
ChiLCV Siege - How Guntur Farmers Fight to Save India's Chilli Crown

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ABSTRACT

Guntur district, popularly known as the “Land of Chillies” in Andhra Pradesh, represents the core of India’s chilli economy, producing export-oriented. In recent years, chilli production in this region has been increasingly threatened by Chilli Leaf Curl Virus (ChiLCV), a begomovirus transmitted by the whitefly *Bemisia tabaci*. The disease induces severe leaf curling, stunting, reduced flowering and drastic yield losses, particularly when infection occurs during early vegetative stages. Favouring the high cost of chilli cultivation, frequent disease outbreaks result in substantial economic losses (60-98%) for farmers and prompting shifts to other crops. Strengthening integrated disease management, vector surveillance, extension support and development of virus-tolerant cultivars is crucial for increasing productivity and ensuring long-term resilience of the Guntur chilli production system.

UNDERSTANDING THE SCIENCE, ECONOMICS AND FARMER RESPONSES BEHIND A GROWING THREAT TO INDIA’S CHILLI ECONOMY THE CHILLI HEARTLAND OF INDIA

Just after sunrise in the chilli-growing landscapes of Guntur in Andhra Pradesh, farmers traditionally begin their day walking through rows of vibrant green plants dotted with bright red pods. For decades, this region has been synonymous with chilli cultivation, producing some of the most

pungent and highly valued chillies in the world. The chilli economy here represents far more than agriculture, as it embodies culture, regional identity and the primary livelihood for thousands of farming families. From roadside kitchens in Mumbai to food industries and restaurants in New York City and beyond, the distinctive heat of Indian chilli has travelled across global culinary landscapes.

However, in recent years, a silent biological threat has begun to reshape the future of this iconic crop. Across thousands of hectares of farmland, farmers are observing troubling symptoms such as twisted leaves, stunted plant growth, reduced flowering and drastically lower fruit production. The underlying cause is the rapidly spreading Chilli Leaf Curl Virus (ChiLCV), a viral disease that has emerged as one of the most serious constraints to chilli production in India. The virus is transmitted by the tiny whitefly *Bemisia tabaci*, an insect capable of spreading the disease rapidly across entire farming regions. Understanding the biological nature of this virus, its economic consequences, and the strategies farmers are adopting to manage it has therefore become essential for safeguarding the future of India's chilli belt.



Figure 1. Farmers harvesting chilli in Guntur fields, highlighting the region's pivotal role in India's chilli economy.

ECONOMIC IMPORTANCE OF GUNTUR CHILLI PRODUCTION

India remains the world's largest producer of chillies, and the scale of production highlights the importance of this crop in the country's agricultural economy. According to the first advance estimates for 2024-25, chilli cultivation in India covers approximately 9.22 lakh hectares and produces nearly 26.93 lakh tonnes, with an average productivity of about 2,923 kg per hectare. Within this national framework, Andhra Pradesh plays a dominant role, producing nearly 10.33 lakh tonnes of chillies and ranking as the leading chilli-producing state in the country. At the heart of this production system lies Guntur district, which cultivated around 18,400 ha (<https://guntur.ap.gov.in/odop2024/>), along with nearby trading hubs in the Krishna region, contributes nearly 31 percent of India's total chilli production and forms one of the most important centres for chilli trade and export.

The economic significance of this region extends far beyond farm boundaries. India exported approximately 5.36 lakh metric tonnes of chillies in 2024, and about 1.38 lakh metric tonnes of

red chillies were exported by 2025 to various Asian and international markets. Much of this trade flows through the chilli markets centered in Guntur, which together generate an estimated ₹25,000 crore annually, making it one of the largest spice economies in Asia. Among the varieties cultivated in this region, the famous Guntur Sannam chilli occupies a special position due to its deep red colour, high pungency, and strong oleoresin content. These qualities make it highly preferred by spice processing industries and global markets across the Middle East, Europe, and the United States. As a result, more than 150,000 farming households depend directly on chilli cultivation in the Guntur region, while thousands of traders, labourers, transporters, and exporters also rely on this crop for their livelihoods.

BIOLOGY OF CHILLI LEAF CURL VIRUS

Despite this strong economic foundation, the growing incidence of Chilli Leaf Curl Virus has created serious concerns for farmers and researchers alike. ChiLCV belongs to a group of plant viruses known as begomoviruses, which infect host plants by entering plant cells and hijacking their genetic machinery. Once inside the plant, the virus disrupts normal physiological processes, resulting in severe abnormalities in growth and development (Shingote et al. 2022).

Infected plants typically show symptoms such as upward curling of leaves, thickening of veins, leaf distortion, yellowing of foliage, reduced plant height, and poor flowering. As the disease progresses, fruit formation becomes severely affected, and in extreme cases plants may produce almost no marketable pods. These symptoms not only reduce productivity but also affect the quality of harvested chillies, thereby lowering their market value (Kushwaha et al. 2019).

The spread of this disease is closely linked to the whitefly vector *Bemisia tabaci*. These tiny insects feed on plant sap using needle-like mouthparts, allowing them to acquire viral particles when feeding on infected plants. Once the virus enters the insect's body, it can be transmitted to healthy plants during subsequent feeding. Because viruses multiply inside plant tissues, infected plants cannot be cured through chemical treatments. Consequently, effective management strategies must focus primarily on preventing infection and controlling the vector population before the disease spreads widely.

SEASONAL OCCURRENCE AND DISEASE DYNAMICS

Environmental conditions in the chilli-growing regions of Andhra Pradesh often favour the rapid multiplication of whiteflies, which explains the seasonal pattern of disease outbreaks. Whitefly populations typically increase during late kharif and early rabi seasons, particularly between November and February, when temperatures generally range between 25°C and 35°C.

Under such favourable conditions, a single generation of whiteflies can develop within 14 to 18 days, enabling rapid population expansion. As a result, infestations frequently peak between 30 and 50 days after transplanting, when chilli plants are still in the vegetative stage and are highly vulnerable to viral infection. If infection occurs during this early stage, yield losses can range from 60 percent to as high as 90 percent. Climate variability, including warmer winters and irregular rainfall patterns, is also believed to be enhancing the survival and dispersal capacity of whiteflies, further intensifying disease outbreaks across the region.

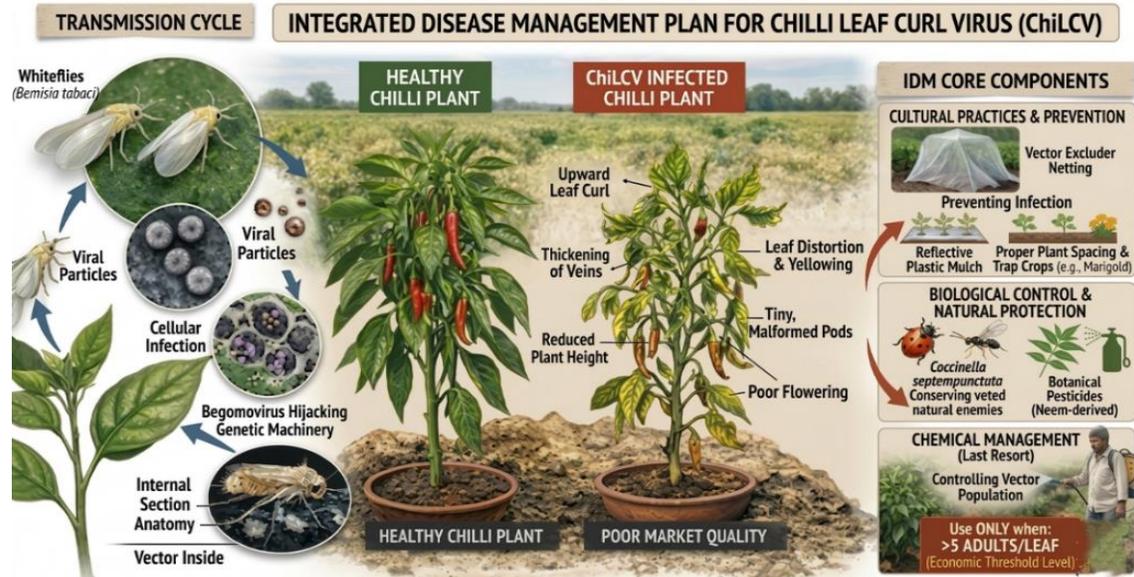


Figure 2. Chilli LCV. Transmission cycle through whiteflies, symptoms on infected plants and core strategies including cultural practices, biological control and chemical management to maintain healthy chilli plants and marketable yield.

COST OF CULTIVATION AND ECONOMIC IMPACT ON FARMERS

For farmers, these biological challenges translate directly into economic risks. Chilli cultivation in Guntur is widely considered a high-investment enterprise, requiring substantial expenditure on seeds, fertilizers, irrigation, labour, and plant protection measures. Recent estimates indicate that the cost of chilli cultivation during the 2023-24 season was approximately ₹2.96 lakh per hectare. At the acre level, farmers typically invest between ₹1.5 lakh and ₹2 lakh per acre.



Figure 3. Chilli field affected with leaf curl viruses

Hybrid seeds alone may cost between ₹8,000 and ₹12,000, while land preparation and transplanting require an additional ₹15,000 to ₹20,000. Fertilizers and micronutrients account for about ₹25,000 to ₹30,000; labour charges range from ₹30,000 to ₹40,000, and plant protection chemicals often require ₹50,000 to ₹80,000 per acre. Under favourable conditions, yields in the region may reach 20 to 25 quintals per acre, and with market prices ranging between ₹12,000

and ₹15,000 per quintal, farmers can potentially generate gross returns of ₹3 to ₹4 lakh per acre. However, when ChiLCV infection occurs early in the cropping cycle, these projections quickly collapse. Yields may decline drastically to only 8 to 10 quintals per acre, and in severe outbreaks losses can reach as high as 60 to 98 percent. Such dramatic declines not only wipe out profits but also leave farmers struggling to recover their initial investment, creating serious financial stress in rural communities.

VARIETIES AND HYBRIDS CULTIVATED IN THE REGION

Farmers in the Guntur chilli belt cultivate a mix of traditional varieties and commercial hybrids to balance productivity, quality, and market demand. Popular cultivars include:

- 1. Guntur Sannam (S4 type):** Export king with thick red skin, 35-45,000 SHU pungency, 50-80 ASTA color; peak Dec-May harvest (280k tonnes/year); 20-25 qtl dry/acre
- 2. Teja (S17):** 50%Guntur area; ultra-hot 65-100k SHU, pest-resistant, highest prices for sauces/pickles; 25-30 qtl dry/acre
- 3. Byadgi:** Bright red, high oleoresin for color extracts, moderate 8-15k SHU; export favourite; 18-22 qtl dry/acre
- 4. Armour:** High-yield hybrid, strong market demand, uniform fruits; 28-32 qtl dry/acre
- 5. BSS-355 (Bangaram):** Reliable hybrid, good pungency/yield balance; 25-28 qtl dry/acre
- 6. 2222:** Compact plants, early maturity for double-cropping; 22-26 qtl dry/acre
- 7. Classic:** Vibrant color, export-quality oleoresin content; 24-28 qtl dry/acre
- 8. 5531:** High-yielding hybrid, trader-preferred uniformity; 26-30 qtl dry/acre
- 9. 155 (Gayathri-155):** Market leader for fresh/dry; 30-35 qtl dry/acre
- 10. 250:** Local OP hybrid; cost-effective, moderate resistance; 20-24 qtl dry/acre
- 11. 275:** Local OP hybrid; cost-effective, moderate resistance; 20-24 qtl dry/acre
- 12. 341 (US-341):** Premium ₹18k/qtl, high demand for processing; 28-32 qtl dry/acre
- 13. No.5 (Indo-5):** Traditional OP, cheaper seeds, stable local sales; 18-22 qtl dry/acre

Common varieties grown in the region indicate that nearly 60% of the chilli area is planted with hybrids and 40% with open-pollinated varieties, covering about 18,400 ha. Among the major hybrids cultivated are Armour, Teja, 341 and No.5, which are preferred for their high yield potential and strong market demand. Armour currently fetches around ₹17,000 per quintal in the market. For export purposes, varieties such as Teja, Byadgi, and Classic are widely grown because of their colour and oleoresin content, although they are susceptible to ChiLCV. Although these varieties perform well under favourable conditions, most lack strong resistance to ChiLCV, making them vulnerable during severe disease outbreaks. These cultivars dominate cultivation due to trader demand. However, early virus infection can reduce yields drastically,

with losses ranging from 60-98%. Plant breeders are currently working to develop virus-tolerant chilli varieties, but adoption remains limited due to issues such as seed availability, higher costs and lack of farmer awareness.

INTEGRATED MANAGEMENT STRATEGIES

Given the complexity of the disease, scientists increasingly recommend an integrated disease management approach rather than reliance on a single control method. Regular field monitoring allows farmers to identify infected plants during the early stages of disease development. Prompt removal of infected plants can reduce the availability of virus sources and may lower disease spread by 30 to 40 percent (Subramaniam et al. 2010).

Table 1. Recommended insecticides to control ChiLCV, which are available in market

Insecticide	Active Ingredient	Whitefly Control	ChiLCV Benefit	Dosage (per acre)
Oberon	Spiromesifen 240 SC	Excellent (eggs/nymphs 80-90%; translaminar, long residual 14-21 days)	High- sterilizes eggs, cuts populations fast	200-250 ml
Actara	Thiamethoxam 25 WG	Good (adults/nymphs 70-85%; systemic)	Moderate- quick knockdown but shorter residual	80-100 g
Polo	Diafenthiuron - 50% WP	Moderate-Good (70-80%; nymphs/adults)	Moderate- reduces vectors effectively	250g
Pegasus	Diafenthiuron - 50% WP	Good (75-85%; contact/systemic)	Good- targets all stages	200-250g
Ulala	Flonicamid 50% WG	Excellent (80-90%; systemic)	Moderate-High - Blocks feeding/transmission (40-60% disease cut)	60-80g
Viro Raze	Bio-formulation (neem/bio-agents)	Moderate (60-80% vector kill; eco-friendly)	High- stops virus multiplication + vectors	Foliar spray as per label

Monitoring of whitefly populations is equally important and farmers are encouraged to install yellow sticky traps in their fields. Approximately 25 to 30 traps per acre can help reduce vector populations and provide early warning signals of pest outbreaks. Reflective silver plastic mulches discourage 65-75% of whitefly landings by disrupting visual host-finding cues, cutting ChiLCV incidence by 35-55% during the critical 30-50 DAT period when transmission peaks (Patel et al. 2015). Biological control methods provide an additional layer of protection. Natural predators such as the ladybird beetle *Coccinella septempunctata* and parasitoid wasps like *Encarsia formosa* can significantly suppress whitefly populations when their presence is conserved in agricultural ecosystems. Botanical pesticides derived from neem also provide environmentally safer alternatives to conventional insecticides (Thilak et al. 2025). Cultural practices further contribute to disease management. Adjusting planting dates to avoid peak whitefly seasons, maintaining proper plant spacing to improve air circulation, and intercropping chilli with marigold or other trap crops can reduce the likelihood of severe infestations.

Chemical insecticides (Table 1) still play a role in disease management, but their use must be carefully regulated. Experts recommend that insecticides be applied only when whitefly populations exceed the economic threshold level of about five adult whiteflies per leaf. Excessive and indiscriminate pesticide use has already led to widespread insecticide resistance among whitefly populations, reducing the effectiveness of many commonly used chemicals and increasing production costs for farmers.

KNOWLEDGE GAPS AND EXTENSION CHALLENGES

Despite the availability of management strategies, their adoption across Guntur remains uneven as farmers heavily rely on pesticide dealers who prioritize chemical solutions over integrated pest management, while access to biological control agents, tolerant variety seeds, and reliable extension services stays limited in rural areas. This gap worsens due to the uneven reach of frontline systems like Rythu Bharosa Kendras (RBKs) and Farmer Producer Organizations (FPOs), which face staffing shortages and lack ChiLCV-specific training modules, contributing to the chilli area's drastic crash from 1.96 lakh ha in 2024 to just 1.06 lakh ha in 2025-26 that has prompted diversification into lower-risk maize hybrids and Bt cotton for stable returns amid repeated failures. Strengthening extension programs through RBK-led demo plots, FPO bulk procurement of bio-agents and reflective mulches, and mobile apps for whitefly alerts is therefore essential to promote sustainable practices and rebuild farmer confidence in chilli cultivation.

CROP DIVERSIFICATION AS A FARMER RESPONSE

Faced with repeated crop failures and rising production risks, some farmers have begun exploring alternative livelihood strategies. Crop diversification has emerged as a common response, with farmers gradually shifting to crops such as tobacco, maize hybrids, cotton, onions, and various vegetables. These crops generally experience lower pest pressure and provide relatively stable returns, helping farmers reduce financial uncertainty. However, widespread diversification could eventually weaken Guntur's long-standing dominance in the chilli trade, potentially transforming the agricultural landscape of the region.

THE FUTURE OF INDIA'S CHILLI CAPITAL

The growing crisis caused by Chilli Leaf Curl Virus indicates the complex interaction between plant diseases, climate variability, agricultural economics, and farmer decision-making. Protecting the future of chilli cultivation in Guntur will therefore require coordinated efforts involving farmers, scientists, policymakers and agricultural extension agencies. Developing virus-resistant chilli varieties, expanding integrated pest management programs, strengthening farmer education, and improving access to biological control technologies will all be critical steps in addressing this challenge. If these efforts succeed, the chilli fields of Guntur may once again flourish as the vibrant heart of India's spice economy. For now, however, farmers continue their daily battle against a virus too small to see but powerful enough to reshape the future of Asia's chilli capital.

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