CHEMICAL ALTERNATIVES TO MB FOR STRAWBERRY NURSERIES IN SPAIN. 2002 RESULTS.

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Funding from the National project INIA SC 97-130 on alternatives to Methyl Bromide (MB) has allowed five years of work on chemical alternatives for high-elevation strawberry nurseries in Spain. Results (1998-2001) were presented in MBAO Conference and elsewhere (De Cal et al., 2002; López-Aranda, 1999; López-Aranda et al., 2002; Melgarejo et al., 2001). Up to 2001, high-elevation nursery peculiarities such as high geographical mobility, previous crops, application of fumigant treatments in winter, etc, have caused different patterns on each year and location (inconsistent results). The trials reported herein, corresponding to 2002, are the last of a series started in 1998. These trials were carried out in two nurseries: Viveros California Inc. (Vinaderos-3, Avila) and Viveros Rio Eresma Inc. (Navalmanzano-5, Segovia) in Castile-Leon (Northern-Central part of Spain), named as locations 1 and 2, respectively. The experimental design on each nursery was in complete randomized blocks with 3 large replications of 275 m^2 each and 10 fumigant treatments (Table 1). New alternatives, incorporated for first time in Spain on the 2002 nursery experiments, were MB-Pic (33-67) broadcast shank-applied under transparent VIF film, to minimize the use and emissions of MB, and DMDS (Dimethyldisulfide) broadcast shank-applied under transparent PE, a very interesting and promising European solution due to its zero ODP and very low toxicity profile. Preceding crops were cereals and sugar beet in location 1 and vegetables (carrots, asparagus) in location 2. Fumigation dates were April 3-4, (1^{st} longitudinal pass of applications) and April 16 (2^{nd} longitudinal pass of applications), 2002. Table 2 reports a summary of the climatic conditions during fumigant applications. Cv. 'Camarosa' mother-plants from Californian nurseries were planted in May 7 (location 2) and May 9-11 (location 1), 2002. Commercial daughter runner plants were harvested in October 2 (location 2) and October 8 (location 1), 2002. Soil samples from each nursery were evaluated before (March 25) and after (May 5) treatments in selective media. Total colony forming units per gram of dry soil (cfu/g) of soil-borne fungi *Fusarium, Phytophthora, Pythium*, *Rhizoctonia*, and *Verticillium*

were estimated in each replication. A large sample of 600 mother plants from each field experiment was examined before planting. Four times (July 2, July 27, August 28, September 25) during the strawberry growing period (initial, medium and full running activity, and just before digging), 20 runner plants were randomly chosen from the central row in each replication and analyzed to calculate the incidence of diseased plants (%) for each treatment. Weeding was recorded by two different ways: a) cost of weed elimination in location 1 (Vinaderos-3) (Table 3); b) fresh and dry weight of weeds eliminated from a sample of 5 m length of row per replication and location (Table 4).

Total fungal population was homogeneous in both locations before fumigant treatments, ranging from 2.3 x 10^4 to 8.0 x 10^4 cfu/g of dry soil in Vinaderos-3, and from 3.8 x 10^4 to 9.7 x 10^4 cfu/g of dry soil in Navalmanzano-5. Presence of *Penicillium* spp. was predominant; genera *Alternaria, Fusarium, Cladosporium, Trichoderma, Rhizoctonia* and *Morteriella* were also present. Initial population of *Verticillium* sp. was 10^3 and 10^2 cfu/g of dry soil and population of *Phytophthora cactorum* was 10^2 cfu/g of dry soil in Vinaderos-3 and Navalmanzano-5, respectively. Initial total soil-borne fungal population was reduced significantly after fumigant treatments, with the exception of Control and DMDS treatments in Vinaderos-3. The largest reduction was achieved by Dazomet treatment. However, fungal population reduction after treatments was not significant in Navalmanzano-5. Before planting, mother plant samples from Californian nurseries showed a good sanitary status, although 20.5% of plants from Vinaderos-3 plants showed frost damage (probably due to cold-stored shipment from California); 3.9% and 2.8% of mother plants presented symptoms of disease caused by *Phytophthora cactorum* in Vinaderos-3 and Navalmanzano-5, respectively. In relation with the incidence of diseased plants (%) during the growing season, small problems were detected (5% of runner plants in both locations with symptoms of disease caused by *Phytophthora cactorum* symptoms) only in Control replications. The most important problem detected was of abiotic origin, a strong storm occurred in Navalmanzano-5 at mid-August caused important flooding in all treatments with subsequent problems of plant stress. Results regarding fresh commercial daughter plants harvested are presented in Table 5. In general, the number of plants harvested in Navalmanzano-5 was much lower than in Vinaderos-3, probably due to stress suffered by the plants as a result of the flooding at mid-August. Only after MB (40) treatment, standard in strawberry nurseries, yields in both locations were similar. Yields obtained with other MB solutions, MB(20)VIF and MB (33/67)VIF were inconsistent. In spite of the poor weed control observed with Vapam (Table 4), this treatment showed better results than in former experiments and years. Telopic and Telopic VIF results in Navalmanzano-5 were poorer than expected. Dazomet and DMDS treatments need to be implemented by means of VIF film utilization and/or combinations with chloropicrin. As in previous years, the two-location 2002 experiments showed that agronomic results are not consistent enough. For this reason, application for critical use exemption for the Spanish high-elevation strawberry nurseries has been presented and recommended by MBTOC in 2003.

References

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Table 1. MB Alternatives 2002. High-elevation nursery trials in Castile-Leon.

Treatments	Description
Control	Check without any kind of soil disinfestation
MB(40)	MB-Pic (50-50), 40 g/m^2 broadcast shank-applied under transp. PE
MB(20)VIF	MB-Pic (50-50), 20 g/m^2 broadcast shank-applied under transp. VIF
MB(33/67)VIF	MB-Pic (33-67), 20 g/m^2 broadcast shank-applied under transp. VIF
Dazomet	Dazomet, 50 g/m^2 broadcast, rotovator incorporation and sealed under transp. PE
Telopic	1,3D+Pic (61-35), 40 cc/m^2 broadcast shank-applied under transp. PE
Telopic VIF	1,3D+Pic (61-35), 20 cc/m^2 broadcast shank-applied under transp. VIF
Vapam	Metam Sodium, 125 cc/m^2 broadcast shank-applied under transp. PE
MetamK	Metam Potassium, 160 cc/m^2 broadcast shank-applied under transp. PE
DMDS	DMDS, 80g/m^2 broadcast shank applied under transp. PE

Table 2.- Climatic conditions during fumigant treatment applications. Year 2002.

Location	1st pass	2nd pass	T soil (ºC)	T air (ºC)	Wind	Soil humidity	T soil (ºC) under plastic
Vinaderos-3	Apr. 04	-	9.6	7.0	Strong	Very high	nd
Navalmanzano-5	Apr. 03	-	9.0	5.0	Strong	Very high	nd
Vinaderos-3	Apr. 11	2nd pass cancelled because 4ºC in soil and 1ºC in air (noon)					
Vinaderos-3	-	Apr. 16 (morning)	9.3	10.1	Weak	Normal (field capac.)	12.5
Navalmanzano-5	-	Apr. 16 (afternoon)	16.5	19.0	Weak	Dry	24.6

Table 3.- Weeding. Estimated cost per ha in Location 1 (Vinaderos-3) (Euros/ha).

Treatments	Mother-plant rows weeding	1st broadcast weeding	2nd broadcast weeding	3rd broadcast weeding	Total cost (€/ha)
	June 8	July 5	August 6	September 9	
Control	240	870	320	9,350	10,780
MB(40)	240	90	320	420	1,070
MB(20)VIF	240	70	320	420	1,050
MB(33/67)VIF	240	80	320	420	1,060
Dazomet	240	80	320	420	1,060
Telopic	240	70	320	420	1,050
Telopic VIF	240	80	320	420	1,060
Vapam	240	140	320	420	1,120
MetamK	240	100	320	420	1,080
DMDS	240	380	320	7,060	8,000

Table 4.- Weeding. Fresh and dry weight of weeds[1].

Treatments	1st sampling: July 4, 2002				2nd sampling: August 13, 2002			
	Vinaderos-3 (loc.1)		Navalmanzano-5 (loc. 2)		Vinaderos-3 (loc.1)		Navalmanzano-5 (loc. 2)	
	Fresh	Dry	Fresh	Dry	Fresh	Dry	Fresh	Dry
Control	2951	418	2850	669	30241 a	7155 a	3637 ab	979 a
MB(40)	0	0	13	7	3705 b	204 b	2210 abc	640 ab
MB(20)VIF	13	5	21	1	0 b	0 b	782 bc	301 ab
MB(33/67)VIF	37	12	2	0	0 b	0 b	227 c	28 b
Dazomet	0	0	28	6	0 b	0 b	2127 c	586 ab
Telopic	1	0	33	4	2358 b	672 b	106 c	21 b
Telopic VIF	65	30	1	0	217 b	30 b	147 c	23 b
Vapam	3124	484	25	7	14930 ab	3263 ab	238 c	102 b
MetamK	375	55	56	11	1263 b	273 b	91 c	57 b
DMDS	758	108	593	110	23790 a	5443 a	3950 a	570 ab
					P = 0.05			

[1] Sample: g per replication in a 5 m length of rows

Table 5.- Harvested commercial daughter runner plants.

Treatments	Vinaderos-3 (loc.1)	Navalmanzano-5 (loc. 2)	Two locations average
MB(40)	556667 ab	566667 a	561667 a
MB(20)VIF	636667 a	430000 ab	533333 ab
Vapam	546667 abc	493333 ab	520000 abc
MB(33/67)VIF	566667 ab	423333 ab	495000 abc
Telopic	616667 ab	370000 b	493333 abc
Telopic VIF	546667 abc	420000 ab	483333 abcd
MetamK	530000 abc	370000 b	450000 bcd
DMDS	473333 bcd	396667 b	435000 cd
Dazomet	420000 cd	366667 b	393333 d
Control	380000 d	193333 c	286667 e
P = 0.05			