

Enhancing profits for Himachal Pradesh growers: Exploring kiwifruit production technologies

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Kiwifruit cultivation has great potential in Himachal Pradesh due to its suitable agro-climatic conditions. With apple production on the decline, kiwifruit offers a promising alternative for Himachal Pradesh farmers. The state has already started promoting kiwifruit cultivation in recent years, and the crop has shown good performance in some regions. In Himachal Pradesh, the mid-hills and valleys of Solan, Shimla, Sirmour, Mandi and Kullu districts are ideally suited for kiwifruit cultivation. The state government has also been promoting kiwifruit cultivation through various schemes and subsidies. The Himachal Pradesh Horticulture Development Society (HPHDS) provides technical and financial assistance to farmers for setting up kiwifruit orchards and other horticultural activities. With proper management and support, the scope of kiwifruit cultivation can be further expanded to other districts like Chamba, Bilaspur and Kangra, leading to increased income for farmers and boosting the state's economy. It is believed that kiwifruit cultivation is a good initiative towards crop diversification and also profitable for the farmers.

Keywords: Himachal Pradesh, Kiwifruit, Profit

Kiwifruit, also known as the Chinese gooseberry, is native to China. In China, kiwifruit has been nicknamed as China's miracle fruit because of its many health benefits. In New Zealand, the kiwifruit is a major horticultural export and is commonly referred to as a horticulture wonder of New Zealand. The Kiwi bird is a flightless bird native to New Zealand and is known for its distinctive long beak and brown, fuzzy feathers, which inspired the fruit's name due to its resemblance to the bird's appearance. Kiwifruit is uniquely appealing with a brown, fuzzy exterior and bright green, juicy interior full of tiny black seeds. It's an excellent source of vitamin C, vital for immune function, skin health, and wound healing. Additionally, kiwifruit is rich in essential nutrients like potassium, phosphorus, and iron, supporting overall health and wellness.

Kiwifruit is cultivated in many parts of the world, with a global area of 4.51 million ha and production of 6.54 million tonnes. The leading kiwifruit producing countries in the world are China, New Zealand, Italy, and Chile. These countries have favourable climates and growing conditions for the cultivation of kiwifruit, and they have developed robust production systems to meet the global demand for this fruit. In India, kiwifruit is cultivated in a relatively small area of 4,000 ha and produces 12,000 metric tonnes, but it is still an important fruit crop. While this is a relatively small amount compared to the global production, kiwifruit is becoming increasingly popular in India due to its nutritional value and unique flavour, and it has the potential of being a significant fruit crop in the future.

History of kiwifruit production in India

Kiwifruit was initially introduced

in the Lal Bagh garden, Bangalore, in the 1960s for both ornamental and fruit purposes. However, due to insufficient chilling hours, the plants couldn't bear fruit there. In 1963, it was successfully grown at the Division of Indian Agricultural Research Institute (IARI) in Phagli, Shimla, Himachal Pradesh, under Harbhajan Singh leadership. This led to successful Kiwifruit cultivation in India, with the first commercial orchard established in 1985 at Dr Yashwant Singh Parmar University of Horticulture and Forestry in Solan, Himachal Pradesh. Today, Kiwifruit is grown in various parts of the country, including Himachal Pradesh, Uttarakhand, Jammu and Kashmir, Sikkim, Meghalaya, and Nilgiri hills.

Effect of climate and soil on crop success

For optimal kiwifruit production, specific climatic requirements are essential. It thrives in Himachal

Pradesh, at elevations of 900–1800 m amsl, with 600–800 chilling hours to break dormancy. Frost and low temperatures during spring and autumn can be harmful, while high summer temperatures (>38°C) and low humidity can cause leaf scorch and fruit damage. Proper rainfall (120–150 cm) throughout the growing period is crucial. Protection from high winds, hail, and rainfall during flowering is necessary. Ideal soil is deep, well-drained sandy loam with pH between 5.5–6.5, providing sufficient moisture and organic matter. Heavy clay soil with poor drainage is unsuitable for kiwifruit cultivation.

Diversity of kiwifruit varieties: Focus on staminate and pistillate kiwifruit

Kiwifruit is a dioecious plant, which means that it bears staminate and pistillate flowers on separate plants. This means that both male and female plants are needed for fruit production. Pistillate kiwifruit varieties commercially grown in Himachal Pradesh include Hayward, Allison, Abbott, Monty and Bruno. There are also staminate (male) kiwifruit varieties, including: Allison, Tomuri and Matua.

The Hayward variety is the most commonly grown and commercially important variety of kiwifruit, accounting for the majority of global production. The Allison kiwifruit variety is primarily grown in

different regions of the state for its high yield, excellent fruit quality, and also good disease resistance and is the best choice for Himachal Pradesh.

Approaches for propagating kiwifruit plants

Kiwifruit propagation employs several methods, such as softwood, semi-hard, and hardwood cuttings. Softwood cuttings come from the middle part of the current season's growth, while semi-hard ones are taken in June–July, and hardwood cuttings are sourced from one-year-old shoots during January–February. Among these methods, hardwood cuttings are widely used in commercial kiwifruit propagation. These cuttings should be 0.5–1.0 cm thick, with short internodes (spaces between leaves or buds) of about 10–15 cm in length, and at least 4–5 buds. To promote rooting, the cuttings are briefly dipped in a 4000–5000 ppm IBA solution and then planted in a mist propagation chamber or open field conditions.

Propagation of kiwifruit through grafting and budding on seedling rootstock

Tongue grafting and chip budding are popular kiwifruit propagation methods, cost-effective for large-scale multiplication, but require two years for nursery plant development. Prior to sowing in February, seeds undergo



Propagation by hardwood cuttings

stratification in moist sand for 30–35 days at 0–5°C to break dormancy. Germinating seedlings are sensitive to sunlight, so shade or shade nets protect them. Transplantation into polybags and nursery beds occurs between July and August, reaching grafted size within a year. The grafting process, done from the last week of January to the end of February, achieves a high success rate of 90–95% for bud-take. To ensure growth and development, proper nursery management is essential, including regular weeding, irrigation, and staking. Moreover, appropriate fertilization, pest, and disease management are crucial for healthy plant growth and successful crop production.

Building a T-bar trellis system to support kiwifruit plant growth

Kiwifruit plants are typically planted at a spacing of 4 m × 4 m between rows and 6 m × 6 m between individual plants when trained on the T-bar trellis system. Planting is done during the dormant season, usually from December to January. It's crucial to maintain a male to female ratio of 1:8 or 1:9 to ensure proper pollination for good fruit set and yield since kiwifruit plants are dioecious, with separate male and female plants. The T-bar trellis system, similar to that used for grapevines, provides support for the vine crop. Pillars are placed 6 m apart in rows, and each pole has a cross arm carrying five outrigger



Staminate (male) flower



Pistillate (female) flower

Kiwifruit plant



T-bar trellis system used for training kiwifruit vines



Five outrigger wires spaced 45 cm apart

wires spaced 45 cm apart. Vines are trained along the wires as a single stem with two leaders in opposite directions along the center wire. Temporary fruiting arms are then selected along both sides of each leader for better fruit production.

Optimizing kiwifruit plant growth with proper pruning techniques

Pruning is an important management practice in kiwifruit cultivation to promote high yield of quality fruit production and manage excessive vegetative growth. The following principles are kept in mind while pruning:

- Fruits develop on the current season's growth arising from one-year-old shoots.
- Only the basal buds of nodes 4-12 on the current season's growth are productive.
- Vines grow 2-3 m every year, which can become overcrowded if not controlled by summer and winter pruning.
- The shoots developed on older wood by heading back will not fruit normally in the first season.

To achieve the above principles, pruning is carried out in a 3-4 year lateral replacement system. In dormant pruning, in the month of January and February, the fruiting lateral is cut back to 2 vegetative buds beyond the last fruit. In the second year, these vegetative buds produce the fruiting shoots,

which are pruned again. The arms on lateral shoots are pruned and allowed to fruit for 3-4 years. After this, the lateral is removed from the main branches and other laterals are selected and pruned accordingly to maintain a balance between vegetative and reproductive growth for continuity in fruit production. In summer pruning, the shoot is cut beyond 6-8 buds from the last fruit during June-July.

Pollination management for successful kiwifruit production

Kiwifruit comes into bearing after 2-3 years of planting, but for quality fruit production it comes into bearing after 4-5 years. Kiwifruit is a unique crop because it has separate male and female flowers on different vines, and the flowers don't produce nectar to attract honey bees. This can make it challenging for the flowers of kiwifruit to be effectively pollinated and result in smaller yields. To address this, kiwifruit growers often resort to artificial pollination



Bearing at current season growth

or hand pollination, which involves manually collecting pollen from the male flowers and transferring it to the female flowers. One male flower is enough for pollination of five female flowers. But this method takes a lot of practice. This method ensures that the flower receives enough pollen and can increase the overall pollination percentage and yield of the kiwifruit crop.

Optimizing nutrient levels for kiwifruit cultivation

For kiwifruit vines, it's generally advised to apply a basal dose of 20 kg FYM along with 0.5 kg of NPK fertilizers (15% N) per year of age. Fully bearing vines (8 years and above) should receive 60-80 kg FYM, 800 g N, 560 g P, and 1200 g K per vine annually. FYM, P, and K should be applied during December-January, while N is given in two equal dressings - half before bud-burst and the remaining dose at the onset of monsoon in July. To enhance efficiency, it's recommended to apply 2/3rd of the NPK fertilizers through drip irrigation in eight equal split doses, starting from bud burst, with 10-day intervals. This approach leads to a 25% reduction in fertilizer usage and improved yield of quality fruits compared to traditional methods.

Balancing water requirement in kiwifruit cultivation

Kiwifruit cultivation demands a substantial amount of water, especially because of the vine's large leaves, which increase water requirements. In regions with irregular rainfall, supplemented irrigation is vital for successful kiwifruit production. Young vines need more frequent irrigation than mature ones, while bearing vines should be irrigated when soil moisture reaches 20% depletion from field capacity. Drip irrigation is the preferred method as it can lead to higher yields of quality fruits. During summer, fully grown vines require 80-100 litre of water daily to account for transpiration from their 16-17 m² canopy area. Nylon mulch is beneficial for kiwifruit plants, promoting soil moisture

conservation, rainwater infiltration, and proper soil aeration.

Thinning management for healthy kiwifruit plants

Fruit thinning is a crucial step in kiwifruit production after pollination. Kiwifruit trees produce a large number of fruits, leading to competition for resources, resulting in smaller fruit size. Thinning immature fruits ensures remaining ones grow to the desired size and quality. This is typically done during the pea stage of fruit development, allowing the remaining fruits to grow larger and have a higher percentage of Grade A fruits. Kiwifruit growers also limit the number of fruits per branch (6–8) to promote even growth and overall health. Proper fruit thinning optimizes yields and produces high-quality fruits meeting market demand.

Role of CPPU in kiwifruit size

N1-(2-Chloro-4-pyridyl)-N3-phenylurea referred as CPPU (Cycocel and Forchlorfenuron), a synthetic plant growth regulator also known as Sifofex, plays a significant role in Kiwifruit size. Applied during early fruit development, CPPU stimulates cell division and elongation, resulting in larger and more uniform fruit size. The standard concentration of CPPU ranges between 5 and 20 ppm, with the best application time being 2–3 weeks after full bloom. By utilizing CPPU, kiwifruit growers can enhance fruit size and overall quality, contributing to improved market outcomes.

Guide to assessing kiwifruit maturity indices and harvesting

To ensure excellent sugar-acid ratio, flavour, and texture, kiwifruit should be harvested at the right maturity stage. While harvesting before maturity might bring a better price, it can compromise taste and quality, leading to dissatisfied customers. Kiwifruit continues to grow and increase in weight until harvest, with the most significant growth occurring in the first 100 days after bloom. The sugar content, measured in degree Brix, is an essential indicator of maturity and sweetness. A brix value of 6.2 is generally considered suitable, but it may vary depending on factors like cultivar and growing conditions. Harvesting maturity can also be determined by checking the hairs on the fruit's surface; when mature, the hairs fall off easily. Kiwifruit is typically harvested in October–November, done manually by gently twisting and removing the fruit from the vine without damaging it.

Maximizing profits through effective post-harvest management

Currently no standard grading system for kiwifruit in India, but that internationally, kiwifruit is graded based on grading size shown in Table 1.

Table 1. Grading size in kiwifruit

Grade	Size
A grade	100 g
B grade	70–100 g
C grade	Below 70 g

In India, kiwifruit is typically packed in cardboard boxes weighing

3–5 kg, while in other countries; they are packed in tray packs consisting of an outer case, a plastic tray, corrugated strawboard and a cardboard lid, with 33 fruits of 100 g weight in each tray. Kiwifruit has a good storage life, with the ability to be stored at ambient temperature for 6–7 weeks, but for longer storage periods, refrigeration is necessary. Additionally, kiwifruit is used in a variety of processed products, including jam, jelly, candy, squash and wine.

SUMMARY

Kiwifruit has a bright future prospect in Himachal Pradesh, as well as in other hilly regions of the country. The fruit has been assessed as one of the important future commercial fruits due to its high return per unit area and consistent yields without any crop failure. According to reports, farmers in Himachal Pradesh can earn about ₹4–5 lakhs per hectare annually from kiwifruit cultivation. Kiwifruit cultivation in Himachal Pradesh is relatively new; there is tremendous scope for its development and expansion. With proper training and support, kiwifruit could be developed into a vital industry for sustainable economic growth in hilly regions. As such, there is a need for continued research and development in this field to improve the quality and productivity of kiwifruit cultivation in the country.

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The *Krishi Unnati Yojana*, a central sector scheme, is envisaged as umbrella programme for focusing on food security, by merging schemes on Soil-health Card, Integrated Scheme on Agricultural Co-operation and Agricultural Marketing, National Mission on Agriculture Extension, Horticulture Development, Price Stabilization Fund, National Mission on Sustainable Agriculture and other programmes.

Pradhan Mantri Krishi Sinchai Yojana

This *Yojana* brings

- Per Drop More Crop.
- Inputs from MoWR and DOLR received.
- Increase in agricultural production and productivity and enhance farm income.