



CROP ROTATION AND INTERCROPPING

Agriculture starts with crop rotation

Organic techniques can make a significant contribution to improving small-scale farming. Crop rotation is the technique number one, not only in organic farming. It is fundamental for crop protection and stands for sustained soil fertility and higher food security - and it is available at no cost for everyone.

Crop rotation - the key for healthy crops

Crop rotation has always been the heart of good agriculture. If a certain crop is planted on the same piece of land season after season, it can be observed that it does worse and worse every time. This was always well known by farmers all over the world, and over the centuries, they developed and practised some form of crop rotation in order to avoid this effect.

Only in recent times have these traditional practices been abandoned in some parts of the world. Chemical inputs can, at least in the short run, overcome some of the adverse effects of continuous cropping. But in the long run, higher and higher dosages are necessary, leading to increased expenses, risk of intoxication and contamination and to resistance of pests and diseases against pesticides.

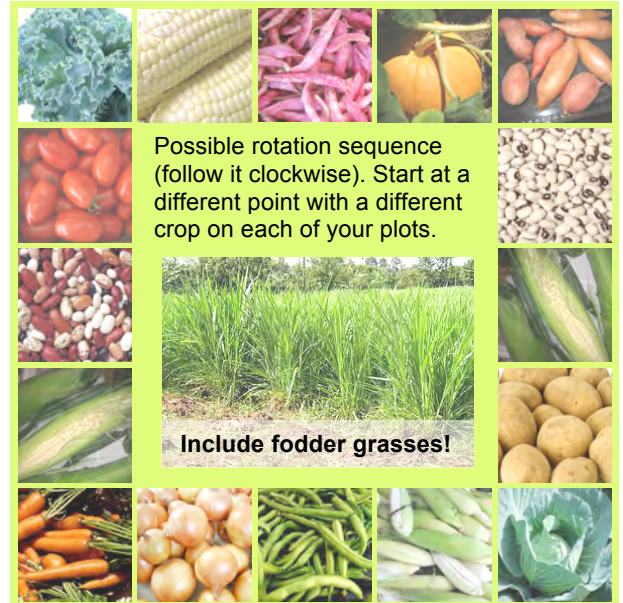
Further benefits: healthier soils and food security

- Crop rotation improves soil structure due to the different root systems of different crops. Deep roots loosen the soil, enhance aeration and increase soil moisture. Soil fertility is maintained or increased due to the diversity of crops grown and due to the nitrogen-fixing ability of legumes included in the rotation.
- In a good rotation, one crop follows the other in a way that the soil is always covered, which reduces soil erosion.
- Crop rotation increases food security: if a wide variety of crops is grown, then the failure of one crop will have a much smaller impact than if only a few crops are grown.

Why all seasonal crops need rotation

There are two main reasons why crop rotation is so essential:

1. Many diseases and pests, but also weeds, are specifically associated with certain crops or plant families and can multiply only together with their host crop. They survive the dry or the cold season either in the soil or in crop residues left on the field. They are very happy if you plant their favourite dish again in the next season! They will immediately start multiplying even more.
2. During the growing period, each crop requires a specific set of nutrients from the soil. If you plant the same crop on the same land season by season, this leads to soil depletion, poor growth, and weak plants which are easily attacked by pests and diseases.



Different rules for different crops!

How long do you have to wait before you plant a certain crop on the same field again? This depends mainly on the pests and diseases associated with it. Some diseases and pests can survive in the soil for many years. Others are not so long-lived.

In Table 1 "Plant families and planting frequency for different seasonal crops" on the next page you can look up how often you may grow the most frequent crops on the same field, and which problems you may encounter if you plant them more frequently. Vegetables are more susceptible to diseases than grains and should therefore be rotated carefully.

Get familiar with the plant families

Plants from the same botanical plant family often suffer from the same or similar pests and diseases. Because Irish potatoes, tomatoes, nightshade, peppers and eggplants all belong to the same botanical family (nightshades), you can plant only one of them on the same field within four years.

It is good to rotate leaf crops, fruit crops, root crops, legumes and cereals, as many African farmers already do. This concept considers differences in nutrient requirements. But with regard to plant health, this is not enough, as you can see in the example of tomatoes (fruit crop) and potatoes (root crop) – both are nightshades and should never follow each other.

Crop rotation on small farms

Rotation is not a question of farm size. If you have a small farm, it is even more essential that your crops are healthy. Healthy crops produce a bigger harvest, more food, and more cash. If you grow crops from different plant families every season, you can rotate them on your fields.

Crops can be rotated on large plots as well as on small plots, and with exactly the same effect even on the tiniest plots!

Because maize and grains are less susceptible to diseases and do not need to be shifted as often as vegetables, they can occupy a larger area of the land dedicated to seasonal crops. Maize may take up to two thirds of the area, and rice and other grains up to one half. Cotton may make up to one third.

The rest of your land can be used for vegetables and fodder grasses. They can be rotated with each other and with the maize and the grains.

These are the botanical families and groups which suffer from the same or similar diseases and pests:

Table 1: Plant families and planting frequency for different seasonal crops

Family	Crop	Plant on one plot	Reason
Fodder grasses	Napier, Boma, Kikuyu, Sudan, Rhodes	for 3 years	perennial crops
Grains	Maize, sweet corn, baby corn sorghum, millet	2 of 3 years	fungi
	rice	continuously, but rotation is better	fungal diseases, nematodes
	wheat, barley	once in 2 years	fungi
	oats	once in 4 years	nematodes
Legumes	dry beans, French beans, soybeans, groundnuts, cowpeas, pigeon peas, green grams	once in 4 years	blight, root rots and other fungi, viruses, nematodes
	garden peas, snow peas, sugar snaps, chickpeas	once in 6 years	Fusarium wilt, root rots, nematodes
Nightshades Solanaceae	Irish potatoes, tomatoes, peppers, chillies, eggplants, African nightshade	once in 4 years	very susceptible to blights, wilts and bacterial diseases, nematodes
Cabbage family Brassicaceae	kales, cabbages broccoli, cauliflower, radish, rape, turnips, collards	once in 4 years	very susceptible to bacterial and fungal rots and diseases, nematodes
Apiaceae	carrots, celeries, fennels	once in 4 years	fungal and bacterial root rots, nematodes
Roots different families	sweet potatoes cassava yams	once in 4 years once in 2 years	weevils, root rot, nematode bacterial blight, root rot root rot, nematodes
Spinach family	spinach, beetroots	once in 4 years	fungal and bacterial diseases
Onion family	onions, garlic leeks	once in 5 years once in 4 years	fungi, root rots, nematodes
Asteraceae	sunflowers lettuces	once in 5 years once in 4 years	fungi, root rots, nematodes
Cucumber family Cucurbitaceae	pumpkins, squashes, gourds cucumbers, zucchini melons	once in 4 years once in 5 years once in 6 years	Anthraxnose, Fusarium wilt and others
Mallow family	okra, cotton	once in 3 years	nematodes, fungi

These are recommendations for **minimum rotational intervals**. They will protect your crops from the most common diseases which survive in the soil.

In case of severe problems, it may be necessary to extend the recommended intervals. One example is *Fusarium* root rot in beans: a period of 6 and more years before planting legumes on the same piece of land again is necessary to eliminate this problem.

For more information on crops, diseases and pests go to: www.infonet-biovision.org

Rotations with vegetables

Most vegetables should be planted on the same land only once in four years. With two growing seasons per year, each of your fields will have 8 planting seasons before one certain vegetable family is planted again.

The easiest way to establish a good rotation with vegetables is to divide your land for seasonal crops into 8 plots of more or less equal size. These plots should be permanent for the following years!

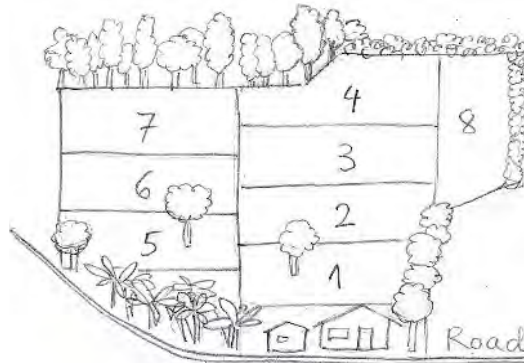
Reserve up to 5 plots for maize, or up to 4 plots for other grains and on the remaining plots you can plant vegetables and grasses if you have animals to feed. You may also subdivide them further. Then for each plot, follow a planting sequence which meets your needs and keeps the planting intervals necessary for the different plant families.

Good sequences

There are crop sequences which are more favourable than others, and some sequences are even unfavourable. In Table 2 you can find planting sequences for different crops which have proved to be beneficial for crop health.

Do not trust your memory!

For most people, it is impossible to remember all the crops they planted on each of their plots during the past years. Therefore, you need at least a small booklet where you can note down what you planted every rainy season. Make a sketch of your farm which shows all your plots and give them a name or a number. Then list for each plot which crop or intercrop you planted there. Keep the booklet in a safe place where you will find it again before the beginning of the next planting season.



Draw a sketch of your shamba

Table 2: Good preceding and subsequent crops for some common crops

Good in the preceding season	crop	Good to plant afterwards
all crops are good	maize, sorghum, millet	all crops except carrots
all crops except wheat, barley, oats	wheat, barley, oats	all crops except wheat, barley, oats
rotate rice with: maize and other grains, legumes, cotton, sweet potatoes	rice	cowpeas
maize, grains, spinach, carrots, onions	beans	Irish potatoes, tomatoes, cabbage, onions, maize, grains
maize, grains, grasses, legumes, spinach, onions, sunflowers	Irish potatoes	cabbages, spinach, onions, pumpkins and squashes, sunflowers, soybeans, maize, grains, lettuce
legumes (and all families except nightshades and cucurbits)	tomatoes	cabbages, maize, grains, grasses
maize, grains, grasses, legumes, tomatoes, Irish potatoes, onions	cabbage family	only maize, grains, grasses, leeks
cucurbits, onion family, spinach family, grains, grasses	carrots	maize, grains, grasses, beans
cucurbits, spinach, lettuce, sunflowers	sweet potatoes	legumes, maize, rice, grains, grasses
onion family, Irish potatoes, carrots, peas, grains, grasses	spinach	groundnuts, soybeans, all crops except spinach family and lettuce
grains, French beans, Irish potatoes, spinach	onions	all crops except onion family
Irish potatoes, onion family, spinach, legumes, maize, grains, grasses	pumpkin, squashes	root crops (but not Irish potatoes): carrots, sweet potatoes, yam, cassava
spinach, maize, grains, fodder grass	groundnuts	grasses, cotton
maize, grains, rice, Irish and sweet potatoes, sunflowers, spinach	legumes	Irish potatoes, tomatoes, cabbages, squashes, maize, grains, cotton
maize, grains, spinach	sunflowers	Irish potatoes, maize, grains, legumes

Intercropping

Intercropping is the traditional way of farming in most tropical regions of the world, particularly in Africa. It has long been regarded as an inefficient and backward agricultural method and farmers have been discouraged by extension services from planting intercrops. Only in the recent years their numerous benefits have been examined and acknowledged.

Very suitable for organic farming

There is no doubt that intercropping is a more natural way of farming than cultivation of single stands. Farmers in Africa are experienced in planting beneficial crop combinations. If we wanted to enumerate them all, the list would be long!

Here are just a few good examples:

- Napier grass in combination with maize reduces damage from maize stemborer
- tomato - cabbage intercropping reduces diamond-back moth
- pigeon peas and other legumes continue to grow, produce, and protect the soil after the main crop has been harvested
- planting runner beans or peas a few weeks before harvesting tomatoes keeps the soil covered
- row intercrop of sugarcane in furrows and tomatoes on ridges makes good use of resources
- Generally good combinations are tall crops intercropped with shorter crops that require more shade; and deep-rooted crops and shallow-rooted crops.

The most important benefits

- intercropping can produce a higher yield on a given piece of land, because it makes use of resources that can not be utilised by a single crop
- plant diversity enhances soil fertility and food security
- lower incidence of crop-specific pests, diseases and weeds
- increased numbers of natural enemies such as spiders or parasitic wasps help to limit pest and disease outbreaks
- combinations with legumes, a very common practice also in Africa, increase crop yields without the use of synthetic fertilizers, because legumes can fix nitrogen
- better soil cover helps reduce soil erosion and reduces weed germination
- better use of the planting season if intercrop partners keep on growing after the harvest of the main crop
- high-growing plants or climbers are given structural support by their companion crop
- delicate plants are given shade or protection

Intercropping and crop rotation

Intercrops are more difficult to handle in crop rotations, because several crops have to be considered when planning a good rotation or even only the next season's crops. It will be more difficult to keep the planting intervals for the various plant families.

There is only one solution: grow as many different crops as you can use and sell, not in one field, but on the whole farm and over several seasons.

Legumes

The central role of this plant family in organic farming can not be overemphasized, because they are a very important source of nitrogen on the farm. But if legumes are intercropped frequently, it will be more difficult to avoid soil-borne legume diseases. It is therefore advisable to include a wide range of different legume species in the rotation.

Try to keep the recommended rotational intervals at least for important legume cash crops such as French beans or peas. They will then do much better!



Good for the crops, for the soil, and for human nutrition: Maize-bean intercrop

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