Thermal Weed Management

Carlene A. Chase
HOS 4932/6932

Direct heating
- Fire
- Flaming
- Infrared weeders
- Hot water
- Steaming
- Hot air

Indirect
- Electrocution
- Microwaves
- Lasers
- UV

Disadvantages of Thermal Weed Control
- High cost of labor, fuel, and equipment
- Low selectivity
- Large amounts of energy per unit area
- Nonrenewable fossil fuels
- Air pollution from combustion by-products

Benefits of Thermal Weed Control
- Quick weed control without chemical residues
- Do not bring weed seeds to the soil surface
  - Better weed control than cultivation for small-seeded crops.
- Can be used on wet soils
- Generally do not affect organic materials on the soil surface
- May kill some insect pests and pathogens on plant residues and soil surface

Fire

- Controlled burns or prescribed burns: usually used for reasons other than weed control.
- Agricultural field burning
  - Removes existing crop residue
  - Kills weeds and weed seeds.
  - Generally postharvest (preharvest in sugarcane)
  - Grass seed farmers in the west for clearing their fields.
Crop residue burning in Florida

- Everglades Agricultural Area south of Lake Okeechobee (162,000 ha of sugarcane)

Invasive weed management – Imperata cylindrica (Cogongrass)

- Prescribed burn prior to herbicide application to remove built-up thatch and promote active growth.
- Burning is not recommended without a follow-up herbicide treatment.

Flaming definition

- A method of weed control that utilizes the heat from propane-burners to expose weeds to rapid lethal temperatures.

Heat Injury

- Denaturation and aggregation of cellular proteins and protoplast expansion and rupture resulting in plant desiccation.

Flaming

- The most widely used thermal weed control method.
- Seedlings more easily controlled than larger plants.
- Used in US 1940-to mid 1960s:
  - Cotton, corn, soybeans, beans, alfalfa, potatoes, onions, grapes, blueberries, strawberries.
**Flaming**

- 1960s - covered flamers developed for inter-row weeding, insect control in alfalfa, potato vine killing.
- Decline in 1970s:
  - greater availability of herbicides,
  - high cost of petroleum.
- Renewed interest in US and Canada:
  - Environmental concerns about herbicides.

**Weed Susceptibility to Flaming**

**Group 1: Most susceptible**
- Species with unprotected growing points and thin leaves.
- 0-4 true leaves killed with 20-50 kg/ha propane.
- 4-12 true leaves 50-200 kg/ha propane.
  - *Chenopodium album* and *Stellaria media*

**Group 2: Moderately sensitive**
- Species with relatively heat tolerant leaves or protected growing points.
- Completely killed at early and late developmental stages.
- Higher fuel requirement than Group 1.
  - *Polygonum aviculare; Senecio vulgaris*

**Group 3: Species with more protected growing points.**
- 0-4 true leaves – killed.
- Larger plants: regrowth; repeated applications needed.
  - *Capsella bursa-pastoris* (shepherd's purse)
Weeds with protected growing points may require a second application

Pre-emergence Non-Selective Flame Weeding

Group 4: Very tolerant of flaming

- Creeping growth habit and protected growing points.
- Repeated applications needed.
- Grasses and perennial weeds with underground organs.

Flame Weeder with Insulated Cover

Pre-emergence Non-selective Flame Weeding

- Covers improve heat transfer to weeds.
- Requires less fuel to achieve a comparable result than open flamers.
- Generally makes flaming more effective on larger plants and tolerant species.
- Cover design must not cause oxygen deficiency.
In-Row Flame Weeding
- Selective, post-emergence for small weed seedlings in taller and heat-resistant crops.
- Cotton, soybeans, corn, brassicas, onions.
- Smooth soil surface for best results.

Infrared Weeders - Hoaf KB 4.5
- Infra-red radiation and hot air.
- Fuel LP gas.

Hoaf KB 4.5
- Working width of 450 cm.
- 3 autonomous working burners, each with a width of 150 cm.
- Suitable for weed control on seedbeds.
- Adjustable height permits potato vine-killing.

Hoaf Twin Sprite
- Inter-row flamer.
- Burners have 25 cm working width.

Hoaf FB 35
- Suitable for orchards and vineyards.
Organic Hot Foam Weed Control System
- Non toxic, biodegradable hot foam.
- Reportedly kills weeds instantly.
- Solution contains natural plant extract sugar from corn and coconut.

http://www.waipuna.com/

Zacho Turbo Weed Blaster
- High temperature hot air system.
- Effective on hard surfaces.
- Reduced fire risk.

http://www.zacho.dk/siteUK/index.htm

Steam Weeders – Batchen Stinger

Direct-fired Steam Weeder
- Steam generated when water is misted directly into the exhaust gases from a burner.
- A wide range of fuels can be used, including diesel, biodiesel.
- Less complex, less costly, and less dangerous than systems using superheated water.

http://www.thermalweeding.co.nz/index.htm

Steam Weeding Advantages

- Heat can be more precisely directed onto unwanted vegetation.
- Hot moisture laden air sinks into targeted vegetation rather than rising like hot air in flaming.
- No fire risk.
- Non target effects on crop and beneficial insects reduced.

Steam Weeding Disadvantages

- High consumption of fossil fuels.
- Time consuming.
  - Band steaming in strips where the crop will be planted to limit time and fuel costs.