THREE YEARS OF SHORT-TERM ALTERNATIVES TO MB ON HUELVA STRAWBERRIES

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The experiments on strawberry reported in this communication are part of a project (INIA SC 97-130) supported by the Ministry of Science and Technology, in connection with the main grower's organization (Freshuelva), to find out short-term chemical and non-chemical alternatives to Methyl bromide (MB) for pre-planting fumigation. Strawberry fields pose the major problems in relation with the MB issue in Spain. Alternatives to the use of MB have been tested in two field experiments at real scale (Moguer and Cartaya) in the area of Huelva during 1997-1998, 1998-1999 and 1999-2000. The strawberry sector in Huelva uses the annual planting system with fresh plants. Planting dates are in October. The general sanitary status of the culture is usually well solved, it could be due to the traditional utilization of MB even in nurseries. The pathogens that usually cause problems in strawberry production at Huelva are *Botrytis cinerea* and *Sphaeroteca macularis*. In spite of that, the growers are familiarized traditionally with shank fumigation of 67-33 MB-chloropicrin (40 g/sm).

In two collaborating farms (Torreagro SA-Cartaya and Fresrica-Moguer) there were two permanent randomized complete blocks with three replications each, the size of each experimental unit was 400 sm testing the same alternatives in each location and block. Strawberry cv. "Camarosa" was grown every year with the normal production system; namely: last week of October as date of plantation with 55,000 plants/ha, small plastic tunnel protection and mulching with black lineal polyethylene (PE). Material and methods of 1997-1998 and 1998-1999 trials as well as general data and several results were reported on the last 1999 MBAO Conference at San Diego (López-Aranda, 1999). Maintaining the same alternatives in the same grounds than in 1997/1998 and 1998/1999, and shortening the soil solarization period to 4 weeks, the treatments for the third season of trials (1999-2000) started in the last week of July 1999 and they were similar to the formers or with slight variations of dosage or soil incorporation techniques: e.g. soil solarization with simultaneous shank-applied 75cc/sm of MS; changes in biofumigation technique: without solarization, sowing turnip at the end of July and green soil incorporation one month after and then additional supply of chicken manure, 5 kg/sm; shank application on preformed beds with 175 cc/sm of MS and dosage of Dazomet with 45 g/sm.

In 1997-1998, including controls, a very good sanitary status of plant material was evident. The chemical alternatives (Chloropicrin and Telone C-17) gave the highest yields, but at the same significance level than dosage reductions (VIF) and standard injection (40 g/sm) of MB (Table 1); however, soil solarization combined with chemical treatments (MS and MB)

were in a lower level of productivity, but not significantly different than the former treatments as suggested by Cebolla *et al.* (1995). Soil solarization alone or in combination with biofumigation and not pre-planting desinfestation controls gave the significantly poorest results (Tables 1 and 2). As observed in 1997-1998 and in 1998-1999 (López-Aranda, 1999), in the season of 1999-2000 the sanitary status of the trials was normal. In all cases, including controls, only a little amount of populations of *Meloidogyne* sp. with very low index of severity in plants was found in several plots of Cartaya. In these second and third years of trials, we have found out bigger and increasing differences among treatments in morphological traits (number of leaves and diameter of plants) (Table 4) and agronomical ones (yield and size of fruit) (Tables 1 to 3). Once more, in 1999 and in 2000 seasons, chemical alternatives: Chloropicrin, Telone C-35 (Telopic) and Dazomet gave the highest yields, but at the same significance level than dosage reductions and standard shank-applied (40 g/sm) MB. However, soil solarization combined with shank-applied chemical treatments ranked at a lower level of productivity than the former treatments. Alternatives with soil solarization alone or in combination with biofumigation and not pre-planting desinfestation controls gave, very significantly, the poorest yield results (Tables 1 and 2) as suggested by Duniway *et al.* (1999). The size of cv. "Camarosa" fruits has been affected by treatments influence in the same way than productivity (Table 3). In absence of relevant lethal pathological problems, these three years results point out the possible chemical alternatives with clear potential to maintain productivity, fruit quality and sanitary status levels, similar to MB standard utilization (40 g/sm) in this area (see "**MB (40g) wh.surf. (phys)**" treatments on Tables 1 to 4). This observation must be verified over more several seasons and connected with the nursery issue. Moreover, soil solarization technology must be improved and implemented very much. In relation with dosage reduction of MB treatments, very important to accompany European phase-out calendar, these results showed that there are no differences between standard dosage (40 g/sm) of MB and those treatments with a 50% dosage reduction (20 g/sm) under VIF plastic. The great morphological and agronomical differences among treatments found out only three years after the initiation of the trials can be related with soil stress fenomena and/or with the reduction of sublethal microorganisms (Larson and Shaw, 1995). This first set of data supports that short-term alternatives (chemicals and non chemicals) to MB exist for the strawberry. However, it is necessary to take a cautious attitude because it is not known the long-term effect of the lack of MB and the economical evaluation of new alternatives is under way.

References

Cebolla, V., Martínez, P.F., Gómez de Barreda, D., Tuset, J.J., Del Busto, A. and Vanacher, A. 1995. Dosage reduction of methyl bromide fumigation in the Spanish Mediterranean coast. Acta Horticulturae 382: 156-163.

Duniway, J.M., Xiao, C.L., Ajwa, H. and Gubler, W.D. 1999. Chemical and cultural alternatives to Methyl bromide fumigation of soil for strawberry. En: 1999 Annual International Research Conference on Methyl Bromide Alternatives and Emissions Reductions. G.L. Obenauf and A.Williams, eds: 2-1/2-2.

Larson, K.D. and Shaw, D.V. 1995. Strawberry nursery soil fumigation and runner plant production. HortScience 30(2): 236-237.

López-Aranda, J.M. 1999. The Spanish National Project on alternatives to MB: The case of strawberry. En: 1999 Annual International Research Conference on Methyl Bromide

Alternatives and Emissions Reductions. G.L. Obenauf and A.Williams, eds: 8-1/8-4.

Table 1. Commercial (g/plant) and Relative yield * in cv. "Camarosa". Two locations results

Season	1997-1998		1998-1999		1999-2000	
Cumulate yield	until May, 16th, 98		until May, 15th, 99		until May, 13th, 00	
Treatments	Total y.	Relative y.	Total y.	Relative y.	Total y.	Relative y.
Telone C-35 (40cc) (Telopic)	-	-	565 a	106	581 a	111
Telone C-17 (60cc)	648 a	106	-	-	-	-
MB (40g) pref.beds	637 a	105	527 abc	99	585 a	112
MB (20g) pref.beds VIF	630 a	103	544 abc	102	569 ab	109
Chloropicrin (40g)	663 a	109	551 ab	103	540 abc	103
Dazomet (45-50g) w. surf.	-	-	535 abc	100	565 ab	108
MB (40g) wh. surf.(chem).	625 ab	103	-	-	-	-
MB (20g) VIF whole. surf.	615 ab	101	-	-	-	-
MB (40g) wh.surf. (phys).	**610 ab**	**100**	**534 abc**	**100**	**522 abcd**	**100**
Solariz. + MS (100cc)	-	-	523 abc	98	-	-
Solariz. + MS (75cc)	-	-	-	-	510 bcd	98
Solariz. + MB (10g)	614 ab	101	500 c	93	515 bcd	99
Solariz. + MS (50cc)	598 abc	98	-	-	-	-
MS (125cc) pref.beds	-	-	513 bc	96	-	-
MS (175cc) pref.beds	-	-	-	-	489 cd	94
Biofumigation	-	-	-	-	459 d	88
Solariz. + Biofumig.	546 bcd	89	446 d	83	-	-
Solarization	546 bcd	90	434 ef	81	393 e	75
Control (no desinf.) chem.	523 cd	86	374 g	70	356 e	68
Control (no desinf.) phys.	497 d	82	387 fg	72	356 e	68

*Relative yield = % of productivity versus standardized shank-applied MB (67-33), 40 g/sm

Table 2. Early commercial (g/plant) and Relative yield in cv. "Camarosa". Two locations results

Season	1997-1998		1998-1999		1999-2000	
Cumulate yield	until March, 31st, 98		until March, 31st, 99		until March, 31st, 00	
Treatments	Total y.	Relative y.	Total y.	Relative y.	Total y.	Relative y.
Telone C-17 (60cc)	271 a	101	-	-	-	-
Dazomet (45-50g) w. surf.	-	-	193 ab	101	247 a	101
MB (20g) pref.beds VIF	261 ab	97	196 a	103	248 a	101
MB (40g) wh. surf.(chem).	267 a	100	-	-	-	-
MB (40g) wh.surf. (phys).	**267 a**	**100**	**191 ab**	**100**	**245 ab**	**100**
Solariz. + MS (50cc)	264 ab	99	-	-	-	-
Solariz. + MS (100cc)	-	-	189 ab	99	-	-
Chloropicrin (40g)	278 a	104	184 ab	96	230 ab	94
MB (20g) VIF whole. surf.	263 ab	98	-	-	-	-
MB (40g) pref.beds	259 abc	97	188 ab	99	237 ab	97
Solariz. + MB (10g)	265 ab	100	173 abcd	91	239 ab	98
Telone C-35 (40cc) (Telopic)	-	-	179 abc	94	237 ab	97
MS (125cc) pref.beds	-	-	178 abc	94	-	-
Solariz. + MS (75cc)	-	-	-	-	223 bc	91
Solariz. + Biofumig.	240 bcd	90	172 bcd	90	-	-
Biofumigation	-	-	-	-	200 c	82
MS (175cc) pref.beds	-	-	-	-	202 c	82
Solarization	233 cd	87	160 cd	84	171 d	70
Control (no desinf.) phys.	221 de	83	152 de	80	154 d	63
Control (no desinf.) chem.	205 e	77	134 e	70	150 d	61

Table 3. Final fruit size (g/fruit) in cv. "Camarosa". Two locations results

Season	1997-1998	1998-1999	1999-2000
Treatments	Fruit size	Fruit size	Fruit size
Telone C-35 (40cc) (Telopic)	-	26.0 a	28.4 a
MB (40g) pref.beds	25.9 a	25.1 ab	28.0 a
Chloropicrin (40g)	25.0 abcd	25.4 ab	27.6 ab
MB (20g) pref.beds VIF	25.4 ab	25.3 ab	27.4 abc
Dazomet (45-50g) w. surf.	-	25.5 ab	26.5 bcde
MB (40g) wh.surf. (phys).	**25.2 abc**	**25.6 ab**	**27.3 abcd**
Solariz. + MS (75cc)	-	-	26.2 cde
MS (175cc) pref.beds	-	-	25.4 e
Solariz. + MS (50cc)	25.4 ab	-	-
Telone C-17 (60cc)	25.3 abc	-	-
MB (20g) VIF whole. surf.	25.3 abc	-	-
Solariz. + MB (10g)	25.0 abcd	24.7 ab	26.0 de
MB (40g) wh. surf.(chem).	24.9 bcd	-	-
Solariz. + MS (100cc)	-	24.4 b	-
MS (125cc) pref.beds	-	24.4 b	-
Biofumigation	-	-	23.9 f
Solariz. + Biofumig.	24.9 bcd	22.7 c	-
Solarization	24.2 de	22.8 c	24.1 f
Control (no desinf.) chem.	24.4 cde	22.5 c	21.9 g
Control (no desinf.) phys.	23.9 e	21.9 c	22.9 fg

Table 4. Leaves/plant and Plant diameter (cms) at the end of march-april in cv. "Camarosa. Two locations results

Season	1997-1998	1998-1999	1999-2000	1997-1998	1998-1999	1999-2000
Treatments	Leaves March,20th	Leaves April, 5-6th	Leaves April, 12-18th	Diameter March,20th	Diameter April, 5-6th	Diameter April,12-18th

Chloropicrin (40g)	12.02 de	19.2 a	24.0 ab	27.5 cd	30.2 abc	32.2 ab
Telone C-17 (60cc)	13.9 bcd	-	-	28.2 c	-	-
Telone C-35-40cc Telopic	-	20.4 a	26.4 a	-	29.9 bcd	34.6 a
MB (40g) pref.beds	11.4 e	20.1 a	23.4 ab	27.5 cd	29.8 bcd	33.0 ab
MB (20g) pref.beds VIF	12.6 de	20.4 a	25.2 ab	27.7 cd	29.8 bcd	33.6 ab
MB (40g) wh.surf.(chem).	11.3 e	-	-	27.3 cd	-	-
MB (20g) VIF whole.surf.	13.1 cde	-	-	27.5 cd	-	-
Dazomet (45-50g) w. surf.	-	20.1 a	24.4 ab	-	31.7 a	32.4 ab
Solariz. + MB (10g)	15.8 b	19.5 a	25.1 ab	34.1 ab	30.4 ab	32.0 ab
MB (40g) wh.surf.(phys).	**19.4 a**	**19.6 a**	**26.5 a**	**36.3 a**	**30.7 ab**	**33.9 ab**
Solariz. + MS (50cc)	13.9 bcd	-	-	33.0 b	-	-
Solariz. + MS (100cc)	-	19.3 a	-	-	29.5 bcd	-
Solariz. + MS (75cc)	-	-	21.5 bc	-	-	30.2 bc
MS (125cc) pref.beds	-	18.4 ab	-	-	28.7 cd	-
MS (175cc) pref.beds	-	-	23.0 ab	-	-	31.8 ab
Solarization	13.9 bcd	15.9 c	18.2 cd	34.5 ab	27.1 ef	26.9 c
Biofumigation	-	-	21.4 bc	-	-	29.8 bc
Solariz. + Biofumig.	15.9 b	18.5 a	-	33.1 b	28.4 de	-
Control (no desinf.) chem.	11.9 de	14.2 c	17.9 cd	25.7 d	25.7 f	27.4 c
Control (no desinf.) phys.	15.0 bc	15.4 c	16.5 d	32.1 b	25.5 f	26.3 c