

Studies on *Heliotropium* in Saudi Arabia

Shaukat A. Chaudhary

National Herbarium, Regional Agriculture and Water Research Center,
Ministry of Agriculture and Water, P.O. Box 17285 Riyadh, Saudi Arabia

ABSTRACT. Sixteen taxa of *Heliotropium* (Boraginaceae) in Saudi Arabia are described. They are: *H. aegyptiacum* Lehm., *H. arbainense* Fres., two subspecies of *H. bacciferum* Forssk., *H. bouae* Deff., *H. crispum* Desf., *H. curassavicum* L., *H. digynum* (Forssk.) Asch. ex C. Christ., *H. europaeum* L., *H. longiflorum* (Hochst. & Steud. ex DC.) Jaub. & Spach, *H. ovalifolium* Forssk., *H. pterocarpum* (Hochst. & Steud. ex DC.) Jaub. & Spach, *H. strigosum* Willd., *H. subulatum* (DC.) Vatke, *H. sp. A* and *H. sp. B*. Four other species which may be present in Saudi Arabia are discussed.

Heliotropium comprises about 275 tropical and temperate species of which probably 20 species (15 described in this paper) are present or may be expected in Saudi Arabia. There has been a lot of confusion about the status or names of the taxa present in Saudi Arabia. The commonest species is *H. crispum* Desf. which, in the past, was often called *H. bacciferum* Forssk. or *H. ramosissimum* (Lehm.) DC. Similarly *H. arbainense* Fres. was identified as *H. hirsutissimum* Grauer; and *H. subulatum* (Hochst. ex DC.) Vatke as *H. zeylanicum* (Burm. f.) Lam.! Saudi material for *H. dolosum* De Not (in an unpublished list of I.S. Collenette) has not been seen by the author; it is just like *H. europaeum* L. but has a short-conical stigma and glabrous nutlets. Because of the possibility of their presence in Saudi Arabia (but not seen by the author), *H. hirsutissimum* Grauer, *H. rariflorum* Stocks, and *H. supinum* L. are included in the key below. *H. kassasii* Täckh. & Boulos has characters within the range of variation in the material of *H. pterocarpum* (Hochst. & Steud.) Jaub. & Spach with which it is merged in the present treatment. *H. fruticosum* L. (listed by De Marco and Dinelli) should be placed under *Echiochilon* and not *Heliotropium*. It has not been possible to find out the identity of *H. sp. A* & *B* which are so called pending further studies. *H. eritri-*

chioides Kotschy from 'Asir' ('no precise locality, collected by an unknown German physician'; fide Schwartz) has not been seen nor included in the present work.

The species here are arranged in alphabetic sequence because the primary objective of this study was to find out or confirm the identities of *Heliotropium* taxa from Saudi Arabia; no effort was made to study their inter-relationships. Identification of the material was carried out mostly at the Royal Botanic Garden, Edinburgh, while material from Saudi Arabia in the herbaria at the Royal Botanic Gardens, Kew and the British Museum (Natural History), London was also consulted. The study is mostly based on the material present at the National Herbarium of Saudi Arabia (RIY), Regional Agriculture and Water Research Center, Riyadh. The numbers cited are RIY numbers (except where otherwise stated) of representative specimens.

Heliotropium L., Sp. Pl. 130. 1753

Annuals or perennials, rarely glabrous, usually hairy or scabrous-hairy herbs or undershrubs with alternate leaves. Inflorescence of short or long, axillary and or terminal, usually branched, spicate cymes. Flowers small, bracteate or ebracteate, white or yellowish or bluish (not in our area), bisexual. Calyx of 5 sepals, free or basally united, sometimes two of the sepals fused to above their middle. Corolla 5-lobed, the lobes mostly smaller than the tube; corolla-tube tubular-cylindrical, infundibuliform or fusiform, pubescent on the outside and sometimes inside; corolla lobes acute or obtuse, usually spreading. Stamens mostly included, rarely the anther tips showing above the throat, attached to the corolla tube at the very base or in the middle or near the mouth; anthers acute or rounded at the apex or truncate to retuse. Ovary 4-chambered or incompletely so; style almost obsolete to relatively very long, with a circular 'stigmatic disc'; stigma short or long-conical, shallowly or deeply bifid. Fruit usually of 4 nutlets sometimes united into 2 pairs or single.

Key to the Species

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|---|---------------------------|
| 1. Fruit completely enclosed by the calyx and falling with it. Nutlet one. | * <i>H. supinum</i> |
| 1+. Fruit not completely enclosed by the calyx. Calyx more or less persistent, not falling off with the fruit enclosed. Nutlets 2 or 4. | 2 |
| 2. Plants completely glabrous or almost so. Leaves more or less succulent | 6. <i>H. curassavicum</i> |
| 2+. Plants variously hairy. Leaves not succulent . . . | 3 |

* Possibly present in or doubtful record from Saudi Arabia.

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|---|-----|---------------------------|
| 3. Flowers bracteate, sometimes the bracts much reduced | 4 | |
| 3+. Flowers ebracteate | 5 | |
| 4. Leaves usually 2 cm or longer. Corolla c. 2 mm long, hairy within | | * <i>H. rariflorum</i> |
| 4+. Leaves not exceeding 2 cm, usually shorter. Corolla 2.5-4 mm long, not hairy below the throat . . . | 12. | <i>H. strigosum</i> |
| 5. Corolla hairy within | 6 | |
| 5+. Corolla glabrous within | 7 | |
| 6. Corolla with 5 hairy ribs within, each ending below the throat in a hairy, rigid tooth above each anther. | | * <i>H. hirsutissimum</i> |
| 6+. Corolla otherwise, and without the 5, rigid teeth within | 10. | <i>H. ovalifolium</i> |
| 7. The two posterior calyx lobes fused to above their middle | 11. | <i>H. pterocarpum</i> |
| 7+. None of the calyx lobes fused to above their middle. | 8 | |
| 8. Plants annual | 9 | |
| 8+. Plants perennial with more or less woody base: if apparently annual then corolla lobes very shallow (as in <i>H. longiflorum</i>) | 13 | |
| 9. Nutlets hairy | 10 | |
| 9+. Nutlets glabrous | 11 | |
| 10. Stigma abruptly narrowed from its disc and the stigma lobes long, filiform. Nutlets not margined (nor winged) | 8. | <i>H. europaeum</i> |
| 10+. Stigma short-conical. Nutlets margined or shortly winged at least near the apex | 14. | <i>H. sp. A</i> |
| 11. Nutlets not margined, nor winged | 12 | |
| 11+. Nutlets with prominent margins or wings | 15. | <i>H. sp. B</i> |
| 12. Stigma short conical with a hairy tip, subsessile with a short style. Anther c. 1 mm long | | * <i>H. dolosum</i> |
| 12+. Stigma long conical; style prominent, only a little shorter than the stigma. Anther c. 2 mm long . . | 1. | <i>H. aegyptiacum</i> |
| 13. Corolla tube green (though corolla-lobes white), fusiform (widest at middle and gradually tapering to the two narrow ends): corolla lobes shallow. Nutlets with a triangular, somewhat winged band, narrower than the bulging sides | 9. | <i>H. longiflorum</i> |
| 13+. Corolla tube and corolla lobes white or yellow, not green nor fusiform. Nutlets without dorsal band. . | 14 | |
| 14. Flowers yellow. Stamens inserted at the base of corolla tube. Style obsolete; stigma a small conical protuberance over the circular stigmatic disc . . . | 2. | <i>H. arbainense</i> |

- 14+. Flowers white or yellow. Stamens inserted at middle or at top of the corolla tube. Style prominent or not: stigma prominent, short- or long-conical to fili-form at the tip 15
15. Stamens inserted near throat of corolla tube. Style twice or more than twice the length of stigma . . 16
- 15+. Stamens inserted at the middle of the corolla tube. Style shorter than the stigma 18
16. Flowers yellowish to yellow. Anther truncate or double-pointed (retuse). Corolla tube slightly bulging near the top 17
- 16+. Flowers white. Anther pointed or rounded, neither truncate nor double-pointed (retuse). Corolla tube cylindrical above the calyx level 4. *H. bottae*
17. Corolla lobes attenuate, long, subulate. Nutlets glabrous, tubercled, up to c. 2 mm long 13. *H. subulatum*
- 17+. Corolla lobes not attenuate-subulate. Nutlets larger (up to 6 mm long), hirsute 7. *H. digynum*
18. Nutlets 2, or more or less fused into two pairs, \pm margined. Style short but discernable 3. *H. bacciferum*
- 18+. Nutlets 4, not margined. Style almost obsolete with the stigma sitting on top of nutlets at maturity . . 5. *H. crispum*

1. *Heliotropium aegyptiacum* Lehm., Ind. Sem. Hort. Hamb. 8. 1820: Pugill. Pl. in bot. Hamb. horto occurent. 1828.
= *H. pallens* Del.

Annual decumbent, pubescent herb. Leaves with up to c. 1 cm long petioles; lamina ovate to lanceolate, up to c. 3×1.5 cm, soft-pubescent, entire, acute. Inflorescence of rather lax, spicate scorpioid cymes, up to c. 12 cm long. Flowers white, sessile. Calyx persistent, divided to the base into 5, narrow, c. 2 mm long lobes, shorter than the corolla tube, pilose-hairy, the marginal hairs spreading so that the corolla tube (or the nutlets in fruiting calyx) is visible through the hairs. Corolla c. 4 mm long, the lower 2 mm much narrower than the upper part; lobes spreading, undulate, obtuse. Stamens inserted at about the middle of the corolla tube. Anthers c. 2 mm long, tapering. Stigma long-conical: style shorter than the stigma but prominent in flower. Nutlets 4, glabrous, minutely tubercled, c. 2.5×2 mm, shorter than the lobes of the fruiting calyx.

Saudi Arabia. Southwestern region. Hali-Bin-Yaqoob near Qunfidah, S. Chaudhary 774.

Distribution. Eastern Africa and Southwestern Arabian Peninsula.

2. *Heliotropium arbainense* Fresen., Mus. Senckenb. 1:168. 1834.

Perennial, densely hairy, yellowish-green, low herb with woody base. Leaves with c. 5 mm petioles, ovate to lanceolate, up to c. 3.5 × 1 cm, prominently veined on the ventral face, the veins sunken on the dorsal face, undulate, acute. Inflorescence of short, spicate, scorpioid cymes; the spikes usually c. 2.5 cm long, dense. Flowers yellow. Calyx c. 3.5 mm long, 5-lobed, densely hairy. Corolla up to c. 7 mm long, densely hairy outside; tube 5-ribbed, wider near the top, with 5 undulate lobes. Anthers c. 1.5 mm long, inserted nearer the base of corolla-tube. Stigma almost sessile on the ovary, flattened-conical. Nutlets four, glabrous, tubercled, as long as or shorter than the calyx lobes.

Saudi Arabia. Southwestern region and Asir. Abha-Jizan Road, S. Chaudhary 932; Rajal-al-Maa, S. Chaudhary 918; Near Abha, S. Chaudhary 2015; Asir, west slope, De Marco 3642.

Distribution. Palestine, Jordan, Egypt, Sudan.

Remarks. This plant has often been misidentified as *H. hirsutissimum* Grauer (Pl. Min. Cogn. Dec. 1, 1784) in Saudi Arabia. Most reports of *H. hirsutissimum* from here could possibly be a misidentification of *H. arbainense*. It is an Eastern Mediterranean annual with white flowers (Feinbrun-Dothan 1978). Täckholm described it as yellow-flowered which combined with the brevity of descriptions and a little doubt about the material being annual or perennial might have led to the misdetermination of *H. arbainense* as *H. hirsutissimum*.

3. *Heliotropium bacciferum* Forssk., Fl. Aeg.-Arab. 38. 1775. ssp. *bacciferum* var. *tuberculosum* (Boiss.) Kazmi, J. Arnold Arbor. 51:162. 1970. Fig. 1 = *H. bacciferum* Forssk. ssp. *tuberculosum* (Boiss.) H. Riedl; *H. kotschyi* Bunge; *H. tuberculosum* (Boiss.) Boiss.; *H. undulatum* Vahl var. *tuberculosum* Boiss.

Perennial rigid shrub. Leaves sessile, short, c. 5 mm long, strongly revolute, 1.5-2 mm wide and peg-like, with prominent, white tubercles. Inflorescence of short, terminal or usually paired cymes. Calyx more or less tubular with 5 short rather unequal lobes, the outer-facing lobes with prominent tubercle-based trichomes, the inner ± glabrous, persistent, spreading (and showing unequal divisions of the lobes after dehiscence of nutlets), c. 3 mm long. Corolla white; the tube a little longer than the calyx lobes, hairy on the outside, glabrous inside; corolla-lobes short. Anthers c. 1 mm long, inserted near the middle of the corolla. Stigma conical on a short, rather stout style and reaching above middle of corolla tube. Nutlets fused in two pairs, tubercled, wide margined or prominently winged; the line of separation between the two nutlets in a pair missing or sometimes indistinctly apparent.

Saudi Arabia. Eastern Province. Sine loc., N. Munro 3281; Dhahran, K. Naylor 13 (E), 7777 (RIY).

Distribution. From Morocco to Pakistan. The type of this taxon (not seen) is

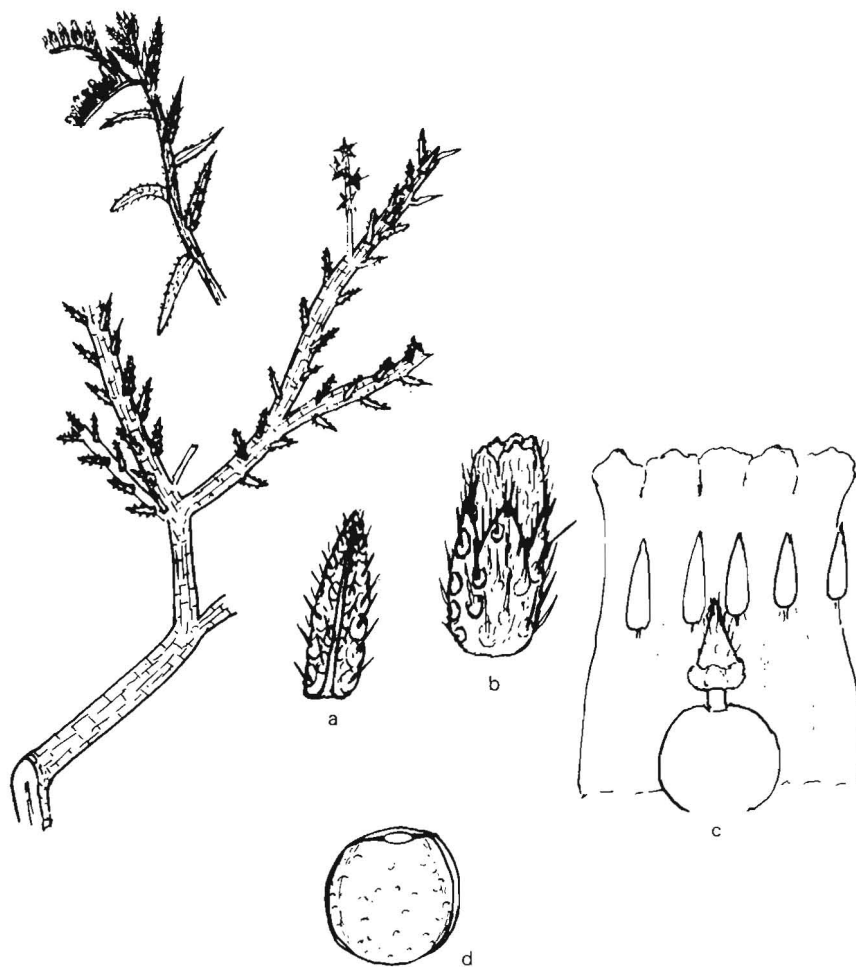


Fig. 1. *Heliotropium bacciferum* Forssk. ssp. *bacciferum* var. *tuberculosum* (Boiss.) Kazmi
 a. Leaf (magnified, ventral view). b. Flower. c. Dissected flower. d. Nutlets.

'Insula Khark in Sinus Persica', Kotschy 22 (W).

Remarks. The name *H. bacciferum* Forssk. has been wrongly used for *H. crispum* Desf. in most works concerning the flora of Saudi Arabia, Egypt, Palestine, etc. *H. bacciferum* as a rule has the nutlets firmly or loosely fused in two pairs and these are margined or winged. *H. crispum* has four non-margined nutlets with variable indumentum.

The subspecies *bacciferum* and *lignosum* (Vatke) Kazmi are quite distinct. In ssp. *bacciferum*, there is no discernable line of separation between the two nutlets in a pair (*i.e.*, the nutlets do not separate at all) and each pair is broadly margined

or prominently winged. The nutlet-pairs in ssp. *lignosum* have a discernable line of separation between nutlets (*i.e.*, the nutlets may separate from each other) and a very narrow, thin margin.

Of the ssp. *bacciferum*, the var. *bacciferum* usually has flat leaves (5-7 mm wide) while var. *tuberculosum* has narrow (2-3 mm wide), \pm peg-like leaves. Var. *bacciferum*, apparently, has not so far been collected from Saudi Arabia.

Of the ssp. *lignosum*, the var. *lignosum* usually has peg-like leaves and a deep line of separation between the two nutlets of a pair. The type for this taxon is Arabia: Ras Ranar, Schweinfurth 2111 (B). Var. *fartakense* (Schwartz) Kazmi has flat (not peg-like) leaves while the line of separation between the two nutlets of a pair is rather shallow.

**3A. *Heliotropium bacciferum* Forssk. ssp. *lignosum* (Vatke) Kazmi var. *fartakense* (O. Schwartz) Kazmi, J. Arnold Arbor. 51:163. 1970. Fig. 2
= *H. fartakense* O. Schwartz**

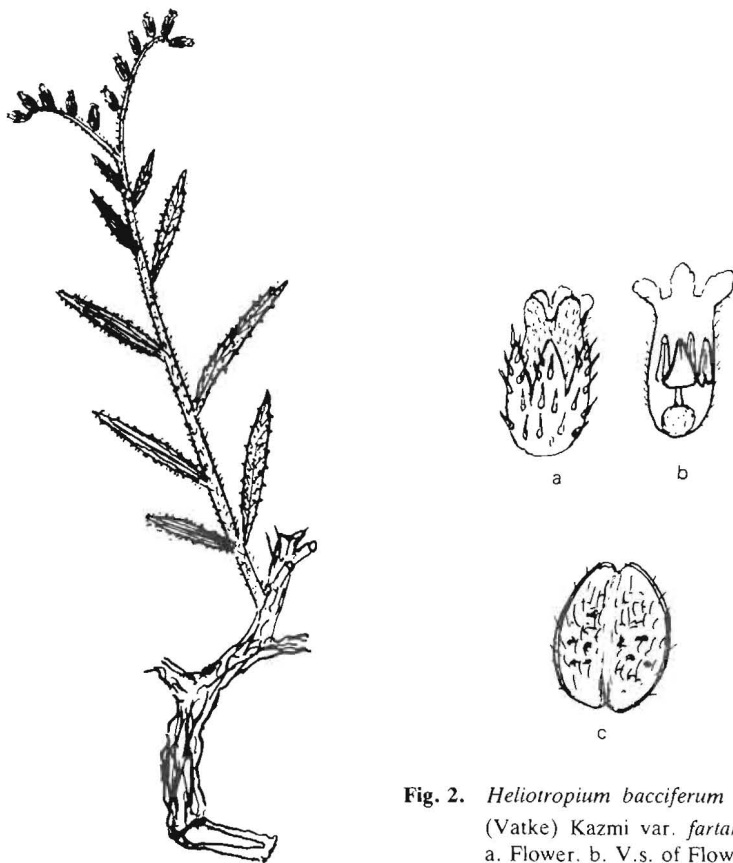


Fig. 2. *Heliotropium bacciferum* Forssk. ssp. *lignosum* (Vatke) Kazmi var. *fartakense* (Schwartz) Kazmi
a. Flower. b. V.s. of Flower. c. Nutlet-pair.

Perennial herbs woody below; young branches tuberculate hairy. Leaves subsessile or sessile, up to c. 3 cm × 3 mm, linear-lanceolate, undulate to almost dentate, revolute, bristly-hairy with tuberculate hairs; nerves sunk on the upper surface. Inflorescence of lax, short, terminal, usually paired, spicate cymes. Calyx c. 3 mm long, the tube as long as the calyx lobes, bristly-hairy. Corolla white, the tube a little longer than the calyx; corolla lobes very small. Anthers c. 1 mm long, inserted at or about the middle of the corolla tube. Stigma conical, bifid at the tip; reaching about the middle of the corolla tube: style short, rather stout. Nutlets c. 3 mm long, fused in 2 pairs, margined to very narrowly winged; the line of separation between the 2 nutlets in a pair apparent; pubescent, tubercled.

Saudi Arabia. Eastern Province. Hofuf, Ads 6782, (152-154 King Abdul Aziz University, Jeddah); Dhahran, Longhitano 3449.

Distribution. Reported from the Arabian Peninsula and Western Pakistan.

Remarks. The type of *H. bacciferum* Forssk. ssp. *bacciferum* var. *bacciferum* is: 'Arabia Felix, Lohaja', Forsskal (C). The type (not seen) for ssp. *lignosum* (Vatke) Kazmi var. *fartakense* (O. Schwartz) Kazmi is: 'Küstengebiet von Hadramaut auf Dunensand bei Ras Fartak', Paulay s.n. (HBG).

4. *Heliotropium bottae* Deff., Yemen 172. 1889. Fig. 3

A much branched, woody shrub up to c. 75 cm tall. Young branches herbaceous, appressed hairy, the hairs asymmetrically medifixed, appearing almost basifixed. Leaves short-petiolate, ovate to lanceolate, up to c. 3.5 × 1.5 cm, more or less undulate, obtuse or acute, pubescent, densely so on the veins on the lower surface; the hairs often white, bulbous-based and short-bristly. Inflorescence of usually two, terminal, long, spicate cymes (resembling those of *H. longiflorum* - q.v.). Flowers white, up to c. 5.5 mm long. Calyx short, c. 2 mm long, the lobes divided almost to the base. Corolla tube hairy on the outside, green, c. 4 mm long, slightly constricted at the mouth and then again at about 1/4 of its length from the top; the lower 1/2 to 1/4 narrower than the upper part; lobes about 1 mm long, spreading at the top of the corolla tube. Stigma narrow-conical, the tip almost reaching the top of the corolla tube: style relatively very long, about 3 times the length of the stigma. Nutlets fused in 2 pairs, the line of separation of nutlets in a pair distinct; glabrous or so at maturity, up to about 3 mm long and wide, more or less muricate.

Saudi Arabia. No material from Saudi Arabia has been seen, but its presence in the S.W. Saudi Arabia is almost certain; it is a frequent species in the adjacent N. Yemen highlands. Representative specimen - Sanaa (North Yemen), S. Chaudhary 3466.

Distribution. Southwestern Arabian Peninsula, Somalia, Ethiopia and Sudan.



Fig. 3. *Heliotropium bottae* Defl.
a. Flower. b. V.s. of Flower. c. Fruit. d. Nutlet-pair.

5. *Heliotropium crispum* Desf., Fl. Atlant. 1:151. t. 41. 1798. Fig. 4
 = *H. afghanicum* Boiss.; *H. bacciferum* auctt. non Forssk.; *H. nubicum*
 Bunge; *H. persicum* Boiss., non (Burm.f.) Lam.; *H. turcomanicum* M.
 Pop.; *H. ramosissimum* (Lehm.) DC.; *H. sarothroclados* Bornm.; *H. un-*
dulatum Vahl; *Lithospermum hispidum* Forssk.

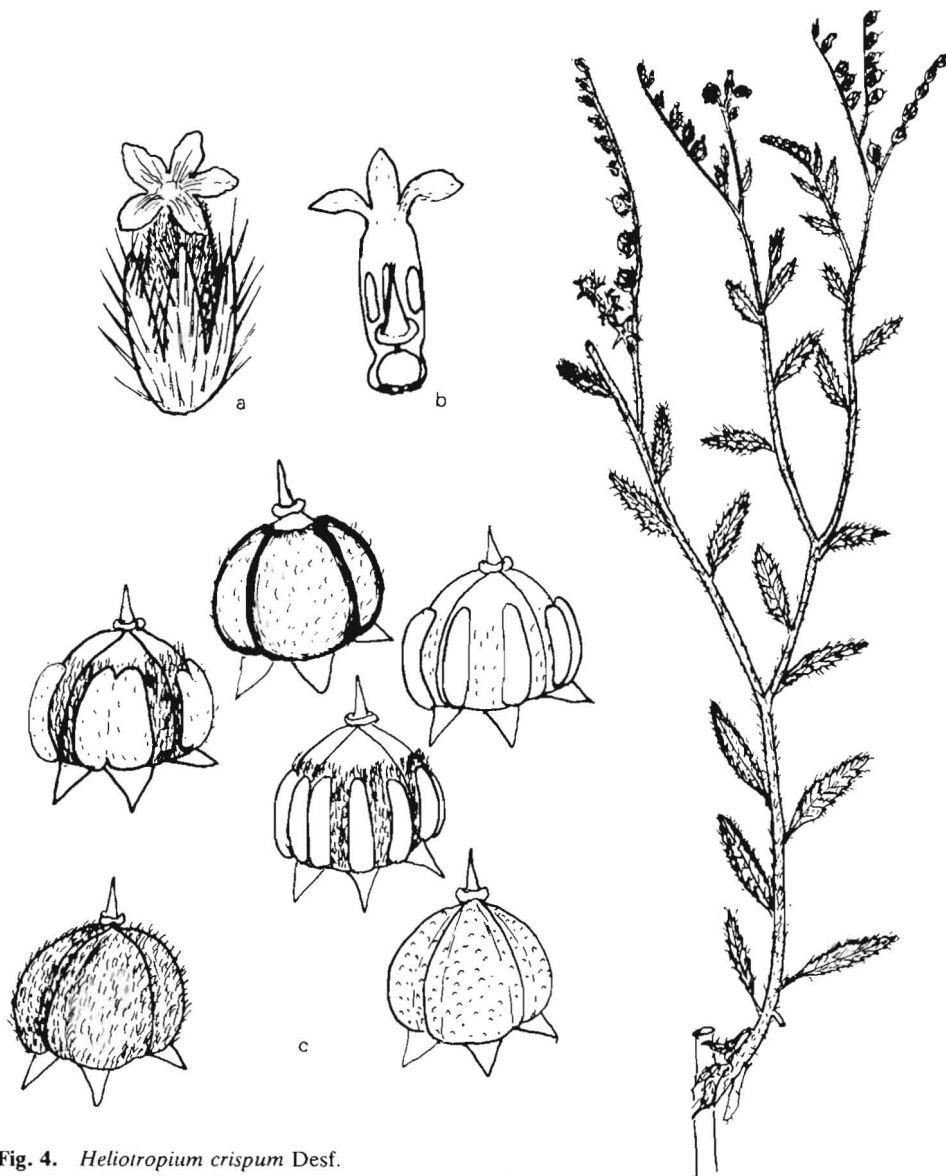


Fig. 4. *Heliotropium crispum* Desf.
 a. Flower. b. V.s. of Flower. c. Variation in fruits.

A perennial, much branched, erect, densely pubescent to bristly-pubescent herb or small shrub. Leaves up to 4×1 cm, often less; lower leaves petiolate, upper subsessile or sessile, lanceolate, undulate-dentate, pubescent to almost tomentose, the indumentum very often with longer bristly hairs. Inflorescence of one-sided, lax, spicate cymes. Flowers white to creamy-white. Calyx bristly-hairy, persistent, c. 2 mm long in flowers, slightly enlarged and spreading in fruit. Corolla c. 4 mm long; tube densely pubescent on outside; lobes short, oblong-ovate, \pm undulate. Anthers c. 1 mm long, inserted at about middle of corolla tube. Stigma conical, sessile or subsessile, persistent (on top of the nutlets), reaching above the middle of the corolla tube. Nutlets 4, separating easily, glabrescent, pubescent, or densely tomentose, only minutely tubercled or with very prominent 1-3, corky callosities on each nutlet. Combination of these nutlet characters (*i.e.*, glabrescent with callosities, glabrescent without callosities, pubescent with callosities, pubescent without callosities) occur in different populations or within the same population or even on the same plant: sometimes, except for the apex, the nutlets swollen-corky all over on dorsal surface.

Saudi Arabia. All regions. Tamaryaat (Al-Jauf), S. Chaudhary 3453; Arar, De Marco 3457; Haradh, S. Chaudhary 3456; Riyadh, S. Chaudhary 3452; Najran, S. Chaudhary 741; Taif, S. Chaudhary 3459; Khamaseen-Thathleeth, A.R. Daud 3458.

Distribution. A very common plant throughout Saudi Arabia. Widely distributed in the Middle East, Pakistan and parts of Africa.

Remarks. This species had most commonly been misidentified as *H. bacciferum* (see under *H. bacciferum*). The type of *H. crispum* Desf. is: 'Habitat in arenis prope Tozzer et Elhamma', lacking name of collector (P). Only a photograph (at RIY) of the type seen.

6. *Heliotropium curassavicum* L., Sp. Pl. 130. 1753.

= *H. chenopodioides* Willd.; *H. glaucophyllum* Moench; *H. glaucum* Salisb.; *H. virens* E. Mey. ex DC.

Perennial, suberect, glabrous, rather succulent herb. Stem and branches hollow. Leaves more or less fleshy, obtuse-spathulate or oblong-lanceolate, tapering at the base to a short petiole; those on the smaller axillary branches near the apex often linear-lanceolate: entire with usually only the mid-vein visible: lamina up to c. 5×1 cm. Inflorescence usually of terminal, single or paired, short, spicate, scorpioid cymes up to c. 5 cm long. Flowers sessile, biseriate (although reportedly usually uniseriate), small. Calyx persistent, divided nearly to the base, c. 1 mm long. Corolla white, c. 2 mm long, the tube more or less urceolate; the lobes ovate, undulate. Anthers c. 1 mm long, beaked. Stigma sessile, glabrous. Nutlets 4, prominently thin-ridged at the back.

Saudi Arabia. Western and Eastern regions. Jeddah-Makkah Road, J. Grainger 7750; Madinah, S. Chaudhary 7816; Eastern Province, Sine loc., Neil Munro 1052.

Distribution. Arabia, Middle East, Pakistan, India, Africa, Europe, Australia, Americas.

Remarks. A halophytic species originally described from 'America'.

7. *Heliotropium digynum* (Forssk.) Asch. ex C. Christ., Dansk Bot. Ark. 4, 3:14. 1922.

= *H. luteum* Poir.; *Lithospermum digynum* Forssk.

Perennial, woody-based, much branched shrublet up to about 50 cm tall. Branches rigid, silvery-white, with a dense indumentum of white, antrorse or often retrorse bristles when young. Leaves mostly petiolate, the upper subsessile to sessile; up to 3 × 1.75 cm, but usually much smaller; bright green with sunken venation on the upper face and white, raised major veins on the lower face, ovate-lanceolate to orbiculate, entire or undulate, often with revolute margins, obtuse or acute. Inflorescence of terminal, short, usually few-flowered, dense cymes becoming lax at fruiting. Flowers yellow, practically sessile. Calyx lobes c. 3 mm long enlarging up to 7 mm in fruit. Corolla up to 7 mm long, the tube pubescent, inflated above the calyx: corolla lobes narrow-linear, spreading. Anthers c. 1 mm long, truncate, with two, short, acute points. Ovary densely hairy. Stigma conical, bifid, hairy. Style more than double the length of stigma. Nutlets 4, hirsute, up to 6 mm long.

Saudi Arabia. All regions except probably the higher elevation in Asir. Hail, S. Chaudhary 7645; Dammam, A. Podzorski 3768; Unaiza, S. Chaudhary 6746; Khurais Nafud, S. Chaudhary 6747; Ruba-al-Khali, S. Chaudhary 3044; Thathleeth, De Marco 6748.

Distribution. North Africa, north-eastern Africa, Arabian Peninsula and parts of the Middle East.

Remarks. This plant is characteristic of deep-sand regions.

8. *Heliotropium europaeum* L., Sp. Pl. 130. 1753. var. *lasiocarpum* (Fisch. & Mey.) Kazmi, J. Arnold Arbor. 51:176. 1970.

= *H. eichwaldii* Steud. var. *lasiocarpum* (Fisch. & Mey.) C.B. Clk.; *H. ellipticum* Ledeb. var. *lasiocarpum* (Fisch. & Mey.) M. Pop.; *H. lasiocarpum* Fisch. & Mey.; *H. tenuiflorum* Bunge.

Annual, densely pubescent, erect herb up to c. 50 cm tall. Branches herbaceous, rather stout, densely pubescent. Leaves petiolate, the petioles on lower leaves up to c. 5 cm long; lamina ovate, lanceolate, elliptic to obovate, entire, up to c. 8 × 4 cm, usually obtuse but often acute. Inflorescence terminal or extra-axillary, sometimes axillary; spicate, scorpioid cymes; the cymes single or paired, somewhat racemose on robust branches, up to about 6 cm (rarely to 13 cm) long: flowers in 2 dense rows on each cyme. Calyx 2-3 mm long, divided almost to the base, persistent, the lobes finally spreading at the dehiscence of the nutlets. Corolla white, the tube as long as or a little longer than the calyx lobes, somewhat con-

stricted at the mouth; lobes spreading, relatively short: tube hairy outside. Anthers small, c. 1 mm long, inserted near middle of corolla-tube. Stigma sessile or with a short style, narrowly conical, bifid or bilobed at the tip. Nutlets 4, sparsely or densely retrose-pubescent, as long as the calyx lobes or a little shorter or shortly exceeding the calyx, usually green.

Saudi Arabia. All regions. Qateef, S. Chaudhary 3448; Riyadh, S. Chaudhary 3443, 3444, 3447; Al-Kharj, S. Chaudhary 3442.

Distribution. A common plant, often a bad weed in agricultural areas in the Arabian Peninsula. Throughout the Middle East to Pakistan and India.

9. *Heliotropium longiflorum* (Hochst. & Steud. ex DC.) Jaub. & Spach, Ill. Pl. Orient. 4, t. 360. 1852.
= *Heliophytum longiflorum* Hochst. & Steud. ex DC.

Perennial, much-branched, erect herb with the young branches and the leaves covered with appressed, asymmetrically medifixed, short hairs some of which are milky-white and bulbous on the shorter end. Older branches rather woody, younger whitish-green, herbaceous. Leaves petiolate, the lower up to 10 × 1.5 cm; oblong-lanceolate, entire, usually obtuse. Inflorescence most often of long, paired spicate cymes up to c. 25 cm long; sometimes more than 2 spikes on a peduncle. Flowers rather small, c. 5 mm long, white. Calyx minute, c. 1 mm long, divided almost to the base. Corolla c. 5 mm long, the tube narrowed at the mouth and then again near the base giving the appearance of two inflated regions; green, pubescent on the outside; lobes rather shallow from a circular, spreading, white limb. Anthers c. 1.5 mm long, narrow-tipped, inserted at the middle of corolla-tube. Stigma conical, on a rather long, slender style and ending in the lower 1/3 of the corolla-tube. Nutlets 4, c. 2 mm long; each nutlet bulged laterally and wider than a distinct, raised, muricate, dorsal band: green.

Saudi Arabia. Southwestern region and Asir. Taif, S. Chaudhary 767; Abu-Arish, S. Chaudhary 3464; Jabal Fayfa, S. Chaudhary and Y. Al-Makki 5893.

Distribution. Arabia, East Africa.

Remarks. The type for this species is from Jabal Sedder (Saudi Arabia), Schimper 842 (not seen). *H. somalense* Vatke, from E. Africa, is a very similar species with similar but thicker, corky nutlets.

10. *Heliotropium ovalifolium* Forssk., Fl. Aeg.-Arab. 38. 1775.
= *H. ambiguum* DC.; *H. brocchianum* Visiani; *H. coromandalianum* Raddi ex DC.; *H. niloticum* DC.; *H. syenites* Spreng.

Prostrate or ascending, annual herb, diffusely branched, appressed white-pubescent with short-trichomes. Leaves petiolate, obovate to oblanceolate, entire, obtuse, usually up to 3 × c. 1.5 cm. Inflorescence of terminal, solitary, paired or shortly paniced cymes up to 12 cm long, usually much smaller. Flowers sessile, or sub-sessile. Calyx lobes unequal, up to c. 2 mm long. Corolla c. 3 mm long,

pubescent on the outside and above the middle of the tube internally. Anthers less than 1 mm long, apically sharp-pointed. Stigma conical. Style obsolete. Nutlets 4, appressed pubescent, about 2 mm long.

Distribution. Africa to Australia.

Remarks. We do not have any material from Saudi Arabia at RIY, but a collection from Saudi Arabia is present at Edinburgh (E) (A.G. Miller, personal communication) which could not be seen though.

- 11. *Heliotropium pterocarpum* (Hochst. & Steud. ex DC.) Jaub. & Spach, Ill. Pl. Orient. 4, 1852. Fig. 5**
 = *Heliophyton pterocarpum* Hochst. & Steud. ex DC.; *Heliotropium kassasii* Täckh. & Boulos

Annual branched herb with dense, spreading and retrorse bristly-hairs. Leaves petiolate, up to c. 6 cm long below but mostly less than $4 \times c. 1$ cm, ovate to lanceolate, more or less undulate, acute. Inflorescence terminal of 2 or 3 short, spicate scorpioid cymes with the flowers in 2 dense rows. Flowers white, c. 5 mm long. Calyx almost bilabiate, the outer lip longer (c. 3 mm long) and bifid or bilobed, the inner (next to the axis) of 3 narrower lobes divided almost to the base: calyx enlarging to c. 5 mm in fruit, persistent, enclosing the fruit with only the wings of the latter projecting. Corolla c. 5 mm long; the tube cylindrical, slightly constricted just above the ovary, densely hairy on the outside. Anthers c. 1 mm long, pointed, inserted about the middle of tube. Stigma conical, about as long as the slender style and ending in the lower 1/3 of the corolla tube. Nutlets 2, usually broadly winged; some of the nutlets, sometimes, narrowly winged but then the tips divergently projected, rarely wingless; glabrous or retrorsely pubescent, tubercled or veined; up to c. 2.5 mm long and to c. 6 mm wide including the wings.

Saudi Arabia. Western and Southwestern regions. Abu-Arish, S. Chaudhary 3439; 3223, Western region without locality or collector's name; Hali-Bin-Yaqoub near Qunfidah, S. Chaudhary; Near Jeddah, Schimper 835, Unio Itiner, 29.2.36, (the type, at K).

Distribution. Southwestern and Western Arabia, Eastern Africa, including the Sudan and Egypt.

Remarks. The type of *H. kassasii* Täckh. & Boulos has not been studied. However, sheets (No. 364 and 3536) at the king Abdul Aziz University, Faculty of Science herbarium, Jeddah, identified by L. Boulos as *H. kassasii*, possess short-winged or wingless nutlet-pairs which are within the range of variation of *H. pterocarpum*!

- 12. *Heliotropium strigosum* Willd., Linn. Sp. Pl. ed. 4, 1:743. 1798.**

Perennial or annual, prostrate or decumbent, intricately branched herb, up to c. 25 cm tall; all parts of the plant covered with densely appressed, short, white, rather bristly hairs. Lower leaves very shortly petiolate, upper sessile, small, up to



Fig. 5. *Heliotropium pterocarpum* (DC) Steud. & Hochst.
a. Calyx. b. V.s. of Flower. c. Fruit with partially removed calyx. d. Nutlets.

c. 1 cm × 2.5 mm, linear to linear-lanceolate, acute. Inflorescence rather long, c. 16 cm long in fruit. Flowers bracteate, bluish-white or white. Calyx c. 3 mm long, divided to the base into 5 lobes, persistent, enlarged and spreading in fruit. Corolla c. 4 mm long. Anthers less than 1 mm long. Stigma short, conical, about as long as the style. Nutlets 4, 1.5 mm long, scabrid-hairy, shorter than lobes of fruiting calyx.

Saudi Arabia. Mostly in western and southerwestern regions. Hali Bin Yaqoob, S. Chaudhary 764; Jizan, S. Chaudhary 762; Abu-Arish, S. Chaudhary 6744.

Distribution. From Africa to China.

- 13. *Heliotropium subulatum* (DC.) Vatke**, Oesterr. Bot. Zeitschr. 25:166. 1875.
= *H. zeylanicum* Täckh. non (Burm.f.) Lam.; *Messerschmidia hispida* Benth.;
Tournefortia subulata Hochst. ex DC.; *T. edgeworthii* DC.; *T. royleana* DC.

A perennial, much branched, erect herb, less than 1 m tall. Stem and branches glandular-pubescent and with longer, spreading or retrorse, bulbous-based trichomes. Leaves petiolate, lanceolate, up to 10 × 2 cm, with rather dense, bulbous-based, short trichomes on both surfaces, undulate or entire, or revolute-margined, acute. Inflorescence of lax spikes up to 25 cm long. Flowers sessile, dirty yellow. Calyx persistent, divided almost to the base into 5 lobes, lobes triangular, acute, c. 2.5 mm long, trichome-fringed. Corolla tube c. 3.5 mm long, inflated below the narrower mouth, pubescent with short trichomes near the middle and 5 rows of trichomes in the upper region, lobes c. 2.5 mm long, narrow, triangular, gradually tapering into long, very narrow points, spreading in the lower half, upturned in the upper half. Anthers 1 mm long, slightly exerted, divided at the apex into two, prominent, acute lobes. Stigma narrowly conical, bifid, hairy. Style about twice the length of stigma. Nutlets 4, glabrous, tubercled, c. 2 mm long.

Saudi Arabia. Southwestern region. Abu-Arish, S. Chaudhary 768; Ash-Shuqayq, A. Podzorski 6677; Jabal Fayfa, S. Chaudhary 1002, 3440.

Distribution. Central and northeastern Africa, Arabian Peninsula, Pakistan and India.

14. *Heliotropium* sp. (A) Fig. 6

Annual, erect, bristly-hairy and retrorsely pilose herb. Leaves petiolate; the lower leaves on the main stem much larger than the others, up to c. 10 × c. 2 cm; lamina lanceolate to rhomboid, up to c. 6 cm long, usually smaller, entire or undulate, acute or obtuse. Inflorescence terminal, of 2-3 spicate cymes, often paniculate; the cymes dense but becoming rather lax in fruit. Flowers white, c. 4 mm long. Calyx c. 3 mm long, densely bristly-hairy, lobed almost to base. Corolla white, tube hairy outside, a little longer than the calyx, constricted at the mouth below the stigma level: lobes obtuse, spreading. Anthers c. 1 mm long, pointed, inserted about the middle of the corolla-tube. Nutlets paired but easily breaking

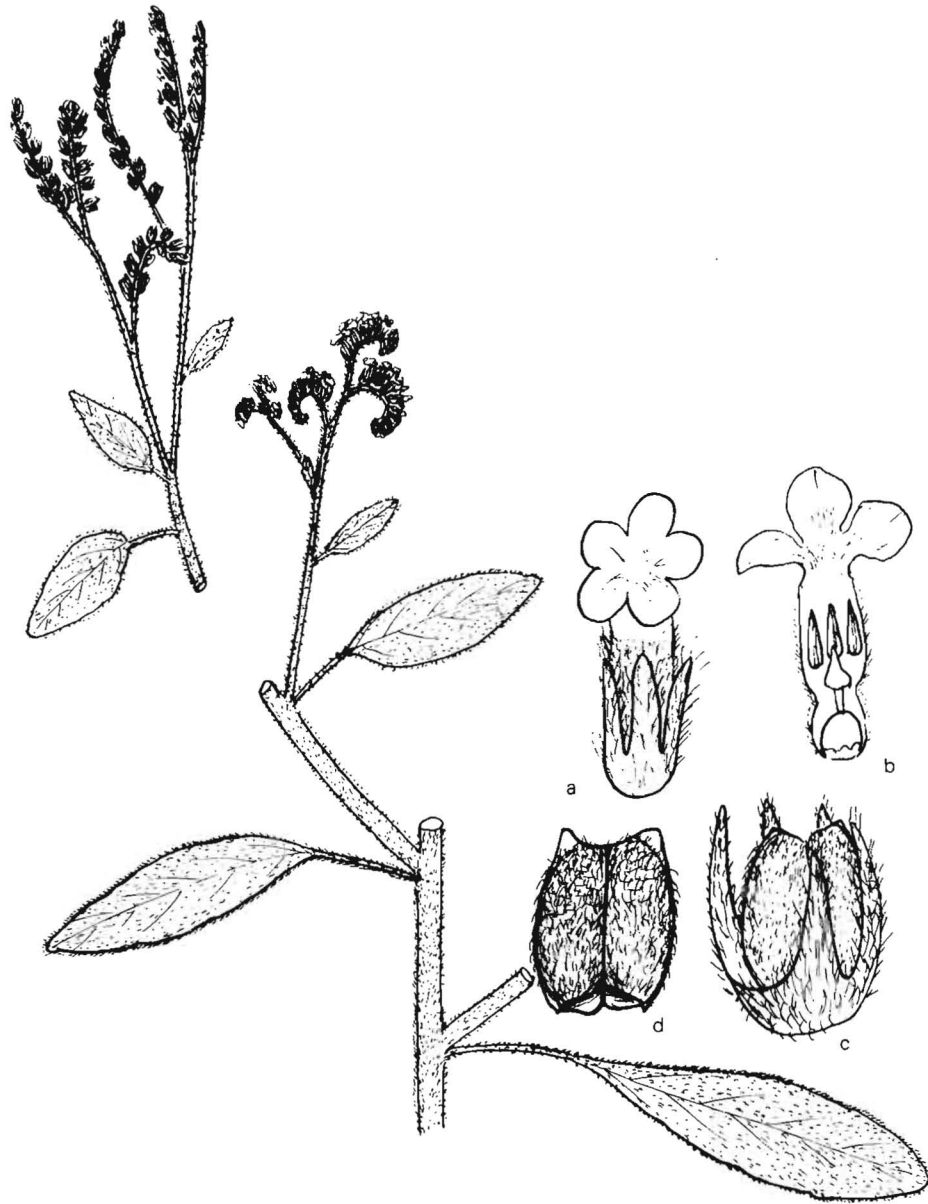


Fig. 6. *Heliotropium* sp. (A)
a. Flower. b. V.s. of Flower. c. Fruit. d. Nutlets.

into 4, retrorsely pilose, very narrowly winged, c. 2 mm long, 2 mm wide; each pair with a prominent longitudinal suture from where it easily separates into 2 nutlets.

Saudi Arabia. Southwestern region. Abu-Arish, S. Chaudhary 3438.

15. *Heliotropium* sp. (B) Fig. 7

Annual, much branched erect herb with spreading and retrorse hairs. Leaves petiolate, up to c. 11.5 cm long (usually smaller), gradually reduced in size above: lamina lanceolate to ovate, up to c. 8.5×3 cm in lower leaves, undulate, spreading and retrorsely bristly-hairy; obtuse or acute. Inflorescence terminal, of usually more than 2, spicate cymes, elongating in fruit. Flowers white, c. 5 mm long. Calyx c. 3 mm long; the lobes c. 2.5 mm long, densely bristly-hairy except at the base. Corolla c. 5 mm long; tube slightly constricted near the mouth and below the stigma level; lobes obtuse, spreading. Anthers about 1 mm long, pointed, inserted at c. the middle of the corolla tube. Nutlets 2, shortly winged, c. 3 mm long and wide including the wing, glabrous, with or without one or two spongy callosities on the outer face.

Saudi Arabia. Southwestern region. Abu-Arish-Jizan, S. Chaudhary 766, 2042; Hakima, S. Chaudhary 3437.

Doubtful Records

H. dolosum De Not. (Repert. Fl. Ligust. 284. 1844) has its distribution in 'S. Europe, S. Russia, S.W. Asia to Afghanistan' (Riedl 1978). Material of this species collected by I.S. Collenette (personal communication) needs further studies. It could possibly be *H. europaeum* L. s.l.

Reports about the occurrence of *H. hirsutissimum* Grauer (Pl. Min. Cogn. Dec. 1. 1784) in Saudi Arabia have been discussed under *H. arbainense* Fresen. elsewhere in the present paper.

H. supinum L. (Sp. Pl. 130. 1753) is a procumbent, densely hairy annual with the thick-margined, glabrous, single nutlet remaining enclosed within the deciduous calyx and falling with it. It has been reported (unconfirmed report) by Migahid. Since it is found in adjacent countries, there is a likelihood of its occurrence in Saudi Arabia.

H. rariflorum Stocks (in Hook. Jour. Bot. 4:174. 1852) is a rigidly branched undershrub with upto $3.5 \text{ cm} \times 5 \text{ mm}$, revolute-margined leaves and bracteate, distant flowers in terminal and extra-axillary cymes upto 7 cm long. This species is found in Pakistan, India and E. Africa, and may be expected in Saudi Arabia.

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Fig. 7. *Heliotropium* sp. (B)
a. Flower. b. V.s. of Flower. c. Fruit. d. Nutlets.

ing the present studies, while Dr. Salah Abu-Shakra, Technical Director, has most willingly provided constructive criticism. The author is grateful to the above gentlemen. Mr. Anthony G. Miller of the Royal Botanic Garden, Edinburgh was of tremendous help during this study and I am indebted to him for his help. Also, the author would like to thank the authorities of the Royal Botanic Garden, Edinburgh (E), Royal Botanic Gardens, Kew (K), and the British Museum (Natural History), London (BM), for kindly allowing me the use of facilities of their herbaria during this study. C. Campbell, D. Keele, and R. Bhatti showed a lot of patience in typing this manuscript and deserve special thanks.

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دراسات على رقيب الشمس (الهليوتروبيوم) في المملكة العربية السعودية

شوكت علي شودري

المعشبة الوطنية - المركز الإقليمي لأبحاث الزراعة والمياه - وزارة

الزراعة والمياه

ص. ب. ١٧٢٨٥

الرياض - ١١٤٨٤ - المملكة العربية السعودية

تم وصف ستة عشر نوعاً ونوعاً من رقيب الشمس (فصيلة
الجُمجُمِيَّات) في المملكة العربية السعودية. هذه الأنواع
والنويغات هي:

H. aegyptiacum Lehm., *H. arbainense* Fres., *H. bottae*
Defl., *H. crispum* Desf., *H. curassavicum* L., *H. digynum*
(Forssk.) Asch. ex C. Christ., *H. europaeum* L., *H. longi-*
florum (Hochst. & Steud. ex DC.) Jaub. & Spach, *H. ovali-*
folium Forssk., *H. pterocarpum* (Hochst. & Steud. ex DC.)
Jaub. & Spach, *H. strigosum* Willd., *H. subulatum* (DC.)
Vatke, *H. sp. A*, *H. sp. B*, *H. bacciferum* Forssk.

(ونويغان من النوع الأخير). كما تمت دراسة أربعة أنواع
أخرى من المحتمل وجودها في المملكة العربية السعودية.