Grower Summary

BOF 070a

Narcissus: Chlorine dioxide – assessing crop safety in daffodils treated in hot-water treatment

Final 2013

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Before using all pesticides check the approval status and conditions of use.

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Further information

If you would like a copy of the full report, please email the HDC office (hdc@hdc.ahdb.org.uk), quoting your HDC number, alternatively contact the HDC at the address below.

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Project Title:	Narcissus: Chlorine dioxide – assessing crop safety in daffodils treated in hot-water treatment
Project Leader:	Gordon Hanks
Industry Representative:	Adrian Jansen; Lingarden Bulbs Ltd
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Headline

As a biocide in the hot-water treatment of daffodil bulbs, chlorine dioxide appeared to have no adverse effects over a two-year growth period, compared with using 'FAM 30' + 'Bravo 500', the current recommendation. For one of the two varieties tested, 'Mando', treatment with chlorine dioxide had a positive effect on the number of stems, the rate of shoot development, stem length and flower count. A negative impact on bulb yield was observed at the end of the two-year period which, though possibly an artefact of the procedures used, warrants further investigation.

Background

To manage stem nematode (*Ditylenchus dipsaci*) and base rot (basal or *Fusarium* rot caused by *Fusarium oxysporum f.sp. narcissi*) in daffodils, hot-water treatment (HWT) of the bulbs is essential. For decades, the HWT dip used for treating daffodil bulbs has invariably contained formalin (formaldehyde), a biocide that provides general disinfection of the bulbs, water and equipment, as well as apparently augmenting the kill of stem nematodes by the hot water itself. At the end of 2008 clearance to use formalin in the agriculture/horticulture industry in the EU was withdrawn without any alternative being available. Effective alternative biocides for use in HWT have therefore been urgently sought. As a result of HDC-funded projects (BOF 61, 61a, 61b and 61c) an iodophore biocide, 'FAM 30', had been suggested as an alternative to formalin, where appropriate in tank-mix with a chlorothalonil fungicide ('Bravo 500'). However, the practical use of 'FAM 30' is hampered by the rapid dissipation of its active ingredient (iodine) in bulb-dipping tanks and difficulties in assessing iodine concentrations on-farm using a 'dip-stick' test. Another biocide, chlorine dioxide (ClO_2), was investigated in this project following successful research in the USA; it has the advantage that its concentration can be automatically monitored and maintained in bulb-dip tanks. The main aim of the present project was to determine whether chlorine dioxide treatment resulted in any adverse or phytotoxic effects on the crop.

Summary of the project and main conclusions

As a feasibility study, two daffodil stocks ('Mando' and 'Quirinus') were treated in 2010 with chlorine dioxide (4 to 5ppm) using HWT facilities at a commercial farm (project BOF 70). The technique was judged to have potential for practical on-farm use, and the treated bulbs were planted in the field along with comparable batches treated in HWT with 'FAM 30' + 'Bravo 500', the dip additives currently recommended as a result of the earlier projects. Growth and development of the four batches of bulbs was assessed during two-year-down growing.

After shoot emergence in the first year (2011) ‘Mando’ plants previously treated with chlorine dioxide were both more numerous and more advanced than those treated with ‘FAM 30’ + ‘Bravo 500’. The number of shoots or stems per plot, and stem length, were greater in the chlorine dioxide-treated plants than in the standard ‘FAM 30’ + ‘Bravo 500’ treatment (on average by 42% for numbers and 12% for length). The plots of ‘Quirinus’ showed no such difference. Crop development, measured as the passage through standard growth stages (GS), was similar for both treatments, and, apart from minor flower damage typical of that caused by HWT, flower quality was normal in all four batches of plants.

In 2012 there was a strong trend for variety ‘Mando’ previously treated with chlorine dioxide to produce more stems than those treated with ‘FAM 30’ + ‘Bravo 500’. This was not the case for ‘Quirinus’. Stem length, crop development rate and the incidence of disease symptoms were unaffected by treatment in either variety. Flower yields, scaled-up from counts on sample areas, were higher for chlorine dioxide-treated plants than for bulbs treated with ‘FAM 30’ + ‘Bravo 500’, by 28% for ‘Mando’ and 5% for ‘Quirinus’. No appreciable defects in bud or flower quality were observed in either ‘Mando’ or ‘Quirinus’ or in either treatment.

The approximate bulb yields for the four blocks were recorded by the grower. The yields were poor, with percentage bulb weight increases between 33 and 121%, almost certainly a result of a very dry growing season in 2011 followed, in the case of the earlier ‘Mando’, by serious foliar damage from 2012’s late frosts. Of serious concern, however, was the apparently reduced yield of both cultivars following HWT with chlorine dioxide, compared with the blocks treated with ‘FAM 30’ + ‘Bravo 500’. The percentage increase for ‘Mando’ was 33% for chlorine dioxide and 94% for ‘FAM 30’ + ‘Bravo 500’, and for ‘Quirinus’ the figures were 42 and 121%, repectively. However, since the data were from an unreplicated observation and the bulbs in the two ‘treatments’ may have received different handling and husbandry at some stages, despite the efforts made to avoid this, the result should be treated with caution, especially as in all other respects the growth and development of bullbs from the two ‘treaments’ were either equal or better when chlorine dioxide was used. Following the other results just described, this conclusion was surprising and may have been an artefact of the procedures used, but it cannot at this point be confirmed or repudiated.

This means that UK growers should continue to rely for HWT on ‘FAM 30’ (or similar) biocides plus ensuring that the appropriate temperature-time combination is used. From the results of project BOF 61b, 61c and 63b, this means using ‘FAM 30’ at a rate between 4 and 8L product/1000L water (the higher rate being used for stocks in which there are base rot problems, despite the slightly reduced first-year crop vigour this may produce) and a regular HWT of 3¼ hours at 44.4°C. It would not be wise to continue to rely entirely on ‘FAM 30’ as

the continuing availability of a product or active substance cannot be assumed, and because of the rapid dissipation of iodine that can occur in HWT tanks.

Financial benefits

This project provided useful information about chlorine dioxide, a potential replacement for formalin in daffodil bulb HWT. However, while the effects of chlorine dioxide on bulb growth and development were mainly neutral or positive in comparison with HWT using ‘FAM 30’ + ‘Bravo 500’, using chlorine dioxide appeared to result in a reduction of bulb yields; although this was considered very likely an artefact of procedures used, until this result can be clarified no financial benefits can be given.

Action points for growers

Bulb growers should continue to rely for daffodil bulb HWT on using ‘FAM 30’ (or similar) biocides and ensuring that the appropriate temperature-time combination is used. From the results of project BOF 61b, 61c and 63b, this means using ‘FAM 30’ at a rate between 4 and 8L product/1000L water (the higher rate being used for stocks in which there are base rot problems, despite the slightly reduced first-year crop vigour this may produce) and a regular HWT of 3¼ hours at 44.4°C. When using ‘FAM 30’ in bulb-dipping tanks care should be taken to ensure the biocide is topped-up as necessary.