

8. Soil Fertility Management

Continuous production of a crop as sole crops, a practice called monoculture, usually results in a decline of soil fertility over time. The use of cereal-legume intercrops or rotations is one of the effective ways for improving soil fertility in cropping systems.

In general, legumes have the capacity to manufacture nitrogen through nitrogen fixation process. Cowpea, groundnut and pigeonpea, can fix high amounts of nitrogen into the soil ($> 30 \text{ kg N/ha}$). In general, the higher the amount of biomass produced by the legume the higher the amount of nitrogen fixed. However, legumes such as soybean can fix nitrogen if the seed is inoculated or coated with a rhizobia inoculant that helps the crop to capture naturally occurring atmospheric nitrogen into the soil. The nitrogen is captured by the plant in root nodules. When the crop dies some of the nitrogen left in the soil can be taken up by the next crop thereby benefitting crops that come after the legumes. The use of legumes either as sole crops in rotation with maize or as intercrops increases yields as other nutrients apart from nitrogen is also activated to become available to the next crop because of the legume crop.

The most important nutrients required by crops in large quantities annually are Nitrogen (N), Phosphorus (P) and Potassium (K). Continuous cropping results in a decline of these primary nutrients and thus they need to be replenished through organic and inorganic fertilizers. Nutrients that are required in smaller quantities such as Sulphur, Calcium, Zinc, Iron, Molybdenum and others are often found in specialized fertilizers but can be found in sufficient quantities in organic manures.

Use of Manure

Apart from the nitrogen fixation from legumes, nutrients required by the crops can also be added to the soil through the use of organic manures from livestock such as cattle, goats, chicken and pigs. Organic manures may also be prepared through use of farm prepared composts. Local extension officers can advise farmers on how to prepare this type of manure from commonly decomposing organic manures. The use of such manures can save farmers from purchasing expensive mineral fertilizers and they also improve the soil's ability to hold water. Rates of application vary depending on the quality of compost or manure but in general 5 to 10 tonnes/ha are needed. Application rates may be lowered if farmers apply the manure in rows or on planting stations instead of broadcasting. Composting and fermentation techniques are also commonly used to prepare farmyard manure using techniques such as Bokash manure.

Basal Fertilizer

Basal fertilizer is applied to a crop at planting and supplies nutrients needed by the crop in its early stages of growth and most of these nutrients are released slowly to the crop during the life of the crop (see Table 7.1). The main nutrient needed by maize at early stages of growth is phosphorus (P) and because of its limited mobility it needs to be applied at planting. Most basal fertilizers, also known in some countries as NPK, contain sufficient quantities of nitrogen to meet the needs of maize and other crops at early stages. About one third of the recommended fertilizer nitrogen (N) rate can also be applied at planting. The rest of the nitrogen needs may be supplemented through top dressing using Urea or other such fertilizers.

Farmers should seek the guidance of local extension staff on recommended fertilization strategies for their area and soils (Table 7.2). Most soils become acidic over time and periodic application of lime every 3 to 5 years is often recommended. Lime helps to reduce acidity in the soil. Farmers seeking to produce cash crops should also have their soil tested before cropping if suitable laboratories are available in their locality.

Topdressing Fertilizer

Top dressing fertilizers e.g. Urea, Ammonium Nitrate, are applied to maize and other cereals at 4 to 6 weeks after emergence to supplement crop with extra nitrogen. Common deficiency symptoms of nitrogen is yellowing of the crop and a dark green coloured maize crop is a sign of good or adequate nitrogen fertilization. Top dressing fertilizer is applied as side dressings in small quantities and in places of high rainfall may need to be applied twice as the nitrogen can get washed out of the soil by rainfall. Farmers should avoid applying top dressing fertilizer when the soil is dry as this causes fertilizer burn to the crop. Always ensure top dressing is done after receiving at least 20mm of rainfall.

Table 8.1 Fertility management techniques

Fertility amendment	Recommended practice	Why is it important
Use of manures /composts	Organic matter management practices i.e. Composting, Green manure, Farmyard manure • Ensure high quality of manures is kept	Build soil organic matter and improve soil structure and fertility
Mineral fertilizers	Use phosphorus and nitrogen fertilisers e.g. TSP, DAP, NPK, SSP • Use fertilisers with micro-nutrients and lime to improve soil responsiveness • Use right methods and quantities • Check level of fertility or health of your soil to guide your actions	Improve soil fertility rapidly and improve crop production • Address the high Nitrogen and Phosphorus deficiency • Increase biomass production for soil cover • Build soil organic matter, improve soil structure and fertility
Lime	Use agricultural lime or dolomitic lime for soils deficient in Magnesium Rates may vary from about 200-1500 kg/ha Use fertilizers with lime such as Calcium ammonium nitrate	Reduce acidity or improve pH to between 5.5 and 6.5. Nutrient uptake improves when the soil is neutral or slight acidic Most mineral fertilizers make soil acidic so the use of lime helps to mitigate that effect.

Table 8.2 General recommended Fertilizer rates for maize if no specific soil analysis or local recommendations are available

Target yield (t/ha)	Nutrient requirements (kg/ha)		Basal fertilizer (kg/ha)	Top dressing
	Nitrogen	Phosphorus	DAP (kg/ha)	UREA (kg/ha)
2	30	10	60	40
3	60	20	120	80
4	90	30	180	120
5	100	40	240	160