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The genus *Trifolium* (Fabaceae) in Kentucky

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ABSTRACT

The scope and range of the genus *Trifolium* (Fabaceae) were examined for Kentucky. Review of literature and 910 herbarium specimens from 35 herbaria revealed 11 species of clover as part of the state's flora: *T. arvense, T. aureum, T. campestre, T. dubium, T. hybridum, T. incarnatum, T. pratense, T. reflexum, T. repens, T. resupinatum, and T. stoloniferum.* Four species are rejected as a part of the flora: *T. alexandrinum, T. ambiguum, T. hirtum, and T. medium.* Descriptions, illustrations, and distribution maps are provided for each species accepted.

INTRODUCTION

The genus *Trifolium* (true clovers) is a nearly cosmopolitan member of the papilionoid Fabaceae (Leguminosae) that contains 240 to 250 species (Zohary and Heller 1984), though this number, rising as new species are described, may be closer to 300 (Gillett and Cochrane 1973). In the Old World, *Trifolium* is native to the Mediterranean region in southern Europe, Asia Minor, the Middle East, and northern Africa, extending into northern Europe and east to northwestern China; in Africa, the genus occurs through eastern regions to South Africa. In the New World, there is a wide diversity of species in western North America, with fewer species native to eastern portions, Central America, and South America. According to Zohary and Heller (1984), the genus may be subdivided into eight sections, six of which (*Paramesus, Mistyllus, Vesicaria, Chronosemium, Trifolium,* and *Trichocephalum*) are native entirely to the eastern hemisphere; *Lotoidea* is native to both the eastern and western hemispheres; *Involucrarium* is endemic to the western hemisphere. The word "clover" is probably derived from the Dutch "klafer" or the Anglo-Saxon "cloefer," meaning "club," a reference to the three-parted leaf that supposedly resemble the three-lobed club of Hercules (Evans 1957; Haragan 1991).

North America is home to ca. 95 species of *Trifolium,* 65 native, 30 introduced. These numbers are higher than those of Isely (1998), since he was not aware of some of the less frequently encountered introduced species. Kartesz (1999) lists 96 species for North America. Of the native North American species, 43 belong in section *Lotoidea*; of these, six are found east of the Mississippi River; the remaining 37, mainly in the Rocky Mountains and along the Pacific coast. The native species in section *Involucrarium* are all found in western North America. The introduced species, representing all sections of the genus except *Paramesus,* have been imported mainly for agricultural purposes, though some introductions appear to have been inadvertent (Isely 1998).

Clover species have been widely cultivated as forage crops for hundreds, if not thousands of years, and are of great economic importance (Duke 1981). In North America, most of the species cultivated are perennials, among the most commonly grown of which are *T.*

pratense (red clover), *T. repens* (white, Dutch, or Ladino clover), and *T. hybridum* (Alsike clover). Annual species sometimes cultivated include *T. incarnatum* (crimson clover), *T. hirtum* (rose clover), and *T. alexandrinum* (berseem clover). Clovers are used as forage crops, as sources of nectar for honey production (Pellett n.d.), for erosion control, and as nitrogen sources for crop fields and pastures. Menke and Hillenmeyer (1886) considered "clover" (species not specified) to be the most important crop then grown in Kentucky.

There is a considerable body of folklore associated with the clovers (Evans 1957). Four-leaf clovers have long been considered a source of good luck and with having the ability to protect against witchcraft (RDA 1986). Four-leaf clovers are actually leaves with mutations resulting in the proliferation of leaflets, with leaflet numbers ranging anywhere from the more commonly seen 4 to 24 or more (Ford and Claydon 1996; Jaranowski and Broda 1978) or rarely a single leaflet (Atwood 1938). The multifoliolate condition is relatively common throughout *Trifolium*. Also of interest to many are the leaf marking patterns on the leaves of many clover species. These can range from the more commonly encountered V-shaped pattern, or chevron, to various types of dark to light, colored or white patterns (Corkill 1971; Ganders et al. 1980). These marks, although attractive, are very variable within a species; they can be inherited to differing degrees, may sometimes vary according to growing conditions, and provide no information of taxonomic value.

During the last 200 years, beginning with M'Murtrie's *Florula Louisvillensis* (1819), many reports have been published on the flora of Kentucky. In those reports, various accounts of the clovers have appeared. The earliest report of *Trifolium* in the state was of *T. arvense, T. pratense,* and *T. repens* (M'Murtrie 1819). In the 20th century, McFarland (1942) reported 9 species, and Braun (1943) reported 5. Wharton and Barbour (1971) mentioned only 1, Meijer (1992) listed 9, and Browne and Athey (1992) and Medley (1993) accepted 11. Most recently, Kartesz (1999) recognized 10 species as part of the Kentucky flora.

The purpose of this paper is to determine which species of *Trifolium* are documented for Kentucky and to clarify the known distribution for each species in the state.

MATERIALS AND METHODS

I examined 910 herbarium specimens from the following herbaria (acronyms from Holmgren et al. 1990): APSC, BEREA, BH, BRIT, CAN, CINC, CM, DAO, DHL, EKY, F, GA, GH, KNK, KY, LLO, LSU, MDKY, MICH, MO, MU, NCU, NY, OKL, OSH, PH, SIU, US, VDB, WIS, WKU, and WVA. In addition, specimens were studied from the herbaria of Cumberland College in Wilmington, Kentucky (cumb), the Kentucky Agricultural Experiment Station in Lexington (kes), and the clover herbarium of the Department of Agriculture, University of Kentucky, Lexington (uk). Distributional data were gathered from herbarium records only; no undocumented reports are included in distribution maps. Unfortunately, specimens in the Athey Herbarium (MEM) were unavailable. Distribution records from books, papers, and theses were not included, and data in other published sources may not coincide with those presented here (e.g., Browne and Athey 1992).

RESULTS

Eleven species of *Trifolium* are documented by herbarium specimens for Kentucky. Of these, nine are introduced and two are native to the state. Three clover species reported for Kentucky in literature could not be documented by specimens and are excluded from the flora. For 13 of the 120 Kentucky counties (Adair, Boyd, Cumberland, Hancock, Henderson, Owsley, Robertson, Scott, Simpson, Taylor, Union, Wayne, and Webster), I saw no clover specimens at all.

TAXONOMIC TREATMENT

Trifolium L., Sp. Pl. 764. 1753.

Annual, biennial, or perennial, glabrous to pubescent herbs with a taproot or fibrous roots. Stems simple to much-branched from the base and above. Leaves alternate, palmately trifoliolate to 5–7 foliolate; leaflets toothed; stipules adnate to the petiole. Inflorescences umbelliform, racemose, or capitate, axillary or terminal, long-peduncled to sessile, leafy or not; involucre absent or of small to large free to fused bracts; flowers pedicellate

to nearly sessile, with or without bracts; calyx tubular to campanulate, 5-lobed, lobes nearly equal in length or the lower one longer, each lobe entire to toothed; petals free to basally fused, white, pink, red, purple, or yellow, persisting in fruit, the petals clawed and often fused with the staminal column, the upper (banner) broad, oblong to obovate, the lateral pair (wings) narrow, usually longer than the lower pair (keel), which are fused into a boat-shaped structure; stamens diadelphous, filaments dilated below the uniform anthers; ovary sessile or stalked, style curved upward, stigma capitate to curved, ovules 1–12; fruit a straight legume enclosed by the persistent calyx and corolla, dehiscent or indehiscent, seeds 1–3(9), globular to reniform.

KEY TO SPECIES OF *TRIFOLIUM* IN KENTUCKY

1. Plants perennial, stoloniferous, rooting at the nodes; inflorescences held on axillary, upright stems, with or without a pair of bract-like leaves; petals white to pinkish; flowers reflexing with age.
   2. Peduncles 1–2, arising from upright axillary stems with a pair of bract-like leaves; calyx 4–7 mm long, teeth subulate, twice as long as tube . . . . . 11. *T. stoloniferum*
   2. Peduncles 1, arising from leaf axil on stolon, without bract-like leaves; calyx 3–5 mm long, teeth triangular-lanceolate, lower about same length as tube . . . . . 9. *T. repens*
1. Plants erect or decumbent, not rooting at the nodes.
   3. Petals yellow; banner petal obovate, straight or downcurved; fruit with an obvious stalk inside calyx; petioles mostly shorter than leaflets.
      4. Terminal leaflet sessile or nearly so; stipules nearly as long as to longer than the petiole; fruits 2 times the length of the style; seed ovoid . . . . . 2. *T. aureum*
      4. Terminal leaflet stalked; stipules about half as long as the petiole; fruits 3–6 times the length of the style; seeds ellipsoid.
         5. Inflorescences 5–7 mm wide; flowers 2.5–3.5 mm long; terminal leaflet stalk about 1 mm long . . . . . 4. *T. dubium*
         5. Inflorescences 7–12 mm wide; flowers 3.5–7 mm long; terminal leaflet stalk 1–3 mm long . . . . . 3. *T. campestre*
   3. Petals white, pink, red, or purple; banner petal oblong, upcurved; fruit not stalked or minutely so; petioles mostly longer than leaflets.
      6. Flowers sessile or nearly so, erect to spreading in fruit, in dense globose to elongate heads.
         7. Petals lavender to white; flowers resupinate; calyx with a more densely pubescent region dorsally, becoming inflated in fruit, with obvious reticulating veins . . . . . 10. *T. resupinatum*
         7. Petals pink, red, or white; flowers not resupinate; calyx glabrous or with evenly distributed pubescence, not becoming inflated in fruit, veins not obviously reticulating.
            8. Flowers 10–20 mm long; corolla much longer than the calyx; leaflets broadly ovate to obovate; stipules broad, ovate.
               9. Perennial; heads sessile or nearly so, globose to ovoid; stipules abruptly narrowed into an awn-like tip . . . . . 7. *T. pratense*
               9. Annual; heads stalked, elongate-ovoid to cylindrical; stipules broadly rounded at the tip . . . . . 6. *T. incarnatum*
            8. Flowers 5–7 mm long; corolla scarcely longer than to shorter than the calyx; leaflets narrowly oblong to linear-lanceolate; stipules narrowly ovate to oblong . . 1. *T. arvense*
      6. Flowers with pedicels, sharply reflexed in fruit, in umbels.
         10. Annual or biennial; flowers 8–14 mm long; inflorescences 2–4 cm wide; pedicels 4–12 mm long; calyx 6–9 mm long, teeth 2–3 times the length of the tube; leaflets 1–4.5 × 0.5–2 cm; stipules broadly ovate, leaflike . . . . . 8. *T. reflexum*
         10. Perennial; flowers 7–10 mm long, inflorescences 1–2.5 cm wide; pedicels 1–5 mm long; calyx 3–4 mm long, teeth 1–2 times the length of the tube; leaflets 1–3.5 × 1–2 cm; stipules narrowly obovate to lanceolate, not leaflike . . . . . 5. *T. hybridum*

1. *Trifolium arvense* L., Sp. Pl. 2: 769. 1753. Rabbit-foot clover. (Figure 1)

Annual, upright, 5–40 cm tall. Stems often much-branched, with short appressed to spreading hairs. Leaves petiolate below to nearly sessile above, longest petioles to 15 mm, shorter than the leaflets. Stipules ovate to oblong, tips long attenuate, longer than the

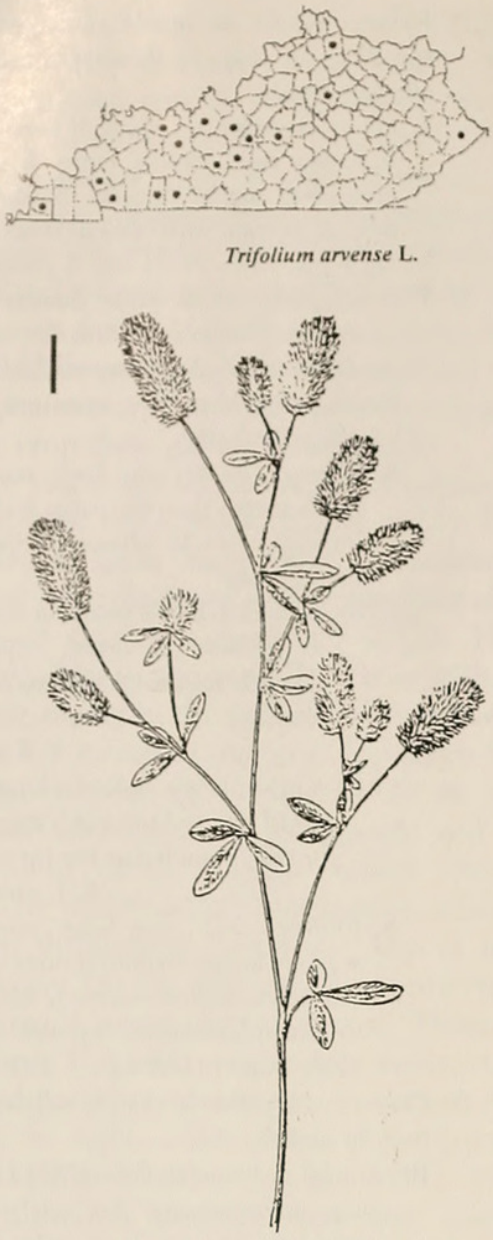


Figure 1. *Trifolium arvense* L. Documented county-distribution in Kentucky; plant (from Besette and Chapman 1992). Bar = 10 mm.

associated petioles. Leaflets 5–20 × 2–4 mm, sessile or nearly so, linear to narrowly lanceolate, base cuneate, apex acute to mucronate and slightly serrate. Inflorescence 8–30 × 8–10 mm, racemose, densely ovoid or cylindrical, on peduncles 5–30 mm, or nearly sessile; flowers 10–150, sessile. Calyx long-hairy, often silvery to pinkish or purplish, tube 1.5–2 mm, teeth subulate, nearly equal, 2.5–5 mm, plumose. Corolla white to pinkish, slightly shorter than the calyx lobes, 4 mm, the standard narrow, oblong, obtuse. Fruit ovoid, 1.3 mm. Seed 1, pale yellow, 0.9–1.3 mm. $2n$ = 14, 16, 28. Flowering in Kentucky in June–July, fruiting August–September.

Native to Europe, northern Africa, and western Asia, rabbit-foot clover is naturalized in many areas of the world and throughout much of North America. Zohary and Heller (1984) recognized two varieties, which differ somewhat in habit and pubescence density. This species was first reported for Kentucky by M'Murtrie (1819). The earliest Kentucky collection I saw was from 1835, Fayette County (*Short s.n.*, CINC, KY).

Trifolium arvense is sometimes cultivated as a winter annual (Henson and Hollowell 1960). It is adapted to infertile, dry, often sandy soil such as that found on roadsides, where is makes an attractive, silvery-pink display when in flower, and rose to buff when in fruit.

This species is sometimes also called hare's foot (M'Murtrie 1819), stone clover, old-field clover, and pussies (Delorit and Gunn 1986; Small 1933).

2. *Trifolium aureum* Pollich, Hist. Pl. Palat. 2: 344. 1777. Hop clover. (Figure 2)

(*T. agrarium* L., a confused name [Dandy 1958])

Annual or biennial, upright, 20–60 cm tall. Stems often much-branched, with short appressed hairs. Leaves petiolate below to short-petiolate above, longest petioles to 12 mm, shorter than the leaflets. Stipules oblong-lanceolate, tips narrowly long-triangular, as long as or longer than the associated petioles, adnate to the petiole for half their length or more. Leaflets 15–25 × 6–8 mm, sessile or essentially so, oblanceolate to obovate or elliptic, base cuneate, apex obtuse to emarginate and mucronate, serrate in the upper half. Inflorescence 10–25 × 12–14 mm, racemose, densely ovoid or cylindrical, with a flat top in age, on peduncles 10–50 mm; flowers 10–40(80), short-pedicellate. Calyx glabrous, tube 1 mm, teeth narrowly triangular to subulate, lower teeth 2–3 times the length of the upper, 1.2–1.8 mm. Corolla bright yellow, turning brown with age, 5–8 mm, the standard broadly obovate, obtuse-emarginate, strongly parallel-veined, especially in age. Fruit oblong, 3–3.5 mm, stalked. Seed 1, pale yellow green to yellow brown, 1–1.2 mm. $2n$ = 14, 16. Flowering in Kentucky in June–July, fruiting August–September.

Native to Europe, hop clover is introduced in eastern and northern North America;

George Washington is known to have ordered seed of this species from Europe in 1786 (Pieters 1920). Zohary and Heller (1984) recognized two subspecies, which differ mainly in the leaf apices and style position. The earliest Kentucky collection I saw was from 1903, Boone County (*Davis s.n.*, kes).

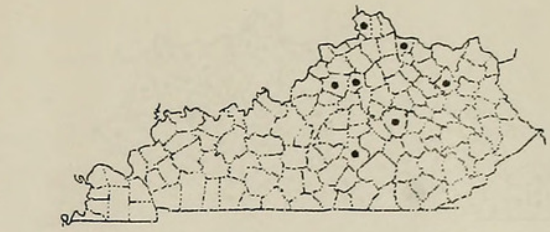
Trifolium aureum has also been called large hop clover, yellow clover, and palmate hop-clover (Gillett and Cochrane 1973; Gleason and Cronquist 1991; Knight 1985b). It is sometimes cultivated (Knight 1985b).

3. *Trifolium campestre* Schreb. in Sturm, Deutsch. Fl. Abt. 1, Band 4, Heft 16, t. 253. 1804. Low hop clover. (Figure 3)

(*T. procumbens* L., a confused name [Dandy 1958])

Annual, upright to ascending (rarely prostrate), 5–40 cm tall. Stems often much-branched, with short appressed hairs to nearly glabrous. Leaves pinnate, long-petiolate below to short-petiolate above, longest petioles to 1.5 times as long as the leaflets. Stipules ovate, tips acute to somewhat attenuate, shorter than the associated petioles. Leaflets 4–16 × 4–8 mm, oblong-obovate, base cuneate, apex truncate to emarginate, slightly serrate in the upper half, the terminal leaflet on a 1–3 mm long stalk, lateral leaflets nearly sessile. Inflorescence 7–15 × 7–10 mm, racemose, densely globose to ovoid or cylindrical, on peduncles as long as or shorter than subtending leaves; flowers (10)20–40(50), short-pedicellate. Calyx glabrous to slightly pubescent, tube 0.5–1 mm, teeth narrowly triangular to subulate, lower teeth 2–3 times the length of the upper, 0.6–1.3 mm, each tooth often tipped with 1–2 stiff hairs. Corolla pale to bright yellow, 3.5–6 mm, the standard obovate, with a slightly toothed margin, emarginate, more or less enveloping the wing and keel petals, strongly parallel-veined, especially in age. Fruit oblong, stalked, 2–2.5 mm. Seed 1, shiny yellow, 1–1.5 mm. $2n = 14$. Flowering in Kentucky in April–June, fruiting June–August.

Native to Europe and widely introduced elsewhere, *Trifolium campestre* is widely distributed in North America, often being found along roadsides, in lawns, and in other disturbed places. Haragan (1991) considers this species a weed in Kentucky. The earliest Kentucky collection I saw was from 1882, Jessamine County (*Peter s.n.*, KY). This species is also called hop clover, pinnate hop clover, and small hop clover (Gillett 1985; Gleason and Cronquist 1991; Knight 1985b).



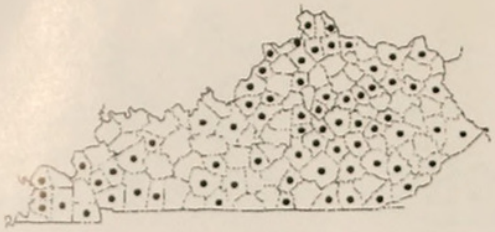
Trifolium aureum Pollich

Figure 2. *Trifolium aureum* Pollich. Documented county-distribution in Kentucky; plant (from Cost 1901 [right figure] and Hegi 1923 [left figures]). Bar = 20 mm (whole plant), 10 mm (branch), 2 mm (flower).

Low hop clover and especially least hop clover (the next species) are often confused with *Medicago lupulina* L. (black medic), a commonly encountered annual or biennial, prostrate to ascending species. It differs from these clovers by its usually obviously toothed stipules, deciduous corolla, and reniform, shiny black fruits.

4. *Trifolium dubium* Sibth., Fl. Oxon. 231. 1794. Least hop clover. (Figure 4)

Annual, upright, 5–40 cm tall. Stems simple or branched, glabrous to slightly hairy. Leaves



Trifolium campestre Schreb.

Trifolium dubium Sibth.

Figure 3. *Trifolium campestre* Schreb. Documented county-distribution in Kentucky; plant (from Cost 1901 [upper right figure] and Hegi 1923 [lower right and left figures]). Bar = 15 mm (whole plant), 10 mm (branch), 2 mm (flower).

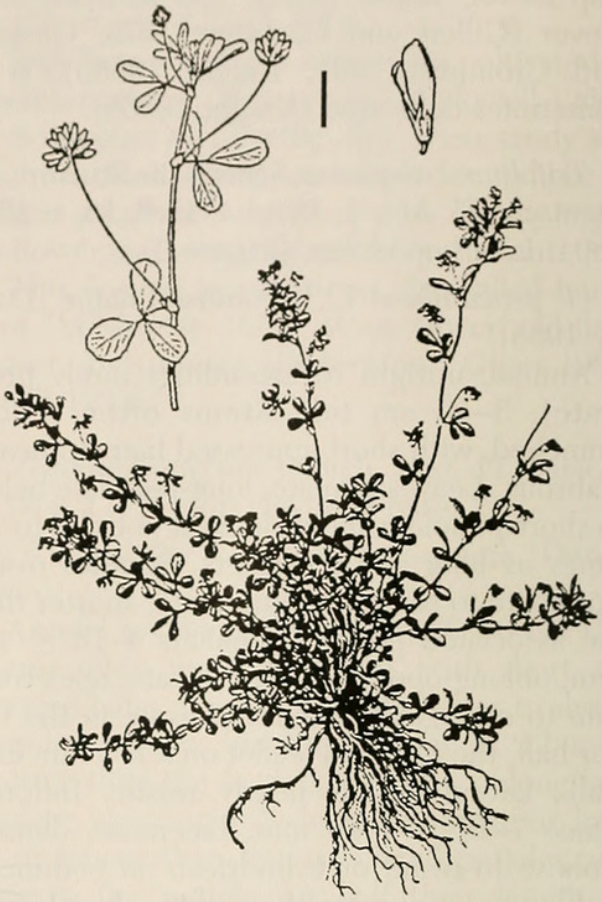


Figure 4. *Trifolium dubium* Sibth. Documented county-distribution in Kentucky; plant (from Cost 1901 [upper figures] and Hegi 1923 [lower figure]). Bar = 20 mm (whole plant), 10 mm (branch), 4 mm (flower).

pinnate, petiolate below to nearly sessile above, longest petioles to 15 mm, mostly shorter than the leaflets. Stipules ovate, tips acute, slightly adnate to and shorter than the associated petioles, 3–5 mm. Leaflets 5–15 × 4–7 mm, terminal stalked, lateral nearly sessile, obovate, base cuneate, apex rounded to slightly emarginate and slightly serrate. Inflorescence 5–10 × 6–8 mm, racemose, loosely ovoid to obovoid, on peduncles much longer than associated leaves; flowers 3–20, pedicels short, reflexing dramatically with age. Calyx glabrous, tube 0.5–0.8 mm, teeth subulate, lower about twice as long as upper. Corolla pale yellow, 3–4 mm, the standard narrow, oblong, obtuse. Fruit ovoid, nearly sessile, 1.5–2 mm. Seed 1 (rarely 2), shiny tan to dark brown, 1–1.5 mm. $2n$ = 16, 28. Flowering in Kentucky in May–June, fruiting July–August.

Least hop clover is native to Europe and is now introduced throughout the world. It is widely distributed in North America. It is sometimes cultivated as a pasture plant (Delorit and Gunn 1986). *Trifolium dubium* was reported as new to Kentucky by McFarland (1942). Mohlenbrock et al. (1966) again reported the species, but I could not locate the specimen cited in that paper. The species was also reported for Henry County in an unpublished thesis (Gentry 1963), but again the voucher could not be located. Medley (1993) accepted only reports from Lyon, Trigg, and

Rockcastle counties. The earliest Kentucky collection I saw was from 1855, without locality (*C.W. Short s.n.*, PH).

Trifolium dubium is also called little hop clover (Gillett and Cochrane 1973; Gleason and Cronquist 1991), small hop clover (Delorit and Gunn 1986; Isely 1998) and shamrock (Small 1933). It is often confused with *T. campestre*, but can be distinguished from it by the smaller inflorescences with fewer flowers; its standard is not striate or only faintly so, whereas that of *T. campestre* is strongly striate. It is also commonly confused with *Medicago lupulina* L. (black medic), but can be distinguished as described in the entry for *T. campestre*; more records for little hop clover identified as black medic may lurk in herbaria. *Trifolium dubium* is thought by some to be the "shamrock" of Irish folklore, but others claim that the shamrock may be one of several species of *Trifolium*, *Medicago*, or *Oxalis* (Colgan 1896; Everett 1971; Nelson 1991).

5. *Trifolium hybridum* L., Sp. Pl. 2: 766. 1753. Alsike clover. (Figure 5)

Perennial, upright to ascending, 15–60(80) cm tall. Stems often much-branched, nearly glabrous, often somewhat fleshy. Leaves petiolate, longest petioles to 80 (sometimes even 100) mm, longer than the leaflets, gradually reduced upward. Stipules obovate to lanceolate, tips long attenuate, 10–30 cm, adnate to petioles for about one-third their length. Leaflets 10–35 × 10–20 mm, sessile or nearly so, ovate to elliptical or rhombic, base cuneate, apex rounded to slightly emarginate, serrate. Inflorescence 10–25 mm broad, globose, short-racemose to nearly umbellate, on peduncles 20–80 mm; flowers 20–80; pedicels 1–5 mm, reflexing with age. Calyx glabrous except in the U-shaped sinuses, tube 1–2 mm, teeth subulate, nearly equal, as long as or longer than the tube. Corolla white and pink, 6–11 mm, the standard ovate-oblong, obtuse, sometimes emarginate. Fruit oblong, 3–4 mm. Seeds 2–4, mottled yellow brown, red brown, to nearly black, 1–1.3 mm. $2n = 16$. Flowering in Kentucky in May–July, fruiting July–September.

Alsike clover is native to Europe, probably in the Mediterranean region. It is introduced throughout temperate regions worldwide, and is often cultivated. The species, also called Al-

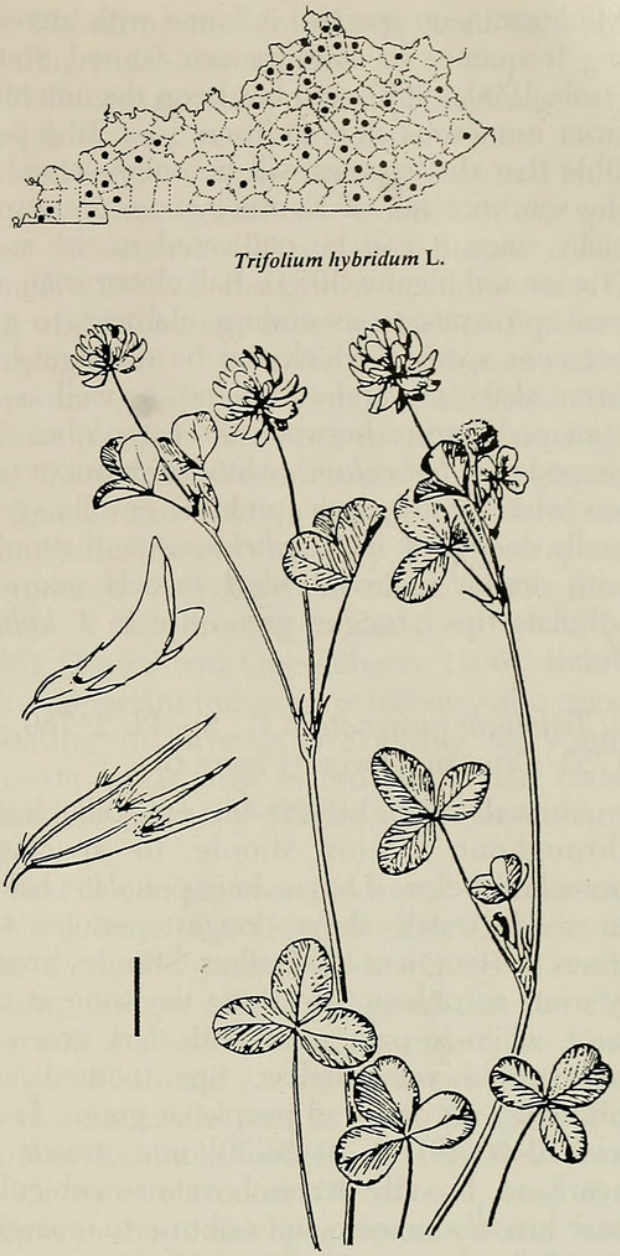


Figure 5. *Trifolium hybridum* L. Documented county-distribution in Kentucky; plant (from Hermann 1966). Bar = 20 mm (whole plant), 5 mm (flower), 1.5 mm (calyx).

satian clover and Swedish clover (Delorit and Gunn 1986; Small 1933), was apparently first cultivated in Sweden, and first cultivated in England about 1832 (Taylor 1975). It was first brought to the United States about 1839 (Taylor 1975). The earliest Kentucky collection I saw was from 1895, Rockcastle County (*n.c.*, CINC).

Trifolium hybridum may cause dermatitis in sensitive humans (Hardin and Arena 1974). Alsike clover is said to cause photosensitivity and biliary fibrosis in horses (Fisher 1995), though the connection between these diseases and the clover is not conclusive (Nation 1989).

Trifolium nigrescens Viv. (ball clover, a

Mediterranean species) is found with increasing frequency in southeastern United States (Isely 1990, 1998), and has been documented from numerous sites in Tennessee. It is possible that this species will be encountered in the southern tier of Kentucky counties, especially since it can be cultivated in the state (Taylor and Sigafus 1984). Ball clover is an annual, prostrate to ascending, glabrous to glabrescent species, which can be distinguished from Alsike clover by its habit, as well as by V-shaped sinuses between the calyx lobes (U-shaped in *T. hybridum*), white to cream or yellow-white (rarely pale pinkish) corolla (generally deep pink in *T. hybridum*), and stipules with sharply recurved, black to dark maroon, subulate tips (straight, green tips in *T. hybridum*).

6. *Trifolium incarnatum* L., Sp. Pl. 2: 769. 1753. Crimson clover. (Figure 6)

Annual, upright, 20–90 cm tall, hairy throughout. Stems simple to sparingly branched below. Leaves long-petiolate below to nearly sessile above, longest petioles 4–5 times the length of the leaflets. Stipules broadly ovate to oblong, sheathing the stem at the base, white to pale green with dark green to red purple veins below, tips toothed and rimmed with dark red purple or green. Leaflets 10–30(40) × 10–20(30) mm, sessile or nearly so, broadly ovate-obovate to orbicular, base broadly cuneate, apex obtuse to emarginate. Inflorescence 20–60 × 10–20 mm, spicate, densely cylindrical, peduncles 10–60 mm; flowers many, sessile or nearly so. Calyx long-hairy, tube 3–5 mm, teeth subulate, nearly equal, 1–2 times as long as the tube. Corolla crimson, rarely white or pink, longer than the calyx lobes, 10–17 mm, the standard linear-oblong to elliptical, acute. Fruit sessile, oblong, 3–4 mm. Seed 1, buff to brown, 1.9–2.3 mm. $2n = 14$. Flowering in Kentucky in April–May, fruiting June–July.

Crimson clover (also called Italian clover [Small 1933] and many other common names [Knight 1985a; Nourse 1894]), is native to southern and western Europe and widely naturalized in other areas. The species has been cultivated since the 1700s in Europe and was introduced into the United States in 1818 (Knight 1985a). Crimson clover is used extensively as a ground cover in crop rotations, for green manure, and as a nitrogen-fixing plant in fields (Taylor and Sigafus 1984); it is also used an annual hay crop (Nourse 1894). It is occasionally cultivated in Kentucky (Garman 1902; Taylor 1986; Taylor and Sigafus 1984). The earliest Kentucky collection I saw was from 1934, Jefferson County (*Bishop & Bishop s.n.*, DHL).

Trifolium incarnatum L.

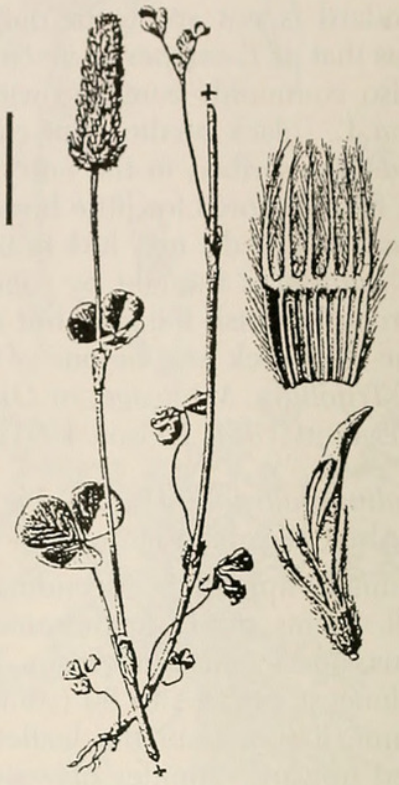


Figure 6. *Trifolium incarnatum* L. Documented county-distribution in Kentucky; plant (from Hegi 1923). Bar = 40 mm (whole plant), 10 mm (flower), 5 mm (calyx).

7. *Trifolium pratense* L., Sp. Pl. 2: 768. 1753. Red clover. (Figure 7)

Perennial, ascending to upright, 20–60(100) cm tall. Stems much-branched, with appressed to spreading hairs or glabrous. Leaves long-petiolate below to nearly sessile above, longest petioles 3–4 times the length of the leaflets. Stipules ovate to lanceolate, 10–30

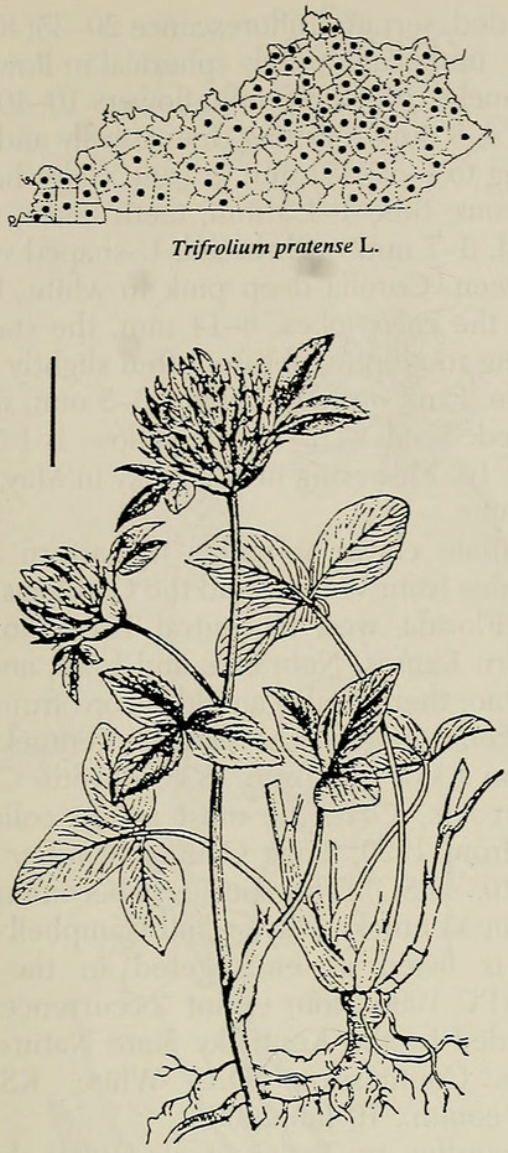


Figure 7. *Trifolium pratense* L. Documented county-distribution in Kentucky; plant (from Besette and Chapman 1992). Bar = 20 mm.

mm, adnate to the petioles for most of their length, the lower portion pale with dark green to red veins tips long mucronate. Leaflets 10–30(50) × 7–15(25) mm, sessile or nearly so, ovate to elliptic or obovate, base broadly cuneate, apex rounded, rarely slightly emarginate, essentially entire. Inflorescence single or in pairs, 10–30 × 10–30 mm, head-like, globose, dense, sessile or on peduncles to about 4 mm, subtended by a pair of bract-like leaves; flowers 40–150, sessile. Calyx hairy, tube 2.5–4 mm, teeth subulate, lowest about as long as the tube, others nearly equal and much shorter than the lowest. Corolla red purple to white or pinkish, longer than the calyx lobes, 11–18 mm, the standard oblong-oblanceolate, emarginate. Fruit ovoid-oblong, 2–3 mm. Seed 1(2), tan to brown, 1.5–2 mm. $2n$ = 14, 28, 56. Flowering in Kentucky in April–October, fruiting June–November.

Trifolium pratense is morphologically very variable, and many binomials have been coined for the various forms; Zohary and Heller (1984) recognized six varieties of the species. Red clover (also called purple clover [Small 1933]) is the grown in more areas of the world than any other species of *Trifolium* (Taylor 1975). It is native to southeastern Europe and Asia Minor (Smith et al. 1985). *Trifolium pratense* has been in cultivation since the 3rd and 4th centuries, probably beginning in Spain, from where it spread to Holland and Lombardy, then to Germany. This species was introduced into England about 1645, from where it was brought to the New World by 1663 (Taylor and Quesenberry 1996). It is a very important forage crop but may also cause bloating in animals overeating its young growth; a diet high in red clover may cause infertility in sheep (Taylor and Quesenberry 1996).

Red clover has been cultivated in Kentucky since at least 1803 (Fergus 1931; Taylor et al. 1997a), and is probably naturalized in every county; Fergus (1931) indicated that red clover was cultivated in every county in Kentucky. M'Murtrie (1819) reported red clover in the Louisville area as early as 1819. The earliest Kentucky collection I saw was from 1892, Fayette County (*Terrill s.n.*, kes). *Trifolium pratense* has been described as a "ubiquitist," which may occur in practically any plant community (Merkenschlager 1934). Red clover has been used in revegetation of strip mine coal spoil fields in western Kentucky (Powell et al. 1980). It is the state flower of Vermont.

Red clover may be used for tea or as an ingredient in herbal cough syrup (Coon 1980; Gibbons 1962), to flavor vinegar (Coon 1980), and as a salve to treat eye and skin diseases (RDA 1984). There are even claims that red clover can be used in cancer treatments (Duke 1985; Ritchason 1995). The young growth can be cooked as a vegetable (Coon 1980). Dried flower heads have been powdered and used in breads during times of famine (Millspaugh 1974).

Trifolium medium (zigzag clover) is a similar perennial species sometimes cultivated in Kentucky (see Excluded Species). It differs

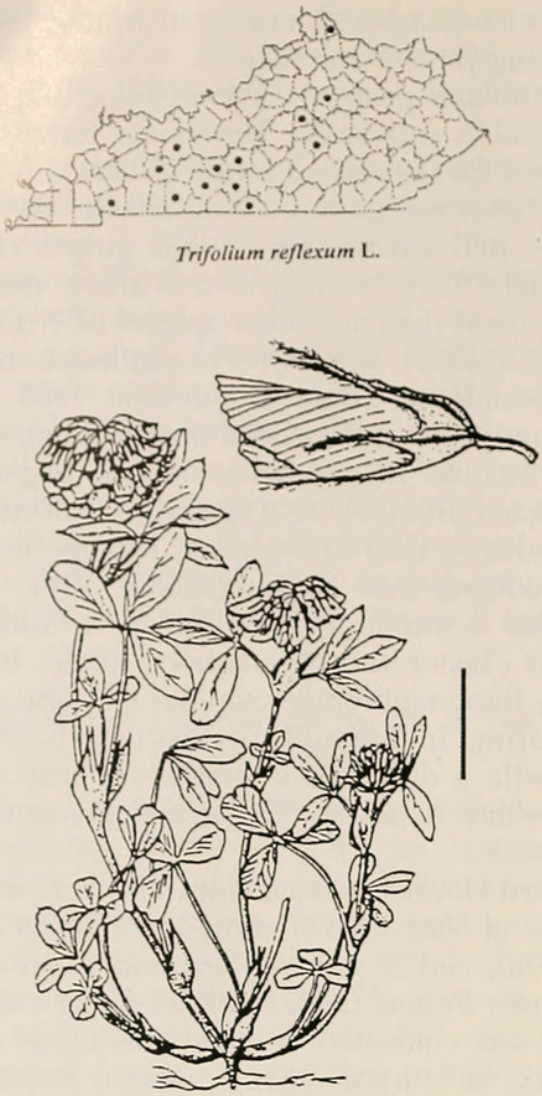


Figure 8. *Trifolium reflexum* L. Documented county-distribution in Kentucky; plant (from Isely 1951). Bar = 20 mm (whole plant), 3 mm (flower).

from *T. pratense* by its peduncled inflorescences, narrowly elliptical leaflets, and rhizomatous nature. *Trifolium hirtum* (rose clover), an annual species resembling red clover, has been reported from nearby states and is occasionally cultivated in Kentucky (see Excluded Species).

8. *Trifolium reflexum* L., Sp. Pl. 2: 766. 1753. Buffalo clover. (Figure 8)

Annual to biennial, ascending-upright, 20–50 cm tall. Stems simple to branched from the base, densely pubescent to glabrous. Leaves petiolate, gradually reduced upward, longest petioles 3–4 times the lengths of the leaflets. Stipules broadly ovate, leaflike, tips long acuminate, entire to serrate. Leaflets 10–30(45) × 6–20(25) mm, sessile or nearly so, ovate to obovate, base cuneate, apex acute to broadly rounded, serrate. Inflorescence 20–35(40) mm wide, umbellate, nearly spherical in flower, on peduncles 20–60(80) mm; flowers 10–40; pedicels 4–8 mm, reflexing dramatically and elongating to 7–12(15) mm in fruit. Calyx hairy to glabrous, tube 1–1.5 mm, teeth linear, nearly equal, 3–7 mm, with broad, U-shaped sinuses between. Corolla deep pink to white, longer than the calyx lobes, 8–14 mm, the standard oblong to elliptic, obtuse, often slightly emarginate. Fruit ovoid to oblong, 3–5 mm, slightly stalked. Seeds (1)2–4, pale yellow, 1–1.5 mm. $2n = 16$. Flowering in Kentucky in May, fruiting June.

Buffalo clover is native to eastern North America from Virginia and the Carolinas south into Florida, west to central Texas, north to eastern Kansas, Nebraska, and Iowa, and east to Ohio; there is also an old record from eastern Pennsylvania. The earliest Kentucky collection I saw was from 1835, Fayette County (*Short s.n.*, GH); the most recent collection was from 1990, Trigg County (*Chester et al. 90-210*, APSC). This species is becoming very rare in Kentucky (Taylor and Campbell 1989) and is listed as endangered in the state (KSNPC 1996); four extant "occurrences" are recorded by the Kentucky State Nature Preserves Commission (D.L. White, KSNPC, pers. comm., 19 Jan 2000).

According to Taylor et al. (1994), buffalo clover is autogamously self pollinated. Some authors have recognized two varieties, based on pubescence differences, but this character is variable and probably clinal in nature, with the more glabrous forms in the northeastern part of the range of the species. Glabrous and pubescent forms may grow intermingled in some mid-south populations, with the most densely pubescent populations occurring in the deep south and the western portion of the range. The species was rediscovered in Ohio in 1990 at a site that had burned the previous fall (Vincent 1991), but there have been no further fires, and it has not reappeared there since. Populations of this species often reappear in sites after a burn, heavy logging, or some equally severe disturbance (pers. obs.).

Trifolium virginicum Small ex Small & Vail (Kate's Mountain clover) is a similar species found on exposed shale barrens from southwestern Pennsylvania south through West Virginia to the Shenandoah Valley of Virginia

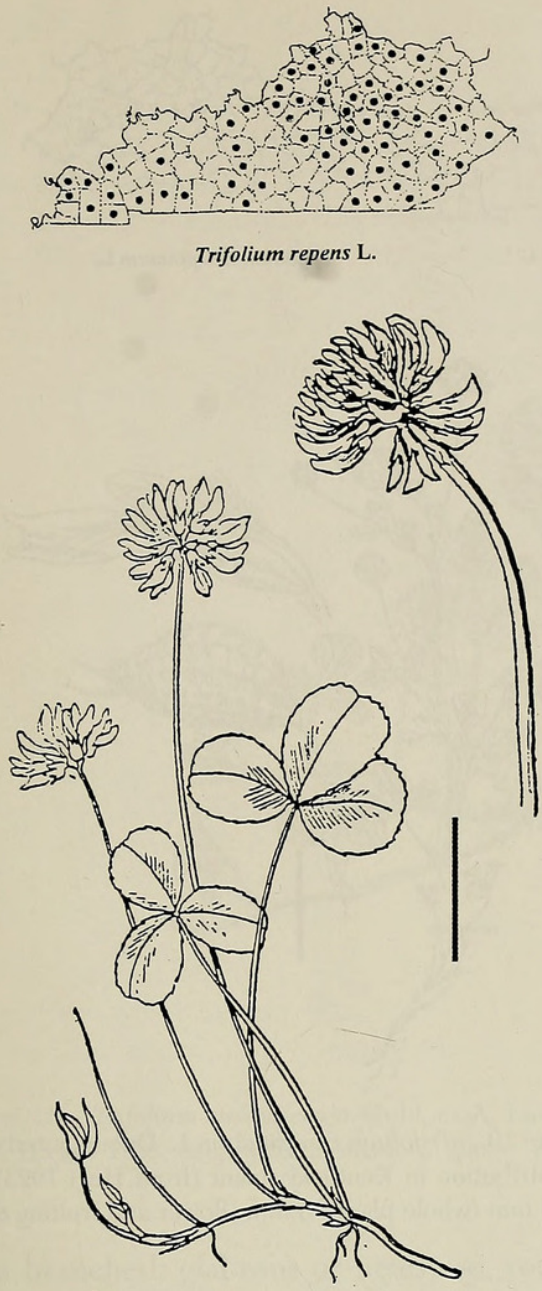


Figure 9. *Trifolium repens* L. Documented county-distribution in Kentucky; plant (from Besette and Chapman 1992). Bar = 20 mm (whole plant), 15 mm (inflorescence).

(Linscott 1994). It is a perennial species, with a rosette of leaves with narrowly elliptical leaflets; the corolla is white. If suitable habitat were found in eastern Kentucky, this species might be found there.

9. *Trifolium repens* L., Sp. Pl. 2: 767. 1753. White clover. (Figure 9)

Perennial, stoloniferous to rhizomatous, rooting at the nodes, 10–30 cm tall. Stems much-branched, glabrous to sparsely hairy. Leaves petiolate, petioles 10–200 mm. Stipules thin and membranous, whitish to brownish, often with darker reddish to greenish veins, ovate-lanceolate, fused into a tube, tips short-attenuate, 8–15 mm. Leaflets 6–30 × 10–25 mm, sessile or nearly so, broadly elliptic to ovate, base broadly cuneate, apex obtuse to emarginate or obcordate, serrate. Inflorescence 15–35 mm broad, umbellate to short-racemose, nearly globose, on peduncles as long as or longer than the associated leaves, arising from leaf axils on the stolons; flowers 20–50(100); pedicels reflexing dramatically with age. Calyx glabrous, often whitish with a purplish to green apex, tube 1.8–3 mm, teeth triangular-lanceolate, unequal, upper shorter than the tube, lower about as long as tube, sinus sharply V-shaped. Corolla white to pinkish, 7–12 mm, the standard elliptic-obovate, obtuse. Fruit linear-oblong, 3–5 mm. Seeds 3–4, yellowish tan to brown, 0.9–1.5 mm. $2n$ = 16, 28, 32, 48, 64. Flowering in Kentucky in March–November, fruiting June–November.

White clover (also called Dutch clover and Ladino clover) may very well be the most important temperate pasture plant (Baker and Williams 1987). It was introduced so early and was so widely grown in North America that it was known to Native Americans as "White man's foot grass" (Strickland 1801); its cultivation may have begun in the early 1700s, and it was widespread by the middle of that century (Isely 1998). Piper (1924) considered white clover "the most important perennial pasture plant in North America." The species is widely grown in Kentucky (Rice et al. 1982) and was the earliest clover species cultivated in the state (Carrier and Bort 1916). M'Murtrie (1819) reported this species from the Louisville area. The earliest known Kentucky collection I saw was from 1890, Fayette County (*Garman s.n.*, kes). The species is undoubtedly to be found in every Kentucky county.

Trifolium repens is extremely morphologically plastic, and varies greatly in size of both leaves and flowers depending upon environmental conditions (Gillett and Cochrane 1973). Zohary and Heller (1984) recognized nine intergrading varieties. Most North American specimens appear to be *T. repens* var. *repens*. A recent monograph on the species covers in great detail many aspects of its taxonomy, morphology, and cultivation (Baker and Williams 1987).

White clover may have some medicinal uses, although human ingestion of powdered fresh flower heads resulted in "a sensation of fullness and congestion of the salivary glands with pain, and . . . mump-like pain . . . followed by copious flow of saliva" (Millspaugh 1974).

A similar species is *T. calcaricum* Collins & Wieboldt, which differs from white clover in its terminal inflorescences. It is native to the cedar glades of central Tennessee and southwestern Virginia (Collins and Wieboldt 1992). If similar cedar glade habitat exists in southeastern Kentucky, it is possible that this species could be found in the state; it is found in Lee County, Virginia, within 10 miles of the Kentucky state line.

10. *Trifolium resupinatum* L., Sp. Pl. 2: 771. 1753. Persian clover. (Figure 10)

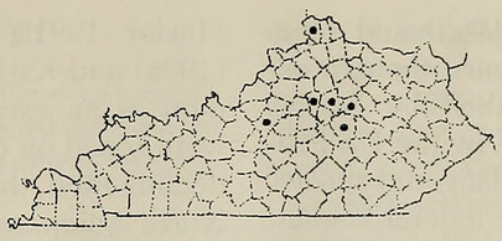
Annual, procumbent to ascending or upright, 10–60 cm tall. Stems often much-branched, glabrous or nearly so. Leaves petiolate below to nearly sessile above, longest petioles to 4–5 times the length of the leaflets. Stipules lanceolate to lanceolate-ovate, tubular at the base, tips long attenuate, shorter than the associated petioles. Leaflets 5–20(30) × 2–4 mm, sessile or nearly so, obovate, elliptic to lanceolate, or rhombic, serrate, base cuneate, apex rounded to acute. Inflorescence 8–15 mm broad, capitate, densely hemispherical, on peduncles 20–50 mm; flowers 6–20, short-petiolate to sessile. Calyx glabrous except for a dorsal band of hairs, whitish to pale green with a dark basal band, tube 1.5–2 mm, teeth subulate, unequal, shorter than the tube, often dark green; calyx becoming inflated and enclosing the fruit at maturity, the veins obviously reticulating. Corolla resupinate, lavender to pink or rarely white, 4–9 mm, the standard oblong, emarginate. Fruiting head globose, looking star-like. Fruit ovoid-lenticular, 1.7–2.3 mm. Seed 1, yellow to tan or purple brown, 1.2–2 mm. $2n = 14, 16, 32$. Flowering in Kentucky in May–June, fruiting June–July.

The resupinate (inverted, with the standard below and the keel above) corolla and inflated fruiting calyx makes *T. resupinatum* easy to distinguish from other clovers. The presence of Persian clover in Kentucky was first reported by McFarland (1942), whose report was accepted by Browne and Athey (1992) and Medley (1993). It may be cultivated in the state as a winter annual (Taylor and Sigafus 1984). I located only one Kentucky collection, from 1915, Metcalfe County (*Salmon s.n.*, kes). A report by Browne and Athey (1992) for the Shawnee Hills was rejected by Medley (1993), and I was unable to locate a specimen to verify the report. Widespread in much of the southeastern United States (Isely 1990), this species was recently documented from Ohio (Vincent and Cusick 1998). It is reported from "scattered stations" in northeastern U.S. by Gleason and Cronquist (1991).

Figure 10. *Trifolium resupinatum* L. Documented county-distribution in Kentucky; plant (from Hegi 1923). Bar = 20 mm (whole plant), 3 mm (flower and fruiting calyx).

11. *Trifolium stoloniferum* Muhl. ex A. Eaton, Man. Bot. 468. 1818. Running buffalo clover. (Figure 11)

Perennial, stoloniferous, upright flowering branches 10–40 cm tall. Prostrate stems often



Trifolium stoloniferum
Muhl. ex A.Eaton

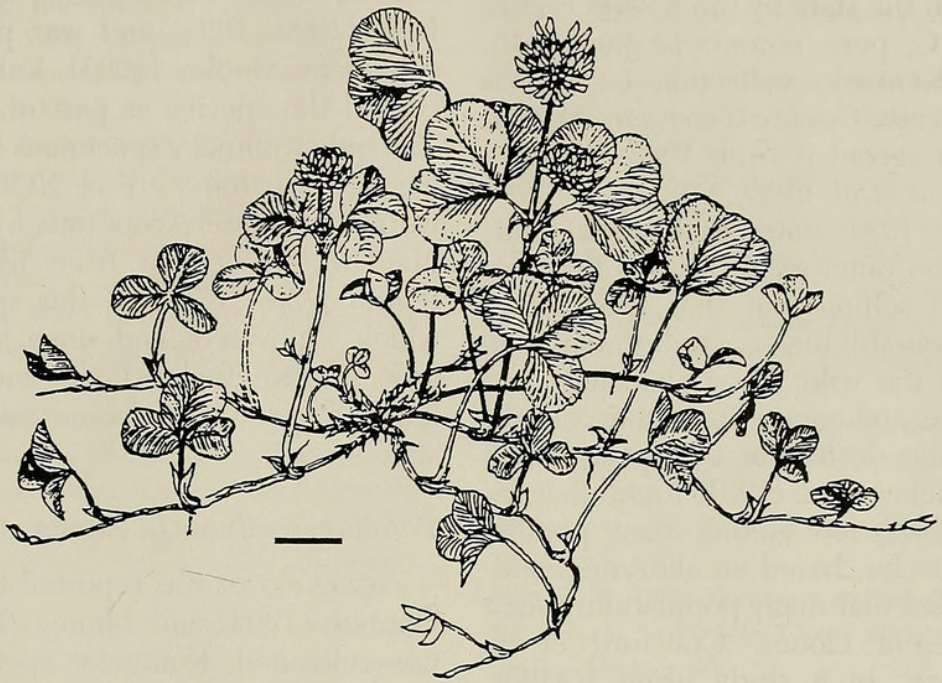


Figure 11. *Trifolium stoloniferum* Muhl. ex A. Eaton. Documented county-distribution in Kentucky; plant (drawn by Ethel Hickey 1995, used with permission). Bar = 20 mm.

little branched, glabrous or nearly so, rooting at the nodes, forming extensive clones. Leaves from stolons long-petiolate, those on the upright flowering stems in a pair, petioles as long as the leaflets or shorter. Stipules of stolons broadly lanceolate, membranous, tips attenuate, shorter than the associated petioles; those of the upright stems leaf-like, ovate-oblong, broadly triangular to attenuate, slightly to much-serrate. Leaflets 10–40 × 8–35 mm, serrate, on petiolules about 1 mm, obovate to obcordate, base broadly cuneate, apex rounded to emarginate. Inflorescence 15–30 mm wide, umbellate, spherical, on peduncles 10–30 mm; flowers 25–45; pedicels 2–8 mm, reflexing dramatically in age. Calyx glabrous or nearly so, tube 1.5–2.5 mm, teeth subulate, nearly equal, about twice the length of the tube. Corolla white, sometimes pinkish with age, 8–14 mm, the standard obovate to oblong, rounded to emarginate. Fruit oblong, 2.5–3 mm. Seeds 1–2, yellow to brown, 1.3–2 mm. $2n$ = 16, 32. Flowering in Kentucky in April–May, fruiting May–June.

In spite of the use of the citation "Muhl., Cat. Pl. Amer. Sept. 67. 1813." for this name (Browne and Athey 1992; Medley 1993; Zohary and Heller 1984), the authorship should be given as "Muhl. ex A. Eaton" since Muhlenberg's (1813) publication of the name was a "nomen nudum" as stated by Merrill and Hu (1949) and Brooks (1983).

Running buffalo clover once ranged widely over middle east-central North America from present-day West Virginia west to Kansas, and from Arkansas north to north-central Ohio (Brooks 1983). Its predominant range was montane West Virginia and the Ohio River drainage in Ohio and south to central Kentucky. It was once found in great stands in

Kentucky (Campbell et al. 1988) and Ohio (Cusick 1989). This species, once thought extinct, was rediscovered in 1983 by Bartgis (1985), and was listed in 1987 by the US Fish and Wildlife Service as an endangered species (Anonymous 1987) under the federal Endangered Species Act. It was thought to be very rare in Kentucky (Taylor and Campbell 1989), and is listed as a threatened species in the state (KSNPC 1996); 69 extant "occurrences" are recorded in the state by the KSNPC (D.L. White, KNSPC, pers. comm. 19 Jan 2000). The earliest Kentucky collection I saw was from 1834, Fayette County (*Peter s.n.*, MICH, NY); the most recent is from 1995, Madison County (*Vincent et al. 6959*, MU).

Taylor et al. (1994) stated that running buffalo clover is an outcrossing species that sets fewer seeds if selfing, but that seed set in selfed plants was still high enough to maintain the species in the wild. They also suggested that habitat loss and competition may contribute more to the decline of the species than inbreeding. Hickey et al. (1991) found that genetic diversity was low among many populations of the species, based on allozyme banding patterns, and that many populations might actually represent clones. Crawford et al. (1998), however, in a study using RAPDs, found that most populations were not single clones, and that even the smallest populations contained unique genetic information.

Running buffalo clover is sometimes confused with *T. repens*, from which it differs by the bract-like pair of leaves below the inflorescence on the upright stems, and by the overall larger size of the former. Another similar species is *T. calcaricum*, which is discussed under the treatment of *T. repens*.

EXCLUDED SPECIES

Trifolium alexandrinum L. Berseem clover

This species was reported from cultivation by Garman (1902) and more recently by Taylor and Sigafus (1984). Its presence in Kentucky outside of cultivation was rejected by Medley (1993). There is a Fayette County specimen (*Garman s.n.*, kes), but it is from cultivation. I saw no specimen of this clover from other than cultivation.

Trifolium ambiguum L. Kura clover

Kura clover can be cultivated in Kentucky and is a very hardy rhizomatous perennial (Taylor 1991a; Taylor et al. 1997b). Isely (1998) and Kartesz (1999) reported *T. ambiguum* as an escape in Ohio, but the reports were based on cultivated material; it is not yet documented that the species will escape in North America. All Kentucky collections I examined were of cultivated material.

Trifolium hirtum L. Rose clover

Rose clover was reported for Kentucky by Isely (1990, 1998) and was provisionally accepted by Medley (1993). Kartesz (1999) accepted the species as part of the state flora. The only Kentucky specimens identified by Isely as *T. hirtum* were at NCU. Of those, all were *T. pratense* except one, a cultivated specimen of rose clover from Jefferson County (*Gunn J150*, NCU). If this species becomes widely cultivated, and since it is possible to grow it in Kentucky (Taylor and Sigafus 1984), it could very well become established in the state.

Trifolium medium L. Zigzag clover

Zigzag clover was reported for Kentucky by Garman (1902) and Linney (1880). I saw no non-cultivated Kentucky specimens of this species, although it is known to be cultivated in the state (Taylor 1991b). Medley (1993) rejected the occurrence of this species in Kentucky. Gleason and Cronquist (1991) reported that *T. medium* occasionally escapes from cultivation in northeastern North America. I have seen specimens from escaped populations in North Carolina, Massachusetts, Maine, and eastern Canada.

Other clover species which are known only from cultivation in Kentucky include *T. vesiculosum* Savi (arrowleaf clover) and *T. subterranean* L. (sub clover) (Taylor and Sigafus 1984). In addition, Dr. Norman Taylor has cultivated many other species in greenhouses and field plots in Lexington.

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