NEW TECHNIQUES FOR METHYL BROMIDE EMISSION REDUCTION FROM SOIL FUMIGATION IN SPAIN.

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Methyl bromide (MB), used as fumigant in soil, will be phased out on the year 2010, because the effect of their emissions on the ozone layer depletion. Only some critical uses will remain allowed. In the meanwhile a limitation in the consumption of this fumigant is regulated. In any case it is crucial to improve the techniques to reduce the emissions affecting the ozone hole.

We have studied the improvement of application technique by using Hytibar (HT) from Hyplast (Belgium), which is considered a Very Impermeable Film (VIF) for MB, as cover sheet, and the combination with soil Solarization, in order to reduce the emissions to the atmosphere during application, The possibility of creating negative side effects, like increment of residues in soil, have also been taken into account.

These techniques were compared in a research experiment, conducted in a pepper greenhouse, which soil was naturally infested by *Phytophthora capsici* from previous crops. The studied treatments were (1) Non Disinfested Control, (2) MB standard dose (60 g/m^2) Low Density Polyethylene (PE) cover sheet, (3) Half dosage (30 g/m^2) PE cover sheet, (4) MB Half dosage (30 g/m^2) HT cover sheet, (5) Solarization with PE cover sheet, and (6) Solarization combined with MB 1/4 dosage (15 g/m^2) with PE cover sheet. Application of MB was made by hand, using hot technique.

The effect on inoculum destruction assessment was done by using dry soil containing chlamidospores of *Fusarium oxysporum f. sp. dianthi*, and pepper root pieces infested by *P. capsici*, Also gas concentration along disinfestation, biomass production, bromine residues and yield were monitored.

Treatments (2) and (4) were the best in controling *F.o.dianthi* (Table 1), with statistical significant differences from all other treatments at 40 cm depth. With respect to efficacy against *P.capsici* inoculum at 40 cm depth, the best treatments are (2) and (4) followed by (3). The increase of CxT product (Concentration x Time) of Treatment (4) with respect to Treatment (3), due to VIF sheet, can explain (Table 1) the improvement of efficacy with the same gas dosage.

Solarization treatments (5) and (6) does not control inocula (Table 1) as treatments (2) and (4) but the effect (Table 3) of treatment (6) on foliar surface, plant weight, disease index, yield and weeds are similar to treatments (2) and (4).

Foliar surface of plants, as biomass parameter, points out (Table 3) treatments (4) and (2) as the best, the same occurs for weight.

Bromine residues in soil (Table 2) shows a small increment for treatment (4) due to the use of VIF sheet, but this increase is not significant. Fruit residues remain at the same level for treatments (2), (3) and (4). No negative side effects are appreciated.

The yield (Table 3) given by treatment (4) was almost identical to treatment (2), also treatment (6) was very interesting. Disease index (Table 4) of treatments (2), (4) and (6) were similar statistically. All treatments were better than control (1). Weeds were quite well controlled by all treatments as compared with control.

Generally all parameters studied show a close behavior, with non significant statistical differences, between standard application (2), half dosage with VIF sheet (4) and the treatment 1/4 dose + Solarization (6). Treatment (3) stays in an intermediate place between the best treatments and the Control. Solarization failed in part because the application was late (September) and the exposure to sun radiation was short (4 weeks).

Emission, calculated by using the mass balance approach, is reduced from 72% of bromine applied in standard treatment (2) down to 20 % for treatment (4) and 18 % for treatment (6). This signify a reduction of more than 70% on treatments (4) and (5) with regard to treatment (6) with similar results.

These techniques allow an important reduction of dosages up to 1/2 if VIF sheet is used and 1/4 if combined with solarization.

Future trends should lie in extending the technique to other crops and improving gas distribution when using lower dosage, study of emissions through the edges and mechanical application.

Table 1. Methil bromide concentration (g/m^3) per Time (Hr) product (CxT) and surviving *F. o. dianthi* and *P.Capsici* inocula per cent at 40 cm depth under soil surface.

Treatment	CxT	*F.o.dianthi*	*P. capsici*
(1) Control			
(2) 60 PE	2015 b	99.6 a	54.1 a
(3) 30 PE	1309 ab	99.5 b	32.1 abc
(4) 30 HT	1742 ab	99.7 a	55.4 ab
(5) Solarization		95.6 b	1.8 c
(6) 15 PE+Solariz.	1002 a	96.2 b	10.7 c

Table 2. Bromine (Br- ppm) residues from soil after disinfestation

Treatment	Depth 0-20 cm	Depth 20-40 cm
(2) 60 PE	37	25
(3) 30 PE	35	42
(4) 30 HT	43	47
(6) 15 PE+Solarization	25	21

Table 3. Average of foliar surface (cm^2/plant), weight (g/plant) and yield (g/plant), per treatment.

Treatment	Fol.Surface	P.Weight	Yield
(1) Control	738.7 a	41.7 a	725 a
(2) 60 PE	1706.1 cd	92.7 bc	1318 b
(3) 30 PE	1407.5 bcd	78.2 b	1156 b
(4) 30 HT	1905.0 d	115.2 c	1320 b
(5) Solarization	1055.6 ab	42.5 a	739 a
(6) 15 PE+Solari.	1358.2 bc	76.7 b	1235 a

Table 4. Average disease index (number of dead plants per cent), Fruit residues (Br- ppm), and weeds/m^2 per treatment.

Treatment	Disease Index	Residues	Weeds
(1) Control	33.2 a	2.6 a	3.9
(2) 60 PE	1.2 c	14.4 b	1.0
(3) 30 PE	16.0 b	14.1 b	0.3
(4) 30 HT	3.8 bc	15.1 b	0.2
(5) Solarization	12.3 b	3.2 a	0.8
(6) 15 PE+Solariz.	5.3 bc	6.4 a	0.1

Figures affected by the same letter are not significant differents p=0.05.