



Beans Production Guide



Researching Soils, Crops and
Water in Zambia



Table of Contents

Foreword	ii
Acknowledgement	iii
1. Introduction	1
2. Climatic and Soil Requirements	1
3. Recommended Varieties	2
4. Recommended Management Practices	4
5. Crop Protection	5
6. Harvesting	12
7. Post-Harvest Handling and Processing	13

Foreword



Zambia has the potential to produce sufficient food for its citizens and for export.

In order to ensure that good agricultural practices are employed by farmers, crop specific production information should be made available to them.

Due to technological advances and the changing environmental and socio-economic conditions it became necessary to revise the first edition of the Bean Production Guide, which was published in 2002. This revised edition of the Bean Production Guide is meant to provide farmers and other stakeholders crop specific information in order to promote good agricultural practices and enhance productivity and production.

The information contained in this booklet has been generated over a number of years of research and is appropriate for all categories of farmers. The information is meant for extension officers, agricultural training institutions and other development partners.

It is my sincere hope that this information will go a long way in stimulating Beans production in Zambia.

The Zambia Agriculture Research Institute (ZARI) is committed to alleviating poverty and enhancing food security by contributing to increased and sustainable food production.

A stylized handwritten signature in blue ink, consisting of a large loop followed by a series of smaller, connected strokes.

Director,
Zambia Agriculture Research Institute,
Ministry of Agriculture,

2018

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1.0 Introduction

Beans (*Phaseolus vulgaris*) belong to the family Leguminosae. They are mostly grown in Region II and III. Field beans commonly referred to as common beans include bush (dwarf) and climbing types. In Zambia the crop is usually harvested as a dry bean and consumed as boiled dry grain, green pods and leaves. It supplies the bulk of the protein in the diet of many low income families in the country that have limited access to sources of animal protein.

Most of the bean crop in Zambia is produced in the higher altitude, cooler and high rainfall zone of Region III-(Northern, North-Western and Luapula provinces) followed by the medium rainfall warm zone of Region II-(Central and Eastern provinces) mostly by small-scale subsistence farmers. The lower, hotter and drier parts of Region I-(Western and Southern provinces) are not suitable for bean production.

The major constraints to bean production and productivity in Zambia are lack of seed of improved varieties, inadequate agronomic practices by small scale farmers and damage by diseases and insect pests.

2.0 Climatic and Soil Requirements

Inadequate rainfall also affects bean production. Soil acidity, sub-optimal levels of phosphorus and poor micro-nutrients status are problems in the high rainfall zone. The low rainfall zone is beset by soil moisture deficits, leading to low yields and even crop failure.

2.1 Climate

Higher altitudes, cooler and high rainfall areas, which are found in Region II and III are more suitable for bean production. The altitude in the major growing areas ranges from 1,200 to 1,700 metres above sea level, with an annual average rainfall of above 800 mm. Higher altitudes, cooler and high rainfall areas, which are found in Region II and III are more suitable for bean production. The altitude in the major growing areas ranges from

1,200 to 1,700 metres above sea level, with an annual average rainfall of above 800 mm.

For optimum growth the crop requires an average temperature of 16-24°C. Growth stops at temperatures below 10°C and the plant is killed by frost. An evenly distributed rainfall is required throughout the growing period and during flowering the relative humidity should be preferably above 50%.

2.2 Soil Types

The crop can be grown successfully on most soil types, from light sands to heavy clays, but a friable, deep, well-drained loamy soil with a pH of around 5.25 is preferred.

Highly compacted clay soils result in poor germination, produce, stunted plants with restricted root development and having fewer nodules. Compacted soils can also lead to water logging resulting in poor plant stand and growth. Acidic soils inhibit development of nodules forming bacteria, which result in the reduction of atmospheric nitrogen fixation.

3.0 Recommended Varieties

There are currently eleven recommended bean varieties in Zambia. These varieties with the main agronomic and other characteristics are given in the table below.

S/N	Bean Variety	Days to Maturity	Potential Yield (Kg/ha)	Other characteristics
1	Lwangenii	90-95	2000 -2500	Colour – white Seed size – small Good for Canning
2	Kabale	80-85	1500 -2000	Colour – red Seed size - medium
3	Kapisha	75-80	1000 -1500	Colour – Khaki Seed size - medium
4	Kabulangeti	80 – 85	1000 – 1500	Colour – purple Seed size - medium Highly marketable
5	Kalungu	75-80	1500 -2000	Colour – white Seed size - medium
6	Lyambai	85-90	1500 -2000	Colour – red mottled Seed size - medium
7	Lukupa	75-80	1500 – 2000	Colour – cream mottled Seed size – medium
8	Chambeshi	85-90	1500 – 2000	Colour – Khaki Seed size - Large
9	Kalambo	80-85	1500 -2000	Colour–Cream mottled Size- medium Sugar bean
10	Mbereshi	80-85	1500 -2000	Colour-Red mottled Size-Medium High Iron and Zinc
11	Sadzu	80-85	2000 -2500	Colour-Red Mottled Size- Medium Climber
12	Lungwe-bunga	85-90	1500 -2000	Bush type, seed colour -cream mottled, resistant to Angular leaf spot, Antracnose, Rust and Bean Common bean mosaic virus
13	Lunga	85-90	1500 -2000	Large seed size; seed colour -purple; resistant to Antracnose, Rust, Angular leaf spot and Bean common mosaic virus

4.0 Recommended Management Practices

4.1 Land Preparation

Bean can be planted conventionally where land is ploughed and disced to a fine tilth seedbed or under conservation agriculture using minimum tillage. Beans may also be planted on ridges, especially in high rainfall areas (Region III) or on the flat in medium rainfall areas (Region II).

4.2 Planting

Planting Time

Beans may be planted as a mono crop or inter-cropped. When inter-cropped with other crops, beans, especially local varieties could be planted with the first effective rains. Apart from a few indeterminate climbing types beans require a growing period of about 75-90 days. If grown as a sole crop beans, especially improved varieties are better planted by the first week of January.

In general the planting date should be adjusted to allow the harvest to take place after the main rains have passed. Hence late December or early January planting tend to be the most appropriate. Dry season planting can be done in late July to early August in dambos or under irrigation.

Planting Method

Seed rate will depend on the seed size, but the range is between 50-60 kg/ha. In general seed rates are lower for small seeded (Lwangenzi – seed rate: 50Kg /ha) and higher for medium and large seeded types (Kabulangeti-seed rate: 60Kg/ha).



Sowing depth ranges from 3-6 cm depending on whether the soils are heavy or light and moisture availability at the time of

planting. On heavier soils the planting depth can be reduced to 3-4cm while on light soils depth is increased. As moisture is very crucial for seed germination, planted seed should be placed in a moist layer of the soil.

Recommended spacing is 50 to 75cm between ridges and 8 to 10cm between stations. For dwarf types the spacing is 60 x 10 cm, while for climbers it is 75 x 15 cm.

4.3 Weed Control

The field should be weeded twice, with first weeding done in the first two weeks after germination and the second 3-4 weeks later. Hand pulling of weeds is recommended during flowering stages so as to avoid dropping of flower buds.

Planting should be in a weed free field as beans are not good competitors with weeds especially in early stages. Weed control also reduces competition for nutrients, water and light. Closer spacing reduces weed competition especially when the crop is still developing. Hand weeding is preferable but herbicides can also be used. Care should be taken when using herbicides.

4.4 Fertiliser Use

.Residual fertiliser is greatly beneficial to bean seed production. However a basal dressing of 'D' compound at 150-200 kg/ha, followed by a top dressing of Ammonium Nitrate or Urea at 100 kg/ha at early flowering stage is recommended especially in Region III where there is a lot of nutrient leaching.

4.5 Crop Rotation Practices

Crop rotation is recommended in the production of beans in order to minimize the buildup of soil borne diseases to which beans, like many other crops, is prone to. This requires that a new bean crop is grown where there has been no bean crop in previous two seasons and no other legume for at least a season.

5.0 Crop Protection

Beans is susceptible to a number of insect pests and diseases

that reduce the yield and quality of the produce. There are measures that can be taken to minimize the damage.

5.1 Major Diseases and Control Measures

5.1.1 Anthracnose (*Colletotrichum lindemuthianum*)

The disease is important in most bean growing areas. The yield losses of 95 % have been recorded. The disease is seed-borne and also survives on infected crop debris. The disease is common in small holder farmer's fields because they tend to re-use seeds from previous crop which is mostly infected by anthracnose.



Anthracnose on leaves

The first symptoms are brown, elongated lesions that appear along the veins of the lower leaf surfaces and then spread to the upper side, to the stems, petioles, pods and seeds. In severe cases such lesions coalesce, causing death of whole or part of the plant.

Control Measures

Control measures include cultural practices such as use of clean seed, crop rotation and burying of infected crop debris. Spraying crop with fungicides like Benlate (500g/ha) + Dithane M45 (1.5kg/ha) is effective in minimising yield losses due to diseases.

5.1.2 Angular leaf spot (*Phaeoisariopsis griseola*)

The disease is more widespread in Zambia and can cause significant losses in yield. The pathogen is seed-borne and also survives in the infected crop debris. It is usually severe in Northern part of the country in the rainfed crop and is becoming serious in the off-season plantings in dambo areas of the Eastern and parts of Muchinga Provinces.

The symptoms appear on leaves as small greyish-brown spots which are angular because they are restricted by the leaf veins.

In severe cases, the leaves turn yellow and drop prematurely. Diseased pods have rounded lesions which are reddish-brown to blackish-brown. Epidemics may occur in damp micro-environments created by high plant densities or by crop association practices.



Angular leaf spot
on leaves

Control Measures

Crop rotation for at least two seasons, planting clean seed and burying infected crop debris are useful cultural practices to reduce disease incidence.

5.1.3 *Ascochyta* blight (*Phomaexigua* var. *diversispora*)

The disease is prevalent in Northern Zambia and its severity is low to moderate in farmers' crops. Although it causes extensive damage to foliage, its onset is usually late in the season, therefore, yield losses due to the disease are favoured by high humidity and low moderate temperatures. Severe infection leads to extensive blighting and defoliation. Circular lesions may also form on peduncles, petioles, stems and pods, of the affected plants. Pod lesions result in significant damage to the pods and seed.

Control Measures

The disease incidence may be reduced by crop rotation, planting disease free seed and burying infected crop debris. Application of appropriate common foliar fungicides may also be effective.

5.1.4 Scab (*Elsinoe phaseoli*)

The disease is usually found in the high rainfall, higher altitude regions of Zambia. The pathogen perpetuate from season to season on infected crop debris and seeds.



Ascochyta blight
on leaves

Symptoms appear as circular, grey

coloured spots, particularly along the veins. The centres of lesions on leaves often fall out, leaving “shot-hole” lesions. Scab infections of stem, branches, peduncles and pods lead to the development of silvery grey, circular to oval lesions which may later coalesce leading to distortion, particularly of pods.

Control Measures

Usual cultural practices such as crop rotation, planting clean seed and burying infected crop debris are useful in reducing scab disease. Fungicide sprays such as Benlate/Dithane M45 will also help to reduce scab severity.

5.1.5 Bean Rust (*Uromyces appendiculatus*)

It is one of the most prevalent diseases of beans in Zambia affecting both rain fed and off season crops. Although rust is widespread, the severity is usually low to moderate. Infection and subsequent development of the pathogen are favoured by temperatures of 18°C - 23°C and high humidity.



Rust on leaves

The symptoms appear as reddish brown spots on the upper and lower leaf surfaces, stems and pods. Severely infected leaves turn yellow, wilt and then leads to premature defoliation.

Control Measures

Control measures include crop rotation and burning the infected crop debris so as to reduce initial infection. Application of recommended fungicides may also reduce disease incidence and severity.

5.1.6 Bean Common Mosaic Virus (BCMV)

This is the most important disease in the warm-medium rainfall areas of Zambia as the weather is also favourable for build-up of aphid populations which are responsible for spreading of BCMV. Primarily BCMV is transmitted through seeds produced on

infected plants.

BCMV may induce a variety of symptoms in infected plants, including mosaic, green vein-banding, leaf curling, secondary leaf malformation and plant stunting.

Yield losses of up to 100% can occur in susceptible varieties.



Infected plant

Control Measures

Disease incidence can be reduced by planting virus-free seeds, use of resistant varieties and early planting to avoid peak aphid-vector activity. Control of aphids will reduce incidences of the disease.

5.1.7 Common bacterial blight (*Xanthomonas campestris* pv. *phaseoli*)

The disease is prevalent where the temperatures are moderate to high during the rainy season. Initial infection appear as water-soaked lesions on leaves. The lesions enlarge and merge producing irregular areas of necrosis. In addition, stems and pods are also infected and pod infection can lead to seed discolouration.



Common bacterial blight on leaves

Control Measures

Cultural practices such as clean seed, crop rotation and burning of infected crop debris are useful in minimising disease incidence and severity.

5.2 Major Insect Pests and Control Measures

A number of insect pests are known to attack bean crops but the two most important insects are the bean stem maggot (bean fly) and the leaf beetle (*Ootheca* beetle). The other insects which

occasionally become serious include aphids, whiteflies, leafhoppers, flower thrips, flower beetles, pod sucking bugs and bruchids.

5.2.1 Bean stem maggot (*Ophiomyia* spp.)

This pest occurs in all bean growing areas usually in moderate to high infestation. It normally causes about 10% to 50% yield loss, while in severe cases; more than 80% loss has been observed. The adult is a small sized fly with metallic body, often found moving about on the upper surface of the leaves. Its cream coloured larvae tunnel into the stem, resulting in mines or stem cracks which are prominent at the base. Due to this injury the plants start wilting at the primary leaves and in severe infestations, the plant dies.



Bean stem maggot damage

Control Measures

Preventive method of control is to plant seeds dressed with endosulfan. A spoonful (5g) of endosulfan 50% WP is mixed with one kg of seed, a little water is sprinkled to make a wet dressing and then the seed is left to dry overnight and planted within a week. Other chemicals such as the liquid formulations of chlorpyrifos (Dursban 40% EC) can also be used, at about one tablespoon per kg of seed. Care should, however, be taken to avoid poisoning hazards while handling the treated seeds. Gaucho powder is another systemic pesticide, which has proven to be very effective in controlling root, foliar and sucking pests, including bean stem maggot. It is applied as a seed dressing, before planting. For exact application rate, follow manufacturer's recommendations, which are usually presented with the package. Use of Furadan/Phorate/Umet/Planet granules at 4-5kg per hectare is effective against bean stem maggot.

5.2.2 Leaf beetle (*Ootheca spp.*)

This pest is widespread, but more important in the high rainfall areas of region III. The adult is a small (about 5mm long) black coloured beetle, with reddish or blackish head depending on the species. It is active throughout the rain season and commences defoliating even from the primary leaf stage onwards. When the damage is early and severe, the young plants are rendered bare resulting in stunting, and failure to produce flowers or pods.

Control Measures

Control of this pest on bean depends on how severe is the foliar damage, since mild attacks are compensated by the plant. Use of insecticides is recommended if over one fourth of the foliage is damaged. Spraying with pyrethroids (Fastac 10% EC at 0.5ml per litre) is recommended but the leaves should not be consumed for at least up to two weeks after spraying.

5.2.3 Aphid (*Aphis fabae*)

Aphids are more prevalent in medium rainfall region characterised by warm weather. These are small-sized dark green coloured insects, mostly found in clusters (colonies) on the stem or petiole, occasionally also infecting the flowers and pods. By sucking the plant sap, they affect the vigour of the plant, thereby reducing the yield.

Control Measures

Early planting, use of recommended seed rate (plant density), and intercropping with maize can offer substantial reduction in aphid incidence. If chemical control is necessary, sprays of Cypermethrin or monocrotophos (Nuvacron 40% EC) at manufacturers' recommended rate and instructions may be applied.

5.2.4 Pod sucking bugs (*Clavigralla spp.*)

These are common in bean growing areas, but become severe occasionally. They are mainly dark brown and elongated and both nymphs and adults suck the sap of the seed inside the

developing pods. The affected pods tend to shrivel while the seeds inside are either malformed or shrunken. The inner side of the pod wall shows distinct brown pin head spots which are the points of feeding by the bugs.

Control Measures

The insecticides suggested against aphids can be used for control of bugs. Dusting of carbarly (Sevin 10% at 25 kg/ha) may also be useful.

5.2.5 Bruchids

These are occasionally found in the fields infesting mature pods, but are mainly a problem in storage. The adults are small sized dark brown beetles and infected seeds show tiny white elongate eggs on the surface with circular holes where the adult has emerged out.

Control Measures

Prevention of bruchids damage in storage is possible by treating the seeds with storage chemicals such as Actellic, Shumba or Chirindamatura. Mixing the seed with vegetable oil (5mls per kg seed) may also be effective. The storage space or structure should be disinfected before storing the seeds.

6.0 Harvesting

Harvesting is done by cutting or pulling of the plant whose seed has a moisture content of between 18% -20% in order to prevent losses caused by shattering and disease infections. It is not advisable to harvest pods in contact with the soil. Timely and quick harvesting of the seed reduces the grain deterioration in the field. At the small scale farmer level where resources and amount of seed is limited, hand harvesting is most recommended to minimise losses.

7.0 Post Harvest Handling and Processing

7.1 Threshing

Threshing of beans can be done manually by hand or mechanically. Harvested plants are filled into sacks, beaten gently and then winnowed to get clean seed. Before threshing, the seed should be dried to a moisture level of 14% - 15%.

7.2 Storage

Seed should be dried to below 13% moisture content before storage. A good way to determine the moisture of threshed seed is by using the salt test.

To do this, you need a clean dry jar with a lid, dry salt and a sample of beans. Take a sample of beans and treat each sample separately applying the following steps:

- a) Ensure that the jar you are using is clean and completely dry.
- b) Put the salt in the jar (enough to fill up to a quarter of the jar) and add a sample of seed (enough to fill the half of the jar) and close the jar with a lid.
- c) Shake the jar well and allow the seed to settle for about 10 minutes.

If damp salt is stuck on the sides of the jar, the seed is too moist. This means the moisture content is above 13-15%, which is above the moisture content required for seed storage.

If the jar is still dry and no salt is stuck on the sides, the seed is dry.

Shelled beans should be stored in cool dry place. Treatment with insecticides such as Actellic powder and Shumba dusts are recommended. Traditionally ash can also be used for dusting stored seed. Storage structures should also be water proof and prevent rodents and pests from attacking the seed.

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