Fabaceae—Pea family

Ulex europaeus L.

common gorse

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Growth habit, occurrence, and use. Gorse is a leafless, spined shrub introduced from western Europe. In its homeland, it grows 1 to 2 m tall and is primarily a non-aggressive invader of disturbed areas that is recognized as useful for wildlife protection, soil stabilization, and revegetation. It has also been cultivated as an ornamental and as forage for livestock, which feed on the soft, new growing shoots. Its major use in the past, however, was for hedgerows to contain livestock before barbed wire (Jobson and Thomas 1964). As a useful plant, European settlers carried gorse to many parts of the world where it quickly escaped from cultivation and formed aggressive feral populations. These feral plants grow 3 to 5 m tall in dense, spiny, impenetrable stands that exclude desirable vegetation in pasture lands (Hill 1983; Sandrey 1985) and, in open forests, interfere with reforestation and forest management (Balneaves and Zabkiewicz 1981; Zabkiewicz 1976). Gorse is presently recognized as one of the worst weeds in New Zealand, Chile, and Tasmania and is recognized as a weed in at least 15 other countries or island groups around the world (Holm and others 1979).

In North America, gorse is still used to a limited extent as an ornamental for its dense yellow flowers. In the eastern United States, scattered feral populations have been recorded, but apparently these are not of an aggressive nature. By contrast, along the Pacific Coast, gorse is found scattered along the coastline from San Francisco, California, north to Vancouver, British Columbia (Markin and others 1994). Through most of this area, it is found in small, scattered populations that are usually targeted for intensive control programs to keep them from expanding. The major outbreak is along the southwestern coast of Oregon, where it covers at least 15,000 ha and is a major problem in forest management. This gorse population interferes with reforestation and, because of the plant's highly flammable nature, creates an extreme fire hazard (Herman and Newton 1968). Gorse also infests 14,000 ha at higher elevations on the islands of Hawaii and Maui in Hawaii (Markin and others 1988).

As a useful agricultural and ornamental plant in its native range, methods for propagating gorse have been developed in Europe (Rudolf 1974). As a major weed through the rest of the world, no effort has been made to propagate it for sale or outplanting. However, very extensive work has been done in studying the regeneration, reproduction, and propagation of this plant for research purposes and to develop control methods, particularly in New Zealand. A more recent need has been to propagate gorse to be used as food for insects being tested as potential biocontrol agents (Markin and Yoshioka 1989).

Flowering and fruiting. The small, bright yellow, pea-like flowers (Whitson and others 1991) are very similar in size and appearance to those of the closely related Scotch

broom—*Cytisus scoparius* (L.) Link—with which it shares much of its range on the Pacific Coast. In Europe, gorse blooms in late spring, usually for 1 month; depending upon the latitude, this can occur from late February to early June. On the Oregon coast, gorse blooms from February to early May; in Hawaii, it blooms from December to May, peaking in February and April. Flowers may be solitary or in clusters, but because they are often synchronized in blooming, an entire plant will sometimes be covered with thousands of blooms. The flowers are insect-pollinated and require a large insect that, while probing for nectar, can trip and release the stamens held in the keel on the lower surface of the flower. The major pollinator in North America and Hawaii is the common honey bee (*Apis mellifera* L.). When massive blooms occur in areas where feral bees are scarce, poor pod set may be seen in limited areas (a desirable feature for land managers). Beekeepers, however, recognize the bloom as an excellent source of early spring pollen that can be used to build up their hives, and they usually move hives in to take advantage of the bloom, resulting in adequate pollination (Sandrey 1985). One method of control that has been used in Hawaii is restricting commercial bees in an effort to reduce seed production.

The mature fruit is a typical, small (1 to 1.5 cm), black legume (pod) that contains 1 to 12 seeds, although the average is 4 to 5. After pollination, a legume requires 2 months to mature, so peak legume set occurs 2 months after peak flowering. In Oregon, this is mid-May through July; in Hawaii, peak legume set is in May and is finished by the first of July. On maturing and drying, the legumes open violently (dehisce), naturally dispersing the seeds 1 to 3 m out from the parent plant. In Oregon and Hawaii, natural germination usually occurs during the wetter winter and spring months.

Fruit collection; seed extraction and storage. As an aggressive, noxious weed, there is no demand for the commercial collection of seeds. Researchers obtain the seeds they need by collecting the mature black legumes individually or by cutting a branch containing them. When allowed to dry out in a cloth sack at room temperature, the legumes naturally dehisce, releasing the seeds. The mature brown seeds are spherical, 1.25 to 2 mm in diameter (figure 1). Each seed initially contains an elaiosome, a yellow, fleshy appendage, rich in oil and protein (Pemberton and Irving 1990) that attract ants; this is another method of seed dispersal (Weiss 1909). The gorse seedcoat is notorious for its hardness (it is water impermeable), which gives the seeds a very long field life and has created major problems in managing this weed (Butler 1976; Chater 1931; Moss 1959). Seed numbers range from 145,000 to 159,000/kg and average about 150,000/kg (66,000 to 72,000/lb and average about 68,000/lb) (Rudolf 1974). The seeds are orthodox in storage behavior and can be kept indefinitely in ordinary cool, dry storage.

Pregermination treatments. Germination of mature, well-dried seeds varies greatly according to the literature but can be as low as 10 to 30% in 6 months. In the field, the seeds have a long life; it has been estimated that they can remain viable for up to 26 years or more (Moss 1959).

Because of the seedcoat's hardness, a number of different pregermination treatments have been tried. In the field, the most common method to trigger germination is fire. When a gorse area burns, the seeds in the top centimeter or two of duff are destroyed, but the deeper seeds survive and most of these are often triggered into germinating (Rolston and Talbot 1980; Zabkiewicz and Gaskin 1978). In the laboratory, this can be duplicated by heating the seeds from 60 to 80 EC for 30 minutes in an oven (Butler 1976; Moss 1959). Placing gorse seeds in boiling water for 30 seconds and then cooling them in cold water can increase germination to over 90%

(Millener 1961).

Other methods of germination include soaking in concentrated sulfuric acid for ½ to 1½ hours, and mechanical scarification (Buttler 1976), most simply done with emery paper (Moss 1959).

Germination tests. Because of the noxious nature of gorse in North America, standardized germination tests for quality control have not been developed. In Europe, where gorse is a beneficial native plant, germination tests at one time were apparently developed in which seeds were tested in germinators or sand flats at 20 EC for 30 days using 400 pretreatment seeds/test (Rudolf 1974). Researchers have reported no problem in obtaining germination by planting scarified seeds 1 cm deep in different media. First signs of germination are usually seen within 10 days of planting. In 15 to 25 days, seedlings are small rosettes with true leaves, approximately 1.5 cm in diameter. Small leaves continue to form until the plant is approximately 5 cm tall, at which time the first spines are produced. During the remainder of its life, the plant produces no more leaves, only spines. The juvenile stage of the plant, from seed germination until spines begin to form, requires 4 to 6 months in the field. In Europe, large-scale germination in pots and direct seeding into the field have been practiced in the past (Rudolf 1974).

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Figure 1—*Ulex europaeus,* common gorse: seeds, H 6 (photograph courtesy of the California Department of Agriculture (CDFA 2002).