

USE OF MECHANICAL WEED CONTROL



Photo: Innovative Farmers/Royal Agricultural University

PROBLEM

Reliance on manufactured chemical herbicide to control weeds, particularly when resistance and environmental pressures are important.

SOLUTION

Tined, harrow comb weeders and spoon weeders which dislodge small annual weeds germinating, particularly between rows. Brush or finger weeders are effective in root crops, controlling weeds within rows.

OUTCOME

The use of mechanical weeding systems can reduce the dependence on manufactured chemical herbicide, particularly those where resistance is a possible problem. Some weeds are minor in the crop but are difficult to control chemically. Mechanical techniques could control these weeds, or reduce their competitiveness to allow chemical control at a more appropriate time. Alternatively, a mechanical weed control technique could be applied to control weeds that have germinated after the previous chemical applications have become in-effective, but before the crops natural competitiveness becomes effective, reducing the need for repeat herbicide applications.

APPLICABILITY

Applicable production types



Application time

Late winter and spring up to early stem extension in cereals. Post drilling up to ground cover in row crops.

Required time

Time required depends on crop and amount of weed

Equipment/resource required

Tined weeder, interrow cultivator, brush weeder

Best in

Row crops and all cereal crops

PRACTICAL RECOMMENDATIONS

IMPLEMENTATION

- Weed control can start as soon as the weed seeds start to germinate with the cotyledon stage being the most susceptible.
- The white thread stage is when the seedling is just germinating and the plant is at its weakest.
- A pass with a harrow comb just before the crop seed emerges can reduce weed competition at that stage.
- A common trick is to use a sheet of glass to speed up germination in a small area. The weeder is used when the weed seedlings appear under the glass.
- Later passes are best when the weed is at less than 4 true leaves because after this their roots become stronger and dislodging is harder.



- Some crop plants respond to the harrowing by producing more tillers, partly because the action causes release of some of the soil nitrogen.
- Harrow combing is less suitable for crops like peas which have a weak stem and growing point at or above the soil surface as damage can kill the growing seedling.
- For cereals the growing point is below the ground and safe from damage, however Zadocs growth stage 32 is the latest that harrows should be used, crop damage is possible after this stage.
- Bigger, or deeper weeds can be destroyed using spring tine, or duck footed tines which work between the rows, ripping up or cutting of the weeds from their roots.
- Control of weeds growing between rows is particularly important in vegetable crops and root crops which have a wider row crop than is normal with cereals.
- Although this does not control weeds growing within the rows, these would be under competition from the crop plant.
- Brush type weeders can control weeds within the rows of root crops with a good degree of precision.
- Prevention of weed seed return may be more important than increase yield in current year's crop.
- Up to 95% control has been found in weed control using a camera steered hoe in a Sugar beet crop.
- There are different hoes available for different situations.
- Intra-row weeding is possible through camera-guided hoes, for wider-spaced crops. Finger weeders can also work the spaces between rows.
- Mechanical weeding should be implemented within an framework together with improved rotations

EASE OF ADOPTION ON NON-ORGANIC FARMS

- This technique is readily applicable for use on non-organic farms, particularly where herbicide-resistant weeds are present.
- In crops like sugar beet and maize where weed control is becoming difficult the wider rows also makes these techniques possible.
- Machinery is readily available, and increasingly technically advanced with GPS and camera steering available. Sensors are getting better.
- The move to wider drill spacing in cereals with direct drilling techniques opens the opportunity to use interrow weeders in late spring to control late germinating and herbicide-resistant weeds.
- Further development of mechanical robotic weeders would be beneficial

BENEFITS OF IMPLEMENTATION

- Labour saving (compared to hand-weeding).
- Reduction in manufactured chemical usage and ability to reduce herbicide-resistance developing.
- Late season pass can be used to under-sow the crop with grass or covercrop seeds, with good seed to soil contact, leading to better germination.

DRAWBACKS OF IMPLEMENTATION

- No system is suitable for all weed types, and the action of the weeder may trigger more weed germination.
- Possible crop damage from tractor activity, particularly later in growing season.
- Cost of machinery, particularly on smaller farms.
- Effectiveness is less on stony soils, and higher on drier soils so timings can be weather dependant, which means that ideal weeding times can be missed.
- Possible damage to soil structure and biology.
- Risk of disturbance to ground-nesting birds.



BARRIERS AND RISKS

- Some cropping systems are not considered compatible with mechanical weed control and would need to be changed to suit new machinery.
- Potential to damage/destroy ground-nesting birds and soil organic matter.
- Machinery cost is a factor, particularly on small farms.
- Difficult to find machinery suitable for use with maize crops.
- Increased costs per acre. Labour and time requirements, particularly because it is weather dependent.
- May be some resistance from no-till advocates as any disturbance to soil is considered damaging to soil structure and biology.
- It is considered to be fuel intensive and diesel is expensive.

FINANCIAL ANALYSIS

The use of mechanical weed control is likely to be associated with an increase in net margins, mainly due to a decrease in the costs of inputs.

Initial investment	Ongoing costs	Yields	Financial output	Expected effect on margin
↑	↓	~	~	↑

Rating approach used to describe the effect and direction of change (increase or decrease): Unknown = ? None = ~ Low = ∨ Moderate = ∨∨ High = ∨∨∨

The estimate of the financial implications is based on the following assumptions:

- Herbicide use can be reduced by 50% in crops such as winter wheat
- Crops such as spring barley or spring beans can be grown without herbicide (i.e. only using mechanical weed control)
- Seed rates would need to be increased by 10% to offset losses from mechanical weeding

RELEVANT LEGISLATION AND CURRENT INCENTIVES

- A ban on glyphosate and other 'actives' would be a major incentive for using more mechanical weed control.
- Loss of labour availability in horticulture sector is a major driver / incentive for using more mechanical weed control.
- Producer organisations will often help fund upfront costs of new equipment.
- More demonstrations of machinery in action would lead to a higher uptake

FURTHER INFORMATION

Video

- Example of interrow cultivator in cereals <https://youtu.be/iYmilRe60ZQ>
- Example of harrowing beans https://youtu.be/0mO0gT_wGjs
- Putting mechanical weeders through their paces. <https://youtu.be/vX6ufUutoIQ>
- Mechanical Weed Control in Vegetable Production (2013) FiBL <https://youtu.be/kGWNsgttNXk>

Further reading and weblinks

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- PAN Europe (2018) Alternatives to glyphosate in weed management. Integrated weed management. Many little Hammers. <https://tinyurl.com/PAN-weeds>
- Soil Association (2015) Organic Arable Production: Weed Control. <https://www.agricology.co.uk/resources/organic-arable-production-weed-control>
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- Garden Organic (HDRA) Organic weed management website. <https://www.agricology.co.uk/resources/organic-weed-management>
- Davies G, Turner B, Bond B (2008) Weed Management for Organic Farmers, Growers and Smallholders: A Complete Guide. Crowood Books.

CASE STUDY FARMER APPLYING THE PRACTICE: SHIMPLING PARK FARMS

Location: Suffolk

Size: 649 hectares

Enterprises: wheat, barley, beans, spelt, oats, quinoa, sheep

John Pawsey bought a System Cameleon, which is a seed drill combined with an inter-row hoe in 2015.



John explained: “At that stage I had almost given up inter-row hoeing as the hoe that I had wasn’t really designed to work on our heavy flinty soils and just left too many weeds behind as there was too much movement at ground level for the hoe blade to get near enough to the crop without ripping it out and it tended to jump over large tillered weeds due to the nature of it’s spring tine which was what the design was based on.

“Firstly, it’s a great seed drill. Every coulter is independent to its neighbour and so the drilling depth is extremely accurate meaning that crop emergence is even making blind weeding possible. It’s also a low disturbance drill so you are not recreationally cultivating, but if you do want to cultivate out weeds when you sow, you can leave the hoes on while you are sowing.

“Secondly, and most importantly, in my opinion it is the best inter-row hoe on the market. Although having a level seedbed is a good start for any hoe, the Cameleon is able to cope with unevenness because every hoe is independent. Setting the hoeing depth is very precise and so you can set it to scalp weeds just under the soil surface meaning that resetting of weeds is less likely. Because the hoes are so rigid and the Cameleon has sown the crop that it is hoeing, you can hoe right up to the edge of the crop rows meaning that more land is hoed. The camera that guides the hoe is extremely accurate and because the machine is trailed, it eliminates the twitchiness of a hoe that is mounted on the three point linkage of a tractor. On windy days it is often difficult to hoe as the crop’s leaves blow across the rows which can confuse a camera, but the Cameleon has a simple but effective set of dividers that part the rows in the camera’s line of sight giving it the definition to continue steering the hoe.

“But all of this comes at a cost and System Cameleon is not a cheap tool. However, to replace my previous 8m drill and inter-row hoe I would have seen little change from £130,000, whereas an 8 meter Cameleon will still save you around 25% on that total depending on the spec that you opt for. When you start taking into account better weed control, less wheelings, less damage to crops on the headlands, more timely sowing, better fertility building ley establishment and potential savings in seed cost it all starts to sound like a good long term investment.”

<http://johnpawsey.blogspot.com/>

ABOUT THIS PRACTICE ABSTRACT

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