Promising results in Europe with DMDS for soil fumigation

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Summary

Existing soil fumigants in Europe are under re-evaluation in accordance with the directive 91/414/CE and their inscriptions or non in Anex I are forecasted before 2010.
Therefore, we also have to consider any other potential alternatives under development as Dimethyl Disulfure, DMDS (CH3-S-S-CH3). DMDS is a natural molecule naturally found in alliums and used as a flavour agent produced by Arkema.
For seven years Arkema in collaboration with UPL Cerexagri has been developing DMDS in the US, Europe and Mediterranean countries for soil disinfestation in shank and drip applications (pure product and 95% Emulsifiable Concentrate). This compound has a zero Ozone Depletion Potential and has a favourable toxicological and eco-toxicological profile
New experimental trials were carried out in order to evaluate the effectiveness on strawberries & vegetables for nematodes and soil diseases control in Belgium, France, Spain & in Italy.
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Keywords

Dimethyl Disulfide, soil fumigation, strawberries, vegetables, alternative, Europe

INTRODUCTION

All trials were carried out in compliance with the principles of good experimental practices.
Strawberries trials were conducted in France (Perigord) by Hortis Aquitaine & LNDS Laboratory; in Italy (Emilia Romagna, Veneto & Campana) by field trial company, in Spain (Huelva area) by IFAPA.
Carrots trials were conducted in Belgium (Flanders), France (Landes & Normandie), Italy (Lazio & Emilia Romagna) & Spain (Valencia area) by LNDS laboratory, the University of Leuven in Belgium, French Institutes (CTIFL, HORTIS Aquitaine, SILEBAN), French growers association (Altus), & field trial company.
Tomato & eggplants trials were conducted in Italy (Albenga area & Sicily) by DIVAPRA.

MATERIALS AND METHODS

Strawberries trials

The purpose of strawberries trials was to evaluate DMDS (code number ATOMAL 07) at 40-80 g/m^2 & DMDS in combination with chloropicrin at 25+25 g/m^2, 40+10 g/m^2 , 20+20 g/m^2 , 25+15 g/m^2 in comparison with the standard treatments Methyl bromide (MB), MB + chloropicrin, Metam sodium and 1.3-dichloropropene (1.3d) +chloropicrin (table 1)
Products were injected with shank equipment in a broadcast application (France & Italy) or bed shank application (Spain) and plots were covered immediately after application with virtually impermeable films. All the assessments were carried out to evaluate crop safety, nematicide effect and yield (weight of marketable strawberries). Harvest was evaluated in measuring total marketable and unmarketable yield. Nematode damage or nematodes number *(Meloidogyne sp, Pratylinchus sp)* were also evaluated in these trials.

Carrots trials

DMDS (code number ATOMAL 07) has been tested at doses between 20-60 g/m². by injection with a shank equipment in a broadcast application. Some plots were covered immediately after application with virtually impermeable films (VIF), others were not

covered. In that case several sealing materials (rollers) were used. The trials also included standard treatment 1,3d at 10-35 g/m². All the assessments were carried out to evaluate herbicide, fungicide & nematicide effect and yield (weight of marketable carrots).

Tomatoes, eggplants & cucumber trials

Emulsifiable concentrate of DMDS (code number ATOMAL 11) has been tested at doses between 20-80g/m² and in combination with chloropicrin at 20+20, 30+10 g/m^2 , 35+5 g/m^2 in drip fumigation under VIF in comparison with methyl bromide, 1.3d+chloropicin & chloropicrin alone. Drip application was carried out with an average water volume of 20litres/m^2. For example drip irrigation was carried out in broadcast with drip lines (17 mm diameter) equipped with water nozzle (flow rate 2.4 l/h)., placed on the soil surface, 30-60 cm spaced apart. Some trials were conducted with artificial infestation. Main assessments were for diseases (*Fusarium oxysporum* f.sp. *lycopersici, Fusarium oxysporum* f.sp. *radicis licopersici, Colletotrichum coccodes)* & nematodes (*Meloidogyne sp*) control.

RESULTS

Main results are presented in tables 2, 3, 4, 5 & 6

In the table 7 are indicated the effective rates and distribution techniques for using DMDS in some key crops.

Trials are still under progress (recommended doses for testing 20 – 80g/m2 in straight or in combination with other fumigants) for nematodes, soil diseases & weeds control on strawberries nurseries, peppers, melons, cucumbers, lettuces, lambs lettuces, asparagus, potatoes, ornamentals, cut flowers, orchards & grapes.

CONCLUSION

The results, along with the other data available on the product, show that DMDS in straight and in combination with chloropicrin could be a viable replacement for existing fumigants.

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Table 1 - Standard treatments used in the trials

Crops	Applications	Standard products	Rates in g/m²
Strawberries	shank	Methyl bromide MB+Chloropicrin 1.3d+Chloropicrin Metam sodium	50 under VIF 40 under LDPE 30-50 under VIF 120 under LDPE
Tomatoes, eggplants,	drip	Methyl bromide 1.3d+Chloropicrin Chloropicrin	50 under VIF 40-50 under VIF 20 under VIF
Carrots	shank	1.3d	10-30 under VIF or not tarped

Table 2 - Strawberries trials results in France & in Italy: yield in % compared with untreated plots

	2 trials in France in 2003-2004	1 trial in France in 2006	4 trials in Italy in 2005-2006
Control	100	100	100
Metam sodium 120g/m²	141	151	
Methyl bromide 50g/m²	168		
1.3d+Chloropicrin 25+25g/m²			134
DMDS+Chloropicrin 25+25g/m²			138
DMDS+Chloropicrin 40+10g/m²			134
DMDS 40g/m²		145	127
DMDS 60g/m²			134
DMDS 80g/m²	177		136

Table 3 - Strawberries trials results in Spain: yield in % compared with untreated plots

	2 trials in 2002	2 trials in 2003	2 trials in 2004	2 trials in 2005	2 trials in 2006
Control	100	100	100	100	100
MB+Chloropicrin 40g/m²	118	144	139	156	136
1.3d+Chloropicrin 30g/m²	119	140	148	139	132
DMDS 40g/m²	112				
DMDS 60g/m²				138	
DMDS+Chloropicrin 25+25g/m²		145	151		
DMDS+Chloropicrin 25+15g/m²					139

Table 4 - Carrots trials results in Europe: % roots infested or number of nematodes in 100ml soil (6 trials in Europe)

	France (North)	France (South)	Belgium	Italy (Center)	Italy (North)	Spain (North)
Nematodes	*Heterodera*	Mixed*	*Pratylenchus*	*Meloidogyne*	*Heterodera*	*Meloidogyne*
Untreated	20%	252	102	17%	412	28%
Dichloropropene	10%	121	1	10%	210	12%
DMDS 20g/m² VIF	16%	19	3	10%	230	12%
DMDS 40g/m² VIF	6%	2	0	5%	216	2%
DMDS 40g/m² not tarped	12%	13	26	2%	256	11%

* *Tylenchides & Pratylenchus*

Table 5 - Yield at harvest: weight of marketable carrots in MT/(ha or plots)

	France (North)	France (South)	Belgium	Italy (Center)	Italy (North)	Spain (North)
Untreated	100	100	100	100	100	100
Dichloropropene	142	107	180	219	193	133
DMDS 20g/m² VIF	142	116	160	208	170	117
DMDS 40g/m² VIF	183	100	195	186	258	117
DMDS 40g/m² not tarped	167	112	164	194	191	133

Table 6 - Tomato & eggplant trials results in Italy: Gall index (0-5) or % of infested plants in 2003-2006

	1 trial	**3 trials**	**1 trial**	**2 trials**
Main pests	*Meloidogyne*	*FOL FORL*	*Meloidogyne FOL FORL*	*Meloidogyne Verticillium*
Control	4.2	44%	86%	61%
MB 40g/m²	0			
1.3d+Chloropicrin 24+30g/m²	0			
1.3d+Chloropicrin 20+20g/m²		16%	27%	14%
Chloropicrin 20g/m²		14%	36%	31%
DMDS+Chloropicrin 20+20g/m²		19%	28%	8%
DMDS+Chloropicrin 30+10g/m²				6%
DMDS+Chloropicrin 30+5g/m²				10%
DMDS 30g/m²	0.3			
DMDS 40g/m²		25%	32%	18%
DMDS 60g/m²	0	11%	15%	14%
DMDS 80g/m²	0.1	8%	12%	11%

Table 7 - Effective rates and distribution techniques for using DMDS in some key crops.

Crops	**Application**	**Pests**	**Effective rates in g/m²**	
			DMDS	**DMDS + chloropicrin**
Strawberries	Shank	Soil diseases complex & nematodes (*Meloidogynesp,Pratylenchus sp)*	60-80 g/m²	40 g/m²
Carrots	shank	Nematodes (*Meloidogyne sp, Pratylenchus sp & Heterodera sp*) & weeds	40 g/m²	
Tomatoes, eggplants	drip	Nematodes *(Meloidogyne sp)*	40 g/m²	
		Soil diseases *(Fusarium sp, Verticillium sp)* & nematodes *(Meloidogyne sp)*	60-80 g/m²	40 g/m²