



AGRICULTURE AND FOOD AUTHORITY

HORTICULTURAL CROPS DIRECTORATE

Nairobi Horticultural Centre next to JKIA; P.O. Box 42601 – 00100; Telephone: 020-2088469, 020-2131560

Email: directorhcd@afa.go.ke, directorhcd@agricultureauthority.go.ke Website: www.afa.go.ke

TREE TOMATO (*Solanum betaceum*) GROWERS MANUAL

PREFACE

Kenya has been endowed with an enabling environment for production of horticultural crops that attracts high demand both in the domestic and international markets. Production is mainly by smallholder farmers, many of whom require skills and knowledge on good agricultural practices (GAP) to produce and handle the fresh produce. According to the Economic Survey 2022 published by the Kenya National Bureau of Statistics (KNBS), horticulture is among the leading sub sectors in agriculture. Therefore, enhancing the capacity of these producers could be of immense beneficial to the Kenyan economy.

Agriculture and Food Authority – Horticulture Crops Directorate (HCD) is a government agency mandated to Regulate, Promote and Develop the horticulture industry in Kenya. In carrying out its mandate, the Directorate through the Technical and Advisory Services department (TAS) has developed this grower’s manual for its stakeholders. The manual has been designed with a simple language and where necessary photos have been used to highlights all processes from plough to plate. HCD envisages that by using this grower’s manual, its stakeholders especially the smallholder farmers, extension staff and trainers would upgrade their knowledge and skills to enable them increase production of the crops thereby improving on food security, household health, as well as create employment and generate income.

The content has largely been developed from the TAS field staff experiences in the 26 stations spread across the country (*Collins & Dinah – Nairobi [NHC], Antonina – Nakuru, Miriam - Nandi, Grace – Homabay, Barnabas- Eldoret & Iten, Carol - Bungoma, Peter- Busia, Charles -Kisumu, Irene - Narok, Lal – Kisii, Victor – Mombasa, Crispin – Kibwezi, Esther Ngutho– Kitui, Esther Kabatha – Nyandarua, Susan – Taveta, Syphrosa – Machakos, Catherine – Yatta, James – Kitale, Julius – Kajiado, Amedeo & Brenda – Meru, Mary – Kericho, David & Delphina – Mwea, Fridah – Nyeri, Emma – Sagana, Sarah – Limuru*), some content were reviewed from literature and images used properly acknowledged. Technical editing and reviewing of the manuals were done by Mary Chacha, Syphrosa Wanyama, Barnabas Kiptum, Antonina Lutta, Carol Soita, Amedeo Muriungi, Peter Mwanja, Victor Omari, Emma Ndirangu, Esther Kabatha, David Makori, Dinah Karimi, Collins Otieno, Dr Jacqueline Oseko the acting Deputy Director, Technical and Advisory Services department and Director Benjamin Tito all of Horticulture Crops Directorate.

TREE TOMATO (*Solanum betaceum*) GROWERS MANUAL

Common name- Tamarillo (English), Matunda Damu (Swahili)



Introduction

Tree tomato is in the Solanaceae family and is an important cash crop for domestic market in Kenya. It is rich source of antioxidants, vitamins (e.g., A, B6, C, and E) and minerals (e.g., calcium, copper, phosphorous, potassium and iron).

The two major types are the red and yellow tamarillo, with common varieties grown in Kenya including Red Oratia, Red Oratia Giant, Goldline, and Rothamer.

The leading producing counties are: Nyandarua, Uasin Gishu, Elgeyo Marakwet, Meru, Kirinyaga, Kiambu, Narok, Nakuru, Muranga, Tharaka Nithi and Nyeri.

Ecological requirements

1. Temperature: 15-20°C
2. Rainfall: 600-2000mm is suitable but can also be planted under irrigation
3. Soils: Well drained sandy, loam, and clay loam soils rich in organic matter with pH ranging between 5.0 -8.5. Tree tomato is not tolerant to water logging.
4. Altitude: between 1,500m to 3,000m a.s.l

Good Agricultural Practices (GAP)

Horticulture industry in Kenya is guided by code of practice (KS1758)-2016 II) which is a food standard for vegetables, fruits herbs and spices for both local and export market. The standard aims at improving food safety, ensures environmental sustainability and social accountability by following Good Agricultural Practices from production, processing, transportation and marketing of fresh produce. It is essential to maintain accurate records for all operation for traceability purposes.

Propagation materials

Certified tree tomatoes fruit seedlings are acquired from registered tree nurseries.

Soil testing

Soil testing is recommended before planting to guide on fertilizer and manure application.

Land preparation

Land preparation should involve ploughing the soil sufficiently to a fine tilth to eliminate debris and clods. Dig planting holes 60cm × 60cm × 60cm during the dry season and separate top soil and sub soil. At planting, top soil is mixed with well decomposed manure 20kg and 125g DAP/DSP and returned in the planting hole. Excavate soil at centre of the hole and place seedling, firmly press soil at the base of the seedling and add more soil up to the level as the seedling was in the potting bag in the nursery but keep the graft union above soil surface.

Spacing is 2m by 2m attaining 1000 trees per acre.

Irrigation

Irrigation is done especially if rainfall is inadequate to ensure a steady supply of moisture and especially during transplanting, flowering and fruit development. The plant requires a consistent supply of water.

Fertilizer and manure application

Spray foliar feed to ensure faster and stronger plants and also during flowering to boost more flowers and prevent flower abortion.

| Fertilizer | Year 1 | Year 2 | Year 3 | Year 4 |
|----------------------|--------|--------|--------|--------|
| DAP(g/tree) | 150 | - | - | - |
| NPK(g/tree) 17:17:17 | 150 | 200 | 200 | 200 |
| Manure (kg/tree) | 20 | 20 | 25 | 30 |

NB: the NPK fertilizer should be given in two splits per year per plant.

Mulching and weeding

Mulching helps in the suppression of weeds and moisture conservation. Decomposed mulch materials release nutrients into the soil which are absorbed by the plant, improvement of soil structure and water infiltration, checking of soil erosion and topsoil temperature as well as reduction of pests' incidences.

Weeding is done to prevent weeds from competing with the target crop for growth factors like nutrients, sunlight, space, and water, as well as harboring pathogens that directly affect the performance of the crop.



Pruning and training



Newly grown tree tomatoes should be pruned to a height of 90-120cm (3-4ft) to encourage branching and makes them stronger to carry the weight of fruits. Pruning helps to control plant growth, increase fruit size and easy harvesting.



At fruit bearing stage, tree tomatoes need support to prevent branches from breaking off when laden with fruits. The trees can easily be blown over by the wind as they are shallow rooted.



Pests management

Intergraded crops management (ICM) is the best option for food safety. These methods include scouting of pest, field hygiene, proper spacing, and physical methods like use of traps, pheromone, biological methods and others that will only give an option of using pesticide as a last option.




| Pests (Insects) | symptoms | Control |
|--|---|---|
| <p>Aphid (<i>Myzus persicae</i>)</p>  <p>https://oxfarm.co.ke</p> | <ul style="list-style-type: none"> -Aphids feed by piercing and sucking sap from tender shoots and leaves -young shoots and leaves become stunted -leaves are curled and twisted. -They transmit Mosaic virus disease | <ul style="list-style-type: none"> _Crop rotation, -weeding, Use -biological control like parasitic wasp and neem-based insecticides use pyrethrin based pest side |
| <p>White flies. (<i>Trialeurodes abutilonia</i>)</p>  <p>https://oxfarm.co.ke</p> | <ul style="list-style-type: none"> -The affected plant loses its vitality resulting in yellowing, downward curling, and an eventual drying of leaves | <ul style="list-style-type: none"> -weeding - crop rotation -Yellow sticky traps -Use pesticide: Amitraz, buprofezin, Azadiractin |
| <p>Root knot nematode (<i>Meloidogyne spp</i>)</p> | <p>Microscopic parasites found in the soil, whose infestation leads to wilting of the plant. When the infested plants are pulled from the soil, the roots</p> | <ul style="list-style-type: none"> -crop rotation _weeding -use nematode free seedlings -avoid irrigation water runoff. |

| | | | | |
|---|---|--|---|---|
|  | <p>are distorted, swollen and bearing knots or galls. These roots eventually rot causing death of the plant</p> | <ul style="list-style-type: none"> -Keep tools and equipment clean, -crop rotation -Soil solarization. -Use resistant varieties. -Use Nematicides: paecilomyce, lilacinus, metham sodium, abamectin | | |
| <p>https://oxfarm.co.ke</p> | <p>Flea Beetle (<i>Chrysomelidae: Alticinae</i>)</p> |  | <ul style="list-style-type: none"> -The larvae generally feed on the plant roots, but usually do not cause economic damage. -The characteristic symptom of an adult flea beetle attack is the presence of small, round holes all over the leaf surface. -Damage may be of importance when flea beetles are present in large numbers, especially during the seedling stage. | <ul style="list-style-type: none"> -Weeding in and around fields may help to eliminate flea beetle shelters and breeding sites, reducing crop damage. -Covering the seedbed with a fine-mesh material is useful to protect seedlings. - Use recommended insecticides e.g. Deltamethrin |

| Diseases | Symptoms | Control |
|---|---|--|
| <p>Alternanthera mosaic virus (AltMV)</p>  <p>http://www.ehinga.org</p> | <ul style="list-style-type: none"> -The virus is mechanically transmitted by several species of aphids in a non-persistent mode. -Attacked leaves have reduced size and patches of dark-green tissue alternating with yellow-green. -Plant becomes stunted and the quality of fruits is greatly reduced. | <ul style="list-style-type: none"> -Control vectors -Good orchard hygiene, -pruning and burning infected plants -Planting resistance varieties -Use seed and seedling free from disease. |
| <p>Powdery mildew (<i>Erysiphe cichoracearum</i> <i>Erysiphales</i>)</p>  | <p>Infection is characterized by the development of gray-white powdery growth majorly on leaves and stems, which causes them to become distorted. The plant may eventually wilt as disease severity increases</p> | <ul style="list-style-type: none"> - create well-aerated fields, reduces powdery mildew incidence. -Regular watering -Avoid inter cropping with Solanaceae family crops |

| | | |
|--|--|--|
| <p>www.ehinga.org</p> | | <p>-Use sulphur-based fungicides</p> |
| <p>Blight (<i>Alternaria solani</i>)</p>  <p>http://www.ehinga.org/</p> | <p>Initial infection occurs in older leaves with concentric dark brown spots developing on the leaves. As infection advances, infected leaves turn yellow and fall off. On stems, spots without clear contours are seen. The lesions enlarge as severity increases</p> | <p>-crop rotation -weeding -Use blight resistance varieties -Spray fungicides: metalaxyl, mancozeb, propineb, cymoxanil</p> |
| <p>Die back (<i>Sclerobinia sclerotium</i>)</p>  <p>https://www.freepik.com/</p> | <p>wilting leaf drop and stem plant necrosis</p> <p>affect blanches, inflorescence and stem</p> <p>plant drying from the top down ward</p> <p>cause %100 of fruit loss</p> | <p>-rotate susceptible crops with resistant ones such cereals</p> <p>Apply the recommended</p> <p>-Pruning</p> <p>- use fungicides. Correct timing and</p> |

Nutrients deficiency in tree tomatoes

| Element | Deficiency symptoms | Control |
|---|--|---|
| <p>Potassium</p>  <p>https://www.oxfarmorganic.com/wp</p> | <p>The young leaves become small, dull and cupped while the older ones develop marginal chlorosis. In severe cases, leaves dry.</p> | <p>Manage by applying muriate of potash, urea and super phosphate fertilizer</p> |
| <p>Nitrogen deficiency</p>  <p>https://www.oxfarmorganic.com/wp</p> | <p>The growth rate of deficient trees is highly reduced and leaves turn yellow, starting with the older ones.</p> | <p>Use CAN fertilizer 50 grams per tree Use foliar fertilizer containing nitrogen</p> |
| <p>Boron</p> | <p>The growing points of the affected trees die and leaves become chlorotic, then necrotic.</p> <p>Fruit quality is greatly reduced</p> | <p>Apply borax or solubor foliar.</p> |
| <p>Phosphorous</p>  <p>https://www.plantix.net</p> | <p>The deficient plants become stunted, internodes shorten, leaves turn purplish and there's production of poor-quality flowers which bear low-quality fruits.</p> | <p>Foliar fertilizer application with phosphorous</p> |

Harvesting and harvesting techniques

Tree tomatoes trees mature at 18 months. Ripening of fruits is not simultaneous; fruits are harvested throughout the year after every 2 weeks. Harvesting is achieved through simply pulling the fruits from the shrubs with a snapping motion leaving the stalk attached.

Maturity indices-Change of colour from green to pink, red, or yellow depending on the varieties.

Expected Yields

Expected average output 20-30kgs per tree, 20 to 30 tons per acre per year.

Postharvest activities

Packaging of harvested fruits should be done to maintain quality, preferably in crates and transported in closed trucks as per the crops (Horticultural crops) Regulation 2020.

Precooling

Fruits must be cooled as quickly as possible within 5 hours of harvesting to temperature range of 5-7 degrees Celsius.

Sorting

Fruits are sorted to remove diseased, misshaped, immature, bruised and any foreign materials.

Grading

Grade tree tomato based on the standard criteria accepted by the industry. Tree tomatoes that are of good quality and safe for consumption should be: ripe, clean, well-formed and free from insect, disease damage, mechanical damages, microbial, chemical and physical contamination. Minimal defects such as wind scar may be accepted. Fruits are graded according to size and color of the skin (ripening stage).

Packaging

Fruits are packed in well ventilated boxes or cartons for effective cooling and air circulation.

Transport

Use covered vehicles to avoid direct sunlight heat which cause damage to the fruits. Minimize fruits contact with soil to avoid contamination that causes decay and safety concerns. Use clean plastic crates for fruit transportation.

Gross margin analysis for 1 acre tree tomatoes (2023)

| 1 acre (1000 trees, spacing 2m by 2m) 3 year tree yield of 25 kg per year | Units | Quantity | Cost ksh/unit | Year 1 | Year 2 | Year 3 | Year 4 |
|--|-------|----------|---------------|------------------|--------------------------------|----------------------------------|----------------------------------|
| Gross income | Kgs | | 70 | - | 840,000 | 1,680,000 | 1,960,000 |
| Variable costs | | | | | | | |
| Land preparation | | 1 | 5000 | 5000 | - | - | - |
| Harrowing | | 1 | 4000 | 4000 | | | |
| Seedlings | | 1000 | 100 | 100,000 | - | - | - |
| Holes | | 1000 | 50 | 50,000 | - | - | - |
| Manure | tons | 20 | 2000 | 40000 | 80000 | 80000 | 80000 |
| planting | Mds | 12 | 500 | 6000 | -- | - | - |
| DAP | Kgs | 200 | 120 | 24000 | - | - | - |
| NPK | | 200 | 120 | 24000 | 24000 | 24000 | 24000 |
| Foliar (boron, potassium) | ml | 500 | 500 | 1000 | 1000 | 1500 | 2000 |
| Insecticides | ml | 500 | 500 | 500 | 500 | 500 | 1000 |
| Fungicides | ml | 500 | 500 | 500 | 750 | 1000 | 1500 |
| Soil testing | | 1 | 2500 | 2500 | | | |
| Support (sticks) | | 1000 | 20 | - | 20000 | | |
| Labour cost | | | | | | | |
| Pruning | Mds | days | 500 | 1500 | 2000 | 2000 | 2500 |
| Spraying | Mds | days | 500 | 1500 | 1500 | 1500 | 2000 |
| Top dressing | Mds | days | 500 | 1000 | 1000 | 1500 | 1500 |
| Manure application | Mds | days | 500 | 1500 | 1500 | 1500 | 1500 |
| Support labour | Mds | 6 | 500 | | 3000 | | |
| -Weeding | Mds | 8 | 500 | 4000 | 4000 | 4000 | 4000 |
| -Harvesting | Mds | day | 500 | 1500 | 1500 | 2000 | 3000 |
| Total variable costs | | | | 268500 | 140750 | 119,500 | 123,000 |
| Gross margin/profits | | | | - 268,500 | 840,000-140,750= 699250 | 1680,000-119500= 1,560500 | 1960,000-123000= 1,837000 |

Key-Mds- Man days

References

1. Infonet-biovision (Accessed on 14th March 2023) spider plant. <https://infonet-biovision.org/PlantHealth/Indigenous/Spider-plant>
2. Agriculture and Food Authority (2022). Horticulture validated data report. In. AFA year book of statistics. Pg 91 -112.

<https://www.agricultureauthority.go.ke/index.php/en/statistics/afa-year-books-of-statistics>

3. Greenlife (Accessed on 17th March). Tree tomato production. <https://www.greenlife.co.ke/tree-tomato-production>
4. OXFARM (accessed on 16th March) Pest and diseases control in tree tomato (tamarrilo) farming. <https://www.oxfarmorganic.com/blog/tree-tomato/earn>.
5. E-Hinga (accessed on 18th March) management of pest and disease for tree tomato. http://www.ehinga.org/eng/articles/tree_tomato/varieties

HORTICULTURAL CROPS DIRECTORATE (HCD)