A SITE-SPECIFIC FERTILIZER RECOMMENDATION FOR RICE (*Oryza sativa* L.) USING A SYSTEMATIC APPROACH TO SOIL FERTILITY EVALUATION

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ABSTRACT

Rice (*Oryza sativa* L.) is one of the oldest crops cultivated and the staple food in Sri Lanka. To feed the nation in future, the present average yield has to be increased up to 4.5 t ha^{-1} even though it is presently stagnated at 4.0 t ha^{-1}. Therefore, the main objectives of this study were to identify soil fertility limiting factors in three rice growing soil series in the Low Country Intermediate and Dry zones of Sri Lanka using a systematic approach combining soil analysis, fixation studies and greenhouse nutrient survey and to formulate a fertilizer recommendation for the three soils and finally to test the validity of these recommendations by conducting field experiments at the respective sites.

Three rice growing soil series *viz* Galwewa soil series (Alfisols) at Aralaganwila, Agricultural Research and Development Centre, Elayapattuwa soil series (alfisols) at Maha Illuppalama, Seed Farm in Low Country Dry Zone and Kurunegala soil series (Ultisols) at Batalagoda, Rice Research and Development Institute in Low Country Intermediate Zone were used. Representative composite soil samples (0-20 cm) were analyzed for physical and chemical properties under dry conditions as well as submerged conditions using standard methods. Both under dry and submerged conditions, available nutrient status was determined by a three step extraction method; extraction with ASI solution (0.25 *M* $NaHCO_3$+ 0.01 *M* EDTA+0.01 *M* NH_4F) for P, K, Cu, Fe, Mn and Zn, 1 *M* KCl extraction for NH_4-N, Ca, Mg, Na and active acidity and 0.08 *M* $CaH_2(H_2PO_4)_2.H_2O$ extraction for B and S. A fixation study was

conducted to identify the fixation capacity of these soils for P, K, Cu, Zn, Fe, Mn, S and B under both dry and submerged conditions. The amount of fertilizer to be supplemented was calculated based on the initial nutrient values and, when deficient, the rates of P, K, Cu, Zn, Fe, Mn, S and B were adjusted based on the fixation capacity. The optimum fertilizer recommendations formulated based on dry and submerged soils were tested in the greenhouse using a modified missing element technique. These recommendations were tested in fields where soils were sampled using rice (variety *Bg 352*) for two seasons; *Yala* followed by *Maha.* The routine soil analysis showed deficient levels of N, P, K, S, Mg, B, Cu, Mn and Zn in Galwewa soils under dry soil analysis basis while Mn was sufficient when soil was analyzed after submergence. Nitrogen, P, K, Mg, S and Zn were deficient in Elayapattuwa and Kurunegala soil series under both dry and submerge conditions. However, availability of N, P, K, Fe and Mn was increased while S, Zn and Cu were decreased with the submergence of soils.

The greenhouse nutrient survey confirmed the deficiencies of nutrients identified through soil analysis. Responses to nutrients were clearly indicated, with significantly low dry mater yields ($p<0.05$) in most treatments that provided one nutrient at a deficient level, as compared to the optimum, which provided all nutrients at adequate levels. Nutrients formulated under dry soil analysis gave high biomass yield than that formulated under submerged soil analysis in both Galwewa and Kurunegala soil series but in Elayapattuwa series it was *vice versa.* The results of the greenhouse studies therefore, indicate that analysis of air-dry soils is equally effective or even better than analysis under submerged conditions to predict deficiencies, toxicities and other nutrient problems for rice grown on submerged soils.

Considering the grain yields obtained in different fertilizer treatments, following fertilizer recommendations could be suggested for the three soils: 175 kg N, 40 kg P, 100 kg K, 40 kg S, 25 kg Mg, 0.5 kg B, 0.5 kg Cu, 2 kg Zn and 2 Kg Mn for Galwewa series, 175 kg N, 65 kg P, 60 kg K, 50 kg S, 25 kg Mg and 2 kg Zn for Elayapattuwa series, and 160 kg N, 60 kg P, 120 kg K, 25 kg S, 30 kg Mg and 2 kg Zn rates for Kurunegala soil series. Cost benefit analysis clearly indicated that the suggested recommendations for the three soil series were more economical. Therefore, providing nutrients to the soil based on systematic approach was beneficial in terms of rice yield and profit.