

Climate resilient and nutri-smart fruit varieties

Long-term research and advanced breeding strategies on subtropical fruit crops have led to the development of climate-resilient varieties that cater to economic stability, consumer preferences, and industry standards. ICAR-CISH has identified and released several climate-resilient fruit varieties through the State Variety Release Committee (SVRC) of Uttar Pradesh and the Central Variety Release Committee (CVRC), New Delhi, for the Uttar Pradesh region. This paper highlights varieties officially released in 2024 and 2025, exemplifying the institute's efforts to strengthen the resilience and productivity of subtropical fruit crops.

Keywords: Abiotic stress tolerance, Climate resilient, High-yielding fruit varieties, Nutri-smart cultivars, Subtropical fruit breeding

SUBTROPICAL fruit production has been severely challenged by unpredictable climatic conditions in northern India. Unfavourable environmental factors such as rainfall variability, humidity, temperature extremes, light intensity, wind, drought, and waterlogging have detrimental effects on the growth and productivity of subtropical fruits. Heat stress, in particular, poses a major challenge to fruit production systems by disrupting physiological and developmental processes in fruit-bearing plants. The negative impacts of climatic variations on growth and development—especially sudden increases in temperature during flowering and unseasonal rainfall—have been regularly observed in recent years. Changing climate patterns and seasonal variability are thus creating greater uncertainties and risks in the production and productivity of subtropical fruits. Additionally, climate change has led to the emergence of new diseases and pests with increased virulence, posing a serious threat to sustainable fruit production in subtropical regions.

Mango and guava are the most important fruit crops of the subtropical region. However, existing traditional mango and guava varieties are not sufficiently climate-resilient, and their production and productivity fluctuate under changing climatic conditions. Considering the growing demand for new multi-trait varieties in mango and guava, the ICAR–Central Institute for Subtropical Horticulture (ICAR-CISH), Lucknow, oriented its fruit improvement programme towards the development of climate-resilient, high-yielding, regular-bearing, nutri-smart fruit varieties with superior quality, extended shelf life, and wider adaptability. Long-term research and advanced breeding strategies have led to the development of climate-resilient varieties that cater to economic stability, consumer preferences, and industry standards. ICAR-CISH has identified and released several such

climate-resilient fruit varieties through the State Variety Release Committee (SVRC) of Uttar Pradesh and the Central Variety Release Committee (CVRC), New Delhi, for the Uttar Pradesh region.

MANGO

CISH Ambika

CISH Ambika is a nutri-smart mango hybrid developed by crossing *Amrapali* × *Janardan Pasand*. It is a regular bearer, high-yielding, and late-maturing hybrid. The fruits have an attractive dark red blush on a yellow peel; the pulp is dark yellow, firm, and contains scanty fibre, with good keeping quality. The fruit weigh about 300–350 g, with a total soluble solids (TSS) content of 21 °Brix, and the hybrid is rich in mangiferin (35.1 µg/g). Under improved cultural practices, it yields about 80 kg/plant by 10 years of planting.



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The hybrid has wide adaptability and is suitable for cultivation in mango-growing areas of both subtropical and tropical regions, except high-rainfall areas of the country, namely Uttar Pradesh, Bihar, Madhya Pradesh, Andhra Pradesh, Karnataka, Gujarat, Maharashtra, and Tamil Nadu. Owing to its attractive fruit colour, *CISH Ambika* has potential for both domestic and export markets.

CISH Ambika has been registered with the PPV&FRA, New Delhi, under registration number REG/2016/375, and was notified by the Central Variety Release

Committee (CVRC) for Uttar Pradesh State in 2024.

CISH Arunika

CISH Arunika is a nutri-smart mango hybrid developed by crossing *Amrapali* × *Vanraj*. It is a regular bearer and late-maturing hybrid. The fruits are smooth, orange-yellow in colour with a red blush, and possess excellent keeping quality with a pleasant flavour. The fruit weigh about 190–210 g; the pulp is orange-yellow, firm, and contains scanty fibre. The total soluble solids (TSS) content is 24.6 °Brix.



The hybrid is exceptionally rich in β -carotene and mangiferin (49.5 $\mu\text{g/g}$). The tree produces a dwarf and compact canopy and is therefore suitable for high-density planting. Under improved cultural practices, it yields about 70 kg/plant by 10 years of planting. *CISH Arunika* has wide adaptability and is suitable for cultivation in all mango-growing regions under both subtropical and tropical conditions.

CISH Arunika has been registered with the PPV&FRA, New Delhi, under registration number REG/2019/101, and was notified by the Central Variety Release Committee (CVRC) for Uttar Pradesh in 2024.

Awadh Abhaya

Awadh Abhaya is a climate-resilient, nutri-smart, high-yielding, regular-bearing, and very late-maturing mango hybrid. It was developed by crossing *Neelum* × *Tommy Atkins*. The fruits are medium to large in size, light yellow in colour with a red blush on the peel, and have strong stalk attachment. Fruits weigh about 300–400 g and are very firm in texture. The pulp constitutes about 80.76% of the fruit, is light yellow in colour, and has a total soluble solids (TSS) content of 25.4 °Brix. The fruits contain total sugars of 12.59%, acidity of 0.39%, and a TSS:acid ratio of 65.12. The ascorbic acid content is 24.0 mg/100 g pulp, total phenol content is 67.92 mg/100 g pulp, and total antioxidant activity is 0.84 $\mu\text{mol Trolox/100 g pulp}$.



Awadh Abhaya exhibits excellent shelf life of up to 15 days at ambient room temperature. The plants are spreading in growth habit and produce a medium canopy. The hybrid begins bearing within 2–3 years of planting and takes about 135–145 days from fruit set to fruit maturity. Under improved cultural practices, it yields about 89.5 kg/tree by 10 years of planting. It is primarily grown under irrigated conditions but is also suitable for rainfed cultivation with assisted irrigation at critical stages

of crop growth.

The hybrid is suitable for cultivation in all mango-growing regions under both subtropical and tropical conditions and has strong potential for both domestic and export markets owing to its firm texture and extended shelf life. *Awadh Abhaya* was notified by the Central Variety Release Committee (CVRC) for Uttar Pradesh in 2025.

Awadh Samriddhi

Awadh Samriddhi is a climate-resilient, nutri-smart, regular-bearing, high-yielding, and late-maturing mango hybrid developed by crossing *Amrapali* × *Vanraj*. The fruits are uniform in size, weighing about 300–350 g, smooth, and bright yellow in colour with an attractive dark red blush on the peel. The pulp constitutes about 71.8% of the fruit, is dark yellow in colour, firm in texture, and contains scanty fibre. The total soluble solids (TSS) content is 21.6 °Brix, with total sugars of 11.84% and a TSS:acid ratio of 40.0. The fruits are rich in total phenols (105.69 mg per 100 g pulp) and contain 60.80 mg ascorbic acid per 100 g pulp.



The fruits have a shelf life of 9–10 days at ambient room temperature. The tree produces a semi-dwarf and compact canopy. The hybrid begins bearing within 2–3 years of planting and takes about 130–135 days from fruit set to fruit maturity. Under improved cultural practices, it yields about 90 kg/plant by 10 years of planting. It is primarily grown under irrigated conditions but is also suitable for rainfed cultivation with assisted irrigation at critical growth stages.

Awadh Samriddhi is suitable for cultivation in all mango-growing regions under both subtropical and tropical conditions and has potential for both domestic and export markets owing to its attractive fruit colour and good shelf life. The hybrid was notified by the Central Variety Release Committee (CVRC) for Uttar Pradesh in 2025.

ICAR Sagarika (ML-2)

ICAR Sagarika is a regular-bearing, salt- and sodicity-tolerant, polyembryonic mango rootstock. At maturity, the fruits have an attractive yellow peel with dark yellow, firm, and fibrous pulp. Fruits weigh about 45–50 g, have a TSS of 21 °Brix, and are rich in carotene. Under salt-



stressed calcareous soil conditions (soil pH 9.0–9.39), it yields about 10–20 kg/plant, producing approximately 150–250 fruits/plant after 8 years of planting.

The rootstock has strong potential for promoting mango cultivation in degraded and salt-affected soils due to its high tolerance to soil sodicity and regular bearing habit.

GUAVA

Awadh Bhushan

Awadh Bhushan is a guava variety selected from a half-sib population of *Sardar*. It is a prolific bearer under improved management practices. The fruits are yellowish-green, attractive, broadly round in shape, bold in size, and weigh about 300 g on average. The pulp is firm and crispy with a thick pericarp (>1.5 cm), relatively few and soft seeds, and high ascorbic acid content (280 mg/100 g pulp).



The variety yields about 80 kg/ tree by 6 years of planting under improved cultural practices. The trees are responsive to pruning and suitable for high-density planting. *Awadh Bhushan* is suitable for table purposes and can also be processed for products not requiring pink pulp. It was notified by the CVRC for Uttar Pradesh in 2025.

CISH-Lalit

CISH-Lalit is a high-yielding guava variety with wide adaptability. The trees are highly responsive to pruning and yield about 100 kg/tree by the sixth year of planting under improved management. The fruits are saffron-yellow in colour with firm pink pulp, weigh about 185–200 g, contain approximately 250 mg ascorbic acid/100 g pulp, and have a TSS of about 13.25 °Brix.



The variety is suitable for both fresh consumption and processing. It was recommended for Rajasthan during the 8th AICRP Group Discussion in 2021 and notified by the CVRC for Uttar Pradesh in 2024.

CISH-Shweta

CISH-Shweta is a high-yielding guava variety that performs well in several guava-growing states of India. The fruits are attractive with snow-white pulp, weigh about 250 g, contain approximately 300 mg ascorbic acid/100 g pulp, and have a TSS ranging from 12.5 to 13.2 °Brix. The



fruits have a good balance of sugars and acids and relatively few and soft seeds.

The variety yields about 90 kg/tree by the sixth year of planting under improved management. It was recommended for Madhya Pradesh during the 8th AICRP Group Discussion in 2021 and notified by the CVRC for Uttar Pradesh in 2024.

CISH Dhawal

CISH-Dhawal is a prolific-bearing, soft-seeded guava variety. Six-year-old trees yield about 90 kg of fruits/tree, which is approximately 20% higher than the popular variety *Allahabad Safeda*. The fruits are medium-sized, smooth-surfaced, broadly round, and visually appealing, weighing about 200–225 g. They contain approximately 250 mg ascorbic acid/100 g pulp and have a TSS of about 13.4 °Brix.



The variety is suitable for both fresh consumption and processing. It was recommended for Punjab and Uttar Pradesh during the 8th AICRP(F) Group Discussion in 2021 and by the State Variety Release Committee (SVRC) for Uttar Pradesh in 2024.

CISH Lalima

CISH-Lalima produces medium-sized, round fruits with a thick pericarp and an attractive crimson colour at maturity. The fruits weigh about 200 g on average, contain 150–220 mg ascorbic acid/100 g pulp, and have a TSS of about 13.0 °Brix. The pulp is firm with a good balance of sugars and acids.



The variety has good yield potential in the subtropical plains and is suitable for both fresh consumption and processing. *CISH-Lalima* was recommended by the SVRC for Uttar Pradesh in 2024.

JAMUN

Awadh Jamwant

Awadh Jamwant is a high-yielding jamun variety characterized by bold, large-sized bunches with an attractive deep purple colour. It is a mid-season variety that matures during the second week of June. The fruits are bold and oblong, weigh about 18–21 g, have a pulp percentage of 92.26%, and a TSS of 16.4 °Brix.



The variety is suitable for both table and processing purposes and was notified by the CVRC for Uttar Pradesh in 2025.

BAEL

Awadh Arpan

Awadh Arpan is a seedling selection with a medium-sized tree, early ripening (April), and drought tolerance, showing luxuriant growth under low rainfall and high temperature conditions. It is a prolific bearer, yielding about 75.20 kg/tree at 15 years of age. The fruits are oblong, weigh about 1.0–1.3 kg, and develop an attractive golden-yellow colour upon ripening.

The pulp is rich in marmelosin (596.57 µg/g), psoralen (102.02 µg/g), polyphenols (3.66 µg/g), riboflavin (158 µg/g), niacin (1,340.0 µg/g), ascorbic acid (23.60 mg/100 g pulp), and total carotenoids (2.42%). The fruits have fewer seeds (91.64), moderate TSS (36.10 °Brix), low mucilage, thin shell (1.90 mm), and high total sugar content (16.26%). *Awadh Arpan* was notified by the CVRC for Uttar Pradesh in 2025.



Awadh Shrestha

Awadh Shrestha is a high-yielding seedling selection (67.43 kg/tree at 15 years of age) with semi-spreading growth habit, sparse foliage, and very few thorns. The fruits mature in mid-



season (May), are large and oblong to round in shape, weighing about 1.4–2.35 kg, and develop an attractive golden-yellow colour at maturity. The pulp is pale yellow with moderate TSS (32.03 °Brix), acidity of 0.41%, and vitamin C content of 14.41 mg/100 g pulp.

The fruits show reduced susceptibility to fruit drop and cracking, have a thin shell (2.14 mm), moderate seed content (142 seeds per fruit), low mucilage, high riboflavin (182.57 µg/g), phenols (2.67%), total sugars (13.03%), and reducing sugars (6.14%). *Awadh Shrestha* was notified by the CVRC for Uttar Pradesh in 2025.

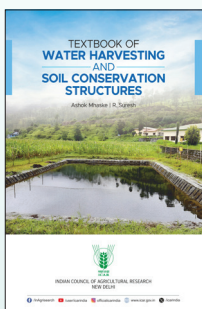
CONCLUSION

The survival, growth, and development of subtropical fruit crops are largely influenced by abiotic stresses such as high temperature, unseasonal rainfall, and drought. It is vital to understand how climate change affects the growth and development of fruit trees, as well as how multiple concurrent stresses influence their physiological and regulatory mechanisms. ICAR-CISH is actively engaged in the development of nutri-smart and climate-resilient fruit varieties that are capable of coping with major environmental challenges and performing well under changing climatic scenarios.

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TECHNICAL ASPECTS

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