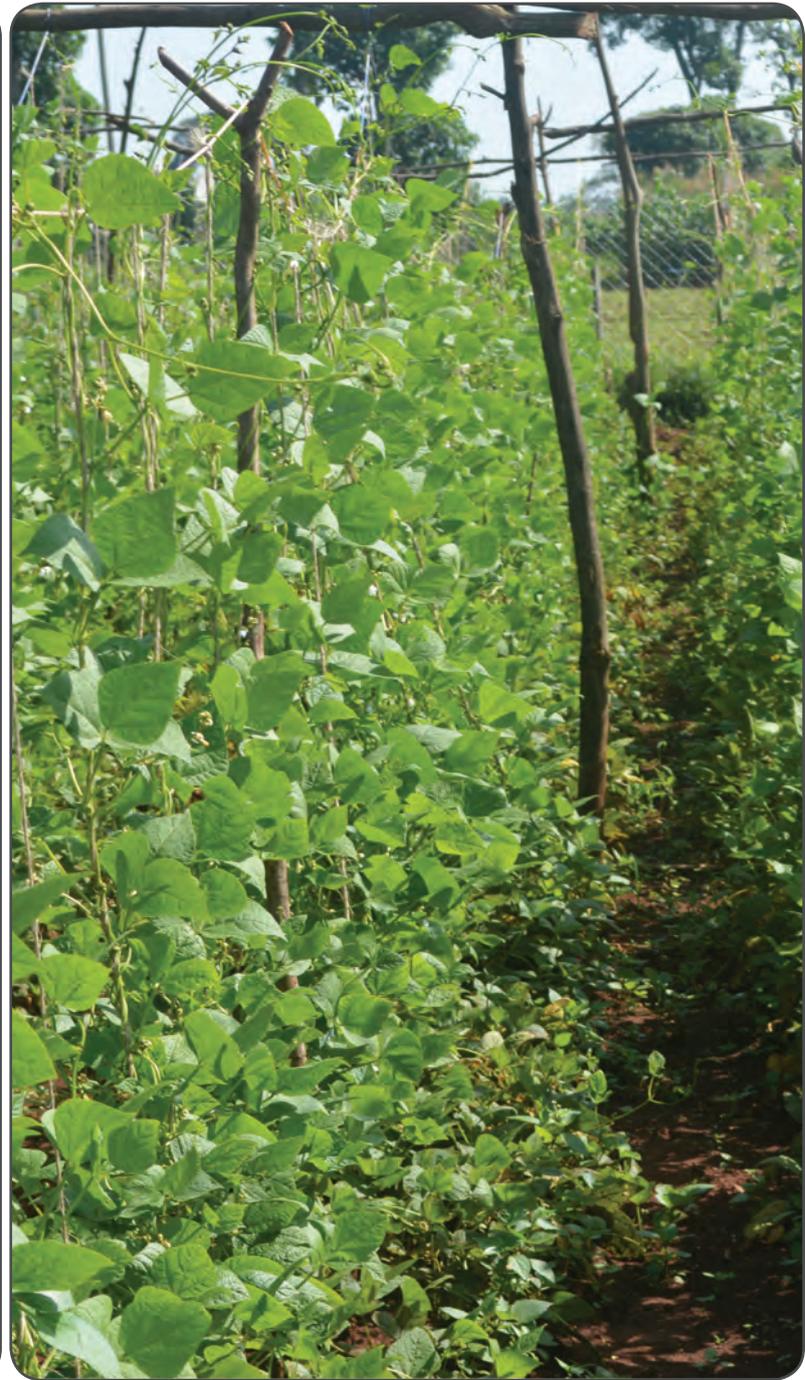


Better beans

through good agricultural practices



For farmers in Northern Tanzania



Common bean is a nutritious grain legume with high protein content. The leaves, green pods, young and mature seeds are edible. The crop residues are good feed for livestock or form a good basis for compost manure. There is a ready market for common bean.

Together with bacteria from the soil, 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 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, haulms 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 2000 kg/ha. Climbing varieties can even yield over 6000 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. You can plant common bean on ridges or on a flat seedbed. 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



Bean comes in bush (non-climbing) and climbing varieties. Bush varieties are suitable for lower and mid altitudes. Climbing varieties are suitable for mid and higher altitudes, where they can give a higher yield and fix more nitrogen than bush bean. Pay attention to the maturity period when you select a variety. 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.

All varieties listed below are resistant to anthracnose, angular leaf spot, common bacterial blight, halo blight and bean common mosaic virus.

Variety	Grain characteristics	Attainable grain yield (t/ha)	Maturity period (days)	Growth habits	Seed rate (kg/acre)	Suitable altitude (masl)
Lyamungo 85	Large red, mottled	2.0-3.4	85	Bush	40-50	1000-1500
Lyamungo 90	Large red, mottled	2.0-3.5	87	Bush	40-50	1000-1500
Selian 94	Pink, mottled	2.0-3.0	89	Bush	40-50	1000-1500
Selian 97	Large, red	2.0-3.4	85	Bush	40-50	1000-1500
JESCA	Light purple, speckled	2.0-3.4	80	Bush	40-50	1000-1500
Selian 05	Small, khaki	1.5-2.5	90-100	Climber	40	>1500 *
Selian 06	Medium, purple	4.0-6.5	100-110	Climber	40	>1500*
Cheupe	Small, white	4.6-6.5	110-120	Climber	40	>1500*

* Can be planted at 1000-1500 masl, but only with reliable water for irrigation.

* masl is Metres above sea level

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 you do not need to apply nitrogen fertilizer like urea or CAN.
- However, common bean cannot fix other nutrients, and therefore you do need to apply other nutrients such as phosphorus at planting.
- Good fertilizer types for common bean that supply phosphorus are DAP or Minjingu Phosphate. Choose Minjingu Phosphate when the pH of the soil is below 5.6. SSP and TSP are also good phosphorus fertilizers, but they are not readily available in Tanzania. NPK (10:20:20) supplies both phosphorus and potassium.

Application

- Apply fertilizer directly in the furrows made for planting. The furrow should be 5-7 cm deep. Place the fertilizer in the furrow and cover with 2 cm of soil. If you don't cover the fertilizer with soil, the fertilizer will burn the seed.
- Use the fertilizer rates given in the table below for mono-cropped bean. Spread the recommended amount of fertilizer equally over the furrows. If you want to do this very precisely, you can use a teaspoon or soda bottle-cap.
- When you applied manure recently, you can reduce the fertilizer rates.

Fertilizer type	Rate (kg/ha)	In the furrow, spread 1	
		Teaspoon	Soda bottle-cap
TSP, DAP	100	Every 1 meter	Every 60 cm
SSP	225	Every 40 cm	Every 30 cm
NPK	200	Every 50 cm	Every 30 cm
Minjingu	250	Every 40 cm	Every 25 cm

Step 4: Planting



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

Planting bush beans in a mono-culture

- Plant in rows which are 50 cm apart. Within a row, plant seeds at 10 cm apart (1 seed per stand) or 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 cereal crops. Bush beans do not grow very well when shaded. To reduce the shading effect, multiple rows of bush bean can be planted after 2 rows of a cereal crop.

Planting climbing beans

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

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 are 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. Available herbicides in Tanzania are *Stomp 500EC*, *Galex 500EC*, *Pursuit plus* or *Fusilade*. Follow the instructions from the manufacturer or seek advice from an extension agent.



Aphid

Insect pests

The most common insects that affect bean plants are aphids, the bean stem maggot, ootheca (a beetle which eats the leaves of bean plants), the bean foliage beetle, pod borers and pod bugs. 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. When insects are seriously damaging your bean crop, they can be controlled by spraying with insecticides.

The insecticides recommended for use in Northern Tanzania are listed below. Follow the recommendations from the manufacturer or seek advice from an extension worker.

<i>Brand or common name</i>	<i>Name of active ingredient</i>	<i>For which pest</i>
Karate GW	Lambdacyhalothrin	Bollworm, leaf miner, beetle, thrips
Sapa Dimethoate 40 ec	Dimethoate	Various insects
Decis EC	Deltamethrin	Caterpillar, thrips, aphids, leaf miners
Thionex	Endosulfan	Aphids, caterpillars, beetles
Aster Extrim 20SL	Acetamiprid + Cypermethrin	Aphids, whiteflies, leaf miners, thrips
Dursban 4E	Chlorpyrifos 480g/l	Chewing and sucking insect pests on bean

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.



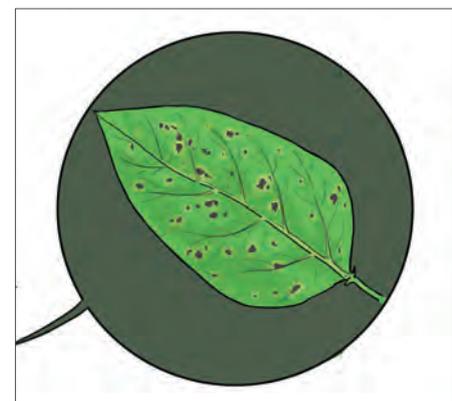
Anthracnose

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. Branches and pods have reddish-brown angular spots. Angular leaf spot is seed borne and seed transmitted.



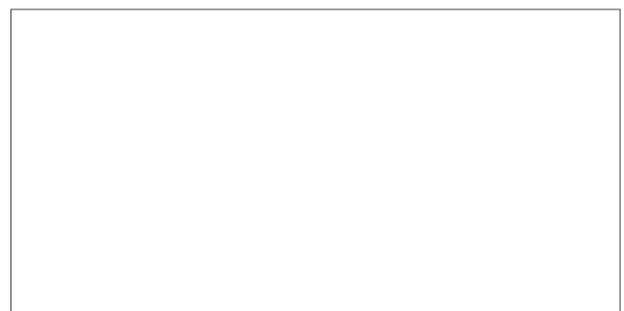
Angular leaf spot

Leaf rust is an airborne, fungal disease. Yellow to brown pustules with spores occur on all above-ground parts of the plant, but mostly on leaves. Initially, pustules are very small and slightly raised. Later, the pustules become reddish brown distinct circles surrounded by a yellow halo. Humid areas are more prone to infection and spreading of the disease. Besides the control measures mentioned below, avoid movement in wet fields to prevent leaf rust from spreading.



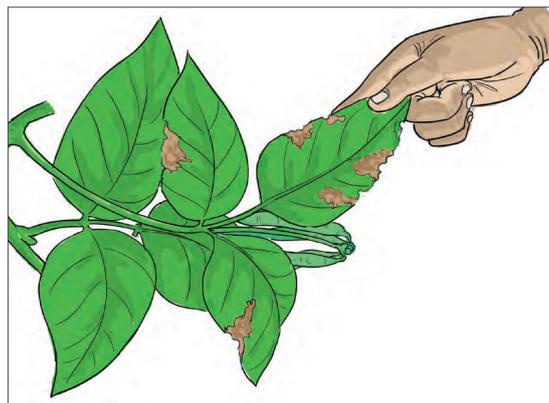
Leaf rust

White mold is a fungal disease. Wet, soft spots develop on infected leaves, branches, stems and pods. Later, the spots enlarge and become watery and rotten, covered by white mold. Infected plants wilt and later die. White mold is favoured by wet and cool periods. The disease originates from infected seed, infected crop residues that are left in the field or farm implements when moving through infected plants.



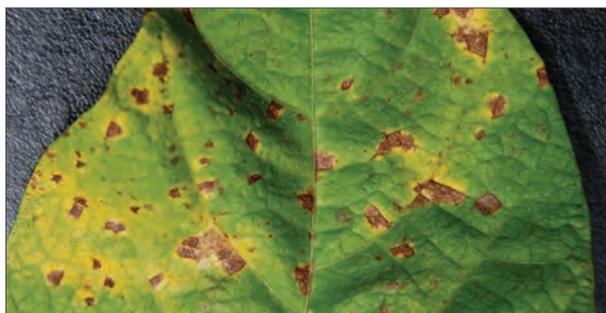
White mold

Common bacterial blight is a bacterial disease. Water-soaked spots appear on the lower surface of the leaves. The pods can show small, water-soaked, greasy looking spots. Lesions can also develop on the stem. Infected seed can have yellow lesions and become wrinkled, but sometimes does not show any symptoms.



Common bacterial blight

Halo blight is a bacterial disease. First, it gives small water-soaked spots on the leaf surface. Within a few days, the spots turn brown and are surrounded by a yellow halo. Small water-soaked spots can also develop on the pods. Later, these lesions become dark sunken spots. Lesions can also develop on pods, where they turn into dark sunken spots.



Halo blight

Bean common mosaic virus is transmitted by aphids. 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.



Common mosaic virus

General measures to control diseases

- Using resistant varieties often is the most cost-effective management option.
- Fungal and bacterial diseases survive in seed or in plant residues. The use of clean seed, crop rotation, proper weeding and post-harvest tillage 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*).

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 agrodealer 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 6: Harvesting

1. Start harvesting when the leaves and pods are dry and yellow-brown.
2. Pick the dry pods or uproot whole plants.
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 in the sun until the grains have a moisture content of 10-12%. 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 the container/bag before placing grain.
8. Grain can be treated before storage to control storage pests. For example, coat grain with edible oil, ash 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.
11. Finally, do not throw away or burn the residues. Bean residues are rich in nitrogen and therefore excellent as livestock feed, or a good basis for compost. You can also incorporate the residues in the field directly.

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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For more information, contact your extension officer or:
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Working in partnership to create down-to-earth messages on integrated soil fertility management