STRAWBERRY NURSERIES IN SPAIN: ALTERNATIVES TO MB, 2005 RESULTS.

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The National project INIA on alternatives to Methyl Bromide (MB) has allowed eight years of work on chemical ones for high-elevation strawberry nurseries in Spain. The activities reported herein, corresponding to 2005, are the last of a series started in 1998. These activities (named experiments) were carried out in two nurseries: Viveros California Inc. (Palacios Rubios, Avila) and Viveros Rio Eresma Inc. (Navalmanzano, 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, 2004 and 2005 experiments, treatments are presented in Table 1. Alternative treatments incorporated on 2005 experiments (all of them under VIF film) were similar to those applied on 2003 and 2004, but in general with increased dose and several new mixtures (i.e. Dazomet+Telopic, Enzone+pic, Propozone+MS). EDN (Cyanogen) was applied for first time at experimental level in Europe. Preceding crops were cereals in both locations. Fumigation dates were April 6-7, 2005, with averaged 7-8ºC soil temperature and good weather. Cv. 'Camarosa' mother-plants from Californian nurseries were planted in May 6-7, 2005. Commercial daughter runner plants were recorded (harvested) in October 10-11, 2005.

Beside these experiments, similar to 2003 and 2004, 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) and Viveros Herol Inc. (Segovia, Mudrián). Field demonstrations are presented in Table 2. Preceding crops were cereals in both locations. Fumigation, planting and harvesting dates were similar to those utilized for experiments.

Soil samples from each field experiment were evaluated before (March, 29) and after (May, 5) soil fumigant treatments in selective media. Total colony forming units per gram of dry soil (CFU/g) of *Fusarium, Phytophthora, Pythium*, *Rhizoctonia,* and *Verticillium* were estimated in each replication (Figures 1 and

2). A large sample of 360 mother plants from each field experiment was examined before planting. Three times (July 28, September 13 and October 10) during the strawberry growing period (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. Results on soil borne fungi control will be discussed. To track weed populations, areas of 3.5 m^2 per replication in field experiments and two areas of 15 m^2 per demonstration were left without weeding during the growing season. 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 presence of weeds is summarized in Table 3. Results on weed control will be discussed.

The results regarding fresh commercial plants harvested (field experiments) are in Table 4. As in previous years, the 2005 experiments showed that agronomic results are not consistent enough. Furthermore, field demonstrations showed yield inconsistency (Table 5). Results and MB current status on strawberry plant production will be discussed. So far, inconsistency on weed control and yield stability results remains for the most important chemical alternative to MB in strawberry nurseries.

Table 1. MB Alternatives 2003, 2004 and 2005. 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
2005 Experiments:			
Treatments	Description		
T1: Control PE	Untreated		
T2: DMDS+Pic VIF	40+15 g/m^2 - 8 chisels		
T3: MB(50/50)[1] PE	40 g/m^2 - 8 chisels		
T4: MS+Pic VIF	50+15 g/m^2- 8 chisels		
T5: Propozone+MS	45+30 g/m^2 - 8 chisels		
T6: Pic VIF	30 g/m^2 - 8 chisels		
T7: EDN VIF	40 g/m^2 - 8 chisels		
T8: Enzone+Pic VIF	50+15 g/m^2- 8 chisels		
T9: Dazomet +Telopic VIF	25+20 g/m^2 - 8 chisels		
T10: Telopic VIF	30 g/m^2 - 8 chisels		
[1]MB+Pic mixture; All treatments were broadcast applied			

Table 2. MB Alternatives 2005. Nursery field demonstrations.

Treatment	Demo surface (m^2)
MB-Pic (50:50) 400 kg/ha PE	1,000
Telopic 600 kg/ha PE	1,000
Telopic 350 kg/ha VIF	1,000
Pic alone 350 kg/ha VIF	1,000

Table 3. Field experiments. Weed presence. Number of weed/sampling

	Locations			Locations	
Experiments	P.Rubios	Navalmanz.	Demonstrations	C.Alambre	Mudrián
T1: Control PE	85.15 a	128.95 a	MB-Pic (50:50) 400 kg/ha PE	0.6 a	14.6 ab
T2: DMDS+Pic VIF	0.65 b	6.45 b	Telopic 600 kg/ha PE	0.7 a	27.6 ab
T3: MB(50/50) PE	0.65 b	1.45 b	Telopic 350 kg/ha VIF	1.8 a	4.9 b
T4: MS+Pic VIF	0.35 b	2.95 b	Pic alone 350 kg/ha VIF	2.1 a	78.6 a
T5: Propozone+MS	1.70 b	7.55 b			
T6: Pic VIF	3.65 b	6.05 b			
T7: EDN VIF	1.05 b	4.85 b			
T8: Enzone+PicVIF	24.90 b	7.45 b			
T9: Dazomet +Telopic VIF	0.90 b	1.85 b			
T10: Telopic VIF	1.60 b	4.00 b			
P ≤ 0.05. Duncan test;					

Table 4. 2005 Field experiments. Harvested commercial runner plants per hectare.

Treatments	P.Rubios (loc.1)	Navalmanzano (loc. 2)	Two locations aver.
T3: MB(50/50) PE	467,500 a	595,000 a	531,250 a
T6: Pic VIF	470,000 a	442,500 b	456,250 ab
T2: DMDS+Pic VIF	437,500 ab	442,500 bc	440,000 ab
T7: EDN VIF	455,000 a	410,000 bc	432,500 ab
T10: Telopic VIF	405,000 abc	445,000 b	425,000n ab
T5: Propozone+MS	360,000 d	470,000 b	415,000 b
T4: MS+Pic VIF	395,500 abc	422,500 bc	407,500 b
T8: Enzone+PicVIF	325,000 d	435,000 b	380,000 bc
T9: Dazomet +Telopic VIF	242,500 d	325,000 c	283,750 cd
T1: Control PE	225,500 d	175,200 d	197,500 d
P ≤ 0.05. LSD test			

Table 5. 2005 Demonstrations. Harvested commercial runner plants per hectare.

Treatment	Surface (m^2)	Cabezas Alambre (Avila)*	Mudrián (Segovia)
MB-Pic (50:50) 400 kg/ha PE	1,000	615,310	506,980
Telopic 600 kg/ha PE	1,000	482,365	346,630
Telopic 350 kg/ha VIF	1,000	505,070	365,420
Pic alone 350 kg/ha VIF	1,000	563,310	307,400
*date of harvest: October 25, 2005			

Figure 1: Location 1 (P. Rubios, Avila).

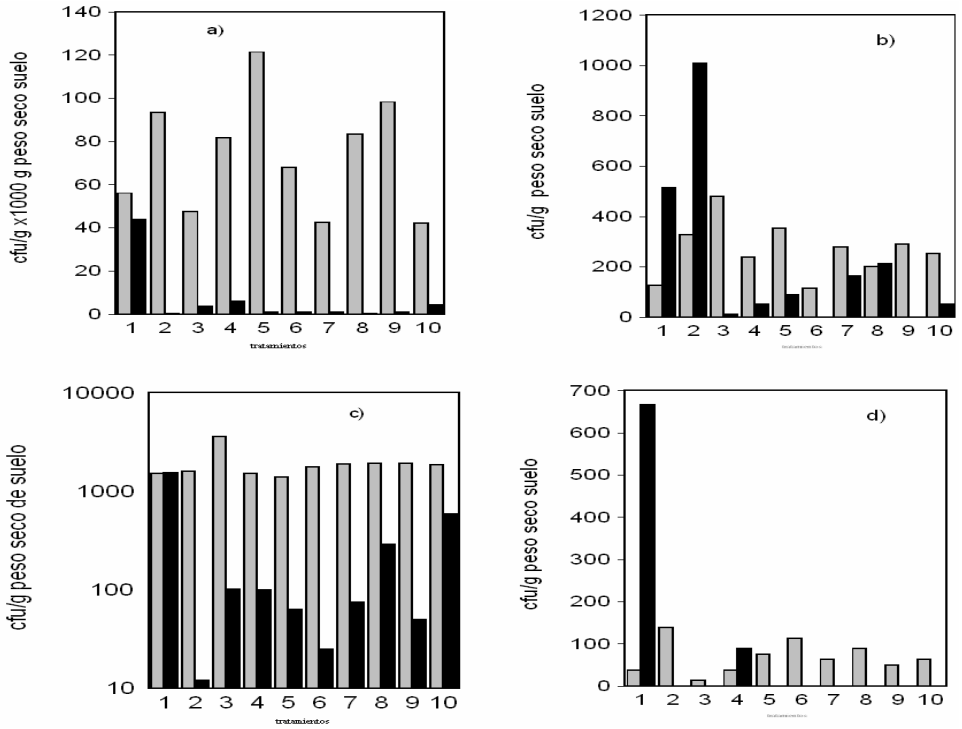
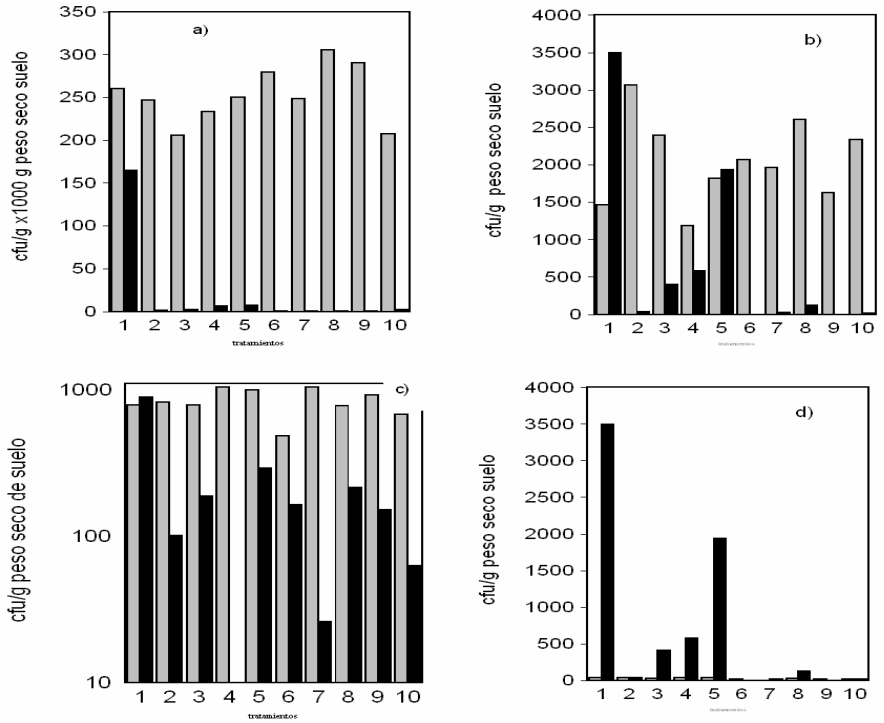


Figure 1: Location 2 (Navalmanzano, Segovia).



a) Total fungal population ; b) *Fusarium* population ; c) *Pythium* population ; d) *Verticillium* population, before (□) and after (■), fumigant treatments. CFU/g of dry soil x 1000 in the case of a). 1, 2, …10 are treatments T1,T2, …T10, respectively.