

Improvement of the physical fertility of a degraded Alfisol with planted and natural fallows under humid tropical conditions

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Abstract

Topsoil (0–15 cm) bulk density, aggregate stability, soil dispersibility, water retention and infiltration were measured between 1989 and 1996 on an Alfisol under rehabilitation in southwestern Nigeria. The planted leguminous species were *Pueraria phaseoloides*, *Senna siamea*, *Leucaena leucocephala*, *Acacia leptocarpa* and *A. auriculiformis*. Also, plots with natural fallow and maize/cassava intercropping were included. Level (minimum) and mound tillage with hoes was adopted for the cultivated areas under study after 4 and 6 year fallow periods. Under fallow, the soil bulk density decreased from 1.56 to 1.11 t m⁻³. The continuously cropped treatment (level tillage) had significantly higher bulk density than the fallowed subplots after 6 years. Mean soil penetrometer resistance ranged from 75 to 157 kPa for fallowed plots and from 192 to 295 kPa for the continuously cropped (level tillage) subplot. Surface soil water contents were similar for all the treatments during the soil strength measurements. Although soil aggregates were generally of low stability and not well formed, they were improved by fallowing.

Soil structural improvement by planted fallows was similar to that by natural fallow, but the trees were more promising for long-term fallow (>6 years) than the herbaceous *P. phaseoloides*. However, the improvement in soil structure after 4 or 6 year fallow could not be maintained in subsequent cropping. Furthermore, the significant improvement in soil bulk density caused by *A. auriculiformis* and natural fallow was more rapidly lost on the cultivated subplots compared with other fallow treatments. Thus, soil structure recovery under a fallow does not imply a sustained improvement when stress is applied to this soil. Post-fallow soil management options such as residue incorporation and tillage to ameliorate compaction or soil strength will be necessary to enhance the improvements by fallow species.