

attributed to the effective suppression of weeds, which reduces competition between weeds and crop plants (Bhutia et al., 2017). A direct relationship between plant height and soil residual moisture has been reported, where moisture stress reduces plant growth, while mulching helps maintain favorable conditions (Otuaro et al., 2024). Furthermore, mulching creates stable soil physical conditions that promote root expansion and enhance nutrient uptake, thereby contributing to improved plant growth (Kamble et al., 2020).

Black plastic mulch significantly influenced the leaf number of okra at 25, 40, and 60 DAS, consistently producing the highest number of leaves across all growth stages. This trend aligns with findings from recent studies showing that plastic mulches, especially black plastic, improved vegetative growth characteristics in okra and other vegetable crops, such as leaf number (Chaulagain et al., 2024). On the other hand, organic mulches such as sawdust and leaf litter exhibited lower leaf numbers, particularly at 40 and 60 DAS. The comparatively weaker performance of organic mulches may be due to their limited ability to modify soil temperature and moisture conditions in the short term, which are critical for rapid vegetative growth (Kim et al., 2016).

The superior performance of black plastic mulch can be more broadly attributed to its regulation of the soil microenvironment. Modifying the soil energy balance and limiting evaporative losses, it creates conditions that favor rapid leaf initiation and expansion (Thakur et al., 2020; El-Beltagi et al., 2022).

The fruit characteristics and productivity of okra were significantly influenced by mulching. Black plastic mulch produced the highest average fruit weight (245.80 g), fruit length (14.91 cm), and productivity (14.897 Mt/ha), whereas the lowest fruit weight (129.85 g) and productivity (7.87 Mt/ha) were recorded under leaf litter mulch. This yield advantage under black plastic mulch can be linked to cumulative effects on plant growth, rather than a single factor, resulting in improved fruit size and development.

The superior fruit length observed under black plastic mulch is consistent with earlier findings that plastic mulches enhance fruit elongation through improved soil moisture conservation and temperature regulation (Thakur et al., 2020). Similar improvements in pod length were reported by Singh et al. (2025) and Godawatte and De Silva (2016), who associated this response with improved growing conditions under mulch.

In contrast, organic mulches generally showed limited or inconsistent effects on productivity, which may reflect their slower modification of the soil environment and delayed nutrient availability (Thakur et al., 2020; Chaulagain et al., 2024), as also observed in the present study.

In contrast to the present study, Adhikari et al. (2023) and Smith and Onamadi (2021) reported higher okra yield under organic mulches, mainly due to reduced weed competition. This variation among studies indicates that environmental conditions, moisture availability, and management practices influence the effectiveness of mulching materials.

## **5 Conclusion**

The findings of this study support that the black plastic mulch consistently outperformed other mulching materials in enhancing the growth and yield of okra under the agro-climatic conditions of East Rukum, Nepal. Plants grown with black plastic mulch exhibited greater plant height and higher leaf number at all growth stages compared to other treatments. This enhanced vegetative growth contributed to improved yield attributes, resulting in higher fruit weight and longer fruits. Consequently, black plastic mulch produced significantly higher productivity, while leaf litter mulch resulted in the lowest yield performance. Overall, the use of black plastic mulch was found to be the most effective mulching practice for improving the growth and productivity of okra.

## **Authors' contributions**

Princess Magar conceived and designed the study, conducted the experiment, and collected the data. She also assisted with data analysis, statistical interpretation, and preparation of figures and tables. Jenisha Lama and Rakshya Devkota interpreted the results and contributed to manuscript writing. Jenisha contributed to the literature review and gathered relevant resources for manuscript