ASSESSMENT OF THE POTENTIAL OF BIOFERTILIZERS AND NATURAL SOIL AMENDMENTS TO REDUCE THE DEPENDENCY ON CHEMICAL FERTILIZERS IN RICE (*Oryza sativa* L.) FARMING IN THE DRY ZONE, SRI LANKA

By

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ABSTRACT

Among all the food crops, rice is the most important food crop in Sri Lanka and most of the Asian countries. Over the past six decades, rice farmers have become increasingly dependent on synthetic chemical fertilizers as source of nitrogen (N), phosphorous (P) and potassium (K) nutrients. However, dramatically increasing costs, serious environmental and health issues attached to chemical fertilizers, forced researchers to develop supplementary or alternate sources of N, P and K for rice. Therefore, this study was carried out with the aim of assessing the potential of biofertilizers and natural soil amendments to replace chemical fertilizers in rice (*Oryza sativa* L.) farming in the dry zone, Sri Lanka. Field trial was carried out at Ranpathwela in Anuradhapura, North Central Province, Sri Lanka, during *Yala* season in 2016. The experiment was designed as factorial with five varieties and the second factor comprised of control and seven treatments as follows: CON: control; AMF: AMF inoculants (2 Mg ha^{-1}); RAMF: ERP (153.3 kg ha^{-1}) with AMF inoculants (2 Mg ha^{-1}); MC: mixed microbial culture (5 L ha^{-1}); RMC: ERP (153.3 kg ha^{-1}) with mixed microbial culture [mixed culture of *Azospirillum* sp., *Pseudomonas* sp. and *Bacillus* sp. (5 L ha^{-1})]; BC: biochar (6 Mg ha^{-1}); CP: standard compost (10 Mg ha^{-1}) and IF: inorganic synthetic fertilizer (125 N kg ha^{-1}, 50 P_2O_5 kg ha^{-1} and 50 K_2O kg ha^{-1}). The experiment was designed as a factorial, randomized complete block design, comprised of 24 plots and three replicates. Soil, roots and grains of rice were analyzed for different nutrients, mainly N, P, K, iron (Fe) and zinc (Zn). Some other elements such as sodium (Na), aluminum (Al), toxic heavy metals [e.g., lead (Pb), mercury (Hg), cadmium (Cd)] and metalloids [arsenic (As)] were estimated by using Inductively Coupled Plasma Optical Emission Spectrophotometer (ICP-OES). Plant growth, grain yield and yield components of the rice plants were estimated during growth and after harvest. Potential of native arbuscular mycorrhizal colonization of rice roots were evaluated under flooded conditions. Finally, the variables and their interaction networks among the rice varieties and amendments used were also statistically analyzed.

Statistically significant rice varieties, amendments and variety and treatment interactions were observed with soil physiochemical characteristics ($p<0.05$). Compost exerted an influence on soil electrical conductivity, which is regulated by several soil fertility attributes, such as pH, Na^+, K^+, Total organic carbon (TOC) and compost amended soil, enriched with appropriate amounts of nutrient ions has facilitated the proper growth of rice plants. Multifunctional microbial consortium in amended soil included *Azospirillum* sp., *Pseudomonas* sp. *Bacillus* sp. and arbuscular mycorrhizal fungi, which were proven to be capable of increasing soil N, P and K. The range of percentage AMF colonization in rice under flooded conditions was in a range from 1.53% to 12.85%. Biofertilizers, organic soil amendment and biochar has played a significant role in maintaining the growth and grain yield of both traditional and improved rice varieties selected. The soil-plant interactions were more complex and interrelated. Network analysis revealed the interaction patterns of soil and grain variables, which can be used to optimize productivity and soil fertility of the rice ecosystem. From this study, it is now evident that synthetic chemical fertilizers in rice farming even with modern high yielding varieties, can effectively be substituted by proper organic amendments and biofertilizers without compromising the productivity.

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