



## VEGETATION MANAGEMENT GUIDELINE

Chinese yam (*Dioscorea oppositifolia* L.; syn. *D. batatas* Dcne.)

### SPECIES CHARACTER

#### DESCRIPTION

Chinese yam or cinnamon vine (*Dioscorea oppositifolia* L.; syn. *Dioscorea batatas* Decaisne, *Dioscorea divaricata* Blanco, and *Dioscorea opposita* Thunberg) is a perennial, herbaceous vine native to China that was introduced into the United States as a vegetable in the mid 1800's (Prairie Farmer 1859) and was later sold as an ornamental. This species has large tubers that grow vertically in the ground at a depth of nearly 1 m from a slender rhizome. The leaves are usually opposite but they may also rarely be alternate or whorled. Leaves may be ovate (egg-shaped) or hastate (shield-shaped) with a heart-shaped base and a tapered tip. The junction of the petiole and leaf blade often has a distinctive red-purple color. A small aerial tuber, called a bulbil or tubercle, is usually produced in each leaf axil. Bulbils range in size from 0.7 to 3.0 cm long and are produced at a rate of 10-20 per each meter of stem. Stems are angled, twine in a clockwise fashion, and can reach lengths of 7 m. Staminate plants have bell-shaped flowers in axillary spikes or panicles at the ends of branches. Staminate flowers are produced from June through August. These flowers often have a spicy, cinnamon fragrance. It is thought that pistillate plants do not occur in the United States. Thus, the spread of this species from original garden or ornamental plantings is attributed to bulbil production.

#### SIMILAR SPECIES

Chinese yam may be confused with other native, herbaceous vines with alternate or opposite leaves. There are two native yam species in Illinois, *Dioscorea quaternata* (Walter) J.F. Gmelin and *D. villosa* L. Each of these wild yam species lacks aerial bulbils and the hastate leaf shape. They have thick, horizontal rhizomes instead of tubers and pistillate plants often form large masses of capsules. Climbing buckwheat (*Polygonum scandens* L.) is a perennial vine with cordate or ovate leaves that has white flowers and a triangular achene fruit. Wild sweet potato vine [*Ipomoea pandurata* (L.) G.F. Meyer] is a similar perennial vine with a large underground tuber-like root, alternate, cordate leaves, and it has white, funnel-shaped flowers with a purple center. Bluevine [*Cynanchum laeve* (Michx.) Pers.] is a similar opposite leafed, perennial vine with cordate to ovate leaves that has milky sap, small greenish-white flowers in clusters, and a follicle fruit that contains many seeds, each with a mass of silky hairs.

#### DISTRIBUTION

Chinese yam is native to the temperate forests of eastern China. It



was introduced into the United States in the mid 1800's. This species is currently found in 23 states from Vermont south to Georgia and west to Oklahoma and Kansas. Chinese yam is hardy to zone 5, which has a potential low temperature range of -10 to -20 F.

In Illinois, Chinese yam is currently known from 20 counties and 68 populations. It has been collected in 13 counties and 54 populations and has been reported from seven counties and 14 populations. Eighty percent of the populations are located in the southernmost counties of Hardin, Jackson, Madison, Pope, and Union; however populations are scattered in south-central Illinois and reports exist from as far north as Champaign, Lake, Montgomery, Piatt, and Pike counties. Ninety percent of the populations are located in the Ozark Hills, Shawnee Hills, and Southern Till Plain Physiographic Divisions. Over one-third of the populations are found on the Shawnee National Forest and Crab Orchard National Wildlife Refuge and populations are found in over one-half of the nature preserves and state parks in the southern one-third of the state. Chinese yam has the potential to be found throughout Illinois, primarily in the forested regions of the state.

#### HABITAT

Chinese yam can grow in a wide variety of habitats but it is found most frequently in Illinois at old home sites, along roadsides, and in the riparian corridors of creeks and streams. Optimal conditions appear to be at the forest edge with an intermediate amount of sunlight; however, this species has the ability to grow in full sun and full shade. The species seems to grow well under a wide range of soil conditions, but best growth occurs in the loamy soils of floodplains.

#### LIFE HISTORY

In Illinois, Chinese yam begins to germinate in early to mid-April. The vines grow rapidly and are 3 m or more long by June. The primary vines grow from vertically-oriented tubers that can be 1 m long and weight several kilograms. Flowers are formed in long spikes from the leaf axils of the upper portions of the vines in late June to early July. Flowers are small, white, and have a distinct cinnamon fragrance. Fruits have not been observed in plants in the United States. Bulbil production begins in July and the newly formed bulbils have the potential to form new plants if they fall from the parent plant. One bulbil is produced per leaf axil. Vines have the potential to reach 7 m in length by the time they begin to die in late September to mid-October. Leaves turn yellow or brownish in autumn and fall with other deciduous plants. Vines die but remain standing throughout the winter. Bulbils often fall from the vines during the winter but some tend to remain on the vines until the following spring. Bulbils most commonly fall within a few meters of the parent vine and gradually work into the soil with the freeze and thaw cycles.

Field observations suggest that bulbils are the most important mode of dispersal since the plant rarely flowers and has not been observed to fruit and set seed in the United States. Gravity is a primary mechanism of dispersal. Plants that are established on hilltops and ridges produce bulbils that can roll downslope and establish new colonies. Water appears to be the primary dispersal agent for bulbils along streams. Flooding events and high water velocity can transport bulbils downstream, which can potentially lead to the establishment of new colonies. Animals such as birds and small mammals

may also be dispersal agents. Chinese yam is often observed along county or state maintained roads. It is likely that roadside mowing in the fall can trap bulbils on the tractor or bush-hog. These bulbils could be transported to new locations on the mowing equipment and form new populations when they fall off.

#### EFFECTS ON NATURAL AREAS

Chinese yam has the ability to form pure stands in upland disturbed habitats (cemeteries, home sites, and roadsides) and riparian corridors. This species is primarily a threat to woody plant establishment and the late summer-autumn herbaceous graminoids and forbs. Chinese yam is an extremely invasive species that can invade even the most pristine forested habitats in the southern one-half of Illinois. Chinese yam is established in most of the watersheds in the southern 13 counties in the state. Once established, Chinese yam is difficult to eradicate and requires a long-term commitment. Populations are found in several state parks, nature preserves, and natural areas in the extreme southern portion of the state (Spivey Limestone Glade Nature Preserve, Ferne Rocks Nature Preserve, Big Creek Woods Nature Preserve, Lusk Creek Nature Preserve, Berryville Shale Glade Nature Preserve, Giant City State Park, John M. Olin Nature Preserve, Dixon Springs State Park, Lake Murphysboro State Park, Red Hills State Park, LaRue-Pine Hills Research Natural Area, Bellsmith Springs Natural Area, Cave Hill Research Natural Area, Lusk Creek Natural Area, and Poco Barrens Natural Area). These populations should be targeted for eradication and annual surveillance should be conducted to prevent new infestations. To prevent new infestations, the actual source of the invasion should be identified and controlled as well.

#### CONTROL RECOMMENDATIONS

Successful control of any invasive species requires persistence in monitoring and thoroughness in treating patches in a multi-year program. Chinese yam is difficult to control because of its rapid growth rate and capability of producing large masses of bulbils. Large tubers make established populations difficult to eradicate and provide centers of dispersal for bulbils to spread into adjacent habitats. It appears that Chinese yam is so widespread in Illinois at this time that complete eradication is impossible. However, it is important to eradicate populations in state and federal owned natural areas. Any attempt to control this species within a natural area should identify and eliminate the source of the invasion. This may require cooperating with neighboring landowners. Eradication will require several years of monitoring and follow-up treatments, but it is the only way to ensure complete control of this species in the states remnant natural areas.

#### RECOMMENDED PRACTICES IN HIGH QUALITY NATURAL COMMUNITIES

##### Chemical Control

**Roundup**, a systemic, non-selective herbicide with glyphosate as the active ingredient, may kill the aboveground foliage, but bulbils and the subterranean tuber will re-sprout. This herbicide has been used in a study of bulbil germination in North Carolina and a 2.0% active ingredient solution was not effective (50% of the bulbils germinated after being sprayed).

Care should be taken to avoid contacting nontarget plants. **Do not spray so heavily that herbicide drips off the target species.** The herbicide should be applied while backing away from the area to avoid walking through wet herbicide. By law, herbicides may only be applied as per label instructions and by licensed herbicide applicators or operators when working on public properties.

**Crossbow**, a systemic herbicide with triclopyr and 2,4-D as the active ingredients, is effective when sprayed on the dormant bulbils. Though Crossbow is primarily used to control broadleaf or dicot vegetation, a 2.5% active ingredient solution sprayed on bulbils in North Carolina inhibited their germination. There is concern about using this herbicide since 2,4-D breaks down very slowly in the environment.

**Garlon 3A or Tahoe 3A**, a systemic, non-selective herbicide with triclopyr as the active ingredient, is very effective when sprayed on the dormant bulbils; applications would be best in early spring or just as the bulbils are beginning to germinate in April. Varying concentrations have been used in Florida for invasive yam species that are woody and 3.0-10.0% solutions provide adequate control of the bulbils and the foliage. Data collected during a herbicide study in Illinois indicated that Garlon 3A applied at 1.3% inactive ingredient solution will effectively control bulbil germination and growth.

**Scythe**, a non-selective herbicide with pelargonic acid as the active ingredient, is also effective in bulbil control and it can also be used to kill the vines although re-sprouting of the tuber is very likely. Scythe, in a 5.7% active ingredient solution, was fairly effective in controlling bulbil germination in an Illinois study.

#### RECOMMENDED PRACTICES IN BUFFER AND DISTURBED SITES

All methods recommended for high quality communities can be employed on buffer areas and severely disturbed sites.

#### Fire Management Considerations

Prescribed fire in early spring may prevent germination of bulbils. Stems that have germinated will succumb to fire but the subterranean tubers will re-sprout quickly. Patchy fire temperature would be an important consideration, because low fire temperature in a stand of Chinese yam may not kill the bulbils and may promote their growth by removing litter and surrounding vegetation.

#### Mechanical control

Manual removal of bulbils and young first year plants is very effective but is labor intensive. Bulbils can be removed during the dormant season by hand or by raking. Bulbils that are missed and germinate can be easily pulled up at least during their first year of growth. First-year plants typically have a more rounded leaf shape and the stem is less sturdy and more purplish than older plants.

Mowing the vines throughout the growing season can reduce food storage in the underground tuber and can limit bulbil production if plants are mowed consistently during the growing season to prevent rapid growth from re-sprouting. Caution should be taken while mowing because dense patches of Chinese yam may conceal ditches, holes, logs, or other hazards that could pose a danger for the mower operator. Mowing equipment should be closely inspected after use to prevent bulbil spread to new locations.

## BIOLOGICAL CONTROL

Biological control involves the use of parasites, pathogens, or predators that specifically feed on the target species and reduce their populations. There are no current biological control agents being considered in the control of Chinese yam or other invasive yam species in the United States.

Years of research and testing are required when evaluating the efficacy of any control agent that is introduced into the environment because the control organism may potentially pose problems on a similar scale as the invasive species it is intended to target. Biological control is not a feasible part of an integrated pest management plan to control Chinese yam in Illinois at this time.

## FAILED OR INEFFECTIVE PRACTICES

Burning of living aboveground plant material during August with a propane torch was not effective in trails conducted on the Shawnee National Forest. Populations treated with this method readily re-sprouted and recolonized the treated area in a few weeks.

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Written in 2000 for the Illinois Nature Preserves Commission by:

Jody Shimp  
Illinois Department of Natural Resources  
11731 State Highway 37  
Benton, IL 62818

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