



Identifying and managing yellow woodsorrel (*Oxalis stricta* L.) in nurseries and greenhouses

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Container-grown ornamental plants need to be weed-free or there is the risk of significantly reduced growth, aesthetics and the market value of nursery crops (Fretz, 1972). Yellow woodsorrel (*Oxalis stricta*), also known as oxalis, is one of the most common broadleaves weed species in container nurseries and greenhouses in Michigan. It is an annual weed species in cool climates, such as the northern United States, and a perennial weed in warmer regions. Oxalis is native to North America and is widely distributed throughout the world including the eastern and central United States, Europe, Africa, Asia, Japan and New Zealand (Lollar and Marble, 2015).

Oxalis is difficult to control because it can spread by rhizomes, stolons and by seeds, which have no dormancy requirement. According to Neal and Derr, 2005, oxalis populations can negatively affect the growth rates of ornamental crops. This bulletin will aid in oxalis identification, understanding its biology and developing management strategies.

Yellow woodsorrel biology and identification

HABITAT

Oxalis naturally grows in woodlands, grasslands, disturbed areas and turf. It can be found growing in the drain holes of containers or on the surface of container media (Fig. 1) in nurseries and greenhouses under full sun and partial sun conditions. Oxalis can also be found growing in sidewalk cracks, alongside trails, flower beds, lawns, cultivated fields and even in container nursery stock.

GROWTH HABITAT

Oxalis is herbaceous and usually grows upright with extensive branching but may also grow flat along the soil surface (Lollar and Marble, 2015). Branches or unbranched stems arise from fleshy



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Figure 1. A mature yellow woodsorrel (*Oxalis stricta*) growing on container media surface inside a greenhouse.

rhizomes in the soil or substrate. The underground rhizomes can overwinter depending on the severity of the weather (Marshall, 1987). The plant height ranges from 6 to 20 inches.

SEEDLING

The cotyledons have a pinkish tint with alternate trifoliate leaves. Leaves are very thin and herbaceous with three heart-shaped leaflets. The upper surface of the leaflets is smooth while there is minimal pubescence (hair) on the lower leaf surfaces and margins (Lollar and Marble, 2015).

ROOTS

The tap root is the main root system of this plant. The rhizomes (underground stems) can also form secondary fibrous root structure.

SHOOT

The stems are soft, herbaceous and light green with slight pubescence (hair). The leaves are alternate, palmately compound and light green



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Figure 2. Arrows showing palmately compound leaf with heart-shaped leaflets.

with smooth margins and heart-shaped (cordate) leaflets (Fig. 2). Leaflets are generally 0.2 to 0.4 inches long and 0.2 to 0.4 inches wide.

INFLORESCENCE

The inflorescence is an open branched cluster (a cyme) of two to five long-stalked flowers. Flowers are bright yellow with five petals (Fig. 3). They are approximately 0.5 inches in diameter and bloom from spring through fall (Lollar and Marble, 2015).



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Figure 3. Bright yellow five-petaled flower of yellow woodsorrel (*Oxalis stricta*).

SEEDPODS

The seedpods (fruit) of oxalis are in the form of capsules that resemble the shape of okra pods (Fig. 4). The capsules have five ridges and are approximately 0.5 inches long. The seedpods, which are produced from spring through fall, explosively burst when touched, thereby



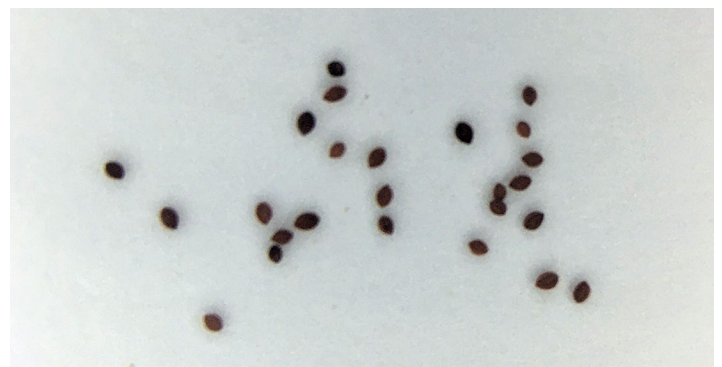
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Figure 4. Seed capsules of yellow woodsorrel (*Oxalis stricta*) resemble the shape of okra pods.

spreading seeds out rapidly up to 16 feet away from the parent plant (Neal and Derr, 2005).

SEEDS

The seeds are very tiny, teardrop-shaped (Fig. 5) and brown (Lollar and Marble, 2015). A single oxalis plant can produce up to 5,000 seeds per year and have an almost 100% germination rate immediately after dispersal (Holt and Elmore, 1985). Oxalis seeds are photoblastic, meaning they require light for germination, and the optimum temperature requirement for germination ranges from 50 to 84 degrees Fahrenheit; however, seeds have a broader germination temperature range when produced in warmer months than seeds produced during cooler months (Holt and Elmore, 1985).



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Figure 5. Teardrop-shaped and brown colored seeds of yellow woodsorrel (*Oxalis stricta*) under 10X magnification.

SIMILAR SPECIES

Creeping woodsorrel (*Oxalis corniculata*) is a similar species that often has darker green to purplish leaves, grows more flat and produces stolons, which are aboveground plant stems that roots at the nodes (Hall, Vandiver, and Sellers, 2012). The foliage of creeping woodsorrel is more pubescent than yellow woodsorrel, especially along leaf margins (Lollar and Marble, 2015).

Pink sorrel (*O. debilis* var. *corymbosa*) is another species of oxalis that has larger leaves, purple flowers and reproduce by bulbs and seeds (Fig. 6) (Lollar and Marble, 2015). Other species of oxalis, including *Oxalis purpurea* cultivars, which have large, pink flowers, are commercially propagated as ornamentals.



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Figure 6. Purple colored flower of pink sorrel (*Oxalis debilis* var. *corymbosa*).

White clover (*Trifolium repens*) have similar shaped leaves (Fig. 7) but the flowers are whitish and produced in ball-shaped clusters. Clover belong to a completely different plant family. Black medic (*Medicago lupulina*) also has similar leaves. However, the distinguishing features of black medic are dark green leaves, yellow flowers that are grouped in tight bunches and fruit that is a single-seeded pod.



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Figure 7. White clover (*Trifolium repens*) leaf containing three leaflets.

Birdsfoot trefoil (*Lotus corniculatus*) is another plant species that has similar leaves and can be misidentified as oxalis and some clovers. In birdsfoot trefoil, leaves are compound with five oval leaflets and flowers develop in clusters of two to eight on a long stalk.

Managing yellow woodsorrel

PHYSICAL AND CULTURAL CONTROL

Sanitation is one of the most effective methods to control oxalis in nurseries and greenhouses (Neal and Derr, 2005). Regularly check all the incoming liners and plants for oxalis before placing them in production beds, and regularly scout for this weed in both crop and non-crop areas (Lollar and Marble, 2015). Oxalis can propagate from cut rhizomes and stems, therefore mature oxalis should not be rototilled (Halvorson and Guertin, 2003).

You can achieve the best control by hand weeding young oxalis plants prior to the seed capsule development, usually six weeks or younger. According to Halvorson and Guertin, 2003, hand weeding should be done when soil is moist to avoid displacing small ornamentals and to ensure all vegetative portions including roots and rhizomes are removed. Using a shallow layer of organic mulch can also reduce oxalis populations by blocking the light required for germination (Holt and Elmore, 1985).

CHEMICAL CONTROL

Preemergence control

Most of the preemergent herbicides that are labeled for nursery and landscape use can control oxalis emerging from seed in container and field production; however, they will not be as effective if plants are emerging from roots or rhizomes left behind after hand weeding (Lollar and Marble, 2015). Preemergence herbicides labeled for use in ornamental crop production that provide oxalis control are listed in Table 1 (see next page).

For effective control, the containers and planting beds need to be completely weed free at the time of preemergence herbicide application. The only preemergent herbicide that can be used in a greenhouse or a fully enclosed structure is indaziflam (Marengo). Indaziflam also provides some control on emerged oxalis until the four-leaf stage (Marble et al., 2013). Marengo needs to be applied as directed application, avoiding contact with ornamental foliage.

Table 1. Preemergence herbicides labeled for use in ornamental crop production to control yellow woodsorrel (*Oxalis stricta* L.) (adapted from Lollar and Marble, 2015).

Common name (active ingredient)	Trade name and formulation	Efficacy ¹	Container production	Field production	Greenhouse or fully enclosed structures
indaziflam ²	Marengo [®] 0.622 SC	C	No ³	Yes	Yes ⁴
	Marengo [®] 0.0224G		Yes	Yes	No
flumioxazin	Broadstar [™] 0.25G	C	Yes	Yes	No
	Sureguard [®] 51WDG		Yes ⁵	Yes ⁵	No
pendimethalin	Pendulum [®] 2G	S-C	Yes	Yes	No
	Pendulum [®] 3.3EC, 3.8AC		Yes	Yes	No
oryzalin	Surflan [®] 4AS	C	Yes	Yes	No
	Oryzalin 4 Pro		Yes	Yes	No
dithiopyr	Dimension [®] 2EW	C	Yes	Yes	No
prodiamine	Barricade [®] 4FL, 65WG	S-C	Yes	Yes	No
trifluralin	Treflan 5G	S	Yes	Yes	No
oxadiazon	Ronstar [®] 2G	C	Yes	Yes	No
dimethenamid-P	Tower [®] 6EC	C	Yes	Yes	No
isoxaben	Gallery [®] 75DF, 4.16SC	C	Yes	Yes	No
pendimethalin + dimethenamid-p	FreeHand [®] 1.75G	C	Yes	Yes	No
prodiamine + isoxaben	Gemini [™] 3.7SC	C	Yes	Yes	No
s-metolachlor	Pennant Magnum [®] 7.6 EC	P-S	Yes	Yes	No
trifluralin + isoxaben	Snapshot [®] 2.5TG	C	Yes	Yes	No
oxyfluorfen + oryzalin	Rout [®] 3G	C	Yes	Yes	No
oxyfluorfen + pendimethalin	OH2 [®] 3G	C	Yes	Yes	No
oxyfluorfen + prodiamine	Biathlon [®] 2.75G	C	Yes	Yes	No

¹P = poor control; S = suppression; C = good control

²Indaziflam is also available by trade name Specticle which can be applied to turf and landscape sites.

³Marengo[®] 0.622 SC can be used in pot-in-pot container ornamentals as a directed application only.

⁴Labeled for use on greenhouse floors prior to plant production. Can be applied in empty greenhouse and plants can be placed back inside greenhouse after 24 hrs of application.

⁵Can only be used in selected conifer and deciduous tree species. Check manufacturer's label for complete list of species and recommended application methods.

Early postemergence control

There are several postemergence herbicides that have showed successful control of oxalis in field or outdoor container production. A list of herbicides labeled for use in and around ornamentals that provide early postemergence control of oxalis is given in Table 2. According to Saha et al., 2018, isoxaben (Gallery 4SC), dithiopyr plus isoxaben (Dimension 2EW plus Gallery

4SC), dithiopyr (Dimension 2EW) and prodiamine plus isoxaben (Gemini SC) have shown acceptable (more than 80%) control of oxalis during its earliest growth stages: from cotyledon up to the six leaf stage. Indaziflam (Specticle FLO) has shown excellent control until the oxalis plants have 12 leaves.

Table 2. Herbicides labeled for use in ornamental production that have shown early postemergence yellow woodsorrel (*Oxalis stricta* L.) control.

Common name (active ingredient)	Trade name and formulation	Efficacy ¹	Field Container production	Greenhouse or fully enclosed structures	Notes
sulfentrazone	Dismiss [®] 4F	C	Yes	No	Excellent control of cotyledon stage to 1-2 leaf stage with 8 and 12 fl oz
isoxaben	Gallery [®] 75DF	C	Yes	No	Very good to excellent control with 1 lb. active ingredient per acre as a preemergent from the cotyledon to one leaf stage. Provides poor control at 2-4 leaf stage.
flumioxazin	Sureguard [®] 51WDG	C	Yes	No	Excellent control of all growth stages with 0.383 lb. of active ingredient per acre.
indaziflam	Marengo [®] 74SC	C	Yes	No	Excellent control at all stages with 0.045 and 0.089 lb. active ingredient per acre.

¹P = poor control; S = suppression; C = good control

Other herbicides that have shown significant early postemergence control of oxalis are sulfentrazone (Dismiss 4F) and flumioxazin (Sureguard 51WDG). However, none of these postemergence herbicides are labeled for use in a greenhouse or other fully enclosed structure.

Postemergence control

Several postemergence herbicides are effective for mature oxalis control (i.e., greater than 12 leaves), but have similar restrictions to the early postemergence herbicides. Most of these herbicides need to be applied as a directed application and are most effective when the weeds are actively growing and small (Lollar and Marble, 2015). Some of the effective active ingredients include glyphosate (RoundUp), diquat (Re-

ward), glufosinate (Finale) and pelargonic acid (Scythe). Contact herbicides such as diquat and pelargonic acid requires thorough coverage for effective control. Before application, always consult the manufacturer's label and follow all precautions while applying herbicides.



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