



“If we want to have very low soil disturbance, we have to stop destoning and bed tilling.”

Lowering cultivation intensity

Potato-LITE project

Developing lower intensity potato cultivations could help growers to improve soil health and save money, but stone content remains a challenge. CPM investigates the latest research which aims to address this.

By Mike Abram

A multi-million-pound project is starting to show that reducing the intensity of potato cultivations is possible without impacting yields. But better understanding of stone content in soils is likely to be required to unlock wider adoption.

The four-year Potato-LITE (Low Intensity Tillage Enhancement) project was awarded £2.83M to explore optimised systems for potato cultivations through the Innovate UK Farming Innovation Programme in March 2023.

While reduced tillage technologies have enabled regenerative agriculture in cereal systems, they've not been particularly well-developed for root crops, where production systems require the soil to be cultivated to create a deep seedbed – free from stones and clods

– to provide a favourable environment for growth and damage avoidance.

Typical 'maxi-till' for potatoes involves multiple passes of primary cultivations, such as the plough or deep non-inversion cultivators, followed by bed formers, bed tillers and destoners before the crop is planted.

Deep cultivations

“Many of these operations are excessively deep,” says Mark Stalham, an independent potato consultant and researcher working on the Potato-LITE project. “A destoner can typically sieve 6500t/ha of soil and stone. A bed tiller cultivates a similar amount of soil while a plough would invert that volume of soil involving more energy and more disturbance.”

One key aspect of the project has been to find a method for quantifying the intensity of various potato cultivation operations to give a baseline to work from when reducing cultivations.

A metric used by the US Department of Agriculture's National Resources Conservation Service proved ideal, says agricultural engineer Philip Wright of Wright Resolutions, which he's been developing for use in the potato crop with McCain for some years. “It's part of an algorithm used to look at soil loss and indirectly, trends in soil carbon,” he explains.

As part of that calculation, it uses a soil tillage intensity rating (STIR), assessed using

the operational speed of tillage equipment, tillage type, depth of tillage operation and percent of the soil surface area disturbed.

“STIR is driven by the type of operation. For example, mouldboard ploughing is quite intensive; low disturbance soil lifting and loosening will have a lower factor, and if we only tilled strips across the field rather than the whole field, it would be even less.”

Speed is also a key factor. For non-powered operations, the faster you go, the more intensively you move soil and the more energy you put in, so the higher the STIR. The depth you work at and the



A soil tillage intensity rating (STIR) can be calculated using the operational speed of tillage equipment, tillage type, depth of tillage operation and percent of the soil surface area disturbed, explains Philip Wright. Photo: Agrovista

Potato-LITE project

▶ amount of soil moved across the working width also comes into this, says Philip.

For powered operations such as bed tilling, the slower you drive the higher the intensity. "It has more time to deliver energy to the soil," he explains. Destoning also has an inverse relationship with working speeds. "The closer the web or star spacing, the longer it takes to filter out soil and the slower you have to drive."

Soil tillage intensity ratings have been calculated for each operation and machine according to depth, including planting and harvesting.

"Harvesting is effectively like a destoner at the end of the season," adds Mark. "But

the soil might be in a very different state, either extremely dry or extremely wet. The level of impact is related to the dryness of the soil but if the harvester is moving very slowly, then this is likely to have a greater impact. So it's possible to compromise soils at both ends of the season."

Even within a traditional establishment system there'll be potential for optimisation, stresses Mark. "We can work soil more shallowly, use wider pitch webs, and run powered rotary equipment less aggressively."

Destoning, however, normally has the highest STIR along with bed tilling. "If we want to have very low soil disturbance,

we have to stop destoning and bed tilling as the default practice," he suggests.

Using STIR for maxi-till establishment as the benchmark, the project team has tested three novel alternative establishment methods with much lower STIR values on four potato farms.

The 2023 trials involved growing an overwintered cover crop provided by Kings ahead of the potato crop, and then using either a rotary cultivator or low disturbance tine ahead of the planter. The last option was using the low disturbance tine without a cover crop.

"We envisage the rotary cultivator system being able to create ridges

Single-pass establishment intrigue

Shropshire potato grower John Bubb says he's impressed by the potential of one-pass establishment, as demonstrated in the Potato-LITE project. "It definitely works and I'd have no problem doing it. It's good for soil health, definitely cuts costs and is so simple compared with what we do now.

"But there are two questions – bruising from stones, and secondly, will it work in all scenarios? We haven't seen it in a heavier clay field or in really wet or dry conditions."

John grows 184ha of potatoes for McCain alongside wheat, oilseed rape and flowers for drying. During the past few years he's made changes to the farm's practices towards a regenerative system after recognition that years of using various pesticides, especially soil sterilants and nematicides, leaving soil bare over winter and intensive cultivation, had left the farm's soils in poor health.

Examples include the adoption of growing multi-species cover crops before potatoes and flowers, growing catch crops between OSR and wheat and using strip-till to plant flowers and OSR.

The use of targeted nutrition, sap analysis, clover in cover crops, and in-field beneficial strips have contributed to reduced fertiliser and pesticide applications across the rotation, including potatoes, while growing cover crops has helped to reduce bed tilling to just 25% of the area and improved conditions following primary cultivations.

His push towards a more sustainable system made him a natural choice to be involved in Potato-LITE. "While cultivations are only a small part of regenerative farming in my view, it's obviously of interest and there are potential cost savings to be had," he says.

His current establishment system uses a DTX for primary cultivations to around

30cm depth, bed tilling where required, followed by destoning and the planter.

"One of the challenges is getting the soil dry enough because with a plough you do dry soil quicker. But we're in transition and in five- or 10-years' time, I suspect it'll be less of an issue because the soils will drain more freely as we grow more cover crops and use fewer chemicals."

The Potato-LITE trial this season covers around 1.2ha with the four systems compared across replicated 60m strips of four rows. The sandy loam field is quite stony in places, comments John.

Planting this season, unlike last year when planting into a green cover crop proved difficult, was no problem with any of the systems, he says.

"The massive benefit of a one-pass system is that when 10 March comes and we want to start planting, currently it's a big decision since we require at least two days of dry weather to start even thinking about it so we have time between each operation.

"With one machine you can literally go out and do a few hours and maybe plant 4ha. That's worth its weight in gold."

That benefit and the one to soil health, within reason, should counter any harvesting challenges, he believes. "I'm not sure it should slow harvesting down that much. It has to stack up, but if we can create more efficiencies at planting and gain soil health, we'll try and sort out harvesting afterwards, although we have to grow quality potatoes and can't have more bruised."

Optical grading, for example, could be one solution on farm to removing stones, while delivering into the factory immediately post-harvest could also allow crops to be processed before bruising develops. Both are options being considered by McCain, suggests Matt Smallwood, the firm's head



Farmer John Bubb says he's impressed by the potential of one-pass establishment, as demonstrated in the Potato-LITE project. Photo: Hutchinsons.

of agronomy and applied research.

"In parallel with this project we're looking at commercial grading solutions to remove a low stone content prior to delivery to the factory," he says. "There is a land base that has a low enough stone content to enable that.

"But we also appreciate that a large area will still likely require destoning and this project is also looking at alternatives or modifications for that."

McCain already has a few growers no longer destoning, grading out stone post-harvest and then delivering to factory before bruising becomes apparent, but that could be expanded as an option once commercially viable cultivation and grading options have been developed, he says.

It's all part of McCain's plan that 100% of its potato crop will involve regenerative agricultural practices by 2030. "Part of regenerative agriculture is reducing soil disturbance, and so within commercial limits, we want to enable growers to achieve that," he concludes.

where we have the potential for cloddy soil, so sandy clay loams or heavier, where fixed tine tillage would not create enough fine tilth,” explains Mark.

The STIR value for that system is just 40% of conventional establishment with work rates almost doubled while using two-thirds of the fuel.

Using the prototype Grange toolbar with low disturbance tine following a cover crop reduces tillage intensity to just 15%, with further improvements in work rates and fuel use, while removing the cover crop brings the STIR down to just 7%.

“The key thing is work rate. If we can work soil faster, we can target cultivation into windows when the soil is in a fit state,” stresses Mark. “Coming shallower conventionally will be an improvement, but the work rate improvements from this more min-tillage approach are massive. You can plant areas very quickly.”

It may also have a knock-on impact on reducing greenhouse gas emissions (GHG), he points out. This is being measured as part of the project, although data is yet to be analysed. “Current understanding is that STIR and GHG emissions go hand-in-hand – if you move a lot of soil intensively when it’s warm and wet, you’ll get a lot of gas losses.”

Yields were marginally lower on average



Grimme has provided the project with a new Prios planter for less passive sliding and more rotating disc type action which moves the soil during ridge formation.

for the experimental systems, although they weren’t significantly different due to considerable variation between the three farms where the systems were tested in 2023. Some practical observations taken in the first year should help improve yields this season, suggests Philip.

For example, in the first year, some of the novel establishment systems were used straight into a living cover crop which created significant challenges

for both the cultivations and planting, with the cover crop holding on to aggregates bound to its root system.

“If you have a non-powered piece of kit, it’s difficult to shake those aggregates off, and form a ridge when there are big lumps of root mass glued together,” he says. “You have lumps of root ball going through a planter not designed to cope with it. It doesn’t take much for soil flow to be slowed and result in a poorly formed ridge, ▶



1,4SIGHT®



PRESERVE FIELD-FRESH QUALITY

ACHIEVE SUPERIOR PRESERVATION IN STORE BY TREATING EARLY WITH 1,4SIGHT®.

Treating potatoes soon after store loading preserves their weight and firmness, leading to higher quality and increased storage revenues

Contact us today to find out more! +44 1738 633 859 | www.dormfresh.co.uk



Potato-LITE project

▶ where tubers aren't covered properly."

Those problems have resulted in two changes for 2024. Firstly, terminating the cover crop earlier – around 4-6 weeks ahead of planting – to allow its roots to die and not bind aggregates.

"A cover crop has to condition the soil over winter to be able to use a minimum tillage system," comments Mark. "But a cover crop creates virtually all its porosity in the soil by the end of January – killing it then results in 95% of the benefit."

Leaving it until later, as well as creating potential issues with establishment in this system, also adds more workload for growers, he points out.

The second improvement is a planter which could process that type of soil better. Working with project partner Grimme, a new Prios planter has been provided with less passive sliding and more rotating disc type action which moves the soil during ridge formation, explains Philip. "It's a planter for minimum tillage and has the capability for material to flow through. Albeit, it still requires the right soil aggregation and quality, which is where cover crop termination time comes in."

Greater clearance

Another tweak was to the Grange toolbar,



The aim of the Grange toolbar is to zone cultivate where required with a leg in line with where the potatoes are being planted.

which now has greater clearance and can undertake some surface cultivation, adds Philip. "The principle with the Grange is to zone cultivate where required with a leg in line with where the potatoes are being planted. Between those deep legs the Grange can now cultivate shallowly to provide tilth. We've made a big jump forward with the improvements this season."

Indeed, Mark suggests it's difficult to

see differences across the cultivation systems this season to the extent he thinks yield differences should be unlikely.

That leaves two major challenges: harvesting speeds and efficiency, and stones. Harvesting rates in 2023 were on average 14-18% slower. "That concerns me," admits Mark. "There's no point in being three times quicker at planting if you can't get the crop out of the ground in time."

Southern Counties
**FARMING &
MACHINERY
SHOW**

2024

THE SOUTHERN COUNTIES' PREMIER FARMING EVENT

BOOK YOUR SPACE NOW!

- Meet new customers and showcase new products and services
- Manufacturers and the region's top dealers attending
- Network with potential new clients and suppliers
- Support and promote farming in the South of England to a wider audience

6th November 2024 at Newbury Showground

For more information and to request a media pack,
call **07501 228882** or email: **southerncountiesshow@kelsey.co.uk**

Register for free as an attendee

southerncountiesmachineryshow.co.uk

LIMITED
AVAILABILITY
- RESERVE
TODAY!

BROUGHT TO YOU BY:

AGRICULTURAL
TRADER.co.uk

profi

cpm

SOUTH EAST
Farmer

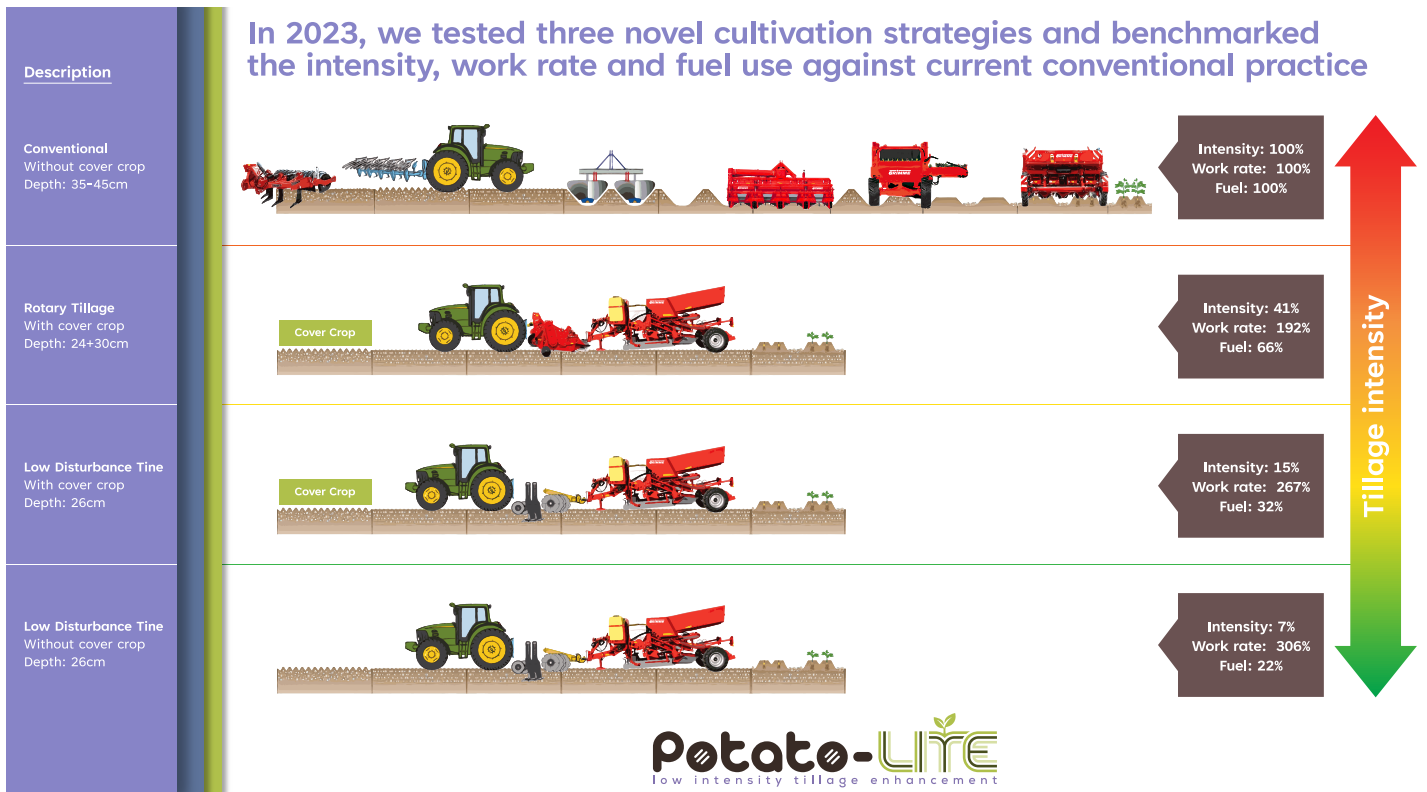
AUCTION SPONSOR:

Symonds
& Sampson

SHOW SPONSORS:

OMEX

KÖCKERLING



The Potato-LITE project has tested three novel alternative establishment methods to benchmark intensity, work rate and fuel rate against conventional practice.

Beet moth pressure concerns

Warm, dry weather in August which caused sugar beet canopies to wilt and open has led to the re-appearance of beet moth, growers heard at BBRO's BeetField24 events.

Furthermore, low levels of beet moth have been present for the past couple of months, reported Prof Mark Stevens, BBRO's head of science. "We know numbers started to move around six weeks ago, but during the last week where the canopy has gone down [due to wilting in warmer, dry weather] it's opening up hearts for the adults to get in and start to load their eggs," he said.

"If you walk in tramlines or where there are any flat patches on farm, which clearly has been the case on lighter land, keep an eye on it as we don't want the situation we had in 2022."

This season was different, he stressed, as there hadn't been a prolonged drought, but continued warm and dry autumn conditions would favour the spread and development of the moth potentially into early October, while rain and cooler weather would slow or halt it.

Check sugar beet crowns for caterpillars feeding – early symptoms can resemble boron deficiency or downy mildew – and control if necessary, he said, although be aware that using a pyrethroid insecticide has consequences on beneficials and high water rates are required as there's only limited evidence of efficacy.



Warm, dry weather in August has led to the re-appearance of beet moth.

Currently, there's no threshold for treatment, which BBRO is working on providing as well as trying to identify alternative approaches for beet moth caterpillar control.

A second moth, Silver Y, has also caused some sporadic damage in factory areas this season, added Mark. "I believe these moths are now overwintering not just on the south coast but potentially around the East Anglian coastline."

With the potential for a second generation, it also requires keeping an eye on, he said. "There's a threshold for treatment of five caterpillars per plant, again with pyrethroids, although we do have to look at alternative chemistry."

Last year's results had an element of drivers being a little cautious about what they might find and perhaps in future could go quicker, he suggests. But ultimately, not destoning where required will always create harvesting issues. "There's not much harvester drivers can do if they pick up stone – it will damage the crop and harvesting will be slower."

While in the trials in 2023 there wasn't any consistent bruising difference between systems, the exception was on very stony sites where higher levels were seen which Mark says is pretty obvious.

On those types of sites, destoning is likely to be required. But commercially, destoning depths have started to reduce – finished beds of 28cm depth are becoming more of a standard than 35cm – following research by Mark and Philip.

The project is also looking at whether alternative destoning techniques could be an option – understanding the stone content of soils is going to be critical for knowing what establishment system is most appropriate, says Mark.

"We don't know what the minimum stone content should be to advise growers whether they should destone or not."

With the ultimate aim of creating a decision support tool for growers to use to decide on cultivation strategy, such an ability will be vital to enable the right advice to be followed, he concludes. ■