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Climate-Resilient Chickpea Production: Innovations, Challenges and Sustainable Strategies

*Pravin Sanjay Shinde
MPKV, Rahuri, Maharashtra, India
Corresponding Author's email: pravinshinde55000@gmail.com

Chickpea (*Cicer arietinum* L.) is an important pulse crop that supports food and nutritional security, farm income and soil fertility. Its productivity is increasingly affected by terminal drought, high temperatures, irregular rainfall and changing pest and disease pressures. These challenges are particularly important in semi-arid regions of India, where the crop often depends on residual soil moisture after the monsoon. This article reviews climate-related production constraints and practical strategies for improving resilience, including stress-tolerant varieties, timely sowing, soil-moisture conservation, balanced nutrient management, integrated pest management and weather-based advisories. It emphasizes that successful adaptation depends on combining suitable varieties with locally validated crop-management practices. Affordable technologies, farmer training and location-specific research are essential to maintain stable yields and improve the sustainability of chickpea-based farming systems.
Keywords: Chickpea, climate resilience, drought, heat stress, sustainable agriculture, soil-moisture conservation, integrated crop management.

Introduction

Chickpea (*Cicer arietinum* L.) is a major cool-season legume cultivated in India and other semi-arid regions. It is valued as a protein-rich food and contributes to sustainable farming through biological nitrogen fixation. In Maharashtra, chickpea is an important rabi crop, especially in areas where production depends on moisture stored in the soil after the monsoon. Variations in rainfall, soil-water availability and temperature can therefore strongly influence crop establishment and yield. Climate change creates additional uncertainty through warmer winters, terminal heat, prolonged dry spells and irregular rainfall. Stress during flowering, pod formation and seed filling can reduce pod number, seed weight and final yield. A climate-resilient approach combines improved crop varieties, efficient soil and water management, crop protection and reliable agricultural advisories.

Major Climate Challenges

Terminal drought is a key constraint because declining soil moisture during reproductive growth limits photosynthesis, nutrient uptake and pod development. High temperatures can shorten crop duration and affect pollen viability, fertilization and seed filling. Irregular rainfall may delay sowing or cause poor establishment, while waterlogging in poorly drained fields can damage roots. Changing seasonal conditions may also alter the severity of pests and diseases, including gram pod borer (*Helicoverpa armigera*), Fusarium wilt and Ascochyta blight.

Sustainable Strategies and Innovations

Climate-adapted varieties and sowing: Varieties with suitable maturity, drought and heat tolerance, and disease resistance can reduce climate-related risk. Timely sowing helps the crop complete sensitive reproductive stages before severe terminal heat. Variety and sowing recommendations should be based on local agricultural advisories and field performance.

Soil-moisture conservation: Appropriate land preparation, residue management, reduced soil disturbance and crop rotation can support soil structure and water conservation. Drainage measures such as broad-bed and furrow systems may be useful in heavy soils or locations prone to waterlogging. Practices must be matched to local soil and rainfall conditions.

Balanced nutrition and biological inputs: Soil testing helps guide nutrient application and avoid unnecessary fertilizer costs. Phosphorus and other nutrients should be applied according to local recommendations. Compatible Rhizobium inoculants can support biological nitrogen fixation, while other microbial products should be used when quality and local field performance are established.

Efficient water management and digital advisories: Where supplemental irrigation is available, scheduling should consider crop stage, soil moisture and water availability. Weather forecasts, mobile advisories and field observations can support decisions on sowing, irrigation and pest management. Digital information is most useful when linked with local extension services.

Integrated pest and disease management: Healthy seed, crop rotation, resistant varieties, field sanitation and regular crop scouting help reduce losses. Pheromone traps and biological control may support pest monitoring. Registered pesticides should be used only when appropriate, following label directions and local recommendations.

Challenges and Future Directions

Adoption of climate-resilient practices can be limited by the cost or availability of quality seed, irrigation facilities, machinery and timely weather information. Technologies may also perform differently across soils and seasons. Multi-location field trials, demonstration plots and farmer training are therefore essential. Future research should prioritize varieties combining heat and drought tolerance, affordable moisture-conservation practices, reliable biological inputs and integrated advisories that improve yield stability and farm profitability.

Conclusion

Climate-resilient chickpea production requires an integrated approach that addresses drought, heat, rainfall variability and crop-health risks. Improved varieties, timely sowing, soil-moisture conservation, balanced nutrition, integrated pest management and locally relevant weather advisories can strengthen production when appropriately adapted to field conditions. For Maharashtra and other semi-arid regions, combining scientific research with practical extension support can help farmers conserve resources, stabilize yields and build more sustainable chickpea-based farming systems.

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