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# A Systematic Study of the Native *Geum* L. species of Illinois

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A systematic study of the  
native Geum L. species of Illinois  
(TITLE)

BY

Michael B. Wenzel

1768 -

**THESIS**

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS  
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A SYSTEMATIC STUDY OF THE NATIVE  
*GEUM* L. SPECIES OF ILLINOIS

By Michael B. Wenzel

## ABSTRACT

A systematic study of the seven species of *Geum* L. (Rosaceae) native to Illinois including *G. aleppicum* var. *strictum* (Aiton) Fernald, *G. canadense* Jaquin, *G. laciniatum* Murray var. *trichocarpum* Fernald, *G. rivale* Linnaeus, *G. triflorum* Pursh, *G. vernum* (Rafinesque) Torrey & Gray, and *G. virginianum* Linnaeus is presented. Early classification systems are briefly compared, especially regarding the topic of subgenera. Detailed taxonomic descriptions, distribution information including county citations, and identification keys were developed for this study. Two separate keys, one for floral characters and the second for specimens in fruit are given for greater ease in proper identification.

Two principal component analyses (PCA), one including vegetative and floral characteristics and another including vegetative and mature fruit characteristics, are used to illustrate the relative cohesiveness between the Illinois species. Most of the species involved show a high degree of separation in both floral and fruit studies.

Of particular interest is the relationship between *Geum canadense* and *G. virginianum*. It has been proposed that *G. virginianum* is a naturally occurring hybrid between *G. canadense* and *G. aleppicum* var. *strictum*. In the floral study these species segregate completely, although an affinity is apparent. Mild cohesion between the clusters in the fruit study representing *Geum canadense* and *G. virginianum* does reinforce the high degree of morphological similarity between these species. Indeed in fruit the main

distinguishing characteristic is that the stipules of *G. virginianum* are up to five times the length of those on specimens of *G. canadense*. There are many morphological differences between *G. virginianum* and *G. aleppicum* var. *strictum*. From the distributions of the proposed parents it is unlikely that *G. virginianum* occurs as a natural hybrid in Illinois. *Geum virginianum* occurs in the southern 1/4 of Illinois while *G. aleppicum* var. *strictum* occurs in the northern 2/3 of the state. These groupings conform to the currently accepted species.

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## INTRODUCTION

In Illinois seven species of *Geum* (Rosaceae) occur naturally. These species include: *Geum aleppicum* var. *strictum* (Aiton) Fernald, *G. canadense* Jaquin, *G. laciniatum* Murray var. *trichocarpum* Fernald, *G. rivale* Linnaeus, *G. triflorum* Pursh, *G. vernum* (Rafinesque) Torrey & Gray, and *G. virginianum* Linnaeus. Representatives of this genus in Illinois have a number of things in common. They are herbaceous perennials, forming a basal rosette, with the inflorescence terminating the stems arising from the rosette, flowers 5-merous, in fruit producing an aggregate of achenes, styles are persistent, with one ascending ovule per carpel, and  $2n=42$  (Robertson 1974, Kalkman 1988).

As a genus *Geum* occurs primarily in temperate regions of the northern hemisphere, with a few species found in the higher elevations and southern reaches of South America, South Africa, and Tasmania. Even with such a wide distribution, there are relatively few species, approximately 60 in 11 subgenera worldwide (Robertson, 1974).

Bolle (1933) placed *Geum* in the subfamily Dryadoideae which was divided into four tribes (Fig. 1). The tribe Geeae contained the species of *Geum* currently recognized, as well as the genera *Coluria* R. Brown and *Waldsteinia* Willd. Although not universally accepted today, there is mounting evidence that a tribe composed of these genera (possibly including the genus *Fallugia* Endl.) might be an accurate representation of these relationships (Morgan et al., 1994).

Some of the species of *Geum* recognized today were at other times placed in other genera. Of the species included in this study, *Geum triflorum* was placed in the genus *Erythrocoma* (*E. triflora* (Pursh) E. L. Greene). Bolle (1933) was not the only one to consider *G. triflorum* as a member of a different genus, however, cytological studies indicate that this species should be included in *Geum* proper (Gajewski 1957).

Bolle's classification system then divided *Geum* into four subgenera, two of which involve species in this study (Figure 1). *Geum vernum* was placed in the subgenus *Stylipus* due to its lack of bracteoles. The second pertinent subgenus, *Eugeum*, was divided into two sections. The first section, *Gmeliniana*, was further divided into two series. *Geum rivale*, with its large flowers and long stigmatic surface, was placed in the series *Campanulatum*. The second section, *Murrayana*, was also further divided into two series. *G. laciniatum* and *G. aleppicum* were placed in the series *Pubescentia*. The remaining two species in this study, *G. canadense* and *G. virginianum*, were placed in the series *Hirsuta*. Hybrid crosses of these sections show high degrees of fertility, indicating that these species are closely related. Separation into sections is thus considered artificial by Gajewski (1957).

The differences between the species can best be illustrated by utilizing characteristics used by Gajewski (1957) to organize the genus (Fig. 1). Gajewski's classification is based on the work of Bolle (1933) with some modifications. First, *Geum triflorum* is placed within *Geum* proper. Second, only subgeneric classifications are

used, as more detailed studies would need to be performed to warrant the use of any further subcategories. The characters which separate the species are, first, whether the persistent style is entire, or if the distal portion is deciduous. Of the taxa considered here, only *G. triflorum* has an entire and persistent style, and is placed in the subgenus *Erythrocoma*. All the other species in this discussion have a deciduous distal portion of the style. The second distinguishing character is whether bracteoles are present on the calyx. Within this genus, only *G. vernum*, lacks bracteoles. It is therefore placed in the subgenus *Stylipus*. All of the remaining species; *G. aleppicum*, *G. canadense*, *G. laciniatum*, *G. rivale* and *G. virginianum* are found in the subgenus *Eugeum*. This subgenus is characterized by the deciduous portion of the pistil, and the hooked apex of the persistent portion. These points are mentioned merely to help illustrate the morphological variation within *Geum*, not to discuss at length the intricacies of subgeneric divisions. For additional detailed subgeneric taxonomies refer to Bolle (1933), Juel (1918), Rydberg (1913), and Scheutz (1870).

This study will examine the relationships between *Geum* species in Illinois using principle component analysis (PCA). A PCA is a type of multivariate analysis useful in determining relationships between individuals by examining many characters simultaneously (Jeffers 1967). The end product of this analysis will be a graphical representation where clusters of similar individuals will have a closer proximity than those more dissimilar. Well-defined taxa will form "clumps" of related individuals. Taxonomically important

morphologic characteristics will be used exclusively in this investigation. This study will help to establish the nature of the morphological relationships between the *Geum* species that occur in the state of Illinois and illustrate the potential importance of using PCA to help distinguish taxa in the genus *Geum*.

#### MATERIALS AND METHODS

Early in the study readily available floras for areas of the upper midwest (Deam, 1940; Radford, et al., 1968; Seymour, 1969; Stone, 1973; Taylor, 1915; Torrey & Gray, 1968) were consulted to develop a sense of distributions for the species one might expect to encounter in Illinois. A map was generated which projected the distributions for areas where no flora was available. Projected distributions were compared with generally accepted distributions of native Illinois *Geum* species (Mohlenbrock, 1986). Any inconsistencies in these results were noted.

Habitat observations were made in the field for *Geum canadense*, *G. laciniatum*, *G. vernum*, and *G. triflorum*; all of which occur in Coles and Winnebago counties.

The information used in this study was gathered primarily from herbarium specimens. These included both on-site material in the Stover-Ebinger Herbarium at Eastern Illinois University (EIU) as well as from eight loaning institutions (CR, DEK, F, ILL, ILS, MOR, MWI, & SIU). These herbaria were chosen based on the number of collections and their location within the state. It was important to receive representative material from a wide geographic range to help

record morphological variations within the species. Specimens of *G. virginianum* were borrowed from Cornell University, Ithica, New York as to compare with populations in Illinois.

Specimens were first evaluated based on morphological measurements that would contribute to detailed species descriptions and identification keys. Measurements of characters were taken manually and with an ocular micrometer. Only specimens that exhibited mature characteristics were used. Maturity was determined in flower by the presence of developed stigmas and in fruit by the absence of the distal portion of the style. Collection data on each specimen was recorded to contribute to detailed distribution reports for each species. From this preliminary data, characteristics were chosen for a principal component analysis (PCA).

Both dichotomous and quantitative data were used for the PCA. Due to the importance of both flower and fruit characters in the PCA, data sets were collected separately into two groups. Distinguishing vegetative characters that were independent of reproductive material was repeated in both data sets (Fig. 2 & 3).

Ideally each data set was to contain 20 Illinois specimens of each species. This would produce two data sets with a maximum of 160 different individuals in each group. An individual could be used in both data sets only if it exhibited both flowers and mature fruits. This was necessary in species where there were low numbers of individuals, if they had either persistent flowers or a long flowering period. Out-of-state specimens were used when the number of available in-state specimens was so low that it

jeopardized the integrity of the study for that taxon. This was especially true with *Geum rivale* where morphological variation is relatively low. Out-of-state material was not used in the case of *G. virginianum*. Illinois material was used exclusively due to the apparently close morphological similarity with other species found in Illinois. The PCA was performed using NTSYS-pc (Rohlf, 1990). Cluster graphs were produced for interpretation.

## RESULTS AND DISCUSSION

The development of a projected distribution was consistent with established records for *Geum* species occurring in Illinois, with one exception. It was noted that *Geum macrophyllum* was listed as occurring in Indiana (Deam, 1940), Wisconsin (Robinson & Fernald, 1908), and Iowa (Greene, 1907). Curiously, there was no mention of this species in Illinois. Occasionally a sterile specimen identified as *G. macrophyllum* was found among the specimens examined. These would inevitably turn out to be misidentified *G. laciniatum*.

When the flower data set containing 59 individuals was run, the first three principle components accounted for 49.6%, 16.8%, and 13.3% respectively, or 79.7% of the total variance. The amount of variance contributed by the remaining components diminished slowly from the third principle component onward. Petal length, stolon habit, flower position, hypanthium shape, and calyx lobe position (characters 12, 4, 6, 7, and 8), are the most important in determining the component score in the first component, while peduncle thickness, gynophore presence, and receptacle pubescence

(characters 5, 14, and 15), are the most important in determining the score in the second component (Table 1).

Well-defined clusters are produced in a plot of the first two principle components (Fig. 4). The clusters correspond with previously described taxa. *Geum rivale* and *G. triflorum* are found to be strongly segregated from the rest of the clusters. An aberrant specimen of *G. aleppicum* var. *strictum* shows a close affinity with the cluster representing *G. laciniatum* var. *trichocarpum*. Since these two species are very similar vegetatively, this proximity is not surprising.

When the fruit data set containing 59 individuals was run, the first three principle components accounted for 44.4%, 16.3%, and 13.1% respectively, or 73.8% of the total variance. The amount of variance contributed by the remaining components diminished slowly from the third principle component onward. Well-defined clusters were produced in a plot of the first two principle components (Fig. 5). Bracteole length, stolon habit, hypanthium shape, and calyx lobe position (characters 10, 4, 6, and 7), were the most important in determining the component score in the first component, while gynophore presence, peduncle thickness, and glandular hair presence (characters 11, 5, and 18), were the most important in determining the score in the second component (Table 2).

The study involving fruit characters also shows the strong affinity between *G. aleppicum* var. *strictum* and *G. laciniatum* var. *trichocarpum*. However, *G. canadense* and *G. virginianum* did not

separate completely. This situation corresponds to the very similar morphologies of these two species when in fruit. The only striking difference between them while not in flower is the length of the stipules found on *G. virginianum* which can be up to 5 times the size of those on *G. canadense*.

#### TAXONOMIC TREATMENT

This taxonomic treatment is based primarily on herbarium specimens, when possible supplemental habitat data was obtained in the field. Characters were used which are the most important in distinguishing species. A point was made to determine these characters throughout the growing season including both floral and fruit morphologies. The specimens used in the taxonomic treatment were also used in the PCA's.

All species in this treatment are perennial herbs, forming basal rosettes. The leaves can be elliptic, ovate, rhomboid, or lyrate in overall shape, many times they are lobed to pinnately compound. From this basal rosette arises the terminal, paniculate inflorescence. The flowers are 5-merous, forming a hypanthium, and bracteoles are usually present. The stamens are numerous and the filaments persisting. The pistils are numerous and may be entirely persistent; usually, however, only the basal portion persists, with a hooked apex. An aggregate of achenes is produced on the receptacle



KEYS TO THE GEUM OF ILLINOIS

## FLORAL KEY

- 1a. Petals white, cream, or yellow; calyx lobes reflexed; flowers erect
- 2a. Bracteoles absent; gynophore present-----*G. vernum*
- 2b. Bracteoles present; gynophore absent
- 3a. Petals shorter than calyx lobes
- 4a. Receptacle hirsute; peduncle filiform;  
lower stem sparsely hirsute to glabrous -----  
-----*G. virginianum*
- 4b. Receptacle glabrous; peduncle thick and stout;  
lower stem densely hirsute -----  
-----*G. laciniatum* var. *trichocarpum*
- 3b. Petals equal to or longer than the calyx lobes
- 5a. Petals white; basal leaves generally broadly lobed-----*G. canadense*
- 5b. Petals yellow; basal leaves generally narrowly lobed -----*G. aleppicum* var. *strictum*
- 1b. Petals purple or purple-yellow; calyx lobes ascending; flowers pendulous
- 6a. Styles entire, plumose; cauline leaves reduced; gynophore absent-----*G. triflorum*
- 6b. Style tips deciduous; cauline leaves not reduced; gynophore present-----*G. rivale*

## FRUITING KEY

- 1a. Style plumose, to 8 cm, entire, tip straight; many finely lobed alternate leaflets in tight basal rosette; cauline leaves reduced  
-----*G. triflorum*
- 1b. Style glabrous to hirsute, apex deciduous, tip hooked; leaves not finely lobed cauline leaves prominent, mostly broad
  - 2a. Gynophore present
    - 3a. Bracteoles absent; pericarp mildly puberulent; calyx lobes reflexed, green-----*G. vernum*
    - 3b. Bracteoles present; pericarp hirsute; calyx lobes ascending, usually purplish-----*G. rivale*
  - 2b. Gynophore absent
    - 4a. Receptacle glabrous; persistent styles wide spreading, drab brown; glandular hairs absent-----*G. laciniatum* var. *trichocarpum*
    - 4b. Receptacle hirsute
      - 5a. Persistent styles tightly reflexed, appressed; basal leaves mostly with narrow lobes-*G. aleppicum* var. *strictum*
      - 5b. Persistent styles loosely spreading; basal leaves mostly entire or with distinct terminal leaflet

- 6a. Leaf teeth rounded; stipules large, often longer than 1 cm.-----  
-----*G. virginianum*
- 6b. Leaf teeth acute; stipules small, shorter than 1 cm.---*G. canadense*

1. *Geum aleppicum* Jaquin var. *strictum* (Aiton) Fernald; *Rhodora* 37. 294.1935.  
Yellow Avens.

Herbaceous perennial with short, vertical, persistent rootstock. Stem thick, 4-9 dm long, hirsute, commonly puberulent above. Basal leaves few, long-petioled, leaflets 5-9, often deeply lobed, may have a large, rounded, terminal leaflet; petioles 4-16 cm long, grooved, strongly hirsute; leaflets elliptic to rhomboid, the terminal leaflets may be strongly lobed or entire, 4-10 cm long, and 5-8 cm wide, the smaller, lower leaflets often intermingled with minute ones, appressed pubescent on both surfaces, margins serrate. Cauline leaves alternate, mostly trifoliate, the lower pinnately compound with small lower leaflets, simple above; petiole 1-5 cm long, becoming very short near stem apex, hirsute; leaflets and simple leaves often deeply lobed and serrate, near base 2-8 cm long, 1-6 cm wide, the upper simple leaves elliptic, 2-5 cm long, 0.3-1.1 cm wide, appressed pubescent on both surfaces, base cuneate, apex acute; stipules 8-20 mm long, 6-18 mm wide, deeply serrated, rarely lobed, hirsute. Inflorescence a loose, bracteated, terminal panicle; pedicels

to 20 cm long, densely puberulent and commonly lightly hirsute, glandular hairs often present. Flowers 0.75-1.5 across, erect; hypanthium saucer-shaped, hirsute; bracteoles 5, 1-3 mm long, 0.5-1.0 mm wide, hirsute; calyx 5-lobed, the lobes triangular, 3-8 mm long, 2.5-3.0 mm wide near the base, strongly reflexed in fruit, densely puberulent, long, straight hairs and glandular hairs also present; petals 5, bright yellow, ovate to obovate, 5-9 mm long, 5-8 mm wide, longer than calyx lobes; stamens 80-100, the filaments persistent, 2.0-3.5 mm long, the anthers 0.5 mm long; receptacle conical, elongating with fruit maturation, hirsute, the hairs to 1.1 mm long; pistils numerous (50-200), reddish-brown, the styles jointed, the distal portion 1.5-2.0 mm long, hirsute, tardily deciduous, the basal portion glabrous, hooked at apex, persistent. Fruiting aggregate obovoid to globose, 15-23 mm across, basal portion of styles usually reflexed in aggregate, composed of up to 200 achenes; gynophore absent; achenes oblanceoloid, 2.5-3.5 mm long, 1.3-1.8 mm wide, hirsute, with hairs to 2.1 mm long, occurring dorsally, the persistent, hooked style 4-7 mm long, glabrous. Flowering: May-June.

Habitat: wet disturbed areas, thickets, meadows and forest clearings. In Illinois it is found mostly in the north-east 1/4 with scattered populations in the central portion of the state. This variety can be found throughout most of the northern portions of North America including portions of Canada and Mexico.

## REPRESENTATIVE SPECIMENS.

BOONE: 7 May 1946, *G. Fell*

*f46489* (ILLS); COOK: Chicago,

31 July 1860, *F. Scammon*

*35654* (F); DEKALB: W. of

Kirkland, 9 June 1964, *R. Evers*

*79896* (ILLS); DUPAGE: Shick

Road, 10 July 1975, *R.*

*Schulenberg 75-816* (MOR);

KANE: S Elgin, 2 blocks SE of

village water tank, 22 July

1972, *F. Swink 21302* (MOR);

LAKE: Roney Farm near Wauconda, 3 Aug 1952, *F. Swink 1695* (F);

MCLEAN: 15477 (ILL); MERCER: 3 mi. NE of New Boston, 2 July 1966,

*R. Wunderlin 234* (SIU); OGLE: Pine Rock Natural Area, 25 June 1965,

*D. Wade 1538* (DEK); ROCK ISLAND: E part of Co., 17 May 1932,

*Pepoon & Barrett 4187* (ILLS); WILL: Joliet, 28 June 1964, *H. Skeels*

*353* (F); WINNEBAGO: Fountaindale, 1867, *M. Bebb 393912* (F).



Distribution of *Geum aleppicum* var. *strictum* in Illinois

*Geum aleppicum* var. *strictum* is found mostly in the northern 1/4 of Illinois with occasional populations reaching into the central portions of the state. Rarely forming dense colonies, this species often occurs as scattered individuals. As with other members of the subgenus *Eugeum*, *Geum aleppicum* var. *strictum* has hooked, persistent styles and is dispersed by animals.

*Geum aleppicum* has the widest distribution of any *Geum*<sup>14</sup> species, being found in northern latitudes across the globe (Gajewski 1957). Accompanying this distribution are wide levels of variation. Even so, *G. aleppicum* var. *strictum* is considered the only North American variety. The basis for this varietal separation is that the achene of *G. aleppicum* var. *strictum* is glabrous, except at the margin and summit, while the achene of *G. aleppicum* is long-villous throughout (Fernald, 1935). The recognition of this taxon is not completely agreed upon (Voss, 1985; Robertson, 1974).

This species is very closely related to *Geum laciniatum*. Without petals or mature achenes, the vegetative feature may be very similar and one must check the receptacle for pubescence to make a certain determination. This species is also characterized by the presence of yellow petals which exceed the calyx lobes.

2. *Geum canadense* Jaquin; Hortus Botanicus Vindobonensis.

2:82 1773.

White Avens

Herbaceous perennial with a short, vertical, persistent rootstock. Stem slender, 4-10 dm tall, glabrous to sparsely hirsute below, densely velvety-puberulent above, often with few scattered long hairs. Basal leaves few, long-petioled, mostly trifoliate (rarely simple or with 5-7 leaflets); petiole 5-25 cm long, grooved, usually strongly hirsute; leaflets obovate, 3-8 cm long, 2.5-6.0 cm wide, appressed pubescent on both surfaces, margins coarsely serrate,

often slightly lobed. Cauline leaves alternate, usually trifoliate<sup>15</sup> below, simple above; petiole mostly less than 1 cm long except on the lower cauline leaves, puberulent, longer hairs also common; leaflets and simple leaves, elliptic to rhombic, 3-8 cm long, 1-5 cm wide, appressed pubescent on both surfaces, margins coarsely serrate, often lobed, base cuneate, apex acute; stipules 4-10 mm long, 1-5 mm wide, usually entire or with a few acute teeth. Inflorescence a loose, bracteate, terminal panicle; pedicels to 10 cm long, densely puberulent. Flowers 12-16 mm across, erect; hypanthium saucer-shaped, puberulent; bracteoles 5, to 1.1 mm long, to 0.4 mm wide; calyx 5-lobed, the lobes lanceolate to triangular, 3-8 mm long, 1.8-3.5 mm wide near the base, reflexed in fruit, densely puberulent and lightly hirsute on the lower surface, glabrous within; petals 5, white, oblong to obovate, 3-7 mm long, 2-4 mm wide, equaling to longer than the calyx-lobes; stamens 30-50, the filaments persistent, 1.5-3.0 mm long, the anthers 0.6 mm long; receptacle cylindrical, densely hirsute with hyaline hairs to 2.5 mm long that are shorter than the achenes; pistils numerous (30-140), the styles jointed, the distal portion to 1.5 mm long, hirsute, deciduous, the basal portion glabrous, hooked at the apex, persistent. Fruiting aggregate obovoid to spherical, 12-20 mm across, composed of up to 140 achenes; gynophore absent; achenes oblanceoloid, 2.0-3.5 mm long, 1-2 mm wide, lightly hirsute, the longer hairs 0.7-1.8 mm long, occurring dorsally, the persistent, hooked style 3-5 mm long. Flowering June-August.

Habitat moist woods, particularly in disturbed areas, throughout Illinois. This species is found throughout most of the northern 3/4 of North America extending south into northern Mexico

REPRESENTATIVE SPECIMENS.

ADAMS: N of Rock Creek, 8 Sept

1949, *R. Evers 20914* (ILLS);

BOND: E of Smithsboro, 21 June

1952, *R. Evers 34043* (ILLS);

ALEXANDER: SE of Sandusky,

18 June 1991, *S. Franklin 126*

(SIU); BOONE: 3 mi. N of Hunter,

4 Aug 1949, *R. Evers 19177*

(ILLS); BROWN: NW of

Versailles, 12 July 1948, *R.*

*Evers 11717* (ILLS); BUREAU:

SE of Princeton, 15 July 1955, *R. Evers 47650* (ILLS); CALHOUN: Cove

Spring, SW of Batchtown, 10 July 1957, *R. Evers 54082* (ILLS);

CARROLL: 22 July 1962, *R. Wunderlin 161* (MWI); CASS: 4 July 1966,

*R. Rexroat 15427* (MWI); CHAMPAIGN: 2 mi. NE of Urbana, 12 Aug

1947, *R. Evers, 6286* (ILLS); CHRISTIAN: NE of Clarksdale, 22 June

1949, *R. Evers 17824* (ILLS); CLARK: 3.5 mi. E of Walnut Prairie, 5

July 1971, *P. Phillippe 244* (EIU); CLAY: W of Flora, 9 Aug 1955, *R.*

*Evers 48218* (ILLS); CLINTON: 2 mi. S of Frogtown, 7 July 1959, *R.*

*Evers 60769* (ILLS); COLES: 3.25 mi. E of Charleston, S of route 16

0.25 mi., 22 June 1957, *Phipps & Speer 382* (EIU); COOK: Forest Hill,



Distribution of *Geum canadense* in Illinois



22 July 1890, *J. Hill 5411890* (IL); CRAWFORD: 11 mi. S of Robinson,  
 19 June 1971, *L. Phillippe 282* (EIU); CUMBERLAND: 4 mi. E of Neoga,  
 30 July 1947, *R. Evers 5670* (ILLS); DEKALB: Kishwaukee Audubon  
 Sanct., 30 Aug 1975, *L. Jacoby 7* (DEK); DEWITT: NW of Kenny, 28  
 June 1955, *R. Evers 46920* (ILLS); DOUGLAS: Douglas Co. Conserv. Area,  
 30 July 1972, *J. Ebinger 11872* (EIU); DU PAGE: Morton Arboretum,  
 23 June 1970, *C. Ciolac 21310* (DEK); EDGAR: 2 mi. SE of Paris, 25 Aug  
 1966, *J. Ebinger 6386* (EIU); EDWARDS: ICA Mark's Science Preserve,  
 NE of Blood, 25 June 1967, *J. Ebinger 7074* (EIU); EFFINGHAM: 6 mi. S  
 of Beecher City, 17 July 1979, *J. Ebinger 18278* (EIU); FAYETTE: 4 mi.  
 E of Ramsey, 26 June 1956, *R. Evers 50443* (ILLS); FORD: 3 mi. W of  
 Paxton, 26 July 1955, *R. Evers 47754* (ILLS); FRANKLIN: 4-H Camp,  
 West Frankfurt Lake, 11 Aug 1967, *J. Swayne 71* (SIU); FULTON: E of  
 Duncan Mills, 6 Aug 1952, *R. Evers 35084* (ILLS); GALLATIN: 3 mi. W  
 of Omaha, 19 June 1958, *Voight 1960* (SIU); GREENE: N of Eldred, 24  
 June 1975, *R. Henry 239* (MWI); GRUNDY: 1.5 mi. S of South  
 Wilmington, 15 Sept 1982, *B. Szafoni 386* (ILLS); HAMILTON: 2 mi. S  
 of Dale, 15 Aug 1947, *R. Evers 5079* (ILLS); HANCOCK: rt. 94, N of  
 Long Creek, Carthage, 8 July 1942, *G. Boewe 15643* (ILLS); HARDIN:  
 Marsh Spring, 24 June 1967, *C. Ott 434* (SIU); HENDERSON: Bald Bluff,  
 18 Aug 1951, *R. Evers 31986* (ILLS); HENRY: Shabonna Grove, 29 Aug  
 1943, *R. Dobbs 18286* (ILLS); IROQUOIS: 1 mi. E of Iroquois, 26 July  
 1955, *R. Evers 47798* (ILLS); JACKSON: Lake Kinkaid, along  
 Buttermilk Trail, 13 July 1977, *J. Joshu 24* (SIU); JASPER: N of  
 Falmouth, 26 Aug 1955, *R. Evers 49082* (ILLS); JEFFERSON: Devil's  
 Prop, 2 mi. S of Divide, 12 Sept 1949, *R. Evers 58466* (ILLS); JERSEY:

28 July 1970, *D. Smeltzer 411* (EIU); JO DAVIES: 15 June 1982, *J. Heim 621* (SIU); JOHNSON: Ferne Cliffe State Park, 9 July 1992, *M. Mibb 710* (SIU); KANE: Leroy Oakes Forest Preserve, 2 mi. N of route 64, 0.5 mi. W of Randall Rd., 14 July 1972, *R. Ratner 22* (DEK); KANKAKEE: along Iroquois River, SW of Aroma Park, Kankakee, 19 Aug 1949, *R. Evers 19727* (ILLS); KENDALL: SE of Plattville, 16 June 1951, *R. Evers 30235* (ILLS); KNOX: Horseshoe Lake, 20 July 1965, *G. Baker 201* (SIU); LASALLE: 4 mi. E of Leonore, 24 June 1958, *R. Evers 57119* (ILLS); LAKE: Chain of Lakes State Park, 6 Aug 1976, *J. Ebinger 15949* (EIU); LAWRENCE: Purgatory Swamp, SW of Russellville, 8 July 1967, *R. Evers 91505* (ILLS); LEE: Knox Grove, SE of Sublette, 28 Aug 1953, *R. Evers 40974* (ILLS); LIVINGSTON: W of Rowe, 30 July 1968, *R. Evers 97199* (ILLS); LOGAN: SW Lake Fork, 28 June 1955, *R. Evers 46955* (ILLS); MACON: Bois du Sangamon Nature Preserve, E of Lake Decatur, 24 Aug 1994, *D. Haug 293* (EIU); MACOUPIN: S of Reader, 12 Aug 1955, *R. Evers 48517* (ILLS); MADISON: W end of McDonough Lake, 6 July 1978, *J. Solomon 457* (SIU); MARION: 12 mi. N of Centralia, 10 Sept 1931, *H. Pepoon & T. Foster 1320* (ILLS); MARSHALL: 2 mi. N of Lacon, 23 July 1953, *R. Evers 39529* (ILLS); MASON: W of Mid-State Dragway, 2.5 mi. E of Illinois River, 13 June 1988, *L. Phillippe 126* (EIU); MASSAC: 2 mi. S of Mermet, 17 July 1947, *R. Evers 5270* (ILLS); MCDONOUGH: WIU campus, 1 July 1970, *R. Meyers 3124* (MWI); MCHENRY: NE of Harvard, 6 July 1955, *R. Evers 47210* (ILLS); MCLEAN: Funk's Grove, 16 July 1950, *R. Calef 61100* (ILLS); MENARD: 3 mi. E of Oakford, 14 Aug 1948, *R. Evers 12968* (ILLS); MERCER: W of Joy, 25 July 1964,

*Ozment & DeFilipps 826* (SIU); MONROE: N of Renault, 30 June 1952, *W. Bailey 2599* (SIU); MONTGOMERY: N of Van Burensburg, 25 June 1954, *R. Evers 44247* (ILLS); MORGAN: NE of Lynnville, 1 July 1960, *R. Evers 65081* (ILLS); MOULTRIE: 2 mi. S of Kirksville, 9 July 1966, *R. Wunderlin 313* (SIU); OGLE: 0.6 mi. W of Meridian Rd, N side of Lindenwood Rd., on N side of Stillman Creek, 11 June 1986, *J. Friberg 21* (DEK); PEORIA: 18 July 1966, *A. Clausen 349* (MWI); PERRY: Pyramid State Park, 11 June 1969, *J. Raveill 1337* (SIU); PIATT: E of Lodge, 10 July 1953, *R. Evers 39375* (ILLS); PIKE: near Valley City, 28 Aug 1930, *L. Campell & C.J. Alexopoulos 6534* (ILLS); POPE: Kruger Spring, 10 July 1968, *J. Schwegman 1862* (SIU); PULASKI: NW of highway junction 169 & 37, 20 July 1969, *J. Henderson 121* (SIU); PUTNAM: W of Magnolia, 15 July 1955, *R. Evers 47665* (ILLS); RANDOLPH: 1 mi. S of Hearderville, 8 July 1953, *R. Evers 39013* (ILLS); RICHLAND: 8 mi. SW of Olney, 29 Aug 1974, *J. Ebinger 015130* (EIU); ROCK ISLAND: O'Melia Woods, 25 July 1978, *T. Root 30544* (MWI); SALINE: Murray Bluff S of Carrier Mills, 30 July 1954, *R. Evers 45399* (ILLS); SANGOMON: Rochester, 23 June 1941, *G. Fuller 16010* (ILLS); SCHUYLER: 10 July 1968, *R. Rexroat 16764* (MWI); SCOTT: 25 June 1975, *R. Henry 578* (MWI); SHELBY: Williamsburg Hill SW of Lakewood, 26 June 1956, *R. Evers 50418* (ILLS); ST. CLAIR: below Dupo, 3 Aug 1957, *J. Neill 8373* (SIU); STARK: near Spoon River, N of Modena, 4 Aug 1950, *R. Evers 25902* (ILLS); STEPHENSON: Cedar Creek N of Cedarville, 5 Aug 1949, *R. Evers 19264* (ILLS); TAZEWELL: Spring Mill Bog, N of East Peoria, 23 July 1953, *R. Evers 39468*, (ILLS); UNION: Panther's Den, 8 Sept 1959, *R. MacMahon 986*

(SIU); VERMILION: Forest Glen Preserve, 3 mi. E of Georgetown, 4 June 1991, *M. Hruska* 274 (EIU); WABASH: W of Mt. Carmel, 8 Aug 1950, *R. Evers* 26079 (ILLS); WARREN: Shank's Farm, 15 Aug 1979, *R. Henry* 2767 (MWI); WASHINGTON: 1 mi. S of Washington Co. Park entrance, 30 July 1964, *D. Windler* 599 (SIU); WAYNE: along right of way rt. 15, W of Dry Fork Creek, 2.75 mi. NE of Sims, 12 June 1946, *G. Boewe* 19312 (ILLS); WHITE: 0.5 mi. SE of Phillipstown, 20 Aug 1973, *R. Evers* 111604 (ILLS); WHITESIDE: 3 mi. W of Garden Plain, 21 Aug 1947, *R. Evers* 6891 (ILLS); WILL: SE of Ritchey, 26 July 1955, *R. Evers* 47839 (ILLS); WILLIAMSON: Crab Orchard Natl. Wldlf. Refuge, 13 July 1973, *Jackson* 119934 (SIU); WINNEBAGO: 1715 N. Second, Rockford, 8 July 1959, *N. Wright* (DEK); WOODFORD: N of Spring Bay, 23 July 1953, *R. Evers* 39488 (ILLS).

Of the species that occur in Illinois *G. canadense* has the widest distribution and occurs in every county. This species spreads quickly, often colonizing disturbed, shady habitats where there is adequate moisture. The hooked apex of the persistent style provides for dispersal by animals who catch the fruits on fur. In this manner the seeds are rapidly dispersed long distances by animals and people. It is often found along the edge of paths and trails leading through moist forests.

It is also the most variable of the species in Illinois. In order to help recognize this variance Fernald & Weatherby (1922) developed six sub-specific categories including four varieties and two forms. These categories separate *Geum canadense* primarily by degree of

pubescence, variation in number of carpels, and degree of robust habit (i.e., strength of stem and texture of leaves). Two of these sub-specific categories have been reported in Illinois by Mohlenbrock (1986). First, *G. canadense* var. *grimesii* is separated from the standard variety by the inconspicuously hispidulous upper stylar internode and presence of glands on the peduncle. The second, *G. canadense* var. *camporum*, has thicker leaves and 60-160 achenes per inflorescence. Numerous specimens observed by the author do not consistently segregate into these groups. This observation has been recognized by other authors (Robertson, 1974; Gleason, 1963). The characters observed by Fernald and Weatherby (1922) seem to be of the type easily influenced by the environment. Controlled growth studies might prove useful in determining the inheritability of these characters.

3. *Geum laciniatum* Murray var. *trichocarpum* Fernald; Rhodora 37. 293. 1935.  
Rough Avens,

Herbaceous perennial with short, vertical, persistent rootstock. Stem thick, 3-10 dm long, hirsute becoming dense toward apex, lightly puberulent above. Basal leaves few to many, long-petioled, simple, trifoliate, or pinnately compound; petioles 3-21 cm long, grooved, hirsute; leaflets trilobed to irregularly reniform, 3-11 cm long, 3-10 cm wide, blades may also be deeply lobed with 8-20 lobes, 6-8 cm long, 1-2 cm wide, the large terminal leaflet, weakly trilobed, 7-15

cm wide 6-12 cm long, sparsely hirsute on both surfaces, margins serrate. Cauline leaves alternate, usually trifoliate below, simple above; petiole 3-5 cm long, becoming very small toward apex, hirsute; leaflets and simple leaves elliptic to rhombic, 2-10 cm long, 1.5-5.5 cm wide, becoming simple and usually trilobed, margins coarsely serrate, sparsely hirsute on both surfaces, base cuneate, apex acute; stipules 5-30 mm long, 5-25 mm wide, with 3 to 7 lobes, serrate. Inflorescence a loose, bracteate, terminal panicle; pedicels to 11 cm long, densely hirsute, and sometime puberulent. Flowers 7-15 mm across, erect; hypanthium saucer-shaped, sparsely hirsute; bracteoles 5, 3-7 mm long, 0.4-1.0 mm wide, hirsute; calyx 5-lobed, the lobes triangular, 4-10 mm long, 3-5 mm wide near the base, reflexed in fruit, sparsely hirsute, glabrous within; petals 5, white, lanceolate, 3-6 mm long, 3-4 mm wide, shorter than calyx lobes; stamens 50-100, the filaments yellow to red, persistent, 2-4 mm long, the anthers 0.6 mm long; receptacle cylindrical, glabrous to puberulent; pistils numerous (50-200), yellow-green to red, the styles jointed, the distal portion 1.5-1.9 mm long, lightly hirsute, deciduous, the basal portion usually reddish-brown, glabrous, hooked at the apex, persistent. Fruiting aggregate spherical, 14-23 mm across, composed of up to 200 achenes; gynophore absent; achenes oblanceoloid, 3.5-5.5 mm long, 1.5-2.2 mm wide, glabrous to sparsely hirsute, the hairs to 1.2 mm long, the persistent hooked style 2-5 mm long, glabrous. Flowering: late May-late June.

Habitat: Wet areas, commonly in roadside ditches and disturbed wet areas in the northern 3/4 of the state. This variety

can be found throughout most of the mid-west states from Canada to northern Mexico.

#### REPRESENTATIVE SPECIMENS.

ALEXANDER: 27 May 1932,  
*Pepoon & Barrett 4328* (ILLS);  
 BOND: S of Greenville, 17 July  
 1949, *R. Evers 18745* (ILLS);  
 BOONE: W of Belvidere, 12 July  
 1956, *R. Evers 51148* (ILLS);  
 BROWN: E shoulder, 100 m N of  
 McKee Creek, 3 July 1984, *P.*  
*Shildneck 13841* (IL); BUREAU:  
 S of Buda, 10 Sept 1949, *R.*  
*Evers 21221* (ILLS); CASS: 16



Distribution of *Geum laciniatum* var.  
*trichocarpum* in Illinois.

July 1967, *R. Rexroat 16183* (MWI); CHAMPAIGN: Deers Station, 11  
 July 1938, *R. Yeatter 6550* (ILLS); CHRISTIAN: roadside NW of Pana,  
 25 July 1950, *G. Winterringer 4901* (ILLS); CLARK: 8 mi. S of  
 Marshall, 22 July 1952, *R. Evers 34641* (ILLS); COLES: high area of  
 Lake Paradise Lake shore area, 22 July 1968, *B. Dolbeare 2615* (SIU);  
 COOK: 19 July 1911, *E. Sherff 674603* (F); CRAWFORD: 5 mi. S of  
 Oblong, 28 Sept 1968, *N. Tracy 511* (EIU); CUMBERLAND: 1 mi. N of  
 Montrose, 1 July 1983, *J. Ebinger 22024* (EIU); DEKALB: RR tracks in  
 DeKalb City, 25 June 1972, *P. Sorensen 7179* (DEK); DOUGLAS: E of  
 Chesterville, 7 July 1959, *R. Evers 60682* (ILLS); DU PAGE: sedge  
 meadow, Belmont Prairie, Downer's Grove, 31 July 1983, *J. Ebinger*

22355 (EIU); EDGAR: 2 mi. S of Brockton, 23 Aug 1969, *J. Ebinger* 8766 (EIU); EDWARDS: ICA Mark's Science Preserve, 3 Aug 1972, *L. Phillippe* 1852 (EIU); EFFINGHAM: Prairie Swamp, 2 mi. S of Montrose, 7 June 1947, *R. Evers* 3964 (ILLS); FAYETTE: 5 mi. N of Farina, 29 June 1940, *L. O'Dell* 175 (IL); FORD: Gardner Prairie Restoration, plot #20, 5 June 1991, *D. Gardner* 127 (ILLS); FULTON: Canton, 23 July 1949, *V. Chase* 10555 (IL); HANCOCK: N of Nauvoo, Robinson Creek, 19 July 1989, *S. Peitzmeier Romano* 1-9 (MWI); HENRY: S of Hooppole, 12 Aug 1960, *R. Evers* 66792 (ILLS); IROQUOIS: Iroquois Co. Conserv. Area, 26 June 1983, *J. Ebinger* 21959 (EIU); JASPER: S of Boos, 7 June 1947, *R. Evers* 3988 (ILLS); JODAVIES: SW of Derinda, 16 June 1965, *R. Evers* 83973 (ILLS); KANE: N of Sugar Grove, 21 June 1948, *R. Evers* 10875 (ILLS); KANKAKEE: 1 mi. NE of ST. Anne, 9 July 1982, *J. Ebinger* 21200 (EIU); KENDALL: bank of Rob Roy Creek, 4.6 mi. N of Bristol, 11 July 1947, *R. Evers* 5011 (ILLS); KNOX: Spoon River, near Williamsfield, 21 Aug 1949, *V. Chase* 10718 (IL); LASALLE: 20 July 1967, *R. Johnson* 119899 (SIU); LAKE: Chain of Lakes State Park, 6 Aug 1976, *J. Ebinger* 15936 (EIU); LAWRENCE: RR 1 mi. W of Lawrenceville, 13 June 1949, *J. Sivert* (IL); LIVINGSTON: Pontiac, 25 July 1944, *G. Fuller* 9136 (ILLS); MACON: NW of Decatur, 19 June 1952, *R. Evers* 33782 (ILLS); MACOUPIN: Taylorville, 9 July 1898, *W. Andrews* (IL); MARION: Salem, 1860, *M. Bebb* 147624 (EIU); MARSHALL: S of Lacon, 29 Aug 1966, *R. Evers* 88018 (ILLS); MASON: 4 mi. N of Easton, 14 Aug 1948, *R. Evers* 13075 (ILLS); MCDONOUGH: 1 mi. S of Columbar, 10 July 1949, *R. Meyers* 800 (MWI); MCHENRY: near Coon



Creek S of Marengo, 21 June 1948, *R. Evers 10825* (ILLS); MCLEAN: Funk's Grove, 13 June 1944, *G. Fuller 8750* (ILLS); MERCER: shore of Swan Lake, NW of New Boston, 3 Aug 1961, *R. Evers 69898* (ILLS); MONTGOMERY: W of Raymond, 23 June 1954, *R. Evers 43980* (ILLS); MOULTRIE: 0.5 mi. E, 1 mi. N, 0.5 mi. E of Cadwell, 19 Aug 1971, *L. Dennis 1269* (EIU); OGLE: Pine Rock Natural Area, 4 mi. E of Oregon, 9 June 1965, *D. Wade 1438* (DEK); PEORIA: *J. Stewart 1467* (F); PIKE: edge of Eagle Creek, 3 mi. E of Hannibal, 22 May 1987, *J. Ebinger 23608* (EIU); RICHLAND: 3 mi. S of Claremont, 24 June 1947, *V. Scherer 252* (IL); ROCK ISLAND: Green Valley Church, 7 July 1978, *T. Root 30516* (MWI); STARK: 22 July 1898, *V. Chase 129* (F); TAZEWELL: S of Pekin, 17 June 1932, *Pepoon & Barrett 5078* (ILLS); VERMILION: NW 1/4(28-1) H 5(3E) 20 July 1978, *P. Shieldeck 9690* (SIU); WABASH: S of Keensburg, 28 July 1951, *H. Ahles 4643* (IL); WARREN: Swan Creek, 19 June 1978, *R. Henry & A. Scott 927* (MWI); WHITESIDE: SW of Erie, 14 June 1965, *R. Evers 83879* (ILLS); WILL: 3 mi. N of Crete, 9 July 1964, *R. Evers 81084* (ILLS); WINNEBAGO: *M. Bebb 62168* (F); WOODFORD: along RR, W of Congerville, 8 Aug 1947, *R. Evers 6257* (ILLS).

This species is found in the northern 3/4 of the state with isolated populations in the southern tip of the state. Rarely forming dense colonies, *Geum laciniatum* var. *trichocarpum* populations often occur as scattered individuals. The hooked achenes formed by the fruits suggest dispersal by animals.

*Geum laciniatum* var. *trichocarpum* differs from *G. laciniatum* var. *laciniatum* in the presence of hairs at the apex of the achene. In contrast *G. laciniatum* is completely glabrous (Fernald, 1935). There are reports of *G. laciniatum* var. *laciniatum* occurring in Illinois (Mohlenbrock & Ladd, 1978). *Geum laciniatum* var. *laciniatum* probably does not occur in Illinois, *G. laciniatum* var. *trichocarpum* being the representative variety in this state (Robinson & Fernald, 1908; Fernald, 1923; Deam, 1940; Swink & Wilhelm, 1994). The Illinois specimens examined by this author were consistently identified as *G. laciniatum* var. *trichocarpum* morphology.

This species is also very similar to *Geum aleppicum* var. *strictum*. Without petals or mature achenes, the vegetative features are very similar and one must check that the receptacle is glabrous to make a positive determination. *Geum laciniatum* var. *trichocarpum* is easily recognized by its white petals which are shorter than the calyx lobes and glabrous receptacle.

4. *Geum rivale* Linnaeus; Species Plantarum 501. 1753.

Purple Water Avens.

Herbaceous perennial developing woody, prostrate rhizome 15 cm or more in length, chambered, the petiole bases may persist for many years. Stem thick, 3-12 dm tall, thinly pubescent near base becoming densely puberulent and hirsute above. Basal leaves few, long-petioled, pinnately compound, often with a large terminal leaflet and a few smaller leaflets; petiole to 30 cm, grooved, hirsute;

leaflets variable, terminal leaflet broadly ovate to subrotund, simple or lobed, 4-10 cm long, 4-15 cm wide, serrate, the lateral leaflets ovate to lanceolate or rhomboid, remote and irregular, to 8 cm long, moderately to sparsely appressed pubescent on both surfaces, margins coarsely serrate, often lobed. Cauline leaves alternate, usually trifoliate below, commonly simple above; petioles 0.3-3.0 cm long, hirsute; leaflets and simple leaves elliptic to lanceolate, 2-7 cm long, 0.5-5.0 cm wide, appressed pubescent on both surfaces, margins coarsely serrate, base cuneate, apex acute; stipules 5-20 mm long, 3-8 mm wide, hirsute, toothed, and lobed. Inflorescence a loose, bracteate, terminal, panicle; pedicels to 20 cm long, densely puberulent and hirsute, glandular hairs present above. Flowers 15-20 mm across, pendulous, becoming erect in fruit; hypanthium campanulate, pubescent; bracteoles 5, 3-5 mm long, 0.5-1.0 mm wide, pubescent; calyx 5-lobed, purple, lanceolate to deltoid, 6-11 mm long, 3-5 mm wide at base, ascending, not reflexed until seed maturation, hirsute below, glabrous within; petals 5, yellowish, suffused with purple, purple-veined, obovate, abruptly contracted into a claw, 5-11 mm long, 4-9 mm wide, about the same length as the calyx lobes; stamens 80-100, the filaments persistent, 5-8 mm long, the anthers 0.5-0.7 mm long; receptacle cylindrical, becoming elongated during seed maturation, densely hirsute, with hairs to 1.5 mm long; pistils numerous (40-50), styles jointed, the distal portion 3-4 mm long, hirsute, deciduous, the basal portion hirsute on lower half, hooked at the apex, persistent. Fruiting aggregate ovoid, 15-20 mm wide, composed of up to 50 achenes; gynophore 8-12 mm long,

hirsute; achenes oblanceoloid, 2.5-3.5 mm long, 0.9-1.3 mm wide, hirsute, with longest hairs to 2.2 mm long, the persistent, decurved, hooked style 7-12 mm long, hirsute on lower half. Flowering: late April to mid July.

Habitat: the only Illinois specimen observed was from a fen habitat in Trout Park Nature Preserve in Kane county. This species is found in the northern portions of North America, throughout Europe, and Eurasia.

#### REPRESENTATIVE SPECIMEN.

KANE: T41N,R9E,north. 1/2  
sect.1 & south. 1/2 sect.35, 29  
June 1949, *J. Steyermark*  
68331 (F).



Distribution of *Geum rivale* in Illinois

*Geum rivale* was listed as extirpated from Illinois by the Illinois Endangered Species Protection Board (Herkert, 1994). This species reaches part of its southern range limit in Illinois and has always been considered rare in the state. Only one in-state specimen was obtainable (listed above), although there are reports that *G. rivale* was seen in McHenry county by Patterson in 1876 (Swink &

Wilhelm, 1994), and Winnebago county (Mohlenbrock & Ladd, 1978). Rarely forming dense colonies, this species mostly occurs as scattered individuals. Although much of the persistent style is villous, the hooked achenes and large seeds (to 3.5 mm) at maturity indicate that it is likely to not be dispersed by wind but by animals.

This species has many characteristics which are similar with *Geum triflorum* including; the long prostrate stolon, pendulous flowers, campanulate hypanthium, often purple calyx lobe, and a plumose persistent portion of the style. These attributes are also what separate *G. rivale* from the remaining species in Illinois. The broader leaves, deciduous distal portion of the style, and hooked apex of the persistent basal portion of the style set *G. rivale* apart from *G. triflorum*.

5. *Geum triflorum* Pursh; Flora Americae Septentrionalis.

2:736 1814.

Prairie Smoke.

Herbaceous perennial developing woody, prostrate rhizome to 15 cm or more in length, branching and forming clumps, petiole bases may persist for many years. Stem mostly slender, may be thickened, 1.5-4.0 dm long, densely velvety puberulent with short and long hairs, glandular hairs present above. Basal leaves many (6-25), forming a tight rosette, short-petioled, pinnately compound, with 9-25 leaflets; petioles to 5 cm long, grooved, broadly clasping at base, villous, the ascending hairs to 3 mm long; leaflets oblanceolate, deeply incised,

1.0-3.5 cm long, 3-10 mm wide, progressively larger toward the tip, appressed pubescent on both surfaces, base cuneate. Cauline leaves sessile, opposite or nearly so, few, small, laciniate, lobed.

Inflorescence a loose, bracteate, terminal, panicle; pedicels to 15 cm long, densely pubescent. Flowers 11-20 mm across, pendulous, becoming erect in fruit; hypanthium campanulate, densely pubescent; bracteoles 5, usually purplish, narrow lanceolate, 7-14 mm long, 1-2 mm wide, longer than the calyx lobes, pubescent; calyx 5-lobed, usually purplish, triangular, 6-11 mm long, 3-5 mm wide at the base, ascending, not reflexed until late seed maturation, densely pubescent on the lower surface, glabrous within; petals 5, pale purple to greenish purple, oblanceolate, 7-11 mm long, 3-5 mm wide, usually longer than the calyx lobes; stamens 60-90, the filaments persistent, 7 mm long, the anthers 1 mm long; receptacle globose, glabrous; pistils numerous (40-70), the style not jointed, no portion deciduous, densely hirsute. Fruiting aggregate short ovoid, 9-15 mm across, composed of up to 70 achenes; gynophore absent; achenes obovate, 2.5-3.0 mm long, 0.8-1.2 mm wide, pubescent throughout, the persistent style 4.0-8.7 cm long, plumose. Flowering: May-June.

Habitat: Well drained prairies, usually on sand or gravel in extreme northern Illinois. This species occurs mostly in the Great Plains areas of the United States and Canada in short grass prairies and gravels. Its range extends east in northern states to New York where those habitats occur.

## REPRESENTATIVE SPECIMENS.

BOONE: 3 mi. S of Cherry Valley,  
 29 April 1946, *G. Fell f46180*  
 (ILLS); COOK: Peacock Prairie,  
 Milwaukee/Greenwood, 1967,  
*Cole 21338* (MOR); DEKALB: NE  
 of Hinckly, 9 June 1893, *H. Geo*  
*7-33* (MOR); DUPAGE: West  
 Chicago, 25 May 1897, *L.*  
*Umbach 434628* (F); JODAVIES:  
 Army Depot, 1996, K.  
 Robertson, comm. (not

accessioned); KANE: sect. 16 Plato township, 19 April 1991, *J. Coffey*  
*96237* (MOR); LAKE: 15 May 1954, *H. Hurlbutt 17177* (ILLS);  
 MCHENRY: 2.5 mi. NW of Ringwood near Wonder Lake, 15 June 1947,  
*J. Steyermark 64527* (F); OGLE: "Liberty Hill", Oregon, 16 May 1883,  
*M. Waite* (ILL); STEPHENSON: Freeport Prairie Nature Preserve, 13  
 May 1987, *K. Robertson 4456* (ILLS); WINNEBAGO: Rockford, 28 May  
 1940, *G. Fuller 126417* (ILLS).



Distribution of *Geum triflorum* in  
 Illinois

This species is common west of Illinois. It is typically found in short grass prairies of the western Great Plains. The eastern limit of *Geum triflorum* extends into Illinois in the northern 1/4 of the state where dry, sand or gravel prairies are most common. This species forms colonies with high population densities, but can also be found

as scattered individuals. The latter situation is often the case on sites that are marginally suited for this species.

Of the species occurring in Illinois, this is the only one dispersed by wind. The long plumose achenes and relatively small seeds provide for this type of dispersal.

*Geum triflorum* can readily be distinguished from the other species occurring in Illinois by its long, plumose, entire, persistent style. It was primarily this character that has, in the past, led to its placement in the genus *Erythrocoma* (Greene, 1905), and *Sieversia* (Rydberg, 1913). Cytological and morphological studies show that *G. triflorum* is closely allied with other members of *Geum* and that separation from this group is unwarranted (Raynor, 1952).

6. *Geum vernum* (Rafinesque) Torrey & Gray; Flora of North America 1:422. 1840.

Spring Avens,

Herbaceous perennial with a short, vertical, persistent rootstock. Stem usually thick, 3-6 dm tall, weakly pubescent below becoming glabrous above. Basal leaves numerous, long-petioled, some simple with a blade 3-7 cm long, 3-8 cm wide, others pinnately compound, usually with many small lobed and toothed leaflets; petiole 3-20 cm long, grooved, sparsely hirsute; leaflets elliptic to obovate, generally 5-11, ranging in size from 1-2 cm long, 0.5-1 cm wide and moderately incised, glabrous to lightly appressed pubescence on both surfaces, margins serrate. Cauline leaves alternate, pinnately



compound or more commonly trifoliate; petiole usually less than 2 cm except on the lower cauline leaves; leaflets elliptic to ovate, 1-4 cm long, 0.5-3.0 cm wide, 3-5 acute incised lobes, weakly appressed pubescence on upper surface, often glabrous below, margins serrate, base cuneate, apex acute; stipules 6-17 mm long, 4-15 mm wide, serrate and occasionally lobed. Inflorescence a loose, bracteate, terminal panicle; pedicels to 10 cm long, glabrous to lightly pubescent with occasional long hairs. Flowers 3-5 mm across, erect; hypanthium saucer-shaped, glabrous or nearly so; bracteoles absent; calyx 5-lobed, the lobes triangular, 1.2-2.0 mm long, 1.0-1.8 mm wide near base, strongly reflexed soon after maturity, mostly glabrous; petals 5, yellow to white, narrowly ovate, 1.0-1.9 mm long, 0.4-1.1 mm wide, shorter than calyx lobes; stamens 20-30, the filaments persistent, 1 mm long, the anthers 0.3 mm long; receptacle cylindrical, nearly glabrous; pistils numerous (20-50), the styles jointed, distal portion to 0.7 mm long, glabrous, deciduous, the basal portion glabrous, hooked at apex, persistent. Fruiting aggregate spherical, 8-14 mm across, composed of up to 50 achenes; gynophore 2-5 mm long, glabrous; achenes oblanceoloid, 1.8-3.2 mm long, 1.0-1.6 mm wide, glabrous to sparsely appressed pubescent, glandular hairs sometimes present, the persistent, hooked style 1.8-2.8 mm long. Flowering: April-May.

Habitat: Moist woods, commonly in disturbed areas throughout the state though not common in the northern and central counties. This species occurs in the north-east portion of the United States and the eastern portion of Canada.

## REPRESENTATIVE SPECIMENS.

ADAMS: McKee twp., sec. 13, 20  
 April 1945, *R. Brinker* 3877  
 (ILLS); ALEXANDER: Horseshoe  
 Lake, 1 May 1971, *J. Huston*  
 657 (SIU); BOND: N of Mulberry  
 Grove, 25 May 1961, *R. Evers*  
 68854 (ILLS); BOONE: W of  
 Caledonia, 26 May 1954, *R.*  
*Evers* 42676 (ILLS); BROWN:  
 Siloam Springs, 13 April 1946,  
*R. Evers* 1342 (IL);

Distribution of *Geum vernum* in Illinois

CHAMPAIGN: NE of Gifford, 14 May 1968, *R. Evers* 94612 (ILLS);  
 CLARK: 5 mi. NW of Martinsville, 18 May 1969, *J. Ebinger* 8128 (EIU);  
 CLAY: sec. 6, Larkinsburg twp., 3 June 1953, *R. Evers* 37248 (ILLS);  
 CLINTON: N of Carlyle, 30 April 1965, *R. Evers* 82517 (ILLS); COLES:  
 Bugner Acres Nature Preserve, 24 April 1991, *J. Ebinger* 25221 (EIU);  
 COOK: 10 May 1900, *R. Bebb* 200 (IL); CRAWFORD: near Wabash  
 River, 27 April 1972, *L. Phillippe* 1272 (EIU); CUMBERLAND: 1 mi. N  
 of Montrose, 18 May 1983, *J. Ebinger* 21645 (EIU); DEWITT: Weldon  
 Springs, 2 June 1964, *R. Evers* 79633 (ILLS); DOUGLAS: N of Kemp, 15  
 May 1966, *R. Evers* 86463 (ILLS); DUPAGE: Morton Arboretum, 11  
 May 1985, *F. Swink* 5124 (DEK); EDGAR: 3.5 mi. S of Logan, 15 May  
 1985, *J. Ebinger* 23170 (EIU); EDWARDS: ICA Mark's Science  
 Preserve, 22 April, *J. Ebinger* 7037 (EIU); EFFINGHAM: E of Beecher

City, 15 May 1953, *R. Evers 37022* (ILLS); FAYETTE: stream bank E of Ramsey, 9 May 1984, *P. Shildneck 116307* (SIU); FRANKLIN: 4 mi. E of 148, 0.5 mi. S of Christopher, 30 April 1982, *J. Bione 076377* (SIU); GALLATIN: the Pounds, SW of Gibsonia, 25 April 1963, *R. Evers 75787* (ILLS); HANCOCK: Augusta, 1847, *S. Mead* (IL); HARDIN: 22 April 1967, *C. Ott 155* (SIU); JACKSON: Cedar Lake Reservoir, 16 April 1976, *T. Heineke 1517* (SIU); JASPER: S of Boas, 7 June 1947, *R. Evers 3983* (ILLS); JEFFERSON: NE of southern RR on Tolle Road, Mt. Vernon, 29 April 1972, *L. Williams 50* (SIU); JOHNSON: SE of Cedar Grove Cemetery, 13 May 1992, *M. Mibb 681* (SIU); LAWRENCE: 1 mi. NE of Sumner, 1 May 1948, *J. Sivert* (IL); MACON: tributary to Big Creek, 12 May 1972, *P. Shildneck 3532* (SIU); MACOUPIN: 10 May 1884, *C. Robertson 13802* (ILLS); MARION: S of Salem, 11 May 1972, *R. Evers 107702* (ILLS); MASSAC: NE of Mermet, 21 April 1955, *R. Evers 45745* (ILLS); MCDONOUGH: 1 June 1983, *R. Henry 4377* (MWI); MONTGOMERY: N of Honey Bend, 3 May 1961, *R. Evers 68451* (ILLS); MOULTRIE: 2 mi. N of Sullivan, 10 May 1949, *R. Evers 16001* (ILLS); OGLE: 12 km SE of Oregon, 31 May 1992, *P. Sorensen 9239*(DEK); PERRY: Pyramid State Park, 11 April 1981, *J. Raveill 40* (SIU); PIKE: 20 April 1985, *R. Henry 5336* (MWI); POPE: Jackson Hollow, 13 May 1951, *W. Bailey & J. Swayne 1373* (SIU); PULASKI: Liberty Cemetery, 3 mi. SE of Pulaski, 13 May 1978, *J. Ebinger 17110* (EIU); RICHLAND: 5 mi. N of Noble, 10 May 1947, *V. Scherer 89* (IL); SALINE: 2 mi. S of Rudement, 7 May 1951, *H. Ahles 3744* (IL); SCOTT: RR NE of Winchester, 8 May 1990 (IL); SHELBY: Wolf Creek State Park, 14 July 1987, *L. Horton 154* (EIU); ST CLAIR: S of Mascoutah, 3 May 1961, *R.*

*Evers 68534* (ILLS); UNION: Union Co. Consv. Area, 16 April 1981, G. *Westmoreland 391* (SIU); VERMILION: Forest Glen Preserve, 3 mi. E of Georgetown, 23 April 1991, *M. Huskra 161* (EIU); WABASH: E of Keensburg, 25 May 1964, *R. Evers 79584* (ILLS); WARREN: SE of Roseville, 9 June 1956, *R. Evers 50070* (ILLS); WASHINGTON: *J. Voigt 1366* (SIU); WAYNE: 2 mi. W of Cisne, 12 May 1964, *R. Evers 79105* (ILLS); WILL: Romeo, 16 May 1903, *R. Evers 79105* (ILLS); WILLIAMSON: Crab Orchard Lake, S of dam, 27 April 1950, *J. Swayne & W. Bailey 974* (SIU).

In Illinois this species is found in the southern 3/4 of the state with populations in a few northern counties. This species often forms thick patches along paths in disturbed woods. The density often decreases dramatically away from regularly disturbed areas. The hooked achenes at maturity provide for dispersal by animals.

Morphological variation in *Geum vernum* is relatively low. No varietal categories have been proposed for this species. It is easily recognized by the small petals, aggregate of achenes elevated on a gynophore, and lack of bracteoles. This last character has consistently separated this species from all other *Geum* species worldwide.

7. Geum virginianum Linnaeus; Species Plantarum 2:716. 1753.

Cream-colored Avens,

Herbaceous perennial with a short, vertical, persistent rootstock. Stem slender, to 7.5 dm tall, hirsute below, densely velvety-puberulent above, often with few scattered long hairs. Basal leaves few, long-petioled, mostly trifoliolate (rarely simple or with 5-7 leaflets); petiole 5-25 cm long, grooved, usually strongly hirsute; leaflets obovate, 3-10 cm long, 2.5-8.0 cm wide, appressed pubescent on both surfaces, margins broadly serrate, often slightly lobed. Cauline leaves alternate, usually trifoliolate below, simple above; petiole mostly less than 1 cm long except on the lower cauline leaves, puberulent, longer, straight hairs also present; leaflets and simple leaves, elliptic to rhombic, 3-12 cm long, 1-8 cm wide, appressed pubescent on both surfaces, margins coarsely serrate, often lobed, base cuneate, apex acute; stipules 1.5-3.5 cm long, 0.5-2.0 cm wide, strongly serrate with acute teeth. Inflorescence a loose, bracteated, terminal panicle; pedicels to 10 cm long, densely puberulent. Flowers 5-10 mm across, erect; hypanthium saucer-shaped, puberulent; bracteoles 5, to 1.5 mm long, to 0.4 mm wide; calyx 5-lobed, the lobes lanceolate to triangular, 3-6 mm long, 1.8-3.0 mm wide near the base, reflexed in fruit, densely puberulent and lightly hirsute on the lower surface, glabrous within; petals 5, cream to yellow, oblong to obovate, 1.5-2.5 mm long, 0.8-1.5 mm wide, shorter than the calyx-lobes; stamens 30-50, the filaments persistent, 1.5-3.0 mm long, the anthers 0.6 mm long; receptacle cylindrical, densely

hirsute with hyaline hairs to 2.5 mm long that are shorter than the achenes; pistils numerous (30-140), the styles jointed, the distal portion to 2 mm long, hirsute, deciduous, the basal portion glabrous, hooked at the apex, persistent. Fruiting aggregate obovoid to spherical, 10-18 mm across, composed of up to 140 achenes; gynophore absent; achenes oblanceoloid, 2.0-3.5 mm long, 1.0-1.4 mm wide, lightly hirsute, the longest hairs to 1.2 mm long, occurring dorsally, the persistent, hooked style 3-6 mm long, glabrous. Flowering June-August.

Habitat: Dry to moist woodlands in southern Illinois. This species occurs in roughly the eastern 1/4 of the United States.

#### REPRESENTATIVE SPECIMENS.

CLARK: Lincoln Trail State Park,

7 July 1968, *J. Ebinger 7639*

(EIU); JACKSON: Lake

Murphysboro, 7 July 1955, *R.*

*Mohlenbrock 5503* (SIU);

JASPER: Island Grove, N of

Wheeler, 9 July 1968, *R. Evers*

*96285* (ILLS); JOHNSON:

Schwartz Hill, July 1931, *J.*

*Schopf 6559* (ILLS); POPE: Belle

Smith Springs State Park, 1966,

*T. Elias* (SIU); RANDOLPH: S of Devil's Hole, Rock Castle Creek, 11 Aug

1973, *K. Wilson 1539* (SIU); WAYNE: S of Fairfield, 8 Aug 1961, *R.*



Distribution of *Geum virginianum* in Illinois

Evers 70244 (ILLS); WHITE: S of Enfield, 10 July 1969, R. Evers 99829 (ILLS).

This species is found in the southern 1/4 of the state with isolated occurrences documented in east-central Illinois. It appears that this species occurs as scattered populations in Illinois. This species exhibits animal dispersal provided by the hooked mature achenes.

*Geum virginianum* is very similar morphologically to *G. canadense*. It is distinguishable by its small (never exceeding the calyx lobes) cream to yellow petals and stipules which are more than 1 cm long. In fruit, the stipule length readily separates this species from *G. canadense*. The strong similarity of *G. virginianum* to *G. canadense* was shown in the PCA and discussed earlier in this paper.

*Geum virginianum* has been proposed to be the result of a hybrid cross between *G. canadense* x *G. aleppicum* var. *strictum* (Raynor, 1952). The study done by Raynor concludes that "G. virginianum" F<sub>1</sub> conforms to the morphology of *G. virginianum*. Although mildly meiotically impaired, these impairments become less frequent in subsequent generations. It is noted that *G. virginianum* occurs in central New York where the alleged parents (*G. canadense* and *G. aleppicum* var. *strictum*) occur sympatrically. This is not the case in Illinois. *G. canadense* occurs throughout Illinois, while *G. aleppicum* var. *strictum* occurs only in the upper 2/3 of the state. *G. virginianum* occurs roughly in the southern 1/4 of the state

where only one of the parents exist. All of the specimens observed by the author appear to have normal seed development.

The apparent absence of a hybridization zone and clear separation in PCA for the flower data set suggest that *Geum virginianum* exists as a self-sustaining species in Illinois. The cluster blending of *G. canadense* and *G. virginianum* in PCA for the fruit data set further illustrates the similarity of these species.

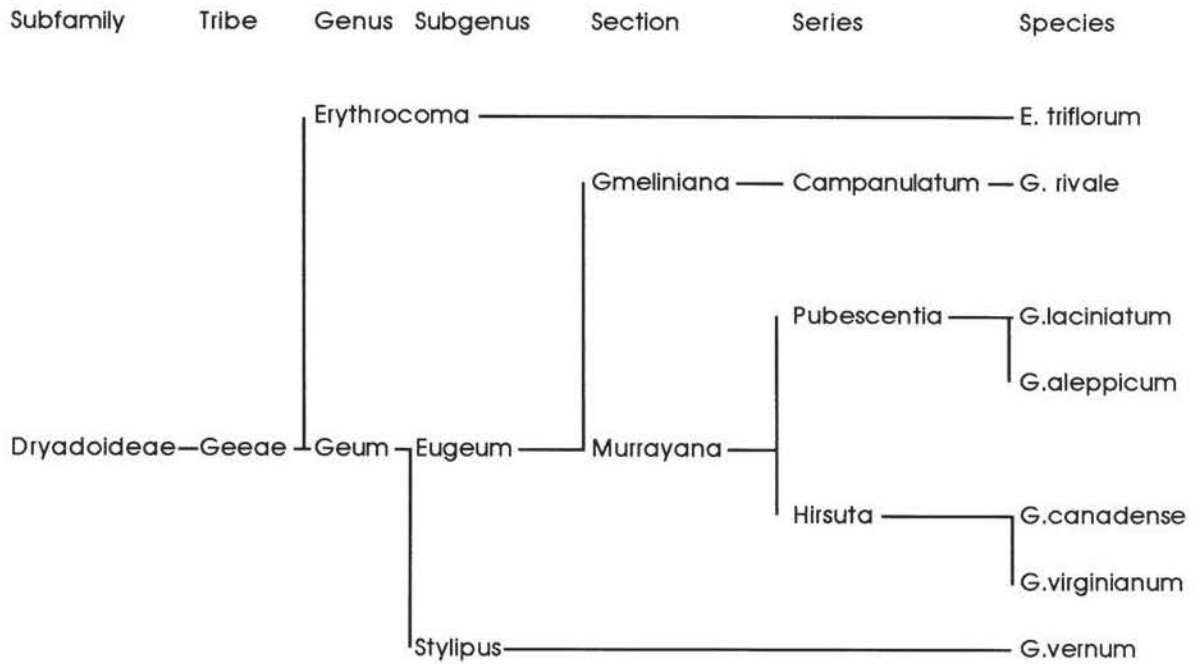


## SUMMARY

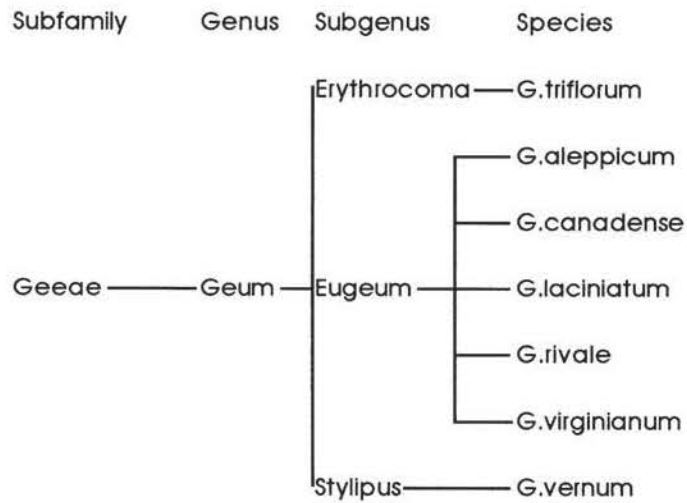
It is evident that the *Geum* of Illinois have many similarities that make field identification sometimes difficult. With the help of the floral and fruit keys that were developed for this study, as well as detailed distribution maps, these common ,yet little noticed, plants will be easier to identify in the field. The morphological descriptions should give the reader detailed knowledge needed in order to understand the plants as a whole.

The PCA shows morphological affinities between some of the species. These affinities are evident in the fruit study between *Geum aleppicum* var. *strictum* with *G. laciniatum* var. *trichocarpum* and between *G. canadense* with *G. virginianum*. Indeed when attempting a determination between *G. aleppicum* var. *strictum* and *G. laciniatum* var. *trichocarpum* one should be sure to examine the receptacle for pubescence. When in fruit *G. canadense* and *G. virginianum* can also be difficult to distinguish. In this case the length of the stipules is the best distinguishing character.

The results provided from the PCA indicate that these are likely distinct species. When viewed in light of the distribution data it is even more compelling to submit that *G. canadense* and *G. virginianum* are distinct species and not related by hybridization events in Illinois. Other studies such as chemical analysis, and DNA analysis should be used to further clarify this closely related pair.



Classification system from Bolle (1933).



Classification system from Gajewski (1957).

Figure 1: Classification of the species of Geum in Illinois by Gajewski (1957) and Bolle (1933).

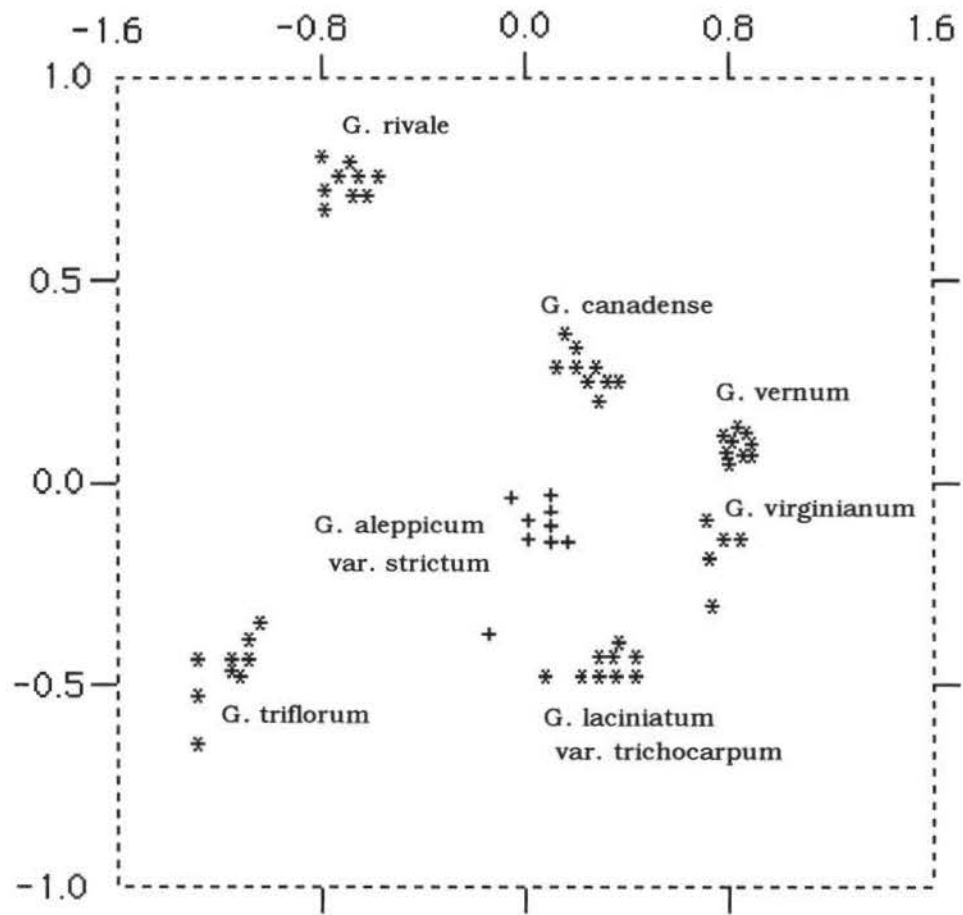


Figure 2: Graphic display of PCA flower data.

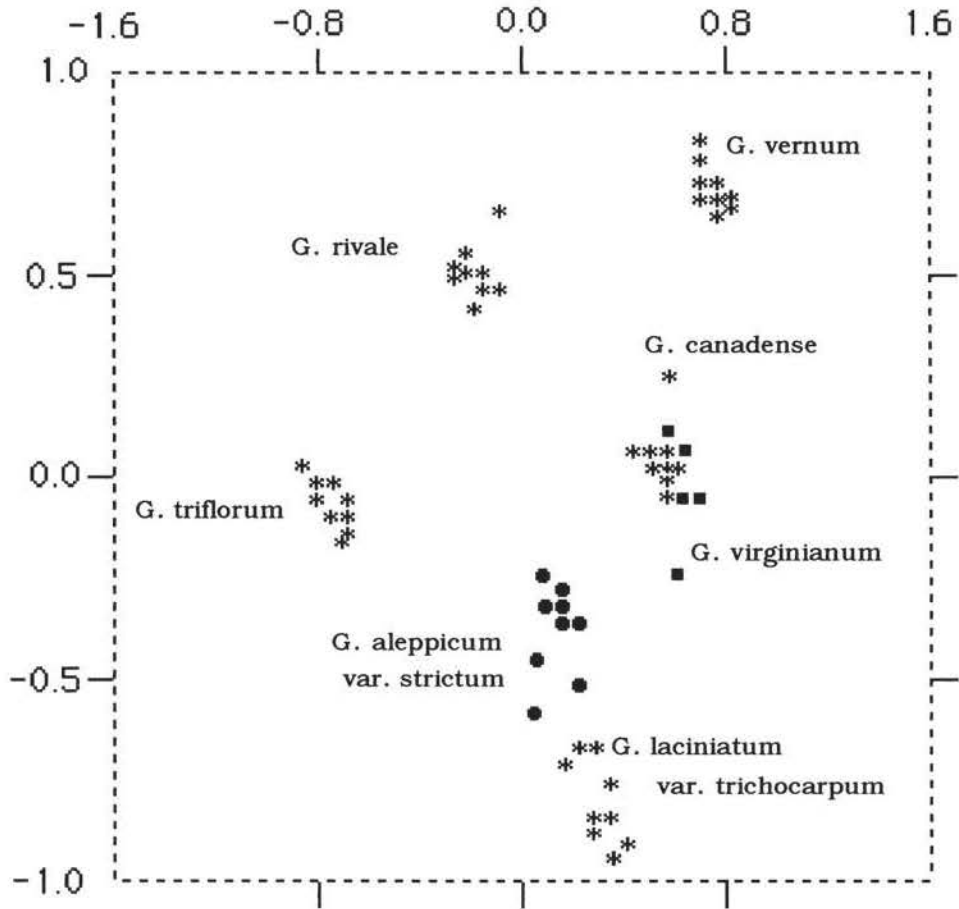


Figure 3: Graphic display of PCA fruit data.

Table 1: Characters scored for PCA of the flower data set (group 1)

|  |  |
|--|--|
| 1. Basal leaves with distinct terminal lobes | no=1 yes=2   |
| 2. Leaf teeth                                | acute=1 rounded=2  |
| 3. Stipule length                            | length in mm   |
| 4. Stolon woody and prostrate                | yes=1 no=2   |
| 5. Peduncle                                  | thick and stout=1 thin=2   |
| 6. Flowers                                   | pedulous=1 erect=2   |
| 7. Hypanthium                                | campanulate=1 saucer-shaped=2  |
| 8. Calyx lobes                               | ascending=1 reflexed=2   |
| 9. Calyx lobe length                         | length in mm   |
| 10. Bracteoles                               | present=1 absent=2   |
| 11. Length of bracteoles                     | length in mm   |
| 12. Petal length                             | length in mm   |
| 13. Petal width                              | width in mm  |
| 14. Gynophore                                | absent=1 present=2   |
| 15. Receptacle                               | glabrous=1 pubescent=2   |
| 16. Styles                                   | entire=1 jointed=2   |
| 17. Stipule lobing                           | entire to few short teeth=1 lobed=2  |
| 18. Pubescence of upper stem                 | puberulent lacking longer hairs=1 hirsute with hairs 0.5 mm or more=2.         |
| 19. Petal versus calyx lobe length           | petals shorter than calyx lobes=1 petals as long or longer than calyx lobes=2. |

Table 2: Characters scored for the PCA of the fruit data set (group 2)

|   |   |
|---|---|
| 1. Basal leaves with<br>distinct terminal lobes | no=1 yes=2  |
| 2. Leaf teeth                                   | acute=1 rounded=2   |
| 3. Stipule length                               | length in mm  |
| 4. Stolon woody and prostrate                   | yes=1 no=2  |
| 5. Peduncle                                     | thick and stout=1 thin=2  |
| 6. Hypanthium                                   | campanulate=1 saucer-shaped=2   |
| 7. Calyx lobes                                  | ascending=1 reflexed=2  |
| 8. Calyx lobe length                            | length in mm  |
| 9. Bracteoles                                   | present=1 absent=2  |
| 10. Length of bracteoles                        | length in mm  |
| 11. Gynophore                                   | absent=1 present=2  |
| 12. Receptacle                                  | glabrous=1 pubescent=2  |
| 13. Styles                                      | entire=1 jointed=2  |
| 14. Persistent style tips                       | straight=1 hooked=2   |
| 15. Persistent style length                     | length in mm  |
| 16. Persistent style pubescence                 | half or more=1 base only=2 glabrous=3                                     |
| 17. Length of persistent<br>style hairs         | length in mm  |
| 18. Glandular hairs                             | present=1 absent=2  |
| 19. Length of pericarp                          | length in mm  |
| 20. Width of pericarp                           | width in mm   |
| 21. Stipule lobing                              | entire to few short teeth=1 lobed=2.                                      |
| 22. Pubescence of upper stem                    | puberulent lacking longer hairs=1 hirsute<br>with hairs 0.5 mm or more=2. |
| 23. Styles strongly<br>reflexed in fruit        | no=1 yes=2.   |

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