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# AJO PEAK TO TINAJAS ALTAS: A FLORA OF SOUTHWESTERN ARIZONA. PART 14. EUDICOTS: FABACEAE – LEGUME FAMILY

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## ABSTRACT

A floristic account is provided for the legume family (Fabaceae) as part of the vascular plant flora of the contiguous protected areas of Organ Pipe Cactus National Monument, Cabeza Prieta National Wildlife Refuge, and the Tinajas Altas Region in the heart of the Sonoran Desert of southwestern Arizona. This flora includes 47 legume species in 28 genera, which is 6% of the total local vascular plant flora. These legumes are distributed across three subfamilies: Caesalpinioideae with 7 species, Mimosoideae 9 species, and Papilionoideae 28 species. Organ Pipe includes 38 legume species, Cabeza Prieta 22 species, and Tinajas Altas 10 species. Perennials, ranging from herbaceous to trees, account for 49 percent of the flora, the rest being annuals or facultative annuals or perennials and mostly growing during the cooler seasons.

This publication, encompassing the legume family, is our fourteenth contribution to the vascular plant flora in southwestern Arizona. The flora area covers 5141 $km^2$ (1985 $mi^2$) in the Sonoran Desert (Figure 1). These contributions are published in Phytoneuron and also posted on the website of the University of Arizona Herbarium (http://cals.arizona.edu/herbarium/content/flora-sw-arizona).

The first article in this series includes maps and brief descriptions of the physical, biological, ecological, floristic, and deep history of the flora area (Felger et al. 2013a). This flora includes the modern, present-day taxa as well as fossil records from packrat middens. Fossil specimens are indicated with a dagger symbol (†). Non-natives not established (not reproducing) in the flora area are marked with double asterisks (**) and the one non-native species with an established population is marked with an asterisk (*). In the following species accounts, the accepted scientific names are in bold and selected synonyms are italicized within brackets [--]. Common names, when known or worthwhile, are in English, Spanish, and the Hia-Ced O'odham dialect, respectively (see Felger 2007a and Felger et al. 1992 for usage of Hia-Ced O'odham plant names). Spanish-language names are italicized. The qualifications *about* and *approximately* are generally omitted, with the obvious understanding that such quantitative values are, to varying degrees, seldom exact.

All photos and scans are by Sue Rutman unless otherwise stated and botanical illustrations are by Lucretia Breazeale Hamilton (1908–1986) unless otherwise stated. All specimens cited are at the University of Arizona Herbarium (ARIZ) unless otherwise indicated by the abbreviations for herbaria at Cabeza Prieta National Wildlife Refuge (CAB), Organ Pipe Cactus National Monument (ORPI), and the standardized abbreviations for herbaria (Index Herbariorum, Thiers 2014). We have

seen specimens or images of all specimens cited. When no collection number is provided, the specimen is identified by the date of collection. Generally only the first collector's name is given. Area designations are: OP = Organ Pipe Cactus National Monument; CP = Cabeza Prieta National Wildlife Refuge; TA = Tinajas Altas Region. Additional explanation of the format for this flora series is provided in Part 3 of this flora series (Felger et al. 2013b). Descriptions and keys pertain to taxa and populations as they occur in the flora area.

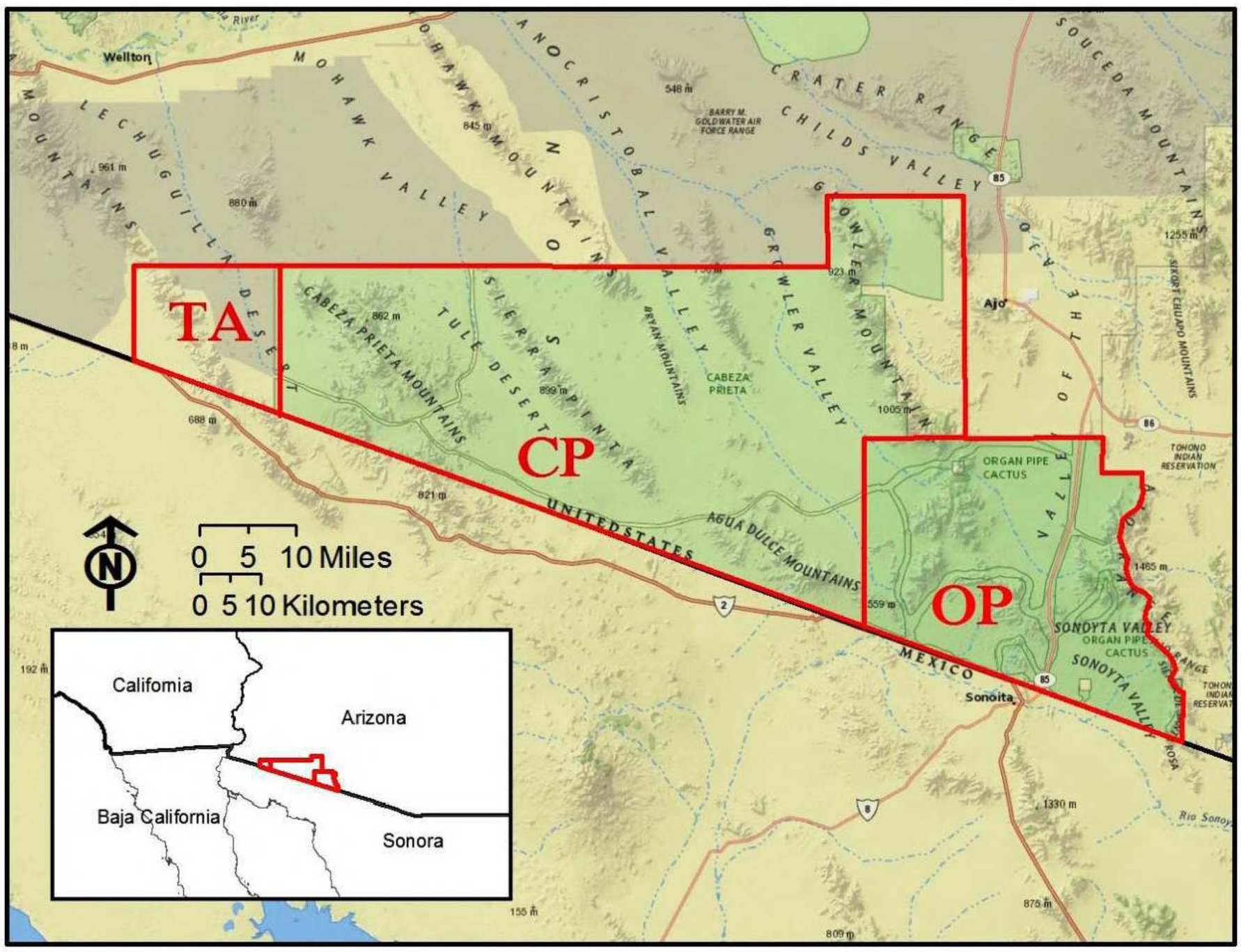


Figure 1. Flora area in southwestern Arizona. OP = Organ Pipe Cactus National Monument; CP = Cabeza Prieta National Wildlife Refuge; TA = Tinajas Altas Region. Green shading indicates approximate boundaries of federally designated wilderness.

**FABACEAE (LEGUMINOSAE)** – Legume Family

Annual or perennial herbs, shrubs, trees, or vines, many with nitrogen-fixing bacteria in root nodules. Leaves and branches usually alternate. Leaves mostly once or twice pinnately compound, often with pulvini at base of petioles, pinnae, and individual leaflets. (Pulvini are swollen areas, often dark or differently colored, that swell or contract to open or close leaf parts, often in response to water stress and night-day cycles; pulvini may sometimes be present but not functional.) Stipules usually present, often well developed and persistent. Flowers usually bisexual and 5-merous. Sepals usually 5 and united. Petals mostly 5, often separate. Stamens mostly 5 or 10 to numerous. Pistil single, superior, simple (1 carpel), the ovules attached along one side. Fruit usually a pod, highly diverse in morphology, dry and dehiscent (opening) along one or both edges, or indehiscent and often with mealy or fleshy pulp. Seeds 1 to many, often long-lived, the seed coat often hard and impervious to water and air (scarification, i.e., nicking or abrading the seed coat, enhances germination).

Worldwide with 3 subfamilies, 650 genera, 16,500 species. There are 47 species of legumes in 28 genera in the flora area (Table 1). Four species are not native to the region, and only one, *Melilotus indicus,* is established in the flora area. The Sonoran Desert flora includes 281 legume species (estimate modified from Wiggins 1964), or about 11% of the total Sonoran Desert flora. Legume species make up only 6.5% of the flora of southwestern Arizona (726 species, based on our original checklist (Felger et al. 2013) and 12 subsequent additions). In comparison, legumes make up only 5% of the flora of the Gran Desierto in adjacent northwestern Sonora (34 species of 668 total native and non-native species; Felger 2000). The Organ Pipe flora includes 38 legume species (3 of them not established as reproducing populations), Cabeza Prieta 22 species, and only 10 occur in the hyper arid Tinajas Altas Region (Table 1). The subfamilies with their genera are listed below with the number of species in the flora area in parentheses (for genera with more than one species).

Subfamily **Caesalpinioideae**. Trees, shrubs, and herbs in the flora area; seldom nitrogen-fixing. Leaves once or twice pinnate. Flowers often showy, bilaterally symmetrical but often not conspicuously so. Stamens usually 10, mostly separate. Largely of tropical or subtropical origin: *Chamaecrista, Hoffmannseggia* (2), *Parkinsonia* (3), and *Senna*.

Subfamily **Mimosoideae**. Trees and shrubs (in the flora area), mostly nitrogen-fixing. Leaves usually twice pinnate; leafstalks often with crateriform or cup-shaped nectary glands, the center often raised and nectar filled when fresh, later becoming sunken. Flowers radial except the pistil, mostly sessile or nearly so, and close together in spikes, heads, and racemes. Stamens usually 10 or numerous, usually much longer than the petals and forming the showy part of the flower, the anthers small and often with a deciduous gland at the tip of the tissue connecting the 2 anther cells. Mostly tropical and subtropical: *Acaciella, Calliandra, Mimosa, Prosopis* (3), *Senegalia*, and *Vachellia* (2).

Subfamily **Papilionoideae**. Annual to perennial herbs, vines, shrubs, or trees, almost all nitrogen-fixing. Leaves pinnately or digitately once compound or simple. Flowers bilaterally symmetrical. Upper petal (banner or standard) flanked by 2 lateral petals (wings), the 2 lower petals coalesced into a boat-shaped structure (keel) enclosing the stamens and style. Stamens mostly 10; monodelphous, the filaments united into a tube, or diadelphous, with 1 free stamen and the others with filaments united into a tube surrounding the ovary. Tropical to temperate: *Acmispon* (4), *Astragalus* (4), *Coursetia, Dalea* (3), *Desmodium, Galactia, Lupinus* (3), *Marina, *Medicago, *Melilotus, Nissolia, Olneya, Phaseolus* (2), *Psorothamnus* (3), *Rhynchosia, Tephrosia, Trifolium*, and *Vicia*.

Legumes rival the grass family in economic importance worldwide, providing food, forage and fodder, dye, fiber, medicine, and timber. Major legume food and fodder crops include alfalfa, beans, clover, peanuts, peas, and soybeans, all of which are papilionoids. Several legumes in the flora area featured importantly in the economies of local Sonoran Desert people: ironwood (*Olneya*), foothill palo verde (*Parkinsonia microphylla*), desert and tepary beans (*Phaseolus acutifolius* and *P. filiformis*), mesquite (*Prosopis glandulosa/P. velutina*), and screwbean (*Prosopis pubescens*) (e.g., Bell & Castetter 1937; Castetter & Bell 1942, 1951; Felger 2000, 2007a, 2007b; Felger & Moser 1985; Felger et al. 1992; Rea 1997). Legumes form important components of the local desert vegetation. The most abundant and important larger legumes in the local vegetation are *Olneya tesota, Parkinsonia* spp., *Prosopis glandulosa*, and *P. velutina.* These large Sonoran Desert legumes are important nurse plants for an array of herbs, shrubs, and larger perennials including columnar cacti.

Table 1. Local distributions and growth forms of legumes in southwestern Arizona. † = Fossil and modern specimens; * = non-native; ** = non-native species not established in the flora area. OP = Organ Pipe Cactus National Monument; CP = Cabeza Prieta National Wildlife Refuge; TA = Tinajas Altas Region. SU = Summer/warm-season ephemerals; WI = winter-spring/cool-season ephemerals; NS = non-seasonal ephemerals; PR = perennials. Totals are for the modern, established flora.

| **Species** | **Region** | | | **Growth Form** | | | |
|---|---|---|---|---|---|---|---|
| | | | | Ephemerals | | | |
| | Organ Pipe | Cabeza Prieta | Tinajas Altas | Summer | Winter | Non-seasonal | Perennials |
| *Acaciella angustissima* | OP | | | | | | PR |
| *Acmispon brachycarpus* | OP | | | | WI | | |
| *Acmispon maritimus* | OP | CP | | | WI | | |
| *†Acmispon rigidus* | OP | CP | TA | | | | PR |
| *Acmispon strigosus* | OP | CP | TA | | WI | | |
| *†Acmispon sp./spp.* | (OP) | | | | | | |
| *Astragalus didymocarpus* | OP | | | | WI | | |
| *Astragalus insularis* | | CP | | | WI | | |
| *Astragalus lentiginosus* | OP | | | | WI | | |
| *Astragalus nuttallianus* | OP | CP | | | WI | | |
| *†Astragalus sp.* | (OP) | | | | | | |
| *Calliandra eriophylla* | OP | CP | | | | | PR |
| *Chamaecrista nictitans* | OP | | | SU | | | |
| *Coursetia glandulosa* | OP | | | | | | PR |
| *Dalea mollis* | OP | CP | TA | | | NS | |
| *Dalea pogonathera* | OP | | | | | | PR |
| *Dalea pringlei* | OP | | | | | | PR |
| *Desmodium procumbens* | OP | | | SU | | | |
| *Galactia wrightii* | OP | | | | | | PR |
| *Hoffmannseggia glauca* | | CP | | | | | PR |
| *Hoffmannseggia microphylla* | | | (TA) | | | | (PR) |
| *Lupinus arizonicus* | OP | CP | TA | | WI | | |
| *Lupinus concinnus* | OP | CP | | | WI | | |
| *Lupinus sparsiflorus* | OP | | | | WI | | |
| *†Lupinus sp./spp.* | (OP) | | (TA) | | | | |
| *†Marina parryi* | OP | CP | | | | NS | |
| ***Medicago polymorpha* | (OP) | | | | | (NS) | |
| **Melilotus indicus* | OP | | | | | NS | |
| *Mimosa distachya* | OP | | | | | | PR |
| *Nissolia schottii* | OP | | | | | | PR |
| *†Olneya tesota* | OP | CP | TA | | | | PR |
| ***Parkinsonia aculeata* | (OP) | | | | | | (PR) |
| *†Parkinsonia florida* | OP | CP | TA | | | | PR |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| †*Parkinsonia microphylla* | OP | CP | TA | | | | PR |
| *Phaseolus acutifolius* | OP | | | SU | | | |
| *Phaseolus filiformis* | OP | CP | | | | NS | |
| *Prosopis glandulosa* | | CP | TA | | | | PR |
| †*Prosopis glandulosa &/or P. velutina* | (OP) | | (TA) | | | | (PR) |
| *Prosopis pubescens* | OP | | | | | | PR |
| *Prosopis velutina* | OP | CP | | | | | PR |
| *Psorothamnus emoryi* | | CP | | | | | PR |
| *Psorothamnus fremontii* | | | TA | | | | PR |
| *Psorothamnus spinosus* | OP | CP | | | | | PR |
| *Rhynchosia texana* | OP | | | | | | PR |
| †*Senegalia greggii* | OP | CP | TA | | | | PR |
| †*Senna covesii* | OP | CP | | | | | PR |
| *Tephrosia tenella* | OP | | | | | | PR |
| *Trifolium wormskioldii* | OP | | | | WI | | |
| †*Vachellia constricta* | OP | CP | | | | | PR |
| ***Vachellia farnesiana* | (OP) | (CP) | | | | | (PR) |
| *Vicia ludoviciana* | OP | | | | WI | | |
| Totals: 43 | 38 | 22 | 10 | 3 | 12 | 4 | 24 |

## KEY TO THE GENERA

1. Trees or woody shrubs, mostly more than 1 m tall (ambiguous cases key out in both places).

2. Small shrubs 1.5 m or less in height, unarmed (no spines or thorns).

3. Leaves twice pinnate; flowers mimosoid, whitish to pinkish…… **Calliandra**
3. Leaves once pinnate; flowers papilionoid, various colors.

4. Leaves sparsely pubescent, becoming glabrate, not gland-dotted and not staining yellow; flowers white with yellow and pink; pods dehiscent, multiple-seeded…… **Coursetia**
4. Herbage densely hairy, gland-dotted, often staining yellowish or orange when rubbed or crushed; flowers blue or purplish; pods indehiscent, 1(2)-seeded.
…… **Psorothamnus emoryi, P. fremontii**

2. Large shrubs or trees, usually more than 2 m tall; armed with spines or thorns or the twigs thorn-tipped (individual branches sometimes unarmed).

5. Bark green, at least on upper limbs; flowers caesalpinioid…….. **Parkinsonia**
5. Bark not green (except sometimes on first or second year's growth); flowers mimosoid or papilionoid.

6. Leaves once pinnate, unifoliolate ("simple") or plants leafless or essentially so; flowers papilionoid.

7. Bark smooth, the trunk not massive; leafless or with few, scattered, simple (unifoliolate) leaves; branchlets sharp-pointed (spinescent) but otherwise unarmed. ..... **Psorothamnus spinosus**
7. Bark shredding, the trunk often massive; branches leafy, the leaves pinnate, with prominent spines at base of at least some leaves..... **Olneya**

6. Leaves twice pinnate; flowers mimosoid.

8. Spines between nodes, recurved, usually laterally compressed, and single (not paired); mature pods conspicuously flattened (more than twice as wide as thick) and dehiscent.

9. Leaves (3.5) 6–8 cm long, with 2–4 pairs of pinnae; flowers lavender-pink; stamens 10 or fewer; pods 4–5.5 × 1 cm wide, separating into 1-seeded segments..... **Mimosa**
9. Leaves 2.5–3.5 cm long, with 2–3 pairs of pinnae; flowers pale yellow; stamens numerous, more than 10; pods (3.5) 6–15 × 1–2+ cm, gradually dehiscent, not separating into segments..... **Senegalia**

8. Spines at nodes (not between nodes), straight, round in cross-section, usually paired; pods terete or nearly so (if somewhat flattened, then less than twice as wide as thick), dehiscent or indehiscent.

10. Shrubs to trees often more than 5 m tall; leaves with 1 or 2 pairs of pinnae; stamens 10; pods (7) 10–20 cm long, or tightly coiled, indehiscent..... **Prosopis**
10. Shrubs to 4 m tall; leaves with 2–6 pairs of pinnae; stamens more than 10; pods to 7.5 cm long (not coiled), gradually dehiscent (or sometimes indehiscent in *V. farnesiana*). ..... **Vachellia**

1. Herbaceous annuals and perennials, not woody (ambiguous cases included if stems not rigid and woody).

11. Vines, the stems not self-supporting; flowers papilionoid.

12. Annuals.

13. Plants without tendrils; leaflets 3..... **Phaseolus**
13. Leafstalk (rachis) ending in a tendril, the leaflets paired, 4 or more..... **Vicia**

12. Perennials.

14. Leaves with 5 leaflets; pods indehiscent, and 1-seeded (samaras)..... **Nissolia**
14. Leaves with 3 leaflets; pods dehiscent with 2 or more seeds.

15. Leaflets mostly widest at about the middle, not gland dotted; flowers pinkish, in raceme-like inflorescences much longer than the leaves; pods multiple-seeded..... **Galactia**
15. Leaflets mostly widest below the middle, the lower surfaces densely dotted with minute golden glands (use magnification); flowers yellow, in small clusters shorter than the leaves; pods 2-seeded..... **Rhynchosia**

11. Not vines.

16. Perennials (note that *Dalea* and *Marina* have annual and perennials species and key in both couplets).

17. Leaves twice pinnate.

18. Slender-stem shrubs more than 50 cm tall; without reddish glands; flowers in nearly rounded heads, mimosoid, white with a pinkish tinge; pods 4–6 cm long..... **Acaciella**
18. Herbaceous perennials to 30 cm tall; with stalked reddish glands on herbage, inflorescences and pods; flowers in racemes, caesalpinioid, yellow; pods 2.5–3 cm long. ..... **Hoffmannseggia glauca**

17. Leaves once pinnate.

19. Leaves even-pinnate with (4) 6 (8) leaflets; flowers caesalpinioid, the anthers large, with terminal pores..... **Senna**
19. Leaves somewhat palmate with 3–5 leaflets, or odd-pinnate with 9–23 leaflets; flowers papilionoid, the anthers small, without terminal pores.

20. Leaflets 3–5; herbage not gland-dotted; flowers yellow; pods more than 20 mm long, dehiscent, the valves rolled up after dehiscence, with more than 2 seeds. ..... **Acmispon rigidus**
20. Leaflets 9–23; herbage gland-dotted; flowers blue to purple, pods 1.8–2.5 mm long, indehiscent, 1-seeded.

21. Flowers subtended by bracts remaining with the open flowers; calyx lobes or teeth (awns) longer than the calyx tube ..... **Dalea**
21. Flowers subtended by bracts falling away before the flower opens; calyx teeth markedly shorter than the tube ..... **Marina**

16. Obviously annuals; flowers papilionoid.

22. Leaves all with 3 leaflets.

23. Leaflets sessile; flowers in compact, bracteate, head-like clusters, the bracts conspicuous and spinose..... **Trifolium**
23. At least the terminal leaflet on a slender stalk; flowers 1–few or in racemes, not in head-like clusters, the bracts inconspicuous or absent.

24. Flower stalks not longer than the leaves; pods coiled and bur-like, several-seeded..... **Medicago**
24. Flower stalks generally much longer than the leaves; pods ovoid and smooth, 1-seeded..... **Melilotus**

22. Most or all leaves with 5 or more leaflets.

25. Leaves digitately compound..... **Lupinus**
25. Leaves pinnately compound.

26. Herbage conspicuously gland-dotted; pods 2.5–3 (4) mm long, 1-seeded.

27. Flowers subtended by bracts remaining with the open flowers; calyx lobes or teeth (awns) longer than the calyx tube ..... **Dalea**
27. Flowers subtended by bracts falling away before the flower opens; calyx teeth markedly shorter than the tube ..... **Marina**

26. Herbage not gland-dotted; pods 4 mm or more in length, with 2 or more seeds.

28. Leaves with (3) 5–7 leaflets; stipules represented by small, dark glands; flowers yellow or orange and red, solitary or in umbels..... **Acmispon**
28. Leaves with 7–25 leaflets; stipules not gland-like; flowers lavender or purple and white, in racemes (1–3 in *Astragalus nuttallianus* and sometimes appearing umbellate).

29. Pods indehiscent (gradually or partially dehiscent in *A. nuttallianus* but the valves do not separate and twist); widespread..... **Astragalus**
29. Pods dehiscent, the valves twisting after opening; Ajo Mts..... **Tephrosia**

***Acacia***, see **Acaciella**, **Senegalia**, and **Vachellia**

The genus *Acacia* sensu lato, the second largest in the legume family (after *Astragalus*), includes some 1300 species worldwide: Australia (957 species), Americas (185 species), Africa (144 species), and Asia (89 species). The type of *Acacia* is generally considered to be *A. scorpioides* (Linnaeus) W.F. Wight (= *A. nilotica* (Linnaeus) Willdenow ex Delile), a species of tropical Africa and western Asia. The classic *Acacia* genus is polyphyletic, calling for generic reassignments. Australian botanists wanted to reserve the name *Acacia* for their species in order to avoid nearly 1000 nomenclatural new combinations. In a decidedly political, albeit practical (depending on where you live and work), taxonomic coup on the part of Australian botanists, the genus *Acacia* became a conserved name applied only to Australian species (e.g., Brummitt 2004; Orchard & Maslin 2005)—unless you decide not to recognize splitting of the genus. Seeming to take a cue from the U.S. Congress, the proposal was presented and voted on in the late afternoon of the last day of a multi-day meeting after most of the participants had gone home. That proposal, to retypify *Acacia* Miller from an African to an Australian type by the Committee for Spermatophyta, was ratified at the final closing session of the XVIIth International Botanical Congress held in Vienna, Austria, in July 2005. That binding change by the Committee to the International Code of Botanical Nomenclature has been highly contentious (e.g., Brummitt 2011; Cameron 2006; Kull & Rangan 2012; Luckow et al. 2005).

In their "Science, sentiment and territorial chauvinism in the acacia name change debate," Kull and Rangan (2012: 215) provided useful insights into this case and its wider implications for biological taxonomy:

> "As Helmreich (2005: 119) points out in the case of naming the algae species found around Hawaii, 'it is ironic that, through oral traditions, the Hawaiian names have been perpetuated and usually *accurately applied* to the individual species, whereas three-fourths of the scientific names have been changed in the past 90 years'. The living scientific name for *Acacia* is *Acacia* in its broad sense, regardless of whether it is properly classified according to the rules of cladistics or any other system. This, in part, is why the acacia name change has generated such furor and emotion among members of the international botanical community and generated outpourings of sentiment among non-botanists in Australia, Africa and many other parts of the world.

Brummitt (2010, 2011) noted that the unprecedented uproar over the acacia name required unconventional approaches to taxonomic rules so as to accommodate cases where particular plant names are associated with strong sentiments. While he suggests that bending the rules this one time would be 'unlikely to impact on other names in the future' (2010: 1925), we suggest that aesthetic sentiments, territorial chauvinisms, and personal agendas will always play a role in debates over classification and nomenclature. Molecular systematics has put many plant classifications, and hence names, under pressure, as have other scientific advances in the past and as others will no doubt do in the future. The crises that result, for acacia and other names, may only be truly resolved by finding ways to recognize and incorporate people's feelings for sounds,

> places and traditions in plant names – even in Latin names. Denying their importance by invoking the pretext of 'scientific objectivity' will only undermine the ability of the International Code of Botanical Nomenclature to serve as a universal system into the future."

**Acaciella**

Herbaceous perennials, shrubs, and trees; flowers mimosoid. A Neotropical genus of 15 species, segregated from *Acacia*.

**Acaciella angustissima** (Miller) Britton & Rose
[*Mimosa angustissima* Miller. *Acacia angustissima* (Miller) Kuntze]
White-ball acacia. Figure 2.

Attractive, slender-stem shrubs to 2 m tall, woody below, unarmed (without spines or thorns), growing with warm weather, winter dormant. Leaves (8) 10–16 cm long, bipinnate, larger leaves with 7–11 pairs of pinnae and many small leaflets; often sparsely hirsute or glabrous or essentially so, especially with age; without leafstalk glands. Stipules inconspicuous. Flowers in nearly rounded heads, white, sometimes with a pinkish tinge; stamens numerous (perhaps as many as 100), white, and separate; flowering at least May to August. Pods 4–6 cm long, multiple seeded, dry at maturity without mesocarp, the valves thin and rather papery, and gradually dehiscent.

Ajo Mountains in canyons and rocky slopes to peak elevations, but generally not on the more arid slopes. This is the western limit for the species; the nearest populations are in the Sauceda and Baboquivari mountains.

This species ranges across much of southern USA to Missouri and southward to Central America.

Isely (1998) recognized three varieties of *Acacia angustissima* in Arizona, and Benson and Darrow (1981) recognized two. Plants in Organ Pipe and nearby areas most nearly fit Isely's concept of *A. angustissima* var. *suffrutescens* (Rose) Isely, of southern and east-central Arizona and northern Sonora. Some plants show features of *A. angustissima* var. *shrevei* (Britton & Rose) Isely, of south-central Arizona and northern Sonora, but these two entities are doubtfully worthy of taxonomic separation. Benson and Darrow (1981) treat var. *suffrutescens* and var. *shrevei* as synonyms of *A. angustissima* var. *hirta* (Nuttall) B.L. Robinson, ranging from southern USA to Costa Rica.

This highly variable species includes a perplexing array of variation and more than two dozen named taxa that a number of botanists have attempted to sort with varying degrees of success. In temperate regions it is an herbaceous perennial, freezing to the ground in winter, but in the tropics it is often a tree with a well-formed trunk and weedy shrub forms are common. The noted botanists Lyman Benson (Benson & Darrow 1945, 1981), Duane Isely (1969, 1998), Rogers McVaugh (1987), and Ira Wiggins (1942) all complained about the morphological and taxonomic morass but yet defined infraspecific taxa for their own part of the world. Wiggins (1942: 233) summed up the situation: "One recognizes a difference in two entities, but tries in vain to describe it." It is hard to slice up a continuum. The taxonomic revision of the genus by Rico and Bachman (2006) likewise leaves an unresolved situation for the populations in northwestern Mexico and adjacent southwestern USA.

**OP**: N fork of Alamo Canyon, 2750 ft, rocky soil, on cliff, 7 Oct 1951, *Parker 7741*. Bull Pasture, 3300 ft, 9 Aug 1979, *Bowers 1793*. Alamo Canyon, north fork, 2296 ft, shrub to 1.5 m tall, leaves dark green, fruit pendulous, 17 Oct 1987, *Baker 7550* (ASU).

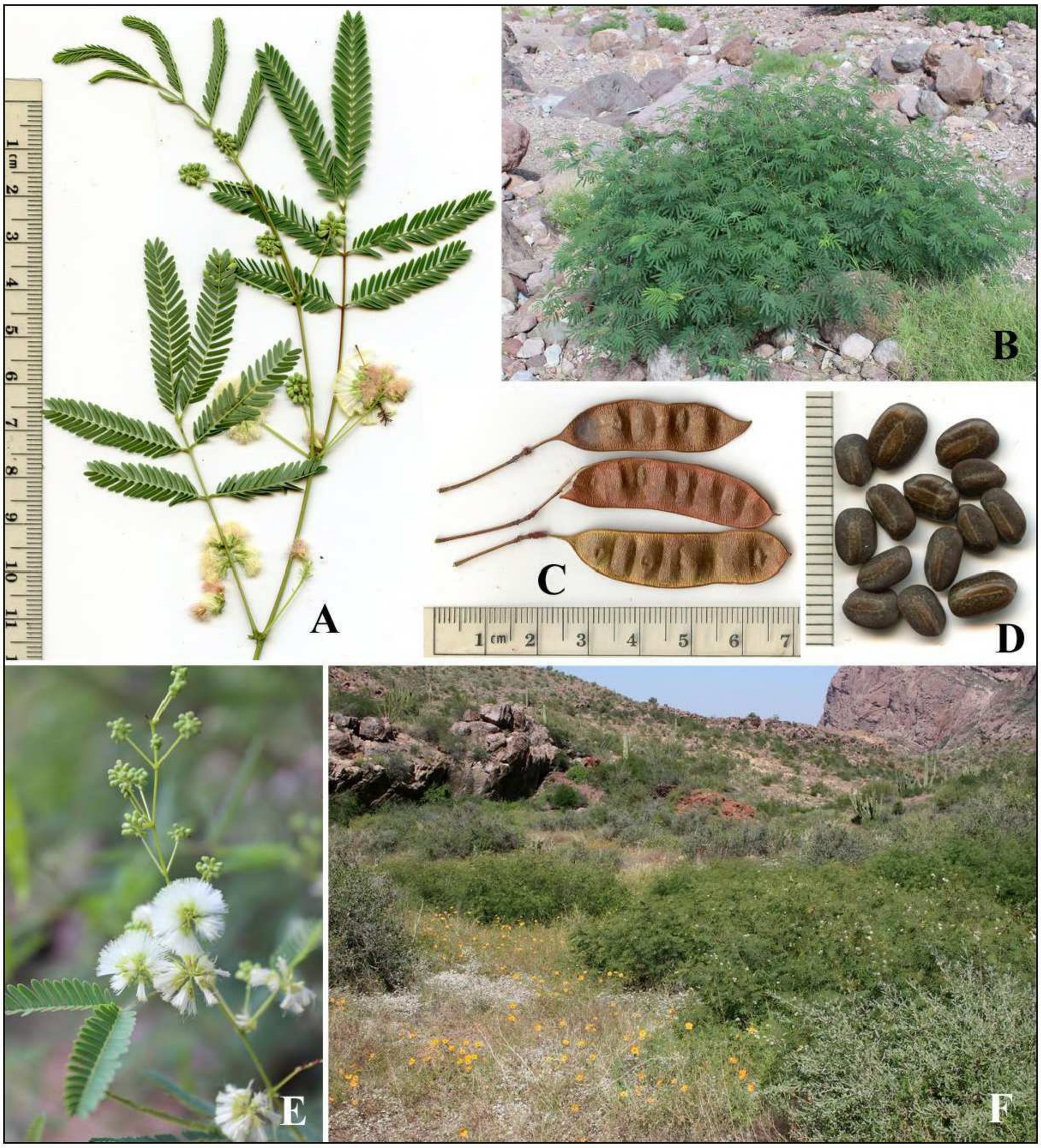


Figure 2. *Acaciella angustissima*. (A) South fork of Alamo Canyon, 3 Sep 2014. Alamo Well: (B) 7 Sep 2013; (E) 9 Sep 2013. Bull Pasture: (C & D) 19 Sep 2014; (F) 24 Sep 2006.

**Acmispon** – Deer vetch, trefoil

Annual or perennial herbs or subshrubs. Leaves odd-pinnate, the leaflets 3–7; stipules (those in the Sonoran Desert) represented by small but conspicuous, dark glands. Flowers papilionoid; yellow to red-orange, in small axillary umbels, the peduncle often with a leaf-like bract, or flowers solitary in leaf axils. Stamens 10; 9 filaments fused, 1 free. Pods elastically dehiscent, the valves coiling; seeds 2–12 (those in the flora area).

Western North America from Canada to Mexico, and South America; 23 species. A genus segregated from *Lotus*.

1. Perennials; stems firm and upright, the internodes notably longer than the leaves; peduncles much longer than the leaves; flowers 1.5–2 cm long..... **Acmispon rigidus**
1. Winter-spring annuals; stems not firm, ascending to prostrate, the internodes usually not longer than the leaves; flowers nearly sessile or on peduncles shorter to slightly longer than the leaves; flowers less than 1 cm long.

2. Plants markedly pubescent with long hairs; flowers sessile or nearly so, 1 per leaf axil. ..... **Acmispon brachycarpus**
2. Plants glabrous or pubescent but not densely long-haired; peduncles to slightly longer than the leaves, 1- to several-flowered.

3. Leaflets broadly elliptic or nearly so, widest at or slightly above middle, the tip rounded to pointed (acute) ..... **Acmispon maritimus**
3. Leaflets markedly obovate, broadest at or near the tip and gradually tapered to the base, the tip blunt (truncate) and sometimes notched ..... **Acmispon strigosus**

**Acmispon brachycarpus** (Bentham) D.D. Sokoloff
[*Hosackia brachycarpa* Bentham. *Lotus humistratus* Greene]
Hill lotus. Figure 3.

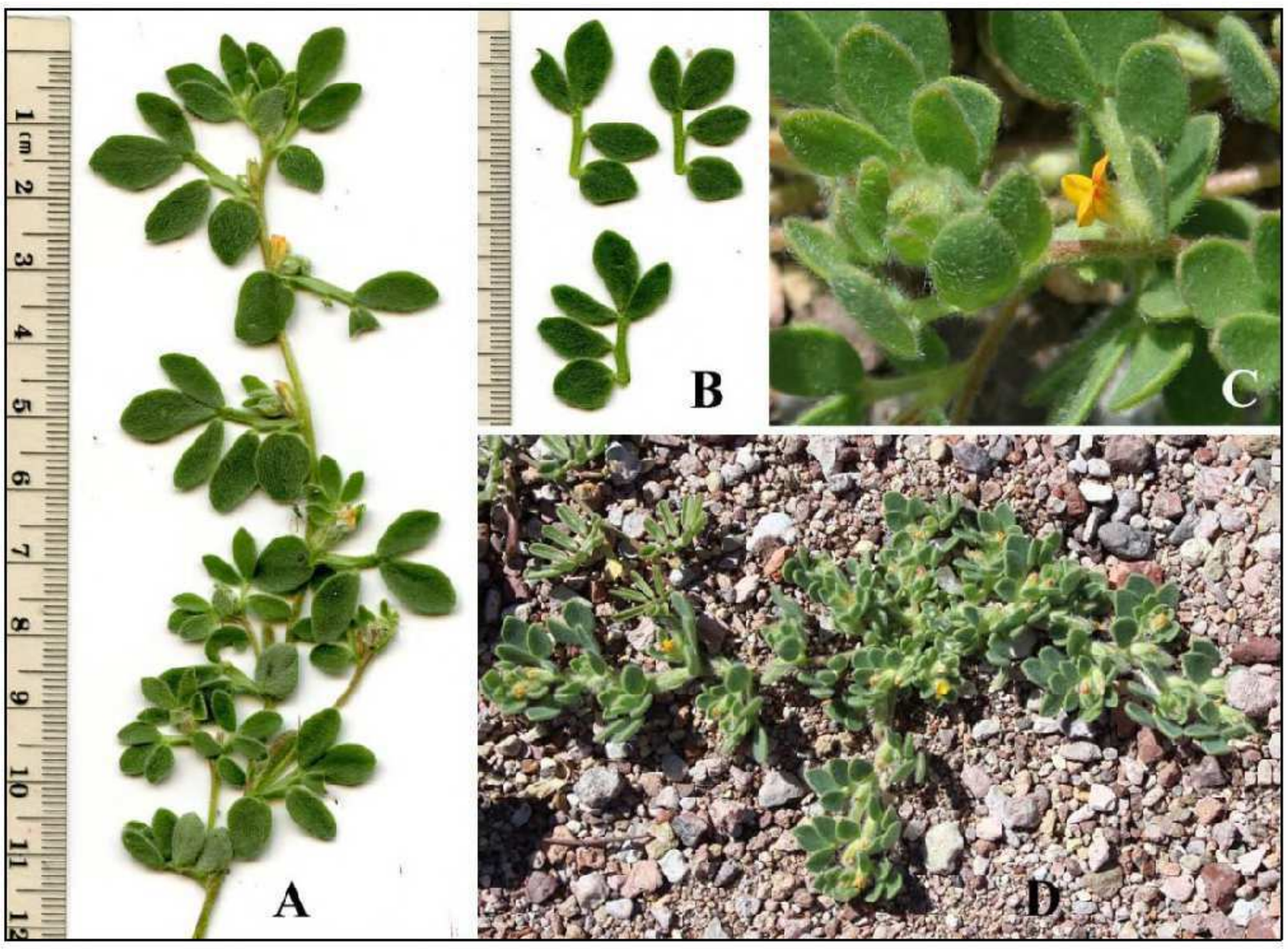


Figure 3. *Acmispon brachycarpus*. (A, B, & D) Kuakatch Wash near Kuakatch Village, 11 Mar 2015. (C) Coffeepot Mtn, 27 Feb 2005.

Spring annuals, mostly prostrate, densely hairy with rather long, soft, white to yellowish hairs. Leaves ± 1 cm long; the leafstalk flattened, the leaflets 3 or 5, 5–15 mm long, broadly elliptic to obovate. Flowers sessile or nearly so, ca. 5–7 mm long, yellow-gold, becoming reddish with age. Pods 6–12 mm long, with 2–5 seeds.

Widespread at least in the eastern half of Organ Pipe; on wide-ranging substrates such as desert pavement and sandy or gravelly sediments in wash beds, from lower bajadas to upper elevations.

Southwestern USA and adjacent Mexico.

**OP**: Near road 9 mi N of Sonoyta, 22 Mar 1941, *McDougall 14*. Dripping Springs, 25 Mar 1944, *Clark 11459* (ORPI). Alamo Canyon, 12 Apr 1978, *Bowers 1246* (ORPI). 1.4 mi N of Visitors Center on Hwy 85, 31 Mar 1979, *Bowers 1610*. Trail from The Cones to Mount Ajo, 4090 ft, 10 Apr 2005, *Felger 05-280*.

**Acmispon maritimus** (Nuttall) D.D. Sokoloff var. **brevivexillus** (Ottley) Brouillet
[*Lotus salsuginosus* Greene var. *brevivexillus* Ottley. *L. humilis* Greene. *Hosackia humilis* (Greene) Abrams]
Bird's-foot trefoil. Figure 4.

Spring annuals, mostly low-growing or prostrate. Herbage often semi-succulent, glabrous or sparsely pubescent. Leaves 1.5–2.8 cm long, the leafstalk moderately flattened, the leaflets 3–7 (lower leaflet often single rather than paired), thick, broadly elliptic, the tip broadly rounded to acute with a small, blunt point. Flowers 2–4 on slender peduncles with a leaflet-like bract on the joint (node) below the flowers. Flowers 5.5–7 mm long, the corollas bright yellow, or the banner becoming pale orange. Pods 10.5–16.5 mm long. Seeds 5–8 per pod, rounded, 1.3–1.4 mm wide, mottled, and smooth.

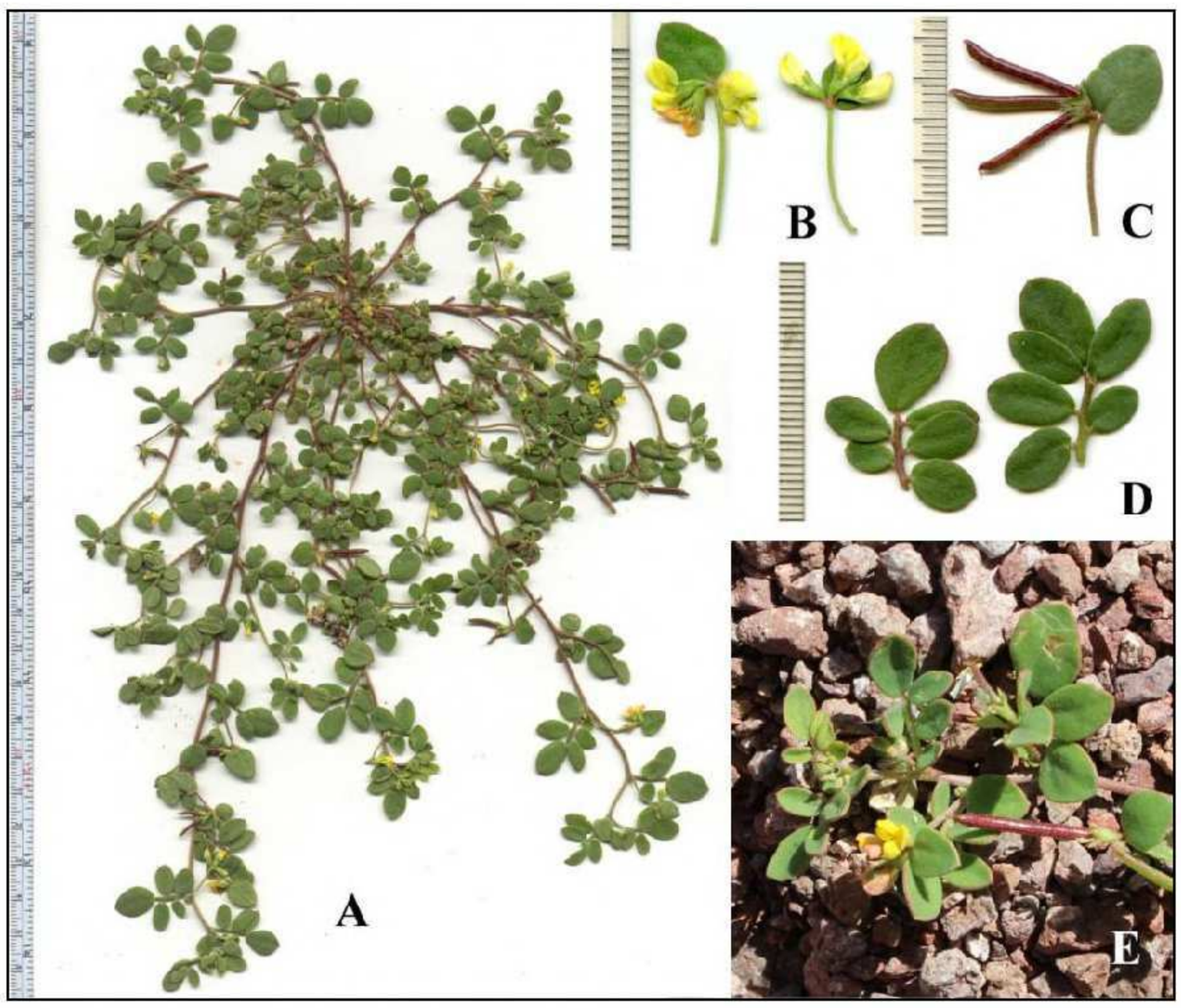


Figure 4. *Acmispon maritimus* var. *brevivexillus*. Kuakatch Wash near Hwy 85: (A) 24 Mar 2014; (B–D) La Abra Plain, South Puerto Blanco Drive, 25 Feb 2015. (E) Alamo Wash, 11 Mar 2014.

Widespread across the flora area; mostly along washes, also on bajadas and plains, and rocky slopes.

Baja California to southern California, Arizona, and northwestern Sonora.

**OP**: Headquarters Area, 10 Apr 1941, *McDougall 78*. Pozo Nuevo, 30 Mar 1978, *Bowers 1105*. 2.5 mi W of Hwy 85 on one-way Puerto Blanco Drive, 11 Apr 1978, *Bowers 1221*. Above Bull Pasture on trail to crestline, 3220 ft, 10 Apr 2005, *Felger 05-232*.

**CP**: 7 mi E of Papago Well, 22 Mar 1935, *Peebles 10863*. Tule Tank, 2 Feb 1992, *Felger 92-67*. San Cristobal Wash, 11 Apr 1992, *Harlan 157a* (CAB). Bassarisc Tank, 26 Feb 1993, *Felger 93-122A*.

**Acmispon rigidus** (Bentham) Brouillet
[*Hosackia rigida* Bentham. *Lotus rigidus* (Bentham) Greene]
Desert rock-pea. Figure 5.

Perennial subshrubs, often summer-dormant, 20–70 cm tall; strigose with appressed white hairs. Stems firm, brittle with age, with long internodes and sparsely leafy. Leaves and ultimately many twigs drought deciduous. Leaves sessile or the petioles very short (1–2 mm long), the leaflets 3–5, thick, linear-oblong, 10–15 mm long. Peduncles (3) 5–10 cm long, resembling the twigs, mostly 1-flowered, with a 1–3-foliolate bract below the flower. Flowers 1.5–2 cm long, the corolla uniformly bright yellow, soon developing a red-orange nectar guide, and with age the corollas becoming red-orange or pink. Pods slender, 1.8–4 cm long. Seeds 6–12 per pod, 1.5–2 mm wide, rounded or quadrangular. Flowering at least in early spring and sometimes with summer rains. Plants sometimes killed by low temperatures.

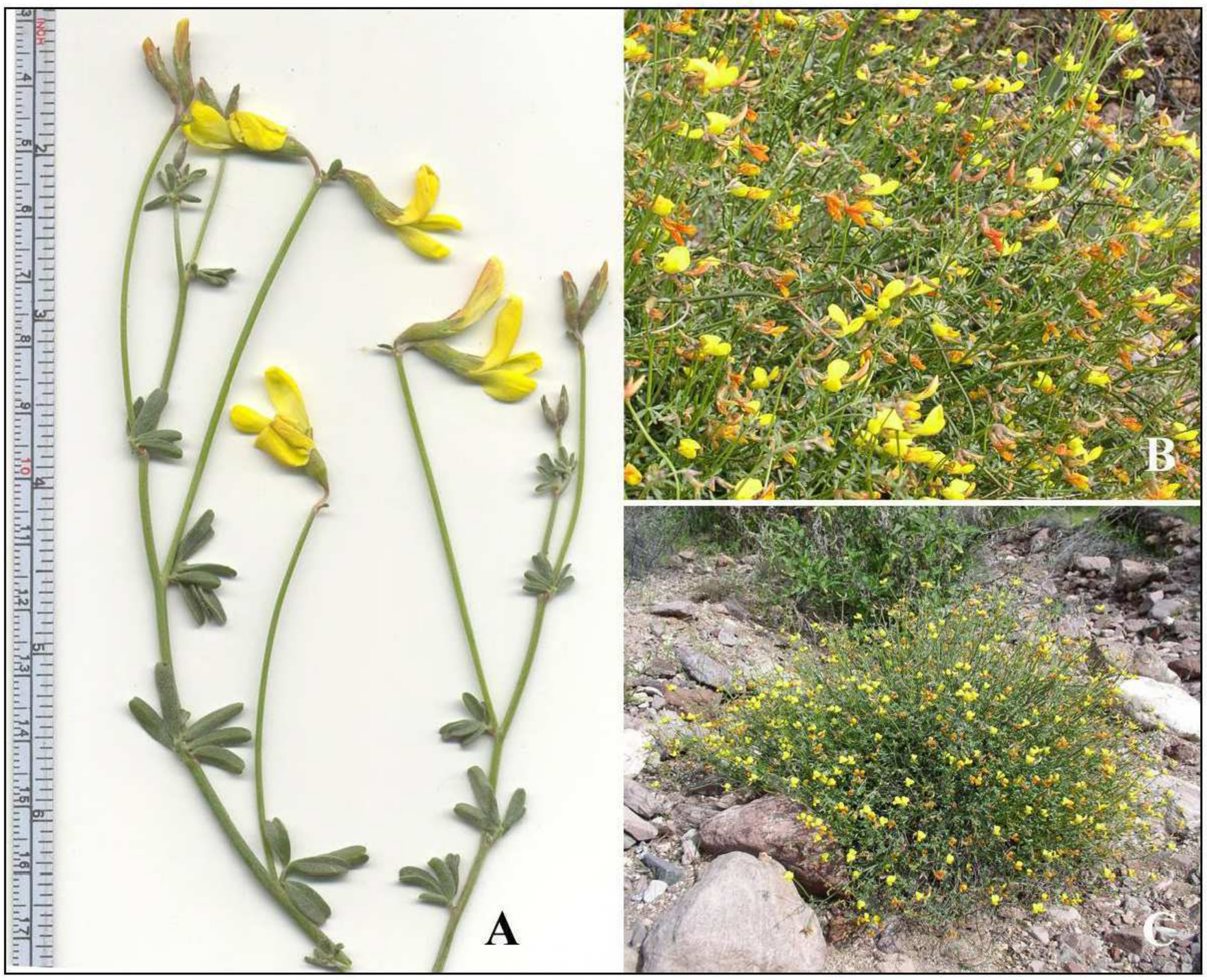


Figure 5. *Acmispon rigidus*. Estes Canyon: (A) 2 Mar 2008; (B & C) 16 Feb 2005.

Arroyos and canyons among boulders and rock slopes, often north-facing; to the summits in the granitic ranges in Tinajas Altas and eastward to the larger mountains in Organ Pipe. It has grown in the Tinajas Altas Mountains for 11,000 years.

Arizona, southern Nevada, southwestern Utah, southeastern California, both Baja California states, and northern Sonora. Isely (1998: 657) wrote, "This desert species is perhaps our ugliest *Lotus*." We disagree, it is a beautiful plant when in full flower and is commercially grown as an ornamental plant in southern Arizona (e.g., Mountain States Wholsale Nursery 2015).

**OP**: Pitahaya Canyon, *Nichol 23 Feb 1939* (ORPI). Ajo Mts, summit, 1 Apr 1944, *Clark 11527* (ORPI). W slopes of Montezuma's Head, 2600 ft, 16 Jan 1976, *Van Devender 76-1*. Canyon Diablo, 13 Feb 1978, *Bowers 1058*. Arch Canyon, 900 m, 2 Dec 1990, *Felger 90-547*.

**CP**: Tule Tanks, 21 Mar 1933, *Shreve 6228*. Buckhorn Tank, 20 Mar 1987, *Elias 10281*. Vicinity of Heart Tank, 27 Feb 1993, *Felger 93-153*. Observations: Halfway Tank, 15 Jun 1992, *Felger*. Sierra Pinta, summit, 15 Nov 2003, *Cain*.

**TA**: Tinajas Altas, 5 Mar 1927, *Harrison 3610*. †Tinajas Altas, fruits, seeds, 4010 to 10,750 ybp (7 samples).

**Acmispon strigosus** (Nuttall) Brouillet
[*Hosackia strigosa* Nuttall. *Lotus strigosus* (Nuttall) Greene var. *tomentellus* (Greene) Isely. *L. tomentellus* Greene]
Hairy lotus. Figure 6.

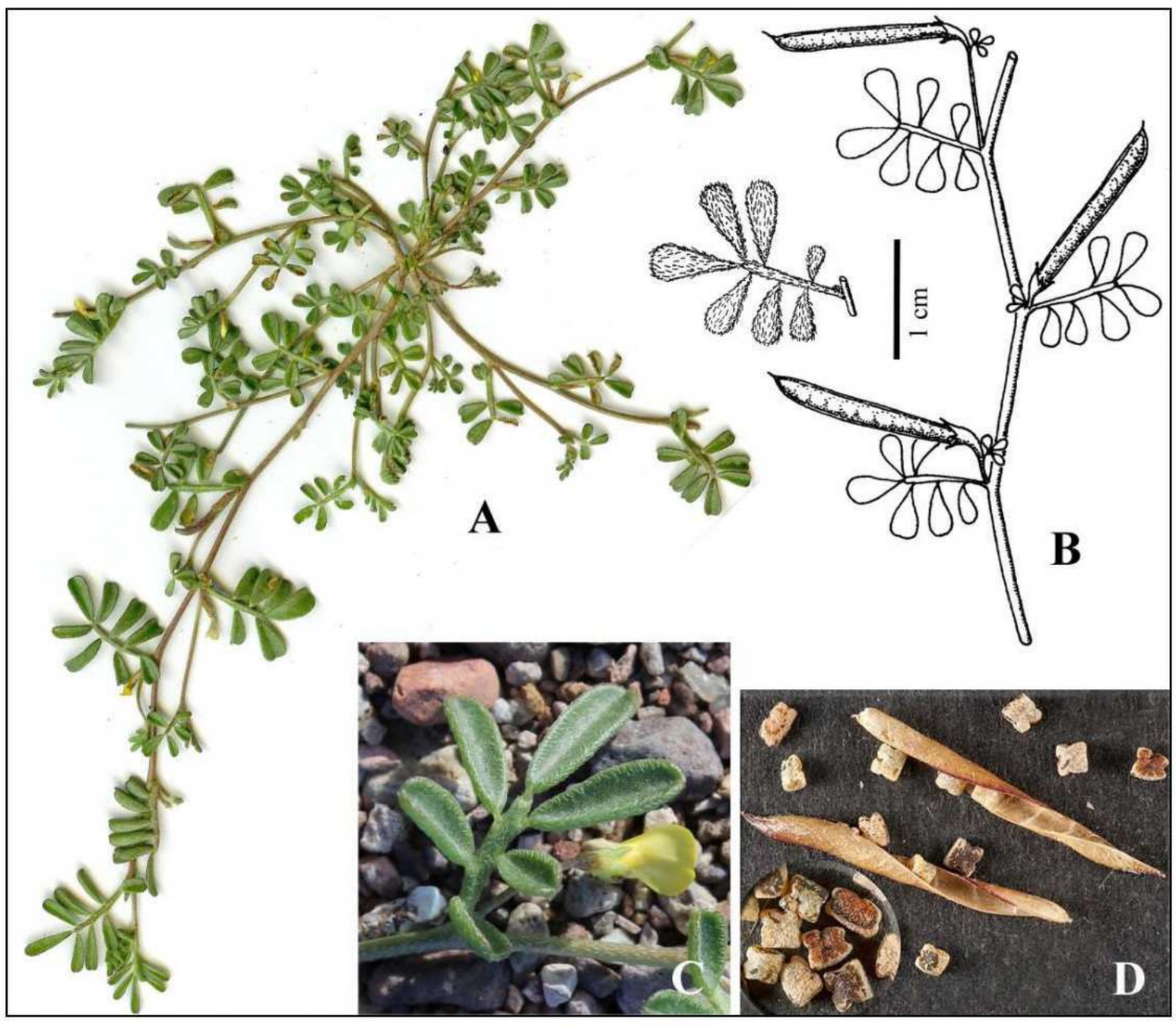


Figure 6. *Acmispon strigosus*. (A) Armenta Ranch, 13 Feb 2005. (B) By Matthew B. Johnson. (C) Alamo Wash near Alamo Bridge, 26 Feb 2014. (D) Sandy Flat Campground, Kern River, Kern Co., CA, photo by Jean Pawek, Rancho Santa Ana Botanic Garden Seed Program.

Winter-spring ephemerals; roots conspicuously nodulated. Stems spreading, becoming prostrate, 4–30+ cm long. Herbage sparsely to densely hairy (cinereous to strigose). Leaves 7–23 mm long, the leafstalk flattened, the petioles 4–7.5 mm long, the leaflets (3) 5–7, relatively thick,

keeled, obovate, 4.5–13 mm long, the tip truncate (blunt) and sometimes notched. Flowers solitary and sessile in axils, or 1 or 2 on slender peduncles with a leaflet-like or sometimes 3-foliolate bract on the joint (node) just below the flower(s). Flowers 7.5–9 mm long, the corollas bright yellow with a red nectar guideline on the banner. Pods 12–27 mm long. Seeds 8–11 per pod, 1.5–2.2 mm wide; of two kinds: nearly round, yellow-green, and minutely granulate, or somewhat kidney- or thickly U-shaped, mottled brown on buff, and smooth. Seed morphology seems constant for an individual plant and perhaps among local populations.

Widespread in many habitats including washes, flats, dunes, and desert pavements, and less common on rocky slopes.

Arizona below the Mogollon Rim to Nevada and California, Baja California, and northwestern Sonora.

**OP**: Tres Alamos Canyon, 2700 ft, *Nichol 24 Feb 1939*. Dripping Springs, 16 Apr 1952, *Parker 7939*. 2 mi WSW of Bates Well, 30 Mar 1978, *Bowers 1126*. Aguajita, 6 Apr 1988, *Felger 88-283*. Trail above Bull Pasture to the crestline, 3220 ft, 10 Apr 2005, *Felger 05-233*.

**CP**: Papago Well, 26 Mar 1932, *Shreve 5923*. Tule Tank, 2 Feb 1992, *Felger 92-68*. Bassarisc Tank, 26 Feb 1993, *Felger 93-124*. Pinta Sands, dunes, 11 Apr 1993, *Felger 93-428*. Chico Suni Hills, 2 Feb 2003, *Rutman 2003-32*.

**TA**: Tinajas Altas, *Van Devender 9 Mar 1980*. Tinajas Altas Canyon, 19 Mar 1998, *Felger* (observation).

**†Acmispon** sp./spp.

**OP**: †Puerto Blanco Mts, fruit fragments, seeds, modern (30) to 14,100 ybp (7 samples).

**Astragalus** – Milkvetch, locoweed

Winter-spring annuals in the flora area (elsewhere many are perennial herbs) with a well-developed taproot. Leaves odd-pinnate. Inflorescences of axillary racemes or spikes. Flowers papilionoid. Calyx 5-toothed. Stamens 10; 9 filaments fused, 1 free. Pods variable, inflated or not, sessile or the base variously elongated into a stipe or stipe-like stalk. Seeds 2 to many per pod.

This is the largest genus of flowering plants, with over 2500 species worldwide.

1. Racemes 2–18+ cm long (flower-bearing portion, does not include the peduncle), the flowers not crowded, each 7–20 mm long; pods inflated.

   2. Racemes 2–4 cm long; flowers 7–8 mm long; pods conspicuously inflated, one-celled; dunes of Pinta Sands, Cabeza Prieta ..... **Astragalus insularis**
   2. Racemes often 10–18 cm long; flowers ±10 mm long; pods moderately inflated, 2-celled with a well-formed septum; east side of Organ Pipe..... **Astragalus lentiginosus**

1. Racemes 2 cm or less in length, the flowers crowded, each 3–6 mm long; pods not inflated.

   3. Racemes many-flowered; pods 4–5 mm long, rounded or ovoid, not curved, 2-seeded. ..... **Astragalus didymocarpus**
   3. Racemes 1–3-flowered; pods 12–20 mm long, curved at maturity, multiple-seeded. ..... **Astragalus nuttallianus**

**Astragalus didymocarpus** Hooker & Arnott var. **dispermus** (A. Gray) Jepson
[*A. dispermus* A. Gray]
Dwarf white milkvetch. Figure 7.

Herbage bluish green, with short white hairs. Stems very slender, spreading or sprawling, not erect. Leaves 2–5 cm long; leaflets 9–17, oblong to oblanceolate or obovate, 3–10 mm long. Flowers crowded into small, head-like rounded or ovate clusters on long, slender peduncles; flowers 5–6 mm long, pink-purple with white on tips of wing petals. Pods 4–5 mm long, firm and wrinkled, with a septum forming 2 chambers, each with a single seed.


Figure 7. *Astragalus didymocarpus* var. *dispermus*. (A & C) Armenta Ranch, 13 Feb 2005. (B & D) Coffeepot Mountain, Maricopa Co., 27 Feb 2005.

Ajo Mountains, especially common and widespread above Bull Pasture, and elsewhere near the north end of the mountains and the northern margin of the monument. Often growing with *A. nuttallianus*.

Variety *dispermus* occurs in southeastern California, eastern Baja California, southern and western Arizona, and expected in Sonora east of Sonoyta. This species, with four varieties, ranges to northern California and Pacific Baja California.

**OP**: *Larrea-Ambrosia* flat in valley N of Montezuma's Head, *Rutman 4 Apr 1998* (ORPI). Armenta Road 1.4 mi W of Hwy 85, 11 Mar 2003, *Felger 03-260*. Above Bull Pasture, trail to crestline, 3220 ft, 10 Apr 2005, *Felger 05-226* (ARIZ, ASU).

**Astragalus insularis** Kellogg var. **harwoodii** Munz & McBurney
Sand locoweed; *kopondakud*. Figure 8.

Stems erect to sprawling. Herbage green to silvery (strigulose), the pubescence mostly of hairs much less than 0.5–0.6 mm long, firm, white, and mostly appressed. Leaves (3) 4–11 cm long; leaflets 13–19 in number, 6–12 (20) mm long. Racemes 2–4 cm long; flowers not crowded, (5) 8–9 (10) in number, 7–8 mm long. Corollas violet when fresh and dry, the banner petal with dark spots and a white eye between lavender veins. Pods (16) 20–24 mm long, papery-membranous, greatly swollen (inflated), and purple flecked with minute, coarse hairs; with 8 or more seeds.

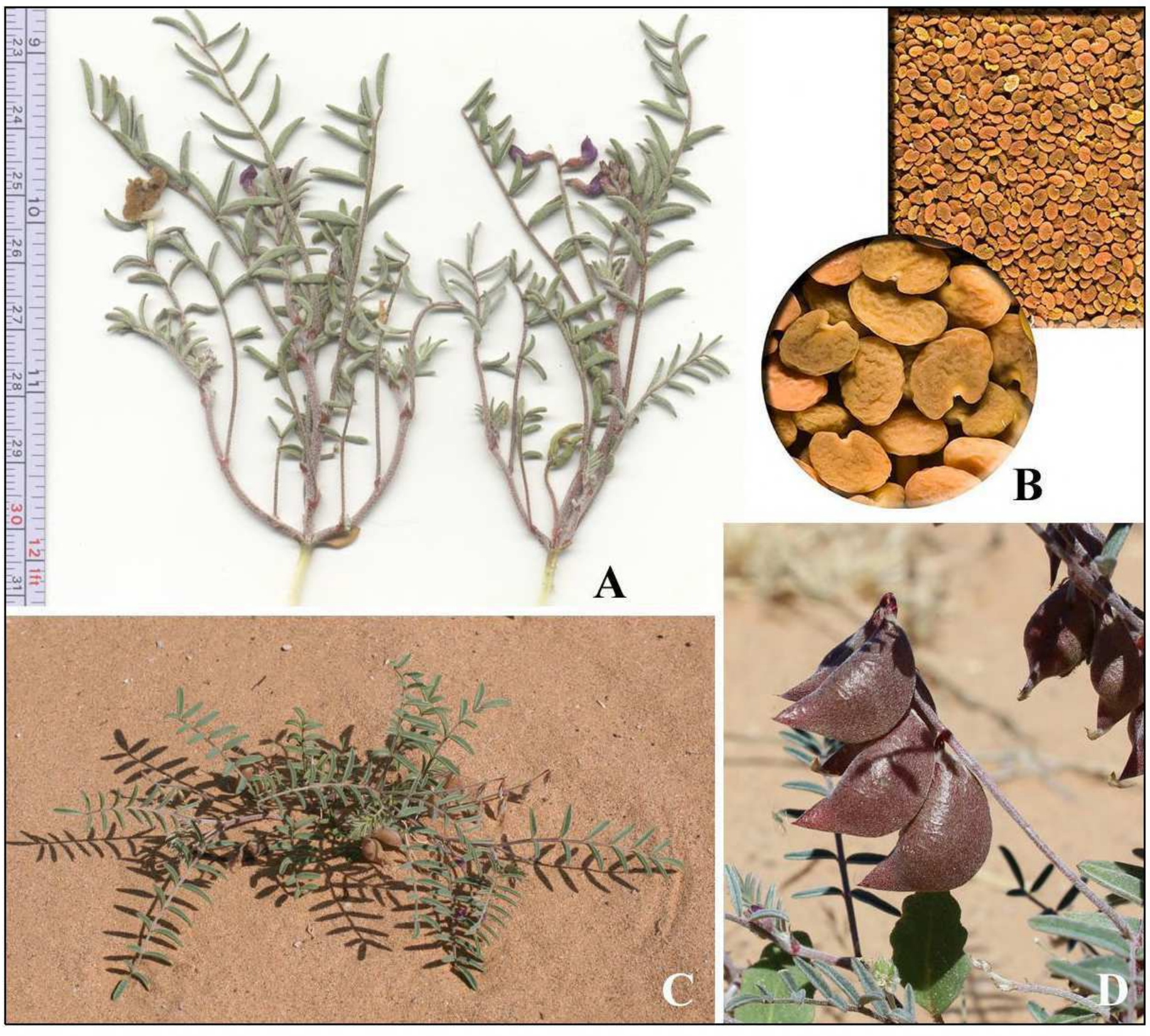


Figure 8. *Astragalus insularis* var. *harwoodii*. (A) Pinta Sands, 11 Feb 2014. (B) Photo by John MacDonald, Rancho Santa Ana Botanic Garden Seed Program. (C) Dunes 22 mi SW of Sonoyta on Mex Hwy 8, Sonora, 27 Mar 2010. (D) Gran Desierto near Mex Hwy 2, Pinacate Biosphere Reserve, Sonora, 5 Mar 2014.

Sand flats and dunes in the vicinity of the Pinta Sands and Pinacate Lava.

This variety occurs in southwestern Arizona, southeastern California, northeastern Baja California, and northwestern Sonora. This species, with three varieties, ranges to Baja California Sur.

**CP**: Pinta Sands, *Monson 21 Feb 1958* (CAB). Pinta Sands, 1.3 mi N of Mexico, 780 ft, sandy *Larrea* desert, 10 Apr 1978, *Reeves 6798* (ASU, det. R. Barneby 1978). Pinta Sands E of Pinacate Lava Flow, sand dunes, 21 Mar 1979, *Yatskievych 79-243*. Dunes, 6 mi W of O'Neill's Grave, 31 Mar 1983, *Eiber 33*.

**Astragalus lentiginosus** Douglas ex Hooker var. **australis** Barneby
Freckled milkvetch. Figure 9.

Figure 9. *Astragalus lentiginosus* var. *australis*. Vicinity of E boundary of Organ Pipe, near Kuakatch Village, 24 Mar 2013.

Plants fairly robust, the herbage glabrate or with curved or spreading hairs. Larger leaves 10 or more cm long; leaflets mostly 9–21, obovate to elliptic. Racemes elongate, open, the flowers not crowded. Flowers ±1 cm long; pale pink-purple, becoming bluish with age, the banner with a white spot at the base (white between pink-purple veins). Pods ±1.5–2 cm long, greenish and speckled with red when fresh, moderately firm and inflated, nearly rounded in cross section, curved upward and held upright, with coarse white and somewhat silky hairs; incompletely 2-chambered, the septum readily visible, dividing ¾ of the pod. Seeds probably 10–20.

Known from the east side of Organ Pipe by a few specimens. These are likely waifs from nearby areas to the east of Organ Pipe, where this milkvetch is fairly common. Plants from Organ

Pipe and adjacent areas are spring annuals, although elsewhere this variety is known as a short-lived perennial.

Southern Arizona eastward from Organ Pipe to west Texas and adjacent northern Mexico.

Barneby (1964) distinguished an amazing diversity of 36 geographic varieties of this species, and Isely (1998) expanded the complex to 40 varieties; western USA and northern Mexico.

**OP**: Alamo Canyon, 2000 ft, *Tinkham 18 Apr 1942* (det. Duane Isely, no date). Wash, 1798 ft, *Walden 19 Apr 1964* (ASU, det. R. Barneby 1970). Victoria mine site 1.5 mi W of campground, 1650 ft, *Kurmes 13 Mar 1989* (ASC).

**Astragalus nuttallianus** de Candolle cf. var. **imperfectus** (Rydberg) Barneby
[*Hamosa imperfecta* Rydber]
Small-flowered milkvetch. Figure 10.

Plants often diminutive, the stems very slender; hairs appressed, white and firm. Leaves often 2–5.5 (7) cm long; leaflets 7–11 (13), elliptic to linear-elliptic, 3.7–17.6 mm long, the tips pointed (acute to obtuse). Racemes on very slender peduncles 2.5–5 (8) cm long, 1–3-flowered: flowers close together, each 5–6 mm long, semi-cleistogamous (only partially opening and selfing), the petals lavender-pink. Pods 12–20 mm long, multiple-seeded, slender and strongly curved at maturity, not inflated and gradually or partially dehiscent. Seeds mostly 12–16 per pod.

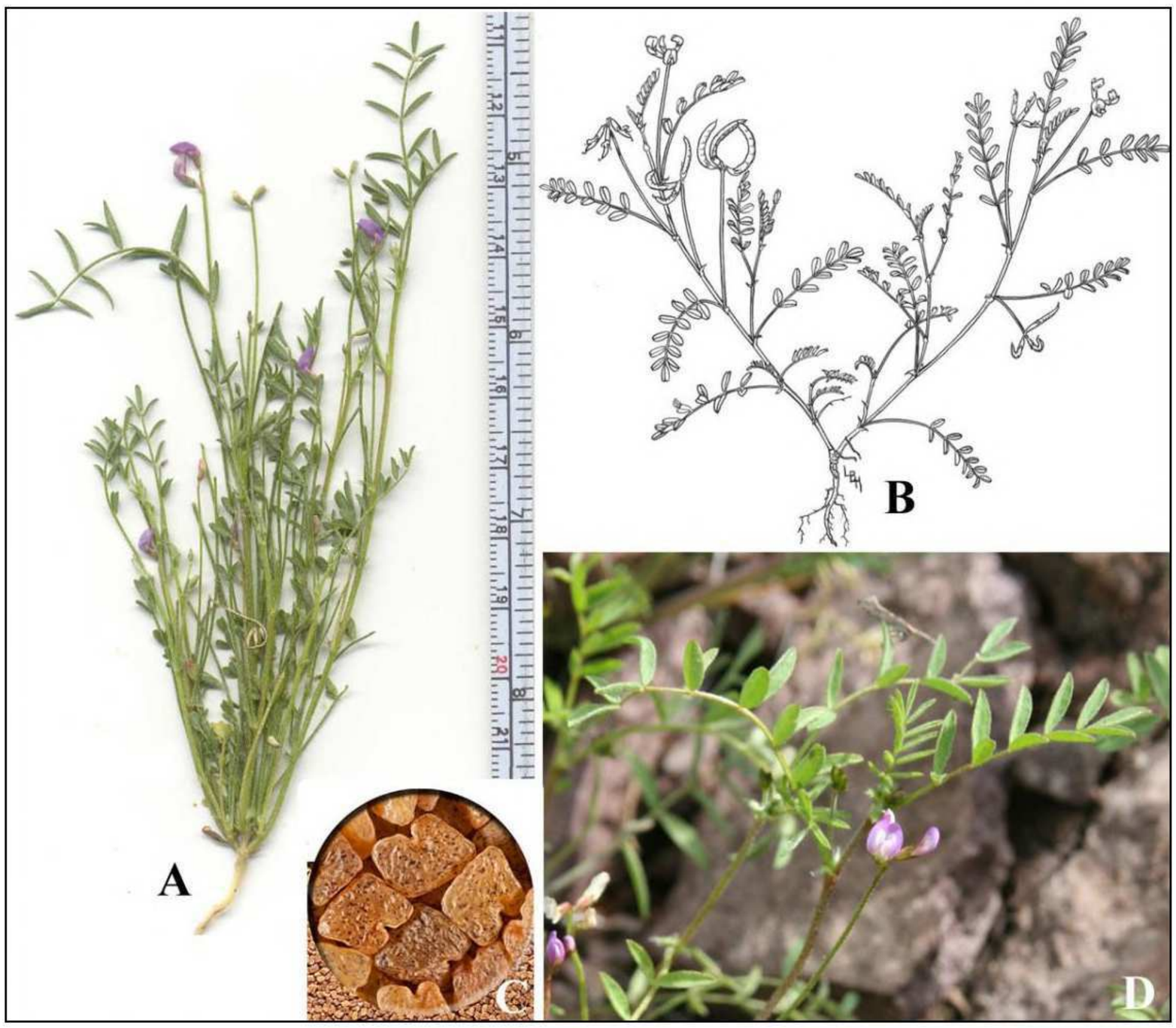


Figure 10. *Astragalus nuttallianus*. (A) Kuakatch Wash near Hwy 85, 2 Mar 2008. (B) By Lucretia Breazeale Hamilton. (C) *A. nuttallianus* var. *imperfectus*, photo by John MacDonald, Rancho Santa Ana Botanic Garden Seed Program. (D) Chuckwalla Hills, 27 Feb 2005.

In many habitats across most of the flora area; sandy, gravelly, and rocky soils, especially along washes, canyons, and floodplains, also on bajadas, plains, slopes, and mountains. This is the most common and widespread *Astragalus* in the region and the only one that occurs in both Cabeza Prieta and Organ Pipe. A member of this species complex was present in the Ajo Mountains 9600 years ago.

*Astragalus nuttallianus* occupies southwestern USA and the northern half of Mexico.

Barneby (1964) recognized 10 varieties. Most of the specimens from the flora area resemble var. *imperfectus*, which occurs in western Arizona, southeastern California, Nevada, northwestern Arizona, and northeastern Baja California. This variety is distinguished in part by its relatively short calyx lobes (to ca. 1.5 mm long) and short hairs (0.8 mm long or less). Two other varieties have been cited for the region: var. *austrinus* (Small) Barneby, which mostly ranges eastward, and var. *cedrosensis* M.E. Jones, which mostly ranges westward. Specimens from the general flora area identified or annotated by Barneby (1964) and also by Isely (1998) do not necessarily match key features for the varieties given in their publications.

**OP**: Tres Alamos Canyon, *Nichol 24 Feb 1939*. Boulder Canyon, 10 Mar 1973, *Shervanick 723* (RSA). N end Bates Mts, 23 Feb 2003, *Rutman 2003-180* (ORPI). 0.5 mi W of Growler Pass, 8 Mar 2003, *Rutman 2003-273* (ORPI). 0.1 mile E of OP western boundary, San Cristobal Valley, 20 Mar 2003, *Rutman 2003-369* (keys to var. *cedrocensis*). Above Bull Pasture, trail to crestline, 3220 ft, 10 Apr 2005, *Felger 05-227*. †Variety not known: Alamo Canyon, fruits, seeds, 9570 ybp.

**CP**: Agua Dulce Mts, *Elias 19 Mar 1987* (RSA). NE of Davis Hills, *Elias 20 Mar 1987* (RSA). Tule Mts, 12 Apr 1992, *Harlan 245* (CAB). Childs Mt, 2240 ft, 9 Apr 1993, *Felger 93-270*.

**†Astragalus sp.**

**OP**: Montezuma's Head, seeds, 21,840 ybp.

## Calliandra

Herbaceous perennials, shrubs, and trees. Flowers mimosoid. Southwestern USA to South America; 130 species.

**Calliandra eriophylla** Bentham

Fairy duster; *huajillo*. Figure 11.

Unarmed woody shrubs often 0.5–0.8 (1) m tall, with firm but flexible stems and grayish bark; especially the young growth moderately to densely pubescent with short white hairs. Leaves twice pinnate, without leafstalk glands, gradually drought deciduous and frost sensitive, the pinnae (1) 2–4 pairs; leaflets 2.5–6 mm long, 6–15 pairs per pinna. Long-shoot leaves may be much larger than short-shoot leaves. Flowering mostly in February and March and also with summer rains; inflorescences axillary; flowers clustered in pedunculate heads. Flowers sessile, the stamens showy and numerous, united below, 1.5–2 cm long, whitish to pinkish, opening at night, drooping with daytime heat; anthers small, the pollen shed in 8-grained polyads. Pods often 4–7.5 cm long, flattened with thick cord-like margins, the valves separating elastically and curling back but not twisting.

Widespread in Organ Pipe, mostly along washes and rocky slopes of hills and mountains, and in the eastern portion of Cabeza Prieta mostly on north-facing slopes and arroyo banks.

Southeastern California to Texas and southward to Chiapas and Baja California.

**OP**: Quitobaquito, *Nichol 3 Mar 1939* (ORPI). Ajo Mt Drive, Mar 1976, *McCarten 2058*. Puerto Blanco Drive, 13 mi NW Visitor Center, 11 Feb 1978, *Bowers 1048*. Walls Well Road, *Van Devender 30 Aug 1978*. Bull Pasture, 1500 ft, *Mittleman 10 Mar 1981* (DES).

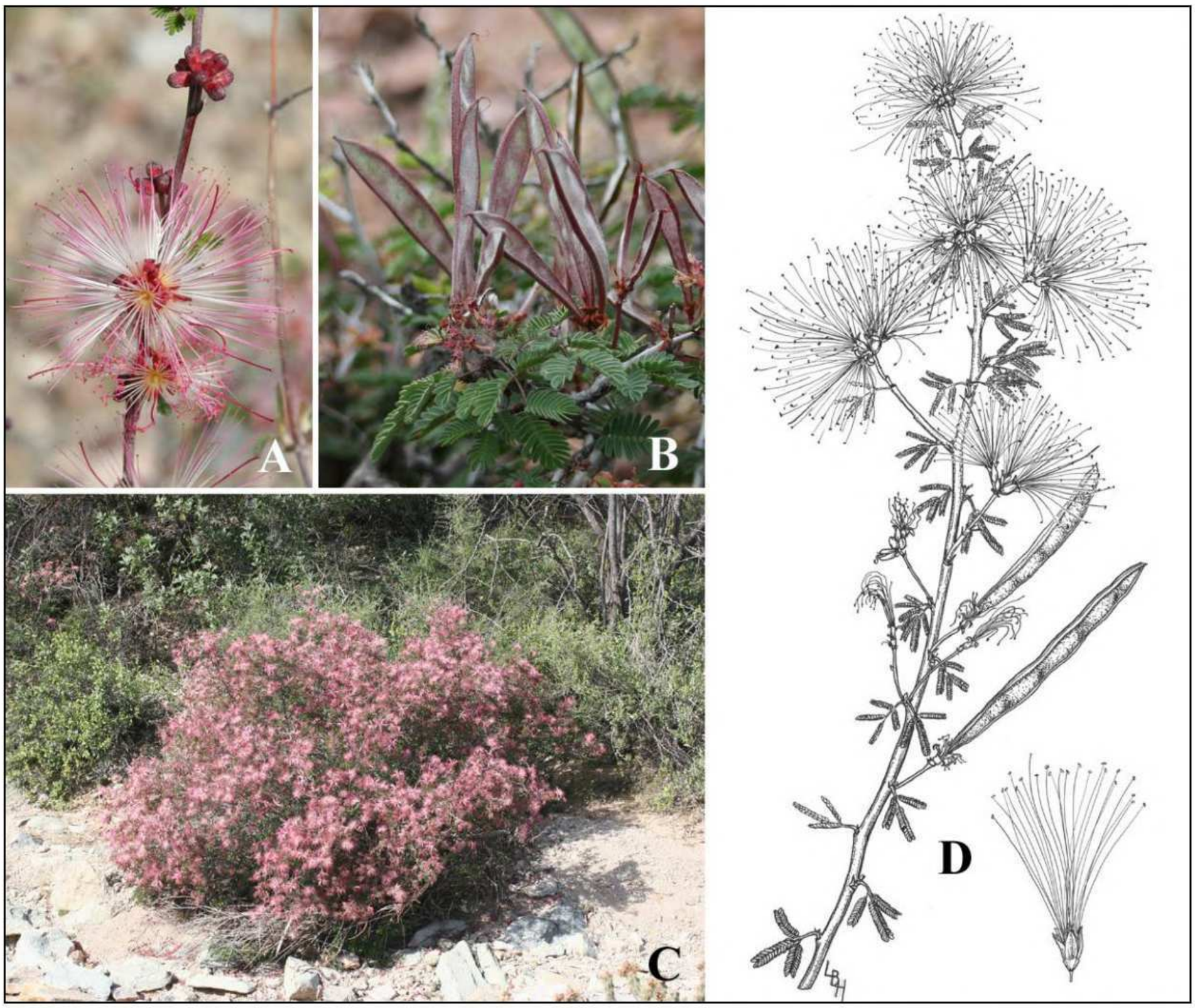


Figure 11. *Calliandra eriophylla*. (A) Little Ajo Mts, 24 Feb 2008. (B) Ajo, 18 Mar 2005. (C) Victoria Mine, 1 Apr 2010. (D) By Lucretia Breazeale Hamilton.

**CP**: Charlie Bell Road at E boundary of Refuge, 25 Feb 1993, *Felger 93-48*.

**Chamaecrista** – Partridge-pea

Annuals, herbaceous perennials, shrubs, and trees. Flowers caesalpinioid. Mostly New World; 270 species. A genus segregated from *Cassia*.

**Chamaecrista nictitans** (Linnaeus) Moench var. **mensalis** (Greenman) H.S. Irwin & Barneby
[*Cassia leptadenia* Greenman var. *mensalis* Greenman. *Chamaecrista leptadenia* (Greenman) Cockerell]
Sensitive partridge pea. Figure 12.

Delicate summer annuals with a single main axis, often 10–30+ cm tall. Herbage pubescent, the leaflets ciliate. Leaves once-pinnate, (2) 3–4.5+ cm long, with a prominent, raised petiole gland, and 7–15 pairs of leaflets. Flowers in leaf axils, bright yellow, ± 5 mm long. Stamens variable in this species, with 5–10 functional stamens; anthers opening by terminal pores. Pods 3.5–4+ cm long,

elastically dehiscent, with (5) 8–12 seeds. Seeds ± quadrangular, 2 mm wide, dotted with raised glands.

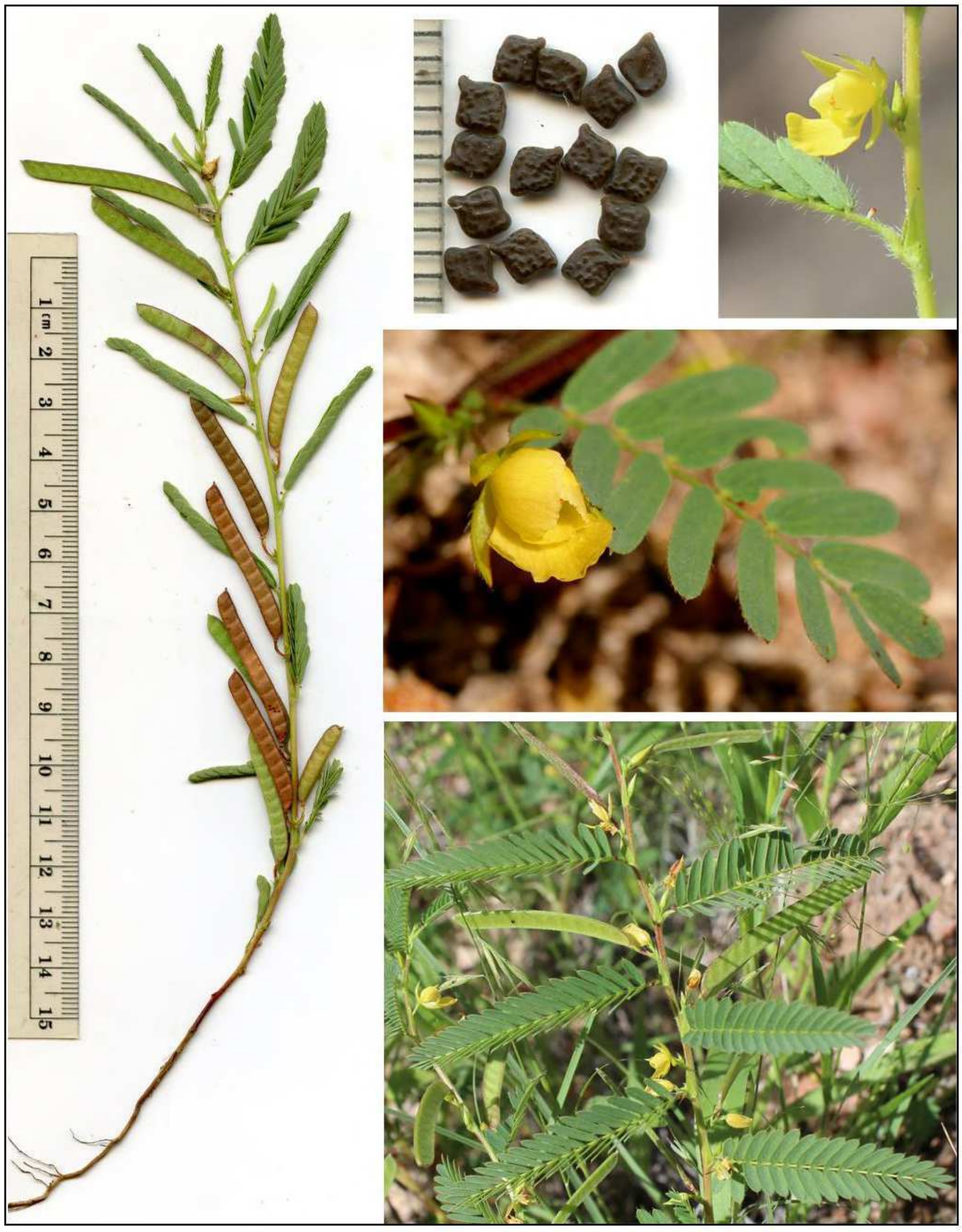

Figure 12. *Chamaecrista nictitans* var. *mensalis*. Bull Pasture, 19 Sep 2014.

Known from the flora area by a single collection from the Ajo Mountains, where it was common along an ephemeral stream.

Irwin and Barneby (1982) recognized 12 subspecies and varieties of this annual species, ranging from the USA to Argentina. Variety *mensalis* ranges from the southwestern USA to Michoacán and also occurs in Baja California Sur.

**OP**: Bull Pasture, along ephemeral stream, 19 Sep 2014, *Rutman 20140919-5*.

**Coursetia**

Herbaceous perennials, shrubs, and trees. Flowers papilionoid. Southwest USA to Argentina and the Caribbean; 40 species.

**Coursetia glandulosa** A. Gray
[*C. microphylla* A. Gray]
*Sámota*. Figure 13.

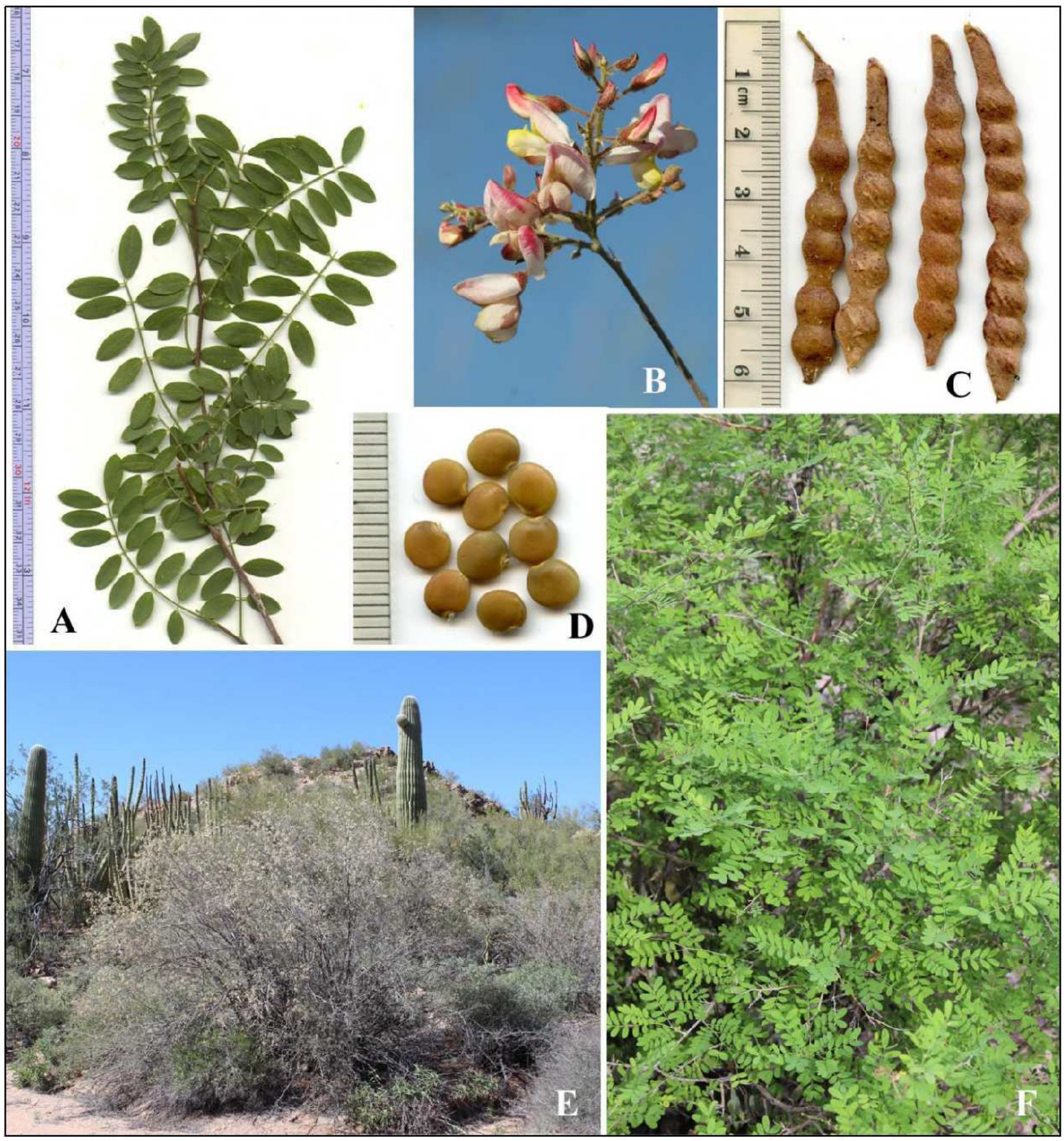


Figure 13. *Coursetia glandulosa*. (A) Estes Canyon Trail, 25 Sep 2013. (B) Alamo Canyon, 4 Mar 2006. (C–D) Ajo, 17 Mar 2015. (E) Senita Basin, 15 Mar 2015. (F) Arch Canyon, 2 Aug 2013.

Unarmed shrubs to 2.5 m tall with multiple and slender, flexible, hardwood stems. Leaves often 2–6 cm long (highly variable, reaching ca. 12 cm when well watered, especially with summer-fall rains), even-pinnate mostly with 8–18 leaflets, the leaflet midrib extends into a short bristle-tip (apiculate); foliage unfolding after flowering if there is sufficient soil moisture; leaves luxuriant with large, thin leaflets during the summer-fall rainy season and gradually drought deciduous during fall and winter. Inflorescence branches, peduncles, calyx, and pods glandular pubescent. Flowers 10–12 mm long, the petals pale yellow and white with faint red tinges, flowering mostly in March and April, often when the plants are leafless or nearly so. Stamens 10; 9 filaments fused, 1 free. Pods to 6+ cm long, slender, glandular-sticky, multiple-seeded, with a septum and constriction between each seed, and explosively dehiscent, the valves coiling.

Widespread in the less arid areas in Organ Pipe; canyons and on rocky slopes, especially north- and east-facing. The most arid locality for this shrub is in the Bates Mountains. It was in the Ajo Mountains 1200 years ago.

Southern Arizona and southwestern Chihuahua to Oaxaca and Baja California Sur.

The stems are sometimes encrusted with orange-colored lac produced by the ant-tended scale insect *Tachardiella fulgens* (Kondo & Gullan 2011). In southern Arizona and western Sonora we know of this orange lac only occurring on *Coursetia glandulosa*, although the occurrence tends to be highly localized. This lac, plastic when heated, was used by Native Americans as a sealant and adhesive (Felger 2007a; Felger & Moser 1985; Felger & Wilder 2012). *Sesbania* is erroneous reported as a possible host plant (e.g., Kondo & Gullan 2011). The error can be traced to Cockerell (1895: 1–2), who wrote, "*Hab.* Arizona, received from Prof. J.W. Toumey [University of Arizona, Tucson] . . . . has seen only the stem of the food-plant, but thinks it is a *Sesbania*" (Kondo & Gullan 2011: 357). *Sesbania* is an annual in the Sonoran Desert region and is not known to be a host plant for *Tachardiella*. Similar and far more common and more widely utilized lac from *T. larrea* occurs on creosotebush (*Larrea*) (e.g., Felger 2007a; Stacey et al. 1998).

**OP**: Alamo Canyon, *Nichol 4 May 1939*. Senita Pass, 13 Apr 1941, *McDougall 86*. Dripping Springs, 15 Apr 1952, *Parker 7919*. N end Puerto Blanco Mts, 14 Mar 2003, *Rutman 2003-308* (ORPI). Canyon NW of Kino Peak, 2000 ft, 20 Mar 2005, *Rutman 2005-0320-35* (ORPI). †Alamo Canyon, twigs, leaflets, 1150 ybp.

**Dalea**

Annual or perennial herbs and shrubs. Herbage and flowers dotted with blister-like glands (secretory vesicles with aromatic oils). Leaves odd-pinnate (leaflets lacking the small wavy lines seen in *Marina*). Flowers papilionoid, subtended by a bract and usually 2 bractlets. Calyx tube 10-ribbed with rows of glands between the ribs, and 5 ribs extending into lobes, teeth and/or awns longer than the tube (those in the flora area). Stamens 9 or 10 (those in the flora area), the filaments united below (basally) into a tube. Pods indehiscent, small and 1-seeded (two ovules in each ovary but only one matures into a seed). New World; 165 species.

1. Annuals; stems and leaves pubescent; widespread and common..... **Dalea mollis**
1. Perennials; stems and leaves glabrous or glabrate; Ajo Mountains and not common.

2. Leaflets 5–7 per leaf; floral bracts (subtending each flower) glabrous..... **Dalea pogonathera**
2. Leaflets 13–29; floral bracts hairy..... **Dalea pringlei**

**Dalea mollis** Bentham
Silky dalea. Figure 14.

Non-seasonal annuals, mostly found during spring and sometimes living through the summer; highly variable in size depending on soil moisture; with a relatively deep, yellow-orange taproot and nodulated secondary roots. Herbage with slender, spreading, white hairs and dotted with swollen, maroon glands. Stems 10–30+ cm long, erect to prostrate with age. Leaves 1.5–2.7 (3) cm long; leaflets (7 or 9) 11 or 13, often glaucous, mostly cuneate to obovate or obcordate, 4–7 mm long, the tip often truncate or notched, the lower surfaces gland-dotted, the upper surfaces glandless, the margins entire and flat. Racemes (1) 1.5–3.5 cm long, densely flowered and appearing furry due to densely crowded, long, whitish to tawny, and tightly spiraled silky hairs on the calyx tube and teeth, the hairs often obscuring the flowers and fruits. Inflorescences and pedicels with conspicuous teardrop-shaped, dark maroon-brown glands remaining after the flowers or fruits have fallen. Flowering at a very early age and continuing as long as soil moisture is available. Floral bracts 0.7–1 mm wide, often extending into an awn-like bristle. Pedicels very short and persistent. Calyx tube 1.8–2.4 mm long (measured from pedicel to sinus between calyx teeth), with rows of small iridescent orange glands, the margins and midribs dark maroon, the teeth triangular, the midribs extending into stout, densely long-haired bristles (awns). Corollas (3.5) 4.5–6.5 mm long, scarcely longer than the calyx teeth/bristles. Wing petals notched with a gland, or the notch and gland sometimes absent. Upper, or exposed, portion of petals violet, drying red-purple. Pods 2.5 mm long, obovoid.

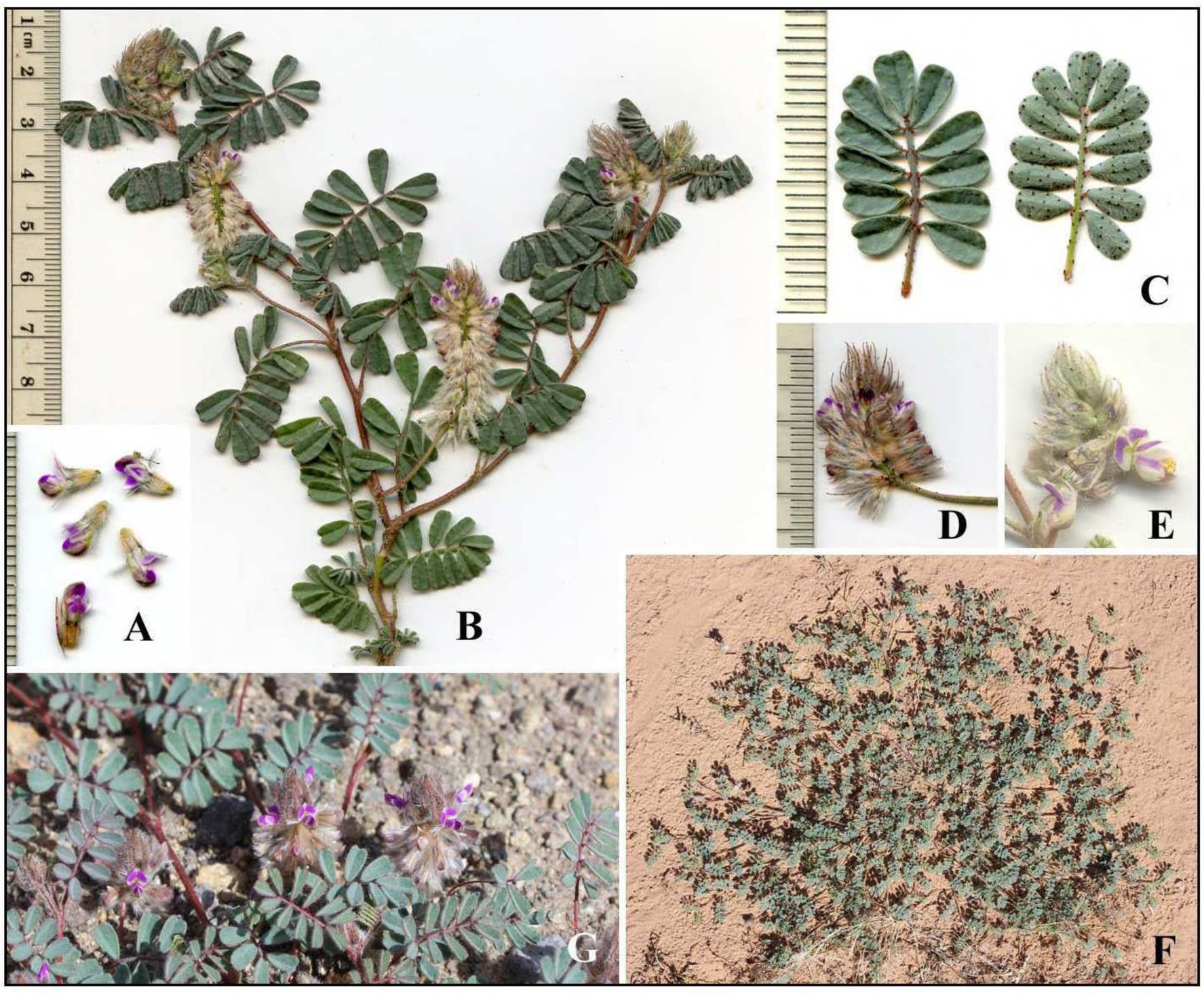


Figure 14. *Dalea mollis*. (A & D) Knucklehead Wash, south of Childs Mtn, 3 Mar 2015. (B) Charlie Bell Road, southern foothills of Childs Mtn, 5 Sep 2014. (C) Ajo, 23 Mar 2015. (E & F) Gran Desierto, 5 Mar 2014. (G) Acuna Valley, 12 Mar 2015.

One of the most common and widespread ephemeral legumes in the region. Found on a wide variety of substrates, disturbed and undisturbed, from low to high elevations, including washes, sandy plains, dunes, and slopes. Plants on dunes are lighter-colored than those off the dunes. Its history in the flora area extends to 6000 years.

Sonoran Desert in Arizona, California, Baja California, Baja California Sur, and Sonora.

**OP**: 8 mi S of Growler Well, Bates Mts, *Nichol 17 Apr 1939*. Growler Mts, foothills, 16 Apr 1952, *Parker 7976*. Cipriano Pass, 30 Mar 1978, *Bowers 1115*. E end of Quitobaquito Hills, *Warren 10 Nov 1983*. Alamo Canyon, 17 Oct 2013, *Rutman 20131017-5*. Trail above Bull Pasture, 4090 ft, 15 m below crestline, 10 Apr 2005, *Felger 05-286*.

**CP**: 1 mi E of Papago Well along Camino del Diablo, 13 Mar 1983, *Eiber 19*. NE edge of Las Playas, 15 Apr 1964, *Niles 363*. Pinta Sands, 15 Sep 1992, *Felger 92-779*. Tule Desert, 2 mi NW of Christmas Pass, *Rutman 18 February 2002*.

**TA**: E margin of Davis Plain at base of Gila Mountain, W branch of Camino del Diablo, 965 ft, in rock crevices and nearby on sandy soil, *Felger 05-67*. †Tinajas Altas, fruits, 5860 & 5940 ybp.

*Dalea mollis* is one of five species comprising sect. *Theodora* of subg. *Theodora*, occurring in Mexico and southwestern USA (Barneby 1977). *Dalea mollis*, *D. mollissima*, and *D. neomexicana* form a complex of similar appearing but distinctive species. Some confusion is due to the many misidentified specimens in herbaria. Barneby's extraordinarily detailed descriptions, information, and insight are worthy of review and continued investigation.

*Dalea mollis* is replaced by *D. mollissima* in the hotter and drier, lower elevations of the western and northwestern reaches of the Sonoran Desert mostly in southwestern USA and into the Mohave Desert. However, their geographic ranges overlap and the two species often occur together with no indication of intermediates or hybrids. "Probably the small, dull-hued flowers are autogamous, which would permit two closely related species to mingle without loosing their identity" (Barneby 1977: 162). *Dalea mollis* is replaced to the east, from Arizona to Texas and southward into the Chihuahuan Desert Region in Mexico, by *D. neomexicana* A. Gray. They are apparently allopatric. In Arizona *D. neomexicana* generally occurs at elevations above the Sonoran Desert.

**Dalea mollissima** (Rydberg) Munz
[*Paroselea mollissima* Rydberg]

Non-seasonal ephemerals; resembling *Dalea mollis* but generally more robust and larger in all dimensions, the leaflets notably more glaucous and their margins undulate (wavy). Leaflets (9) 11–15 per leaf, mostly 5–8+ mm long. Floral bracts greenish, lanceolate, 0.8–1.6 mm wide. Calyx tube 2.5–3 mm long, the bristles (awns) 2.6–4.5+ mm long. Keel petals about as long as the calyx, thus hardly showing; wing petals entire, glandless.

Sandy plains with *Larrea* and *Ambrosia dumosa* in the extreme northwestern corner of the Gran Desierto in Sonora, closely approaching the southwestern part of the flora area in Cabeza Prieta and the Tinajas Altas Region. *Dalea mollissima* also occurs in Arizona near the western and northwestern limits of the flora area, as well as other dry regions of western Arizona, southern Nevada, northeastern Baja California, and southeastern California. They can be distinguished as follows:

1. Leaflet margins entire and flat; floral bracts 0.7–1 mm wide; calyx tube 1.8–2.4 mm long, the calyx teeth (bristles) 1.1–3.1 mm long; wing petals often notched and with a gland..... **Dalea mollis**
1. Leaflet margins undulate (wavy); floral bracts 0.8–1.6 mm wide; calyx tube 2.5–3 mm long, the calyx teeth (bristles) 2.6–4.5+ mm long; wing petals entire, glandless..... **Dalea mollissima**

**Dalea pogonathera** A. Gray var. **pogonathera**
Bearded prairie-clover. Figure 15.

Herbaceous perennials, often with slender stems from a thick, knotty rootstock; herbage and inflorescences gland-dotted; herbage glabrous. Leaves often to 2 cm long; leaflets mostly 5 or 7, linear to narrowly elliptic, less than 1 cm long. Flowers to 10 mm long, crowded on spikes often 3–10 cm long; calyces densely hairy with long, silky, brownish hairs; corollas purple; anthers bright orange and conspicuous. Flowering non-seasonally following rains. Pods 4 mm long, and with silky hairs.


Figure 15. *Dalea pogonathera* var. *pogonathera*. (A) Salero Ranch, Santa Cruz Co., 8 Aug 2013, photo by Sue Carnahan. (B & C) Portal-Paradise Road, Chiricahua Mts, Cochise Co., 2 Jul 2006, photos by Patrick Alexander (SEINet).

Scattered records from the Ajo Mountains to the west-central part of Organ Pipe where it is a western outlier from the main population. The nearest recorded population is in the Baboquivari Mountains.

Arizona to western Texas, and northern Sonora to Coahuila and Zacatecas. Another variety occurs eastward in Texas and northeastern Mexico.

**OP**: Near Dripping Springs, Puerto Blanco Mts, 2000 ft, gravelly soil along wash on desert plain, foothill palo verde association, 16 Apr 1952, *Parker 7922*. 50 Mile Drive near Quitobaquito, 26 Mar 1965, *Ranzoni 338* (ORPI). Estes Canyon, *Hesselberg 10 Apr 1966* (ASU). 2-way Puerto Blanco Drive, 10 mi W of Hwy 85, 11 Apr 1978, *Bowers 1223* (ORPI; essentially the same place as *Parker 7922*).

**Dalea pringlei** A. Gray var. **pringlei**
[*Thornbera pringlei* (A. Gray) Rydberg]
Pringle's prairie-clover. Figure 16.

Herbaceous perennials and also flowering in the first season or year, erect growing, 0.5–2 m tall, the stems generally straight, glabrous or sparsely pubescent near the inflorescences. Herbage, calyces, and pods gland-dotted. Foliage sparse; leaves glabrous, often 1.5–5 cm long with 13–29

leaflets. Floral bracts densely hairy. Flowers crowded in terminal spikes 2–9 cm long appearing furry with silky haired (silky pilose) calyces. Corollas purple; anthers yellow. Flowering in spring and with summer rains. Pods 2.5–3 mm long.

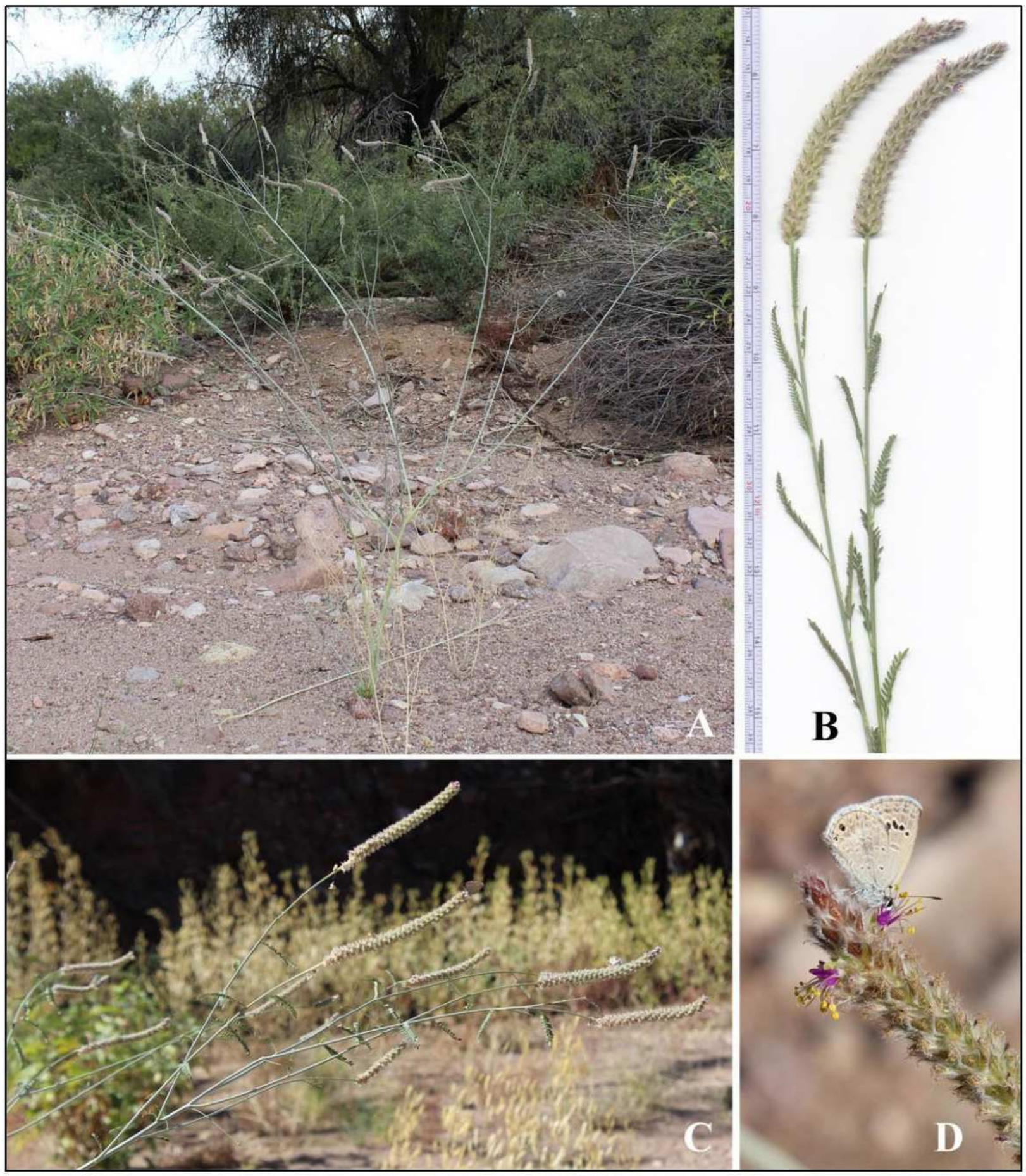


Figure 16. *Dalea pringlei* var. *pringlei*. Alamo Canyon: (A) 5 Nov 2013; (B–D) 20 Oct 2013.

Higher elevations in the Ajo Mountains, often on nearly barren rock, and Alamo Wash from the canyon area to below the Hwy 85 bridge.

Variety *pringlei* occurs eastward in southern Arizona and in northern Sonora. Two other varieties occur in southern Sonora, Sinaloa, and southwestern Chihuahua.

**OP**: Near top Mt Ajo, *Dakan 25 Jan 1973* (ORPI). Trail from The Cones to Mount Ajo, 4090 ft, 10 Apr 2005, *Felger 05-286*. Alamo Canyon, ⅓ mi upstream from Alamo Campground, 17 Oct 2013, *Rutman 20131017-5*.

**Desmodium**

Annuals, herbaceous perennials, shrubs, and a few trees. Flowers papilionoid; pods irregularly shaped. Nearly worldwide; 275 species.

**Desmodium procumbens** (Miller) Hitchcock

[*Hedysarum procumbens* Miller. *Desmodium procumbens* var. *exiguum* (A. Gray) B.G. Schubert. *D. procumbens* var. *transversum* (B.L. Robinson & Greenman) B.G. Schubert. *D. wigginsii* Schubert]

Western tick-clover. Figure 17.

Delicate summer annuals, often beneath trees and shrubs; usually short-lived and with very slender stems. Leaflets rough and dry to the touch due to minute hooked hairs. Leaves polymorphic, the earliest (lower) leaves with a single and broad leaflet, mid-stem leaves with 3 leaflets, the upper leaves with 1–3 narrow leaflets. Corollas pink, keel plus banner ca. 3–4 mm long; banner with a basal yellow-green "eyespot." Stamens 10, 9 united, 1 free. Pods unique, slender with minute hooked hairs, and often twisted or curled and resembling a string of cut-outs with 1-seeded triangular to somewhat square segments, and breaking apart between the segments. Reproductive August and September.

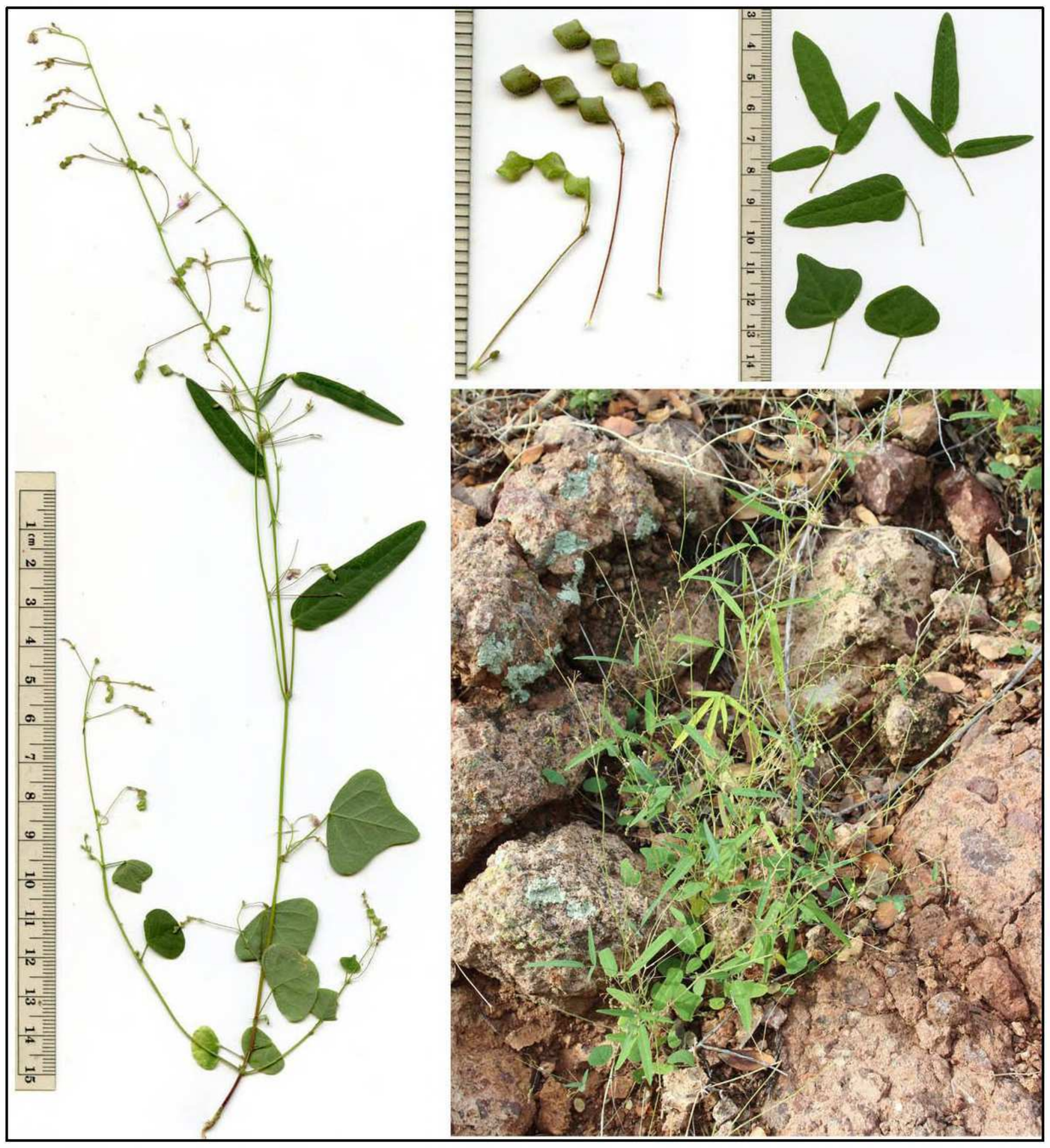

Figure 17. *Desmodium procumbens*. Bull Pasture Trail, 8 Sep 2014.

Ajo and Diablo mountains, mostly above 850 m; among rocks, along washes, and beneath trees and shrubs.

Eastward and northward in southern and central Arizona to New Mexico, Mexico to South America, the West Indies, and adventive in the Old World. If varieties are recognized, Arizona populations are var. *exiguum*. The varieties as well as species boundaries are poorly understood. *D. procumbens* is closely related to and perhaps not distinct from *D. neomexicanum* A. Gray, ranging from southeastern Arizona to Texas and South America.

**OP**: Bull Pasture, under shrubs, 20 Oct 1978, *Bowers 1549* (ORPI). Ajo Mts, saddle between Arch & Boulder Canyons, also common along the trail up N-slope to the saddle, 16 Sep 2006, *Rutman 2006-0916-2*. Diablo Mts, 2647 ft, shaded base of N-facing cliff, coarse colluvium, 22 Sep 2013, *Rutman 20130922-26*.

**Galactia**

Perennial herbs and vines. Flowers papilionoid. Nearly worldwide; 60 species.

**Galactia wrightii** A. Gray
Figure 18.

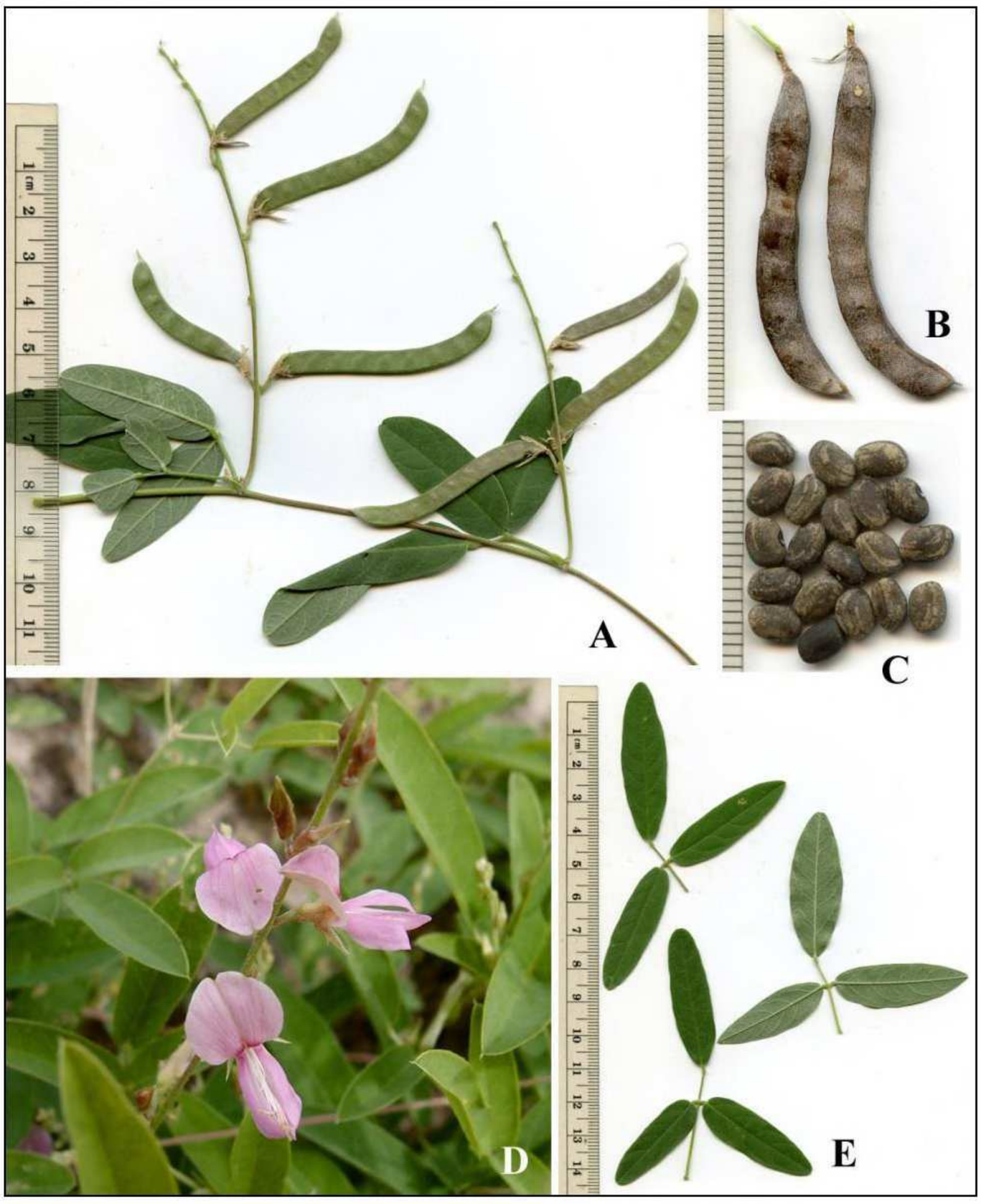


Figure 18. *Galactia wrightii*. Bull Pasture Trail: (A & E) 8 Sep 2014; (B & C) 19 Sep 2014. (D) Salero Ranch, Santa Cruz Co., 1 Aug 2013, photo by Sue Carnahan.

Herbaceous perennial vines from tough rootstocks. Leaves pinnately 3 foliolate, the leaflets usually oblong, variable with seasonal conditions; stipules small and deciduous. Inflorescences of several- to many-flowered racemes. Flowering at least August to October. Calyx 4-lobed, resulting from fusing of the upper 2 lobes, the lobes longer than the tube. Banner petal whitish with pink lines (nectar guides), other petals pale purple and pink. Stamens 10; 9 fused, 1 free. Pods slender, 5–6 cm long, straight to moderately curved, dehiscent with twisting valves. Seeds often 8–10 per pod, mottled black and brown.

Ajo Mountains above 850 m, often growing with *Quercus* and *Vauquelinia*.

Central Arizona to western Texas southward at least to Chihuahua and Sinaloa.

**OP**: Bull Pasture Trail, ca. 2800 ft, 20 Oct 1978, *Bowers 1543*. Arch Canyon, beneath arch, *Rutman 26 Sep 2002* (ORPI). Trail below Bull Pasture, NE-facing slope against wall of bedrock, common on mid-elevation and higher elevations of Ajo Mts, 22 Oct 2006, *Rutman 20061022-16*.

**Hoffmannseggia**

Unarmed perennial herbs and shrubs, generally with stalked glands. Leaves twice pinnate, the pinnae odd-pinnate; stipules small. Flowers caesalpinioid, in terminal racemes or panicles. Flowers yellow, the petals often red-flecked. Stamens 10, separate. Pods flattened, tardily dehiscent or indehiscent.

Southern USA and Mexico, and South America; 21 species.

1. Herbaceous perennials with seasonal stems less than 30 cm tall..... **Hoffmannseggia glauca**
1. Shrubs with perennial stems to about 1 m tall..... **Hoffmannseggia microphylla**

**Hoffmannseggia glauca** (Ortega) Eifert
[*Larrea glauca* Ortega. *Caesalpinia glauca* (Ortega) Kuntze]
Hog potato; *camote de ratón*; 'i:kovi. Figure 19.

Herbaceous perennials from deep rhizomes and edible, small, potato-like tuberous roots; herbage with stalked, reddish glands and short, white hairs. Stems renewed annually or seasonally, usually several, ca. 15–20+ cm tall including the terminal inflorescence. Leaves several near the stem base, twice pinnate, 6–12 cm long, long petioled, with (7) 9 or 11 pinnae, the terminal pinna longest and with as many as 11 leaflet pairs, the other pinnae with 4–9 leaflet pairs; leaflets oblong, 2.8–5.5 (7) mm long. Inflorescences, flowers including sepals, petals, and filaments, and pods dotted with stalked glands, these sometimes red. Flowers in terminal racemes, the petals predominantly yellow-gold, the upper, keeled petal spotted red, stamens 10, separate, often red, and shorter than the petals. Pods 2.5–3 cm long, compressed, glandular, indehiscent to tardily dehiscent, and readily deciduous; several-seeded. Flowering during warm weather.

Locally abundant in clay soils of the large internally draining playas in Cabeza Prieta.

Southeastern California to Kansas and southward to both states of Baja California and northern Sonora to San Luis Potosí; also Peru, Chile, and Argentina.

The tuberous "potato-like" roots, or "wild potatoes," were cooked and eaten by the Cocopahs, Quechans (Yumas), Gila River Pimas, and others (Castetter & Bell 1951; Chittenden 1901; Forde 1931; Gifford 1933). The Gila River Pimas sometimes got the tuberous roots from a ground squirrel's cache during plowing (Rea 1997).

**CP**: Pinta Playa, *Phelps 9 Oct 1977*. Las Playas: 11 Apr 1978, *Reeves 6806*; 28 Nov 2001, *Felger 01-556*.

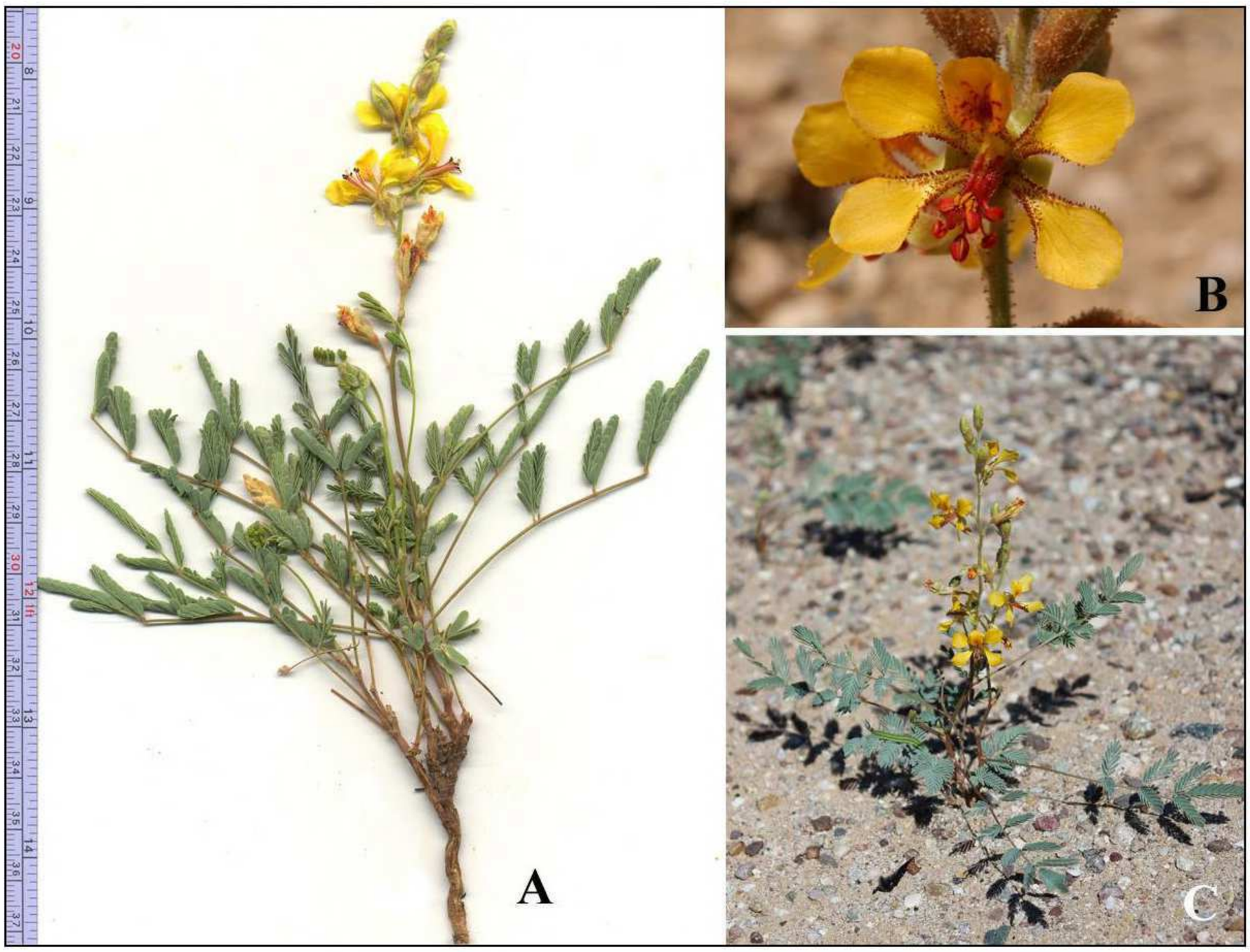


Figure 19. *Hoffmannseggia glauca*. (A & C) Ajo, 12 Sep 2013. (B) Dog Canyon Trailhead, Big Bend National Park, TX, 16 Apr 2007, photo by Patrick Alexander (SEINet).

**Hoffmannseggia microphylla** Torrey
[*Caesalpinia virgata* Fisher] Figure 20.

Shrubs to about 1 m tall, with many slender, rush-like slender stems and sparse foliage. New shoots, leafstalks, inflorescences, and buds with short white hairs but not stipitate glandular, the leaflets sparsely hairy or glabrate. Leaves few and widely spaced, quickly drought deciduous, 1.5–4.5 cm long, with 3 pinnae, the terminal one with 6–11 leaflet pairs, the lateral pinnae with 3–9 leaflet pairs; leaflets 2–3 (5) mm long. Inflorescences reaching 10–25 cm long. Flowers 13–15 mm wide, yellow, the banner with a yellow-brown or reddish arc, the sepals becoming orange with age. Pods 1.5–2 cm long, crescent-shaped, densely dotted with thick-stalked yellowish glands. Flowering various seasons including spring.

This species approaches the Tinajas Altas Region at the Fortuna Mine site on the west side of the Gila Mountains.

Southwestern Arizona, northwestern Sonora, southeastern California, and northeastern Baja California.

**Yuma Co**.: Foot of the Fortuna Mts (W side), 27 Mar 1935, stony wash, *Aven Nelson & Ruth A. Nelson 1298* (RM). Gila Mts near Fortuna Mine, 21 Feb 1979, *Bowers 1588*.


Figure 20. *Hoffmannseggia microphylla*. (A & B) Mecca Hills, Riverside Co., CA, 25 Feb 2012. (C) Near Cactus City Rest Area, Riverside Co. 9 Feb 2012. Photos by Keir Morse (CalPhotos).

*Lotus*, see **Acmispon**

**Lupinus** – Lupine, *lupino*

Spring annuals in the flora area (elsewhere also herbaceous perennials and shrubs). Leaves digitately compound, leaflets 5–13 (those in the flora area); stipules fused to petiole base. Flowers papilionoid, in terminal racemes. Stamens 10, the filaments fused (monodelphous), the anthers dimorphic (every other one longer and basifixed or shorter and versatile). Pods laterally compressed, several-seeded and obliquely depressed between the seeds, elastically dehiscent, the valves coiling to eject the seeds. Seeds resembling pebbles. Lupines have been in the flora area for at least 10,000 years. Both hemispheres; 220 species.

1. Leaflets narrow — linear to narrowly obovate or narrowly elliptic, the tips acute; flowers bright blue with a white "eye" spot on the banner petal..... **Lupinus sparsiflorus**
1. Leaflets relatively broad—obovate to elliptic, the tips mostly blunt to broadly rounded, often notched or apiculate; flowers pink to lavender-pink or pale blue (not bright blue).

2. Plants, especially the leaves, often essentially glabrous or sparsely to moderately hairy, the upper leaflet surfaces glabrous, the lower surface often hairy; flowers not minute, lavender-pink to pale blue..... **Lupinus arizonicus**
2. Plants conspicuously and densely hairy including both upper and lower leaflet surfaces; flowers minute, pink..... **Lupinus concinnus**

**Lupinus arizonicus** (S. Watson) S. Watson
[*L. concinnus* var. *arizonicus* S. Watson. *L. arizonicus* subsp. *sonorensis* J.A. Christian & D.B. Dunn]
Arizona lupine; *lupino*; tas ha:hag. Figure 21.

Plants 12–60+ cm tall, the herbage often semi-succulent, with relatively coarse hairs and the leaflets moderately hairy or glabrate. Stems mostly erect to ascending, solitary to much-branched. Leaflets (5) 7–9 per leaf, (13) 15–37 × 4–12 mm, obovate, the tip mostly blunt to broadly rounded

and sometimes notched to apiculate (with a soft, blunt projection at the tip). Flowers pale lavender-pink, rarely white, the corollas 7–9 mm long. Pods (9) 15–24 mm long. Seeds 4–6 per pod, 2.8–3.1 mm long, smooth and marbled.

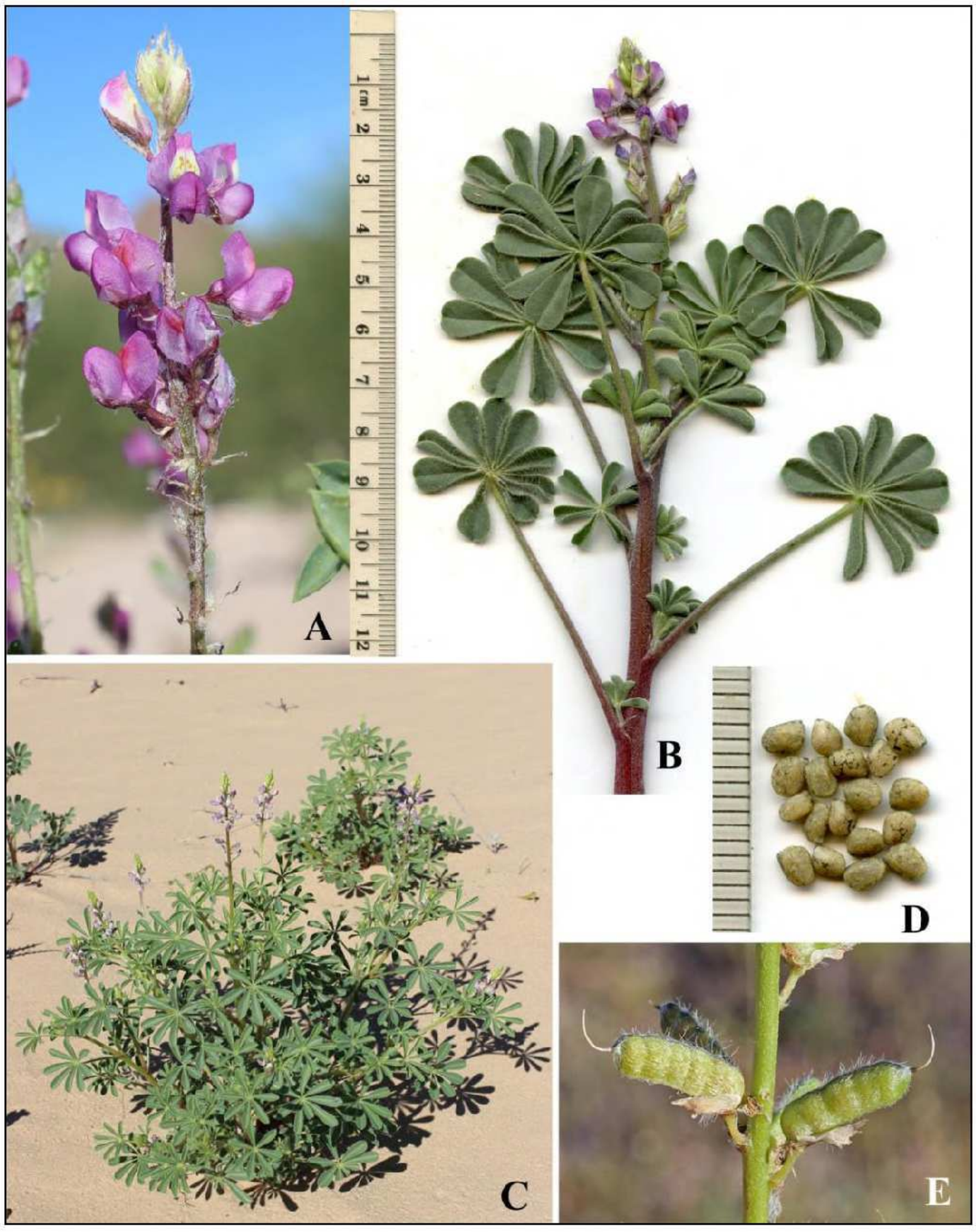


Figure 21. *Lupinus arizonicus*. (A) Hat Mtn area, Sauceda Mts, 22 Mar 2014. (B) Puerto Peñasco, 19 Feb 2015. (C) Dunes S of Sierra Blanca, Pinacate Biosphere Reserve, 15 Feb 2014. (D & E) Midway Wash at Hwy 85, Maricopa Co., 8 Mar 2015.

Widespread through the flora area in lowland habitats, especially washes, upper bajadas, sand flats and dunes, as well as often on rocky slopes; often abundant during favorable years in the western part of the region, and generally scarce towards the eastern part of Organ Pipe.

Southwestern Arizona and southeastern California to the Cape Region of Baja California Sur and coastal Sonora southward to the vicinity of Tastiota (28°20′N).

**OP**: Bates Well, *McDougall 21 Mar 1941*. S end of Cipriano Pass, 1350 ft, 30 Mar 1978, *Bowers 1113*. Aguajita Wash, 6 Apr 1988, *Felger 88-284*.

**CP**: Tule Tank, 23 Mar 1935, *Peebles 10891*. 3 mi E of Pinacate Lava Flow, 14 Apr 1964, *Niles 347*. Charlie Bell Pass, 3 Apr 1992, *Whipple 3913*. Bassarisc Tank, 26 Feb 1993, *Felger 93-119*.

**TA**: Tinajas Altas, *Van Devender 25 Mar 1983*. Tinajas Altas Mts, Surveyors Canyon, canyon bottom below Surveyors Tank, 29 Mar 2010, *Felger 10-212*.

**Lupinus concinnus** J. Agardh
[*L. concinnus* var. *orcuttii* (S. Watson) C.P. Smith]
Bajada lupine. Figure 22.

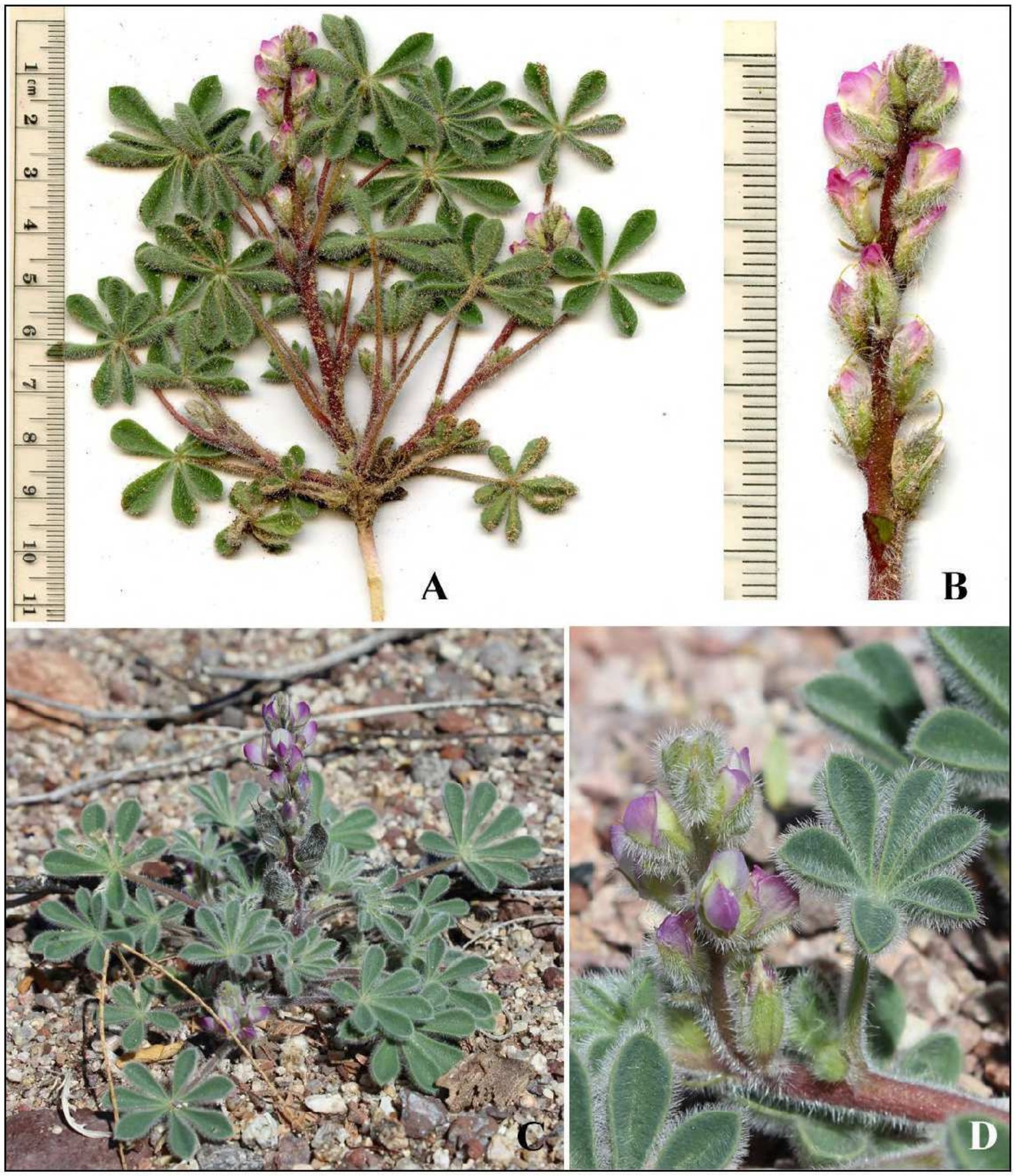


Figure 22. *Lupinus concinnus*. (A & B) Midway Wash at Hwy 85, Maricopa Co., 8 Mar 2015. (C) Kuakatch Wash near Hwy 85, 3 Mar 2014. (D) Alamo Wash near Hwy 85, 26 Feb 2014.

Plants notably woolly (pilose), with long slender hairs, the leaves crowded and the stems usually short, the plants generally less than 15 cm tall. Leaves with 5–9 leaflets. Flowers crowded on spike-like racemes often shorter than the leaves. Corollas small and pink, the banner with a white or yellowish spot. Pods 1–1.5 cm long. Seeds 3–5 per pod.

Often on gravelly-sandy soil of open washes; widespread across the lowlands of the Arizona Upland region of Organ Pipe and the east side of Cabeza Prieta, and occasionally at higher elevations.

California to Utah and west Texas, Baja California, and northern Sonora.

**OP**: Growler Canyon, Bates Mts, 30 Mar 1979, *Bowers 1601*. Alamo Wash at bridge [Hwy 85], *Beale 1 Mar 1986* (ORPI). W branch of Cuerda de Leña at N boundary, *Rutman 16 Mar 1995* (ORPI). Alamo Canyon, 29 Mar 2003, *Felger* (observation). Trail from The Cones to Mount Ajo, 4090 ft, 10 Apr 2005, *Felger 05-287*.

**CP**: Charlie Bell Road at Daniels Arroyo, 10 Apr 1993, with *L. arizonicus* and *L. sparsiflorus*, *Felger 93-349*.

**Lupinus sparsiflorus** Bentham

[*L. sparsiflorus* subsp. *mohavensis* Dziekanowski & D.B. Dunn. *L. sparsiflorus* var. *mohavensis* Welsh]

Coulter's lupine, desert lupine. Figure 23.

Plants 12–45 cm tall, with coarse white to golden yellow hairs. Stems erect to ascending, solitary to much-branched. Leaflets 6–10 per leaf, 11–40 × 2–6 mm, linear to narrowly obovate or narrowly elliptic, the tips mostly acute. Flowers showy, the corollas 8–11 mm long, bright blue with a white blotch (eye) surrounding a yellow area with dark spots at the base of the banner. The white blotch becomes pink or violet when the flower is pollinated (Figure 23E & F). Pods 10–23 mm long. Seeds 3–8 per pod, 2.4–2.8 mm long, smooth (but less so than in *L. arizonicus*), tan, and marbled.

Washes, roadsides, hills, and mountains; Ajo Mountains, where it is the most common lupine and extends to higher elevations. Widespread in Organ Pipe except the more arid, lower elevations, and in the eastern part of Cabeza Prieta.

Arizona, northern Sonora, southern Nevada, southwestern Utah, and southern California to Baja California Sur.

**OP**: Growler Mts, *Crooks 31 Mar 1937*. Tres Alamos Canyon, 2700 ft, *Nichol 4 Feb 1939*. Pozo Nuevo, 30 Mar 1978, *Bowers 1096*. Puerto Blanco Drive, near marker no. 10, 12 Apr 1978, *Bowers 1260*. Trail above Bull Pasture, 3220 ft, 10 Apr 2005, *Felger* (observation).

**CP**: 0.5 mi N of Papago Well, 16 Mar 1992, *Yeatts 3222* (CAB). Bassarisc Tank, 26 Feb 1993, *Felger 93-120*. Charlie Bell Road near E boundary of Refuge, 9 Apr 1993, *Felger 93-327*. 4.7 mi E of Tule Well, 11 Apr 1993, *Felger 93-443*.

**†Lupinus sp./spp.**

**OP**: †Puerto Blanco Mts, seeds and seed fragments, modern (30) to 9860 ybp (7 samples).

**TA**: †Butler Mts, fruits, calyx, seeds, 740 & 3820 ybp. Tinajas Altas, seeds, 1230 to 9900 ybp (9 samples).

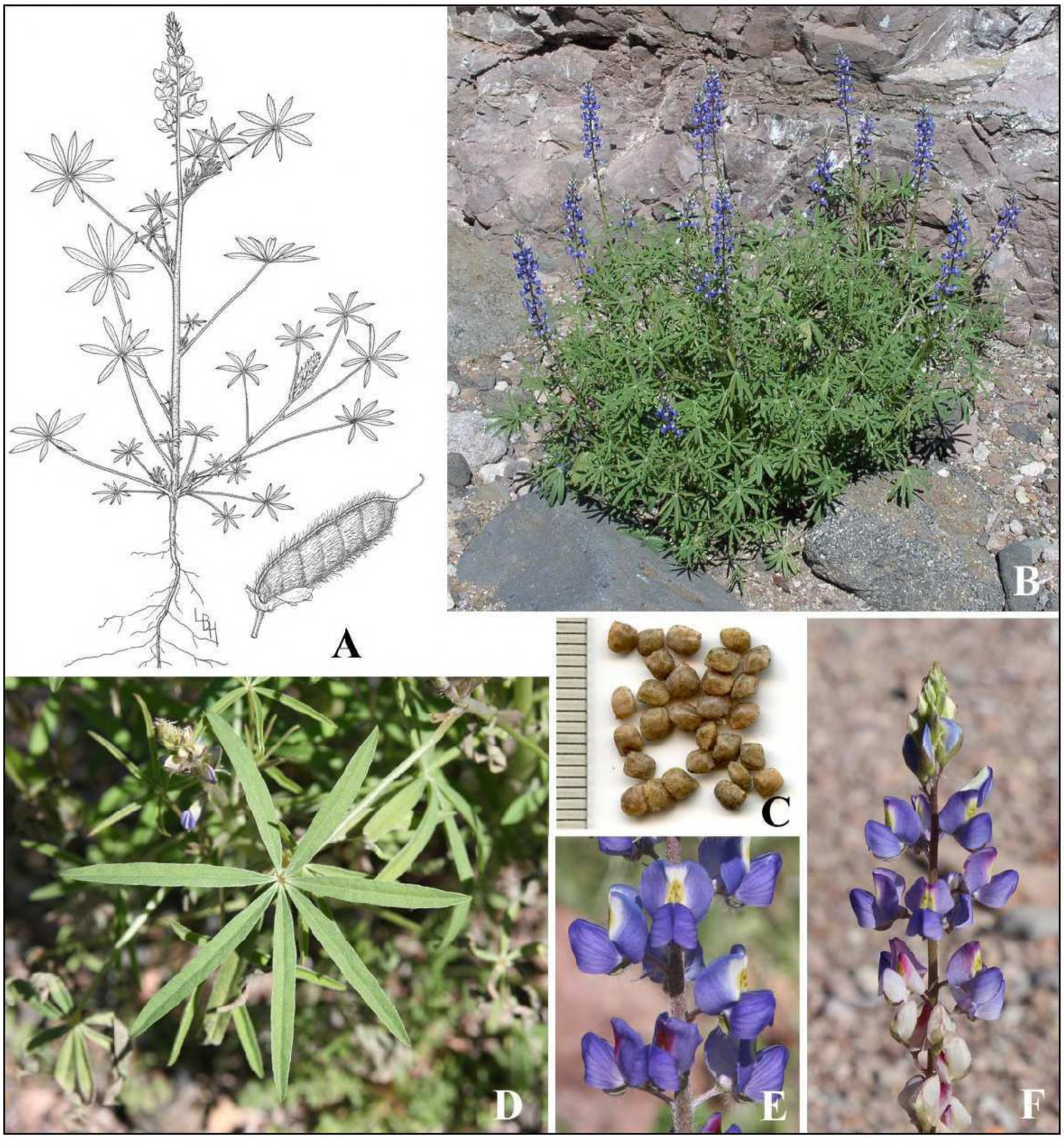


Figure 23. *Lupinus sparsiflorus*. (A) By Lucretia Breazeale Hamilton. (B) Pomeroy (aka Coffeepot) Wash at the Pipeline Road, Sauceda Mts, Maricopa Co., 27 Feb 2005. (C) Midway Wash at Hwy 85, Maricopa Co., 8 Mar 2015. (D) Coffeepot Mountain, Maricopa Co., 27 Feb 2005. (E) Estes Canyon, 2 Mar 2008. (F) Alamo Wash near Hwy 85, 26 Feb 2014.

**Marina**

Annuals, herbaceous perennials, and shrubs. Flowers papilionoid. Southwestern USA to northern South America; 38 species. A genus segregated from *Dalea*.

**Marina parryi** (Torrey & A. Gray) Barneby
[*Dalea parryi* Torrey & A. Gray]
Parry dalea, Parry's false prairie-clover. Figure 24.

Non-seasonal ephemerals, mostly growing with winter-spring rains, or occasionally short-lived perennials; with a yellow taproot. Stems erect to spreading, commonly 30–50 cm long,

sometimes reproducing at only 8–10 cm, rarely reaching 1.5 m across; dotted with maroon glands. New shoots usually densely pubescent with short, firm, appressed hairs, but during summer rainy seasons the plants sometimes becoming glabrate with only the stem tips pubescent. Leaves odd-pinnate, the terminal leaflet stalked; leaflets marked on upper surfaces with tiny wavy lines representing veins (these sometimes difficult to see on small leaflets of drought-stressed plants); leaves 2.5–3.5 cm long, green to grayish depending on density of hairs, the leaflets 13–29 per leaf, 1.5–6.5 mm long, underside dotted with glands. Small bracts subtend the buds but fall away before the flowers open. Flowers 2.8–5.9 mm long. Calyx 2.5–3.5 mm long, densely hairy but with a wide range in density and length of hairs, 5-toothed and 10-ribbed with prominent rows of reddish glands between the ribs; calyx teeth markedly shorter than the tube. Corollas dark blue and white. Stamens 9 or 10. Pods 1.8–2.5 mm long, 1-seeded.

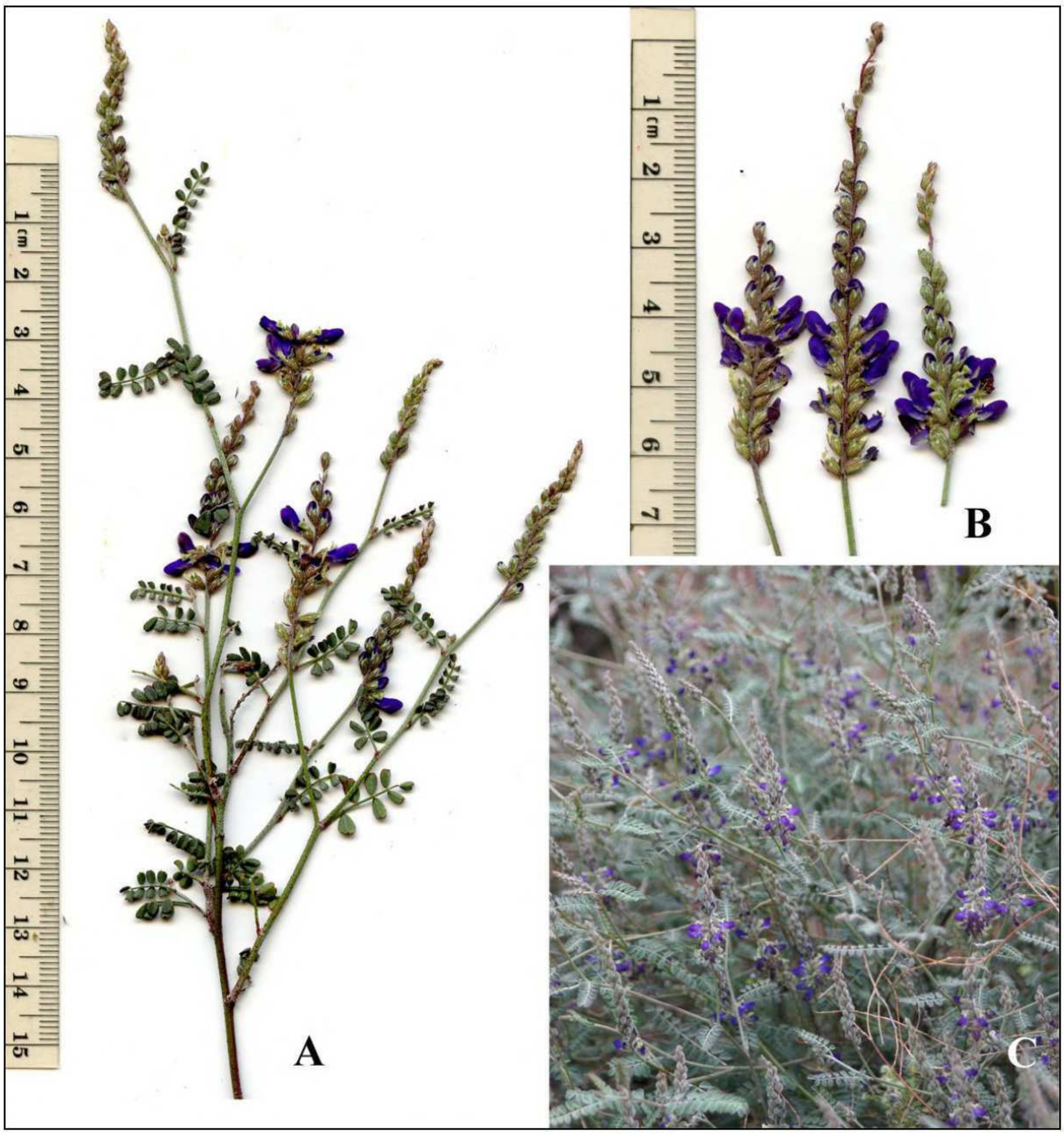


Figure 24. *Marina parryi*. (A & B) Ajo, 23 Mar 2015. (C) Estes Canyon, 18 Mar 2005.

Organ Pipe and Cabeza Prieta in many habitats including washes, plains, and rocky slopes. It was in the Puerto Blanco Mountains 9900 years ago.

The geographic range nearly coincides with the boundaries of the Sonoran Desert as defined by Shreve (1951), and over most of the region it is the only species of *Marina* present.

**OP**: Walls Well, *Nichol 28 Apr 1939*. Sinita Basin, 23 Mar 1969, *Keil 15424* (ASU). Alamo Canyon, 3 Dec 1977, *Bowers 986*. Aguajita, arroyo, 13 Sep 1986, *Felger 86-286*. †Puerto Blanco Mts, fruit, 9860 ybp.
**CP**: Agua Dulce Mts, 8 Apr 1979, *Lehto L23603* (ASU). Surprise Canyon, Cabeza Prieta Mts, 10 Mar 1984, *Hodgson 2736* (DES). E Pinta Sands, 15 Sep 1992, *Felger 92-755* (ASU, NY). About ¼ mi W of Chico Suni Well, in drainage, 2 Feb 2003, *Rutman 2003-16*.

## *Medicago

Annuals, herbaceous perennials, and shrubs. Flowers papilionoid. Mediterranean and Asia; 80 species.

### **Medicago polymorpha** Linnaeus

[*M. hispida* Gaertner]
Burclover. Figure 25.

Annuals with decumbent, spreading branches. Leaflets 3. Flowers small and yellow. Pods less than 1 cm wide, bur-like and coiled, with several seeds.

Uncommon garden weed in disturbed habitat at Organ Pipe headquarters. Widespread weed, native to the Mediterranean region.

**OP**: Resource Center, 28 Feb 1985, *Bennett 8681* (ORPI). Research Center, not common, 30 Mar 1988, *Felger 88-142B* (ORPI).

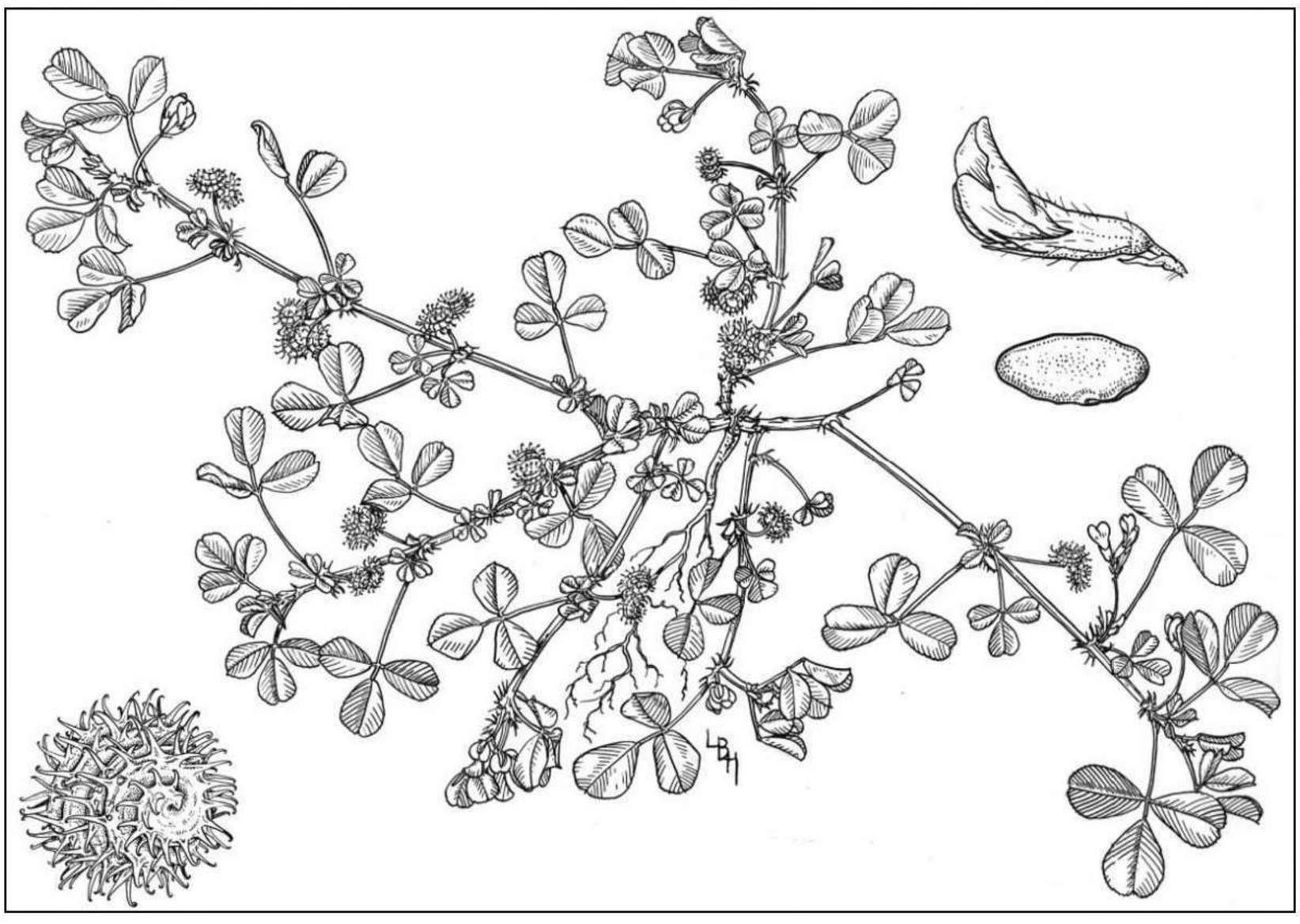

Figure 25. *Medicago polymorpha*. By Lucretia Breazeale Hamilton.

***Melilotus**

Annuals and herbaceous perennials. Flowers papilionoid. Mediterranean and Asia; 20 species.

***Melilotus indicus** (Linnaeus) Allioni
[*Trifolium melilotus* var. *indicum* Linnaeus]
Yellow sour-clover; yellow sweet-clover; *trébol agrio*; pu:wl. Figure 26.

Non-seasonal annuals; glabrous, the stems mostly erect to ascending; the dry herbage fragrant. Leaflets 3, each 1–3 cm long, ovate to obovate, the margins serrated mostly toward the tip, or occasionally some leaflets essentially entire. Flowers yellow and fragrant, 3–4.5 mm long, turning downward after anthesis, in spike-like racemes. Pods 2.5 mm long, indehiscent, reflexed, ovoid, and wrinkled; 1-seeded.

Localized on moist soils at Quitobaquito and occasional weed in the residence area in Organ Pipe. Common in disturbed wetland habitats in Sonora just south of Quitobaquito including sandy riverbanks and floodplain of the Río Sonoyta and in Sonoyta.

Widespread weed, native to the Mediterranean region.

**OP**: Quitobaquito: 25 Mar 1944, *Clark 11511* (ORPI); 30 Mar 1979, *Bowers 1607*; Common along irrigation ditch below pond, 26 Apr 1990, *Felger 90-92* (ARIZ, ASU). Residence Area, 30 Mar 1988, *Felger 88-142*.

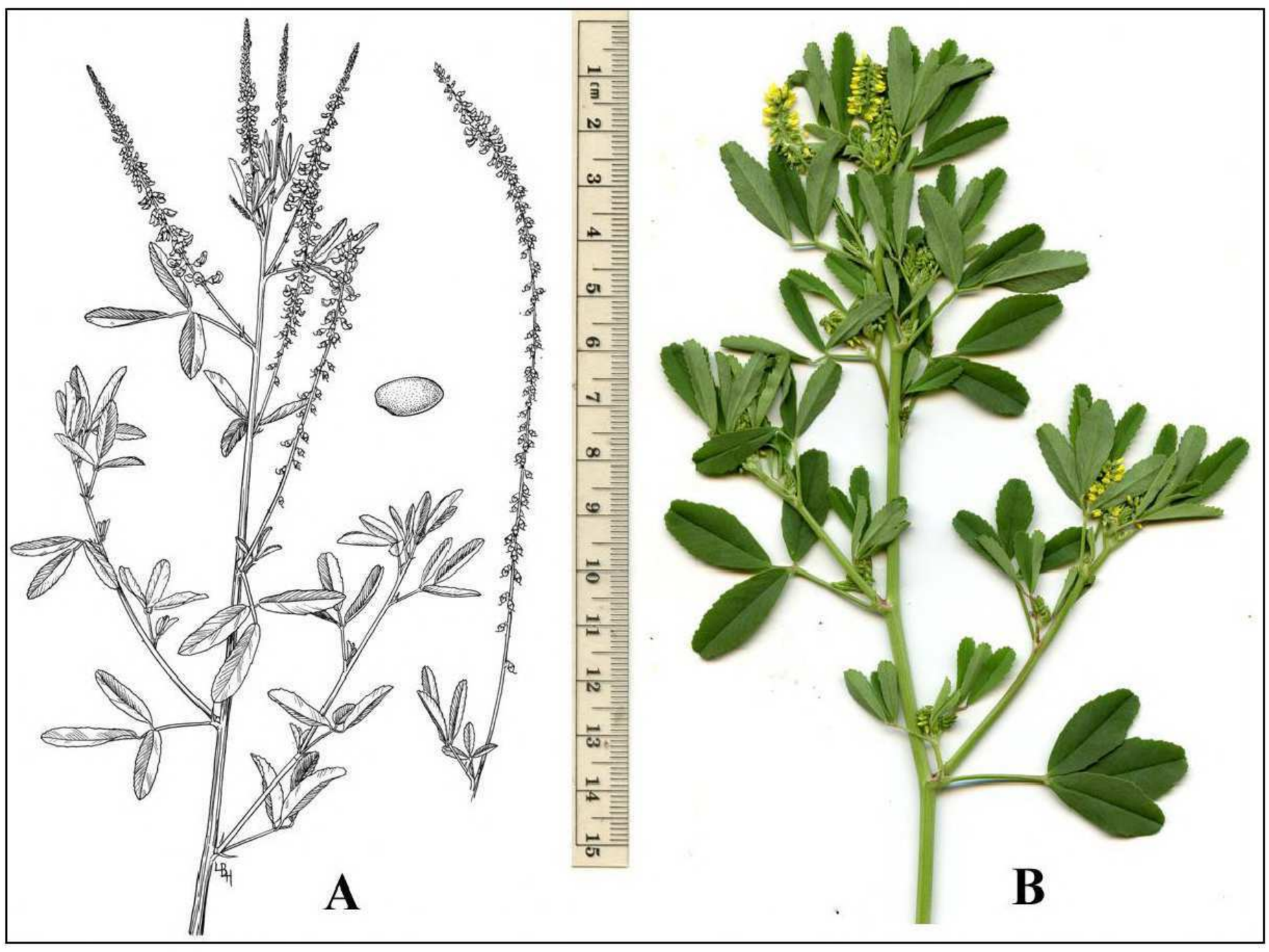


Figure 26. *Melilotus indicus*. (A) By Lucretia Breazeale Hamilton. (B) Ajo, 13 Mar 2015.

**Mimosa**

Herbaceous perennials, shrubs, and trees. Flowers mimosoid. New World, mostly Neotropical; 530 species.

**Mimosa distachya** Cavanilles var. **laxiflora** (Bentham) Barneby
[*M. laxiflora* Bentham]
Arizona mimosa; *garabatillo, uña de gato*. Figure 27.

Shrubs to 2.6 m tall, the stems with sharp, recurved internodal prickles (spines) 2–3 (6) mm long or some stems or portions of stems unarmed. Leaves (3.5) 6–8 cm long, with 2–4 pairs of pinnae, twice pinnate; drought- and cold-deciduous. Flowers in cylindrical spike-like racemes; flowering with summer rains in August and September. Calyx pink. Stamens 8–10; filaments lavender-pink, fading to white, the anthers whitish. Pods 4.5–5.5 × 5–9 mm, multiple-seeded, forming 1-seeded, quadrangular segments separating from each other and from the rim.

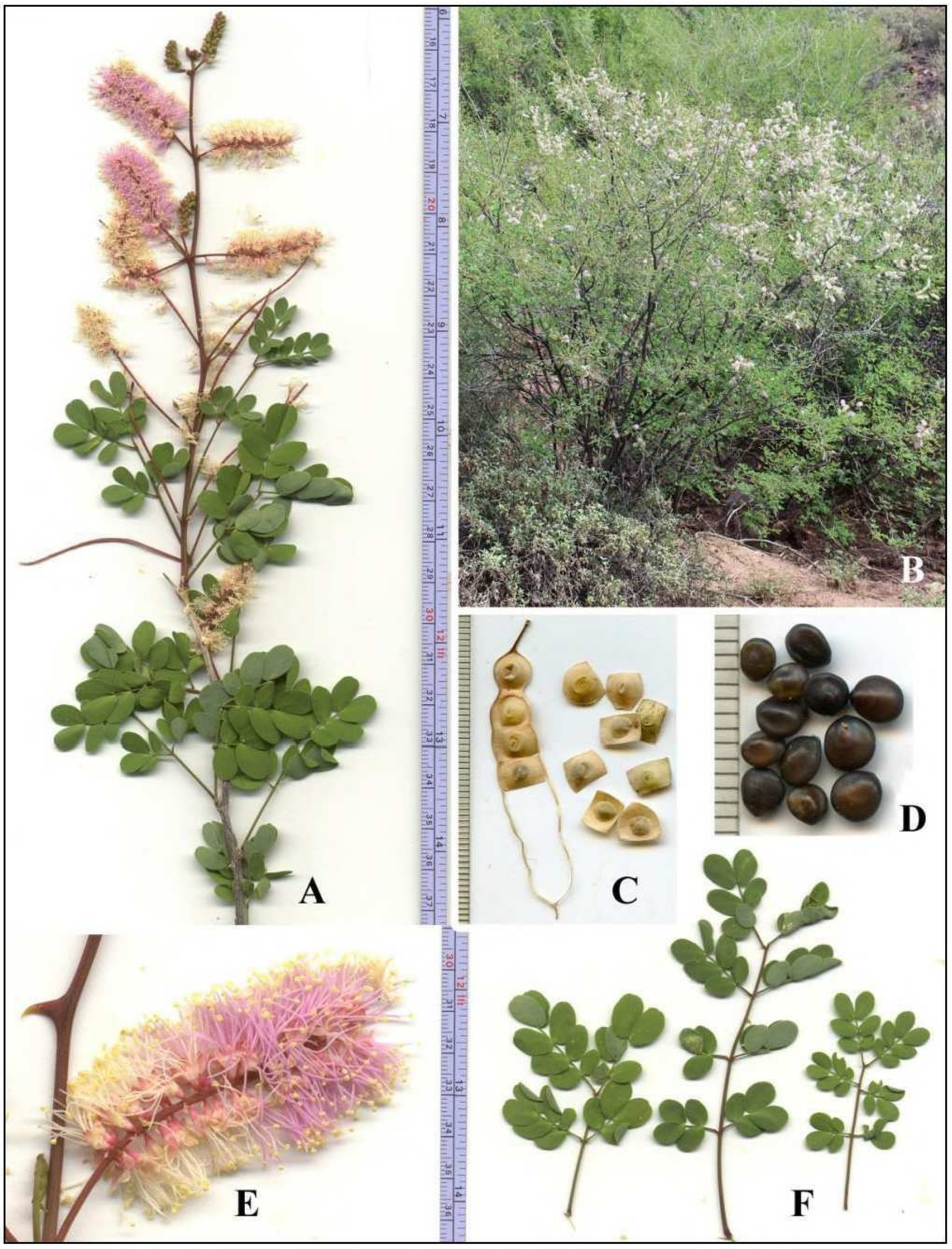


Figure 27. *Mimosa distachya* var. *laxiflora*. Ajo Mountain Drive, 0.5 mi S of Estes Canyon picnic area: (A, E, & F) 14 Aug 2013; (B) 2 Aug 2013; (C) 7 Sep 2014; (D) 12 Sep 2014.

Rocky slopes and canyon bottoms in the Santa Rosa, Diablo, and Ajo mountains. It is especially common at the base of Diaz Peak and Diaz Spire in the southern Ajo Mountains.

Var. *laxiflora* occurs in western Pima County, Arizona to Sinaloa and western Chihuahua. *Mimosa distachya*, with four varieties, extends to southern Mexico.

**OP**: Ajo Mts at International boundary [Santa Rosa Mountains], *Supernaugh 3 Aug 1947* (ORPI). Estes Canyon, wash, 2400 ft, 12 Sep 1978, *Bowers 1517*. Santa Rosa Mts at International boundary, *Rutman 29 Aug 2001* (ORPI). W side and base of Sierra Santa Rosa, 1640 ft, small canyon through black lava, shrubs 1.8-2.6 m tall, 12 Mar 2003, *Felger 03-306*. Small wash between Ajo and Diablo Mts, along Ajo Mountain Drive, S of Estes Canyon Picnic Area, 2320 ft, 8 Aug 2013, *Rutman 20130808-3*.

## Nissolia

Perennial vines and shrubs. Flowers papilionoid. Southwestern USA to South America; 13 species.

**Nissolia schottii** (Torrey) A. Gray
[*Chaetocalyx schottii* Torrey]
Schott's yellowhood. Figure 28.

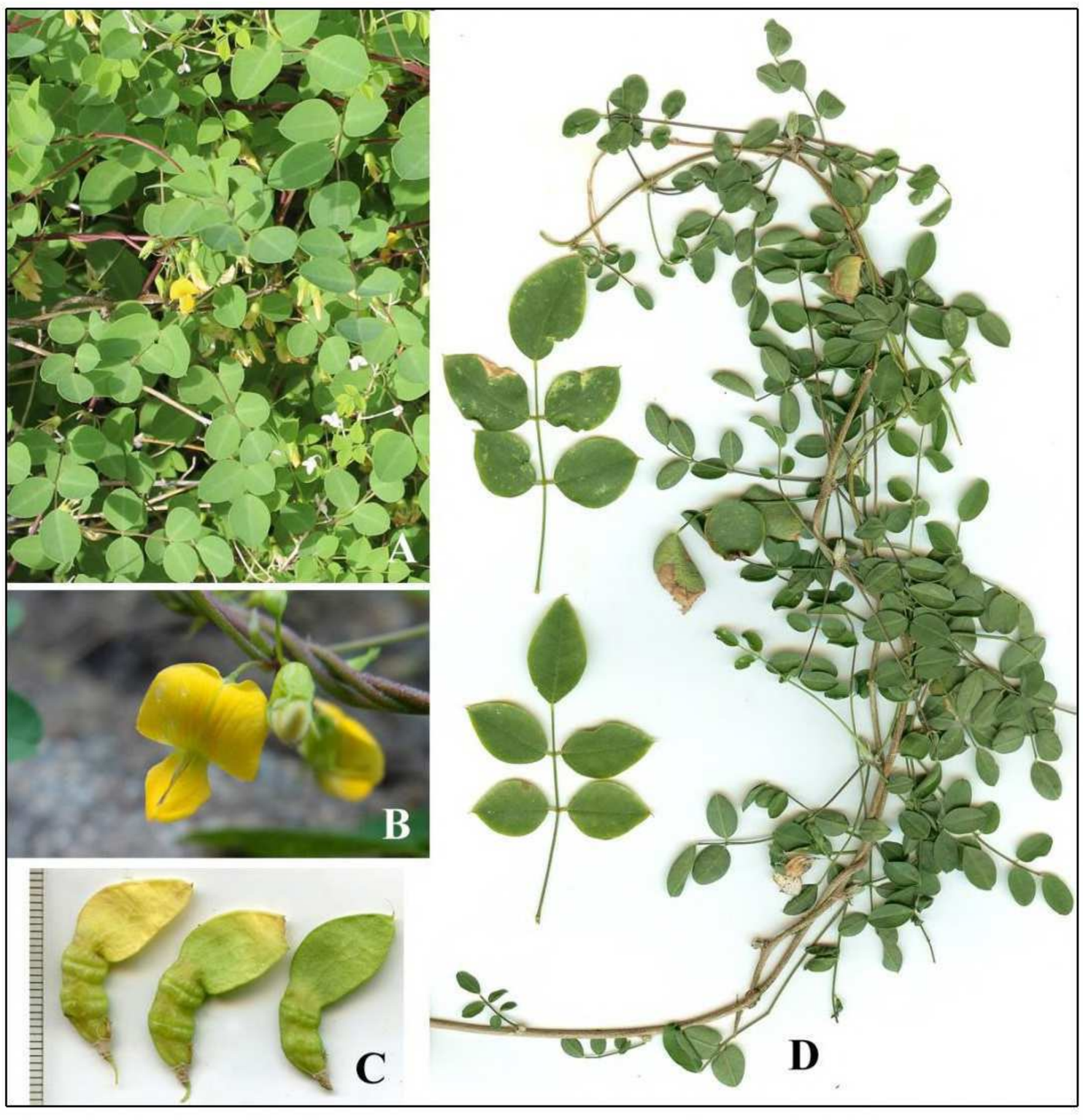


Figure 28. *Nissolia schottii*. (A) Arch Canyon, 2 Aug 2013. (B) Lower Josephine Canyon, Santa Rita Mts, Santa Cruz Co., 26 Jul 2013, photo by Sue Carnahan. Bull Pasture Trail: (C) 19 Sep 2014; (D) 16 Mar 2008.

Unarmed perennial vines, often twining on shrubs and trees; glabrous or glabrate. Leaves once pinnate with 5 leaflets, and gradually drought and winter deciduous. Leaflets broadly ovate or elliptic, 1–2 cm long, often with a mucronate tip; stipules inconspicuous. Flowers 1–5 in leaf axils; pedicels slender. Corollas bright yellow; banner petal with closely set vertical grooves giving a pleated appearance. Stamens 10, the filaments united into a tube. Pods indehiscent, papery-winged, and samara-like, with 1–3 (4) seeds. Flowering during warmer months, especially with summer rains.

Ajo and Santa Rosa mountains; common in canyons and on rocky slopes.

Eastward in southern Arizona and southward to southern Sonora and western Chihuahua.

**OP**: Bull Pasture Trail, 5 Nov 1977, *Bowers 939*. Arch Canyon, *Wirt 13 Oct 1990* (ORPI). Ajo Mts, crestline above middle fork of Alamo Canyon, 15 Mar 2003, *Rutman 2003-338* (ORPI). Diablo Mts, 2740 ft, shaded base of N-facing cliff, 22 Sep 2013, *Rutman 20130922-15*.

**Olneya**

This genus has a single species. Flowers papilionoid.

**Olneya tesota** A. Gray.

Ironwood, desert ironwood; *palo fierro, tesota*; ho'idkam. Figure 29.

Large shrubs or trees 5–8.5 (10) m tall, long-lived and slow growing, with 1 to several massive trunks, and dense foliage often bright green from June (after pods drop) to September and becoming grayish green after the summer, although often becoming leafless or nearly so prior to flowering in spring. Trunks have shredding gray bark, mid-sized branches have smooth gray bark, and branchlets are greenish. Herbage with dense, short, relatively coarse whitish hairs, the leaflets sometimes sparsely hairy and appearing glabrous except under magnification. Many twigs bear single or paired spines at the nodes, the spines (3) 4–11 mm long, slender to thickened at base, sharp, straight to slightly curved, or spines absent from some twigs. Leaves gradually deciduous in extreme drought or deciduous prior to flowering, odd- or even-pinnate, mostly 3–9 cm long. Leaflets opposite, subopposite, or sometimes alternate, 6–16 per leaf, (7) 10–20 mm long, oblong to mostly oblong-spatulate, often slightly asymmetric (especially toward base), the tip entire, notched, or sometimes with a minute apiculate projection.

Flowers pale to dark pink-lavender; mass flowering in late April and May during years of sufficient rainfall, attracting myriads of bees and other insects. Each tree or population might not flower each year. Inflorescence branches, pedicels, sepals, and portion of banner petal exposed in bud densely pubescent with short white hairs. Flowers ca. 1.5 cm long, pedicelled, in short, dense racemes or panicles. Calyx purple-brown, the lobes about as long as the tube, spreading at anthesis. Petals pinkish to purplish on exposed portions of the blades, white below. Banner petal with a thickened, succulent, white callus at junction of blade and claw, the flat blade of the banner folding back later in the day behind a protruding nectar guide. The nectar guide invaginated and chartreuse on the banner above the callus, with a whitish band surrounding and highlighting the nectar guide and margined with red-purple apically. Wing and keel petals reddish purple (darker than the other petals). Stamens 10, the filaments white, the upper stamen free, the others with the filaments united into a tube. Anthers yellow-orange. Style pale green, the distal portion with spreading hairs forming a pollen brush, the stigma yellow-orange like the anthers. Ovary densely studded with white, thick-stalked, globular glands except at its distal end.

Pods often 2–6 cm long, thick and mostly constricted between the seeds, with stout, glandular hairs and shorter non-glandular hairs; tardily dehiscent, the valves spreading from the tip and not twisting. The pods are yellowish brown until mature, when they become a cinnamon color

and harden. The valves open with a snap in the early morning light but most seeds remain inside. Seeds 1–4 (6) per pod, ca. 7–8 mm long, ellipsoid, mostly 50% longer than wide, dark purplish brown, and darkly mottled.

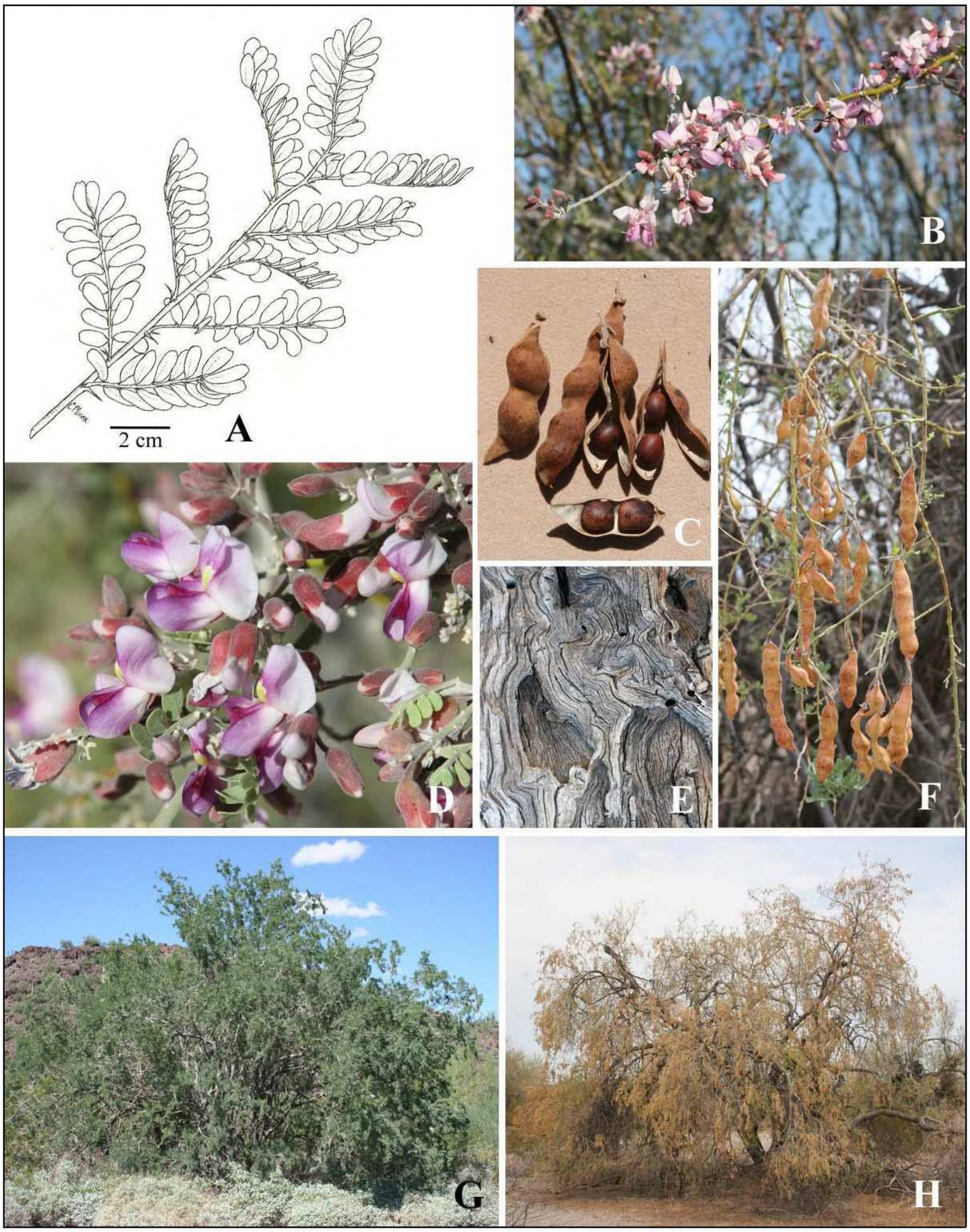


Figure 29. *Olneya tesota*. (A) By Cathy Moser Marlett. Organ Pipe headquarters: (B & D) 14 May 2006; (C) 5 Aug 2006; (E) 10 May 2005; (G) 15 Sep 2008. (F & H) Near international boundary, La Abra Plain, 3 Jul 2006; this tree, with a massive crop of pods, is nearly leafless.

Widespread along washes, major drainageways, bajada-plains, mountain canyons, and infrequent and usually of smaller stature on rocky slopes. A number of mighty ironwoods in the Tinajas Altas Region are scattered about the arroyo-wash between the Mesa del Muerto and the lower tinajas. The largest known ironwood in the region is more than 10 m tall with a massive trunk (photo in Felger et al. 2012). The 9900-year-old Tinajas Altas record is the oldest known for ironwood.

Southeastern California to the Cape Region of Baja California Sur and southwestern Arizona to southwestern Sonora; essentially endemic to the Sonoran Desert but extending beyond the desert in the lowland thornscrub of the Cape Region and in southwestern Sonora. *Olneya* seeds are smaller in the north (Arizona) than in the south (southern Sonora), seeming to represent a latitudinal cline in seed size and weight (Felger 1979: 17). *Olneya* has no obvious close relative. Matt Lavin's work (Lavin 1988; Lavin & Sousa 1995) places *Olneya* with a group of genera including *Coursetia* that are of South American origin.

*Olneya* is one of the most common and important trees in the region and one of the longest-lived trees in the Sonoran Desert. It has long been an important source of wood and fuel. Many large, axe- or saw-cut ironwood stumps can be seen throughout the region, especially along old roads. Edward Havins (pers. comm. to Sue Rutman, 2001) said that fuel wood was so limited in the 1920s and 1930s that people were stealing dynamite from the (Ajo) mine and blowing up ironwood trees. There are very few large, old ironwoods left in the flora area because of woodcutting. The open niches left by ironwood removal were taken by palo verdes and mesquites, which are not as long-lived and do not have the habitat structure that some birds prefer, e.g. cactus ferruginous pygmy-owl. Bryan (1925: 422) wrote that, at Tinajas Altas, "A few palo verde or ironwood trees are still standing and may furnish horse feed, but the traveler should bring his own firewood." *Olneya* is one of the favorite foods of desert bighorn and many small mammals and a prominent "nurse plant" for cacti, especially saguaros, and numerous other plant species (e.g., Turner et al. 1995). Tim Tibbitts was monitoring Sonoran pronghorn in the Valley of the Ajo on 13 May 2013 and watched them eat *Olneya* and *Parkinsonia microphylla* flowers as well as *Phoradendron californicum* for hours. There are other, unrelated trees in different regions that are also called ironwood because they have extremely hard wood, so dense that it does not float in water.

Ironwood seeds, harvested in early summer, were probably a significant resource. It is one of the few Sonoran Desert foods that was cooked in changes of water, or water-leached (Castetter & Bell 1951; Felger & Moser 1985). The seeds were variously prepared for food, including by the Hia-Ced O'odham (Felger 2007a). "They would roast the seeds and grind it and eat it" (Betty Melvin, in Zepeda 1985: 82, also 47, 59). Lumholtz (1912: 331) reported the seeds "were toasted, ground, and consumed as pinole." An infusion of the sapwood was drunk by the Seris as an emetic, to prevent breathing hard when running and to obtain power or visions during the vision quest (Felger & Moser 1985). The extremely hard wood was used in many ways, including as digging sticks with fire-hardened points, fences, firewood, house posts, musical rasps, utensils, and war clubs (Castetter & Bell 1942; Castetter & Underhill 1935; Gifford 1933; Rea 1997) and by the Seris for sculptures (e.g., Felger & Moser 1985).

**OP**: Quitobaquito, *Nichol 28 Apr 1939*. Alamo Canyon, 20 Apr 1942, *Cooper 577*. 3 mi N of Bates Well, *Tinkham 23 Apr 1942*. South Puerto Blanco Drive 2.5 mi W of Hwy 85, 11 Aug 1990, *Felger 90-403*. †Puerto Blanco Mts, on ridge, twigs with spines, leaflets, 1910 to 7560 ybp (8 samples).

**CP**: Observations: Agua Dulce Mts, Little Tule Well, 12 Jun 1992, *Felger*; Bajada on N side of Sheep Peak, 31 Jan 1992, *Felger*.

**TA**: Tinajas Altas, wash just E of the tinajas, 20 Nov 2008, *Felger 08-171*. Frontera Canyon, 18 Mar 1998, *Felger* (observation). †Butler Mts, spines, leaves, fruits, 740 to 8570 ybp (3 samples). †Tinajas Altas, twigs with spines, leaflets, 1230 to 9900 ybp (4 samples).

**Parkinsonia** – palo verde

Trees and large, heavy-branched shrubs with smooth green bark (except older branches and trunk) and relatively soft wood. Twigs with paired stipular spines, or stipular spines absent and the twigs spinescent. Short shoots very reduced. Leaves twice pinnate with 1–3 pairs of pinnae, petioled or the pinnae sessile and the leaves then appearing once pinnate. Leaflets small, the leaflets and leaves quickly drought deciduous, the leaflets often falling independently. Flowers caesalpinioid and showy, produced in prodigious quantities in spring; banner petal yellow or whitish and often with orange spots or flecks, and often becoming orange or orange-flecked with age, the other petals yellow. Stamens 10, separate; anthers orange. Pods ripening in early summer, indehiscent to tardily partially dehiscent, seeds 1–several.

Botanical bickering about the approximately 12 species belonging to a single genus (*Parkinsonia*) or two genera (*Cercidium* and *Parkinsonia*) had been going on for more than a century, although most recently the one-genus camp has won as the species form a strongly monophyletic taxon (e.g., Haston et al. 2005; Hawkins et al. 1999; Krings, accepted for publication). *Parkinsonia* in the narrow sense includes three species in Africa plus *P. aculeata* widespread in both hemispheres. *Cercidium* ranges from the southwestern USA to Argentina. Selection of a hybrid found in the Tucson region, a cultivar called "Desert Museum," involves hybridization of *P. aculeata, P. florida,* and *P. microphylla* (Dimmitt 1987). It is propagated by cuttings and widely planted in southern Arizona.

1. Leaves more than (10) 20 cm long..... **Parkinsonia aculeata**
1. Leaves less than 7 cm long.

2. Twigs not spinescent at tip; solitary or paired axillary spines often present; leaves petioled, the leaflets mostly 5–9 mm long..... **Parkinsonia florida**
2. Twigs spinescent at tip; axillary spines absent; petiole absent, leaves with two sessile pinnae, the leaflets mostly 1–3.5 (6) mm long..... **Parkinsonia microphylla**

****Parkinsonia aculeata** Linnaeus

Mexican palo verde; *bagote, retama, guacapora*. Figure 30.

Trees with a well-developed trunk. Leaves of long shoots bearing long slender pinnae (each pinna resembling an individual leaf), the actual leafstalk (petiole and primary leaf rachis) modified into a very stout, stiff, sharp spine; the stipules form sharp spines. The pinnae, appearing as the leaves, (10) 20–45+ cm long, slender and strap-shaped, with numerous small leaflets. Short-shoot leaves mostly spineless. Flowers bright yellow; mass flowering in late spring. Pods few-seeded.

Occasional plants found in disturbed areas near Lukeville and a few near the highway between Lukeville and Organ Pipe headquarters, apparently spreading from trees planted or weedy in Lukeville or near the border in Sonora.

Cultivated and naturalized worldwide in warm regions. Native to tropical America (Hawkins et al. 2007).

The seeds (probably the seed coats) are bitter and probably toxic (Felger 2007a; Hodgson 2001). Reports of the seeds being eaten (e.g., Castetter & Bell 1942: 60) should be viewed with caution. Gentry (1942) reports that in southeastern Sonora the fresh, green seeds were eaten raw after peeling off the seed coat.

**OP**: Lukeville, 0.1 mi W of Hwy 85, single tree, 12 May 2003, *Rutman 2003-524*. Disturbed area, Hwy 85 ca. 1.5 mi S of visitor center, 2 plants, 2+ m tall, 4 Nov 2003, *Rutman* (observation). Near Ajo Mt Wayside (parking area) Hwy 85, *Rutman 26 Jun 2007* (single plant ca. 2 m tall, growing in disturbed area following construction of the Wayside interpretive site, the plant removed).

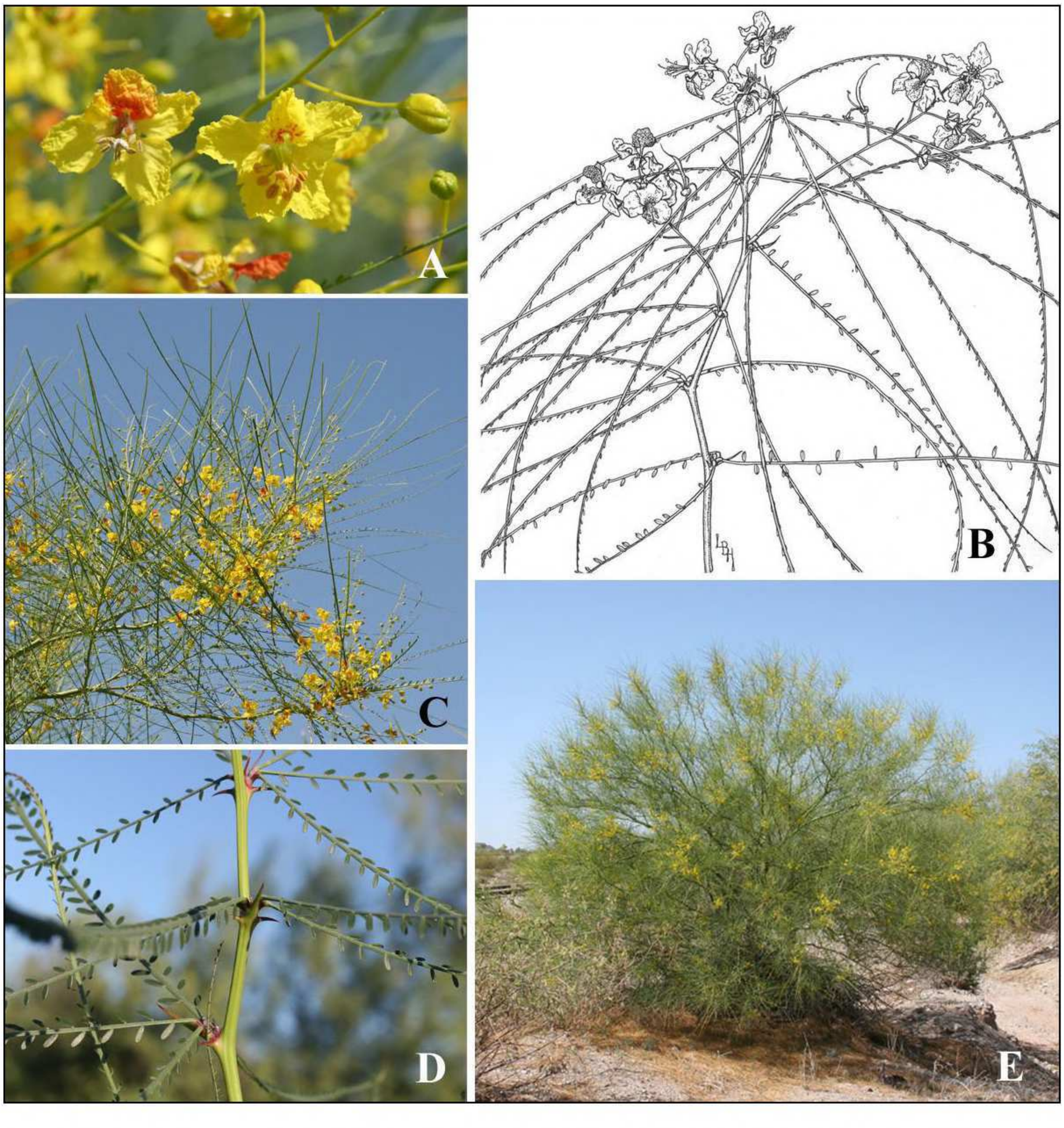


Figure 30. *Parkinsonia aculeata*. Ajo: (A, C, & E) 6 May 2006; (D) 2 Sep 2005. (B) By Lucretia Breazeale Hamilton.

**Parkinsonia florida** (Bentham ex A. Gray) S. Watson
[*Cercidium floridum* Bentham ex A. Gray]
Blue palo verde; *palo verde*; ko'okomadk, kalisp. Figure 31.

Large shrubs to small trees reaching 7–10 m tall, with a well-developed trunk. Bark of twigs and branches, smooth, and bluish green. Leaves short petioled, usually with 1 pair of pinnae, each 5–12 mm long and usually with 3 or 4 pairs of leaflets, the leaflets 5–9 mm long; often with stalked or cylindrical glands at the base of pinnae and between the leaflets (on upper surfaces), darkening when dried. Blazing yellow masses of flowers occur in spring, the peak usually late March–early April (about two weeks in advance of flowering of *P. microphylla*); also sometimes sparsely flowering in fall. Flowers (18) 22–28.7 mm wide. Calyx green to yellow-green, the lobes reflexed. Petals bright

yellow, the banner with a few small orange-red spots basally, or the spots absent. Filaments and petals with long white hairs at their bases; filaments bright yellow. Ovary sparsely pubescent at base, otherwise glabrate. Pods 3–7 (10) × 1.1–1.4 cm, moderately flattened, mostly indehiscent, generally not constricted between the seeds; seeds 1–6. Prodigious crops of pods usually ripening in May and June.

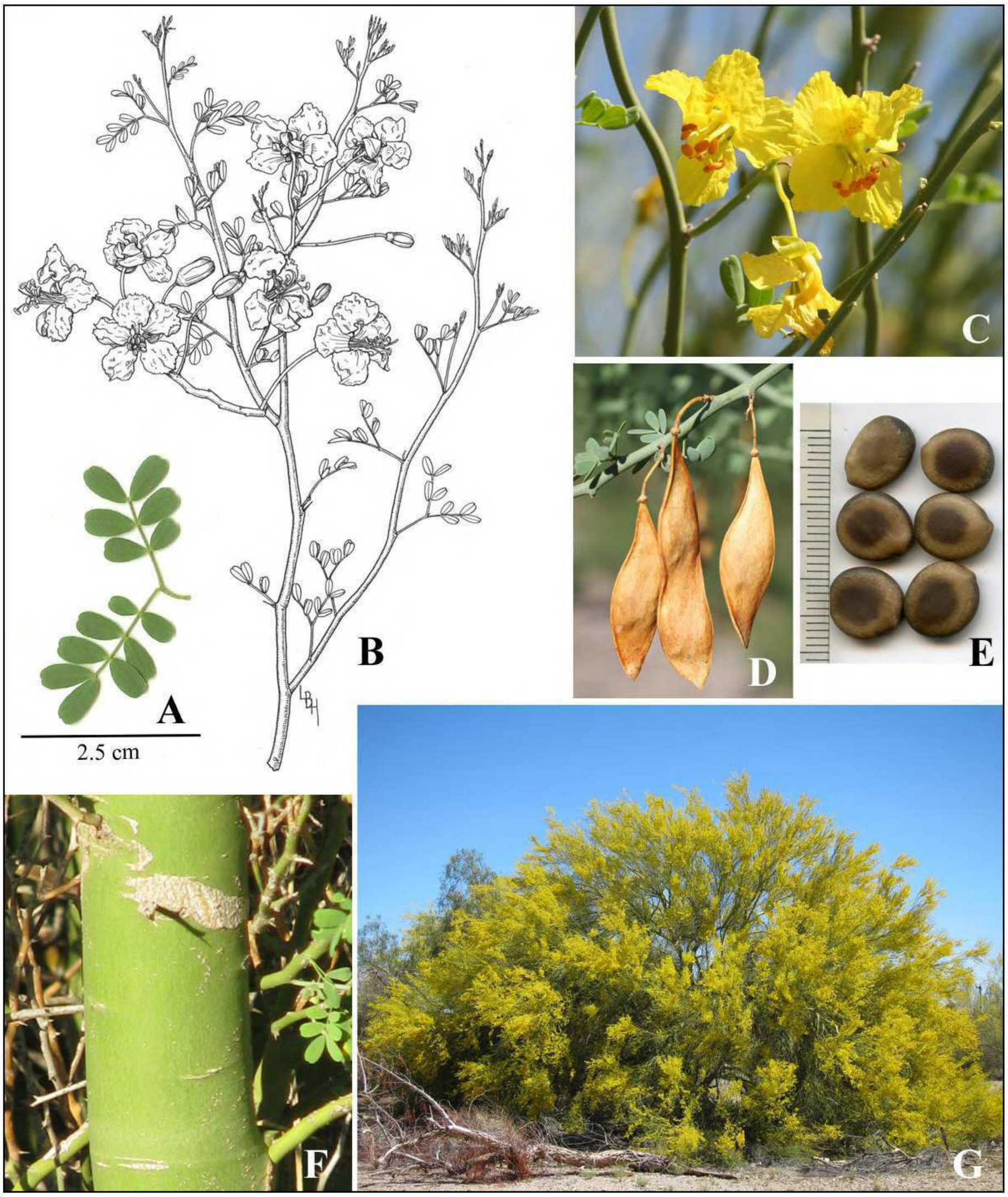


Figure 31. *Parkinsonia florida*. Ajo: (A) 7 Oct 2008; (E) 21 Dec 2014. (B) By Lucretia Breazeale Hamilton. (C) Eagle Pass near Hwy 85, 6 May 2005. (D) Growler Canyon, Bates Mts, 9 Sep 2012. Kuakatch Wash near Hwy 85: (F) 8 Oct 2008; (G) 12 Apr 2011.

One of the several larger trees in the region. Widespread; mostly along larger canyons and drainageways of the desert floor, and often on dunes, and occasionally on rocky slopes. It has been in the flora area for more than 8300 years and was at least sometimes common.

Blue palo verde trees are fairly common in canyon bottoms and the larger washes along the eastern side of the Tinajas Altas Mountains, such as the broad wash leading out of Borrego Canyon, and many of the small washes on the upper bajada. Only two or three blue palo verdes, however, were found between 2000 and 2006 in the wash below the Tinajas Altas. The absence of more of the trees was perhaps due to earlier woodcutting, but by 2008 even these trees were gone, apparently due to drought and firewood collecting by visitors. Although the soft wood is of poor quality for fuel, it was utilized because little else was available. The trees were numerous on the Davis Plain west of the Gila Mountains, although many of them perished during extreme drought of 2004 and 2005. Palo verdes and ironwoods were not seen along Coyote Wash in the vicinity of Coyote Water, but palo verde and ironwood occur only 8 km southward in La Jolla Wash. At the northern end of the Tinajas Altas Region, blue palo verde replaces foothill palo verde in certain unexpected circumstances, such as among the basalt boulders of Raven Butte—hardly typical habitat, but the basalt is a veneer atop coarse granitic alluvium, and perhaps well drained and not so different from an arroyo.

Southern Arizona to northwestern Sinaloa and southeastern California to Baja California Sur.

The seeds, available in early summer, were generally considered less desirable and less important than those of *Parkinsonia microphylla*, although prepared in essentially the same manner (Felger & Moser 1985; Hodgson 2001). The seeds and sometimes the flowers and young green pods were eaten by the Cahuillas, Gila River Pimas, Hia-Ced O'odham, and Seris (Bean & Saubel 1972; Felger & Moser 1985; Felger et al. 1992; Rea 1997). The soft wood was used for utensils and sometimes for fuel (Felger et al. 1992; Felger & Moser 1985). The seeds are an important food for many small mammals.

**OP**: Bates Well, *Nichol 26 Apr 1939*. Pozo Nuevo, 17 Apr 1985, *Bennett 8771* (ORPI). Puerto Blanco Drive 2.4 mi W of Hwy 85, 19 Jun 1989, *Felger 89-228*. †Puerto Blanco Mts, on ridge, twigs, 5240 to 9720 ybp (5 samples; 7560 to 7970 ybp, in 3 samples, common to abundant; the site is on a rocky slope, today *P. florida* occurs below the slope in an arroyo bed).

**CP**: Papago Well, 11 Apr 1978, *Lehto L22488* (ASU). Pinta Sands, 11 Apr 1993, *Felger 93-415*.

**TA**: W side of Tinajas Altas Pass, 1100 ft, wash, 8 Mar 1986, *Van Devender 86-11*. Borrego Canyon, 16 Jun 1992, *Felger* (observation). Camino del Diablo, E of Raven Butte, 25 Oct 2004, *Felger* (observation). Canyon wash at NW side of Raven Butte, 30 Dec 2005, *Felger* (observation). E side of Tinajas Altas Mts, 2.5 mi SE of Tinajas Altas, major wash from first canyon N of Surveyors Canyon, 1160 ft, trees 5–6 m tall with a well formed trunk, some with bright yellow flowers and green pods, 22 Nov 2008, *Felger 08-195* (ARIZ, ASU, BRIT, CAS, DES, MPO, RSA, SNM). †Butler Mts, twigs, spines, fruits, 740 & 3820 ybp. †Tinajas Altas, twigs, spines, 4010 & 8255 ybp.

**Parkinsonia microphylla** Torrey
[*Cercidium microphyllum* (Torrey) Rose & I.M. Johnston]
Foothill palo verde; *palo verde*; kek cehedagĭ. Figure 32.

Small desert trees or large shrubs to 5 m tall, with thick limbs branching from near the base of a very short, thick trunk; bark smooth and yellowish green. Leaves lacking a petiole, with 1 pair of pinnae, each pinna 1–5.3 cm long (each sessile pinna might be confused for a single, once-pinnate leaf), with 4–8 (10) pairs of leaflets, the leaflets 1–3.5 (6) mm long, broadly elliptic to broadly oblong or sometimes orbicular; pulvini conspicuous at the base of leaflets, less conspicuous at the base of pinnae; individual leaflets and ultimately the leafstalks drought deciduous. Twigs glabrate with age; youngest, emerging herbage protected by short, stiff, white hairs and glands, the glands clustered at leaflet bases, 0.1 mm diameter, globular, and translucent on youngest twigs, dark brown with age.

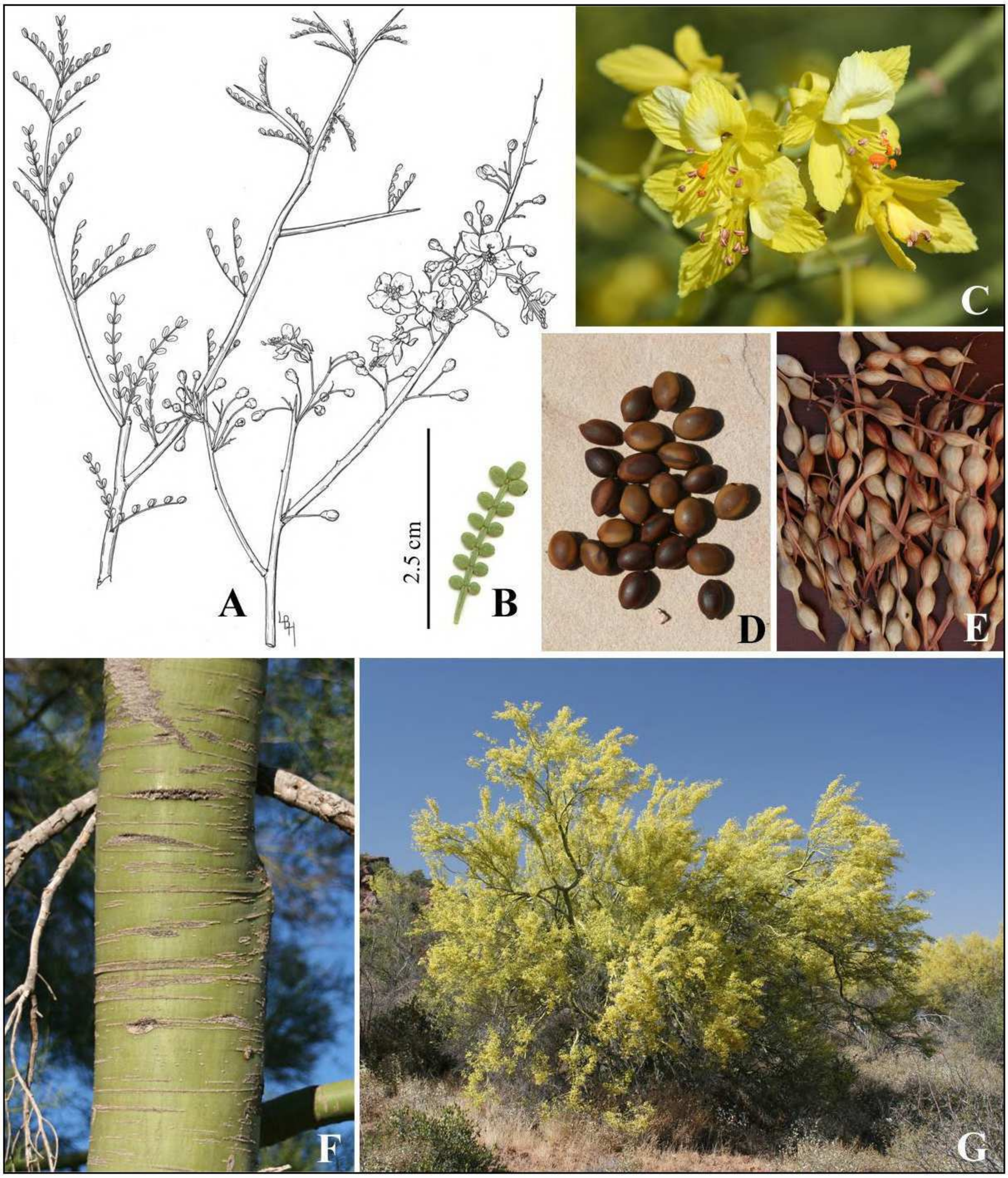


Figure 32. *Parkinsonia microphylla*. (A) By Lucretia Breazeale Hamilton. Ajo: (B) 24 Jul 2014; (C) 6 May 2005; (D & E) 5 Aug 2006. (F) Kuakatch Wash near Hwy 85, 8 Oct 2008. (G) Eagle Pass, Hwy 85, 10 May 2005.

Masses of pale yellow flowers, mostly April–early May, the pods ripening late May–June. Peduncles and pedicels with short white hairs similar to those on the young herbage. Flowers (10) 12–18 mm wide. Calyx tube green to yellow-green, the lobes pale yellow, spreading to reflexed (not as strongly reflexed as in *Parkinsonia florida*). Banner (upper) petal white, with age becoming pale yellow and then orange-flecked or not, the other 4 petals pale yellow. Filaments pale yellow, with long white hairs below. Ovary and young green fruits densely white pubescent. Style and stigma pale yellow. Pods sparsely pubescent, 3–9.5 × 1 cm, indehiscent to tardily and partially dehiscent,

onstricted between the seeds, the tip often extending into a slender, sterile snout. Seeds 1–5 per pod, hard, and ovoid, 8.3–9.4 × 6.8–7 mm.

The severe drought of the mid-2000s caused a notable dieback of *Parkinsonia microphylla* and *P. florida* in the flora area. A study of dieback and episodic mortality in 1000 *P. microphylla* plants at the Desert Laboratory on Tumamoc Hill, Tucson, determined that diebacks tended to occur during severe deficits in annual, especially summer, rains. Severe drought caused disproportionally more mortality in older plants than younger ones (Bowers & Turner 2001).

Widespread and abundant across the flora area, mostly on slopes and bajadas away from larger watercourses. In the Tinajas Altas Region it is found on upper bajadas on the east side of the mountains and in canyons, washes, and rocky slopes from the base to higher elevations on all slope exposures. Its history in Organ Pipe extends back 5300 years.

Sonoran Desert from southwestern Arizona to the Guaymas Region in Sonora, both Baja California states, and California at a few stations along the Colorado River.

Tim Tibbitts was monitoring Sonoran pronghorn in the Valley of the Ajo on 13 May 2013 and watched them eat *Parkinsonia microphylla* flowers for hours, along with *Olneya* flowers and *Phoradendron californicum*. The seeds, harvested in early summer, provided an important food resource for the Cahuillas, Cocopahs, Gila River Pimas, Hia-Ced O'odham, Seris, Tohono O'odham, and other Sonoran Desert people (Bean & Saubel 1972; Bell et al. 1980; Bell & Castetter 1937; Felger & Moser 1985; Felger et al. 1992; Hodgson 2001; Rea 1997; Betty Melvin in Zepeda 1985: 47, 61–62). The seeds were parched, ground into flour, and generally consumed as a gruel, and they were often stored. Hia-Ced O'odham baked the flour with deer fat and water to make a bread-like mass (Fernando Flores in Bell et al. 1980). The flour was also sometimes mixed with ironwood or mesquite flour (Nabhan et al. 1979; Russell 1908). The Seris ate the flowers fresh or cooked, cooked the young green pods with meat, and often got the seeds by robbing packrat nests (Felger & Moser 1985). Fresh green seeds were eaten as snacks (Felger & Moser 1985; Hodgson 2001). The wood was used for utensils, digging tools and pry bars, small sculptures, and sometimes fuel (Castetter & Bell 1942; Felger & Moser 1985).

Betty Melvin said "The beans of the palo verde, yes they would gather it and then they would grind the beans of the palo verde, and they would roast them and grind it again. And it would turn into a floury substance, or else it would be loosely ground and crunchy. They would salt it . . . . Even the children would prepare it themselves, because it was simple and everybody ate it" (Betty Melvin in Zepeda 1985: 47, 61, 62). "We would get the foothill palo verde beans and we would soak them and then we would fry it until they popped. They tasted like peanuts" (Betty Melvin in Zepeda 1985: 77).

**OP**: Alamo Canyon, 2000 ft, 20 Apr 1942, *Cooper 561*. 2.4 mi W of AZ Hwy 85 on Puerto Blanco Drive, 1500 ft, sandy-gravelly wash, 19 Jun 1989, *Felger 89-227*. Quitobaquito, 24 Oct 1990, *Felger 90-492*. †Puerto Blanco Mts, on ridge, twigs, leaflets, modern (30) to 5240 ybp (12 samples).

**CP**: Agua Dulce Mts, Buck Mt Tank, Buckhorn Tank, Cabeza Prieta Tanks, Charlie Bell Road near E Refuge boundary, Little Tule Well, Senita Tank, Tuseral Tank, 12–15 Jun 1992, *Felger* (observations).

**TA**: Frontera Canyon, 18 Mar 1998, *Felger* (observation). Tinajas Altas Canyon, vicinity of uppermost tinajas, 21 Nov 2008, *Felger 08-177*.

**Phaseolus** – Beans; *frijoles*

Annual and perennial vines. Pubescence often of small, straight hairs and small, hooked hairs (seen with 20× magnification). Leaves prominently petioled, with 3 leaflets. Flowers papilionoid,

small, and pink. Calyx 5-lobed, the keel petal bent across the flower and twisted above the bend (a key character of this genus). Stamens 10; 9 united, 1 free. Pods multiple seeded, flattened, and explosively dehiscent, the valves twisting (the cultivated beans have indehiscent pods). Americas; 65 species.

1. Leaves "rough" and dry to the touch with small, recurved hairs; leaflets entire or essentially so; pods about the same width throughout..... **Phaseolus acutifolius**
1. Leaves smooth, with small, straight hairs or glabrate; leaflets generally 3-lobed; pods narrowest at base, broader toward the tip..... **Phaseolus filiformis**

**Phaseolus acutifolius** A. Gray var. **acutifolius**
[*P. acutifolius* var. *latifolius* G.F. Freeman. *P. acutifolius* var. *tenuifolius* A. Gray]
Tepary (wild); *tépari del monte*; bavĭ. Figure 33.

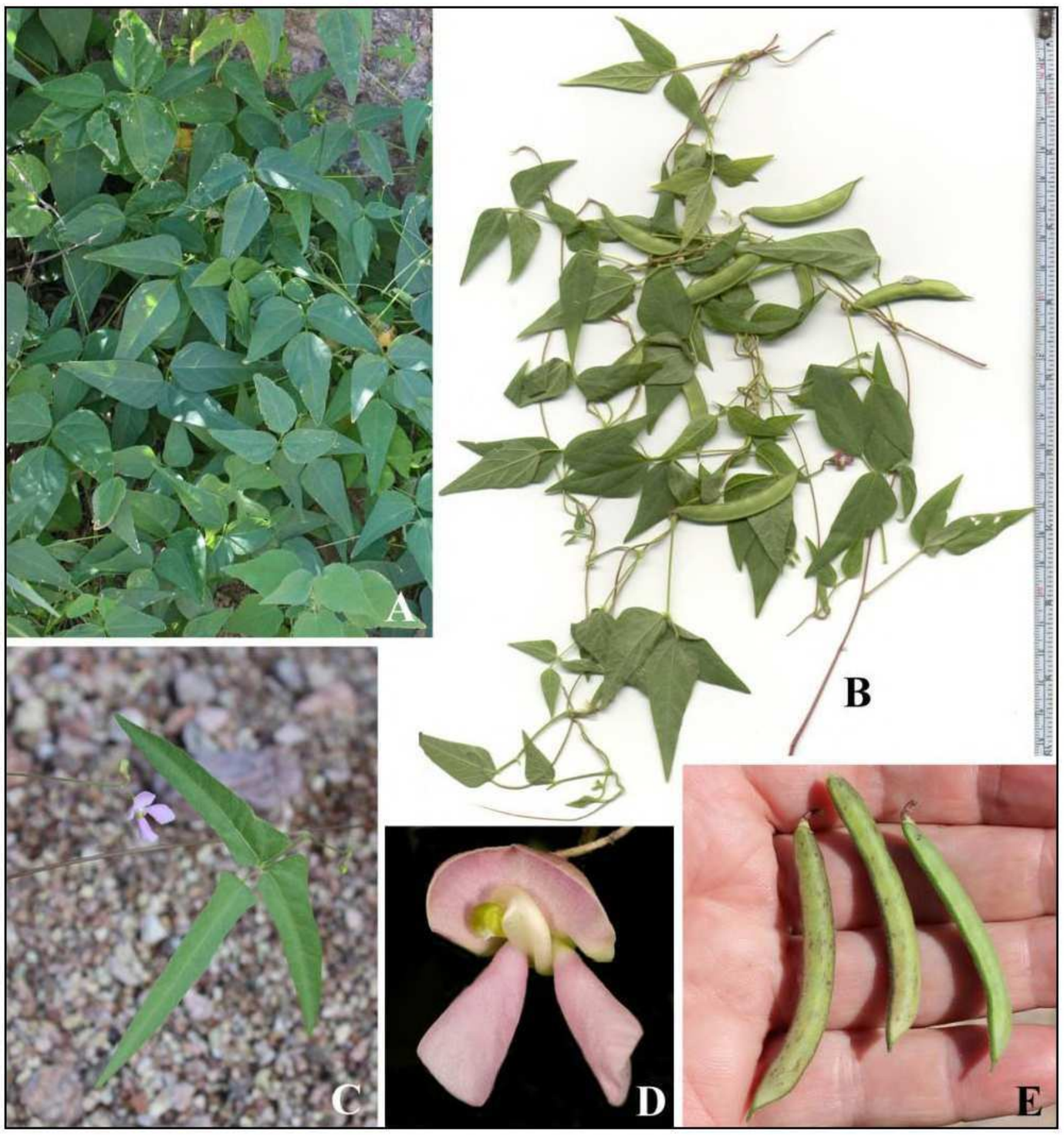


Figure 33. *Phaseolus acutifolius* var. *acutifolius*. Bull Pasture Trail: (A) 24 Sep 2006; (B) 21 Sep 2008. Alamo Canyon above the well: (C) 9 Sep 2013; (E) 17 Oct 2013. (D) Garden Canyon, Huachuca Mountains, 24 Aug 2010, photo by Jillian Cowles.

Annuals growing with summer and early fall rains, producing slender vines climbing through desert shrubs and small trees. Herbage with slender, recurved hairs. Leaflets mostly ovate, probably often to 5+ cm long, the margins generally entire. Petals pink. Pods about 5–6 cm long, several-seeded, and dehiscent, the valve coiling. Seeds 3.5–5 mm long, dark grayish and mottled, resembling gravel.

Seasonally abundant in the Ajo Mountains at middle to higher elevations where it is common on slopes. This is the westernmost population of this species.

Southern Arizona to western Texas and southward to Jalisco.

The green pods were gathered and dried, and the seeds ground into flour (Felger 2007a; Nabhan & Felger 1978). The wild tepary, unlike the domesticated tepary, has pods that burst open explosively when ripe and the seeds are smaller.

**OP**: Arch Canyon: *Wirt 13 Oct 1990*; Steep rocky NE-facing slope near the arch, 26 Oct 2003, *Rutman 20031026-25* (ORPI).

****Phaseolus acutifolius* var. *latifolius*** G.F. Freeman
Tepary (cultivated); *tepari*; bavĭ

Teparies, the traditional cultivated beans in the region, were grown wherever agriculture was practiced, including oases such as Quitobaquito (Burrus 1971; Castetter & Bell 1951; Felger 2007a; Felger et al. 1992; Gifford 1933; Kelly 1977; Nabhan & Felger 1978; Rea 1997; Betty Melvin in Zepeda 1985: 65). Kino and Manje obtained beans, presumably teparies, at Sonoyta, Sonora, on February 16, 1699 (Burrus 1971).

The cultivar is readily distinguished from the wild teparies by always having broad leaflets, and indehiscent and larger pods, and larger seeds with a multitude of genetically stable differently colored seeds (e.g., Delagado-Salinas 1985; Frytag & Debouk 2002; Nabhan & Felger 1978; Pratt & Nabhan 1988). Freeman (1912) described the tepary cultivar as var. *latifolius*. However, the type specimen he cited is a wild plant, not the cultivar (Alfonso Delgado, pers. comm. to Felger, June 2015). Therefore, var. *latifolius* appears to be a *nomen confusum* because it has been assigned to two materials (an impossible treatment according to the Code of Botanical Nomenclature) — the broad-leaved wild tepary and the cultivar tepary (see Debouck 1991).

**Pima Co**.: Topawa, E. Chico field, growing in a field, *Nabhan 17 Oct 1981* (DES 39382 and 40488).
**Sonora**: Suvuk, E of Pinacate Peak, floodwater field crop, *Nabhan 25 Sep 1982* (DES).

**Phaseolus filiformis** A. Gray
[*P. wrightii* A. Gray]
Desert bean; ban bavĭ, cepuliñ bavĭ. Figure 34.

Non-seasonal annual vines, mostly in spring; with a well-developed taproot. Herbage and inflorescences moderately to sparsely pubescent or glabrate. Stems twining or sprawling. Leaflets (1) 2–5 cm long, thin, highly variable in size and shape, often ovate, generally 3-lobed, sometimes entire, often smaller and narrower toward stem tips and with drier conditions. Flowers 6–9 mm long, the petals pink. Pods 1.5–3+ cm long, slightly curved, laterally flattened, broadest above the middle, explosively dehiscent, the valves twisting. Seeds 3–3.9 × 1.6–3.4 mm, flattened, light-colored, mottled brown and black.

Widespread and seasonally common across the flora area, especially along washes and other drainageways, rocky slopes, and dunes.

Arizona below the Mogollon Rim to western Texas, Sonora southward to the Guaymas Region, and both Baja California states.

Nabhan (1985) reported the immature pods were eaten fresh and the dry seeds boiled and eaten like lentils.

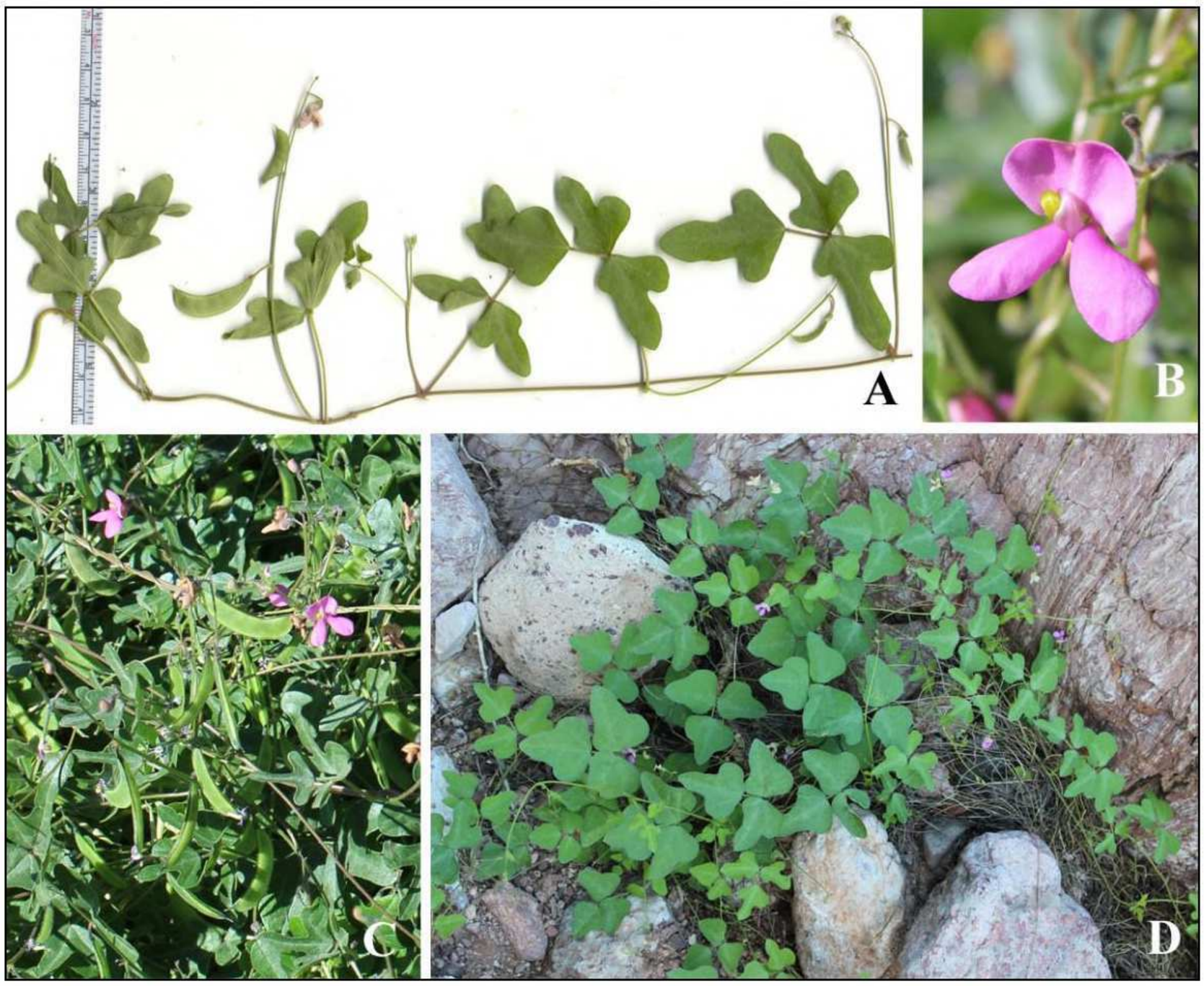


Figure 34. *Phaseolus filiformis*. Alamo Canyon: (A) 10 Sep 2008; (B & C) 26 Feb 2014. (D) Diablo Canyon near Ajo Mountain Drive, 12 Sep 2013.

**OP**: Bates Well, 18 Nov 1939, *Harbison 26158*. Quitobaquito, 5 Mar 1940, *Peebles 14554A*. Alamo Canyon, 7 Oct 1951, *Parker 7747*. Dripping Springs, 15 Apr 1952, *Parker 7916*. Estes Canyon, 11 Apr 1978, *Bowers 1236*. Cherioni Wash, 5 mi N of Visitor Center, *Johnson 10 Nov 1983*.

**CP**: Agua Dulce Spring: 13 Apr 1964, *Niles 342*; *Simmons 13 Apr 1964* (CAB). Christmas Pass, 13 Apr 1992, *Harlan 254* (CAB). Pinta Sands, 15 Sep 1992, *Felger 92-780*.

**Prosopis** – Mesquite, screwbean; *mezquite, tornillo*

Hardwood trees and shrubs, generally armed with spines or thorns. Leaves twice pinnate; gradually winter deciduous, with 1 or 2 pairs of opposite pinnae, each with 4–24+ pairs of leaflets (Figure 35). Petiole with a circular (crateriform) nectar gland at the base of the lower pinnae; pulvini well developed at base of the pinnae and leaflets. Flowers mimosoid, small, cream white or yellow, in densely flowered spike-like racemes or spikes. Calyx shallowly toothed. Stamens 10 in 2 series and separate, the anthers with a small terminal gland. Flowers usually protogynous (the slender style protrudes from the bud before the stamens and petals emerge). Pods indehiscent, straight to curved or coiled, multiple seeded, indehiscent with carbohydrate-rich mesocarp.

Americas, Africa, and Asia; 44 species.

1. Leaflets 4–7 (10) pairs per pinna; flowers sessile, bright yellow, the petals united below; pods tightly coiled..... sect. **Strombocarpa**, **Prosopis pubescens**, screwbean
1. Leaflets 9–24+ pairs per pinna; pedicels ca. 0.5 mm long, the flowers cream or dull yellow, the petals separate; pods straight or moderated curved but not coiled..... sect. **Algarobia**, mesquites

2. Most leaves with a single pair of pinnae; leaves and twigs glabrous or hairy. ..... **Prosopis glandulosa**
2. At least some leaves with 2 pairs of pinnae; leaves and twigs hairy..... **Prosopis velutina**

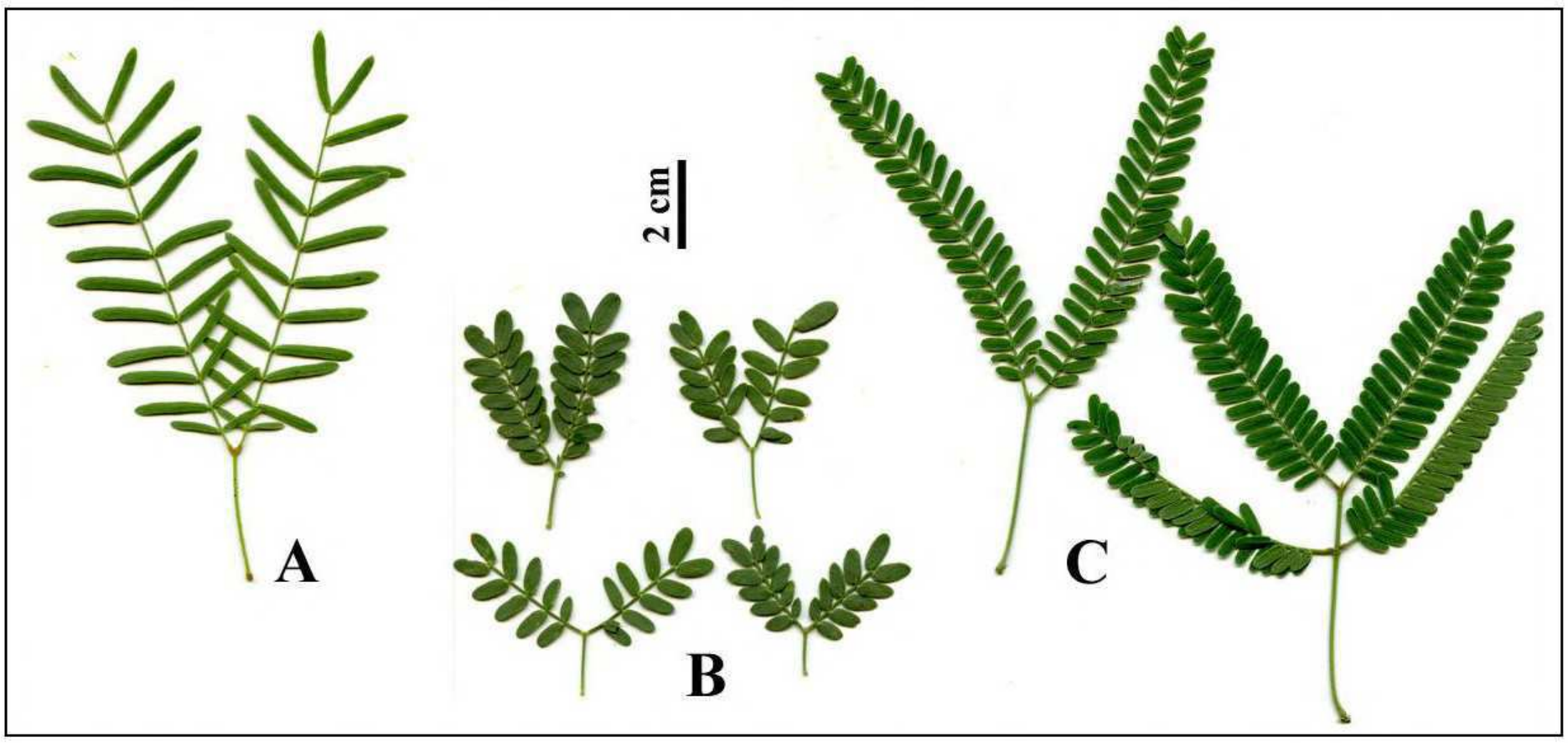


Figure 35. *Prosopis* leaves. Quitobaquito, 29 May 2015: (A) *P. glandulosa*. (B) *P. pubescens*. (C) *P. velutina*, Ajo, 4 Apr 2015.

**Prosopis**, sect. **Algarobia**. Mesquite

Two closely related mesquites are widespread across the flora area, honey mesquite in the west and velvet mesquite to the east. Mesquites are concentrated along the larger drainageways where the largest trees occur, and are also very common, mostly as large shrubs or small trees, along smaller drainageways, roadsides, at dirt tanks (charcos), and less common in other habitats including rocky slopes. The severe drought of the 2000s caused a dieback of mesquites, and many surviving trees lost many branches.

The fossil mesquite specimens do not allow us to determine which of the two species were gathered by Ice Age packrats. Mesquites have been in the flora area for at least 18,850 years. Mesquite in the Ajo Mountains seems to have been more common in the older samples than in the younger ones and there are some shifts in local distributions. It no longer grows near the rock shelter with the midden site in Alamo Canyon. The Puerto Blanco fossil site is a rocky slope and today velvet mesquite grows below the slope in the arroyo bed.

†**OP**: Alamo Canyon, leaflets, endocarps, 1150 to 9570 ybp (4 samples). Puerto Blanco Mts, on ridge, twigs, spines, leaflets, endocarps, 980 to 10,540 (7 samples).

†**TA**: Butler Mts, leaflets, 740 & 8160 ybp. Tinajas Altas, spines, leaflets, endocarps, 1230 to 18,700 ybp (14 samples).

Mesquite was the single most useful plant in the Sonoran Desert (Bell & Castetter 1937; Felger 1977, 2007a & b; Felger & Johnson, accepted for publication; Felger & Logan 2010; Felger & Moser 1985; Hodgson 2001). There are no known differences in usage between the two mesquite (*Algarobia*) species in the flora area. Every part of the tree was used (see Rea 1997 for an excellent, detailed account). Mesquite was the common denominator among the diverse indigenous people of the region—people who grew crops as well as hunters and gatherers who lived where it was too arid to farm. It was part of everyday life from cradle to grave and featured prominently in oral literature.

The pods were used for food and the wood as fuel. The largest mesquite groves, growing along major washes and watercourses, provided ample shade and places to camp and build homes.

Mesquite pods are large and easy to pick, either from the tree when ripe or from the ground soon after they fall. The pod is indehiscent (does not split apart) and thus the contents do not fall out. People knew the location of trees or groves that produced sweeter pods and superior yields. Ripe pods would be broken open and tasted for sweetness and ripeness. In addition, mesquite and screwbean pods were obtained from packrat nests, which allowed an extension of the harvest season. Harvested pods were sun-dried or fire-parched and laboriously crushed or ground into flour, often in a bedrock or stone mortar using a large pestle. There were numerous variations in the preparation of the pods and flour — mesquite "was a versatile staple" (Rea 1997: 187).

Mesquite and screwbean food products generally were prepared without cooking. The flour was most often steeped in water and consumed as a gruel (*atole de mesquite*) or made into cakes. Pods were also crushed and boiled or steeped in water as a beverage. Whole mesquite pods or cakes were stored — the flour was not stored because it is hygroscopic and soon becomes hard and undesirable.

"You can also grind the mesquite beans and make it into flour. There are many different ways to eat mesquite beans. You can also mix mesquite bean with roasted wheat flour" (Betty Melvin in Zepeda 1985: 49). "They would make a corral, my grandmother and my grandfather. . . . They would then gather mesquite beans . . . and they would fill up that corral. . . . When it was real sweet they would make gruel out of it. And they would grind it when they were dried. . . . It is very good. And they would buy some raw sugar in Sonoita and eat it with it" (p. 77). Sue Rutman observed Norma Quiroz de Walker make *atole de pechita*: she pounded the pods then simmered them in water and added sugar, cinnamon, and sometimes some cornstarch — Sue thought it was delicious. In addition, mesquite flowers were gently mashed in water and the sweet liquid drunk.

For the most part mesquite pods were available for harvest at the height of the early summer dry season. Lumholtz (1912: 331) reported that Hia-Ced O'odham "used to come as far as Quitovaquito and Santo Domingo to gather mezquite beans (called by the Mexicans *pechita*)." In modern times mesquite pods serve as fodder or forage for cattle. Many animals consume the pods, which are the primary seasonal food for coyotes. The pods are eaten within a few weeks of falling to the ground.

The whitish or amber-colored gum, oozing from wounds on the branches or trunk, was extensively employed for medicine (especially for eye ailments), eaten as candy, chewed as gum, or mixed with saguaro fruit and eaten like jam. The black sap or pitch collected from the bark was used as a general-purpose black dye as well as for many medicinal purposes.

Mesquite continues to be the preferred regional cooking fuel, not only because it is so readily available but also because of superior burning qualities and the flavor it imparts to food. House posts most often were made of mesquite trunks and the forked trunks or main branches were especially popular in local architecture. The roots were fashioned into multi-purpose cordage.

Most of the historic corrals in the region were made from mesquite, ironwood (*Olneya*), and railroad ties. During the late 19th and first half of the 20th centuries many Arizona and Sonora ranches used large quantities of mesquite logs for corrals, many of which were still standing in the late 20th and early 21st centuries. Stacked mesquite corrals were located at Aguajita, Bates Well, Daniels Well, Gachado line camp, and the Gray Ranch at Dos Lomitas (e.g., Bobby Gray, in Hoy 1970). Most of the mesquite logs at the Gray Ranch and Gachado corrals had been stolen by the

1990s (most of these corrals are on the international border, where there was essentially no fence there until 2004). Railroad ties were sometimes used as the upright supports for stacked mesquite logs.

The following discussion is excerpted and slightly modified from an essay by Felger (2007b):

> Along the east side of the Cabeza Prieta Refuge the mesquites are readily identified as the velvet mesquite (*Prosopis velutina*)—the common mesquite of the Arizona Upland around Tucson and elsewhere across Pima County. Continuing westward along the rough dirt road, after entering Yuma County on the Camino del Diablo you soon cross the Pinta Sands and the northern outlier of the Pinacate Lava Flow.
>
> In washes in and around the Pinacate Lava and Pinta Sands, a number of "western" desert or Lower Colorado Valley species have replaced the "eastern" or Arizona Upland species (Felger 2000; Rosen 2007; Shreve 1951). The washes are much more densely vegetated than the open, creosotebush desert flats, and the trinity of large legumes (ironwood, mesquite, and palo verde) is still present. But there are some subtle as well as not-so-subtle changes. The mesquites here have more beautiful leaves than the ones seen on the east side of the Refuge. The leaves of these mesquites have larger leaflets and seemingly brighter greener leaves with only one pair of pinnae like those of the western honey mesquite (*Prosopis glandulosa* var. *torreyana*). But the leaves and twigs have the small hairs characteristic of the velvet mesquite (*P. velutina*). Farther west, in the vicinity of the Colorado River and southward along the Sonora coast, the leaves are both hairless (glabrous) and once-pinnate—the two major key features of the honey mesquite.

Thus the Pinta Sands mesquites share features of the two supposedly different species. There are several possibilities: (1) The mesquites are confused, non-cooperative, and don't know that they have been classified; (2) the taxonomy is confused and does not accurately reflect the situation; or (3) it is difficult or indeed impossible to make a "perfect" linear classification system for an evolutionary continuum. Any botanist engaged in taxonomy has struggled with problems of this kind — the mesquites in the western part of the Refuge are indeed intermediate in character. In fact the area of transition, or the intermediate population, is quite large. Yet we need names in order to communicate about the different kinds of life. As biologists we strive to make the classification reflect evolutionary patterns as closely as possible. But a continuum sometimes does not slice up into discrete units — there are fuzzy boundaries.

Kearney and Peebles (1960) listed Arizona mesquites as varieties of *Prosopis juliflora*. Marshall Johnston (1962) of the University of Texas published a study of the North American mesquites in which the Arizona mesquites are quite differently classified — as *P. velutina* and *P. glandulosa* var. *torreyana,* and this system was followed by the great botanists Arturo Burkart (1976) of Argentina and Jerzy Rzedowski of Mexico and his wife Graciela Calderón (Rzedowski & Calderón 1988). But Lyman Benson, in his revision of *Trees and Shrubs of the Southwest* (Benson & Darrow 1981), continued to treat the Arizona mesquites as varieties of *P. juliflora*. The overwhelming evidence, however, shows that *P. juliflora* is a tropical species that does not reach the USA or even the Sonoran Desert.

Sect. *Algarobia* includes about two dozens species in South America and half a dozen species in North America. The North American taxa tend to be allopatric (occupying different geographic ranges) and in general are notorious in having indistinct ("fuzzy") species boundaries with often broad areas of populations with intermediate morphologies. These distributional patterns probably represent continuous (clinal) variation or even reticulate evolution and sometimes can confound attempts at realistic taxonomy (e.g., Bessega et al. 2000; Bessega et al. 2006; Burghardt & Esper

2007; Palacios 2006). Although some intermediate populations might be of hybrid origin rather than continuous (clinal) evolution, extensive observations indicate clinal variation to be common among native North American *Algarobia* (e.g., Felger 2000). An intriguing and radical taxonomy of native *Algarobia* species in Mexico, and by extension the U.S.–Mexico borderlands, is based on morphology (Palacios 2006) but is at odds with much of our experience and awaits confirmation with rigorous molecular/genetic studies.

**Prosopis glandulosa** Torrey var. **torreyana** (L.D. Benson) M.C. Johnston
[*P. juliflora* (Swartz) de Candolle var. *torreyana* L.D. Benson. *P. odorata* Torrey & Frémont (in part, sensu Palacios 2006)]
Western honey mesquite; *mezquite*; kui. Figures 35A & 36.

Trees and shrubs. Bark on old stems dark brown to charcoal gray, irregularly checkered to shredding; bark on mid-sized and small branches smooth, gray or greenish brown. Older stems often with oily, black, oozing, bacterial slime flux from wounds beneath the bark; younger stems sometimes exuding light-colored gum. Paired or sometimes single thorns (apparently modified branches) above leaves in axillary buds (short shoots), or sometimes absent or reduced from some or most stems, and especially prominent among juvenile and salt- or water-stressed plants; these thorns often 0.8–4 cm long, straight, rigid, and sharp, at first dark colored, becoming whitish. Twigs and leaves glabrous or hairy. Leaves appearing simultaneously in spring after the last freezing weather; the plants gradually deciduous in winter. Leaves with 1 pair of pinnae (jugate); leaflets (6) 11–24 pairs per pinna, individual leaflets about 5 times longer than wide, 4.5–31 × 1.3–6 (8) mm (the smaller measurements are from drought-stressed plants).

Flowers dull yellow; mass flowering April and May, and sporadically through early fall; pods mostly ripening in early summer and sporadically through fall. Inflorescences spike-like racemes, cylindrical, (4) 6–9 cm long, often several in a cluster. Flowers numerous, crowded, pale yellowish, 4.5–5 mm long, with pedicels ca. 0.5 mm long. Stamens longer than the petals; ovary and inner surface of petals densely white hairy. Pods straight to moderately curved, often (7) 10–20 cm × 7.5–10 mm, slightly compressed, often slightly to conspicuously constricted between some or most or all seeds; mesocarp sweet and well developed. Seeds encased in a tough, leathery endocarp drying hard and bony; cotyledons bright green even within the endocarp in the fruit. Pods pale tan to reddish and often mottled.

Western honey mesquite is characteristic of the Lower Colorado Desert region of the Sonoran Desert. It often has larger and more widely spaced leaflets than velvet mesquite. In the southwestern corner of Organ Pipe and nearby areas of Cabeza Prieta many of the mesquites appear intermediate between honey and velvet mesquite (*see* Felger 2000). Honey mesquite then extends westward across Cabeza Prieta and the Tinajas Altas Region. However, even in the Tinajas Altas Mountains, in Frontera Canyon, the honey mesquite has pubescence like that of velvet mesquite. Shrub-sized honey mesquites are abundant around the margins of Las Playas and other playas.

Var. *torreyana* primarily occurs from Baja California to southern California, western Arizona, and southwestern Utah, and then Sonora southward along the coastal fringe of the state to Guaymas, then inland, beyond the desert, through the thornscrub to northern Sinaloa, and then eastward and northward to the Chihuahuan Desert of southeastern Arizona, New Mexico, and nearby northern Mexico. East of the continental divide it is largely replaced by var. *glandulosa*.

Palacios (2006) restricts *Prosopis glandulosa* to Nuevo León and Zacatecas in northeastern Mexico and places much of the rest of the distribution in Mexico and by extension the range in the USA in *P. odorata* Torrey & Frémont.

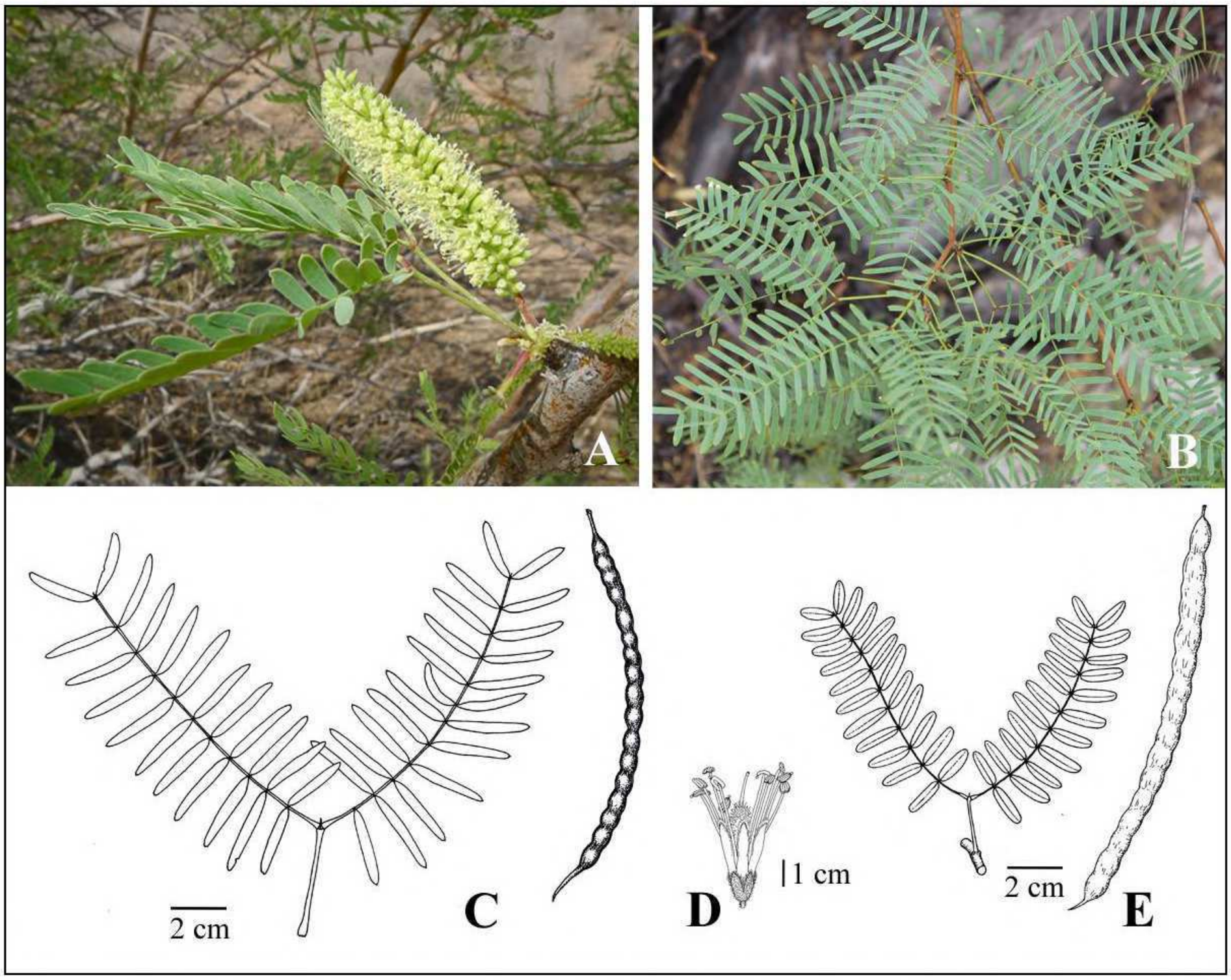


Figure 36. *Prosopis glandulosa* var. *torreyana*. (A) Near Blyth, Riverside Co., CA, 16 Apr 2002, photo by Keir Morse (CalPhotos). (B) Quitobaquito, 17 Jul 2013. Drawings by Matthew B. Johnson: (C & D) Tucson, Jul 2006; (E) Aguajita Spring, *Felger 88-28*.

**CP**: Salazaria Wash, 12 Apr 1992, *Harlan 213* (CAB). Camino del Diablo at boundary with OP, 1090 ft., 26 Mar 2010, *Felger 10-103* (ARIZ, ASU).

**TA**: Base of Tinajas Altas, 29 Mar 1930, *Harrison 6581*. Frontera Canyon, 18 Mar 1998, herbage pubescent, *Felger* (observation). Coyote Water, 25 Oct 2004, *Felger 04-62*. Surveyors Tank, 29 Mar 2010, *Felger* (observation).

**Prosopis velutina** Wooton
[*P. juliflora* (Swartz) de Candolle var. *velutina* (Wooton) Sargent]
Velvet mesquite; *mezquite*; kui. Figures 35C, 37, & 38.

Large woody shrubs or trees. Similar to *P. glandulosa* var. *torreyana* but (1) the herbage and inflorescences pubescent, (2) at least some and usually most leaves bijugate (two pairs of pinnae; some new growth and drought-stressed leaves may be jugate), and (3) the leaflets proportionally broader, not attaining as large a size, usually more closely spaced, and tending to average more leaflets per pinnae. Leaflets about 3 times longer than wide, often 6–13 × 2–3.5 mm, 11–22+ leaflet pairs per pinna. As in *P. glandulosa*, flowering mostly April to June, and also sporadically through summer and early fall; pods mostly ripening in early summer and sporadically through summer and fall.

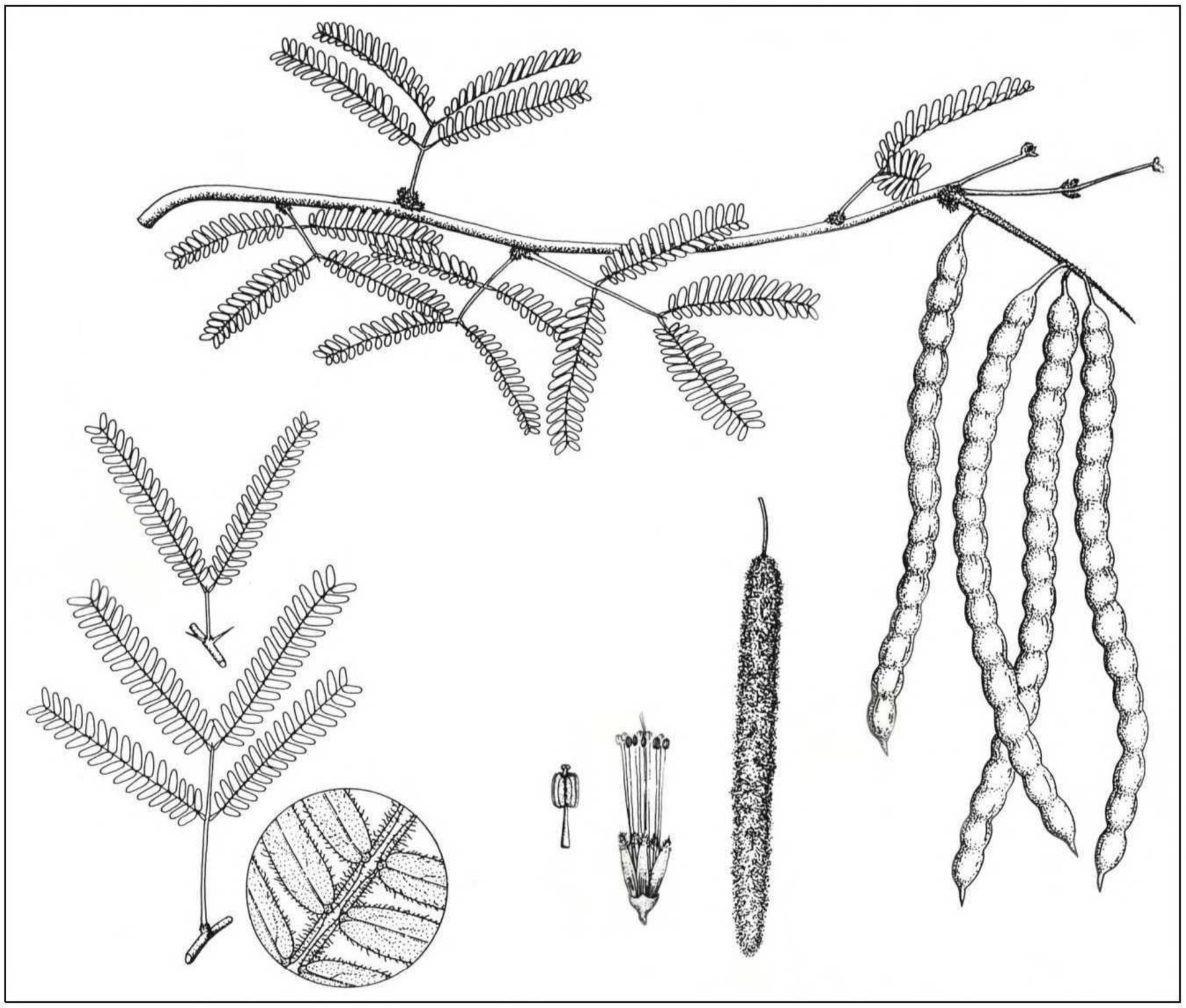

Figure 37. *Prosopis velutina.* By Matthew B. Johnson.

Eastern margins of Cabeza Prieta and across Organ Pipe. Common especially along washes and major drainageways, and scattered elsewhere including desert flats and rocky slopes. Mesquite forests grew near Armenta Ranch in Organ Pipe, but erosion and arroyo downcutting following overgrazing has killed these forests (Rutman 1995). In addition, innumerable mesquite trees were cut to supply the town of Ajo and the mines during the last decades of the 19th century and first few decades of the 20th century.

Velvet mesquite is characteristic of the Arizona Upland region of the Sonoran Desert. Widespread in Arizona, northern Sonora southward to the vicinity of Guaymas, and extreme southwestern New Mexico and northwestern Chihuahua.

**OP**: 8 mi S of Growler Well, *Nichol 17 Apr 1939.* Ridge between Alamo and Arch Canyons, *Fouts 8 Aug 1949* (ORPI). Aguajita, 23 Oct 1987, *Felger 87-270.* Quitobaquito, 14 Sep 1988, *Felger 88-451* (intermediate with *P. glandulosa* var. *torreyana*).

**CP**: Papago Well, 11 Apr 1978, *Lehto L-22487* (ASU). From Bates Well to Papago Well, 31 Jan 1992, *Felger* (observation).


Figure 38. *Prosopis velutina*. (A) Kuakatch Wash W of Hwy 85, 7 Oct 2006. (B) Hat Mountain, Sauceda Mts, Maricopa Co., 22 Mar 2014. Ajo: (C) 21 Jul 2014; (D) 14 May 2006; (F) 14 Jun 2013. (E) Between Why and Ajo, 4 Aug 2006.

**Prosopis** sect. **Strombocarpa**
**Prosopis pubescens** Bentham
[*Strombocarpa pubescens* (Bentham) A. Gray. *Prosopis odorata* Torrey & Frémont (not sensu Palacios 2006). *Strombocarpa odorata* (Torrey & Frémont) A. Gray]
Screwbean; *tornillo*; kujel. Figures 35B & 39.

Large shrubs or small trees to 6 m tall. Spines stipular, paired, straight, white, often stout, reaching 1–2.5 cm long. Leaves with one pair of pinnae (exceptionally 2); leaflets 4.5–13 mm long, 4–7 (10) pairs per pinna. Inflorescences of cylindrical spikes 3–4.5 cm long. Flowers sessile, the petals, sepals, filaments, anthers, and anther glands bright yellow. Stamens well exerted, the filaments with some reddish flecks. Style and ovary hidden by dense white hairs. Pods in clusters of (3) 6–20+; individual pods tightly coiled, cylindrical, (2) 3–4 cm × 4–5.5 mm—these coiled pods are unique among the flora of western North America. Flowering in May and sporadically through summer and fall; pods ripening during the summer months.

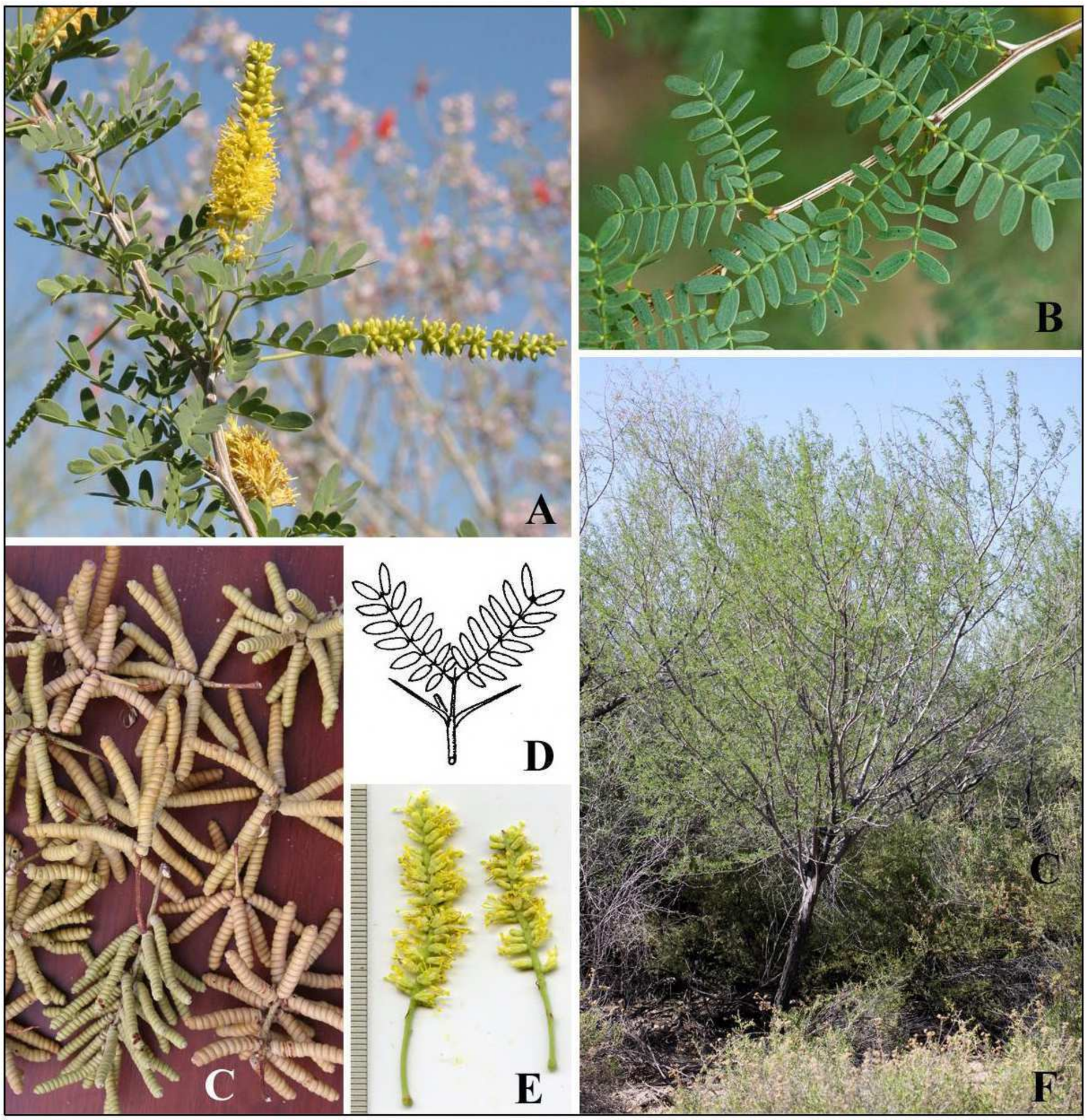


Figure 39. *Prosopis pubescens*. (A) Ajo, 14 May 2006. (B) Mesilla Bosque State Park, Doña Ana Co., NM, 16 Aug 2008, photo by Patrick Alexander. Quitobaquito: (C) 4 Aug 2006; (E) 23 Sep 2013; (F) 5 Apr 2013. (D) By Matthew B. Johnson.

Localized in wet soil and washes in the Quitobaquito region, and also recorded at Walls Well in 1939. The nearest populations are along the lower Gila and Colorado rivers.

Southern California to southwestern Utah, Arizona, Texas, northern Chihuahua, and northwestern Sonora.

The pulp (mesocarp) of the pods is sweet and served as a significant carbohydrate source. The pods were harvested in early summer, and parched, or often buried in a pit to "ripen" or partially ferment, and then ground into flour. The pods were also sometimes fermented as a beverage (Bell &

Castetter 1937; Castetter & Bell 1951). The wood was used for house construction and fuel, and perhaps weapons, and the roots and bark as medicine (Bell & Castetter 1937; Felger 2007a).

**OP**: Quitobaquito and vicinity: 28 Jan 1894, *Mearns 2738* (US, not seen); 14 Sep 1986, *Felger 86-327*; Near water channel, in and around spring, 23 May 1991, *Baker 8363*. Walls Well, *Nichol 28 Apr 1939*.

**Psorothamnus**

Shrubs or small trees, pubescent and with lens-like glands, especially on the stems. Leaves odd-pinnate or reduced and mostly leafless in *P. spinosus*. Flowers papilionoid, the petals pink or vivid blue or purple. Stamens 10, the filaments united. Ovules 2 to several; pods indehiscent, 1- or 2-seeded.

Deserts in southwestern USA and northern Mexico; 9 species. A genus segregated from *Dalea*.

1. Nearly leafless large shrubs or small trees, mostly more than 1.5 m tall; trunks and lower limbs with well-developed hardwood; twigs ending in sharp thorns; leafless or with few, quickly deciduous, simple (unifoliolate) leaves..... **Psorothamnus spinosus**
1. Leafy shrubs seldom more than 1 m tall, scarcely woody at base, lacking well-developed hardwood; twigs not spinescent; leaves odd-pinnate.

2. Flowers sessile, in dense head-like (capitate) spikes; leaves with (3) 5–11 leaflets. .....**Psorothamnus emoryi**
2. Flowers pedicelled, in racemes; leaves with 3 or 5 leaflets..... **Psorothamnus fremontii**

**Psorothamnus emoryi** (A. Gray) Rydberg var. **emoryi**
[*Dalea emoryi* A. Gray]
Emory's smokebush. Figure 40.

Densely branched shrubs probably less than 1 m tall. Herbage tomentose, grayish white with very dense tangled hairs obscuring the surfaces, and sparsely dotted with minute red-orange glands. Crushed herbage and flowers sweet smelling and imparting a fugitive yellow-orange stain. Leaves gradually drought deciduous, 1.8–4.5 cm long, odd-pinnate with (3) 5–11 leaflets, or sometimes reduced by 1 leaflet and even-pinnate on upper branches; leaflet margins entire or with rounded, shallow teeth; the paired leaflets 2–9 mm long, mostly obovate to spatulate, and blunt-tipped, the terminal leaflet (7) 12–32 mm long, linear to narrowly oblong. Flowers sessile, in short, head-like spikes; flowering following rains, spring and summer. Calyx 4.5–6.1 mm long, with oval, red-orange glands between the ribs. Corollas dark purple, longer than the calyx. Pods ca. 2.5 mm long, the seeds 1.5 mm long, smooth, brown.

In the flora area known only from dunes of the Pinta Sands and apparently not common. It is very common on sandy soils in adjacent northwestern Sonora and farther west in Arizona, as well as on the Mohawk Dunes (Felger et al. 2003).

Southwestern Arizona, northwestern Sonora, and southeastern California to Baja California Sur. Another variety occurs in Baja California Sur.

A fugitive yellow dye was made from the herbage by Cahuillas and Seris (Bean & Saubel 1972; Felger & Moser 1985).

**CP:** E Pinta Sands, 15 Sep 1992, *Felger 92-757* (ARIZ, NY). E side of Pinacate Lava flow and E Pinta Sands, low dunes encroaching lava field, seen only on higher [part of] dunes, 11 Apr 1993, *Felger 93-390* (ARIZ, ASU).

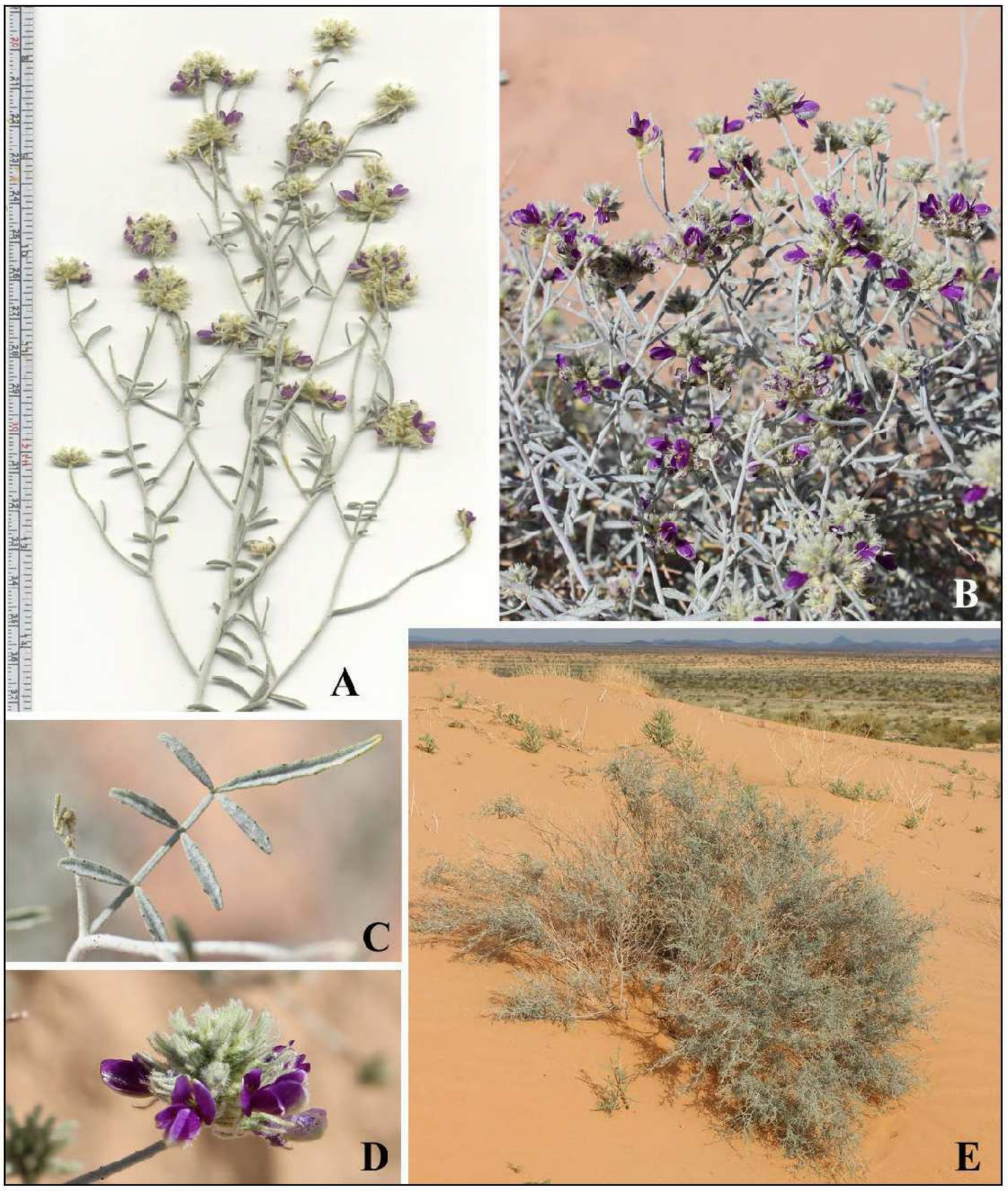


Figure 40. *Psorothamnus emoryi* var. *emoryi*. Dunes 22 mi SW of Sonoyta, E of Mex Hwy 8, Sonora: (A & B) 17 Mar 2014; (C) 19 Mar 2010; (D) 20 Feb 2014; (E) 6 Feb 2014.

**Psorothamnus fremontii** (Torrey ex A. Gray) Barneby
[*Dalea fremontii* Torrey ex A. Gray]
Frémont's dalea. Figure 41.

Shrubs less than 1 m tall, gland-dotted and generally pubescent (silvery strigose). Leaves odd-pinnate with 3–7 (9) leaflets, and leafless or essentially so in drought. Inflorescence a raceme, the flowers 7–9.5 mm long, and bright violet-purple. Pods indehiscent, 1-seeded, 7–10 mm long,

with small glands forming longitudinal lines. [Description based on plants from farther north in Arizona and the Jepson Flora Project (2012)].


Figure 41. *Psorothamnus fremontii*. (A) By Lucretia Breazeale Hamilton. (B) Near 1000 Palms Reserve, Riverside Co., CA, 5 Mar 2004, photo by Brent Miller (CalPhotos). (C) 18 mi N of La Paz County line, Mohave Co., *Richardson 11 Apr 2003* (ASU).

A single shrub of this species was found at the north end of the Sierra de la Lechuguilla at the south end of the Lechuguilla Valley. Frémont's dalea is common farther north with four disjunct southern records: this one, one near the Colorado River in southeastern California collected in 1969, one in Yuma collected in 1905, and one from Puerto Peñasco in northwestern Sonora (Felger 2000; SEINet 2015). This species occurs in the Sonoran and Mohave deserts in Arizona, California, Nevada, Utah, Sonora, and Baja California.

The single specimen from the flora area was collected during a dry season—there were a few buds and no flowers. Two varieties are described: var. *fremontii* generally grows on sedimentary rocks, while var. *attenuatus* Barneby is on granitic and volcanic rocks (Turner et al. 1995). *Psorothamnus fremontii*, however, may not be distinct from *P. arborescens* (Torrey ex A. Gray)

Barneby, both of which have somewhat similar distributions primarily north of the Sonoran Desert in dry regions of Arizona, California, Colorado, and Nevada (Barneby 1977; Turner et al. 1995).

**TA**: Rounded hills along La Jolla Wash, between the Sierra de la Lechuguilla and the Tinajas Altas, UTM 2 18 915 E, 35 73 341 N, WGS 84, 1050 ft, shrub about 0.8 m tall, uncommon, with *Larrea*, *Ambrosia dumosa*, *Fagonia californica*, & *Parkinsonia microphylla*; *Sundt, MacKinnon, & Malusa 2 Apr 2011*.

**Psorothamnus spinosus** (A. Gray) Barneby
[*Dalea spinosa* A. Gray. *Psorodendron spinosum* (A. Gray) Rydberg]
Smoke tree; *palo cenizo*. Figure 42.

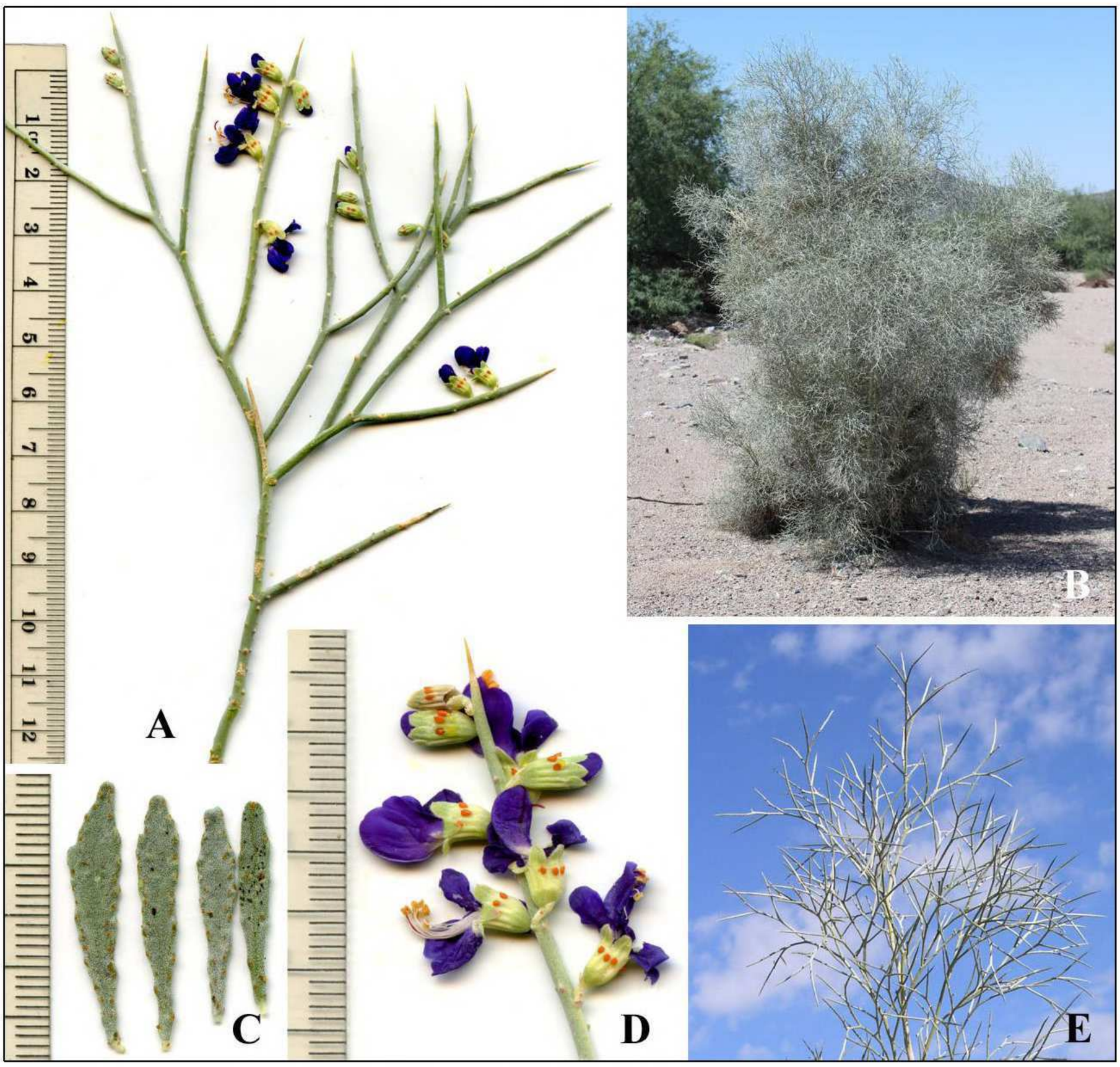


Figure 42. *Psorothamnus spinosus*. (A & D) Drainage about 25 miles S of Sonoyta on Hwy 8, 17 May 2015. (B & E) Aguajita Wash near El Papalote, Sonora, 5 Sep 2013. (C) Aguajita Wash at El Papalote, 2 Aug 2014.

Unique hardwood large shrubs or small trees 3–6 m tall; trunks or major limbs often several, often moderately irregular and twisted, sometimes reaching 22–35 cm diameter; bark smooth and gray, with age the trunk often somewhat fissured and rough. New growth appearing during hot weather. Upper and smaller stems much-branched, the twigs silvery to bluish gray, thorn-tipped and

painful to handle (perhaps due to mild toxins). Twigs, pedicels, and calyces densely hairy with short, appressed, white hairs; twigs, inflorescence branches, calyces, and pods bearing bright orange glands. Essentially leafless, the leaves very sparse, present on fresh young growth, quickly deciduous, reduced to 1 leaflet often 5–25 mm long, oblanceolate, bluish gray, thick and almost succulent, dotted with orange glands. (This leaflet is analogous to the enlarged terminal leaflet of other *Psorothamnus* species.) Seedlings and young plants with leaves reaching 20–65 mm long and usually leafier than new growth of adult plants. Flowers brilliant blue-purple (indigo), produced in spectacular masses during the hottest, driest time of year — May and June. Inflorescences of few-flowered, spinescent, twig-like racemes; individual flowers 12 mm long. Calyx 4.5–5 mm long, the tube prominently ribbed with several large orange-brown blister glands around the middle, the lobes reflexed with age. Corollas deep indigo-blue. Pods often 5–5.5 mm long with several orange-brown blister glands around the middle, and a tail-like persistent style; 1(2?)-seeded, the seeds 4–4.3 mm long, oblong-ovoid, smooth, brown, and mottled.

Large gravelly washes such as ones leading out of the Cabeza Prieta and Tule mountains, and in the Mohawk Valley in Cabeza Prieta, and scattered along Aguajita Wash in Organ Pipe. A number of smoke trees at Aguajita Wash were killed by a scouring flood in 2012. Smoke trees are much more common in nearby areas.

Southwestern Arizona, southeastern California, southern Nevada, east side of Baja California, and northwestern Sonora.

**OP**: Quitobaquito, *Nichol 3 Mar 1939*. 3 mi E of Quitobaquito, large wash, 24 Oct 1965, *Lehto 5488* (ASU). Aguajita, *Wirt 12 Apr 1989* (ORPI).

**CP**: Smoke-tree Wash, Cabeza Prieta Mts (Simmons 1966). Drift Hills, 0.5 mi W of Senita Tank, 1070 ft, large wash, 14 Jun 1992, *Felger 92-595*. Mohawk Wash, W of Bean Pass, Sierra Pinta, *Rutman 17 Feb 2002*.

**Rhynchosia** – Rosary bean

Herbaceous perennials, vines, and shrubs. Flowers papilionoid. Worldwide, mostly tropics and subtropics; 230 species. The colored seeds, including bicolored black and red seeds, are used as necklaces and other decorations.

**Rhynchosia texana** Torrey & A. Gray

[*R. senna* Gillies ex Hooker & Arnott var. *texana* (Torrey & A. Gray) M.C. Johnston. *R. texana* var. *angustifolia* (A. Gray) Grear]

Texas snout-bean. Figure 43.

Perennial vines; pubescent and glandular. Leaflets 3, dark green, ovate, or ovate-lanceolate to linear, with prominent veins, and small, round golden glands dotting the lower surfaces, the margins minutely ciliate. Flowers solitary or in pairs on pedicels to 6 mm long, the corollas 5–7 mm long, bright yellow-orange. Stamens 10; 9 fused, 1 free. Pods 2-seeded and dehiscent. Reproductive during the warmer months.

In the flora area restricted to the Ajo Mountains in canyons and at the upper limits of the desert.

Arizona, mostly southeastern and central, to Texas and Mexico and disjunct in South America (Ecuador to Argentina).

**OP**: Bull Pasture, 9 May 1979, *Bowers 1710* (ORPI). Alamo Canyon: N fork, 700 m, 17 Oct 1987, *Baker 7552* (ORPI); Above the waterfall, 2470 ft, 17 Oct 2013, *Rutman 20131017-3*. Tributary canyon to Arch Canyon, shaded protected niche, *Rutman 16 Sep 2006*.

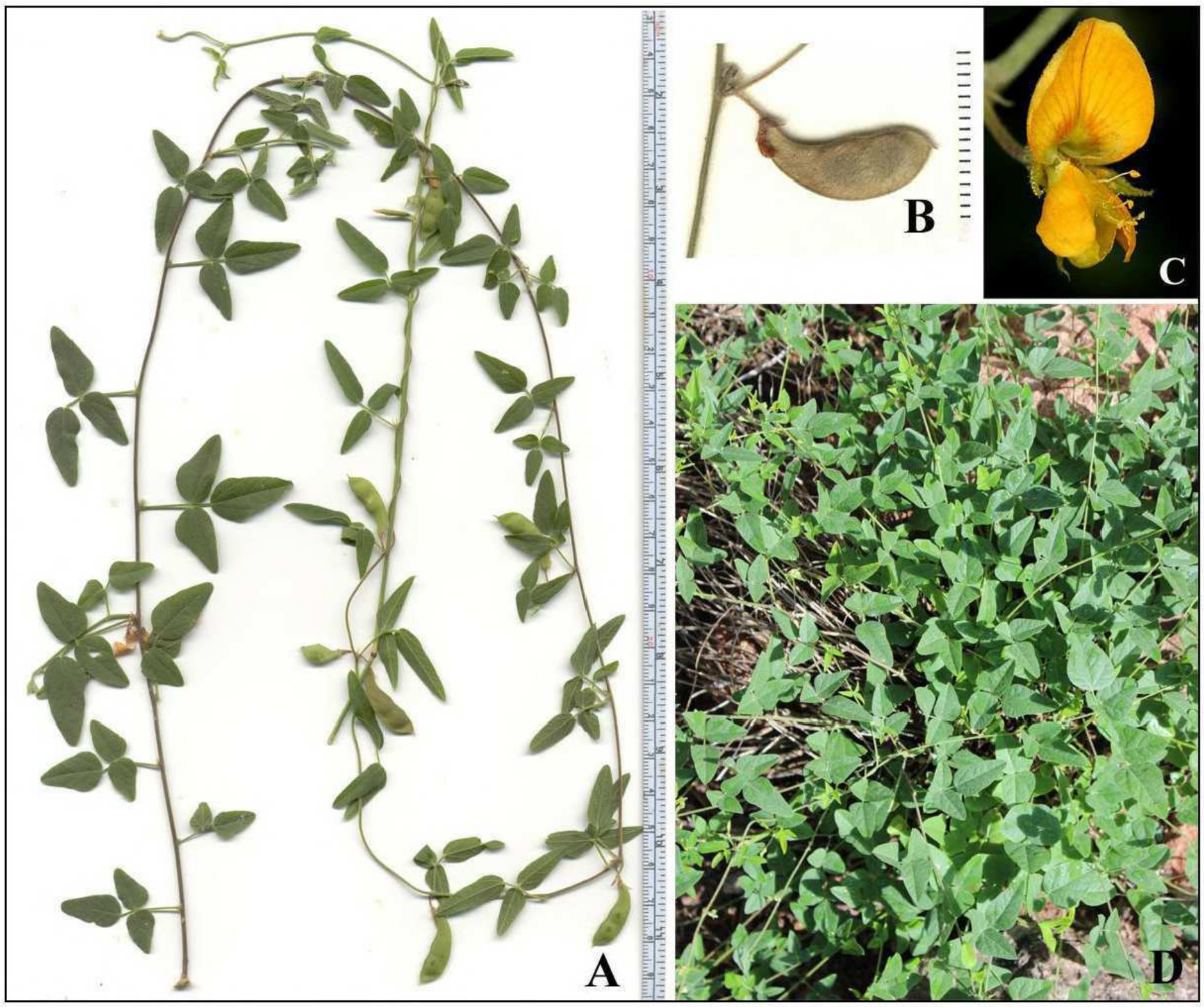


Figure 43. *Rhynchosia texana*. (A) Bull Pasture Trail, 21 Sep 2008. (B) Vicinity of Visitor Center, Chiricahua National Monument, Cochise Co., *Reeves R-3551* (ASU). (C) Piños Altos, Piños Altos Range, Grant Co., NM, 25 Jul 2009, photo by Russ Kleinman (gilaflora.com). (D) Alamo Canyon, 9 Sep 2014.

**Senegalia**

Trees and shrubs. Flowers mimosoid. Tropics to deserts, nearly worldwide; 200 species. A genus segregated from *Acacia*.

**Senegalia greggii** (A. Gray) Britton & Rose
[*Acacia greggii* A. Gray. *A. greggii* var. *arizonica* Isely]
Catclaw; *uña de gato, gatuño*; 'u:pad. Figure 44.

Large, irregularly branched shrubs with crooked trunks and branches, often 2–5 (6) m tall; wood strong and hard, the heartwood reddish. At least some stems armed with catclaw-like solitary prickles between or just below the nodes, these curved downward, and tapering to sharp point. Young twigs, leaves, and inflorescences moderately to densely pubescent with short hairs. Leaves gradually winter deciduous, twice pinnate, often 2.5–3.5 cm long, the pinnae 1 or 3 pairs; leaflets 3.5–6 (8) mm long, 4–6 (7) pairs per pinna; petioles with a prominent nectary gland. Inflorescences of dense, cylindrical, spike-like racemes, often 1.8–3 cm long, the peduncle often 1–2.5+ cm long. Flowers fragrant, pale yellowish, at first sessile or nearly so, becoming very short-pedicelled. Calyx shallowly lobed. Stamens numerous and separate, the anthers very small, sometimes with a terminal gland. Pods (3.5) 6–15.5 × 1–1.6 (2+) cm, conspicuously flattened, ribbon-like, more than twice as wide as

thick, usually curved or curled, sometimes moderately constricted between some seeds, and indehiscent or tardily semi-dehiscent (the whole pod usually falls and is chewed by rodents). Seeds oval to orbicular, conspicuously flattened, dark brown, 10.3–12.7 × 3.4–3.9 mm. Mostly flowering in spring, the pods ripening in June.

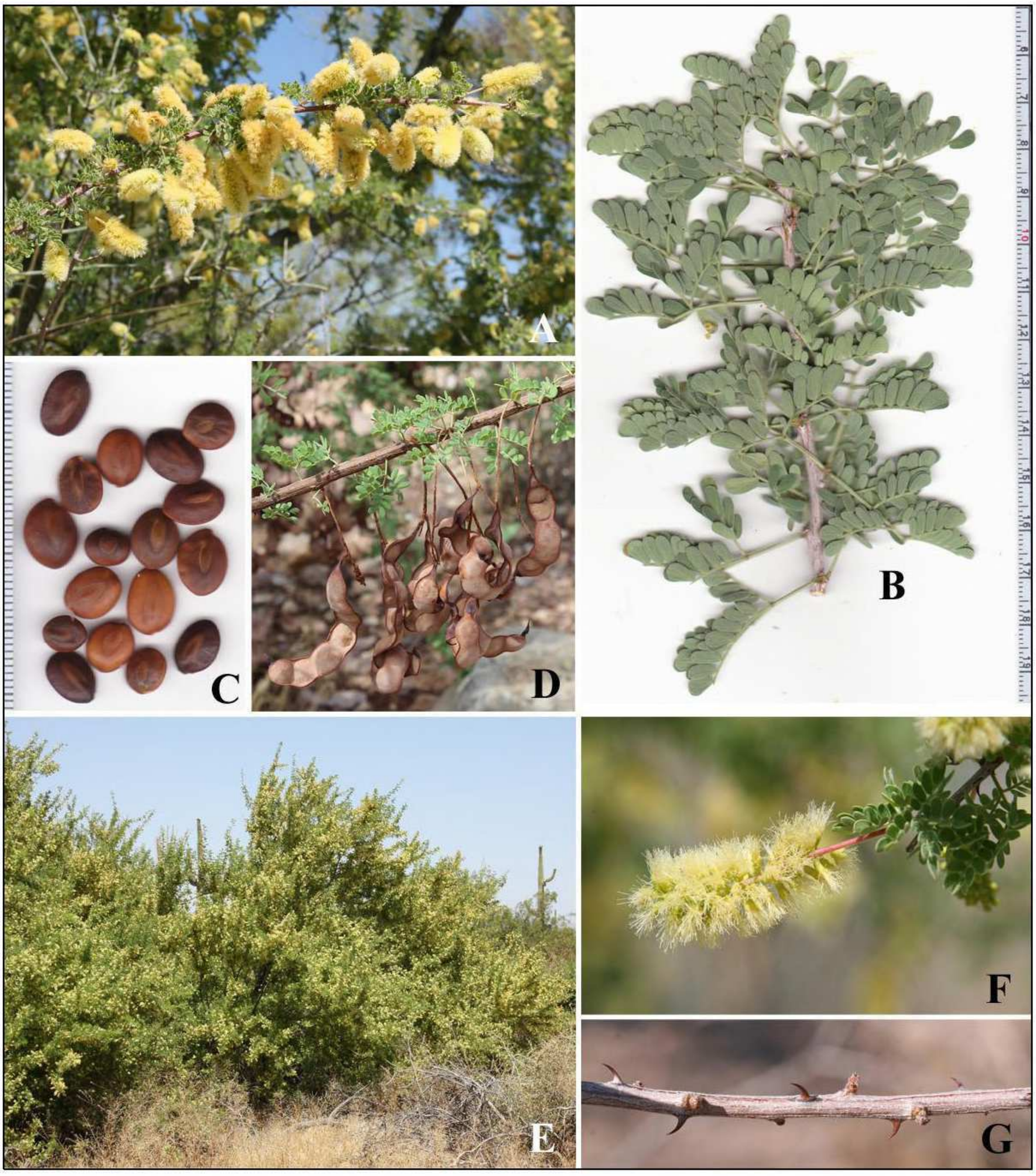


Figure 44. *Senegalia greggii*. Ajo: (A & F) 6 May 2006; (B & E) 23 May 2010; (C) 13 Sep 2008. (D) Diablo Mts, Ajo Mountain Drive, 2 Aug 2013. (G) Kuakatch Wash near Hwy 85, 13 Mar 2010.

Widespread across the flora area, in larger washes and arroyos, less often along smaller drainageways, and hills and slopes, especially north-facing. Often dominant along valley floor

washes. Large catclaw trees occur along Cuerda de Leña in Organ Pipe. Catclaw is one of the favorite foods of desert bighorn. It extended across the region during the Ice Ages and has been in the Tinajas Altas Region for at least 37,000 years.

Deserts across northern Mexico, and western Texas to southwestern Utah and southeastern California.

Isely (1969, 1998) segregated populations west of Texas as var. *arizonica*, characterized by densely hairy leaves. "However, since glabrous individuals occur as far west as Baja California, and the leaflets of part of Gregg's original gathering are puberulent, a taxonomic distinction is difficult to sustain" (Barneby 1989: 7).

The seeds were parched and ground, or the pods pounded, and the flour consumed as a gruel or made into cakes (Castetter 1935; Russell 1908). These foods, however, were sometimes bitter and not esteemed (Bean & Saubel 1972). The Gila River Pimas drank tea from the root for stomach ulcers and more recently to alleviate kidney problems caused by alcohol consumption (Rea 1997). The hard, reddish wood served many purposes, including bows, crosspieces of saguaro fruit–gathering poles, prayer sticks with eagle feathers, and firewood, and the flexible branches were used for cradleboard frames (Bean & Saubel 1972; Castetter & Underhill 1935; Felger & Moser 1985; Rea 1997).

**OP**: Cipriano Well, *Nichol 27 Apr 1939*. Alamo Canyon, 19 Apr 1942, *Cooper 564*. Aguajita, 19 Jun 1989, *Felger 89-238*. †Alamo Canyon, spines (prickles), leaflets, 1150 to 14,500 ybp (4 samples).

**CP**: Lower Well (Simmons 1966). Little Tule Well, 12 Jun 1992, *Felger 92-537*. Vicinity of Papago Well, 26 Mar 2010, *Felger 10-129*. Junction of Camino del Diablo and road to Cabeza Prieta Tanks, 32°13'13.6"N, 113°48'04.9"W, 360 m, 28 Mar 2010, *Felger 10-156*. *Felger*, observations: Charlie Bell Rd, 0.4 mi W of E Refuge Boundary, 31 Jan 1992; Daniels Wash at Charlie Bell Road crossing, 18 Aug 1992; Agua Dulce Pass, Jose Juan Represo, Heart Tank, 3.5 mi NE of Tule Well on road from Christmas Pass in the Drift Hills, Cabeza Prieta Tanks, Half-way Tank, Buck Mt. Tank, 12–15 Jun 1992.

**TA**: Tinajas Altas, 19 Mar 1998, *Felger* (observation). Coyote Water, 25 Oct 2004, *Felger 04-21*. †Butler Mts, stem prickles, leaflets, fruits fragments, 740 to 8160 ybp (3 samples). †Tinajas Altas, twigs (prickles), leaves, 1230 to 11,040, & >37,000 (14 samples).

## Senna

Herbaceous perennials to trees. Flowers caesalpinioid. Tropics, warm temperate regions, and deserts, nearly worldwide; 300–350 species. A genus segregated from *Cassia*.

**Senna covesii** (A. Gray) H.S. Irwin & Barneby
[*Cassia covesii* A. Gray]
Desert senna; *hojasén*, *daisillo*; ko'ovĭ ta:tamĭ. Figure 45.

Perennials from a semi-woody base, probably not long-lived; dormant during cooler and drier months. Stems mostly erect, dying back in drought; herbage densely white-velvety hairy. Leaves drought deciduous, even-pinnate, the leafstalk with a long-stalked, orange nectary gland between the leaflets of each pair; leaflets (2) 3 (4) pairs, elliptic to elliptic-oblong, the larger ones 1.5–2.8 (3.5) cm long. Flowers 1.5–2 cm wide, yellow-gold, becoming pale yellow or whitish with age. Fertile stamens 7, the filaments shorter than to about as long as the anthers, the anthers orange-brown, opening by terminal pores (the flowers are buzz-pollinated by bees); sterile stamens 3, shorter than the fertile stamens. Pods 2.2–3.5+ cm long, several seeded, splitting along both sutures, with dense, short, appressed to spreading hairs. Flowering response non-seasonal during warmer weather.

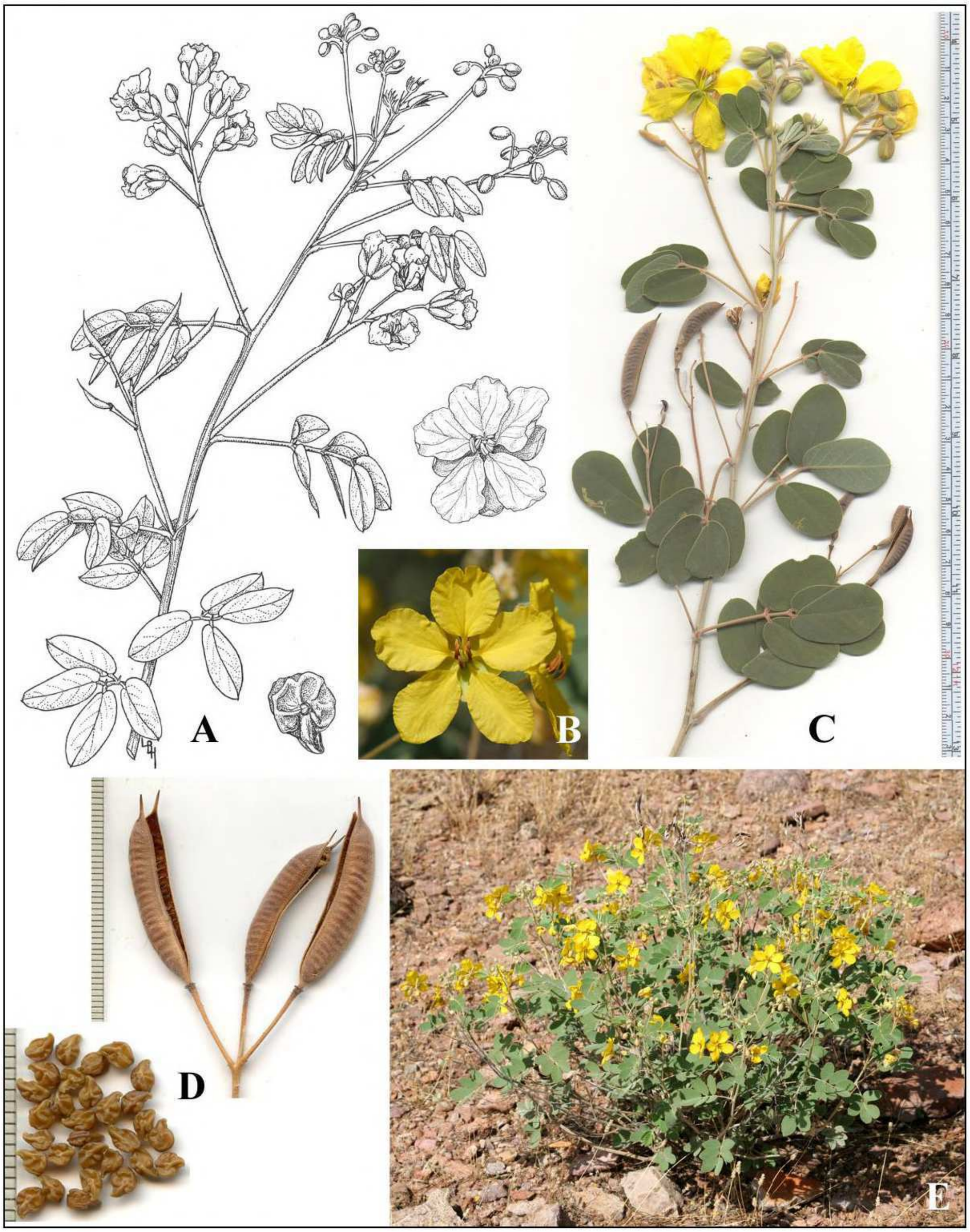


Figure 45. *Senna covesii*. (A) By Lucretia Breazeale Hamilton. Copper Mountain: (B) 7 Aug 2005; (E) 7 Aug 2005. (C) Alamo Wash near Hwy 85, Aug 2008. (D) Arch Canyon trailhead, 12 Sep 2014.

Widespread across much of the flora area but not extending to the Tinajas Altas Region. Often localized; various habitats including washes, sand flats, dunes, and rocky slopes. Often in

disturbed habitats such as roadsides, old rodent mounds, and scoured wash beds. It was in the Puerto Blanco Mountains about 2000 years ago.

Arizona, southern California, Nevada, southwestern New Mexico, Sonora, Sinaloa, and Baja California.

**OP**: Alamo Canyon, *Nichol 4 May 1939*. Bates Well, 23 Apr 1942, *Garth 562*. 16 mi N of Lukeville, 26 Sep 1964, *Felger 10530*. Puerto Blanco Drive, 5.2 mi W of Visitor Center, 16 Oct 1977, *Bowers 885*. †Puerto Blanco Mts, on ridge, seeds, 1910 ybp.

**CP**: Childs Mountain, 2300 ft, 18 Aug 1992, *Felger 92-645* (ARIZ, ASU). E Pinta Sands, 15 Sep 1992, *Felger 92-764* (ARIZ, ASU). Senita Tank Wash, 14 Apr 1992, *Harlan 280* (CAB). Charlie Bell Road 1.9 km NE of Little Tule Well, 5 Mar 1994, *Felger 94-28*.

## Tephrosia

Herbaceous perennials and shrubs, rarely annuals. Flowers papilionoid. Worldwide, mostly tropics and subtropics; 400 species.

**Tephrosia tenella** A. Gray
Red hoary-pea. Figure 46.

Herbaceous perennials. Herbage sparsely pubescent or essentially glabrous. Leaves odd-pinnate, to ca. 10 cm long; leaflets pale green, 5–11, potentially 1.5–3.5 cm long, linear to narrowly oblong or elliptic; stipules 5–8 mm long. Flowers pink, drying wine colored, less than 8 mm long. Stamens 9 united, 1 free. Pods 3–4 cm long, multiple-seeded, elastically dehiscent, the valves coiling.


Figure 46. *Tephrosia tenella*. (A & B) N end of Salero Ranch, Santa Cruz Co., 23 Sep 2013, photos by Sue Carnahan. (C) Cracks in bedrock, upper elevations of middle fork of Alamo Canyon, *Rutman 5 Sep 1999*.

Ajo Mountains, known from a single record, although probably more widespread at higher elevations.

Southern Arizona to Texas, and Mexico to Central America. These plants have been treated as *Tephrosia vicioides* Schlechtendal, but Téllez (2001) showed that *T. vicioides* is a different species that Nesom (accepted for publication & in press) restricts to Veracruz and Oaxaca.

**OP**: Ajo Mts, upper elevation of the headwaters of the middle fork of Alamo Canyon, in cracks in bedrock, potential habitat is extensive but unsurveyed, *Rutman 5 Sep 1999* (ARIZ, ORPI).

**Trifolium**

Annuals and herbaceous perennials. Flowers papilionoid. Nearly worldwide, 300 species.

**Trifolium wormskioldii** Lehmann

[*T. wormskioldii* var. *arizonicum* (Greene) Barneby. *T. lacerum* Greene. *T. willdenovii* Sprengel]

Cow clover. Figure 47.

Spring-flowering ephemerals, glabrous. Leaflets 3, 1–3 cm long, elliptic to ovate, the margins serrate-toothed. Stipules rather large, spinescent on lower leaves, broader on upper leaves. Flowers in head-like clusters subtended by spinescent bracts. Calyx lobes bristle-tipped. Corollas lavender, 12–15 mm long. Stamens 10; 9 fused, 1 free. Pods ca. 3.5–5 mm long, 1–3-seeded.

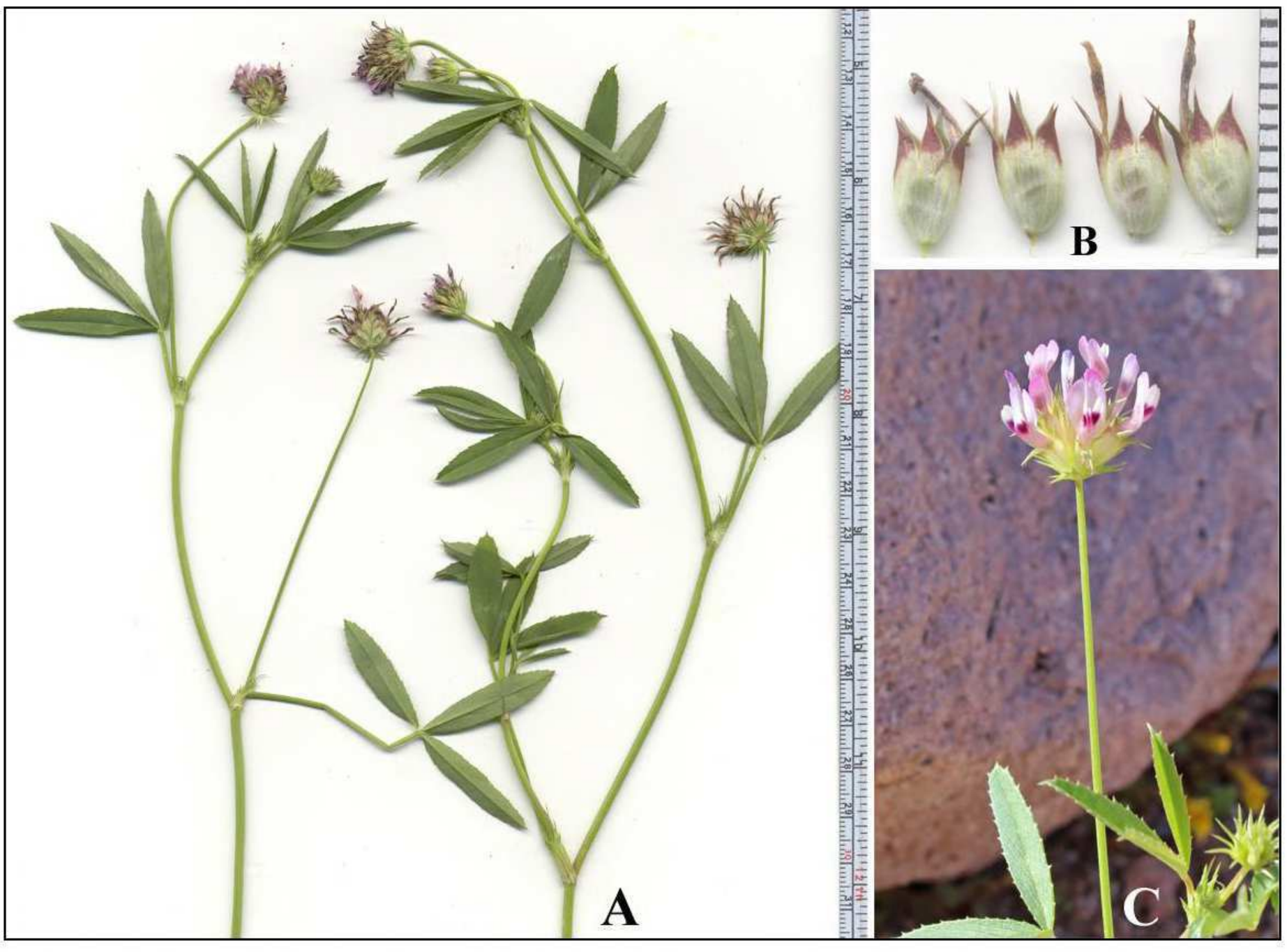


Figure 47. *Trifolium wormskioldii*. Alamo Canyon: (A) 22 Jul 2014; (B & C) 11 Mar 2014.

Ajo and Diablo mountains; often locally abundant in riparian canyon bottoms and especially open, rocky areas at higher elevations where it may grow hidden among grasses.

Although the Ajo Mountains plants are cool-season ephemerals, this species is generally perennial over most of its range. British Columbia to Baja California and east to Idaho, and southward to central Mexico.

**OP**: Alamo Canyon: *Nichol 14 Mar 1939* (ORPI); 2800 ft, N-facing slope, 12 Apr 1978, *Bowers 1243*; Canyon bottom, among dense growth of annuals, 29 Mar 2003, *Felger 03-405* (ARIZ, ASU). Ajo Mts, summit, 1 Apr 1944, *Clark 11549* (ORPI). Canyon Diablo, *Supernaugh 5 May 1949* (ORPI). Bull Pasture, 3300 ft, 5 Apr 1978, *Bowers 1205* (ORPI). Abundant near the crestline of the Ajo Mts, middle fork of Alamo Canyon, 15 Mar 2003, *Rutman 2003-357*.

**Vachellia**

Trees and shrubs; flowers mimosoid. Mostly tropics, subtropics, and deserts, nearly worldwide; 160 species. A genus segregated from *Acacia*.

1. Pods reddish or brownish, slender and dehiscent, 4–6 mm wide; common and widespread in the flora area..... **Vachellia constricta**
1. Pods dark brown to blackish when ripe, thick and tardily or not dehiscent, 8–10 mm wide; rare in the flora area..... **Vachellia farnesiana**

**Vachellia constricta** (Bentham) Seigler & Ebinger
[*Acacia constricta* Bentham]
White-thorn acacia; *mezquitillo*; gidag. Figure 48.

Shrubs to 4 m tall, with mostly straight branches. Bark of small- to mid-sized branches smooth and reddish brown. Spines at nodes (stipular), the larger ones 1–3 cm long, paired, straight, terete, and usually white, or some stems without spines. Herbage at first viscid with dot-like glands and sparsely to moderately pubescent with small white hairs, and becoming glabrate with age. Foliage gradually winter and/or drought deciduous, new leaves mostly appearing in mid-spring and with summer rains. Leaves (1.5) 3.5–4 cm long, the pinnae mostly 3–6 pairs (elsewhere sometimes 7 or 8 pairs), the leaflets 1.5–3 mm long; petioles bearing a prominent nectary gland. Flowers bright yellow and noticeably fragrant, in rounded heads ca. 1 cm wide. Pods slender, 4.5–13.5 cm × 4–6 mm, constricted between each seed, and gradually dehiscent.

Young pods reddish, sometimes bright red or green, glistening sticky-viscid, and spotted with small, dot-like raised glands, these range from colorless to golden to dark brownish-purple. This viscid exudate, probably derived from the glands, is water soluble. Mature pods become dull brown, no longer viscid, and the glands fewer or mostly no longer visible—however, look closely with magnification and you will see dot-like depressions in place of the glands. Similar glands are seen on the youngest herbage including newly forming spines, and these glands likewise leave depressions on slightly older stems. Seeds 4.5–5.2 mm long, mottled, moderately compressed, and somewhat oblong; seeds in freshly opened pods (ones that open naturally) have a glossy-resinous coating; exposed to the air they become dull (not glossy). Flowering mostly in spring, the pods ripe in June and July, and also flowering later in summer, depending on rainfall, and producing pods in fall.

Widespread in washes, canyons, rocky hills, and lower mountains, and extending into valleys on coarse, well-drained soils; across Organ Pipe and Cabeza Prieta except the western portion. It grew in the Ajo Mountains 1200 years ago.

Arizona to Texas and much of arid and semi-arid Mexico to Puebla and Oaxaca.

**OP**: Cipriano Well, *Nichol 27 Apr 1939*. Ajo Mt Drive, 9 mi by road NE of Visitor Center, 5 Nov 1977, *Bowers 928*. 5.8 mi E of Lukeville, 11 Nov 1987, *Felger 87-331*. S Puerto Blanco Drive, 2.4 mi W of Hwy 85, 19 Jun 1989, *Felger 89-222*. †Alamo Canyon, spines, 1150 ybp.

**CP**: Adobe Windmill (Simmons 1966). Camino del Diablo, SW of O'Neill Hills, 13 Mar 1993, *Harlan 360* (CAB). Charlie Bell Rd, 1 km W of E boundary of Refuge, 5 Mar 1994, *Felger 94-23*.

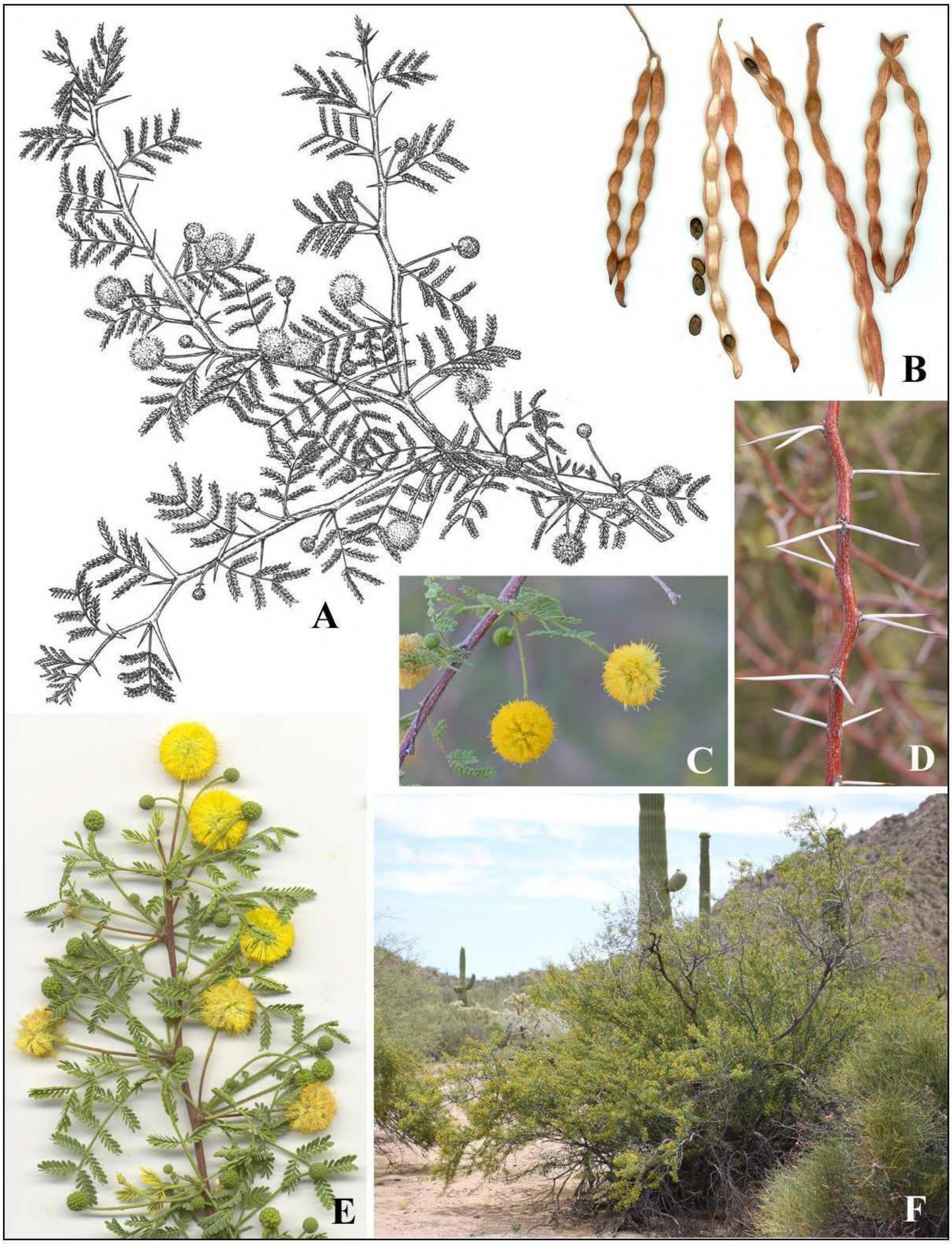


Figure 48. *Vachellia constricta*. (A) By Lucretia Breazeale Hamilton. Ajo: (B) 10 Sep 2006; (C) 21 May 2006; (E) 15 Sep 2008. (D) Near Valentine Tank, S of Ajo, 4 Mar 2009. (F) Senita Basin, 10 May 2010.

****Vachellia farnesiana** (Linnaeus) Wight & Arnott
[*Mimosa farnesiana* Linnaeus. *Acacia farnesiana* (Linnaeus) Willdenow. *A. smallii* Isely]
Sweet acacia; *huizache, vinorama*. Figure 49.

Generally called *vinorama* in Sonora and *huizache* elsewhere in Mexico. Shrubs to small trees; pubescent, the leaves becoming sparsely hairy with age. Spines reaching 2–4.5 cm, stipular, paired, white, straight, and terete. Leaves tardily drought deciduous and partially to fully winter deciduous. Leaves 2.5–5.5 cm long, the pinnae 2–6 pairs, the leaflets many, 3–7 mm long; petiole or rachis sometimes with a dark nectary gland. Flowers bright yellow-orange, in globose heads, with a strong and far-reaching sweet fragrance. Pods 4–7.5 cm × 0.8–1 cm, indehiscent to tardily dehiscent, dark brown to blackish, thick and not constricted between the seeds, with pulpy mesocarp, the seeds crowded in two rows. Young pods have sweet, pulpy mesocarp, which shrinks as the pods mature or age.

*Vachellia farnesiana* may be difficult to distinguish from *V. constricta* if pods are not available: *V. farnesiana* herbage lacks the golden glands usually seen on *V. constricta*, and in cultivation *V. farnesiana* is more robust and with larger leaves.

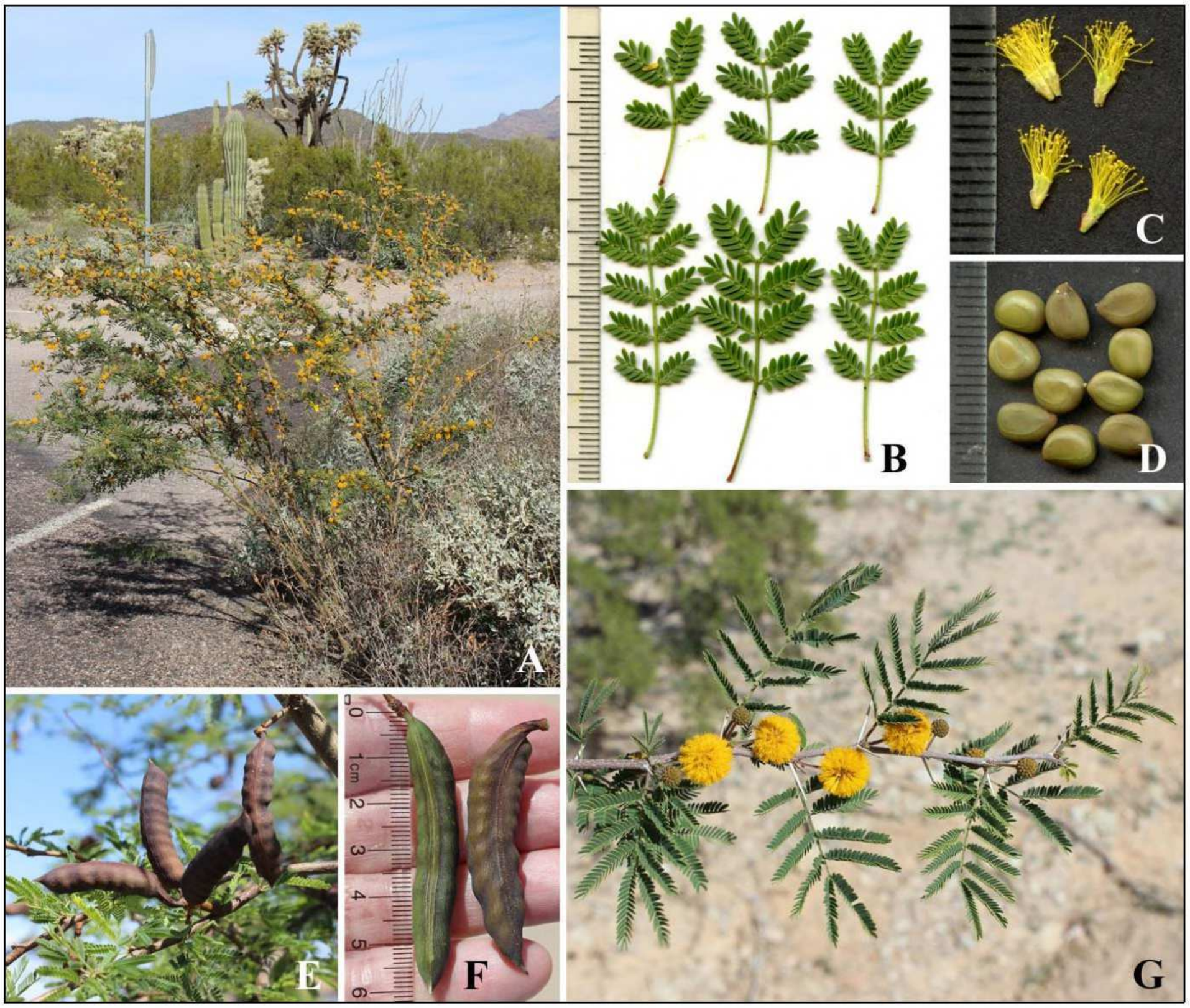


Figure 49. *Vachellia farnesiana*. (A & G) Intersection of Hwy 85 and Ajo Mountain Drive, 30 Jan 2014. Ajo: (B) 16 Jun 2015; (C–E) Ajo, 16 May 2015. (F) Pods from the Organ Pipe plant (left) and from cultivated plant in Ajo (right), 16 May 2015.

Three varieties of *Vachellia farnesiana* are recognized (Ebinger et al. 2002). Var. *farnesiana* is native in the Baboquivari Mountains in Arizona. This variety is extensively cultivated in southern Arizona and has become established in many areas in the state outside of cultivation; all or most Arizona plants are this variety. It is distinguished in part by having pods less than 10 cm long and seeds in 2 rows or irregularly arranged. Var. *minuta* (M.E. Jones) Siegler & Ebinger has pods 10 or more cm long and seeds in seeds in one row. Sweet acacias sampled in Ajo have pods less than 10 cm long and seeds in 2 rows. Several pods from the single sweet acacia shrub in Organ Pipe were 5–6 cm long but with seeds in a single row.

Var. *farnesiana* ranges from southern USA to South America and the West Indies. It is cultivated, naturalized, and/or weedy in many warm regions worldwide. An essential oil from the flowers has been an important ingredient in perfumes. Var. *minuta* occurs from southwestern California through the Baja California Peninsula and might be found in cultivation or feral elsewhere. Var. *pinetorum* occurs in Florida.

**OP**: Intersection of Hwy 85 and Ajo Mt Drive, single roadside waif, about 2 m tall, *Rutman 30 Jan 2014*.

**CP**: Ajo, Cabeza Prieta headquarters, planted, not given supplemental water, 1 Jan 2015, *Rutman*, observation.

**Vicia** – Vetch

Annuals and herbaceous perennials. Flowers papilionoid. Nearly worldwide; 160 species.

**Vicia ludoviciana** Nuttall ex Torrey & A. Gray subsp. **ludoviciana**
[*V. exigua* Nuttall]
Deer-pea vetch. Figure 50.

Delicate winter-spring annuals, the stems sprawling or climbing; pubescent or perhaps glabrate or glabrous. Leaves once pinnate, the leafstalk (rachis) ending in an unbranched or branched tendril, this sometimes branched (figure 50A); leaflets 4–12, linear to narrowly elliptic; stipules small. Corollas blue, 5–7 mm long. Flowering March to May. Pods 1.5–2.5 cm long, several-seeded, and dehiscent. This is the only legume in the flora area with tendrils.

Arizona Upland mountains in Organ Pipe including the Ajo, Bates, Diablo, and Santa Rosa mountains, often along canyon bottoms.

This subspecies from California to southeastern USA and northern Mexico; another subspecies occurs in Texas, southeastern USA, and northeastern Mexico.

**OP**: Alamo Canyon, 19 Apr 1942, *Cooper 578*. Alamo Wash, canyon outwash, 11 Sep 1946, *Haskell 1091* (UCR, det. Andrew C. Sanders 1988). Bull Pasture trail, 11 Apr 1978, *Bowers 1233*. Middle fork Alamo Canyon near crestline of Ajo Mts, 15 Mar 2003, *Rutman 2003-330* (ORPI). Alamo Canyon, 2408 ft, canyon bottom, in shade among dense growth of annuals, 29 Mar 2003, *Felger 03-403* (ASU, ARIZ). Foothills of Santa Rosa Mts, W of Diaz Peak, 2 Apr 2003, *Rutman 2003-447* (ORPI). Canyon, NW of Kino Peak, 2000 ft, 20 Mar 2005, *Rutman 2005-0320-29* (ORPI).

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Figure 50. *Vicia ludoviciana* subsp. *ludoviciana*. Alamo Canyon: (A, C & D) 4 Apr 2015; (B) 2 Mar 2008. (E) Estes Canyon, 18 Mar 2005.

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