Table 4 Effect of date of pinching on yield per plant (kg) and yield per hectare (mt/ha) of cucumber (*Cucumis sativus* L. cv. Kamini) at Kawasoti, Nepal (2024)

Treatment	Yield per plant (kg)	Yield per hectare (mt/ha)
Pinching at 15 days	5.20^{ab}	42.82^{a}
Pinching at 20 days	5.77^{a}	46.14^{a}
Pinching at 25 days	4.58^{bc}	36.58^{b}
Pinching at 30 days	4.25^{cd}	34.76^{b}
Control	3.79^{d}	30.54^{b}
Grand mean	4.71	38.16
SEM (±)	0.26	2.20
LSD (0.05)	0.71	5.89
CV (%)	9.71	9.64
F- test	***	***

Note: Means followed by common letter(s) within column are non-significantly different based on DMRT at P=0.05; LSD, Least Significant Difference; SEM, Standard Error of Mean; CV, Coefficient of Variation; DAT, Days After Transplanting; *** significant at 0.1% level of significance

4 Discussion

The present study demonstrated that pinching significantly altered vegetative growth, floral sex expression, and yield components of cucumber relative to unpinched controls. Control plants attained the greatest plant height and produced the highest number of male flowers and the highest overall sex ratio, whereas pinching at 20 days after transplanting (DAT) maximized lateral branch number, female flower production, fruit weight, fruit circumference, and marketable yield per hectare. These findings collectively indicate that the timing of apical bud removal is a critical determinant of the balance between vegetative vigor and reproductive (female-biased) output in cucumber.

The reduction in plant height following pinching is consistent with the disruption of apical dominance, the process by which the growing shoot tip suppresses outgrowth of axillary buds. This regulation allows the plant flexibility to respond to environmental factors while optimizing its resources, and removal of the shoot apex alleviates the inhibition of lateral bud outgrowth. Classically, this phenomenon was attributed almost exclusively to auxin (IAA) synthesized in the apical meristem and young leaves, which is transported basipetally to suppress lateral bud activity (Vanneste and Friml, 2009). However, more recent physiological work has substantially revised this view. While apical dominance was originally thought to be mediated by auxin, recent studies highlight the importance of shoot-tip sink strength and the role of sugars in promoting branching, raising questions about the relative contributions of auxin and carbohydrate supply. Cao et al. (2023) further showed that auxin depletion after decapitation is not always the initial trigger of the rapid cytokinin increases observed in axillary buds, which instead correlate more closely with enhanced sugar availability. This suggests that the increase in lateral branching observed in the present study following pinching may reflect not only reduced apical auxin flux but also an improved carbohydrate supply to axillary buds once the assimilate-demanding apex is removed consistent with the higher fruit weight recorded in 20-DAT pinched plants, which was attributed to greater photoassimilate diversion toward lateral branches (Anand et al., 2014; Naafe, 2022).

The hormonal basis for the shift toward female flower dominance under pinching can be further explained by ethylene and gibberellin dynamics. Ethylene evolved in greater quantities from female floral buds than from male ones, and its endogenous production is understood to promote femaleness in cucumber. In cucumber, ethylene and auxin mediate feminization, whereas gibberellins induce masculinization, a pattern also confirmed in later transcriptomic work. Genes associated with hormone transduction and synthesis including ethylene, which promotes femaleness, and gibberellin, which promotes maleness have been identified as differentially expressed between male and female cucumber tissues, and exogenous gibberellin has been shown to inhibit ethylene biosynthesis by suppressing expression of the ethylene-synthesis gene *CsACS1G*. This antagonism helps explain why control (unpinched) plants, which retained an intact, actively growing apex and higher endogenous