South Ripley Solar Project – Summary of Literature Review on Tall Ironweed

Eckberg, James, Jennifer Hopwood, Eric Lee-Mader. 2016. *Collecting and Using Your Own Wildflower Seed to Expand Pollinator Habitat on Farms*. The Xerces Society for Invertebrate Conservation. Available at: https://xerces.org/sites/default/files/2018-05/16-026_01_XercesSoc_Collecting%2BUsing-Your-Own-Wildflower-Seed_web.pdf. (Accessed November 2020).

- This guide from the Xerces Society provides information on how to identify seeds ready for harvest, harvesting wildflower seeds, processing seed for future planting, and seed storage. **This guide could be particularly helpful resource should seeds be collected from existing tall ironweed populations at the project site and sowed in other areas, such as field edges and visual mitigation planting areas.** Other research regarding seed collection of ironweeds specifically is provided below (see Hawke, 2020).

Hawke, Richard G. 2020. *Plant Evaluation Notes: A Comparative Evaluation of Ironweeds (*Vernonia *spp.).* Chicago Botanic Garden, Issue 45, 2020. Available at: https://www.chicagobotanic.org/sites/default/files/pdf/plantevaluation/no45_vernonia.pdf. (Accessed November 2020).

- In this study, the Chicago Botanic Garden undertook a comparative trial of *Vernonia* species and cultivars from 2012 through 2018. "Their value as a food source for pollinators is irrefutable – scores of bees, butterflies, and numerous other insects feverishly work the flowers throughout the late bloom season." The goal of the trial was to determine the garden-worthiness of a variety of cold-hardy ironweeds. The trial group consisted of 17 taxa representing ten species with eight associated subspecies, cultivars, or hybrid selections. *V. gigantea* and seven other taxa were grown from wild-collected seeds, while the other species were acquired commercially. Five plants of each taxon were grown in side-by-side plots for easy comparison of ornamental traits and landscape performance. In the trial, the ironweeds were regularly observed for their cultural adaptability to the soil and environmental conditions of the full sun evaluation garden; diseases and pests; winter hardiness and survivability; and ornamental qualities associated with foliage, floral display, and plant habits. The four taxa that were top-rated (5 stars) were all cultivars. *V. gigantea* was rated 4 stars, with the lower score attributed to susceptibility to foliar rust diseases. **This study suggests the possibility of seed collection as a potential mitigation option for any plants to be impacted by project construction; seeds collected from impacted plants could then be cultivated and planted as part of the vegetation management plan.**

Johnson, Bill. Marcelo Zimmer. 2020. *The Ironweeds*. Purdue University Plant and Pest Diagnostic Laboratory. Available at: https://ag.purdue.edu/btny/ppdl/Pages/POTW2020/POTW10052020.aspx. (Accessed November 2020).

- In this summary information page from researchers at Purdue University, the authors suggest that an annual mowing regime may encourage growth of ironweeds, while subsequent mowing beginning early in the growing season, followed by additional mowing when growth reaches 6 to 8 inches could result in a reduction of the population when compared to areas without mechanical treatment. Various chemical controls were also reviewed, including glyphosate (reduction rate of 2% to 88% depending on timing), triclopyr, and dicamba. Dicamba and triclopyr controls were found to reduce stems in the short term by 76% to 91% with 81% and 39% of the populations treated showing regrowth, respectively. **Although this research is regarding treatment of ironweeds as pests in pasture areas, it does suggest that a once or twice annual mowing could be sustainable.** See also Tolson (2012).

Missouri Botanical Garden. 2020. *Gardening Help: Vernonia gigantea.* Available at: https://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?taxonid=277606&isprofile=0&. (Accessed November 2020).

- This informational page from the Missouri Botanical Garden references tall ironweed's preference for moist soils and its use in gardening in wildflower meadows and as a border plant.

The Ohio State University. 2020. *Tall Ironweed (*Vernonia gigantea*)*. Ohio Agricultural Research and Development Center. Available at: https://www.oardc.ohio-state.edu/weedguide/single_weed.php?id=57. (Accessed November 2020).

- This document contains an interesting but unsubstantiated statement about mowing: "Research showed that 9 successive years of mowing on two dates during the year caused no significant stand reduction of tall ironweed." This data seems in direct contradiction to the results of Tolson (2012).

Tolson, Joshua Allen. 2012. *The Effect of Integrated Weed Management Strategies on Weed Populations and Biomass, Pasture Productivity, Economic Returns, and Forage Quality With and Without Grazing.* Theses and Dissertations – Plant and Soil Sciences, 4, University of Kentucky. Available at: https://uknowledge.uky.edu/cgi/viewcontent.cgi?article=1003&context=pss_etds. (Accessed November 2020).

- In this thesis research, different management strategies of mowing, herbicide, fertility, and all possible combinations were compared across various study plots to determine efficacy in controlling (eliminating/reducing) tall ironweed populations at three Kentucky locations. Mowing was performed in July 2008 and 2009, herbicide was applied in August 2008, and fertilizer was applied in September 2008 and 2009 at all locations. Weed populations were measured in 2008, 2009, and 2010, and forage grass, clover, and weed biomass was collected in May or early June of 2009 and 2010. All treatments with herbicide reduced tall ironweed stems by 64% or greater in 2009 at all locations. Mowing alone, fertilizer alone, and mowing plus fertilizer did not reduce tall ironweed populations, except at one location where mowing alone reduced tall ironweed stems by 64% in 2009. Tall ironweed stems were not reduced in 2010 with any treatment at two locations, but herbicide combined with mowing or fertilizer reduced tall ironweed stems by 78% at the other location. **This study suggests that under certain undetermined conditions, mowing does not appear to reduce tall ironweed populations in the short-term.** This study does not appear to be one referenced by Ohio State Weed Guide (see The Ohio State University, 2020) because of short duration.

Unknown author. 2018.*Gardening FAQ: Can I grow Ironweed at home? How do I care for it?* New York Botanical Garden, The LuEsther T. Mertz Library. Available at: https://libanswers.nybg.org/faq/223221. (Accessed November 2020).

- This FAQ from the New York Botanical Garden states, in response to a question about gardening with ironweeds, "giant ironweed (*Vernonia gigantea*) is the tallest species and has been known to grow up to ten feet." This should be taken into consideration for potential use in vegetation management plan. With reference to a closely related species, New York ironweed (*Vernonia noveboracensis*), this page describes a way of managing the height of the plant; apparently pruning the plant, while still small, can reduce the height at maturity by several feet. "One such method is to cut down the plants to the ground when they reach 2 feet. tall. (They) may have about a 3-week delay in bloom but will flower nicely." **It is unclear whether tall ironweed would have the same response to this pruning option; however, this literature offers optional pruning methods that could be considered as adaptive vegetation management.**

Unknown author. 2020. *Butterfly gardening & all things milkweed: Vernonia gigantea.* Available at: https://sites.google.com/site/gardeningforbutterflies/vernonia-gigantea. (Accessed November 2020).

- This appears to be a personal web page and not any kind of official site but contains some potentially useful information: “can be grown in containers for long periods of time before transplanting (use deep saucers to ensure consistent moisture -- will go dormant if allowed to dry out)” and “not all seeds are fertile, cold moist stratification improves germination rate.”

Urbatsch, Lowell. 1973. *A Study of Ecotypes In Vernonia Gigantea Gigantea (Compositae).* Transactions of the Nebraska Academy of Sciences and Affiliated Societies, 393. Available at: https://digitalcommons.unl.edu/tnas/393. (Accessed November 2020).

- In this study, reciprocal transplant experiments were conducted to determine if morphological variation in *Vernonia gigantea* plants along a north-south transect is due to genetic differences or to environmental modification. Morphological measurements were made on population samples (25 plants each in full flower) collected along a north-south geographical transect ranging from Alabama and Mississippi in the south to Indiana in the north. To determine the effects of northern and southern environments on plants from different localities, clones of *V. gigantea* were secured by dividing the underground perennial rootstocks. One member of each clonal pair was planted in a garden at Athens, Georgia and the other in a garden at Osage, Iowa. Analysis of morphological characteristics of the field-collected samples showed that differences in leaf width and leaf length existed among the populations. Southern populations have narrower and shorter leaves than northern populations. There were also differences in flowering times. Clones from northern collection sites flowered as much as six weeks earlier in the Georgia transplant garden than those from southern collection sites, while plants from southern collection sites grown in Iowa developed buds which had not yet flowered at the time the plants were harvested (October 1, 1969). Plants from northern collection sites reached anthesis throughout the middle of September in Iowa. Plants from the different localities throughout the range of *V. gigantea* range were also transplanted to a greenhouse for crossing experiments. The results of the hybridization experiments suggested that breeding barriers probably do not exist between populations of Vernonia gigantea since all crosses attempted produced vigorous F1 hybrids. The earlier flowering times of northern ramets in the southern transplant garden and the non-flowering of southern ramets in the northern transplant garden suggest that ecotypic differences exist within *V. gigantea*. This has implications for conservation, in that local ecotypes represent those that should be protected in New York, where this species is endangered. **If planting *V. gigantea* on-site as part of the vegetation management plan, plant materials should be sourced locally (i.e., wild collected seeds or transplanted rootstocks) rather than obtained commercially. This study also conclusively demonstrates that *V. gigantea* can be successfully transplanted.**