Battle the bittercress army with sanitation and consistency

It occurred to me that of all the weed species I've written about, I've never covered the one that is most abundant. Bittercress (*Cardamine oligosperma*) is not necessarily the most difficult weed to kill, but its ability to reproduce quickly and in large numbers makes it very difficult to manage. Bittercress is probably the most ubiquitous nursery weed in Oregon. This article discusses the biology of bittercress relevant to nursery production, as well as the most useful tools for controlling it.

Nomenclature

Bittercress is known by many names, including snapweed, pepper weed, popcorn weed and shotgun weed. Many of these names come from the plant's ability to forcefully project its seeds like tiny cannons.

The Latin name of the weed has been debated. I once questioned if bittercress in Oregon container nurseries was, in fact, *C. oligosperma*, as was widely thought. Other weed scientists throughout the U.S. have referred to the same plant, or at least what looks like the same plant, as *C. hirsuta*. A colleague and I used molecular markers to conclusively identify the Oregon species. We collected bittercress samples and compared their DNA to known genetic markers in the GenBank database. We found that the bittercress growing in the Oregon landscapes, pastures and roadsides was *C. hirsuta*. However, bittercress growing in Oregon container nurseries did not match any species in GenBank. We concluded, based on morphological characteristics and inconclusive results from molecular markers, that the species is likely *C. oligosperma*.

Bittercress that occurs in Oregon container nurseries is most likely little western bittercress (*C. oligosperma*). Bittercress occurring in fields and roadsides is hairy bittercress (*C. hirsuta*). From here on, my primary focus is on little western bittercress growing in container nurseries.

Biology

Bittercress seedlings emerge primarily in the cool fall and spring seasons. However, germination in a nursery setting can occur throughout the year, due to the artificially cool climate created by canopy shade and frequent irrigation. Seedlings have oval cotyledons with a small notch at the tip. The first true leaves are club-shaped. Soon after germination, a small rosette forms with deeply lobed foliage. Flowering stems with more elongated leaves emerge from the rosette. Flowers occur in clusters called racemes, and individual flowers are white with four petals. Stamens within the flowers are critical for distinguishing the two major bittercress species in Oregon. *C. hirsuta* flowers have a variable number of stamens. About 80 percent of the flowers have four stamens, about 18 percent have five, and about 2 percent have six. *C. oligosperma* always has six stamens.

A single bittercress plant produces 675 to 4,980 seeds per plant (Bachman and Whitwell, 1994). Seeds are forcefully projected from the mature silique (fruit pod) up to 3 feet from the mother plant. Seeds have up to 99 percent viability (Leishman et al., 1998) and can germinate in about five days. Bittercress (*C. oligosperma*) seeds have no dormancy mechanism and will germinate upon dispersal year-round in container crops. In contrast, *C. hirsuta* seeds have innate dormancy when released from the mother plant, and thus only germinate in late fall or early spring. The dormancy mechanism in *C. hirsuta* seed is likely the reason that this species does not occur in containers. A common thread among all container weed species is that their seed lacks a dormancy mechanism, allowing them to reproduce multiple times in a growing season.

Sanitation

Virtually all of my articles on weed control include some section on sanitation. This is especially true for bittercress. One bittercress plant can produce nearly 5,000 seeds in just five weeks. A short life cycle and the ability to project seeds several feet from the mother plant make sanitation paramount. The two primary sanitation deficiencies I see in many nurseries are failure to control bittercress on the gravel beneath containers and the use of old pots.

Bittercress is a weed that can thrive with limited resources. It germinates readily in coarse gravel and on top of woven weed fabrics. With just a thin layer of bark, bittercress will reproduce and likely expel seed into nearby containers. There must be a concerted effort to kill bittercress growing in gravel and to remove debris from weed fabric that might serve as a repository for germination.

Old and reused containers harbor many weed seeds. Bittercress seeds are small and remain attached to plastic containers. Many have commented that herbicides are least effective near the container edge because that's where most weeds germinate first. Shrinking and swelling of the container substrate may reduce herbicide efficacy; however, poor sanitation and use of old pots are more likely the reasons that weeds seem to germinate near the container edge. I recently visited a nursery with a severe weed problem in its larger containers (No. 2 and No. 3 containers). Weeds in those containers were emerging from the center of the pot around the stem of the shrub. It was clear that these weeds started in propagation. In the propagation area, all weeds were emerging from the container edge in the liners. The source of weeds at this nursery was reused and dirty propagation liners.

Do not underestimate the power of sanitation in your weed-management

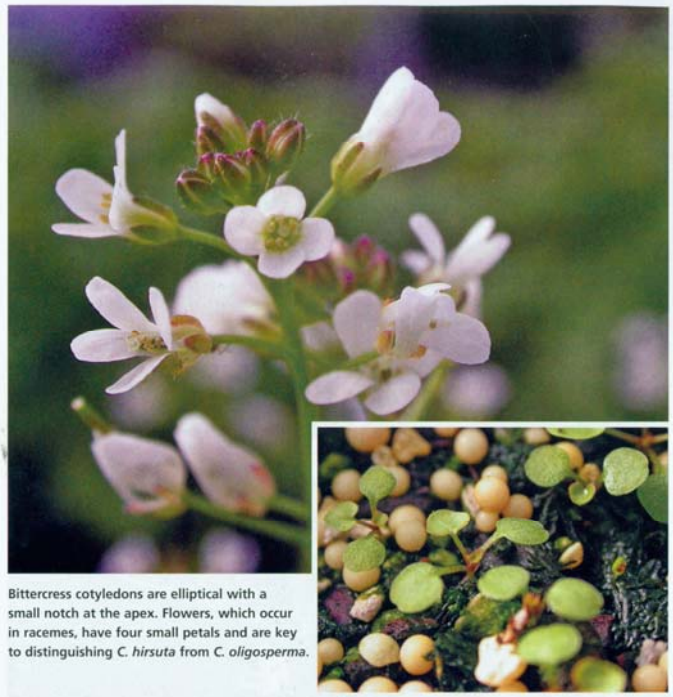
program. A sound sanitation program is more effective, in terms of total weed control, than any pre-emergence herbicide on the market.

Chemical control

No sanitation program is perfect, and that's where pre-emergence herbicides earn their cost. Pre-emergence herbicides control weeds that escape your sanitation program. Be sure to make applications of pre-emergence herbicides prior to bittercress germination. This can be difficult, considering the weed germinates year-round with no well-defined period of emergence. Use the following rules to guide application timing:

1. Apply pre-emergence herbicides one to three days after potting (follow label instructions). If bittercress seeds are dispersed into recently potted containers, they will germinate quickly. It is important to have the chemical barrier from the pre-emergence herbicide established quickly.
2. Scout containers regularly to look for escaped weeds. An increase in the number of germinating weeds is an indication that the chemical barrier has deteriorated and another pre-emergence herbicide application is needed (usually 75 to 90 days).
3. Organize a work crew to thoroughly hand-weed all containers, and follow with an herbicide application immediately (the same or next day).
4. Plan for a final pre-emergence herbicide application just prior to over-wintering. Applications must normally occur three weeks prior to covering, but the schedule varies with each product (follow label instructions). The mild and constantly cool climate beneath over-wintering structures is ideal for bittercress growth. Make sure an effective herbicide is applied uniformly and thoroughly prior to overwintering.

28 ▶



Bittercress cotyledons are elliptical with a small notch at the apex. Flowers, which occur in racemes, have four small petals and are key to distinguishing *C. hirsuta* from *C. oligosperma*.

The most effective herbicide for bittercress control depends on a number of factors relative to how containers are managed. We conducted two experiments at the North Willamette Research and Extension Center to compare several commonly used products.

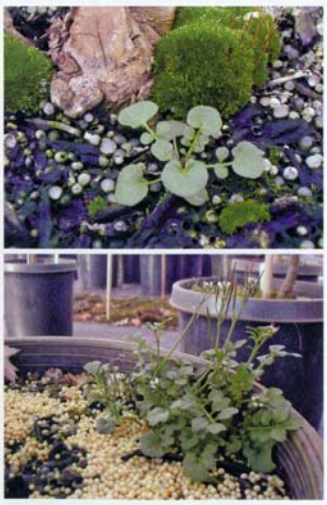
In 2003, containers were filled on July 17 with 100 percent Douglas fir bark amended with 1.5 pounds per yard^3 Micromax and 9 pounds per yard^3 Osmocote 18-6-12. Herbicides (Table 1) were applied July 21 at their maximum labeled rate with a handheld shaker. Bittercress (*C. oligosperma*) was applied to containers by placing 20 seeds in each pot. Containers were evaluated for weed number, percent weed control and weed shoot fresh weight (SFW) at the conclusion of the study.

A second study including more herbicides was initiated in 2004. Containers were filled on May 6 and herbicides were applied on May 17. Otherwise the experiment was conducted similarly to that in 2003.

The 2003 experiment took place over a longer period of time than the 2004 experiment. This is because the 2003 experiment was initiated during the summer. While bittercress germinated and grew, warm summer temperatures slowed its growth when compared with the vigorous growth observed in the more conducive spring temperatures of 2004. The relative efficacy of each herbicide from highest to

30 ▶

Many growers believe poor herbicide efficacy near container edges is to blame for growth of bittercress there, but poor sanitation is more likely the cause.



Bittercress initially forms a decumbent rosette with deeply lobed leaves, followed by more upright, flowering stems.

Table 1.
Bittercress control in two experiments with commonly used pre-emergent herbicides.

Herbicide	Rate (lb/ acre)	2003 Experiment			2004 Experiment		
		Weed number 2 WAT	Control (%) 13 WAT	SFW (g) 13 WAT	Weed number 2 WAT	Control (%) 7 WAT	SFW (g) 9 WAT
OH2	100	2.4	63	16.8	3.6	93	3.8
Regal O-O	100	0.6	71	20.3	1.8	97	2.1
Rout	100	0.7	60	10.5	4.4	96	2.2
Snapshot	200	0.1	96	0.1	1.4	100	0.0
Broadstar	150	0.1	54	7.4	3.1	96	2.7
RegalStar	200				10.8	72	13.7
RegalKade	200				13.1	74	12.6
Ronstar	200				6.1	91	5.7
Kansel+	100				13.0	72	13.2
Control		3.3	53	28.4	15.8	43	30.7

SFW = shoot fresh weight, or total weight of weed stem and leaves.
WAT = weeks after treatment.