

“ We’re confident when growers use the PET system, they’ll see fry colours as good as they get with any other product. ”

SPot store event

Could ethylene finally be used safely in crisping and chip shop potato stores? CPM hears about advances in its use at a GB Potatoes SPot store event, run in conjunction with Potato Storage Insight and SDF Agriculture.

By Mike Abram

New technology that introduces micro-doses of ethylene into potato stores is being claimed to overcome the impact on crisp and chip fry colours — one of the main drawbacks of its use in those sectors — while still maintaining sprout control.

Ethylene is a naturally occurring plant growth regulator and, when maintained at suitable levels in stores, inhibits the elongation of sprouts. Since the loss of approval of chlorpropham (CIPC), it’s emerged as a relatively cheap alternative for packing and in some processing stores.

But concerns over darker fry colours have ruled out its application in potatoes destined for crisping or for use in fish and chip shops.

Such darker fry colours are caused when ethylene stimulates increased respiration rates in the potato, resulting in a sugar spike when starch is converted into reducing

Evolving ethylene

sugars. When the potatoes are fried, a chemical reaction occurs between those sugars and amino acids to produce a characteristic browning.

If the sugar level is too high in crisps and chips, that reaction goes too far beyond the desired pale golden colouring and consumer acceptance diminishes.

Ethylene detection

Research from the 1970s revealed there was an intrinsic link between tuber respiration and initial ethylene concentration, but it hasn’t been easy to manage because potatoes can detect ethylene at lower levels than the best currently available sensors can detect, explains Paul Coleman, director of technology for ethylene system supplier, Restrain.

“That’s why a lot of the time where fry colour hasn’t been great after the use of ethylene, it’s because of the way it’s been introduced,” he continues.

Both Restrain, which converts liquid ethanol into ethylene in a generator, and Biofresh, which pumps bottled ethylene gas into store through its ethylene management unit (EMU), use a ramping up system to introduce initial low doses of ethylene into the store before achieving the concentration required for sprout control.

The idea is, that helps the potato to acclimatise to the ethylene, reducing the impact on respiration rates and therefore reducing sugar production within the tuber. But the limit on being able to detect ethylene has knock-on constraints in being able to

control the change in respiration rate in tubers.

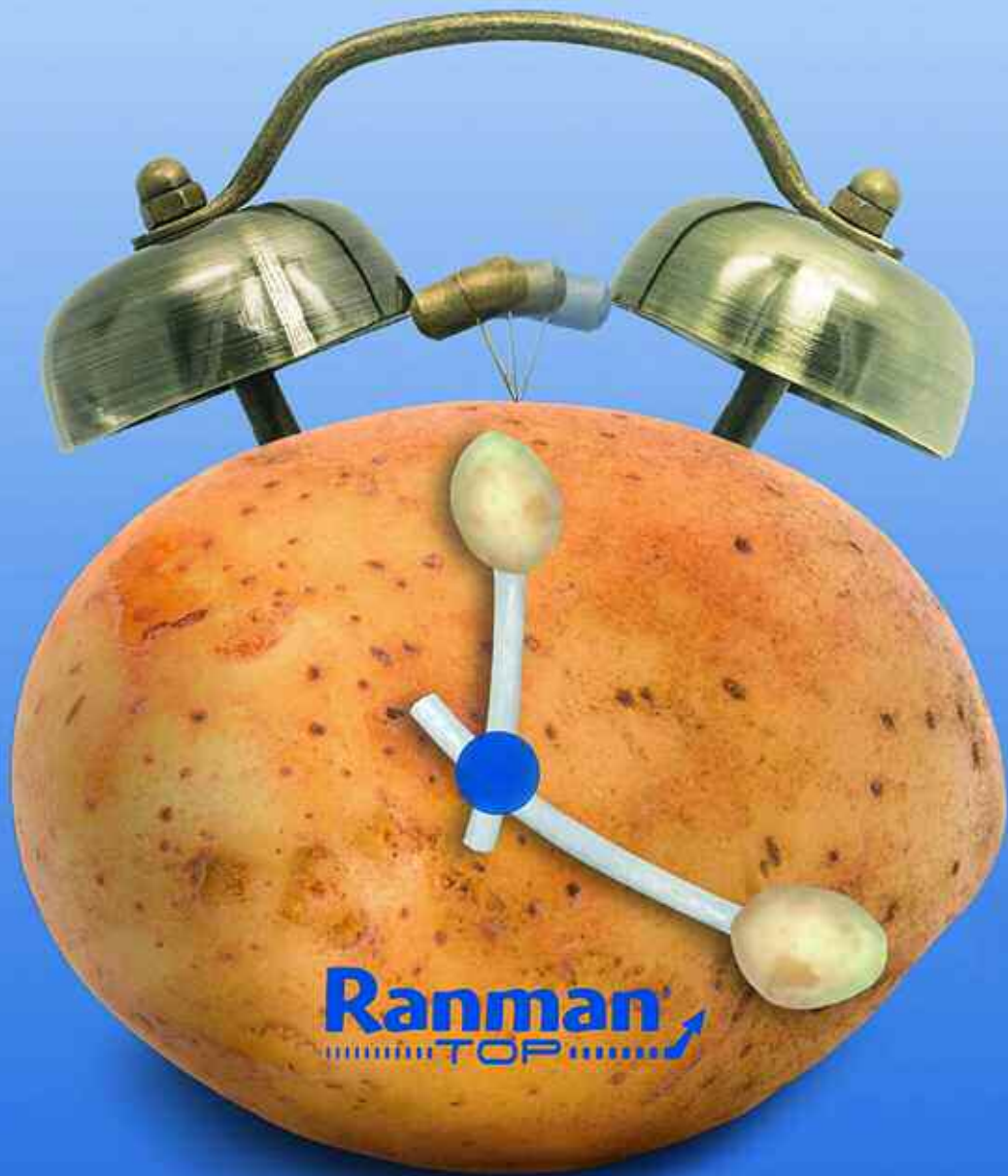
“The challenge has been how do you introduce parts per billion of ethylene into stores, rather than parts per million,” says Paul.

But now, Restrain technical manager Adrian Briddon has created a way of delivering such super low doses into stores using the software and technology in the Restrain generator. “This software delivers micro doses of ethanol into the generator, which produces ethylene at just parts per billion level into the store,” explains Paul.

“We can’t detect it with sensors, but the ▶



Potatoes can detect ethylene at lower levels than the best currently available sensors can detect, explains Paul Coleman.



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SPot store event

► potatoes detect it. Each day we build that up so the potatoes receive a slightly bigger dose but the respiration rate isn't reacting, you achieve a much flatter ethylene respiration response rate."

The process takes around a week and is now fully automated and the same for all varieties. After a week, Restrain's conventional slow-start ramp-up begins when the ethylene concentration has reached the sensor's lowest detectable level of around 0.1ppm. That slowly increases to 10ppm — the level required for sprout

suppression — during a period of 21 days.

But in comparison, the new Precision Ethylene Technology (PET) system starts at levels around a 100-fold lower, says Paul. "It's a tiny amount of ethanol going in, but the clever thing is we can control it, which we weren't able to do in the past."

Trials on three crisping varieties, selected because they respond to ethylene by producing higher levels of sugars, show much better results than using ethylene without PET through PepsiCo fry test protocols.

"For example, the new variety VR808 can be fried without any concerns for colour using the PET system, and also SCH1010 which again now looks superb for fry colour."

The results are equivalent to potatoes stores treated with 1,4Sight (1,4-dimethylnaphthalene), he adds.

These trials, however, have been conducted on crisping varieties stored in French fry processing stores, admits Paul. "These are 20°C colder than what the crisping industry uses, so we'd like to get some potatoes in crisping stores treated."

The outcome of a difficult storage season



A thermal imaging device can help to analyse insulation breaks or inefficiencies in store, says Adrian Cunningham.

Observations from one of the most difficult potato storage seasons in recent times include the importance of good air systems for drying potatoes quickly after harvest, says Adrian Cunningham.

"The value was crystal clear — if you don't have enough air in your store, you're at risk of losing a crop in a wet season.

"Some crops went into store and came out again within a matter of weeks because they were too wet. You can't store wet potatoes so you have to get them dry, and therefore require a way of forcing air through them and getting the moisture out," says Adrian. "If you don't, then you're on a down slope pretty quickly."

Positive ventilation systems, such as the Aspire system for boxes demonstrated at SPot store event host Winters Lane Storage, near Long Sutton, showed their worth, he notes.

"Aspire is a positive ventilation system where the air comes out over the top, falls into a gap either side of the boxes. It goes into the potatoes down those lines, and is then drawn across the boxes so you get lateral air

movement across the store," explains Adrian.

This season, the store was loaded late with a wet crop lifted after weather broke in mid-October. A high rate of airflow was used to dry the crop aggressively, which had been treated in-field with maleic hydrazide, before being run at a temperature of 3.5°C with Biofresh ethylene applied.

While energy use in the store was relatively high at 115kW/t during the season, only 17 boxes from 400 were lost to rot, he says. "If those boxes had gone into a different store without positive ventilation, I think the outcome would have been catastrophic."

Investment in improving stores should, in theory, be made a little easier to justify with current higher potato prices, suggests GB Potatoes chair, Mark Taylor.

"Off the back of some better prices, the industry has a little more confidence again, but it's important we stop lurching from one season to the next and start thinking longer term.

"Our cost base is still considerably higher than pre-2021, so we do require the market prices we see today. Those prices are required to reinvest in our industry, for example, in storage assets that are generally getting older. We store around 60% of the national crop so it's something we have to get right," continues Mark.

A thermal imaging device — an iPad with a camera attached — can help analyse insulation breaks or inefficiencies in store, adds Adrian.

"That's crucial when we work out how many kilowatts we're going to use, as that equals money. Cutting down on excess leakage or temperature loss helps to prevent fridges running longer and higher electricity bills. We have a lot of older stores that we have to know how to upgrade."

One example of an older store being relatively simply upgraded was at the second host site for the SPot storage event at a store being used by S&S Pugh in Gedney Dyke. An old ambient store it was converted to an overhead throw



According to Mark Taylor, investment in improving potato stores should be made a little easier to justify with current higher potato prices.

Photo: Mike Abram.

refrigerated store for the fresh market 20 years previously, explains Adrian.

Upgrades to the store include a new controller installed by Crop Systems which allows data to be relayed to the store manager's phone rather than being under simple regular thermostat control. "Just by changing the controller you can make a difference in the way you operate the store on a daily basis," he says.

Other upgrades have been adding a secondary door inside the main door, which seals the aperture completely, and a fresh air flush as it's now storing processing crops that helps to regulate CO₂ levels.

An upgrade Adrian would like to see is an improvement to air flow from the vertical discharge ducts. "This store has no curtain, goalpost or plenum, and looking at the roof you can see dust where the airflow is ending up — not clearing the first beam.

"That's common in overhead throw stores and requires some air straighteners to get air thrown to the back of the store," he concludes.



Simon Faulkner is unsure whether a micro-dosing approach will be enough to persuade crisping potato growers to change to ethylene. Photo: Mike Abram.

Ethylene use in potatoes stored for French fry output is much more accepted, with McCain comfortable with its use. “The big difference between McCain French fries and chip shop chips is in a French fry factory they blanch the potato — wash it in hot water. That removes the sugar from the outside and helps to create the crispy texture. It’s then allowed to dry before frying and that process reduces fry colour risk.”

Despite the lack of testing in commercial crisping or chip shop potato stores, Paul believes the PET system will prove to be a big step change which will remove grower concerns surrounding fry colour in both the crisp and chip shop sectors.

“We’re confident when growers use the PET system, they’ll see fry colours in the chip shop and for crisps as good as they get with any other product.”

Industry experts agree the ramp-up procedure is crucial for best results from ethylene. Potato agronomist and storage expert Simon Faulkner from SDF Agriculture has been using a less sophisticated process of using a ‘sniff’ of ethylene in processing stores before turning the production off for four or five days and then starting a ramp up.

That’s worked well, he says. “It does appear a small application is beneficial to controlling fry colours — I’m getting enough dose in to acclimatise the potatoes before ramping up.”

Convincing growers

He’s slightly more cautious about whether a micro-dosing approach will be enough to persuade crisping potato growers to change to ethylene, however. “I think growers remember some of the issues they had with ethylene when it was first introduced, which caused quite a lot of crop downgrading or loss.

“So they’re likely to be cautious. At some point, someone will ask about whether a company will underwrite its use, which opens another can of worms about how the store is managed, so it’s quite difficult.”

Potato Storage Insight’s Adrian Cunnington says micro-dosing is a good way to take ethylene forward. “The big issue we’ve had with ethylene is that its application



The SPot store event was hosted by GB Potatoes, Potato Storage Insight and SDF Agriculture.

was too clunky, especially before the ramp was brought in. Now they’re trying to refine it to get the ramp working better.

“The principle is right, because tubers react to too much ethylene — it’s like giving you a shot of adrenaline.”

Even so, he too thinks crisping and chip shop growers will remain reluctant to use ethylene. “The chip shop market has dabbled with ethylene and come unstuck so that’s not where you want to be. We want a little more confidence before giving people recommendations.”

He also believes there’s a desire for an earlier and better testing system for assessing ethylene risk in varieties. “Varieties are introduced into the market and then it’s thought whether to use ethylene. That’s the wrong way round — we should do the ethylene work earlier in the process so you can establish whether the variety works with ethylene or not,” suggests Adrian.

A potential alternative to managing the sugar spike in tubers with ethylene is to use recently approved 1-methylcyclopropene (1-MCP).

“It’s an ethylene blocker that’s supposed to inhibit the sugar spike,” explains Simon. “You apply it as 1ppm. Allow the crop to settle down; cured and down to your holding temperature and then apply it as a single dose before you start the ethylene treatment. It costs around £6/t.”

A trial he conducted on behalf of GB Potatoes for the SPot storage event in Lincolnshire compared the in-store use of 1-MCP in combination with ethylene, with 1,4Sight across a range of processing varieties. A fry test was then conducted on each variety.

“There was a difference in fry colours between the two, but it was very subtle,” says Simon. “The question is whether growers want a marginal difference for a cost of £6/t,” he concludes. ■

Residue data still required

Store managers are being asked to submit CIPC residue data to the CIPC Residues Monitoring Group (CRMG) to help prevent the Maximum Residue Level for the product being set to the limit of quantification (0.01 mg/kg).

Residues left in potato stores following CIPC use were reduced substantially by intensive store cleaning in the initial years following its withdrawal, explains Mark Taylor, chair of GB Potatoes. “But we’re still dealing with the legacy of decades of use of CIPC.”

Good store management, including the continuation of cleaning regimes, exposing boxes to sunlight and ventilating stores will all help residues dissipate, says Mark.

However, the Chemicals Regulation Division is asking for evidence that good management is reducing CIPC residues. It set a temporary MRL of 0.35mg/kg in April 2024, which is

workable, but it’s only for a limited time period, according to Mark.

“European store managers have started to reduce their levels and CRD is saying to the industry we’d like the UK to demonstrate residues are reducing. So we require the data.”

Data from at least 120 stores has been requested by CRD to be received by August to prevent the MRL being lowered to the limit of quantification, which would make previously treated stores unusable.

“At the moment we’re only about 50% of the way to that target so we require industry’s help quickly on this,” adds CRMG independent chair, Adrian Cunnington.

Store managers can submit anonymised CIPC residue levels from regular compliance testing to the CRMG through Adrian at PSI (adrian@potatostorageinsight.com).

Blight management

With plenty having been said about the confirmed withdrawal of mancozeb, growers and agronomists alike will be developing alternative protection strategies. But with recent regulatory changes, is this straight forward?

According to ProCam's Harry James, although alternative active ingredients are available, the rules and regulations surrounding their use, and application intervals, aren't entirely straightforward.

"For example, instead of being able to apply three consecutive applications of CAA (carboxylic acid amide) fungicides, the latest FRAC (Fungicide Resistance Action Committee) guidance is that these should be limited to a maximum of two consecutive applications," he explains.

"That's a sensible recommendation based on the loss of efficacy of this group of fungicides on the continent, with crop protection manufacturers such as Syngenta going a step further by advocating the use of mandipropamid in alternation with fungicides with a different mode of action."

Mancozeb's expiry date has now been and gone (31 May 2024) with the final date for sale and supply of all products containing the active being 31 November 2024. Furthermore, the final storage, disposal and use-up period ends on 31 November 2025.

Complications arise in that resistance to oxathiapiprolin (Zorvec) has been confirmed in some parts of northern continental Europe including the Netherlands, Belgium and Germany, as such the

post-Zorvec application interval has been reduced from 10 days to seven. It must also be used in alternation with non-CAA chemistry.

"This makes it more labour intensive and time consuming to keep crops clean especially as this key active no longer provides a curative effect," stresses Harry. "Instead, it can only be relied upon to deliver preventative activity which means sprays will have to be applied on-time, every time, for crops to remain protected.

"To avoid potential confusion, UK potato growers should seek advice from their agronomist or industry experts to help devise a suitable blight programme for this season and beyond," he adds.

Harry says growers should also be aware that although fungicide resistance hasn't yet been confirmed in UK crops, pressure remains high and is further escalated by the shortfall in British seed potatoes, meaning there's a risk of resistant strains being introduced by imported seed stock.

"The high incidence of foliar and tuber blight in continental seed crops means there's a very real risk of resistance affecting British crops," he continues. "For that reason, anti-resistance strategies — alternating modes of action and limiting the exposure of any single active — must be followed from the outset.

"Keeping a close eye on resistance updates throughout the season will be essential, as will taking professional advice to devise a suitable spray programme. Not least because the ever-changing legislative position and evolving resistance situation will make



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keeping abreast of the latest rules that much more complex."

According to Harry, growers and agronomists should still be able to achieve good levels of blight management and as a result stay ahead of the threat of resistance. "However, the key to reliable control will be adapting programmes according to weather conditions and to use forecasting tools to determine when the threat of blight is at its highest.

"Cultural controls, such as selecting varieties with better natural blight resistance and taking extra care to remove volunteer potatoes from dumps and other crops in the rotation, should also be factored into the equation.

"Nothing, however, will beat getting into the field and putting boots on the ground to assess the crop, the severity of disease pressure and if a blight infection has occurred," he concludes.



The withdrawal timeline for mancozeb has been confirmed; the product's expiry date has now passed (31 May 2024).

Confirmed withdrawal timeline	
Expiry date for mancozeb	31 May, 2024 (now passed)
Final date for sale and supply of any plant protection product containing mancozeb	30 November, 2024
Final date for storage, disposal, and use of any plant protection product containing mancozeb	30 November, 2025