> *"PPO products were 2-4 days slower in killing leaves than Reglone."*

AHDB

from theory to field

To flail or spray?

It's all change this autumn as far as desiccation strategies are concerned. *CPM* investigates the alternatives to diquat and finds out their possible effects on crop management decisions and costs.

By Lucy de la Pasture

Since the news that diquat was being withdrawn, work has been going on apace to gather information on alternative desiccation methods. In just a few months, many growers will roll out burn-down strategies that are very different to the one they've been used to.

AHDB has been funding research that is pulling together agronomy and desiccation decisions, as well as making sure there aren't unintended consequences from a change in desiccation regime when it comes to harvesting and storage. The guidelines developed will help take some of the unknowns out of the equation, explains AHDB's Joe Martin.

The research has been led by Dr Mark Stalham, head of NIAB CUF, and took place at five sites in Lincolnshire, Suffolk and Dundee. It also incorporated the AHDB's SPot Farm demonstration sites in Somerset and Shropshire to give a geographical spread across the UK.

Mark explains that the desiccation trials included different varieties and targeted vigorous, complete canopies at close-to commercial defoliation timings to replicate the challenge growers face in the field. The work evaluated the speed of leaf and stem desiccation and skin-set, as well as any effects on yields, internal defects and disease in both ware and seed crops.

Performance evaluated

The two active ingredients currently approved for desiccation are both protoporphyrinogen oxidase inhibitors (PPOs) — Gozai (pyraflufen-ethyl) and Spotlight Plus (carfentrazone-ethyl) — which have previously had a role primarily as stem desiccants. Their performance was evaluated in different sequences alongside the unapproved alternatives, Finalsan (pelargonic acid) and Saltex (brine product), and compared with diquat and undefoliated control treatments, he explains.

As growers contemplate their options, many have indicated they'll move to a flail and spray system because neither PPO is as effective as diquat at removing the foliage. Mechanical flailing using tractor-mounted flails was included in the research to investigate performance and a hand-simulated haulm puller was applied to the seed experiments to mimic commercial practice, explains Mark.

"Flail and haulm-pulling produced instant leaf removal, but stems were difficult to cut to the required length on the indeterminate variety Royal, which had the effect of slowing stem desiccation. There was no regrowth from flail or haulm-pulled treatments at the sites in England, but some did occur in the two sites in Scotland."

Re-growth and compaction from additional wheelings are two of the problems often associated with flail operations and compaction was observed in the trials, notes Mark. "With the soils generally being wet at T1, there was significant soil compaction in the wheeled furrows and edges of ridges following flailing, particularly on the silty clay loam soils.

"The level of compaction observed would increase the risk of bruising at harvest owing to clods," he adds.

"Diquat performed as expected and was the most effective chemical in removing ▸

Mark Stalham describes 2019 as a kind season for desiccation so the differences between strategies may be more pronounced in a difficult season.

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Research agronomist Jonathan Holland of James Hutton Institute in a flailed plot at the desiccation trial in Invergowrie last season.

▸ leaves. Saltex was as effective as Reglone (diquat) under hotter, brighter conditions and there was rapid leaf wilting in most experiments," highlights Mark.

"Spotlight and Gozai were both similar in terms of leaf kill, but in general these PPO products (applied individually or in combination) were 2-4 days slower in killing leaves than Reglone."

Greater varietal differences in the speed of desiccation of stems were observed in the trials, but the efficacy of different chemicals followed the same pattern as for leaf death, he points out.

"There was no advantage of one PPO product over the other and tank mixes were not additive in their effects. There was also no advantage in using one PPO in sequence with the other, or in the order in which they were applied.

"Most chemical treatments were made in two applications and no benefits were noted from a third application two weeks after the initial one, but there's more work to be done on timings of the PPO desiccants to improve their efficacy," he notes.

Finalsan (pelargonic acid) was the slowest to act on leaves across all experiments and often had some leaf area left when skins were close to setting — something that could have devastating consequences.

"Allowing leaf material to remain or the slow death of leaves is clearly a risk for alone. If growers are moving to a flail and spray system from a diquat-alone system, then for a two or three-section flail and Spotlight growers will see a 205% or 211% increase in their costs.

"Where a two-section flail and spray regime is already being used then substituting the diquat for Spotlight costs around 13% more," he explains.

"Ultimately the regime growers will use will depend on their circumstances and the market for the crop. Diquat gave more reliable desiccation than Spotlight/Gozai combinations and, because of the risk associated with relying totally on PPO inhibitors, many growers will use flail followed by spray, even when the soil is wet."

Key recommendations for 2020

So what are the practical recommendations from the trials that will support growers' decision-making processes this season?

Temperature can play a part when applying PPOs, says Mark. "At T1/T2, sprays were mostly applied during moderate conditions (16-18°C) during mid-late morning. Time of application for Spotlight/Gozai was more crucial later in the season when it was cooler. We've found it's best to aim for early to mid-morning application to give the chemical maximum time to kill cells."

Soil moisture at the time of desiccation plays a part in the speed of skin-set. "Most sites were desiccated with wet soil in 2019 and it would be expected that this would result in slower skin-set than in dry soils."

Variety can also have a big effect. "In the trials, Royal had not set its skin at four weeks after initial application or defoliation. Stem desiccation in this variety delayed skin-set despite the fairly rapid loss of leaf cover after desiccation or flailing, indicating that it depends on a combination of factors, not just leaf death," he comments.

Nitrogen management will be crucial. "Crops which had signs of active senescence (ground cover <98 %, lodging, brittle leaf texture and paler green colouration) responded rapidly in terms of leaf death when chemical desiccation took place. Where crops did not demonstrate these symptoms, leaf death was more prolonged."

Neither of the PPO chemical desiccants are as effective at removing the haulm as a flail.

The economics of desiccation

The loss of diquat means that desiccation will become a more expensive process for everyone. AHDB economist Mark Topliff has been assessing the likely costs of different approaches to establish just how much inflation of costs there will be for growers in 2020.

"The two common desiccation regimes have been either flail and spray (2.5 l/ha diquat) or a split application of diquat (total 4 l/ha). We've compared that with an all-chemical treatment using two applications of Gozai (total 1.6 l/ha) and one of Spotlight (1 l/ha) and a regime where the flail is followed by an application of Spotlight (1 l/ha)," he explains.

The maths shows that for growers already using a flail and spray regime, the increase in cost isn't as significant as for those moving to a flail and spray regime or sticking to a chemical approach.

"Using the Gozai and Spotlight sequence works out at 151% higher than using diquat

Economic analysis of different strategies

Cost (£/ha)	Diquat only	2 section flail and diquat	3 section flail and diquat	2 section flail and Spotlight	3 section flail and diquat	Gozai and Spotlight
Chemicals	28	18	18	38	38	100
Application	30	15	15	15	15	45
Flailing		124	127	124	127	
Total	**58**	**156**	**160**	**177**	**180**	**145**
Difference to diquat only costs				119	122	87
Difference to 2 or 3 section flail and diquat costs				21	20	-11

Source: AHDB, 2020

A member of NIAB TAG staff applying a desiccation product at a SPot North demonstration farm.

late blight, particularly tuber infection, so growers must be aware of the slower kill in relation to blight control programmes if it gains approval for use as a desiccant," warns Mark.

One of the key observations from the trials was that, despite the differences in canopy death across treatments, there were only small differences in the time taken from initial defoliation until the tubers were judged suitable for harvesting.

Defoliating hastens skin-set, but not always immediately, points out Mark. "Leaving the crop to grow-on slowed the achievement of adequate skin-set for harvesting. However, chemical or mechanical treatments didn't always have an effect on skin-set two weeks after the initial spray or mechanical treatment.

Taken across all experiments and demonstrations, Spotlight/Gozai combinations were slightly worse in terms of skin-set at three weeks post-T1 when compared with Reglone, flail or haulm-pulling.

"This would only equate to 1-3 days delay in reaching a condition suitable for harvesting. Haulm pulling in the two seed experiments resulted in the fastest skin-set, with flail intermediate between pulling and chemical (but not significantly different to either)."

The slower kill-time for Spotlight/Gozai gave a slightly greater yield increase after application compared with Reglone. "This would be unlikely to have a major impact on main-crop but there could be implications for seed or salad crops, so keep an eye on specs," he suggests.

"Where the crops were defoliated when canopies were just beginning to senesce naturally, skin-set was rapid, in some cases within two weeks. This canopy state is clearly the target for nitrogen and irrigation management so that skin-set is achieved as rapidly as possible."

The incidence and severity of vascular browning, stem-end necrosis and stolon adhesion was low and related to variety, but there was no effect from defoliation method, chemical or timing. The same was found to be true for the incidence of tuber rots or blemish diseases, either pre- or post-storage, he comments.

Despite differences in the speed of canopy death across treatments, there were only small differences in the time taken to reach skin-set.

Last season was widely noted as being kind for desiccation and Mark says this was the case for most of the sites. "The relative ranking of different methods should, however, be maintained in a more difficult year, although the differences might be greater than in 2019," he adds. ■

Research roundup

AHDB Project NO 11120038 'Potato desiccation', ran from Apr 2019 to Mar 2020 and was led by NAIB-CUF at a cost of costing £77,373. Syngenta and Certis were commercial partners.

From Theory to Field is part of AHDB's delivery of knowledge exchange on grower-funded research projects. *CPM* would like to thank AHDB for its support and in providing privileged access to staff and others involved in helping put these articles together.

Not a straightforward decision

The loss of diquat is a massive blow to the potato industry, says Will Gagg, manager of RJ & AE Godfrey, AHDB's strategic potato (SPot) farm in the North. He points out that the decision on how to replace diquat in the desiccation strategy isn't necessarily a straightforward one — opting for flailing before desiccating could create a nightmare for harvesting on heavy soils in wet autumns, such as in 2019.

The farm has been hosting some of the trials carried out by Mark Stalham which has given Will a good insight on the desiccation options in a post-diquat world, looking at both approved chemistry and potential candidates.

"We have been impressed by the trials, surprised and pleased with some results but disappointed by others," he says.

He had been expecting more from pelargonic acid, but despite observing differences in the haulms within just twenty minutes of application, desiccation did not then go any further. On the other hand, Saltex performed better than he had expected.

"This is good news as it is readily available as a fertiliser product and has limited effects on the next crop. This is an area we certainly want to follow up next year," he says, adding that it isn't approved by Chemicals Regulations Directorate (CRD) for use as a desiccant.

He notes that the trials showed that the PPO desiccants, Gozai and Spotlight Plus worked efficiently, although he doesn't feel Spotlight opened up the crop enough on his farm.

"We need to do more research into later applications of desiccants, perhaps repeating the same trials next year but desiccating indeterminate varieties in Sept or Oct."

Will says canopy management is going to be important to achieve good desiccation and he's been cutting back on the amount of nitrogen applied to crops, which has been the message from Mark's research for many years.

Will Gagg has been getting a unique insight into different desiccation strategies on his farm in North Lincs.

"On some varieties I plan to cut right back on nitrogen so that we can kill the plant more easily. I think the flail we've invested in will cope, however if we were going solely down the chemical route to desiccate, it's something I'd look at even more closely," he says.