TWO YEARS EFFECT OF SOME ALTERNATIVES TO METHYL BROMIDE ON STRAWBERRY CROPS

Vicent Cebolla*, Rafael Bartual, Alfonso Giner, Julia Bustos.
Instituto Valenciano de Investigaciones Agrarias (IVIA). Moncada (Valencia) Spain

Methyl Bromide (MB) is one of the most important fumigants in soil fumigation. It is used because its broad spectrum of activity against most of soil borne parasites (pests, nematodes, fungi) and some bacteria as well as weed control effect. The beneficial effect on the crop in absence of a characterised pathogen is very appreciated by farmers, strawberry growers specially, who use to disinfest the soil as one of the standard soil preparation. This is very significant in large farms where strawberries are the mono-culture of the region as it is the Spanish case. This situation implies a special interest by Spanish farmers and scientists, in finding possible alternatives to the use of MB.

Distribution of MB has been already reduced in a 25 % in Spain since 1998, according to the schedule approved by EU, and it will continue descending up to the phase out on 1st of January 2005.

Also the long term effect, possibility of repeating the treatment for many years, the dosage reduction to adapt to the time up to the phase out, and treatments without MB have to be studied.

The aim of the experiment is to compare the behaviour of treatment of reducing MB dosage, by using VIF tarp (3), fresh manure at large rates (15 g/m2) (7) and moderate rates (5Kg/m2) combined with Solarization (4). Other traditional fumigant such as Metham Na at standard dosages (140g/m2) (6) or reduced dosages (35g/m2) combined with Solarization (5) was included into the experiment. Non treated control (1) and Standard dosage application of MB (60g/m2) (2) were used as references. Tarping period for MB treatments was 5 days while with Solarization was 5 weeks.

Manure composition for treatments Solarization improved with manure and Manure itself was 75% sheep and 25% chicken manure buried by deeply ploughing followed by irrigation once in the former and three times in the later.

A requirement to consider a treatment as an alternative to the use of MB is the feasibility of repeating the treatment and crop in the same land several years consecutively without loses in fruit quality and yield as well as the occurrence of harmful side effects.

The experimental design consisted in a complete randomised block with three replicates originally (1st year). The treatments were repeated on the same plots for a second year but one of the replicates had to be removed. In order to be close to the reality, single plots were established with a large size (400 to 600m2). The statistical comparison among treatments were done by Duncan Test at 95% level.

No important pathogens were detected in the soil or plants, nevertheless soil fatigue was observed, due possibly to a fungal complex in which *Fusarium* spp participates as a main component.

Some small pieces of roots infested by *Fusarium* were buried at 10 and 30 cm depth before application, and recovered on Komada selective media after the treatment served to monitor the effect on Inoculum. Plant failure was registered two weeks after planting date by counting the dead plants. Missing plants were replaced with new ones to keep the plant population.

The incidence of weeds in each treatment was monitored all along the growing season by time of removing weeds plus cleaning the plants, expressed in min/plant.

Cold stored plants of cv. *Pajaro* were planted in two-row bed at 30cm apart the 1st year while cv. *Camarosa* was used at 35cm apart the 2nd year of experimentation. Two parameters were used for estimating plant vigour i.e. plant diameter and plant height, both in cm.

Yield was registered individually for each of the three categories (1st Quality, 2nd quality and debris) and expressed in g/plant. Earliness was considered as the yield harvested before 1st of May. Quality of the yield was measured as average 1st quality fruit weight. Sample size was 20 fruits randomly chosen in each picking. Commercial yield and percentage of 2nd fruit quality on commercial yield were registered too.

Results on survival of *Fusarium* spp from small pieces of roots (Table 1) show that control and Manure treatments do not destroy inocula independently of the depth of sampling. However MB and improved Solarization treatments are effective on surface but not in depth. Only standard MB treatment eliminates completely the inoculum. However Solarization combined with manure is promising in this aspect too.

Results concerning plant failure (Table 2) show that mortality level of plants is quite low, except in the case of manure treatment which is significantly higher than the rest of treatments in both years.

Plant vigour (Table 2), both in diameter and height, show two homogeneous groups, the best including MB treatments, improved Solarization and Metham Na in the 1st year. On the other group Control and Manure treatments show the smaller plants. The 2nd year Metham Na loses efficacy and Manure treatment plants are significantly smaller than Control ones. The general pattern in vigour offers a similar trend with independence of the planted variety. Plant failure and small plant size in Manure treatment could be due to phytotoxicity caused by excess of manure.

The effect of weeds (Table 2) was significantly higher only in Manure and Control treatments the 1st year. From the point of view of weed control any other treatment has a similar effect compared with MB treatments in both years of experiments.

Results concerning earliness (Table 4) are not fully representative because of excessive cold temperature in winter 98-99. In fact cv. *Camarosa* is well known to be an earlier type than cv. *Pajaro*. However the results of second year are the opposite to

this for that reason. Taking into account the results of the 1st year only there is a slight trend to increase earliness in the improved Solarization treatments

Although the yield is not comparable from one year to the other because of the change of variety, parameters related with yield and fruit size show similar pattern. Results of total and commercial yield Table 4) show the same pattern both years. MB and improved Solarization treatments do not differ in these traits significantly in the 1st year. Solarization combined with Metham Na loses efficacy in the 2nd year if we compare results with those obtained with MB treatments and Solarization combined with manure. In fact it differs with standard MB treatment significantly while it did not the 1st year. In both years Metham Na treatment was placed in an intermediate position and the worse results were got with the Control an Manure treatments. First quality fruit yield show the same pattern than total and commercial yield in the 1st year, but the second year results are better in those treatments based on the application of MB.

From stand point of view of fruit size (Table 5) no treatments offers any possibility to replace MB treatments. This situation occurs in both years. Results of 2nd fruit quality indicate that MB treatments offer the lower rates although they do not differ from improved Solarization treatments in both years significantly . However the increase of this percentage is lower in the case of MB treatments.

As a final conclusion we can say that some treatments can replace to MB in the yield and plant vigour aspect. To the contrary none of the treatments considered under study could be an alternative to MB from the stand point of view of fruit size.

Particularly Solarization combined with manure globally considered can be a possible alternative, specially in small farms where manure supplies are available and make it economically feasible.

With respect to Solarization combined with Metham Na at the dosage used in this research results were not promising after two consecutive years of application on the same plot. Maybe this lack of effectiveness could be corrected by increasing the dosages.

More research has to be done in order to find new alternatives to MB taking into account the infrastructure of the rural property in different regions to make it economically feasible

Table 1. Survival rate of Fusarium spp in root pieces at two depths after disinfestation.

	Depth	
	10cm	30cm
1 Control	100	100
2 Br60PE	0	0
3 Br30VIF	5	50
4 Sol+Manure 5	5	10
5 Sol+Metham	0	55
6 Metham Na	10	75
7 Manure 15	100	100

Table 2. Plant failure after planting and plant vigour at mid season.

	Plant failure %		Plant Diameter (cm)		Plant Height (cm)	
	1998	1999	1998	1999	1998	1999
1 Control	2.06 ab	5.21 a	22.4 b	24.8 bc	16.0 b	22.8 c
2 Br60PE	0.66 a	2.98 a	26.6 a	29.5 a	23.8 a	30.1 a
3 Br30VIF	0.98 a	3.93 a	27.0 a	29.6 a	22.7 a	29.9 a
4 Sol+Manure 5	3.54 ab	5.49 a	28.0 a	29.3 a	23.3 a	28.9 a
5 Sol+Metham	1.38 a	4.29 a	28.3 a	27.1 ab	22.7 a	27.4 ab
6 Metham Na	1.65 a	4.11 a	25.2 ab	23.5 c	20.9 a	23.9 bc
7 Manure 15	9.39 b	10.11 b	22.2 b	19.0 d	16.7 b	17.3 d

Table 3. Removing weeds plus cleaning plants time (min/plant).

	Removing weeds time	
	1998	1999
1 Control	0.40 bc	1.26 b
2 Br60PE	0.20 ab	0.83 a
3 Br30VIF	0.19 a	0.7 a
4 Sol+Manure 5	0.28 abc	0.79 a
5 Sol+Metham	0.26 abc	0.81 ab
6 Metham Na	0.23 ab	0.85 ab
7 Manure 15	0.44 c	1.03 ab

Table 4. Yield in the 1st and 2nd year of planting.

	Total Yield		1st Quality Y		Early yield		Commercial	
	1998	1999	1998	1999	1998	1999	1998	1999
1 Control	335.9 c	438.5 c	271.2 c	321.8 d	112.4 cd	49.3 a	319.7 c	392.5 c
2 Br60PE	561.0 a	807.2 a	497.3 a	656.4 a	127.4 abc	40.0 ab	544.0 a	738.2 a
3 Br30VIF	531.3 a	738.0 ab	472.3 a	610.3 ab	117.5 bcd	36.4 ab	513.5 a	682.7 ab
4 Sol+Manure 5	585.1 a	635.6 b	507.2 a	497.2 bc	144.4 ab	21.7 b	562.4 a	579.5 ab
5 Sol+Metham	579.6 a	585.8 bc	501.3 a	456.5 cd	149.8 a	48.0 a	553.9 a	541.8 bc
6 Metham Na	442.5 b	452.2 c	382.4 b	343.1 d	120.8 abc	27.6 ab	426.8 b	410.2 c
7 Manure 15	300.5 c	228.7 d	243.5 c	142.7 f	90.1 d	33.5 ab	284.5 c	193.1 d

Table 5. Fruit size of 1st quality and percentage of 2nd quality yield.

	Fruit size 1st Quality		2nd quality per cent	
	1998	1999	1998	1999
1 Control	17.6 c	17.3 b	16.2 c	23.1 b
2 Br60PE	19.4 a	19.5 a	8.5 a	14.6 a
3 Br30VIF	19.6 a	20.1 a	8.6 a	13.9 a
4 Sol+Manure 5	18.7 b	18.2 b	10.3 a	18.3 ab
5 Sol+Metham	18.6 b	18.2 b	9.7 a	18.9 ab
6 Metham Na	18.6 b	17.7 b	11.3 ab	23.3 b
7 Manure 15	18.4 b	16.1 c	15.1 bc	34.2 c