

TECHNOLOGY TEST DRIVE

CROP.ZONE Integrated weed management

WHAT IS IT?

CROP.ZONE is a weed management system that combines application of conductive liquid with electricity. It can be used to terminate potato crops as an alternative to herbicide.

HOW DOES IT WORK?

The system combines an ionic liquid with electricity (Figure 1).

A 12m wide spray boom is attached to the front of the tractor, spraying the potato plants with "Volt.fuel" conductive liquid. The liquid contains a spreader and dissolved solutes, somewhat resembling a leaf fertilizer but without nitrate or phosphate.

Spraying the plants with Volt.fuel maximises electric conductivity between the applicator electrodes and the waxy, hairy, uneven plant surfaces. This decreases electrical resistance, significantly reducing the voltage required.



Electrical energy is delivered using applicators attached to the rear of the tractor. The system works best if the soil is dry, as electricity passes preferentially through the wet tissues of the plant vascular system. The current collapses the vascular bundles, stopping water and nutrient supply to the plant leaves (Figure 2).

Depending on plant geometry, applicator setting and distances between the electric poles, the electric current is concentrated into the stalks and leaves or delivered through the stems into the roots, penetrating up to 10 cm into the soil.

Tractor speeds of 6-8kmh have been shown to be effective. There

Figure 1. The CROP.ZONE system combines a conductive spray with electrical applicators



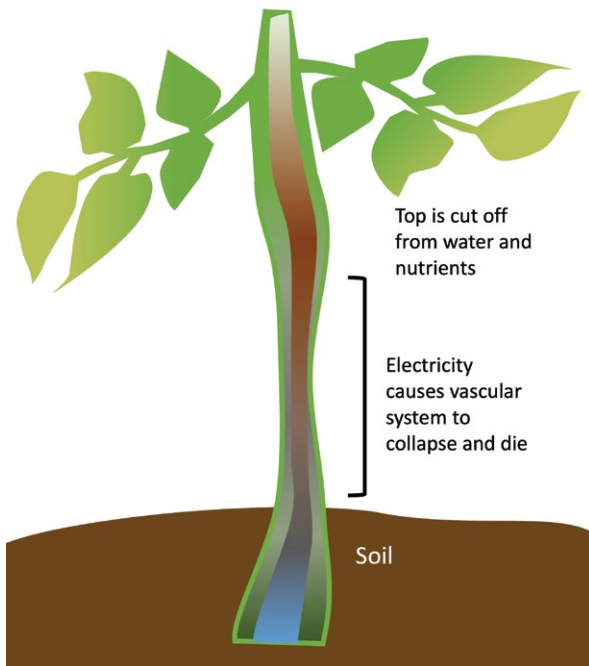


Figure 2. Passing electricity through the potato plant causes the vascular system to collapse and the plant to die

is effectively no consistent dose response, as vascular bundles are either destroyed or not. However, slower driving speeds could potentially allow a larger boom width.

Depending on plant vigour and maturity stage, the treatment may need to be repeated after 3-5 days to achieve complete kill.

Although the CROP.ZONE is still in relatively early stages of development, 15 machines are already operating in Europe. Some units have been purchased by co-operative for use by members, a relatively common model in parts of Europe. Other units are operated by NuFarm and may be leased as either a “full service” or lease arrangement.

WHAT PROBLEM DOES IT SOLVE?

Potato crops are usually desiccated using the powerful herbicide diquat, the active ingredient in Reglone®. Reglone is efficient and highly effective, particularly on broadleaf crops such as potatoes. A contact herbicide, it binds tightly to clay particles in the soil and does not translocate through plant roots. It can persist a long time in the environment in this inactivated state. However, the

product presents significant risks to operators, bystanders and birds.

In May 2018, the European Commission voted to ban the use of diquat. Most growers in Europe and the UK had until February 2020 to use up their stockpiles, although a number of temporary permits were given.

In Canada, there have been concerns raised about presence of diquat in drinking water, with the result that last year the maximum concentration was reduced. Although diquat is still registered in the US and many other countries, changing regulations remain a concern.

The CROP.ZONE system enables residue-free crop termination. It does not affect tuber quality and can be adjusted to maximise vine recovery, enhancing tuber size.

Nufarm is currently arranging importation of a test unit. The unit will allow the system to be tested under Australian conditions, both for weed management and potato crop termination.

SHOW ME THE DATA

Company trials in 2020 compared the effectiveness of CROP.ZONE against two herbicides still registered for haulm kill in Europe; Pyraflufen-ethyl (Quickdown) and Carfentrazone-ethyl (Shark) (Figure 4).

The most effective treatment was two passes with CROP.ZONE in opposing directions. This killed >65% of stems, with the remainder yellowed (after three weeks). Although two passes in the same direction increased the number of dead stems to over 80%, around 10% green stems remained, particularly between the hills (Figures 3 and 4).

In contrast, the two herbicides left approximately 20% yellow and 20% green stems. This low efficacy level was surprising. Although both herbicides require sunlight to be effective, conditions in 2020 were ideal. As a result, three herbicide treatments were needed to achieve

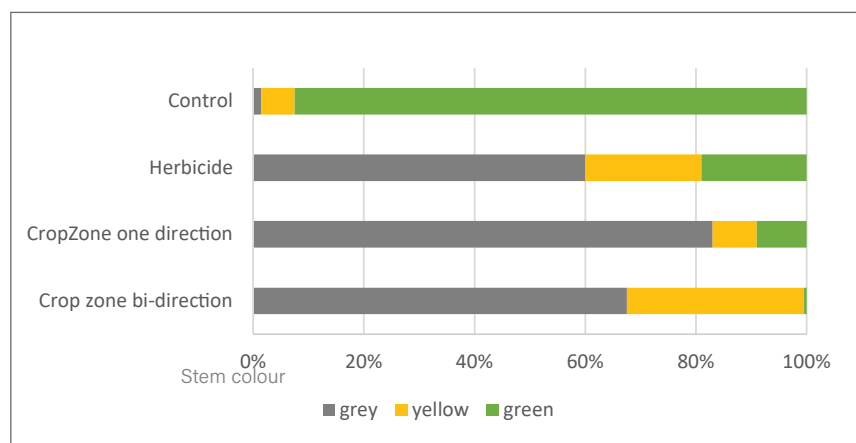


Figure 3. Comparison of haulm termination by Herbicide (Quickdown + Shark), CROP.ZONE applied twice in the same direction, CROP.ZONE applied twice in opposing directions or untreated plants (Control).

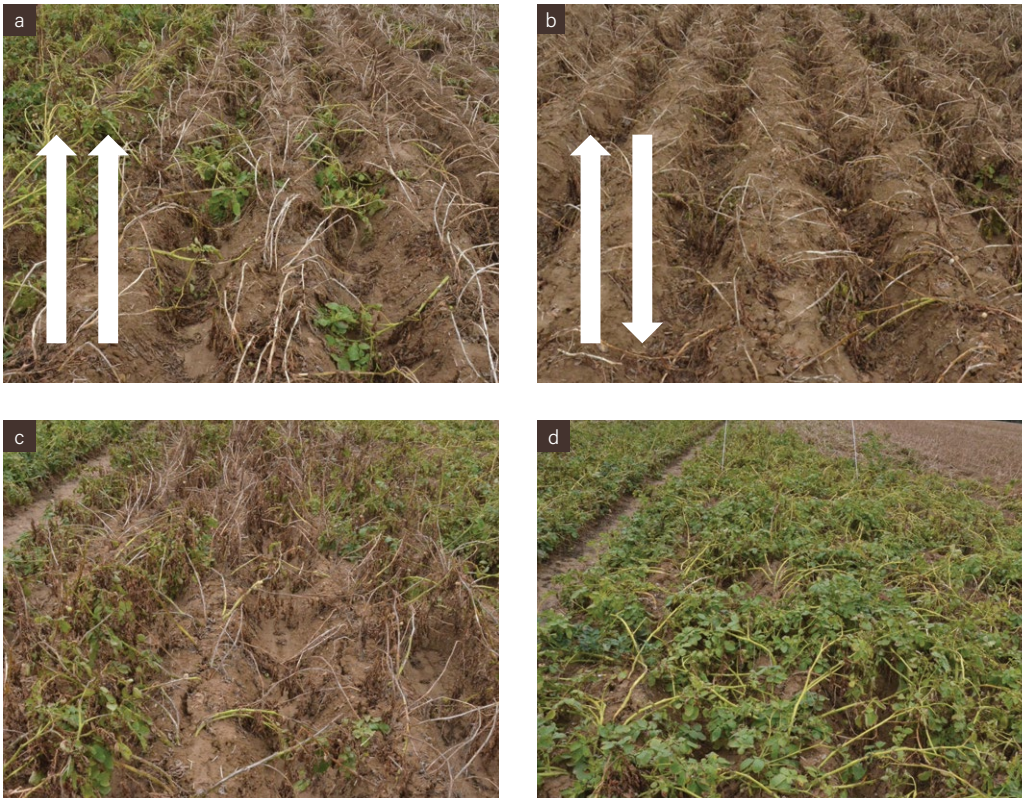


Figure 4. Effect of (a) CROP.ZONE applied twice in the same direction at 6kmh and 4kmh, or (b) twice in opposite directions at 6kmh and 6kmh, compared to (c) crop sprayed with Quickdown® and Shark® and (d) untreated

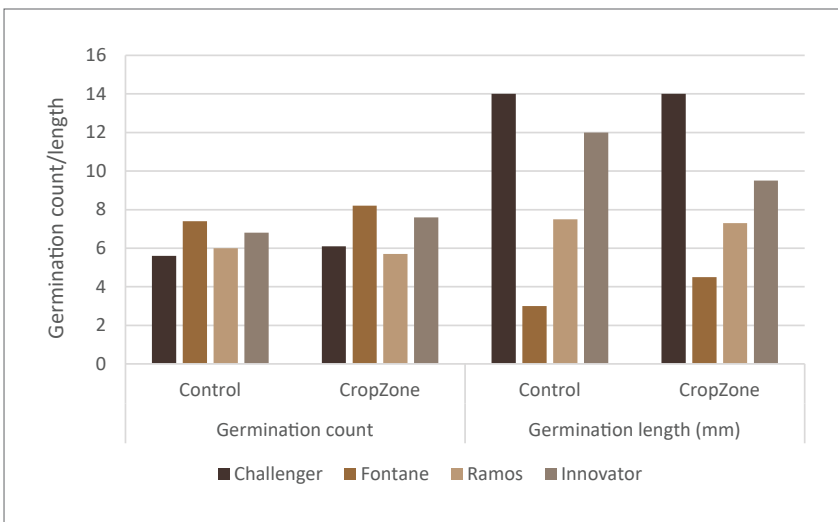


Figure 5. Comparison of quality of seed potatoes from vines terminated using CROP.ZONE with conventionally killed controls

good chemical desiccation, which is the maximum allowed in Europe. Under overcast conditions, this treatment would be even less effective.

The company has made further refinements to the applicators based on these results, with trials ongoing during the European summer.

Other company trials examined the effects on germination counts and sprout length of seed potato varieties

Challenger, Ramos, Fontane and Innovator. There was no significant difference due to method of haulm kill, with CROP.ZONE, chemical herbicides and untreated controls all providing similar results (Figure 5). Similar effects were reported for starch content, baking colour and other quality attributes, with no differences between CROP.ZONE and other termination treatments.

COSTS VS BENEFITS

While the requirement for 112 kW electrical power is unlikely to be a problem, the 12m boom width may be limiting for some growers. Wider boom widths are theoretically possible, but yet to be developed.

The energy footprint of Crop.Zone has been estimated to be approximately 5x greater than herbicide application, but slightly less than haulm topping and less than 25% of the energy used for cultivation.

In Europe, the cost of using CROP.ZONE is similar to using herbicides, excepting potential increased tractor running costs. Although the cost in Australia is unclear, the system may struggle to compete with herbicides on a cost basis alone.

However, there is strong demand by consumers and retailers for reduced residues in food. This has been particularly the case in Europe but increasingly in Australia as well. By reducing pesticide use, as well as avoiding impacts on soil biology, the system could potentially improve sustainability and meet new market demands.