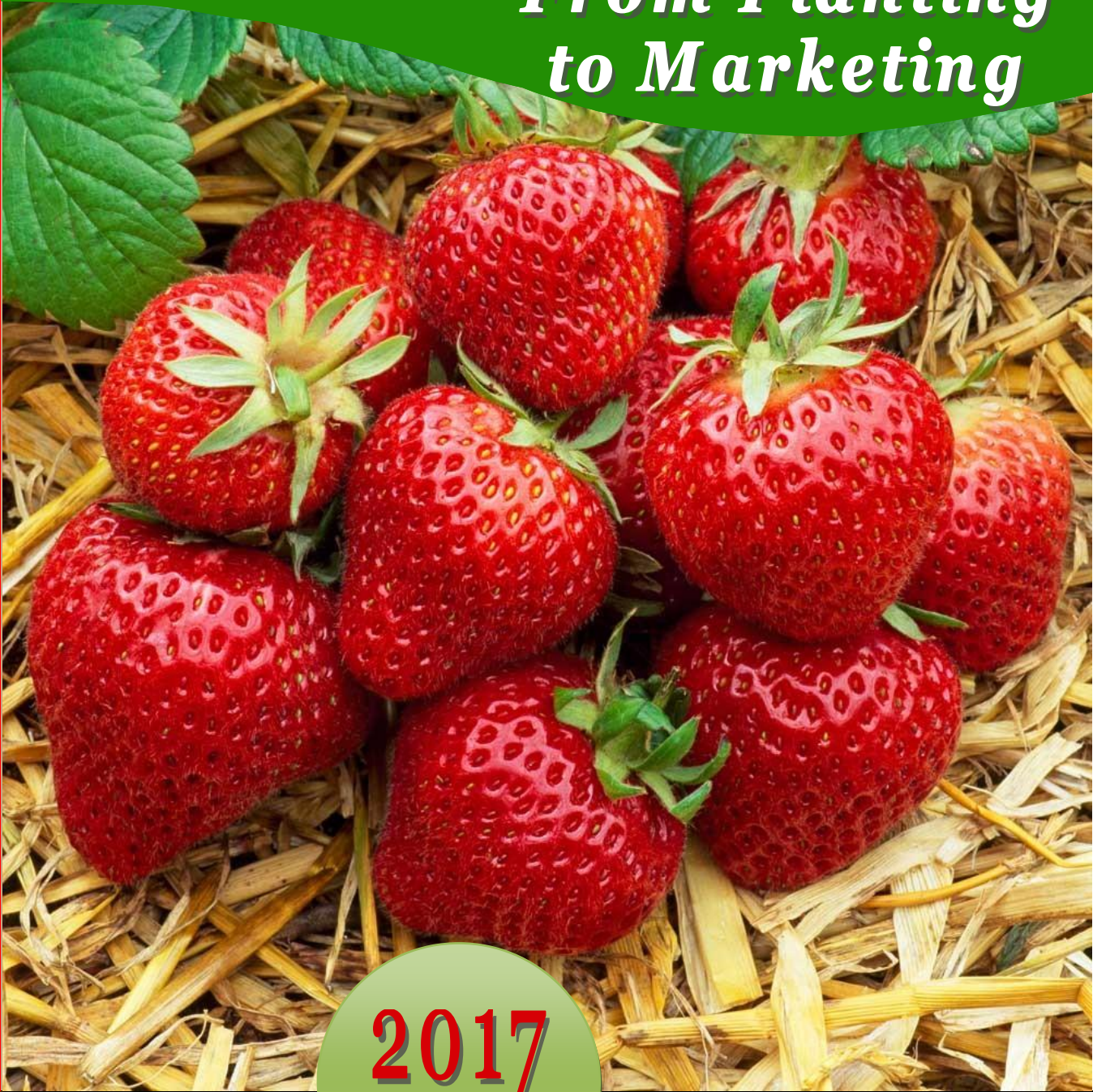


# The Strawberry Production Guide For Kenya

*From Planting  
to Marketing*



**2017**

**Edition**

**Evans Nthiga**  
**Practicing farmer at EastPole Farms**

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# Strawberry Production Guide for Kenya

## Introduction

Strawberry (scientifically known as *Fragaria* spp.) is a high value crop with great potential for income generation and creation of employment opportunities. In Kenya currently, strawberries are being used in various industries including the making of yogurt, ice-cream, fresh juice and jam. The fruits are also a favourite in many urban households as a rich source of vitamins.



Although a ready market for strawberries exists and there is a huge demand especially in urban areas, the fruits are in short supply which has caused them to be very costly in Kenyan markets. In addition, the fruits are in high demand in foreign markets, especially in colder countries such as those in the European Union.

The scarcity of strawberries in Kenya is mainly due to limited production because there are very few farmers who have engaged in full-scale production of the fruit. This can mainly be attributed to:

- Scarcity and high cost of planting materials
- Lack of knowledge on appropriate planting and crop management practices
- Low awareness on the huge potential of the crop and available market opportunities

Therefore, this guide seeks to address the above three limiting factors and provide researched suggestions for marketing avenues of strawberries.

# Site selection and land preparation

## Strategic siting

Even though strawberries can grow in most parts of Kenya, it is important to select the most suitable site for maximum yield and ease of marketing. An ideal site is one that is close to an urban centre since town dwellers provide the largest market for strawberries in Kenya currently.

Strawberries can be grown commercially even on small plot of land such as an eighth of an acre. However, your farm should be of sufficient acreage to sufficiently produce for your customers but most importantly to allow for crop rotation. Availability of water for irrigation is critical since strawberries require water throughout the year during which they produce fruits.

## Soil quality

The soils must be deep, well-drained and with a pH of 6.0 to 6.5. The planting area should not have recently been cropped with plants such as tomatoes, potatoes, melons, pumpkins, cucumbers and pepper, which are susceptible to Verticillium wilt. For this reason, land that has been under fallow for at least two years is best.

Strawberries grow best in sandy loam soils because they have excellent soil drainage. Wet soils restrict root growth and respiration, resulting in weak growth and reduced yields. Heavier soils with finer textures can still be used for growing strawberries. In such soils you will have to make highly raised beds in order to remove excess water and improve internal soil drainage. However, strawberries should not be grown on heavy clay soils. Because of the need for frequent light cultivation to manage weeds, stony and gravelly soils can also prove difficult.

Although strawberries can be grown on a wide variety of soil types, shallow soils have less water holding capacity and will limit root development, resulting in smaller plants with smaller crops. Rooting depth of 12 inches or more is considered important for adequate plant growth and cropping levels. Digging test soil pits can help you evaluate potential rooting depth and drainage issues and evaluate what measures to take to address soil management issues before planting.

You should ensure that you conduct all the needed site improvements (as explained in the land preparation section below) prior to planting. Once strawberries are planted it is very difficult to make major changes to such as to modify soil texture, pH, or nutrient status.

## **Climatic conditions**

Weather plays a critical role in site selection, as well. Strawberries are particularly sensitive to frost and strong wind. Therefore the site of your strawberry farm should be in an area that is open and receiving adequate sunlight (at least 8 hours a day) but well sheltered from strong winds. You should avoid areas that are lower than the general landscape as these are the regions where cold air and frost settles during the cold seasons.

## **Land preparation**

Land preparation before the establishment of a strawberry plantation is mainly aimed at achieving the optimum soil characteristics for the crop. It entails soil testing and implementation of the recommendations, ploughing, adding fertilizers and making of beds.

### **Soil testing**

Soil testing should be done at least a year before planting. You must do a soil test and use the results to bring the soil pH to the 6.0-6.5 level. The results will give recommendations for the appropriate amount of lime (used to raise pH) or sulphur (to lower pH) to apply. The lime or sulphur requirement will depend on soil texture, current pH, and organic matter content. It typically takes one year for the applied lime or sulphur to raise or lower the soil pH, respectively.

### **Ploughing and harrowing**

Ploughing and harrowing is done to remove weeds and to break the soil into particles that make up the crumb texture which is best for strawberries. This improves the internal drainage of the soil and creates air spaces necessary for the thriving of micro-organisms that also help in improving the soil quality.

### **Application of fertilizers**

It is advisable to use compost or animal manure for strawberry farming. Organically produced fruits are best for the market and meet the standards for export market. Addition of organic matter in the form of mulches, compost, or manure creates a soil that is biologically active, with good structure and capacity to hold nutrients and water. Decomposing plant materials will support a diverse pool of microbes, including those that break down organic matter into plant-available nutrients as well as others that compete with plant pathogens in the soil and on the root surface.

## **Making beds**

Strawberries grow best on beds. Beds are made by creating rows of soil mounds which should typically be about a meter wide. These beds help to increase the soil depth, improve the internal soil drainage and the general drainage of the land; excess water drains away through the ditches in between the beds.



*Strawberry beds*

## **Strawberry variety selection**

There are six main varieties of strawberries grown in Kenya. These are:

- Chandler Strawberry
- Douglas Strawberry
- Aiko Strawberry
- Pajaro Strawberry
- Fern Strawberry
- Cambridge Favourite Strawberry

All these varieties can grow well in all parts of Kenya provided the soils are well drained. The selection of the variety to grow is based on the needs of the market to which you will be selling your fruits and your personal preference.



## 1. Chandler strawberry



This is the most preferred variety by most Kenyan farmers. The vigorous, high-yielding, Chandler strawberry plants produce very desirable strawberries. Chandler strawberries are very large, firm, and produce within 60 -75 days of planting. The strawberries fruits vary from being long and wedge-shaped to large and conical. They are a brilliant red

colour, glossy, and have an exceptional flavour Chandler strawberries are good for eating fresh or shipping and are very good for freezing. They are, however not the best for processing.

## 2. Douglas Strawberry

This is another widely grown variety among the strawberry farmers in Kenya. This variety has a vigorous plant, clear foliage and grows in a semi-erect manner. It produces great fruits, of elongate conical shape and orange red colour. The fruits have firm flesh, red-colour with pink centre, good taste and resistance to transport damages. It is a high yielding variety.

## 3. Aiko strawberries

This variety produces uniform fruits that are large, long and of conical shape with a pointed end. The fruits have firm flesh, pale red colour, slightly sweet and very resistant to transport damages. It is a very high yielding variety.

## 4. Pajaro strawberry

It is a variety suited for areas that do not receive a lot of sunshine. Its fruits have a symmetrical shape a mild colour and flavour. It is late maturing, with low production hence not popular.

## 5. Fern Strawberry

It is high yielding variety and its fruits have a firm skin and are very sweet. It is good for fresh market and processing. It offers good sized, firm, sweet berries. It is an ideal addition to the edible garden since it is also very attractive when used as a ground cover or border plant. It can be grown well in containers.

# Strawberry plant propagation

There are three main ways to propagate strawberry plants. New plants can be grown from strawberry seeds, existing plants can be divided and transplanted once multiple crowns have been grown (division of rhizomes), or the runners that strawberry plants put out can be controlled, guided, and caused to root where clone plants can be utilized most efficiently.

The division and the runners methods are the most commonly used in Kenya (and the only ones available so far). So we shall discuss these two methods.

## 1. Division of Rhizomes

Many types of strawberry plants will, either by nature or if encouraged by pruning runners, put out lateral crowns at the base of the strawberry plant.

These lateral crowns can be divided and replanted to propagate strawberry plants. Additionally, the genetically generative rhizomes of strawberry plants can, under the right circumstances, be divided into multiple pieces with each piece being sufficient to grow a new plant.



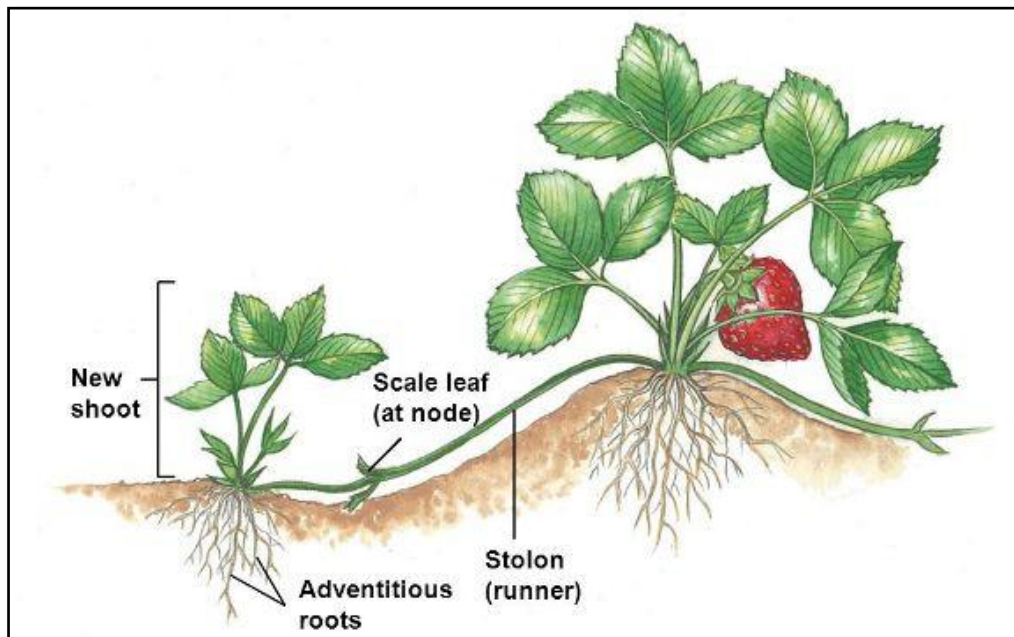
There are, however, several drawbacks to this type of strawberry propagation. Often, the mother plant will be compromised (if not done correctly) and will die. Thus, the net increase of strawberry plants is diminished. Also, it tends to be more labour-intensive and technical as the division or cutting takes both precision and a bit of expertise. However, for well-funded or commercial operations, this division can be used to propagate cloned plants quickly and extensively.



## 2. Strawberry Propagation by Runners

Growing strawberry plants from a runner is, for most, the easiest and quickest way to propagate strawberries. If you plant a strawberry seedling of any variety available in Kenya today, it will produce at least a few runners.

The strawberry runners are stolons (creeping horizontal plant stems that take root at points along its length to form new plants). These horizontal stems are sent outward from the base of the strawberry plants.



At variable distances new strawberry plants will form (at nodes). This is possible because of a strawberry plant's ability to form adventitious roots. These specialized roots are formed at the nodes along a runner. Wherever these roots touch nutritious soil, they will continue to grow into that soil and establish a new clone plant that is genetically identical to the plant that originally set forth the runner.

Due to this aspect of runners, it is relatively easy to propagate strawberry plants using them. The long, flexible intermodal parts of the runners allow them to be bent and positioned according to the desire of the gardener. To collect new clone strawberry plants, all one has to do is direct the runners so that the adventitious roots will grow down into the ground or a seedling container that can even be movable.

Once the adventitious root has established the new clone plant, separate the new plant from the mother strawberry plant by snipping the runner. If it has been established for a while, the runners will eventually shrivel and snap on their own. But, as long as the new plant is well-rooted, no growth will be hindered by snipping or snapping the runners.

## Where to buy initial strawberry seedlings

The contacts of suppliers of strawberry seedlings listed below are as January 2017. We shall do our best to keep updating this booklet during which times we shall revise the contacts information.

Provider	Price per unit	Contacts
KARLO - Thika	60	Tel. 020-2055038 E-mail: <a href="mailto:director.hri@kalro.org">director.hri@kalro.org</a>
KALRO - Tigoni	60	Tel: 020-2022052 or 0727 031783 Email: <a href="mailto:kalro.tigoni@kalro.org">kalro.tigoni@kalro.org</a>
Capetoda Smart Farm, Kiambu	30	Tel: 0724 786319
The Strawberry Farm, Uthiru	40	Tel: 0723 701237
Strawberry Farm, Mweiga	30	Tel: 0727983131

Most of the above providers have the Chandler variety.

## Planting, field organisation and spacing

Well rooted runners can be planted directly into a well prepared land. However, it is a good practice to first raise the seedlings in a nursery to ensure that their roots become well developed. Such seedlings when transplanted into the main field grow with a lot of vigour and strength and end up producing more. It is therefore advisable that when you buy seedlings from existing farmers, you go for the ones that are well rooted preferably grown in nursery tubes.

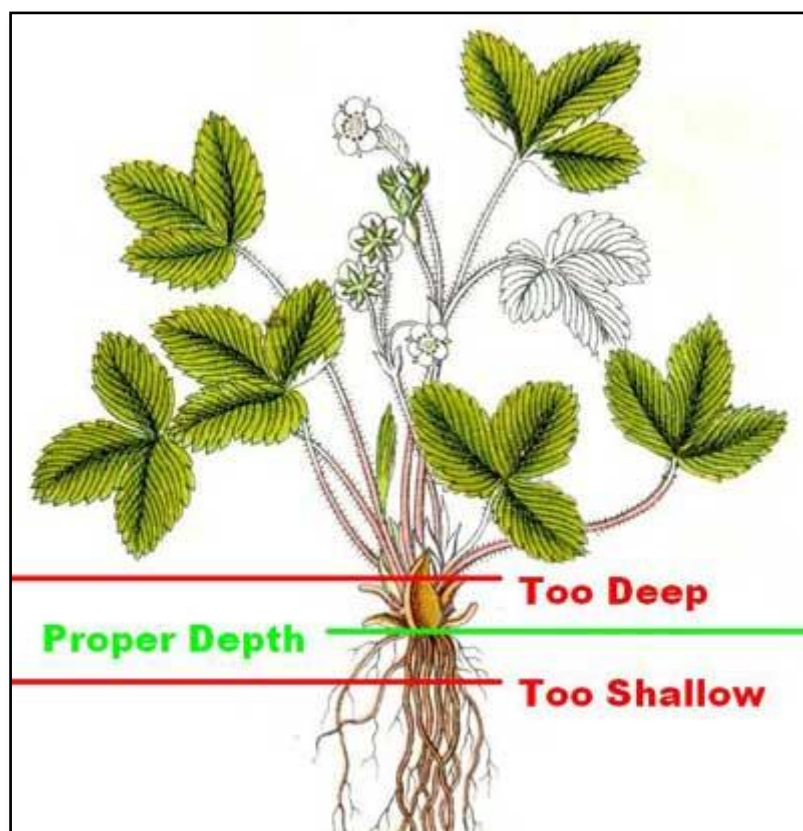
As mentioned earlier, strawberries are best grown in raised beds. The advantages of growing strawberries on raised beds include:

- 1) They reduce the risk of water logging and soil-borne diseases.
- 2) They increase the available rooting depth on shallow soils.
- 3) They warm up quickly and so produce early crops.

The beds should be one meter wide and at least one foot deep. You can make beds of any desirable length and leave a path of about 50cm wide between the beds. Level the beds using a rake, and water the whole bed in preparation for planting. The ridge should have an even curve and the soil broken down to a fine texture.

In modern strawberry farming, black polythene of 200 gauge is laid over the beds and the seedlings planted in holes made through the polythene. This has many advantages as will be discussed later in this booklet and it is our recommendation that you use this method. When growing your strawberries under irrigation, the drip line should be laid along the top of the ridge such that water drips directly into the holes and onto the plant roots. However, you can still grow strawberries without using this method.

The seedlings should be covered adequately to ensure that all the roots are under the soil surface. However, you should be careful not to cover the seedling too much.



The spacing recommended by the Kenya Agricultural and Livestock Research Organisation (KALRO) for strawberries in Kenya is 45 cm between the rows and 30 cm from plant to plant. However, observations from practical farming shows that a 30 by 30 cm spacing is also adequate especially when using the plastic mulching which eradicates the need for manual weeding.



# Caring for strawberry plantings

## Pruning

Pruning of the strawberries starts at early stages of establishment. Immediately after transplanting, you should remove the existing flowers and small fruits. Yellowing leaves and those that look old and unhealthy should also be removed. Pruning continues throughout the year and is done mostly during the cold season when the plants go into a rest.

## Irrigation

The best method of irrigating strawberries is the drip irrigation method. This method ensures that it delivers water right at the roots of each plant thereby minimising wastage.

During the first month after transplanting, the crops should be irrigated daily in the afternoon. After the first month, irrigation can be done 2 to 3 times a week. While it is important to irrigate strawberries throughout the production period, it is crucial to ensure that the soil does not become water logged since this induces root rot.

## Weed control

Weed control is a major challenge for strawberry growers in Kenya. Besides competing for water and nutrients, weeds provide alternate hosts for pests and they alter the microclimate around the plants, leading to higher disease pressure. Weeds in strawberry farms are controlled using the following methods:

### First tillage

The first tillage during land preparation is the first step towards weeds control. This provides lasting benefits in weed control. Eliminating perennial weeds can be achieved with repeated cultivation and using green manure. During this cultivation, cover crops that do not require the same essential nutrients as strawberries should be planted. A good one to use is sweet potatoes. However, you should keep in mind that excessive cultivation can lead to undesirable consequences such as soil erosion, reduced soil organic matter, and breakdown in soil structure resulting in compaction and reduced permeability.

## **Regular hand weeding**

Once plants are set, regular hand weeding, hoeing, and cultivation are required throughout the first year. You should never let weeds go to seed. If a first year planting is healthy, dense, and weed free, then weed problems will be much less in the second and subsequent years since the strawberries will cover them suppressing their growth.

## **Mulching**

Weeds are effectively suppressed using plastic mulches. Various types and colours of these mulches are available, but whichever type is chosen, it is essential to select the correct width and thickness to last the life of the crop.

However, it is noteworthy here that clear mulches do not suppress weeds. White and black polythene laid with the white side up is useful for delaying weed control. The white side reflects light and heat, keeping the soil and therefore the roots cool, whilst the black side suppresses weed growth. This is the best plastic mulch to use in the hotter areas of Kenya such as Eastern and parts of Rift Valley.

In the colder regions such as the central and western highlands of Kenya, strawberry farmers can use black plastic mulching. Such mulches result in soil warming, and can advance cropping by up to a week while still performing the important task of suppressing weeds. However, in very hot sunny weather, fruit resting on the black polythene can be damaged by the heat. In such cases, you should use straw to protect the berries from 'cooking'.

In addition to weed control, using plastic mulches also keep soil moisture by preventing evaporation from the surface. The mulches also protect the berries from touching the soil and rotting and also keep them clean.

However, plastic mulches have their disadvantages:

- i) Certain pests, in particular vine weevil, find the microclimate beneath the polythene very attractive and their numbers can build up rapidly.
- ii) The runners cannot root through the plastic mulches hence where the mulches are used the field cannot be used for further propagation.
- iii) Certain materials used for making the mulches dictate that the mulch be removed after one year in order to meet organic farming standards. Those that can be used throughout the productive period of strawberries are very expensive.

## **Pests and disease control**

Before we get to discuss the pests and diseases that affect strawberries in Kenya, allow me to make a forward remark. The development of disease and insect damage is highly dependent on characteristics and conditions of the crop (host), the pathogen/pest population, and the environment. These factors all must be conducive before disease development and/or considerable insect damage occurs.

Characteristics of the host that influence disease and pest susceptibility include the host's vigour, physiology, and variety (genetics). Aggressiveness or virulence, abundance, and physiology are characteristics of the pest or pathogen populations that influence their ability to cause disease or damage.

To successfully minimize disease and pest damage, the relevant aspects of the host, pathogen/pest, and environment must all be managed within specific timeframes.

## **Strawberry diseases**

The following are the common strawberry diseases in Kenya and their organic control measures:

### **1. Leaf Blight** (*Phomopsis obscurans*)

This disease causes the strawberry leaves to begin having small, circular to irregular, reddish, or purplish spots. As they expand, the cells at the spots' die and the centres turn light brown with a dark purple halo. Older spots along major leaf veins develop into large V-shaped lesions that eventually kill the leaf.

Heavy leaf infections can inhibit the production of flower buds. Fruit may also be infected in some instances.

### **Leaf Blight Management Options**

#### **Cultural management:**

Destroy infected leaves at renovation (e.g., mowing and burying).

Promote air circulation by increasing plant spacing and employing effective and early weed control measures.



## **2. Leaf Scorch** (*Diplocarpon earliana*)

Dark purple leaf spots about one eighth to one quarter inch in diameter appear scattered over the upper leaf surfaces or petioles. These spots differ from those of leaf spot in that they are purple throughout (no light centres). Numerous infections can cause a leaf to appear red or light purple and eventually to dry up and appear to have been burned (scorched).

Heavy leaf infections can inhibit the production of flowers and produce inoculum for infection of the fruit caps.

### **Leaf Scorch Management Options**

Some strains of strawberries have shown resistance and tolerance to leaf scorch. If you identify such, propagate more plants from them.

#### **Cultural management:**

The cultural management is the same as that of leaf blight.

## **3. Leaf Spot** (*Mycosphaerella fragariae*)

Initial lesions (affected spots) on leaves begin as small, irregularly shaped purple spots. Mature lesions become approximately one eighth to one quarter inch in diameter, remain relatively round and the centres of lesions turn from purplish brown to grayish white. The pathogen primarily infects young, expanding leaves and petioles, and occasionally fruit (black seed).

Heavy leaf infections can inhibit the production of flowers and produce inoculum for infection of the fruit caps.

### **Leaf Spot Management Options**

Some strains of strawberries have shown resistance and tolerance to leaf spot as well. If you identify such, propagate more plants from them.

#### **Cultural management:**

The cultural management is the same as that of leaf blight.

## **4. Powdery Mildew** (*Podosphaera aphanis*)

The edges of infected leaves roll up, sometimes revealing a white, powdery layer of mycelium and spores on the lower leaf surfaces. Purple to reddish blotches also occur frequently on the lower leaf surfaces. Symptoms are usually not evident during the cold season.

### **Powdery Mildew Management Options**

#### **Cultural management:**

Manage weeds effectively and timely and ensure correct planting spacing to promote good air circulation.

Avoid excessive nitrogen and sites with poor air drainage.

## **5. Gray Mold/Botrytis Fruit Rot (*Botrytis cinerea*)**

Botrytis fruit rot usually begins as a small lesion (sick spot) at the blossom end or where a berry is touching another infected berry. The infected portion is firm and brown while the berry is still green, but it expands and softens as the fruit ripens. A powdery gray mass of spores covers infected berries if the weather remains humid and/or air circulation is poor.

### **Gray Mold (Botrytis Fruit Rot) Management Options**

#### **Cultural management:**

Disease control is greatly aided by managing weeds and by using other practices that promote good air circulation and rapid drying of the fruit such as regulating plant density.

Avoid applications of nitrogenous fertilisers especially on the onset of rains or the irrigation regime as this can dramatically increase the potential for infection.

Prompt harvest of ripe fruit helps reduce disease development and spread. It may be beneficial to employ a picker to remove only overripe and diseased fruit to prevent infection of clean fruits by other pickers. Overripe fruit should not be consumed. Cull piles should be buried or otherwise physically removed from fields during harvest.

## **6. Anthracnose (*Colletotrichum acutatum*)**

One or more circular spots occur on the fruit. Spots originally are tan or light brown but become darker and sunken. Sunken spots are usually about one eighth to one quarter inch in diameter and may be covered with pink slimy spore masses during wet or very humid periods. The disease may occur on both green and ripe fruit, but is most common on ripe fruit following periods of warm, wet weather.

### **Anthracnose Management Options**

#### **Cultural management:**

Provide good air circulation by controlling weeds and reducing planting density. The anthracnose fungus is spread throughout a planting by splashing raindrops or sprinkler irrigation hence the use of drip irrigation and straw mulch may reduce the rate of disease spread relative to bare ground (less rain splash).

## **7. Leather Rot (*Phytophthora Cactorum*)**

Infected areas on immature fruit are brown, whereas those on maturing fruit appear bleached out. On all fruit, the infected areas are tough, leathery, and discoloured on the inside as well as the outside of the fruit. Diseased fruits have a pungent smell and bitter taste.

Leather rot is most severe during periods of abundant warm rains during the fruiting period and in flooded soils.

### **Leather Rot Management Options**

#### **Cultural management:**

Plant only on a well-drained site or provide supplemental drainage. Growing strawberries on raised beds will also reduce disease severity. Minimize soil flooding through site selection; by avoiding planting in ruts; and by preventing or reducing soil compaction.

Provide an extra layer of straw mulch between rows throughout the fruiting season. The mulch provides a physical barrier between the soil-borne pathogen and the susceptible fruit.

### **8. Red Stele (*Phytophthora Fragariae*)**

Red stele is caused by a soil-borne aquatic pathogen (*Phytophthora*) that may persist in the soil for many years even when strawberries are no longer grown. Symptoms of infection often appear just before harvest. Diseased plants appear stunted and off-colour, and will often wilt and collapse if the weather becomes warm and dry.

Because these same symptoms may be caused by other factors that destroy roots (such as root-feeding insects), the diagnosis depends on an examination of the plant's root system. In a diseased plant, the roots have a "rat-tail" appearance caused by loss of the fine branched feeder roots from the main fleshy roots.

The main fleshy roots are rotted from the tips back toward the crown. Cutting or scraping away the white outer portion (epidermis and cortex) just above the rotten areas in early infections sometimes reveals a reddish root core (stele). Infected plants usually appear in groups and are frequently found in the lowest or wettest parts of a field.

### **Red Stele Management Options**

#### **Cultural management:**

Because the red stele fungus is particularly active in extremely wet soil, plant only on a well drained sites or provide supplemental drainage. Growing strawberries on raised beds will also reduce disease severity.

### **9. Black Root Rot**

Black root rot constitutes a complex set of symptoms caused by one or more of the following organisms: nematodes, root rot fungi (*pythium spp. Rhizoctonia spp.*).



Black root rot is most commonly observed in older plantings or on heavy compacted soils. Over time, plant vigour and productivity declines. Feeder rootlets die, and fleshy structural roots deteriorate and become blackened. The blackening starts as patches along the length of the root, rather than from the tip back.

This disease is often associated with fields having a long history of strawberry production. Because no single cause of black root rot has been defined, there is no single straight control.

### **Black Root Rot Management Options**

#### **Cultural management:**

Fields with high nematode populations may be more prone to black root rot development. Such fields should be avoided. Also check nematode populations prior to planting.

Cultural practices that reduce soil compaction, improve aeration, and promote good drainage are beneficial for reducing disease.

Rotating a field out of strawberries for at least 2 - 3 years before replanting is strongly recommended to minimize black root rot damage.

Measures to control red stele will also help alleviate black root rot.

Cover crops such as brown mustard and Indian grass and incorporation of compost can also provide disease suppression.

#### **10. Angular Leaf Spot (*Xanthomonas fragariae*)**

Minute water-soaked lesions appear first on lower leaf surfaces. These enlarge to form angular spots usually bordered by small veins. When held up to the light spots appear translucent, but are dark green under reflected light. Spots may ooze bacteria under moist conditions, which dry to form a whitish scaly skin.

Lesions eventually become visible on upper leaf surfaces as irregular reddish brown spots. Calyxes may also become infected. The disease is favoured by day temperature around 20°C, low to near freezing night temperature, and precipitation events such as rain, overhead irrigation or heavy dews.

This disease does not have any straight organic control measures since it is much related to the air temperature.

## **11. Verticillium Wilt** (*Verticillium albo-atrum*)

Plants are affected most severely during their first year of growth. Outer leaves turn brown and eventually collapse, but inner leaves remain green until the plant dies. This symptom distinguishes Verticillium wilt from other root and crown disorders.

Affected plants may occur uniformly, but more typically, they appear scattered throughout a field.

### **Verticillium Wilt Management Options**

#### **Cultural management:**

In problem areas plant strawberries after 2-3 years.

Do not rotate strawberries with crops such as tomatoes, potatoes or eggplant, since these crops are also susceptible to this disease.

Many weeds are hosts of the Verticillium fungus and should be strictly controlled in current and future planting sites to keep *Verticillium* inoculum low.

## **Strawberry pests**

The insects and mites that are considered major pests in strawberries can vary in occurrence both from year to year and from place to place.

The following are the common insects and mites found in strawberry plantings in Kenya.

### **1. Root Weevil**

There are different species of weevils, but most commonly found in strawberry plantings are the strawberry root weevil, the black vine weevil, and the rough strawberry root weevil.

These pests attack the roots or crowns of plants while in the grub stage. All have a one-year life cycle, although some are known to live longer.

Beds with heavy infestations show distinct patches or spots that appear stunted and have substantially reduced yields. The roots of injured plants are badly eaten away, and continued infestation may destroy infested plants.

### **Root Weevil Management Options**

#### **Cultural management:**

Rotate out of strawberries for at least 1 year to reduce root weevil density. A barrier (plastic fence) can prevent adults from moving from an infested field to a new field to be planted.

## **2. Sap Beetle**

Sap beetle adults make cavities in ripe and overripe fruit as well as spread spores of decay organisms. The larvae also feed on ripe and overripe fruit and are a source of contamination in harvested fruit.



Sap beetles are occasionally found in high numbers in later ripening strawberry plantings. Two species feed on strawberry fruits: the common picnic beetle, one quarter inch long with four yellow spots on the back, and the smaller, brown strawberry sap beetle without distinctive markings. Strawberry

sap beetle is the more serious pest because it does not limit its activity to over-ripe fruit. As strawberries ripen, beetles move into the field and begin feeding and laying eggs. Fruit touching the ground or straw mulch appears particularly vulnerable.

### **Sap Beetle Management Options**

#### **Cultural management:**

Keep the field free of ripe and over-ripe fruit.

## **3. Two-Spotted Spider Mite**



These mites begin feeding on the undersides of new leaves, sometimes resulting in small yellow spots on the upper leaf surfaces. These symptoms do not occur in all cases, however, and are not seen later in the year. Brownish dry areas on the lower leaf surfaces are more characteristic of damage. Later, the entire lower leaf may become dry and brown, giving it a bronzed appearance.

Heavily infested plants look dry and stunted, and their sparse new growth is yellowish and distorted. Damage is first seen and is most prevalent in dry areas of a field.

### **Two-spotted Spider Mite Management Options**

#### **Cultural management:**

Ensure plots are not over fertilized.

Provide adequate irrigation. Cool, moist conditions are unfavorable to mites.

Do not use other insecticides that kill predatory mites.

Mow and incorporate leaves at renovation.

### **3. Greenhouse Whitefly**

These are small, white insects that resemble flies but are actually more closely related to aphids. Whiteflies feed on young plants, causing stunting.



Whiteflies may reduce crop yields directly through their feeding on leaf tissue, which removes plant sap, stunts plant growth, and decreases sugars in fruit. They also produce sticky honeydew that they excrete during feeding. The honeydew may cover plants and support the growth of black sooty mould fungus. Greenhouse whitefly can also transmit viruses.

### **Greenhouse Whitefly Management Options**

#### **Cultural management:**

Successful management of greenhouse whiteflies requires an integrated program that focuses on prevention. Treatments are often necessary if strawberries are grown so that continuous plantings are present in areas where greenhouse whiteflies have become established.

No precise treatment threshold has yet been developed for greenhouse whiteflies on strawberries, but even feeding at relatively low densities after transplanting can result in yield loss. Treatment may be necessary when honeydew or moderate to heavy whitefly populations are apparent during periods of warmer weather for summer- and fall-planted berries. Select treatments carefully and use them only when monitoring indicates a need.

### **4. Leafroller**



Several species of moth larvae roll or fold strawberry leaves with silk. Leaf injury can be seen throughout the season, but an extremely large population is required before noticeable crop damage occurs.

#### **Leafroller Management Options**

##### **Cultural management:**

Remove accumulated trash around the plants to limit the potential for a large population build-up. This is especially important in second year fields where it is more likely for leafrollers to be present.

Because it is difficult to distinguish the light brown apple moth larvae from other leafrollers in appearance and behaviour, a preventive approach, consisting of sanitation and monitoring targeting all leafrollers is currently suggested for strawberry fields.

Remove dead vegetation from strawberry fields to reduce populations.



## **5. Aphids**



These soft-bodied insects usually occur on new shoots and buds in the crown of the plant and along the veins on the undersides of the leaves. When present in large numbers, they weaken the plant. Their honeydew promotes the growth of a black sooty mould, which makes the fruit and leaves sticky, hindering harvest and reducing marketability. More important, aphids are vectors for several serious

virus diseases. Aphid populations often are controlled by natural enemies and do not require insecticide control.

### **Greenhouse Whitefly Management Options**

#### **Cultural management:**

Some row covers (such as plastic tunnels) have reduced aphid populations to below economic levels, but the costs are substantial and the economic viability for large-scale plantings has not been established.

Controlling dust is important to facilitate parasite and predator activity. Aphid populations tend to be especially large in plants that receive an excess of nitrogen fertilizer.

## **6. Slug**



These soft-bodied molluscs resemble snails without a shell. Slugs feed on ripening fruit, leaving holes in the berries. They are most active at night and during cool, wet weather. Populations are greatest when the weather is damp and the planting is mulched. Translucent silver to whitish slime trails are visible on damaged plant parts.

### **Slug Management Options**

#### **Cultural management:**

Eliminating mulch will reduce slug populations, but will cause other problems, so this is not recommended.

Good sanitation and weed control helps to reduce slug populations. In areas where slugs are a problem, avoid perennial clovers as cover crops and rotate out of alfalfa or other perennial legumes 1 year prior to planting establishment.

Overhead irrigation creates conditions especially favourable to slugs so drip irrigation is most suitable. If overhead irrigation must be used, irrigate during morning hours to allow foliage to dry before evening.

## **7. Wildlife Management**

Various birds and rodents can damage a strawberry planting. Closely mowing the area around the planting will reduce the habitat for moles and mice. The habitats (woodlots) of predators that feed on rodents (hawks, owls, foxes) should be protected around the area.

There are also various birds that eat the ripe berries thus lowering yields and quality.

### **Animal Pest Management Practices**

#### **Mice and Moles**

Remove dropped fruit and destroy habitat including elimination of surrounding vegetation. Monitor to determine the need for management.

Birds can be controlled using fishing nets or covering the crops in plastic tunnels as in the picture below.



## **Strawberry Plantation Renovation**

Renovation of strawberry plantings controls plant density, maintains plants in manageable beds, and selectively removes older plants. After the first growing season, most strawberry plantings become overcrowded and the plant population becomes too high because of the perennial growth habit and prolific runnering.

Overcrowding reduces quality and yield. Fruit size, quality and yield decrease when the plant population becomes too great. Only six or seven plants per square foot are needed for best yields.

Disease problems also increase when plantings become too dense, making foliage and fruit slow to dry after rains and more difficult to adequately spray when need be.

Renovation practices consist of the following activities:

- Cutting off strawberry leaves 1 inch above the crown. This is simply done to remove excess leaves. It is best done one week after the first picking.
- Narrowing the rows with and thinning plants in the rows by hand hoeing. This is done to maintain a healthy spacing between the rows and the plants.
- Application of fertilizer: you should constantly monitor the soil quality of your orchard to figure out which nutrients are missing and need replenishment. It is essential to apply fertilizers during renovation.
- Replacement of plants that were eradicated due to disease infection or those that died from attacks.

## Harvesting strawberries

Strawberries are ready for picking when the fruits have coloured to that shade of red which is characteristic of that particular variety. For example, the Chandler variety which is the most preferred by Kenyan farmers has a shiny red colour that is very attractive.



At this stage of development, the fruits will have developed their full flavour, sweetness and aroma.

They are best picked at this stage for eating fresh, freezing and making into jam; they will keep very satisfactorily for forty-eight hours in a domestic refrigerator at a temperature of 2°C.

When necessary, for instance, if the family is going away for a few days, the fruit may be picked when two thirds of the berry has turned to pink. This is also the right stage to pick strawberries meant for packaging for the market. Such berries should also be stored in a refrigerator at 2°C where they will remain in a satisfactory condition for up to ten days, during which period they will gradually ripen, though the quality and flavour will not equal that of fruit that ripens on the plant.

Strawberries should always be picked with the green calyx in place and without bruising the flesh. The stalk of each berry should be taken between the thumb and forefinger and severed by the nails pressing each side. A little practice soon enables this to be done so that the berries can be placed in the picking container without the actual fruit being touched or bruised.

Fruits should only be picked into shallow containers, because by using deeper ones, the lower fruits will be bruised by the weight of fruit above pressing down on them.

## **Marketing strawberries**

Owing to the low number of farmers and the larger and growing market for strawberries, marketing this crop is currently very easy. There is a huge ready market for strawberries and even the existing farmers are struggling to meet the demand.

However, that does not mean you can sit in your farm for customers to come looking for you. Penetrating into the market, especially if you are just getting started, takes quite a bit of effort. Thereafter, once you have established customers and your name is circulating as a credible farmer of strawberries, the buyers will come looking for you.

### **1. Search for buyers in urban areas**

Strawberries are mostly consumed by urban dwellers. As we mentioned in an earlier section of this booklet, siting your farm close to a town or city, especially Nairobi, has massive advantages when it comes to marketing.

However, you can still cultivate your crop in any place and transport your produce to the nearest towns. At first, you will need to do a lot of marketing. The best method I have seen is to use business cards or information pamphlets and give these to targeted individuals. You may have to carry sample with you as you do this kind of marketing.



## **2. Tap the immense power of social media**

You will appreciate the power of social media in marketing goods in the world today – you most probably got this guide through social media. It is very easy to market your products through social media, Facebook and Whatsapp being the platforms with most people.

All you need to do is take a few nice photos of your products and post them as items for sale on Facebook and Whatsapp groups. By so doing, your products get around very fast.

## **3. Sell to institutions and processing companies**

Strawberries are sold in all major Supermarkets such as Tuskey, Uchumi, Nakumat, Naivas etc. There is a huge demand by these chains that is far from being satisfied. The only challenge in working with supermarkets is that you must enter into a contract which requires you to have a huge production capacity that consistent. You will also have to wait for payments long after you have delivered your produce.

Hotels such as Serena, Norfolk, Safaripark, and all the tourist lodges countrywide are also a good market. Each of them will have their own regulations so you have to visit each of them in person to negotiate your deal.

Major Hospital such as Getrudes, Aga-khan; Nairobi, Karen and Kijabe, and main green grocers such as Corner shop, Zuchini, City park, City market and Spring valley also offer a ready market for your strawberries.

Food Processors such as Trufood and Zesta and milk processors such as Limuru processor, Brookside, Fresha, KCC and Uplands Premium are potential buyers since most of them are currently importing their strawberries due to lack of volumes and unreliability of supply from Kenyan farmers.

## **4. Engage in value addition**

While most of the strawberry fruits are eaten fresh, some are canned or processed into jams and juices. Strawberries are also used in the processing of milk shake and yoghurt, and in cake decorations as well as being used commercially as flavouring for candies and cosmetic items.

As an individual, you can engage in the processing of jams and juices. To do this you will require training and JKUAT is the best institution for offering training on this. Other farmers such as The Strawberry Farm (find contacts in the table under “where to buy initial strawberry seedlings”) also offer such training.