Biodiversity and biotechnological applications of novel plant growth promoting methylotrophs

Editorial

Methylotrophic bacterial community is a very important group of bacteria utilizing reduced carbon compounds. Methylotrophic bacteria are well enough to survive in all types of environmental conditions including acidic/alkaline conditions,1–3 hyper saline,4–5 low temperature6–10 and high temperature,11–13. The methylotrophic microbes help plant for adaptation under diverse unfavourable environmental conditions. The pink pigmented facultative methylotrophic (PPMFs) bacteria is abundantly reported as plant microorganisms (epiphytes, endophytes, rhizospheric).14,15 The methylotrophic microorganisms could be promote the plant growth and soil health for sustainable agriculture directly by N2-fixation fixation; P, K and Zn solubilization; production of Fe-chelating compounds; production of PGP hormones such gibberellic acids, auxin and cytokinin and ACC deaminase activities14,15,16 or by in-directly by production of siderophores, ammonia, HCN, enzymes and secondary metabolites.17–19 The plant growth promoting methylotrophs as single bioinoculants or with co-inoculated as microbial consortium may be used as bioinoculants/biofertilizers of biocontrol agents for enhanced crops production and soil fertility for sustainable agriculture.20–21

The different class α, β and γ-proteobacteria of methylotrophic bacterial communities have been reported worldwide. The class α-proteobacteria has been reported as most dominant followed by β-proteobacteria. The novel methylotrophic microbes have been isolated and characterized from different habitats worldwide including Methylothermus silvestris BL2T, Methylocella palustris KT, Methylerula stellata ARAT and Methylocapsa acidiphila B2T from acidic soil;22–24 Methylobacterium tarhaniae N4211T from arid soil;25 Methylobacterium iners 53175S-3T and Methylobacterium aerolatum 5413S-11T from air sample;26 Methylobacterium adhaesivum AR27T and Methylobacterium isbilenese AR24T from drinking water;27–29 Methylobacterium brachiatum B0021T, Methylobacterium gregas 002-074T, Methylobacterium komagatae 002-075T, Methylobacterium persicinum 002-165T and Methylobacterium tardum RB677T from freshwater sample;30 Methylocystis organophilum XX, Methylophilum versatilis 301T and Methylophilum mobilis JLFST from lakes;31–33 Methylophilum brachyclytius 995T, Methylophilum cassidii C44, Methylophilum gnaphalii 23eT, Methylophilum glossipicola Gh-105T, Methylophilum hapolocadi 87eT, Methylophilum oxalidicis 35aT, Methylophilum phyllostachios BL47T, Methylophilum platani PMB02T, Methylophilum pseudosastila BL36T, Methylophilum thuringiensis C34T, Methylophilum trifolii TA37T, from leaf surface of diverse plants;34–42 Methylophilum aminovorans TH-1, Methylophilum goeingense iElI3, Methylophilum soli YIM 48816T, Methylophilum suomiensis, F20T, Methylophilum thiocyanatan, Methylophilum variabile GR3T, Methylphilopip capsulata 1IM1T, and Methylphilopip helvetica VKMB-189 from soil samples.43–50

To understand the mechanisms of plant growth promotion and genes involved in plant growth promotion there are many reports on whole genome sequences of methylotrophic bacteria are available at NCBI GenBank database (https://www.ncbi.nlm.nih.gov) Methylbacterium populi B1001, Methylbacterium extorquens CM4, Methylbacterium nodulans ORS 2060, Methylbacterium aquaticum MA-22A, Methylbacterium radiotolerans JCM 2831, Methylferula stellata AR4, Methylotenera mobilis JLF18, Methylotenera versatilis 301, Methylotenera sp. AMS5, Methylotenera versatilis 301 Methylotenera mobilis JLF8, Methylvorus glucosetrophus SIP3-4, Methylvorus glucosetrophus SIP3-4, Methylotenera mesophilicus SR1.6/6, and Methylotenera indicum SE2.11

Plant-associated methylotrophs produce PGP phytohormones such as auxins, gibberellics and cytokinin by Methylbacterium extorquens IWP-43, M. extorquens MP1, M. mesophilicus B-2143, M. mesophilicus HHS1-36, M. mesophilicus IWP-45, M. mesophilicus NIAW1-41, M. phyllophaeaces HHS2-67, M. radiotolerans HHS1-45, M. radiotolerans IHD-35 and M. zatmanii MS4. Many methylotrophs has been reported to fix N2 e.g. Methylbacterium mesophilicus B-2143, M. nodulans 2060T, and Methylbacterium sp. THD-3511,35–36. A vast number methylotrophs with P-solubilizing ability have been reported Methylbacterium arborutum Iva, M. extorquens G10, M. extorquens IWP-43, M. lusitanum MSF 32, M. mesophilicus IWP-45, M. mesophilicus NIAW1-41, M. radiotolerans IHD-35, Methylphilopip musalis MUSA and Methylphilopip mensalis MM.34,37,38

Conclusion

The methylotrophic microbes from diverse sources have potential applications in agriculture, industry and allied sectors. The methylotrophic bacteria could be used for plant growth and soil health for sustainable agriculture when inoculated as single or as consortium under the natural as well as abiotic stress conditions.

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Conflict of interest

All authors declare that they have no conflicts of interest to this work.

References


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