

# Better soybean

through good agricultural practices



For farmers in Rwanda





Soybean is a grain legume that is very nutritious and contains on average 40% protein. It can be used directly for food in the household, or processed for soy-milk, cooking oil and a range of other products, including infant weaning food. Also the poultry industry uses soybean for feed production. Soybean grain often has a good market demand. The crop residues are also rich in protein and are good feed for livestock or form a good basis for compost manure.

Soybean forms root nodules which contain bacteria called rhizobia. The bacteria can fix nitrogen from the air into a form that soybean can use for growth. This is called biological nitrogen fixation. Some of the nitrogen is also left behind through falling leaves and roots to improve soil fertility. This makes soybean a good crop to grow as intercrop or in rotation with other crops, because these other crops then also benefit from the nitrogen. In addition, soybean has the potential to control the parasitic weed *Striga hermonthica*.

To form nodules and fix nitrogen, soybean needs specific rhizobia. In most soils, these rhizobia are not abundant. Thus inoculating soybean seed with the correct rhizobium increases biological nitrogen fixation and gives a good yield for very little cost. With good practices and the right varieties, grain yields can be as high as 3500-4000 kg/ha when grown as a sole crop.

## Step 1: Land selection and preparation

- Soybean can be grown on a wide range of soils with a pH between 4.5 and 8.5.
- Avoid waterlogged, or very sandy, gravelly soils.
- Think about the rotation scheme for the field you want to plant. Do not plant soybean in the same field for two succeeding seasons, as this increases the chance for disease.
- Well-prepared land ensures good germination and reduces weed infestation. Clear all vegetation and prepare the field manually with a hoe, or use animal power or a tractor. In Rwanda, soybean is often planted on a flat seedbed, but can also be planted on ridges to avoid waterlogging. Make ridges 75 cm apart from each other.

## Step 2: Variety and seed selection



Select a good soybean variety which suits your agro-ecological zone. Also pay attention to the maturity period. Some varieties have a relatively short maturity period and are suitable for areas with low rainfall, or when planted late in the season. Late maturing varieties are less suitable for drier environments, but often produce higher grain and biomass yields, fix more nitrogen and contribute more to soil fertility than early maturing varieties. Some of varieties available are listed in the table below:

Variety	Grain colour	Attainable grain yield (kg/ha)	Maturity period (days)	Growth habits	Pest/diseases resistance	Seed rate
SB24	Yellow	2700	129	Determinate	Tolerant to rust	40 kg/ha
SC Saga	Yellow	3300	125	Indeterminate	Tolerant to rust	
SC Sequel	Yellow-green	2200	122	Determinate		
SC Squire	Yellow	3300	128	Indeterminate	Tolerant to rust	

Use only high quality seed for planting.

- Make sure seed is not more than 12 months old to ensure good germination.
- Sort out the good seeds for planting to ensure that they are free from insects, disease infestation and weed seeds.
- Do a germination test at least 10 days before planting. Plant 50 seeds. If at least 40 emerge, the seed is good for planting. If 30-40 emerge, plant more seeds than recommended. Get new seeds if less than 30 seeds emerge.



## Step 3: Inoculation



To be able to form nodules and fix nitrogen, soybean seeds need to be inoculated with rhizobia. Each legume crop needs a different type of rhizobium bacteria, so always check you have the right inoculant for soybean. Directions for using inoculants can be found on the package. Below, directions are given for the most commonly used inoculant in Rwanda, *Rizobiyumu*.

### ***How to inoculate using Rizobiyumu (80 g package)***

1. Measure 8 kg of legume seed. Place in any container that will accommodate the seeds.
2. Measure one soda bottle (300 ml) of clean lukewarm water.
3. Sprinkle the water on the seed.
4. Add the rhizobium inoculant onto the wet seeds.
5. Mix the seeds and the inoculant thoroughly but gently until all seeds are uniformly covered with the inoculant.
6. Protect the inoculated seed from direct sunlight by covering the container with paper, cloth or gunny bag and keep under a shade until planted.

***For smaller amounts of seed, use 8 teaspoons or soda bottle-tops (40 ml) of the sticker solution, and 2 heaped teaspoons or soda bottle-tops (10 g) of inoculant for every 1 kg of seed.***



*Important:*

- The right inoculant must be used with the right legume. You should not apply, for instance, a bean inoculant on soybean seed.
- Inoculant contains living organisms that must be protected from heat and sun. Therefore always store the package in a cool place away from direct sunlight (for example, in a clay pot in the coolest place in the house).
- Inoculants lose their effectiveness when stored in an open package. Always store inoculants in their original package and use them quickly after opening the bag.
- Seeds should be coated with inoculant just before planting.
- Do not use inoculant after its sell-by date, as the inoculant may then not be effective anymore.



## Step 4: Applying fertilizer



### Important points

- Soybean can fix its own nitrogen, and therefore you do not need to apply nitrogen fertilizer like urea, NPK or CAN.
- Soybean cannot fix other nutrients, and therefore you do need to apply other nutrients such as phosphorus at planting.
- Good fertilizer types for soybean that supply phosphorus are SSP, TSP and DAP.

### Application

- Make a furrow next to the rows of soybean and place the fertilizer in the furrow and cover. Do this at planting or within two weeks after planting.
- Use the rates given in the table below for mono-cropped soybean. You can use a teaspoon or soda bottle-cap to measure the amount of fertilizer and apply it along the rows of soybean, according to the distances in the table below.
- When manure has been recently applied, the fertilizer rates can be reduced.

Fertilizer type	Rate (kg/ha)	Row spacing: 50 cm		Row spacing: 75 cm	
		In the furrow spread 1		In the furrow spread 1	
		Teaspoon	Soda bottle-cap	Teaspoon	Soda bottle-cap
DAP, TSP	100	Every 100 cm	Every 60 cm	Every 60 cm	Every 40 cm
SSP	225	Every 40 cm	Every 30 cm	Every 30 cm	Every 20 cm

## Step 5: Planting



### ***Planting***

- Plant when the rains are well established to avoid dry spells after planting.
- Plant in the morning or evening to avoid direct sunlight on the inoculated seed. Sunlight will make the inoculant ineffective.
- Planting in rows has many advantages; you use the correct plant density, weeding is easier and harvesting takes less time.
- Plant at 2-5 cm depth. Planting deeper than 5 cm may result in loss of vigour or failure to emerge.
- Fill gaps one to two weeks after sowing when plants have emerged.

### ***Spacing of mono-cropped soybean***

- Spacing between rows and within rows depends on the variety and planting method. When you plant on ridges the row spacing will be wider than planting on flat. Generally, early maturing varieties need closer spacing than late maturing varieties.
- When using 50 cm between rows, plant seeds at 4-8 cm apart (1 seed per stand) or 7-15 cm apart (2 seeds per stand).
- When using 75 cm between rows, plant seeds at 2-5 cm apart (1 seed per stand) or 5-10 cm apart (2 seeds per stand).

### ***Intercropped soybean***

As an alternative to growing soybean as a sole crop, you can intercrop soybean with a cereal crop. Soybean does not grow well when shaded. Therefore it is best grown in strip intercroops with 2-4 rows of soybean and 2 rows of a cereal crop. Soybean can also be planted in between rows of newly-established crops of cassava. Use the recommended planting distances for both crops.



## Step 6: Field management



### **Weeds**

Control weeds to minimize competition for nutrients, water, sunlight and space. Weed control can be manual or chemical, or both.

#### *Manual weed control:*

Weed about 2 weeks after planting and again 5-6 weeks after planting. If the plants grow very well and the canopy closes early, the second weeding is not needed.

#### *Chemical weed control:*

Herbicides, if used properly, are safe and effective in controlling weeds. There are different types of herbicides. Which type to use depends on the predominant weed species and its availability.

Herbicides are available for pre-emergence or post-emergence weed control. If pre-emergence herbicide is applied at planting, one weeding may be required at 5-6 weeks after planting. Use post-emergence herbicides *Basagran* and *Targa Super*, or seek advice from an extension agent.

## Pests and diseases

### **Insect pests**

If pests are damaging leaves, you do not have to spray, as leaf damage is unlikely to reduce the yield. From flowering onwards, soybean becomes attractive to pod-sucking bugs that can seriously reduce seed quality.

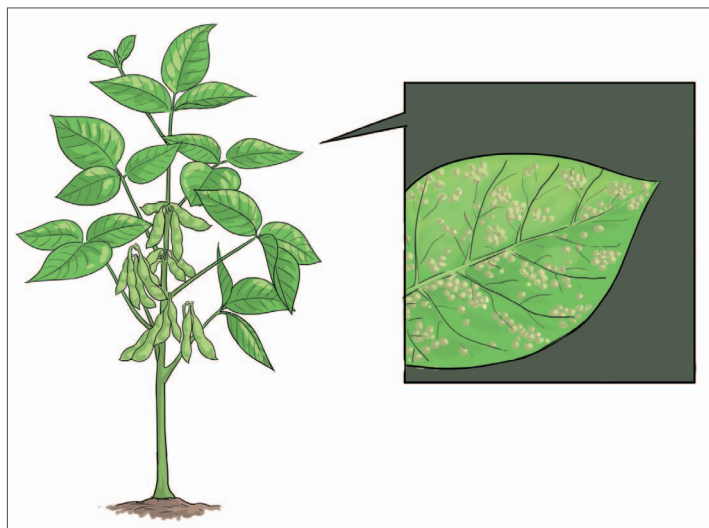
If pests are damaging pods, control the pest with a single spray of *Cypermethrin + Dimethoate 10 EC* at the rate of 100 ml in 15 litres water, or seek advice from an extension agent or agrodealer.



## Diseases

Soybean diseases can be caused by fungi, bacteria or viruses and can result in major yield losses.

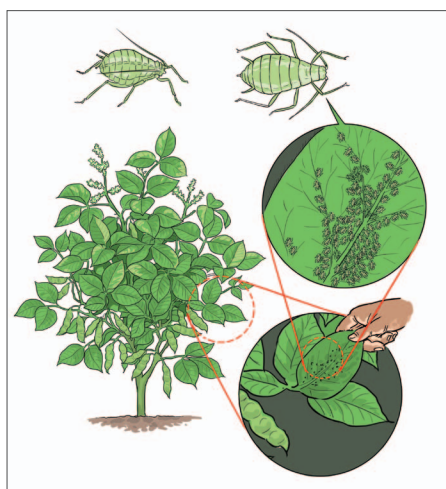
*Soybean rust* is a fungal disease. Infected leaves have small tan to dark brown or reddish brown lesions. From the lesions, small raised pustules or bumps can occur on the lower surface of the leaves. Severe infection leads to premature defoliation and can cause high yield losses.



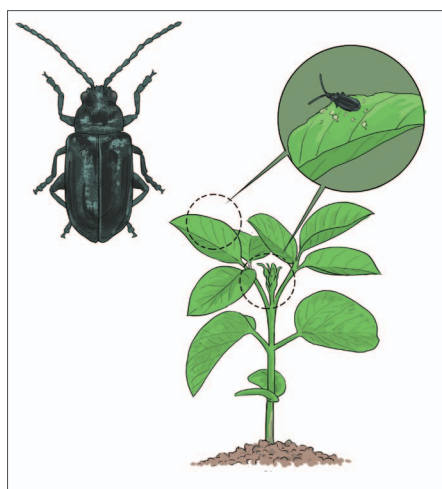
*Soybean rust*

*Septoria brown spot* is a fungal disease that affects lower leaves first. Infected leaves have irregular shaped, dark brown lesions on both leaf surfaces that can join to form large blotches. The infected leaves yellow quickly and drop.

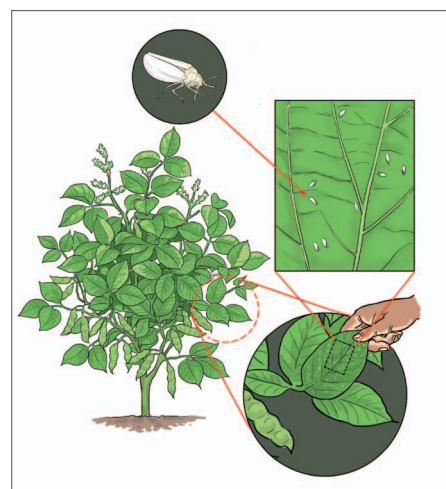
*Viral diseases* can be transmitted by aphids, beetles and whiteflies. Soybean seeds originating from infected plants can also carry viruses. Most of the viral diseases result in foliar symptoms such as mosaic and mottling, thickening/brittling of older leaves, puckering, leaf distortion, severe reduction in leaf size, and stunting of plants.



*Aphids*



*Beetle*



*White flies*

### **To control fungal and bacterial diseases:**

- Plant resistant varieties.
- Plant in a good seedbed and avoid poorly drained or compacted soils.
- Rotate soybean with non-legumes to prevent the built-up of diseases.
- You can treat seeds with fungicides (for example *Captan*, *Apron Plus* or *Thiram*, use 1 sachet/8 kg seed) for protection against soil-borne fungal diseases.

### **To control viral diseases:**

- Plant resistant varieties.
- Many viruses involved in mosaic disease are seed transmitted. Therefore, do not plant seeds from mosaic-affected plants. Instead, use certified seed or use seeds that produced away from the infection source.
- Uproot and destroy affected plants. This can reduce the incidence of insect-transmitted viruses.
- Control weeds in and around the soybean farms.
- Soybean is most vulnerable to virus infections in the pre-flowering stage. During this period, you can spray one or two times with insecticides to reduce the number of insects that can transmit viruses.

### **Safe use of chemicals**

- Use only herbicides, pesticides and fungicides that are recommended to soybean to avoid damage to the plant.
- Chemicals can be toxic, so always follow instructions on the product package or from the agro-dealer for safe use. Also follow the instructions about the time needed between spraying and safe consumption of fresh pods.
- Do not store chemicals in the same place as food.
- Do not eat from the same spoon you used to measure chemicals.





## Step 7: Harvesting



Soybean should be harvested when 9 out of 10 pods are mature (brown or dry). Leaving the crop in the field too long makes the pods very dry, so they might shatter during harvest. To avoid shattering, it is best to harvest early in the morning.

Do not harvest soybean by hand pulling because this may remove the roots that contain nitrogen and contribute to soil fertility. Instead, cut the mature plants at ground level using a cutlass, hoe or sickles. Make sure grain of different varieties is not mixed. Mixed grains lower the market value.

1. Dry the soybean plants in the sun and protect from rain and animals. Preferably, dry on a mat, plastic sheet or tarpaulin, or on a raised platform.
2. Thresh gently on a clean surface when the plants are dry.
3. Dry the threshed grains on mats, plastic sheets or other clean surface for two sunny days; protect from rain and animals. Test the grain to see if it is dry enough by biting or pinching grain with your finger nails - grain should break or crack, not bend or stick between your teeth or fingernails.
4. Clean the grains. Winnow to remove chaff, dust and other rubbish. Also remove shrivelled, diseased, broken grains and grains of other varieties.
5. Place grain in clean bags or other containers; if re-using bags in which grain was previously stored, the bags must first be washed and then disinfected by boiling them in water for 5 minutes. If the bag is polyethylene, make sure it doesn't touch the outside of the pot or it will melt. Completely dry container/bag.
6. Clean the storage room; remove all old grains and insects. Do not store grain which is to be eaten in the same place as pesticides or other dangerous chemicals. Stack the grain bags on a raised platform or wooden pallet away from the wall. Avoid direct contact of storage bags with the ground. Inspect and remove infested or rotting grains on a regular basis.



### ***Using soybean***

- The first step in making delicious soybean dishes is to put the dried grain in boiling water and quickly cook for 20-30 minutes. This reduces anti-nutritional factors - these factors can interfere with absorption of nutrients. Then remove the skin and dry. Soybean develops a bad flavour if the cooking step is left out.
- Soybean flour can be made by grinding the pre-boiled and dried grains. The soybean flour can be mixed with cassava or maize meal to make a very nutritious porridge, or for baking soybean bread or soybean cakes.
- Grains can be roasted and eaten as snacks, much like groundnut.
- The grains can also be used in a variety of dishes as relish.
- Soaked and pounded soybean can be used to make soy milk and tofu.
- Ask an extension agent for more soybean recipes!
- Crop residues can be fed to livestock or composted. Because the residues are rich in nitrogen, bringing them back in the form of compost or manure from the livestock enriches your field in nitrogen.



This leaflet was produced by N2Africa in October 2014 for farmers in Rwanda. It is available on the website of N2Africa and the Africa Soil Health Consortium (ASHC) - ([www.cabi.org/ashc](http://www.cabi.org/ashc)) as Creative Commons material which can be reproduced and re-used without permission - provided N2Africa and ASHC are credited. The content was developed by N2Africa. Photographs are courtesy of N2Africa, ASHC and International Plant Nutrition Institute (IPNI).

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see [www.N2Africa.org](http://www.N2Africa.org) (email: [N2Africa.office@wur.nl](mailto:N2Africa.office@wur.nl))



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