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REPORT FOR HDC
Assessment of Fungicide Uptake by Narcissus bulbs (1992 Trial)
HDC Project BOF/6a

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Summary

Bulbs of narcissus cv Ice Follies were treated with thiabendazole (TBZ) between lifting in the field and hot-water treatment (HWT), which was applied 6 weeks later. The level of TBZ in treated bulbs and in an untreated control was determined about 1 week after the HWT was given.

The lowest level of TBZ was found in the bulbs which were not treated with TBZ during the experiment. All of the remaining bulbs were treated with TBZ at 1.3 g/litre of dip solution. Where this was applied shortly after lifting as a 15-minute cold dip, a mean of 6.1 mg TBZ/kg bulb tissue was measured 7 weeks later, after the bulbs had been stored for 5 weeks at ambient temperature, then 1 week at 30°C, followed by a 3-hour cold soak and HWT at 46°C for 3 hours. Where bulbs were lifted, stored at ambient temperature for 5 weeks, then 30°C for 1 week, followed by a cold soak for 3 hours in a solution containing TBZ and finally HWT at 46°C for 3 hours, the level of TBZ measured was 13.3 mg/kg. Where the treatment was similar to the previous one except that the TBZ was applied in the HWT tank rather than the cold soak, the level of TBZ measured in the bulbs was 62.7 mg/kg. Finally, where bulbs were lifted, stored at ambient temperature for 6 weeks and then given HWT at 44.4°C for 3 hours in a solution containing TBZ they were found to contain 98.0 mg/kg.

The timing of the application of thiabendazole to bulbs and/or the manner in which the application is made appears to have an influence on the uptake of TBZ by the bulbs.

Introduction

Basal rot, the main disease of narcissus bulbs, is caused by the fungus Fusarium oxysporum f. sp. narcissi. Thiabendazole has been found to be effective in reducing basal rot infection in susceptible varieties. Recently concern has been expressed about the cost-effectiveness of using this chemical during Hot Water Treatment (HWT) of narcissus bulbs. As a result, the Horticultural Development Council (HDC) commissioned ADAS to conduct a preliminary investigation rather than a fully replicated experiment to determine whether the timing of the fungicide treatment affected the uptake of the thiabendazole (TBZ).

Control of basal rot had been a predominant feature of work at both former ADAS experimental stations at Kirton and Rosewarne. Thiabendazole as Storite Clear emerged as the most effective fungicide in limiting the disease. Timing appeared critical, a dip within 24 hours of lifting giving the best control. In practice very few growers carry out this procedure. They prefer to include the chemical during Hot Water Treatment (HWT). This gave reasonable control in the Eastern counties but in the South West where first year flowers are more important, bulbs are stored for 7 days at 30°C followed by at least a 3 hour cold soak prior to the HWT, to minimise flower damage. The level of control achieved using TBZ in this system varied and with the increasing cost of the chemical, questions were asked about fungicide uptake. The cold soak that followed the period of warm storage was believed to rehydrate outer layers of the bulb, thus reducing uptake of TBZ by the bulb during the HWT. Therefore, it was thought that including the chemical in the cold soak would be more effective. The counter argument ran that if this was done the TBZ absorbed would be surrendered during the HWT which followed the cold soak.

With these questions in mind a series of treatments was devised to cover the various cultural practices used. This report describes this trial.

Materials and methods

Plant Material

Bulbs of narcissus Ice Follies were picked up from the soil surface at Treluswell, near Falmouth in the afternoon of 20 July and put into bulb nets. All bulbs were graded size 47-57 mm to ensure sample uniformity as far as possible. Treatment 1 was given within 2 hours of lifting

Treatments

1. Lift; within 24 hours dip 25 bulbs in cold water containing thiabendazole as 5 litres Storite Clear product per 1,000 litres of water for 15 minutes. Store for 5 weeks at ambient temperature: warm store for 7 days at 30°C: cold soak for 3 hours, prior to HWT for 3 hours at 46°C.

2. Lift; store 25 bulbs for 5 weeks at ambient temperature, warm store for 7 days at 30°C, cold soak for 3 hours in water containing Storite Clear at 5 litres of product per 1,000 litres of water, prior to HWT for 3 hours at 46°C.

3. Lift; store 25 bulbs for 5 weeks at ambient temperature, warm store for 7 days at 30°C, cold soak for 3 hours in water prior to HWT for 3 hours at 46°C in a solution containing Storite Clear at 5 litre of product per 1,000 litres of water.

4. Lift; store 25 bulbs for 6 weeks at ambient temperature, HWT for 3 hours at 44.4°C in solution containing Storite Clear at 5 litres of product per 1,000 litres of water.

5. Control. Lift, store 25 bulbs for 5 weeks at ambient temperature, store for 7 days at 30°C: cold soak for 3 hours and HWT for 3 hours at 46°C.

After the 5 weeks of ambient storage the appropriate bulbs were placed in a commercial bulb store for 7 days at 30°C. The bulbs were removed on 1 September and taken to the Starcross Laboratory, Exeter for further treatment. On arrival, bulbs were cold soaked for 3 hours before placement in a water bath for the required duration of HWT. Formaldehyde at the recommended concentration was included in the HWT process. The 3 hours of HWT started from when the water bath reached the required temperature.

Following treatment bulbs were removed and allowed to drip dry before being laid out to complete drying. Each treatment was then divided into 3 sub-samples and sent to Aspland and James, Chatteris for the determination of thiabendazole. Bulbs were received by the laboratory on 8 September.

Results

Table 1: LEVEL OF THIABENDAZOLE IN NARCISSUS BULBS

		Thiabendazole (mg/kg)				
Treatment	sub sample	1	2	3	Mean	(SD)
1		2.6	7.9	7.7	6.1	(±3.0)
2		16.0	15.0	8.8	13.3	(±3.9)
3		67.0	69.0	52.0	62.7	(±9.3)
4		102.0	111.0	81.0	98.0	(±15.4)
5		1.5	0.9	1.1	1.2	(±0.3)

SD is Standard Deviation

Bulbs stored for 6 weeks at ambient temperature and then given HWT for 3 hours at 44.4°C without pre-soaking showed the highest level of thiabendazole at the time of analysis. The lowest concentration of thiabendazole in treated bulbs was found in Treatment 1 where the TBZ was given immediately post-lifting. However, this treatment is not comparable with Treatments 2, 3 and 4 in which bulbs were not dipped in thiabendazole until 6 weeks later. The untreated control showed very low levels of thiabendazole.

Discussion

The current recommendations for the application of TBZ to bulbs are based on earlier experimental evidence. These are either to dip the bulbs in a cold fungicide solution for 15 minutes immediately post-lifting or to spray the bulbs with TBZ, again immediately post lifting. In this trial the level of TBZ found on bulbs (treatment 1) when they were analysed 6 weeks after treating with TBZ was 6.1 mg/kg. It is interesting to note that the level of TBZ in the other bulbs that were treated in a cold dip (treatment 2) was only about double this level (13.3 mg/kg), despite the differences in duration of the dips (15 minutes vs 3 hours) and the lag between treatment and analysis (7 weeks vs 1 week).

Where the treatment was applied in the hot water tank (treatments 3 and 4) the residues of TBZ were much higher than in the cold dip treatment (treatment 2) that was applied at almost the same time. The residues were highest where no cold soak was given. The factors that may influence TBZ residues in bulbs are

1. Turgidity of bulbs

   When bulbs are freshly harvested from the ground they are fully turgid and have a relatively closed structure. After the drying and storing process they have lost some moisture and a more open structure develops. It may be that the open structure facilities the entry of TBZ into the bulb. It is likely that soaking bulbs in cold water also influences the openness of structure of a bulb and hence its propensity to absorb/adsorb.

2. Duration of dip

The duration of the exposure of bulb surfaces to a dip may influence the absorption and/or adsorption of substances from that dip. However, we do not know whether the critical time is measured in seconds, minutes or hours.

3. Time elapsed after treatment

The half-life of TBZ in narcissus tissue is not known. However, the presence of detectable residues in bulb tissue that was last treated more than 2 years before residue levels were analysed (treatment 5), may indicate that the half-life is measured in weeks rather than days. Work done on the persistence of thiabendazole in apple peel indicated that the half-life was much more than one month (Coosemans and Van Assche 1983).

4. Temperature of dip

Generally speaking the speed of chemical and biological events is influenced by temperature. It is possible that absorption of TBZ from a dip solution is more rapid if that dip is warmer. The rate of loss of TBZ from treated bulbs into a dip may also be influenced by temperature.

This simple experiment has not looked at the biological effect of the TBZ in/on the bulb. Although the indication seems to be that the most TBZ is taken up when bulbs are treated in the HWT tank, this does mean that the bulbs would be

unprotected for the period between lifting and HWT being given. We do not know if this is important. It is possible that the relatively low level of TBZ present on bulbs treated at lifting is sufficient to have biological action, and that the first few weeks after lifting are the most critical for Fusarium infection. Further work could investigate this.

Conclusions

The level of uptake of TBZ by narcissus bulbs is influenced by the method of application. The highest level of absorption of TBZ seems to occur where the bulbs are treated by the addition of TBZ to the hot water treatment tank. The influence of this on the control of Fusarium basal rot in narcissus by TBZ is not known.

Recommendations

Following this work two lines of investigation suggest themselves. Firstly, to clarify the fate of TBZ in cold dips and hot water tanks the contents of the tanks, as well as the bulbs, should be analysed both before and after dipping. Secondly, the biological effects of TBZ at different concentrations in the bulb and different treatment timings should be investigated.

REFERENCE:

J. COOSEMANS, C. VAN ASSHE. Residues on post harvest treated apples against scald and fungi. PROCEEDINGS OF 10TH INTERNATIONAL CONGRESS OF PLANT PROTECTION 1983 VOL 3 p 1009.

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Authentication

I declare that this work was done by me according to the procedures described herein and that his report represents a true and accurate record of the results obtained.

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