



Evaluation of Cauliflower Genotypes for Growth, Yield and Quality Traits under Foothill Condition of Nagaland

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ABSTRACT

Background: A field experiment was conducted during the Rabi season of 2022-2023 and 2023-2024 at the experimental farm of the Department of Horticulture, School of Agricultural Sciences, Nagaland University, Medziphema Campus, to evaluate different genotypes of cauliflower for their growth, yield and quality under the foothill conditions of Chumukedima district, Nagaland.

Methods: Twelve genotypes of cauliflower were evaluated in a randomized block design with three replications and the data were pooled over two years. The experimental material comprised twelve genotypes: G₁, G₂, G₃, G₄, G₅, G₆, G₇, G₈, G₉, G₁₀, G₁₁ and G₁₂.

Result: The results revealed that genotype G₁₁ exhibited maximum plant height (42.55 cm), plant spread (56.59 cm), curd diameter (12.96 cm), curd size (103.03 cm²), net curd weight (513.97 g), curd yield (139.99 Q ha⁻¹) and curd compactness (61.00). Genotype G₄ recorded the highest stalk length (11.67 cm), while genotype G₉ had the maximum number of leaves per plant (18.97). Genotype G₅ showed the highest gross curd weight (707.33 g). The ascorbic acid content was highest in genotype G₁₁ (20.14 mg/100 g). Based on the experimental findings, genotype G₁₁ was proven to be a potential high yielder over other genotypes under the foothill conditions of Nagaland.

Key words: Cauliflower, Genotypes, Growth, Quality, Yield.

INTRODUCTION

Cauliflower (*Brassica oleraceae* var. *botrytis* L.), a member of the Cruciferae family, is a significant vegetable crop cultivated worldwide, particularly in diverse climates ranging from temperate to tropical regions. Originating from the Mediterranean region, specifically Cyprus. Cauliflower is rich in sources of vitamins and minerals which can protect against heart disease and also helps to maintain the cholesterol level (Keck, 2004), rich in vitamins A (51 IU/100 g) and C (6 mg/100 g) and minerals such as phosphorus, potassium, calcium, sodium and iron (Kanaujia *et al.*, 2020). The edible part is curd and consumed as curry, raw as salad, cooking vegetables, pickle and also widely used in preparing burgers, fried snacks and sandwiches in restaurants (Ashraf *et al.*, 2017). Consumption of excess cauliflower have been reported with reduction in the hazard of prostate cancer (Kushwaha *et al.*, 2013). This plant can also withstand with temperature of 10 to 40°C. It is grown throughout the country from latitudes 11°N to 35°N (Swarup and Chatterjee, 1972).

Temperature has a significant impact on the initiation and growth of curds and cauliflower is extremely sensitive to this factor. For cauliflower to begin curding, early varieties need a higher temperature than mid-and late-season varieties. Higher temperatures above 20°C in the late winter season may result in fuzzy, ricey and loose curds (Fujime, 1983; Swiader *et al.*, 1992). The genetic traits of the varieties also influence when cauliflower curds begin to form (Saini, 1996). While late varieties of cauliflower require low temperatures (10-16°C), early varieties require higher temperatures (20-25°C) to initiate curd (Bose and Som, 1993; Chatterjee, 2013). The crop is now produced across

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an area of 459,000 hectares, resulting in a production of 9.34 million tonnes, with an average productivity of 20.34 tonnes per hectare (NHB, 2022). In Nagaland, the area under cauliflower cultivation is approximately 2,040 hectare, with a productivity of 8.2 tonnes per hectare and a total production of 16,720 tonnes.

Despite the favourable agro-climatic conditions, the potential of cauliflower as a fresh vegetable in Nagaland is not fully exploited, likely due to a lack of knowledge regarding the genotypes best suited to the region's specific conditions. Given the importance of selecting the right genotypes for optimal yield and quality, it is crucial to evaluate the performance of different cauliflower genotypes under the unique foothill conditions of Nagaland. The

performance of cauliflower genotypes can vary significantly depending on the agro-climatic conditions, making it essential to identify the best-suited genotypes for this region. This study aims to address this need by conducting an experiment to evaluate cauliflower genotypes in the foothill conditions of Nagaland, with the goal of identifying the most suitable genotype for cultivation in this region.

MATERIALS AND METHODS

The present investigation was carried out at the Experimental Farm of the Department of Horticulture, School of Agricultural Sciences and Rural Development, Nagaland University, Medziphema Campus, Nagaland during the Rabi season of 2022-2023 and 2023-24 and the values were pooled. The experimental site is located at an altitude of 304.8 m above mean sea level, with a geographical location of 20°45'43" N latitude and 93°53'04" E longitude. The experimental material comprised twelve genotypes of cauliflower, designated as G1 to G12. All twelve genotypes were evaluated using a randomized block design with three replications. Seeds were sown in a nursery on the 10th of October 2022 and 20th October, 2023 under a low-cost polyhouse. Thirty-day-old, healthy and uniform seedlings, free from insect pests and diseases, with a good root system and a height of about 10-15 cm, having 3-4 true leaves, were transplanted into the main field. The plot size and spacing were maintained at 2.4×2.4 m and 60×60 cm, respectively. Recommended cultural practices and plant protection measures were followed during the cultivation of the crop. Observations were recorded for various growth and yield parameters including plant height, stalk length, number of leaves per plant, plant spread, curd diameter, curd size, gross curd weight, net curd weight, yield per plot, yield per hectare, curd compactness and ascorbic acid

content in the curd. The compactness of the curd was determined using the formula provided by Pearson (1931). The ascorbic acid content was determined using the 2,6-Dichlorophenol indophenol visual titration method as described by A.O.A.C. (1984) and was expressed in mg per 100g. The experimental data were statistically analyzed as suggested by Panse and Sukhatme (1978).

RESULTS AND DISCUSSION

Growth attributes

All the genotypes showed considerable variation in plant height at maturity, ranging from 29.23 cm to 42.55 cm as shown in (Table 1 and Fig 1). Genotype G11 recorded the highest plant height of 42.55 cm, followed by G₈ at 41.32 cm, while the minimum plant height of 29.23 cm was observed in genotype G₁₀. Stalk length also showed significant differences among the genotypes, ranging from 5.53 cm to 11.67 cm. The highest stalk length was recorded in genotype G₄ (11.67 cm), closely followed by G₈ (11.17 cm), while the lowest was seen in G₁₀ (5.53 cm). The number of leaves per plant varied significantly across the genotypes, ranging from 11.80 to 18.97 leaves per plant. Genotype G₉ produced the maximum number of leaves per plant (18.97), followed by G₇ (18.20), while the minimum was observed in genotype G₂ (11.80). Significant differences were also observed among the genotypes concerning plant spread, which ranged from 35.56 cm to 56.59 cm. The highest plant spread was recorded by genotype G₁₁ (56.59 cm), followed by G₃ (54.78 cm), with the lowest recorded in genotype G₂ (35.56 cm). Generally, taller plants are associated with longer stalks, more leaves and greater plant spread, as observed in certain genotypes. However, variations exist, with some genotypes showing deviations from this trend due to genetic and environmental factors.

Table 1: Effect of genotypes on the plant height, stalk length, number of leaves plant⁻¹ and plant spread of cauliflower.

Characters	Plant height (cm)	Stalk length (cm)	Number of leaves plant ⁻¹	Plant spread (cm)
G ₁	40.37	9.67	13.43	40.67
G ₂	35.06	8.82	11.8	35.56
G ₃	41.03	9.6	13.82	54.78
G ₄	40.55	11.67	12.87	44.42
G ₅	36.61	8.09	16.37	39.5
G ₆	33.88	10.63	14.97	36.47
G ₇	32.41	9.15	18.2	37.8
G ₈	41.32	11.17	16.17	53.37
G ₉	33.35	9.53	18.97	41.08
G ₁₀	29.23	5.53	15.7	39.08
G ₁₁	42.55	9.45	16.5	56.59
G ₁₂	32.23	7.48	12.1	38.85
Mean	36.55	9.232	15.073	43.181
SEm (±)	0.73	0.33	0.69	0.69
SEd (±)	1.03	0.47	0.98	0.97
CD at 5%	2.1	0.96	1.98	1.97
CV (%)	3.47	6.27	7.94	2.76

Stalk length tends to influence plant spread, while a higher number of leaves often correlates with a larger spread. The observed relationships among plant height, stalk length, number of leaves and plant spread can be scientifically attributed to factors such as genetic regulation, hormonal balance and resource allocation within the plant. Taller plants with longer stalks typically exhibit greater vegetative growth, might be due to higher levels of growth hormones like auxins and gibberellins, which promote both vertical and lateral expansion. The number of leaves is influenced by nutrient availability and genetic potential for foliage production, which contributes to photosynthetic capacity, thereby supporting greater plant spread. Variations among genotypes may be due to differing genetic expressions for growth habits, internode elongation and branching patterns, leading to deviations from general

growth trends. Similar findings were reported by Yadav *et al.* (2013), Singh *et al.* (2016) and Singh (2021). Rana *et al.* (2014) also observed that stalk length had moderate effects on plant spread and growth. Choudhury and Thakur (2017) also reported on how plant height and number of leaves in cauliflower affect overall plant architecture and productivity.

Yield and yield attributes

It is evident from the study that there is a significant difference in yield and yield-attributing characters among various cauliflower genotypes evaluated as shown in (Table 2 and Fig 2). All the genotypes exhibited a significant effect on the curd diameter of cauliflower. Curd size (cm²) is directly proportional to curd diameter (cm). As the diameter increases, the surface area (curd size) also expands. This is observable in the dataset, where larger diameters

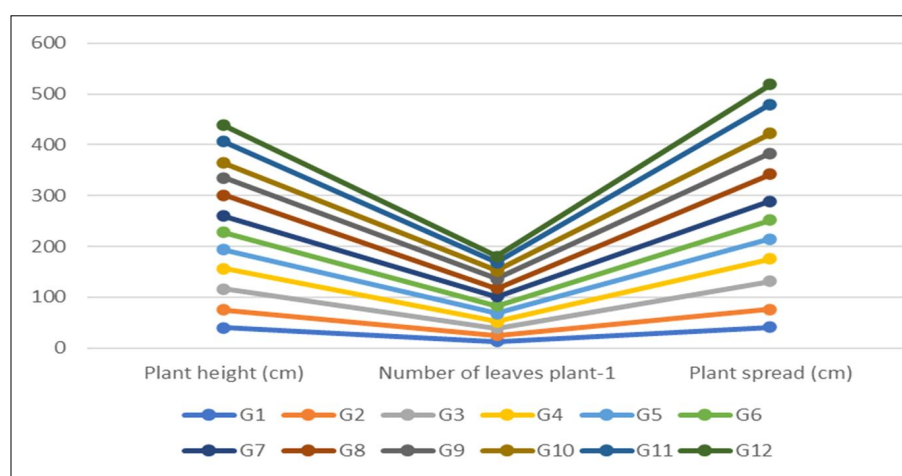


Fig 1: Effect of different genotypes on plant height (cm), number of leaves per plant and plant spread.

Table 2: Effect of genotypes on yield and yield attributes of cauliflower.

Characters	Curd diameter (cm)	Curd size (cm ²)	Gross curd wt (g)	Net curd wt (g)	Yield per plot (kg)	Yield per hectare (q)
G ₁	11.12	72.64	583.00	293.20	4.69	81.44
G ₂	9.49	61.36	516.00	145.00	2.32	40.28
G ₃	12.92	41.92	691.67	499.53	7.99	138.76
G ₄	10.82	74.82	596.00	307.87	4.93	85.52
G ₅	11.76	88.40	707.33	254.07	4.07	70.57
G ₆	9.27	65.76	506.33	285.53	4.57	79.31
G ₇	11.43	81.40	533.10	239.57	3.83	66.55
G ₈	11.18	72.70	589.33	463.67	7.42	128.8
G ₉	11.70	59.90	569.67	295.67	4.73	82.13
G ₁₀	11.43	85.88	513.33	216.67	3.47	60.19
G ₁₁	12.96	103.03	615.33	513.97	8.06	139.99
G ₁₂	10.49	64.88	467.00	247.30	3.96	68.69
Mean	11.21	72.72	574	313.49	5.00	86.85
SEm (±)	0.47	4.692	16.35	24.34	0.37	6.35
SEd (±)	0.66	6.635	23.12	34.43	0.52	8.98
CD at 5%	1.34	13.85	46.94	69.89	1.05	18.22
CV (%)	7.22	11.175	4.93	13.45	12.66	12.66

typically correspond to larger curd sizes, viz. diameter of G_{11} (12.96 cm) corresponds to a size of 103.03 cm² and a smaller diameter of G_2 (9.49 cm) corresponds to 61.36 cm². Whereas, curd size impacts the gross curd weight since larger curds are generally heavier due to more mass. In Table 1, it can be noted that larger curd sizes are usually associated with higher gross curd weights viz. a curd size of G_{11} (103.03 cm²) leads to a gross weight of 615.33 g, while a smaller curd size of G_3 (41.92 cm²) has a gross weight of 691.67 g, but this case also suggests that the density and internal structure may influence curd weight beyond just size. Gross curd weight represents the total mass of the curd before removing any waste or unusable parts, while net curd weight is the usable portion. There is a clear connection between gross and net weights, higher gross weights generally yield higher net weights as observed in gross weight of G_3 (691.67 g) corresponding to net weight (499.53 g). However, this relationship also

shows the variability of waste, as seen in cases where larger gross weights may not lead to proportionally higher net weights as in case of gross weight of G_5 (707.33 g) yields a net weight (254.07 g). The net curd weight directly affects yield per plot, as the total usable curd weight from all plants in a plot contributes to overall plot yield. Higher net curd weights result in larger yields per plot, which then scale up to yields per hectare. A high net curd weight of G_{11} (513.97 g) results in a yield of 8.06 kg per plot and 139.99 q per hectare. Conversely, a lower net curd weight of G_2 (145.00 g) results in smaller yields per plot (2.32 kg) and per hectare (40.28 q). The differences in curd yield among the genotypes could be attributed to genetic factors and their responses to the environmental conditions of the region. The results are in close conformity with the findings of Booi, R. (1990), Yadav *et al.* (2013), Singh (2021), Giri *et al.* (2023), Kumar *et al.* (2011) and Elavarasan *et al.* (2014), who reported significant differences in curd yield among different cauliflower genotypes under varying environmental conditions.

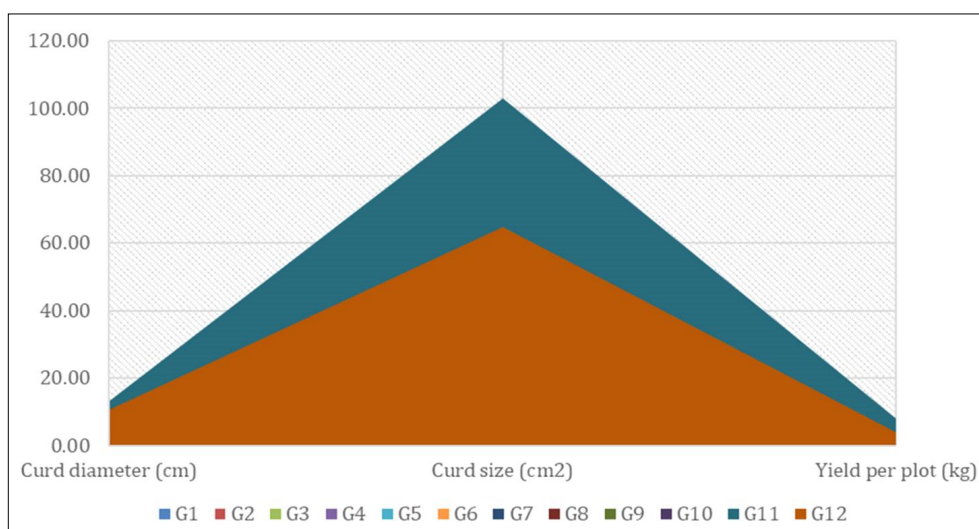


Fig 2: Relationship between curd diameter, curd size and yield per plot.

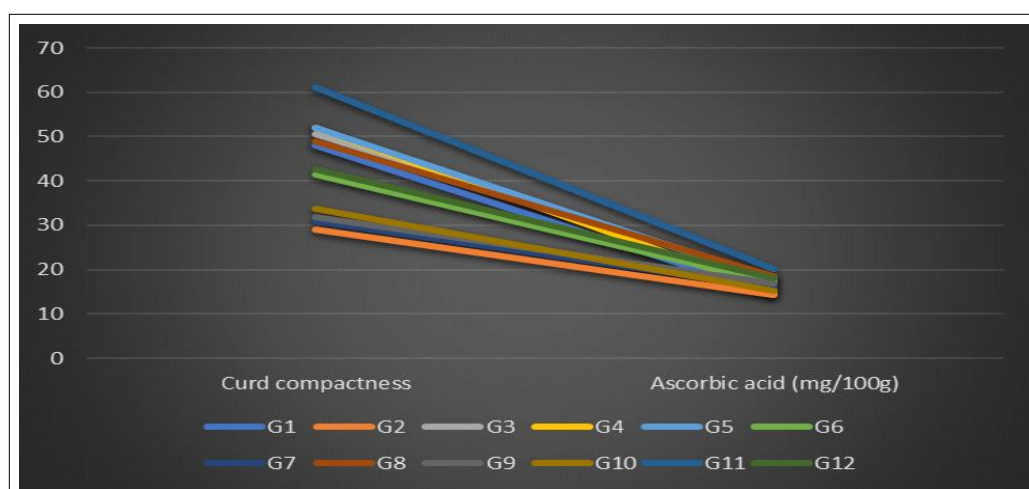


Fig 3: Chart showing the relation between curd compactness and ascorbic acid (mg/100 g).

Table 3: Effect of genotypes on curd compactness and ascorbic acid (mg/100 g) of cauliflower.

Characters	Curd compactness	Ascorbic acid (mg/100 g)
G ₁	47.90	14.60
G ₂	28.94	14.33
G ₃	50.51	18.10
G ₄	52.05	15.33
G ₅	52.05	17.60
G ₆	41.47	17.00
G ₇	31.03	16.00
G ₈	48.88	18.50
G ₉	31.80	16.80
G ₁₀	33.69	15.33
G ₁₁	61.00	20.14
G ₁₂	42.70	18.15
Mean	43.50	16.82
SEm (±)	3.26	0.36
SEd (±)	4.61	0.51
CD at 5%	9.35	1.04
CV (%)	12.97	3.72

Quality attributes

A preliminary analysis indicates a positive relationship between curd compactness and ascorbic acid content as shown in (Table 3 and Fig 3). Specifically, genotypes G₁₁, G₃ and G₅ exhibited the highest curd compactness values of 61.00, 50.51 and 52.05, respectively, correlating with elevated ascorbic acid contents of 20.14 mg/100 g, 18.1 mg/100 g and 17.6 mg/100 g. Conversely, genotypes G₂ and G₇, characterized by lower curd compactness (28.94 and 31.03), demonstrated lower ascorbic acid levels (14.33 and 16.00 mg/100 g). The results from this study suggest a significant relationship between curd compactness and ascorbic acid content in the evaluated genotypes. The trend indicates that genotypes with higher curd compactness tend to possess elevated levels of ascorbic acid, implying that structural attributes of the curd may play a role in nutritional quality.

Curd compactness can be indicative of several physiological traits, including water retention capacity and nutrient accumulation. Denser curds may be a reflection of effective physiological processes that enhance the plant's ability to synthesize secondary metabolites, including ascorbic acid. The compact plant structures often facilitate improved nutrient uptake and metabolic efficiency, leading to higher antioxidant levels. However, it might also be influenced by underlying genetic traits governing both curd compactness and ascorbic acid synthesis. Furthermore, environmental conditions such as soil nutrient levels and water availability might also influence both curd development and ascorbic acid content. Similar findings were reported by Kanaujia *et al.* (2020), who noted significant differences in quality traits among cauliflower genotypes.

CONCLUSION

Based on the experimental findings, Genotype G₁₁ exhibited superiority in most growth and yield parameters, making it a potential candidate for commercial cultivation in the Chumukedima district of Nagaland. This genotype's adaptability to local conditions, coupled with its high yield and quality attributes, suggests it is well-suited for further crop improvement programs.

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Disclaimers

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Conflict of interest

All authors declared that there is no conflict of interest.

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