SOIL FUMIGATION WITH *ALLIUM* SULFUR VOLATILES AND *ALLIUM* BY-PRODUCTS

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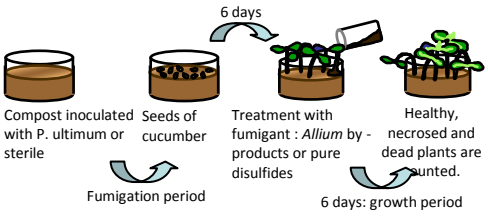
Abstract

Like Brassicaeae spp, Allium spp present biofumigation properties which are attributed to sulphur compounds and mainly three disulfides: dimethyl disulfide (DMDS), dipropyl disulfide (DPDS) and diallyl disulfide (DADS) with a superior efficacy of DMDS. In this study, the biofumigant activity and soil behavior of Allium *(onion and leek) by-products were investigated in vitro and in vivo. In vitro, the experimental model consists of a host-pathogen system: cucumber-* Pythium ultimum. *The results of the bioassay show that cucumber plants in compost inoculated with the pathogen and containing onion or leek by-products present a better vegetative growth compared to the control.*

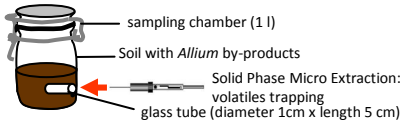
In vivo soil biodesinfection with onion by-products in asparagus crops leads to an intermediate yield between the untreated soil modality and the methyl bromide treatment modality. An other aim of the present study was to produce more data about nematicid activity of disulfides. The activity of DMDS and DADS was evaluated on two nematods, Heterodera sacchari *and* Meloidogyne graminicola.

Material and methods

Fungicidal tests: *Pythium ultimum* type test



Behaviour in soil



Nematicidal tests

Heterodera sacchari is a cyst nematode common in African and some Asian countries. Rice and sugarcane are the major field crops infected by this nematode. *Meloidogyne graminicola* (rice-root nematode) is a common species in the tropic and subtropic area where it infects numerous grasses including rice.

As infesting larvae stage day 2 (d2) is the most sensitive to biofumigants, we calculated the CL 50 (concentration lethal for 50% of population) with DMDS of the 2 species at d2.

Field experiment

In 2002, an elementary parcel was composed of 3 asparagus ranks (128 plants, 144 m²). The control was the central rank. The biodesinfection effect is evaluated with the incorporation of onion (*A. cepa*) and leek (*A.porrum*) by-products (75T/ha).

The plantation of asparagus in the parcel was in April 2003, the harvest was in April 2004 and 2005

Results and discussion

Fungicidal tests

➢DMDS treatment shows healthy cucumber but moreover a stimulant effect can be observed (figure 1).

Figure 1 : cucumber plants after DMDS soil treatment

➢The optimum disinfectant effect is more rapidly reached for 240 T/ha than for 120T/ha: 1 month against 2 (figure 2).

➢Leek by-products are less efficient than onion by-products

➢The CT (Concentration.Time) effect is also observed. After 15 days, there is 74% of healthy plants and 94% at 1 month (for onion). For leek, three is 48 % of healthy plants after 15 days and 64% at 1 month.

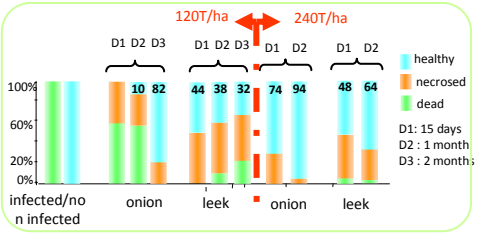


Figure 2 : % of healthy, necrosed and dead cucumbers after the *Allium* by-products incorporation in soil (120T/ha and 240T/ha)

Behavior in soil

➢DPDS is the major emitted compound in soil after *Allium* by-products incorporation

➢6 days is the maximum of emission-DPDS persist more than one month in soil :CT effect (figure 3)

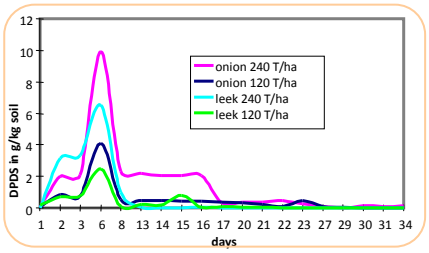


Figure 3 : DPDS evolution in soil after *Allium* by-products incorporation.

Nematicidal tests

➢*M. Graminicola* (CL50=0,79 µl/l) seems to be more sensitive to DMDS than *H. sacchari* (CL50 1,6µl/l) (figure 4).

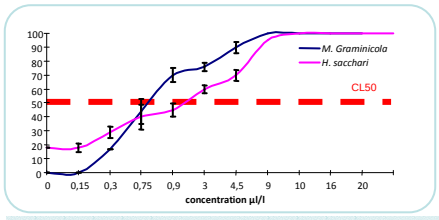


Figure 4: mortality % of larval stage J2 of *H. sacchari* and *M. graminicola* with DMDS

Field experiment

➢2 years after plantation, the incorporation of onions leads to an intermediate yield between the reference and the non desinfected parcel (figure 5).

➢The incorporation of leek by-products seems to have no effect

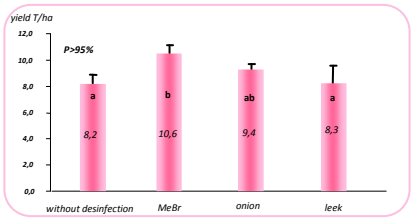


Figure 5: yield of asparagus crops under 4 different desinfection conditions : not desinfected, MeBr, onion, leek.

The doses, contact time and characteristics of by-products are very important but the practice in field must be improved. For this purpose, ***the choice of*** **Allium** ***spp*** *can be modulated. As DMDS is greatly more disinfectant and pesticide than DPDS,* **Allium** ***spp with high DMDS potential*** *could be tested and furthermore the quantities in field could be reduced. Some wild* Allium *species contain more DMDS than marketable* Allium. *For example,* A. vineale *(wild garlic),* A .ursinum *(bear's garlic), produce significative quantities of DMDS.*

Conclusion

This study allows showing in vitro and in vivo, the desinfection effect of Allium spp and particularly onion by-products. ***DPDS*** *is the main gas produced by onion and leek by-products in soil and it is persistent during more than one month. The potential of other* Allium *spp or* A. cepa *varieties producing DMDS has to be evaluated.*