Treatment of Plants with Hypochlorite Solutions

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Hypochlorite solutions are one of the cheapest and most effective disinfectants available to the nursery industry and one of the least harmful to treated plants. However, there seems be some confusion about concentrations, duration of treatment, and conditions for effective treatment. Part of this confusion might be due to differences in objectives by different users of hypochlorite treatments. The objectives in a micropropagation laboratory, for example, are quite different from those in nurseries using other propagation methods.

MICROPROPAGATION—DISINFECTING OBJECTIVES

The disinfecting objectives in the initiation of plant material into culture (commonly called Stage-I) are more demanding than in nurseries. The aim is to kill ALL microbes on the plant material WITHOUT killing the part of the plant to be placed in culture. Plant material harbors millions upon millions of microbes but the vast majority of these do the plant no harm. They are, however, a NUISANCE because many of them grow well on the food supply of the culture medium, they overgrow the explant in the culture vessel and, in the case of slow-growing bacteria, alter the chemical composition of the medium.

The methods used in micropropagation laboratories for the control of these NUISANCE microbes are mostly also effective against the other categories of microbes called PATHOGENS, that is, disease-producing organisms. It is important to realize that treatment of plant material with hypochlorite solutions alone is rarely sufficient to kill both NUISANCE and PATHOGENIC organisms. Micropropagation laboratories employ additional treatments such as growing mother plants in hygienic conditions, thorough cleaning of the plant material, washing in running water, removal of excess plant material, treatment with hypochlorite with added detergent and with agitation and/or with reduced pressure, dissection of growing points and further treatment with hypochlorite solutions (de Fossard, 1990). And we would still expect to get some cultures with microbial contamination.

OTHER METHODS OF PROPAGATION—DISINFECTING OBJECTIVES

When discussion turns from micropropagation to propagation by seeds, cuttings and budding, the key difference is that propagators need not be concerned with the numerous NUISANCE microbes which plague laboratories but, instead, must concentrate on PATHOGENS. And the first step is to learn what diseases affect the plants being propagated so as to recognize their symptoms in mother plants—THEN to destroy plants showing these symptoms. They should have no place in a *nursery's propagation schemes.*

Yes, we've done that, says the nurseryman, but we also want to do something with our propagation material in case the mother plants are carrying pathogens but are

symptom-less at the time we strike cuttings. Can we use hypochlorite solutions as a prophylactic measure?

Before trying to answer that question, it is necessary to examine more closely the properties of hypochlorite solutions.

HYPOCHLORITE SOLUTIONS

The cheapest form of hypochlorite is the one that comes as a powder and this is calcium hypochlorite. The author has avoided using this, first, because it can be dangerous to users if used carelessly, and, second, because it is more laborious to prepare as a solution. Instead, various proprietary brands (White King, Snow White, Clorox) of sodium hypochlorite solutions can be used, and the cheapest of these is "pool chlorine".

The stated concentrations of these types of hypochlorite varies and should be stated. as "%(w/v) available chlorine". Clorox is 5.25% (w/v) available chlorine, White King is 4%, and pool chlorine may be 10% or higher. The problem is that the stated (on the label) %(w/v) available chlorine is mostly higher than reality because the % available chlorine (even in tightly stoppered containers) decreases with time and decreases fastest with higher temperatures in storage (in the supermarket, for example). "Pool chlorine", purchased from swimming pool stores, is most often the "freshest" (that is, nearest to the stated concentration) because of high turnover in these stores.

Ideally, the concentration of hypochlorite solutions should be tested in the laboratory or nursery before use, and a method for doing this is described in de Fossard (1990). The standard hypochlorite treatment used in the author's laboratory is 1%(w/v) available chlorine for 20 min. If this is found to harm plant material, a 0.1% solution is used for 40 min, and other variations in procedure may be used. Pool chlorine, ostensibly with 10%(w/v) available chlorine, may have been purchased and, to prepare a 1% solution from this, a simple calculation is followed:

> Volume(ml){V-1} pool chlorine to be taken equals volume(ml){V-2} of 1%(C-2) required divided by % concentration {C-1} of pool chlorine, or:

$$V\text{-}1 = \frac{V\text{-}2 \times C\text{-}2}{C\text{-}1}$$

$$V\text{-}1 = \frac{1000 \times 1}{10} = 100 \text{ ml}$$

Thus, take 100 ml of pool chlorine and add water to 1,000 ml to prepare 1,000 ml of 1% (w/v) available chlorine solution.

If, on testing, the ostensibly 10% pool chlorine it is found to have say, 9.5% (w/v) available chlorine, then the calculation would be:

$$V\text{-}1 = \frac{1000 \times 1}{9.5} = 105 \text{ ml}$$

and, 105 ml of pool chlorine plus water to 1,000 ml would be used to prepare 1,000 ml of 1% (w/v) available chlorine solution.

ARE HYPOCHLORITE SOLUTIONS EFFECTIVE PROPHYLACTIC MEASURES IN PROPAGATION?

The effectiveness of hypochlorite solutions in killing microbes is a function of concentration (that is, % (w/v) available chlorine) and duration of treatment, or, in general terms, they are effective if they are STRONG ENOUGH and applied for LONG ENOUGH. A solution containing 1% (w/v) available chlorine applied for 20 min would probably be effective against a very wide range of microbes in THEIR VEGETATIVE form, but if SPORES of pathogens were present a minimum 4-h treatment would probably be required. And the story has to be qualified. In micropropagation, the hypochlorite treatments are effective when given with a number of other treatments and, in particular, with the prior cleaning and washing treatments.

CONCLUSIONS

Simply dipping plant material in hypochlorite solutions is unlikely to have a discernible effect on microbes on the plants so dipped. A dip in water alone may have the same beneficial effect (if, indeed, there is a beneficial effect) and hypochlorite in such water baths may then have a prophylactic role in regard to minimizing cross-contamination—the hypochlorite, if strong enough, would have the time to kill microbes in the dip.

But are hypochlorite solutions likely to be effective as far as pathogens are concerned in propagation? If the pathogen is in its vegetative mode, the answer is a qualified "maybe".

If the nurseryman cannot give this assurance, then the minimum 4-h treatments required may harm the propagating material, and there would be no guarantee of total kill of spores because some would have not been contacted by the hypochlorite. Internally situated pathogens, of course, would be in this latter category.

Hypochlorite solutions if strong enough and applied for long enough are likely to be as effective or even more effective than many other more complicated and expensive chemical treatments in general hygienic practices in nurseries. But against pathogens in stock plants, hypochlorite solutions would not be recommended by this author. Knowing one's plants, knowing the pathogens which they are susceptible to, taking measures to eliminate diseased stock, and isolating and protecting "tested" mother plants is the first line of defence against pathogens, not hypochlorite treatments.

LITERATURE CITED

de Fossard, R.A. 1990. Micropropagation. Xarma Pty. Ltd., P.O. Eagle Heights Queensland 4271 Pages vi + 320 accompanied by 16 files on floppy disks responding to LOTUS 123 commands.