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Scientific Cultivation of Strawberry

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Abstract

The *Fragaria* genus includes 20 identified species and is native to Europe, Asia, and several other regions of North and South America. The hybrid plant that produces cultivated strawberries was created by crossing *Fragaria virginiana* and *Fragaria chiloensis*. Its cultivation is now limited to mountainous regions in India, including Himachal Pradesh, Uttaranchal, sections of Uttar Pradesh, and the Kashmir valley, although with the arrival of day-neutral cultivars, this plant's cultivation has even reached tropical and subtropical regions. The term "strawberry" is believed to have originated from the producers' technique of covering their plants with a coating of straw when the berries started to form. In this article, efforts have been made to provide detailed package of practices.

Keywords: Strawberry, Cultivation, Insect-pest Management, Disease Management.

Introduction

The cultivated strawberry, *Fragaria x ananassa* Duch, is a monoecious octaploid (2n=56) hybrid of the predominantly dioecious octaploid species *Fragaria chiloensis* Duch and *Fragaria virginiana* Duch. (Cv *et al.*, 2016). It is a member of the Rosaceae family (Salentijn *et al*., 2003). Strawberry cultivation in India first started in some hilly areas of Uttar Pradesh and Himachal Pradesh in the 1960s, but due to non-availability of suitable varieties and lack of technical knowledge, no special success could be achieved in its cultivation till now. Strawberry cultivation in India is also being done in hydroponics, polyhouse and in general in many types of land and climate. The strawberry, or *Fragaria ananassa*, is a short-day plant that contains ellagic acid, an antioxidant, anti-inflammatory, anti-neurodegenerative, and anti-cancer compound (Katel *et al.*, 2022). Strawberry is a delicious light sour sweet fruit. Strawberry is a tasty, healthy red fruit whose flavour is influenced by three substances viz.

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sugar (0.5%), acid (0.90-1.85%), and aromatic components (Sahana *et al*., 2020). It contains water, carbohydrate, protein, phenolics and flavonoids, and is high in vitamins like vitamin C (30–120 mg/100 g), vitamin A (60 IU/100 g) thiamine, niacin, and minerals like potassium, phosphorus, calcium, and iron (Roussos *et al.*, 2009). Fruits are generally consumed fresh, but jam, jelly, squash, chutney, etc. food items made from their fruits are also consumed in large quantities.

Botany

The strawberry shrub is a non-woody perennial with a crown, leaves, and runners, as well as an underground root system. It bears short stems known as "crowns" that bear blooms and develop leaflets along the stem axes. Primary roots and secondary roots are both present in strawberry plants. Primary roots are perennial and transport nutrients and water to the crown. Primary roots are generated higher on the crown over the course of several years. The secondary roots are regularly replenished and only last a few days or a week. In the winter, older leaves often die and get substituted by new ones in the spring. All throughout the season, leaves are generated, but the most is produced during the long days. Strawberry inflorescence branch structures are characterized as " dichasial cymes" and are highly varied. Typically, strawberry blooms have more than five petals and 20 to 35 stamens, all of which vary in length and size within the same flower. When anthers are filled with pollen, they are a deep golden yellow, but when pollen is expelled, they become paler. Botanically, it refers a pseudocarp, or aggregate fruit. The receptacle, petioles, achenes, or actual fruit, and seed of the strawberry are all edible. Anthocyanin, pelarogonidin, 3-monoglucoside, and residues of cyanide give the fruit its red color (Srivastav *et al*., 2018).

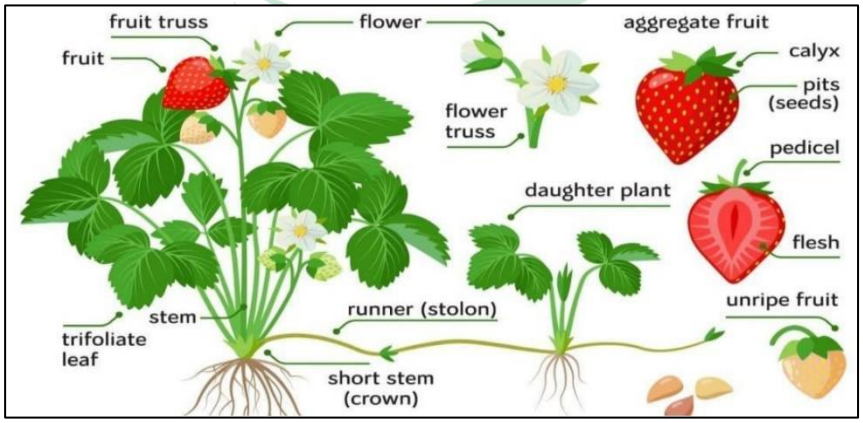

Fig 1. Botanical description of strawberry plant (*Source:* Katel *et al*., 2022)

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Soil and Climate

Strawberry cultivation is possible in almost every climate but it can be grown successfully in sub-tropical and temperate climates, both of which have plants that behave like annuals and small perennial herbs, respectively (Salentijn *et al*., 2003). Its plants are planted in hilly areas from August to September and in plains from October to November. Here the fruits ripen and get ready in the months of February-March. Strawberry plants are highly influenced by environmental parameters such as temperature, light duration, and light intensity. It requires optimum day temperature of 22 to 25ºC and night temperature of 7 to 13ºC. Good air drainage and covering the row with plastic mulch can reduce frost damage.

Strawberry can be cultivated in almost every fertile land, but sandy loam soil is beneficial for good yield. Smooth and waterlogged soil does not prove to be suitable for its cultivation because the roots of the plants do not develop well and there is a possibility of disease in the roots. In its cultivation, the pH value of the land should be between 5 to 6.5. The land on which tomato, potato, chilli, brinjal was grown in the previous crop should not be cultivated for strawberry.

Propagation

Strawberry is propagated commercially by runners. Although the runner produces the correct type of plant, viral diseases are often transmitted through the runner itself. Hence a separate bed should be used for runner production. The location and soil where strawberry has not been grown for at least 3 to 4 years should be selected for runner production. Planting should be done at a distance of 1.2 x 1.2 m or 1.8 x 1.8 m. Generally, 30-40 runners per plant is considered a satisfactory rate of production. The rate of runner production can be increased by spraying GA_3 @ 50-100 ppm (Chadha, 2019).

Varieties

Only a few improved varieties of strawberry are being grown in India, which have been designed to get more production according to different regions, some of which give small size and some big size fruits. Varieties like Pusa Early Dwarf, Premier, Surprise des Hailes, Dilpasand, Bangalore, Florida-90, Seascape Redgauntlet, Black Peacock, Sujata, Majestic, Fanil, Cardinal, Cambridge Favourite, Tioga, Talisman, TriStar, Olympus, Shuxon, Chandler Confucura, Laguna, Douglas, Gorella, Camarosa, Pajarón, Fern, Domanil, Addie, Festival,

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Brighton, Sweet Charlie, Senga, Sengan, Senga precosana, Belrubi, Dana and Eatna etc. are different cultivars of strawberry (Sharma and Singh, 2009)

Field preparation and planting method

Strawberry cultivation requires friable soil. The soil is made friable by ploughing. It can be cultivated well in beds raised 15 cm from the surface. In terraced fields on hill slopes, beds are prepared 60 cm wide and according to the length of the field. Healthy and well-rooted runners should be plucked off their outer leaves before planting in the soil and only one or two newly grown leaves should be kept. Planting should be done after washing the roots thoroughly with the help of water. Strawberry planting is mainly done in India using matted method. In this, the runner is planted at a distance of 45 cm and a distance of 90 cm is kept between the rows. Runners develop in rows during June-July and are left to form a mat of runners about 40 to 45 cm wide. In this method, due to the increase in the number of plants, the yield also increases, but there is a decrease in the size and quality of the fruits. At the time of planting, a small pit about 15 cm deep is made in the beds and after planting the plant, it is pressed well around the treated roots so that there is no air between the roots and the soil. Light irrigation is necessary after planting (Chadha, 2019).

Manures and Fertilizers

Strawberry plants require a large amount of nutrients for growth. In sub-tropical areas, 20-50 tons of well decomposed cow dung, one-third of Nitrogen (100 kg), full dose of Phosphorous (70 kg) and Potash (150 kg) per hectare are applied at the time of field preparation before planting. The remaining quantity of nitrogen is given by drip method after planting in equal quantity at an interval of 10 to 15 days (Chadha, 2019).

Uses of Plant growth regulators

PGR serve as the catalysts for blooming, fruit development, and fruit ripening PGRs are used more and more frequently every day, mostly in numerous agricultural fruit crops. In order to control the growth and development of crops, numerous synthetic compounds are utilized. These growth-regulating substances can also be used to produce fruit in a sustainable and environmentally friendly manner. Application of GA_3 @ 25 ppm enhances foliar spray, fruit weight, TSS, ascorbic acid and yield (Ingle *et al.*2001). At the rate of 50 ppm, GA_3 inhibits flowering and promotes runner development (Dennis & Bennet, 1969; Paroussi *et al.*, 2002). El-Shabashi *et al.*, 2008 reported that application of 100 ppm GA_3 increases flower production.

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A growth retardant like CCC @100-200 ppm has been proved to enhance first flower opening and fruit set (Baritt, 1975).

Irrigation

Irrigation is necessary in the first year after planting and rooting of runners. Strawberries require about 1 inch of water per week during the growing season. The roots of strawberry are found in the top 6 to 10 inches of the soil, so it should be irrigated at intervals of a few days. Strawberry crop needs light irrigation. Under normal conditions, irrigation is necessary at an interval of 10-15 days in autumn and 5-7 days in summer. Watering should be avoided at the time of harvesting because it makes the fruits very soft, making them unsuitable for long distance markets. (Chadha, 2019).

Weed control

Weeds pose a major threat and increase in growth during wet weather. Common weeds are present in strawberry fields are *Cynodon dactylon* (Burmuda grass), *Eleusine indica* (Goose grass), *Oxalis latifolia* (Sorrel), *Duchesnea indica* (Mock Strawberry), *Melilotus indica* (Sweet yellow clover), *Spergula arvensis* (Corn spray), *Elymus repens* (Couch grass) etc. Weed control is considered one of the most expensive management practices. Herbicides like simazine @ 3 kg/ha and pendimethalin @ 330 g/l can be used to keep the weeds under control. Black plastic mulch is used for weed control in India (Chadha, 2019).

Mulching

Fig 3. Different types of mulch used in strawberry cultivation
(A) Black polythene mulch (B) Sawdust mulch (C) Straw mulch

Mulching reduces winter damage, weed growth and soil erosion. An ideal mulching material should be loose and light. Commonly used mulching materials include white straw, marsh hay, and saw dust. Mulching with black polythene material gives good control of weeds,

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as it helps in early harvest and increase in total yield. The need to remove polyethylene mulch from the field and dispose of it after each fruiting season is a drawback of utilizing it as mulch (Chadha, 2019).

Disease Management

1. **Verticillium wilt (*Verticillium alboatrum*):**

   In dry weather infected plants wilt, older leaves turn brown and shrivel up and eventually die. Try to not plant tomatoes, potatoes, peppers, brinjal, or raspberries. For its management, soil should be treated with Formalin @ 5000 l/ha or Chloropicrin @ 210 l/ha.

2. **Anthracnose (*Colletotrichum* spp.):**

   Leaf lesions that are round, black, or light grey in color may appear. Multiple spots may form, but leaf do not wither Dark brown or black deep, circular lesions on stems, petioles, and runners may appear. Plants may seem stunted and yellow, wilt, and eventually collapse. The use of crop rotation with non-host crops, rinsing of all soil particles around plant crowns before planting, and routine weeding around plants should be done**.** Transplants only disease-free runners and avoid using excess dose of nitrogen fertilizer.

3. **Leaf spot (*Mycosphaerella fragariae*):**

   The most obvious symptom of the disease is small, circular spots. These spots develop on the upper surface of the leaf and are dark purple to reddish-purple at first. Black spots develop on the surface of fruits during wet weather. Remove and burn trash from the previous crop. Avoid overhead irrigation. It can be prevented by spraying Bordeaux mixture 2-3 times at an interval of 10-15 days.

4. **Powdery mildew (*Sphaerotheca macularis*):**

   The disease begins with upward folding of the leaf edges. After that, the upper leaf surfaces begin to exhibit erratic, purple blotching, frequently along prominent veins. The foliage appears fragile. The thick clouds of spores that are characteristic symptom of powdery mildew on other crops do not occur in this disease. Remove and destroy infected plant parts and leaves. Powdery mildew is a problem since it is resistant to fungicides. One option is to use sulphur as a preventive. Sprays of Bayleton or Karathane (0.05%) at 15 days interval are quite efficient at controlling the infection.

5. **Botrytis rot (*Botrytis cinerea*):**

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The disease appears as light brown spots on green and ripening fruits. The fruits dry out, harden and become covered with a layer of fungus which results in complete rotting of the fruit. To prevent this, the fruits should be protected from coming in contact with the soil. Good drainage should be arranged in the field and excessive use of nitrogen fertilizers should be avoided.

Insect- Pest Management:

1. **White grubs (*Phyllophaga* spp.):**

   Cut the root and stem of young plants. The larva is visible accumulating on the roots in the bottom soil exposure. Plants may perish if there are a lot of insects around. To manage them, do deep ploughing and soil spraying with Chlorpyriphos @ 1-2 ml/Lit of water.

2. **Thrips (*Scirtothrips dorsalis*):**

   The stigmas and anthers of strawberry flowers that have been fed by thrips turn brown and prematurely wither. Surface russeting surrounding planting materials in late green to ripe fruit is an example of fruit damage. The fruit may appear seedy and bronze-like. To prevent pest infestation, crop rotation should be used, particularly with legumes and cow pea. After harvest, remove trash from the old fields to prevent pest invasion. If there is a pest population in a hill system, the beds should be renewed after the first fruiting season is harvested. Cypermethrin (6.6 g a.i/ha) and Deltamethrin (2.25 g a.i/ha) decrease the occurrence of thrips and the quantity of deformed fruits.

3. **Red spider mite (*Tetranychus urticae*):**

   The surface of leaves exhibits speckling and mottling are the first indications of damage. Due to their outbreak, the plants remain dwarf and show less yield. Their high numbers can weaken strawberry plants and cause a webbed pattern on the underside of the leaves. Aldicarb (10G) @ 4-5 kg/ha is very effective in controlling the pest. Surveys should be done to preserve natural enemies (predators) like Ladybird beetles, Green lace wings, Phytoseiid mites, and Syrphids, and P.D. ratios should be kept monitored. Release the ladybird beetle with the green lace wings at the rate of two per plant.

Harvesting, Yield and Storage

In temperate regions, a profitable crop of a plant can be taken for three years, but the maximum yield is given by a plant of two years of age. In the plains, the fruits start ripening from the last week of February to the month of March. Red color of more than half of the fruit

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is the appropriate time for harvesting. At the time of harvesting the fruits should be plucked along with the stem at some distance so that the fruits cannot be touched. The fruit is placed into shallow trays, as it is a perishable fruit and can be easily damaged if a heavy container is used. While placing the fruits in the crate, it is necessary to note that there should not be too many piles of fruits in them so that the fruits do not get damaged by pressing on each other. On an average, the yield of the recommended varieties is found to be around 250-500 g/plant. Strawberries are packed in plastic punnets and placed in fibre trays or ventilated cardboard boxes. Strawberry is available in the market for a very short time, but its availability can be increased for a long time by storing it properly. Fruits can be stored for 10 – 12 days in controlled atmosphere storage containing 2% O_2 and 5% CO_2 at 3 °C (Chadha, 2019).

Future prospects

With the development of new technologies, the cultivation of strawberry is possible everywhere. In terms of temperate fruits, strawberries stand out. It has plenty of vitamins and nutrients. As it is sold at very high price, farmers can make huge profit by growing it on their farm. For successful cultivation, it requires a little concern on disease and pest outbreaks. The market has a significant demand for strawberries.

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