The present study was undertaken to isolate, characterize and identify potential PGPR having multiple plant growth and health promoting activities from the rhizospheric soils.

Phosphate solubilizing activity of isolates with organic acid production was employed as a basis for the screening of PGPR strains. Isolates were evaluated for their ability to solubilize phosphate, IAA production, Ammonia production, production of amylase, chitinase, lipase and cellulose. Isolates were also checked for HCN production and antagonistic activity. Total 30 PGPR strains isolated and screened for above activities and biochemically characterized. Four promising isolates showing multiple PGP activities were defined using biochemical test and 16S r-DNA sequencing as *Pseudomonas aeruginosa* T-2, *Klebsiella pneumonie* T-4, *Cronobacter malonaticus* BR-1 and *Bacillus subtilis* RR-1.

PGPR strains evaluated for their ability to produce organic acids and it was found that all the isolates showed similar pattern of producing organic acid in the manner of gluconic acid, pyruvic acid, lactic and citric acid but *K. pneumonie* T-4 and *C. malonaticus* BR-1 also produced succinic acid. All the PGPR strains exhibited anti fungal activity against *A. flavus*, *A. niger*, *Alt. solani*, *F. leguminosporum*, *Pn. roqueforti* and *R. solani*. Among them *K. pneumonie* T-4 exhibited maximum antifungal index against *A. niger*. Together with high P solubilizing activity (405 µg/ml). PGPR isolates show the inverse relationship between P solubilization and decrease in the pH. *C. malonaticus* BR-1 and *B. subtilis* RR-1 produced high amount of IAA. The isolates were checked for their IAA production ability under varying pH, temperature, tryptophan concentration and incubation time. All selected PGPR strains produced siderophores and
gibberellins. These isolates produced acid and alkaline phosphatase activity above 35 IU/ml.

Isolates are biocompatible to each other and non pathogenic as they do not possess hemolytic activity.

One of the PGPR isolates *C. malonaticus* BR-1 produce 2.5 g/l of biopolymer. It was purified, hydrolyzed and characterized. The biopolymer contains dextrose as a major carbon moiety where as glutamic acid and four different fatty acids (palmitic acid, steric acid, linoleic acid and elaidic acid) as major amino acid and lipid moieties respectively. Production of biopolymer was evaluated at different pH, temperature, in presence of various carbon sources and under varying salt concentration. It showed at 37°C, pH 7 and after 72 h incubation.

Ability to survive and promote plant growth under stress condition was also evaluated. Bacterial strains show proline production in increasing amount with the increase in NaCl (5-15%) concentration and Polyethylene glycol (2-6%). *C. malonaticus* BR-1 and *B. subtilis* RR-1 exhibited higher proline production as an indicator of able to tolerate higher stress as compared to other test isolates. As with proline production all the test isolates produced biofilm on the surface wall of tissue culture plate. *C. malonaticus* BR-1 EPS producing isolate showed greater amount of biofilm production with the increase in the biomass also with the higher carbohydrate content as compare with other test isolates. *P. aeruginosa* T-2, *K. pneumonie* T-4 and *B. subtilis* RR-1 showed biofilm production in decreasing manner. PGPR isolates by their ability to grow under the heavy metal concentration revealed that all the test isolate grow on the NA containing heavy metals like Cr, Pb, Hg, Co, Zn and Cu. *P. aeruginosa* T-2 grows on the metal containing NA, produced increasing amount of bacterial pigments with the Zn, Cr and Cu. During the growth in NA containing the other heavy metals isolate did not produce the pigments and is the only isolate which tolerated 100 ppm of Mercury. *K. pneumonie* T-4 is found to be more tolerant against Chromium and Lead as it tolerated 400 ppm while against Copper and Zinc it tolerates up to 150
ppm. These isolates solubilize P even when they are growing in media containing 200 ppm of Chromium. Isolates also show IAA production under heavy metal influence, B. subtilis RR-1 produced 13 µg/ml of IAA at 200 ppm of Chromium concentration. In the IAA production isolates produce more amount of IAA in the presence of Chromium as compare to other heavy metals. PGPR strains produce acid and alkaline phosphatase activity with the presence of heavy metals in the concentration of 14-29 IU/ml. In the presence of Pb the acid phosphatase production is higher as compare with the alkaline phosphatase while for the other isolate this not happened may be due to heavy metal specific tolerance ability.

PGPR strains improves seed germination of wheat, mung bean and barley seedlings, increase in the vigor index and plant growth parameters were further evaluated with the pot trials and field trials study resulted in the increase in the overall plant biomass and yield. Field trials were carried out by using formulation of peat as a carrier for application of PGPR strains to the wheat and chick pea plants. Crop yield increased for chick pea from 8.56 to 12.59 g/50 seeds weight and for wheat 2.86 to 4.26 g/50 seeds. C. malonaticus BR-1 increased number of root nodules as compare with control and all other test isolates for chick pea plant.

PGPR strains isolated from the native rhizosphere having multiple PGP traits isolated and characterized for ability to promote plant growth showed that these PGPR strains can grow and have PGP traits at different physiological conditions and having anti fungal activity. Isolates are biocompatible to each other and found to be non pathogenic, can tolerate higher salt concentration and show PGP traits at higher heavy metal concentration. Improved seed germination and plant growth parameters in pot and in field conditions also, Strains also improved the yield of chick pea and wheat plants in field conditions can be a prominent source for improving yield of agricultural crops.

For the future perspective the viability of cells in the rhizosphere will be checked for the reduction in the application of formulations and nutrient content of the crops should be evaluated.