A hand-held version of the electrothermal weeder being demonstrated

Back to the future

Electrothermal weedkillers have been around for a while. **Charles Merfield** outlines the advantages of the latest generation of electrothermal weeders that are on the market

The only practical and successful thermal weeding techniques to date are flame weeders, however, they only kill the parts they contact, that is, they are a contact kill, not systemic weed kill. This is a key reason why thermal weeding has been unable to supplant herbicides, especially broad-spectrum, systemic herbicides, and also because flaming is more expensive. For thermal weeding to have a chance of supplanting herbicides, it needs to be systemic and cheaper than flaming. That is what makes electrothermal weeding stand out. It is both systemic and lower in cost, which is why its resurrection re-opens a window for non-chemical weed control and a potential game-changer for non-chemical weed control, not just for organics, but for all weed management.
Electrothermal weeding has a long history, but the main research period was in the 1980s. However, the technique failed to achieve commercial success, mainly due to cheaper herbicides.

How does it work?

Electrothermal weeding uses high voltage (5,000–30,000 volts), but low amperage (0.5–2 amps) electricity to kill plants. When the electrode touches the plant, electricity instantaneously spreads through the stem from the point of contact into the roots, rapidly heating the water in the vascular system into steam, causing cell destruction and death. By focusing on the ground level stem, less plant tissue has to be heated, so less energy is used. By killing the plant tissues where the stem and roots join (the hypocotyl), it is akin to ring-barking or beheading the plant but is much more effective, as both phloem and xylem are destroyed over a much larger area, including into the roots, thus completely killing the plant. This is the key difference that means electrothermal can have a systemic kill while flame is only a contact kill. As an example of how deep the electricity can penetrate, a creeping thistle (*Cirsium arvense*) root was killed 23cm below ground level.

There is a variety of other factors that point to electrothermal being a revolutionary weed-control technique:

- All living things have a thermal death point, so it is impossible for weeds to develop resistance to thermal weeding techniques.
- Because of the highly efficient energy transfer between electrode and plant, ancillary heating is kept to a minimum, which, coupled with targeting the plant


An electrode touches a stem, heating the water in the vascular system

- stem, makes electrothermal is much more energy efficient than flame weeding.
- Electrothermal is effective in windy conditions and immediately before rain is due, conditions that would prohibit or reduce the efficacy of herbicides and mechanical weeding. However, rain, or plants that are wet, will stop electrothermal working due to the electricity earthing through the water on the outside of plants.
- Pushing the boat out, it is also conceivable that electrothermal could allow organic/non-chem no-till, as it is in theory possible to kill all the plants in a field, including pasture, using electrothermal. However, due to the large number of plants, power/fuel use would be considerable so the practicality is unknown.

Finally, the high voltages of 5,000 to 30,000 volts used in electrothermal weeding are highly dangerous, indeed lethal. However, there is a wide range of comparably dangerous equipment used in farming, such as the Weed Surfer, so as long as safety precautions are put in place, the risk is considered manageable.

With its unique properties, electrothermal is considered to have a wide range of potential uses, including:

- amenity/urban areas
- woody weeds
- arable and vegetables
- pasture
- woody weeds.

Woody weeds, such as gorse (*Ulex europaeus*) and broom (*Cytisus scoparius*) are often difficult to control as they can have high tolerance to herbicides, and if they are cut down, many will regrow from the stump (true stem). Electrothermal, targeted at the base of the stem or trunk, should kill all of the stem below the contact point and into the root system. Once this hypocotyl zone is killed, the plant cannot regrow so the plant dies.

The main current use for flame weeding in cropping is killing newly germinated weeds for stale seedbeds. However, it is considered difficult for electrothermal to kill newly emerged weeds, as they are small and very close to the soil so the electricity is likely to go direct to ground. Therefore electrothermal is considered unlikely to replace flame weeders for this purpose. However, there are many situations with weeds standing above the crop, and electrothermal should be a valuable new weeding solution. A key point is that weeds in both the interrow and, much more importantly, the intrarow would be killed, and as intrarow weeds are much more difficult to control, especially once they are established, this could be a significant benefit.

Pasture weeds typically stand above the pasture, so these are ideal targets for electrothermal weeding. Many pasture weeds also have protected growing points at their base or just below the soil surface, which allows them to survive grazing and mowing. Electrothermal weeding should be able to kill these plants as the electricity kills all the way down the stem and into the roots, while leaving surrounding pasture unharmed.

The reason for this article and the renewed interest in electrothermal weeding is that, after a 30 year hiatus, the idea has been resurrected by Ubiqutek (www.ubiqutek.com), which was established by the sons of Dr Mike Diprose, who was a key researcher in the 1980s. The machinery and science behind it are therefore considered to have a solid scientific pedigree. OF

Dr Charles 'Merf' Merfield is head of the BHU Future Farming Centre in New Zealand

This article is based on a detailed article published in the BHU Future Farming Centre Bulletin **www.bhu.org.nz/future-farming-centre/information/bulletin**


Before (left) and after (right) photos of nettles growing at Wimpole Hall Farm

Case history – treating weeds

ADAS weed scientists have carried out several trials using the electrothermal weeder. At Wimpole Hall Farm they treated nettles growing in grass paddocks with the hand-held electrical weeder, either once or twice (one week apart) and at two intensities. All plants treated twice were observed to have been severely knocked back. The method was ideal for this organic pasture and stock were able to continue grazing immediately after treatment.

Trials at Woburn Abbey Gardens on giant hogweed growing in a paddock resulted in complete control. This form of weed control could prove to be very useful to control weeds, such as the giant hogweed, where cutting or pulling can be dangerous.