The plants have their own immune system which is elicited on induction of various defence-related pathways. In the present study, *F. oxysporum* f. sp. *lycopersici* causing the dreaded wilt disease in tomato is managed through activating ISR which is an economical and eco-friendly strategy of managing plant diseases.

Interaction between plants and the rhizo-microbiome in a natural ecosystem is highly complex. The fluorescent pseudomonads, a group of PGPR, are widely considered as a model organism for the studies on plant-microbe interaction which is highly unpredictable for most of the time in the environment. The identification of any new potential isolate which can induce resistance in the otherwise susceptible plants is a contribution to sustainable agriculture which may benefit to reform the multi-decade old mainstream pesticide based disease management approaches. Hence, the present study was designed to analyse the interaction between a set of new shortlisted (in terms of their plant-probiotic traits and rhizosphere competence) fluorescent pseudomonad strains.

As many biocontrol agents perform well under controlled conditions, but often fail under field conditions, the initial stages of the study involved isolation of fluorescent pseudomonad isolates and their characterization based on their *in vitro* potential probiotic traits which were analyzed statistically to shortlist the potential pseudomonad candidates. Most of the shortlisted fluorescent pseudomonads in the current study, demonstrated enhanced plant growth promotion properties, offering a better application choice in biocontrol strategies. At the end of first objective, eleven isolates were shortlisted based on the observed biocontrol traits substantiated by the Kendall’s coefficient.

Further, all eleven isolates were analysed for their genomic and outer membrane protein diversity to understand their specificity, which could further be correlated with their disease protection ability and was an unconventional approach. The results of the genomic diversity analyses suggested that the Rep-PCR markers were better markers with the use of less number of PCR primers. Outer membrane protein was a less-promising diversity marker with its limited banding pattern. Altogether, genomic fingerprinting using RAPD and Rep primers, indicated promising results to correlate the diversity with biocontrol behaviour.
Latour’s strategy for identifying and shortlisting potential PGPR isolates has a disadvantage that the lower ranking isolates outperform the higher ranking ones. In addition, it completely rely on the secondary metabolite traits of the isolate. This necessitates the need to look for an alternative strategy to find the best competent biocontrol strain. The present study was designed to look for a strategic genomic diversity between the eleven isolates using PCR primers. The use of such kind of PCR primer-based strategy helped in overcoming the limitations of probiotic trait-based shortlisting of PGPR. PCR marker primers for genomic and membrane protein profiling were used to find the heterogeneity of fluorescent pseudomonads and were correlated with resistance inducing traits against fusarium wilt under green-house conditions.

All eleven isolates were further tested for their in vitro rhizosphere traits such as sorbitol fermentation, nitrate reduction, various mycolytic enzymes, ACC deaminase and antibiotic production. All isolates were also checked for AHL production showed that none of the shortlisted fluorescent pseudomonads were AHL mutants. An extended green-house investigation using seed-priming with the shortlisted eleven isolates showed that the isolates M80, M96 and T109 as the best executors in rhizosphere competence and fusarium wilt inhibition under green-house conditions. All the three aforesaid isolates showed similar linkage distance and were placed in the same RAPD and Rep-PCR cluster depicting a substantial link between genomic diversity and host-defence signal activation against phyto-pathogens. The signaling associated with priming in tomato plants depicted an increase in PAL and LOX activity, along with antioxidant markers during Fusarium encounters. The observed LOX increment in host plants indicates the activation of JA signaling in the ISR activation. Altogether, the biochemical modifications associated with pseudomonad priming was significantly high and fast compared to the unprimed and pathogen challenged control plants. Especially the PA and LOX activity, which showed significant uplift on seed-primed plants. Since the site of pseudomonad-priming and fungal challenge were spatially separated in the experiment set up, it is certain that defence mechanisms were not associated with mycolytic enzyme production, which, however, may help them to counter Fusarium, offering a direct way of plant protection, without necessarily disturbing the host immune system.
The kinetics of specific oxidative stress markers (total phenol, proline, catalases, ascorbate peroxidases, monodehydroascorbate reductase, guaiacol peroxidase, superoxide dismutases, glutathione reductase and dehydroascorbate reductase) of pseudomonad-primed tomato plants on encountering *F. oxysporum* strongly correlated with the green-house results. A decrement in H$_2$O$_2$ and MDA content was supported by significant increment in antioxidant enzymes in primed plants across time. The discussed oxidative stress variation study using classic oxidative markers displayed the efficiency of pseudomonad-priming in stress alleviation. All the antioxidant markers showed significant increment at the initial 24 hpi whereas SOD appeared to be elevated at 48 hpi in the fluorescent pseudomonad-primed plants. Moreover, systemic increment in phenolics, peroxidase and PPO activity was supported with lignification as observed histochemically. Besides, another observed feature in the green-house experiments was the strain-specific variation in the biochemical parameters. Similarly the antioxidant markers also showed an elevated level, however the signals between the oxidative marker pathway and the defence-specific signaling is still unknown. Hence, signaling mechanism which interconnects induction of resistance and oxidative changes is a potential area of study.

Additionally, the observed uplift in time course study of PR proteins (β-1,3 glucanase and chitinase) was reasonably high in M80-primed tomato plants. Chitinase displayed much significant elevation whereas β-1,3 glucanase showed a relatively slow uplift during fungal encounter. Similarly, LOX also displayed a better increment than PAL, suggesting the activation of phenylpropanoid and oxylipin pathway in the primed host plants.

Development of a formulation is an inevitable step in any biocontrol strategies to use under field conditions. In the present study, the M80-talc formulation showed promising results under green-house conditions with a relatively significant shelf life. The green-house study correlated with the systemic biochemical changes in the host. This evidently indicated that pseudomonad-primed plant’s antioxidant system could withstand the *Fusarium*-induced stress.

The present study identified a potential fluorescent pseudomonad isolate M80 against fusarium wilt in tomato plants under green-house conditions. In addition, the
study attempted a novel strategy using diversity markers, which found a very promising correlation with biocontrol traits against *Fusarium* in host plants.