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The Effect Of Pinching On The Growth And Yield Of Purple Globe Amaranth (Gomphrena globosa)

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Abstract

Globe amaranth (Gomphrena globosa) is an annual ornamental plant from the Amaranthaceae family with high aesthetic value, widely utilized as a cut flower, garden decoration, and as raw material for the pharmaceutical and food industries. Pinching is an important cultivation technique to improve yield; however, studies on the optimal timing and frequency of pinching in this plant are still limited. This study aimed to determine the effect of pinching on the growth and yield of globe amaranth. The experimental design used was a Randomized Complete Block Design (RCBD) consisting of five treatments: no pinching (P0), single pinching at 20 days after planting (P1) and 25 days after planting (P2), as well as double pinching at 20 and 35 days after planting (P3) and 25 and 40 days after planting (P4). The results showed that the no-pinching treatment (P0) tended to produce the best outcomes across almost all observed parameters. Plants in the P0 treatment were significantly higher and recorded the highest values for the number of primary branches, secondary branches, productive branches, days to first flowering, flowering period, days to first harvest, number of flowers, and total flower weight per plant compared with the pinching treatments. Thus, it can be concluded that under the specific environmental conditions of this study, the no-pinching treatment (P0) was the most effective treatment for the growth and yield of globe amaranth

Keywords: apical dominance, edible flower, herbal plants, pinching

1. Introduction

Gomphrena globosa (globe amaranth) is an ornamental species in the Amaranthaceae family valued for both aesthetics and functional properties. It is commonly used as a cut flower and landscape plant and serves as raw material for food and pharmaceutical products due to its bioactive compounds, such as vitamin C, β-carotene, and flavonoids (Dwiyani et al., 2023). Its adaptability to diverse environments contributes to its popularity in horticulture (Nathan et al., 2019). Moreover, this plant provides natural antioxidants and betacyanin-based pigments for food applications (Dwiyani et al., 2023). Traditionally, it has been used to manage hypertension, respiratory disorders, and renal problems (Tarnam et al., 2014).

One of the essential cultivation techniques to improve flower yield and quality is pinching. This technique helps regulate the distribution of growth hormones, stimulate branching, and redirect assimilates toward generative growth (Yaseen et al., 2021). Numerous studies have demonstrated the effectiveness of pinching in enhancing the performance of ornamental plants. In Chrysanthemum indicum, triple pinching has been shown to produce more branches, leaves, and flowers compared to no pinching (Ehsanullah et al., 2021). Similar findings were reported for Tagetes erecta, which exhibited improved flower quality following pinching (Singh et al., 2019). Double pinching at 20 and 40 days after planting has even been reported to yield more optimal results compared to single pinching (Yadav et al., 2024). However, research specifically examining the effect of pinching age and frequency on globe amaranth remains limited. Most previous studies have focused on fertilization, genetic variation, and bioactive compound content, leaving a knowledge gap regarding optimal pinching techniques.

Based on this background, the present study aims to evaluate the effect of pinching age and frequency on the growth and yield of globe amaranth. The research focuses on comparing plants without pinching, plants subjected to single pinching at specific ages, and those undergoing double pinching at different time intervals. The findings are expected to provide practical recommendations on proper pinching techniques to enhance the productivity and quality of globe amaranth

2. Materials and Methods

Research was conducted over four months, from January to May 2025, at the UG Technopark field in Jamali-Mulyasari Village, Mande District, Cianjur Regency, West Java, Indonesia. Materials used included purple globe amaranth (Gomphrena globosa) seeds, a planting medium consisting of a mixture of soil, manure, and rice husk charcoal in a 2:1:1 ratio, and water. The tools used were hoes, watering cans, pinching scissors, labels, rulers, luxmeter, 30 × 30 cm polybags, trowels, sprayers, an analytical balance, and seed trays.

The experimental design employed a Randomized Complete Block Design (RCBD) with a single factor, namely pinching, consisting of five treatment levels: no pinching (control), single pinching at 20 days after planting (DAP), single pinching at 25 DAP, double pinching at 20 and 35 DAP, and double pinching at 25 and 40 DAP. Each treatment was replicated five times, with each replication consisting of four plants, resulting in 25 experimental units and a total of 100 plants.

Seeds were sown in trays containing the mixed medium (2:1:1) until germination (Sugianto et al., 2021). Uniform seedlings aged 30 days were transplanted into polybags filled with the same planting medium (Nathan et al., 2019). Plant maintenance included watering once or twice daily, manual weed control, application of 100 g of cow manure per plant every 14 days, and pest control using neem oil-based botanical pesticide at a concentration of 25 ml/L. Pinching was performed according to the treatments using sterilized scissors by removing approximately 7 cm of the shoot tip to stimulate branching (Nathan et al., 2019). In double pinching treatments, the second pinching was applied to the primary branches resulting from the first pinching (Ehsanullah et al., 2021). Harvesting was carried out when the flowers had bright colors with a diameter of 2–3 cm, followed by measurements of flower weight and other yield parameters.

Light intensity and air temperature were measured three times daily (morning, afternoon, and evening) throughout the experimental period. Light intensity was measured using a lux meter, while air temperature was recorded using a digital thermometer. Each measurement was repeated three times, and daily average values were calculated.

Observed parameters included vegetative growth (plant height, number of leaves, number of nodes, number of primary and secondary branches), generative growth (number of productive branches, days to first flowering, flowering period, and days to harvest), and yield (flower stalk length, number of flowers per plant, flower weight per bloom, and total weight per plant). Branch measurements were conducted using specific counting criteria. Primary branches were defined and counted as branches emerging directly from the main stem (Novita and Basri, 2024). Secondary branches were defined and counted as branches emerging from the primary branches (Novita and Basri, 2024). Productive branches were identified and counted based on their ability to produce flowers (Wulandari et al., 2021). Data were analyzed using analysis of variance (ANOVA) at a 5% significance level with IBM SPSS Statistics and Microsoft Excel software. When significant differences were found, the analysis was followed by Duncan's Multiple Range Test (DMRT) at the 5% level.

3. Result and Discussions

Climatological Conditions of the Research Area

The research site was located under tree shading; therefore, light intensity (lux) and air temperature (°C) were measured as supporting environmental data (Table 1). The average daily light intensity during the study was 21,512.11 lux, which is lower than the full sunlight requirement for *Gomphrena globosa* (Gilman et al., 2007), indicating partial shading conditions that may reduce photosynthetic capacity and influence plant responses to pinching. The average daily temperature was 30.93°C, which remains suitable for tropical plant growth.

Table 1. Climatological Data of the Research Area

	Morning	Afternoon	Evening	Daily
Light Intensity (lux)	6504.56 ±1143.87	33434.02 ±13463.21	24597.75 ±8264.01	21512.11 ±11208.3
Temperature (°C)	29.22 ±0.19	30.65 ±0.28	32.94 ±0.09	30.93 ±1.53

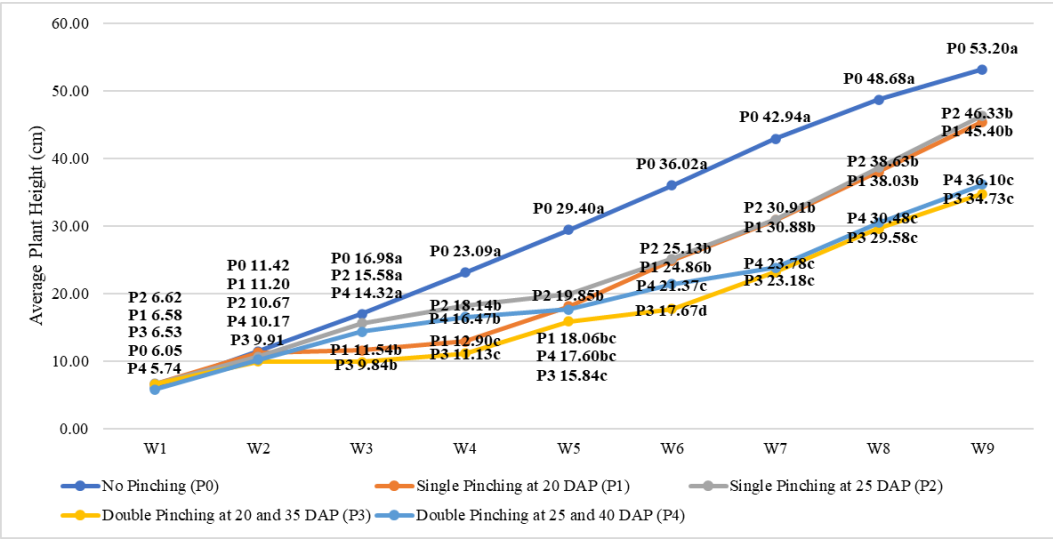
Note: *± = standard deviation*

Plant Height (cm)

Based on Figure 1, data analysis showed that pinching treatments had a significant effect starting from the third to the ninth week. Plants with no pinching (P0) exhibited the greatest vertical growth, reaching a final height of 53.20 cm. In contrast, single pinching treatments (P1 and P2) resulted in lower plant heights of 45.40 cm and 46.33 cm, respectively. The lowest heights were observed in double pinching treatments (P3 and P4), with 34.73 cm and 36.10 cm.

These differences are likely related to stress duration and recovery time. Plants in single pinching treatments (P1 and P2) experienced only one stress phase, allowing a longer recovery period. Conversely, double pinching treatments (P3 and P4) induced two episodes of physiological stress, cumulatively inhibiting growth. This finding aligns with the concept of apical dominance, in which the main stem is more dominant than lateral shoots (Yaseen *et al.*, 2021). According to Nathan et al. (2019), pinching (P1–P4) removes the primary source of auxins, terminating apical dominance and redirecting metabolic energy from vertical growth to lateral shoot development, resulting in new branches. In contrast, in P0 plants, intact apical meristems continuously produce auxins, hormones that promote cell elongation and vertical growth, because there is no disruption of apical dominance.

The results of this study are consistent with previous research. In *Gomphrena globosa*, Yaseen *et al.* (2021) reported that unpinched plants (P0) reached a height of 68.23 cm, while pinched plants only reached 56.33 cm. Similarly, Nathan *et al.* (2019) observed a reduction in height in pinched plants, where control treatment achieved 77.14 cm and the best pinching treatment reached only 73.53 cm. Thus, it can be concluded that reduced plant height is a predictable physiological response to pinching. This practice effectively sacrifices vertical growth to stimulate branching, ultimately forming a denser plant canopy.



Note : Numbers followed by the same letters in the same column and treatment indicate no significant difference based on the DMRT test at a = 5%. DAP = days after planting.

Figure 1. Average Plant Height of Globe Amaranth from Week 1 to Week 9 (W1–W9)

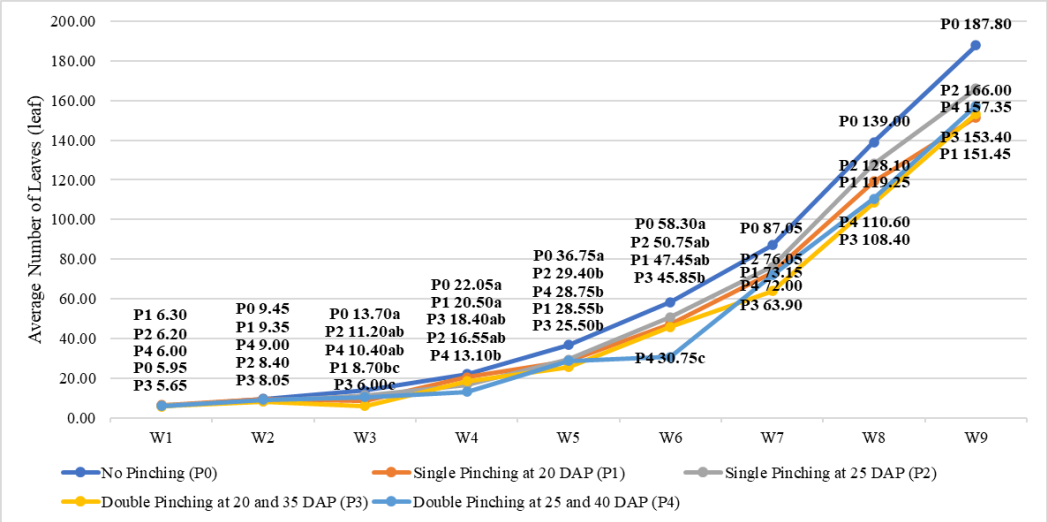
Number of Leaves (leaves)

The analysis of leaf number showed that pinching treatments had a significant effect from the third to the sixth week, however, at the final observation, the effect was not statistically significant. Plants with no pinching (P0) consistently produced the highest number of leaves, reaching 187.80 leaves at the end of the observation period (Figure 2). This value was higher than that of pinched plants, with the lowest recorded in treatment P1 at 151.45 leaves.

This finding contradicts agronomic principles and previous studies, which generally report that pinching increases the number of leaves. Yaseen *et al.* (2021) found that pinching in *Gomphrena globosa* increased leaf number from 269.49 leaves (control) to 309.49 leaves. Similarly, Nathan *et al.* (2019) reported an increase from 83.05 leaves (control) to 138.61 leaves under the best pinching treatment. Comparable results were also reported by Ehsanullah *et al.* (2021) in *chrysanthemum*, where triple pinching raised leaf count from 200 leaves (control) to 235 leaves.

Three main factors are suspected to have caused the contrasting results in this study. First, each pinching action induces physiological stress, requiring energy and nutrient allocation for recovery. Second, nutrient supply was likely insufficient. This study only used cow manure, which is slow-release (Arifah *et al.*, 2019) and requires time for microbial decomposition (Febriani *et al.*, 2021). Consequently, essential nutrients such as nitrogen critical for leaf formation were not immediately available after pinching (Varma *et al.*, 2023). Third, limited light intensity was a dominant limiting factor. *Gomphrena globosa* requires full sunlight exposure for optimal growth (Gilman *et al.*, 2007), with an intensity of about 120,000 lux (Michael *et al.*, 2020). However, the average daily light intensity at the research site was only 21,512.11 lux. This shaded condition inhibited photosynthesis, reduced energy production, and impaired the plant's ability to recover from stress (Wulandari *et al.*, 2021).

Thus, the combination of physiological stress, nutrient limitation, and low light intensity likely explains why pinched plants (P1–P4) failed to optimally produce new leaves. This unusual finding reflects the complex interaction between agronomic treatments and suboptimal environmental conditions.



Note : Numbers followed by the same letters in the same column and treatment indicate no significant difference based on the DMRT test at a = 5%. DAP = days after planting.

Figure 2. Average Number of Leaves of Globe Amaranth from Week 1 to Week 9 (W1–W9)

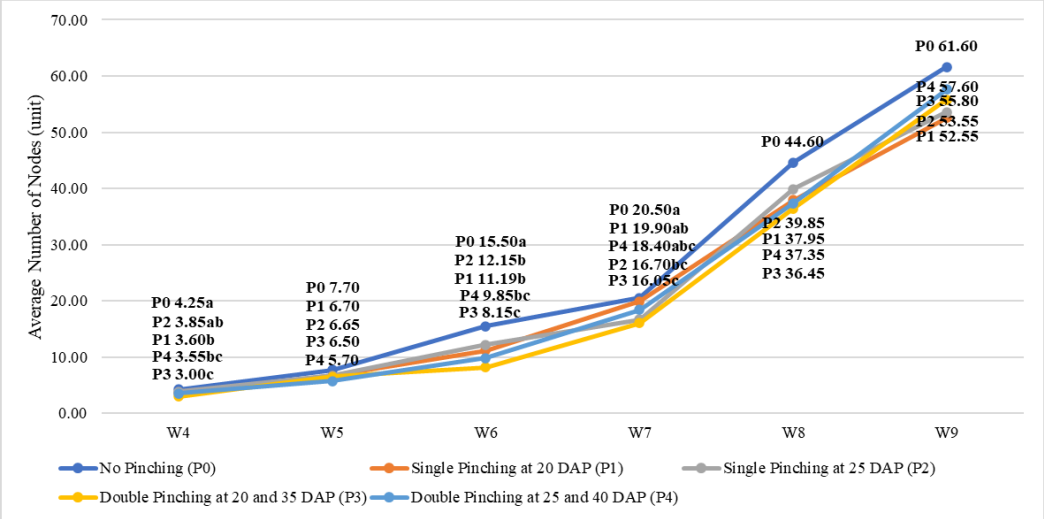
Number of Nodes (units)

Based on the data analysis, pinching significantly affected the number of nodes in the 4th, 6th, and 7th weeks, whereas at the final observation, the difference was not significant. The control treatment (P0) consistently exhibited the highest increase in node number from the 4th to the 9th week. At week 9, P0 reached 61.60 nodes, while P1 and P2 showed the lowest counts, 53.55 and 52.55 nodes, respectively (Figure 3).

The higher node number in P0 during the early to mid-growth phases can be attributed to uninterrupted vertical growth. The number of nodes is closely correlated with plant height, as a longer main stem accommodates more node formation (Yono & Putri, 2023). Control plants (P0) that were not pinched maintained consistent vertical elongation, enabling rapid node formation compared to plants that temporarily halted growth after pinching. Pinching is intended to break apical dominance and stimulate lateral bud development into new branches (Nathan *et al.*, 2019).

The equalization of node numbers in pinched plants by the end of the observation period was due

to the formation of additional nodes on lateral branches. Nodes function as leaf growth points that enhance photosynthesis and serve as sites for productive branch development (Wulandari et al., 2021). This accumulation compensates for the lower node count on the main stem, indicating that pinching effectively modified plant architecture from vertical to a more spreading, bushy form with evenly distributed growth points.



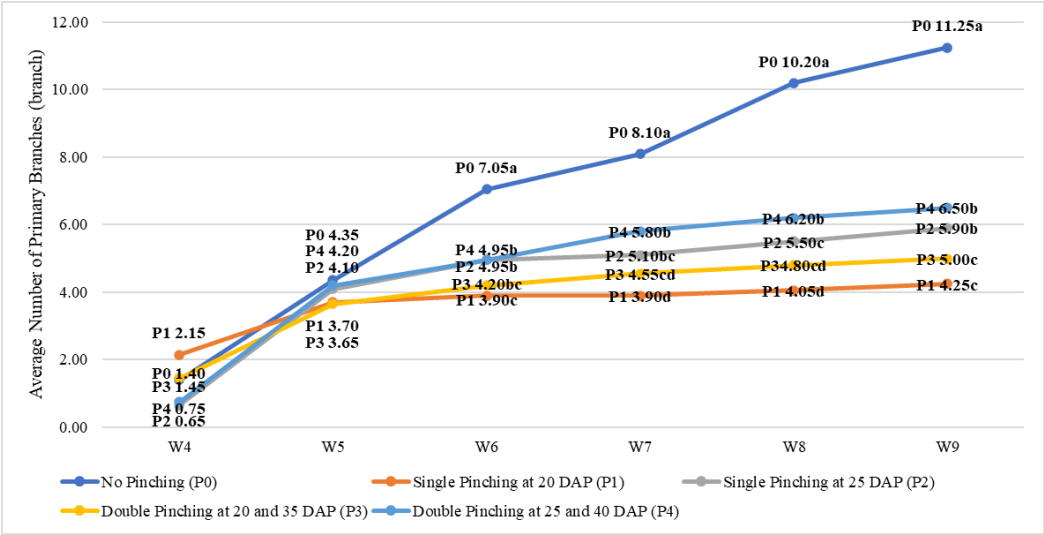
Note : Numbers followed by the same letters in the same column and treatment indicate no significant difference based on the DMRT test at a = 5%. DAP = days after planting.

Figure 3. Average Number of Nodes of Globe Amaranth Plants (Weeks 4–9)

Number of Primary Branches (branches), Secondary Branches (branches), and Productive Branches (branches)

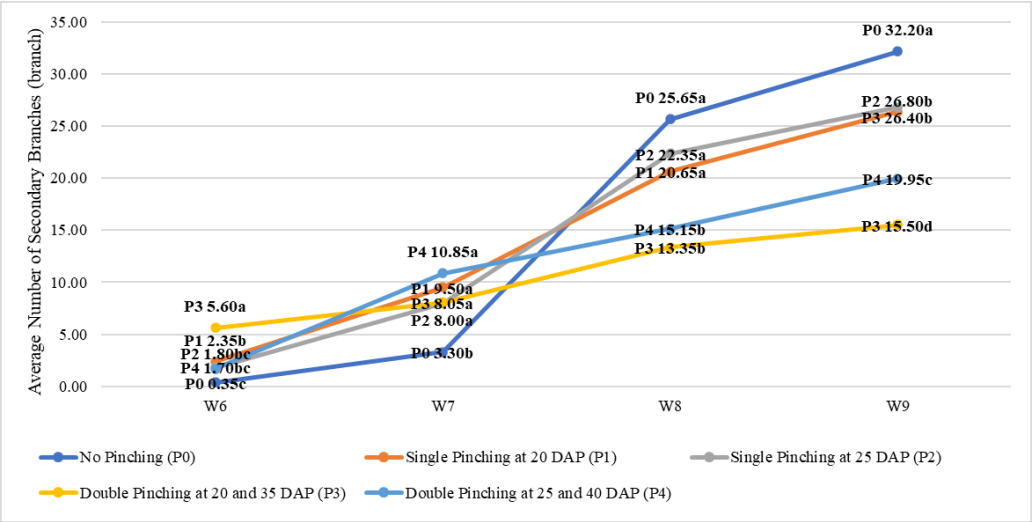
Based on the analysis in Figure 4, pinching had a significant effect on branching variables, including primary, secondary, and productive branches. For primary branches, there was no significant difference in weeks 4 and 5, but starting from week 6 to week 9, a significant effect was observed. The control treatment (P0) consistently produced the highest number of primary branches, reaching 11.25 branches in week 9, while the lowest numbers were recorded in P1 and P3, with 4.25 and 5 branches, respectively.

For secondary branches, pinching also showed a significant effect starting in week 6. P0 experienced a sharp increase in the number of secondary branches, from 3.30 branches in week 7 to 25.65 branches in week 8, reaching 32.20 branches in week 9. Conversely, the lowest number of secondary branches was found in P3, with 15.50 branches (Figure 5). A similar trend was observed in productive branches, where P0 again produced the highest number, 36.60 branches, while pinching treatments (P1–P4) resulted in lower numbers, ranging from 21.90 to 31.40 branches as shown in Table 2



Note : Numbers followed by the same letters in the same column and treatment indicate no significant difference based on the DMRT test at a = 5%. DAP = days after planting.

Figure 4. Average Number of Primary Branches of *Gomphrena* Flowers (Weeks 4–9)



Note : Numbers followed by the same letters in the same column and treatment indicate no significant difference based on the DMRT test at a = 5%. DAP = days after planting.

Figure 5. Average Number of Secondary Branches of *Gomphrena* Flowers (Weeks 6–9)

Table 2. Number of Productive Branches in *Gomphrena* Plants (branches)

	Number of Productive Branches (branch)
No Pinching (P0)	36.60a
Single Pinching at 20 DAP (P1)	29.90b
Single Pinching at 25 DAP (P2)	31.40b
Double Pinching at 20 and 35 DAP (P3)	28.45b
Double Pinching at 20 and 35 DAP (P4)	29.60b

Note : Numbers followed by the same letters in the same column and treatment indicate no significant difference based on the DMRT test at a = 5%. DAP = days after planting.

Time of Flower Emergence (DAP), Flowering Period (days), and First Harvest Age (DAP)

Based on Table 3, pinching has a significant effect on the time of first flower emergence, flowering period, and the first harvest age. Control plants (P0) showed the earliest flowering (29.20 DAP) and fastest harvest (59.60 DAP). Single pinching (P1 and P2) delayed flowering to 40.80–43.60 DAP and harvest to 70–71 DAP, while double pinching (P3 and P4) caused the longest delays, with flowering around 50.20 DAP and harvest close to 80 DAP. Furthermore, single pinching resulted in a shorter flowering duration compared to the control and double pinching treatments.

Table 3. Days to First Flowering, Flowering Period, and Flower Stalk Length of *Gomphrena globosa*

	Days to First Flowering (DAP)	Flowering Period (days)	Days to First Harvest (DAP)
No Pinching (P0)	29.20c	28.90a	59.60c
Single Pinching at 20 DAP (P1)	40.80b	27.70ab	70.35b
Single Pinching at 25 DAP (P2)	43.60b	26.90b	71.15b
Double Pinching at 20 and 35 DAP (P3)	50.20a	28.65a	79.65a
Double Pinching at 25 and 40 DAP (P4)	50.20a	28.55a	79.40a

Note : Numbers followed by the same letters in the same column and treatment indicate no significant difference based on the DMRT test at a = 5%. DAP = days after planting.

Pinching delays flower initiation by extending the vegetative phase, as energy is redirected to tissue recovery (Kobayashi & Iwase, 2017). New shoots formed after pinching also require additional time to reach maturity before flowering (Ehsanullah *et al*., 2021). This explains the later first harvest observed in pinched plants. In contrast, single pinching shortened the flowering period, likely due to improved source–sink balance that enables efficient photosynthate translocation (Ningsih *et al*., 2024). Phosphorus supports this process through energy transfer, while potassium facilitates sugar mobilization to floral organs (Varma *et al*., 2023).

Thus, although pinching has been proven to delay the onset of flowering and postpone the first harvest, single pinching is able to accelerate flower maturation after flower formation. These results confirm the existence of a physiological trade-off between vegetative growth after pinching and reproductive efficiency. In the context of *Gomphrena globosa* cultivation, pinching techniques should be adjusted according to the final goal whether to accelerate harvesting or to form a denser canopy with a more controlled flowering period.

Flower Stalk Length (cm), Number of Flowers (flowers), Flower Weight (g), and Total Flower Weight per Plant (g)

Pinching did not significantly affect flower stalk length (19.92–20.42 cm) or individual flower weight, although the control treatment (P0) tended to produce heavier flowers (0.68 g compared to 0.58 g in P4). However, pinching significantly influenced the number of flowers and total flower weight per plant. P0 produced the highest flower count (18.65) and total weight (13.40 g), which was statistically similar to P1 (9.83 g) and P2 (10.55 g) but significantly higher than P3 (5.48 g) and P4 (6.08 g). Double pinching (P3 and P4) resulted in the lowest flower counts (8.35 and 9.40), while single pinching (P1 and P2) showed intermediate values (13.95 and 14.60).

Based on the result, this suggests that flower stalk length is more strongly influenced by genetic factors than by agronomic manipulation. Kumar *et al*. (2022) reported that the heritability of flower stalk length in *Gomphrena* is extremely high, reaching 99.90%. Similarly, Rahayu *et al*. (2025) confirmed that phenotype plays a dominant role in determining the morphology of *Gomphrena globosa*. Therefore, although pinching successfully modified plant architecture, the stalk length adhered to the genetic pattern already established.

In contrast, the number of flowers per plant showed a clear response to pinching. These findings contradict the common theory that pinching increases flower number by stimulating lateral branching. Nathan *et al*. (2019) reported that pinching significantly enhanced flower production in *Gomphrena*, and similar results were observed by Yaseen *et al*. (2021). The difference in this study can be explained by the limited number of productive branches formed due to physiological stress after pinching. Kobayashi & Iwase (2017) explained that pinching triggers a recovery mechanism requiring high energy. Haider *et al*. (2023) reported that environmental conditions influence plant trait expression. In this study, shading and a 90-day cultivation period limited the ability of pinched plants to optimize flower production.

For flower weight, the results indicate that this trait is relatively stable as a genetic characteristic compared to flower number. Kumar *et al*. (2022) reported that genetic factors play a major role in determining flower organ weight. This trend supports the photosynthate allocation theory, where control plants (P0) with more leaves exhibit greater photosynthetic capacity, enabling higher flower number and weight. In contrast, pinched plants allocate energy for tissue recovery, reducing flower weight.

A similar pattern was observed in total flower weight per plant. Control plants (P0) utilized their full photosynthetic capacity for flower production, while pinched plants diverted energy to tissue regeneration, reducing productivity. Shaded conditions intensified these effects, leading to the lowest flower weight in double pinching treatments. This trend contrasts with findings by Nathan *et al*. (2019), who reported a significant increase in flower yield through pinching. The differences can be attributed to the combined effects of fewer flowers and lighter flower weight in pinching treatments.

Table 4. Flower Stalk Length, Number of Flowers, Flower Weight per Flower, and Flower Weight per Plant of *Gomphrena globosa*

	Flower Stalk Length (cm)	Number of Flowers (flower)	Flower Weight per Flower (g)	Flower Weight per Plant (g)
No Pinching (P0)	20.16	18.65a	0.68	13.40a
Single Pinching at 20 DAP (P1)	19.92	13.95b	0.66	9.83a
Single Pinching at 25 DAP (P2)	20.42	14.60ab	0.65	10.55a
Double Pinching at 20 and 35 DAP (P3)	20.16	8.35c	0.61	5.48b
Double Pinching at 20 and 35 DAP (P4)	20.20	9.40c	0.58	6.08b

Note : Numbers followed by the same letters in the same column and treatment indicate no significant difference based on the DMRT test at a = 5%. DAP = days after planting.

4. Conclusion

Under the specific low-light conditions of this study, pinching treatments significantly influenced plant height, branching characteristics (primary, secondary, and productive branches), flowering time, flowering duration, harvest age, number of flowers, and total flower weight per plant. The no-pinching treatment produced the best vegetative performance, with plant height reaching 53.20 cm, 11.25 primary branches, and 32.20 secondary branches. In generative performance, this treatment also resulted in the highest number of productive branches (36.60), the earliest flowering (29.20 DAP), the earliest harvest age (59.60 DAP), and the highest number of flowers (18.65 flowers per plant).

The flower weight per plant in the no-pinching treatment (13.40 g) was relatively comparable to single pinching at 20 DAP (9.83 g) and 25 DAP (10.55 g). Meanwhile, pinching at 25 DAP produced the shortest flowering period (26.90 days). These findings suggest that plant responses to pinching are strongly influenced by environmental conditions. Therefore, pinching recommendations should be adjusted according to the growing environment, particularly under limited light conditions.

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