BRASSICA CARINATA FOR CONTROL OF *PHYTOPHTHORA* SPP. IN STRAWBERRY FIELD CROPS

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ABSTRACT

Soil biofumigation (SB) and soil solarization (SS) are nonchemical methods for the control of soilborne pathogens. SS uses solar radiation to heat soil and SB is based on the action of volatile compounds produced by the decomposition of Cruciferae, essentially glucosinolates (Gs) and isothiocyanates (ITCs). Brassica spp. are used as biofumigant because of their different concentrations and types of ITCs that are different in their toxicity against pathogenic fungi. Suppressiveness of the Brassica varies between species. Biofumigant effect depends on plant age and environmental growth conditions. *Brassica carinata*, the most effective species on the in vitro control of *Phytophthora* spp., was selected as biofumigant to evaluate and compare the ability of SB and SS to control *Phytophthora* spp. in soil and to enhance field production of strawberry. SB with *B. carinata* + SS reduce *P. cactorum* in soil and increases strawberry yield and fruit weigh.

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RESUMO

A biofumigação do solo (SB) e a solarização do solo (SS) são métodos não químicos para a luta contra os micróbios patogénicos do solo. A SS usa a radiação solar para aquecer o solo e o SB é baseado na acção dos compostos temporários produzidos pela decomposição das Crucíferas, essencialmente glucosinolatos (Gs) e isothiocianatos (ITCs). *Brassica* spp. é usada como biofumigante por causa da concentração de compostos biofumigantes e tipos diferentes de ITCs que diferem na toxicidade face aos fungos patogénicos. A capacidade supressiva de *Brassica* varia com a espécie. O efeito de Biofumigação depende da idade de planta e das condições ambientais de crescimento. *Brassica carinata* é a espécie mais eficaz *in vitro*, na luta contra *Phytophthora* spp., foi seleccionada como biofumigante para avaliar e comparar a capacidade de SB e SS na luta contra este fungo no solo, e para avaliar a produção de morango. A SB com *B. carinata* + SS reduz *P. cactorum* no solo e aumenta o rendimento da produção de morango e o peso do fruto.

Palavras-chave: Biofumigação do solo, solarização do solo, *Brassica carinata*, *Phytophthora cactorum*, glucosinolatos.

INTRODUCTION

Pathogens control based on the chemical soil desinfestation are under revision due to their negative environmental connotations derived from their use. Soil biofumigation (SB) and soil solarization (SS) are non-chemical alternative methods for soilborne pathogen control. SS uses solar radiation to heat soil under a transparent plastic film to temperature levels that are detrimental to soilborne plant pathogen (Katan, 1981).

SB control is based on the action of volatile compounds produced by the decomposition of Cruciferae, essentially glucosinolates (Gs) and isothiocyanates (ITCs) derived from their hydrolysis. Different species of Brassica are used as biofumigant because of their different concentrations and types of ITCs emission during their decomposition. ITCs are different in their toxicity against the pathogenic fungi (Angus, *et al*., 1994; Harding & Wicks, 2001).

Preliminary results published by this research team have demonstrated the existence of differences in the biofumigant in vitro effect depending on the Cruciferae tested. These works showed that the suppressiveness of the Brassica varies between species, variation of biofumigant effect depends on factors as: plant age and environmental growth conditions (Porras *et al.*, 2007a, Romero *et al.*, 2007). These results make possible the utilisation of different species as biofumigant according to the crops. *Brassica carinata* in siliquas formation was the most effective biofumigant tested in vitro against *Phytophthora* spp. (Zurera *et al*., 2007).

The objectives of the current work was to determine SB and SS effect in strawberry fields, using B. carinata selected as biofumigant to evaluate and compare the ability in soil to control *Phytophthor*a spp. and the effect on field production of strawberry.

MATERIAL AND METHODS

Field experiments were conducted in an experimental strawberry farm located in Moguer (Huelva, SW Spain). Plots, never treated with methyl bromide, were naturally infested by *Phytophthora* spp. Treatments were SS, SB+SS, and the untreated control (C). A randomized complete block design with eight replications was used. SB was done with *B. carinata* (10 $Kg.m^{-2}$ incorporated at l0 cm depth). Plots were solarized from July to September, using clear 50-µm low-density polyethylene mulch.

In October of 2007, strawberry cv. "Camarosa" was planted. Plants were grown in an intensive annual system on drip-irrigated raised beds with black plastic mulch (Porras *et al.*, 2007b).

Soil samples (20 cm deep) were collected in July (prior to SS), in October (10 days before planting), and monthly from the date of planting to the end of the trials, each year. One gram of air-dried soil was suspended in 99 ml of sterile water agar (0.3%), and 1 ml aliquots were spread onto petri dishes containing semiselectives medium P5 ARP to determine the presence of *Phytophthora* spp. (Jeffers and Martin, 1986). Plates (10 replicates) were incubated at 25°C in dark for 7 days. *Phytophthora* colonies were identified (Erwin and Ribeiro, 1996), counted, and expressed as colony forming units (CFU) per gram of soil.

All ripe fruit of 8 randomly selected plants per plot were harvest once per week from January to May, and marketable fruit were weighed.

Analysis of variance (Statistics 8, Analytical Software for Windows) was performed for fruit weight, strawberry production, and Phytophthora CFU. Mean separation was conducted using the Tukey´s Studentized Range (HSD) comparison method at $P<0.05$.

RESULTS AND CONCLUSIONS

Results published by this research team showed that SB with Brassicas combined with SS showed a high potential in the control of pathogens of the soil (Romero *et al.,* 2006) and the increase crops productivity (Barrau, *et al.,* 2005,2006).

SB+SS and SS significantly increased total accumulated strawberry yield from February to May and also increased mean fruit weight relative to C (Table 1).

Both treatments reduced *Phytophthora* soil population from October to May relative to C, especially SB+SS at beginning of the season, one month after plantation, critical moment for the establishment of strawberry plant (Figure 1.).

The current work contributed to the development and optimization of SB with Brassica and SS as alternatives to the traditional use of chemicals in strawberry production.

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Table 1 – Strawberry yield and fruit weight (***, P<0.001).

Treatment	Strawberry yie1d (g/plant)	Fruit weight (g/fruit)
SB + SS	980,25 a	24,73 a
SS	849,61 a	22,27 a
C	737,73 b	17,32 b
F 2,35	18,50 ***	15,70 ***

SB= Soil Biofumigation.
SS= Soil solarization.
C= Untreated control.

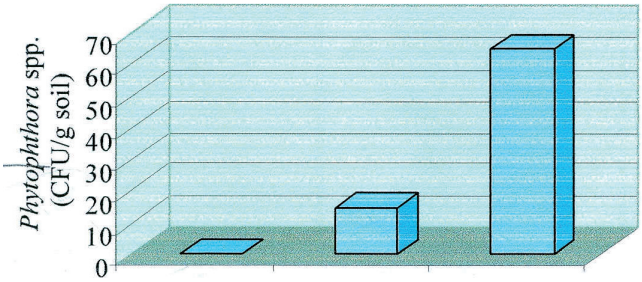

Figure 1 – *Phytophthora* spp. soil population at the beginning of the season. SB= Soil biofumigation; SS= Soil solarization; C= Untreated control.