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A study on *Reseda lutea* L. distributed naturally in West Anatolia in Turkey

YUNUS DOĞAN*, SÜLEYMAN BAŞLAR, HASAN HÜSEYIN MERT

Dokuz Eylül University, Faculty of Education, Dept. Biology, 35150 Buca İzmir, Turkey

Morphology and seed germination of *Reseda lutea* L. (*Resedaceae*), which is distributed naturally in Turkey, were investigated. Germination trial was observed at 10, 15, 20, 25, 30, 35 and 40 °C. In laboratory conditions at 25 °C, 87% of the seeds of *R. lutea* germinated, while in soil conditions, the best germination rate was only 23%, achieved with seeds sowed at 10 mm depth. The results of germination under different light conditions showed that the germination rate at 25 °C in continuous darkness was 87%, 76% with 6 hours of light, 67% with 12 hours of light, 52% with 18 hours of light and 42% with continuous light. Measurements of samples collected from different localities showed that the length of the plant is inversely proportional to the altitude.

Key words: *Reseda lutea,* morphology, seed germination.

Introduction

About 60 species of *Reseda* genus are known to be distributed in the world, but in Turkey there are only 15 of them (DAVIS 1965). Among them, *Reseda lutea* can be found throughout Turkey between the altitudes of 0 m and 2300 m; in the world, however, it is widely distributed only in the temperate zone. Both *R. lutea* and *R. luteola* are used as dye plants in Turkey, where hand-woven carpet making is very common (EYBOĞLU et al. 1983, SEÇMEN et al. 1986, UĞUR 1988, ANONYMOUS 1991, ÖZTÜRK and ÖZÇELİK 1991, MERT et al. 1993, DOĞAN 2001). The species *R. lutea* is also reported to be one of the plants used in apiculture, grazing and the struggle against erosion (MOGHADDAM 1977, JABLONSKI et al. 1992, BRUNS and JOCHIMSEN 1989, JOCHIMSEN and JANSEN 1991, HEAP et al. 1995, DOĞAN 2001). However, in some countries, this species has been reported as a weed (ABDALLAH and DE WITT 1978, FORBES and MATHEWS 1985, HEAP et al. 1995).

We investigated the morphological characteristics and seed germination of the species. To know the ecological characteristics of a plant, it is necessary to determine the properties and structure of its habitats, particularly the soil. This is possible through an autecological study. To be able to identify the ecological characteristics of a plant species, the determination of soil properties alone is not enough, for it is also necessary to determine the non-eco-

* Corresponding author: Fax: 0090 232 2500863, e-mail: yunus.dogan@deu.edu.tr

logical characteristics of the plant. Therefore in this study, the morphology and seed germination characteristics of *R. lutea* were investigated. The morphological characteristics of *R. lutea* were compared with the results of studies done in other countries on this plant.

Material and methods

Specimens of *R. lutea* collected from 54 different localities from the West Anatolian part of Turkey were identified taxonomically according to the »Flora of Turkey and the East Aegean islands« (DAVIS 1965) and »The biology of Australian weeds« (HEAP et al. 1995). Plant samples collected from 54 different localities were used for biometric measurements. Seeds which had completed stratification were used in the germination trials. These were sterilised with 5% sodium hypochloride to prevent fungal invasion during the experiment. After sterilisation, the seeds were washed in distilled water three times and put for germination in sterilised petri dishes containing double filter papers. A refrigerated oven was used as an incubator for germination with a 7 W-fluorescence-lamp for illumination. The petri dishes were kept 40 cm away from the light source. In the dark room, a 25 W green-lamp was used for counting the germinated seeds. The petri dishes were placed 30 cm away from the light source for the counting of the seeds in the dark. Although the germination was completely finished at the end of the eleventh day, the petri dishes were left for up to 21 days, but no more seeds germinated. The experiments were duplicated with 100 seeds per petri dish. The effects of temperature on germination were investigated at 10, 15, 20, 25, 30, 35, 40 and 45 °C, in continuous dark and light. The effects of light on germination was observed by leaving the seeds in continuous darkness, and in 6, 12, 18 and 24 hours of continuous light at 25 °C, which was the optimum germination temperature. In addition, to show the effects of the vertical position of the seeds in the soil on germination, the seeds were left at 10, 30, 50 and 100 mm depths from the surface in 500 mL glass jars, filled with garden soil. 100 seeds were kept in the middle and at the border of the jars. Germination was registered when the first leaf appeared on the soil surface. The study was carried out for four weeks.

Results and Discussion

Localities established during the study of *Reseda lutea* in West Anatolia according to the DAVIS (1965) grid-square are given below. Al: Çanakkale, centre (5); Eceabat (l); Eceabat (2); Lapseki (4); Balikesir, Gönen (12). A2: Balikesir, Bandirma (11). Bl: Çanakkale, Ayvacik (3); Balikesir, centre (9); Ayvalik (6); Savaştepe (10); Manisa (15); Spil mountain 13); Sabuncubeli (14); Akhisar (16); İzmir, Dikili, (22); Bergama (23); Gümüldür (24); Bornova (26); Seferihisar (27); Urla (28); Karaburun (29); Çeşme (30); Konak (31); Aliağa (32). B2: Balikesir, Bigadiç (7); Bigadiç (8); Manisa, Akhisar (17); Gördes (18); Demirci (19); Kula (20); Sarigöl (21), Denizli, Güney (37); Güney (38); Çal (39); Çal (44); Çivril (45); Kütahya, Şaphane (52); Gediz (53); Uşak (54). Cl: İzmir, Selçuk (25); Aydin, Kuşadasi (33); Söke (34); Ortaklar (35); Didim (36); Muğla, Milas (48). C2 Denizli, centre (41); Güzelpinar (40); Honaz Mountain (42); Tavas (43); Baklan (46); Pamukkale (47); Muğla, centre (51); Yatağan (49); Ula (50).

The morphological characteristics identified as a result of this study are given below: *R. lutea* is a perennial or rarely an annual herb; with stems erect or ascending, usually diffusely branched, glabrous or scabrous-papillose, 25 to 130 cm tall (Tab. l). Leaves are usually dark green; narrow, trifid or pinnatifid; segments elongate. Basal leaves are sometimes entire, 34.55 to 178.05 mm; cauline leaves are 19.80 to 84.05 mm in length. Bracts are usually caducous. Flowers are zygomorphic and arranged in racemes. Sepals are 5–6, free, persistent and becoming twisted in fruit, 2.8–3.5 × 0.6–0.9 mm long × broad. Petals are 6, free, yellow coloured, 3.55–4.00 × 2.20–2.50 mm; the limbs are trilobed, and with the lateral lobes are lunulate, entire, crenulate and occasionally more deeply divided into irregular segments; the midlobes are shorter, entire, narrowly linear. Stamens are 13–24, inserted on a dorsally enlarged disc, their lengths being 2.40–4.50 mm, and anther length 1.20–1.50 mm. Filaments are caducous very long before the fruit is ripe, 2.30–3.70 mm. Ovaries are 3, superior, unilocular, usually open at the apex, 2.00–3.30 mm, ovules are numerous. Placentation is parietal, capsules are 4.00–15.00 × 2.00–5.40 mm, erect, rarely, the lowermost stem capsules are pendulous when fully ripe, opening more widely at maturity: capsule nerves are scabrous, cylindrical, sometimes ovate or even subglobose or triquetrous, glabrous, with three very short teeth. Pedicel is 2.2–4.4 mm (in flower). Seeds are 1.40–1.80 × 1.05–1.25 mm, reniform or suborbicular, without endosperm; each capsule has 4–27 seeds (Tab. l), shiny, yellow to black, slightly smooth, the mature seeds remain in the capsules until dispersed by physical disturbance. The flowering period is from April to late September.

The morphological observations and biometric measurements were completed on the plants of *R. lutea* collected from West Anatolia. These results were compared with the results of other studies, those of BONNIER (1934), HEGI (1958), BUTCHER (1961), TUTIN et al. (1964), DAVIS (1965), PEARCE (1982), and HARRIS et al. (1995). Plant length, which usually changes with the habitat, is reported as 20–70 cm by BONNIER (1934), 30–60 cm by HEGI (1958), 30 cm by BUTCHER (1961), 70 cm by DAVIS (1965), 20–80 cm by PEARCE (1982) and 30–70 cm by HARRIS et al. (1995). It was found that the length in our 54 plant samples varies between 25 and 130 cm (Tab. l). The average plant length is 103 cm at an average altitude of 68 m in 11 localities in the province of Izmir, while the same values in 11 localities in the province of Denizli are 62 cm and 801 m respectively (Tab. 2).

There are also some differences in the plant lengths of our samples collected from different localities. As is seen in Table 2, at lower altitudes plant length is higher than plant length in the higher altitudes. The average plant length of the samples collected from Izmir is higher than the average plant length of all our samples collected from 54 different localities, which comes to 82.82 cm. This is in inverse proportion to the altitude. Again in Denizli, plant length is less than the average length of the 54 plants, also inversely proportional to altitude. Altitude starts from 750 m in localities numbered 13, 37, 38, 39, 40, 42, 43, 44, 45, 46 and 52. Plant lengths are lower in these localities: the 59.54 cm average is lower than the average length of the other group of 54 plants, which is 82.82 cm. Plant length starts decreasing after 750 m, as long as altitude increases. The reason for this decrease is reported to be that the higher altitude areas have higher solar radiation and stronger air currents. In our case ecological factors mentioned above are not effective in these areas; rather, the longer vegetative periods due to the effects of ecological factors cause the lengthening of these plants.

Although HARRIS et al. (1995) stated the petal length as being 5 mm on average, in our 40 plant samples petal length was 3.57 mm on average (Tab. l). The value reported by HARRIS et al. (1995) is thus considerably higher than ours.

The number of anthers in *R. lutea* flowers is reported as being 20 on average by BONNIER (1934), 15–25 by HARRIS et al. (1995) and 14–18 by HEAP et al. (1995), but it was observed to be around 17.30 in our area (Tab. l). Thus the anther numbers of our flowers are lower than those reported BONNIER (1934), but commensurate with those of the other authors.

Although TUTIN et al. (1964) reported the capsule width as 4.5–5.5 mm, it was seen that these numbers vary between 2.00–5.40 mm in our samples, and the fruit capsule width *of R. lutea* is narrower in our materials (Tab. l). DAVIS (1965) reported on biometric measurements of *R. lutea* seeds, giving an average seed length of 2 mm or more, but our measurements lie around 1.58 mm on average. Again BUTCHER (1961) found an average seed width of 1.4 mm on, as against 1.15 mm on average in our samples.

The differences in the biometric measurements *of R. lutea,* can be explained as follows: Other workers might have used only limited numbers of samples. Other factors could have been the differences in geographic areas studied by other researchers as well as the differences in soil and edaphic conditions of these areas. Ecological differences can cause differ-

Tab. 1. Biometric measurements of *Reseda lutea* (plant lenght mean of 54 samples, others mean of 40 samples). S.D. – standard deviation, S.E.- standard error

Morphological characteristics	Min.	Max.	Mean	S. D.	S. E.
Plant height (above ground) (cm)	25	130	82.82	25.353	3.585
Basal leaves (mm)	34.55	178.05	74.97	36.792	6.953
Cauline leaves (mm)	19.80	84.05	42.65	16.211	2.629
Sepal length (mm)	2.80	3.50	2.76	0.346	0.081
Sepal width (mm)	0.60	0.90	0.73	0.084	0.020
Petal length (mm)	3.55	4.00	3.57	0.298	0.054
Petal width (mm)	2.20	2.50	2.19	0.142	0.031
Stigma length (mm)	2.00	3.30	2.91	0.376	0.094
Stamen length (mm)	2.40	4.50	3.46	0.634	0.184
Stamen number of a flower	13	24	17.30	2.398	0.379
Filament length (mm)	2.30	3.70	2.92	0.306	0.055
Anther length (mm)	1.20	1.50	1.43	0.099	0.026
Pedicel length of the flower (mm)	2.20	4.40	3.45	0.441	0.068
Pedicel length of the fruit (mm)	4.40	7.55	6.14	0.780	0.123
Capsule length (mm)	4.00	15.0	8.98	3.135	0.522
Capsule width (mm)	2.00	5.40	3.86	0.762	0.122
Seed length (mm)	1.40	1.80	1.58	0.103	0.018
Seed width (mm)	1.05	1.25	1.15	0.060	0.010
Seed number in a capsule	4	27	13.91	8.423	1.339

ences in the morphological features of a plant (ÖZTÜRK and SEÇMEN 1996). Although DAVIS (1965) separated *R. lutea* into two varieties as var. *lutea* and var. *nutans* and ABDALLAH and DE WITT (1978) separated this species into two subspecies, subsp. *lutea* and subsp. *neglecta,* our study is not a taxonomical revision study, and so we have dealt with species level.

Except with respect to the morphological features mentioned above, our measurements and observations on the morphology *of R. lutea* show a considerable resemblance to those reported by DAVIS (1965).

The germination rates *of R. lutea* seeds at different temperatures are given table 3. The germination trial was observed at 10, 15, 20, 25, 30, 35 and 40 °C for 21 days to find the optimum temperature in continuous darkness and in continuous light. At the end of 21 days, no germination had occurred below 10 or above 40 °C. The germination rates obtained are 17% at 10 °C, 39% at 15 °C, 58% at 20 °C, 87% at 25 °C, 69% at 30 °C, 45% at 35 °C and 28% at 40 °C. According to these results, the highest germination rate of *R. lutea* seeds is 87%, achieved at 25 °C.

The optimum germination temperature of *R. lutea* is thus 25 °C. The best germination rate in continuous darkness was 87%, and it was 76% in 6 hours of light, 67% in 12 hours of light, 52% in 18 hours of light and 42% in continuous light. Germination occurs under all light periods (Tab. 4). The highest rate of germination (87%) is seen in continuous dark, and germination rates decrease when the light periods last longer. Germination at all temperatures starts on the second day, reaches the highest level on the third and fourth days and decreases slowly after the fifth day. Although experiments continued until the twenty-first day, germination had stopped at the end of the eleventh day.

Tab. 2. Measurement of the length of the plants collected from Izmir and Denizli. Loc. – locality number

Izmir			Denizli		
Loc.	Altitude (m)	Plant height (cm)	Loc.	Altitude (m)	Plant height (cm)
22	50	103	37	750	50
23	150	86	38	800	80
24	50	116	39	830	75
25	50	106	40	1200	60
26	200	106	41	520	82
27	25	102	42	1500	50
28	25	107	43	1150	67
29	50	86	44	875	81
30	50	103	45	850	25
31	60	86	46	850	60
32	40	130	47	340	50
Mean	68	103	Mean	801	62

HEAP (1994) reported that this plant can germinate between 10–35 °C in conditions of darkness; nevertheless, the maximum germination rate of 85% occurs at 25 °C under laboratory conditions. In our findings it is ascertained the maximum germination rate is 87% at 25 °C, but it can germinate between 10–40 °C under dark conditions. Our findings show a parallelism with those of HEAP (1994). The germination of *R. lutea* seeds at 40 °C is new information, not reported previously. HEAP (1994) studied six year old *R. lutea* seeds in laboratory. He found the same germination rate, but seeds over 11 years old did not show any evidence of germination under laboratory conditions. In our study l- and 2 year-old seeds were used. Our germination results and those of HEAP (1994) show a good similarity.

In germination studies, the effect of light showed that seeds can germinate under all light conditions from continuous darkness up to continuous light (Tab. 4). The lowest germination occurs in continuous light (42%), germination increasing in parallel to the increase of darkness. The highest germination rate (87%) is seen in continuous darkness. These results resemble those of HEAP (1994) and HEAP et al. (1995).

When the germination results are examined on daily basis, it is seen that the highest germination is on the third and fourth days. The germination decreases from the fifth day, finishes at the end of the eleventh day (Tab. 4). In another study, the following rates of germination were obtained: 40% at the end of the seventh day, 73% at the end of the fourteenth day. As for the seeds that did not germinate at all, 25% were thought to be dead, while 2% did not germinate although they were alive (HEAP et al. 1995). In our results, these rates are 83% at the end of the seventh day, 87% at the end of the fourteenth day. The germination was completed to a large extent in the first week.

In a study done in South Australia, it was reported that *R. lutea* seeds, could stay alive in the soil for at least 4 years. The germination rate was reported as of 33–63% (HEAP 1994).

BOLLE (1936) and ABDALLAH and DE WITT (1978) reported similar findings on the germination of seeds of members of the Resedaceae, pointing out that these seeds do not stay alive for more than 4 years. It was reported that 93% of *R. lutea* seeds could germinate at the end of the first or second year (DOLPH-PETERSON 1925). These results, too, are close to the germination results of *R. lutea.*

MOGHADDAM (1977) reported that *R. lutea* could grow even in areas where temperatures decrease to as far as –25 °C in Iran. Germination studies on seeds pre-treated for seven

Tab. 3. Germination of seeds of *Reseda lutea* at different temperatures. T – Temperature, Cd – continuous dark, Cl – continuous light

T (°C)	Germination (%)	
	Cd.	Cl
10	17	4
15	39	7
20	58	10
25	87	42
30	69	25
35	45	21
40	28	16

Tab. 4. Germination rates of *Reseda lutea* seeds at different photoperiods at 25 °C.

Illumination (Hours)	Germination (% / day)												Total germination (%)
	1	2	3	4	5	6	7	8	9	10	11	21	
0	0	2	47	28	5	1	0	2	1	0	1	0	87
6	0	3	45	23	2	1	1	0	0	1	0	0	76
12	0	2	23	28	9	3	0	0	2	0	0	0	67
18	0	2	22	14	6	3	2	1	1	1	0	0	52
24	0	0	18	16	5	1	0	0	1	0	1	0	42

days at 5 °C, showed a higher rate of germination than those treated for seven days at 20 °C (HEAP et al. 1995). HEAP et al. (1995) pointed out that *R. lutea* seeds could stay alive at low temperatures and under low temperatures. This resulted in an increase in their germination rates. This shows that seeds need a vernalisation treatment for better germination.

The experiment of germination at different depths in soil lasted for four weeks. Sowing was done at 10, 30, 50 and 100 mm in depths, in the middle and along the edge of glass jars (Tab. 5). The reason for using jars instead of flowerpots is to ascertain the germination ability of seeds in light, in soil. 30% of seeds at 10 mm and in the middle, and 23% of seeds at 10 mm and along the border of jars germinated. At 30 mm, 18% of seeds in the middle and 1% along the border germinated. At 50 and 100 mm, no germination occurred. It is clearly seen that germination and seedling appearance decreases with an increase in depth. Besides this, the negative effect of light on germination has been ascertained.

Seeds germinate at an optimum depth, according to their light requirement. Under some depths, seeds cannot germinate because they cannot get light. But seeds germinate easily if they are close to the soil surface, because there is enough light. Each species has an optimum germination depth, changing according to conditions (WEAVER and CLEMENTS 1938). ÖZTÜRK et al. (1984) reported that seed germination rates show differences in relation to planting on the surface and at the border of a glass jar and planting from surface to deeper parts. The seeds of *Myrtus communis* L. (ÖZTÜRK 1979), *Inula viscosa* (L.) Aiton (PIRDAL 1989) and *Asphedolus aestivus* Brot. (PIRDAL 1989),which show a parallel distribution with our species, showed optimum germination at 10 mm, *Briza* (ÖZDEMIR et al. 1984) and *Bromus* (TÜRDÜ et al. 1984) showed better germination on the surface in soil less than 10 mm deep. *R. lutea* seeds germinate well at 10 mm of soil depth (36%). Germination decreased as depth increased. Optimum germination and seedling appearance were seen in the middle as well as along the border of the glass jars (Tab. 5). This shows that *R. lutea*

Tab. 5. Germination results of the seeds of *Reseda lutea* at different depths in jars. Grc – germination ratio in the centre, Grb – germination ratio at the border

Depth (mm)	Grc (%)	Grb (%)
10	36	23
30	18	1
50	0	0
100	0	0

seeds do not need light for germination, as was reported before in the discussion of the effects of light on germination. The germination ability of *R. lutea* seeds is better under dark conditions (Tab. 5). HEAP (1994) reported that *R. lutea* seeds can germinate at a depth of even up to 80 mm, but the maximum germination is seen between 5–10 mm. Our results show a parallel with those of ÖZTÜRK (1979), PIRDAL (1980), ÖZDEMIR et al. (1984), TÜRDÜ et al. (1984), PIRDAL (1989) and HEAP (1994).

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References

ABDALLAH, M. S., DE WITT, H. C. D., 1978: The Resedaceae: A taxonomical revision of the family. Belmontia, New Ser. 8: 1–416.

ANONYMOUS, 1991: Bitkilerden Elde Edilen Boyalarla Yün Liflerinin Boyanmasi. Sanayi ve Ticaret Bak. Küçük Sanatlar ve San. Bol. ve Siteleri Gen. Müd. Yay., Ankara.

BOLLE, F., 1936: Resedaceae. In: ENGER, A., PRANTL, K. (eds.), Die Naturlichen Pflanzenfamilien, 659–692. Dunker and Humplot, Berlin.

BONNIER, G., 1934: Flore complete illustree en couleurs de France Suiss et Belgique, Tome 3. Librairie générale de l'enseignement, Paris.

BRUNS, D., JOCHIMSEN, M., 1989: Der Einfluß unterschiedlich behandelten Bergematerials auf das Wurzelwachstum ausgewählter Pionierpflanzen. Verhandlungen Gesellschaft für Ökologie 18, Essen, 1988, 73–78.

BUTCHER, R. W., 1961: A new illustrated British flora, Part I. Leonard Hill, London.

DOĞAN, Y., 2001: A study on the autecology of *Reseda lutea* L. (Resedaceae) distributed in Western Anatolia. Turk J Bot, 25, 137–148.

DAVIS, P. H., 1965: Flora of Turkey and East Aegean Island. Edinburgh Univ. Press, Edinburgh.

DOLPH-PETERSEN, K., 1925. Examination of the occurrence and vitality of various weed seed species under different conditions, made at the Danish State Seed Testing Station during the years 1896–1923. Proc. of the 4. International Seed Testing Congress, Cambridge, 4:128–138.

EYÜBOĞLU, Ü., OKAYGÜN, İ., YARAS, F., 1983: Doğal Boyalarla Yün Boyama. Uygulamali Eğitim Vakfi Yayinlari, Özkur Basimevi, Istanbul.

FORBES, G. R., MATHEWS, P. R., 1985. Pre-emergence R–40244 for early weed control in potatoes and carrots. Br. Crop Prot. Conf. Weeds 3, 747–804.

HARRIS, J. D., DAVIS, E. S., WICHMAN, D. M., 1995: Yellow mignonette *(Reseda lutea)* in the United States. Weed Technol. 9, 196–198.

HEAP, J. W., 1994: Biology and control of *Reseda lutea* L. (Cutleaf mignonette). MSc. Thesis, University of Adelaide, South Australia.

HEAP, J. W., WILCOCKS, M.C., KLOOT, P. M., 1995: *Reseda lutea.* In: GROVES, R. H., SHEPHERD, R. C. H., RICHARDSON, R. G. (eds.), The biology of Australian weeds, Volume I. 203–216. R. G. & F. J. Richardson Pub., Melbourne.

HEGI, G., 1958: Illustrierte Flora von Mittel-Europa IV/I. Carl Hanser Verlag, München.

JABLONSKI, B., KOLTOWSKI, Z., DABSKA, B., 1992: Nectar secretion and honey efficiency of important plants in Poland conditions, Part 7. Pszczeinicze Zeszyty Naukowe 36, 54–64.

JOCHIMSEN, M., JANZEN, D., 1991: Structure and phytomass production of a pioneer community. In: EASER, G. OVERDBECK, D. (eds.), Modern ecology, 39–69. Elsevier, Amsterdam.

MERT, H. H., BASLAR, S., DOĞAN, Y., 1993: Çevre Sorunlari Yönünden Bitkisel Boyalarin Önemi. Proc. 2. Int. Symp. Ecology and Environmental Problems, Ankara, 104–111.

MOGHADDAM, M. R., 1977: *Reseda lutea:* Multipurpose plant for arid and semiarid lands. J. Range Manage 30, 71–72.

ÖZDEMIR, F., ZEYBEK, N., ÖZTÜRK, M., 1984: Morphological, anatomical and ecological observations on three *Briza* L. species. Ege University Faculty of Science Journal Series B, 7, 111–121.

ÖZTÜRK, M. A., 1979: Preliminary observations on the edaphic and biotic relations of *Myrtus communis* L. Ege University Faculty of Science Journal Series B, 3, 137–142.

ÖZTÜRK, M., OFLAS, S., MERT, H. H., 1984: Studies on the germination of *Inula graviolens* Desf. seeds. Ege University Faculty of Science Journal, Series B, 7, 39–46.

ÖZTÜRK, M., ÖZÇELİK, H., 1991: Doğu Anadolu'nun Faydali Bitkileri. Siskav, Ankara.

ÖZTÜRK, M. A., SEÇMEN, Ö., 1996: Bitki Ekolojisi. Ege Üniversitesi Basimevi, Izmir.

PEARCE, R.D., 1982: Resedaceae. In: GEORGE, A. S. (ed.), Flora of Australia, 359–361. Australian Government Pub. Service, Canberra.

PIRDAL, M., 1980: *Inula viscosa* (L.) Aiton Bitkisin Edafik Etmenlerle Olan İlişkisi. Proc. of the 7. National Biology Congress, Aydin, 657–664.

PIRDAL, M., 1989: *Asphodelus aestivus* Brot.'un Autekolojisi Üzerinde Bir Araştirma. Doga Türk Botanik Dergisi, 13, 89–101.

SEÇMEN, Ö., GEMİCİ, Y., LEBLEBİCİ, E., GÖRK, G., BEKAT, L., 1986: Tohumlu Bitkiler Sistematiği. Ege Üniversitesi Matbaasi, İzmir.

TÜRDÜ, P., ZEYBEK, N., ÖZTÜRK, M. 1984: Studies on the morphology, anatomy and ecology of some *Bromus* L. species. Ege University Faculty of Science Journal Series B, 7, 29–38.

TUTIN, T. G. et al. (eds), 1964: Flora Europe, I. Cambridge Univ. Press, Cambridge.

UĞUR, G. 1988: Türk Halilarinda Doğal Renkler ve Boyalar. Türkiye İş Bankasi Kültür Yay. 289, Ankara.

WEAVER, J. E., CLEMENTS, F. E., 1938: Plant ecology. Mc Graw-Hill, New York.