## Session 2: Biological agents for pest and nutrient management

### PGPRs from saffron rhizosphere for nutrition management

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Plant growth promoting rhizobacteria are reported to be present in the rhizosphere of various plants like wheat, rice and maize which helps the plant to grow better and produce more. This could be true of Saffron as well. The production of Saffron is dwindling from last few years and the trend has not changed with 2.5 kg/hectare produced in 2009 to 2.06 kg/hectare in 2010. In the present study, rhizosphere ecology of Saffron was analyzed and potential PGPRs were isolated from the different fields of Pulwama district of Kashmir, J&K. The fields were selected on the basis of total production of Saffron (High production; Wuyan and low production; Khrew) and further, a comparison of the bacterial diversity and load in rhizosphere of Saffron was done with that of the bulk soil taken from respective fields. Analysis of rhizobacterial diversity was also done at the time of flowering (Oct-Nov) and before flowering (Jul-Aug).
Comparison of the bacterial diversity and load of Saffron from Wuyan and Khrew fields before and during flowering period revealed that the total bacterial load is more in rhizosphere as compared to bulk soil but, the microbial diversity is more in bulk soil. Three major genera were isolated from the bulk and rhizosphere soil namely, *Bacillus*, *Pseudomonas* and *Kurthia*. However, the percentage of these rhizobacteria varied from high productive soil (Wuyan) to low productive soil (Khrew) as well as at the time of flowering and before flowering.
*Bacillus* genera dominated the rhizosphere of both high (90.9%) and low production soil (61.53%) before flowering whereas its percentage decreased to less than half at the time of flowering in Wuyan region (33.3%) but was not much effected in Khrew (63.6%) during flowering. On the contrary, *Pseudomonads* were absent in Saffron rhizosphere before flowering in High productive soil (Wuyan) which increased to substantial amount (50%) during flowering, but surprisingly in low productive soil, the percentage of *Pseudomonas* decreased to half (Before flowering: 30.77%; during flowering: 18.1%). In addition to these two genera, the percentage of *Kurthia* sp was also increasing to double during flowering in both soil types. [(High production, before flowering: 9.09%; during flowering: 16.7%), (low production, before flowering: 7.69%; during flowering: 8.1%)]
All the rhizobacteria isolated were further screened for PGPR activity. Comparative functional analysis of rhizobacterial of high and low productive soil from Wuyan and Khrew respectively resulted in isolation of 55.6% PGPR from Wuyan soil in comparison of 24.3% PGPRs from Khrew. The preliminary results mentioned above clearly indicate the role of rhizobacter in growth and production of Saffron.

### Beneficial nutritional properties of *Lactobacillus fermentum* CFR 2195

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Beneficial properties of the *Lactobacillus fermentum* CFR 2195, isolated from healthy infant feces have been evaluated. The adherence of *L. fermentum* to HT-29 and Caco-2 cell-lines were found to be 197.66 ± 15.62 and 100.33 ± 15.69 per 100 cells, respectively. The effect of different concentrations of FOS, a well known prebiotic at different concentration (05, 1.0, 1.5, 2.0 and 2.5%v/v) on the growth of *L. fermentum* was studied. Of the different concentrations tested 2.0% FOS was found to be optimum and was selected for further studies. The synbiotic preparation containing *L. fermentum* and FOS exhibited significant antimicrobial activity against a few tested common food borne pathogens. The proteolytic activity of the *L. fermentum* was significant and the total amino acid content in milk fermented with *L. fermentum* was 555 mg/l. Additionally the test organism was found to be a potent producer of vitamin $B_{12}$ (29.45 ng/g)





dry biomass by submerged fermentation (96 h) with successive anaerobic and aerobic phases of 48 h each. The results clearly indicate the potential of *L. fermentum* to be used in the management of nutritional deficiencies such as amino acid, vitamin $B_{12}$, coupled with significant adhesion and antimicrobial properties.

Keywords: L. fermentum, Caco-2, fermented milk, fructooligosaccharides, amino acids, vitamin $B_{12}$

### Effects of mycorrhiza and plant growth-promoting rhizo-bacteria on rice in Northern India: field trial results from 2005-2008

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Beneficial microorganisms such as arbuscular mycorrhizal fungi (AMF) and plant growth promoting rhizo-bacteria (PGPR) can ameliorate plant nutrition through an extended extra-radical hyphal network and by nutrient mobilisation[1]. In the past, host specificity may not have been adequately considered when microbial inoculants were developed for different crops. In the Bio-fertilizer Network of the Indo-Swiss Collaboration in Biotechnology (ISCB), AMF and PGPR are integrated as bio-inoculants in wheat-rice and wheat-black gram systems.
The inoculants were isolated from wheat roots and selected for plant growth performance and desirable biochemical properties. They were tested alone or in combination at seven sites extending from the Himalayan foothills to the Indo-Gangetic Plain, each managed at two fertilizer levels (zero and farmer's practice). Here we present results on the impact of these AMF and PGPR strains on rice grown in a wheat-rice rotation experiment in Bhawanipur (Uttar Pradesh) between 2005 and 2008.
The AMF inoculum used consisted of a natural consortium (Mnat), which was multiplied *via* host plants and comprised several AMF strains. A commercial AMF (Mss2; *Glomus intraradices*), multiplied *via* a root organ culture, was also applied. The PGPR inoculum consisted of two *fluorescent Pseudomonas* strains (Ps; R62 and R81, always applied in combination). A control (Cont) treatment remained un-inoculated.
Calculated across both fertilizer levels applied and over four seasons, rice grain yield was most increased by inoculation with Mnat in combination with Ps (Mnat+Ps). Depending on the absence or presence of an intercrop with *Sesbania* (a nitrogen fixing green manure) before rice, grain yield was 16% and 22% higher, respectively, than in the control treatment (means of four rice crops, $p \leq 0.001$). Zinc (Zn) concentration in seeds was significantly enhanced in all treatments (60 to 80%; means of three rice crops, $p \leq 0.001$), whereas Fe concentration in seeds was not significantly affected by any of the inoculants applied. Our results show that the the AMF and PGPR strains had the ability to optimize rice production in low input systems, in terms of crop yield and Zn concentration. Applying the same inoculants, isolated from the target crop wheat, Mäder et al. (2011) obtained a remarkable wheat grain yield enhancement of 41% compared to un-inoculated control plots[2]. Therefore, we suggest that isolates from the rhizosphere of the target crop are more efficient.

*References:*
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