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Aegilops triuncialis subsp. *bozdagensis* (Poaceae), a new subspecies from South-Western Turkey

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Abstract: A new subspecies *Aegilops triuncialis* L. subsp. *bozdagensis* Cabi & Doğan, is described and illustrated. This new subspecies is confined to Denizli, Acıpayam, Bozdağ in southwestern Anatolia. It differs from the other two subspecies of *Ae. triuncialis* subsp. *triuncialis* and *Ae. triuncialis* subsp. *persica*, by its unawned glumes of the lateral spikelets. Concerning the new subspecies, IUCN red list category, distribution map, notes on its biogeography and ecology are given. An identification key of the subspecies of *Ae. triuncialis* is also provided.

Keywords: *Aegilops*, Poaceae, New subspecies, Turkey.

Introduction

The genus *Aegilops* L. consists of ca. 25 species in the world. It constitutes the primary and secondary gene pool for cultivated wheats (van Slageren, 1994; Cabi, 2010). Species in the genus are distributed in Southwest and Central Asia and throughout the Mediterranean basin. A primary center of diversity of the *Aegilops* is considered to be the 'Fertile Crescent', because a larger number of *Aegilops* species are found there than those in other areas (van Slageren, 1994; Cabi, 2010).

In the Flora of Turkey, Davis (1985) reported 15 species. Subsequently, two *Aegilops* species have been added from Turkey (Güner et al., 2000; Cabi, 2010; Cabi & Doğan, 2009; 2012). Turkey is now one of the center of diversity for *Aegilops* with 17 species (Cabi, 2010; Cabi & Doğan, 2012).

In 2007, while conducting field work around Bozdağ, Denizli-Acıpayam, we found an interesting *Aegilops* population. The specimens were similar to *Ae. triuncialis*, however, they were not matched with any previously known *Ae. triuncialis* specimens. Therefore, to accommodate them, new subspecies is described

Materials and Methods

We carried out extensive field studies between 2006 and 2009 and collected a large number of specimens for revising the genus *Aegilops*. In addition, population size, phenological traits and ecological preferences of the species in the genus were observed during the field studies. Particular attention was paid to *Aegilops* specimens collected from Bozdağ Mountain, Southwest Anatolia (B2 Denizli sensu Davis, 1965) in 2007. Upon closer examination and going through the Flora of Turkey (Davis, 1985) and other relevant floras, such as Flora Orientalis (Boissier, 1884), Flora of Syria, Palestine and Sinai (Post, 1933), Flora of Iraq (Bor, 1968), Flora Iranica (Bor, 1970) and the latest monographic treatment of van Slageren (1994), these specimens were identified as a new subspecies of *Ae. triuncialis*. All the authors of plant name are given according to Brummit and Powell (1992).

Taxonomic treatment

Aegilops triuncialis* L. susbp. *bozdagensis Cabi & Dogan *subsp. nov.* (Figs. 1C, 2E)

Aegilops triuncialis susbp. *bozdagensis* differs from the other subspecies by having lateral spikelets without any awns. Glumes have three teeth up to 0.5 cm, the middle one is shorter than the others.

Type:-Turkey. Denizli: Bozdağ, Geyran yaylası, roadsides, open forest, 1400-1650 m, 30.06.2009, *E. Cabi 4050* (holotype GAZI, isotype ANK).

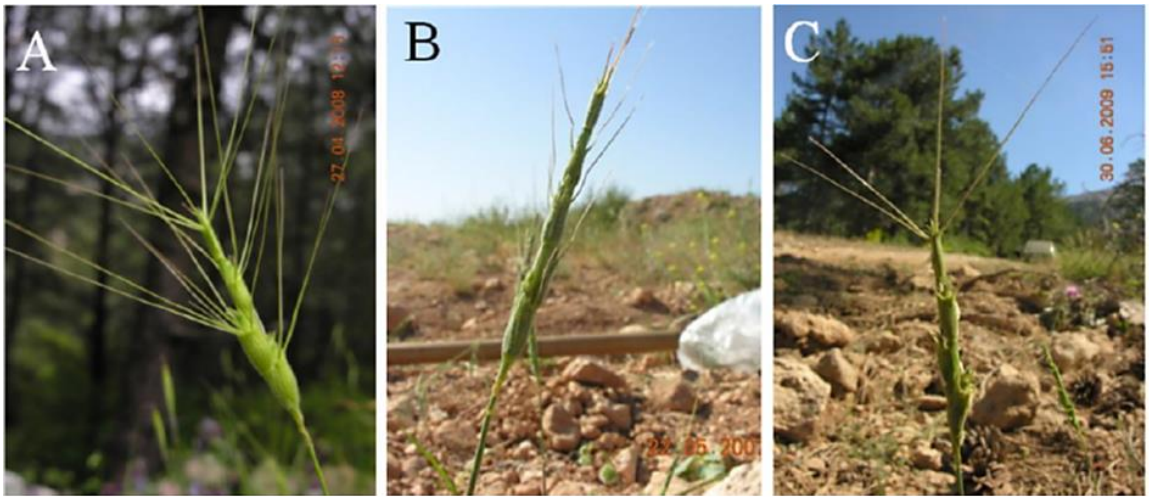

Figure 1. (A) *Aegilops triuncialis* subsp. *triuncialis*, (B) *Ae. triuncialis* subsp. *persica* and (C) *Ae. triuncialis* L. subsp. *bozdagensis*.

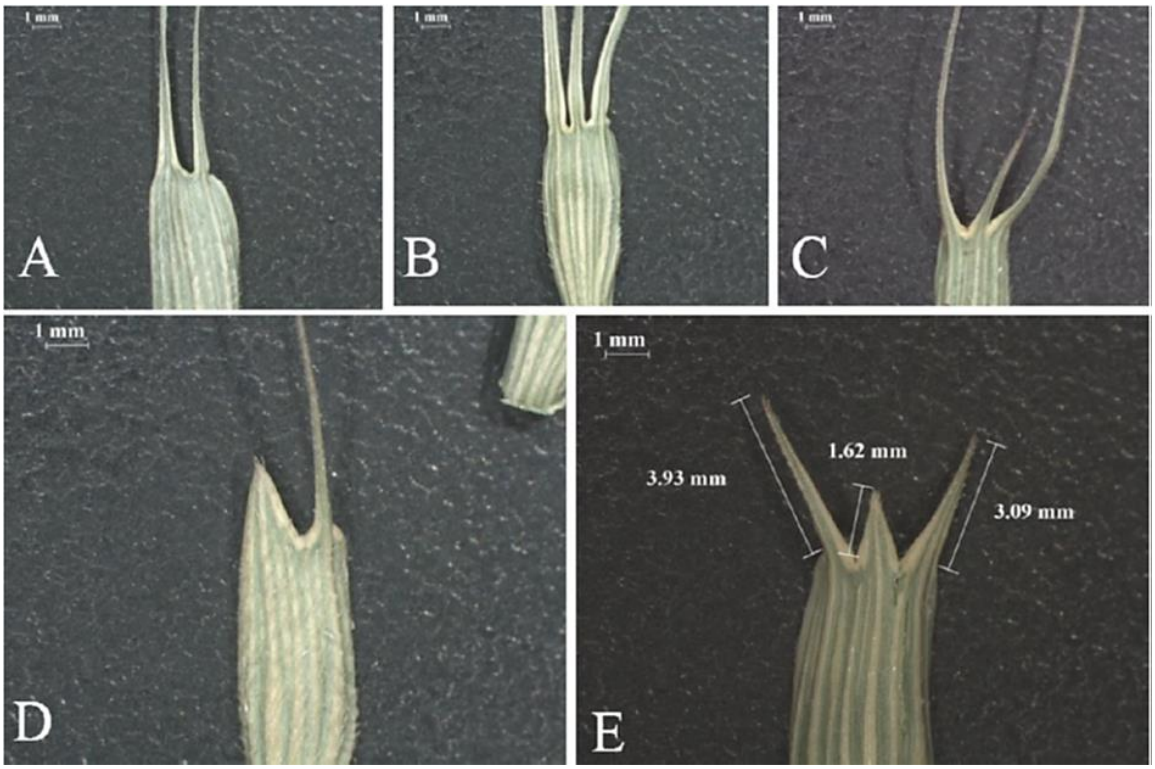

Figure 2. (A, B and C) Glume of *Aegilops triuncialis* subsp. *triuncialis* (D) Glume of *Aegilops triuncialis* subsp. *persica* and (E) Glume of *Ae. triuncialis* subsp. *bozdagensis*.

Tufted annuals. Stem 20-25 cm (excl. spikes). Leaves linear-lanceolate, 1.5-3 mm broad, pilose or glabrous. Spike 3-5 cm, subcylindrical (excl. awns). Spikelets (3-) 4-5 (-7), all fertile, appearing ± superimposed on the sinuate rachis, forming a regular though slight1y tapering column, internodes c. as long as glumes; fruiting spike shed as a unit. Vestigial spikelets 3 (rarely 2). Glumes of lateral spikelets oblong, 6-10 mm, 1.5-2 × as long as broad, subglabrous to antrorsely scabridulous or pubescent, with pallid close-set veins; awns 2-3, 1-6 cm setaceous or middle awn sometimes reduced to a tooth; at least lowest lemma setaceous-awned, the others shortly awned or spine-toothed. Uppermost spikelet with glumes bearing 3 long setaceous awns overlapping awns of lateral spikelets; lemma of florets bearing 3 setaceous awns shorter than those of glumes, lateral pair much shorter than middle awn.

Results and Discussion

Aegilops triuncialis (Fig. 1) is one of the most widespread

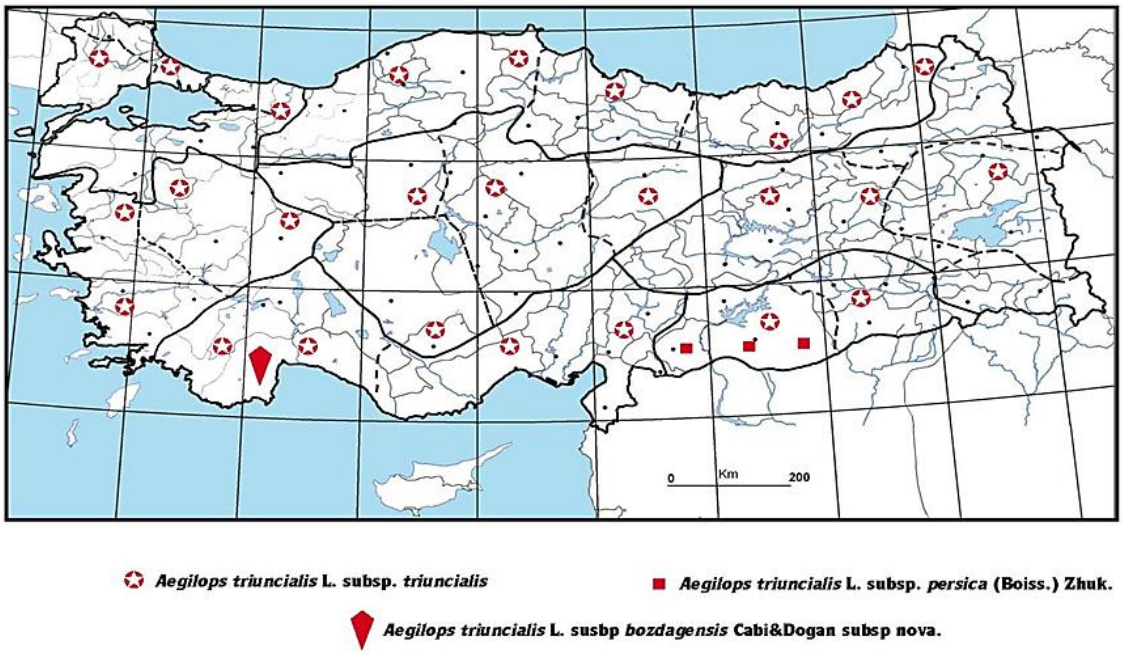

Figure 3. Distribution map of *Aegilops triuncialis* subsp. *triuncialis*, *Ae. triuncialis* subsp. *persica*, *Ae. triuncialis* subsp. *bozdagensis*.

species of the genus and can easily adapt to a wide range of habitats (van Slageren, 1994). Since its recognition by Linneaus (1753), many infraspecific taxa have been described under this species (Popova, 1923; Eig, 1928; Zhukovsky, 1928; Hammer, 1980). Zhukovsky (1928) recognized 6 subspecies under *Ae. triuncialis,* namely subsp. *brachyathera* Boiss., subsp. *caput-medusae* Zhuk., subsp. *fasicularis* Zhuk., subsp. *kotschyi* Boiss. subsp. *persica* (Boiss.) Zhuk. and subsp. *typica* Zhuk. In the Flora of Turkey, Davis (1985) reported only typical subspecies of *Ae. triuncialis* (Figs. 1A, 2A-C) and additionally pointed out that subsp. *persica* (Boiss.) Zhuk. (Figs. 1B, 2D) might occur in eastern part of Turkey. Because subsp. *persica* is known from Caucasia, N. Iraq, Iran and Afghanistan. Subsequently, van Slageren (1994) proved the presence of subsp. *persica* from Turkey.

Van Slageren (1994) in his last monographic study on the genus stated that *Ae. triuncialis* varies greatly in some characters, i.e. length of spike, number of spikelets and length of glume awns, and recognized two morphologically distinct subgroups ranked as variety rather than subspecies. According to him, *Ae. triuncialis* var. *persica* is characterized by having glumes of lateral spikelets with 2 teeth or 1 tooth and 1 short awn only, while var. *triuncialis* is characterized by having glumes of lateral spikelets with 2-3 well developed awns. Afterward Valdés and Scholz (2009) and Cabi and Doğan (2012) treated the varieties of van Slageren as subspecies rank and only accepted two subspecies in *Ae. triuncialis*, as *Ae. triuncialis* subsp. *triuncialis* and *Ae. triuncialis* subsp. *persica*. This new subspecies, described here, differs from other subspecies by having lateral spikelets without any awns. Glumes have three teeth up to 0.5 cm, the middle one being shorter than the others.

Key to subspecies

1. Glumes of lateral spikelets unawned, with 3 teeth up to 0.5 cm long and the middle one is shorter than the others……..**subsp. *bozdagensis***

1. Glumes of lateral spikelets distinctly 1-3 awned

2. Glume of lateral spikelets with 1 tooth and 1 short, up to 1.5 cm long awn; apical glumes with a well-developed central awn and 2 short lateral awns, or lateral awns reduced to teeth……..….**subsp. *persica***

2. Glumes of lateral spikelets with 2-3 well developed, 1.5– 6 cm long awns; apical glumes with a well-developed, central awn of 5-8 cm that is the longest awn of the spike, and 1-3 cm long lateral awns……..……....**subsp. *triuncialis***

Conservation Status:-*Ae. triuncialis* subsp. *bozdagensis* is only known from the type locality and its population size and geographic range seem to be very small. The estimated area of occupancy is less than 500 km^2 with the

number of mature individuals being less than 2500 (criteria B2 ab (i, iii) of IUCN 2012). Therefore, we recommend that the threat category of *Ae. triuncialis* subsp. *bozdagensis* should be regarded as Endangered (EN).

Distribution and ecology:-*Ae. triuncialis* subsp. *bozdagensis* is known in only South-western Turkey and Mediterranean element (Fig. 3). It grows only at an elevation ranging from 1400–1650 m. The vegetation in this place is mainly formed by trees, herbaceous and suffruticose plants including *Pinus nigra* J.F. Arnold, *Salvia chrysophylla* Stapf, *Centaurea* sp., and *Origanum* sp., *Torillis* sp., *Jurinella* sp., *Euphorbia* sp. *Aegilops triuncialis* subsp. *triuncialis* is a widespread subspecies and known from S. Europe & N. Africa, S.W. Asia, Transcaucasia. It flowers between May and June and grows at steppe, open meadow, faIlow fields, rocky limestone slopes, waste places and etc. at an altitude of l-1900 m. *Aegilops triuncialis* subsp. *persica* is known from Turkey, Caucasia, N Iraq, Iran and Afghanistan. It flowers in May and grows at meadows and field margins at an altitude of 400-700 m.

Examined specimens: - *Aegilops triuncialis* subsp. *triuncialis*. Kırklareli: İğneada, seashore, 41°53.013'N 27°59.333'E, 29.05.06, E. Cabi 789; Tekirdağ: Gaziköy to Kumbağ, 5 km to Kumbağ, open *Quercus* woods, 234 m, 40°50.472'N 27°26.101'E, 28.05.06, E. Cabi 760; Edirne: Havsa, Hasköy, 167 m, roadsides, fallow fields, 41°40.829'N 27°06.208'E, 29.05.06, E. Cabi 785; Bursa: Bursa to Mudanya, 3 km N. of Bademli, Holtz 00.285 & Hanel!; Ankara: 10 km to Nallıhan from Mudurnu, streamsides, 708 m, 40°14.463'N 31°20.663'E, 27.06.06, E. Cabi 1223; Ankara, Çığır to Akçaören village, 946 m, roadsides and field margins, 40°15.689'N 32°42.462'E, 27.06.06, E. Cabi 1159; Çankırı, Kalecik to Çankırı, roadside, 791 m, 40°19'28.3"N 33°30'48.9"E 13.06.07, E. Cabi 2356; Amasya: Amasya, 400-600 m, Bornm. 1889:470!; Amasya, Ladik to Taşova, Borabay streamside, 598m, 40°47'58.3"N 36°12'51.0"E, 15.06.07, E. Cabi 2339; Sivas, Gölova, Aşağıtepecik village, limestone, soil slopes, 40°01'46.5"N 38°35'05.9"E 07.06.07, E. Cabi 2456; Erzurum, Erzurum to Oltu, 12 km to Oltu, 1390 m, 40°28.517'N 41°58.697'E, 05.06.06, E. Cabi 1496; Artvin: Ardanuç, Gevhernik castle, 582 m, 41°07.605'N, 42°03.397'E, roadsides, 25.06.08, E. Cabi 3543; Artvin: Ardanuç to Arevet (Torbalı village), near Ekşiler village, slopes, 560 m, 41°06'142"N, 42°03'316"E, 25.06.08, E. Cabi 3526; B1 İzmir: Kemalpaşa, Nif mountain foothills, screes, 620 m, 38°25.054'N 27°23.740'E 12.05.06, E. Cabi 485; İzmir: Hills above Pınarbaşı, 500 m to Radio tower, 517 m, 01.06.08, E. Cabi 3141; Manisa, Turgutlu, 1 km to Çıkrıkçı, 129 m, screes, 38°28.933'N 27°48.607'E 12.05.06 E. Cabi 500; B2 Manisa: Salihli to Bozdağ, 240 m, 38°27.361'N 28°03.088'E 11.05.06, E. Cabi 464; Uşak Kışlayolu, 5 km below from Gold mine, screes, 964 m, 38°28.159'N 29°09.027'E 11.05.06, E. Cabi 409; B3 Eskişehir: 20 km to Eskişehir, screes, 930 m, 39°41.465'N 30°43.223'E 27.05.06, E. Cabi 701; Eskişehir to Sivrihisar, ~40 km to Sivrihisar, calcerous slopes, 934 m, 39°34.639'N 30°55.630'E 31.05.06, E. Cabi 884; B4 Kırıkkale, Kırıkkale to Kayseri, around cemetery, 690 m, 39°50'20" N 33°28'35" E 18.05.07, E. Cabi 2070 **(with *Ae. biuncialis*)**; Kırşehir: Kaman to Kırşehir, above Demirci village, Kalkanlı mount. 1430 m, 39°17.567'N 33°56.859' E, 10.06.08, E. Cabi 3226, Ankara to Kırşehir, Keskin to Çelebi 5 km from Keskin, 993 m, 39°36.102' N 33°36.575' E, 10.06.08, E. Cabi 3220; B5 Yozgat, 2-3 km from Yozgat to Sivas, Muslubelen pass, 1400 m, 39°49.971'N 34°51.757'E, 12.07.05, E. Cabi 1554; Kayseri, Mucur to Kayseri ~20 km, slopes and steps, 1103 m, 38°46'03"N 35°16'53"E, 18.05.07, E. Cabi 2073; Nevşehir: 12 km from Nevşehir to Gülşehir, near historical sites, 950 m, 38°44'155"N 34°40.299'E, 29.05.08, E. Cabi 3063; B6 Sivas, Etyemez to Dürmepınar, around Dürmepınar, 1377 m, stony slopes, wet places, 38°58.646'N 37°25.981'E 01.07.06, E. Cabi 1344; Sivas, between Etyemez and Dürmepınar, around Dürmepınar, 1377 m, stony slope, wet places, 38°58.646'N 37°25.981'E, 01.07.06, E. Cabi 1348; B7 Tunceli, Perlek to Hozat, 1143 m, calcerous slopes, 38° 55.588'N 39°14.805'E, 02.06.06, E. Cabi 1373; Malatya: Darende to Malatya, 27 km to Malatya, roadsides, 912 m, 38°21'05"N 38°02'47"E 18.05.07, E. Cabi 2083; Erzincan, Refahiye to İmranlı, 49 km before İmranlı, exit of Refahiye, 1571 m, roadside, 39°57.73"N 38°46.073'E, 06.07.06, E. Cabi 1516; B8 Siirt: 6 km W. of Bekirhan, 700 m, Watson et al. 1140!; B9 Van: S. shore of Erçek G., 1900 m, D. 44266!; B9 Van, Erek Dağı, Yedikilise village, 2178 m, 38°26.832'N 43°27.827'E, 29.07.08, E. Cabi 3734; C1 Izmir: c. 10 km N. of Kuşadasi, 40 m, Sorger 65-9-60!; C2 Aydın: Eskiçine to Muğla, 29 km to Yatağan, 154 m, roadsides, 37°30.691'N 28°05.834'E, 13.05.06, E. Cabi 559; C3 Antalya S. outskirts of Isparta town centre, in vineyard with

Taeniatherum sp., 950 m, 37°45'N, 30°33'E, 16.06.94, RMN 4598; C4 Konya: Keskin, just before Köprülü village, exit of Keskin, Çelebi road ~1 km, roadsides, 1132 m, 36°39.909'N 33°26.712'E, 09.06.06, E. Cabi 891; C4 Karaman: Entrance of Ermenek, towards Anamur, 1279 m, calcerous rocks, roadsides, 36°37.151'N 32°55.333'E 15.06.06 E. Cabi 1132; C5 Niğde: Çamardı, Aladağlar, N. of Çukurbağ village, 1613 m, steppe 37°47.601'N 35°03.792' E 14.06.06, E. Cabi 1039; Mersin, Silifke, around Silifke castle, roadsides and degraded steppe, 50-60 m, 36°22.373"N 33°54.921'E, 01.05.08, E. Cabi 2763; Adana, Pozantı, Gülek pass, machie, 1149 m, 37°17.250'N 34°47.072'E, 14.06.06, E. Cabi 1068; Adana, Kandilsırtı pass, Gülek to Pozantı, 1370 m, 37°17.176'N 34°44.231'E, 14.06.06, E. Cabi 1079; C6 Adana: Halbur plateau, Andırın to Goben, Göksun road, roadsides, rocky slopes, 1444 m, 37°39.437' N 36°26.622'E, 12.06.06, E. Cabi 1012; Adana: Zorkun to Sarıüce district, roadsides and under the *Pinus* trees, 1300 m, 36°59.710'N 36°18.816'E, 12.06.06, E. Cabi 1026; Kahramanmaraş: Çağlayan Cerit entrance, 965 m, streamsides, 37°44.474'N 37°22.341'E, 11.06.06, E. Cabi 988; Kahramanmaraş; Nurhak, S. of Nurhak, on the Umutlu village ~10 km, 1297 m, 37°55.082'N 37°20.612' E, 11.06.06, E. Cabi 972; C7 Şanlıurfa: Ceylanpınar Farm State, TUEM roadsides, 415 m, roadside and field margins, 36°43.518'N 39°37.358'E, 23.04.07, E. Cabi 1861, Şanlıurfa: Ceylanpınar farm state Güzelyat area, 23.04.07, E. Cabi 1881; Viranşehir to Şanlıurfa, ~21-22 km before Şanlıurfa, field margins, ~610 m, 37°09'39"N 39°01'10"E, 22.05.07, E. Cabi 2221, Viranşehir to Şanlıurfa, ~66 km before Şanlıurfa, fallow fields, 627 m, 37°13'34"N 39°26'21"E 22.05.07 E. Cabi 2218; Viranşehir to Şanlıurfa, 62 km to Şanlıurfa, Before Karakaş graveyard, 658 m, 37°13.515"N 39°23.325"E, 14.05.08, E. Cabi 2931; Viranşehir to Şanlıurfa, ~62 km to Şanlıurfa, before Karakaş graveyard, 658 m, 37°13.515' N 39°23.325'E, 14.05.08, E. Cabi 2935, C8 Mardin: Gercüş-Savur, ~5-6 km to Gercüs, slopes and roadsides, 833 m, 37°34'52"N 41°20'01"E, 23.05.07, E. Cabi 2306b; Savur to Sürgücü, 952 m, 37°32'58"N 40°53'29"E, 23.05.07, E. Cabi 2312.

- ***Aegilops triuncialis* subsp. *persica*.** C6 Gaziantep: Nizip to Birecik, 446-450 m, 37°00.720'N 37°51.989'E, 12.05.08, E. Cabi 2880; C7 Şanlıurfa:Viranşehir, 22 km from Şanlıurfa, field margins, 484 m, 37°09.635'N 39°00.689'E, 14.05.08, E. Cabi 2939; Viranşehir to Şanlıurfa, ~21-22 km to Urfa, field margins, 610 m, 37°09'39"N 39°01'10"E, 22.05.07, E. Cabi 2221; Şanlıurfa to Viranşehir, 484 m, 37°09.635'N 39°00.689' E, 14.05.08, E. Cabi 2943.

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