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Formulation and Characterization of *Azolla pinnata* and Effective Microorganisms-Based Organic Vermi-Liquid Fertilizer

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Abstract

The challenges of modern agriculture should be addressed using environmentally sound, economically viable and socially supportive techniques. This study aims to determine the effects of *Azolla* based vermi-liquid fertilizers enriched with Effective Microorganisms (EM) as an organic liquid fertilizer. Cattle manure, loamy soil, paddy straw, rice husk biochar and banana peels were used as bedding materials and applied into 5 L plastic cans as layers and the red earth worms (*Eisenia fetida*) were introduced. Water was added daily, maintaining 60% moisture level and from day-15 to day-45, the liquid was collected at 15-day intervals for physicochemical characterization. The treatments were arranged as T1: only vermicomposting bedding materials (VBM), T2: VBM + 1 part of *Azolla*, T3: VBM+1 part of *Azolla*+EM, T4: VBM+2 parts of *Azolla,* and T5: VBM+2 parts of *Azolla*+EM. The characterization of the collected liquid fertilizer (day 15, 30 and 45) was done by measuring pH, EC, available NO_3^--N, NH_4^+-N, P, K, extractable Ca, and Mg. The pH of all liquid fertilizers in every treatment decreased with time and was alkaline. The EC values in every treatment were high on day-15 with the highest observed value in T5 (7.45±0.42 $mScm^{-1}$). Then, EC decreased without significant difference between EC values on day-30 and day-45 in all treatments. The NO_3^--N concentration increased with the time in every treatment while T1 showed the highest concentration on day-45 (351.45±69.54 ppm). However, the NH_4^+-N concentration was decreased with the time in all treatments except T5 obtaining the highest NH_4^+-N concentration on day-45. In T5, NH_4^+-N concentration decreased until day-30 and then increased again on day-45. The P concentration increased over time in every treatment, with T5 showing the highest concentration on day-45 (19.93±9.21 ppm). The K concentration showed significant difference ($p<0.05$) among all treatment in day-15 and T5 showed the highest (554.54±27.73 ppm) concentration. The Ca and Mg concentrations increased significantly ($p<0.05$) over time where T3 showing maximum concentration of 251.78±8.96 ppm of Ca and T5 showing maximum concentrations of 55±8.66 ppm of Mg on day-45. According to the results, the highest ammonium, phosphorus, potassium, and magnesium values were obtained in T5 with VBM, 2 parts of *Azolla* and EM on day-45 vermi-liquid fertilizer collection. Hence, this combination could be introduced as an effective vermi-liquid fertilizer.

Keywords: *Azolla,* Biochar, Earthworms, Effective microorganisms, Vermi-liquid