Introduction

Weed management is a major challenge across many horticultural crops. In recent decades, there has been a revival of interest and investment in mechanical weed control due to EU pesticide reduction targets, increasing problems with herbicide resistance and an increase in conversion to organic production. Mechanical weeding is the most common physical method used for weed control in vegetable crops, and a key part of integrated pest management (IPM) for weeds.

The main focus of this technical report is on mechanical weeding methods for controlling weeds in the upper layer of soil in vegetable crops. The mechanical weeding machines, implements and technologies presented were demonstrated at the Crops and Cultivations Mechanical Weed Control Demonstration at Teagasc Oak Park on 21st June 2023. These included: tine harrows and a rotary hoe cultivator; inter-row cultivators (between crop rows) and intra-row cultivators (within crop rows); and a thermal weeder. This technical report provides a brief overview of these specific mechanical weeding tools and is not intended as a comprehensive review of mechanical weed control. Specifications and prices for the machines are available from distributors and manufacturers.

Technical report authors/editors:
Teagasc Specialised Vegetable Advisors: William Deasy, Andy Whelton and Eoin Sweetman.

Contents

Section 1

Tine harrow cultivation

1.1 Einböck AEROSTAR-EXACT 3
1.2 Treffler Precision Tine Harrow 5

Section 2

Rotary hoe cultivation

2.1 Pöttinger ROTOCARE V 6600 rotary hoe 7

Section 3

Inter-row and intra-row cultivation

3.1 Einböck CHOPSTAR 9
3.2 FarmDroid FD20 11
3.3 Ferrari Remoweed 12
3.4 Garford Robocrop inter-row cultivators and custom finger weeder 13
3.5 Steketee EC-Weeder 16
3.6 Terrateck wheel hoe 17

Section 4

Thermal weeding

4.1 Farmer's Friend Pyroweeder 19

Section 5

Appendices

5.1 Acknowledgements and photo credits 20
5.2 Disclaimer and copyright 20

Section 1
Tine harrow cultivation

1.1 Einböck AEROSTAR-EXACT

Einböck AEROSTAR-EXACT.

The Einböck AEROSTAR-EXACT is a versatile precision tine weeder for arable, grassland and vegetable row crops. The 1.5 m wide weeder sections, fix mounted on the frame, are equipped with 600 mm long spring loaded tines 700 mm in diameter. The tine angle is adjustable from the tractor via hydraulic pressure adjustment, which ensures that all of the tine sections operate equally over the entire working width, even on uneven ground. Precise depth control is achieved through rear support wheels. A 6-row arrangement of 60 tines per 1.5 m section provides a 2.5 cm line spacing. With a frame clearance of up to 55 cm, the AEROSTAR-EXACT working width ranges from 3 m rigid to 18 m folding frame.

"The AEROSTAR-EXACT tine weeder is a very effective form of mechanical weeding for smaller weeds, from germinated white thread to cotyledon stage. Timing is key, as is weather and the condition of the soil. The aim is to control the weeds before they start growing. Germinating weeds are dislodged and prevented from emerging while weed seedlings are uprooted from the soil and dry out on the surface, particularly under sunny weather with a drying wind" says Shane Kelly of P.J. Callan Ltd., distributors for Einböck in Ireland.

He explains "precision control over the tine depth and adjustment of the tine aggressiveness allows pre-emergence blind weeding. For post-emergence crops, working speed and tine pressure can be adjusted to work under the crop leaves when cultivating the soil between the rows without the tines damaging the crop." Adding "tines can be lifted for row crops like carrots and brassicas and for more advanced crops to reduce the risk of dragging or dislodging crop plants. The 600 mm long tines also assist weeding later stage crops." He continues "while vibration and lateral movement of the tines allows plant residue and uprooted weeds to pass through minimising clogging, the AEROSTAR-EXACT operates most efficiently on even beds with minimum organic residues."

"The machine has one of the highest adjustment range of tine pressure on the market. It is possible to adjust tine pressure for very little ground contact to drag out sticky weeds in cereals, or the AEROSTAR-EXACT can very effectively be used to break up the soil surface" He says.

Along with the AEROSTAR-EXACT and a range of other weeders, Einböck manufacture the AEROSTAR-FUSION tine weeder that is suitable for ridged crops such as potatoes.

The Einböck AEROSTAR-EXACT is available from P.J. Callan Ltd.

Further information:
https://www.einboeck.at/en/products/crop-care/weeding-technology/aerostar-exact

1.2 Treffler Precision Tine Harrow

Treffler Precision Tine Harrow.

The Treffler precision tine harrow is used for mechanical weed control in conventional and organic cereal and vegetable crops and grassland. It can control weeds from the germinated white thread to cotyledon stages in any row (flat, beds, ridged or drilled), regardless of the sowing and planting width. Direct seeded crops can be harrowed pre-emergence and post-emergence. Transplanted crops need to be established before harrowing.

The Treffler precision tine harrow is available in various models with working widths of 0.8 m to 29.2 m and front and rear attachment options. The tines are assembled under the frame, each individually pivot mounted on the frame and tensioned with a spring to produce a 2.8 cm tine spacing and tine pressure range of 100 g to 5 kg. The tines can be adjusted manually, and hydraulically from the tractor depending on soil conditions and crop stage, or to release residue if needed. 105 and 120 degree tines are available with or without carbide tips. The 120 degree tine has a gentler angle, which increases drag along the ground and reduces digging making it more suitable for speciality crops such as vegetables. Using sensors the harrow automatically adjusts to maintain the desired working depth. Support wheels running before and after the harrow can be manually and hydraulically adjusted to help maintain working depth and to ensure the frame

adapts to uneven ground. Track harrows can be installed to control weeds in the wheel track.

"Each tine is mounted individually and follows the contour of the field. All of the tines have equal downward pressure. Lowering the frame reduces pressure, raising increases. When the frame is raised the tine is more upright and aggressive. Lowering the frame reduces aggressiveness and makes the tines more precise. Frame height and tine tension is increased for breaking up the soil surface. Tine tension is reduced for blind weeding or where there is a lot of organic debris in the soil. Forward speed is also important and needs to be adjusted. Drive speed can be reduced for precise weeding of early stage crops. Tine lifters can be used to lift tines on the 3rd, 5th and last bar of the frame to allow weed control between rows without damaging the crop." explains Jos and Ana Pelgröm of Treffler-Man@Machine.

The Treffler precision tine harrow was originally developed for organic growers but Ana says it has wide applications in conventional systems. Jos and Ana have seen a shift in demand for their mechanical weeding machinery in recent years, both in Europe and around the world, as Ana who is responsible for promotion and marketing discusses "we are seeing a hybrid form of farming more and more where conventional farmers are integrating mechanical weeding with reduced herbicide use." With weeds, she says "it is best to be proactive rather than reactive and that weed control can begin as soon as the weeds start to germinate, with the cotyledon stage being the most susceptible. Timing is key. Implementing mechanical weed control with the Treffler precision tine harrow as early as possible when the seedling is germinating and the weed plant is at its weakest is most effective. A pass with the harrow just before the crop seed emerges can significantly reduce weed competition. Later passes are best carried out before weed roots become more established and dislodging is harder. For grass weeds, which are challenging, early control is essential. Time of day and weather conditions are also important to utilise. Wind and sun can help dehydrate weeds that have been dislodged during harrowing. The effectiveness of the tine harrow is increased in drier soils."

Treffler produce a range of manual and hydraulic machines for mechanical weed control and shallow tillage. Treffler-Man@Machine is the licenced seller of these machines.

Further information:
https://www.treffler.net/en/agricultural-technology/products/harrow/

Section 2
Rotary hoe cultivation

2.1 Pöttinger ROTOCARE V 6600 rotary hoe

Pöttinger ROTOCARE V 6600 rotary hoe.

The Pöttinger ROTOCARE V 6600 rotary hoe is a versatile machine that can be used for weed management in a range of conventional and organic crops from drilled cereals to row crop vegetables, as well as loosening up soil surface, shallow stubble cultivation, aerating grassland and incorporating fertiliser.

The ROTOCARE comprises a robust frame with depth control wheels that allow the machine to run smoothly over the ground, and rotary hoe stars that have 16 self-sharpening 18 mm wide wear resistant spoon-shaped points. The offset angle of the rotary hoe stars and spoon points protects the crop but lifts out the fine weeds. Each rotary hoe star has a row spacing of 89 mm and is individually mounted on a spring to ensure optimum ground tracking.

Paul Wilson, Territory Manager Pöttinger Ireland, explains "during operation, the rotary hoe stars sweep weeds that are in the germinating, white thread to first leaf stage out

of the soil on to the surface to dry out, dislodge weeds that have germinated but have not emerged, or cover weeds in the early stages of growth." He adds "the ROTOCARE is most effective for controlling small weeds. Weeds that already have true leaves are too big to be controlled and are more likely to survive so pass timing is critical." He continues "the ROTOCARE is most effective when used in dry, hot weather."
The working depth of the ROTOCARE is adjusted, to a maximum of 40 mm, using the depth control wheels and the top link position. The top link also regulates the working intensity by adjusting the weight on the rotary hoe stars, with up to 20 kg downward weight per rotary hoe star possible.
Paul says "depending on the type of crop, blind weeding is possible. When used in row crops, the track width of the depth control wheels can be adjusted to the bed width or row spacing. For crops growing on ridges, elements can be lifted to protect the crop and prevent knocking the ridges." He adds "sufficient time is needed before making the first pass for transplanted crops, like calabrese and cabbage, to allow new root growth and to avoid dislodging the transplants."
Driving speed, ranging from 10 to 30 km/h, is a key influence on the aggressiveness of the ROTOCARE rotary hoe weeding tools. Depending on soil conditions and crop growth stage, increasing and decreasing speed affects the depth of penetration into the soil. "Faster speed reduces the working depth and is less aggressive than slower driving speed. A faster pass dislodges more weeds in blind cultivation. Established crops can have a faster pass" Paul says.
The high underframe clearance of 500 mm allows the ROTOCARE to be used in more established crops. While clogging of the machine is avoided by the underframe clearance and the single row configuration of the offset rotary hoe stars.
The Pöttinger ROTOCARE is available in three models: ROTOCARE V 6600 at 6.6 m width, ROTOCARE V 8000 at 8.0 m, and TOTOCARE V 12400 at 12.4 m.

Further information:
https://www.poettinger.at/en_ie/produkte/detail/rotov/rotocare-v-folding-rotary-hoes

Section 3
Inter-row and intra-row cultivation

3.1 Einböck CHOPSTAR

Einböck CHOPSTAR.

The Einböck CHOPSTAR is a spring tine cultivator for mechanical weed control in a range of conventional and organic row crops including cereals and vegetables. Available in a number of versions, the CHOPSTAR can be used for crops with a spacing of 30 cm, 60 cm, 90 cm and 150 cm. “Depending on the aim of the hoeing pass, crop and weed growth stage and conditions, the CHOPSTAR can be equipped with a variety of tools such as heaping/hilling elements, heaping sweeps, weeder tines mounted behind the elements, finger weeders and manual hydraulic or automated camera-guided steering systems” explains Shane Kelly of P.J. Callan Ltd., distributors for Einböck in Ireland. “Weather, soil conditions and timing are key. Dry conditions are most effective for using the CHOPSTAR spring tine cultivator when the soil is slightly crusty on top and the weather can desiccate the dislodged weeds” Shane says. He continues “the number of tines and width of sweeps for each hoe section on the CHOPSTAR depends on row distance and weeding width. A range of tines and sweeps are available for different working depths. For crops with row spacing over 60 cm there are shares and tines that

allow greater working depths, and for tracks behind tractor wheels or between ridges to loosen up the soil and drag out the weeds. For narrow row spacing vibro-tines with shallow sweeps are recommended. In addition, adjustable rolling discs are available to protect small plants during early weeding operations."

The CHOPSTAR frame, on which the hoeing parallelograms are mounted, is available in a rigid or hydraulic folding version, both for front or rear mounting. The CHOPSTAR design allows the rear mounted machine to be converted to front mounted. Shane says "Einböck build CHOPSTAR frames individually for a small rigid machine, up to an 18 m frame as a folding machine." The rear mounted CHOPSTAR is steered by the upper link of the 3-point hitch and gauge wheels that carry the weight of the machine and prevent it from drifting, especially on hilly land. Each hoeing parallelogram is equipped with a three step adjustable retraction spring, for down pressure adjustment of up to 105 kg, and depth control wheels so that the working depth of the hoeing tools are precisely maintained during operation. A frame clearance of 70 cm allows weeding and ridging up in later stage crops. For precision weeding of early stage crops, the parallelogram can be mounted directly above the crop, rather than between the rows, to create a very narrow hoeing belt (CHOPSTAR-TWIN).

Shane explains "the CHOPSTAR can work on the flat as well as on beds or in ridged potato crops, and can be assembled according to customer specifications." He says "for weeding crops such as brassicas, the machine can be fitted with three tines for 45 cm row spacing with a further two tines on each parallelogram that creates a small hoeing belt between 8 cm and 10 cm." He adds "the vibro-tines can be more easily adjusted than the spring tines to a working depth of 2-3 cm to avoid spilling soil on the crop, and the special vibro-tines (40 x 12 mm) that are mounted on most CHOPSTAR machines are recommended for hard, stony soil."

"Finger weeders can be added to control weeds particularly at the early stages. They break up the unworked hoeing belt close to and between the crop plants without damaging the crop and roots. The CHOPSTAR can also be fitted with a seat and steering system for further manual precision or the Einböck camera steering system and the ROW-GUARD side shift frame that can be operated via a control unit in the tractor cabin" he says.

The Einböck CHOPSTAR IS available from P.J. Callan Ltd.

Further information:

https://www.einboeck.at/en/products/crop-care/standard-hoeing-technology/chopstar-5-90

3.2 FarmDroid FD20

FarmDroid FD20.

The FarmDroid FD20 is a fully autonomous, solar powered field robot that is capable of precision seeding and weeding in a range of conventional and organic crops including beets, kale, salad leaves, herbs, onions and turnips. It has a 3 m working width, up to 24 hours operation time per day and a forward speed of 450 m to 950 m per hour in autonomous working mode, which makes it capable of seeding and weeding up to 6 hectares per day.

Setting up the FarmDroid FD20 begins by recording the field or working area boundary and the row spacing and plant density required into the control system. The software then calculates the in-row seed spacing and creates a map of where each seed will be placed. Using accurate RTK-GPS, the FarmDroid FD20 knows where the crop plants should be and can weed both between the row and in the row without using a camera.

There are two sets of soil engaging assemblies trailing from the front toolbar. One set of trailers for precision sowing and intra-row weeding and another set of trailers for carrying interchangeable weeding tools. For weeding, hoe shares and weeding wires run between each row, while blades cut between each crop plant in the row. FarmDroid FD20 is capable of working to within 5 mm of crop plants between the rows and 20 mm in the row. The weeding arm for in-row weeding is connected to an electrical motor, which pulls the arm in and out of the row. The timing is managed by the robot's computer and can be adjusted closer or further from the crop. Weeding is performed both up and down the row. For seeded crops, FarmDroid recommend blind weeding before the crop has emerged followed by inter and intra row weeding. The FarmDroid FD20 can be configured for 4-12 rows with row widths of 22.5 cm to 90 cm.

FarmDroid was founded in 2018. IAM Agricultural Machinery Ltd. is the distributor for the FarmDroid FD20 in Ireland.

Further information:
https://www.farmdroid.co.uk/products/farmdroid-fd20/

3.3 Ferrari Removeed

Ferrari Removeed.

The Ferrari Removeed, produced by Ferrari Growtech (Costruzioni Meccaniche Ferrari) in Italy, is an automatic three point linkage mounted weeder that can remove weeds both inter-row and intra-row in a single pass. It is suitable for conventional and organic vegetable crops such as salads, cabbage, broccoli and cauliflower that have similar shape. The Removeed consists of a hydraulic floating frame with weeding units equalling the number of rows to weed (available for single or multi-beds). The machine can remove weeds along the width of its frame while moving forward. Each independent weeding unit is equipped with an infrared light sensor that detects the presence of crop plants during a pass. Every weeding unit is also equipped with a pair of hydraulically operated arms with two cutting blades at the ends that cut weeds up to 1 cm away from crop plants. The working height of the blades is adjustable while the opening and closing speeds are automatically set to the working speed and type of soil.
The Removeed is suited to crops with a minimum inter-row spacing of 25 cm and 4 cm in-row spacing. Weeding becomes more accurate and reliable when crop plants are larger than weeds and when there is enough space between crop plants within the row. The Removeed can weed between 6,500-9,000 plants/ha and comes fitted with an electronically controlled fertiliser spreader. Operating parameters such as working height and the distance between the blades are set using a touch screen panel in the tractor cab.
Brophy Produce Ltd. demonstrated the Ferrari Removeed automatic weeder.

Further information:
https://ferrarigrowtech.com/en/automated-weeders/28-removeed.html

3.4 Garford Robocrop inter-row cultivators and custom finger weeder

Garford Robocrop inter-row cultivator.

Garford inter-row cultivators are custom built to suit customer requirements for mechanical weed control in a wide range of row crops. Garford offer hoes from small 1.5 m working width up to 24 m trailed types. Hoes can be front or rear mounted, guided by the tractor driver, a second operator on a seat behind the hoe, or the Robocrop Precision Guidance System.

The Garford inter-row hoes can be equipped with a variety of tools including tines with duck foot and flat shares, blades, hilling shares and finger weeders. Raised bed cultivator systems feature tines and ridging ploughs in the wheel tracks and a range of shares between the rows on the bed. Different crop protection shields and disc options are available for non-bed applications. For row widths of 25 cm and below, Garford supply one wheel unit per three rows. Front linkage is available for frame sizes up to 6 m. The pressure ram system used for most models transfers weight from the toolbar onto the row unit to improve soil penetration and unit and hoe stability. Specialised equipment can be added such as fertiliser or spraying systems.

The Garford Robocrop inter-row weeder uses a digital video camera to capture images of the crop ahead of the weeder. These images are analysed by the computer to find

the position of the individual crop plants as they pass through the image. For reliable operation the crop must be the more dominant feature in the image. This information is then utilised for lateral steering of the hoe, and individual synchronisation of the weeder discs in the Garford Robocrop InRow Weeder.
The Garford Robocrop inter-row weeder can be used in most crops that are planted with regular plant and row spacing where the foliage is separated from the next plant, including vegetable crops such as lettuce, cabbage, celery and carrots.
Emmett Dunne of Leo Dunne Ltd., Leo Dunne Organics and O'Duinn Organacha uses tractor GPS and a Garford Robocrop inter-row weeder with a front mounted camera guided cultivator and a rear mounted hoe guided by a second operator on a seat. The weeder is equipped with tines and modified duck foot shares on the bed, and tines and ridgers for the wheel tracks. Emmett uses mechanical weeders in both his conventional and organic crops and says it significantly reduces labour costs and is a vital weed control option with reducing herbicide availability. Depending on the crop, he typically uses a brush weeder first followed by four or five passes with the Garford Robocrop inter-row weeder working at 7 km/h. Dry weather conditions greatly improve mechanical weeding he says.

Further information:
https://garford.com/products/robocrop-inrow-weeder/

Emmett also uses a home-modified rear mounted inter-row cultivator equipped with staggered finger weeders designed to control germinated, small and emerging weeds in row crops. With tractor GPS, his finger weeder is steered by a second operator who sits on a seat behind the cultivator. The finger weeder consists of a turning disc with fingers on it. The flexible fingers work in between the crop row to uproot weeds between the crop plants.

Custom finger weeder.

3.5 Steketee EC-Weeder

Steketee EC-Weeder.

The EC-Weeder by Steketee, a Lemken brand, is a fully customisable hoeing machine for all crops seeded in rows including cereals, beets and vegetable crops such as lettuce, carrots and onions. The machine can be adapted to row widths from 15 cm to 150 cm, working widths up to 17 m and 70 cm passage height, and can be equipped with a complete range of inter-row and intra-row tool options.

"Hoeing as close as 2 cm from crop plants is possible with the EC-Weeder. The hoeing tools cut weeds close to the surface, pull them out or bury them. Finger weeders remove weeds from within the row by means of rubber fingers, which act between the crop plants. For crops meeting across the row, a single blade or ridging shares can be used" says Derek Delahunty Area Sales Manager for Lemken Ireland.

The base frame is rigid or folding, while the parallel steering frame (EC-Steer) has a swivel range of 20 cm left and right. When the EC-Weeder is raised, the hoeing machine is automatically centred behind the tractor. The support wheels allow the machine to be operated with open lower link stabilisers, which prevents the transfer of movement between the tractor and steering frame. Hydraulically operated parallelogram elements allow section control and adaptation to changing soil conditions.

The EC-Weeder is available with a manual or automatic steering system (IC-Light camera control). Both systems hydraulically control the parallel sliding frame. Manual control is achieved with a joystick and the tractor hydraulics. The optional automatic IC-Light camera steering system contains three key components: the camera, the terminal

including job computer and the parallel sliding frame. The high resolution camera makes images of the crop rows and sends these data to the terminal. It detects between one and five crop rows in hues of green and the red, blue and green colour spectrum. The touch screen terminal is integrated in the job computer, which processes the camera images to precise steering signals. The parallel sliding frame transfers the steering signal from the terminal to the EC-Weeder hydraulically. The hoeing machine is then steered between the roes independently from tractor movements.

Leonard Mol Head of Sales at Steketee says "timing is key with mechanical weeding. It needs to start when there are no weeds, especially with the finger weeder." Adding "it is important to have the right combination of tools. Machines can be altered to suit grower scale. For example, it is possible to have a basic hoe system for a small grower by removing the steering system and the camera control system. The quality of weed management in that instance will largely come down to the driver."

He continues "mechanical weeding decisions start a year ahead, such as whether to plough or not, seed bed preparation, rotation and planting dates. Decisions are not just dependent on herbicide options. Future growers will have both sprayers and hoeing machines. An integrated approach."

He adds "in the Netherlands it has been very dry this season so growers who normally spray are not able to because spraying is not as effective in dry conditions. They need mechanical weeding options."

"There is demand from the vegetable sector. The crops are high value relative to other crops. The bottom line, mechanical weeding reduces the need for labour. The EC-Weeder is very adaptable for vegetable crop growers. It is successfully being used in commercial crops of carrots, leeks, celery, brassicas" Leonard says

Further information:
https://lemken.com/en-en/agricultural-machines/cropcare/weed-control/mechanical-weed-control/ec-weeder

3.6 Terrateck wheel hoe

Terrateck wheel hoe.

The Terrateck wheel hoe is a versatile mechanical weeding tool for small to medium sized growers and market gardeners. Available as a single or double wheel hoe, with a comprehensive range of attachments, the Terrateck wheel hoe can be adapted to any type of soil and crop.

Elmer Koomans, Sales Manager at Fruit Hill Farm, explains "the single wheel hoe, fitted with an oscillating how for example, is used for weeding between rows of vegetables, while the double wheel hoe equipped with Lelievre blades or finger weeders improves precision by passing directly over the row to control weeds as close as possible to the crop."

Elmer continues "using the double wheel hoe and parabolic discs covers weeds in the row and also removes soil and weeds beside the crop making it an ideal tool for leeks and onions."

Additional tools can provide a range of mechanical weeding solutions for growers, as Elmer explains, "the 5 tine cultivator/aerator can be used for loosening hardened topsoil, removing established weeds and uprooting the remains of crops after harvesting, the collinear hoe for weeding between rows, and the ridger for ridging potato, leek and onion crops."

"An offset arm assembly for both the single and double wheel hoe allows you to walk alongside the wheel hoe as opposed to behind it" he adds.
On the benefits of the Terratek wheel hoe Elmer says "the Terrateck wheel hoe is a cheaper solution than machinery for small to medium scale growers and is a very useful tool for small areas. It has the potential to significantly improve weed control and reduce the time and labour costs involved in hand hoeing."
The Terratek wheel hoe and attachments are available from Fruit Hill Farm.

Further information
https://www.terrateck.com/en/16-houes-pousse-pousse

Section 4 Thermal weeding

4.1 Farmer's Friend Pyroweeder

Farmer's Friend Pyroweeder

The Farmer's Friend Pyroweeder is a professional 5-burner flame weeder for small growers and market gardeners. Engineered from aluminium and stainless steel, the lightweight walk behind Pyroweeder can be used to create stale seedbeds or for after sowing flaming for pre-emergence weed control in direct seeded crops such as carrots, swede, spinach and beetroot.
Elmer Koomans, Sales Manager at Fruit Hill Farm, explains "the Pyroweeder does not need to burn the weeds. Temperature of 100°C applied for several seconds will result in expansion of cell water, cell rupture and consequently desiccation of the weed leaves." Elmer adds "small weeds are generally more susceptible to thermal weeding than larger ones, as are weeds with more open growth habit."
There are two models available that can be set up to suit bed width or ridges. The 80 cm Pyroweeder can be adjusted to 79 to 96 cm wide, while the 120 cm can be set to a width of 106 cm to 137 cm. Both models can be assembled to give a ground clearance of 17 cm or 27 cm.
The offset handle allows the operator to walk next to the bed to avoid compacting or disturbing the soil bed. A hood 'Flame Blade' accessory is available to shelter the flames from wind and direct heat more evenly onto the soil. The Farmer's Friend Pyroweeder and Flame Blade hood are available from Fruit Hill Farm.

Further information:
https://www.farmersfriend.com/p/pyroweeder-flame-weeder

Section 5 Appendices

5.1 Acknowledgements and photo credits

Teagasc Horticulture Development Department is grateful to the following:

- Eoin Sweetman and Andy Whelton Teagasc Specialised Vegetable Advisors and Stephen Robb the Irish Farmers Journal who organised and presented the machinery demonstrations at the Crops and Cultivations Mechanical Weed Control Demonstration 2023.
- Shane Kelly of P.J. Callan Ltd., distributors for Einböck in Ireland.
- Jos and Ana Pelgröm of Treffler-Man@Machine, licenced seller of Treffler machines.
- Paul Wilson, Territory Manager Pöttinger Ireland.
- IAM Agricultural Machinery Ltd. distributor for the FarmDroid FD20 in Ireland.
- Brophy Produce Ltd. who demonstrated the Ferrari Remoweed automatic weeder.
- Emmett Dunne of Leo Dunne Ltd. and Leo Dunne Organics who demonstrated the Garford Robocrop inter-row cultivator and custom finger weeder.
- Leonard Mol Head of Sales at Steketee and Derek Delahunty Area Sales Manager for Lemken Ireland.
- Elmer Koomans, Sales Manager at Fruit Hill Farm.

Our thanks to the Irish Farmers Journal and Teagasc Oak Park for hosting the Crops and Cultivations Open Day 2023. Our gratitude to the Teagasc Oak Park staff for their support and input preparing the demonstration site.
Finally, thank you to Gary Abbott the Irish Farmers Journal, Brian McGuinness Technologist Teagasc, Declan McArdle KT Online Media Specialist Teagasc and William Deasy Specialised Vegetable Advisor Teagasc for providing images used in this technical report.

5.2 Disclaimer and copyright

This technical report is provided as an information guide only. Every effort has been made to ensure that the content is accurate and up-to-date at the time of publication. The information may change after the date of publication. Teagasc accepts no liability for loss, damage or injury caused in relation to information or opinions contained in or omitted from this technical report. Copyright and/or other intellectual rights have been attributed to the rightful owners where appropriate. The contents of this technical report are protected by copyright law.