ABSTRACT

The world is facing immense food security challenges primarily due to expeditious urbanization and unpredicted environmental variations. Waste diversion from landfills to resource recovery is an important strategy to attain food security, enhanced nutrition and sustainable agriculture. Conversion of agricultural waste PM (PM) into biofertilizer would reduce its environmental impacts by improving soil nutrient contents level and decreasing the requirements of mineral fertilizer (MF). Phosphorus (P) and potassium (K) are the primary least available macronutrients in many cropping environments. In Pakistan, farmers are usually more focused on nitrogen (N) fertilizers in the form of urea and overlook these important nutrients. The current study was aimed to explore microbial isolates responsible for producing hydrolytic enzymes and plant growth-stimulating hormones for efficient and enriched conversion of PM into biofertilizer through composting and derived biofertilizer was evaluated for higher nutrient use efficiency (NUE) and nutrient agronomic efficiency (NAE) in comparison to MF on different crops (maize, wheat, and canola) in different treatments during three consecutive growing seasons. Four bacterial (*B. altitudinis* CD2E, *P. aeruginosa* CD6C, *B. velezensis* BS2, *B. wiedmannii* BTA) and one fungal isolate (*A. niger* PM-4) were selected due to its efficacy, for non-pathogenic and non-aflatoxigenic effects. The selected strains were found compatible with each other, however, *A. niger* PM-4 was found non-compatible with *P. aeruginosa* CD6C and *B. velezensis* BS2. Selected strains subjected to PM composting revealed heap inoculated with bacterial consortium T3 (PM + consortium) found its maturity at 21st day by reducing more C/N and TOC (total organic carbon) and higher nutrient contents TKN (2.15±0.02%), TP (1.42±0.01%), and TK (1.0±0.03%) than any other treatments. The treatment T3 (PM + consortium) was applied to wheat and canola crops, however, T2 (PM+*A. niger*) was used in maize treatment. Biofertilizer derived from treatments T2 (PM+*A. niger*) and T3 (PM + consortium) were found to enhance crop yield, biological yield, grain yield, nutrient contents (P/K), nutrient uptake (P/K), NUE, and NAE of maize, wheat, and canola. Higher grain yield and harvest index (HI) were achieved in T5 (100%Org+50%MF) containing a higher amount of nutrient contents from minerals and biofertilizer. However, higher NUE & NAE were found in the following order: T6>T5>T2>T3>T4>T1 for all experimental crops, demonstrating the importance of integrated and balanced use of fertilizers.