*Biological Forum – An International Journal* **16(7): 246-251(2024)**

**ISSN No. (Print): 0975-1130**
**ISSN No. (Online): 2249-3239**

# Temperature Profile in Chickpea Crop under Semi-Arid Region of Haryana

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*(Received: 22 April 2024; Revised: 17 May 2024; Accepted: 07 June 2024; Published: 15 July 2024)*
*(Published by Research Trend)*

**ABSTRACT: A study was conducted during the *Rabi* season of 2021-22 at the Research Farm of the Department of Agricultural Meteorology, CCS HAU, Hisar (Latitude: 29°10′ N, Longitude: 75°46′ E, Altitude: 215.2 m). The study included four different sowing dates as the main plot treatments: D1 (November 16, 2021), D2 (November 23, 2021), D3 (November 29, 2021), and D4 (December 8, 2021). These were paired with five varieties as sub-plot treatments: V1 (HC 1), V2 (HC 3), V3 (HC 5), V4 (HC 6), and V5 (HC 7), using a split-plot design replicated three times. Temperature profiles showed a general decrease with height within the chickpea crop canopy, except at 3 PM on the 60 and 90 days after sowing (DAS), where temperatures increased with height. The highest temperatures were recorded at 3 PM due to heat absorption, while the lowest occurred at 9 AM. Overall, the highest temperatures in the profile were observed at 90 DAS across all treatments.**

**Keywords :** Chickpea, Temperature, Profile, Growing environments and Days after sowing.

## INTRODUCTION

Chickpea (*Cicer arietinum* L.) a key legume crop globally and in South Asia, particularly India, widely cultivated for its nutritious seeds rich in protein, fiber, and essential minerals. Originating from the Middle East, it has been a staple in human diets for over 7,000 years (Zohary *et al.*, 2012). Due to its ability to withstand drought and its propensity to grow in semi-arid conditions, chickpeas are an essential crop in areas with limited water resources (Varshney *et al.*, 2014). It is a rich source of unsaturated fatty acids including linoleic acid and stigma sterol is profusely present in chickpea. Some vitamins like riboflavin, niacin, thymine and folate as well provided by chickpeas. Millions of the people in the world who cannot afford protein via animals or are vegetarians it serves as a cheap and readily available protein source (Yousef *et al.*, 2020). The crop's capacity to fix atmospheric nitrogen and increase soil fertility makes it an important component of sustainable agriculture (Jukanti *et al.*, 2012). The most crucial factor affecting its yield is the timing of sowing, which varies by variety and region due to different agro ecological conditions. Sowing dates influence the plant's growth stages by exposing it to varying levels of heat, solar radiation, and day length. Chickpea genotypes vary in their productivity, highlighting the necessity for further research on how different chickpea varieties respond to varying sowing dates to maximize yields in specific agro-climatic conditions (Pandey *et al.*, 2014). Different sowing dates impact the crop's development by subjecting it to various temperatures and environmental conditions. . In the semi-arid tropics unfavorable soil surface temperatures have been reported to reduce seed germination, emergence and cause poor seedling establishment (Merga and Haji 2019). The temperature profile within a chickpea (*Cicer arietinum* L.) crop canopy varies between the bottom and the top. Studying the temperature profile in chickpea crops is crucial for optimizing growth conditions and maximizing yield. Temperature significantly influences germination rates, seedling establishment, vegetative growth, and reproductive development in chickpeas. Understanding temperature variations within the crop canopy helps in selecting optimal sowing times and managing irrigation effectively. High temperatures during flowering and pod formation can reduce yields, while low temperatures can hinder germination, especially in kabuli varieties. The temperature profile in chickpea cultivation changes dramatically with plant height. Lower canopy levels experience more diurnal temperature changes, while higher canopy levels maintain more stable temperatures that impact plant development and physiological responses (Turner *et al.*, 2001). Due to direct solar exposure, the temperature at the soil's surface tends to rise during the day, which affects germination and the early phases of growth (Toker, 2004).

Additionally, monitoring temperature profiles assists in managing soil moisture and predicting pest and disease outbreaks. Overall, an accurate understanding of the temperature profile in chickpea crops is essential for improving productivity and ensuring crop resilience. To investigate the significance of temperature in chickpea growth, so, the present investigation was undertaken to study the temperature profile within the chickpea canopy during daytime hours.

## MATERIALS AND METHODS

A field experiment was conducted in the University Research Farm, Department of Agricultural Meteorology, CCS HAU, Hisar during *Rabi* season of 2021-2022 which is located at latitude 29°10'N, longitude 75°46'E and altitude of 215.2 m above mean sea level. The main characteristics of climate in Hisar are dryness, extreme of temperature and scanty rainfall with very hot summers and relatively cool winters. The study was comprised of four sowing dates as main plot treatment *viz.*, D1 (16th November ), D2 (23rd November 2021), D3 (29th November 2021) and D4 (8th December 2021) comprising five varieties as sub plot treatment *viz.*, V1(HC 1), V2(HC 3), V3(HC 5), V4(HC 6) and V5(HC 7) in split plot design with three replications. The inter and intra row spacing was 30 × 10 cm and gross plot of size 6.0 m × 5.0 m and net plot of size 5.0 m × 3.6 m. Temperature profile were measured at 9:00 AM, 12:00 PM and 3:00 PM at two levels of crop canopy: top and bottom with the help of a Digital Psychrometer at 30, 60 and 90 days after sowing. By using the corresponding values temperature, profiles were drawn at 30, 60 and 90 DAS.

## RESULT AND DISCUSSION

The temperature profiles shown in Fig. 1 to 6 indicated that temperature profiles were lapse in nature *i.e.* decrease in temperature with height inside the crop canopy except at 3 PM at 60 DAS in D4 and at 90 DAS in which temperature increase with height. The temperature varied from the bottom to the top of the canopy among the treatments. The maximum temperature was observed at 3 PM and the minimum was at 9 AM. The maximum temperature recorded at 3 PM was (18.7°C, 17.2°C), (14.4°C, 12.9°C) (25.7°C, 26.6°C) in D1, (19.1°C, 18.3°C), (14.9°C,12.1°C), (24.3°C, 25.2°C) in D2, (18.5°C, 15.2°C), (18.8°C, 17.4°C), (24.4°C, 25.1°C) in D3 and (16.2°C, 15.3°C), (24.7°C, 25.4°C), (26.8°C, 27.7°C) in D4 at bottom and top of the crop at 30 DAS, 60DAS and 90 DAS, respectively.

Among varieties, the maximum temperature was also recorded at 3 PM was (18.0°C, 16.1°C), (18.1°C, 16.7°C), (25.6°C, 26.2°C) in V1 , (18.5°C, 16.5°C), (18°C,16.6°C), (25.1°C, 26.1°C) in V2, (17.8°C, 16.7°C), (18.4°C, 17.2°C), (25.2°C, 26.2°C) in V3, (18.1°C, 16.5°C), (18.3°C, 17.3°C), (25.0°C, 26.1°C) in V4 and (18.2°C, 16.6°C), (18.2°C, 17.2°C), (25.6°C, 26.1°C) in V5 at bottom and top of the crop at 30 DAS, 60DAS and 90 DAS, respectively.

The temperature profile at 90DAS revealed the greatest temperature among the treatments. The heat absorption caused the maximum temperature to be recorded at 3 PM. At 30 and 60 DAS, the temperature is higher at the base of the canopy because of heat absorption by the soil as a result of less canopy coverage, and it is lower at the top of the canopy because there is more actively green foliage present, which lowers the temperature there. Due to shading effects, the canopy base temperature is greater than the upper canopy but slightly lower than the soil surface just above it (Kashiwagi *et al*., 2008) and in upper canopy greater air circulation and less direct heat from the soil, the top canopy is cooler than the lower sections (Berger *et al*., 2011). At 90 DAS, the temperature profile was inverse in character, as greatest LAI caused more absorption of solar radiation by the upper canopy, resulting in high temperature at the top. Similar results were reported by Shamim *et al*. (2008); Tripathi *et al*. (2012); Singh *et al*. (2023) ; Painkra *et al*. (2024).

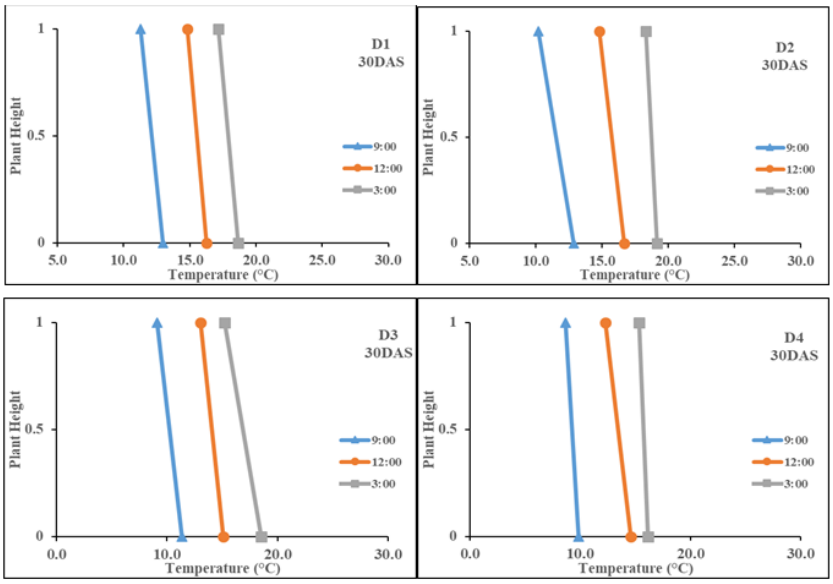


**Fig. 1.** Temperature profile (°C) of chickpea under different growing environments at 30 DAS during 2021-22.

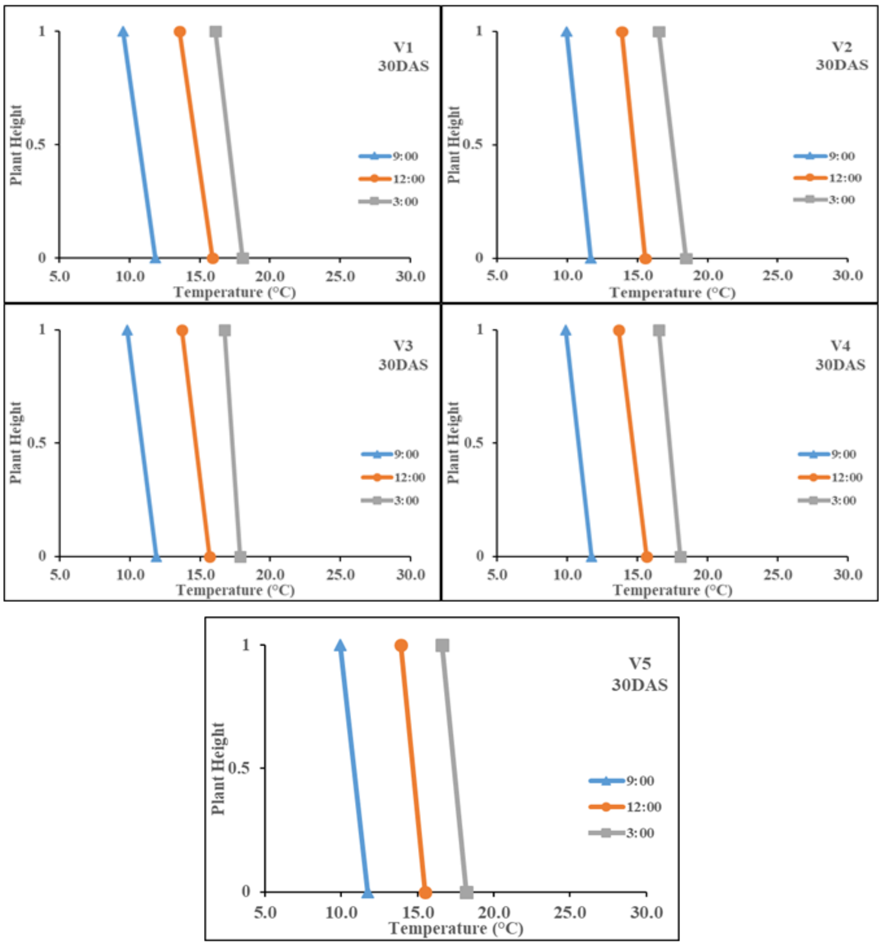


**Fig. 2.** Temperature profile (°C) of different chickpea varieties at 30 DAS during 2021-22.

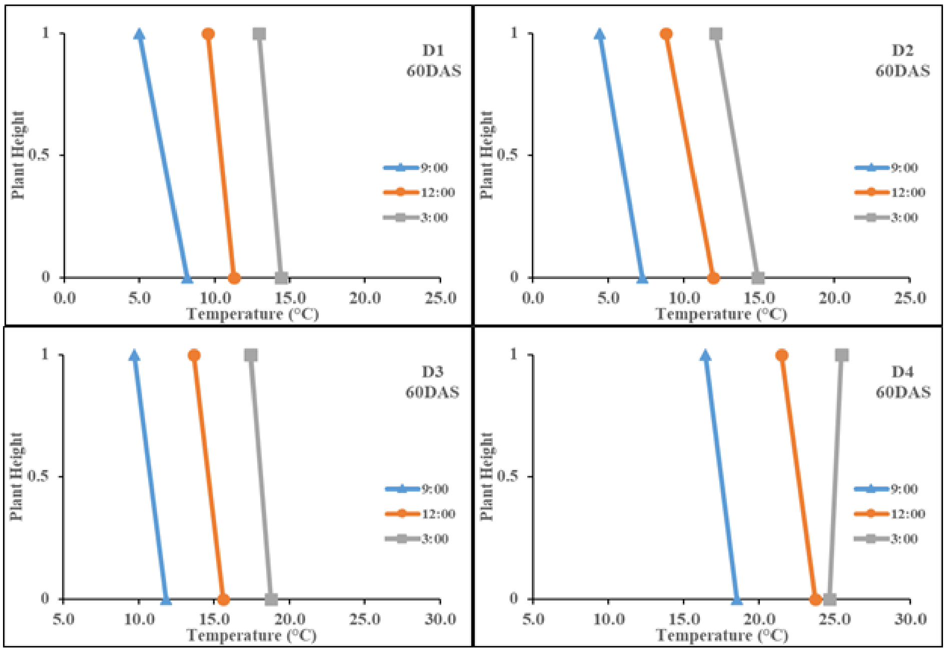


**Fig. 3.** Temperature profile (°C) of chickpea under different growing environments at 60 DAS during 2021-22.

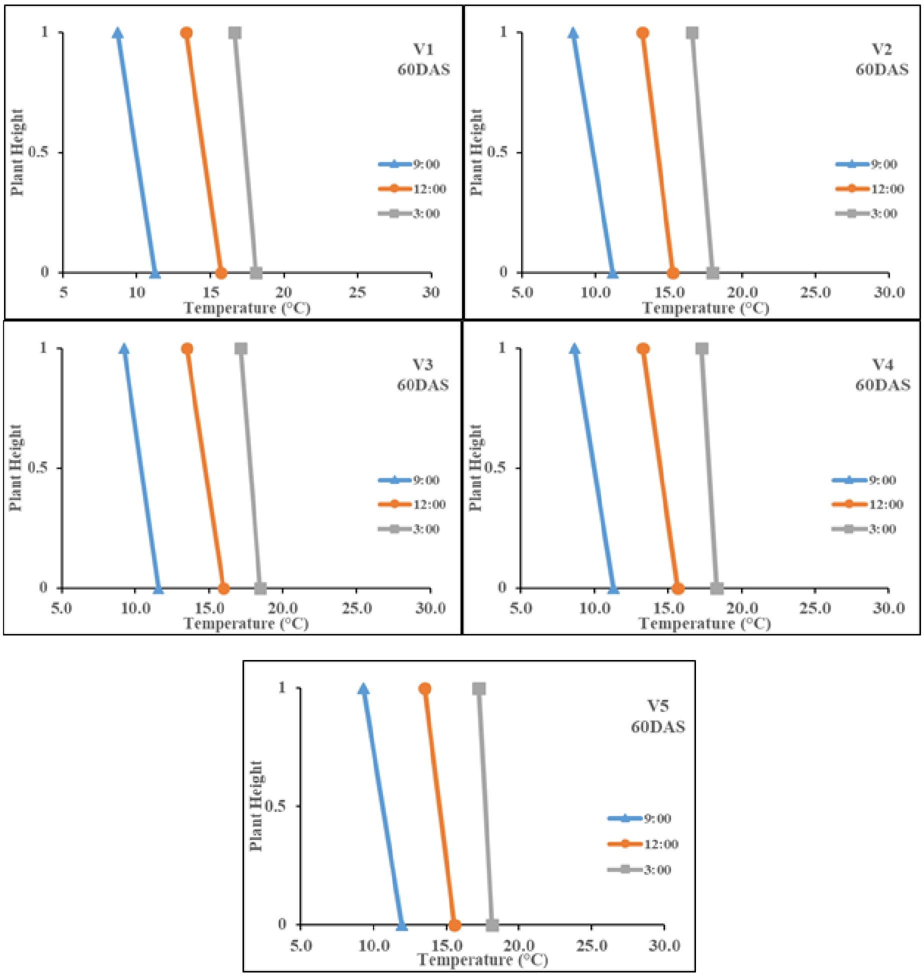


**Fig. 4.** Temperature profile (°C) of different chickpea varieties at 60 DAS during 2021-22.

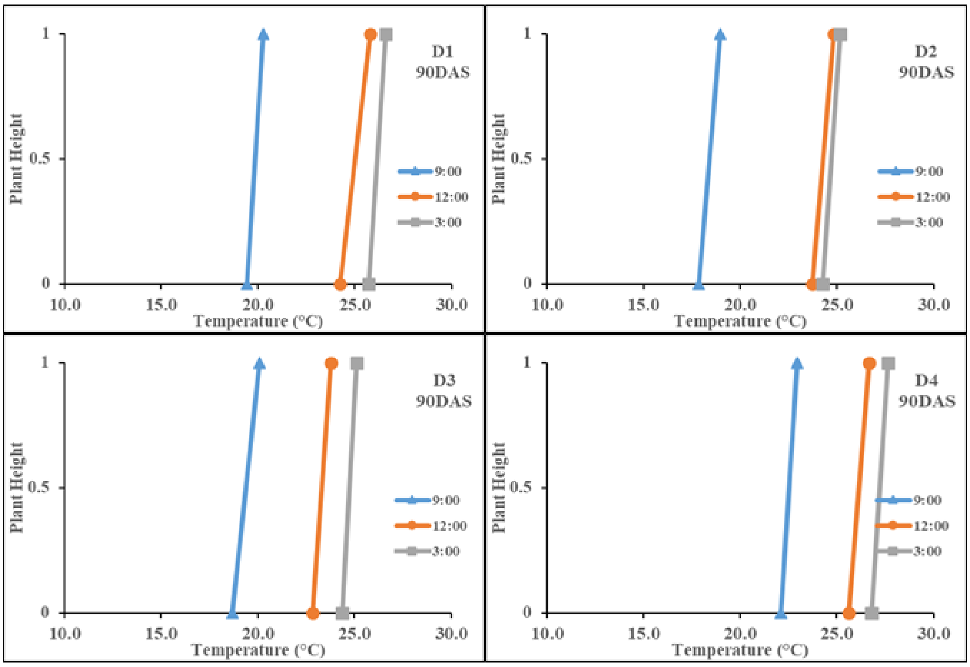


**Fig. 5.** Temperature profile (°C) of chickpea under different growing environments at 90 DAS during 2021-22.

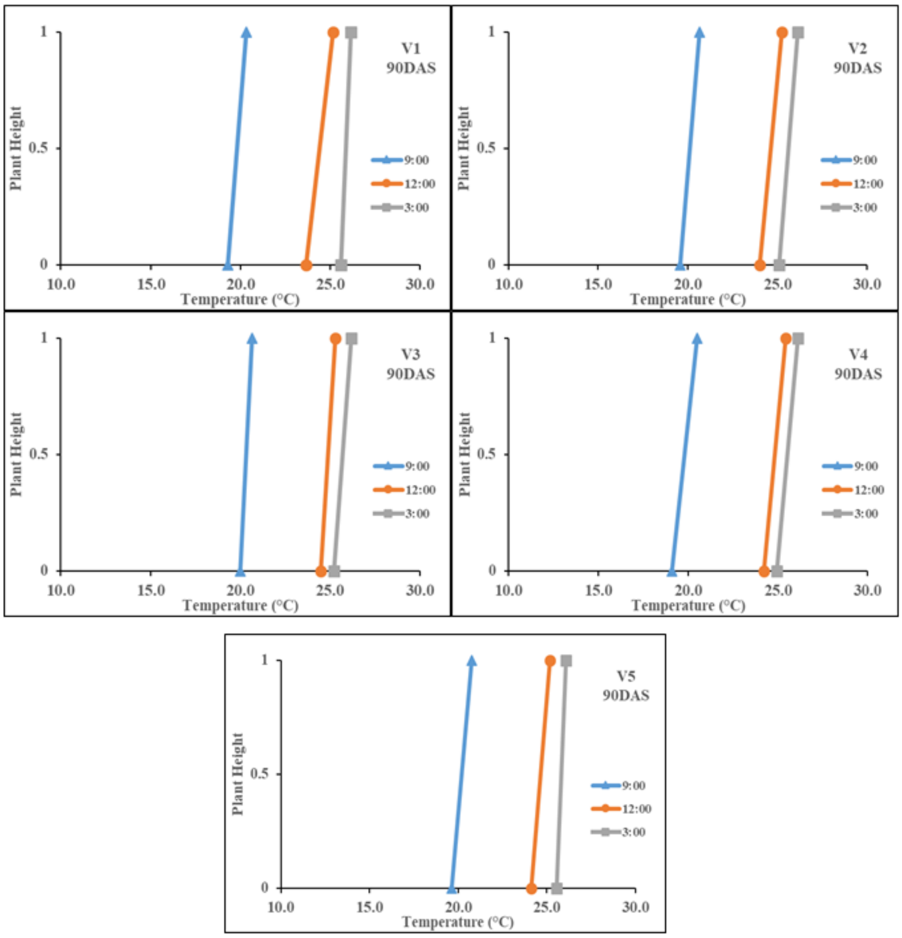


**Fig. 6.** Temperature profile (°C) of different chickpea varieties at 90 DAS during 2021-22.

## CONCLUSIONS

The temperature profile in the chickpea crop canopy generally showed a decrease in temperature with increasing height, indicating a lapse in nature. However, there were exceptions to this pattern observed at 3 PM during the 60 DAS (Days after Sowing) and at 90 DAS, where temperature increased with height. The highest temperatures across the crop canopy were recorded at 3 PM, attributed to peak heat absorption during this time of day, while the lowest temperatures were observed at 9 AM, reflecting the cooler morning conditions. Notably, the maximum temperature was recorded across all treatments at 90 DAS.

## FUTURE SCOPE

The crop of chickpeas has a bright future. It is acknowledge as a source of biologically active compounds and is already a staple diet in many Asian nations Studying temperature profiles in chickpea crops holds promise for developing climate-resilient varieties and optimizing agricultural practices through precision farming. It can refine yield predictions, improve pest and disease management, and enhance understanding of soil-plant interactions. Insights into temperature effects on phenology and genetics can accelerate cultivar development. Overall, these temperature profiles is crucial for optimizing crop management practices and improving chickpea yield.

**AUTHOR CONTRIBUTION.** Renu who is the first author collected the data from experiment field, performed the data analysis and wrote the paper. Dr. Raj Singh and Dr. Anil Kumar help in designed the analysis and provide guidance throughout the experiment. Mehak Nagora helps during the field data collection and analysis.

**Acknowledgement.** Authors are grateful to faculty and staff of Department of Agro meteorology, CCS Haryana Agricultural University, Hisar (Haryana), India for providing funding and experimental material to the first author to carry out the study.

**Conflict of Interest.** None.

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**How to cite this article:** Renu, Raj Singh, Anil Kumar and Mehak Nagora (2024). Temperature Profile in Chickpea Crop under Semi-Arid Region of Haryana. *Biological Forum – An International Journal, 16*(7): 246-251.