

2019

Soya Bean Growers Guide



Soya beans

— *Production guidelines* —

2019

Zambia Agribusiness Society

Soya Bean Growers Guide

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Introduction

[Soya bean](#) (*Glycine max*) belongs to [leguminosae](#) (legume) family. It contains 18 to 22% oil and is highly desirable in the diet and have 40 to 42 percent of good quality protein and 34% carbohydrate. (Tab.1) It is an economically important oilseed crop because of its versatile use.

Table 1: Breakdown of Nutrients in Soya Bean

Nutrients	Protein	Oil	Insoluble Carbohydrates	Soluble Carbohydrates	Mineral	Fibre
% content	40%	20%	15%	11%	5%	2%

Source: Ministry of Agriculture (2017)

Origin

Soya beans are indigenous to Manchuria, China. The crop is considered one of the five oldest cultivated crops and was utilised by the Chinese as a source of food before 2500 BC. However, it was only discovered by the western world as a source of oil and protein in the 19th century. In the past 30 years, world production of soya beans increased to more than 100 million metric tonnes. Of this, 51% is produced in the USA, 20% in Brazil, 10% in Argentina and 10% in China. Soya bean was first introduced in Zambia in the 1930s, but remained a minor crop grown mostly by the commercial farmers. The crop is now grown by both small and large scale farmers.



Figure 1. Soya bean

Botany

Growth cycle. It is an herbaceous annual legume crop and can grow up to about 30 to 150cm in height.

Stem. The number of stems varies per cultivator and planting density and the stems are hairy which also helps as a defence mechanism against pests. The number of stems may range from 1 to 3 per plant.

Leaves. The leaves are hairy and trifoliate in arrangement. The colour ranges from light green to dark green and are ovate to lanceolate in shape.

Inflorescence. Consists of small flowers varying in colour from white to deep purple and is self-pollinating.

Fruits. Pods are hairy and are born in clusters on short stalks in groups of 3 to 15 and the colour of the pods may range from pale yellow to grey in colour. The pods are slightly curved and somewhat compressed and may contain from 1 to 5 seeds with 2 to 3 being common. The dimension of the pods is usually 3 to 7cm long and 1 to 2cm in diameter.



Figure 2. Soya bean fruits

Seeds. These are slightly spherical and the testa (seed coat) colour ranges from straw yellow, green to brown.



Figure 3. Soya bean seeds

Benefits of Soya Production

- Soya beans offer a variety of potential benefits to the production systems, diets, and incomes of smallholder producers. In addition to being a potentially profitable cash crop, the high protein content (about 40%) in soya means, it could also contribute to improved nutritional status of rural households (Dixit et al. 2011). Though soya beans are not usually boiled and eaten like other legumes such as beans, cowpeas, or groundnuts, the soya flour is often mixed with other ingredients to form a nutritious rich protein blend that can be prepared into breakfast porridge. Given high levels of under nutrition in Zambia (USAID 2011), it is believed that soya porridge can improve the health of the malnourished children.
- Soya production also has potential agronomic benefit of rejuvenating soils. Soya bean canopies protect the soil from recurrent erosion, fix atmospheric nitrogen into the soil and decaying root residues improve soil fertility. Soil improvement leads to higher levels of sustainable agriculture with minimal input requirement.
- In Zambia, the soya bean is mostly used as an industrial crop. It is used in oil production and in products such as soya chunks and soya meal. The by-product (cake) is fed directly to animals or processed with other ingredients into animal feed stock. As an animal feed, soya by-products provide relatively low cost, high quality protein to feed rations. With a livestock revolution underway in developing countries, including Zambia, industrial demand for

soya is likely to increase. The growing demand of soya offers significant opportunity for smallholder farmers to improve their cash base.

Despite the clear benefits of soya production for smallholders, soya production remains limited. In part, this may be linked to the pervasive belief among farmers that soya markets are unreliable. However recent research suggest that there is, in fact, significant unmet demand for soya in Zambia.

Soils and Climate

Soil Requirements

- Well drained soils, rich in organic matter
- Soil varying in texture from sandy, sandy loam to clay loam are recommended
- The pH should range between 5.0 to 5.5

Climatic Requirements

- **Temperature.** The optimum temperature range for soya bean is 22 ° C to 35 ° C. Soya bean will not germinate at temperature below 10 ° C.
- **Rainfall.** The crop is best suited in region 2 and 3 with a rainfall range of 800 to 1000mm during the growing period. Too much rains, leading to anaerobic condition in the soil may reduce [nodulation](#).

Varietal Choice

Varieties. Two types based on nodulation:

- **Non – promiscuous cultivar.** These are varieties that are not able to form nodules on their own, but will need to enhance in order for them to form nodules by inoculating them with the bacterium, [Bradyrhizobium japonicum](#); nodules will fix atmospheric nitrogen. These are:
 - . Kaleya
 - . Tunia
 - . Santa Rosa



Figure 4. Cross section through a [soybean](#) root nodule. The bacterium, [Bradyrhizobium japonicum](#), colonizes the roots and establishes a nitrogen fixing symbiosis. This high magnification image shows part of a cell with single bacteroids within their [symbiosomes](#). In this image, endoplasmic reticulum, dictyosome and cell wall can be seen.

How to apply inoculum? Mix fresh peat powder inoculum with an equal quantity of water to make slurry e.g. 100g of inoculum mix with 100mls of water (or 5% sugar

solution) treats approximately 20kg of seed. To prevent drying out do not open the inoculum packet until immediately before use. Mix slurry with seed until is evenly coated and plant immediately in moist soil.

- **Promiscuous cultivars.** These are cultivars that are able to nodulate on their own naturally without the need of artificial inoculum. These are Magoye and Herman 147. These can be easily grown by small scale farmers because they do not need to acquire inoculum.

Choosing the Right Soya Bean Variety

Cultivars

Soya bean cultivars are area-specific with regard to optional adaptation. The duration from planting to maturity should be approximately 120 to 130 days for a well-adapted cultivar. Where cultivars are planted at higher altitudes or latitudes than recommended; the growth period will be longer. There are several registered determinate and indeterminate cultivars in Zambia with suitability varying according to regions or provinces.

The cultivars also vary in their resistance to diseases, stressful weather conditions, weeds and other factors that affect production. Cultivars with a relatively long growing season should be considered when planting soya bean for fodder where much emphasis should be placed on vegetative growth rather than grain production. The seeds can be purchased from the registered seed suppliers in the country. When making a particular cultivar choice, producers should consider characteristics such as growth habit, shattering, pod height, resistance to pest, diseases and chemicals. (Tab. 2)

Table 2. Commonly grown cultivars in Zambia and their agronomic characteristics

Cultivar	Maturity In Days	Pod Clearance	Resistance To Shattering	Resistance To Lodging	Resistance To Red Leaf Blotch	Potential Yield Tonnes/Ha
Magoye	125-135	average	poor	good		2.5-3.0
Hermon 147	120-130	average	average	good	susceptible	
Kaleya	100-110	average	good			2.5-3.0
Santa Rosa	110-120	average	good		good	2.5-3.0
Tunia	115-125	average	good	good		2.5-3.0
Lukanga	125-145	good	good	good		2.0-2.5

Land Preparation

Land preparation can be started with winter ploughing which can be done in May – August period and the weeks before the rains start discing can be done. For small scale farmers, ridges of not more than 30cm are made usually with the on-set of the rains. Conventional tillage can be done; this aims at a weed free seedbed and is done by ploughing first and then discing to have a fine seedbed.

Planting and Crop Management

Planting. In Zambia, mid to late December is the right time to plant. In region III, it can be extended to early January. Delayed planting may lead to reduced potential yield and early planting to poor seedling establishment. Early maturing when there is still plenty of water may affect seed quality and lead to a reduction in storability, occurrence of red leaf blotch.

Seed Rate. This varies with cultivars, small seeded cultivars e.g. Magoye have small seed rates while big seeded cultivars e.g. Hermon 147 have high seed rates. The recommended seed rate is 75 to 110kg/ha depending on cultivar, but safety measure against germination a slightly high seed rate is normally recommended.

Plant Spacing. Soya bean is usually planted by drilling and the following patterns can be used. (Tab. 3)

Table 3. Recommended Soya bean plant spacing

Row spacing	Seeds/ m
20	10
40	20
60	30
70	40

Under this pattern of planting, no thinning is required. Soya bean seed easily loses its viability therefore, planting seed that was not properly stored may lead to poor crop stands.

Plant Population. With the above spacing, the aim should be to achieve a plant population of between 35,000 to 40,000 plants/ha.



Figure 5. Soya bean plant spacing

Crop Rotation. Soya bean may be grown in rotation with maize, cotton, wheat etc.

Maize – Soya bean

Cotton – Soya bean

Maize – Cotton – Soya bean

Soya bean – Wheat

Soya beans are susceptible to nematodes and therefore, should not be grown in rotation with [solanaceous](#) plants or other nematode susceptible crops.

Fertilisation

For enhanced soil fertility, Soya beans needs about 350 to 400kg/ha of compound D for low fertility soils and 100 to 300kg/ha for medium fertility soils. Where there is an effective crop rotation programme Soya bean yields reasonable produce even without fertilization.

Top Dressing. This is not necessary in Soya beans because it will be fixing its own nitrogen.

- The general trend under small-scale farming is not to add any fertilizer at all as it is believed Soya bean does not require any fertilizer.

Irrigation

Although soya beans require less water in the late reproductive growth stage, water is still essential for the translocation of nutrients from leaf and stem to the seeds. The method of irrigation will be determined by water availability, type of cultivar and the irrigation equipment available. The best methods are the sprinkler and drip irrigation. Irrigation systems are not 100% effective and more water must be applied to compensate for this deficit. Most soya beans are rainfed grown, the main factor limiting irrigation being profitability. In dry areas in underdeveloped countries, yield obtained under irrigation can be offset by drastically increased costs of production and aggravated where bulk and storage facilities are limited. Soya beans are sensitive to water shortage during the pod-set stage. Maximum seed yield is possible where water in the root zone is kept above 50% plant-available.

A substantial pre-planting irrigation which wets the soil from 60 to 100cm is recommended and moderately large amounts at longer intervals are preferred to frequent small applications. Irrigation at planting or three to four days later stimulates rapid germination and prevents possible crust formation. Adequate moisture during flowering stage will ensure that the maximum number of flowers will be fertilised and will produce pods. Shortage of water during late grain-filling stage can reduce yields by as much as 30%.

Weed Control

Two weeding are recommended after irrigation. Weeds compete with Soya beans for nutrients, moisture and light and thus, reduce yield. The most effective measure for developing weed control in Soya bean vary; depending on types of weeds, degree of weed infestation, soil type, weather patterns, crop rotation, tillage methods, row spacing and equipment's available. A good weed control program should include combination of preventive, cultural, mechanical and chemical practices.

Pests and Diseases

Pests. The common pests in Soya beans are:

- **Cut worms.** If they occur, control by spraying Dursban 4E at the rate of 30mls in 10lts of water or FASTAC 10% EC.
- **Termites.** Control with Dursban 4E at the rate of 30mls into 10lts of water.
- If **Loppers** occur, control with Thiodan 100mls into 10lts of water.
- **Eating Caterpillar.** Once they occur, control with Thiodan 100mls into 10lts of water.

Diseases. Soya beans are susceptible to various viral and fungal diseases caused by different organisms. These diseases may result in low yield and poor quality of the grains and should be controlled from soil preparation until harvesting in order to obtain better yields. Integrated mechanisms such as chemical, mechanical, biological and other cultural practices can be used to control the diseases. The soya bean production is affected by some of the following diseases:

- **Red leaf blotch** (Pyrenochaeta glycines)
- **Bacterial blight** (Pseudomonas glycine)

- **Bacterial pustule** (*Xanthomonas sojina*)
- **Frog eye leaf spot** (*Carpospore sojina*)
- **Downy mildew** (*Peronospora manshurica*)

The recommended varieties have resistance to the above diseases

Harvesting

Harvesting is usually done by hand under small-scale and by combine harvesters under large-scale.

Signs of Maturity

- Pods change colour, and the colour depends much on cultivar e.g. Hermon change colour to grey on maturity. Most cultivars will change colour to golden yellow.
- Dropping of leaves (senescence) will start
- Shattering will start in some cultivars
- Seeds become firm with 12 to 14% moisture content



Figure 7. Dried Soya bean ready for harvest

Time of Harvesting

In order to avoid losses, harvesting should be done as soon as the crop matures. On the actual day of harvesting should be done in the morning, because the presence of dew prevents shattering and harvesting should be stopped as soon as it gets hot and dry.

Delayed Harvesting

This may lead to shattering in some cultivars e.g. Magoye and Hermon 147. The usual practice is to collect the cut plants and then heap them somewhere especially on a concrete slab to continue drying and eventually threshing.

Threshing

This is the removal of the seed from the pods and is done by pulling the plants on a concrete floor. The plants are then beaten lightly to remove the seeds from the pods; the removal of seed is very easy if the plants are thoroughly dry.

Winnowing

Winnowing is necessary in Soya bean to remove the plant debris from threshed seeds.

Yield

The average yields range from 2 to 3 ton/ha depending on the management and cultivars.

Storage

Soya bean should be stored in cool well ventilated stores. The moisture content should be between 10 to 12%.

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