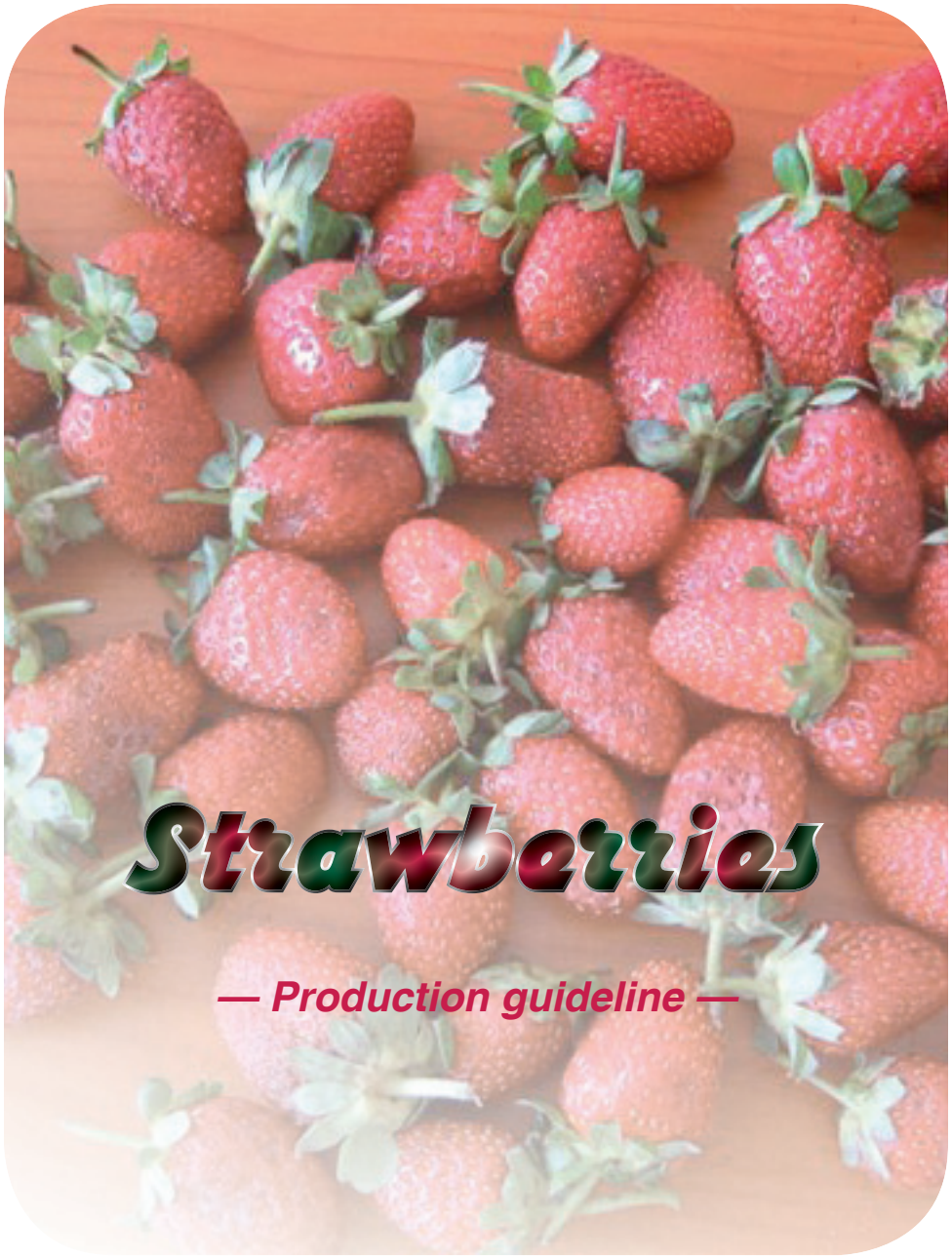

Strawberries

— Production guideline —

agriculture,
forestry & fisheries

Department:
Agriculture, Forestry and Fisheries
REPUBLIC OF SOUTH AFRICA

Strawberries

— Production guideline —

March 2010

Department of Agriculture, Forestry and Fisheries

2010

Printed and published by

Department of Agriculture, Forestry and Fisheries

Compiled by

Directorate Plant Production in collaboration with the ARC

Design and layout by

Directorate Agricultural Information Services

Obtainable from

Resource Centre
Directorate Agricultural Information Services
Private Bag X144
PRETORIA
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CONTENT

GENERAL

Scientific name: *Fragaria X ananassa* Duch.

Common names: Strawberry (English); Aarbei (Afrikaans), Amaqunube (Xhosa)

Origin and distribution

Strawberries were known to exist in the Roman Empire from 234 BC. Apparently wild strawberries flourished in ancient Rome as it was mentioned in writings of ancient Roman authors such as Virgilius Marco (70 BC –9 BC), Ovidius Naso (43 BC–17 BC) and Plinius Secundus (79 BC–23 BC). The Greeks, on the other hand, were familiar with strawberries but did not utilise it as they were not allowed to consume anything which had a red colour (Lowe, 2006). Strawberries were considered to be medicinal by the Romans. However, during the middle ages pregnant women avoided strawberries, as they believed that consuming it or even touching it, would cause the children to be born with strawberry-shaped birthmarks.

The dainty, red, heart-shaped fruit is often associated with romance, passion, innocence and healing. Even William Shakespeare, the much acclaimed English author, decorated the handkerchief of Desdemona, one of the characters in the drama Othello, with strawberries (Anon, 2006a). One of the prominent and colourful figures in the French Revolution, Madame Thérésa Tallien, was said to have bathed in the juice of strawberries as she believed strawberries had healing properties (Anon, 2006b). According to the extension services of the University of Illinois (Anon, 2006a) and Lowe (2006), strawberries were already consumed by the Cherokee tribes in the United States of America prior to colonisation circa 1600. Apparently a kind of bread was made by mixing the strawberries with corn meal which was then baked. The colonists modified the recipe, resulting in what is presently known as strawberry shortcake.

According to Anon (2006a), native forms of strawberries adapt to various climates and are indigenous to every major continent except Africa, Australia and New Zealand. The first documented botanical illustration of a strawberry plant appeared as a figure in Herbaries in 1454.

The name strawberry is most probably derived from the Anglo-Saxon word strawberiġe *viz*. straw meaning spread around and beriġe meaning berry (Lowe, 2006). According to Anon (2006b), the name Fragaria is most probably derived from the word “fragans”, referring to the odorous flesh of the fruit (Anon, 2006b).

The modern strawberry (*Fragaria X ananassa*) is a hybrid between the domesticated *Fragaria virgiania* Duch. and *Fragaria chiloensis* (L.) Duch. (Robertson, 2006). According to Lowe (2006), an English horticulturist, Thomas Andrew Knight, became this first person to practise large-scale strawberry breeding, which led to the large, delectable strawberries presently available.

Strawberries were introduced to South Africa by Jan van Riebeeck, the first Governor of what was then known as a Dutch settlement. The first reference on strawberries was on 11 October 1656 when he recorded in his diary that ''…currants and strawberries are also thriving well….'' (Karsten, 1955).

Production levels and areas

South Africa

According to the national Department of Agriculture (2006), the production, gross value, trade on fresh produce markets and purchases for processing of strawberries produced in South Africa from the 1999/2000 season up to the 2004/05 season were as follows:

Year	Total production (t)	Gross value (R1 000)	Trade on fresh produce markets		Purchases for processing	
			Volume (t)	Average price (R/t)	Volume (t)	Average price (R/t)
1999/00	7 257	28 832	3 241	5 199	1 554	1 554
2000/01	5 514	24 365	2 674	5 511	1 306	1 306
2001/02	4 102	22 117	1 858	7 188	1 202	1 202
2002/03	4 794	25 636	2 300	6 920	1 317	1 317
2003/04	6 389	29 817	3 031	5 964	1 710	1 710
2004/05	4 744	38 065	2 229	10 954	1 356	1 356

International

Major international strawberry producers (FAO, 2006) for 2005 were as follows:

Rank	Country	Income (international $1 000)	Production (t)
1	United States of America	1 033 847	974 500
2	Spain	326 757	308 000

Rank	Country	Income (international $1 000)	Production (t)
3	Russian Federation	230 215	217 000
4	Japan	212 180	200 000
5	Korea, Republic of	212 180	200 000
6	Poland	190 962	180 000
7	Turkey	169 744	160 000
8	Italy	163 904	154 795
9	Mexico	159 412	150 261
10	Germany	139 949	131 915
11	Morocco	112 562	106 100
12	Egypt	106 090	100 000
12	France	55 061	51 900
12	United Kingdom	50 923	48 000
12	Belgium	44 558	42 000
12	Ukraine	38 192	36 000
12	The Netherlands	38 192	36 000
12	Serbia and Montenegro	36 071	34 000
19	Iran, Islamic Republic of	28 644	27 000
20	Chile	27 159	25 600

Description of the plant

Roots

The relatively shallow roots of a strawberry plant are mainly concentrated within the top 20 to 30 cm of soil. The older, brownish roots can clearly be distinguished from the younger, white-coloured capillary roots. Water and nutrients are absorbed by the capillary roots while the older roots are responsible for transporting the nutrients and water to the other parts of the plant. The colour and consistency of the vascular systems of the roots will determine the health status of the plant. White and flexible central vascular strands within the older roots would be an indicator of a healthy plant.

Stem

The stem of a strawberry plant is compressed to form a rosaceous (clustered) crown of about 2,5 cm in diameter. However, this crown cannot be seen as it is covered on the outside by the overlapping bases of the leaves. The rosaceous growth is characteristic to strawberries. Strawberries produce long, slender runners which produce a new bud, with roots, at the furthest point of each runner. This allows the plant to reproduce vegetatively.

Leaves

Strawberry leaves usually consist of three leaflets. The colour of the upper leaf surfaces can vary from light green to very dark green while the bottom surfaces have waxy, light-green colours with protruding veins.

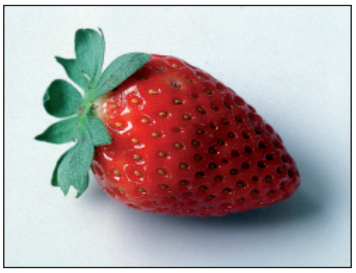
Flowers

The fragile, white flowers have a typical rosaceous structure and are borne in racemes or inflorescences. A raceme is a flower cluster in which the flowers are borne on short stalks along a long main stem. The berries from the primary flowers will therefore ripen first. The flowers consist of the normal floral parts comprising the green sepals on the outside, followed by the white petals and the anthers (male parts). The pistils (female parts) are located in the in the middle and are arranged around a swollen receptacle (floral axis). The plants will only initiate flower-buds during times of cool, short daylight, i.e. from April to September. Maximum production will be determined by the performance and growth of the plants during the early part of the season (April to September). The more active the plants grow during this period, the more crowns will be formed. This will improve the production as each crown has the potential to bear two racemes.

Fruit

The fruit of the strawberry plant is very peculiar. The receptacle (floral axis) swells out into a fleshy, dome-shaped or flattened mass in which the pips or seeds are embedded. The berries are known for their bright red colour and are heart-shaped. However, the colour of the flesh can range from

white to dark red. The size and shape can differ, depending on the cultivar or the environmental conditions. The length of the fruit can vary between 2 and 5 cm.



Seeds/nuts/pods

Cultivars

The choice of a specific cultivar will normally be determined by its climatic requirements, resistance to diseases, specific soil type requirements and the purpose for which the fruit will be produced, i.e. fresh consumption or processing. Two cultivars, *viz*. Selekta and Chandler™ would be an excellent choice for home gardeners and smaller farming enterprises, mainly because of their versatility.

Selekta

This is the most popular cultivar which is established throughout South Africa. The fruit is long and wedge-shaped, red in colour, has an attractive glossy shine and with a high sugar content. This cultivar is particularly suitable for the fresh market. The flesh in the centre of the fruit has a white colour. The fruit is reasonably firm although most of the large berries have a hollow centre. The first fruit of the season might be poorly coloured, with white shoulders, as it is usually produced under cold weather conditions. However, the colouring improves under more favourable conditions. This cultivar is reasonably resistant to leaf diseases, grows vigorously but is sensitive to late planting.

Chandler™

The fruit of this cultivar is firm, with a distinct strawberry aroma and has a high sugar content. It is generally a very popular cultivar for the fresh market. The sugar to acid ratio is good and therefore resulting in good eating quality. The fruit does not have the problem of “white shoulders” during the earlier part of the season and internal fruit has a uniform red colour. The fruit does not crack easily.

Climatic requirements

Temperature

Strawberries are more tolerant of variations in climatic weather compared to many other crops. However, climatic factors such as sunlight, tem-

perature, volume of water available and wind can influence the growth and production of strawberry plants. Although strawberries are grown in full sun, high summer temperatures have a negative effect on fruit size as well as fruit quality. Fruit size and quality is enhanced by cooler temperatures, more pollen would be available for pollination, the fruit will ripen gradually and better-shaped fruit will be produced. The root system will also experience less stress during cooler temperatures.

Rainfall

The volume of rain will play an important role in the successful cultivation of strawberries. Strawberry plants require large volumes of water and should never be allowed to wilt. Supplementary irrigation should therefore be applied to strawberries in areas such as the Western Cape Province, which has a winter rainfall season. Similarly, additional irrigation should be applied during dry periods within the summer rainfall areas. However, too much rain will cause the fruit to burst.

Soil requirements

Strawberries require well-drained, sandy-loam to loamy soils with a pH level between 5,0 and 5,5. However, strawberries can be grown in more clayey soils if a sufficient quantity of compost is added to the soil during soil preparation. Saline and waterlogged soils should be avoided.

CULTIVATION PRACTICES

Propagation

Strawberries should be replanted each year. Strawberry plants are usually propagated by runners. It is advisable to obtain virus and nematode-free plant material from your local nursery or from certified strawberry nurseries. The utilisation of your own runner plants should be avoided as it can lead to the spread of diseases and viruses. Nurseries use only superior selected and tested plant material which is disease free in order to ensure maximum production. The plants, especially the roots, should not be allowed to dry out before being planted. Plants and roots should be kept moist in soil or peat in a cool, shady area prior to planting.

Soil preparation

Soil samples should be taken in order to determine the water-holding capacity as well as the nutrient content of the soil. At least five sample holes

should be made in a plot of 1 ha (100 m x 100 m). A spade should be used to make a hole of 1 m wide, 1 m in length and 60 cm in depth. A vertical sod on the side of the hole to a depth of 30 cm must be taken and transferred into a marked plastic bag. The second sample should be taken the side of the hole in the bottom part of the profile (30 cm to 60 cm depth). The blade length of a new spade is approximately 30 cm.

Any layers in the soil, such as a stone or clay layer as well as the depth at which it occur should be noted. All stones larger than 10 cm in diameter may be removed from the sample. However, the number and sizes of stones not included in the sample should be noted. The samples can be sent to a reputable institution where the soils will be analysed. The sampling hole should be filled again. The bottom layer soil, in other words, the layer which was removed last, should be replaced first into the hole. This step is important as the bottom layer usually consists of more clay. If the bottom layer of soil is replaced into the top part of the hole, it can lead to soil compaction. The samples taken at the different holes should not be mixed or added together. This is important as the soils within one plot can differ in texture. The position within the plot where the samples were taken should be marked.

The results of the soil analysis will indicate whether the soil is suitable for strawberry production and, if so, which kind of fertilisers as well as the quantity of fertiliser that has to be applied. Soil preparation prior to planting involves the following: Eradicating all the weeds; improving aeration as well as general fertility of the soil by applying matured compost; forming raised beds and rectifying the soil where required. This is also the stage to add lime to the soil in order to establish a soil pH(KCl) of between 5,0 and 5,5 and to correct the phosphorus (P) level to between 20 and 30 mg/kg. Lime applications will increase the pH levels while superphosphate or bonemeal will increase the P levels within the soil. Excessive application of lime will induce trace element deficiencies. Nitrogen (N) and potassium (K) are usually added after planting. Application of fertilisers containing sodium (Na) or chlorine (Cl) and poultry or other manure which is high in soluble salts, should be avoided as strawberry plants are sensitivity to saline soil conditions.

Strawberries are very sensitive to all nematode (eelworm) species. These nematodes attack the roots of the plants and can severely inhibit the growth of the plants. The occurrence of small, deformed growths (galls) on the roots of the plants is usually an indication of nematode infestation. Nematode infestation can be controlled chemically. However, chemicals which are used to control nematodes are dangerous and present a health

risk. Fortunately, nematodes can be controlled without chemicals by starting with nematode-free plant material and following crop rotation practices. Crops such as strawberries should be rotated with garlic, onions, carrots, beetroot, radish, spinach, lettuce, cabbages, beans and peas. A period of 2 years should have passed before the crop is established again on the same plot. Diseases and nematodes can partially be controlled by the addition of organic matter such as matured compost and manure. The organic matter stimulates microorganism activity within the soil in order to establish a natural balance.

Planting

Planting time

It is important to plant strawberries at the correct time of year as it is sensitive to changes in daylight length.

Planting dates for strawberries

Province	Time
Gauteng and summer rainfall regions	February to March
Free State	February to March
KwaZulu-Natal	March to June
Western Cape	March to May

Strawberries should be planted as early as possible during the above-mentioned periods as the degree of growth prior to winter will determine the production potential. Flower initiation is dependent on low temperatures and short days.

General planting methods

Strawberry plants should be planted at the correct depth. The crown of the plant must be above the soil surface (see picture below). The newly formed leaves would not be able to penetrate the soil surface if the plants are planted too deep. The crown will consequently rot and the plant will eventually die. However, the plants will be partially uprooted by strong winds if they are planted too shallow, resulting in poor growth and eventually poor production. Plants should be irrigated as soon as possible after planting in order to stabilise the soil around the roots. Irrigation should be applied daily for at least 10 days after planting. Most of the old leaves might turn brown and die after planting in certain weather conditions. However, new leaves develop and become visible within 7 to 10 days after planting. The

number of leaves, especially the number of crowns, which will be formed under favourable temperature and soil conditions prior to winter, will be a direct indication of the potential yield of the plants.

Spacing of plants

Strawberries are normally planted in staggered double rows with an in-row and diagonal spacing of 20 cm x 20 cm (see picture below). However, this spacing can differ. Plants should be spaced wider (30 cm x 30 cm) when planted early but closer (10 cm x 10 cm) when planted late.

Plants should not be spaced too densely as it will create favourable conditions for pests and diseases. It will also be difficult to harvest the fruit. Either 66 000 or 120 000 to 130 000 plants per hectare can be established, depending on the cultivar, climate or plant density.

Planting in containers

Strawberries can also be planted in containers such as planting boxes or even used motor vehicle tyres. The containers should be positioned in a sunny area which is sheltered from strong winds. Two to three tyres can be stacked and filled with well-prepared soil. Planting should be done in the same way as described above. Irrigation should be applied regularly.

Establishing strawberry plants on raised plastic-covered beds

Strawberry plants are usually established on raised planting beds which are covered by plastic mulch. This plastic mulch is used in order to control the weeds and to ensure that the fruit is kept clear of the soil surface as well as to prevent soil particles from splashing onto the fruit during irrigation. The paths between the beds provide access to harvesters.

Organic material such as straw, lawn cuttings, wood chips, bark or any other organic material can be applied between the beds. This organic material not only assists in conserving water, it also provides compost for the next year's crop and prevents sand particles from splashing onto fruit during irrigation. It is advisable to use raised plastic-covered beds if sufficient space is available. Any type of plastic sheeting can be used. However, black plastic sheeting (100 m in length, 1 m wide and 30 to 40 micron thick) is most commonly used by commercial producers. The plastic should be extended across the raised beds and anchored at the sides with a layer of soil. Individual plant holes (4 to 5 cm in diameter) can be burned or cut into the plastic.

Establishing strawberry plants on raised straw-covered beds

Straw can be used instead of the plastic to cover the beds. The plants should be planted in a similar manner as described previously. The use of straw is beneficial, as it is less expensive than plastic mulch, it prevents evaporation from the soil, prevents soil particles from splashing onto the fruit during irrigation and controls leather rot and weeds. The straw also provides a habitat for spiders which predate on other harmful insects. Straw is also an excellent source of compost, which will ensure long-term improvement of the quality of the soil.

Planting in containers

Strawberries can also be planted in containers such as planting boxes or even used motor vehicle tyres. The containers should be positioned in a sunny area which is sheltered from strong winds. Two to three tyres can be stacked and filled with well-prepared soil. Planting should be done in the same way as described above. Irrigation should be applied regularly.

Fertilisation

No lime or phosphorus should be applied after planting as it has already been applied during soil preparation. However, regular applications of nitrogen (N) and potassium (K) throughout the season are essential. Potassium is vital for the formation of flowers and to ensure quality fruit. Sufficient quantities of potassium will also ensure a good yield and quality fruit. Potassium should be applied monthly, starting from the date on which the first flowers appear. Strawberries also need a constant supply of nitrogen, especially after they have been planted. Any source of nitrogen can be used. However, care should be taken when using granular fertilisers such as limestone ammoniumitrate (LAN). All the granules should be removed from the leaves by applying irrigation directly after fertilisation. This will prevent the fertiliser from burning the leaves. Potassium and nitrogen levels within the soil of between 20 to 30 mg/kg and 40 to 80 mg/kg respectively will ensure optimum production.

Liquid or slow-releasing nitrogen fertilisers can be applied. However, these types of fertilisers are more expensive, although they are more effective. A practical way of fertilising strawberries is to dissolve the fertiliser in water. Two handfuls (± 100 g) of LAN and one handful (± 50 g) of potassium chloride (KCl) can be dissolved in 10 ℓ of water. This quantity should be sufficient for 200 to 300 plants if it is applied with a watering can. Excessive nitrogen applications will result in excessive vegetal growth with little or no

fruit. It is therefore advisable to apply small quantities of nitrogen every fortnight. Small volumes of irrigation should be applied directly after each application in order to prevent leaching of fertilisers.

Irrigation

Certain important factors should be taken into account in deciding on the time and frequency of irrigation. Such factors include soil type, water quality, weather conditions, season, type of fruit, the type of irrigation system used as well as mulching.

Sandy soils have low water-holding capacities. It is therefore essential to apply small volumes of water at relatively short intervals, i.e. 2 to 3 days between irrigations. Loamy and clayey soils, on the other hand, have higher water-holding capacities. Larger volumes of water should therefore be applied with longer intervals between irrigations such as once 4 to 5 days between irrigations.

Soil containing large quantities of organic material can hold water more effectively and longer intervals between irrigations should be allowed. Excessive irrigation can result in the leaching of nutrients from the soil while waterlogging and root disease can occur. Insufficient water would inevitably inhibit plant and fruit growth as well as fruit quality. Plants should therefore never be allowed to wilt.

The climate also determines how often and how intensively one should irrigate. It is evident that strawberries, which are planted in warmer climatic regions, would require more water in comparison to plants in cooler regions. Rainfall should be taken into account in deciding when to irrigate. Wind also influences the water consumption. It is essential to replenish the water in the soil after a long windy period. Less irrigation will be necessary during spring and autumn when the temperatures are lower than during the warmer and drier summer months.

Watering-cans, buckets and hosepipes can be used to irrigate the plants. An irrigation system can be installed if more sophisticated equipment is preferred. However, it is important to have the irrigation system designed by an expert. Different types of irrigation systems can be used, such as overhead sprinklers, microsprinklers and drippers.

Weed control

Weeds can be controlled either mechanically of chemically. However, hand hoeing is labour intensive and time consuming. Hoeing can also damage the roots or fruit of the strawberry plants. Caution should be taken

when herbicides are used for weed control. The herbicide must not come into contact with the strawberry plant. User instructions, as supplied by the manufacturer of the herbicide, should be adhered to.

Pest control

Regular monitoring of pest is of the utmost importance. This will ensure timely intervention in order to control the pests before the infestations reach critical levels. There are several insecticides, which are registered for strawberries in order to control specific pests. It is important to adhere to the user instructions as supplied by the manufacturers. However, more environmental friendly insecticides can also be used, such as infusions (tea) which can be obtained from herbs such as sweet basil, garlic or khaki bush weed. There are certain general control measures which can be taken to minimise pests and diseases, *viz*:

- Avoid planting strawberries in poorly drained soils
- Avoid planting in areas where pests and diseases prevailed
- Apply crop rotation practices
- Remove weeds and any unwanted crop residue
- Choose pest resistant cultivars
- Aerate the soil before planting

Red spider mite infestations present one of the biggest problems in strawberry production. They can cause severe damage to a plant by sucking the sap from the leaves. Red spider mites are usually visible as tiny red spots on the underside of the leaves and are particularly active on leaves which are exposed to direct sunlight. Heavy infestations can be identified by visible shiny threads, which are produced by the mites. Although there are insecticides available which can be used to eradicate this pest, adequate control can usually be obtained by spraying the affected plants with a diluted sugar or soap solution. Liquid extracts which were mentioned above, can also be sprayed onto the underside of the leaves order to control red spider mite.

An alternative is biological control. However, any chemical formulation that is used to kill red spider mites would also kill their natural enemies, *viz*. predatory mites. It is very difficult to control red spider mites as they appear to have a developed a certain degree of resistance to most of the miticides which are currently used commercially.

Other pests, which generally damage the fruit, include crickets, snails and slugs, American bollworms and cutworms, millipedes and certain kinds

of beetles. The best method of controlling these pests is to prevent them from multiplying by the use of Mesurol pellets. Another approach is to use pineapple and apple skins, which is covered with carbaryl powder, as bait. Birds are also problematic. Scarecrows or light-reflecting mirrors can be erected to repel birds.

Disease control

Leafspot, also called chocolate spot, is the most frequent fungal disease which affects strawberry leaves. The first signs of this disease appear as small, brown spots on the upper leaf surfaces of older leaves. The number of spots is usually an indication of the extent of the disease. The key to good control is proper sanitation. Infected and old leaves should be removed. Good air flow through proper plant spacing will minimise the spread of the disease. The volume of free water around the plants should be reduced. Hot, humid conditions promote fungal infections.

Reddish-purple spots and blotches on the leaves can identify powdery mildew, another fungal disease which inhibits plant growth, reduces the yield and reduces fruit quality. Closer examination would reveal white, powdery mycelium which is a loose network of the delicate filaments (hyphae) that form the body of a fungus. Warm, wet weather conditions are favourable to the occurrence of fungal diseases and the longer these conditions prevail, the higher the risks of fungal infections will be. Plants should therefore not be spaced too densely as it will take a long period for the leaves to dry. Copper-containing chemicals, such as copper oxychloride, will control fungal diseases to a reasonable extent, especially if applied as a preventive measure. Systemic fungicides are used by commercial farmers. However, it is not advisable for the home gardener to use these fungicides as it is not only expensive but it also poses a health risk.

Botrytis is a grey mould which is most probably the biggest enemy of strawberries. This disease can only infect damaged of dead plant tissue. Most of the infection occurs during the flowering period, especially during hot, humid weather conditions. Fruit which is damaged by insects or other means is usually infected. The infected fruit consequently starts rooting and will eventually be covered with a dense grey blanket of mycelium. The fungus can also affect dying petals and stamens and will spread rapidly to the developing fruit. Botrytis can be controlled by fungicides which are formulated specifically to control it. These fungicides should be applied from flowering until harvest. User instructions of these fungicides should be adhered to.

Botrytis can also be controlled by following sensible cultivation practices. Cultivation practices which would enhance the infection by the fungus should be avoided. Plants should not be spaced too closely. More water should be applied per irrigation and the intervals between irrigations should be increased. This would allow the leaves to dry and therefore inhibit fungal infection.

Excessive application of nitrogen fertiliser should be avoided as it would stimulate excessive leaf growth. This, in turn, will lead to a dense canopy of leaves which would create humid conditions with consequential fungal infection. Even small, immature berries would be affected under these conditions. The disease would spread rapidly on fruit which is in direct contact with warm, wet soil or on wet organic material. The use of plastic mulching can assist in avoiding this problem. Infected fruit should be removed and disposed of by either incinerating it or burying it in an area far from the strawberry field.

Other fungal diseases attack strawberry plants apart from the most frequent diseases mentioned earlier. These include leaf scorch, leaf blight, leather rot, Anthracnose and red stele root rot. It is therefore important to contact the authors of this publication for expert advice on the identification and control of these diseases.

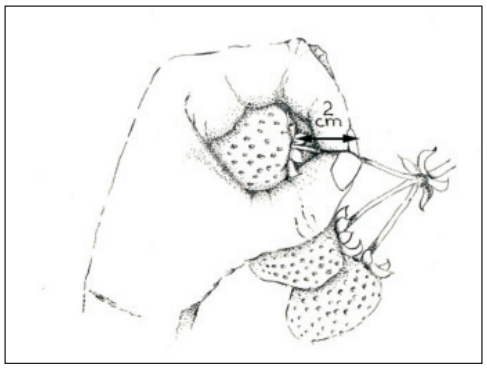
Other cultivation practices

The use of mulch has many advantages. It can improve the structure of the soil, minimise evaporation and prevent runoff of the applied water. Germination of weed seeds can be prevented by the smothering effect of the mulch. Different types of materials can be used as mulch. Bark, wood chippings, newspapers, hay, compost, plastic and even stones can be used as mulch.

The application of fertilisers should not be obstructed by the mulch. Organic materials will also hold water and can prevent some of the applied water from reaching the soil surface. It is therefore necessary to adapt the irrigation and more water should therefore be applied. This will ensure that adequate water reaches the root zone.

Harvesting

Fruit is hand-harvested. The best time for harvesting is either during the early morning or late in the afternoon when temperatures are low. The fruit must be picked when ripe and mature, in other words, when the fruit tastes



sweet and are completely red. Fruit should be harvested every second day or twice per week. The strawberries can be picked form the plant by grasping the stem, approximately 2 cm above each berry, between the forefinger and thumbnail and pulling it with a slight twisting motion (see picture below).

The calyx end (hull) should still be intact. Care should be taken not to bruise the fruit. The fruit should then be placed carefully into a container without stacking it. Overripe or damaged fruit must be removed. The fruit must be protected from direct sunlight, warm winds and dirt once it has been harvested, whereupon it should be transported to a cool, clean shed or room where it is graded according to size and packaged. Large and small fruit should not be packaged together. The fruit should be packed in such a way that all the berries are supported as well as visible to the consumer. Packaging material consists of transparent plastic trays (also called punnets) and suitable cling wrap. The last step is to transport it into cold storage as soon as possible. Care should be taken in handling and during transportation to prevent the fruit from bruising.

POST-HARVEST HANDLING

The shelf-life of strawberries is directly related to temperature. Variations in temperature from time of harvesting up to presenting the fruit to the consumer, will determine the marketability of the fruit. Grey mould, leather rot and other fungi which cause the fruit to rot, cannot grow at low temperatures (0 to 2 °C). Warm fruit also bruises easily. It is therefore essential to precool the fruit within 1 hour after harvesting before it is refrigerated. This can be achieved by keeping the fruit in a cool, well-ventilated room.

Strawberries have a shelf-life of about 4 days, provided ideal handling and cooling conditions prevail. Unripe, red-pink coloured fruit can be kept for 7 to 10 days at 2 °C. However, the flavour and aroma of the fruit would not be similar to the fruit which has ripened naturally.

It is important to wrap the fruit with suitable wrapping material (PWGS Vitafilm). Wrapping creates an artificial atmosphere around the fruit where the oxygen concentration is decreased and carbon dioxide increased. This

artificial atmosphere will improve the keeping quality. Wrapping will also limit bruising and contamination when handled.

PRODUCTION SCHEDULES

A typical production schedule, which is followed within the Western Cape Province, is shown below.

Activities	January	February	March	April	May	June	July	August	September	October	November	December
Soil sampling												
Soil preparation												
Planting												
Fertilisation												
Irrigation												
Pest control												
Disease control												
Weed control												
Harvesting												
Marketing												

UTILISATION

Apart from fresh consumption, strawberries can be frozen or processed into either canned strawberries, jams, jellies, syrups or juices. Strawberries can be added to a variety of products such as yogurt, ice cream and fruit nectars as well as in confectionery such as cakes and pastry.

Strawberries are not only an excellent source of vitamins A and C, calcium, iron, potassium and antioxidants but are also low in calories and contain a fairly high percentage of dietary fibre. Strawberries contain more vitamin C than oranges and a 100 g portion will meet the daily dietary requirements of vitamin C of an adult person. The leaves and roots are believed to have medicinal value as it is used to cure diarrhoea, indigestion and gout, while the fruit juice is used to treat sunburn, skin blemishes and discoloured teeth (Robertson, 2006).

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PERSONAL COMMUNICATION

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