ALTERNATIVES TO MB FOR STRAWBERRY NURSERIES IN SPAIN. 2004 RESULTS.

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The National project INIA on alternatives to Methyl Bromide (MB) has allowed seven years of work on alternatives for high-elevation strawberry nurseries in Spain. Up to 2003, high-elevation nursery peculiarities have caused inconsistent results on experiment and demonstrations fields. The activities reported herein, corresponding to 2004, are the last of a series started in 1998. These activities (named experiments) were carried out in two nurseries: Viveros California Inc. (Vinaderos-5, Avila) and Viveros Rio Eresma Inc. (Navalmanzano-7, Segovia) in Castile-Leon (Northern-Central part of Spain), locations 1 and 2, respectively. The experimental design on each nursery was a 10 fumigant treatment complete randomized blocks with 4 large replications of 137.5 m^2 each. To emphasize differences between 2003 and 2004 experiments, treatments are presented in Table 1. Alternative treatments incorporated on 2004 experiments were similar to those applied on 2003 season but in general with increased dose (i.e. MB+pic, Dazomet, DMDS+pic and Propozone, all of them under VIF film). Preceding crops were cereals and fallow in location 1, and vegetables (carrots, asparagus, potatoes) in location 2. Fumigation dates were April 2-5, 2004, with averaged 7-8ºC soil temperature and rainy weather. Cv. 'Camarosa' mother-plants from Californian nurseries were planted in May 4-5, 2004. Commercial daughter runner plants were recorded (harvested) in October 5-6, 2004.

Beside these experiments, a field demonstrations program has been carried out by the National project INIA in two different locations (named demonstrations): Viveros Grufresa Inc. (Avila, Cabezas de Alambre-2) and Viveros Herol Inc. (Segovia, Mudrián-2). Field demonstrations are presented in Table 2. Preceding crops were strawberry nursery in Cabezas de Alambre-2 and vegetables in Mudrián-2. Fumigation dates were March 17-18, and 24-25, 2004. Cv. 'Camarosa' mother-plants were planted in April 29-30, 2004. Commercial daughter runner plants were harvested in October 29-30, 2004.

Soil samples from each field experiment were evaluated before (March 3) and after (April 28) 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 400 mother plants from each field experiment was examined before planting. Three times (June 25, July 23, September 9) during the strawberry growing period (initial, medium and full running activity), 20 runner plants were randomly chosen in each replication and analyzed to calculate the incidence of diseased plants (%) per each treatment.

To track weeds populations in field experiments, areas of 3.5 m^2 per replication were left without weeding during the growing season. In the case of field demonstrations two areas of 15 m^2 per demonstration were left without weeding. In both activities (experiments and demonstrations), sampling was carried out in six dates, from mid-June until first-October, and the estimated variables were the total number of weeds present in each treatment and the total fresh weight, considering all the species as a whole. The results regarding presence of weeds are summarized in Table 3 and 4.

Total fungal population (field experiments) was homogeneous in both locations before fumigant treatments. The total initial soil-borne fungal population was reduced significantly after all fumigant treatments. The results will be discussed. Before planting, mother plant samples from Californian nurseries showed a good sanitary status. In location 1 (Vinaderos-5): 2.5% of plants with frost damage (due to cold-stored shipment from California) and 0.25% presented symptoms of *Colletotrichum* sp. In location 2 (Navalmanzano-7): 4.5% of plants presented symptoms of *Phytophthora cactorum* and 0.25% *Rhizoctonia solani*. In relation with the incidence of diseased plants (%) during the growing season, after the evaluation of 800 runner plants per date of sampling (3) and location (2), only small problems were observed. The most important problems detected were of abiotic origin, strong storms occurred several times in both locations during the summer.

Results related to the herbicide efficiency of different chemical alternatives, have evidenced that in the case of field experiments (Vinaderos-5) and demonstrations (Cabezas de Alambre-2) carried out after cereals/fallow and MB nursery, weed control has been quite similar to standard MB+pic after all fumigant treatments; however in the case of field experiments (Navalmanzano-7) and demonstrations (Mudrián-2) after vegetables (carrots, asparagus, potatoes), weed control has not been consistent enough (Table 3 and 4).

The results regarding fresh commercial plants harvested (field experiments) are presented in Table 5. As in previous years, the two-location 2004 experiments showed that agronomic results are not consistent enough. Furthermore, field demonstrations showed yield inconsistency (Table 6).

Table 1. MB Alternatives 2003 and 2004. High-elevation nursery field experiments.

2003 Experiments		2004 Experiments	
Treatments	Description	Treatments	Description
Control PE	Untreated	Control PE	Untreated
MB(50/50)[1]PE	40 g/m^2 - 8 chisels	MB(50/50)[1] PE	40 g/m^2 - 8 chisels
MB(33/67)[1]VIF	20 g/m^2 - 8 chisels	MB(33/67)[1]VIF	30 g/m^2 - 8 chisels
Dazomet VIF	35 g/m^2 - rototilled	Dazomet VIF	40 g/m^2 - rototilled
Telopic VIF	30 g/m^2 - 8 chisels	Telopic VIF	30 g/m^2 - 8 chisels
Pic VIF	30 g/m^2 - 8 chisels	Pic VIF	30 g/m^2 - 8 chisels
MS+Pic VIF	40+25 g/m^2 - 8 chisels	MS+Pic VIF	40+25 g/m^2- 8 chisels
DMDS VIF	65 g/m^2 - 8 chisels	MB(50/50)[1]VIF	30 g/m^2 - 8 chisels
DMDS+Pic VIF	20+20 g/m^2 - 8 chisels	DMDS+Pic VIF	25+25 g/m^2 - 8 chisels
Propozone PE	30 g/m^2 - 8 chisels	Propozone VIF	50 g/m^2 - 8 chisels
[1]MB+Pic mixture; All treatments were broadcast applied			

Table 2. MB Alternatives 2004. Nursery field demonstrations.

Treatment	Demo surface (m^2)
MB-Pic (50:50) 400 kg/ha PE	2,500
MB-Pic (33:67) 300 kg/ha VIF	2,500
Telopic 300 kg/ha VIF	2,500
Pic alone 300 kg/ha VIF	2,500
Dazomet 400 kg/ha VIF	2,500

Table 3. Field experiments. Weed presence[1].

	Total number of weeds		Total fresh weight (g)	
Treatments	Navalmanzano-7	Vinaderos-5	Navalmanzano-7	Vinaderos-5
Control PE	652.68 a	64.25 a	1278.1 a	240.54 a
MB(50/50) PE	11.42 b	0.17 b	119.9 bc	0.96 b
MB(33/67)VIF	9.75 b	0.88 b	77.0 bc	2.17 b
Dazomet VIF	3.29 b	0.29 b	51.5 c	1.42 b
Telopic VIF	29.67 b	1.17 b	314.6 b	8.42 b
Pic VIF	29.79 b	3.21 b	264.3 bc	18.79 b
MS+Pic VIF	13.17 b	1.88 b	188.7 bc	9.00 b
MB(50/50)VIF	5.29 b	0.17 b	52.0 c	0.92 b
DMDS+Pic VIF	5.21 b	0.75 b	54.0 c	1.79 b
Propozone VIF	11.79 b	6.04 b	106.6 bc	17.96 b
$P \leq 0.05$. Duncan test; [1]Areas of 3,5 m^2 per replication without weeding during the growing season				

Table 4. Field demonstrations. Weed presence[1].

	Total number of weeds		Total fresh weight (g)	
Treatments	C. Alambre-2 (Avila)	Mudrián-2 (Segovia)	C. Alambre-2 (Avila)	Mudrián-2 (Segovia)
MB-Pic (50:50) 400 kg/ha PE	1.42 a	11.8 b	6.42 a	35.0 b
MB-Pic (50:50) 300 kg/ha VIF	1.42 a	574.8 a	9.75 a	3442 a
Telopic 300 kg/ha VIF	2.58 a	455,5	27.0 a	5189 a
Pic alone 300 kg/ha VIF	7.42 a	378.0 ab	85.75 a	4852 a
Dazomet 400 kg/ha VIF	2.08 a	233.6 ab	7.33 a	1827 a
$P \leq 0.05$. Duncan test; [1]Areas of 2x15 m^2 without weeding during the growing season				

Table 5. Field experiments. Harvested commercial runner plants per hectare.

Treatments	Vinaderos-5 (loc.1)	Navalmanzano-7 (loc. 2)	Two locations average
Control PE	315,000 d	352,500 d	333,750 d
MB(50/50)[1] PE	447,500 ab	507,500 abc	477,500 abc
MB(33/67)[1]VIF	440,000 abc	532,500 abc	486,250 ab
Dazomet VIF	412,500 abc	440,000 bcd	426,250 bc
Telopic VIF	435,000 abc	547,500 abc	491,250 ab
Chloropicrin VIF	412,500 abc	572,500 ab	492,500 ab
MS+Pic VIF	402,500 abc	565,000 ab	483,750 ab
MB(50/50) VIF	465,000 a	612,500 a	538,750 a
DMDS+Pic VIF	382,500 bcd	522,500 abc	452,500 bc
Propozone VIF	375,000 cd	422,500 cd	398,750 cd
$P \leq 0.05$. LSD test			

Table 6. 2004 Field demonstrations. Harvested commercial runner plants per hectare.

		Locations	
Treatment	Demo surface (m^2)	Cabezas Alambre-2 (Avila)	Mudrián-2 (Segovia)
MB-Pic (50:50) 400 kg/ha PE	2,500	665,000	637,000
MB-Pic (33:67) 300 kg/ha VIF	2,500	707,000	491,300
Telopic 300 kg/ha VIF	2,500	623,000	598,000
Pic alone 300 kg/ha VIF	2,500	476,000	439,300
Dazomet 400 kg/ha VIF	2,500	287,000	450,000