REVIEW OF USE OF ALTERNATIVES TO METHYL BROMIDE FOR HORTICULTURAL CROPS IN ASIA

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Methyl bromide is a broad spectrum pesticide, principally used as a fumigant. On soil, it is used as a pre-plant soil fumigant in locations where a broad complex of soil-borne pests limit the production of certain crops, particularly when they are repeatedly grown on the same land. In SE Asia and the Pacific, the use of methyl bromide as a soil sterilant is only about 6 % of all methyl bromide used (UNDP, 1995). Alternative methods to control soil pests are widespread. Aware of the negative side effects of pesticides, alternative soil pest control practices with reduced chemical inputs are being suggested. Soil pest control practices include biological control by means of natural enemies and integrated methods, such as integrated pest management (IPM) or integrated crop management (ICM). This paper documents a number of cases of alternative soil pest control methods with reduced chemical inputs in commercial use for horticultural crops in Asia. In addition, alternatives that have been found effective in field and/or greenhouse trials are reviewed.

Cases of alternative soil pest control methods used commercially for horticultural crops on modem as well as traditional farms in Asia are listed in Table 1. The methods range from relatively new techniques, such as substrates and solarisation, to improved methods of traditional techniques, such as composting. There is now greater appreciation and respect for low-input, traditional agricultural systems, and the methods that are employed by traditional farmers are recognised as often being more efficient and logical than previously thought. In fact, to manage nematodes, integrated systems are being developed that incorporate or consider many alternative small-scale farmer practices (Bridge, 1996). Most of the identified techniques can be applied in intensive horticultural production.

In addition to the cases of commercially applied alternative soil pest control methods described in the previous section, there are numerous reports of IPM experimental efforts and successes in many parts of the world, and farmers would benefit from further verification on a larger scale at the farm level. Table 2 lists cases of experimental use of soil pest control methods that could be used as elements of an IPM / ICM approach to successfully replace methyl bromide, with a general indication of applicability.

This review shows that alternative methods to manage soil-borne pests are widespread on various crops in Asia. The choice of method(s) varies to suit the cropping system and the environment. It is concluded that practices do exist to manage soil-borne pests successfully in ecologically sound ways to achieve sustainable crop production.

It should be stressed that, in addition to the documented cases given here, many other (cultural) practices are widespread throughout the Asian region which are applied for various reasons. These, integrated with other crop management measures contribute to the management of soil pests in general, such as sanitation, various methods of tillage (e.g. repeated summer ploughing), crop rotation, balanced fertilising, regulation of irrigation, optimising planting time, choice of seed / planting material, planting distance and habitat management. IPM integrates the available pest control methods to achieve a farmer's most effective, economical, and sustainable combination for a particular local situation. There are now many IPM success cases reported at the farm level for a variety of crops, including horticultural crops. In Asia, all of these success cases contradict the claim that methyl bromide would be needed to grow commercial horticultural crops successfully and economically.

***Table* 1: Cam using alternative practices for the effective control of soil pests commercially.**

	crop(s)	**Method**	Country/ies	Source(s) of information
1	various horticultural crops	Composting and using compost	India Malaysia Philippines South Korea Thailand Elsewhere	IIBC staff Harris (1996) FOAM (1996)
2	Shallot Hot popper Tomato Other vegetables	Flooding of fields	Indonesia Malaysia Vietnam Elsewhere	IIBC staff Vos et al. (1993) Sariah and Tanaka (1994) Vu (1990)
3	Strawberry Tomato Pepper Leafy vegetables	Cultivation on substrates	Malaysia Indonesia Singapore	IIBC staff 'Various private growers
4	Cabbage Solanaceous crops	Application of lime	Malaysia Thailand Philippines Elsewhere	IIBC staff Vattanatengum (1990)
5	Pepper Tomato Watermelon	Application of mulch	Taiwan Indonesia Malaysia Vietnam	IIBC staff Vos and Sumarni (1997) Vu (1990)
6	Cabbage	Treatment of seed	Countries in Asia	IIBC staff Vattanatangum (1990)
7	Various horticultural crops	Burning of top-soil	India Bangladesh	IIBC staff Choudhury and Hoque (1982)
8	Various horticultural crops	Application of neem cake	India	IIBC staff Alam (1991)
9	Various horticultural crops	Mixed cropping with marigold	India Vietnam	IIBC staff Khan et al. (1971)
10	various horticultural crops	Tillage of soil	Vietnam Bangladesh India	IIBC staff Vu (1990) Hossain (1990) Prasad and Chawla (1991)
11	Cucumber Eggplant Tomato	Grafting on resistant root stocks	China Japan	IIBC staff Qiu (1990)
12	Various horticultural crops	Use of resistant cultivars.	Japan Malaysia Elsewhere	IIBC staff Takeuchi (1990)
13	Various horticultural crops	Solarisation in greenhouses	Japan	Horiuchi (1991)
14	Potato	Increase of hilling and irrigation	Australia	Osmelak (1990)
15	Tomato	Rotation of	Bangladesh	Hossain (1990)
16	Various horticultural crops	Solarisation of seed beds	China	Qiu (1990)
17	Tomato Eggplant Other vegetables	Adjusting of planting time	India	Sethi and Gaur (1986)

Table 2: **Alternative soil pest control methods found effective in tests or trials.**

	Crop(s)	Method	Country/ies	Source(s) of information	Applicability
I	Tomato	Resistance against bacterial wilt	Indonesia Elsewhere	Purwati and Hanudin (1995)	Regions with equal wilt strains
2	Cabbage Onion	Solarisation	Philippines Australia	Boteng (I 990) Porter and Merriman (1985)	Regions with hot sunny climates
3	Eggplant	Biological control using Talaromyces flavus	USA	Marois et a/. (1982)	Fields and greenhouses
4	Cumin Clusterbean	Solarisation, summer irrigation, amendments	India	Lodha(1995)	Hot and regions
5	Tomato Strawberry	Integration of biological and chemical control	Israel	Elad et al. (1994)	Fields and greenhouses with Botrytis *cinerea*
6	Tomato	Resistance to rootknot nematode	Argentina Elsewhere	Gallardo (1988)	Tomato Wowing areas
7	Lettuce	Biological control using Trichoderma viride	Austria	Bedlan (1988)	Greenhouse lettuce crops
8	Cucumber Tomato	Integration of biological and cultural control	Japan	Kobayashi (1991)	Vegetable crops in greenhouses and fields
9	Tomato	Use of trap crops	India	Rangaswamy and Reddy (1993)	Greenhouses and fields
10	Tomato Cucumber Eggplant Pepper	Grafting on resistant rootstocks	Switzerland Japan China Italy Korea	Dufour and Taillens (1994) Kuwata et al. (1994) Lu et al. (1992) Mona et al. (1992) Choe (1989)	Fields and greenhouses
11	Banana	Hot water treatment	?	Prasad and Reddy (1994)	Small-hold farms
12	Tea	Soil sterilisation for young tea plants	India	Rao (1976)	Small-hold farms

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