Brazilian Journal of Biology®

ISSN 1519-6984 (Print)
ISSN 1678-4375 (Online)

Original Article

Survey of Portulacaceae family flora in Taif, Saudi Arabia

Levantamento da flora da família Portulacaceae em Taif, Arábia Saudita

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Abstract

The presence of weeds in areas of agricultural activities is a hinderance to the development of these activities. It is important to take advantage of the vast open spaces suitable for agriculture and provide food security for humans, and also it is an important indicator for determining the feasibility of growing crops, benefiting from yield and determining the percentage of loss, clearing fields through agricultural practices, that protect crops from weed attack and agricultural practice method must be followed that will reduce weed presence. This study was conducted during the years 2018 to 2020 to evaluate Portulacaceae of Flora in the Taif area in the Kingdom of Saudi Arabia at different altitudes (Area 1 =1700 m, Area 2 =1500 m, Area 3 =1500 m, Area 4 =500 m, Area 5 = 2200 m, and Area 6 = 2200 m). The results show that there were 2,816 individuals of *Portulaca oleracea* weed, with the highest density found in A 1, followed by A 2, while in A 5 and A 6, no weeds were recorded. The highest density of weeds were in the Pomegranate fields, followed by Grape fields. The lowest density was found in A man field. The results of this study will help to take the necessary measures to combat weeds and its management in areas of agricultural activity, while more studies are needed to survey the ecology of weeds of Taif in The Kingdom of Saudi Arabia.

Keywords: weeds, flowering plants, biology, agricultural activities.

Resumo

A presença de plantas daninhas em áreas de atividades agrícolas é um entrave ao desenvolvimento dessas atividades. É importante aproveitar os vastos espaços abertos adequados para a agricultura e dar segurança alimentar para o homem. Também é um indicador importante para determinar a viabilidade de cultivo de lavouras, beneficiando-se da produtividade e determinando o percentual de perda, desmatando campos agrícolas, práticas que protegem as lavouras do ataque de ervas daninhas, e métodos de práticas agrícolas devem ser seguidos para reduzir a presença de ervas daninhas. Este estudo foi realizado durante os anos de 2018 a 2020 para avaliar Portulacaceae de flora na área de Taif, no Reino da Arábia Saudita, em diferentes altitudes (Área 1 = 1.700 m, Área 2 = 1.500 m, Área 3 = 1.500 m, Área 4 = 500 m, Área 5 = 2.200 m, e Área 6 = 2.200 m). Os resultados mostram que houve 2.816 indivíduos de planta daninha *Portulaca oleracea*, com a maior densidade encontrada em A 1, seguida de A 2, enquanto em A 5 e A 6, nas plantas daninhas foram registrados. A maior densidade de ervas daninhas estava nos campos de romã, seguido pelos campos de uva. A densidade mais baixa foi encontrada no campo A man. Os resultados deste estudo ajudarão a tomar as medidas necessárias para combater as ervas daninhas e seu manejo em áreas de atividade agrícola, enquanto mais estudos são necessários para levantar a ecologia das ervas daninhas de Taif na Arábia Saudita.

Palavras-chave: ervas daninhas, plantas com flores, biologia, atividades agrícolas.

1. Introduction

Plants of this family are shrubs or crowded weeds which have thick woody short basal stems, the leaves are spirally arranged or sometimes opposite, with simple hairs or spines. There are scales in the leave axils which are often interpreted as stipules. Inflorescences variously cymosely and terminal, rarely clusters. Flowers are mostly bisexual and rarely unisexual. Some genera are cultivated as ornamental plants (*Lewisia*, Heckard and Stebbins, 1974, Portulaca), the leaves of a few species can be eaten as vegetables and roots of (*Lewisia*) were used by Native Americans as a starch source (Carolin, 1993). Portulacaceae comprise 30 genera and about 450 species, is has a special characteristic as its flowers contains two sepals, five withering quick petals, and capsular fruits consisting of usually three consolidate carpels. These properties are mostly responsible for the traditional classification of the family Portulacaceae (Takhtajan, 2009). The contents of chemical components within this family of plants varies

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Received: February 28, 2021 – Accepted: August 18, 2021

according to their types, as they contain many bioactive compounds such as organic acids, alkaloids, glycosides, flavonoids, and others, as well as other chemicals such as urea, phosphorous, iron, calcium, manganese and copper, and also contain fatty acids, especially omega-3, also β-sitosterol, β-sitosterol-glucoside, N,N`- dicyclohexylurea, and allantois being extracted from *Portulaca oleracea* (Portulacaceae) (Rasheed et al., 2004). There is an old debate between scientists and researchers over the concept of the Portulacaceae family, where two concepts of the family are proposed: the first is a narrow concept that includes the genera of current Portulacaceae and Basellaceae, while the other concept is broader, some genera of present families such as Aizoaceae, Caryophyllaceae, and Molluginaceae were added to Portulacaceae. However, the narrow concept of the family was later adhered to (Nyffeler and Eggli, 2010). New studies of molecular phylogenetic have shown that the genera *Dendroportulaca* Eggli and *Pleuropetalum* Hook which were classified in the family Portulacaceae, actually are represented in family Amaranthaceae despite the difference in the type of fruits in this genera, while the genera *Calyptrotheca* Gilg is included in the family Didiereaceae, which was previously included in the family Portulacaceae (Applequist and Wallace, 2003). The first suggestion for sub-classification of the family Portulacaceae was by Franz (1908), he divided it into two subfamilies, and each was further divided into two tribes and four subtribes, using the morphological characteristics of the parts of the flower, then Pax and Hoffmann (1934), modified this classification through separating the tribe Baselleae of subfamily Montioideae as a separate family. There should be further investigation for the morphological characteristics and studies resulting from the molecular genetics of the family Portulacaceae to accurately identify the taxa derived from it according to the phylogenetic relationships resulting from molecular genetic analyzes, as dividing the family into two does not serve the systemic cultivation in the long term. So it is necessary to work for a classification that better reflects the phylogenetic hypothesis to reach the taxonomic stability through the compatibility between taxon delimitation of the family and the well-supported monotype groups of extant species (Nyffeler and Eggli, 2010). Studying the composition of the weed community and its characteristics is an important element for developing a plan for managing weeds, as Majrashi and Khandaker (2016) stated, 50% of annual agricultural products worldwide were lost to weeds, where losses of more than 20% were recorded in developed countries and 10% in less developed countries. Studying the distribution of weeds in a particular area helps in determining the best methods for controlling and managing them effectively, and it also helps to know the extent of their impact on the different agricultural activities in this area (Pimentel et al., 2005).

Weed abundance is the geographical distribution of their species and studying their biological life cycle to understand the species is termed nature (Majrashi et al., 2018). Weeds are studied in order to understand the nature of their growth, distribution and abundance in a particular region and to know the extent of their impact on the agroecosystem (Enninful, 2019). There are a few species of plants in the Kingdom of Saudi Arabia that tolerate difficult environmental conditions, where there are high temperatures and severity of drought. Some plants can adapt to these conditions and have the ability to survive, while others can not tolerate the conditions and die. One of the clear characteristics of plant formation in Saudi Arabia, is that a few important plant families are represented by only one or two species, which makes it easier for researchers to study these families (Fakhireh et al., 2012). Accurate estimation of weed numbers in a given area is important for studying plant biological diversity and selecting appropriate agricultural practices (Marshall et al., 2003). Taif, with a total preserved area for agricultural activities of more than 594 000 hectares, is famous for its good vegetation cover and agricultural activities among the communities of Saudi Arabia.

This study aimed to conduct research through a survey of the Portulacaceae family in the Taif region of Saudi Arabia. We understand that there have been no studies carried out on this family in Taif. We hope the research results help to solve issues related to managing weeds toward sustainable agricultural in Saudi Arabia.

2. Materials and Methods

The study area is in Taif, Saudi Arabia (Figure 1) located on the Sarwat Mountains eastern slopes at the altitude of 1700 m above sea level. Slopes of the Mountains with increases toward the head to the south and west up to the level of 2500 m, located between 20-22° N and 40-42° E.

Taif is famous for its gardens, fruit and vegetable farms and aromatic flowers. It is known in the summer period for its many fruits, including berries, pomegranates, grapes, dates, peaches, and other seasonal fruits, with a total preserved area for agricultural activities of more than 594 000 hectares.

This study was carried out at the mountainous area at different elevation levels from the surface of the sea (Area 1 = Al sail 1700 m, Area 2 = Al Wahat and Al Watit 1500 m, Area 3 = Leeih 1500 m, Area 4 = AL Gaim and Saisad 1500 m, Area 5 = Al Shafa 2200 m, and Area 6 = AL Hada 2200 m) (Table 1).

A weed survey was conducted in different areas of Taif between 2018 and 2020. Samples of weeds were collected and prepared for further identification and deposition in the Taif University weed herbarium, Taif, Saudi Arabia. Weeds were collected in the areas where they were growing. Six separate areas at Taif in Saudi Arabia were selected for the study. The extent of crop infestation by weeds and the level of density of different weeds were based on random observations. The results of the Mandarille (1990) study were used as a reference point to identify weed species (Figure 2).

3. Data Analysis

Data were collected from different areas of Taif and converted to $\log^{+1}$ prior to statistical analysis and further subjected to one-way ANOVA means were tested for

Figure 1. Map of location for six areas in Taif city (Saudi Arabia).

Table 1. Areas of study and their elevation.

No.	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6
Area Name	Al Sail	Al Wahat and Al Watit	Leeih	AL Gaim and Saisad	Al Shafa	Al Hada
Elevation	1700 m	1500 m	1500 m	1500 m	2200 m	2200 m

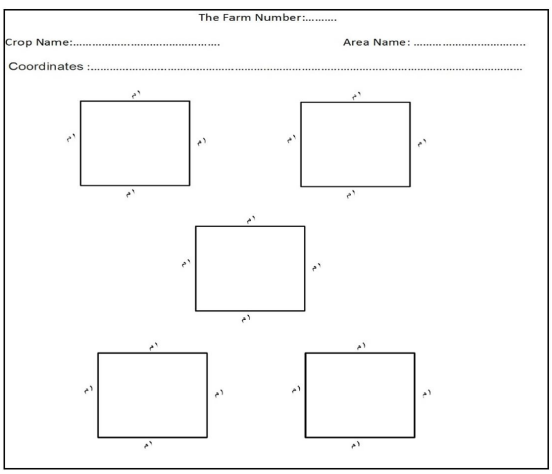

Figure 2. Experimental design and quadrat arrangement of weeds in Taif crops at six areas.

significant difference. Data with significant difference were further subjected to t-tests. A similar analysis was used previously by Juan et al. (2010) and Besaw et al. (2011).

4. Results

The results in the region under study showed that there were a total of 2,816 individuals of *Portulaca oleracea* L weeds (Table 2 and Figure 3), the largest number of weeds was in Area 1 (Al Sail) with 947, followed by Area 2 (Al Wahat and Al Watit) with 912, then Area 4 (AL Gaim and Saisad) and Area 3 (Leeih) with 697 and 260 respectively. There were no weeds found in Area 5 (Al Shafa) and Area 6 (AL Hada).

The study similarly documented 12 agricultural crops from the study area; A man (*Portulaca oleracea* L.), Common fig (*Ficus carica* L.), Date palm (*Phoenix dactylifera* L.), Courgette (*Cucurbita pepo* L.),

Table 2. Weed number of *Portulaca oleracea* L. documented in Taif, Saudi Arabia.

Species Name	Weed Number						Total
	Area 1 Al sail 1700 m	Area 2 Al Wahat and Al Watit 1500 m	Area 3 Leeih 1500m	Area 4 AL Gaim and Saisad 1500 m	Area 5 Al Shafa 2200 m	Area 6 AL Hada 2200 m	
Portnlaca oleracea	947	912	260	697	0	0	2816

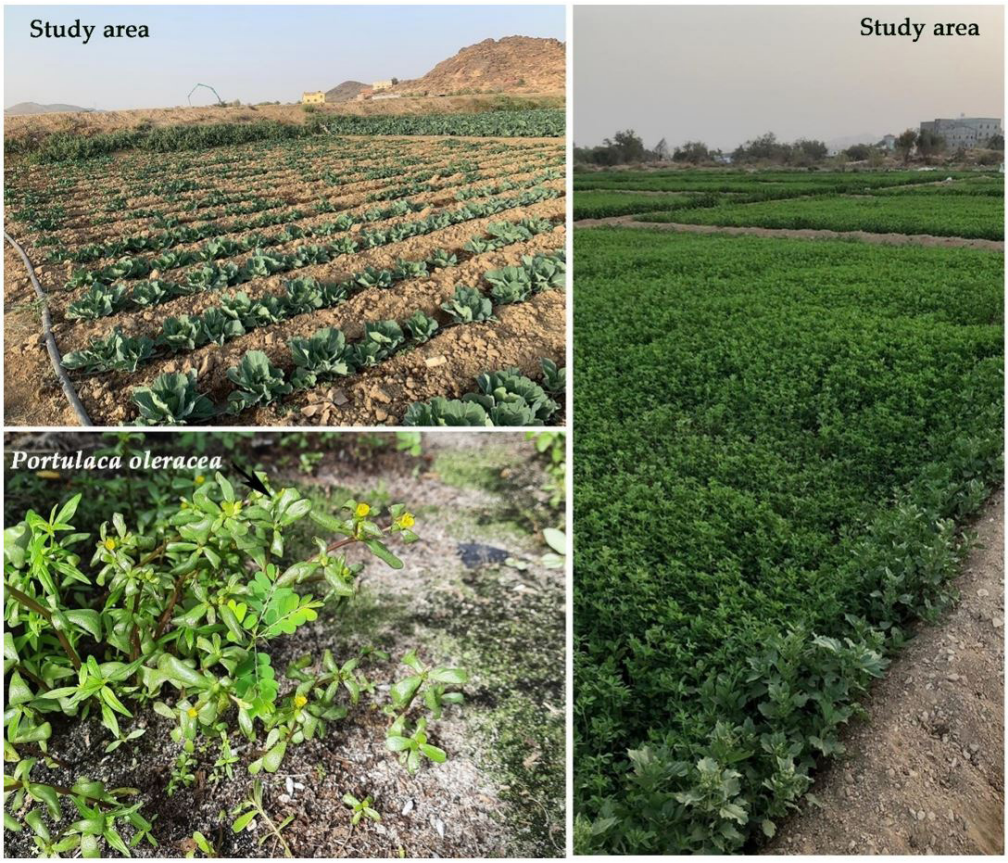

Figure 3. The study area of Taif, Saudi Arabia and identified weed species *Portulaca oleracea* in the agriculture crop field of study area.

Tomato (*Solanum lycopersicum* L.), Pomegranate (*Punica granatum* L.), Parsley (*Petroselinum sp* L.), Grape (*Vitis spp.* L.), Lettuce (*Lactuca sativa* L.), Mint (*Mentha sp.* L.), Cauliflower (*Brassica oleracea var. botrytis* L.) and Radish (*Raphanus sativus* L.) as shown in (Table 3).

Table 3 shows the density of weeds in the various vegetable fields in the Taif region of the Saudi Arabian Peninsula. From the Area 1 survey, the highest weed density of 255 was reported for Date Palm, followed by Cauliflower, Courgette, Pomegranate at 226, 163 and 91 respectively. The lowest density of weeds was among the Grape and Lettuce crops where no weeds were found. From the Area 2 survey, the highest weed density of 334 was reported for Grape, followed by Common fig, Pomegranate and A man at 233, 224 and 50 respectively. The lowest density of weeds was in Date Palm, Tomato, Cauliflower and Radish crops where no weeds were found. From the Area 3 survey, the highest weed density, 54, was reported for Grape, followed by Courgette, Tomato and Lettuce at 48, 40 and 31 respectively. From the Area 4 survey, the highest weed density, 157 was reported for Lettuce, followed by Pomegranate, Mint and Cauliflower at 150, 136 and 75 respectively. For both Area 5 and 6 no weeds were found.

Also, Table 2 shows that the highest weed number was documented among the Pomegranate crop with 465, followed by Grape and Date Palm at 398 and 305 respectively. While the lowest weed number was documented for Radish and A man with111 and 78 respectively. From the same table it is clear that the highest weed numbers were found in Area 1 (947) followed by Area 2 (912), Area 3 and 4 recorded 260 and 697 respectively, while no weeds were recorded in Area 5 and 6.

Table 3. Agricultural crops documented in six areas from Taif, Saudi Arabia Peninsular.

Agricultural Crop		Weed Number						
Species Name	English Name	Area1 (Al sail 1700 m)	Area 2 (Al Wahat and Al Watit 1500 m)	Area 3 (Leeih 1500m)	Area 4 (AL Gaim and Saisad 1500 m)	Area 5 (Al Shafa 2200 m)	Area 6 (AL Hada 2200 m)	Total
Portulaca oleracea	A man	6	50	17	5	0	0	78
Ficus carica	Common fig	20	233	25	14	0	0	292
Phoenix dactylifera	Date palm	255	0	0	50	0	0	305
Cucurbita pepo	Courgette	163	6	48	0	0	0	217
Solanum lycopersicum	Tomato	82	0	40	15	0	0	137
Punica granatum	Pomegranate	91	224	0	150	0	0	465
Petroselinum sp.	Parsley	36	10	23	40	0	0	109
Vitis spp.	Grape	0	344	54	0	0	0	398
Lactuca sativa	Lettuce	0	26	31	157	0	0	214
Mentha	Mint	34	19	0	136	0	0	189
Brassica oleracea var. botrytis	Cauliflower	226	0	0	75	0	0	301
Raphanus sativus	Radish	34	0	22	55	0	0	111
Total		947	912	260	697	0	0	2816

5. Discussion

The world is witnessing ecological changes that necessitate providing food security for humans and preserving the cultivated areas to produce crops needed to meet these needs. The researcher's aims from this study on weeds is to understand the nature of growth, density and distribution of weeds in a specific area. The abundance of weeds affects the agricultural ecosystem. Overcoming the competition of weeds for water and nutrients in the soil with important crops is important for production. Reducing weed problems such as disease transmission, competition for nutrients and water, low crop yields and increased production costs is one of the main tasks of studying the distribution of weeds. In this study we try to provide useful information by surveying the Portulacaceae family of Flora in the Taif region of the Kingdom of Saudi Arabia in six different areas and elevations. The diversity and density of vegetation cover and development in the Kingdom of Saudi Arabia is closely related to the topography and landform (Fakhireh et al., 2012). Most plant species in the Kingdom of Saudi Arabia are distinguished by belonging under a small number of plant families, which makes it easier for researchers to understand their nature and deal with them appropriately (Al Nafie, 2008). The intense human activity during the past few years has directly affected the green areas in all regions of Saudi Arabia, as it has led to a change in vegetation cover in terms of diversity and density (Moawed, 2016). On the other side, (Juraimi et al., 2010) mentioned that weed populations in an area are affected by surrounding environmental conditions and with passage of time, weed floristic composition changes, because weed communities are a complex ecological structure.

Weeds are considered one of the enemies of basic crops as they invade cultivated areas and compete with crops for water and nutrients and cause great losses in yield. Many researchers have studied the effects of weeds on crops in specific areas. In a similar study, Ali and Khandaker (2020) documented the weed composition in relation to different altitudes in the Taif Saudi Arabia Peninsular in association with agricultural crops. Some weeds were identified in the area and the necessary information was provided for weed management and control. The weed species cause serious damage to important agricultural crops cultivated in an area with these damages differing from one crop to another (Johnson et al., 2009). Weeds are considered pathogens and insects, directly or indirectly, because they cause infectious diseases and harm agricultural crops, and also compete with crops for nutrients and water in the soil (Jabran et al., 2015). Weeds cause significant losses in agricultural products around the world, as they damage some of these products (Majrashi and Khandaker, 2016). The presence of weeds in crop fields is undesirable, the weed management plan depends on knowing weed species, especially the method of growth and density of each species found in the field (Krueger et al., 2000). Crop yields are severely affected by the presence of weeds, as Zimdahl (2018) mentioned that losses due to weeds can be more than 40% of yield. Iyagba (2010) argued that less developed countries lose at about 30% of crop yields because of weeds. There is a dense population of multiple types of weeds like Amaranthaceae, Asteraceae, Boraginaceae,

Cyperaceae, Poaceae, Convolvulaceae, Chenopodiaceae, Malvaceae, Papaveraceae, and Solanaceae in the Taif region. This is despite the change of intense human activities to the vegetation cover in that region (Abdullah et al., 2017). Studying the distribution and density of weeds in a particular area leads to knowing the best ways to manage and control them, leading to a greater benefit from the cultivated area (Abdulrahman et al., 2018a). The density of weeds in an area is related to the different characteristics of the soil in terms of soil fertility, composition and other soil characteristics (Girish et al., 2003).

The weed species and their density are affected by the different environmental conditions in the same area through the difference of time in the past and present, as the weed species differ according to those conditions and also according to the type of crops grown in same area (Balasubramanian and Karthikeyan, 2016). On the other hand (Juraimi et al., 2010) mentioned that the weed floristic composition of an area may change over time because of its complex ecological population communities. An understanding of the weed community and its density in a region is necessary for effective weed management (Majrashi et al., 2014). In Saudi Arabia, Emad and Fadl (2016) studied plant diversity in the Taif region, specifically Al Shafa area, through studying, they reported that, the floristic composition, life forms, and chorological categories of species and noted the presence of a great diversity of plant species in this area compared to many other areas. Allowing weed to grow in cultivated lands during crops development leads to poor development and less production, clearing fields through agricultural practices, that protect crops from weed attack, and the method of agricultural practices in an area with one or more species of weeds may reduce or increase the presence of these weeds. Therefore, agricultural practice method must be followed that will reduce the presence of weeds (Holzschuh et al., 2008). Aggressive weed species in a region threaten agricultural activity and crops, leading to environmental, social and economic damage. Therefore, attention must be given to follow a successful strategy to manage weeds and to avoid the problems that exist in the basic crops resulting from the presence of weeds (Ali and Khandaker, 2020). Human activity such as overgrazing and wood cutting affects vegetation cover in arable lands in the Kingdom of Saudi Arabia. The density of plants varies according to different human practices, as vegetation increases with decreasing human activities and decreases with increasing activity. These human practices must be controlled to maintain the density of vegetation cover (Osman and Abdein, 2019). Some chemical properties of crop plants enable us to use small amounts of herbicides) Alam et al. (2018), but the use of bio-pesticides remains safer for the environment and human health.

6. Conclusion

From the results of this study, it can be concluded that the species of family Portulacaceae weeds differ in density at different elevations in the Taif region in the Kingdom of Saudi Arabia, and also by the different crops being cultivated. Some areas recorded a high density of weeds and some areas had medium density, while other areas did not record the presence of weeds. This study provides useful information for taking necessary measures to manage weeds in the area. More studies are needed on the demography and environment of weeds.

Acknowledgements

We would like to thank Taif University, Taif, Saudi Arabia for supporting this project number (TURSP-202-/110), and facilitating the research and publication support of this manuscript.

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