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The evolution of diseases of vegetables in the cross-border area (Piedmont and Provence Alpes Cote d'Azur PACA regions) and sustainable management strategies

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Objectives of the project and activities carried out

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a) Monitoring of lettuce, pepper and cucurbit crops in Piedmont farms were carried out.

b) Evaluation of the varietal susceptibility against selected soil-borne pathogens of pepper.

- Trials under controlled conditions were carried out in Agroinnova glasshouses by using the artificial inoculation of selected pathogens.
- resistance of grafted plants of pepper against *Phytophthora capsici* was evaluated in field condition.

Objectives of the project and activities carried out

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c) Sustainable management strategies to control leaf and soil-borne diseases of zucchini.

- Trials were carried out in Agroinnova against *Podosphaera xanthii* of zucchini;

- trials were carried out in Agroinnova against *Phytophthora capsici* basal rot of zucchini under greenhouse.

Field monitoring of lettuce, pepper and cucurbit crops in Piedmont farms were carried out

I. 70 oomycetes strains were isolated from pepper;
II. 2 strains of *Rhizoctonia solani* were isolated from pepper;
III. 3 strains of *Fusarium oxysporum* f. sp. *lactucae* were isolated from lettuce;
IV. 4 strains of *Sclerotinia sclerotiorum* were obtained from cucumber;
V. 7 strains of *Sclerotinia sclerotiorum* were obtained from lettuce.

P. capsici on pepper and cucumber

Sclerotinia sclerotiorum on lettuce and cucumber

Monitoring of soil-borne pathogens of pepper in the Piedmont farms

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Two isolates of *Rhizoctonia solani* were isolated from pepper rootstock (cv Rocal and Robusto).

Among 70 oomycetes isolates from pepper:

a) 3 isolates were identified as *Pythium;*

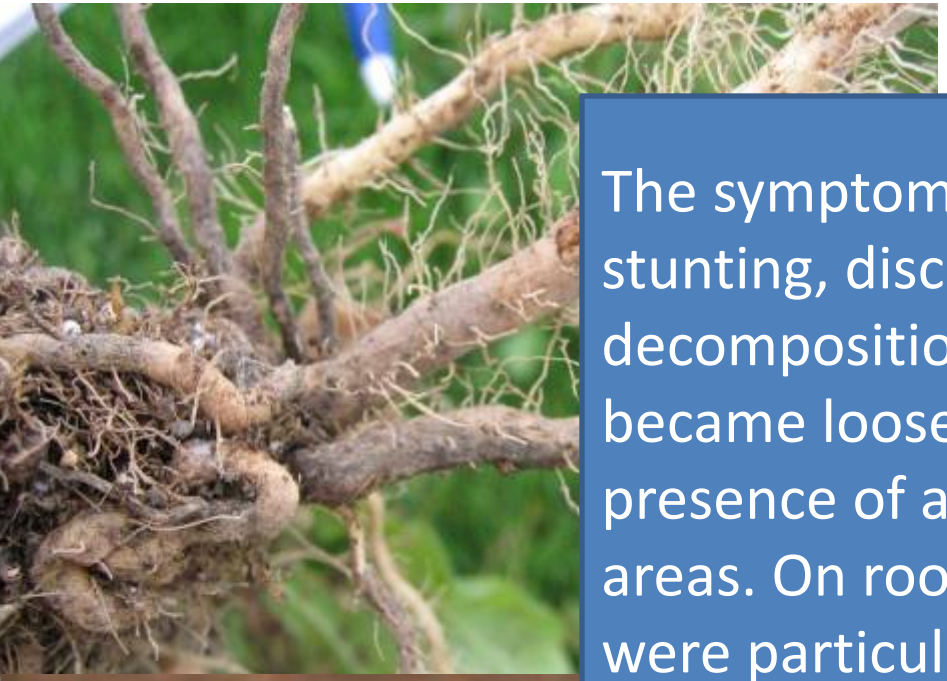
b) 2 isolates identified as *Phytophthora* spp. are under evaluation;

c) 65 strains belong to *P. capsici.*

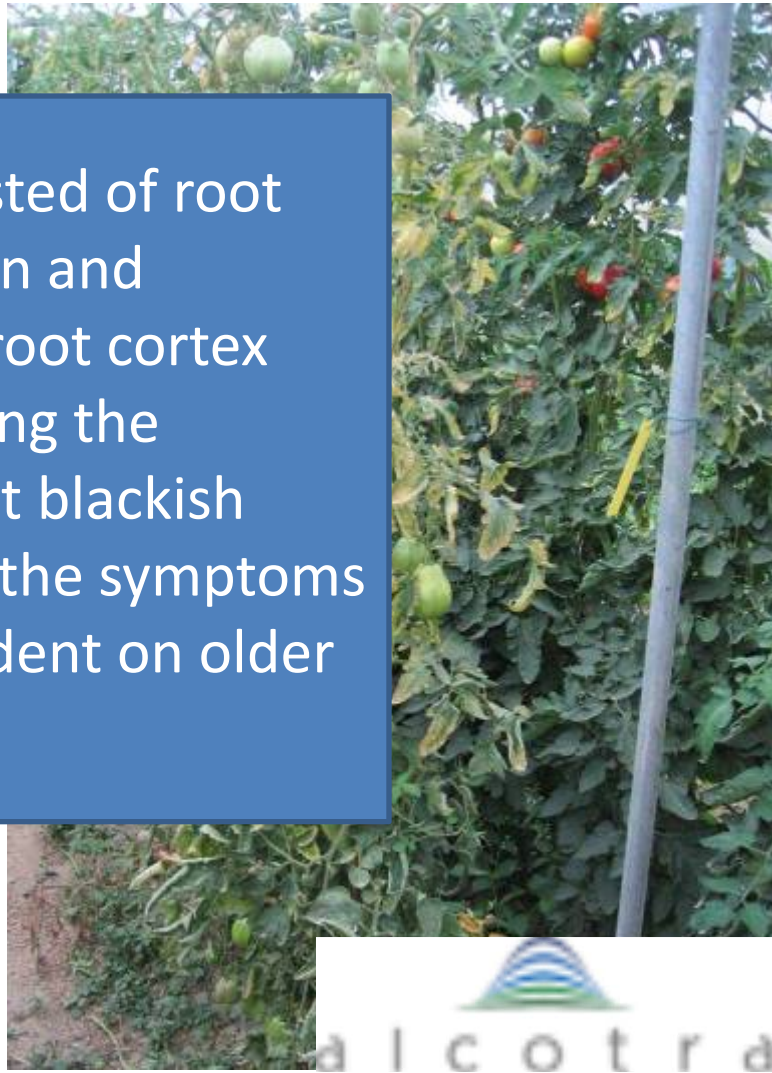
	Ospite	ITS
PHC 1	Zucchino	*Phytophthora capsici*
PHC 2	Peperone	*Pythium aphanidermatum*
PHC 3		
PHC 4	Peperone	*Phytophthora capsici*
PHC 5	Peperone	*Phytophthora capsici*
PHC 6	Peperone	*Phytophthora capsici*
PHC 7	Peperone	*Pythium ultimum*
PHC 8	Peperone grande	*Phytophthora capsici*
PHC 9	Peperone corno	*Phytophthora capsici*
PHC 11	Peperone quadrato	*Phytophthora capsici*
PHC 12	Peperone quadrato	*Phytophthora capsici*
PHC 13	Peperone quadrato	*Phytophthora capsici*
PHC 14	Zucchino Alessandria	*Phytophthora capsici*
PHC 15	Peperone	*Phytophthora capsici*
PHC 16	Peperone	*Phytophthora capsici*
PHC 17	Peperone	*Phytophthora capsici*
PHC 18	Peperone	*Pythium aphanidermatum*
PHC 19	Peperone	*Phytophthora capsici*
PHC 20	Peperone var Cuneo	*Phytophthora capsici*
PHC 22	Peperone	*Phytophthora capsici*
PHC 23	Cetriolo	*Phytophthora capsici*
PHC 24	Cetriolo	*Phytophthora capsici*
PHC 25	Peperone	*Phytophthora capsici*
PHC 26	Peperone	*Phytophthora capsici*
PHC 27	Peperone	*Phytophthora capsici*
PHC 28	Peperone	*Phytophthora capsici*
PHC 29	Peperone	*Phytophthora capsici*
PHC 30	Cetriolo	*Phytophthora capsici*
PHC 31	Peperone piccante	*Phytophthora capsici*
PHC 32	Peperone	*Phytophthora capsici*
PHC 33	Peperone Fenice	*Phytophthora capsici*
PHC 34	Peperone sel Cuneo	*Phytophthora capsici*
PHC 35	Peperone corno	
PHC 37	Peperone corno	*Phytophthora capsici*
PHC 41	Peperone Fenice	*Pithium paroecandrum*
PHC 43	Peper -E 490812666	*Phytophthora capsici*
PHC 44	Peperoncino piccante	*Phytophthora capsici*
PHC 46	Peperone var Teseo	*uncultured fungus*
PHC 47	Peper E- 490812483	*Phytophthora capsici*
PHC 48	Peperone var Sat 414	*uncultured fungus*
PHC 49	peper E-490812515	*Phytophthora capsici*
PHC 50	var 490812611	
PHC 51	Peperone Ceresello	*Phytophthora capsici*
PHC 52	peper E 4917783	*Phytophthora capsici*
PHC 53	Peperone var Carbon	*Phytophthora capsici*
PHC 54	Peperone var golden h	*uncultured fungus*
PHC 55	Peper var E 4917783	*Phytophthora nicotianae*
PHC 56	Peperone var Carbon	*Phytophthora nicotianae*
PHC 57	Peperone	*Phytophthora capsici*
PHC 58	Peperone quadrato	
PHC 59	Peperone classico	
PHC79		*Phytophthora capsici*
PHC80		*Mortierella alpina*

Emerging problems on solanaceous crops

Colletotrichum coccodes on grafted tomato



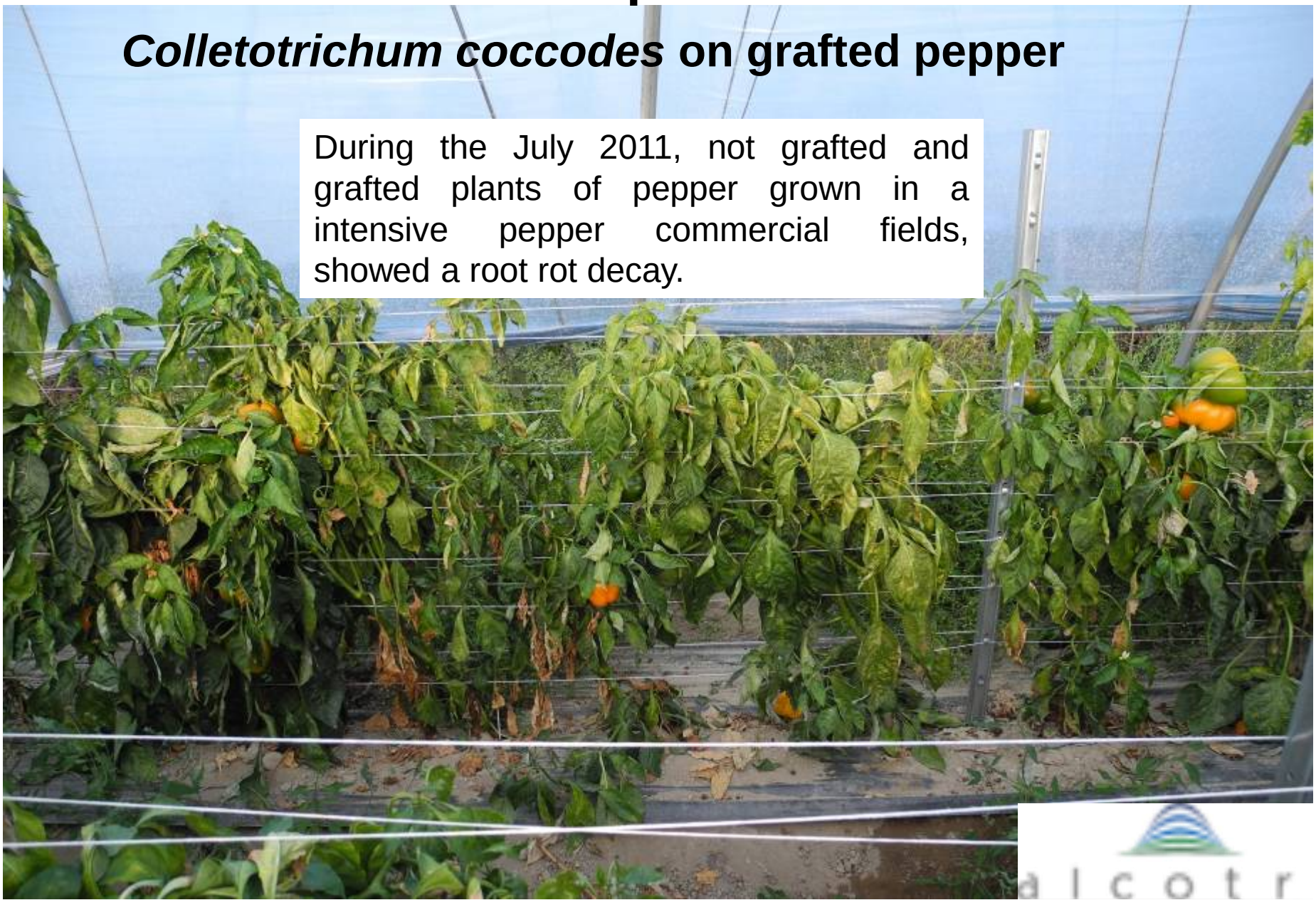
The symptoms consisted of root stunting, discoloration and decomposition. The root cortex became loose, showing the presence of abundant blackish areas. On rootstocks the symptoms were particularly evident on older roots.



Emerging problems on solanaceaus crops

Colletotrichum coccodes on grafted pepper

During the July 2011, not grafted and grafted plants of pepper grown in a intensive pepper commercial fields, showed a root rot decay.



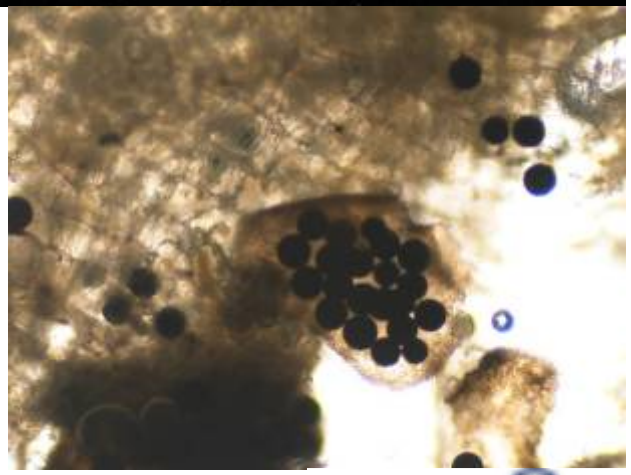
Emerging problems on solanaceaus crops

Colletotrichum coccodes on grafted pepper

The root systems appeared extremely damaged, with large necrosis completely deteriorating old and young roots; the root tissues became blackish, showing generally cracks as in the case of corky root infections

Emerging problems on grafted melon

Monosporascus Root Rot and Vine Decline



Emerging problems:

Rhizoctonia solani on grafted tomato and melon.

Symptoms: damping off, crown rot.

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Evaluation of varietal susceptibility against selected soil-borne pathogens of lettuce and pepper

Commercial cultivars of lettuce and pepper were evaluated for resistance :

I. n.70 pepper ibrids;
II. N.8 pepper rootstocks;
III. n. 37 summer lettuce cultivars;
IV. n.36 autumn lettuce cultivars,

Pepper	*Phytophthora capsici*
	Rhizoctonia solani

Zucchini	*Phytophthora capsici*

Lettuce	*Fusarium oxysporum* f.sp. *lactucae* Races 1, 2 e 3
	Scletorinia sclerotiorum
	Verticillium dahliae

Evaluation of varietal susceptibility of pepper rootstocks against selected soil borne pathogens

Greenhouse trials under artificial inoculations

Isolate code	Pathogen	Original host	Trials carried at °C
AgRh1P	*Rhizoctonia solani*	*Capsicum annuum*	Greenhouse at 24-28°C
AgRh1T	*Rhizoctonia solani*	*Solanum lycopersicum*	Greenhouse at 24-28°C
VD1	*Verticillium dahliae*	*Capsicum annuum*	Greenhouse at 20 -24°C
VD2	*Verticillium dahliae*	*Solanum torvum*	Greenhouse at 20 -24°C
VD3	***Verticillium dahliae***	***Solanum melongena***	Greenhouse at 20 -24°C

Evaluation of varietal susceptibility of pepper rootstocks against selected soil borne pathogens

The artificial inoculation of 20 and 30 days-old pepper plants was carried out by using selected isolates of *Verticillum dahliae* and *Rhizoctonia solani*, obtained from infected plants and previously tested for a medium-high pathogencity on pepper .

Soil was infested with each strains *R. solani* by mixing 2 g L^{-1} of the infested kernels immediately before seedling transplanting. The isolates *V. dahliae* were applied by root dipping Inoculated and not inoculated seedlings were watered daily and maintained in a greenhouse, at temperatures favorable to disease development.

Symptoms started to be visible 8-13 days after artificial inoculation of *R. solani*, while, 25 days were necessary for the appearance of wilt caused by *V.dahliae*.

The data are expressed as Disease index 0-100.
The final disease rating took place 3-5 weeks after inoculation.

Evaluation of varietal susceptibility of pepper rootstocks against selected soil borne pathogens

Susceptibility of different pepper rootstocks inoculated 20 and 30 days after sowing with *Rhizoctonia solani*, compared with that of the cv. Corno di toro and Cuneo.

Rootstocks	*Rhizoctonia solani* Isolates RH1T		*Verticillium dahliae* (Isolates VD1)		*Phytophthora capsici* (Isolates PHC4)	
	20[1]	***30***	***20***	***30***	***20***	***30***
Rocal	PR[2]	PR	R	R	R	R
Tresor	S	S	R	R	HS	HS
Atlante	S	S	R	R	HS	-
Snooker	R	R	R	R	S	PR
Galaxy	PR	PR	R	R	R	-
Robusto	S	PR	R	R	S	S
Corno di toro[3]	HS	S	S	S	HS	HS

1) Days after sowing in plug tray at 24°C; **2)** Resistant (R, disease index from 0 to10), partly resistant (PR, DI: 11-30), susceptible (S, DI: 31-60) and highly susceptible (HS, DI: 61-100); **3)** Susceptible control.

Evaluation of varietal susceptibility of pepper against *Phytopththora capsici*

Zoospore productions and artificial inoculation.

Zoospore was released by chilling culture.

One milliliter zoospores suspension (5×10^4 ml^{-1}) was pipetted around the base of the plant.

Artificial inoculation by mixing into the soil 30 g/m^2 of the biomass of 3 isolates of *P. capsici.*

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Field trial at CReSO Experimental Center

Efficacy of grafting on resistant rootstocks against *P. capsici* of pepper.

Evaluation of varietal susceptibility of pepper rootstocks against selected soil borne pathogens

- The results obtained in this study confirmed that the susceptibility of pepper rootstocks against *R. solani* is age-dependent, thus confirming the significant effect of the timing of the infections on the incidence of root rot. Clearly, older plants were already well developed and had well-thickened and lignified cells, which contribute to resistance against *R. solani*.

- All the rootstocks, with the exception of 'Rocal' and 'Snooker' were partially susceptible to *R. solani*. On the contrary all the tested rootstocks were resistant to *V. dahliae*.

- Among the tested pepper rootstocks "Robusto", "PG5738", "Terrano" "Snooker" and "Brutus" are resistant or partially resistant to *P. capsici*, while "Tresor" showed a variable reaction depending on the isolates. Further evaluation will be conducted by extending the study to other isolates obtained in Piedmont farms.

Critical aspect of grafted pepper.

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Sustainable management strategies against soil-borne and foliar diseases of zucchini.

Trial conditions	*Phytophthora capsici*	*Podosphaera xanthii*
Greenhouse at	22-24°C	23-25°C
Zucchini (cv Genovese)	30 days	15 days
Artificial inoculation	1 g/L of *pathogen biomass*	$1x10^5$ conidial /ml

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Greenhouse Trial under artificial inoculation

Sustainable management strategies to control *Phytophthora capsici* on zucchini

Experimental protocol

Treatments	Active ingredient	Dosage*	Transplant @
Healthy control	-	-	-
Untrerated control	-	-	-
Micosat	Symbiotic fungi (mycorrhizas) and bacteria of the rhyzosphere	0.4 g/m^2	7 and 14**
Serenade	*Bacillus subtilis*	4 g/L of soil	7 and 14
Remedier	*Trichoderma harzianum +T.viride*	0.3 g/L of soil	7 and 14
Biofence	*B. carinata* pellet	250 g/m^2	7 and 14
Vaporine	Natural fertilizer	20 g/m^2	7 and 14

** Days after treatment.

Products were applied as soil treatments at the suggested dosages.

Treatments were carried out one day after artificial inoculation of the biomass of *P. capsici* at 1g/L of soil.

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Disease management strategies to control *Phytophthora capsici* on zucchini

Greenhouse Trial under artificial inoculation

Efficacy of different soil treatments agains *P. capsici* on zucchini (30 days after transplanting) First results.

Biological control agents as well as natural compounds are possible alternatives to the use of chemicals, that have been proposed and evaluated in numerous pathosystems, with different degrees of success.

The artificial inoculation with *P. capsici* resulted in high infection levels in all trials, *Brassica carinata* pellet (Biofrnce) showed a partial activity and Vaporine reduced *P. capsici* attacks from 90% (untreated control) to 35% of dead plants.

Sustainable management strategies to control powdery mildew of zucchini
Experimental protocol

A.I.	Commercial product	Dosage ml/hl	Number of treatment (days between treatment)
Untreated control	-	-	-
Fertilizer	Oidium (Bioplanet)	300	2(7)
Fertilizer	Kendal cops (Valagro)	300	2(7)
Cyflufenamid	Cyflamid (Certis)	15	2(7)
Myclobutanil	Thiocur forte EW (Dow)	125	2(7)
Sulphur plus terpenes	Heliosufre (Intrachem)	300	2(7)
Mustard oil	DuoLif (Cerealtoscana)	1000	2(7)
Azoxystrobin	Ortiva (Syngenta)	80	2(7)

Sustainable management strategies to control powdery mildew of zucchini

Sulphur plus terpenes and mustard oil consistently controlled powdery mildew, followed by mychlobutanil alone or combined with *A. quisqualis*. *B. subtilis* and *A. quisqualis* when tested alone were partially effective (Gilardi G., Baudino M., Gullino M.L., Garibaldi A. Phytoparasitica, 2012).

The use of cyflufenamide has maintained the best protection of the crop.

Thanks for the attention!

Valorization des productions légumières transfrontalières

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