



Elevated Agrivoltaics over Table Grapes

Field Results and Design Insights from Sahyadri Farms, Nashik

A 246 kWp cable-stabilised single-axis tracker over a commercial table-grape farm

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Sahyadri Farms

Sustainable profitable agri enterprise driven by a fully integrated tech-enabled platform, spanning across horticulture value chain



Seeding goodness

Robust Farmer Network

Multi-product, multi-channel supply chain

Scalable Technology

Integrated platform

Sahyadri Farms has created India's largest fully integrated platform for horticulture crops

Pre-Harvest

Robust Farmer Network

Strong supply side ecosystem

Driven by scientific crop advisory, international best practices, access to quality inputs



Higher profits for farmers associated with Sahyadri Farms

Multi-crop, Multi-product Offering



Fresh Produce

Table grape, citrus, banana, mango, pomegranate etc.



Processed Products

Aseptic, concentrate, freeze dried, IQF, ketchup, jam, juice, fruit extraction etc.

Post-Harvest

Multi-channel Distribution Network

Strong demand side ecosystem

Marquee clients across Europe, India, Middle East, Asia and North America



Institutional

+

Non-institutional

Multi-level domestic mandi network



Technology enabling operations at scale



Crop R&D



Crop Agronomy



Testing and Monitoring



Harvest Planning



Inventory Management



Full Traceability

TECH-DRIVEN END-TO-END PLATFORM has helped Sahyadri Farms create a large, profitable business

Sahyadri Farms Platform

Full integration across value chain – replicable across crops

Pre-Harvest Offerings

- Quality agri- inputs at best prices
- Patented varieties, R&D, nurseries
- Crop specific agronomy
- Access to financial products
- Farm certifications/ Global standardization

Multi-Capability Processing Facility



Multi-crop

+

Multi-product

Fresh, aseptic, frozen, FMCG, bio actives and waste management

Post-Harvest Network

- Global distribution network
- Domestic institutional business
- Domestic supply chain network

Core Crops



End-to-end platform approach enables **MAXIMUM VALUE CREATION** for the business

Scale of operations

Revolutionizing horticulture sector with unparalleled efficiency through large scale operations...



Why this project

Helping our grape growers stay strong as the climate changes

Protect the crop

Shield vines and fruit from rising heat and erratic weather

Save water

Ease the pressure on irrigation in dry years

Support farmer income

Add a steady income stream alongside grapes

Learn, then share

Test it on our farm before taking it to our growers

Grapes in Maharashtra

Nashik anchors India's grape industry, and its biggest risks are climatic

67%

of India's grape production came from Maharashtra in 2023–24

>90%

of India's exportable grapes are grown in Nashik district

265 of 358

Maharashtra talukas declared drought-affected in September 2026

What the climate does to the crop

- Grapes do well between 15 and 40 °C; above 40 °C during fruit growth, fruit set and berry size fall.
- If temperature goes above 35 °C during bunch formation, coloured bunches can turn pink and lose market value (ICAR-NRCG).
- In 2025, prolonged rain and low sunlight after foundation pruning cut bud fruitfulness; the 2026 harvest began 40–45% down in key belts.
- In the 2026 drought, Nashik-belt growers have reported vines drying and sought tanker water to keep plantations alive.

Source: [Plant Archives review](#), [ICAR-NRCG Vision 2050](#), [NTER News](#), [NCPAH study](#), [FreshPlaza](#), [Times of India](#)

Light and heat

Grapes are hurt by both too much sun and too little; the aim is to dose light

Too much sun and heat

- Severe sunburn usually appears above 40 °C air temperature; the berry surface can run 12–15 °C hotter than the air.
- Indian practice already uses shade: ICAR-NIASM advises shade net over cordons after foundation pruning for uniform sprouting.
- Shade nets with 30–50% light reduction are the most commonly used in grape production.

Too little sun

- In 2025, inadequate sunlight and prolonged rain led NRCG scientists to warn of up to 50% yield loss across Maharashtra.
- The cause was low bud fruitfulness: fruit buds form in the months after foundation pruning and need light.
- In Italian field trials, vines grown at 30% sunlight had lower light-saturated photosynthesis than unshaded vines.

Source: [IVES Technical Reviews](#), [ICAR-NIASM advisory](#), [PMC review \(Riesling\)](#), [Times of India](#), [AJEV](#)

The grape season

In Maharashtra’s two-pruning cycle, light needs change by stage

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Vine stage	Foundation pruning → shoot growth and fruit-bud formation (~5 months)						Forward pruning (Sep–Oct) → flowering → berry growth → ripening, harvest					
Weather	Peak summer heat		Monsoon: cloud and rain				Dry, mild winter				Heat rising	
Light priority			Maximise light for bud fruitfulness				Full light for canopy and fruit set					
Shade benefit	Protect cordons, new shoots										Limit sunburn and water use	

Why this matters for a tracker: the same panels can open up during the monsoon bud-formation window and give shade in the April–May and February–March heat. Maharashtra production peaks in March–April, the hottest part of the fruiting season.

Indicative calendar for a typical Maharashtra double-pruning, single-crop schedule; adjust the months to the pilot block’s actual pruning dates.

Source: [National Horticulture Board](#), [FAO](#), [ICAR-NIASM advisory](#), [Times of India](#)

The synergy

The benefit runs both ways: panels help the vines, and vines help the panels

What panels give the vines

Cooler canopy

Grenache under dynamic panels: about 2 °C cooler on average in heatwaves, up to 5 °C in extreme events

Less water

Sun'Agri reported 12–34% lower vine water demand from reduced evapotranspiration

Better berry balance

Acidity preserved at similar sugar; veraison delayed 2–5 days in Piolenc, France

What vines give the panels

Cooler modules

An elevated vineyard array ran 3.6 °C cooler than a ground-mounted reference, about +1.1% output

More rear-side light

Rear irradiance was 64% higher above the vines; the canopy reflects more than bare soil

Bifacial upside

Estimated bifacial gain potential of 14.7% above vines versus 8.9% for a ground mount

Source: [IVES \(Piolenc 2019–22\)](#), [IVES \(Piolenc 2019–24\)](#), [pv magazine](#), [Tausz-Posch et al.](#), [Plants People Planet](#)

The Sahyadri pilot

A commercial table-grape farm under a 246 kWp single-axis tracker

- Table grapes, variety ARD 36, trellised and planted to the array geometry
- Cable-stabilised single-axis tracker on a north–south axis; column centre height 3.75 m; ground coverage ratio (GCR) 36%
- Grapes under the array compared side by side with an adjacent open-sun control
- Same soil, rootstock, irrigation and canopy management, and identical planting density — yield per vine therefore compares directly per unit area
- Installed: March 2024 · First season: Oct 2025 to March 2026

Integrated trellis

The array's columns double as trellis supports, reducing the farm's own trellis cost



Conventional grape farm

- The grower installs a dedicated trellis: posts, anchors and wires
- Reference establishment cost: ₹12-15.00 lakh per ha for trellis support system

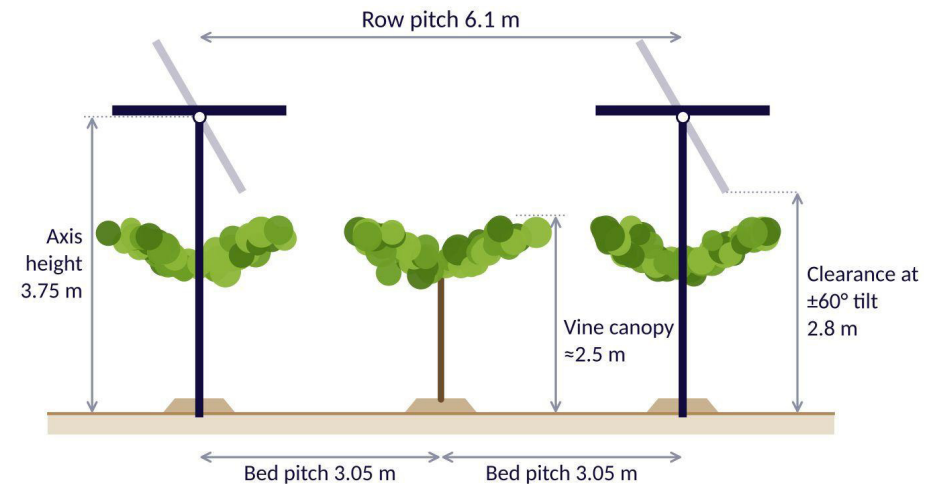
Designed around the farm

One tracker row for every two grape beds: a 36% GCR, set jointly by the bed layout and the light the vines need

Configuration	
Mounting	Single-axis tracker, north–south axis
Axis height	3.75 m
Ground coverage ratio (GCR)	36%
Clearance at full $\pm 60^\circ$ tilt	2.8 m
Row pitch	6.1 m (two grape beds of 3.05 m)

- Two grape beds per tracker row
- Height for machinery and airflow beneath the array
- GCR set jointly by the bed layout and a light analysis of the vines' needs

Designed in, not retrofitted: the column grid was laid out with the vine rows



Schematic cross-section, east-west, to scale. 1P single-axis tracker, north-south axis; GCR 36%. Shaded module: full $\pm 60^\circ$ tilt

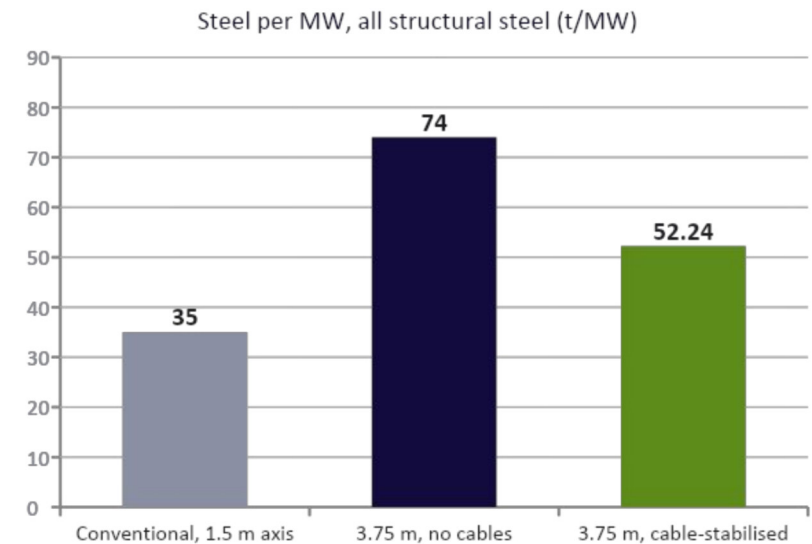
Cable-stabilised structure

Raising the tracker to 3.75 m would more than double its steel; cable stabilisation holds it to 1.5 times a conventional tracker



Cable-stabilised array, Sahyadri Farms, Nashik

- Raising the axis from 1.5 m to 3.75 m makes the columns 2.5 times as tall
- At that height, wind makes a free-standing column sway far more than it stresses it, so the column must be sized to limit deflection, not to avoid failure
- Pre-tensioned east–west cables tie all eight rows back to a deep tie beam and take over that sway, so lighter columns suffice



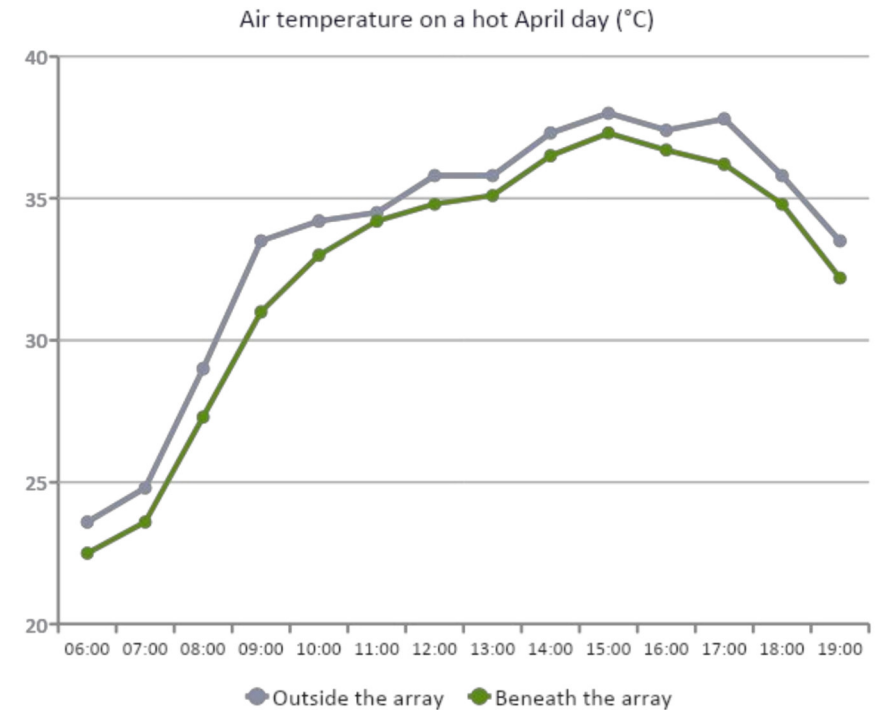
35: SUNSEED design reference · 74: estimated · 52.24: as built (columns, cables, purlins, torque tube)

56% of the extra steel for elevation removed (calculated)

Agronomic practice and microclimate

Farm operations continue beneath the array, and in the hot season the air beneath it is cooler

- Canopy around 2.5 m; the lowest module edge clears 2.8 m even at full $\pm 60^\circ$ tilt
- Compact tractors with air-blast sprayer or electrostatic sprayers pass beneath the array
- Foundation pruning has unobstructed access: no low beams or low cross-bracing
- Height and an open 36% GCR keep air moving through the canopy against fungal disease
- Runoff from the modules concentrates on the drip line, so runoff management is part of the design
- Flat Bower trellis system is developed under array, this will give advantage for better exposure to sunlight
- Drip irrigation system installed
- Soil moisture sensors will help to study water requirement in open and beneath condition



Cooler at every hour 06:00–19:00, by up to 2.5 °C. Two weather stations; read from chart (± 0.2 °C).

Crop performance

93.6% of open-field yield retained, with longer, larger and 21% heavier berries

	Open control	Under the array	Change
Yield per vine (kg)	6.09	5.70	-6.4%
Berry length (mm)	29.3	31.9	+8.7%
Berry size (mm)	17.7	18.8	+6.3%
Berry weight (g)	5	6.05	+21.0%
Total soluble solids (°Brix)	17.8	16.85	-0.95 °Brix
Bunch length (mm)	173.2	159.6	-7.9%

Measured: mean of 10 plants, ripe bunches before harvest. Change: calculated.

- Heavier berries offset a smaller bunch count
- Total soluble solids in both treatments exceed the EU marketing-standard minimum for table grapes (14 °Brix seedless; 13 °Brix seeded)

93.6%

of open-field yield retained under the array

calculated from measured yield

+21%

heavier berries under the array

measured

What we set out to test

Questions grape agrivoltaics must answer in a hot, semi-arid climate

Microclimate

How much cooler are the canopy and berries under the panels during April–May and February–March heat?

Water

How much irrigation can shade save when water is the scarcest input?

Fruitfulness

Does bud fruitfulness hold when the panels open up during the monsoon window?

Yield and quality

How do bunch weight, sugar, acidity and sunburn compare with the open-sun control?

Energy

What do bifacial modules on a single-axis tracker deliver above a grape canopy?