Table 3: Case studies of *PGPB* enhanced phytoremediation of heavy metals on FA

PGP Bacteria	Associated plant	Description	References
Rahnella Aquatilis NBRI K3, *Enterobacter aerogenes* NBRI K24	*Brassica juncea*	FA isolated strains produced siderophore, and increases the tolerance of host plants by producing ACC, IAA, deaminase, and solubilising the phosphates. PGPB increases phytoextraction of Cr and Ni from FA by *Brassica juncea.*	(Kumar et al. 2009)
Micrococcus roseus NBRFT2 (a), Bacillus endophyticus NBRFT4(b), Paenibacillus macerans NBRFT5 (c), and Bacillus pumilus NBRFT9 (d)	*Brassica juncea*	The bacterial strains (*i.e.,* a, g, c, and d) were isolated *Typha latifolia* on FA dumpsite. Different combinations of isolated bacteria were inoculated in *B juncea.* (a+b+d+C), (c+d), and (c+a+d) bacterial combinations resulted the accumulation of Ni, Mn, Pb, Cr, Zn and Cd in many folds.	(Kumari and Singh 2011)
Bacillus anthracis MHR2, Staphylococcus sp. MHR3 and Bacillus sp. strain MHR4	*Brassica juncea L.*	Isolated and identified bacterial strain from *Saccharum spontaneum* on FA dump. MHR3 and MHR4 considered for field scale but not with MHR2. The root and shoot length increased as well as improved in the production of phytohormones like IAA, ammonia, siderophore, and hydrocyanide.	(Mukherjee et al. 2017)
Bacillus boroniphilus, Gracilibacillus boraciitolerans, Chimaereicella boritolerans, Lysinibacillus fusiformis, Bacillus safensis and		Isolated 17 Boron tolerant bacterial strains were also resistant to heavy metals *viz.* As, Cd, Cu, Pb, Ni, Se and Zn. The strains are arsenic oxidising and salt resistant. Removing mg boron from the fly ash in 7 days.	(Raja and Omine 2013)

Lysinibacillus boronitolerans			
NBRFT1, NBRFT2, NBRFT3, NBRFT4, NBRFT5, NBRFT6, NBRFT7, NBRFT8, NBRFT9, NBRFT10, NBRFT11	*Typha latifolia*	Bacterial strains isolated from *T. latifolia* grown on FA. These strains encouraged the of Fe, Zn, Ni and immobilization of Cr, Cu, Pb, Cd in FA. NBRFT8 and NBRFT9 boosted Cu availability, NBRFT6 and NBRFT2 causes immobility of Zn, Fe, and Mn respectively.	(Tiwari et al. 2008)
Microbacterium barkeri IPSr74, *Brochothrix campestris* BPSr3, Serratia *marcescens* IPSr90 and IPSr82, *Pseudomonas aeruginosa* BPSr43, *Enterococcus casseliflavus* BPSr32, *Bacillus sp.* IPSr80	*Saccharum ravennae*	The high potential rhizobacteria were isolated from rhizosphere of *S ravennae* from FA dump. They are multiple-metal tolerant and joined with high siderophore production, showed ACC-deaminase (ACCD) activity.	Rau et al 2009
Rhizobium, Azotobacter species	*Dendrocalamus strictus*	Inoculation of nitrogen fixing bacterial species *Rhizobium* and *Azotobacter* with VAM and FYM caused improvement in the nitrogen content by 4.5 folds. Furthermore, benefits in excessive root growth showing many times higher growth in *D. strictus* plant as compared to the control.	(Juwarkar and Jambhulkar 2008)
NBRIK28 SD1, NBRI K28 Enterobacter sp	*Brassica juncea*	NBRI K28 is PGPB, isolated from FA dumps. NBRI K28 SD1 is overproducing siderophore mutant and capable of promoting plant growth and accelerate phytoextraction of metals Cr, Ni and Zn from FA by *Brassica- juncea*. Simultaneous production of siderophores, IAA and solubilising phosphate promotes plant growth. These strains showed ACC deaminase activity.	(Kumar et al. 2009)

Micrococcus roseus NBRFT2, *Bacillus endophyticus* NBRFT4, *Paenibacillus macerans* NBRFT5 and *Bacillus pumilus* NBRFT9	*Brassica juncea*	The bacterial strains have been isolated from the rhizospheric zone of *T. latifolia grown on FA* dump and injected in *Brassica juncea* grown in FA amended with press mud. Bacterial strains have been used in different combinations. NBRFT5, NBRFT4 and NBRFT9 (ST3) originated with maximum metal accumulations as compared to other combinations. The bioaugmentation of the ST3 combination consortia boosted Fe, Ni and Zn by above 200 % in *B. juncea* as compared to control plants	(Tiwari et al. 2012)
Bacillus endophyticus NBRFT4, Paenibacillus macerans NBRFT5, and Bacillus pumilus NBRFT9	*S. munja*	These PGPB isolated from FA and inoculated in *S. munja.* The study revealed that PGPB boosted up metal uptake and promoted the plant growth. Collectively these factors enhanced the phytoextraction Ni, Zn and Fe in many folds. Bacteria synthesises siderophore, IAA, cytokinin gibberellic acid, which improves plant growth and metal availability.	(Tiwari et al. 2013)