Better beans

through good agricultural practices

For farmers in Rwanda

Common bean is a grain legume which is very nutritious and rich in protein. The leaves, green pods, young and mature seeds are edible. The crop residues are good feed for livestock and also form a good basis for compost manure. There is a ready market for common bean.

Together with bacteria, common bean forms root nodules. These bacteria are called rhizobia. In the root nodules, the bacteria can fix nitrogen from the air into a form that common bean can use for growth. This explains why common bean can grow and yield very well in soils which are poor in nitrogen. Part of the fixed nitrogen is used to make protein in the grains, but some of the nitrogen is also left behind through falling leaves and roots. The nitrogen that is left behind improves soil fertility.

This makes common bean a good crop to grow as intercrop or in rotation with other crops, because these other crops then also benefit from the nitrogen. With good practices and the right varieties, grain yields can be over 1500 kg/ha. Climbing varieties can even yield over 4000 kg/ha.

Step 1: Land selection and preparation

- Select fertile to moderately fertile land with no water logging. Common bean does not tolerate acidic soils.
- Think about the rotation scheme for the field you want to plant. To prevent diseases, do not plant beans in the same field you used for beans last season.
- Clear all vegetation and prepare the field manually with a hoe, or use animal power or a tractor.
- On the hill sides, prepare a flat bed. If planting on hillsides, ensure that soil erosion is controlled e.g. by terracing.
- On flat volcanic soils which are subject to floods, prepare ridges which 75 cm between two ridges. Planting on ridges helps prevent waterlogging, which damages the common bean plants.

Well-prepared land ensures good germination and reduces weed infestation.

Step 2: Variety and seed selection

Select a good bean variety which suits your agro-ecological zone. Bean comes in bush (non-climbing) and climbing varieties. In mid and high altitudes, climbing varieties can give a higher yield per area and fix more nitrogen than bush bean. 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.

Variety	*Grain characteristics*	*Attainable grain yield (kg/ha)*	*Maturity period (days)*	*Growth habits*	*Pest/diseases resistance*	*Seed rate*
RWR 2245	Large, red mottled, iron-rich	2500	87	Bush	Tolerant to: • angular leaf spots • ascochyta blight • anthracnose • common moasaic virus	50 kg/ha
RWR 1668	Medium, red	1500	78			
Gasilida	Large, dark red	4000-4500	90-96	Climber	Tolerant to: • angular leaf spots, • ascochyta blight • anthracnose Good resistance to common bean mosaic virus	60 kg/ha
RWV 1348	Small, pink	3800	110			50 kg/ha
RWV 2070	Large, khaki	3000-4000	90- 120			70 kg/ha
RWV 3006	Large, white, iron-rich	3800	110		Good resistance to angular leaf spots, ascochyta, anthracnose, and virus	

Use only high quality seed for planting.

- Sort out good seeds to ensure that they are free from insects, disease infestation and weed seeds. Do not use damaged or wrinkled seeds, or seeds with holes.
- Do a germination test at least 10 days before time of 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: Fertilizer application

Important points

- Common bean can fix its own nitrogen, and therefore does not need to be fertilized with N-fertilizers like urea, or compound fertilizers containing much N such as NPK or CAN.
- Common bean cannot fix other nutrients, and therefore does need other nutrients such as phosphorus at planting.
- Good fertilizer types for common bean that supply phosphorus are SSP, TSP or DAP.

Application

- Make a furrow next to the rows of bean 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 bean. You can use a teaspoon or soda bottle-cap to measure the amount of fertilizer and apply it along the rows of bean, according to the distances in the table below.
- When manure has been recently applied, 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 4: Planting

Planting bush beans in a mono-culture

- Plant when the soil is moist.
- On a flat bed, plant in rows which are 50 cm apart. Within a row, plant seeds at 8-10 cm apart (1 seed per stand) or 15-20 cm apart (2 seeds per stand).
- Plant seeds at a depth of about 5 cm.
- Fill gaps one to two weeks after planting when plants have emerged.

Planting bush beans in a mixed culture

Bush beans can be intercropped with maize, sorghum, cassava or banana. Bush beans do not grow very well when shaded. To reduce the shading effect, multiple rows of bush bean can be planted after every two rows of a cereal crop or cassava.

Planting climbing beans

Plant climbing bean in rows which are 75 cm apart. Within a row, sow seeds 15 cm apart (1 seed per stand) or 25-30 cm apart (2 seeds per stand).

Planting in rows has many advantages - you use the correct plant density, weeding is easier and harvesting takes less time.

Staking climbing beans

Climbing varieties grow taller than bush varieties and can therefore attain higher yields on the same land area. To grow tall, climbing bean requires staking which provides support to the plants. Different staking methods can be used, but the highest yields are obtained with stakes that are at least 175 cm long and when you use at least 20,000 stakes per hectare, or 8,000 stakes per acre. The higher and stronger the stakes are and the more stakes you use, the higher the yield! Start staking climbing beans two weeks after germination.

Single stakes:

Use stakes from woody trees such as bamboo, *Eucalyptus or Grevillea;* or from forage shrubs such as *Cedrella, Leucaena, Alnus* or *Calliandra*. Put stakes deep and firmly in the ground. One stake can support 1-4 plants. The highest yields are obtained when at least 20,000 stakes are used per hectare (8,000 stakes per acre), each stake measuring at least 175 cm long.

Tripod:

Tie 2, 3 or 4 strong stakes together. Tying stakes together increases their strength. Use a tripod when the soil is shallow or when stakes or not very strong (for example when using *Pennisetum*). Each stake of the tripod can support 1-3 plants.

Ropes:

A rope or stake is tied horizontally between 2 strong single stakes or between 2 tripods. From this horizontal stake or rope, many ropes fall vertically over the climbing beans and act as stakes. Ropes are usually cheaper than good wooden stakes. Good ropes are made from sisal.

Intercropping with maize:

Method 1: Plant climbing beans 2 weeks after maize, so the maize stems are strong enough to support the climbing bean.

Method 2: Plant climbing beans right after maize harvest so that the old maize stem functions as a stake. This structure is not very strong and beans cannot climb high, so yields will be lower.

Step 5: Field management

Weeds

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

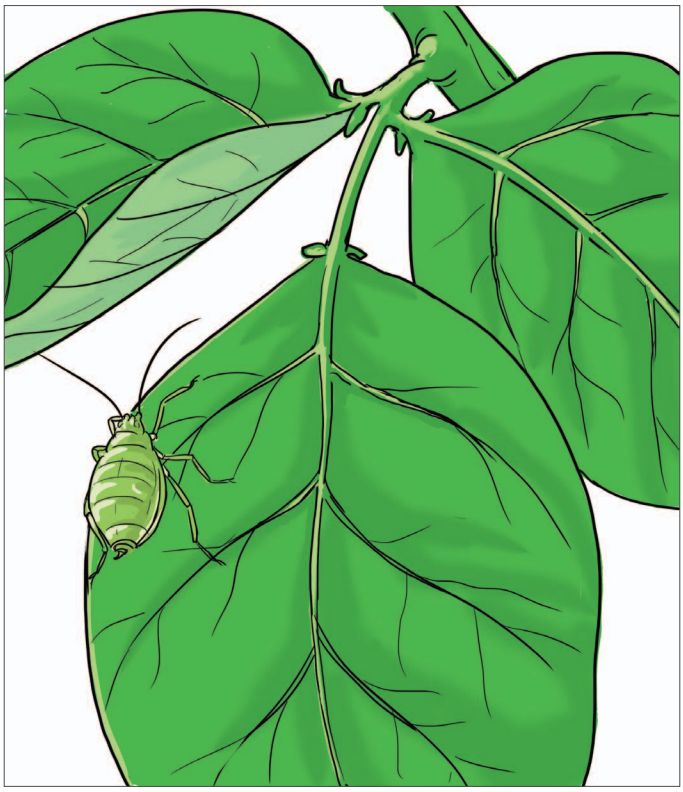
Manual weed control:

Weed about 2 weeks after planting and again 5-6 weeks after planting.

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 the availability of the herbicide. 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.



Aphid

Insect pests

The most common insects that affect bean plants in Rwanda are aphids. Insects like aphids can damage an entire crop. Therefore, check the field regularly for insects that damage your plants. Not all insects, however, cause damage to the bean plant. For example, bees will not harm your crop and some insects such as spiders, lady birds and ants are natural enemies of harmful insects. Ask for advice from an extension agent if you are not sure.

Aphids can be controlled by spraying with *Dimethoate (Dursban)* or *Sumithion.* Use 20 ml (4 teaspoons) per 15-litre knapsack sprayer. With one litre of the insecticide, you can spray one hectare.

If unsure about how to manage pests, seek advice from an extension worker or agrodealer.

Diseases

Anthracnose is a seed borne and seed transmitted fungal disease where dark red to black lesions develop on the whole plant, including the pods. On stems and pods, lesions are sunken. In moist weather the centres of lesions can become covered with pink spores. Seeds from infected pods also become infected. Anthracnose especially occurs in a cool and humid climate. Do not work in the field when plants are wet.

Anthracnose

Angular Leaf Spot is a fungal disease which is usually observed at flowering. Primary leaves have round lesions and are usually larger than the lesions on trifoliolate leaves. Lesions are first grey, and then become dark brown in colour. The spots may increase in size and join together.

Angular leaf spot

Ascochyta blight is a fungal disease. Symptoms include black or brown concentric lesions with a diameter of 1-3 cm on the leaves and pods. Stems can show black nodes.

Bean common mosaic virus is transmitted through ahpids. The virus also survives in seeds. A light green-yellow and dark green mosaic pattern develops on the leaves. Often, the change in colour is accompanied by puckering, blistering, distortion and downward curling and rolling of the leaves. The disease causes stunting of plants and reduced flowering and reduced yields.

Seek advice from an extension worker on the use of recommended insecticides.

Controlling diseases

- Fungal and bacterial diseases survive in seed or in plant residues. The use of clean seed, crop rotation and proper weeding helps to control the disease. Do not use seed from diseased plants because these seeds are also infected.
- Fungal diseases can also survive in the soil. Shallow sowing, deep ploughing, use of raised beds, and rotation can help prevent this disease spreading through infected soil.
- When fungal diseases are common, seed can be treated with fungicides before planting (e.g. *Quintozene*).
- The bean common mosaic virus can be controlled by controlling the aphids which spread the disease and by using clean seed.

Safe use of chemicals

- Use only herbicides, pesticides and fungicides that are recommended to common bean 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 5: Harvesting

1. Start harvesting when the leaves and pods are dry and yellow-brown.
2. Pick the dry pods or uproot whole plants. Do not harvest 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
3. Dry the pods or the plants with pods in the sun on a clean surface like a mat, plastic sheet or tarpaulin, or on a raised platform. Dry for about one day. Do not dry the pods on the soil.
4. Thresh the pods or plants with pods on a clean surface.
5. Dry the threshed grains on a 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.
6. Clean the grains. Winnow to remove chaff, dust and other rubbish. Also remove shrivelled, diseased, broken grains and grains of other varieties.
7. 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 before placing grain.
8. Grain can be treated before storage to control storage pests. For example, coat grain with edible oil or *Actellic Super.*
9. You can also use PICS (Purdue Improved Cowpea Storage) triple bags to store grain under air-tight conditions and keep away insects from the grain. Place grain in the innermost bag and tie this bag tightly, then tie the middle bag, and finally tie the outermost bag. When all the bags are tied, any insects in the grain die from lack of oxygen. It is not necessary to treat seed against storage pests when using PICS bags.
10. Clean the storage room. 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.

If you apply chemicals to grain before storage, do not eat or sell the grain until it is safe for consumption.

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