



SURVIVING THE HEATWAVES: PROTECTING HIGH-VALUE CROPS

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INTRODUCTION

Heatwaves have become a recurrent threat to agriculture, driven by intensifying climate change. In India, rising temperatures during sensitive crop growth stages now pose major risks, particularly for high-value crops such as fruits, vegetables, flowers, spices, and plantation crops. These crops unlike staples—are highly temperature-sensitive, and even short heat spikes can reduce yield, quality, and market value. To succeed in this “new normal,” farmers must move from reactive irrigation to proactive, data-driven crop management. Excessive heat accelerates water loss, disrupts flowering and pollination, triggers fruit drop, and increases pest incidence. Quality traits such as taste, texture, and shelf life also decline under thermal stress. With appropriate planning, agrometeorological insights, and climate-smart technologies, however, farmers can minimize losses and enhance crop resilience.

Impact of Heatwaves on High-Value Crops

High value crops are particularly vulnerable because of their delicate physiological processes and high moisture requirements. Heat stress affects crops in different ways:

Reduced Flowering and Fruit Set - High temperatures during flowering can disturb pollination and fertilization. In crops like tomato, chilli, brinjal, mango, and grapes, excessive heat often causes flower drop and poor fruit development.

Sunburn and Quality Loss - Direct exposure to intense sunlight may cause scorching or sunburn on fruits and vegetables. Apples, pomegranates, grapes, and capsicum commonly develop discoloured patches, reducing their market value.

Increased Water Stress - Heatwaves accelerate evapotranspiration, increasing crop water demand. If irrigation is insufficient, plants wilt quickly and growth becomes stunted.

Pest and Disease Outbreaks - Warm conditions favour the multiplication of several insect pests such as whiteflies, mites, thrips, and fruit borers. Heat stressed plants also become more susceptible to diseases.

Shortened Crop Duration - Extreme heat speeds up crop maturity, reducing the grain filling or fruit development period. This ultimately lowers yield and quality.

Strategies to Protect High-Value Crops

Efficient Irrigation Management - Water management is the most critical practice during heatwaves. Drip irrigation helps provide moisture directly to the root zone while minimizing water loss. Frequent light irrigation is often more beneficial than heavy irrigation at longer intervals. Farmers should irrigate during early morning or evening hours to reduce evaporation losses. Adoption of fertigation through drip systems also improves nutrient uptake under stress conditions. **Smart Irrigation: Beyond "More Water"** During extreme heat, plants often lose moisture faster than they can absorb it. **Pulse Irrigation:** Rather than one long soak, use "pulse" sprinkling short 1-2 minute bursts during peak hours (12:30 PM to 4:30 PM) to maintain "Canopy Temperature Depression". **Nighttime Watering:** Always irrigate in the early morning or late evening. This allows the plant to fully rehydrate when transpiration rates are lowest. **Precision Misting:** High-pressure systems, such as the FILOX Fogger Kit, create an ultra-fine mist that evaporates before hitting the leaf, cooling the surrounding air by up to 10°C without increasing fungal risk.

Mulching for Moisture Conservation -

Applying organic mulches such as straw, dry leaves, sugarcane trash, or plastic mulch helps conserve soil moisture and regulate soil temperature. Mulching reduces evaporation, suppresses weeds, and improves root health during hot weather. In vegetable cultivation, plastic mulching has shown significant benefits in maintaining soil moisture and increasing

water-use efficiency. Reflective Mulching: Switching to white-on-black plastic mulch reflects solar radiation, keeping the root zone 3–5°C cooler than traditional organic straw mulch.

Shade Nets and Protected Cultivation –

Protected structures such as shade nets, polyhouses, and low tunnels provide partial protection from extreme heat and solar radiation. Shade nets reduce canopy temperature and help maintain favourable microclimatic conditions for crops like cucumber, capsicum, flowers, and nursery plants. The use of 35–50% shade nets is particularly effective in reducing heat stress during summer months. Shade Netting for open fields, 35%–50% [Agro Shade Nets] are essential. They reduce canopy temperature by 4–6°C and protect fruit from "sunburn necrosis," which commonly affects cucumbers and peppers at temperatures above 38°C.

Foliar Spray for Heat Stress Management –

Foliar application of nutrients and anti-stress compounds can improve crop tolerance. Sprays containing potassium nitrate, calcium, micronutrients, amino acids, or seaweed extracts help maintain physiological balance under heat stress. In some crops, kaolin spray acts as a reflective layer, reducing leaf temperature and preventing sunburn injury.

Selection of Heat-Tolerant Varieties –

Cultivating heat-tolerant and short-duration crop varieties is a sustainable strategy for climate resilience. Agricultural universities and research institutes are developing improved varieties capable of performing better under high temperatures. Farmers should choose region-specific varieties recommended by local agricultural departments or universities.

Timely Weather-Based Advisory Services –

Weather forecasting and agrometeorological advisory services play a vital role in protecting crops from extreme events. Predictive Planning - Modern protection begins with data. High-value farming now relies on hyperlocal weather stations like the RainWise AgroMET Weather Station to monitor real-time canopy temperature and humidity. Early Warnings - Use apps that track the Heat

Humidity Index (HHI). When a "Red" warning is issued, immediate physiological interventions must begin 48–72 hours before the peak heat arrives. Early warning of heatwaves enables farmers to plan irrigation, harvesting, pesticide application, and protective measures in advance. In India, services provided through weather-based agro-advisories help farmers make informed decisions and minimize losses.

Maintaining Soil Health –

Healthy soils with good organic matter retain more moisture and support better root growth. Application of farmyard manure, compost, green manure, and biochar improves soil structure and water-holding capacity. Balanced fertilization is equally important because excessive nitrogen may increase crop sensitivity to heat stress.

Chemical & Nutritional Shielding –

Specific nutrients act as internal "coolants" for high-value varieties. Foliar Sunscreens: Products like [Kaolin clay] or [liquid calcium carbonate] form a microscopic film that reflects UV rays and reduces leaf scorching. Potassium & Zinc: Foliar sprays of Potassium Chloride or [WL Zinc Chelate] help maintain cell membrane stability and support the plant's antioxidant defence system, which neutralizes the "reactive oxygen species" (ROS) produced by heat. Avoid Nitrogen: Do not apply heavy urea during a heatwave; it encourages lush, weak growth that is highly susceptible to heat collapse.

Role of Technology in Heatwave Management –

Modern technologies are transforming climate risk management in agriculture. Remote sensing, automatic weather stations, soil moisture sensors, and mobile-based advisory apps provide real-time information to farmers. Precision agriculture tools help optimize irrigation scheduling and monitor crop stress. Drones and satellite-based systems can identify heat-affected areas quickly, enabling timely interventions. Digital agriculture and artificial intelligence are also supporting climate-smart farming practices by improving decision-making at the farm level. By combining precision technology with strategic agronomy, growers can ensure that even in the harshest summers, their high-value crops don't just survive they thrive.

Building Long-Term Climate Resilience -

Managing heatwaves is not only about short-term protection but also about building long-term resilience in farming systems. Diversification of crops, integrated farming systems, agroforestry, rainwater harvesting, and climate-resilient infrastructure are important adaptation strategies. Training and awareness programs can help farmers understand changing climate patterns and adopt suitable technologies. Strengthening extension services and improving access to weather information will further support sustainable high-value agriculture. Stress Priming: Research shows that "priming" crops with mild, controlled heat exposure or specific biostimulants like [Phylgreen] a few days before a major event can activate the plant's internal "heat shock proteins".

CONCLUSION

Heatwaves are emerging as a major threat to high-value crop production, affecting both yield and quality. As climate variability continues to increase, farmers must adopt proactive and climate-smart approaches to protect their crops from extreme temperatures. Efficient irrigation, mulching, protected cultivation, heat-tolerant varieties, and weather-based advisories can significantly reduce the adverse effects of heat stress. The integration of scientific management practices with modern technology offers a promising pathway for sustaining productivity and profitability in high-value agriculture. By improving preparedness and resilience, farmers can successfully face the challenges of rising temperatures and continue producing quality crops even under harsh climatic conditions. As global temperatures continue to climb, heatwaves have shifted from occasional hazards to seasonal certainties. For growers of high-value crops such as export quality grapes, greenhouse tomatoes, and delicate leafy greens the financial stakes of a single 45°C spike are immense. Heat stress doesn't just wilt leaves; it triggers flower abortion, fruit sunscald, and irreversible cellular damage that can wipe out an entire season's profit.

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