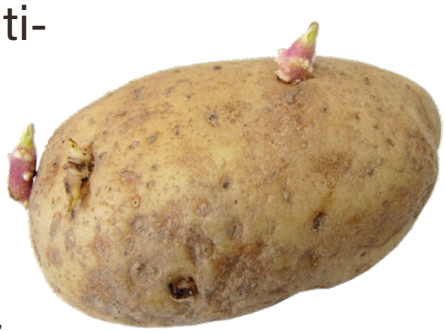
Assessment of pre- and postharvest anti-sprouting treatments to replace CIPC for potato storage



What's it about?

Unless it's being planted, nobody wants a sprouted potato. However, sprouting becomes almost inevitable as tubers reach the limits of dormancy. This is an issue if trying to match supply with processing capacity, in which case extended storage may be needed.

Premature sprouting accelerates shrinkage, decreases turgidity and reduces both nutritional and processing properties. Low temperatures reduce ageing and, therefore, tuber sprouting. However cooling is limited by cold-induced sweetening, which negatively affects flavour and colour.

Stored chipping potatoes. Photo by Bert Jansen.

The most effective way to prevent sprouting is treatment with chlopropham (CIPC), which has been used commercially since 1951. However, in 2019 the European Union banned its use due to potential risks to human health from CIPC and its breakdown products.

A number of alternative methods to control sprouting are used in other countries. For example, maleic hydrazide (MH) is registered for sprout control in Australia under a number of different trademarks. Unlike other methods, it is sprayed on the crop during tuber formation. The product has also been used to abort small tubers, but with mixed success.

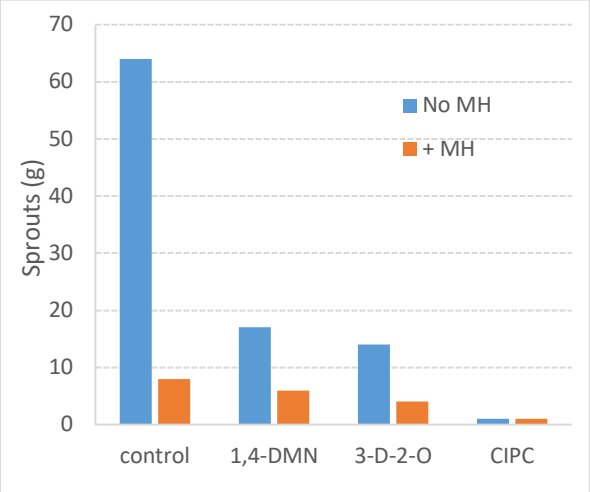
Postharvest treatments include 1,4-dimethylnapthalene (1,4-DMN) and 3-decen-2-one (3-D-2-O), which are applied as fogs. In the case of 3-D-2-O growing sprouts are killed rather than prevented from forming. Both may need to be applied multiple times during long storage.

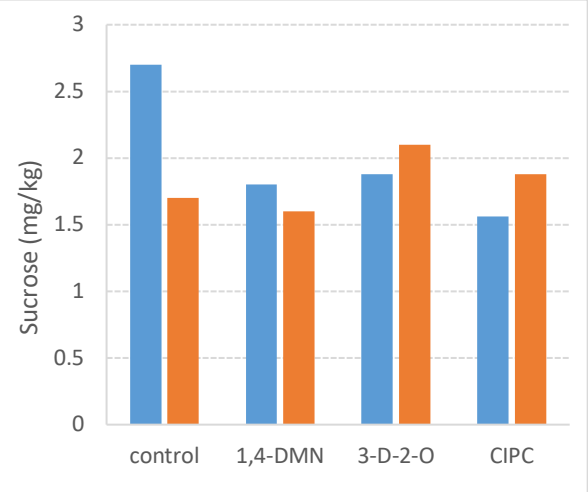
Ethylene gas and spearmint essential oil (Biox-M) offer organic alternatives. In Canada, recent research has focussed on extracts from black spruce, with reports that it can inhibit sprouting by up to 95%. Essential oils are likely to add significant cost and, while ethylene is far cheaper, it can increase sugar accumulation and senescence in some varieties.

What did they do?

Two crisping and two chipping varieties were grown over three seasons. Half were sprayed with Fazor® (60% MH) when 80% of tubers reached 25mm (approximately 6 weeks before haulm kill). Both MH treated and untreated potatoes were fogged postharvest with SmartBlock (3-D-2-O), DORMIR® (1,4-DMN) or Neo-Stop Starter ® (CIPC). The 3-D-2-O, 1,4-DMN and CIPC were applied three times, four times and once respectively during 7-months storage.

On removal, the researchers measured sprout length and weight, as well as sugar content for each combination. They also tested residues in peeled and unpeeled potatoes.





What was concluded?

Field treatment with MH was efficient at controlling sprouting during storage, but not as effective as CIPC:

- Pre-harvest treatment with MH reduced sprouting by 87%, whereas 3-D-2-O and 1,4-DMN were 78% and 74% effective respectively.
- There was no additional benefit from combining MH with postharvest treatments.
- The effects of MH were consistent across the four varieties tested.
- Sucrose accumulation was similar across all of the tested treatments.
- CIPC remained the most effective method, reducing sprouting by 99.8%.

CIPC residues are mainly in the potato peel; potatoes tested with skin on exceeded the MRL (10mg/kg) in one of three seasons. Peeling and cooking both reduced CIPC residues below the MRL. Residues of MH were also detected, although also below the MRL (60mg/kg).

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ABSTRACT

To avoid losses from sprouting during potato storage, the anti-sprouting agent chlorpropham [CIPC] has been widely used over the past few decades. However, the European Union recently decided not to authorize the renewal of CIPC, prompting the value chain to find alternative treatments. We assessed for three years the potential of pre- and post-harvest anti-sprouting treatments to replace CIPC using four potato-processing varieties. Pre-harvest application of maleic hydrazide [MH] and post-harvest applications of 3-decen-2-one, 1,4-dimethylnapthalene [1,4-DMN] and CIPC were performed following supplier's recommendations. In addition, we evaluated the potential of 3-decen-2-one and 1,4-DMN to prolong the efficacy of pre-harvest MH treatment anti-sprouting activity during storage. All molecules significantly reduced sprouting after seven months of storage compared with the untreated control group. MH, 3-decen-2-one, 1,4-DMN and CIPC displayed respectively 86.9 %; 77.9 %, 73.6 % and 99.8 % of efficacy to control sprout weight and 79.4 %; 73.4 %, 68.4 % and 96.9 % of efficacy to control sprout length. Our results suggest that using 3-decen-2-one and 1,4-DMN in combination with MH do not bring additional benefit to control sprouting. Because differences in dormancies could be observed between varieties, we also showed that the efficacy of post-harvest treatments is genotype-dependent, while MH pre-harvest treatment is effective equally for all varieties. Applications of CIPC and MH led to detectable residues in tubers, while no residue of 1,4-DMN has been detected in tubers treated with this molecule (< LOQ). We concluded that treatments with MH, 1,4-DMN and 3-decen-2-one are valuable alternatives to CIPC to control sprouting of processing potatoes.