

# MANY LITTLE HAMMERS

## ECOLOGICALLY-BASED WEED MANAGEMENT

*By Av Singh*

**If you were a betting man and in one corner you had the likes of Arsenal, Bullet, Gangster, Gunslinger and Squadron, while in the other corner you had vinegar, citric acid, and maybe the dynamic duo of ‘clove and cinnamon oil,’ who do you think would win the ‘war on weeds’?**

Industrial agriculture is reliant on a ‘one big hammer’ approach to effective weed control. That hammer is, of course, herbicides. The closest organic equivalent to a herbicide mindset may be tillage. Tillage is not only diesel-intensive, but when used frequently or inappropriately, it can be devastating to soil structure and soil life. Herbicides and tillage both control weeds directly; because of this, they may be less effective when facing a wide array of weeds. They only function under certain weather conditions and under certain types of crop management.

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**‘Many little hammers’ describes the multiple strategies available in the organic farmer’s toolbox.**

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The phrase ‘many little hammers’ was coined to describe the multiple strategies available in the organic farmer’s toolbox. At the 2012 Canadian Organic Science Conference, Dr. Eric Gallandt summarized the approach as, “The idea with many little hammers is that...we start looking at multiple points of the weed’s lifecycle. We’ve got the really important crop-weed competition, we’ve got weed predation that can occur, we’ve got weed seed decay...we’ve got processes that affect germination. All of these, if stressed appropriately, can reduce the performance of the weed.”<sup>1</sup>

Ecological weed management sounds like common sense, but somehow many farmers and gardeners are drawn to the magic bullet that will solve a



*A Schmotzer cultivator, imported from Germany, cultivates barley which was sown in wide rows to permit inter-row hoeing.*

‘problem’ and keep getting lured back to the ‘big hammer’ mindset. A systems-based approach is non-linear and has its foundation rooted in acknowledg-



*Brassica cover crops are competitive, fast growing, and can provide mulch after being winterkilled.*

ing that the system is complex and its components (crops, soil, weeds, insects and microorganisms) are constantly interacting. In recognizing the complexity of the system, the farmer gains insight on many avenues to manage weeds and begins to see how every decision can adversely or favourably affect weeds. Canadian researchers, including those participating in the Organic Science Cluster (OSC), are exploring systems-based approaches to develop weed management tools and strategies.

### **First step – problem avoidance by design**

Dr. E. Ann Clark, former professor at the University of Guelph and long-time advocate for organic farming, defines organic farming as, “Problem avoidance by design.” Of course, this is the first and arguably most important tool for weed management—designing a system that minimizes weeds. What does that look like? It ranges

from matching your crops to your soil conditions, to practicing crop rotation.

If the soil conditions don’t match the needs of the crop, it’s going to be an uphill battle. For example, weeds invade blueberry fields where the soil pH favours grass and not blueberries. Using elemental sulphur to lower the pH can lead to a noticeable reduction in grass weeds.

Creative and well-planned crop rotations can also have a substantial influence on weed populations. Tight crop rotations in which the soil is seldom bare leave no niche for weeds to invade.

A diverse crop rotation is also credited with preventing weeds from getting too ‘comfortable’ with their surroundings. Weed types become accustomed to planting patterns. For example, annual weeds become well adapted to frequent tillage. Weed communities also become adapted to crop cycles. Rotating a long-

term perennial crop, such as alfalfa, with vegetables will break the pattern of annual weeds. Alternating warm season (e.g., corn) and cool season (e.g., wheat) crops, as well as alternating between spring and fall planted crops, can also affect weed patterns.

At the University of Saskatchewan, OSC researchers, headed by Dr. Steve Shirtliffe, are exploring the hypothesis that diverse crop rotations will result in diminished weed seedbanks, a reduction in the emergence of weed seeds, and hence, reduced crop yield losses from weed pressure.

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When tillage or cultivation is required, ensure that you are using the techniques that will best meet your needs. Between-row weed management is relatively easy with the use of such implements as rotary hoes and finger weeders. In contrast, careful thought (based on your equipment and labour resources) is needed when considering within-row weeds. Dense plantings may inhibit weeds but, may produce smaller fruit or be more prone to disease. Sparse plantings permit cultivation around the plant but may have lower yield per area.

Many proactive little hammers when swung together can pack a collective force like no one big hammer. Dilshan Benaragama, a graduate student under Shirtliffe’s supervision, examined how weed control and yields of



*The Weed Master is an innovative set of cultivation and flame-weeding equipment, designed and built by a team of Finnish small-scale farmers. [www.umaine.edu/weedecology/evaluating\\_the\\_weed\\_master.html](http://www.umaine.edu/weedecology/evaluating_the_weed_master.html)*

oats were affected by:

- 1) the choice of competitive cultivars;
- 2) high planting densities;
- 3) narrow row spacing; and
- 4) post-emergence weed harrowing.

Each practice helped to control weeds to a certain degree, but the highest level of suppression was obtained by using all of the factors together, or many little hammers. This decreased weed biomass by 71% compared to the standard practices.<sup>2</sup>

## Second step – know thy enemy

To be honest, ‘enemy’ seems rather harsh considering that weeds have very important roles in agricultural ecosystems, ranging from increasing biodiversity to providing habitats for beneficial insects, to nutrient cycling and keeping the soil covered.\* However, it is imperative that organic

\*see [www.cog.ca/documents/WeedsMessengerSU06.pdf](http://www.cog.ca/documents/WeedsMessengerSU06.pdf)

growers learn about a weed’s life cycle, growth habit, how it spreads, seed dormancy and germination. Perhaps most importantly, farmers must recognize how a particular weed will affect the productivity of the desired crop—will it compete for water or nutrients, or will it introduce disease or affect harvesting? For example, plantain in orchards can exacerbate pest prob-

lems (as described on pages 58–59). On the other hand, weeds can support populations of beneficial organisms that destroy pests (for details, see pages 16–21).

In knowing a weed intimately, you identify its vulnerabilities, know when to strike and which tactic is most effective. Traditionally, organic management of Canada thistle was timely cultivation to destroy rhizomes. This had mixed success because sometimes cultivation would actually help spread the weed. Researchers and farmers learned more about Canada thistle. They recognized that reducing root reserves and seed production by mowing, coupled with a weed-suppressive cover crop like alfalfa, can nearly eradicate Canada thistle. The thistle is targeted at various life stages:

- 1) at flowering by mowing, and
- 2) at the rosette stage by a competitive cover crop.

When using a multi-tactic approach, the efficacy of each tactic can be lower than a big hammer because another little hammer can finish the job.

### Reduced tillage and cover crops

In Manitoba, OSC researchers led by Dr. Martin Entz are studying the use of cover crops and reduced tillage practices to control weeds. Results to date suggest that:

- Fall-seeded cover crops of rye and barley can provide early season weed control in field beans, with greatest suppression by the rye. However, in no-till conditions, early crop growth may suffer from competition with the rye for light and/or nitrogen, or cool soil (because of shading by the rye).<sup>3</sup>
- Termination of a pea-barley green manure cover crop on the Canadian Prairies with a blade roller or flail mower results in higher weed pressure and less available N than termination by noble blade or standard tillage.<sup>4</sup>
- Thick mulches of green manures, such as hairy vetch, show potential for no-till planting. The cover crops are planted in the spring before crop planting and terminated in mid-summer (when flowering) with a roller. Crops were planted the following fall.<sup>5</sup>



### Third step – give your crops the advantage

In sports, there is a saying that the first line of defence is a good offence and the same goes for weeds. Fast-growing healthy crops in optimal growing conditions can often outcompete weeds.

As organic farming has evolved, compost, compost tea, ‘fertigation’ and biofertilizers allow for more precise nutrient management than the liberal application of manure over a whole field. Where water may be a limiting factor, drip irrigation can favour the crop over weeds. Opaque synthetic mulches, like black plastic and woven polypropylene weed fabric, can reduce weed seed germination and hours of weeding.

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**It is important for farmers to choose [crop] varieties that are well adapted to their conditions.**

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At the Nova Scotia Agricultural College, an OSC research team led by Dr. Andy Hammermeister is exploring weed management strategies for organic black currant production. The researchers are evaluating the use of tillage, mowing, acetic acid, and various man-made and organic mulches. Preliminary results suggest that the use of man-made mulches, such as black plastic and black fabric, serve to increase plant growth when compared to mowing.

Another technique, solarization, uses clear plastic on the soil before planting. This encourages soil warming and weed seed germination, but, because of the



*David Greenberg (Abundant Acres/Heliotrust in Centre Burlington, NS) uses woven polypropylene weed fabric as mulch. He uses a propane torch to burn holes for planting.*

intense heat, most weed seedlings die before the crops are planted.

It is important for farmers to choose varieties that are well adapted to their conditions. OSC researchers working in the Prairies are developing wheat and oat varieties adapted to organic management. Currently, many organic farmers must plant varieties that have been bred under conventional management conditions, and may not be best suited for the weed pressures and nutrient availability found on organic farms.

### The last step – never stop taking steps

Big hammers can do more harm than just the environmental damages of excessive herbicide use and tillage—they downplay the knowledge required to fully understand a complex system. Simplifying nature so you can employ one tactic for weed control diminishes the synergistic potential of using several solutions. By understanding the ecology of a weed, the farmer has intimate knowledge of

the weed’s weaknesses and can exploit them by employing a wide variety of tactics both spatially and temporally to stress and kill the weeds.

*The Organic Science Cluster projects described on pages 10–15 are funded by Agriculture and Agri-Food Canada and industry partners, Anne’s P.E.I. Farm, Canadian Seed Growers Association, Canadian Wheat Board, Grain Millers Canada, Nature’s Path Foods Inc., Prairie Oat Growers Association and the Province of Prince Edward Island.*

**Suggested reading:** *Many Little Hammers: Ecological approaches for management of crop-weed interactions.* 1997. Liebman, M. & E. R. Gallandt. pp. 291–343. In L.E. Jackson (ed.) **Ecology in Agriculture.** Academic Press, San Diego. CA.

Photo credits: Eric Gallandt (pgs. 10, 11, 12), Jen Greenberg (pg. 13), Joanna MacKenzie (pg. 14)

### References:

1. Gallandt, E. 2012. Many little hammers. Presentation at the 2012 Canadian Organic Science Conference.
2. Benaragama, DI & SJ Shirliffe. 2012. Integration of cultural and mechanical weed control strategies enhance weed control in organic cropping systems. *Proceedings of 2012 Canadian Organic Science Conference*.
3. Evans, RL, MH Entz & YE Lawley. 2012. Cereal cover crops for early season weed control in organic field beans. *Proceedings of 2012 Canadian Organic Science Conference*.
4. Podolsky, K, R Blackshaw & M Entz. 2012. Comparing reduced tillage implements for termination of cover crops. *Proceedings of 2012 Canadian Organic Science Conference*.
5. Halde, C, RH Gulden, AM Hammermeister, KH Ominski, M Tenuta & MH Entz. 2012. Using mulches to reduce tillage in organic grain production in Western Canada. *Proceedings of 2012 Canadian Organic Science Conference*.

## WEEDING CUCURBITS

Organic farmers growing cucumbers, squash, melons and other cucurbits use many techniques to reduce weed pressure. Weed control helps achieve optimal yields but also reduces the incidence of disease, and minimizes interference during harvest.

Maintaining a weed-free period for the first four to six weeks after planting gives delicate young cucurbits a competitive advantage. After the canopy closes, lack of sunlight keeps weeds in check. Organic farmers have traditionally used cultivation as the primary tool to combat weeds, often beginning with a stale seedbed or cultivated fallow weeks before planting. This is followed by several shallow cultivations both within and between rows. This form of weed management can be very diesel-intensive.

Ontario OSC researchers led by Dr. Robert Nurse are working on a reduced or no-till production system to address weeds in cucurbits, particularly oilseed pumpkins. Cover crops and living mulches may provide an alternative to cultivation, but their tendency to

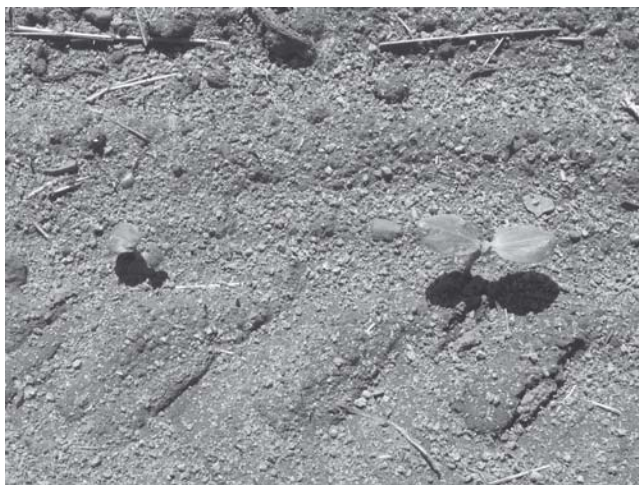
maintain cooler soil temperatures, which is undesirable for cucurbits, needs to be considered.

Most promising is an emerging technology: using a roller-crimper to kill cover crops like fall rye. The roller-crimper creates a mat of plant material which serves as a barrier to weed emergence, keeps the fruit off of the soil, and provides organic matter to the soil.

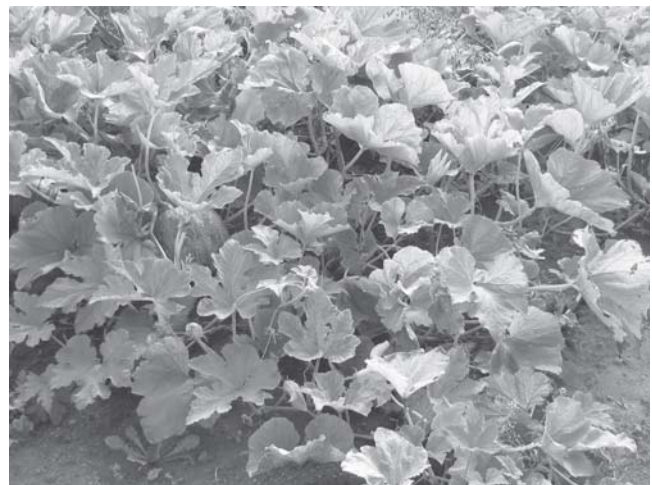
In many parts of Canada, weed control practices will have to be compatible with the use of floating row covers. These covers are used to help warm the soil and protect the plants from both wind (which can damage large-leaved plants) and pests, like the striped cucumber beetle and the squash bug.

Variety choice can affect weed management. With Styrian (oilseed) pumpkins, OSC researchers are selecting varieties that mature early, mature uniformly and require less nitrogen—all factors that help with weed control. For details on growing oilseed pumpkins, read the full article in Spring 2012 *TCOG*.

—Av Singh



Oilseed pumpkin seedlings June 5, 2007.



Oilseed pumpkin plants September 22, 2007.