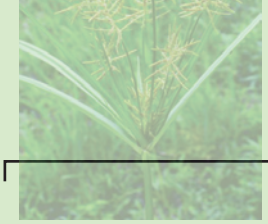



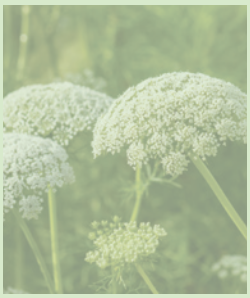

Weed Biology & Management

Biology and Management of Velvetleaf (*Abutilon theophrasti*) in Christmas Tree Production

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Mature leaves of Velvetleaf. Photo credits: Michigan State University Extension Integrate Pest Management, canr.msu.edu.

Velvetleaf (Abutilon theophrasti) is a weed historically native to Asia and India. The plant was brought to North America by English settlers in the early 18th century to be used as a potential fiber source (Spencer, 1984). Today, Velvetleaf is broadly distributed throughout the Midwest of the United States as an invasive of row crop production systems. Velvetleaf is a problematic weed species for American Christmas Tree production and is considered a noxious weed in several states including Michigan, Colorado, Washington, and Iowa (USDA, 2022). Velvetleaf is a member of the Malvaceae (Mallow) family and is named for the pubescence on their leaves which give them a velvety feel. Other names this weed is known by include buttonweed, butterprint, China jute, and American jute (Spencer, 1984). It is an erect annual herb (Warwick and Black, 1988) and reproduces through the dispersion of its seeds, where one plant is known to produce up to 8,000 seeds with the potential to spread 10-12 feet in a single season (Washington State Noxious Weed Control Board, 2021).

Biology of Fall Velvetleaf:

Habitat:

Velvetleaf inhabits disturbed areas including cropland, construction sights, fields, vacant lots, orchards, vineyards, gardens, and roadsides (University of California Agriculture and Natural Resources, 2016). It is known to occur in a range of soil types from sandy to clay loams (Warrick and Black, 1988).

Growth Habits

Velvetleaf is an annual erect herbaceous, broadleaved plant (Michigan State University, 2022). Germination is optimal between 24 – 30 degrees Celsius (75 – 86 Fahrenheit) and will typically begin to emerge in the months of March to May in the United States (CABI Invasive Species Compendium, 2022). The plant will grow during the summer months and will

typically die after the first frost, though its seeds are able to remain dormant for months until the next spring.

Seedling:

Seedlings will contain one heart-shaped and one round shaped cotyledon covered in pubescence measuring from 1/3 to 1/2 an inch (7-12 mm) in length and width. Cotyledons stalks are also covered in hair with two types possible: short and simple or star-shaped hairs. Seedlings will generate a taproot when first emerging followed by the development of lateral roots 1 to 2 days once emergence has occurred (CABI Invasive Species Compendium, 2022). The first true leaves will be alternate and heart-shaped with blunt leaf margins and a rounded tip with both sides of the leaf surface covered in dense hairs (University of California IPM, 2016).

Roots:

Velvetleaf has a fibrous root system paired with a shallow taproot and is known to demonstrate a partnership with mycorrhiza for the purpose of phosphorus nutrition (Cornell University, 2022; SARE Outreach 2021).

Shoot:

Stems are sturdy and coarse growing up to 5-7 feet (1.5 - 2.1m) tall. Mature leaves can range from 3-8 inches (7.6–20 cm) long and are just as wide (Michigan State University Plant and Pest Diagnostics, 2022). The leaves are heart-shaped, palmate, and covered in small, velvety hairs giving them their unique texture (Fig. 1). The leaves grow alternate to each other on the stalk and are connected by long, slender petioles. The bottom of the leaf will show dense, prominent veins stretching across the entire leaf. (University of California IPM, 2016; University of Wisconsin-Madison 2022).

Inflorescence:

The blooming period of Velvetleaf flowers is during the summer months, from July to August. The flowers are orangish yellow in color and radially symmetric, measuring 2/5 – 1 inch (1-2.5 cm) in diameter. They are found individually or in clusters at the axils of the leaves, where the leaf connects with the stalk. The flowers are made of 5 petals, 5 sepals, and up to 13 stamens connected to a base to form a column-like shape. (Native Plant Trust, Go Botany, 2022; University of California IPM, 2016; Abaye, 2018).

Fruit and Seeds:

Seedpods replace the flowers at the leaf axis. These seedpods are circular, cupped capsules 1 inch in length. The pods are light green during early stages of development and upon maturity turn brown, black, or greyish in color. In addition, these seedpods contain distinctive points. Each of these capsules contain 35-45 seeds and once mature will release the brown, kidney-shaped seeds. Velvetleaf seeds are 0.04-0.06 inches (0.1-0.15cm) thick and 0.08-0.1 inches (0.2-0.3cm) long. The seeds are notched on one side and appear nettled in texture as sparse, tiny hairs cover their surface. Velvetleaf seeds can remain viable for up to 60 years meaning that one plant can produce a large seed bank. (Michigan State University Plant and Pest Diagnostics, 2022; SARE Outreach, 2021; Abaye, 2018).

Propagation:

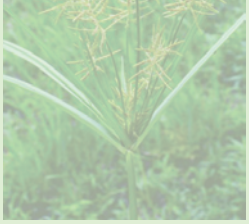
Velvetleaf propagates predominately by seed production. One velvetleaf can produce between 700 – 9,000 seeds. These seeds are dispersed through the opening of seed capsules, which can hold up to 35-45 seeds each. The seeds are dispersed by wind, wildlife, and gravity. Seeds can remain viable up to 60 years and can persist longer when buried further down within the soil profile. (Michigan State University Weed Extension, 2022).

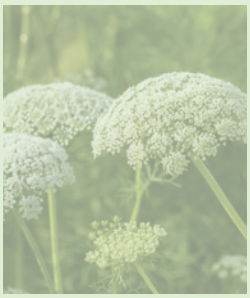
Similar Species:

Velvetleaf seedlings can easily be mis-identified as Spurred Anoda (Anoda cristata), Arrowleaf Sida (Sida rhombifolia), Prickly Sida (Sida spinosa), Common Marrow (Malva neglecta), or Venice Mallow (Hibiscus trionum). Both Prickly and Arrowleaf Sida seedlings have two-heart-shaped cotyledons. Spurred anoda seedlings also emerge with two heart-shaped cotyledons, however, Spurred Anoda does not have coarsely toothed leaf margins like Prickly and Arrowleaf Aida. Common Mallow and Venice Mallow also demonstrate heart-shaped leaves during early stages of growth; however, both plants lack velvety hairs. (Abaye, 2018; Cornell University; SARE 2021). Other similar species include Coltsfoot (Tussilago farfara) and Violet (Viola papilonacea). Coltsfoot is an erect plant with yellow blooms and heart-shaped leaves with a short taproot. Violet also has heart-shaped leaves, but largely differs from a mature Velvetleaf plant as they are smaller and contain blue and purple flower blooms (Penn State Department of Plant Science, 2022).

Non-Chemical Control:

One potential method of hindering velvetleaf emergence is the use of mulch to block sunlight required for germination and photosynthesis. In addition, velvetleaf decreases in the presence of shade, therefore cover crops may be introduced





for the purpose of increasing shade to suppress velvetleaf growth. Though both methods require further research; they are the forefront of cultural methods used to combat velvetleaf in Christmas tree farms (Saha et. al., 2020).

Chemical Control

Preemergence control: Preemergence herbicides must be applied prior to germination of the weed seeds. Herbicides known to manage velvetleaf growth include atrazine (Aatrex 4L), isoxaben (Gallery 75 DF), oxyfluorfen (Goaltender 4 SC), indaziflam (Marengo 0.622 SC), pendimethalin (Pendulum Aqua Cap 3.8 CS), flazasulfuron (Mission 25 WG), flumioxazin (Sureguard 51 WDG), hexainone (Velpar 2L), and hexinone + sulfometuron methyl (Westar 75 DG) (Zandstra and O'Donnell, 2018). Growers must be sure to check labels to determine the correct implementation of the chemical herbicides and follow the necessary guidance. Furthermore, to avoid potential phytotoxicity it is important for growers to determine how the chemical will affect the trees as the effects can vary by location or species.

Postemergence control: Postemergence herbicides that have demonstrated a level of control over velvetleaf in Christmas tree production systems include 2,4-D (Defy amine 4; Turret 5.5 L), triclopyr (Garlon 3A), oxyfluorfen (Goaltender 4SC), and glyphosate (Roundup ultra 4L) (Zandstra and O'Donnell, 2018). The timing of application for these chemicals varies, however, these chemicals should not be applied to stressed trees or to those actively growing during early – to mid- summer, as this increases risk for phytotoxicity to occur on tree foliage. Christmas trees are moderately tolerant for low doses of postemergence herbicides, but smaller trees can be sensitive. Before application growers must always follow label instructions regarding the proper age, time, and size a tree should be for postemergence applications.

REFERENCES

Abaye, A. O. (2018). *Common grasses, legumes and forbs of the eastern United States: identification and adaptation.* Academic Press.

CABI – Invasive Species Compendium. 1987. Abutilon theophrasti (velvetleaf). https://www.cabi.org/isc/datasheet/1987. (Accessed June 24, 2022).

Cornell University – Weed Ecology and Management Laboratory. 2022. Velvetleaf. https://weedecology.css.cornell.edu/weed/weed.php?id=2. (Accessed June 24, 2022).

Cornell Weed Identification. 2022. Velvetleaf. https://blogs.cornell.edu/weedid/velvetleaf/. (Accessed June 24, 2022).

IA State – Crop Extension. 2022. Velvetleaf – Weed Identification Agronomy 217. https://crops.extension.iastate.edu/files/article/velvetleaf_0.pdf.(Accessed June 24, 2022).

Michigan State University Extension Field Crop. 2022. Velvetleaf. https://www.canr.msu.edu/weeds/extension/velvetleaf. (Accessed June 24, 2022)

Michigan State University Plant and Pest Diagnostics. 2022. Velvetleaf – Abutilon theophrasti. https://www.canr.msu.edu/resources/velvetleaf-abutilon-theophrasti. (Accessed June 24, 2022).

Native Plant Trust – Go Botany. 2022. Abutilon theophrasti – velvetleaf Indian-mallow. https://gobotany.nativeplanttrust.org/species/abutilon/theophrasti/. (Accessed June 24, 2022).

Abaye, A. O. (2018). *Common grasses, legumes and forbs of the eastern United States: identification and adaptation.* Academic Press.

Penn State Department of Plant Science. 2022. Extension and Outreach - Velvetleaf. https://plantscience.psu.edu/outreach/plant-id/broadleaf/velvet-leaf-1. (Accessed June 24, 2022).

SARE Outreach – Manage Weeds on Your Farm. 2021. Velvetleaf. https://www.sare.org/publications/manage-weeds-on-your-farm/velvetleaf/. (Accessed June 24, 2022).

Spencer, N. R. (1984). Velvetleaf, Abutilon theophrasti (Malvaceae), history and economic impact in the United States. *Economic Botany,* 38(4), 407-416.

Spencer, N. R., Sankaran, T., & Delfosse, E. S. (1985). Prospects for biological control of velvetleaf (Abutilon theophrasti). In *Proceedings of the VIth International Symposium on Biological Control of Weeds, Agriculture Canada, Vancouver Canada* (pp. 167-175).

University of California IPM. 2016. Velvetleaf *(Abutilon theophrasti)*. http://ipm.ucanr.edu/PMG/WEEDS/velvetleaf.html. (Accessed June 24, 2022)

University of Wisconsin-Madison – Wisconsin Horticulture Division of Extension. 2022. Velvetleaf, *Abutilon theophrasti.* https://hort.extension.wisc.edu/articles/velvetleaf-abutilon-theophrasti/. (Accessed June 24, 2022).

USDA. (2022, February). *All states noxious-weed seed list - Agricultural Marketing Service.* State Noxious -Weed Seed Requirements Recognized in the Administration of the Federal Seed Act. Retrieved June 9, 2022, from https://www.ams.usda.gov/sites/default/files/media/StateNoxiousWeedsSeedList.pdf

Warwick, S. I., & Black, L. D. (1988). THE BIOLOGY OF CANADIAN WEEDS.: 90. Abutilon theophrasti. *Canadian Journal of Plant Science,* 68(4), 1069-1085.

Washington State Weed Control Board. 2022. Velvetleaf *(Abutlion theophrasti).* https://www.nwcb.wa.gov/weeds/velvetleaf. (Accessed June 24, 2022).

Wymore, L. A., Watson, A. K., & Gotlieb, A. R. (1987). Interaction between Colletotrichum coccodes and thidiazuron for control of velvetleaf (Abutilon theophrasti). *Weed Science,* 35(3), 377-383.

Zandstra, B. and J. O'Donnell. 2018. Weed control in Christmas trees. Michigan State University extension bulletin E3237. https://www.canr.msu.edu/christmas_trees/uploads/files/e3237%20wcag%202.0.pdf