DECONTAMINATION OF AZOXYSTROBIN, CYPRODINIL AND FLUDIOXONIL IN SOIL FROM GREENHOUSE PEPPERS CULTIVATION FOR SOLARIZATION AND BIOSOLARIZATION TECHNIQUES

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The application of pesticides is a usual practice in modern agriculture to control pests and diseases that damage the crops. These compounds provide benefits by reducing production losses; however, a fraction of the amount used can reach the soil by aerial or ground application leading to soil contamination.

The prohibition of methyl bromide as disinfection technique in agriculture has influenced in the decision of growers to adopt other disinfection techniques more respectful of the environment. In this respect, solarization and biosolarization (solarization + biofumigation) are currently used in the Region of Murcia for the growing of pepper in greenhouses. Solarization is a technique in that moist soil is coverted with a transparent polyetylene mulch and is exposed to sunlight during the months with higher levels of solar radiation. Biofumigation is based on the action of gasses resulting from the decomposition of organic matter for control of plants pathogens. In addition to its disinfecting effect, these techniques have shown to increase the dissipation of certain pesticides in the soil.

Dynamic of pesticides in soil depends on several phisical, chemical and microbiologic process (chemical and microbiologic degradation, climatic conditions, volatilization, adsorption/desorption). Degradation is the main process in the dissipation of pesticides in soil, this process is affected for several factors such as climatic conditions (temperature and moisture), solar radiation, organic matter, amount and kind of microorganiscs in soil.

Sweet pepper is an important horticultural crop in the Region of Murcia (Spain). During pepper cultivation several pesticides are used for controlling usual pests. Azoxystrobin, cyprodinil and fludioxonil are some of the fungicides usually used. Azoxystrobin is a systemic broad spectrum fungicide with preventive and curative action, it is actually allowed in Spain for the control of powdery mildew. Cyprodinil (sytemic fungicide) combined with fludioxonil (non-siytemic fungicide with contact action) are used to control of Botrytis and Sclerotinia.

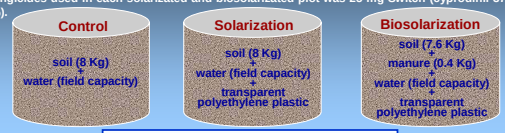
A research was performed to evaluate the effect of solarization and biosolarization techniques on the decontamination of the three fungicides in soil of greenhouse pepper cultivation.

The study was carried out in last days of july during 90 days in an experimental greenhouse situated in Dolores de Pacheco (Murcia, southeast of Spain).

MATERIALS

Soil texture was clay loam, pH 7.86, OM 1.59% and EC 3.54 dS m^{-1}.

The application rate of fungicides used in each solarizated and biosolarizated plot was 25 mg Switch (cyprodinil 37,5 % + fludioxonil 25 %) and 32 µL Ortiva (azoxystrobin 25 %).



EXTRACTION

5 g SOIL + 10 ml DESTILLED WATER + 20 ml ACETONITRILE + 20 ml DICHLOROMETHANE.

The organic phase was separated and concentrated to dryness.

The residue was redissolved in 5 ml of ETHYL ACETATE/CYCLOHEXANE (1:1).

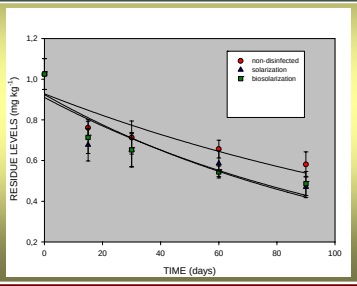
APPARATUS AND ANALYSIS

Gas chromatography (GC) (Agilent model HP 6890) with nitrogen-phosphorus detection (NPD) was used to study the disappearance of this insecticide in soil.

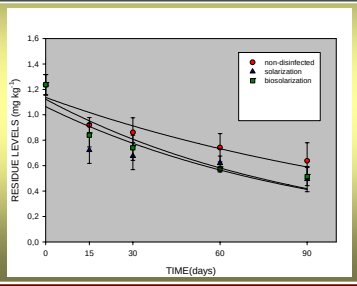
Confirmation analysis of insecticide was carried out by capillary gas chromatography (Agilent model HP 6890) coupled with a mass spectrometric detector (model 5973N) operated in ion monitoring (SIM) mode.

The total analysis time was 41.87 min.

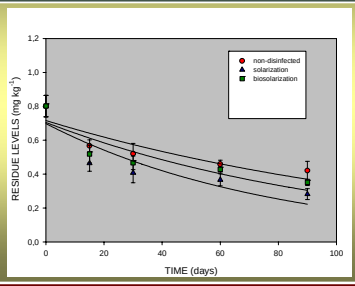
DISSIPATION OF AZOXYSTROBIN RESIDUES IN SOIL OF A GREENHOUSE PEPPER CULTIVATION FOR SOLARIZATION AND BIOSOLARIZATION TECHNIQUES



DISSIPATION OF CYPRODINIL RESIDUES IN SOIL OF A GREENHOUSE PEPPER CULTIVATION FOR SOLARIZATION AND BIOSOLARIZATION TECHNIQUES



DISSIPATION OF FLUDIOXONIL RESIDUES IN SOIL OF A GREENHOUSE PEPPER CULTIVATION FOR SOLARIZATION AND BIOSOLARIZATION TECHNIQUES



LINEAR FIT OF THE DATA FOR THE DISSIPATION OF THREE FUNGICIDES IN SOIL OF GREENHOUSE *

PARAMETERS

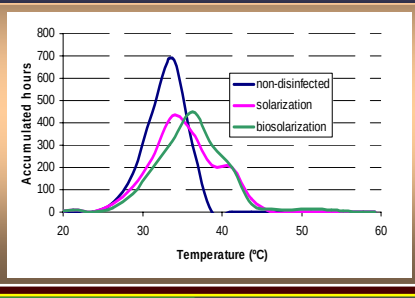
AZOXYSTROBIN	r	r^2	a	K	$t_{1/2}$
Non-disinfected soil	-0.908	0.824	-0.101	-0.005	129.53
Solarization Technique	-0.911	0.831	-0.136	-0.007	96.43
Biosolarization Technique	-0.928	0.862	-0.125	-0.007	93.80

CYPRODINIL	r	r^2	a	K	$t_{1/2}$
Non-disinfected soil	-0.950	0.902	0.101	-0.006	105.92
Solarization Technique	-0.876	0.767	-0.017	-0.008	84.28
Biosolarization Technique	-0.942	0.887	0.054	-0.009	76.87

FLUDIOXONIL	r	r^2	a	K	$t_{1/2}$
Non-disinfected soil	-0.899	0.808	-0.376	-0.006	111.77
Solarization Technique	-0.903	0.816	-0.454	-0.097	71.60
Biosolarization Technique	-0.900	0.810	-0.409	-0.007	90.71

* Ln [R] = Ln [R_o] + kt (general formula y = a + kt)

ACCUMULATED HOURS *vs* TEMPERATURE IN CONTROL, SOLARIZATED AND BIOSOLARIZATED SOILS



CONCLUSIONS

- The disappearance rate of the three fungicides on soils was described as pseudo-first-order kinetics (r between 0.876 and 0.950).
- The data concerning the behaviour of these fungicides under the different disinfection techniques showed that dissipation rate was higher in soil during biosolarization and solarization than in non-disinfected soil, being $k_{biosolarization} \sim k_{solarization} > k_{non\text{-}disinfected}$ for azoxystrobin and cyprodinil, and $k_{solarization} > k_{biosolarization} > k_{non\text{-}disinfected}$ for fludioxonil. The similar behaviour of azoxystrobin and cyprodinil can be due to their adsorption constants values (2.9 and 3.3 for azoxystrobin and cyprodinil respectively), these values show a moderate adsorption for these fungicides, which could increase with the application of organic amendment in the biosolarization, leading to a lower availability of the compounds to be degraded. The adsorption constant value for fludioxoni is 3.2, but the dissipation rate during solarization was higher than during biosolarization, this can be due to the adsorption constant of fludioxonil in our soil was higher than adsorption constant of cyprodinil.
- The half-lives of the three studied fungicides were between 1.2 and 1.5 times higher in non-disinfected soil than in biosolarizated or solarizated soil. This can be probably attributed to an increase in microbial activity, and higher soil humidity and temperature.
- We can conclude that biosolarization and solarization are effective techniques to disinfect contaminated soil, and it depends on the fungicide and kind of soil that technique is more effective.

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