

FIELD ROBOTS BECOME COMMERCIAL REALITY

In recent years, autonomous field machines have developed from unattainable prototypes into fully available vehicles. One of the most recent UK market introductions is from Opico, which has just completed its first season selling and supporting the Danish-made FarmDroid. Martin Rickatson attended its launch and later gathered some first-season customer experience.

Over the past year or so, autonomous or robotic agricultural vehicles have become reality. The first UK sale of a conventionally-engined machine suited to vegetable farm weeding duties, Agrobot's Robotti, was announced two years ago. Now, though, the principle has moved yet further forward, with the UK launch early last year of a solar-powered robot that not only performs simple, repetitive weeding tasks, but plants the crop in the first place.

Recently announced as winner of both the Arable Innovation Award and the Future Innovation Award at LAMMA, the Danish designed and built FarmDroid FD20 now marketed in the UK by Opico also last year took a Gold Award and the Dr Alban Davies Trophy at the Royal Welsh Show as well as a Silver Award for Technical Innovation at the Royal Highland Show.

Development of the FarmDroid, now being sold and supported through a selected network of Opico dealers, began in 2011 on

a family farm in central Denmark, where Jens Warming first began to investigate the idea of a simpler, more time and fuel-efficient and less labour-intensive way of inter-row weeding sugar beet. Joined subsequently by his brother Kristian, and by specialist robotics engineer Esben Østergaard, the three set out to create an autonomous machine for seeding and subsequent weeding of row crops, based on the principle that a machine using ultra-high precision placement based on RTK for planting would then be able to use recorded placement data to subsequently weed not just between plant rows, but also between plants in each row, without the need for camera systems.

A further principle was to harness solar energy for propulsion, reckoned to be practical given the relatively low energy requirement of a machine that, because it is aimed mainly at vegetable growers, operates largely on light, flat land. After eight years' development, the



Opico has signed a deal with Danish manufacturer FarmDroid to be the field robot maker's UK importer.

first production version – made by a team that had expanded to 30 working from a new manufacturing complex – was shown at Agritechnica 2019. Twelve machines were working on Danish farms by 2020, and an updated model was developed by that autumn. Production was ramped up to 60 units, with six international distributors appointed. Today FarmDroid is represented in 18 countries, with over 250 units sold.

Power is sourced from four solar panels that charge two lithium batteries. Two further spare batteries can be charged remotely if required, although charging takes place during daylight operation whatever the light level, with 24-hour operation possible from battery storage of solar-generated power. Should it run out of power during darkness, the machine simply begins moving again when the sun rises and the solar panels again become active. A rain sensor stops the machine or notifies the user's app if a certain amount is detected.

Propulsion is via a 400W electric motor on each wheel, and operation is therefore fuel and emission-free, and CO2-neutral, something the firm points out will particularly aid farmers whose produce buyers are pressuring them to fulfil environmental demands along with crop supply contracts. Electric motors also engage and power the seeding and weeding units. Steering is via drive motors on the front wheels, which work constantly at different forward speeds to keep the machine

running straight. There is a single wheel at the rear. The majority of the machine's working parts are stainless steel, with Hardox weeding wires and seed coulters.

The 3.0m FarmDroid can be equipped with four, six or eight precision drill and inter/intra-row cultivation element sets, both developed and manufactured in-house. Although cameras are not required for guidance, one unit provides the person monitoring the machine via FarmDroid's smartphone app with an anytime view of its activity. The app also provides data such as forward speed and any error message alerts.

Weighing 900kg without attachments, the machine is transported between fields by tractor, and because it operates at less than 1.0 km/hr (working speeds can be set from 450-950m/hr) and is fully equipped with safety stop and smartphone app alert features should it come into close proximity with an object or person, it isn't subject to any further safety legislation during operation. The maker suggests that, where practical/required, it can be left in the field for the season and calculates that despite its sedate pace it has a 6.0ha/24hr potential workrate. Although it does not work deeply, slower working speed minimises required downforce and therefore power and torque.

The FarmDroid is guided around the field perimeter to record the corner points thereafter setting a geofence from this to recognise the field boundary and set the headlands.



FarmDroid's Eddie Pedersen (left) with James Woolway, MD of UK importer Opico.



The machine uses a combination of weeding wires and blades to remove weeds between and within rows, based on records of each seed's sown location.

In addition, any obstacles, the number of headland bouts and the seed spacing are set at this point. From this, the machine calculates the best working path plan. All this is recorded via FarmDroid's own RTK system, which works to a repeatable 0.8cm accuracy, using front- and rear-mounted machine-mounted antennas communicating with a farm-installed fixed base station which must be within 10km of the field. This enables the FarmDroid to work within 5mm of each seedling between the rows and 20mm in the row.

"If we can seed, it we can weed it," says Eddie Pedersen, FarmDroid's sales manager. "To enable inter- and intra-row weeding without cameras, we had to design a high precision seeding system. For drilling, once the field parameters are set, it's simply a matter of programming in the required plant density and spacing and setting it off.

"Roller disc pairs are followed by a furrow opener that creates a V-shaped slot. The individual six-litre seed hoppers each supply an electrically driven seed motor feeding individual seeding discs, with a range of interchangeable units 3D-printed in-house, featuring different hole diameters, disc thicknesses and disc diameters for different seed types. Gravity feed is preferred over a more complex pressure or vacuum system, and a mark in each disc provides monitoring of positive seed disc drive.

A light sensor at the base of each unit requires a beam to be broken to show a seed has passed and been placed. The last element of the seeding set-up is individually pressured soil-firming wheels.

"As the machine remembers where each seed has been placed within a variation of 0.8cm, once drilling is complete the tool units can be changed over – the seeding units simply flip up out of work and the weeding ones drop down – and the FarmDroid can then be set for pre-emergence or 'blind' weeding soon after drilling, and for repeated passes at intervals in the weeks afterwards to catch weeds as they chit. While the weeding wires remove weeds between rows, separate weeding knives interject between each plant, based on the known seed positions.

"The number of selective herbicides available to farmers is shrinking, as is the availability of labour for manual or even tractor-operated hoeing, whether a farm is producing organic or conventional crops. This machine can overcome those issues in crops up to 40-50cm in height, at row widths of 22.5-90.0cm." Harvey Sherwin, Opico's FarmDroid product manager, says weeding is best done in relatively dry conditions that will cause uprooted weeds to desiccate and die.

"The inter-row hoeing is passive – it is working all the time, and when the machine is set up the row width is fixed," he explains. Conversely, the active intra-row hoeing, with the knives moving in and out between plants, can be altered down to 10cm spacing, according to crop type and stage."

Opico MD James Woolway says the company believes robotics will form the backbone of the next major step in agricultural technology development. "The technology isn't so radical –

many farmers are already working with remote monitoring, RTK and automation. But the potential savings in herbicides, fuel, labour and machinery costs, including depreciation, maintenance, tyres and capital tie-up, are what makes the financial argument for FarmDroid strong, especially as the purchase price and ongoing running costs are a fraction of those associated with traditional equipment used for these tasks."

His assertion is based on a retail price of £62,566 for a four-row machine, with additional rows at £3,680 each. An additional £5,578 is required for the necessary high-accuracy RTK base station. "This could be recouped in two years through reductions in labour, herbicide and other machinery costs. Grants may be available to help customers fund a proportion of this."

Mr Woolway says dealers who have signed up as FarmDroid agents include Ernest Doe and Chandlers. "Installation, support and advice represent an important part of getting these machines onto farm working at their best. We have hand-picked dealers we think are best placed to do this. Many took stock units last spring, and that resulted in the sales of eight units during the machine's first UK season, on farms across Scotland, East Anglia, Somerset, Shropshire and Staffordshire. A number of these later hosted viewing days for interested visitors to see FarmDroid units at work."

Speaking at last autumn's Brassica and Leafy Salad conference on the subject of field robot investment, Andrew Williams, farms director at Home Farm Nacton, a conventional and organic 1,940ha concern based near Ipswich, outlined how he and the business's owners had justified investment in Robotti and FarmDroid machines over the past two years.

"We'd been looking for some time for new weed control ideas, given difficulties finding labour for weeding operations and, on the conventional side, pressures on herbicide product availability and usage. We saw the twin diesel-engined Agrointelli Robotti on-line and met with the makers online during lockdown. Liking what we saw and heard, we took a

leap of faith and, without seeing one in the flesh we committed to a purchase, the first commercially sold unit in the UK, arriving in April 2021.

"We started off naively using a tined cultivator to weed potatoes that had been bedformed using RTK, then destoned and planted. That didn't work well because things drift even on our flat fields, so we soon recognised the need for greater planting accuracy, and invested in higher-accuracy mapping, plus GPS for the destoner steering.

"Meanwhile, in a crop of organic leeks planted with RTK the Robotti was much more successful. And once we'd destoned and planted potatoes with greater accuracy, that worked well too. Once machines like this are set up, it's much easier to weed continually and keep on top of populations. Wanting to keep it working through the winter, we also equipped it with a rotavator to destroy cover crops in two or three passes, which also seemed to help control wireworm."

While he had found a role for the Robotti, while in Denmark later visiting the manufacturers, Mr Williams decided to also visit FarmDroid's maker, having again seen the machine on-line. "Although also autonomous, it's obviously a very different machine – solar-powered, slower-moving, and because it drills the crop and then knows where plants are for subsequent operations, capable of much more," he said.

"We were so convinced by its merits for use in crops such as onions and red and fodder beet that we bought one that afternoon. It arrived in late March 2022, and within three days we had it working as long as there was daylight. Purchasing an additional set of batteries enabled us to change them in the evening and then benefit from through-the-night work in winter.

"While it's sold as a machine that will do 20 hectares, I tried to get it to do 40, which pushed it a bit too much – if I hadn't done so our weed levels would have been even lower than they were.

"To do the job properly you need to stick to 20ha per machine and make multiple



Andrew Williams says the FarmDroid has been the solution to the weed control challenges of growing organic onions.

passes. But I can honestly say it's been the solution to our struggle to grow organic onions. The only issue was that we were constantly changing from one configuration to another, often on a Sunday afternoon, to move between different crops, with the onions grown in beds, and beet in 50cm rows. A relatively low purchase price means we've therefore invested in a second machine, so one will do the beet and one will be dedicated to onions." ♦

AgVantage takes over Yorkshire & Humber Machinery

Yorkshire & Humber Machinery are best known for dealing with root crop equipment throughout Yorkshire and North Lincolnshire and have been providing service and support to their customers in the area for over 4 years.

As of March this year, AgVantage UK Ltd have taken over the distribution and support activities in the area. AgVantage was founded in 2020 as a joint venture between Andy Carse and DeWulf, who as a shareholder, supply the resources and support that the company needs to expand.

Andy Carse commented; "We recognise the importance of local support and therefore will continue to operate from a local base in Yorkshire holding a parts stock and operating a local service team, backed up closely by the larger stock and team at our headquarters in Peterborough".

"We are delighted that Russell Button, one of the founders of Yorkshire & Humber Machinery, will be our Depot Manager for the Yorkshire and North Lincolnshire area. Russell has a wealth of knowledge and experience in the agricultural industry, especially within the root crop and crop protection sectors. His expertise in understanding customer needs and delivering a high level of service makes him an excellent fit for this role."

Speaking of the recent changes Russell said, "I am excited for the future and looking forward to being part of a larger organisation structure, and being able to maximise our potential in the area. We want it to be very much 'business as normal' for all our customers".

Hendrik Decramer, Dewulf Group CEO, commented; "Dewulf has been active in the UK for more than 20 years. Together with our dealers we have built a substantial market share, but we are not there yet. In 2020 we formed a partnership with Andy Carse and setting up a service hub in Yorkshire, together with Russell Button, is the next logical step. We are very pleased with this promising new venture.

"In addition to this, we are excited to share our plans to invest more into resources, staff and training over the coming three years. This investment will ensure that we are providing the best support possible for our customers and will help us achieve our long-term goals."

Andy went on to say; "AgVantage will be honouring all existing agreements customers may have with the Yorkshire & Humber business. We are dedicated to providing a seamless transition and look forward to continuing to support customers in all areas of root crop and crop protection machinery."



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