Identification, Ecology and Diseases of Whorled Sunflower, *Helianthus verticillatus*

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Introduction

Whorled sunflower (*Helianthus verticillatus* Small) is a rare perennial herbaceous plant only found at a few sites in the southeastern United States (Figure 1) [1-3]. Although considered a candidate endangered species in 2005, the whorled sunflower was officially federally (U.S.) declared endangered in 2014 [4]. It reproduces clonally by slender rhizomes in natural settings, such as sunny prairie openings in floodplains. In contrast, sexual reproduction occurs by seeds only if compatible plants are present [1,5]. The whorled sunflower owes its ornamental popularity to the unique verticillate leaf arrangement in whorls of three or four leaves, showy yellow daisy-like inflorescences and late-season blooming (Figure 1) [4]. Hence, this sheet is intended for nursery professionals, horticultural enthusiasts and landscapers looking forward to including novel and attractive ornamental plants in their nurseries, gardens and yards.

Figure 1. Multiple whorled sunflower (*Helianthus verticillatus*) plants.

Identifying Characteristics

The whorled sunflower is a member of the sunflower family and emerges in the spring from horizontal, tuberous-thickened roots with slender rhizomes to produce erect, hairless and waxy stems, which can reach up to 10 feet (2-4 meters) in the fall [6]. The leaves are long and narrow. The whorled name refers to leaves that occur as groups of 3-4 leaves at mid-stem (Figure 2B). The leaf texture is stiff and has a prominent white or light-yellow mid-vein. Many clusters of bright yellow, daisy-like flowers are produced in late September and October (Figures 2A). Numerous black or gray seeds are formed in late fall [1,7].

The following two cultivars of the whorled sunflower have been described: 'Denita's Autumn Sunshine' and 'Bonnie's Purple Majesty.' 'Denita's Autumn Sunshine' has a green stem and is susceptible to powdery mildew and rust. Conversely, 'Bonnie's Purple Majesty' displays purple stems, and is also susceptible to powdery mildew and rust.

Figure 2. Identifying characteristics of whorled sunflower including (A) bright yellow flower head surrounding a central disk of numerous tiny lighter with dark anthers, and (B) wide, linearly to lance-shaped leaves and verticillate in groups of 3-4 leaves at mid-stem.

Habitat

The whorled sunflower grows on isolated small tracts of land in West Tennessee, eastern Alabama, and western Georgia and recently was discovered in Mississippi Co., Arkansas (2-3), and Virginia (personal communication, prof. Robert N. Trigiano). Although first described in 1898 from Tennessee, this sunflower went missing for a century when it was rediscovered in Georgia [1].

Habitat degradation and loss almost pushed this species to the edge of extinction. Hence, in 2014 U.S. Fish and Wildlife Service listed the whorled sunflower as an endangered species [4]. Interestingly, studies show that groups of the plants have high genetic diversity, which suggests that the whorled sunflower was common in the past [8].

Phenology

Whorled sunflowers typically emerge as basal rosettes in February in Tennessee (USA). Clonal propagation occurs through underground rhizomes. Individual plants produce many self-incompatible flowers in September until a hard frost [1,7,8], and seeds only occur if sexually compatible plants are present. Insect pollination is crucial for sexual reproduction, and there are more than 30 species of potential pollinators, which include native bees and flies and a variety of moths and butterflies. Common small bumble bees are the most frequent visitors to the whorled sunflower (Figure 3) [9].

Figure 3. Pollination by potentially over 30 species of insects but a bumble bee (*Bombus impatiens*) is the most common.

Propagation Methods

The whorled sunflower's endangered nature requires different strategies to conserve its biodiversity, including clonal propagation via tissue culture and rooted stem cuttings [7,10-12]. Tissue culture is a method in which plant tissue, such as axillary buds, are cultured on a nutrient agar medium under sterile conditions. Appropriate growing conditions lead to rapid multiplication of pathogen-free plantlets in a relatively short time [13].

Another successful method for cloning the whorled sunflower is via rooted stem cuttings (Figure 4A). This type of clonal reproduction aids in maintaining the ornamental uniformity of these plants, and it is convenient for mass reproduction. For instance, a single founder stem can initiate the formation of more than 10 clonal stems in one growing season (Figure 4B). The whorled sunflower can produce plentiful seeds, which are non-dormant, and can germinate immediately after collection. Dry, room temperature storage is best for seeds, which retain the ability to germinate for up to eight months [13].

Figure 4. Whorled sunflower propagation: (A) rooted cutting of whorled sunflower and (B) tray of whorled sunflower plantlets obtained via rooted cuttings of 'Denita's Autumn Sunshine'.

Common Fungal Diseases of Whorled Sunflower

The whorled sunflower is affected by a few fungal diseases that occur mainly on leaves. These are powdery mildew, leaf spots, rust and anthracnose (14-19). All the listed pathogens do not kill the plants and do not require control measures but can cause significant cosmetic damage.

Powdery mildew

Powdery mildew on whorled sunflower is caused by the fungus *Golovinomyces ambrosiae*. This disease has not been seen in wild populations; however, it can severely impact residential plantings. Symptoms appear as a white powder on upper and lower leaf surfaces and stems (Figure 5). Severe infections lead to leaf abscission and stunted plant growth [14].

Figure 5. Powdery mildew of whorled sunflower rooted cuttings caused by *Golovinomyces ambrosiae*.

Leaf spots

Three fungi cause leaf spots on whorled sunflowers: *Alternaria alternata*, *Stagonosporopsis heliopsidis* and *Cercospora* sp., whereas, among them, only *A. alteranta* was detected in wild populations in Georgia and Alabama. *A. alteranta* and *S. heliopsidis* cause small, circular, brown dead tissues, sometimes surrounded by a yellow halo, on older leaves. In contrast, *Cercospora* sp. produces small, circular spots with small, white, papery centers surrounded by a thin band of purple or black leaf tissue [15-17].

Leaf rust

Coleosporium helianthi causes leaf rust on whorled sunflower and was found at three locations in Knoxville, Tennessee. Symptoms developed in June and July as yellowish, irregularly shaped spots on the top of mature leaves. In September, yellow-to-orange spores form on the bottom surface of leaves. Leaf rust is a significant disease of whorled sunflower and reduces photosynthesis and plant development. Luckily, the rust does not affect flowering adversely but degrades the esthetic appeal of the plants [18].

Sunflower leaf anthracnose

Colletotrichum fioriniae causes sunflower leaf anthracnose that has not yet been detected in wild populations. Symptoms appear on mature leaves as irregularly shaped spots with brown centers surrounded by yellow halos [19].

Conclusion

The whorled sunflower is an ecologically important endangered plant species. The ability to accurately detect and identify diseases affecting this esthetically attractive plant is crucial for its conservation. Currently, there is no need to use fungicides to manage diseases.

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