

Populations of *Linaria* (Scrophulariaceae) in Northeastern Texas

Robert Kral

Two native species of *Linaria* (*L. texana* Scheele and *L. canadensis* (L.) Dumort. occur in Texas. The former is common on sandy to sandy clay loams nearly throughout the state; the latter is confined to sandy sites in the central and eastern counties. Both are abundant in recently abandoned fields in east Texas. Mass-collections were made during March and April of 1955, totalling 335 plants (207 *L. texana*, 128 *L. canadensis*) in 8 counties of northeastern Texas. Numbers of individuals taken ranged from 3 to 47 at each of 21 locations. Seven contained both species, 4 only *L. canadensis*, 10 only *L. texana*.

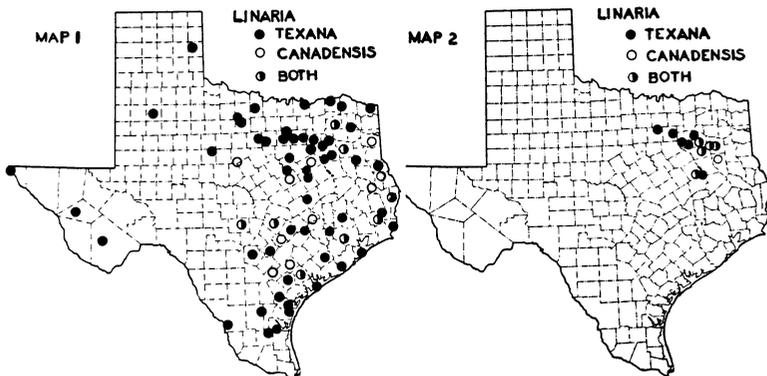
The two species are distinct, and there is no difficulty in recognizing them in the field when growing together. Essential differences are:

	<i>L. canadensis</i>	<i>L. texana</i>
Corolla length	5-8 mm.	8-15 mm.
Spur length	0.5-2.5 mm.	5-8 mm.
Capsule length	1.8-2.2 mm.	2.5-3.2 mm.
Seed length	0.20-0.27 mm.	0.35-0.50 mm.
Seed surface (10x magnification)	smooth or pebbled edges	tuberculate edges rounded
Seed color	rounded black	to sharp grey

Plants of *L. canadensis* characteristically are less robust than those of *L. texana*, and the flowering stems are consistently much more slender. Stem bases and terminal portions of *L. canadensis* are typically maroon-red tinted with whitish, lenticular dots. In *L. texana* they are typically pale green in color.

Both *L. canadensis* and *L. texana* have pedicels consistently shorter in length than their corollas, and in Texas, both may have glandular pedicels. *L. texana* at one station had pedicels ranging from glabrous to moderately glandular; all my specimens of *L. canadensis* had glandular pedicels. In almost all specimens of both species, the sepals were slightly to moderately glandular; and several specimens of *L. texana* had glandular-ciliate sepal margins. The variation in glandulosity of pedicel- and sepal surfaces was noticed in both mixed and separate collections of the two. The *L. texana* collected in Tarrant County, outside the known

range of *L. canadensis*, showed fully as much variation as elsewhere. In those plants of both species which had glandular pedicels, the development of glands decreased, apparently, with the age of the tissues. An older plant which had mature, opened capsules together with a few late flowers often showed a complete range from glabrous lower pedicels to glandular-hairy upper ones.



MAP 1. Distribution in Texas of *Linaria texana* and *L. canadensis*, plotted from Pennell's (1935) data, to which are added SMU Herbarium collections. MAP 2. Distribution of these two species in my collections from northeastern Texas, 1955.

Although the coloration of the corollas (blue to lavender) of both species is similar, every specimen of *L. texana* examined had a darker blue to purple venation on the lower lip. Corollas of *L. canadensis* lacked such venation.

While both species are to be found upon the same soil types in east Texas, the water requirements of the two differ. In three collecting localities, *L. texana* grew upon low, moist sites as well as upon the drier uplands. On the other hand, *L. canadensis* was found only in dry, sandy areas. While both were found on dry ridges and slopes in old fields, only *L. texana* was seen in the moister depressions. This is paradoxical, since it is the species that ranges the furthest west, into regions of drier sands and less rainfall. Neither species was found under heavy forest, nor in any area covered by grass or appreciable litter. For both species, optimum habitats are open, mature hardwood or pine stands, sandy patches in pastures, or the infertile, bare sands of old fields. In such habitats they are accompanied by other early successional species such as *Festuca octoflora*,

F. sciurea, *Phacelia strictiflora*, *Astragalus leptocarpus*, *A. Soxmaniorum*, and *Oenothera laciniata*.

The first collections of *Linaria* were made in early March; *L. canadensis* was the first to bloom, being in full flower when most plants of *L. texana* were still in the bud. This difference in flowering time was obvious at every locality in which both species grew. By the time *L. texana* was in full bloom, some seed capsules of *L. canadensis* were already open and only terminal flowers remained. Although there is overlap of time of anthesis, the height of flowering for the two species was two weeks apart in 1955. This difference, if consistent, may provide an internal isolating factor that aids in the maintaining of the two distinct populations.

LOCALITIES AND NUMBERS OF INDIVIDUALS OF *Linaria* COLLECTED
(arranged chronologically)

County	Date	Description of Locality	<i>texana</i>	<i>canadensis</i>
Freestone	5Mr	Open post oak woods 15 m SSE of Fairfield; sandy-loam	—	3
Anderson	12Mr	10 m. N of Palestine; sandy hillside under open stand of post oak-shortleaf pine	—	4
Dallas	19Mr	One m. SE of Kleberg; low sandy area below RR grade	3	—
Dallas	19Mr	One m. E of Seagoville; open post oak woods	3	—
Van Zandt	19Mr	5 m. W of Canton; old field; sandy-loam	6	—
Henderson	20Mr	6.5 m. N of Murchison; open post oak woods; sandy-loam	—	9
Henderson	20Mr	8 m. N of Murchison; old field; sandy soil	5	11
Smith	20Mr	8 m. W of Tyler; sandy-loam of old road bank	8	—
Van Zandt	20Mr	5 m. E of Edom; open stand of mature shortleaf pine; sandy-loam	8	6
Van Zandt	20Mr	2.5 m. SE of Ben Wheeler; dry sandy clearing in oak-hickory woods	—	8
Tarrant	23Mr	6 m. W of Grapevine; road-side sands	7	—
Kaufman	8Ap	8 m. SE of Kaufman; road-side sandy clay-loam	12	—
Kaufman	8Ap	9 m. SSW of Kaufman; old field; sandy-loam	20	—
Freestone	9Ap	11 m. SSE of Fairfield; open post oak woods; sandy soil	17	13
Freestone	9Ap	15 m. SSE of Fairfield; open oak-hickory woods; sandy-loam	9	11

Leon	9Apr	3 m. E of Buffalo; roadside sands	15	—
Van Zandt	15Apr	2 m. W of Wills Point; old field pasture; sandy clay-loam	16	—
Van Zandt	15Apr	Northern outskirts of Ben Wheeler; old field; sandy soil	15	32
Van Zandt	16Apr	2.5 m. SE of Ben Wheeler; sandy clearing in oak-hickory woods	2	2
Smith	16Apr	1 m. W of Tyler; old field; sandy-loam	20	18
			207	128

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A Laboratory Experiment Involving Paper-Chromatography and Statistics

*Charles T. Kenner and Joan Schneider*¹

Many experiments have been suggested for the use of paper chromatography in the laboratory. These include the separations of amino acids and other biological materials (2,7,10,11,12); cations (4,5,6,9,13,14,15); and dyes (8). Some of these have the disadvantage that they cannot be completed in one laboratory period, and some call for the use of materials which are not found in the usual laboratory equipment.

This article suggests a paper chromatographic separation of the dyes in commercial black inks, which has been designed for completion in one 3-hour laboratory period with the use of equipment and solvents found in practically all laboratories. The experiment gives very satisfactory results, and allows the student to become familiar with the general field of paper chromatography and some of the factors which affect R_f values of constituents of mixtures. It also may be used to demonstrate the use of simple statistical tests, if desired.

Several commercial black inks are run by each student using water and two buffer solutions having different pH values. The equipment consists of a short-form 100-ml. Tuttle graduate (Kimble No. 200032) covered by an in-

¹Department of Chemistry, Southern Methodist University, Dallas.