

## Impact of important ICAR-CISH technologies

The ICAR-Central Institute for Subtropical Horticulture, Lucknow has pioneered the development and dissemination of varieties and technologies to enhance productivity, quality, and marketability of fruits in Subtropical region of the country. The impact of CISH developed guava varieties Lalit and Shweta, technologies such as ICAR FUSICONT, CISH Metwash and the effect of cluster-based programs was evaluated. Adoption of varieties have led to increased yield, adoption of ICAR FUSICONT increased the productivity, adoption of GAP led to decreased use of chemicals and increased exports besides promoting entrepreneurship, and generated significant economic benefits. The study underscores the importance of large-scale adoption of these varieties and technologies to maximize economic and social benefits for all stakeholders.

**Keywords:** Cluster-based approach, Economic surplus, Good Agricultural Practices, Post-harvest technologies, Subtropical fruits

THE ICAR-Central Institute for Subtropical Horticulture (CISH), Lucknow, has been addressing the challenges faced by farmers in cultivating fruit crops in the subtropical regions of India. The institute has developed improved varieties and hybrids, including four mango hybrids, one sodicity-tolerant rootstock in mango, five guava hybrids, three *bael* varieties, and two varieties each of *aonla* and *jamun*. To enhance productivity and sustainability, ICAR-CISH has devised a range of production and protection technologies such as Good Agricultural Practices (GAP) in mango, rejuvenation techniques in mango, high-density planting systems in mango and guava, espalier training in guava, met wash, fruit wash, and an automatic fruit washer-cum-grader. Value-added inputs like *Fasal Prabhat* (a micronutrient mixture), Bio-enhancer, Biozapper, and hydroponic solutions for solanaceous crops and leafy vegetables have also been developed.

In crop protection, the institute has contributed significantly by developing ICAR-FUSICONT (for managing Fusarium wilt in banana caused by TR4, in collaboration with CSSRI, RRS Lucknow), bio-immunization technology for wilt tolerance in banana, and wilt management protocols. Mechanical pest management innovations include CISH Trap 1, 2 and 3, multilayer sticky traps, CISH-OMAT and VMAT, and the autorotary light trap. ICAR-CISH has also developed processing protocols and value-added products such as beverages from mango, guava, *aonla*, *bael*, and *jamun* (pulp, RTS, squash), mango wine, butter, bars, instant *aampanna*, guava nutri-bite, hot water-dispersible *aonla*-herbal tablets, iron-fortified *aonla* candy, and spice-blended *aonla* juice. Several of these technologies have been commercialized for entrepreneurs, ensuring widespread adoption.

Beyond research, the institute has promoted cluster-based production of export-quality mangoes, dissemination of technologies through training, demonstrations, and programs such as SCSCP, TSP, NEH, Farmer FIRST, and digital advisories via WhatsApp and newspapers. This article provides the impact of a few varieties and technologies released by the institute.

### Economic surplus from the varieties and ICAR-FUSICONT

#### Varieties

The economic surplus generated by two guava varieties (CISH *Lalit* – released in 1999 and CISH *Shweta* – released in 2005) and ICAR-FUSICONT technology. Though the varieties were released during the 2000s, the data of the planting materials sold from the institute from 2012 was considered for the analysis. Guava variety CISH *Lalit* had wider adoption, covering 8,570.68 ha. *Lalit* variety was mainly spread to states like Madhya Pradesh, Andhra Pradesh, Maharashtra, Karnataka, Rajasthan, and North Eastern States. The variety generated a total economic surplus of ₹33.85 crore with 68% being producer surplus. The net social gain per ha was ₹49,165. CISH *Shweta* variety of guava has spread mainly to Uttar Pradesh, Haryana, Punjab, and Rajasthan (5,815.87 ha) and generated an economic surplus of ₹11.71 crore with a net social gain of ₹19,766/ha.

#### ICAR-FUSICONT

ICAR-FUSICONT, a biological control-based formulation, offers a sustainable solution to combat the effect of Fusarium wilt in banana caused by *Fusarium*

Particulars	CISH Lalit	CISH Shweta	ICAR-FUSICONT
Year of release	1999	2005	2021-22
Total area spread (ha)	8,570.68	5,815.87	8,550
Consumer surplus (₹ crore)	10.74	4.39	94
Producer surplus (₹ crore)	23.11	7.32	210
Total economic surplus (₹ crore)	33.85	11.71	304
Net economic surplus (₹ crore)	32.62	10.77	302
Net social gain (₹/ha)	49,165	19,766	8550

*oxysporum* f.sp. *cubense* Tropical Race 4 (Foc TR4). The technology has been commercialized to M/S Innoterra India Ltd. and M/S Khandelwal Fertilizers Private Limited, Belagavi, Karnataka. Fusarium wilt has spread across 31,500 ha in the states under consideration, of which diseased area in Karnataka is 15,500 ha, followed by UP with 11,500 ha and Bihar (4,500 ha). The technology has spread to an area of 8,550 ha. The area under the technology is higher in Karnataka (70%) followed by Uttar Pradesh (23.5%) and Bihar (6.5%). In Karnataka, control farmers growing *Elakki* banana realized 19.25 t/ha, which is 42.85% lower than the treated farmers (27.5 t/ha). In Uttar Pradesh, control farmers realized a yield of 37.2 t/ha, whereas treated farmers obtained 56 t/ha, which is 50.53% higher than the control farmers. In Bihar, treated farmers of Grand Naine variety obtained 35.67% higher yield (45.83 t/ha) than the control farmers (32.08 tonnes/ha). The producer surplus generated by the technology was ₹210 crore, while the consumer surplus was ₹94 crore, resulting in a total economic surplus of ₹304 crore. The net social gain/ha was ₹8,550.

### Success of guava cv. *Dhawal* in Madhya Pradesh

*Dhawal* variety of guava released by the institute is a highly preferred variety by the farmers. Shri Ansari Ali, a progressive farmer from Badi Tehsil of Raisen district, Madhya Pradesh, has made remarkable success in guava cultivation. Shri Ali owned 6 acres of guava orchards consisting of *Dhawal* (80%) and *Bharafkhana* (20%) varieties. He realized an excellent yield of 80–100 kg/tree. The fruit has superior shine, attractive appearance, outstanding quality, and exceptional taste, said the farmer. These factors have helped him build a customer

base and fetch higher prices. During the peak season, *Dhawal* fetches ₹700–800/crate (20 kg), while during the lean period, crates are sold at ₹1,500–1,600. Most of the guavas are sold on pre-orders. This direct demand ensures stabilized price and reduced market risk. Farmers of the region also grew VNR *Bihi*, which requires high investment cost and high management cost. Unlike VNR *Bihi*, *Dhawal* variety does not require bagging or espalier architecture to maintain fruit quality. VNR guavas with bagging fetched around ₹400/ crate, while unbagged fruits fetched ₹200–250/ crate. Shri Ali has been able to achieve a net return exceeding ₹50 lakh. His story highlights the potential of *Dhawal* variety.

### Export cluster development in Uttar Pradesh

Uttar Pradesh, India's leading mango-producing state, lags in exports due to poor fruit quality. The institute, in collaboration with the Government of Uttar Pradesh, promoted Good Agricultural Practices (GAP) in mango cultivation using a cluster-based approach in Central and Western parts of Uttar Pradesh. Around 2,000 farmers are part of this cluster program in Central UP, providing them with hands-on training and guidance to produce clean mangoes. Adoption of GAP resulted in significant reduction in pesticide use. The number of sprays per hectare was reduced from nine to four. Adopters of GAP spent ₹28,257/ha, compared to ₹40,587/ha by non-adopters. GAP adopters incurred an additional expenditure of ₹38,796/ha, primarily due to fruit bagging (₹31,575/ha). The benefits in terms of premium price realization and marginal yield increase outweighed these costs. The practice led to a marginal yield increase of 0.9 t/ha. The price for the bagged mangoes was stable throughout the period; however, the price of non-bagged mangoes crashed to ₹15–20/kg during the peak season. This enabled farmers in the cluster to export around 20 tonnes of high-quality mangoes. The benefit-cost ratio was 1.45 and 1.05 for adopters and non-adopters, respectively. Beyond financial gains, GAP adoption under the cluster approach has led to entrepreneurship



Shri Ansari Ali with guava cv. *Dhawal*



development in fruit bagging. Earlier the bags were obtained from Telangana, but due to the impact of bagging, two new industries have been set up in the region.

### Mango cluster development at Malda, West Bengal

ICAR-CISH, KVK Malda, West Bengal has established the mango cluster at Malda for production and export of mangoes. The interventions by ICAR-CISH KVK, Malda have transformed the mango sector in Malda's Old Malda and English Bazar blocks, benefiting the Scheduled Caste farmers across 5,500–6,000 ha. KVK Malda provided information on Good Agricultural Practices (GAP), Integrated Pest Management (IPM), Integrated Nutrient Management (INM) and eco-friendly post-harvest technologies. Customized IPM kits and trainings reduced pesticide spray from six to three or four improving both environmental sustainability and fruit safety. Adoption of GAP led to higher yields, increased market prices (*Fazli* mango from ₹35/kg to ₹50/kg), reduced cultivation costs to ₹42,000/acre against ₹60,000/acre, and improved benefit-cost ratio (2.785 for adopters and 2.0 for non-adopters). Adoption of GAP facilitated the first-ever shipment of 4 tonnes of *Fazli*, *Arazanuva*, and *Asina* mangoes to the UAE through an entrepreneur incubated at ICAR-CISH Lucknow. Adoption of GAP has created new export avenues and promotes local entrepreneurship. GAP enhanced fruit quality, farmer incomes, international recognition for *Malda* mangoes and created a replicable model for cluster-based technology adoption to foster the socioeconomic upliftment of the farmers.

### CISH Met wash

It is a Bio-smart Secondary Metabolite Based Formulation that controls the post-harvest anthracnose disease and enhances the shelf life of mango. The technology has been validated by M/s Innova Agri Bio Park Ltd. Malur, Karnataka. This technology facilitates the export of mangoes and bananas through sea route making our product competitive in the global market. Sea route export of mango and banana were undertaken with the use of this technology. All shipments were conducted in collaboration with APEDA, New Delhi to test the technology's effectiveness in preserving fruit quality during international transit. Four shipments of mango and banana



were conducted. Mango cultivar *Banaganapalli* were sent to London (7 tonnes, 53 days), *Kesar* mangoes to Japan (7 tonnes, 40 days), *Dashehari* mangoes to Singapore (6 tonnes, 25 days) and *Dudhia Malda* mangoes to Dubai (14 tonnes, 10 days). In case of banana, shipment of 18–24 tonnes were made to St. Petersburg and Moscow in Russia, Spain and Rotterdam in the Netherlands. The seatransit ranged from 22 to 32 days and the bananas reached the target markets in good condition reflecting the viability of the technology.

### CONCLUSION

Adoption of improved varieties, technologies and Good Agricultural Practices have enhanced yields, reduced pesticide use, increased farmer incomes and facilitated exports. ICAR-FUSICONT and CISH Met wash has proved its potential in addressing the key production and post-harvest challenges and have generated substantial economic gains to the adopters. Cluster-based approaches in Uttar Pradesh and Malda have nurtured local entrepreneurship besides establishing the global market links and created scalable models for sustainable, profitable and globally competitive subtropical fruit production. There is a need for wide spread adoption of the technologies and varieties across the subtropical region of the country to realize higher economic and social benefits.

For further information, please write to:  
ICAR-Central Institute for Subtropical Horticulture, Lucknow, Uttar Pradesh; \*Corresponding email: ravisc3@gmail.com

**Please renew your *Indian Horticulture* subscription on time**

For assistance contact: **Business Manager**

Directorate of Knowledge Management in Agriculture (DKMA)

Indian Council of Agricultural Research

Krishi Anusandhan Bhavan-I, Pusa, New Delhi 110 012 *Telefax:* 011-2584 3657; *E-mail:* bmicar@gmail.com