Japan International Cooperation Agency

Agriculture and Food Authority
Horticultural Crops Directorate

Ministry of Agriculture, Livestock and Fisheries
State Department for Crop Development & Agricultural Research

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’

Photo: SHEP PLUS

French Bean crop stand

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

Photo: SHEP PLUS

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

"Amy"

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

Altitude	**1,000 – 2,100 M.A.S.L.**
Rainfall	**900 – 1,200 mm of rainfall annually**
Growing Temperature	**14 - 32 ^{0}C**
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

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

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

Thrips damage on French bean pod

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

Infested leaf showing silvery white discoration

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

Photo: By Neil Phillips from uk (Large Yellow Underwing caterpiller) [CC BY 2.0 (http://creativecommons.org/licenses/by/2.0)], via Wikimedia Commons https://commons.wikimedia.org/wiki/File:Neil_Phillips_-_Large_Yellow_Underwing_caterpiller_(by).jpg

A Cutworm larva

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

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

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

Bean leaf infested with whiteflies

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

African Bollworm on beans

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 **shinny 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'

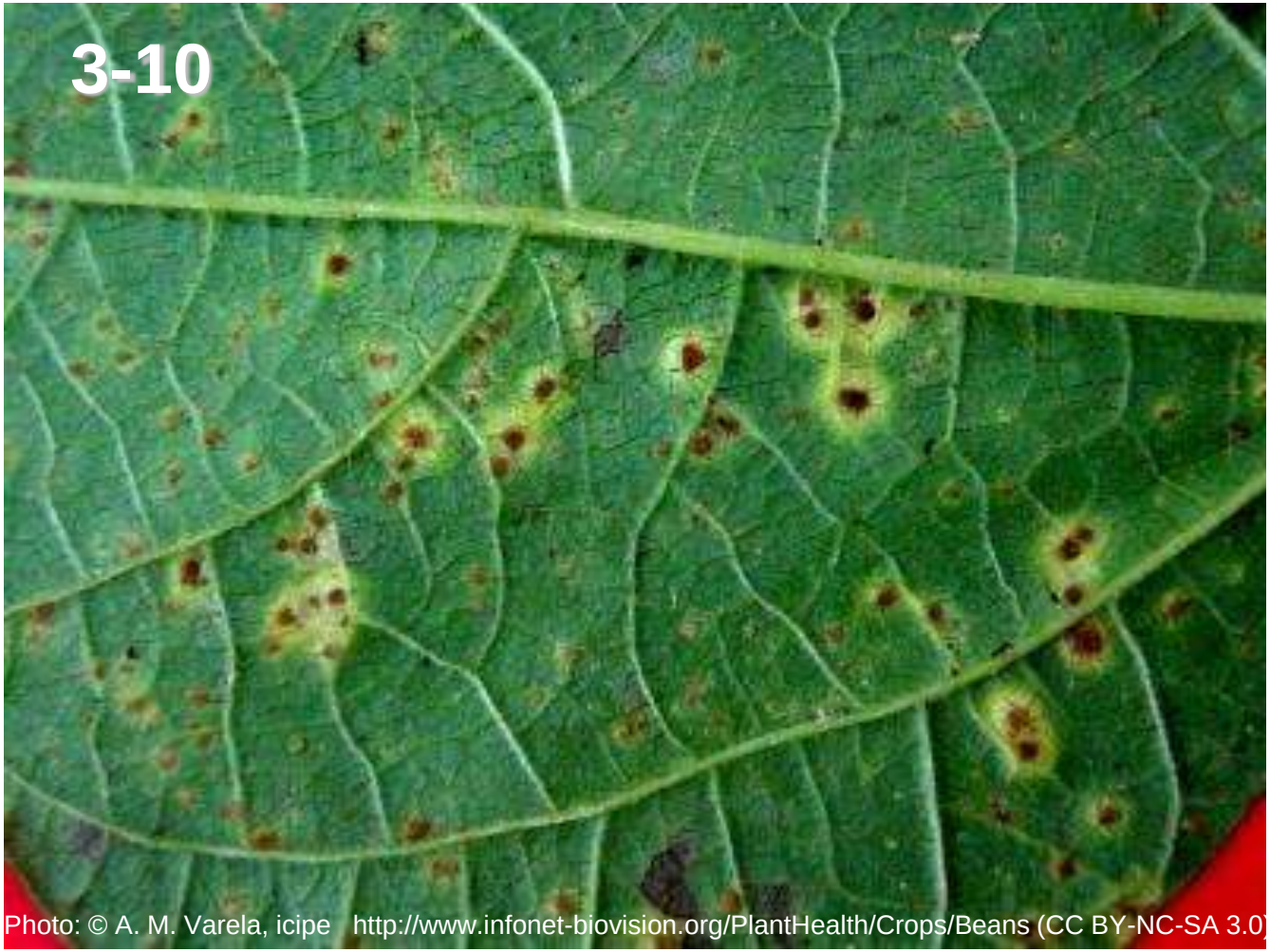
Control:

- **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

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)

Photo: http://rachel.golearn.us/modules/en-infonet/export/printct118$crops.html

Curling of bean leaf

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

Photo: Michelle Au
https://www.flickr.com/photos/scotnelson/37702219795
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Bean leaves infected by Powdery Mildew

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

Photo: https://www.infonet-biovision.org/PlantHealth/Crops/Beans

Angular leaf spot on French Bean leaves

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

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

Bean plants affected by root rot disease

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 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

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

Photo: SHEP PLUS

Harvested French Beans

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 ^{0}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.

Processed French Beans

Reference

- 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.
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THANK YOU

ASANTE SANA

DOMO ARIGATO GOZAIMASU

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