



# Weed Management in Annual Cropping Systems

Weeds can cause significant yield losses, reduce soil quality and become more problematic over time. Preventing their introduction on the farm is the best way to avoid these issues. A long-term plan combined with short-term action is crucial for the management of weeds. This factsheet outlines techniques to help manage weeds.

## Why manage weeds?

If left unchecked, weeds can have significant direct impacts, including:

- Yield losses
- Reduction in produce quality
- Pest and disease harbouring
- Decreased harvesting efficiency
- Damage to soil structure
- Limits to viable crop type

## How often should weeding occur?

Removal of all weeds in organic agroecosystems is unnecessary: sufficient weeding needs to happen when impacts can be measured as decreased marketable crop yield, value and harvesting efficiency. The goal is management of weeds, not complete annihilation of them.<sup>1</sup>

The frequency and timing depends on various factors, including<sup>2</sup>

- Germination window
  - Early germinating weeds are more competitive
  - Late germinating may contribute to the weed seed bank, contaminate the harvest and harbour pests and disease
- Crop type
  - Narrow-leaved annuals, like onions, are less competitive
- Cost versus potential net return

<sup>1</sup> To better assess potential sources of weed contamination, visit [http://www.gardenorganic.org.uk/organicweeds/weed\\_management/show\\_wman.php?id=12](http://www.gardenorganic.org.uk/organicweeds/weed_management/show_wman.php?id=12)

<sup>2</sup> For more information on when weed control is needed, see [http://www.gardenorganic.org.uk/organicweeds/weed\\_management/show\\_wman.php?id=14](http://www.gardenorganic.org.uk/organicweeds/weed_management/show_wman.php?id=14)

## What are the foundations for weed management?

- Prevention of weeds from entering the agroecosystem
  - How?
    - Sow weed free seeds
    - Compost any manure used
    - Control weeds before they set seed
    - Keep equipment clean
- Use several different weeding methods in rotation or in combination, preventing a build up of a particular weed species
- Prevent seed set of perennial weed species that contribute to the long term seedbank.

## Management strategies<sup>3</sup>

### Crop Rotation

Crop rotations are a good way to prevent the domination of one weed type. Appropriate rotation depends on physical factors, soil health of the land, balanced against market demands. Generally, crops in a given location should vary according to:

- Spring sown and fall sown
- Annual and perennial
- Dense leaf cover and open leaf cover
- Shallow root systems and deep root systems
- Heavy nutrient users and light nutrient users (considered soil builders)/
- Long growing season and quick maturing crops

<sup>3</sup> See the following link for some crop-specific weed management techniques [http://www.gardenorganic.org.uk/organicweeds/weed\\_management/show\\_wmcat.php?id=3](http://www.gardenorganic.org.uk/organicweeds/weed_management/show_wmcat.php?id=3)

## **Weed Management in Annual Cropping Systems**

### **Cover crops**

Cover crops are often included in crop rotations. They generally establish quickly and create a dense canopy, preventing weeds from taking over. Added benefits of cover crops include building soil fertility and preventing soil erosion. Cutting down a fall cover crop in the spring not only suppresses weeds, but can be used as the basis of mulch and provide habitat for weed seed-eating predators.<sup>4</sup> Rye (*Secale*) is an example of a cover crop with allelopathic properties that aid in suppressing weeds.<sup>5</sup>

### **What crop varieties should be used?**

Varieties that compete better against weeds have the following characteristics:

- Faster germination and establishment rates
- Rapid early growth
- Vigorous growth
- The ability to quickly cover and shade the soil
- Generally have a larger seed size
- Locally adapted
- Weed suppressing varieties

### **How can planting strategies help?**

Weeds are more easily controlled by making various planting choices:

- Increasing the seeding rate and decreasing the crop row spacing helps crowd out weeds
- Transplanting crop seedlings instead of direct seeding encourages faster crop establishment
- Waiting for ideal soil temperature
- Intercropping and under-sowing with either both varieties grown as sellable commodities or growing one as the soil builder/living mulch. The success of the intercropping/under-sowing depends on the crop density, resources available and crop varieties. Not all crops are compatible with each other, while sometimes limiting resources, such as nutrients or water, may make this system

unfavourable. When this arrangement does work, however, the weed control gained is much greater than if the crops were grown in monoculture.



Intercropping narrow and broad leaved vegetables for better weed control.

### **Why shouldn't fallowing be used? Is there an alternative?**

Fallowing has undesirable environmental and economic effects. An alternative to fallowing is growing rapidly developing crops, such as radishes, or by using "cleaning crops" like potatoes and turnips. Quick maturing crops like radishes are harvested before the onset of weed competition. Weeds germinate between crop establishment and harvest, but do not have time to reproduce.

### **How does the cultivation method affect weed management?**

Not all cultivation practices – ploughing, shallow cultivation and reduced-tillage systems - control weeds equally.

- Ploughing
  - Buries weed seeds to a depth where they won't germinate.
  - Temporary control only because buried seed increases the persistence of the weed seed bank
- Shallow cultivation
  - Allows a flush of weeds to germinate that can be tilled just prior to planting
  - Decreases the weed seed bank in the soil
  - Recommended 1-2 cm (0.4-0.8 inches) only, or a second flush of weeds may occur

<sup>4</sup> For more in depth information on cover crops, go to <http://www.sare.org/publications/covercrops/covercrops.pdf>

<sup>5</sup> For more information on allelopathy, see [http://www.gardenorganic.org.uk/organicweeds/weed\\_management/show\\_wman.php?id=47](http://www.gardenorganic.org.uk/organicweeds/weed_management/show_wman.php?id=47)

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- But must be balanced against the benefits of reduced-tillage which
  - Sustains soil structure hence quality
  - Conserves energy
  - But perennial and grassy weeds may become more problematic

### **What conditions allow for effective cultivation?**

- Having relatively dry soil
- Delaying irrigation after cultivation so weeds cannot re-establish
- Not cultivating if it is going to rain shortly after
- Performing cultivation before weeds have a chance to set seeds (early in all weed lifecycles)
- Proper timing
  - This depends on the weed growth. Spring cultivation needs to occur more frequently than in the fall, about every 2-3 weeks.
- Growing rapidly maturing crops, like lettuce, allows for multiple field-wide cultivations, preventing slower developing weeds from reaching maturity.

### **When is hand weeding useful?**

- Small-scale annual crop systems, since labour and time commitments are high
- High value crops like vegetables
- Taprooted weeds

Picking the weeds when they are young is generally the best and easiest method and minimizes early crop competition.

### **What does mulching do?**

- Suppresses weed growth
- Prevents light from reaching weed seeds, stopping germination
- Increases moisture retention
- Improved soil quality

It does have its limitations, though, being less effective at preventing perennial weed development and for practical purposes, is only used in well-spaced, high value crops and perennial crops.

## Types of mulches

*Living mulches* – Living mulches are dense, low growing plants that establish just before crop planting or right after harvest. In some cases, properly managed annual weeds can be used. A living mulch must be carefully managed to keep it from competing with the crop. Management strategies used include tilling the living mulch into the soil or carefully regulating its growth. The best application for living mulches is in perennial rather than annual cropping systems. Examples include white clover (*Trifolium repens*), perennial ryegrass (*Lolium perenne*) and common purslane (*Portulaca oleracea*).

*Particle mulches* – Particle mulches consist of loose material spread over soil; examples include bark, straw, compost and newspaper (non-glossy and vegetable dyed only). It is important with this type of mulch to have at least a 3cm (1.2 inch) layer to properly suppress weeds. The thicker the layer, the better the weed suppression becomes. For this reason, it may only be economical if the mulch is produced on-site or nearby, especially with the high decomposition rate. During the growing season, particle mulches need to be constantly replenished.

Other considerations include:

- Some, when decomposing, release chemicals that can negatively affect the crops (known as allelopathy<sup>6</sup>)
- Will the wind blow the mulch away?
- Large scale use requires mechanized spreading
- Manure needs to go through a high-temperature aerobic composting process (maintaining the temperature >60°C (140°F) for 3d or more), to kill the majority of weed seeds present.
  - Manure used in organic systems must comply with organic requirements<sup>7</sup>

<sup>6</sup> For more information on allelopathy, see [http://www.gardenorganic.org.uk/organicweeds/weed\\_management/show\\_wman.php?id=47](http://www.gardenorganic.org.uk/organicweeds/weed_management/show_wman.php?id=47)

<sup>7</sup> For information on manure standards, see section 5.5 "Manure Management" [http://www.pwgsc.gc.ca/cgsb/on\\_the\\_net/organic/032\\_0310\\_2006-e.pdf](http://www.pwgsc.gc.ca/cgsb/on_the_net/organic/032_0310_2006-e.pdf)

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- Applying compost is best done
  - In a manner that reduces excessive soil disturbance
  - Selectively applied on the crop, rather than over the entire field, keeping the immediately available nutrients away from the weeds
  - Placing the manure 10 cm (4 inches) into the soil allowing the crop to get the nutrients first



Straw mulch

**Sheeted mulches** – Sheeted mulches come in the form of polypropylene or paper. The paper mulches are preferred over the polypropylene ones, since they are biodegradable, eliminating the problem of disposal. They are also easily used in annual vegetable production. Make sure that if using the biodegradable type that the brand is non-GMO and that it does not contain any prohibited materials. Have the verification documentation available for the certification agency. The polypropylene sheets generally last longer, making them useful for perennial not annual crops. Proper installation is necessary to avoid being torn by the wind.

### **Biological control**

The use of biological control in annual systems is limited due to the high disturbance rate of the environment.

### **How can animals be used for weed control?**

Animals can eat weed plants or seeds, while providing manure. For example, chickens scratch at the soil, exposing weed seeds, as well as eating them. Geese can be used while crops are growing, eating most types of weeds

and in particular grasses. This does mean that grass, corn and newly established crops must be protected if using geese.

### **How can water be used to manage weeds?**

#### *Planned irrigation*

1. Irrigate (or if it rains) just prior to planting, causing germination of weed seeds
2. Then flame or lightly cultivate
3. Plant crop

#### *Planting to moisture*

- Works well in bean and corn crops
1. Kill emergent weeds by cultivation
  2. Allow the top 5-7 cm (2-3 inches) of the soil to dry (dry soil forms a “mulch”)
  3. As soon as possible, plant crop seed deeper into moist soil, allowing for selective moisture use, without supplemental irrigation

#### *Buried drip irrigation*

- Targets water to crop rather than surface weeds

### **Thermal Weed Control**

- Flame before crop emergence, rupturing the weed plant cells

Pro:

- More cost effective than hand weeding

Cons:

- Fuel intensive (propane-fuelled flammers)
- Unable to kill grass & perennial weeds
- Decreased efficiency when weed plants have more than two true leaves, the wind is blowing or if moisture is present on the leaves



Weeds being killed by a flamer.

## Weed Management in Annual Cropping Systems

### Photo Credits:

1. [http://www.ewrs.org/EWRS\\_CWI/crop\\_weed\\_competition\\_research.htm](http://www.ewrs.org/EWRS_CWI/crop_weed_competition_research.htm)
2. HDRA Organic Weed Management ([www.organicweeds.hdra.org.uk](http://www.organicweeds.hdra.org.uk))
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