

## CHAPTER 4: Mechanical Control

**M**echanical control of weeds usually means cutting or uprooting them. Mechanical control options for yellow starthistle include hand pulling, hoeing, tillage, and mowing.

### Hand Pulling or Hoeing

Hand pulling and hoeing are the oldest methods of weed control. Although they are labor intensive and often relatively ineffective for the control of perennial weeds, they typically cause minimal environmental impact.

### ECONOMICS

Depending on the size of the infestation, manual control of yellow starthistle can be relatively cheap or very expensive. If only a few plants require removal, the cost can be minimal. However, hand-weeding a large area may require several people and can cost dramatically more than other control options.

### METHODS AND TIMING

Manual removal of yellow starthistle is most effective for controlling small patches or in maintenance programs where plants are sparsely located in the grassland system. This usually occurs with a new infestation or in the third year or later in a long-term management program. It can also be an important tool in steep or uneven terrain where other mechanical tools (e.g., mowing and tillage) are impossible to use (Woo *et al.* 1999). To ensure that plants do not recover it is important to detach all above ground stem material. Leaving even two inches of rooted stem can result in recovery if leaves and buds are still attached to the base of the plant (Benefield *et al.* 1999). The best timing for manual removal is after plants have bolted but before they produce viable seed (early flowering). At this time, plants are easy to recognize and some or most of the lower leaves have senesced. Hand removal is particularly easy in areas with competing vegetation. Under this condition, starthistle will develop a more erect, slender stem with few basal leaves. These plants are relatively brittle and easy to remove. In addition, they rarely have leaves attached



**Hand tools.** Shovels, lopper, and hoes are effective for small, sparsely-spaced populations. (Photo: G. Kyser)

at the base and, consequently, rarely recover, even when a portion of the stem is left intact.

A larger starthistle population can be controlled through physical removal by starting at the outward edge of the population and moving in (Fuller and Barbe 1995). This technique requires repeated visits, but it ensures that no new seeds are produced and minimizes unnecessary soil disturbance. Using this method, it is possible to control relatively large starthistle-infested areas (up to 40 acres) with low impact. Cost of control will depend on the extent and density of the infestation.

### RISKS

When using manual removal techniques, it is important to minimize soil disturbance around the removed plants. Soil disturbance can create sites for re-establishment of new seedlings or rapid invasion by another undesirable species (DiTomaso 1997).

In addition, trampling of habitat by large numbers of people in these sites can damage sensitive native species and further disturb the soil. The potential also exists for physical injury when removing plants once the spines have developed. This risk is minimized with appropriate protective clothing and gloves.



**Tillage.** Harrowing, a kind of tillage, damages the roots and separates shoots from roots in young plants.

## Tillage

Tillage is more common in agricultural areas than in non-crop areas. On occasion, tillage can be used in rangelands, along roadsides, and in utility rights-of-way. Tillage using plows or discs can control annual weeds by burying plant parts. This is more effective on annuals than perennials. In contrast, tillage using harrows, knives, and sweeps can be used to damage root systems or to separate shoots from roots in younger plants, and can also be used to damage roots in larger plants (Thomsen *et al.* 1996b).

## ECONOMICS

If equipment is already available the cost of tillage may be reasonable, but is generally still higher than the use of chemical control. In this case, the costs incurred are generally associated with labor, fuel and equipment maintenance. Costs increase when repeated tillage is necessary.

## METHODS AND TIMING

Early summer tillage will control yellow starthistle provided the roots are detached from the shoots. Repeated cultivation can be used in the same season if rainfall stimulates additional germination between tillage practices (Thomsen *et al.* 1996b). This will rapidly deplete the starthistle seedbank, but may also deplete seedbanks of desirable species. To be effective, this method must be conducted before yellow starthistle produces viable seeds. Tillage is often used on cropland and probably accounts for the rarity of starthistle as an agricultural weed. It is occasionally used on roadsides. In wildlands and rangelands, tillage usually is not an appropriate option for control of yellow starthistle.

## RISKS

Tillage must be applied when the surface soil is dry, or fragmented plant segments can re-grow and possibly magnify the problem. Despite its effectiveness in controlling annual weeds, it can damage important desirable species, expose the soil for rapid reinfestation if subsequent rainfall occurs (DiTomaso and Gerlach 2000a), and prolong the longevity of yellow starthistle propagules by burying seeds deep in the soil profile. In addition, it can alter soil structure (e.g., by compaction), increase erosion, and cause the loss of soil moisture by exposing subsoil. Heavy equipment also produces fuel exhausts and raises dust, including fine particles  $\leq 10$  microns in diameter (PM10) (DiTomaso 1997).



**Deck mower.** (Photo: G. Kyser)



**Flail mower.** (Photo: G. Kyser)



**Pincushions.** If mowed too early, yellow starthistle may recover and form a “pincushion” of low-growing flowerheads.

## Mowing

Mowing is a popular control technique along highways and in recreational areas and has less impact on the environment than tillage. Various power mowers can be used depending on topography and the need to avoid rocks and non-target plants. A handheld string trimmer (weed whip) may be used for mowing in small areas.

## ECONOMICS

Although mowing can be a cost-effective method for control of starthistle, it is not feasible in many locations due to rocks and steep terrain. Costs are generally associated with labor, fuel, and equipment maintenance, as well as owning or leasing the appropriate equipment.

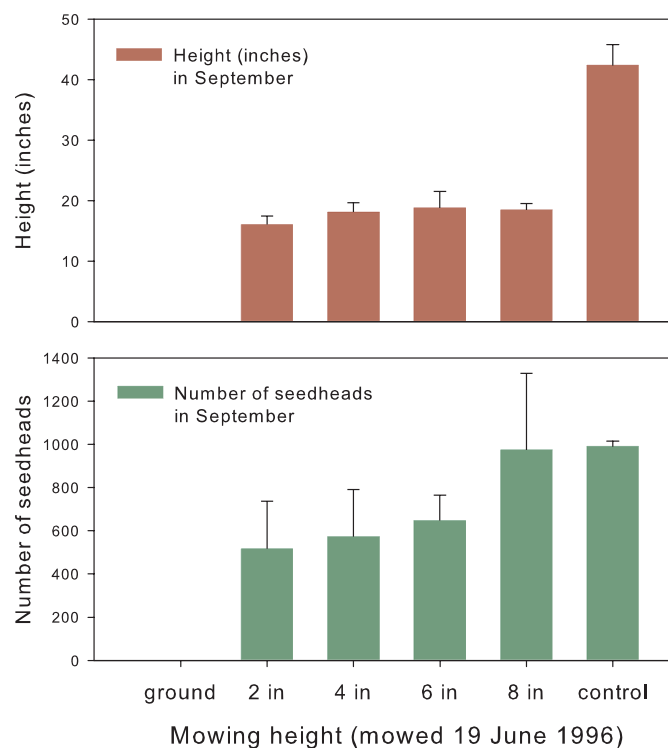
## METHODS AND TIMING

Success with mowing depends on proper timing and the growth form of the plant. Mowing is most successful at the spiny to early flower stage. Mowing too early, before yellow starthistle seed heads reach the spiny stage, may allow starthistle to recover and also can suppress competing vegetation, thus enhancing light penetration and increasing the starthistle problem. Even repeated mowing, if conducted too early, will not control starthistle and may even extend its life cycle. On the other hand, mowing after plants have produced viable seed will not substantially reduce the seedbank and the following year’s infestation. Regardless of timing, in non-crop areas mowers often must be set

high (four inches or above) to avoid striking rocks and other obstacles, but higher mowing can be less effective in controlling starthistle.

Despite the limitations of mowing, Thomsen *et al.* (1994a, 1997) and Benefield *et al.* (1999) demonstrated the successful use of mowing for yellow starthistle control. Thomsen *et al.* (1994a, 1997) consistently demonstrated over 90% control of yellow starthistle using two timely mowings per year over a three-year period. Benefield *et al.* (1999) showed that mowing at the early flowering stage, before viable seed production, was most effective in controlling yellow starthistle.

These researchers also demonstrated that the success of mowing as a control strategy depends partly on the plant’s growth form and branching pattern. Yellow starthistle plants growing among other plants in grassland tend to have an erect, high-branching growth form and are effectively controlled by a single mowing at the early flowering stage. Plants grown in the open tend to have a sprawling, low-branching form and are not controlled well even with repeated mowing at the proper timing.



**Fig. 12. Effect of mowing height on seed heads.** Mowing yellow starthistle above the basal branches does not prevent development of seed heads (Benefield *et al.* 1999).

Mowing may be a useful strategy for small landowners who do not wish to use herbicides. A few land managers have successfully controlled yellow starthistle using continuous mowing over multiple years. However, since mowing is a late season management tool, in most cases it is best employed in the latter years of a long-term management program or in a lightly infested area.

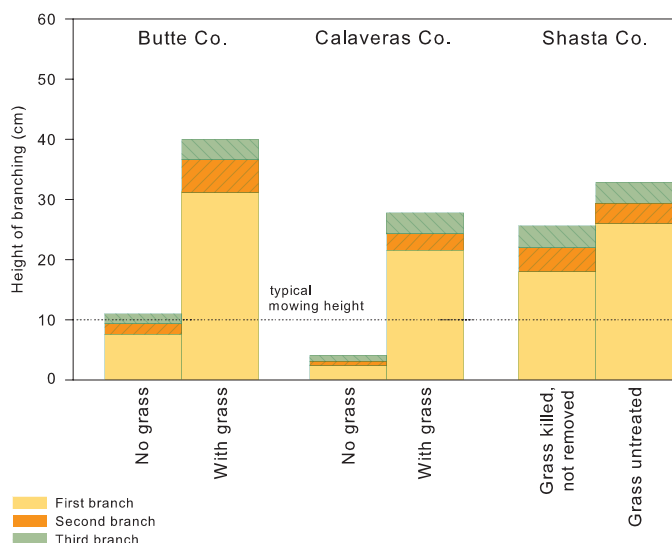
### RISKS

Mowing is a popular control technique along highways and in recreational areas. It has less impact on the environment than tillage. Like tillage, however, it can produce fuel exhaust and PM10. In this case, the particles are very small plant fragments, often detached hairs. When mowing is conducted in rocky areas, there is a risk of sparks (from metal blades striking rocks) igniting the dried vegetation. This occurred during a yellow starthistle control mow at Fort Hunter Liggett (A. Hazebrook, Fort Hunter Liggett, pers. comm.).

Perhaps the greatest risk with mowing is the impact on the plant community. Mowing can injure late growing native forb species (Rusmore 1995) and reduce fall and winter forage for wildlife and livestock (DiTomaso 1997, DiTomaso *et al.* 2000b). Proper timing can minimize these risks, whereas mowing at the wrong time can increase noxious weed populations (DiTomaso 1997).

Mowing may also decrease the reproductive efforts of insect biocontrol agents. For example,

mowing yellow starthistle during the early flowering stage—which is most effective—may cause significant damage to seed-feeding biocontrol agents.



**Fig. 13. Effect of cover on branching habit.** Yellow starthistle develops different branching patterns depending on whether it is grown in open sun or among grasses in a grassland. A typical mowing height of 10 cm (4 inches) is shown for comparison (Benefield *et al.* 1999).



**Two branching patterns.** Yellow starthistle rosettes in full sunlight grow compact and flattened (top). In grasslands where they receive less light, rosettes develop a more erect growth form (bottom). The erect form is more susceptible to mowing.