

Biology, Ecology and Management of

Yellowflag Iris

(*Iris pseudacorus* L.)



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Terms in bold can be found in the glossary on page 11.

Cover photo of Yellowflag iris infestation along irrigation ditch courtesy of Monica Pokorny, 2010.
Inset cover photo courtesy of Jane Mangold, 2010.

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Yellowflag iris (*Iris pseudacorus* L.) is an introduced wetland plant that is now widespread throughout North America. It can displace desired vegetation, decrease wildlife habitat and livestock forage, and reduce water flow in irrigation systems. It was first reported in Montana in 1966 (Lake County). The plant disperses by seeds and rhizomes which move throughout the riparian areas that this species inhabits. Prevention, early detection and immediate action to contain or eradicate infestations are most important for management of this plant in Montana.

PLANT BIOLOGY

Identification

Yellowflag iris, a member of the iris family (Iridaceae), is an herbaceous perennial, wetland plant. Plants grow from a stout **rhizome** which ranges in diameter from 0.4 to 2 inches (1-5 centimeters, Figure 1). The sap of the rhizome is black. Roots are normally 4 to 8 inches (10-20 centimeters) long but may reach lengths of 12 inches (30 centimeters). Plants are 3 to 5 feet (1-1.5 m) tall with long, linear leaves. Each plant has few to several leaves which are 20 to 40 inches (50-100 cm) long and about 0.4 to 1.2 inches (10-30 cm) wide. Yellowflag iris leaves emerge from the ground in a fan-like arrangement (Figure 2). Leaves are similar to common garden iris and are smooth edged, mostly **basal**, and flattened with a sword-like pointed tip. Leaves have a raised midrib and are erect with the upper part of the leaf having an arching appearance. Several flowers are born on the erect flower stalks that are round in cross-section and often branched. Beneath each flower is a large solitary bract, with thin, dry margins that lack green color. Flower **pedicels** are about 1.5 to 3 inches (4-8 cm) long, about the length of the **ovary**. The large pale yellow to deep yellow flowers have six segments including



FIGURE 1. Rhizome of yellowflag iris (photo courtesy of Leslie Mehrhoff, University of Connecticut, 2010).



FIGURE 2. Leaves of yellowflag iris (photo courtesy of www.texaswaterlilies.com, 2011).



FIGURE 3. Yellowflag iris flower (photo by Nancy Loewenstein, Auburn University, bugwood.org).

three downward pointing **sepals** and three upward pointing petals (Figure 3). The petals are usually smaller than the sepals. Some sepals and petals have light brown to purple veins or flecks. The style has three petal-like yellow branches, and on the underside near the tip is a small lip-like **stigma**. The three **stamens** are hidden beneath the three **style** branches. The fruit is a three-angled cylindrical **capsule** 1 to 4 inches (2.5-10.5 cm) long (Figure 4). Each fruit has three chambers that contain two

rows of flat brown seeds (Figure 5). The seeds are smooth, disc-shaped, variable in size, and initially green but turn dark brown when mature.

Only two species of *Iris* are known to occur in Montana outside of horticultural plantings: one is yellowflag iris, and the other is the native species Rocky Mountain iris (*Iris missouriensis*). The native iris has blue to purple flowers so it is unlikely to be mistaken for yellowflag iris when in bloom. When not in bloom, the two can be distinguished by the leaves or rhizomes. The leaves of Rocky Mountain iris grow to a height of 8 to 16 inches (20-40 centimeters), generally shorter than leaves of yellowflag iris, and the rhizomes of the Rocky Mountain iris lack black sap.

Life History

Yellowflag iris reproduces from both rhizomes and seeds. Rhizomes increase in size from year to year unless flowering occurs or the rhizomes branch, which typically occurs after flowering. The seasonal accumulation



FIGURE 4. Seed capsule of yellowflag iris showing immature seeds (photo courtesy of Monica Pokorny, 2010).

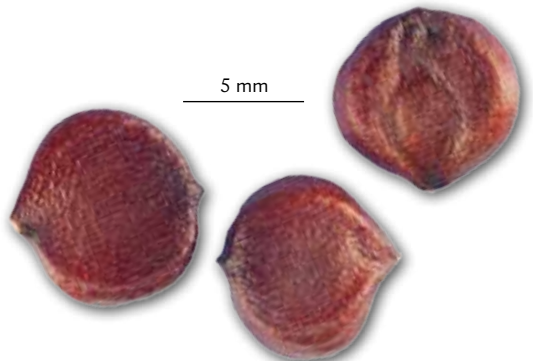


FIGURE 5. Mature seeds of yellowflag iris (photo courtesy of Steve Hurst, bugwood.org, 2010).

of carbohydrates in the rhizomes results in annual segments that can be counted to determine plant age. The rhizomes have air spaces in the cellular tissues that facilitate survival in low oxygen conditions characteristic of the riparian habitats that this species inhabits. Carbohydrates are stored in rhizomes, roots, leaf bases, and developing flower shoots. One study documented excavated rhizomes that continued growing for three months indoors without water, indicating they can tolerate extensive drought. Rhizomes and leaves contain glycosides that deter **herbivory**. Vegetative (leaf) growth on rhizomes can occur all year when winters are mild. Leaf growth peaks from April to June, and few new leaves grow after July. Leaves start to die in July.

SpeedyWeed ID

Yellowflag iris is fairly easy to identify, but could be mistaken for the native Rocky Mountain iris (purple flowers and shorter leaves [8 to 16 inches], Figure 6) or cattail (*Typha latifolia*, Figure 7) which has round leaf bases (Figure 8A). If you are unsure whether a plant is yellowflag iris, check for the following characteristics:

- Black rhizome sap.
- Plants 3 to 5 feet (1-1.5 m) tall.
- Basal leaves that emerge in a fan-like arrangement (Figure 8B).
- Smooth edged, flattened, sword-like leaves with a pointed tip and have raised midrib.
- Large pale yellow to deep yellow flowers.
- Fruit that is a three-angled cylindrical capsule 1 to 4 inches long.
- Smooth, disc-shaped seeds that are dark brown when mature.



FIGURE 6. Rocky Mountain iris (photo courtesy of Monica Pokorny, 2010).



FIGURE 7. Broadleaf cattail (photo courtesy of Naturesongs.com, 2011).



FIGURE 8. Leaf bases of A) cattail (photo courtesy of the North Carolina Native Plant Society, 2011), and B) yellowflag iris (photo courtesy of Monica Pokorny, 2010).

Most flowers bloom between May and July. Flowers are insect pollinated. A study in Europe found that insect species visiting flowers included bumblebees, honey bees, solitary bees and hoverflies. Seeds are produced between July and October. Plants produce about 6 seed pods each; however, the number of seeds per pod varied from 6 to 120 with many seeds undeveloped and not viable.

The percentage of seeds that germinate is variable. Laboratory studies found germination of freshly collected seeds was 48 percent at 40° Fahrenheit (5° Centigrade). Scarification increased germination to 70 percent, and washing seeds with xylene to remove a fat-like substance from the seed coat increased germination to over 80 percent. Most seeds germinate in spring but some germinate in summer as well. Seeds rarely germinate in autumn. Monitoring under field conditions indicates that 20 percent of seeds dispersed in October germinated the next spring, with an additional 20 percent germinating the following year.

During germination under normal growth conditions, the root emerges and grows for about five days. The shoot emerges on the seventh day, and the first leaf appears on the tenth day. After one month seedlings can have three leaves, lateral roots, and adventitious roots. The proportion of roots relative to shoots is high during early seedling development, which is believed to prevent the seedling from being washed from muddy substrates and improves survival and establishment.

CURRENT STATUS AND DISTRIBUTION

Yellowflag iris is native to Europe, northern Africa, the Mediterranean region, and temperate Asia. It was brought to North America as a valued horticultural plant and has since escaped cultivation. It was documented in the state of Virginia as early as 1771. Yellowflag iris is sometimes used in water gardens around the country and continues to escape cultivation. This species is now widely distributed across most of the United States with the exceptions of North and South Dakota, Wyoming, Iowa, Colorado, Oklahoma, New Mexico, Arizona, Alaska and Hawaii (Figure 9). This species is listed as a noxious weed in Connecticut, Massachusetts, New Hampshire,



FIGURE 9. States and provinces in North America where yellowflag iris has been reported (NRCS Plants Database, <http://plants.usda.gov/>).

Oregon, Washington and Montana. It is listed as a Priority 2A noxious weed in Montana, indicating it is common in isolated areas. Yellowflag iris was first documented in Montana in Lake County in 1966. It has been reported in the following seven counties: Lake, Flathead, Missoula, Ravalli, Granite, Sanders and Gallatin.

ECOLOGY

Habitat

Yellowflag iris occurs in temperate climates, typically in plant communities associated with water. It has been documented from sea level to 4300 feet (1300 m) in elevation, and can grow in full sun to partial shade. It can be found in forested or open wetlands, riparian and floodplain communities, and in swamps. It is also associated with depressions within terrestrial habitats and ground water seepages. It forms dense clumps in shallow water or wet places around lakes and ponds, often encircling the entire edge of ponds. Yellowflag iris also grows along the banks of streams, rivers and irrigation ditches where it can form monocultures along the banks. It typically grows in shallow water but has been found growing in water depths of 2 to 3 feet. Rhizome clumps can form floating mats as well. It usually grows on water-deposited (silt, sand, gravel or cobble) substrates and is associated with calcareous, sandy loam, clay loam and peat soils. It also usually grows on sites with continuously high soil water content, but not necessarily submerged soil, and it can grow in seasonably dry soil. It tolerates soil pH ranging from 3.6 to 7.7. It requires high levels of soil nitrogen, and tolerates high levels of organics and low levels of oxygen.

Spread and Establishment Potential

Because yellowflag iris was introduced to North America as a horticultural plant, it has the potential to continue spreading through gardeners acquiring the plants from garden dealers and over the internet until the sale of the species is banned. Once established, yellowflag iris reproduces by seed and vegetatively through rhizomes. Along rivers and streams, flooding may transport rhizomes or seeds downstream where they subsequently establish new colonies. Wave action along lake shores may also break-up rhizome clumps and result in establishment of new colonies along the shore. Dry rhizomes remain viable for more than three months and may establish if moistened. Once established, individual rhizomes may persist for 10 years.



FIGURE 10. Floating seeds of yellowflag iris
(Photo courtesy of Monica Pokorny, 2010).

Reproduction by seed is thought to be more important than vegetative reproduction. Long distance dispersal can occur by seeds floating downstream with the flow of water (Figure 10).

Some seeds of yellowflag iris contain air in their seed coats allowing them to float readily before coming to rest on exposed soil above the water level. The ability of yellowflag iris seeds to float for long periods of time contributes to long

distance dispersal. In laboratory seed-buoyancy tests, 95 percent of yellowflag iris seeds floated for two months, 25 percent remained floating for 354 days, and 10 percent of the seeds were still floating after 429 days. The longevity of yellowflag iris seeds in the seed bank is unknown.

Damage Potential

Yellowflag iris forms dense monotypic colonies in riparian areas where it crowds-out native species, thus reducing plant community diversity. This may result in altered riparian area function and reduced habitat for a diversity of wildlife, bird, fish and pollinator species. In the eastern United States, reduction of native sedges and rushes that support waterfowl is associated with yellowflag iris invasion. Yellowflag iris has also been found to facilitate its own spread by contributing to soil compaction and hardpan development, which prevents other desired species from establishing on a site. Clumps of yellowflag iris can restrict or eliminate water flow in irrigation and flood control ditches, and seeds clog water control structures. It also may reduce available forage for livestock. It is considered poisonous due to large amounts of glycosides in the leaves and rhizomes, which make the plant unpalatable to livestock. Animals eating hay containing yellowflag iris commonly experience gastroenteritis. Cattle have been found to suffer acute diarrhea after eating rhizomes. Not only do livestock grazers avoid eating the plant, but they avoid grazing other palatable species where yellowflag iris grows densely. For humans, yellowflag iris can cause skin irritation or allergic reactions. It is of little value for wildlife, but muskrats do use it for building dens.

Because yellowflag iris tolerates low oxygen, it lives in high levels of soluble organics and may reduce the organic load by 25 percent over one year. Within a 24-hour period, yellowflag iris rhizomes reduced *Echerichia coli* populations by 50 percent, *Salmonella* by 70 percent, and *Enterocoli* by

60 percent. It has been suggested that yellowflag iris can absorb heavy metals efficiently and economically from wastewater because of its ability to absorb the metals and survive in unfavorable conditions.

MANAGEMENT ALTERNATIVES

In Montana yellowflag iris is listed as a Priority 2A noxious weed, indicating that populations are common only in isolated areas and should be contained or eradicated if possible. Management is prioritized by local weed districts. Therefore, contact your local weed coordinator or county Extension agent if populations are present.

Prevention

Prevention and early detection are the most important management tools for yellowflag iris throughout Montana. Early detection of new populations is important to prevent the spread of this weed. Regular monitoring of riparian and wetland areas, particularly near or downstream of known populations is critical. Clean equipment and vehicles to prevent the spread of seeds or rhizomes when moving from infested areas to non-infested areas, eradicate small patches, and contain or control large infestations. In irrigation ditches where yellowflag iris populations are present, woven wire (hardware cloth) screens constructed at irrigation turnouts have been found to limit or prevent spread into adjacent ditches and wetlands. These screens require limited maintenance if constructed in a convex design to allow seeds or debris to bounce off the screen and continue down-current in the already infested areas while preventing movement into adjacent wetlands.

Chemical Control

Glyphosate is the most widely used chemical for yellowflag iris management. A 5 to 8 percent solution (1 to 2 quarts/acre) of an aquatic label glyphosate (Rodeo®) applied with a surfactant to actively growing foliage in late spring or early summer has been effective. Missoula County weed managers have experienced up to 90 percent control using an 8 percent glyphosate solution when yellowflag iris begins to flower by applying the herbicide to the folds of the leaves. Spraying in the spring or early summer may prevent seed development. Lake County weed managers have found spraying a 2 to 8 percent glyphosate solution (1 pint to 2 quarts/acre) after the first frost in the fall provides effective control. Follow-up treatments are needed to treat newly emerging plants. Glyphosate is a non-selective herbicide and revegetation to provide competition to re-establishing yellowflag iris may be needed (see the Revegetation section on the following page).

Chemical control of yellowflag iris may require direct application of herbicides to wetlands or riparian areas. Use only herbicides approved for aquatic use by the U.S. Environmental Protection Agency. Check with state agencies for permitting and licensing requirements when working in wetlands. An Aquatic Pest Endorsement for a Montana Department of Agriculture Pesticide License may be required. Vegetable or methylated seed oil (MSO)-based surfactants should be used because they are safer than non-ionic surfactants (NIS) for aquatic animals and amphibians. Carefully follow label instructions and use restrictions.

Mechanical Control

Digging or grubbing rhizomes may be effective if all rhizomes are removed. Retreatment to remove missed rhizomes will most likely be necessary. Removed rhizomes should be disposed of in a landfill away from riparian areas. Gloves and skin protection are recommended to prevent skin irritation. Repeated mowing of the entire plant or clipping flowering stalks may prevent seed production or reduce spread by rhizomes through depletion of energy reserves. Using mowing equipment that simultaneously applies herbicide (wet blade mower) may also be a way to target yellowflag iris for herbicide control while reducing non-target impacts.

Biological Control

There are no biological control agents developed or approved for the management of yellowflag iris in the United States.

Cultural Control

Grazing: Yellowflag iris is usually avoided by cattle, sheep, goats, horses and rabbits because of glycosides present in the leaves. Unpublished reports indicate sheep eat early season leaves, and cattle will eat leaves down to the rhizomes if leaves are present and short in the autumn.

Prescribed burning: Prescribed fire is not likely to be a useful management tool for yellowflag iris or other plants in wetland or riparian plant communities where fires are typically rare and native species are not fire-adapted.

Fertilization: Fertilization is not effective for managing yellowflag iris because this species benefits from increases in nutrients.

Flooding: Yellowflag iris is adapted to tolerate long periods of inundation, therefore flooding is not an effective management tool.

Revegetation: Revegetation with desired species may be necessary after the removal of dense populations of yellowflag iris with herbicide, particularly in areas of moving water where erosion is possible. In many cases, removal

Yellowflag Iris Uses and Lore

Yellowflag iris has a long history of human use. Most commonly it has been used as an ornamental plant in water gardens and in flower arrangements. It has been planted throughout the world with several cultivars developed. It was also used for erosion control and in sewage treatment cells of water treatment plants. The dried and powdered roots were used as snuff. The seeds were roasted and prepared like coffee. The flowers were used to make a yellow dye and the plant used for fiber. The rhizomes were used as a powerful herbal laxative and emetic.

of this aquatic weed leaves bare, exposed soils. Adding native woody or herbaceous species through container plantings or willow cuttings can help stabilize the banks and provide diversity and structure for wildlife.

INTEGRATED WEED MANAGEMENT (IWM)

In Montana populations of yellowflag iris have proven their ability to overtake large areas of riparian and wetland systems. Attempts to control these populations have been expensive and the risks to the integrity of sensitive riparian habitats are high. Therefore, early detection and rapid response are critical to management of this weed. Scouting, identification and removal of populations using glyphosate, digging of rhizomes, cutting flowering stalks, or any combination of these are the primary components of yellowflag iris IWM. Preventing seed development and dispersal is critical.

GLOSSARY

Basal – located at bottom of stem.

Capsule – dry fruit with more than one seed.

Herbivory – the consumption of herbaceous vegetation.

Ovary – the female part of the plant containing the structure which develops into a seed.

Pedicel – a small stalk or stalk-like part bearing a single flower.

Rhizome – a horizontal stem growing beneath the ground; can develop roots or sprouts at joints.

Sepals – one of the outermost flower structures, usually enclosing the other flower parts in bud.

Stamen – organ of the flower containing the pollen; male part of flower.

Stigma – pollen-receiving tip of female part of flower, usually sticky.

Style – stalk-like portion of the female part of the flower between the ovary and stigma.

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