

The naturalized species of *Lupinus* (Fabaceae) in southern Africa

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ABSTRACT

Four species of *Lupinus* have become naturalized in southern Africa: *L. consentinii* Guss., *L. angustifolius* L., *L. pilosus* Murray and *L. luteus* L. Their morphological variation and geographical distribution is discussed and a key is provided.

UITTREKSEL

Vier *Lupinus*-spesies het in suidelike Afrika genaturaliseerd geraak: *L. consentinii* Guss., *L. angustifolius* L., *L. pilosus* Murray en *L. luteus* L. Hulle morfologiese variasie en geografiese verspreiding word bespreek en 'n sleutel word voorsien.

INTRODUCTION

The genus *Lupinus* comprises some 200 species of annual and perennial herbs, or sometimes subshrubs (Polhill 1976; Bisby 1981). It is best represented in the western parts of North and South America, with a second centre in Mediterranean Europe with some extensions into the highlands of eastern Africa (Kay 1979). Twelve species of European and African origin are recorded from Africa (Gladstones 1974; Plitmann 1981; Williams, Demissie & Harborne 1983).

Lupins have been used by man for thousands of years, principally for fodder, green manure, ornament and as grain legumes. A few species have become naturalized weeds in Mediterranean Europe, the south-east United States of America, the Andes, Australia, New Zealand and South Africa (Kay 1979).

The taxonomy of the genus has been confused for a long time. This was exacerbated to some extent by the development and growing importance of large-seeded lupins as a source of edible protein (Gladstones 1974). The most important grain legumes are *Lupinus albus* L., *L. angustifolius* L., *L. luteus* L. and *L. mutabilis* Sweet.

Recent studies on the flavonoid chemistry of the Old World species of *Lupinus* provide useful taxonomic markers (Williams *et al.* 1983) to separate the species cultivated or naturalized in southern Africa. *L. albus* has flavonols only, *L. angustifolius* and *L. luteus* have flavones and flavonols, whereas *L. consentinii* and *L. pilosus* are characterized by the presence of flavone C-glycosides, luteolin and novel 2'-hydroxyflavone. *L. angustifolius* is chemically distinct from all the other Old World species as it accumulates diosmetin derivatives as major leaf constituents (Williams *et al.* 1983). It is chemically the most variable species and is divided into a number of varieties (Plitmann 1966).

The commercial exploitation of lupins in South Africa began early this century but it was C.C.P. Wagener who first drew attention to the importance of the crop (Van Vuuren 1962). He used bitter lupins as fodder for sheep. Prior to that the crop had been used as a green-manuring crop in vineyards and orchards. By 1947 lupins had become part of crop rotations in the wheatbelt of the Cape (Preller 1949; Henning 1949). The introduction of sweet lupins at about that time did much to increase wheat yields and resulted in a substantial increase in the number of livestock animals that could be maintained in the region.

Fourteen cultivars were available in 1962 (Van Vuuren 1962): 1, *L. albus*: *albus* (German origin), *carstens*, *pflugs gela*, *pflugs ultra*, and S.S.K. (white sweet); 2, *L. angustifolius*: *borre*, *jackalsfontein*, *ligvoet*, S. E. blue No. 1, B. resistant, blue sweet (German origin) and 7002 (white); 3, *L. luteus*: S. E. yellow No. 1 and *weiko* III. The *weiko* III cultivar is an alkaloid-free, white-seeded and early maturing strain and is the dominant lupin cultivated in a number of European countries. A similar strain named Stellenbosch-Elsenburg Geel-1 is popular in South Africa. Lupins are still popular in the western Cape and have begun to be used in other parts of South Africa, for example, in the south-eastern Transvaal Highveld (Van Zyl 1973).

It was perhaps inevitable that as lupins became increasingly popular some species would become naturalized. This study, based on herbarium material as well as fresh specimens collected during three field trips to the region in 1975, 1976 and 1984, is a first attempt to monitor the spread of naturalized lupins in the Cape. It should be stressed, however, that the distribution maps (Figures 1–4) are only an indication of the extent of naturalization. Botanists, farmers and extension-officers are urged to collect herbarium material from areas which are not recorded in this survey. The author will provide identifications of any well pressed, vouchered material that is sent to him.

The descriptions and keys are based on fresh material and cover naturalized species only.

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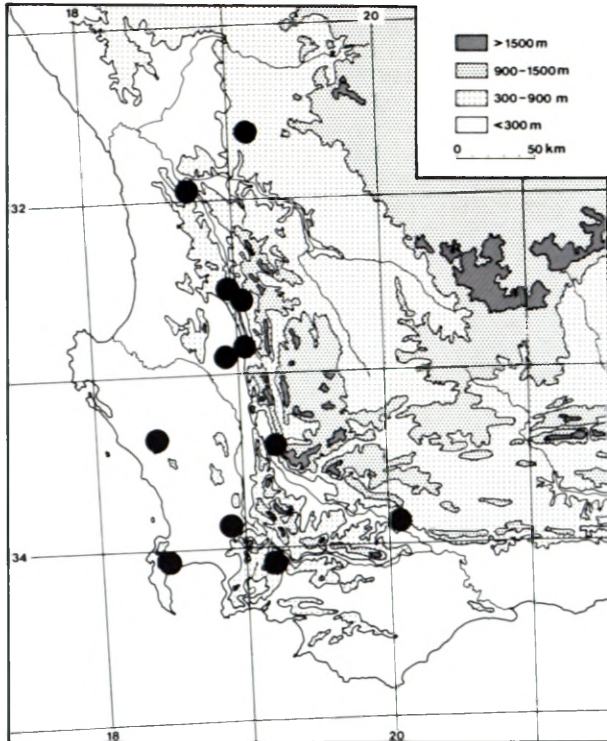


FIGURE 1.—Naturalized distribution of *L. angustifolius* in South Africa.

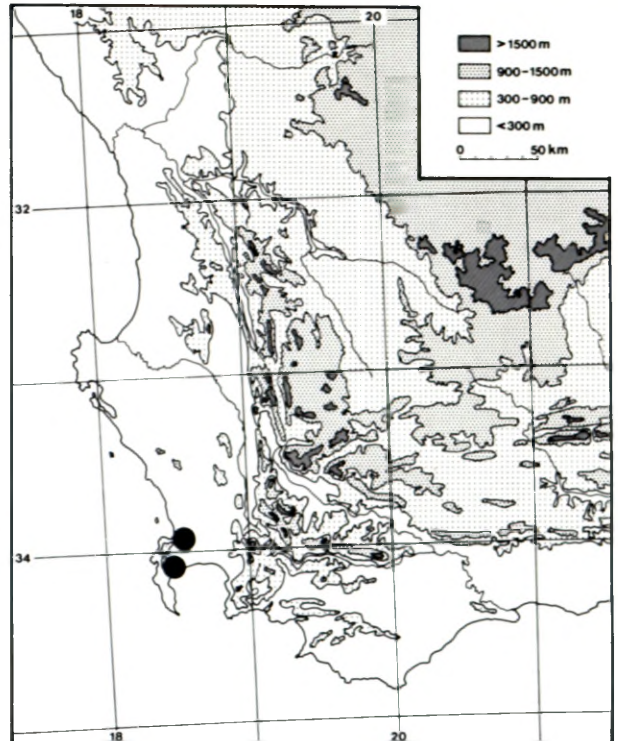


FIGURE 2.—Naturalized distribution of *L. consentinii* in South Africa.

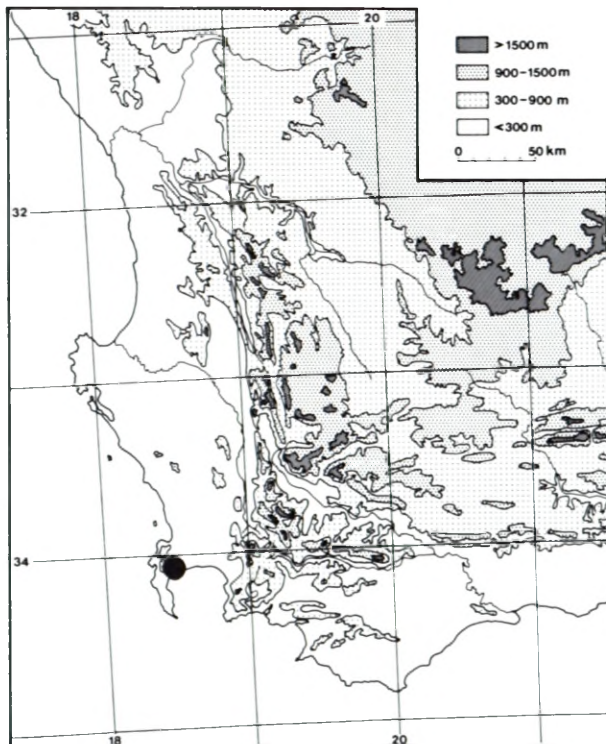


FIGURE 3.—Naturalized distribution of *L. pilosus* in South Africa.

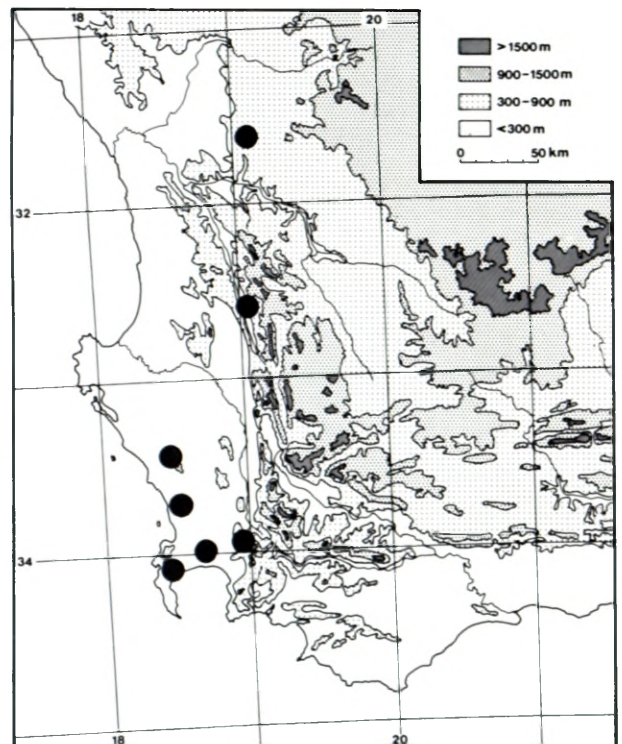


FIGURE 4.—Naturalized distribution of *L. luteus* in South Africa.

KEY TO SPECIES

1a Flowers blue, rarely white:

2a Leaflets 8–11, 40–80 × 11–21 mm, flattened out, oblanceolate, upper surface finely sericeous; stipules 10–11 mm long; flowers 18–19 mm long, keel obtuse to acute; bracteoles extending past the sculpturing pattern on the wing petals 1. *consentinii*

2b Leaflets 7–9, 25–27 × 4.5–5.0 mm, folded, linear-spathulate, upper surface glabrous; stipules 7–8 mm long; flowers 15 mm long, keel rostrate; bracteoles shorter than the sculpturing pattern on the wing petals 2. *angustifolius*

1b Flowers pink or yellow:

- 3a Flowers pink; plants densely hirsute, hairs up to 4,5 mm long; leaflets 14–20 mm wide, obovate; bracteoles pinkish; tip of keel brown; seeds rough 3. *pilosus*
- 3b Flowers yellow; plants sparsely hirsute; leaflets 5–12 mm wide, narrowly obovate; bracteoles black; tip of keel black; seeds smooth 4. *luteus*

KEY TO DISTINCTIVE FEATURES

- A. Apex of petiole, where the leaflets emerge, distinctly domed *consentinii*
 Apex of petiole, where the leaflets emerge, flattened *angustifolius, luteus, pilosus*
- B. Stipules recurved *angustifolius, luteus*
 Stipules straight *consentinii, pilosus*
- C. Stipules shaggy *pilosus*
 Stipules pubescent *angustifolius, consentinii, luteus*
- D. Upper surface of leaflets glabrous *angustifolius*
 Upper surface of leaflets pubescent *consentinii, luteus, pilosus*
- E. Flowers blue *angustifolius, consentinii*
 Flowers pink *pilosus*
 Flowers yellow *luteus*
 Flowers white *angustifolius*

1. **Lupinus consentinii** Guss., *Florae siculae prodromus* 2: 398 (1828). For a detailed synonym listing see Gladstones: 29 (1972) and Gladstones: 21 (1974).

Robust annual up to 1 m tall, erect with vigorous lateral branching, covered in shortly villous 1 mm long patent hairs. *Stipules* 10–11 mm long, linear-subulate, straight, arching back towards branch, pubescent. *Leaflets* 8–11, 40–80 × 14–21 mm, oblanceolate, midrib prominent, apex blunt with a point, base cuneate, finely sericeous above and below; petiole 85–135 mm long, terete for most of its length but flattened adaxially towards the base. *Inflorescences* axillary, verticillate, lowest verticil quintuplicate sometimes subalternate, 25–(40)-flowered, 60–180 mm long. *Flowers* 18–19 mm long, on stout 5 mm long pedicels; bract 6–7 mm long, lanceolate, early caducous; bracteoles linear. *Calyx* 10–12 mm long; upper lobes deeply divided; lower lobes much longer, fused but shallowly 3-toothed, villous. *Corolla* 15–16 × 14–18 mm, dull violet-blue darkening with age, nectar patch white turning lilac after anthesis; scentless. *Standard* 17–18 mm long and wide, very broadly ovate, scarcely clawed or auriculate, apex rounded. *Wing petals* 15 mm long, barely longer than keel petals, dull violet-blue; fused at apex; claw 2 mm long; sculpturing on upper basal parts comprising 10 rows of 14–20 intercostal lunae. *Keel petals* 14 mm long; fused halfway along the base to the acute apex, tip pigmented. *Androecium* 15 mm long; anthers dimorphic, comprising 5 basifixed, linear anthers 1,2 mm long, and 5 medifixed, reniform anthers 0,5 mm long. *Pistil* 13 mm long; ovary 8 mm long, densely shaggy, height of curvature 5 mm. *Fruits* 40–50 × 13–15 mm, densely villous, apple-green, rostrate, segmented. *Seeds* 4, rough. Figure 5B.

Lupinus consentinii is most commonly confused with *L. angustifolius* but it is easily separated from that species by its much longer, wider, open, oblanceolate leaflets and obtuse to acute keel petals. Flowering takes place in August and September.

2. **L. angustifolius** L., *Species plantarum*: 721 (1753); Gladstones: 28 (1972). Holotype: *Linnaean Collection* 898.7 (LINN).

Erect annual up to 150 mm high, compact, with profuse lateral branching; finely appressed puberulent. *Stipules* 7–8 mm long, linear-subulate, recurved, pubescent, glabrous above. *Leaflets* 7–9, 25–27 × 4,5–5,0 mm, conduplicate, linear to linear-spathulate, upper surface glabrous, lower surface sparsely sericeous; petiole 35–45 mm long, adaxial surface flattened, somewhat canaliculate. *Inflorescences* axillary, on short shoots, with flowers generally alternate towards base but subverticillate towards apex, 5–30-flowered, 50–170 mm long, subsessile but elongating in fruit. *Flowers* 12–15 mm long, on 2–4 mm long pedicels; bract 7 mm long, oblanceolate to ovate, caducous; bracteoles 2–3 mm long, oblong. *Calyx* 9–10 mm long; upper lobes deeply divided; lower lobes united into a longer lip, entire or irregularly 3-toothed, bluish, appressed pubescent. *Corolla* 12–15 mm long, 9 mm wide, lavender to bluish, rarely pure white, upper margin of wing petals turns pink after anthesis. *Standard* 12–13 × 9–10 mm, elliptic, shortly clawed, auricles absent, apex truncate. *Wing petals* 12 mm long, 5 mm wide, longer than keel petals, lavender, fused at apex; claw 2 mm long; sculpturing on upper basal parts comprising 5 rows, each with 20–25 intercostal lunae. *Keel petals* 11 mm long, 3,5 mm wide, rostrate, sharply upcurved, tip deep purple. *Androecium* 12 mm long; anthers dimorphic, comprising 5 basifixed, elongated, 0,9 mm long anthers and 5 short, medifixed, 0,3 mm long anthers; pollen orange. *Pistil* 12 mm long; ovary 4 mm long, densely shaggy, height of curvature 3 mm. *Fruit* 40–50 × 7–8 mm, villous, pale apple-green. *Seeds* 5–7, smooth. Figure 5A.

The differences between this species and the only other blue-flowered species, *L. consentinii*, are given under the former. White-flowered morphs are known to occur in *L. angustifolius*. It is distinguished from the other three species by the glabrousness of the upper surface of the leaflets.

Flowering occurs between August and October. This is the most weedy of the naturalized lupins in South Africa. It can eventually form large stands where it has become established.

3. **L. pilosus** Murray in L., *Systema vegetabilium*, edn 13: 545 (1774). The complicated synonymy and typification of this species is outlined in Gladstones (1974).

Erect, 350–700 mm tall, sparsely branched annual. *Stems*, petioles and peduncles all clothed in 4,5 mm long, soft white hairs. *Stipules* 10–14 mm long, linear-subulate, straight, more or less parallel to the subtending branch, shaggy. *Leaflets* 9, 40–60 × 14–20 mm, obovate, finely appressed villous on both sides, partly conduplicate; petioles 50–60 mm long, adaxially flattened

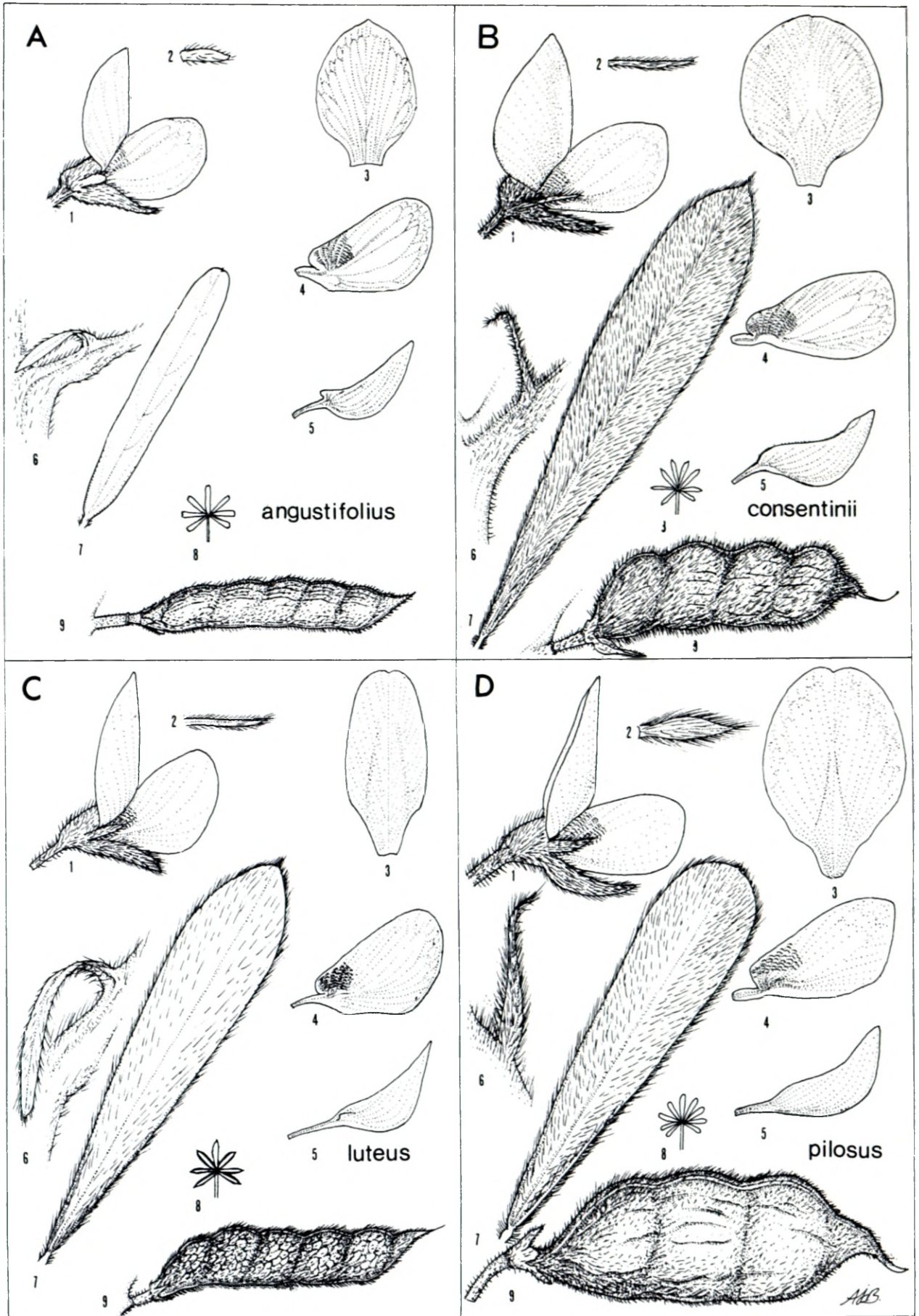


FIGURE 5.—Naturalized species of *Lupinus* in South Africa: A, *L. angustifolius*; B, *L. consentinii*; C, *L. luteus*; D, *L. pilosus*. 1, flower, $\times 2$; 2, bracteole, $\times 4$; 3, standard, $\times 2$; 4, wing petal showing lunulate sculpturing, $\times 2$; 5, keel petal, $\times 2$; 6, junction of the petiole with the stem, showing shape and orientation of the stipule, $\times 2$; 7, upper surface of middle leaflet, $\times 2$; 8, basic shape of leaf; 9, fruit, $\times 1$.

towards the base. *Inflorescences* axillary, lax, 12–16 mm long; peduncle stout; 20–30-flowered, subverticillate proximally, verticillate distally. *Flowers* large, 20 mm long, 25 mm high; pedicels 6–7 mm long; bract 10–13 × 5 mm, boat-shaped, caducous; bracteoles 5 mm long, lanceolate. *Calyx* 13 mm long; upper lobes deeply cleft, widely spaced; lower lobes united, entire, longer than upper ones; tinged with pink. *Corolla* pink. *Standard* 22–24 mm long and wide, ovate, pink with large white nectar guide, turning rose after anthesis, grooved on inner face; claw 4–5 mm long, broad. *Wing petals* 18–19 × 9–10 mm, pale pink but whiter towards the claw; claw 4 mm long, twisted. *Keel petals* 16 × 5 mm, rostrate; apex brown-tipped. *Androecium* 18 mm long; anthers dimorphic, comprising 5 basifixed, elongated anthers 2 mm long, alternating with 5 shorter, 1 mm long, medifixed anthers; pollen orange. *Pistil* 14 mm long; ovary 10 mm long, shaggy; stigma penicillate, forward sloping; height of curvature 6 mm. *Fruits* 50–80 × 20–25 mm, hirsute, yellow-green. *Seeds* 3–4. Figure 5D.

Lupinus pilosus is distinguished by its shaggy stipules, densely hairy fruits and pink flowers. Flowering occurs from late July to October.

4. *L. luteus* L., *Species plantarum*: 721 (1753); Gladstones: 28 (1972) for full synonymy. Holotype: *Linnaean Collection 898.8* (LINN).

Herbaceous annual up to 700 mm tall; rosetted initially but later becoming erect with vigorous basal branching; lightly hirsute. *Stipules* of stem leaves 12–20 × 2–5 mm, smaller on rosette leaves, subulate, recurved, pubescent but glabrous on lower half of inner face. *Leaflets* 7–9(10), 33–55 × 5–12 mm, narrowly obovate, mucronate, villous above and below, partly conduplicate; petioles 70–90 mm long, adaxially flat-tish, shallowly channelled. *Inflorescences* axillary, 13–17 mm long, elongating in fruit, verticillate, 25–45-flowered; peduncle 5–7 mm long. *Flowers* 14–15 mm long, yellow; pedicels 2–3 mm long, weak; bract 4 mm long, obovate, scoop-like, early caducous, black; bracteoles 4–5 mm long, linear, black. *Calyx* 7–8 mm long; lobes equal, pubescent; upper lobes deeply divided; lower lobes united, shallowly 3-toothed, tips of lobes tinged with black. *Corolla* chrome-yellow, sweetly scented. *Standard* 15–17 × 10–11 mm, narrowly ovate; claw 3 mm long; apex emarginate, front of standard channelled; auricles weakly developed. *Wing petals* 15–16 × 3–4 mm; claw 3–4 mm long; tips fused; sculpturing in upper basal parts with 6–7 rows of 15–20 intercostal lunae. *Keel petals* 13–14 × 3–4 mm, rostrate, sharply upcurved, tip black. *Androecium* 14 mm long; anthers dimorphic, comprising 5 basifixed, elongated, 1.5 mm long anthers alternating with 5 medifixed, ovate, 0.3 mm long anthers; pollen yellow. *Pistil* 12 mm long; ovary 6 mm long, densely appressed shaggy; height of curvature 6 mm. *Fruits* 45–50 × 11–13 mm, reticulate, densely villous, olive-green. *Seeds* 2–4, smooth. Figure 5C.

Lupinus luteus is distinguished by its bright yellow flowers and distinctly reticulate, densely villous fruits. Flowering occurs in August and September.

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SPECIMENS EXAMINED

Bos 28 (2) STE. *Cloete s.n.* (4) STE. *Markötter s.n.* (2) STE 19310. *Snijman* 882 (2) K, NBG, PRE: 883 (4) K, NBG, PRE: 884 (2) K, NBG, PRE: 886 (2) K, NBG, PRE: 903a (2) K, NBG, PRE: 908 (4) K, NBG, PRE. *Stirton* 5021 (1) PRE: 5036 (4) K, PRE: 5037 (2) K, PRE: 5882 (2) K, PRE: 5940 (2) K, PRE: 6129 (2) K, PRE: 10751 (1) NBG: 10752 (3) NBG: 10753 (4) NBG: 10762 (2) NBG: 10765 (4) NBG. *Vahrmeijer* 2321 (2) PRE. Cultivated specimens: *Codd s.n.* (3) K. *Henning s.n.* (1) K.

