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Leblanc, John W

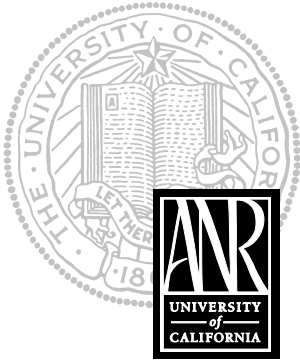
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Getting a Handle on Broom

Scotch, French, Spanish, and Portuguese Brooms in California

JOHN W. LEBLANC, University of California Cooperative Extension Program Representative, El Dorado County

Scotch broom (*Cytisus scoparius*), French broom (*Genista monspessulana*), Spanish broom (*Spartium junceum*), and Portuguese, or striated, broom (*Cytisus striatus*) were introduced into California in the mid-1800s for landscape planting, mine tailings stabilization, and roadside erosion control. The abundant bright yellow flowers were used medicinally, and the stems were cut for broom-making materials.

The traits that were once considered useful and desirable are the same attributes that define brooms as aggressive and invasive noxious weeds. These traits include their tolerance for most soil conditions, ability to fix nitrogen and grow for most of the year, and copious production of long-lived seed. These attractive attributes for erosion control make the plants difficult to manage where erosion control is not a goal.

Brooms grow rapidly and form dense stands that are inaccessible to and unpalatable to wildlife. The dense stems make regeneration of most other species difficult or impossible, and they also create a dangerous fire hazard. As plants grow, the inner stems die back, providing a highly flammable fuel. The California State Department of Food and Agriculture (CDFA) has listed brooms as a Class C pest species, that is, “troublesome, aggressive, intrusive, detrimental, or destructive to agriculture, silviculture, or important native species, and difficult to control or eradicate.” The California Exotic Pest Plant Council (CalEPPC) has placed Scotch, French, and Portuguese brooms on their List A, Most Invasive Wildland Pest Plants, aggressive invaders that displace natives and disrupt natural habitats. Spanish broom is placed on List B, Wildland Pest Plants of Lesser Invasiveness, invasive pest plants that spread less rapidly, cause a lesser degree of habitat disruption, and may be widespread or regional (CalEPPC 1999).

IDENTIFICATION

Scotch Broom

Scotch broom is an upright evergreen shrub that can grow to 12 feet (3.6 m) tall but is more commonly 3 to 6 feet (0.9 to 1.8 m) high (fig. 1). It reproduces by seed that germinate mainly in spring and autumn. Young plants usually do not flower until their third year. While plants live for up to 25 years (Waloff 1968), Scotch broom has an average life span of 17 years (Waloff and Richards 1977).

Stems are numerous, erect, woody, green to brownish green, prominently ridged, and five-angled. Young stems remain green for about 3 years and actively photosynthesize (Munz and Keck 1973).

Leaves occur singly or in clusters, on short stalks, with scattered hairs above and soft hairs below the bright green groups of three leaflets. Single leaflets can be found on the growing tips. Each leaflet is oval to lance-shaped, $\frac{1}{16}$ to $\frac{5}{16}$ inch (1.6 to 8 mm) wide. The central leaflet is largest, up to $\frac{3}{4}$ inch (19 mm) long. New leaves,



Figure 1. Mature scotch broom.

Credit: Brother Alfred Brousseau. © 1995 Saint Mary's College of California. Reprinted with permission.

produced in spring, are often lost during the dry summer months or other periods of stress. Plants may be leafless for most of the year (Munz and Keck 1973).

Flowers are pea-like, bright yellow, and sometimes with red markings in the center, and are borne on short stalks. They are solitary in the leaf axil and are about $\frac{1}{2}$ to 1 inch (12.5 to 25.5 mm) long. April to June is the peak flowering time, but some flowers may appear sporadically throughout the year (Munz and Keck 1973).

Fruit are flat, brown or black, and hairy on the margins. Mature pods are 1 to $2\frac{1}{2}$ inches (2.5 to 6.5 cm) long and $\frac{5}{16}$ to $\frac{1}{2}$ inch (8 to 12.5 mm) wide (fig. 2). The pods ripen during summer and burst open to eject the seed. Some pods curl up after seed are ejected.

Seed are green to yellowish-brown when ripe. Each pod contains 5 to 20 shiny, rounded or slightly flattened seed that are $\frac{1}{8}$ inch (3.2 mm) long and $\frac{1}{16}$ inch (1.6 mm) wide (Hickman 1993).

Other Brooms

Portuguese, French, and Spanish brooms can be similar to Scotch broom in size, color, and appearance of flowers and stems (see table 1).

French broom has obvious and more persistent trifoliate leaves than Scotch broom. Leaflets are largely oval and about $\frac{1}{4}$ inch (6.5 mm) long. Leaflets appear waxy above and slightly hairy below. Spanish broom is often leafless or nearly leafless, especially later in the season (Hickman 1993). Portuguese broom closely resembles Scotch broom in terms of leaf patterns and is often mistaken for it.



Figure 2. Scotch broom seed pod.
 Credit: Charles Webber. © 1998 California Academy of Sciences. Reprinted with permission.

Table 1. Broom identification

	Scotch broom <i>Cytisus scoparius</i>	French broom <i>Genista monspessulana</i>	Spanish broom <i>Spartium junceum</i>	Portuguese broom <i>Cytisus striatus</i>
stems	usually 5-angled; star-shaped in cross-section	8- to 10-ridged; round in cross-section	finely ribbed; round in cross-section	8- to 10-ridged; round in cross-section
leaves	compound, 3 leaflets, sometimes single on new twigs; deciduous	compound, 3 leaflets, usually dense; evergreen	simple, sparse; deciduous	compound, 3 leaflets, sometimes single on new twigs; deciduous
flowers	single or paired in leaf axils; slight to no fragrance	4 to 10 in headlike clusters at ends of short axillary branchlets; slight fragrance	several in open racemes at stem tips; strong fragrance	single or paired in leaf axils
petals	yellow or partially to entirely dark red	yellow	yellow	yellow
calyx	2-lipped; top lip minutely toothed; smooth (glabrous)	2-lipped, top lip 2-lobed to near middle, lower lip shallow, 1 to 3-lobed; covered with short hairs (pubescent)	1-lipped, parted to base on top, rarely 2-lipped and 5-lobed; smooth (glabrous)	2-lipped, top lip minutely toothed; covered with short hairs (pubescent)
seed pods	flattened; glabrous with margins densely lined with long hairs; about 3/4-2" (2-5 cm) long, 1/2" (1.3 cm) wide	slightly flattened; densely covered with long hairs; about 1/2-1 1/4" (1.3-3 cm) long, 1/4" (0.6 cm) wide	slightly flattened; densely covered with long hairs; about 1 1/2-4 1/3" (4-11 cm) long, 1/4" (0.6 cm) wide	slightly inflated; densely covered with long hairs; about 1/2-2" (1.3-5 cm) long, 1/2" (1.3 cm) wide

Unlike Scotch broom, the flowers of Spanish and French brooms occur in clusters. Spanish broom flowers appear as racemes at the end of the twigs; French broom clusters are found in the axial of the branches. Spanish broom flowers are noticeably fragrant; French broom flowers are less fragrant. Spanish broom has round stems; French broom stems are ridged but not sharply angled. Portuguese broom is round in cross-section with 8 to 10 very fine ribs along the surface.

USES

As the name implies, broom species were used historically for broom production. Broom plants were also used for thatching, fence rows, and cattle fodder. The flowers were used as a hop substitute in beer making, and the seed have been used as a coffee substitute. The woody plant was used for tanning leather, and very large, old stems were used for veneer. Even the fibrous stems were used to make cloth (Hoshovsky 1985).

The leaves, bark, and flowers were gathered for their medicinal properties. Broom contains alkaloids and hydroxytyramine and should not be ingested in any form. While various parts of the plant are said to be cathartic, diuretic, and emetic, large doses can cause vomiting, purging, and low blood pressure and can also speed up the heartbeat. Large doses have been reported to cause fatal poisoning. Advanced stages of toxicity can cause complete respiratory collapse (Duke 1985).

ECOLOGY

Scotch broom is native to the British Isles and central and southern Europe. It was initially introduced into the United States as an ornamental and later to control erosion and stabilize coastal dunes. Today Scotch broom is estimated to infest more than 600,000 acres (240,000 ha) in California (McClintock 1985).

French and Spanish brooms are native to the Mediterranean region and the Canary Islands. They were first introduced into California around 1850 as ornamentals (Butterfield 1964). French broom is the most widespread of the three species, reported in at least 23 counties in California. Spanish broom is less widely distributed but appears to be expanding its range.

Distribution of all the brooms in Southern California and the Central Valley is limited by dry conditions. At higher elevations, cold winter temperatures limit them.

SOILS AND ROOT SYSTEM

Brooms can successfully invade pastures, fields, and grasslands. All brooms grow best in dry, sandy soils in full sunlight, but they also grow well in a variety of soil textures and a wide pH range (Gill and Pogge 1974).

A common feature of the invasive brooms is an aggressive root system characterized by a taproot that can exceed 2 feet (0.6 m) in length and an extensive, many-branched, shallow lateral root system. As with most legume species, brooms are able to fix nitrogen from the atmosphere. This allows them to grow on otherwise poor-quality soils (Mountjoy 1979).

GROWTH

Stem growth can be rapid (3 to 4 feet, or 0.9 to 1.2 m) in the first year. Initial rapid growth during the first 4 or 5 years is followed by 6 to 8 years of relatively slow growth. This is followed by a period of senescence in which there is more dead, woody tissue than green tissue.

Green broom stems are photosynthetic. On mature Scotch, Portuguese, and Spanish brooms, the stems are responsible for almost all of the plant's photosynthetic capacity. French broom also has photosynthetic stems, but the persistent leaves also contribute significantly to the plant's photosynthetic ability.

REPRODUCTION AND SPROUTING

Brooms are often found along roadsides in nearly pure stands where soils are frequently disturbed. Equipment and contaminated road surfacing materials can spread seed. While Scotch, French, Portuguese, and Spanish brooms do not establish well in highly shaded areas, they initially invade open sites such as logging roads, landings, skid trails, and harvest areas.

A mature Scotch broom plant can produce about 15,000 seed per year. On average, less than 5 percent of the seed are lost to insect predation, and 98 percent of surviving seed are viable (Bossard 1990).

Scotch broom, like other pioneer species, uses a variety of tactics to spread. About 40 percent of the seed in any year germinate immediately after dispersal, and another 25 percent germinate the second year (fig. 3). The majority of the remaining seed have an impervious seed coat that requires scarification for germination to occur. Movement along waterways, transportation in gravel and road surface materials, or exposure to low-intensity grass or brush fires can stimulate germination of these seed (Bossard 1990).

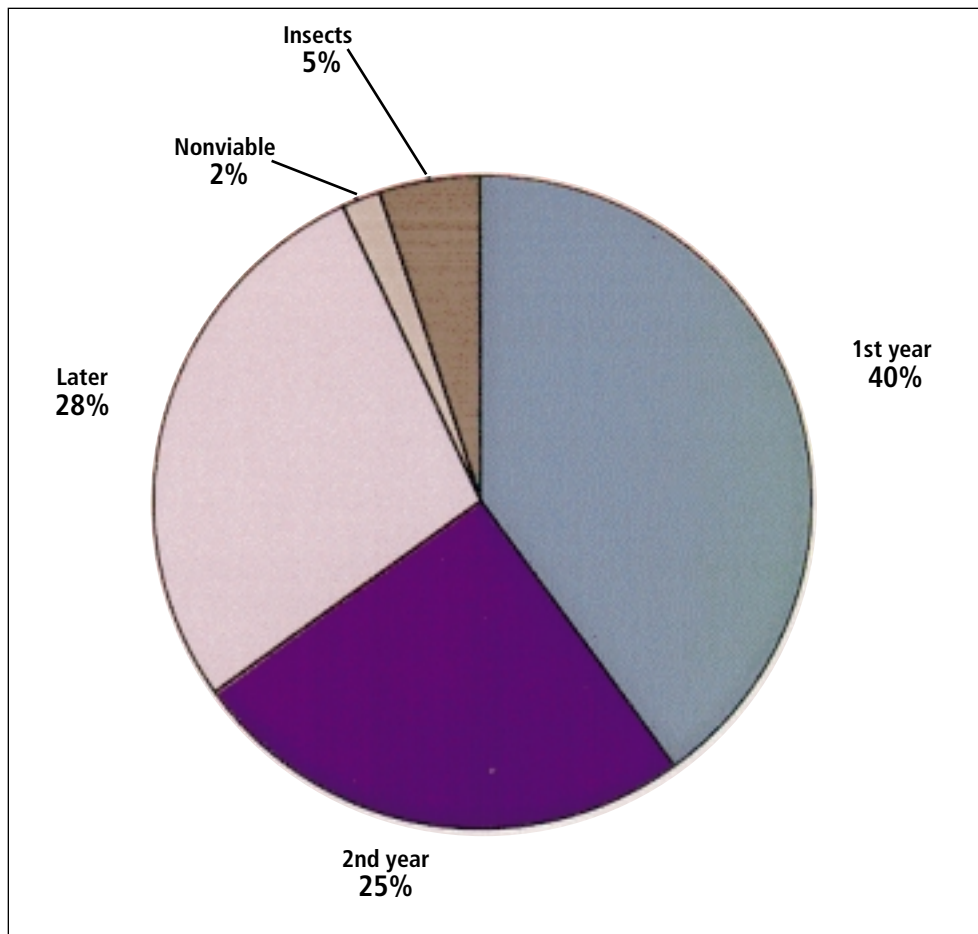


Figure 3. Scotch broom seed viability. Source: Bossard 1990.

Seed will germinate for many years even after the parent plants are removed. Seed stored in glass jars at Kew Gardens in England remained viable after 81 years (Turner 1933). In the field, seed were found to germinate at least 4 years after removal of the seed (Bossard 1990).

In the Sierra Nevada, few animals eat Scotch broom seed. In coastal conditions, quail and grouse can be relatively effective seed predators, digesting enough of the seed to effectively kill them. Increased soil disturbance can increase infestation in most sites, but it can also increase predation by quail and grouse, possibly because seed are easier for the birds to find (Bossard 1990).

Scotch broom also sprouts readily. Plants that are cut during the growing season can grow back to the original size in 1 to 2 years (Bossard 1990).

CONTROL STRATEGIES

IPM

Integrated pest management (IPM) is an ecosystem-based strategy that focuses on long-term prevention of pests through a combination of techniques such as biological control, pesticide use, habitat manipulation, and modification of cultural practices. Pesticides are used only after monitoring indicates that they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism. Pest control chemicals are selected and applied in a manner that minimizes risks to human health, beneficial and nontarget organisms, and the environment.

Through IPM practices, we can develop a strategy for controlling Scotch, French, Portuguese, and Spanish brooms. Heavy shade is an effective long-term treatment. Broom is moderately shade intolerant, needing nearly full sunlight to thrive. It will grow in partial shade, but the plants grow slower. French broom appears to be more tolerant of shade than Scotch or Spanish brooms (Williams 1981). Competition from grasses and other vegetation may control broom seedlings; removal of broom should be followed by propagation of preferred plants. Although about a dozen potential insect biological control agents have been identified and are under investigation, no releases have yet been approved.

Mechanical Control

Hand-pulling of young plants is an effective strategy when the infestation is relatively small. Hand-pulling is easiest when the soil is moist. It is most effective before the plants produce seed, in the first 2 years following germination. Large plants can be mechanically removed using specialized tools. Hoeing very young plants can also be effective. Both of these techniques cause some soil disturbance that can lead to reinvasion.

Broom seed geminate only in the top 2½ inches (6.5 cm) of the soil (Bossard 1990). Soil disturbance should be avoided as much as possible, as it can bring these long-lived seed close enough to the surface to germinate.

Only about 10 percent of Scotch broom stems will re-sprout when lopped near the base during the driest period of the season, which generally extends from the end of July until the first rains in October. Lopping at other times can lead to vigorous sprouting. For the most effective results, lop within 3 inches (7.5 cm) of the soil surface (Bossard 1990).

Mowing is also more effective when Scotch broom is under drought stress. Since drought stress and high fire danger occur together, care should be taken to avoid causing sparks with the equipment. Mowing close to the ground results in the least amount of sprouting.

Deer, rabbits, and other herbivores do not readily graze brooms, possibly due to the bitter taste of the stems and the availability of more palatable forage (Bossard 1990). However, grazing does occur in other parts of the world, where goats control Scotch broom.

Fire for Control

Using fire to control Scotch and French brooms has had varied results. Some researchers suggest frequent prescribed fires to encourage regeneration and deplete the seed bank over time. Cooler fires can encourage seed germination, followed by prescribed fires that kill the young seedlings before they generate seed (Swezy and Odion 1997). Soil temperatures from 130°F to 300°F (54°C to 149°C) in moist conditions have been shown to stimulate seed germination (Bossard 1990).

A hot fire produced by hand-cutting mature plants, allowing the cut material to dry, and then burning in spring effectively controlled French broom re-spouts but had little effect on germination (Boyd 1995). Hot fires that generate soil temperatures over 300°F (149°C) killed Scotch broom seed (Bossard 1990). Obtaining soil temperatures at this high temperature and deep enough to effectively deplete the seed bank is difficult to achieve safely.

Chemical Control

Many herbicides are effective on broom. The concentration, timing, and method of application determine which herbicide and method of application are most appropriate. Since herbicide formulations and recommendations are subject to change, check with your local county agricultural commissioner or pest control adviser for current recommendations.

Glyphosate is an effective herbicide that is available to landowners for control of broom. Spray the plant with a solution of 1.5 to 2 percent a.i. glyphosate mixed in water until the plant is thoroughly wet. Apply this mixture just as the flowers are blooming for most effective control. Painting the cambium region of cut broom stumps with a glyphosate or triclopyr solution at 50 percent a.i in water can also be effective. Stump treatments are most effective when applied within a few minutes of cutting.

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