Studies in Plant Science, 2

Kuwaiti Plants

B.S. Middleditch and Amer M. Amer

Elsevier

Kuwaiti Plants

This page intentionally left blank

Studies in Plant Science, 2

Kuwaiti Plants

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

Brian S. Middleditch and Amer M. Amer

University of Houston
Dept. of Biochemical and Biophysical Sciences
4800 Calhoun Road
Houston, TX 77004, U.S.A.

ELSEVIER

Amsterdam — London — Oxford — Tokyo **1991**

ELSEVIER SCIENCE PUBLISHERS B.V.
Sara Burghartstraat 25
P.O. Box 211, 1000 AE Amsterdam, The Netherlands

Distributors for the United States and Canada:

ELSEVIER SCIENCE PUBLISHING COMPANY INC.
655, Avenue of the Americas
New York, NY 10010, U.S.A.

ISBN 0-444-89215-X

This book is printed on acid-free paper.

Printed in The Netherlands

CONTENTS

This page intentionally left blank

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.

This page intentionally left blank

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 mannifera 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, vermifuge. 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 Vishwapaul (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 has been found to contain (–)-5-[2-(acetoxy)-3-hydroxy-3-methylbutoxy]psoralen, (–)-heraclenin, 8-[2-(3-methylbutyroxy)-3-hydroxy-3-methylbutoxy]psoralen, (–)-5-[2-(3-methylbutyroxy)-3-hydroxy-3-methylbutoxy]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 Vishwapaul, 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 caerulae 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 leaches.

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→3 or 4) [arabinose 1→4 or 3]-glucose (1→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 (Glombitza and Kurth, 1987a). Four saponins were isolated and partially characterized by Glombitza and Kurth (1987b). The aglycone of two of them was priverogenin A, while the aglycone of the other two was 3β,16α,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-oxooleanan-3β,23-diol (anagalligenone B) (Heitz et al., 1971).

Cucurbitacins isolated from the plant include cucurbitacin E, 2-*O*-β-D-glucopyranosyl-cucurbitacin 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-glucopyranosylcucurbitacn 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 telephioides 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 tetrastigma Forssk.

Arnebia tinctoria Forssk.
Lithospermum arnebia Del.
Lithospermum tetrastigma 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 cylleneus* Boiss. & Heldr., *Astragalus echidnaeformis* Sirjaev, *Astragalus elymaiticus* Boiss. & Haussk., *Astragalus globiflorus* Boiss., *Astragalus gossypinus* Fisch., *Astragalus gummifera* Lab., *Astragalus heratensis* Bunge (Indian tragacanth), *Astragalus kurdicus* Boiss., *Astragalus leiocIados* 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 butyraceae* 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. (Epie, 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-butenyl, 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 vermifuge to expel lumbricoid 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 indiacted 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→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 dehydrodiconiferyl alcohol 4-*O*-β-D-glucopyranoside, 8-epiloganic acid, 20-hydroxyecdysone, 8-hydroxygeraniol 1-β-D-glucopyranoside, liriodendrin, 6-deoxycatalpol, (+)-pinoresinol *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 C_{16} to C_{36}, 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, methyleugenol, 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 mellon) 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).

DIPLOTAXIS 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; Hondelmann 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 (Wasiur 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 neriifolia* 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 antisyphilitica* 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 rheumatism. 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 *Farseta 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.
Salicornia 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 trimethylglycine 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 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 C_{29} 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 tetrandrus* 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 dihydroperfamine, 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"-epoxyoctyloxy]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 μg/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 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 eichwaldi* 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 3β-*O*-glucuronide, 16α-hydroxymedicagenic acid, medicagenic acid, and medicagenic acid 3β-*O*-glucuronide and its 16α-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.

Hyocsyamus 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 apoatropine, 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 faleslez* 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 (±)-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), refering 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 thouini (Viv.) Kuntze

Statice thouini (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 afra 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 halamifolium* 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 emolient.

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 forskahlei* 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**

Moltokiopsis ciliata (Forssk.) I.M. Johnston

Lithospermum angustifolium Forssk.
Lithospermum callosum Vahl
Lithospermum callosum Vahl var. *asperrimum* Bornm.
Lithospermum ciliatum Forssk.
Moltkia callosa (Vahl) Wettst.
Moltkia 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-galactorhamnogalactoside, 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 bicorne (Aiton) Amo

Erysimum bicorne 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.

ONOBRYCHIS 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-hydroxypipecolic 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→4")-gluco-(1→6")-6'''-*O*-acetylsophoriside] (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, deoxyvasicinone, and vasicinone (Kurbanov and Zharekeev, 1974; Batsuren et al., 1980). Deoxypeganine, deoxyvasicinone, 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

Pituranthos 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-methoxypsoralen 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 C_{16} to C_{19} 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-dihydroisoromerialinone, (–)-isoorientalinone, (–)-isoroemerialinone, (–)-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, vicenin 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 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-3β-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 asparagoides* 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, 7β-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 carnosoate (Al-Hazimi, 1986), 3β-hydroxyoleanan-13β→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 & Jativá 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 miltiorhiza* 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. Mucillage from the fruit of *Salvia pratensis* L. (Meadow sage) has been used to treat ophthalmic disorders. *Salvia tiliaefolia* 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

Schimpera arabica Hochst. & Steudel ex Boiss.

> *Schimpera 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 virginiaca* 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 (Raie 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), refering 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

Teucreum 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, gonorrhea, 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-diglucorhamnoside (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-diosgenin, 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-gentiotrioside, 3-gentiotrioside-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-gentiotrioside, 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 suavissima* 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 Forssk.
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 LD_{50} 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.

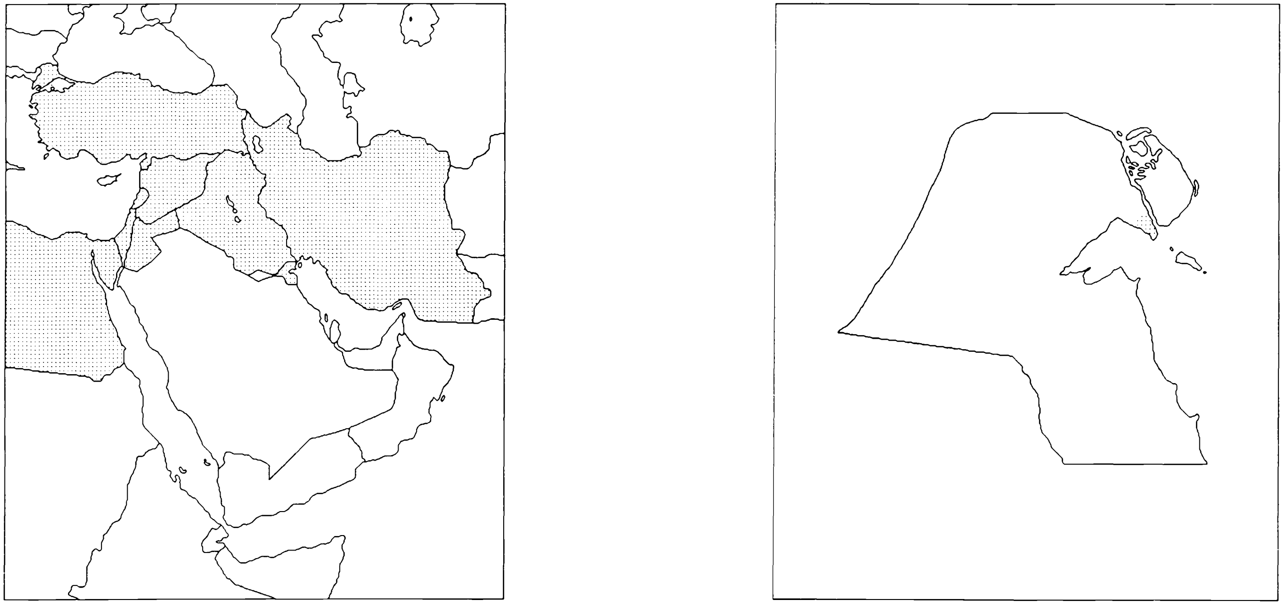


Figure 1. Geographic distribution of *Adonis dentatus* Del.

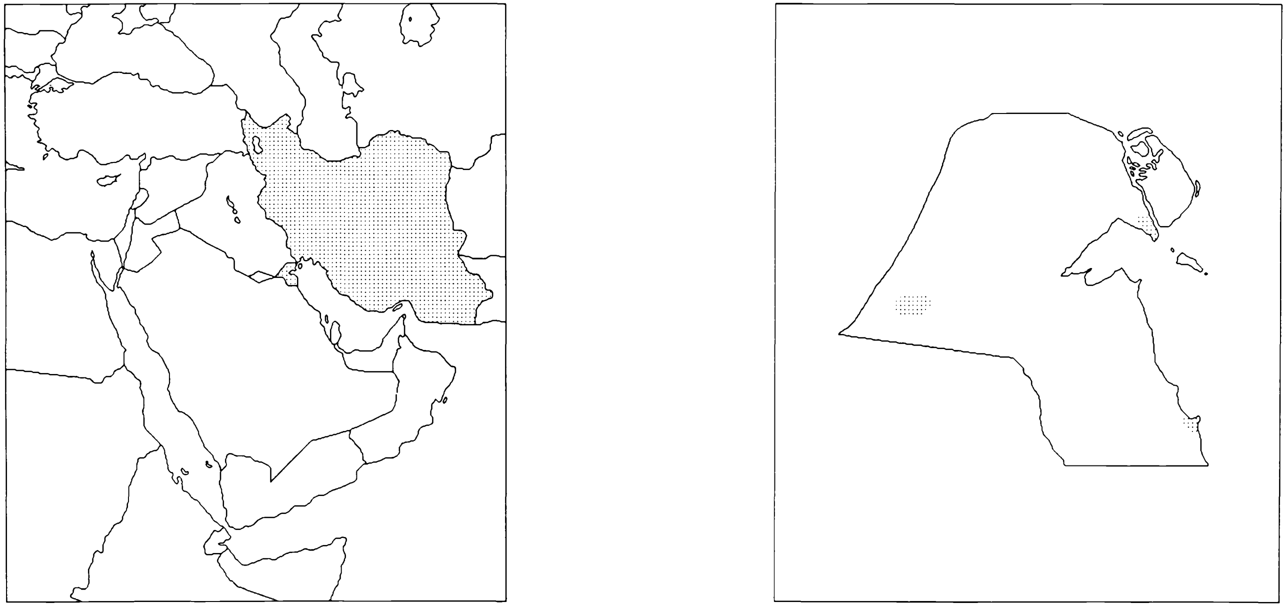


Figure 2. Geographic distribution of *Aellenia glauca* (M.B.) Aellen.

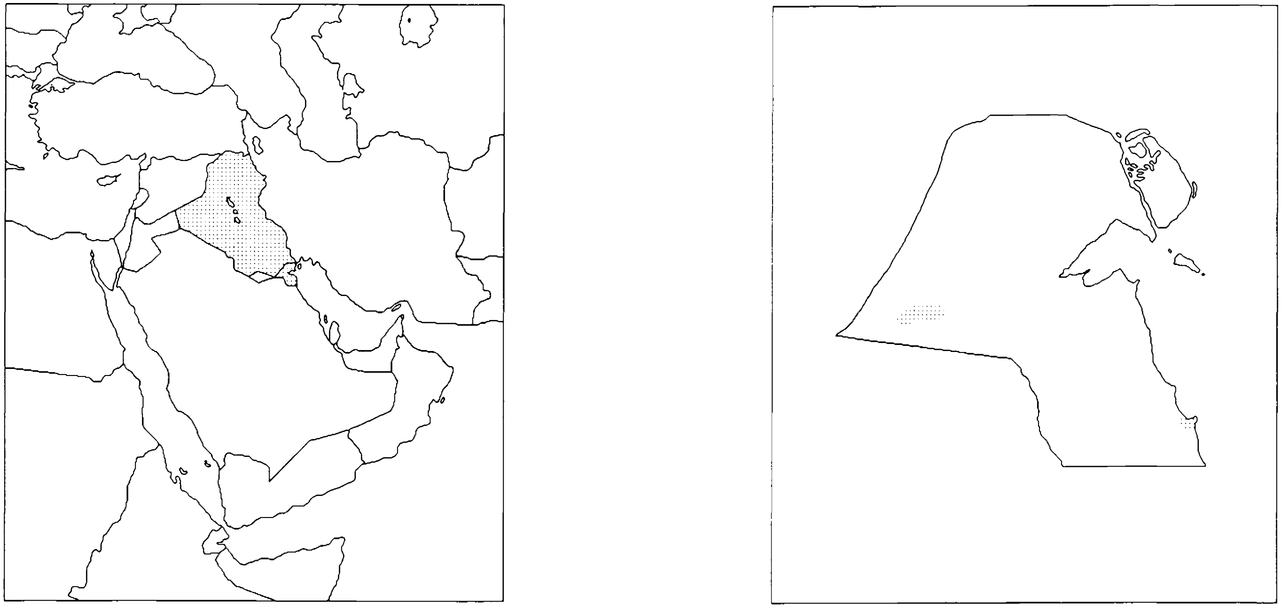


Figure 3. Geographic distribution of *Aellenia subaphylla* (C.A. Mey.) Botsch.

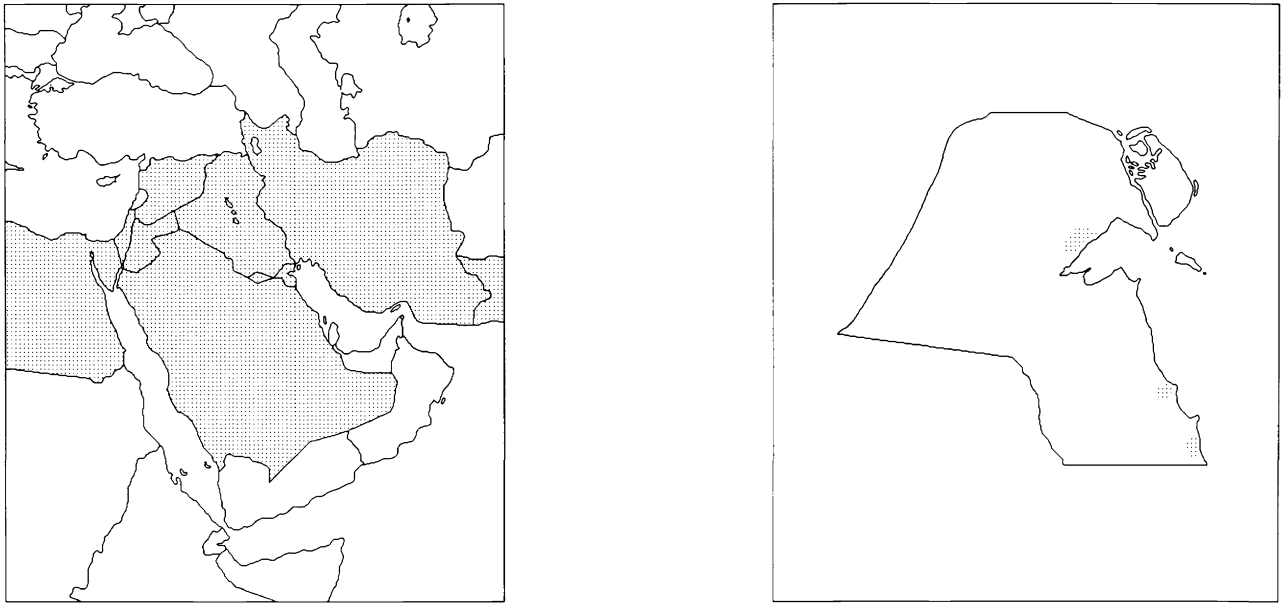


Figure 4. Geographic distribution of *Aizoon canariense* L.

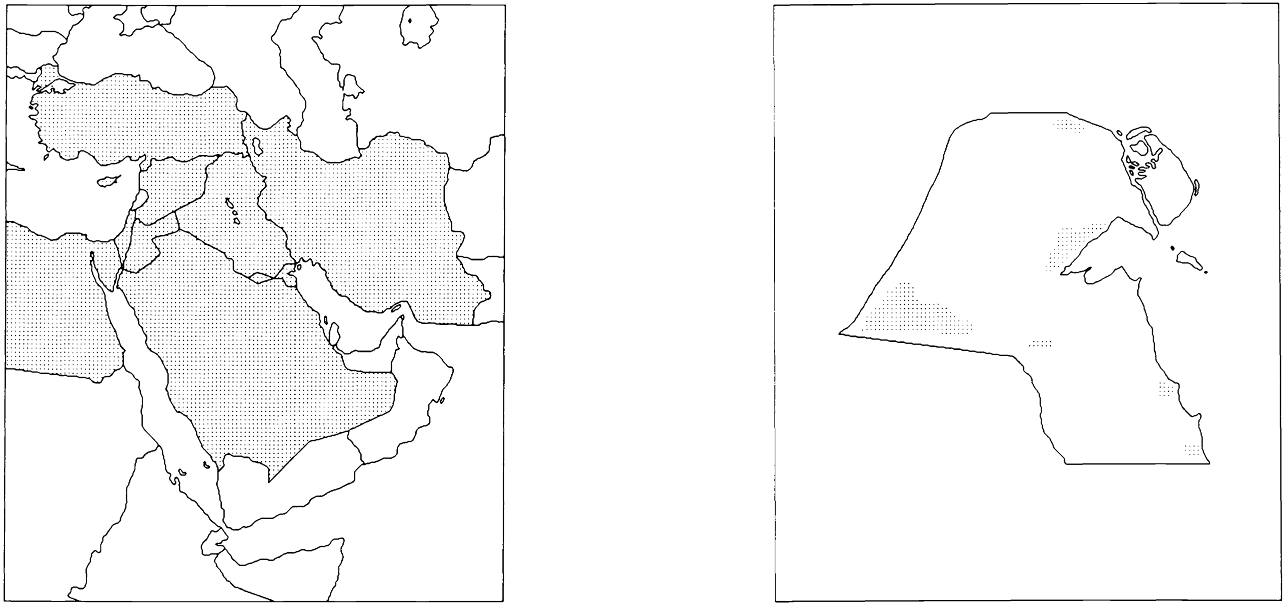


Figure 5. Geographic distribution of *Aizoon hispanicum* L.

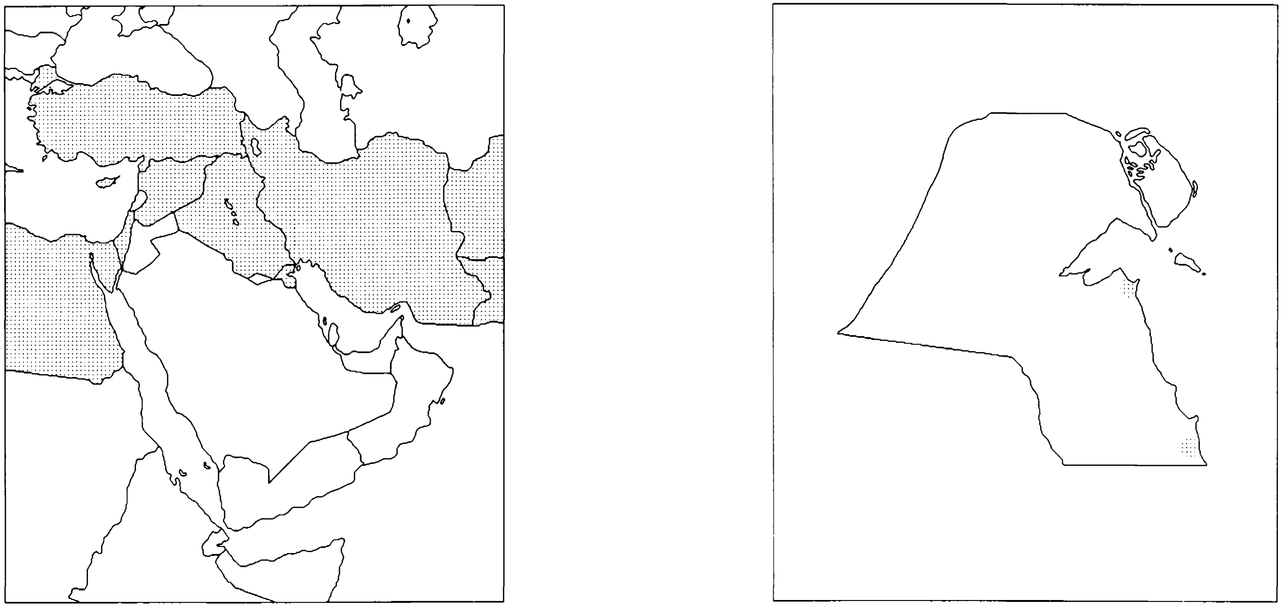


Figure 6. Geographic distribution of *Alhagi maurorum* Medik.—non DC.

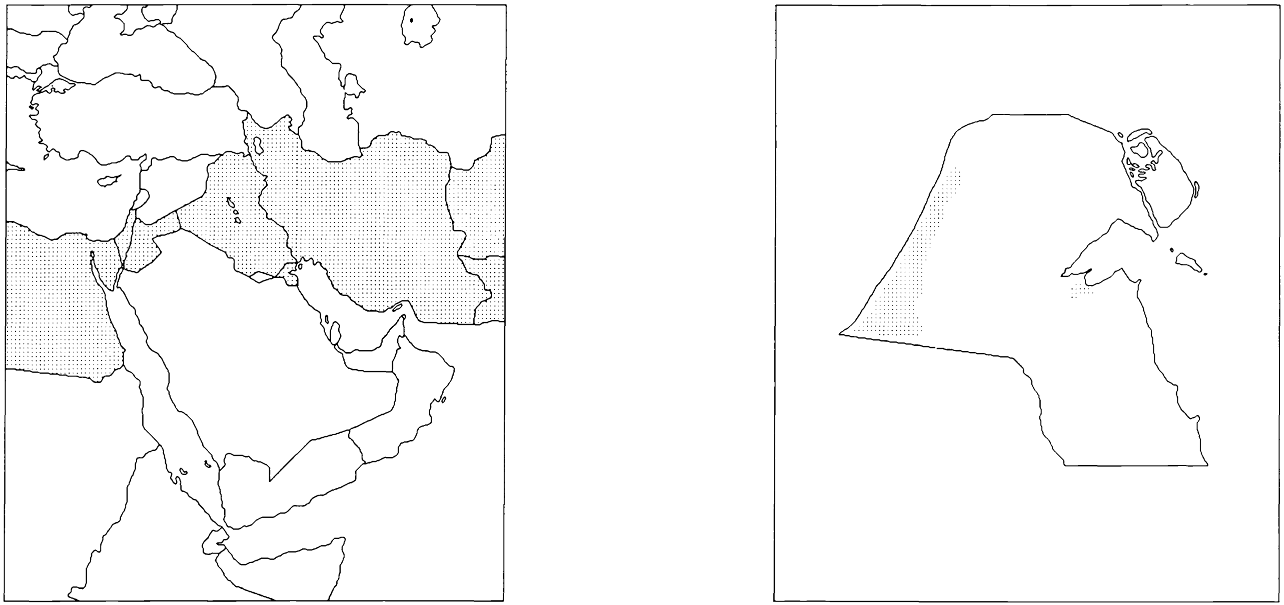


Figure 7. Geographic distribution of *Althaea ludwigii* L.

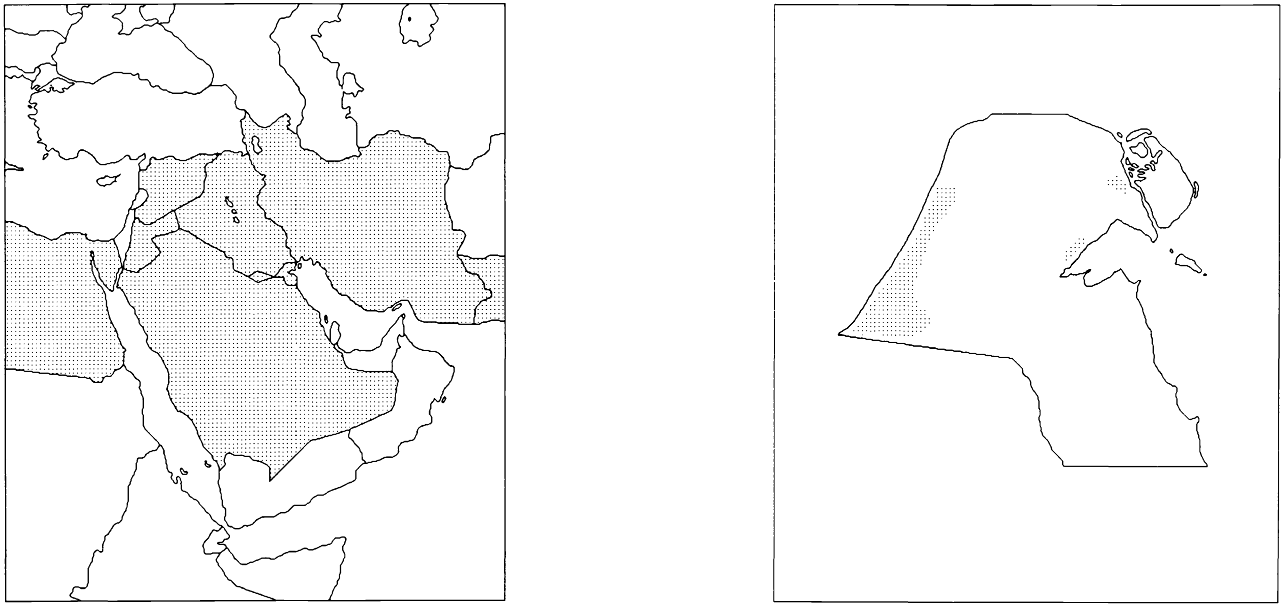


Figure 8. Geographic distribution of *Alyssum homalocarpum* (Fisch. & Mey.) Boiss.

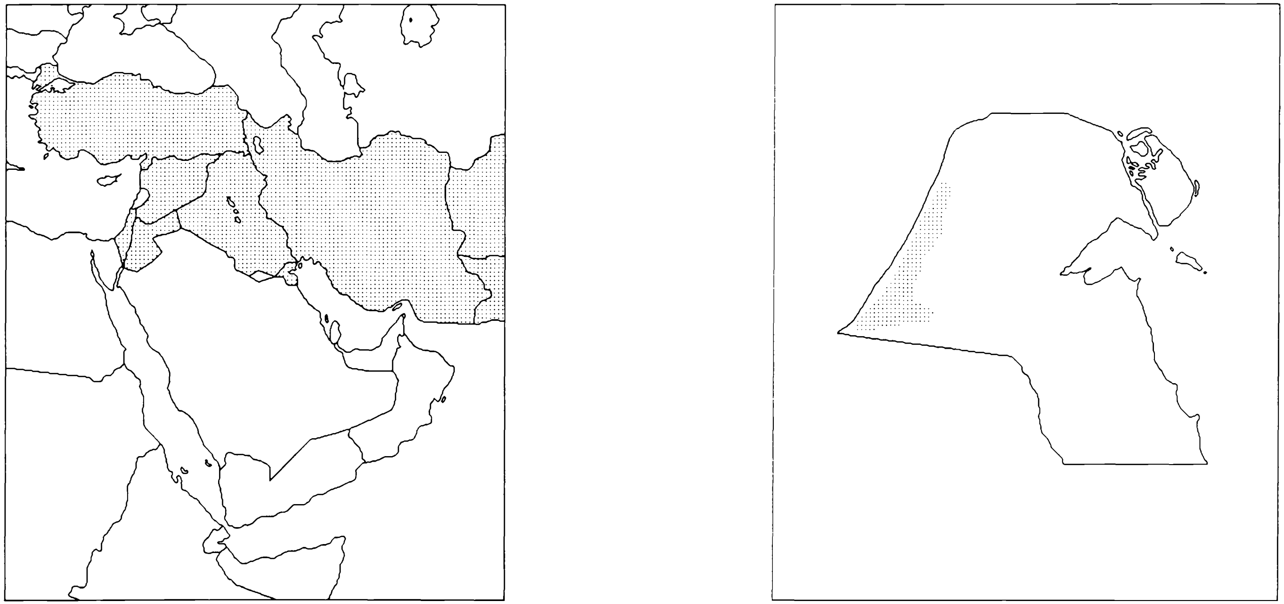


Figure 9. Geographic distribution of *Alyssum linifolium* Steph. ex Willd.

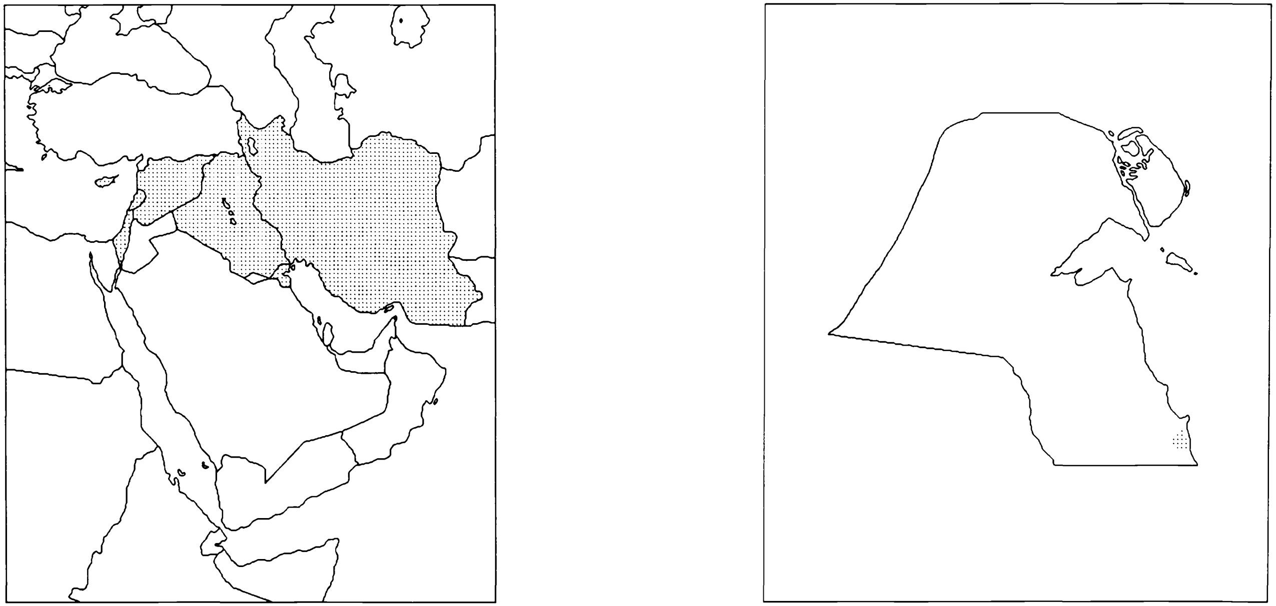


Figure 10. Geographic distribution of *Ammi majus* L.

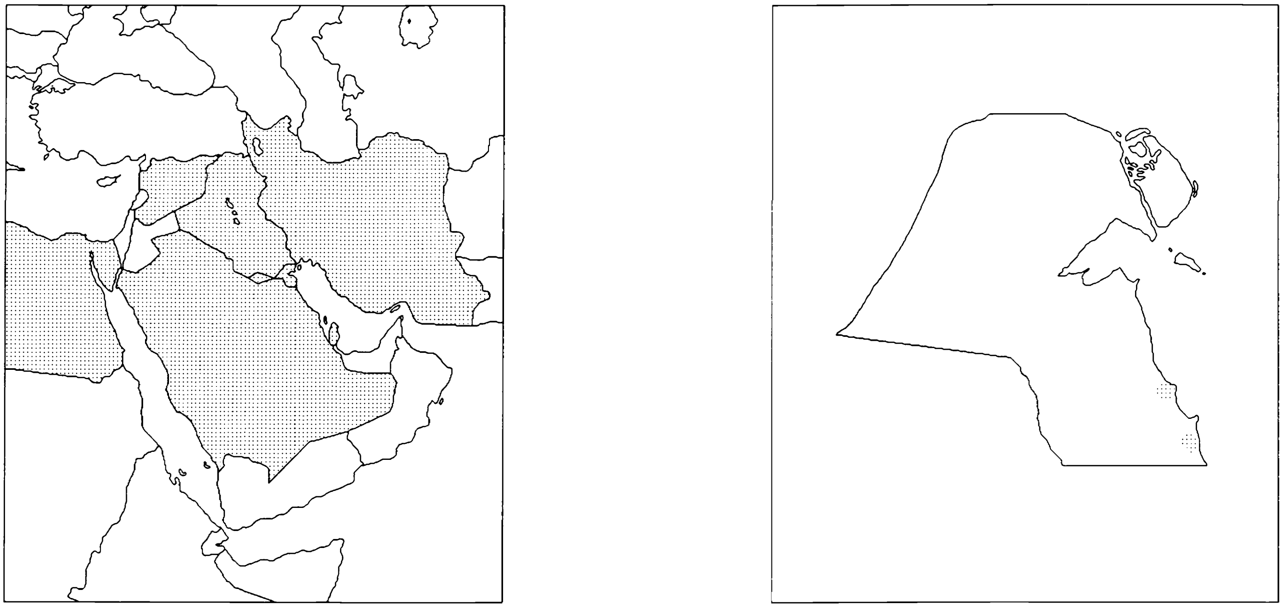


Figure 11. Geographic distribution of *Anabasis setifera* Moq.

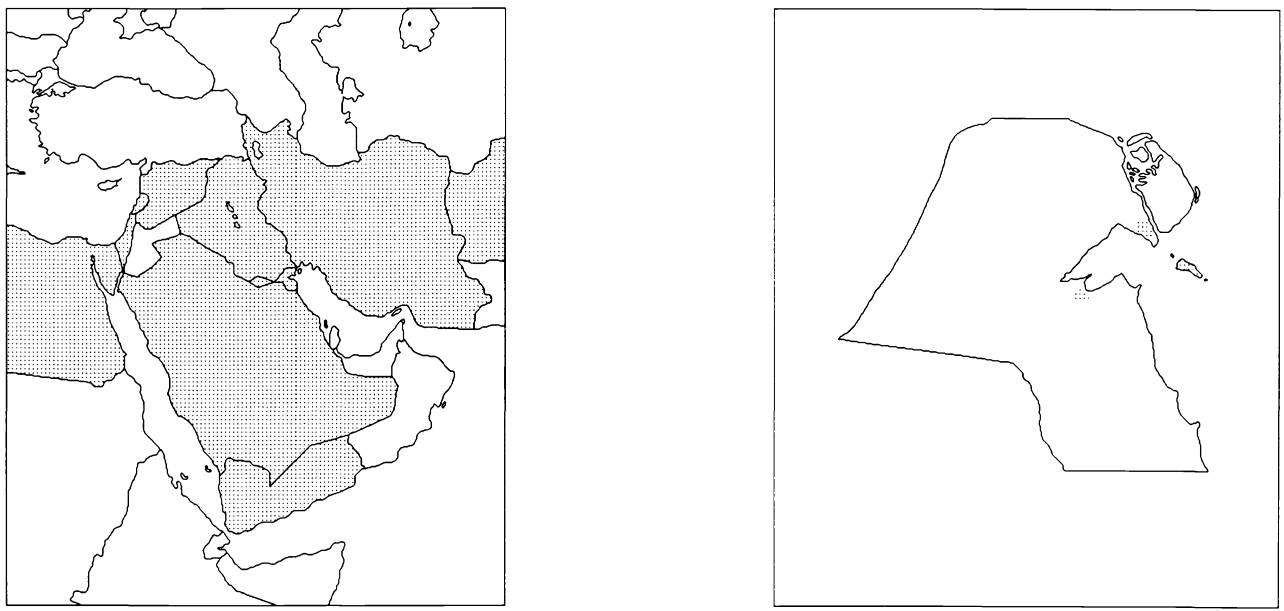


Figure 12. Geographic distribution of *Anagallis arvensis* L.

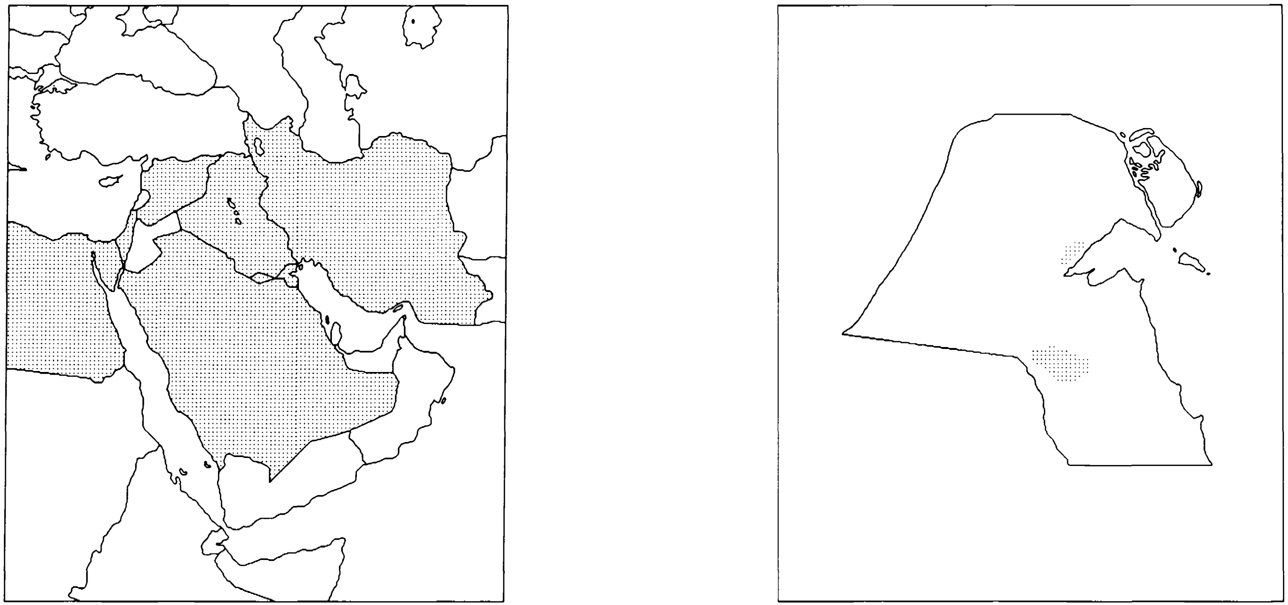


Figure 13. Geographic distribution of *Anastatica hierochuntica* L.

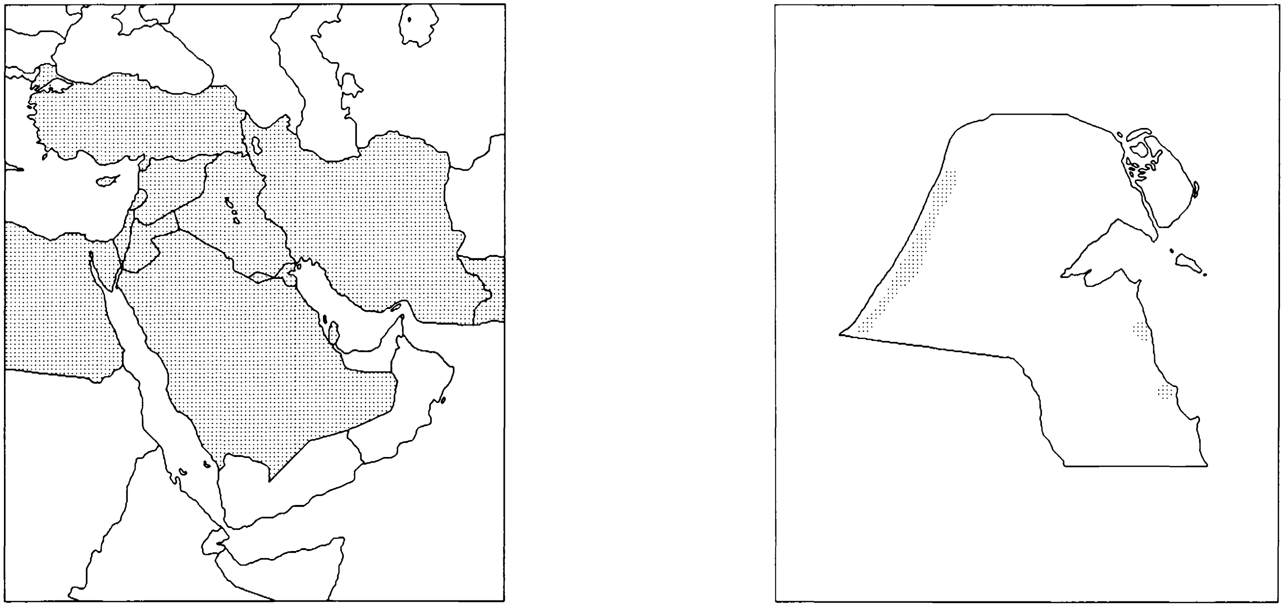


Figure 14. Geographic distribution of *Andrachne telephioides* L.

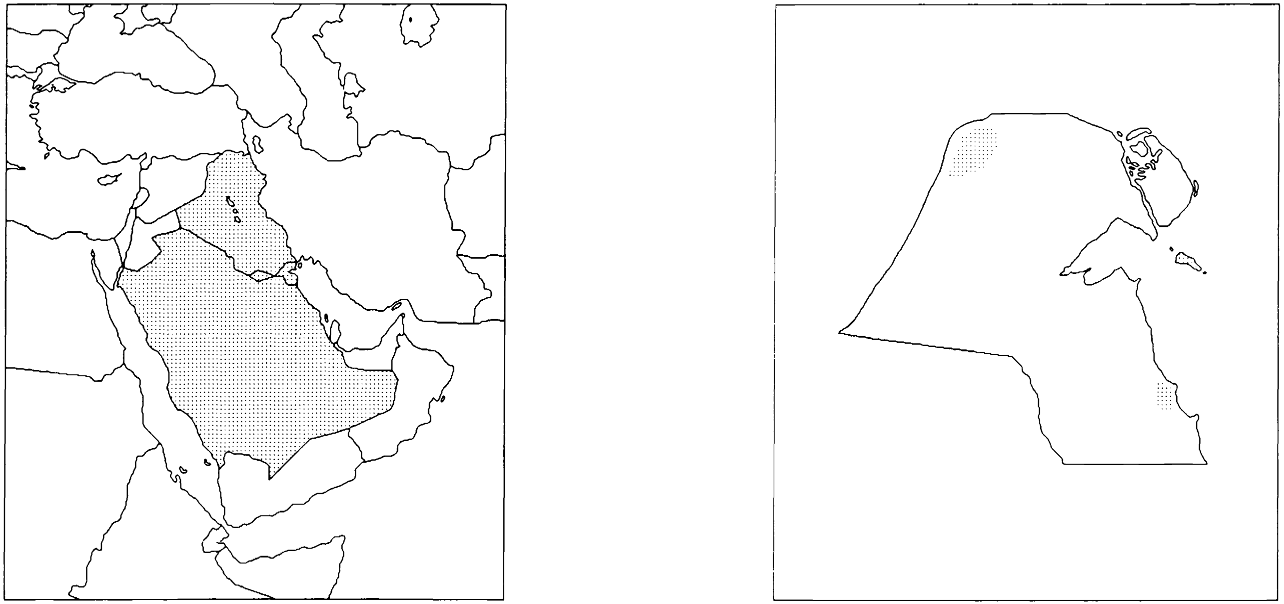


Figure 15. Geographic distribution of *Anisosciadium lanatum* Boiss.

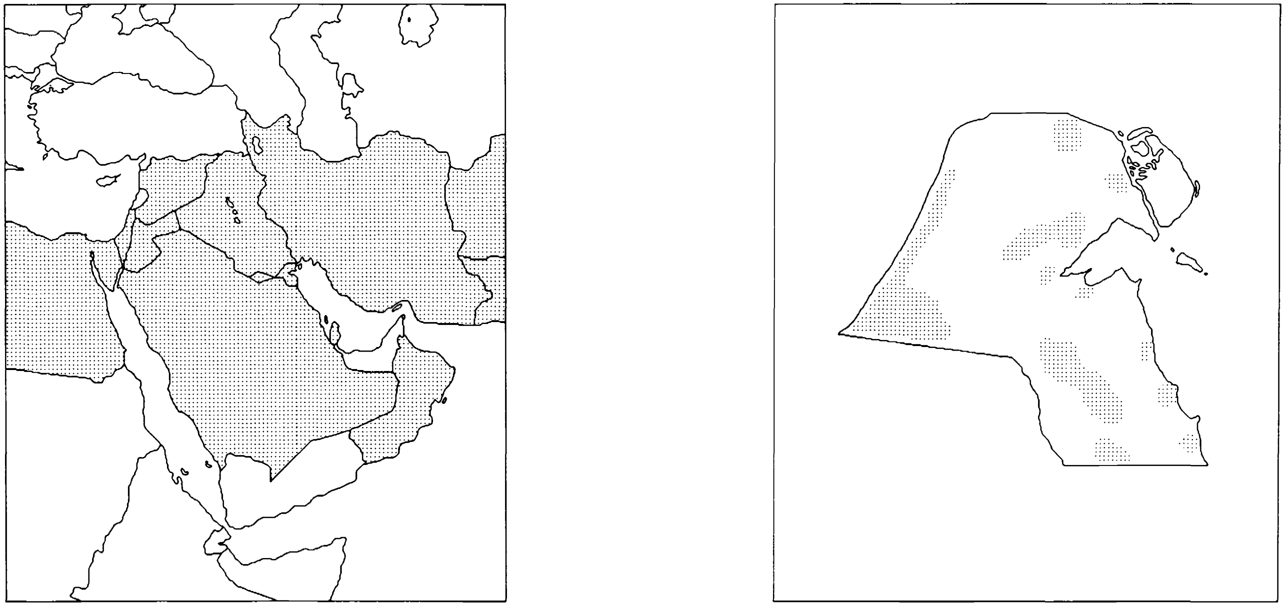


Figure 16. Geographic distribution of *Arnebia decumbens* (Vent.) Coss. & Kral.

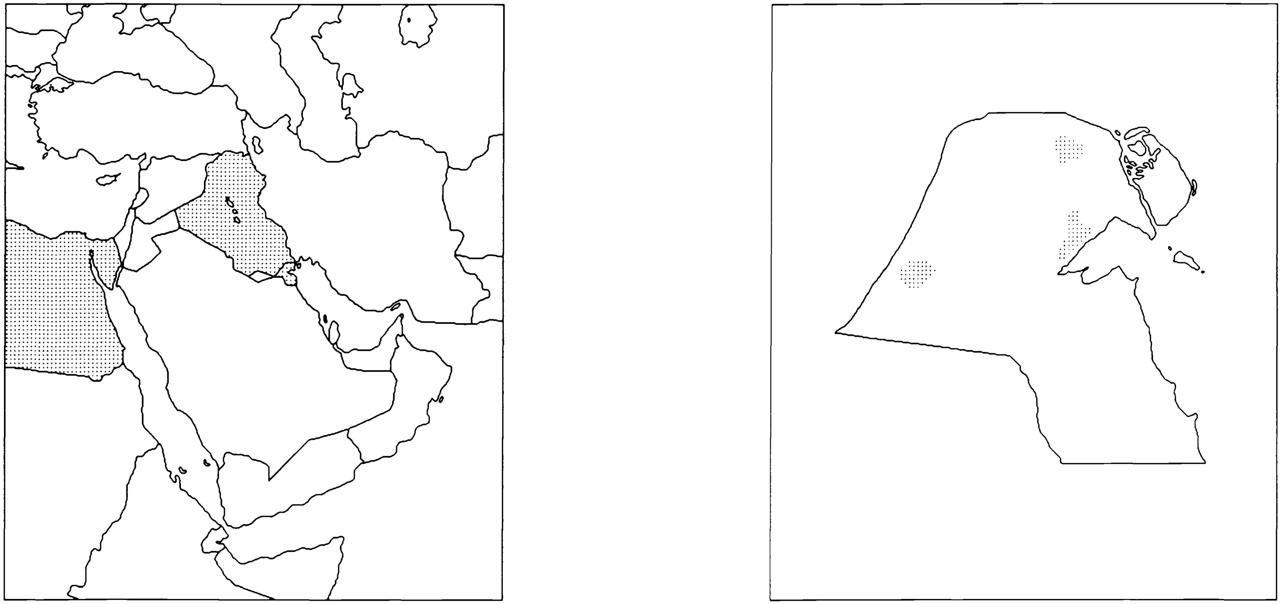


Figure 17. Geographic distribution of *Arnebia tetrastigma* Forssk.

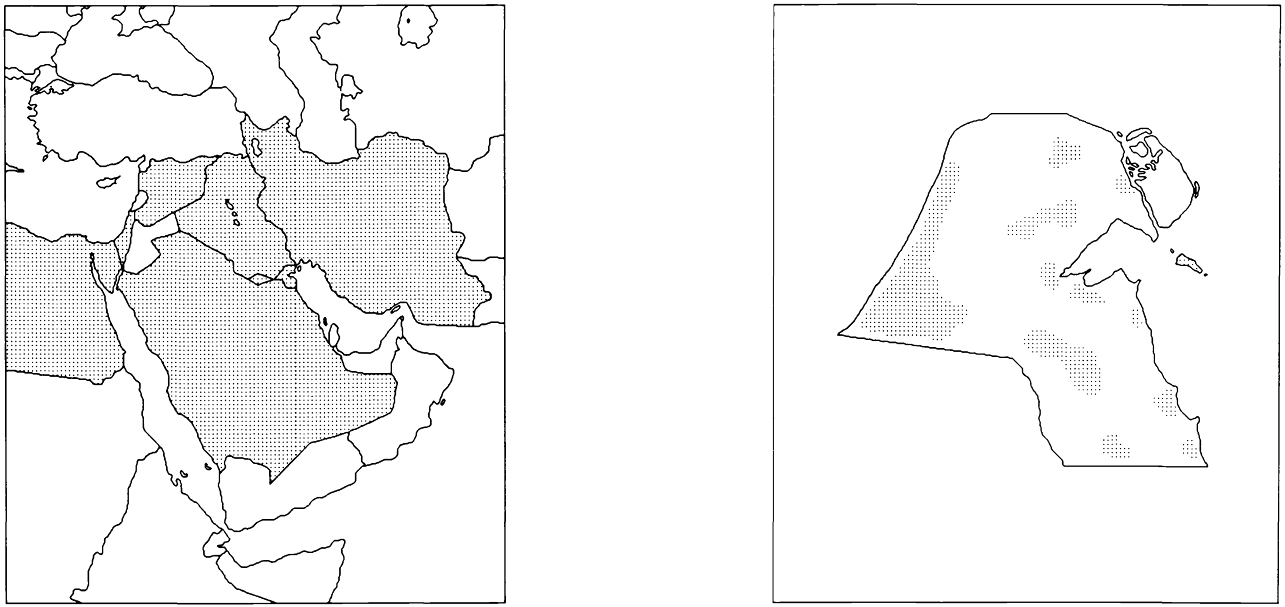


Figure 18. Geographic distribution of *Astragalus annularis* Forssk.

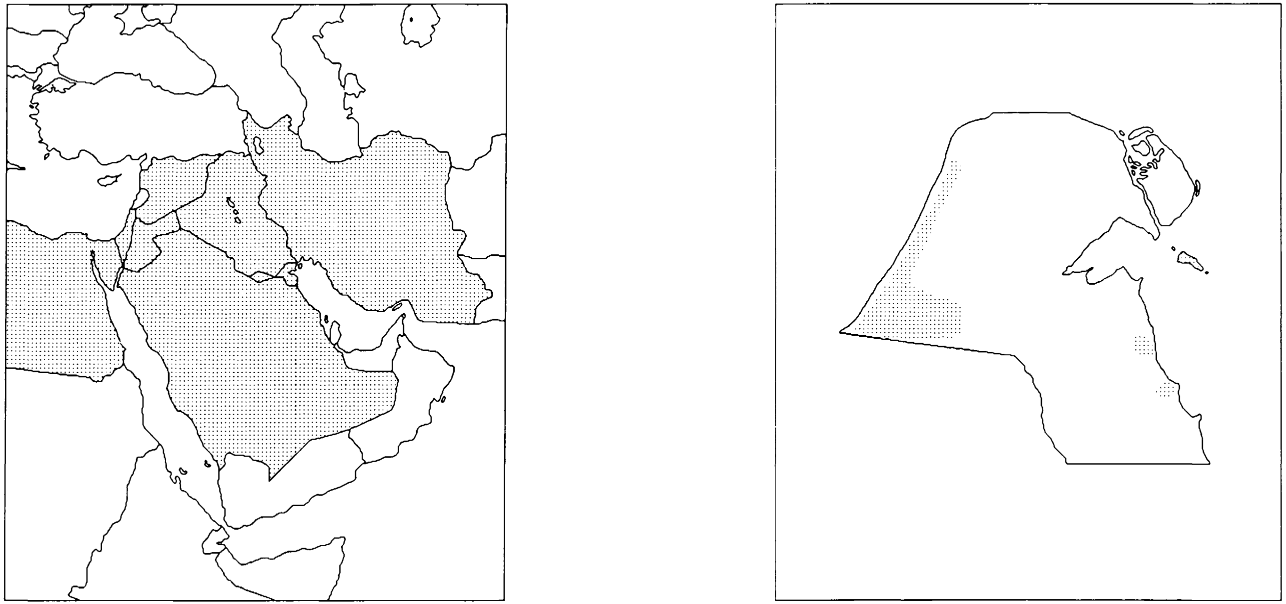


Figure 19. Geographic distribution of *Astragalus bombycinus* Boiss.

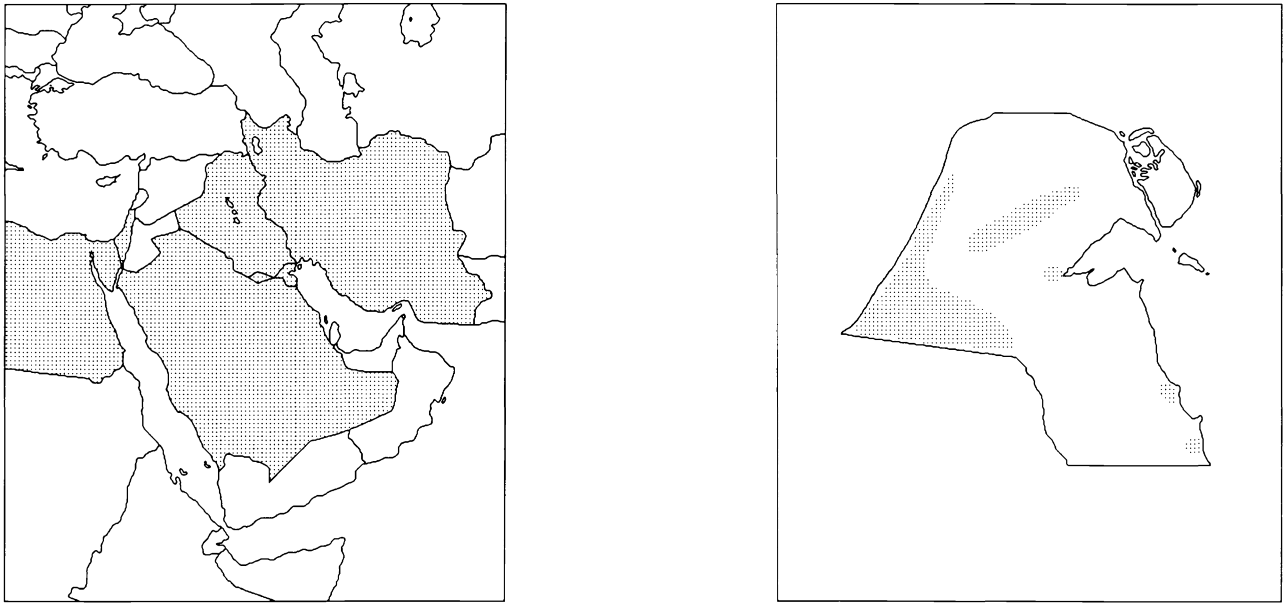


Figure 20. Geographic distribution of *Astragalus corrugatus* Boiss.

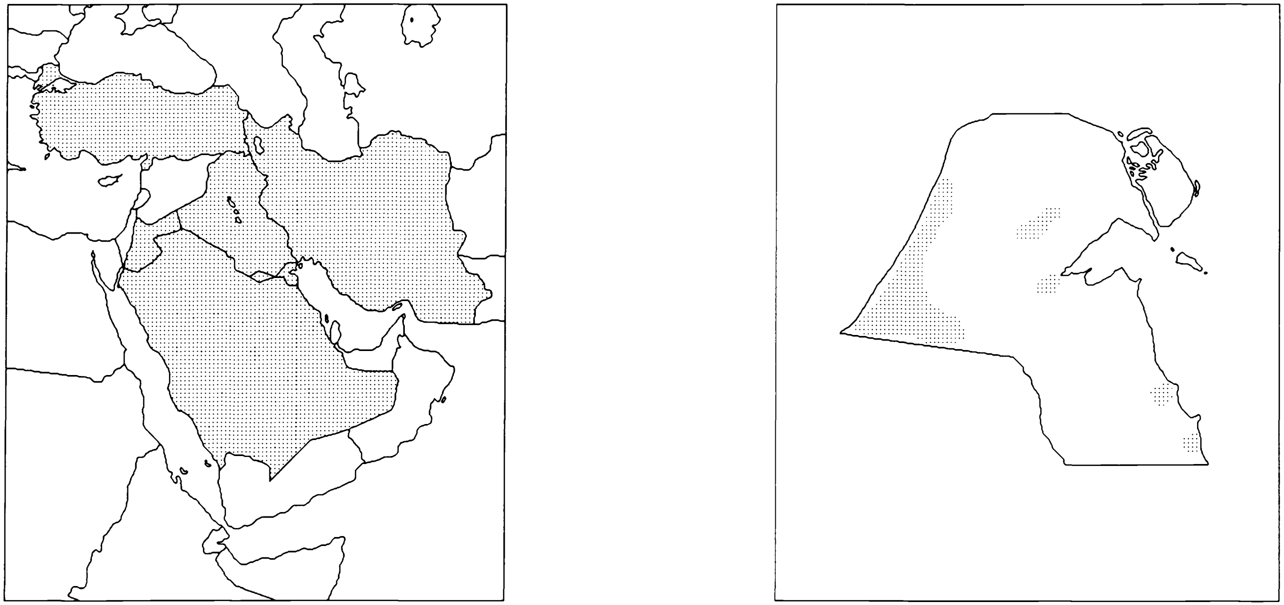


Figure 21. Geographic distribution of *Astragalus dactylocarpus* Bertol.

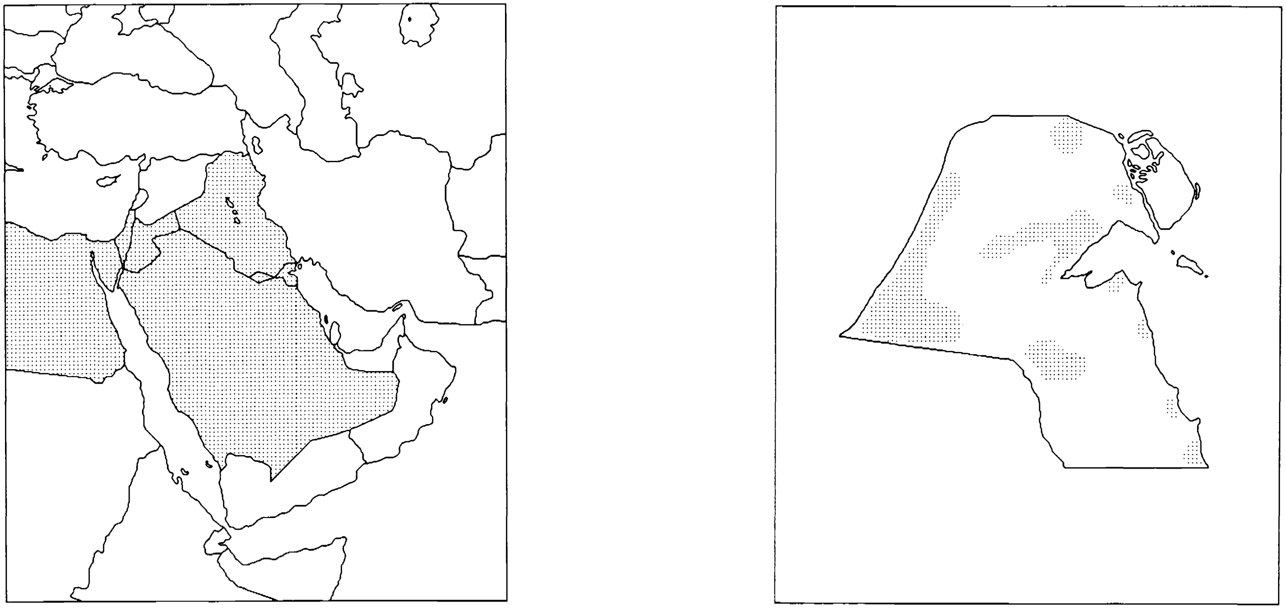


Figure 22. Geographic distribution of *Astragalus hauarensis* Boiss.

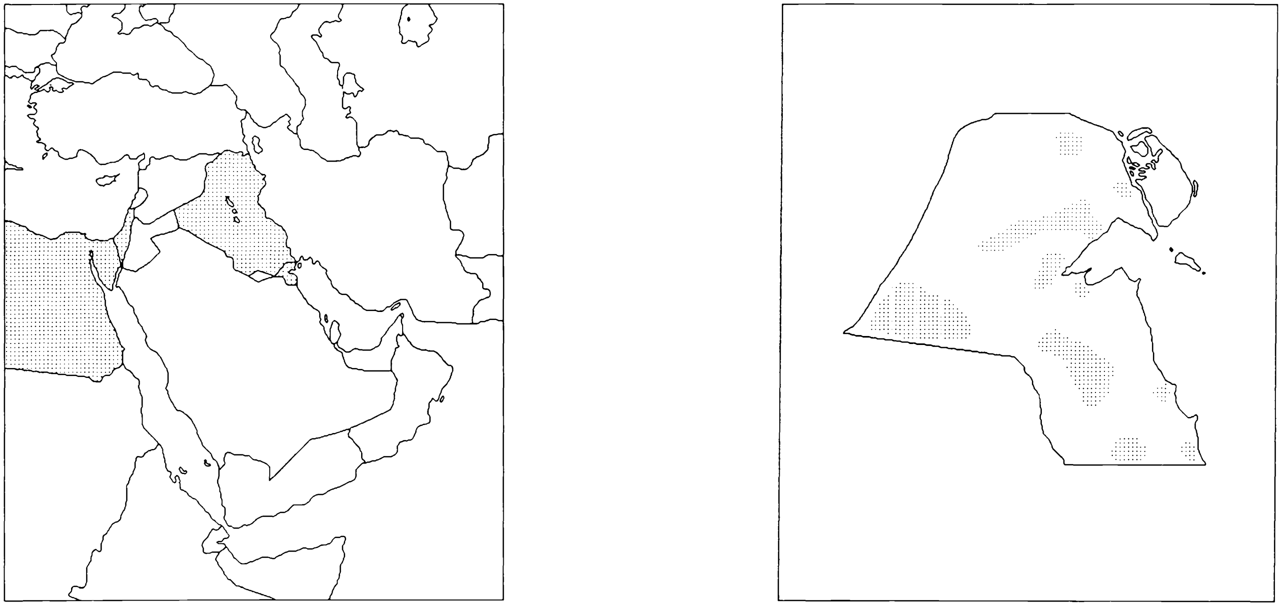


Figure 23. Geographic distribution of *Astragalus schimperi* Boiss.

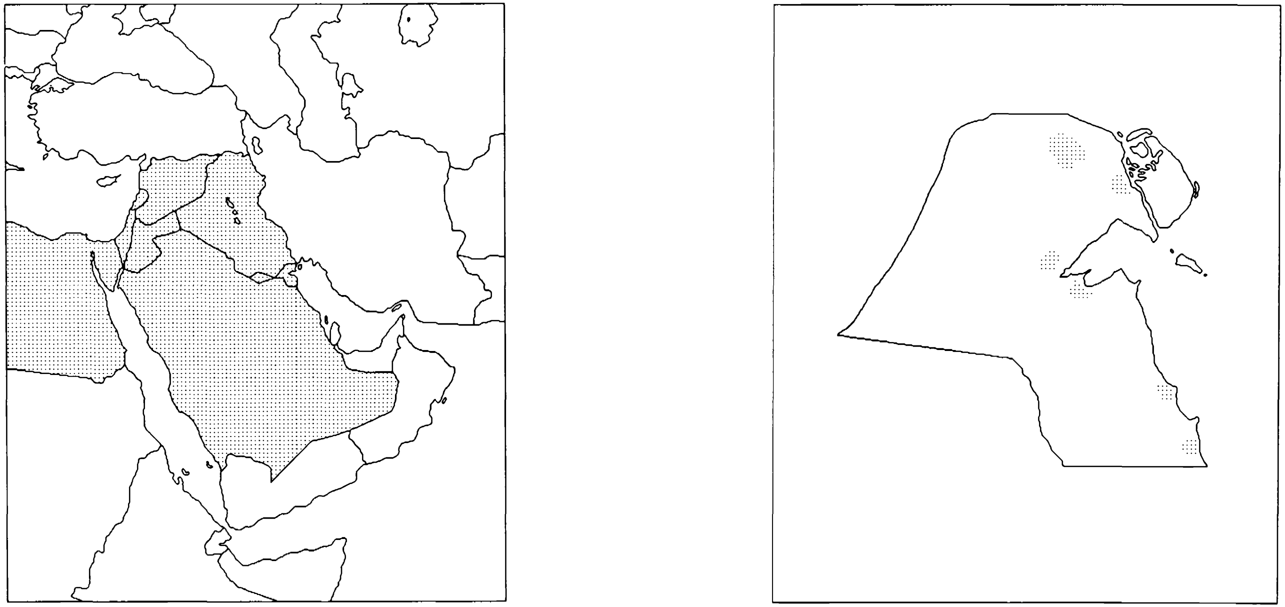


Figure 24. Geographic distribution of *Astragalus spinosus* (Forssk.) Muschl.

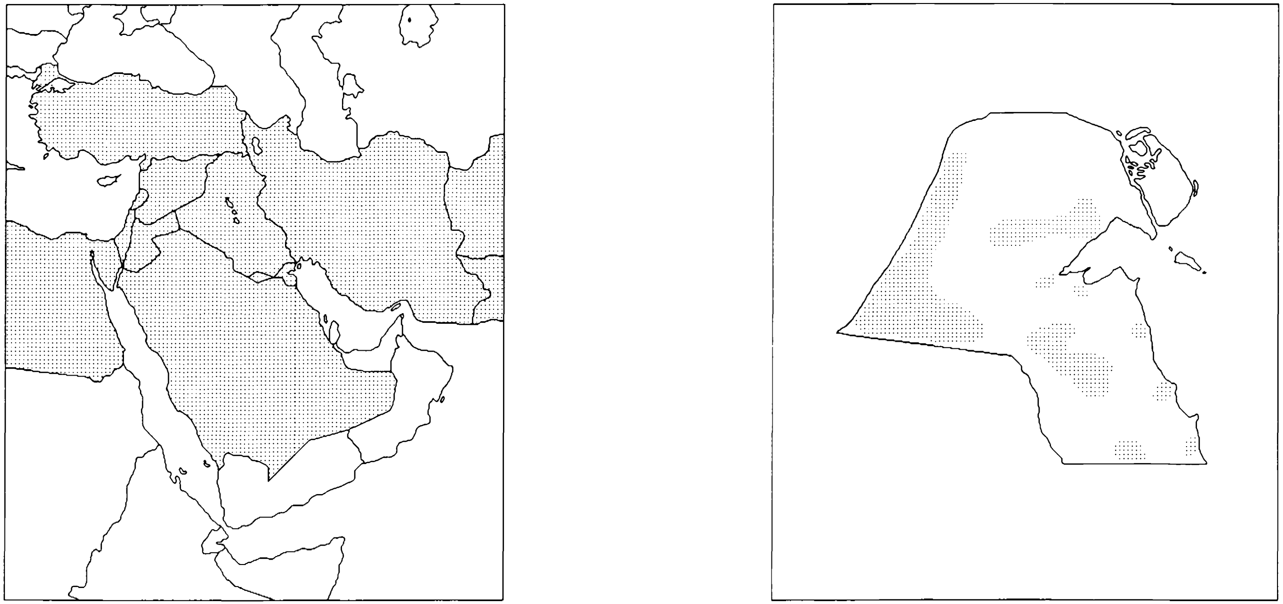


Figure 25. Geographic distribution of *Astragalus tribuloides* Del.

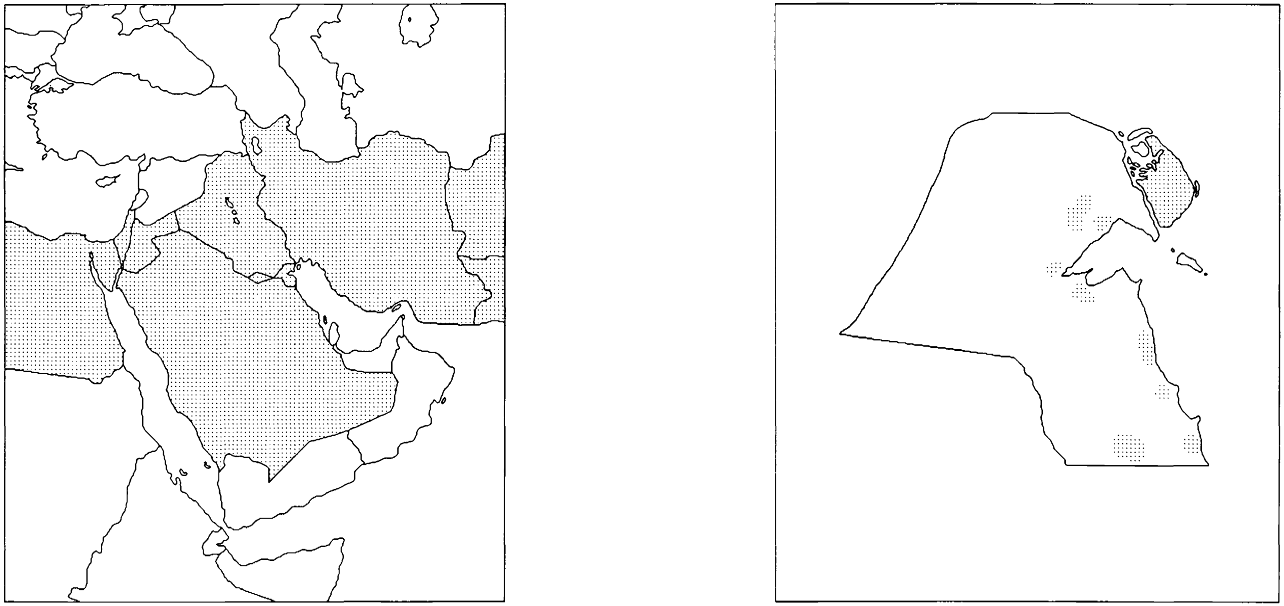


Figure 26. Geographic distribution of *Atriplex dimorphostegia* Boiss.

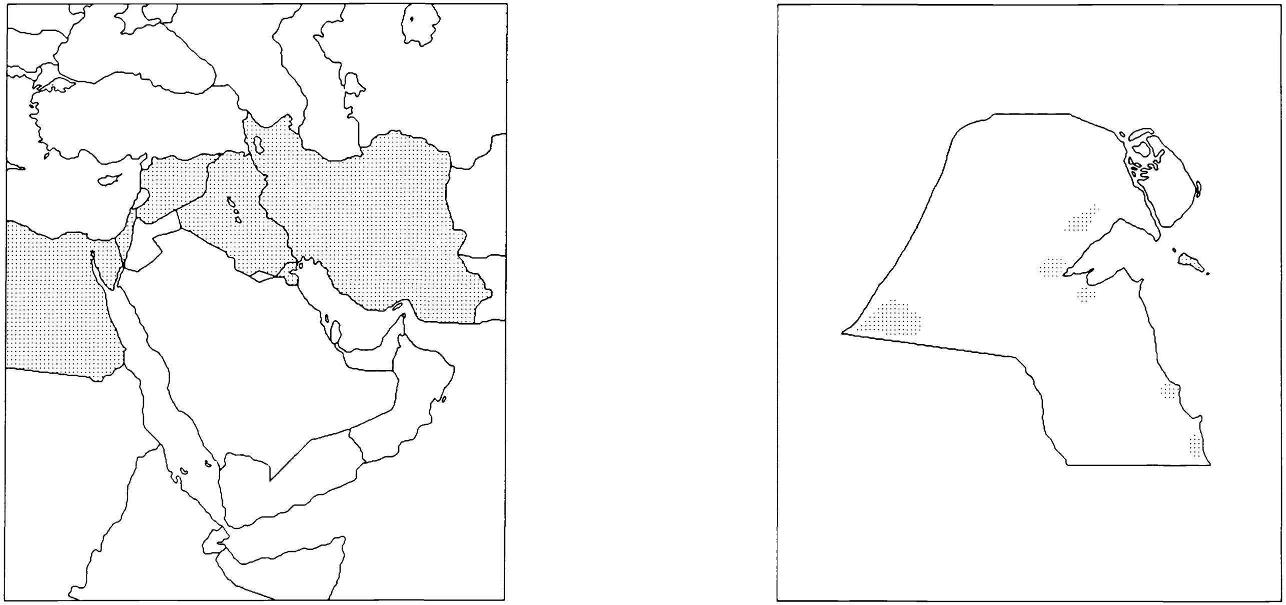


Figure 27. Geographic distribution of *Atriplex leucoclada* Kar. & Kir.

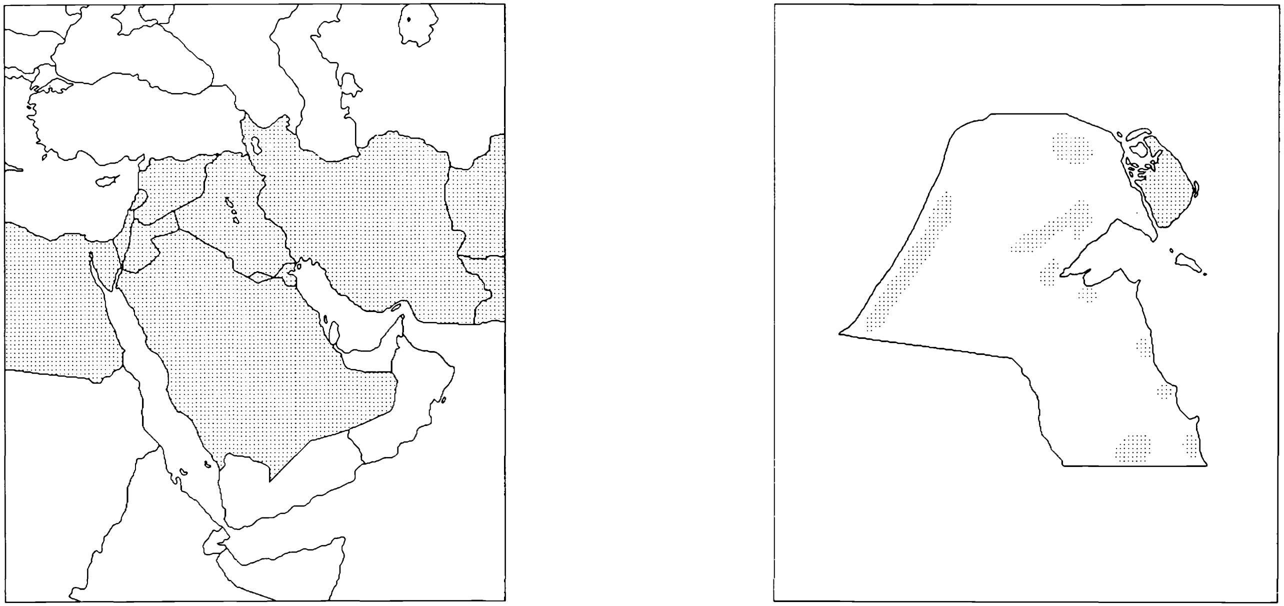


Figure 28. Geographic distribution of *Bassia eriophora* (Schrad.) Aschers.

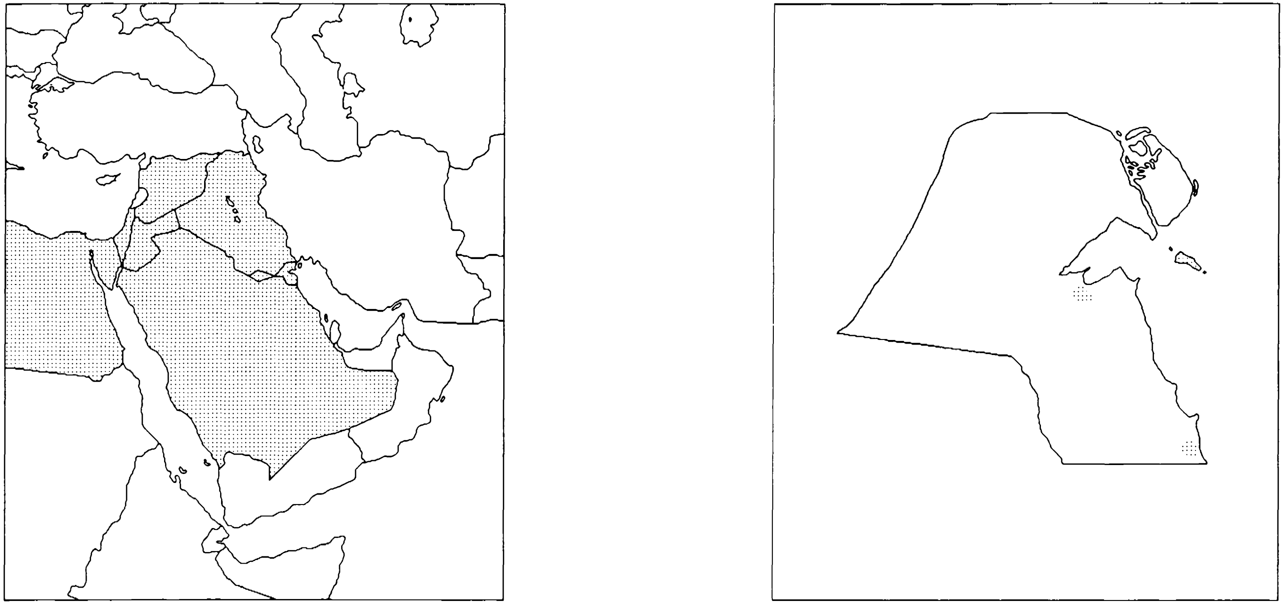


Figure 29. Geographic distribution of *Bassia muricata* (L.) Aschers.

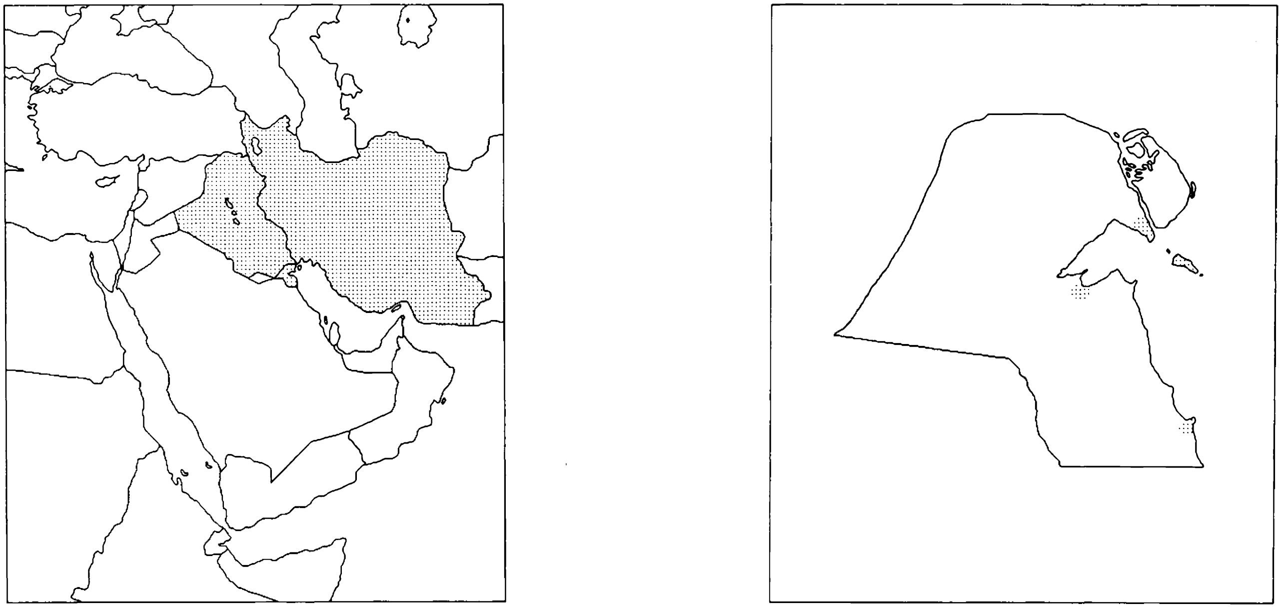


Figure 30. Geographic distribution of *Bienertia cycloptera* Bunge ex Boiss.

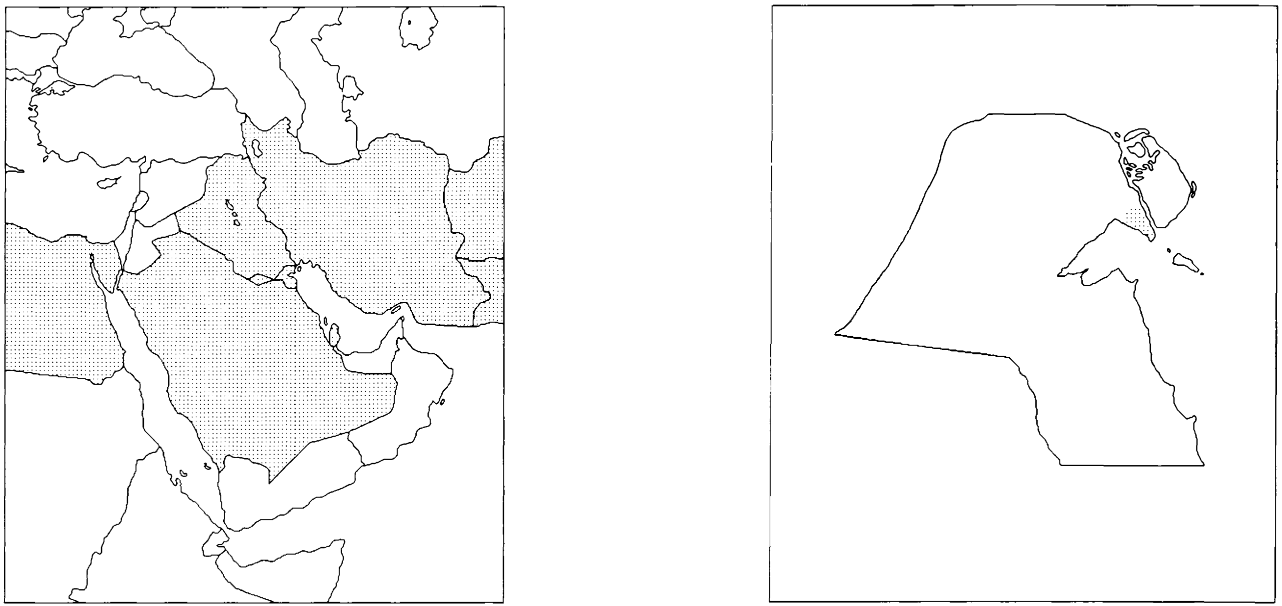


Figure 31. Geographic distribution of *Brassica juncea* (L.) Czerniak.

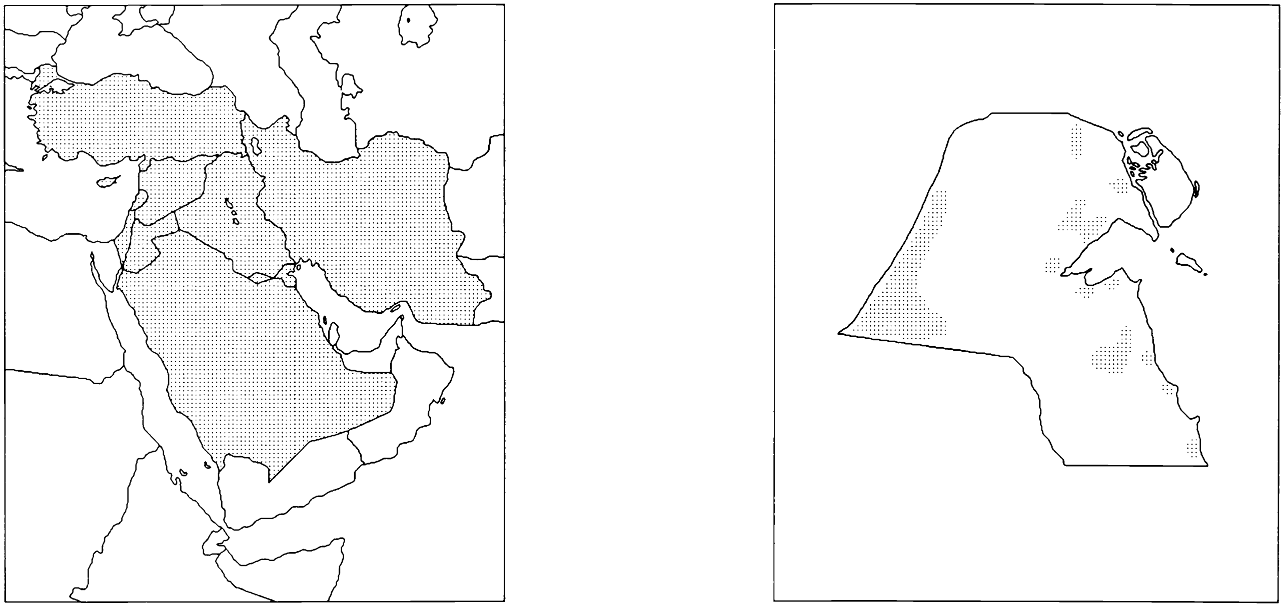


Figure 32. Geographic distribution of *Brassica tournefortii* Gouan.

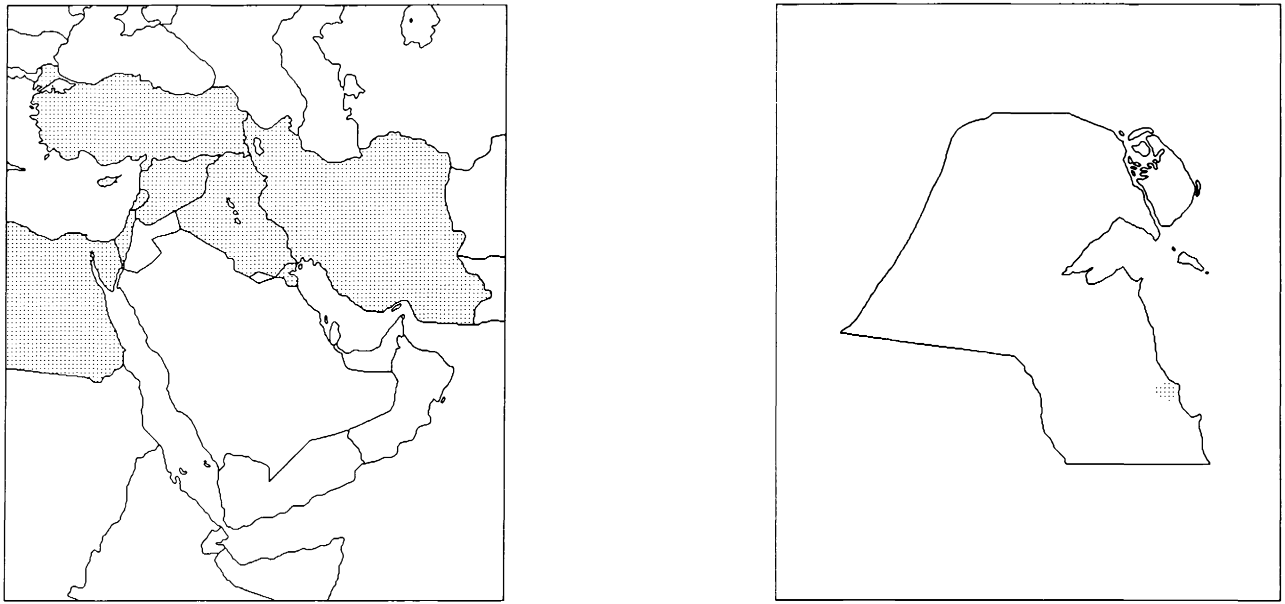


Figure 33. Geographic distribution of *Bupleurum semicompositum* L.

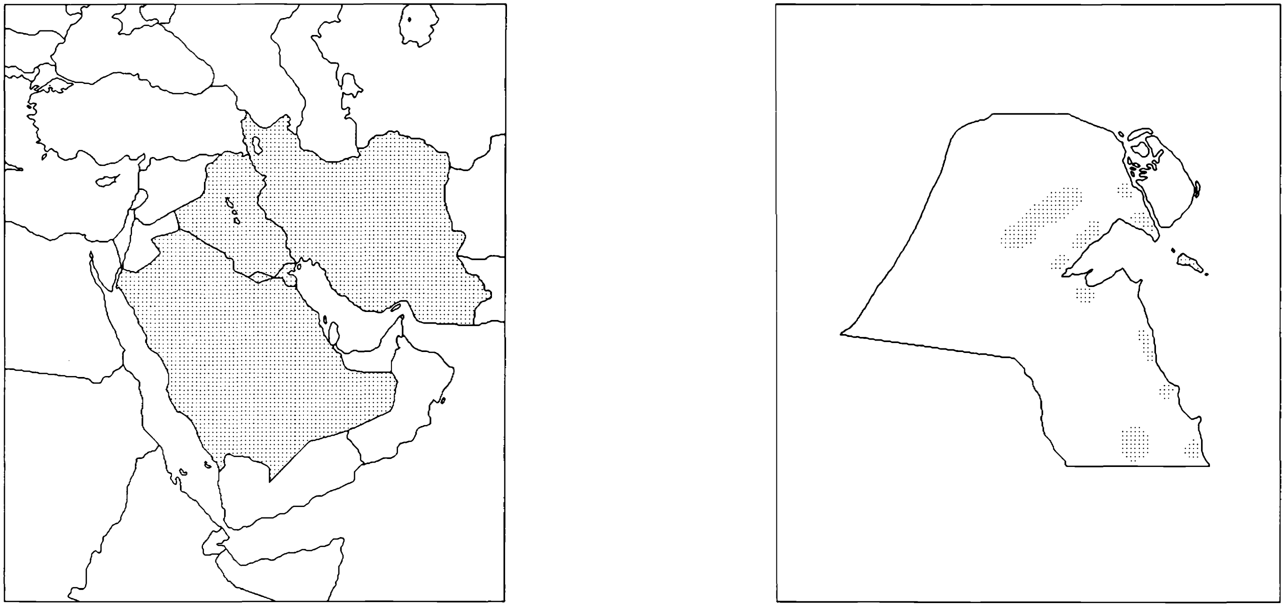


Figure 34. Geographic distribution of *Cakile arabica* Velen. & Bornm.

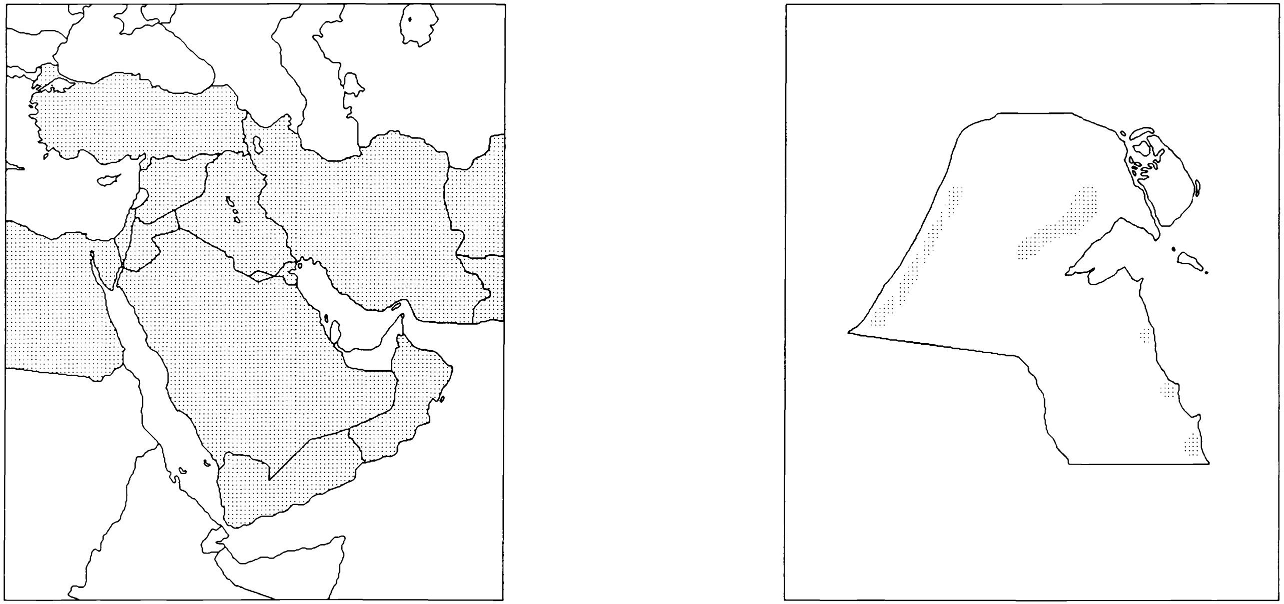


Figure 35. Geographic distribution of *Calligonum comosum* L'Hér.

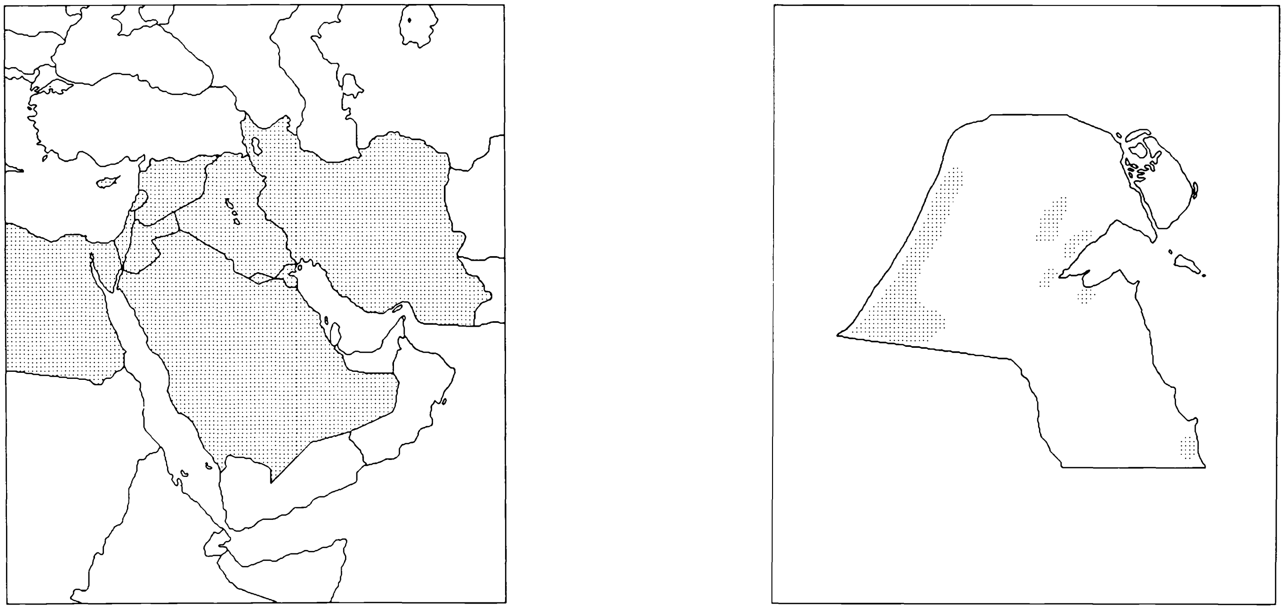


Figure 36. Geographic distribution of *Carrichtera annua* (L.) DC.

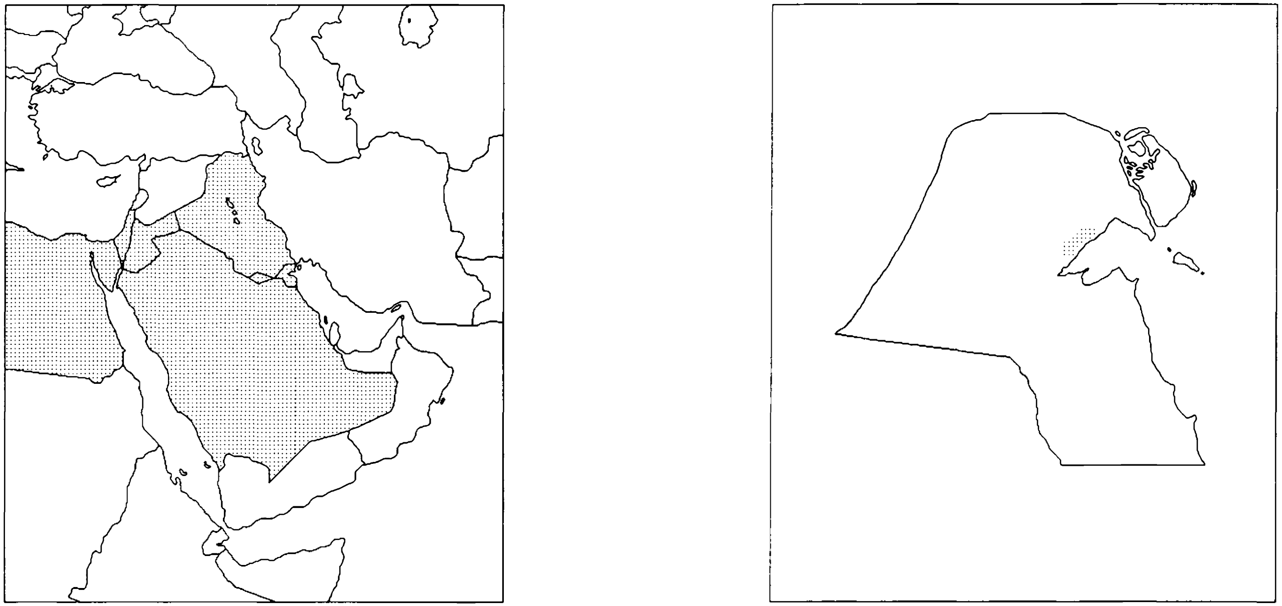


Figure 37. Geographic distribution of *Caylusea hexagyna* (Forssk.) M.L. Green.

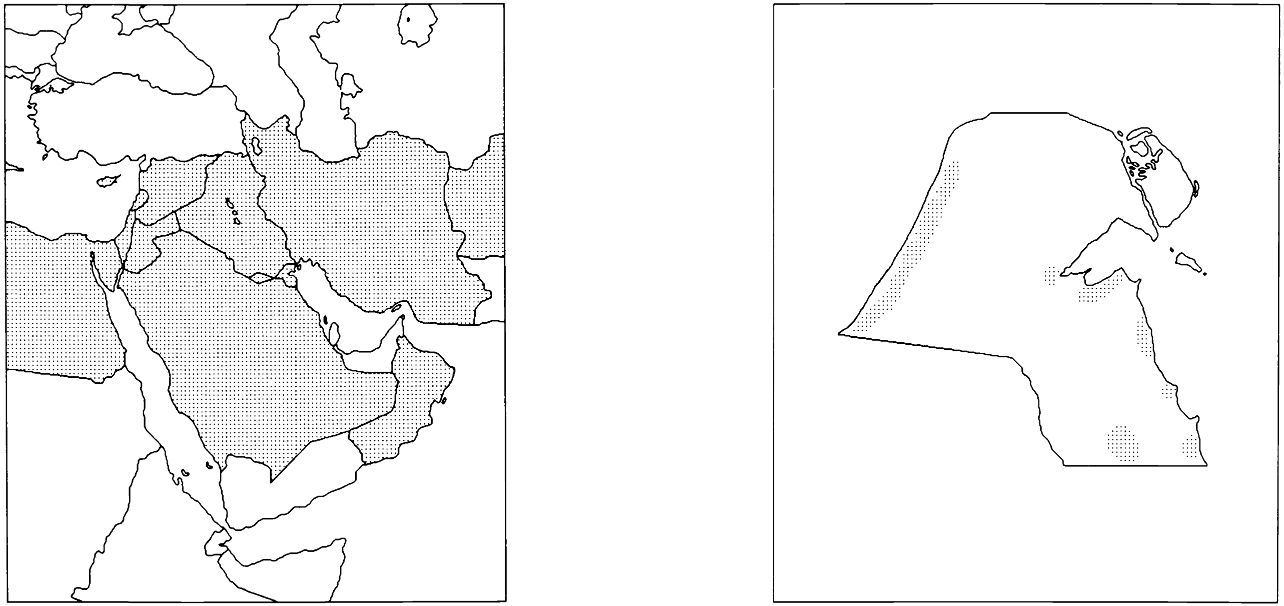


Figure 38. Geographic distribution of *Chenopodium murale* L.

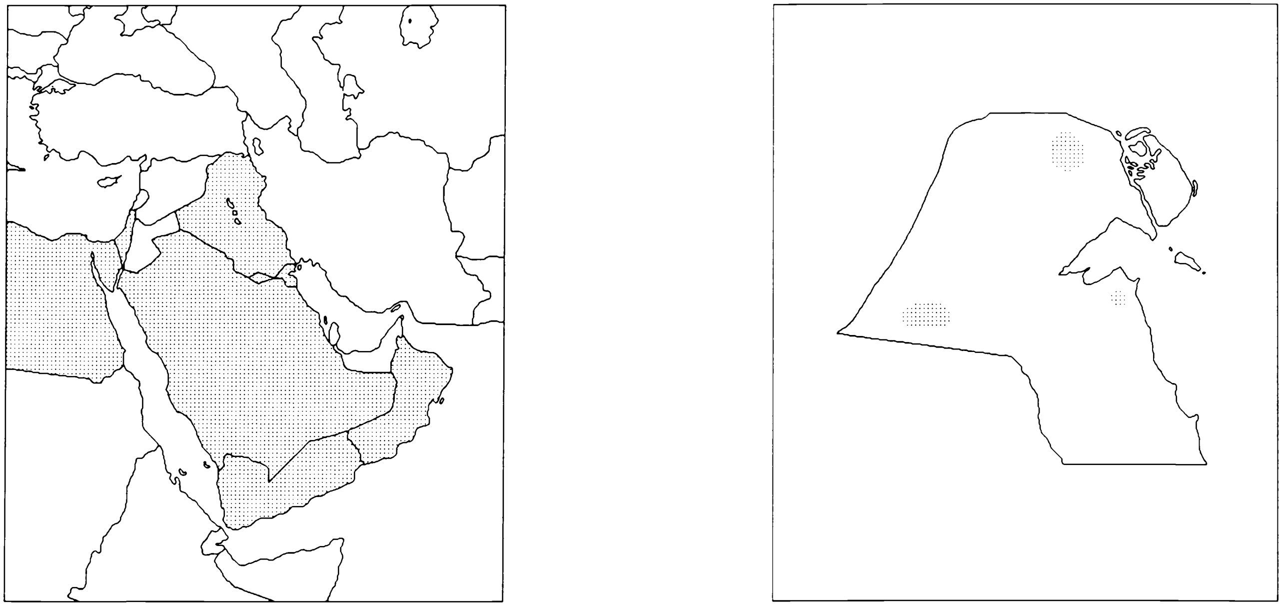


Figure 39. Geographic distribution of *Chrozophora verbascifolia* (Willd.) A. Juss.

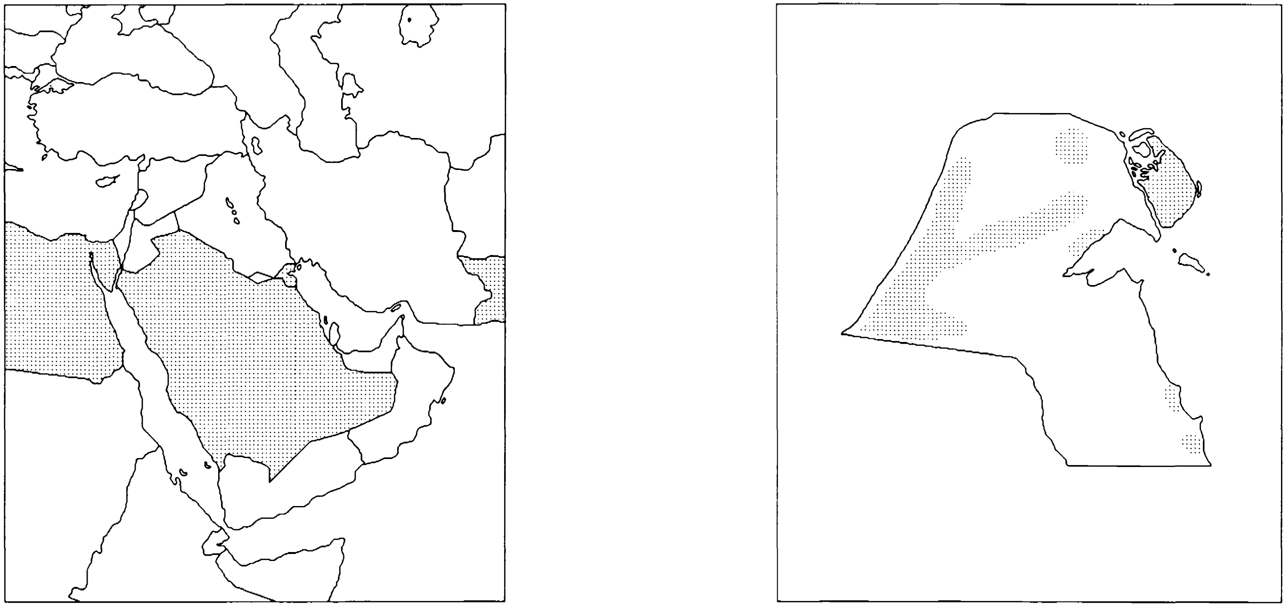


Figure 40. Geographic distribution of *Cistanche tubulosa* (Schrenk) Hook. f.

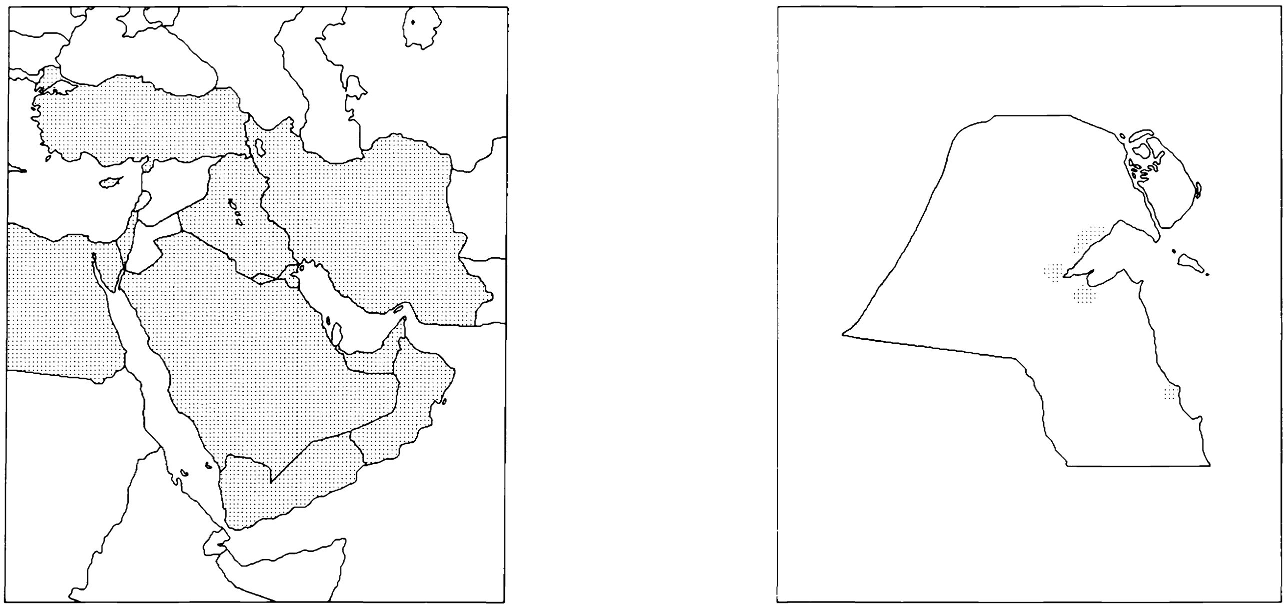


Figure 41. Geographic distribution of *Citrullus colocynthis* (L.) Schrad.

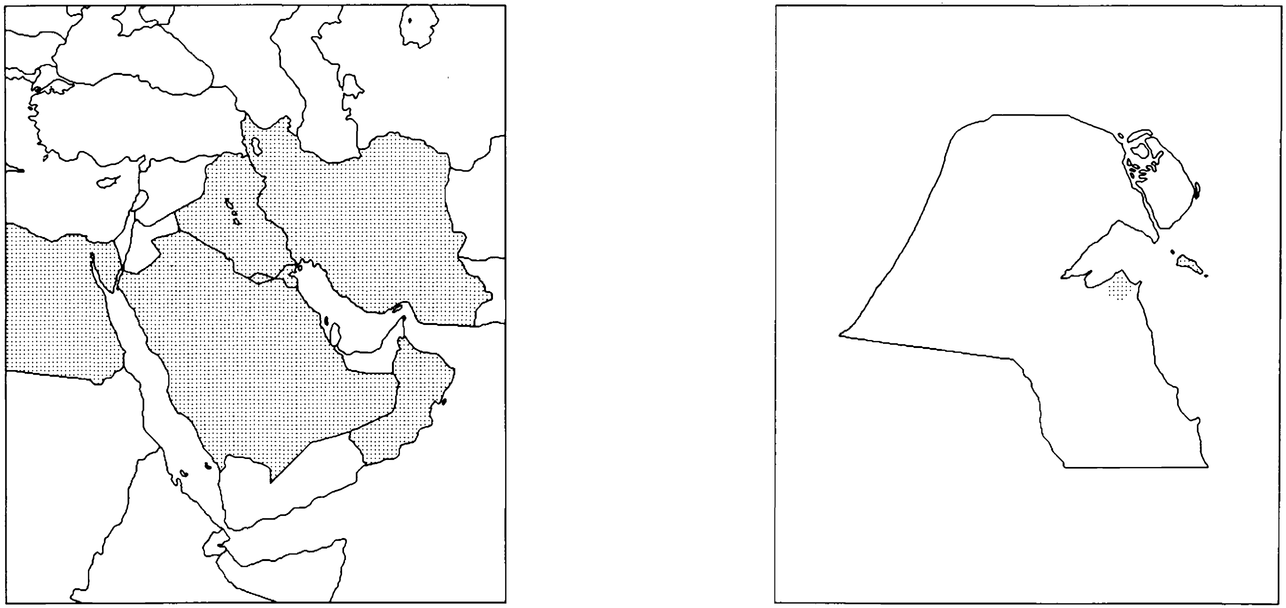


Figure 42. Geographic distribution of *Convolvulus buschiricus* Bornm.

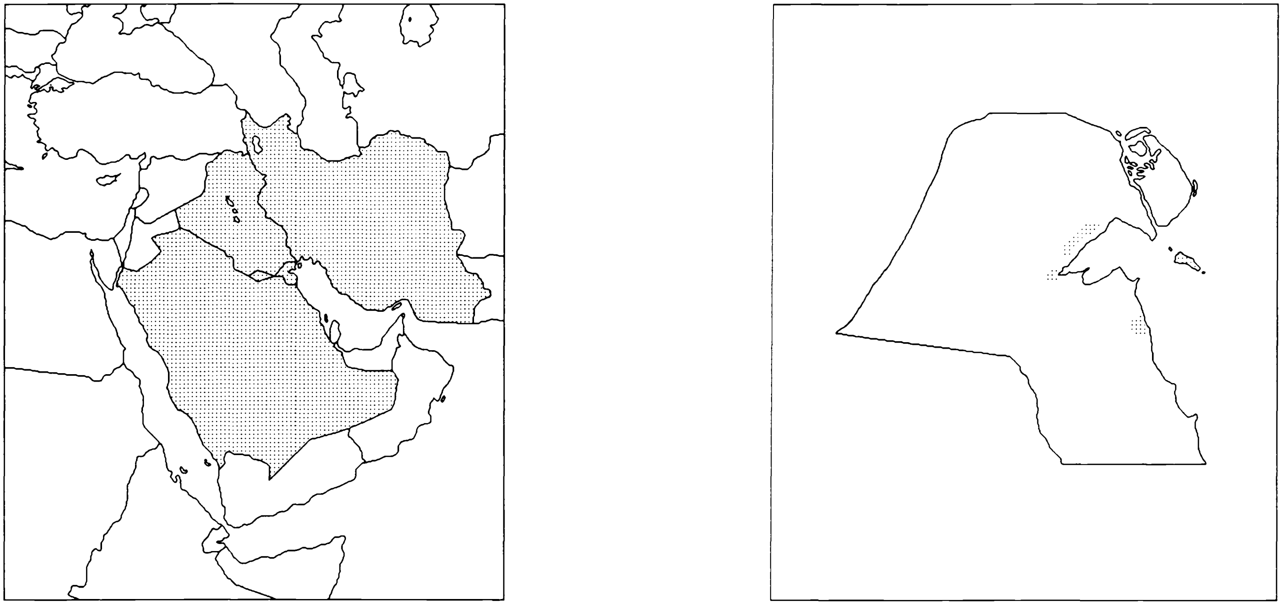


Figure 43. Geographic distribution of *Convolvulus oxyphyllus* Boiss.

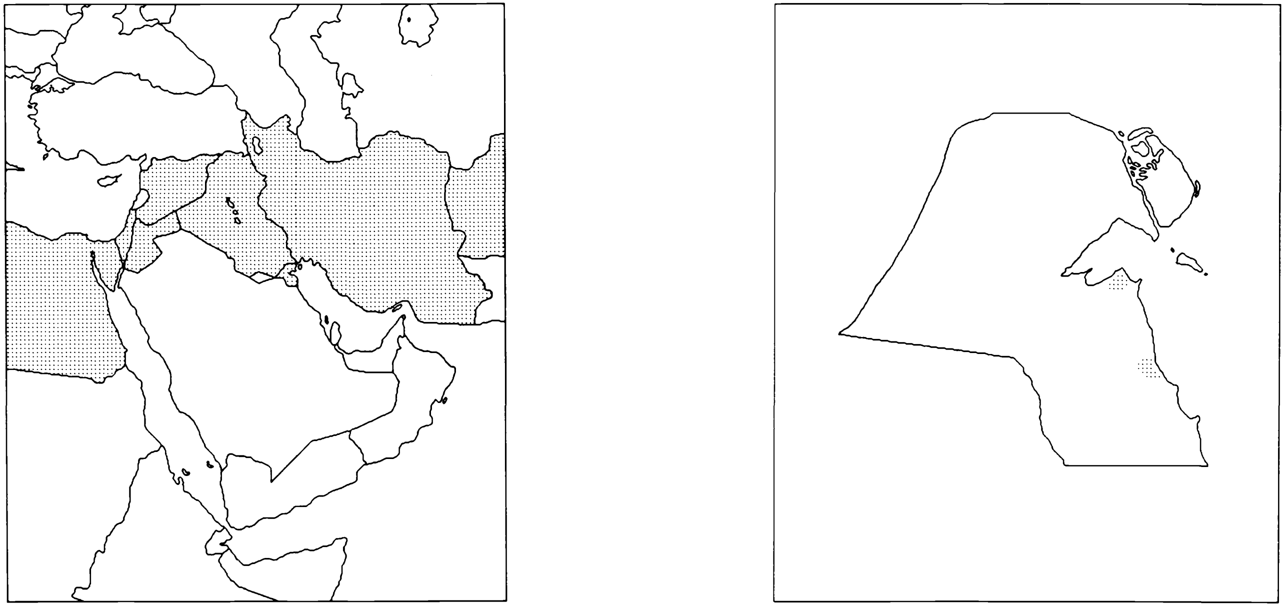


Figure 44. Geographic distribution of *Convolvulus pilosellaefolius* Desr.

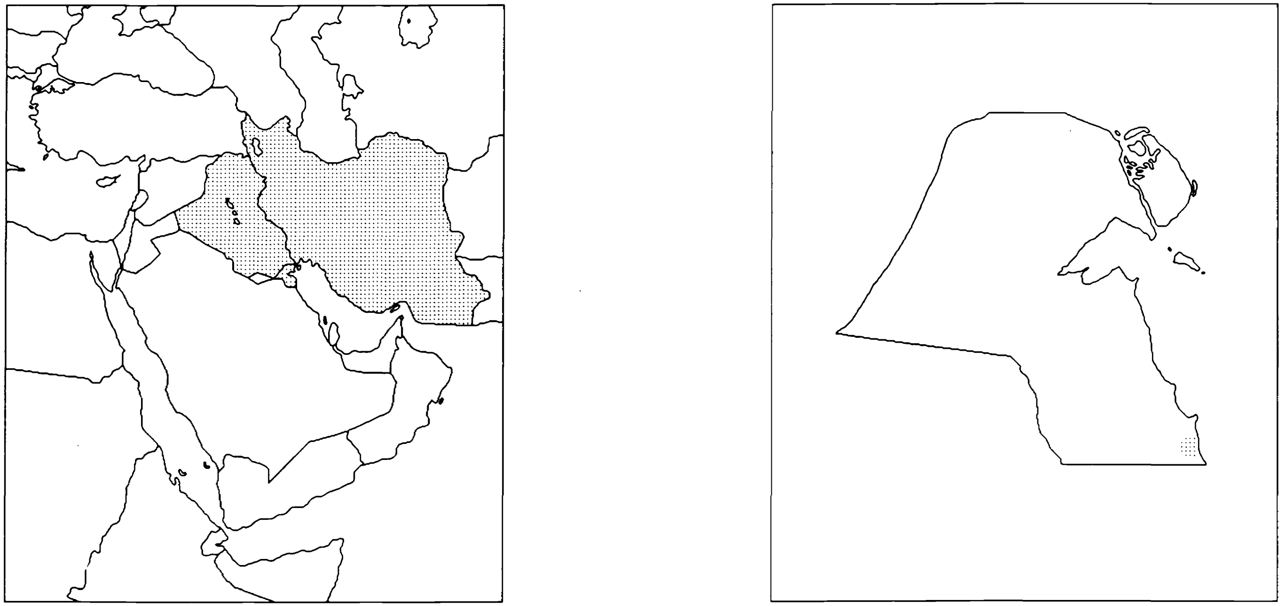


Figure 45. Geographic distribution of *Cornulaca aucheri* Moq.

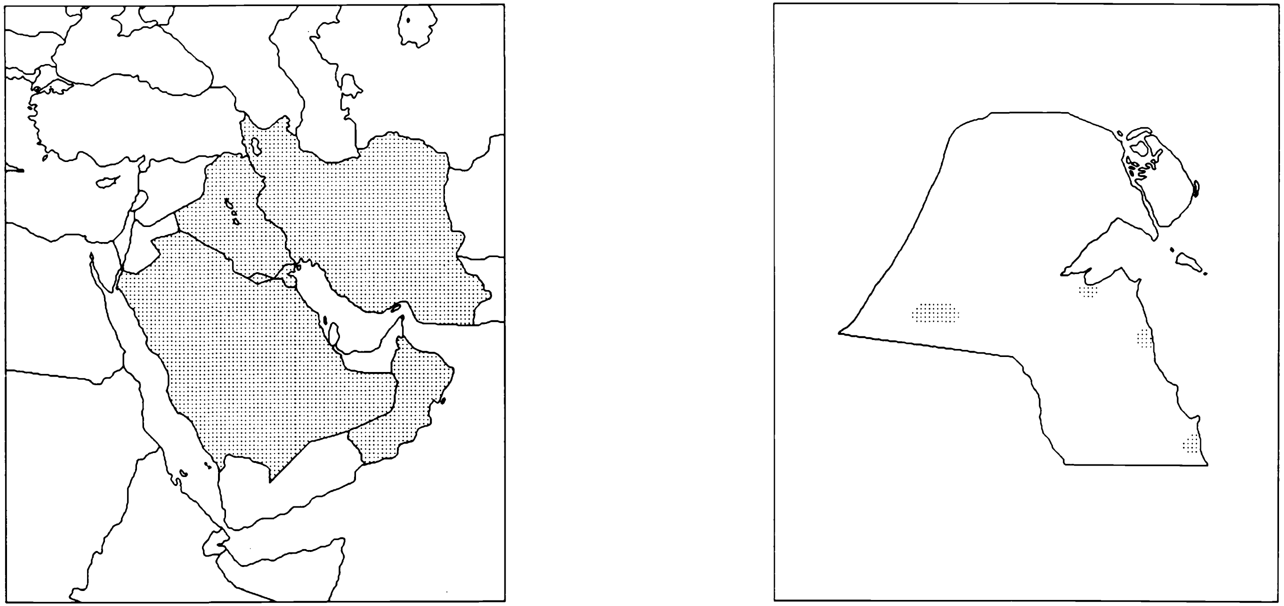


Figure 46. Geographic distribution of *Cornulaca leucacantha* Charif & Aellen.

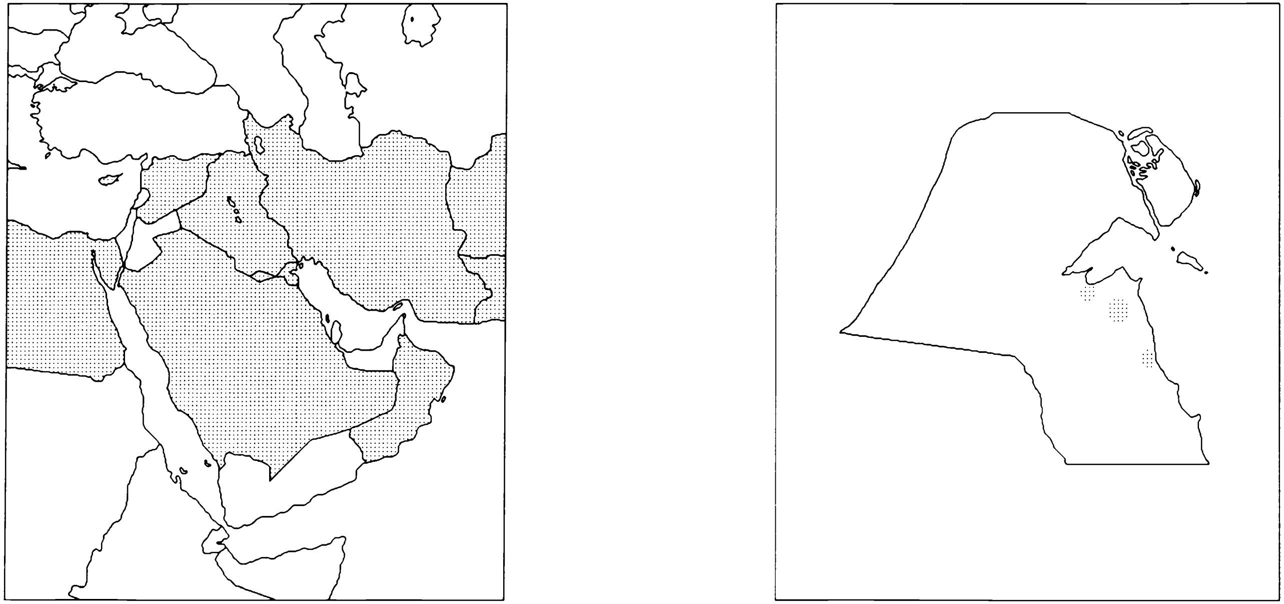


Figure 47. Geographic distribution of *Cressa cretica* L.

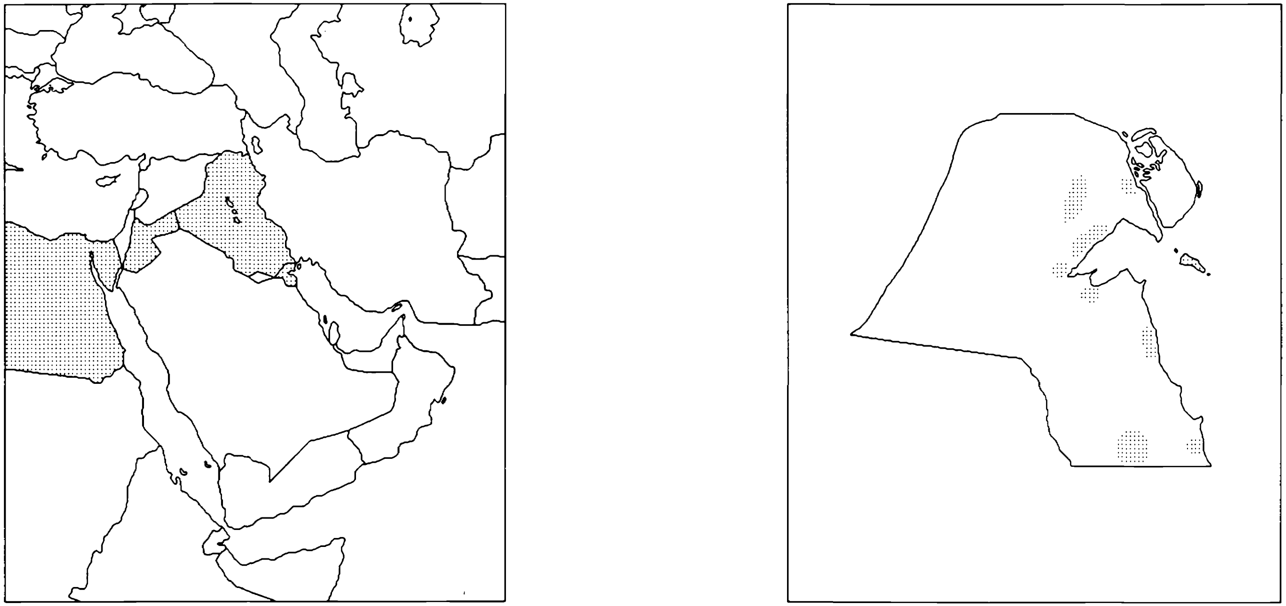


Figure 48. Geographic distribution of *Crucianella membranacea* Boiss.

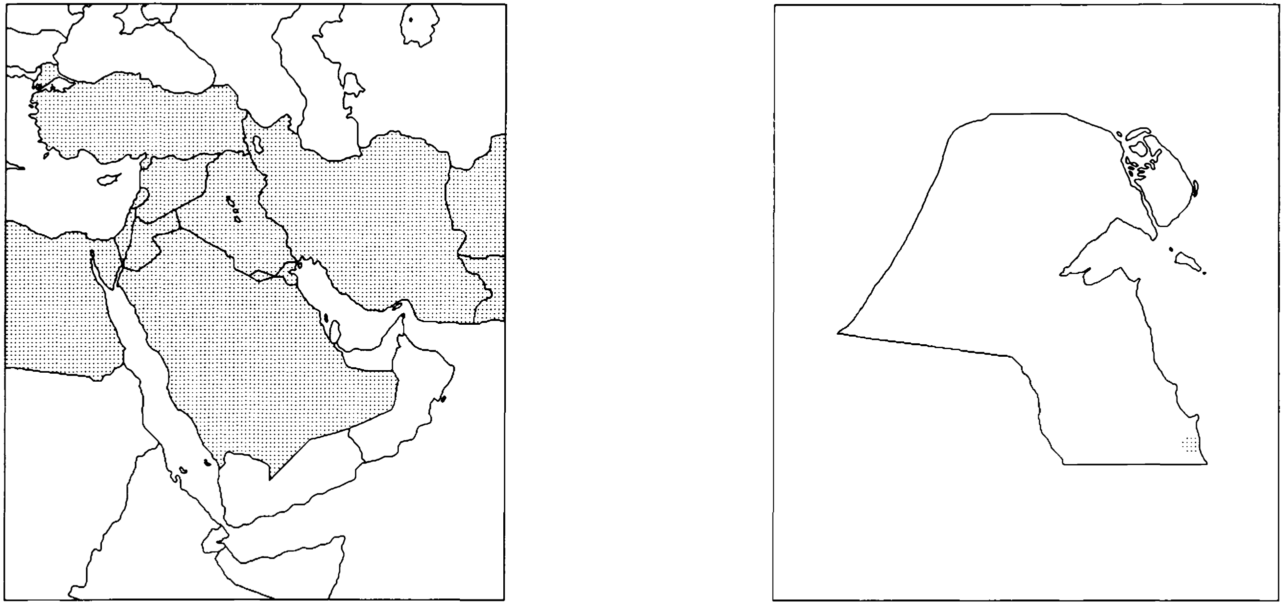


Figure 49. Geographic distribution of *Cuscuta planiflora* Ten.

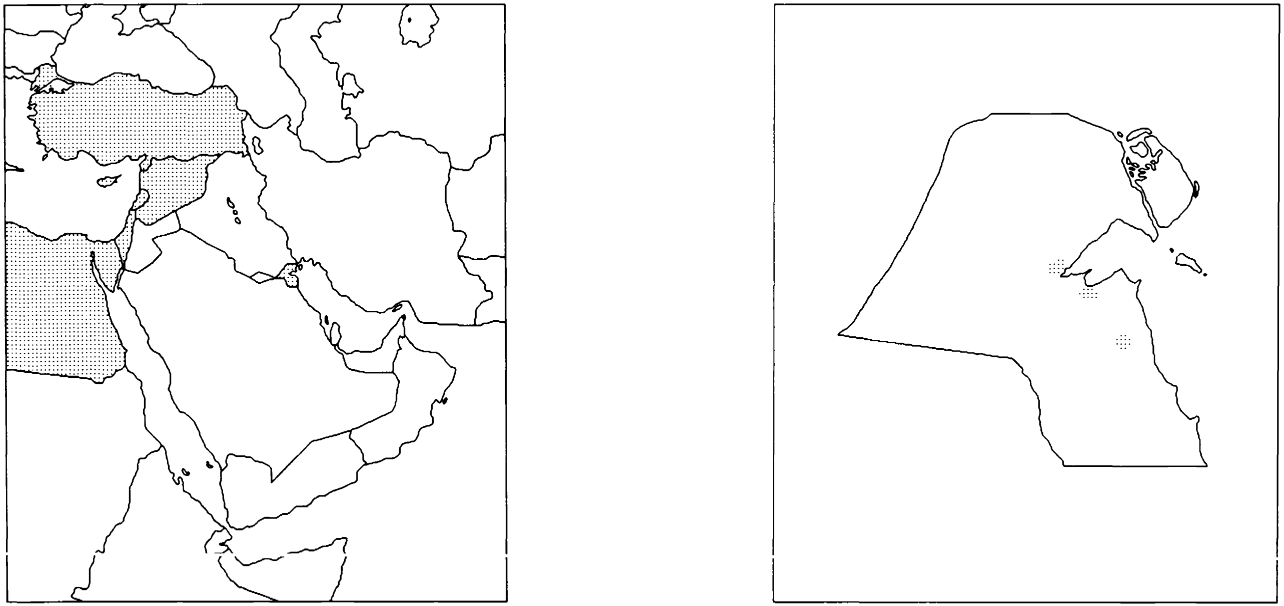


Figure 50. Geographic distribution of *Cynomorium coccineum* L.

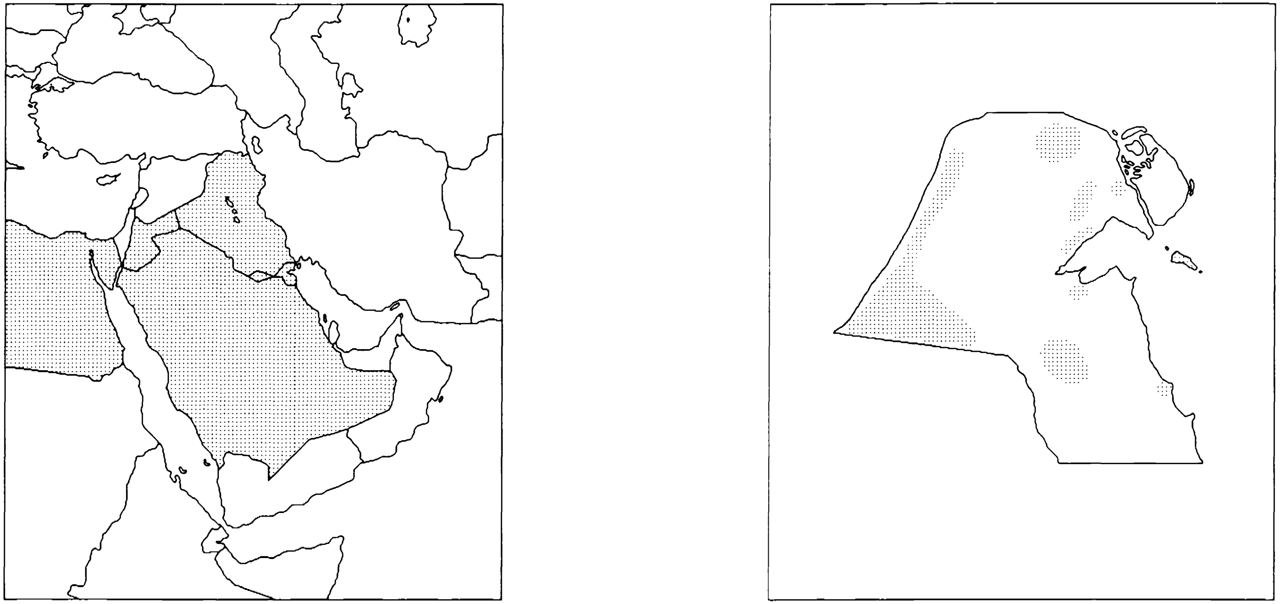


Figure 51. Geographic distribution of *Diplotaxis acris* (Forssk.) Boiss.

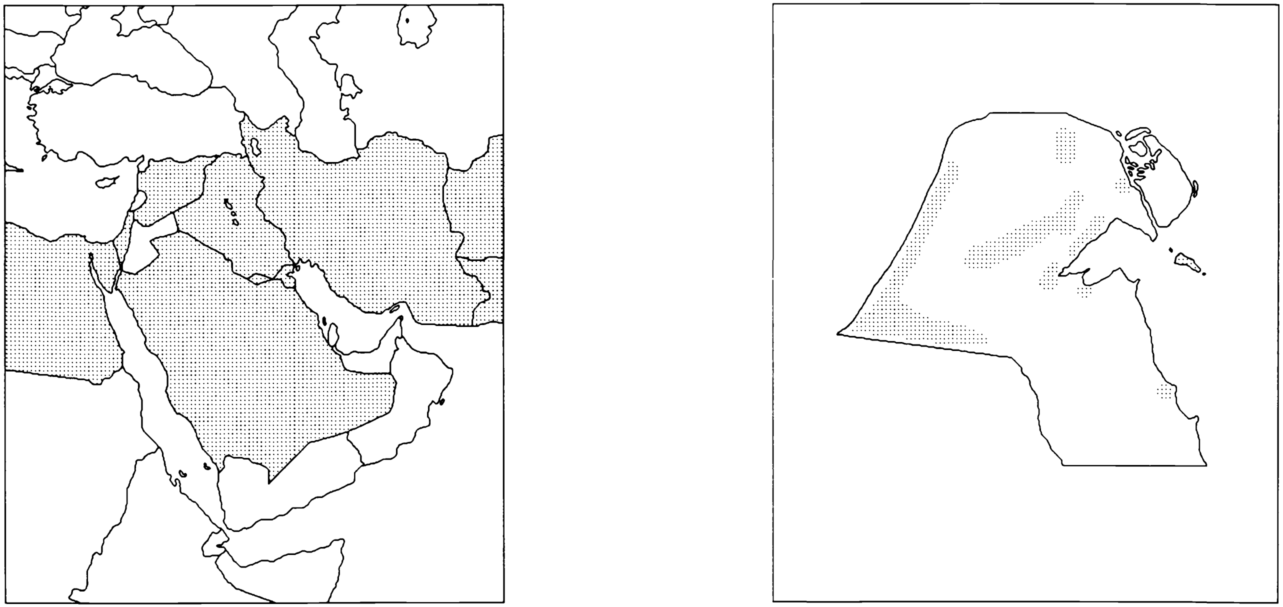


Figure 52. Geographic distribution of *Diplotaxis harra* (Forssk.) Boiss.

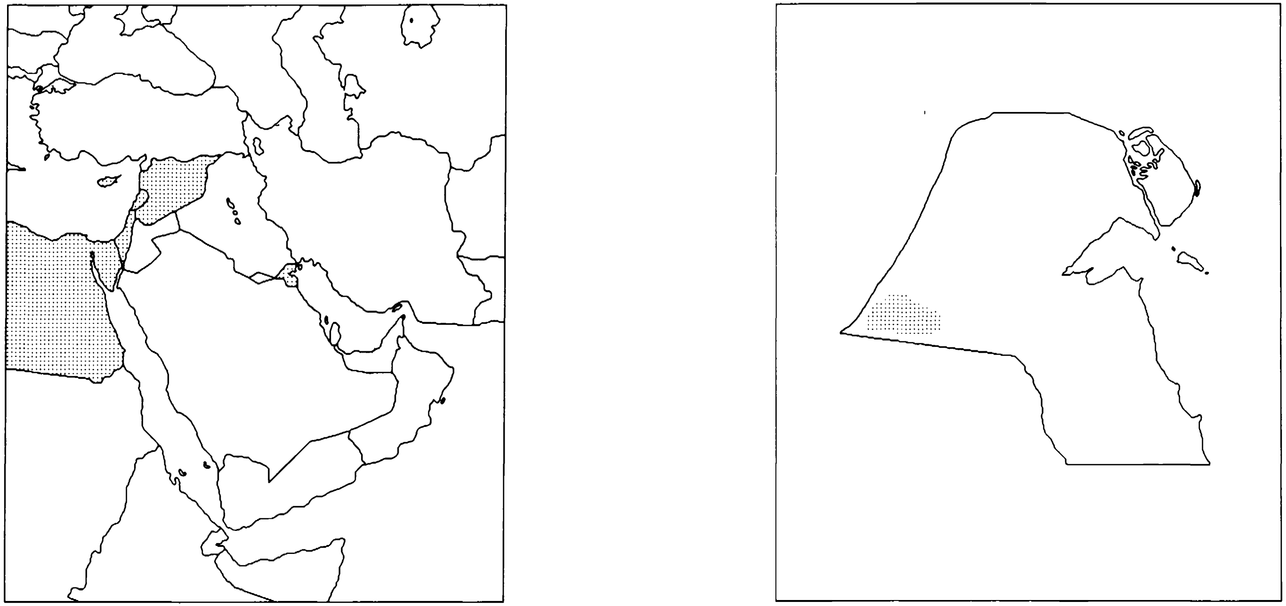


Figure 53. Geographic distribution of *Echium sericeum* Vahl.

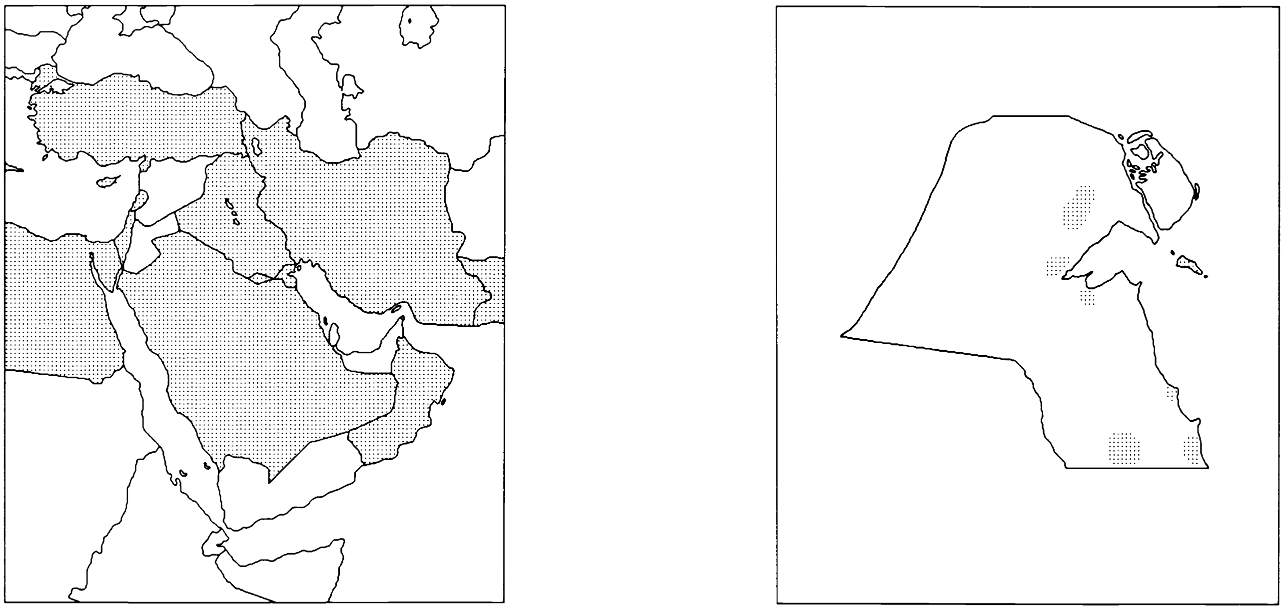


Figure 54. Geographic distribution of *Emex spinosus* (L.) Campderá.

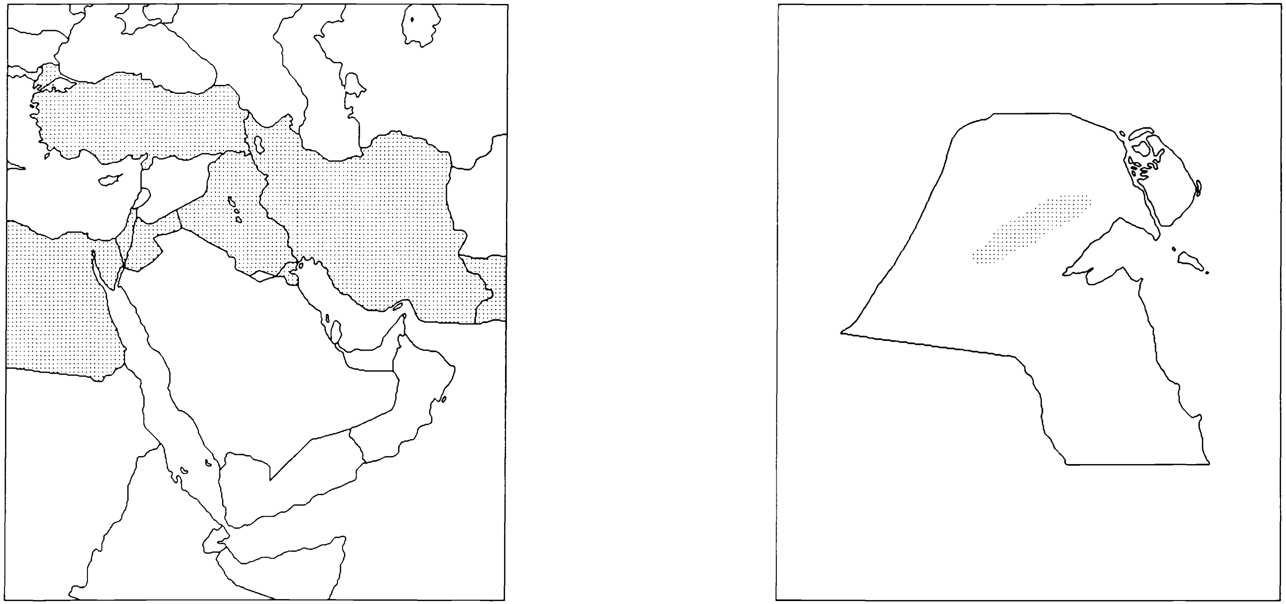


Figure 55. Geographic distribution of *Erodium bryoniifolium* Boiss.

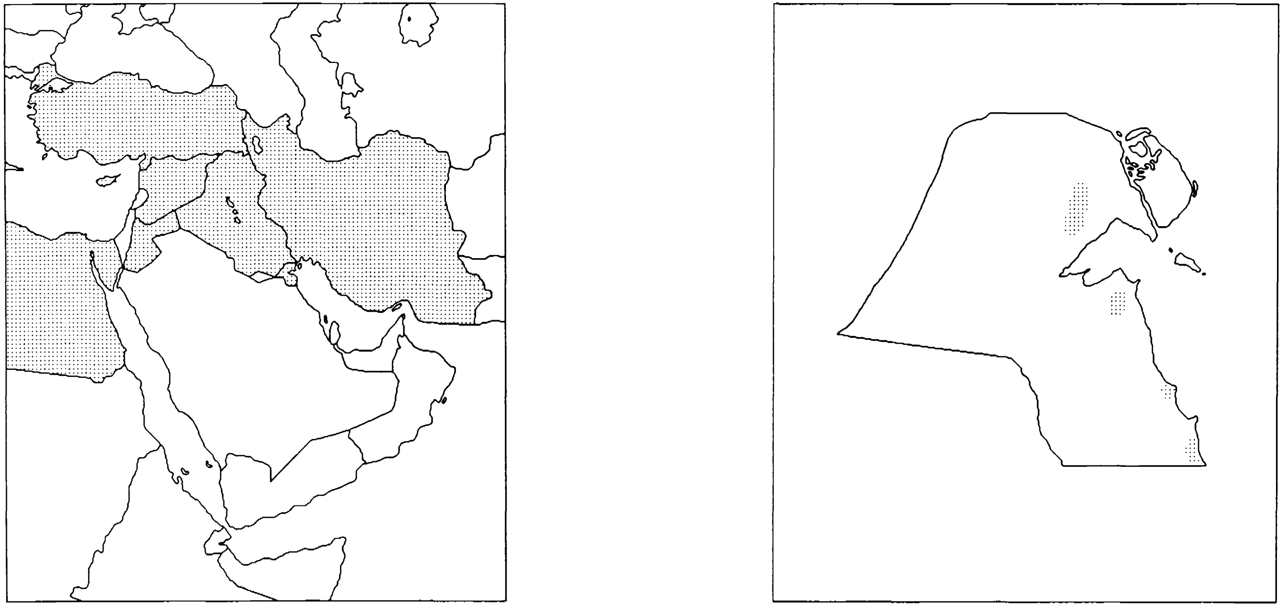


Figure 56. Geographic distribution of *Erodium ciconium* (L.) L'Hérit.

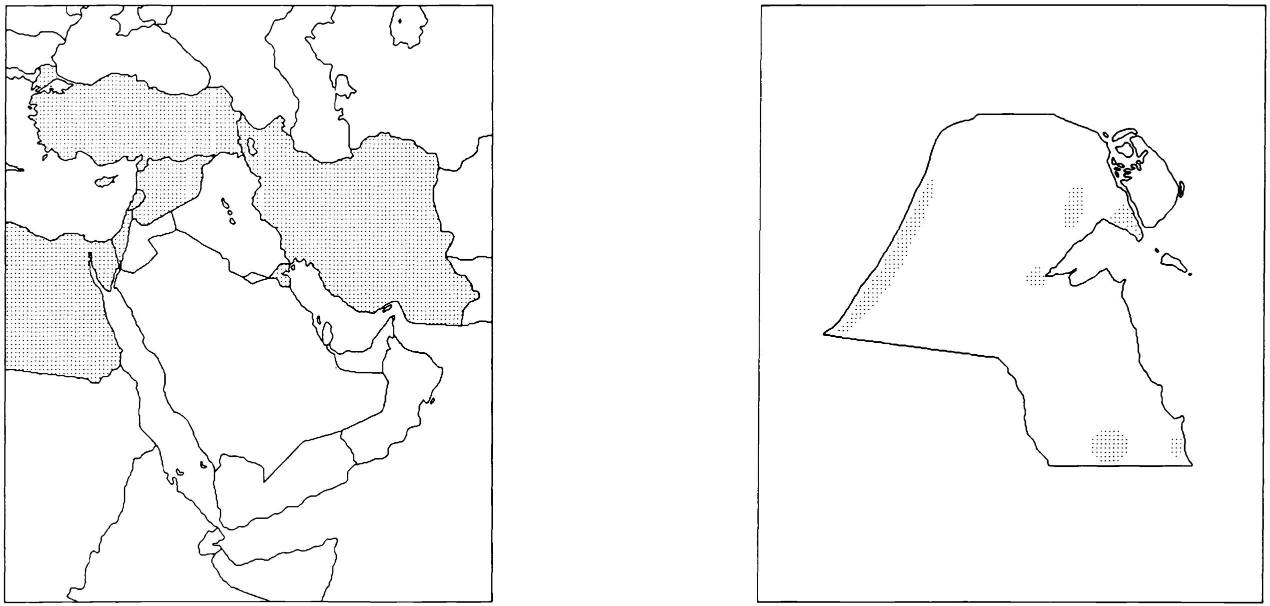


Figure 57. Geographic distribution of *Erodium cicutarium* (L.) L'Hérit.

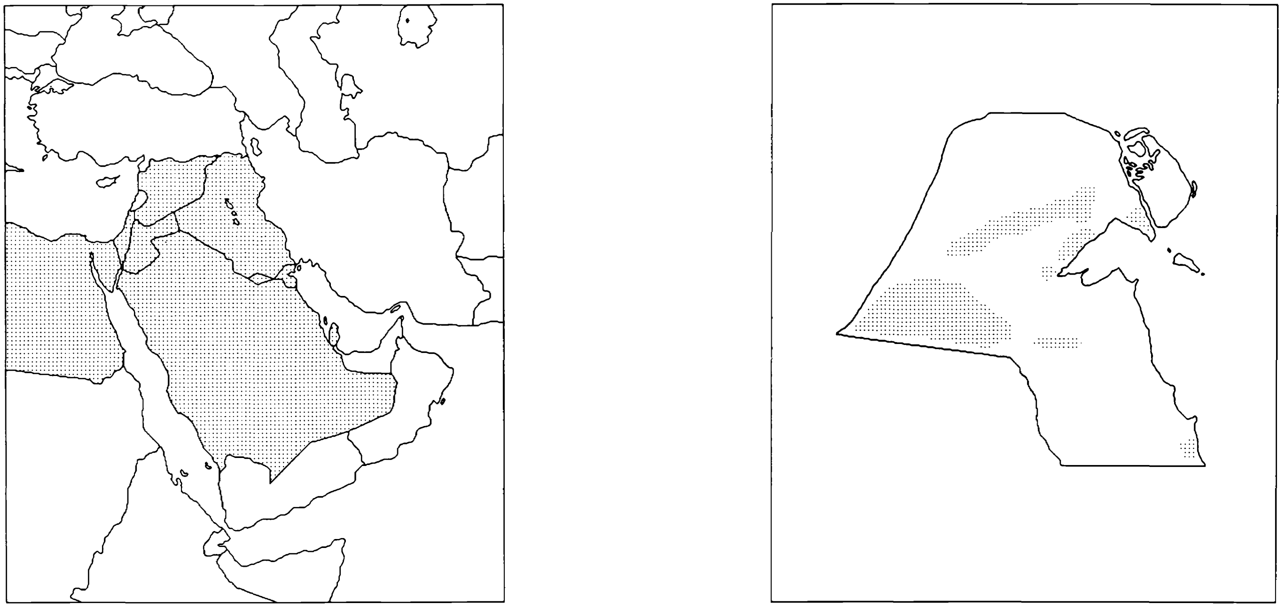


Figure 58. Geographic distribution of *Erodium glaucophyllum* (L.) L'Hérit.

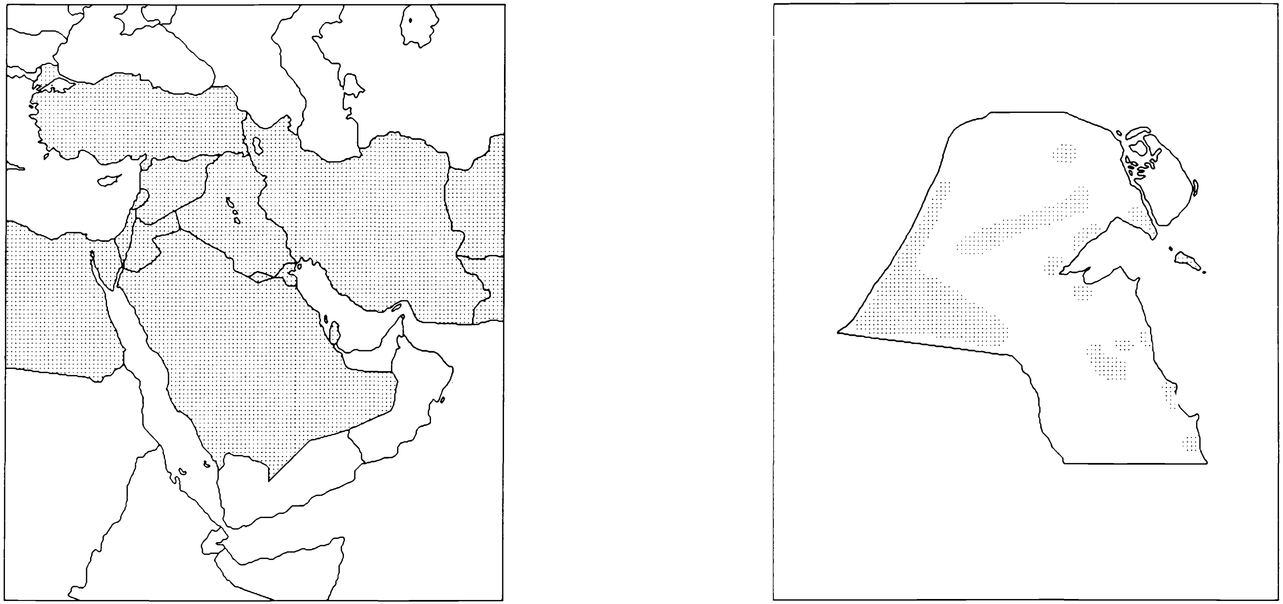


Figure 59. Geographic distribution of *Erodium laciniatum* (Cav.) Willd.

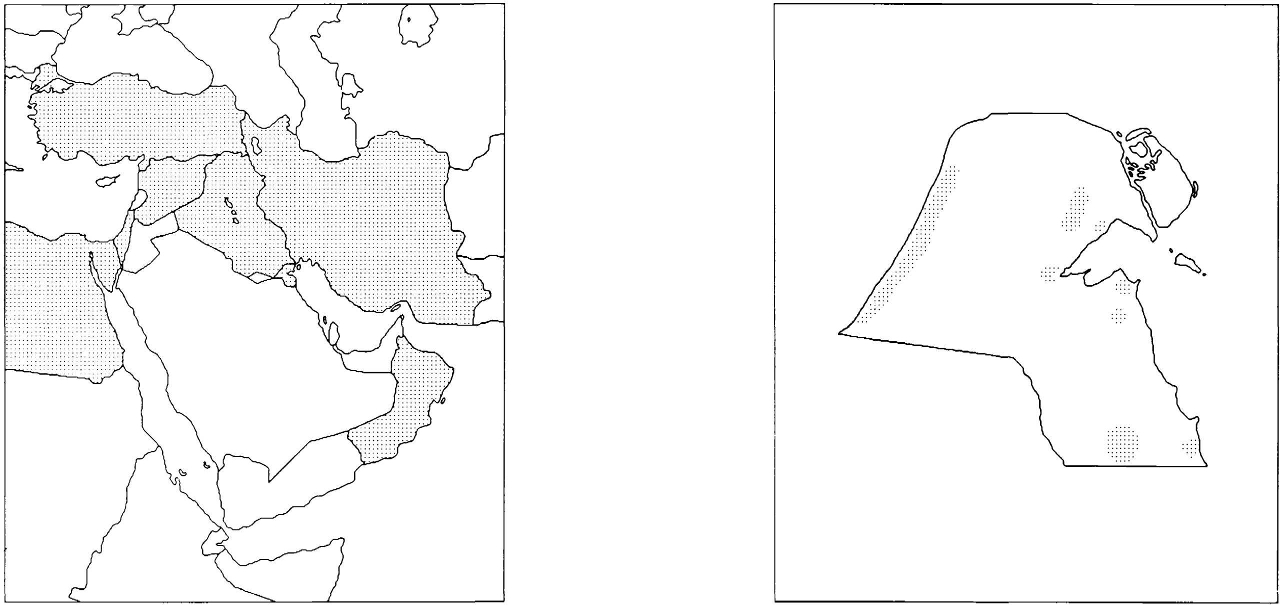


Figure 60. Geographic distribution of *Eruca sativa* Miller.

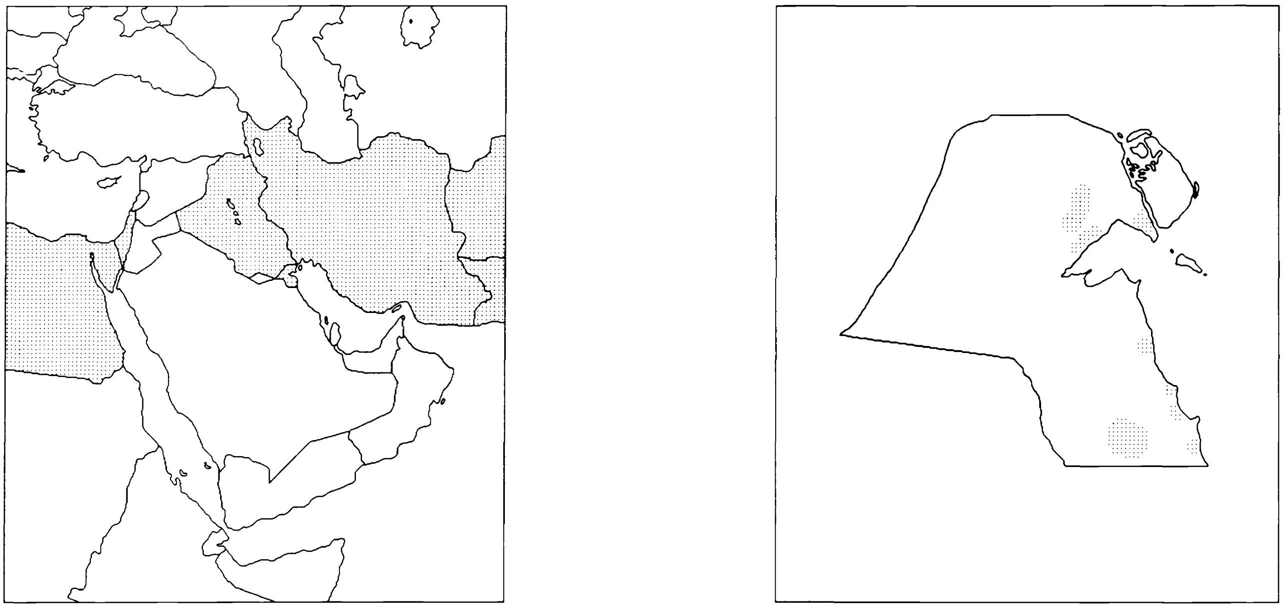


Figure 61. Geographic distribution of *Euphorbia densa* Schrenk.

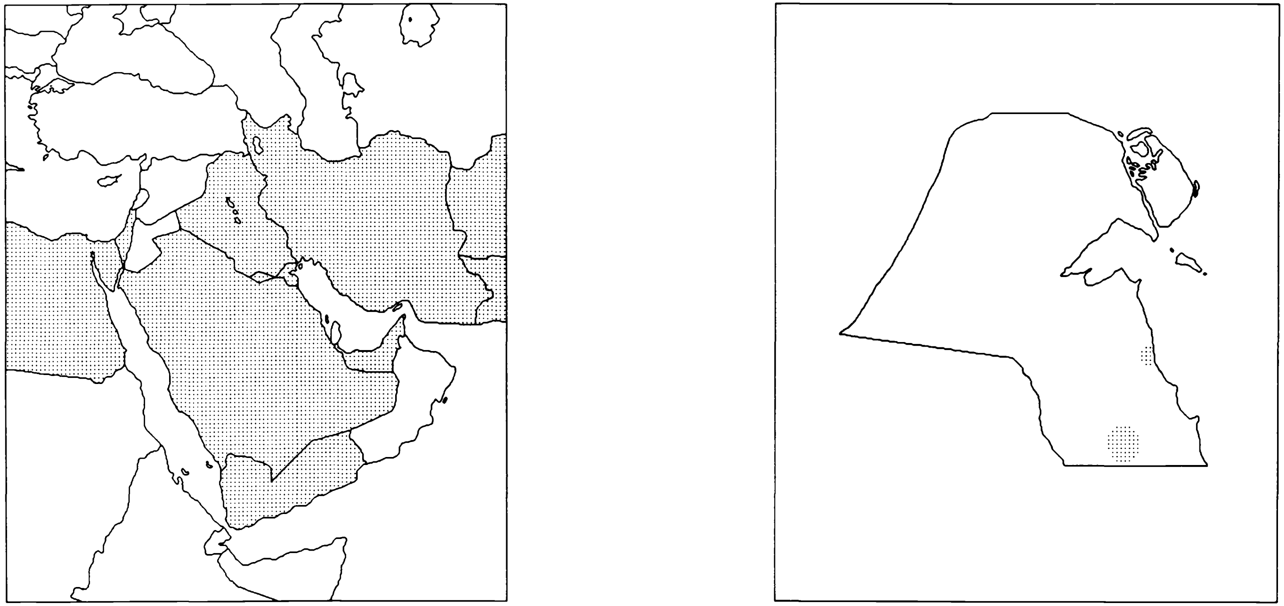


Figure 62. Geographic distribution of *Euphorbia granulata* Forssk.

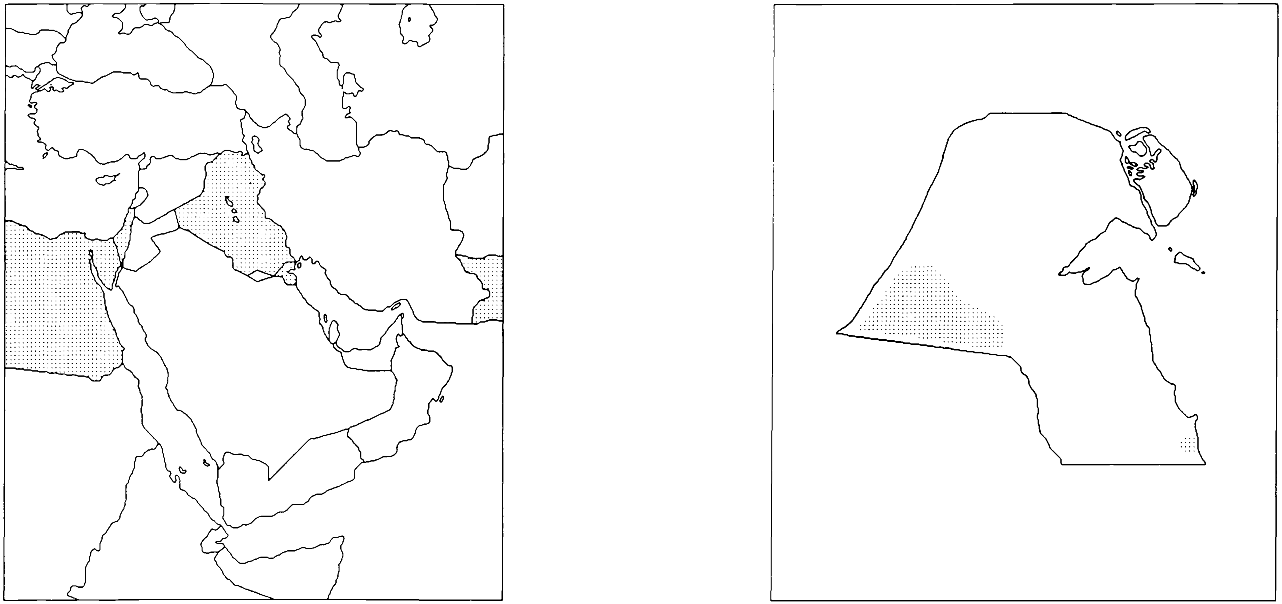


Figure 63. Geographic distribution of *Euphorbia isthmia* V. Täckh.

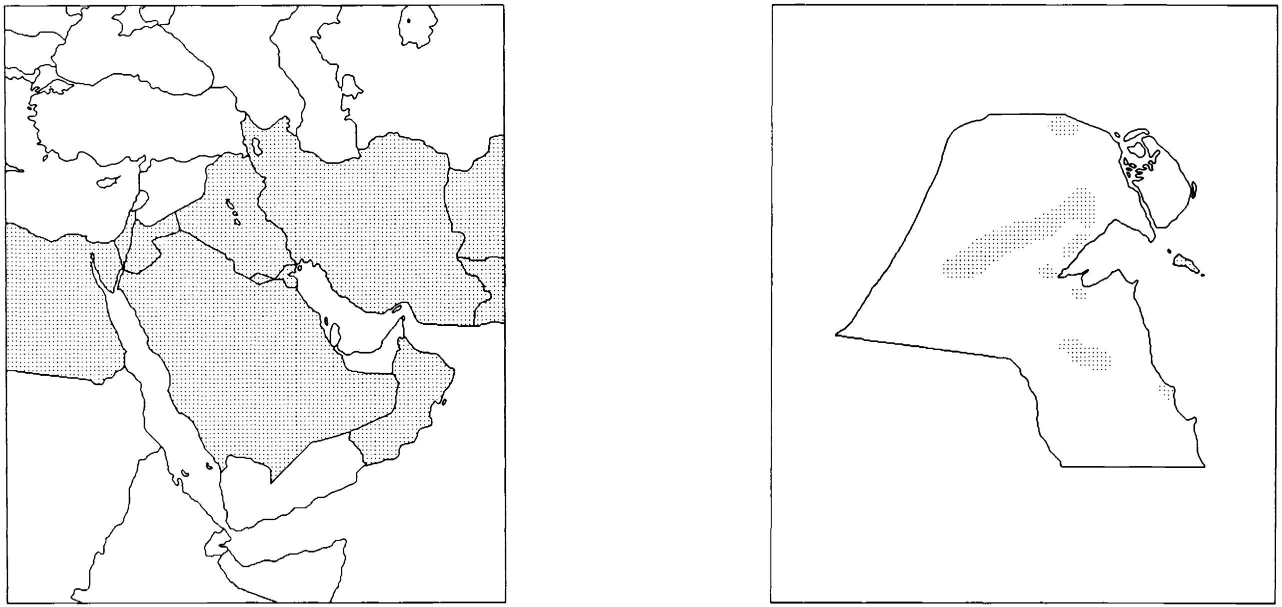


Figure 64. Geographic distribution of *Fagonia bruguieri* DC.

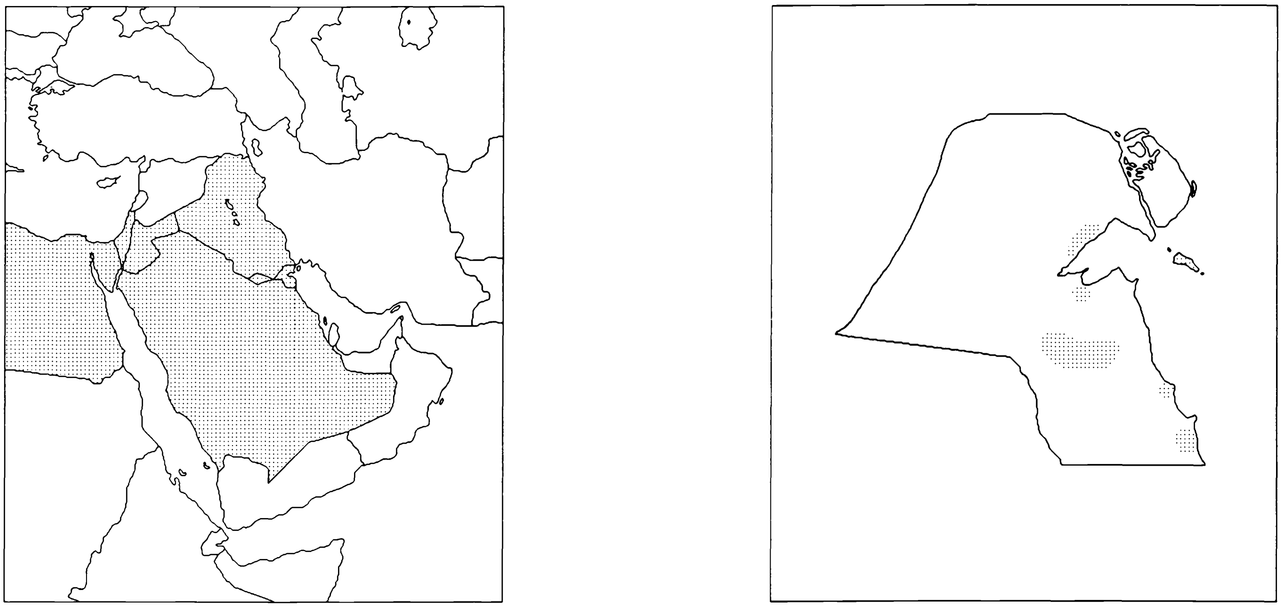


Figure 65. Geographic distribution of *Fagonia glutinosa* Del.

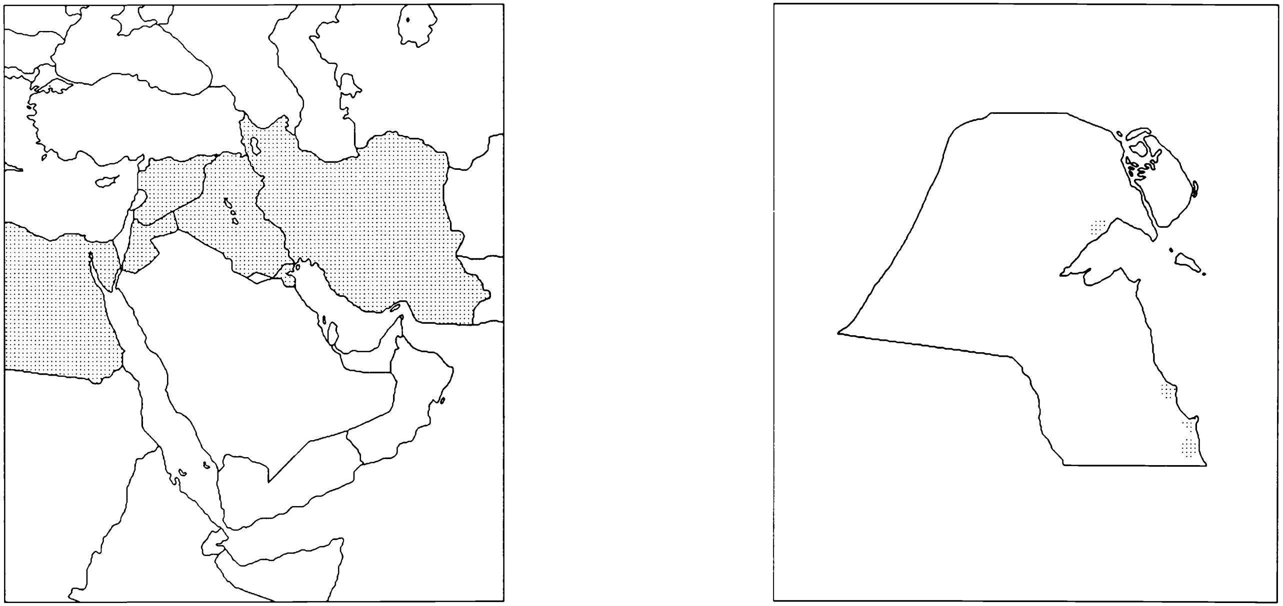


Figure 66. Geographic distribution of *Fagonia olivieri* DC.

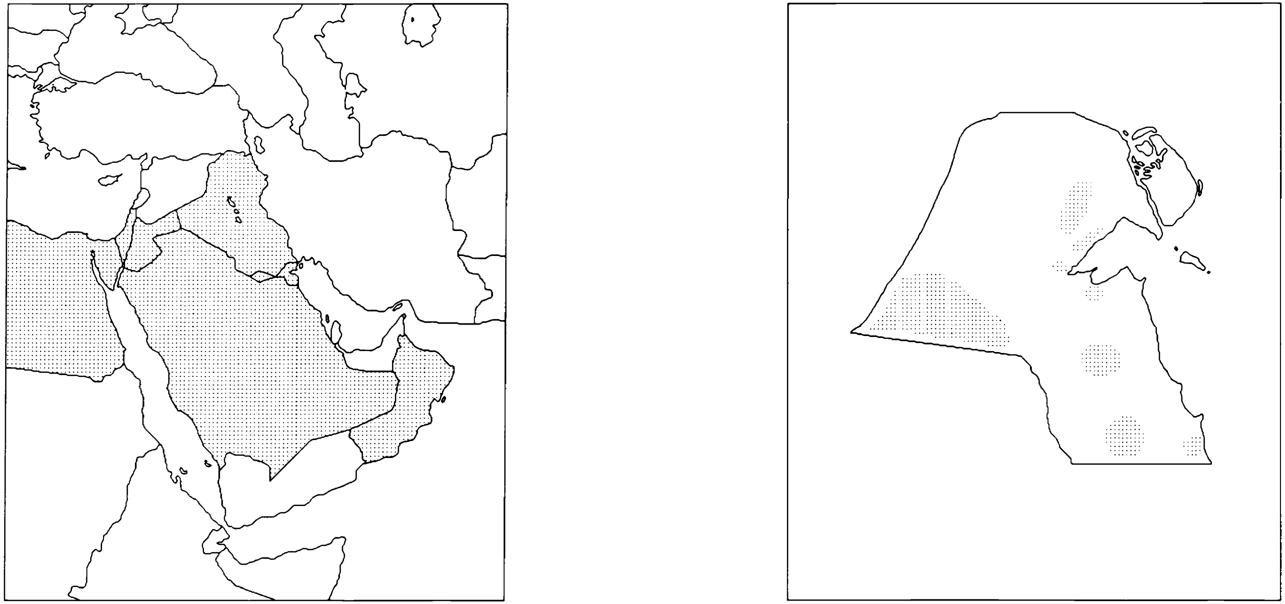


Figure 67. Geographic distribution of *Farsetia aegyptiaca* Turra.

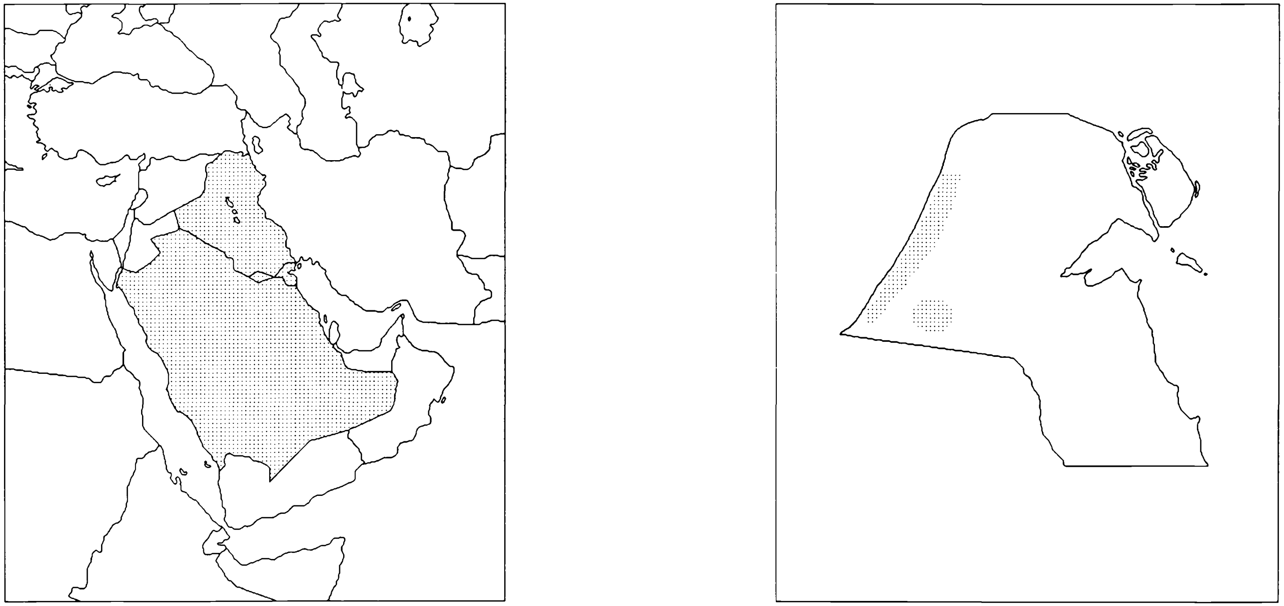


Figure 68. Geographic distribution of *Farsetia burtonae* Oliv.

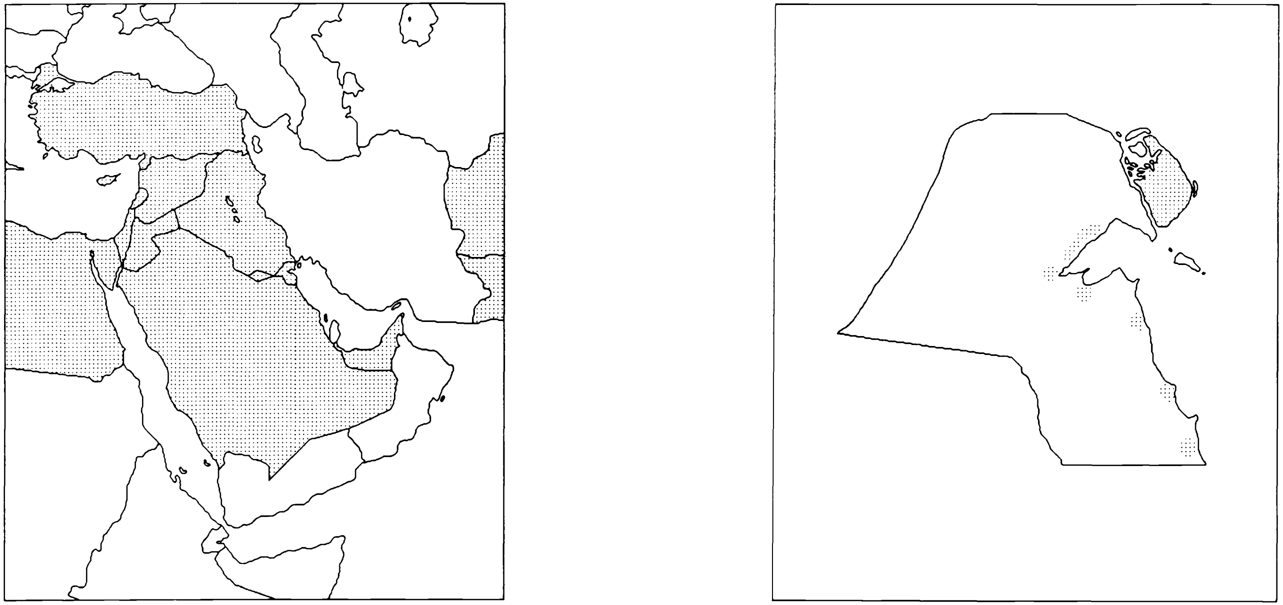


Figure 69. Geographic distribution of *Frankenia pulverulenta* L.

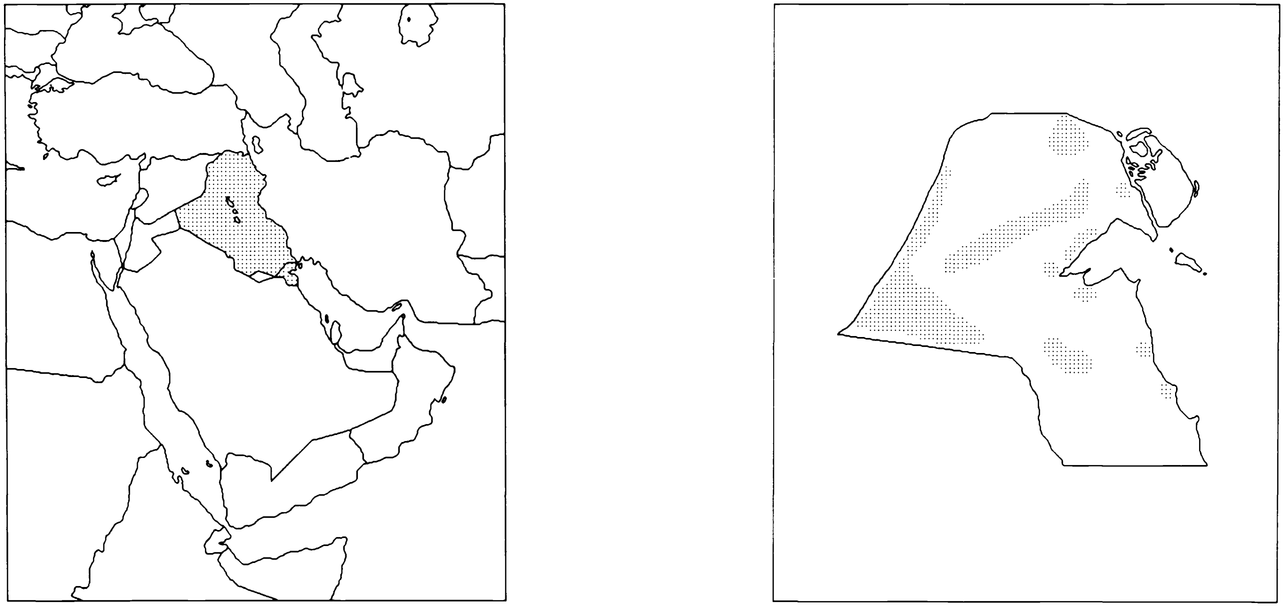


Figure 70. Geographic distribution of *Gastrocotyle hispida* (Forssk.) Bunge.

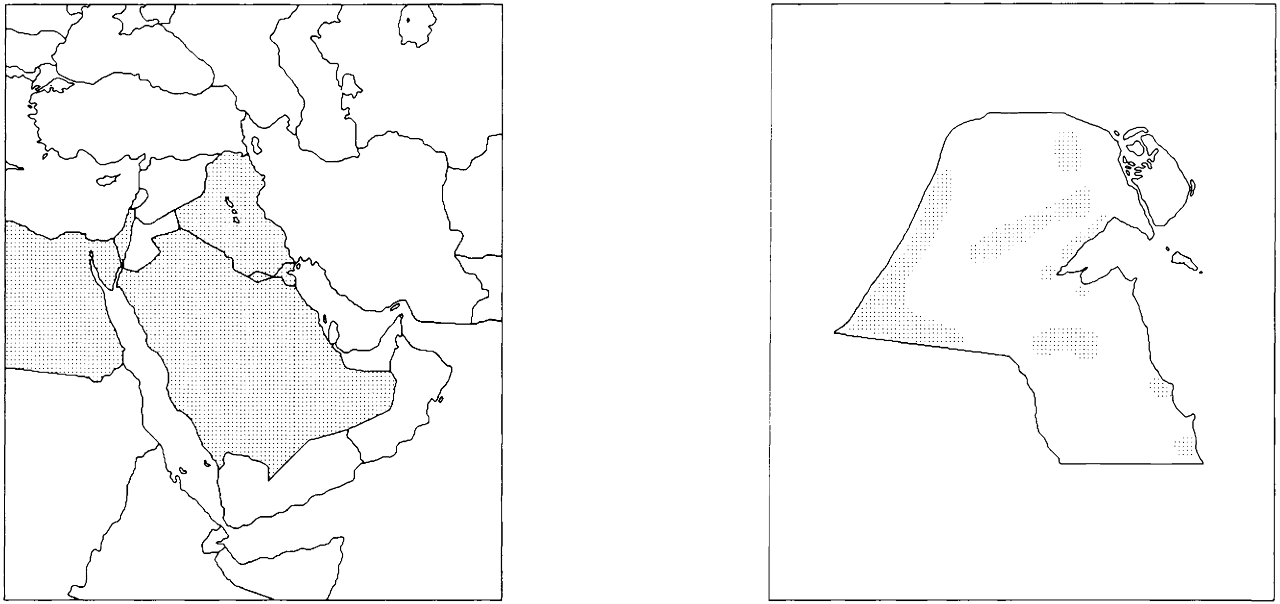


Figure 71. Geographic distribution of *Gypsophila capillaris* (Forssk.) C. Christensen.

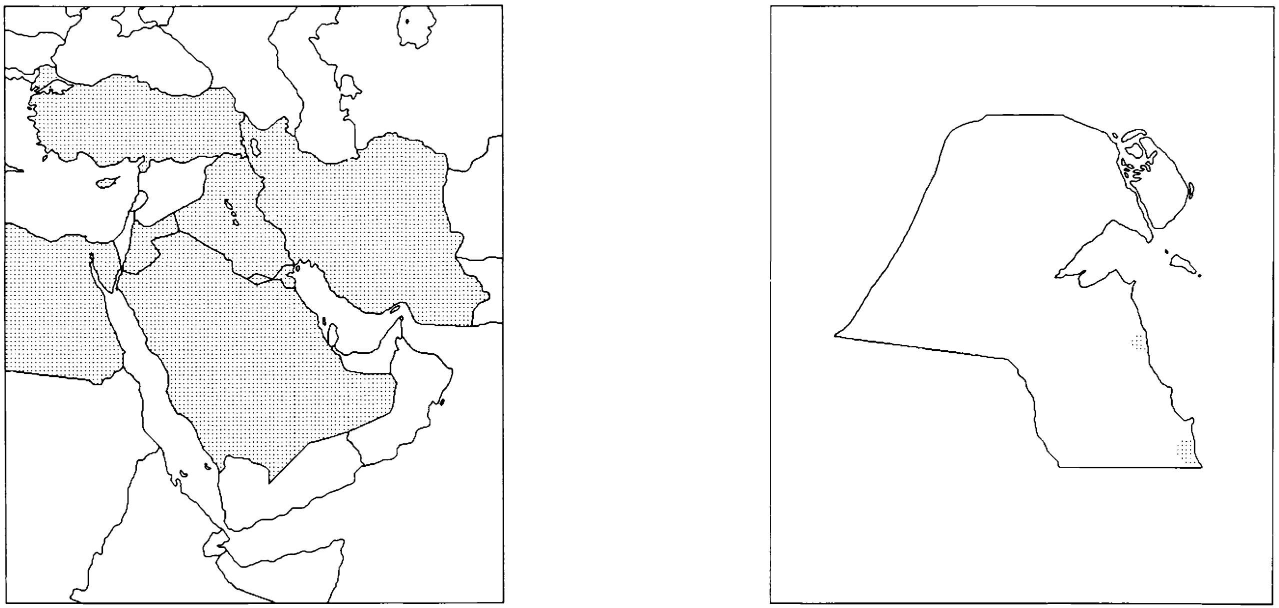


Figure 72. Geographic distribution of *Halocnemum strobilaceum* (Pall.) M. Bieb.

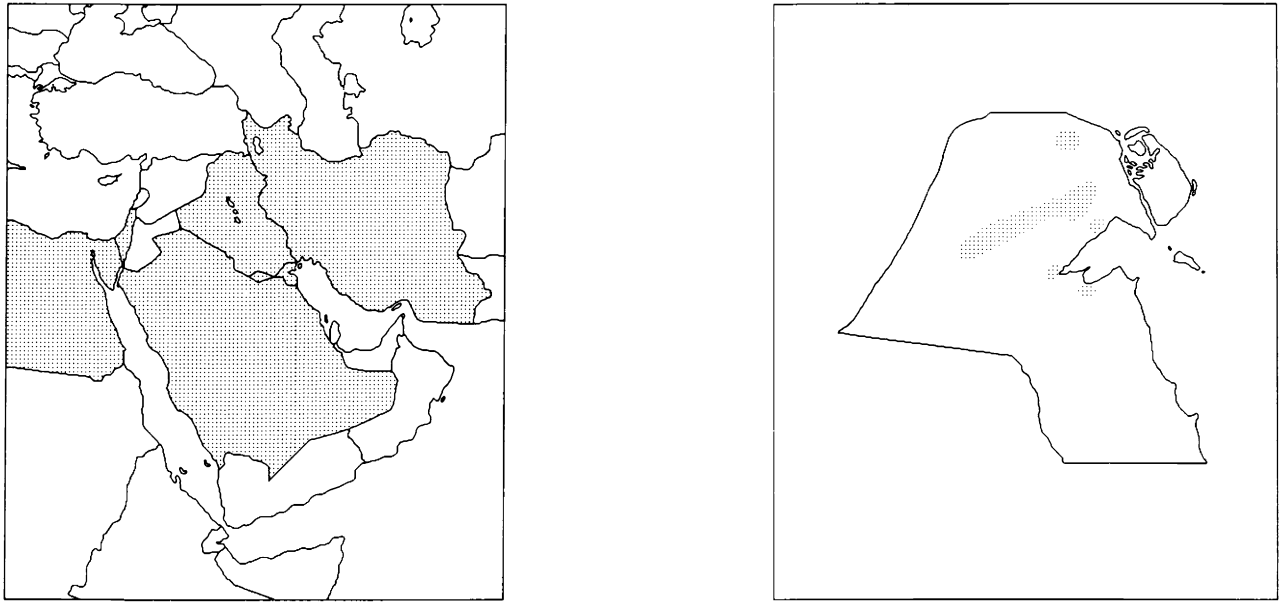


Figure 73. Geographic distribution of *Haloxylon salicornicum* (Moq.) Bunge ex Boiss.

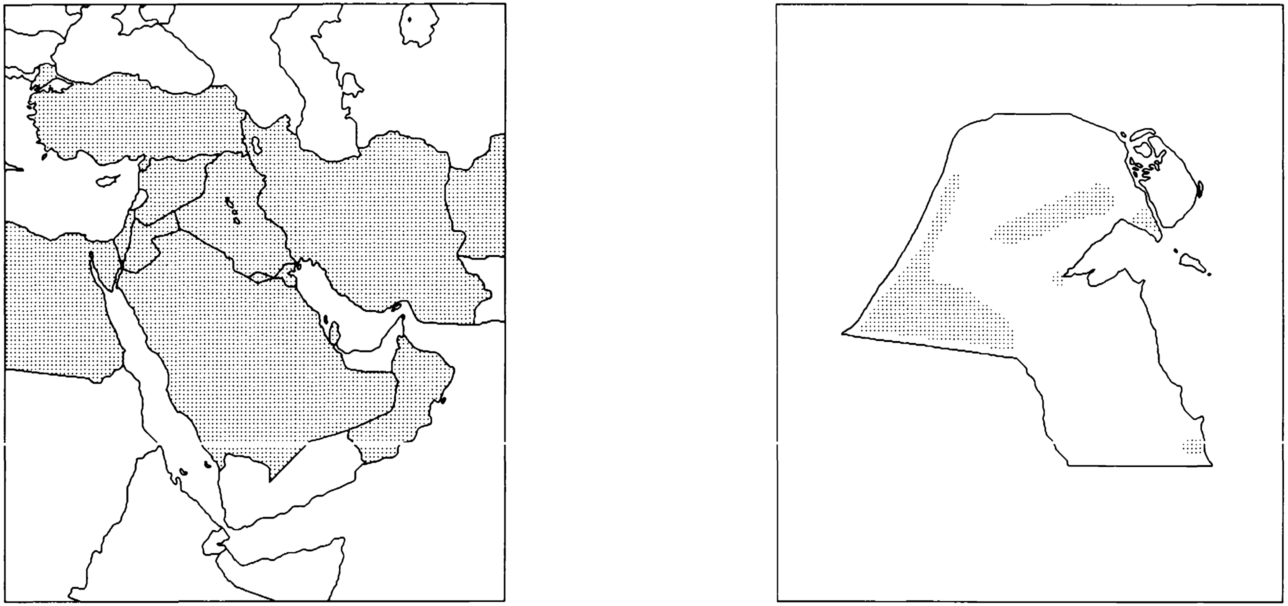


Figure 74. Geographic distribution of *Haplophyllum tuberculatum* (Forssk.) A. Juss.

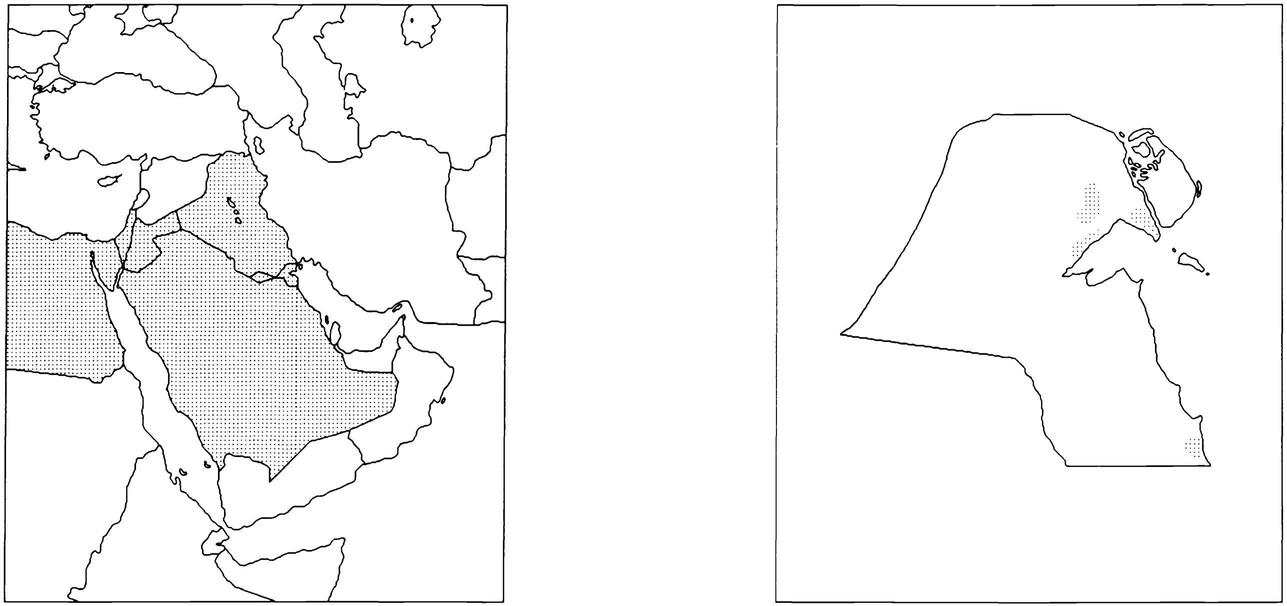


Figure 75. Geographic distribution of *Helianthemum kahiricum* Del.

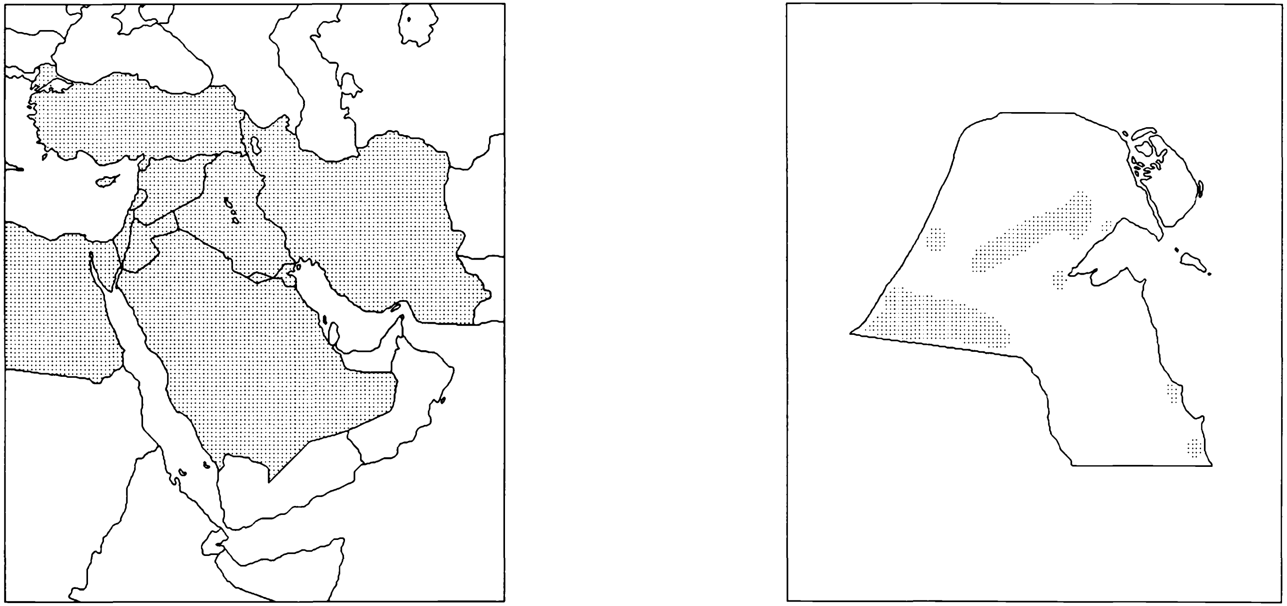


Figure 76. Geographic distribution of *Helianthemum ledifolium* (L.) Mill.

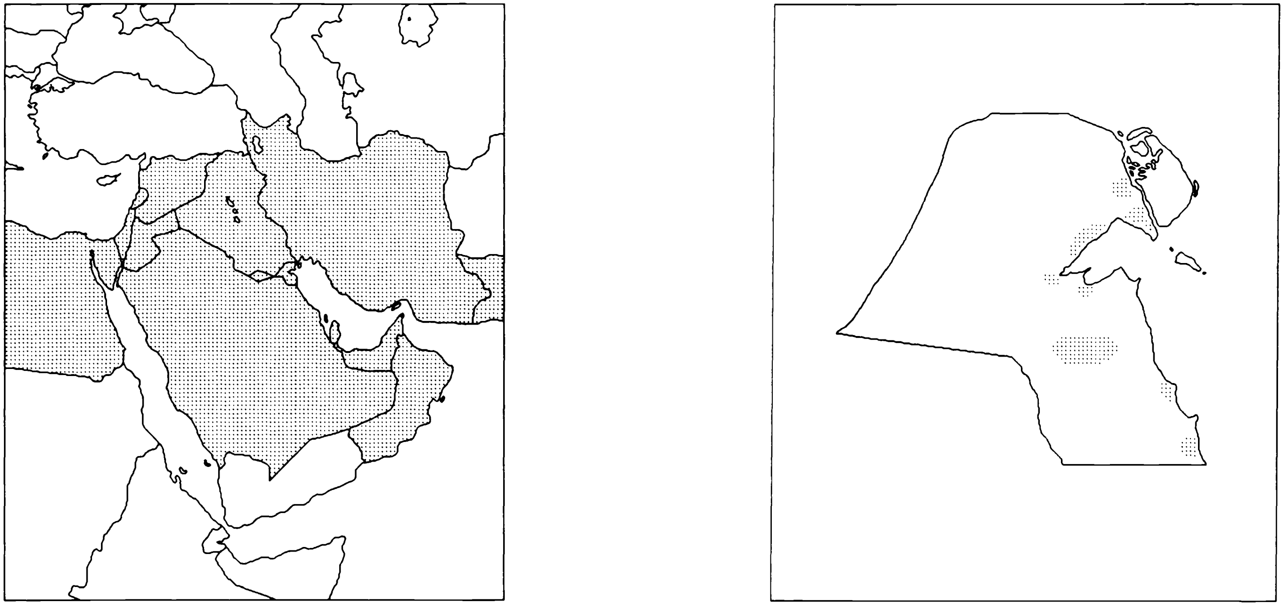


Figure 77. Geographic distribution of *Helianthemum lippii* (L.) Pers.

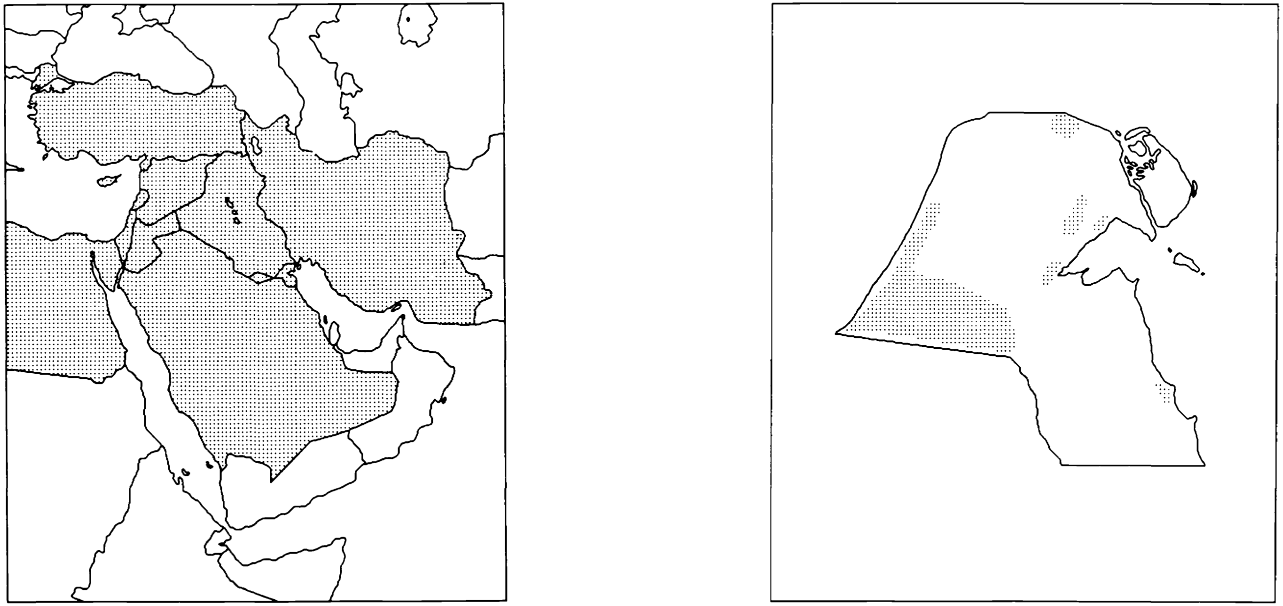


Figure 78. Geographic distribution of *Helianthemum salicifolium* (L.) Mill.

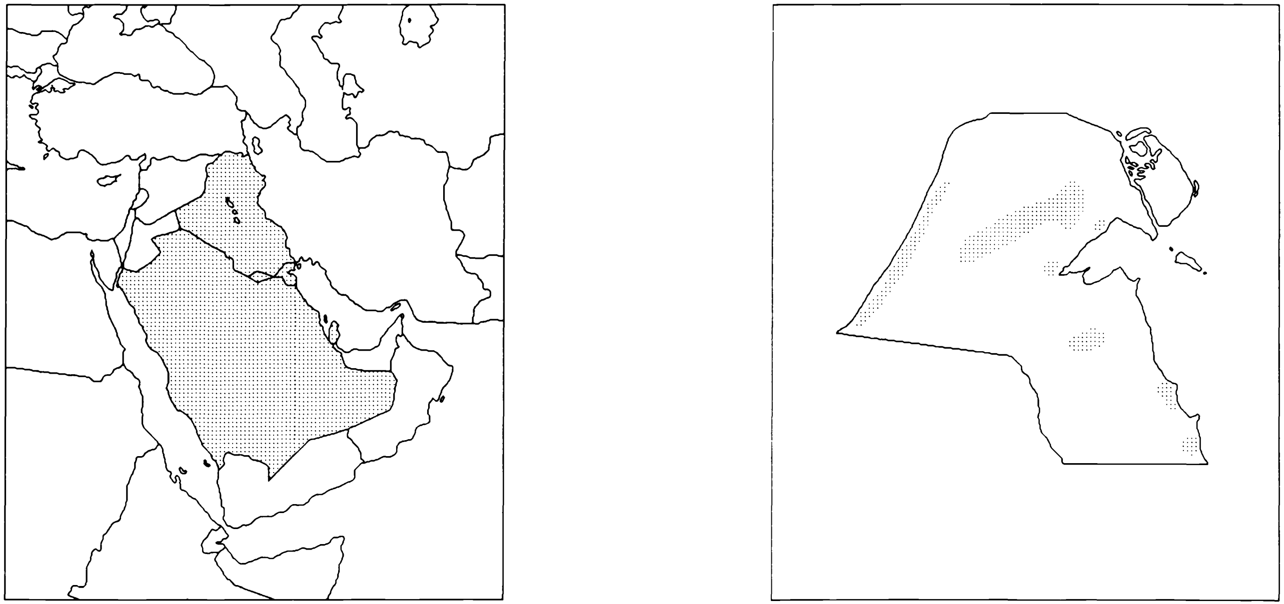


Figure 79. Geographic distribution of *Heliotropium bacciferum* Forssk.

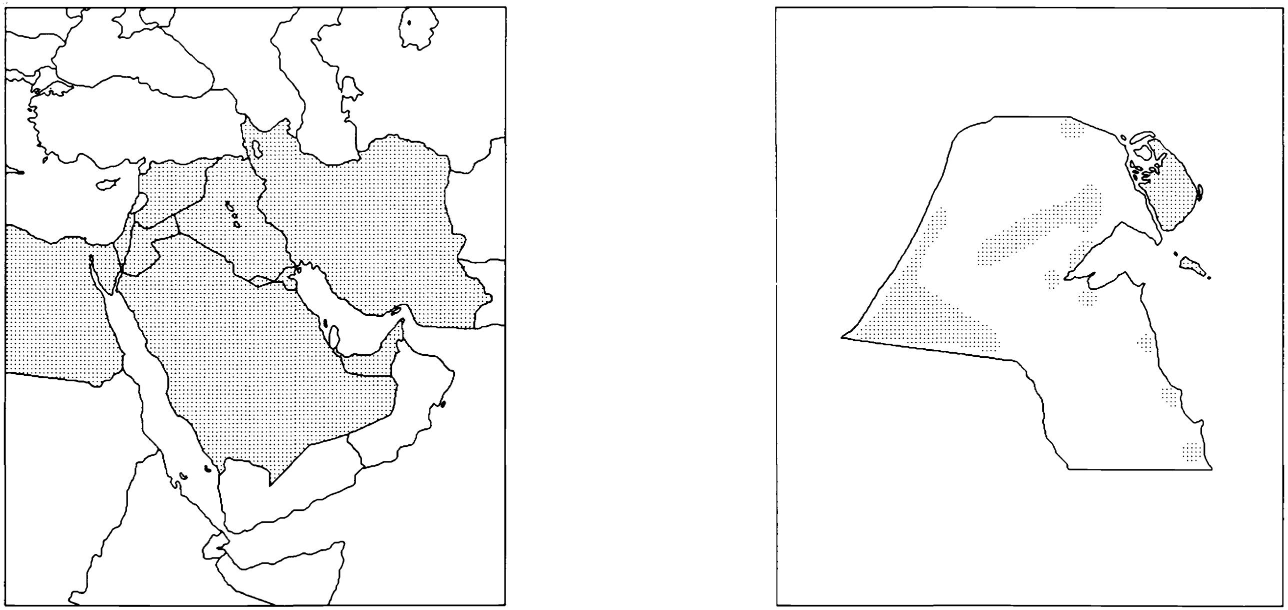


Figure 80. Geographic distribution of *Herniaria hemistemon* J. Gay.

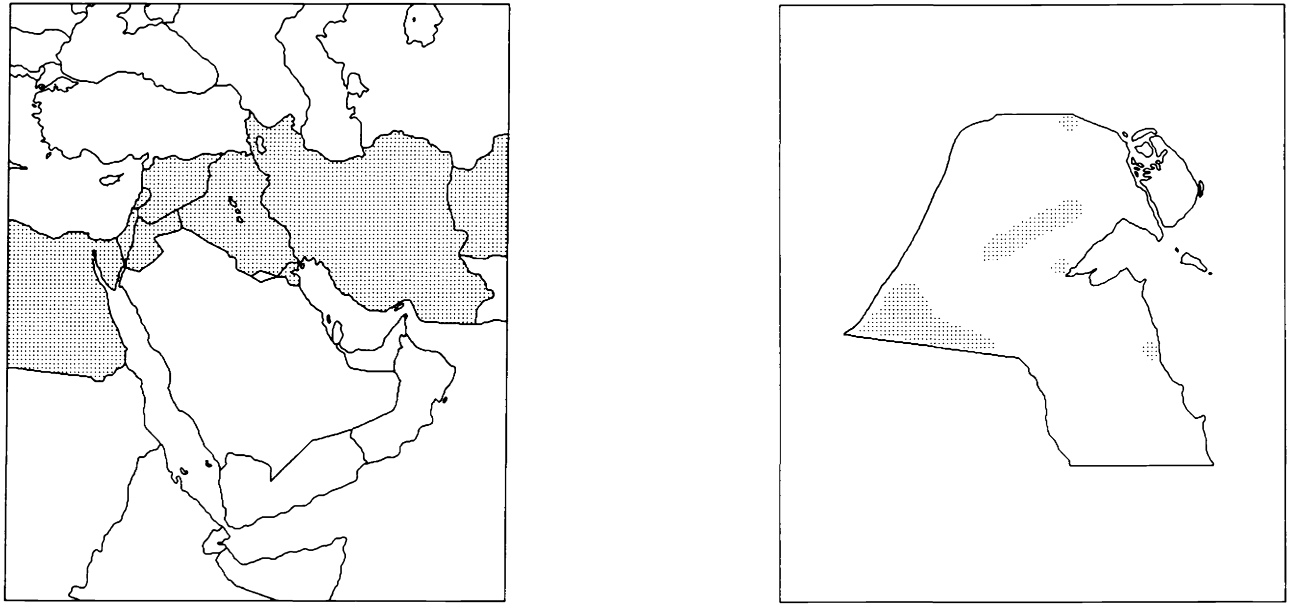


Figure 81. Geographic distribution of *Herniaria hirsuta* L.

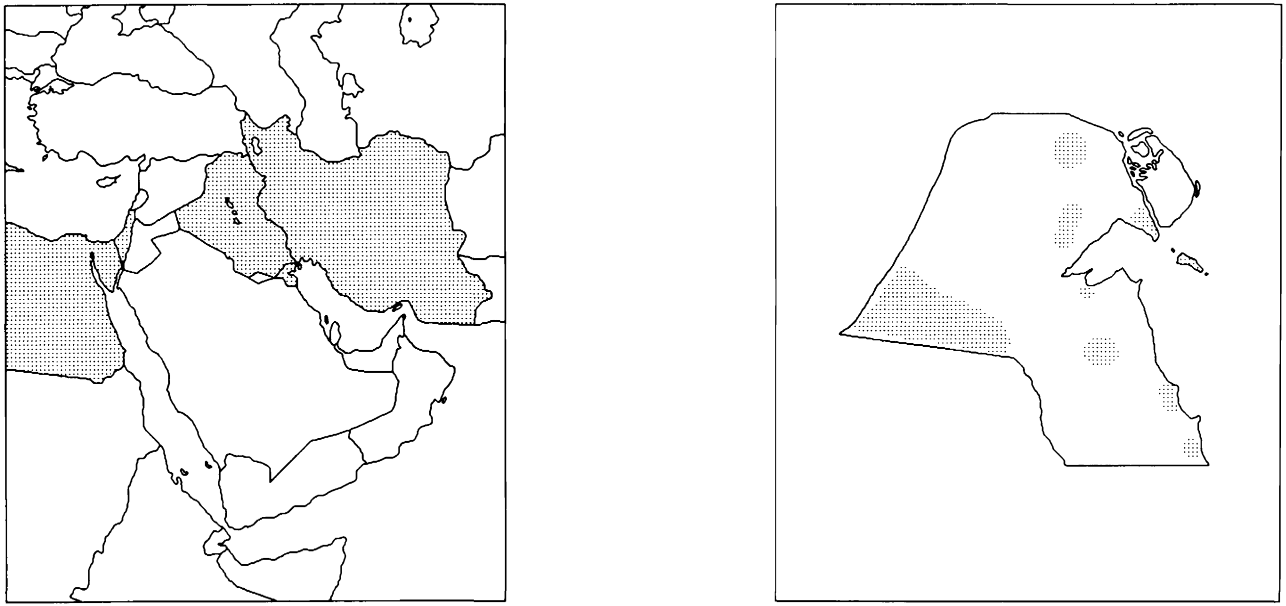


Figure 82. Geographic distribution of *Hippocrepis bicontorta* Loisel.

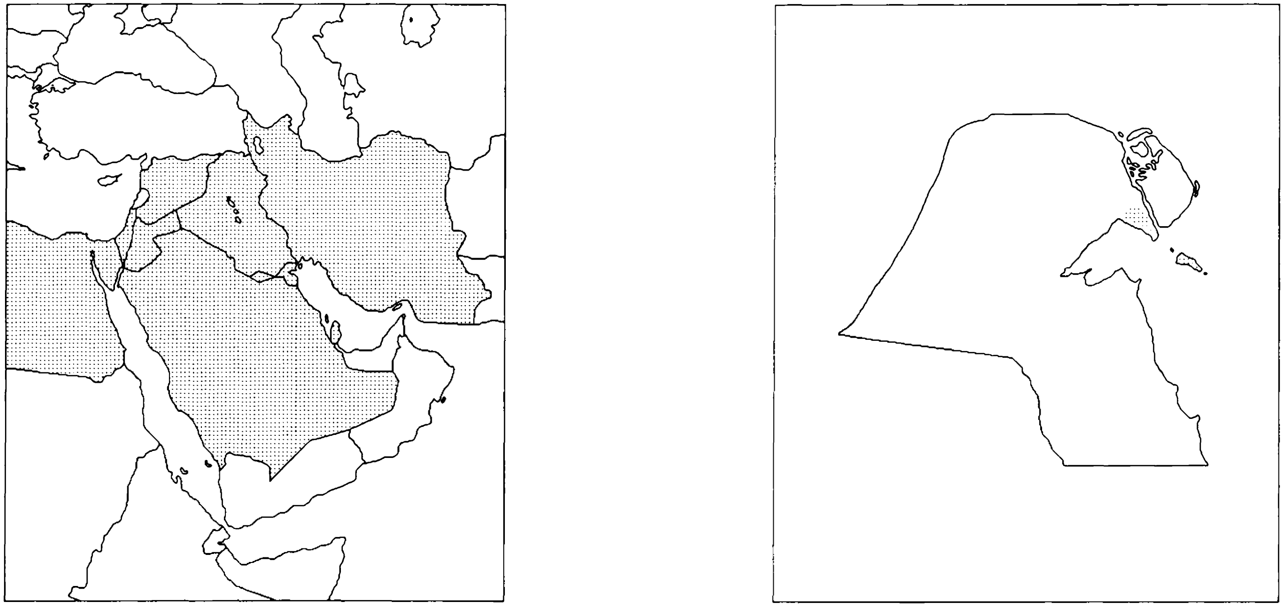


Figure 83. Geographic distribution of *Hippocrepis unisiliquosa* L.

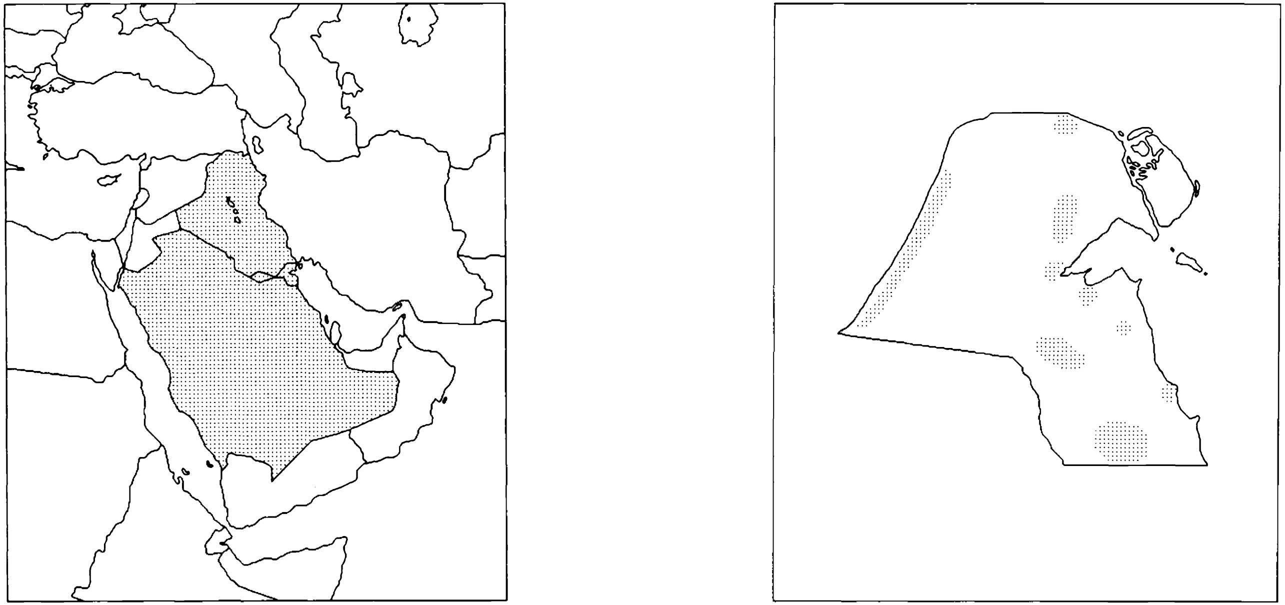


Figure 84. Geographic distribution of *Horwoodia dicksoniae* Turrill.

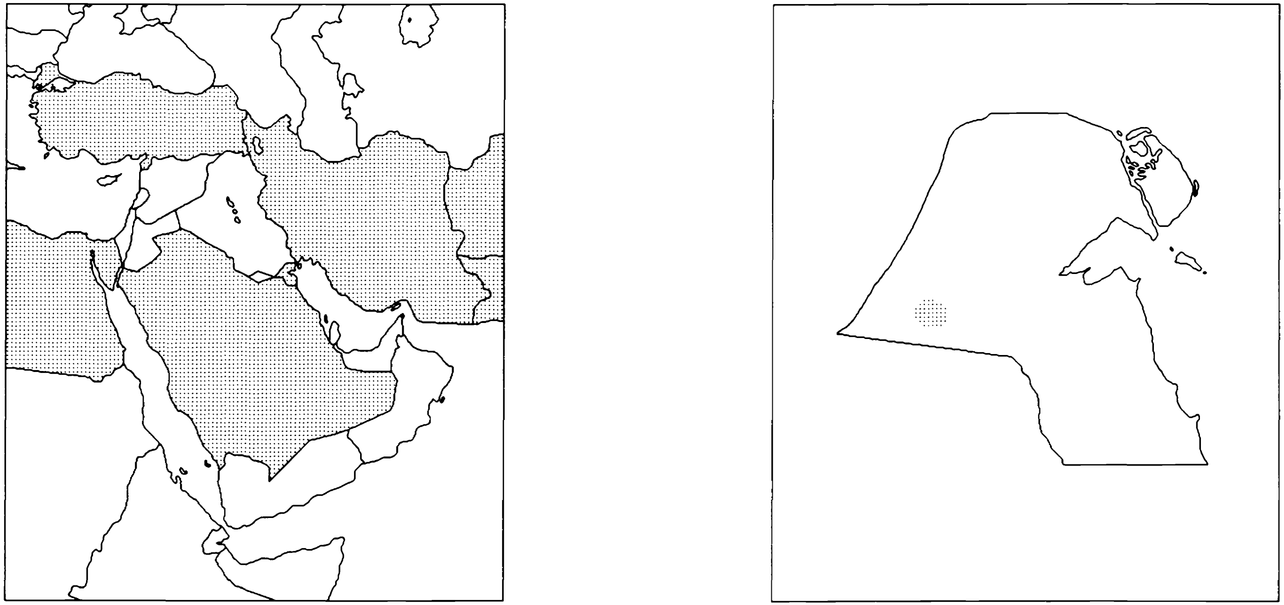


Figure 85. Geographic distribution of *Hyoscyamus pusillus* L.

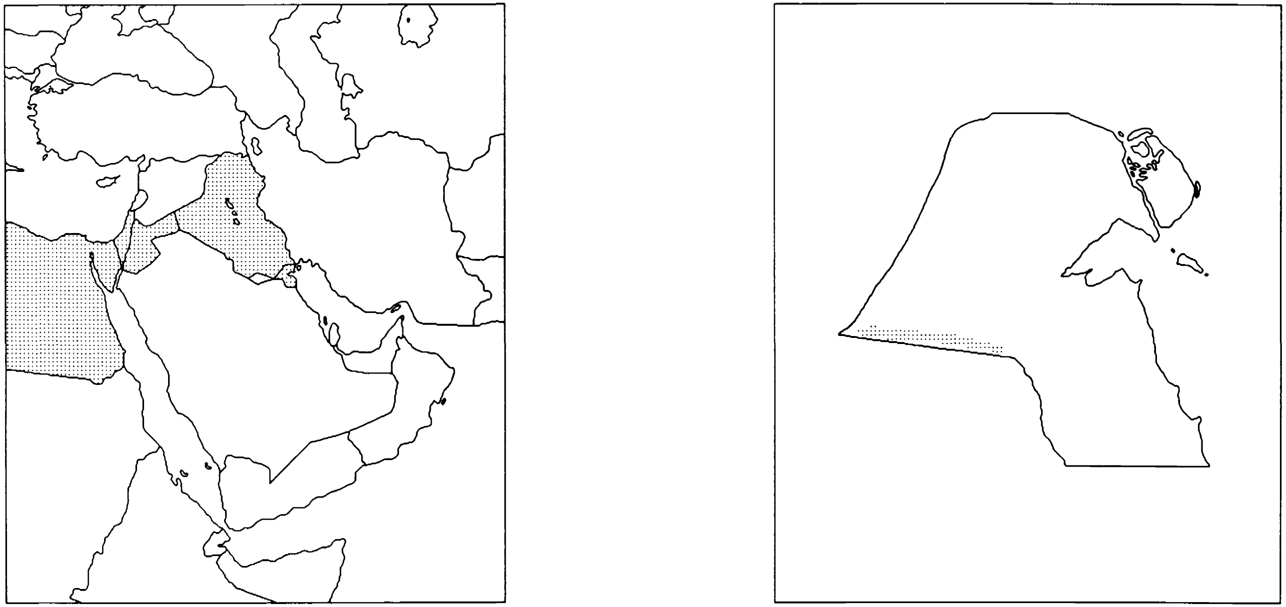


Figure 86. Geographic distribution of *Hypecoum geslinii* Coss. & Kral.

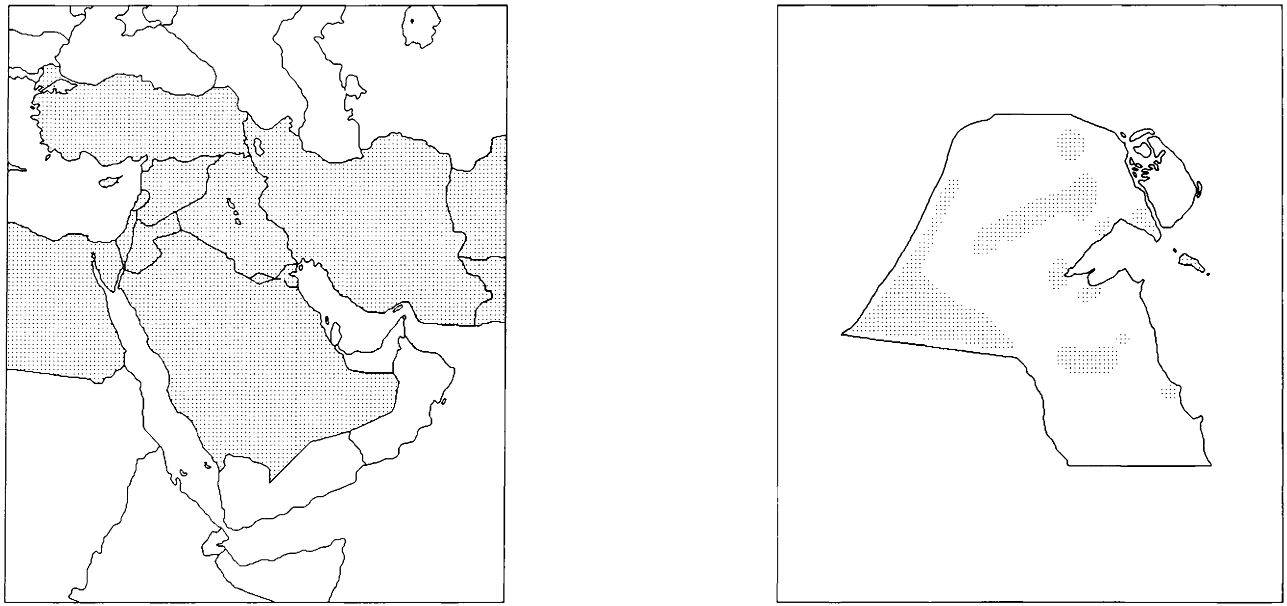


Figure 87. Geographic distribution of *Hypecoum pendulum* L.

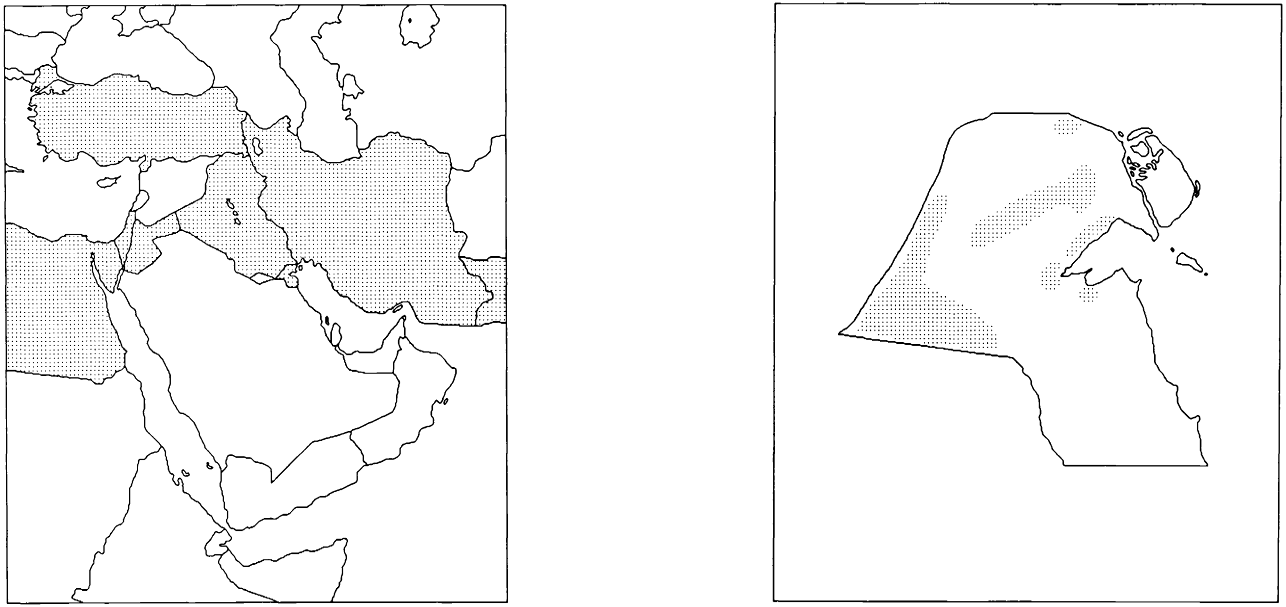


Figure 88. Geographic distribution of *Lappula spinocarpos* (Forssk.) Ascherson & Kuntze.

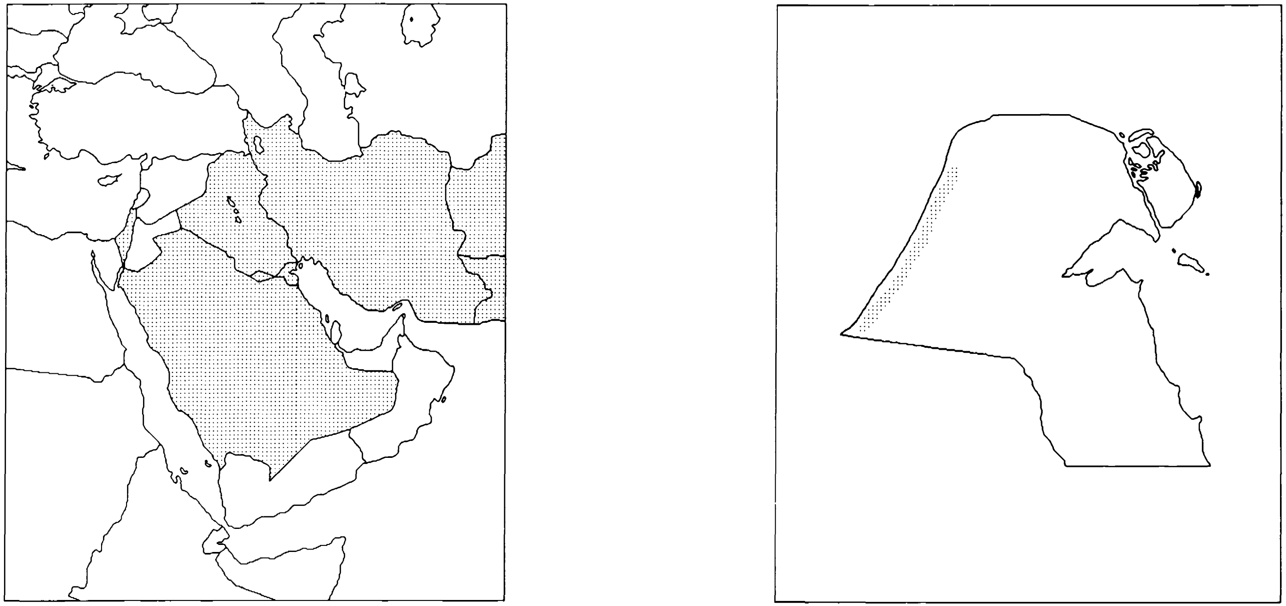


Figure 89. Geographic distribution of *Lepidium aucheri* Boiss.

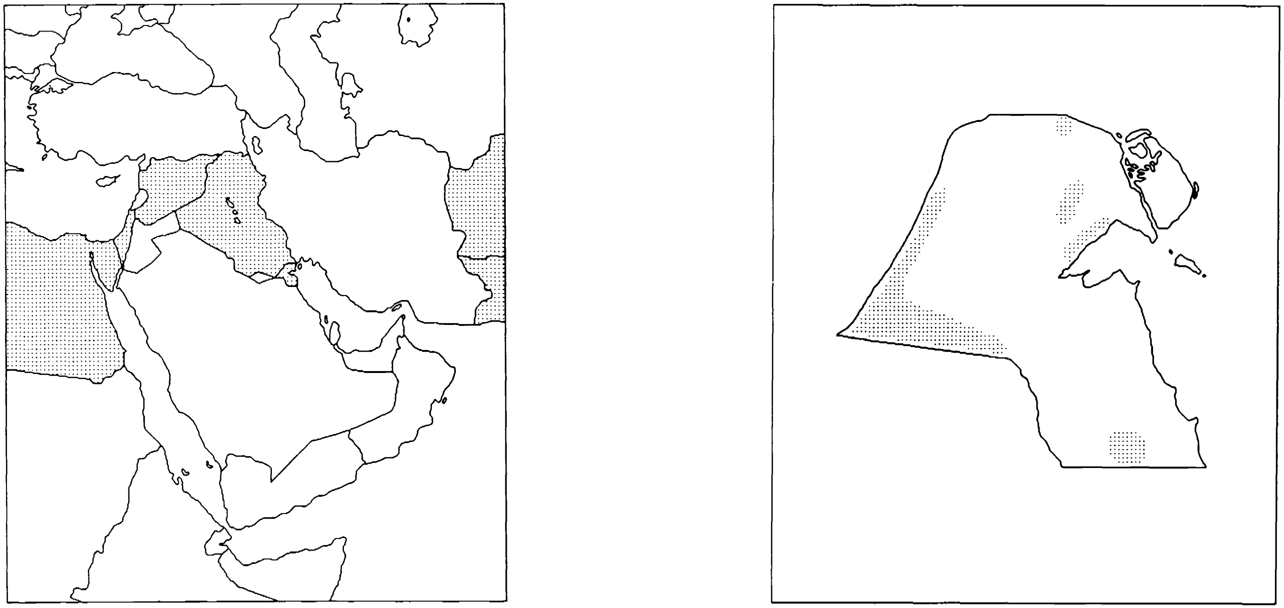


Figure 90. Geographic distribution of *Leptaleum filifolium* (Willd.) DC.

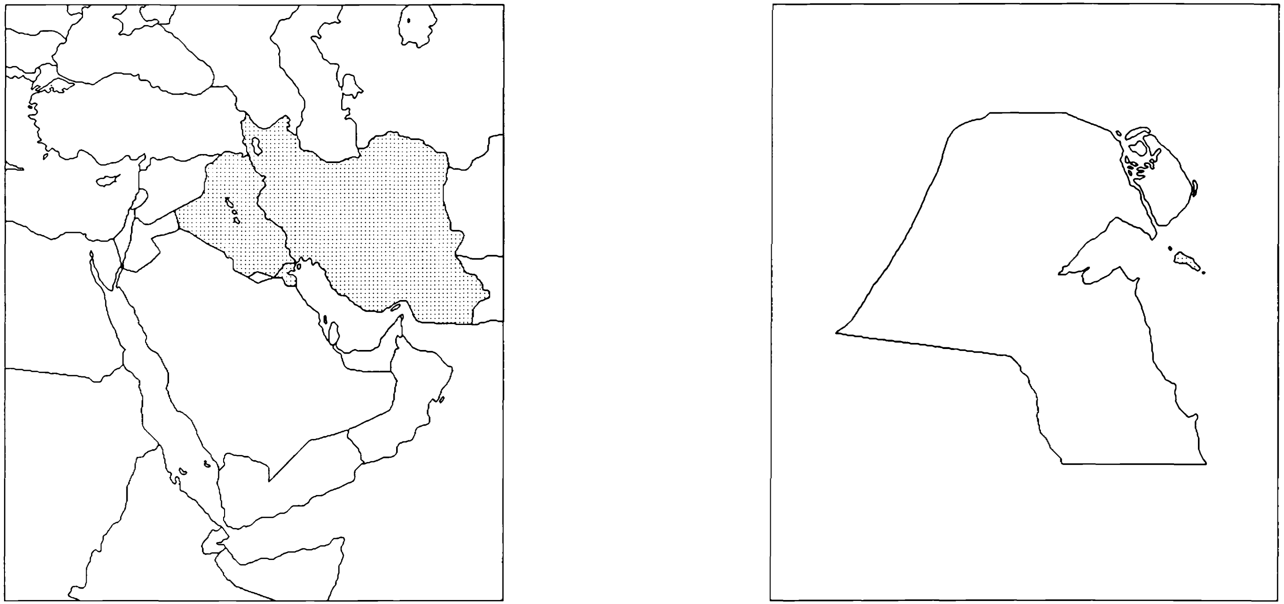


Figure 91. Geographic distribution of *Limonium carnosum* (Boiss.) Kuntze.

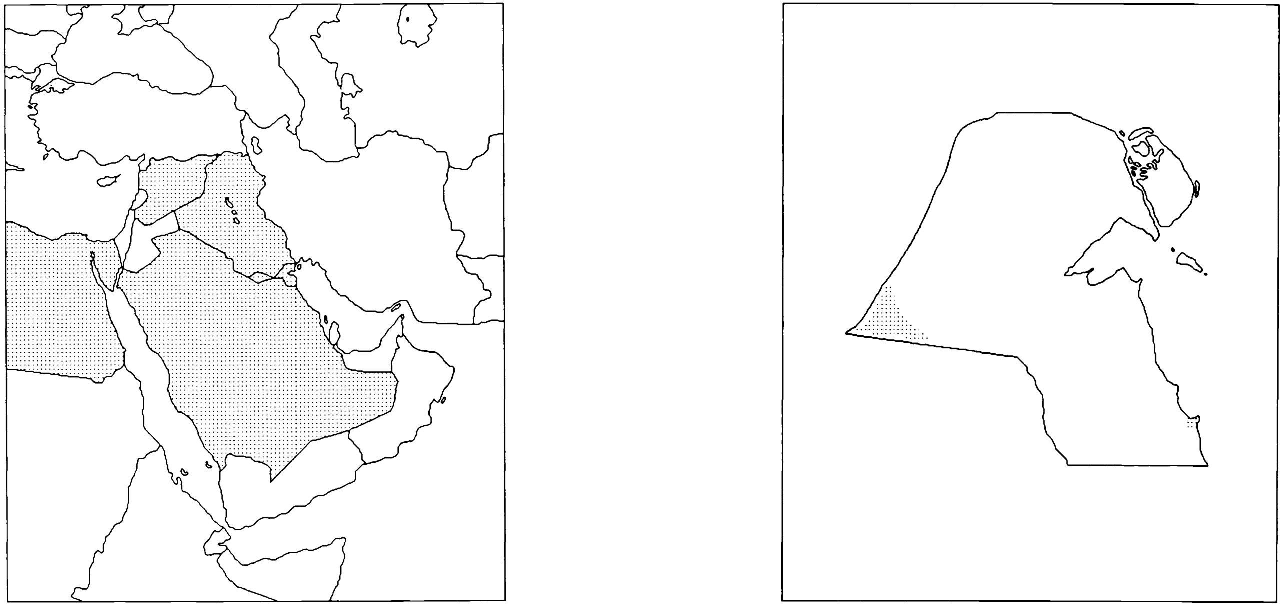


Figure 92. Geographic distribution of *Limonium thouini* (Viv.) Kuntze.

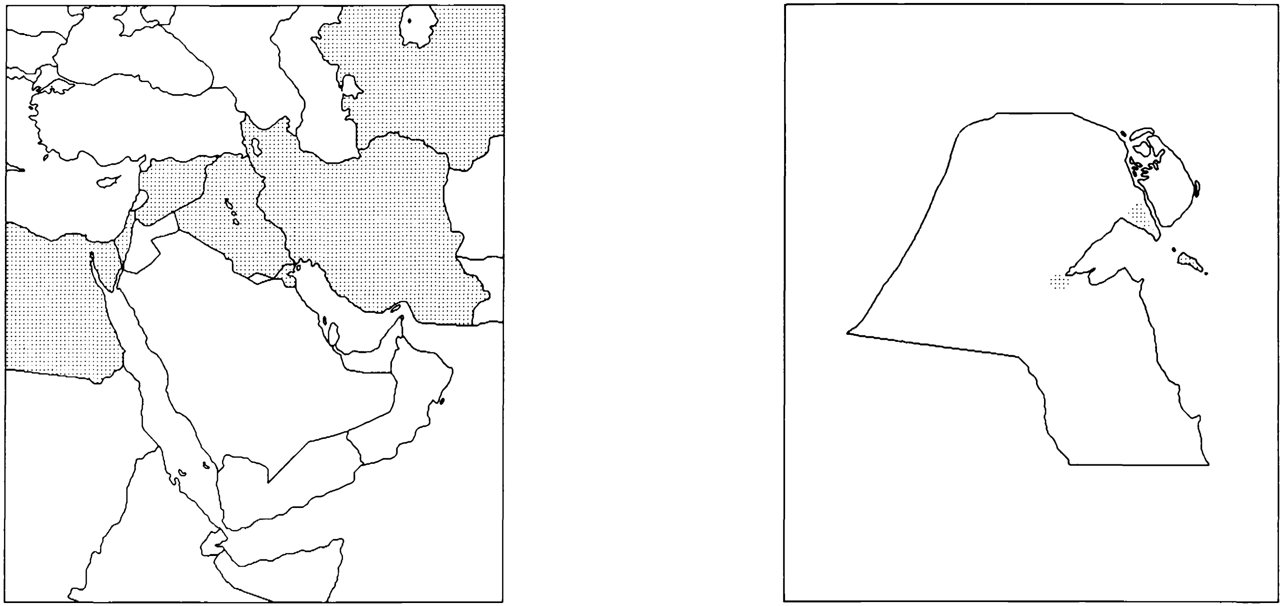


Figure 93. Geographic distribution of *Linaria albifrons* (Sibth. & Sm.) Spreng.

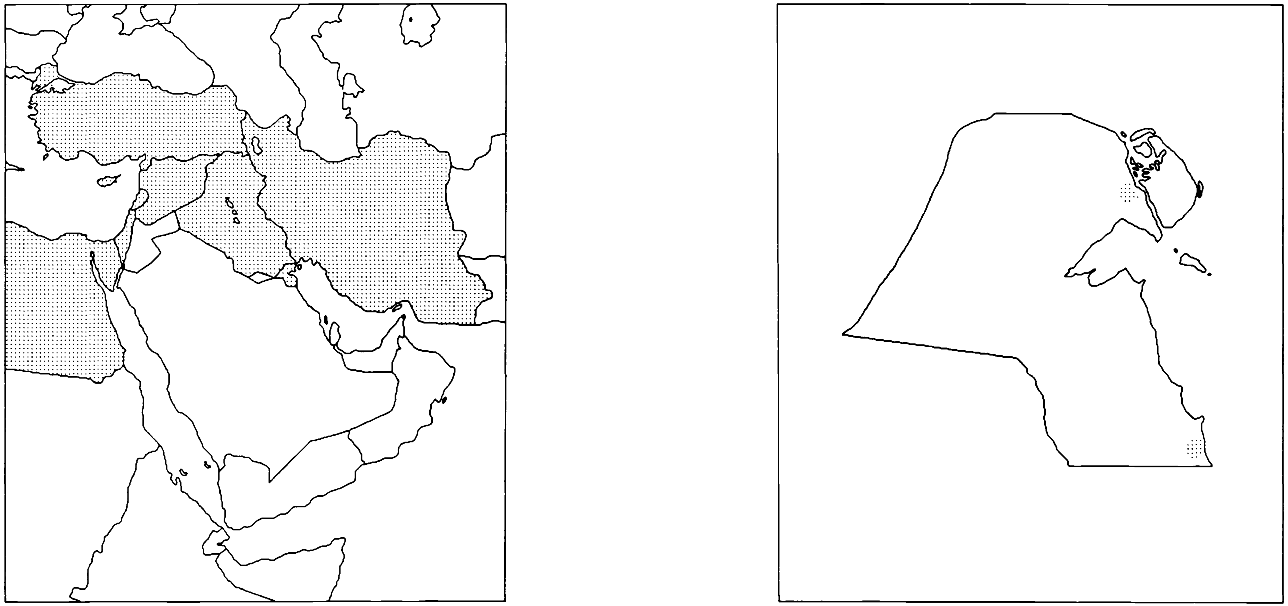


Figure 94. Geographic distribution of *Linaria simplex* (Willd.) DC.

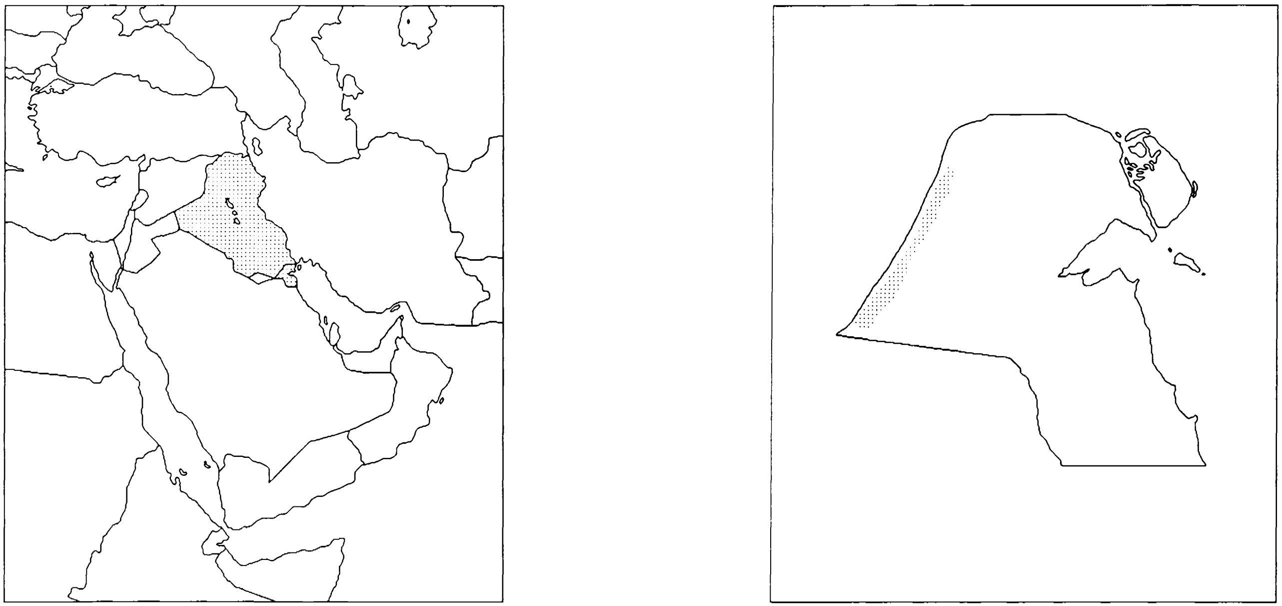


Figure 95. Geographic distribution of *Lithospermum apulum* (L.) Vahl.

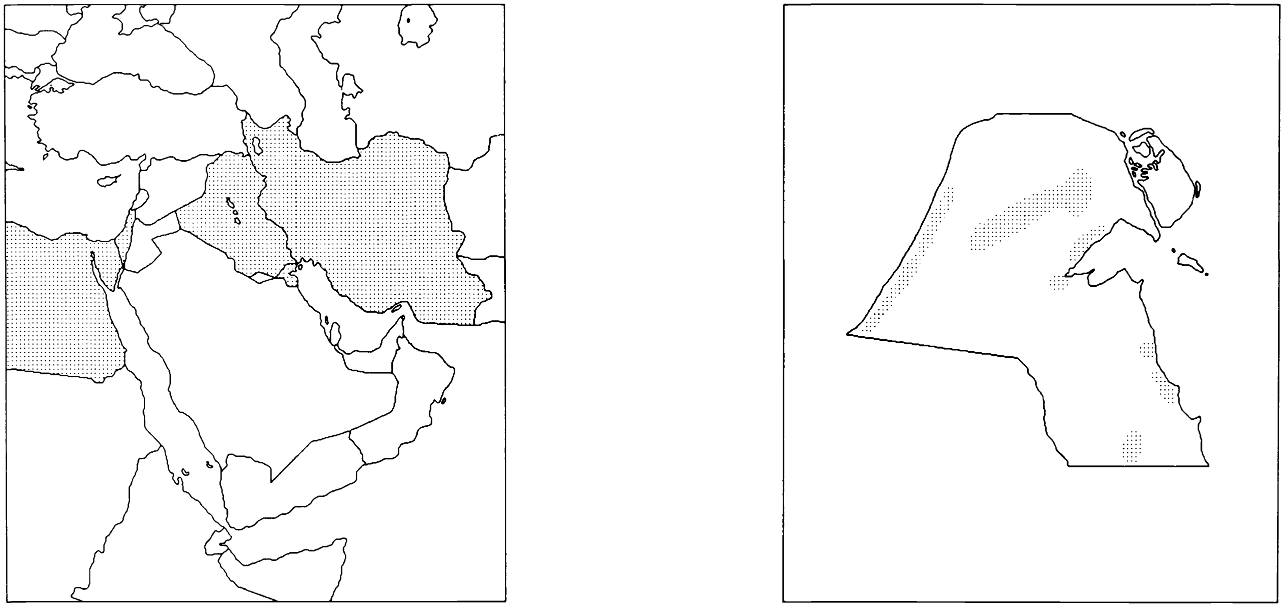


Figure 96. Geographic distribution of *Loeflingia hispanica* L.

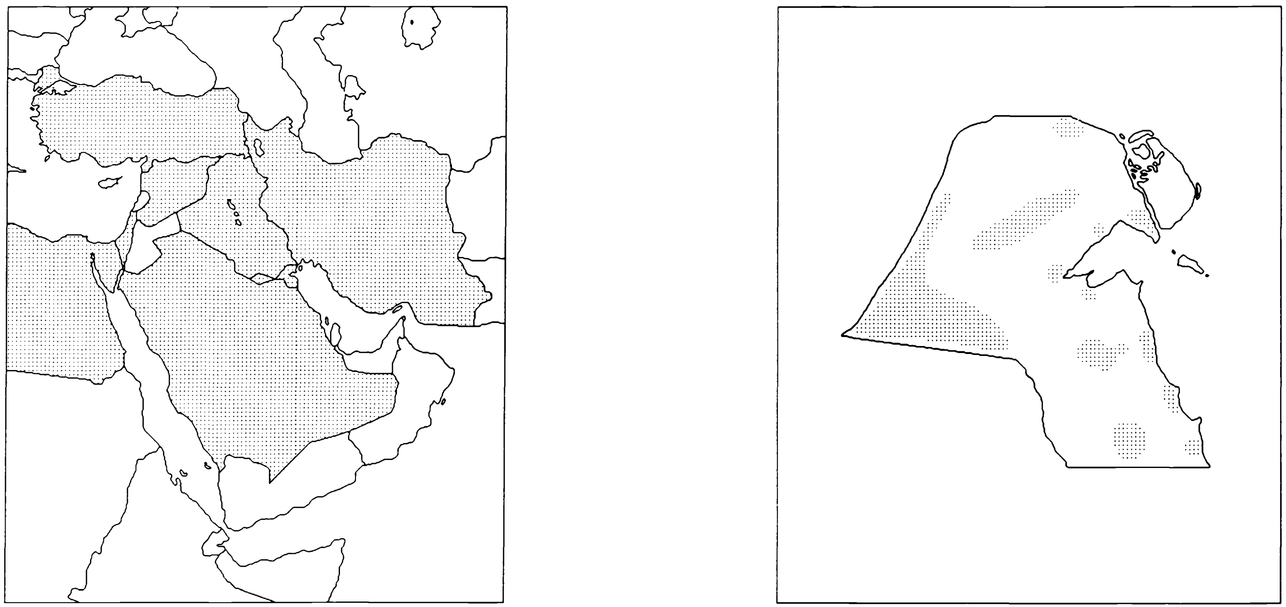


Figure 97. Geographic distribution of *Lotus halophilus* Boiss. & Sprun.

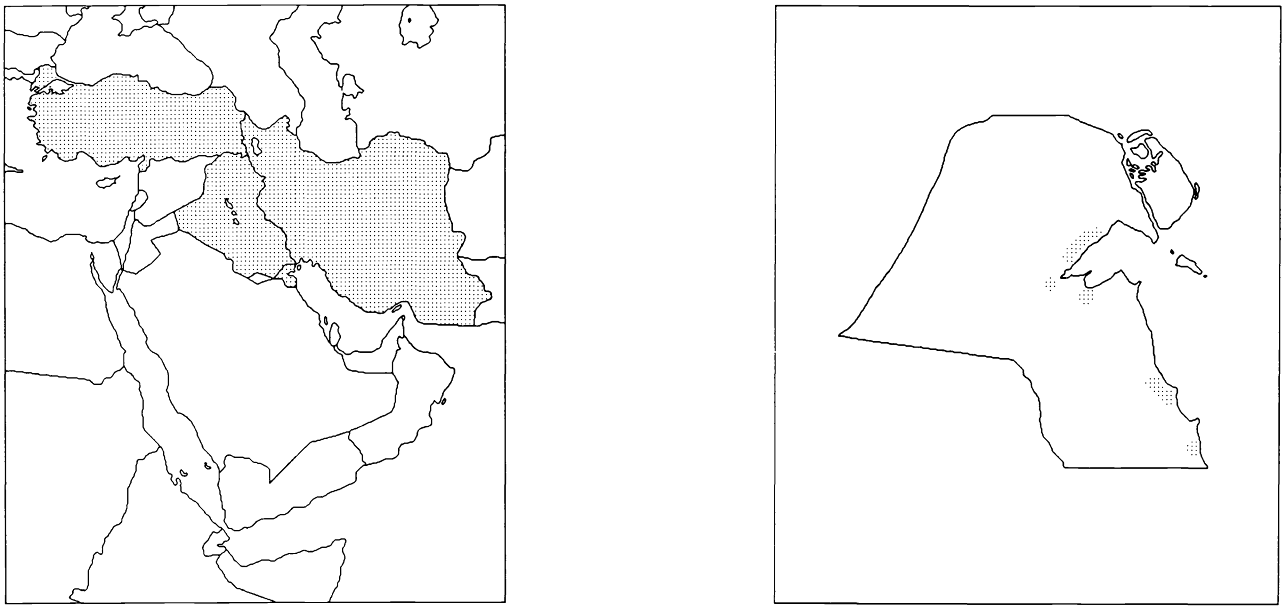


Figure 98. Geographic distribution of *Lycium shawii* Roem. & Schult.

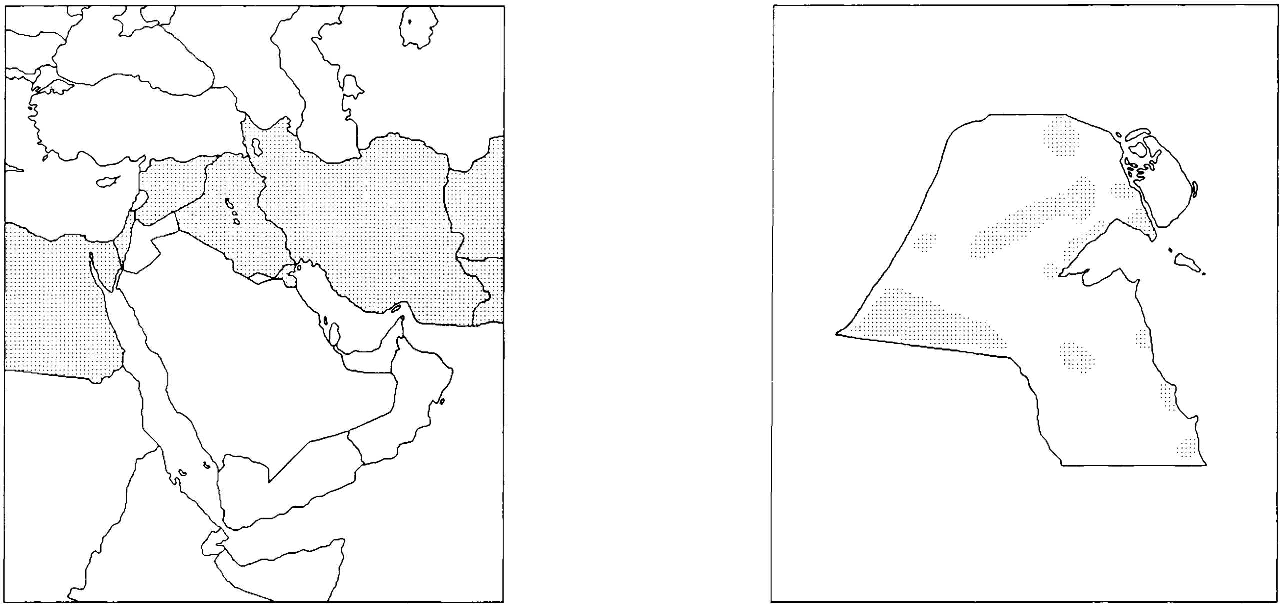


Figure 99. Geographic distribution of *Malcolmia grandiflora* (Bunge) Kuntze.

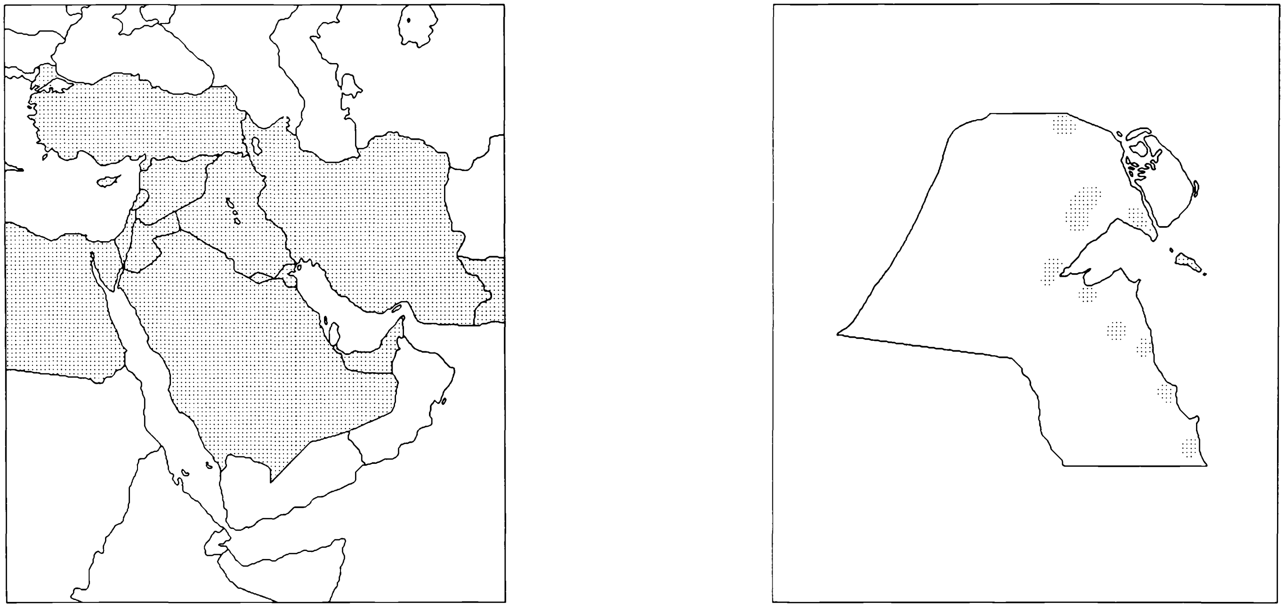


Figure 100. Geographic distribution of *Malva parviflora* L.

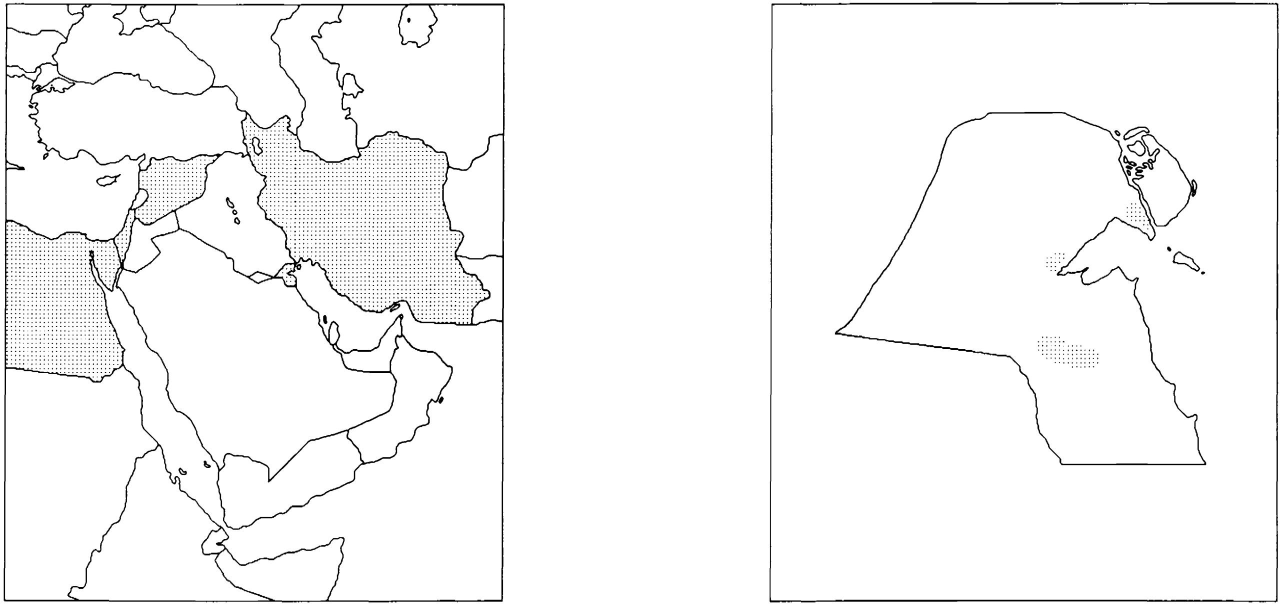


Figure 101. Geographic distribution of *Maresia pygmaea* (Del.) O.E. Schulz.

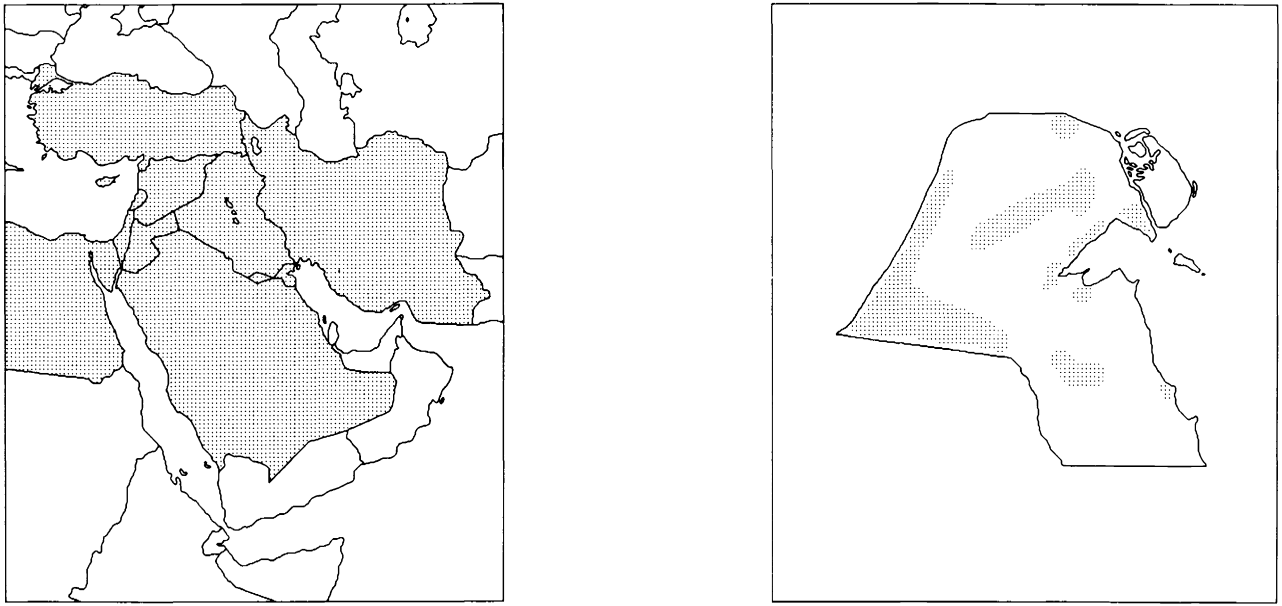


Figure 102. Geographic distribution of *Matthiola longipetala* (Vent.) DC.

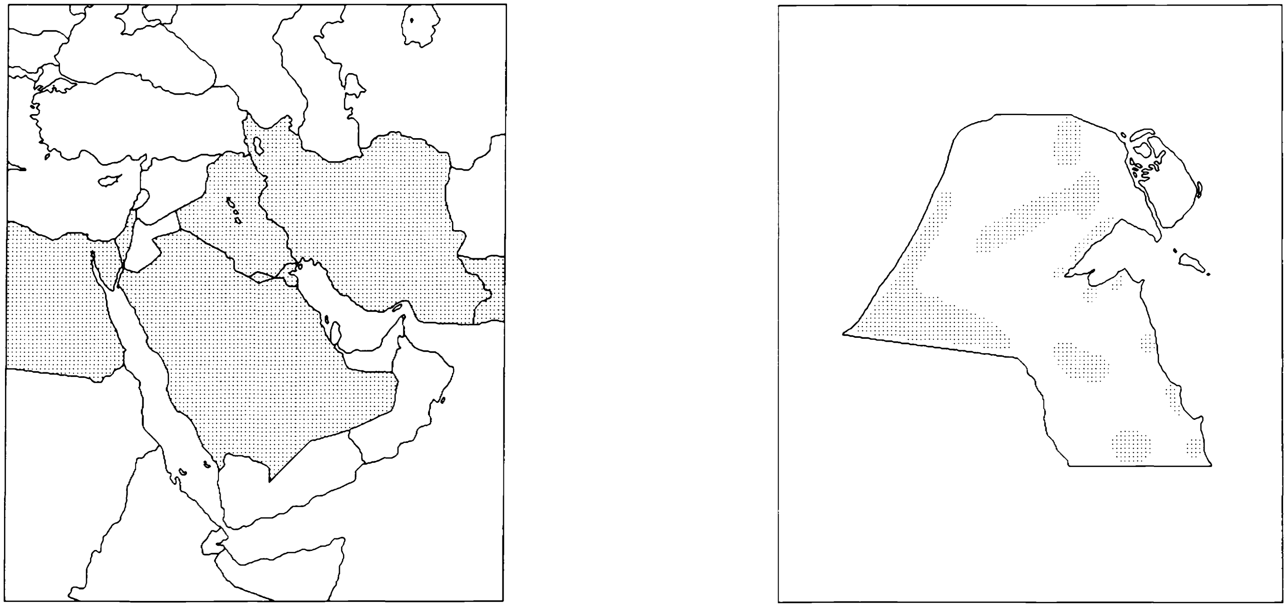


Figure 103. Geographic distribution of *Medicago laciniata* (L.) Mill.

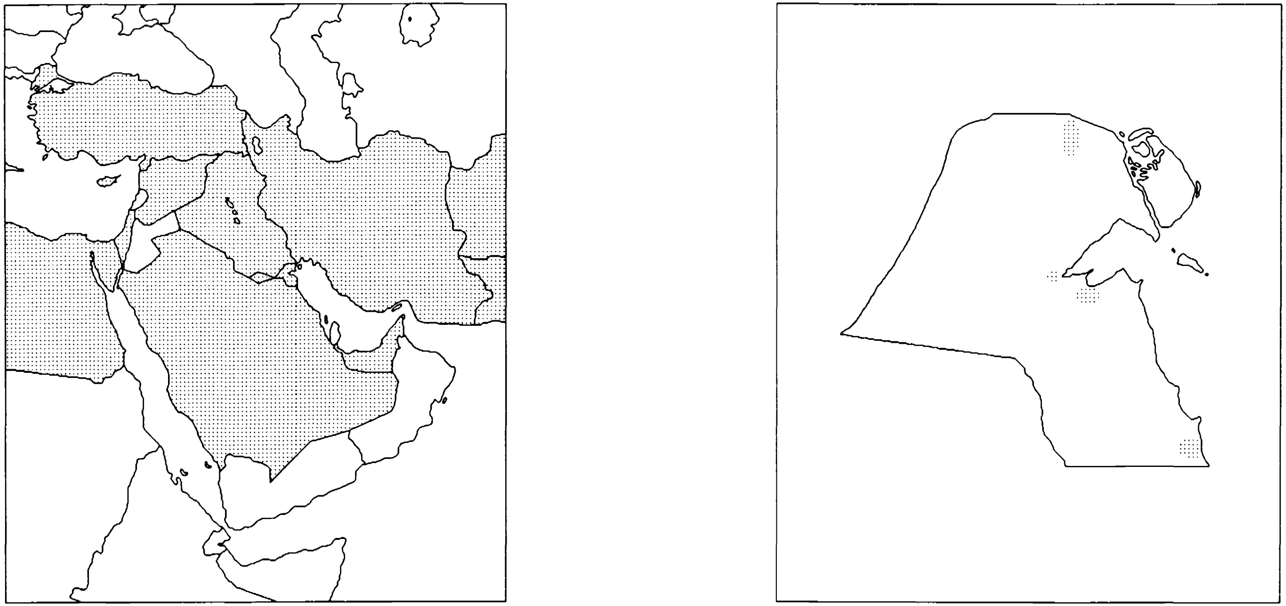


Figure 104. Geographic distribution of *Melilotus indicus* (L.) All.

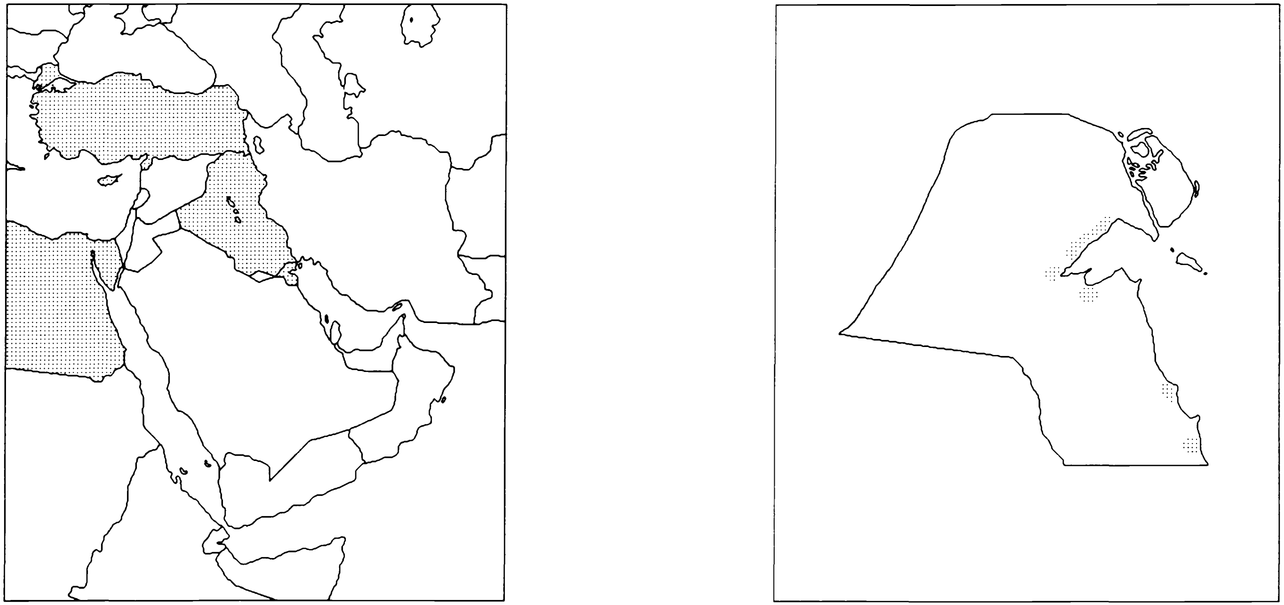


Figure 105. Geographic distribution of *Mesembryanthemum nodiflorum* L.

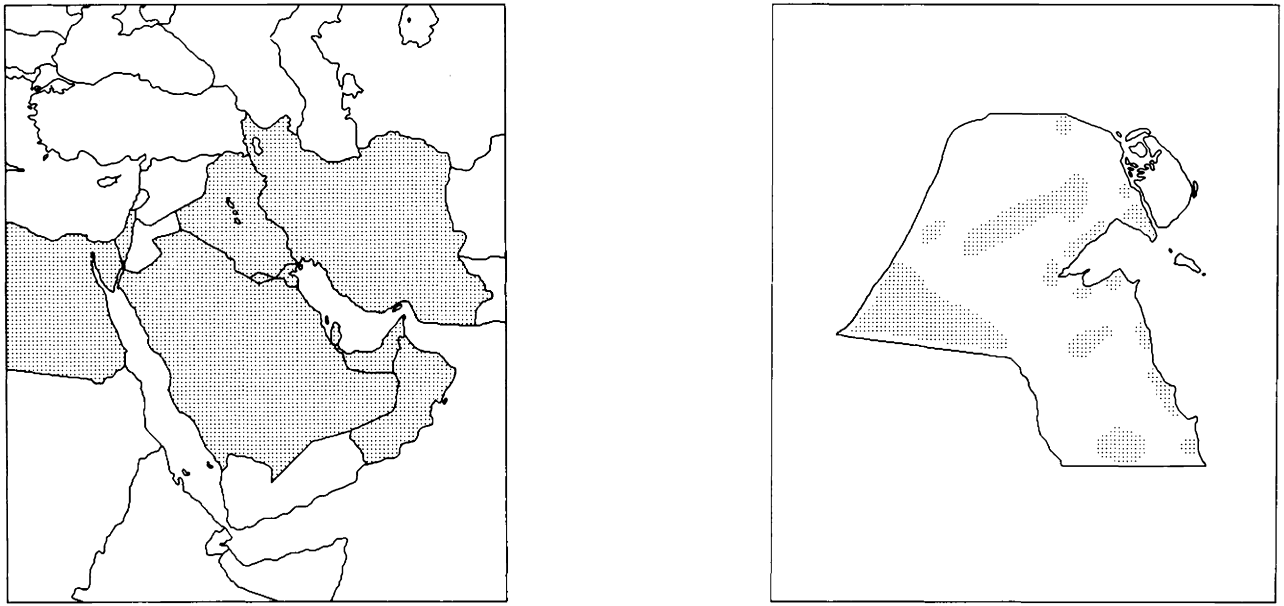


Figure 106. Geographic distribution of *Moltokiopsis ciliata* (Forssk.) I.M. Johnston.

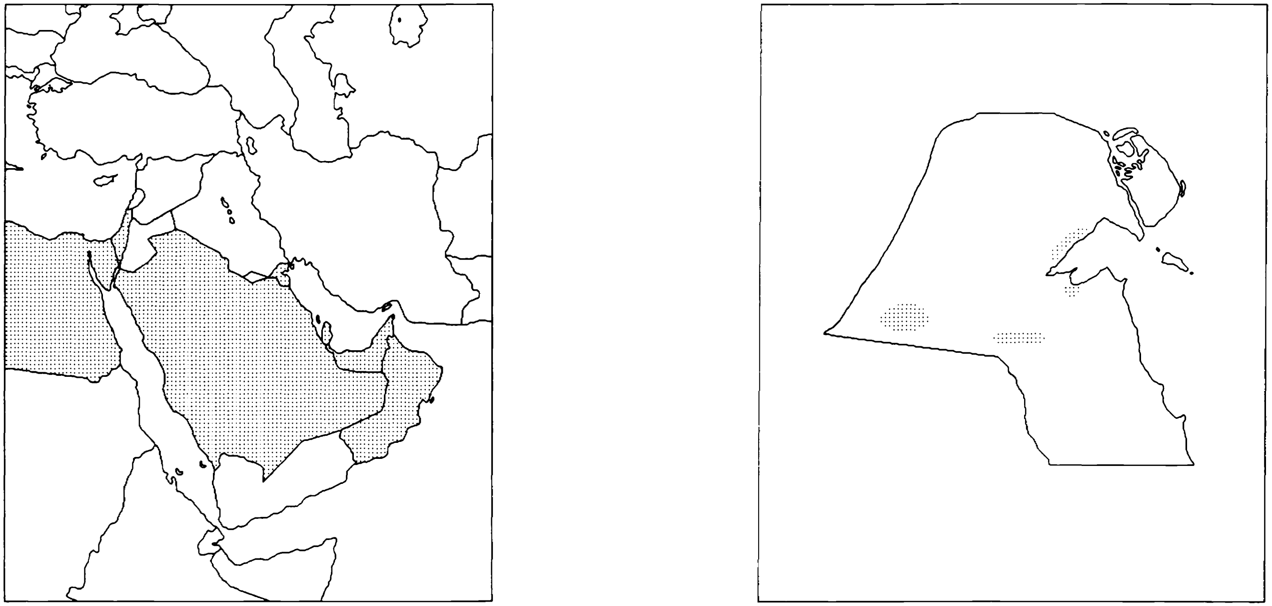


Figure 107. Geographic distribution of *Monsonia nivea* (Decne.) Decne. ex Webb.

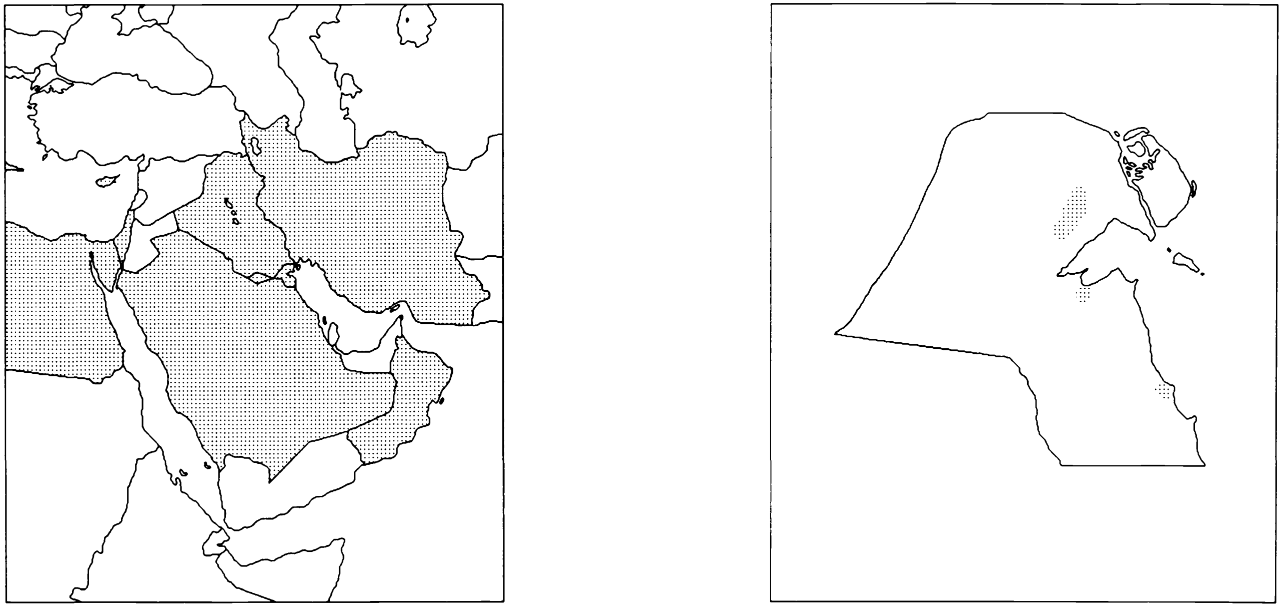


Figure 108. Geographic distribution of *Neurada procumbens* L.

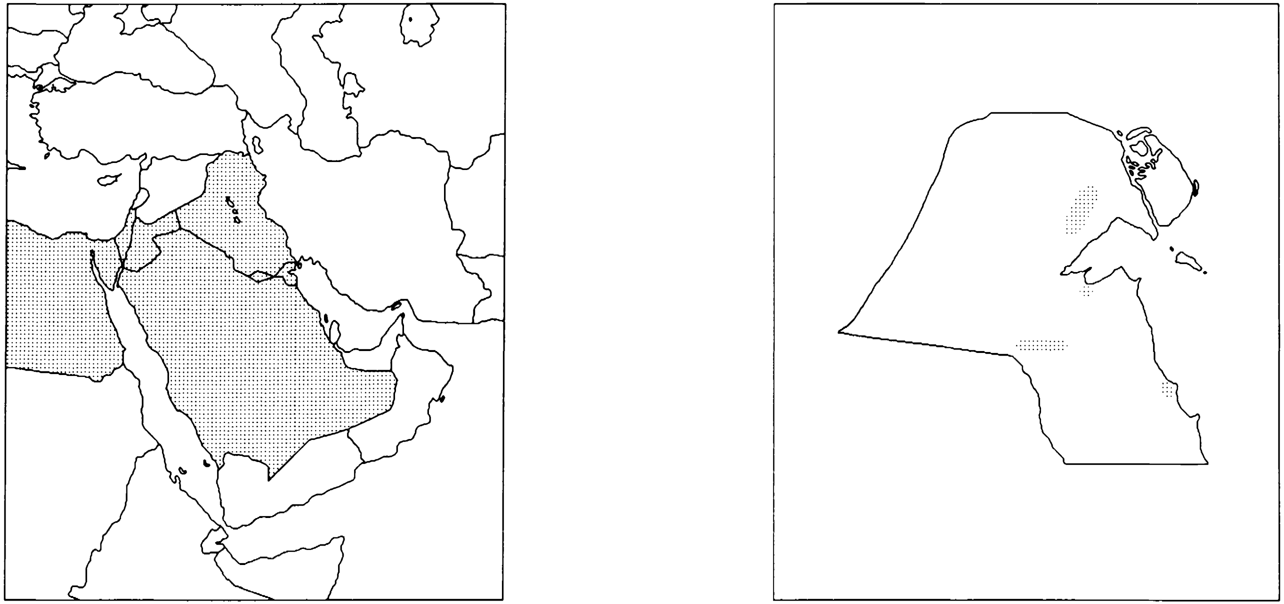


Figure 109. Geographic distribution of *Nitraria retusa* (Forssk.) Aschers.

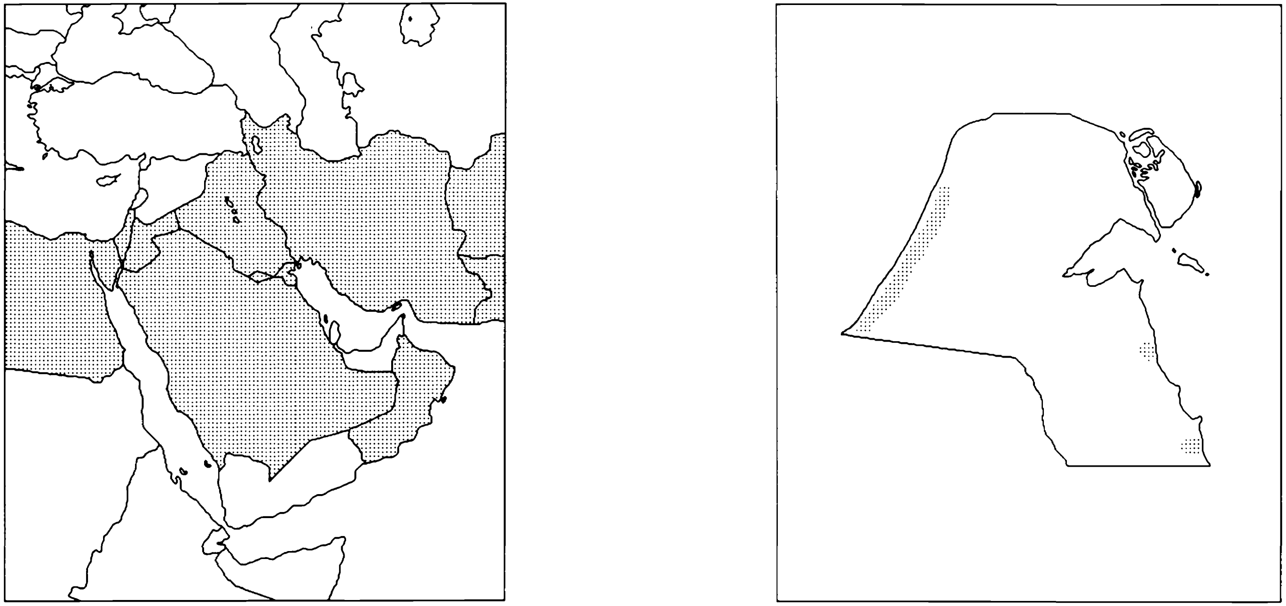


Figure 110. Geographic distribution of *Notoceras bicorne* (Aiton) Amo.

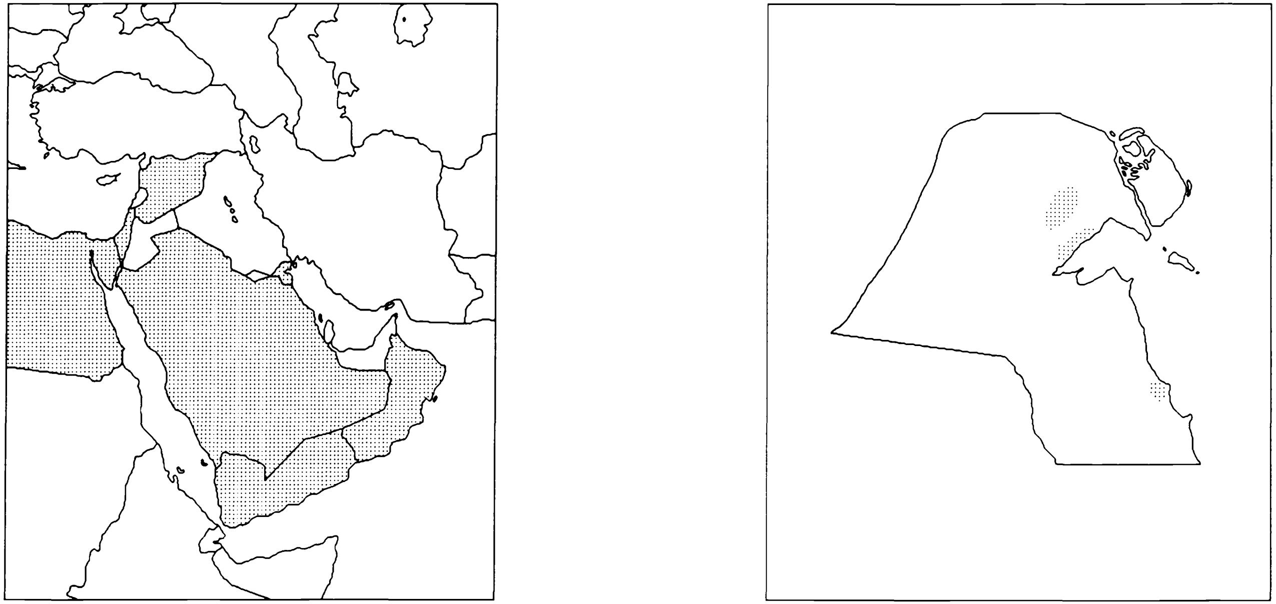


Figure 111. Geographic distribution of *Ochradenus baccatus* Del.

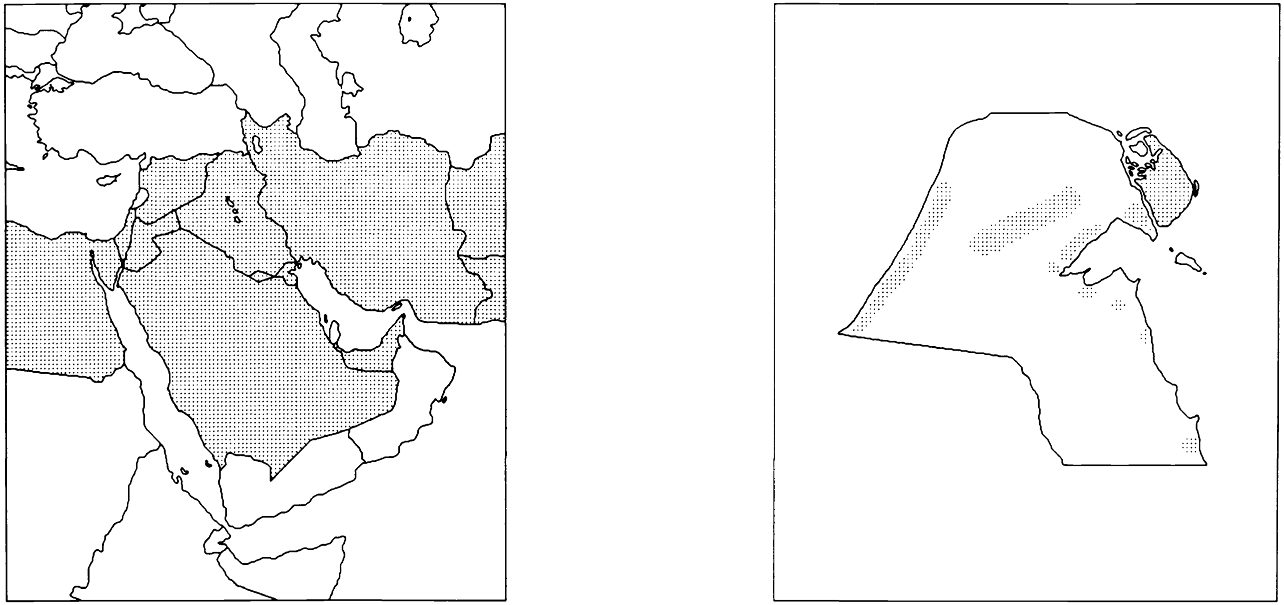


Figure 112. Geographic distribution of *Oligomeris subulata* (Del.) Boiss.

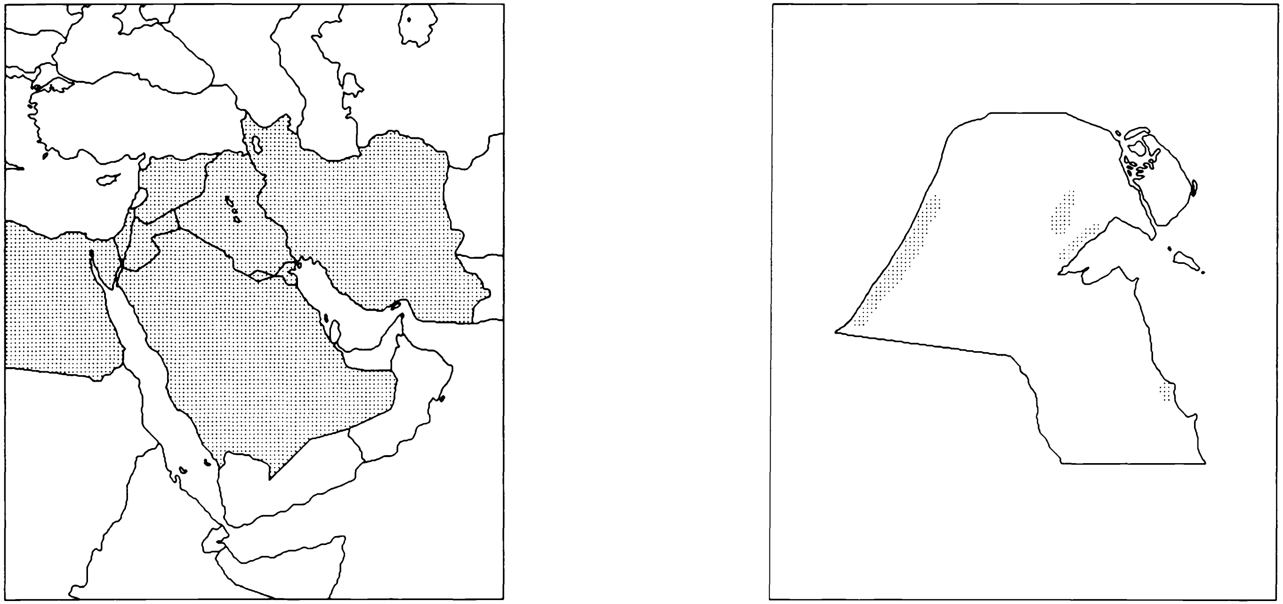


Figure 113. Geographic distribution of *Onobrychis ptolemaica* (Del.) DC.

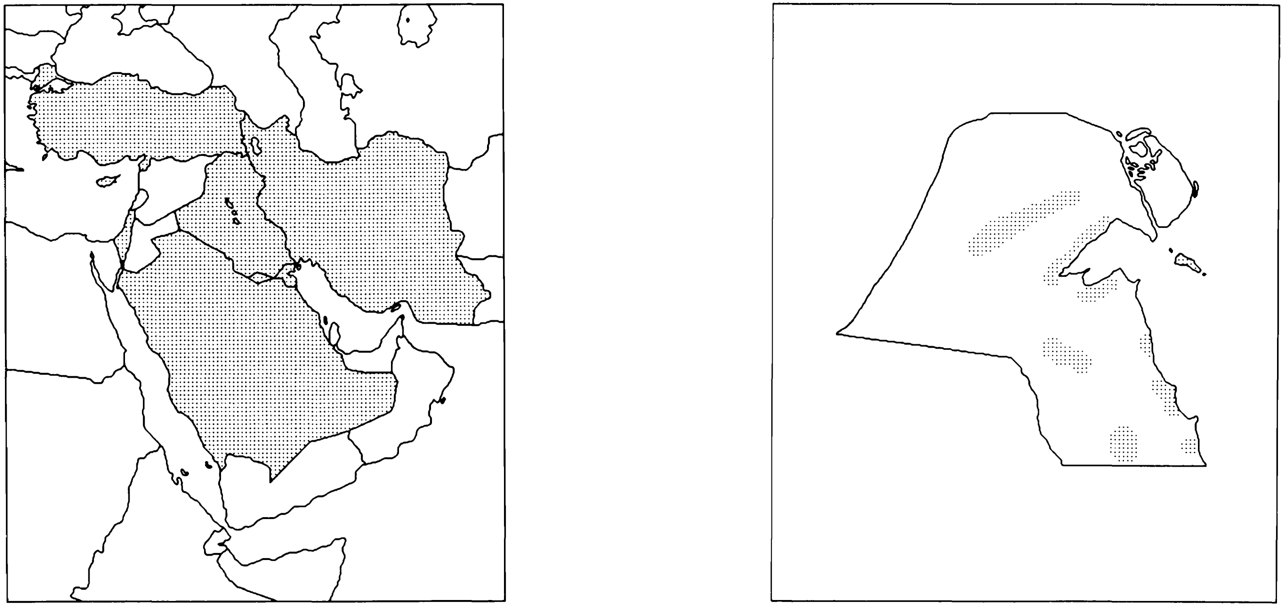


Figure 114. Geographic distribution of *Ononis serrata* Forssk.

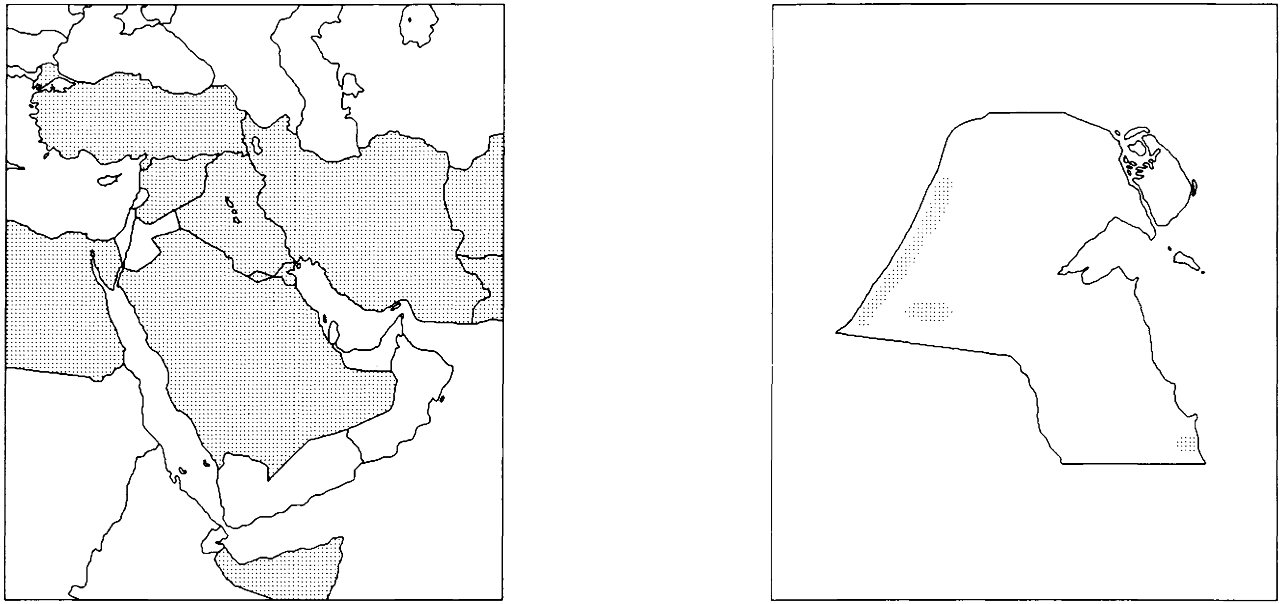


Figure 115. Geographic distribution of *Orobanche cernua* Loefl.

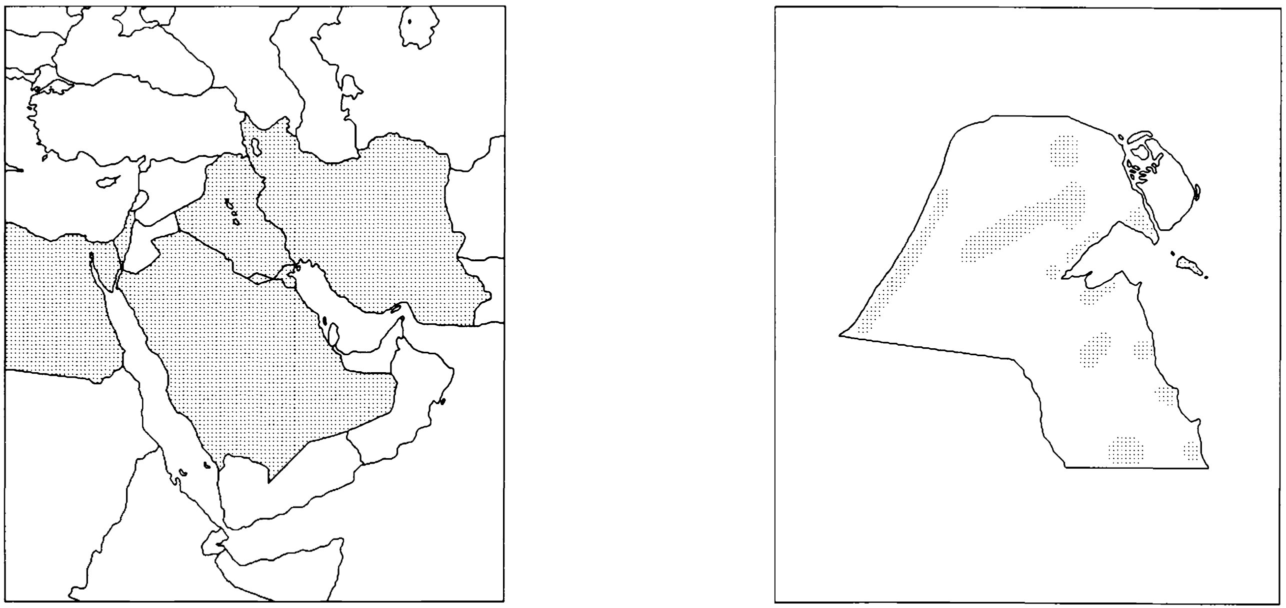


Figure 116. Geographic distribution of *Paronychia arabica* (L.) DC.

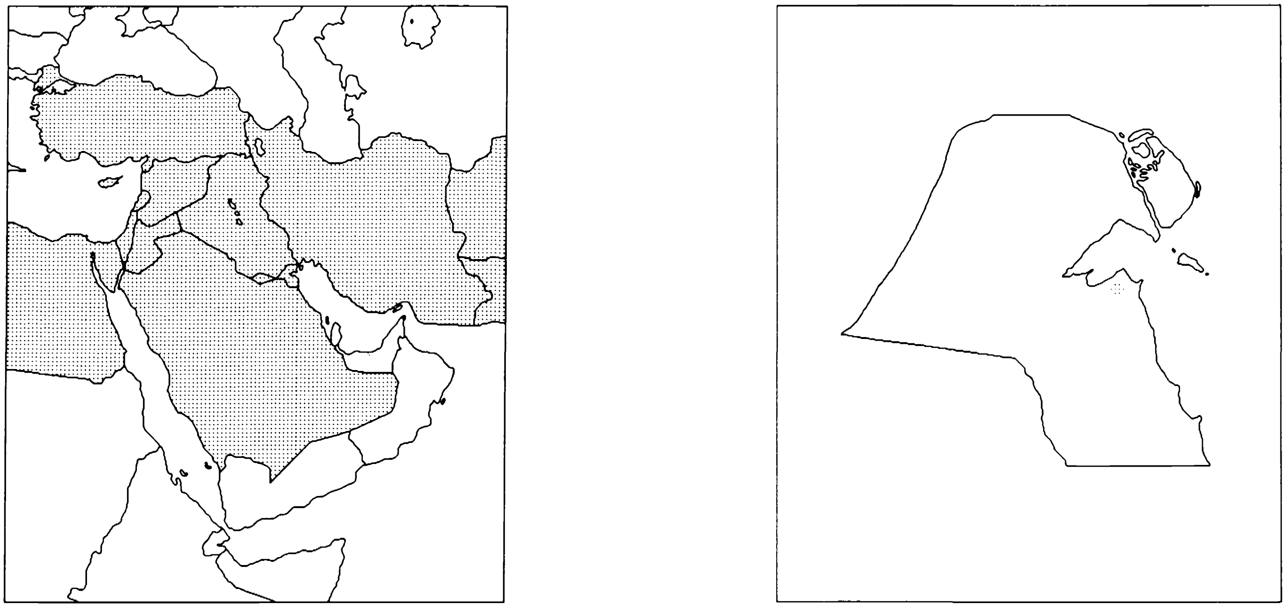


Figure 117. Geographic distribution of *Peganum harmala* L.

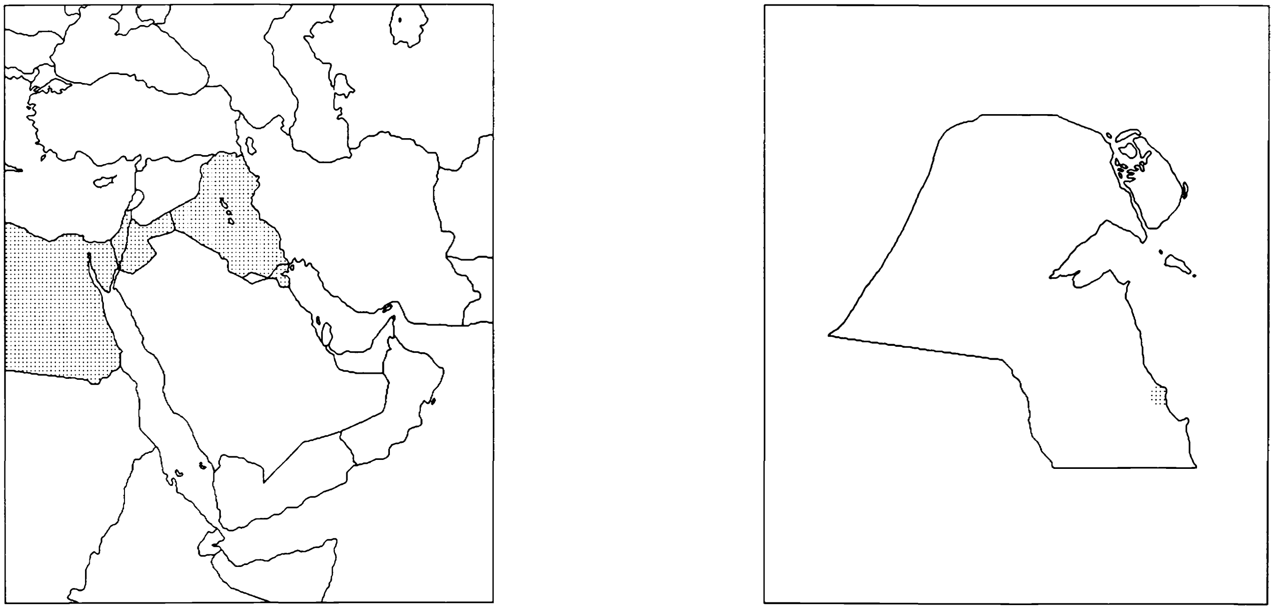


Figure 118. Geographic distribution of *Pituranthos triradiatus* (Hochst. ex Boiss.) Aschers. & Schweinf.

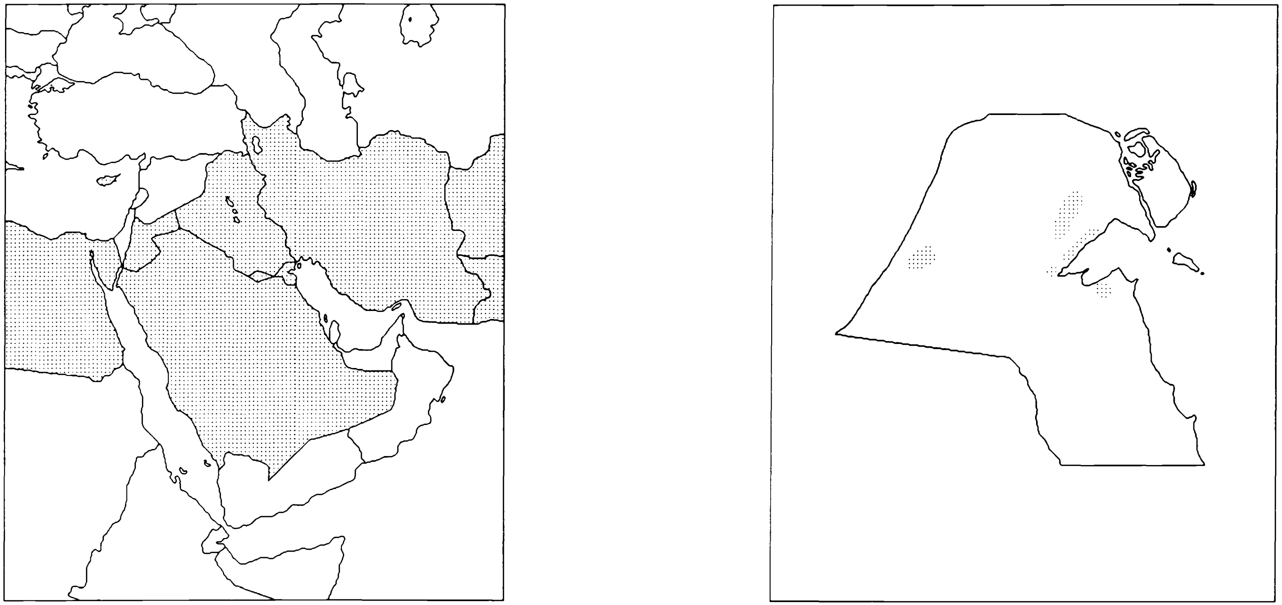


Figure 119. Geographic distribution of *Plantago amplexicaulis* Cav. subsp. *bauphula* (Edgew.) Rech. f.

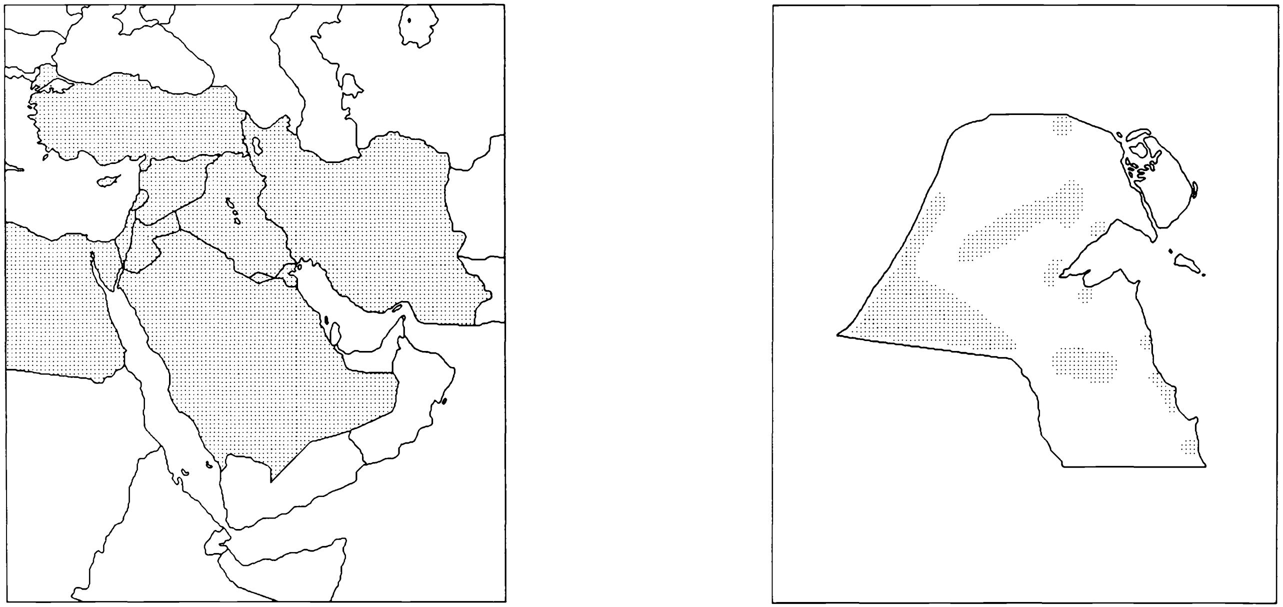


Figure 120. Geographic distribution of *Plantago boissieri* Hausskn. & Bornm.

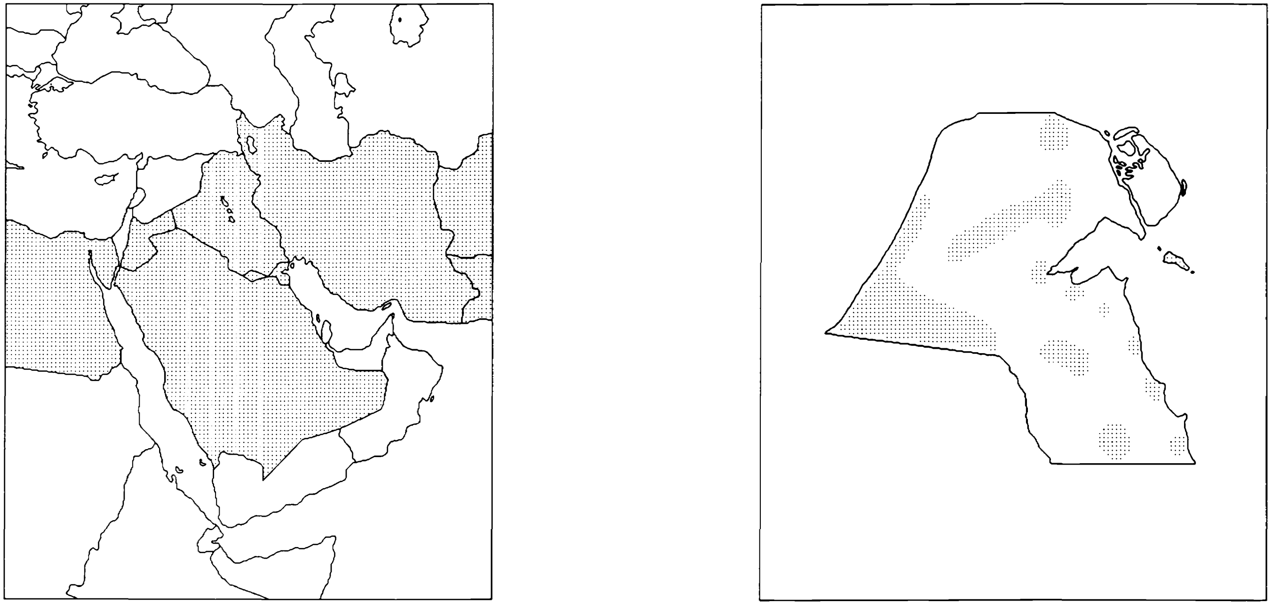


Figure 121. Geographic distribution of *Plantago ciliata* Desf.

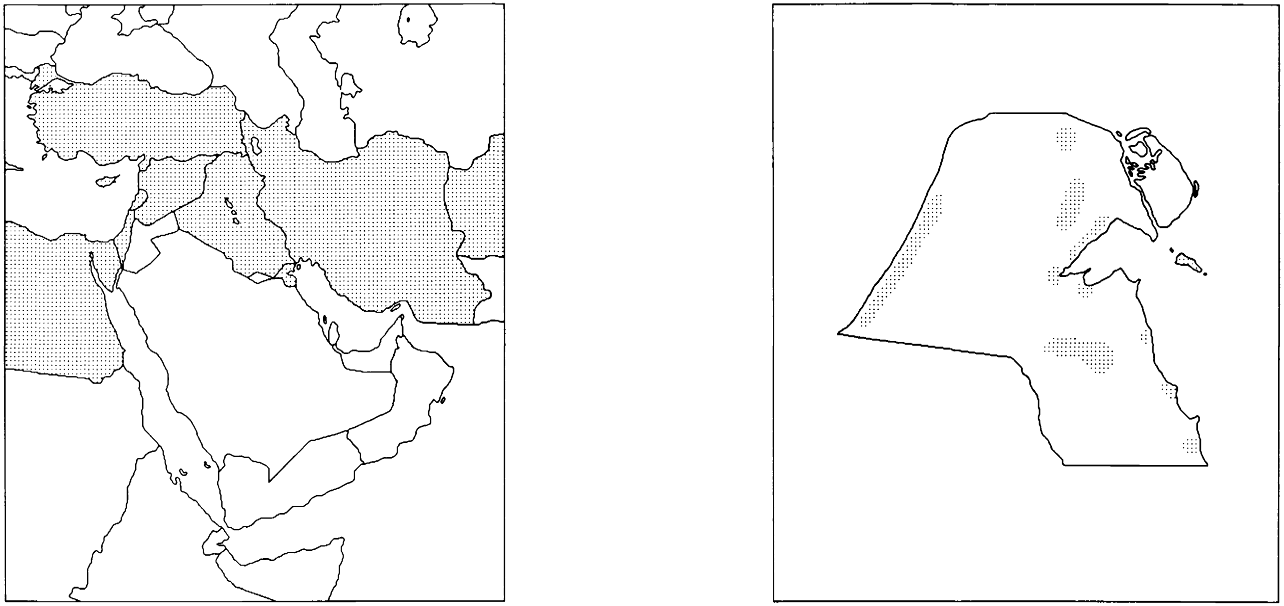


Figure 122. Geographic distribution of *Plantago coronopus* L.

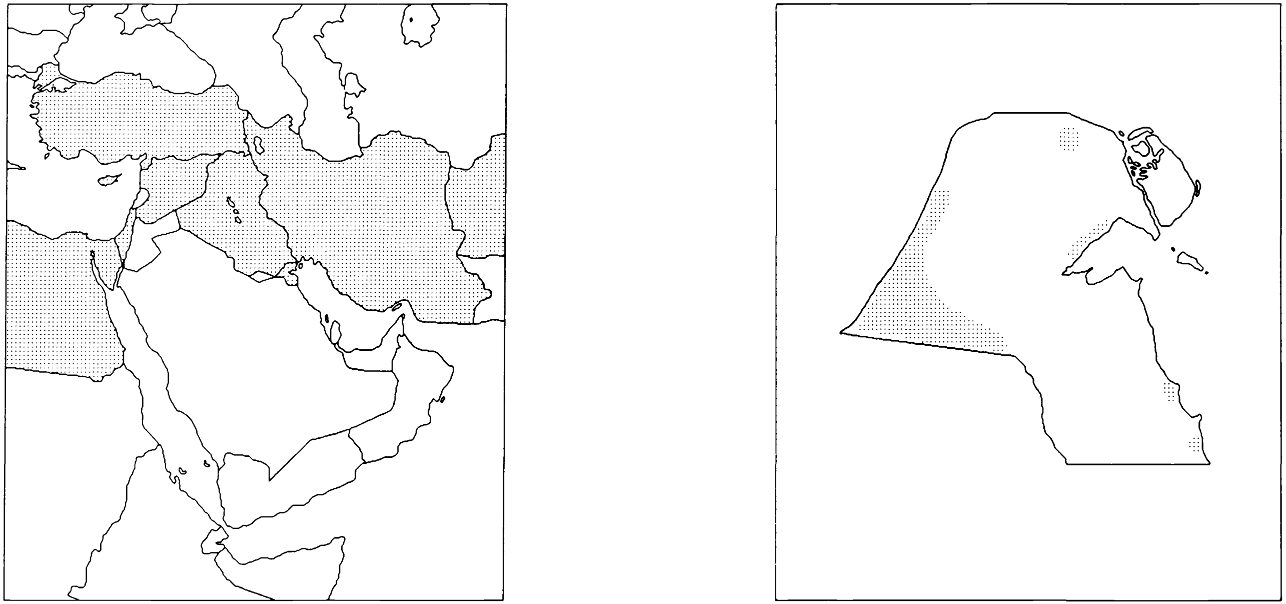


Figure 123. Geographic distribution of *Plantago lagopus* L.

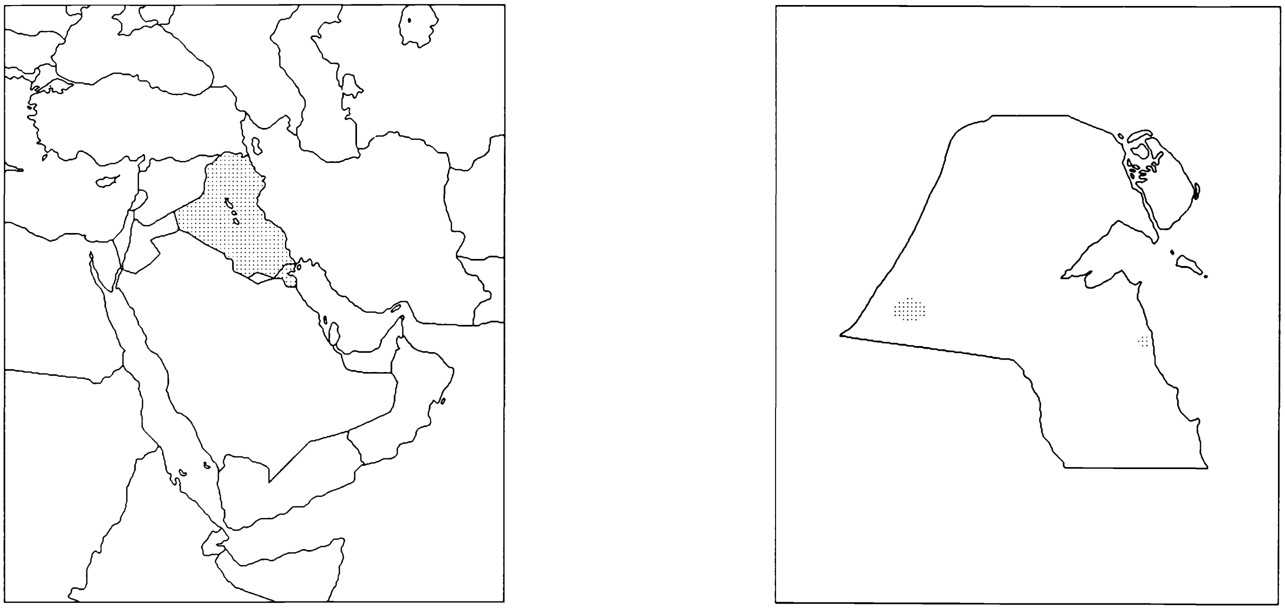


Figure 124. Geographic distribution of *Plantago notata* Lag.

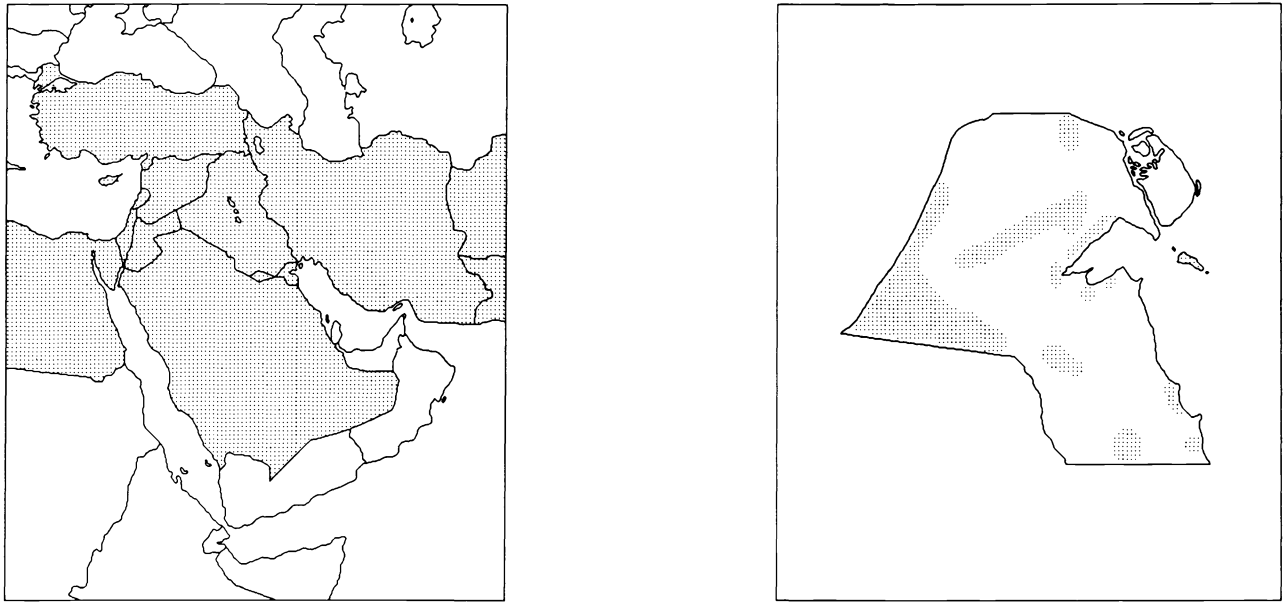


Figure 125. Geographic distribution of *Plantago ovata* Forssk.

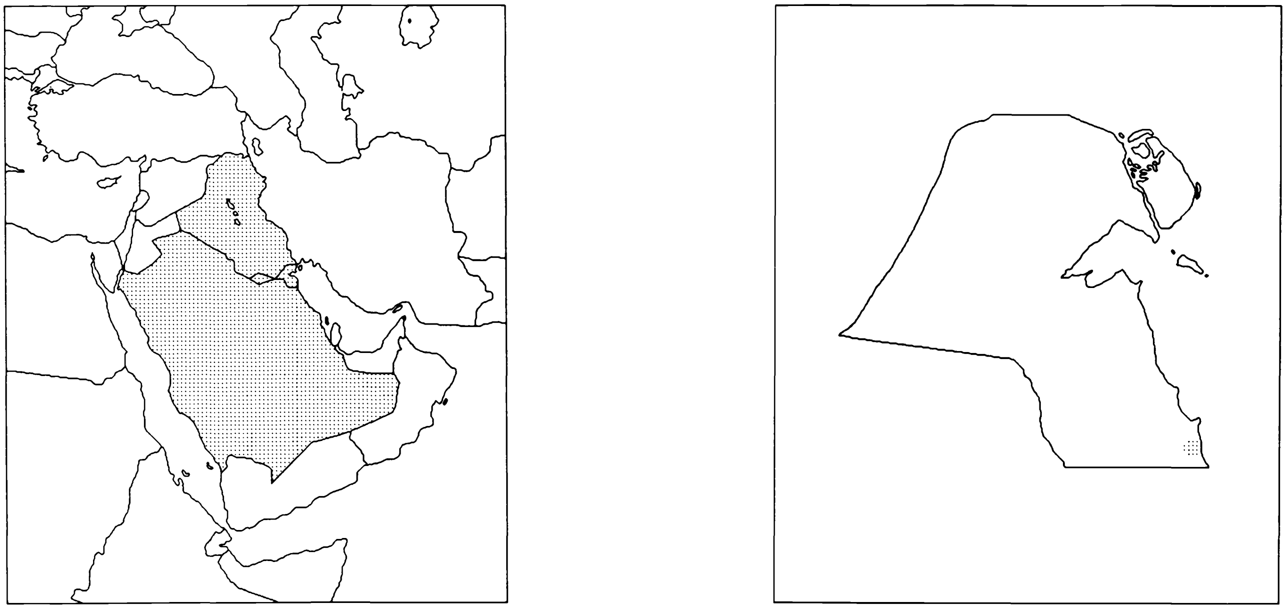


Figure 126. Geographic distribution of *Plantago psammophila* Agnew & Chalabi-Ka'bi.

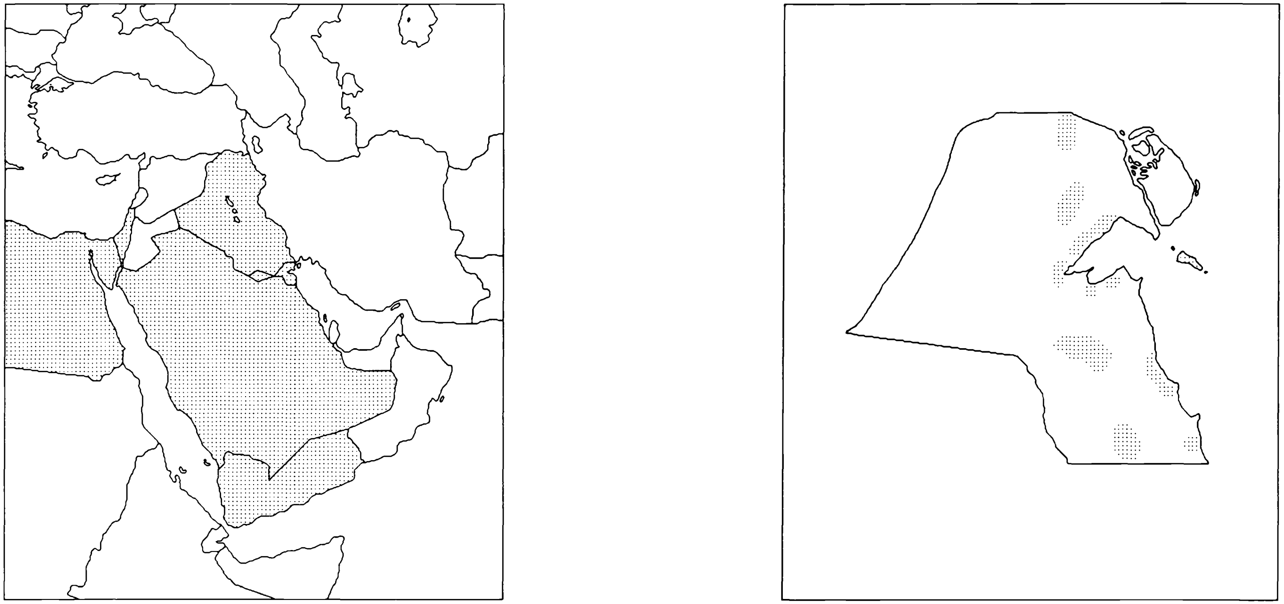


Figure 127. Geographic distribution of *Polycarpaea repens* (Forssk.) Aschers. & Schweinf.

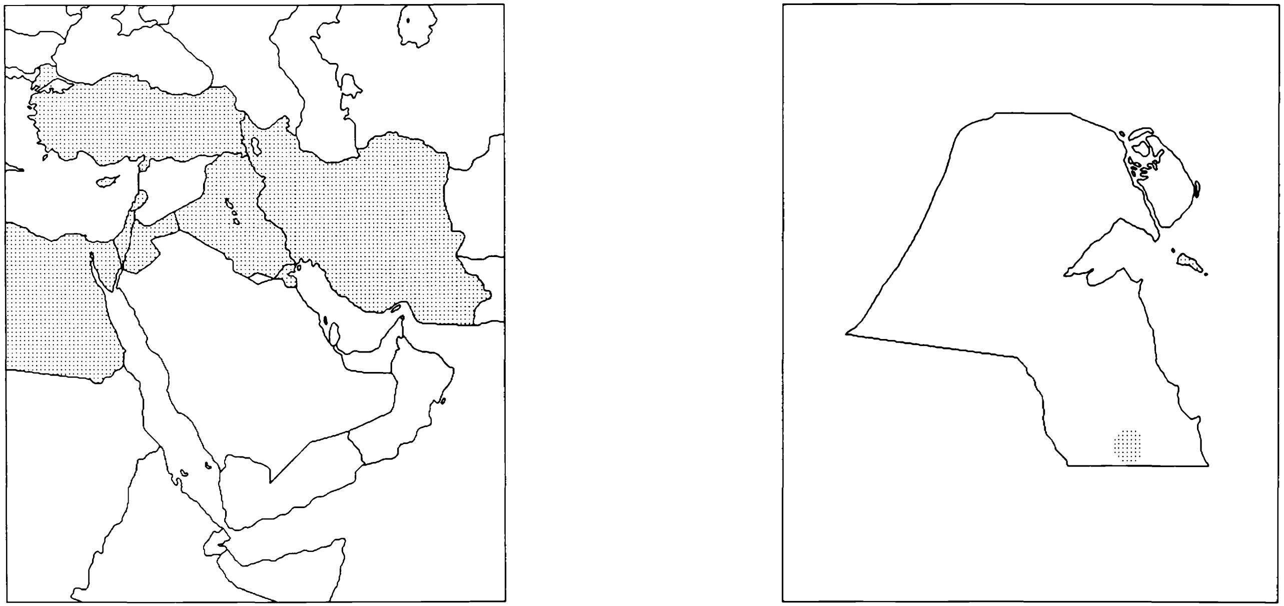


Figure 128. Geographic distribution of *Polycarpon tetraphyllum* (L.) L.

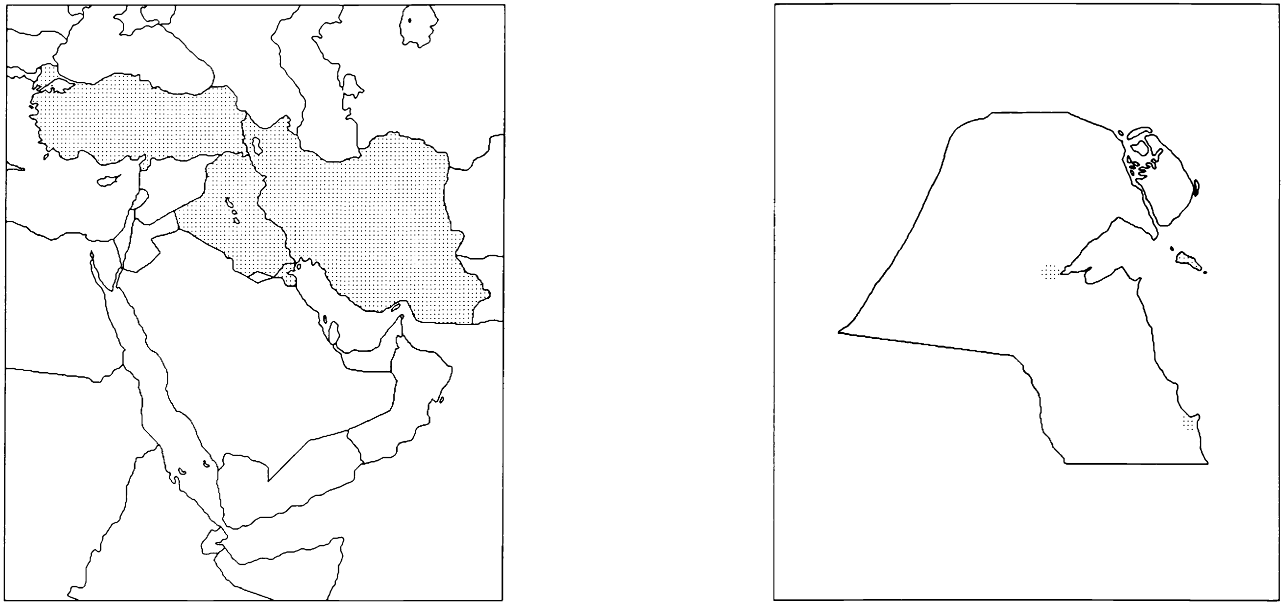


Figure 129. Geographic distribution of *Psylliostachys spicata* (Willd.) Nevski.

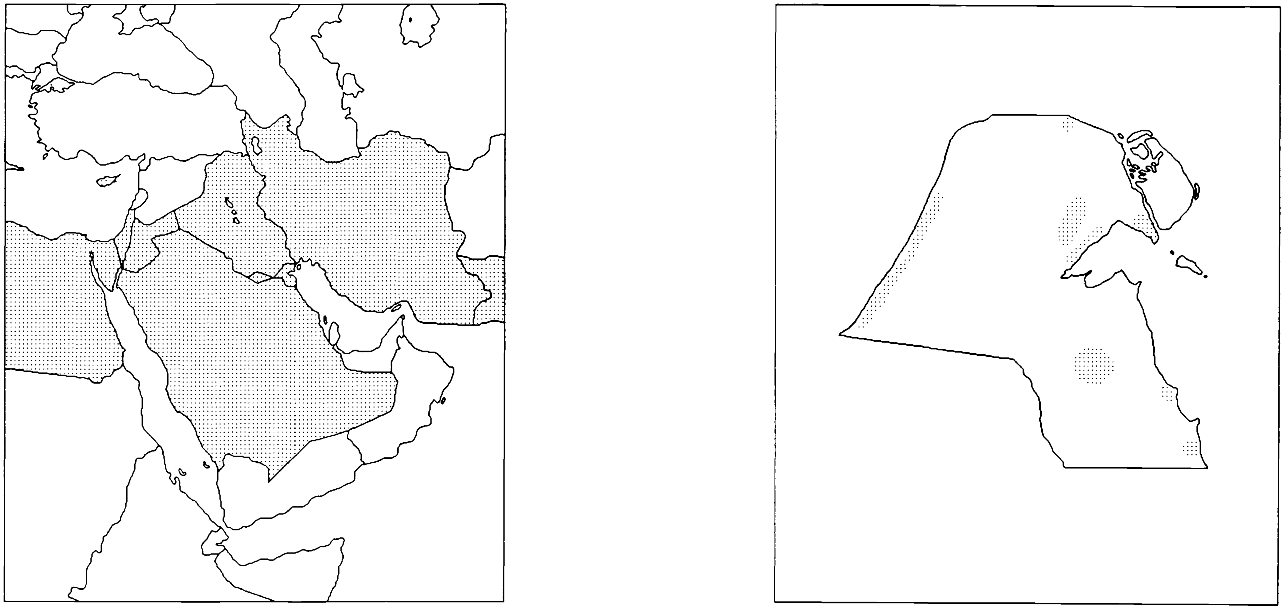


Figure 130. Geographic distribution of *Pteranthus dichotomus* Forssk.

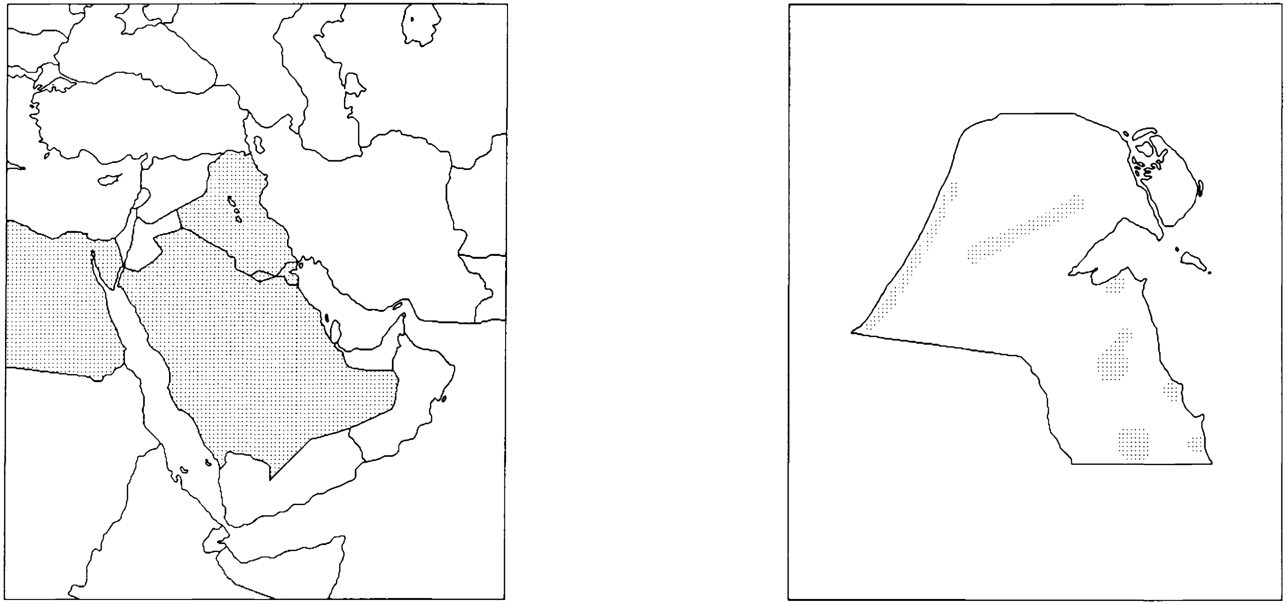
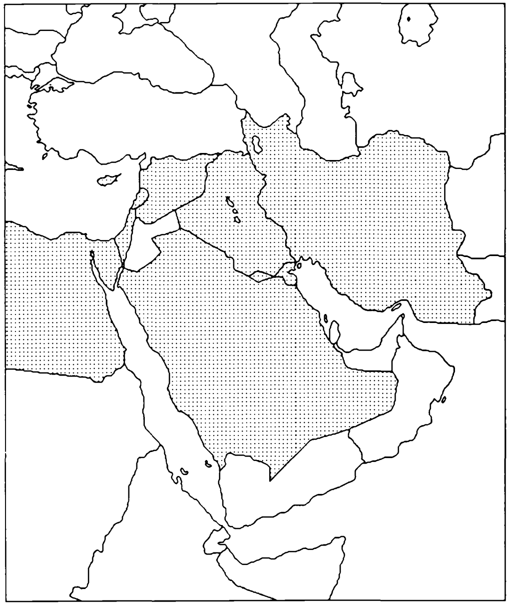


Figure 131. Geographic distribution of *Reseda arabica* Boiss.



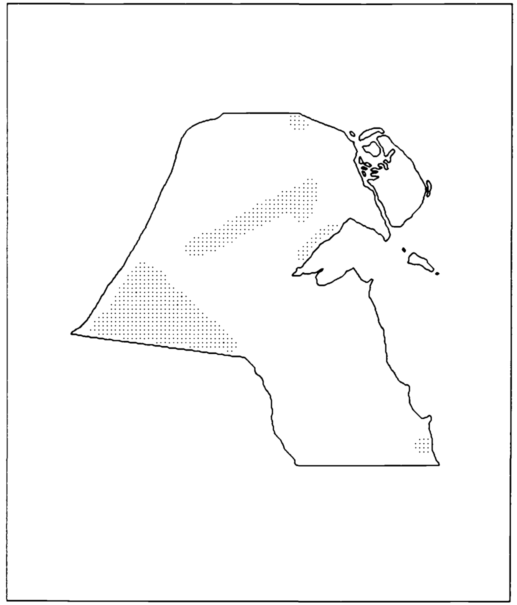


Figure 132. Geographic distribution of *Reseda decursiva* Forssk.

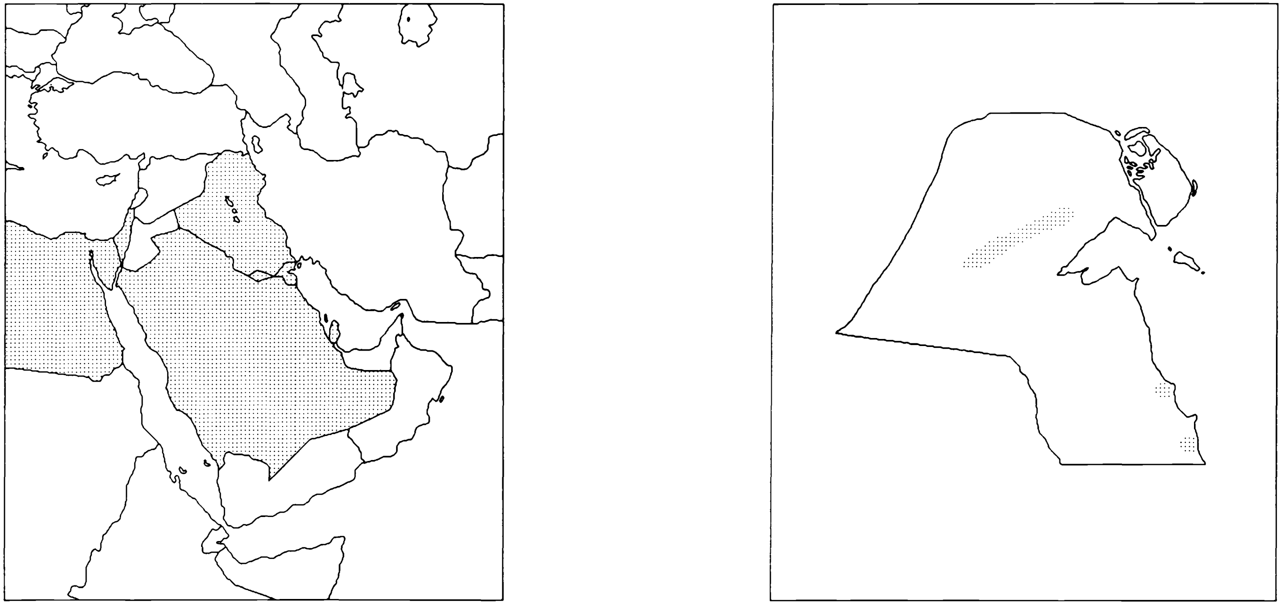


Figure 133. Geographic distribution of ***Reseda muricata*** **C. Presl.**

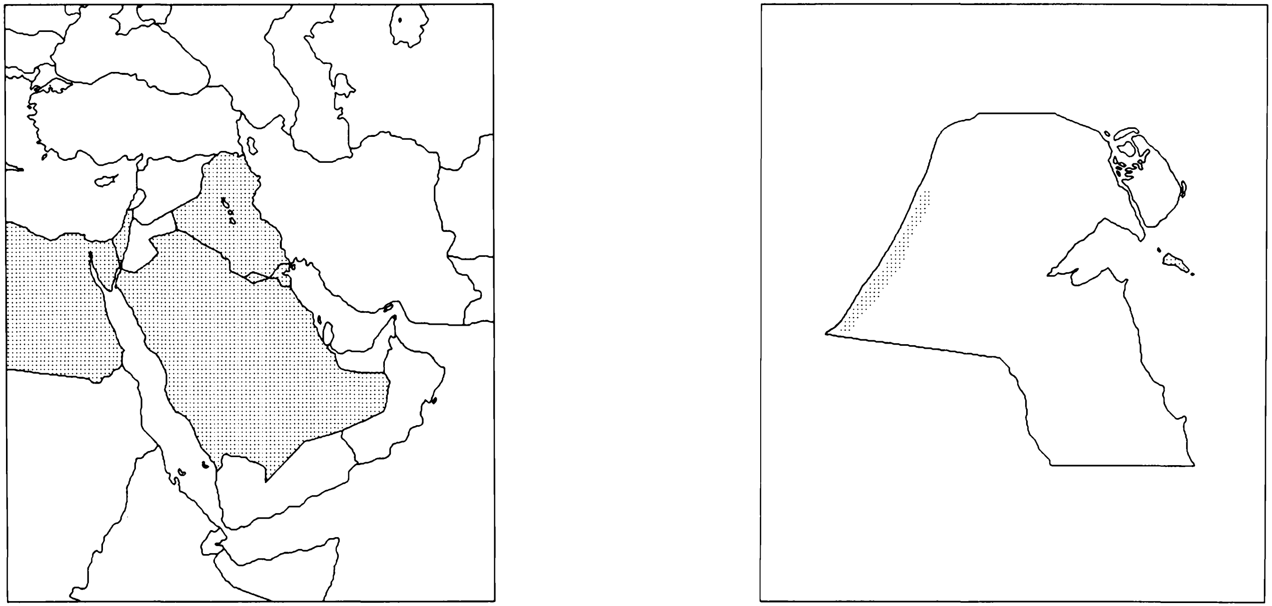


Figure 134. Geographic distribution of *Robbairea delileana* (Forssk.) Boiss.

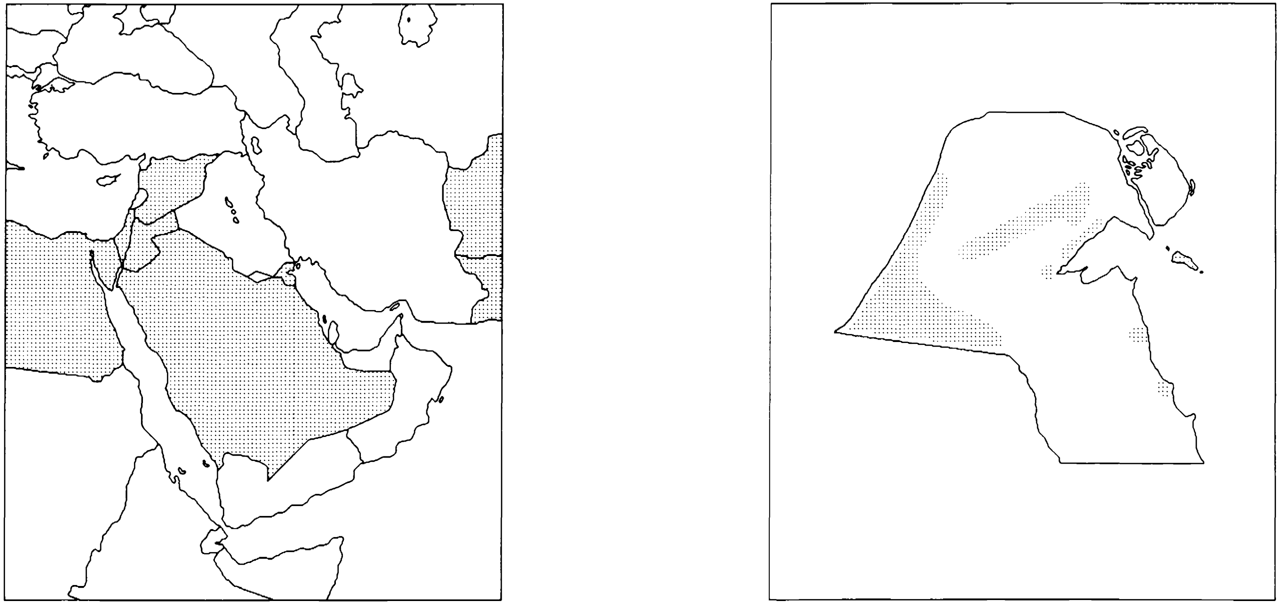


Figure 135. Geographic distribution of *Roemeria hybrida* (L.) DC. subsp. *hybrida*.

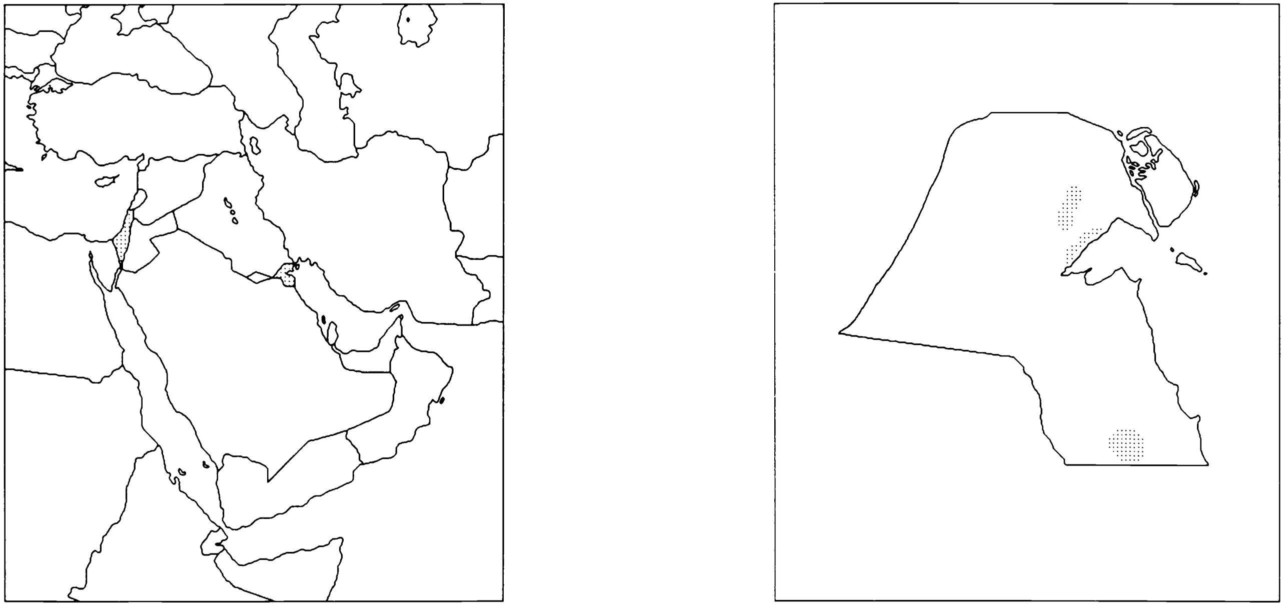
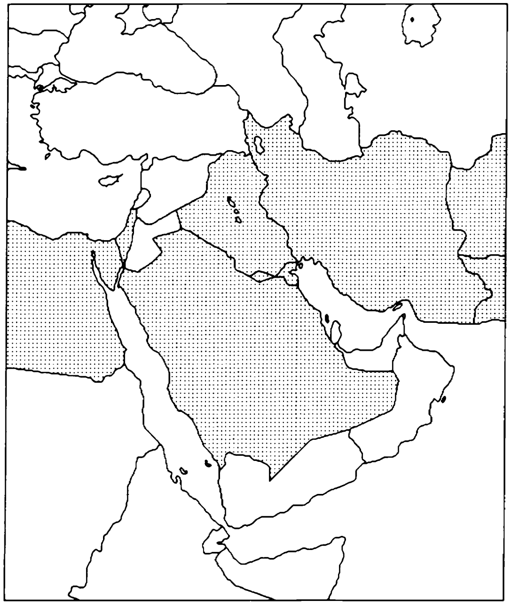


Figure 136. Geographic distribution of *Rumex pictus* Forssk.



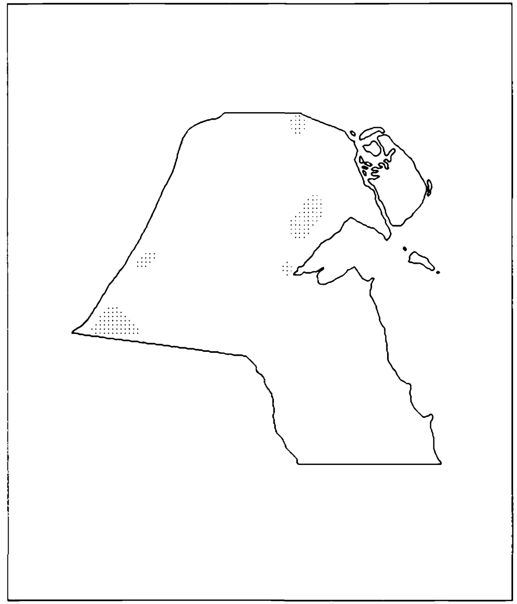


Figure 137. Geographic distribution of *Rumex vesicarius* L.

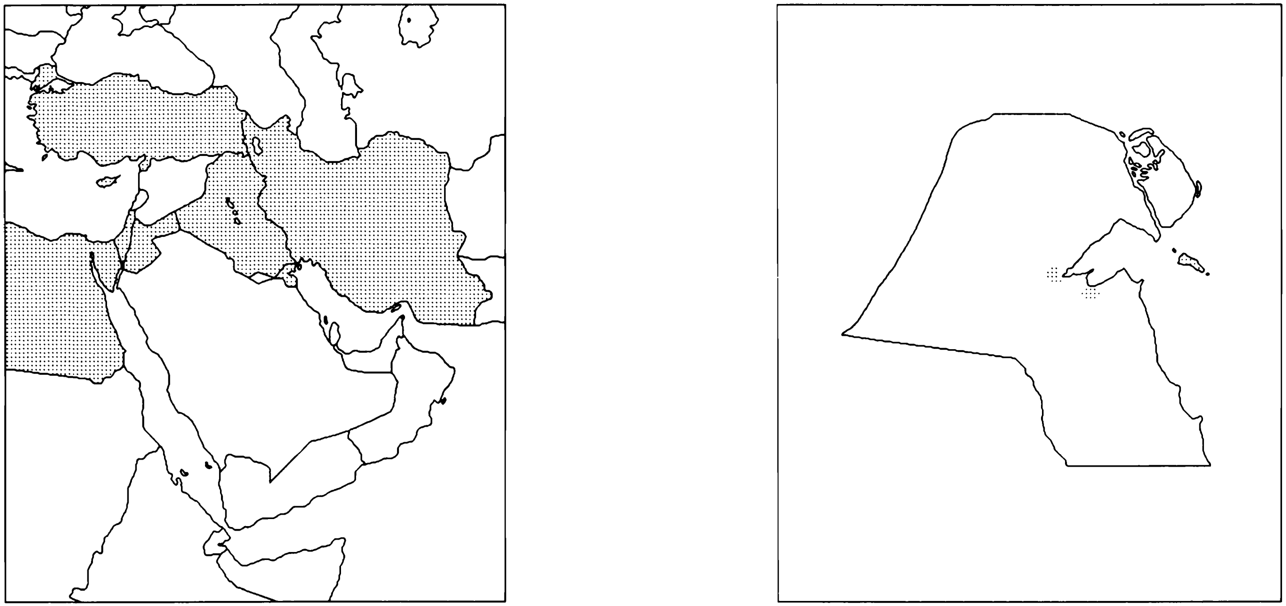


Figure 138. Geographic distribution of *Salicornia herbacea* L.

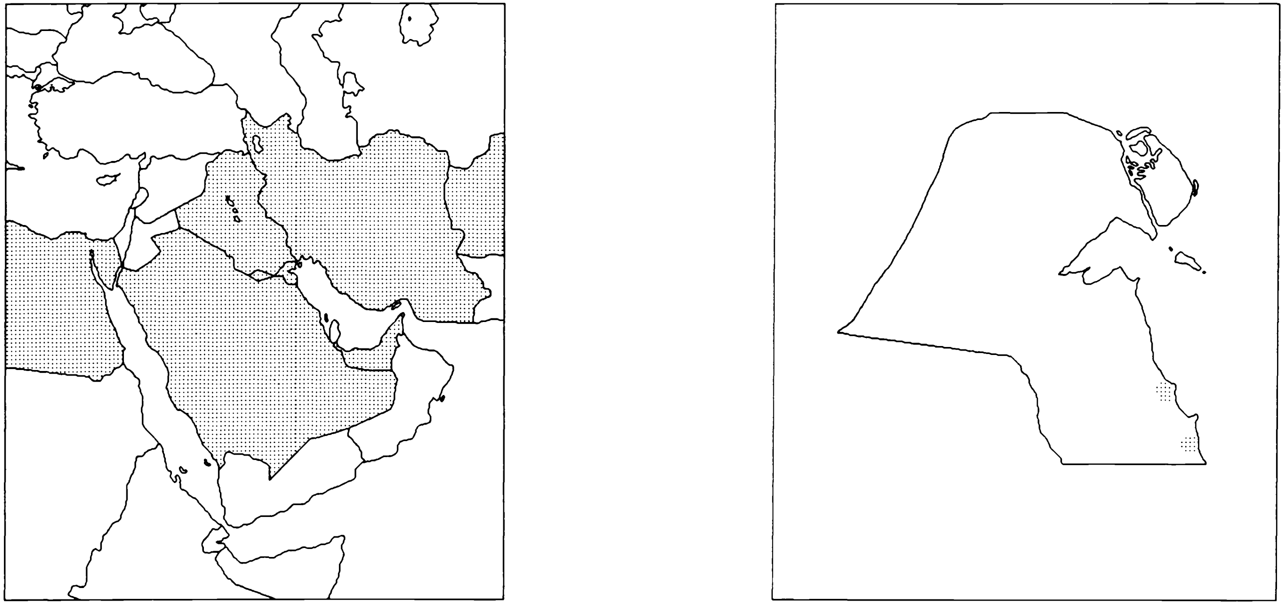


Figure 139. Geographic distribution of *Salsola baryosma* (Roem. & Schult.) Dandy.

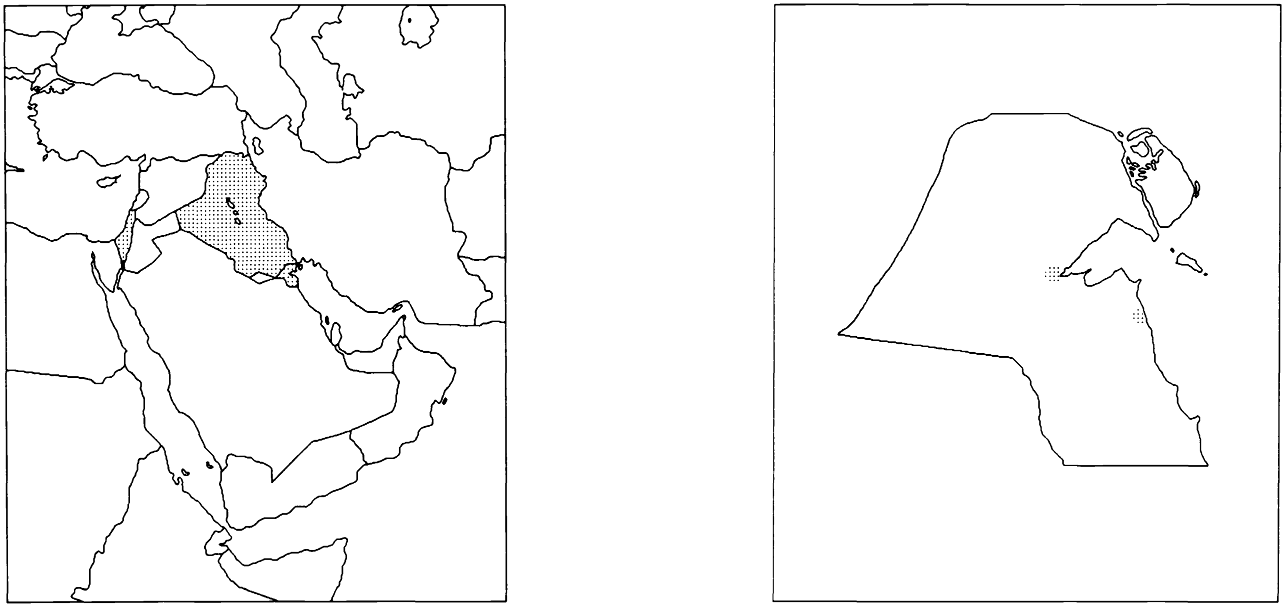


Figure 140. Geographic distribution of *Salsola jordanicola* Eig.

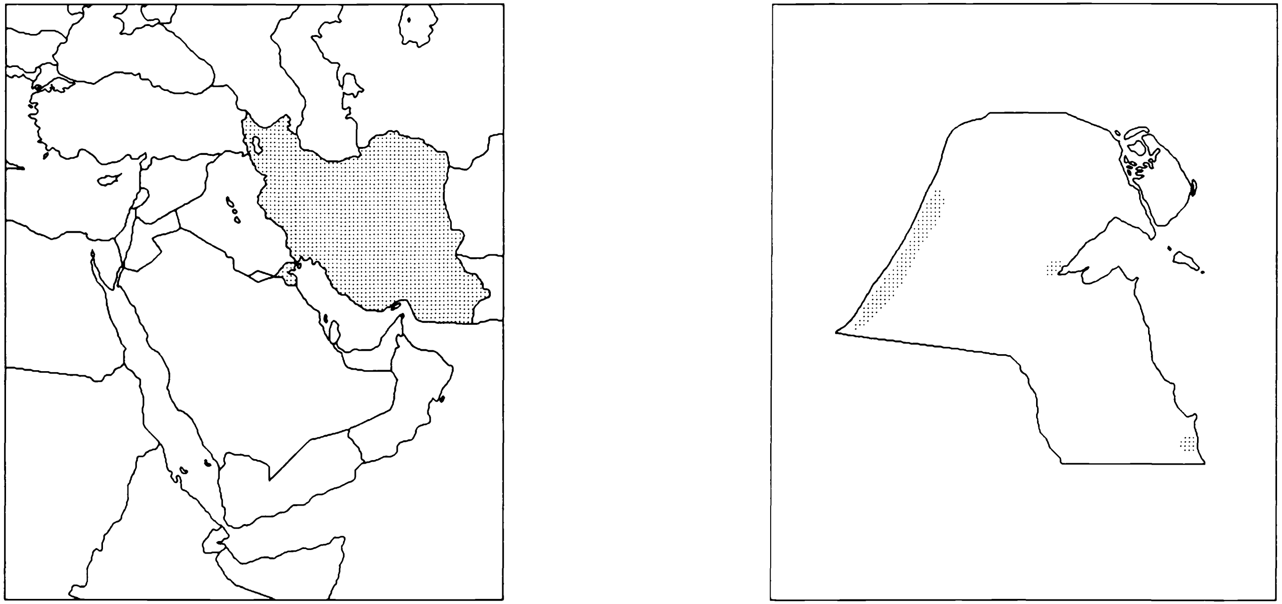


Figure 141. Geographic distribution of *Salvia lanigera* Poir.

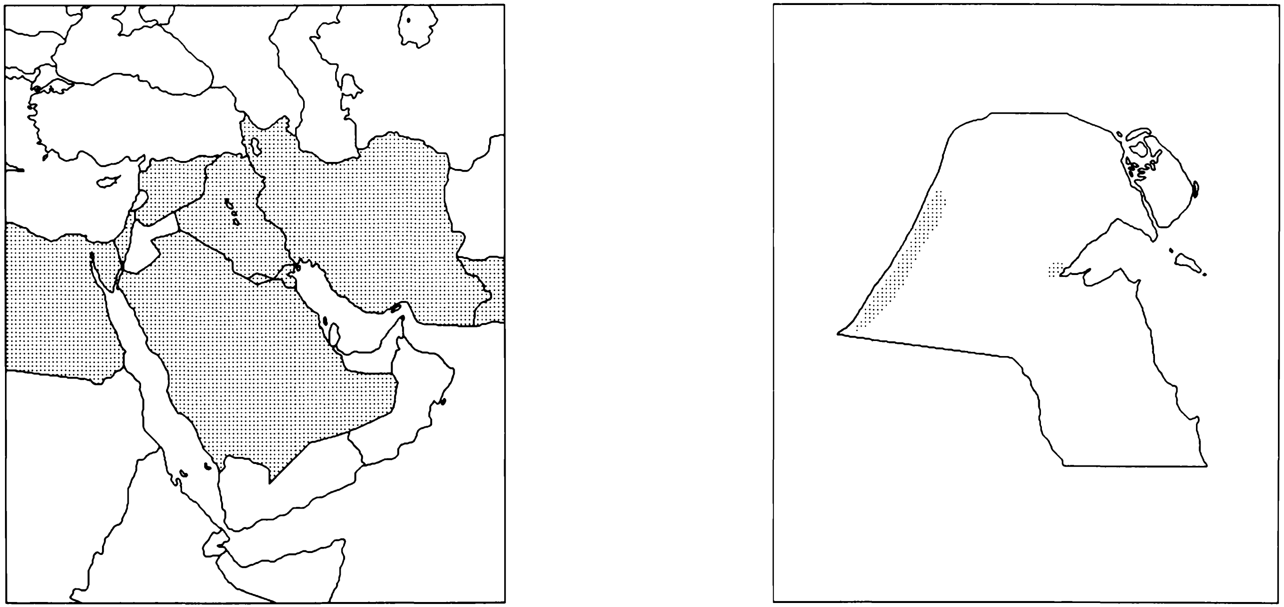


Figure 142. Geographic distribution of *Salvia spinosa* L.

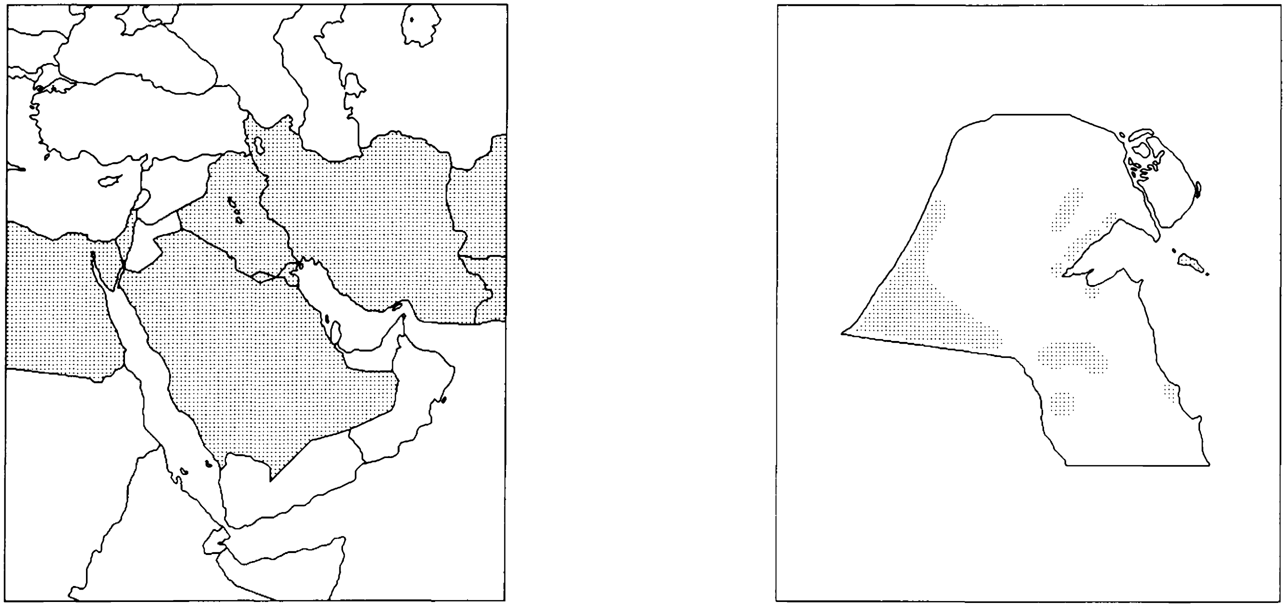


Figure 143. Geographic distribution of *Savignya parviflora* (Del.) Webb.

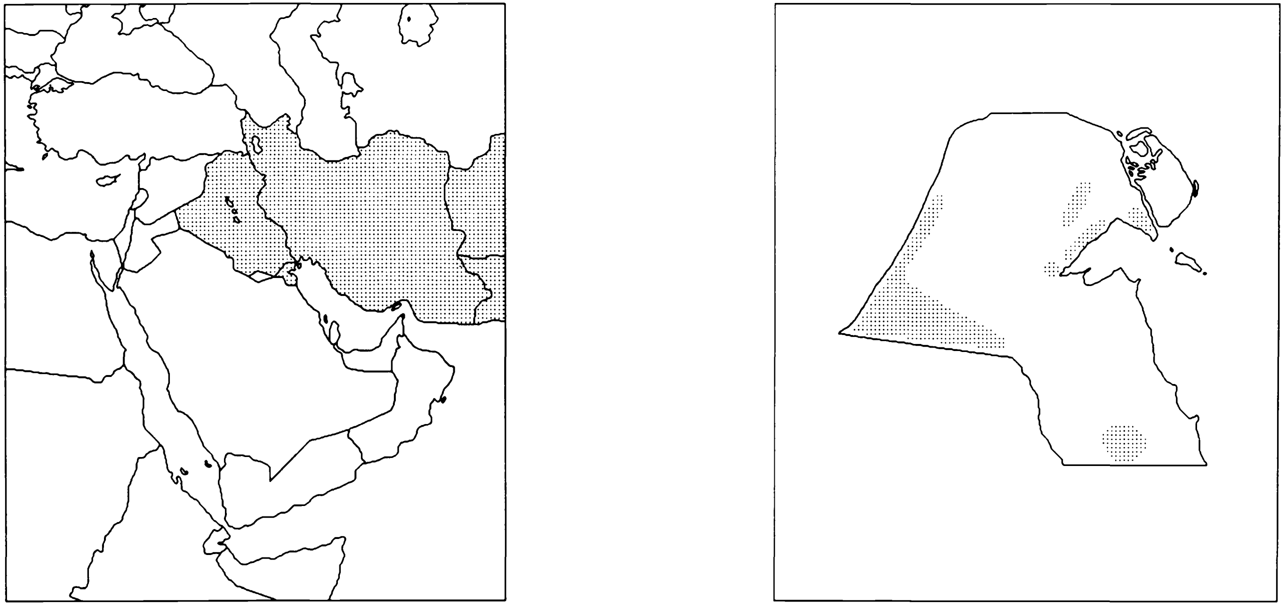


Figure 144. Geographic distribution of *Scabiosa olivieri* Coulter.

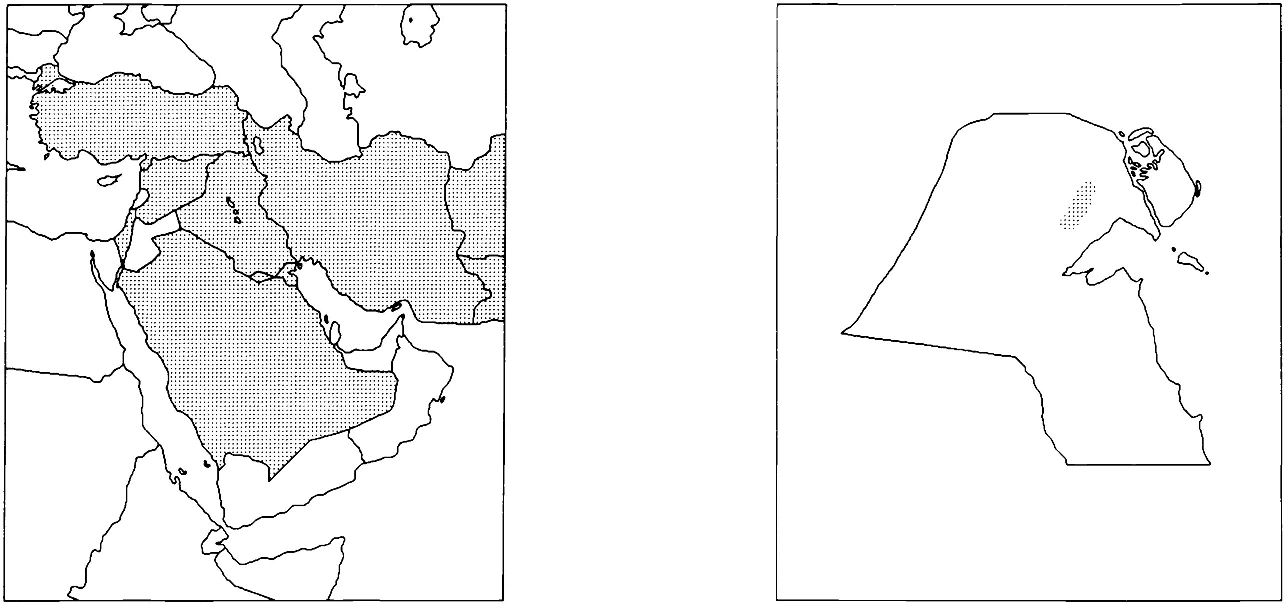


Figure 145. Geographic distribution of *Scabiosa palaestina* L.

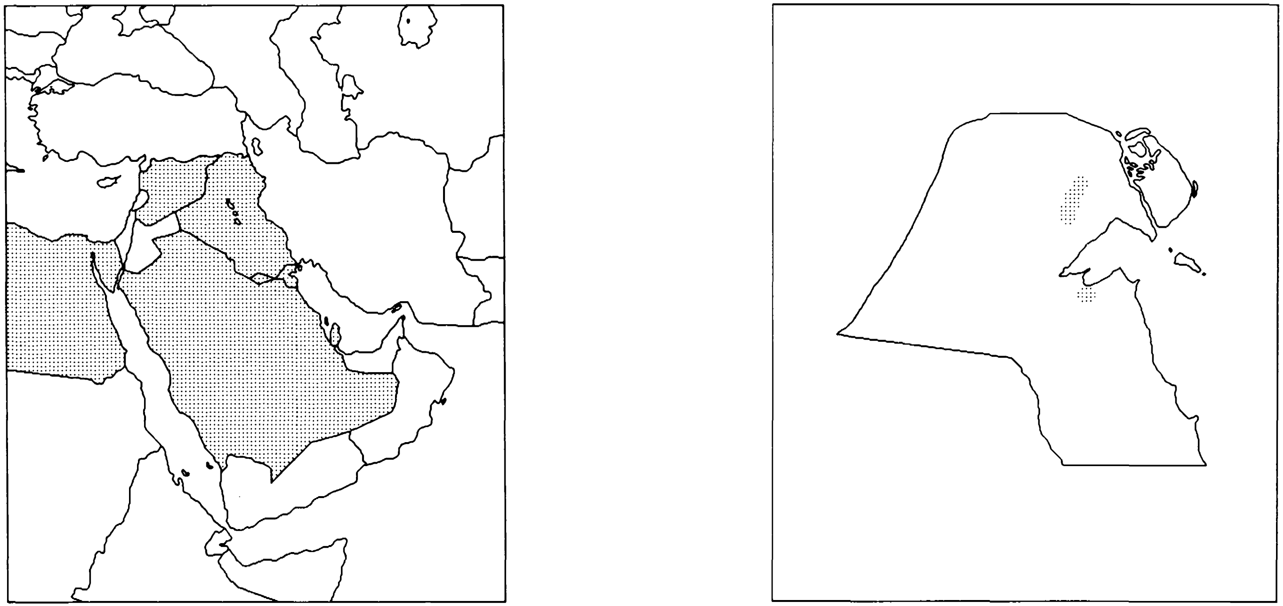


Figure 146. Geographic distribution of *Schanginia aegyptiaca* (Hasselq.) Aellen.

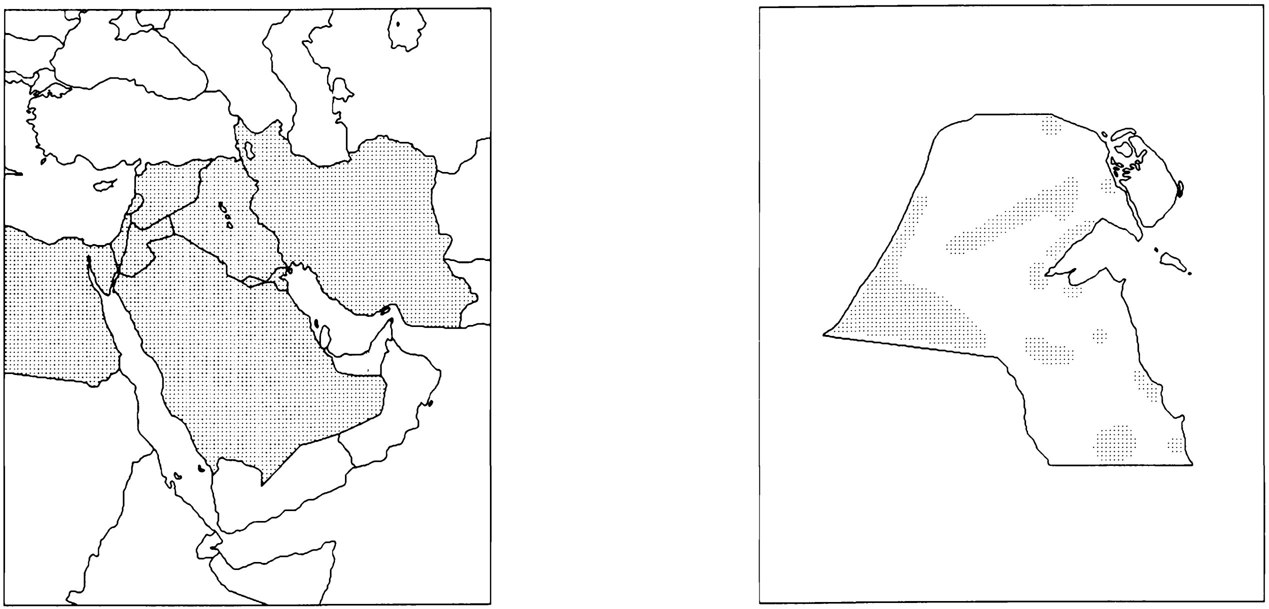


Figure 147. Geographic distribution of *Schimpera arabica* Hochst. & Steudel ex Boiss.

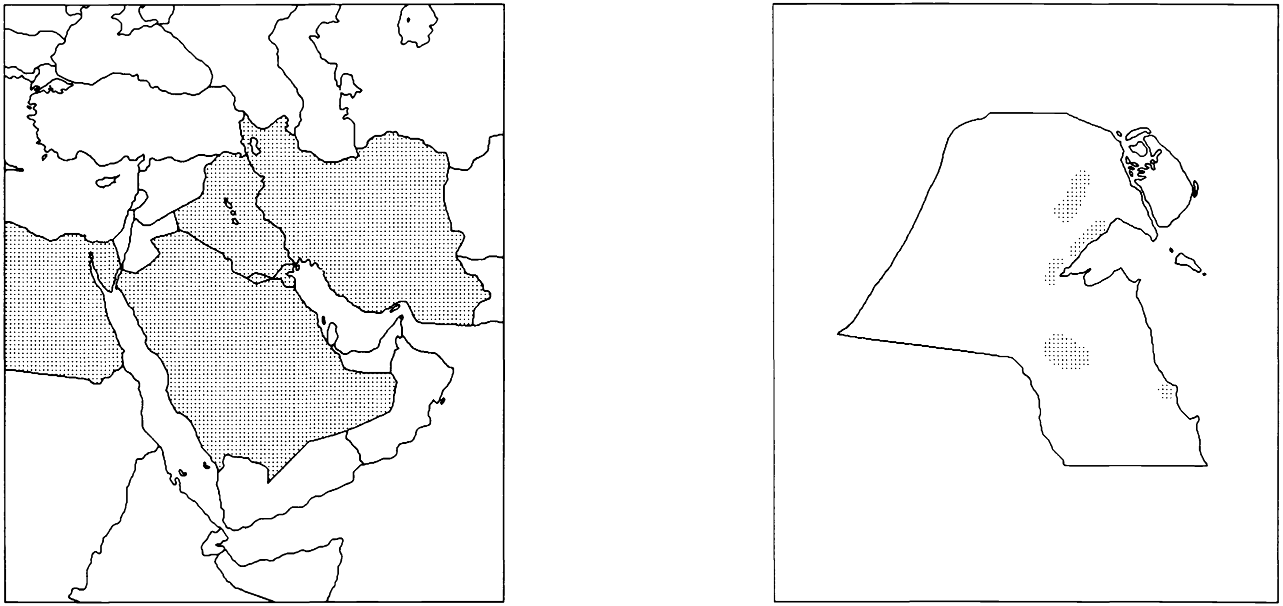


Figure 148. Geographic distribution of *Sclerocephalus arabicus* Boiss.

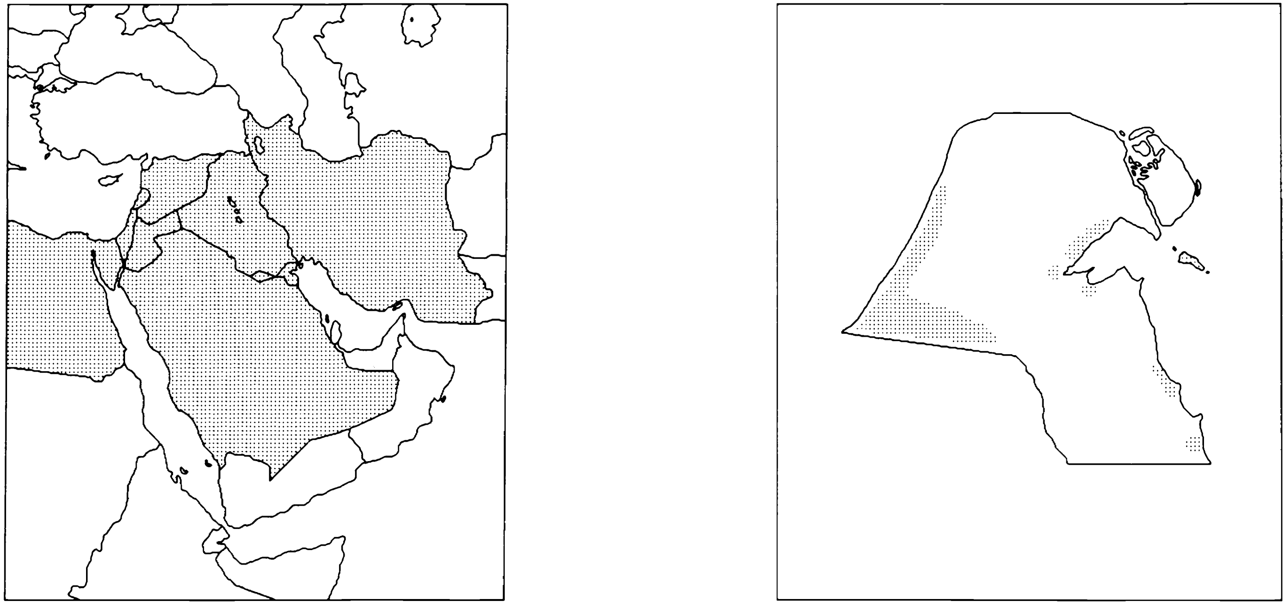


Figure 149. Geographic distribution of *Scrophularia deserti* Del.

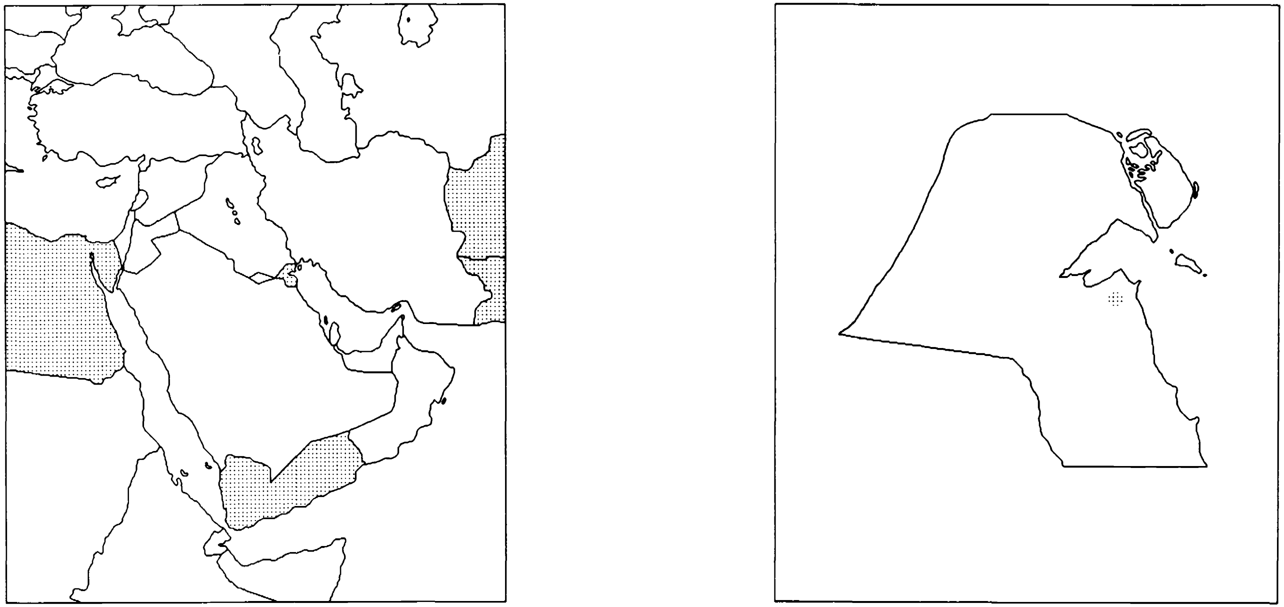


Figure 150. Geographic distribution of ***Seetzenia orientalis*** Decne.

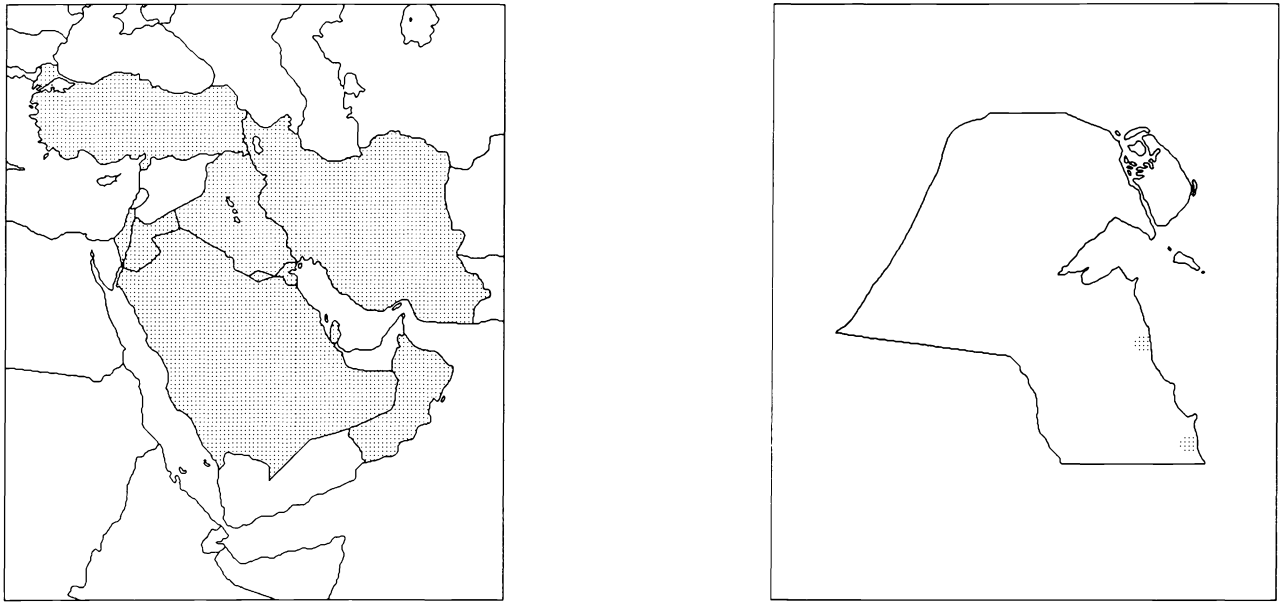


Figure 151. Geographic distribution of *Seidlitzia rosmarinus* Bunge ex Boiss.

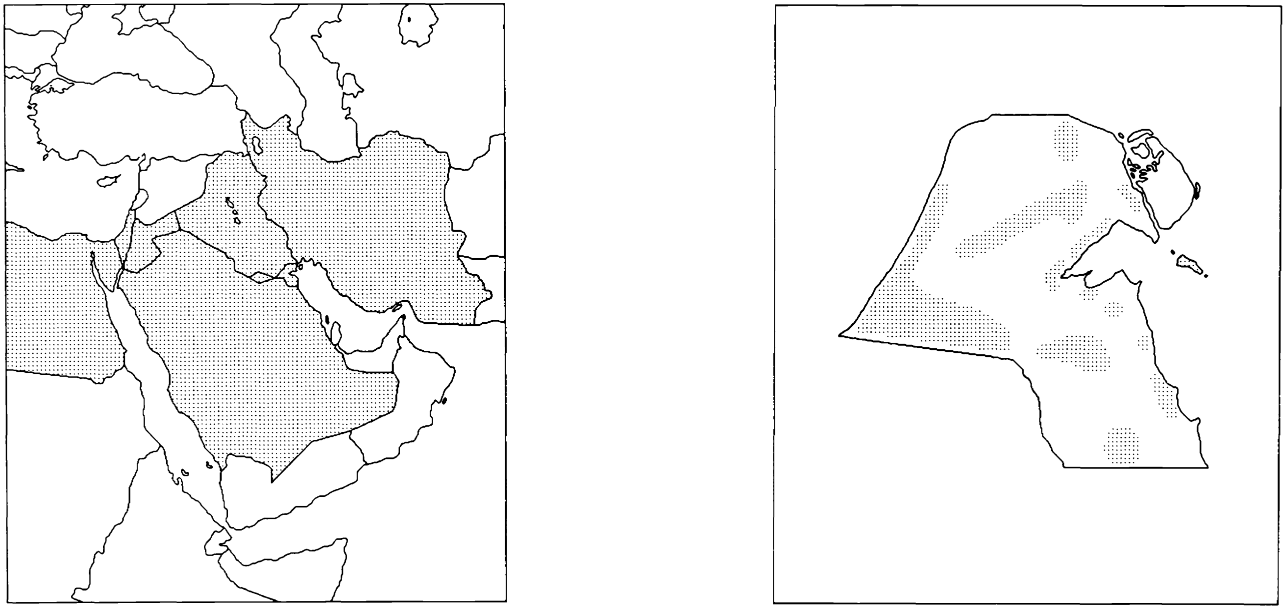


Figure 152. Geographic distribution of *Silene arabica* Boiss.

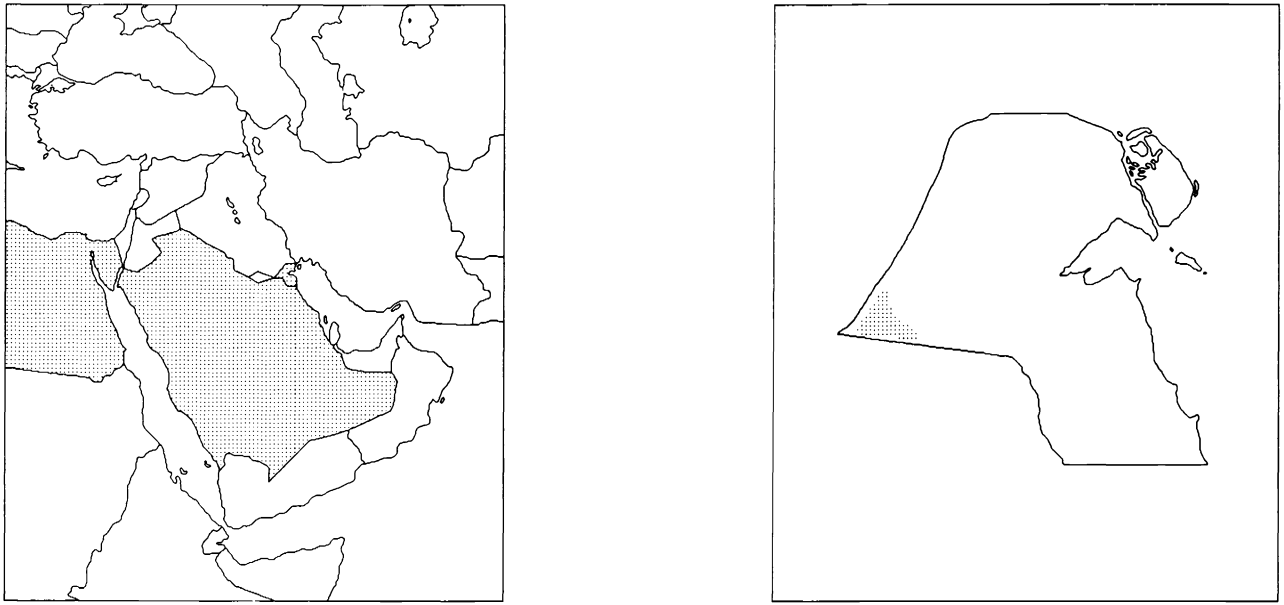


Figure 153. Geographic distribution of *Silene linearis* Decne.

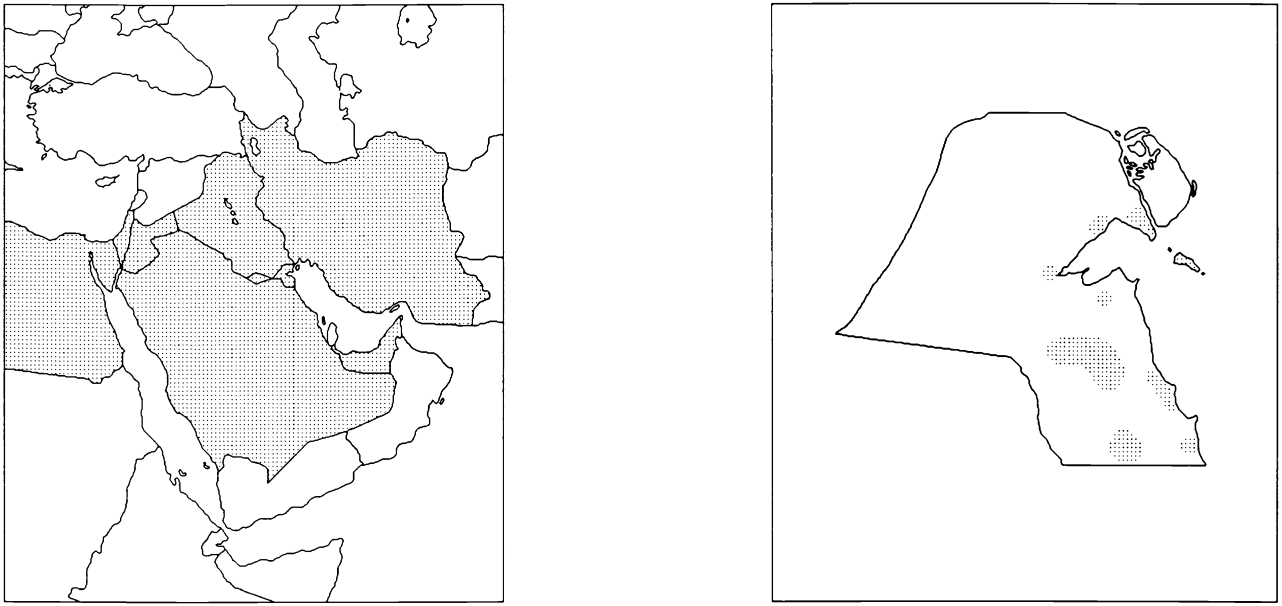


Figure 154. Geographic distribution of *Silene villosa* Forssk.

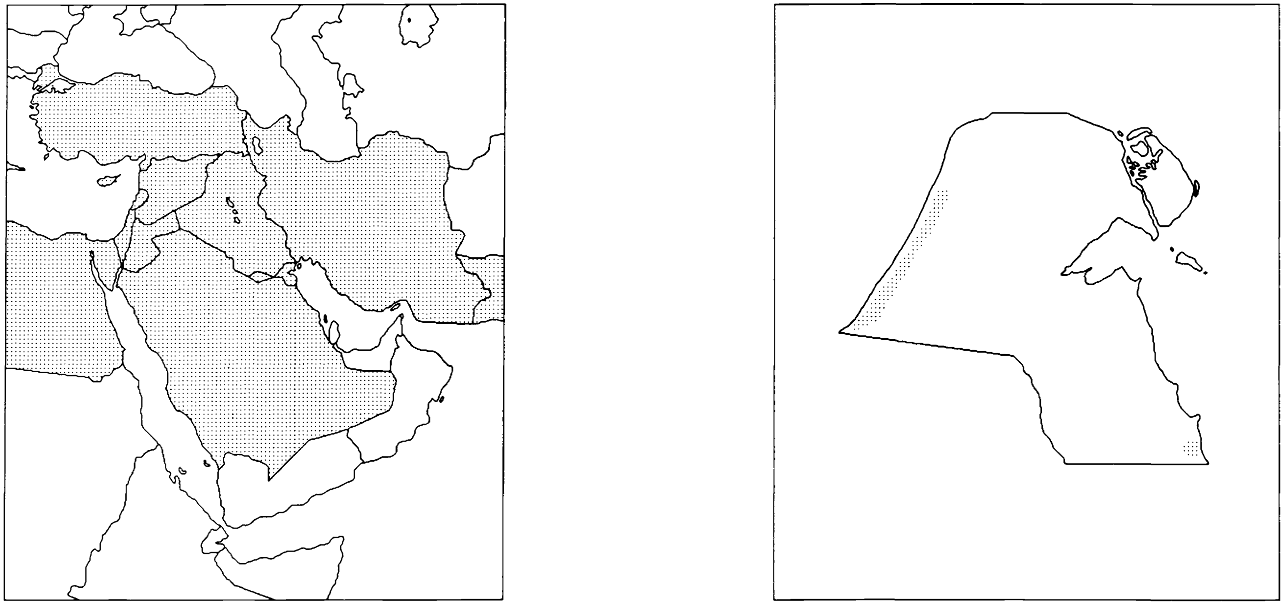


Figure 155. Geographic distribution of *Sisymbrium erysimoides* Desf.

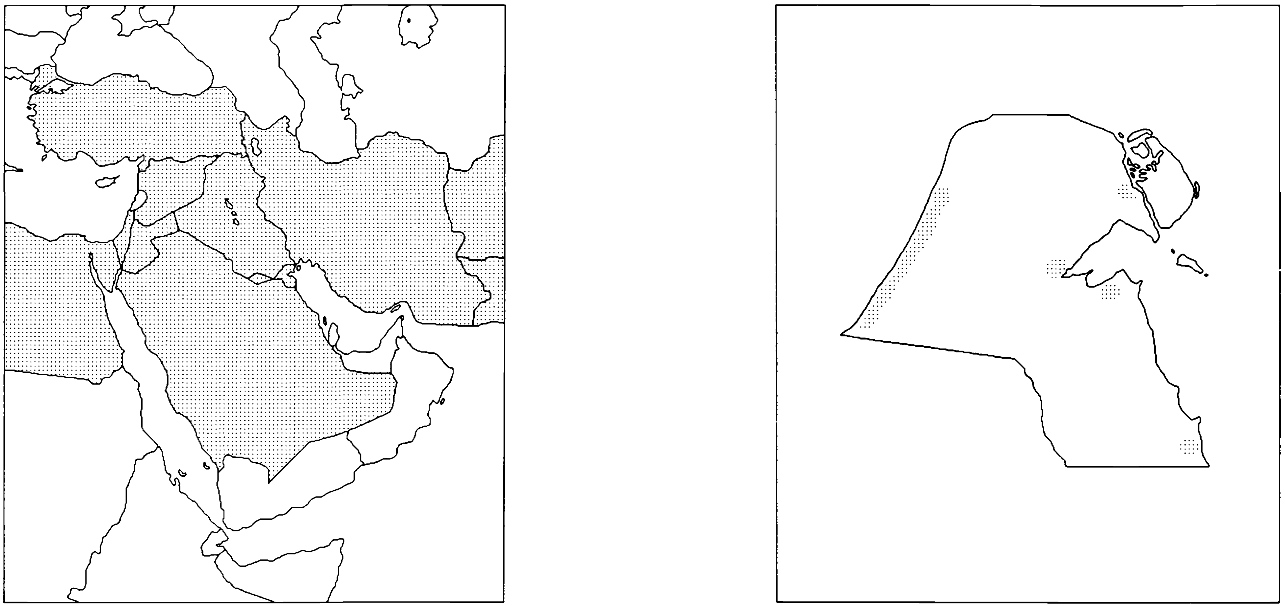


Figure 156. Geographic distribution of *Sisymbrium irio* L.

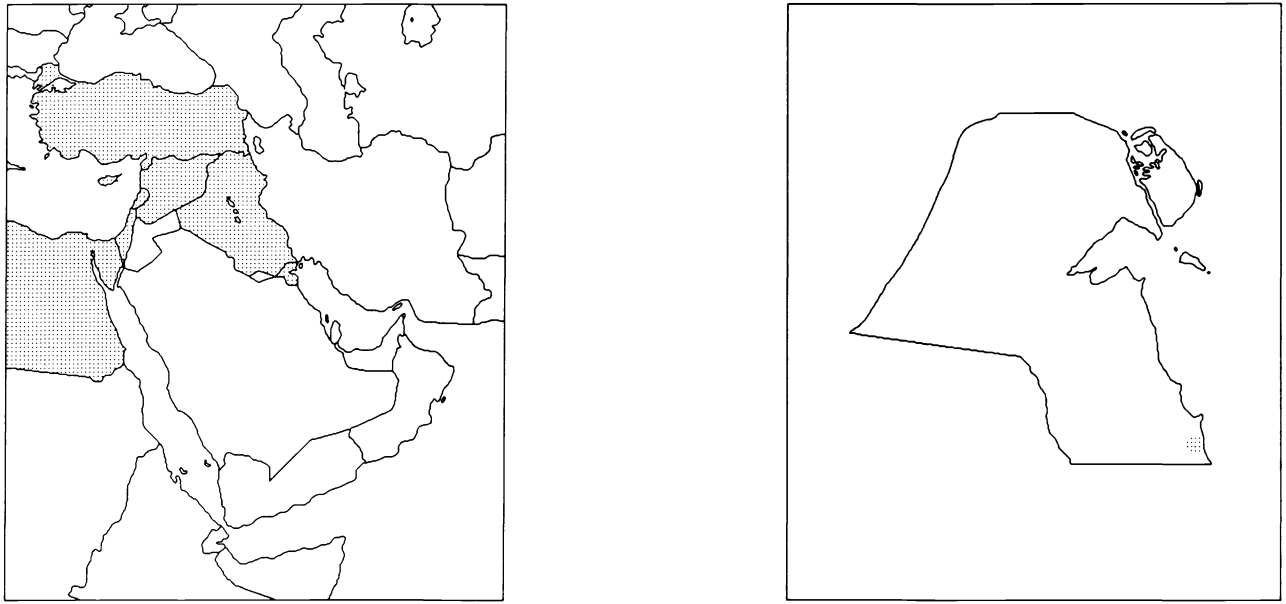


Figure 157. Geographic distribution of *Sisymbrium orientale* L.

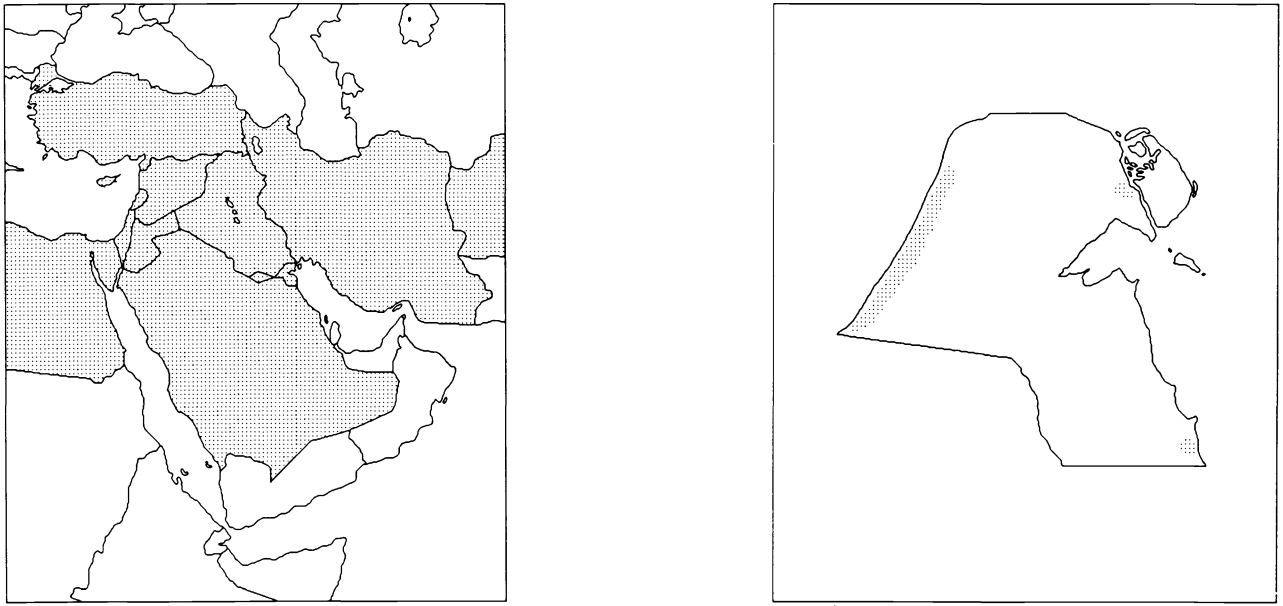


Figure 158. Geographic distribution of *Sisymbrium septulatum* DC.

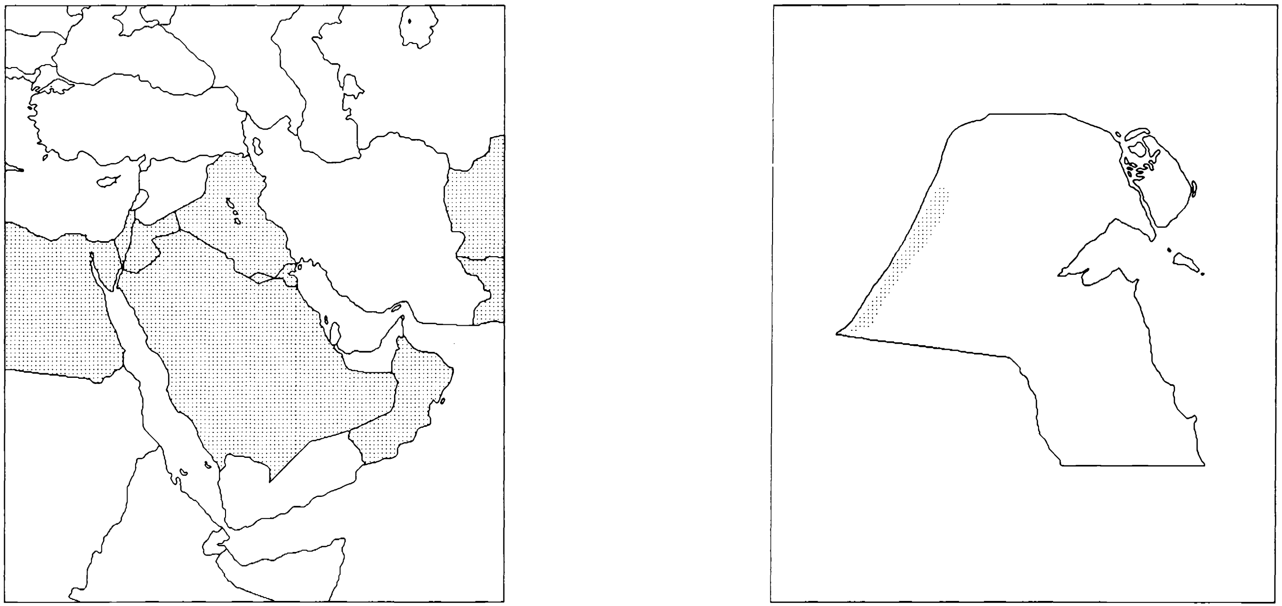


Figure 159. Geographic distribution of *Spergula fallax* (Lowe) Krause.

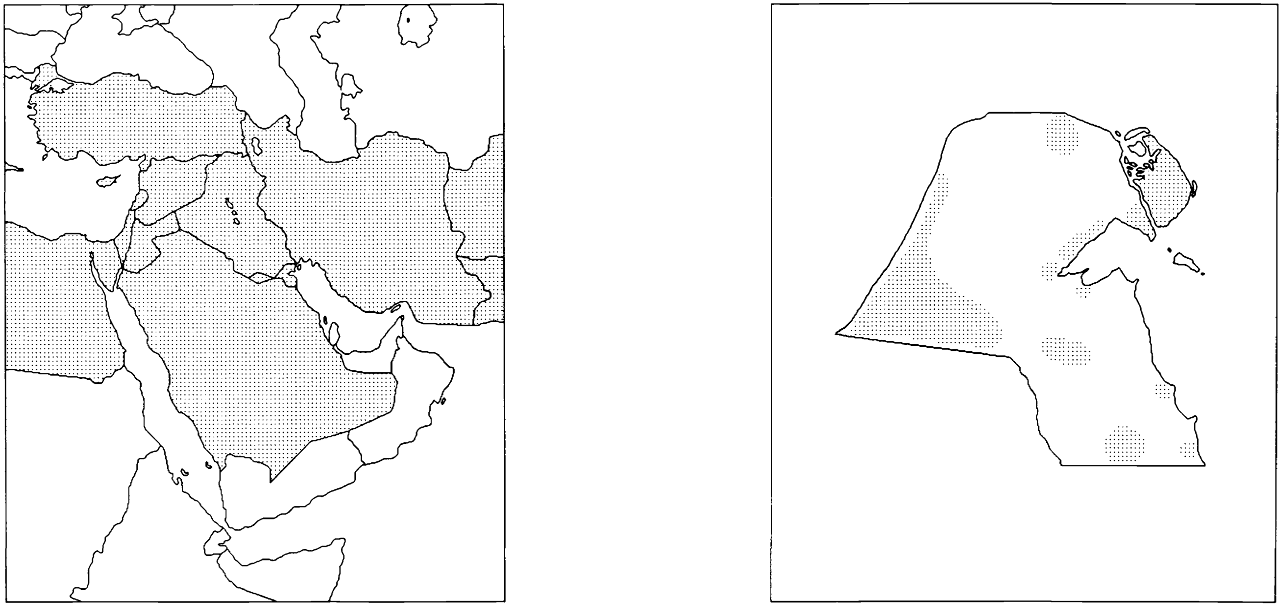


Figure 160. Geographic distribution of *Spergularia diandra* (Guss.) Heldr. & Sart.

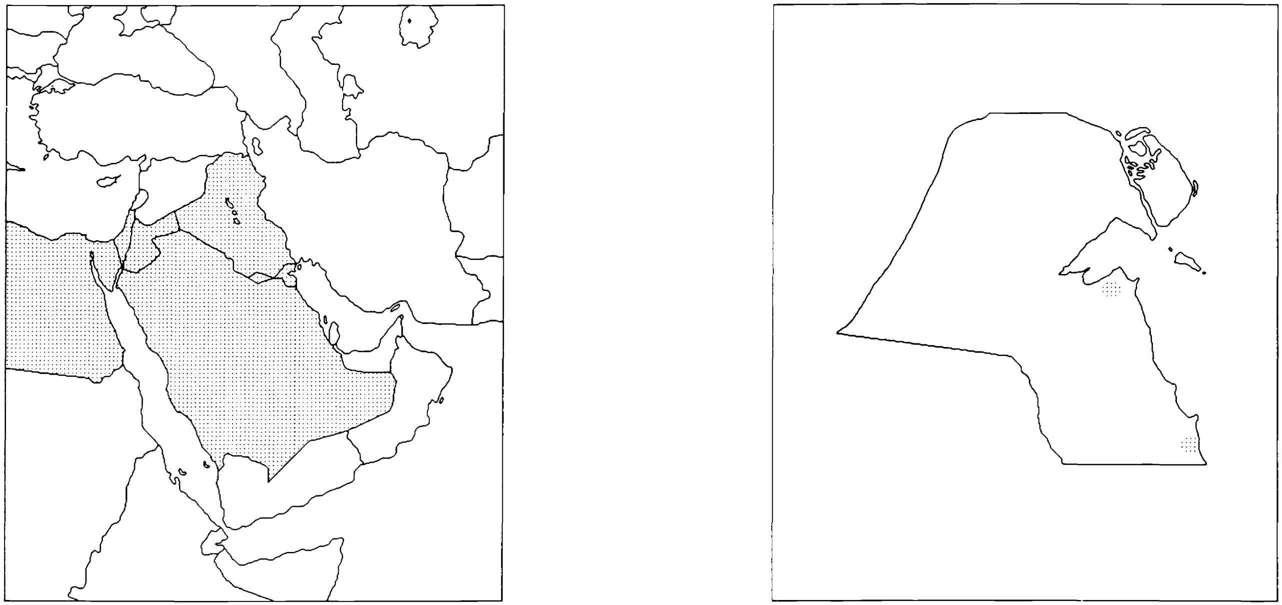


Figure 161. Geographic distribution of *Suaeda vermiculata* Forssk. ex J.F. Gmel.

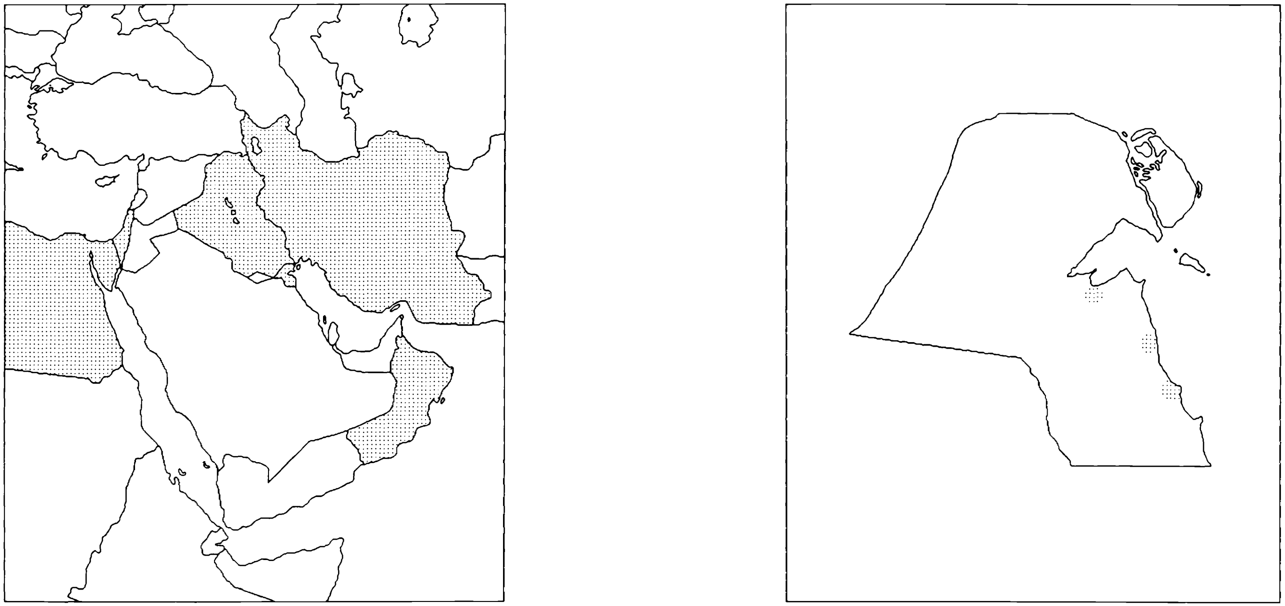


Figure 162. Geographic distribution of *Tamarix aucheriana* (Decne. ex Walp.) Baum.

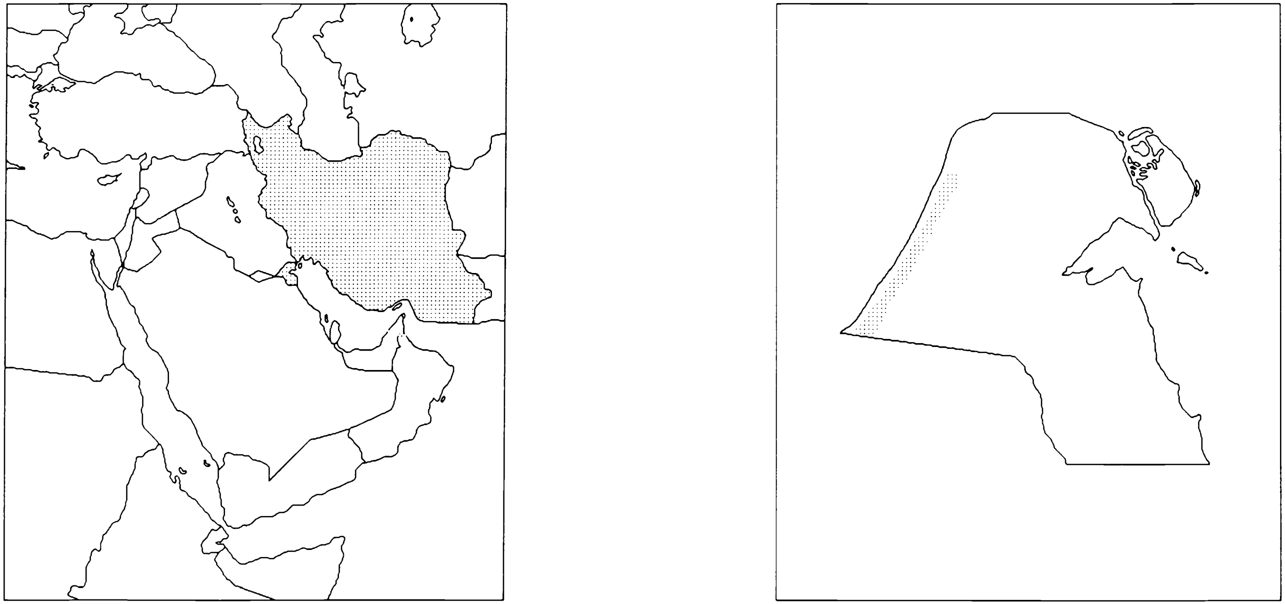


Figure 163. Geographic distribution of *Teucreum oliverianum* Ging. ex Benth.

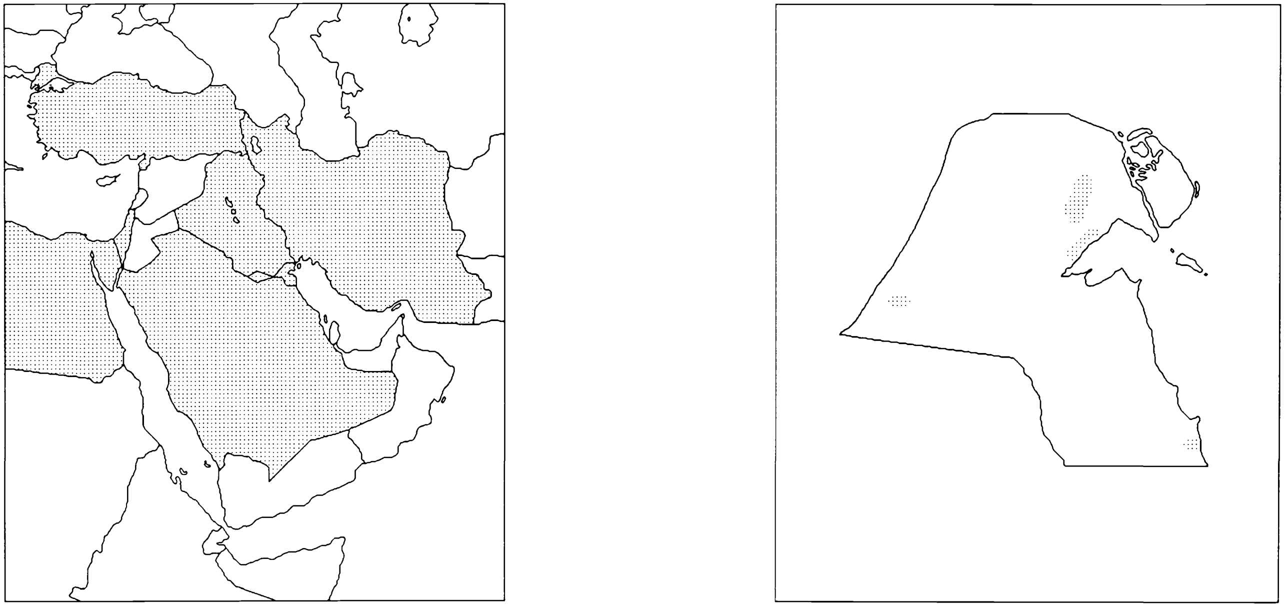


Figure 164. Geographic distribution of *Teucreum polium* L.

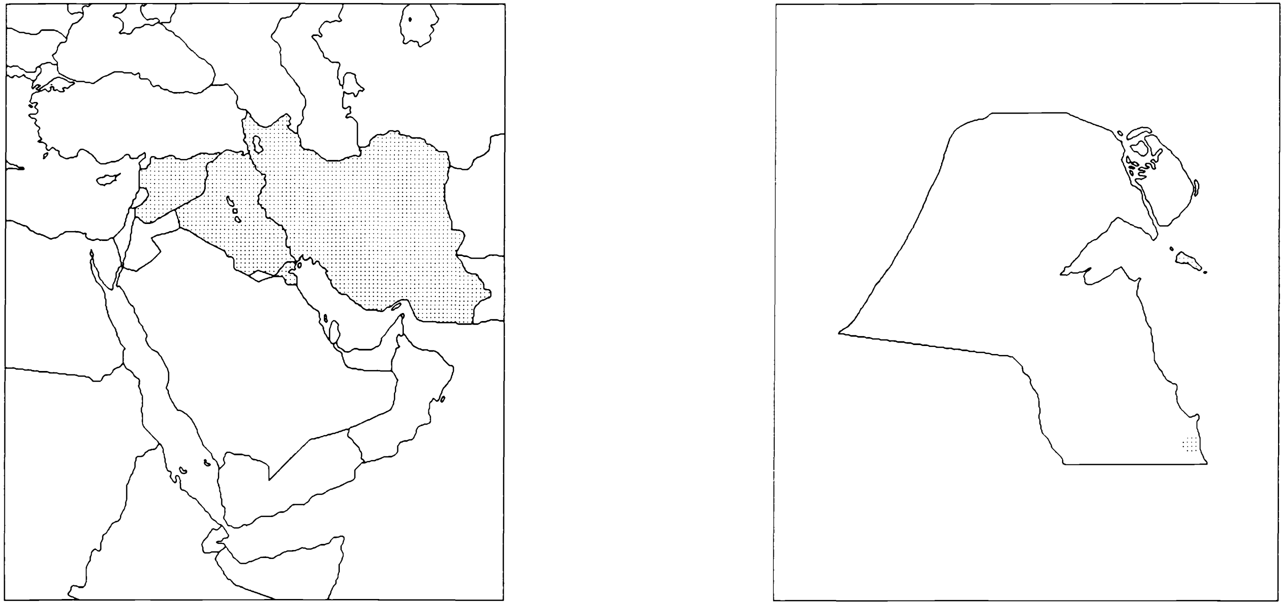


Figure 165. Geographic distribution of *Thymelaea mesopotamica* (C. Jeffrey) B. Peterson.

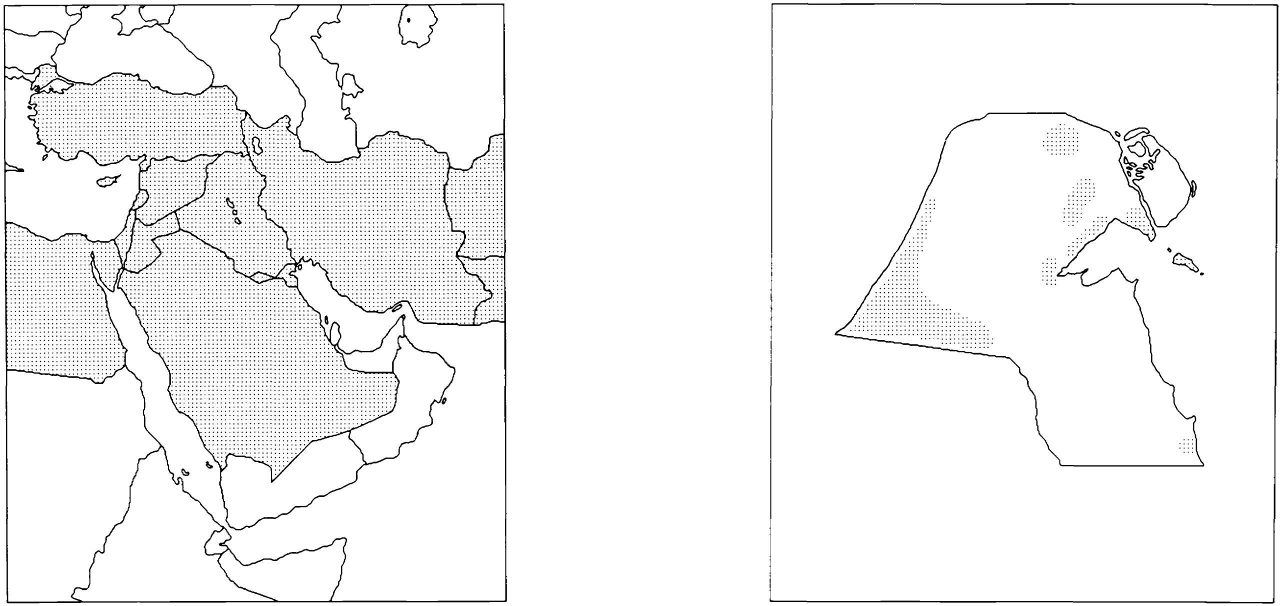


Figure 166. Geographic distribution of *Torularia torulosa* (Desf.) O.E. Schulz.

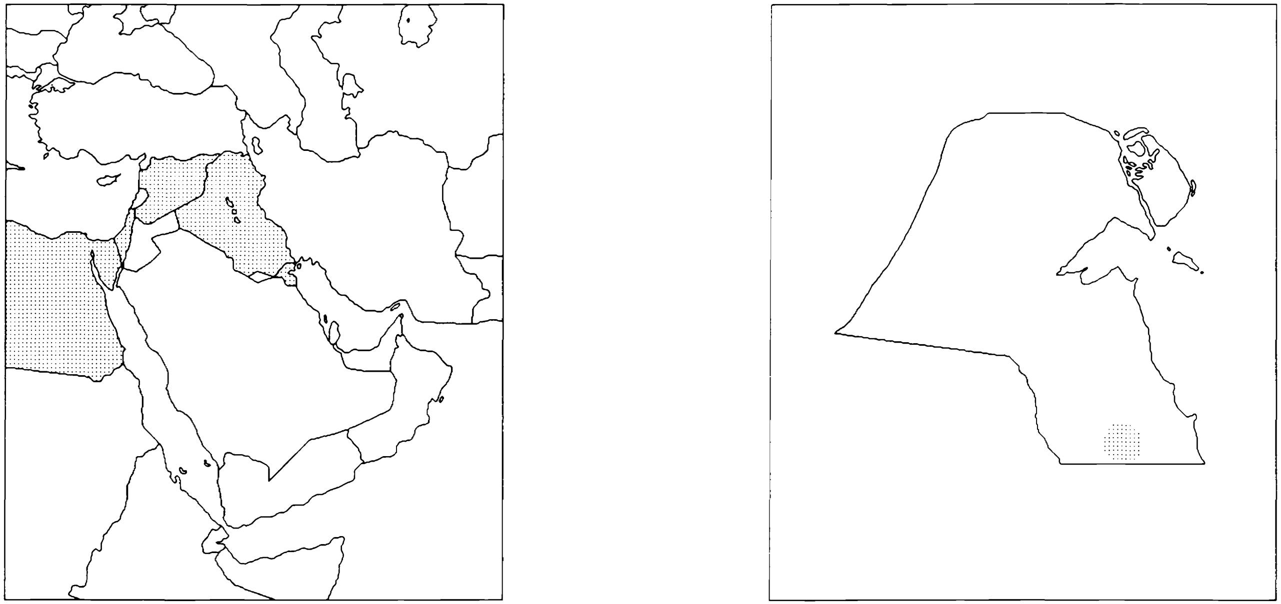


Figure 167. Geographic distribution of *Traganum nudatum* Del.

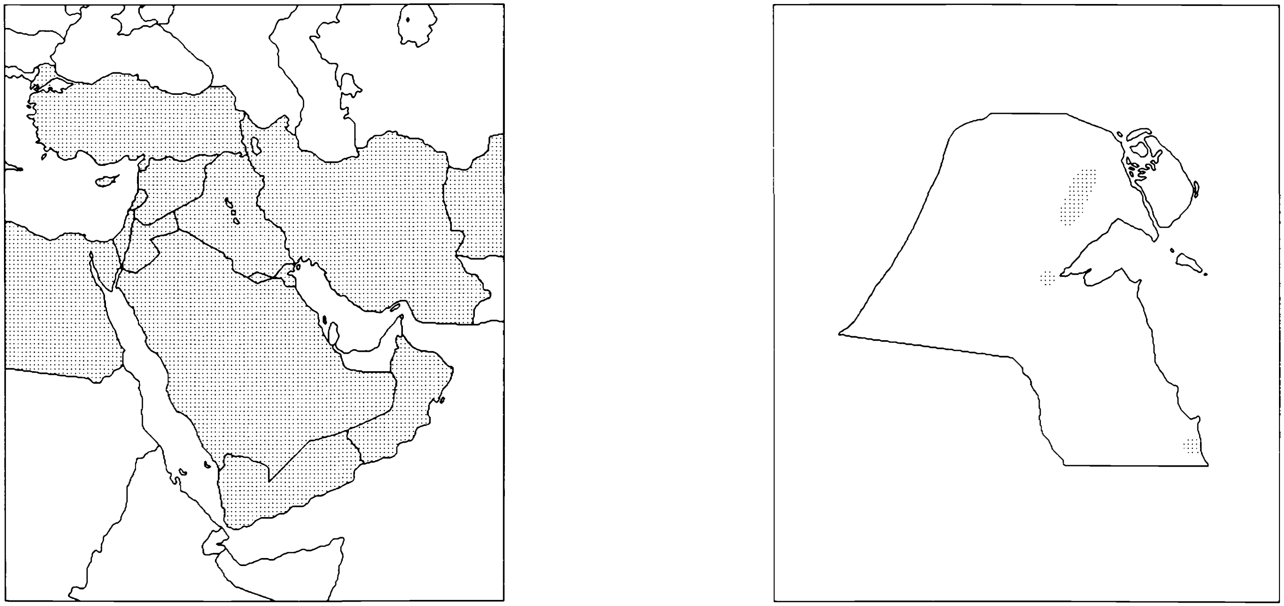


Figure 168. Geographic distribution of *Tribulus terrestris* L.

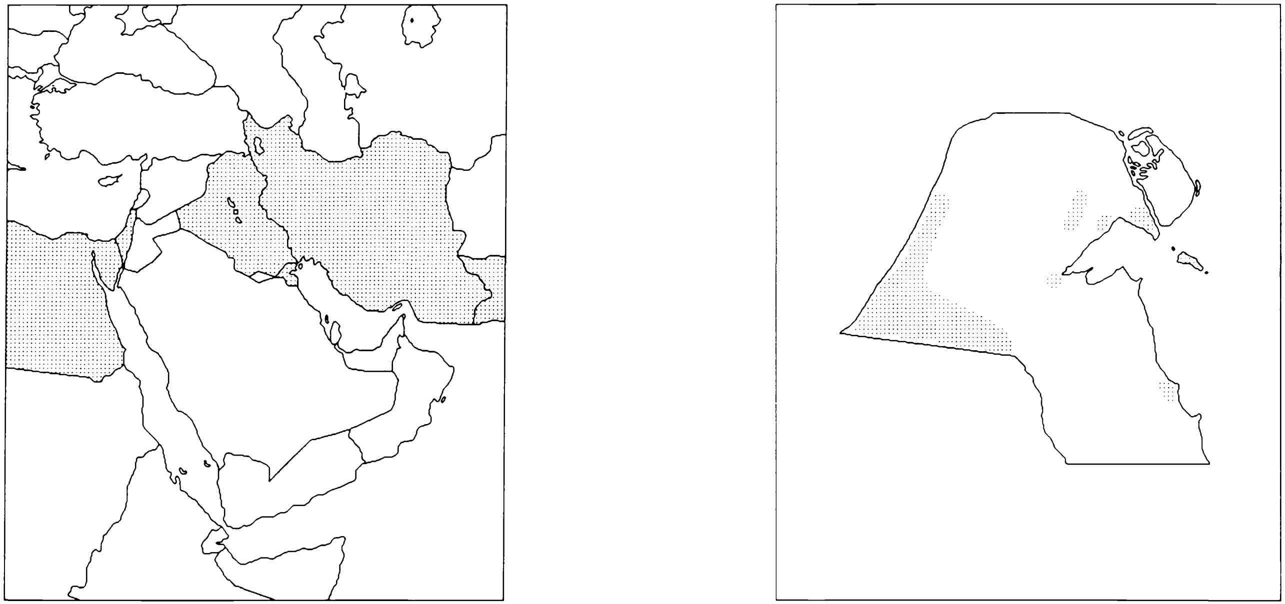


Figure 169. Geographic distribution of *Trigonella anguina* Del.

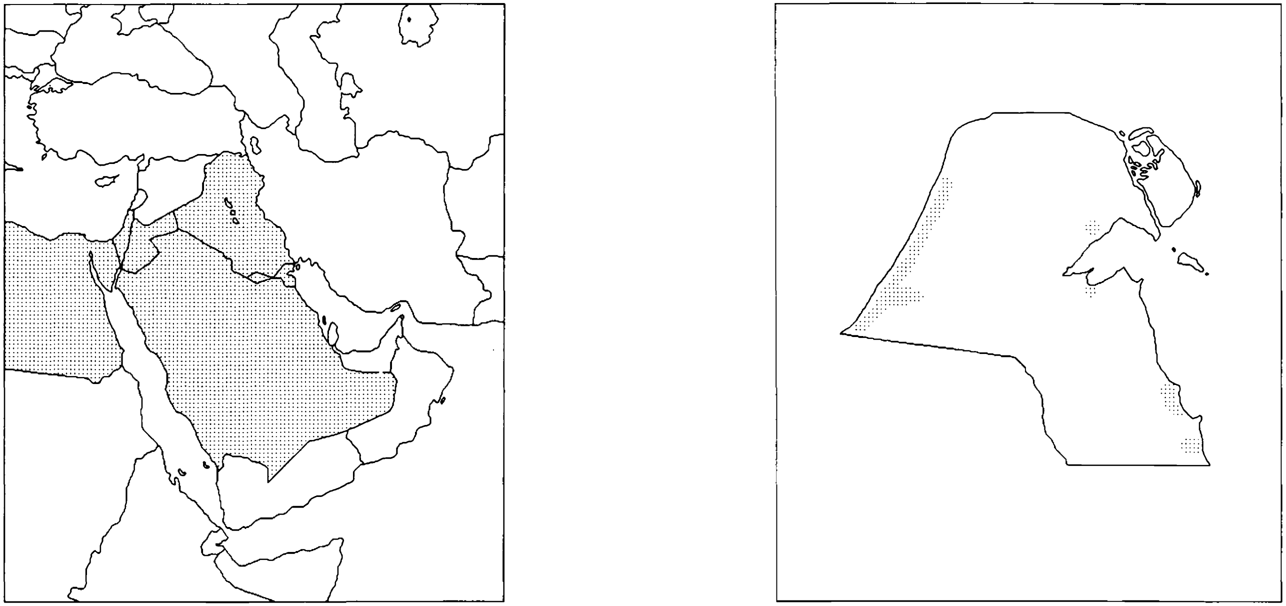


Figure 170. Geographic distribution of *Trigonella hamosa* Forssk.

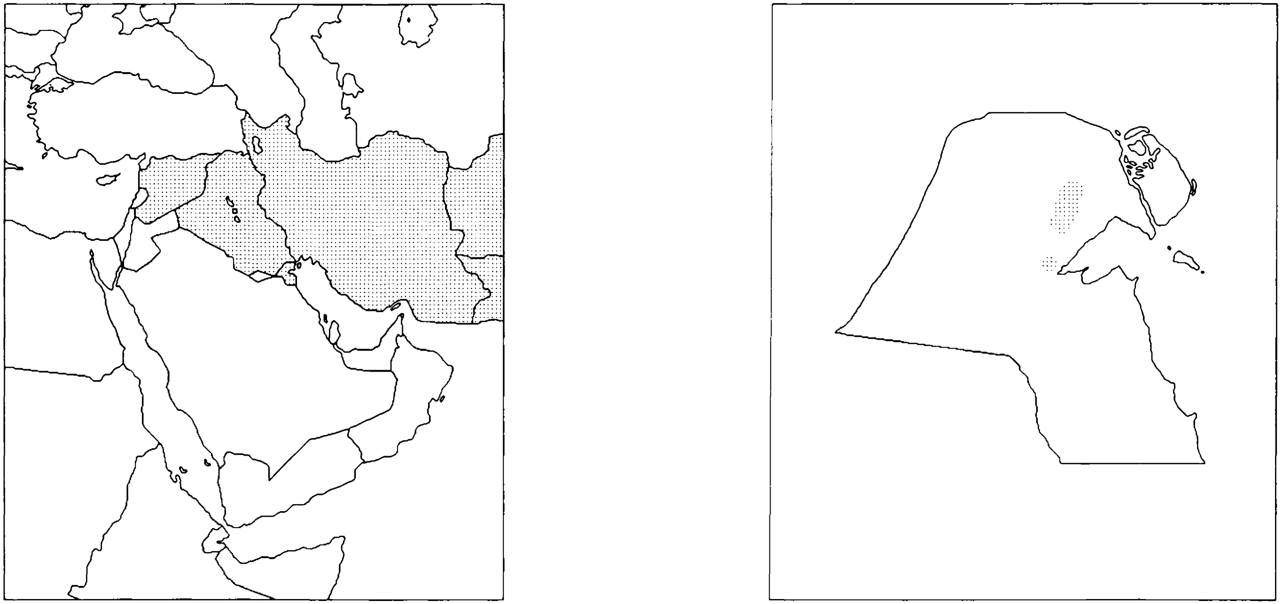


Figure 171. Geographic distribution of *Valerianella dufresnia* Bunge ex Boiss.

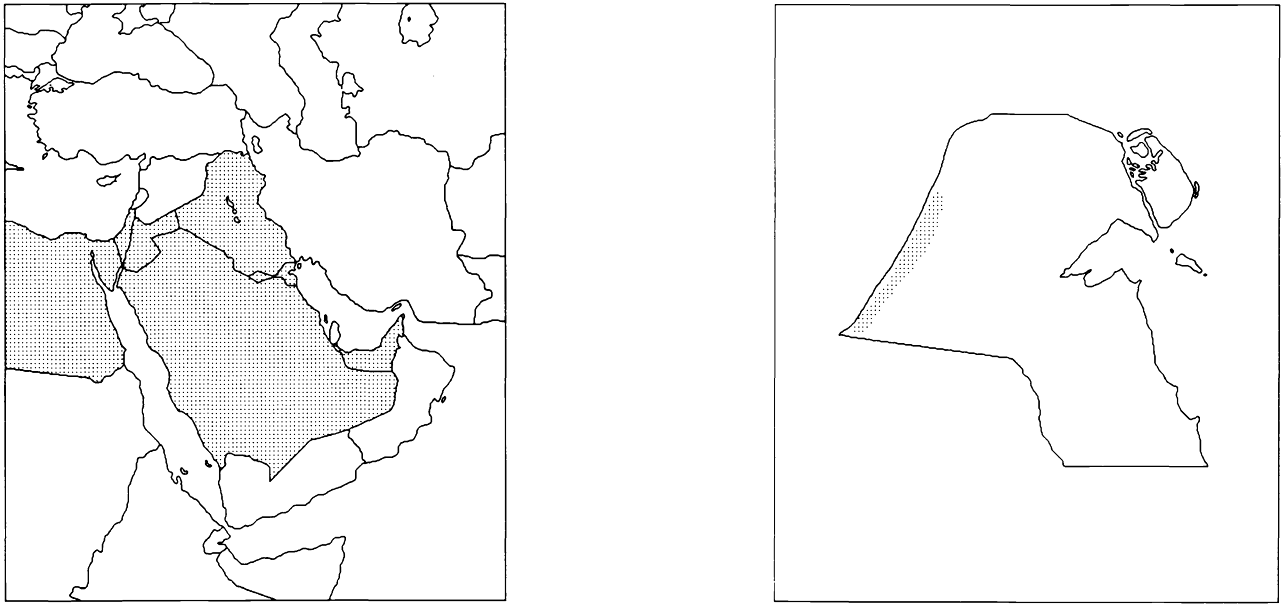


Figure 172. Geographic distribution of *Zilla spinosa* (L.) Prantl.

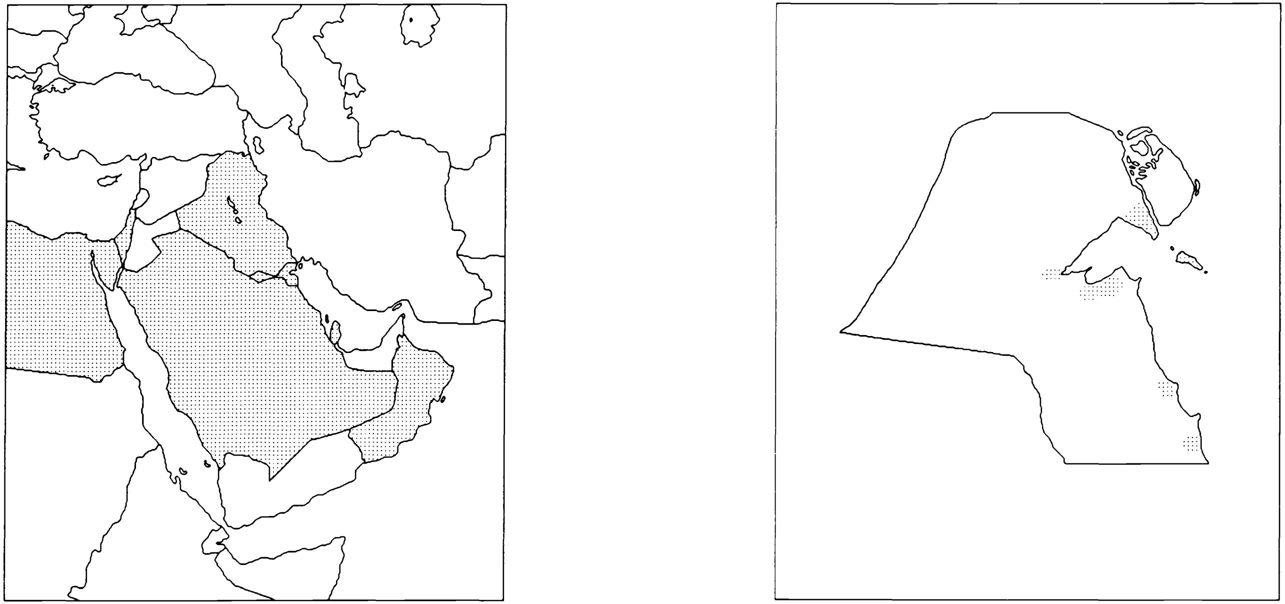


Figure 173. Geographic distribution of *Zygophyllum coccineum* L.

LITERATURE CITED

Abd El-Kawy, M.A., El-Kashoury, E.A., El-Fishawy, A.M., Atta, A.H. and Soliman, F.M. (1989) Alkaloids and lignans of *Haplophyllum tuberculatum* (Forssk.) A. Juss. *Egypt. J. Pharm. Sci.* **30**(1-4):299-308.

Abdel-Moneim, F.M., Elgamal, M.H.A., Fayez, M.B.E. and Salam, L.A.R. (1967) Constituents of local plants. XI. Triterpenoid acids of *Salvia lanigera* and *S. triloba*. *Phytochemistry* **6**(7):1035-1036.

Abdou, I.A., Abou-Zeid, A.A., El-Sherbeeny, M.R. and Abou-El-Gheat, Z.H. (1972) Antimicrobial activities of *Allium sativum*, *Allium cepa*, *Raphanus sativus*, *Capsicum frutescens*, *Eruca sativa* and *Allium kurrat* on bacteria. *Qual. Plant. Mater. Veg.* **22**(1):29-35.

Abrosimov, S.P., Shchelochkova, A.P., Denikeeva, M.F. and Koshoev, K.K. (1970) Kirghiz SSR plants containing steroid saponins [Russian]. *Fiziol. Aktiv. Soedin. Rast. Kirg.* 59-63. Ed.: Ivanov, V.I., Izd. "Ilim," Frunz, USSR.

Abu-Mustafa, E.A. and Fayez, M.B.E. (1976) Natural coumarins. Part XIX. Recovery of xanthotoxin from "meladenine mixture." *Egypt. J. Chem.* **19**(3):533-535.

Abu-Mustafa, E.A., El-Bay, F.K.A. and Fayez, M.B.E. (1968) Natural coumarins. X. Isoimperatorin, a further constituent of the fruits of *Ammi majus*. *Recl. Trav. Chim. Pays-Bas* **87**(9):925-928.

Abu-Mustafa, E.A., El-Bay, F.K.A. and Fayez, M.B.E. (1971a) Natural coumarins. XIII. Structure of majurin, a new constituent of *Ammi majus* fruits. *Tetrahedron Lett.* (20):1657-1658.

Abu-Mustafa, E.A., El-Bay, F.K.A. and Fayez, M.B.E. (1971b) Natural coumarins. XII. Umbelliprenin, a constituent of *Ammi majus* fruits. *J. Pharm. Sci.* **60**(5):788-789.

Abu-Mustafa, E.A., El-Bay, F.K.A. and Fayez, M.B.E. (1975a) Natural coumarins. XVI. Ammirin, a new coumarin constituent from *Ammi majus* fruits. *Naturwissenschaften* **62**(1):39-40.

Abu-Mustafa, E.A., El-Bay, F.K.A. and Fayez, M.B.E. (1975b) Natural coumarins. XX. Alloimperatorin from *Ammi majus* fruits. *Naturwissenschaften* **62**(1):40.

Afza, N., Qureshi, I.H. and Ahmad, Y. (1987) Reinvestigation of the chemical constituents of *Lycium europeum* Linn. *J. Chem. Soc. Pak.* **9**(4):627-628.

Afzal, M. and Al-Oriquat, G. (1986a) Shikonin derivatives. V. Chemical investigations of *Arnebia decumbens*. *Agric. Biol. Chem.* **50**(3):759-760.

Afzal, M. and Al-Oriquat, G. (1986b) Shikonin derivatives, Part VI. Chemical investigations of *Arnebia decumbens*. *Agric. Biol. Chem.* **50**(6):1651-1652.

Ahmad, V.U. and Fizza, K. (1986) Chemical constituents of *Euphorbia granulata*. *Fitoterapia* **57**(4):280.

Ahmad, V.U. and Khan, M.A. (1971) L-(–)-4-Hydroxypipecolic acid from *Peganum harmala*. *Phytochemistry* **10**(12):3339-3340.

Ahmad, I., Ahmad, F. and Osman, S.M. (1977) A new dihydroxy acid from the oil of *Peganum harmala*. *Phytochemistry* **16**(11):1761-1763.

Ahmad, M.U., Husain, S.K., Ansari, A.A. and Osman, S.M. (1979) Studies on herbaceous seed oils. XII. *J. Oil Technol. Assoc. India* **11**(3):70-72.

Ahmad, M.U., Sinha, S., Husain, S.K. and Osman, S.M. (1984) The nature of the oxygenated fatty acids present in *Malva parviflora* seed oil. *J. Sci. Food Agric.* **35**(4):408-414.

Ahmed, A.A. and Saleh, N.A.M. (1987) Peganetin, a new branched acetylated tetraglycoside of acacetin from *Peganum harmala*. *J. Nat. Prod.* **50**(2):256-258.

Ajabnoor, M.A., Al-Yahya, M.A., Tariq, M. and Jayyab, A.A. (1984) Phytochemical and biological studies on Saudi medicinal plants. Part 7. Antidiabetic activity of *Hammada salicornica*. *Fitoterapia* **55**(2):107-109.

Al-Hazimi, H.M.G. (1986) The isolation of methyl carnosoate from *Salvia lanigera*. *Phytochemistry* **25**(5):1238-1239.

Al-Hazimi, H.M.G., Deep, M.S.H. and Miana, G.A. (1984) Isocarnosol, a diterpene from *Salvia lanigera*. *Phytochemistry* **23**(4):919-921.

Al-Hazimi, H.M.G., Miana, G.A. and Deep, M.S.H. (1987) Terpenoids from *Salvia lanigera*. *Phytochemistry* **26**(4):1091-1093.

Alimbaeva, P.K. and Mukhamedziev, M.M. (1969) Characteristics of saponin-containing Primulaceae in the Kirgiz SSR [Russian]. *Rast. Resur.* **5**(3):380-385.

Al-Nagdy, S.A. and Rizk, A.M. (1978) Constituents of Qatar flora. I. Phytochemical investigation of *Fagonia glutinosa*. *Fitoterapia* **49**(6):243-245.

Al-Shamma, A., Al-Douri, N.A. and Phillipson, J.D. (1979) Alkaloids of *Halophyllum tuberculatum* from Iraq. *Phytochemistry* **18**(8):1417-1419.

Al-Shamma, A., Drake, S., Flynn, D.L., Mitscher, L.A., Park, Y.H., Rao, G.S.R., Simpson, A., Swayze, J.K., Veysoglu, T. and Wu, S.T.S. (1981) Antimicrobial agents from higher plants. Antimicrobial agents from *Peganum harmala* seeds. *J. Nat. Prod.* **44**(6):745-747.

Al-Yahya, M.A. (1986) Phytochemical studies of the plants used in traditional medicine of Saudi Arabia. *Fitoterapia* **57**(3):179-182.

Al-Yahya, M.A., Mossa, J.S., Al-Badr, A.A., Tariq, M. and Al-Meshai, I.A. (1987) Phytochemical and biological studies on Saudi medicinal plants: part 12. A study on Saudi plants of family "Leguminosae." *Int. J. Crude Drug Res.* **25**(2):65-71.

Amoros, M. and Girre, R.L. (1987) Structure of two antiviral triterpene saponins from *Anagallis arvensis*. *Phytochemistry* **26**(3):787-791.

Amoros, M., Fauconnier, B. and Girre, L. (1979) Antiviral properties of the scarlet pimpernel *Anagallis arvensis*, Primulaceae [French]. *Plant. Med. Phytother.* **13**(2):122-133.

Amoros, M., Fauconnier, B. and Girre, R.L. (1987) In vitro antiviral activity of a saponin from *Anagallis arvensis*, Primulaceae, against *Herpes simplex* virus and poliovirus. *Antiviral Res.* **8**(1):13-25.

Amoros, M., Fauconnier, B. and Girre, R.L. (1988) Effect of saponins from *Anagallis arvensis* on experimental *Herpes simplex* keratitis in rabbits. *Planta Med.* **54**(2):128-131.

Andhiwal, C.K. and Kishore, K. (1984) Sterols of *Salsola foetida*. *J. Indian Chem. Soc.* **61**(8):729-730.

Antonova, O.K. and Kabonov, V.S. (1985) Analysis of ammifurin composition in relation to the quality of raw material and manufacture [Russian]. *Khim.-Farm. Zh.* **19**(10):1252-1255.

Aripova, S.F. (1985) Alkaloids of *Hyoscyamus pusillus* [Russian]. *Khim. Prir. Soedin.* (2):274.

Arutyunyan, L.S., Agababyan, E.Yu., Melkumyan, Kh.A. and Mnatsakanyan, V.A. (1975) Betaine hydrochloride from *Bienertia cycloptera* [Russian]. *Arm. Khim. Zh.* **28**(9):752-754.

Arutyunyan, L.S., Agababyan, E.Yu., Melkumyan, Kh.A. and Mnatsakanyan, V.A. (1976) *Halocnemum strobilaceum* (Pall.) M. B. bases [Russian]. *Arm. Khim. Zh.* **29**(5):467.

Ashirova, A.A. and Meredov, K. (1974) Dynamics of the content and distribution of furocoumarins during ontogenesis of *Ammi majus* during irrigation [Russian]. *Izv. Akad. Nauk Turkm. SSR, Ser. Biol. Nauk* (6):66-68.

Ashkenazy, D., Friedman, J. and Kashman, Y. (1983) The furocoumarin composition of *Pituranthos triradiatus*. *Planta Med.* **47**(4):218-220.

Ashkenazy, D., Friedman, J., Kashman, Y., Egyed, M.N., Shlosberg, A. and Nyska, A. (1984) Photosensitization in ducklings induced by *Pituranthos triradiatus*. *Vet. Hum. Toxicol.* **26**(2):118-120.

Ashkenazy, D., Kashman, Y., Nyska, A. and Friedman, J. (1985) Furocoumarins in shoots of *Pituranthos triradiatus* (Umbelliferae) as protectants against grazing by hyrax (Procaviidea: *Procavis capensis syriaca*). *J. Chem. Ecol.* **11**(2):231-239.

Ashkenazy, D., Eshel, A., Friedman, J. and Kashman, Y. (1987) Morphological and chemical variations in natural populations of *Pituranthos triradiatus* in the Negev desert. *Biochem. Syst. Ecol.* **15**(4):453-458.

Ashraf, M., Ahmad, R. and Bhatty, M.K. (1979) Studies on the essential oils of the Pakistani species of the family Umbelliferae. Part XXX. *Ammi majus* seed oil. *Pak. J. Sci. Ind. Res.* **22**(5):255-257.

Aynehchi, Y., Sormaghi, M.H.S., Amin, Gh. and Ghahreman, A. (1981) Survey of Iranian plants for saponins, alkaloids, flavonoids and tannins. I. *Int. J. Crude Drug Res.* **19**(2-3):53-63.

Aynehchi, Y., Sormaghi, M.H.S., Amin, Gh., Soltani, A. and Qumehr, N. (1982) Survey of Iranian plants for saponins, alkaloids, flavonoids and tannins. II. *Int. J. Crude Drug Res.* **20**(2):61-70.

Aynehchi, Y., Sormaghi, M.H.S., Amin, Gh., Khoshkhow, M. and Shabani, A. (1985) Survey of Iranian plants for saponins, alkaloids, flavonoids and tannins. III. *Int. J. Crude Drug Res.* **23**(1):33-41.

Ayoub, S.M.H. and Yankov, L.K. (1980) Alkanes and unsaturated ketone from the peels of *Citrullus colocynthis*. L. *Dokl. Bolg. Akad. Nauk* **33**(6):811-814.

Ayoub, S.M.H. and Yankov, L.K. (1981a) On the constituents of the peels of *Citrullus colocynthis*. Part 1. *Fitoterapia* **52**(1):9-12.

Ayoub, S.M.H. and Yankov, L.K. (1981b) On the constituents of the peels of *Citrullus colocynthis*. Part 2. *Fitoterapia* **52**(1):13-16.

Ayoub, S.M.H. and Yankov, L.K. (1981c) On the constituents of the peels of *Citrullus colocynthis*. Part 3. *Fitoterapia* **52**(1):17-18.

Ayoub, S.M.H. and Yankov, L.K. (1981d) On the constituents of the peels of *Citrullus colocynthis*. Part 4. *Fitoterapia* **52**(1):19-20.

Ayoub, S.M.H. and Yankov, L.K. (1981e) Two isomeric dimethylhexadecan-14-ol-2-ones from *Citrullus colocynthis*. L. fruit peels. *Dokl. Bolg. Akad. Nauk* **34**(6):795-798.

Ayoub, M.T., Rashan, L.J., Khazraji, A.T. and Adaay, M.H. (1989) An oxamide from *Peganum harmala* seeds. *Phytochemistry* **28**(7):2000-2001.

Baghdadi, H.H., El-Sayed, S.H., Salem, G.A. and Metwally, A.M. (1988) A comparative chemical study of *Lycium* species growing in Egypt. *Alexandria J. Pharm. Sci.* **2**(1):73-76.

Bahrman, N., Jay, M. and Gorenflot, R. (1985) Contributions to the chemosystematic knowledge of some species of the genus *Chenopodium* L. [French]. *Lett. Bot.* (2):107-113.

Bajaj, R.K., Kokate, C.K. and Chauhan, C.S. (1971) Fixed oil of seeds of *Eruca sativa*. *East. Pharm.* **14**(167):45-46.

Balbaa, S.I., Hilal, S.H. and Haggag, M.Y. (1972a) Active constituents of *Ammi majus* fruits at different stages of maturity. *Planta Med.* **22**(2):122-126.

Balbaa, S.I., Hilal, S.H. and Haggag, M.Y. (1972b) Method for the estimation of furocoumarin content of the fruits of *Ammi majus*. *Planta Med.* **22**(2):209-212.

Balbaa, S.I., Hilal, S.H. and Haggag, M.Y. (1973) Separation of ammajin and marmesin from the fruits of *Ammi majus* and their chemical estimation. *Planta Med.* **23**(2):191-195.

Banerji, R., Prakash, D., Misra, G., Nigam, S.K., Saxena, A.K., Mathur, A.K., Sinha, J.N. and Bhargava, K.P. (1981) Cardiovascular and hemolytic activity of saponins. *Indian Drugs* **18**(4):121-124.

Basalah, M.O., Al-Whaibi, M.H. and Muhammad, S. (1985) Comparative study of some metabolites of *Citrullus colocynthis* Schrad. and *Cucumis prophetarum* L. *J. Biol. Sci. Research* **16**(1):105-123.

Batsuren, D., Telezhenetskaya, M.V. and Yunusov, S.Yu. (1980) Alkaloids of *Peganum harmala* and *Peganum nigellastrum* [Russian]. *Khim. Prir. Soedin.* (5):736-737.

Beg, M.U., Prakash, S., Singh, M., Tewari, K.K. and Krishnan, P.S. (1968) Biochemical aspects of parasitism by the angiosperm parasites. III. Phytic acid and other forms of acid-soluble phosphate in angiosperm parasites and hosts. *Indian J. Biochem.* **5**(4):157-160.

Bhattacharya, J. and Chaudhuri, D.K. (1974) Isolation and characterization of a crystalline antithiamine factor from mustard seed, *Brassica juncea*. *Biochim. Biophys. Acta* **343**(1):211-214.

Bhatnagar, R., Bhushan, R., Garg, S.P. and Kapoor, R.C. (1976) Protein and free amino acids of *Citrullus colocynthis*. *J. Indian Chem. Soc.* **53**(3):309.

Bhutani, S.P., Chibber, S.S. and Seshadri, T.R. (1969) Flavonoids of the fruits and leaves of *Tribulus terrestris*. *Phytochemistry* **8**(1):299-303.

Bilgir, B. (1982) Studies on some wild plant foods used for human nutrition in western Anatolia [Turkish]. *Ege Univ. Ziraat Fak. Derg.* **19**(3):11-26.

Birza, E., Ciulei, I., Popescu, V., Mateescu, Th. and Balaci, P. (1974) Detection and biological determination of estrogenic substances in *Anagallis arvensis* [Romanian]. *Farmacia (Bucharest)* **22**(8):499-503.

Bohannon, M.B. and Kleiman, R. (1978) Cyclopropene fatty acids of selected seed oils from Bombacaceae, Malvaceae, and Sterculiaceae. *Lipids* **13**(4):270-273.

Botbaev, A.I., Plekhanova, N.V. and Nikitina, E.V. (1974) Alkaloids in *Peganum harmala* of the flora of Kirgizia [Russian]. *Izv. Akad. Nauk Kirg. SSR* (2):52-53.

Boukhris, M. (1972) Histoautoradiographic localization of sulfate-^{35}S in *Erodium glaucophyllum* and *Moricandia arvensis suffruticosa* tissues [French]. *C. R. Acad. Sci., Ser. D* **275**(23):2651-2654.

Boukhris, M. and Lossaint, P. (1975) Ecological aspects of the mineral nutrition of Tunisian gypsicole plants [French]. *Rev. Ecol. Biol. Sol* **12**(1):329-348.

Buckova, A., Eisenreichova, E. and Haladova, M. (1983) Isolation of heraclenin from the fruits of *Ammi majus* L. [Slovak]. *Cesk. Farm.* **32**(9-10):348-349.

Carr, M.E., Phillips, B.S. and Bagby, M.O. (1985) Multipurpose oil-bearing plants tolerant of arid or semiarid environments. *J. Am. Oil Chem. Soc.* **62**(9):1367-1370.

Chatterjee, A. and Ganguly, M. (1968) Alkaloidal constituents of *Peganum harmala* and synthesis of the minor alkaloid deoxyvascinone. *Phytochemistry* **7**(2):307-311.

Cherkavskii, O.F. and Tetyura, V.Kh. (1986) Content of chemical elements on *Orobanche ramosa* L. seeds [Ukrainian]. *Ukr. Bot. Zh.* **43**(3):108-110.

Chirkina, N.N. and Degtyareva, A.P. (1972) Chemical nature of the antiviral principle of some higher plants [Russian]. *Fitontsidy, Mater. Soveshch., 6th*, 147-50. Ed.: Aizenman, B.E. "Naukova Dumka," Kiev, USSR.

Das, V.S.R., Rao, J.V.S. and Rao, K.N. (1967) Levels of phenolic acids during fruit growth in *Citrullus colocynthis*. *Z. Pflanzenphysiol.* **56**(5):466-468.

Das Gupta, S.K. (1974) Changes in chemical and fatty acid composition during the last phase of maturation of seeds of two Indian mustard cultivars (*Brassica juncea*). *Indian J. Biochem. Biophys.* **11**(3):263-264.

Daulatabad, C.D. and Ankalgi, R.F. (1978) *J. Oil. Technol. Assoc. India* **10**(2):36-39.

Dawidar, A.M. and Amer, M.A. (1974) Sterol contents of *Arthrocnemum glaucum, Cornulaca monacantha* and *Haloxylon salicornicum*. *Egypt J. Chem.* **17**(6):869-872.

Devys, M., Barbier, M., Loiselet, I., Rouxel, T., Sarniguet, A., Kollmann, A. and Bousquet, J.F. (1988) Brassilexin, a novel sulfur-containing phytoalexin from *Brassica juncea* L. (Cruciferae). *Tetrahedron Lett.* **29**(49):6447-6448.

Devys, M., Barbier, M., Kollmann, A. Rouxel, T., and Bousquet, J.F. (1990) Cyclobrassinin sulfoxide, a sulfur-containing phytoalexin from *Brassica juncea*. *Phytochemistry* **29**(4):1087-1088.

Dolya, V.S., Koreshchuk, K.E., Fursa, N.S., Golodner, D.N. and Kaminskii, N.A. (1972) Oils from three representatives of the Cruciferae family [Russian]. *Khim. Prir. Soedin.* (3):386-387.

Dolya, V.S., Koreshchuk, K.E., Shkurupii, E.N. and Kaminskii, N.A. (1974) Oils from three representatives of the Cruciferae family. II [Russian]. *Khim. Prir. Soedin.* (4):440-442.

Eisenreichova, E., Buckova, A., Kosakova, L. and Tomko, J. (1980) Content of *Ammi majus* L. substances [Slovak]. *Farm. Obs.* **49**(11):503-506.

Elawad, A.A., Abdel Bari, E.M., Mahmoud, O.M. and Adam, S.E.I. (1984) The effect of *Citrullus colocynthis* on sheep. *Vet. Hum. Toxicol.* **26**(6):481-485.

El-Beih, F.K.H. (1984) Constituents of local plants. XVIII. Isolation of flavone from *Peganum harmala* L. *Herba Hung.* **23**(3):25-28.

El-Hakeem, L.M. and Weinert, E. (1976) Botanical and phytochemical screening of a new species of *Anabasis* growing in Iraq. *Wiss. Z. Martin-Luther-Univ., Halle-Wittenberg, Math.-Naturwiss. Reihe* **25**(4):65-71.

El-Masry, S., Mahmoud, Z., Amer, M., Freyer, A.J., Valencia, E., Patra, A. and Shamma, M. (1985) (–)-Misramine: an unusual proaporphine alkaloid. *J. Org. Chem.* **50**(5):729-730.

El-Sayyad, S. and Wagner, H. (1978) A phytochemical study of *Calligonum comosum* L'Hér. *Planta Med.* **33**(3):262-264.

Fiad, S. and Osman, F. (1975) Structure of glycerides and phospholipids in some wild Egyptian Umbelliferae [German]. *Seifen, Oele, Fette, Wachse* **101**(16):469-471.

Flanders, A. and Abdulkarim, S.M. (1985) The composition of seed and seed oils of taramira (*Eruca sativa*). *J. Am. Oil Chem. Soc.* **62**(7):1134-1135.

Fomenko, K.P. and Krivut, B.A. (1972) Effect of environmental factors on the development of *Ammi majus* and on the accumulation of furocoumarins in it [Russian]. *Rast. Resur.* **8**(2):217-225.

Friedman, J., Rushkin, E. and Waller, G.R. (1982) Highly potent germination inhibitors in aqueous eluates of fruits of Bishop's weed (*Ammi majus* L.) and avoidance of auto-inhibition. *J. Chem. Ecol.* **8**(1):55-65.

Garg, S.P. and Gupta, U. (1987) Chemical constituents of *Citrullus colocynthis*. *J. Indian Chem. Soc.* **64**(7):448-449.

Gasmelseed, G.A., Hayat, L.J. and El-Rayyess, N.R. (1989) Solvent selection and recovery in a counter-current leaching process. *J. Environ. Sci. Health, Part A* **A24**(8):935-942.

Gelpi, E., Schneider, H., Doctor, V.M., Tennison, J. and Tennison, J. (1969) Gas chromatographic–mass spectrometric identifications of the hydrocarbons and fatty acids of *Plantago ovata* seeds. *Phytochemistry* **8**(10):2077-2081.

Gheorghiu, A. and Ionescu-Matiu, E. (1968a) Steroid sapogenins. Presence of chlorogenin in *Tribulus terrestris* [Romanian]. *Stud. Cercet. Biochim.* **11**(3):269-273.

Gheorghiu, A. and Ionescu-Matiu, E. (1968b) Presence of chlorogenin with diosgenin and gitogenin in *Tribulus terrestris* [French]. *Ann. Pharm. Fr.* **26**(12):745-748.

Gill, S. and Raszeja, W. (1971) Chromatographic analysis of harman derivatives in some plant raw materials [Polish]. *Gdansk Tow. Nauk, Rozpr. Wydz.* **3**(8):137-143.

Glombitza, K.W. and Kurth, H. (1987a) The structures of some triterpene saponins from *Anagallis arvensis* [German]. *Planta Med.* **53**(6):548-555.

Glombitza, K.W. and Kurth, H. (1987b) Saponins from *Anagallis arvensis* L. (Primulaceae) [German]. *Arch. Pharm. (Weinheim, Ger.)* **320**(10):1083-1087.

Gmelin, R. and Schlueter, M. (1970) Isolation of [(4-methylthio)butyl]glucosinolate (glucoerucin) from seeds of *Eruca sativa* [German]. *Arch. Pharm. (Weinheim)* **303**(4):330-334.

Gnan, S.O. and Sheriha, G.M. (1986) Antimicrobial activity of (+)-tuberine. *J. Food Prot.* **49**(5):340-341.

Gozler, B. (1990) Labrandine: a new pentacyclic proaporphine alkaloid from *Roemeria hybrida*. *Heterocycles* **31**(1):149-152.

Gozler, B., Gozler, T., Mete, I.E., Freyer, A.J., Guinaudeau, H. and Shamma, M. (1987) New proaporphine alkaloids from *Roemeria hybrida*. *Tetrahedron* **43**(8):1765-1770.

Gozler, B., Freyer, A.J. and Shamma, M. (1989) A new class of isoquinoline alkaloids: the proaporphine-tryptamine dimers. *Tetrahedron Lett.* **30**(10):1165-1168.

Gribanovski-Sassu, O., Pellicciari, R. and Cataldi Hiughez, C. (1969) Leaf pigments of *Lycium auropaeum*: seasonal effect of zeaxanthin and lutein formation. *Ann. Ist. Super. Sanita* **5**(1-2):51-53.

Gromakova, A.I. and Perel'son, M.E. (1980) Chromatospectrophotometric method for the quantitative determination of total furocoumarins in *Ammi majus* L. seeds [Russian]. *Khim.-Farm. Zh.* **14**(2):78-81.

Gromakova, A.I., Kabanov, V.S. and Perel'son, M.E. (1983) Gas chromatographic method for the quantitative determination of furocoumarins in the fruit of *Ammi majus* [Russian]. *Khim.-Farm. Zh.* **17**(6):707-711.

Gryzlov, V.P. and Chernobai, N.Kh. (1969) Effect of nutrition on the yield and quality of *Ammi majus* [Russian]. *Agrokhimiya* (9):35-40.

Gu, R.-Q. (1986) The radiation protective effect of sinapine distributed in cruciferous plants on germinating seeds of barley and wheat. *Sci. Sin., Ser. B (engl. Ed.)* **29**(7):723-732.

Gunasekaran, K. and Chelliah, S. (1985) Juvenile hormone effect of *Tribulus terrestris* L. and *Parthenium hysterophorus* L. on *Dysdercus cingulatus* F. *Behav. Physiol. Approaches Pest Manage., Pap. Natl. Semin.* 123-125. Ed.: Regupathy, A and Jayaraj, S., Tamil Nadu Agric. Univ., Coimbatore, India.

Gupta, B.K., Nandra, K.S. and Chopra, A.K. (1980) Chemical and mineral composition of different strains of white senji (*Melilotus parviflora*) fodder. *J. Res. (Punjab Agric. Univ.)* **17**(1):95-97.

Gyulemetova, R., Tomova, M., Simova, M., Pangarova, T. and Peeva, S. (1982) Determination of furostanol saponins in the preparation Tribestan [German]. *Pharmazie* **37**(4):296.

Habs, M., Jahn, S.A.A. and Schmaehl, D. (1984) Carcinogenic activity of condensate from coloquint seeds (*Citrullus colocynthis*) after chronic epicutaneous administration to mice. *J. Cancer Res. Clin. Oncol.* **108**(1):154-156.

Haggag, M.Y. and Hilal, S.H. (1977) Gas chromatography of furocoumarins. *Egypt. J. Pharm. Sci.* **18**(1):71-76.

Hamence, J.H. and Taylor, D. (1978) The composition of rapeseed meals. Part I: the determination of the isothiocyanate present in *Eruca sativa*, a cruciferous seed, present in some rapeseed meals. *J. Assoc. Public Anal.* **16**(2):49-57.

Han, Y.B., Kim, M.R., Han, B.H. and Han, Y.N. (1987) Studies on antioxidant component of mustard leaf and seed [Korean]. *Saengyak Hakhoechi* **18**(1):41-49.

Handa, K.L., Rao, P.R. and Atal, C.K. (1977) Some furanocoumarins of economic importance. *Cultiv. Util. Med. Arom. Plants* 111-114. Ed.: Atal, C.K. and Kapur, B.M., Reg. Res. Lab., Jammu-Tawi, India.

Harborne, J.B. (1975) Flavonoid bisulfates and their cooccurrences with ellagic acid in the Bixaceae, Frankeniaceae, and related families. *Phytochemistry* **14**(5-6):1331-1337.

Harborne, J.B. and Williams, C.A. (1972) Comparative biochemistry of the flavonoids. XVII. Flavonoid patterns in the fruits of the Umbelliferae. *Phytochemistry* **11**(5):1741-1750.

Hassan, M.M. (1970) Epoxy acids and epoxidized oils. III. Isolation and characterization of epoxyoleic acid in the seed oil of *Malva parviflora*. *Grasas Aceites (Seville)* **21**(6):323-325.

Hassan, M.M., Souka, L.M. and Gad, A.M. (1966) Epoxy acids and epoxidized oils. I. Quantitative evaluation of naturally occurring epoxy fatty acids in some malvaceous seed oils. *Fette, Seifen, Anstrichm.* **68**(12):1028-1030.

Hatam, N.A.R., Whiting, D.A. and Yousif, N.J. (1989) Cucurbitacin glycosides from *Citrulluscolocynthis*. *Phytochemistry* **28**(4):1268-1271.

Heitz, S., Billet, D. and Raulais, D. (1971) Triterpenes of *Anagallis arvensis*. I. Structure of anagalligenone B (French). *Bull. Soc. Chim. Fr.* (6):2320-2324.

Hilal, S.H. and Haggag, M.Y. (1975) A thin-layer chromatography (TLC)–colorimetric assay of furocoumarins. *Egypt. J. Pharm. Sci.* **16**(4):495-499.

Hilal, S.H., Haggag, M.Y. and El-Kashoury, S. (1977) Chromatographic study of *Peganum harmala* L. alkaloids. *Egypt. J. Pharm. Sci.* **18**(1):9-18.

Hilal, S.H., Haggag, M.Y., Soliman, F.M. and El-Kashoury, S. (1978) Alkaloids of *Peganum harmala*. *Egypt. J. Pharm. Sci.* **19**(1-4):393-399.

Hilal, S.H., Radwan, A.S., Haggag, M.Y., Melek, F.R. and Abdel Khalek, S.M. (1982) Fluorometric analysis of furocoumarins. *Egypt J. Pharm. Sci.* **23**(1-4):365-370.

Hogge, L.R., Reed, D.W. and Underhill, E.W. (1988) The identification of desulfoglucosinolates using thermospray liquid chromatography/mass spectrometry. *J. Chromatogr. Sci.* **26**(7):348-351.

Hondelmann, W. and Radatz, W. (1982) Fatty acids in seed oils of European wild plants: a starting-point for developing industrial crops? [German]. *Fette, Seifen, Anstrichm.* **84**(2):73-75.

Horn, P.J. and Vaughan, J.G. (1983) Seed glucosinolates of fourteen wild Brassica species. *Phytochemistry* **22**(2):465-470.

Hoshi, T. and Hosoda, T. (1978) Interrelation between the genome and flavonoid composition in the genus *Brassica*. *Ikushugaku Zasshi* **28**(2):137-142.

Hsu, C.-C., Odell, G.V. and Williams, T. (1968) Characterization of the saponin fraction of *Tribulus terrestris*. *Proc. Okla. Acad. Sci.* **47**:21-24.

Ibrahim, M.E., El-Khrisy, E.A.M., Al-Abdallah, M.M. and Baraka, A. (1981) Evaluation of the inhibitor effect of some natural substances used as corrosion inhibitors. 1. During the dissolution of tin in nitric acid [German]. *Metalloberflaeche* **35**(4):134-136.

Ishikura, N. (1981) Flavonoids in the petal cells of *Anagallis arvensis* f. *coerulea* containing a blue crystalline anthocyanin. *Z. Pflanzenphysiol.* **103**(5):469-473.

Iskenderov, G.B. (1970) Steroidal sapogenins from *Tribulus terrestris* [Russian]. *Khim. Prir. Soedin.* **6**(4):488-489.

Ivie, G.W. (1978) Linear furocoumarins (psoralens) from the seed of Texas *Ammi majus* L. (Bishop's weed). *J. Agric. Food Chem.* **26**(6):1394-1403.

Jacob, R.H. and Peet, R.L. (1989) Acute oxalate toxicity of sheep associated with slender iceplant (*Mesembryanthemum nodiflorum*). *Aust. Vet. J.* **66**(3):91-92.

Jado, A.I., Hassan, M.M.A., Ezmirly, S.T. and Muhtadi, F.J. (1979) The chemical investigation of *Peganum harmala* L. growing in Saudi Arabia. Part 2. The seeds and leaves. *Pharmazie* **34**(2):108-109.

Jamal, S., Ahmad, I., Agarwal, R., Ahmad, M. and Osman, S.M. (1987) A novel oxo fatty acid in *Plantago ovata* seed oil. *Phytochemistry* **26**(11):3067-3069.

Javed, M.A., Khan, S.A., Qureshi, M.I. and Bhatty, M.K. (1972) Fatty acids of indigenous resources for possible industrial applications. III. *Peganum harmala* seed oil. *Pak. J. Sci. Ind. Res.* **15**(3):218-219.

Kameoka, H. and Hashimoto, S. (1980a) The constituents of the steam-volatile oil from *Brassica juncea* Czerniak [Japanese]. *Nippon Nogei Kagaku Kaishi* **54**(2):99-103.

Kameoka, H. and Hashimoto, S. (1980b) The constituents of the steam-volatile oils of various varieties of Brassicae of various districts [Japanese]. *Nippon Nogei Kagaku Kaishi* **54**(7):535-539.

Kanya, T.C.S. and Urs, M.K. (1989) Studies on taramira (*Eruca sativa*) seed oil and meal. *J. Am. Oil Chem. Soc.* **65**(1):139-140.

Karawya, M.S., Khayyal, S.E. and Youssef, G.F. (1970) Estimation of xanthotoxin, imperatorin, and bergapten in *Ammi majus* fruits and formulations. *Planta Med.* **18**(3):195-200.

Karawya, M.S., Wassel, G.M. and El-Menshawi, B.Sh. (1973) Isolation of the antithyroid factor goitrin and its glucosinolate precursor from *Zilla spinosa*. *Acta Pharm. Suec.* **10**(6):477-482.

Karawya, M.S., Wassel, G.M. and El-Menshawi, B.Sh. (1974) Phytochemical study of *Zilla spinosa*. General analysis. Carbohydrates and lipids. *Pharmazie* **29**(1):60-61.

Kerber, E. and Buchloh, G. (1982) Sinapine in the tribe Brassiceae (Cruciferae) [German]. *Angew. Bot.* **56**(1-2):85-91.

Khafagy, S.M., Sabri, N.N. and Abou Donia, A.H. (1978) Pharmacognostical study of *Melilotus indicus* (L.) All. var. *tommasinii* Jord. *Egypt. J. Pharm. Sci.* **19**(1-4):293-300.

Khaitov, I.Kh. (1974) Prospecting chemical studies of several medicinal plants of the flora in Tadzhikistan [Russian]. *Aktual. Vopr. Farm.* **2**:7-11.

Khalid, S.A. and Waterman, P.G. (1981) Alkaloid, lignan and flavonoid constituents of *Halophyllum tuberculatum* from Sudan. *Planta Med.* **43**(2):148-152.

Khan, M.S.Y. (1967) Chemical examination of the seeds of *Sisymbrium irio*. *Curr. Sci.* **36**(8):206.

Khan, M.A.J. and Khan, R.J. (1985) Insecticidal effects of indigenous vegetable oils (Taramira and Artemisia) on some rice delphacids in Pakistan. *Pak. J. Sci. Ind. Res.* **28**(6):428-429.

Khan, S.A., Salma, Sabir, A.W. and Aziz, P. (1984) Development of erucic acid and glucosinolate-free rapeseeds (crucifers) in Pakistan. Part IV. The instance of erucic acid and glucosinolate occurrence in some wild crucifers of Pakistan. *Pak. J. Sci. Ind. Res.* **27**(4):225-228.

Khanna, S.G.S., Nene, Y.L., Banerjee, C.K. and Thapliyal, P.N. (1967) Isolation and chemical characterization of antifungal agents from extracts of *Anagallis arvensis*. *Indian Phytopathol.* **20**(1):64-66.

Khashimov, Kh.N., Telezhenetskaya, M.V. and Yususov, S.Yu. (1969a) Deoxypeganine, a new alkaloid from *Peganum harmala* [Russian]. *Khim. Prir. Soedin.* **5**(5):456.

Khashimov, Kh.N., Telezhenetskaya, M.V. and Yususov, S.Yu. (1969b) Peganidin, a new base from *Peganum harmala* [Russian]. *Khim. Prir. Soedin.* **5**(6):599-600.

Khashimov, Kh.N., Telezhenetskaya, M.V., Rashkes, Ya.V. and Yususov, S.Yu. (1970) Pegamin, a new alkaloid from *Peganum harmala* [Russian]. *Khim. Prir. Soedin.* **6**(4):453-455.

Kintya, P.K., Perepelitsa, E.D., Chirva, V.Ya and Kretsu, L.G. (1972) Steroid saponins. II. Glycosides of *Tribulus terrestris* [Russian]. *Khim. Prir. Soedin.* **8**(4):475-477.

Klein, G., Jurenitsch, J. and Kubelka, W. (1982) Structure of the sapogenins from Herba Herniariae (*Herniaria glabra* L. and *Herniaria hirsuta* L.) [German]. *Sci. Pharm.* **50**(3):216-233.

Klocke, J.A., van Wagenen, B. and Balandrin, M.F. (1986) Biologically active constituents of Noth American plants. Part 2. The ellagitannin geraniin and its hydrolysis products isolated as insect growth inhibitors from semi-arid land plants. *Phytochemistry* **25**(1):85-91.

Kobayashi, H., Oguchi, H., Takizawa, N., Miyase, T., Ueno, A., Usmanghani, K. and Ahmad, M. (1987) New phenylethanoid glycosides from *Cistanche tubulosa* (Schrenk) Hook. f. I. *Chem. Pharm. Bull.* **35**(8):3309-3314.

Kojima, M., Uchida, M. and Akahori, Y. (1973) Studies on the volatile components of *Wasabia japonica*, *Brassica juncea*, and *Cocholearia armoracia* by gas chromatography – mass spectrometry. I. Determination of low-mass volatile components [Japanese]. *Yakugaku Zasshi* **93**(4):453-459.

Kondo, H., Yamauchi, M. and Nozaki, H. (1986) Glucosinolates and their autolysis products in *Brassica* seeds [Japanese]. *Nippon Nogei Kagaku Kaishi* **60**(10):815-821.

Krishchenko, V.P., Rotar, A.I., Zadnipryanyi, Yu.F., Kosorukov, M.L., Pratov, U. and Anofrina, N.D. (1984) Chemical composition and nutritive value of plants of the family Chenopodiaceae of a Libyan rangeland massif [Russian]. *Izv. Timiryazevsk. S-kh. Akad.* (4):38-45.

Kull, U. and Breckle, S.W. (1975) Fatty acid patterns during development of some therophytes from the steppes near Kabul, Afghanistan [German]. *Z. Pflanzenphysiol.* **75**(4):332-338.

Kumar, P.R. and Tsunoda (1978) Fatty acid spectrum of Mediterranean wild Cruciferae. *J. Am. Oil Chem. Soc.* **55**(3):320-323.

Kurachko, K., Umarov, A.U. and Markman, A.L. (1969) Oil from *Peganum harmala* seeds [Russian]. *Khim. Prir. Soedin.* **5**(5):434.

Kurbanov, D. and Zharekeev, B.Kh. (1974) Alkaloids of *Biebersteinia multifida* and *Peganum harmala* from the Karakalpak ASSR [Russian]. *Khim. Prir. Soedin.* (5):685-686.

Lavie, D., Danieli, N., Weitman, R. and Glotter, E. (1968) New quinoline type alkaloid from *Haplophyllum tuberculatum*. *Tetrahedron* **24**(7):3011-3018.

Li, G.-W., Ying, B.-P. and Liu, D.-X. (1989) The isolation and structural determination of γ-harmine from the seed of *Peganum harmala* L. [Chinese]. *Zhiwu Xuebao* **31**(5):393-397.

Lin, Z.-K. and Hua, Y.-F. (1986) A study of the volatile flavor constituents of Sichuan zhacai (*Brassica juncea*) [Chinese]. *Zhiwu Xuebao* **28**(3):299-306.

Loufty, M.A., Hassan, M.M.A. and Abu-Shady, H. (1975) Furocoumarins. 2. Esters and ethers with expected pharmacological activity. *Pharmazie* **30**(11):748-749.

Lutomski, J. and Nowicki, B. (1968) Simple carboline alkaloids. VI. Comparative chemical evaluation of alkaloid fractions from different sources [Polish]. *Herba Pol.* **14**(4):235-238.

Lutomski, J., Kowalewski, Z., Drost, K. and Schmidt, K. (1967) Simple carboline alkaloids. I. Thin-layer chromatography of harman alkaloids occurring in plant material and in preparations [Polish]. *Herba Pol.* **13**(1-2):44-52.

Mahajan, C. and Vishwapaul (1977) Production of methoxsalen from *Ammi majus* seeds. *Res. Ind.* **22**(1):12-14.

Mahato, S.B., Sahu, N.P., Pal, B.C., Chakravarti, R.N., Chakravarti, D. and Ghosh, A. (1978) Screening of *Tribulus terrestris* plants for diosgenin. *J. Inst. Chem. (India)* **50**(1):49-50.

Mahato, S.B., Sahu, N.P., Ganguly, A.N., Miyahara, K. and Kawasaki, T. (1981) Steroidal glycosides of *Tribulus terrestric* Linn. *J. Chem. Soc., Perkin Trans. 1* (9):2405-2410.

Malik, M.S., Rafique, M., Sattar, A. and Khan, S.A. (1987) The fatty acids of indigenous resources for possible industrial applications. Part XII. The fatty acids composition of the fixed oils of *Ocimum sanctum* and *Salvia aegyptiaca* seeds. *Pak. J. Sci. Ind. Res.* **30**(5):369-371.

Mannan, A., Farooqi, J.A., Ahmad, I. and Asif, M. (1986) Studies on minor seed oils. VII. *Fette, Seifen, Anstrichm.* **88**(8):301-302.

Manzoor-i-Khuda, M. and Sultana, S. (1968) Chemical constituents of *Lycium europaeum*. I. Isolation of lyceamine and β-sitosterol. *Pak. J. Sci. Ind. Res.* **11**(3):247-249.

Masood, M., Minocha, P.K., Rathore, Y.K.S. and Tiwari, K.P. (1982) 10-*C*-Glucopyranosyl-1,8-dihydroxy-3-methylanthraquinone from *Rumex vesicarius* L. *Proc. Natl. Acad. Sci., India, Sect. A* **52**(1):123-125.

Matsumoto, T., Shimizu, N., Shigemoto, T., Itoh, T., Iida, T. and Nishioka, A. (1983a) Isolation of 22-dehydrocampesterol from the seeds of *Brassica juncea*. *Phytochemistry* **22**(3):789-790.

Matsumoto, T., Asano, S. and Itoh, T. (1983b) 24-Methylene-25-methylcholesterol, a sterol from the seeds of *Brassica juncea*. *Phytochemistry* **22**(11):2619-2620.

McKenzie, E., Nettleship, L. and Slaytor, M. (1975) New natural products from *Peganum harmala*. *Phytochemistry* **14**(1):273-275.

Medrano, M.A., Frontera, M.A. and Tomas, M.A. (1978) Anthocyanins in the flowers of *Erodium cicutarium* L. and *Erodium malacoides* L. [Spanish]. *An. Asoc. Quim. Argent.* **66**(2):107-108.

Melkumyan, Kh.A. (1969) Hypotensive action of *Bienertia cyclopter* alkaloids [Armenian]. *Zh. Eksp. Klin. Med.* **9**(1):54-56.

Mete, I.E. and Gozler, T. (1988) (+)-Oxoturkiyenine: an isoquinoline-derived alkaloid from *Hypecoum pendulum. J. Nat. Prod.* **51**(2):272-274.

Miana, G.A., Deep, M.S.H. and Al-Hazimi, M.G. (1985) The isolation and characterization of salvigenin, a flavone from *Salvia lanigera. J. Chem. Soc. Pak.* **7**(1):67-68.

Michel, K.H. and Sandberg, F. (1968) Occurrence of tyramine and *N*-methyltyramine in *Haloxylon salicornicum. Acta Pharm. Suecica* **5**(2):67-70.

Michel, K.H., Sandberg, F., Haglid, F. and Norin, T. (1967) Alkaloids of *Haloxylon salicornicum* (Moq.-Tand.) Boiss. *Acta Pharm. Suec.* **4**(2):97-116.

Miettinen, T.A. and Tarpila, S. (1989) Serum lipids and cholesterol metabolism during guar gum, *Plantago ovata* and high fiber treatments. *Clin. Chim. Acta* **183**(3):253-262.

Miller, R.W., Earle, F.R., Wolff, I.A. and Barclay, A.S. (1968) Search for new seed oils. XV. oils of Boraginaceae. *Lipids* **3**(1):443-445.

Mishaal, A.S., Nawar, M.A., Nofal, Z., Elsherbiny, A. and Abu-Mustafa, E.A. (1981) Flavone glycosides, further constituents of *Ammi majus* L. fruits. *Int. Conf. Chem. Biotechnol. Biol. Act. Nat. Prod., [Proc.], 1st,* **3**(1):111-113. Ed.: Atanasova, B., Bulg. Acad. Sci., Sofia, Bulgaria.

Mnatsakanyan, V.A., Agababyan, E.Yu. and Arutyunyan, L.S. (1981) Flavonoids of *Salsola glauca* and *Salsola macera* [Russian]. *Khim. Prir. Soedin.* (5):660-661.

Mueller, R. and Auterhoff, H. (1968) Components of pharmaceutically useful colocynths. II. [German]. *Deut. Apoth.-Ztg.* **108**(33):1191-1192.

Muhtadi, F.J., Jado, A.I., Ezmirly, S.T., Hassan, M.M.A. and Jawan, O.A. (1974) Chemical investigation of *Peganum harmala* growing in Saudi Arabia. I. Stems. *Bull. Fac. Sci., Riyadh Univ.* **6**:59-71.

Mukhamedziev, M.M. and Alimbaeva, P.K. (1970) Saponin levels of primrose and teasel family plants of Kirgiz flora [Russian]. *Izv. Akad. Nauk. Kirg. SSR* (1):54-59.

Murthi, T.N. and Devdhara, V.D. (1988) Determination of allyl isothiocyanate in Indian mustard oil by high pressure liquid chromatography. *J. Oil Technol. Assoc. India (Bombay)* **20**(1):12-13.

Nag, T.S., Mathur, G.S. and Goyal, S.C. (1979) Phytochemical studies of *Tribulus alatus, T. terrestris* and *Agave wightii*: contents of primary and secondary products. *Comp. Physiol. Ecol.* **4**(3):157-160.

Nag, T.N., Grover, S., Tiwari, A., Surendrajit, S.S.S. and Harsh, M.L. (1986) Free endogenous ascorbic acid from zygophyllaceous plants growing in the arid zone of Rajasthan. *Indian J. Bot.* **9**(2):112-113.

Nahid, T. and Zaidi, Z.H. (1969) Amino acid and carbohydrate contents of *Peganum harmala* seeds. *Pak. J. Biochem.* **2**(2):63-66.

Nettleship, L. and Slaytor, M. (1971) Ruine: a glucosidic β-carboline from *Peganum harmala*. *Phytochemistry* **10**(2):231-234.

Norula, J.L., Loiwal, S.D. and Rastogi, J.N. (1978) Chemical studies of *Anagallis arvensis* seed oil. *Chem. Era* **14**(10):455-457.

O'Donovan, D.G. and Creedon, P.B. (1971) Biosynthesis of the alkaloids of *Haloxylon salicornicum*. *Tetrahedron Lett.* (18):1341-1344.

Ono, K., Nakane, H., Meng, Z.-M., Ose, Y., Sakai, Y. and Mizuno, M. (1989) Differential inhibitory effects of various herb extracts on the activities of reverse transcriptase and various deoxyribonucleic acid (DNA) polymerases. *Chem. Pharm. Bull.* **37**(7):1810-1812.

Osman, F. and Fiad, S. (1975) Glyceride structure of Egyptian vegetable oils. VII. Erucic acid rich oils. *Nahrung* **19**(8):641-647.

Pabuccuoglu, V., Arar, G., Gozler, T., Freyer, A.J. and Shamma, M. (1989) Nitrotyrasanguinarine: an unusual nitrated benzophenanthridine alkaloid from *Hypecoum* species. *J. Nat. Prod.* **52**(4):716-719.

Panova, D. and Tomova, M. (1970) *Tribulus terrestris* for producing phenol compounds [Bulgarian]. *Farmatsiya (Sofia)* **20**(3):29-32.

Park, K.-H. (1979a) Studies on the anthocyanins of *Brassica juncea*. Part I. Identification of anthocyanins [Korean]. *Hanguk Nonghwa Hakhoe Chi* **22**(1):33-38.

Park, K.-H. (1979b) Studies on the anthocyanins of *Brassica juncea*. Part II. Quantitative determination of anthocyanins [Korean]. *Hanguk Nonghwa Hakhoe Chi* **22**(1):39-41.

Patel, R.B., Rana, N.G., Patel, M.R., Dhyani, H.K. and Chauhan, H.V. (1981) Chromatographic screening of proteins of seeds of *Plantago ovata* Forssk. *Indian Drugs Pharm. Ind.* **16**(1):3-5.

Perepelitsa, E.D. and Kintya, P.K. (1974) Dioscin, a steroid glycoside from *Tribulus terrestris* [Russian]. *Izv. Akad. Nauk Mold. SSR, Ser. Biol. Khim. Nauk* (6):76-80.

Perepelitsa, E.D. and Kintya, P.K. (1975) Chemical study of steroid glycosides of *Tribulus terrestris*. IV. Steroid saponins [Russian]. *Khim. Prir. Soedin.* **11**(2):260-261.

Perepelitsa, E.D. and Kintya, P.K. (1978) Use of hydrolytic enzymes from the fungus *Aspergillus niger* BKMt-33 to increase the diosgenin yield from *Tribulus terrestris*. [Russian]. *Prikl. Biokhim. Mikrobiol.* **14**(2):309-312.

Peterka, S. and Schlosser, E. (1989) *In vitro* activity of glucosinolates against *Leptosphaeria maculans* in comparison to the glucosinolate content and susceptibility of seedlings of different *Brassica* spp. *Meded. Fac. Landbouwwet., Rijksuniv. Gent* **54**(2a):439-446.

Phillipson, J.D., Gray, A.I., Askari, A.A.R. and Khalil, A.A. (1981) Alkaloids from Iraqi species of Papaveraceae. *J. Nat. Prod.* **44**(3):296-307.

Pitre, S. and Srivastava, S.K. (1987) Two new anthraquinones from the seeds of *Peganum harmala*. *Planta Med.* **53**(1):106-107.

Pkheidze, T.A., Kereselidze, E.V., Kachukhashvili, T.N. and Kemertelidze, E.P. (1967) Steroid sapogenins of some Georgian plants [Russian]. *Tr. 1-go Vses. S'ezda Farm.* 215-221.

Prikhod'ko, L.S., Frantsev, A.P. and Klyshev, L.K. (1979) Study of the peptide pool in *Salicornia* [Russian]. *Fiziol. Rast. (Moscow)* **26**(1):86-92.

Prikhod'ko, L.S., Rakova, N.M., Amiryanova, G.M. and Kabisheva, T.Z. (1987) Physical and chemical properties of biologically active plant glycoprotein. *F. E. C. S. Int. Conf. Chem. Biotechnol. Biol. Act. Nat. Prod., 3 rd* **4**:173-177. VCH, Weinheim, Germany.

Purushothaman, K.K. and Kalyani, K. (1974) The flavonoids of Rudanti (*Cressa cretica* Linn.). *J. Res. Indian Med.* **9**(3):109-110.

Rai, J. and Thakar, K.A. (1970) Chemical investigation of *Rumex vesicarius*. *Indian J. Chem.* **8**(11):1046-1047.

Raie, M.Y., Manzoor, A., Khan, S.A. and Chaudry, A.H. (1983) Chromatographic fixed oils analysis of *Sisymbrium irio* and *Camelina sativa* of Cruciferae family. *Fette, Seifen, Anstrichm.* **85**(6):238-239.

Rao, K.B., Bhat, G.G. and Syamasundar, J. (1978) *Cressa cretica*, a salt-extruding plant in salt-affected soils. *Curr. Res. (Univ. Agric. Sci., Bangalore)* **7**(11):186.

Rastogi, J.N. and Norula, J.L. (1979) Lacceric acid from *Anagallis arvensis* Linn. *Chem. Era* **15**(10):10-11.

Rastogi, J.N. and Norula, J.L. (1980) Chemical investigations of *Anagallis arvensis* flowers. *J. Indian Chem. Soc.* **57**(7):761-762.

Reed, D.W., Pivnick, K.A. and Underhill, E.W. (1989) Identification of chemical oviposition stimulants for the diamondback moth, *Plutella xylostella*, present in three species of Brassicaceae. *Entomol. Exp. Appl.* **53**(3):277-286.

Rizk, A.M., Al-Nagdy, S.A. and El-Missiry, M.M. (1982) Constituents of plants growing in Qatar. Part 2. Investigation of *Euphorbia granulata*. *Pharmazie* **37**(10):737-738.

Rizk, A.M., Ismail, S.L. and Hussein, L. (1984) Constituents of plants growing in Qatar. Part IV. Chemical investigation of *Schanginia aegyptica*. *Fitoterapia* **55**(3):179-182.

Rizk, A.M., Hammouda, F.M., Roder, E., Wiedenfeld, H., Ismail, S.I., Hassan, N.M. and Hosseiny, H.A. (1988) Constituents of plants growing in Qatar. XIII. Occurrence of pyrrolizidine alkaloids in *Heliotropium bacciferum* Forssk. *Sci. Pharm.* **56**(2):105-110.

Rodman, J.E. (1976) Differentiation and migration of *Cakile* (Cruciferae): seed glucosinolate evidence. *Syst. Bot.* **1**(2):137-148.

Ross, S.A., Megalla, S.E., Bishay, D.W. and Awad, A.H. (1980) Studies for determining antibiotic substances in some Egyptian plants. Part II. Antimicrobial alkaloids from the seeds of *Peganum harmala*. *Fitoterapia* **51**(6):309-312.

Saad, S.F., Saber, A.E.A.H. and Scott, P.M. (1967) Pharmacological studies on *Zygophyllum coccineum* extract. *Bull. Fac. Pharm., Cairo Univ.* **6**(1):245-252.

Sabahi, M., Mansouri, Sh., Ramezanian, M. and Gholam-Hoseinian, A. (1987) Screening of plants from the southeast of Iran for antimicrobial activity. *Int. J. Crude Drug Res.* **25**(2):72-76.

Sabri, N.N., Abou-Donia, A.A., Assad, A.M., Ghazy, N.M., El-Lakany, A.M., Tempesta, M.S. and Sanson, D.R. (1989a) Abietane diterpene quinones from roots of *Salvia verbenaca* and *S. lanigera*. *Planta Med.* **55**(6):582.

Sabri, N.N., Abou-Donia, A.A., Ghazy, N.M., Assad, A.M., El-Lakany, A.M., Sanson, D.R., Gracz, H., Barnes, C.L., Schlemper, E.O. and Tempesta, M.S. (1989b) Two new rearranged abietane diterpene quinones from *Salvia aegyptiaca* L. *J. Org. Chem.* **54**(17):4097-4099.

Saleh, M.A. (1986) A desert plant from Egypt, *Anabasis setifera*: an efficient natural factory of carvacrol and thymol. *J. Agric. Food Chem.* **34**(2):192-194.

Saleh, N.A.M. and El-Hadidi, M.N. (1977) An approach to the chemosystematics of the Zygophyllaceae. *Biochem. Syst. Ecol.* **5**(2):121-128.

Saleh, M.R.I., Sabri, N.M. and El-Masry, S. (1978) Diterpenequinones from the roots of *Salvia lanigera* Poir. *Egypt. J. Pharm. Sci.* **19**(1-4):313-318.

Saleh, N.A.M., Ahmed, A.A. and Abdalla, M.F. (1982) Flavonoid glycosides of *Tribulus pentandrus* and *T. terrestris*. *Phytochemistry* **21**(8):1995-2000.

Saleh, N.A.M., Maksoud, S.A., El-Hadidi, M.N. and Amer, W.M.M. (1987) A comparative study of flavonoids in some members of the Papaveraceae. *Biochem. Syst. Ecol.* **15**(6):673-675.

Saleh, N.A.M., Maksoud, S.A., Amer, W.M.M., Markham, K.R. and Barron, D. (1988) Herbacetin and gossypetin 3-glucuronide-8-glucosides from *Roemeria hybrida*. *Phytochemistry* **27**(1):309-310.

Sandberg, F. (1972) Alkaloids of *Haloxylon* species. *Biochem. Physiol. Alkaloide, Int. Sym., 4th.* 177-179. Ed.: Mothes, K., Akad.-Verlag., Berlin.

Sawaya, W.N., Daghir, N.J. and Khan, P. (1983) Chemical characterization and edibility of the oil extracted from *Citrullus colocynthis* seeds. *J. Food. Sci.* **48**(1):104-106, 110.

Sawaya, W.N., Daghir, N.J. and Khalil, J.K. (1986) *Citrullus colocynthis* seeds as a potential source of protein for food and feed. *J. Agric. Food Chem.* **34**(2):285-288.

Sayed, M.D., Balbaa, S.I. and Afifi, M.S. (1973) Nitrogenous bases of the different organs of *Citrullus colocynthis*. *Planta Med.* **24**(3):260-265.

Sayed, M.D., Balbaa, S.I. and Afifi, M.S. (1974) Glycoside content of the different organs of *Citrullus colocynthis*. *Planta Med.* **26**(3):293-298.

Seehuber, R. (1987) Experiments with oilseed crops for the production of erucic acid [German]. *Fette Wiss. Technol.* **89**(7):263-268.

Sener, B., Evren, N. and Baykal, T. (1986) Separation and determination of khellin and visnagin in *Ammi majus* L. fruits by HPLC. *Gazi Univ. Eczacilik Fak. Derg.* **3**(2):149-152.

Shawl, A.S. and Vishwapaul (1977) Thin-layer chromatographic–spectrophotometric determination of methoxsalen (xanthotoxin) in *Ammi majus* seed. *Analyst (London)* **102**(1219):779.

Sheberstov, V.V., Fomenko, K.P., Zhuravlev, Yu.P., Arsyukhina, N.N., Gindich, N.N., Poludennyi, L.V., Nesterov, N.N., Naumova, G.E. and Fonin, V.S. (1972) Fertilizers, yields, and levels of active substances in medicinal plants [Russian]. *Postep Dziedzinie Leku Rosl., Pr. Ref. Dosw. Wygloszone Symp.* 268-75. Ed: Kaczmarek, F., Inst. Przem. Zielarskiego, Poznan, Poland.

Sheriha, G.M. and Abouamer, K. (1984) Lignans of *Halophyllum tuberculatum*. *Phytochemistry* **23**(1):151-153.

Sheriha, G.M., Abouamer, K. and Elshtaiwi, B.Z. (1985) An alkaloid from *Halophyllum tuberculatum*. *Phytochemistry* **24**(4):884-886.

Sheriha, G.M., Abouamer, K., Elshtaiwi, B.Z., Ashour, A.S., Abed, F.A. and Alhallaq, H.H. (1987) Quinoline alkaloids and cytotoxic lignans from *Halophyllum tuberculatum*. *Phytochemistry* **26**(12):3339-3341.

Shlosberg, A., Egyed, M.N. and Eilat, A. (1974) Comparative photosensitizing properties of *Ammi majus* and *Ammi visnaga* in goslings. *Avian Dis.* **18**(4):544-550.

Siddiqui, S., Khan, O.Y., Siddiqui, B.S. and Faizi, S. (1987a) Harmalidine, a β-carboline alkaloid from *Peganum harmala*. *Phytochemistry* **26**(5):1548-1550.

Siddiqui, S., Khan, O.Y., Faizi, S. and Siddiqui, B.S. (1987b) Studies on the chemical constituents of the seeds of *Peganum harmala*. Isolation and structure of a new β-carboline alkaloid–harmalicine. *Heterocycles* **26**(6):1563-1567.

Siddiqui, S., Khan, O.Y., Faizi, S. and Siddiqui, B.S. (1988) Studies on the chemical constituents of the seeds of *Peganum harmala*: isolation and structure elucidation of two β-carboline lactams–harmalanine and harmalacidine. *Heterocycles* **27**(6):1401-1410.

Siddiqui, S., Khan, O.Y., Faizi, S. and Siddiqui, B.S. (1989) Studies on the chemical constituents of the seeds of *Peganum harmala*: isolation and structure elucidation of two β-carbolines–harmalacinine and norharmine. *Heterocycles* **29**(3):521-527.

Silva, G.A. de A.B. e, Saraiva, N.C. de S., Sant'Ana, B.M.S. and Bauer, L. (1976) Benzo-1,2-pyrone in *Melilotus indicus* (L.) All. [Portuguese]. *Rev. Bras. Farm.* **57**(3-4):111-115.

Singh, D. and Nag, T.N. (1981) Steroidal components of seeds of *Peganum harmala* growing in Rajasthan. *Comp. Physiol. Ecol.* **6**(3):163-164.

Singh, R.C.P. and Sisodia, C.S. (1971) Effect of *Tribulus terrestris* fruit extracts on chloride and creatinine renal clearance in dogs. *Indian J. Physiol. Pharmacol.* **15**(3):93-96.

Slavik, J., Dolejs, L. and Slavikova, L. (1974) Alkaloids from *Roemeria hybrida*. *Collect. Czech. Chem. Commum.* **39**(3):888-894.

Soliman, M.A., El Sawy, A.A., Fadel, H.M., Osman, F. and Gad, A.M. (1985) Volatile components of roasted *Citrullus colocynthis* var. *colocynthoides*. *Agric. Biol. Chem.* **49**(2):269-275.

Stahl, E. and Herting, D. (1976) The content of essential oil and coumarins in single fruits of some Apiaceae [German]. *Planta Med.* **29**(1):1-9.

Staron, T., Allard, C., Heitz, S. and Billet, D. (1969) Purification and antifungal properties of a triterpene glycoside isolated from the stems and leaves of *Anagallis arvensis* var. *phoenicea* [French]. *Phytiat.-Phytopharm.* **18**(3):161-166.

Sud, S., Siddhu, A. and Bijlani, R.L. (1988) Effect of isphaghula husk on postprandial glycemia and insulinemia following glucose and starch drinks. *Nutrition (Burbank, Calif.)* **4**(3):221-223.

Syamasundar, J., Challaiah and Boraiah, G. (1977) *Cressa cretica* Linn. eliminates sodium chloride from the soil. *Curr. Res. (Univ. Agric. Sci., Bangalore)* **6**(8):129-130.

Tarpo, E., Contz, O. and Zamfiresw-Gheorghiu, M. (1966) Isolation of isopimpinellin from indigenous fruits of *Ammi majus* [Romanian]. *Farmacia (Bucharest)* **14**(8):473-478.

Tarpo, E., Contz, O. and Zamfiresw-Gheorghiu, M. (1967) Isolation of xanthotoxin and of bergapten from fruits of *Ammi majus* acclimatized in Romania [Romanian]. *Farmacia (Bucharest)* **15**(8):493-498.

Tarpo, E., Contz, O. and Gheorghiu, M. (1968) Isolation of ammajin from fruits of *Ammi majus* acclimatized in Romania [Romanian]. *Farmacia (Bucharest)* **16**(4):213-218.

Telezhenetskaya, M.V. and Yusunov, S.Yu. (1977) Alkaloids of *Peganum harmala* [Russian]. *Khim. Prir. Soedin.* (6):731-743.

Telezhenetskaya, M.V., Khashimov, Kh.N. and Yusunov, S.Yu. (1971) Peganol, a new alkaloid from *Peganum harmala* [Russian]. *Khim. Prir. Soedin.* **7**(6):849-850.

Telezhenetskaya, M.V., Tashkhodzhaev, B., Yagudaev, M.R., Ibragimov, B.T. and Yusunov, S.Yu. (1989) Structure of vasicol [Russian]. *Khim. Prir. Soedin.* (1):18-23.

Tiwari, K.P. and Rathore, Y.K.S. (1977) Amino acid content of *Rumex vesicarius* [Hindi]. *Vijnana Parishad Anusandhan Patrika* **20**(1):65-66.

Tombesi, O.L. (1983) Steroidal sapogenins of *Tribulus terrestris* [Spanish]. *An. Asoc. Quim. Argent.* **71**(4):501-504.

Tomova, M. (1987) Tribestan [Bulgarian]. *Farmatsiya (Sofia)* **37**(6):40-42.

Tomova, M.P., Panova, D.I. and Vul'fson, N.S. (1973) Phytosterols from *Tribulus terrestris*. *Dokl. Bolg. Akad. Nauk* **26**(3):379-381.

Tomova, M.P., Panova, D. and Vul'fson, N.S. (1974) Steroid saponins and sapogenins. IV. Saponins from *Tribulus terrestris* [German]. *Planta Med.* **25**(3):231-237.

Tomova, M., Gyulemetova, R., Zarkova, S., Peeva, S., Pangarova, T. and Simova, M. (1981) Steroidal saponins from *Tribulus terrestris* L. with a stimulating action on the sexual functions. *Int. Conf. Chem. Biotechnol. Act. Nat. Prod., 1st.* **3**(1):298-302. Ed.: Atanasova, B., Bulg. Acad. Sci., Sofia, Bulgaria.

Turova, A.D. and Skachkova, N.I. (1974) Comparative study of the cardiotonic activity of plant steroids [Russian]. *Vestn. Akad. Nauk Kaz. SSR* (11):68-70.

Uda, Y., Ozawa, Y., Takayama, M., Suzuki, K. and Maeda, Y. (1988) Free and soluble bound phenolic acids in some Cruciferous vegetables. *Nippon Shokuhin Kogyo Gakkaishi* **35**(5):360-366.

Umarov, A.U., Markman, A.L. and Baram, B.M. (1972) Oils of several species of cruciferae [Russian]. *Prikl. Biokhim. Mikrobiol.* **8**(5):595-599.

Urazkov, I.U. (1974) Flour from sarsazan [Russian]. *Zdravookhr. Kaz.* (7):44-45.

Urazkov, I.U. (1975) Sarsazan flour [Russian]. *Vopr. Pitan.* (4):81-82.

Wasiur, R., Ilyas, M. and Usmani, J.N. (1969) Flavonoids from *Eruca sativa*. *J. Indian Chem. Soc.* **46**(3):286.

Wassel, G., El-Menshawi, B., Saeed, A., Mahran, G. and El-Merzabani, M. (1987a) Screening of selected plants for pyrrolizidine alkaloids and antitumor activity. *Pharmazie* **42**(10):709.

Wassel, G., El-Menshawi, B., Saeed, A. and Mahran, G. (1987b) Toxic pyrrolizidine alkaloids of certain boraginaceous plants. *Acta Pharm. Suec.* **24**(4):199-204.

Weinert, E. and Sakri, F.A. (1977) Sulfate content in plant tissues of some Iraqi desert plants. *Flora (Jena)* **166**(1):65-73.

Yamada, Y., Hagiwara, K., Iguchi, K. and Suzuki, S. (1977) Structures of arvenin I and II, bitter principles from *Anagallis arvensis* L. (Primulaceae). New cucurbitacin glucosides. *Tetrahedron Lett.* (24):2099-2102.

Yamada, Y., Hagiwara, K., Iguchi, K., Suzuki, S. and Hsu, H.-Y. (1978a) Isolation and structures of arvenins from *Anagallis arvensis* L. (Primulaceae). New cucurbitacin glucosides. *Chem. Pharm. Bull.* **26**(10):3107-3112.

Yamada, Y., Hagiwara, K., Iguchi, K., Takahasi, Y. and Hsu, H.-Y. (1978b) Cucurbitacins from *Anagallis arvensis*. *Phytochemistry* **17**(10):1798.

Yang, S.-X., Chen, R.-Y., Wu, Z.-L., Zheng, Q.-L., Shi, Y.-N., Liu, Z. and Zhang, C.-X. (1987) A study on active substances in common peganum [Chinese]. *Zhiwu Shenglixue Tongxun* (1):18-21.

Yankov, L.K. and Ayoub, S.M.H. (1981a) Waxes and the essential oil from the peel of the fruit of *Citrullus colocynthis*. (II). *Dokl. Bolg. Akad. Nauk* **34**(1):55-58.

Yankov, L.K. and Ayoub, S.M.H. (1981b) Docosanyl acetate and 10,13-dimethylpenta-13-decen-1-al from peels of *Citrullus colocynthis*. L. *Dokl. Bolg. Akad. Nauk* **34**(4):529-532.

Yankov, L.K. and Hussein, S.M. (1975) Fatty acids from the oil of the seeds of *Citrullus colocynthis*.. *Dokl. Bolg. Akad. Nauk* **28**(2):209-212.

Yankov, L.K. and Khusein, S. (1975) Citrullonol, a new hydroxyketotetracyclic triterpene, isolated from neutral components of the oil from *Citrullus colocynthis*. L. seeds. *Dokl. Bolg. Akad. Nauk* **28**(12):1641-1644.

Yankov, L.K., Ivanov, Ch. and Khusein, S.M. (1975) Content and composition of the alkanes and the primary aliphatic alcohols in unsaponifiables of *Citrullus colocynthis*. seed oil. *Dokl. Bolg. Akad. Nauk* **28**(8):1065-1068.

Yoshizawa, F., Deyama, T., Takizawa, N., Usmanghani, K. and Ahmad, M. (1990) The constituents of *Cistanche tubulosa* (Schrenk) Hook. f. II. Isolation and structures of a new phenylethanoid glycoside and a new neolignan glycoside. *Chem. Pharm. Bull.* **38**(7):1927-1930.

Zafar, R. and Nasa, A.K. (1987) Quercetin and kaempferol from the fruits and stem of *Tribulus terrestris* Linn. *Indian J. Nat. Prod.* **3**(2):17-18.

Zafar, R., Lalwani, M. and Siddiqui, A.A. (1989) Hecogenin and neotigogenin from the root of *Tribulus terrestris*. *Indian Drugs* **26**(9):460.

Zarrouk, M. and Cherif, A. (1983) Lipid contents of halophytes and salt resistance [French]. *Z. Pflanzenphysiol.* **112**(4):373-380.

Zharekeev, B.Kh., Telezhenetskaya, M.V. and Yusunov, S.Yu. (1973) Deoxypeganidine, a new alkaloid from *Peganum harmala* [Russian]. *Khim. Prir. Soedin.* (2):279-280.

Zharekeev, B.Kh., Khashimov, Kh.N., Telezhenetskaya, M.V. and Yusunov, S.Yu. (1974) New alkaloids from *Peganum harmala* [Russian]. *Khim. Prir. Soedin.* **10**(2):264-265.

Zielinska-Jenczylik, J., Sypula, A., Budko, E. and Rzadkowska-Bodalska, H. (1988) Interferogenic and antiviral effect of extracts from *Erodium cicutarium*. II. Modulatory activity of *Erodium cicutarium* extracts. *Arch. Immunol. Ther. Exp.* **36**(5):527-536.

Zolotnitskaya, S.Ya. and Melkumyan, Kh.A. (1969) Alkaloids of *Bienertia cycloptera* [Russian]. *Biol. Zh. Arm.* **22**(2):21-24.

This page intentionally left blank

BIBLIOGRAPHY

General information concerning the plants and their traditional uses was obtained from the following sources. They are not cited in the text to avoid needless repetition.

Boulos, L. (1983) Medicinal Plants of North Africa. Reference Publications, Algonac, Michigan, 286 pp.

Coombes, A.J. (1985) Dictionary of Plant Names. Timber Press, Portland, Oregon, 207 pp.

Daoud, H.S. and Al-Rawi, A. (1985) Flora of Kuwait, Volume 1: Dicotyledoneae. KPI, London, xi + 224 pp.

Dastur, J.F. (1962) Medicinal Plants of India and Pakistan. Taraporevala, Bombay, 2nd edn., vii + 212 pp.

Dickson, V. (1955) The Wild Flowers of Kuwait and Bahrain. George Allen & Unwin, London, 144 pp.

Dymock, W., Warden, C.J.H. and Hooper, D. (1890) Pharmacographia Indica: A History of the Principal Drugs of Vegetable Origin met with in British India. Kegan Paul, Trench, Trubner, London, Vol. 1, vii + 599 pp.; Vol. 2, vi + 643 pp.; Vol. 3, vi + 642 pp.

Ellingwood, F. and Lloyd, J.U. (1898) American Materia Medica, Therapeutics and Pharmacognosy, 564 pp. Facsimile edition, Eclectic Medical Publications, Portland, Oregon (1985).

Felter, H.W. (1922) The Eclectic Materia Medica, Pharmacology and Therapeutics, Cincinnati, Ohio, 743 pp. Facsimile edition, Eclectic Medical Publications, Portland, Oregon (1985).

Felter, H.W. and Lloyd, J.U. (1898) King's American Dispensatory. 18th edn., Vol. 1, x + 904 + xxxvii pp.; Vol. 2, viii + 1268 + lvii pp. Facsimile edition, Eclectic Medical Publications, Portland, Oregon (1983).

Gerard, J. (1633) The Herball or Generall Historie of Plantes, Norton and Whitakers, London, xxxiv + 1631 + xlvi pp. Facsimile edition, Dover Publications, New York (1975).

Hedrick, U.P. (1919) Sturtevant's Notes on Edible Plants, J.B. Lyon, Albany, NY, vii + 686 pp. Facsimile edition as Sturtevant's Edible Plants of the World, Dover Publications, New York (1972).

Jayaweera, D.M.A. (1981) Medicinal Plants (Indigenous and Exotic) Used in Ceylon. The National Science Council of Sri Lanka, Colombo, Part 1 (Acanthaceae – Burseraceae), viii + 232 pp; Part 2 (Cactaceae – Fagaceae), viii + 279 pp; Part 3 (Flacourtiaceae – Lythraceae), viii + 323 pp.; Part 4 (Magnoliaceae – Rubiaceae), ix + 341 pp; Part 5 (Rutaceae – Zygophyllaceae), viii + 255 pp.

Mabberley, D.J. (1987) The Plant-Book. A Portable Dictionary of the Higher Plants. Cambridge University Press, Cambridge, xii + 706 pp.

Manniche, L. (1989) An Ancient Egyptian Herbal. University of Texas Press, Austin, 176 pp.

Miller, A.G. and Morris, M. (1988) Plants of Dhofar, the Southern Region of Oman. Traditional, Economic and Medicinal Uses. Office of the Advisor for Conservation of The Environment, Diwan of Royal Court, Sultanate of Oman, xxvii + 361 pp.

Millspaugh, C.F. (1892) Medicinal Plants, Yorston, Philadelphia, xvi + 806 pp. Facsimile edition as American Medicinal Plants, Dover Publications, New York (1974).

Uphof, J.C.Th. (1968) Dictionary of Economic Plants, 2nd edn. J. Cramer.

von Reis, S. and Lipp, F.J., Jr. (1982) New Plant Sources for Drugs and Foods from The New York Botanical Garden Herbarium. Harvard Univ. Press, Cambridge, Massachusetts.

von Reis Altschul, S. (1973) Drugs and Foods from Little-Known Plants. Harvard Univ. Press, Cambridge, Massachusetts, xii + 366 pp.

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

Bienertia
Chenopodium
Cornulaca
Halocnemum
Haloxylon
Salicornia
Salsola
Schanginia
Seidlitzia
Suaeda
Traganum

CISTACEAE — Rock-rose family

Helianthemum

CONVOLVULACEAE — Convolvulus family

Convolvulus
Cressa

CRUCIFERAE — Mustard family

Anastatica
Alyssum
Brassica
Cakile
Carrichtera
Diplotaxis
Eruca
Farsetia
Horwoodia
Lepidium
Leptaleum
Malcolmia
Maresia
Matthiola
Notoceras
Savignya
Schimpera
Sisymbrium
Torularia
Zilla

CUCURBITACEAE — Gourd family

Citrullus

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

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

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

This page intentionally left blank

AUTHOR INDEX

CHEMICAL NAME INDEX

PLANT SYSTEMATIC NAME INDEX

PLANT COMMON NAME INDEX

GENERAL INDEX