

Better beans

through good agricultural practices



For farmers in Ethiopia



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.

Common bean forms root nodules which contain bacteria called rhizobia. The rhizobia can fix nitrogen from the air into a form that common bean can use for growth. This is called biological nitrogen fixation. Some of the nitrogen is left behind through falling leaves and roots and improves soil fertility. Therefore, common bean is a good crop to grow as an intercrop or in rotation with other crops. These other crops then also benefit from the nitrogen fixed by common bean.

The rhizobia that common bean needs for nitrogen fixation do not always occur in the soil naturally. To ensure that common bean finds the right rhizobia, you can inoculate the seeds with these rhizobia. This ensures nitrogen fixation and gives a good yield with very little cost. With good practices and the right varieties, grain yields can be over 2000 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.
- Common beans can be planted on a flat bed or on ridges.

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.

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.

	Variety	Grain colour, size	Grain yield (kg/ha)	Maturity period (days)	Ecology/Region (where grown)
1	Anger	Dark Red, medium	3000	85-96	Bako & similar areas of western Oromiya
2	AR04GY	White, small	2200	90-95	Central rift valley & similar areas
3	Awash Melka	White, small	3200	95-100	All bean growing areas of Ethiopia
4	Awash-1	White, small	2400	50-90	Central rift valley & similar areas
5	Batagonia	Creamy, medium	1800	140-160	Sidama, Wolaita & similar areas of Southern Ethiopia
6	Bobbe Red	Red, medium	2500	82-102	Central rift valley & similar areas
7	Chercher	Red, small	2800	93-103	All bean growing areas of Eastern Hararghe
8	Chore	White, small	2300	87-109	All bean growing areas of Ethiopia
9	Cranscope	Red speckled, small	2700	90-98	Central rift valley & similar areas
10	Dimtu	Red, small	2100	91-93	All bean growing areas of Ethiopia
11	Gabisa	Tan, small	3500	87-96	Bako & similar areas of western Oromiya
12	Haramaya	Cream, medium	3200	90-114	All bean growing areas of eastern Hararghe
13	Ibado	Red, large	2900	90-120	Sidama, Wolaita & similar areas of Southern Ethiopia
14	Melka Dimma	Red, small	2300	79-102	Central rift valley & similar areas
15	Mexican 142	White, small	2000	95-110	All bean growing areas of Ethiopia
16	Montcalm	Dark red, small	2200	75-82	Central rift valley & similar areas
17	Nasir	Red, small	2000	86-88	All bean growing areas of Ethiopia
18	Nazareth-2	White, small	2200	90-95	Central rift valley & similar areas
19	Tabor	Brown, small	2000	80-90	Sidama & similar areas of Southern Ethiopia
20	Tibe	Red, medium	2800	95-103	Bako & similar areas of western Oromiya

* All the above varieties have a seed rate is 90-100kg/hectare and have bushy growth patterns, except Tibe (no. 20) which is climbing

Step 3: Inoculation

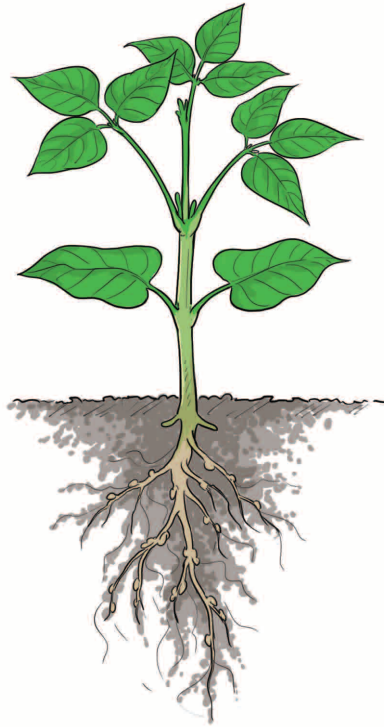


To be able to form nodules and fix nitrogen, bean seeds need to be inoculated with rhizobia. Each legume crop needs a different type of rhizobium bacteria, so always check you have the right inoculant for beans. Directions for using inoculants can be found on the package.

How to inoculate common bean seeds

1. Measure 15 kg of legume seed, this will be approximately 15 litres. Place in any container that will accommodate the seeds.
2. Measure one soda bottle (300 ml) of clean lukewarm water.
3. Pour the water into a larger bottle (500 ml plastic bottle) so that it is easier to mix the sugar.
4. Add 2 tablespoons of sugar to the water.
5. Mix thoroughly to get an even solution of sugar. This solution is called the sticker.
6. Add the sticker to the seed.
7. Mix the seed with sticker solution until all the seeds are evenly coated with the sticker.
8. Add the rhizobium inoculant onto the seeds and sticker. The inoculant is the 125 g black powder contained in the pack.
9. Mix the seeds and the inoculant thoroughly but gently until all seeds are uniformly covered with the inoculant.
10. 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 4 teaspoons or soda bottle-tops (20 ml) of the sticker solution, and 2 heaped teaspoons or soda bottle-tops (10 g) of inoculant for every 1 kg of seed.

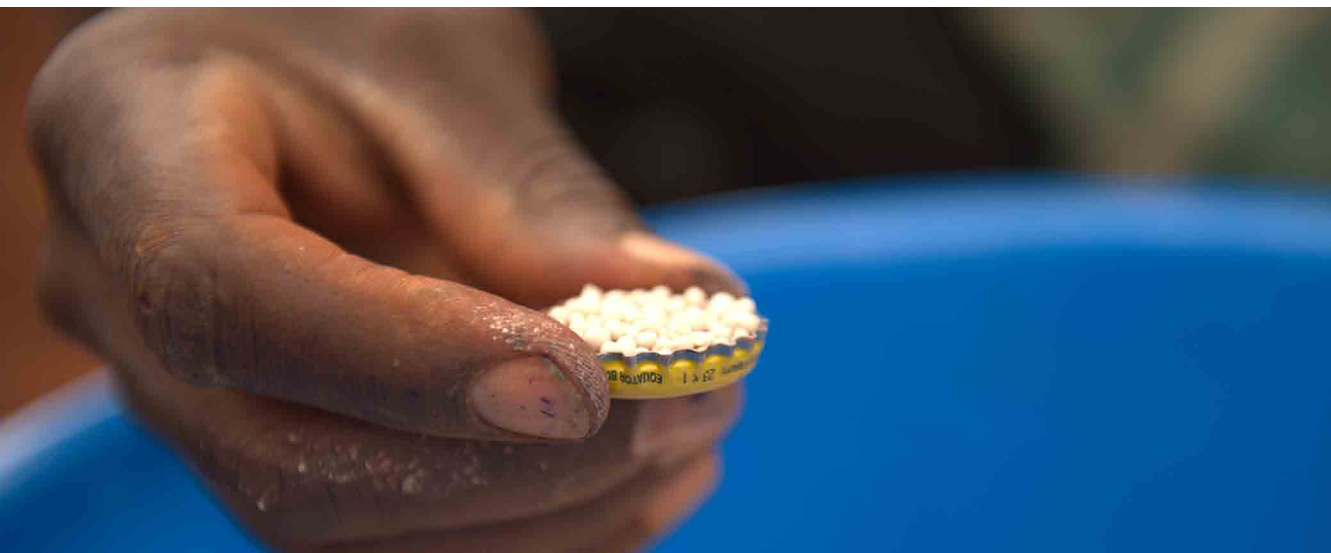


Facts about inoculants:

- The roots of legumes and rhizobium bacteria work together to biologically fix nitrogen. Inoculants contain the bacteria that help the soybean to make nitrogen.
- Inoculants are much cheaper than nitrogen fertilizer.
- Each legume crop needs a different type of rhizobium bacteria, so always check you have the right inoculant for the crop you want to sow.
- Inoculants lose their effectiveness when stored in an open package. Therefore do not open the package until you are ready to use it.
- Inoculants also lose their effectiveness when exposed to heat or direct sunlight. Therefore always store the package in a cool place in the house.
- Directions for using inoculants can be found on the package.

How to inoculate depends on the type of inoculant you use. Always check the instructions on the package or ask an agro-dealer or extension worker.

Step 4: Fertilizer application



Important points

- Common bean can fix its own nitrogen, and therefore does not need to be fertilized with N-fertilizers like urea.
- 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 DAP or NPS.

Application

- Place fertilizer directly in the furrows made for planting and cover with 2-3 cm soil. If you don't cover the fertilizer with soil before placing the seed, the fertilizer will burn the seed.
- You can also 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 in the furrows, according to the distances in the table.
- When manure has been applied recently, rates can be reduced.

Fertilizer type	Rate (kg/ha)	Row spacing: 40 cm In the furrow, spread 1	
		Teaspoon	Soda bottle-cap
DAP	100	Every 4 feet	Every 2½ feet
NPS	100	Every 4 feet	Every 2½ feet

Step 5: Planting



Planting bush beans in a mono-culture

- Plant when the soil is moist.
- Plant in rows which are 40 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 in rows has many advantages - you use the correct plant density, weeding is easier and harvesting takes less time.

Planting bush beans in a mixed culture

Bush beans can be intercropped with maize, sorghum, coffee or *enset*. Especially shade tolerant and early maturing varieties of bush beans are suitable for intercropping. To reduce the shading effect, multiple rows of bush bean can be planted after two rows of a cereal crop.

Planting climbing beans

Plant climbing bean varieties in rows which are 50 cm apart. Within a row, plant 2 seeds per stand at 25 cm apart.

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 strong stakes and put them deeply and firmly in the ground. Woody stakes from tree species such as *Eucalyptus* or *Grevillea* or from forage shrubs such as *Cedrella*, *Leucaena*, *Alnus* or *Calliandra* are suitable. You can also use bamboo stakes. One stake can support 1-4 plants.



Tripod:

Tie 2, 3 or 4 long 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.



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 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.

To apply herbicides, follow the instructions from the manufacturer or seek advice from an extension agent.

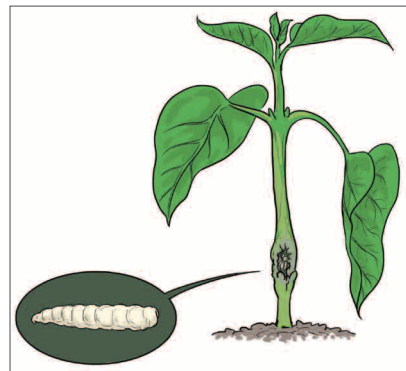
Brand or common name	Name of active ingredient	Use rate (L/ha)	Time of application	For which type of weeds
Fusilade	Fluzifop-p-butyl	0.25 kg a.i. ha-1	Pre-emergence	grass weeds
Lasso	Alachlor 480 EC	4 lt/ha	Pre-emergence	broad leaf weeds
Dual Gold	S-metolachlor 960 EC	1 lt/ha	Pre-emergence	broad leaf weeds

Pests and diseases

Insect pests

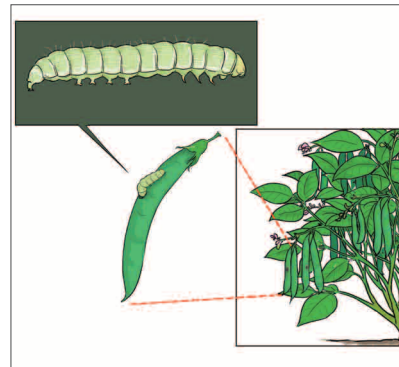
Insects can damage an entire crop. Therefore, check the field regularly for insects that damage your plants. Not all insects, however, cause damage to the bean plant. For example, bees will not harm your crop and some insects such as spiders, lady birds and ants are natural enemies of harmful insects.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

Bean stem maggot: Larvae feed on the outer tissue of the stem at ground level. This causes longitudinal cracks, yellowing of the leaves and weak and stunted plants. Bean seedlings can die. Bean stem maggot can be controlled with early planting, crop rotation, earthing up during weeding, using tolerant varieties or dressing seed with systemic insecticides.



Bean stem maggot

African bollworm is a caterpillar that bores pods, making clean round holes in the pods. Regularly monitor the crop, and handpick and destroy infested pods and the bollworms. When fields are large or when there is a heavy infestation, you can spray with *Cypermethrin*.



African bollworm

Bean bruchids are small beetles causing storage pests. Female beetles lay eggs between the bean grains. The larvae develop in the grain, and emerge as adult beetles through a hole in the grain, thereby damaging or destroying the grain. Heavy infestation can result in a large number of holed seeds, with adults moving across the stored beans. Proper drying of the seeds, good storage hygiene, coating seeds with vegetable oil such as cotton seed, groundnut oil or coconut oil, or storing grains in PICS bags help to control bruchids. Alternatively, you can use the insecticide *Primiphosmethyl* to control bruchids.



Bean bruchids

(Source: www7.inra.fr/hyppz/IMAGES/7030490.jpg)

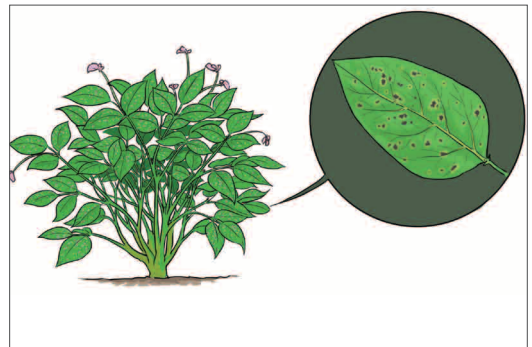
Diseases

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

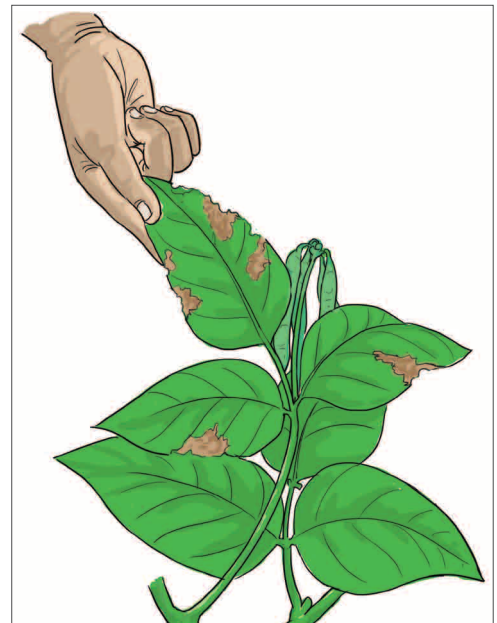
Bean rust is an airborne, fungal disease. Yellow to brown pustules with spores occur on all aboveground parts of the plant, but mostly on leaves. Initially, pustules are very small and slightly raised. Later, the pustules become reddish brown distinct circles surrounded by a yellow halo. Humid areas 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.



Bean rust

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.

Bean common mosaic virus is a virus that is transmitted through aphids and can survive 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 leaf. The disease causes stunting of plants and reduced flowering and reduced yields.



Common bacterial blight

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 (for example *Actellic*, *Apron Star* or *Thiram*).
- Viruses are transmitted by aphids and survive in seeds. Control viral diseases by using healthy seeds and controlling aphids. Always destroy infected plants.



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 7: Harvesting



1. Start harvesting when the leaves and pods are dry and yellow-brown.
2. Harvest by cutting the plant at ground level using a sickle. Leave the roots on farm to improve soil fertility.
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 you reuse 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 vegetable oil, or insecticides such as *Primiphosmethyl*.
9. 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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Working in partnership to create down-to-earth messages on integrated soil fertility management