

Euphorbia cyparissias

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INTRODUCTORY

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AUTHORSHIP AND CITATION:

Gucker, Corey L. 2009. *Euphorbia cyparissias*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: <http://www.fs.fed.us/database/feis/> [2010, May 28].

FEIS ABBREVIATION:

EUPCYP

NRCS PLANT CODE [[109](#)]:

EUCY2

COMMON NAMES:

cypress spurge
graveyard spurge
graveyard weed

yellowweed

TAXONOMY:

The scientific name of cypress spurge is *Euphorbia cyparissias* L. (Euphorbiaceae) [48].

Diploid, tetraploid, and hybrid types: A fertile tetraploid cypress spurge type is capable of hybridizing with leafy spurge (*Euphorbia esula*) in Europe and North America [3].

Euphorbia × *pseudoesula* Schur. [5,68,82,95]

Experimental hybrids were not produced between leafy spurge and diploid cypress spurge types, although a fertile diploid type exists in Europe [82]. Additional information about the diploid and tetraploid cypress spurge types and how they affect [distribution](#), [seed production](#), [vegetative regeneration](#), and potential [impacts and control](#) of cypress spurge is presented in later sections.

SYNONYMS:

for *Euphorbia cyparissias* L.:

Tithymalus cyparissias (L.) Lamarck [112]

for *Euphorbia* × *pseudoesula* Schur.:

Euphorbia figerti Dorfl. [95]

LIFE FORM:

Forb

DISTRIBUTION AND OCCURRENCE

SPECIES: *Euphorbia cyparissias*

- [GENERAL DISTRIBUTION](#)
- [HABITAT TYPES AND PLANT COMMUNITIES](#)

GENERAL DISTRIBUTION:

Cypress spurge occurs nearly throughout middle North America. It is rare or absent from northern Canada and the southern United States. Although widely distributed in North America, cypress spurge is most common in eastern North America and dense populations are restricted to this region. Cypress spurge is native to Eurasia [90]. It is common in eastern, central, and western Europe [35], but populations occur as far east as Lake Baikal in Siberia [69] and as far south as Greece [104]. [NatureServe](#) provides a map of cypress spurge's North American distribution.

Cypress spurge is most common in the northeastern United States and in the Canadian provinces of Nova Scotia, Quebec, and Ontario [35,42]. As of the late 1980s, cypress spurge was only known from 19 sites west of Lake Huron in Canada, and this western distribution was considered similar for the United States [95]. Cypress spurge occurs in nearly every county in Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, and New York [61]. It occurs throughout West Virginia [99], but populations become more sporadic and rare farther south [83,115]. Cypress spurge likewise becomes less common to the west. Cypress spurge is considered widespread in Michigan [111], occasional in Illinois [66], and scattered and infrequent in the northern part of the Great Plains [39]. Cypress spurge is described as rarely escaped, occasional, or restricted in areas west of the northern Great Plains [7,17,22,43,113].

Distribution of diploid, tetraploid, and hybrid types: In North America, there are 2 cypress spurge types.

The most common type is a sterile diploid, which does not produce seeds. The other type, a fertile tetraploid, is capable of producing seeds. Cypress spurge × leafy spurge hybrids (*Euphorbia* × *pseudoesula*) are possible in areas supporting both leafy spurge and seed-producing cypress spurge stands. In Canada, *E. × pseudoesula* has been collected from British Columbia, Saskatchewan, and 3 widely separated locations in Ontario [68,95].

In North America, seed-producing cypress spurge is relatively rare but can form large populations. Sterile cypress spurge is much more widely dispersed but generally produces smaller populations. In North America, the sterile type was introduced and has been widely cultivated as an ornamental (reviews by [5,35,95]). The seed-producing type was likely introduced as a seed contaminant (Crabtree 1930 cited in [71], review by [95]). In Europe, there are 3 cypress spurge forms: a fertile tetraploid, a sterile diploid, and a fertile diploid. Sterile diploids are common garden plants restricted to central Europe; fertile tetraploids are wild and occupy a wide geographical range. Fertile diploids are somewhat rare and were first discovered in a deciduous forest in central France. As in North America, sterile diploids in Europe were distributed through ornamental plantings and disposal of garden waste [3,81,82]. Additional information about the sterile and fertile cypress spurge types is discussed below and in the following later sections: [Aboveground description](#), [Seed production](#), [Vegetative regeneration](#), and [Impacts and Control](#).

Introduction(s) and spread in North America: Cypress spurge occurred in New England by the late 1850s [73,94], and seeds or cuttings were available for sale from garden catalogs sent to Massachusetts residents in 1833 and New York residents in 1841 [59]. Below is a sporadic timeline that provides information about cypress spurge introductions and spread in North America:

- Cypress spurge escapes found by 1867 in Essex County, Massachusetts (review by [95])
- Found outside of cultivation by 1880 in the Ottawa district (review by [69])
- Escaped by 1883 in Nova Scotia, New Brunswick, and Ontario (reviews by [69,95])
- Found outside of planting areas by 1889 in Quebec (review by [95])
- Introduced as a contaminant in grass seed planted on a dry hillside in Montgomery, New York, in the late 1800s (Crabtree 1930 cited in [71])
- Known as an escape in Broome County, New York, by 1885 [65]
- Reported along fence lines around farm houses and abandoned properties in Nantucket, Massachusetts, in 1909 [6]
- Widely cultivated in cemeteries soon after its introduction in eastern North America [86]
- Reported in Topeka County, Kansas, by the late 1880s [93] and Wabaunsee County by 1927 [63]
- "Obviously escaped from cultivation" near Douglas Lake, Michigan, by 1914 [37]
- Reported in Washington by 1890, in Idaho by 1930, in Montana by 1950, and in Wyoming by 1970 [32]
- Reported for the first time in Tennessee in 1975 [12]

Since the 1950s, many range and population size increases have been noted for cypress spurge. In 1975, cypress spurge had escaped cultivation in 26 US states, and by 2000, cypress spurge had escaped cultivation in 42 states (Van Driesche 2002 cited in [86]). In northwestern Ohio, the frequency of cypress spurge in oak openings increased over a 50-year period [28].

Most large cypress spurge populations are dominated by the seed-producing type and are restricted to southeastern Canada or the northeastern United States. Cypress spurge was introduced to Ontario's Braeside region in 1870, and as of 1951, the seed-producing type infested a 9-square-mile (23 km²) area, of which 316 acres (128 ha) were "heavily infested" [57,69]. Other large, fertile cypress spurge populations were reported in West River, New Brunswick, Baie-Saint-Paul and Charteris, Quebec, and Bobcaygeon, Port Hope, Galt, and Goderich, Ontario, although the largest was in Braeside [57]. Seed-producing stands in Baie-Saint-Paul, Quebec, covered about 100 acres (41 ha) of pasture land [33]. By 1981, cypress spurge occupied about 54 square miles (140 km²) of limestone ridges at Braeside, Ontario. Cypress spurge spread during highway construction in the area. Large cypress spurge stands at Braeside have potential to invade another 1,390 square miles (3,600 km²) of similar habitats on the Smith Falls Limestone Plain that occur just 15 km (9.3 miles) away [42]. By 2000, seed-producing cypress spurge stands occupied thousands of hectares of pastures, open areas, and roadsides in Ontario's Dufferin and Renfrew counties [86].

Cypress spurge is widely distributed in the United States. As of the 1970s, cypress spurge populations occurred in 314

US counties from Washington to northern California and from North Carolina to New Hampshire. Cypress spurge occupied 67 counties in Pennsylvania, 61 counties in Minnesota, and 29 counties in Ohio, and the largest infestation (300 acres (121 ha)) was reported in Bland County, Virginia [24]. As of late 1980s in United States, there were 25 counties with cypress spurge infestations larger than 490 acres (200 ha), and 287 counties with smaller infestations (review by [95]). In the late 1970s, researchers released European spurge hawkmoth biocontrols in a cypress spurge population that occurred along highways and nonforested areas for at least 8.9 miles (14.4 km) east and west and 17.9 miles north and south (28.8 km) in Chestertown, New York [5].

Large cypress spurge stands and infestations are often dominated by seed-producing types. Seed-producing populations are known from New Hampshire, Massachusetts, New York (review by [5]), and Rhode Island but likely occur in other states as well [31]. Researchers surveyed cypress spurge stands in Rhode Island in 2000 and found that 53 of 54 stands supported fruiting plants, suggesting that the seed-producing type is most common [31].

HABITAT TYPES AND PLANT COMMUNITIES:

Cypress spurge occupies similar habitats in Europe and North America, although it may be more common in habitats with a dense overstory in its native than nonnative range.



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Native habitats: Although generally most common in dry to moderately moist pastures, meadows, stream banks, heathlands, forest edges, and open woodlands in Europe ([82,89,95], Hegi 1930 cited in [57]), cypress spurge also occurs in dense shrublands and forests. In central and southern Europe, cypress spurge is common in forb-grasslands [30,51], spurge-sheep fescue (*Euphorbia* spp.-*Festuca ovina*) meadows [92], erect brome (*Bromus erectus*) grasslands [58], and dry calcareous grasslands [89]. Cypress spurge also occurred in *Quercus coccifera* shrublands [104], thermophilous oak woodlands [13], and sparse to dense coniferous forests [58]. When research sites throughout Europe were evaluated, cypress spurge was often associated with moderate to high levels of grass and forb species and relatively low productivity [76].

Nonnative habitats: In North America, cypress spurge is most common in dry to moderately wet pastures, grasslands, prairies, and woodlands ([12,18,28,63], reviews by [18,95]). Although cypress spurge is most typical in dry habitats, it may occur along wet ditch banks and in woodland openings [57]. Cypress spurge is rare on "intensively cultivated soils" and in heavily forested areas (review by [95]).

In Ontario, the seed-producing cypress spurge type is more frequent than the sterile type in wooded areas. Although researchers did not identify plant communities or associations most vulnerable to cypress spurge invasions in eastern Canada, they did find that cypress spurge often occurred with sumac (*Rhus* spp.) along railroad embankments. Sumac is common on disturbed, sandy soils, and these site characteristics may be more important to the presence of cypress spurge than vegetation type (review by [95]). The large seed-producing cypress spurge populations in Braeside,

Ontario, occurred with grasses, and nonnative forbs that included: white sweetclover (*Melilotus alba*), common viper's bugloss (*Echium vulgare*), yellow toadflax (*Linaria vulgaris*), and St Johnswort (*Hypericum perforatum*) [72]. A large cypress spurge population in Chestertown, New York, occurred on fine-textured sand with the following native species: common milkweed (*Asclepias syriaca*) and steeplebush (*Spiraea tomentosa*) and nonnative species: bouncingbet (*Saponaria officinalis*) and spotted knapweed (*Centaurea maculosa*) [5].

Additional information on site conditions associated with European and North American cypress spurge habitats is available in [Site Characteristics](#).

BOTANICAL AND ECOLOGICAL CHARACTERISTICS

SPECIES: *Euphorbia cyparissias*

- [GENERAL BOTANICAL CHARACTERISTICS](#)
- [SEASONAL DEVELOPMENT](#)
- [REGENERATION PROCESSES](#)
- [SITE CHARACTERISTICS](#)
- [SUCCESSIONAL STATUS](#)



Photo © Marilyn Jordan, The Nature Conservancy

GENERAL BOTANICAL CHARACTERISTICS:

- [Botanical description](#)
- [Raunkiaer life form](#)

Botanical description: This description covers characteristics that may be relevant to fire ecology and is not meant for identification. Keys for identification are available (e.g., [39,43,53,83,90,113]).

Aboveground description: Cypress spurge is an erect, tufted perennial that occurs in small to large patches because of clonal growth and, in the fertile type, seed production [39,90,99]. From the semiwoody [root crown](#), cypress spurge produces several to many clustered stems that may reach 28 inches (70 cm) tall [23,61,73,99] but are often 16 inches (40 cm) or shorter [36,95]. Linear leaves are numerous and crowded on the stems and branches [7,39], causing plants to resemble young conifers [29,95]. Leaves are alternate, and leaf margins are entire to slightly wavy. Leaves on the main stems may reach 1 inch (3 cm) long and on lateral branches can be 9 mm long. Leaves are several times longer than they are wide [7,43,95].

Cypress spurge produces inflorescences that consist of a pistillate flower surrounded by several staminate flowers that lack sepals and petals [39,41,43,95]. Plants produce 25 to 60 inflorescences [95]. As indicated in earlier sections (see [Introductory](#) and [Distribution and Occurrence](#)), there are sterile and seed-producing cypress spurge types in North

America. These types can be distinguished by examining male flowers, which are well developed on seed-producing plants and lacking or very rudimentary on sterile plants [69]. Fruits produced by fertile plants are [capsules](#) containing up to 3 seeds [43,99]. Capsules are typically 3 mm in diameter [99]. Fruits are described as "explosively dehiscent"; when mature, they eject single-seeded achenes [95]. Seeds are smooth, plump, and up to 2.5 mm long [17,83,113].

Morphology and physiology can be altered when cypress spurge is infected by pathogenic rust fungi (*Uromyces striatus*). Infected plants produce mostly unbranched stems with oval instead of needle-like leaves and are incapable of seed production. Upper stem leaves turn yellow and are folded into a flower-like shape called a pseudoflower. Nectar glands are produced on the underside of the folded leaves and attract insect visitors that fertilize the rust ([89], review by [95]).

Look-alikes and hybrids: Although cypress spurge and leafy spurge are morphologically similar, cypress spurge is smaller and produces narrower and more crowded leaves than cypress spurge [17]. Cypress spurge leaves are especially dense on lateral shoots, which overtop the inflorescence; this does not occur in leafy spurge [111]. For a key to distinguish cypress spurge from other spurge species, see Stahevitch and others [95].

Euphorbia × *pseudoesula* plant height, leaf size, and leaf abundance are generally intermediate to what is characteristic of the parents, although hybrids more closely resemble leafy spurge than cypress spurge. For more on identifying and distinguishing cypress spurge, leafy spurge, and *Euphorbia* × *pseudoesula* see these references: [16,67,68].



Belowground description: Cypress spurge is capable of extensive vegetative growth from woody rhizomes and horizontal branching roots with adventitious buds [23,39,41,50,73,83,90]. As a seedling, cypress spurge produces a long taproot. The taproot persists and grows vertically up to 10 feet (3 m) deep. Lateral roots are primarily horizontal, and some produce adventitious buds. Vegetative growth from the root system results in the development of a nearly circular colony [57,86,95].

Photo © Leslie J. Mehrhoff, University of Connecticut, Bugwood.org

Rhizome production may increase in dry conditions. Researchers documented the growth of a single cypress spurge plant that emerged from a soil sample collected from the Burnt Lands Nature Reserve in Ontario. After the plant reached 6.5 inches (17 cm) tall in the greenhouse, where it was watered daily, it was moved outdoors and watered just once a week. With decreased watering, the plant's production of rhizomes increased. Within a month of decreased watering, there were multiple rhizomes measuring 3.2 to 22 inches (8-56 cm) long, some of which grew through pot drainage holes to just below the soil surface [86].

Raunkiaer [84] life form:

[Hemicryptophyte](#)
[Geophyte](#)

SEASONAL DEVELOPMENT:

Only in southeastern Canada was the complete growing-season phenology of cypress spurge evaluated. Cypress spurge shoots emerged from established plants in early spring soon after snow melt in Ontario and Quebec [33,72,86,95] and

as early as the 2nd week of April in the Ottawa Valley [95]. Cypress spurge seedlings emerged in mid- or late May in the Ottawa Valley. Flowering and seed production occurred twice. The first mature seeds were present by the 3rd week in June, and the second flush of flowers was produced in late summer or early fall. Cypress spurge developed lateral vegetative shoots when the first flowers were produced, and buds developed on root crowns by mid-fall (review and original research by [95]). In Quebec, many new cypress spurge shoots were noted in early August [33].

When cypress spurge, leafy spurge, and *E. × pseudoesula* were grown for 2 years in field plots in Ottawa, the flowering period of hybrids was much longer than that of either parent. Hybrids first flowered from early May to late June. Flowering occurred again in late summer on lateral branches, especially at the clump edge. Sparse flowering continued to late September [67].

Throughout its nonnative range, cypress spurge begins to flower between March and May. In the eastern United States, flowers were earliest in areas south of West Virginia.

Approximate dates for cypress spurge flowering and fruiting by area	
Area	Flowering and/or fruiting dates
Illinois	May-September [66]; During 9 years in natural areas in the Chicago area, earliest and latest flowering dates were 17 May and 25 August, respectively [101]
New York (Adirondack Uplands)	29 May-16 June [52]
North Carolina	March-May; sporadically after May [83]
Rhode Island	Flowers most abundant in May, but sporadic throughout the summer [100]
Utah	May-July [17]
West Virginia	May-September [99]
Atlantic Coast	April-August [23]
Blue Ridge Province	March-May [115]
Great Plains	April-August [39]
Northeastern United States	April-September [36,61]
Eastern Canada	Abundant flowers in late May or early June; sporadic flowering throughout the summer [57]
Southeastern Ontario	May-June [72]; in full bloom by 24 May and some mature seeds by 27 June in Galt, Ontario (Herriot 1911 cited in [20])
Quebec (Baie-Saint-Paul)	Flowers by 24 May, abundant fruit by 4 June, and mature seeds by 28 June [33]

Carbohydrates and root crown buds: Cypress spurge generally accumulates root carbohydrates throughout the summer and fall and develops [root crown](#) buds by mid-fall. However, root carbohydrates decrease with flushes of vegetative growth in the summer. In an oak woodland in Budapest, Hungary, the dry weight of the belowground portion of cypress spurge increased from 10.4% in July to 47.7% in September. New root crown buds developed in mid-September [102]. In Belleville, Ontario, root and shoot carbohydrate changes were evaluated from April through August. Root carbohydrates increased as cypress spurge seeds matured. After producing mature seeds, plants produced vegetative shoots and root carbohydrate reserves decreased [42]. In Quebec, mature seeds were produced by 28 June [33]. Crown buds were produced by mid-fall in Ontario (review and original research by [95]).

REGENERATION PROCESSES:

The fertile cypress spurge type is capable of sexual reproduction from seeds and asexual regeneration from rhizomes

and roots [35], while the sterile type regenerates only vegetatively [3]. Field observations indicate that *E. × pseudoesula* is capable of producing seed [68], suggesting that hybrids reproduce both sexually and asexually. Reproduction and regeneration topics are covered in more detail below.

- [Pollination and breeding system](#)
- [Seed production](#)
- [Seed dispersal](#)
- [Seed banking](#)
- [Germination](#)
- [Seedling establishment and plant growth](#)
- [Vegetative regeneration](#)

Pollination and breeding system: Cypress spurge is [monoecious](#) [113], and flowers are [protogynous](#). When sterile and fertile cypress spurge populations in eastern Canada were studied, researchers found that all pollen produced by sterile plants was abortive and that sterility is genetically controlled [69].

Bees, flies, and ants pollinate cypress spurge flowers. Protogyny limits natural self fertilization. In Ontario, fertile plants failed to produce seed when inflorescences were protected from insects [95]. During experiments in Switzerland, 10 of 20 artificially fertilized cypress spurge plants set seed. Selfed flowers produced an average of 1.45 seeds; outcrossed flowers averaged 2.77 seeds. When insects were excluded, seed set was 10%, but seed set was 86% when insects were allowed ($P < 0.0001$). Researchers concluded that pollination is necessary for full seed set. Ants and winged insects pollinated cypress spurge flowers. Plants with only ant visitors set significantly ($P = 0.048$) more seed than plants with all visitors excluded [89]. On south-facing ruderal sites in southeastern Poland, dense cypress spurge patches were visited by honey bees and non-*Apis* bees; flies (*Diptera* spp.) were the most abundant foragers. Flower longevity averaged 9 to 11 days [21].

Seed production: Sterile types occur in cypress spurge's native and nonnative ranges. Sterility likely explains reports of rare or no seed production in the northeastern United States [36], Nova Scotia [87], Bílé Karpaty Mountains in the Czech Republic [50], and from plants grown from root sections collected in the northern US, southern Canada, or Austria [29].

Fertile cypress spurge populations are limited, but high levels of seed production by fertile plants have been reported. The fertile cypress spurge type was not discovered in North America until the early 1900s. After searching 30 years, Walter Deane discovered fruits and mature seeds on cypress spurge plants in Shelburne, New Hampshire. A plant with 4 stems produced 88 capsules. If each capsule produced 3 seeds, that plant would produce 264 seeds. Plants in this fertile population were "large and vigorous" and "loaded with ripe capsules to an extraordinary degree". After this discovery, Deane visited herbariums and surveyed other botanists to determine the rarity of seed production by cypress spurge. Cypress spurge fruits were found on an herbarium sample collected from Staten Island, New York [19]. Soon after publishing his findings, Deane was contacted by other botanists who reported seed-producing cypress spurge in Greenfield, Massachusetts and Galt, Ontario. In Massachusetts, plants were described as heavy with fruit [20]. Additional seed-producing populations have since been reported in several northeastern New York counties (Muenscher and Maguire 1931 cited in [71]), throughout Rhode Island [31], in Massachusetts (Lombard 1925 cited in [71]), New Hampshire (review by [5]), New Brunswick, Quebec, and Ontario [33,42,57,86].

There is little to no chance that fertile characteristics could be transferred to sterile populations (Stahévitch and Wojtas unpublished study cited in [95]). *Ephorbia × pseudoesula* hybrids between leafy spurge and fertile cypress spurge, however, do produce small numbers of seeds [67,68].

Fertile cypress spurge plants can produce 30 to more than 900 seeds (review and original research by [95]). Abundant seed production was reported from cypress spurge populations at Braeside, Ontario [57]. In southeastern Poland, observations and studies suggest that flower production could be reduced in cool, low-moisture years. Over a 5-year period, cypress spurge averaged 117 flowers/shoot. Flower number was lowest when spring temperatures were about 4

°F (2° C) colder than average and when spring precipitation was below average [21].

Seed dispersal: In North America, cypress spurge seed is likely dispersed by wind, insects, birds, water, and human activities. Cypress spurge fruits are "explosively dehiscent" at maturity (review by [95]). This process may aid wind dispersal. Seed dispersal by both wind and ants was studied in an old field in southeastern France where the frequency of cypress spurge was nearly 100%. Frequency of cypress spurge in seed rain traps was 0.14% and in ant traps was 0.28% [10]. Cypress spurge seeds have [elaiosomes](#), which are an attractive food source for ants [79,89]. In a study reporting years of observations made at New York's Jamaica Bay Wildlife Refuge, cypress spurge was reportedly dispersed by birds, but observation details were lacking [96]. Spring flooding was considered important to the spread of a cypress spurge population near Braeside, Ontario [57].

Human activities have been associated with the spread of cypress spurge seed in Ontario and Rhode Island. The largest infestation of cypress spurge in eastern Canada occurs near a major gravel pit operation. Use of contaminated gravel in culvert construction and road repairs contributed to the spread of cypress spurge [57,95]. Cypress spurge seed was likely transported in hay harvested from a meadow in Rhode Island. Hay was harvested from a 170-acre (70 ha) meadow that was about 40% infested with fertile cypress spurge [31]. Cypress spurge is also capable of [dispersal by vegetative means](#).

Seed banking: The few studies that report on the longevity of cypress spurge seed in the soil suggest a long-lived seed bank. A maximum density of 408 cypress spurge seeds/m² was recovered from soil samples collected in natural areas in northwestern Europe [103]. When last season's cypress spurge seeds were sown outdoors in the spring, germination did not occur until 4 to 7 years later, and the majority of seeds germinated after 7 years in the soil [1]. There were no additional details about this study. Based on previous burial experiments and comparative seed bank studies along a chronosequence, researchers report that cypress spurge seeds remain viable after more than 20 years in the soil (German studies cited in [80]).

Because sterile cypress spurge types are common and plants can regenerate from rhizome or root fragments, emergence or non-emergence from soil samples is difficult to interpret as an indication of seed banking. Cypress spurge failed to emerge from soil samples collected from grassland, sparse forest, or dense forest vegetation in Tuscany, Italy, although cypress spurge occurred in all vegetation types. Vegetative materials were removed from soil samples before emergence was monitored in the greenhouse [58]; however, researchers did not investigate cypress spurge fertility in this study area. In the Burnt Lands Nature Reserve in Almonte, Ontario, just 4 cypress spurge stems emerged from soil samples collected from 60 plots, although cypress spurge occurred in the aboveground vegetation in 32 plots. Researchers speculated that cypress spurge was sterile in this area and that stems emerged from root or rhizome pieces missed when vegetative pieces were removed from the soil [86].

Germination: Although there are few detailed studies on the germination of cypress spurge seeds, seed coat damage, chilling, and alternating temperatures have increased germination. Germination percentages as low as 16% were reported for seeds with the elaiosome scratched or removed (Dymes 1933 cited in [95]). Germination as high as 85% was reported by Salisbury (1961 study cited in [95]); pretreatments, if any, were not described. Additional studies are needed to determine the best mechanisms or environmental conditions for breaking cypress spurge seed dormancy.

Experiments conducted by Crocker [15] showed that seed coat breakage increased germination of cypress spurge seed. Prechilling and alternating temperatures increased cypress spurge germination in the laboratory [56].

It is unclear which conditions or mechanisms are best for breaking cypress spurge seed coats and/or seed dormancy. Germination percentages were low for cypress spurge seeds collected from Hampshire, England. Seeds sown outdoors in the fall or summer failed to germinate after up to 2 years. When elaiosomes were removed before sowing, 8 of 50 seeds germinated. During 2 years of observations in the seed-collection area, no cypress spurge seedlings emerged [27].

Seedling establishment and plant growth: Studies on cypress spurge seedling establishment were rare in the published literature (as of 2010). Cypress spurge seedling establishment is generally restricted to sites with sparse or patchy vegetative cover and typically fails on sites with dense grass cover (review and original research and

observations by [95]). Seed-producing cypress spurge populations are often larger, spread farther, and spread more quickly than sterile populations, suggesting that seedling establishment is important to population increases and spread.

In the late 1800s, cypress spurge was introduced as a contaminant in grass seed spread on a dry hillside in Montgomery, New York. Cypress spurge "flourished there" and "spread to surrounding fields" after its introduction (Crabtree 1930 cited in [71]). In the early 1900s, land owners in New Hampshire reported that 2 small seed-producing cypress spurge patches spread "rapidly though sparsely" to cover 20 acres within 3 years [19]. In a later visit to this area, the researcher reported that cypress spurge had "flourished inordinately" and was "spreading over much of the territory". "Fresh plants appear(ed) many rods from established areas", suggesting that seeds were important to spread [20].

Plant growth: In an oak woodland in Budapest, Hungary, the relative growth rate of cypress spurge was highest when fruits were still green in mid-May [102]. This information may be useful in determining the timing of cypress spurge [control](#) methods.

Vegetative regeneration: Both sterile and fertile cypress spurge types are capable of vegetative regeneration and spread by rhizomes and horizontal roots [36,41]. Cypress spurge often occurs in dense, persistent patches because of vegetative regeneration and spread [41,69,83]. By the 10-leaf developmental stage, cypress spurge is capable of clonal growth (review and original research and observations by [95]).

Cypress spurge growth from root or rhizome fragments can be prolific. A year after live cypress spurge root fragments had been planted in buried tubes of irrigation pipe, 240 stems emerged from 1 tube and 160 stems from another tube [29].

Dispersal by vegetative means: Shoots can develop from deeply buried root fragments [5], and fragmentation and movement of root or rhizome pieces can be important to cypress spurge dispersal. Some indicate that "almost any broken part of a (cypress spurge) plant is capable of reproducing vegetatively" (University of Rhode Island Extension document [100]). This claim likely comes from observations made in fertile cypress spurge populations, which are most common in Rhode Island [31]. Cypress spurge can be dispersed through transportation of root or rhizome pieces on cultivation equipment [31] and by grading or plowing infested sites [69]. Cypress spurge may also be dispersed in yard waste disposal. Gardeners identified cypress spurge as a plant that was discarded during yard maintenance [45].

Vegetative regeneration and spread among diploid, tetraploid, and hybrid types: Studies conducted in cypress spurge's native and nonnative habitats indicate that the capacity for vegetative regeneration and spread is distributed as follows for the cypress spurge types: fertile diploid (only in Europe) < sterile diploid < fertile tetraploid. In field plots in Fontainebleau, England, fertile tetraploids produced 3 to 14 times as many shoots as fertile diploids (Pritchard 1958 cited in [95]). Fertile diploids, which are currently restricted to Europe, are capable of only weak vegetative reproduction and spread. In eastern Canada, sterile diploid types occur as continuous patches in stable or "moderately closed" communities, unless roots are broken mechanically, in which case, population and patch size increases are likely. Fertile tetraploid population types typically occupy much larger areas than sterile diploid populations of a similar age. Fertile tetraploids occur as circular clusters scattered throughout an area, which merge over time to form very large stands. Field studies in Ontario revealed that sterile diploids averaged 3.3 shoots/plant, while fertile tetraploids averaged 6.6 shoots/plant (review and original research and observations by [95]).

In 2 years of observations in field plots in Ottawa, hybrids were described as "very vigorous" and "spread rapidly by underground parts" [67]. Diploid, tetraploid, and hybrid cypress spurge types are also discussed in the [Introductory](#) and [Distribution](#) sections of this review.

SITE CHARACTERISTICS:

In North America, cypress spurge is common near old homesteads, in and around cemeteries, along roads, and in pastures and fields. Many cypress spurge populations have escaped from cemeteries and gardens [7,23,36,39,87,111,112].

Studies conducted in cypress spurge's native habitats indicate that it has "broad ecological amplitude" but is most

common in poor, stony, dry soils of pasture, sparse woodland, and forest edge habitats (review by [35]). In a study of vegetation types in the Prokop Valley Nature Reserve near Prague, Czech Republic, cypress spurge was one of the species with the greatest ecological amplitude but tended to favor southern slopes [51]. In the Weinviertel region of lower Austria, cypress spurge constancy and cover were high in grasslands on steep south-facing slopes with very stony soils and good to excessive drainage [30]. When site characteristics and habitat associations were evaluated for 17 European research sites, cypress spurge had the greatest ecological amplitude of the spurge species studied (cypress spurge, *E. seguieriana*, *E. virgata*, *E. lucida*). Cypress spurge was associated with moderate to high abundance of grass and forb species, relatively low levels of plant productivity, and relatively high levels of sand, calcium carbonate, and zinc. Cypress spurge occurred in all xeric sites and 5 of 9 mesic sites visited [76].

Climate: Cypress spurge is common in "warm temperate" climates and "snow climates with equitable precipitation" based on the Köppen-Geiger climate system. In Europe, the north-south range for cypress spurge generally extends from central Scandinavia to central Italy. In North America, the north-south range for cypress spurge reached from Gaspé Peninsula, Quebec, to Tennessee as of the late 1980s. In Europe, cypress spurge occupies an elevational range from lowlands to alpine regions (8,500 feet (2,600 m) in Switzerland). Given this distribution, researchers suggest that cypress spurge is limited in areas of western North America by aridity rather than low temperatures (review by [95]). Although successful cypress spurge growth has been reported on sandy soils and in low-moisture conditions [57,86], the majority of these studies and observations occurred in the northeastern United States or southeastern Canada. Dryness is a relative term that likely refers to a much longer period with little moisture and low humidity in the West than in the East.

Productivity of cypress spurge may increase with dry weather conditions, at least relative to that of associated species. On thin limestone soils at Braeside, Ontario, cypress spurge made up 56% of the total herbaceous vegetation in a dry year and 26% in a wet year [42].

Soils: In Europe and in North America, cypress spurge is common on stony or sandy, dry soils ([35,57,86,92], review by [95]). Along the Desna River floodplain in Ukraine, cypress spurge dominated the vegetation on sandy soils with groundwater at about 5 feet (1.5 m) deep [92]. In the Prokop Valley Nature Reserve in the Czech Republic, cypress spurge occurred in vegetation types on limestone and shallow soils [51].

Nonnative habitats: In North America, cypress spurge is most common on fairly dry, gravelly, sand to sandy loam soils [86]. The largest cypress spurge infestation (fertile type) in eastern Canada occurs in light, sandy loams or shallow, rocky soils with a pH of 5.6 to 7. Cypress spurge populations also occur along wet ditch banks [57]. In Shelburne, New Hampshire, home to some of the first seed-producing cypress spurge populations discovered, cypress spurge occurred in barren, rocky soils; the largest infestations occurred in a hay field that was cut, plowed, and fertilized a year earlier [19]. Sandy and/or limestone soils have been described for cypress spurge habitats in Kentucky [14], along the Atlantic Coast [23], and in New York [52,97], Rhode Island [100], and Ontario [86]. In Chestertown, New York, a site for release of European spurge hawkmoth [biocontrols](#), cypress spurge occurred on fine textured sands. This infestation occupied a stretch of highway at least 8.9 miles (14.4 km) east and west and 17.9 miles north and south (28.8 km) [5].

Soil moisture: Cypress spurge occurs in Burnt Lands Nature Reserve in Ontario which is typically flooded or heavily saturated in the spring, but severe droughts occur throughout much of the growing season. In most study plots, soil depth ranged between 4 and 8 inches (10-20 cm) [86].

SUCCESSIONAL STATUS:

Although described as a ruderal species [14,25] common on disturbed, open sites [62,107], cypress spurge has also been described in dense shrublands and forests [34,80]. However, cypress spurge is typically more common in grasslands and disturbed areas than in closed-canopy forests, particularly in its nonnative range.

Shade tolerance: Cypress spurge has been described as shade intolerant [64] and preferring open, full-sun conditions [62]; however, it has some shade tolerance [34,76]. In native and nonnative habitats, fertile tetraploid cypress spurge types seem more shade tolerant than diploid types ([3], Pritchard 1958 cited in [95]). In Ontario, the

fertile tetraploid type is more frequent on wooded sites than the sterile diploid type (review by [95]).

Disturbances: Cypress spurge tolerates disturbance (review by [95]). A large, seed-producing cypress spurge population in Shelburne, New Hampshire, occurred in a hay field that was cut, plowed, and fertilized a year earlier [19]. As of 2004, the Forest Service's Eastern Region ranked cypress spurge as a category 3 invasive species often restricted to disturbed sites. Cypress spurge was not considered especially invasive in undisturbed natural habitats [107]. In the Prokop Valley Nature Reserve in the Czech Republic, cypress spurge was common in the *Erysimum crepidifolium-Festuca valesiaca* vegetation type, which increased with human management [51]. In northeastern France, the frequency of cypress spurge was 27% in previously farmed areas and 0% in "apparently undisturbed" forests, when researchers compared areas farmed by Romans for centuries about 2,000 years ago to undisturbed parts of the oak-beech forest type [25]. Although tolerant of disturbance, cypress spurge does not likely tolerate prolonged cultivation (review by [95]), because it is not noted as an agricultural pest.

Bare ground succession: When vegetation composition was compared on basalt quarries abandoned 1 to 78 years earlier in northwestern Czech Republic, cypress spurge was most common on unstable debris and screes of 11- to 25-year-old quarries. This does not imply that cypress spurge was necessarily absent from quarries of other ages [74].

Secondary succession: Cypress spurge occurred on logged, severely grazed, and previously cultivated areas but also persisted in the dense shrub and forest stages of succession in its native range. In central Europe, cypress spurge is considered typical in deforested areas. In the Bükk Mountains of northern Hungary, cypress spurge was a dominant species within the first 6 years of cutting in a *Quercus petraeae-cerris* woodland [78]. Along the Desna River Floodplain in Ukraine, cypress spurge is a dominant in spurge-sheep fescue meadows that occur on severely grazed and previously cultivated sites [92]. When successional communities ranging from grazed grasslands to forests were evaluated in Germany's middle Swabian Alb, cypress spurge persisted in dense shrub and forest stages [80]. Based on 7 years of observations in English oak (*Q. robur*) savannas in the Bílé Karpaty Mountains in the Czech Republic, cypress spurge was persistent but rare, did not flower, and failed to reach the understory canopy [50].

FIRE EFFECTS AND MANAGEMENT

SPECIES: *Euphorbia cyparissias*

- [FIRE EFFECTS](#)
- [FUELS AND FIRE REGIMES](#)
- [FIRE MANAGEMENT CONSIDERATIONS](#)

FIRE EFFECTS:

- [Immediate fire effect on plant](#)
- [Postfire regeneration strategy](#)
- [Fire adaptations](#)
- [Plant response to fire](#)

Immediate fire effect on plant: Cypress spurge is likely only top-killed by fire [29,47], although direct observations of this were lacking in the reviewed literature available as of 2010.

Postfire regeneration strategy [98]:

Rhizomatous herb, [rhizome](#) in soil

[Ground residual colonizer](#) (on site, initial community)

[Secondary colonizer](#) (on- or off-site seed sources)

Fire adaptations: Cypress spurge likely sprouts from surviving roots and/or rhizomes following fire [29,47]. However, published fire effects studies documenting this response were not available as of 2010. Without additional information, it is impossible to assess effects of fire season, fire severity, and/or frequency on cypress spurge responses to fire. Effects of fire on cypress spurge seeds are unknown. However, seed coats [15] and a persistent [seed bank](#) [1,80] suggest that seeds may survive fire.

Plant response to fire: Two studies indicate that cypress spurge abundance may increase on burned sites. Cover of cypress spurge increased after fall fires in a tallgrass prairie in Nassau County, New York. Within 6 years of 2 November fires, cypress spurge cover increased from about 0% to about 40%. Fires occurred 3 years apart, and postfire cover of cypress spurge was evaluated 6 years after the last fire [47]. In the eastern French Pyrenees, the frequency of cypress spurge was greater on burned than unburned sites. Vegetation composition was evaluated after 22 prescribed headfires that burned between November and March in the supalpine zone. Subalpine vegetation was a mosaic of fescue grasslands, *Cytisus purgans* shrublands, and mountain pine (*Pinus uncinata*) forests. Fires that burned during dry and wet conditions were evaluated separately. Conditions were considered wet when the ground was partly covered with snow or atmospheric humidity levels were high. Frequency of cypress spurge was assessed 1 to 8 years after dry fires and 1 to 4 years after wet fires. The frequency of cypress spurge was 9% on unburned, 26% on dry-burned, and 18% on wet-burned sites [75]. The timing of postfire sampling allowed dry-burned sites a longer recovery period than wet-burned sites. These differences in time since fire make it impossible to link differences in cypress spurge frequency to meteorological conditions alone.

FUELS AND FIRE REGIMES:

Fuel characteristics of cypress spurge were not described in the reviewed literature as of 2010, nor were the effects of dense cypress spurge stands on fire frequency or fire severity described. Although large cypress spurge stands are reported in several areas of southwestern Canada and the northeastern United States, the invaded vegetation types were rarely described in detail (see [Nonnative habitats](#)). Because of cypress spurge's wide distribution and the generic, broad descriptions given of its habitat, this review does not identify particular fire regimes for cypress spurge habitat; use the complete [FEIS Fire Regime Table](#) to obtain information on vegetation communities of interest.

FIRE MANAGEMENT CONSIDERATIONS:

Potential for postfire establishment and spread: Although only two studies report the effects of fire on cypress spurge, both indicate that increases in cypress spurge abundance after fire could be expected even on sites with low prefire cover [47,75]. Because seed-producing cypress spurge populations occur in eastern North America (see [Distribution](#)) and cypress spurge seed [dispersal](#) by animals is suspected, burned areas near fertile stands should be monitored for postfire [seedling establishment](#).

Preventing postfire establishment and spread: Preventing establishment of cypress spurge in uninfested burned areas is likely the most effective and least costly management method. This may be accomplished through early detection and eradication, careful monitoring and follow-up, and limiting dispersal of cypress spurge seed as well as root and rhizome fragments into burned areas. General recommendations for preventing postfire establishment and spread of invasive plants include:

- Incorporate cost of weed prevention and management into fire rehabilitation plans
- Acquire restoration funding
- Include weed prevention education in fire training
- Minimize soil disturbance and vegetation removal during fire suppression and rehabilitation activities
- Minimize the use of retardants that may alter soil nutrient availability, such as those containing nitrogen and phosphorus
- Avoid areas dominated by high priority invasive plants when locating firelines, monitoring camps, staging areas, and helibases
- Clean equipment and vehicles prior to entering burned areas
- Regulate or prevent human and livestock entry into burned areas until desirable site vegetation has recovered sufficiently to resist invasion by undesirable vegetation

- Monitor burned areas and areas of significant disturbance or traffic from management activity
- Detect weeds early and eradicate before vegetative spread and/or seed dispersal
- Eradicate small patches and contain or control large infestations within or adjacent to the burned area
- Reestablish vegetation on bare ground as soon as possible
- Avoid use of fertilizers in postfire rehabilitation and restoration
- Use only certified weed-free seed mixes when revegetation is necessary

For more detailed information on these topics see the following publications: [[2,8,38,108](#)].

Use of prescribed fire as a control agent: Fire may be useful in conjunction with other control methods to control cypress spurge. Herbicides may be more effective on postfire sprouts [[105](#)] than on full-sized plants. A review reports that control methods and management techniques used to control leafy spurge may work similarly on cypress spurge, but research from Nassau County, New York [[47](#)], suggests this may not be true. When conducted for 2 consecutive years, late-fall herbicide applications followed by fire provided very good control of leafy spurge. However, herbicide treatments in conjunction with fall or spring prescribed fires did not control cypress spurge. By 2001, cypress spurge cover had increased by up to 75% on sites burned and treated with herbicide in 1992 and burned again in 1995 [[47](#)].

Altered fuel characteristics: Potential changes in fuel characteristics and fire regimes in plant communities invaded by cypress spurge were not addressed in the available literature (2010).

MANAGEMENT CONSIDERATIONS

SPECIES: *Euphorbia cyparissias*

- [FEDERAL LEGAL STATUS](#)
- [OTHER STATUS](#)
- [IMPORTANCE TO WILDLIFE AND LIVESTOCK](#)
- [OTHER USES](#)
- [IMPACTS AND CONTROL](#)

FEDERAL LEGAL STATUS:
None

OTHER STATUS:
Information on state-level noxious weed status of plants in the United States is available at [Plants Database](#). As of the late 1980s, cypress spurge was designated a noxious weed in Alberta, Manitoba, Quebec, and Nova Scotia (review by [[95](#)]).

IMPORTANCE TO WILDLIFE AND LIVESTOCK:
Cypress spurge is avoided by most livestock except sheep [[42](#)]. Cypress spurge produces a milky latex that can cause dermatitis in animals (review by [[5](#)]). When ingested, cypress spurge can make cattle and horses ill, although sheep graze cypress spurge without getting ill [[26,31,88](#)]. A review reports that when large amounts of cypress spurge are present in hay, cattle can develop scours or severe diarrhea and without treatment may die [[49](#)].

OTHER USES:
Historically, cypress spurge latex has been used to treat skin conditions including face cancers, cysts, warts, hangnails, calluses, freckles, and corns. Cypress spurge has also been used to treat stomach, liver, and uterine cancers, and researchers have located an active anticarcinogenic fraction (review by [[95](#)]).

IMPACTS AND CONTROL:

Although rarely quantified, the most common impacts described for cypress spurge infestations are reduced abundance of desired vegetation and reduced cattle-grazing or hay-production capacity. Cypress spurge produces a milky latex that can cause dermatitis or skin blistering in humans and is "intensely irritating" to the eyes ([26,42] reviews by [5,31]). Mechanical and physical removal methods may require protective clothing and eyewear. The negative impacts from sterile cypress spurge stands are likely less than those from fertile populations, which have a greater capacity for dispersal (see [Seed production](#), [Seed dispersal](#), and [Vegetative regeneration](#)) ([20,82] review and original research by [95]).

The current and potential negative impacts described for cypress spurge are variable. This variability may be related to the study area, climatic conditions, and/or fertility of the cypress spurge type. Using a model that incorporated the climatic ranges, biological traits, and habitat preferences of cypress spurge, researchers rated cypress spurge as a "high risk" for establishment and proliferation in Riding Mountain National Park, Quebec [77]. In a survey of plant and natural area experts in Wisconsin, cypress spurge ranked 36th out of 66 nonnative invasive plants evaluated for their negative impacts on native plant communities [85]. As of 2004, the Forest Service's Eastern Region indicated that cypress spurge was typically restricted to disturbed sites and not especially invasive in undisturbed natural habitats [107].

Cypress spurge can reduce native vegetation and reduce the cattle-grazing and grain-growing value of an area [42]. Some report that even in poor conditions cypress spurge can "overwhelm every plant growing near it" (Rhode Island Cooperative Extension document by [100]). In the 1940s, farmers gave up dairy farming in areas of Herkimer County, New York, because cypress spurge-infested pastures required farmers to purchase feed from other areas and made dairy farms uneconomical [70]. Cypress spurge seed is difficult to separate from grain, so the fertile cypress spurge type is problematic in grain-production areas [100].

Fertile cypress spurge stands that spread vigorously by seeds, roots, and rhizomes are likely to negatively impact invaded communities most. In Shelburne, New Hampshire, 2 small seed-producing cypress spurge patches spread "rapidly though sparsely" to cover 20 acres (8 ha) in a period of 2 to 3 years. Local residents were "astonished to see how (cypress spurge) had invaded a new territory and obtained so strong a footing in so short a time" [19]. When this area was visited 3 growing seasons later, cypress spurge had "flourished inordinately" and "fresh plants appear(ed) many rods from established areas" [20]. In contrast to the rapid spread described for fertile cypress spurge, sterile cypress spurge populations in eastern Canada are minor components of communities that generally lack open colonization sites. Extensive colonies develop only with mechanical breakage of roots and rhizomes (review and original research by [95]).

In some areas, cypress spurge does not appear to be impacting native vegetation. As of 2005 the Massachusetts Invasive Plant Advisory Group indicated that evidence was lacking "that (cypress spurge) out-competes other vegetation in minimally managed habitats" [62]. In Ontario's Burnt Lands Nature Reserve, cypress spurge did not appear to impact vegetation and had not expanded its range extensively since it was first reported. Percent canopy closure of cypress spurge did not significantly reduce aboveground vegetation richness, seed bank species richness, or soil nutrient levels. Researchers suggested that the extensive cypress spurge root and rhizome system may have provided a high-moisture resource island for other species (although moisture content was not measured). After this study, researchers concluded that cypress spurge impacts on other vegetation were indeed minor, undetectable at significant levels, or masked by above-average precipitation [86]. Because cypress spurge abundance can be much greater in dry than wet years [42], and experiments revealed that cypress spurge "flourish(ed) in dry conditions", above-average precipitation during the study period may have impacted study findings [86].

Control: The high potential for regrowth from the extensive root and rhizome system of both fertile and sterile types make cypress spurge difficult to control. Persistent [seed banks](#) and the potential for long-distance [seed dispersal](#) make control of fertile types even more difficult (review by [95]). Prioritization in the control of cypress spurge is important. Seed-producing stands should receive priority, since they have the greatest capacity for spread. Controlling infestations near gravel pits or other operations conducive to spread should receive priority [57]. Seed-producing stands will likely require more vigilant posttreatment monitoring and follow-up treatments than sterile stands. Because of the need for more aggressive treatment and monitoring, treating fertile stands will likely be more costly and time consuming than

treating sterile stands [70]. In a Cooperative Extension publication from the University of Rhode Island, where the fertile type dominates, cypress spurge is described as "extremely difficult to eradicate under any circumstances". This publication suggests that the best method to control cypress spurge may be removal of all vegetation with "vigorous, repeated cultivation" and "start(ing) over" [100].

In all cases where invasive species are targeted for control, no matter what method is employed, the potential for other invasive species to fill their void must be considered [9]. In cypress spurge-invaded portions of Ontario's Burnt Lands Nature Reserve, seedlings of St Johnswort, another nonnative invasive herb, dominated emergence from collected soil samples. Other nonnative species also emerged from soil samples, suggesting that different weedy species would occupy areas where cypress spurge was removed [86]. Control of biotic invasions is most effective when it employs a long-term, ecosystem-wide strategy rather than a tactical approach focused on battling individual invaders [60].

Fire: For information on the use of prescribed fire to control cypress spurge, see [Fire Management Considerations](#).

Prevention: Preventing the spread of cypress spurge should involve discouraging its ornamental sale and planting [57] and controlling populations near gravel pits or other potential seed-spreading operations. In Renfrew County, Ontario, cypress spurge seed was spread to new sites through contaminated gravel used in culvert construction and road repair [95].

It is commonly argued that the most cost-efficient and effective method of managing invasive species is to prevent their establishment and spread by maintaining "healthy" natural communities [60,91] (e.g., avoid road building in wildlands [106]) and by monitoring several times each year [46]. Managing to maintain the integrity of the native plant community and mitigate the factors enhancing ecosystem invasibility is likely to be more effective than managing solely to control the invader [44].

Weed prevention and control can be incorporated into many types of management plans, including those for logging and site preparation, grazing allotments, recreation management, research projects, road building and maintenance, and fire management [108]. See the [Guide to noxious weed prevention practices](#) [108] for specific guidelines in preventing the spread of weed seeds and propagules under different management conditions.

Cultural control: No information is available on this topic.

Physical or mechanical control: Cypress spurge may be controlled by frequent and repeated hand-pulling or mowing, and cypress spurge does not tolerate prolonged cultivation (review by [95]). In a nursery, fertile cypress spurge types were controlled by monthly hand-pulling for a year [95]. In Norfolk, Maryland, sterile cypress spurge was controlled in a garden by repeated cutting (Ware 1912 cited in [20]). In Nassau County, New York, mowing led to increased cypress spurge cover in a tallgrass prairie. Within 8 years of the last mowing, cypress spurge cover increased by at least 20% on sites mowed 1 to 3 times/year over a 3-year period [47].

Biological control: Since 2002, there have been 7 European insects released in the eastern United States and 10 released in Canada to control cypress spurge. Spurge hawkmoth (*Hyles euphorbiae*), flea beetle (*Apthona* spp.), stem- and root-boring beetle (*Oberea erthrocephala*), and gall midge (*Spurgia esulae*) populations are established in the eastern United States and Canada (review and original research by [31]).

Although most insects were successful in defoliating or weakening cypress spurge in the laboratory and/or in some release sites, over time researchers learned that biocontrol success can be site specific (review and original research by [31]), and successful control of cypress spurge will likely require a variety of biocontrol insects [42]. During laboratory testing, a single spurge hawkmoth larva consumed 2.7 g of dry cypress spurge [72]. In Chestertown, New York, 180 spurge hawkmoth larvae were released in an area with dense, fertile stands. Within 5 years of release, 1 million larvae occupied 1.5 square miles (4 km²). Cypress spurge was completely defoliated in some areas [5]. Spurge hawkmoths failed to establish in several release sites in Canada, and although successful establishment occurred in a cypress spurge stand in Ontario, it had little impact on the stands [42]. In Rhode Island, excellent cypress spurge control occurred at some flea beetle release sites. At most release sites, several species were released. Within 2 years at some release sites, suppression was "noticeable", flea beetle dispersal was substantial (up to 230 feet (70 m)), and there

were patches "nearly free" of cypress spurge. Good control, however, was restricted to open grassland habitats and did not occur in high-moisture and/or shaded habitats (review and original research by [31]). Based on early insect biocontrol failures in Canada, Harris [42] provides information about insect releases, potential reasons for establishment failure, and possible ways to improve success for future releases. Harris concluded that a variety of insects is likely necessary for successful biological control of cypress spurge in its nonnative range, since a single insect is "only able to utilize a small proportion of the total resource", and a complex of insects feeds on cypress spurge in its native range [42].

Biological control of invasive species has a long history that indicates many factors must be considered before using biological controls. Refer to these sources: [110,114] and the [Weed control methods handbook](#) [105] for background information and important considerations for developing and implementing biological control programs.

Chemical control: Control of cypress spurge with herbicides has shown variable success, which may be related to the cypress spurge type, application method, and/or timing of posttreatment evaluation. Riley [86] reported that herbicides have little effect on cypress spurge. Others indicate that because of cypress spurge's waxy cuticle layer, a surfactant is required for absorption, and that a combination of herbicides may effectively control cypress spurge. For details, see the review by [95]. In nursery trials, nonselective herbicides applied 4 times/year did not control the fertile cypress spurge type (original research by [95]). In Nassau County, New York, 1 to 2 herbicide treatments in 5 years did not control cypress spurge in a tall grassland community. Herbicide treatments paired with fall or spring prescribed fires were also ineffective. Cypress spurge cover increased up to 75% within 6 years of herbicide and burning treatments [47].

While herbicides may be effective in gaining initial control of a new invasion or a severe infestation, they are rarely a complete or long-term solution to weed management [11]. See the [Weed control methods handbook](#) [105] for considerations on the use of herbicides in natural areas and detailed information on specific chemicals.

Integrated management: No information is available on this topic.

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