Genotype-genotype interactions determine the degree of induced resistance in wheat

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Crop plants are colonized by a myriad of micro-organisms on all plant organs. These micro-organism can interact in many different ways as beneficials, as pathogens or as saprophytes with their host plant. By this, they probably play a primordial role in the adaptation to environmental conditions, resilience to abiotic stresses and in the resistance against diseases and pests. The present experiments explored the effects of several rhizosphere-borne biocontrol strains of *Pseudomonas protegens* and *P. fluorescens* on the resistance of wheat varieties against leaf rust disease caused by *Puccinia triticina*.

Experimental set- up

Greenhouse experiments using seed inoculation at planting. Infection with CH- P. triticina strains at 3 leaf stage. Scoring of disease severity at 10dpi by estimation of infected leaf surface. At 12 dpi (days after infection), evaluation of root colonization by extraction of bacteria from the root surface and plating on KB with rifampicine.

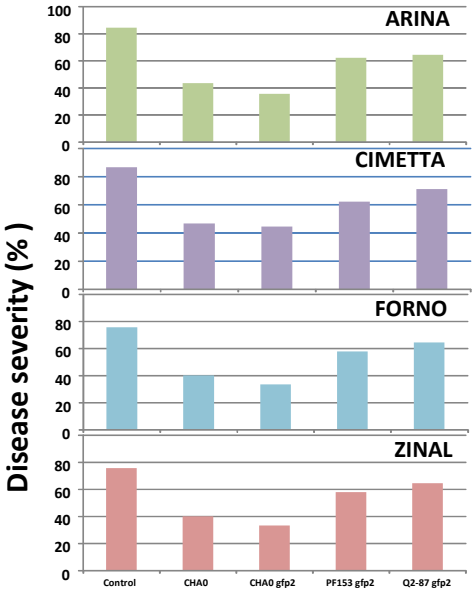

Fig.2 Disease severity of leaf rust on wheat. Symptoms were scored at 12dpi estimating the percentage of leave area covered with pustules.

Fig.3 Disease severity of leaf rust in 4 wheat varieties inoculated with 4 different beneficial Pseudomonas strains.

Variety	Released	Resistance level	Lr genes
Zinal	2003	intermediate	unknown
Arina	1981	susceptible	Lr12
Cimetta	2003	susceptible	Lr12
Forno	1994	intermediate	Lr34

All varieties are obtentions by Agroscope and DSP Ltd.

Tab.1 Wheat varieties used in this experiment and their resistance level against leaf rust (Puccinia triticina).

Strain	Description	Reference
P. protegens CHA0*	wild type	Keel et al., 1989
P. protegens CHAO gfp*	tagged with the GFP protein	Péchy-Tarr & Keel, unpublished
P. fluorescens PF153 gfp*	tagged with the GFP protein	Péchy-Tarr & Keel, unpublished
P. fluorescens Q2-87 gfp*	tagged with the GFP protein	Péchy-Tarr & Keel, unpublished

* for environmental and tracing studies, strain CHA0 was marked with a spontaneous rifampicine resistance

* bacterial strains were tagged with the GFP protein for further tracing studies in artificial and natural soils.

Tab.2 Pseudomonas strains used in the present experiments.

Fig.1 Experimental set up of the experiment in the greenhouse. Plants were kept at a constant temperature (+/-18°C). Pots were random distributed on the table. Plastic covers were used to avoid spilling of modified strains in the environment.

Factor	Disease severity	Root colonization
Variety	<0.05	<0.002
Strain	<0.002	<0.002
Variety x Strain	<0.002	<0.002

Tab.3 Two-way ANOVA analysis of the factors variety and strain on disease severity and the capacity of root colonization of the 4 bacterial strains at the end of the experiment.

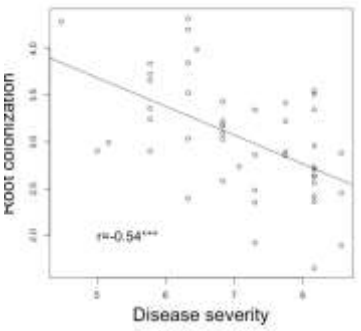

Fig.4 Correlation plot of disease severity vs. root colonization. Pearson product-moment correlation coefficient is r=0.54 ***.

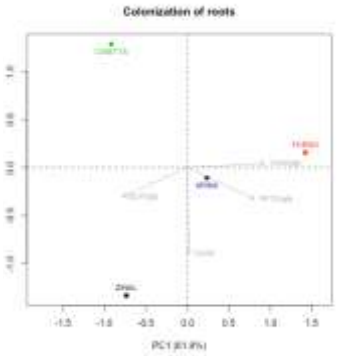

Fig.5 Principal component analysis of factors variety and bacterial strain on the colonization of the roots.

Conclusions

- Beneficial *Pseudomonas spp*. strains colonize wheat roots and can induce resistance against the leaf pathogen *Puccinia triticina*.
- The magnitude of induction depends on the capacity of the strain to colonize the root.
- Analysis of root colonization by bacteria and wheat cultivar reveals specific affinities between the bacterial strain and the wheat varieties.
- These results suggest an straight interaction between plant and beneficial bacteria at the molecular level

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