



GREEN MANURE, COVER CROPS, MULCHING, WEEDING

Improve soil fertility and reduce weeds!

Green manures, cover crops and mulching are the most effective practices for building fertility of agricultural soils. At the same time, they provide soil cover and therefore prevent erosion. Good soil cover discourages weed development and reduces the necessity for extensive weed management.

Green manure (Mboleya kijani) Using green manures for fertilization instead of synthetic fertilizers is a classical organic method.

Green manure crops are grown before a main crop. They are usually slashed two to three weeks before sowing the main crop and ideally before or at the flowering stage, when they have accumulated a maximum of nitrogen. They are worked into the topsoil to decay and to feed a subsequent crop with their nutrients (picture: crotalaria pure stand).

Alternatively, fresh plant material from shrubs and trees or grass cuttings can be worked into the soil one to two weeks before planting.

The benefits of green manures

- ☒ Large amounts of organic matter are added to the soil, stimulating soil organisms.
- ☒ Green manures decay easily and release nutrients quickly, as they are at a soft, early stage of maturity.
- ☒ Leguminous plants fix nitrogen from the air and store it in the plant. About half of this nitrogen will be available to the subsequent crop, and some even for the next two crops grown on the same field. Purple vetch, for example, can accumulate 90 kg of nitrogen per acre and will provide about 45 kg of nitrogen per acre to a subsequent grain or vegetable crop.



Cover crops Cover crops are grown to provide soil cover and organic matter and to suppress weeds. They may be incorporated into the soil while young or can be used as a mulch layer at a later stage of maturity. Cover crops are often used to provide soil cover during the dry or cold season and are just rolled down or slashed and left in the field one or two weeks before planting the main crop.

Leguminous crops are preferred for this purpose, and often the same species as for green manures are used. Cover crops provide animal fodder and sometimes products for human consumption like beans, or peas (picture: cowpea as cover crop in sorghum).



Mulch Mulch is a layer of any material, usually vegetative matter, spread on the soil surface. A layer of organic litter characterizes all productive natural environments – deserts are not productive! Mulch retains soil moisture, balances soil temperatures, and provides organic matter and nutrients as it decomposes. A mulch layer keeps delicate crops like strawberries clean (picture).

Mulching can be used universally. Young, quickly decomposing material provides nutrients for crops within short time, while slowly decomposing, older material like crop residues gives longer lasting soil protection.

Plastic mulch is thin plastic sheeting covering the soil. Crops grow through slits in the plastic and are watered by drip irrigation. However, disposal of the plastic is regarded as a problem



These are the benefits of all three methods

- They provide ground cover and minimize soil erosion.
- They prevent weed germination and suppress weeds.
- They build up soil organic matter, improve soil structure, and increase water storage capacity and soil fertility.
- They improve overall crop health and yields.
- They provide nutrients for other crops.
- Deep rooting plants can accumulate and recycle nutrients from deeper soil layers.
- They are effective and cheap soil amendments

Good green manure and cover crop legume species for Kenya

A wide range of legumes has been tested by KARI and other institutions for their suitability as green manure and cover crops. Some species emerged as especially beneficial. But besides the fact that most farmers are not used to grow crops which are not for consumption, seed availability is still a problem for farmers who are willing to try them. The list below is incomplete – ask your local agricultural advisor for suitable and available species in your region!



Pigeon pea, *Cajanus cajan* (Mbaazi)

Pigeon pea is ideal for intercropping. It does not compete with other crops as it has a deep taproot and a slow initial development. It is especially well suited for dry climates and for restoration of poor soils. Residues can be used as mulch for the next crop.

- **Intercrops:** with maize, sorghum, millet, cotton, groundnut, cassava, and others. After harvest of the main crop, pigeon pea continues to grow and protects the soil (picture).
- **Intercropped with grass:** pigeon pea increases grass growth.
- **Sole stand:** Grow sole stands within a rotation to improve soil productivity.



Dolichos lablab (Njahi)

Lablab is a vigorous, drought resistant climber. It provides excellent fodder, and leaves may be prepared as vegetable. Pods begin to mature after about five months, and harvesting continues for about 6 months. Lablab is cut and left in the field as mulch before the next crop is planted.

- **Intercropped with maize:** Plant two seeds per hole every 60 cm in between maize rows, preferably 3 to 4 weeks after maize to avoid competition.
- **Pure stand:** Within a rotation, pure stands are very beneficial for soil productivity. In very poor soils, lablab will do better if some manure is applied.



Mucuna pruriens

Mucuna is a very vigorous climber which improves soil fertility and farm productivity. Mucuna can only be digested by ruminants and is toxic to humans. To use as fodder, cut mucuna before flowering at a stem height of 40 cm for rapid regrowth. Feed it fresh, but at a maximum proportion of 20% in the ration.

- **Intercropped with maize:** Plant mucuna 3 to 4 weeks after maize as it is very competitive. Sow one seed between maize rows every 50 cm. Leave mucuna to grow during the dry season. Incorporate it or uproot it and leave it on the surface before planting the next crop.
- **Intercropped with bananas:** Plant one mucuna stand between four banana plants. Mucuna should be cut back to prevent climbing on the bananas.
- **Single crop:** Mucuna shows very good weed suppression. It increases yields of the following two crops and improves poor soils effectively (picture).



Crotalaria (Sunn hemp)

Crotalaria is fast growing, matures within 3 to 4 months, and is drought tolerant and adapted to poor soils. Nitrogen fixation of crotalaria is very effective. Some varieties may be eaten as vegetables. For use as fodder, prepare hay before crotalaria starts flowering, as the seeds of some varieties are toxic. Feed at a proportion of 10% of the ration.

- **Intercropped with maize:** Sow around 100 seeds per meter between maize rows about 3 weeks after planting maize. Leave to grow, don't forget to harvest the seeds, and uproot and lay crotalaria on the ground as mulch shortly before planting the next crop.
- **Intercropped with cassava:** Sow two rows of crotalaria between cassava rows immediately after planting cassava.
- **Other intercrops:** with sweet potatoes, bananas, coffee and other crops. Always avoid that crotalaria grows too near to them.
- **Single crop:** To improve soil productivity, grow crotalaria during the short rainy season.



Canavalia (Jackbean)

Canavalia improves very poor soils and is tolerant of drought and shade. It is easy to manage and can be intercropped with almost all crops. It grows on during the dry season. After harvesting the pods to obtain seeds for subsequent seasons, residues are left on the soil surface as mulch. Canavalia can be used as livestock fodder, but has to be wilted after cutting and only small amounts may be fed as it contains a toxin.

- **Intercropped with maize:** Sow canavalia 4 weeks after sowing maize. Place one seed per hole in a row between the maize rows every 50 cm, like mucuna (picture).
- **Intercropped with banana or coffee:** Plant two rows 60 cm apart between rows of banana or coffee. Keep a distance of one meter from the banana or coffee plants. Apply as mulch.
- **Intercropped with sweet potato:** Plant canavalia in furrows. After the harvest of sweet potatoes, incorporate canavalia or leave it as mulch on the soil surface.
- **Sole crop:** On fields with low fertility, sow one seed every 30 cm in rows spaced 75 cm apart. At the end of the season, harvest the pods and leave the mulch on the field.

Some things to consider

- If residues of crops or cover crops are left on the soil surface, they decompose slowly and nutrients are also released slowly. The soil is covered and protected for a long time, which is beneficial.
- Diseases and pests may survive in crop residues. To prevent accumulation, it is essential to practise crop rotation.
- For decomposition of large amounts of woody materials such as straw or stalks, soil microorganisms need nitrogen which will then be temporarily unavailable for plant growth. It can be beneficial to topdress some nitrogen rich fertilizer if you feel that crops are suffering from lack of nitrogen because of the mulch.
- When young green manure crops are incorporated into the soil before planting, there is a rapid development of soil organisms. They quickly break the soft material down and large amounts of nutrients are released. The small seedlings are not able to take them all up, resulting in nutrient losses through leaching. In addition, there is a danger of erosion as the soil is not protected by a plant canopy after incorporation and during crop establishment.
- If a legume species is grown in a field for the first time, inoculation of the seeds with suitable Rhizobium bacteria may be necessary to make nitrogen fixation possible. Bacteria should be available from the seed supplier.

Some practical aspects

Green manures as a sole crop to improve soil fertility

In regions like Kakamega where the second rainy season is unreliable or short, plant maize as a pure stand during the long rains. After the maize harvest, plant green manure legumes and leave them in the field during the dry season. Slash and incorporate them during land preparation before the next long rains.

Intercropping green manure legumes with maize

In regions with two longer rainy season per year, green manure legumes are usually planted at the same time as maize. Very vigorous species like mucuna and lablab should be sown 2 to 4 weeks later to give the main crop an advantage. Do a weeding if necessary. The legume is planted in between maize rows and left to grow during the dry season. It is slashed and incorporated into the soil at the beginning of the next rainy season.

In regions like Kitale with only one long rainy season per year, legume cover crops are planted between the maize rows in August, about 4 months after planting maize. The lower maize leaves are stripped (they are an excellent fodder for dairy animals!) to allow better legume establishment. The legume is slashed and incorporated into the topsoil only 2 to 3 weeks before planting the next crop.

Intercropping green manures with vegetables

Legumes can also be intercropped with vegetables like kales. Choose a legume that grows upright and does not coil around the vegetables, e.g. crotalaria or Jackbean (canavalia).

Cover crops for conservation agriculture

Cover crops are a central element in conservation agriculture. Even in drier regions like Machakos district, suitable cover crops like lablab provide complete ground cover within three months. The legume plants are left on the surface as mulch and the next crop is planted directly through the mulch layer.

Mulching in high value crops

Mulching is often used for young plants in vegetable production to conserve soil moisture and to provide a good soil climate. The mulch material is spread by hand or with a rake in a layer 1 to 4 inches thick. In a wet climate, only thin layers should be used, while in a dry climate, thicker layers can be applied. Wet green material should be allowed to dry and wilt before application.

Tithonia provides very good mulch – and nutrients

Where Tithonia is applied as mulch, plants show increased growth rates. Plant Tithonia in hedges around your fields! They can be pruned several times a year about knee high above the ground. Cut the shoots before flowering and when they are about 2 m high. Chop them and spread a layer of about two inches around the plants or all over the bed.

Banana mulch

Mulch should be applied about 60 - 90 cm away from banana stools in order to encourage growth of deep vertical roots. When mulch is applied close to the stool, more superficial lateral roots develop. The plants will suffer during dry spells, and there is a risk that stems are uprooted in strong wind.



Green manures from shrubs and trees

Tithonia is one of the most effective green manure plants as it decays quickly and grows in many regions in Kenya (see picture above). Chop the young shoots before flowering and incorporate them into the topsoil (3 to 5 kg / square meter) 1-2 weeks before planting or transplanting a vegetable.

Working green manures into the soil

Green manure plants are worked in when they are still young and fresh. It is preferable to chop them to allow easier decomposition. The older the plants, the longer decomposition will take.

Cover crops in plantations and for establishment of plantation crops

In plantations (coffee, tea, coconut, citrus, sugarcane etc.), cover crops provide excellent ground cover for weed suppression, control of soil erosion and a good soil climate for growth.



Organic weed management

All topsoils contain large amounts of weed seeds – enough for a hundred years, some say. Every time the soil is moved, a new lot germinates. Weeds have to be controlled, because otherwise they take advantage of the situation and consume the valuable nutrients from fertilizers and from the soil, leaving your crops poor and hungry.

Organic farmers do not use herbicides to control weeds, as herbicides can be harmful to people and the environment. Some of them stay in the soil for a long time and they may contaminate surface and ground water. Organic farmers therefore prefer to rely on crop rotation, on hand weeding and on ground cover.



- **Practise crop rotation.** Rotation prevents a certain weed type from becoming dominant.
- **Plant ground cover plants** like beans, lablab, desmodium, mucuna etc. Usually, one weeding will be necessary to ensure good establishment of the cover crop. After that, further weed germination should be suppressed.
Especially legumes are suited, as they provide their own nitrogen. They often continue to grow after the main crop is harvested, providing soil protection until the next crop is planted. They can be fed to livestock and may be used as green manure or as mulch cover for the next cropping season.
- **Practise mulching** by leaving a layer of crop residues or other plant material on the surface. Besides suppressing weeds, this will also reduce soil temperatures, conserve moisture, reduce soil crusting and add organic matter to the soil.
- **Slash weeds before planting.** This allows a better initial development of the crop.
- **Always weed early** and before weeds start to compete with crops and snatch the nutrients away from them!
- **Slash weeds at ground level** when 10 -15 cm tall and before flowering and seeding, and leave them on the ground as mulch. This reduces the weeding work, and intervals between slashings can be longer than between traditional hoe weedings or diggings.

Weed control in row crops

Keep the soil covered with useful plants during the growing season. Legumes for intercropping with maize or cassava should be sown directly after the first weeding. Blue vetch is a good legume to intercrop with small grains. Peas in an oat field will both improve forage yield and nutritional value of the combined crop, while keeping other weeds under control.

Residues and cover crops should be left in the field during the dry season to protect the soil. On sloping land which has not been terraced, leave strips of vegetation across the slope to prevent soil erosion.

Avoid these practices!

- Removing weeds from the field also removes all the nutrients collected by them. Leave them in the field as mulch or recycle them by composting.
- Bare, unprotected, weed free soil is prone to erosion and crusting through rain and sun. Leaving the soil bare is almost a guarantee for rapid soil degradation.
- Clearing by burning burns and removes not only weeds and residues, but also soil organic matter from the topsoil. This is called "soil mining". It will not improve soil fertility, but reduce and ruin it within short time.

Leguminous weeds like clover help to improve soil fertility. Used as soil cover, they prevent weed emergence and soil erosion, e.g. in passion plantations. When legumes become too vigorous, they can be cut and used to feed livestock or as mulch for other crops.

Clover overpowers weeds including couch grass and sedges and can be used to control them. Kenya white clover, for example, mixed with grass, is a very good protein rich feed for all livestock.

Sedges (including nut sedges and water grass) release chemicals that reduce the growth of other plants near them. Often crops grow very poorly in the presence of sedges. Their roots can go deep, and after weeding very small pieces of roots or stems can regrow and create new plants.

To control sedges, plant leguminous ground cover plants. Alternatively, apply thick layers of mulch. Initially, the weeds will grow prolifically, but after a wet period they are easy to remove by hand pulling. Make sure the "nut" is not left in the soil.

Witchweed (*Striga*) grows best in dry climates. Improving soil fertility is vital for control of striga: apply compost and manures, rotate and intercrop your crops with legumes and cover crops, and practise mulching with cover crops and crop residues.

Tithonia (wild sunflower) should not be regarded as a weed! It provides a nitrogen rich fertilizer when its leaves are chopped and used as green manure or mulch (see previous page).