WEED FLORA OF LENTIL IN DIYARBAKIR PROVINCE, TURKEY

SUMMARY

Lentil is usually cultivated under rainfed conditions in various geographic regions of the globe. Thus, lentil productivity is constrained by various biotic and abiotic factors. Weeds are one of the biotic factors negatively influencing the productivity and profitability of the crop. Lentil is intensively cultivated in southeastern Anatolia region of Turkey under rainfed conditions. Weeds have been identified as one of the major challenges to lentil productivity in the region. Therefore, development of suitable management strategies is inevitable in the region. The development of effective weed management strategies relies on the basic knowledge of weed species/weed inventories. The current study was conducted to determine the weed flora in lentil production areas of Diyarbakır province situated in southeastern Anatolia region of Turkey. A total 55 fields were surveyed and data relating to weed species, their densities and frequency of occurrence were recorded. A total 89 weed species and 78 taxa belonging to 28 plant families (2 parasitic, 7 monocotyledonous and 19 dicotyledonous) were recorded form the province. The overall weed species’ density in the province was 35 weeds m$^{-2}$. The weed species having the highest density in the province were; Sinapis arvensis L. (7.38 plants/m$^2$), Avena sterilis L. (6.55 plants/m$^2$), Ranunculus arvensis L. (3.49 plants/m$^2$), Papaver sp. (2.78 plants/m$^2$), Anthemis chia L. (2.11 plants/m$^2$), Vaccaria pyramidata Medik. (1.72 plants/m$^2$), Galium spp. (1.43 plants/m$^2$) and Vicia sativa L. (1.19 plants/m$^2$). Similarly, the weed species having the highest frequency of occurrence were; Sinapis arvensis L. (87.96%), Vaccaria pyramidata Medik. (87.22%), Papaver sp. (84.38%), Vicia sativa (77.02%), Ranunculus arvensis (68.11%), Avena sterilis L. (67%), Cephalaria syriaca (L.) Schrad (61.93%), Silene conica L. (53.59%) and Anthemis sp. (52.60%). The current study has improved our understanding on the weed flora of lentil fields in Diyarbakır province of the country. The data generated through this study could be used to devise suitable weed management strategies for lentil in the province.

Keywords: Weed flora, Lentil, Diyarbakır, Southeastern Anatolia, Turkey.

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INTRODUCTION

The increasing global population demands more food production than ever before. Therefore, cereals, oilseeds and legumes have an important position in human nutrition. Lentils (Lens culinaris Medik.) is one of the most important legume species, regarded as a high quality proteins source and used in human nutrition (El-Nahry et al., 1980; Desphande and Damodaran, 1990; Costa et al. 2006; Wang et al., 2009; Şehirali, 1988; Pekşen and Artık, 2005; Urbano et al., 2007). The crop is cultivated in temperate and sub-tropic climate regions worldwide (Şehirali 1988). Turkey is 3rd largest lentil producer following India and Canada. However, lentil production varies considerably from year to year globally and in Turkey (FAO, 2014; TÜİK, 2016).

Several biotic and abiotic factors affect the lentil production in the country. The plant protection problems, i.e., weeds, diseases and insects are among the major constraints impairing lentil production. However, weeds cause more nuisance than other plant protection agents (Tepe, 1997; Özer at al., 2001). The damage caused by weeds to lentil production is higher compared to the other agents since weeds compete and suppress lentil plants from the early stage of growing period. Competition for water is much more severe in arid areas and yield losses can reach ~93% during dry seasons (Şehirali, 1988). In addition, weeds also cause quality losses in lentil (Kuntay, 1944; Güncan, 1982; Yeğen, 1984; Çınar and Uygun 1987). Therefore, Sepetoğlu (1992) concluded that weeds should be controlled during the lentil growing season in order to obtain good yield. The weed surveys are critical to determine the distribution patterns of the weed species at spatial and landscape scales, and possible factors shaping the distribution patterns (Rankins et al. 2005; Ozaslan et al., 2016; Korres et al., 2015a, b).

The information obtained from surveys makes an important contribution to the development of effective regional or site-specific weed management strategies (Önen and Özer, 2001; Özaslan et al., 2002; Önen et al., 2018). However, there is no information available on the weed flora of lentil fields in Diyarbakır province. Therefore, the current survey study was conducted with an objective to determine the weed flora prevailing in the lentil fields of Diyarbakır province, Turkey. The results will contribute towards the development of site-specific weed management practices in the region. It was hypothesized that different fields will differ in weed species composition.

MATERIAL AND METHODS

Geographic location

Survey studies were carried out in six districts of Diyarbakır province during 2017. Diyarbakır is located in the north of Mesopotamia in the central part of the Southeastern Anatolia Region. It is surrounded by Elazığ and Bingöl provinces from the north, Siirt and Muş from the east, Mardin from the south, and Şanlıurfa, Adıyaman, Malatya from the west. The total area of the province is
Weed flora of lentil in Diyarbakir province, Turkey

15,362 km² and lies between 37.90° and 40.23° north latitudes, and 40.37° and 41.20° east longitudes.

The frequency of occurrence of the observed weed species was computed using following formula:

\[
\text{Frequency of Occurrence (\%) = } \frac{N}{M} \times 100
\]

Where: 
\(N\) = Number of lentil fields where particular species was observed,
\(M\) = Total number of lentil fields surveyed.

For density (plant/m²) calculation, arithmetic averages were taken by counting the weeds in the quadrates according to their types and species, and density was calculated. The density was calculated by following Odum (1971) and Uygur (1991). The plants having density <0.05 were denoted with letter K.

**Surveyed Fields**

The geographic locations of the surveyed fields recorded with the help of GPS and are represented in Figure 1.

![Map of surveyed lentil fields](image)

**Figure 1.** The locations of lentil fields surveyed during the study

**Survey Studies**

Survey studies were carried out during April and May, when weed species could be easily identified. Surveys were conducted in 55 fields. Survey fields were selected from separate directions and locations representing the whole province. Lentil production areas were surveyed by stopping at every 5 km randomly. In order to avoid the border effect of the fields, surveys were started by entering 10 meters in each field. A 1 m² quadrat was used for density determination. The number of quadrates to be placed was determined through preliminary observations. The quadrates to be placed within a field were; 3 for lentil fields smaller than 0.5 ha, 5 for 0.5-1.0 ha, and 8 for >1.0 ha (Bora and Karaca 1970; Önen et al., 2018). The whole plant was accepted as a plant for broad-leaved weed species, whereas each tiller was considered as a plant for...
grasses. The recorded data on coverage area and density from different sub-sampling sites of the same field were averaged to get the coverage and density for whole field. Herbarium of the recorded weed species were prepared and stored in the Department of Plant Protection, Dicle University Diyarbakır, Turkey. The recorded weed species were identified with the help of Davis (1965-1988); Önen (2015); Özer et al. (1999).

RESULTS AND DISCUSSION

A total 89 weed species and 78 taxa belonging to 28 plant families (2 parasitic, 7 monocotyledonous and 19 dicotyledonous) were recorded form the province. The plant families with the most number of species were Asteraceae 13 species, Fabaceae 12 species, Brassicaceae 8 species, Apiaceae 6 species and Lamiaceae 5 species. Other families were represented by 1-4 species.

Considering the frequency of occurrence of recorded weed species, 9 species had >50% frequency of occurrence. These species were; Sinapis arvensis L. (87.96%), Vaccaria pyramidata Medik. (87.22%), Papaver sp. (84.38%), Vicia sativa (77.02%), Ranunculus arvensis (68.11%), Avena sterilis L. (67%), Cephalaria syriaca (L.) Schrad (61.93%), Silene conica L. (53.59%) and Anthemis sp. (52.60%) (Figure 2).

The density of 8 species in the province had more that 1 plant m$^{-2}$. These species were; S. arvensis (7.38 plants/m$^{2}$), A. sterilis (6.55 plants/m$^{2}$), R. arvensis (3.49 plants/m$^{2}$), Papaver sp. (2.78 plants/m$^{2}$), Anthemis chia L. (2.11 plants/m$^{2}$), V. pyramidata (1.72 plants/m$^{2}$), Galium spp. (1.43 plants/m$^{2}$) and V. sativa (1.19 plants/m$^{2}$).

![Figure 2. Weed species having >50% frequency of occurrence in lentil fields of Diyarbakır province](image-url)
Weed flora of lentil in Diyarbakır province, Turkey

![Density (plant/m²)](image)

Figure 3. Weed species having density >1 plant m⁻² in lentil fields of Diyarbakır province

| Weed Species                  | Density (plants m⁻²) | FO (%) |
|-------------------------------|----------------------|--------|
| **Parasitic Plant Species**   |                      |        |
| Fam: Orobanchaceae            |                      |        |
| *Orobanche creneta* Forsk.    | 0.162                | 12.49  |
| *Orobanche ramosa* L.         | 0.065                | 6.48   |
| **MONOCOTYLEDONEAE**          |                      |        |
| Fam: Liliaceae                |                      |        |
| *Bellevalia* sp.              | 0.080                | 13.42  |
| *Allium pallens* L. supsp. *pallens* L. | K | 1.38 |
| *Ornithogalum narbonense* L.  | K                    | 5.55   |
| Fam: Poaceae                  |                      |        |
| *Avena sterilis* L.           | 6.559                | 67     |
| *Bromus tectorum* L.          | K                    | 4.22   |
| *Hordeum spontaneum* L.       | 0.416                | 17.55  |
| *Hordeum bulbosum* L.         | K                    | 8.71   |
| **DICOTYLEDONEAE**            |                      |        |
| Fam: Apiaceae (Umbelliferae)  |                      |        |
| *Bubleurum rotundifolium* L.  | 0.105                | 20.49  |
| Family | Common Name | Species Name | Concentration (K) | T.L. (%) |
|--------|-------------|--------------|-------------------|----------|
| Echinophora tenuifolia L. | K | 11.16 |
| Falcaria vulgaris Bernh. | K | 5.09 |
| Pimpinela rhodontha Boiss. | K | 1.85 |
| Scandix pecten-veneris L. | 0.881 | 41.16 |
| Turgenia latifolia (L.) Hoffm. | 0.268 | 19.53 |
| Fam: Araceae | | |
| Dracunculus vulgaris Schott. | K | 1.38 |
| Fam: Aristolochiaceae | | |
| Aristolochia bottae Jaub. & Spach. | 0.124 | 15.83 |
| Fam: Asteraceae (Compositae) | | |
| Centaurea solstitialis L. | 0.213 | 44.61 |
| Centaurea balsamita Lam. | K | 4.68 |
| Gundelia tournefortii L. | K | 2.83 |
| Crepis alpina L. | 0.645 | 43.56 |
| Cirsium acarna L. | K | 2.94 |
| Echinops orientalis Trautv. | K | 2.64 |
| Notabasis syriaca (L.) Cass. | K | 39.54 |
| Anthemis chia L. | 2.113 | 52.60 |
| Lactuca serriole L. | 0.434 | 38.06 |
| Carduus pycnocephalus L. | K | 19.10 |
| Scolymus maculatus L. | 0.094 | 32.45 |
| Scorzonera hispanica L. | K | 7.22 |
| Tragopogon longirostis BISCH. EX SCHULTZ BIP. | K | 12.96 |
| Fam: Brassicaceae (Cruciferae) | | |
| Sinapis arvensis L. | 7.380 | 87.96 |
| Cardaria draba (L.) Desv. | 0.107 | 19.90 |
| Conringia persica Boiss. | K | 1.85 |
| Crambe orientalis L. | K | 1.85 |
| Neslia apiculata Fisch. | K | 27.91 |
| Myagrum perfoliatum L. | 0.193 | 7.87 |
| Sisymbrium officinale (L.) SCOP. | 0.008 | 4.72 |
| Thlaspi perfoliatum L. | K | 1.85 |
| Fam: Boraginaceae | | |
| Buglossoides arvense (L.) I.M. Johnst. | K | 13.81 |
| Anchusa azurea Miller. | K | 3.51 |
| Alkanna tinctoria (TAUSCH) | | 1.85 |
| Fam: Campanulaceae | | |
| Campanula strigosa Banks Et Sol. | K | 15.38 |
| Fam: Caryophyllaceae | | |
| Vaccaria pyramidata Medik. | 1.729 | 87.22 |
| Cerastium dichotomum L. | K | 7.05 |
| Silene conica L. | 0.865 | 53.59 |
| Silene conoidea L. | K | 1.85 |
### Weeds Flora of Lentil in Diyarbakir Province, Turkey

| Family | Species | K Value | Percentage |
|--------|---------|---------|------------|
| **Fam: Convolvulaceae** | *Convolvulus betonicifolius* Mill. | 25.66 |
| | *Convolvulus galaticus* Roston. Ex Choisy | 2.77 |
| **Fam: Dipsacaceae** | *Cephalaria syriaca* (L.) Schrad | 61.93 |
| | *Euphorbia sp.* | 38.23 |
| | *Euphorbia aleppica* L. | 13.42 |
| | *Euphorbia helioscopia* L. | 15.71 |
| **Fam: Fabaceae** | *Astragalus fodinarum* Boiss & Noe | 1.85 |
| | *Alhagi pseudoalhagi* (Bieb.) Desv. | 1.85 |
| | *Lathyrus aphaca* L. | 10.34 |
| | *Lathyrus rotundifolius* Willd. | 1.85 |
| | *Pisum sativum* L. | 5.18 |
| | *Vicia hybrida* L. | 44.38 |
| | *Vicia assyriaca* Boiss. | 36.41 |
| | *Vicia sativa* L. | 77.07 |
| | *Vicia narbonensis* L. | 8.95 |
| | *Trifolium nigrescens* L. | 9.83 |
| | *Trifolium hybridum* L. | 1.85 |
| **Fam: Gentianaceae** | *Flavus herba* | 4.62 |
| **Fam: Geraniaceae** | *Geranium tuberosum* L. | 1.85 |
| **Fam: Guttiferae** | *Hypericum triquetrifolium* Turra. | 5.55 |
| **Fam: Iridaceae** | *Gladiolus atroviolaceus* Boiss. | 3.70 |
| **Fam: Lamiaceae** | *Lallemantia iberica* (Bieb.) Fisch. & Mey. | 16.79 |
| | *Molucella laevis* L. | 3.24 |
| | *Phlomis sieheana* Rech.Fil. | 8.79 |
| | *Salvia verbenaca* L. | 1.85 |
| | *Satureja hortensis* L. | 1.38 |
| **Fam: Linaceae** | *Linum mucranatum* Bertol. subsp. armenum Davis | 1.85 |
| | *Linum flavum* L. | 1.38 |
| **Fam: Malvaceae** | *Alcea sp.* | 1.85 |
| **Fam: Papaveraceae** | *Fumaria asepale* Boiss. | 10.74 |
| | *Papaver sp.* | 84.38 |
| **Fam: Poaceae** | *Alopecurus myosuroides* Huds. | 3.81 |
Weeds directly harm lentil by lowering yield and quality, and indirectly cause serious problems by making harvesting difficult. The selection of effective management methods is only possible with the determination of the problematic weeds species in the lentil fields (Eroğlu, 2006). Therefore the first step of an effective weed management strategy is determining the species and their density (Önen and Özer, 2001).

A total 89 weed species and 78 taxa belonging to 28 plant families (2 parasitic, 7 monocotyledonous and 19 dicotyledonous) were recorded form the province. The plant families with the most number of species were Asteraceae 13 species, Fabaceae 12 species, Brassicaceae 8 species, Apiaceae 6 species and Lamiaceae 5 species. Other families were represented by 1-4 species. Five out of 28 botanical families (i.e., Asteraceae, Brassicaceae, Fabaceae, Apiaceae 6 species and Lamiaceae) had >50% of the weed species observed during the surveys. The highest contribution of these families to the observed weed flora is attributed to the higher presence of weedy species in these families (Düzenli et al., 1993; Önen and Özer, 1995; Özer et al., 1999). The predominance of annuals can be attributed to their short life span and higher allocation resources for reproduction even under harsh climatic conditions (Sans and Masalles 1995). In some studies, annuals were reported to be dominant in lentil and other annual crops in Turkey (Uzun, 1988; Önen and Özer, 1995; Kızılkaya et al., 2001; Özaslan et. al., 2002; Özaslan, 2011; Arikan et al., 2015).

Large variations were observed in density and frequency of occurrence of the recorded weed species in different surveyed fields (Table 1). The variation in the weed densities and frequency of occurrence can be explained by heterogeneity in the soil properties and microclimatic conditions (James et al., 2006; Onen et al., 2018).
In a study carried out in the lentil fields during 1984-1986 in Şanlıurfa, Diyarbakır and Mardin provinces a total 74, 30 and 56 weed species identified, respectively (Uzun 1988). The most frequently observed weed species were found as *Galium tricorne* With., *A. sterilis*, *Scandix pecten-veneris* L., *Lathyrus* spp., *R. arvensis*, *Geranium tuberosum* L., *Turgenia latifolia* (L.) Hoffm., *C. syriaca* (L.) Schrader and *Isatis tinctoria* L. However in the corent study a total of 89 weed species were identified. Beside the most common species in the province were; *S. arvensis*, *V. pyramidata*, *Papaver* sp., *V. sativa* (77.02%), *R. arvensis*, *A. sterilis*, *C. syriaca*, *S. conica* and *Anthemis* sp. (Figure 2). When the results of the two studies are compared, it is seen that the number of species increased in the region over time. In addition, it is observed that the problematic species had significantly changed in the region. These results are thought to be a result of the surveyed areas are partially different, the changes in the ecological conditions in the region and the differences seen in the cultivation applied (fertilizer, herbicides etc) over time.

**CONCLUSIONS**

It is concluded cosmopolite species were the most problematic weeds in the surveyed fields and it is possible to imply a general recommendation for their management. The existence of large-scale spatial variation in weed distribution and soil properties necessitates the adoption of site-specific management practices for successful weed management in the region. Nonetheless, use of integrated weed management practices for the recorded species could lower weed pressure in the region.

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