

# Isolation of fungal root endophytes and analysis of their impact on plant performance

## Molecular physiology

Nutrient exchange  
Induced resistance  
Plant development

## Impact on plant performance

yield  
quality  
interaction with pathogens

## Glomeromycota

arbuscular mycorrhizal fungi

## Ascomycota

dark septate endophytes  
other endophytes

## Isolation and characterisation

## Basidiomycota

Sebacinales: *Piriformospora indica*

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**Impact on plant performance**

yield

quality

interaction with pathogens

**Isolation and  
characterisation**

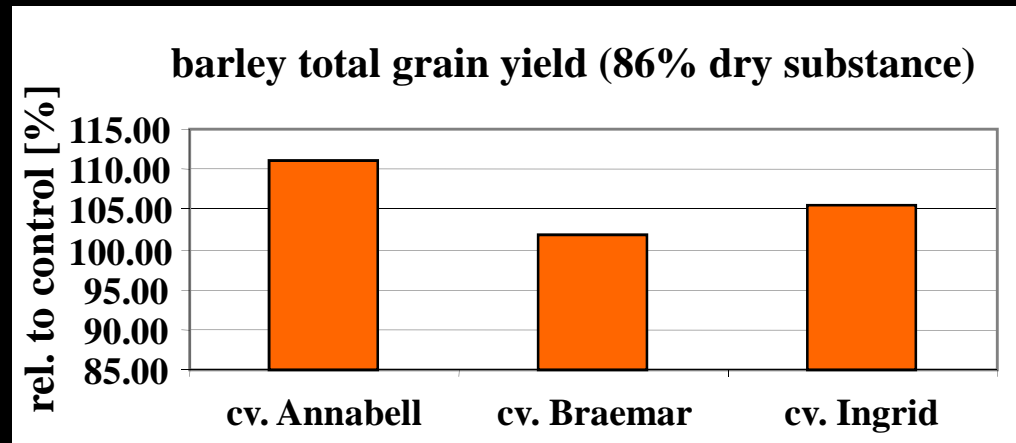
**Basidiomycota**

**Sebacinales: *Piriformospora indica***

# *Piriformospora indica*

- isolated in the Indian Thar desert  
Verma et al. 1998; Varma et al. 1999
- Sebaciales, Basidiomycota
- promotes ...

## yield



Waller et al. 2005; Achatz et al. 2010

## rooting of cuttings



Drüge et al. 2007

## In vitro cultures

Varma et al. 1999



+ benzyl amino purine

+ *Piriformospora indica*

transfer to substrate

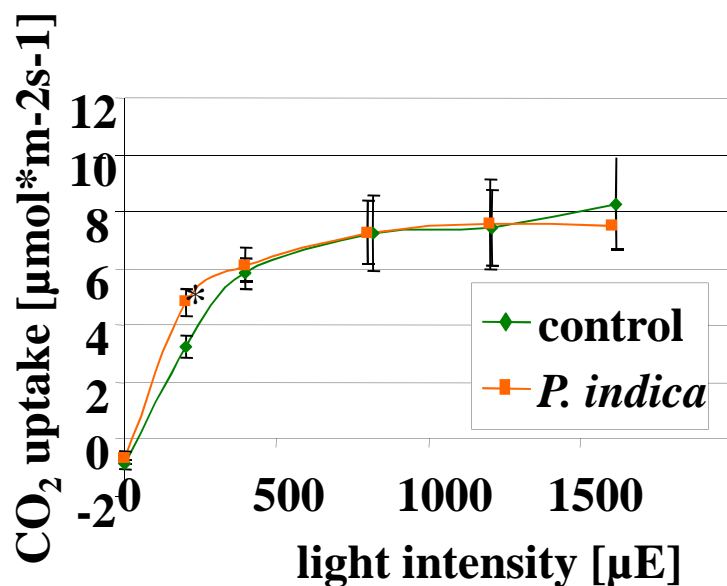
57% survival

95% survival

# *Piriformospora indica*

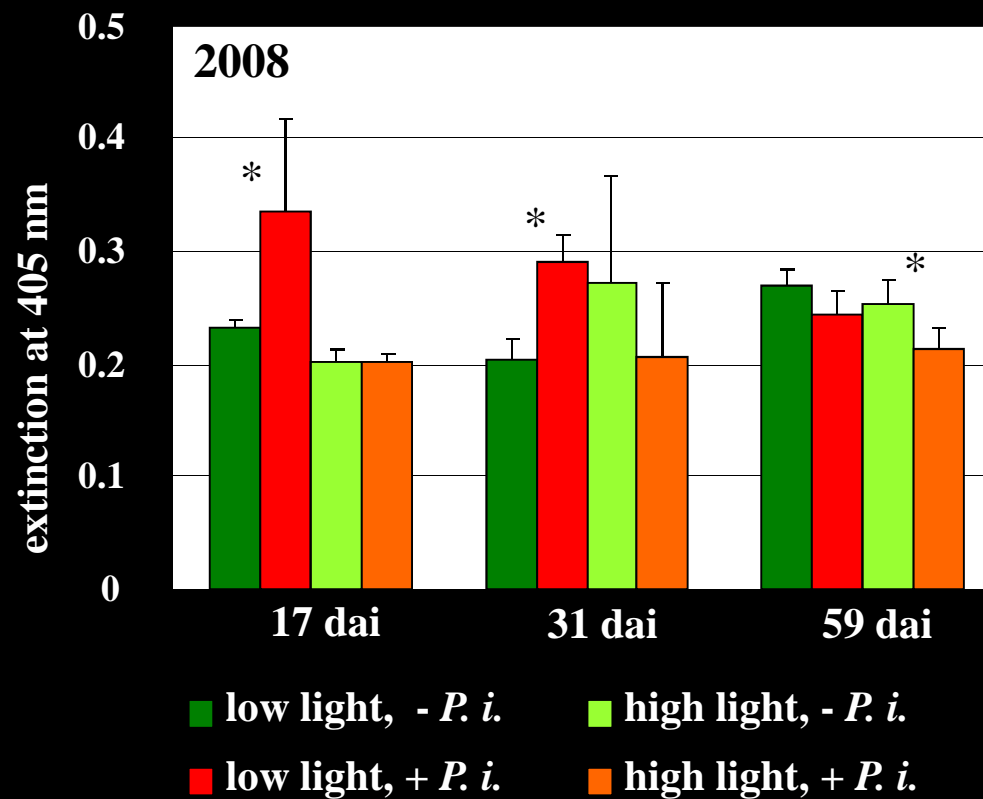


## photosynthesis



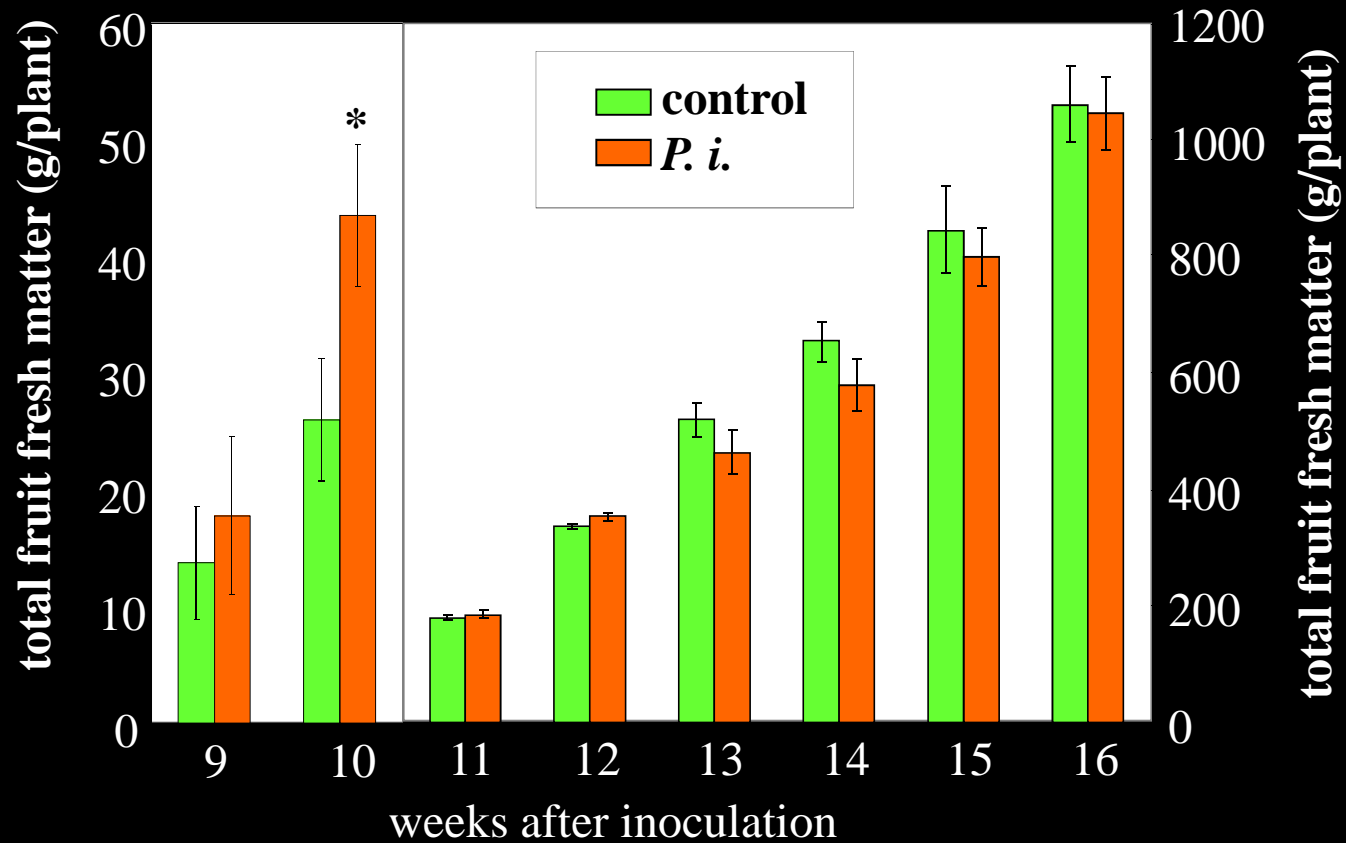
Achatz et al. 2010

## Pepino Mosaic Virus spread



Fakhro et al. 2010

## *P. indica* impact on tomato fruit biomass during time



***P. indica* increases yields at early harvests.**

**Impact on plant performance**

yield

quality

interaction with pathogens

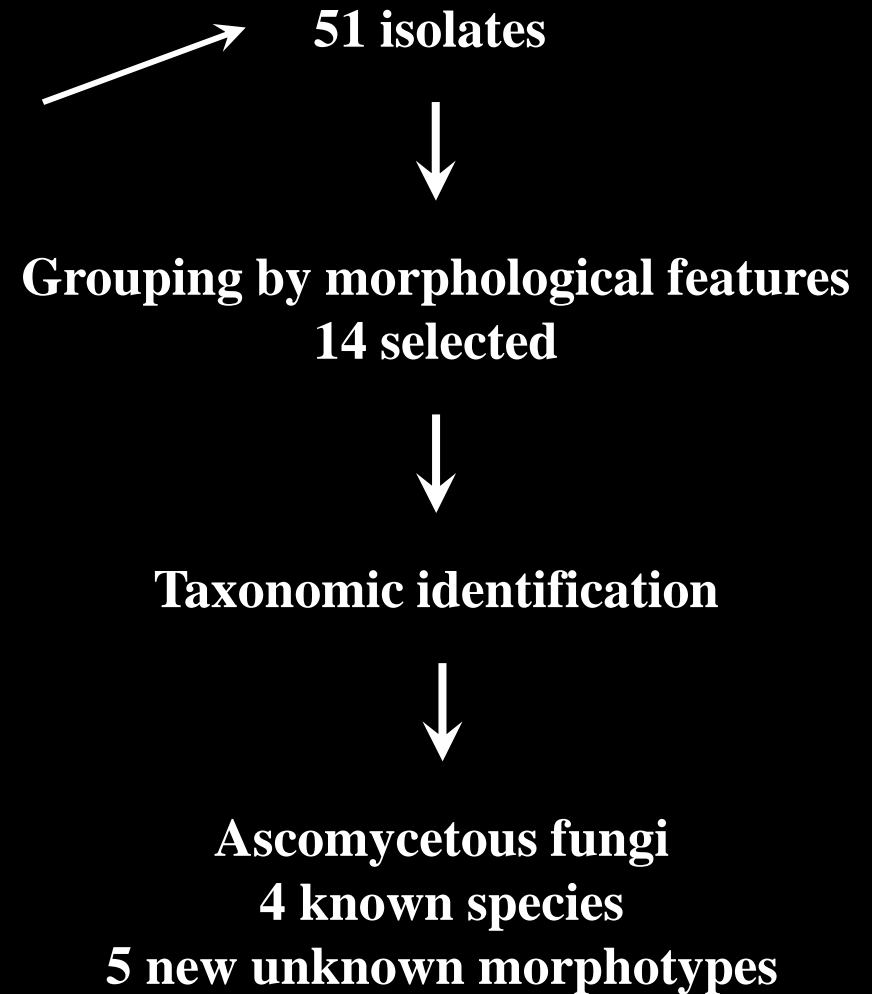
**Ascomycota**

dark septate endophytes

other endophytes

**Isolation and  
characterisation**

# Identification of fungal endophytes from tomato roots



# Identification of fungal endophytes from tomato roots

Fungal group	Mineral fertiliser		Organic fertiliser		Total
	VL	CT	TN	MD	
Fusarium spp.	3		7	10	20
<b>DSE/SM<sup>a</sup></b>			<b>4</b>	<b>4</b>	<b>8</b>
<b>OMT<sup>b</sup></b>	<b>1</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>6</b>
NG <sup>c</sup>	2	2	6	7	17
Total	6	5	18	22	51

**a Dark septate endophytes and sterile mycelia**

**b Others morphotypes which produced conidia or spores**

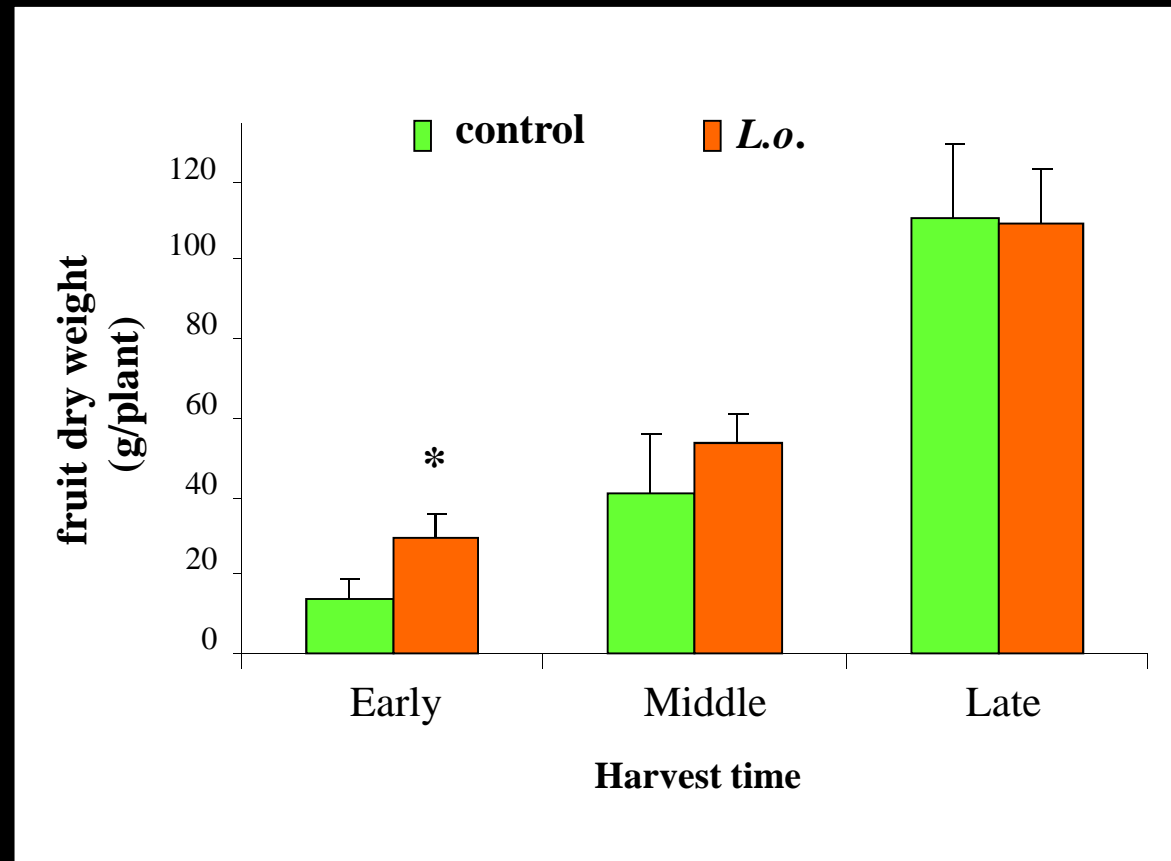
**c NG: no growth.**



# Characterisation of fungal endophytes from tomato roots

Isolate	Characterised as	Colonisation pattern	Plant impact
E20	<i>Plectosphaerella cucumerina</i>	single adhesion tips rhizodermis	neutral
E27	<i>Bionectria rossmaniae</i>	appressoria symplastic occurrence	negative
DSE36, DSE41	Pleosporales	Single adhesion tips cortex	neutral
DSE48	Pleosporales	branched adhesion tips cortex	neutral
DSE49	Pleosporales	Swollen cells cortex	neutral
DSE63	<i>Pyrenochaeta lycopersici</i>	appressoria hyphal coils	negative
E67	<i>Trichoderma</i> sp.	single adhesion tips cortex	neutral
DSE131, DSE135	<i>Leptodontidium orchidicola</i>	appressoria epidermis and cortex	positive
DSE133	Chaetosphaeriales	branched adhesion tips mainly surface	neutral

# *Leptodontidium orchidicola* impact on yield

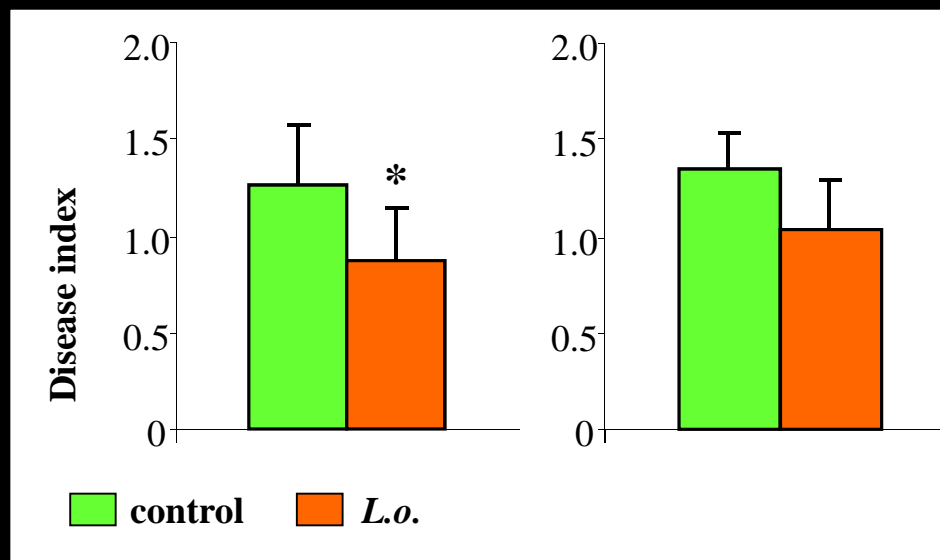


**The DSE *L. orchidicola* increases yields at early harvests.**

# *L. orchidicola* impact on plant resistance

## Weight loss percentage of tomato shoots after infection with the pathogen *Verticillium dahliae*

Inoculum	5X10 <sup>5</sup> conidia/ml		7X10 <sup>6</sup> conidia/ml	
Endophytic Isolate	Weight loss percentage		Weight loss percentage	
	FW	DW	FW	DW
control	22.2 <sup>a</sup>	23.6 <sup>a</sup>	30.23 <sup>a</sup>	31.25 <sup>a</sup>
L.o.	4.5 <sup>b</sup>	10.1 <sup>b</sup>	28.9 <sup>a</sup>	27.25 <sup>a</sup>
L.o. x V. d	<b>0.00815</b>	<b>0.00123</b>	0.819	0.539



**The DSE *L. orchidicola* increases resistance at low pathogen doses.**

## Summary

Also roots of crops in agricultural soils harbour many fungal root endophytes up to now only found in natural ecosystems.

Fungal root endophytes show very diverse colonisation patterns.

The DSE *L. orchidicola* and the basidiomycete *P. indica* can improve plant resistance.

The DSE *L. orchidicola* and the basidiomycete *P. indica* increase tomato yield at early harvests.

## **Future directions**

**Observation during our experiments:  
colonisation intensity and growth performance of DSE is  
correlated with organic matter**

**Biotrophic - Saprotrophic**

**Exchange of nutrients**

**Influence of organic matter**

## Future directions

### Root endophytic fungi for improving *in vitro* culture of cherry trees

Clone	Growth	Stem	Branch	Number of isolates of root endophytic fungi			Morphotypes
				PDA	MA	WA	
Asteria	+	+++		23.3±4.6 c	23.3±5.7 b	25.0±5.3 b	NA
Concordia	++	+	++	15.3±1.5 bd	14.7±4.7 a	22.7±3.8 b	25
Peleus	++	+++		8.7±0.6 a	15.0±1.0 a	11.3±6.8 a	26
Hypnos	+	+++		19.3±4.6 cd	19.7±3.2 ab	24.3±3.5 b	36

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