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Fertilization of cotton crops in sub-Saharan Africa

In West and Central Africa, cotton farmers buy most of their chemical fertilizers from cotton companies—directly for cotton crop fertilizers and under payment guarantees for food crop fertilizers. These companies provide credit for input supplies and farmers pay them back when the cotton is first marketed. Cotton cropping has an economic role via the cash income this activity generates, but it is also essential in maintaining soil fertility through mineral inputs by chemical fertilizer applications. CIRAD is studying fertilization practices under crop rotation systems to assess the short-term economic impacts and longer term effects on soil fertility.

High mineral deficiency

There can be a shortage of some minerals (K^+ , Ca^{++} , Mg^{++}) in soils under cotton-cereal rotation systems. Organic and chemical fertilizer applications cannot offset mineral losses caused by the export of harvested crops and crop residue.

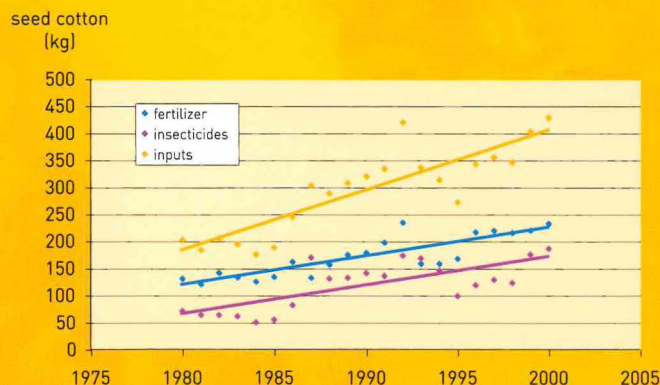
Example of the potassium mineral balance of a typical 3-year crop rotation (sorghum-cotton-sorghum) in Mali.

Crop and obtained yield (kg/ha seed or seed cotton)	Fertilization (K_2O , kg/ha)		Exportation (K_2O , kg/ha)		Potassium balance (kg/ha)
	fertilizer	manure	harvest	residue	
Sorghum 1 000 kg	12	17	11	16	+ 2
Cotton 1 300 kg	4	17	5	52	- 36
Sorghum 1 000 kg	4	17	5	52	- 36
Total: 3-year deficit balance					- 70

Chemical fertility of tropical soils

Maintaining the organic fertility of tropical soils is a key challenge for the future of cotton-growing areas in sub-Saharan Africa, for three reasons. First, soil organic matter mineralization is the main source of essential nutrients for crops. Secondly, in addition to clay contents, soil organic matter accounts for a major share of the cation exchange capacity of soils, which is an essential transitional phase for some mineral elements (potassium, calcium, magnesium) prior to their assimilation by crops. Thirdly, the intense bioactivity in soils, which is responsible for soil organic matter mineralization, makes the chemical soil fertility component highly volatile.

Since the 1980s, the price of chemical fertilizers has increased substantially whereas the purchase price for seed cotton from producers has markedly dropped—in 2000, producers had to sell twice as much cotton to pay for their inputs than in 1980. The quantity of chemical fertilizers applied by farmers in their crop fields has consequently decreased. This means that the crops do not grow as well, i.e. lower yields, and lower amount of crop residue recycled in the soil (roots, stems, straw, etc.), with a concomitant worsening of the soil mineral deficiency in these fields.



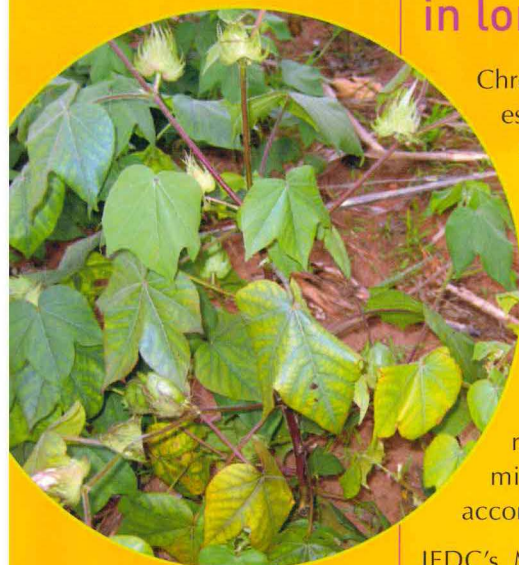
Variations (in seed cotton equivalents) in costs concerning cotton cropping inputs (fertilizers, pesticides, sum of these inputs) in Burkina Faso.

Nutrient deficiency symptoms in long-standing cotton fields

Chronic soil mineral deficits can lead to the depletion of soil reserves of some minerals, especially potassium and magnesium. Crops may then show visible signs of nutrient deficiency disorders—magnesium and potassium deficiency symptoms are very common in regions with a long history of cotton growing. In these areas, the formula of compound fertilizers commonly used in cotton crop fields (14 N - 23 P - 14 K - 5 S - 1 B) should thus be modified by reducing the phosphorus concentration, increasing that of potassium and adding magnesium.

CIRAD, in partnership with national agricultural research systems, puts forward recommendations to cotton companies with respect to establishing conditions for chemical fertilizer supply tender requests. CIRAD experts also advise farmers on adapting mineral manure applications in cotton crop fields according to the cropping history of the field.

IFDC's MIR project, based on recommendations put forward at the Cotton Conference of West and Central Africa (Cotonou, 2005), is under way in four countries (Benin, Togo, Burkina Faso and Mali), in collaboration with the West and Central African Council for Agricultural Research and Development (WECARD), farmers' organizations and fertilizer manufacturers. The aim of this project is to conduct tests in Benin, Togo and Burkina Faso to assess results previously obtained in Mali, while also tailoring fertilizer formulas to overcome soil mineral deficiencies noted in this part of Africa.



Potassium deficiency symptom on a cotton plant.
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Magnesium deficiency symptom on a cotton plant.
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Partners

Africa: INRAB, Institut national des recherches agricoles du Bénin, Bénin • INERA, Institut national de l'environnement et des recherches agricoles, Burkina Faso • IER, Institut d'économie rurale, Mali • ITRA, Institut togolais de recherche agronomique, Togo

IFDC, International Center for Soil Fertility and Agricultural Development (Benin, Burkina Faso, Mali, Togo)

Frequency (%) of deficiency symptoms observed in cotton-growing regions of Mali in 2004 relative to the number of plots surveyed (104 plots in 12 villages).

Region	Nitrogen	Phosphorus	Potassium	Magnesium
Fana	12	4	59	57
Koutiala	100	0	97	84
Sikasso	25	0	52	50
Bougouni	46	0	71	0
Kita	10	0	91	58

For further information

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