Impacts of biostimulant products on wheat productivity & its rhizomicrobial communities

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Introduction

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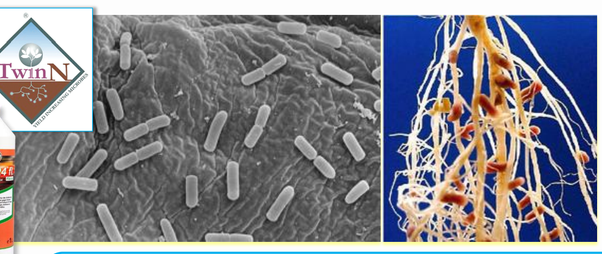
BIOSTIMULANTS

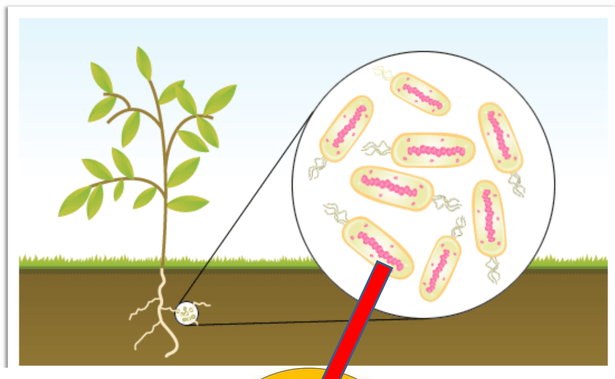


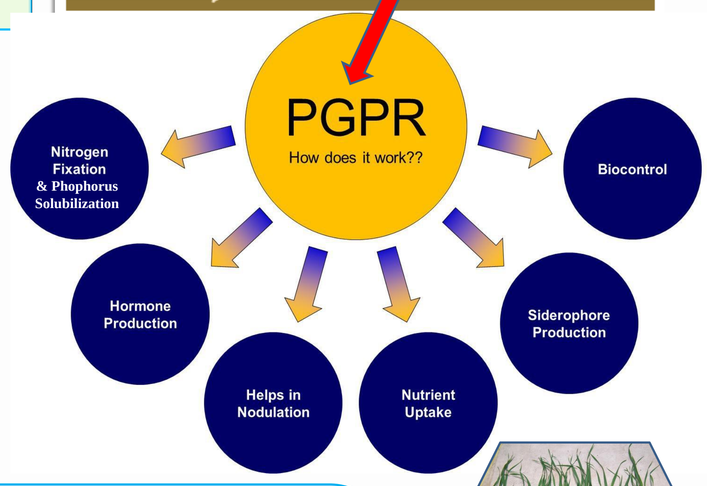
Today's chemical fertilizers:
- Source of soil & water pollution
- Greenhouse-gas generators
- Expensive
- Reduction of fossil resources (e.g. phosphate)

Biostimulants based on beneficial microorganism (PGPR) are able to reduce the use of chemical fertilizers and increase the nutrient use efficiency by the plant

Biostimulants are compounds, substances and microorganisms that are applied to plants or soils to regulate and enhance the crop's physiological processes in order to make them more productive. At least 8 classes of compound-based biostimulants exist, including humic substances, complex organic materials, beneficial chemical elements, inorganic salts, seaweed extract, chitin and chitosan, antitranspirants, free amino acids & other N-containing substances[3, 4].

In parallel, biostimulants may also include **living microorganisms** like plant growth-promoting fungi (PGPF) and **rhizobacteria (PGPR)**[1, 2]. Our present study will initially focus on the last class of products.





Objective

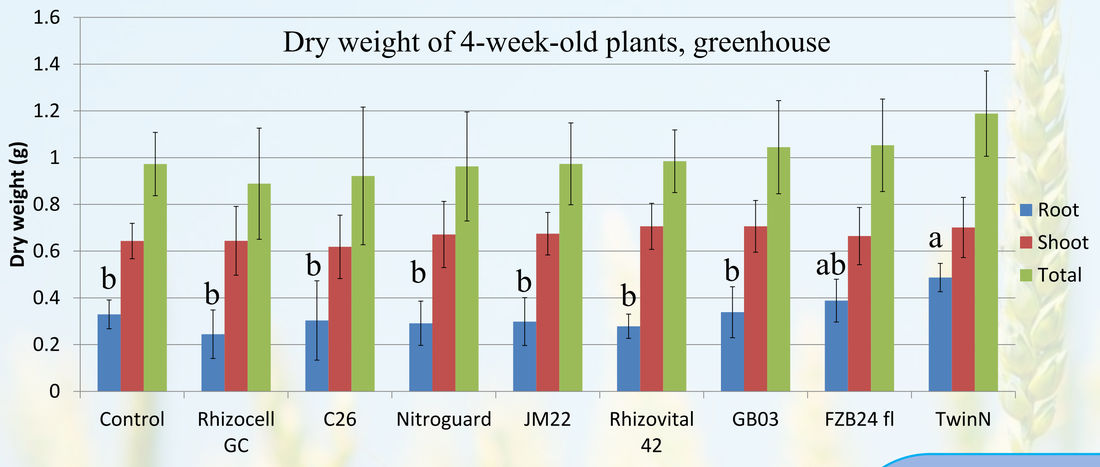
Development of relevant research tools:
- To assess the impacts of such changes on plant growth, yield, tolerance to abiotic stresses & soil fertility
- To stimulate the increase of beneficial microorganism communities and the decrease of pathogenic ones in the wheat rhizosphere
- To figure out the best agronomical practices to stimulate the beneficial microbial communities under different productions systems

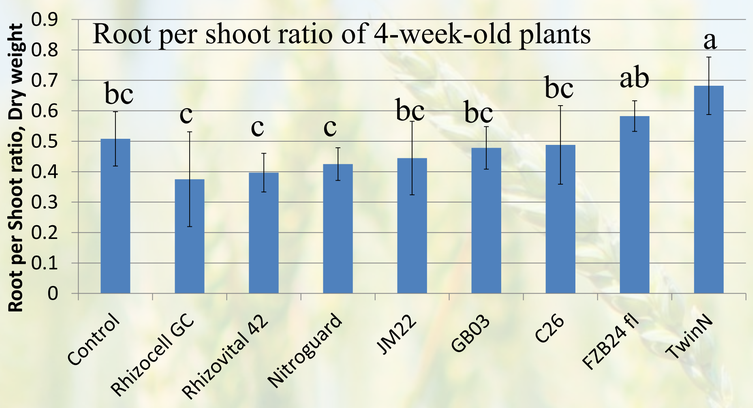
Materials & method

- **PGPR strains** include in-house strains (*Bacillus pumilus* C26, *B. subtilis* AP-305-GB03, *Enterobacter cloacae* AP-12-JM22) and commercial biostimulant products [TwinN (diazotrophic bacteria); NitroGuard (TwinN + 2 *Bacillus* sp. trains); FZB24 fl (*B. subtilis*); Rhizocell GC (*Bacillus* sp. IT45); RhizoVital 42 (*B. amyloliquefaciens*)]
- **PGPR screening under controlled condition (greenhouse)**: Seeds of a spring wheat, *Triticum aestivum* (variety Tibalt) were planted in 30-cm depth PVC tubes filled with field soil (maintained at 16% humidity, no fertilizer) and inoculated with 10^8 cells/plant under LED lighting (flux: 150 W/m2). After 4 weeks, plant biomass and tiller number were measured.
- **PGPR screening under field condition in combination with N fertilizer**: Seeds of a winter wheat, *T. aestivum* (varirty Forum) were sowed on 2nd Dec. 2013 in a criss-cross design. Two fixed factors were used: the PGPR strain (five biostimulant products above and control) and N fertilizer (0, 50, 75 and 100%). The shoot weight, spike number and grain yield will be measured at Zadoks' stage 39, 69 & 100, respectively.

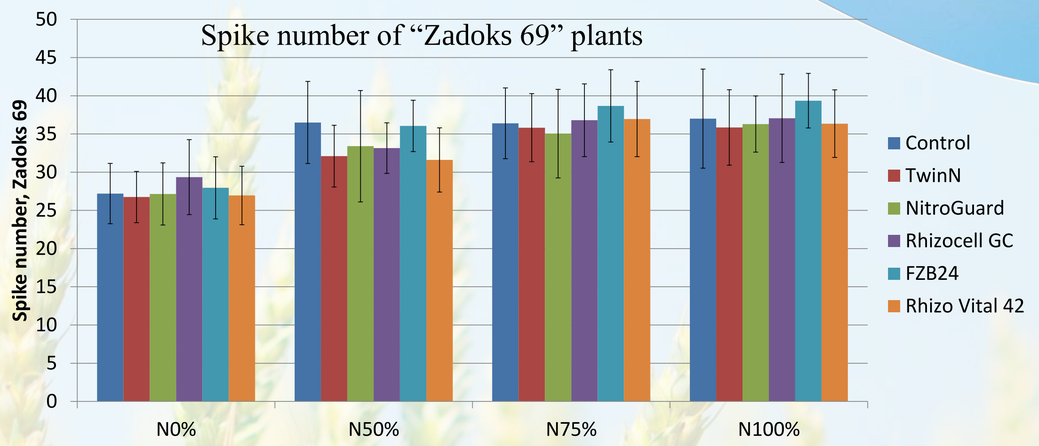
Result and Discussion

Spring wheat
GREENHOUSE TRIALS





Winter wheat
FIELD TRIALS



Results:
- **Under greenhouse condition:** TwinN results in the highest root biomass and root per shoot ratio (one-way ANOVA, p=0.000).
- **Under field condition:** (1) A significant increase in spike number was observed in the Control and FZB in combination with N50%, and FZB in N75% (p=0.005 & 0.031, respectively). (2) N75% and N100% have similar spike number and significant higher than that of N0% and N50% (p=0.00). (3) FZB24 results in the highest spike number compared to other products and PGPR (p=0.009).

Perspectives:
- Continue to optimise the growth condition (e.g. fertilizer level) and select the proper plant stage to inoculate PGPR efficiently in greenhouse as well as in field.
- Assess the grain yield of field experiments.
- Identify the potentially stressing condition that could allow PGPR products to express their growth promotion capacity.
- Metagenomic approaches (based on shotgun sequencing of rDNA) will be developed to assess the impacts of biostimulants to soil microbial community.

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