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RESEARCH CENTRE FOR INDUSTRIAL CROPS – BOLOGNA (ITALY)
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Department of Agriculture Plant Protection Service

New products based on brassicaceae materials: a new liquid formulation with fertilizing and biocidal effects for application in drip irrigation

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INTRODUCTION

In Italy, in these last few years, some new materials for biofumigation based on defatted meals have been defined and are currently beginning to be applied more and more, also at commercial level. In addition to the organic soil amendment coming from biocidal green manure plants or pellets, italian research has recently been strongly geared towards the definition and optimization of new liquid formulations based on a vegetable oil emulsion containing small amounts of defatted meals. The first patented liquid formulation was essentially focused on the plant epigean treatment for the prevention and the control of some fungi and insects and some applications were presented at the Second Biofumigation Symposium while here we present the characteristics of a new liquid formulation for application in drip irrigation.

BASIC FORMULATION

(Patent application n. BO2008A10)

- ***vegetable oil***
  rich in long chain fatty acids preferably extracted from brassicaceae seeds
- ***organic fertilizer***
  organic nitrogen extract
- ***brassicaceae defatted meals*** with high glucosinolate content

MINIMAL DOSES	
Vegetable oil	0.1%[a]
Organic nitrogen extract	0.1%[a]
Brassicaceae meal [b]	0.02 gL^{-1}[c]

[a] V/V on total emulsion volume
[b] min. Gls content: 50 µmol/g seed
[c] W/V on final dilution

The formulation consists of an emulsion formed of organic nitrogen extract, oil and water in which properly ground meals are dispersed.

In principle, the formulation acts through the combination of three effects:

- the biofumigant action of glucosinolate hydrolysis derived products,
- the oil's property of limiting bioactive compound dispersion and of playing a suffocating effect,
- the biostimulant effect of an organic fertilizer.

ALLYL-ISOTHIOCYANATE RELEASE

Allyl-isothiocyanate was quantified in the emulsion by head space GC analysis with reference to the standard curve obtained from pure AITC.

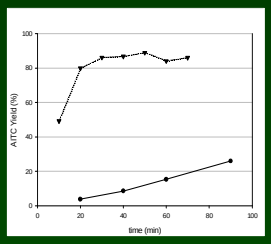


Figure 1. Non formulated (•) and formulated (▾) brassica meals.

Our formulation makes it possible to achieve 80% of potential AITC yield in about 30 min after watering brassica seed meals in the lipidic fractions.

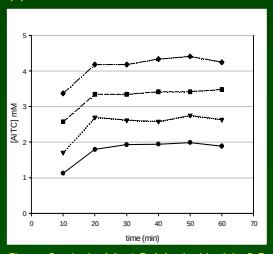


Figure 2. single (•), 1.5 (▾), double (■), 2.5 meal dose (♦).

SINIGRIN – AITC

Sinigrin and AITC content in a large scale liquid formulation was evaluated during the reaction time. It is easy to observe how the decrease of glucosinolates (after a few minutes for their solubilisation in the emulsion) corresponds to the improvement of AITC in the emulsion. After 30 minutes the reaction was ended with a rate higher than 80%.

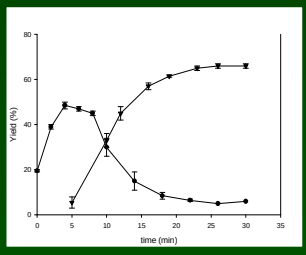


Figure 3. Time = 0, meals were added to the water emulsion, and after 30 minutes were filtered off. Sinigrin (•) was quantified by HPLC analysis of desulfo-derivatives (ISO 9167-1, 1992), AITC (▼) by HS-GC analysis.

EFFECT ON NEMATODE *MELOIDOGYNE INCOGNITA* POPULATION

The effect of two repeated treatments with two different formulations was studied: single and triple meal dose in the oily fraction.

The diagnosis of *Meloidogyne* incognita infestation in the soil was carried out by extracting second stage juveniles from the soil, and the bioassay method using tomato plants cv. UC82 particularly sensitive to nematode attack.

Effectiveness of the liquid formulation in controlling of *M. incognita*

	First assessment[a]		Second assessment[b]	
Treatment	L2 (100 cc)[c]	Galling index[d]	L2 (100 cc)[c]	Galling index[d]
Untreated control	45.8	2.6	9	3.5
Formulation with single meal dose	8.8	2.1	40.7	2.1
Formulation with triple meal dose	7.4	1.7	6.7	1.1

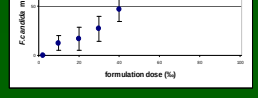
[a] 28 days after the first treatment
[b] 71 days after the first treatment and 41 days after the second treatment
[c] infested soil
[d] on tomato roots according to the Lamberti (1971) classification. The galling index (GI) was calculated as the weighted mean of the classes: GI = Σ (root n° x class)/total root N° of the sample.

30-days-old tomato plants were transplanted in plastic pots containing highly infested soil. Treatments were repeated 8 and 36 days after transplantation, the first soil sampling was assessed 37 days after transplantation and the second one after 71 days.

The results clearly indicated that the high dose permitted a significant reduction of nematode L2 and a lower galling index even after 71 days if compared to an untreated soil.

EFFECT ON SPRINGTAIL *F. CANDIDA*, A NONTARGET SOIL ARTHROPOD

Utilising a bioassay optimized by CRA-CIN, the effect of different doses of liquid formulation on *F. candida* mortality was studied in closed system for 24h exposure.
The formulation was expressly prepared for trials at a 1.5 dose and utilized after 30 min (see figure 2).
Figure 4 shows the range of toxicity; the lethal dose of half the population tested (LC50) calculated by probit analysis was 40.8 ppt (95% fiducial limits 37.4-45.3).
Utilising a dose of 60 parts per thousand (‰) (figure 5), different components were evaluated: meals were essential in producing a biocidal effect on *F. candida* but the interaction with the other components increased it considerably.



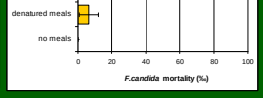


Figure 4. Effect on *F.candida* mortality. Figure 5 Effect of different components at the dose of 60 ppt. The effect of the product was compared with a formulation without vegetable oil and all components except brassicaceae defatted meals (a), a formulation utilizing meal treated in autoclave at 121° for 10 min to denature enzyme (b) and a formulation without meals (c). These results showed how the interaction between the formulation components contributes to biocidal activity better than the individual components.

CONCLUSIONS

The new liquid formulations defined in these last few years at CRA-CIN open interesting perspectives for low environmental impact agriculture based on the use of natural products from brassicaceae. These new liquid products enlarge the field of application from the pre plant treatment for the control of soil borne pest and pathogens to the treatment of both epigeal (patented in 2006) and hypogeal (presented here for the first time) plant apparatus during cultivation. In this way, by means of liquid product application in drip irrigation every 20-30 days, the farmer can obtain not only a fertilising effect but also limit nematode presence on the plant root system. The first trials encourage these perspectives, also because they are linked to a clear biostimulating effect of these products that will be studied over the next few years.

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