MANAGEMENT OF ACID SOILS IN THE LLANOS OF COLOMBIA*

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The neotropical savannas (243 million hectares) in South America are one of the most rapidly expanding agricultural frontiers in the world Oxisols predominate in the Colombian savannas and cover an area of 17 million hectares Out of this total area 3 5 million hectares are the well-drained savannas known as Altillanura Intensification of agricultural production in this agroecosystem requires acid soil (aluminum) tolerant crop and forage germplasm soil chemical and biological improvement in addition to management of highly vulnerable physical properties Monocropping systems with high levels of inputs and excessive cultivation (disc harrowing) are not sustainable since they cause deterioration of soil physical chemical and biological properties as well as escalation of pest and disease problems Alternative systems incorporating components that attenuate or reverse the deleterious effects of monocultures are required and biophysical measures of sustainability need to be developed as predictors of system health to sustain agricultural production at high levels while minimizing soil degradation

Grain legumes green manures intercrops and leys are possible system components that could increase the stability of systems involving annual crops To test the effects of these components on system sustainability and to identify indicators of soil quality a long term field study was implemented in 1993 on a Colombian Oxisol in Carimagua under native savanna grassland using a selection of alternatives based on these components The study was extended through almost two cycles of the principal rotation i e the agropastoral system recognizing that the degrading or beneficial effects of various agricultural practices are often subtle and only manifest themselves over long periods

The experimental design was a split plot with four randomized blocks as replications with main plots assigned to upland rice based (fertilizer lime) systems and maize-based (remedial lime) systems The rice based system treatments included rice monoculture rice rotated with cowpeas (for grain) cowpea green manure (GM) and rice agropastoral rotation The maize based system treatments included maize monoculture maize-soybean rotation maize-soybean green manure rotation and maize-agropastoral rotation A native savanna control was used to measure changes in soil quality Crop production and soil quality characteristics were measured in two phases After Phase I (a period of five years with conventional tillage) the plots were split and no tillage (direct sowing) or minimum tillage (chisel + direct sowing) treatments were introduced in Phase II with an objective to evaluate which agropastoral treatments were suitable for improving soil conditions that are needed for implementing no-till systems Increasing intensity of production system (with concomitant use of inputs) resulted in changes in soil quality Soil organic matter declined with increasing intensity

of cultivation as did populations of macrofauna in different systems Some agropastoral treatments such as cereal-green manure rotation and cereal-improved pasture rotation resulted in improved soil conditions to implement no till systems
The above long-term studies were complemented with satellite experiments (at Matazul Farm in the Altillanura) for developing soil management technologies to build-up an arable layer as a precondition to implement no till systems The main purpose of building an arable layer is to improve and maintain physical and chemical conditions of the soil in order to favor root growth and soil biological activity These experiments were monitored over a four-year period and changes in some physical and chemical properties at different soil depths plant growth and nutrient uptake as influenced by tillage intensity (1 2 or 3 passes of chisel) and land use (crop-rotation agropastoral systems) were measured Results indicated that agropastoral systems based on acid soil adapted and deep-rooted tropical forage grasses are markedly superior to crop rotation for building an arable layer for infertile savanna Oxisols Using this integrated soil management technology it was possible to improve profitability and sustainability of agropastoral systems in the Altillanura of Colombia
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