WILL FUMIGANTS, BIOFUMIGANTS OR IPM, ADEQUATELY REPLACE MB IN AUSTRALIA?

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Most growers in Australia who are reliant on methyl bromide fumigation, are currently considering chemical fumigants as the most suitable replacement for methyl bromide. This is because they have become used to the simple management, the potential high quality yields and profits obtainable with MB. Markets, consumers and major food companies however, want chemical-free produce grown under integrated production systems that have minimal impact on the environment (soil, water and air). This is forcing growers to reconsider future soil production methods and soil disinfestation options. Will crops grown in fumigated soil satisfy future market requirements? Will industries dependent on MB change to more sustainable production systems?

Since 1992, a range of chemical and non-chemical soil disinfestation options to MB have been evaluated in randomised block trials in the strawberry fruit and runner industries, and the tomato and ornamental flower bulb industries in Victoria and Queensland. From this work, the most likely alternatives have been evaluated over the past two seasons in grower demonstration trials on growers properties at 6 sites throughout Australia. Generally chemical treatments have included alternative fumigants or mixtures of MB, chloropicrin (Pic), 1,3-dichloropropene (1,3-D), metham sodium (MS) and dazomet. The non-chemical treatments have included, solarisation either alone or in combination with fumigants, hot water, biological controls (eg. Nemacheck®), biofumigants, herbicides and pesticides, and a range of nutrient treatments (calcium cyanamide, calcium oxide).

In the flower bulb industry to date, three alternative chemical fumigants (Pic, MS/Pic and 1,3-D/Pic) have been as effective as MB for control of *Sclerotium rolfsii*, and clearly more effective than other treatments (Figure 1). In the strawberry industry, similar results have been obtained and mixtures of MB/Pic with lower concentrations of methyl bromide (30:70) have consistently outyielded (up to 14% greater) crops treated with the standard MB/Pic mixture (70:30).

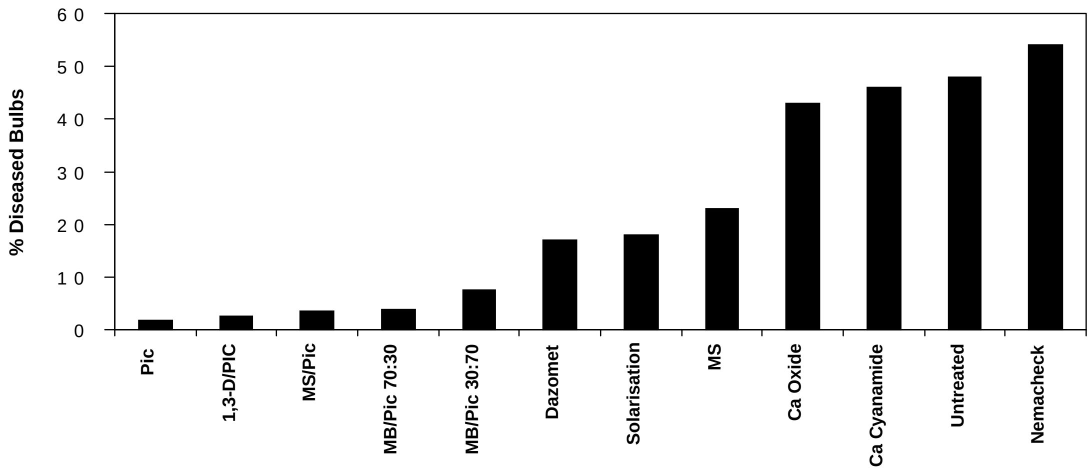

Figure 1. Relative performance of soil disinfestation practices for control of *S. rolfsii* on Dutch iris in Victoria in trials between 1992 to 1997. (Pic was applied at 150 kg/ha, all other fumigants applied at 500kg/ha; Calcium oxide at 5t/ha, calcium cyanamide at 1t/ha, Nemacheck 50g/kg bulbs)

Due to unavailability (lack of registration), unreliability under present application methods and increased plant back periods (up to 8 weeks for products with MITC), none of the alternative fumigants have been adopted by growers on a large scale. A large proportion of growers (> 50% strawberry growers in Victoria) have switched to MB/Pic formulations with reduced amounts of MB (50:50) and this has assisted Australia to meet reduction schedules imposed under the Montreal Protocol. Where practical, growers are also being advised to lower rates of MB/Pic mixtures to as low as 325 kg/ha and use formulations of MB/Pic 30:70 mixtures as short term alternatives to reduce MB consumption. Supplementary programs, such as the use of fungicide dips and disease free bulbs are reducing the need for flower growers to annually fumigate soils for flower bulb crops. Alternative fumigants together with herbicide programs have shown promise for replacing the need for MB fumigation in the strawberry runner industry, however, the need for certification of runners, is forcing this industry to consider other production strategies (eg. Soilless culture and protected cropping).

Fumigants, biofumigants or IPM?

To date, several experiments involving biofumigant crops (neem meal, mustard meal) have failed to produce consistent control of weeds, pathogens or suitable yield responses. Experiments to evaluate the relative efficacy of chemical fumigants compared to biofumigant crops (eg. *Brassica spp*.) have shown that the total isothiocyanate (ITC) concentration released from roots is 3.0 μmol ITC/g at a standard rate of application to soil (7 tonnes dry weight/ha), which is equivalent to 156 nmol/g soil. This is much less than the estimated ITC concentration released by the commercial fumigant, metham sodium (2060 nmol methyl ITC/g soil), applied at a much lower rate of 320 kg methyl ITC/ha and incorporated to a depth of 20 cm. This suggests that addition of biofumigant Brassica crops may not produce the required quantity of ITC's to control soilborne pathogens, compared to that from a short-term exposure associated with a chemical fumigation. Thus if biofumigant crops are to act as a replacement for MB, they may be better used as rotation crops where, increased organic matter content and microbial activity in soil, together with sub lethal doses of ITC's and other allelochemicals over extended periods of time, may provide more effective control of pathogens and weeds.

Conclusion

High value industries, such as flowers, strawberries and capsicums have become so reliant on soil fumigation of soil, that these industries appear set to change to the next available chemical alternative, if and when registration and appropriate application methods become available in Australia. In the longer term, IPM strategies based on prediction, monitoring, biofumigants, resistant varieties and strategic application of pesticides, are considered to be more sustainable options for soil disinfestation in certain MB user industries (eg. tomatoes) in the future. Some industries (eg. strawberry runners) may need to change cropping practices and produce crops in protected systems (ie. plastic tunnels) using artificial substrates which guarantee disease free crop status.

References Cited:

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