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""

PASSION FRUIT 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

1-1

Passion Fruits

1. Introduction:

1.1 Background

- Passion fruit is a **vigorous**, **shallow rooted**, **perennial vine** that climbs by means of tendrils
- It can grow as tall as **20 ft (6 m or 600 cm) high** and a more realistic life expectation is **3 – 5 years**
- It is mainly grown for **fresh market** and **juice extraction**
- Preferred by small scale farmers due to good returns
- Exported mainly to Uganda, **Europe**; France, Denmark & the UK

1.2 Common Varieties

1-2

“Purple Passion Fruit”

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1-3

“Yellow Passion Fruit”

Photo: By No machine-readable author provided. Fibonacci assumed (based on copyright claims). [GFDL (http://www.gnu.org/copyleft/fdl.html) or CC-BY-SA-3.0 (http://creativecommons.org/licenses/by-sa/3.0/)], via Wikimedia Commons https://commons.wikimedia.org/wiki/File%3AMaracuy%C3%A1.jpg

1.2 Common Varieties

“Purple Passion Fruit”

- Does well in **upper midland** to **upper highland zones** (**1,200 – 2,000 m above sea level**)
- Produces purple colored fruits of **4 – 5 cm** in diameter
- Has **superior** and **aromatic flavor**
- Used for **fresh market** and **juice extraction**
- Popular in the **export market**

1.2 Common Varieties Cont'

"Yellow Passion"

- Does well in the lower midland and lowland zones
- Is more vigorous and produces larger fruits of **5 – 7 cm** in diameter
- M**ore acidic- used for juice extraction**
- Resistant to **Fusarium Wilt**
- Tolerant to **Phytophtora Root Rot**, **Nematodes** and **Brown Spot**
- **Used as rootstock** for purple passion fruit

1.3 Optimal Ecological Requirements

Altitude	**1,200 – 2,000 masl (purple)** **0 – 800 masl (yellow)**
Rainfall	**900 – 2,000 mm annually**
Growing Temperature	**Purple Passion: 18 – 25 ^{0}C** **Yellow Passion: 25 – 30 ^{0}C**
Soils	**•Loamy soils which are deep and well drained** **•pH range 5.5 – 6.5**

2. G20 technologies

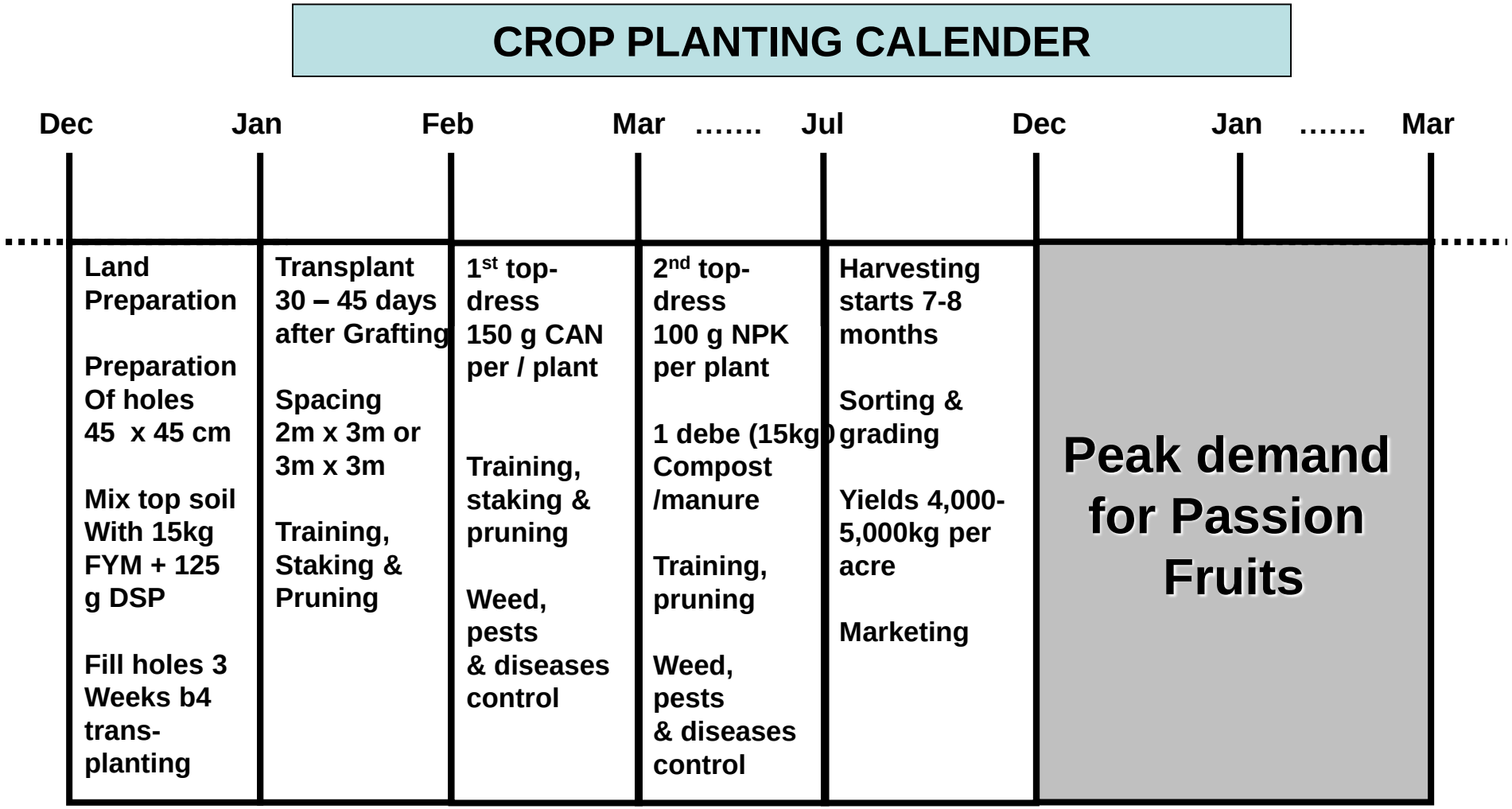
- Make sure to support farmers carry out G20 techniques for any crop

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 Crop Planting Calendar



A Sample of a Passion Fruit Planting Calendar

3. Cultural Practices:

3.2 Land Preparation

(GHCP&PHHT20: Q6)

- Aggressive perennial weeds such as **Kikuyu grass** should be eliminated before planting
- Land preparation is done mechanically (ploughing) or by use of herbicides such as **glyphosate**

3. Cultural Practices:

3.2 Land Preparation Cont'

Preparation of Holes:

- Dig holes **45 x 45 x 45 cm** separating the top and sub-soils
- Spacing : **2 x 3 m** (**640 plants/acre**)
- Mix the topsoil with a debe (**15 kg**) of Farm Yard Manure (FYM) and **125 g of Triple Super Phosphate** (**46 % P_2O_5**)
- Fill the hole with this mixture at least **3 weeks before transplanting**

3. Cultural Practices:

3.2 Land Preparation Cont'

Preparation of Poles:

- Number of poles per acre: 350
- **Pole size:** 2.5 – 3 m high with thickness of **150** mm
- **Galvanized wire: 120** kg of plain galvanized wire
- **Sisal twine:** 10 kg
- **4-5 inch Nails:** 5 kg

3.3 Raising Seedlings:

3.3.1 Open Nursery

Sowing Seeds:

- Seeds are selected from **well-developed ripe fruit**
- **Seed Rate:** sow at least **2 seeds per bag**

After Sowing:

- **Weeding:** weekly
- **Watering:** daily in dry season
- Maintenance of constructions
- Discard **weak rootstock**, **pest or diseases** & **affected plants** weekly
- **Root pruning:** monthly

3.3 Raising Seedlings:

3.3.1 Open Nursery Cont'

Grafting:

- Select a young, healthy vine the same diameter as the rootstock from which to cut scions
- Cut a scion at the node in a long angle with a budding knife
- Cut about **2.5 cm** slit into the rootstock vine with a grafting knife
- Slide the angle of the scion into the slit in the rootstock, pairing the two pieces up in size
- Wrap grafting tape tightly around the union
- Seal the graft union with grafting compound. The graft union should be at least 45 cm above the soil level

3.3 Raising Seedlings:

3.3.1 Open Nursery Cont'

Grafting Cont':

- Brush a layer of the compound over the grafting tape

Labeling:

- **Labeling of the improved plants** as labels may get lost

Record Keeping:

- Daily, weekly; number grafted, taken grafts, sold fruit trees, expenses and selling

3.3 Raising Seedlings:

3.3.1 Open Nursery Cont'

Management of Nursery:

- **Harden the improved cultivars before planting** as the environment in the field after planting is less controlled than that of the nursery
- **Remove/reduce shade** in a stepwise manner
- Remove grafting tape **after 8 weeks** as it can strangle the scion
- When the colour of the leaves become dark green, **remove shade completely**
- Prick out, weed and water carefully

3.3 Raising Seedlings:

3.3.2 Screen House

Passion fruit nursery

3.3 Raising Seedlings:

3.3.2 Screen House

- Raise seedlings **under an insect proof screen house**
- **Source seeds from recommended sources** or **collect healthy mature fruit of recommended Yellow Passion Fruit** from parent with a history of good bearing capacity; extract seeds by fermenting for 3 days to ease separation of pulp and seed and then dry the seed under shade
- Sow the seed shallowly into **prepared beds** or **eco bags** filled with sterilized soil
- Bags should be **5 by 9 inches (12.7 x 22.9 cm)**
- Germination starts after **14 – 21 days**

3.4 Transplanting/Field Establishment

- **One month after grafting**, the seedlings are ready for transplanting in the field
- Transplanting should be done **early morning** or **late in the evening**
- It should be done **at the onset of rains** or anytime under irrigation

3.5 Top-dressing (GHCP&PHHT20: Q14)

- The top dressing fertiliser should be applied in two splits per year
- Application of **100g NPK** (17-17-17/20-20-20) per plant at start of every rainy season.
- This could be at least four times in a year
- **1 debe (15 kg)** of well decomposed manure per plant per year is applied before the rains begin
- Spraying with foliar feed and trace elements every three months is recommended

3.6 Crop Management:

3.6.1 Staking & Trellising

Trellised Passion Fruit plants

3.6 Crop Management:

3.6.1 Staking & Trellising

- The common system of support is by use of **plain wires strung on posts** (**trellis**)
- The trellis should be erected **immediately after transplanting**
- Post for trellising should be about **3.0 m long and 15 cm in diameter:** they are dug **60 cm deep** and **spaced 6 m apart** in the row
- A single strand of wire is **tightly stretched over each row of posts** and **fixed firmly to the end posts**

3.6 Crop Management:

3.6.2 Training and Pruning

Well trained and pruned Passion Fruit plants

3.6 Crop Management:

3.6.2 Training

- A light stick is driven into the ground close to the plant or a piece of sisal twine from the base of the young plant to the wire above
- **Two healthy shoots** at the base of the plant are then selected and trained up the stick or the sisal strands by twining them regularly
- All other shoots below the wire and side branches that emerge are **removed regularly until the shoots reach the wire**

3.6 Crop Management:

3.6.2 Training Cont’

- The two shoots are then trained along the wire in opposite direction by **twining** and **tying regularly**

- It should be ensured that **the laterals which bear fruit hang down from the wire**

3.6 Crop Management:

3.6.3 Pruning

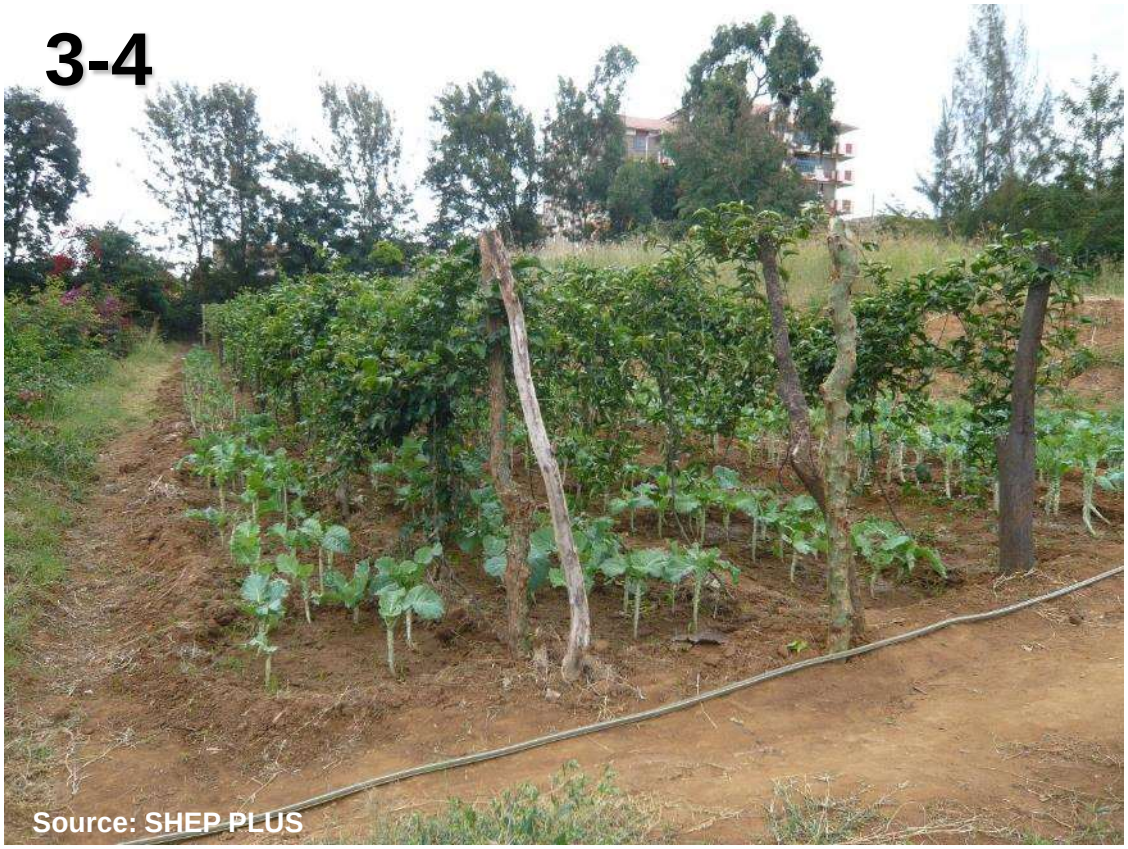
- **Secondary shoots**, **old shoots** which have produced fruit and dead wood **should be removed**

- Additionally, **laterals** reaching ground level should be cut off **10 – 15 cm above ground** as well as entangling tendrils

3.6 Crop Management:

3.6.4 Intercropping

3-4



Kale intercropped with Passion Fruits

3.6 Crop Management:

3.6.4 Intercropping

- Passion Fruit may be intercropped with vegetables such as **Beans**, **Cabbage** and **Tomatoes** during the first year
- Crops for intercropping should be supplied with their **own nutrition** to avoid competing with Passion Fruits
- **Cucurbits** (cucumbers, pumpkin, and squashes) are not recommended due to the woodiness virus and fruit flies
- In addition, maize, cowpea, sorghum, okra, sweet potatoes and other creepers should be avoided

3.7 Pests & Diseases Control:

(GHCP&PHHT20: Q15 & 16)

3.7.1 Major Pests

- The following are the major pests of **Passion Fruits** in Kenya:
  - **A. Aphids**
  - **B. Mealy Bugs**
  - **C. Spider mites**
  - **D. Thrips**
  - **E. Nematodes**
  - **F. Bugs**
  - **G. Broad/ Yellow Tea Mite**

3.7.1.A: Aphids

Aphids on a Leaf

3.7.1.A: Aphids

Identification:

- Aphids damage plants by **sucking plant sap**

Symptoms:

- They cause **curling**, **wrinkling** or **cupping** of infested leaves, **deforming plants**
- They spread **viruses** and **excrete honeydew**, which coat the plants and leads to growth of **sooty mould**, which can **diminish the photosynthetic capacity of plants**

3.7.1.A: Aphids Cont’

Control:

- Usually controlled by **natural enemies**
- **Pesticides: Oxydemeton-Methyl (HATTRICK EC®)**
- **Avoid applying too much nitrogenous fertilizer**, as this will make the plants juicy and attractive to aphids

3.7.1.B: Mealy Bugs

A mealy bug on a leaf

3.7.1.B: Mealy Bugs

Identification:

- Mealy **bugs infest fruits** and **foliage**
- They can be serious pests **in the warm season**

Symptoms:

- Heavy mealy bug attack appears as **white**, **waxy masses of mealy bugs** on **stems**, **fruits** and **along the veins** on the underside of leaves
- Usually result in coating of adjacent stems, leaves and fruits with **honeydew** and **sooty mould**
- Severely infested plants may **wilt** due to sap depletion; **leaves turn yellow**, **gradually dry** and **ultimately fall off**

3.7.1.B: Mealy Bugs Cont'

- Feeding on fruit results in **discoloured**, **bumpy** and **scarred fruits** with low market value

Control

- **Prune** and **destroy** affected parts at the initial stage of infestation
- **Remove** and **destroy heavily infested plants**
- **Spray a steady stream of water** (reasonably high pressure) on the host plant to knock-off mealy bugs
- **Pesticides:** Buprofezin (APPLAUD 40%SC®)

3.7.1.C: Spider Mites

Photo: By CSIRO, CC BY 3.0, https://commons.wikimedia.org/w/index.php?curid=35432982

Spider mites on a plant leaf

3.7.1.C: Spider Mites

Identification:

- Adult Spider Mites are **oval in shape** and appear **reddish** or **greenish** and have **eight (8) legs**
- Eggs are **very tiny**, **spherical** and **whitish**; and are laid **singly on underside of leaves**
- Spider Mites spin silk threads which anchor the **pest** and **their eggs to the plant**

Symptoms:

- Their feeding causes tiny yellow or white speckles, eventually leaves become yellowish and may drop, and may led to complete defoliation

3.7.1.C: Spider Mites Cont'

Symptoms Cont':

- Heavily infested plants may become **stunted**
- Heavy infestation might also cause **vine dieback**, **shrivelling** and **dropping of immature fruits**
- Spider mites are normally more numerous in **hot & dry weather**

Control:

- **Uprooting** and **burning infested plants** can be successful during the early stages of infestation when the mites concentrate on a few plants
- Keep the field **free of weeds**
- Remove and burn infested crop residues **immediately after harvest**
- **Pesticides:** Tetradifon (TERRAMITE 7.52 EC ®)

3.7.1.D: Thrips

Thrips on a leaf

Affected Passion Fruit

3.7.1.D: Thrips

Identification:

- Thrips cause **stunting of young plants**
- They feed on **leaves**, **flowers** and **fruits**

Symptoms:

- Attacked plant parts **shrivel**
- Attacked flowers & young fruits **fall prematurely**
- Feeding by thrips on fruits causes **tiny lesions**, which affect the marketability of the fruit
- A heavy infestation causes **premature wilting**, **delay in leaf development** and **distortion of leaves and young shoots**

3.7.1.D: Thrips Cont'

Control:

- Ploughing and harrowing **can kill pupae in the soil** from previously infested crops
- In some cases, **intercropping** has been found to reduce thrips infestation
- Avoidance of successive planting of susceptible crops reduces the impact of thrips i.e. **Crop Rotation**
- Use **recommended pesticides** such as Oxydemeton-Methyl (HATTRICK EC®) to kill thrips

3.7.1.E: Nematodes

http://www.infonet-biovision.org/PlantHealth/Crops/Passion-fruit

Affected roots (Left) and Healthy roots (Right)

3.7.1.E: Nematodes

Identification:

- Root-knot nematodes are **soil inhabitants**
- They are **spread by transplanting infested seedlings**, from **soil washed downslopes** or **sticking to farm implements**
- They may also be **spread by irrigation water**

Symptoms:

- **Formation of galls or knots** on roots
- **Yellowing of leaves**
- **Stunting** and **eventual wilting** of the affected plants

3.7.1.E: Nematodes

Control:

- Rotate with **Cassava**, **Cereals**, **Maize**, **Baby Corn**, **Sweet Corn**, **Sweet Potato**, **Onions**, **Cabbage** and **Kale**
- **Use of Yellow Passion** which has tolerance to Nematode as rootstock
- Use clean planting materials
- Field hygiene

3.7.1.F: Bugs

Left: Adult tip wilter (*Anoplocnemis curvipes*) is 2.5cm long
Right: Stinkbug damage on passionfruit

3.7.1.F: Bugs

- Several bugs attack passion fruit; **The green stinkbug** (*Nezara viridula),* The brown stinkbug (*Boerias maculata*) etc.
- They **sack** sap at the growing tips

Symptoms:

- Pierce terminal buds that wilt and die back
- Young seedlings die under severe attack
- Punctured young fruits develop localised hardened spots that lower market value

Control

- Intercrop with strong smelling plants e.g. Garlic
- Hand pick and maintain field hygiene
- Irrigate with sprinklers

3.7.1.G: Broad/Yellow Tea Mite

Broad mite damage

3.7.1.G: Broad/Yellow Tea Mite

- Most important mite in passion fruit (0.1-0.2 mm long)- too tiny to be seen

Symptoms

- **Discolouration**, **necrosis** and **defoliation**
- Initially attack terminal shoots and leaves
- Leaves **stunt**, **deform** (slender, twisted or crumpled), **wilt** and **die**
- **Shoots**: swollen, roughened or russeted
- A bronzed dusty appearance may occur on affected plant parts

3.7.1.G: Broad/Yellow Tea Cont'

- Fruits are deformed with white to tan or brown scars on the skin affecting market value despite having no quality effect inside the fruit
- Severely attacked fruits may fall or left with long term scars

Control

- Predatory mites- *Amblyseius californicus*

3.7.2 Major Diseases & Physiological Disorders

- The following are the major diseases and physiological disorders of Passion Fruits in Kenya:
  a. **Fusarium wilt**
  b. **Passion fruit woodiness**
  c. **Brown spot**
  d. **Septoria spot**
  e. **Phytophthora blight**

3.7.2.a: Fusarium Wilt

3-14

Fusarium Wilt on Passion Fruit vines

3-15

Infected plants in the orchard

3.7.2.a: Fusarium Wilt

- This is a soil borne disease

Symptoms:

- **Yellowing of leaves**
- The collar region of affected plant at soil level turns **brownish** and **vertically cracks**
- **Vines wilt** followed by a complete collapse of the plant
- On dissection of infected stem, vascular tissues show **brown discoloration**

3.7.2.a: Fusarium Wilt Cont’

Control:

- Affected parts should be **removed and burned**
- **Do Not cut tissue** and then use the knife on healthy plants
- Keep the base of the plant clear of grass and weeds, which **favour fungal growth**
- Grafting to wilt-resistant Yellow Passion Fruit rootstocks is **the most practical way of control**

3.7.2.b: Woodiness Virus

Cracked Passion Fruits due to Woodiness Virus

3.7.2.b: Woodiness Virus

- They are spread by **aphids** and **pruning knives**
- The virus has a wide host range including **Bananas**, **Cucurbits** and **many weeds**

Symptoms:

- Affected leaves show **light** and **dark green mosaic pattern** often with **light yellow speckle**
- Sometimes **small**, **yellow ring spots** may develop on upper leaf surface
- Infected fruits are **small** and **misshapen with very hard rind** and **small pulp cavity**
- Some strains of the virus cause **cracking of affected fruits**

3.7.2.b: Woodiness Virus Cont’

Control:

- **Use clean planting material**
- Clean **pruning tools**
- Use **resistant hybrids** or **rootstocks of Yellow Passion Fruit**
- **Removing diseased vines** from the field
- **Do proper weeding**
- Avoid planting **Bananas** and **Cucurbits** near Passion Fruit fields
- Control vectors (**aphids**)

3.7.2.c: Brown Spot

Brown spot on Passion Fruit leaf

Brown spot on passion fruits

3.7.2.c: Brown Spot

- **The most economically important Passion Fruit disease** worldwide affecting **leaves**, **vines** and **fruits**
- It is a fungal disease caused by *Alternaria Passiflorae and Alternaria alternate*
- **Warm**, **moist weather** favours disease development

Symptoms:

- Brown Spots up to **10 mm diameter** on the leaves, often **extending along the veins** and **drying out in the centre**
- **On the stems:** spots are up to **30 mm long**, and when they occur at the leaf axils may **kill the vine**, **resulting in dieback**
- **On the fruit:** the spots are **light brown**, **round** and **sunken**; they often **merge**, **covering large areas** and produce **red-brown spore masses**

3.7.2.c: Brown Spot Cont’

Control:

- **Field sanitation** (collection and disposal of fallen diseased **fruits**, **leaves** and **vines**)
- **Pruning vines** to reduce density and thereby reducing humidity within the crop
- **Timely sprays** with fungicides such as Mancozeb (DITHANE M-45 WP®)
- During humid weather, when the vines are growing rapidly, **reduce the intervals between spray applications** to **2 or 3 weeks** to protect new growth

3.7.2.d: Septoria Spot

Septoria spot on Passion Fruit leaf

Septoria spot on Passion Fruit

3.7.2.d: Septoria Spot

- The disease attacks **leaves**, **stems** and **fruits**
- The disease is spread by **rain**, **dew** and **overhead irrigation**

Symptoms:

- **Brown spots up to 2mm** with **minute**, **black dots** develop on leaf surface
- Infected leaves **fall readily** leading to **defoliation of vines**
- Similar spots may form **on the stems** albeit elongated
- On fruits, **light-brown spots** studded with **minute black dots** may be formed
- The spots often join up to cover large areas of the fruit

3.7.2.d: Septoria Spot Cont'

Symptoms Cont':

- Affected fruits ripen unevenly

Control (As in Brown spot):

- **Field sanitation** (collection and disposal of fallen diseased fruits, leaves and vines)
- **Pruning vines** to reduce density and thereby reducing humidity within the crop

3.7.2.e: Phytophthora Blight

Phytophthora blight on Passion Fruit leaves

Phytophthora blight on Passion Fruit

3.7.2.e: Phytophthora Blight

- **Fungal spores** are initially produced in wet soil beneath the vines and are splashed up to lower leaf canopy
- The disease is favoured by **wet**, **windy weather**

Symptoms:

- Affected leaves are **water-soaked** and **light-brown in colour** and **fall readily**, leading to defoliation of the vines
- Affected areas of the stem are **first purple** and **later brown** above the graft union
- They may **completely girdle the stem** causing wilting of vine

3.7.2.e: Phytophthora Blight Cont’

- Fruit symptoms comprise of **large**, **water-soaked areas**
- Diseased fruits **fall readily** and in wet weather become covered with **white**, **fungal growth**

Control:

- **Good field sanitation**
- **Pruning** and **keeping a grass sward under the vines** to minimize spore splashed up to the lower leaves
- **Mulching** of orchards to minimize water splash

4. Harvest

4.1 Harvesting Indices (GHCP&PHHT20: Q17)

Harvesting Period:

- The crop comes into bearing within **7 – 8 months after transplanting**
- The main harvest is obtained **12 – 13 months after transplanting**
- There are normally two harvesting peaks: **July – August** and **December – January**

Harvesting Method:

- Passion Fruit **for fresh market** should be picked when they have developed their characteristic colour (purple or yellow)
- The fruits fall naturally from the vine when they are ripe: these are **suitable for juice extraction**

4. Harvest Cont'

Yields:

- Average yields are about **4,000kg per acre per year**
- With good management and crop husbandry yields of more than **6,000 – 8,000kg per acre** can be realized
- Yellow passion fruit should be stored at **7 to 10 °C** with **90 to 95 % Relative Humidity** for **up to 2 weeks**
- Purple passion fruits are chilling tolerant and can be stored at **3 to 5 °C** for **3 to 5 weeks**

5. Post-Harvest Handling

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

- Fruits are harvested when they are **≥ 75 % turning** yellow or purple
- They are packed in **4.5 and 6 kg fibreboard cartons**, sometimes in **one or two layer trays** or **cell packs**

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

- **Sorting and Grading:** Fruits should have a diameter of **5 to 8 cm** for Purple Passion Fruits and **6 to 8cm** for Yellow Passion Fruits

5. Post-Harvest Handling Cont'

Processing:

- The fruit is easy to process
- The fruit is cut in half (lengthwise) and the seedy pulp is scooped out
- The resulting rich juice (natural concentrate), can be sweetened and diluted with water or other juices (especially orange or pineapple), to make cold drinks
- The seeded pulp is made into **jelly** or is **combined with pineapple** or **tomato** in making **jam**

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.
- Wikipedia: Passion fruits (Last accessed on 1 Dec 2016)
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THANK YOU

ASANTE SANA

DOMO ARIGATO GOZAIMASU

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