CASTANEA 80(4): 262–272. DECEMBER

A New Hybrid of *Asimina* (Annonaceae) Based on Morphological and Ecological Data

Charles N. Horn
Biology Program, Newberry College, 2100 College Street, Newberry, South Carolina 29108

ABSTRACT Two species of the genus *Asimina* (Annonaceae), *A. triloba* and *A. parviflora*, are well known to occur in South Carolina. Recent work investigating variation in leaf size, flower morphology, and habitat of *Asimina* in the state shows that a hybrid between the two species exists. The differences in the three taxa are best related to growth form, peduncle length, and outer petal length and width. This new hybrid, *Asimina* × *piedmontana*, is hereby described and distinguished from both parents.

Key words: *Asimina*, paw paw, hybrid, *parviflora*, *triloba*, *piedmontana*

INTRODUCTION The genus *Asimina* (paw paw), of the Annonaceae, was circumscribed by Kral (1997) to include eight species in subtropical and temperate North America. Since then, two species have been described, *A. spatulata* (Kral) D B. Ward (Ward 2001) and *A. manasota* DeLaney (DeLaney 2010), making a total of 10 known species. Most species are restricted to Florida and Georgia; however, two species are known over a large portion of eastern North America, *A. triloba* (L.) Dunal and *A. parviflora* (Michx.) Dunal. Both of these species are found in a variety of rich woodland sites associated with stream and river valleys. Based on personal observation in the piedmont of South Carolina, *A. triloba* is commonly restricted to river flood plains and stream bottoms, whereas *A. parviflora* is more commonly found on well-drained slopes adjacent to the bottoms.

Asimina triloba (common paw paw) grows as a shrub or tree and can reach a height of 14 m (Kral 1997). Plants commonly grow clonally in populations that can cover several hectares of stream or river floodplains. However, Pomper et al. (2009) demonstrated that a local population of stems was not always genetically uniform. In his landmark revision of the genus, Kral (1960, p. 242) described *A. triloba* leaves as "oblong-obovate to oblanceolate, 15–30 cm long; apex acute to acuminate; base more or less gradually attenuate to the short (0.5–1 cm) petiole." Field measurements of plants in South Carolina agree with that description, except that leaves were observed with lengths up to 45 cm. This species can also be recognized by the presence of floral peduncles over 1 cm at anthesis and flowers 2–5 cm in diameter (Kral 1997). The solitary flowers include sepals 8–12 mm long and outer petals 15–25 mm long (Kral 1960).

Asimina parviflora (dwarf paw paw) has been described by Kral (1997) as a miniature version of the common paw paw with plants up to 6 m tall; however, plants over 3 m tall are restricted to the karst country of Florida. Individuals grow on woodland slopes or ridges above streams and rivers where clonal growth has not been personally observed. *Asimina parviflora* leaves are "oblong-obovate to oblanceolate, 6–15 (–20) cm long; apex acute to acuminate; base more or less gradually attenuate to the short (0.5–1 cm) petiole" (Kral 1960, p. 244). Measurements have revealed leaves up to 27 cm long. Plants can be distinguished, as stated by Kral (1997), by a peduncle less than 1 cm at anthesis and flowers 1.0–1.7 cm in diameter. The flowers include sepals that are 4–7 mm long and outer petals 10–13 mm long (Kral 1960).

Geographically, *A. triloba* populations have been recorded from southern Ontario (Canada)

Received June 16, 2015; Accepted December 30, 2015.
DOI: 10.2179/15-067

to Georgia and west to eastern Nebraska and eastern Texas (Kral 1997). *Asimina parviflora* has a more southern distribution, occurring from southern Virginia to northern Florida and west to eastern Texas. The area of distributional overlap between the two species generally occurs within the piedmont of North Carolina and westward through South Carolina, Georgia, and Alabama. Further overlap occurs within the coastal plain of Mississippi and Louisiana (Kral 1997).

Previous work on the reproductive biology of *Asimina parviflora* (Norman et al. 1992) and *A. triloba* (Willson and Schemske 1980) revealed that both species are protogynous with an overlap of at least one day between stigma receptivity and pollen production. Norman et al. (1992) then postulated that, at least for *A. parviflora*, pollination and fruit production could either be the result of self-compatibility or out-crossing. Despite the two potential mechanisms of pollination, fruit set is typically less than 10% in nature for both species (Willson and Schemske 1980, Norman et al. 1992).

During the growing season of 2006, unusually short-stemmed clonal populations of *Asimina*, typically no more than 2 m tall, were noticed by Kate Goodrich, at that time a graduate student at the University of South Carolina. Further field work by the author revealed additional populations in the piedmont of South Carolina that fit the above morphological description. It was suggested that the populations might represent hybrid material between the two well-known species of the region. A review of literature revealed that hybridization in the genus *Asimina* is common, especially among the species of Florida (Zimmerman 1941, Kral 1960, DeLaney 2010). Kral (1960), in his treatment of the genus, noted that hybridization between *Asimina triloba* and *A. parviflora* is likely, noting herbarium specimens with intermediate flower sizes. He cited a collection from Brunswick County, North Carolina as an example. Later, Kral (1997, p. 16) stated that "putative hybrids between the two have been observed in northern Alabama." The potential hybrid nature of the populations in South Carolina, especially at Lynch's Woods Park (Newberry County) was recognized by Horn (2008).

Field work in April of 2007 and 2008 revealed putative hybrid populations with distinctly intermediate-sized flowers. Especially noted were the intermediate length of sepals and petals. The petals were found to be clearly narrower than those of *A. triloba*. Most striking was that the outer petals were rolled outwards laterally along their length on the hybrid (Figure 1c, 1d). This was in comparison to outer petals with the apical tip curved outward on both *A. parviflora* (Figure 1a, 1b) and *A. triloba* (Figure 1e, 1f). Vegetatively, the hybrid populations also have a different growth form. The hybrids were observed to have a clonal growth pattern, with most stems arching over and being no more than 1.5 m high. This clonal pattern is like that seen with *A. triloba* populations.

Observations of herbarium specimens at the University of South Carolina (USCH) revealed many specimens without flowers or fruits, leading to question whether leaf features could be used to separate the two species from the putative hybrid on a consistent basis. Further study was needed to clarify the status of the hybrid and to determine specific morphological and ecological features associated with intermediate plants. Thus, the purpose of this investigation was to determine if vegetative and flowering characters would allow for taxonomic separation of the three taxa.

MATERIALS AND METHODS Vegetative and flowering material was observed and collected during the growing seasons of 2007–10 within the piedmont of South Carolina. At least three populations of each taxon were sampled for leaf and floral material. Voucher specimens of both vegetative and flowering plants were collected and deposited in the herbarium at Newberry College (NBYC) and are listed in the Appendix. Because plants flower before leaves are fully developed, multiple voucher specimens were collected in most cases.

Initial identification and placement of populations into taxa during field trips was based on a combination of two features, habitat and flower morphology. Small plants (about 1 m tall) on upper slopes that did not appear clonal and had flowers with apically excurved petals less than 13 mm long were considered *A. parviflora*. Clonal populations with individuals over 3 m tall growing on floodplains, and having bell-shaped flowers with apically excurved petals more than 15 mm long were considered *A. triloba*. Putative hybrid individuals (hereafter called hybrid) were identified from low-growing (less than 2 m) clonal populations having petals that projected at right angles from the floral axis.

Figure 1. Photographs of *Asimina* species. Hand of author present for scale. (a–b) *Asimina parviflora*; both photographed at Lynch's Woods, Newberry County, South Carolina. (c–d) *Asimina* × *piedmontana*; (c) photographed at Johnson Creek (Union County, South Carolina), (d) photographed at Broad River (Union County, South Carolina). (e–f) *Asimina triloba*; (e) photographed at Lynch's Woods, (f) photographed at Pagett's Creek (Union County, South Carolina).

Leaf measurements were made on plants in the field during June 2009. At each population site, 50 leaves were measured for total leaf length, leaf length to the widest point, and leaf width. Only branches with multiple leaves were used, and on each stem the largest 2–3 leaves were measured after realizing that the first-produced leaves each year are typically smaller and the terminal leaves were the last produced and potentially still developing. Damaged leaves

were not measured if any of the three measurements was compromised.

Floral material was collected during April 2008 and field preserved in 90% ethanol for later measurement in the laboratory. Only mature, burgundy-colored open flowers were collected. Unfortunately, some populations did not have 30 mature flowers due to a small number of mature flowers present at the time of visit. The parameters of peduncle length, sepal length and width, and petal length and width were measured.

A Principal Components Analysis (PCA, using NTSYSpc; Rohlf 2009) was completed to determine if the leaf and flower measurements indicated above could be used to separate the three taxa. Data from population averages were used in this analysis. Only populations for which both leaf and flower measurements could be gathered were used: three of *A. parviflora*, five of the putative hybrid, and four of *A. triloba*.

A one-way ANOVA was used with each of the eight morphological features to determine if significant differences existed among populations. A probability α value of 0.05 was used to confirm significant differences. If a significant difference was revealed from the ANOVA, a Newman-Keuls multiple range test was used to determine differences among ranked populations, also using a critical value of α value of 0.05.

RESULTS

Principle Components Analysis

The PCA clearly showed a separation of the three taxa in the first dimension. Within the first dimension (which explained 73% of the overall variation), petal width (coefficient = 0.984), leaf length (0.979), and leaf width to widest point (0.977), were of greatest value. In the second dimension (which explained 4% of the variation) was most separated by leaf width (0.448), peduncle length (–0.231), and petal length (0.211) had the highest coefficient values (Figure 2).

Vegetative Morphology

Populations of *A. parviflora* mostly had the smallest leaves of the three taxa. Leaf length population averages ranged from 16.0–19.6 cm, length to the widest point ranged from 9.4–12.3 cm, and width ranged from 6.9–9.0 cm (Figure 3a, 3b, 3c). Populations of *A. triloba* commonly had the largest leaves of the three taxa. Leaf length population averages ranged from 29.6–33.0 cm, length to the widest point ranged from 16.0–20.8 cm, and width ranged from 9.7–12.9 cm (Figure 3a, 3b, 3c). Populations of hybrids generally had intermediate leaf size. Leaf length population averages ranged from 19.6–27.5 cm, length to the widest point ranged from 11.3–18.4 cm, and width ranged from 7.2–10.4 cm (Figure 3a, 3b, 3c).

Even though population averages allowed for separation of most populations, individual leaf measurements clearly overlapped among the three taxa (Figure 3a, 3b, 3c). Populations placed in rank order by average leaf length generally reflected species; however, overlap was present between hybrid and *A. triloba* with the hybrid H1 (average = 27.5 cm) and *A. triloba* T1 (average = 25.3 cm) being out of order (Figure 3a). Further, no significant difference was detected between *A. parviflora* P3 (average = 19.6 cm) and hybrid H2 (average = 19.6 cm) ($q = 0.03$, $q_{crit} = 2.77$). Otherwise, differences among *A. parviflora*, hybrid populations, and *A. triloba* were present. Length to widest point showed a similar overlap (Figure 3b). First, it was observed that hybrid H2 (average = 11.3 cm) was less than *A. parviflora* P3 (average = 12.3 mm). Also, *A. triloba* T1 (average = 16.0 cm) was less than hybrid H1 (average = 16.4 cm). Leaf width generated the greatest overlap among taxa. The hybrid population averages varied greatly and clearly overlapped both *A. parviflora* and *A. triloba* (Figure 3c). Hybrid H2 (average = 7.2 cm) was not significantly different from the smallest *A. parviflora* (P1, average = 6.9 cm) ($q = 2.11$, $q_{crit} = 3.31$). At the other extreme, hybrid H1 (average = 10.4 cm) was not statistically different from two *A. triloba* populations, T5 (average = 10.2 mm) ($q = 1.69$, $q_{crit} = 2.77$) and T3 (average = 10.4 cm) ($q = 0.21$, $q_{crit} = 2.77$).

If the hybrid populations were removed from the analysis, *A. triloba* and *A. parviflora* can be easily separated, most easily using leaf length. The largest *A. parviflora* length was P3 (average = 19.6 cm) and the smallest *A. triloba* population was T1 (average = 25.3 cm) ($q = 16.89$, $q_{crit} = 3.86$). Leaf width had the least noticeable differences between species, with the largest *A. parviflora* (P3, average = 9.0 cm) being similar to the smallest *A. triloba* (T1, average = 9.7 cm), even though the two populations were statistically different ($q = 4.86$, $q_{crit} = 3.31$).

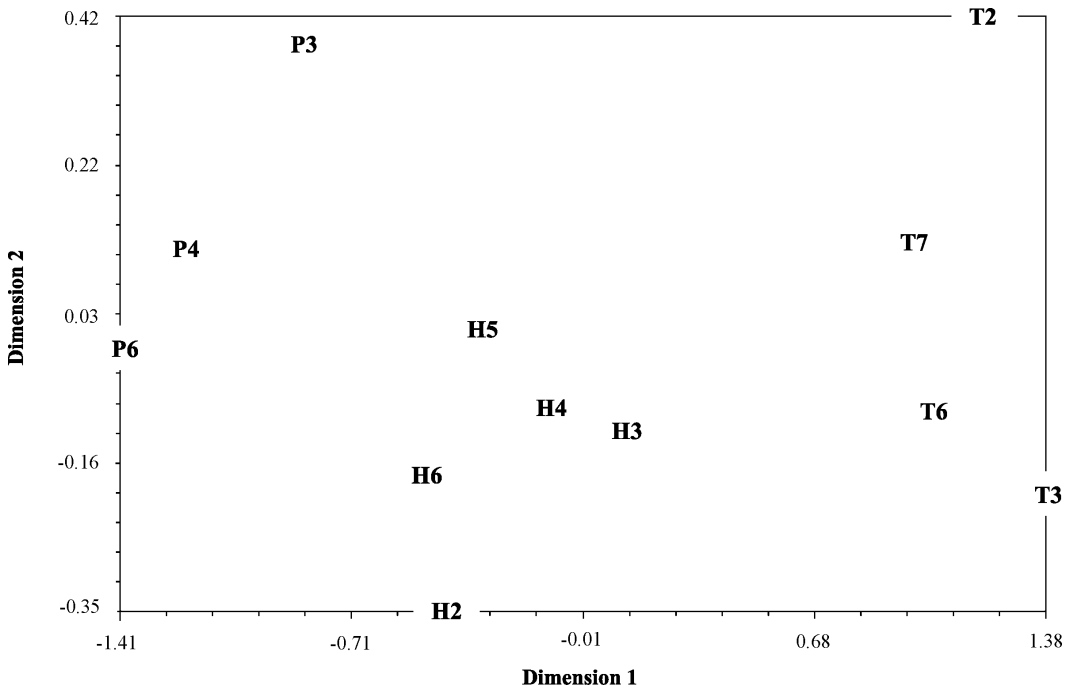

Figure 2. Principal Components Analysis graph showing dimensions 1 and 2. Prefix letters are as follows P = *Asimina parviflora*, H = *Asimina* × *piedmontana*, and T = *Asimina triloba*.

Floral Morphology

Population averages for peduncle length varied in the range of 3.9–15.2 mm (Figure 3d). No overlap of the populations among the three taxa was detected with a size sequence of *A. parviflora* < hybrid < *A. triloba*. Sepal length population averages ranged from 3.7–12.0 mm (Figure 3e). Like the peduncle length, there was no overlap among the taxa and the order of taxa was *A. parviflora* < hybrid < *A. triloba*. For sepal width the population averages ranged from 3.5–9.0 mm (Figure 3f). Some overlap among population averages was detected with no significant difference between hybrid H3 (average = 6.8 mm) and *A. triflora* T7 (average = 6.9 mm) ($q = 0.80$, $q_{crit} = 2.77$). Petal length averages ranged from 4.9–22.0 mm (Figure 3g). There was no overlap among taxa except for no significant difference between hybrid H2 (average = 16.3 mm) and *A. triloba* T7 (average = 16.9 mm) ($q = 2.18$, $q_{crit} = 2.77$). For petal width the averages ranged from 5.1–22.2 mm (Figure 3h). No overlap in population averages was detected among taxa and the size sequence was *A. parviflora* < hybrid < *A. triloba*.

Graphical observation of the floral data revealed several important size gaps among the taxa. For peduncle length (Figure 3d), *A. parviflora* was distinctly shorter than the other two taxa. The largest *A. parviflora* (P3, average = 4.9 mm), was much smaller that the smallest hybrid (H5, average = 8.3 mm). A similar gap was seen for petal length (Figure 3g), with the largest *A. parviflora* (P3, average = 7.1 mm) being distinctly smaller that the smallest hybrid (H6, average = 13.1 mm). The third clear gap was for petal width (Figure 3h), with *A. triloba* being much larger than any population of the hybrid, with the smallest *A. triloba* (T2, average = 19.9 mm) being distinctly larger than the largest hybrid (H3, average = 11.7 mm).

DISCUSSION

Overall, population averages for the measured leaf size parameters do not allow for distinction among the three taxa of *Asimina*. This makes separation of vegetative populations in the field difficult. Further, populations do vary, especially in *A. triloba*. Thus, when looking at only a few leaves, such as on a herbarium specimen, classification is a challenge.

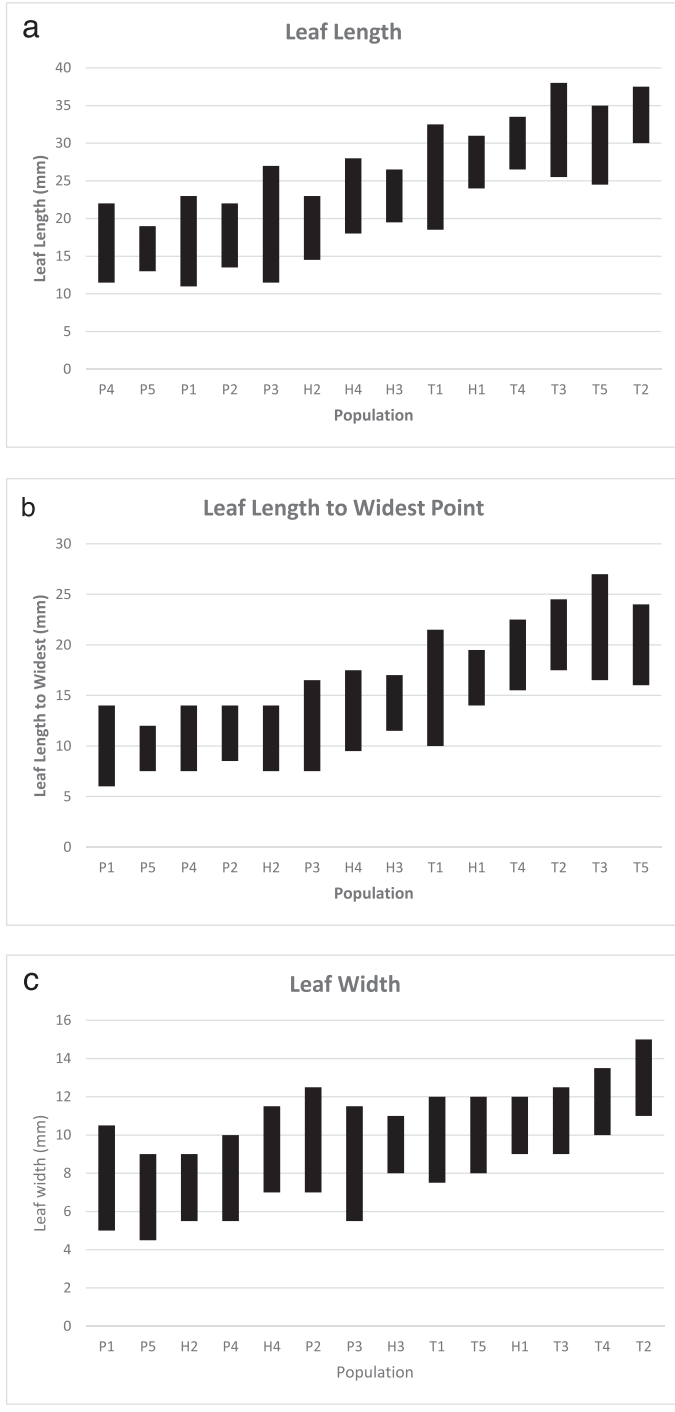

Figure 3. Population parameter measurements. Measured parameters are (a) leaf length, (b) leaf length to widest point, (c) leaf width, (d) peduncle length, (e) sepal length, (f) sepal width, (g) petal length, and (h) petal width. Populations are listed in order (left to right) with increasing average with the vertical bar representing minimum to maximum values. Population abbreviations are explained in the Appendix.

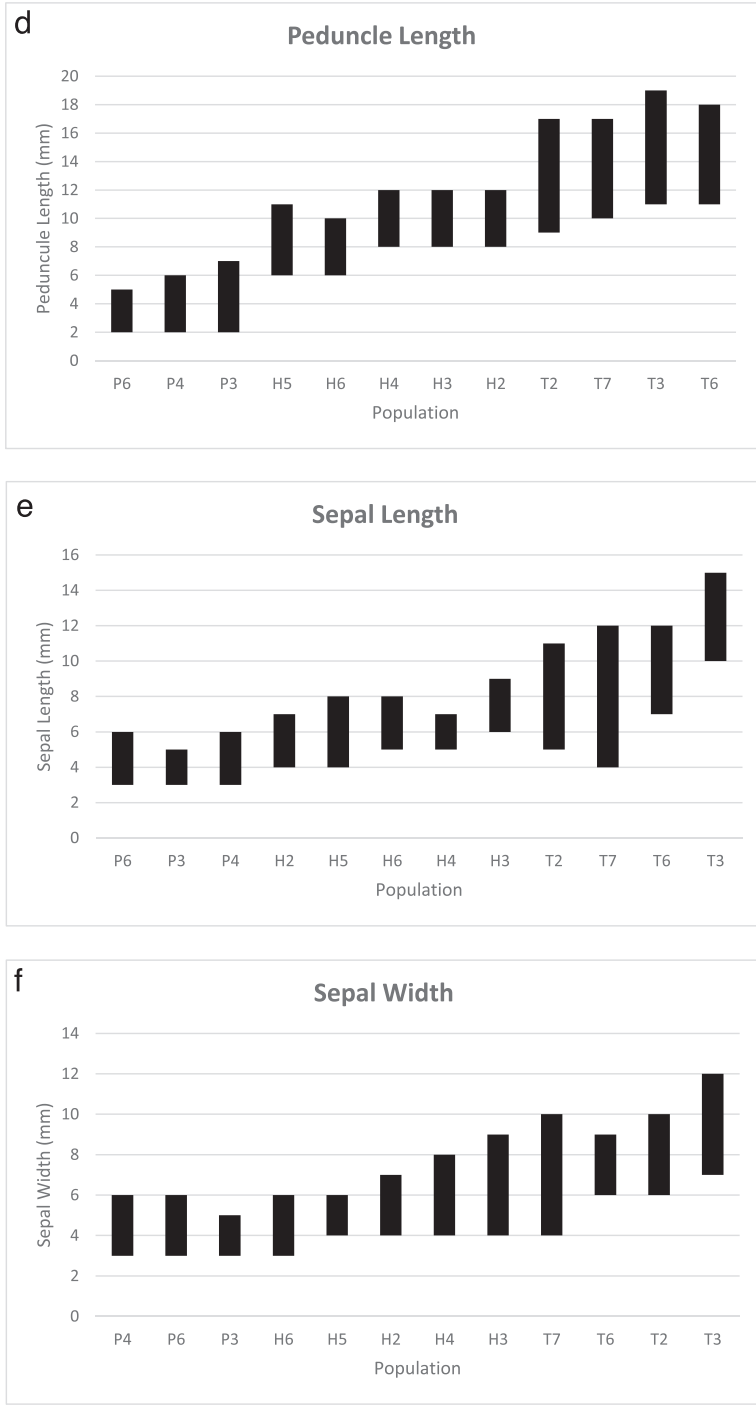

Figure 3. Continued.

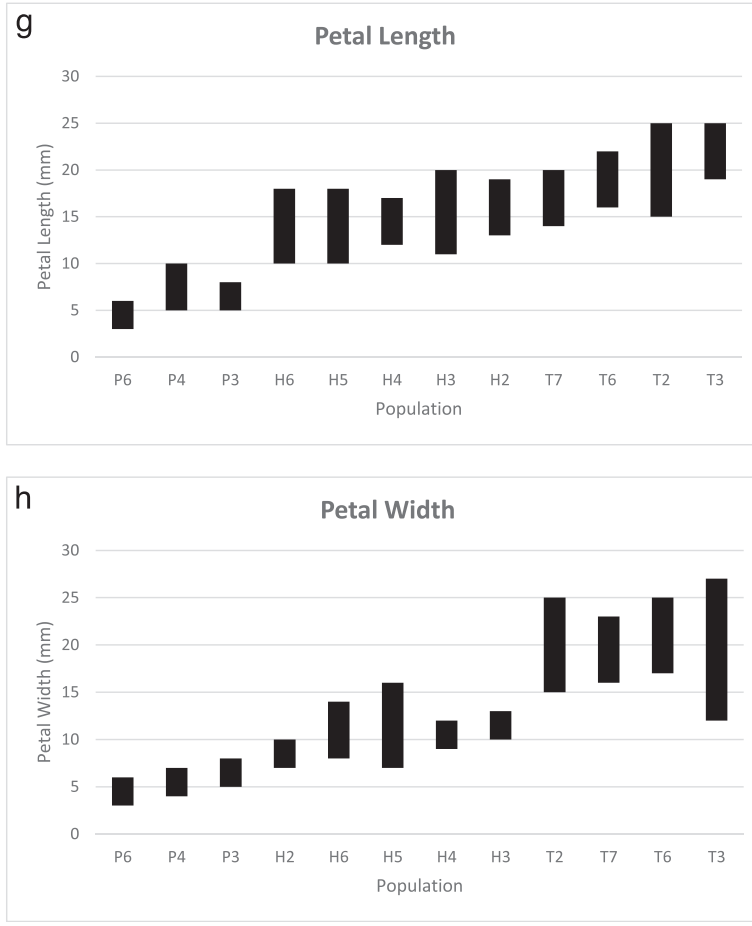

Figure 3. Continued.

The floral features of peduncle length, petal length, and petal width, are clearly the best flower parameters to help separate the three taxa. For each of these three parameters, no overlap was observed in population averages. Specifically, peduncle length (Figure 3d) and petal length (Figure 3g) are best to uniquely identify *A. parviflora*, whereas peduncle length (Figure 3d) and petal width (Figure 3h) are best to uniquely identify *A. triloba*. These three morphological features will best allow for unique identification of the hybrid. Hybrid populations have less variation in these characters, so a single flower, as might be found on a herbarium specimen, could be used to separate the taxa.

In the field, habitat features aid in identifying taxa. Based on personal observation, *A. parviflora* populations are on slopes or upland sites, stems are typically shorter than 2 m tall, and are rarely in clusters of more than five stems. *Asimina triloba* populations are commonly restricted to floodplains, have tree-like features (typically being taller than 3 m), and are distinctly clonal in growth. Hybrid populations can be recognized by being located near floodplains or on lower slopes, growing no more the 3 m tall and forming clones.

In the field, young *A. triloba* and mature hybrid populations can sometimes be hard to tell apart. Some populations were observed as small clumps of plants (less than 50 stems) with short stems (1–2 m tall) that appeared clonal and had moderate-sized leaves that could be classified as either hybrid or *A. triloba* on casual observation. To resolve this problem, it was realized that

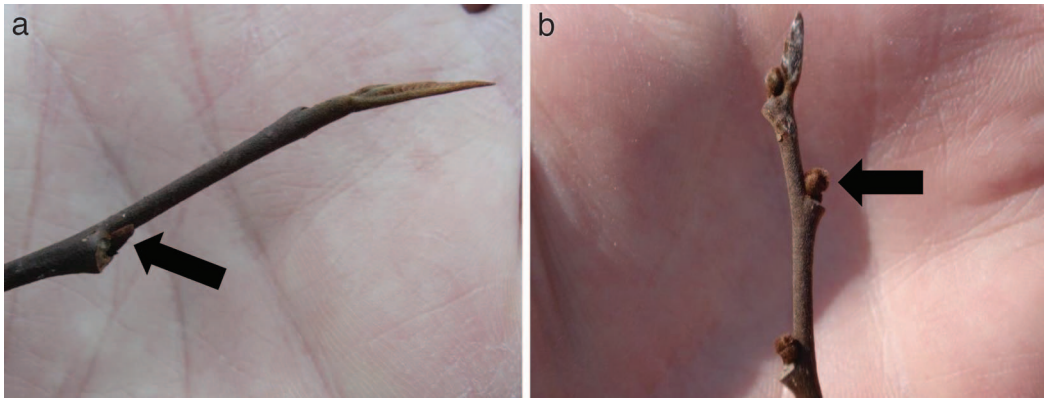

Figure 4. Vegetative and flowering buds of *Asimina* plants. (a) vegetative buds, both terminal and lateral (arrow) on *Asimina triloba* (photograph taken December 2014 at Lynch's Woods, Newberry County, South Carolina), (b) vegetative (terminal) and flowering lateral bud (arrow) of *Asimina* × *piedmontana* (photo taken March 2008 at Lynch's Woods, Newberry County, South Carolina).

vegetative and floral buds look morphologically different in late summer (by August). Vegetative buds (Figure 4a) are elongate (2–3 times longer than wide), and floral buds (Figure 4b) are of about the same length and width. This observation was confirmed in hybrid populations that included plants about 2 m tall with floral buds. Conversely, an *A. triloba* population with plants less than 3 m tall could be confidently identified if flower buds were absent on all stems.

Subsequent to the original floral field work, an unusual population was found on a slope at Lynch's Woods Park (Newberry County, South Carolina) that was identified as potentially of hybrid origin. The population was not on a flood plain, was somewhat clonal, individuals were 3–4 m tall, and leaves appeared to be smaller that would be expected for *A. triloba*. Analysis of leaf size showed a clear affinity with the hybrid. Observation of flower morphology and size the next spring supported the hypothesis of a hybrid origin of this population.

At locations where species of *Asimina* were found, commonly no physical overlap in the three taxa was observed. Most commonly, *A. triloba* individuals were located on floodplains, *A. parviflora* individuals were on slopes well above the floodplain, and hybrids were at the base of slopes, sometimes extending onto floodplains. However, at Padgett's Creek (Union County, South Carolina) both *A. triloba* and the putative hybrid were found growing in proximity to one another. Even here some separation was seen in microhabitat, because on the south side of the road (with a beaver-dammed pond) were only *A. triloba* plants and on the north side of the road were essentially only hybrid individuals. Further, at this site most of the hybrid individuals were 4 m tall and lacked arching stems. Vegetatively, it was difficult to distinguish between a juvenile *A. triloba* and a mature hybrid individual. This growth pattern was similar to that seen at Lynch's Woods, as previously noted.

As the hybrid nature of populations was contemplated, the presence of the two parental species was reviewed. At five of the six population sites for the hybrid, populations of both *A. parviflora* and *A. triloba* were found within 500 m of each other. This supported the hybrid nature of the two taxa. Looking at the overall species distributions under the hybrid assumption, hybrid populations should be found in the region of species overlap. This area, as seen from analysis of maps in Kral's (1997) Flora of North America treatment, would include most of North Carolina, the piedmont (northwestern portion) of South Carolina, northern Georgia, northern Alabama, northern Mississippi, and northeastern Louisiana.

As a result of this work, the hybrid is hereby designated.

Asimina × **piedmontana** C. N. Horn, **hybrid nov.** (Figure 1 c–d). TYPE: USA, South Carolina, Laurens County, Enoree Rich Woods site to south of Enoree River. Floodplain to west of terminus of Forest Service road 334, off of County 554. Sumter National Forest, 11 April 2009, Charles N. Horn 18587 (Holotype: USCH; isotypes:

NCU, NBYC). Paratype for leaves and flower buds: same location, 34°33.469′N, 81°45.873′W, Charles N. Horn 20680, 16 August 2014 (CLEMS, NBYC, NCU, US, USCH)

Hybrid between *Asimina parviflora* (Michx.) Dunal and *Asimina triloba* (L.) Dunal. Outer petals excurved at base. Differs from *A. parviflora* in having peduncle length (6–) 8–12 mm (vs. 2–7 mm) and outer petal length 10–20 mm (vs. 3–8 [–10] mm). Differs from *A. triloba* in having peduncle length (6–) 8–12 mm (vs. [9–] 11–19 mm) and outer petal width (12–) 15–27 mm (vs. 7–14 [–16] mm).

Shrubs clonal, up to 3 m tall with branches commonly arching. Vegetative buds elongate, valvate, with rusty pubescence. Leaves aromatic, alternate, obovate, base cuneate, apex acuminate to slightly caudate, glabrous above, rusty pubescent below, especially along veins, 13–31 cm long, 6–12 cm wide, petioles rusty pubescent, 3–8 mm long. Flowers axillary, solitary, developing before leaves; peduncle rusty pubescent, 6–12 mm long. Sepals 3, slightly longer than wide with acute apex, densely rusty pilose, 4–9 mm long. Petals 6, burgundy, in two series; outer petals elongate, excurved near base, rusty on outer surface, 10–19 mm long, inner petals rounded, about one-half as long as the outer petals. Stamens many, spirally arranged, burgundy; carpels few, ovary superior. Fruit not seen.

In conclusion, a taxonomic key can be used to distinguish the three taxa when in flower, as follows.

1. Peduncle length 2–7 mm and outer petal length 3–8 (–10) mm ..... *Asimina parviflora*
1. Peduncle length (6–) 8–19 mm and outer petal length 10–25 mm 2
   2. Peduncle length (6–) 8–12 mm and outer petal width 7–14 (–16) mm; outer petals curved outward near base .... *Asimina* × *piedmontana*
   2. Peduncle length (9–) 11–19 mm and outer petal width (12–) 15–27 mm; outer petals curved outward near apex ... *Asimina triloba*

Use of leaf dimensions or other vegetative features is not consistent enough to generate a reliable taxonomic key. However, leaf features, along with habit and habitat, does produce a generally reliable key.

1. Populations not clonal (although can be found in clumps), plants located on slopes or uplands, largest leaves mostly <22 cm long .... *Asimina parviflora*
1. Populations clonal, plants located on floodplains or adjacent slopes, largest leaves mostly >18 cm long 2
   2. Plants typically <2 m tall, largest leaves mostly <27 cm long .... *Asimina* × *piedmontana*
   2. Plants typically more than 3 m tall (stems <3 m tall, lack flower buds in late summer), largest leaves mostly >24 cm long ..... *Asimina triloba*

ACKNOWLEDGMENTS A special thank you goes to Katherine Goodrich for initially pointing out a hybrid *Asimina* population and suggesting the need for further research. Assistance with field work was provided by Olivia Hightower, Erica Deahl, C. Clinton Harshaw, Grace McCartha, and C. Hart Scott. Special assistance with statistical analyses was obtained from C. Clinton Harshaw (leaves and flowers). Floral measurements and preliminary data analyses were completed by Jaimi Goodman as part of her research project at Newberry College (Newberry, South Carolina). Statistical analyses of leaf measurements were initially completed by Olivia Hightower as part of her summer research experience at Presbyterian College (Clinton, South Carolina). John Wiersema edited an early version of this manuscript. An anonymous reviewer helped improve the quality of the original manuscript.

LITERATURE CITED

DeLaney, K. 2010. *Asimina manasota* (Annonaceae), a new pawpaw from west-central Florida, with notes on variation and natural hybridization within the genus. Bot. Explor. 4: 1–68.

Horn, C.N. 2008. A flora of Lynch's Woods Park, Newberry County, South Carolina. Castanea 73(2):111–122.

Kral, R. 1960. A revision of *Asimina* and *Deeringothamnus* (Annonaceae). Brittonia 12(4):233–278.

Kral, R. 1997. Annonaceae Jussieu, custard-apple family. *In:* Flora of North American Editorial Committee (eds.). 1993+. Flora of North America North of Mexico. 12+ Vols. New York and Oxford. Vol. 3, pp. 11–19.

Norman, E.M., K. Rice, and S. Cochran. 1992. Reproductive biology of *Asimina parviflora* (Annonaceae). Bull. Torrey Bot. Club 119(1): 1–5.

Pomper, K.W., J.D. Lowe, L. Lu, S.B. Crabtree, and L.A. Collins. 2009. Clonality of Pawpaw (*Asimina triloba*) patches in Kentucky. J. Kentucky Acad. Sci. 70(1):3–11.

Rohlf, F. 2009. NTSYSpc, Numerical Taxonomy System, ver. 2.21. Exeter Software, Setauket, New York.

Ward, D.B. 2001. New combinations in the Florida flora. Novon 11(3):360–365.

Willson, M.F. and D.W. Schemske. 1980. Pollinator limitation, fruit production, and floral display in pawpaw (*Asimina triloba*). Bull. Torrey Bot. Club 107(3):401–408.

Zimmerman, G.A. 1941. Hybrids of the American pawpaw. J. Heredity 32:82–91.

APPENDIX Populations from South Carolina sampled for leaf (*) and floral (#) measurements. Information in parenthesis after each collection number represents material visible on the voucher; leaf, flower, or fruit. All voucher specimens are deposited at the Newberry College (Newberry, South Carolina) herbarium (abbreviation NBYC). The last component of each location is the abbreviation used in the data graphs.

Asimina parviflora

*#Laurens County, Ned Wesson Branch north of Forest Service Road 427, 1.4 mi north of SC 66. *Horn 18035* (leaf), *Horn 18110* (flower) – P4

*Laurens County, tributary to Duncan Creek north of SC 66 opposite Forest Service Road 1071. *Horn 18926* (leaf) – P5

*Laurens County, tributary to Duncan Creek northwest of Forest Service Road 349B, 0.5 mi southwest of County Route 26. *Horn 18925* (leaf) – P2

*#Newberry County, Lynch's Woods Park, 0.4 mi from park entrance along dirt road off of US 76. *Horn 18103* (flower), *Horn 18924* (leaf) – P3

#Union County, above tributary to Enoree River, southwest of Lee Cemetery and south of County Route 18. *Horn 18034* (leaf), *Horn 18104* (flower) – P6

*Union County, tributary to Tyger River to west of Forest Service road 325, 1.1 mi north of County Route 63. *Horn 16593* (leaf, fruit), *Horn 18927* (leaf) – P1

Asimina × *piedmontana*

*Laurens County, tributary to Enoree River north of terminus of Forest Service Road 334. *Horn 18580* (flower), *Horn 18764* (leaf) – H1

*#Newberry County, Lynch's Woods Park, 1.0 mi from park entrance along dirt road off of US 76. *Horn 18118* (flower), *Horn 18026* (leaf) – H2

*#Newberry County, Sulfur Spring Branch west of Forest Service Road 391, 2.5 mi east of SC 121. *Horn 18101* (flower), *Horn 18886* (leaf, fruit) – H4

#Union County, Johnson Creek east of Forest Service Road 316, 1.5 mi south of junction with unnumbered road between County Routes 278 and 156. *Horn 18028* (leaf), *Horn 18115* (flower) – H5

*#Union County, Padgetts Creek at County Route 18, 2.1 mi west of junction with County Route 16. *Horn 18108* (flower), *Horn 18847* (leaf, fruit) – H3

#Union County, tributary to Broad River east of County Route 37, 4.8 mi south of junction with SC 121 in Carlisle. *Horn 18032* (leaf), *Horn 18113* (flower), *Horn 18908* (leaf, fruit) – H6

Asimina triloba

*Greenwood County, Tolberts Branch just east of SC 248. *Horn 18923* (leaf, fruit) – T5

*#Laurens County, floodplain of Enoree River north of terminus of Forest Service Road 334. *Horn 18112* (flower), *Horn 18589* (flower) – T2

*Newberry County, Lynch's Woods Park, 1.5 mi from park entrance along dirt road off of US 76. *Horn 18027* (leaf) – T1

*Saluda County, Terrapin Creek at County Route 44, 3.3 mi west of pavement end. *Horn 18683* (flower), *Horn 18911* (leaf, fruit) – T4

#Union County, Fairforest Creek east of County Route 16. *Horn 18030* (leaf), *Horn 18117* (flower) – T7

*#Union County, Padgetts Creek at County Route 18, 2.1 mi west of junction with County Route 16. *Horn 18031* (leaf), *Horn 18107* (flower), *Horn 18846* (leaf, fruit) – T3

#Union County, tributary to Broad River east of County Route 37, 4.8 mi south of junction with SC 121 in Carlisle. *Horn 18033* (leaf), *Horn 18114* (flower) – T6