

Full Length Research Paper

Morphological variation in *Heliotropium digynum* growing in four locations of the central region of Saudi Arabia

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Accepted 6 February, 2013

This study was carried out to compare the morphological features of the floral and shoot systems of *Heliotropium digynum* that were collected from different locations in the central region of Saudi Arabia. *Heliotropium digynum* is a member of Boraginaceae family. The plant is a shrub that has an ecological importance. The height of the plant differs from one population to another and the difference in length of the inflorescences can be attributed to environmental factors, such as rainfall or type of soil and temperature. These plants can grow in different temperature zones (including temperate and warm), and in arid regions, flourishes greatly, in terms of height, spread, leaf area, length of inflorescences, number of flowers, and speed of development, when it grows in sandy soil disturbed by human activity, species or individuals compared to specimens growing on hard soil and frequented by the public.

Key words: *Heliotropium digynum*, morphological features, inflorescences.

INTRODUCTION

Heliotropium digynum, a member of Boraginaceae family, is an erect perennial shrub, reaching a height from 30 to 50 cm above the ground. The growth of the plant, as well as its size, length of inflorescence, and speed of development, depends on the amount of rain in its habitat. The study by Forssk (1877) is regarded as the first work mentioning the presence of the genus *Heliotropium*, in the Arabian region. It normally grows in areas with deep sand, and is found in north and north east Africa, the Arabian Peninsula, and some other areas of the Middle East (Chaudhary, 2001). In Saudi Arabia, it is found in the form of scattered families spread in the Hijaz region, and in the south region. It is also found in some areas of central Saudi Arabia such as Kharj, Muzahimiyah, Dir'iyyah, Zufi, Unaizah and Rimah.

The plant is a shrub that has an ecological importance. It is regarded as a grazing plant, as indicated by Guenther (2005), a fodder plant (Peacock et al., 2003), and a medicinal plant (AL-Degwy, 1996). It can withstand

arid conditions (Al-Yemeni and Zayed, 1999) and is one of the components of the floral cover of the Thumamah area 90 km from Riyadh proximal to (Nufud Banban), Al-ammariah area 20 km north west of Riyadh (Al-Yemeni, 2000), as well as the Al-kharj area which is south east of Riyadh, specifically in the arid expanses of that area (Al-Yemeni, 2000).

Morphological variations are one of the first criteria used for describing, classifying and studying differences between and within species (Stace, 1980). Hence, this leaf deals with those parameters of *H. digynum* specimens collected from different locations of the central region of Saudi Arabia to highlight the variations specimens.

MATERIALS AND METHODS

Specimens of *H. digynum* were collected from their natural habitat at an average of five specimens per chosen location, and given numbers and symbols to distinguish them, as follows: Dirab (numbers 1 to 5 and the symbol D); Dir'iya (numbers 1 to 5 and the symbol Dr); Al-kharj (numbers 1 to 5 and the symbol K); Rumah (numbers 1 to 5 and the symbol R).

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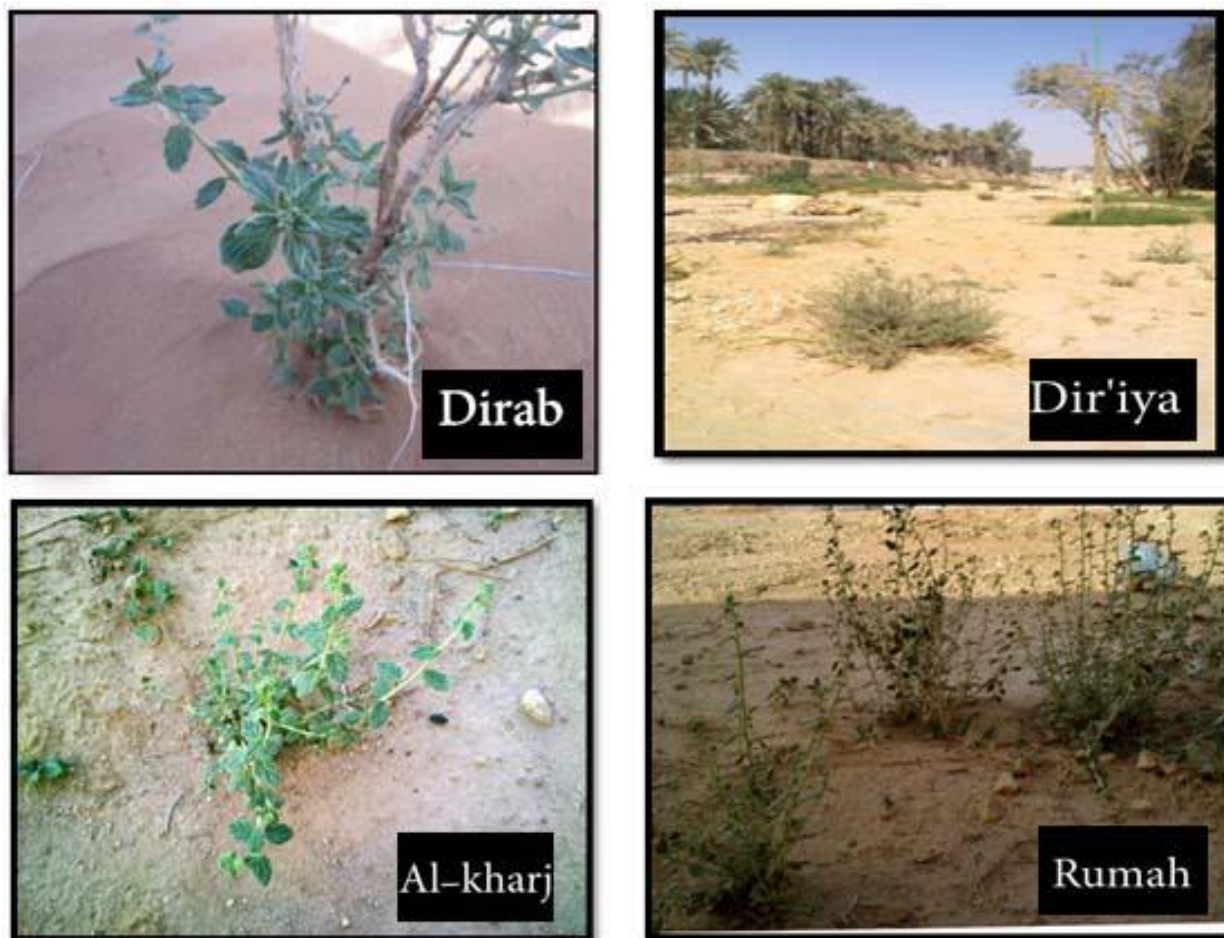


Figure 1. Pictures of *H. digynum* growing in the four locations in the central region of Saudi Arabia.

The morphology of the shoot system, including the stem and leaf of each species, was inspected. Specifically, the shape of the blade was inspected, as well as its base and tip. Besides measuring the dimensions of the blade and determining leaf distribution on the stem as well as leaf venation, also inspected were the inflorescence, the axil, the density of flowers on the axil, the length of the sepals, and the length of the petals. All results and notes were recorded, and shapes were drawn for the different parts of each plant belonging to different specimens .

RESULTS AND DISCUSSION

Biological types and nature of growth

H. digynum can be described as an herbaceous, perennial plant, with a thick hispid indumentum. Figure 1 shows the plant growth in the four locations.

The height of the plant differed from plant samples to another of the same type. As shown in Table 1, the specimens from the Dirab and Al-kharj areas had the highest height, reaching 60 cm, followed by by Dir'iya and Rumah reaching 40 and 35 cm, respectively. A

connection was noticed in this study between the growth of the plant, its size, the length of its inflorescences and the speed of its development, on one hand, and the amount of rainfall in its habitat and the type of soil, on the other. The plant was on its optimal in sandy soil (Rajendra et al., 2011).

The stem

The stem of *H. digynum* was cylindrical in shape and covered by in a thick hispid indumentum, differing in roughness from one population to another. The stem which appears solid was branched and carried alternative leaves. All stems grew erect (Figure 2).

The leaf

Table 1 shows that the leaves were simple, entire and extipulate. They were also petioled and covered by hairs, varying in thickness in accordance with the habitat. The

Table 1. The location, the height, and the Dimensions of the leaves of *H. digynum* specimens collected from the central region of Saudi Arabia.

Area	Specimen number	Location (GPS)			Height of plant (specify) (cm)	Leaf (specify)	
		Latitude (North) (°)	Longitude (east) (°)	Elevation (m)		Width (mm)	Length (mm)
Dirab	D1	24.40952	46.53782	636	60	3.5	2
	D2	24.40902	46.53720	636	57	0.6	1.6
	D3	24.40985	46.53782	641	59	1.1	1.2
	D4	24.41099	46.53845	625	61	1.1	1.6
	D5	24.41181	46.53971	631	60	1.3	1.7
Dir'iya	Dr1	24.4413	46.3712	643	40	1.9	2.4
	Dr2	24.4553	46.3274	620	44	1.5	2.4
	Dr3	24.4352	46.3419	637	41	1.3	2
	Dr4	24.6544	46.5311	637	45	1.8	2.8
	Dr5	24.9231	46.7823	637	47	1.2	1.9
Al-kharj	K1	24.1524	47.2907	626	59	1.1	2
	K2	24.1532	47.2990	626	61	1.4	2.2
	K3	24.1557	47.3033	621	60	1.5	2.4
	K4	24.1587	47.3050	621	57	1.8	3
	K5	24.1590	47.3055	619	58	1.5	2.3
Rumah	R1	25.5540	47.1615	626	39	1.5	2.3
	R2	25.5542	47.1623	625	40	1.2	2.6
	R3	25.5547	47.1605	627	37	1.4	2.8
	R4	25.5551	47.2966	627	37	1.1	2.4
	R5	25.4901	47.2967	627	39	1.6	2.,2



Figure 2. Stem of *H. digynum*.

blade was elliptical with an undulate edge. The tip of the blade was acute while the base was cuneate. The leaves

were distributed alternately on the stem and were invariably solitary (Figure 3).



Figure 3. Leaves of *H. digynum*.



Figure 4. Inflorescence of *H. digynum*.

Inflorescences

The inflorescence of the plant represents ebracteate, bisexual plants. All inflorescences were sessile, dissymmetrical and hypogaeous (Figure 4).

Calyx

The calyx was persistent in type and was comprised of five sepals separated at the base or slightly higher. They were elliptical in shape while their apex was obtuse. The edge of the sepal was invariably entire. The sepals were covered in rough hairs (strigose) from the outside, but were smooth or glabrous from the inside. Their color was the same as the plant itself. Regarding their length, and

as shown in Table 2, it varied from one individual to another in the same species. It fluctuated between 2.98 to 4.49 mm (Figure 5).

The corolla

The corolla was comprised of five fused (tubular) petals, with the length of the corolla tube varying from one individual to another (4.94 to 6.04 mm) as shown in Table 2. They were yellow in color with white tips (Figure 5).

The androecium

The androecium consists of five epipetalous stamens that

Table 2. The features of the flowers of *H. digynum* specimens collected from the central region of Saudi Arabia.

Area	Specimen number	Flower part		
		Calyx (mm)	Corolla (mm)	Inflorescence (cm)
Dirab	D1	3.3	5.3	1.83
	D2	2.98	4.94	1.77
	D3	3.97	5.09	1.98
	D4	3.4	5.3	2.48
	D5	3.8	5.28	2.6
Dir'iya	Dr1	4.49	6.06	2.31
	Dr2	3.13	5.16	2.02
	Dr3	4.02	5.2	2.01
	Dr4	5.37	5.3	2.02
	Dr5	4.13	5.37	2.38
Al-kharj	K1	4.38	6.03	2.28
	K2	3.4	5.3	2.13
	K3	4.28	5.3	2.04
	K4	4.06	5.39	2.45
	K5	3.16	5.51	2.37
Rumah	R1	4.3	6.04	2.34
	R2	3.35	5.39	2.16
	R3	4.29	5.38	2.13
	R4	4.11	5.5	2.46
	R5	3.25	5.5	2.39

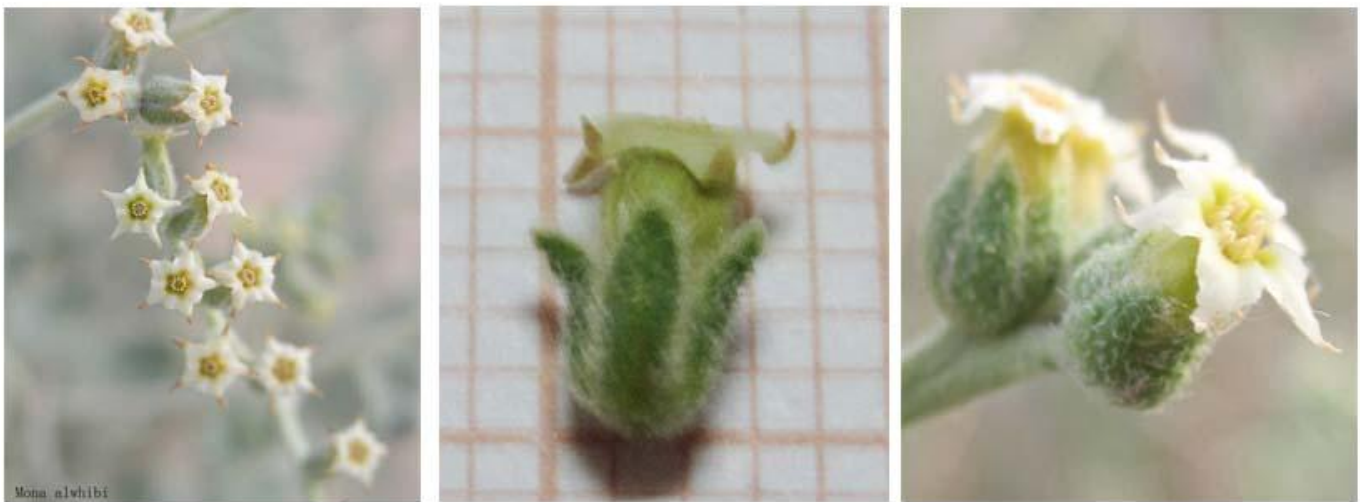


Figure 5. Calyx and corolla of *H. digynum*.

contain no apparent filament, showing only a beak shaped anther lobe that was fixed into center of the corolla tube from the inside. The length of the stamens varied from 1 to 2.5 mm.

The gynoecium

The gynoecium consists of two completely fused (syncarpous) carpels. Each carpel consists of a two

Table 3. Results of the analysis (one way ANOVA) for differences between sites with regard to the high plant.

Dimension	Group	Sum of square	Degrees of freedom	Mean square	F value	Prob>F
Plant height	Between	1737.4	3	579.12	155.468	.000
	Within	59.6	16	3.725		
	Total	1797	19			
Length of leaf	Between	0.098	3	0.033	0.088	0.966
	Within	5.964	16	0.373		
	Total	6.062	19			
Width of leaf	Between	2.23	3	0.743	7.217	0.003
	Within	1.648	16	0.103		
	Total	3.878	19			

Table 4. Test least significant difference (LSD) of the differences between plant height in different locations.

Location	N	SMA	SD	Dirab	Dir'iya	Al-kharj	Rumah
Dirab	5	59.4	1.52	-			
Dir'iya	5	43.4	2.88		-		
Al-kharj	5	59	1.58			-	
Rumah	5	38.4	1.34	**0.001	**0.001	**0.001	-

chambered ovary, with each chamber carrying one ovule in a basal-placentation position. The style was absent, therefore the stigma was sessile.

Analysis of the results using statistical analysis (SPSS)

There were statistically significant differences between the plant height, leaf length and leaf width in different locations. One way analysis of variance (ANOVA) test was used as evidenced in Table 3.

Plant height

Table 3 shows that there were statistically significant differences between the mean plant heights in different locations, as the value of the significance level (0.000). To find out the direction of the differences in favor of any of the sites, least significant difference (LSD) test was used (Table 4).

Table 4 shows the results of comparisons *posteriori* the average plant height in different locations. It is clear from the results that the differences in plant height was between plant location Rumah and plant sites (Dirab, Dir'iya and Al-kharj), and for Dirab plants, average height was 59.4 cm (Figure 6).

Leaf length

There were no statistically significant differences between

the average length of the leaf different sites (Table 3); the value of the significance level was 0.699, a value greater than 0.05. The previous result indicates convergence length of the leaf with both sites (Dirab, Dir'iya, Al-kharj, Rumah).

Leaf width

There were some differences between the mean width of the leaf in different locations (Table 3); the value of the significance level was 0.003. To find out the direction of the differences in favor of any of the sites, least significant difference (LSD) test was used (Table 5).

Table 4 shows the results of comparisons *posteriori* the averages of the leaf in various locations. It is clear from the results that the differences in the presentation of a leaf plant came between plant site Dirab and plant both sites (Diriyah, Al-Kharj and Rumah), and for plant location Rumah, an average leaf displayed 2.46 mm, and the previous result indicates that the plant location of Rumah leaf were wider than for the other sites (Figure 7).

These results are in agreement with those of previous reports (Chaudhary, 2001; Boulos, 2000; Thomas, 1997), whereas the results for the measurements of flower parts were similar to the results of Jongbloed (2003), Chaudhary (2001) Mandaville (1990) and Migahid (1974). The difference in length of the inflorescences can be attributed to environmental factors, such as rainfall or type of soil, noting that as the inflorescence growths in length it becomes sticky, supposedly serving the purpose

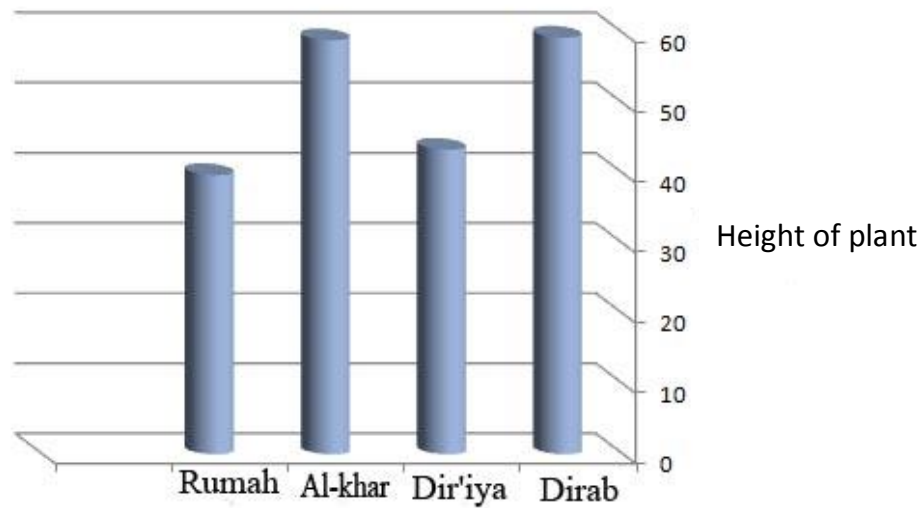


Figure 6. Average plant height (cm) in different locations.

Table 5. Test least significant difference (LSD) of the differences between the leaf different sites.

Location	N	SMA	SD	Dirab	Dir'iya	Al-kharj	Rumah
Dirab	5	1.62	0.29	-	0.004**	0.002**	0.001**
Dir'iya	5	2.3	0.36		-		
Al-kharj	5	2.38	0.38			-	
Rumah	5	2.46	0.24				-

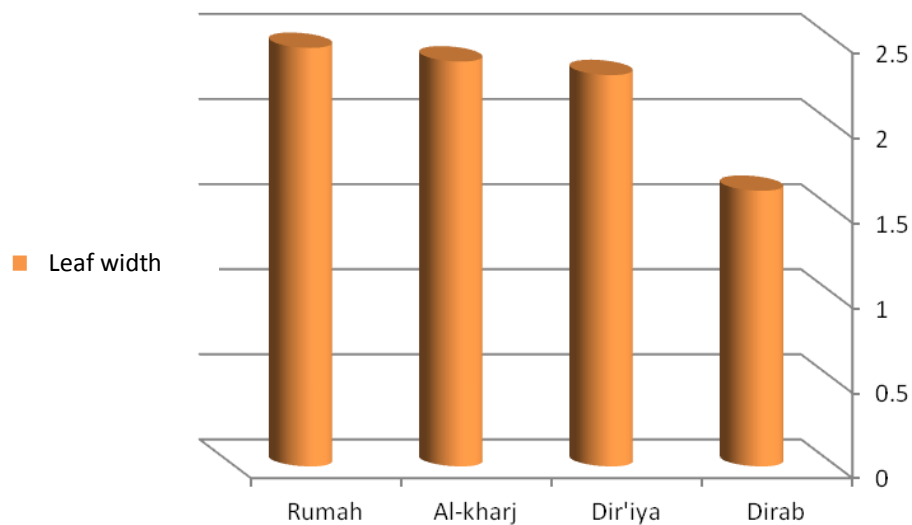


Figure 7. Average width (cm) of the leaf for different sites.

of pollination (Chaudhary, 2001; Boulos, 2000). The length of the inflorescence can also be influenced by other factors, including temperature. Worth mentioning is that these plants can grow in various temperature zones

(including temperate and warm), and in arid regions, leading to differences in inflorescence length, as referred to by others (Park and Pearson, 2000; Thomas, 1997).

It was also noticed during the collection of the specimens

that the plant flourishes greatly, in terms of height, spread, leaf area, length of inflorescences, number of flowers and speed of development, when it grows in sandy soil disturbed by human activity that is normal stretches of garbage land abundant in carcasses and dead birds, compared to specimens growing on hard soil and frequented by the public. This could be due to the fact that this decompose enriches the soil organically. The studies of Zahran and Willis (1992), Wojterski (1985), Frankenberg and Klaus (1980) and Batanouny (1979) indicated similar observations and emphasized that the species of *Heliotropium* are generally regarded as "ruins" plants that grow better in soil that is rich in dead bones.

ACKNOWLEDGEMENT

This research project was supported by a grant from the Research Center of The Center For Female Scientific and Medical Colleges in King Saud University.

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