Smallholder Horticulture Empowerment & Promotion Project for Local and Up-Scaling (SHEP PLUS)

“Changing Farmers’ Mindset from “Grow and Sell” to ”Grow to Sell””

FRENCH BEANS PRODUCTION

Presented to the County & AFA (HCD) Staff in charge of the SHEP PLUS Model Farmer Groups during the FT-FaDDE

Prepared by SHEP PLUS
1. Introduction:

1.1 Background

French Beans (Maharagwe Maji)
1. Introduction:

1.1 Background

• French Beans are the immature green pods of *Phaseolus vulgaris*

• Also referred to as Green Beans or Snap Beans

• It’s a major export crop in Kenya. Main markets are the U.K., France, Germany, Holland and Belgium

• Grown by both large scale and smallholder farmers

• Staggered planting in small portions is recommended due to its high labour requirements

• Grown both for fresh consumption and processing, mainly canning and freezing
1. Introduction:

1.1 Background Cont’

• The leaves have **three (3) leaflets** with a long petiole
• The long pods vary in **colour**, depending on cultivar
• The seeds may be **black, white** or red coloured, **two coloured** or **marbled**
• The growth habit is both **dwarf** and **climbing type**, however **dwarf** is common in Kenya
1.1 Background Cont’

French Bean crop stand

Photo: SHEP PLUS
1.2 Common Varieties

• Most French Bean cultivars have cylindrical pods and belong either to the climbing, unbranched “pole” type, or to the dwarf “bush” type
  – **Pole Cultivars:** Indeterminate growth up to 3 m high and are normally supported
  – **Bush Cultivars:** Early maturing, 20 – 60 cm tall, and have determinate growth with short internodes
  – **Stringless Cultivars:** The predominant type
1.2 Common Varieties Cont’

Varieties grown in Kenya:

• Fresh Market: Serengeti, Amy, Pekara, Teresa, Paulista, Rexas, Samantha, Belcampo and Cupvert

• Processing: Julia, Ogandi, Vernandon and Sasa

French Beans
1.2 Common Varieties Cont’

“Serengeti”:

- Plant is medium erect bush
- **Maturity Period:** 55 days
- **Pod length:** 14 – 16 cm
- Tolerant to rust, bean common mosaic virus & anthracnose

Photo: https://www.royalseed.biz/french-bean---export.php

“Serengeti”
1.2 Common Varieties Cont’

“Amy”:

- Grown for fresh export market
- **Maturity Period:** 58 – 60 days
- Flowering starts after 40 days
- Tolerant to anthracnose
- **Pod size:** 10 – 12 cm long

[Photo: http://www.greenlands.co.ke/Frenchbeans.html]
1.2 Common Varieties Cont’

“Paulista”:
• **Maturity Period:** 58 – 60 days
• Grown for Bobby grade for export mainly to **UK**

“Samantha”:
• Grown for extra fine & fine grades
• Flowering starts after 45 days
• **Maturity Period:** 58 – 60 days
1.3 Optimal Ecological Requirements

<table>
<thead>
<tr>
<th>Altitude</th>
<th>1,000 – 2,100 M.A.S.L.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rainfall</td>
<td>900 – 1,200 mm of rainfall annually</td>
</tr>
<tr>
<td>Growing Temperature</td>
<td>14 - 32 °C</td>
</tr>
</tbody>
</table>
| Soils          | • Light sandy loams to clay.  
                 | • Friable, medium loam soils that are well drained and have a lot of organic matter.  
                 | • pH range 6.5 – 7.5 |
2. G20 technologies

- Make sure to support farmers carry out G20 techniques for any crop

1. Market survey
2. Crop planting calendar
3. Soil testing
4. Composting
5. Use of quality planting materials
6. Recommended land preparation practices
7. Incorporating crop residues
8. Basal application of compost/ manure
9. Recommended practices of seedling preparation/ seedlings from registered nursery
2. G20 technologies

10. Recommended spacing
11. Recommended fertilizer application rate
12. Supplementing water
13. Timely weeding
14. Top-dressing
15. IPM practices
16. Safe and effective use of pesticides
17. Use of harvesting indices
18. Appropriate post harvest handling containers
19. Value addition techniques
20. Keeping farm records
3.1 Planting

French beans at early stage of growth

Photo: SHEP PLUS
3.1 Planting

3.1.1 Appropriate Time:
• French Beans are sown directly into the seed bed
• Seed Rate: 20–25 kg per acre
• Planting should be scheduled so that most of the crop is ready between October to mid-December and from mid-January to end of May at 2 – 3 weeks intervals (in convenient sized plots) to maintain continuous production and ensure proper management
• In warm areas, beans take 45 to 50 days from planting to first picking, hence, plant from mid-August to mid-October, then plant again early in December
3.1 Planting Cont’

3.1.2 Recommended Spacing (GHCP&PHHT20: Q10):

• Single rows **30 X 15cm** (1 seed per hole) or double rows **60 X 30 X 10 cm** is used
• Plant population: **88,888** per acre
• It is advisable to plant in blocks of four single rows separated by a path of **about 50 cm** for ease of management practices

3.1.3 Fertilizer Application Rates (GHCP&PHHT20: Q11):

• At planting, **80 Kg/acre** of DAP is applied in the furrow and mixed well with the soils before placing the seeds
3.2 Water Requirement

Drip irrigation on French beans
3.2 Water Requirement  
(GHCP&PHHT20: Q12)

- A regular water supply is essential as moisture affects yields, uniformity and quality.
- Water stress during flowering causes flower abortion and thus reduces yields.
- It is advisable to grow the beans on ridges while using furrow irrigation in heavy clays since beans are very sensitive to water logging.
- It is recommended to apply 35 mm/week at planting to 10 days post emergence and 50 mm/week thereafter to flowering stage.
3.3 Managing of Weeds (GHCP&PHHT20: Q13)

- **Timely** and **thorough weeding** is absolutely essential
- The first weeding should be done **2 – 3 weeks after emergence** followed by a second weeding **2 – 3 weeks later**
- Care should be taken to avoid damaging the **shallow roots** especially during the first weeding
- Never weed the crop when it is at flowering time and/or when the field is wet to avoid flower shedding, spread of diseases and soil compaction
3.3 Managing of Weeds Cont’

- **Herbicide use** may be economically feasible for the commercial French Beans grower

- The following pre-emergence herbicides can be used:
  - **Stomp 455CS®** *(Pendimethalin)*: 2.5 Litres in 400 Litres of water per hectare
  - **Basagran®, BEANSCLEAN 480 SL®** *(Bentazon)*: Can be applied post-emergence at 2.5 – 3 Litres in 160 Litres of water per acre for control of broad leaved weeds
3.4 Top-dressing (GHCP&PHHT20: Q14)

- At the first trifoliate leaf stage, French Beans are top dressed at the rate of 40 Kg/acre of CAN and a second application of the same amount at the onset of flowering.

- An application of foliar feeds such as Bayfolan or Rapid-grow fortnightly from the 2nd week after planting to mid-podding stage also promotes higher yields.

- However, excessive nitrogen application promotes vegetative growth at the expense of pod production.
3.5 Pests & Diseases Control: (GHCP&PHHT20: Q15 & 16)

3.5.1 Major Pests

- The following are the major pests of french beans in Kenya:
  A. Flower Thrips
  B. Red Spider Mites
  C. Cut Worms
  D. Bean Fly
  E. White Fly
  F. African Bollworm
3.5.1.A: Flower Thrips

Thrips damage on French bean pod

Infested leaf showing silvery white discoration

Photo: http://www.infonet-biovision.org/PlantHealth/Crops/Beans © A.M. Varela, ICIPE (CC BY-NC-SA 3.0)

Photo: Howard F. Schwartz, Colorado State University, Bugwood.org (CC BY 3.0 US)
3.5.1.A: Flower Thrips

Identification:
• Adults are small (3 mm long) and shiny black with clear wings
• The larvae/maggots are cream with dark mouthparts and reach 3 mm in length
• Pupae are small, brown and cylindrical with rounded ends

Damage:
• Feeding by flower thrips causes scars & blemishes on leaves and pods
• Heavy feeding causes flower abortion and malformation. The pods become scarred (rough silvery surface) and malformed— not marketable
3.5.1.A: Flower Thrips Cont’

Control:

• Foliar spraying using recommended chemicals starting at 2 leaf stage and during flowering is recommended:
  – Spinosad (Tracer 480 SC®)
  – Alpha-cypermethrin (ALPHAGUARD 10EC®, ALPHA-KING 10EC®, FASTAC 10EC®)
  – Teflubenzuron (NOMOLT 150SC®)
  – Imidacloprid (CONFIDOR 70WG®)
3.5.1.B: Red Spider Mites

Photo: By Gilles San Martin from Namur, Belgium - Tetranychus urticaeUploaded by Jacopo Werther, CC BY-SA 2.0, https://commons.wikimedia.org/w/index.php?curid=24611144

Red Spider Mites on a leaf
3.5.1.B: Red Spider Mites

Identification:
• Adults are tiny, oval and reddish or greenish in colour

Damage:
• Infested leaves turn silvery and brownish in colour
• The leaves have cobwebs on the lower leaf surface
3.5.1.B: Red Spider Mites Cont’

Control:

- **Weed control** to remove alternative hosts
- In severe infestation, **burn the bean straw**
- Foliar sprays with recommended chemicals e.g.
  - Amitraz (**Mitac®**)
  - Abamectin (**Dynamec®**)
  - Spiromesifen (**Oberon®**)
3.5.1.C: Cut Worms

A Cutworm larva

Photo: By Neil Phillips from uk (Large Yellow Underwing caterpillar) [CC BY 2.0 (http://creativecommons.org/licenses/by/2.0)], via Wikimedia Commons
3.5.1.C: Cut Worms

Identification:

- These are **larvae of moths**
- They are also referred to as **root maggots**
- Root maggots are **white, chubby grub-like larvae** that reach **1/3 inches** in length at maturity
- Adult moths lay eggs **at the base of plants**, where the larvae feed after hatching
- The moths are **active at night** and hide during the day
3.5.1.C: Cut Worms Cont’

Damage:
• They cut stems of young plants above or below soil level and also feed on plant foliage
• The affected young plants wither and fall off

Control:
• Soil treatment
• Foliar sprays using recommended chemicals e.g. Deltamethrin (ATOM 2.5EC®, DECIS 2.5EC®)
3.5.1.D: Bean Fly

Bean seedling showing yellow colouration after infestation with bean fly

Photo: © A.M. Varela, icipe
http://www.infonet-biovision.org/PlantHealth/Crops/Beans (CC BY-NC-SA 3.0)
3.5.1.D: Bean Fly

Identification:
- Adult is small (3 mm long) and shiny black with 2 clear wings
- Adults rest on leaves where it lays eggs
- The larvae/maggots are cream with dark mouthparts and reach 3 mm in length
- Pupae are small, brown and cylindrical with rounded ends

Damage:
- Affected plants are yellow, stunted and stems are cracked at the soil level
- The damage is caused by the larvae which mine the stem and feed on the cotyledons of seedlings before or after emergence
3.5.1.D: Bean Fly Cont’

Control:

- **Seed treatment** e.g. using *Gaucho* or *Apron Star*
- **Chemical sprays** with recommended chemicals e.g.:
  - Cypermethrin (*RIPCORD 5%EC®*) at 100 ml/20L at 2 weeks intervals
  - Lambda Cyhalothrin (*Karate 2.5WG®*) and Deltamethrin (*Decis 2.5EC®*) to be applied from the flowering stage and through the harvesting period at weekly intervals
3.5.1.E: White Fly

Bean leaf infested with whiteflies

Photo: http://www.infonet-biovision.org/PlantHealth/Crops/Beans © B. Loehr, icipe (CC BY-NC-SA 3.0)
3.5.1.E: White Fly

Identification:
• The adults are 1 – 3 mm long
• Their bodies are entirely covered by white waxy bloom
• The nymphs are greenish white, oval in outline, scale-like and shiny

Damage:
• Infested plants are low in vigour, may wilt, turn yellow in colour and eventually die
3.5.1.E: White Fly

Control:

• When populations builds up, spray using recommended chemicals:
  – Lambda Cyhalothrin (Karate 2.5WG®)
  – Thiamethoxam (Actara 25WG®)
  – Deltamethrin (FARM – X 2.5EC®)
  – Alpha cypermethrin (SUPREMO 100EC®, TATA ALPHA 10EC®, CYRUX 10EC®)
3.5.1.F: African Bollworm

Photo: http://www.infonet-biovision.org/PlantHealth/Crops/Beans#27680
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3.5.1.F: African Bollworm

Identification:

- Adult moth is dull yellow to brown with dark speck grayish wavy lines
- The female moth lays tiny round & brownish eggs near or on leaves, flowers or small fruits
- Larvae have alternating light and dark colored stripes on either side of the body and also have a black head
- Fully grown caterpillars (3 – 4 cm long) drop from the plant and burrow into the soil to pupate
- The pupa is shiny brown
3.5.1.F: African Bollworm Cont’

Damage:

- Attack on flower buds causes **flower abortion**
- Larvae bore **clean circular holes on pods**
- **Feeding holes** made by the larvae serve as entry point for pathogens which may lead to secondary infection
3.5.1.F: African Bollworm Cont’

Control:

• Early detection of caterpillars is important
• Surrounding field should be weed free
• Planting of trap crops (Maize & Cucumber etc.) which attract the pest before it attacks French Beans
• Use of selective pesticides, such as microbial control agents *Bacillus thuringiensis* (BIO-T-PLUS ®, BIOKIL WP®), Azadirachtin (Neemraj Super 3000®)
3.5.2 Major Diseases

- The following are the major diseases of french beans in Kenya:
  a. Rust
  b. Bean Common Mosaic Virus (BCMV)
  c. Powdery Mildew
  d. Angular Leaf Spot
  e. Fusarium Root Rot
3.5.2.a: Rust

Bean leaves affected by Rust

Photo: © A. M. Varela, icipe  http://www.infonet-biovision.org/PlantHealth/Crops/Beans (CC BY-NC-SA 3.0)
3.5.2.a: Rust

General Information:
• The disease is caused by a fungus

Symptoms:
• Rust spots appear on all the plant parts above the ground
• The reddish brown spots (postules) mostly appear on the underside of the leaves
• These spots are surrounded by a yellow halo
• Severely infected leaves eventually fall off
3.5.2.a: Rust Cont’

Control:
- Use of **crop rotation**
- Destroy infected crop residues
- Regularly inspect fields
- Spray fungicides **before flower formation**
  - Azoxystrobin + Difenoconazole (AMISTAR TOP 325SC®, AZOXY TOP 325 SC®)
  - Azoxystrobin (AMITIV 250SC®)
  - Mancozeb (BIOTHANE 80WP®, DITHANE DG®)
  - Copper hydroxide (CHAMPFLO SL®)
  - Cupric hydroxide (CHAMPION 50 WP®)
  - Copper Oxychloride (Cuprocaffaro Micro 37.5WG®)
  - Chlorothalonil (DACONIL 720SC®, BRAVO 720 SC®)
  - Sulphur (DEVISULPHUR WP®)
3.5.2.b: Bean Common Mosaic Virus (BCMV)

Curling of bean leaf

Photo: http://rachel.golearn.us/modules/en-infonet/export/print$c118$crops.html
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3.5.2.b: Bean Common Mosaic Virus (BCMV)

General Information:
• The disease is transmitted by aphids
• It can also be introduced to the fields through infected seed

Symptoms:
• Cupping and twisting of the leaves with light and dark green mosaic pattern
• The dark green tissue is often bubbled next to the veins
• Affected plants produce smaller curled pods with a greasy appearance
3.5.2.b: Bean Common Mosaic Virus (BCMV) Cont’

Control:
• Use disease-free certified seed
• Seed treatment with Imidacloprid to control aphids
• Rogue (remove) infected plants
3.5.2.c: Powdery Mildew

Bean leaves infected by Powdery Mildew

Photo: Michelle Au
https://www.flickr.com/photos/scotnelson/37702219795
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3.5.2.c: Powdery Mildew

General Information:
• The disease is caused by a fungus *Erysiphe polygoni*

Symptoms:
• A white powdery mould appears on the upper surface of the leaves
• The tissue beneath the affected plant becomes reddish brown
• The leaves eventually turn yellow and fall off
3.5.2.c: Powdery Mildew Cont’

Control:

• Plough down crop residues from diseased plants after harvest
• Crop rotation
• Weed control
• **Use of fungicides** e.g.) Sulphur (Cosavet DF®), Hexaconazole (COTAF 5% EC®)
3.5.2.d: Angular Leaf Spot

Angular leaf spot on French Bean leaves

Photo: https://www.infonet-biovision.org/PlantHealth/Crops/Beans
© A.M. Varela, icipe (CC BY-NC-SA 3.0)
3.5.2.d: Angular Leaf Spot

General Information:
• The disease is caused by a fungus

Symptoms:
• Fungal lesions appear on the primary leaves
• The affected leaves have dark brown spots which have angular edges
• The affected leaves turn yellow, necrotic and fall off
• Affected pods have grey mould
3.5.2.d: Angular Leaf Spot Cont’

Control:
• Use **certified planting material**
• **Plough down** crop residues
• Practice **crop rotation**
• **Seed treatment** with insecticide and fungicide
• **Spray with fungicides:**
  – Difenoconazole (SCORE 250 EC®)
  – Mancozeb (MITAZEB 80®, MOSTHANE 80 WP®, OSHOTHANE PLUS WDG®)
  – Azoxystrobin + Difenoconazole (ORTIVA TOP 325 SC®)
  – Fosetyl aluminium + Mancozeb (PYRAMID 700 WP ®)
  – Pyrimethanil + Carbendazim (RIMETA GOLD 300 SC®)
  – Carbendazim (RODAZIM SC®)
  – Azoxystrobin (RUSTOP 250 SC®)
3.5.2.e: Fusarium Root Rot

Bean plants affected by root rot disease

Photo: https://www.infonet-biovision.org/PlantHealth/Crops/Beans © A.M. Varela (CC BY-NC-SA 3.0)
3.5.2.e: Fusarium Root Rot

General Information:
• The disease is caused by a fungus, *Fusarium solani*
• It is prevalent when the soil is too wet or too cold

Symptoms:
• Infected seedlings appear dwarfed
• Leaves turn yellow and finally the seedlings wilt
• The tap root of affected seedlings appear red and later brown and pithy
• Lateral roots fail to develop
3.5.2.e: Fusarium Root Rot Rot

Cont'

Control:
- **Crop rotation** is important since the fungi is soil borne
- Sanitation in the fields
- Remove and burn diseased crop residues
- Plant crop on **well drained soil**
- Use **certified seeds**
- Spray **Carbendazim** (BENDAZIM 500SC®, RODAZIM SC®)
4. Harvest

Harvesting French Beans

Photo: © Victor Omari, HCD 2019
4. Harvest

4.1 Harvesting Indices (GHCP&PHHT20: Q17)

Harvesting Period:

• Harvesting of the pods commences 6 to 8 weeks after planting and continues for 1.5 – 2 months
• French beans are harvested before the pods are fully grown
• Picking should be done at regular intervals ideally thrice a week to maintain export quality

Harvesting Method:

• The pods are carefully picked and should have the stalk still attached
• They should be harvested early in the morning when it is cool since the pod temperature is low
4. Harvest Cont’

• Harvesting during wet conditions is Not recommended but if unavoidable, the pods should be placed on a clean cloth to dry before packing

• Yield:
  - Average yield will be 3,000 – 6,000kg per acre
5. Post-Harvest Handling

Harvested French Beans

Photo: SHEP PLUS
5. Post-Harvest Handling

- Harvested pods should be placed in clean, plastic containers and covered with a clean damp cloth to avoid shriveling.
- Harvested beans should be kept in a cool, shaded and ventilated area e.g. charcoal cooler in order to reduce field heat.

5.1 Containers & Packaging Materials (GHCP&PHHT20: Q18)

- The pods are packaged in corrugated fibreboard cartons of 3 kg gross weight or in plastic pre-packs weighing 250, 500 or 1,000 gm.
5. Post-Harvest Handling Cont’

5.2 Value Addition Techniques: Sorting, Cleaning & Grading (GHCP&PHHT20: Q19)

Sorting:
• Beans must be **intact, sound, of fresh appearance, clean and free** from excess external moisture
• Beans must be of **specified size** to meet market requirements

Grading:
• **Three (3) grades** are prominent:
  - Extra Fine
  - Fine
  - Bobby
5. Post-Harvest Handling Cont’

Grading Cont’:

Extra Fine Grade:
- Pods are **straight, tender** and **seedless** with no strings
- Pod diameter should be less than **6 mm** and minimum length of **10 cm**

Fine Grade:
- Pods are **short with soft string** and may have small seeds
- Pod diameter should be between **6 – 9 mm** and length of **12 – 14 cm**
5. Post-Harvest Handling Cont’

Grading Cont’:

Bobby Grade:
- Pods are **bigger in size** than fine grade and are reasonably tender with small seeds
- Diameter should be more than **9 mm**
5. Post-Harvest Handling Cont’

Pre Cooling:
• The beans can be stored at 7 to 8 °C and a relative humidity of 95 – 100 % for up to 1 – 2 weeks

Processing:
• French Beans are also canned and frozen

Photo: F Delventhal, CC BY 2.0.
The proposed agrochemicals are in accordance with “Products Registered for Use on Crops Version 1_2018”. The registered agrochemicals are subject to change. Please refer to the latest registered agrochemicals by Pest Control Product Board.

- Royal Seed (accessed on 11 Oct 2016)
  https://www.royalseed.biz/french-bean---export.php
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- Northharvest Bean Growers Association (accessed on 11 Oct 2016)
Reference

• Canned green French beans (accessed on 11 Oct 2016)
THANK YOU

ASANTE SANA

DOMO ARIGATO

GOZAIMASU

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