SOIL DISINFESTATION IN ITALY: STATUS TWO YEARS BEFORE THE PHASE-OUT OF METHYL BROMIDE

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Introduction

Since the seventies, many horticultural crops heavily relied on methyl bromide (MB) to control soilborne pests, diseases and weeds in Italy. As one of the major consumer of MB, after its inclusion among substances that deplete the ozone layer, Italy was forced to invest many resources in the development and implementation of alternative strategies for soil disinfestation. Such activities have been strongly and effectively supported by the Italian Ministry for Environment and Territory.

Present uses of MB in Italy

MB consumption decreased from 7,000 tons in 1994 to 4,000 in 2001, thus exceeding the 25% reduction imposed by the European regulation CE 2037/2000 within the period 1st January 1999 - 31st December 2000 (Camponogara *et al*., 2002). During 2001, more than 90% of MB has been applied on tomato (41.9%), strawberry (13.7%), eggplant (12.8%) and melon (10.7%) (table 1); moreover the use of MB still remains mostly concentrated (82% of total consumption) in Southern Italy (table 2).

VIFs adoption

Since 1995, virtually impermeable films (VIFs) have been tested to reduce emissions of MB into the atmosphere. The use of VIFs is now mandatory in Europe (CE Reg. n° 2037/2000, 29/07/2000). VIFs permit to achieve a 25 - 50 % reduction in the dosage of MB, while maintaining the same efficacy in terms of pest and disease control. In 2001, more than 2,500 hectares were fumigated under VIFs: the increased use of VIFs is due to their reduced cost, improved mechanical properties for hand and mechanical application and size availability. VIFs can also be successfully used with other fumigants such as chloropicrin (CP) (Gullino *et al*., 2002a), 1,3 dichloropropene (1,3 D) (Ajwa *et al*., 2002) and methylisotiocianate generators (metham-sodium and dazomet) (Gullino *et al*., 2002b), permitting to improve their efficacy while reducing their emissions into the atmosphere.

Other old and new chemical compounds

Metham sodium (MS, liquid soil fumigant) and dazomet (DZ, solid soil fumigant), registered since longtime in Italy, are effective for controlling weeds and soil-borne pathogens, principally fungi, as well as a limited number of nematode species. They can be applied at a relatively low cost by growers themselves; however they often show low efficacy against several vascular diseases and some specific soil-borne pathogens and nematodes, due to their uneven distribution in the soil or to the climate unpredictability. During the last few years, new formulations of 1,3 D (Telone EC ex

Dow AgroSciences, emulsified formulation, 94 % a.i. w/w) and chloropicrin (CP, Tripicrin ex Triagriberia, emulsified formulation, 94 % a.i. w/w) have been developed. CP is now registered for drip and shank fumigation in open field or under protection to control soilborne pathogens on tomato, eggplant, melons, watermelon and strawberry at a recommended rate between 200 and 400 Kg/Ha (120 - 240 l/Ha). The nematocide 1,3 D, already registered for shank application in open field (Telone 97 ex Dow AgroSciences, 97 % a.i. w/w) is now available as a new emulsifiable formulation (Telone EC), for drip irrigation also under protection; the recommended rate is within 150 - 250 l/Ha (180 - 300 Kg/Ha). However, MS, DZ, CP, and 1,3 D alone cannot completely replace MB. The combination of CP and 1,3 D can be considered as the most promising alternative for Italian growers, being effective also against weeds (Ajwa *et al*., 2002). A mixture of CP and 1,3 D, with improved efficacy against soilborne diseases and pests is currently under registration in Italy: particularly its application throughout drip irrigation could be effective against weeds too. Also iodomethane (IM) is expected to be registered in the coming years for soil disinfestation (Beker *et al*., 1998; Eayre *et al*., 2000). At present, chemical alternatives are often considered by Italian growers as the most reliable tools. All chemicals must be applied taking into consideration the need of minimizing their environmental impact. Moreover, no one of the available chemicals can be considered as the only replacement for MB.

Non chemical alternatives

Resistant varieties, physical disinfestation (steaming, soil solarization), cultural practices (crop rotation, soilless cultivation) are among the most widely applied non chemical methods for the management of soilborne pathogens without MB. In most cases, the combination of at least two of such techniques, including the use of chemicals, represents a reliable strategy for intensive horticultural crops. From a practical point of view, grafting on resistant rootstocks represents an interesting option for tomato, pepper, eggplant, melon, cucumber and watermelon, being already widely and successfully adopted for watermelon and melon. Moreover grafting should permit to continue cultivating old and sensitive varieties - often appreciated for their characteristics – as scion. Unfortunately several critical aspects must be taken into consideration: the need of an in-depth technical knowledge for an efficient implementation of this technology, mostly related to the fertilization and irrigation management, the risk of sudden onset of new physiological disorders [i.e. physiological wilt of tomato grafted on resistant rootstocks (Minuto & Garibaldi, 2001)], the reduced rootstock tolerance against some pests (root knot nematodes) and diseases (*Pyrenochaeta lycopersici* on tomato rootstocks). Nevertheless, the rootstocks now available on the Italian market can mostly satisfy grower expectations as shown by the strong increase of grafted plants from 4 millions in 1997 to 14 millions in 2000.

Conclusions

Italy faced with a realistic and positive attitude the MB phasing-out period, by setting short, mid- and long-term strategies. The rational combination of chemicals such as MS, DZ, CP alone or mixed with 1,3 D with non-chemical methods such as grafting, soil solarization and resistant varieties permits to maintain the economical competitiveness of Italian horticulture. From a practical point of view, the recent registration of CP and of new formulations of 1,3 D will lead to a further reduction in MB usage. Environmentally friendly application technologies of fumigants, the improvement of grafting methods and the development of more efficient biocontrol agents will permit to continue producing high quality horticultural products.

However, it must be stressed the fact that the successful replacement of MB always relies on the presence of an efficient extension service, able to provide growers the needed assistance during this transition period.

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Table 1 – Italian consumption of MB split by crop (adapted from Camponogara *et al*., 2002).

Crop	Tons	%
Perennials	0.0	0.0
Tomato	1636.5	41.9
Pepper	246.6	6.3
Eggplant	501.8	12.8
Melon	417.5	10.7
Cucumber	42.0	1.1
Watermelon	106.0	2.7
Zucchini	55.8	1.4
Strawberry	381.6	9.8
Strawberry (nursery)	154.3	3.9
Lettuce	10.0	0.3
Cut Flowers	354.2	9.1
Total	**3906.3**	**100**

Table 2 – Italian consumption of MB on 2000 split by geographical area (adapted from Camponogara *et al*., 2002).

Italian area	Tons	%
North	152.0	3.9
Center	553.0	14.1
South	3201.3	82.0
Total	**3906.3**	**100**