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Full Length Research Paper

Ecological investigation of the weed flora in arable and non arable lands of Al-kharj Area, Saudi Arabia

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A radical change has been observed in various agronomic practices including increase in crop productivity which lead to changes in the composition, diversity and abundance of weed flora in arable as well as in non-arable lands. In this context, a survey was conducted both in agricultural and non-agricultural areas in different parts of Al-Kharj (Saudi Arabia). The aim of the study was to prepare an ecotaxonomical inventory of weed flora useful for ecological management in the survey area. The study documented 52 weed species belonging to 27 families including 25 dicots and two monocots families (Lilaceae and Poaceae). Poaceae (8 spp.) followed by Asteraceae (5 spp) and Solonaceae (4 spp.) are the largest families while the remaining are represented either by three or less than three species. They comprises of thirty five herbs, eight grasses, seven shrubs and each climber and parasite have one species in the area. The 52 weed species includes annual herb (28), annual grasses (5), perennial shrub (7) and perennial herb (6). Out of 52 weed species, Chaemophytes (5), therophytes (30), hemicryptophytes (12), geophytes (3), and one nanophaneorophytes. The results showed that the relative availability of common weed species has generally decreased during the last decena. According to their availability, they were classified dominant (5 spp.), rare (6 spp.), respectively occasionally available (18 spp.), and frequently available (23 spp.). Most of these weeds causes moderate to severe infestation to various agricultural crops. The study concluded that weed communities has significance value in agro-ecosystem function and, therefore, its ecological management for conservation of biodiversity is utmost important. This finding suggests that disturbed habitats may be important areas to search for novel compounds in drug discovery.

Key words: Weeds flora, arable and non arable land, agricultural practices, ecological availability, Biological Spectrum Al-kharj, Saudi Arabia.

INTRODUCTION

Weeds have been defined as unwanted obnoxious plants growing in places where they are generally undesirable (Walker, 2009). They are nuisance to agriculture mainly because of their adverse effect on the crops yield (Chaudhary and Akram, 1987; Storkey, 2006). However, not all weeds are unwanted; for instance in range land areas many annual plants are considered as weeds to crops and useful as animal feeds. The authors of the current paper described that all those plants which grow in a wrong time at wrong place fall in the category of weeds. Weeds represent a widely distributed plant species and biologically important components of most natural and semi-natural ecosystems in the world (such as arable, range lands, forest and aquatic ecosystems). Robbins et al. (1952) defined weeds as plants that are harmful because they interfere with agricultural operations, add to costs, reduce crop yields and increases labour input. Recently, Holzner (1977) defined weeds as “plants adopting manmade habitats and interfering with human activities”. The distribution of weeds is strongly influenced by environmental and biological factors.

Weeds are an important constraint in agricultural production systems (Williams and West, 2000). Acting at the same tropic level as the crop, weeds capture a part

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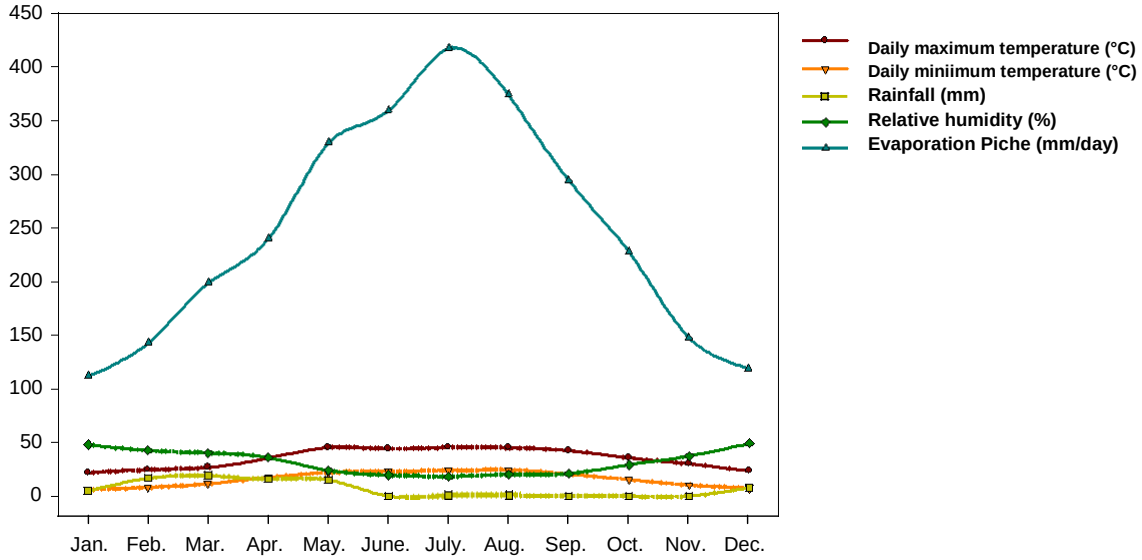

Figure 1. Meteorological data for Al-Kharj (data are averages for the period 2001 to 2010).Source: Al-Kharj Agricultural station, Saudi Arabia.

of the available resources that are essential for plant growth. Inevitably, leaving weeds uncontrolled will sooner or later lead to considerable reductions in crop yield. Crops and weeds compete for shared resources like light, water and nutrients. If resource supply is insufficient to meet the combined demand of crop and weeds, resource capture by weeds will result in a reduced growth and production of the crop. Often, the relation between relative yield loss because of weed competition and weed plant density can be accurately described by a simple hyperbolic function (Storkey, 2006).

The losses in crop yield are resulted from weeds competing for water, nutrient uptake, light, space and other ecological resources. Hill et al. (1977), Sen et al. (1984) and Chaudhary (1989) reported that the losses caused by weeds to agriculture are more than losses caused by pest put together. However, weeds have certain limited uses such as those for medicinal or ornamental purposes. In fact, weeds and wild plants are still used quite largely by indigenous people in medicine as well as in emergency food supplies. Since weeds occur with wild plant, they are also grazed by livestock as well as wild life which depend largely on natural vegetation. Greater attention is required in order to understand the nature of weeds and to analyze their interactions between crops and environment, in order to reduce their effects on crop yield. Weeds control managements require knowledge of the weed flora of the region and possible noxious quality of different type of weed species.

Documentation of flora changes has some ecological interest even for common weed species because these make up an important food reservoir for the wild life and, as such, help to maintain the function of agro-ecosystem including the diversity and quantity of wild life in the landscape. However, studies on weeds flora in the Kingdom of Saudi Arabia are still very fragmentary and incomplete. Documentation of weeds flora is, therefore, valuable as grounding knowledge and information for political decision concerning the ecological management of arable land. In the present study, attempts were made to prepare records of weeds growing in Al-Kharj region of Saudi Arabia, and the results are presented in the current communication.

MATERIALS AND METHODS

Study area

Al-Kharj is one of the important agricultural regions of the central province of Saudi Arabia (Figure 1); it occupies an area of 18,000 km^2, out of this 18,060 ha is cultivated. A great deal of agricultural developments had taken place during the last three decades. Al-Kharj is located about 80 km south east of Riyadh (24° 10`N 47° 24`E). The elevation is 430 m.a s.l. The area has a desert climate with a low rainfall (the mean is 67 mm $year^{-1}$) and high maximum temperature range (22.9 to 45.5°C) where as monthly mean relative humidity range is from 15.7 to 45.1% (Table 1). The most important agricultural crops cultivated are wheat, sorghum, alfalfa, and barley, fruit crops like date palm, citrus, watermelon and some vegetable crops such as tomato, onions, cucumbers, brinjal, pepper and cauliflower etc. The weeds which interfere with the above agricultural crops are virtually based on irrigation.

Study procedure

Specimens were collected and identified from twenty farms in five localities in Al-Kharj area. Samples of these recorded species were prepared as herbarium specimens for identification. The weeds specimens were collected from both arable including fields of date palm, alfalfa and wheat and non arable lands. Infestation of crops by weeds was based on visual or arbitrary observations.

Table 1. Biological spectrum along with life cycle and ecological availability and habit of the weed flora in Al-kharj Area of Saudi Arabia.

No.	Botanical name	Family	Local name	Voucherspecimen number	Avaliability status	Life cycle and habit	Life form	Leaf size spectra
1	*Aerva javanica* (Burm. F.) Spreng.	Amaranthaceae	Errwa	H-KSU / 06-2010-1	Oc	Annual herb	Ch	Mi
2	*Amaranthus viridis* L.	Amaranthaceae	Qutaifa	H-KSU / 06-2010-2a	Fr	Annual herb	Ch	Mi
3	*Anisosciadium lanatum* Boiss.	Apiaceae	Lassai	H-KSU / 06-2010-40	Oc	Perennial herb	Th	L
4	*Calotropis procera* (Willd) R.Br.	Asclepiadaceae	Ushar	H-KSU / 06-2010-2	Ra	Perennial shrub	Th	Me
5	*Flaveria trinervia* (Spreng.) Mohr.	Asteraceae	Shagaira	H-KSU / 08-2010-8d	Oc	Annual herb	Th	Mi
6	*Lactuca serriola* L	Asteraceae	Libbayn	H-KSU / 06-2010-11	Fr	Annual herb	Th	Na
7	*Launaea capitata*	Asteraceae	Hawwa	H-KSU / 06-2010-1f	Fr	Annual herb	Th	Na
8	*Calendula arvensis* L.	Asteraceae	Hanwah	H-KSU / 07-2010-7	Fr	Annual herb	Th	Mi
9	*Conyza bonariensis*	Asteraeae	Nafle	H-KSU / 08-2010-8c	Do	Seasonal herb	Th	Na
10	*Gastrocotyle hispidia* (Forssk.) Bunge	Boraginaceae	Gahalle	H-KSU / 07-2010-2b	Ra	Annual herb	Th	Mi
11	*Heliotropium bacciferum* Forssk.	Boraginaceae	Ramraam	H-KSU / 06-2010-5	Oc	Perennial shrub	H	Mi
12	*Eruca sativa* Mill	Brassicaceae	Jirjir	H-KSU / 05-2010-6h	Oc	Annual herb	Th	Mi
13	*Zilla spinosa* Prantl.	Brassicaceae	Silla	H-KSU / 07-2010-7d	Fr	Annual herb	H	Mi
14	*Capparis spinosa* L	Capparaceae	Shaffallah	H-KSU / 05-2010-7	Oc	Perennial shrub	Np	Me
15	*Sclerocephalus arabicus* Bioss.	Caryophyllaceae	Dareesah	H-KSU / 06-2010-7	Oc	Annual herb	Th	Na
16	*Bassia muricata* (L.) Murr.	Chenopodiaceae	Quttain	H-KSU / 05-2010-1	Fr	Annual herb	Th	Mi
17	*Salsola imbricate* Forssk.	Chenopodiaceae	Mullayh	H-KSU / 06-2010-9	Oc	Shrublet plant	Th	Na
18	*Helianthemum lippii*(L.) Dum. Cours.	Cistaceae	Raqruq	H-KSU / 08-2010-1	Oc	Annual herb	Th	Mi
19	*Convolvulus arvensis* L	Convolvulaceae	Olleyq	H-KSU / 09-2010-1	Fr	Perennial climber	Th	Mi
20	*Citrullus colocynthis* (L.) Schrad.	Cucurbitaceae	Hanzel	H-KSU / 06-2010-13	Oc	Annual herb	Th	Mi
21	*Cuscuta planiflora* Tens	Cuscutaceae	Shubaykah	H-KSU / 06-2010-14	Ra	Seasonal parasite	Cli	Na
22	*Chrozophora oblongifolia* (Del.) A. Juss. Ex Spreng.	Euphorbiaceae	Tannum	H-KSU / 06-2010-15	Oc	Perennial herb	H	Mi
23	*Ricinus communis* L.	Euphorbiaceae	Khurwa	H-KSU / 06-2010-16	Fr	Perennial shrub	Th	L
24	*Alhagi maurorum*	Fabaceae	Shubrum	H-KSU / 06-2010-18	Fr	Perennial shrub	Th	L
25	*Prosopis farcta* F.W. (Banks et Sol. MACBR).	Fabaceae	Aagul	H-KSU / 06-2010-19	Fr	Perennial shrub	H	Na
26	*Trigonella stellata*	Fabaceae	Nafal	H-KSU / 06-2010-20	Fr	Annual herb	Th	L
27	*Juncus rigidus* C.A. Meg.	Juncaceae	Khaus	H-KSU / 06-2010-17	Oc	Perennial herb	G	Mi
28	*Asphodelus tenuifolius*	Liliaceae	Barwaq	H-KSU / 06-2010-21	Oc	Annual herb	G	Mi
29	*Malva parviflora*	Malvaceae	Khubbayza	H-KSU / 06-2010-22	Fr	Seasonal herb	H	Mi
30	*Plantago amplexicaulis*	Plantaginaceae	Riblah	H-KSU / 06-2010-23	Oc	Annual herb	H	Mi
31	*Cenchrus setigerus*	Poaceae	Humrah	H-KSU / 06-2010-24	Fr	Annual grass	H	Mi
32	*Chloris barbata* Sw	Poaceae	Nagil	H-KSU / 06-2010-25	Fr	Annual grass	Th	L
33	*Cynodon dactylon*	Poaceae	Thayyil	H-KSU / 06-2010-25a	Do	Perennial grass	H	L
34	*Dactyloctenium aegyptium* (L.) P. Beauv.	Poaceae	Abo-Robka	H-KSU / 06-2010-26	Fr	Annual grass	H	L
35	*Echinochloa colona* (L) Link.	Poaceae	Sahma	H-KSU / 06-2010-27	Ra	Annual grass	H	Mi

Table 1. Contd.

36	*Ochthochloa compressa* (Forssk.) Hilu	Poaceae	Hamra	H-KSU / 06-2010-28	Fr	Perennial grasses	Th	L
37	*Panicum turgidum* Forssk.	Poaceae	Thomam	H-KSU / 06-2010-29	Do	Perennial grasses	H	L
38	*Setaria verticillata* (L.) P. Beauv.	Poaceae	Lussaq	H-KSU / 06-2010-30	Fr	Annual grass	Th	L
39	*Calligonum comosum* L. Her. F.	Polygonaceae	Arta	H-KSU / 06-2010-31	Fr	Annual herb	Th	Na
40	*Emex spinosa* (L.) Campd.	Polygonaceae	Humbas	H-KSU / 06-2010-32	Ra	Annual herb	Th	Na
41	*Rumex vesicarius*	Polygonoceae	Hummayd	H-KSU / 06-2010-33	Fr	Perennial herb	Th	Me
42	*Portulaca oleracea* L.	Portulaceae	Rigla	H-KSU / 06-2010-34	Fr	Annual herb	Th	Na
43	*Anagallis arvensis* L	Primulaceae	Khunaizah	H-KSU / 06-2010-35	Do	Annual herb	Th	Na
44	*Datura innoxia*	Solonaceae	Sim-al-faar	H-KSU / 06-2010-36	Oc	Annual herb	Ch	Me
45	*Datura stramonium* L.	Solonaceae	Sim-al-faar	H-KSU / 06-2010-37	Oc	Annual herb	Ch	Me
46	*Solanum elaeagnifolium*	Solonaceae	Winjai	H-KSU / 06-2010-38	Fr	Perennial herb	Th	Na
47	*Withania somnifera*	Solonaceae	Semm-al-firakh	H-KSU / 06-2010-37ab	Oc	Perennial herb	Ch	Me
48	*Typha domingensis* Pers	Typhaceae	Barda	H-KSU / 06-2010-39	Do	Perennial herb	G	Me
49	*Forsskalea tenacissima* L	Urticaceae	Hava	H-KSU / 06-2010-41	Ra	Annual herb	Th	Mi
50	*Peganum harmala*	Zygophyllaceae	Harmal	H-KSU / 06-2010-42	Fr	Annual herb	Th	Na
51	*Tribulus terrestris*	Zyogophyllaceae	Haraas	H-KSU / 06-2010-43	Fr	Annual herb	Th	L
52	*Zygophyllum album* L.	Zyogophyllaceae	Retreet	H-KSU / 06-2010-44	Oc	Annual herb	H	Mi

Th, therophytes; L, leptophylls; H, hemicrytophytes; Mi, microphylls; Ch, chamaeophytes Na, nanophylls; Me, mesophylls; Np, nanophanerophytes; G, geophytes Cli, climber. Do, dominant; Fr, frequent; Oc, occassional; Ra, rare.

Additionally, local farmers were also interviewed regarding the adverse impact of weeds on agricultural crops. The local arabic names and distribution pattern of each weed species were also recorded from the local during interviews and discussion.

Plants specimens were collected, dried, preserved and mounted on standard herbarium sheets (12"×18") and were identified with the help of available literature (James, 1990), and the International Plant Names Index (IPI 2008). The information on weeds flora of the present study was compared with standard literature of Migahid (1987), Colenette (1985), Chaudhary (1989) and Mandaville (1990). The nomenclature was later on confirmed from Herbarium, King Saud, Riyadh (Saudi Arabia). The plants are arranged and described according to family alphabetical names. Biological spectrum of the weed flora based on the life form was prepared by following Raunkiar's (1934) life form classes. Similarly, leaf size classes of each weed species were also classified into Raunkiarian leaf sizes (Raunkiaer, 1934). For every species found, the local people were asked about its availability. In addition personal observations were made in the field to note any pertinent events which could help gain better understanding the presence, availability based on the ecological characteristics of the weed species into, rare, occasional, frequently and dominant species by using standard method of IUCN (2001).

RESULTS AND DISCUSSION

The study documented (Table 1) 52 weed species belonging to 27 families including 25 dicots and two monocots families (Lilaceae and Poaceae). Poaceae (8 spp.) followed by Asteraceae (5 spp.) and Solonaceae (4 spp.) are the largest families while the remaining are represented either by three or less than three species. They were comprises of thirty five herbs, eight grasses, seven shrubs and each climber and parasite have one species in the area. Of the 52 weed species, 28 are annual herb, 5 are annual grasses, 7 are perennial shrub and 6 are perennial herb. Out of 52 weed species, 5 are Chaemophytes, 30 are therophytes, 12 are hemicryptophytes, 3 are geophytes, and one nanophaneorophytes. Of the 52 weed species 11 are Leptophylls, 7 mesophylls, 21 microphylls and 13 nanophylls (Table 1 and Figure 2).

The results showed that the relative availability of common weed species is generally decreasing from the last few decades. When the risk factor and availability situation of the presented documented weed species is considered, it can classified into four categories, five weed species

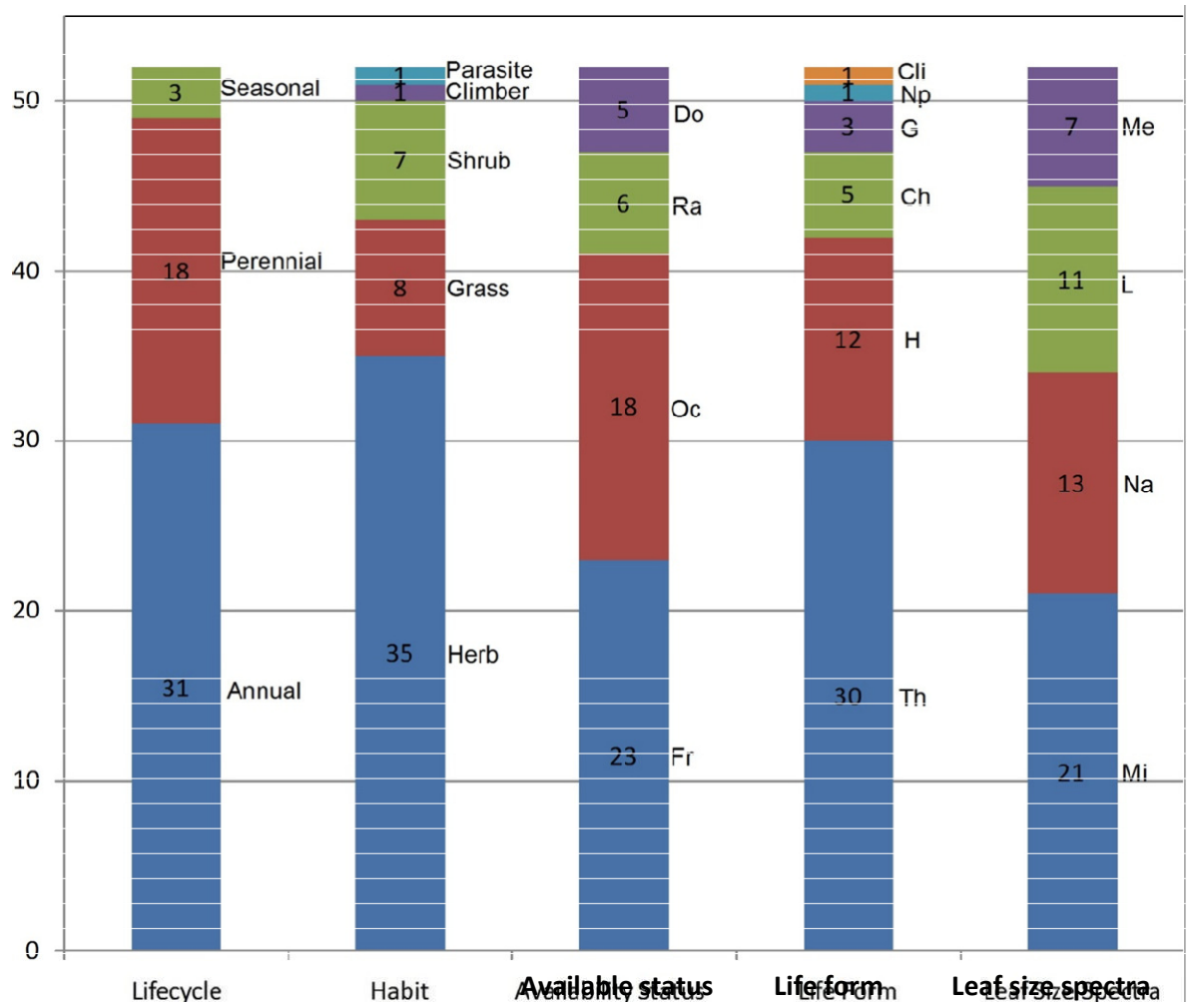

Figure 2. Biological spectrum along with life cycle and ecological availability and habit of the weed flora in Al-kharj Area of Saudi Arabia Th, therophytes; L, leptophylls; H, hemicrytophytes; Mi, microphylls; Ch, chamaeophytes Na, nanophylls; Me, mesophylls; Np, nanophanerophytes; G, geophytes Cli, climber. Do, dominant; Fr, frequent; Oc, occassional; Ra, rare.

are dominant, 6 are rare, 18 and 23 are respectively occasionally and frequently available in the investigated area ((Table 1 and Figure 2).

The vegetation of Saudi Arabia reflects the floristic elements of six phytogeographic regions namely the Palaearctic (Europe and Asia), Afro-tropical (Africa south of the Sahara), Indo-Malayan terrestrial realm and smaller complement of the Saharo-Sindian, Somali-Masur, and Afro-Montane (Alyemeni and Sher, 2010). Life forms and cycles of the plant species also indicate their adaptation to these ecological features (Alyemeni, 1987, 1999; Ture and Bocuk, 2008; Alyemeni and Sher, 2010). The flora of Saudi Arabia is comprised of 2,250 species of flowering plants, 837 genera belonging to 132 families and having 246 regionally endemic taxa (James, 1990). The study revealed that most of the documented weed plants are therophytes and hemicryptophytes. They were distributed both in arable and non arable lands of the study area. Representation by these weeds might reflect the fact they are subjected to agricultural applications more than hemicryptophytes. The study generally observed that several factors have caused changes in weed abundance during the last 50 years. It is common knowledge that weed flora are affected by changes in crop rotation, increasing depth of ploughing, fertilisation, mechanisation, management strategies and, last but not least, use of weedicides. The findings of the present study are in agreement with the study of Alyemeni (1989), Alyemeni and Sher (2010a), Storkey (2006) and Ture and Bocuk (2008). They reported that it is not possible to quantify unambiguously the changes in the distribution of weed species brought about by any single factor, but herbicides seem to be a major driving force.

The results of the present study also showed that the relative availability of the reported weed species is

generally decreasing from the last few decades, due to radical changes in various agronomic practices. The results of the present study is in line with the finding of Ture and Bocuk (2000, 2008), and Alyemeni and Sher (2010). They reported that due to anthrophogenic activities several plants species are disappearing and this situation is particularly serious for endemic weed taxa which are not distributed everywhere and having narrow ecological amplitude. Furthermore, Kleijn and Sutherland (2003) also supported our finding and stated that the type of farming is an important factor influencing diversity and community structure of arable weeds. The current study, therefore, recommend the use of environment-friendly agricultural technology. Secondly, education of the farmers community is utmost important for weed control and conservation methods. The finding of the present endeavour also suggests that disturbed habitats may be important areas to search for novel compounds in drug discovery.

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