REVIEW

Maleic hydrazide as a potato sprout suppressant

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AHDB SUTTON BRIDGE CROP STORAGE RESEARCH

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CONTENTS

EXECUTIVE SUMMARY

Maleic hydrazide (MH) was first identified as a plant growth regulator in the 1940s and in the early part of the following decade its activity on potato as a sprout inhibitor was discovered. It acts by inhibiting cell division but not extension of existing cells.

MH is applied to the growing crop as a foliar spray, not as an in-storage treatment; this also enables it to provide control of volunteers/groundkeepers in potato. Its capability for this was reviewed extensively by Buckley *et al.* (2006), whereas this review has focused on its use as a sprout suppressant. This is of particular interest due to the imminent loss of chlorpropham (CIPC) as the main sprout suppressant used on stored potato in Europe for the last fifty years or more.

MH use for sprout suppression developed in the US but its adoption in Europe was much slower. Its dependence on weather at application for uniform uptake by the foliage may have been a significant factor in this; early evaluations reported variable efficacy. Commercial use in the UK began in 1984 with the launch of Uniroyal's *Fazor* product, although other European countries did not have approval for MH use until up to twenty years later. In early trials, a residue of 12ppm was reported as necessary for maximum sprout control. The residue distributes evenly throughout actively growing tubers although some side effects of application have been widely reported, including yield loss and phytotoxicity. Significant yield loss is important to avoid as the economic impact is two-fold from the cost of the product and the loss of sales. Some control of secondary growth has been reported in trials but results were variable.

Timing of application is important. Applying too early reduces yield; too late reduces the efficacy of uptake and sprout control is compromised. Late July or early August application (*circa* 5 weeks before defoliation) is favoured for best results.

Reductions in the permitted treatment rates for CIPC have driven an increase in MH use in recent years. A total of 20,000 acres (15% of all crop) was treated in the UK in 2016 and there was some reversal of previously limited acceptance of MH use within fresh market crops for some markets, notably for short dormant varieties.

In recent trials investigating alternative sprout suppressants to CIPC, combinations containing MH, used in conjunction with other active substances, have performed better that the single products alone.

Combination treatments including MH were also exclusively used in commercial processing stores visited in mainland Europe in spring 2019. This included stores of up to 4000 tonnes capacity using either *BioxM* (spearmint oil) or *1-4 Sight* (dimethylnaphthalene).

In a survey for this Review of MH use in Great Britain (yielding 51 responses), 78% of users said they apply MH for sprout suppression compared with 66% for volunteer control. 95% of respondents applied MH when the foliage was more than 75% green and over half did so when the canopy was fully green. 13 of 18 respondents not currently using MH for sprout control felt they were likely to need to apply it as a sprout suppressant in future. Overall, MH received a modest score of 6.1-6.5 out of 10 for volunteer control, sprout suppression, control of second growth and its consistency of response, reflecting some of the risks and challenges its use can pose.

Nevertheless, it is evident that the performance of future sprout control options in potato storage will be much less predictable than CIPC. MH, whilst inconsistent in its own level of control, does provide an element of stability to a sprout suppression strategy – especially over the loading, drying and pull-down periods, and it was therefore a 'must-have' component of control strategies in the European processing stores visited by AHDB staff.

Current difficulties in the management of MH-treated stocks in relation to disposal of waste for stockfeed (due to a metabolite data gap) could seriously compromise the availability of the most cost-effective sprout control options post-CIPC which should include the regular use of maleic hydrazide.

Introduction

The activity of **maleic hydrazide** (MH) as a plant growth regulator was first described in the journal *Science* by Schoene & Hoffman (1949).

Work on potato took place in the early 1950s with papers published for example by Denisen (1950, 1953), Kennedy & Smith (1951), Marshall & Smith (1951), Highlands et al (1952), Paterson et al (1952) and Franklin & Thompson (1953).

Paterson et al (1952) showed that MH inhibits apical dominance. They applied sprays of 500, 1000 and 2500ppm MH to cvs Irish Cobbler and Pontiac on 4 dates July 15 – Aug 19 and Jul 15 - Sep 2 respectively. Haulm kill was 2 days after the final application and harvest 4 days after. Storage followed at 45°F (7°C) and 55°F (13°C) for 7 months. 2500 ppm MH applied 4-7 weeks before harvest resulted in almost complete inhibition of sprouting at both temperatures.

Various authors hypothesised that MH acts by inhibiting cell division, but not extension of existing cells; this was confirmed by Nooden (1969). MH is applied to the potato crop as a foliar spray in the field rather than as an in- storage treatment. As such, it is able to act in two ways: in the field as a means of volunteer/groundkeeper control and in subsequent storage as a sprout suppressant.

MH was reviewed extensively for the British Potato Council by Buckley et al (2006) in relation to its use of as a means of **volunteer control.** There will be some overlap with the content that follows but the primary focus here is to review the use and potential of maleic hydrazide as a **potato sprout suppressant**.

The need for this has been accentuated by recent changes in the likely availability of chlorpropham (CIPC) which has been subject to European review during 2018 and early 2019. Following detailed analysis of the toxicology of a metabolite of CIPC, 3-chloroaniline, by the European Food Safety Authority (EFSA), the European

Commission has recommended CIPC for non-renewal. It is likely therefore, following a series of SCoPAFF meetings to review this information, that CIPC will be lost as a sprout control option to the European potato industry before the end of 2020.

Focus has therefore moved quickly to assess potential alternative compounds for use as sprout suppressants. Maleic hydrazide is one such compound alongside others such as carvone, ethylene, spearmint oil, 1,4-dimethylnaphthalene, limonene (orange oil), 3-decen-2-one and eugenol (clove oil), many of which are now available for commercial use or are being readied for market, subject to approval (Kleinkopf et al, 2003; Daniels-Lake & Prange, 2007; Harris, 2016).

Developments in maleic hydrazide use as a sprout suppressant

The use of maleic hydrazide as a sprout suppressant option developed relatively quickly, notably in the US, with many tonnes treated in their processing industry (Sawyer & Malagamba, 1987).

In Europe, maleic hydrazide use developed much more slowly. In the UK it was restricted to uses such as growth regulation of grass, sucker growth on trees and to control onion sprouting in storage (Buckley et al, 2006).

Burton (1978), evaluating its potential on UK crops, described the use of MH at 2.5 kg/ha a.i. applied 3-5 weeks before death or destruction of foliage. He reported loss of yield and misshapen tubers if application was made too early. But it was also ineffective when applied too late. As it was reliant on take up by the foliage, weather conditions at the time of application could have a significant effect on efficacy.

Commercial use in the UK began in 1984 when Uniroyal secured a limited approval for its *Fazor* product. 'Limited commercial clearance' was given for the use of MH on 15,000 ha of potatoes (Buckley et al, 2006). *Fazor* was launched with the dual objective of providing sprout suppression during storage and reducing volunteers in the field. Some European countries did not have clearance for MH use until much later (van Es & Hartmans, 1987; De Blauwer et al, 2012)

Shortly after the UK launch, trials undertaken at Sutton Bridge (PMB 1987, 1988) assessed MH performance on crops of cvs. Maris Piper, Pentland Dell and Record across five sites. Total and ware yields from MH treated and untreated crops are shown in Table 1.

Table 1. Estimated total & ware yields after defoliation (t/ha) (PMB, 1988)

		MH treated		MH untreated	
Site	Variety	Total	Ware	Total	Ware
1	Record	41.7	37.9	46.2	41.7
	Maris Piper	57.9	49.2	48.4	42.8
2	Record	48.9	45.0	53.2	49.9
3	Maris Piper	61.3	58.0	62.1	60.0
4	Pentland Dell	38.9	37.3	43.2	38.9
5	Pentland Dell	47.3	44.4	49.8	44.7
	Mean	49.3	45.3	50.5	46.3

The mean total and ware yields from the maleic hydrazide and untreated crops were similar.

Residue data analysed as part of this series of work is provided in Table 2.

Table 2. Residues and recovery from two analyses in MH-treated commercial crops (PMB, 1987)

Crop	Yield (t/ha)	Residue (mg/kg)		Recovery (%)	
		GU	Uniroyal[1]	GU	Uniroyal[1]
Record 1	58.2	23.1	15.8	45	31
Record 2	54.0	7.5	6.4	13	12
M Piper 1	63.0	17.0	14.1	36	30
M Piper 2	58.6	5.7	3.8	11	8
P Dell	34.2	21.7	13.9	25	16

[1] Data read from a chart and are approximate. GU=Glasgow University

In reporting this work, it was noted that a residue of ‘12ppm (maleic hydrazide) was considered to be the requirement for maximum sprout control for long-term storage'. The variability of MH uptake was also clearly evident in these trials, although no data on the crop condition at treatment was reported.

Dias & Duncan (1999) assessed the distribution of residues in MH-treated tubers. They found that MH was evenly distributed throughout the tuber (peel, outer and inner flesh) but concentration increased slightly as tuber size increased. The concentration of free MH decreased from 7 to 3 mg/kg over a storage period of 5½ months. They suggested that this may be due to free MH being gradually converted to a bound form with time after treatment.

MH has not always been available for use in all countries. An example of more recent introduction of MH is in Belgium, where the compound was not brought to market until 2005. Here, field trials were conducted by De Blauwer et al (2012) over 4 seasons (2005-2008) at 4 locations per year. Application of MH was made to four cultivars (Bintje, Fontane, Asterix and Cilena). After application, cv. Asterix suffered - in virtually every year - some temporary phytotoxicity (bronze discolouration of foliage).

Yield was determined at harvest. When maleic hydrazide was applied "too early" (80% tubers 25mm diameter) yield was negatively affected (in 3 years of 4) except in the fresh market variety Cilena. Internal quality (dry matter and fry quality) was not influenced by the application of MH except in cv. Fontane, which had a slightly lower dry matter content. MH treatment also had some influence on secondary growth but the results were very variable depending on cultivar, location and time of application. After harvest, crops were held in storage and assessed monthly for sprouting. Potatoes treated "late" in the growing season were reported as breaking dormancy the earliest.

Achieving a balance between MH use to secure effective sprout suppression but doing so without impacting yield is difficult enough, but maintaining yield is important from an economic perspective as a large reduction, combined with the cost of MH treatment, could compromise the crop's economic viability. Sabba et al (2009) assessed impact on yield (Table 3) although they were able to generate few significant differences across a wide range of timings.

Table 3. Yield as influenced by MH application timing (Sabba et al, 2009)

Cultivar	Application date	Average tuber diameter at application (cm)	Total yield* (t/ha)	Mean tuber weight* (g)
Atlantic	none	control	63.1a	152.5a
	19-23 Jun	3.0	60.5a	143.9b
	12-15 Jul	4.7	61.7a	149.1ab
	5-18 Aug	5.8	61.3a	148.5ab
White Pearl	none	control	56.7a	117.6a
	12-13 Jul	3.9	50.9a	111.1a
	31 Jul – 3 Aug	4.4	52.8a	113.9a
	14-17 Aug	4.9	50.0a	111.4a
Freedom Russet	none	control	56.8a	184.1a
	12-13 Jul	3.3	60.8ab	182.5a
	31 Jul – 3 Aug	4.5	60.8ab	192.6a
	14-17 Aug	5.0	63.2b	194.4a

*Means within cultivar with the same letter within a column are not different by LSD (5% level)

Timing of application is also a crucial component of MH use, in order to get consistency of uptake and therefore efficacy. This is a key element of volunteer control (Heath et al, 1993; Appendix I) but is similarly important for treatments where the use of MH is, first and foremost, as a sprout suppressant.

In field trials in the US in 1973-5 by Weis et al (1980), using foliar applications of 3.36 kg maleic hydrazide/ha, an improvement in the quality and shape of potato tubers (cv. Russet Burbank) was observed. MH application in early or mid-July reduced the yield of malformed tubers by 40%. Applications made in mid- or late July improved the length:diameter ratio of treated tubers. Earlier MH application in early or mid-June severely reduced yield and increased the incidence of misshapes. MH provided effective sprout inhibition in tubers for all treatment dates – except when applied in early June.

MH use is challenging even without the complications of weather which can compound matters significantly. Poor uptake through the leaf will inevitably result in sub-optimal efficacy. The crop's hydration at treatment is also a vital factor as it affects uptake and impacts on the crop's reaction to treatment; in 2018 – a very dry season – many UK crops were reported to have suffered markedly following MH application due to their drought-affected condition (Tholhuijsen et al, 2018).

Temperature of storage will inevitably have an effect on efficacy as sprouting increases with temperature up to around 20°C (Burton, 1989). Maleic hydrazide, used in combination with storage temperatures of typically 7-10°C, has provided short term sprout control (2-4 months) in processing or chipping stocks – usually without any further treatment - in the UK since its introduction to the market in the 1980s (Cunnington, 2018).

In high temperature trials in India (Kaul & Mehta, 1994), efficacy of MH, applied as a 0.3% foliar spray 3 weeks before haulm cutting, was studied in four cultivars over two seasons. The harvested potatoes were stored in an evaporatively-cooled potato store (15-29°C, RH 68-90%) and at room temperature (20-36°C, RH 30-72%) from March to May. Maleic hydrazide treatment significantly reduced the mean number of sprouted tubers by 27% up to 10 weeks of storage; sprout weight was also reduced by 76% after 12 weeks' storage. The interaction between MH treatment and storage environment was significant.

One factor which has escalated the use of MH as a sprout suppressant in recent years has been a decline in permitted chlorpropham (CIPC) dose rates. In the UK, this has been largely as a result of CIPC being under stewardship since 2008 and a need to manage dose in order to maintain availability of the chemical without the risk of Maximum Residue Level (MRL) exceedance. Maximum CIPC usage dropped in processing storage from 63.75 g/t in 2013 to 36g/t in 2017 alongside a need to add 'active recirculation' to optimise use of this lower dose within potato stores (PICSG, 2017). With less CIPC at their disposal and a desire to maintain storage temperatures as high as possible - this is done to maintain a light fry colour (Cunnington, 2018) - store managers utilised more MH, in combination with CIPC, as part of their sprout control strategy; a total of 20,000 ha (*c.* 15% of all crop) received treatment in summer 2016 (Garthwaite et al, 2017). Some markets which had previously limited their acceptance of MH, lifted restrictions to permit use on, for example, high-risk short dormant varieties, such as King Edward, destined for the fresh pre-pack trade.

It is likely that the approval of chlorpropham (CIPC) will not be renewed in Europe in 2019 (T. Hofman, personal communication). Interim data from recent trials by

AHDB at Sutton Bridge (Harper, 2019) has shown that in the absence of CIPC, MH can offer good sprout control and boost the efficacy of alternative treatments (essential oils) when used in combination with them.

MH *(Fazor)* was applied to crops of five varieties (cvs. Innovator, Maris Piper, Performer, Royal and VR808) and the tubers stored at 9°C for up to 9 months. Five other crops of these varieties were also stored which did not receive MH. Samples from each of the crops were treated as follows in accordance with the relevant product label:

- CIPC (chlorpropham) [industry standard]
- Ethylene (Restrain)
- Spearmint oil (Xeda BIOX-M)
- 1,4-dimethylnaphthalene (Dormfresh 1-4 SIGHT)
- Untreated [control]
- Combination treatments were also trialled (12g/t CIPC + alternatives).

Assessments of sprouting were carried out after 3, 6 and 9 months' storage. Sprout control data is shown in Figures 1 and 2.

Fig 1. Length of longest sprout, mean 5 varieties, no MH treatment, after storage

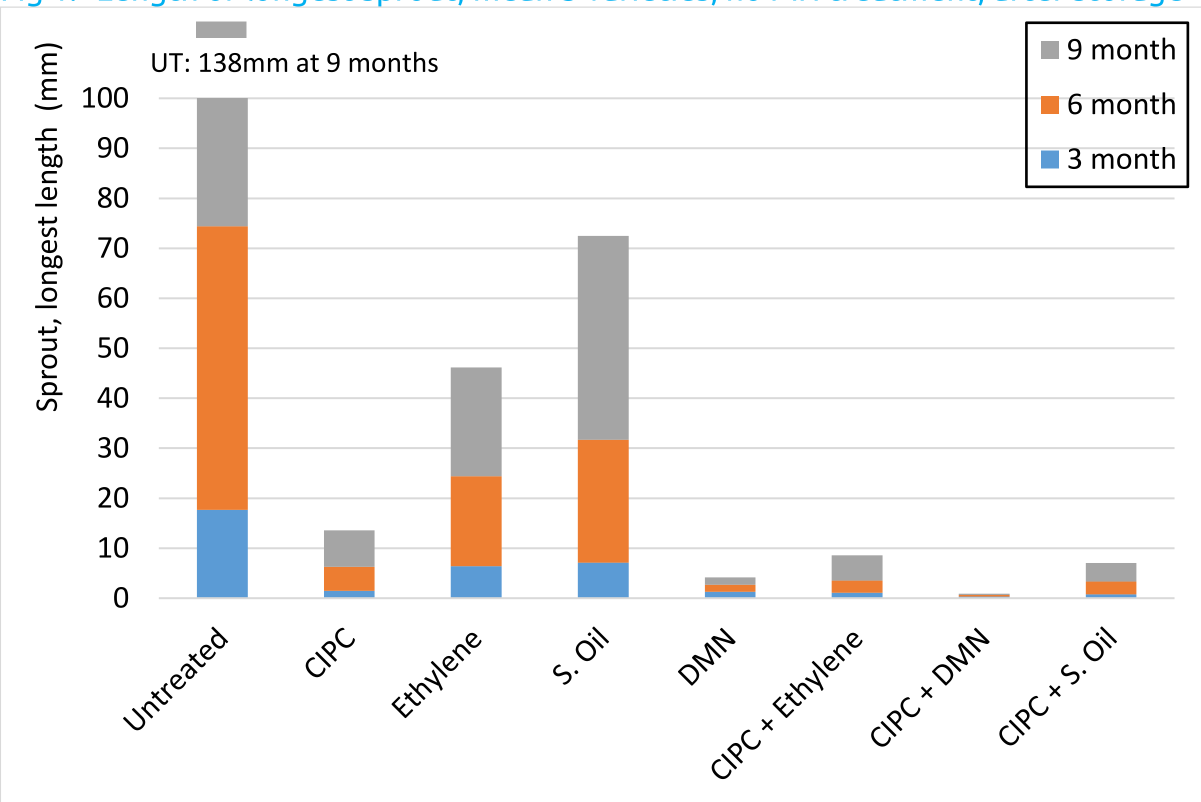
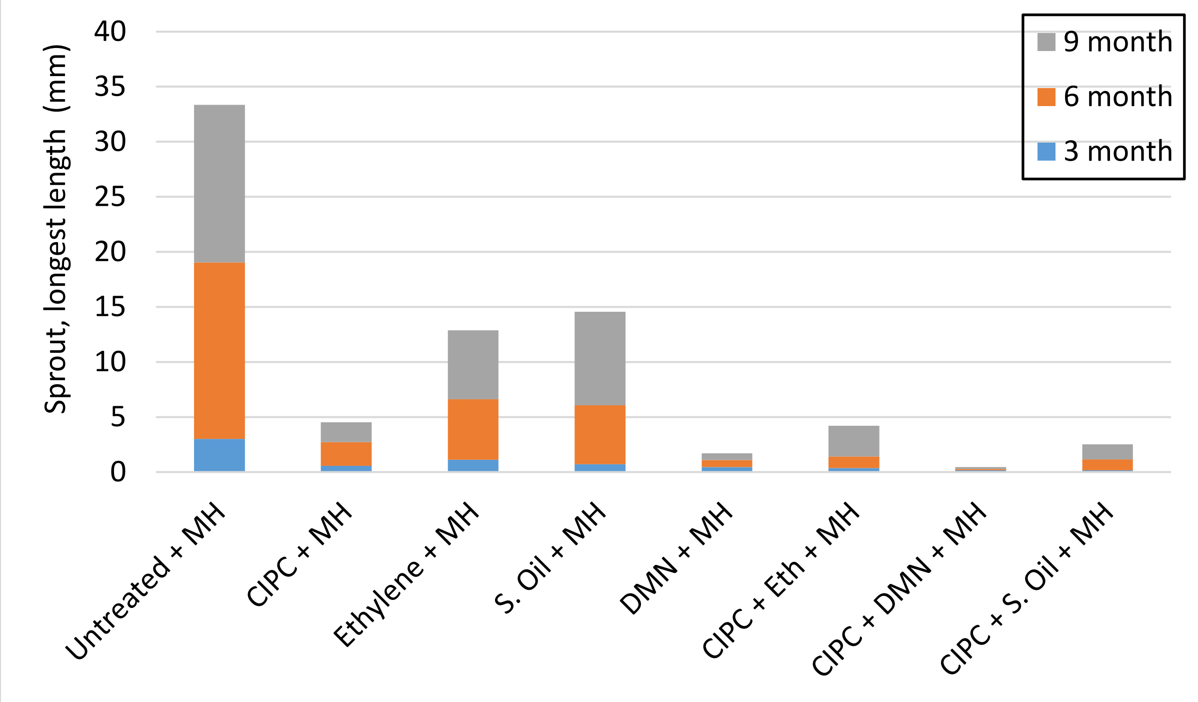


Fig 2. Length of longest sprout, mean 5 varieties, with MH treatment after storage



Additional samples were stored at 15°C to assess relative dormancy (Table 4)

Table 4. Mean days to 50% sprouting at 15°C for each variety with and without MH

Variety	Mean days to sprouting (≥3mm)
Innovator - no MH	19.6
Innovator + MH	43.3
M. Piper - no MH	18.6
M. Piper + MH	38.3
Performer - no MH	46.5
Performer + MH	91.9
Royal - no MH	26.2
Royal + MH	57.2
VR808 - no MH	37.6
VR808 + MH	68.0

In all cases MH treatment extended dormancy markedly (by at least 20 days) at the standardised test temperature of 15°C. This clearly translates into a greater effect at lower storage temperatures used for commercial storage as is evident from the data in Figure 2. NB: Crops in this study were not the same for + and – MH treatments.

Current practice in the use of maleic hydrazide

Beyond the usage data referred to above, there is very little information available about current practice – i.e. *how* MH is used. To improve understanding therefore, AHDB has undertaken a survey of major growers, agronomists and advisors on use of the active substance on potato. The survey undertaken is at Appendix 1.

Surveys were made available through a wide range of AHDB contacts with industry during December 2018 and the first three months of 2019 and a total of 51 questionnaires were returned.

A summary of key points from the survey are provided below:

- 40% of users apply MH to potato every year
- 78% of users apply MH for sprout suppression
- 72% of users apply MH for second growth control
- 66% of users apply MH for volunteer control

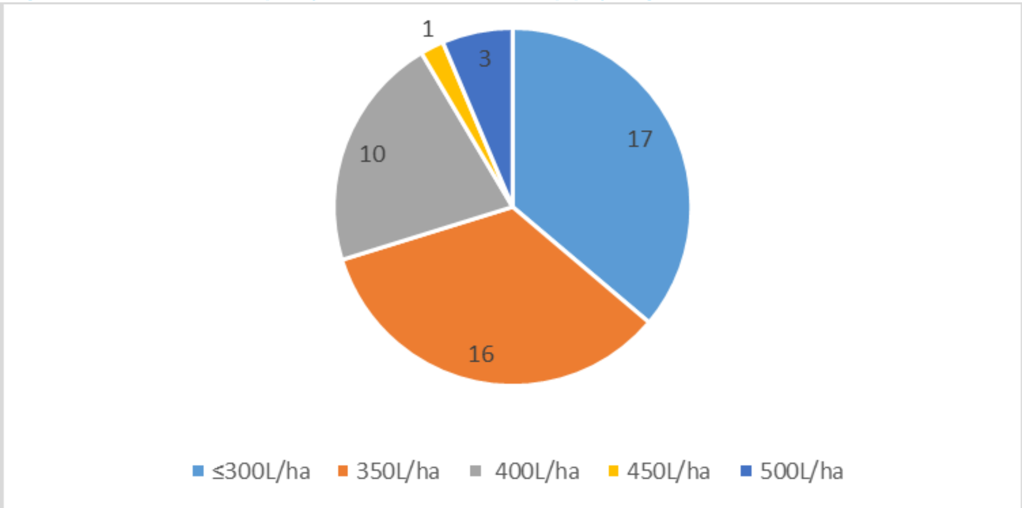
Timing:

- Respondents applied the product on average 5.1 weeks before defoliation but there was a lot of variation around this figure from 2 weeks to 8 weeks
- 88% of users timed application relative to defoliation rather than harvest

Application:

- Total volume applied varied substantially for MH treatments (Figure 3).

Fig 3. Total foliar spray volume when applying MH (n=47)



When considered alongside crop condition at application, these reflect the practicality of application alongside the need for a green crop canopy at application to ensure uptake. In this regard, 95% of respondents said they made applications when foliage was more than 75% green. Of these, 54% stated they applied MH when the foliage was fully green.

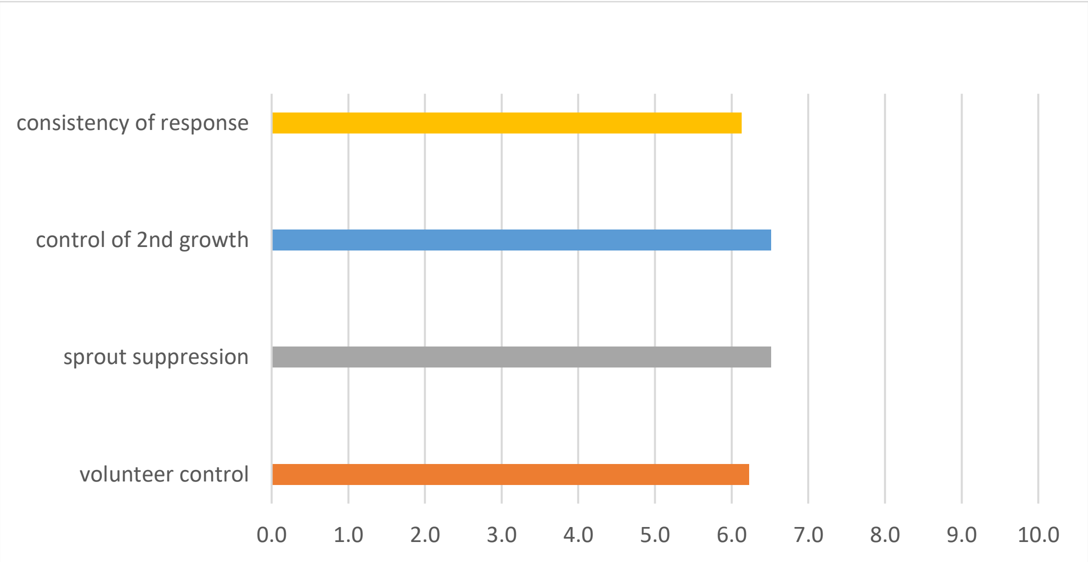
Application were typically made at a temperature of 12-23°C with no rain having fallen for at least 12 hours beforehand and no forecast of rain for at least the following 24 hours.

There was a difference of opinion on how to apply the product. 72% said they never mix MH when applying the treatment but 13% did so 'frequently'.

In a reflection of changes in the availability of sprout control options, 13 of 18 respondents not currently using MH for sprout suppression said they felt they were likely to need to use it for that purpose in future.

Finally, forty-seven of those surveyed rated MH in relation to four characteristics: its use for volunteer control, sprout suppression, control of second growth and its consistency of response. In all these respects, the chemical was given a modest rating, ranging from 6.1 to 6.5 out of 10 (Figure 4), perhaps reflecting some of the challenges it can provide in practical use and the risk associated with them.

Fig 4. Average rating (out of 10) for performance of maleic hydrazide (n=48)



In addition to this survey conducted by AHDB, researchers from Sutton Bridge Crop Storage Research undertook a short European study tour in April 2019 to assess current use of sprout suppressants in commercial potato storage supplying the processing market. A total of eleven potato stores were visited (10 in the Netherlands, 1 in Germany, *pictured below)* of up to 4000 tonnes capacity; in all cases, stores were selected as they had **not been treated with CIPC**.

Good control of sprouting was observed in the majority of stores as a result of the use of either 1,4-dimethylnaphthalene [*1,4-SIGHT*; 1,4 Group/BASF] or spearmint oil [*Biox M*; Xeda/Certis] but in **all cases this was following treatment with maleic hydrazide** (eg *Fazor* or *Crown MH)* **in the field**. Within these stores, long-dormant varieties predominated (eg VR808, Agria, Fontane, Innovator, Markies) and, for the majority of stores, temperatures were maintained at or below 8°C for long term storage. The volatile nature of the essential oils applied within the store also meant that growers were managing crops in order to minimise the need for ambient ventilation.

These observations suggest that sprout suppression going forward post-CIPC will be a significant challenge and will require a multi-faceted and integrated approach to store management and chemical treatment. It would seem that the role of MH in any such strategy could be key, especially if it reduces the need for repeat applications of expensive essential oil treatments (*circa* £3.50 per tonne per application).

On the evidence of this study tour, successful control can be achieved with some of the more volatile sprout suppressants but, in the commercial stores seen operating without CIPC, this was heavily dependent on pre-treatment with MH to give some underlying level of control should the level of volatile in the store atmosphere fall. This might be due to a range of factors such as use of ambient ventilation, carbon dioxide flushing or store leakage. This dependence could, potentially, be accentuated in circumstances of high 'sprouting pressure' or early dormancy break – eg following warmer than average growing seasons or even in areas of a store subjected to condensation.

New limitations as a result of re-registration of maleic hydrazide

The upturn in MH use - following the limitations on the use of CIPC (and its potential loss) - may well be reversed in the UK from the 2019 season as, following a review of the approval for maleic hydrazide in November 2018, there was a limit imposed on the level of hydrazine impurity permitted and a gap identified in the provision of data for residual 3-pyridazinone accumulation in meat. This has resulted in the issue of a label condition (HSE, 2018) that precludes the use of MH-treated potatoes as stockfeed.

As a result, there is the potential for MH to become subject to stewardship in the UK (approval holders are known to be discussing this with CRD/HSE) and for some supply chains to restrict their acceptance of MH-treated crops to avoid the need to segregate their waste potatoes. In the short term, it will be imperative for producers, packers and processors to consult markets prior to supply of MH-treated crop to check on its acceptability for individual outlets.

On a strategic level, however, it may be necessary to find ways to accommodate MH use more widely if it is to be a key component of many sprout control strategies in long-term stored potatoes.

Research gaps in use of maleic hydrazide as a sprout suppressant

There is a broad spread of information on the use of maleic hydrazide as a sprout suppressant but, at the same time, some of the data that are available are not very up to date or particularly comprehensive for current use.

Optimal timing of application, foliage status at spraying and rates of use remain unclear with a wide variety of strategies employed in practice by GB potato producers.

These strategies will be further muddied by the likely future use of MH in conjunction with new sprout suppressant compounds where there will also be a wide range of timing options for application of follow up treatments.

It will also be important to establish if, when MH is used with novel suppressant options, there are synergistic benefits available from the use of combination treatments.

Finally, and importantly, it is crucial to establish the underlying importance of MH in commercial treatment for processing stores. The study tour undertaken suggests that those pioneering the use of novel sprout suppressants in processing storage see MH as an important part of their future storage strategies. Clearly, if MH is to be subjected to further controls from a stewardship perspective or market acceptability is diminished, this could have a significant bearing on the quality of sprout control that might be achieved in post-CIPC potato storage.

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AHDB SUTTON BRIDGE CROP STORAGE RESEARCH

Industry questionnaire about maleic hydrazide use in potato: can we have your help please?

As part of a wider strategy to optimise our options for potato storage, we are currently reviewing the use of MALEIC HYDRAZIDE[1] (MH) as a sprout suppressant. If you have used it for this purpose, or for groundkeeper control, we would very much value your feedback. All responses will be treated confidentially.

[[1]Product names: *Clayton Stun, Cleancrop Malahide, Crown MH, Fazor, Gro-Slo, Himalaya, Itcan SL270, Magna SL, Source II*]

1. NAME (optional) ____________________

2. How often do you use MH on your crops ?

A. Never ☐
B. Occasionally ☐
C. Frequently but not always ☐
D. Every year ☐

3. Why do YOU apply MH (tick all relevant)?

A. Groundkeeper control ☐
B. Sprout control in storage ☐
C. Control second growth ☐

5.2 Suitable conditions for application

Temperature: Min ________ Max ________ °C

Rain: None for past ________ hours

Rain forecast: Clear for ________ hours

Foliage:

Rank green ☐ 50% green ☐

75% green ☐ Apply if any green ☐

4. If you choose to treat with MH, when do you apply the product? ☐ weeks before ☐ defoliation/desiccation ☐ harvest

5.1 If you choose to treat with MH, at what volume do you apply the product?

A. Foliar spray at 300 L/ha ☐
B. Foliar spray at 350 L/ha ☐
C. Foliar spray at 400 L/ha ☐
D. Foliar spray at 450 L/ha ☐
E. Foliar spray at 500 L/ha ☐
F. Other volume rate (specify) ________ L/ha
G. Don't know ☐

5.2 Please fill in what you consider to be suitable conditions for application in the blue box

6. Do you tank mix MH at application? Always ☐ Frequently ☐ Occasionally ☐ Never ☐

If yes, what do you mix it with? ____________________

Please answer Q7 - 8 using the scale 1= very poor to 9= very good:

	1	2	3	4	5	6	7	8	9
7.1 How good do you think MH is for volunteer control?	1	2	3	4	5	6	7	8	9
Why?									
7.2 How good do you think MH is for sprout control?	1	2	3	4	5	6	7	8	9
Why?									
7.3 How good do you think MH is for control of second growth?	1	2	3	4	5	6	7	8	9
Why?									
8. How is the consistency of response you get to MH treatment?	1	2	3	4	5	6	7	8	9
Why?									

9. Do you use the product on all potato crops or target its use to specific crops (tick all relevant)?

A. Policy to treat all crops ☐
B. Treat specific varieties ☐
C. Treat specific maturity of crop ☐
D. Treat crop according to defoliation status ☐
E. Use depends on crop yield/size distribution ☐

What other factors influence your decision to use or not to use maleic hydrazide?

10. If you don't currently use MH for sprout suppression, do you anticipate you may use it in the future? Yes ☐ No ☐

Why?

11. Finally, would you be willing to receive a follow up call about this questionnaire? Yes ☐ No ☐

If yes, what number is best for us to call?

what is the best time for us to call?

Please return the questionnaire to the address below or by email to emma.bates@ahdb.org.uk

Thank you very much for your assistance

AHDB
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