

Agro-techniques of high value fruit crops in Bihar

Dragon fruit, Pineapple and Strawberry are the fruit crops having very high commercial and nutraceutical values. Farmers are not much aware about their cultivation practices. These crops are highly nutritious and have very high demand in national and international market. They can be grown in fertile as well as marginal land also. Therefore, there is a need to popularise their cultivation practices among farmers of Bihar.

Agro-techniques of Dragon fruits

Dragon fruit, pitaya or strawberry pear (*Hylocereus spp.* and *Selenicereus spp.*) is one of the most important emerging fruit crop for marginal land, though is a tropical fruit of the family Cactaceae and originated in Central and South America. It is also called as noble woman or queen of the night, due to night opening of the flowers. It has become increasingly popular due to its unique shape and taste along with its health benefit and medicinal value. Gujarat, Karnataka and Maharashtra are the major producing state of India sharing about 70% of total dragon fruits production. In Bihar, its cultivation started first in Kishanganj district during 2014. Now, it is mainly grown in Katihar, Purnia, Araria, Supaul, Jamui, Nalanda and Nawada districts of Bihar.

Recently, Gujarat's CM gave it a new name "Kamalam" as it looks like lotus flower. There are two types of dragon fruit, sweet and sour. Fruit under the genus *Stenocereus* are of sour type having juicy flesh and

refreshing taste whereas, fruits under genus *Selenicereus* are sweet in taste.

Dragon fruit's plant is a fast-growing perennial vine generally propagated through seeds and/or commercially through vegetative means by stem cutting. In Bihar, stem cutting is generally preferred for its propagation. It is highly profitable for farmers as it takes short duration for flowering and fruiting in comparison to seed propagated plant. For this, 20-25 cm long stem, treated with rooting hormone are planted in 12 × 30 cm poly bag or Potting mixture containing soil, sand and FYM in equal proportion. The rooted cuttings are ready for planting within 5-6 months. Flower blooms overnight and usually wilt by evening, that's why it requires nocturnal pollinators like bats or moths for its pollination. Flowers are of white colour with 25-30 cm size. It has faster growth and starts bearing within 6-9 months of planting.

Agricultural practices: Due to climbing nature, vine of plants need some support and the life of plant is about



Dragon fruit plants in the field

15-20 year, which is important from production and profit for longer duration. Therefore, before planting, orchard is framed with concrete pillar or iron pole with discarded bike tyre at top at a spacing of 3 m × 3 m which require high initial cost. Total 3-4 plants are planted around the pillar like structure as shown in the figure. The plants are tied with the help of plastic strip/rope at every 30-35 cm height starting from ground level to give support. Once frame structure is prepared farmers get yield for 15-20 year continuously with minimum input cost. It starts fruiting after one year of planting.

Soil and climate: Dragon fruit grows successfully in wide range of soils. The best soil is loamy, rich in organic matter having slightly acidic pH (5.5-6.5). Best result obtained in the area having average rainfall of 500-1500 mm. It performs well at temperature range of 20-30°C. The plants can thrive well in temperature up to 40°C and can tolerate short duration frost.

Drip irrigation is most ideally suitable for dragon fruit plant. Irrigation water is required at the time of planting, flowering and fruiting stage. The fertilizer dose of urea, single super phosphate and muriate of potash @ 50:50:100 g/pillar and 10-12 kg of organic manure per plant during initial year and dose increases @ 2 kg every year. Fertilizers are applied in 2-3 split application, first during February-March before flowering and then in November-December after harvesting of fruit in order to get quality.

Fruit thinning out operation is followed for proper growth and development of fruit. To keep field free from weed, frequent manual weeding operation is needed as and when required to be performed.

Harvesting: The fruit should be harvested 30-35 days after flowering and fruit set when skin colour changes from green to purplish red colour. At this stage fruits are firm and have good storage and eating quality. It can be harvested manually with the help of small handheld gardening tools.

During the initial year (2-3 year) 4.5 tons/ha of fruits can be harvested and full commercial production after three to four years of planting (to 25 tons/ha). The fruit weight ranges from 150- 600 g and may go up to 1 kg, but fruit of 400-500 g is preferred by consumer.



Harvested dragon fruit

Pests and diseases management: Dragon fruit is infested by ant, nematode, scale insect and mealy bug pest. The infestation of pest on fruit can be easily controlled by need based insecticidal spray @ 5-6 ml/litre water. However, 15-25 days before harvesting, stop the spray of chemical pesticide.

The pitaya plants and fruits are susceptible to various diseases caused by bacteria, fungi, nematode and virus. Excessive rainfall or watering can cause flower drop and fruit rotting.

The most common disease of dragon plants is Anthracnose (*Colletotrichum gloeosporoides*) with symptoms of red brown concentric lesion with ascervuli near vine ribs. It can be controlled by fungicidal spray (mancozeb+ carbendazim) @ 2 g/litre water.

Economic importance of dragon fruit: People, who are interested in doing something new away from traditional farming, can easily earn ₹8-10 lakh/annum with the investment of ₹6-8 lakh per hectare land in Kosi and Seemanchal region of Bihar. At present many exotic fruits like pear, peach, kiwi and green apple, dragon fruit are imported due to preference by consumers. Import of dragon fruit can be reduced up to some extent by commercial cultivation in climatic conditions of Bihar. The attractive red colour fruit costs ₹300-400/kg in malls or local market shows giving high economical return values to the farmers.

Agro-techniques for successful cultivation of Pineapple

Pineapple (*Ananas comosus*) is an important commercial fruit crop of India and belongs to family Bromeliaceae. The binomial name *ananas* comes from the Tupi word nanas, means excellent fruit and *comosus* from the word “tufted” means stem of the fruit. It is mainly cultivated in Assam, Meghalaya, Tripura, Mizoram, Kerala, Karnataka, Goa and West Bengal. In Bihar, it is mainly cultivated in Kishanganj district.

Fruits are rich source of Vitamin A, B, C and minerals calcium, magnesium, potassium and iron. It is eaten fresh, canned as well as in processed form and fruit has good source of digestive enzyme Bromelin which has anti-inflammatory property that prevents of arthritis. It has very high antioxidant property especially in flavonoids and phenolic acid.

Soil and climate: Pineapple prefers humid climate with plenty of rainfall (100-150 cm). It grows successfully in sandy loam soil with good drainage facility. The growth and development of plant is good at a temperature range of 22-32 °C.

Varieties: The cultivars are Kew, Giant Kew, Queen, Mauritius, Lakhat, and Jaldhup. In Bihar, mostly intermediated type (Mauritius) has been preferred.

Propagation: Pineapple is propagated through sucker, slip and crown. Under Bihar condition it gave



Pineapple plants in fields under double hedge row system

best result in ridge and furrow system. August to October month is best time for planting in this region. It is a long duration crop taking 12 months when planting with sucker and slip and took 19-20 months in case of crown for flowering. Plants are planted at a spacing of $22.5 \times 60 \times 90$ cm with double hedge row system. Depending on rainfall, the plant should be irrigated at 20-25 days interval in hot and low rainfall area.

Manures and fertilizer: The plant requires plenty of nitrogen and potash. The fertilizer doses of NPK @ 12:4:12 g/plant/year should be applied. The nitrogen should be applied in six split doses at every two-month interval.

Intercultural operation: The intercultural operations are listed here.

Weeding and earthing up: Weeding is an important operation for successful cultivation. As it is shallow rooted, it needs earthing up to prevent the plant from lodging. In this, the soils from ridges are lifted to trenches.

Mulching: Under Bihar condition, it is generally mulched with straw and/or dry leaves to conserve moisture and suppresses the weed infestation.

Removing crowns, slips and suckers: The emergence of sucker and slip starts with the development of flower and fruit. Excess of sucker and slip should be removed, leaving 1-2 sucker intact with plant, as it extends the fruit maturity period.

Yield and harvesting:

Pineapple plant takes 2-2.5 year for harvesting mature fruits from planting time. For canning purpose, it is harvested just after colour change at the base of fruit and at golden colour stage for table purpose.

Pests and diseases and their management:

Pineapple plants get infected by various insect pests like mealy bugs, thrips, fruit borer, beetles, weevils and termites. Among them, mealy bug affects the plant in many countries whereas, others may cause damages under certain favourable condition. Mealy bug infests the developing fruit, thereby reduces its quality and quantity. It can be controlled by dipping the suckers in insecticidal solution before planting. Application of chloropyrifos 20 EC (@ 2.5



Pineapple fruit at developmental stage



Strawberry plant at fruiting stage

ml/l) and imidacloprid (200 SL, @ 0.3 ml/l) after planting also reduces its infestation.

Bacterial disease, heart rot and fruit collapse (*Erwinia chrysanthemi*) may cause water-soaked lesion on leaves, reduces juice content in infected fruits and develop cavities within the fruit. The control measures like removal of infected fruits and avoidance of infected planting material along with use of dicofol 18.5 EC @ 1-2 ml/l water reduces the disease infestation.

Phytophthora heart rot (*Phytophthora cinnamomi* and *Phytophthora nicotinae*) infect the plants at all growing stages. It causes yellowing of heart leaf and finally drying. It is a soil born disease and can be controlled by the application of systemic fungicide. Dip the planting materials (suckers, slips or crown) in carbendazim or (carboxin 37.5% + Thiram 37.5% DS) @ 2 ml/l water for about half an hour. During planting, care should be taken to prevent entry of soil in the heart and avoid excess deep planting.

Economic importance of pineapple: It is a long duration fruit crop, but has high demand in the market. The fruit is eaten fresh as well as in processed form. Each fruit cost ₹ 30-40 that give high economic return to the farmers.

Agro-techniques for Strawberry cultivation

Strawberry (*Fragaria × ananassa* Duch.) is a low growing, perennial, herbaceous plant, which belongs to the family Rosaceae and originated in Europe during 18th century. It is cultivated in plains as well as in the hills up to an elevation of 3,000 m. It is grown for red attractive and nutritious fruit. It is considered as complete fruit, rich in vitamin C and B with 98% edible part. Low calorie, absence of cholesterol and high mineral (P, K, Ca and Fe) content makes it health conscious. Among the fruits, strawberry gives quickest returns in the shortest period of time. It is eaten fresh as well in processed products like jam, jellies or preserves. Strawberry is now considered as an important fruit crop of India and its commercial cultivation is now possible in temperate and sub-tropical areas of the country. Nowadays, it is grown successfully in Haryana, Punjab, Uttar Pradesh, Delhi and Bihar region.

The cultivars grown are Chandler, Sweet Charlee, Festival, Chandler, Ofra and Cama Rosa. But cv. Winter Down gives best result in farmer's field.

Propagation: Plants are commercially propagated with runners. It can grow in open as well as under greenhouse condition. The commercial cultivation followed plasticulture with micro-irrigation facility. Strawberry can be grown successfully in raised bed or matted row system. Plastic/paddy straw is used as mulching material to suppress weed growth, soil erosion and prevents growth of some harmful pathogens.

Climate and soil: It is a short-day plant, which requires 10 days exposure of less than 8 hours sunshine for flower initiation. During winter, plants remain dormant. The varieties grown in subtropical climate do not require chilling and continue some growth even in winter. Soil should be well drained, medium loam with rich in organic matter and slightly acidic pH (5.7- 6.5), because at higher pH root formation become slow. Excess calcium in soil causes yellowing of leaves while, light soil rich in organic matter content gives better runners production.

Manures and fertilizers: Strawberry plants require plenty of organic matter along with reasonable amounts of nitrogenous fertilizers. For successful cultivation it requires FYM @ 500 q/ha, nitrogen 84-112 kg/ha, phosphorus 56-84 kg/ha and potassium 56-112 kg/ha. The total amount of phosphatic fertilizer should be incorporated into the soil before planting and potassium at the time of flowering only. The nitrogenous fertilizer should be applied in two split doses, one at three weeks after planting and second at the time of flowering. Foliar spray of GA3 enhances flowering, fruiting and fruit size.

Harvesting: Harvesting of fruit starts just after ripening in February and ends up to April in the plain. For local market, it should be picked at fully ripe stage, but for export to distant markets, it should be picked at firm ripe stage and before attainment of fully red colour of the fruit. The optimum fruit yield of strawberry is 20 ton/ha. After harvesting fruits are packed in punnets as per size of fruit and finally in bigger size CFB boxes.

Pests and diseases management: Strawberry plants are

infested with number of pests like red spider mite, leaf roller, fruit fly and thrips which are most common. Crop rotation and soil solarization reduces thrips and red spider mite population in the field. Application of malathion 50 EC@ 2 ml/l water is also effective in minimization of pest infestation.

Diseases like leaf spot (*Sphaerella fragariae*) and leaf blight (*Phomopsis obscurans*) mainly affect the vegetative part of plant. It can be controlled by removing and burning of trash from the previous crop and avoid overhead irrigation.

In grey mould (*Rhizopus* rot) disease, fruits and whole plants often get infected. Application of carbendazim or thiophanate methyl has been found effective in reducing the disease incidence.

Red stele/red core (*Phytophthora fragariae*) and wilt (*Verticillium albo-atrum*) affect the crown as well as root of the plant. To control this, only certified and resistant cultivars (Delite, Allstar, Redchief etc.) are selected. Planting should be done in new bed, after every 4-5 years of planting. Good drainage facility in strawberry field also reduces the disease incidence.

Economic importance of strawberry: Due to high nutritive value and red colour fruit it attracts most of the

people. At present, strawberry cultivation is adopted by most of the farmers, as it gives early production (after 3-4 month of planting) and fruits have high demand in the market.

Conclusion

In future, cultivation of dragon fruit, pineapple and strawberry will gain the popularity due to its high nutritive and high economical return as well as farm family's employment. Dragon fruits can be harvested in off season also by improved orchard management and lengthening the day time (using electrical light). Besides, the pharmaceutical value of strawberry and dragon fruit, they are natural source of colorants that have high demand in food and cosmetic industries in future. Therefore, the demand of fruits increases day by day as a new crop.

For further interaction please write to:

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About Our New Project Director

Dr Suresh Kumar Malhotra, joined as Project Director, ICAR-Directorate of Knowledge Management in Agriculture. Before taking over this position he has served at positions of Agriculture and Horticulture Commissioner, in the Ministry of Agriculture & Farmers' Welfare and Assistant Director General (Horticultural Science) in ICAR. He has more than 32 years of experience in Research and Development in Agriculture. He has provided leadership in development of agriculture in the country through policy planning, programme development, coordination, execution, supervision of R&D multidisciplinary activities. He administered the National Food Security Mission programme which ensures food security of the country. Country has achieved highest ever food grain production continuously for the last five years during his tenure. His concerted efforts as a team, made India self-sufficient in pulses production. He is the architect of Per Drop More Crop programme under PMKSY, High value agriculture, National Saffron Mission, National Pulses Mission, National Millets Mission Targeting Rice Fellow Area, and National Bee and Honey Mission programmes. He renewed the regulatory systems of the country related to pesticides including biopesticides, fertilizers involving biofertilizers, biostimulants regulation and for seed certification, ensuring quality input system in agriculture. As a scientist, his research contributions to the agriculture science involved development of 15 high yielding varieties and technologies for spices, which are now basis of cultivation in the rainfed farming system. There are 312 publications to his credit. His outstanding contribution in agriculture has earned him 12 awards and 7 fellowships. He has widely travelled and represented India in more than 21 international programmes of FAO, CODEX, G20, SAARC, WHO, UNECE, CGIAR, ADB, BRICS, G4, SCO, CGIAR institutes (CIMMYT, ICRISAT, ICARDA, CIPA, Bioversity International, AVRDC). As a Chairman of more than 30 high powered committees, and task forces he has guided and provided solutions to emerging problems in agriculture.

