

Flaming: A Non-Chemical Approach to Manage Weeds

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SUMMARY

Weed management is a system by which the infestation of weeds of a farm or an area is kept to lower than the economic injury level without deteriorating the environment. The use of flame weeding can be adopted as one of the alternatives to chemical weed control, as it eliminates concerns over direct residual effects on soil, water, and food quality and can lessen the reliance on herbicides, hand weeding, and/or mechanical cultivation.

INTRODUCTION

Flame weeding belongs to a group of thermal weed control methods, which is a collective name for different physical methods using high or low temperatures or electrical fields. A wide range of methods exists including infrared radiation, freezing and different electro-thermal methods. Flaming is an integral part of the weed control strategy in organic farming for non-selective weed control in slow-germinating row crops. In some heat-tolerant crops such as onions and maize, selective post emergence flaming is also used. A patent on flame cultivators was obtained as early as in 1852. Flame weeding was widely used in the USA in various crops including cotton, maize, soybeans, beans, alfalfa, potatoes, onions, grapes, blueberries and strawberries. At that time, liquid fuels such as kerosene and oils were gradually being replaced by LPG, mainly propane and butane. Flame weeding is mainly effective on small annual weeds. The use of flame weeding eliminates the risks of pollution from herbicides. Flame weeding can be used in other situations in which the presence of herbicide is undesirable, such as in cities, parks and other urban settings.

What is flaming?



Flaming is the killing of weeds with intense heat produced by a fuel-burning device, either hand-held or tractor-mounted. Flaming does not burn the plants but heats them rapidly, enough to rupture the cell membranes. Using fire to control *weeds* in organic farming systems shows promise for reducing *weed* populations without herbicides. A carefully directed *flame*. Flaming is used to control carpets of seedlings of broadleaf weed species that germinate together in large numbers and are localized in small areas. It typically involves sweeping a propane torch flame over very young plants, causing their cells to rupture from the heat. Flame weeding entails passing a flame over a weed briefly to heat the plant tissues just enough to kill them. The goal is not to burn up the weed, but to destroy plant tissue so that the weed dies. Flame weeding kills the above ground portion of the weed, but it doesn't kill the roots.

Flaming equipment



Flamer Hand Gun



Hood Flamer



Infrared Flamer



Flaming Mower



Flaming Torch



Wheel Flamer

How flaming works?

- It is a misconception that plant tissue ignites during flaming treatment. Flaming kills weeds by exposing plant tissue to an intense wave of heat. Thus, it is a combination of thermal energy applied to the plant and exposure time that determines effectiveness of flaming.
- It is reported in the literature that temperatures necessary to kill the plants range from 55 to 94°C which can be achieved with exposure time of 0.65 to 0.13 seconds.
- Propane burners generate waves of heat with combustion temperatures of up to 1900°C, which increases the internal temperature of the exposed plant tissues rapidly.
- Direct heat injury results in denaturation of membrane proteins, which results in loss of cell function and eventually the plants die or their competitive ability is drastically reduced.
- The effectiveness of flaming treatment can be assessed by pressing a treated weed leaf between the thumb and index finger – the so called “fingerprint test”. If a darkened impression is visible after firmly pressing on the leaf surface, it is likely evidence of a loss of internal pressure within the leaf due to water leakage from ruptured cell walls.

Type of flaming

Pre-emergence flaming: Pre-emergence flaming kills the first flush of weeds before the crop emerges. This technique is most commonly used in vegetable production where weeds are killed the preparation of stale seedbed or just before vegetable seedlings emerge.

Post-emergence flaming: Flaming can apply once the crop has emerged. Such treatment is selective and aims to direct the heat towards the weeds while avoiding damaging the crop. Post-emergence flaming technique is primarily used in fast germinating crops such as cotton, maize, soybean and bean etc.

Cross-flaming: In agronomic row crops post-emergence flaming is accomplished either by cross flaming or by parallel-flaming.

Parallel-flaming: Parallel-flaming was developed along with the discovery of the midget burner in the late 1950s in Arkansas. During the parallel flaming treatment, a high-velocity stream of intense heat is directed onto the weeds on either side of the crop row.

Factors influencing flaming efficacy



Morning dew



At Afternoon



Dicot Weed



Monocot Weed

- **Plant size:** In general, larger plants are more tolerant to flaming than smaller ones. This is mainly due to greater surface of leaves and stem and greater plant biomass to heat ratio thus; higher temperature and longer exposure is necessary to achieve control.
- **Degree of exposure of the growing point at the time of flaming:** Grassy weeds were more difficult to control with flaming than broadleaf weeds because their growing point is either below the soil surface (early growth stages) or well protected by the bundle of leaves (later growth stages).
- **Time of the day:** The water content of weed in morning is more due to formation of dew on leaf surface results into higher energy require for flaming which reduce flaming efficacy so it is better to flaming during afternoon.
- **Leaf surface moisture:** Leaf surface moisture is higher on dicot weed (broad leaf) as compared to monocot weed so because of more surface moisture it requires more energy for flaming to control it as compare to monocot weed.
- **Wind:** Higher wind velocities, different wind directions (relative to the traveling direction) and wind gusts can change the predictable shape and pattern of the flames coming out of the burners which reduce flaming efficacy and cause damage to crop by temperature drift.

Advantages of flaming

- It leaves no chemical residues in plants, soil, air or water
- Produces no drift hazards or herbicide carry-over to the next season
- Can control herbicide-tolerant or resistant weeds
- Flaming also provides benefits over mechanical cultivation and hand weeding. Because it does not disturb the soil
- Flaming does not bring buried weed seeds to the surface where germination is likely to occur
- Reduces potential for soil erosion
- Can be used when fields are too wet or stony for cultivation
- It is less costly than hand weeding
- It might provide benefits in insect or disease control

Disadvantages of flaming

- Higher cost of equipment compared to herbicide applicators
- Lack of selectivity for crop safety
- Low speed of application
- Low field capacity due to narrow working widths and
- Lack of residual weed control

CONCLUSION

Though there are many benefits to applying flames to control weeds in organic systems, there are also downsides. Optimal weed control often requires multiple flame applications, with little or no residual weed control effects. Flame applications must be timed precisely to effectively kill weeds, and weeds that emerge with the crop are particularly difficult to control without damaging the crop. The rising cost of propane gas is another factor to consider when deciding whether to add flaming to a weed management system. Conducting a cost/ benefit analysis is important to see if flaming is a financially viable option for an individual operation. There are many considerations to take into account when deciding whether to use flaming as a weed control practice in any farming system. Farmers should carefully evaluate the positives and the negatives before integrating a flame-applied weed control approach into their operations.

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