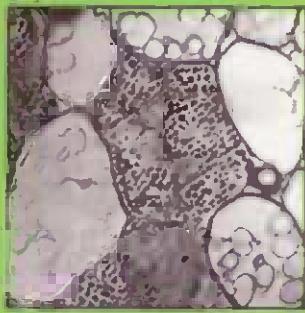


Studies in Plant Science, 2

Kuwaiti Plants

B.S. Middleditch and Amer M. Amer



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Studies in Plant Science, 2

Kuwaiti Plants

***DISTRIBUTION, TRADITIONAL MEDICINE,
PHYTOCHEMISTRY, PHARMACOLOGY, AND ECONOMIC
VALUE***

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CONTENTS

| | |
|---|------|
| PREFACE | XIII |
| <i>ADONIS</i> L. | 1 |
| <i>Adonis dentatus</i> Del. | 1 |
| <i>AELLENIA</i> Ulbr. | 1 |
| <i>Aellenia subaphylla</i> (C.A. Mey.) Botsch | 2 |
| <i>AIZOON</i> L. | 2 |
| <i>Aizoon canariense</i> L. | 2 |
| <i>Aizoon hispanicum</i> L. | 2 |
| <i>ALHAGI</i> Gagnebin | 3 |
| <i>Alhagi maurorum</i> Medik.—non DC. | 3 |
| <i>ALTHAEA</i> L. | 4 |
| <i>Althaea ludwigii</i> L. | 4 |
| <i>ALYSSUM</i> L. | 4 |
| <i>Alyssum homalocarpum</i> (Fisch. & Mey.) Boiss. | 4 |
| <i>Alyssum linifolium</i> Steph. ex Willd. | 4 |
| <i>AMMI</i> L. | 5 |
| <i>Ammi majus</i> L. | 5 |
| <i>ANABASIS</i> L. | 7 |
| <i>Anabasis setifera</i> Moq. | 7 |
| <i>ANAGALLIS</i> L. | 7 |
| <i>Anagallis arvensis</i> L. | 7 |
| <i>ANASTATICA</i> L. | 9 |
| <i>Anastatica hierochuntica</i> L. | 9 |
| <i>ANDRACHNE</i> L. | 10 |
| <i>Andrachne telephiooides</i> L. | 10 |
| <i>ANISOSCIADIUM</i> DC. | 10 |
| <i>Anisosciadium lanatum</i> Boiss. | 10 |
| <i>ARNEBIA</i> Forssk. | 11 |
| <i>Arnebia decumbens</i> (Vent.) Coss. & Kral. | 11 |
| <i>Arnebia tetragigma</i> Forssk. | 11 |
| <i>ASTRAGALUS</i> L. | 12 |
| <i>Astragalus annularis</i> Forssk. | 12 |
| <i>Astragalus bombycinus</i> Boiss. | 12 |
| <i>Astragalus corrugatus</i> Bertol. | 12 |
| <i>Astragalus dactylocarpus</i> Boiss. | 12 |
| <i>Astragalus hauarensis</i> Boiss. | 12 |

| | |
|--|----|
| <i>Astragalus schimperi</i> Boiss. | 13 |
| <i>Astragalus spinosus</i> (Forssk.) Muschl. | 13 |
| <i>Astragalus tribuloides</i> Del. | 13 |
| ATRIPLEX L. | 14 |
| <i>Atriplex dimorphostegia</i> Boiss. | 14 |
| <i>Atriplex leucoclada</i> Kar. & Kir. | 14 |
| BASSIA All. | 15 |
| <i>Bassia eriophora</i> (Schrad.) Aschers. | 15 |
| <i>Bassia muricata</i> (L.) Aschers. | 15 |
| BIENERTIA Bunge ex Boiss. | 15 |
| <i>Biennertia cycloptera</i> Bunge ex Boiss. | 15 |
| BRASSICA L. | 16 |
| <i>Brassica juncea</i> (L.) Czerniak | 16 |
| <i>Brassica tournefortii</i> Gouan. | 17 |
| BUPLEURUM L. | 18 |
| <i>Bupleurum semicompositum</i> L. | 18 |
| CAKILE Miller | 18 |
| <i>Cakile arabica</i> Velen. & Bornm. | 18 |
| CALLIGONUM L. | 19 |
| <i>Calligonum comosum</i> L'Hér. | 19 |
| CARRICHTERA DC. | 19 |
| <i>Carrichtera annua</i> (L.) DC. | 19 |
| CAYLUSEA A. St-Hil. | 20 |
| <i>Caylusea hexagyna</i> (Forssk.) M.L. Green | 20 |
| CHENOPODIUM L. | 20 |
| <i>Chenopodium murale</i> L. | 20 |
| CHROZOPHORA A. Juss. | 21 |
| <i>Chrozophora verbascifolia</i> (Willd.) A. Juss. | 21 |
| CISTANCHE Hoffsgg & Link | 21 |
| <i>Cistanche tubulosa</i> (Schrenk) Hook. f. | 21 |
| CITRULLUS Schrader | 22 |
| <i>Citrullus colocynthis</i> (L.) Schrad. | 22 |
| CONVOLVULUS L. | 24 |
| <i>Convolvulus buschtricus</i> Bornm. | 24 |
| <i>Convolvulus oxyphyllus</i> Boiss. | 24 |
| <i>Convolvulus pilosellaefolius</i> Desr. | 25 |
| CORNULACA Del. | 25 |
| <i>Cornulaca aucheri</i> Moq. | 25 |
| <i>Cornulaca leucacantha</i> Charif & Aellen | 25 |
| CRESSA L. | 26 |
| <i>Cressa cretica</i> L. | 26 |
| CRUCIANELLA L. | 26 |
| <i>Crucianella membranacea</i> Boiss. | 26 |
| CUSCUTA L. | 26 |
| <i>Cuscuta planiflora</i> Ten. | 26 |
| CYNOMORIUM L. | 27 |
| <i>Cynomorium coccineum</i> L. | 27 |

| | |
|---|----|
| DIPIOTAXIS DC. | 28 |
| <i>Diplotaxis acris</i> (Forssk.) Boiss. | 28 |
| <i>Diplotaxis harra</i> (Forssk.) Boiss. | 28 |
| ECHIUM L. | 29 |
| <i>Echium sericeum</i> Vahl | 29 |
| EMEX Campderá | 29 |
| <i>Emex spinosus</i> (L.) Campderá | 29 |
| ERODIUM L'Hérit. | 30 |
| <i>Erodium bryoniifolium</i> Boiss. | 30 |
| <i>Erodium ciconium</i> (L.) L'Hérit. | 30 |
| <i>Erodium cicutarium</i> (L.) L'Hérit. | 30 |
| <i>Erodium glaucophyllum</i> (L.) L'Hérit. | 31 |
| <i>Erodium laciniatum</i> (Cav.) Willd. | 31 |
| ERUCA Miller | 32 |
| <i>Eruca sativa</i> Miller | 32 |
| EUPHORBIA L. | 33 |
| <i>Euphorbia densa</i> Schrenk | 33 |
| <i>Euphorbia granulata</i> Forssk. | 33 |
| <i>Euphorbia isthmia</i> V. Täckh. | 33 |
| FAGONIA L. | 34 |
| <i>Fagonia bruguieri</i> DC. | 34 |
| <i>Fagonia glutinosa</i> Del. | 34 |
| <i>Fagonia olivieri</i> DC. | 35 |
| FARSETIA Turra | 35 |
| <i>Farsetia aegyptiaca</i> Turra | 35 |
| <i>Farsetia burtonae</i> Oliv. | 35 |
| FRANKENIA L. | 36 |
| <i>Frankenia pulverulenta</i> L. | 36 |
| GASTROCOTYLE Bunge | 36 |
| <i>Gastrocotyle hispida</i> (Forssk.) Bunge | 36 |
| GYPSOPHILA L. | 37 |
| <i>Gypsophila capillaris</i> . (Forssk.) C. Christensen | 37 |
| HALOCNEMUM M. Bieb. | 37 |
| <i>Halocnemum strobilaceum</i> (Pall.) M. Bieb. | 37 |
| HALOXYLON Bunge | 38 |
| <i>Haloxylon salicornicum</i> (Moq.) Bunge ex Boiss. | 38 |
| HAPLOPHYLLUM A. Juss. | 39 |
| <i>Haplophyllum tuberculatum</i> (Forssk.) A. Juss. | 39 |
| HELIANTHEMUM Miller | 40 |
| <i>Helianthemum kahiricum</i> Del. | 40 |
| <i>Helianthemum ledifolium</i> (L.) Mill. | 40 |
| <i>Helianthemum lippii</i> (L.) Pers. | 40 |
| <i>Helianthemum salicifolium</i> (L.) Mill. | 40 |
| HELIOTROPIUM L. | 41 |
| <i>Heliotropium bacciferum</i> Forssk. | 41 |
| HERNIARIA L. | 42 |
| <i>Herriaria hemistemon</i> J. Gay | 42 |

| | |
|---|----|
| <i>Herniaria hirsuta</i> L. | 42 |
| HIPPOCREPIS L. | 42 |
| <i>Hippocrepis bicontorta</i> Loisel. | 42 |
| <i>Hippocrepis unisiliquosa</i> L. | 43 |
| HORWOODIA Turrill | 43 |
| <i>Horwoodia dicksoniae</i> Turrill | 43 |
| HYOSCYAMUS L. | 43 |
| <i>Hyoscyamus pusillus</i> L. | 43 |
| HYPECOUM L. | 44 |
| <i>Hypecoum gestinii</i> Coss. & Kral. | 44 |
| <i>Hypecoum pendulum</i> L. | 44 |
| LAPPULA Gilib. | 45 |
| <i>Lappula spinocarpos</i> (Forssk.) Ascherson & Kuntze | 45 |
| LEPIDIUM L. | 45 |
| <i>Lepidium aucheri</i> Boiss. | 45 |
| LEPTALEUM DC. | 46 |
| <i>Leptaleum filifolium</i> . (Willd.) DC. | 46 |
| LIMONIUM Miller | 46 |
| <i>Limonium carnosum</i> (Boiss.) Kuntze | 46 |
| <i>Limonium thouini</i> (Viv.) Kuntze | 46 |
| LINARIA Miller | 47 |
| <i>Linaria albibrons</i> (Sibth. & Sm.) Spreng. | 47 |
| <i>Linaria simplex</i> (Willd.) DC. | 47 |
| LITHOSPERMUM L. | 48 |
| <i>Lithospermum apulum</i> (L.) Vahl | 48 |
| LOEFLINGIA L. | 48 |
| <i>Loeflingia hispanica</i> L. | 48 |
| LOTUS L. | 48 |
| <i>Lotus halophilus</i> Boiss. & Sprun. | 48 |
| LYCIUM L. | 49 |
| <i>Lycium shawii</i> Roem. & Schult. | 49 |
| MALCOLMIA R. Br. | 50 |
| <i>Malcolmia grandiflora</i> . (Bunge) Kuntze | 50 |
| MALVA L. | 50 |
| <i>Malva parviflora</i> L. | 50 |
| MARESIA Pomel | 51 |
| <i>Maresia pygmaea</i> . (Del.) O.E. Schulz | 51 |
| MATTHIOLA R. Br. | 51 |
| <i>Matthiola longipetala</i> . (Vent.) DC. | 51 |
| MEDICAGO L. | 52 |
| <i>Medicago laciniata</i> (L.) Mill. | 52 |
| MELILOTUS Miller | 53 |
| <i>Melilotus indicus</i> (L.) All. | 53 |
| MESEMBRYANTHEMUM L. | 53 |
| <i>Mesembryanthemum nodiflorum</i> L. | 53 |
| MOLTOKIOPSIS I.M. Johnston | 54 |
| <i>Moltokiopsis ciliata</i> (Forssk.) I.M. Johnston | 54 |

| | |
|---|----|
| <i>MONSONIA</i> L. | 55 |
| <i>Monsonia nivea</i> (Decne.) Decne. ex Webb | 55 |
| <i>NEURADA</i> L. | 55 |
| <i>Neurada procumbens</i> L. | 55 |
| <i>NITRARIA</i> L. | 55 |
| <i>Nitaria retusa</i> (Forssk.) Aschers. | 55 |
| <i>NOTOCERAS</i> R. Br. | 56 |
| <i>Notoceras bicorne</i> (Aiton) Amo | 56 |
| <i>OCHRADENUS</i> Del. | 56 |
| <i>Ochradenus baccatus</i> Del. | 56 |
| <i>OLIGOMERIS</i> Cambess. | 57 |
| <i>Oligomeris subulata</i> (Del.) Boiss. | 57 |
| <i>ONOBRYCHIS</i> Miller | 57 |
| <i>Onobrychis ptolemaica</i> (Del.) DC. | 57 |
| <i>ONONIS</i> L. | 57 |
| <i>Ononis serrata</i> Forssk. | 57 |
| <i>OROBANCHE</i> L. | 58 |
| <i>Orobanche cernua</i> Loefl. | 58 |
| <i>PARONYCHIA</i> Miller | 59 |
| <i>Paronychia arabica</i> (L.) DC. | 59 |
| <i>PEGANUM</i> L. | 59 |
| <i>Peganum harmala</i> L. | 59 |
| <i>PITURANTHOS</i> Viv. | 61 |
| <i>Pituranthus triradiatus</i> (Hochst. ex Boiss.) Aschers & Schweinf. | 61 |
| <i>PLANTAGO</i> L. | 62 |
| <i>Plantago amplexicaulis</i> Cav. subsp. <i>bauphula</i> (Edgew.) Rech. f. | 62 |
| <i>Plantago boissieri</i> Hausskn. & Bornm. | 62 |
| <i>Plantago ciliata</i> Desf. | 62 |
| <i>Plantago coronopus</i> L. | 63 |
| <i>Plantago lagopus</i> L. | 63 |
| <i>Plantago notata</i> Lag. | 63 |
| <i>Plantago ovata</i> Forssk. | 63 |
| <i>Plantago psammophila</i> Agnew & Chalabi-Ka'bl | 64 |
| <i>POLYCARPAEA</i> Lam. | 64 |
| <i>Polycarpaea repens</i> (Forssk.) Aschers. & Schweinf. | 64 |
| <i>POLYCARPON</i> L. | 65 |
| <i>Polycarpion tetraphyllum</i> (L.) L. | 65 |
| <i>PSYLLIOSTACHYS</i> (Jaub. & Spach) Nevski | 65 |
| <i>Psylliostachys spicata</i> (Willd.) Nevski | 65 |
| <i>PTERANTHUS</i> Forssk. | 65 |
| <i>Pteranthus dichotomus</i> Forssk. | 65 |
| <i>RESEDA</i> L. | 66 |
| <i>Reseda arabica</i> Boiss. | 66 |
| <i>Reseda decursiva</i> Forssk. | 66 |
| <i>Reseda muricata</i> C. Presl | 66 |
| <i>ROBBAIREA</i> Boiss. | 67 |
| <i>Robbairea delileana</i> (Forssk.) Boiss. | 67 |

| | |
|--|----|
| ROEMERIA Medikus | 67 |
| <i>Roemeria hybrida</i> (L.) DC. subsp. <i>hybrida</i> | 67 |
| RUMEX L. | 68 |
| <i>Rumex pictus</i> Forssk. | 68 |
| <i>Rumex vesicarius</i> L. | 68 |
| SALICORNIA L. | 69 |
| <i>Salicornia herbacea</i> L. | 69 |
| SALSOLA L. | 70 |
| <i>Salsola baryosma</i> (Roem. & Schult.) Dandy | 70 |
| <i>Salsola jordanicola</i> Eig | 70 |
| SAVIGNYA DC. | 70 |
| <i>Savignya parviflora</i> (Del.) Webb | 72 |
| SCABIOSA L. | 72 |
| <i>Scabiosa olivieri</i> Coulter | 72 |
| <i>Scabiosa palaestina</i> L. | 72 |
| SCHANGINIA C.A. Mey. | 73 |
| <i>Schanginia aegyptiaca</i> (Hasselq.) Aellen | 73 |
| SCHIMPERA Hochst. & Steudel ex Engel | 73 |
| <i>Schimpera arabica</i> Hochst. & Steudel ex Boiss. | 73 |
| SCLEROCEPHALUS Boiss. | 73 |
| <i>Sclerocephalus arabicus</i> Boiss. | 73 |
| SCROPHULARIA L. | 74 |
| <i>Scrophularia deserti</i> Del. | 74 |
| SEETZENIA R. Br. ex Decne. | 74 |
| <i>Seetzenia orientalis</i> Decne. | 74 |
| SEIDLITZIA Bunge ex Boiss. | 75 |
| <i>Seidlitzia rosmarinus</i> Bunge ex Boiss. | 75 |
| SILENE L. | 75 |
| <i>Silene arabica</i> Boiss. | 75 |
| <i>Silene linearis</i> Decne. | 75 |
| <i>Silene villosa</i> Forssk. | 76 |
| SISYMBRIUM L. | 76 |
| <i>Sisymbrium erysimoides</i> Desf. | 76 |
| <i>Sisymbrium trio</i> L. | 76 |
| <i>Sisymbrium orientale</i> L. | 77 |
| <i>Sisymbrium septulatum</i> DC. | 77 |
| SPERGULA L. | 77 |
| <i>Spergula fallax</i> (Lowe) Krause | 77 |
| SPERGULARIA (Pers.) J. Presl & C. Presl | 78 |
| <i>Spergularia diandra</i> (Guss.) Heldr. & Sart. | 78 |
| SUAEDA Forssk. ex Scop. | 78 |
| <i>Suaeda vermiculata</i> Forssk. ex J.F. Gmel. | 78 |
| TAMARIX L. | 79 |
| <i>Tamarix aucherana</i> (Decne. ex Walp.) Baum. | 79 |

| | |
|--|-----|
| TEUCREUM L. | 79 |
| <i>Teucreum oliverianum</i> Ging. ex Benth. | 79 |
| <i>Teucreum polium</i> L. | 80 |
| THYMELAEA Miller | 80 |
| <i>Thymelaea mesopotamica</i> (C. Jeffrey) B. Peterson | 80 |
| TORULARIA (Cossion) O. Schulz | 81 |
| <i>Torularia torulosa</i> (Desf.) O.E. Schulz | 81 |
| TRAGANUM Del. | 81 |
| <i>Traganum nudatum</i> Del. | 81 |
| TRIBULUS L. | 81 |
| <i>Tribulus terrestris</i> L. | 81 |
| TRIGONELLA L. | 83 |
| <i>Trigonella anguina</i> Del. | 83 |
| <i>Trigonella hirsuta</i> Forssk. | 83 |
| VALERIANELLA Miller | 84 |
| <i>Valerianella diffracta</i> Bunge ex Boiss. | 84 |
| ZILLA Forssk. | 84 |
| <i>Zilla spinosa</i> (L.) Prantl | 84 |
| ZYGOPHYLLUM L. | 85 |
| <i>Zygophyllum coccineum</i> L. | 85 |
| LITERATURE CITED | 259 |
| BIBLIOGRAPHY | 283 |
| ALPHABETICAL LIST OF FAMILIES AND GENERA | 285 |
| AUTHOR INDEX | 291 |
| CHEMICAL NAME INDEX | 299 |
| PLANT SYSTEMATIC NAME INDEX | 305 |
| PLANT COMMON NAME INDEX | 315 |
| GENERAL INDEX | 319 |

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PREFACE

Nestled at the head of the Gulf, Kuwait's major resource for more than two centuries was its fine natural harbor. The people of Kuwait depended almost entirely on the sea and trade, and its sailors and boat builders had a high reputation. Horses, sheep, and wool were exported in exchange for such staples as rice, sugar and tea. The plants of Kuwait were of value only for forage and fodder and for subsistence-level farming.

Oil was discovered in 1938, although production had to await the ending of the Second World War. Kuwait has been transformed since the spigots were opened. The most valuable plants now are the petrochemical plants and the desalinization plants.

The recent unrest has resulted in widespread damage to many of Kuwait's plants. This is an appropriate time, therefore, to review the information on them that has accumulated over the years. It is fortunate that the first volume of the *Flora of Kuwait* was recently published. That monograph covered all of the dicotyledons, with the exception of the Compositae. Those are the plants that we discuss in the current volume.

For each of the species, we have reviewed traditional uses in Kuwait and elsewhere. We have conducted extensive searches of the scientific literature on the phytochemistry, pharmacology, and contemporary economic value of the plants. In addition, we have provided brief notes on the utility of related species. The distribution of each species is illustrated on maps of Kuwait and the Middle East.

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ADONIS L.**RANUNCULACEAE**

The generic name derives from that of the Greek god Adonis who, embodying the yearly growth and death of vegetation, was said to have been changed into an adonis plant after death.

***Adonis dentatus* Del.**

Geographic Distribution. See Figure 1.

Other Useful *Adonis* Species

Adonis chrysocyathus Hook. f. & Thoms. ex Hook. f. is said to be poisonous and is avoided by animals. *Adonis vernalis* L. (Spring adonis) is employed as a diuretic and cardiac stimulant, inducing an effect similar to that of digitalis. *Adonis aestivalis* L. (Summer adonis, Summer pheasant's eye, Tall adonis) and *Adonis annua* L. (Autumn adonis, Pheasant's eye) are occasionally substituted.

AELLENIA Ulbr.**CHENOPodiaceae**

***Aellenia glauca* (M.B.) Aellen**

Salsola glauca M.B.

Geographic Distribution. See Figure 2.

Phytochemistry, Pharmacology, and Economic Value. Contains betaine and the bioflavonoids isorhamnetin 3-O- β -D-glucoside, quercetin, and rutin (Mnatsakanyan et al., 1981).

A classical pharmacognostic screen of the above-ground portion of the plant indicated the presence of alkaloids, flavonoids, saponins, and tannins (Aynehchi et al., 1981).

***Aellenia subaphylla* (C.A. Mey.) Botsch.**

Salsola subaphylla C.A. Mey.

Geographic Distribution. See Figure 3.

AIZOON L.

AIZOACEAE

***Aizoon canariense* L.**

The herb is consumed as a food by the Tuareg, and also by camels in Kuwait.

Geographic Distribution. See Figure 4.

***Aizoon hispanicum* L.**

Occasionally eaten by camels in Kuwait.

Geographic Distribution. See Figure 5.

ALHAGI Gagnebin**LEGUMINOSAE**

Alhagi maurorum Medik.—non DC.

Alhagi graecorum Boiss.
Alhagi manniifera Desv.
Manna hebraica D. Don
Hedysarum alhagi L.

Persian manna plant

The term 'manna' has been applied to the sweet, powdery substance obtained from this shrub. It appears when the plant flowers after the spring rains, and can be shaken from the branches and collected on a cloth spread on the ground. The plant is an important food for camels. The roots are occasionally consumed by nomadic desert tribes. A source of firewood.

Geographic Distribution. See Figure 6.

Traditional Medicine. Diuretic, expectorant, laxative, purgative, tonic, vermicide. Infusion of thorny flower stalks and branches used for treatment of bilharziasis, hemorrhoids, migraine headaches, opacity of the cornea, and rheumatic pains. The manna is used as an aperient, blood purifier, cholagogue, diuretic, expectorant, and restorative.

Phytochemistry, Pharmacology, and Economic Value. A classical pharmacognostic screen of the above-ground portion of the plant indicated that it contained anthraquinones, flavonoids, saponins, sterols/triterpenes, and tannins. An ethanolic extract (5 mg) showed a positive inotropic effect on isolated rabbit heart, while a 10-mg dose caused a transient fall in blood pressure in an anesthetized rabbit. Central nervous system stimulation was accompanied by rapid respiration, twitches, and tremors (Al-Yahya et al., 1987).

Other Useful *Alhagi* Species

The sap of some species is employed as a laxative. *Alhagi camelorum* Fisch. (Camelsthorn, Manna plant) also exudes a manna (manna mereniabin), and a decoction of the root is employed to treat swellings and abscesses. *Alhagi persorum* Boiss. & Buhse is the source of a widely-used laxative.

ALTHAEA L.**MALVACEAE**

***Althaea ludwigii* L.**

Geographic Distribution. See Figure 7.

Other Useful *Althaea* Species

The root, Radix Althaeae, of *Althaea officinalis* L. (Marsh mallow, White mallow) has been used medicinally as a demulcent and diuretic since the time of Theophrastus. The boiled leaves are edible, and the root is chewed to ease teething pains. An infusion made of the flower of *Althaea lavateraeflora* DC. is drunk in Afghanistan to treat coughs. The leaves of *Althaea rosea* (L.) Cav. (Hollyhock) are employed in Egyptian cookery, while the root has been employed medicinally as a demulcent, diuretic, and emollient.

ALYSSUM L.**CRUCIFERAE**

The generic name derives from the Greek *lyssa* (= madness), since a plant of this species was reputed to cure insanity.

***Alyssum homalocarpum* (Fisch. & Mey.) Boiss.**

Psilonema homalocarpum Fisch. & Mey.

Geographic Distribution. See Figure 8.

***Alyssum linifolium* Steph. ex Willd.**

Alyssum cupreum Freyn & Sint.

Meniocus linifolius (Steph. ex Willd.) DC.

Geographic Distribution. See Figure 9.

AMMI L.**UMBELLIFERAE*****Ammi majus* L.**

Bishop's weed, May weed

Cultivated in some countries as a cut flower. In Bermuda, the plant is reputed to be poisonous if handled when moist. It is also said to cramp the feet of chickens and turkeys so that they cannot open their claws. Not common in Kuwait.

Geographic Distribution. See Figure 10.

Traditional Medicine. Seeds carminative, diuretic, stomachic, tonic. Used to treat angina pectoris and asthma.

Phytochemistry, Pharmacology, and Economic Value. The fruit contains the bioflavonoids luteolin, quercetin (Harborne and Williams, 1972), isoquercetin, kaempferol 7-O-glucoside, and marmesinin (Mishaal et al., 1981) and the furochromones khellin and visnagin (Sener et al., 1986). "Ammifurin" is a mixture of furocoumarins obtained from the fruit, containing bergapten, isopimpinellin, and xanthotoxin (Antonova and Kabanov, 1985). These three compounds had previously been isolated from the fruit and identified individually (Tarpo et al., 1966, 1967; Eisenreichova et al., 1980; Gromakova and Perel'son, 1980; Gromakova et al., 1983). Imperatorin has been detected, in addition to bergapten and xanthotoxin, by Karawya et al. (1970) and by Hilal and coworkers (Balbaa et al., 1972a,b; Hilal and Haggag, 1975; Haggag and Hilal, 1977; Hilal et al., 1982). The analytical resolution of imperatorin from xanthotoxin has been described by Shawl and Vishwapaal (1977). "Meladenin," a by-product of processing of the fruit, contains bergapten, imperatorin, and isopimpinellin (Abu-Mustafa and Fayez, 1976). Ammirin has also been found in the coumarin glycoside fraction of the fruit (Abu-Mustafa et al., 1975a), while alloimperatorin was present in the free coumarin fraction (Abu-Mustafa et al., 1975b). Ammajin (Tarpo et al., 1968) and its aglycone marmesin have been found in the fruit (Balbaa et al., 1973). Isoimperatorin (Abu-Mustafa et al., 1968), majurin (Abu-Mustafa et al., 1971a) and umbelliprenin (Abu-Mustafa et al., 1971b) are also present in the fruit. Heraclenin has been isolated from fruit grown in Czechoslovakia (Buckova et al., 1983). Oleic and palmitic acids predominate in the triglycerides, 2-monoglycerides, and phospholipids of the plant (Fiad and Osman, 1975). Seed from plants grown in Texas was found to contain (-)-5-[2-(acetoxyl)-3-hydroxy-3-methylbutoxyl]psoralen, (-)-heraclenin, 8-[2-(3-methylbutyroxy)-3-hydroxy-3-methylbutoxyl]psoralen, (-)-5-[2-(3-methylbutyroxy)-3-hydroxy-3-methylbutoxyl]psoralen, (+)-oxypeucedanin, (+)-oxypeucedanin hydrate, pabulenol, and saxalin, in addition to bergapten, isoimperatorin, isopimpinellin, and xanthotoxin (Ivie, 1978). The seed oil contains high-boiling hydrocarbons (1.34%), dl-piperitone (10%), an unsaturated cyclic terpene alcohol (15%), and a mixture of furocoumarins (60%), including bergapten, imperatorin, isoimperatorin, isopimpinellin, and xanthotoxin (Ashraf et al., 1979).

The coumarin content is highest in the fully-grown green fruit, and decreases rapidly as they ripen (Balbaa et al., 1972a; Stahl and Herting, 1976). The seeds contain their greatest concentration of furocoumarins during the wax stage of ripeness (Ashirova and Meredov, 1974). The yield of furocoumarins has been found to be greatest in plants growing in soil treated with a high-nitrogen fertilizer having an N-P-K ratio of 2:2:1 (Fomenko and Krivut, 1972; Sheberstov et al., 1972). High-nitrogen fertilizers increase the yield of seeds (Gryzlov and Chernobai, 1969).

The photosensitizing effect of the seeds on goslings has been investigated, the animals developing erythema, hematomas and blisters on the upper side of the beak and also conjunctivitis (Shlosberg et al., 1974). The furocoumarins probably account for the high photosensitizing activity of this plant toward cattle and sheep (Ivie, 1978). The utility of bergapten, isopimpinellin, and xanthotoxin against skin disease has been investigated (Eisenreichova et al., 1982).

The fruit contains substances that inhibit germination of seeds of other species, such as *Anastatica hierochuntica* L., lettuce, and tomato. Xanthotoxin accounts for only 15% of the inhibition activity, and the other active components have not been identified. This phenomenon may contribute to the success of *Ammi majus* L. as a weed (Friedman et al., 1982).

The utility of this plant as a commercial source of xanthotoxin has been discussed (Handa et al., 1977; Mahajan and Vishwapaal, 1977). Loufty et al. (1975) had already isolated imperatorin and xanthotoxin from this species and used them as synthetic precursors of related compounds.

An aqueous extract of *Ammi majus* L. is an effective corrosion inhibitor (Ibrahim et al., 1981).

Other Useful *Ammi* Species

Dried fruits of *Ammi visnagi* Lam. (Toothpick plant) have been employed medicinally in the treatment of angina pectoris, asthma, gastric ulcers, rheumatism, and urinary disorders. It is the pedicels that are used as toothpicks (in Egypt).

ANABASIS L.**CHENOPodiaceae*****Anabasis setifera* Moq.**

Seidlitzia lanigera Post

Provides good grazing for camels in Kuwait.

Geographic Distribution. See Figure 11.

Phytochemistry, Pharmacology, and Economic Value. The volatile oil, which comprises 2.5% fresh weight of the plant, contains only carvacrol (85%) and thymol (15%). This plant may be a useful source of these two compounds (Saleh, 1986). The plant also contains oxalic acid (0.67%), sulfate (3.8%), and saponins (El-Hakeem and Weinert, 1976).

A classical pharmacognostic screen of the above-ground portion of the plant indicated the presence of alkaloids, flavonoids, and tannins, but not saponins (Aynehchi et al., 1985).

Other Useful *Anabasis* Species

Anabasis aphylla L. has been used as an insecticide. The stem of *Anabasis articulata* (Forssk.) Moq. produces a gum, while the plant serves as camel fodder.

ANAGALLIS L.**PRIMULACEAE**

It has been suggested that the generic name derives from the Greek *anagelao* (= to laugh), either because consumption of the leaves of *Anagallis arvensis* L. leads to such action or because of the relief resulting from removal of intestinal and hepatic obstructions after the drug is taken.

***Anagallis arvensis* L.**

Anagallis arvensis L. var. *micrantha* Gren. & Godron.

Anagallis arvensis L. var. *phoenicia* Gouan

Anagallis caerulea L. var. *parviflora* (Hoffmanns. & Link) Salis.-Marschl.

Anagallis carnea Schrank

Anagallis parviflora Hoffmanns. & Link
Anagallis phoenicea Scop.

Common pimpernel, Poor man's weatherglass, Red chickweed, Red pimpernel, Scarlet pimpernel, Shepherd's clock, Shepherd's weatherglass

The leaves are consumed raw or boiled. The plant is also eaten by sheep in Kuwait. The flowers close at the approach of inclement weather (actually, when the relative humidity increases), hence the name poor man's weatherglass. In India the herb has been employed as a fish poison and to kill leeches.

Geographic Distribution. See Figure 12.

Traditional Medicine. Cephalic, detergent, diaphoretic, diuretic, sudorific, vulnerary. Used for treatment of cirrhosis of the liver, convulsions, epilepsy, gallstones, gout, gravel, lung ailments, and the plague. Antidote for viper venom. Reportedly used to cure even advanced stages of rabies (applied to the bite and also taken orally). Juice administered through nostrils to relieve toothache. Intestinal worms are treated in Ecuador by using two plasters made from the ground plant. One is placed on the forehead and a second on the back, and then an infusion of the plant is drunk. Alternatively, the liquid squeezed from the green plant is taken orally. Small doses are said to lead to the following symptoms: lively mood with extra mental vigor, stitching headache with sticking pains in the eyeballs, dryness of the throat, tickling prickling along the urethra causing desire for coition, prickling in the chest, general drawing rheumatic pains, sleeplessness, trembling and shivering, and trembling of the heart (Millspaugh, 1892). Larger doses may be fatal.

Phytochemistry, Pharmacology, and Economic Value. A triterpene saponin fraction from this species has been found to inhibit the replication of *Herpes simplex* virus type 1 and poliovirus type 2 (Amoros et al., 1979). The saponins had no virucidal activity, but may have inhibited virus-host cell attachment (Amoros et al., 1987). An ointment containing triterpene saponins from this plant was as effective as idoxuridine and vidarabine, but not as effective as acyclovir, in treating *Herpes simplex* keratitis that had been induced in rabbit eyes (Amoros et al., 1988). One antiviral terpene saponin was identified as the 3-O-glucose (1 \rightarrow 3 or 4) [arabinose 1 \rightarrow 4 or 3]-glucose (1 \rightarrow 2)-xyloside of 23-hydroxy-protoprimulagenin A, while a second antiviral triterpene saponin contained an additional glucose moiety (Amoros and Girre, 1987). Triterpene saponins that have been identified in this plant include anagallosides A, B, and C and deglucoanagallosides A and B (Glombitz and Kurth, 1987a). Four saponins were isolated and partially characterized by Glombitz and Kurth (1987b). The aglycone of two of them was priverogenin A, while the aglycone of the other two was 3 β ,16 α ,23,28-tetrahydroolean-12-ene. All four saponins contained arabinose, glucose, and xylose.

Saponins from the roots of this plant have been found to exhibit hemolytic activity (Alimbaeva and Mukhamedziev, 1969; Mukhamedziev and Alimbaeva, 1970; Banerji et al., 1981). A triterpene glycoside from the stems and leaves was found to exhibit antifungal, but not antibacterial, activity. This compound also inhibited the germination of linseed (Staron et al., 1969).

Estrogenic activity was detected in methanol extracts of the aerial portion of the plant, using the Allen-Doisy test. Estrus was induced in 80% of mice following subcutaneous administration of 0.1 g or oral administration of 0.25 g of the dried extract (Birza et al., 1974).

The aerial part of the plant has been found to contain β -amyrin, anagalligenin, arabinose, glucose, hexacosane, lacceric acid, rutin, sitosterol, stigmasterol, and xylose (Rastogi and Norula, 1979). The glycosidic fraction also contains a 13,28-epoxy-16-oxoolean-3 β ,23-diol (anagalligenone B) (Heitz et al., 1971).

Cucurbitacins isolated from the plant include cucurbitacin E, 2-O- β -D-glucopyranosylcucurbitacin B (arvenin I), 2-O- β -D-glucopyranosyl-23,24-dihydrocucurbitacin B (arvenin II) (Yamada et al., 1977), 2-O- β -D-glucopyranosylcucurbitacin D (arvenin III), and 2-O- β -D-glucopyranosylcucurbitacin R (arvenin IV) (Yamada et al., 1978a). The plant also contains cucurbitacins B, D, and E, and possibly cucurbitacins I, L, and R (Yamada et al., 1978b).

Petals have been found to contain the bioflavonoids luteolin, luteolin 7-glucoside, malvidin 3-rhamnoside, and quercitrin (Ishikura, 1981). The flowers also contain the bioflavonoids kaempferol, quercetin, and rutin and the steroids sitosterol, α -spinasterol, and stigmasterol (Rastogi and Norula, 1980).

High levels of linoleic (29.6%) and linolenic (23.9%) acids were found in the seed oil (Ahmad et al., 1979). A more detailed analysis of saponified seed oil revealed the presence of myristic (5.7%), palmitic (31.4%), oleic (26.4%), linoleic (17.6%), linolenic (16.3%) and gadoleic (2.6%) acids, together with long-chain saturated alcohols, sitosterol, and stigmasterol (Norula et al., 1978).

A classical pharmacognostic screen of the above-ground portion of the plant indicated the presence of saponins, but not alkaloids, flavonoids, or tannins (Aynehchi et al., 1985).

An extract of the plant has been found to exhibit antifungal activity against *Helminthosporium maydis* (Khanna et al., 1967).

ANASTATICA L.**CRUCIFERAE**

***Anastatica hierochuntica* L.**

Resurrection plant, Rose of Jericho, St. Mary's flower

The branches of this plant curl up around the seed pod as it ripens, forming a round ball. When this ball is placed in water—even years later—the branches uncurl and spread out.

and the pods open and discharge their seeds. There is a Moslem tradition that the plant expanded in this manner when Ayesha (the favorite wife of the Prophet and mother of the Faithful) gave birth. The dried plants are sold to tourists.

Geographic Distribution. See Figure 13.

Traditional Medicine. The drug is prescribed to ease labor. The plant is placed in water, which is administered to the patient after the plant has expanded. This use is clearly related to the Moslem legend.

Phytochemistry, Pharmacology, and Economic Value. A classical pharmacognostic screen of the whole plant indicated the presence of alkaloids, bioflavonoids, glucosinolates, saponins, sterols/triterpenes, and tannins (Al-Yahya, 1986).

ANDRACHNE L.**EUPHORBIACEAE**

***Andrachne telephiooides* L.**

Geographic Distribution. See Figure 14.

Phytochemistry, Pharmacology, and Economic Value. A classical pharmacognostic screen of the whole plant indicated the presence of alkaloids and saponins, but not flavonoids or tannins (Aynehchi et al., 1981).

ANISOSCIADIUM DC.**UMBELLIFERAE**

***Anisosciadium lanatum* Boiss.**

Echinosciadium arabicus Zoh.

The young, green leaves are eaten by Bedouin children.

Geographic Distribution. See Figure 15.

ARNEBIA Forssk.**BORAGINACEAE*****Arnebia decumbens*** (Vent.) Coss. & Kral.

Arnebia cornuta (Ledeb.) Fisch. & C.A. Mey.
Arnebia orientalis Lipsky
Arnebia vivianii Coss. & Dur.
Lithospermum cornutum Ledeb.
Lithospermum decumbens Vent.
Lithospermum micranthum Viv.
Onosma divaricatum Lehm.

A red pigment from the root is used as a rouge by the Bedouin women.

Geographic Distribution. See Figure 16.

Phytochemistry, Pharmacology, and Economic Value. Air-dried roots were found to contain 5,8-dihydroxy-2-(14-methylpent-13-enyl)-1,4-naphthoquinone, shikonin isovalerate (Afzal and Al-Oriqat, 1986a), shikonin, shikonin acetate, and stigmasterol (Afzal and Al-Oriquat, 1986b). An efficient process has been described for extracting the dye shikonin from this plant (Gasmelseed et al., 1989).

Arnebia tetraستigma Forssk.

Arnebia tinctoria Forssk.
Lithospermum arnebia Del.
Lithospermum tetraستigma Lam.
Lithospermum tinctorium Vahl

This plant is eaten by sheep in Kuwait. The root also contains a red pigment.

Geographic Distribution. See Figure 17.

Other Useful *Arnebia* Species

The root of *Arnebia hispidissima* DC. is the source of a red dye.

ASTRAGALUS L.**LEGUMINOSAE**

***Astragalus annularis* Forssk.**

Geographic Distribution. See Figure 18.

Phytochemistry, Pharmacology, and Economic Value. A classical pharmacognostic screen of the above-ground portion of the plant indicated the presence of saponins, but not alkaloids, flavonoids, or tannins (Aynehchi et al., 1982).

***Astragalus bombycinus* Boiss.**

Geographic Distribution. See Figure 19.

***Astragalus corrugatus* Bertol.**

Astragalus tenuirugis Boiss.

Geographic Distribution. See Figure 20.

***Astragalus dactylocarpus* Boiss.**

This species is rare in Kuwait.

Geographic Distribution. See Figure 21.

Phytochemistry, Pharmacology, and Economic Value. A classical pharmacognostic screen of the leaf and stem of the plant indicated the presence of saponins, but not alkaloids, flavonoids, or tannins (Aynehchi et al., 1985).

***Astragalus hauarensis* Boiss.**

Astragalus gyzensis Del.

Geographic Distribution. See Figure 22.

Astragalus schimperi Boiss.

Geographic Distribution. See Figure 23.

Astragalus spinosus (Forssk.) Muschl.

Astragalus forskahlei Boiss.
Colutea spinosa Forssk.

The plant is very nourishing for camels, but they cannot graze on it because of its thorns. Thus, the Bedouin collect the bushes and burn them sufficiently to destroy the thorns, while only blackening the rest of the plant.

Geographic Distribution. See Figure 24.

Astragalus tribuloides Del.

Geographic Distribution. See Figure 25.

Traditional Medicine. Seeds demulcent.

Other Useful *Astragalus* Species

Several species, including *Astragalus adscendens* Boiss. & Haussk., *Astragalus brachycentrus* Fisch., *Astragalus cerasocrenus* Bunge, *Astragalus creticus* Lam., *Astragalus cylindrus* Boiss. & Heldr., *Astragalus echidnaeformis* Sirjaev, *Astragalus elymaiticus* Boiss. & Haussk., *Astragalus globiflorus* Boiss., *Astragalus gossypinus* Fisch., *Astragalus gummosa* Lab., *Astragalus heratensis* Bunge (Indian tragacanth), *Astragalus kurdicus* Boiss., *Astragalus leioclados* Boiss., *Astragalus microcephalus* Willd., *Astragalus myriacanthus* Boiss., *Astragalus prolixis* Sieb., and *Astragalus pycnocladus* Boiss. & Haussk., produce edible gums, some of which are referred to as gum tragacanth. Manna is obtained from *Astragalus adscendens* Boiss. & Haussk. and *Astragalus florulentus* Boiss. & Haussk. The roots of *Astragalus aboriginorum* Richards, *Astragalus canadensis* L. (Canada milk vetch), *Astragalus christianus* L., and *Astragalus pictus-filifolius* Gray, the seeds of *Astragalus edulis* Dur., and the unripe fruit of *Astragalus caryocarpus* Ker-Gawler (Buffalo bean, Ground plum) and *Astragalus mexicanus* A. DC. are edible. Seeds of *Astragalus boeticus* L. (Swedish coffee) have been roasted, ground, and used as a coffee substitute. An exudate from *Astragalus fasciculifolius* Boiss. is used by women in the Middle East to impart a glossy appearance to the skin. *Astragalus garbancillo* Cav. is reputed to have insecticidal properties. The leaves of *Astragalus glyciphyllus* L. (Milk vetch) have been used to make a tea. The immature fruits of *Astragalus hamosus* L. resemble worms and are used in salads as a

curiosity. *Astragalus menziesii* Gray is one of eight herbal ingredients of the anthelmintic Alexandrian Senna.

ATRIPLEX L.**CHENOPODIACEAE**

***Atriplex dimorphostegia* Boiss.**

Geographic Distribution. See Figure 26.

***Atriplex leucoclada* Kar. & Kir.**

A valuable grazing plant for camels.

Geographic Distribution. See Figure 27.

Phytochemistry, Pharmacology, and Economic Value. A classical pharmacognostic screen indicated the presence in the leaf and stem of alkaloids, flavonoids, and saponins, but not tannins (Aynehchi et al., 1982).

Other Useful *Atriplex* Species

The seeds of *Atriplex canescens* (Pursh) Nutt. (Fourwing saltbush) are edible. Dioscorides knew of both *Atriplex halimus* L. (Sea orach, Sea purslane) and *Atriplex hortensis* L. (Butter leaves, Mountain spinach, Orach) as vegetables that are boiled before eating. The seeds of both species, as well as those of *Atriplex angustifolia* Sm., are emetic when taken in small doses. Large doses can result in poisoning.

BASSIA All.**CHENOPODIACEAE**

Bassia eriophora (Schrad.) Aschers.

Kochia eriophora Schrad.

Kochia latifolia Fresen.

Geographic Distribution. See Figure 28.

Bassia muricata (L.) Aschers.

Kochia muricata (L.) Schrad.

Salsola muricata L.

Geographic Distribution. See Figure 29.

Other Useful Bassia Species

Bassia betis (Blanco) Merr. is the source of betis oil, used in lamps. The seed oil of *Bassia butyracea* Roxb. (Indian butter, Phoolwa oil plant) is used to make a vegetable butter, while a sugar (not unlike date sugar) is obtained from the juice extracted from flowers. Flowers from *Bassia latifolia* Roxb. (Epte, Mahoua, Yallah oil plant), *Bassia longifolia* L. (Illupie plant, Ilpa), and *Bassia malabarica* Bedd. are dried and eaten either raw or cooked, while an edible oil is obtained from the fruit of all three species. *Bassia mottleyana* Clarke is the source of Katio oil, which is used in cooking. The tree is also felled for timber.

BIENERTIA Bunge ex Boiss.**CHENOPODIACEAE**

Bienertia cycloptera Bunge ex Boiss.

Geographic Distribution. See Figure 30.

Phytochemistry, Pharmacology, and Economic Value. Three alkaloids (Bn-1, Bn-2, and Bn-3) from this plant have been shown to exhibit hypotensive activity in dogs. A 1% solution of Bn-1, for example, afforded a decrease in blood pressure of 30 mm Hg (Melkumyan,

1969). Dipterine and salsolidine are among the alkaloids that have been isolated from this plant (Zolotnitskaya and Melkumyan, 1969).

Betaine hydrochloride has been found in this plant (Arutyunyan et al., 1975).

BRASSICA L.**CRUCIFERAE**

***Brassica juncea* (L.) Czerniak**

Sinapis juncea L.

Chinese mustard, Indian mustard, Leaf Mustard

Cultivated as a vegetable in many parts of the world.

Geographic Distribution. See Figure 31.

Traditional Medicine. Small quantities of the powdered seed stimulate the digestive system, while larger quantities are employed as an emetic—especially for patients who have taken overdoses of narcotics. This mustard is also applied externally to ease pains and to stimulate the circulation.

Phytochemistry, Pharmacology, and Economic Value. Bioflavonoids identified in this species include isorhamnetin and kaempferol (Hoshi and Hosoda, 1978) and the anthocyanins peonidin 3-galactoside and peonidin 3-glucoside (Park, 1979a,b).

The seeds contain the sterols 22-dehydrocampesterol (Matsumoto et al., 1983a) and 24-methylene-25-methylcholesterol (Matsumoto et al., 1983b).

The major glucosinolate in the seeds is allyl glucosinolate (Kondo et al., 1986), and there are indications that at least seven desulfoglucosinolates are present (Hogge et al., 1988). The allyl glucosinolate hydrolysis product allyl isothiocyanate has been found in the seed oil (Murthi and Devdhara, 1988). The resistance of this species to infection with the fungus *Leptosphaeria maculans* has been correlated with the glucosinolate content of the cotyledons (Peterka and Schlosser, 1989). A glucosinolate from the aerial portion of the plant has been found to stimulate oviposition in the diamondback moth, *Plutella xylostella* (Reed et al., 1989).

Phenolic acids isolated from the leaves include *p*-hydroxybenzoic, protocatechuic, and vanillic acids, along with the *cis*- and *trans*- isomers of caffeic, *p*-coumaric, ferulic, and sinapic acids (Uda et al., 1988).

The phytoalexins brassilexin (Devys et al., 1988) and cyclobrassinin sulfoxide (Devys et al., 1990) have been obtained from the leaves.

The concentration of erucic acid in the lipids of the seed oil increased, while those of linoleic, linolenic, and oleic acids decreased during maturation (Das Gupta, 1974).

Several studies of the volatile constituents of the seeds have been conducted. Compounds identified include allyl, benzyl, 3-but enyl, butyl, sec-butyl, isopropyl, methyl, 3-methylthiopropyl, 4-pentenyl, phenyl, and β -phenylethyl isothiocyanates (Kojima et al., 1973), 3-butenonitrile, dimethyl trisulfide, phenylacetonitrile, 3-phenylpropionamide, 3-phenylpropionitrile (Kameoka and Hashimoto, 1980a,b), 1-allyl-4-methoxybenzene, 7-methoxybenzofuran, and 1-methoxy-4-(1-propenyl)benzene (Lin and Hua, 1986).

Methyl sinapate from the seed has been found to be an antithiamine factor (Bhattacharya and Chaudhuri, 1974), while sinapine protected barley from growth inhibition induced by x-irradiation (Gu, 1986) and also inhibited lipid peroxidation in the mouse liver (Han et al., 1987).

***Brassica tournefortii* Gouan.**

A valuable grazing plant, common throughout Kuwait.

Geographic Distribution. See Figure 32.

Phytochemistry, Pharmacology, and Economic Value. The seed has been found to contain 3-methylsulfinylpropyl glucosinolate (94% of total glucosinolates), 2-hydroxybut-3-enyl glucosinolate (5%), and 2-phenylethyl glucosinolate (trace) (Horn and Vaughan, 1983), along with palmitic (3.9%), stearic (1.1%), oleic (9.2%), linoleic (12.2%), linolenic (12.9%), eicosenoic (7.6%), and docosenoic (47.8%) acids (Kumar and Tsunoda, 1978).

Other Useful *Brassica* Species

The genus *Brassica* (Latin = cabbage) includes many green, leafy vegetables, including the cabbages and kales, as well as broccoli, brussels sprouts, cauliflower, kohlrabi, mustard, and turnip. Many are edible and a few are employed medicinally.

BUPLEURUM L.**UMBELLIFERAE**

***Bupleurum semicompositum* L.**

Bupleurum glaucum Rob. & Cast ex DC.

Geographic Distribution. See Figure 33.

Other Useful *Bupleurum* Species

The leaves of *Bupleurum falcatum* L. (Hare's ear) and *Bupleurum rotundifolium* L. (Thorow wax) and the tender shoots of *Bupleurum octoradiatum* Bunge are edible.

CAKILE Miller**CRUCIFERAE**

***Cakile arabica* Velen. & Bornm.**

Geographic Distribution. See Figure 34.

Phytochemistry, Pharmacology, and Economic Value. Sixteen glucosinolates have been isolated from the seeds of this plant (Rodman, 1976).

Other Useful *Cakile* Species

North American Indians used the powdered root of *Cakile edulenta* (Bigel.) Hook. and *Cakile maritima* Scop. (Sea rocket), which apparently possessed antiscorbutic properties, in baking.

CALLIGONUM L.**POLYGONACEAE*****Calligonum comosum* L'Hér.**

The leaves are dried and pounded for curing skins, while the wood is employed as firewood.

Geographic Distribution. See Figure 35.

Phytochemistry, Pharmacology, and Economic Value. The bioflavonoids isoquercitrin, kaempferol, and kaempferol 3-O- β -D-glucuronide and the carotenoids neoxanthin and violaxanthin have been isolated from this plant (El-Sayyad and Wagner, 1978).

A classical pharmacognostic screen of the stem and flower indicated the presence of saponins and tannins, but not alkaloids or flavonoids, although flavonoids were detected when the entire above-ground portion of the plant was screened (Aynehchi et al., 1982).

Other Useful *Calligonum* Species

The roots of *Calligonum pallasia* L'Hérit. afford a gum similar in properties to gum tragacanth. The flowers of *Calligonum polygonoides* L. are edible.

CARRICHTERA DC.**CRUCIFERAE*****Carrichtera annua* (L.) DC.**

Carrichtera vellae DC.
Vella annua L.

The plant is edible, and is employed as a purgative for camels.

Geographic Distribution. See Figure 36.

Phytochemistry, Pharmacology, and Economic Value. The lipids of this plant contain palmitic (10.1%), stearic (3.4%), oleic (7.9%), linoleic (19.7%), linolenic (19.4%), eicosenoic (1.7%), and docosenoic (37.7) acids (Kumar and Tsunoda, 1978). The seeds also contain sinapine (Kerber and Buchloh, 1982).

CAYLUSEA A. St-Hil.**RESEDACEAE*****Caylusea hexagyna* (Forssk.) M.L. Green**

Caylusea canescens (L.) Walp.
Reseda canescens L.
Reseda hexagyna Forssk.

The plant is eaten by goats, sheep, and desert animals.

Geographic Distribution. See Figure 37.

CHENOPODIUM L.**CHENOPodiaceae*****Chenopodium murale* L.**

The plant is grazed by camels, goats, and sheep.

Geographic Distribution. See Figure 38.

Traditional Medicine. Employed as a wash to treat skin infections. Used for eruptions on the head.

Phytochemistry, Pharmacology, and Economic Value. A substance with antiviral activity against tobacco mosaic virus has been isolated from the leaves (Chirkina and Degtyareva, 1972). This plant contains the bioflavonoid quercetin (Bahrman et al., 1985).

A classical pharmacognostic screen of the whole plant indicated the presence of alkaloids, flavonoids, and saponins, but not tannins (Aynehchi et al., 1982).

Other Useful *Chenopodium* Species

Chenopodium ambrosioides L. (American wormseed, Epazote, Mexican goosefoot, Mexican tea) is the source of a medicinal oil that has been employed as a vermisuge to expel lumbri-coid worms. It has also been used for fertility control in Uruguay. A tea made from the leaves has been employed medicinally to treat digestive disorders. The leaves and young shoots of *Chenopodium bonus-henricus* L. (All good, Good King Henry) have antiscorbutic properties (Güter Heinrich was a 16th-century goblin familiar with medicinal plants).

Several additional species in this genus are edible, including *Chenopodium quinoa* Willd. (Quinoa) which yields a flour resembling oatmeal. *Chenopodium vulvaria* L. (Dog's orach, Fetid goosefeet, Stinking goosefoot) has a fishy odor, and has been employed medicinally to treat nervous disorders. The red berries of *Chenopodium virgatum* (L.) Aschers have been employed in cosmetics. *Chenopodium vulneraria* L. is the source of a yellow dye.

CHROZOPHORA A. Juss.**EUPHORBIACEAE**

***Chrozophora verbascifolia* (Willd.) A. Juss.**

Croton verbascifolius Willd.

Chrozophora hierosolymitana Spreng.

The seeds are used by the Bedouin as a substitute for clarified butter.

Geographic Distribution. See Figure 39.

Traditional medicine. The leaves, stem, and fruit are used in Iran to treat whooping cough.

Phytochemistry, Pharmacology, and Economic Value. The pods and seeds contain a "semisolid, semisiccative lipid with linoleic-type acids" (Khaitov, 1974).

Other Useful *Chrozophora* Species

The seeds and leaves of *Chrozophora plicata* (Vahl) Sprengel have been employed as a purgative, while the fruit are the source of a blue dye. *Chrozophora tinctoria* (L.) A. Juss., as the name suggests, is the source of a pigment that has been used for coloring foods and beverages, as well as for dyeing textiles.

CISTANCHE Hoffsgg & Link**OROBANCHACEAE**

***Cistanche tubulosa* (Schrenk) Hook. f.**

Cistanche tubulosa var. *tomentosa* Hook. f.
Phelypaea tubulosa Schrenk

Geographic Distribution. See Figure 40.

Phytochemistry, Pharmacology, and Economic Value. A preliminary study indicated that the plant contains tubulosides A I, B II, C, and D IV, together with acetoside, an acetoside isomer, 2'-acetylacetoside, and echinacoside (Kobayashi et al., 1987). A subsequent investigation found 2-(3,4-dihydroxyphenyl)ethyl O- α -L-rhamnopyranosyl-(1 \rightarrow 3)-2-O-acetyl-4-O-p-coumaroyl- β -D-glucopyranoside (tubuloside E) and dehydroconiferyl alcohol γ -O- β -D-glucopyranoside (both new compounds), along with dehydroniconiferyl alcohol 4-O- β -D-glucopyranoside, 8-epiloganic acid, 20-hydroxyecdysone, 8-hydroxygeraniol 1- β -D-glucopyranoside, liriodendrin, 6-deoxycatalpol, (+)-piresinol O- β -D-glucopyranoside, syringalide A 3'- α -L-rhamnopyranoside, (+)-syringaresinol O- β -D-glucopyranoside, and syringin (Yoshizawa et al., 1990).

Other Useful *Cistanche* Species

The shoots of *Cistanche lutea* Hoffsgg. & Link and *Cistanche phelypaea* (L.) Cout. resemble asparagus and are consumed by the Tuareg. A poultice made from the dried, powdered plants and camel milk has been employed to treat bruises.

CITRULLUS Schrader

CUCURBITACEAE

***Citrullus colocynthis* (L.) Schrad.**

Cucumis colocynthis L.

Bitter apple, Bitter gourd, Colocynth, Vine of Sodom

The dried fruits exhibit insecticidal activity against mites and weevils. The fruits are occasionally consumed by sheep during the summer.

Geographic Distribution. See Figure 41.

Traditional Medicine. The drug colocynth is obtained from the bitter pulp of the unripe fruit. Anthelmintic, antipyretic, carminative, cathartic. Used to treat anemia, asthma, bronchitis, constipation, elephantiasis, enlargement of the spleen and liver, epilepsy, jaundice, leucoderma, rheumatism, and urinary discharges. The seeds are chewed (but not swallowed) to treat diabetes. A decoction of the roots and garlic is applied to snakebites, while sap from the unripe fruit is used to treat scorpion stings. The sap and pulp of immature fruit have been employed to induce abortions, but they must be used cautiously since large doses may cause violent vomiting and blood-stained diarrhea. Seeds are used to

prevent hair from turning grey. The sap is heated before being employed to treat skin disorders of camels.

Phytochemistry, Pharmacology, and Economic Value. The fruits have been found to contain cucurbitacin E glucoside, cucurbitacin I glucoside (Mueller and Auterhoff, 1968), 16-O-acetylhexanorcucurbitacin I, elateridine, hentriacontane, hexanorcucurbitacin I (Garg and Gupta, 1987), 2-O- β -D-glucopyranosylcucurbitacin E, 2-O- β -D-glucopyranosylcucurbitacin I, 2-O- β -D-glucopyranosylcucurbitacin L, and 2-O- β -D-glucopyranosyl-(22-27)-hexanorcucurbitacin I (Hatam et al., 1989). Phenolic acids found in the fruit include caffeic, chlorogenic, *m*-coumaric, ferulic, and *p*-hydroxybenzoic acids (Das et al., 1967).

Choline and two alkaloids have been found in roots, stems, leaves, and the seeds, pulp, and rind of the fruit, but a third alkaloid was found only in the pulp, seeds, leaves, and roots (Sayed et al., 1973). All organs of the plant contained α -elaterin 2-D-glucopyranoside and its aglycone, while only the stem, leaves, and fruit contained cucurbitacins B, I, and L (both as glycosides and in the free form) (Sayed et al., 1974).

Peels of the fruit were found to contain citrullonol (Yankov and Khusein, 1975), heptacosane (5%), octacosane (2.19%), nonacosane (16.37%), triacontane (5.67%), hentriacontane (48.23%), dotriacontane (3.32%), tritriacontane (10.46%), 15 additional hydrocarbons in the range C₁₆ to C₃₆, a long-chain unsaturated ketone (Ayoub and Yankov, 1980, 1981a), lauric, myristic, palmitic, hexadecanoic, stearic, oleic, linoleic, and arachidic acids, hexadecanol, octadecanol, eicosanol, docosanol, tetracosanol, hexacosanol, citronellal, citronellol, methylheugenol, methylheptenone, phenylethyl alcohol (Ayoub and Yankov, 1981b; Yankov and Ayoub, 1981a), 10,13-dimethylpentadec-13-en-1-al, docosan-1-ol acetate (Ayoub and Yankov, 1981c; Yankov and Ayoub, 1981b), 14-hydroxy-11,14-dimethylhexadecan-2-one, and 14-hydroxy-10,14-dimethylhexadecan-2-one (Ayoub and Yankov, 1981d,e).

The only amino acid detected in ripe seeds was valine, but unripe seeds also contained glutamic acid and histidine. Arginine was found in the pulp of the fruit (Bhatnagar et al., 1976).

The leaves contain fructosans, fructose, glucose, and inositol, while the roots contain malonic acid (Basalah et al., 1985).

The major fatty acids in the saponified seed oil are hexadecadienoic, palmitic, and stearic acids, accompanied by linoleic, myristic, lauric, tetradecenoic, and arachidic acids (Yankov and Hussein, 1975). In later studies, linoleic (50.6%) and oleic (25%) acids were found to predominate (Sawaya et al., 1983; Mannan et al., 1986). The seed oil also contains 24 hydrocarbons, including the isoprenoids pristane and phytane, along with phytol and other fatty alcohols (Yankov et al., 1975).

A classical pharmacognostic screen of the above-ground portion of the plant indicated the absence of alkaloids, flavonoids, saponins, and tannins (Aynehchi et al., 1985).

The seeds have been evaluated as a source of protein for animal feed, and were found to be satisfactory (Sawaya et al., 1986). The seed oil was not toxic to chicks (Sawaya et al., 1983).

When the fruit and leaves were fed to sheep at doses ranging from 0.25 to 10 g/kg, the animals developed diarrhea, anorexia, and dyspnea and died within 4 hours to 25 days (Elawad et al., 1984).

Forty-four constituents of the roasted seeds, including several pyrazines that may contribute to their flavor, have been identified (Soliman et al., 1985).

A concentrate prepared from the seeds by nomads was found to contain benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, and benzo[j]fluoranthene and, not surprisingly, exhibited a carcinogenic effect in mice (Habs et al., 1984).

Other Useful *Citrullus* Species

Citrullus lanatus (Thunb.) Matsum. & Nakai (Water melon) grows throughout the region.

CONVOLVULUS L.

CONVOLVULACEAE

***Convolvulus buschiricus* Bornm.**

Geographic Distribution. See Figure 42.

***Convolvulus oxyphyllus* Boiss.**

A gum which exudes from the stem is used like chewing gum by children. Many animals graze on the plant, and the wood is used as firewood.

Geographic Distribution. See Figure 43.

Phytochemistry, Pharmacology, and Economic Value. A classical pharmacognostic screen of the above-ground portion of the plant indicated the presence of alkaloids, flavonoids, and saponins, but not tannins (Aynehchi et al., 1985).

***Convolvulus pilosellaefolius* Desr.**

Convolvulus sogdianus Bunge

Many animals, especially gazelles, graze on the plant.

Geographic Distribution. See Figure 44.

Other Useful *Convolvulus* Species

The flowering branches of *Convolvulus althaeoides* L. (Mallow bindweed) have been employed medicinally as a mild purgative. *Convolvulus arvensis* L. (Common bindweed, Cornbind, Corn lily, Field bindweed, Lesser bindweed) was used in Martinique during the nineteenth century to flavor a liquor known as noyeau. The roots have been employed medicinally to inhibit bleeding, the flowering branches have been used as a purgative, and the flowers are boiled before use as a laxative. The roots of *Convolvulus floridus* L. f. are the source Oil of Rhodium. *Convolvulus hystrix* Vahl has been employed in Libya as a purgative. *Convolvulus scammonia* L. (Levant scammony) is the source of a powerful purgative employed as an anthelmintic. *Convolvulus soldanella* L. (Herba Soldanellae) has been used medicinally as a diuretic and a purgative.

CORNULACA Del.**CHENOPODIACEAE*****Cornulaca aucheri* Moq.**

Geographic Distribution. See Figure 45.

***Cornulaca leucacantha* Charif & Aellen**

Geographic Distribution. See Figure 46.

Other Useful *Cornulaca* Species

Cornulaca monacantha Del. is an important camel fodder. Medicinally, a decoction of the leaves has been employed to treat jaundice.

CRESSA L.**CONVOLVULACEAE**

***Cressa cretica* L.**

Rosin weed

The plant is believed to exude moisture, since the ground around it is usually moist.

Geographic Distribution. See Figure 47.

Traditional Medicine. Diuretic. Induces a feeling of exhilaration and is used as a tonic in Sudan. Jaundice is treated using a purgative consisting of crushed leaves and sugar.

Phytochemistry, Pharmacology, and Economic Value. A glycoside of quercetin has been isolated from the plant (Purushothaman and Kalyani, 1974).

A classical pharmacognostic screen of the above-ground portion of the plant indicated the presence of alkaloids, flavonoids, saponins, and tannins (Aynehchi et al., 1985).

The plant removes sodium chloride efficiently from saline soil, accumulating as much as 10% salt (Syamasundar et al., 1977; Rao et al., 1978).

CRUCIANELLA L.**RUBIACEAE**

***Crucianella membranacea* Boiss.**

Geographic Distribution. See Figure 48.

CUSCUTA L.**CONVOLVULACEAE**

***Cuscuta planiflora* Ten.**

Dodder of thyme

Camels graze on the plant.

Geographic Distribution. See Figure 49.

Traditional Medicine. Diuretic, mild laxative, stimulant. Used to treat jaundice and other liver problems.

Phytochemistry, Pharmacology, and Economic Value. The yield of ash from the seeds was found to be 4.0% (Cherkavskii and Tetyura, 1986).

Other Useful *Cuscuta* Species

Cuscuta campestris Yuncker has been used as a styptic to inhibit bleeding. *Cuscuta chinensis* Lam. and *Cuscuta reflexa* Roxb. (Dodder) have been employed medicinally as anthelmintics. *Cuscuta epithymum* (L.) L. (Clover dodder, Lesser dodder) has been used as a substitute for *Cuscuta planiflora* Ten.

CYNOMORIUM L.

BALANOPHORACEAE

***Cynomorium coccineum* L.**

Maltese mushroom, Scarlet synomorium

The dried, powdered roots are used a condiment by the Tuareg. The plant is eaten by Kuwaiti children since it has a sweet taste.

Geographic Distribution. See Figure 50.

Traditional Medicine. Astringent, Tonic. A paste made from butter and the dried, powdered plant is employed to treat obstructions of the bile duct.

Phytochemistry, Pharmacology, and Economic Value. An ethanol extract of the plant has been found to inhibit both reverse transcriptase and DNA polymerase α (Ono et al., 1989).

DILOTAXIS DC.**CRUCIFERAE**

Diplotaxis acris (Forssk.) Boiss.

Hesperis acris Forssk.

Geographic Distribution. See Figure 51.

Diplotaxis harra (Forssk.) Boiss.

Sinapis harra Forssk.

Camels graze on this plant in Kuwait. The milk of animals feeding on it develops a bitter taste.

Geographic Distribution. See Figure 52.

Phytochemistry, Pharmacology, and Economic Value. The seed lipids of this plant contain palmitic (10.2%), stearic (1.8%), oleic (13.4%), linoleic (16.3%), linolenic (25.5%), eicosenoic (7.0%), and docosenoic (25.0%) acids (Kumar and Tsunoda, 1978).

A classical pharmacognostic screen of the whole plant indicated the presence of alkaloids and saponins, but not flavonoids or tannins (Aynehchi et al., 1982).

The plant accumulates sulfate efficiently from gypsum-containing soils characteristic of some semi-desert areas (Weinert and Sakri, 1977).

Other Useful *Diplotaxis* Species

Diplotaxis duveyrierana Coss. and *Diplotaxis pendula* DC. are eaten by the Tuareg, while the leaves of *Diplotaxis sieberi* Presl. are consumed as a salad by the Bedouin.

ECHIUM L.**BORAGINACEAE**

***Echium sericeum* Vahl**

Echium angustifolium Miller

Geographic Distribution. See Figure 53.

Phytochemistry, Pharmacology, and Economic Value. The plant has been found to contain unsaturated alkaloids that are cytotoxic to Ehrlich ascites carcinoma cells *in vitro* (Wassel et al., 1987a). Alkaloids identified in extracts of the plant were echidamine and symlandine, or its isomer symphytine (Wassel et al., 1987b).

Other Useful *Echium* Species

Echium vulgare L. (Blue weed, Viper's bugloss) has been employed medicinally as a diuretic, while the root has been used to produce a fine grade of charcoal prized by artists. The flowers of *Echium plantagineum* L. (Purple viper's bugloss) have also been used as a diuretic.

EMEX Campderá**POLYGONACEAE**

***Emex spinosus* (L.) Campderá**

Rumex spinosus L.

The long, white, carrot-like root is eaten by the Bedouin. Animals graze on this plant in Kuwait, and it has been used medicinally in South Africa.

Geographic Distribution. See Figure 54.

ERODIUM L'Hérit.**GERANIACEAE**

Erodium bryoniifolium Boiss.

Geographic Distribution. See Figure 55.

Erodium ciconium (L.) L'Hérit.

Geranium ciconium L.

Many animals graze on this plant.

Geographic Distribution. See Figure 56.

Erodium cicutarium (L.) L'Hérit.

Geranium cicutarium L.

Hemlock geranium, Pick needle, Pin grass, Storksbill, Wild musk

The young plant is eaten raw or cooked, and is sold in the markets in Turkey. The root was formerly employed as a source of dye in the Hebrides. The remnants of the styles remaining on the fruits curl to various degrees, depending on the relative humidity, and have been used as hygrometers.

Geographic Distribution. See Figure 57.

Traditional Medicine. Diuretic. Used to treat edema. Flowering branches are employed to enhance uterine contractions during childbirth. A decoction is used as a gargle.

Phytochemistry, Pharmacology, and Economic Value. A methanol extract of the plant induced interferon formation in mice and inhibited replication of influenza A virus in lung tissue when the mice were treated 24 and 48 hours after infection (Zielinska-Jenczylik et al., 1988).

This plant contains ascorbic acid and β -carotene (Bilgir, 1982).

The petals have been found to contain the anthocyanins cyanidin 3-glucoside, cyanidin 5-glucoside, cyanidin 3-rutinoside, malvidin 3,5-diglucoside, malvidin 3-glucoside, peonidin 3-glucoside, and petunidin 3,5-diglucoside (Medrano et al., 1978).

Ellagic acid obtained from this plant was found to exhibit growth inhibition activity against the tobacco budworm, *Heliothis virescens* (Klocke et al., 1986).

***Erodium glaucophyllum* (L.) L'Hérit.**

Geranium glaucophyllum L.

Geographic Distribution. See Figure 58.

Phytochemistry, Pharmacology, and Economic Value. This thiophorous gypsophyte accumulates calcium and sulfate efficiently from gypsum-containing soils (Boukhris and Lossaint, 1975). Sulfate accumulates preferentially in the phloem cells of the leaves (Boukhris, 1972).

***Erodium laciniatum* (Cav.) Willd.**

Geranium laciniatum Cav.

Geographic Distribution. See Figure 59.

Other Useful *Erodium* Species

Erodium deserti (Eig) Eig is eaten by many animals in the Arabian desert. The roots of *Erodium hirtum* Willd. are eaten by the Tuareg. The tubercles of *Erodium jacquinianum* Fisch. are consumed in Egypt. The Moroccans use *Erodium malacoides* L'Hér. in salads. *Erodium moschatum* Aiton, which has the odor of musk, has been employed medicinally as a diaphoretic.

ERUCA Miller**CRUCIFERAE*****Eruca sativa*** Miller

Brassica vesicaria L.

Eruca cappadocica Reut.

Eruca lativalvis Boiss.

Eruca vesicaria (L.) Cav.

Eruca vesicaria (L.) Cav. subsp. *sativa* (Miller) Thell.

Garden rocket, Jamba, Salad rocket

The leaves and stalks are consumed as salad greens, and are the source of a seed oil (Jamba oil) similar to rapeseed oil. The seeds are also used in mustard. It has been suggested that if a sour pomegranate is watered with the juice of this plant the fruit will become sweet.

Geographic Distribution. See Figure 60.

Traditional Medicine. Antiscorbutic, diuretic, rubifacient, stimulant, stomachic.

Phytochemistry, Pharmacology, and Economic Value. The seed lipids of this plant contain palmitic (3.5%), stearic (2.0%), oleic (8.8%), linoleic (11.4%), linolenic (11.4%), eicosenoic (10.7%), and docosenoic (49.5%) acids (Kumar and Tsunoda, 1978). The erucic acid content of the seed oil is generally very high (Umarov et al., 1972; Dolya et al., 1974; Osman and Fiad, 1975; Hodelmann and Radatz, 1982; Flanders and Abdulkarim, 1985; Kanya and Urs, 1989), and this species has been evaluated as a candidate for the production of erucic acid (Seehuber et al., 1987).

The principal glucosinolate in the seeds is glucoerucin (Gmelin and Schlueter, 1970; Kanya and Urs, 1989). It apparently degrades to yield 4-methylthiobutyl isothiocyanate (Hamence and Taylor, 1978).

The bioflavonoid isorhamnetin and its 3-glucoside have been isolated from the leaves of this species (Wasir et al., 1969).

A crude juice obtained from the plant exhibited antibacterial activity against *Bacillus subtilis*, *Escherichia coli*, and *Salmonella typhi* (Abdou et al., 1972), while fractions from the seed oil exhibited antibacterial and analgesic activity (Bajaj et al., 1971).

The seed oil, alone and in combination with DDT or γ -BHC, exhibits insecticidal activity against the rice pests *Perigrinus maidis*, *Perkinsiella insignis*, *Sogata striatus*, *Sogatella longifurcifera*, and *Toya attenuata* (Khan and Khan, 1985).

EUPHORBIA L.**EUPHORBIACEAE**

The genus was named by King Juba II of Mauretania (now part of northwestern Morocco, not to be confused with the present-day Mauritania to the south) in honor of his court physician, Euphorbus. The king was married to Cleopatra Selene, daughter of Anthony and Cleopatra.

***Euphorbia densa* Schrenk**

Geographic Distribution. See Figure 61.

***Euphorbia granulata* Forssk.**

Geographic Distribution. See Figure 62.

Traditional Medicine. Sap is used to treat insect bites.

Phytochemistry, Pharmacology, and Economic Value. The plant contains apigenin 7-glucoside, ellagic acid, quercetin, rutin (Rizk et al., 1982), dotriacontane, gallic acid, hentriacontane, lupeol, lupeol acetate, sitosterol, taraxasterol, and taraxasterol acetate (Ahmad and Fizza, 1986).

***Euphorbia isthmia* V. Täckh.**

Geographic Distribution. See Figure 63.

Other Useful *Euphorbia* Species

The sap of *Euphorbia antiquorum* L. (Spurge cactus) and *Euphorbia nerifolia* L. has been used as a purgative. Both species are sacred to Mansá, the Hindu goddess of serpents, and have been employed to treat snakebites. *Euphorbia antisypilitica* Zucc. (Candelilla) does not live up to its name, but the wax that it yields has many industrial uses. The sap of *Euphorbia atoto* Forst. f. has been employed as an abortifacient. The shoots of *Euphorbia balsamifera* Aiton (Balsam spurge) are edible when boiled, and the juice may be jellied and consumed. The sap is toxic, but it is to treat skin disorders of camels and other animals. The bark of *Euphorbia canariensis* L. may be peeled from the stem, which is then sucked to quench the thirst. *Euphorbia edulis* Lour. is used as a culinary herb. An infusion of *Euphorbia falacata* L. and milk has been employed medicinally to treat colds and rheuma-

tism. The latex of *Euphorbia helioscopia* L. (Cat's milk, Sun spurge, Water grass, Wartwort) has been used as a laxative and purgative. A tincture of the root of *Euphorbia ipecacuanhae* L. (Ipecacuanha spurge) has been used as a substitute for the familiar emetic. *Euphorbia lancifolia* Schldl. (Ixbut), a species native to Central America, is purported to stimulate milk flow in women. The seeds of *Euphorbia lathyris* L. (Caper spurge, Myrtle spurge) have been used as a substitute for capers, after first steeping them in brine and then in vinegar to render them less acrid. The raw seed capsules have been employed as an abortifacient, while the seed oil is purgative. The sap of *Euphorbia peplis* L. has been employed medicinally to treat asthma, gout, and liver disorders. *Euphorbia pilulifera* L. contains a potent cardiac poison, but in small doses is employed as a sedative and in the treatment of asthma. The latex of *Euphorbia pulcherrima* Willd. ex Klotzsch (Poinsettia) has been used as a depilatory in Mexico. The dried sap of *Euphorbia resinifera* Berg. (Gum Euphorbium) is a panacea, used to treat everything from toothache to hair loss. *Euphorbia thymifolia* Burm. is applied to wounds. *Euphorbia tirucalli* L. is used for making fences around cultivated fields, since cattle are deterred by the acrid nature of the sap (which has been used medicinally as a purgative).

FAGONIA L.

ZYGOPHYLLACEAE

Fagonia bruguieri DC.

Fagonia echinella Boiss.

This plant is eaten by lizards in Kuwait.

Geographic Distribution. See Figure 64.

Traditional Medicine. In the Peshawar valley, has been administered to children as a prophylactic against smallpox.

Fagonia glutinosa Del.

Geographic Distribution. See Figure 65.

Phytochemistry, Pharmacology, and Economic Value. The plant contains campesterol, sitosterol, stigmasterol, oleanolic acid, fagonin, hexacosanol, and myristic, palmitic, stearic, oleic, linoleic, linolenic, arachidic, and lignoceric acids (Al-Nagdy and Rizk, 1978).

***Fagonia olivieri* DC.**

Geographic Distribution. See Figure 66.

Phytochemistry, Pharmacology, and Economic Value. A classical pharmacognostic screen of the whole plant indicated the presence of saponins and tannins, but not alkaloids or flavonoids (Aynehchi et al., 1982).

Other Useful *Fagonia* Species

Fagonia arabica L. has been employed as a remedy for fever. *Fagonia cretica* L. (Cretan prickly clover) has been employed medicinally as an astringent tonic and a febrifuge. It is also consumed by camels and mules.

FARSETIA* Turra*CRUCIFERAE**

***Farsetia aegyptiaca* Turra**

Cheiranthus farsetia L.

This plant is eaten by camels in Kuwait.

Geographic Distribution. See Figure 67.

***Farsetia burtonae* Oliv.**

Geographic Distribution. See Figure 68.

Other Useful *Farsetia* Species

Farsetia clypeata R. Br. is grown and used like cress. *Farsetia hamiltonii* Royle and *Farsetia ramosissima* Hohst. have been employed medicinally to treat rheumatism.

FRANKENIA L.**FRANKENIACEAE**

***Frankenia pulverulenta* L.**

Geographic Distribution. See Figure 69.

Phytochemistry, Pharmacology, and Economic Value. The leaves contain ellagic acid, the 7-bisulfates of isorhamnetin and kaempferol, and the 7-bisulfate-3-glucuronides of isorhamnetin, kaempferol, and quercetin (Harborne, 1975).

A classical pharmacognostic screen of the above-ground portion of the plant indicated the presence of flavonoids, saponins, and tannins, but not alkaloids (Aynehchi et al., 1985).

Other Useful *Frankenia* Species

Frankenia grandifolia Cham. & Schldl. (*Yerba reuma*) has been used to treat gastrointestinal disorders and rheumatism. The leaves of *Frankenia portulacaefolia* Spreng. have been employed as a tea substitute.

GASTROCOTYLE Bunge**BORAGINACEAE**

***Gastrocotyle hispida* (Forssk.) Bunge**

Anchusa hispida Forssk.

A valuable grazing plant for camels and sheep in Kuwait.

Geographic Distribution. See Figure 70.

Phytochemistry, Pharmacology, and Economic Value. The seed oil contains palmitic (10%), stearic (2%), oleic (28%), linoleic (40%), linolenic (1%), γ -linolenic (16%), eicosenoic (2%), and docosenoic (2%) acids (Miller et al., 1968).

GYPSOPHILA L.**CAROPHYLLACEAE*****Gypsophila capillaris* (Forssk.) C. Christensen**

Gypsophila capillaris Delile
Rokejeka capillaris Forssk.

This plant is eaten by camels and gazelles in Kuwait.

Geographic Distribution. See Figure 71.

Other Useful *Gypsophila* Species

Gypsophila rokejeka Del. is employed in Egypt and other Eastern Mediterranean countries in the preparation of the dessert halva. The sap of *Gypsophila struthium* L. has been used as a soap and—by extension—to cleanse the blood in cases of syphilis.

HALOCNEMUM M. Bieb.**CHENOPODIACEAE*****Halocnemum strobilaceum* (Pall.) M. Bieb.**

Salicornia cruciata Forssk.
Salticornia strobilacea Pall.

Rats in Kuwait burrow among the roots and eat the green shoots. Attempts have been made to cultivate this plant as the source of a flour substitute.

Geographic Distribution. See Figure 72.

Phytochemistry, Pharmacology, and Economic Value. The lipids of this species contain linoleic and linolenic acids (Zarrouk and Cherif, 1983). The plant also contains trimethyl-glycine hydrochloride and two additional alkaloids (Arutyunyan et al., 1976).

A classical pharmacognostic screen of the above-ground portion of the plant indicated the presence of alkaloids, flavonoids, and saponins, but not tannins (Aynehchi et al., 1985).

Flour made from this species is of adequate nutritional value (Urazkov, 1974, 1975).

HALOXYLON Bunge**CHENOPodiaceae**

Haloxylon salicornicum (Moq.) Bunge ex Boiss.

Caroxylon salicornicum Moq.

Hammada salicornica (Moq.) Iljin

One of the best sources of firewood in Kuwait. Young branches are occasionally eaten in Afghanistan and Iran. Camels graze on the plant in Kuwait.

Geographic Distribution. See Figure 73.

Phytochemistry, Pharmacology, and Economic Value. An ethanol extract of the plant was administered to alloxan-treated mice, and a significant decrease in blood sugar levels was observed. There was no evidence of toxicity, so it was suggested that the plant extract is potentially useful in the treatment of diabetes (Ajabnoor et al., 1984).

Fucosterol and two additional C₂₉ sterols have been encountered in this species (Dawidar and Amer, 1974). The plant also contains the alkaloids anabasine, betaine, piperidine (Michel et al., 1967), halosaline (O'Donovan and Creedon, 1971), and haloxine (Sandberg, 1972), along with tyramine and N-methyltyramine (Michel and Sandberg, 1968).

Other Useful *Haloxylon* Species

The wood of *Haloxylon persicum* Bunge is employed by carpenters. A manna is produced by *Haloxylon schweinfurthii* Aschers, and a gum from the plant is consumed by the Bedouin. *Haloxylon tamaricifolium* (L.) Maire is employed as firewood, and the ash is mixed with tobacco to make a snuff. *Haloxylon tetrandrusr* Moq. is also used as firewood.

HAPLOPHYLLUM A. Juss.**RUTACEAE*****Haplophyllum tuberculatum* (Forssk.) A. Juss.**

- Haplophyllum arabicum* Boiss.
Haplophyllum glabrum (DC.) Hand.-Mazz.
Haplophyllum longifolium Boiss.
Haplophyllum obovatum (Steud.) Hand.-Mazz.
Haplophyllum propinquum Spach.
Ruta tuberculata Forssk.

The unpleasant odor of the plant renders it unpalatable to cattle. Bunches of the plant have been hung at the entrances of homes and barns to deter insects.

Geographic Distribution. See Figure 74.

Traditional Medicine. Flowering and fruiting branches are used to treat anemia, constipation, nausea, rheumatism, and vomiting. The Bedouin use the plant to treat scorpion stings.

Phytochemistry, Pharmacology, and Economic Value. The plant contains evoxine, γ -fagarine, skimmianine (Al-Shamma et al., 1979), the aryenaphthalene lignan justicidin A, 5,7,4'-trihydroxy-6-methoxy-3-O-glucosylflavone (Khalid and Waterman, 1981), diphyllin, justicidin B, and tuberculatin (Sheriha and Abouamer, 1984).

The aerial portion of the plant has been found to contain the furoquinoline alkaloid dihydropersfamine, which exhibited smooth muscle relaxant activity and hypotensive activity (Abd El-Kawy et al., 1989).

N-Benzoyl-4'-[2"S,3"S,6"S]-(+)-7"-acetoxy-2"-hydroxy-3",7"-dimethyl-3",6"-epoxyoctyl-oxy]phenethylamine [(+)-tuberine] from this plant (Sheriha et al., 1985) exhibited antibacterial activity against *Bacillus subtilis* and *Staphylococcus aureus* and antifungal activity against *Saccharomyces cerevisiae* at a concentration of 1 μ g/mL. There was only weak inhibition of the bacterium *Escherichia coli* (Gnan and Sheriha, 1986).

The plant also contains 4-(3',3'-dimethylallyloxy)-3-(3",3"-dimethylallyl)-2(1*H*)-quinoline, flindersine (Lavie et al., 1968), 3-(1',1'-dimethylallyl)-(3",3"-dimethylallyl)-1,2,3,4-tetrahydro-2,4-quinoldione, 1-methyl-2-nonyl-4(1*H*)-quinoline, and the cytotoxic lignan lactones kusunokinin and polygamain (Sheriha et al., 1987).

A classical pharmacognostic screen of the whole plant indicated the presence of alkaloids, flavonoids, and saponins, but not tannins (Aynehchi et al., 1982).

HELIANTHEMUM* Miller*CISTACEAE*****Helianthemum kahiricum* Del.**

Cistus stipulatus var. β Forssk.

Geographic Distribution. See Figure 75.

***Helianthemum ledifolium* (L.) Mill.**

Cistus ledifolius L.

Cistus niloticus L.

Helianthemum niloticum sensu Boiss.

Helianthemum niloticus (L.) Pers.

Many animals graze on this plant.

Geographic Distribution. See Figure 76.

***Helianthemum lippii* (L.) Pers.**

Cistus lippii L.

Helianthemum ellipticum (Desf.) Pers.

Helianthemum sessiliflorum (Desf.) Pers.

Eaten by camels in Kuwait.

Geographic Distribution. See Figure 77.

***Helianthemum salicifolium* (L.) Mill.**

Cistus salicifolius L.

This plant is eaten by many animals in Kuwait.

Geographic Distribution. See Figure 78.

Phytochemistry, Pharmacology, and Economic Value. A classical pharmacognostic screen of the whole plant indicated the presence of alkaloids, flavonoids, saponins, and tannins (Aynehchi et al., 1982).

Other Useful *Helianthemum* Species

Helianthemum canadense (L.) Michaux (Frostweed) has been employed as a tonic and an astringent. *Helianthemum corymbosum* Michaux and *Helianthemum vulgare* Gaertner possess similar medicinal properties, and may be substituted for *Helianthemum canadense* (L.) Michaux.

HELIOTROPIUM* L.*BORAGINACEAE**

The generic name derives from a myth related by Ovid in which the nymph Clytie, in love with the Sun, was turned into a plant of this species.

***Heliotropium bacciferum* Forssk.**

Heliotropium undulatum Vahl

Geographic Distribution. See Figure 79.

Traditional Medicine. The dried, powdered leaves are used in a poultice applied to bumps and bruises, as well as snakebites. Used by Cambodians to induce abortions and by the Ashanti to prevent abortion.

Phytochemistry, Pharmacology, and Economic Value. The plant contains the pyrrolizidine alkaloids europine and heliotrine (Rizk et al., 1988).

Other Useful *Heliotropium* Species

An infusion of the leaves of *Heliotropium lanatum* H.B. & K. has been given to women who have fits and spasms during childbirth. *Heliotropium amplexicaule* Vahl has been employed for fertility control in South America. *Heliotropium strigosum* Willd. and *Heliotropium eichwaldii* Steud. have both been used to treat scorpion stings. A decoction of *Heliotropium tuberculosum* Boiss. has been employed to treat the eyes of camels.

HERNIARIA L.**CARYOPHYLLACEAE**

***Herniaria hemistemon* J. Gay**

Geographic Distribution. See Figure 80.

***Herniaria hirsuta* L.**

Herniaria cinera DC.

Geographic Distribution. See Figure 81.

Traditional Medicine. Astringent, diuretic, expectorant.

Phytochemistry, Pharmacology, and Economic Value. The commercially available crude drug preparation Herba Herniariae is a mixture of *Herniaria glabra* L. and *Herniaria hirsuta* L. Following acid hydrolysis of this material, the following compounds were identified: gypsogenic acid, gypsogenic acid 3 β -O-glucuronide, 16 α -hydroxymedicagenic acid, medicagenic acid, and medicagenic acid 3 β -O-glucuronide and its 16 α -hydroxy derivative (Klein et al., 1982).

Other Useful *Herniaria* Species

Herniaria glabra L. (Rupturewort) has been employed as a diuretic. It was formerly believed to be a remedy for hernias, thus the derivation of the generic and common names.

HIPPOCREPIS L.**LEGUMINOSAE**

***Hippocrepis bicontorta* Loisel.**

Hippocrepis cornigera Boiss.

Sheep and goats graze on this plant in Kuwait.

Geographic Distribution. See Figure 82.

***Hippocrepis unisiliquosa* L.**

Hippocrepis biflora Sprengel
Hippocrepis bisiliqua Forssk.

Geographic Distribution. See Figure 83.

Other Useful *Hippocrepis* Species

Hippocrepis comosa L. (Horseshoe vetch) has been used as a food for livestock.

HORWOODIA* Turrill*CRUCIFERAE*****Horwoodia dicksoniae* Turrill**

The only species of this genus is named after Mrs. Dickson who sent specimens of a large number of Kuwaiti plants to Kew, and Mr. Horwood who classified many of them.

Geographic Distribution. See Figure 84.

HYOSCYAMUS* L.*SOLANACEAE*****Hyoscyamus pusillus* L.**

Hyoscyamus micranthus Ledeb. ex D. Don
Hyoscyamus pungens Griseb.

Geographic Distribution. See Figure 85.

Phytochemistry, Pharmacology, and Economic Value. The aerial portion of the plant contains the alkaloids apotaatropine, apohyoscine, hyoscine, hyoscyamine, and tropine (Aripova, 1985).

A classical pharmacognostic screen of the whole plant indicated the presence of alkaloids, flavonoids, and saponins, but not tannins (Aynehchi et al., 1982).

Other Useful *Hyoscyamus* Species

Hyoscyamus albus L. (White henbane) has been employed medicinally to treat hysteria and anxiety associated with a variety of injuries and clinical disorders. *Hyoscyamus falesiez* Coss. is one of the most toxic members of the genus, but the seeds have been used by women to promote weight gain. The dried leaves of *Hyoscyamus muticus* L. (Egyptian henbane) have been made into cigarettes that are smoked by asthmatics. The dried leaves of *Hyoscyamus niger* L. (Henbane) are a source of hypnotic and narcotic alkaloids.

HYPECOUM L.**FUMARIACEAE**

***Hypecoum geslinii* Coss. & Kral.**

Geographic Distribution. See Figure 86.

***Hypecoum pendulum* L.**

Many animals graze on this plant in Kuwait. A cooling drink is made from an extract of the herb by the Waziri.

Geographic Distribution. See Figure 87.

Phytochemistry, Pharmacology, and Economic Value. This plant contains the alkaloids (+)-oxoturkiyenine, (+)-turkiyenine (Mete and Gozler, 1988), and (\pm)-nitrotyrasanguinarine (Pabuccuoglu et al., 1989).

A classical pharmacognostic screen of the above-ground portion of the plant indicated the presence of alkaloids, but not flavonoids, saponins, or tannins (Aynehchi et al., 1981).

Other Useful *Hypecoum* Species

The medicinal properties of *Hypecoum procumbens* L. (Horned cummin) were discussed by Dioscorides.

LAPPULA Gilib.**BORAGINACEAE**

***Lappula spinocarpos* (Forssk.) Ascherson & Kuntze**

Anchusa spinocarpos Forssk.
Echinospermum spinocarpos (Forssk.) Boiss.
Echinospermum tuberculosum Ledeb.
Echinospermum vahlianum Lehm.
Sclerocaryopsis spinocarpos (Forssk.) Brand

The plant is eaten by Jerboas.

Geographic Distribution. See Figure 88.

LEPIDIUM L.**CRUCIFERAE**

***Lepidium aucheri* Boiss.**

Geographic Distribution. See Figure 89.

Other Useful *Lepidium* Species

Several species are used in salads, especially *Lepidium sativum* L. (Cress), the seeds of which have had many medicinal uses. *Lepidium latifolium* L. (Dittander, Poor man's pepper) has been used in veterinary medicine to treat camels. Antiscorbutic properties have been attributed to *Lepidium oleraceum* Forst. f. (New Zealand cress), *Lepidium piscidum* Forst. f., and *Lepidium sativum* L. The seeds of *Lepidium draba* L. (Hoary cress) and *Lepidium latifolium* L. have been employed as a pepper substitute.

LEPTALEUM DC.**CRUCIFERAE**

***Leptaleum filifolium* (Willd.) DC.**

Leptaleum longisiliquosum Freyn & Sint.

Leptaleum pygmaeum DC.

Sisymbrium filifolium Willd.

Has a hot, peppery taste, and is eaten by the Bedouin.

Geographic Distribution. See Figure 90.

LIMONIUM Miller**PLUMBAGINACEAE**

The generic name derives from the Greek word *leimon* (= meadow), referring to the meadow-like appearance of these plants as they grow in coastal marshes.

***Limonium carnosum* (Boiss.) Kuntze**

Statice carnosa Boiss.

Statice suffruticosa var. *carnosa* Kusn.

Statice suffruticosa var. *typica* Trautv.

Geographic Distribution. See Figure 91.

***Limonium thouinii* (Viv.) Kuntze**

Statice thouinii (Viv.) Post

The plant is rare in Kuwait.

Geographic Distribution. See Figure 92.

Other Useful *Limonium* Species

A dye is obtained from the roots and stalks of *Limonium axillare* (Forssk.) Kuntze. A *Limonium* species from Uruguay has been used for fertility control.

LINARIA* Miller*SCROPHULARIACEAE**

Linaria albifrons (Sibth. & Sm.) Spreng.

Geographic Distribution. See Figure 93.

Linaria simplex (Willd.) DC.

Antirrhinum simplex Willd.

Linaria arvensis (L.) Desf. var. *flaviflora* Boiss.

The plant is common in Kuwait.

Geographic Distribution. See Figure 94.

Other Useful *Linaria* Species

An ointment made from *Linaria canadensis* (L.) Dum. has been used to treat hemorrhoids. *Linaria cymbalaria* Mill. (Kenilworth ivy, Pennywort) has been used in salads and has antiscorbutic activity. *Linaria vulgaris* Miller (Butter and eggs, Common toadflax) has been employed as a diuretic and in the treatment of jaundice and hemorrhoids.

LITHOSPERMUM L.**BORAGINACEAE*****Lithospermum apulum* (L.) Vahl**

Lithospermum mesopotamicum DC.

Lithospermum strigosum M.B.

Geographic Distribution. See Figure 95.

Other Useful *Lithospermum* Species

The root bark of *Lithospermum arvense* L. is the source of a red pigment. A purple ointment made by simmering the root of *Lithospermum canescens* Lehm. (Alkanet, Hoary puccoon, Indian paint root) in fresh butter or lard has been used to treat skin wounds. The root of *Lithospermum officinale* L. (Common gromwell) has been employed medicinal as a diuretic, while the leaves are used to make a tea. *Lithospermum ruderale* Douglas ex Lehm. has been employed for fertility control, and apparently provided the inspiration for perfecting oral contraceptives.

LOEFLINGIA L.**CARYOPHYLLACEAE*****Loeflingia hispanica* L.**

Geographic Distribution. See Figure 96.

LOTUS L.**LEGUMINOSAE*****Lotus halophilus* Boiss. & Sprun.**

Lotus aucheri Boiss.

Lotus pusillus Viv.

Lotus pusillus Viv. var. *major* Boiss.

Lotus villosus Forssk.

Goats and sheep graze on this plant in Kuwait.

Geographic Distribution. See Figure 97.

Other Useful *Lotus* Species

Lotus corniculatus L. (Bird's foot trefoil, Eggs and bacon) is used as fodder, but in some instances becomes highly toxic. The pods of *Lotus edulis* L. (Bird's foot trefoil), *Lotus gebelia* Vent., and *Lotus tetragonolobus* L. (Winged pea) have been consumed like string beans.

LYCIUM L.

SOLANACEAE

***Lycium shawii* Roem. & Schult.**

Lycium arabicum Schweinf. ex Boiss.
Lycium europaeum L.

Box thorn

The young shoot has been employed as a vegetable, and the berries are also edible. Camels that consume this shrub produce a rich, sweet milk. The wood is used as a fuel that produces little smoke, but the Bedouin will not cut it for fear of bad luck. Migrating shrikes impale their victims on the thorns.

Geographic Distribution. See Figure 98.

Phytochemistry, Pharmacology, and Economic Value. The aerial portion of the plant has been found to contain lyceamine and sitosterol (Manzoor-i-Khuda and Sultana, 1968). The leaves contain β-carotene, chlorophyll b, lutein, rutin, and zeaxanthin (Gribanovski-Sassu et al., 1969), while the stem contains diosgenin and sitosterol (Baghdadi et al., 1988) and the roots contain cycloartenol, lanosterol, stigmasterol, and ursolic acid (Afza et al., 1987).

Other Useful *Lycium* Species

Lycium afrum L. and *Lycium umbrosum* Humb. & Bonpl. (Matrimony vine) have been employed in the treatment of erysipelas. The berries of *Lycium andersonii* Gray (Anderson wolfberry) and *Lycium pallidum* Miers (Rabbit thorn) are eaten fresh or dried. The amino

acid lysine was first isolated from the leaves and branches of *Lycium barbarum* L. (Duke of Argyll's tea tree). The young leaves of *Lycium chinense* Mill. (Chinese wolfberry) are consumed as a vegetable. The homeopathic medicine Herba Lycii is obtained from *Lycium halimifolium* Mill. (Common matrimony vine). The berries of *Lycium intricatum* Boiss. are edible, and provide relief from diarrhea, while the juice from the leaves is employed as an eye lotion. The fruits of *Lycium pallidum* Miers are consumed in the southwestern United States. The berries of *Lycium sandwicense* Gray are eaten by Hawaiians.

MALCOLMIA R. Br.**CRUCIFERAE**

The genus was named after the London Horticulturalist, William Malcolm (1768-1835).

***Malcolmia grandiflora* (Bunge) Kuntze**

Dontostemon grandiflorus Bunge
Malcolmia bungei Boiss.
Malcolmia circinata Hook. f. & Thoms.

Geographic Distribution. See Figure 99.

Other Useful *Malcolmia* Species

Malcolmia africana Ait. is grazed by cattle in the United States.

MALVA L.**MALVACEAE**

***Malva parviflora* L.**

Egyptian mallow

Has been consumed as a leaf vegetable for about 8000 years.

Geographic Distribution. See Figure 100.

Traditional Medicine. Roots purgative. An infusion of fruiting and flowering branches is used to treat gastrointestinal disorders. Roots are chewed to treat gum disorders.

Phytochemistry, Pharmacology, and Economic Value. The seed oil contains (−)-epoxyoleic, *cis*-epoxystearic, *trans*-epoxystearic (Hassan et al., 1966; Hassan, 1970), malvalic, sterculic (Bohannon and Kleiman, 1978), coriolic and vernolic acids (Ahmad et al., 1984).

Other Useful *Malva* Species

Malva rotundifolia L. (Mallow) and *Malva sylvestris* L. (Cheeses, High mallow, Marsh mallow) have been employed medicinally as demulcents, taking advantage of their mucilaginous properties. Seeds of the former species are used as an intoxicant in Afghanistan, while the flowers are employed in enemas and poultices. *Malva verticillata* L. var. *crispa* L. has also been cultivated as a salad plant.

MARESIA Pomel

CRUCIFERAE

***Maresia pygmaea* (Del.) O.E. Schulz**

Hesperis pygmaea Delile
Malcolmia pygmaea Boiss.

Geographic Distribution. See Figure 101.

MATTHIOLA R. Br.

CRUCIFERAE

***Matthiola longipetala* (Vent.) DC.**

Cheiranthus bicornis Sibth. & Sm.
Cheiranthus longipetalus Vent.
Matthiola bicornis (Sibth. & Smith) DC.
Matthiola oxyceras DC.

This plant is eaten by many animals in Kuwait. The subspecies *bicornis* (Sibth. & Sm.) P. Ball is known as night-scented stock, as a result of the pleasant odor that it produces in the evening.

Geographic Distribution. See Figure 102.

Phytochemistry, Pharmacology, and Economic Value. The seed oil contains oleic (14%), linoleic (10%), and linolenic (66%) acids (Dolya et al., 1972).

Other Useful *Matthiola* Species

Matthiola incana R. Br. (Stock) has been eaten in times of famine.

MEDICAGO L.

LEGUMINOSAE

***Medicago laciniata* (L.) Mill.**

Medicago rigidula L. var. *laciniata* L.

Geographic Distribution. See Figure 103.

Phytochemistry, Pharmacology, and Economic Value. A classical pharmacognostic screen of the whole plant indicated that it contained alkaloids, anthraquinones, flavonoids, sterols/triterpenes, and tannins. An ethanolic extract (40 mg) increased myocardial contractions of isolated rabbit heart, while a 5-mg dose caused a transient fall in blood pressure in an anesthetized rabbit (Al-Yahya et al., 1987).

Other Useful *Medicago* Species

The leaves of *Medicago denticulata* Willd. (Bur clover, Shanghai trefoil), *Medicago platycarpa* Trautv., and *Medicago sativa* L. (Alfalfa, Lucerne) and the seeds of *Medicago lupulina* L. (Black medick, Hop clover, Nonsuch, Yellow trefoil) are edible. Several species are cultivated as fodder.

MELILOTUS Miller**LEGUMINOSAE*****Melilotus indicus* (L.) All.**

Melilotus parviflora Desf.
Trifolium indica L.

Scented trefoil

Geographic Distribution. See Figure 104.

Traditional Medicine. An infusion of the flowering branches is used as an antispasmodic and emollient.

Phytochemistry, Pharmacology, and Economic Value. The leaves and flowers contain benzo-1,2-pyrone (Silva et al., 1976), while the seeds contain choline, coumarin, sitosterol, and sitosterol 3- β -D-glucoside (Khafagy et al., 1978). The aerial portion of the plant also contains coumarin (Gupta et al., 1980).

Other Useful *Melilotus* Species

The flowers and seeds of *Melilotus officinalis* (L.) Pallas (Melilot, Sweet clover) have been used to flavor Gruyère cheese. A decoction of *Melilotus suaveolens* Ledeb. has been employed medicinally to treat ophthalmic disorders.

MESEMBRYANTHEMUM L.**AIZOACEAE**

The generic name is from the Greek *mesembria* (= midday) and *anthemon* (= flower), since the flowers of some species are open only around that time.

***Mesembryanthemum nodiflorum* L.**

Cryophytum nodiflorum (L.) L. Bol.

Slender iceplant

Geographic Distribution. See Figure 105.

Phytochemistry, Pharmacology, and Economic Value. The oxalic acid content of this plant may be as high as 18% dry weight, and consumption of the plant by sheep has resulted in oxalate poisoning (Jacob and Peet, 1989).

Other Useful *Mesembryanthemum* Species

Edible fruit are obtained from *Mesembryanthemum acinaciforme* L. and *Mesembryanthemum edule* L. (both known as Hottentot figs), and the leaves of the latter are pickled and substituted for pickled cucumber. The fruit of *Mesembryanthemum aequilaterale* Haw. (Pig's face) is also edible. *Mesembryanthemum anatomicum* Haw. (Canna root, Kon) and *Mesembryanthemum tortuosum* L. are chewed by the Hottentots to release a narcotic. The leaves of *Mesembryanthemum crystallinum* L. (Ice plant) and *Mesembryanthemum pugioniforme* L. are used as a spinach substitute. The Bedouin employ the seeds of *Mesembryanthemum forskaahlei* Hochst. for making a bread. *Mesembryanthemum stellatum* Will. has a delirient and intoxicating effect, and has been used for making beer. It may be substituted for yeast in making bread. The fruit of *Mesembryanthemum tripolium* L. (Flower of Crete, Rose of Jericho) is soaked in water, which is then administered to women to ease labor.

MOLTOKIOPSIS I.M. Johnston

BORAGINACEAE

***Moltkiopsis ciliata* (Forssk.) I.M. Johnston**

Lithospermum angustifolium Forssk.
Lithospermum callosum Vahl
Lithospermum callosum Vahl var. *asperrimum* Bornm.
Lithospermum ciliatum Forssk.
Mollkia callosa (Vahl) Wettst.
Mollkia ciliata (Forssk.) Maire

This species is eaten by camels and sheep in Kuwait.

Geographic Distribution. See Figure 106.

Traditional Medicine. The fresh plant is used to inhibit bleeding.

MONSONIA L.**GERANIACEAE**

Monsonia nivea (Decne.) Decne. ex Webb

Erodium niveum Decne.

Geographic Distribution. See Figure 107.

Other Useful *Monsonia* Species

Monsonia ovata Cav. has been employed medicinally to treat dysentery.

NEURADA L.**NEURADACEAE**

Neurada procumbens L.

This plant is employed for fattening sheep in Kuwait, and is also a source of fodder for camels. The young fruits are eaten by children in Kuwait.

Geographic Distribution. See Figure 108.

NITRARIA L.**ZYGOPHYLLACEAE**

Nitraria retusa (Forssk.) Aschers.

The fruits are narcotic. Camels graze on the plant. Soda is made from the leaves and young twigs. Used as a firewood in Kuwait.

Geographic Distribution. See Figure 109.

Phytochemistry, Pharmacology, and Economic Value. The plant contains the 3-galacto-rhamnogalactoside, 3-glucoside, 3-rhamnogalactoside, 3-rutinoside, and 3-xylorhamnogalactoside of isorhamnetin (Saleh and El-Hadidi, 1977).

Other Useful *Nitraria* Species

The fruits of *Nitraria schoberi* L. (Nitre bush) and *Nitraria tridentata* Desf. are edible.

NOTOCERAS R. BR.**CRUCIFERAE**

***Notoceras bicornе* (Aiton) Amo**

Erysimum bocrine Aiton
Notoceras canariense DC.
Notoceras hispanicum R. Br.

Geographic Distribution. See Figure 110.

OCHRADENUS Del.**RESEDACEAE**

***Ochradenus baccatus* Del.**

Camels and goats graze on this plant in Kuwait.

Geographic Distribution. See Figure 111.

Phytochemistry, Pharmacology, and Economic Value. A classical pharmacognostic screen of the leaves has indicated the presence of saponins and flavonoids, and the absence of alkaloids and tannins (Aynehchi et al., 1982). A subsequent examination of the above-ground portion of the plant indicated the presence of alkaloids and saponins, but not flavonoids or tannins (Aynehchi et al., 1985).

OLIGOMERIS Cambess.**RESEDACEAE**

***Oligomeris subulata* (Del.) Boiss.**

Oligomeris linifolia (Vahl ex Hornem.) Macbride
Reseda linifolia Vahl ex Hornem.
Reseda subulata Del.

Geographic Distribution. See Figure 112.

ONOBYRYCHIS Miller**LEGUMINOSAE**

***Onobrychis ptolemaica* (Del.) DC.**

Hedysarum ptolemaicum Del.

Geographic Distribution. See Figure 113.

Other Useful *Onobrychis* Species

Onobrychis viciifolia Scop. has been employed as a fodder for livestock.

ONONIS L.**LEGUMINOSAE**

***Ononis serrata* Forssk.**

Many animals graze on this plant in Kuwait.

Geographic Distribution. See Figure 114.

Phytochemistry, Pharmacology, and Economic Value. A classical pharmacognostic screen of the whole plant indicated that it contained anthraquinones, flavonoids, sterols/triterpenes, and tannins. An ethanolic extract (10 mg) caused a decrease in the

force of contraction of isolated rabbit heart, while a 40-mg dose exhibited a hypotensive effect in an anesthetized rabbit. An increase in respiratory rate was induced in mice (Al-Yahya et al., 1987).

Other Useful *Ononis* Species

Gerard, in his Herbal, indicated that the tender sprigs of *Ononis arvensis* L. (Rest harrow) are pickled and eaten with meat. The root of *Ononis spinosa* L. (Tall rest harrow) has been employed medicinally as a diuretic. A decoction of the stem has been used to treat skin disorders. Jaundice has been treated by eating eggs boiled in water containing *Ononis tournefortii* Cosson.

OROBANCHE L.

OROBANCHACEAE

The generic and family names derives from the Greek *orobos* (= bitter vetch) and *anchein* (= strangle), indicating that these root parasites invade the bitter vetch.

Orobanche cernua Loefl.

Orobanche cernua var. *cumana* (Wallr.) G. Beck
Orobanche cumana Wallr.
Orobanche hispanica Boiss.
Orobanche nicotiana Wight
Orobanche speciosa DC.
Orobanche wendelboi Schiman-Czekia

Broom rape

Geographic Distribution. See Figure 115.

Phytochemistry, Pharmacology, and Economic Value. The plant contains phytic acid (Beg et al., 1968).

Other Useful *Orobanche* Species

Several species, including *Orobanche californica* Cham. & Schltr., *Orobanche fasciculata* Nutt., *Orobanche ludoviciana* Nutt., and *Orobanche tuberosa* (Gray) Heller, are edible.

PARONYCHIA Miller**CARYOPHYLLACEAE**

***Paronychia arabica* (L.) DC.**

Illecebrum arabicum L.

Geographic Distribution. See Figure 116.

Traditional Medicine. Stimulant.

Other Useful *Paronychia* Species

An infusion of *Paronychia argentea* Lam. (Silver nailroot) has been employed medicinally as a diuretic. *Paronychia jamesii* Torr. & Gray (James Whitkow wort) has been used to make a tea.

PEGANUM L.**ZYGOPHYLLACEAE**

***Peganum harmala* L.**

Harmala, Harmel shrub, Syrian rue

A pigment (Turkey red) from the seeds is used for dyeing tarbooshes. In Persia the seeds were sprinkled on burning coals to avert the malignant influence of the evil eye. The smoke is said to be stupefying.

Geographic Distribution. See Figure 117.

Traditional Medicine. Seeds anodyne, anthelmintic, antispasmodic, diuretic, emetic, hypnotic, and narcotic. Used to treat eye diseases, fevers, hysteria, jaundice, lumbago,

neuralgia, Parkinson's disease, and rheumatism. Applied to teeth to facilitate extraction. A tincture of the seeds is employed to stimulate menstrual flow and milk production, and to induce abortions. A paste of the roots and mustard oil is used to kill head lice. A paste of the fresh plant and sheep fat is used (externally) to treat rheumatism.

Phytochemistry, Pharmacology, and Economic Value. The seed contains deoxyvascinone (Chatterjee and Ganguly, 1968), 3-hydroxy-9-(2-oxopropyl)pyrrolidino[2,1-*b*]quinazoline (peganidin) (Khashimov et al., 1969), pegamin (Khashimov et al., 1970), 8-hydroxyharmine β -D-glucoside (ruine) (Nettleship and Slaytor, 1971), L-(-)-4-hydroxypipeolic acid (pegaline) (Ahmad and Khan, 1971), peganol (Telezhenetskaya et al., 1971), deoxypeganidine (Zharekeev et al., 1973), dipegine, isopeganidine, quinaldine, quinoline (Zharekeev et al., 1974), dihydroruine, gentisic acid 2,5- β -diglucoside, harmol, 5-hydroxytryptamine, 6-hydroxytryptamine (McKenzie et al., 1975), harmaline, harmalol, harmine (Jado et al., 1979), 3,6-dihydroxy-8-methoxy-2-methylanthraquinone (peganone 1), 8-hydroxy-7-methoxy-2-methylanthraquinone (peganone 2) (Pitre and Srivastava, 1987), harmalidine (Siddiqui et al., 1987a), harmalicine (Siddiqui et al., 1987b), harmalacidine, harmalanine (Siddiqui et al., 1988), harmalacinine, norharmine (Siddiqui et al., 1989), vasicol (Telezhenetskaya et al., 1989), *N,N'*-bis[(3-hydroxy-5-methyl)phenyl]oxamide (Ayoub et al., 1989), and γ -harmine (Li et al., 1989). Amino acids encountered in the seeds include alanine, arginine, aspartic acid, glutamic acid, glycine, histidine, leucine, lysine, phenylalanine, proline, serine, threonine, tyrosine, and valine. They were accompanied by the carbohydrates D-galactose, D-glucose, and sucrose in the free form and L-arabinose, D-galactose, D-galacturonic acid, L-rhamnose, and D-xylose as components of polysaccharides (Nahid and Zaidi, 1969). Steroids isolated from the seeds include kryptogenin, lanosterol, and sitosterol (Singh and Nag, 1981).

The seed oil contains capric, lauric, myristic, palmitic, palmitoleic, margaric, stearic, linoleic, linolenic (Kurachko et al., 1969; Javed et al., 1972), and 9,14-dihydroxyoctadecanoic acids (Ahmad et al., 1977).

The antibacterial activity of the seeds has been attributed largely to harmine (Al-Shamma et al., 1981). Harmalol has also been found to exhibit antimicrobial activity (Ross et al., 1980).

Harmaline and harmine from the seeds enhanced the germination of seeds of *Brassica campestris* L., *Triticum aestivum* L., and *Phaseolus radiatus* L. when used at concentrations of 0.1 and 12.5 ppm, but inhibited seedling growth at concentrations of 10 and 100 ppm (Yang et al., 1987).

The leaves have been found to contain the bioflavonoids apigenin 4-methyl ether (acacetin) (El-Beih, 1984) and acacetin 7-*O*-[rhamnosyl(1 \rightarrow 4")-gluco-(1 \rightarrow 6")-6'"-*O*-acetylsophoroside] (peganetin) (Ahmed and Saleh, 1987). The major alkaloid in the leaves has been identified as peganine (Botbaev et al., 1974; Hilal et al., 1977, 1978). The aerial portion of the plant also contains the alkaloids harmalol, harmine (Muhtadi et al., 1974; Jado et al., 1979), deoxypeganine, deoxyvascinone, and vasicinone (Kurbanov and Zharekeev, 1974; Batsuren et al., 1980). Deoxypeganine, deoxyvascinone, harmine, peganine, and vasicinone were isolated from plants collected during flowering (Khashimov et al., 1969a).

The major alkaloid in the roots has been identified as harmine (Botbaev et al., 1974; Hilal et al., 1978).

A classical pharmacognostic screen of the above-ground portion of the plant indicated the presence of alkaloids, bioflavonoids, saponins, and tannins (Aynehchi et al., 1985). A later screen indicated the presence of alkaloids, bioflavonoids, coumarins, sterols/triterpenes, tannins, and volatile bases (Al-Yahya, 1986).

A methanol extract of the above-ground portion of the plant has been found to exhibit antimicrobial activity against *Sarcina subflava* (Sabahi et al., 1987).

Telezhenetskaya and Yunusov (1977) have reviewed the literature pertaining to the alkaloids of this species, citing 55 publications.

PITURANTHOS viv.**UMBELLIFERAE**

Pituranthus triradiatus (Hochst. ex Boiss.) Aschers. & Schweinf.

Deverra triradiata Hochst. ex Boiss.

This plant is eaten by camels in Kuwait, which apparently enjoy the aromatic, peppery flavor of the stems.

Geographic Distribution. See Figure 118.

Phytochemistry, Pharmacology, and Economic Value. Shoots of the plant have been found to contain the furanocoumarins bergapten, cnidilin, imperatorin, isoimperatorin, isopimpinellin (Ashkenazy et al., 1983), isobergapten, and pimpinellin (Ashkenazy et al., 1987).

It has been suggested that 5-methoxysoralen in seeds of this plant was responsible for photosensitization of ducklings which consumed them (Ashkenazy et al., 1984). It has also been suggested that imperatorin and isoimperatorin that accumulate in the older branches of the plant are responsible for photosensitization of hyraxes. All five animals that had eaten the branches developed apathy, photophobia, and injuries around the eyes and on the back, and four of them died within 20 hours (Ashkenazy et al., 1985).

Other Useful *Pituranthos* Species

The diuretic activity of *Pituranthos tortuosus* (Desf.) Benth. & Hook. f. has been attributed to its high mannitol content.

PLANTAGO L.**PLANTAGINACEAE**

***Plantago amplexicaulis* Cav. subsp. *bauphula* (Edgew.) Rech. f.**

Plantago amplexicaulis Cav. var. *bauphula* (Edgew.) Pilger
Plantago bauphula Edgew.

Geographic Distribution. See Figure 119.

Traditional Medicine. Used to treat intermittent fevers, ophthalmic disorders, and pulmonary ailments.

***Plantago boissieri* Hausskn. & Bornm.**

Plantago albicans Boiss.—non L.
Plantago cylindrica Forssk.

Geographic Distribution. See Figure 120.

Phytochemistry, Pharmacology, and Economic Value. A classical pharmacognostic screen of the whole plant indicated the presence of saponins, but not alkaloids, flavonoids, or tannins (Aynehchi et al., 1982).

***Plantago ciliata* Desf.**

Geographic Distribution. See Figure 121.

***Plantago coronopus* L.**

Plantago coronopus L. subsp. *coronopus* Rechinger

Plantago coronopus L. subsp. *eu-coronopus* Pilger

Buck's horn plantain, Star of the Earth

The leaves have been employed in salads.

Geographic Distribution. See Figure 122.

Traditional Medicine. Leaves analgesic, astringent. Powdered leaves used to treat wide variety of skin wounds. Roots used to treat fevers, hemorrhoids, and malaria.

***Plantago lagopus* L.**

Geographic Distribution. See Figure 123.

***Plantago notata* Lag.**

Geographic Distribution. See Figure 124.

***Plantago ovata* Forssk.**

Plantago decumbens Forssk.

Plantago trichophylla Nab.

Source of isphagul seeds.

Geographic Distribution. See Figure 125.

Traditional Medicine. Seeds diuretic and mild laxative. Used to treat dysentery and other gastrointestinal disorders, as well as disorders of the genitourinary system.

Phytochemistry, Pharmacology, and Economic Value. Consumption of a diet including a preparation containing this species resulted in a lowering of serum cholesterol levels, presumably as a result of efficient fecal elimination of bile acids (Miettinen and Tarpila, 1989).

Blood glucose levels rose to a lesser extent in volunteers after drinking a beverage containing glucose and fibers from the seed husk of this species than after drinking a beverage containing glucose alone (Sud et al., 1988).

The seed oil contains *cis*-9-hydroxyoctadec-12-enoic acid and *cis*-9-oxooctadec-12-enoic acid (Jamal et al., 1987). Amino acids of proteins from the seeds include DL-alanine, L-(–)-asparagine, L-cystine, glutamic acid, glycine, L-lysine, DL-norleucine, tyrosine, and DL-valine (Patel et al., 1981). The seed coating contains linoleic, oleic, and palmitic acids, along with C₁₆ to C₁₉ hydrocarbons (Gelpí et al., 1969).

A classical pharmacognostic screen of the whole plant indicated the presence of alkaloids and saponins, but not flavonoids or tannins (Aynehchi et al., 1982).

***Plantago psammophila* Agnew & Chalabi-Ka'bi**

Geographic Distribution. See Figure 126.

Other Useful *Plantago* Species

The seeds of several species, especially *Plantago afra* L. (Psyllium) are efficient laxatives. The leaves of *Plantago decipiens* Barneoud (Goose tongue, Seaside plantain) are used as a green vegetable or salad. The leaves of *Plantago lanceolata* L. (Lance-leaved plantain), which are edible when young, exhibit hemostatic activity, and have been employed to arrest bleeding. The leaves of *Plantago major* L. (Plantain) and *Plantago maritima* L. (Seaside plantain) are edible when boiled. The latter may also be pickled.

POLYCARPaea Lam.

CARYOPHYLLACEAE

***Polycarpaea repens* (Forssk.) Aschers. & Schweinf.**

Corrigiola repens Forssk.
Polycarpaea fragilis Delile

This plant is eaten by camels in Saudi Arabia.

Geographic Distribution. See Figure 127.

Other Useful *Polycarpaea* Species

Polycarpaea corymbosa Lam. has been used internally and externally to treat patients bitten by venomous reptiles. The leaves and flower clusters have been employed medicinally as astringents and emollients.

POLYCARPON L.**CARYOPHYLLACEAE**

***Polycarpon tetraphyllum* (L.) L.**

Mollugo tetraphylla L.

Geographic Distribution. See Figure 128.

PSYLLIOSTACHYS (Jaub. & Spach) Nevski**PLUMBAGINACEAE**

***Psylliostachys spicata* (Willd.) Nevski**

Limonium spicatum (Willd.) Kuntze
Statice spicata Willd.

Geographic Distribution. See Figure 129.

PTERANTHUS Forssk.**CARYOPHYLLACEAE**

***Pteranthus dichotomus* Forssk.**

Pteranthus echinatus Desf.

Geographic Distribution. See Figure 130.

RESEDA L.**RESEDACEAE**

The generic name is from the Latin *reseda morbis* (= assuage diseases), the first words of a charm used in applying a poultice made from a plant of this genus.

***Reseda arabica* Boiss.**

Geographic Distribution. See Figure 131.

***Reseda decursiva* Forssk.**

Reseda eremophila Boiss.

Reseda propinqua Boiss.

Geographic Distribution. See Figure 132.

***Reseda muricata* C. Presl**

Geographic Distribution. See Figure 133.

Other Useful Reseda Species

Reseda luteola L. (Dyer's rocket, Dyer's weed, Weld, Yellow weed), which contains the pigment luteolin, is the source of a yellow dye that has been used since neolithic times. An infusion of the plant has been employed medicinally to treat gastrointestinal disorders. The essential oil of *Reseda odorata* L. (Common mignonette) is used in perfumery. The leaves of *Reseda phyteum* L. are edible.

ROBBAIREA Boiss.**CARYOPHYLLACEAE**

Robbairea delileana (Forssk.) Boiss.

Alsine prostrata Forssk.

Polycarpon prostratum (Forssk.) Asch & Schweinf.

Robbairea prostrata (Forssk.) Boiss.

Geographic Distribution. See Figure 134.

ROEMERIA Medikus**PAPAVERACEAE**

Roemeria hybrida (L.) DC. subsp. ***hybrida***

Chelidonium dodecandrum Forssk.

Chelidonium hybridum L.

Roemeria dodecandra (Forssk.) Stapf

Roemeria orientalis Boiss.

Geographic Distribution. See Figure 135.

Phytochemistry, Pharmacology, and Economic Value. This plant contains the alkaloids coptisine, (–)-isocorypalmine, roehybridine, roehybrine, roemeridine (Slavik et al., 1974), (–)-misramine (El-Masry et al., 1985), (–)-11,12-dihydroorientalinone, (+)-8,9-dihydroisoorientalinone, (–)-isoorientalinone, (–)-isoroemerinalinone, (–)-mecambrine, (–)-orientalinone, (–)- α -roemehybrine, (–)-roemrialionone (Gozler et al., 1987), (–)-labrandine (Gozler, 1990), and (–)-roemeridine (Gozler et al., 1989). Roehybrine was also detected by Phillipson et al. (1981).

Bioflavonoids isolated from the leaves include isoschaftoside, schaftoside, vicienin 2 (Saleh et al., 1987), gossypetin 3-O- β -D-glucuronide-8-O- β -D-glucoside and herbacetin 3-O- β -D-glucuronide-8-O- β -D-glucoside (Saleh et al., 1988).

A classical pharmacognostic screen of the above-ground portion of the plant indicated the presence of alkaloids and saponins, but not flavonoids or tannins (Aynehchi et al., 1981).

RUMEX L.**POLYGONACEAE*****Rumex pictus* Forssk.**

Rumex lacerus Balb.

The plant is consumed by the Bedouin, and many animals graze on it in Kuwait.

Geographic Distribution. See Figure 136.

***Rumex vesicarius* L.**

Rumex roseus Desf.—non L.

Bladder dock

The smooth leaves have been employed as a substitute for sorrel. They are cooked and eaten by the Bedouin. The essential oil is employed throughout the Middle East for flavoring foods.

Geographic Distribution. See Figure 137.

Traditional Medicine. Juice used to diminish pain of toothache, check nausea, promote the appetite, and improve digestion. Roasted seeds are an antidote to scorpion stings.

Phytochemistry, Pharmacology, and Economic Value. The anthraquinones emodin and crysophanol have been found in the roots and seeds (Rai and Thakar, 1970), while the aerial portion of the plant contains 10-C-glucopyranosyl-1,8-dihydroxy-3-methylanthraquinone (Masood et al., 1982). Amino acids present in the proteins of the plant include cystine, glutamic acid, histidine, phenylalanine, and proline (Tiwari and Rathore, 1977).

Other Useful *Rumex* Species

The leaves of several species are edible, including *Rumex abyssinicus* Jacq., *Rumex acetosa* L. (Sorrel, Sour dock), *Rumex alpinus* L. (Monk's rhubarb, Mountain rhubarb), *Rumex arcticus* Trautv., *Rumex bequaerti* De Wild., *Rumex berlandieri* Meisn., *Rumex crispus* L. (Curled dock), *Rumex hydrolapathum* Huds. (Wild rhubarb), *Rumex hymenosepalus* Torr. (Canaigre), *Rumex longifolius* H. B. & K., *Rumex luxurians* L., *Rumex mexicanus* Meisn., *Rumex montanus* Desf. (French sorrel), *Rumex obtusifolius* L. (Bitter dock, Broad-leaved dock), *Rumex patientia* L. (Garden patience, Herb patience, Monk's rhubarb, Patience dock), *Rumex paucifolius* Nutt. (Mountain sorrel), *Rumex sanguineus* L. (Bloodwort, Bloody veined dock), and *Rumex scutatus* L. (Garden sorrel). *Rumex alpinus* L. is also used in central

Europe to preserve unsalted butter during the summer months. The roots of *Rumex brasiliensis* Link have been employed medicinally as a diuretic, a febrifuge, and a tonic. A decoction of the roots of *Rumex ecklonianus* Meisn. has been used against tapeworms. The roots of *Rumex hymenosepalus* Torr. are the source of a yellow dye, and have been employed medicinally to treat colds and sore throats. *Rumex longifolius* H. B. & K. has antiscorbutic properties. A drink prepared from the leaves of *Rumex maderensis* Lowe has been used as a febrifuge. The roots of *Rumex nepalensis* Spreng. have been employed as a purgative. The Masai chew twigs of *Rumex usambarensis* Dammer ex Peter as a relish. Gerard, in his Herbal, provided an extensive review of the sorrels and their uses.

SALICORNIA L.**CHENOPodiaceae**

***Salicornia herbacea* L.**

Crab grass, Glasswort, Marsh samphire, Saltwort

The shoots have been consumed after pickling, while the stems may be used as a spinach substitute. An ash derived from the plant has been employed in soap making.

Geographic Distribution. See Figure 138.

Phytochemistry, Pharmacology, and Economic Value. A glycopeptide from the aerial portion of this plant has been found to stimulate the growth of wheat coleoptiles by 35% (Prikhod'ko et al., 1979, 1987).

Other Useful *Salicornia* Species

Young shoots of *Salicornia australis* Sol. and *Salicornia brachiata* Roxb. are pickled, while *Salicornia fruticosa* L. is eaten raw. The latter is also employed as camel fodder.

SALSOLA L.**CHENOPODIACEAE**

***Salsola baryosma* (Roem. & Schult.) Dandy**

Chenopodium baryosmon Roem. & Schult.
Salsola foetida Del.

The plants are eaten by camels.

Geographic Distribution. See Figure 139.

Phytochemistry, Pharmacology, and Economic Value. Sterols isolated from this plant include brassicasterol (12.3%), campesterol (5.2%), 24-ethylcholesta-5,24-dien-3 β -ol (15.7%), sitosterol (29.9%), and stigmasterol (36.9%) (Andhiwal and Kishore, 1984).

***Salsola jordanicola* Eig**

Geographic Distribution. See Figure 140.

Other Useful *Salsola* Species

Young plants of *Salsola asparagooides* Miq. are boiled and eaten in Japan. The ashes of *Salsola kali* Willd. were an important source of mineral alkali in the Middle East. The young shoots of this species are edible.

SALVIA L.**LABIATAE**

***Salvia lanigera* Poir.**

Salvia aegyptiaca L.
Salvia clandestina L.
Salvia controversa Boiss.—non Tenn.

The plant is especially liked by camels in Kuwait.

Geographic Distribution. See Figure 141.

Traditional Medicine. Carminative, digestive. Employed medicinally on account of mucilaginous properties of nutlets.

Phytochemistry, Pharmacology, and Economic Value. The roots of this plant contain deacetylnemorone, diacetylroyleanone, 14-hydroxy-6,7-dehydrocarnosolic acid, 7 β -hydroxyroyleanone (Saleh et al., 1980), 6,7-dehydroroyleanone, royleanone, taxodione, taxoquinone (Sabri et al., 1989a), aegyptinone A, and aegyptinone B (Sabri et al., 1989b), while the leaves contain oleanolic acid, ursolic acid (Abdel-Moneim et al., 1967), isocarnosol (Al-Hazimi et al., 1984), salvigenin (Miana et al., 1985), methyl carnosate (Al-Hazimi, 1986), 3 β -hydroxyoleanan-13 β -28-lactone, and 12-methoxycarnosic acid (Al-Hazimi et al., 1987).

The seed oil contains capric (1.3%), palmitic (9.4%), stearic (3.2%), linoleic (84.5%), and arachidic (1.5%) acids (Malik et al., 1987).

A classical pharmacognostic screen of the above-ground portion of the plant indicated the presence of alkaloids, flavonoids, and saponins, but not tannins (Aynehchi et al., 1982). A later screen of whole plant indicated the presence of sterols/triterpenes and tannins (Al-Yahya, 1986).

***Salvia spinosa* L.**

The plant, which has an aromatic smell, is hung by the door to keep flies away.

Geographic Distribution. See Figure 142.

Phytochemistry, Pharmacology, and Economic Value. The major fatty acid of the seed oil is oleic acid (Mannan et al., 1986).

A classical pharmacognostic screen of the whole plant indicated the presence of alkaloids, flavonoids, and saponins, but not tannins (Aynehchi et al., 1982).

Other Useful *Salvia* Species

A decoction of the leaves and stem of *Salvia carnosa* Douglas have been used as a cold remedy. *Salvia divinorum* Epling & Jatívá is employed in Mexico for its hallucinogenic properties. An infusion of the leaves and young shoots of *Salvia fruticosa* Miller (Apple-bearing sage, Sage apple, Three-lobed sage) has been employed medicinally to treat coughs, influenza, and rheumatic pains. *Salvia miltiorrhiza* Bunge has been used to treat heart ailments. The leaves of *Salvia horminum* L. (Hormium clary), *Salvia indica* L., and *Salvia sclarea* L. (Clary), the peeled stems of *Salvia lanata* Roxb., and the seeds of *Salvia columbariae* Benth. (Chia) and *Salvia plebeia* R. Br. are all edible. *Salvia officinalis* L. (Sage) has been used medicinally as an antiemetic, astringent, diaphoretic, and tonic. The generic name is derived from the Latin *salveo* (= I heal), recognizing the medicinal use of this

species. Mucilage from the fruit of *Salvia pratensis* L. (Meadow sage) has been used to treat ophthalmic disorders. *Salvia titaefolia* Vahl (Lindenleaf sage) has been employed to kill head lice. The essential oil of *Salvia viridis* L. (Bluebeard) has been used to flavor beers and wines.

SAVIGNYA DC.**CRUCIFERAE**

***Savignya parviflora* (Del.) Webb**

Lunaria parviflora Del.
Savignya aegyptiaca DC.

A source of good camel fodder.

Geographic Distribution. See Figure 143.

SCABIOSA L.**DIPSACACEAE**

***Scabiosa olivieri* Coulter**

Geographic Distribution. See Figure 144.

Phytochemistry, Pharmacology, and Economic Value. The lipids from this plant contain hexadecenoic and linolenic acids (Kull and Breckle, 1975).

A classical pharmacognostic screen of the whole plant indicated the presence of alkaloids and saponins, but not flavonoids or tannins (Aynehchi et al., 1981).

***Scabiosa palaestina* L.**

Geographic Distribution. See Figure 145.

SCHANGINIA C.A. Mey.**CHENOPODIACEAE**

***Schanginia aegyptiaca* (Hasselq.) Aellen.**

Chenopodium aegyptiacum Hasselq.
Schanginia baccata (Forssk.) Moq.
Suaeda aegyptica (Hasselq.) Zoh.
Suaeda baccata Forssk.

Geographic Distribution. See Figure 146.

Phytochemistry, Pharmacology, and Economic Value. This plant has been found to contain 10.5% protein, 1.6% lipid, 5.9% crude fiber, and 22.3% carbohydrate, and yields 39.8% ash (Rizk et al., 1984).

SCHIMPERA Hochst. & Steudel ex Engel**CRUCIFERAE**

***Schimpéra arabica* Hochst. & Steudel ex Boiss.**

Schimpéra persica Boiss.

Geographic Distribution. See Figure 147.

SCLEROCEPHALUS Boiss.**CARYOPHYLLACEAE**

***Sclerocephalus arabicus* Boiss.**

Paronychia sclerocephala Decne.

This plant is eaten by camels in Kuwait.

Geographic Distribution. See Figure 148.

SCROPHULARIA L.**SCROPHULARIACEAE**

The generic and family names derive from the Latin *scrofulae* (= scrofula), a skin condition treated using *Scrophularia nodosa* L.

***Scrophularia deserti* Del.**

Geographic Distribution. See Figure 149.

Other Useful *Scrophularia* Species

Scrophularia auriculata L. (Bishop's leaves, Brownwort, Water betony) is known in France as 'herbe du siège,' since the roots were consumed during the siege of Rochelle (1628). *Scrophularia frigida* Boiss. affords a sweet exudate. *Scrophularia nodosa* L. (Carpenter's square, Figwort, Scrofula plant) provided the generic and family names and has had many medicinal uses.

SEETZENIA R. Br. ex Decne.**ZYGOPHYLLACEAE**

***Seetzenia orientalis* Decne.**

Geographic Distribution. See Figure 150.

Phytochemistry, Pharmacology, and Economic Value. The plant has been found to contain free ascorbic acid (Nag et al., 1986).

SEIDLITZIA Bunge ex Boiss.**CHENOPODIACEAE*****Seidlitzia rosmarinus*** Bunge ex Boiss.

Salsola rosmarinus (Bunge ex Boiss.). Solms-Laub
Suaeda rosmarinus Ehrenb. ex Boiss.

The dried leaves are pounded and employed by the Bedouin as a soap.

Geographic Distribution. See Figure 151.

Phytochemistry, Pharmacology, and Economic Value. A classical pharmacognostic screen of the above-ground portion of the plant indicated the presence of alkaloids, saponins, and tannins, but not flavonoids (Aynehchi et al., 1981). A subsequent examination of the above-ground portion of the plant failed to detect alkaloids, flavonoids, saponins, or tannins (Aynehchi et al., 1985).

A methanol extract of the above-ground portion of the plant has been found to exhibit antimicrobial activity against *Sarcina subflava* (Sabahi et al., 1987).

SILENE L.**CARYOPHYLLACEAE*****Silene arabica*** Boiss.

Silene affinis Boiss.

Geographic Distribution. See Figure 152.

Silene linearis Decne.

Silene arenosa C. Koch
Silene chaetodonta Boiss.
Silene kotschyi Boiss.
Silene leysseroides Boiss.

Geographic Distribution. See Figure 153.

***Silene villosa* Forssk.**

Geographic Distribution. See Figure 154.

Other Useful *Silene* Species

The young shoots of *Silene cucubalus* Wibel (Bladder campion) are boiled before they are eaten. *Silene macrosolen* Steud. and *Silene virginica* L. (Fire pink) has been employed medicinally as anthelmintics. The roots of *Silene succulenta* Forssk contain a saponin, and are used by the Bedouin for washing.

SISYMBRIUM* L.*CRUCIFERAE**

***Sisymbrium erysimoides* Desf.**

Geographic Distribution. See Figure 155.

Phytochemistry, Pharmacology, and Economic Value. The seed lipids of this plant contain palmitic (14.3%), stearic (0.6%), oleic (13.4%), linoleic (16.3%), linolenic (30.5%), eicosenoic (4.0%), and docosenoic (19.7%) acids (Kumar and Tsunoda, 1978).

***Sisymbrium irio* L.**

London rocket

Geographic Distribution. See Figure 156.

Phytochemistry, Pharmacology, and Economic Value. Of 96 plants growing in arid and semiarid regions of Arizona, this species had the highest protein content (35%) (Carr et al., 1985).

The seeds contain isorhamnetin (Khan, 1967), along with myristic (0.7%), palmitic (15.8%), stearic (3.5%), oleic (17.2%), linoleic (15.6%), linolenic (37.1%), and erucic (10.1%) acids (Rale et al., 1983; Khan et al., 1984).

***Sisymbrium orientale* L.**

Sisymbrium columnae Jacq.

Geographic Distribution. See Figure 157.

***Sisymbrium septulatum* DC.**

Sisymbrium grandiflorum Post.

Sisymbrium pannonicum Boiss.

Sisymbrium sinapistrum Hand.-Mazz.

Geographic Distribution. See Figure 158.

Other Useful *Sisymbrium* Species

The leaves of *Sisymbrium alliaria* Scop. (Hedge garlic) have a taste resembling that of garlic, and are used for seasoning foods. The seeds of *Sisymbrium canescens* Nutt. (Tansy mustard) have been used as a condiment. The leaves and seeds of *Sisymbrium officinale* (L.) Scop. (Bank cress, Crambling rocket, Hedge mustard) have antiscorbutic properties, and have been employed medicinally as diuretics, expectorants, and stimulants. The leaves of this species have a strong odor similar to that of garlic.

SPERGULA L.**CARYOPHYLLACEAE*****Spergula fallax* (Lowe) Krause**

Arenaria flaccida Roxb.

Spergula fallax Lowe

Spergula flaccida (Roxb.) Aschers

Spergula pentandra L. var. *intermedia* Boiss.

Geographic Distribution. See Figure 159.

Other Useful *Spergula* Species

The seeds of *Spergula arvensis* L. (Corn spurry, Toadflax) have been employed to make bread.

SPERGULARIA* (Pers.) J. Presl & C. Presl*CARYOPHYLLACEAE*****Spergularia diandra* (Guss.) Heldr. & Sart.**

Arenaria diandra Guss.

The leaves are eaten in salads.

Geographic Distribution. See Figure 160.

Other Useful *Spergularia* Species

The root of *Spergularia media* (L.) C. Presl has been used as an emetic. The seeds of *Spergularia rubra* (L.) J. Presl & C. Presl (Red sandwort, Sand spurrey) are edible, and a decoction of the plant has been employed medicinally to treat kidney stones. The leaves of *Spergularia speculum* A. DC. (Venus' looking glass) have been used in salads.

SUAEDA* Forssk. ex Scop.*CHENOPodiaceae**

The generic name is derived from the Arabic *suwaida* (= black), referring to the color of the dried leaves of a species of this genus.

***Suaeda vermiculata* Forssk. ex J.F. Gmel.**

Geographic Distribution. See Figure 161.

Other Useful *Suaeda* Species

The ashes of *Suaeda fruticosa* Forssk., *Suaeda indica* Moq., and *Suaeda nudiflora* Moq. were an important source of mineral alkali in the Middle East. The leaves of *Suaeda maritima* Dum. (Sea blite) are edible. *Suaeda vera* Forssk. ex J. Gmelin is employed as camel fodder. A black dye is obtained from *Suaeda suffrutescens* Wats. (Desert seepweed).

TAMARIX L.**TAMARICACEAE**

***Tamarix aucherana* (Decne. ex Walp.) Baum.**

Trichaurus aucherianus Decne. ex Walp.
Trichaurus macrocarpa (non (Ehrenb.) Bunge) Blakelock
Trichaurus passerinoides (non Del. ex Desv.) Boiss.

Geographic Distribution. See Figure 162.

Other Useful *Tamarix* Species

Several species, especially *Tamarix aphylla* L., *Tamarix gallica* L. (Manna plant), and *Tamarix mannifera* Ehrenb. (Manna tamarisk), are sources of manna. The juice of *Tamarix chinensis* Lour. has been used to treat smallpox. Bark of the twigs and galls of *Tamarix gallica* L. has been employed medicinally to treat diarrhea and dysentery, while the manna from that species is a mild laxative.

TEUCREUM L.**LABIATAE**

***Teucrium oliverianum* Ging. ex Benth.**

The plant has a very bitter taste, and is not eaten by animals.

Geographic Distribution. See Figure 163.

***Teucreum polium* L.**

Cat thyme, Hulwort, Mountain germander

Geographic Distribution. See Figure 164.

Traditional Medicine. Infusion of tender portions of plant is used for treatment of cholera and gastrointestinal disorders. Plant is boiled in water and the steam is inhaled to treat colds and fevers.

Phytochemistry, Pharmacology, and Economic Value. A classical pharmacognostic screen of the whole plant indicated the absence of alkaloids, flavonoids, saponins, and tannins (Aynehchi et al., 1981).

Other Useful *Teucreum* Species

Teucreum capense Thunb. is soaked in brandy, which is then used as a stomachic and a tonic. A medicinal tea, drunk as an aid to digestion, is made from the flowering branches of *Teucreum chamaedrys* L. (Chamaedrys germander, Common germander, Ground oak). *Teucreum cubense* Jacq. has been employed as a febrifuge and a tonic. *Teucreum marum* L. (Cat thyme, Mediterranean germander), reportedly a feline aphrodisiac, is the source of Herba Mari veri, which has been used as a diuretic, expectorant, stimulant, and stomachic. *Teucreum scorodonia* L. (Wood germander, Wood sage) has been employed as a hop substitute for brewing beer and to treat wounds.

THYMELAEA Miller**THYMELACEAE*****Thymelaea mesopotamica* (C. Jeffrey) B. Peterson**

Lygia mesopotamica C. Jeffrey

Geographic Distribution. See Figure 165.

Other Useful *Thymelaea* Species

A decoction of the leaves of *Thymelaea hirsuta* (L.) Endl. has been used as a shampoo to treat dandruff. The leaves have been employed medicinally as an anthelmintic.

TORULARIA (Cosson) O. Schulz**CRUCIFERAE*****Torularia torulosa* (Desf.) O.E. Schulz**

Malcolmia torulosa (Desf.) Boiss.
Sisymbrium torulosum Desf.

Geographic Distribution. See Figure 166.

Phytochemistry, Pharmacology, and Economic Value. The lipids of this plant contain palmitic (12.3%), stearic (1.8%), oleic (12.5%), linoleic (9.4%), and linolenic (64.1%) acids (Kumar and Tsunoda, 1978).

TRAGANUM Del.**CHENOPodiaceae*****Traganum nudatum* Del.**

Geographic Distribution. See Figure 167.

Phytochemistry, Pharmacology, and Economic Value. The lipid content of this plant is low (Krishchenko et al., 1984).

TRIBULUS L.**ZYGOPHYLLACEAE*****Tribulus terrestris* L.**

Land caltrops, Devil's thorn, Puncture vine, Small caltrops

The unexpanded capsules, ground to a powder and formed into cakes, have been used as famine food. The leaf is also edible when cooked.

Geographic Distribution. See Figure 168.

Traditional Medicine. Fruits diuretic and tonic. Used to treat dysentery, dysuria, gonorrhoea, and impotence. Flowers applied to the cornea to treat inflammation.

Phytochemistry, Pharmacology, and Economic Value. An early report noted the detection of saponin activity in the leaf and root (Hsu et al., 1968). Subsequently, several authors have reported the presence of diosgenin, a useful precursor of synthetic steroids used in fertility control, in this plant (Pkheidze et al., 1967; Gheorghiu and Ionescu-Matiu, 1968b; Abrosimov et al., 1970; Iskenderov, 1970; Kintya et al., 1972; Mahato et al., 1978). It has been found that the diosgenin yield can be tripled by incubating the plant material with *Aspergillus niger* BKMt-33 for five days prior to extraction (Perepelitsa and Kintya, 1978).

Other steroidal sapogenins and glycosides encountered include chlorogenin, gitogenin (Gheorghiu and Ionescu-Matiu, 1968a,b), ruscogenin (Iskenderov, 1970), tigogenin 3-diglu-corhamnoside (Tomova et al., 1974), dioscin (Perepelitsa and Kintya, 1974), gracillin, trillin (Perepelitsa and Kintya, 1975), neotigogenin (Mahato et al., 1978; Zafar et al., 1989), tigogenin (Nag et al., 1979), neohecogenin glucoside, tribulosin (Mahato et al., 1981), 3-deoxy- Δ^3 -diogenin, and hecogenin (Tombesi, 1983).

The major phytosterols in the plant are campesterol, sitosterol, and stigmasterol (Tomova et al., 1973).

Bioflavonoids isolated from the plant include kaempferol, kaempferol 3-glucoside, kaempferol 3-rutinoside, tribuloside (Bhutani et al., 1969), rutin (Panova and Tomova, 1970), astragalin (Tomova et al., 1974), and quercetin (Zafar and Nasa, 1987). A detailed study of the flavonoid composition of the plant revealed the presence of the 3-p-coumaroylglucoside, 3,7-diglucoside, 3-gentiobioside, 3-gentiobioside-7-glucoside, 3-gentiotriose, 3-gentiotriose-7-glucoside, 3-glucoside, and 3-rutinoside of isorhamnetin, the 3-p-coumaroylglucoside, 3-gentiobioside, 3-gentiobioside-7-glucoside, and 3-rutinoside of kaempferol, and the 3-gentiobioside, 3-gentiotriose, 3-glucoside, 3-rhamnogentiobioside, and 3-rutinoside of quercetin (Saleh et al., 1982).

Alkaloids identified in the plant include harmine, harman (Lutomski et al., 1967; Lutomski and Nowicki, 1968), and harmol (Gill and Raszeja, 1971).

Linoleic acid is the major (71.3%) fatty acid in the seed oil (Daulatabad and Ankalgi, 1978).

A classical pharmacognostic screen of the fruit, leaf, and stem indicated the presence of alkaloids and saponins, but not flavonoids or tannins (Aynehchi et al., 1981).

The pharmaceutical preparation Tribestan, which contains an extract of this plant, has been found to increase the libido, improve and prolong the period of erection, and increase the number and motility of sperm in men. In women, Tribestan improved ovarian function and was effective against frigidity and infertility, and for the prevention of climacteric disturbances. It has been found to be non-toxic and to have no side-effects (Tomova, 1987). The major component of Tribestan was protodioscin (Gyulemetova et al., 1982). It was demonstrated that the furostanol glycosides from the plant stimulate spermatogenesis and Sertoli cell activity in rats. Oral administration of these saponins to male rats increased sexual reflexes and libido, while oral administration to female rats potentiated estrus and increased fertility. There was no evidence of toxicity or teratogenicity (Tomova et al., 1981).

A saponin from this plant increased the amplitude and decreased the frequency of cardiac contractions (Turova and Skachkova, 1974).

An ether extract of the fruit exhibited a diuretic effect and increased creatinine renal clearance in anesthetized dogs (Singh and Sisodia, 1971).

An ether extract of the plant exhibited dose-dependent juvenile hormone activity when applied to the penultimate instar of *Dysdercus cingulatus* in quantities of 100 to 500 µg (Gunasekaran and Chelliah, 1985).

Other Useful *Tribulus* Species

Tribulus alatus Del. has been used as a substitute for *Tribulus terrestris* L.

TRIGONELLA L.

LEGUMINOSAE

***Trigonella anguina* Del.**

Geographic Distribution. See Figure 169.

***Trigonella hamosa* Forssk.**

Geographic Distribution. See Figure 170.

Other Useful *Trigonella* Species

The flowers of *Trigonella caerulea* (L.) Ser. (Sweet trefoil) have been used to flavor cheese in Switzerland. *Trigonella corniculata* L., *Trigonella radiata* Boiss., and *Trigonella suavis-sima* Lindl. are also edible. The fruit of *Trigonella corniculata* L. is applied to bruises and swellings. The seeds of *Trigonella foenum-graecum* L. (Fenugreek) have been employed to treat diabetes, and they supposedly exhibit contraceptive activity.

VALERIANELLA Miller**VALERIANACEAE**

Valerianella dufresnia Bunge ex Boiss.

Dufresnia leiocarpa Koch

Geographic Distribution. See Figure 171.

Other Useful Valerianella Species

The leaves of *Valerianella coronata* DC., *Valerianella eriocarpa* Desv. (Italian corn salad), and *Valerianella olitoria* Pollich (Corn salad) have been used in salads.

ZILLA Forssk.**CRUCIFERAE**

Zilla spinosa (L.) Prantl

Bunias spinosa L.

Zilla myagroides Forssk.

The leaves are boiled and eaten in Egypt, Saudi Arabia, and neighboring countries. Also grazed by camels in Kuwait.

Geographic Distribution. See Figure 172.

Traditional Medicine. Used to treat kidney stones.

Phytochemistry, Pharmacology, and Economic Value. The seed lipids of this plant contain palmitic (7.5%), stearic (1.7%), oleic (24.8%), linoleic (19.3%), linolenic (10.1%), eicosenoic (8.9%), and docosenoic (27.6%) acids (Kumar and Tsunoda, 1978). The aerial portion of the plant has been found to contain lauric, myristic, palmitic, oleic, linoleic, linolenic, and arachidic acids, along with β -amyrin and sitosterol (Karawya et al., 1974).

An antithyroid factor, goitrin, and its metabolic precursor, progoitrin, have been obtained from the plant, along with sinapine thiocyanate (Karawya et al., 1973).

ZYGOPHYLLUM L.**ZYGOPHYLLACEAE*****Zygophyllum coccineum* L.**

Zygophyllum desertorum Forsk.
Zygophyllum propinquum Decne.

The plant is grazed by camels. The seeds are employed as a pepper substitute.

Geographic Distribution. See Figure 173.

Traditional Medicine. Anthelmintic and diuretic. Fruits used to treat asthma, diabetes, gout, hypertension, and rheumatism.

Phytochemistry, Pharmacology, and Economic Value. An aqueous extract of the plant exhibited antihistaminic, antipyretic, diuretic, hypotensive, and local anesthetic activities, and produced stimulation and depression of isolated amphibian heart, relaxation of isolated intestine, contraction of the uterus, and vasodilation. The extract antagonized acetylcholine action on skeletal muscle and acted additively with the muscle relaxant effect of *d*-tubocurarine. The LD₅₀ when injected subcutaneously into toads was found to be 25 mL/100 g (Saad et al., 1967).

Other Useful *Zygophyllum* Species

A tea is made from the tips of the flower clusters of *Zygophyllum album* L. The flowers of *Zygophyllum fabago* L. (Bean caper) are used as a caper substitute. An infusion of the leaves of *Zygophyllum gaetulum* Emberger & Maire is employed as a topical antiseptic. *Zygophyllum simplex* L. is used as a camel fodder.

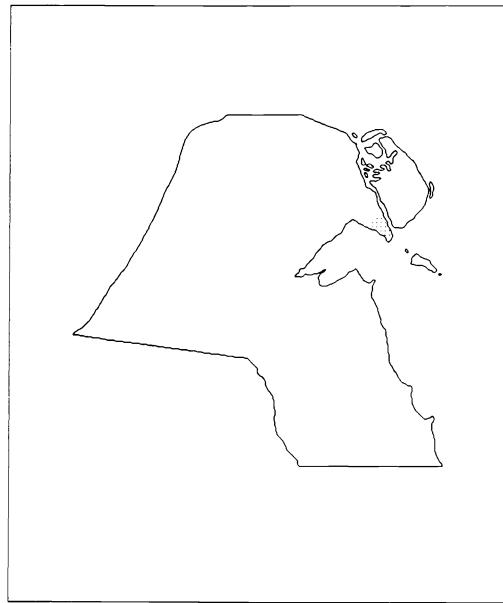
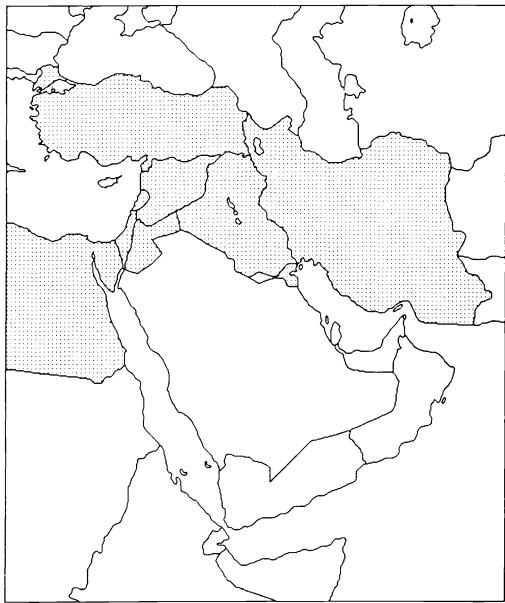


Figure 1. Geographic distribution of *Adonis dentatus* Del.

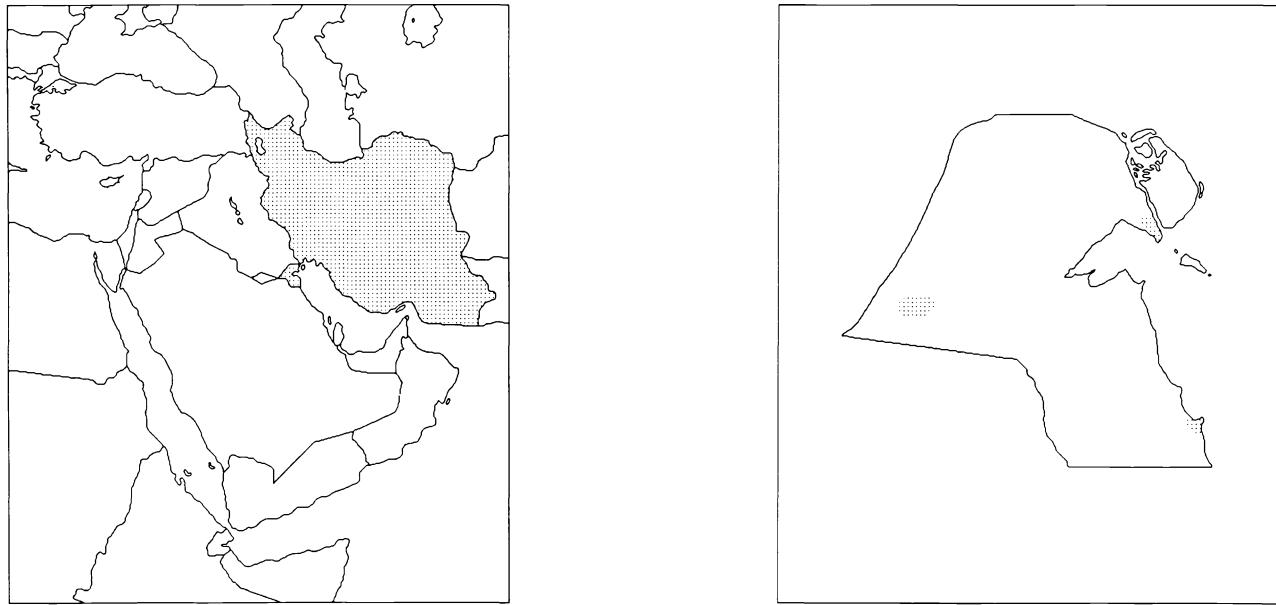


Figure 2. Geographic distribution of *Aellenia glauca* (M.B.) Aellen.

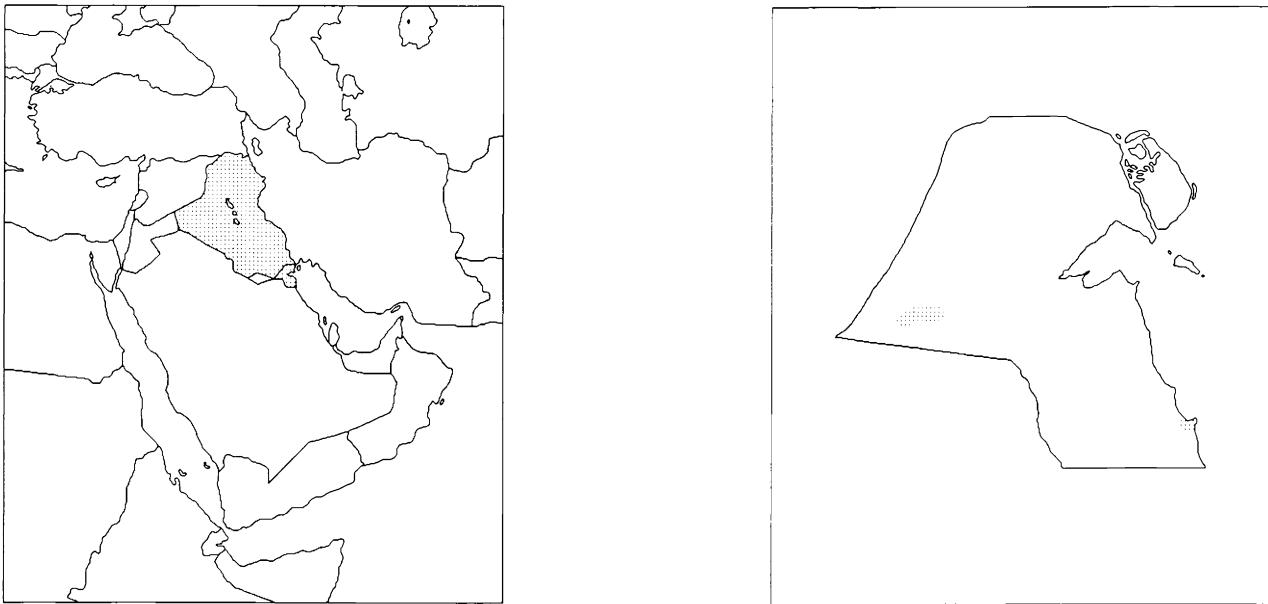


Figure 3. Geographic distribution of *Aellenia subaphylla* (C.A. Mey.) Botsch.

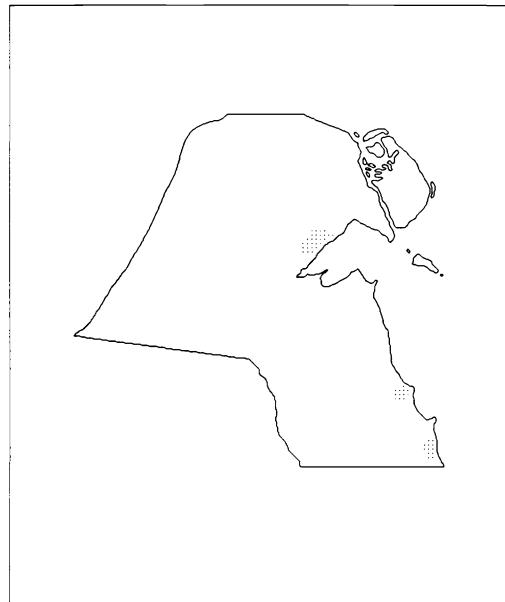
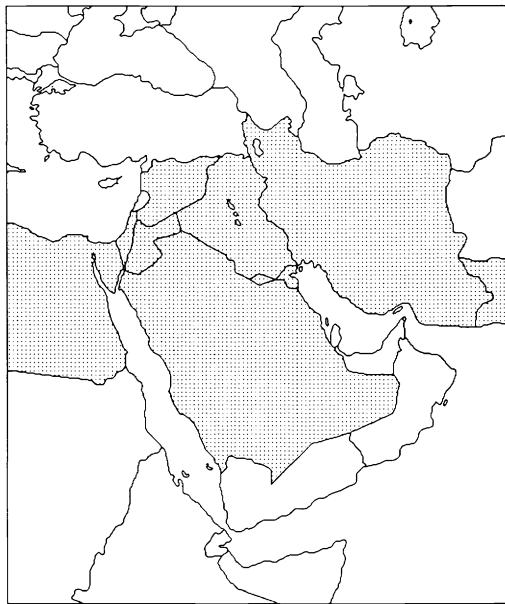


Figure 4. Geographic distribution of *Aizoon canariense* L.

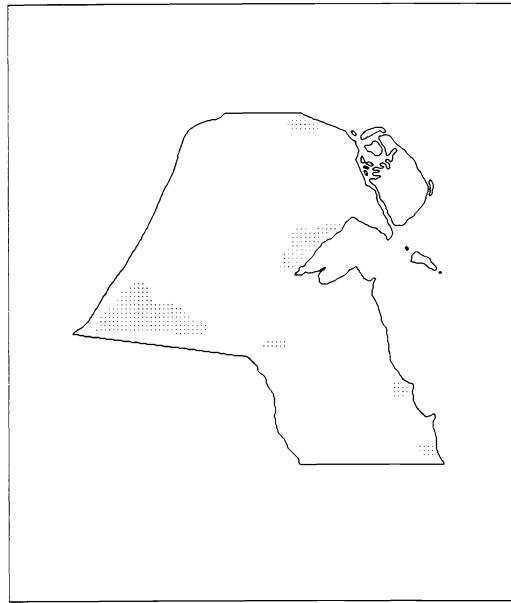
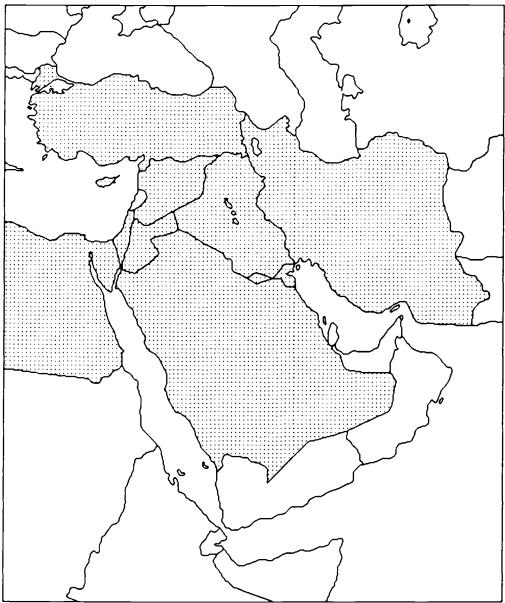


Figure 5. Geographic distribution of *Aizoon hispanicum* L.

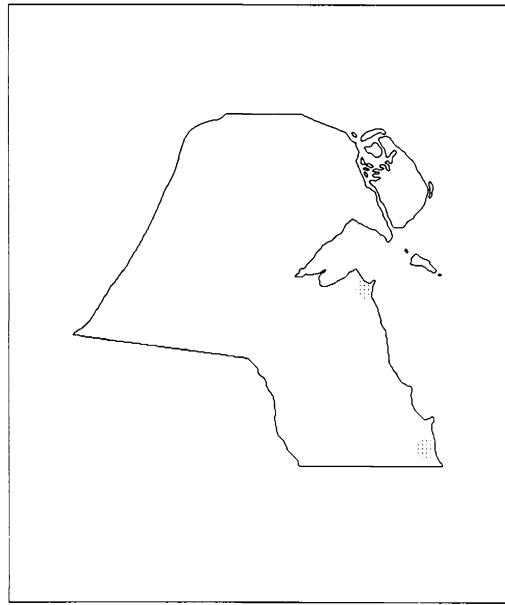
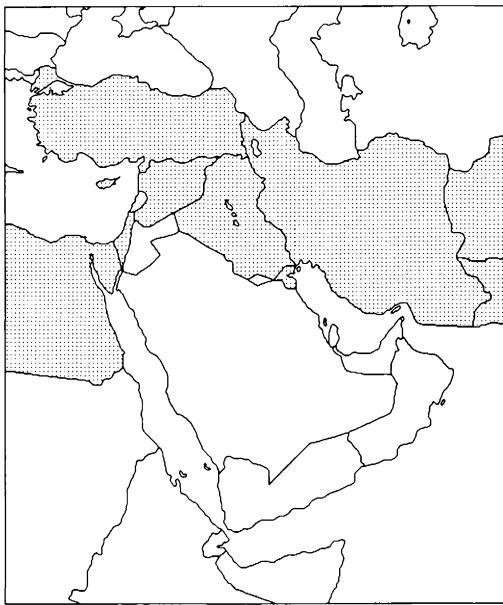


Figure 6. Geographic distribution of *Alhagi maurorum* Medik.—non DC.

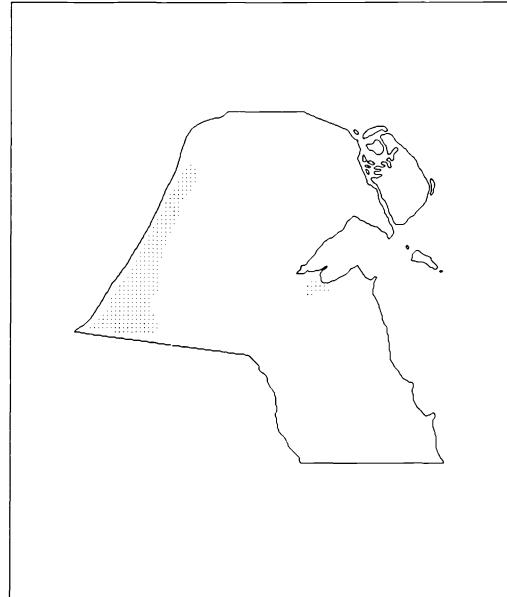
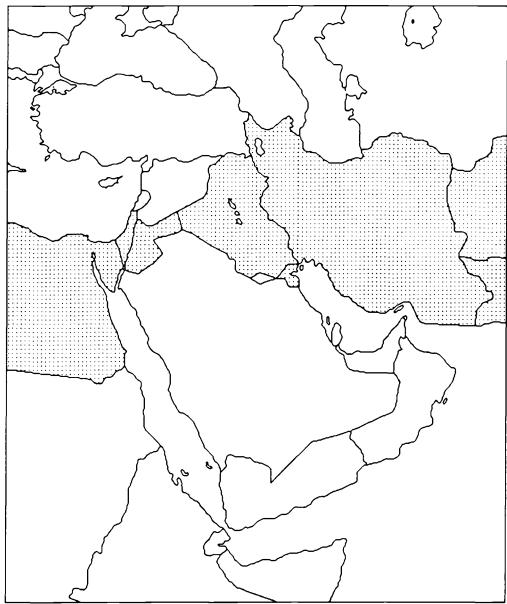


Figure 7. Geographic distribution of *Althaea ludwigii* L.

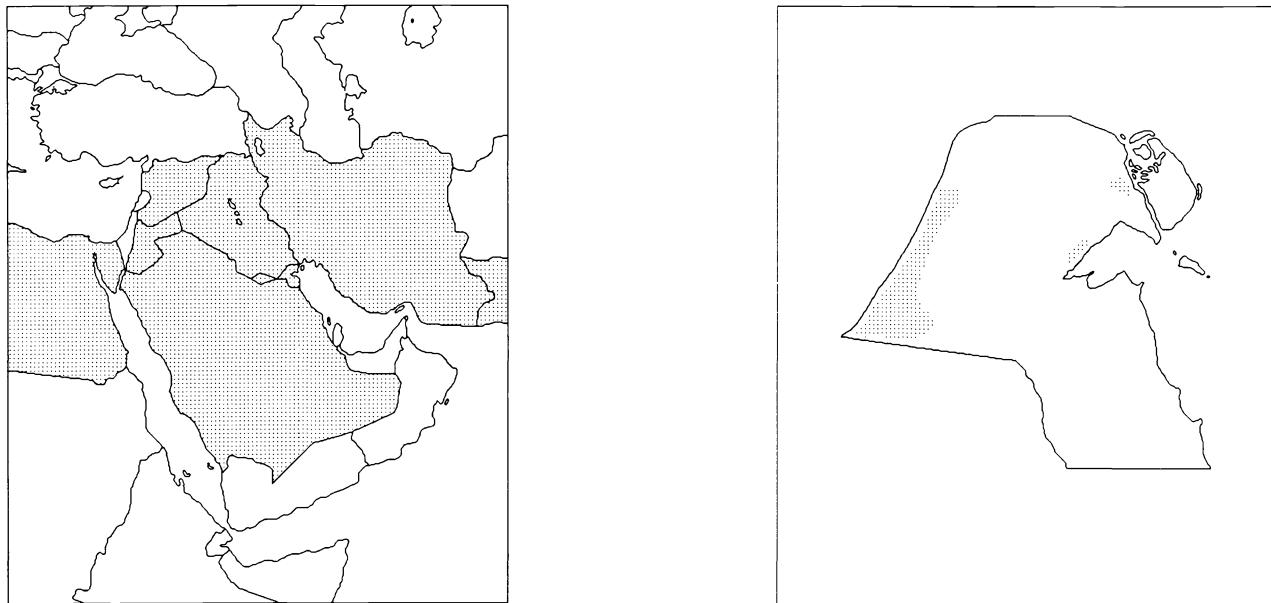


Figure 8. Geographic distribution of *Alyssum homalocarpum* (Fisch. & Mey.) Boiss.

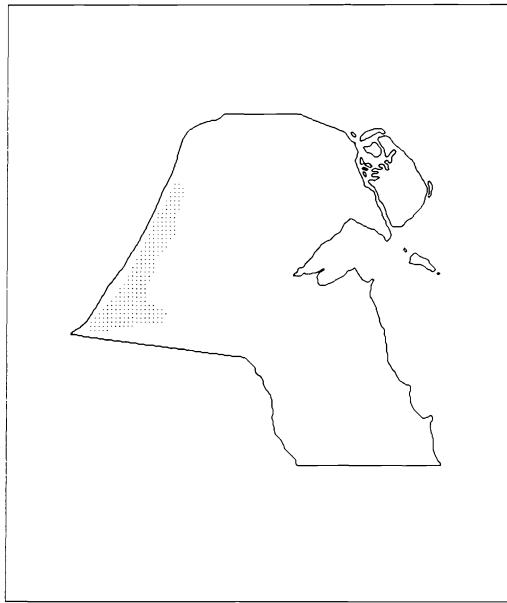
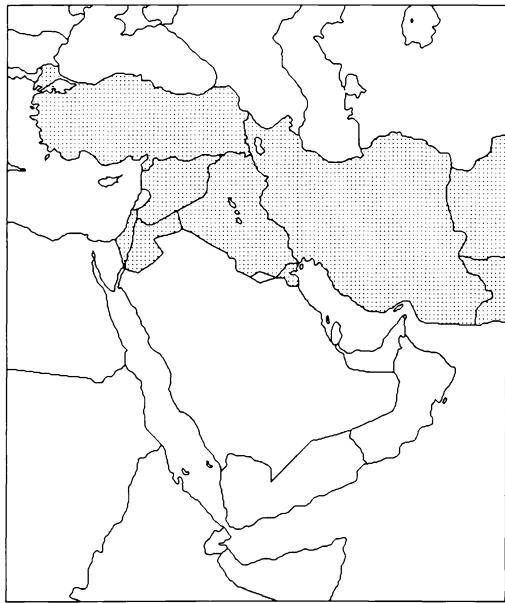


Figure 9. Geographic distribution of *Alyssum linifolium* Steph. ex Willd.

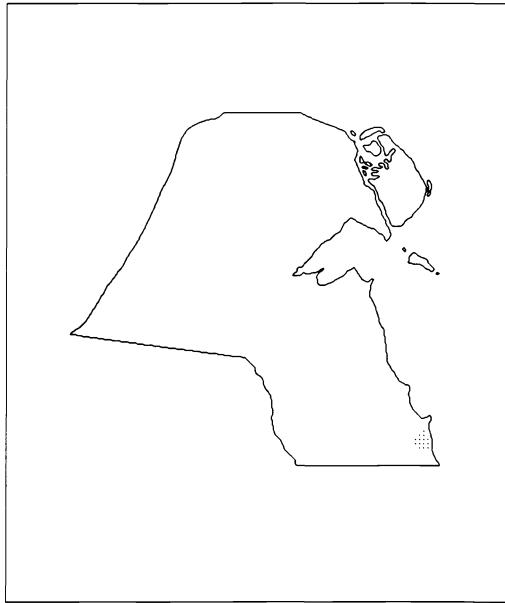
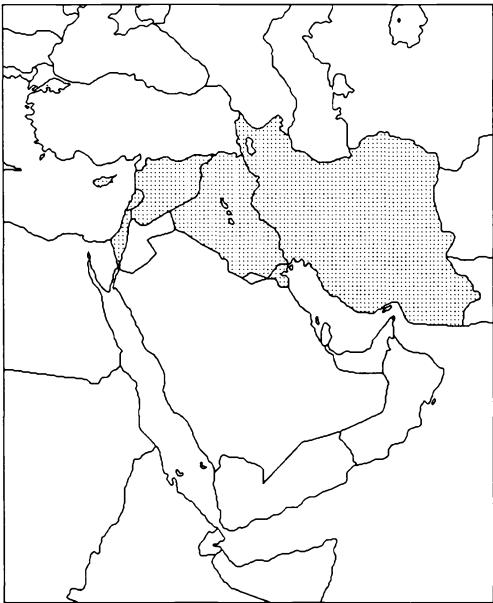


Figure 10. Geographic distribution of *Ammi majus* L.

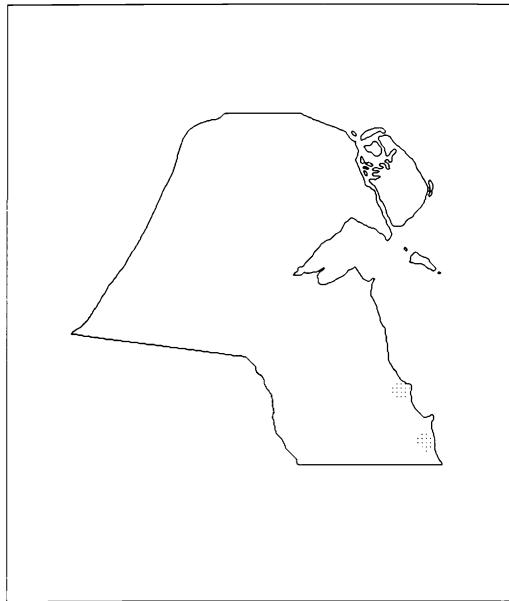
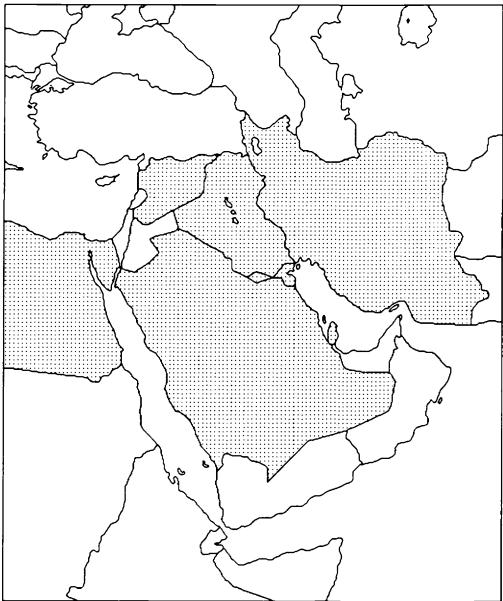


Figure 11. Geographic distribution of *Anabasis setifera* Moq.

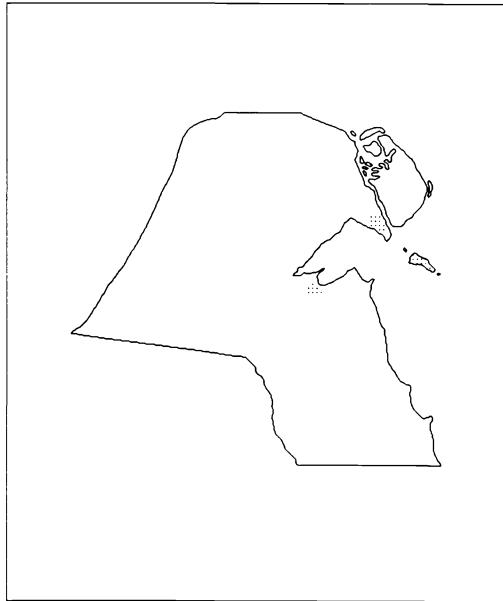
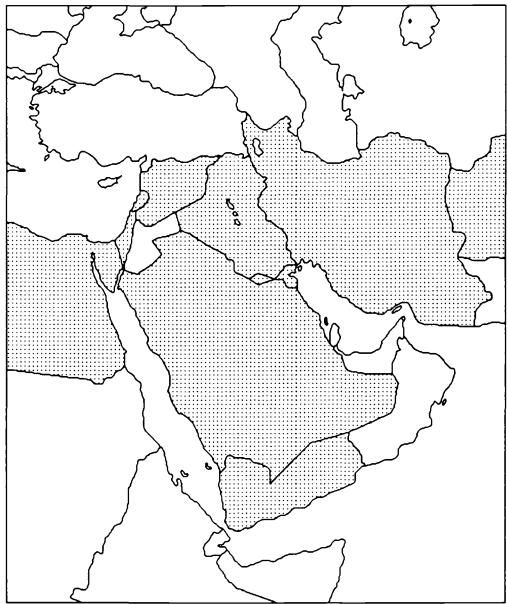


Figure 12. Geographic distribution of *Anagallis arvensis* L.

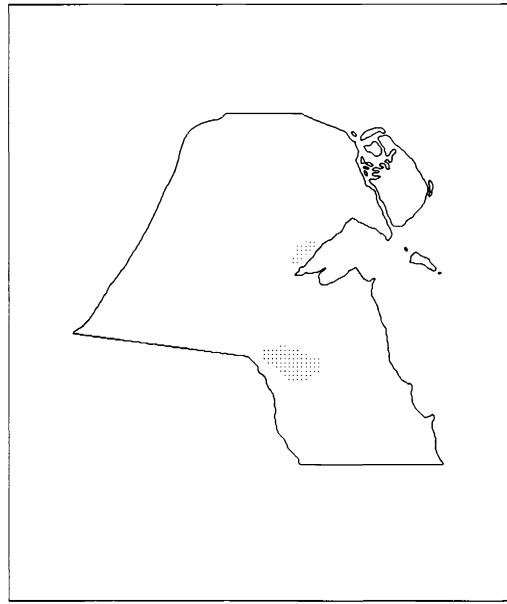
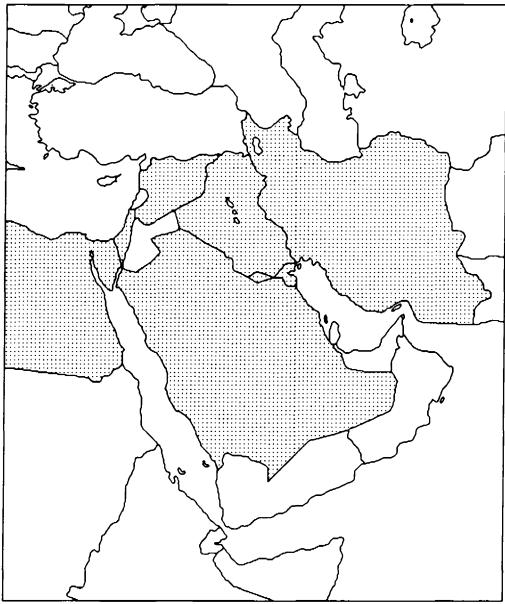


Figure 13. Geographic distribution of *Anastatica hierochuntica* L.

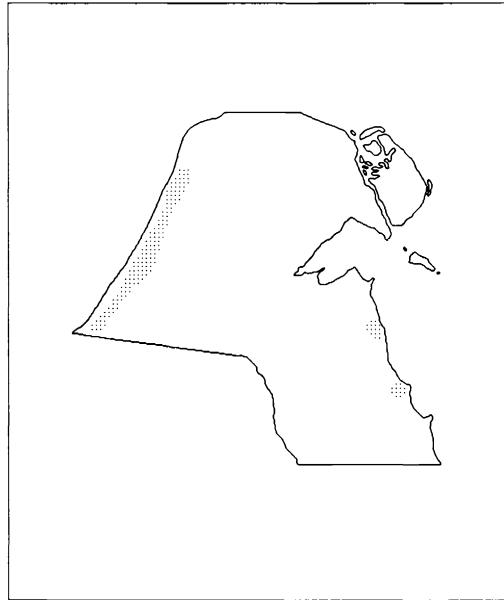
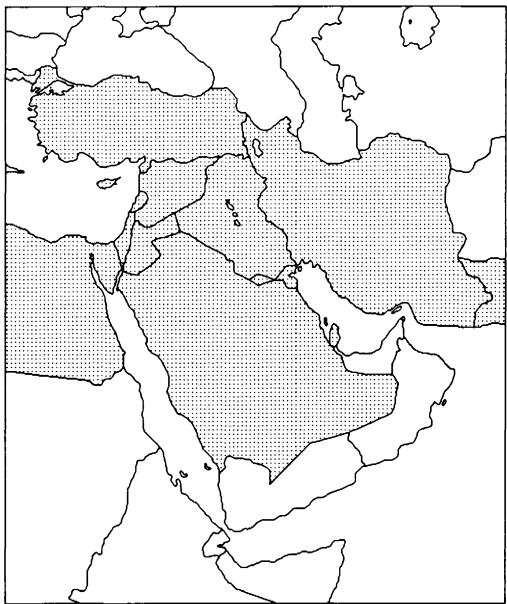


Figure 14. Geographic distribution of *Andrachne telephiooides* L.

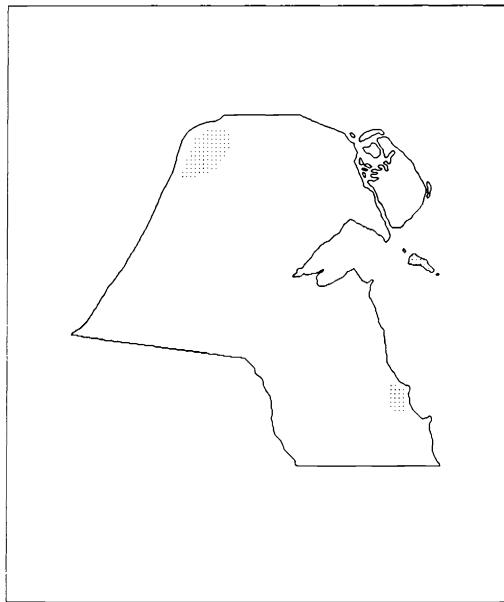
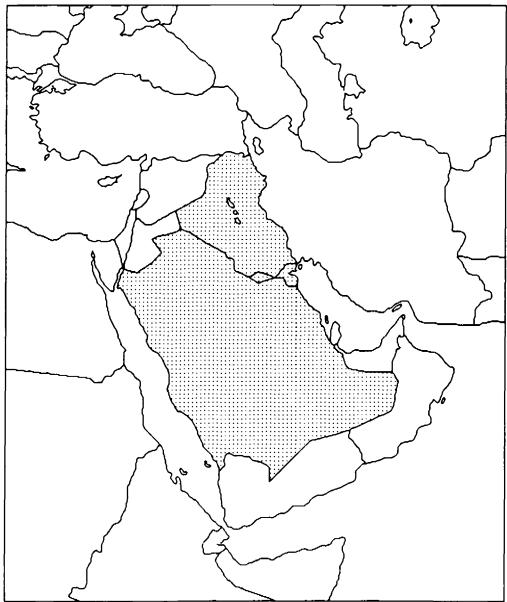


Figure 15. Geographic distribution of *Anisosciadium lanatum* Boiss.

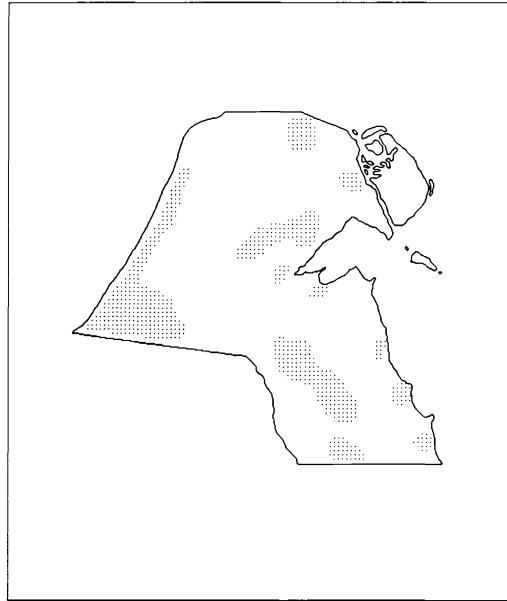
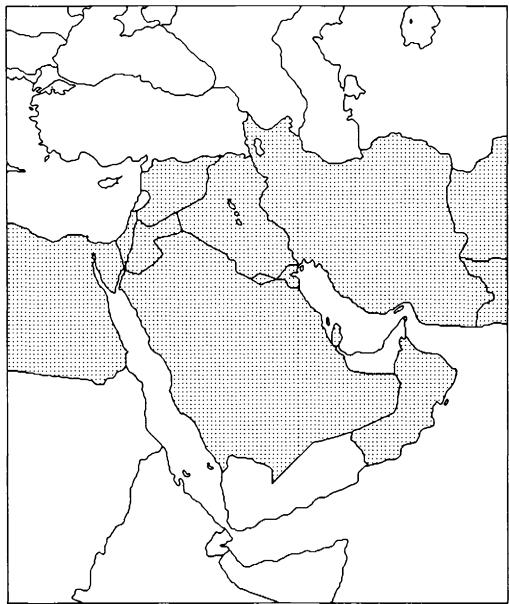


Figure 16. Geographic distribution of *Arnebia decumbens* (Vent.) Coss. & Kral.

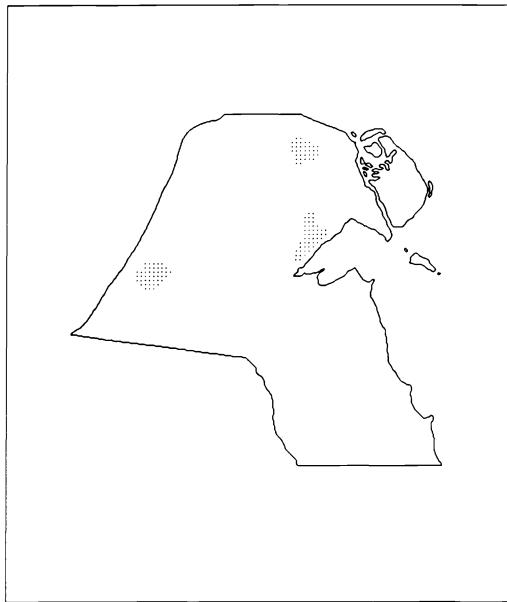
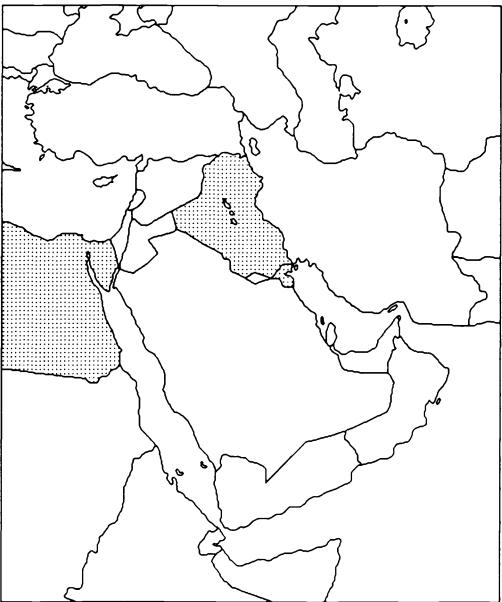


Figure 17. Geographic distribution of *Arnebia tetrastigma* Forssk.

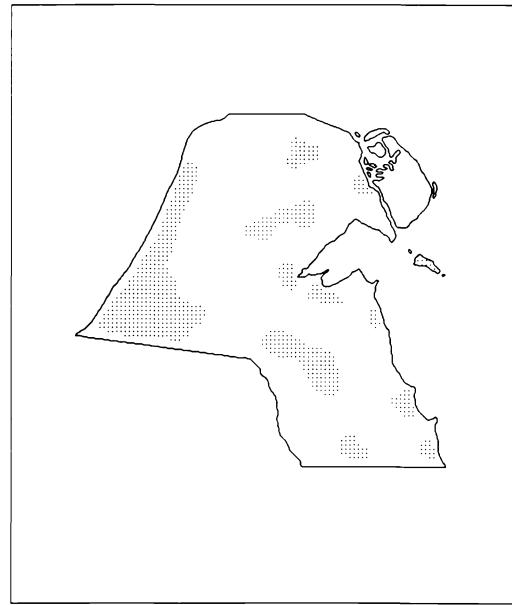
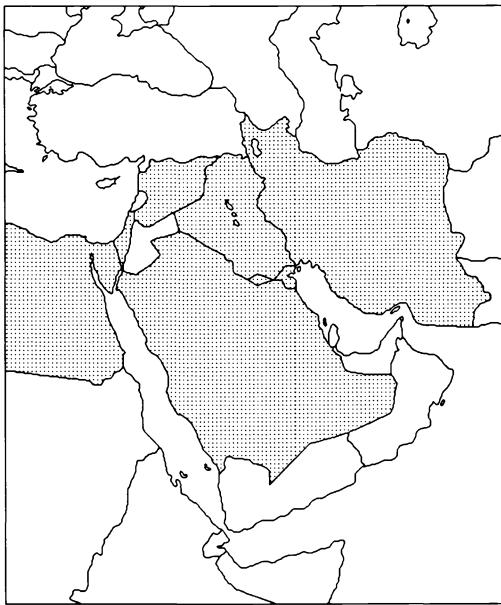


Figure 18. Geographic distribution of *Astragalus annularis* Forssk.

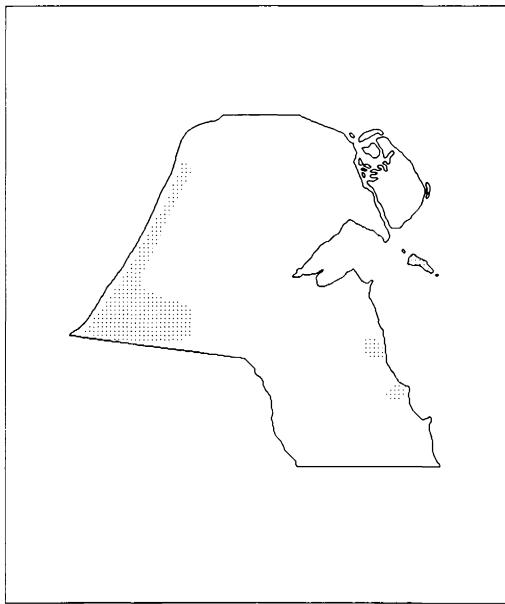
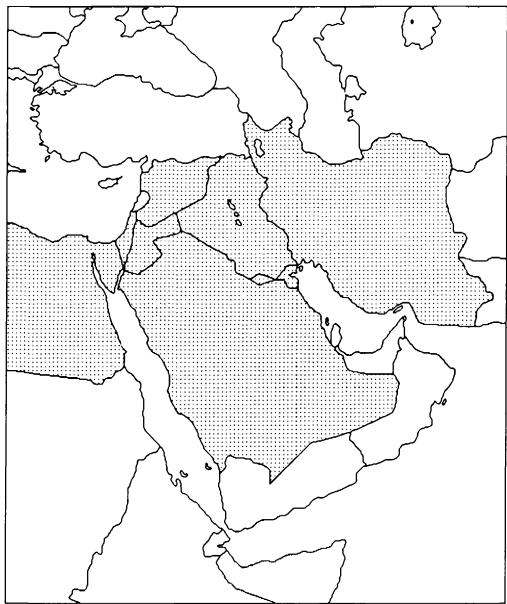


Figure 19. Geographic distribution of *Astragalus bombycinus* Boiss.

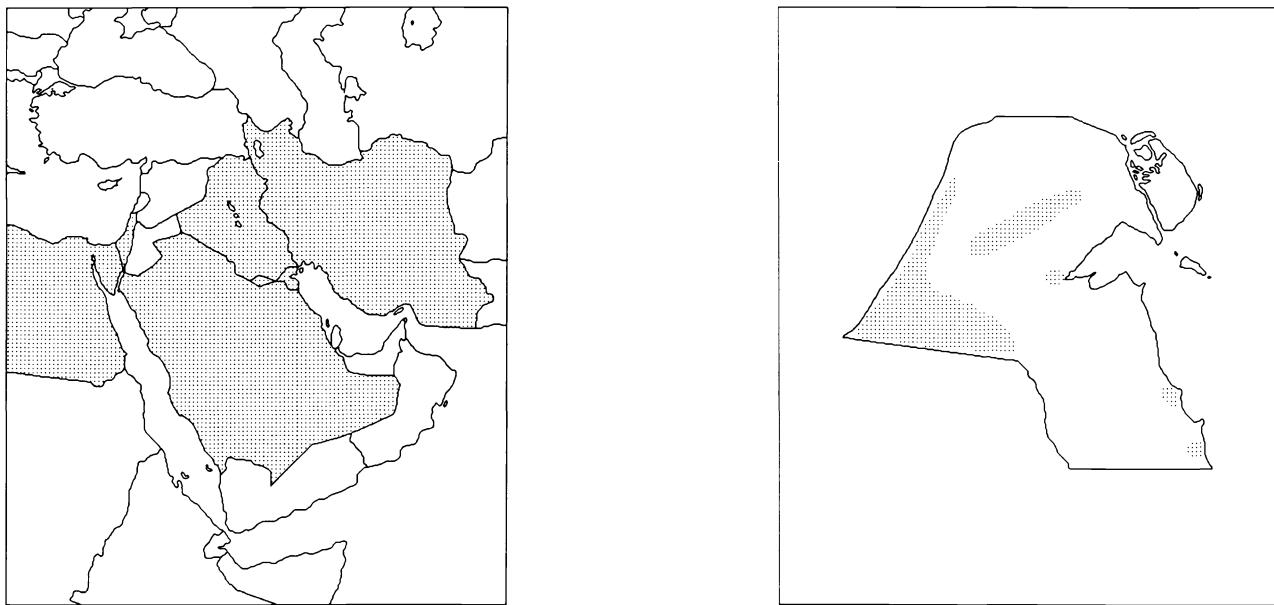


Figure 20. Geographic distribution of *Astragalus corrugatus* Boiss.

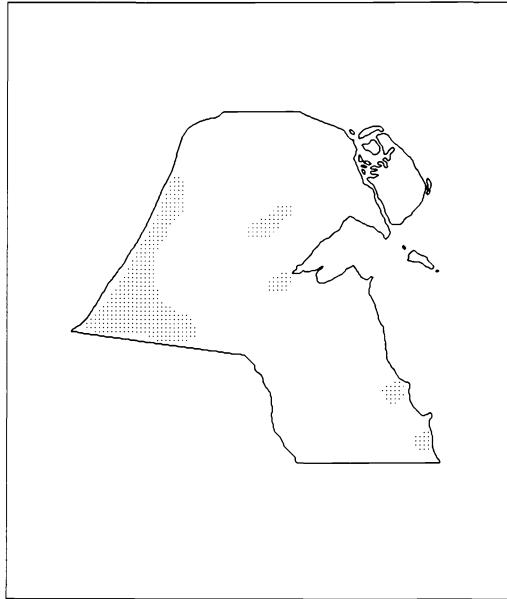
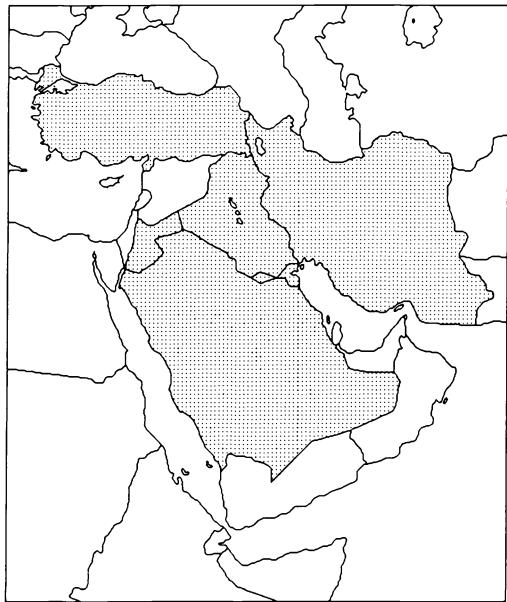


Figure 21. Geographic distribution of *Astragalus dactylocarpus* Bertol.

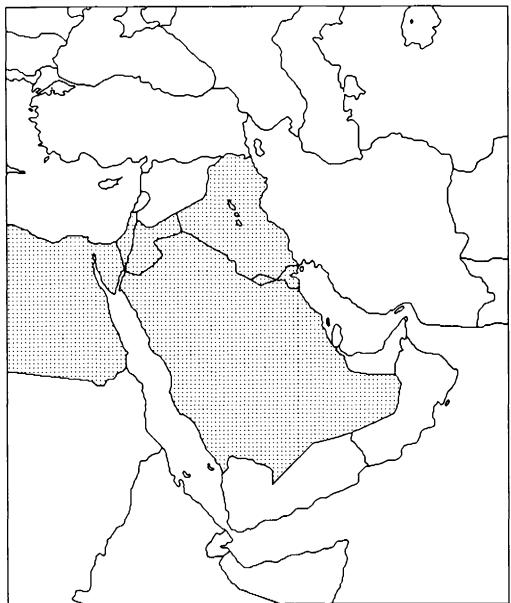


Figure 22. Geographic distribution of *Astragalus hauarensis* Boiss.

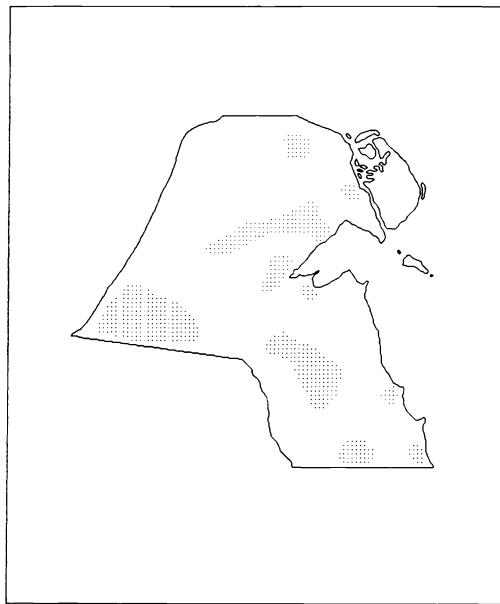
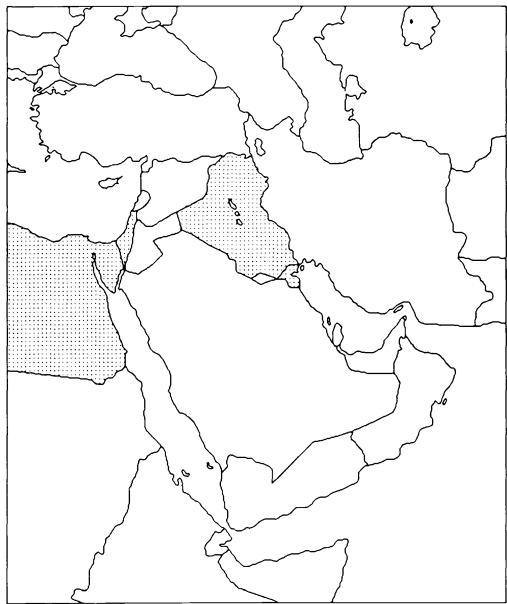


Figure 23. Geographic distribution of *Astragalus schimperi* Boiss.

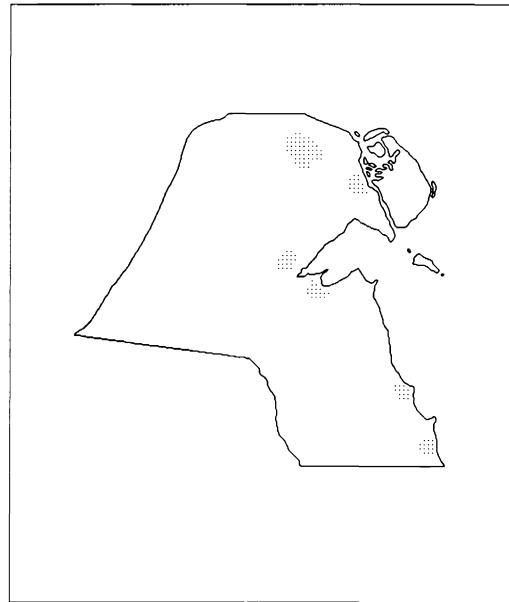
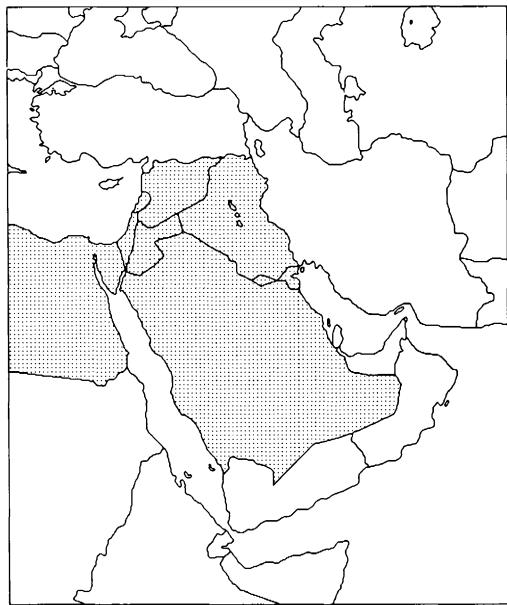


Figure 24. Geographic distribution of *Astragalus spinosus* (Forssk.) Muschl.

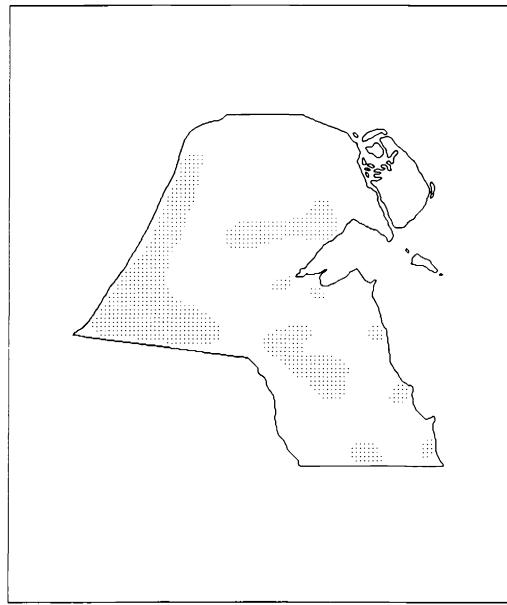
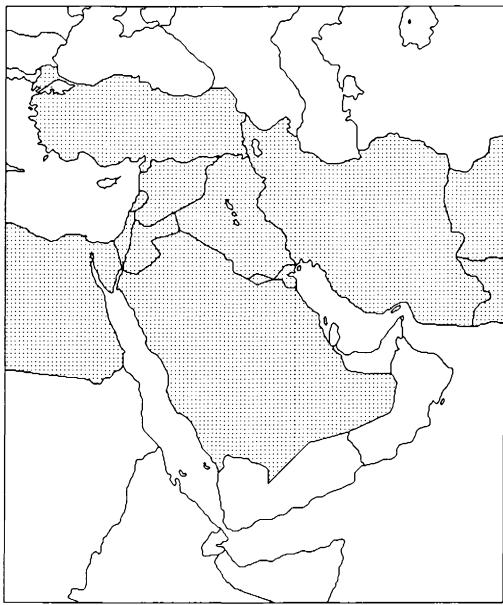


Figure 25. Geographic distribution of *Astragalus tribuloides* Del.

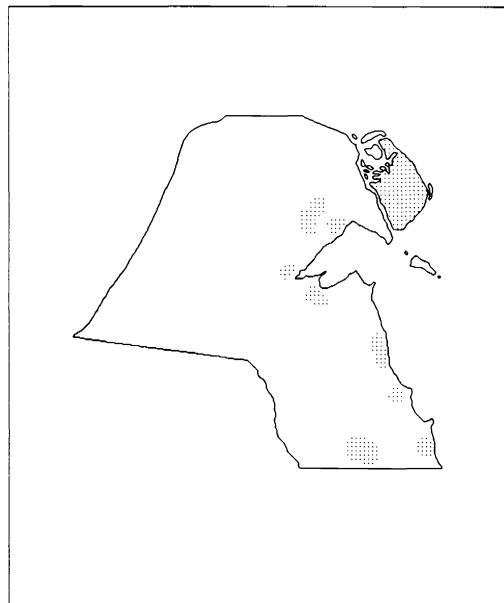
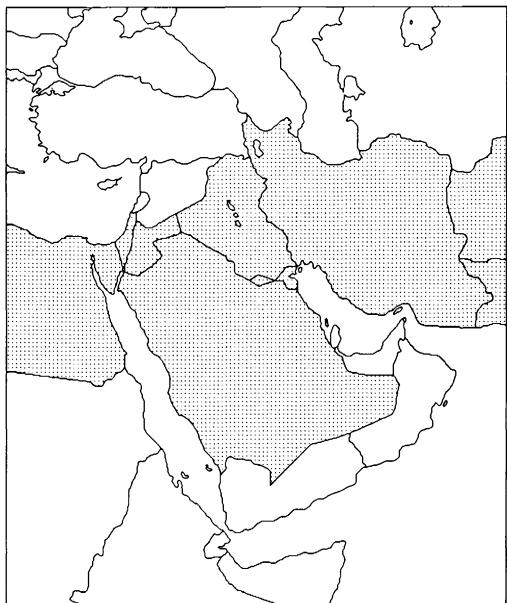


Figure 26. Geographic distribution of *Atriplex dimorphostegia* Boiss.

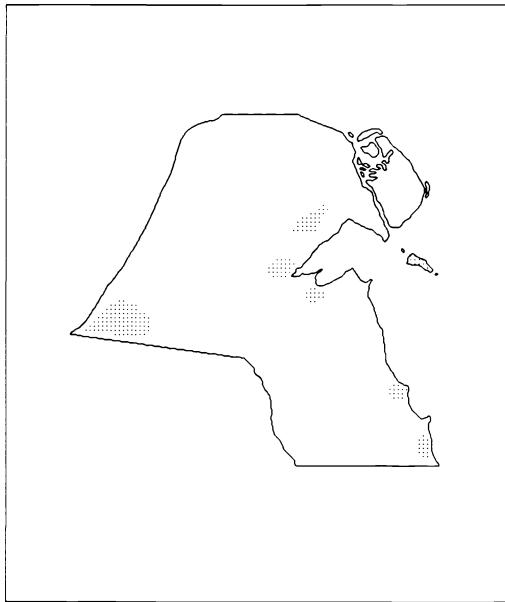
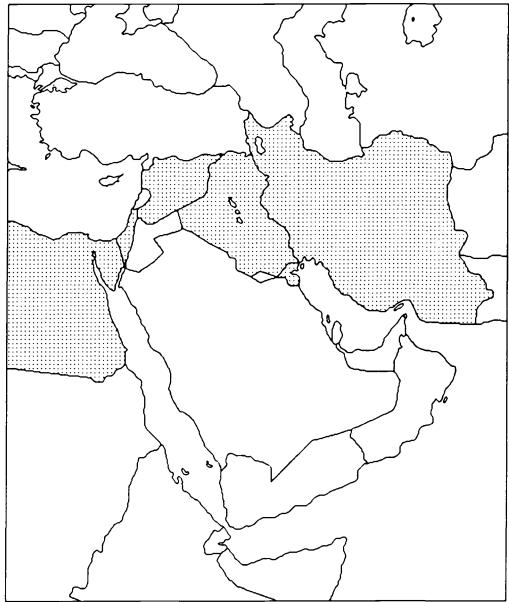


Figure 27. Geographic distribution of *Atriplex leucoclada* Kar. & Kir.

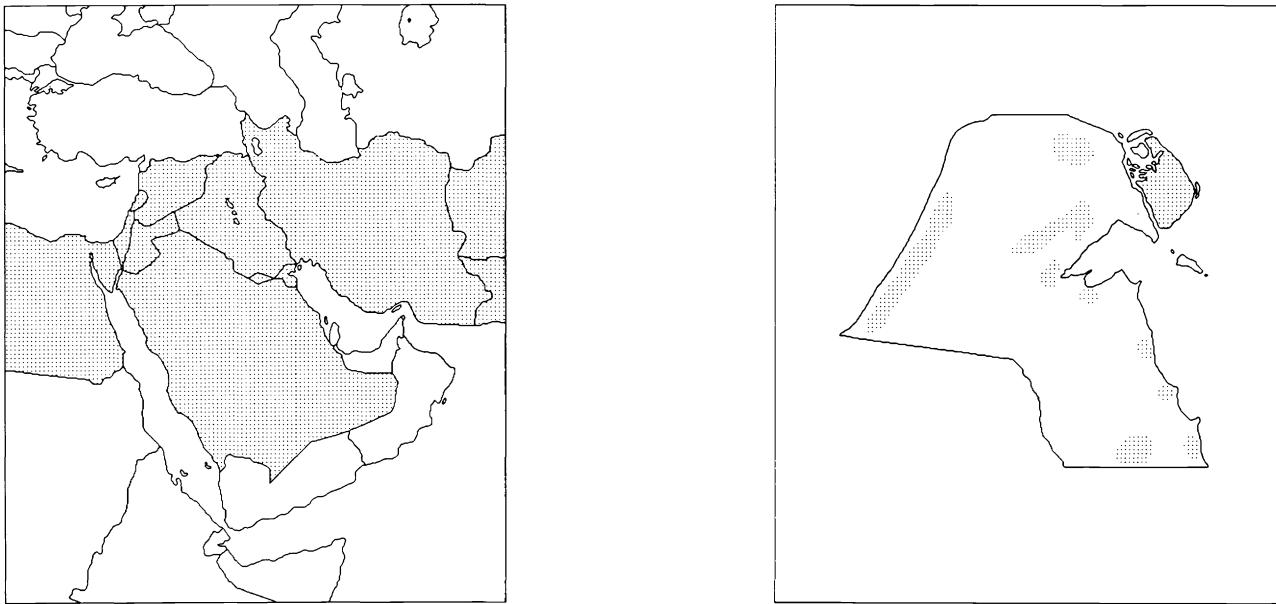


Figure 28. Geographic distribution of *Bassia eriophora* (Schrad.) Aschers.

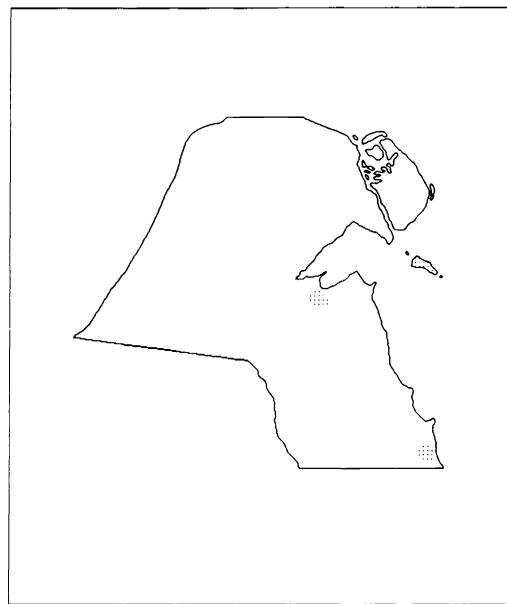
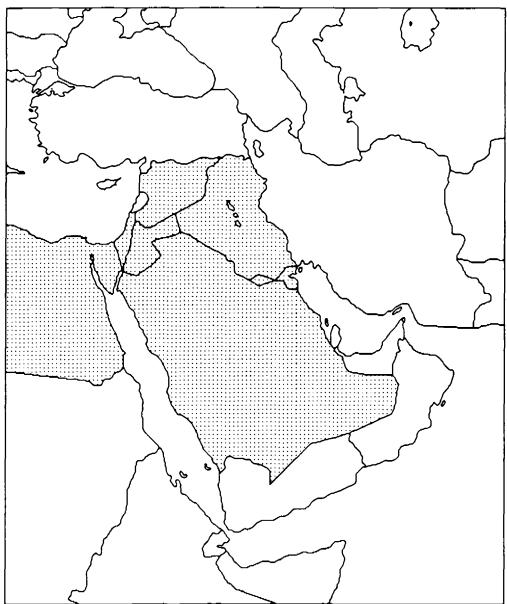


Figure 29. Geographic distribution of *Bassia muricata* (L.) Aschers.

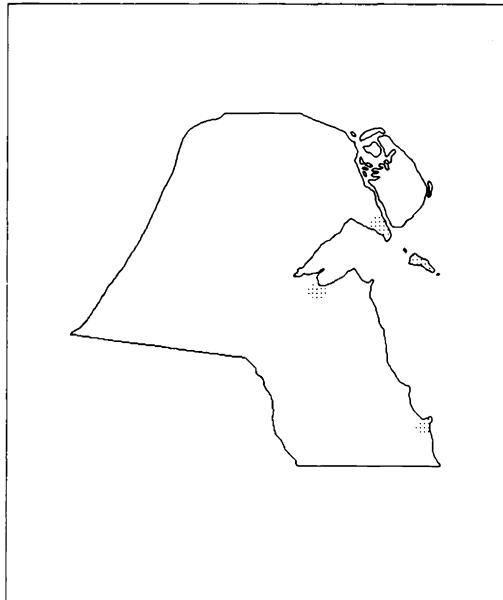
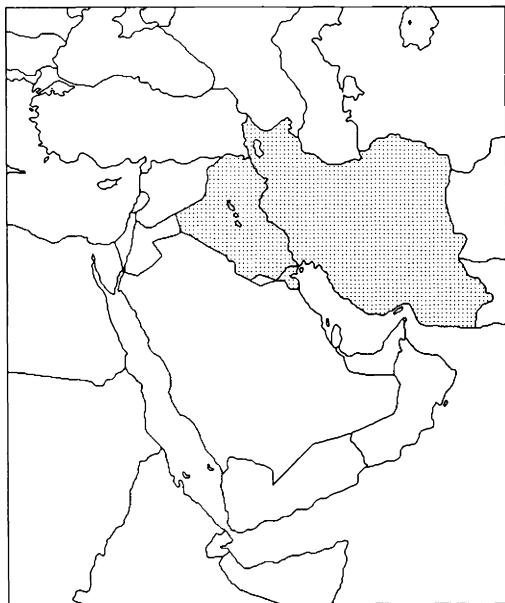


Figure 30. Geographic distribution of *Bienertia cycloptera* Bunge ex Boiss.

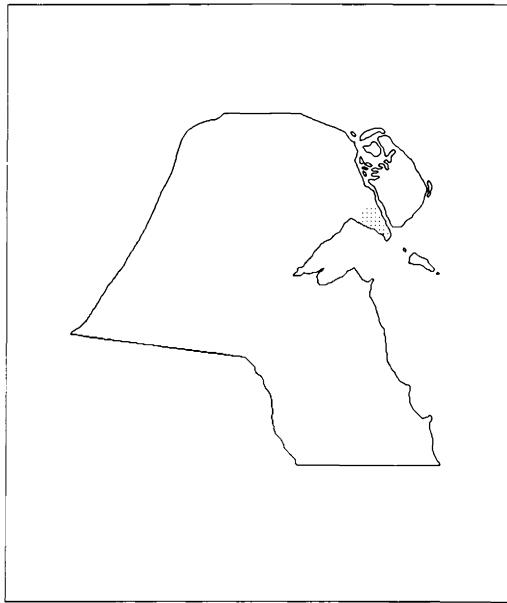
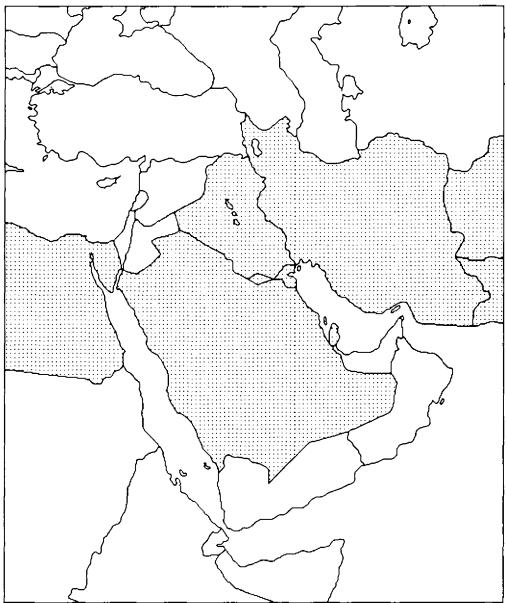


Figure 31. Geographic distribution of *Brassica juncea* (L.) Czerniak.

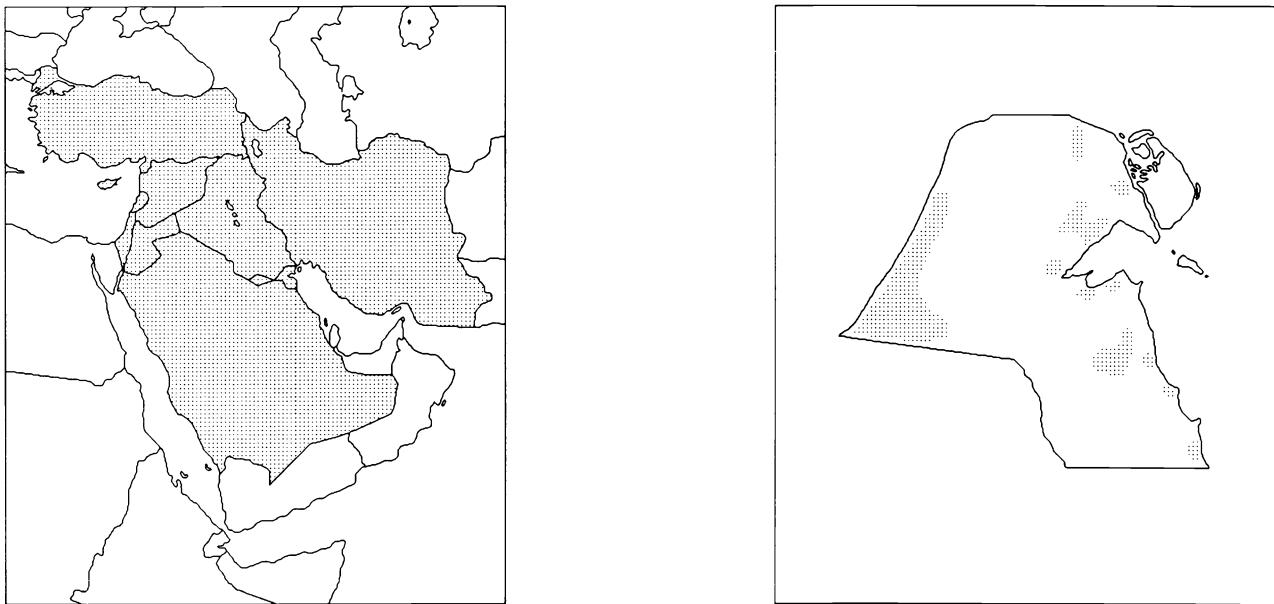


Figure 32. Geographic distribution of *Brassica tournefortii* Gouan.

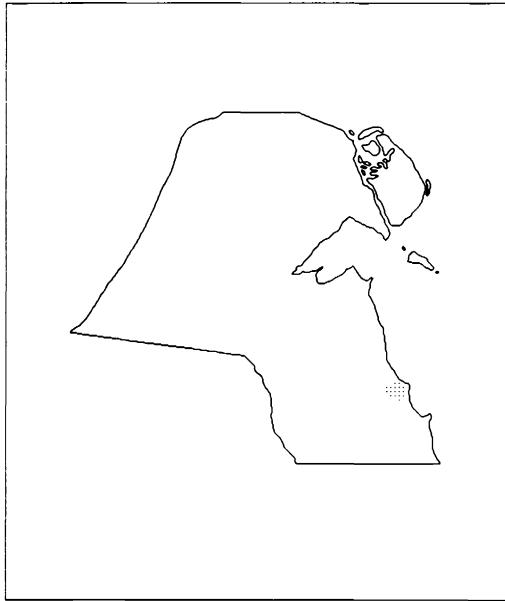
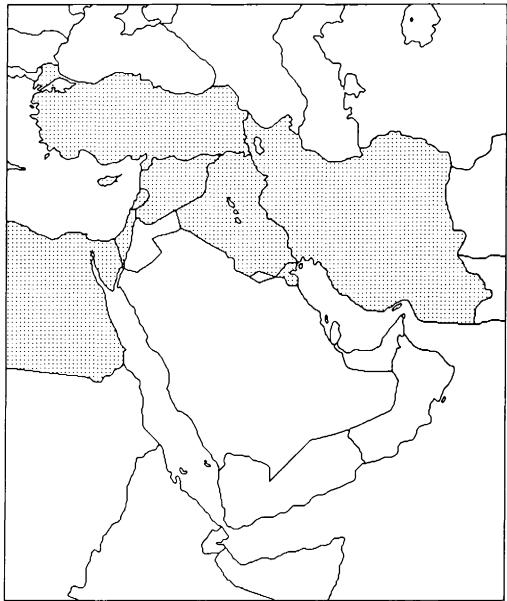


Figure 33. Geographic distribution of *Bupleurum semicompositum* L.

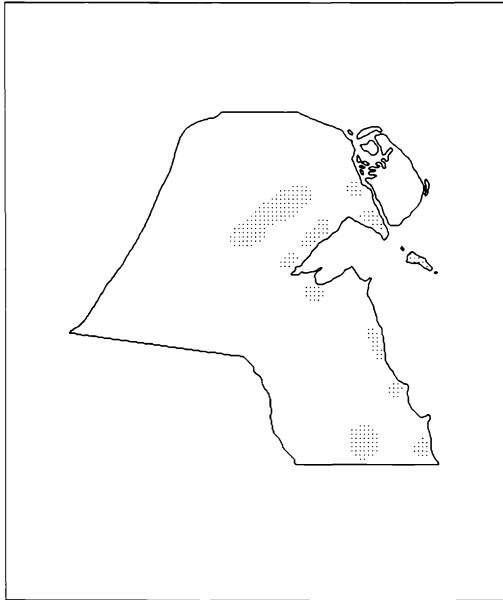
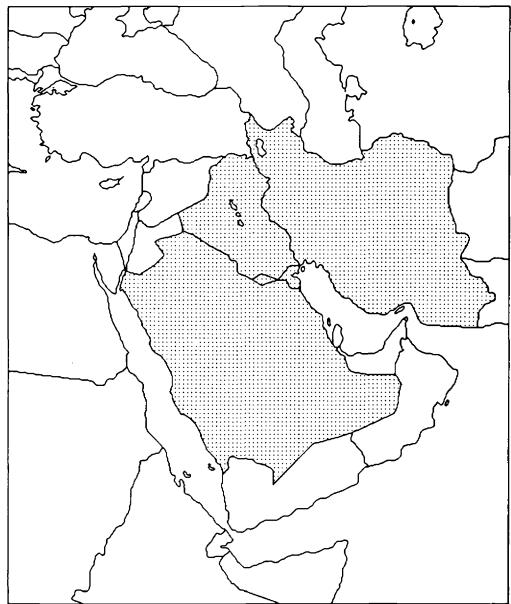


Figure 34. Geographic distribution of *Cakile arabica* Velen. & Bornm.

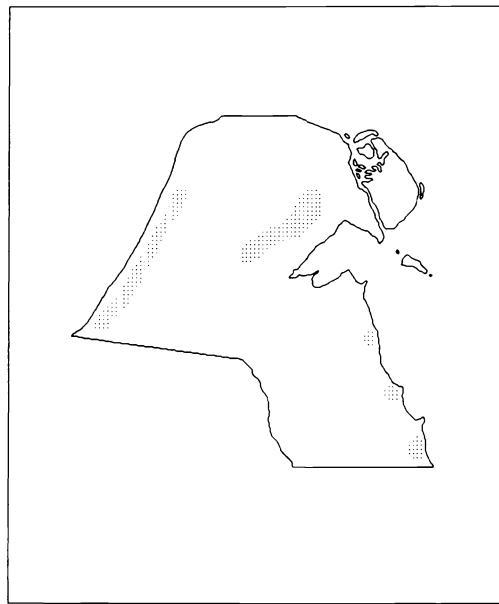
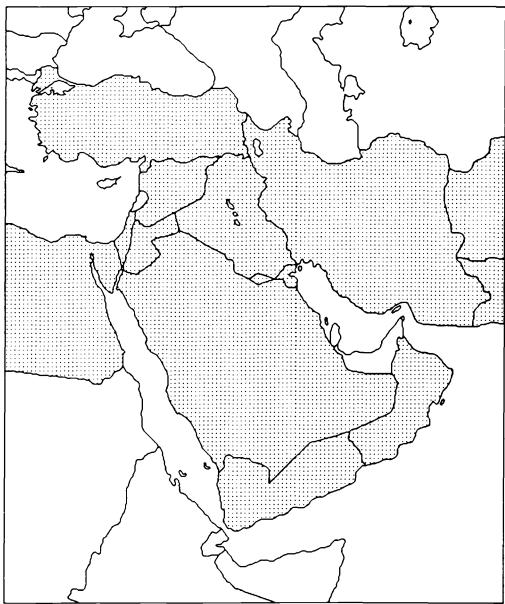


Figure 35. Geographic distribution of *Calligonum comosum* L'Hér.

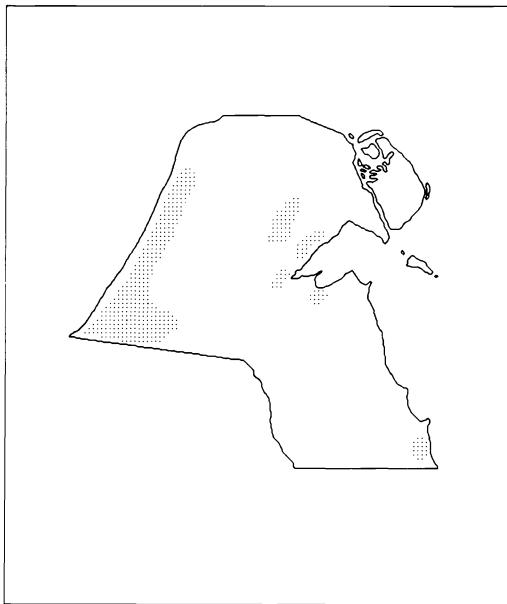
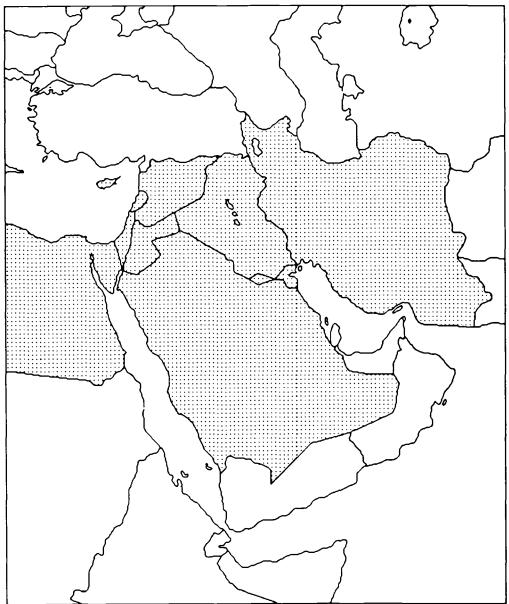


Figure 36. Geographic distribution of *Carrichtera annua* (L.) DC.

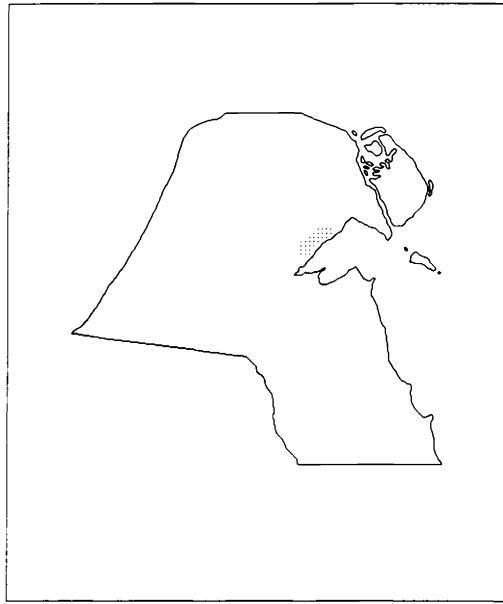
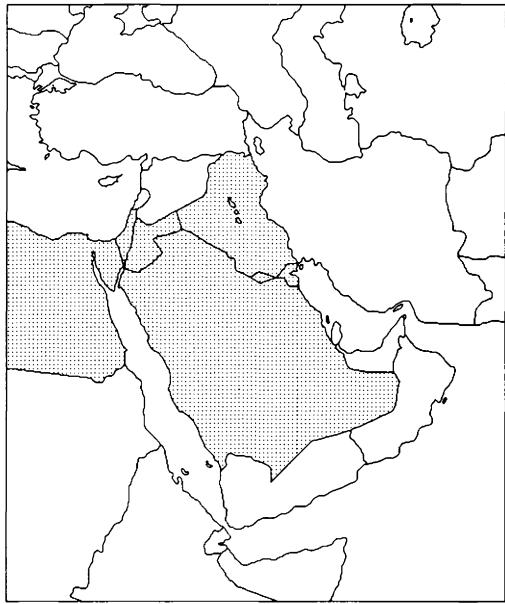


Figure 37. Geographic distribution of *Caylusea hexagyna* (Forssk.) M.L. Green.

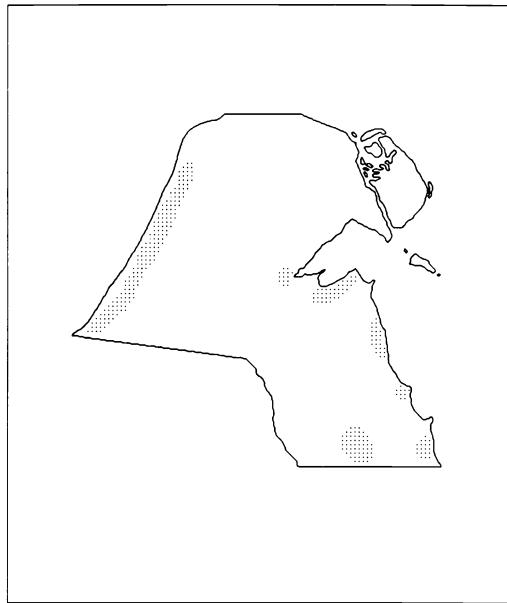
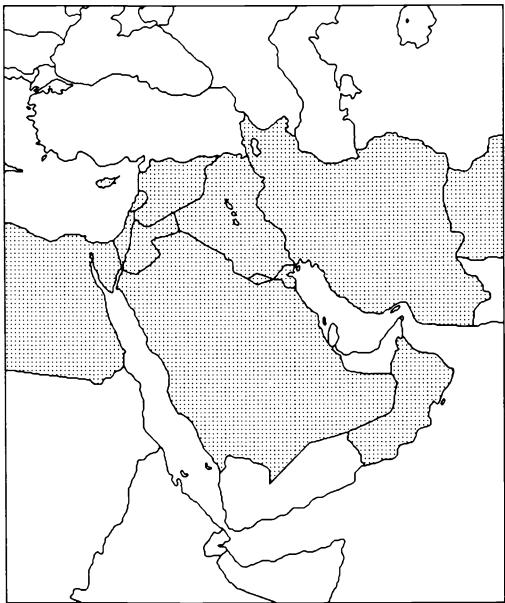


Figure 38. Geographic distribution of *Chenopodium murale* L.

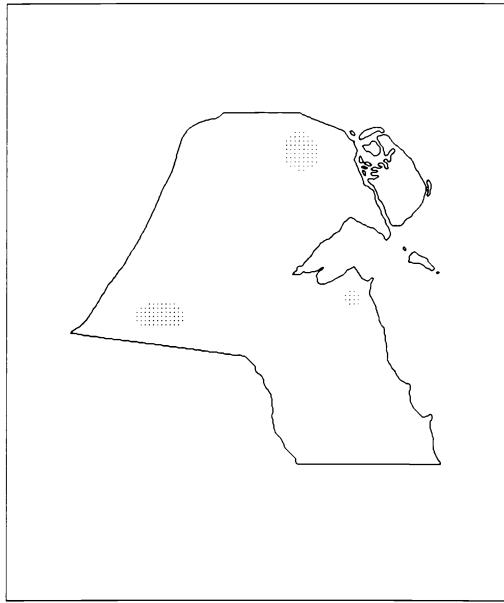
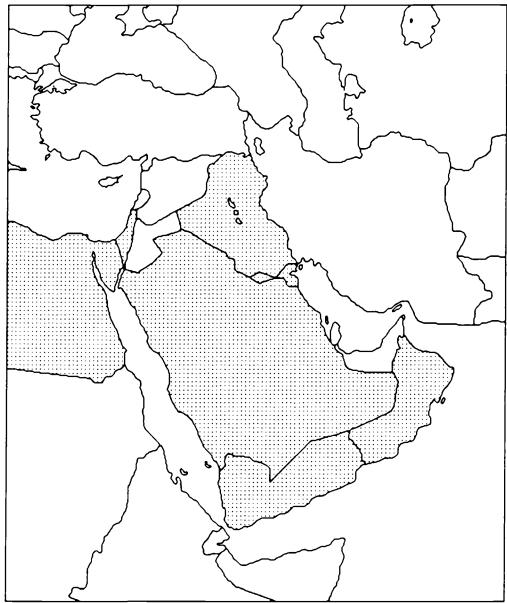


Figure 39. Geographic distribution of *Chrozophora verbascifolia* (Willd.) A. Juss.

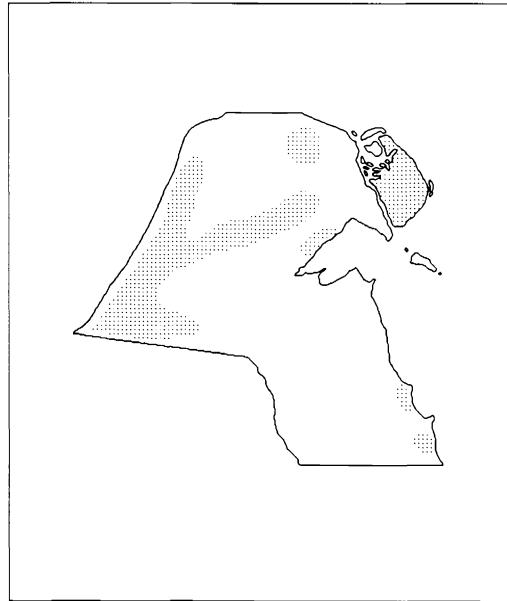
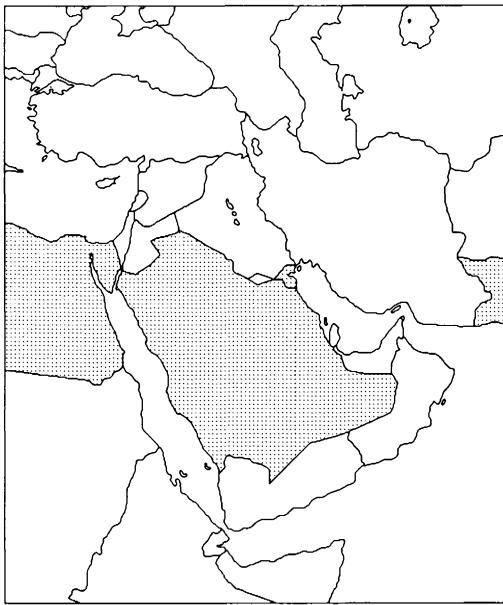


Figure 40. Geographic distribution of *Cistanche tubulosa* (Schrenk) Hook. f.

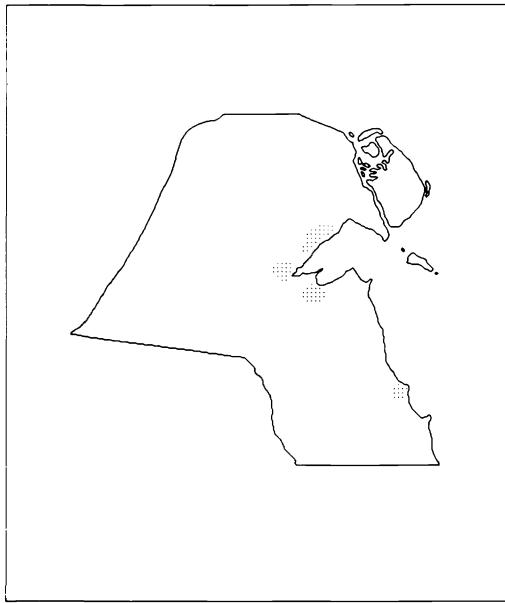
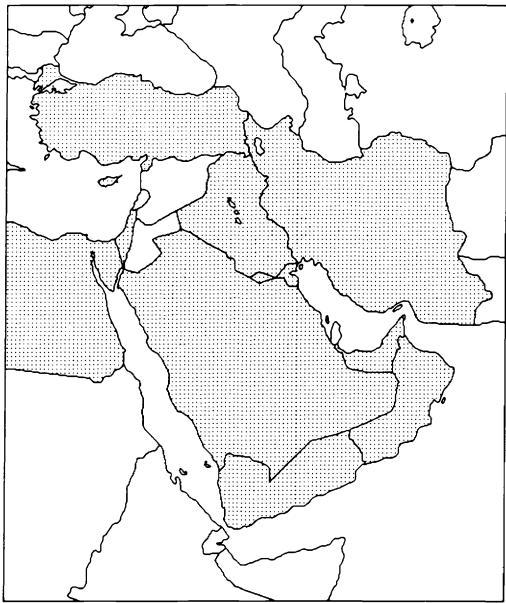


Figure 41. Geographic distribution of *Citrullus colocynthis* (L.) Schrad.

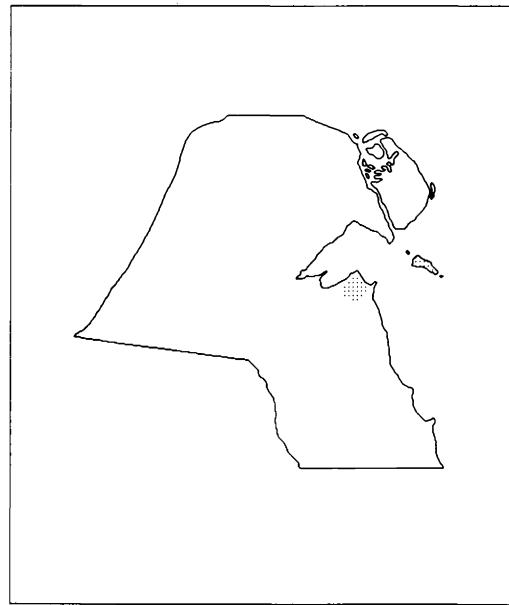
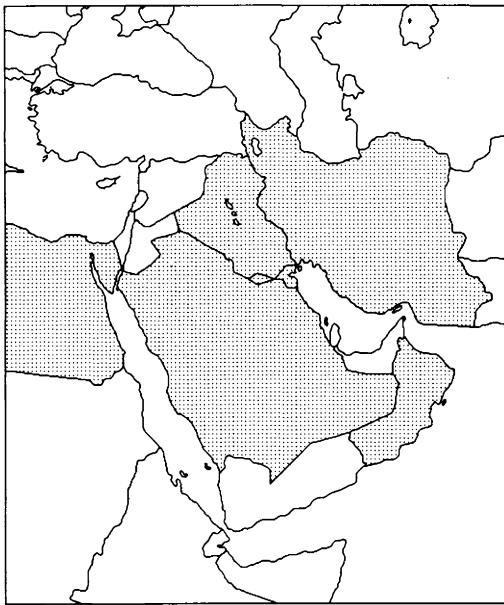


Figure 42. Geographic distribution of *Convolvulus buschiricus* Bornm.

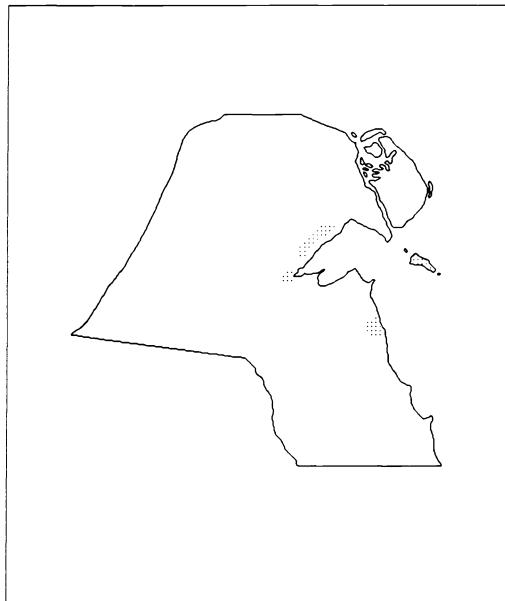
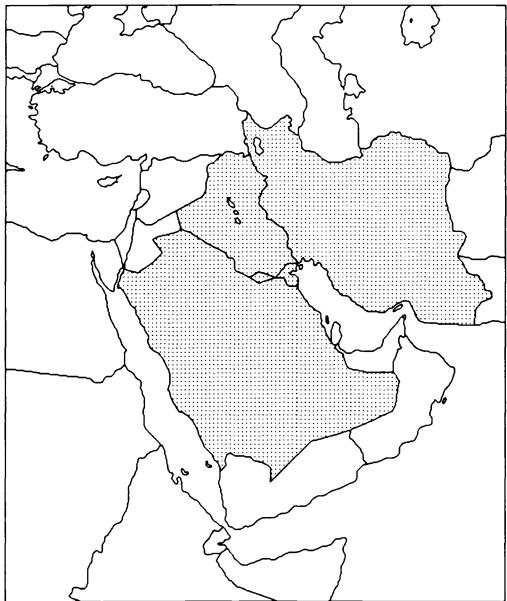


Figure 43. Geographic distribution of *Convolvulus oxyphyllus* Boiss.

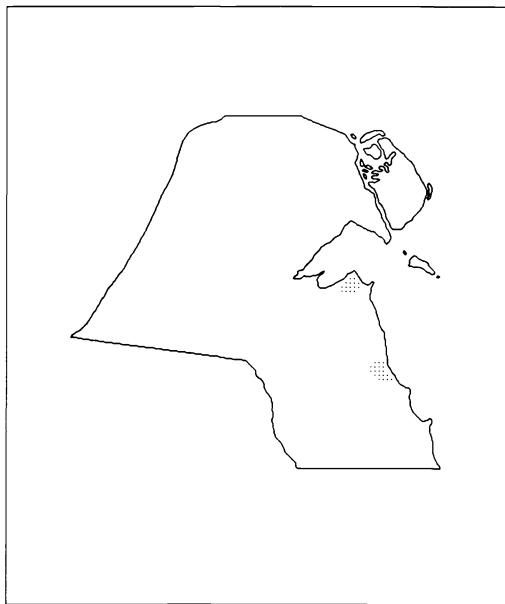
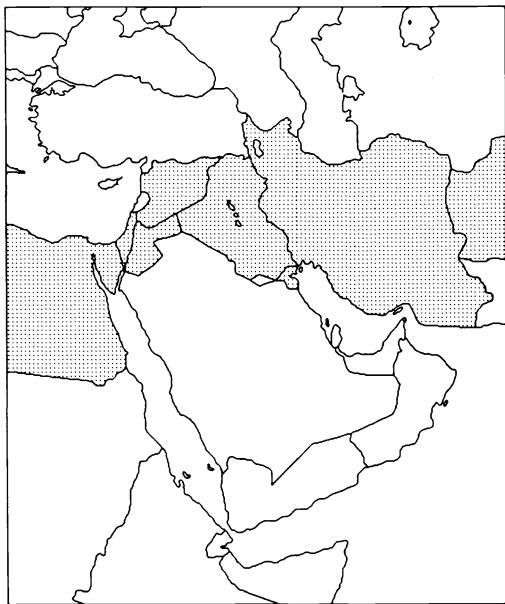


Figure 44. Geographic distribution of *Convolvulus pilosellaefolius* Desr.

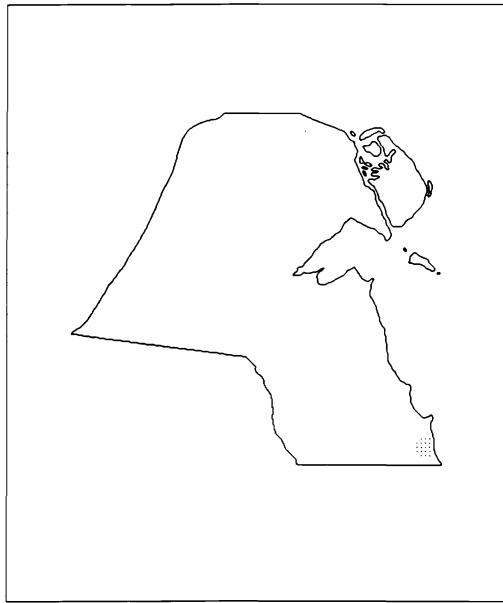
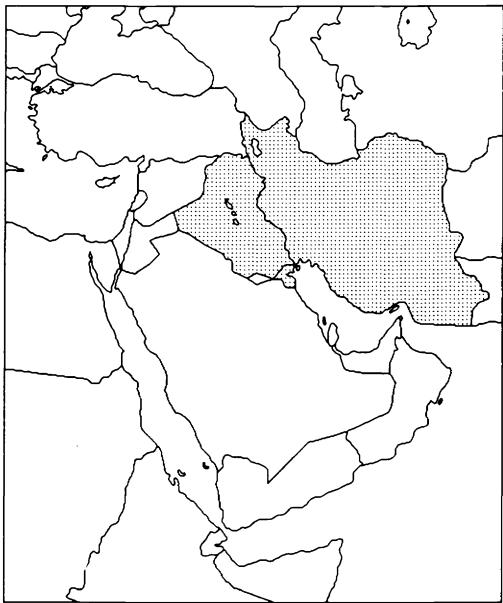


Figure 45. Geographic distribution of *Cornulaca aucheri* Moq.

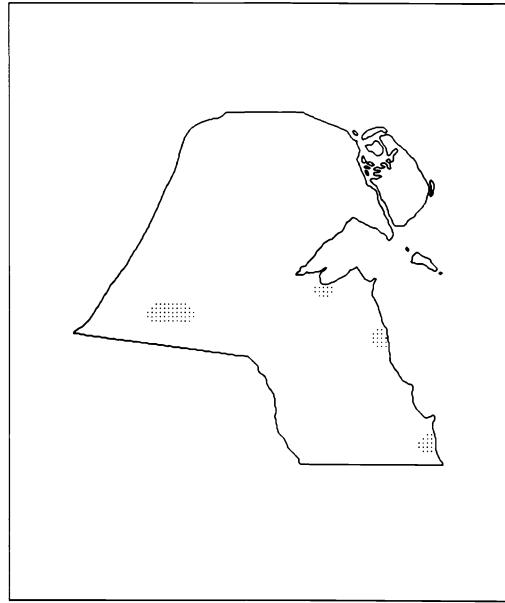
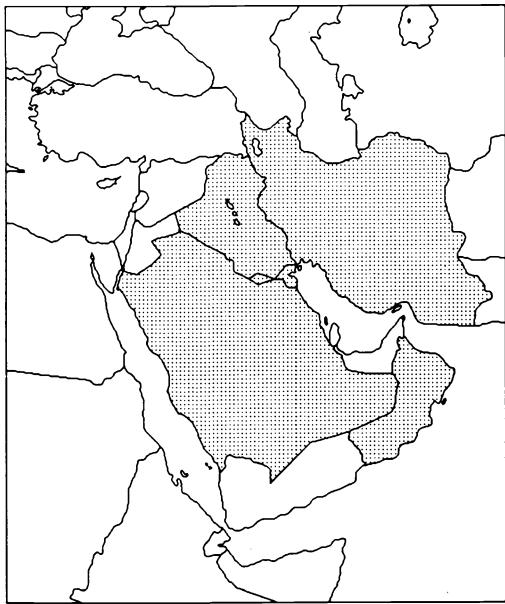


Figure 46. Geographic distribution of *Cornulaca leucacantha* Charif & Aellen.

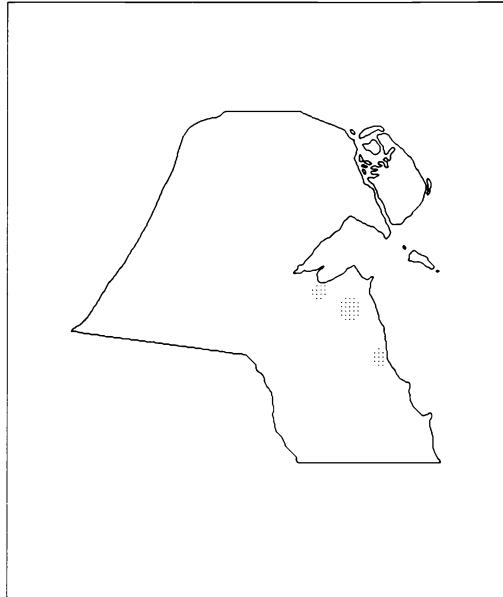
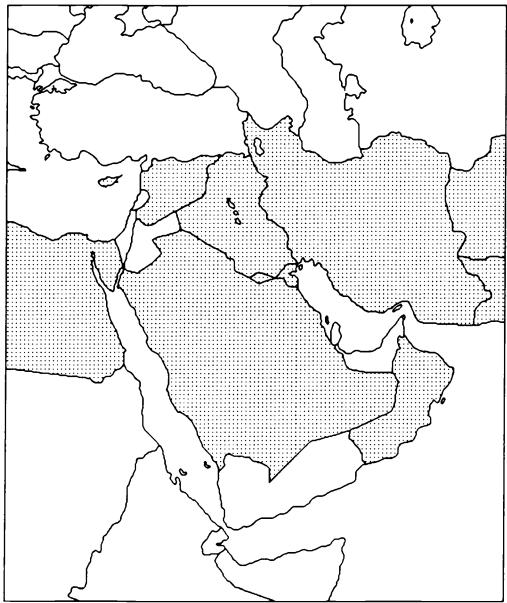


Figure 47. Geographic distribution of *Cressa cretica* L.

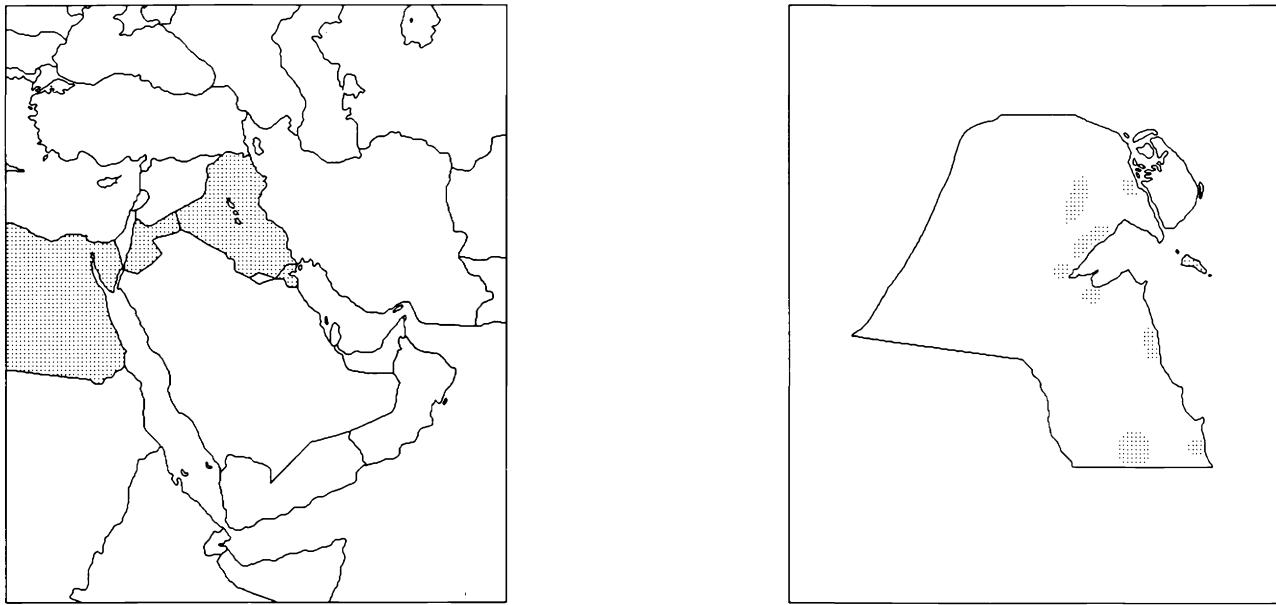


Figure 48. Geographic distribution of *Crucianella membranacea* Boiss.

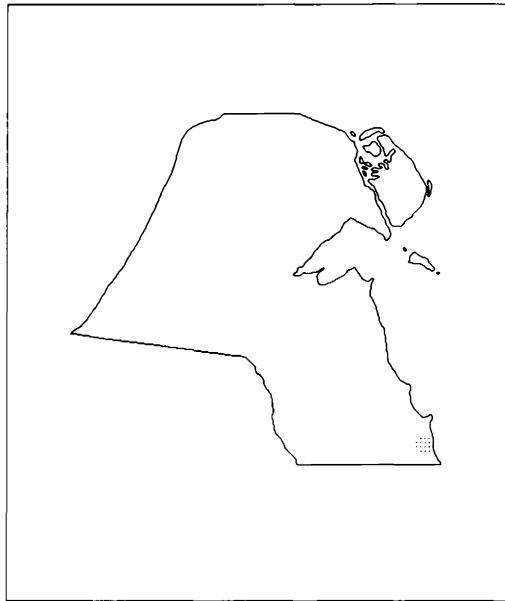
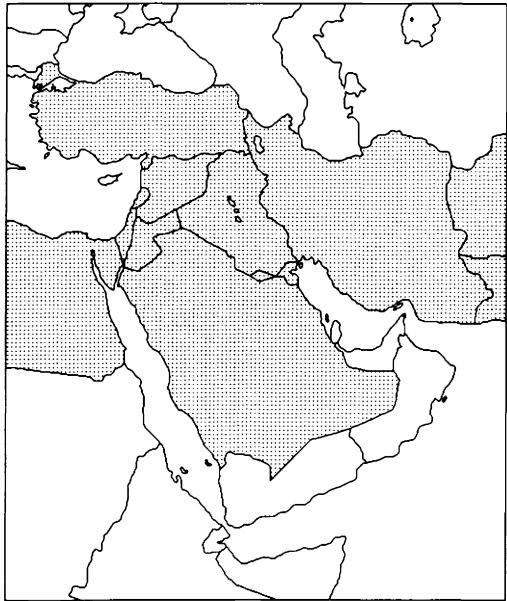


Figure 49. Geographic distribution of *Cuscuta planiflora* Ten.

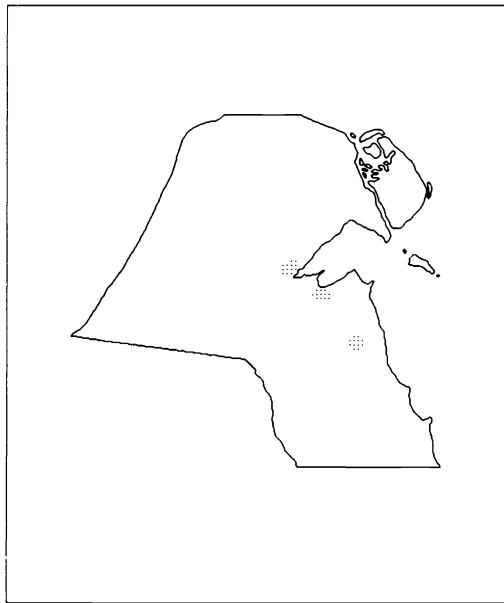
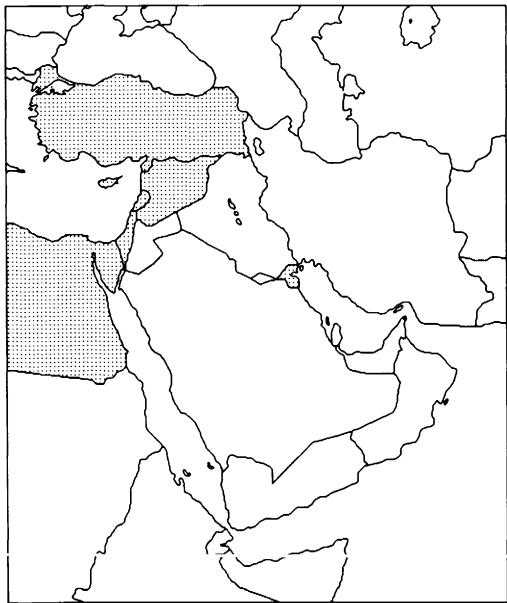


Figure 50. Geographic distribution of *Cynomorium coccineum* L.

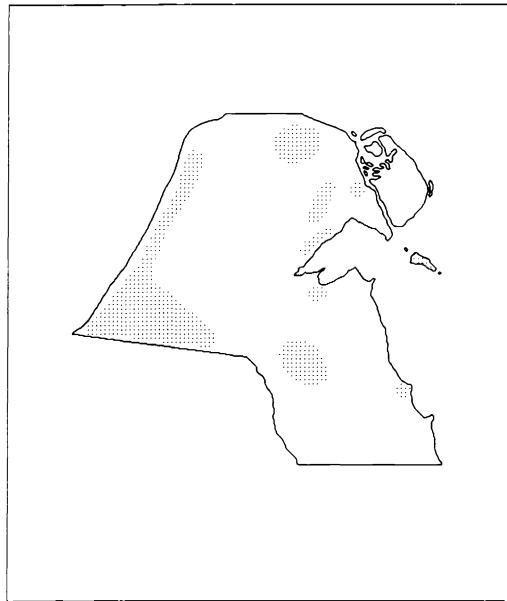
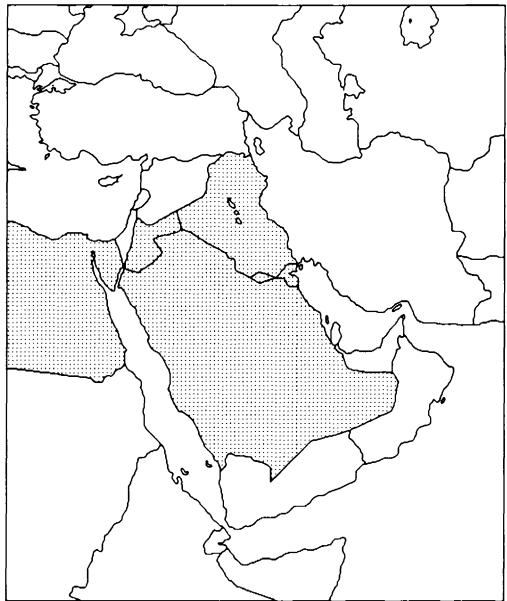


Figure 51. Geographic distribution of *Diplotaxis acris* (Forssk.) Boiss.

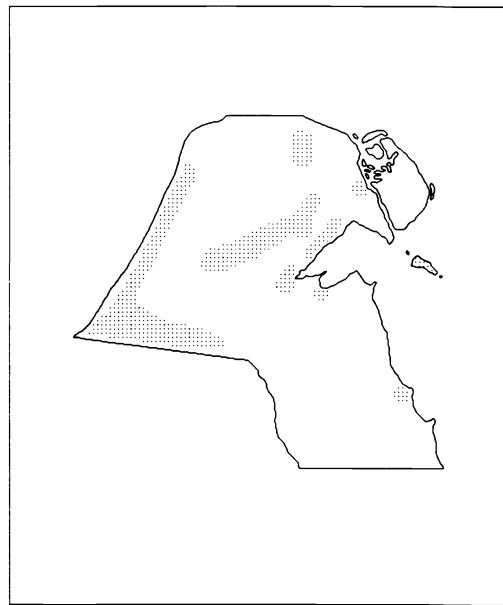
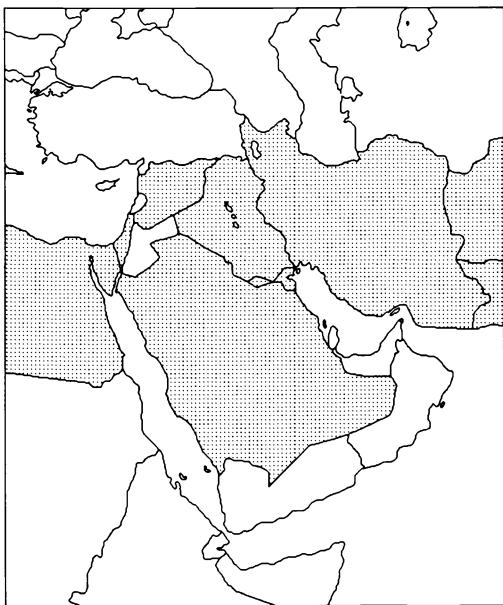


Figure 52. Geographic distribution of *Diplotaxis harra* (Forssk.) Boiss.

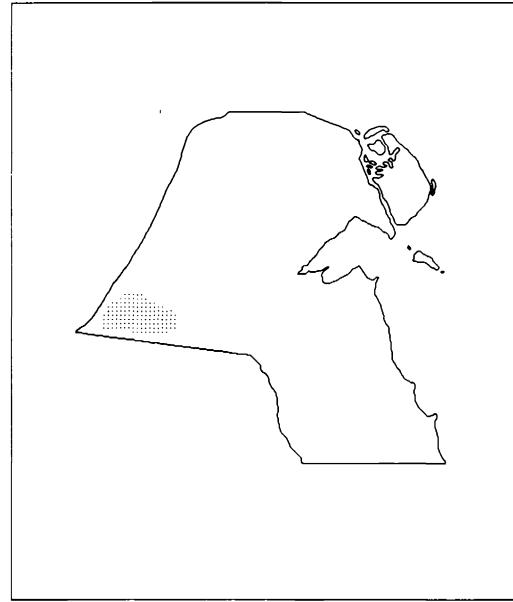
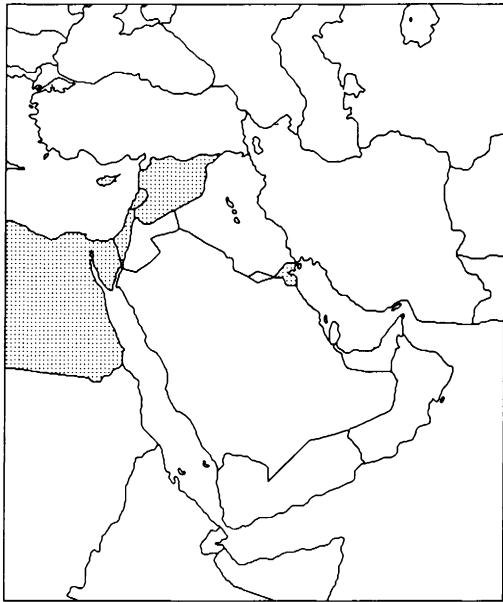


Figure 53. Geographic distribution of *Echium sericeum* Vahl.

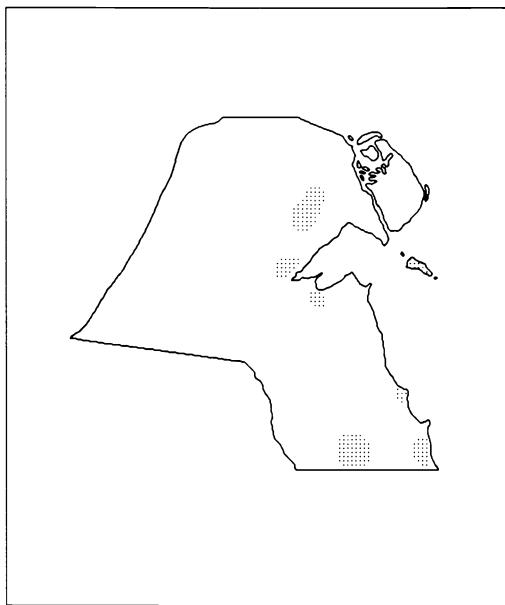
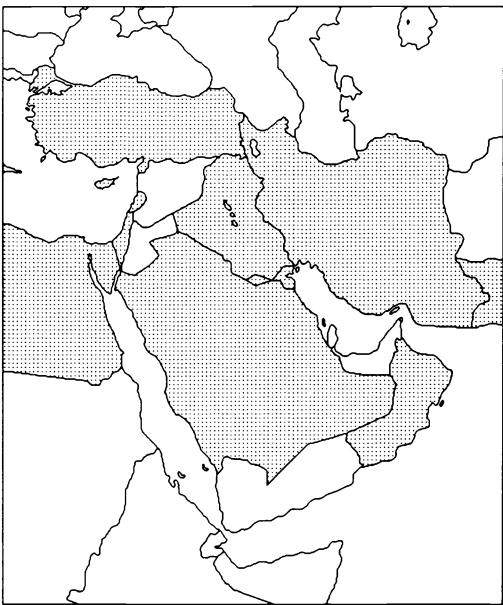


Figure 54. Geographic distribution of *Emex spinosus* (L.) Campderá.

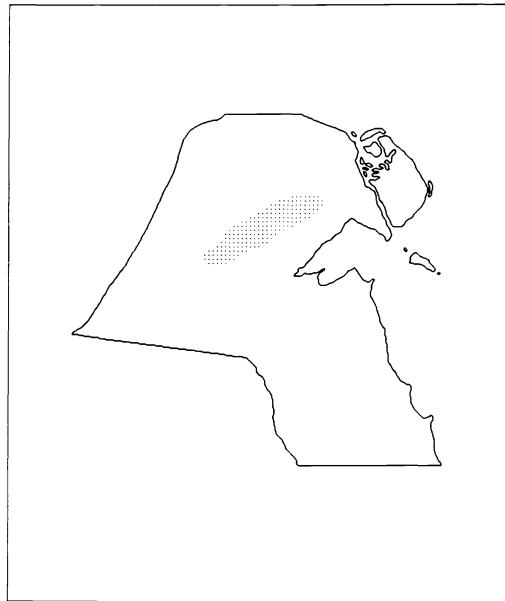
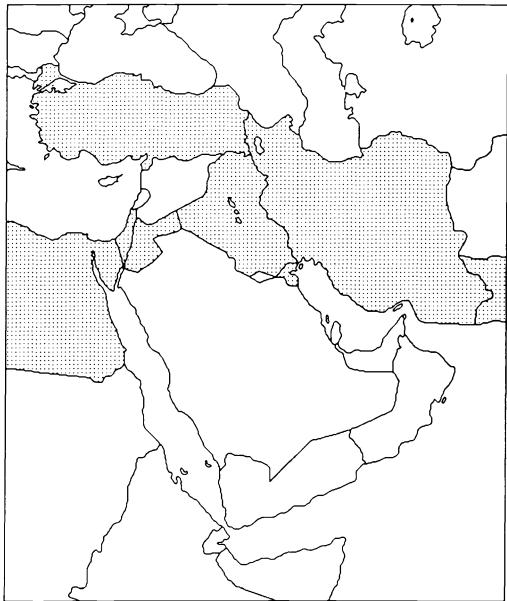


Figure 55. Geographic distribution of *Erodium bryoniifolium* Boiss.

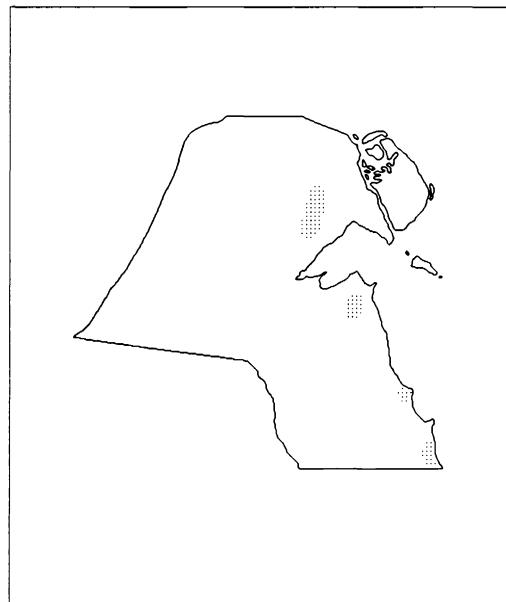
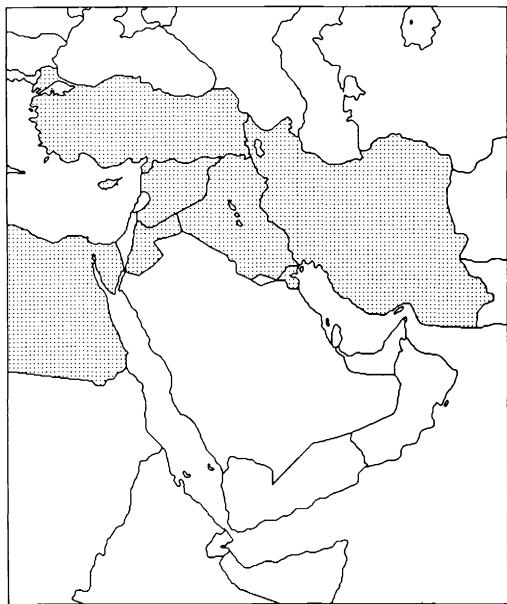


Figure 56. Geographic distribution of *Erodium ciconium* (L.) L'Hérit.

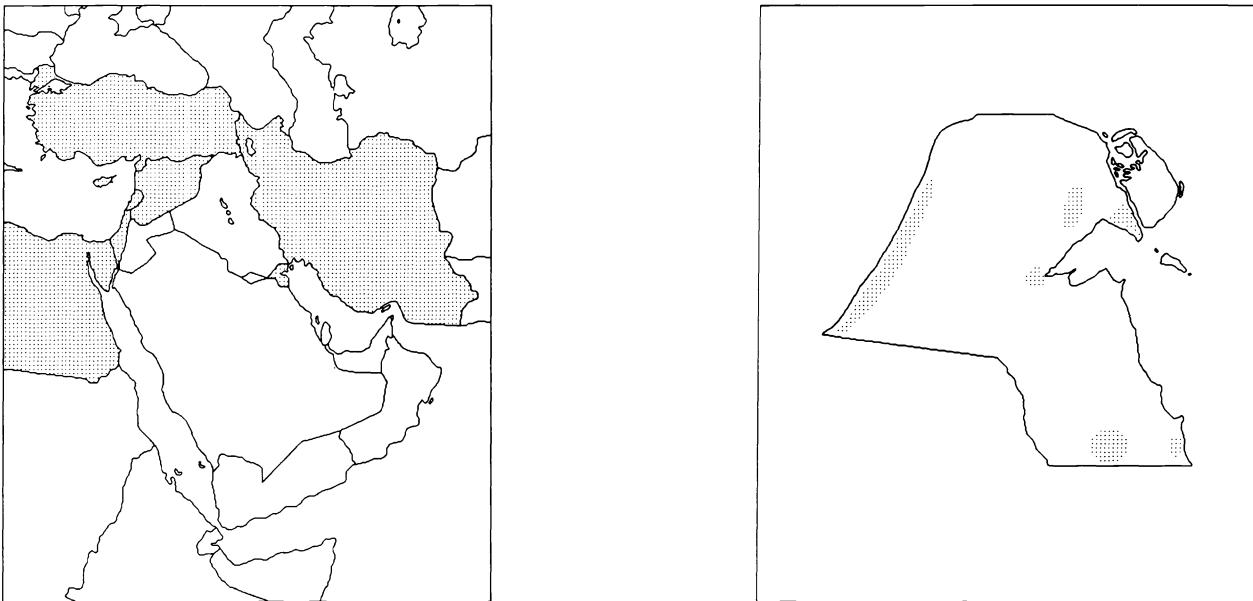


Figure 57. Geographic distribution of *Erodium cicutarium* (L.) L'Hérit.

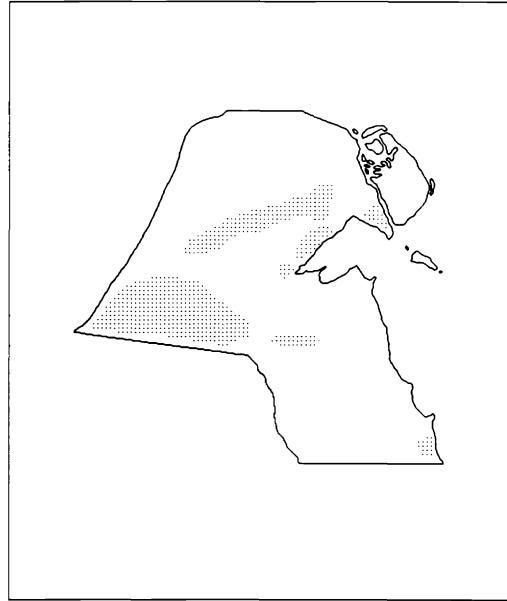
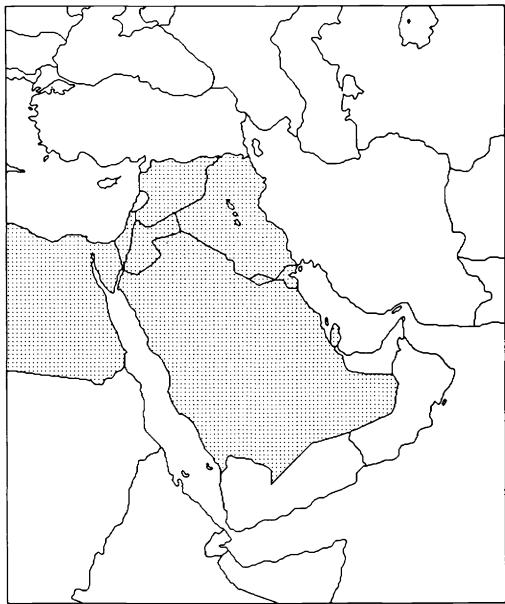


Figure 58. Geographic distribution of *Erodium glaucophyllum* (L.) L'Hérit.

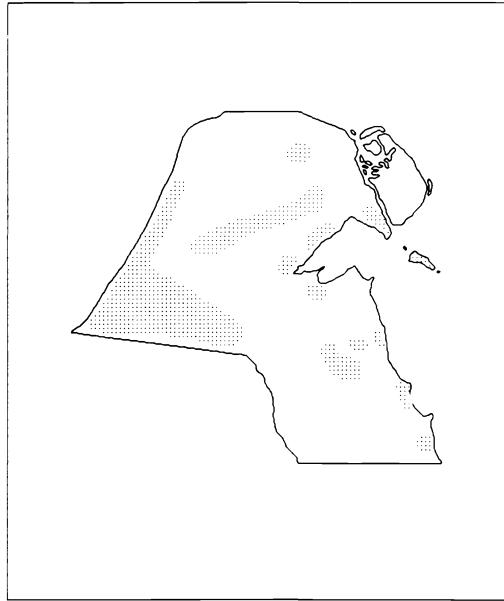
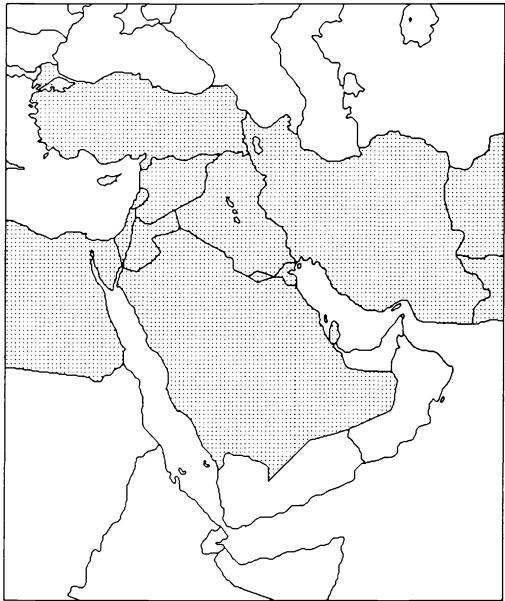


Figure 59. Geographic distribution of *Erodium laciniatum* (Cav.) Willd.

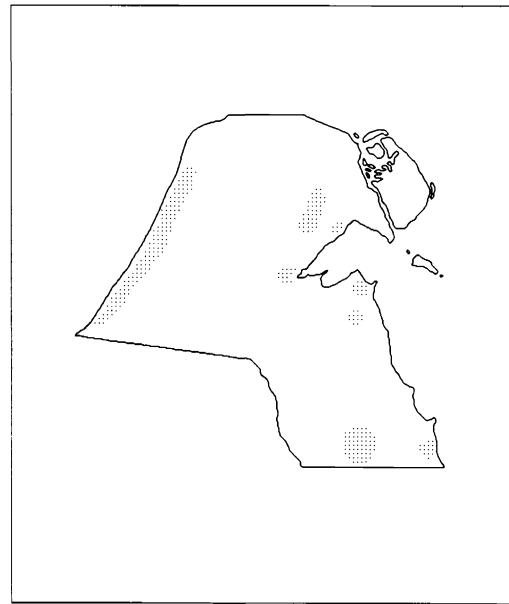
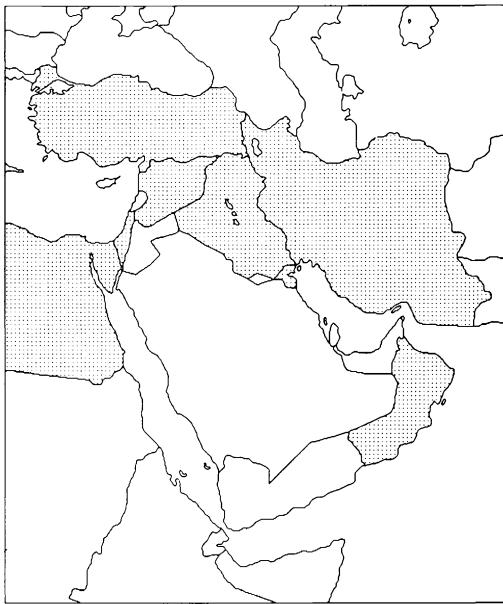


Figure 60. Geographic distribution of *Eruca sativa* Miller.

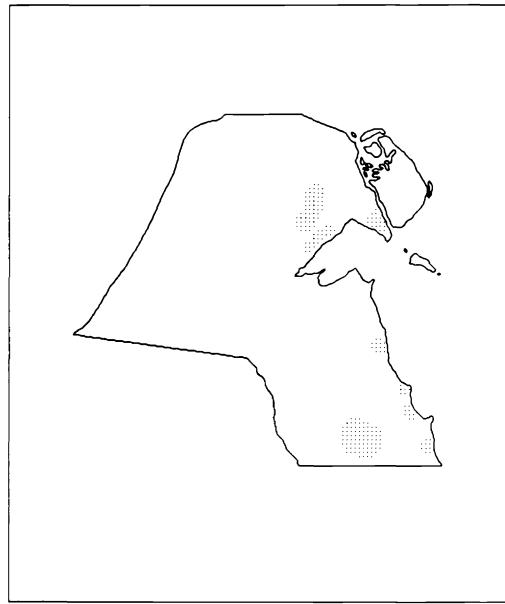
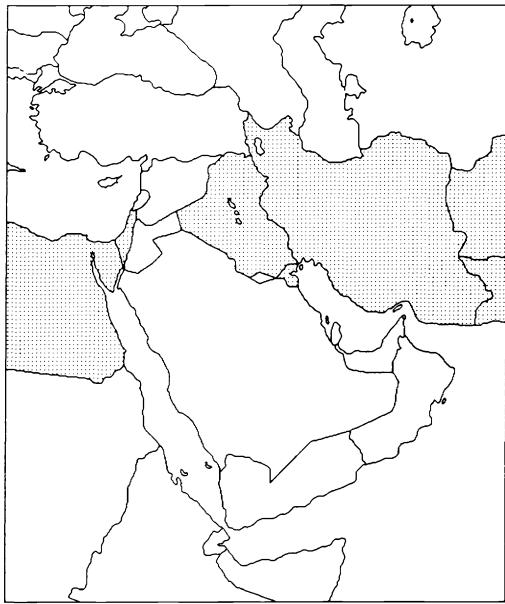


Figure 61. Geographic distribution of *Euphorbia densa* Schrenk.

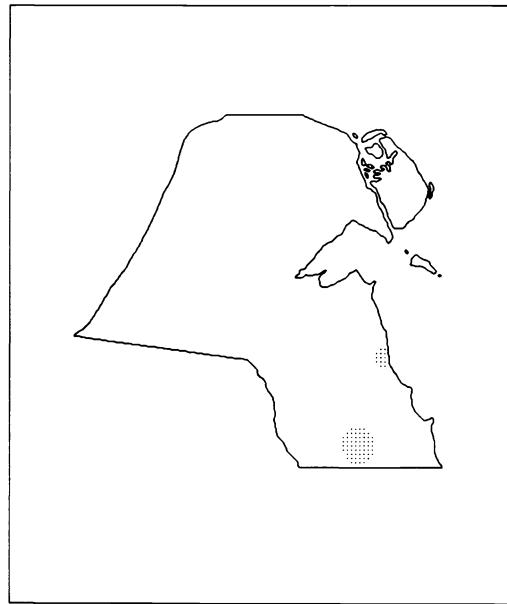
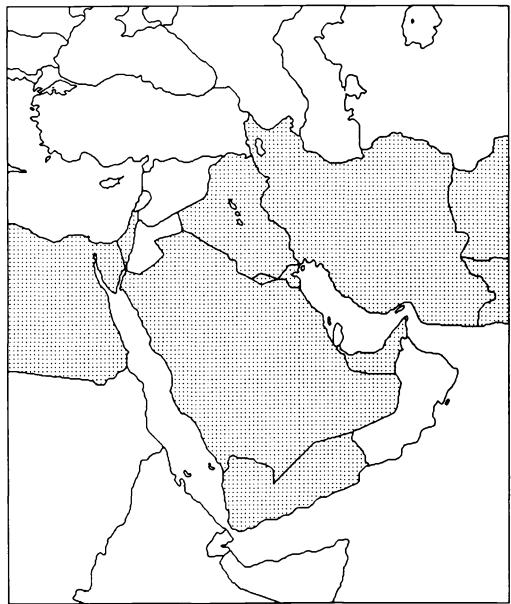


Figure 62. Geographic distribution of *Euphorbia granulata* Forssk.

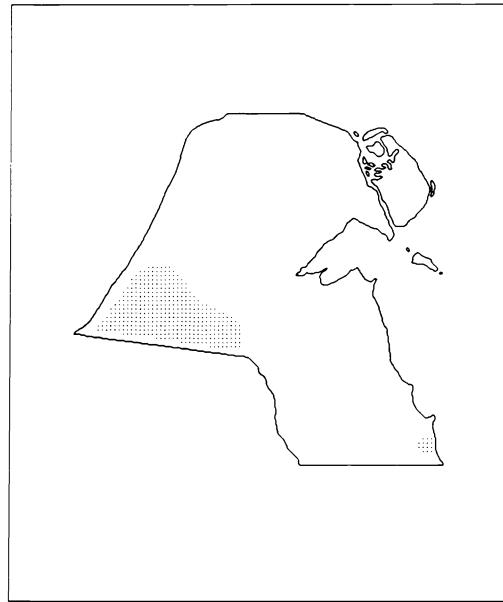
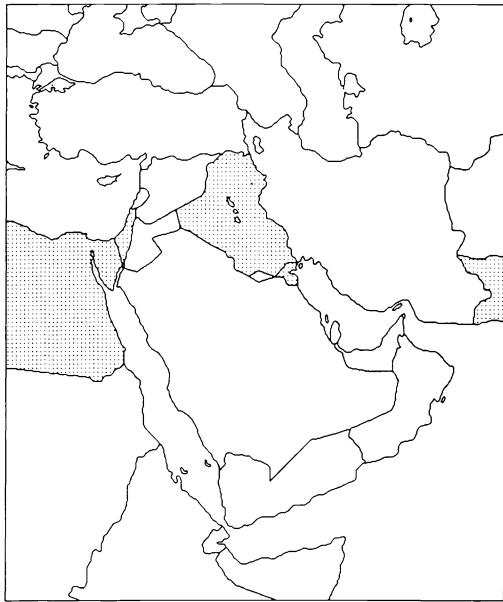


Figure 63. Geographic distribution of *Euphorbia isthmia* V. Täckh.

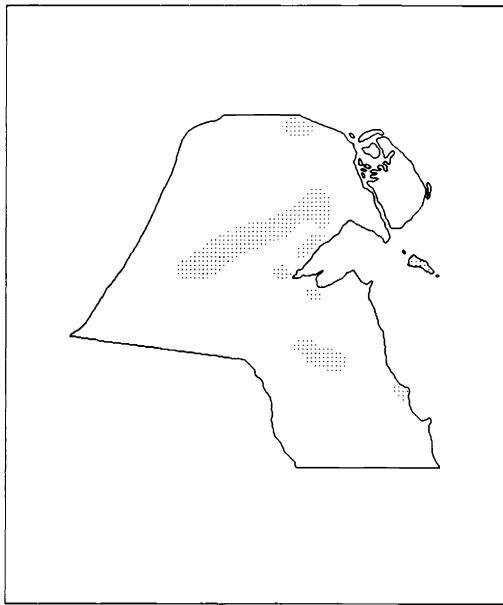
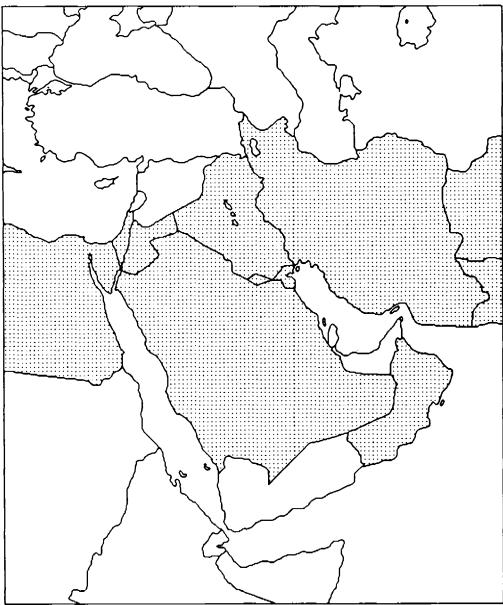


Figure 64. Geographic distribution of *Fagonia bruguieri* DC.

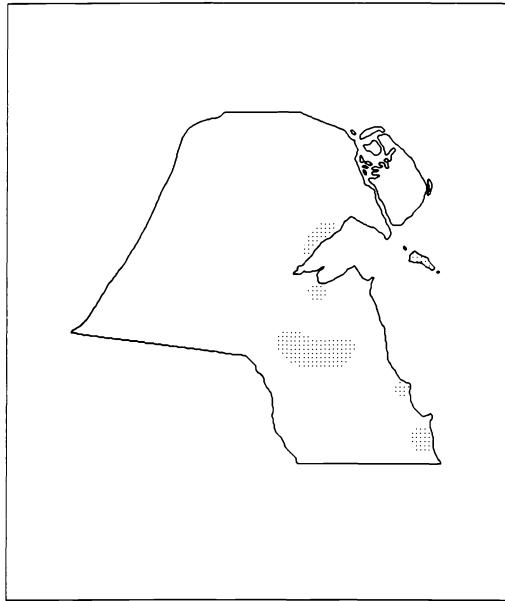
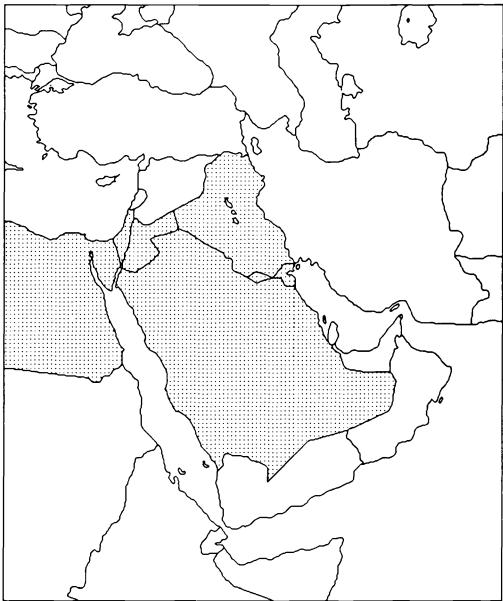


Figure 65. Geographic distribution of *Fagonia glutinosa* Del.

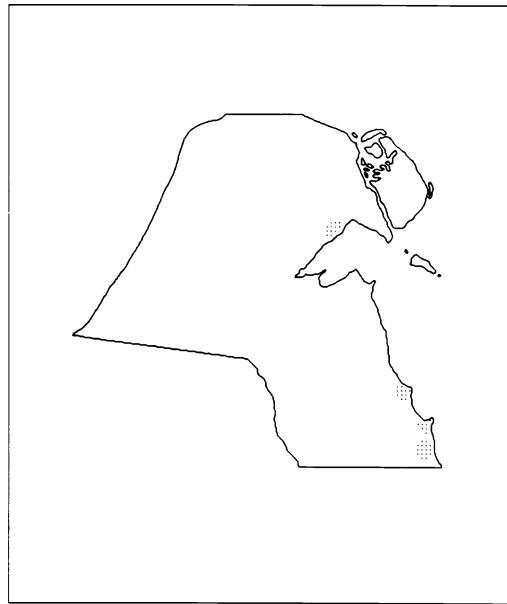
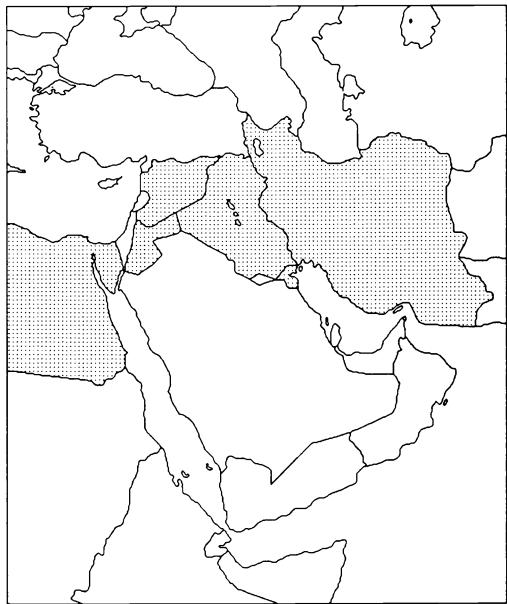


Figure 66. Geographic distribution of *Fagonia olivieri* DC.

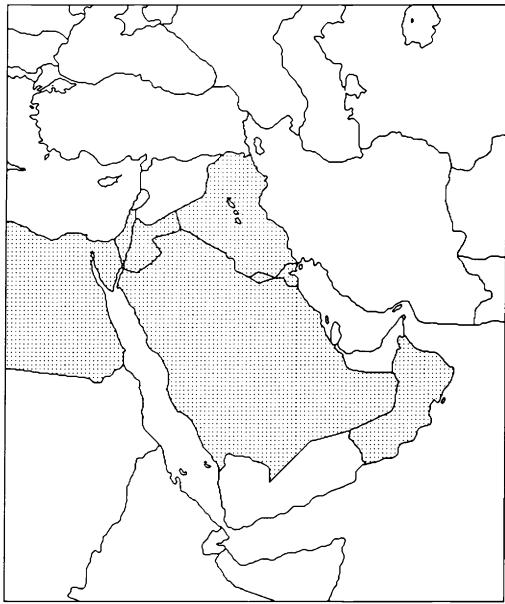


Figure 67. Geographic distribution of *Farsetia aegyptiaca* Turra.

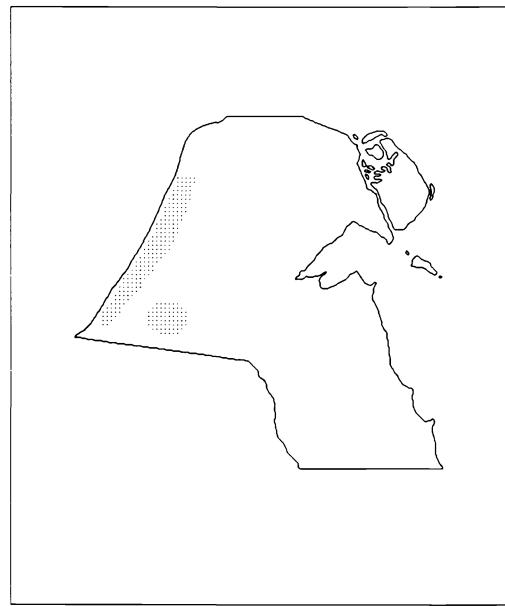
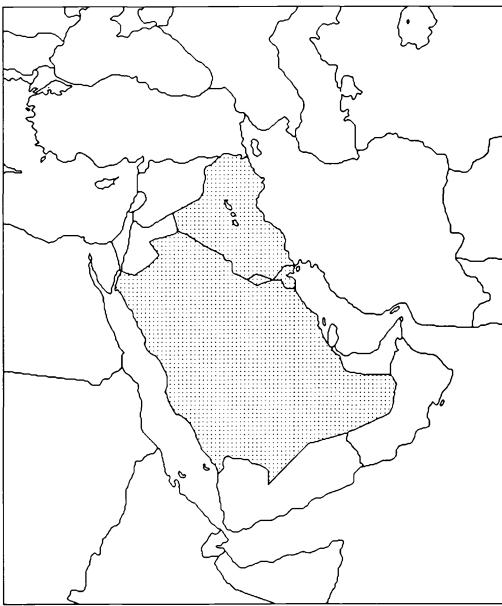


Figure 68. Geographic distribution of *Farsetia burtonae* Oliv.

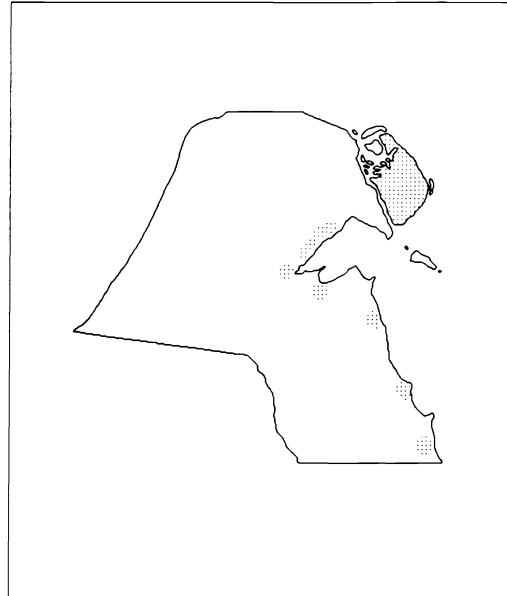
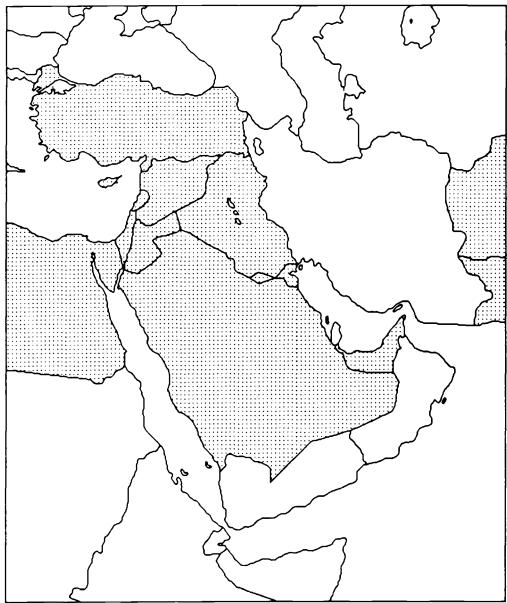


Figure 69. Geographic distribution of *Frankenia pulverulenta* L.

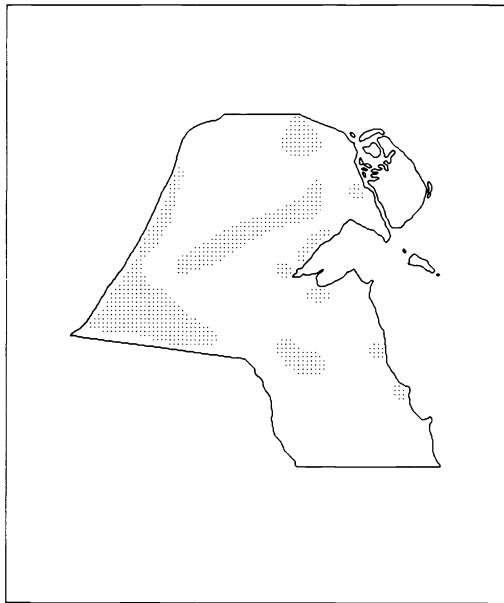
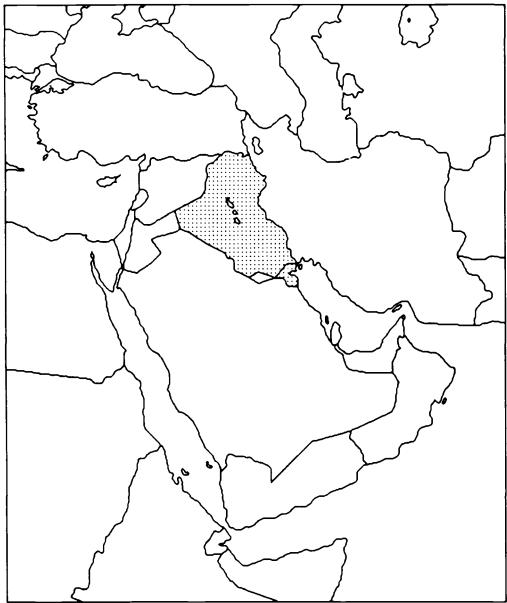


Figure 70. Geographic distribution of *Gastrocotyle hispida* (Forssk.) Bunge.

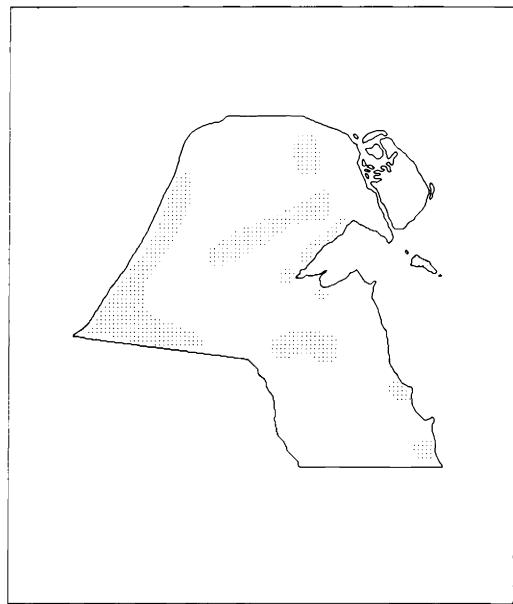
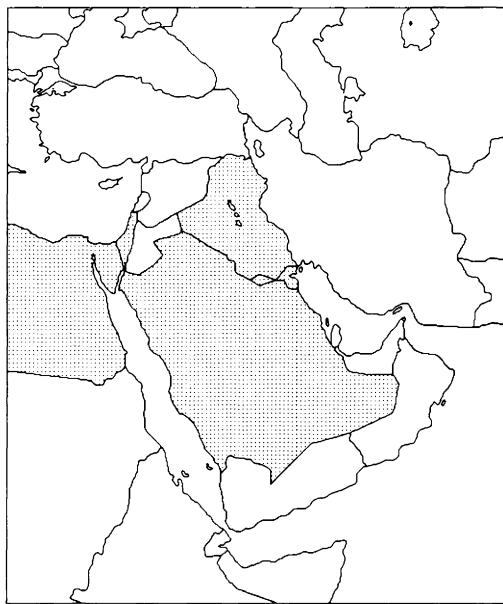


Figure 71. Geographic distribution of *Gypsophila capillaris* (Forssk.) C. Christensen.

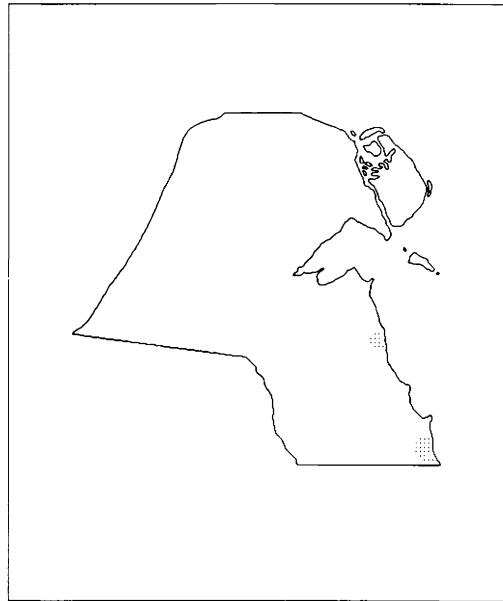
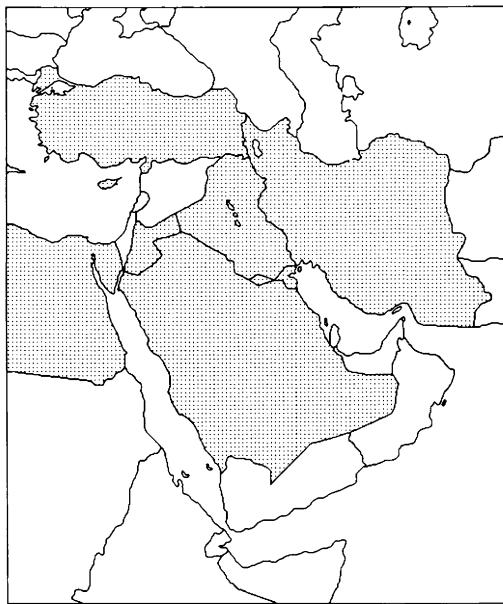


Figure 72. Geographic distribution of *Halocnemum strobilaceum* (Pall.) M. Bieb.

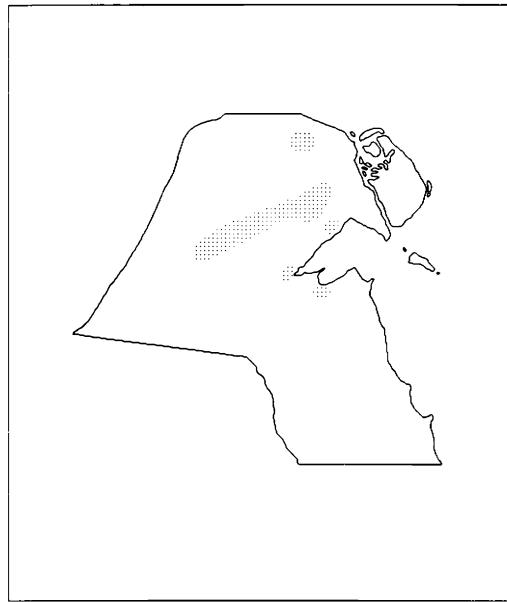
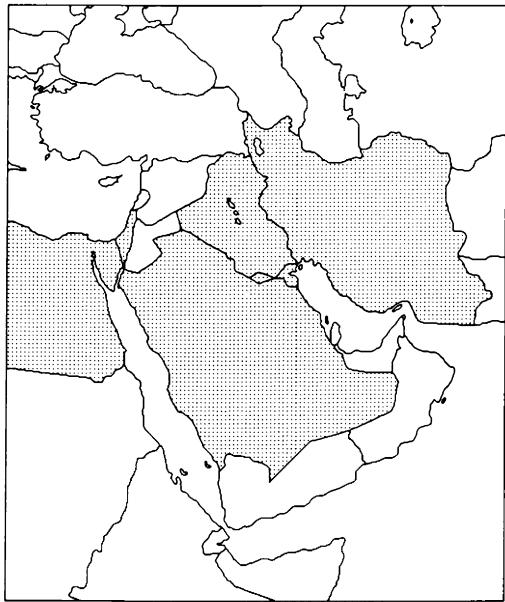


Figure 73. Geographic distribution of *Haloxylon salicornicum* (Moq.) Bunge ex Boiss.

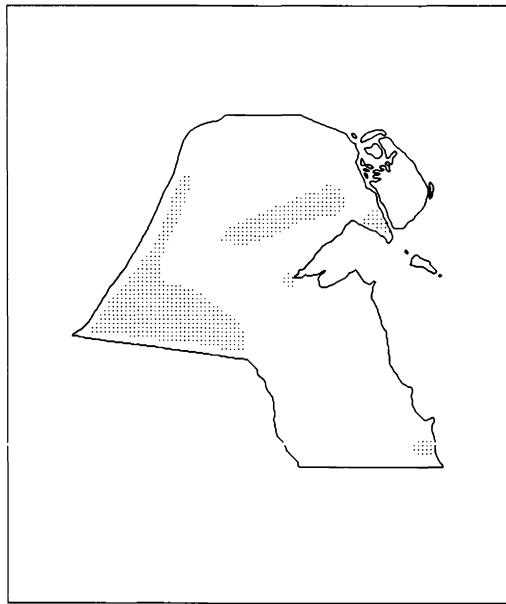
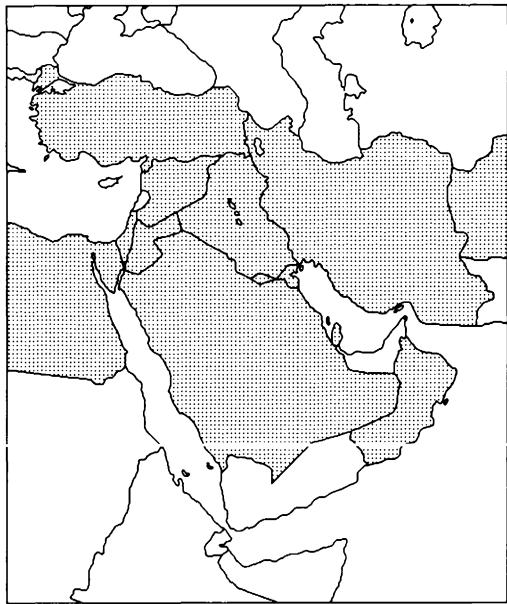


Figure 74. Geographic distribution of *Haplophyllum tuberculatum* (Forssk.) A. Juss.

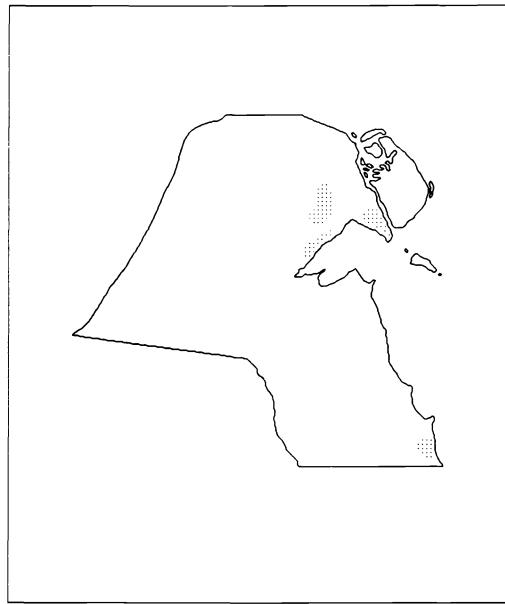
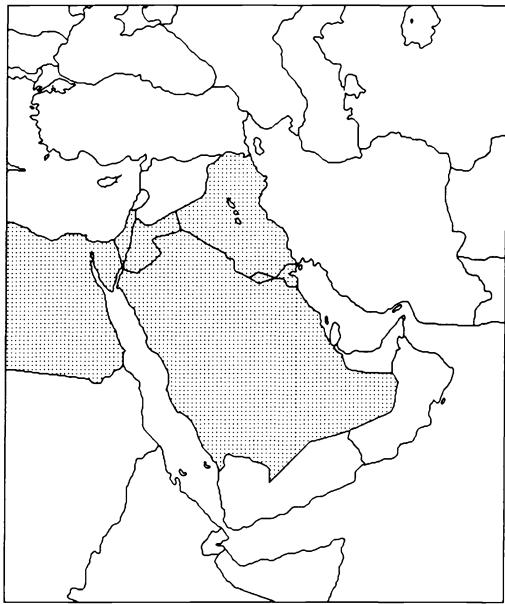


Figure 75. Geographic distribution of *Helianthemum kahiricum* Del.

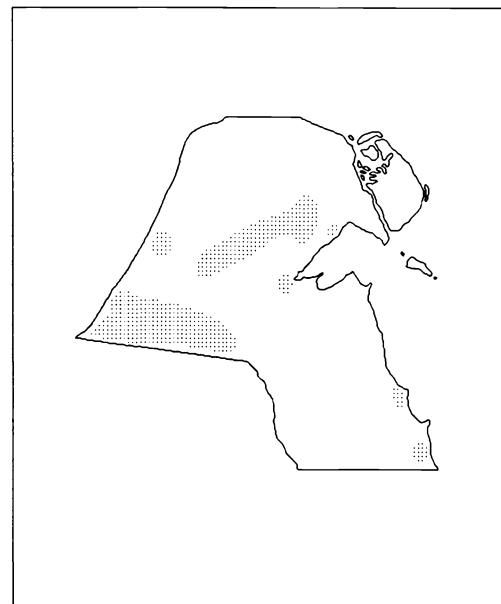
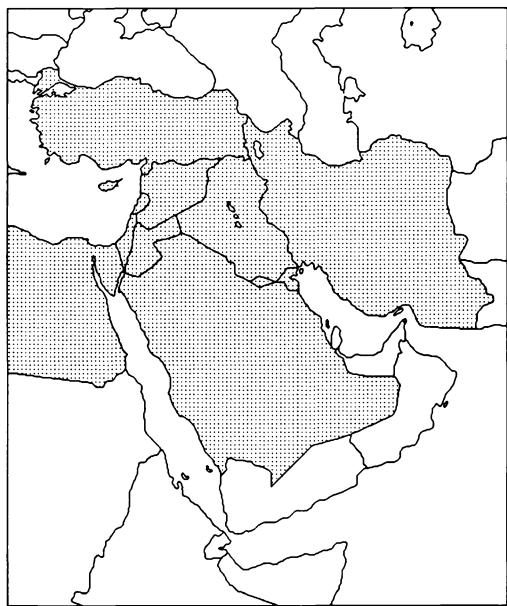


Figure 76. Geographic distribution of *Helianthemum ledifolium* (L.) Mill.

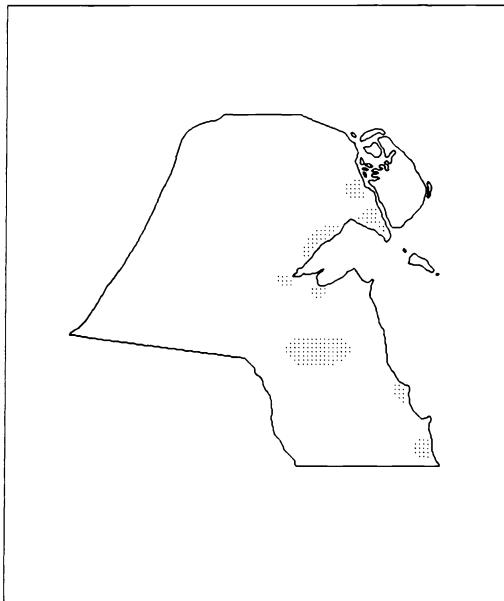
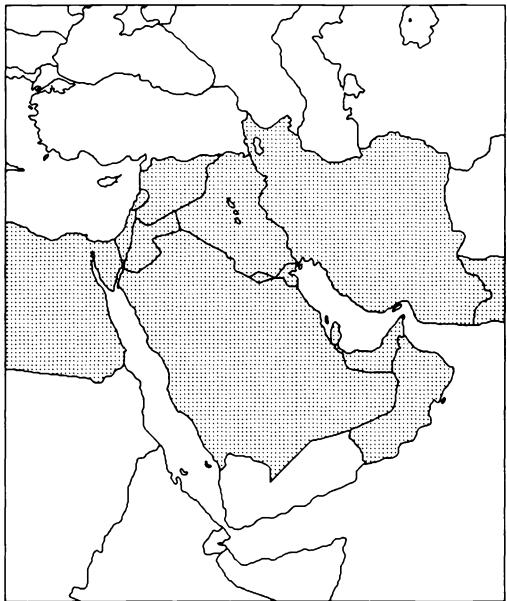


Figure 77. Geographic distribution of *Helianthemum lippii* (L.) Pers.

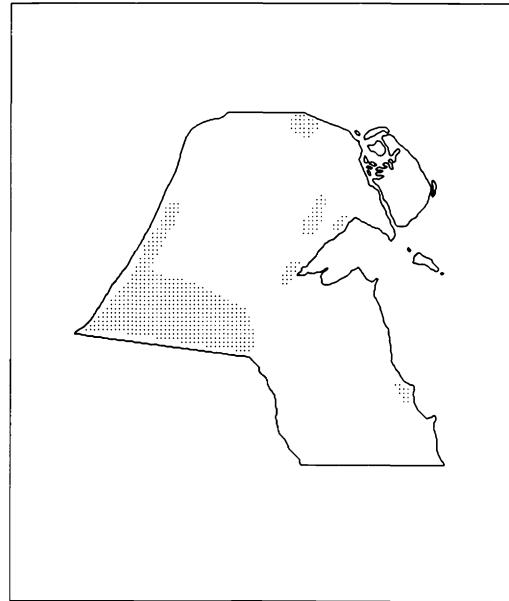
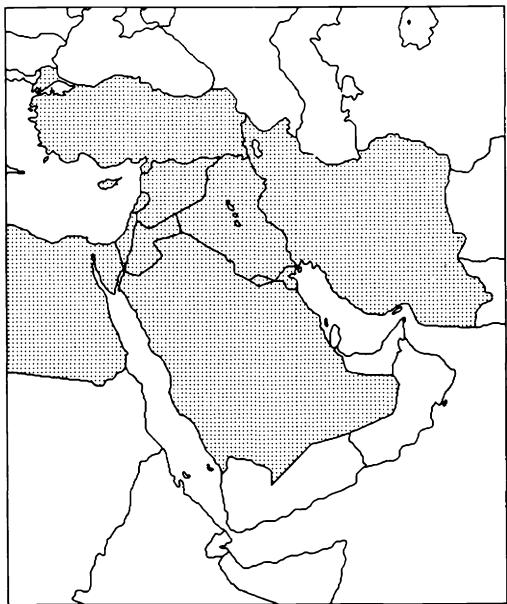


Figure 78. Geographic distribution of *Helianthemum salicifolium* (L.) Mill.

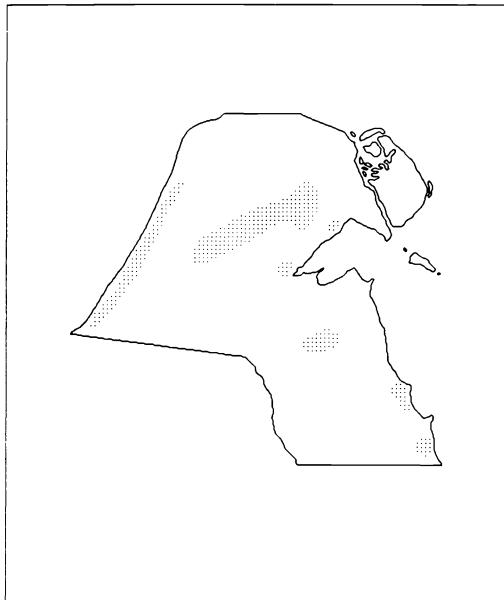
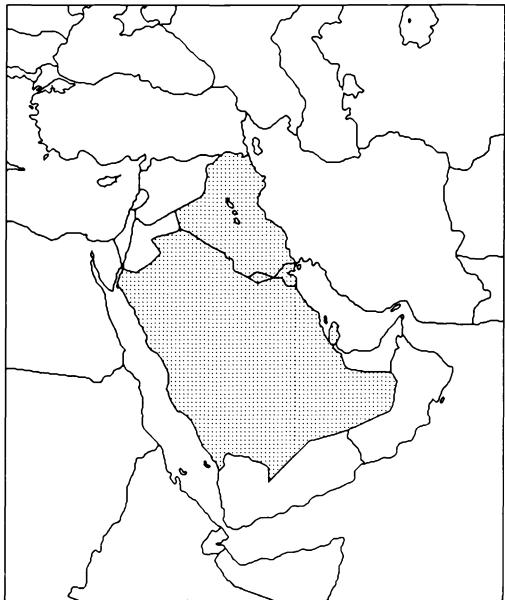


Figure 79. Geographic distribution of *Heliotropium bacciferum* Forssk.

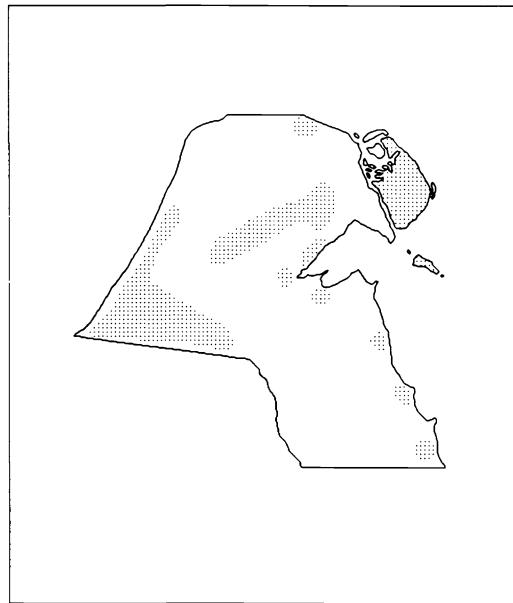
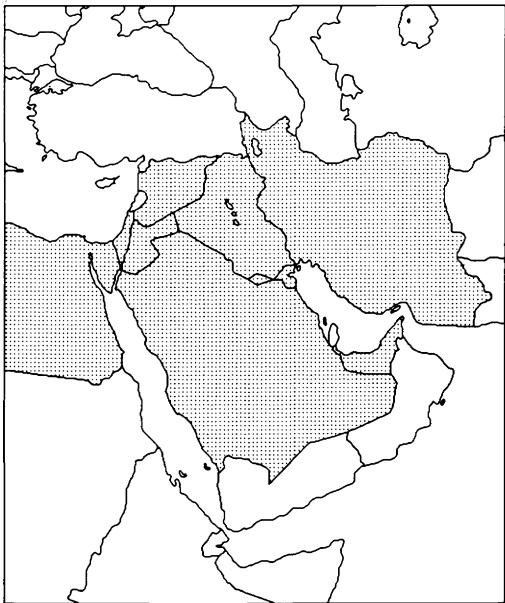


Figure 80. Geographic distribution of *Herniaria hemistemon* J. Gay.

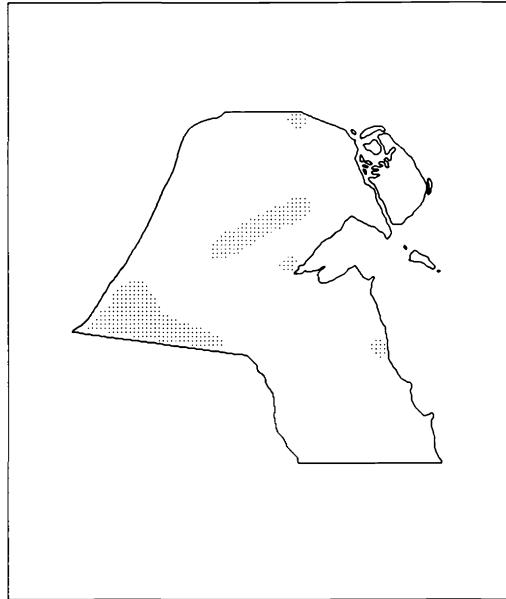
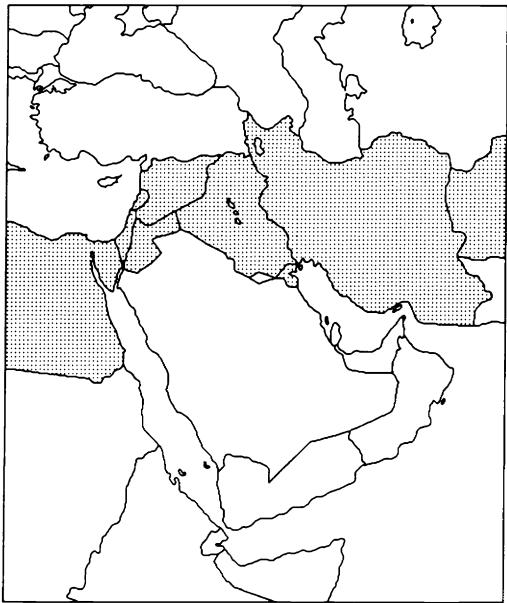


Figure 81. Geographic distribution of *Herniaria hirsuta* L.

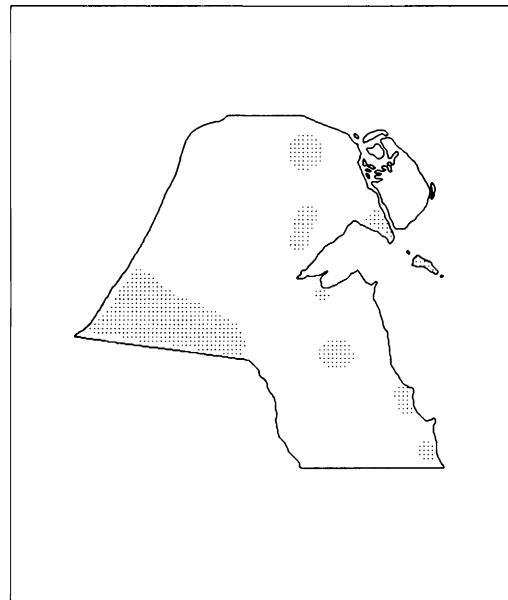
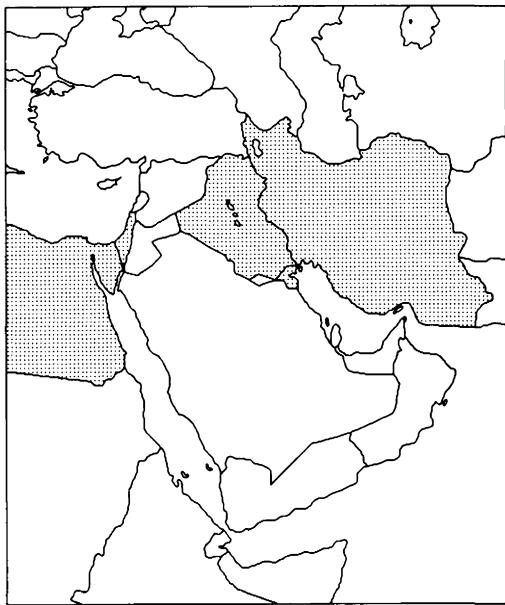


Figure 82. Geographic distribution of *Hippocratea bicontorta* Loisel.

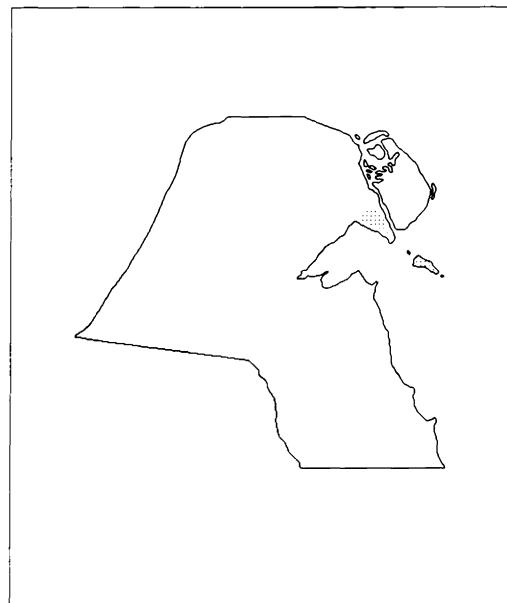
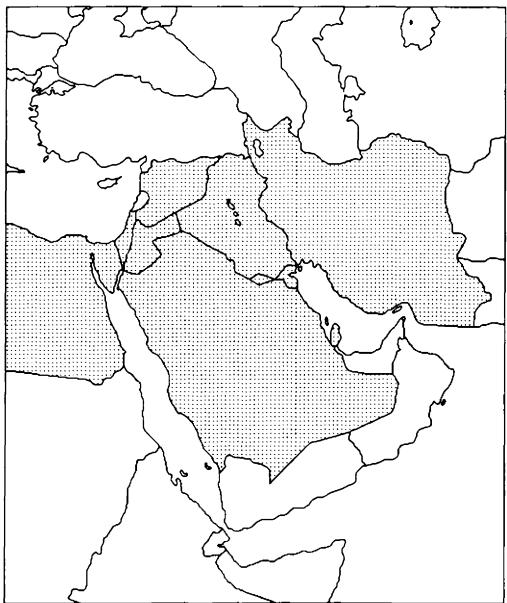


Figure 83. Geographic distribution of *Hippocratea unisiliquosa* L.

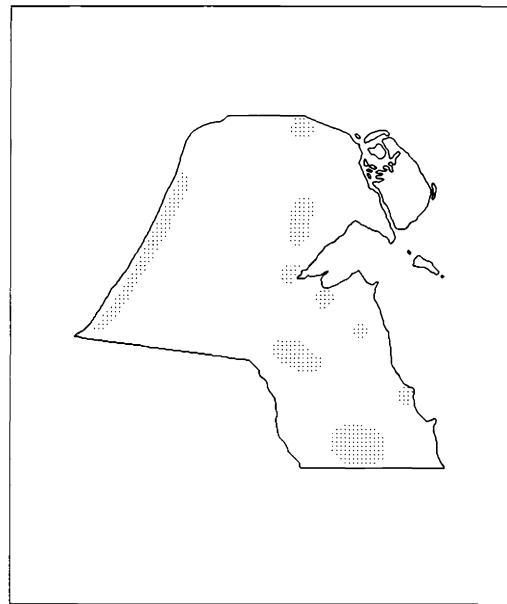
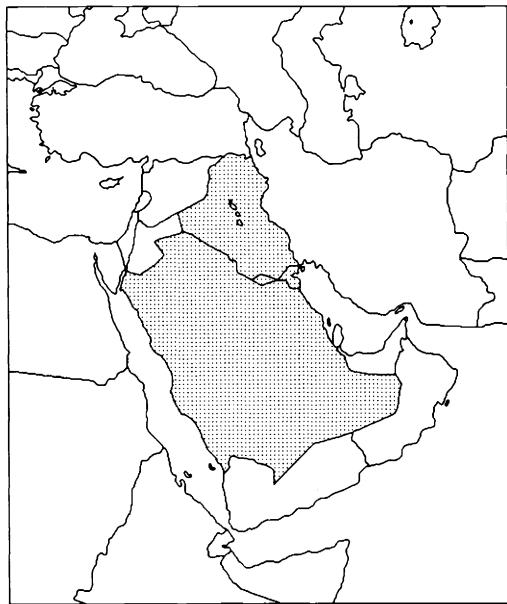


Figure 84. Geographic distribution of *Horwoodia dicksoniae* Turrill.

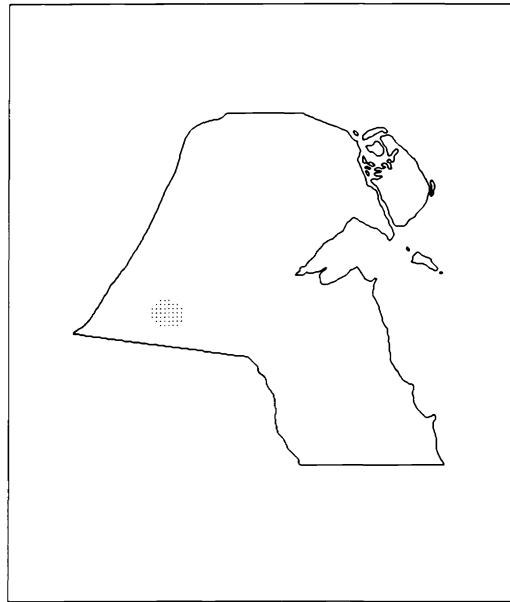
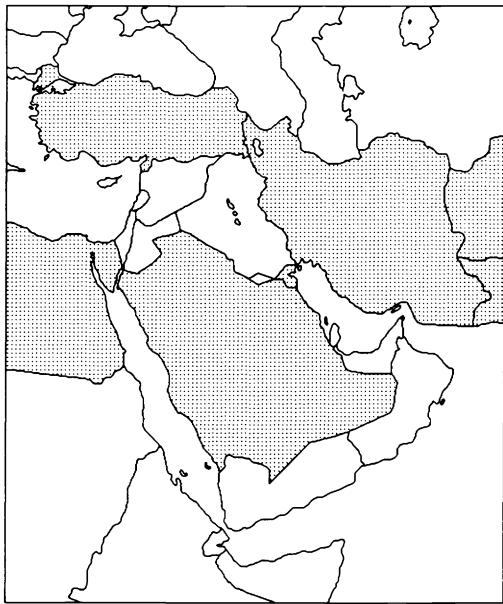


Figure 85. Geographic distribution of *Hyoscyamus pusillus* L.

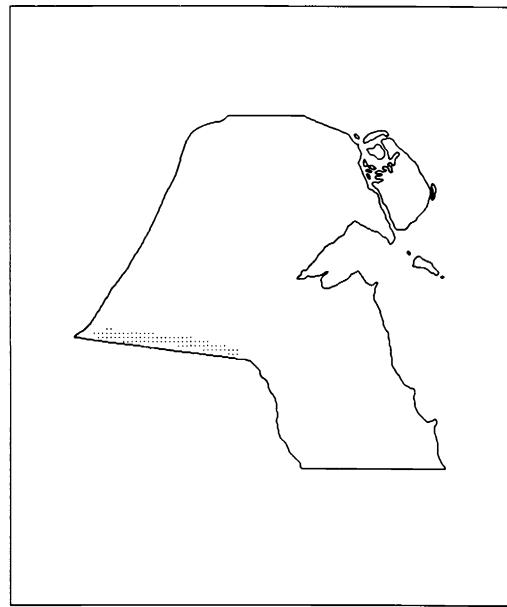
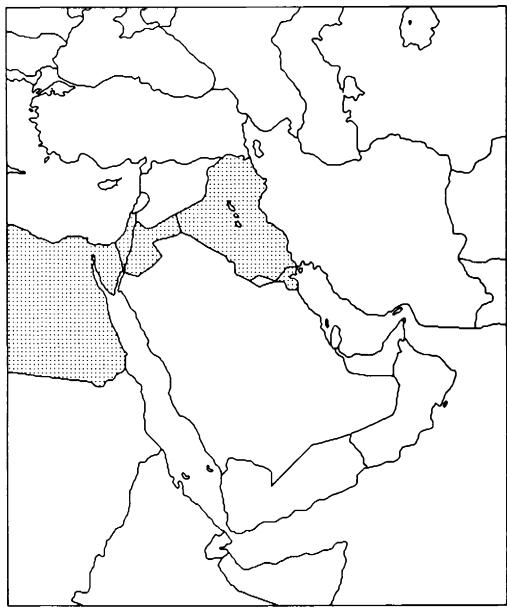


Figure 86. Geographic distribution of *Hypocotyl geslinitii* Coss. & Kral.

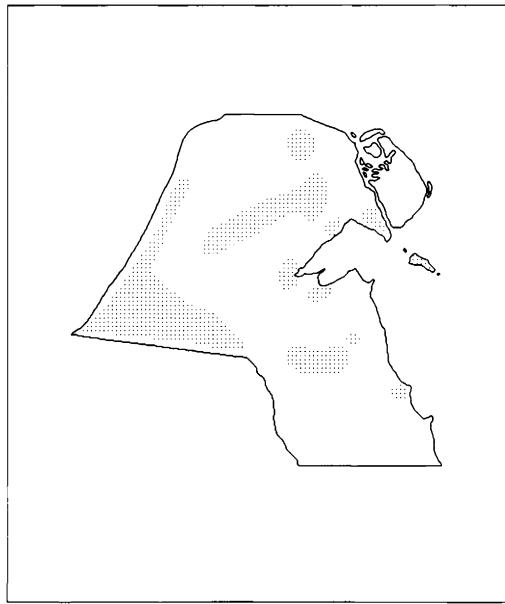
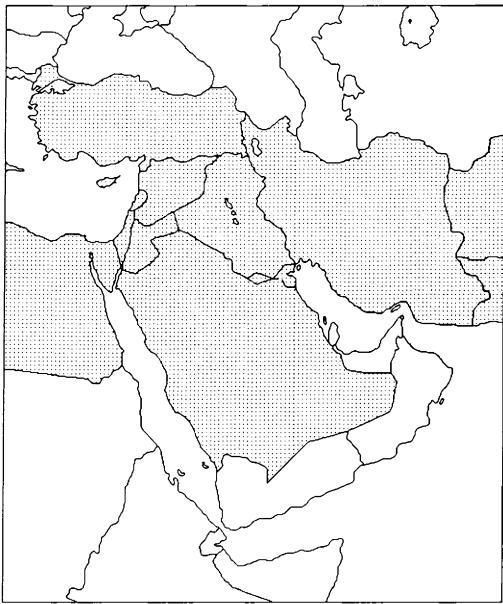


Figure 87. Geographic distribution of *Hypicum pendulum* L.

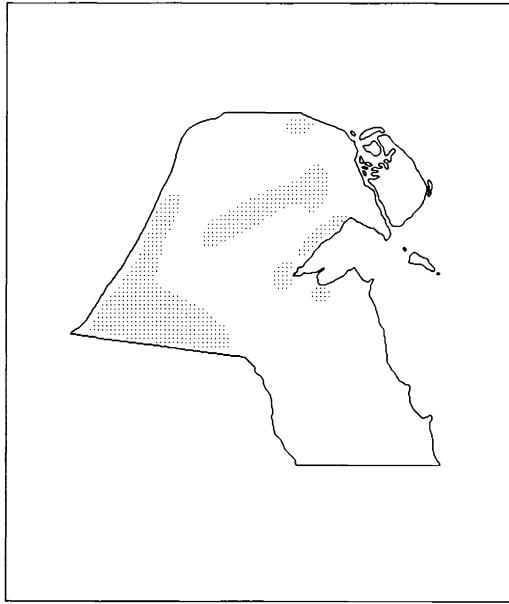
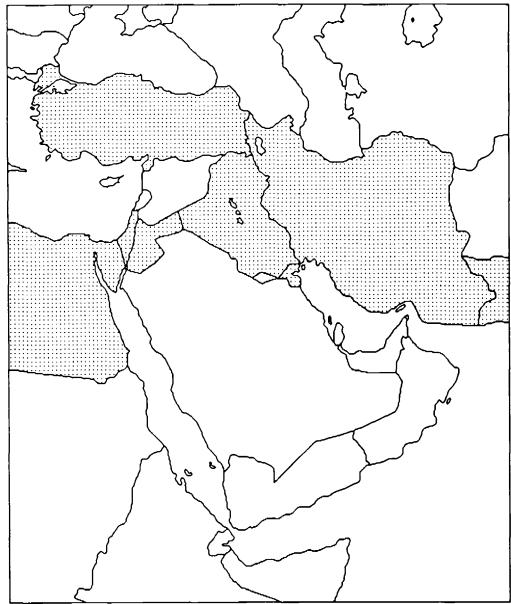


Figure 88. Geographic distribution of *Lappula spinocarpos* (Forssk.) Ascherson & Kuntze.

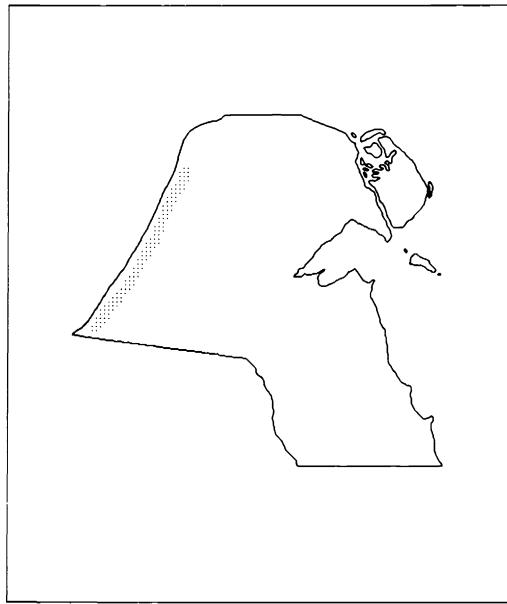
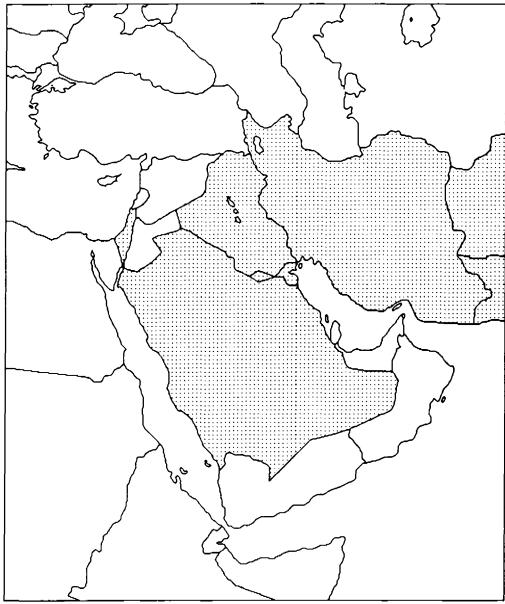


Figure 89. Geographic distribution of *Lepidium aucheri* Boiss.

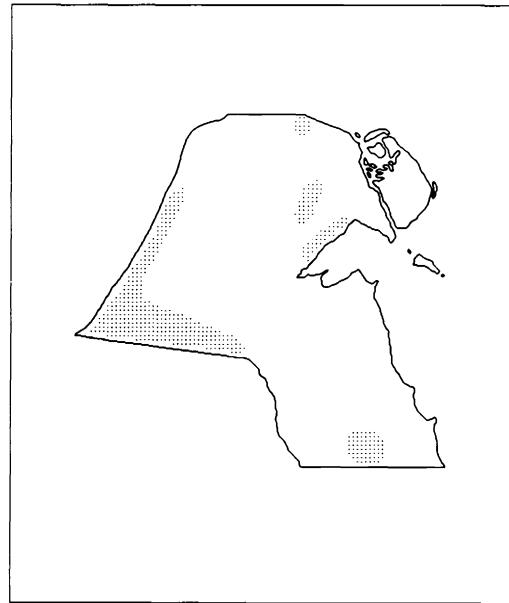
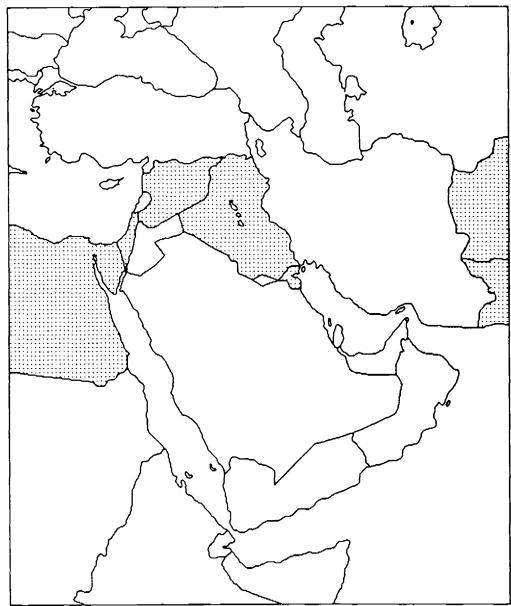


Figure 90. Geographic distribution of *Leptaleum filifolium* (Willd.) DC.

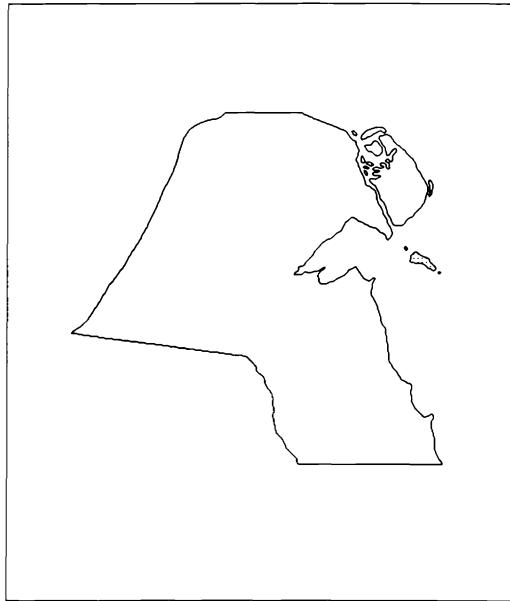
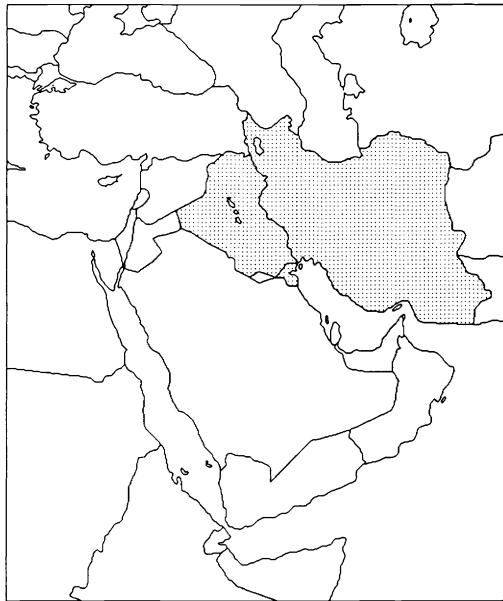


Figure 91. Geographic distribution of *Limonium carnosum* (Boiss.) Kuntze.

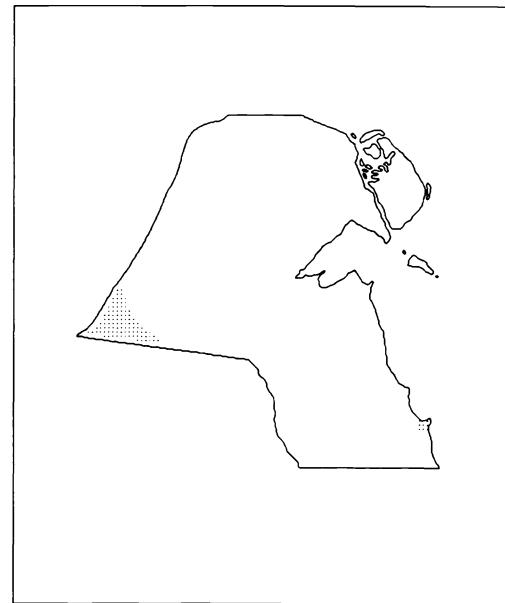
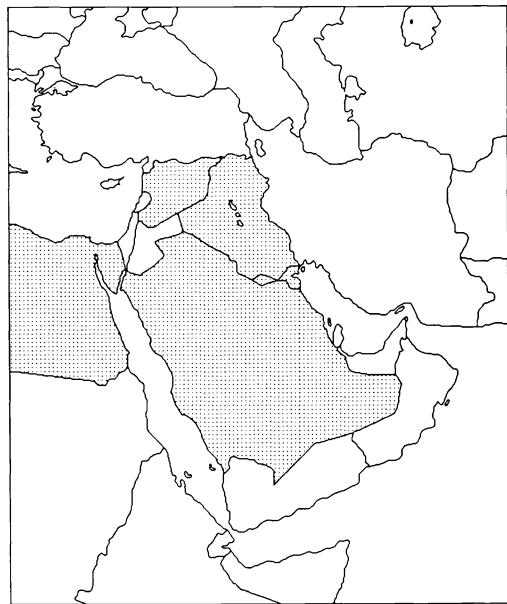


Figure 92. Geographic distribution of *Limonium thouini* (Viv.) Kuntze.

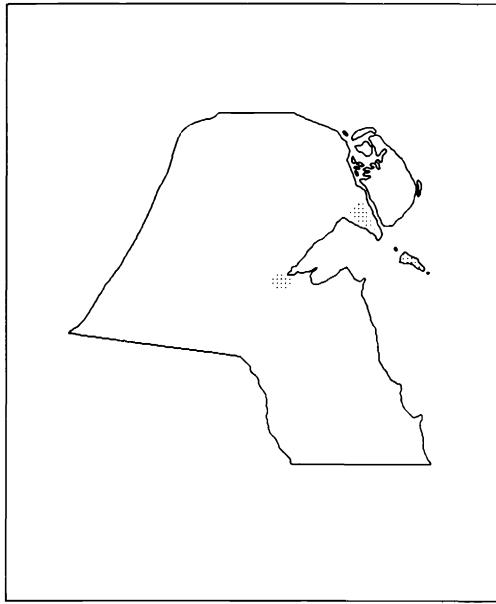
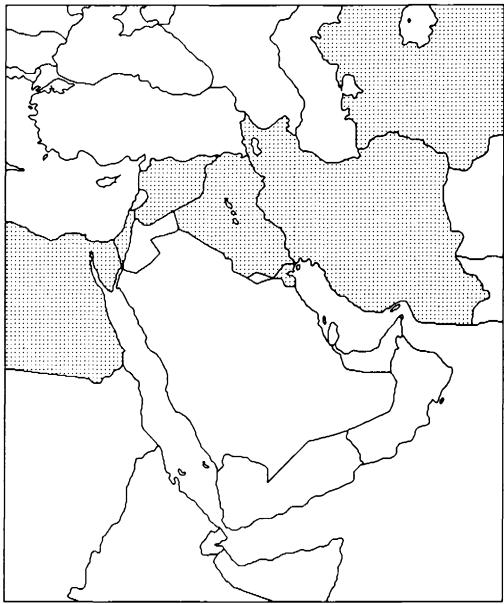


Figure 93. Geographic distribution of *Linaria albifrons* (Sibth. & Sm.) Spreng.

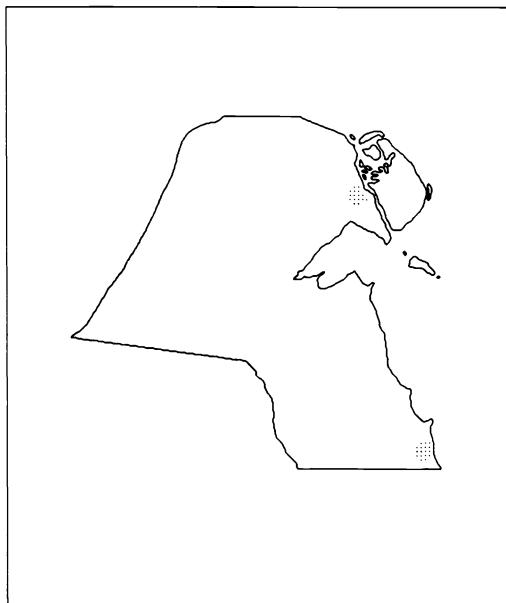
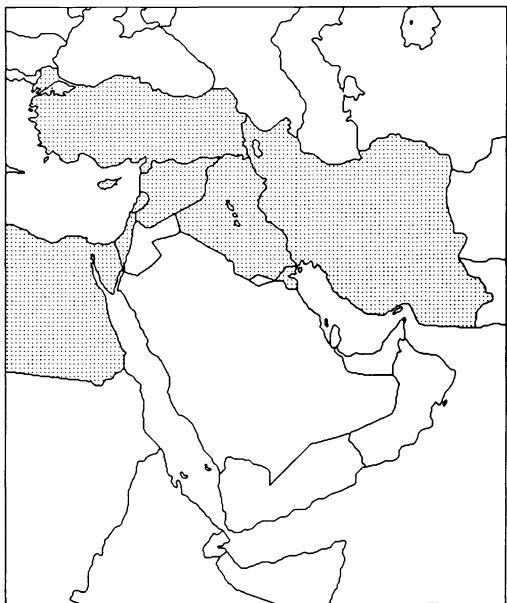


Figure 94. Geographic distribution of *Linaria simplex* (Willd.) DC.

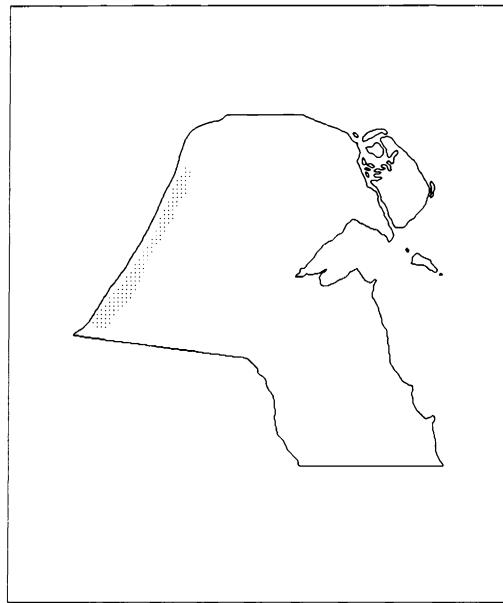
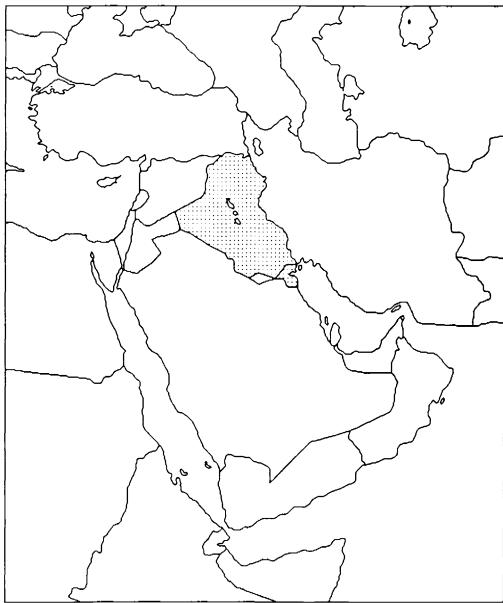


Figure 95. Geographic distribution of *Lithospermum apulum* (L.) Vahl.

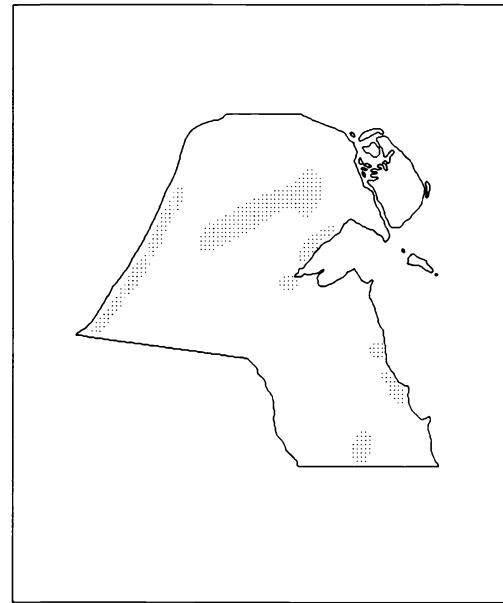
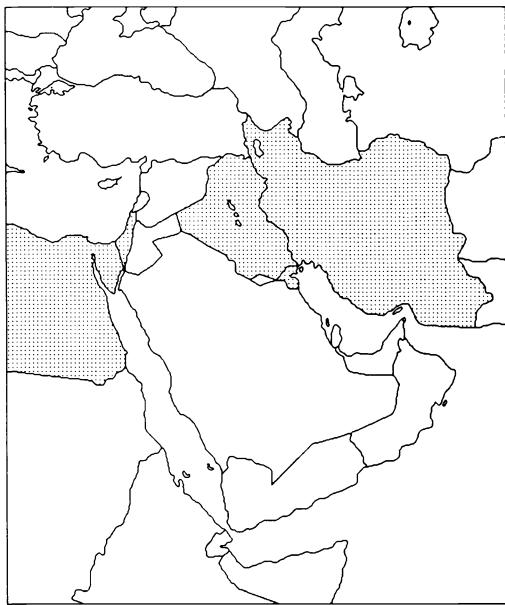


Figure 96. Geographic distribution of *Loeflingia hispanica* L.

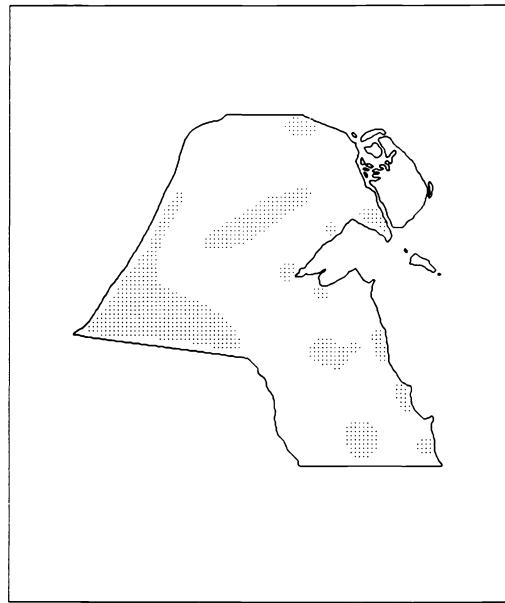
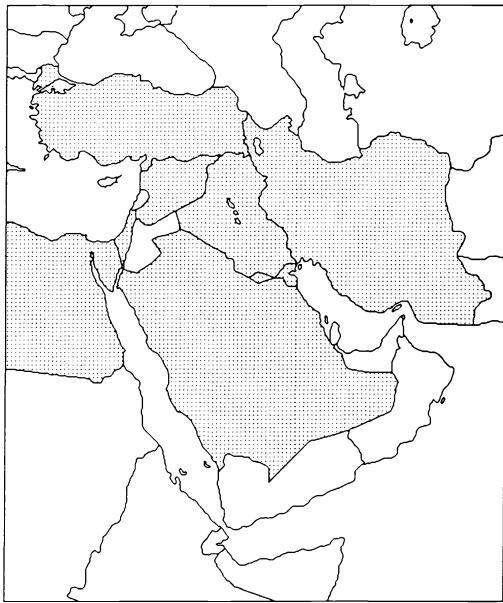


Figure 97. Geographic distribution of *Lotus halophilus* Boiss. & Sprun.

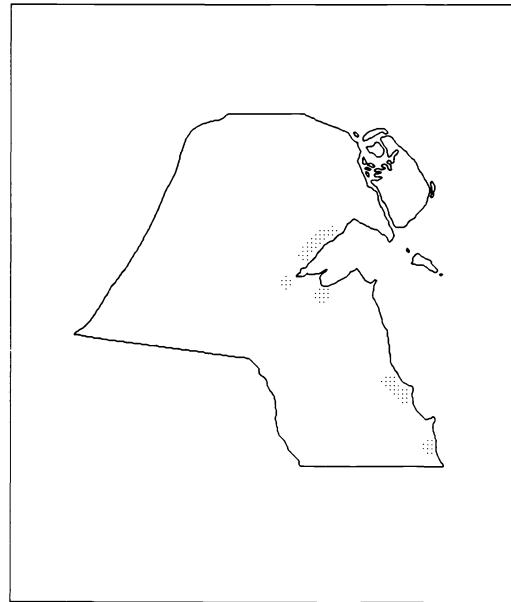
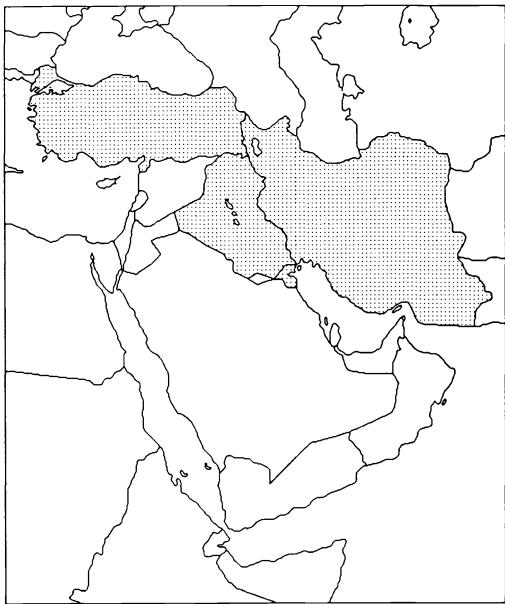


Figure 98. Geographic distribution of *Lycium shawii* Roem. & Schult.

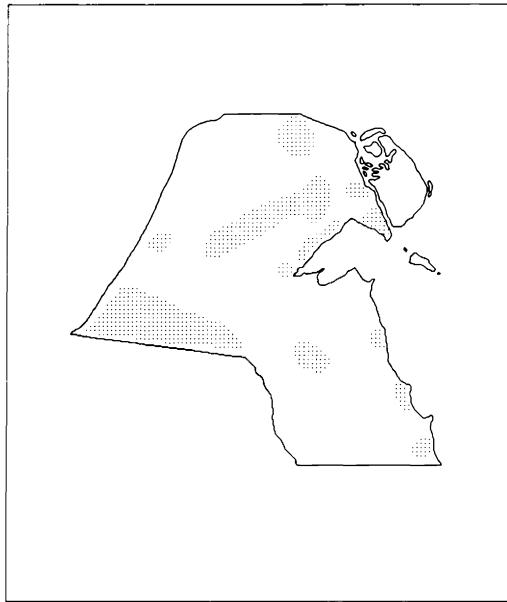
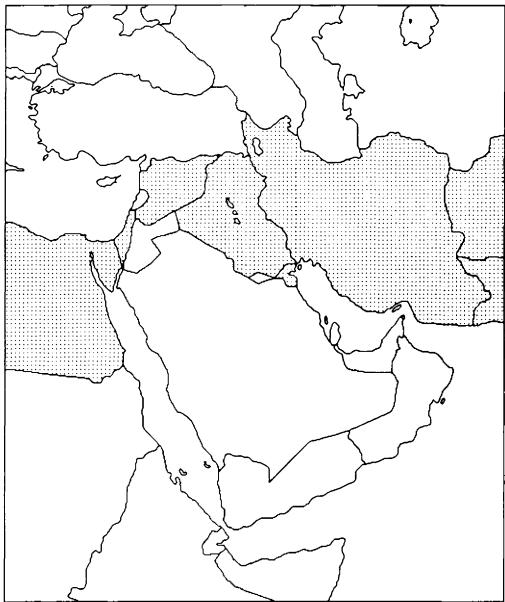


Figure 99. Geographic distribution of *Malcolmia grandiflora* (Bunge) Kuntze.

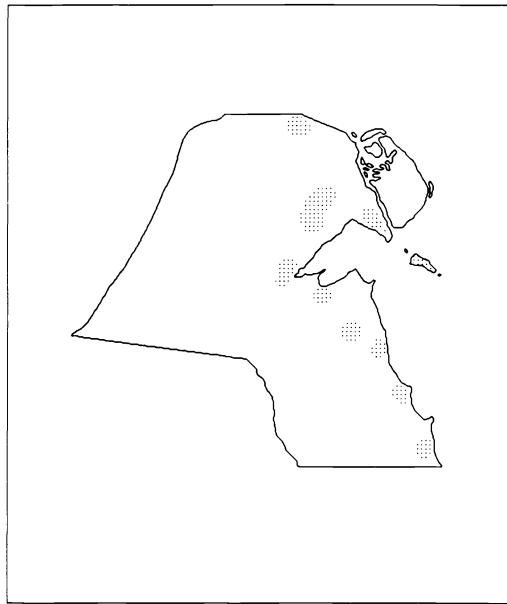
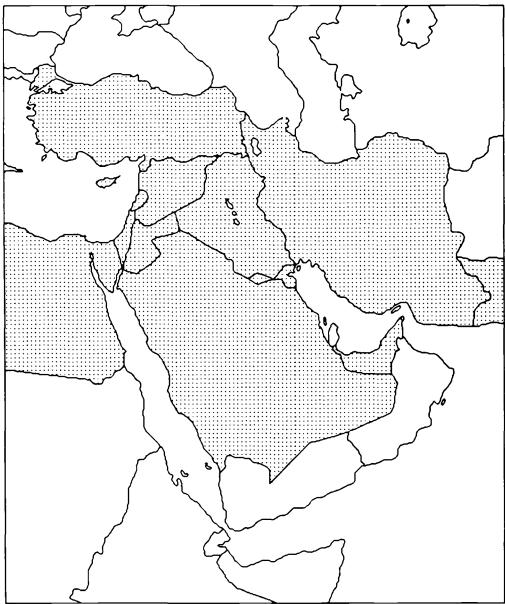


Figure 100. Geographic distribution of *Malva parviflora* L.

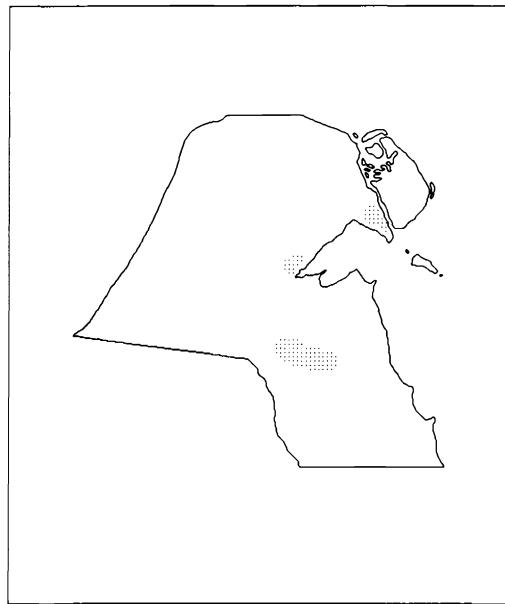
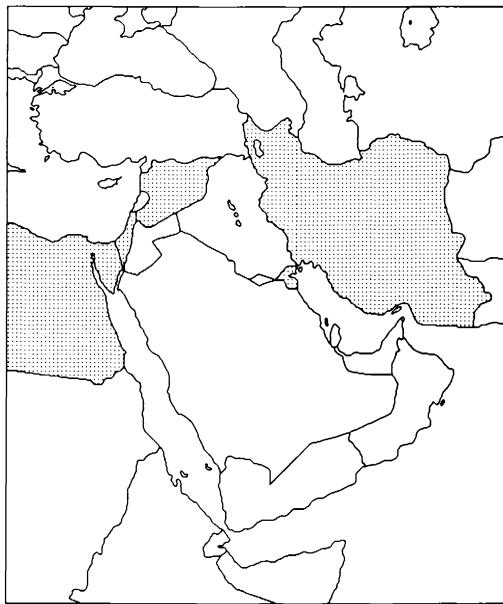


Figure 101. Geographic distribution of *Maresia pygmaea* (Del.) O.E. Schulz.

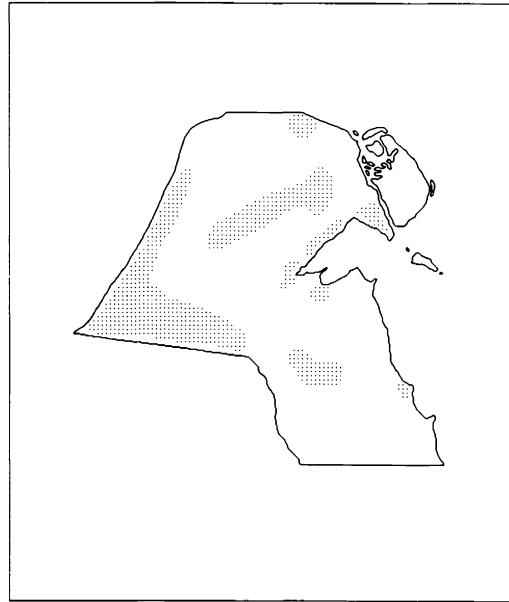
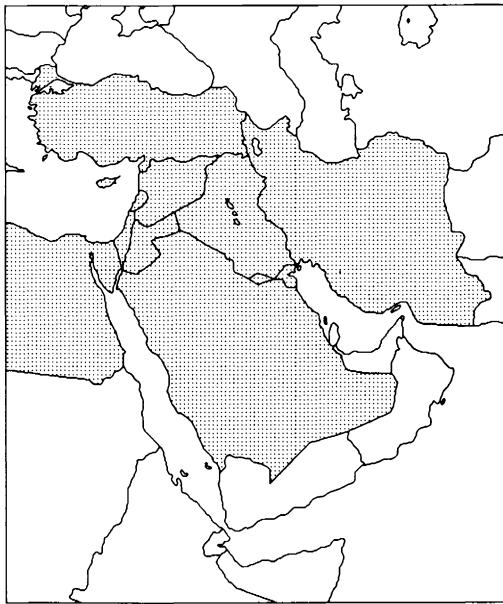


Figure 102. Geographic distribution of *Matthiola longipetala* (Vent.) DC.

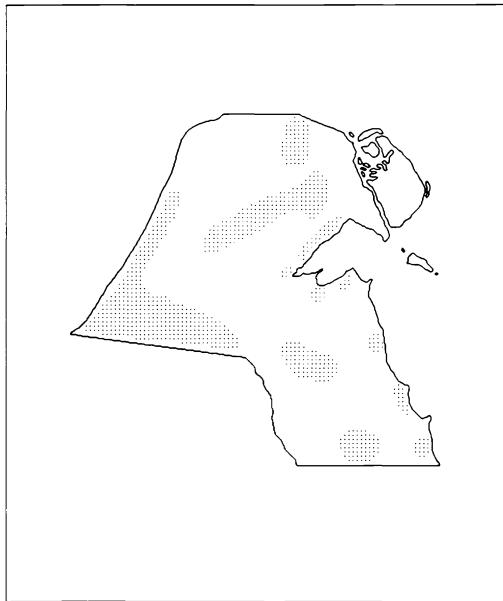
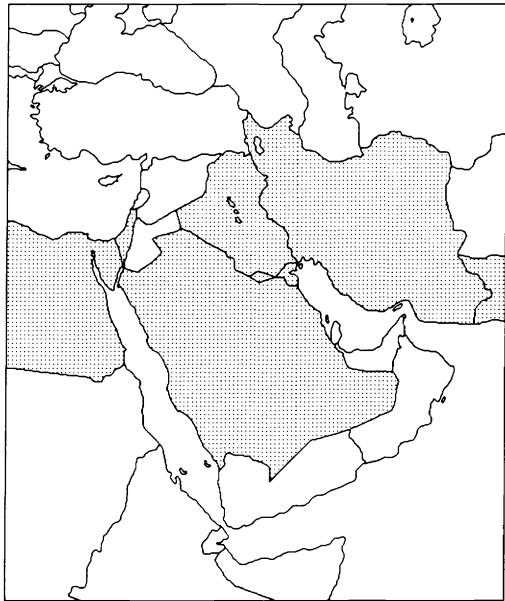


Figure 103. Geographic distribution of *Medicago laciniata* (L.) Mill.

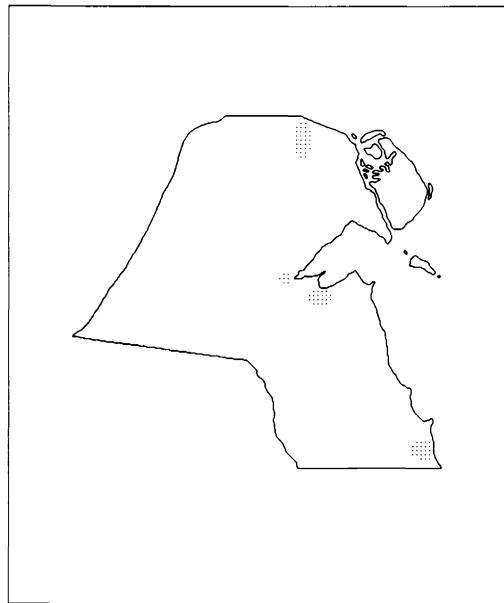
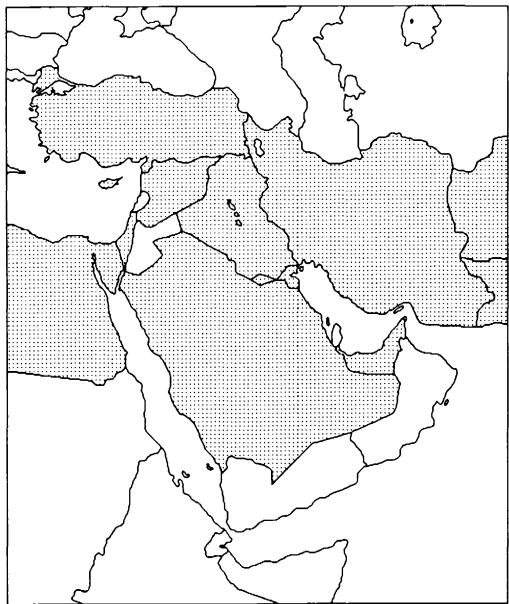


Figure 104. Geographic distribution of *Melilotus indicus* (L.) All.

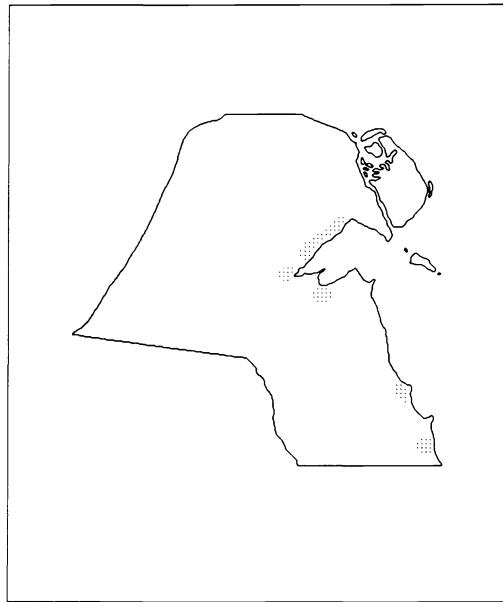
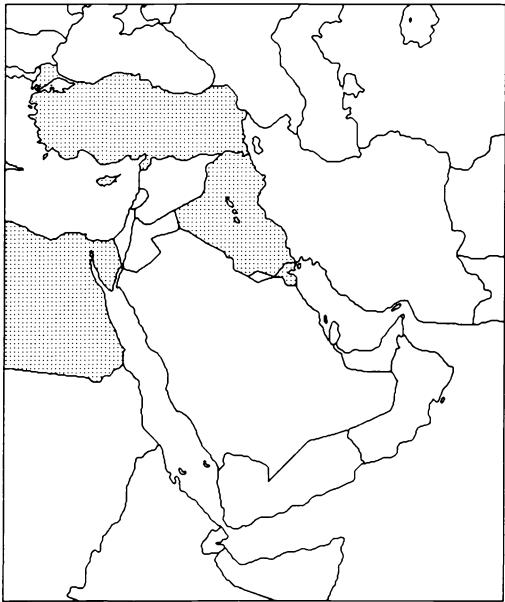


Figure 105. Geographic distribution of *Mesembryanthemum nodiflorum* L.

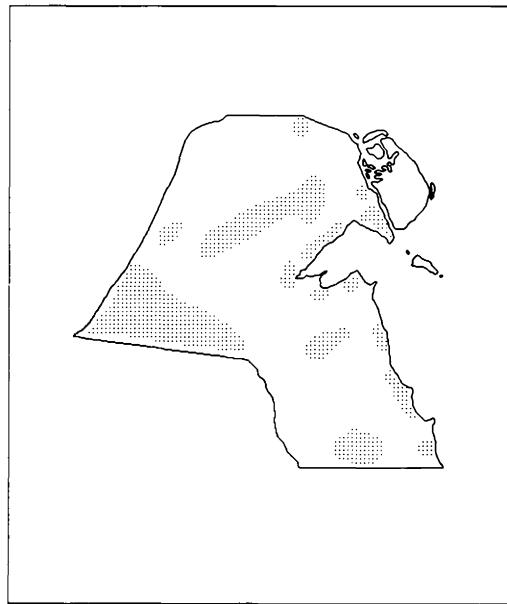
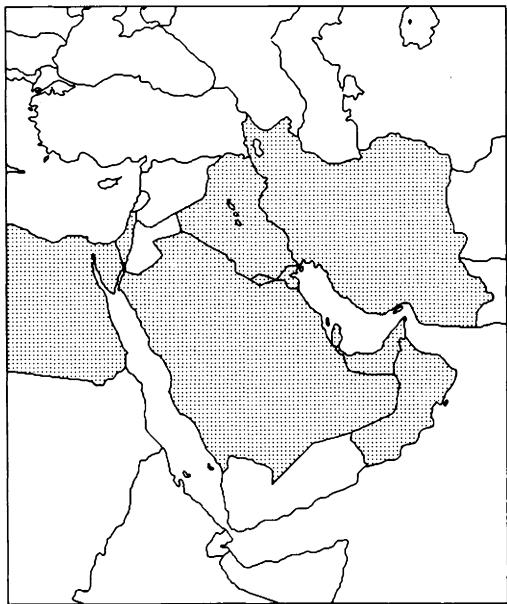


Figure 106. Geographic distribution of *Moltoziopsis ciliata* (Forssk.) I.M. Johnston.

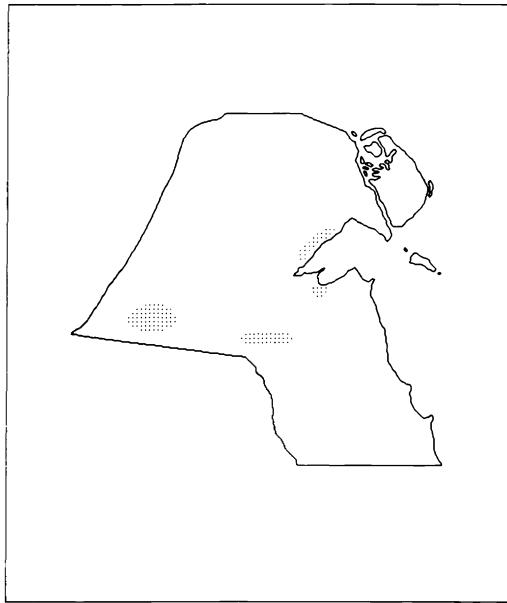
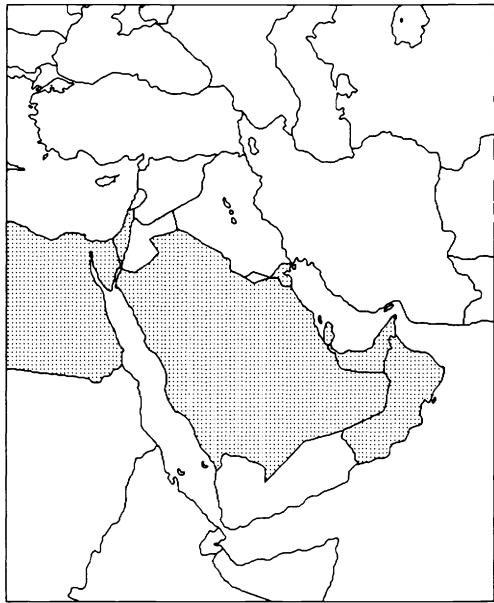


Figure 107. Geographic distribution of *Monsonia nivea* (Decne.) Decne. ex Webb.

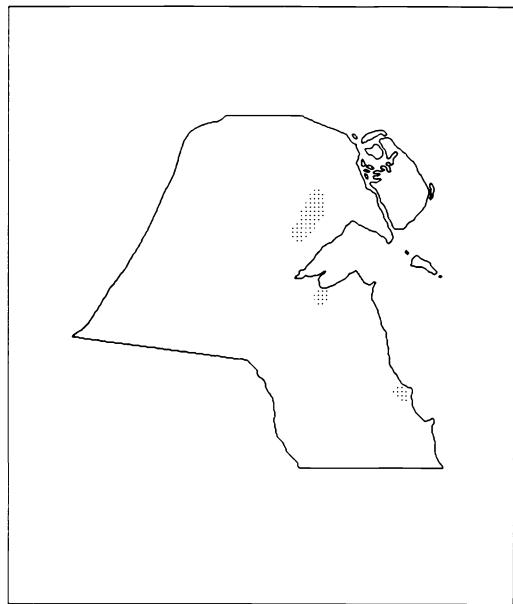
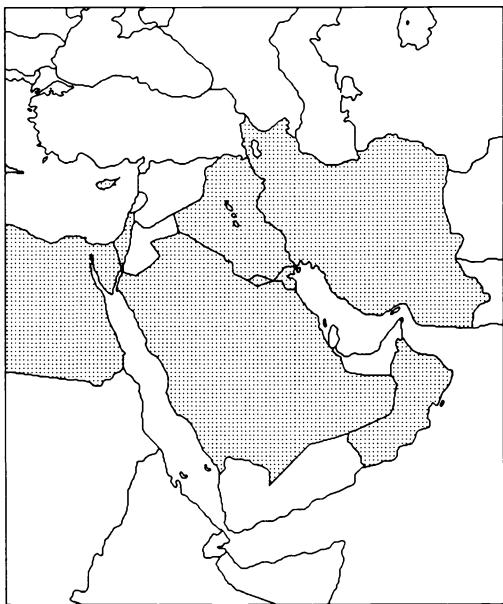


Figure 108. Geographic distribution of *Neurada procumbens* L.

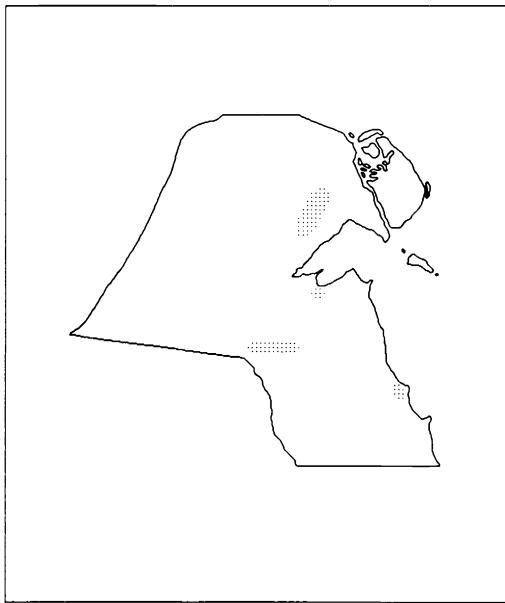
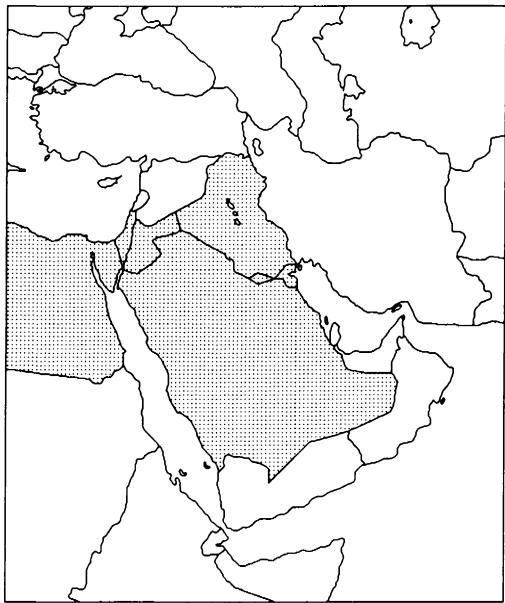


Figure 109. Geographic distribution of *Nitraria retusa* (Forssk.) Aschers.

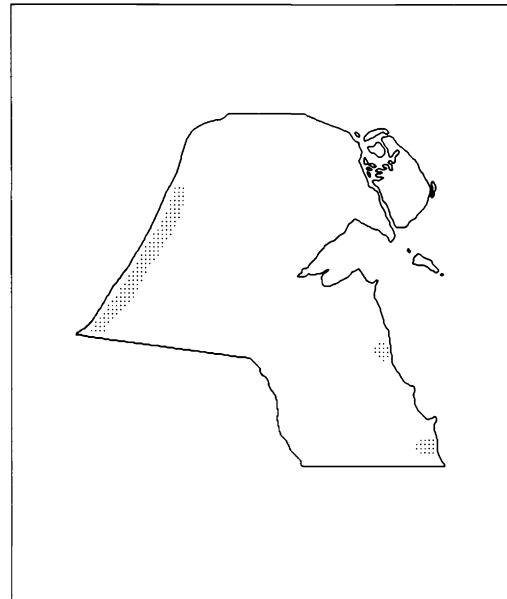
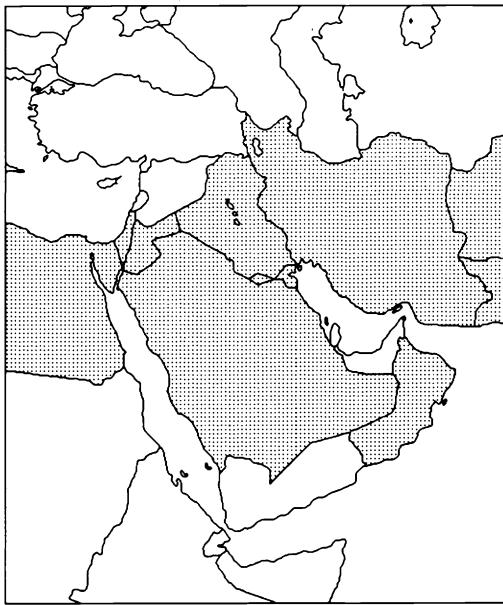


Figure 110. Geographic distribution of *Notoceras bicornis* (Alton) Amo.

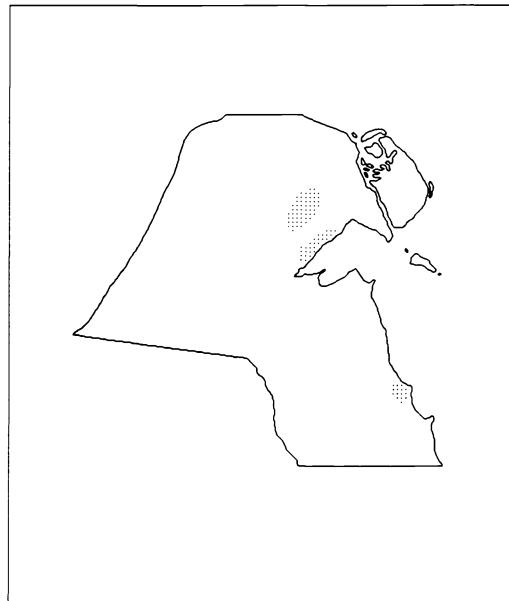
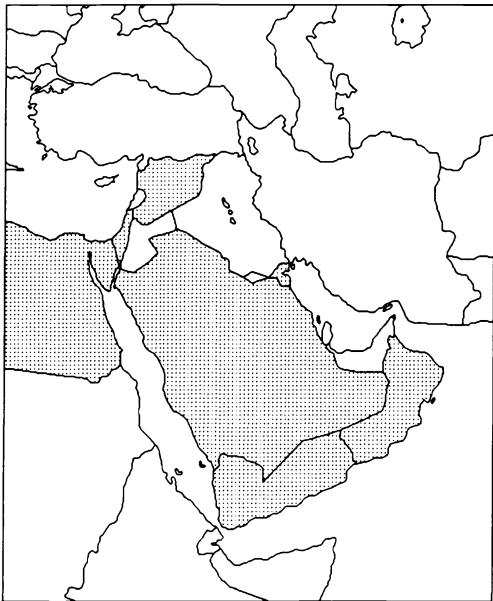


Figure 111. Geographic distribution of *Ochradeanus baccatus* Del.

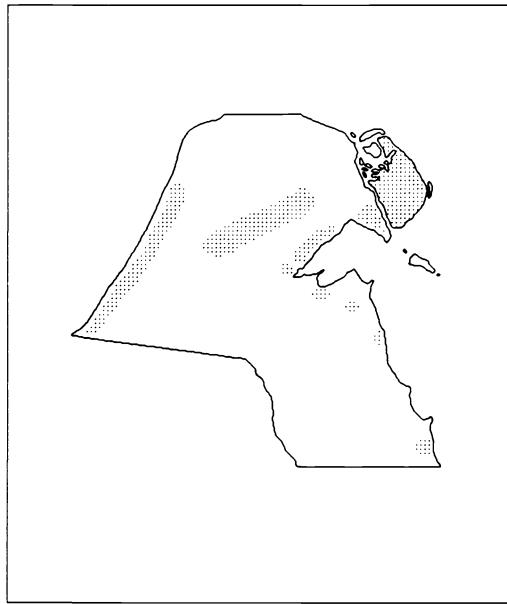
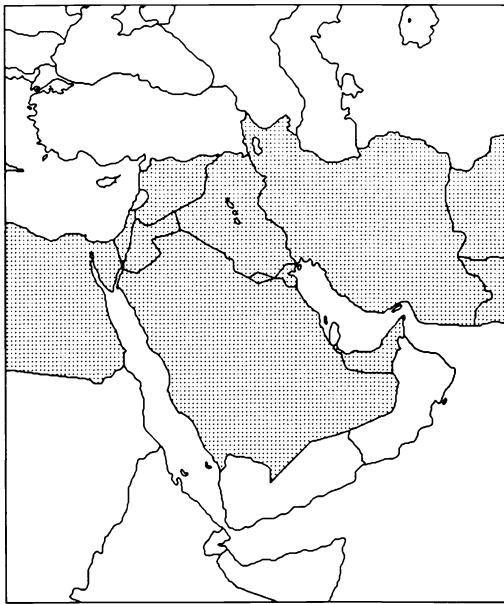


Figure 112. Geographic distribution of *Oligomeris subulata* (Del.) Boiss.

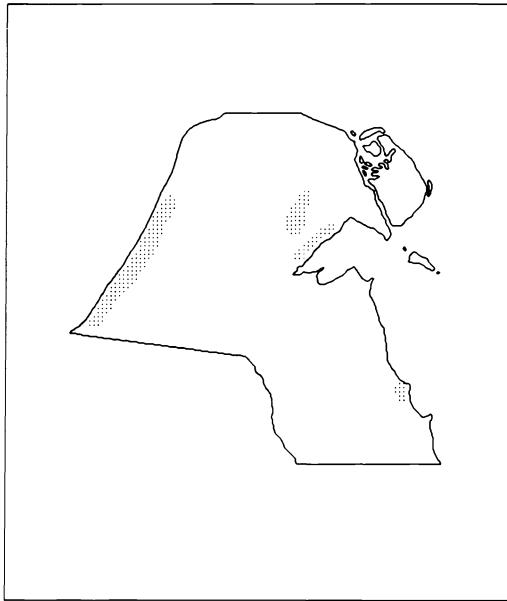
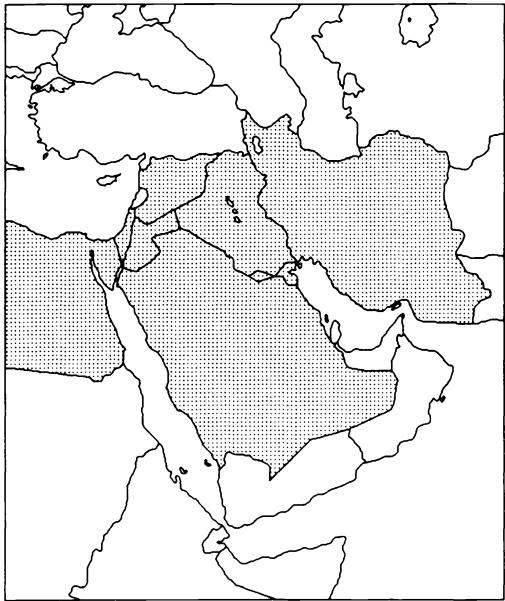


Figure 113. Geographic distribution of *Onobrychis ptolemaica* (Del.) DC.

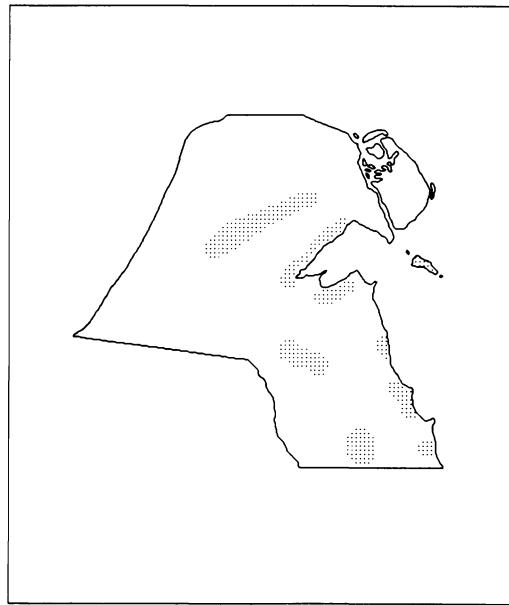
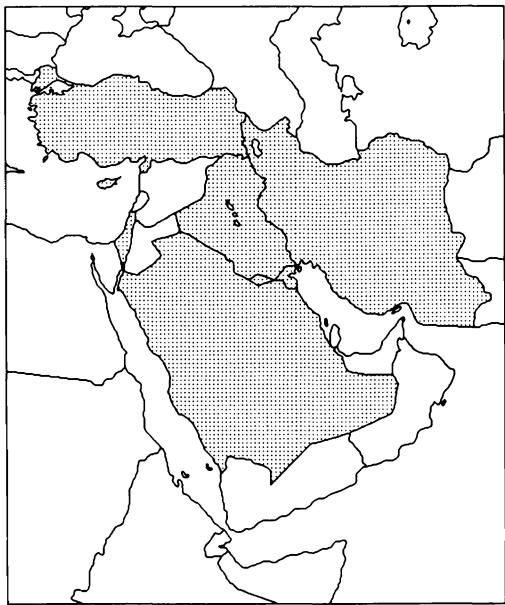


Figure 114. Geographic distribution of *Ononis serrata* Forssk.

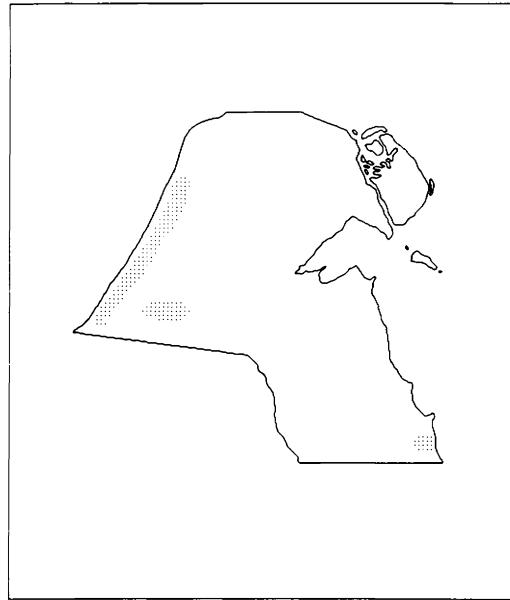
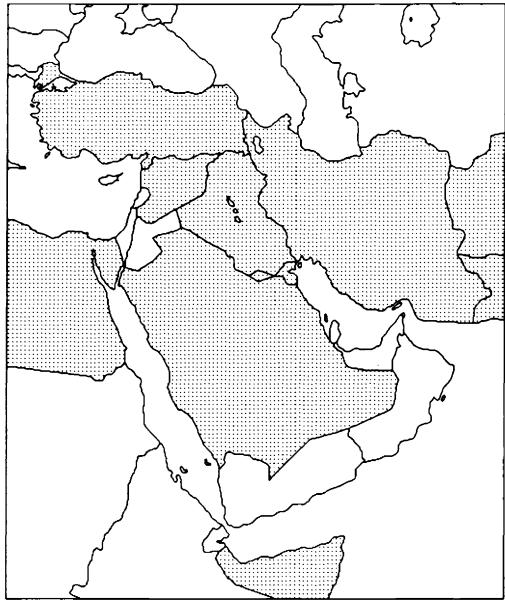


Figure 115. Geographic distribution of *Orobanche cernua* Loefl.

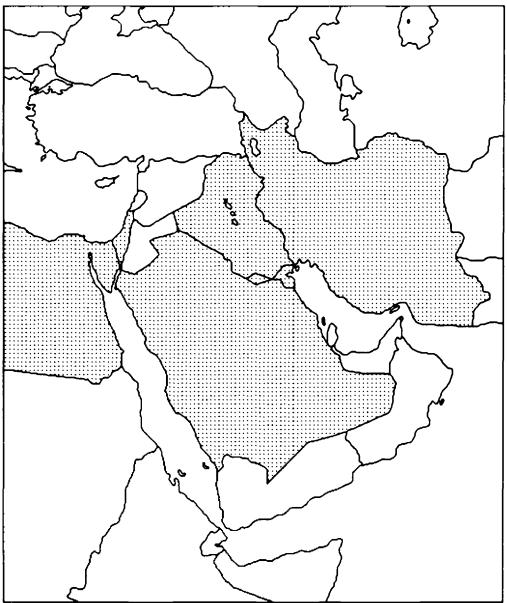


Figure 116. Geographic distribution of *Paronychia arabica* (L.) DC.

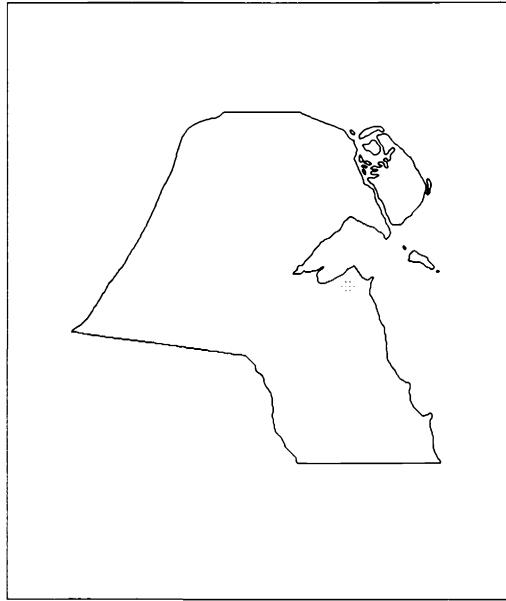
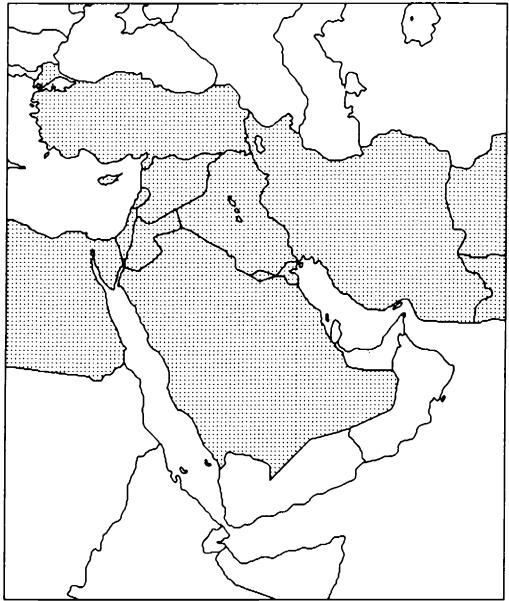


Figure 117. Geographic distribution of *Peganum harmala* L.

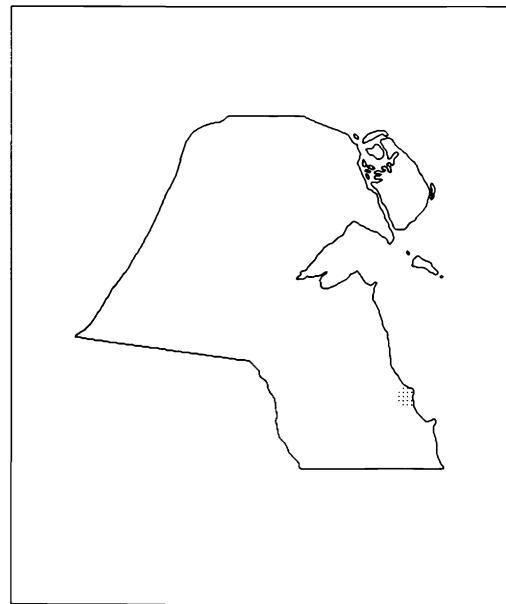
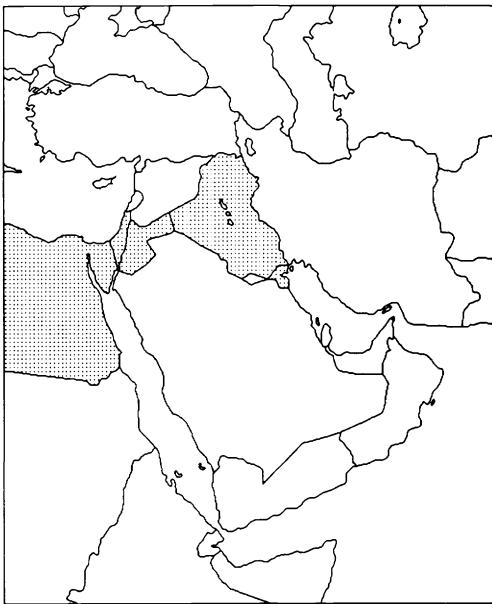


Figure 118. Geographic distribution of *Pituranthus triradiatus* (Hochst. ex Boiss.) Aschers. & Schweinf.

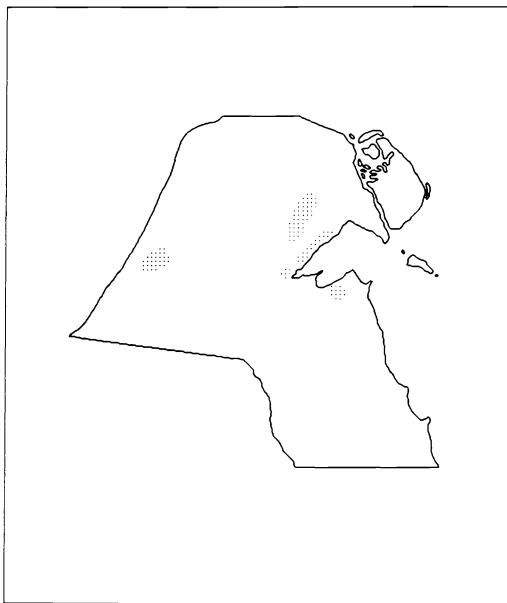
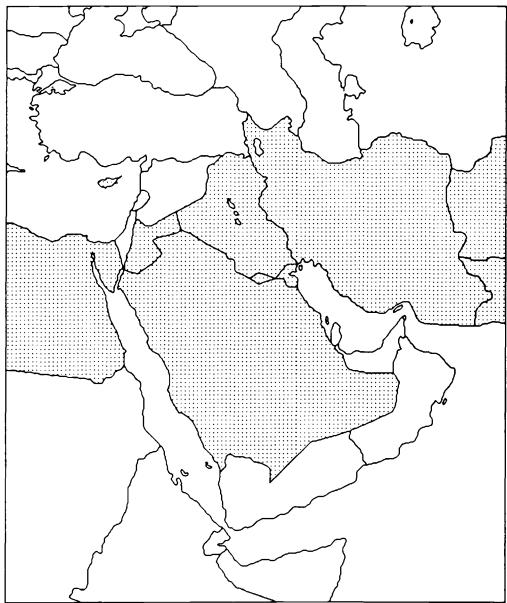


Figure 119. Geographic distribution of *Plantago amplexicaulis* Cav. subsp. *bauphula* (Edgew.) Rech. f.

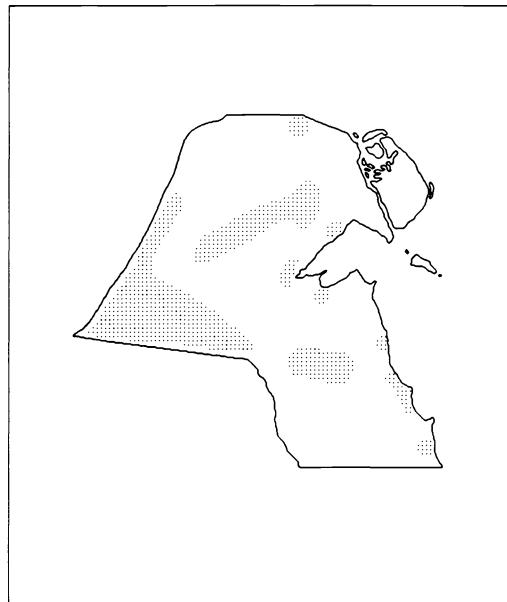
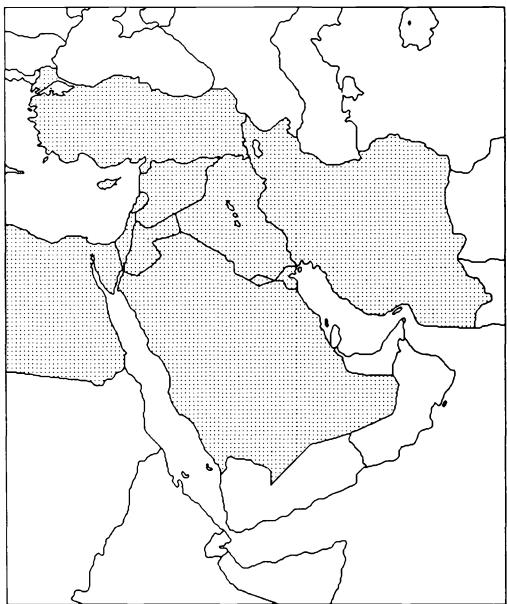


Figure 120. Geographic distribution of *Plantago boissieri* Hausskn. & Bornm.

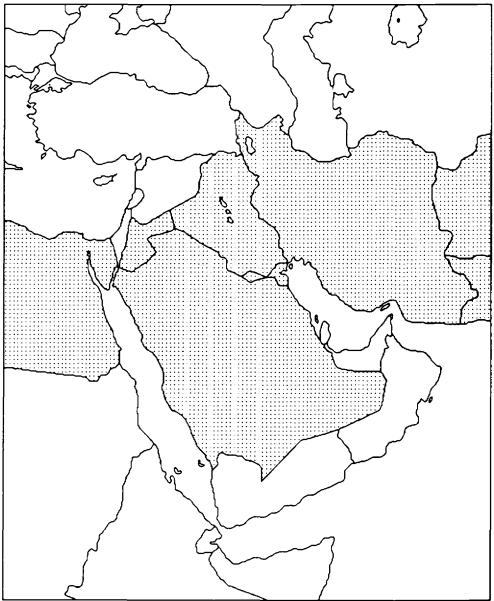


Figure 121. Geographic distribution of *Plantago ciliata* Desf.

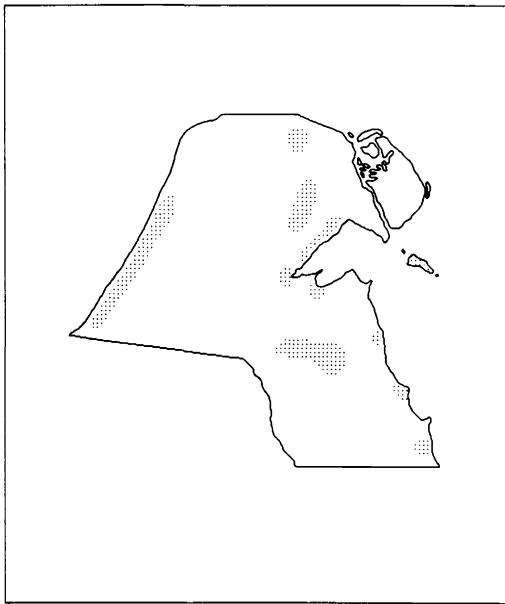
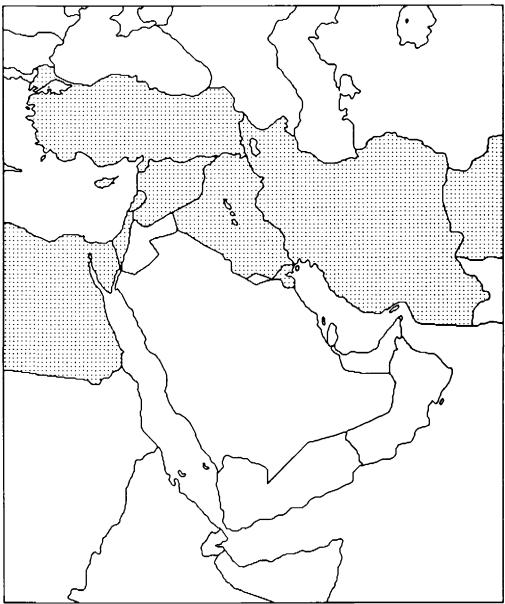


Figure 122. Geographic distribution of *Plantago coronopus* L.

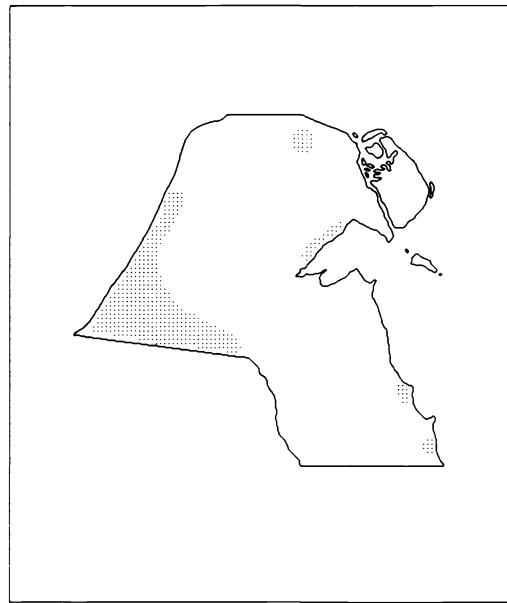
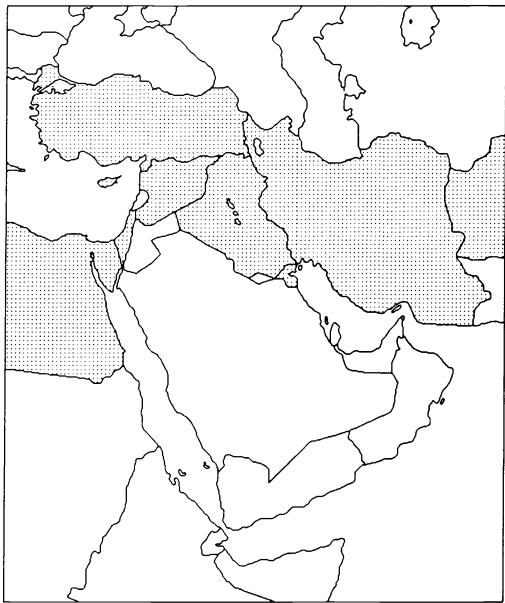


Figure 123. Geographic distribution of *Plantago lagopus* L.

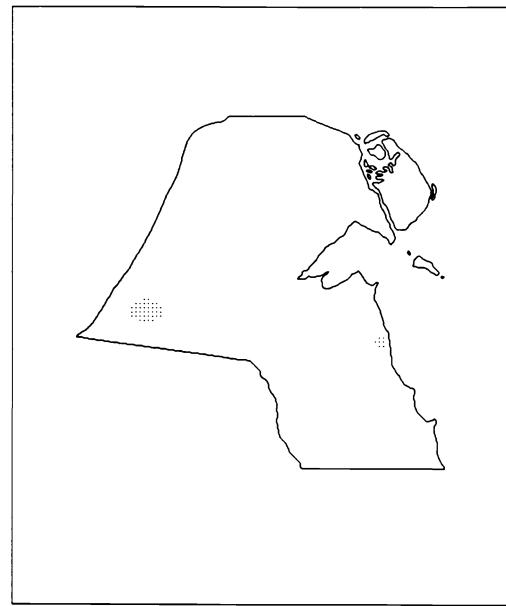
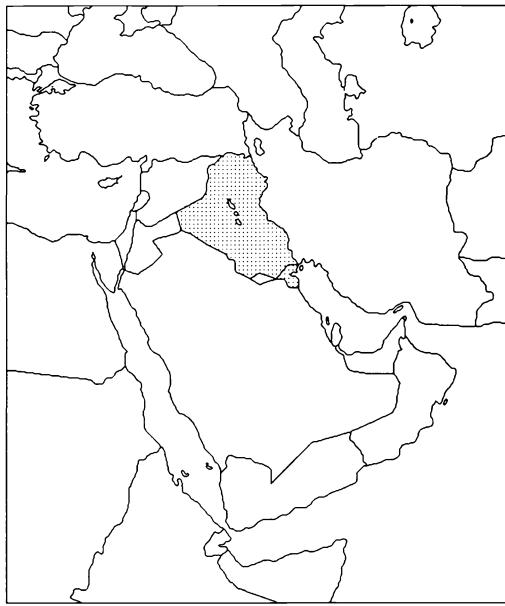


Figure 124. Geographic distribution of *Plantago notata* Lag.

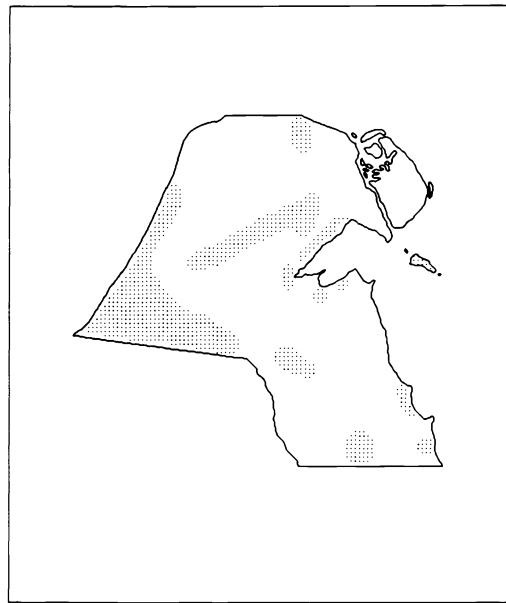
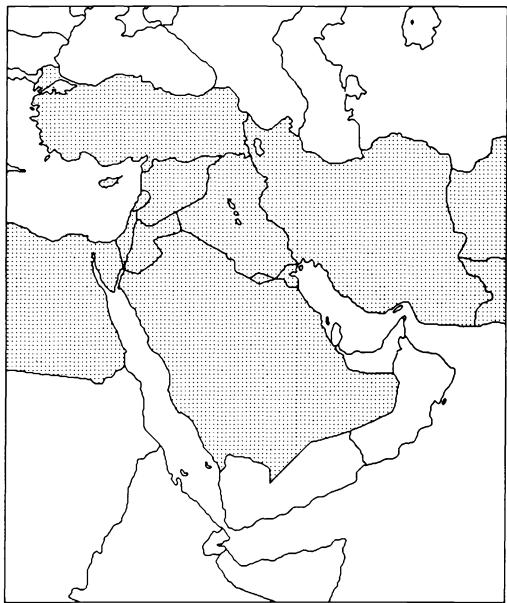


Figure 125. Geographic distribution of *Plantago ovata* Forssk.

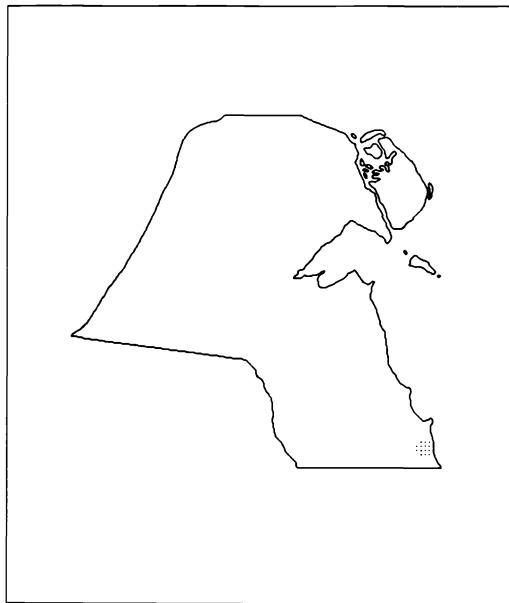
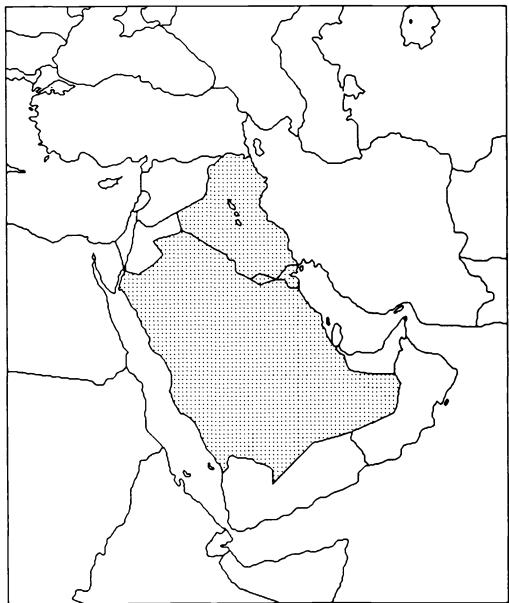


Figure 126. Geographic distribution of *Plantago psammophila* Agnew & Chalabi-Ka'bi.

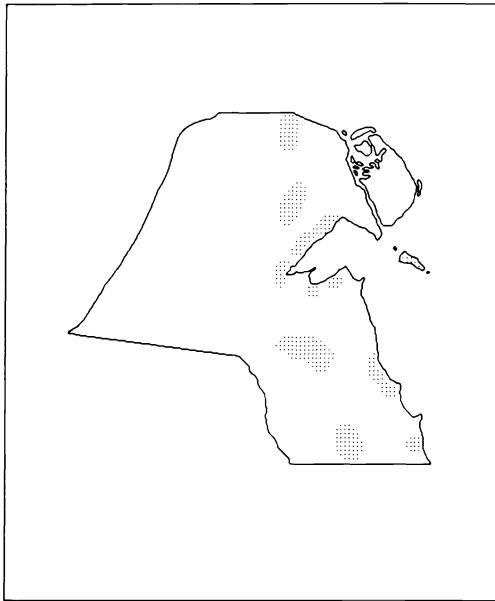
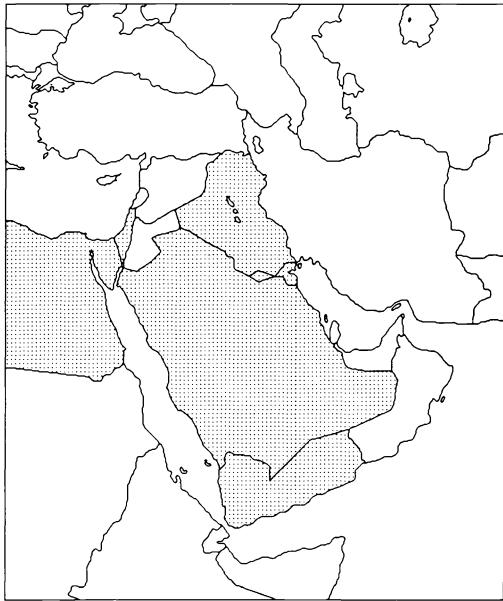


Figure 127. Geographic distribution of *Polycarpaea repens* (Forssk.) Aschers. & Schweinf.

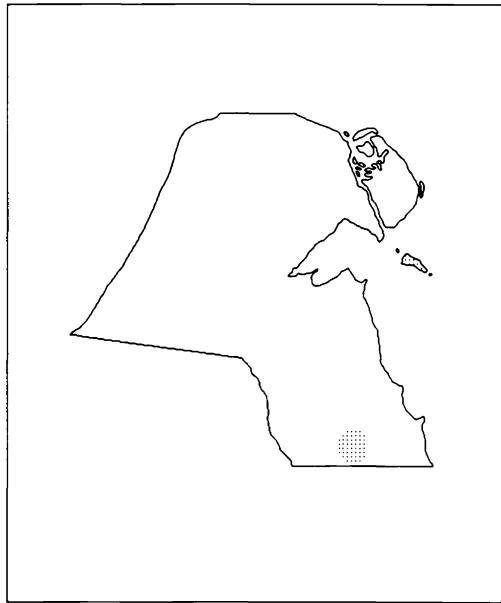
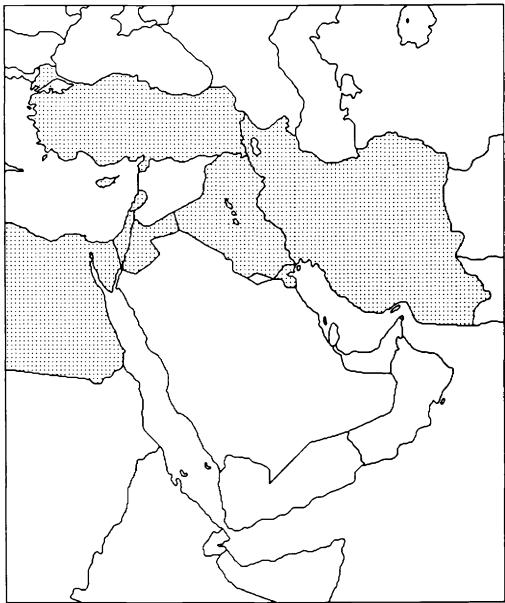


Figure 128. Geographic distribution of *Polycarpon tetraphyllum* (L.) L.

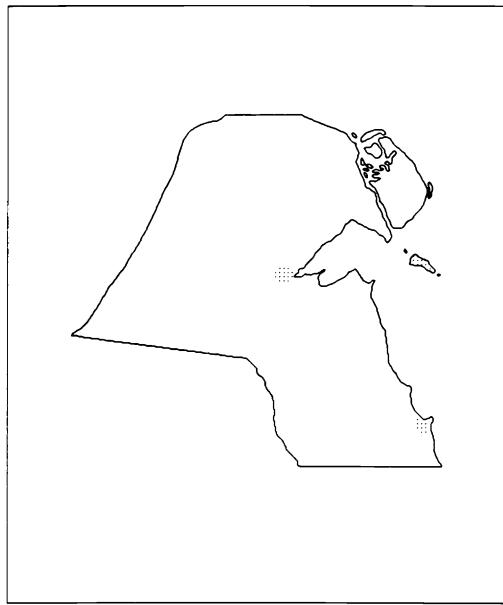
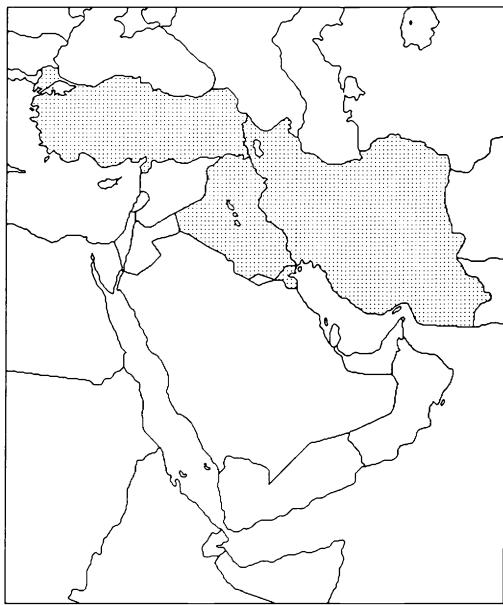


Figure 129. Geographic distribution of *Psylliostachys spicata* (Willd.) Nevski.

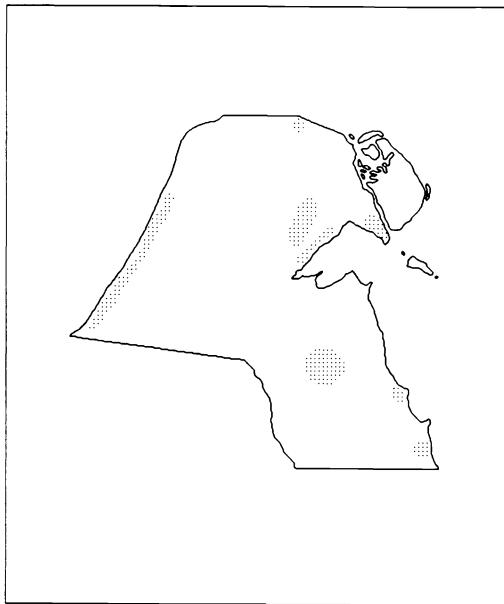
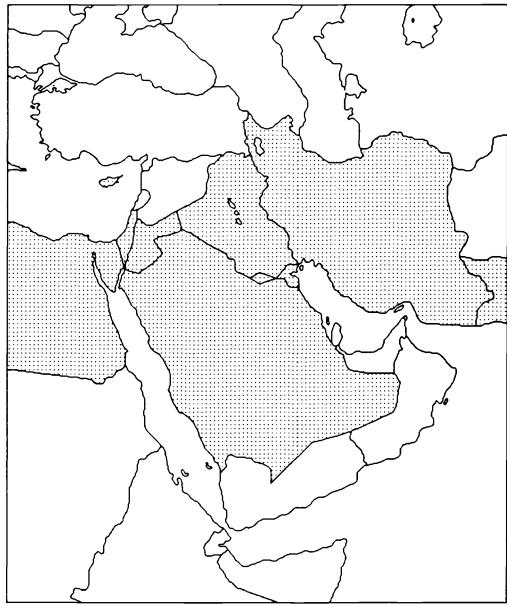


Figure 130. Geographic distribution of *Pteranthus dichotomus* Forssk.

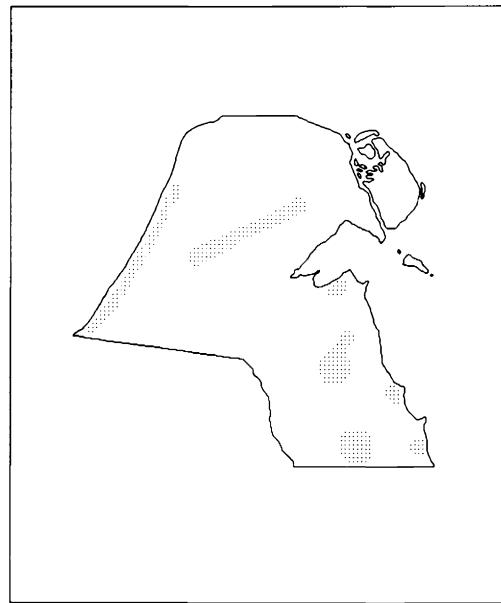
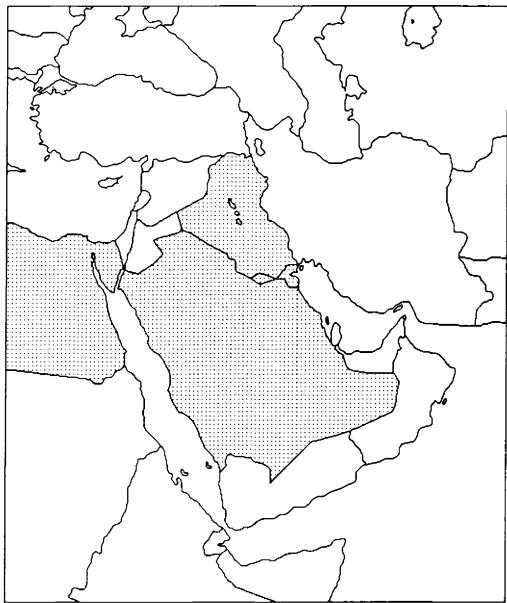


Figure 131. Geographic distribution of *Reseda arabica* Boiss.

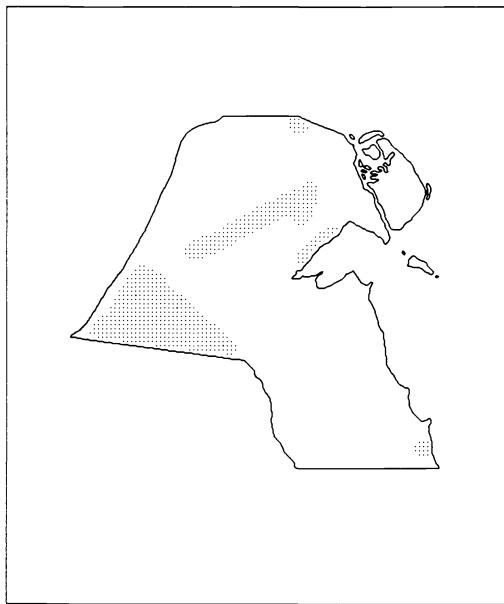
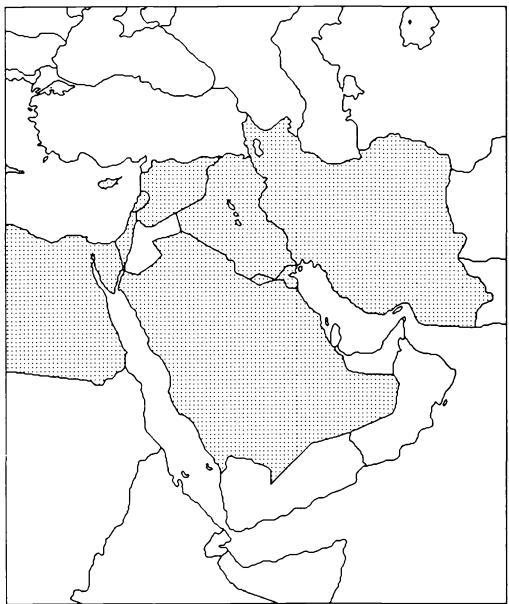


Figure 132. Geographic distribution of *Reseda decursiva* Forssk.

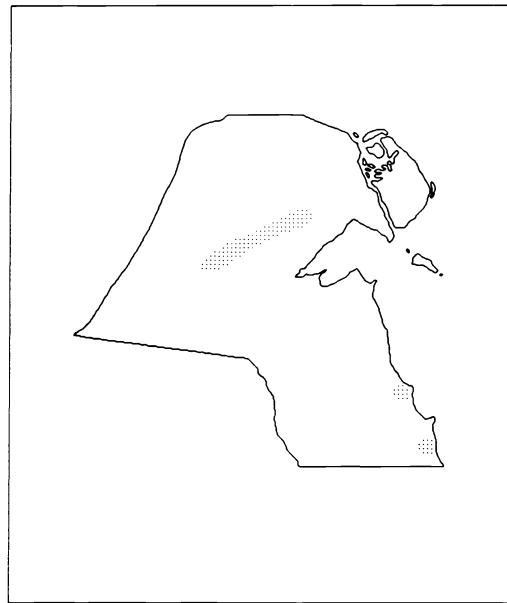
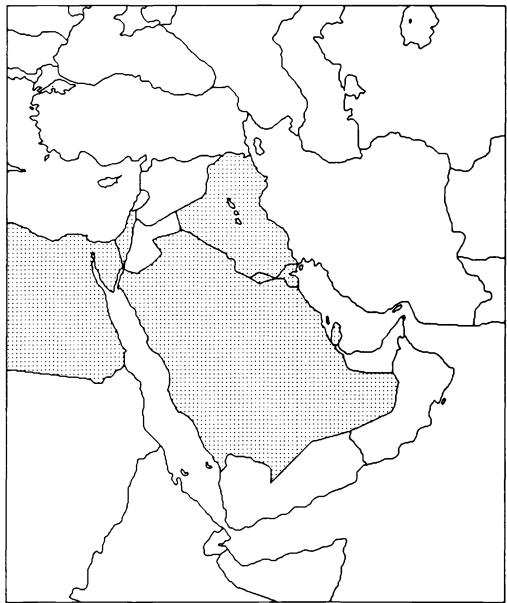


Figure 133. Geographic distribution of *Reseda muricata* C. Presl.

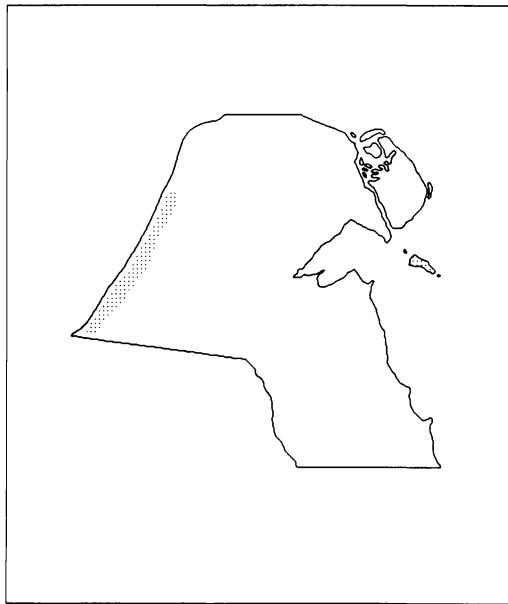
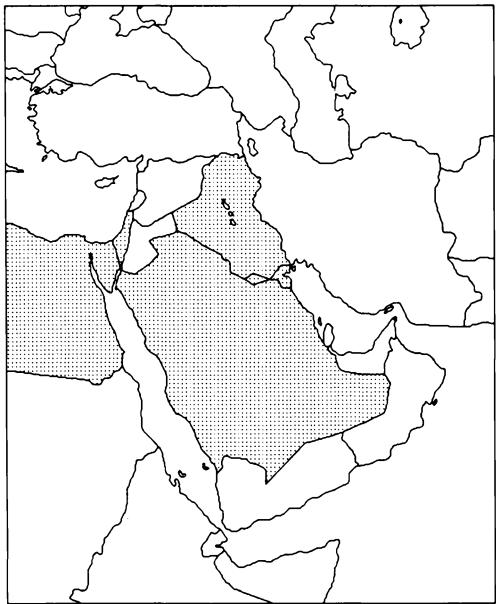


Figure 134. Geographic distribution of *Robbairea delileana* (Forssk.) Boiss.

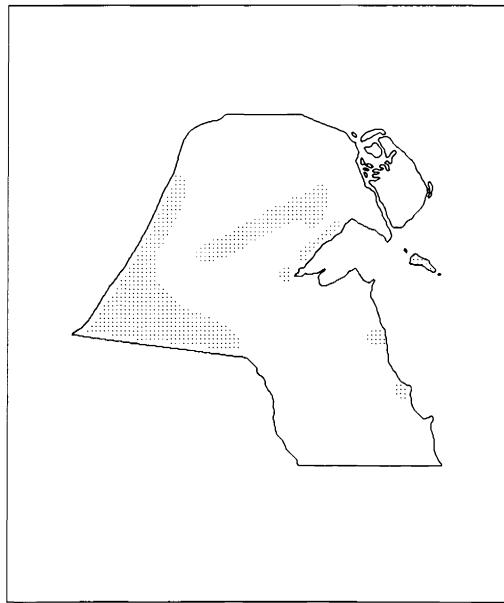
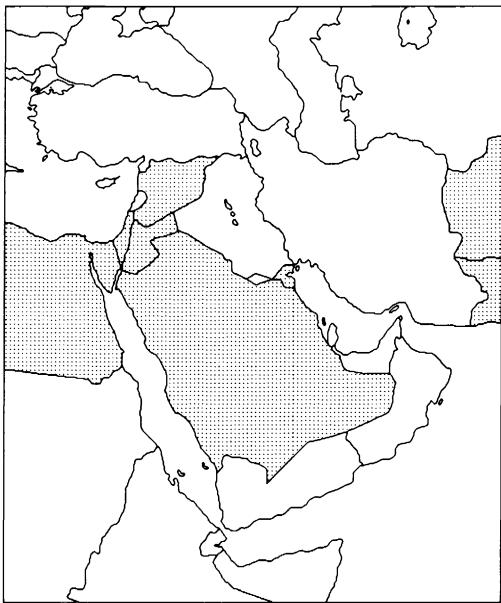


Figure 135. Geographic distribution of *Roemeria hybrida* (L.) DC. subsp. *hybrida*.

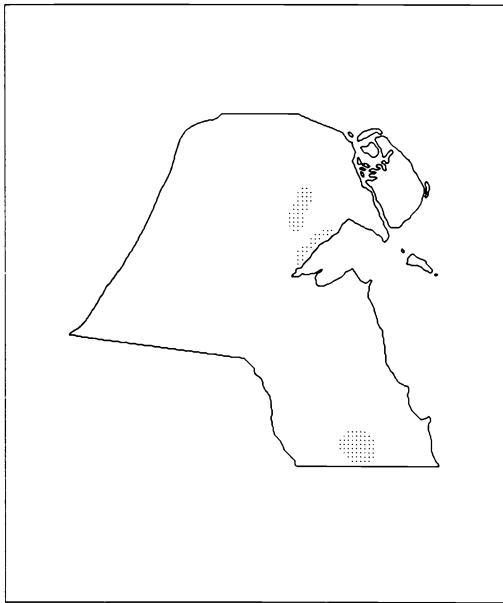
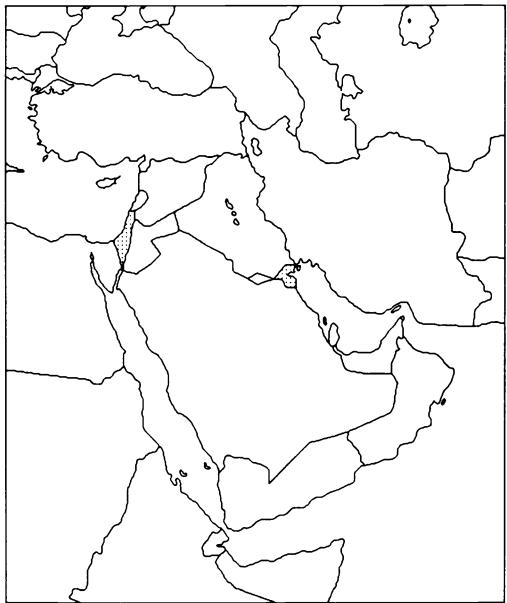


Figure 136. Geographic distribution of *Rumex pictus* Forssk.

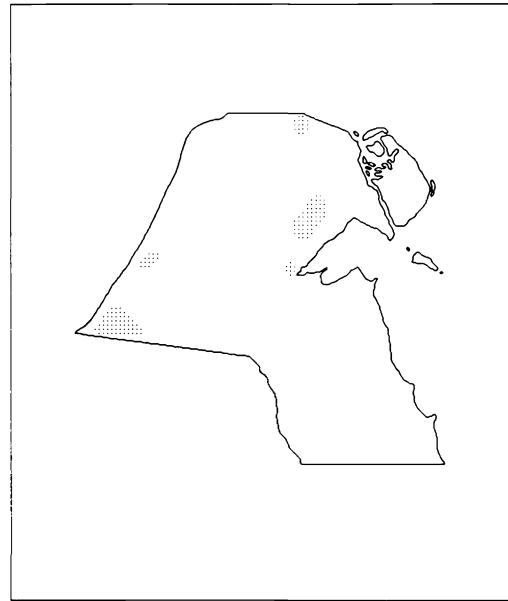
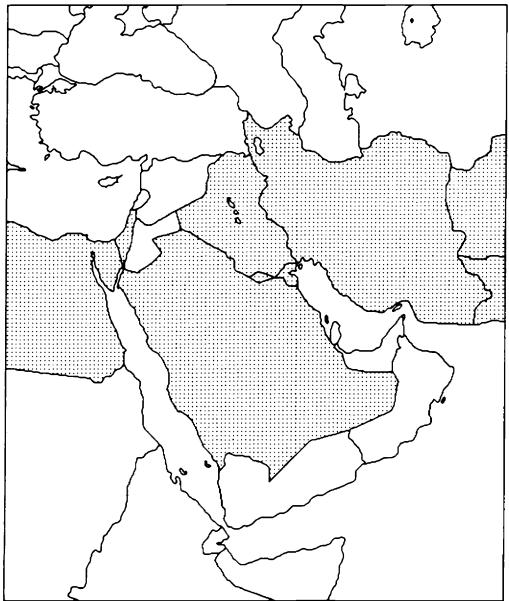


Figure 137. Geographic distribution of *Rumex vesicarius* L.

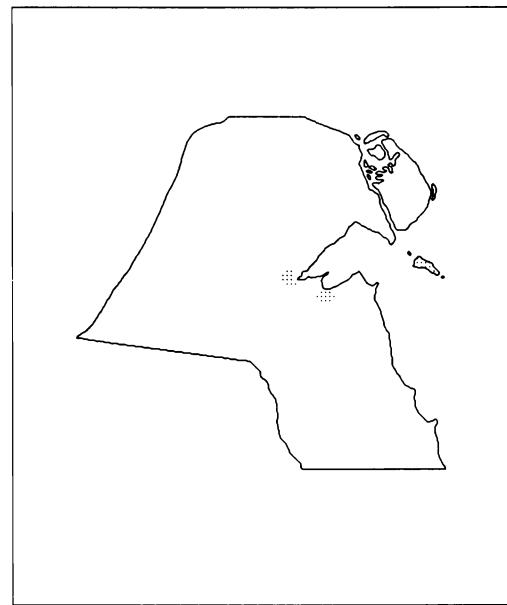
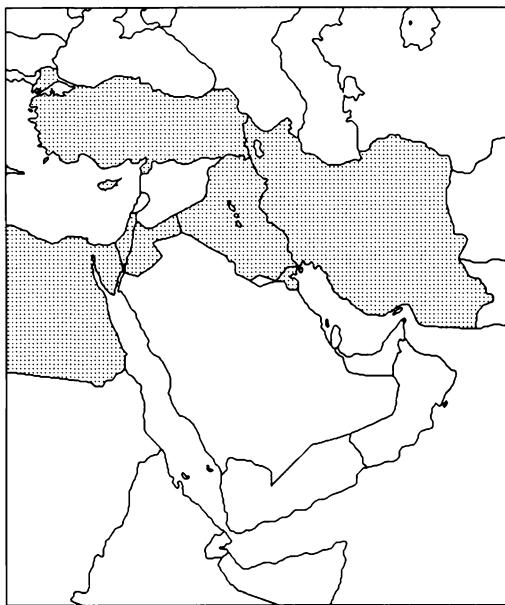


Figure 138. Geographic distribution of *Salicornia herbacea* L.

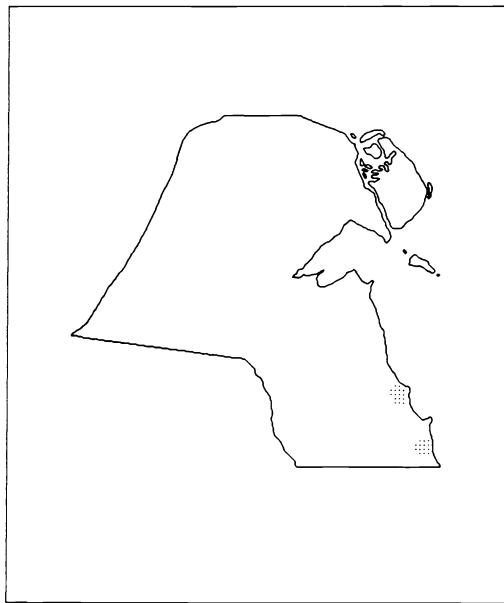
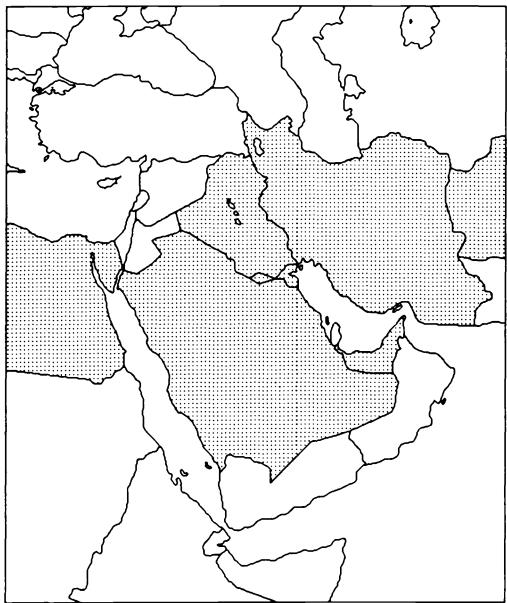


Figure 139. Geographic distribution of *Salsola baryosma* (Roem. & Schult.) Dandy.

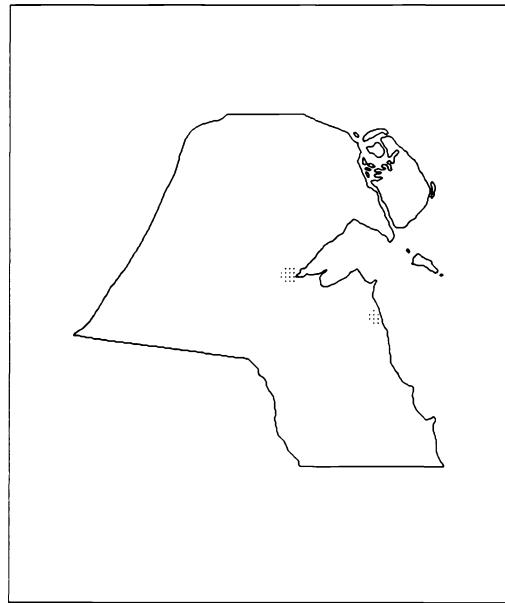
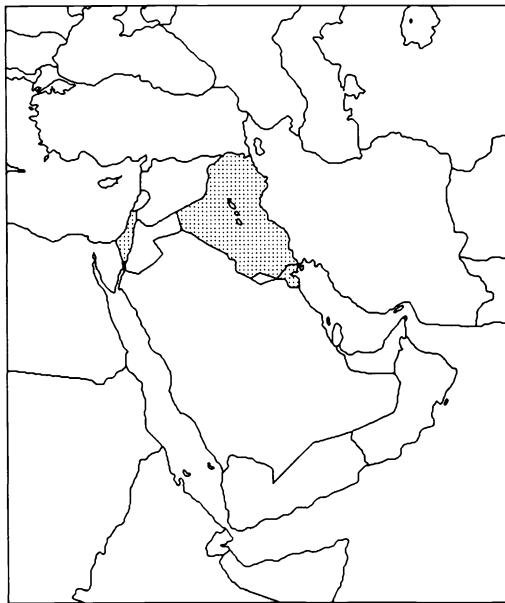


Figure 140. Geographic distribution of *Salsola jordanicola* Eig.

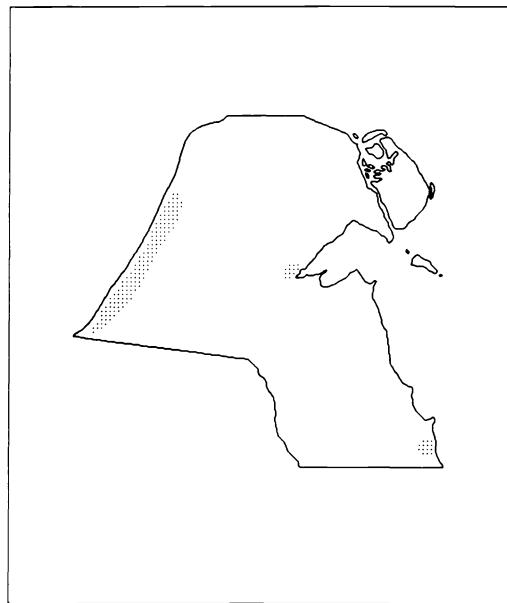
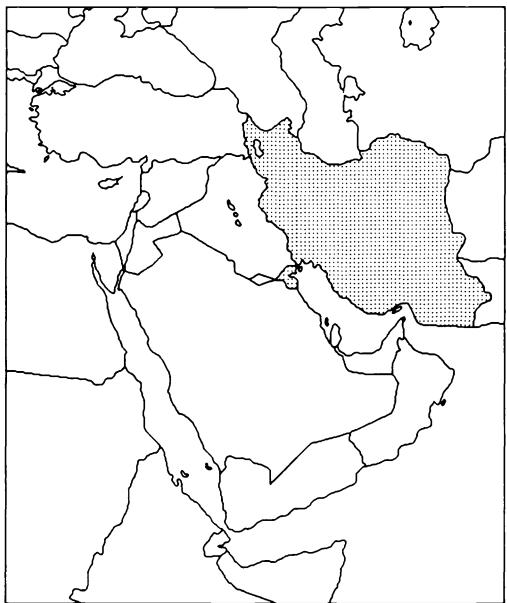


Figure 141. Geographic distribution of *Salvia lanigera* Poir.

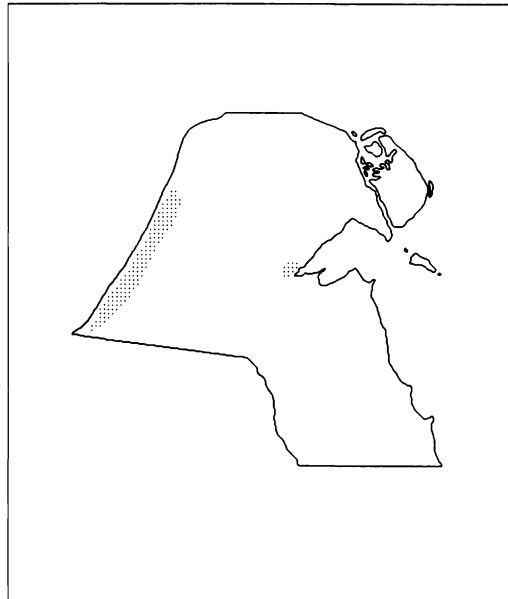
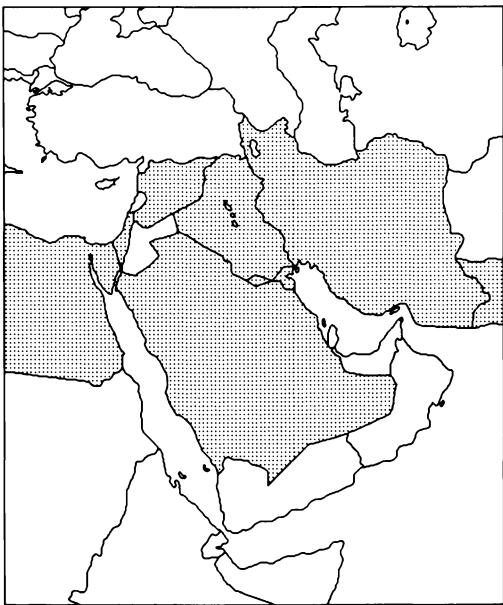


Figure 142. Geographic distribution of *Salvia spinosa* L.

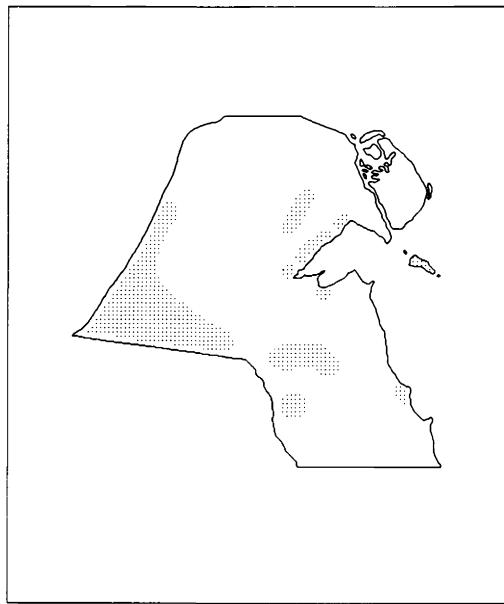
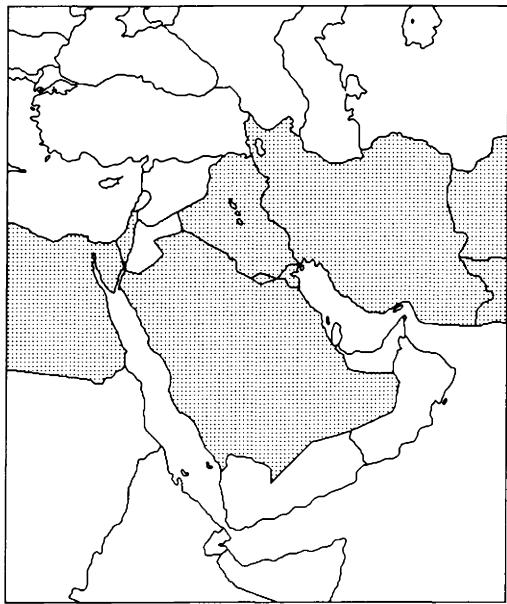


Figure 143. Geographic distribution of *Savignya parviflora* (Del.) Webb.

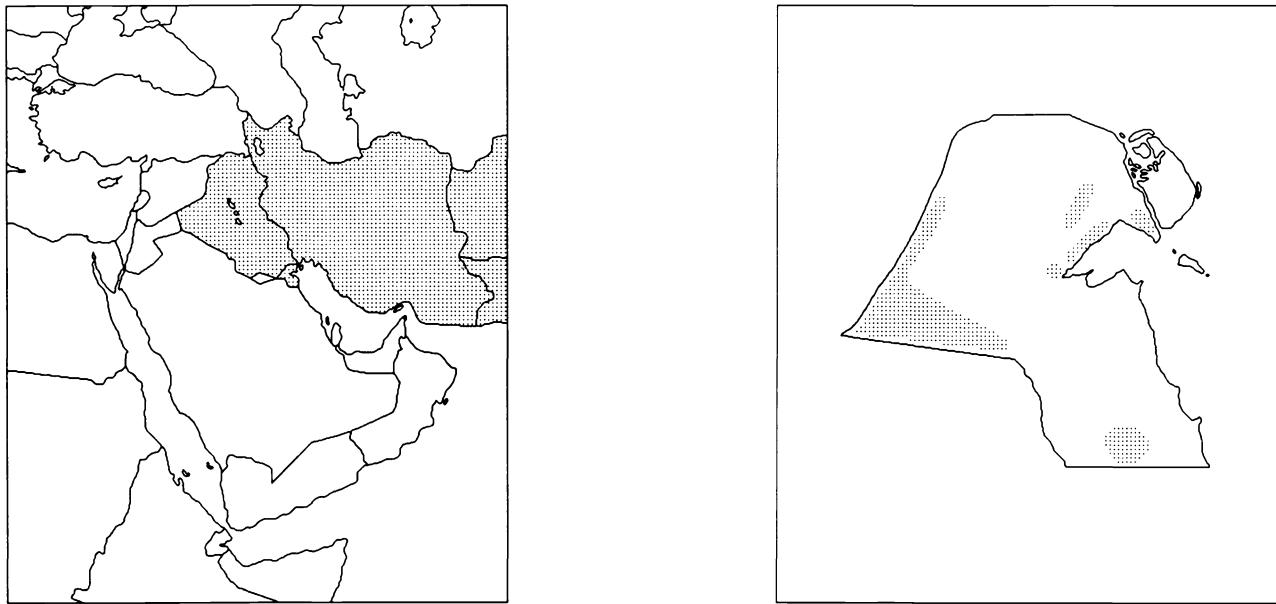


Figure 144. Geographic distribution of *Scabiosa olivieri* Coulter.

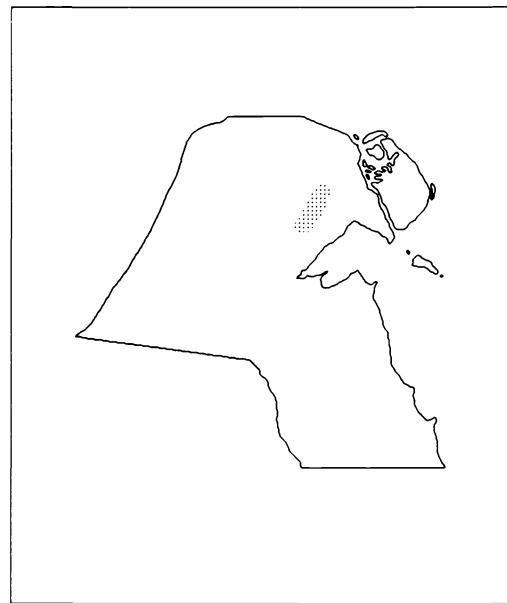
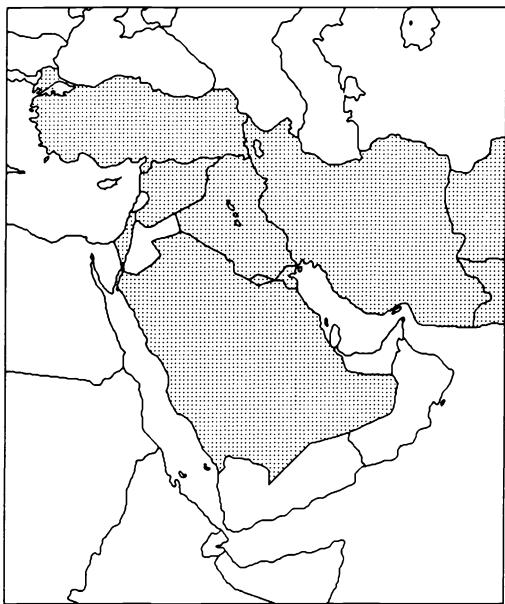


Figure 145. Geographic distribution of *Scabiosa palaestina* L.

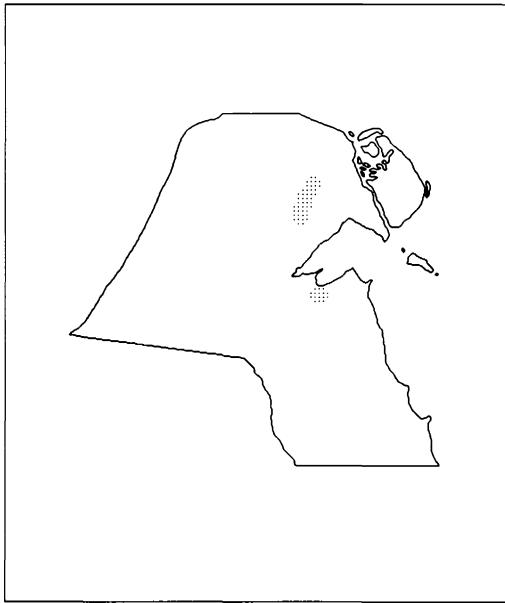
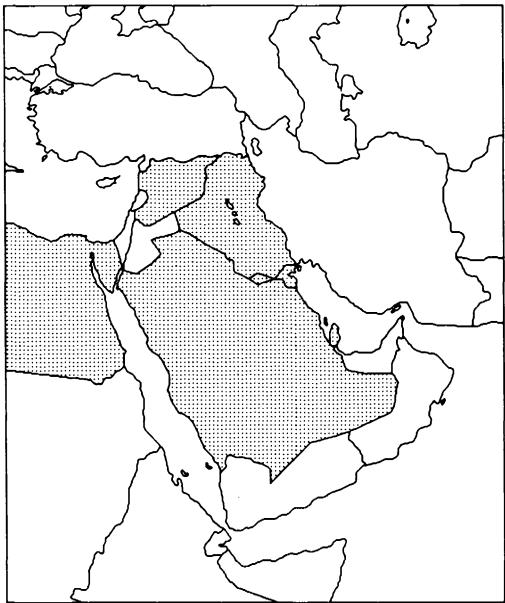


Figure 146. Geographic distribution of *Schanginia aegyptiaca* (Hasselq.) Aellen.

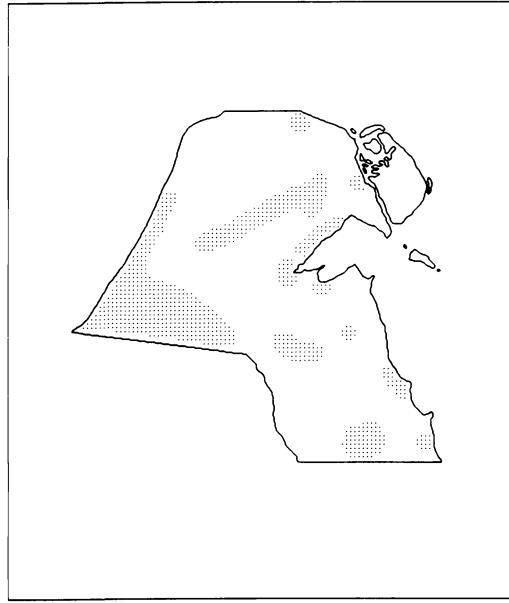
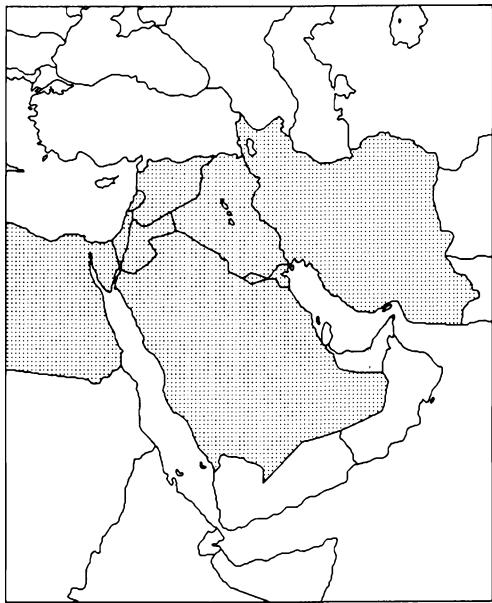


Figure 147. Geographic distribution of *Schimpera arabica* Hochst. & Steudel ex Boiss.

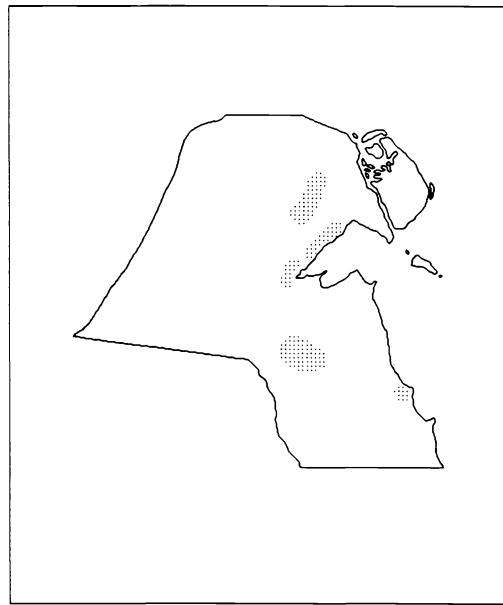
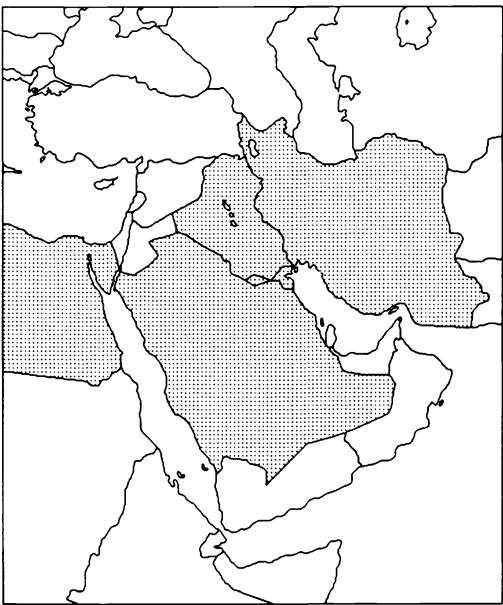


Figure 148. Geographic distribution of *Sclerocephalus arabicus* Boiss.

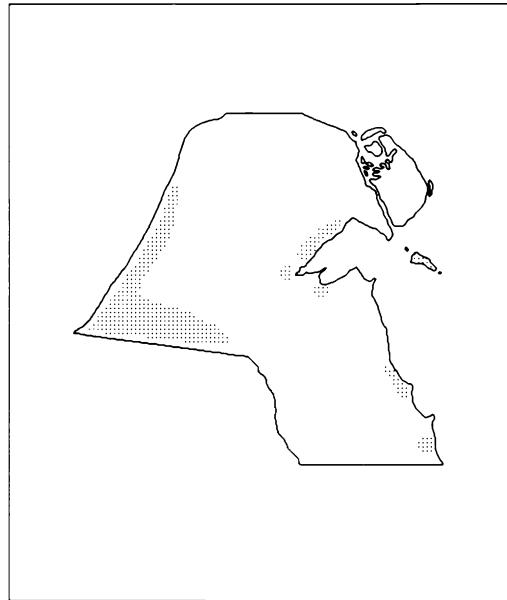
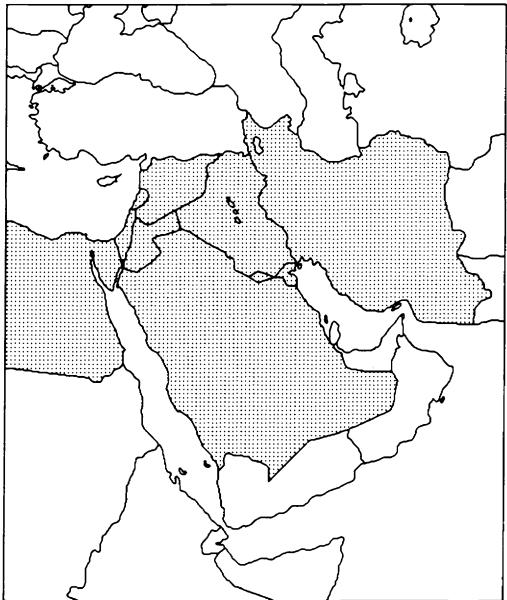


Figure 149. Geographic distribution of *Scrophularia deserti* Del.

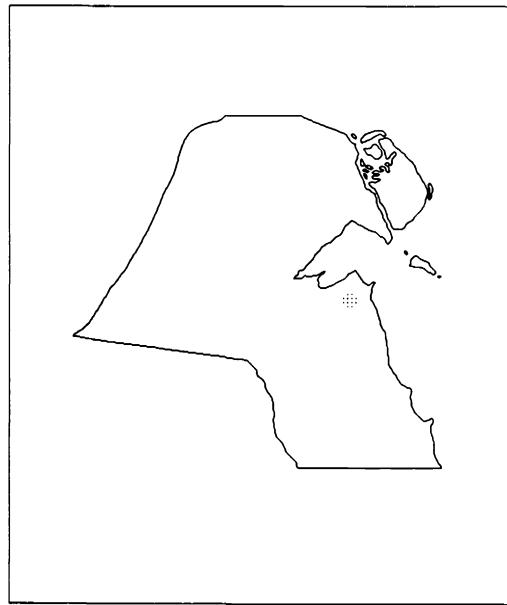
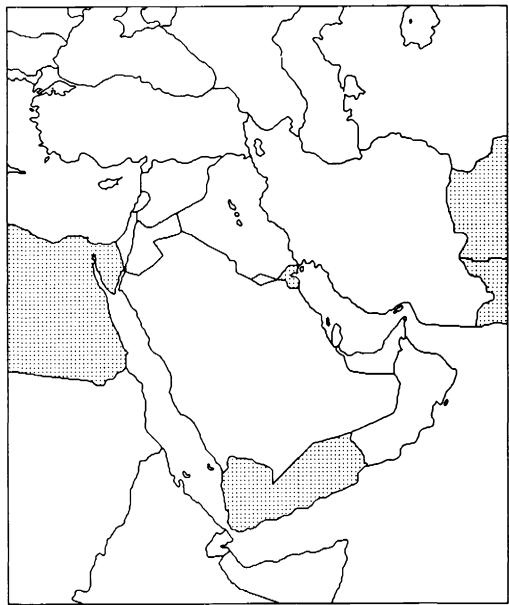


Figure 150. Geographic distribution of *Seetzenia orientalis* Decne.

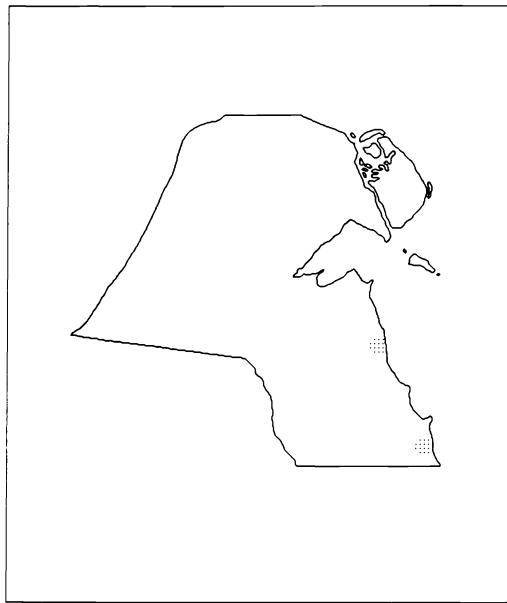
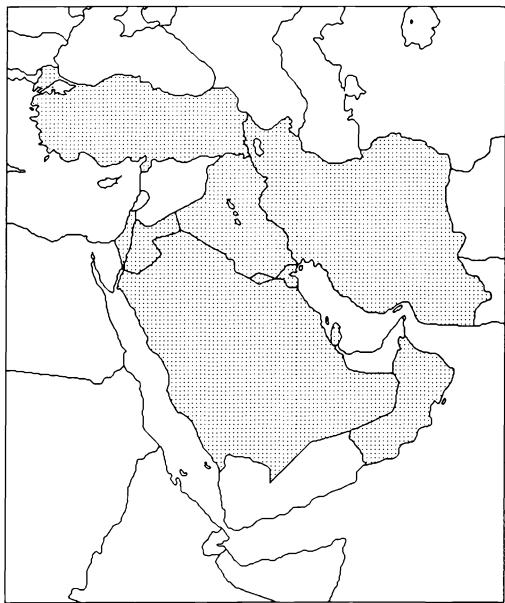


Figure 151. Geographic distribution of *Seidlitzia rosmarinus* Bunge ex Boiss.

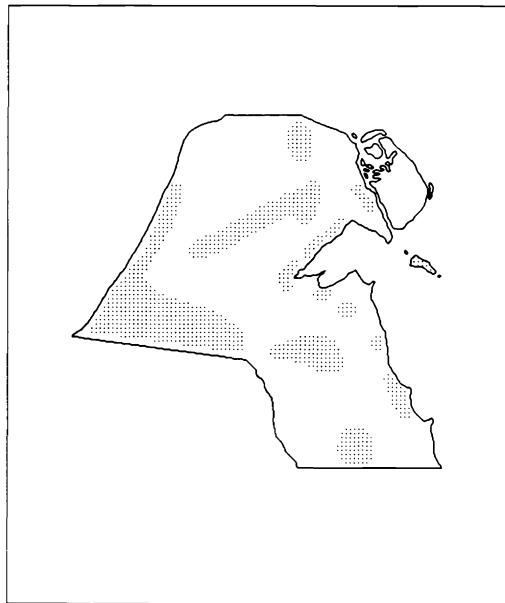
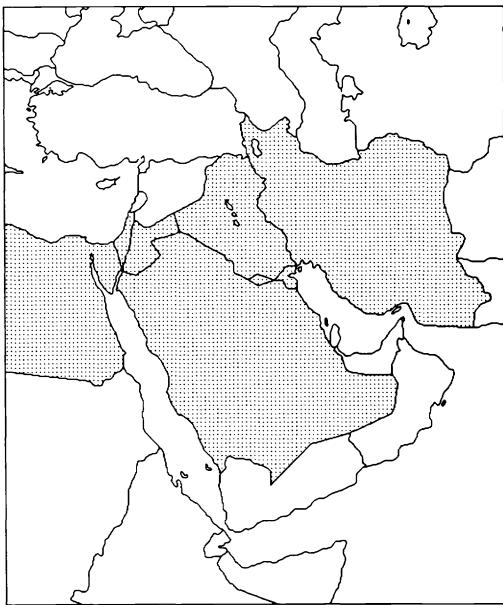


Figure 152. Geographic distribution of *Silene arabica* Boiss.

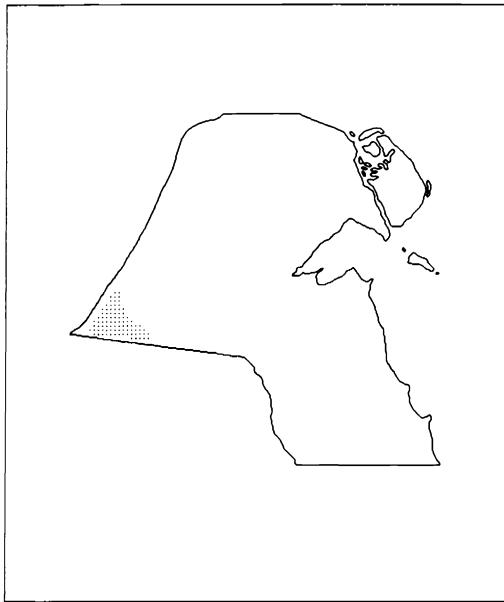
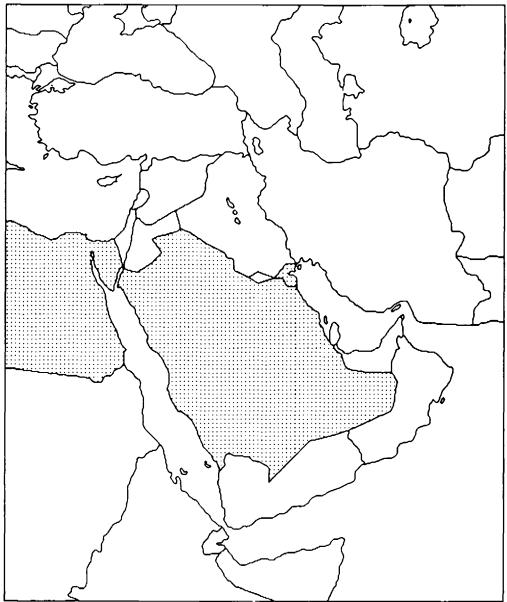


Figure 153. Geographic distribution of *Silene linearis* Decne.

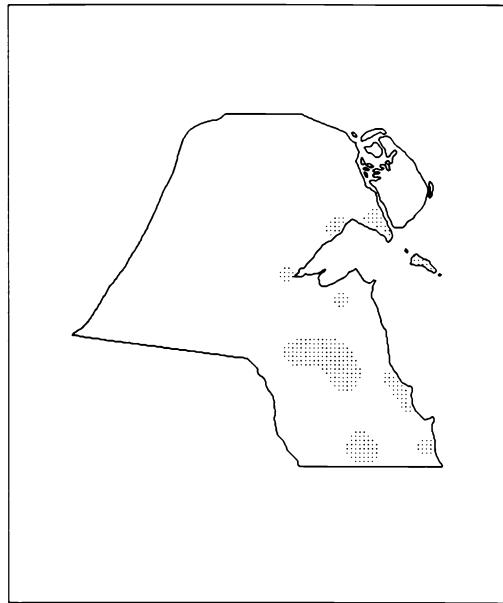
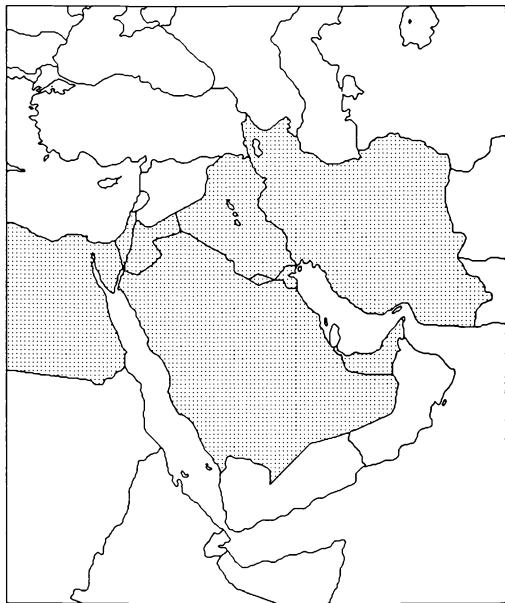


Figure 154. Geographic distribution of *Silene villosa* Forssk.

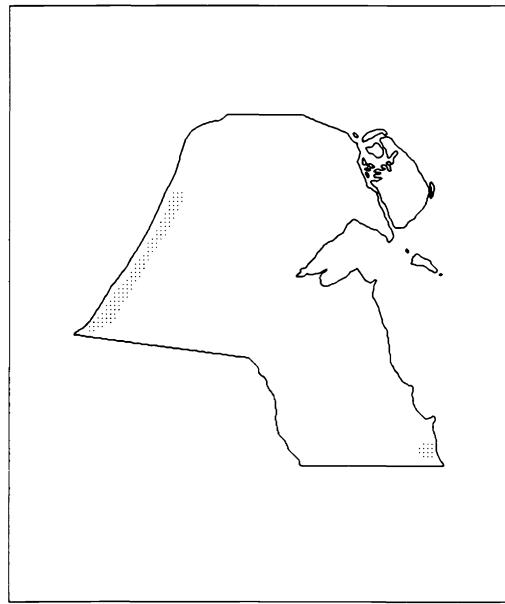
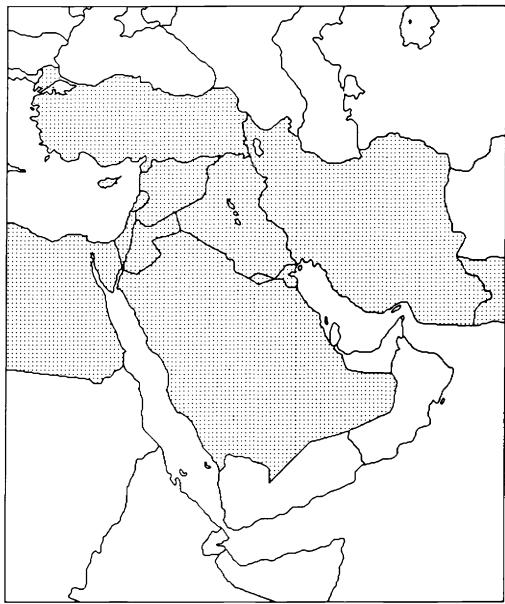


Figure 155. Geographic distribution of *Sisymbrium erysimoides* Desf.

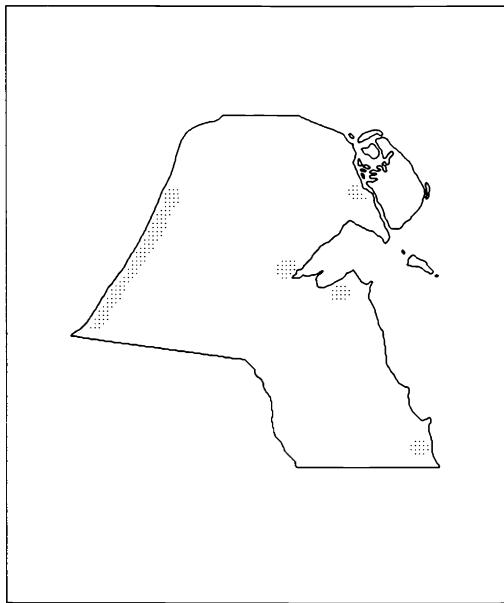
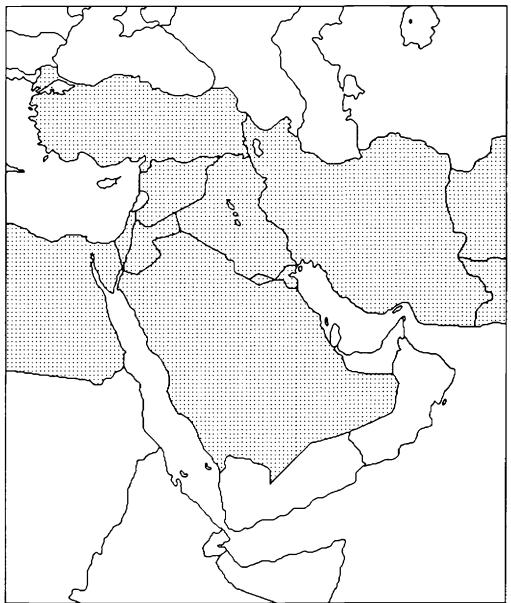


Figure 156. Geographic distribution of *Sisymbrium irio* L.

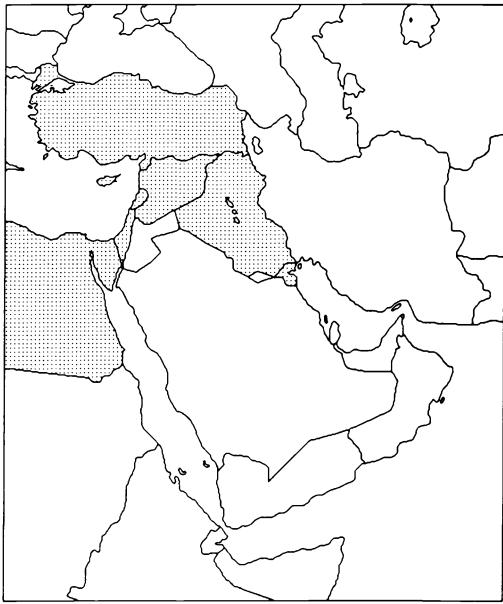


Figure 157. Geographic distribution of *Sisymbrium orientale* L.

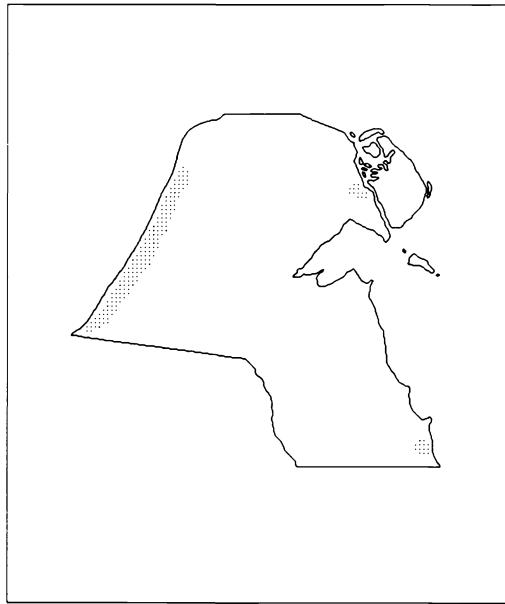
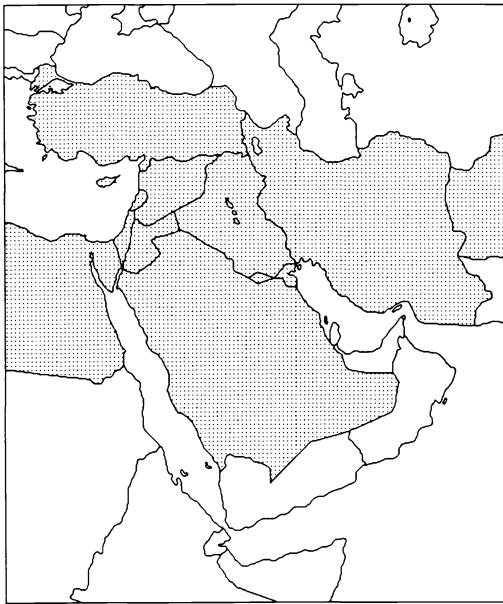


Figure 158. Geographic distribution of *Sisymbrium septulatum* DC.

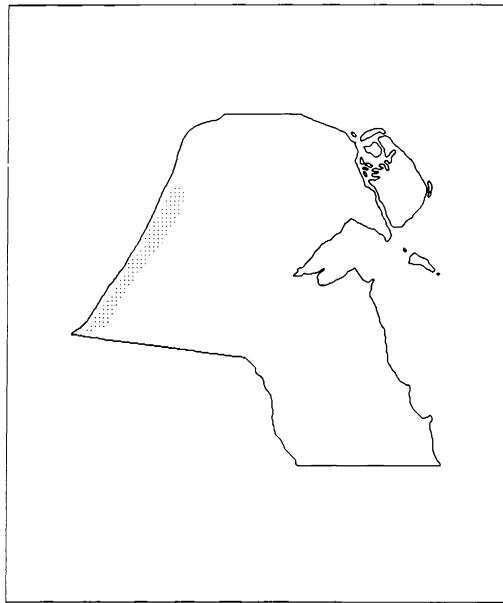
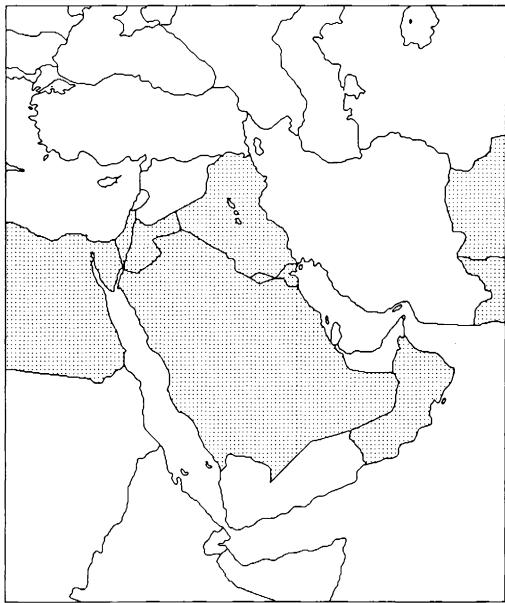


Figure 159. Geographic distribution of *Spergula fallax* (Lowe) Krause.

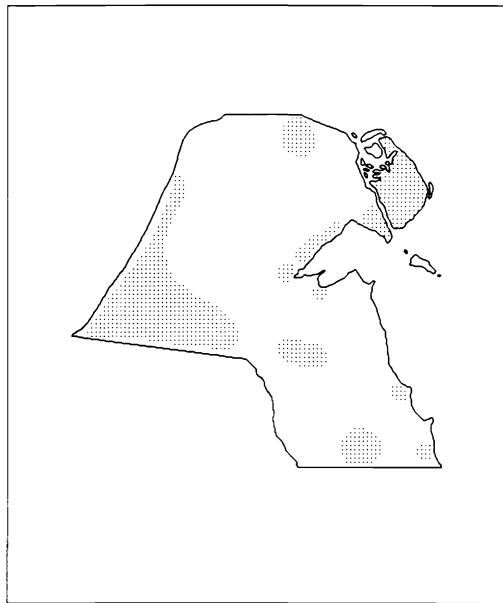
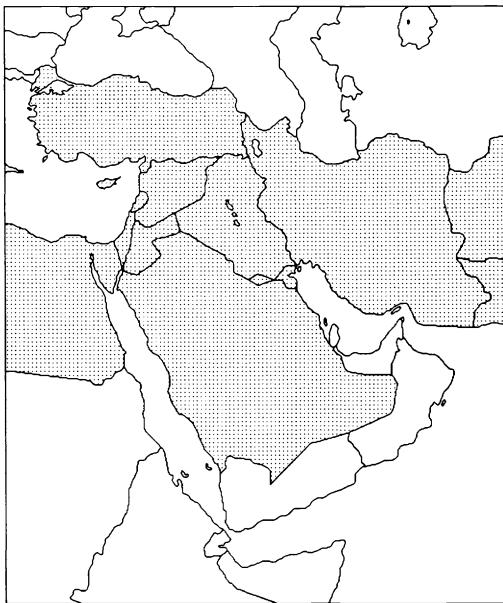


Figure 160. Geographic distribution of *Spergularia diandra* (Guss.) Heldr. & Sart.

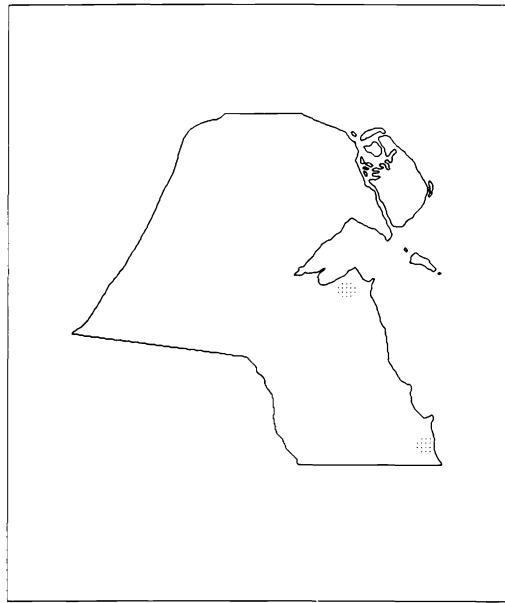
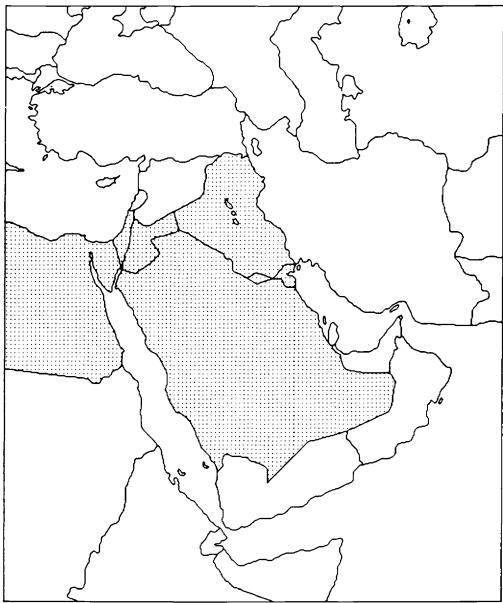


Figure 161. Geographic distribution of *Suaeda vermiculata* Forssk. ex J.F. Gmel.

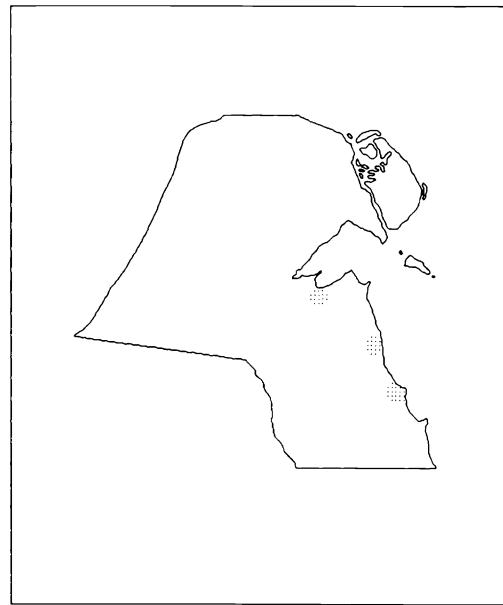
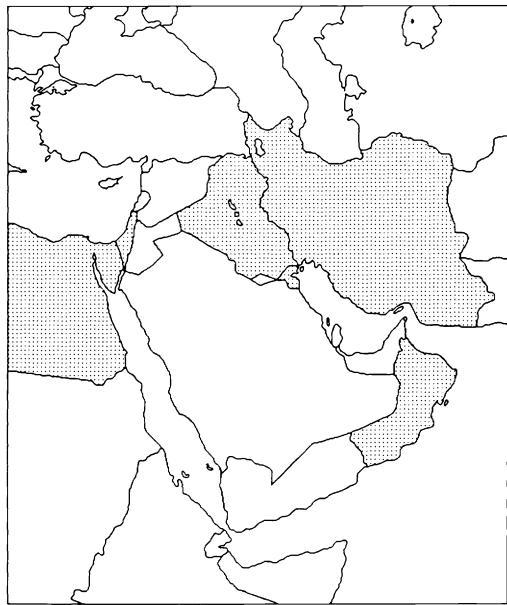


Figure 162. Geographic distribution of *Tamarix aucheriana* (Decne. ex Walp.) Baum.

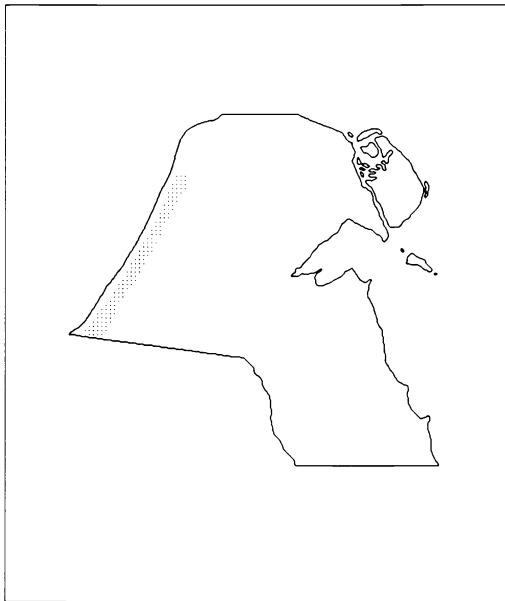
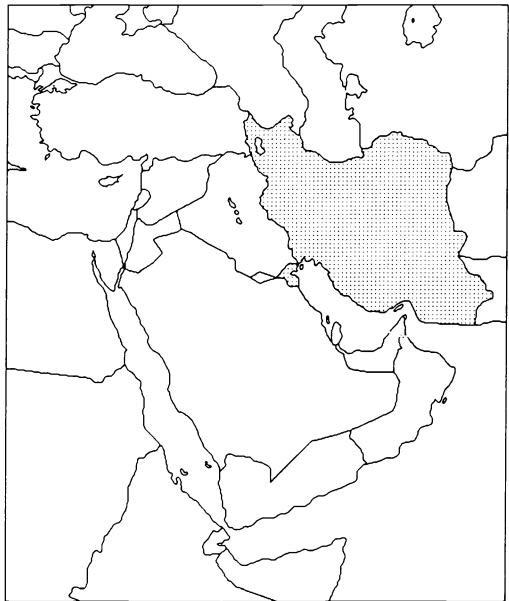


Figure 163. Geographic distribution of *Teucrium oliverianum* Ging. ex Benth.

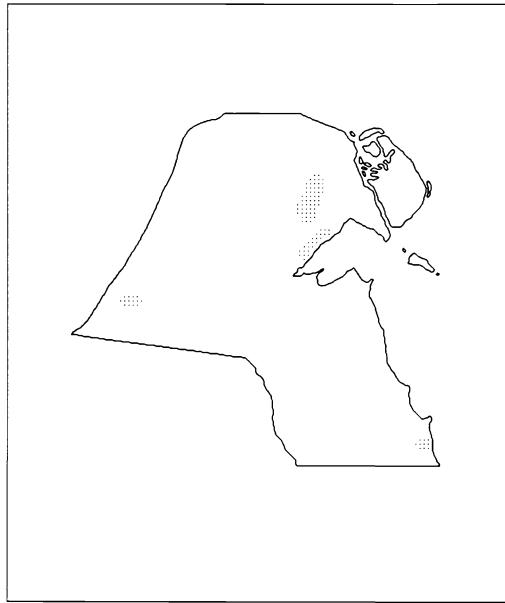
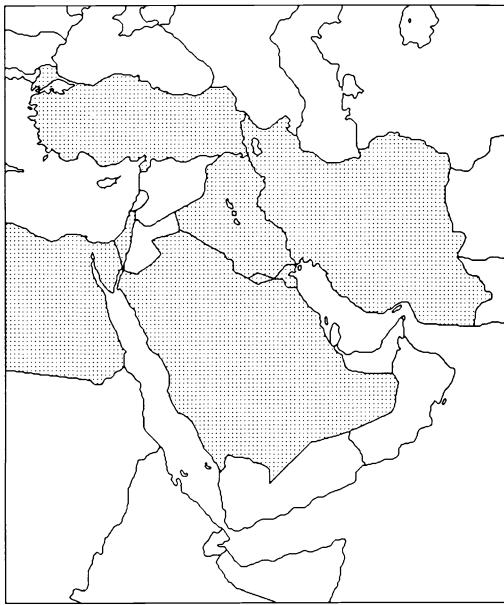


Figure 164. Geographic distribution of *Teucreum polium* L.

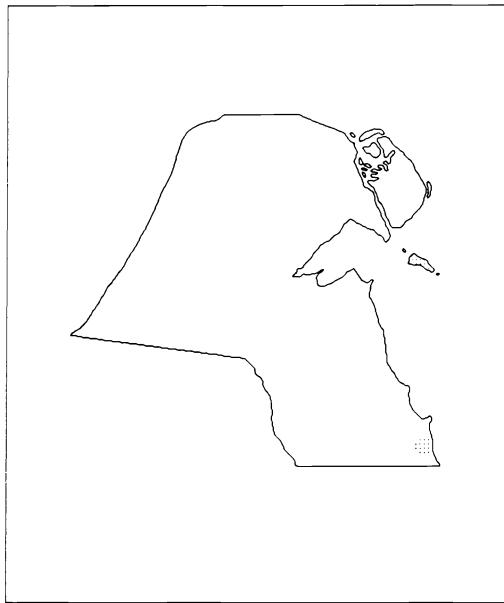
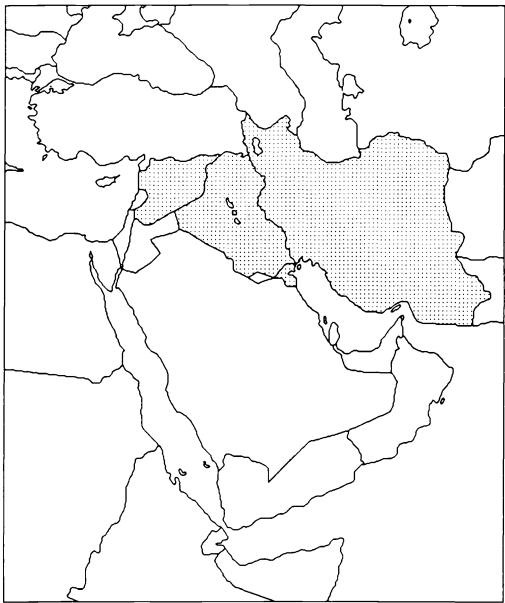


Figure 165. Geographic distribution of *Thymelaea mesopotamica* (C. Jeffrey) B. Peterson.

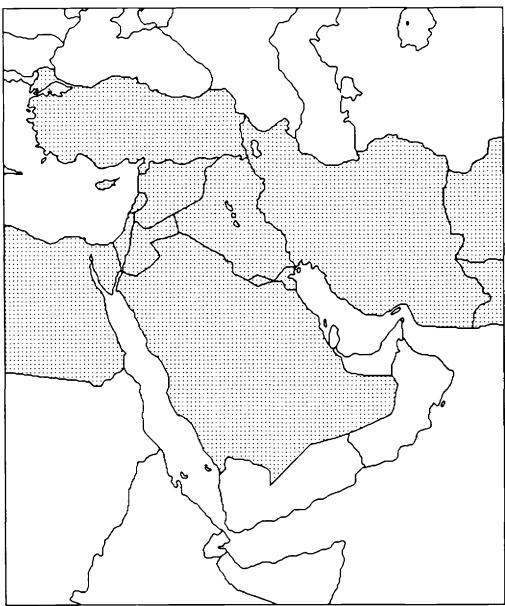


Figure 166. Geographic distribution of *Torularia torulosa* (Desf.) O.E. Schulz.

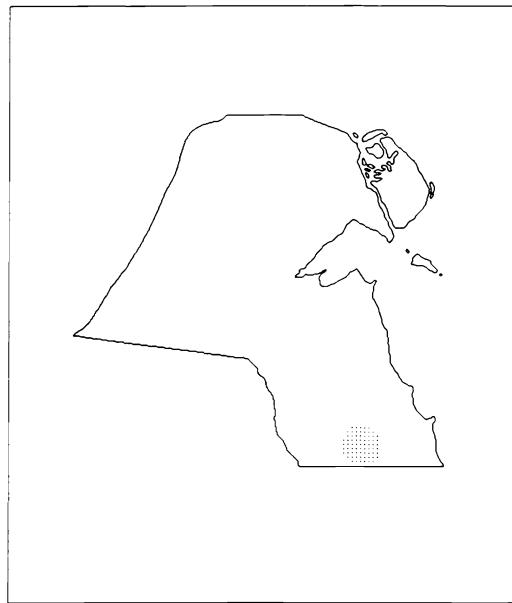
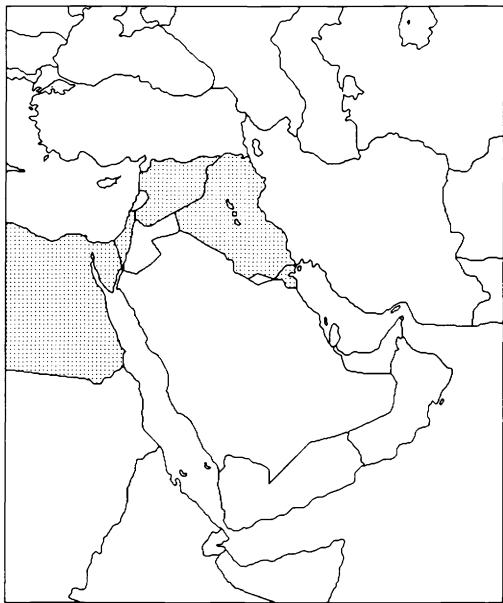


Figure 167. Geographic distribution of *Traganum nudatum* Del.

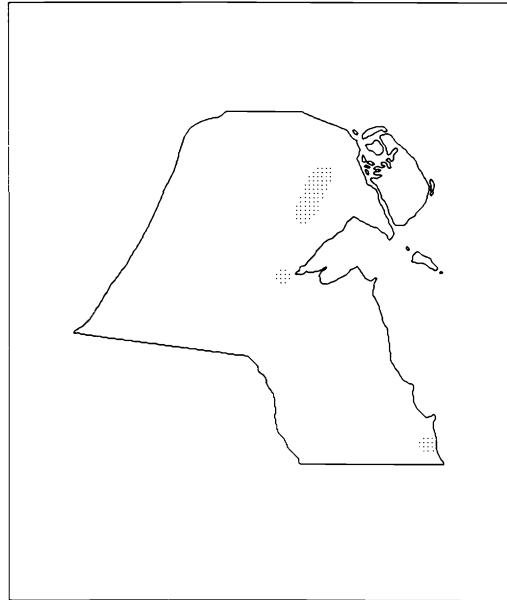
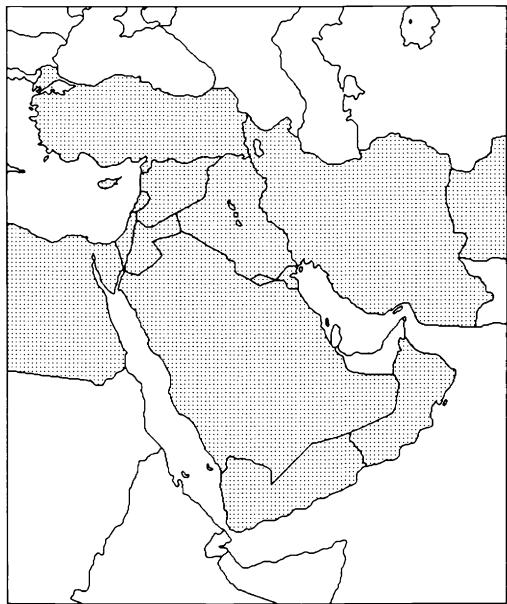


Figure 168. Geographic distribution of *Tribulus terrestris* L.

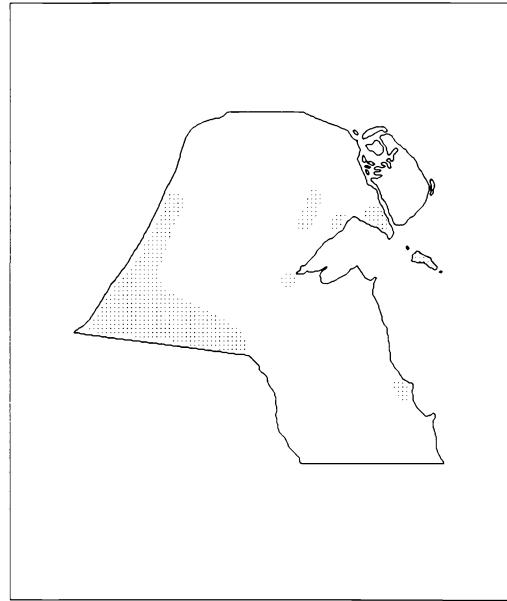
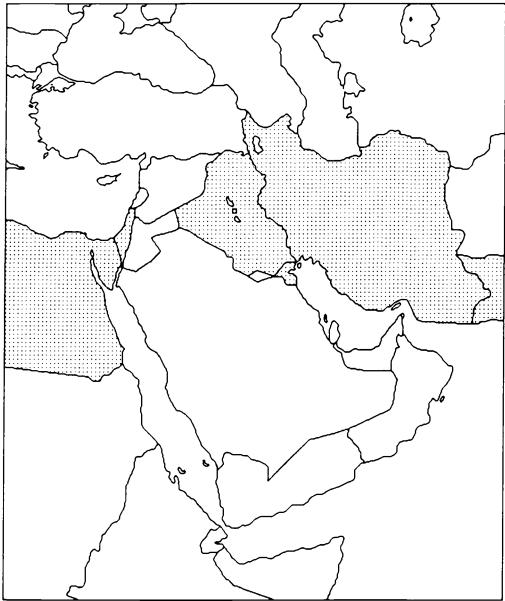


Figure 169. Geographic distribution of *Trigonella anguina* Del.

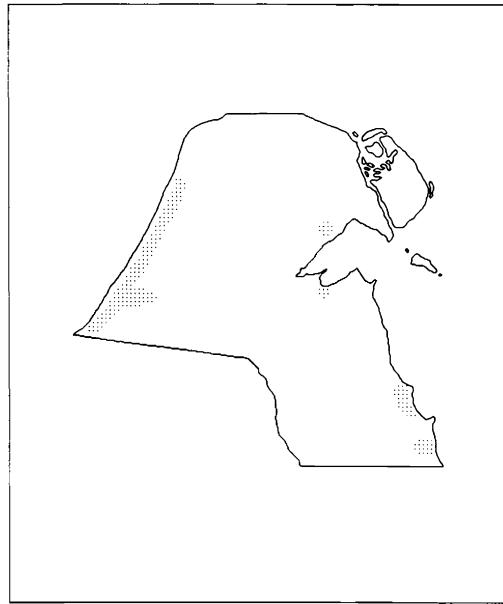
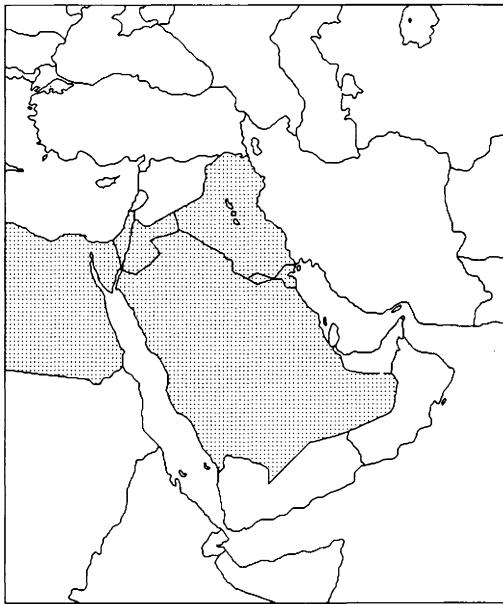


Figure 170. Geographic distribution of *Trigonella hamosa* Forssk.

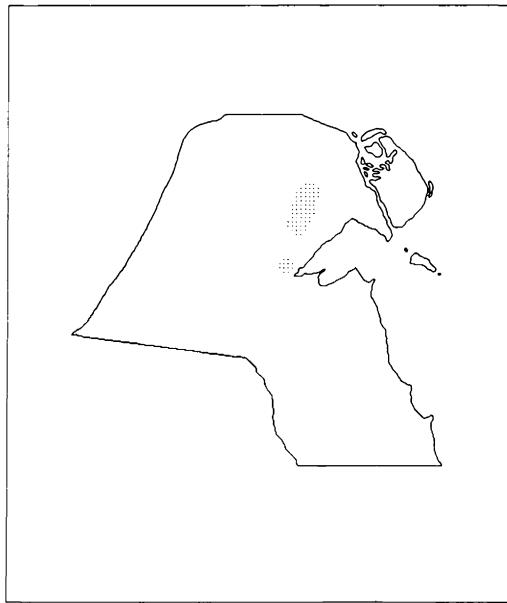
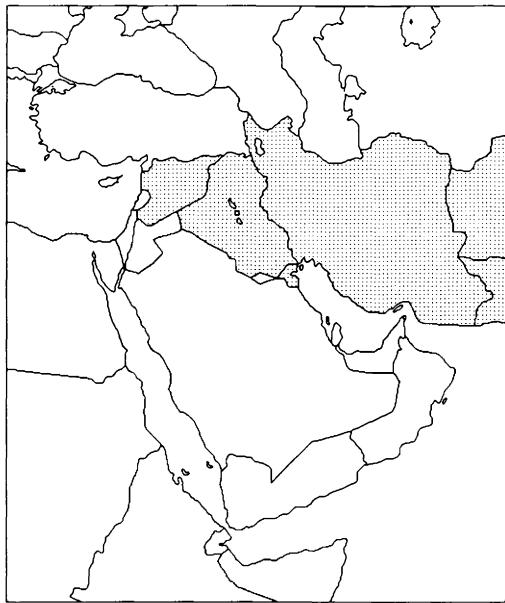


Figure 171. Geographic distribution of *Valerianella dufresnia* Bunge ex Boiss.

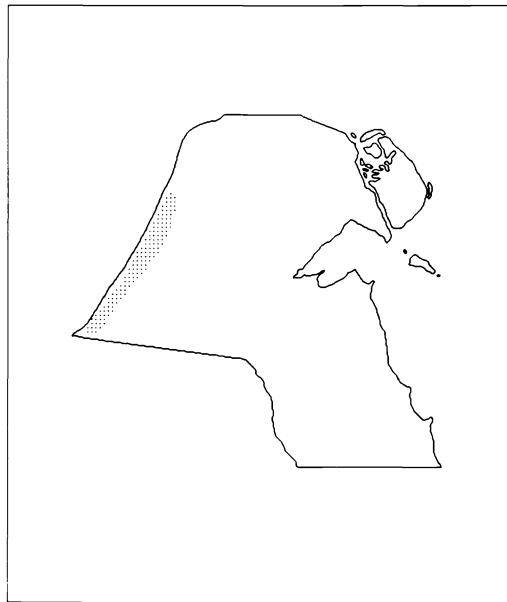
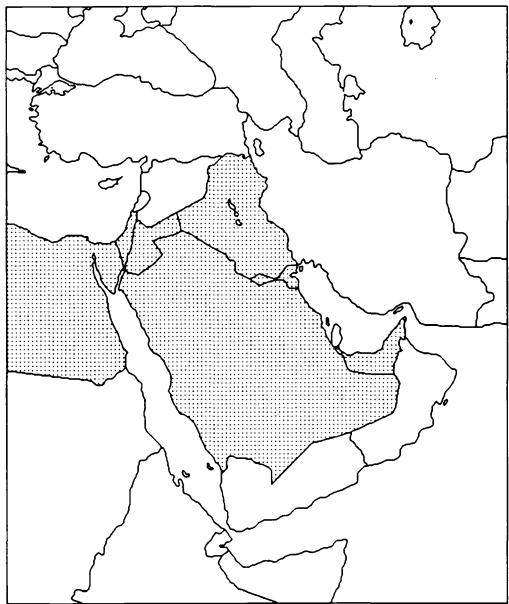


Figure 172. Geographic distribution of *Zilla spinosa* (L.) Prantl.

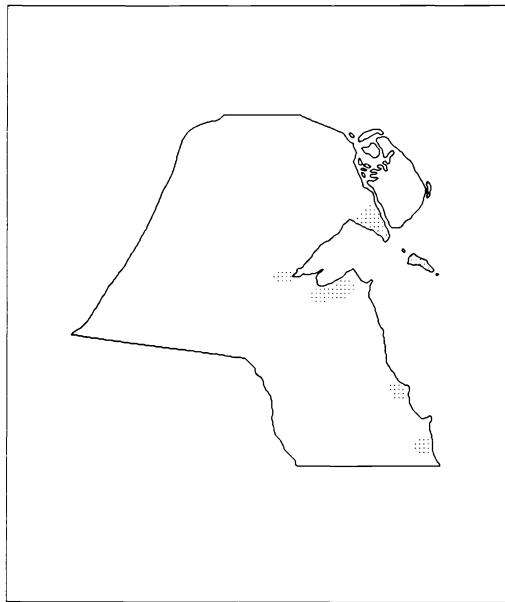
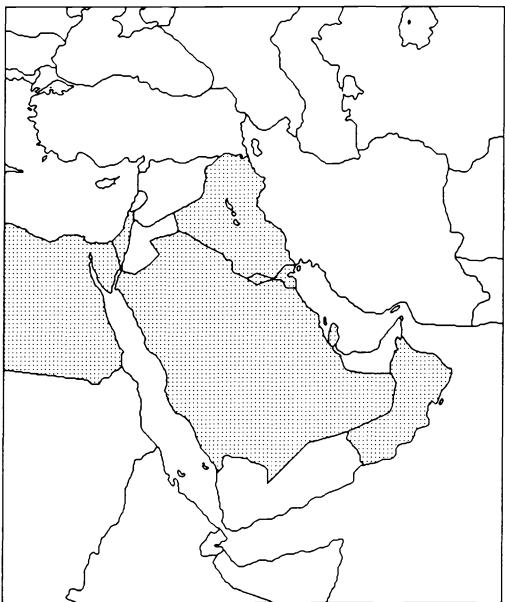


Figure 173. Geographic distribution of *Zygophyllum coccineum* L.

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ALPHABETICAL LIST OF FAMILIES AND GENERA

AIZOACEAE

Aizoon family

Aizoon
Mesembryanthemum

BORAGINACEAE

Borage family

Arnebia
Echium
Gastrocotyle
Heliotropium
Lappula
Lithospermum
Moltkiopsis

CARYOPHYLLACEAE

Pink family

Gypsophila
Herniaria
Loeflingia
Paronychia
Polycarpaea
Polycarpon
Pteranthus
Sclerocephalus
Silene
Spergula
Spergularia

CHENOPodiACEAE

Goosefoot family

Aellenia
Anabasis
Atriplex
Bassia

| | |
|--------------------|---------------------|
| <i>Bienertia</i> | |
| <i>Chenopodium</i> | |
| <i>Cornulaca</i> | |
| <i>Halocnemum</i> | |
| <i>Haloxylon</i> | |
| <i>Salicornia</i> | |
| <i>Salsola</i> | |
| <i>Schanginia</i> | |
| <i>Seidlitzia</i> | |
| <i>Suaeda</i> | |
| <i>Traganum</i> | |
| CISTACEAE | Rock-rose family |
| | <i>Helianthemum</i> |
| CONVOLVULACEAE | Convolvulus family |
| | <i>Convolvulus</i> |
| | <i>Cressa</i> |
| CRUCIFERAE | Mustard family |
| | <i>Anastatica</i> |
| | <i>Alyssum</i> |
| | <i>Brassica</i> |
| | <i>Cakile</i> |
| | <i>Carrichtera</i> |
| | <i>Diplotaxis</i> |
| | <i>Eruca</i> |
| | <i>Farsetia</i> |
| | <i>Horwoodia</i> |
| | <i>Lepidium</i> |
| | <i>Leptaleum</i> |
| | <i>Malcolmia</i> |
| | <i>Maresia</i> |
| | <i>Matthiola</i> |
| | <i>Notoceras</i> |
| | <i>Savignya</i> |
| | <i>Schimpera</i> |
| | <i>Sisymbrium</i> |
| | <i>Torularia</i> |
| | <i>Zilla</i> |
| CUCURBITACEAE | Gourd family |
| | <i>Citrullus</i> |

| | |
|---------------|---------------------|
| CUSCUTACEAE | Cuscuta family |
| | <i>Cuscuta</i> |
| CYNOMORIACEAE | Cynomorium family |
| | <i>Cynomorium</i> |
| DIPSACACEAE | Teasel family |
| | <i>Scabiosa</i> |
| EUPHORBIACEAE | Spurge family |
| | <i>Andrachne</i> |
| | <i>Chrozophora</i> |
| | <i>Euphorbia</i> |
| FRANKENIACEAE | Sea-heath family |
| | <i>Frankenia</i> |
| FUMARIACEAE | Fumitory family |
| | <i>Hypecoum</i> |
| GERANIACEAE | Crane's bill family |
| | <i>Erodium</i> |
| | <i>Monsonia</i> |
| LABIATAE | Mint family |
| | <i>Salvia</i> |
| | <i>Teucreum</i> |
| LEGUMINOSAE | Legume family |
| | <i>Alhagi</i> |
| | <i>Astragalus</i> |
| | <i>Hippocrepis</i> |
| | <i>Lotus</i> |
| | <i>Medicago</i> |
| | <i>Melilotus</i> |
| | <i>Onobrychis</i> |
| | <i>Ononis</i> |
| | <i>Trigonella</i> |

| | |
|-----------------------|-------------------|
| MALVACEAE | Mallow family |
| <i>Althaea</i> | |
| <i>Malva</i> | |
| NEURADACEAE | Neurada family |
| <i>Neurada</i> | |
| OROBANCHACEAE | Broomrape family |
| <i>Cistanche</i> | |
| <i>Orobanche</i> | |
| PAPAVERACEAE | Poppy family |
| <i>Roemeria</i> | |
| PLANTAGINACEAE | Plantain family |
| <i>Plantago</i> | |
| PLUMBAGINACEAE | Leadwort family |
| <i>Limonium</i> | |
| <i>Psylliostachys</i> | |
| POLYGONACEAE | Knotweed family |
| <i>Calligonum</i> | |
| <i>Emex</i> | |
| <i>Rumex</i> | |
| PRIMULACEAE | Primrose family |
| <i>Anagallis</i> | |
| RANUNCULACEAE | Buttercup family |
| <i>Adonis</i> | |
| RESEDACEAE | Mignonette family |
| <i>Caylusea</i> | |
| <i>Ochradenus</i> | |
| <i>Oligomeris</i> | |
| <i>Reseda</i> | |

| | |
|------------------|----------------------|
| RUBIACEAE | Madder family |
| | <i>Crucianella</i> |
| RUTACEAE | Rue family |
| | <i>Haplophyllum</i> |
| SCROPHULARIACEAE | Figwort family |
| | <i>Linaria</i> |
| | <i>Scrophularia</i> |
| SOLANACEAE | Nightshade family |
| | <i>Hyoscyamus</i> |
| | <i>Lycium</i> |
| TAMARICACEAE | Tamarisk family |
| | <i>Tamarix</i> |
| THYMELAEACEAE | Spurge-laurel family |
| | <i>Thymelaea</i> |
| UMBELLIFERAE | Parsley family |
| | <i>Ammi</i> |
| | <i>Anisosciadium</i> |
| | <i>Bupleurum</i> |
| | <i>Pituranthos</i> |
| VALERIANACEAE | Valerian family |
| | <i>Valerianella</i> |
| ZYGOPHYLLACEAE | Caltrops family |
| | <i>Nitraria</i> |
| | <i>Peganum</i> |
| | <i>Zygophyllum</i> |

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AUTHOR INDEX

- Abdalla, M.F. 82, 276
Abdel Bari, E.M. 24, 265
Abd El-Kawy, M.A. 39, 259
Abdel Khalek, S.M. 5, 268
Abdel-Moneim, F.M. 71, 259
Abdou, I.A. 32, 259
Abdulkarim, S.M. 32, 265
Abed, F.A. 39, 278
Abouamer, K. 39, 277, 278
Abou Donia, A.H. 53, 270
Abou-Donia, A.A. 71, 276
Abou-El-Gheat, Z.H. 32, 259
Abou-Zeid, A.A. 32, 259
Abrosimov, S.P. 82, 259
Abu-Mustafa, E.A. 5, 259, 273
Abu-Shady, H. 6, 271
Adaay, M.H. 60, 263
Adam, S.E.I. 24, 265
Afifi, M.S. 23, 277
Afza, N. 49, 260
Afzal, M. 11, 260
Agababyan, E.Yu. 2, 16, 37, 261, 273
Agarwal, R. 64, 269
Ahmad, F. 60, 260
Ahmad, I. 23, 60, 64, 71, 260, 269, 272
Ahmad, M. 22, 64, 269, 271, 281
Ahmad, M.U. 9, 51, 260
Ahmad, R. 5, 262
Ahmad, V.U. 33, 60, 260
Ahmad, Y. 49, 260
Ahmed, A.A. 60, 82, 260, 276
Ajabnoor, M.A. 38, 260
Akahori, Y. 17, 271
Al-Abdallah, M.M. 6, 269
Al-Badr, A.A. 3, 52, 58, 261
Al-Douri, N.A. 39, 260
Alhallaq, H.H. 39, 278
Al-Hazimi, H.M.G. 71, 260
Al-Hazimi, M.G. 71, 273
Alimbaeva, P.K. 8, 260, 273
Allard, C. 8, 278
Al-Meshai, I.A. 3, 52, 58, 261
Al-Nagdy, S.A. 33, 34, 260, 276
Al-Oriquat, G. 11, 260
Al-Rawi, A. 283
Al-Shamma, A. 39, 60, 260, 261
Al-Whaibi, M.H. 23, 263
Al-Yahya, M.A. 3, 10, 38, 52, 58, 61, 71, 260,
261
Amer, M. 67, 265
Amer, M.A. 38, 265
Amer, W.M.M. 67, 277
Amin, Gh. 2, 7, 9, 10, 12, 14, 19, 20, 23, 24, 26,
28, 35-37, 39, 40, 43, 44, 56, 61, 62, 64, 67,
71, 72, 75, 80, 82, 262
Amiryanova, G.M. 69, 275
Amoros, M. 8, 261
Andhiwal, C.K. 70, 261
Ankalgi, R.F. 82, 264
Anofrina, N.D. 81, 271
Ansari, A.A. 9, 260
Antonova, O.K. 5, 261
Arar, G. 44, 274
Aripova, S.F. 43, 261
Arsyukhina, N.N. 6, 277
Arutyunyan, L.S. 2, 16, 37, 261, 273
Asano, S. 16, 272
Ashirova, A.A. 6, 261
Ashkenazy, D. 61, 262
Ashour, A.S. 39, 278
Ashraf, M. 5, 262
Asif, M. 23, 71, 272
Askari, A.A.R. 67, 275
Assad, A.M. 71, 276
Atal, C.K. 6, 267
Atta, A.H. 39, 259

- Auterhoff, H. 23, 273
 Awad, A.H. 60, 276
 Aynehchi, Y. 2, 7, 9, 10, 12, 14, 19, 20, 23, 24,
 26, 28, 35-37, 39, 40, 43, 44, 56, 61, 62, 64,
 67, 71, 72, 75, 80, 82, 262
 Ayoub, M.T. 60, 263
 Ayoub, S.M.H. 23, 262, 280
 Aziz, P. 76, 270
 Bagby, M.O. 76, 264
 Baghdadi, H.H. 49, 263
 Bahrman, N. 20, 263
 Bajaj, R.K. 32, 263
 Balaci, P. 9, 264
 Balandrin, M.F. 31, 271
 Balbaa, S.I. 5, 6, 23, 263, 277
 Banerjee, C.K. 9, 270
 Banerji, R. 8, 263
 Baraka, A. 6, 269
 Baram, B.M. 32, 280
 Barbier, M. 17, 265
 Barclay, A.S. 36, 273
 Barnes, C.L. 71, 276
 Barron, D. 67, 277
 Basalah, M.O. 23, 263
 Batsuren, D. 60, 263
 Bauer, L. 53, 278
 Baykal, T. 5, 277
 Beg, M.U. 58, 263
 Bhargava, K.P. 8, 263
 Bhat, G.G. 26, 275
 Bhatnagar, R. 23, 263
 Bhattacharya, J. 17, 263
 Bhatty, M.K. 5, 60, 262, 269
 Bhushan, R. 23, 263
 Bhutani, S.P. 82, 264
 Bijlani, R.L. 63, 279
 Bilgir, B. 30, 264
 Billet, D. 8, 9, 268, 278
 Birza, E. 9, 264
 Bishay, D.W. 60, 276
 Bohannon, M.B. 51, 264
 Boraiah, G. 26, 279
 Botbaev, A.I. 60, 61, 264
 Boukhris, M. 31, 264
 Boulos, L. 283
 Bousquet, J.F. 17, 265
 Breckle, S.W. 72, 271
 Buchloh, G. 19, 270
 Buckova, A. 5, 6, 264, 265
 Budko, E. 30, 281
 Carr, M.E. 76, 264
 Cataldi Hiughez, C. 49, 267
 Chakravarti, D. 82, 272
 Chakravarti, R.N. 82, 272
 Challaiah 26, 279
 Chatterjee, A. 60, 264
 Chaudhuri, D.K. 17, 263
 Chaudry, A.H. 76, 275
 Chauhan, C.S. 32, 263
 Chauhan, H.V. 64, 274
 Chelliah, S. 83, 267
 Chen, R.-Y. 60, 280
 Cherif, A. 37, 281
 Cherkavskii, O.F. 27, 264
 Chernobai, N.Kh. 6, 267
 Chibber, S.S. 82, 264
 Chirkina, N.N. 20, 264
 Chirva, V.Ya 82, 270
 Chopra, A.K. 53, 267
 Ciulei, I. 9, 264
 Contz, O. 5, 279
 Coombes, A.J. 283
 Creedon, P.B. 38, 274
 Daghir, N.J. 23, 24, 277
 Danieli, N. 39, 271
 Daoud, H.S. 283
 Das, V.S.R. 23, 264
 Das Gupta, S.K. 17, 264
 Dastur, J.F. 283
 Daulatabad, C.D. 82, 264
 Dawidar, A.M. 38, 265
 Deep, M.S.H. 71, 260, 273
 Degtyareva, A.P. 20, 264
 Denikeeva, M.F. 82, 259
 Devdhara, V.D. 16, 273
 Devys, M. 17, 265
 Deyama, T. 22, 281
 Dhyani, H.K. 64, 274
 Dickson, V. 283
 Doctor, V.M. 64, 266
 Dolejs, L. 67, 278

- Dolya, V.S. 32, 52, 265
Drake, S. 60, 261
Drost, K. 82, 272
Dymock, W. 283

Earle, F.R. 36, 273
Egyed, M.N. 6, 61, 262, 278
Eilat, A. 6, 278
Eisenreichova, E. 5, 6, 264, 265
Elawad, A.A. 24, 265
El-Bay, F.K.A. 5, 259
El-Beih, F.K.H. 60, 265
El-Fishawy, A.M. 39, 259
Elgamal, M.H.A. 71, 259
El-Hadidi, M.N. 55, 67, 276, 277
El-Hakeem, L.M. 7, 265
El-Kashoury, E.A. 39, 259
El-Kashoury, S. 60, 61, 268
El-Khrisy, E.A.M. 6, 269
El-Lakany, A.M. 71, 276
Ellingwood, F. 283
El-Masry, S. 67, 71, 265, 276
El-Menshawi, B. 29, 280
El-Menshawi, B.Sh. 84, 269, 270
El-Merzabani, M. 29, 280
El-Missiry, M.M. 33, 276
El-Rayyess, N.R. 11, 266
El Sawy, A.A. 24, 278
El-Sayed, S.H. 49, 263
El-Sayyad, S. 19, 65
El-Sherbeeny, M.R. 32, 259
Elsherbiny, A. 5, 273
Elshtaiwi, B.Z. 39, 277, 278
Eshel, A. 61, 262
Evren, N. 5, 277
Ezmirly, S.T. 60, 269, 273

Fadel, H.M. 24, 278
Faizi, S. 60, 278
Farooqi, J.A. 23, 71, 272
Fauconnier, B. 8, 261
Fayez, M.B.E. 5, 71, 259
Felter, H.W. 283
Fiad, S. 5, 32, 265, 274
Fizz, K. 33, 260
Flanders, A. 32, 265
Flynn, D.L. 60, 261

Fomenko, K.P. 6, 266, 277
Fonin, V.S. 6, 277
Frantsev, A.P. 69, 275
Freyer, A.J. 44, 67, 265, 266, 274
Friedman, J. 6, 61, 262, 266
Frontera, M.A. 30, 272
Fursa, N.S. 52, 265

Gad, A.M. 24, 51, 268, 278
Ganguly, A.N. 82, 272
Ganguly, M. 60, 264
Garg, S.P. 23, 263, 266
Gasmelseed, G.A. 11, 266
Gelpi, E. 64, 266
Gerard, J. 283
Gahreman, A. 2, 10, 44, 67, 72, 75, 80, 82, 262
Ghazy, N.M. 71, 276
Gheorghiu, A. 82, 266
Gheorghiu, M. 5, 279
Gholam-Hoseiniyan, A. 61, 75, 276
Ghosh, A. 82, 272
Gill, S. 82, 266
Gindich, N.N. 6, 277
Girre, L. 8, 261
Girre, R.L. 8, 261
Glombitza, K.W. 8, 266
Glotter, E. 39, 271
Gmelin, R. 32, 266
Gnan, S.O. 39, 266
Golodner, D.N. 52, 265
Gorenflo, R. 20, 263
Goyal, S.C. 82, 273
Gozler, B. 67, 266
Gozler, T. 44, 67, 266, 273, 274
Gracz, H. 71, 276
Gray, A.I. 67, 275
Gribanovski-Sassu, O. 49, 267
Gromakova, A.I. 5, 267
Grover, S. 74, 274
Gryzlov, V.P. 6, 267
Gu, R.-Q. 17, 267
Guinaudeau, H. 67, 266
Gunasekaran, K. 83, 267
Gupta, B.K. 53, 267
Gupta, U. 23, 266
Gyulemetova, R. 82, 267, 279

- Habs, M. 24, 267
 Haggag, M.Y. 5, 6, 60, 61, 263, 267, 268
 Hagiwara, K. 9, 280
 Haglid, F. 38, 273
 Haladova, M. 5, 264
 Hamence, J.H. 32, 267
 Hammouda, F.M. 41, 276
 Han, B.H. 17, 267
 Han, Y.B. 17, 267
 Han, Y.N. 17, 267
 Handa, K.L. 6, 267
 Harborne, J.B. 5, 36, 268
 Harsh, M.L. 74, 274
 Hashimoto, S. 17, 269
 Hassan, M.M. 51, 268
 Hassan, M.M.A. 6, 60, 269, 271, 273
 Hassan, N.M. 41, 276
 Hatam, N.A.R. 23, 268
 Hayat, L.J. 11, 266
 Hedrick, U.P. 284
 Heitz, S. 8, 9, 268, 278
 Herting, D. 6, 278
 Hilal, S.H. 5, 6, 60, 61, 263, 267, 268
 Hogge, L.R. 16, 268
 Hondelmann, W. 32, 268
 Hooper, D. 283
 Horn, P.J. 17, 268
 Hoshi, T. 16, 268
 Hosoda, T. 16, 268
 Hosseiny, H.A. 41, 276
 Hsu, C.-C. 82, 269
 Hsu, H.-Y. 9, 280
 Hua, Y.-F. 17, 271
 Husain, S.K. 9, 51, 260
 Hussein, L. 73, 276
 Hussein, S.M. 23, 280
- Ibragimov, B.T. 60, 279
 Ibrahim, M.E. 6, 269
 Iguchi, K. 9, 280
 Iida, T. 16, 272
 Ilyas, M. 32, 280
 Ionescu-Matiu, E. 82, 266
 Ishikura, N. 9, 269
 Iskenderov, G.B. 82, 269
 Ismail, S.I. 41, 276
 Ismail, S.L. 73, 276
- Itoh, T. 16, 272
 Ivanov, Ch. 23, 281
 Ivie, G.W. 5, 6, 269
- Jacob, R.H. 54, 269
 Jado, A.I. 60, 269, 273
 Jahn, S.A.A. 24, 267
 Jamal, S. 64, 269
 Javed, M.A. 60, 269
 Jawan, O.A. 60, 273
 Jayaweera, D.M.A. 284
 Jay, M. 20, 263
 Jayyab, A.A.. 38, 260
 Jurenitsch, J. 42, 270
- Kabanov, V.S. 5, 267
 Kabisheva, T.Z. 69, 275
 Kabonov, V.S. 5, 261
 Kachukhashvili, T.N. 82, 275
 Kalyani, K. 26, 275
 Kameoka, H. 17, 269
 Kaminskii, N.A. 32, 52, 265
 Kanya, T.C.S. 32, 269
 Kapoor, R.C. 23, 263
 Karawya, M.S. 5, 84, 269, 270
 Kashman, Y. 61, 262
 Kawasaki, T. 82, 272
 Kemertelidze, E.P. 82, 275
 Kerber, E. 19, 270
 Kereselidze, E.V. 82, 275
 Khafagy, S.M. 53, 270
 Khaitov, I.Kh. 21, 270
 Khalid, S.A. 39, 270
 Khalil, A.A. 67, 275
 Khalil, J.K. 24, 277
 Khan, M.A. 60, 260
 Khan, M.A.J. 32, 270
 Khan, M.S.Y. 76, 270
 Khan, O.Y. 60, 278
 Khan, P. 23, 24, 277
 Khan, R.J. 32, 270
 Khan, S.A. 60, 71, 76, 269, 270, 272, 275
 Khanna, S.G.S. 9, 270
 Khashimov, Kh.N. 60, 270, 279, 281
 Khayyal, S.E. 5, 269
 Khazraji, A.T. 60, 263

- Khoshkhow, M. 7, 9, 12, 23, 24, 26, 36, 37, 56, 61, 75, 262
Khusein, S. 23, 281
Khusein, S.M. 23, 281
Kim, M.R. 17, 267
Kintya, P.K. 82, 270, 274, 275
Kishore, K. 70, 261
Kleiman, R. 51, 264
Klein, G. 42, 270
Klocke, J.A. 31, 271
Klyshev, L.K. 69, 275
Kobayashi, H. 22, 271
Kojima, M. 17, 271
Kokate, C.K. 32, 263
Kollmann, A. 17, 265
Kondo, H. 16, 271
Koreshchuk, K.E. 32, 52, 265
Kosakova, L. 5, 6, 265
Koshoev, K.K. 82, 259
Kosorukov, M.L. 81, 271
Kowalewski, Z. 82, 272
Kretsu, L.G. 82, 270
Krishchenko, V.P. 81, 271
Krishnan, P.S. 58, 263
Krivut, B.A. 6, 266
Kubelka, W. 42, 270
Kull, U. 72, 271
Kumar, P.R. 17, 19, 28, 32, 76, 81, 84, 271
Kurachko, K. 60, 271
Kurbanov, D. 60, 271
Kurth, H. 8, 266
- Lalwani, M. 82, 281
Lavie, D. 39, 271
Li, G.-W. 60, 271
Lin, Z.-K. 17, 271
Lipp, F.J., Jr. 284
Liu, D.-X. 60, 271
Liu, Z. 60, 280
Lloyd, J.U. 283
Loiselet, I. 17, 265
Loival, S.D. 9, 274
Lossaint, P. 31, 264
Loufty, M.A. 6, 271
Lutomski, J. 82, 272
- Mabberley, D.J. 284
Maeda, Y. 16, 280
Mahajan, C. 6, 272
Mahato, S.B. 82, 272
Mahmoud, O.M. 24, 265
Mahmoud, Z. 67, 265
Mahran, G. 29, 280
Maksoud, S.A. 67, 277
Malik, M.S. 71, 272
Mannan, A. 23, 71, 272
Manniche, L. 284
Mansouri, Sh. 61, 75, 276
Manzoor, A. 76, 275
Manzoor-i-Khuda, M. 49, 272
Markham, K.R. 67, 277
Markman, A.L. 32, 60, 271, 280
Masood, M. 68, 272
Mateescu, Th. 9, 264
Mathur, A.K. 8, 263
Mathur, G.S. 82, 273
Matsumoto, T. 16, 272
McKenzie, E. 60, 272
Medrano, M.A. 30, 272
Megalla, S.E. 60, 276
Melek, F.R. 5, 268
Melkumyan, Kh.A. 16, 37, 261, 273, 281
Meng, Z.-M. 27, 274
Meredov, K. 6, 261
Mete, I.E. 44, 67, 266, 273
Metwally, A.M. 49, 263
Miana, G.A. 71, 260, 273
Michel, K.H. 38, 273
Miettinen, T.A. 63, 273
Miller, A.G. 284
Miller, R.W. 36, 273
Millspaugh, C.F. 284
Minocha, P.K. 68, 272
Mishaal, A.S. 5, 273
Misra, G. 8, 263
Mitscher, L.A. 60, 261
Miyahara, K. 82, 272
Miyase, T. 22, 271
Mizuno, M. 27, 274
Mnatsakanyan, V.A. 2, 16, 37, 261, 273
Morris, M. 284
Mossa, J.S. 3, 52, 58, 261
Mueller, R. 23, 273
Muhammad, S. 23, 263

- Muhtadi, F.J. 60, 269, 273
 Mukhamedziev, M.M. 8, 260, 273
 Murthi, T.N. 16, 273
- Nag, T.N. 60, 74, 274, 278
 Nag, T.S. 82, 273
 Nahid, T. 60, 274
 Nakane, H. 27, 274
 Nandra, K.S. 53, 267
 Nasa, A.K. 82, 281
 Naumova, G.E. 6, 277
 Nawar, M.A. 5, 273
 Nene, Y.L. 9, 270
 Nesterov, N.N. 6, 277
 Nettleship, L. 60, 272, 274
 Nigam, S.K. 8, 263
 Nikitina, E.V. 60, 61, 264
 Nishioka, A. 16, 272
 Nofal, Z. 5, 273
 Norin, T. 38, 273
 Norula, J.L. 9, 274, 275
 Nowicki, B. 82, 272
 Nozaki, H. 16, 271
 Nyska, A. 61, 262
- Odell, G.V. 82, 269
 O'Donovan, D.G. 38, 274
 Oguchi, H. 22, 271
 Ono, K. 27, 274
 Ose, Y. 27, 274
 Osman, F. 5, 24, 32, 265, 274, 278
 Osman, S.M. 9, 51, 60, 64, 260, 269
 Ozawa, Y. 16, 280
- Pabuccuoglu, V. 44, 274
 Pal, B.C. 82, 272
 Pangarova, T. 82, 267, 279
 Panova, D. 82, 274, 279
 Park, K.-H. 16, 274
 Park, Y.H. 60, 261
 Patel, M.R. 64, 274
 Patel, R.B. 64, 274
 Patra, A. 67, 265
 Peet, R.L. 54, 269
 Peeva, S. 82, 267, 279
 Pellicciari, R. 49, 267
 Perel'son, M.E. 5, 267
- Perepelitsa, E.D. 82
 Perepelitsa, E.D. 82, 270, 274, 275
 Peterka, S. 16, 275
 Phillips, B.S. 76, 264
 Phillipson, J.D. 39, 67, 260, 275
 Pitre, S. 60, 275
 Pivnick, K.A. 16, 275
 Pkheidze, T.A. 82, 275
 Plekhanova, N.V. 60, 61, 264
 Poludennyi, L.V. 6, 277
 Popescu, V. 9, 264
 Prakash, D. 8, 263
 Prakash, S. 58, 263
 Pratov, U. 81, 271
 Prikhod'ko, L.S. 69, 275
 Purushothaman, K.K. 26, 275
- Qumehr, N. 12, 14, 19, 20, 28, 35, 39, 40, 43,
 56, 62, 64, 71, 262
 Qureshi, I.H. 49, 260
 Qureshi, M.I. 60, 269
- Radatz, W. 32, 268
 Radwan, A.S. 5, 268
 Rafique, M. 71, 272
 Rai, J. 68, 275
 Raie, M.Y. 76, 275
 Rakova, N.M. 69, 275
 Ramezanian, M. 61, 75, 276
 Rana, N.G. 64, 274
 Rao, G.S.R. 60, 261
 Rao, J.V.S. 23, 264
 Rao, K.B. 26, 275
 Rao, K.N. 23, 264
 Rao, P.R. 6, 267
 Rashan, L.J. 60, 263
 Rashkes, Ya.V. 60, 270
 Rastogi, J.N. 9, 274, 275
 Raszeja, W. 82, 266
 Rathore, Y.K.S. 68, 272, 279
 Raulais, D. 9, 268
 Reed, D.W. 16, 268, 275
 Rizk, A.M. 33, 34, 41, 73, 260, 276
 Roder, E. 41, 276
 Rodman, J.E. 18, 276
 Ross, S.A. 60, 276
 Rotar, A.I. 81, 271

- Rouxel, T. 17, 265
 Rushkin, E. 6, 266
 Rzadkowska-Bodalska, H. 30, 281
- Saad, S.F. 85, 276
 Sabahi, M. 61, 75, 276
 Saber, A.E.A.H. 85, 276
 Sabir, A.W. 76, 270
 Sabri, N.M. 71, 276
 Sabri, N.N. 53, 71, 270, 276
 Saeed, A. 29, 280
 Sahu, N.P. 82, 272
 Sakai, Y. 27, 274
 Sakri, F.A. 28, 280
 Salam, L.A.R. 71, 259
 Saleh, M.A. 7, 276
 Saleh, M.R.I. 71, 276
 Saleh, N.A.M. 55, 60, 67, 82, 276, 277
 Salem, G.A. 49, 263
 Salma 76, 270
 Sandberg, F. 38, 273, 277
 Sanson, D.R. 71, 276
 Sant'Ana, B.M.S. 53, 278
 Saraiva, N.C. de S. 53, 278
 Sarniguet, A. 17, 265
 Sattar, A. 71, 272
 Sawaya, W.N. 23, 24, 277
 Saxena, A.K. 8, 263
 Sayed, M.D. 23, 277
 Schlemper, E.O. 71, 276
 Schlosser, E. 16, 275
 Schlueter, M. 32, 266
 Schmaehl, D. 24, 267
 Schmidt, K. 82, 272
 Schneider, H. 64, 266
 Scott, P.M. 85, 276
 Seehuber, R. 32, 277
 Sener, B. 5, 277
 Seshadri, T.R. 82, 264
 Shabani, A. 7, 9, 12, 23, 24, 26, 36, 37, 56, 61, 75, 262
 Shamma, M. 44, 67, 265, 266, 274
 Shawl, A.S. 5, 277
 Shchelochkova, A.P. 82, 259
 Sheberstov, V.V. 6, 277
 Sheriha, G.M. 39, 266, 277, 278
 Shi, Y.-N. 60, 280
- Shigemoto, T. 16, 272
 Shimizu, N. 16, 272
 Shkurupii, E.N. 32, 265
 Shlosberg, A. 6, 61, 262, 278
 Siddhu, A. 63, 279
 Siddiqui, A.A. 82, 281
 Siddiqui, B.S. 60, 278
 Siddiqui, S. 60, 278
 Silva, G.A. de A.B. e 53, 278
 Simova, M. 82, 267, 279
 Simpson, A. 60, 261
 Singh, D. 60, 278
 Singh, M. 58, 263
 Singh, R.C.P. 83, 278
 Sinha, J.N. 8, 263
 Sinha, S. 51, 260
 Sisodia, C.S. 83, 278
 Skachkova, N.I. 83, 279
 Slavik, J. 67, 278
 Slavikova, L. 67, 278
 Slaytor, M. 60, 272, 274
 Soliman, F.M. 39, 60, 61, 259, 268
 Soliman, M.A. 24, 278
 Soltani, A. 12, 14, 19, 20, 28, 35, 39, 40, 43, 56, 62, 64, 71, 262
 Sormaghi, M.H.S. 2, 7, 9, 10, 12, 14, 19, 20, 23, 24, 26, 28, 35-37, 39, 40, 43, 44, 56, 61, 62, 64, 67, 71, 72, 75, 80, 82, 262
 Souka, L.M. 51, 268
 Srivastava, S.K. 60, 275
 Stahl, E. 6, 278
 Staron, T. 8, 278
 Sud, S. 63, 279
 Sultana, S. 49, 272
 Surendrajit, S.S.S. 74, 274
 Suzuki, K. 16, 280
 Suzuki, S. 9, 280
 Swayze, J.K. 60, 261
 Syamasundar, J. 26, 275, 279
 Sypula, A. 30, 281
- Takahasi, Y. 9, 280
 Takayama, M. 16, 280
 Takizawa, N. 22, 271, 281
 Tariq, M. 3, 38, 52, 58, 260, 261
 Tarpila, S. 63, 273
 Tarpo, E. 5, 279

- Tashkhodzhaev, B. 60, 279
 Taylor, D. 32, 267
 Telezhenetskaya, M.V. 60, 61, 263, 270, 279, 281
 Tempesta, M.S. 71, 276
 Tennison, J. 64, 266
 Tetyura, V.Kh. 27, 264
 Tewari, K.K. 58, 263
 Thakar, K.A. 68, 275
 Thapliyal, P.N. 9, 270
 Tiwari, A. 74, 274
 Tiwari, K.P. 68, 272, 279
 Tomas, M.A. 30, 272
 Tombesi, O.L. 82, 279
 Tomko, J. 5, 6, 265
 Tomova, M. 82, 267, 274, 279
 Tomova, M.P. 82, 279
 Tsunoda 17, 19, 28, 32, 76, 81, 84, 271
 Turova, A.D. 83, 279
 Uchida, M. 17, 271
 Uda, Y. 16, 280
 Ueno, A. 22, 271
 Umarov, A.U. 32, 60, 271, 280
 Underhill, E.W. 16, 268, 275
 Uphof, J.C.Th. 284
 Urazkov, I.U. 37, 280
 Urs, M.K. 32, 269
 Usmanghani, K. 22, 271, 281
 Usmani, J.N. 32, 280
 Valencia, E. 67, 265
 van Wagenen, B. 31, 271
 Vaughan, J.G. 17, 268
 Veysoglu, T. 60, 261
 Vishwapaul 5, 6, 272, 277
 von Reis, S. 284
 von Reis Altschul, S. 284
 Vul'fson, N.S. 82, 279
 Wagner, H. 19, 265
 Waller, G.R. 6, 266
 Warden, C.J.H. 283
 Wasiur, R. 32, 280
 Wassel, G. 29, 280
 Wassel, G.M. 84, 269, 270
 Waterman, P.G. 39, 270
 Weinert, E. 7, 28, 265, 280
 Weitman, R. 39, 271
 Whiting, D.A. 23, 268
 Wiedenfeld, H. 41, 276
 Williams, C.A. 5, 268
 Williams, T. 82, 269
 Wolff, I.A. 36, 273
 Wu, S.T.S. 60, 261
 Wu, Z.-L. 60, 280
 Yagudaev, M.R. 60, 279
 Yamada, Y. 9, 280
 Yamauchi, M. 16, 271
 Yang, S.-X. 60, 280
 Yankov, L.K. 23, 262, 280, 281
 Ying, B.-P. 60, 271
 Yoshizawa, F. 22, 281
 Yousif, N.J. 23, 268
 Youssef, G.F. 5, 269
 Yunusov, S.Yu. 60, 263
 Yusunov, S.Yu. 60, 61, 279, 281
 Yususov, S.Yu. 60, 270
 Zadnipryanyi, Yu.F. 81, 271
 Zafar, R. 82, 281
 Zaidi, Z.H. 60, 274
 Zamfiresw-Gheorghiu, M. 5, 279
 Zarkova, S. 82, 279
 Zarrouk, M. 37, 281
 Zhang, C.-X. 60, 280
 Zharekeev, B.Kh. 60, 271, 281
 Zheng, Q.-L. 60, 280
 Zhuravlev, Yu.P. 6, 277
 Zielinska-Jenczylik, J. 30, 281
 Zolotnitskaya, S.Ya. 16, 281

CHEMICAL NAME INDEX

- Acacetin 60
Acacetin 7-O-[rhamnosyl(1→4")-gluco-(1→6")-6'"-O-acetylsophoride] 60
Acetoside 22
(-)5-[2-(Acetoxy)-3-hydroxy-3-methylbutoxy]psoralen 5
2'-Acetylacetoside 22
16-O-Acetylhexanorcucurbitacin I 23
Aegyptinone A 71
Aegyptinone B 71
Alanine 60
dl-Alanine 64
Alloimperatorin 5
Allyl glucosinolate 16
Allyl isothiocyanate 16, 17
1-Allyl-4-methoxybenzene 17
Ammajin 5
Ammifurin 5
Ammirin 5
β-Amyrin 9, 84
Anabasine 38
Anagalligenin 9
Anagalligenone B 9
Anagalloside A 8
Anagalloside B 8
Anagallosided C 8
Apigenin 33
Apigenin 4-methyl ether 60
Apoatropine 43
Apohyoscine 43
Arabinose 9
L-Arabinose 60
Arachidic acid 23, 34, 71, 84
Arginine 23, 60
Arvenin I 9
Arvenin II 9
Arvenin III 9
Arvenin IV 9
Ascorbic acid 30, 74
Aspartic acid 60
Astragalin 82
Benz[a]anthracene 24
Benzo[b]fluoranthene 24
Benzo[j]fluoranthene 24
Benzo-1,2-pyrone 53
Benzo[a]pyrene 24
N-Benzoyl-4'-(2"S,3"S,6"S)-(+)-7"-acetoxy-2"-hydroxy-3",7"-dimethyl-3",6"-epoxy-octyloxy]phenethylamine 39
Benzyl isothiocyanate 17
Bergapten 5, 6, 61
Betaine 2, 38
Betaine hydrochloride 16
N,N'-Bis[(3-hydroxy-5-methyl)phenyl]oxamide 60
Bn-1 15
Bn-2 15
Bn-3 15
Brassicasterol 70
Brassilexin 17
3-Butenyl isothiocyanate 17
Butyl isothiocyanate 17
sec-Butyl isothiocyanate 17
Caffeic acid 16, 23
Campesterol 34, 70, 82
Capric acid 60, 71
β-Carotene 30, 49
Carvacrol 7
Chlorogenic acid 23
Chlorogenin 82
Chlorophyll b 49
Choline 23, 53
Citronellal 23
Citronellol 23

- Citrullonol 23
 Cnidilin 61
 Coptisine 67
 Coriolic 51
m-Coumaric acid 23
p-Coumaric acid 16
 Coumarin 53
 4-*O-p*-Coumaroyl- β -D-glucopyranoside 22
 Crysophanol 68
 Cucurbitacin B 9
 Cucurbitacin D 9
 Cucurbitacin E 9
 Cucurbitacin E glucoside 23
 Cucurbitacin I 9, 23
 Cucurbitacin I glucoside 23
 Cucurbitacin L 9, 23
 Cucurbitacin R 9
 Cyanidin 30
 Cyanidin 3-glucoside 30
 Cyanidin 3-rutinoside 30
 Cycloartenol 49
 Cyclobrassinin sulfoxide 17
 Cystine 68
 L-Cystine 64
 Deacetyl nemorone 71
 Deglucoanagalloside A 8
 Deglucoanagalloside B 8
 22-Dehydrocampesterol 16
 Dehydroconiferyl alcohol 22
 Dehydroniconiferyl alcohol 22
 6,7-Dehydroroyleanone 71
 6-Deoxycatalpol 22
 Deoxypeganidine 60
 Deoxypeganine 60
 Deoxyvascinone 60
 Diacetylroyleanone 71
 (+)-8,9-Dihydroisoromerinalinone 67
 (-)-11,12-Dihydroorientalinone 67
 Dihydroperfamine 39
 Dihydroruine 60
 3,6-Dihydroxy-8-methoxy-2-methylanthraquinone 60
 5,8-Dihydroxy-2-(14-methylpent-13-enyl)-1,4-naphthoquinone 11
 9,14-Dihydroxyoctadecanoic acid 60
 2-(3,4-Dihydroxyphenyl)ethyl *O*- α -L-rhamnopyranosyl-(1 \rightarrow 3)-2-*O*-acetyl-3-(1',1'-Dimethylallyl)-(3",3"-dimethylallyl)-1,2,3,4-tetrahydro-2,4-quinol-dione 39
 4-(3',3'-Dimethylallyloxy)-3-(3",3"-dimethylallyl)-2(1*H*)-quinoline 39
 10,13-Dimethylpentadec-13-en-1-al 23
 Dimethyl trisulfide 17
 Dioscin 82
 Diosgenin 49, 82
 Dipegine 60
 Diphyllin 39
 Dipterine 16
 Docosan-1-ol acetate 23
 Docosanol 23
 Docosenoic acid 17, 19, 28, 32, 36, 76, 84
 Dotriaccontane 23, 33
 Echidamine 29
 Echinacoside 22
 Eicosanol 23
 Eicosenoic acid 17, 19, 28, 32, 36, 76, 84
 Elateridine 23
 α -Elaterin 2-D-glucopyranoside 23
 Ellagic acid 33, 36
 Emodin 68
 8-Epilogganic acid 22
 (-)-Epoxyoleic acid 51
 13,28-Epoxy-16-oxooleanan-3 β ,23-diol 9
 cis-Epoxystearic acid 51
 trans-Epoxystearic acid 51
 Erucic acid 17, 32, 76
 24-Ethylcholesta-5,24-dien-3 β -ol 70
 Europine 41
 Evoxine 39
 γ -Fagarine 39
 Fagonin 34
 Ferulic acid 16, 23
 Flindersine 39
 Fructose 23
 Fucosterol 38
 Gadoleic acid 9
 D-Galactose 60
 D-Galacturonic acid 60

- Gallic acid 33
 Gentisic acid 2,5- β -diglucoside 60
 Gitogenin 82
 Glucoerucin 32
 2-O- β -D-Glucopyranosylcucurbitacin B 9
 2-O- β -D-Glucopyranosylcucurbitacin D 9
 2-O- β -D-Glucopyranosylcucurbitacin E 23
 2-O- β -D-Glucopyranosylcucurbitacin I 23
 2-O- β -D-Glucopyranosylcucurbitacin L 23
 2-O- β -D-Glucopyranosyl-23,24-dihydrocucurbitacin B 9
 10-C-Glucopyranosyl-1,8-dihydroxy-3-methylanthraquinone 68
 2-O- β -D-Glucopyranosyl-(22-27)-hexanorcucurbitacin I 23
 Glucose 9, 23
 D-Glucose 60
 Glutamic acid 23, 60, 64, 68
 Glycine 60, 64
 Goitrin 84
 Gossypetin 3-O- β -D-glucuronide-8-O- β -D-glucoside 67
 Gracillin 82
 Gypsogenic acid 3 β -O-glucuronide 42
 Gypsogenic acid 42
 Halosaline 38
 Haloxine 38
 Harmalacidine 60
 Harmalacinine 60
 Harmalanine 60
 Harmalicine 60
 Harmalidine 60
 Harmaline 60
 Harmalol 60
 Harman 82
 Harmine 60, 61, 82
 γ -Harmine 60
 Harmol 60, 82
 Hecogenin 82
 Heliotrine 41
 Hentriacontane 23, 33
 Heptacosane 23
 Heraclenin 5
 (-)-Heraclenin 5
 Herbacetin 67
 Hexadecanol 23
 Hexacosane 9
 Hexacosanol 23, 34
 Hexadecadienoic acid 23
 Hexadecanoic acid 23, 72
 Hexanorcucurbitacin I 23
 Histidine 23, 60, 68
 p-Hydroxybenzoic acid 16, 23
 2-Hydroxybut-3-enyl glucosinolate 17
 14-Hydroxy-6,7-dehydrocarnosolic acid 71
 14-Hydroxy-10,14-dimethylhexadecan-2-one 23
 14-Hydroxy-11,14-dimethylhexadecan-2-one 23
 20-Hydroxyecdysone 22
 8-Hydroxygeraniol 22
 8-Hydroxyharmine β -D-glucoside 60
 16 α -Hydroxymedicagenic acid 42
 8-Hydroxy-7-methoxy-2-methylanthraquinone 60
 cis-9-Hydroxyoctadec-12-enoic acid 64
 3 β -Hydroxyoleanan-13 β -28-lactone 71
 3-Hydroxy-9-(2-oxopropyl)pyrrolidino-[2,1-*b*]quinazoline 60
 L-(-)-4-Hydroxypipeolic acid 60
 7 β -Hydroxyroyleanone 71
 5-Hydroxytryptamine 60
 Hyoscine 43
 Hyoscyamine 43
 Imperatorin 5, 6, 61
 Inositol 23
 Isobergapten 61
 Isocarnosol 71
 (-)-Isocorypalmine 67
 Isoimperatorin 5, 61
 (-)-Isoorientalinone 67
 Isopeganidine 60
 Isopimpinellin 5, 61
 Isopropyl isothiocyanate 17
 Isoquerectin 5
 Isoquercitrin 19
 Isorhamnetin 16, 32, 36, 55, 76, 82
 Isorhamnetin 3-p-coumaroylglycoside 82
 Isorhamnetin 3,7-diglucoside 82
 Isorhamnetin 3-gentiobioside 82
 Isorhamnetin 3-gentiobioside-7-glucoside 82
 Isorhamnetin 3-gentiotrioside 82

- Isorhamnetin 3-glucoside 32, 82
 Isorhamnetin 3-O- β -D-glucoside 2
 Isorhamnetin 3-rutinoside 82
 (-)-Isoroemeralinone 67
 Isoschaftoside 67

 Justicidin A 39
 Justicidin B 39

 Kaempferol 9, 16, 19, 36, 82
 Kaempferol 3-p-coumaroylglicoside 82
 Kaempferol 3-gentiobioside 82
 Kaempferol 3-gentiobioside-7-glucoside 82
 Kaempferol 3-glucoside 82
 Kaempferol 7-O-glucoside 5
 Kaempferol 3-O- β -D-glucuronide 19
 Kaempferol 3-rutinoside 82
 Kaempferol 3-rutinoside 82
 Khellin 5
 Kryptogenin 60
 Kusunokinin 39

 (-)-Labrandine 67
 Laceric acid 9
 Lanosterol 49, 60
 Lauric acid 23, 60, 84
 Leucine 60
 Lignoceric acid 34
 Linoleic acid 9, 17, 19, 23, 28, 32, 34, 36, 37,
 52, 60, 64, 71, 76, 81, 82, 84
 Linolenic acid 9, 17, 19, 28, 32, 34, 36, 37, 52,
 60, 72, 76, 81, 84
 γ -Linolenic acid 36
 Liriodendrin 22
 Lupeol 33
 Lupeol acetate 33
 Lutein 49
 Luteolin 5, 9, 66
 Luteolin 7-glucoside 9
 Lyceamine 49
 Lysine 50, 60
 L-Lysine 64

 Majurin 5
 Malonic acid 23
 Malvalic acid 51
 Malvidin 3,5-diglucoside 30

 Malvidin 3-glucoside 30
 Malvidin 3-rhamnoside 9
 Mannitol 62
 Margaric acid 60
 Marmesin 5
 Marmesinin 5
 (-)-Mecambrine 67
 Medicagenic acid 42
 Medicagenic acid 3 β -O-glucuronide 42
 Meladenin 5
 12-Methoxycarnosic acid 71
 1-Methoxy-4-(1-propenyl)benzene 17
 5-Methoxypsonalen 61
 (-)-5-[2-(3-Methylbutyroxy)-3-hydroxy-3-methylbutoxy]psoralen 5
 8-[2-(3-Methylbutyroxy)-3-hydroxy-3-methylbutoxy]psoralen 5
 Methyl carnosate 71
 Methyleugenol 23
 Methylheptenone 23
 Methyl isothiocyanate 17
 1-Methyl-2-nonyl-4(1H)-quinoline 39
 Methyl sinapate 17
 3-Methylsulfinylpropyl glucosinolate 17
 4-Methylthiobutyl isothiocyanate 32
 3-Methylthiopropyl isothiocyanate 17
 N-Methyltyramine 38
 (-)-Misramine 67
 Myristic acid 9, 23, 34, 60, 76, 84

 Neohecogenin glucoside 82
 Neotigogenin 82
 Neoxanthin 19
 (\pm)-Nitrotyrasanguinarine 44
 Nonacosane 23
 Norharmine 60
 dl-Norleucine 64

 Octacosane 23
 Octadecanol 23
 Oleanolic acid 34, 71
 Oleic acid 5, 9, 17, 19, 23, 28, 32, 34, 36, 52, 64,
 71, 76, 81, 84,
 (-)-Orientalinone 67
 Oxalic acid 7, 54
 cis-9-Oxoctadec-12-enoic acid 64
 (+)-Oxoturkiyenine 44

| | |
|---|--|
| (+)-Oxypeucedanin 5 | Quinaldine 60 |
| (+)-Oxypeucedanin hydrate 5 | Quinoline 60 |
| Pabulenol 5 | L-Rhamnose 60 |
| Palmitic acid 5, 9, 17, 19, 23, 28, 32, 34, 36, 60, 71, 76, 81, 84 | Roehybridine 67 |
| Palmitoleic acid 60 | Roehybrine 67 |
| Pegaline 60 | (-)- α -Roemehybrine 67 |
| Pegamin 60 | Roemeridine 67 |
| Peganetin 60 | (-)-Roemeridine 67 |
| Peganidin 60 | (-)-Roemrialionone 67 |
| Peganine 60 | Roleanone 71 |
| Peganol 60 | Ruine 60 |
| Peganone 1 60 | Ruscogenin 82 |
| Peganone 2 60 | Rutin 2, 9, 33, 49, 82 |
| 4-Pentenyl isothiocyanate 17 | Salsolidine 16 |
| Peonidin 3-galactoside 16 | Salvigenin 71 |
| Peonidin 3-glucoside 16, 30 | Saxalin 5 |
| Petunidin 3,5-diglucoside 30 | Schaftoside 67 |
| Phenylacetonitrile 17 | Serine 60 |
| Phenylalanine 60, 68 | Shikonin 11 |
| Phenylethyl alcohol 23 | Shikonin acetate 11 |
| β -Phenylethyl isothiocyanate 17 | Shikonin isovalerate 11 |
| 2-Phenylethyl glucosinolate 17 | Sinapic acid 16 |
| Phenyl isothiocyanate 17 | Sinapine 17, 19 |
| 3-Phenylpropionamide 17 | Sitosterol 9, 33, 34, 49, 53, 60, 70, 82, 84 |
| 3-Phenylpropionitrile 17 | Sitosterol 3- β -D-glucoside 53 |
| Phytane 23 | Skimmianine 39 |
| Phytic acid 58 | α -Spinasterol 9 |
| Phytol 23 | Stearic acid 17, 19, 23, 28, 32, 34, 36, 60, 71, 76, 81, 84 |
| Pimpinellin 61 | Sterculic acid 51 |
| (+)-Pinoresinol O- β -D-glucopyranoside 22 | Stigmasterol 9, 11, 34, 49, 70, 82 |
| Piperidine 38 | Sucrose 60 |
| Polygamain 39 | Symlandine 29 |
| Pristane 23 | Symphtine 29 |
| Priverogenin A 8 | Syringalide A 3'- α -L-rhamnopyranoside 22 |
| Progoitrin 84 | (+)-Syringesinol O- β -D-glucopyranoside 22 |
| Proline 60, 68 | Syringin 22 |
| Protocatechuic acid 16 | Taraxasterol 33 |
| Protodioscin 82 | Taraxasterol acetate 33 |
| Quercetin 2, 5, 9, 20, 26, 33, 36, 82 | Taxodione 71 |
| Quercetin 3-gentiobioside 82 | Taxoquinone 71 |
| Quercetin 3-gentiotrioside 82 | Tetracosanol 23 |
| Quercetin 3-glucoside 82 | Tetradecenoic acid 23 |
| Quercetin 3-rhamnogentiobioside 82 | 3 β ,16 α ,23,28-Tetrahydroolean-12-ene 8 |
| Quercitrin 9 | |

| | | | |
|--|----|---------------|--------|
| Threonine | 60 | Tyramine | 38 |
| Thymol | 7 | Tyrosine | 60, 64 |
| Tigogenin | 82 | Umbelliprenin | 5 |
| Tigogenin 3-diglucorhamnoside | 82 | Ursolic acid | 49, 71 |
| Triacontane | 23 | Valine | 23, 60 |
| Tribuloside | 82 | dl-Valine | 64 |
| Tribulosin | 82 | Vanillic acid | 16 |
| 5,7,4'-Trihydroxy-6-methoxy-3-O-glucosyl-flavone | 39 | Vasicinone | 60 |
| Trillin | 82 | Vasicol | 60 |
| Trimethylglycine hydrochloride | 37 | Vernolic acid | 51 |
| Tritriaccontane | 23 | Vicenin 2 | 67 |
| Tropine | 43 | Violaxanthin | 19 |
| Tuberculatin | 39 | Visnagin | 5 |
| (+)-Tuberine | 39 | Xanthotoxin | 6 |
| Tubuloside A I | 22 | Xylose | 9 |
| Tubuloside B II | 22 | D-Xylose | 60 |
| Tubuloside C | 22 | Zeaxanthin | 49 |
| Tubuloside D IV | 22 | | |
| Tubuloside E | 22 | | |
| (+)-Turkiyenine | 44 | | |

PLANT SYSTEMATIC NAME INDEX

- ADONIS* L. 1
Adonis aestivalis L. 1
Adonis annua L. 1
Adonis chrysocathus Hook. f. & Thoms.
ex Hook. f. 1
Adonis dentatus Del. 1, 86
AELLENIA Ulbr. 1
Aellenia glauca (M.B.) Aellen 1, 87
Aellenia subaphylla (C.A. Mey.) Botsch. 2,
88
AIZOON L. 2
Aizoon canariense L. 2, 89
Aizoon hispanicum L. 2, 90
ALHAGI Gagnebin 3
Alhagi camelorum Fisch. 3
Alhagi graecorum Boiss. 3
Alhagi mannifera Desv. 3
Alhagi maurorum Medik.—non DC. 3, 91
Alhagi persorum Boiss. & Buhse 3
Alsine prostrata Forssk. 67
ALTHAEA L. 4
Althaea lavateraeflora DC. 4
Althaea ludwigii L. 4, 92
Althaea officinalis L. 4
Althaea rosea (L.) Cav. 4
ALYSSUM L. 4
Alyssum cupreum Freyn & Sint. 4
Alyssum homalocarpum (Fisch. & Mey.)
Boiss. 4, 93
Alyssum linifolium Steph. ex Willd. 4, 94
AMMI L. 5
Ammi majus L. 5, 95
Ammi visnagi Lam. 6
ANABASIS L. 7
Anabasis aphylla L. 7
Anabasis articulata (Forssk.) Moq. 7
Anabasis setifera Moq. 7, 96
ANAGALLIS L. 7
Anagallis arvensis L. 7, 97
Anagallis arvensis L. var. *micrantha*
Gren. & Godron. 7
Anagallis arvensis L. var. *phoenicia*
Gouan 7
Anagallis caerulea L. var. *parviflora*
(Hoffmanns. & Link) Salis.-Marschl.
7
Anagallis carneae Schrank 7
Anagallis parviflora Hoffmanns. & Link
8
Anagallis phoenicea Scop. 8
ANASTATICA L. 9
Anastatica hierochuntica L. 6, 9, 98
Anchusa hispida Forssk. 36
Anchusa spinocarpos Forssk. 45
ANDRACHNE L. 10
Andrachne telephiooides L. 10, 99
ANISOSCIADIUM DC. 10
Anisosciadium lanatum Boiss. 10, 100
Antirrhinum simplex Willd. 47
Arenaria diandra Guss. 78
Arenaria flaccida Roxb. 77
ARNEBIA Forssk. 11
Arnebia cornuta (Ledeb.) Fisch. & C.A.
Mey. 11
Arnebia decumbens (Vent.) Coss. & Kral.
11, 101
Arnebia hispidissima DC. 11
Arnebia orientalis Lipsky 11
Arnebia tetrastigma Forssk. 11, 102
Arnebia tinctoria Forssk. 11
Arnebia vivianii Coss. & Dur. 11
ASTRAGALUS L. 12

- Astragalus aboriginorum* Richards 13
Astragalus adscendens Boiss. & Haussk. 13
Astragalus annularis Forssk. 12, 103
Astragalus boeticus L. 13
Astragalus bombycinus Boiss. 12, 104
Astragalus brachycentrus Fisch. 13
Astragalus canadensis L. 13
Astragalus caryocarpus Ker-Gawler 13
Astragalus cerasocrenus Bunge 13
Astragalus christianus L. 13
Astragalus corrugatus Bertol. 12, 105
Astragalus creticus Lam. 13
Astragalus cylindricus Boiss. & Heldr. 13
Astragalus dactylocarpus Boiss. 12, 106
Astragalus echidnaeformis Sirjaev 13
Astragalus edulis Dur. 13
Astragalus elymaiticus Boiss. & Haussk. 13
Astragalus fasciculifolius Boiss. 13
Astragalus florulentus Boiss. & Haussk. 13
Astragalus forskahlei Boiss. 13
Astragalus garbancillo Cav. 13
Astragalus globiflorus Boiss. 13
Astragalus glycyphylloides L. 13
Astragalus gossypinus Fisch. 13
Astragalus gummosa Lab. 13
Astragalus gyzenensis Del. 12
Astragalus hamosus L. 13
Astragalus hauarensis Boiss. 12, 107
Astragalus heratensis Bunge 13
Astragalus kurdicus Boiss. 13
Astragalus leioclados Boiss. 13
Astragalus menziesii Gray 14
Astragalus mexicanus A. DC. 13
Astragalus microcephalus Willd. 13
Astragalus myriacanthus Boiss. 13
Astragalus pictus Gray 13
Astragalus prolixis Sieb. 13
Astragalus pycnocladus Boiss. & Haussk. 13
Astragalus schimperi Boiss. 13, 108
Astragalus spinosus (Forssk.) Muschl. 13, 109
Astragalus tenuirugis Boiss. 12
Astragalus tribuloides Del. 13, 110
ATRIPLEX L. 14
Atriplex angustifolia Sm. 14
Atriplex canescens (Pursh) Nutt. 14
Atriplex dimorphostegia Boiss. 14, 111
Atriplex halimus L. 14
Atriplex hortensis L. 14
Atriplex leucoclada Kar. & Kir. 14, 112
BASSIA All. 15
Bassia betis (Blanco) Merr. 15
Bassia butyraceae Roxb. 15
Bassia eriophora (Schrad.) Aschers. 15, 113
Bassia latifolia Roxb. 15
Bassia longifolia L. 15
Bassia malabarica Bedd. 15
Bassia mottleyana Clarke 15
Bassia muricata (L.) Aschers. 15, 114
BIENERTIA Bunge ex Boiss. 15
Biennertia cycloptera Bunge ex Boiss. 15, 115
BRASSICA L. 16
Brassica juncea (L.) Czerniak 16, 116
Brassica tournefortii Gouan. 17, 117
Brassica vesicaria L. 32
Bunias spinosa L. 84
BUPLEURUM L. 18
Bupleurum falcatum L. 18
Bupleurum glaucum Rob. & Cast ex DC. 18
Bupleurum octoradiatum Bunge 18
Bupleurum rotundifolium L. 18
Bupleurum semicompositum L. 18, 118
CAKILE Miller 18
Cakile arabica Velen. & Bornm. 18, 119
Cakile edulenta (Bigel.) Hook. 18
Cakile maritima Scop. 18
CALLIGONUM L. 19
Calligonum comosum L'Hér. 19, 120
Calligonum pallasia L'Hérit. 19
Calligonum polygonoides L. 19
Caroxylon salicornicum Moq. 38
CARRICHTERA DC. 19
Carrichtera annua (L.) DC. 19, 121
Carrichtera vellae DC. 19
CAYLUSEA A. St-Hil. 20
Caylusea canescens (L.) Walp. 20

- Caylusea hexagyna* (Forssk.) M.L. Green 20, 122
- Cheiranthes bicornis* Sibth. & Sm. 51
- Cheiranthes farsetia* L. 35
- Cheiranthes longipetalus* Vent. 51
- Chelidonium dodecandrum* Forssk. 67
- Chelidonium hybridum* L. 67
- CHENOPODIUM* L. 20
- Chenopodium aegyptiacum* Hasselq. 73
- Chenopodium ambrosioides* L. 20
- Chenopodium baryosmon* Roem. & Schult. 70
- Chenopodium bonus-henricus* L. 20
- Chenopodium murale* L. 20, 123
- Chenopodium quinoa* Willd. 21
- Chenopodium virgatum* (L.) Aschers 21
- Chenopodium vulneraria* L. 21
- Chenopodium vulvaria* L. 21
- CHROZOPHORA* A. Juss. 21
- Chrozophora hierosolymitana* Spreng. 21
- Chrozophora plicata* (Vahl) Sprengel 21
- Chrozophora tinctoria* (L.) A. Juss. 21
- Chrozophora verbascifolia* (Willd.) A. Juss. 21, 124
- CISTANCHE* Hoffsgg & Link 21
- Cistanche lutea* Hoffsgg. & Link 22
- Cistanche phelypaea* (L.) Cout. 22
- Cistanche tubulosa* (Schrenk) Hook. f. 21, 125
- Cistanche tubulosa* var. *tomentosa* Hook. f. 21
- Cistus ledifolius* L. 40
- Cistus lippii* L. 40
- Cistus niloticus* L. 40
- Cistus salicifolius* L. 40
- Cistus stipulatus* var. β Forssk. 40
- CITRULLUS* Schrader 22
- Citrullus colocynthis* (L.) Schrad. 22, 126
- Citrullus lanatus* (Thunb.) Matsum. & Nakai 24
- Colutea spinosa* Forssk. 13
- CONVOLVULUS* L. 24
- Convolvulus althaeoides* L. 25
- Convolvulus arvensis* L. 25
- Convolvulus buschiricus* Bornm. 24, 127
- Convolvulus floridus* L. f. 25
- Convolvulus hystrix* Vahl 25
- Convolvulus oxyphyllus* Boiss. 24, 128
- Convolvulus pilosellaefolius* Desr. 25, 129
- Convolvulus scammonia* L. 25
- Convolvulus sogdianus* Bunge 25
- Convolvulus soldanella* L. 25
- CORNULACA* Del. 25
- Cornulaca aucheri* Moq. 25, 130
- Cornulaca leucacantha* Charif & Aellen 25, 131
- Cornulaca monacantha* Del. 25
- Corrigiola repens* Forssk. 64
- CRESSA* L. 26
- Cressa cretica* L. 26, 132
- Croton verbascifolius* Willd. 21
- CRUCIANELLA* L. 26
- Crucianella membranacea* Boiss. 26, 133
- Cryophytum nodiflorum* (L.) L. Bol. 53
- Cucumis colocynthis* L. 22
- CUSCUTA* L. 26
- Cuscuta campestris* Yuncker 27
- Cuscuta chinensis* Lam. 27
- Cuscuta epithymum* (L.) L. 27
- Cuscuta planiflora* Ten. 26, 27, 134
- Cuscuta reflexa* Roxb. 27
- CYNOMORIUM* L. 27
- Cynomorium coccineum* L. 27, 135
- Deverra triradiata* Hochst. ex Boiss. 61
- DIPLOTAXIS* DC. 28
- Diplotaxis acris* (Forssk.) Boiss. 28, 136
- Diplotaxis duveyteriana* Coss. 28
- Diplotaxis harra* (Forssk.) Boiss. 28, 137
- Diplotaxis pendula* DC. 28
- Diplotaxis sieberi* Presl. 28
- Dontostemon grandiflorus* Bunge 50
- Dufresnia letocarpa* Koch 84
- Echinosciadium arabicus* Zoh. 10
- Echinospermum spinocarpus* (Forssk.) Boiss. 45
- Echinospermum tuberculosum* Ledeb. 45
- Echinospermum vahlianum* Lehm. 45
- ECHIUM* L. 29
- Echium angustifolium* Miller 29
- Echium plantagineum* L. 29
- Echium sericeum* Vahl 29, 138

- Echium vulgare* L. 29
EMEX Campderá 29
Emex spinosus (L.) Campderá 29, 139
ERODIUM L'Hérit. 30
Erodium bryoniifolium Boiss. 30, 140
Erodium ciconium (L.) L'Hérit. 30, 141
Erodium cicutarium (L.) L'Hérit. 30, 142
Erodium deserti (Eig) Eig 31
Erodium glaucophyllum (L.) L'Hérit. 31, 143
Erodium hirtum Willd. 31
Erodium jacquinianum Fisch. 31
Erodium laciniatum (Cav.) Willd. 31, 144
Erodium malacoides L'Hér. 31
Erodium moschatum Aiton 31
Erodium niveum Decne. 55
ERUCA Miller 32
Eruca cappadocica Reut. 32
Eruca lativalvis Boiss. 32
Eruca sativa Miller 32, 145
Eruca vesicaria (L.) Cav. 32
Eruca vesicaria (L.) Cav. subsp. *sativa* (Miller) Thell. 32
Erysimum bincorne Aiton 56
EUPHORBIA L. 33
Euphorbia antiquorum L. 33
Euphorbia antisiphilitica Zucc. 33
Euphorbia atolo Forst. f. 33
Euphorbia balsamifera Aiton 33
Euphorbia canariensis L. 33
Euphorbia densa Schrenk 33, 146
Euphorbia edulis Lour. 33
Euphorbia falacata L. 33
Euphorbia granulata Forssk. 33, 147
Euphorbia helioscopia L. 34
Euphorbia ipecacuanhae L. 34
Euphorbia isthmia V. Täckh. 33, 148
Euphorbia lancifolia Schldl. 34
Euphorbia lathyris L. 34
Euphorbia nerifolia L. 33
Euphorbia peplis L. 34
Euphorbia pilulifera L. 34
Euphorbia pulcherrima Willd. ex Klotzsch 34
Euphorbia resinifera Berg. 34
Euphorbia thymifolia Burm. 34
Euphorbia tirucalli L. 34
- FAGONIA* L. 34
Fagonia arabica L. 35
Fagonia bruguieri DC. 34, 149
Fagonia cretica L. 35
Fagonia echinella Boiss. 34
Fagonia glutinosa Del. 34, 150
Fagonia olivieri DC. 35, 151
FARSETIA Turra 35
Farsetia ramosissima Hohst. 35
Farsetia aegyptiaca Turra 35, 152
Farsetia burtonae Oliv. 35, 153
Farsetia clypeata R. Br. 35
Farsetia hamiltonii Royle 35
FRANKENIA L. 36
Frankenia grandifolia Cham. & Schldl. 36
Frankenia portulacaefolia Spreng. 36
Frankenia pulverulenta L. 36, 154
- GASTROCOTYLE* Bunge 36
Gastrocotyle hispida (Forssk.) Bunge 36, 155
Geranium ciconium L. 30
Geranium cicutarium L. 30
Geranium glaucophyllum L. 31
Geranium laciniatum Cav. 31
GYPSOPHILA L. 37
Gypsophila capillaris Delile 37
Gypsophila capillaris (Forssk.) C. Christensen 37, 156
Gypsophila rokejeka Del. 37
Gypsophila struthium L. 37
- HALOCNEMUM* M. Bieb. 37
Halocnemum strobilaceum (Pall.) M. Bieb. 37, 157
HALOXYLON Bunge 38
Haloxylon persicum Bunge 38
Haloxylon salicornicum (Moq.) Bunge ex Boiss. 38, 158
Haloxylon schweinfurthii Aschers 38
Haloxylon tamaricifolium (L.) Maire 38
Haloxylon tetrandrurus Moq. 38
Hammada salicornica (Moq.) Iljin 38
HAPLOPHYLLUM A. Juss. 39
Haplophyllum arabicum Boiss. 39

- Haplophyllum glabrum* (DC.) Hand.-Mazz. 39
Haplophyllum longifolium Boiss. 39
Haplophyllum obovatum (Steud.) Hand.-Mazz. 39
Haplophyllum propinquum Spach. 39
Haplophyllum tuberculatum (Forssk.) A. Juss. 39, 159
Hedysarum alhagi L. 3
Hedysarum ptolemaicum Del. 57
HELIANTHEMUM Miller 40
Helianthemum canadense (L.) Michaux 41
Helianthemum corymbosum Michaux 41
Helianthemum ellipticum (Desf.) Pers. 40
Helianthemum kahircum Del. 40, 160
Helianthemum ledifolium (L.) Mill. 40, 161
Helianthemum lippii (L.) Pers. 40, 162
Helianthemum niloticum sensu Boiss. 40
Helianthemum niloticus (L.) Pers. 40
Helianthemum salicifolium (L.) Mill. 163
Helianthemum sessiliflorum (Desf.) Pers. 40
Helianthemum vulgare Gaertner 41
HELIOTROPIUM L. 41
Heliotropium amplexicaule Vahl 41
Heliotropium bacciferum Forssk. 41, 164
Heliotropium eichwaldii Steud. 41
Heliotropium lanatum H.B. & K. 41
Heliotropium strigosum Willd. 41
Heliotropium tuberculosum Boiss. 41
Heliotropium undulatum Vahl 41
HERNIARIA L. 42
Hernaria cinerea DC. 42
Hernaria glabra L. 42
Hernaria hemistemon J. Gay 42, 165
Hernaria hirsuta L. 42, 166
Hesperis acris Forssk. 28
Hesperis pygmaea Delile 51
HIPPOCREPIS L. 42
Hippocrepis bicontorta Loisel. 42, 167
Hippocrepis bisiliqua Forssk. 43
Hippocrepis biflora Sprengel 43
Hippocrepis comosa L. 43
Hippocrepis cornigera Boiss. 42
Hippocrepis unisiliquosa L. 43, 168
HORWOODIA Turrill 43
Horwoodia dicksoniae Turrill 43, 169
HYOSCYAMUS L. 43
Hyoscyamus micranthus Ledeb. ex D. Don 43
Hyoscyamus albus L. 44
Hyoscyamus salesiezii Coss. 44
Hyoscyamus muticus L. 44
Hyoscyamus niger L. 44
Hyoscyamus pungens Griseb. 43
Hyoscyamus pusillus L. 43, 170
HYPECOUM L. 44
Hypecoum geslinii Coss. & Kral. 44, 171
Hypecoum pendulum L. 44, 172
Hypecoum procumbens L. 44
Illecebrum arabicum L. 59
Kochia eriophora Schrad. 15
Kochia latifolia Fresen. 15
Kochia muricata (L.) Schrad. 15
LAPPULA Gilib. 45
Lappula spinocarpos (Forssk.) Ascherson & Kuntze 45, 173
LEPIDIUM L. 45
Lepidium aucheri Boiss. 45, 174
Lepidium draba L. 45
Lepidium latifolium L. 45
Lepidium oleraceum Forst. f. 45
Lepidium piscidum Forst. f. 45
Lepidium sativum L. 45
LEPTALEUM DC. 46
Leptaleum longisiliquosum Freyn & Sint. 46
Leptaleum pygmaeum DC. 46
Leptaleum filifolium (Willd.) DC. 46, 175
LIMONIUM Miller 46
Limonium axillare (Forssk.) Kuntze 47
Limonium carnosum (Boiss.) Kuntze 46, 176
Limonium spicatum (Willd.) Kuntze 65
Limonium thouinii (Viv.) Kuntze 46, 177
LINARIA Miller 47
Linaria albifrons (Sibth. & Sm.) Spreng. 47, 178
Linaria arvensis (L.) Desf. var. *flaviflora* Boiss. 47

- Linaria canadensis* (L.) Dum. 47
Linaria cymbalaria Mill. 47
Linaria simplex (Willd.) DC. 47, 179
Linaria vulgaris Miller 47
LITHOSPERMUM L. 48
Lithospermum angustifolium Forssk. 54
Lithospermum apulum (L.) Vahl 48, 180
Lithospermum arnebia Del. 11
Lithospermum arvense L. 48
Lithospermum callosum Vahl 54
Lithospermum callosum Vahl var.
asperrimum Bornm. 54
Lithospermum canescens Lehm. 48
Lithospermum ciliatum Forssk. 54
Lithospermum cornutum Ledeb. 11
Lithospermum decumbens Vent. 11
Lithospermum mesopotamicum DC. 48
Lithospermum micranthum Viv. 11
Lithospermum officinale L. 48
Lithospermum ruderale Douglas ex Lehm.
 48
Lithospermum strigosum M.B. 48
Lithospermum tetrastigma Lam. 11
Lithospermum tinctorium Vahl 11
LOEFLINGIA L. 48
Loeflingia hispanica L. 48, 181
LOTUS L. 48
Lotus aucheri Boiss. 48
Lotus corniculatus L. 49
Lotus edulis L. 49
Lotus gebelia Vent. 49
Lotus halophilus Boiss. & Sprun. 48, 182
Lotus pusillus Viv. 48
Lotus pusillus Viv. var. *major* Boiss. 48
Lotus tetragonolobus L. 49
Lotus villosus Forssk. 48
Lunaria parviflora Del. 72
LYCIUM L. 49
Lyctum afra L. 49
Lyctum andersonii Gray 49
Lyctum arabicum Schweinf. ex Boiss. 49
Lyctum barbarum L. 50
Lyctum chinense Mill. 50
Lyctum europaeum L. 49
Lyctum halimifolium Mill. 50
Lyctum intricatum Boiss. 50
Lyctum pallidum Miers 49, 50
Lyctum sandwicense Gray 50
Lyctum shawii Roem. & Schult. 49, 183
Lyctum umbrosum Humb. & Bonpl. 49
Lygia mesopotamica C. Jeffrey 80
MALCOLMIA R. Br. 50
Malcolmia africana Ait. 50
Malcolmia bungei Boiss. 50
Malcolmia circinata Hook. f. & Thoms.
 50
Malcolmia grandiflora (Bunge) Kuntze 50,
 184
Malcolmia pygmaea Boiss. 51
Malcolmia torulosa (Desf.) Boiss. 81
MALVA L. 50
Malva parviflora L. 50, 185
Malva rotundifolia L. 51
Malva sylvestris L. 51
Malva verticillata L. var. *crispa* L. 51
Manna hebraica D. Don 3
MARESIA Pomel 51
Maresia pygmaea (Del.) O.E. Schulz 51,
 186
MATTHIOLA R. Br. 51
Matthiola bicornis (Sibth. & Smith) DC.
 51
Matthiola incana R. Br. 52
Matthiola longipetala (Vent.) DC. 51, 187
Matthiola oxyceras DC. 51
MEDICAGO L. 52
Medicago denticulata Willd. 52
Medicago laciniata (L.) Mill. 52, 188
Medicago lupulina L. 52
Medicago platycarpa Trautv. 52
Medicago rigidula L. var. *laciniata* L. 52
Medicago sativa L. 52
MELilotus Miller 53
Melilotus indicus (L.) All. 53, 189
Melilotus officinalis (L.) Pallas 53
Melilotus parviflora Desf. 53
Melilotus suaveolens Ledeb. 53
Menioicus linifolius (Steph. ex Willd.) DC.
 4
MESEMBRYANTHEMUM L. 53
Mesembryanthemum acinaciforme L. 54
Mesembryanthemum aequilaterale Haw.
 54

- Mesembryanthemum anatomicum* Haw. 54
Mesembryanthemum crystallinum L. 54
Mesembryanthemum edule L. 54
Mesembryanthemum forskahlei Hochst. 54
Mesembryanthemum nodiflorum L. 53, 190
Mesembryanthemum pugioniforme L. 54
Mesembryanthemum stellatum Will. 54
Mesembryanthemum tortuosum L. 54
Mesembryanthemum tripolium L. 54
Mollugo tetraphylla L. 65
Moltkia callosa (Vahl) Wettst. 54
Moltkia ciliata (Forssk.) Maire 54
MOLTOKIOPSIS I.M. Johnston 54
Moltkiopsis ciliata (Forssk.) I.M. Johnston 54, 191
MONSONIA L. 55
Monsonia nivea (Decne.) Decne. ex Webb 55, 192
Monsonia ovata Cav. 55

NEURADA L. 55
Neurada procumbens L. 55, 193
NITRARIA L. 55
Nitraria retusa (Forssk.) Aschers. 55, 194
Nitraria schoberi L. 56
Nitraria tridentata Desf. 56
NOTOCERAS R. Br. 56
Notoceras bicornis (Aiton) Amo 56, 195
Notoceras canariense DC. 56
Notoceras hispanicum R. Br. 56

OCHRADENUS Del. 56
Ochradenus baccatus Del. 56, 196
OLIGOMERIS Cambess. 57
Oligomeris linifolia (Vahl ex Hornem.) Macbride 57
Oligomeris subulata (Del.) Boiss. 57, 197
ONOBRYCHIS Miller 57
Onobrychis ptolemaica (Del.) DC. 57, 198
Onobrychis viciifolia Scop. 57
ONONIS L. 57
Ononis arvensis L. 58
Ononis serrata Forssk. 57, 199
Ononis spinosa L. 58

Ononis tournefortii Cosson 58
Onosma divaricatum Lehm. 11
OROBANCHE L. 58
Orobanche californica Cham. & Schltr. 59
Orobanche cernua Loefl. 58, 200
Orobanche cernua var. *cumana* (Wallr.) G. Beck 58
Orobanche cumana Wallr. 58
Orobanche fasciculata Nutt. 59
Orobanche hispanica Boiss. 58
Orobanche ludoviciana Nutt. 59
Orobanche nicotiana Wight 58
Orobanche speciosa DC. 58
Orobanche tuberosa (Gray) Heller 59
Orobanche wendelboi Schiman-Czekia 58

PARONYCHIA Miller 59
Paronychia arabica (L.) DC. 59, 201
Paronychia argentea Lam. 59
Paronychia jamesii Torr. & Gray 59
Paronychia sclerocephala Decne. 73
PEGANUM L. 59
Peganum harmala L. 59, 202
Phelypaea tubulosa Schrenk 21
PITURANTHOS Viv. 61
Pituranthus tortuosus (Desf.) Benth. & Hook. f. 62
Pituranthus triradiatus (Hochst. ex Boiss.) Aschers. & Schweinf. 61, 203
PLANTAGO L. 62
Plantago afra L. 64
Plantago albicans Boiss.—non L. 62
Plantago amplexicaulis Cav. subsp. *bauphula* (Edgew.) Rech. f. 62, 204
Plantago amplexicaulis Cav. var. *bauphula* (Edgew.) Pilger 62
Plantago bauphula Edgew. 62
Plantago boissieri Hausskn. & Bornm. 62, 205
Plantago ciliata Desf. 62, 206
Plantago coronopus L. 63, 207
Plantago coronopus L. subsp. *coronopus* Rechinger 63
Plantago coronopus L. subsp. *eucoronopus* Pilger 63
Plantago cylindrica Forssk. 62

- Plantago decipiens* Barneoud 64
Plantago decumbens Forssk. 63
Plantago lagopus L. 63, 208
Plantago lanceolata L. 64
Plantago major L. 64
Plantago maritima L. 64
Plantago notata Lag. 63, 209
Plantago ovata Forssk. 63, 210
Plantago psammophila Agnew & Chalabi-Ka'bî 64, 211
Plantago trichophylla Nab. 63
POLYCARPAEA Lam. 64
Polycarpea corymbosa Lam. 65
Polycarpea fragilis Delile 64
Polycarpea repens (Forssk.) Aschers. & Schweinf. 64, 212
POLYCARPON L. 65
Polycarpon prostratum (Forssk.) Asch & Schweinf. 67
Polycarpon tetraphyllum (L.) L. 65, 213
Psilonema homalocarpum Fisch. & Mey. 4
PSYLLIOSTACHYS (Jaub. & Spach) Nevski 65
Psylliostachys spicata (Willd.) Nevski 65, 214
PTERANTHUS Forssk. 65
Pteranthus dichotomus Forssk. 65, 215
Pteranthus echinatus Desf. 65

RESEDA L. 66
Reseda arabica Boiss. 66, 216
Reseda canescens L. 20
Reseda decursiva Forssk. 66, 217
Reseda eremophila Boiss. 66
Reseda hexagyna Forssk. 20
Reseda linifolia Vahl ex Hornem. 57
Reseda luteola L. 66
Reseda muricata C. Presl 66, 218
Reseda odorata L. 66
Reseda phyteum L. 66
Reseda propinqua Boiss. 66
Reseda subulata Del. 57
ROBBAIREA Boiss. 67
Robbairea delileana (Forssk.) Boiss. 67, 219
Robbairea prostrata (Forssk.) Boiss. 67

ROEMERIA Medikus 67
Roemeria dodecandra (Forssk.) Stapf 67
Roemeria hybrida (L.) DC. subsp. *hybrida* 67, 220
Roemeria orientalis Boiss. 67
Rokejeka capillaris Forssk. 37
RUMEX L. 68
Rumex abyssinicus Jacq. 68
Rumex acetosa L. 68
Rumex alpinus L. 68
Rumex arcticus Trautv. 68
Rumex bequaerti De Wild. 68
Rumex berlandieri Meisn. 68
Rumex brasiliensis Link 69
Rumex crispus L. 68
Rumex ecklonianus Meisn. 69
Rumex hydrolapathum Huds. 68
Rumex hymenosepalus Torr. 68, 69
Rumex lacerus Balb. 68
Rumex longifolius H. B. & K. 68, 69
Rumex luxurians L. 68
Rumex maderensis Lowe 69
Rumex mexicanus Meisn. 68
Rumex montanus Desf. 68
Rumex nepalensis Spreng. 69
Rumex obtusifolius L. 68
Rumex patientia L. 68
Rumex paucifolius Nutt. 68
Rumex pictus Forssk. 68, 221
Rumex roseus Desf.—non L. 68
Rumex sanguineus L. 68
Rumex scutatus L. 68
Rumex spinosus L. 29
Rumex usambarensis Dammer ex Peter 69
Rumex vesicarius L. 68, 222
Ruta tuberculata Forssk. 39

SALICORNIA L. 69
Salicornia australis Sol. 69
Salicornia brachiata Roxb. 69
Salicornia cruciata Forssk. 37
Salicornia fruticosa L. 69
Salicornia herbacea L. 69, 223
Salicornia strobilacea Pall. 37
SALSOLA L. 70
Salsola asparagoides Miq. 70

- Salsola baryosma* (Roem. & Schult.)
Dandy 70, 224
- Salsola foetida* Del. 70
- Salsola glauca* M.B. 1
- Salsola jordanicola* Eig 70, 225
- Salsola kali* Willd. 70
- Salsola muricata* L. 15
- Salsola rosmarinus* (Bunge ex Boiss.).
Solms-Laub 75
- Salsola subaphylla* C.A. Mey. 2
- SALVIA* L. 70
- Salvia aegyptiaca* L. 70
- Salvia carnosa* Douglas 71
- Salvia clandestina* L. 70
- Salvia columbariae* Benth. 71
- Salvia controversa* Boiss.—non Tenn. 70
- Salvia divinorum* Epling & Jativá 71
- Salvia fruticosa* Miller 71
- Salvia horminum* L. 71
- Salvia indica* L. 71
- Salvia lanata* Roxb. 71
- Salvia lanigera* Poir. 70, 226
- Salvia miltiorrhiza* Bunge 71
- Salvia officinalis* L. 71
- Salvia plebeia* R. Br. 71
- Salvia pratensis* L. 72
- Salvia sclarea* L. 71
- Salvia spinosa* L. 71, 227
- Salvia titaefolia* Vahl 72
- Salvia viridis* L. 72
- SAVIGNYA* DC. 72
- Savignya aegyptiaca* DC. 72
- Savignya parviflora* (Del.) Webb 72, 228
- SCABIOSA* L. 72
- Scabiosa olivieri* Coulter 72, 229
- Scabiosa palaestina* L. 72, 230
- SCHANGINIA* C.A. Mey. 73
- Schanginia aegyptiaca* (Hasselq.) Aellen.
73, 231
- Schanginia baccata* (Forssk.) Moq. 73
- SCHIMPERA* Hochst. & Steudel ex Engel
73
- Schimpfera arabica* Hochst. & Steudel ex
Boiss. 73, 232
- Schimpfera persica* Boiss. 73
- Sclerocaryopsis spinocarpos* (Forssk.)
Brand 45
- SCLEROCEPHALUS* Boiss. 73
- Sclerocephalus arabicus* Boiss. 73, 233
- SCROPHULARIA* L. 74
- Scrophularia auriculata* L. 74
- Scrophularia deserti* Del. 74, 234
- Scrophularia frigida* Boiss. 74
- Scrophularia nodosa* L. 74
- SEETZENIA* R. Br. ex Decne. 74
- Seetzenia orientalis* Decne. 74, 235
- SEIDLITZIA* Bunge ex Boiss. 75
- Seidlitzia lanigera* Post 7
- Seidlitzia rosmarinus* Bunge ex Boiss. 236
- SILENE* L. 75
- Silene affinis* Boiss. 75
- Silene arabica* Boiss. 75, 237
- Silene arenosa* C. Koch 75
- Silene chaetodonta* Boiss. 75
- Silene cucubalus* Wibel 76
- Silene kotschyi* Boiss. 75
- Silene leysseroides* Boiss. 75
- Silene linearis* Decne. 75, 238
- Silene macrosolen* Steud. 76
- Silene succulenta* Forssk. 76
- Silene villosa* Forssk. 76, 239
- Silene virginiana* L. 76
- Sinapis harra* Forssk. 28
- Sinapis juncea* L. 16
- SISYMBRIUM* L. 76
- Sisymbrium alliaria* Scop. 77
- Sisymbrium canescens* Nutt. 77
- Sisymbrium columnae* Jacq. 77
- Sisymbrium erysimoides* Desf. 76, 240
- Sisymbrium grandiflorum* Post. 77
- Sisymbrium irio* L. 76, 241
- Sisymbrium officinale* (L.) Scop. 77
- Sisymbrium orientale* L. 77, 242
- Sisymbrium pannonicum* Boiss. 77
- Sisymbrium septulatum* DC. 77, 243
- Sisymbrium sinapistrum* Hand.-Mazz. 77
- Sisymbrium torulosum* Desf. 81
- Sisymbrium filifolium* Willd. 46
- SPERGULA* L. 77
- Spergula arvensis* L. 78
- Spergula fallax* (Lowe) Krause 77, 244
- Spergula fallax* Lowe 77
- Spergula flaccida* (Roxb.) Aschers 77

- Spergula pentandra* L. var. *intermedia*
Boiss. 77
- SPERGULARIA* (Pers.) J. Presl & C. Presl
78
- Spergularia diandra* (Guss.) Heldr. & Sart.
78, 245
- Spergularia media* (L.) C. Presl 78
- Spergularia rubra* (L.) J. Presl & C. Presl
78
- Spergularia speculum* A. DC. 78
- Statice carnosa* Boiss. 46
- Statice spicata* Willd. 65
- Statice suffruticosa* var. *carnosa* Kusn. 46
- Statice suffruticosa* var. *typica* Trautv. 46
- Statice thouinii* (Viv.) Post 46
- SUAEDA* Forssk. ex Scop. 78
- Suaeda aegyptica* (Hasselq.) Zoh. 73
- Suaeda baccata* Forssk. 73
- Suaeda fruticosa* Forssk. 79
- Suaeda indica* Moq. 79
- Suaeda maritima* Dum. 79
- Suaeda nudiflora* Moq. 79
- Suaeda rosmarinus* Ehrenb. ex Boiss. 75
- Suaeda suffrutescens* Wats. 79
- Suaeda vera* Forssk. ex J. Gmelin 79
- Suaeda vermiculata* Forssk. ex J.F. Gmel.
78, 246
- TAMARIX* L. 79
- Tamarix aphylla* L. 79
- Tamarix aucherana* (Decne. ex Walp.)
Baum. 79, 247
- Tamarix chinensis* Lour. 79
- Tamarix gallica* L. 79
- Tamarix mannifera* Ehrenb. 79
- TEUCREUM* L. 79
- Teucrium capense* Thunb. 80
- Teucrium chamaedrys* L. 80
- Teucrium cubense* Jacq. 80
- Teucrium marum* L. 80
- Teucrium oliverianum* Ging. ex Benth. 79,
248
- Teucrium polium* L. 80, 249
- Teucrium scorodonia* L. 80
- THYMELAEA* Miller 80
- Thymelaea hirsuta* (L.) Endl. 80
- Thymelaea mesopotamica* (C. Jeffrey) B.
Peterson 80, 250
- TORULARIA* (Cosson) O. Schulz 81
- Torularia torulosa* (Desf.) O.E. Schulz 81,
251
- TRAGANUM* Del. 81
- Traganum nudatum* Del. 81, 252
- TRIBULUS* L. 81
- Tribulus alatus* Del. 83
- Tribulus terrestris* L. 81, 253
- Trichaurus aucherianus* Decne. ex Walp.
79
- Trichaurus macrocarpa* (non (Ehrenb.)
Bunge) Blakelock 79
- Trichaurus passerinoides* (non Del. ex
Desv.) Boiss. 79
- Trifolium indica* L. 53
- TRIGONELLA* L. 83
- Trigonella anguina* Del. 83, 254
- Trigonella caerulea* (L.) Ser. 83
- Trigonella corniculata* L. 83
- Trigonella foenum-graecum* L. 83
- Trigonella hamosa* Forssk. 83, 255
- Trigonella radiata* Boiss. 83
- Trigonella suavissima* Lindl. 83
- VALERIANELLA* Miller 84
- Valerianella coronata* DC. 84
- Valerianella dufresnia* Bunge ex Boiss. 84,
256
- Valerianella eriocarpa* Desv. 84
- Valerianella olitoria* Pollich 84
- Vella annua* L. 19
- ZILLA* Forssk. 84
- Zilla myagroides* Forssk. 84
- Zilla spinosa* (L.) Prantl 84, 257
- ZYGOPHYLLUM* L. 85
- Zygophyllum album* L. 85
- Zygophyllum coccineum* L. 85, 258
- Zygophyllum desertorum* Forssk. 85
- Zygophyllum fabago* L. 85
- Zygophyllum gaetulum* Emberger & Maire
85
- Zygophyllum propinquum* Decne. 85
- Zygophyllum simplex* L. 85

PLANT COMMON NAME INDEX

- Alfalfa 52
- Alkanet 48
- All good 20
- American wormseed 20
- Anderson wolfberry 49
- Apple-bearing sage 71
- Autumn adonis 1

- Balsam spurge 33
- Bank cress 77
- Bean caper 85
- Bird's foot trefoil 49
- Bishop's leaves 74
- Bishop's weed 5
- Bitter apple 22
- Bitter dock 68
- Bitter gourd 22
- Black medick 52
- Bladder campion 76
- Bladder dock 68
- Bloodwort 68
- Bloody veined dock 68
- Blue weed 29
- Bluebeard 72
- Box thorn 49
- Broad-leaved dock 68
- Broccoli 17
- Broom rape 58
- Brownwort 74
- Brussels sprouts 17
- Buck's horn plantain 63
- Buffalo bean 13
- Bur clover 52
- Butter and eggs 47
- Butter leaves 14

- Cabbage 17
- Camelsthorn 3
- Canada milk vetch 13
- Canaigre 68
- Candelilla 33
- Canna root 54
- Caper spurge 34
- Carpenter's square 74
- Cat thyme 80
- Cat's milk 34
- Cauliflower 17
- Chamaedrys germander 80
- Cheeses 51
- Chia 71
- Chinese mustard 16
- Chinese wolfberry 50
- Clary 71
- Clover dodder 27
- Colocynth 22
- Common bindweed 25
- Common germander 80
- Common gromwell 48
- Common matrimony vine 50
- Common mignonette 66
- Common pimpernel 8
- Common toadflax 47
- Corn lily 25
- Corn salad 84
- Corn spurry 78
- Cornbind 25
- Crab grass 69
- Crambling rocket 77
- Cress 45
- Cretan prickly clover 35
- Curled dock 68

- Desert seepweed 79
 Devil's thorn 81
 Dittander 45
 Dodder 27
 Dodder of thyme 26
 Dog's orach 21
 Duke of Argyll's tea tree 50
 Dyer's rocket 66
 Dyer's weed 66
- Eggs and bacon 49
 Egyptian henbane 44
 Egyptian mallow 50
 Epazote 20
 Eple 15
- Fenugreek 83
 Fetid goosefeet 21
 Field bindweed 25
 Figwort 74
 Fire pink 76
 Flower of Crete 54
 Fourwing saltbush 14
 French sorrel 68
 Frostweed 41
- Garden patience 68
 Garden rocket 32
 Garden sorrel 68
 Glasswort 69
 Good King Henry 20
 Goose tongue 64
 Ground oak 80
 Ground plum 13
 Gum Euphorbium 34
- Hare's ear 18
 Harmala 59
 Harmel shrub 59
 Hedge garlic 77
 Hedge mustard 77
 Hemlock geranium 30
 Henbane 44
 Herb patience 68
 High mallow 51
 Hoary cress 45
 Hoary puccoon 48
- Hollyhock 4
 Hop clover 52
 Hormium clary 71
 Horned cummin 44
 Horseshoe vetch 43
 Hottentot figs 54
 Hulwort 80
- Ice plant 54
 Illupie plant 15
 Ilpa 15
 Indian butter 15
 Indian mustard 16
 Indian paint root 48
 Indian tragacanth 13
 Ipecacuanha spurge 34
 Italian corn salad 84
 Ixbut 34
- Jamba 32
 James Whitkow wort 59
- Kale 17
 Katio oil 15
 Kenilworth ivy 47
 Kohlrabi 17
 Kon 54
- Lance-leaved plantain 64
 Land caltrops 81
 Leaf Mustard 16
 Lesser bindweed 25
 Lesser dodder 27
 Levant scammony 25
 Lindenleaf sage 72
 London rocket 76
 Lucerne 52
- Mahoua 15
 Mallow 51
 Mallow bindweed 25
 Maltese mushroom 27
 Manna plant 3, 79
 Manna tamarisk 79
 Marsh mallow 4, 51
 Marsh samphire 69
 Matrimony vine 49

- May weed 5
 Meadow sage 72
 Mediterranean germander 80
 Melilot 53
 Mexican goosefoot 20
 Mexican tea 20
 Milk vetch 13
 Monk's rhubarb 68
 Mountain germander 80
 Mountain rhubarb 68
 Mountain sorrel 68
 Mountain spinach 14
 Mustard 17
 Myrtle spurge 34
 New Zealand cress 45
 Night-scented stock 52
 Nitre bush 56
 Nonsuch 52
 Orach 14
 Patience dock 68
 Pennywort 47
 Persian manna plant 3
 Pheasant's eye 1
 Phoolwa oil plant 15
 Pick needle 30
 Pig's face 54
 Pin grass 30
 Plantain 64
 Poinsettia 34
 Poor man's pepper 45
 Poor man's weatherglass 8
 Psyllium 64
 Puncture vine 81
 Purple viper's bugloss 29
 Quinoa 21
 Rabbit thorn 49
 Red chickweed 8
 Red pimpernel 8
 Red sandwort 78
 Rest harrow 58
 Resurrection plant 9
 Rose of Jericho 9, 54
 Rosin weed 26
 Rupturewort 42
 Sage 71
 Sage apple 71
 Salad rocket 32
 Saltwort 69
 Sand spurrey 78
 Scarlet pimpernel 8
 Scarlet synomorium 27
 Scented trefoil 53
 Scrofula plant 74
 Sea blite 79
 Sea orach 14
 Sea purslane 14
 Sea rocket 18
 Seaside plantain 64
 Shanghai trefoil 52
 Shepherd's clock 8
 Shepherd's weatherglass 8
 Silver nailroot 59
 Small caltrops 81
 Sorrel 68
 Sour dock 68
 Spring adonis 1
 Spurge cactus 33
 St. Mary's flower 9
 Star of the Earth 63
 Stinking goosefoot 21
 Stock 52
 Storksbill 30
 Summer adonis 1
 Summer pheasant's eye 1
 Sun spurge 34
 Swedish coffee 13
 Sweet clover 53
 Sweet trefoil 83
 Syrian rue 59
 Tall adonis 1
 Tall rest harrow 58
 Tansy mustard 77
 Thorow wax 18
 Three-lobed sage 71
 Toadflax 78
 Toothpick plant 6
 Turnip 17

- Venus' looking glass 78
Vine of Sodom 22
Viper's bugloss 29

Wartwort 34
Water betony 74
Water grass 34
Water mellon 24
Weld 66
White henbane 44

White mallow 4
Wild musk 30
Wild rhubarb 68
Winged pea 49
Wood germander 80
Wood sage 80
Yallah oil plant 15
Yellow trefoil 52
Yellow weed 66
Yerba reuma 36

GENERAL INDEX

- Abortifacient activity 22, 33, 34, 41, 60
Abscesses 3
Alexandrian Senna 14
Analgesic 63
Anemia 22, 39
Anesthetic 85
Angina pectoris 5, 6
Anodyne 59
Anthelmintic activity 14, 22, 25, 27, 59, 76, 80, 85
Antibacterial activity 32, 39, 60
Antiemetic 71
Antifungal activity 8, 9, 39
Antihistaminic activity 85
Antimicrobial activity 60, 61, 75
Antipyretic activity 22, 85
Antiscorbutic activity 18, 20, 32, 45, 47, 69, 77
Antiseptic 85
Antispasmodic activity 53, 59
Antithiamine factor 17
Antithyroid factor 84
Antiviral activity 20
Anxiety, treatment of 44
Aperient 3
Aphrodisiac, feline 80
Aphrodisiac, human 82
Appetite promotion 68
Asthma 5, 6, 22, 34, 44, 85
Astringent 27, 41, 42, 63, 65, 71

Bacillus subtilis 32, 39
Betis oil 15
Bile duct, obstructions of 27
Bilharziasis 3
Bleeding, inhibition of 25, 54, 64

Blisters 6
Blood purifier 3
Bronchitis 22
Bruises 22, 41, 83
Bumps 41

Caper substitute 85
Cardiac contractions, effect on 83
Cardiac poison 34
Cardiac stimulant 1
Carminative 5, 22, 71
Cathartic activity 22
Cephalic activity 8
Cheese flavoring 83
Childbirth, enhancement of uterine contractions 30
Cholagogue 3
Cholera 80
Circulation, stimulation of 16
Cirrhosis of the liver 8
Climacteric disturbances 82
Coffee substitute 13
Cold remedy 33, 69, 71, 80
Colocynth 22
Condiment 27, 77
Conjunctivitis 6
Constipation 22, 39
Contraceptive activity 83
Convulsions, treatment of 8
Cornea, inflammation of 81
Cornea, opacity of 3
Corrosion inhibitor 6
Cosmetics 21
Coughs, treatment of 71
Creatinine renal clearance 83
Cytotoxic activity 29, 39

- Dandruff 80
- Delirient effect 54
- Demulcent activity 4, 13, 51
- Depilatory 34
- Detergent 8
- Diabetes, treatment of 22, 38, 83, 85
- Diaphoretic activity 8, 31, 71
- Diarrhea 50, 79
- Digestion, aid to 80
- Digestive disorders, treatment of 16, 20, 68, 71
- Diuretic activity 1, 3-5, 8, 25-27, 29, 30, 32, 42, 47, 48, 58, 59, 62, 63, 69, 77, 80, 81, 83, 85
- Dyes 21, 30, 47, 66, 69, 79
- Dysentery, treatment of 55, 63, 79, 81
- Dysuria, treatment of 81
- Edema, treatment of 30
- Ehrlich ascites carcinoma cells 29
- Elephantiasis 22
- Emetic activity 14, 16, 34, 59, 78
- Emollient activity 4, 53, 65
- Enemas 51
- Epilepsy, treatment of 8, 22
- Erection, prolongation of 82
- Erysipelas 49
- Erythema 6
- Escherichia coli* 32, 39
- Estrogenic activity 9
- Estrus, potentiation of 82
- Expectorant activity 3, 42, 77, 80
- Eye diseases, treatment of 59
- Eye lotion 50
- Febrifuge activity 35, 69, 80
- Fertility control 20, 21, 47, 48
- Fertility enhancement 82
- Fevers, treatment of 35, 59, 63, 80
- Fish poison 8
- Flour substitute 37
- Food coloring 21
- Frigidity, treatment of 82
- Gallstones, treatment of 8
- Gargle 30
- Gastric ulcers 6
- Gastrointestinal disorders 36, 51, 63, 66, 80
- Genitourinary system, disorders of 63
- Germination of seeds, enhancement of 60
- Gonorrhea, treatment of 81
- Gout, treatment of 8, 34, 85
- Gravel, treatment of 8
- Gruyère cheese 53
- Gum disorders 51
- Gum tragacanth 13, 19
- Hair loss 34
- Hair, prevention from turning grey 23
- Hallucinogenic activity 71
- Halva 37
- Head lice, treatment of 60, 72
- Heart ailments, treatment of 71
- Helminthosporium maydis* 9
- Hematomas 6
- Hemolytic activity 8
- Hemorrhoids, treatment of 3, 47, 63
- Hemostatic activity 64
- Herba Herniariae 42
- Herba Mari veri 80
- Hernias, treatment of 42
- Herpes simplex* virus type 1 8
- Hop substitute 80
- Hypertension, treatment of 85
- Hypnotic activity 44, 59
- Hypoglycemic activity 63
- Hypotensive activity 15, 39, 85
- Hysteria 44, 59
- Impotence, treatment of 81
- Infertility 82
- Insect bites, treatment of 33
- Insecticidal activity 7, 13, 22, 32
- Interferon formation, induction of 30
- Intestinal worms, treatment of 8
- Intestine, relaxation of 85
- Intoxicants 51, 54
- Influenza A virus 30
- Influenza, treatment of 71
- Isphagul seeds 63
- Jamba oil 32

- Jaundice, treatment of 22, 25, 26, 27, 47, 58, 59
 Juvenile hormone activity 83
- Kidney stones, treatment of 78, 84
- Labor, easing of 10, 54
 Laxative activity 3, 25, 27, 34, 63, 64, 79
 Leaches 8
Leptosphaeria maculans 16
 Leucoderma, treatment of 22
 Libido, increase of 82
 Lipid peroxidation, inhibition of 17
 Liver disorders, treatment of 34
 Liver, enlargement of 22
 Lumbago, treatment of 59
 Lumbricoid worms 20
 Lung ailments, treatment of 8
- Malaria, treatment of 63
 Manna 3, 13, 79
 Menstrual flow, stimulation of 60
 Migraine headaches, treatment of 3
 Milk flow, stimulation of 34, 60
 Muscle relaxant 85
- Narcotics 44, 54, 55, 59
 Nausea, treatment of 39, 68
 Nervous disorders, treatment of 21
 Neuralgia, treatment of 60
 Noyeau 25
- Oil of Rhodium 25
 Ophthalmic disorders, treatment of 53, 72
 Ovarian function, improvement of 82
 Oviposition, stimulation of 16
- Pains, treatment of 16
 Parkinson's disease, treatment of 60
 Pepper substitute 45, 85
Perigrinus maidis 32
Perkinsiella insignis 32
 Photosensitizing effect 6, 61
 Plague, treatment of 8
Plutella xylostella 16
 Poliovirus type 2 8
- Poultices 51
 Purgative activity 3, 21, 25, 33, 34, 51, 69
- Rabies, treatment of 8
 Restorative activity 3
 Rheumatism, treatment of 3, 6, 22, 33, 36, 39, 60, 71, 85
 Rubifacient activity 32
- Saccharomyces cerevisiae* 39
Salmonella typhi 32
 Scorpion stings 22, 41, 68
 Sedative 34
 Sertoli cell activity 82
 Serum cholesterol levels 63
 Sexual reflexes 82
 Skin disorders, camels 23, 33
 Skin disorders, human 6, 58
 Skin wounds , 63
 Smallpox, treatment of 34, 79
 Smooth muscle relaxant activity 39
 Snakebites, treatment of 22, 33, 41
 Soap 37
Sogata striatus 32
Sogatella longifurcifera 32
 Sore throats, treatment of 69
 Sperm, number and motility of 82
 Spermatogenesis, stimulation of 82
 Spleen, enlargement of 22
Staphylococcus aureus 39
 Stimulants 27, 32, 59, 77, 80
 Stomachic activity 5, 32, 80
 Styptic 27
 Sudorific activity 8
 Swellings, treatment of 383
 Syphilis, treatment of 37
- Tapeworms, treatment of 69
 Tarbooshes 59
 Tea substitute 36
 Teeth, facilitation of extraction 60
 Teething pains 4
 Tonics 3, 5, 26, 27, 35, 41, 69, 71, 80, 81
 Toothache, treatment of 8, 34, 68
 Toothpicks 6
Toya attenuata 32
 Tribestan 82

Turkey red 59

Urinary discharges, treatment of 22

Urinary disorders, treatment of 6

Uterus, contraction of 85

Vasodilation 85

Venomous reptiles 65

Vermifuge activity 3, 20

Viper venom 8

Vomiting, treatment of 39

Vulnerary activity 8

Weight gain 44

Wheat growth, stimulation of 69

Wounds, treatment of 34