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DEVELOPING WEEDS OF AGRICULTURAL CROPS AT DIFFERENT LEVELS OF HEIGHTS, IN TAIF AREA OF SAUDIA ARABIA

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Abstract

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This study continued during the eighteen months of 2015-2016 to identify the flora weeds within the agricultural fields at the three levels of height (Area A = 1700 m, Area B = 2200 m, Area C = 2000 m from sea level) in Taif agricultural area of Saudi Arabia. The results showed the presence of high density of weeds which belong to 23 families. Where it was most presence of the family Amaranthaceae, as well as the study shows a prevalence of approximately 10 families in three different areas: Amaranthacea, Asteraceae, Boraginaceae, Cyperaceae, Poaceae, Convolvulaceae, Chenopodiaceae, Malvaceae, Papaveraceae, and Solanaceae. The results also showed the presence of high density of some of the herbs in the study areas such as: Amaranthus viridis, Amarnnthus hybridus, Centure sp., Sonchus oleraceus, Convolvulus arvensis, Cyperus rotundus, Malva parviflora, Argemana Mexicana, Solanum incanum. This study has great significant value to suggesting suitable weed control method and further investigations of weeds ecology at different level of height in Taif Area of Saudi Arabia.

Key words: crop; weeds; Taif area; levels of height

Introduction

Weeds are competing for resources with crops, such as water, nutrients and light (Akobundu, 1987, Oudhia, 2004). Weed also promotes disease problems, insects serve as alternative hosts and harmful diseases, slows down the harvesting operation, increases production costs, reduces the market value of crop plants, and increases the risk of fire incidences in permanent crops, (Oudhia, 2004). Like most plants, weeds are very important to reproduce in their life cycle like the species of annuals or perennials only by seeds (Gulden and Shirtliffe, 2009). Thus, the quality and quantity of weeds in the soil determine the situation of weeds in an arable land. The study of the weeds on different levels of elevations those not only serves the physical history of the successes and failures of the past agricultural systems, but can also help producers determine the extent to which weed competition predicts the impact on crop performance and quality.

The Middle East is a geologically complex region that displays diverse topography: high mountain peaks of more than 5 000 meters and depressions of about 400 meters below sea level, elevated plateaus, mountain foothills, alluvial plains, etc. The climate contrasts in this region also differ greatly from almost rainless subtropical deserts to extremely cold high plateaus, and mild Mediterranean to extremely continental type weather. Its vegetation is comprised of dense humid forests, park-forests, dry and moist steppes and semi-deserts (Zohary, 1973). In considering the geological and phytogeographical history of the Middle East, Zohary noted that since the early Pleistocene Period, man has strongly af-

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fected the natural flora and vegetation and that this influence has led to the domestication of the native plants and animals of this region. He called the last period,which began about 10 000 BC, the 'Segetal Period'.

A number of ecological studies have been published on the vegetation of Saudi Arabia. Zahran, (1983) wrote an introduction to the plant ecology and vegetation types in the country. Some other reports have dealt with the vegetation types in certain regions of the kingdom particularly in the Hijaz and Aseer regions. Batanouny (1979) described the vegetation types in the Jeddah-Makkah road, Batanouny and Baeshain (1983) described vegetation types in the Al-Madinah-Badr road across the Hijaz Mountains and Fayed and Zayed (1999) reported on the vegetation along Makkah-Taif road. More detailed studies was carried out on the vegetation change in relation to elevation in the Aseer mountains (Abulfatih, 1992) and on vegetation analysis and species diversity in the central Hijaz mountains (Abd-El-Ghani, 1997) and Wadi El-Ghayl in Aseer mountains (Fahmy and Hassan, 2005). Studies on the vegetation environment relationship in the mountainous Taif area (80–100 km south east of Makkah), indicated that soil water table and salinity cause discontinuities of vegetation in the area (Abdel-Fattah and Ali, 2005). In the central part of Saudi Arabia, the Raudhas vegetation was analyzed by Shaltout and Madi (1996). The floristic account of Raudhat Khuraim in the central province was also reported by Al-Farhan (2001). In addition, comparative ecological studies were also conducted by Al-Ghanim (2002) on the natural vegetation in the Riyadh region. However, few studies have dealt with vegetation analysis and species diversity Saudi Arabia.

In agricultural ecosystems its role is still doubtful, though there are many agrestals of which allelopathic influences have been proved in laboratory (Grtimmer and Beyer, 1960; Martin and Rademacher, 1960; Welbank, 1960; Grodzinskiy, 1965). The 'classical allelopathic weeds' are species of the genus Camelina (tested against flax, Grtimmer and Beyer,1960). Results of modern, sophisticated experiments have indicated that reduced yields of flax grown in association with Camelina are largely the result of competition for nutrients rather than of allelopathic phenomena (Balschun and Jacob, 1972; Kranz and Jacob, 1977). These and similar results with other species may lead to a skeptical attitude towards the whole concept of allelopathy or at least to its significance in agrophytocoenoses. A final and generally valid answer is still ahead. For agriculturists this problem is negligible anyway as they will be always confronted with the combined effects of allelopathy and competition (and other phenomena) and it will be nearly impossible to se-parate them in nature. A plant 'weakened' by colines of another one will have problems withstanding adverse environmental conditions and vice versa, a plant 'enervated' by an unfavourable environment will more easily become the victim of an allelopathic attack.

The flora of Saudi Arabia is one of the richest biodiversity areas in the Arabian Peninsula and comprises very important genetic resources of crop and medicinal plants. In addition to its large number of endemic species, the components of the flora are the admixture of the elements of Asia, Africa and Mediterranean region. According to Collenette (1998), the greatest species diversity has been observed in Asir and Hijaz, the western mountainous area of the Kingdom, which boarders the Red Sea. And it is due to a greater rainfall and range of altitude from sea level to 9300 ft at Jabal Sawdah, near Abha. A total of 2250 species (including pteridophytes and gymnosperms) in 142 families are represented in the flora of the Kingdom of Saudi Arabia. Of these, there are 242 endemic and 600 rare and endangered species in the wild; thus an action plan should be taken for their conservation and sustainable development.

It is reported that the nature of the culture, cultural practices and model cultivation system, soil type, moisture availability, location and season, changes in abundance and distribution of species weeds in fields (Mohler, 2001). However, most of these researches were not conducted in Saudia Arabia. It is reported that the importance of the dynamics of weeds in a culturing system facilitates the formulation of a suitable management strategy (Derksen et al., 2002), a clear knowledge of the existence different weed plants so different cultivation system is necessary. The objective of this study is to get a better understanding by asking appropriate management strategy to combat weeds. To identify weeds species that can be found at different levels of elevations.

Materials and Methods

Study Area

The Taif Area (Figure 1) on the eastern slopes of the Sarwat Mountains at an altitude of 1700 m above sea level, and increases the rise as we head to the west and south, up to 2500 m, located between (N 20-22° and E 40-42°). Taif area is famous in the agricultural field, where it is of the most famous and the richest agricultural areas in the Kingdom of Saudi Arabia. Where the estimated number of farms and preserve areas affiliate about (25500) farm, with a total area of approximately (594 000).

Specimens were collected from three different levels of elavations (Area A = 1700 m, Area B = 2200 m, Area C = 2000 m) in Al-Hada and Al-Shafa area. Samples of these recorded species were prepared as herbarium specimens for

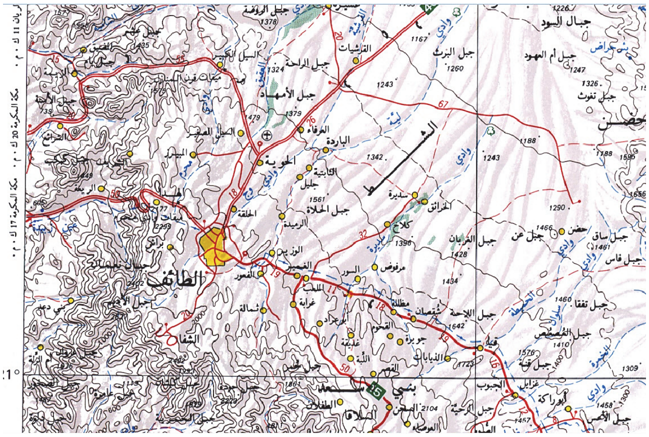

Fig.1. A map showing the area of Taif

identification. Most weeds were collected at *Rosa sp.* cultivated lands. The extent of crop infestation by weeds was measured based on visual observations or arbitrary evaluation. Species determination was done according to the methods described by Collenette, (1998) and Migahid, (1978).

Data analysis

Data were transformed to $\log^{+1}$ or log prior to statistical analysis and subjected to one-way ANOVA and their treatment means were tested for significant difference, if any, using t-tests Similar analyses have been used in many previous studies.

Results and Discussion

Initial weed vegetation analysis of Taif was determined to know the weed species present, and evaluate their density. Successful weed management strategy depends on the knowledge of weeds in the crop field, and the density of each species present (Krueger et al., 2000). According to the results obtained the Amaranthaceae family has the highest density of weeds in the Taif agricultural area in all the height levels that were studied (Table 1). Amaranthaceae are much-branched erect or subscandant herb, to 2 m high, very variable and adaptable to many sorts of location, from shaded damp and swampy sites to savanna conditions and to high altitudes, occurring in the Region from Senegal to W/Cameroon, and widespread elsewhere in Africa and throughout the hotter parts of the world. Prominate weeds species under the Amaranthaceae family: *Amaranthus viridis* has high density in all the levels, *Amaranthus hydridus* also proves its species to survive with density of 70, 58 & 279 in levels A, B, & C respectively. Eight weeds species of amaranthaceae family were identified from Taif crop lands (Table 3).

Table 1
Developing weeds density in agricultural crops of Taif area

Family		Area A	Area B	Area C
1	Aizoaceae	+		
2	Amaranthaceae	+++	+++	++++
3	Asteraceae	+++	++	++++
4	Asphodelaceae			+
5	Boraginaceae	+	++++	++++
6	Brassicaceae			++++
7	Caryophylloideae		+	+
8	Chenopodiaceae	+	+	+
9	Convolvulaceae	+++	+	+
10	Cyperaceae	++++	+	++++
11	Euphorbiaceae	+		
12	Fabaceae		+	+
13	Lamiaceae			+
14	Malvaceae	+	+	+
15	Orobanchaceae	++++		
16	Papaveraceae	+	+	+
17	Plantaginaceae	+		
18	Poaceae	+	+++	++++
19	Portulacaceae	+		
20	Resedaceae			+
21	Solanaceae	+	+	+
22	Urticaceae	+		
23	Zygophyllaceae	+	+	

(+): Weeds density 1-99, (++) : Weeds density 100-199, (+++) : Weeds density 200-299, (++++) : Weeds density more 300

The species in this family are mostly annual or perennial herbs, although a few species are shrub. The flowers of most species in the Amaranthaceae are bisexual (or monoecious), meaning they have both male and female reproductive organs. In all species, the flowers are small and have radial symmetry. The flowers of most species arise in a dense inflorescence, or flower cluster, with each flower of the inflorescence subtended by one or more small red bracts (modified leaves). The small red bracts remain present as the flower matures into a fruit. The flowers of most species produce nectar and are insect-pollinated. The specie Chenopodium

Table 2
Developing weeds family density in agricultural crops in Taif area at different levels

Table 2 describes the results and the spread of some agricultural crops developing weeds

Family		Area A	Area B	Area C
1	Aizoaceae	10	0	0
2	Amaranthaceae	233*	233*	565*
3	Asteraceae	220*	117*	462*
4	Asphodelaceae	0	0	34*
5	Boraginaceae	80*	437*	305*
6	Brassicaceae	0	0	479*
7	Caryophylloideae	0	52*	43*
8	Chenopodiaceae	27*	17*	0
9	Convolvulaceae	199*	54*	83*
10	Cyperaceae	304*	78*	353*
11	Euphorbiaceae	50*	0	0
12	Fabaceae	0	37*	53*
13	Lamiaceae	0	0	17*
14	Malvaceae	10*	15*	31*
15	Orobanchaceae	832*	0	0
16	Papaveraceae	91*	6*	45*
17	Plantaginaceae	1*	0	0
18	Poaceae	67*	207*	347*
19	Portulacaceae	18*	0	0
20	Resedaceae	0	0	27*
21	Solanaceae	27*	70*	33*
22	Urticaceae	43*	0	0
23	Zygophyllaceae	7*	58*	0

(*) All values in density column are significantly different at $p < 0.05$

murale was not noticed at levels A & B but has high density at level C with a density of 180, this indicates that the species grows well at higher elevations, notwithstanding *Chenopodium vulvaria* gives the density of 81 at level A and 39 at level C (Table 3). The Boraginaceae family has much density in levels B & C because the family is a great seed producer and can adapt to any harsh conditions (De Haro et al., 2004).

The asteraceae is also an aggressive weeds family of agricultural crops, from Table 1, it can be noticed that its density is sparsely distribututed through the three levels, although geographically widespread, this genus occurs exclusively in tropical and subtropical regions of the United States and Central and South America (Robinson and King, 1977). The Asteraceae family was studied to have 15 weeds species at all levels, among which Lunaca capitate has the density of 121 at level A, and null at the other levels. The *Centure sp.* was recorded to have 23, 14 & 69 at levels A, B & C respectively (Table 3). Sanchus oleraleus is also a well dense specie at all the levels, 8 in level A, 16 in B and 56 at the highest level. Another specie *Echinops spinosissisimos* has the density of 35 at level A and 180 at level B. *Verbesina encelioides* has the lowest weed density in the asteraceae family with 3 at level A. The Cyperaceae family is high density in area A & C, but not withstanding a significant density is also noticed in Area B, the plants are commonly perennial herbs rarely annual; perennating by means of creeping rhizomes or tubers. The members are inhabitants of damp places, the family is commonly known as 'Sedge family'. It is distributed throughout the world but most abundant in temperate zones. It comprises 70 genera and 4000 species, the Cyperaceae is well distributed because it have tiny, wind-pollinated flowers that lack petals and sepals. They are subtended by specialized scale-like bracts, and aggregated into a special inflorescence type called the "spikelet" (a tiny spike). Sedge spikelets are often (but not always) composed of flowers arranged in tight spirals within which each flower is subtended by a single scale. By contrast, grass spikelets are flattened with the flowers attached in two opposing ranks, and with a somewhat more intricate arrangement that includes additional scale-like bracts found only in grasses. The Poaceae family is also reported to have to well densely distributed in Taif agricultural area, in areas B & C the weeds are so dense, it seems like the weeds are well adapted to high elevations.

The family is commonly known as grass family. It is one of the largest among the angiospermic families. It consists of 620 genera and 6 000 species. The members are cosmopolitan in distribution. The plants represent all the 3 ecological types as hydrophytes, xerophytes and mesophytes distributed worldwide, present in abundance in just about all habitats and ecological zones and often forming the dominant element in open areas (prairie, savannah, etc.). Life in high mountains is mainly constrained by physical components of the environment and some high altitude plant specialists can survive incredible "extremes", for example dipping in liquid nitrogen. Some species manage to grow at altitudes of (Webster, 1961). The study of traits which enable plants to live in such climatic extremes has fascinated generations of biologists, but what is an extreme? Once the ability to cope with environmental extremes has evolved, such extremes become elements of "normal" life. The Boraginaceae family was scouted with 7 weeds species, weeds with higher density are *Heliotropium currsivicum* which has 104 at level B & 268 at level B. The *Brassica tournefortii* has also 283 weeds density at level B and 281 at level C. It can be observe from Table 3 that the Boraginaceae family has no density at level A, this might indicate that the weed specie is adapted to higher elevations.

Table 2 describes the results and the spread of some agricultural crops developing weeds at three different levels

Table 3
Developing weeds species density in agricultural crops at different levels of Taif area

Family	*S. N.*	Area A	Area B	Area C
1	2	3	4	5
Aizoaceae				
	Aizoon canariense	10		
Amaranthaceae				
	Atriplex leucoclada	30*		
	Amaranthus graecizans		12	
	Amaranthus viridis	49*	83*	84*
	Amarnnthus hybridus	70*	58*	279*
	Asphodelus aestivus			34*
	Chenopodium murale			180*
	Chenopodium opulifolium		15	
	chenopodium vulvaria	81*		39*
Asteraceae				
	Launaca capitata	121*		
	Lactuca sativa	6		
	Eclipla alba	17		
	Eclipta prostrate		44*	
	Centure sp.	23	14	69*
	Sonchus asper		3	
	Agratum conyzoides		17	
	Calendula tripterocarpa		6	
	Sonchus oleraceus		28*	
	Conyza dioscoridis	7		31*
	Sonchus oleraceus	8	16	56*
	Echinops spinosissimus	35*		180*
	Eclipta prostrate			44*
	Pulicaria crispa	84*		
	Verbesina encelioides	3		
Boraginaceae				
	Echium vulgars	80*		
	Heliotropium currsivicum		104*	268*
	Sisymbrium orientale		37*	37*
	Brassica tournefortii		283*	281*
	Sisyimbrim altissimum		13	77*
	Coronopus squamatus			84*
	Sisyimbrim irio			37*
Caryophylloideae				
	Silene Arabica		52*	43*
Convolvulaceae				
	Convolvulus arvensis	81*	54*	83*
	Ipomoea sp.	118*		
1	2	3	4	5
Chenopodiaceae				
	Cheropodium murale	53*	91*	
Cyperaceae				
	Cyperus rotundus	10	78*	353*
Euphorbiaceae				
	Euophorbia gronulata	1		
Fabaceae				
	Medicago monspliaca		37*	37*
	Lupinus Lepidus			15
Lamiaceae				
	Nepeta cabiata			17
Malvaceae				
	Malva parviflora	67*	15	31*
Orobanchaceae				
	Orobanche sp.	18		
Papaveraceae				
	Argemana Mexicana	27	6	45*
Plantaginaceae				
	Plantago ovata	27		
Poaceae				
	Astrebla pectinata	149*		
	Eleusine indica		8	
	Setaria viridis		7	
	Stipagrrostis bemralri	46*		
	Cynodon dactylon	39*	24	
	Digitaria sanguinalis		168*	347*
	Polypogon monsepeliensis	70*		
Portulacaceae				
	Portnlaca oleracea	832*		
Resedaceae				
	Reseda alba			27
Solanaceae				
	Solanum incanum	82*	17	17
	Solanum nigrum		19	
	Datura innoxia	9		
	Physalis somnifera		2	16
	Withania somnifera		32*	
Urticaceae				
	Urtica dioica	43*		
Zygophyllaceae				
	Tribulus terriestris	7	58*	

(*) All values in density column are significantly different at $p<0.05$

existed in the Taif area. At area A, the highest weeds density (832) was recorded for the Orobanchaceae family followed by Cyperaceae Amaranthaceae, and asteraceae family with a weed number of 304, 233 and 220 respectively. While, no weeds found from Brassicaceae, Fabaceae and Lamiaceae family at area A. Boraginaceous weeds are the most prevalent weed in case of area B followed by Amaranthaceae and Poaceae. Brassicaceae, Euphorbiaceae and Orobanchaceae also some other species were not found in area B. For Area C, the density of Amaranthaceae family was the highest (565) followed by Brassicaceae, Asteraceae, Cyperaceae and poaceae at the weed density of 479, 462, 353 and 347 respectively. In addition, no weeds recorded in case of family Chenopodiaceae, Euphorbiaceae, Plantaginaceae and Protulacaceae.

The results show differences in density of weeds depending on the species. In a crops area, weed populations are never constant. They are in a dynamic state of flux due to changes in climate and environmental conditions, cropping systems, growing season, cultural practices, weed seed bank composition and periodicity of germination patterns of different weed species (Zedam et al., 2011). Majrashi et al (2013a) reported that weed density differ with the type and fertility status of soil. It was also reported that the weed floristic composition of a particular site may change over time, as weed communities are a complex ecological entity (Juraimi et al., 2010). Pujadas and Hernandex, (1988) reported that a very diverse flora that varied considerably depending on the level of various agricultural inputs. It has been reported that the fertilizer treatment (at NPK 100:30:30) did have a significant impact, albeit small, on growth patterns of *S. grossus* (Majrashi et al., 2013b). For instance, in non-irrigated low input fields of annual crops they recorded 334 species, but found only 79 species in irrigated high input in southern Spain. It was also reported that fertilizer regimes and water depth effect on clonal growth, phenology, and chlorophyll content of S. grossus weed in paddy soil (Majrashi et al., 2014). An understanding of the weed community along with dominance patterns is necessary for effective weed management.

Figure 2 prescribed the densities of weed in agricultural crops in Taif. From our observations, it can be reported that the highest densities of weed at all levels found in Amaranthaceae family, followed by asteraceae Cyperaceae and Boraginaceae family. Medium densities of weed were found from Poacea & Convulculaceae family. Whereas less number of weeds density at all levels were found from lamiacease, aizoceae and plantaginaceae family. Variations of weed density may be due to genetic variability and ability to adaptation in various climatic conditions. Our findings are supported by the results of Balasubramanian and Karthikeyan (2016), who reported that weed species and their intensities varies with different crop species, time and ago ecological systems. It has been also reported that plant densities depends on soil fertility and other properties of soil (Girish et al., 2003).

The weed vegetation in the study area comprises of 60 plant species in 23 families, mostly annual weeds. The high contribution of annuals can be attributed to their short life cycle that enables them to resist the instability of the agro-ecosystem. Moreover, they are generally characterized by high allocation of resources to the reproductive organs (Harper, 1977) and the production of flowers early in their lifespan to ensure some seed production even in a year when the growing season is cut short (Sans and Masalles, 1995).

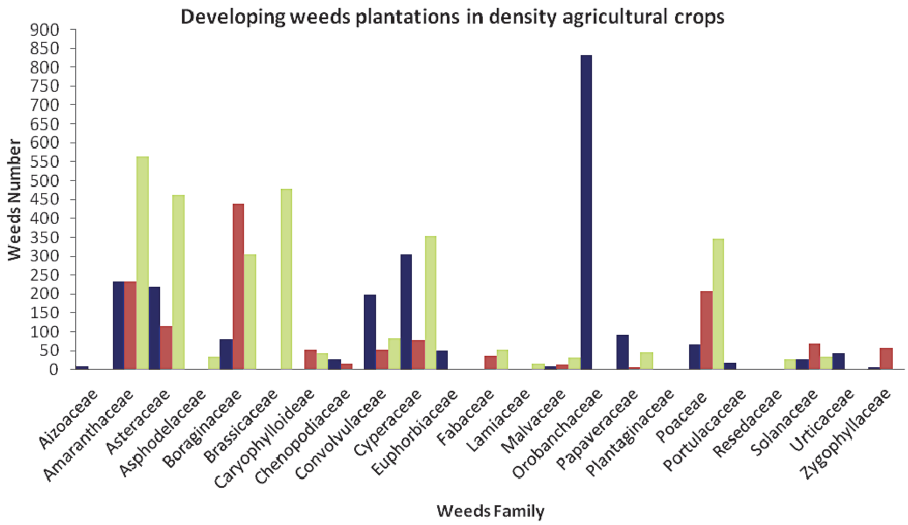

Fig. 2. Developing weeds density in agricultural crop

Conclusion

From this study, it can be concluded that weed species of Amaranthaceae, Asteraceae, Boraginaceae, Cyperaceae, Poaceae, Convolvulaceae, Chenopodiaceae, Malvaceae, Papaveraceae, and Solanaceae are more densely populated at all the different heights of level in Rosa crop plantation in Taif area of Saudi Arabia. It also provides the presence of high density of some of the herbs in the study areas such as: *Amaranthus viridis, Amaranthus hybridus, Centure sp., Sonchus oleraceus, Convolvulus arvensis, Cyperus rotundus, Malva parviflora, Argemana Mexicana, Solanum incanum*. This area provides all the supplements for the conservation on natural vegetation in a region exposed to increasing agricultural activities. During the past five decades, extensive human activities have put great pressure on vegetation in all regions of Saudi Arabia and lead to vegetation change. The results of the present study point out the need for further studies on the diverse and changing vegetation of the Hail region. This paper also points out the need for managerial practices to conserve plant diversity in Saudi Arabia. The findings of this study will be useful in suggesting suitable weed control and further investigations of weeds ecology.

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