Best Management Practices to Address Site Specific Soil Fertility Constraints and Improve Productivity of Marginal Agricultural Lands Cultivated with Maize

W. S. Dandeniya[1*], J. A. S. Chathurika[2], A. A. Mariaselvam[3], S. P. Indraratne[4], R. S. Dharmakeerthi[1], D. Kumaragamage[4]

[1]Department of Soil Science, Faculty of Agriculture, University of Peradeniya, Sri Lanka
[2]SLINTEC (Pvt) Ltd, Nanotechnology & Science Park, Pitipana, Homagama, Sri Lanka.
[3]Department of Biosystems Technology, Faculty of Technology, Eastern University, Sri Lanka
[4]Department of Environmental Studies and Sciences, Faculty of Science, University of Winnipeg, Portage Avenue, R3B 2E9, MB, Canada

Declining soil fertility in agricultural lands is identified as a major contributing factor for food insecurity because both quantity and quality of food produced in infertile soils are poor. Further, crop production is not cost-effective in infertile soils and thus, is a reason for generating marginal lands. In order to bring low-productive lands under successful crop production and to improve or maintain the productivity of present agricultural fields, it is vital to address soil fertility issues. Soil fertility issues are site specific and could develop with long term cultivation, creating imperfect conditions of soil physical, chemical and biological attributes. Hence, application of fertilizers alone is often not effective in improving productivity of such lands. Combining soil amendments with fertilizer application in site specific nutrient management (SSNM) programmes has beneficial effects on soil fertility and crop growth. Carbon-rich soil amendments are often used to enhance soil organic carbon (C) storage, which improves a number of soil properties. However, such material may have negative effects on short-term nutrient cycling in soil leading to low nutrient availability for plants. A comprehensive study was conducted to identify beneficial management practices (BMPs) to improve soil fertility and productivity of marginal agricultural lands cultivated with maize. Site specific nutrient recommendation developed based on soil test and crop requirement, and application of carbon-rich organic soil amendments, rock powder, and mineral fertilizers were tested in a series of laboratory and greenhouse scale experiments to formulate BMPs. Field experiments were conducted to test the developed BMPs at Mahailluppallama (DL1b) with Reddish Brown Earth (RBE: Typic Haplustalfs), Kundasale (IM3c) with Reddish Brown Latosolic soils (RBL; Rhodudalfs) and Peradeniya (WM2b) with an Alluvial soil (Entisol) using maize (variety Sampath) as the test crop. Results indicated that application of rock-powder improved maize yield in lands with poor drainage. The application of C rich organic materials such as biochar (BC) and incubated mixture of cattle manure and sawdust (CS-i) improved soil C pools without negatively affecting nutrient availability in soil. Under field conditions, BC application resulted in high cation exchange capacity (CEC), potentially mineralizable N, active C and C management indices contributing positively for yield improvements. Integrating

organic amendments like BC or CS-i in SSNM improved or maintained soil organic C content and enhanced maize yield compared to sole mineral fertilizer application in all three locations. This study clearly demonstrated that addressing site specific soil fertility constraints help to improve productivity of soil. Further the magnitude of the effect of such amendments on soil fertility depend on inherent soil characteristics, hence, there can be soil to soil variation in terms of the crop response to selected soil amendments.

Key words: Best management practice, soil fertility, maize, biochar, sawdust, site specific nutrient management