



of factors including type of machinery, experience of the operator, growth stage of weeds, and soil moisture,<sup>3</sup> but is NOT dependent on starting weed density (**Box 2**).

## Flaming

Flaming can kill large weeds as well as seedlings, but is more effective against broadleaf weeds. Because flaming does not require soil disturbance, it does not typically

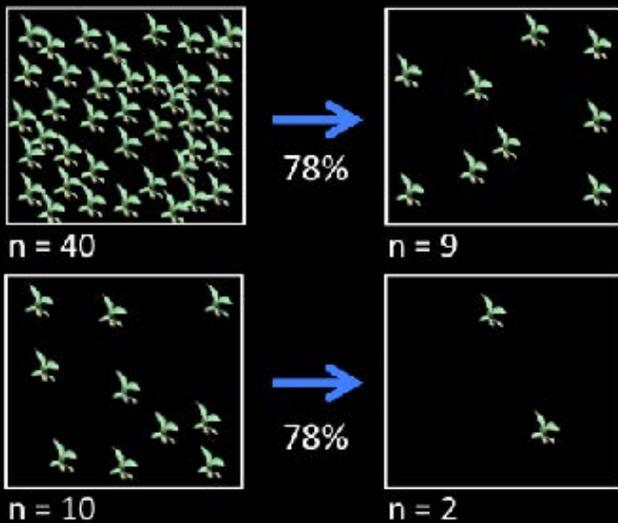
stimulate a 'flush' of new weed emergence, and is therefore a useful tool in stale seedbed preparation. Some disadvantages to flaming are that specialized equipment is required, and that the fossil fuel inputs are higher than those needed for other physical weed control methods.

## Strategies

There are three major strategies for the farmer wishing to reduce her weed pressure through physical means: cultivate more, cultivate better, or manage the weed seedbank.

### Box 2: How does weed density affect cultivation?

Under the same conditions, a single cultivation pass will kill a fixed percentage of the weeds present, regardless of starting weed density. The diagram below illustrates this principle for a high 78% mortality rate per cultivation (which could be achieved under ideal cultivating conditions). The blue arrows represent cultivation events.



While it can be tempting to emphasize the positive - i.e. "I killed 78% of my weeds with one pass!" don't forget that, if starting weed density was high, the remaining weeds (in this case, 22%) may still constitute a serious weed problem.

### 1) Cultivate More

Increasing the number of cultivation events each season is a simple and effective weed management strategy. The disadvantages are that cultivation can cause crop loss, takes time, requires fossil fuel for tractor operation, and can contribute to the spread of weed seeds and rhizomes.

### 2) Cultivate Better

Timing and tool choice are key to better cultivation. For maximal weed mortality, cultivate in dry conditions, when weeds are in the 'white thread' growth stage (**Box 3**). Before they develop true leaves and fibrous root systems, weeds are very vulnerable to both desiccation and burial, and therefore easily killed by cultivation.

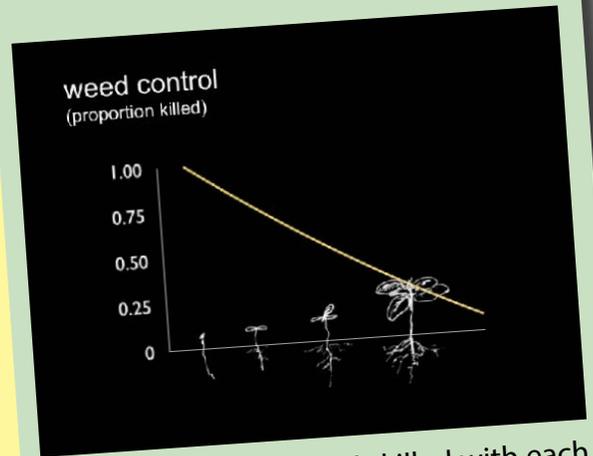
Tool choice also affects weed management success.<sup>4</sup> Using the right cultivation equipment for your crop and soil, flaming when appropriate (especially to combat broadleaf weeds), and adjusting equipment and tractor speed appropriately can all contribute to highly effective organic weed management (**Box 4**).

Finally, understanding the biology of especially

### Box 3: Get 'em while they're white threads

The graph at right shows how cultivation becomes less effective as weeds grow in size.

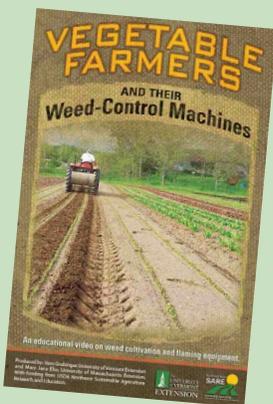
Weeds are most vulnerable when they are in the 'white thread' growth stage, pictured below on the right side of the penny. Once true leaves start to form, as pictured on the penny's left, the root system has already developed enough to hold onto soil when it is unearthed, making it much more resilient against disturbance, and harder to kill.



The proportion of weeds killed with each cultivation pass decreases as weeds grow.

### Box 4: Weed control machines

Farmers throughout the ages have invented and adapted weed control machines to suit their needs. Some examples of New England ingenuity are highlighted in the film *Vegetable Farmers and their Weed Control Machines*<sup>2</sup> put out by UVM Cooperative Extension. In recent years, researchers and farmers in Europe have developed numerous novel weed control machines, including the examples highlighted here.



This robotic flame-weeder is mounted with a camera that distinguishes between weeds and crop plants, allowing it to automatically toast inter-row weeds.



The 'Weedmaster,' pictured here with finger weeder attachments, is a versatile person-powered cultivator that can also be equipped with disk hillers, sweeps, and flaming equipment.

problematic weeds (**Figure 2**) can help you plan crop rotations so that tillage or cultivation coincides with emergence, or preempts seed rain, of weeds you especially wish to control.

### 3) Reduce Your Weed Pressure

Other weed management strategies aimed at depleting the weed seedbank can simplify weed management long-term by reducing the starting weed density (**Box 2**), and therefore the time and effort needed to manage weeds in subsequent growing seasons.<sup>5</sup> Check out to the Seedbank Management Bulletin in this series to learn more.

**Learn more at...**

 [umaine.edu/weedecology](http://umaine.edu/weedecology)

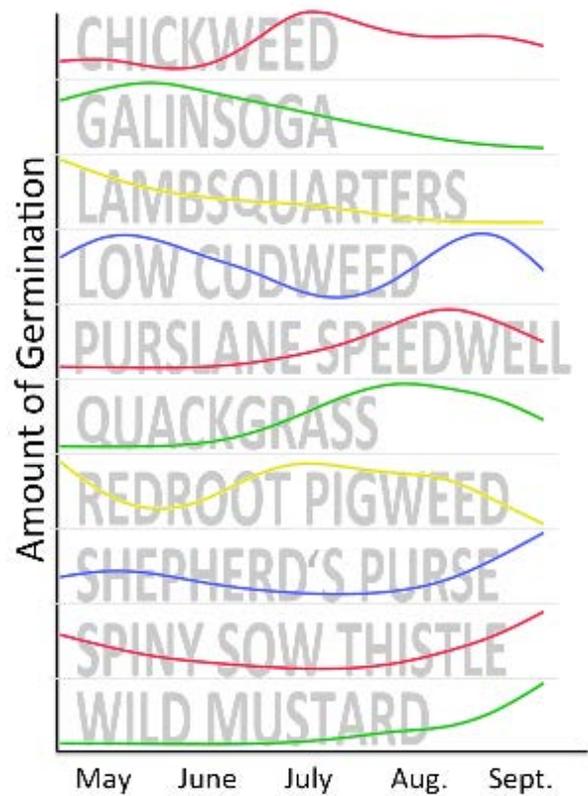
 [zeroseedrain](https://www.youtube.com/channel/UCz0seedrains)

 [gallandt.wordpress.com](http://gallandt.wordpress.com)

### Literature Cited:

1. Bond, W. & Turner, R.J. (2005). A review of mechanical weed control. HDRA, Coventry, UK.
2. Vegetable Farmers and their Weed Control Machines 2005 (video recording), Burlington, VT, Grubiger, V. & Else, M.J.
3. van der Schans, D. *et al.* (2006). Practical weed control in arable farming and outdoor vegetable cultivation without chemicals. Wageningen UR, Wageningen, the Netherlands.
4. van der Weide, R.Y. *et al.* (2008). Innovation in mechanical weed control in crop rows. *Weed Research* 48: 215-224.
5. Melander, B., Rasmussen, I.A., & Barberi, P. (2005). Symposium: Integrating physical and cultural methods of weed control examples from European research. *Weed Science* 53: 369-381.

## Emergence of Common Weeds



**Figure 2:** Graphs of weed seedling emergence on Maine farms over one growing season.

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