Distribution of Dominant Weed Species on Wheat (*Triticum aestivum* Lam.) and Alfalfa (*Medicago sativa* L.) Fields in Ha'il Region, Saudi Arabia

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ABSTRACT

This study was carried out on cultivated alfalfa and wheat fields in Ha'il region, at the northern zone of Saudi Arabia. It aims to invent the weed flora distributed in these fields and their life forms in order to create a data base of weed infestation degree. A total number of ninety seven weed species belonging to twenty seven Angiospermic families and eighty one genera were recorded in this study. The most dominant family in the current weeds' inventory was Poaceae (22.68 %) followed by Asteraceae (16.49 %), Chenopodiaceae (9.28%) and Brassicaceae (7.22%) respectively.

This study also shows that the most abundant weeds in alfalfa and wheat fields belong to the Therophytes group with a dominance of 73.2% of the total species, followed by Chaemophytes with a rate of 16%. Current weed inventory shows that twenty six weed species were first-recorded; among them sixteen species belong to Poaceae family. The most common weed species recorded in wheat fields were *Lolium multiflorum, Polypogon monspeliensis* and *Chenopodium album;* whereas the most dominant weed species on alfalfa fields were *Cynodon dactylon*, *Malva parviflora*, and *Portulaca oleracea* .

Keywords: weeds, flora, *Medicago sativa*, *Triticum aestivum*, inventory.

1. INTRODUCTION

Generally speaking a weed is considered as a harmful plant species. However, plant taxonomists would not agree completely on this perception as they believe a weed plant could be considered undesirable in a particular situation, but might be a valuable crop in some other ones. It can be suggested that a weed is any plant species that grows or reproduces aggressively, or it is invasive outside its own natural environments (Jules, 1979).

As a broad general definition, weeds are unwanted plants that are competitive, pernicious, persistent, and have a negative impact on the agricultural activities. Weeds grow in association with agricultural crops causing significant decline in yields through their competition with crop plants for sunlight, space, nutrients...etc. (Dangwall ***et al.***, 2010). Potentially real new weeds are often neglected until they are largely naturalized and have a negative impact on environment and agricultural production (Waterhouse,

2003, Mseddi ***et al***., 2017). Because of the huge advancement and interactions between sciences, it is somewhat difficult nowadays to describe the weed concept. The current research would go along with the concept of weed that is used in the sense of non-useful plant or unwanted plant as well as a plant out of its own habitat as suggested by many authors such as Hussain ***et al***., (1988) and Rajput ***et al***., (2008).

Most probably the heaviest loss caused by weeds results from their competition with crops for water, light and mineral nutrients. Weeds may cause more loss to agricultural crops than plant diseases, insects and pests (Dangwall ***et al***., 2010). Therefore, many methods of weed control have been adopted such as chemical, mechanical and biological, but before the use of any of these methods it is necessary to identify the weed itself first.

Every country should build up a data base concerning diversity, and distribution of its weed inventory. Weeds should be identified whether they are native or exotic, invasive. In Saudi Arabia, various studies were reported to document the weed flora of the country such as (Parker, 1973; Chaudhary and Al-Howaishel, 1980; Chaudhary ***et al***., 1981; Chaudhary and Zawawi, 1983; Chaudhary and Akram, 1987; Basahy and Monawar, 1994; Al-Yemeny, 1999). However, at the regional level, only the weeds of Al-Qassim region (El Ghazali and Al-Soqeer, 2013) were documented.

The current research aimed to add new reports on weed flora in Ha'il region which is considered to be the fourth largest region in Saudi Arabia. Ha'il region is located between 25° 35′ and 29° 00′ N longitudes and 39° 01′ and 44° 45′ E latitudes and covers an area of 118.322 km^2 and is bordered to the north by Al-Jauf and Northern Frontier, to the south by Al-Qassim, to the east by the Central and Eastern regions and to the west by Tabouk and Al- Madinah AlMonawarra regions. Although the importance of Ha'il region in terms of location, space and environmental characteristics, a few number of researches have carried out to studies on the natural vegetation of this region including (Chaudhary, 1983; Collenette and Tsagarakis, 2001; Al-Turki and Al-Olayan, 2003; Sharawy and Alshammari, 2009; El-Ghanim ***et al***., 2010; Alshammari and Sharawy, 2010; Llewellyn ***et al***., 2011). However, to the best of our knowledge the current research is the first of its kind that has been conducted on Ha'il's weed flora.

Although, alfalfa and wheat are the main crops that grow on a large scale in Ha'il region, famers are facing a serious problem which is the spread of weeds on their farms causing a severe damage of the productivity of their crops. Thus, the current study should offer an important step towards the control and the management approaches of the weeds in Ha'il region through the proper identification of their diversity.

This study is principally a taxonomic study that aims to identify, count weeds at Ha'il Farms, and to highlight the extent of their diversity. The results presented in this work are believed to be the first contribution to study the weeds diversity of the alfalfa and wheat fields in Ha'il region, and thus to increase our knowledge of the plant diversity of the region.

2. MATERIALS AND METHODS

Several field surveys were conducted in Ha'il region, Saudi Arabia in the period from October 2014 to May 2016, covering winter and summer seasons. The specimens were collected from many different sites representing different ecological habitats within the study area (Fig. 1). In each collection site, 2-3 agriculture farms were surveyed. For every weed species, 3-5 samples were collected and their herbarium sheets were developed, following the standard techniques. A voucher specimen has been deposited in the Herbarium of the Biology Department, Faculty of Science, University of Ha'il. The weed species were identified according to Zohary (1966, 1972), Mandaville (1990), Heemstra ***et al.*** (1990), Chaudhary (1983, 1989, 1999, 2000), Migahid (1996), Al-Eisawi (1998),Collenette (1998, 1999) and Al-Turki and

Al-Olayan (2003). The life form (LF) was identified for each species according to Raunkiaer's system of classification (Raunkiaer, 1934).The families of the weed species are arranged in alphabetical order according the classification system proposed by Cronquist (1981), following the scientific names of the weed.

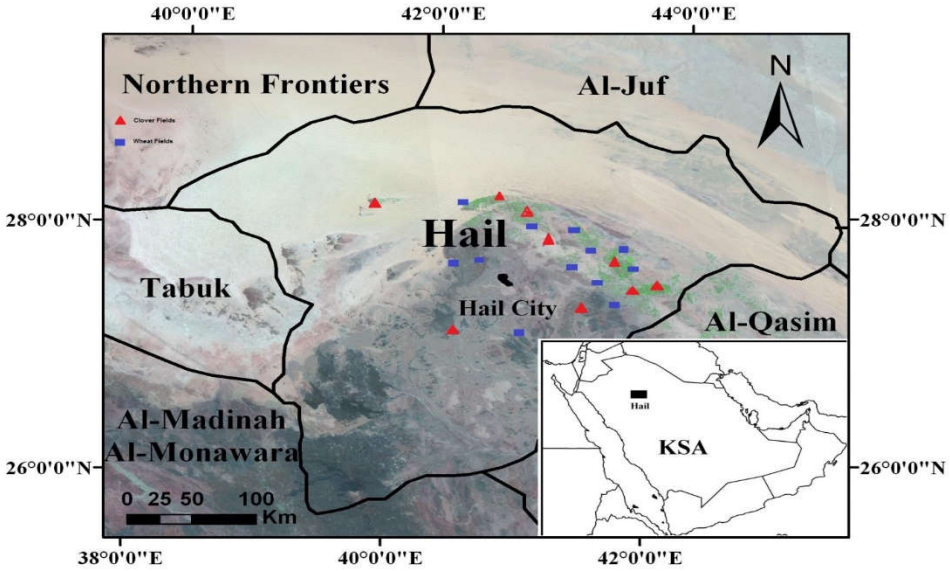

Fig. 1: Collection sites in Ha'il region, Saudi Arabia

3. RESULTS

In the current research, 24 different alfalfa and wheat fields in Ha'il region, north central of Saudi Arabia were surveyed and 97 species of weeds belonging to 81 genera from 27 families were collected, and identified (Table 1). The floristic analysis showed that dominant weeds in this study are annual herbs, while the lower group lies in the shrub category where only 4 species were recorded (*Anvillea garcini, Rhanterium epapposum, Zilla spinosa* and *Withania somnifera*) (Fig. 2).

More than 65% of the recorded weed species belong to 5 species rich families. The largest families in terms of numbers of genera are Poaceae (20) followed by Asteraceae (12), Chenopodiaceae, Brassicaceae (6 for each), Fabaceae (4), Caryophyllaceae, Polygonaceae and Zygophyllaceae (3 for each), Aizoaceae, Boraginaceae, Euphorbiaceae, Orobanchaceae and Solanaceae (2 for each), while fourteen families are monogeneric.

The floristic composition showed that members of the family Poaceae dominate the weed plants of alfalfa and wheat fields in Ha'il region (22 species), followed by Asteraceae (16 species), Chenopodiacea (9 species), Brassicaceae (7 species) and Fabaceae (5 species), while the other thirteen families are monotypic (Fig. 3).

Table 1: Floristic composition of weeds recorded in alfalfa and wheat crops at Ha'il region.

Plant groups	Families	Genera	Species
Angiosperms			
- Dicotyledons	25	60	74
- Monocotyledons	2	21	23
Total Number	27	81	97

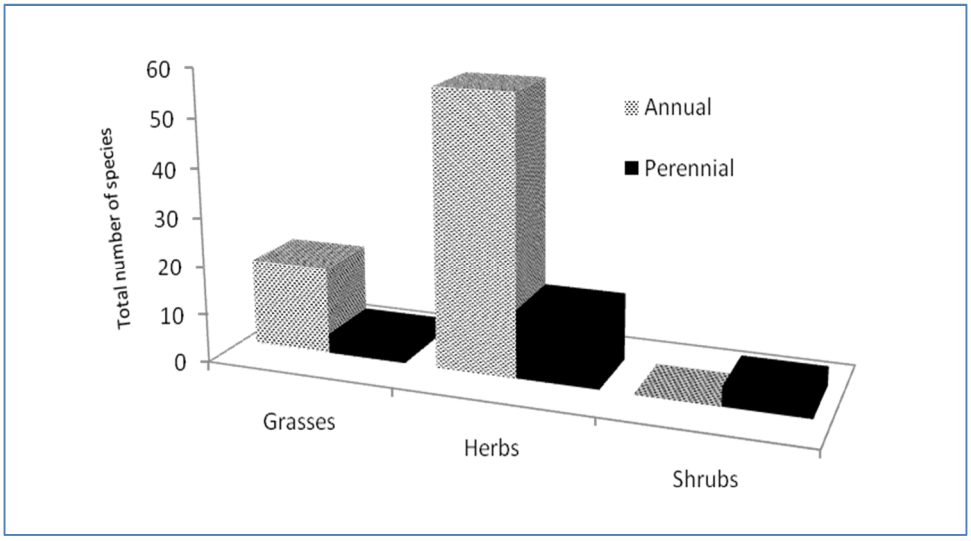

Fig. 2: Pattern of weeds recorded in alfalfa and wheat fields.

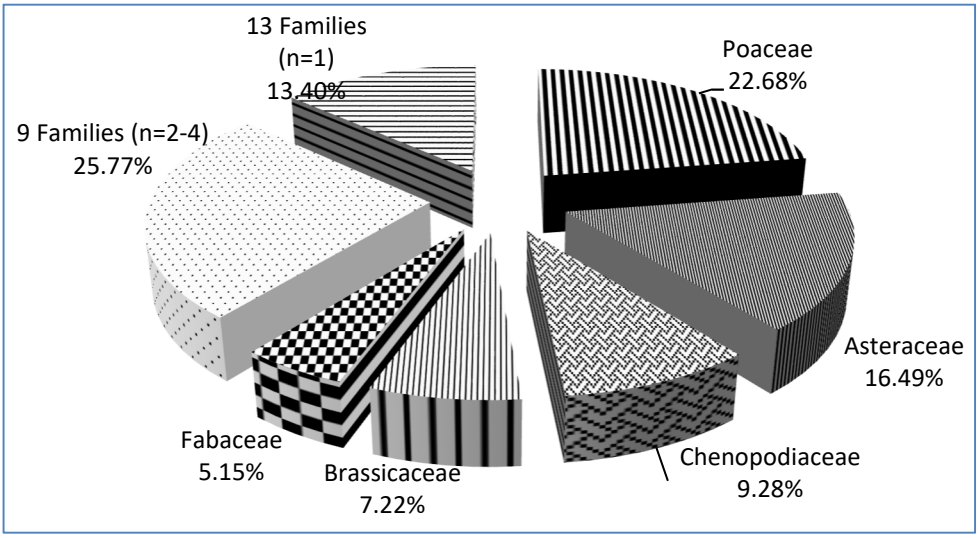

Fig. 3: Diagram of the floristic composition showing 5 species-rich families (n= number of species).

The life form (LF) was identified for each species according to Raunkiaer's system of classification (Raunkiaer, 1934). Thus, it is found that the most frequent life form class was Therophytes which represent 72.16% species of total weed plants recorded in both alfalfa and wheat fields, followed by Chaemophytes (16.49%), Phanerophytes (5.15%), Parasites (4.12%), while the least frequent life form class was Hemicryptophytes (2.06%) (Fig.4).

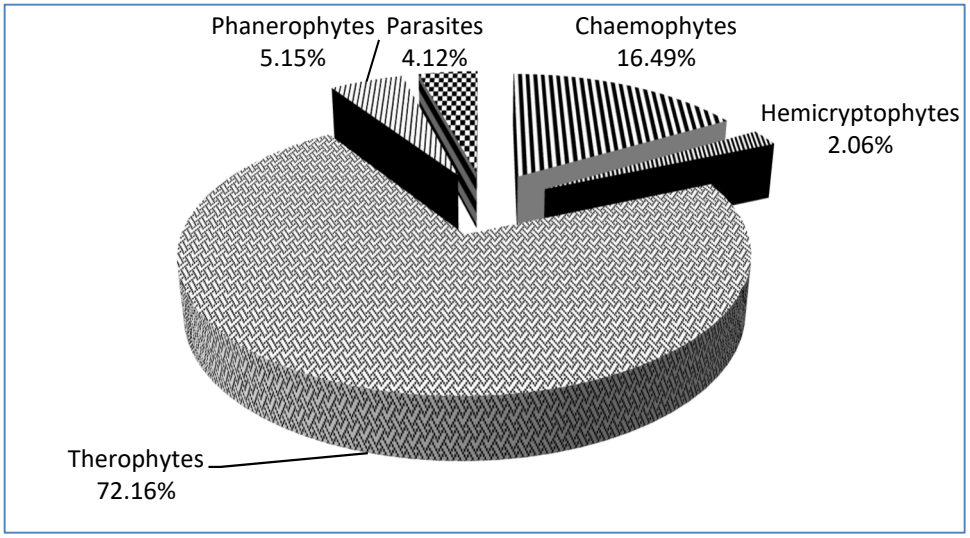

Fig. 4: Percentage of life forms for the weeds found in alfalfa and wheat Fields.

The floristic analysis of the weeds shows that 97 weed plants classified into 81 genera belonging 27 families were recorded in the alfalfa and wheat fields in Ha'il region. Among these recorded species, dicotyledonous comprised 74 species of 60 genera split into 25 families, while monocotyledonous comprised 23 species of 21 genera distributed over 2 families which are Liliaceae and Poaceae. Most of these recorded species were collected from alfalfa fields (95 species) while, in wheat fields only 38 species were collected. Among these species 36 species were recorded as common weed species in both crops and thus only 2 species (*Cutandia dichotoma* and *Lolium temulentum*) were collected from wheat fields (Table 2).

The species which are very common, and are found in all the fields of alfalfa and wheat crops are mostly herbs. It is possible that seeds of these weeds distributed on farms through the cattle manure, which is commonly used by local farmers in the studied area. *Amaranthus lividus, Launaea resedifolia, Senecio flavus, Sonchus oleraceus, Heliotropium digynum, Sisymbrium irio, Chenopodium murale, Malva parviflora, Cynodon dactylon, Rumex vesicarius, Portulaca oleracea, Anagallis arvensis* and *Tribulus terrestris* were recorded to be the most widespread weeds in alfalfa fields. While, *Calendula micrantha, Melilotus indica, Chloris virgata, Cynodon dactylon, Eragrostis barrelieri, Lolium rigidum* and *Polypogonm onospeliensis* were recorded as widespread species in wheat fields. Moreover, four species (*Cuscuta planiflora*, *Cistanche violacea*, *Orobanche cernua* and *Orobanche ramose*) were found as the major parasitic weeds occupying the agriculture farms in Ha'il region.

4. DISCUSSION

The floristic analysis of weeds recorded on alfalfa and wheat fields in Ha'il region showed that the annual herbs dominate the shrubs. Some of these findings were recorded previously by Al-Turki and Al-Olayan, 2003; Sharawy and Alshammari, 2009; El-Ghanim ***et al***., 2010; and Llewwllyn ***et al***., 2011).

Poaceae followed by Asteraceae, Chenopodiaceae, Brassicaceae and Fabaceae were the most dominant families. Those families have been documented previously as the most common in the flora of Saudi Arabia (Migahid and Hammouda, 1978; Collenette, 1985; Mandaville, 1990; Abd El-Ghani and El-Sawaf, 2004). Also, the families Poaceae, Asteraceae, Fabaceae, Chenopodiaceae and Brassicaceae were well documented to comprise the main bulk of the wild plants in Ha'il region (Alshammari and Sharawy, 2010 and Llewwllyn ***et al.***, 2011).

The life form (LF), according to Raunkiaer's system of classification (Raunkiaer, 1934) showed that the most frequent life form class was Therophytes followed by Chaemophytes and Phanerophytes. This result confirms the concept of Cain (1950) and Deschenes (1969) how reported that factors such as overgrazing, dry climate and trampling tend to increase the percentage of Therophytes through the introduction and spread of weedy grasses and forbs. Such results agree also with the life form spectra in desert habitats in some other parts of Saudi Arabia as mentioned by (El-Demerdash ***et al***., 1994; Collenette, 1999; Al-Turki and Al-Olayan, 2003; Alshammari and Sharawy, 2010; El-Ghanim ***et al***., 2010; Alatar ***et al***., 2012; Daur, 2012; El-Ghazali and Al-Soqeer, 2013). Also, the low presence of Phanerophytes (5.15%) recorded in this study is in agreement with the findings of Al-Turki and Al-Olayan (2003), which showed that central and north Arabian Peninsula has very poor species of perennial shrubs and trees.

Table 2: List of the recorded weed species, their growth form and life form in alfalfa and wheat fields in Ha'il Region.

No.	Family	Taxa	Growth Form	Life Form	Occurence	
					Alfalfa Fields	Wheat Fields
1	Aizoaceae	*Aizoon canariensis* L.	H, Ann.	Th.	+	+
2		*Mesembryanthemumn nodiflorum* L.	H, Ann.	Th.	+	-
3	Amaranthaceae	*Amaranthus albus* L. *	H, Ann.	Th.	+	-
4		*Amaranthus graecizans* L.	H, Ann.	Th.	+	+
5		*Amaranthus lividus* L.	H, Ann.	Th.	+	-
6	Apiaceae	*Anisosciadium isosciadium* Bornm	H, Ann	Th.	+	-
7	Asphodelaceae	*Asphodellus fisulosus* L.	H, Ann.	Th.	+	-
8	Asteraceae	*Anvillea garcini* (Burn.f.) D.	S, Per.	Ph.	+	-
9		*Atractylis cancellata* L.	H, Ann.	Th.	+	-
10		*Calendula arvensis* L.	H, Ann.	Th.	+	-
11		*Calendula tripterocarpa* Rupr.	H, Ann.	Th.	+	+
12		*Conyza bonariensis* (L.) Cronquist	H, Ann.	Th.	+	-
13		*Conyza canadensis* (L.) Cronquist *	H, Ann.	Th.	+	-
14		*Conyza stricta* Willd. *	H, Ann.	Th.	+	+
15		*Filago desertorum* Pomel	H, Ann.	Th.	+	-
16		*Koelpinia linearis* Pall.	H, Ann.	Th.	+	-
17		*Lactuca saligna* L. *	H, Ann.	Th.	+	-
18		*Lactuca serriola* L. *	H, Ann.	Th.	+	+
19		*Launaea resedifolia* Druce	H, Ann.	Th.	+	+
20		*Rhanterium epapposum* Oliv.	S, Per.	Ph.	+	+
21		*Senecio flavus* (Decne.) Sch.Bip.	H, Ann.	Th.	+	-
22		*Sonchus oleraceus* L.	H, Ann.	Th.	+	+
23		*Urospermum picroides* (L.) Scop.	H, Ann.	Th.	+	-
24	Boraginaceae	*Arnebia hispidissima* (Lehm.) DC.	H, Ann.	Th.	+	+
25		*Heliotropium digynum* (Forssk.) Asch. Ex C. Christens.	H, Per.	Ch.	+	+
26	Brassicaceae	*Brassica tournefortii* Gouan	H, Ann.	Th.	+	-
27		*Capsella bursa-pastoris* (L.) Medik.	H, Ann.	Th.	+	-
28		*Eruca sativa* (L.) Mill.	H, Ann.	Th.	+	-
29		*Farsetia aegyptia* Turra.	H, Per.	Ch.	+	-
30		*Sisymbrium irio* L.	H, Ann.	Th.	+	+
31		*Sisymbrium orientale* L.	H, Ann.	Th.	+	+
32		*Zilla spinosa* (Turr.) Prantl.	S, Per.	Ph.	+	-
33	Caryophyllaceae	*Herniaria hirsuta* L.	H, Ann.	Th.	+	-
34		*Paronychia arabica* DC.	H, Per.	Ch.	+	-
35		*Spergularia diandra* (Guss.) Heldr. &Sart.	H, Ann.	Th.	+	-
36	Chenopodiaceae	*Anabasis setifera* Moq.	H, Per.	Ph.	+	-
37		*Atriplex suberecta* Verdoorn *	H, Ann.	Th.	+	-
38		*Beta vulgaris* L.	H, Ann.	Th.	+	-
39		*Chenopodium album* L. Bosc. *	H, Ann.	Th.	+	+
40		*Chenopodium ambrosioides* L. *	H, Ann.	Th.	+	-
41		*Chenopodium glaucum* L. *	H, Ann.	Th.	+	-
42		*Chenopodium murale* L.	H, Ann.	Th.	+	+
43		*Salsola baryosma* (Schult.) Dandy	H, Per.	Ch.	+	-

44		*Suaeda aegyptiaca* (Hasselq.) Zoh.	H, Per.	Ch.	+	+
45	Convolvulaceae	*Convolvulus arvensis* L.	H, Per.	Ch.	+	+
46	Cucurbitaceae	*Citrullus colocynthis* (L.) Schrad.	H, Per.	Th.	+	-
47	Cuscutaceae	*Cuscuta planiflora*Ten.	H, Ann.	P.	+	-
48	Euphorbiaceae	*Euphorbia retusa*(L.) Cav.	H, Ann.	Th.	+	-
49		*Chrozophora tinctoria* (L.) Raf.	H, Per.	Ch.	+	-
50	Fabaceae	*Astragalus hamosus* L.	H, Ann.	Th.	+	+
51		*Medicago laciniata* (L.) Mill.	H, Ann.	Th.	+	+
52		*Melilotus indica* (L.) All.	H, Ann.	Th.	+	-
53		*Trifolium tomentosum* L.	H, Ann.	Th.	+	-
54		*Trigonella stellata* Forsssk.	H, Ann.	Th.	+	+
55	Fumariaceae	*Fumaria parviflora* Lam.	H, Ann.	Th.	+	-
56	Malvaceae	*Malva parviflora* L.	H, Ann.	Th.	+	+
57	Neuradaceae	*Neurada procumbens* L.	H, Ann.	Th.	+	-
58	Orobanchaceae	*Cistanche violacea* (Dersf.) Beck. *	H, Per.	P.	+	-
59		*Orobanche cernua* Loefl.	H, Ann.	P.	+	-
60		*Orobanche ramose* L.	H, Ann.	P.	+	-
61	Plantaginaceae	*Plantago ovata* Phil.	H, Ann.	Th.	+	+
62	Poaceae	*Aleuropus lagopoides* (L.) Trin. Ex Thwaites *	H, Per.	Ch.	+	-
63		*Cenchrus ciliaris* L.	H, Ann.	Th.	+	+
64		*Chloris virgata* Swartz. *	H, Ann.	Th.	+	+
65		*Cutandia dichotoma* (Forssk.) Trab. *	H, Ann.	Th.	-	-
66		*Cynodon dactylon* (L.) Pers.	H, Per.	Hem.	+	-
67		*Dactyloctenium scindicum* Boiss. *	H, Ann.	Th.	+	-
68		*Dichanthium annulatum* (Forssk.) Stapf. *	H, Ann.	Th.	+	-
69		*Digitaria sanguinalis (*L.) Scop. *	H, Ann.	Th.	+	+
70		*Echinochloa colonum* (L.) Link. *	H, Ann.	Th.	+	-
71		*Eleusine indica* (L.) Gaertn. *	H, Ann.	Th.	+	-
72		*Eragrostis cilianensis* (All.) F.T. Hubb.	H, Ann.	Th.	+	+
73		*Hordeum leporinum* Link.	H, Ann.	Th.	+	+
74		*Lasiurus scindicus* Henr. *	H, Per.	Ch.	+	-
75		*Lolium temulentum* L. *	H, Ann.	Th.	-	+
76		*Lolium multiflorum* Lam. *	H, Ann.	Th.	+	+
77		*Lolium rigidum* Gaudich. *	H, Ann.	Th.	+	+
78		*Panicum repens* L. *	H, Per.	Hem.	+	+
79		*Poa annua* L. *	H, Ann.	Th.	+	+
80		*Polypogonm monspeliensis* (L.) Desf.	H, Ann.	Th.	+	+
81		*Schismus barbatus* (L.) Thell.	H, Ann.	Th.	+	+
82		*Setaria verticillata* (L.) P. Beauv.	H, Ann.	Th.	+	-
83		*Stipa capensis* Thunb.	H, Ann.	Th.	+	-
84	Polygonaceae	*Emex spinosa* (L.) Campd.	H, Ann.	Ch.	+	-
85		*Polygonum equisetiforme* Sm.	H, Ann.	Ch.	+	+
86		*Rumex vesicarius* L.	H, Ann.	Th.	+	+
87	Portulacaceae	*Portulaca oleracea* L.	H, Ann.	Th.	+	-
88	Primulaceae	*Anagallis arvensis* L.	H, Ann.	Th.	+	+
89	Resedaceae	*Reseda arabica* Boiss.	H, Ann.	Th.	+	+
90	Solanaceae	*Solanum elaeagnifolium* Cav. *	H, Per.	Ch.	+	-
91		*Solanum nigrum* L.	H, Per.	Ch.	+	+
92		*Withania somnifera* (L.) Dun.	S, Per.	Ph.	+	-
93	Urticaceae	*Forsskaolea tenacissima* L.	H, Ann.	Ch.	+	-

94	Zygophyllaceae	*Fagonia glutinosa* Del.	H, Per.	Ch.	+	+
95		*Tribulus terrestris* L.	H, Ann.	Th.	+	-
96		*Zygophyllum simplex* L.	H, Ann.	Th.	+	-
97		*Zygophyllum coccineum* L.	H, Per.	Ch.	+	-

Note: Ann., Annual; **Per.,** Perennial; **H,** Herb; **S,** Shrub; **Th,** Therophytes; **Ph,** Phanerophytes; **Ch,** Chaemophytes; **Hem,** Hemicryptophytes; **P,** Parasites.
***,** species recorded for first time in Ha'il region.

Parasitic species such as *Cuscuta planiflora*, *Cistanche violacea*, *Orobanche cernua* and *Orobanche ramose* were found to be the major parasitic weeds. Parasitic weeds are well known to infest agricultural crops and cause growth damage and yield failure. These parasitic weeds have the ability of producing a large number of seeds accompanied with long seed viability and ability to widely spread by wind such as Cistanche and Orobanche, and hence pose more complications for the control methods (Qasem, 2010). Unfortunately, the current data of parasitic weeds would damage two of the most important crops in Ha'il region (Alfalfa and Wheat), and accordingly special control programs and management activities should be undertaken promptly to hinder their spreading.

The present study showed that six species (*Aizoon canariensis, Mesembryanthemum nodiflorum, Suaeda fruticosa, Portulaca oleracea, Zygophyllum simplex* and *Zygophyllum coccineum*) were encountered as succulent weeds affecting drying the fodder crops in Ha'il region. These weeds are water retaining plants as they store water in various parts, such as leaves and stems to adapt itself against the long dry season. Succulent weeds are not only adversely affecting the yield of fodder crops, but also, when harvested with these fodder crops, it slows their process of drying and may leads to reducing their quality. Moreover, Sharawy and Alshammari (2009) reported these species to be poisonous plants for grazing animals.

Few species like *Amaranthus albus, Paronychia arabica, Chenopodium album, Chrozophora tinctoria, Cutandia dichotoma, Dichanthium annulatum, Setaria verticillata, Emex spinosa* and *Solanum elaeagni*folium are weeds which documented as rare species in this study and found to occur only on the margins. Therefore, field margins deserve special attention as biodiversity refuges in areas of intensive agriculture.

5. CONCLUSIONS

In conclusion, ninety seven weed species belonging to eighty one genera from twenty seven families were recorded in the current research. The floristic analysis showed that the majority of those weeds were annual herbs, while only four species lies in the shrub category namely, (*Anvillea garcini*, *Rhanterium epapposum*, *Zilla spinosa* and *Withania somnifera*).

Also, twenty six species were recorded for the first time in Ha'il region (Table 2). According to this result it is believed that some weeds from nearby regions like Qassim region may invade agricultural farms in Ha'il and become part of its weed flora. Out of these twenty six new record species; about sixteen species are belonging to the family Poaceae. The dominance of the Poaceae family in the current study has been recorded also all over Saudi Arabia which reflects the critical infestation of this family and therefore the necessity of applying more strict methods of weed control.

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