

**The Cruciferae of the Arabian Peninsula:
A Check-List of Species
and a Key to Genera
(Studies in the flora of Arabia IV)**

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ABSTRACT. A check-list is given of the known species of Cruciferae in the Arabian peninsula; it includes a selective synonymy and lists the countries of the area where they grow. An illustrated field-key to the 51 genera is followed by a short discussion on phytogeography and endemism.

The Arabian peninsula, which in this context covers Saudi Arabia, Yemen Arab Republic, People's Democratic Republic of Yemen (including Socotra), Oman, United Arab Emirates, Qatar, Bahrein and Kuwait, has an approximate total of 51 genera of Cruciferae and 97 species. Very similar totals pertain for the phytogeographically similar countries of Egypt with 52 genera and 103 species and Libya with 59 genera and 98 species. In contrast, countries or areas to the north or west which are phytogeographically more diverse have a much richer development of the family. For example, Iraq has 81 genera and 187 species; the area covered by *Flora Iranica* (including Iran, Afghanistan and parts of Iraq and Pakistan) has the massive total of 126 genera and 472 species.

The Cruciferae, at least generically, is one of the larger families in the Arabian peninsula although very far behind the three giant families of the area — Compositae, Gramineae and Leguminosae. It has several different facets of interest and the aim of this paper is to help give a better understanding of the family and its constituent taxa; and also to emphasise that there is still much to do before it is as well known in Arabia as in the countries mentioned above.

It is only in the last decade or so that increased botanical exploration throughout

much of the peninsula has enabled the international botanical community to gain a better understanding, though very far from complete, of its plant life. This huge land mass has always suffered from the lack of a comprehensive Flora and even now despite the appearance of some local Floras it is still very difficult in many families to accurately identify specimens. The Cruciferae in this respect comes into the category of one of the better-known families.

With the recent upsurge of interest in the Arabian flora and the concomitant huge increase in available collections the time is now ripe for a start to be made towards a Flora of the whole peninsula.

Although Arabian specimens are represented in many herbaria throughout the world (Wickens 1982) the three British national Herbaria (British Museum 'Natural History,' Edinburgh and Kew) between them probably hold the most comprehensive collections, old and new, from the peninsula. They are also in the fortunate position of having ideal library resources.

In the course of the last few years, botanists at Edinburgh and Kew have been preparing check-lists of the flowering plants of the peninsula as a first stage towards a Flora. Such a Flora will probably deal with more than 3,500 species of phanerogams and, depending on resources and circumstances, take up to ten years to complete. The participation and active co-operation of local botanists will be an essential prerequisite in the successful progress of the Flora.

Check-list of Species

As indicated above one of the aims of a check-list is to provide a basic framework from which a Flora account can later be prepared. This one lists all the species known from the area by their modern nomenclature, gives selective synonymy, the countries of Arabia from where they are known, and indicates endemic species. All check-lists are by their very nature provisional and should always be regarded as such.

The two main sources of information used in compiling these lists are literature records and herbarium specimens. The literature on Arabian plants is very scattered and searching out all relevant data about a particular plant family is a time-consuming process. To date (August 1982) about 60 Arabian family check-lists have been compiled and the routine followed in their preparation has gradually been modified and improved over the years. About 26 basic references are now checked as a first stage; these are listed on Appendix I. Roughly half deal with the taxa as they occur in Arabia, the rest are papers or Floras dealing with adjacent or nearby areas. Sometimes, when it is known that an Arabian species also grows in, say the Mediterranean area or South West Africa (Namibia) or India, the literature search may be extended to cover these areas. Monographs when available are scrutinized: in the case of the Cruciferae the fundamentally important works of O.E. Schulz in the *Pflanzenfamilien* (1936) and the *Pflanzenreich* (1919, 1923 and 1924). Also searched for relevant papers is the re-

cently published botanical bibliography of the Arabian peninsula (Miller *et al.* 1982). Concurrently with the literature search herbarium specimens are examined, named, and at Edinburgh separated off into 'Arabian' covers. When as often is the case it is not possible to consult the British Museum or Kew material at the same time we have access at Edinburgh to determination lists of Arabian collections housed at these institutes.

Separate record sheets are prepared for each species. They list, in addition to the basic information about nomenclature and Arabian distribution, such further items as the location of herbarium specimens, synonymy, illustrations, external distributions, taxonomic comments and relevant literature. This means that it is often possible to check back on doubtful records or entries. From these record sheets the synoptic check-lists are compiled.

The compiler of a check-list has to use discretion in deciding which taxa should or should not be included. For example, some literature records may be deemed extremely unlikely in the context of other available information. This is the case with the list of species from Saudi Arabia published by De Marco and Dinelli (1974); the authors were concerned that the list might contain inaccuracies and subsequent work has shown this to be true. As a result some records, such as these, may be noted but omitted from the check-list while others are included as 'doubtful records'.

Because there is no single earlier publication which covers the area under discussion, it is not possible to give accurate comparative figures for the increase in knowledge of the Cruciferae over the years. But it is worth noting that Schwartz in his *Flora des tropischen Arabien* of 1939 listed only 16 genera and 30 species. Migahid in his *Flora of Saudi Arabia* (1978) listed 28 genera and 52 species. Equivalent figures here for Saudi Arabia are 43 genera and 76 species.

The abbreviations used below are:

- SA = Saudi Arabia
- NY = North Yemen (Yemen Arab Republic)
- SY = South Yemen (People's Democratic Republic of Yemen)
- SOC = Socotra
- O = Oman (including Dhofar)
- UAE = United Arab Emirates
- Q = Qatar
- B = Bahrein
- K = Kuwait

Endemic refers to a taxon known only from the area under discussion.

Doubtful records or doubtful species are marked with an asterisk.

Check-List of Arabian CRUCIFERAE

<i>Alyssum desertorum</i> Stapf	SA
<i>homalocarpum</i> (Fisch. and Mey.) Boiss.	SA,K
<i>linifolium</i> Steph. ex Willd.	SA,K
<i>singarense</i> Boiss. and Hausskn. (syn. <i>A. anamense</i> Vel.)	SA
<i>Anastatica hierochuntica</i> L.	SA,NY,O,UAE,Q,K
<i>Arabidopsis kneuckeri</i> (Bornm.) O.E. Schulz	SA
<i>thaliana</i> (L.) Heynh.	SA
<i>Arabis alpina</i> L. s.l.	SA,NY
<i>nova</i> Vill.	SA?
* <i>Barbarea arabica</i> Vel.	SA
<i>Biscutella didyma</i> L.	SA
(<i>Brassica arabica</i> (Fisch. and Mey.) Fiori = <i>Erucastrum arabicum</i>)	
<i>Brassica deflexa</i> Boiss. (syn. <i>B. lasiocalycina</i> (Boiss. and Hausskn.)	
Boiss.)	SA,K
<i>juncea</i> (L.) Czern.	NY,SY,O,K
<i>napus</i> L.	NY
<i>oleracea</i> L.	SA,NY
<i>rapa</i> L. (syn. <i>B. campestris</i> L.)	SA,NY,O,Q,K
<i>tournefortii</i> Gouan	SA,SY,UAE,Q,B,K
<i>Cakile arabica</i> Vel. and Bornm.	SA,UAE,K
<i>Capsella bursa-pastoris</i> (L.) Medic.	SA,NY,UAE
<i>Cardamine africana</i> L.	NY
<i>Cardaria draba</i> (L.) Desv. (syn. <i>Lepidium draba</i> L.) incl. subsp.	
<i>draba</i> and subsp. <i>chalepensis</i> (L.)	

- O.E. Schulz SA,NY,O,K
- Carrichtera annua* (L.) DC. (syn. *C. vellae* DC.) SA,K
- ★ *Chorispora purpurascens* (Banks and Sol.) Eig
(syn. *C. syriaca* DC.) SA, K
- Clypeola jonthlaspi* L. SA
- Coronopus didymus* (L.) Sm. O
- niloticus* (Del.) Spreng. SA
- Diceratella incana* Balf. f. (syn. *D. sinuata* (Franch.)
Oliver) SOC
- Diplotaxis acris* (Forssk.) Boiss. (syn. *Malcolmia arabica* Vel.) SA,SY,K
- erucoides* (L.) DC. SA,NY,SY,O
- harra* (Forssk.) Boiss. SA,NY,SY,O,UAE,B,K
- Enarthrocarpus lyratus* (Forssk.) DC. SA,NY
- Eremobium aegyptiacum* (Spreng.) Boiss. (syn. *E. lineare*
(Del.) Aschers. and Schweinf.) incl. var. *lineare* (Del.)
Hochr. syn. *E. nefudicum* (Vel.) Burt and Lewis SA,NY,SY,O,UAE,Q,K
- ★ *diffusum* (Decne.) Botsch. SA
- Eruca sativa* Mill. (syn. *E. lativalvis* (Boiss.) Boiss.) SA,NY,SY,O,UAE,
Q,B,K
- Erucaria crassifolia* (Forssk.) Del. SA,UAE,Q
- hispanica* (L.) Druce (syn. *E. aleppica* Gaertn.;
E. lineariloba Boiss.) SA,O,UAE,B,K
- uncata* (Boiss.) Aschers. and Schweinf. (syn. *Enarthrocarpus uncatus*
(Boiss.) Blatter) SA
- Erucastrum arabicum* Fisch. and Mey. (syn. *Brassica arabica*
(Fisch. and Mey.) Fiori) SA,NY,SY,O,UAE,Q
- (*Fabrisinapis fruticosus* C.C. Townsend = *Hemicrambe townsendii*)
- Farsetia* ★ *aegyptia* Turra (syn. *F. ovalis* Boiss.) SA,O,K

<i>burtonae</i> Oliv.	SA,O,K
<i>heliophila</i> Bge	UAE
<i>linearis</i> Dcne. (syn. <i>F. arabica</i> Boulos) ?ENDEMIC	(? SA,NY,SY) O,UAE,Q,B
<i>longisiliqua</i> Dcne.	SA,NY,SY,SOC
<i>socotrana</i> B.L. Burt (syn. <i>F. prostrata</i> Balf. f.) ENDEMIC	SOC
<i>stylosa</i> R. Br. (syn. <i>F. hamiltonii</i> Royle; <i>F. ramosissima</i> Hochst. ex Fourn.; <i>F. depressa</i> Kotschy; <i>F. prostrata</i> Hochst.).	SA,NY,SY,SOC, O,UAE
sp. A. ENDEMIC?	O
<i>Hemicrambe townsendii</i> Gómez-Campo (syn. <i>Fabrisinapis</i> <i>fruticosus</i> C.C. Townsend) ENDEMIC	SOC
<i>Hirschfeldia incana</i> (L.) Lag.-Foss.	NY
<i>rostrata</i> (Balf. f.) O.E. Schulz (syn. <i>Brassica rostrata</i> Balf. f.) ENDEMIC	SOC
<i>Horwoodia dicksoniae</i> Turrill	SA,K
<i>Isatis lusitanica</i> L. (syn. <i>I. aleppica</i> Scop.)	SA
<i>Lachnocapsa spathulata</i> Balf. f. ENDEMIC GENUS	SOC
<i>Lepidium armoracia</i> Fisch. and Mey. (syn. <i>L. schweinfurthii</i> Thell. incl. subsp. <i>abyssinicum</i> (Hochst.) Thell. and subsp. <i>intermedium</i> (A. Rich.) Thell.)	NY
<i>aucheri</i> Boiss.	SA,Q,K
<i>bonariense</i> L.	NY
<i>(L. draba</i> L. = <i>Cardaria draba</i>)	
<i>latifolium</i> L.	NY
<i>ruderae</i> L.	SA,K
<i>sativum</i> L.	SA,NY,SY,O,K

* We are grateful to Dr Bengt Jonsell, Uppsala, for vetting and amending the *Farsetia* entry. His revision of the genus is now nearing completion.

<i>virginicum</i> L.	SA
<i>Leptaleum filifolium</i> (Willd.) DC.	SA,K
<i>Lobularia libyca</i> (Viv.) Meissner	SA
<i>maritima</i> (L.) Desv.	SA
<i>Malcolmia africana</i> (L.) R. Br. (syn. <i>Strigosella africana</i> (L.) Botsch.)	SA,K
<i>behboudiana</i> Rech. f. and Esfand. (syn. <i>Strigosella</i> <i>behboudiana</i> (Rech. f. and Esfand.) Botsch.)	SA,K
<i>chia</i> (L.) DC.	SA
<i>crenulata</i> (DC.) Boiss.	SA
<i>grandiflora</i> (Bge.) O. Ktze (syn. <i>Strigosella grandiflora</i> (Bge.) Botsch.) incl. var. <i>glabrescens</i> (Boiss.) Burt and Lewis	SA,Q,K
<i>Maresia nana</i> (DC.) Batt. (syn. <i>Malcolmia nana</i> (DC.) Boiss.)	SA,K?
<i>pulchella</i> (DC.) O.E. Schulz	K
<i>pygmaea</i> (DC.) O.E.Schulz (syn. <i>Malcolmia pygmaea</i> (Del.) R.Br.)	SA,K
<i>Matthiola arabica</i> Boiss.	SA,K
<i>humilis</i> DC.	SA
<i>livida</i> (Del.) DC.	K
<i>longipetala</i> (Vent.) DC. (syn. <i>M. oxyceras</i> DC.)	SA,K
<i>Morettia canescens</i> Boiss.	SA
<i>parviflora</i> Boiss.	SA,NY,SY,O,UAE,B
<i>philaeana</i> (Del.) DC. (syn. ? <i>M. asperrima</i> Boiss.)	SA,NY,O
<i>Moricandia sinaica</i> (Boiss.) Boiss. (syn. <i>M. nitens</i> auct. non (Viv.) Dur. and Barr.?)	SA,NY,O,K
<i>Nasturtium microphyllum</i> (Boenn.) Reichenb.	NY

<i>officinale</i> R. Br.	SA
<i>Neslia apiculata</i> Fisch., Mey. and Avé-Lall.	SA
<i>Notoceras bicornis</i> (Ait.) Caruel (syn. <i>N. canariense</i> R. Br.)	SA,O,K
<i>Physorrhynchus chamaerapistrum</i> (Boiss.) Boiss.	SA,O,UAE,K
<i>Raphanus sativus</i> L.	SA,NY,SY,O,Q
<i>Rapistrum rugosum</i> (L.) All. (syn. <i>R. orientale</i> (L.) Crantz)	SA,NY
<i>Rorippa palustris</i> (L.) Besser (syn. <i>R. islandica</i> auct. non (Oeder) Borbas)	NY
<i>Savignya parviflora</i> (Del.) Webb (syn. <i>S. aegyptiaca</i> DC.)	SA,SY,O,UAE, Q,B,K
<i>Schimpera arabica</i> Hochst. and Steud. (syn. <i>S. persica</i> Boiss.)	SA,UAE,Q,K
<i>Schouwia purpurea</i> (Forssk.) Schweinf. (syn. <i>S. arabica</i> DC.; <i>S. schimperi</i> Jaub. and Spach; <i>S. thebaica</i> Webb)	SA,NY,SY
<i>Sinapis arvensis</i> L.	SA,UAE,Q,K
<i>Sisymbrium erysimoides</i> Desf.	SA,NY,SY,SOC,O, UAE,Q,K
<i>irio</i> L.	SA,NY,O,UAE,Q,K
<i>officinale</i> (L.) Scop.	NY,UAE
<i>orientale</i> L.	SA,NY,Q,K?
★ <i>pinnatifidum</i> Forssk.	NY
<i>septulatum</i> DC.	SA,K
<i>Sterigmostemum sulphureum</i> (Banks and Sol.) Bornm.	NY
(<i>Strigosella</i> Boiss. = <i>Malcolmia</i>)	
<i>Torularia torulosa</i> (Desf.) O.E. Schulz (syn. <i>Malcolmia</i> <i>torulosa</i> (Desf.) Boiss.)	SA,K
<i>Zilla spinosa</i> (L.) Prantl	SA,SY,O,UAE,Q,K

Characters

There is a multiplicity of usable taxonomic macroscopic and microscopic characters in the Cruciferae. By far the most important of these concern fruit and seed, and much of the classification of the family is based on them. Unless mature fruit is present on a specimen it is often difficult or impossible to name it with any accuracy. There are many instances where species are similar in flower but have a completely different fruit structure. Among the Arabian species, for example, *Cakile arabica*, *Erucaria crassifolia* and *E. hispanica* are extremely similar in flower but in mature fruit the two genera are clearly different. *Erucastrum arabicum* and *Sisymbrium erysimoides*, in completely different tribes, provide another instance.

One of the most useful characters in the identification of the Arabian genera is the type of hair covering (indumentum). About half the genera in our area have an indumentum of simple, unbranched hairs or lack an indumentum; the other half have branched hairs. A good hand lens ($\times 10$) can easily distinguish the two types. This high percentage of genera with branched hairs in a particular geographical area is certainly unusual in the Cruciferae.

Although there are useful characters in the seeds of Cruciferae which are used in the circumscription of the tribes (see p. 59) these are not used in the following key which is intended as a field-key. It is impossible not to use some technical terms, but as far as possible they have been kept to a minimum. The accompanying diagram shows some of the characters, terms or features that may cause some difficulty. One character that requires careful observation is that of decurrent carpoid lobes. It refers to the situation where the stigmatic surfaces of the style run down the sides of the stylar arms. It contrasts with the situation where the stigmatic surfaces are restricted to the apex of the style (see Fig. 1).

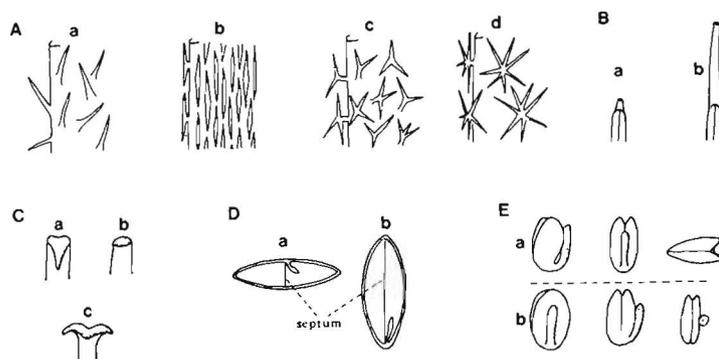


Fig. 1. Some characters used in the identification of Cruciferae. Aa, simple hairs; Ab-d, branched hairs – Ab, medifixed – Ac, forked (furcate) – Ad, stellate-dendroid; Ba, fruit without a beak; Bb, fruit with a beak; Ca-c, stigma types – Ca, with decurrent carpoid lobes – Cb, without decurrent lobes – Cc, bilobed; Da, fruit (in cross section) compressed at right angles to septum (angustiseptate); Db, fruit compressed parallel to septum (latiseptate); Ea-b, embryos with Ea, incumbent radicles and Eb, accumbent radicles.

**Field Key to the Arabian Genera
of CRUCIFERAE**

- | | |
|--|------------------------------------|
| 1. Branched hairs present on at least some part of the plant | 2 |
| + Plant only with simple hairs or glabrous | 23 |
| 2. Fruit short, as long as broad to less than 3 × longer
than broad (silicule) | 3 |
| + Fruit elongated, at least 3 × longer than broad (siliqua) often much
more | 10 |
| 3. Fruit compressed at right angles to septum | 4 |
| + Fruit compressed parallel to the septum or scarcely compressed ... | 5 |
| 4. Annual weed with a thin indumentum including some forked and
dendroid hairs; fruit obtriangular | 26.★ <i>Capsella</i>
(Fig. 2) |
| + Perennial with a very dense indumentum entirely of adpressed
stellate-dendroid hairs; fruit ellipsoid [Socotra] | 25. <i>Lachnocapsa</i>
(Fig. 2) |
| 5. Indumentum on stem and leaves of mixed adpressed hairs | 6 |
| + Indumentum on stem and leaves of branched-dendroid adpressed
or spreading hairs | 7 |
| 6. Fruit at least 8 mm long, ± ovate; seeds broadly winged;
petals c. 8 mm or more | 30. <i>Farsetia</i>
(Fig. 2) |
| + Fruit up to 3 mm long, ± circular; seeds with a narrow
wing; petals c. 3 mm | 32. <i>Lobularia</i>
(Fig. 2) |
| 7. Leaves amplexicaul or sagittate at base; fruit nut-like
indehiscent, ± spherical | 29. <i>Neslia</i>
(Fig. 2) |
| + Leaves attenuate at base; fruit tardily dehiscent or
readily dehiscent, not spherical | 8 |
| 8. Flowers sessile; fruit tardily dehiscent with rounded apical
auricles | 27. <i>Anastatica</i>
(Fig. 2) |
| + Flowers clearly pedicellate; fruit readily dehiscent,
valves without appendages | 9 |
| 9. Fruit glabrous or with stellate hairs; pedicels
spreading-erect | 31. <i>Alyssum</i>
(Fig. 2) |
| + Fruit with simple hook-like hairs; pedicels deflexed
in fruit | 33. <i>Clypeola</i>
(Fig. 2) |

★ The numbers are those of the genera as they are listed in the taxonomic synopsis on p. 59.

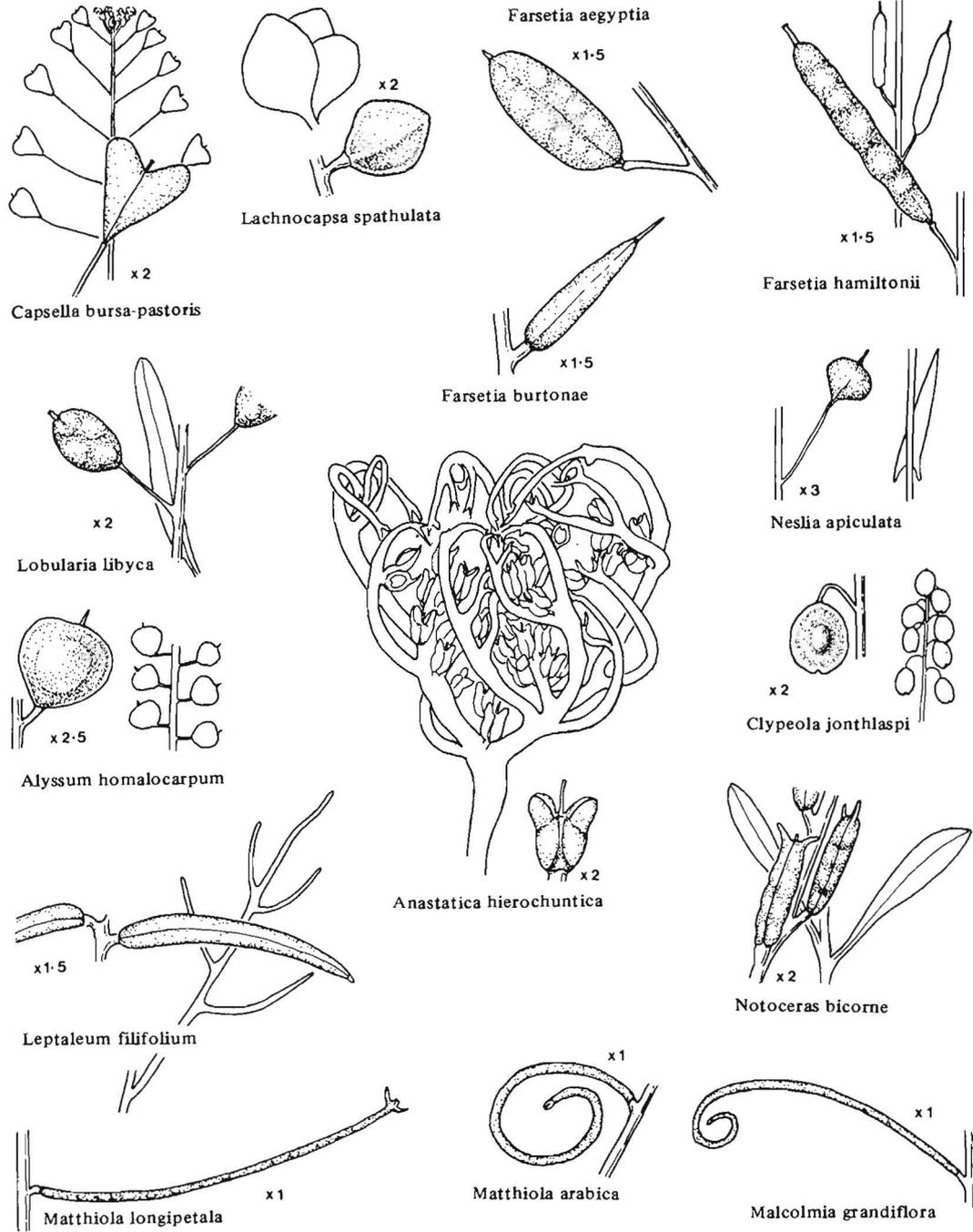


Fig.2. Fruits of Cruciferae complementing the key to genera.

10. Upper cauline leaves simply pinnate with linear-filiform segments 44. *Leptaleum* (Fig. 2)
- + Cauline leaves undivided 11
11. Indumentum entirely, or almost so, of adpressed medifixed hairs 12
- + Indumentum of forked to stellate-dendroid hairs 13
12. Annual with a fairly thin indumentum; fruits apically horned 39. *Notoceras* (Fig. 2)
- + Annual or perennial with a very dense indumentum; fruit without apical horns 30. *Farsetia* (Fig. 2)
13. Stigma with decurrent carpidal lobes 14
- + Stigma without decurrent carpidal lobes 21
14. Petals pink, mauve, livid or brown 15
- + Petals white, cream or yellow 18
15. Apex of fruit with two prominent horns 41. *Mathiola* (Fig. 2)
- + Fruit without apical horns 16
16. Leaves linear or linear-oblong, entire-margined 17
- + Leaves oblong to obovate, at least basal ones dentate or lobed 45. *Malcolmia* (Fig. 2)
17. Annual with \pm glabrous stems; fruit linear-oblong, straight, valves readily separating 46. *Eremobium* (Fig. 3)
- + Perennial with a dense white stem indumentum; fruit narrow linear, \pm torulose, valves not readily separating 41. *Mathiola* (Fig. 2)
18. Apex of fruit with two prominent horns 40. *Diceratella* (Fig. 3)
- + Apex of fruit without horns 19
19. Leaves linear to linear-oblong, not or scarcely attenuate below; valves of fruit readily separating 46. *Eremobium* (Fig. 3)
- + Leaves oblong to ovate, attenuate at base; valves of fruit not readily separating 20
20. Stigma lobes widely divergent; fruiting pedicels
c. 10-12 mm long, slender (Y.A.R.) 47. *Sterigmostemum* (Fig. 3)
- + Stigma lobes not divergent; fruiting pedicels
c. 1-2 mm long, thick 42. *Morettia* (Fig. 3)

21. Perennial with petals c. 8-15 mm 36. *Arabis*
(Fig. 3)
- + Annuals with petals c. 4-7 mm 22
22. Petals pink; inflorescence a few-flowered raceme;
indumentum of stellate hairs only 48. *Maresia*
(Fig. 3)
- + Petals white or pinkish; inflorescence a many-flowered
raceme; indumentum of simple and stellate-dendroid hairs
or stellate-dendroid only 51. *Arabidopsis*
(Fig. 3)
23. Plant with spiny branches, lilac flowers and a hard
indehiscent globose fruit with a conical beak 13. *Zilla*
(Fig. 3)
- + Plant not spiny 24
24. Fruit compressed at right angles to septum 25
- + Fruit compressed parallel to the septum or scarcely compressed ... 31
25. Cauline leaves amplexicaul, auriculate to sagittate 26
- + Cauline leaves sessile to petiolate, not amplexicaul 28
26. Petals yellow; fruit pendent, oblong, 1-seeded 22. *Isatis*
(Fig. 3)
- + Petals white or cream; fruit erect, 2 to several-seeded 27
27. Fruits with rounded turgid valves, cordate or broadly ovate
at base, indehiscent 21. *Cardaria*
(Fig. 3)
- + Fruits with \pm flattened valves, rounded at base, readily
dehiscent 19. *Lepidium*
(Fig. 3)
28. Fruit didymous (with two prominent lobes) 29
- + Fruit not didymous 30
29. Fruits strongly flattened, valves readily dehiscent 24. *Biscutella*
(Fig. 3)
- + Fruits with rounded verrucose indehiscent valves 20. *Coronopus*
(Fig. 3)
30. Flowers mauve-purple; fruit indehiscent, winged, keeled 23. *Horwoodia*
(Fig. 3)
- + Flowers white or cream; fruit dehiscent, winged or not,
not keeled 19. *Lepidium*
(Fig. 3)
31. Fruiting pedicels 10-25 mm, capillary, spreading or reflexed;
silicule shortly stipitate, 10-14 \times 5-7 mm 17. *Savignya*
(Fig. 4)
- + Fruiting pedicels shorter, not capillary; silicule or siliqua
not as above 32

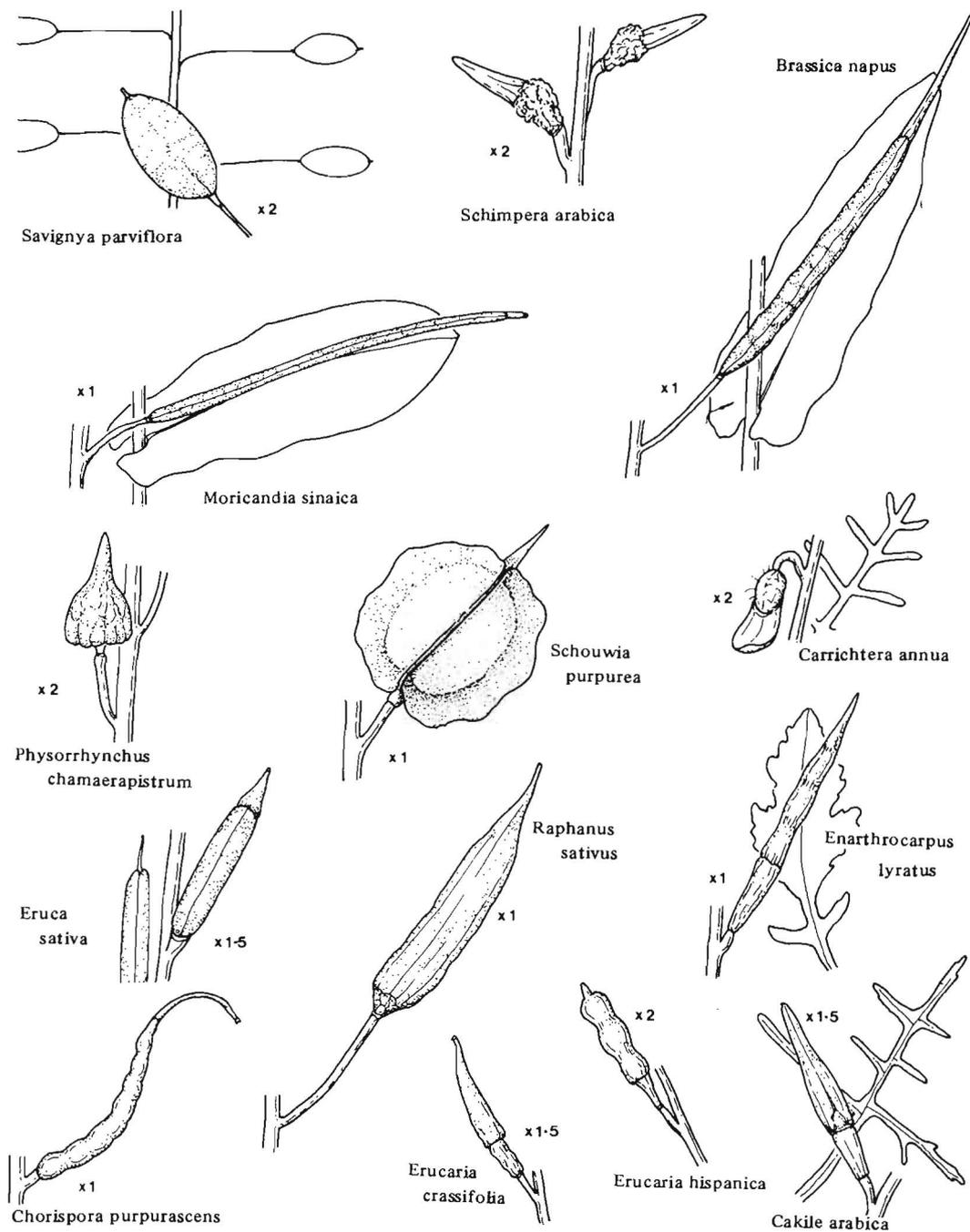


Fig.4. Fruits of Cruciferae complementing the key to genera.

32. Cauline leaves clearly amplexicaul, auriculate to sagittate 33
 + Cauline leaves sessile to petiolate, not amplexicaul 37
33. Flowers yellow 34
 + Flowers white, pink or mauve 35
34. Petals c. 1 mm long; fruit 2-5 mm with a flat beak
 diverging \pm horizontally 28. *Schimpera*
 (Fig. 4)
 + Petals c. 10-15 mm; fruit c. 50-70 mm long 1. *Brassica*
35. Fruit a siliqua c. 50-80 mm long 18. *Moricandia*
 (Fig. 4)
 + Fruit a silicule 36
36. Petals white, c. 15 mm long; fruit 2-membered, lower
 peduncle-like, upper conical, c. 5 mm broad 14. *Physorrhynchus*
 (Fig. 4)
 + Petals lilac, c. 10 mm long; fruit 2-membered with a
 strongly flattened lower portion c. 10-15 mm broad and
 a short c. 4 mm beak 16. *Schowia*
 (Fig. 4)
37. Petals with distinct brown to purple venation 38
 + Petals without distinct darker venation 41
38. Leaves 2-3 \times pinnatisect; petals c. 8 mm; fruit c. 8 mm
 long with a spatulate upper member 15. *Carrichtera*
 (Fig. 4)
 + Leaves undivided to lyrate-pinnatifid; petals 7-15 mm;
 fruit more than 20 mm long, upper member not spatulate 39
39. Petals c. 7 mm; racemes leafy; fruit clearly
 constricted between seeds 9. *Enarthrocarpus*
 (Fig. 4)
 + Petals more than 12 mm; racemes leafless; fruits not
 clearly constricted between seeds 40
40. Upper member of fruit cylindrical with a conical beak;
 fruiting pedicel c. 0.5 mm thick; flowers pink, purple
 or white 8. *Raphanus*
 (Fig. 4)
 + Upper member of fruit a sterile compressed beak;
 fruiting pedicel c. 1 mm thick, \pm adpressed to stem;
 petals yellow to whitish 6. *Eruca*
 (Fig. 4)
41. Stigma with decurrent carpidual lobes 42
 + Stigma without decurrent carpidual lobes 43
42. Plant glabrous, glaucous with simple leaves and
 2-membered fruits, upper conical, c. 10 mm long 15. *Physorrhynchus*
 (Fig. 4)

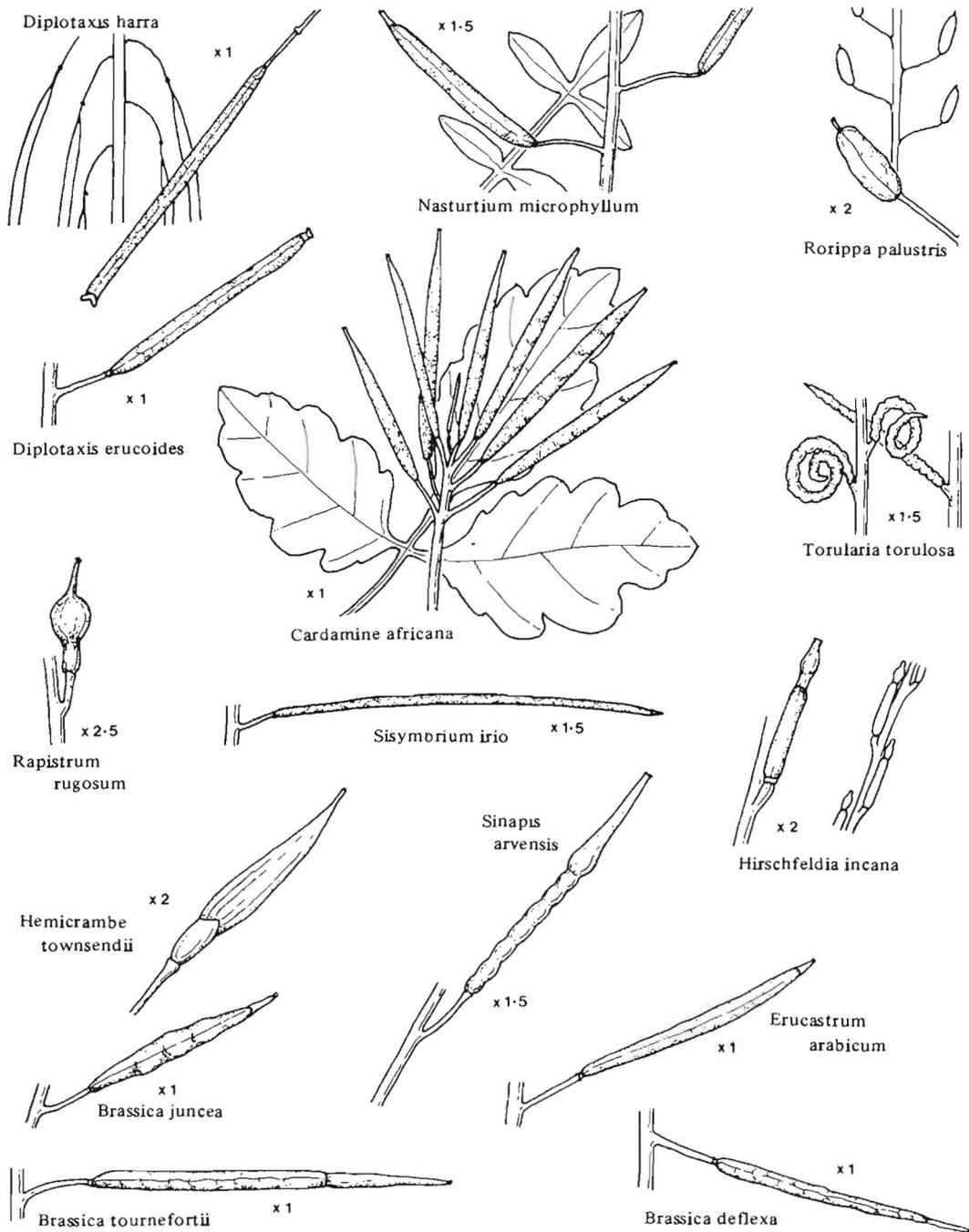


Fig.5. Fruits of Cruciferae complementing the key to genera.

- + Plant with substrigose hairs and small stipitate glands; leaves pinnatisect or \pm lyrate; fruit c. 30-60 mm long, constricted between seeds 43. *Chorispora* (Fig. 4)
- 43. Flowers lilac, pink or purple 44
- + Flowers white, cream or yellow 47
- 44. Leaves pinnate with \pm linear terminal segments 45
- + Leaves undivided to lyrate 46
- 45. Upper segment of fruit a long flattened seedless beak; stigma sessile 12. *Cakile* (Fig. 4)
- + Upper segment of fruit not beaked, but seeded and constricted between the seeds; style distinct 11. *Erucaria* (Fig. 4)
- 46. Fruit a readily dehiscent 1-membered siliqua with straight parallel edges, \pm stipitate 5. *Diplotaxis* (Fig. 5)
- + Fruit a 2-membered siliqua with convex not parallel edges, not stipitate (cultivated or weedy places) 8. *Raphanus* (Fig. 4)
- 47. Completely glabrous plants with pinnately divided leaves; marsh or water plants 48
- + Plants with an indumentum (on at least some part of the plant) growing in dry places; leaves divided or not 49
- 48. Petals white; siliqua c. 20 mm long 37. *Nasturtium* (Fig. 5)
- + Petals yellow; siliqua c. 5 mm long 38. *Rorippa* (Fig. 5)
- 49. Fruits 1-membered, without an obvious beak 50
- + Fruits 2-membered, with a \pm prominent beak 53
- 50. Leaves clearly 3-foliolate with broadly ovate leaflets; decumbent or ascending herbs (Y.A.R.) 34. *Cardamine* (Fig. 5)
- + Leaves simple, pinnatifid or pinnate; \pm erect plants 51
- 51. Petals 2-4 mm long; fruit slender, torulose, often contorted 50. *Torularia* (Fig. 5)
- + Petals more than 6 mm long; fruit \pm straight, not or scarcely constricted between the seeds 52
- 52. Seeds arranged in two rows in each loculus 5. *Diplotaxis* (Fig. 5)
- + Seeds arranged in one row in each loculus 49. *Sisymbrium* (Fig. 5)

53. Seeds arranged in two rows in each loculus 5. *Diploaxis*
(Fig. 5)
- + Seeds arranged in one row in each loculus 54
54. Fruits closely adpressed to stem; fruiting pedicels
short and thick (c. 1-1.5 mm); base of stem with
 \pm stiff retrorse hairs 55
- + Fruits spreading-erect; fruiting pedicels \pm elongated and
slender; base of stem with not, or scarcely, retrorse
hairs or hairs absent 56
55. Upper segment of fruit ovoid or spherical, clearly broader
than lower segment 10. *Rapistrum*
(Fig. 5)
- + Upper segment of fruit oblong, as wide as the lower segment 4. *Hirschfeldia*
(Fig. 5)
56. Fruit with convex not parallel edges; valves not readily
separating at maturity 57
- + Fruit with parallel edges, sometimes somewhat constricted between
the seeds; valves readily separating at maturity 58
57. Upper segment of fruit laterally compressed; leaves
undivided; shrub (Socotra) 7. *Hemicrambe*
(Fig. 5)
- + Upper segment of fruit inflated- cylindrical; leaves
undivided to lyrate-pinnatisect; annual to biennial
(in cultivated or weedy places) 8. *Raphanus*
(Fig. 4)
58. Fruit 4-angled; sepals all equal; stem with retrorse
hairs 2. *Erucastrum*
(Fig. 5)
- + Fruit not 4-angled; sepals \pm unequal; stem glabrous or
with spreading hairs 59
59. Valves of fruit with one prominent middle nerve and few
inconspicuous lateral veins 1. *Brassica*
(Fig. 5)
- + Valves of fruit with 3-7 nerves (apparent on young
fruits) 3. *Sinapis*
(Fig. 5)

Synopsis of Arabian Genera of CRUCIFERAE

Arranged in tribal and taxonomic sequence according to O.E. Schulz, *Pflanzenfamilien*, ed. 2, 17B (1936).

BRASSICEAE - hairs simple or absent; fruit usually a silique with a distinct beak;

cotyledons longitudinally folded round the incumbent radicle.

- | | | |
|------------------------|--------------------------|---------------------------|
| 1. <i>Brassica</i> | 7. <i>Hemicrambe</i> | 13. <i>Zilla</i> |
| 2. <i>Erucastrum</i> | 8. <i>Raphanus</i> | 14. <i>Physorrhynchus</i> |
| 3. <i>Sinapis</i> | 9. <i>Enarthrocarpus</i> | 15. <i>Carrichtera</i> |
| 4. <i>Hirschfeldia</i> | 10. <i>Rapistrum</i> | 16. <i>Schouwia</i> |
| 5. <i>Diplotaxis</i> | 11. <i>Erucaria</i> | 17. <i>Savignya</i> |
| 6. <i>Eruca</i> | 12. <i>Cakile</i> | 18. <i>Moricandia</i> |

LEPIDIEAE - hairs simple or absent; fruit an angustiseptate silicle rarely scarcely compressed; radicle incumbent or accumbent.

- | | | |
|----------------------|-----------------------|------------------------|
| 19. <i>Lepidium</i> | 22. <i>Isatis</i> | 25. <i>Lachnocapsa</i> |
| 20. <i>Coronopus</i> | 23. <i>Horwoodia</i> | 26. <i>Capsella</i> |
| 21. <i>Cardaria</i> | 24. <i>Biscutella</i> | |

EUCLIDIEAE - hairs simple, branched or absent, glandular or eglandular; fruit indehiscent or tardily dehiscent, nut-like, often with appendages; radicle incumbent or accumbent; cotyledons variously folded.

- | | | |
|-----------------------|----------------------|-------------------|
| 27. <i>Anastatica</i> | 28. <i>Schimpera</i> | 29. <i>Neslia</i> |
|-----------------------|----------------------|-------------------|

ALYSSEAE - hairs dendroid, stellate, furcate, medifixed or simple; fruit usually a compressed or somewhat inflated latiseptate silicle.

- | | | |
|---------------------|----------------------|---------------------|
| 30. <i>Farsetia</i> | 32. <i>Lobularia</i> | 33. <i>Clypeola</i> |
| 31. <i>Alyssum</i> | | |

ARABIDEAE - hairs simple, furcate, branched or absent; sepals somewhat spreading; stigma bilobed; fruit a siliqua; radicle accumbent

- | | | |
|----------------------|-----------------------|--------------------|
| 34. <i>Cardamine</i> | 36. <i>Arabis</i> | 38. <i>Rorippa</i> |
| 35. <i>Barbarea</i> | 37. <i>Nasturtium</i> | |

MATTHIOLEAE - hairs simple, furcate, branched or medifixed; sepals erect; stigma usually with decurrent carpoidal lobes; fruit a siliqua; radicle accumbent.

- | | | |
|------------------------|----------------------|-----------------------|
| 39. <i>Notoceras</i> | 41. <i>Matthiola</i> | 43. <i>Chorispora</i> |
| 40. <i>Diceratella</i> | 42. <i>Morettia</i> | |

HESPERIDEAE - hairs simple, furcate, dendroid or medifixed, sometimes glandular; sepals erect; stigma sometimes with decurrent carpoidal lobes; fruit a siliqua; radicle incumbent rarely accumbent.

- | | | |
|----------------------|---------------------------|--------------------|
| 44. <i>Leptaleum</i> | 46. <i>Eremobium</i> | 48. <i>Maresia</i> |
| 45. <i>Malcolmia</i> | 47. <i>Sterigmostemum</i> | |

SISYMBRIEAE - hairs simple or branched; sepals spreading; stigma capitate or bilobed; fruit a siliqua; radicle incumbent.

49. *Sisymbrium*

50. *Torularia*

51. *Arabidopsis*

Discussion

Phytogeography

The vast majority of the Arabian peninsula comes within the Saharo-Sindian phytogeographical region. Various terms and limits have been applied to this phytochorion. Most recently Zohary *et al.* (1980) call it Saharo-Arabian and the eastern end of it, most of the Arabian peninsula, is designated as E Saharo-Arabian. Here, however, the older term of Saharo-Sindian is retained to cover the broad desert belt stretching from NW Africa to Sind — a distance of almost 8000 km. There are many species in different families which have this overall distribution and a substantial number of them are Cruciferae (Hedge 1976). Figure 6 shows the total range of *Savignya parviflora*. Other genera or species with the same basic type of distribution are *Farsetia* (dipping south-eastwards to the Horn of Africa), *Morettia* (Stork and Wüest, 1980), *Eremobium*, *Notoceras bicorne* (also in the Canary Islands), *Anastatica hierochuntica*, *Zilla spinosa*, *Schimpera arabica* and *Schouwia purpurea* (Moggi, 1967).

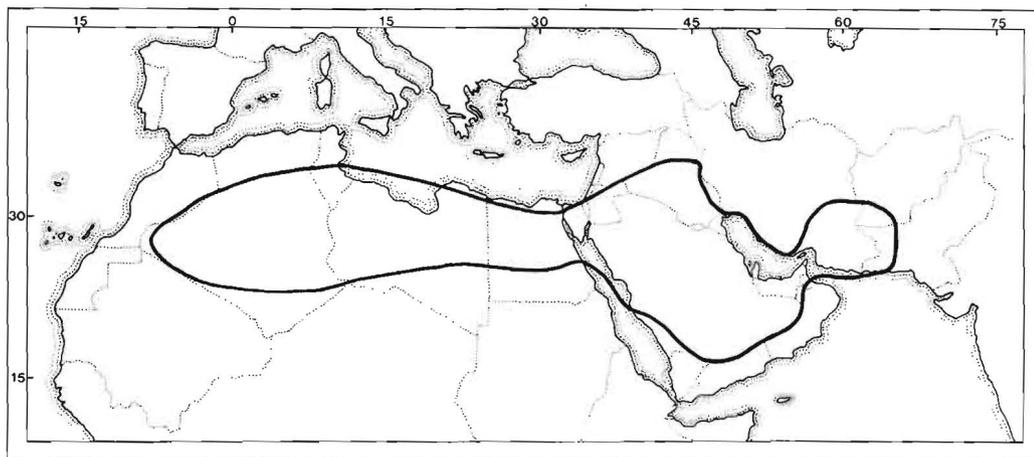


Fig. 6. Total distribution of *Savignya parviflora*: a characteristic Saharo-Sindian species.

Physorrhynchus chamaerapistrum provides an interesting example of a species, certainly Saharo-Sindian in character, which is restricted to the eastern end of the Saharo-Sindian region. Until a few years ago it was known only from Pakistan, SW and S Iran but recent collecting in Arabia has shown that it extends much further west. It is now known from Oman, United Arab Emirates and, with a large disjunction, W Saudi Arabia. Mature fruit is needed of the Saudi plant to confirm that it is the same species. The genus is probably monotypic.

Although no territory in the peninsula can be designated as Mediterranean, there are certainly a number of species in Arabia which are typically Mediterranean. One such Crucifer is *Malcolmia chia*. It is quite a common plant in the East Mediterranean growing in Turkey, Greece, the islands and W Syria. Recently, it has been discovered, in a natural habitat, in the Hijaz area of W Saudi Arabia at an altitude of c. 2100 m.

A link with the mountains of E Africa is provided by *Cardamine africana* and *Arabis alpina*. The latter, at least in the wide sense, is distributed throughout the montane areas of Europe, including Scandinavia, and apparently the same species grows in the mountains of SW Saudi Arabia, N Yemen and E Africa.

Diceratella incana, originally known only from Socotra, is also in Somalia, SE Ethiopia and N Kenya (Jonsell 1978). Socotra has a very remarkable flora with many extremely distinct endemics and most of its floristic links are African even though there are clear connections with the flora of S Yemen and Dhofar.

These four examples of distribution pattern are, of course, not particular to the Cruciferae and similar examples can be found in many other families. Equally, there are many other types of distribution patterns in the Arabian flora which are not evident among the Cruciferae. In this respect, it should be remembered that the Cruciferae is essentially a temperate family with only a small development in tropical areas of the world and then generally montane or alpine. The many African, tropical and southern, and Indian links of the Arabian flora are thus not apparent in this family.

In concluding this brief note on the phyto geography of the Cruciferae it should be noted that many of the Arabian species grow in disturbed habitats as weeds and their overall distributions, sometimes cosmopolitan, may cut across the boundaries of several phytochoria.

Endemism

There is no autochthonous development of the Cruciferae in the Arabian peninsula and only a small number of taxa are endemic: 1 genus and about 6 species.

The only truly endemic genus in our area is the Socotran *Lachnocapsa*. Monotypic and a most distinct member of the Lepidieae, it is far from clear what its allies are, if it has any. Socotra is also the home of another very distinct endemic species: *Hemicrambe townsendii* — originally described as the monotypic *Fabrisinapis*. The closest relative of this remarkable shrubby species is the Moroccan *H. fruticulosa* Webb; there is thus a disjunction of about 7000 km between the two (and only) species of the genus (Gómez-Campo 1977). A third endemic Socotran species is *Hirschfeldia rostrata*, anomalous in the genus and placed in a monotypic section; and a fourth, *Farsetia socotrana* clearly distinct from the mainland species. Two further mainland species of *Farsetia* complete the small total of endemics.

Another genus worth mentioning here is *Horwoodia*. Although it also grows in the

desert areas of S Jordan, C and S Iraq it is quite widespread in Saudi Arabia and also in Kuwait: that is, endemic to the east end of the Saharo-Sindian region. Monotypic and without close allies, it is placed in the tribe Lepidieae on account of the angustiseptate fruit, although the character of longitudinally folded cotyledons is most unusual for that tribe and characteristic of Brassiceae.

The future

Ten years ago the Cruciferae were much less well-known than they are today and ten years hence they should be appreciably better known. There are still several areas in the peninsula, such as much of South Yemen (particularly the Hadhramaut) and parts of Oman (Dhofar), W Saudi Arabia and North Yemen, where good collecting will yield, if not new species, at least new records. Certainly there will be changes, additions and deletions, to the foregoing check-list.

One genus which somewhat surprisingly has not yet been collected in Arabia is the shrubby, probably monotypic, *Fortuynia*, similar in general habit to *Physorrhynchus*, but with a strongly flattened fruit. It is widespread in southern Iran and grows in the Bandar Abbas area only about 100 km across the narrow throat of the Gulf from the Musandam part of Oman.

It is likely that some of the following very widespread weeds or species of disturbed habitats not yet recorded from Arabia will be found in the future: *Bunias erucago* L., *Descurainia sophia* (L.) Webb and Berth., *Raphanus raphanistrum* L., *Sinapis alba* L., *Thlaspi perfoliatum* L. Another species to be looked for in the north of Saudi Arabia is *Reboudia pinnata* (Viv.) O.E. Schulz.

On the other hand, there are two genera given above and marked as 'doubtful records' which may have to be deleted from the list. *Chorispora* may be based on a misidentification — even though with good material the genus is distinct enough — and the record of *Barbarea* is based on a species described by Velenowsky which may have been placed in the wrong genus. In the latter case it has not yet been possible to trace the type specimen.

A further very doubtful generic record seems to be that of *Didesmus*. It is given in Zohary *et al.* (1980) from Saudi Arabia (possibly based on De Marco and Dinelli, 1974) and Kuwait. The records may stem from misidentifications of *Cakile* or *Erucaria* and we have excluded *Didesmus* from the lists and key above, but the possibility of its occurrence in Arabia should not be neglected.

Although the Cruciferae is one of the better-known families in the Arabian peninsula there is still much that can be done. With active co-operation among all those interested in the plant life of Arabia — Arab botanists, ex-patriots and specialists abroad — it could easily become one of the best known.

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Appendix I: basic references used in compiling check-lists

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النباتات الصليبية في شبه الجزيرة العربية :
قائمة لمراجعة الأنواع ودليل للأجناس
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يقدم هذا البحث قائمة لمراجعة الأنواع المعروفة من نبات
الفصيلة الصليبية في الجزيرة العربية، ويشمل البحث
مترادفات منتقاة ويدرج أيضاً بلاد المنطقة حيث تنمو هذه
الأنواع. يتضمن البحث دليلاً حقيقياً موضحاً بالرسوم لعدد
٥١ جنساً، يليه مناقشة موجزة عن الجغرافية النباتية والتوطن
النباتي.