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Comparing Insect Pollinator Visitation for Six Native Shrub Species and Their Cultivars

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Abstract. **Interest in native landscape plants to support pollinators has increased. Most native plants sold by nurseries are cultivars, and some consumer and conservation groups question the suitability of native cultivars to support pollinators. In 2017 and 2018, insect pollinator visitation was quantified for six native shrub species and one or more cultivars of each species (*Aronia melanocarpa, A. melanocarpa* 'UCONNAM012' Ground Hog®, *A. melanocarpa* 'UCONNAM165' Low Scape Mound®, *Clethra alnifolia, C. alnifolia* 'Hummingbird', *C. alnifolia* 'Ruby Spice', *Dasiphora fruticosa, D. fruticosa* 'Goldfinger', *D. fruticosa* 'Pink Beauty', *Hydrangea arborescens, H. arborescens* 'Annabelle', *Kalmia latifolia, K. latifolia* 'Sarah', *Physocarpus opulifolius*, and *P. opulifolius* 'Monlo' Diabolo®). Insects were identified into 12 categories (*Apis mellifera, Bombus* spp., Andrenidae, Halictidae, Megachilidae, other bees, Lepidoptera, Syrphidae, other flies, wasps, Coleoptera, and other insects). The number of inflorescences and insect visitation was similar for *C. alnifolia* and its cultivars, and the compact cultivar Hummingbird had the greatest floral density. *A. melanocarpa* had more total visitors of Andrenidae than both of its compact cultivars because it was larger and produced more inflorescences. Compact *Aronia* cultivars and the straight species were mostly similar for Andrenidae visitation when compared on a per-inflorescence basis. *D. fruticosa* had more visitors of *Bombus* spp. and Megachilidae than both of its cultivars. These insects may have been less attracted to 'Pink Beauty' because of its pink flower color and 'Goldfinger' because of its wider flowers, which result from it being a tetraploid. *H. arborescens* 'Annabelle' had one-third the number of *Bombus* spp. visitors as *H. arborescens* because 'Annabelle' produces >50% fewer fertile florets. *P. opulifolius* 'Monlo' attracted more syrphids than *P. opulifolius* possibly because flowers contrasted more strongly with the reddish purple foliage of 'Monlo' than with the green foliage of the straight species. Insect visitation was similar for *K. latifolia* and *K. latifolia* 'Sarah'. Based on this work, we determined that native shrub cultivars are not universally less or more attractive to pollinators and must be evaluated on a case-by-case basis.**

There is increased interest in using native shrubs for landscaping to support pollinators (Gagliardi and Brand, 2007; Tallamy, 2007). Nurseries producing landscape plants typically grow cultivars, which are selections with better performance and ornamental characteristics than is typical of straight species (Wilde et al., 2015). Native shrubs produced from seeds are less marketable to a broad base of consumers because of variable quality (Getz, 2015). Straight species of native shrubs are frequently less suitable for landscaping because many are naturally large in stature and consumers desire native shrubs that will fit their landscape and also support pollinators (Hansen, 2017). For this reason, nursery growers prefer to produce cultivars of native shrubs that maintain a compact habit. Native shrub cultivars have also been selected for having unique flower or foliage coloration or form compared with the straight species.

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Some consumer and conservation groups claim that native plant cultivars (nativars) are less frequently visited by pollinators than the straight species and are, thus, less useful for developing pollinator plantings (Hansen, 2017). A limited number of studies have compared pollinator visitation for native herbaceous perennials and their cultivars. White (2016) evaluated insect visitation for 11 different native herbaceous perennial species and a single cultivar of each species. Similarly, Poythress and Affolter (2018) evaluated three native herbaceous perennial species and one native grass species and a single cultivar of each species. Nevison (2016) compared insect visitation for native *Phlox paniculata* and six of its cultivars. We could locate no published scientific studies comparing pollinator visitation for native shrub species and their cultivars. Baisden et al. (2018) evaluated caterpillar feeding damage for 10 native woody plant species and 18 cultivars selected for six different desirable traits. We evaluated insect pollinator visitation for six native shrub species and one or more cultivars of each species, which were selected for traits, including compact habit, foliage color, flower color, or flower form. The objectives of this research were to determine if cultivars attracted the same number of insects as their species and to observe the diversity and quantity of different groups of insects.

Materials and Methods

Research planting. In 2015, a replicated research planting containing six native shrub species and one or two cultivars of each species for a total of 15 genotypes (Table 1) was established in a full sun field at the Plant Science Floriculture Greenhouse Facility in Storrs, CT (41.812643, –72.252741). The experimental unit was a single plant, and plants were arranged in a randomized complete block design with three replications (45 plants in total). Plants occupied five planting rows (16.5 m long and 1.2 m wide) with nine plants per row. Blocks were distributed over rows, and all did not have the same shape. Plants were spaced 1.8 m apart within rows, and rows were 1.2 m apart. Grass alleys between the rows were maintained by regular mowing. In 2015, a 3-m nylon-netted post fence was installed around the perimeter of the planting to exclude deer. Because of the observed damage from woodchucks and rabbits, an additional 1-m-tall wire mesh fence was installed in 2017 just outside the existing deer fence. Plants received supplemental irrigation at the rate of 2.7 L per plant per day in 2017 and 2018. Plants were fertilized in April and July of 2017 and 2018 with 30 g of granular 15N–6.5P–12.5K fertilizer (Loveland Products, Inc., Loveland, CO). The soil at the research planting was a sandy loam, which had pH 5.3 and CEC 9.5 meq/100 g.

Plant measurements. In 2017 and 2018, data were collected on plant height and width, number of inflorescences per plant (or flowers per plant for *Dasiphora*), inflorescence height and width, and number of flowers per inflorescence. Duration of flowering time was recorded in 2018. Plant height and width measurements were made in the end of June after leaf expansion. Plant width was measured twice, at right angles to each measurement, and averaged. Plant size was the product of height and two widths. Number of flowers per inflorescence and inflorescence height and width was measured for three representative inflorescences per plant and averaged. Inflorescence width was measured twice, at right angles to each measurement, and averaged. For *D. fruticosa* and *P. opulifolius* genotypes, the number of inflorescences was counted for a 25% quadrant of the plant, selected at random, and multiplied by four. Floral density was calculated by dividing the number of inflorescences per plant by the plant size.

Insect visitation. During the flowering period, insect visitation data were collected using visual observation. For each plant, insect visitation was quantified on 10 separate occasions, with each observation period lasting 5 min. Observations were made during the optimal daily insect visitation time frame of 9:30 AM to 4:30 PM (Garbuzov and Ratnieks, 2014; Gillespie et al., 2017; Goulson and Darvill, 2004). Two observations, one in the morning and one in the afternoon, were made per plant per observation day. Observation days had temperatures above 17.8 °C, wind speeds of less than 13 km per hour, and mostly cloudless skies. Temperature and PAR light intensity at the research planting were monitored using a plant growth station (WatchDog 2475; Spectrum Technologies Inc., Aurora, IL). Insect observation was made 1 m away from the plant. Movement and noise were kept to a minimum during observation periods. An insect visit was defined as an insect landing or present on a flower. Insects were identified into 12 categories: *A. mellifera*, *Bombus* spp., Andrenidae, Halictidae, Megachilidae, other bees, Lepidoptera, Syrphidae, other flies, wasps, Coleoptera, and other insects. Insect counts taken during the 10 observation periods were summed for each plant. In 2016, plants of *A. melanocarpa* genotypes suffered heavy rabbit damage, and many shoots containing flower buds were lost, which prevented data collection in 2017. Following installation of additional fencing in 2017, *A. melanocarpa* plants recovered and produced many new shoots with flowers, and data on plant measurements and insect visitation were taken in 2018. Data were not taken on *K. latifolia* genotypes in 2017 because of the slow establishment of this species in the experimental planting.

Statistical analysis. Data from 2017 and 2018 were combined for statistical analysis, and the year was treated as a random effect. SAS software (version 9.4; SAS Institute, Cary, NC) was used for statistical analysis. Analysis of variance used the PROC GLIMMIX procedure, and mean separation was determined using Tukey's honestly significant difference test ($P \leq 0.05$).

Results and Discussion

For *A. melanocarpa* and its cultivars UCONNAM165 and UCONNAM012, the primary pollinator visitors were bees from the family Andrenidae (Table 2). Additional important insect categories were other bees, other flies, and other insects. Significantly more andrenids visited *A. melanocarpa* than its cultivars UCONNAM165 and UCONNAM012. Hardin (1973) reported andrenids as potential pollinators of *A. melanocarpa* and observed ant (family: Formicidae) and fly visitors for this species. Flowers opened 5 to 7 d earlier for the *A. melanocarpa* cultivars than for the straight species (Fig. 1). Duration of bloom was 10 to 14 d for all three *Aronia* genotypes. As expected, *A. melanocarpa* was significantly (more than double) taller than both of its cultivars, and 'UCONNAM165' was taller than 'UCONNAM012' (Table 3). *A. melanocarpa* had significantly more inflorescences than 'UCONNAM165' and 'UCONNAM012'. To understand how the significant change in height between *A. melanocarpa* and 'UCONNAM012' affected pollinator visitation, for each plant we divided the number of andrenids by the number of inflorescences and compared the quotient, which was equivalent at 0.2. This indicates

Table 1. Nomenclature, flower color, plant habit, and source of study plants for six native shrub species and their cultivars.

Genotype	Flower color	Plant habit	Source of plants
Aronia melanocarpa	White	Upright	Wild collected, Nobleboro, MA
A. melanocarpa 'UCONNAM165'	White	Low-growing; compact	Mark Brand (Breeder), University of Connecticut, Storrs, CT
A. melanocarpa 'UCONNAM012'	White	Low-growing; prostrate	Mark Brand (Breeder), University of Connecticut, Storrs, CT
Clethra alnifolia	White	Upright tall	Prides Corner Farms, Lebanon, CT
C. alnifolia 'Hummingbird'	White	Compact	Prides Corner Farms, Lebanon, CT
C. alnifolia 'Ruby Spice'	Pink	Upright tall	Prides Corner Farms, Lebanon, CT
Dasiphora fruticosa	Yellow	Mounded; diploid	Wild collected, Montvale, CT
D. fruticosa 'Goldfinger'	Yellow	Mounded; tetraploid	Prides Corner Farms, Lebanon, CT
D. fruticosa 'Pink Beauty'	Pink	Mounded; diploid	Prides Corner Farms, Lebanon, CT
Hydrangea arborescens	White; few sterile flowers	Broadly mounded	Prides Corner Farms, Lebanon, CT
H. arborescens 'Annabelle'	White; many sterile flowers	Broadly mounded	Prides Corner Farms, Lebanon, CT
Kalmia latifolia	White	Compact	American Native Plants, Perry Hall, MD
K. latifolia 'Sarah'	Pink	Compact	Prides Corner Farms, Lebanon, CT
Physocarpus opulifolius	White	Upright spreading; green foliage	American Native Plants, Perry Hall, MD
P. opulifolius 'Monlo'	Pink	Upright spreading; purple foliage	Prides Corner Farms, Lebanon, CT

Table 2. Sum of insect pollinators visiting six native shrub species and their cultivars during 10 observation periods per plant in 2017 and 2018.

	Bees						Flies					
Genotype	Andrenidae	*Apis mellifera*	*Bombus* spp.	Halictidae	Megachilidae	Other bees	Other flies	Syrphidae	Coleoptera	Lepidoptera	Other insects	Wasps
Aronia melanocarpa	139.3 a[z]	0.3 a	2.7 a	0.7 a	—	24.0 a	14.7 a	4.7 a	0.7 a	—	8.3 b	1.0 a
A. melanocarpa 'UCONNAM165'	54.3 b	0.3 a	1.3 a	1.7 a	—	49.3 a	22.3 a	12.7 a	0 a	—	13.0 ab	0.3 a
A. melanocarpa 'UCONNAM012'	61.0 b	0.7 a	0.3 a	0.7 a	—	50.0 a	18.3 a	8.0 a	0.7 a	—	19.7 a	0 a
Clethra alnifolia	—	7.3 a	351.3 a	3.0 a	0.5 a	12.0 a	1.3 a	3.3 a	0.8 a	8.5 a	8.0 a	15.5 a
C. alnifolia 'Hummingbird'	—	8.0 a	327.5 a	0.8 a	0.2 a	9.8 a	2.3 a	2.5 a	0.8 a	8.3 a	5.7 a	12.8 a
C. alnifolia 'Ruby Spice'	—	3.7 a	227.7 a	1.8 a	0.2 a	8.5 a	1.8 a	3.5 a	0.3 a	10.2 a	4.8 a	16.3 a
Dasiphora fruticosa	0 a	2.3 a	100.5 a	3.8 a	8.2 a	38.5 a	6.0 a	10.8 a	3.8 ab	4.5 a	11.0 a	23.5 a
D. fruticosa 'Goldfinger'	2.8 a	3.0 a	49.7 b	6.8 a	2.3 b	42.8 a	8.2 a	19.3 a	6.3 a	3.0 a	19.2 a	24.3 a
D. fruticosa 'Pink Beauty'	1.2 a	0.3 a	67.8 b	8.2 a	1.2 b	35.2 a	4.3 a	13.2 a	2.2 b	2.2 a	6.8 a	9.0 a
Hydrangea arborescens	2.5 a	2.0 a	126.3 a	1.3 a	0.3 a	59.0 a	1.8 a	11.5 a	9.8 a	0.8 a	30.3 a	26.5 a
H. arborescens 'Annabelle'	0.2 a	0.8 a	38.3 b	0.2 b	0.3 a	22.0 a	1.3 a	8.8 a	13.8 a	0.2 a	31.0 a	8.3 a
Kalmia latifolia	0.7 a	0.3 a	0 a	—	0.7 a	—	0 a	0.3 a	—	0.3 a	0.3 a	0.3 a
K. latifolia 'Sarah'	0 a	0 a	0.7 a	—	0.3 a	—	0.3 a	0.7 a	—	0.3 a	0 a	0 a
Physocarpus opulifolius	181.2 a	13.8 a	3.5 a	4.0 a	0.7 a	36.3 a	5.2 a	42.5 b	1.3 a	2.3 a	8.3 a	1.7 a
P. opulifolius 'Monlo'	118.0 a	9.5 a	2.8 a	1.8 a	0.3 a	26.0 a	10.7 a	63.2 a	0.3 a	1.2 a	5.0 a	0.7 b

[z]Mean separation within columns, within species, indicated by different letters, by Tukey's least significant difference at $P \leq 0.05$ (n = 6).

that the compact cultivar UCONNAM012 does not appear to be less attractive to pollinators than *A. melanocarpa*, but its smaller size may limit the number of inflorescences and insect visits per plant. Garbuzov and Ratnieks (2014) observed bee preference for tall flowering *Lavandula* hybrid plants over their shorter flowering parental species, suggesting bees may gravitate toward inflorescences that are taller and, thus, more prominent.

A. melanocarpa 'UCONNAM012' is used in the landscape differently than the straight species *A. melanocarpa*. 'UCONNAM012' is normally used in large numbers of plants to develop a groundcover or mass planting, whereas the use of *A. melanocarpa* is typically limited to a small group or a single specimen planting because of its larger stature. A group of 12 'UCONNAM012' would occupy an area similar to that of four *A. melanocarpa* and have similar or greater pollinator visitation. 'UCONNAM012' had significantly more other insect visits than *A. melanocarpa* (Table 1). Other insects consisted of mostly ants, which are ground-dwelling insects that may have found it easier to access inflorescences on the shorter plants of 'UCONNAM012' and 'UCONNAM165' than the taller plants of *A. melanocarpa*.

There were no significant differences in insect visitation for all insect categories between *C. alnifolia* and its cultivars Hummingbird and Ruby Spice (Table 2). Change in the floral color from white (*C. alnifolia* and 'Hummingbird') to pink (*C. alnifolia* 'Ruby Spice') did not affect pollinator visitation. The flower color did not affect bee attraction for *Lavandula* species and cultivars, whose flower colors ranged from white to pink to blue (Garbuzov and Ratnieks, 2014). Most insects (≥80%) for *C. alnifolia* and its cultivars were *Bombus* spp. (Table 2). Additional important insect categories were *A. mellifera*, other bees, Lepidoptera, and wasps. *Bombus impatiens* and *A. mellifera* were determined to be frequent visitors of *C. alnifolia* in a work conducted at the University of Connecticut by Hemingson (1986). In their assessment of bee visitation on woody ornamental landscape plants in Kentucky and southern Ohio, Mach and Potter (2018) found that for *C. alnifolia* 'Sixteen Candles', 39.6% of bee visitors were of the species *Bombus* and 46.2% were halictids. The most abundant bee visitors for *C. alnifolia* 'Sixteen Candles' were members of Apidae (48.5%).

As expected, *C. alnifolia* 'Hummingbird' was somewhat shorter and smaller in size than the straight species, *C. alnifolia* (Table 3). Despite its reduced stature, *C. alnifolia* 'Hummingbird' produced a similar number of inflorescences as *C. alnifolia* and *C. alnifolia* 'Ruby Spice'. Furthermore, *C. alnifolia* 'Hummingbird' had the greatest floral density. The bloom period for *C. alnifolia* and its cultivars lasted 14 d (Fig. 1). Flowers on *C. alnifolia* began opening 7 d earlier than they did for both *C. alnifolia* cultivars. These findings suggest that *C. alnifolia* and its cultivars, Hummingbird and Ruby Spice, do not vary in their ability to attract pollinators.

D. fruticosa had significantly more visitors of *Bombus* spp. and Megachilidae than both of its cultivars Goldfinger and Pink Beauty (Table 2). These insects were less attracted to *D. fruticosa* 'Goldfinger', possibly because 'Goldfinger' may be tetraploid, and changes to ploidy could affect pollinator visitation because of differences in floral resources or flower size (Segraves and Anneberg, 2016). We suspect that 'Goldfinger' is tetraploid because it originated from northern Europe (Holland), where tetraploid *D. fruticosa* is documented to exist (Elkington, 1969; Miller, 2002). In addition, *D. fruticosa* 'Goldfinger' had significantly wider flowers than *D. fruticosa* and *D. fruticosa* 'Pink Beauty' (Table 3), and increased flower size is

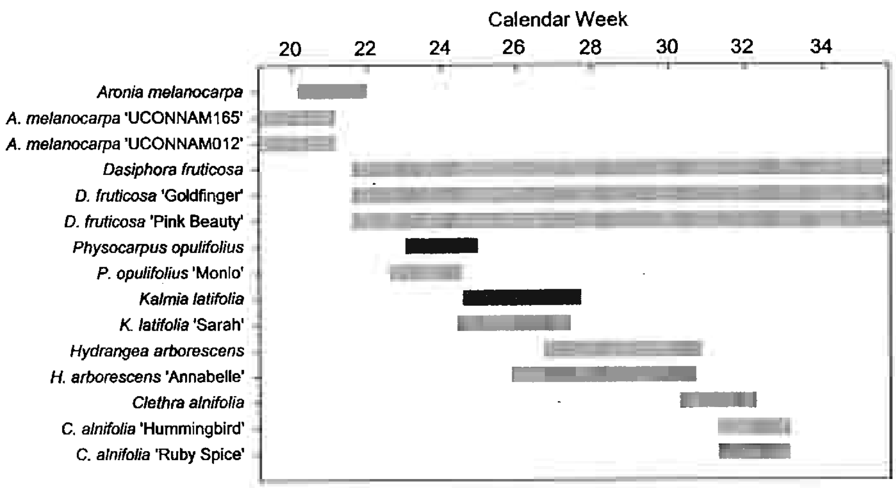

Fig. 1. Duration of bloom in 2018 for six native shrub species and their cultivars.

Table 3. Characteristics of six native shrub species and their cultivars grown in 2017 and 2018.

Genotype	No. of inflorescences per plant^z	Inflorescence ht. (cm)	Inflorescence width (cm)^y	No. of flowers per in florescence	Plant ht. (cm)	Plant width (cm)^x	Plant size (10,000 cm^3)^w	Floral density^v
Aronia melanocarpa	691.3 a^u	3.7 a	3.2 a	12.8 a	137.5 a	141.6 a	287.5 a	2.4 a
A. melanocarpa 'UCONNAM165'	385.0 b	3.3 a	3.5 a	14.6 a	65.9 b	119.8 a	231.4 a	2.3 a
A. melanocarpa 'UCONNAM012'	273.7 b	3.5 a	3.5 a	14.9 a	43.1 c	127.7 a	178.7 a	1.3 a
Clethra alnifolia	389.3 a	12.9 a	2.2 a	62.3 a	138.0 a	135.3 a	241.0 a	1.4 b
C. alnifolia 'Hummingbird'	382.3 a	13.5 a	2.8 a	59.7 a	91.2 b	126.9 a	157.5 b	2.4 a
C. alnifolia 'Ruby Spice'	295.7 a	8.8 a	2.3 a	44.3 a	112.3 ab	134.6 a	209.8 ab	1.4 b
Dasiphora fruticosa	4125.3 a	1.9 a	2.6 b	—	84.2 a	130.5 a	153.0 a	34.0 a
D. fruticosa 'Goldfinger'	5304.7 a	1.5 a	3.0 a	—	78.8 a	129.4 a	140.6 a	53.0 a
D. fruticosa 'Pink Beauty'	4360.0 a	1.4 a	2.5 b	—	84.9 a	135.0 a	159.4 a	32.5 a
Hydrangea arborescens	116.5 a	6.9 a	10.3 b	644.9 a	134.5 a	176.4 a	441.5 a	0.3 a
H. arborescens 'Annabelle'	118.3 a	7.4 a	15.0 a	746.0 a	99.4 a	126.7 a	167.1 a	0.7 a
Kalmia latifolia	45.0 a	7.7 a	8.4 a	75.7 a	71.8 a	79.0 a	48.8 a	1.0 a
K. latifolia 'Sarah'	22.0 a	6.2 a	6.4 a	75.3 a	74.1 a	89.8 a	75.2 a	0.4 a
Physocarpus opulifolius	656.0 a	4.1 a	5.2 a	73.2 a	198.0 a	265.1 a	1449.6 a	0.5 a
P. opulifolius 'Monlo'	702.7 a	3.5 a	4.7 a	48.0 a	191.2 a	246.5 a	1225.6 a	0.7 a

^{z}Number of flowers for *D. fruticosa*, *D. fruticosa* 'Goldfinger', and *D. fruticosa* 'Pink Beauty'.
^{y}Inflorescence width was measured twice at right angles to each measurement and averaged.
^{x}Plant width was measured twice at right angles to each measurement and averaged.
^{w}Plant size calculated using height and two perpendicular width measurements.
^{v}Floral density was calculated by dividing number of inflorescences by plant size.
^{u}Mean separation within columns and within species and indicated by different letters, by Tukey's honestly significant difference at $P \leq 0.05$ (n = 6).

evidence of tetraploidy (Segraves and Thompson, 1999). *D. fruticosa* 'Pink Beauty' and the *D. fruticosa* used in this study were derived from North American germplasm, which is diploid (Elkington, 1969; Lenz, 1997).

Bombus spp. and Megachilidae visitors may have been less attracted to *D. fruticosa* 'Pink Beauty' than the straight species because of its pink flower color. Several reports indicate that changes in flower color can influence pollinator visitation (Comba et al., 1999; Gumbert, 2000; White, 2016). By comparing eight herbaceous perennial species each with a cultivar possessing different flower color, six cultivars were visited less by some types of pollinators (White, 2016). For example, with *Echinacea purpurea*, bumblebees preferred the purple flowers of the straight species to the white flowers of the cultivar White Swan, but other insects did not demonstrate a preference (White, 2016).

Fewer coleopteran visitors were found on *D. fruticosa* 'Pink Beauty' than *D. fruticosa* 'Goldfinger' (Table 1) for two possible reasons: 1) these insects prefer yellow flower color rather than pink flower color (Gottsberger, 1977; Ollerton et al., 2009; Waser et al., 1996) and 2) these insects are attracted to larger flowers, which offer more physical support. After *Bombus* spp., the category other bees (*Ceratina* spp. and *Hylaeus* spp.) had the greatest number of visitors. In a Michigan State University evaluation of 43 northeastern U.S. native plants, *D. fruticosa* was one of only nine species distinguished as "highly attractive" to species of wild bees (Tuell et al., 2008). Denisow et al. (2013) studied the *D. fruticosa* cultivars Manley and Blink and found primarily *Bombus* spp., *A. mellifera*, and other solitary bee visitors. In our study, *Megachile* were observed harvesting flower petals on *D. fruticosa* and *D. fruticosa* 'Goldfinger', likely for use as a nesting material (Wilson and Carril, 2015).

H. arborescens had three times as many visitors of *Bombus* spp. as *H. arborescens* 'Annabelle' (Table 2). Other bees was an additional important insect category, which included *Xylocopa virginica* and *Ceratina* spp. *H. arborescens* and its cultivar Annabelle were of similar size and produced an equivalent number of inflorescences (Table 3). The onset of flowering occurred 7 d earlier for *H. arborescens* 'Annabelle' than *H. arborescens* (Fig. 1). Flowering duration was 28 d for *H. arborescens* 'Annabelle' and 21 d for *H. arborescens*. The inflorescence of *H. arborescens* is a lace cap, where sterile flowers form a ring around the perimeter of the inflorescence and the central flowers are fertile, containing pollen and nectar. *H. arborescens* 'Annabelle' was selected for having large inflorescences, composed of mostly sterile flowers, which are showier than the straight species (Dirr, 2009). As expected, plants of *H. arborescens* 'Annabelle' produced significantly wider inflorescences than *H. arborescens* (Table 3), with only 42% fertile flowers, which was significantly less than the 99% fertile flowers found for *H. arborescens* ($P = 0.0008$). Furthermore, fertile flowers on *H. arborescens* 'Annabelle' were positioned to the interior of the inflorescence and covered by sterile flowers, which may have impeded insect access to fertile flowers, especially for larger insects such as *Bombus* spp. Goulson (2003), and Heinrich (1979) noted that visitors of *Bombus* spp. pursue flowers with greater nectar and pollen resources, which may explain why *H. arborescens* had more *Bombus* spp. visitors than *H. arborescens* 'Annabelle'. An additional important insect category for *Hydrangea* was other insects, which included visitors of ants and ambush bugs (subfamily Phymatinae). Significantly more halictids were found for *H. arborescens* than its cultivar Annabelle, but this was a minor insect category for these plants (Table 2).

Overall, few insect visitors were observed for *K. latifolia* and its cultivar Sarah (Table 2). There were only two to three total insect visits over 10 observation events in 2018, during the 21-d bloom period (Fig. 1). The full sun study site was not optimal for *Kalmia*, which prefers shaded conditions. Plant foliage yellowed somewhat in the full sun and occasionally developed leaf spot disease. In the wild, plants inhabit bogs, barrens, and the edge of woods, swamps, and streams (Hightshoe, 1988). Plants grown in a partially shaded site may have had increased insect visitation. However, less insect visitation was found for *K. latifolia* growing naturally in a southern Appalachian heath bald (Real and Rathcke, 1991). Visitation rate averaged only 1.18 insect visits per 10-min observation of 100 flowers. In our study, plants of *K. latifolia* and its cultivar Sarah were similar in size and produced 22 to 45 inflorescences per plant, with each inflorescence consisting of $\approx$75 flowers (Table 3).

Andrenids were the most abundant visitors for *P. opulifolius* and its cultivar Monlo (Table 1). In their bee visitation study, Mach and Potter (2018) also found that the majority of visitors (57.5%) for *P. opulifolius* were andrenids. We found that significantly more syrphids visited *P. opulifolius* 'Monlo' than *P. opulifolius*. Syrphidae species observed included *Temnostoma* spp., *Toxomerus* spp., and *Eristalis* spp. Plants of *P. opulifolius* and its cultivar Monlo were of the same size and produced a similar number of inflorescences (Table 3). *P. opulifolius* and 'Monlo' have similar leaf and flower forms, but *P. opulifolius* has green foliage and white flowers, and 'Monlo' has reddish purple foliage and flowers that are pink in bud that open to white. Syrphids are attracted to yellow and white flowers (Sajjad and Saeed, 2010; Shi et al., 2009), and for some flowers, olfactory cues are involved in attraction (Primante and Dötterl, 2010). In our study, syrphids may have been more strongly attracted to *P. opulifolius* 'Monlo' than the straight species because its white flowers contrasted more strongly against reddish purple foliage or there were olfactory cues provided by 'Monlo'. *P. opulifolius* had more wasp visitors than *P. opulifolius* 'Monlo', but wasps were a minor insect category for these plants.

The results of this study suggest that native shrub cultivars are not inherently less attractive to insect pollinators than the straight species. Similar conclusions can be drawn from the studies of Nevison (2016), Poythress and Affolter (2018) and White (2016) for native herbaceous perennial species and cultivars. This study and others identify examples of cultivars that were not as supportive of pollinators as the straight species, but also found examples of cultivars that are similarly, or more, attractive to pollinators than the straight species (Baisden et al., 2018; Nevison, 2016; Poythress and Affolter, 2018; White, 2016). Cultivar traits that can affect pollinator visitation may include conversion of anthers and pistils to petals, flower color, floral density, flower size, and possibly plant stature. When recommending plants for pollinator plantings, it is important to understand that whereas compact cultivars may attract fewer pollinators on a per-plant basis, on a landscape area basis, they may be comparable or better at attracting pollinators than the larger straight species form. Native shrub cultivars are not universally less or more attractive to insect pollinators and should be evaluated on a case-by-case basis.

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