gibberellin-associated activity in the main stem, produced disproportionately more male flowers, while pinching-induced lateral branches likely characterized by a more favorable ethylene-to-gibberellin balance produced a higher proportion of female flowers. This is mechanistically consistent with earlier transcriptomic evidence that gibberellin regulates cucumber sex expression via both ethylene-dependent and ethylene-independent pathways, with GA-induced ethylene synthesis genes and ethylene receptors implicated in male flower formation. Cytokinin also appears relevant to this process: in species such as maize and melon, ethylene, auxins, and cytokinins jointly promote female flower formation, aligning with the observation that pinching-related increases in cytokinin activity in released axillary buds may simultaneously stimulate branch outgrowth and reinforce a feminizing hormonal environment. Because fruit length was statistically unaffected by pinching treatment, this parameter appears to be under stronger genetic than hormonal-environmental control, whereas fruit circumference and fruit-per-hectare yield both influenced by carbohydrate allocation and cell division rate responded more directly to the source–sink changes induced by pinching.

The present results are broadly consistent with earlier reports on cucurbit pinching. The suppression of apical dominance and consequent increase in plant bushiness align with the findings of Ghosh et al. (2011), while the reduction in main-stem height following early apical removal corroborates Chaurasiya et al. (2020). The increase in lateral branch number under pinching supports the branching-control framework described by Rafeekhar et al. (2001) and the broader physiological model of apical dominance release described in recent reviews. As synthesized in a century of apical dominance research, auxin was long considered the master regulator acting through secondary messengers such as cytokinin, though this view has since been refined through genetic and multidisciplinary approaches. The reduction in male flower number under pinching corresponds with Kandel and Sah (2023), who reported that removal of lower primary branches reduced overall male flower output, while the increase in female flowers and reduction in sex ratio under pinching mirror the findings of Chapagain et al. (2022) regarding pinching-induced promotion of third-generation, female-biased branches. Similarly, the increase in fruit weight and yield under early pinching is consistent with Nayak et al. (2018), who found that earlier pinching stimulated greater branch number, fruit set, and photosynthate accumulation. The lack of effect on fruit length agrees with Thakur et al. (2018). Notably, a recent comprehensive review of pinching across cucurbitaceous crops reinforces the mechanistic interpretation offered here: by modulating auxin distribution, cytokinin levels, and carbohydrate partitioning, pinching influences apical dominance, lateral shoot growth, and reproductive organ development, supporting the integrated hormonal–physiological explanation proposed in this study rather than a single-hormone account.

Maximum plant height was found in control. It might be due to the free growing of shoots in control conditions. Plant height was affected by pinching as it suppresses apical dominance and makes the plant bushy. It might be related to the flow of auxin in the plants, the synthesis of auxin on the shoot of the main stem is stopped due to the shoot pinching, while the synthesis of cytokinin increases and further affect plant growth. Ghosh et al. (2011) reported that pinching suppresses apical dominance. Earlier pinching of the plant might be the reason for an increase in height of lateral stems and the earlier growth of the primary stem might be the reason for increasing height in case of pinching at 25 DAT and 30 DAT. Growth of lateral stem could be the possible reason for the increase in plant height at 65 DAT. The possible reason behind the reduced height of plants might be removal of the apical portion which promotes the growth of the secondary branch, observed (Chaurasiya et al., 2020). The apical meristem and the young leaves are the centers of TAA and IAA (Indole Acetic Acid) synthesis which are then transported to the stems thus inhibiting the development of lateral shoots. IAA is one type of auxin that causes apical dominance. IAA is a trigger for change in plant development (Vanneste and Friml, 2009).

5 Conclusion and Recommendation for Future Research

Pinching of plants influenced the growth, flowering pattern, and yield of cucumber. In general plant height increases with an increase in the time of pinching initially but has no effect on the later stage of observation. Pinching influenced the growth of stems, branches, and female flowers significantly. Generally, yield character was high in plants treated with pinching compared to those plants that were not pinched. The number of fruits per