Research Application Summary

# The effect of gypsum and NPK fertiliser on groundnut performance in Western Tanzania

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## Abstract

This study was carried out to determine the effect of amending soil with gypsum rich material on the performance of groundnuts (*Arachis hypogea* L.) grown in low fertile sandy textured soil in the miombo woodland ecosystem, western Tanzania. The frequent bush fires, continuous cultivation and use of nitrogenous inorganic fertilisers have resulted in loss of both primary and secondary plant nutrients including Calcium (Ca) and Sulphur (S) which are key mineral requirements for groundnut production. This study was carried out to determine the effect of different application rates of gypsum on performance of groundnut. Results revealed that application of gypsum rich materials and NPK (10:18:24) increased groundnuts kernel yield in western Tanzania. This suggests that the cheap Gypsum materials can be used by resource poor farmers to improve groundnut yields. We recommend that private investors be attracted to process, pack and distribute this cheap fertiliser material to farmers.

Key words: *Arachis hypogeal*, gypsum, inorganic fertiliser, Tanzania

## Résumé

Cette étude a été réalisée afin de déterminer l'effet de l'amendement des sols avec des matériaux riches en gypse sur la performance des arachides (*Arachis hypogea* L.) cultivées dans un sol peu fertile à texture sablonneuse dans l'écosystème boisé de miombo, à l'ouest de la Tanzanie. Les feux de brousse fréquents, la culture continue et l'utilisation des engrais minéraux azotés ont abouti à la perte d'éléments nutritifs à la fois primaires et secondaires, y compris le calcium (Ca) et le soufre (S) qui sont des besoins minéraux essentiels pour la production des arachides. Cette étude a été réalisée pour déterminer l'effet des taux d'application différents de gypse sur la performance des arachides. Les résultats ont révélé que l'application des matériaux riches en gypse et de NPK (10:18:24) a augmenté le rendement du grain des arachides à l'ouest de la Tanzanie. Ceci suggère que les matériaux bon marché de gypse peuvent être utilisés par les agriculteurs pauvres en ressources pour

améliorer les rendements des arachides. Nous recommandons que les investisseurs privés soient attirés à traiter, emballer et distribuer cette matière fertilisante bon marché aux agriculteurs.

Mots clés: *Arachis hypogeal*, gypse, engrais inorganiques, Tanzanie

## Background

Low soil fertility is one of the main factors causing crop yield decline in sub-Saharan Africa. Soil fertility degradation is exacerbated by high frequency of fire in shifting cultivation based farming systems. The tobacco-cereal farming system in the Miombo woodland system of western Tanzania is characterised by woodland clearance and high frequencies of fire for controlling nematodes in flue cured tobacco production. Destruction of vegetation cover and low use of organic fertilisers results not only in the loss of plant primary nutrients NPK but also the secondary nutrients such as Ca and S. Groundnut growth and yield are sensitive to Ca and S supply. Previously farmers were using the fertilisers Triple Super Phosphate (TSP) which in addition supplied both Ca and S. A shift to di-ammonium phosphate (DAP) has deprived soils the much needed Ca and S, besides it is a very expensive fertiliser to resource poor farmers. As a result, groundnut production in Tanzania has been gradually declining. However, these minerals could easily be supplied by "agro-minerals". The role of agro-minerals in Integrated Soil Fertility Management (ISFM) in sub-Saharan Africa has been increasing in recent years. This study was therefore done to establish the performance of groundnuts on low fertile sandy textured soil amended with gypsum rich material.

## Literature Summary

The decline in soil fertility of agricultural soils in Africa has been documented, with most of the attention being focused on NPK as the major soil nutrients needed for improving crop production (Stoorvogel *et al*., 1993). Low soil fertility is considered to be a major cause of poverty in sub-Saharan Africa (Sanchez *et al*., 1997). Soil fertility decline in the Miombo woodlands ecosystem of western Tanzania is exacerbated by widespread deforestation and use of uncontrolled fire in the shifting cultivation system (Nssoko, 2002; Chidumayo and Kwibisa, 2003). Groundnut (*Arachis hypogaea* L.) is an important crop grown in the Miombo woodlands. The crop is grown as sole or intercropped (Ramadhani *et al.*, 2002). It is the third source of edible oil after cotton seed and sunflower. It is also used as an essential ingredient for children food stuffs.

Overall, a gradual yield decline for groundnut in Tanzania has been reported (FAOSTAT, 2008). In addition to drought, diseases (Sibuga *et al*., 1992) and poor varieties (Bucheyeki *et al.* 2008), lack of balanced nutrition also contributes to the poor performance groundnuts (Tandon, 1989). Calcium and sulfur are important soil nutrients required by groundnuts. Sulphur deficiency is common in sandy textured soils with low levels of organic matter (Sigh *et al.*, 1993). Continuous use of Urea and DAP on sandy soils exacerbates the deficiency effects of both Ca and S on these soils. Gypsum is a cheap source of both Ca and S for groundnut production when it is accessed by farmers in their local farming systems settings.

## Study Description

A trial was established in 2010 at Tumbi Agricultural Research Institute, Tabora, Western Tanzania. The site has a warm climate with mean temperature of 23$^{o}$C and receives an average annual rainfall of 928 mm mostly in one season between November and April. The soil is an Oxic Hapustalfs with 82% sand and 12 % clay, and slightly acidic. The experiment was laid in a randomised complete block design with three replications. The treatments were: T1= sole groundnuts, T2= groundnut + 100 kg ha$^{-1}$ NPK (10:18:24), T3=groundnut + 100kg ha$^{-1}$ NPK +400kg ha$^{-1}$ Gypsum soil mineral, and T4= groundnut + 400 kg ha$^{-1}$ gypsum soil mineral. Groundnut var Pendo was planted and spaced at 90cm x 15 cm in double low ridges constructed using hand hoes. NPK was applied (10:18:24) by drilling during planting 5 cm away from the seed placed about 5 cm deep. NPK is a common fertiliser among tobacco farmers in the study area. Gypsum soil mineral was collected from Itigi, in Singida regionand was ground to pass through an 8mm mesh. It was applied during flowering. Laboratory analysis shows that gypsum materials used contained 64 meq Ca/100 gm materials. At maturity, twenty five plants were harvested for groundnut kernel yield assessment.

## Research Application

Application of gypsum material and NPK significantly (P=0.05) reduced the number of unfilled groundnut pods compared to the control treatment. The lowest number (93) of unfilled pods per 25 plants was found in treatment T4, while the control treatment (T1) had the highest number (202) unfilled pods per 25 plants. The application of gypsum material and NPK fertiliser significantly improved groundnut kernel yield. The highest groundnut kernel yield (2500 kg/ha) was recorded from T2, although this yield was not significantly different from that of T4 (2200kg/ha) where Gypsum material alone was applied at

**Table 1. Mean groundnut yield components and kennel yield (kg/ha).**

| Treatments | Plant population/ pot | Unfilled pods/ 25 plants plants | Plant population/ pot | Dry leaf biomass/25 plants (gm) | Pod weight (kgha$^{-1}$) | Fresh filled pods/ 25 plants (gm) | Fresh leaf biomass/ 25 plants | Dry pods/ 25 plants (gm) |
|---|---|---|---|---|---|---|---|---|
| Sole groundnut | 422 | 202a | 422 | 164.1 | 1700a | 616 | 251 | 409 |
| Groundnut + 100 kg$^{-}$NPK | 466 | 133b | 466 | 193.5 | 2500b | 557 | 306 | 372 |
| Groundnut + 100 kg$^{-}$NPK + 400 kg gypsum mineral | 484 | 173b | 484 | 164.6 | 2434b | 618 | 297 | 410 |
| Sole groundnut + 400 kg gypsum mineral | 360 | 93b | 360 | 164.5 | 2200 b | 728 | 247 | 484 |
| LSD (P=0.05) | 340 ns | 106 | 340 ns | 59.2ns | 458 | 175ns | 148.8ns | 126.6ns |

the rate of 400 kg/ha (Table 1). Leaf biomass was not affected by application of either NPK or gypsum materials. The current price of 50kg NPK (10:18:24) is about 70,000 Tshs (43.75US $), while the cost of processing a 50kg pack of Gypsum materials is about 30,000 TShs (18.75 US $).

## Recommendation

Application of the Ca and S rich gypsum material to sandy textured low Ca soils has been found to improve groundnut kernel yield and to reduce the number of unfilled pods. It is recommended to up-scale this technology and to attract private investors to process, pack and distribute this cheap fertiliser material to farmers.

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