



Scope and Importance of Low Chill Apple Cultivation in Lower Hills of Himachal Pradesh

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In the northwest Himalayas, Apple is the most significant fruit crop. Since it is a temperate fruit, almost 90% of its output is produced in the hills of Uttarakhand, Himachal Pradesh, and Jammu & Kashmir, where its chilling needs are met. Arunachal Pradesh, Sikkim, Nagaland, and Meghalaya in the northeastern area, as well as the Nilgiri highlands in Tamil Nadu., The apple cultivation area has been increased from 97438 ha⁻¹ in 2008–09 to 114650 ha⁻¹ by 2021–22 with the production of apple has gradually reached 643000 MT with a productivity of 5.62 MT in 2022 (Anonymous, 2022). During the winter, the majority of apple varieties need 1000–1500 hours of chilling below 7°C to break their rest period. These circumstances are found in the Himalayan ranges at elevations between 1,500 and 2,700 meters above sea level. Climate change has caused temperatures to rise and snowlines to shift to higher elevations, posing a threat to the apple economy of Himachal Pradesh. New cultivars will aid in the cultivation of apples in warmer climates, as output may be impacted by less chilling hours. As temperatures rise, plantations in the traditional apple belt of Shimla and Kullu have changed.

Keywords: Anna, Apple cultivation, Chill units, Chilling hour, Low chill, lower hills, Varieties

Introduction

Apple cultivation is currently limited to the districts of Kullu, Shimla, Kinnaur, Lahaul-Spiti, and a few areas of Mandi. The flavor of apples cultivated in warm regions like as Bilaspur, Mandi, Kangra, Hamirpur, and Sirmour districts is inferior to that of apples grown in colder regions. With time, people from other areas also became interested in growing this fruit and efforts began for extending apple cultivation not only to marginal areas but also to those areas which did not experience typical temperate climate and were not apple growing areas. However, some farmers in these regions have begun cultivating traditional apple types. Warm climates suit these types well. Farmers in the lower regions of Himachal Pradesh have long called for the introduction of local, low-chilling cultivars. By chilling apples for about 300 hours, low-chilling types can increase their range. These apple types have been produced to promote apple cultivation in regions with mild winters, such as the low Shiwalik foothills. They are expected to change the economy of lower areas. The warmer regions of Himachal Pradesh, as well as portions of Punjab and Haryana, are suitable for the effective cultivation of low chilling cultivars. Apple types from these regions sell for a fair price since they start to ripen a month early in June. A further benefit is that these types begin to bear in the third year, even on seedling rootstock. Therefore, there is a relatively short waiting period.

Chilling Requirement

Nature has made a provision for protecting plants from cold injury. As soon as the cold season starts, some plants enter into a phase of dormancy which is indicated by leaf fall beginning in autumn. These dormant leafless plants remain unaffected by low temperatures. They resume growth only after the winter. This process of dormancy is initiated and then ended by some hormonal changes within the tree body. For coming out of the dormancy (or for letting those hormonal changes to take place), tree must get exposed to a specific duration low temperature below 7°C. This exposure is known as “chilling requirement” and its duration is called “chilling hours”. Most traditional apple varieties have a chilling requirement of 700 – 1200 hours. The chilling requirement varies with variety. The higher chilling requirement varieties must be planted in colder areas otherwise these will not fruit.

Anna: Originally bred in Israel, the 'Anna' apple is one of the top choices for low-chill climates with 200-300 chill hours. It produces sweet and tart, crisp, juicy apples with a flavour similar to the popular 'Granny Smith' when picked early but sweetens when allowed ripening longer on the tree. 'Anna' is also known for its early harvest, often producing apples in the early summer months, which is a bonus for regions with shorter growing seasons.



Dorsett Golden: Hailing from the Bahamas, 'Dorsett Golden' is a heat-tolerant apple variety that thrives in subtropical and tropical climates with 100-250 chill hours. This variety resembles the famous 'Golden Delicious' in flavour, offering a sweet and mildly tart taste. Its exceptionally low chill requirement makes it perfect for regions that experience very few cold nights in winter. This apple also performs well when cross-pollinated with 'Anna' harvested late spring to early summer.



Tropic Sweet: As its name suggests, 'Tropic Sweet' was developed specifically for tropical and subtropical regions with 300-400 chill hours. It produces medium-sized, greenish-yellow apples with a pleasingly sweet flavour and minimal tartness, making it a favorite for fresh eating. This variety is relatively new but has quickly become a favorite in regions like Florida and southern California and harvested mid to late summer.








Ein Shemer: Another Israeli variety, 'Ein Shemer' is known for its low chill requirement and early fruiting having 100- 200 chill hours. It bears fruit that has a tarter flavour, which is excellent for those who enjoy tangy apples or want to use them in pies and other baked goods. It is an excellent companion to 'Anna' for crosspollination and grows well in regions where chill hours are minimal and harvested in early summer.



Tropical Beauty Originally raised in about 1930 by Meredith B. Strapp, Maidstone, South Africa. Named and introduced in Australia in 1958 by Longbecker Nurseries, Bunderburg. The Tropical Beauty apple is known for its medium to large fruit size and visually appealing appearance of round fruit with dark red over green-yellow base making it a favorite among fruit enthusiasts. This dessert apple is highly suitable for tropical conditions with hot summers and temperate winters, requiring less than 100 chill hours of dormancy.



<p>Hariman (HRMN-99) This self-pollinating apple variety, developed by a farmer from Bilaspur District of Himachal Pradesh, thrives with fewer chilling hours and is now cultivated in the plains as well as tropical and subtropical regions across India. It successfully grows even in areas where temperatures often reach 40 to 45°C. The fruit is large and conical, featuring a striped red over yellow skin, and is considered superior in quality compared to the Anna and Dorsett Golden varieties.</p>	
<p>Michal: This very low chilling apple is early maturing, ideal for regions with mild winters where fewer chilling hours are needed. Its medium-sized fruits are slightly conical, with a smooth calyx end and a striking red-striped skin over a greenish-yellow base. The fruit typically weighs between 106-142 grams, with a length of 54-59 mm and a diameter of 65-72 mm.</p>	
<p>Maayan: A slightly heavier than Michal, Maayan is a very low chilling requiring variety, early maturing variety. Fruits are globose to slightly conical in shape with stripped red colored over green yellow ground, fruit weight (115-150 g), fruit length and diameter (53-56 and 66-70 mm) respectively.</p>	
<p>IPR Julieta: Performs effectively in regions with 100–500 chill units, resistant to the necrotic leaf blotch. Red strips on fruits surface (30–50%), sweet and juicy, with a delicate texture and moderately vigorous with open canopy (Hauagge 2010)</p>	
<p>Pink Lady: Greenish yellow (30–60%) surface along with pinkish red solid (40–70%), Resistance to bitter pit and slight susceptibility towards powdery mildew</p>	

Major Constraints in Low Chilling Apple Cultivation

1. Majority of the temperate fruit trees require climates with sufficient winter chilling to break internal bud dormancy. This condition generally cannot be fulfilled in subtropical climate. Temperate-zone cultivars have not been commercially productive in subtropics; however, some poor-quality fruits could be produced.
2. Burden of increasing imports.
3. Lack of suitable cultivars for subtropical climate having higher yields and good quality.
4. Lack of quality planting material of scion cultivars and rootstocks Poor fruit quality.
5. Lack of technology to release the dormancy in all the fruit crops and cultivars
6. Inconsistent dormancy breaking through use of chemicals.
7. Insufficient breeding work to support and development of low chilling, high yielding and better quality fruit crops.
8. Incidence of pest and diseases.
9. Lack of awareness.
10. Lack of financial support.

Improved Production Technology for Growing Apples in Low Chill Areas

1. **Suitable Varieties:** Choose varieties with chill hour requirements that align with your local winter temperatures. Apples like 'Anna' and 'Dorsett Golden' can thrive even in regions with as few as 100- 300 chill hours.
2. **Proper Pollination:** Many low-chill apple varieties, though partially self-fertile, experience a significant boost in fruit set and yield through cross-pollination. For instance, the Tropical Beauty apple sees improved production when pollinated by compatible varieties such as Anna or Ein Shemer. This makes cross-pollination a key factor in effective orchard management. Since apples typically need different varieties to cross-pollinate for successful fruiting, planting compatible types like 'Anna' and 'Dorsett Golden' together can lead to higher yields.
3. **Diseases and Pest Protection:** Warm climates can sometimes lead to increased pest and disease pressure. Regular pruning, appropriate watering, and using pest control measures can help keep your apple trees healthy and productive.
4. **Pruning and Training:** In warmer climates, apple trees may grow more vigorously. A consistent annual pruning is essential to encourage airflow, light penetration, and fruitful growth.
5. **Postharvest management** (diseases and disorders during storage): Fruit's shelf life is essential to determining its quality and profitability. Low-chilling apple varieties ('Anna' and 'Dorsett Golden') are often harvested between late June and early July. Most of these fruits are provided to markets for fresh consumption; however prices can be low during that season. The shelf life of low-chilling apple cultivars is thought to be short. Furthermore, cold storage of the harvested crop secures the supply of quality apples throughout the off-season and helps to acquire a reasonable market price in the middle and lower mountain districts. (Mitropoulos & Lambrinos 2000).
6. **Protection of apples against storage diseases:** Low-chilling apple varieties are especially vulnerable to numerous storage diseases, which can have a substantial impact on their postharvest quality and market value. Research reveals that these cultivars frequently have physiological issues due to insufficient chilling hours, increasing sensitivity to pathogens during storage and making them more sensitive to illnesses such as blue mold and soft rot. (Hauagge 2010, Vittani et al. 2023).

Challenges

Despite their benefits, low chilling apple varieties face challenges associated with climate variability, including insufficient chilling hour accumulation and potential genetic vulnerabilities. Warmer winters may disrupt the dormancy cycles crucial for fruit set, creating uncertainties in yield outcomes. Additionally, the economic viability of these varieties can fluctuate based on market demands and climatic constraints, necessitating careful management and strategic varietal choices by growers to mitigate risks.

Conclusion

Growing apples in low-chill regions is entirely possible with the right selection of varieties. From the tangy 'Anna' to the sweet and crisp 'Fuji,' these varieties bring a world of flavour to warmer areas that typically wouldn't support traditional apple cultivation. By selecting apple trees with the appropriate chill hour requirements, you can enjoy homegrown apples, even in regions where winter is brief and mild. With proper care and planning, your low-chill apple orchard can flourish, offering delicious fruit for fresh eating, cooking, and preserving.

References

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