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.
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 ants (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 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 Coleoptera. Bombus impatiens and A. mellifera were determined to be frequent visitors of C. alnifolia in a work conducted at the University of Connecticut by Hemsing (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

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         | Wild collected, Montvale, CT |
| Dasiphora fruticosa  | Yellow       | Mounded; diploid     | Prides Corner Farms, Lebanon, 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 |          | American Native Plants, Perry Hall, MD |
| Kalmia latifolia     | White        | Compact              | Prides Corner Farms, Lebanon, CT |
| Physocarpus opulifolius | White        | Upright spreading; purple 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.

| Genotype | Bees | Flies | Other insects | Wasps |
|----------|------|-------|---------------|-------|
| A. melanocarpa 'UCONNAM016' | Apis mellifera | Bombus spp | Halictidae | Megachilidae | Other bees | Other flies | Syrphidae | Coleoptera | Lepidoptera | Other insects | Wasps |
| A. melanocarpa 'UCONNAM012' | --- | --- | 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 |
| Clethra alnifolia | --- | --- | 327.5 a | 0.8 a | 0.2 a | 9.8 a | 2.3 a | 2.5 a | 0.8 a | 10.2 a | 30.3 a | 26.5 a |
| D. fruticosa | --- | --- | 3.0 a | 49.7 b | 6.8 a | 2.3 b | 42.8 a | 8.2 a | 19.3 a | 6.8 a | 9.0 a | 16.3 a |
| Hydrangea arborescens | --- | --- | 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 |
| Kalmia latifolia | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Physocarpus opulifolius | --- | --- | 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 |
| P. opulifolius 'Monlo' | --- | --- | 0.3 a | 0.7 a | 0.3 a | 0.7 a | 0.3 a | 0.3 a | 0.3 a | 0.3 a | 0.3 a |

*Mean separation within columns, within species, indicated by different letters, by Tukey's least significant difference at P = 0.05 (n = 6).
Table 3. Characteristics of six native shrub species and their cultivars grown in 2017 and 2018.

| Genotype           | No. of inflorescences per plant | Inflorescence ht (cm) | Inflorescence width (cm) | No. of flowers per inflorescence | Plant ht (cm) | Plant width (cm) | Plant size (10,000 cm³) | Floral density |
|--------------------|---------------------------------|-----------------------|--------------------------|---------------------------------|---------------|-----------------|----------------------|---------------|
| Aronia melanocarpa | 691.3 a                         | 3.7 a                 | 3.2 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                    | 65.9 b                          | 119.8 a       | 231.4 a         | 2.3 a                |               |
| A. melanocarpa 'UConnAM012' | 273.7 b             | 3.5 a                 | 3.5 a                    | 43.1 c                          | 127.7 a       | 178.7 a         | 1.3 a                |               |
| Clethra alnifolia  | 383.3 a                         | 12.9 a                | 2.2 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                    | 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                    | 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 | 118.5 a                      | 6.9 a                 | 10.3 a                   | 644.9 a                         | 74.0 a        | 99.4 a          | 1.9 a                |               |
| H. arborescens 'Annabelle' | 118.3 a             | 7.4 a                 | 15.0 a                   | 74.6 a                          | 99.4 a        | 126.7 a         | 0.7 a                |               |
| Kalmia latifolia  | 45.0 a                          | 7.7 a                 | 8.4 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          | 0.4 a                |               |
| Physocarpus opulifolius | 656.0 a                        | 4.1 a                 | 5.2 a                    | 198.0 a                         | 265.1 a       | 1494.6 a        | 0.5 a                |               |
| P. opulifolius 'Monlo' | 702.7 a                        | 3.5 a                 | 4.7 a                    | 191.2 a                         | 246.5 a       | 1225.6 a        | 0.7 a                |               |

*Number of flowers for D. fruticosa, D. fruticosa ‘Goldfinger’, and D. fruticosa ‘Pink Beauty’.
*Inflorescence width was measured twice at right angles to each measurement and averaged.
*Plant width was measured twice at right angles to each measurement and averaged.
*Inflorescence width was measured twice at right angles to each measurement and averaged.
*Number of flowers 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 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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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 Phtymatae). 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 Ratheke, 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 ≈75 flowers (Table 3).
