Maleic hydrazide optimisation as a sprout suppressant

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AHDB SUTTON BRIDGE CROP STORAGE RESEARCH

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Introduction

Since the non-renewal of CIPC (chlorpropham) successful use of the remaining sprout suppressant products has become more important. This is especially so for maleic hydrazide (MH) because its non-volatile nature has the potential to reduce sprout growth over long storage durations. In addition, the use of MH can have an important effect on the economics of potato storage. In many cases, should MH applications not be successful, larger volumes of relatively costly post-harvest treatments may be required to maintain sprout control during storage.

Best practice suggests that application in a larger volume of water and application *early* or *late* in the day will result in greater absorption of maleic hydrazide, resulting in higher tuber residue values. However it is not clear what the mechanism for this is. An experiment was conducted in which the humidity of the air around plants was maintained at an elevated level, in comparison with control plants, to determine the impact this had on subsequent tuber MH residue levels.

Experimental

Seed tubers of the cultivars Innovator and Taurus (courtesy of HZPC Ltd.) were planted on 22 March, 2021 into 2 litre pots of Vitax Grower, Traditional Pot Bedding Compost (13-11-23 + 1.5 MgO + Trace Elements [1.5 kg/m^3] & added lime [3.5 kg/m^3] pH 6.0) and grown on in a glasshouse (Agrii, Throws Farm Technology Centre, Dunmow, CM6 3AQ). Plants were transferred to 7.5 litre pots on 7th May with additional compost (Fig.1).

On 8th July, pots of each cultivar, with a consistent number of stems, were selected and watered. Pots were laid out and treated in a single pass with a Lunchbox compressed air sprayer (Trials Equipment Ltd, Braintree, Essex, CM7 4EH) with MH applied at 3kg ha^{-1} active substance (5kg Fazor ha^{-1}, courtesy of UPL Ltd.) in 400 litres of water per hectare using '04' Flat Fan nozzles (Fig. 2).

Immediately after treatment, capillary matting around some pots was watered, and a frame with plastic sheet was lifted over half of the plants in order to limit moisture loss and generate high humidity. Water was introduced on two further occasions after MH treatment, to prolong the period of high humidity. Care was taken to ensure capillary matting or concrete floor was wetted and pots/plants not watered directly. This constituted the humid treatment. The plastic sheet was removed on 9th July, 25 hours after application. For pots that were not covered, a fan was used to gently move air around the plants in order to promote more rapid drying (the dry treatment).

Humidity was measured automatically amongst the leaves of covered and uncovered plants at 5 minute intervals (Vaisala Instruments, 01670 Vantaa, Finland) and is shown in Fig. 3 for c. 25 hours following the MH treatment, when differences in humidity were evident. The sheet was removed on 9th July and all plants again maintained with regular watering.

Fig. 1. Glasshouse grown cv. Innovator (left) and Taurus plants in early May.

Fig. 2. Application of MH to all plants. The frame with plastic sheet (left) was used to cover half the plants. The leaves of plants were not contacted by the sheet.

Watering of pots was discontinued on 9th August, to promote senescence, before removing haulm and harvesting on 26th August, with samples despatched for MH residue analysis.

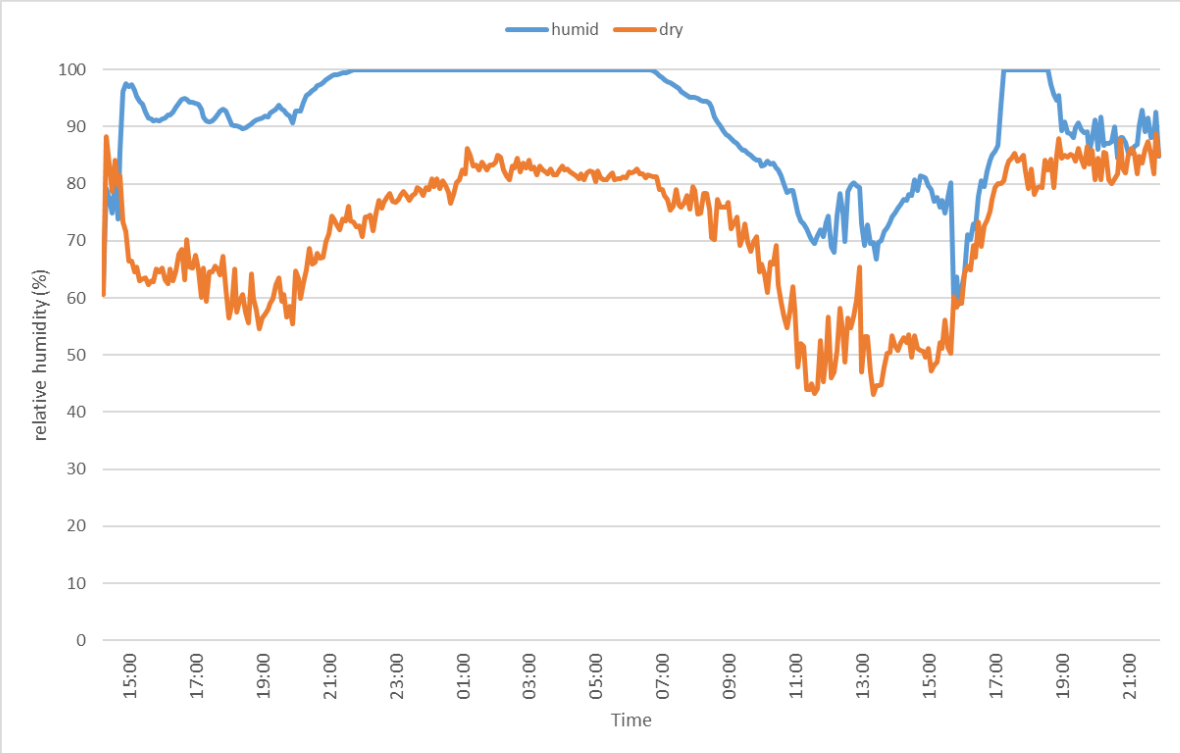

Fig. 3. Relative humidity in humid and dry treatments. Treatment took place at 14:40h on 8th July 2021. The 'humid' crop was uncovered at 15:40h on 9th July 2021.

Results

The average yield of potatoes (weight of all tubers) per pot was 759g for cv. Innovator and 694g for cv. Taurus. Differences in yield (Table 1) between dry and humid treatments were not significant (one-way ANOVA p=0.961 and p=0.552 for cvs Innovator and Taurus respectively) but the dry treatment resulted in fewer tubers of cv. Taurus (12 tubers per pot as opposed to 16, one-way ANOVA p=0.027). Tuber number of cv. Innovator was not significantly affected (one-way ANOVA p=0.202). The progeny tubers from a pot of each cultivar and treatment are shown in Fig. 4.

Table 1. Average yield (g) of potatoes per pot.

cultivar	humid	SD	dry	SD	mean	SD
Innovator	**757.0**	125.98	**760.6**	142.34	**758.8**	129.15
Taurus	**672.7**	74.57	**714.5**	164.59	**693.6**	124.66
mean	**714.8**	108.65	**737.6**	149.75	**726.2**	128.90

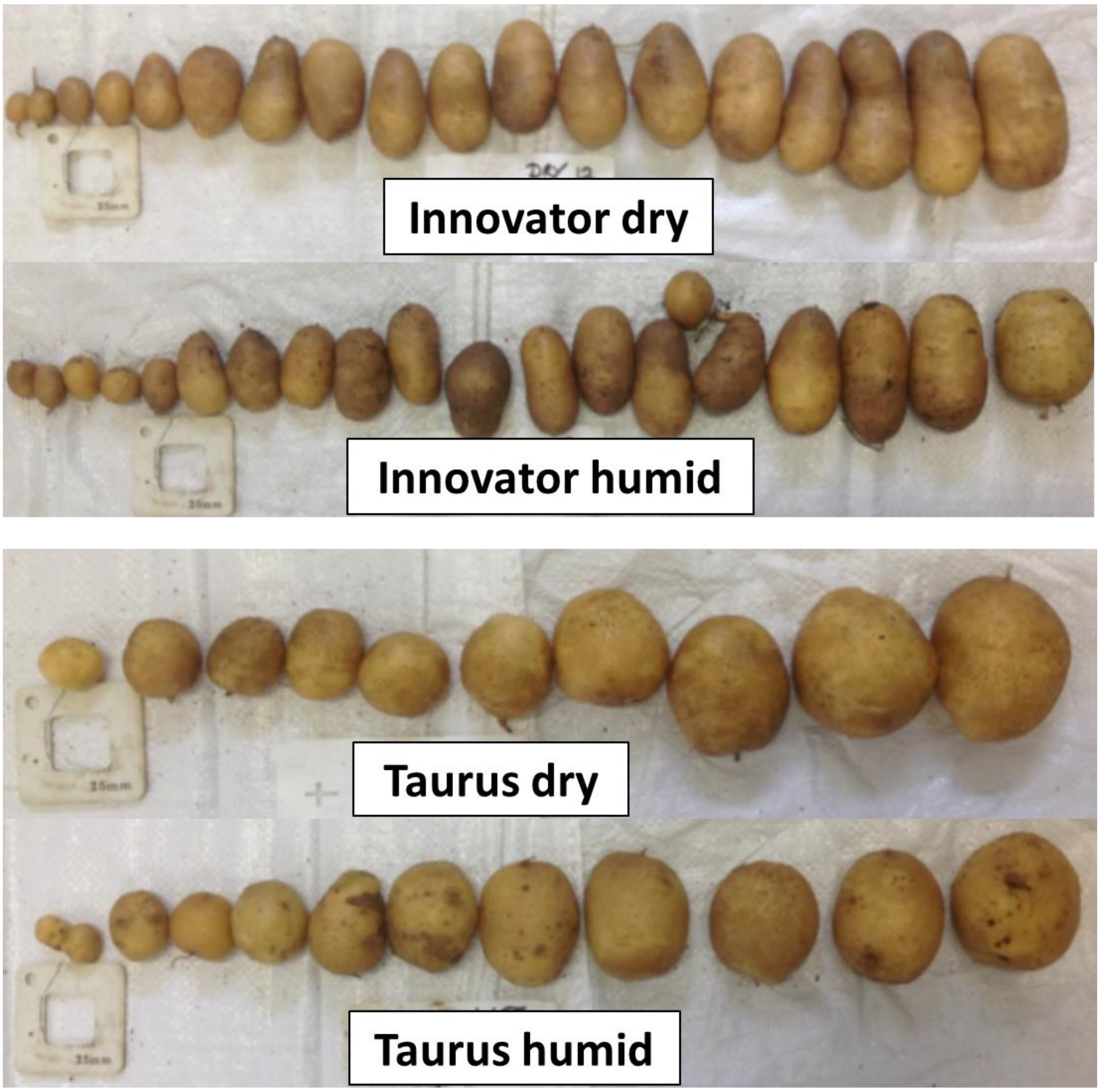

Fig. 4. Progeny tubers from a selected pot of each cultivar from humid and dry MH treatments.

The results of MH residue assessment are shown in Table 2. With both cultivars, MH residue concentration was higher, approximately three-fold, in tubers from plants from the humid treatment. The difference between dry (control) and humid treatments was highly significant for both culivars (one-way ANOVA *p*=0.004 and *p*=0.001 for cvs Innovator and Taurus respectively).

Table 2. Maleic hydrazide residue concentration (mg kg^{-1}) of samples.

cultivar	treatment	**mean**	SD	max	min
Innovator	humid	**26.2**	12.46	42.0	5.3
	dry	**8.8**	2.94	13.0	4.3
	mean	**7.5**	4.18		
Taurus	humid	**32.0**	13.58	49.0	12.0
	dry	**9.2**	5.07	12.0	2.5
	mean	**7.5**	4.18		
average	humid	**29.1**	12.88		
	dry	**9.0**	3.99		

The effect of cultivar on MH residue concentration was not significant. In the dry (control) treatment, mean tuber residue values were 8.8 and 9.2 mg kg^{-1} for cvs Innovator and Taurus respectively (one-way ANOVA *p*=0.865) and in tubers from the humid treatment 26.2 and 32.0 mg kg^{-1} (one-way ANOVA *p*=0.420).

Discussion

Maintaining very high humidity levels for a 24 hour period after application resulted in a three-fold and highly significant increase in tuber maleic hydrazide residue concentration. The effect was similar in both cultivars.

While such conditions are unlikely to occur to this level in a UK growing season, they serve to demonstrate that humidity is a factor that is important for optimising MH applications. Residue levels in commercial crops are difficult to predict and tend to be relatively low. Buckley *et al.* (2006), when reviewing official figures, reported that the Pesticide Residues Committee of the Chemicals Regulation Division had not recorded values of even 50% of the

MRL (when this was 50 mg kg^{-1}, it is now 60 mg kg^{-1}) but did report low residue levels that were considered problematic by the authors, and a reflection of poor application practice. More information regarding conditions suitable for optimal applications would therefore be useful for growers and potato store managers.

The importance of application to 'stress-free' crops is generally recognised by MH product labels. Smith *et al.* (1959) reporting work on tomatoes showed turgidity to be an important factor, with any reduction in plant hydration reducing MH uptake, even before wilting of plants was evident. This concurs with a view (Duncan, 2021) regarding the opening up of 'channels' for transport of MH between wax platelets making up the leaf cuticle, under hydrostatic pressure. Transport of MH in this case, it is proposed, is from droplets of water with dissolved MH, into the leaf. In this work, plants were watered prior to the MH application and so were considered to be 'well hydrated'. The increase in residue concentration, it is proposed, resulted from prolonging the period of MH transport/uptake by extending the duration for which MH was in solution on the leaf, i.e. high humidity was used to extend the drying time. Results indicate that timing of MH applications should also take account of drying conditions.

Other work carried out at Sutton Bridge Crop Storage Research (Briddon & Stroud, 2021) has indicated the possibility of variety interactions with MH residue level. However, there was no evidence of such interactions in this work.

References

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