Limonium angustifolium, L.gmelinii, L.sinuatum, Ricotia carnosula, Rosularia sempervivum* subsp. *sempervivum, Smilax aspera, Vaccaria hispanica* and *Vitex agnus-castus*) with outdoor ornamental value for their reproduction abilities by the germination tests. Among the plant species screened, *Conringia grandiflora, Ricotia carnosula* and *Erica bocquetii* are the endemic species to Antalya and the literature about them are quite limited with the flora-based studies. We have noticed the first two endemic species' potential for being seasonal flower (Arı et al., 2010) and also nutraceutical plant (Şenol et al., 2013) and began to domestication studies recently. *Gypsophila bitlisensis* is another endemic species to Bitlis and it was included to a *Gypsophila* breeding program under the project of TUBITAK-TOVAG-104O364 carried out in BATEM. *Crataegus monogyna, Iberis attica, Limonium sinuatum* and *Vitex agnus-castus* are the well-known species for especially using in landscape designs to be small tree and bedding plants while *Ferula* spp., *Smilax aspera, Vaccaria hispanica* and *Vitex agnus-castus* are the important species for pharmaceutical industry. All these species have been cultivated and bred in the world. Although most of the mentioned plant species are known and desired also in Turkey regarding ornamental or pharmaceutical plant potential, they are not cultivated and so, their produced plantlets are not available in ornamental and medicinal markets. Therefore, revealing of the production methods of the species mentioned above is an important necessity in order to meet the supply for them in the related sectors of Turkey.

Introducing a new plant is a complex process covering a number of steps from establishing a market to providing the plant's requirements (Seaton et al., 2014). Domestication of the plant comes first among all the steps. Since domestication of the wild plants is primarily associated with their cultivation in the most proper environment, firstly the production systems of the involved species should be revealed either generatively or vegetatively. Hence, the seeds of 20 wild plant species thought to be cultivated generatively were subjected to the initial scale germination tests in this work set up *in vivo* greenhouse conditions.

Materials and Methods

This study was performed in Batı Akdeniz Agricultural Research Institute (BATEM) in Antalya, Turkey, in 2007-2009,under the project of TUBITAK-KAMAG-105G068-106G020.

For the screening of 20 wild plant species (Table 1) with primarily outdoor ornamental plant potential for their germination abilities, the seeds of them were collected from their different distribution areas in Antalya in different dates (Table 2) and stored at room temperature until used. Seeds were sown into the viols containing peat or peat and perlite mixture in 3:1 ratio in an unheated greenhouse in the specified dates in Table 2. Except the seeds of 3 *Erica* and 3 *Limonium* species, all seeds were sown individually to the viols. However, 0.10 g seeds of mentioned 6 species had to be sown with scattering due to their very small sized seeds. All seeds in the study were soaked in distilled water for 6 hours before sowing. Germination conditions were not equal for each species since their seeds were collected from different locations in diverse field surveys performed in different times. Therefore, germination trials were set up in different dates with the changing seed numbers for each species and so, statistic analysis of them could not be performed. Some of the species were more privileged for us because of their importance. Thus, their germination tests were repeated. The germinated and survived seedlings were transferred to pots containing peat, perlit, soil mixture in 2:1:2 ratio.

Table 1. Taxonomic information, plant growth habit and potential ornamental use of 20 wild plant species studied in the work (from Arı 2009; Davis 1965-1985; TUBIVES, 2014)

No	Species	Family	Endemism (+ / -)	Plant Growth Form	Flowering Time	Potential Ornamental Plant Use
1	*Conringia grandiflora* BOISS. ET HELDR.	*Brassicaceae*	+	Herbacious, seasonal	March – May	Bedding plant
2	*Crataegus monogyna* JACQ. subsp. *monogyna* JACQ	*Rosaceae*	-	Woody, small tree	April - June	Small tree
3	*Daphne sericea* VAHL	*Thymelaeceae*	-	Semi-woody, evergreen shrub	February -May	Shrub plant
4	*Daphne gnidioides* JAUB. ET SPACH		-	Semi-woody, evergreen shrub	May - August	Shrub plant
5	*Daphne oleoides* SCHREBER subsp. *oleoides* SCHREBER		-	Semi-woody, evergreen shrub	May - September	Shrub plant
6	*Erica bocquetii* (PEÃ MEN) P. F. STEVENS	*Ericaceae*	+	Perennial woody, creeping shrub	July	Rock garden plant
7	*Erica manipuliflora* SALISB.		-	Perennial woody, evergreen shrub	July - November	Shrub plant Golf course plant
8	*Erica sicula* GUSS. subsp. *libanotica* (C. ET W. BARBEY) P. F. STEVENS		-	Perennial woody, evergreen, creeping shrub	April	Rock garden plant
9	*Ferula communis* L. subsp. *communis* L.	*Apiaceae*	-	Perennial, shrub	April-June	Bedding plant, Foliage plant
10	*Ferula tingitana* L.		-	Perennial, shrub	April-June	Bedding plant
11	*Gypsophila bitlisensis* BARK.	*Caryophyllaceae*	+	Herbacious, seasonal	June - July	Bedding plant
12	*Iberis attica* JORD.	*Brassicaceae*	-	Herbacious, seasonal	March - May	Bedding plant
13	*Limonium gmelinii* (WILLD.) O. KUNTZE	*Plumbaginaceae*	-	Herbacious, seasonal	May-October	Bedding plant
14	*Limonium sinuatum* (L.) MILLER		-	Herbacious, seasonal	May-June	Bedding plant
15	*Limonium angustifolium* (TAUSCH) TURRILL		-	Herbacious, seasonal	May-October	Bedding plant
16	*Ricotia carnosula* BOISS. ET HELDR.	*Brassicaceae*	+	Herbacious, seasonal	March -April	Bedding plant Rock garden plant
17	*Rosularia sempervivum* (M. BIEB.) BERGER subsp. *sempervivum*	*Crassulaceae*	-	Herbacious, seasonal	June-September	Bedding plant, Rock garden plant
18	*Smilax aspera* L.	*Smilacaceae*	-	Perennial, creeping shrub	April-June	Rock garden plant, Hedge plant
19	*Vaccaria hispanica* (Mill.) RAUSCHERT	*Caryophyllaceae*	-	Herbacious, seasonal	April - July	Bedding plant
20	*Vitex agnus-castus* L.	*Lamiaceae* (formerly: *Verbenaceae)*	-	Woody, decidious small tree	June-September	Shrub – small tree plant

Results and Discussion

The seeds of 14 wild species germinated at different ratios ranging from 2% to 98%, while the seeds of 6 species did not germinate under the available conditions in the present study. Germination rates and number of the grown plants obtained from 35 germination tests conducted on the seeds of 20 wild plant species were shown in Table 2.

Endemic *Conringia grandiflora* has a good potential for being a late winter - spring annual plant because of its bright, charming, yellow flowers and natural form (Ari et al., 2010). In the 3 germination tests performed for this species at different dates, the most successful germination rate (98%) was acquired from the second one in which the first germination happened in the 5th day in peat medium from the-3-months-old seeds. Interestingly, the fresly harvested seeds collected from Kemer gave the lowest germination rate (18%) and the first germination took place in the 20th day. The possible reason of this might be the genetic origin as well as the seed growing medium consisted of peat and perlite mixture. Consequently, winter seed sowing for *C.grandiflora* was found much more successfull than summer one.

Table 2. Germination rates and number of the grown plants obtained from 35 germination trials conducted on the seeds of 20 wild plant species

No	Plant Species	Location in Antalya	Altitude (m)	Date of seed collection	Date of seed sowing	Number of sown seed	Germination medium	Germination rate (%)	Number of grown plant
1	*Conringia*	Kemer	78	08.07.2008	17.07.2008	100	Peat+Perlite	18	16
2	*grandiflora*	Manavgat	968	31.07.2008	05.11.2008	500	Peat	98	323
3		Manavgat	968	31.07.2008	12.11.2009	300	Peat	95	68
4	*Crataegus monogyna*	Titreyen Göl	73	23.10.2007	05.11.2007	100	Peat	0	0
5	*Daphne gnidioides*	Gazipaşa	250	01.11.2007	05.11.2007	100	Peat	33	33
6	*Daphne oleoides*	Manavgat	1759	08.07.2008	17.07.2008	100	Peat+Perlite	0	0
7	*Daphne*	Masadağı	27	30.04.2008	02.05.2008	100	Peat	0	0
8	*sericea*	Manavgat-Serge	1638	19.06.2008	07.11.2008	150	Peat	0	0
9	*Erica bocquetti*	Elmalı	1787	09.07.2008	05.11.2008	*	Peat	**	4
10	*Erica*	Kemer	7	02.04.2008	10.04.2008	*	Peat	**	8
11	*manipuliflora*	Kumköy	5	10.11.2008	20.11.2008	*	Peat	0	0
12	*Erica sicula*	Kemer	74	06.02.2008	10.04.2008	*	Peat	0	0
13		Kemer	63	15.05.2008	07.11.2008	*	Peat	0	0
14	*Ferula communis*	Akseki	1462	31.07.2008	04.11.2008	100	Peat	3	3
15	*Ferula tingitana*	Akseki	1509	31.07.2008	04.11.2008	50	Peat	60	25
16	*Gypsophila bitlisensis*	BATEM Origin: Digor, Kars	32	10.04.2008	10.04.2008	100	Peat	14	12
17		BATEM	32	26.06.2008	20.11.2008	200	Peat	86	50
18	*Iberis attica*	Alanya	1348	08.07.2008	17.07.2008	100	Peat+Perlite	17	17
19		Alanya	1452	08.07.2008	04.11.2008	100	Peat	44	44
20		Alanya	1297	08.07.2008	04.11.2008	200	Peat	52	76
21	*Limonium angustifolium*	Denizli	1134	05.10.2008	19.12.2008	*	Peat	**	2
22	*Limonium gmelinii*	Küçük Çaltıcak	4	05.11.2008	19.12.2008	*	Peat	**	3
23	*Limonium sinuatum*	Kumluca	0	19.08.2008	19.12.2008	*	Peat	**	128
24	*Ricotia*	Kemer	36	17.04.2007	08.10.2007	400	Peat	98	260
25	*carnosula*	Kemer	42	31.05.2007	10.04.2008	100	Peat	60	50
26		Kemer	29	29.05.2008	15.06.2008	100	Peat	61	42
27		Tekirova	69	29.05.2008	19.12.2008	100	Peat	78	65
28		Kemer	36	08.11.2009	12.11.2009	200	Peat	93	76
29	*Rosularia sempervivum*	Manavgat	549	16.04.2008	20.11.2008	*	Peat	0	0
30	*Smilax aspera*	Side	19	23.10.2007	05.11.2007	150	Peat	0	0
31	*Vaccaria hispanica*	Elmalı	659	07.06.2007	08.10.2007	300	Peat	97	240
32	*Vitex agnus-*	Kaledran	57	01.11.2007	05.11.2007	2000	Peat	96	300
33	*castus*	Gebiz	42	27.11.2007	10.04.2008	100	Peat	72	50
34		Korkuteli	344	12.08.2008	04.11.2008	150	Peat	58	57
35		Korkuteli	344	12.08.2008	16.12.2008	100	Peat	62	45

*: The seed numbers were not counted due to the very small sized seeds and 0.10 g seeds were sown sprinkling.
**: Since the seeds were not counted, the rate of germination could not be calculated.

Daphne gnidioides was the only *Daphne* species germinating at 33% ratio. *D.sericea* was one of our focused species, but we could not germinate it under present conditions. According to Piotto et al. (2003) and Barbie (2008), the seeds of *D.sericea* and other *Daphne* species had deep dormancy and required both physical and chemical pretreatments.

Among the *Erica* species (Heathers), the seeds of *E.manipuliflora* and endemic *E.bocquetii* germinated in a very low numbers. Since *Erica* seeds were could not be counted due to their small sizes and so, they were sown sprinkling, the rate of germination could not be

calculated. Pipinis et al.(2006) also sowed the seeds of *E.manipuliflora* with scattering and achieved quite high germination record (181 seedlings/0.15 gr seed) from the one month of prechilling treatment. In our germination tests in *Erica* species, only 8 seedlings in *E.manipuliflora* and 4 seedlings in *E.bocquetii* could be acquired from 0.10 gr seed samples without prechilling. On the other hand, Piotto et al. (2003) reported *E. arborea* seeds could be germinated after being exposed to smoke and high temperatures up to 120°C for 10 minutes. Accordingly, extra pretreatments are required for germination of this valuable wild species which gained more importance lately especially for landscape designs in particular golf courses and the conservation of ecosystems due to its less water and fertilizer need.
From *Ferula* species, *F.tingitana* (60%) showed much higher germination than *F.communis* (3%). Nikolaeva (1969) reported cold stratification requirement of some other *Ferula* species for germination and effective temperature for this requirement was 0-3°C (Baskin and Baskin, 1989). Thus, *F.communis* also might have seed dormancy and need prechilling treatment. In endemic *Gypsophila bitlisensis*, the autumn seed sowing resulted higher germination rate (86%) than the spring seed sowing (14%). Likewise, the autumn seed sowings (52 and 44%) was found more successfull than the spring seed sowing (17%) in *Iberis attica*. However, the germination medium comprised from peat and perlite might also be effective on the lower result just like the germination test conducted on the summer seed sowing of *C.grandiflora*.
The seeds of *Limonium* species were also sown with scattering and the germination rates of them could not be calculated like *Erica* species. All 3 *Limonium* species were germinated and *L.sinuatum* was the most regenerative (128 seedlings/0.10 gr seed) species among them. Endemic *Ricotia carnosula* has a good potential for being a winter annual plant, because of its odorous, small, white flowers and natural form (Ari et al,2010). Rather high germination rates were achieved varying from 60 to 98% in the 5 germination tests conducted in this species.
We acquired high germination rate(97%) in *Vaccaria hispanica* from the-4-months-old seeds. As to *Vitex agnus-castus*, Belhadj et al. (1998) and Travlos and Karamanos (2007) reported that the seeds of this species have certainly physiological dormancy whilst Dirr and Heuser (1987) said that the seeds of *V. agnus-castus* could germinate without any pretreatment. In our 5 germination tests, we obtained 58 to 96% germination rates and the most successful rate was achieved from the freshly sown seeds collected from Kaledran (Figure 1).

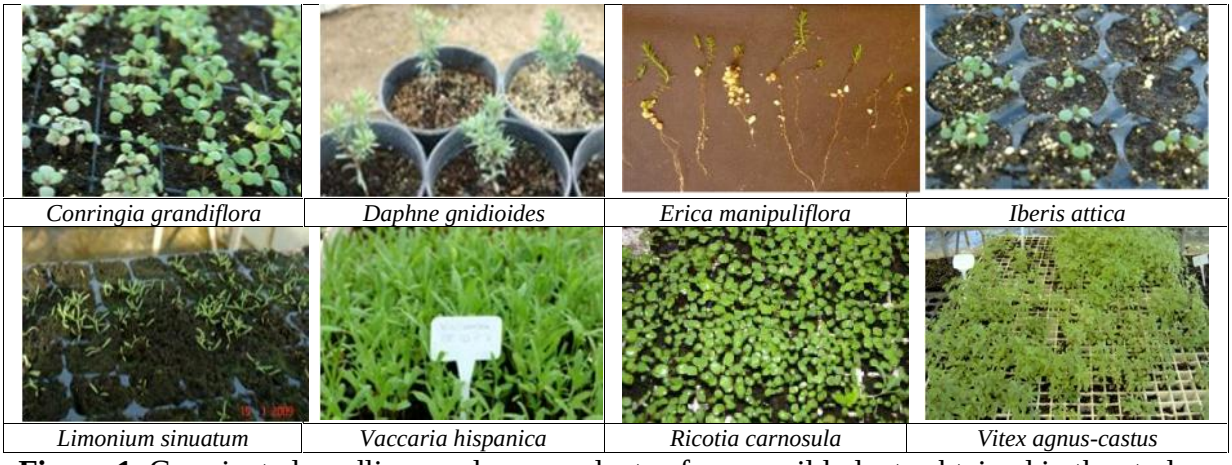

Figure 1. Germinated seedlings and grown plants of some wild plants obtained in the study

On the other hand, the seeds of *Crataegus monogyna, Daphne sericea, D.oleoides, Erica sicula, Rosularia sempervivum* and *Smilax aspera* failed to germinate under the present germination condition in which the only pretreatment was to soak the seeds for 6 hours. The

possible reason of the germination failure for them is most probably different types of dormancies varying according to species. For example *C.monogyna* was reported to have deep physiological dormancy (Flemion, 1934; Baskin and Baskin, 1989) and it may take 1, 2 or 3 years for seeds to germinate (Bujarska-Borkowska, 2002). For the production of *D.sericea*, we believe a mycorrhizal symbiosis is required (Arı et al., 2011). Piotto et al. (2003) pointed out the combination of warm stratification + cold stratification before sowing could improve the percentage of germination in *S.aspera*. To conclude, these results should be evaluated to be initial results of our preliminary tests and it is possible to break dormancies and to increase germination rates by different pretreatments in the subsequent studies.

Conclusion

20 wild plant species with outdoor ornamental plant value were screened in this study in order to determine their germination abilities. Among the scanned species, *Conringia grandiflora, Daphne sericea, Erica manipuliflora, Iberis attica*, *Limonium sinuatum*, *Ricotia carnosula*, *Vaccaria hispanica* and *Vitex agnus-castus* were our most targeted species because of their higher ornamental potential. Except from *D.sericea* and *E.manipuliflora*, we achieved quite high germination rates from the others. Hence, the germination results of this work, in which some of the species were investigated and cultured for the first time, were found quite promising for the cultivation and domestication of them. However, it is possible to increase the germination rates by different pretreatment applications in the forthcoming studies in particular non-germinated species.

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