Tropentag, September 16-18, 2026, hybrid conference

"Towards multi-functional agro-ecosystems
promoting climate resilient futures"

Deciphering the plant growth promotion potential of rice-associated bacteriomes from Chiang Mai, northern Thailand

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Abstract

Synthetically assembled autochthonous bacterial communities containing locally adapted biofertiliser candidates are underexplored reservoirs for sustaining rice productivity and minimising external chemical fertiliser input towards sustainable agriculture. This study involved bioprospecting the bacteriome of three rice cultivars (RD-43, Riceberry and Bue Poh Loh) from representative agroecological zones in Chiang Mai, Northern Thailand. Specifically, the copiotrophic and oligotrophic bacterial communities from the rhizosphere and endosphere of each cultivar were surveyed to identify robust candidates for future bioinoculant development. Bacterial counts, oligotroph:copiotroph ratios, as well as qualitative and quantitative indices of plant growth promotion (PGP) potential, including N-fixation, indole acetic acid (IAA) production, P and K solubilisation were assayed using standard methods. PGP potentials were also statistically compared across bacterial types and rice cultivars. Of the 84 morphologically diverse isolates, 50 have PGP properties. Rhizospheric bacteria did not statistically outnumber endophytes (average: 6.20 vs 4.00 $\times$ 107 $^{\mathrm{CFU}}/_{\mathrm{g}}$, Mann-Whitney U: $p = 0.16$). Principal Component Analysis grouped the isolates into 17 oligotrophs, 16 facultative oligotrophs and 17 copiotrophs similarly distributed among rice cultivars (Chi square: $p = 0.35$). Copiotrophs statistically outnumber oligotrophs (average: 8.50 vs 1.60 $\times$ 107 CFU, Mann-Whitney U: $p = 0.037$). Oligotroph:copiotroph ratios (median range: 0.08–0.25) correlate with agroecological traits, but did not differ by sampling site (Kruskal–Wallis H: $p = 0.065$). No significant difference exists between qualitative PGP traits of oligotrophs and copiotrophs (pooled average: 1.36 vs 1.71, Welch's test: $p = 0.35$). However, oligotrophs produced higher IAA than copiotrophs (average: 12.95 vs 7.16 μg/mL, T-test: $p = 0.00$). Additionally, oligotrophs had higher P solubilisation potential compared to copiotrophs (mean: 145.80 vs 26.32 μg/mL, T-test: $p = 0.006$). Only two oligotrophic bacteria can solubilise K (range: 2.44–8.90 μg/mL). Conclusively, trophic strategy (copiotrophy vs oligotrophy) best determines the PGP potential of the rice bacteriome in the study area, rather than niche (rhizosphere vs endosphere). Further screenings, molecular assays, laboratory and field trials are envisioned to fully unravel the biofertilisation potential of carefully engineered synthetic bacterial communities from these PGP isolates on rice in the study area.

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Keywords: Biofertiliser, plant growth promoting bacteria, rhizosphere, rice, synthetic bacterial communities, Thailand