THE INFLUENCE OF ACACIA SENEGAL ON THE FERTILITY OF A SAND SHEET ('GOZ') SOIL IN THE CENTRAL SUDAN *

by P. A. GERAKIS and C. Z. TSANGARAKIS **

Doxiadis Associates Int. Ltd., Consultants on Development and Ekistics,
El Obeid Office, Sudan

SUMMARY

Acacia senegal increased total nitrogen and organic carbon while it had no effect on the soil texture, pH, available phosphorus and available potassium of a Sand Sheet soil. The higher nitrogen content in the topsoil may have been partly caused by symbiotic fixation. To minimise soil variability when conducting field trials in areas cleared from A. senegal trees the uprooted tree patches must be avoided in plot layout and liberal amounts of nitrogen fertiliser and farmyard manure must be applied over the whole trial area when possible.

INTRODUCTION

Shifting cultivation is practiced in the tropics under conditions of extensive agriculture as the principal means of restoring soil fertility. In the Sand Sheet soils (known locally as 'goz') of the Acacia senegal zone of the Sudan, 12-20 years of A. senegal fallow is followed by 3-10 years cropping period during which sorghum (Sorghum vulgare), penissetum (Penisetum typhoides), sesame (Sesamum indicum) and groundnuts (Arachis hypogaea) are grown. Preliminary field trials with sorghum conducted in 1962 in a soil cultivated for the first year after a 12-year fallow revealed that crop growth was strikingly

* Paper based on investigations carried out as part of the U.N.S.F. 'Land Use and Rural Water Development Research Project for Kordofan' in 1962-1965 supervised by F.A.O. and the Sudan Government and contracted by Doxiadis Associates Int. Ltd. of Athens, Greece.

** Present address: Agronomist, 20 Vasilissis Sophias Str., Thessaloniki, Greece, and Agronomist, Agricultural Research Service, Ministry of Agriculture, Greece, respectively.
better on the sites of the felled and uprooted *A. senegal* trees than at a distance from them.

This was the major source of soil variability and was hard to avoid due to the dense and irregular tree spacing. A precise explanation of this phenomenon would not only provide a means to lower the experimental error in future field trials but would also add to the understanding of the role of the *A. senegal* rotation in soil fertility restoration under the arid tropical conditions of the area. Nye and Greenland have reported that shifting cultivation systems in the humid tropics are usually more dependent on phosphorus, potassium and calcium cycling than on nitrogen although dramatic changes in nitrogen content varying as the relative length of the fallow and cropping period changes have been observed. Booth has mentioned the existence of nitrogen fixing bacteria in *A. senegal* in the Sudan.

As a first step towards the explanation of the problem, detailed soil sampling was carried out at, and around an uprooted *A. senegal* tree and the results of the analyses are presented in this paper.

**PROCEDURE**

This study was carried out at Umm Higlig Experiment Site, Kordofan Province, in December 1964. Composite soil samples were taken around a recently uprooted 12-year old *A. senegal* tree at radii of 0.25, 0.75, 1.25, 1.75, 2.25, 3.25, 4.25 and 5.25 m. The depths sampled were 0–0.20, 0.20–0.50, and 0.50–1.30 m corresponding to the three soil layers as distinguished by Hunting. The maximum radius of 5.25 m coincided with the outer perimeter of the tree branches. For better comparison composite samples were also taken from a radius of 20.00 m. Each composite sample consisted of 20 sub-samples.

The determinations performed on the composite samples were mechanical analysis (pipette method), pH (with soil: water ratio 1:5), total nitrogen (macro-Kjeldahl) organic carbon (dry combustion by Fisher induction carbon apparatus) available phosphorus (extracted by 0.025 N HCl + 0.03 N NH4F) and available potassium (extracted by 1 N NH4Ac). Soil: extractant ratio and shaking time was for both phosphorus and potassium 1:8 and 1 minute respectively.

**RESULTS AND DISCUSSION**

The results are presented in Figures 1–6. Comparison of the clay content (Fig. 1) and pH values (Fig. 2) from samples taken from an increasing distance from the tree did not indicate any differences for any of the three soil layers. Similarly, no differences were evident for