DOI :https://doi.org/10.36378/juatika.v5i2.3046
JUATIKA
JURNAL AGRONOMI TANAMAN TROPIKA
VOL. 5 NO. 2 July 2023
eissn 2656-1727
pissn 2684-785X
Hal : 412 – 424

Exploration and Characterization of Flower Cabbage (*Brassica oleracea* Var. Botrytis) In Banuhampu District

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ABSTRACT

Cauliflower (*Brassica oleracea* var. botrytis) is one of the vegetable commodities with high economic value. Cauliflower production in Indonesia reached 204,328 tonnes in 2020. This research was conducted from January to May 2022 in 3 sub-district in Banuhampu district. This study aimed to identify the morphological characters and growth diversity of cauliflower from Banuhampu district. The research method used is a survey method with purposive sampling consisting of two stages of activity, exploration and characterization. Morphological characterization was carried out on leaves and curds. The exploration has been carried out has succeed in characterizing 18 sampel of cauliflower which show narrow to broad phenotypic variability in the characters of leaves and curds, while the analysis of the level of similarity between samples obtained a coefficient value of 42 to 100%.

Keywords: *exploration, characterization, cauliflower, morphological characters*

1. INTRODUCTION

Indonesia has a tropical climate with year-round sunshine and an abundance of fertile land used for agriculture, including the cultivation of horticultural commodities. Horticultural commodities include fruits, vegetables, ornamental plants, and medicinal plants. Horticultural products, particularly vegetables, play a crucial role in the global food supply, so they must be available at all times, in sufficient quantities, of high quality, secure for human consumption, at reasonable prices, and accessible to all socioeconomic classes (BPS, 2018).

Cauliflower is one of the vegetable commodities with economic value, because the high domestic demand for cauliflower provides numerous business opportunities. Cabbage flowers are classified as Brassica oleracea var. botrytis, a member of the Brassicaceae family that is widely cultivated throughout the globe. The name cauliflower is derived from the Latin words caulis, meaning "cabbage," and flos, meaning "flower." The shape of cabbage flowers resembles that of broccoli. The difference is that cauliflower has numerous, regular, and dense flower crowns. Cauliflower is an annual plant that can grow to a height of 0.5 meters (1.5 feet) and has large, mustard-like leaves (*Brassica oleracea* var. *aceaphala*) (S.R., Praveen, Veronique and S.K, 2008).

The edible portion of cauliflower is referred to as curd, and it is abundant in minerals such as potassium, sodium, iron, phosphorus, calcium, and magnesium, among others. The raw curd of 100 grams of cauliflower contains only 26 calories. The greatest source of vitamin C is fresh cauliflower, which also contains vitamin A and numerous B-complex vitamins, including folic acid (vitamin), pantothenic acid (vitamin), pyridoxine (vitamin), thiamin (vitamin), and nicotinic acid (vitamin). This vegetable is of great interest to health-conscious individuals. Each year, the production of cabbage blossoms continues to increase. The global production of cauliflower and broccoli reached 25,495,394 tons. Where China is the world's largest producer of cauliflower and broccoli with a production volume of 10,638,068 tons and India is second with a production volume of 9,083,000 tons. China and India produce over 70 percent of the world's total output (FAO, 2019), whereas Indonesia's production of cauliflower is only expected to reach 204,238 tons in 2020 (BPS, 2020). It is necessary to conduct an inventory, collection, characterization, and evaluation of existing growth to increase productivity and the quality of results. This strategy is intended to prevent genetic erosion, which leads to the depletion of genetic resources (Suryani and Nurmansyah, 2009). Characterization is the process of accumulating germplasm to determine morphological characteristics that can be used for distinguishing between accessions, assessing genetic diversity, identifying varieties, and so on (Bermawie, 2005). Characterization seeks to create plant descriptions; this activity will generate a plant description, which is crucial for genetic empowerment in breeding programs (Hershey, 1987).

Indonesia has cauliflower varieties such as PM 126, Mona, Aquina, Bima 45,

Diamond, Ilona, and Snow white. The provinces of North Sumatra, West Sumatra, Bengkulu, West Java, Central Java, and East Java are major producers of cauliflower. Banuhampu sub-district, Agam Regency is one of the cauliflower-producing regions in West Sumatra. The combination of fertile soil and a favorable climate encourages farmers to cultivate cauliflower, which can be used to produce cabbage seeds (Kristina and Harianti, 2010). Several varieties of cauliflower have a lengthy harvest period, which can impact cultivation techniques and result in financial losses for farmers (Kristina,2011). As a result, it is essential to conduct characterization as the initial stage in gathering information about plant characteristics. After characterization, it is necessary to create a description that provides information about the characteristics of the germplasm that can be utilized in cauliflower plant reproduction in the future.

The preservation of germplasm in conjunction with its characterization is an endeavor to provide useful genes for developing sustainable agricultural technology used to assemble a new superior variety. A plant's characterization will be able to provide descriptive information about the plant's essential properties. The purpose of the characterization is to evaluate the morphological diversity of cauliflower to determine its kinship. Kinship relationships can reveal the proximity of biological cultivars.

The collection and management of germplasm and plant reproduction are integrated activities that must be conducted simultaneously and in harmony. Cabbage germplasm is a genetic resource that must be conserved because it possesses beneficial characteristics for plant breeding programs. To increase gene reserves, germplasm collections must be maintained and enhanced in accordance with the needs of cultivating varieties.

In order to provide genetic material for plant improvement, it is necessary to gather genetic resources by exploring, preserving, evaluating their characteristics, and employing them (Berthaud 1997, Silitonga 2004). It is necessary to characterize the morphology of the problem based on its description. This investigation seeks to determine cauliflower varieties' morphological characteristics and growth diversity in the Banuhampu District. This research has the advantage of providing researchers with information regarding the morphological diversity of cauliflower, which can be used as a reference for future research developments.

2. MATERIAL AND METHODS

This study was conducted between January and May of 2022 in the Banuhampu District, Agam Regency, West Sumatra, which is 963 meters above sea level. This investigation was conducted in three Nagari: Nagari Padang Lua, Nagari Pakan Sinayan and Nagari Cingkariang. Cauliflower plants discovered at the research site served as the study's subject matter. This study is a survey comprised of two phases: exploration and characterization. The location of the cauliflower plants was chosen purposefully (purposive sampling) based on the conditions that satisfied the researcher's sampling criteria, namely by observing three plants per observation location.

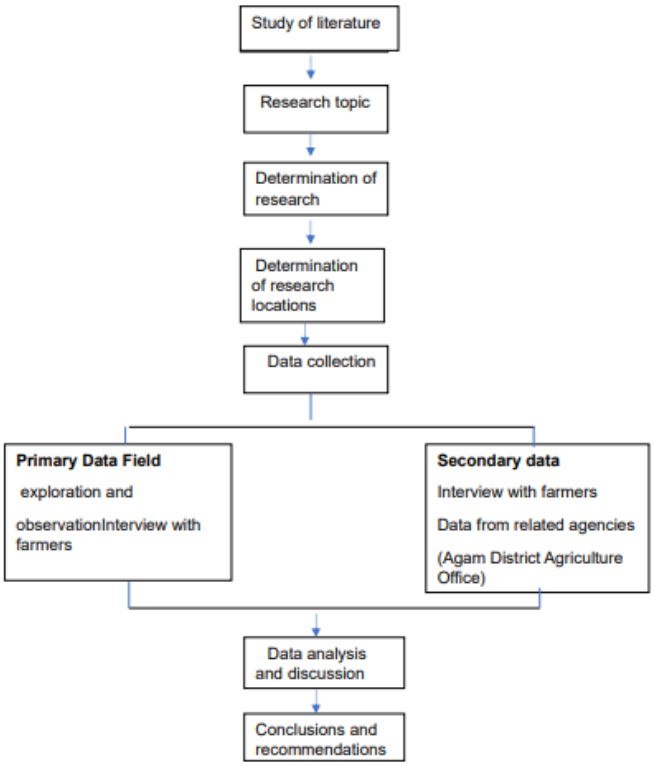

Figure 1. Research Flowcart

3. RESULT AND DISCUSSION

A. Exploration Result

After conducting research in the Banuhampu District, it was discovered that cauliflower was cultivated in three of the seven villages. The communities are 1. Nagari Padang Lua Nagari Pakan Sinayan found 1 farmer at the sampling location in Jorong Bintungan, 3 farmers at the sampling location in Jorong Tabek Sarikan, and 2 farmers (farmers A and B) in Jorong Ladang Lungguak Batu. Two producers in Nagari Cingkariang with sampling locations in Jorong Sungai Landai and in Jorong Cingkariang.

Based on the exploration results, three samples were determined per research location, resulting in the collection of 18 plant samples for characterization. Following is a description of plant samples obtained through interviews with cauliflower cultivating farmers.

Table 1. Samples of Plants Based on the Results of Interviews with Plant Owners

Sampling Location	Plant Age (Since Moving Planting)	Variety	Seed Origin
Bintungan	± 2 bulan	Unknown	Self seed
Tabek Sarikan	± 2,5 bulan	Unknown	Purchase
Cingkariang	± 2,5 bulan	Unknown	Purchase
Ladang Lungguak Batu A	± 2 bulan	Unknown	Self seed
Ladang Lungguak Batu B	± 2,5	Unknown	Purchase
Landai River	± 1,5 bulan	Unknown	Purchase

According to the results of interviews with farmers who cultivate cauliflower, the seeds for cauliflower plants are either self-produced or purchased from farmers who perform the seeding and propagation of cauliflower plants. Plant seeds that are used as a source of seeds typically originate from plants that are experiencing healthy growth, which is why they are ultimately chosen. By administering pesticides and fungicides regularly, parent plants are protected from pests and diseases. Some growers paint the stems of cauliflower to be used as broodstock. The mother plant is tended to until the cauliflower curd elongates and forms floral stalks. The flower of the cauliflower plant is a compound interest consisting of numerous flowers forming clusters with a yellow floral crown. Each flower has stamens and pistils (Bhattacharjee, 2019). The flower's pistil then grows and creates a seed capsule. The desiccated seed capsules can then be collected.

Respondents or farmers who cultivate cauliflower in the Banuhampu subdistrict stated that they did not purchase seeds from farm stores but from cauliflower nurseries/seed producers. Mrs. Widya and Mrs. Artini, two of the six respondents, are also producers of cauliflower seed. During the growth of the cauliflower plants, producers fertilized with NPK, ZA, and SS fertilizers, according to information gathered from the respondents. Cauliflower can be harvested two months after transplanting, and the cauliflower yield in the Banuhampu District has a longer shelf life than the cauliflower yield from seeds purchased from local farm shops. Consequently, respondents favor planting local cauliflower.

B. Morphological Observations

Observing the qualitative and quantitative characteristics allowed for the morphological characterization of cauliflower plants in the district of Banuhampu. (Thanksgiving et al., 2015) Qualitative characteristics are governed by simple genes (one or two genes), so environmental factors have no effect on qualitative characteristics. The qualitative character performance of the six sampling locations did not reveal any variation between genotypes. This demonstrates that the qualitative diversity of cauliflower plants is extremely limited. Characteristics at six locations on all samples of leaf color, leaf color intensity, leaf lesions, leaves covered with curd, and curd color. There are no leaf lesions and the entire leaf is grayish green with a dark leaf color intensity. The curd of some samples is not covered by foliage, except for the sample from Cingkarang, which is partially covered by leaves; the curd color for the entire sample is white.

1. Flower Cabbage Plant Types

The plant variety of flower cauliflower is relatively upright. The relatively upright plant variety is advantageous due to its long, upright leaves and medium-sized curd. This plant is quite upright, so when the cauliflower curd is exposed to sunlight, it is shielded by cauliflower leaves. Exposed to sunlight, curd will change color to yellow or red, diminishing its quality (Hamson, 1989). Figure 1 depicts the variety of cauliflower plants that were harvested.

Figure 1. Cabbage Flower Types in the Banuhampu District are semi-erect (slightly upright)

Based on morphological observations, only cauliflower types, characterized by slight uprightness, were discovered to dominate the population. This slightly erect plant type yields curds that are medium in size, compact, and brilliant white.

2. Leaf Morphology of Flower Cabbage Plants

Cauliflower leaves are defective because they consist only of upih and leaf blades. The cauliflower leaves are oval with serrated edges, relatively long and form pinnate openings that are slightly curved inward; these leaves are green and grow alternately on the plant's stem. Both qualitative and quantitative observations on the leaves were made. Leaf lobes, leaf color, leaf color intensity, leaf tip indentation, leaf blisters, wrinkling near the veins, and leaf wave edge were among the qualitative observations of cauliflower. The quantitative characteristics observed were leaf length, leaf breadth, and leaf width-to-length ratio. Figure 2 depicts the leaf morphology of cauliflower.

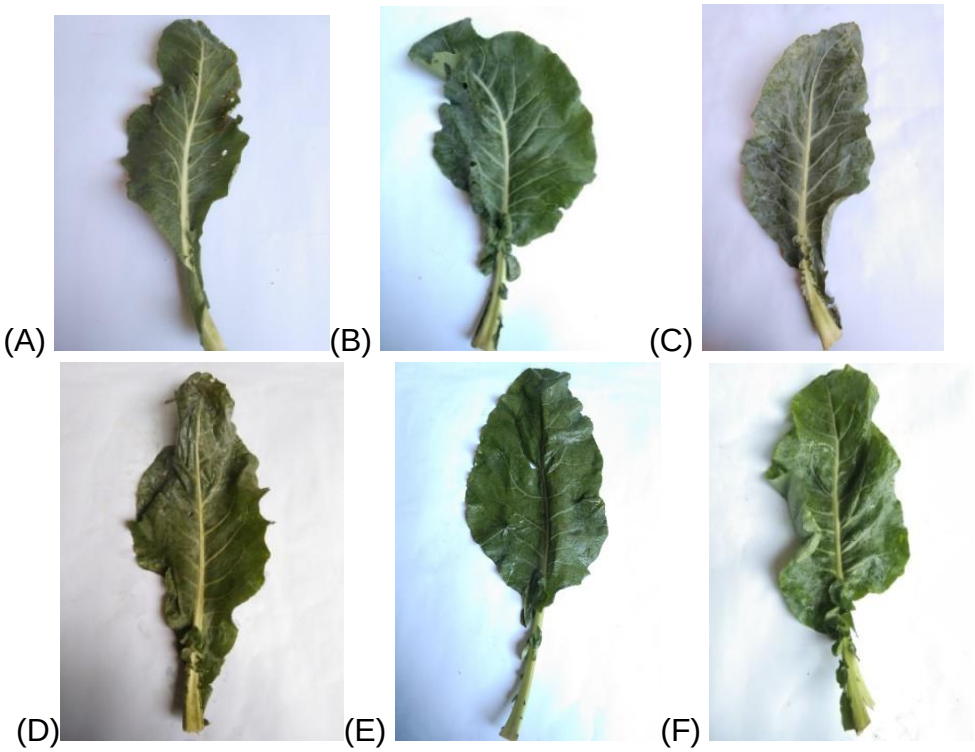

Figure 2. Leaf Morphology of Cabbage Flowers at Locations (A) Bintungan, (B) Tabek Sarikan, (C) Cingkariang, (D) Lungguak Batu A Field, (E) (Lungguak Batu Field B, (F) Sungai Landai

Figure 2 depicts the morphology of cauliflower leaves found in the Banuhampu subdistrict. The color of the cauliflower leaves was determined to be gray-green, which dominated the sample with 100% leaf color intensity. Weak and moderate variations in the indentation of the leaf ends of cauliflower were observed. At the Bintungan, Lungguak Batu B Fields, and Sungai Landai locations, 50 percent of leaf tip indentations were deemed to be weak. Tabek Sarikan, Cingkarang, and Lungguak Batu A Fields samples contained leaf ends with indentations. Only one of the three cauliflower variants described in the cauliflower characterization guidebook contained leaf lesions. Cauliflower leaf blisters are absent or very faint, comprising one hundred percent of the sample.

Near the cauliflower leaves, there were two types of wrinkles: faint and moderate. In samples from Bintungan, Lungguak Batu A Field, Lungguak Batu B Field, and Sungai Landai, feeble veins were found to be surrounded by 66.66 percent of the wrinkles. At the Tabek Sarikan and Cingkariang locations, 33.33 % of samples exhibited midrib wrinkles. An 83.33% majority of the sample consists of a feeble variant with leaf-edge ripples. detected in samples at Bintungan, Tabek Sarikan, Lungguak Batu A Fields, Lungguak Batu B Fields and Sungai Landai, while a moderate variance of 16.66% was detected in samples at the Cingkariang location. Shapes of leaf lobes were both present and absent. 66.66% of Tabek Sarikan, Lungguak Batu A Field, Lungguak Batu B Field, and Sungai Landai samples contained leaf lobes. In samples from Bintungan and Cingkariang, 33.33 percent of the leaf lobes were absent (absence).

Table 2. Quantitative Characteristics of Flower Cabbage in Banuhampu District

Sampling Location	Sampel	Parameter		
		Leaf Length (cm)	Leaf Width (cm)	Rasio L/P
Bintungan	BT1	37,00	14,00	0,37
	BT2	40,50	15,50	0,38
	BT3	39,00	15 ,00	0,38
Tabek Sarikan	TS1	51 ,00	21,50	0,42
	TS2	53 ,00	24,00	0,45
	TS3	49,00	17,50	0,36
Cingkariang	CKRG1	46,00	19,50	0,42
	CKRG2	41,50	18,50	0,44
	CKRG3	52,50	23,50	0,43
Lungguak Batu A Field	LLBA1	50,00	20 ,00	0,40
	LLBA 2	41,50	16,50	0,39
	LLBA 3	44,50	14,50	0,32
Lungguak Batu B Field	LLBB1	44,00	18,00	0,40
	LLBB 2	49,00	24 ,00	0,49

	LLBB 3	48,00	19,00	0,39
	SL1	31 ,00	11,50	0,37
Landai River	SL2	41,50	18,00	0,43
	SL3	42,50	19 ,00	0,44

Variations in leaf length, leaf breadth, and leaf width/length ratio were determined based on the results of qualitative and quantitative characterization of cauliflower leaf morphology. The length of cauliflower leaves ranged from 31 to 53 cm, with Tabek Sarikan 1 producing the longest leaves. The plants with the minimum leaf length were Bintungan 1. Observations of leaf breadth revealed a range of 11.5-24 cm, with Field Lungguak Batu B 2 having the widest leaves at 24 cm and Sungai Landai 1 having the narrowest. Observations of the l/p ratio yielded a range of 0.32 to 0.49 cm, with the greatest l/p ratio being 0.49 cm in the Lungguak Batu B2 Field sample and the least being 0.32 cm in the Lungguak Batu A3 Field sample.

3. Curd Morphology of Flower Cabbage Plants

The portion of cauliflower that is edible is known as the curd. Cauliflower curd is made from flower buds that have not yet bloomed; it is composed of more than 5,000 flower heads with short stalks; and it appears dense and thick, rounded, and white or yellowish white (Jordan, Anthony, & James, 2010)—observations on cauliflower curd, including qualitative and quantitative assessments. Curd covered with inner leaves, curd longitudinal shape, curd dome shape, curd color, curd protrusions, and curd texture were among the qualitative observations of cauliflower curd. Figure 3 illustrates the structure of cauliflower curd.

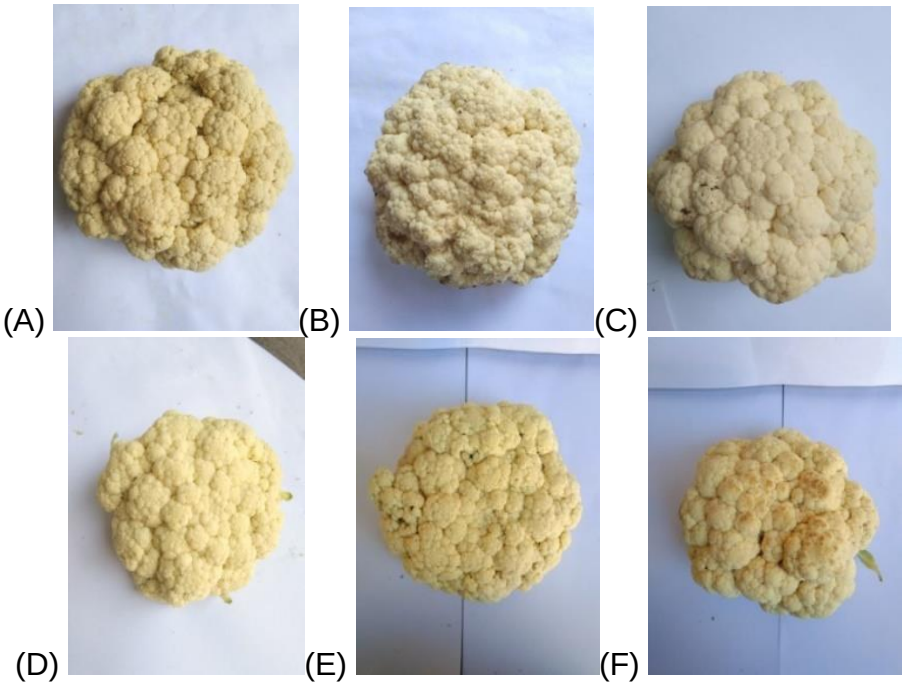

Figure 3. Morphology of Cauliflower Curd at Locations (A) Bintungan, (B) Tabek Sarikan (C) Cingkariang, (D) Lungguak Batu A Field, (Lungguak Batu B Field, (F) Sungai Landai)

Figure 3 illustrates the structure of cauliflower curd. The curd color of the white cauliflower predominates the sample by a factor of one hundred percent at all sampling locations. The curd protrusions on cauliflower come in two distinct forms: tender and medium. Soft cauliflower samples from the Lungguak Batu A Field had 16.66% curd protrusion, while samples from the Bintungan, Tabek Sarikan, Cingkariang, Lungguak Batu B Fields, and Sungai Landai locations had moderate curd protrusion of 83.33%. The samples from Bintungan, Lungguak Batu A Fields, and Lungguak Batu B Fields had a 50% delicate floral curd texture, while those from Tabek Sarikan, Cingkariang, and Sungai Landai had a coarse floral curd texture..

Figure 3 depicts two variations of curd's qualitative characteristics based on leaf coverage: curd not covered with interior leaves and curd partially covered with inner leaves. 83.33% of the samples at Bintungan, Tabek Sarikan, Lungguak Batu A Field, Lungguak Batu B Field, and Sungai Landai were not covered with inner leaves, whereas 16.66% of the samples at Cingkarang were partially covered with inner leaves.

(A)  (B) 

Figure 4. Curd Covered In Cauliflower Leaves (A) Curd Not Covered Inner Leaves, (B) Curd Partially Covered Inner Leaves

As shown in Figure 5, the longitudinal shape of the curd consisted of two variations: a medium ellipse and a narrow ellipse. The longitudinal curd shape with a narrow ellipse predominated in samples from the Bintungan, Tabek Sarikan, Cingkariang, Lungguak Batu A Fields, and Sungai Landai at 83.33 percent. While the longitudinal shape of the curd in the Lungguak Batu B Field sample was determined to be a moderate ellipse. Figure 5 illustrates the rounded hemispheric shape. 66.66% of the samples at Bintungan, Cingkariang, Lungguak Batu A Fields, and Sungai Landai had a feeble curd dome shape, while 33.3% of the samples at Tabek Sarikan and Lungguak Batu B Fields had the medium curd dome shape.

(A)  (B) 

Figure 5. Longitudinal Shape of Curd and Curd Dome Shape of Flower Cabbage (A) Medium, Medium Ellipse, (B) Narrow, Weak Ellipse

C. Analysis of Flower Cabbage Plant Diversity

Diversity is the distinction that results from a plant population's appearance. The presence of genetic diversity in a population indicates that there are differences in genotype values between individuals (Karmana, 1990). The phenotype of a plant is the result of the interaction between genetic and environmental factors. Murti (2002) states that genotype differences or the evolving environment cause phenotypic diversity. This phenotypic diversity is directly observable, measurable, and observable in a plant. This study calculated the range, mean, variance, and standard deviation values for 18 plant samples, including the range, mean, variance, and standard deviation. Upon observing the variability of plants, it is divided into broad and narrow categories. Large variability values enable plant breeders to create new, superior plant varieties. Plant breeders cannot use narrow variability as a basis for selection because selection will not be effective or fruitful. The phenotypic variability of cauliflower based on quantitative characters is detailed below.

Table 3. Analysis of Diversity of Cabbage Flowers Based on Quantitative Characters

Character	range	Average	Variant (S^2)	Standard Deviation	2 SD	Criteria
Leaf Length	31-53	44,52	34,10	5,83	11,67	Wide
Leaf Width	11,5-24	18,87	12,03	3,46	6,93	Wide
L/P ratio	0,32-0,49	0,40	0,002	0,039	0,079	Narrow
Plant height	53-82,5	63,26	6,93	6,93	13,86	Narrow
Curd height	3,5-10,5	7,00	3,88	1,97	3,94	Narrow
Curd diameter	4,25-15,15	10,27	10,90	3,30	6,60	Wide

Three quantitative characteristics of cauliflower in Table 3 have a wide range of variability, while the remaining quantitative characteristics have a narrow range of variability. Cauliflower plants' highly variable quantitative characteristics are leaf length, leaf breadth, and curd diameter. While the quantitative characteristics with restricted variability are the ratio of plant height breadth to length and curd height.

Table 4. Analysis of Diversity Based on Qualitative Characters

Character	S^2	Standard Deviation	2 SD	Criteria
Plant Type	0,94	0,97	1,94	Narrow
Leaf Lobes	15,05	3,88	7,76	Wide
Leaf Tip Curvature	1,05	1,02	2,05	Narrow
Wrinkles Near the Leaf Bones	0,94	0,97	1,94	Narrow
Leaf Edge Wave	0,58	0,76	1,53	Narrow
Deep Leaf Covered Curd	0,14	0,38	0,76	Narrow
Curd Longitudinal Shape	0,14	0,38	0,76	Narrow
Curd Dome Shape	0,94	0,97	1,94	Narrow
Curd bulge	0,58	0,76	1,53	Narrow
Curd texture	3,76	1,94	3,8	Narrow

According to the observations, there are nine characters with limited variability and one with wide variability, as shown in Table 4. Narrowly variable plant characteristics include plant type, leaf tip indentation, vein wrinkles, undulating leaf margins, leaf-covered curd, longitudinal curd shape, curd dome shape, curd pigment, curd protrusions, and curd texture. While leaf lobes are characterized by a high degree of variability, leaf veins are not. Wide phenotypic variability indicates that each individual in each population varies significantly, whereas narrow phenotypic variability indicates that each individual is comparatively uniform (Hanifah & Ruswandi, 2018). Phenotypic variability in the qualitative characteristics of plants demonstrates that genes, not environmental factors, govern the qualitative characteristics of plants.

D. Similarity Analysis

Similarity analysis is a technique used to classify plants into groups (clusters) based on their morphological characteristics, to derive similarities between accessions. The Numeral Taxonomy and Multivariate Analysis System (NTSYS) version 2.02 was used to analyze the similarity of 18 cauliflower plant traits. The similarity coefficient will reflect the degree of similarity between the accessions being compared.

1. Similarity Analysis

Figure 6 below shows the dendogram of the results of the qualitative character analysis showing a similarity level of 42% to 100%. All samples separated at a coefficient of 42% then formed two large groups, groups I and II.

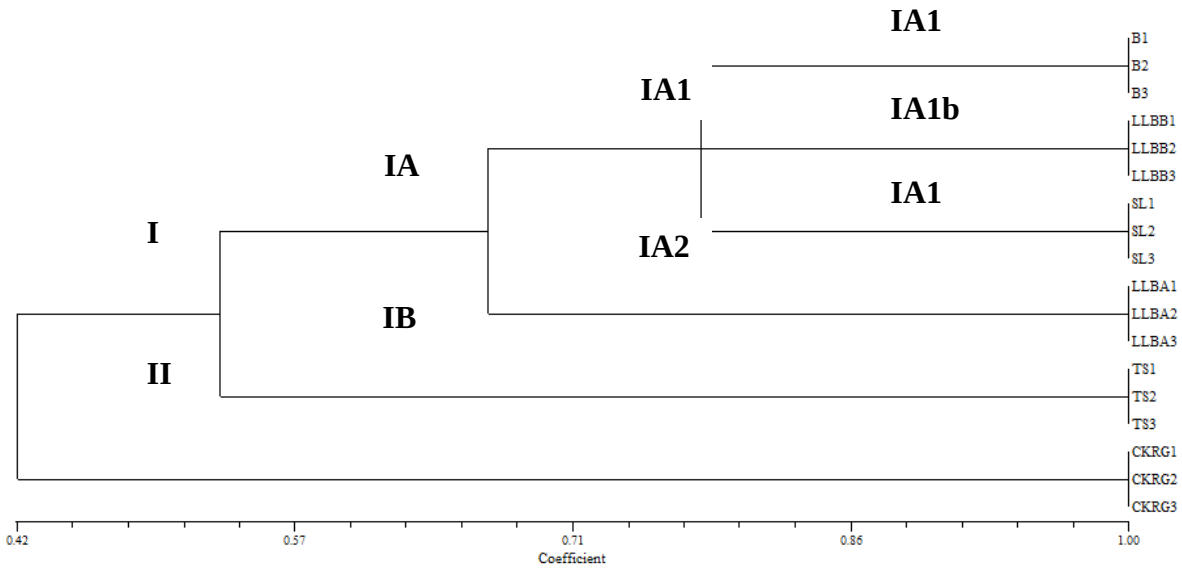

Figure 6. Dendogram of Similarity Coefficient Based on Qualitative Characteristics of Cauliflower Plants in Nagari Banuhampu

The primary cohort is separated into groups I and II. The characteristic that distinguishes these plant families is their leaf-covered curds. The plant specimens in group II were of the curd type with a portion of the curd covered by interior leaves. Group I, which is one of the primary groups, is subdivided into subgroups IA and IB using a coefficient of 68%. The presence of wrinkles near the veins distinguished the IA subgroup from the IB subgroup; in the IB subgroup, the presence of wrinkles near the veins was categorized as moderate. The IA subgroup discovered wrinkling characteristics near the leaf veins in the weak category. A coefficient of 80% then subdivided the IA subgroup. The distinctive feature of this plant is the indentation on the leaf's apex. In the moderate category, plants in group IA2 had an indentation near the leaf veins. In contrast, plants in group IA1 had faint category vein indentations.

4. CONCLUSION

Based on the research conducted, it is possible to conclude that the variety of qualitative characteristics of cauliflower in the Banuhampu subdistrict meets the strict criteria. The character that distinguished the results of the analysis of similarities between groups I and II was the curd-covered-in-leaves character. The coefficient for the analysis of the similarity of the qualitative characteristics of the two categories is between 42% and 100%. Therefore, for future research, it is recommended to identify the two discovered genotypes to complete information about the characteristics of cauliflower plants from the Banuhampu subdistrict.

REFERENCE

Bermawie, N. 2005. *Karakterisasi Plasma Nutfah Tanaman*. In B. L. Pertanian, *Pedoman Pengelolaan Plasma Nutfah Perkebunan* (pp. 38-52). Bogor: Pusat Penelitian dan Pengembangan Perkebunan.

Bhattacharjee, I. 2019. *Cauliflower Breeding.* Prayagraj: Directorat of Research, SHUATS.

[BPS] Badan Pusat Statistik. 2018. S*urvei Struktur Ongkos Usaha Tanaman Hortikultura.* Jakarta: BPS.

[BPS] Badan Pusat Statistik. 2020. *Produksi Tanaman Sayuran .* Jakarta: Badan Pusat Statistik.

[FAO] Food and Agriculture Organization.2019.*Production of Cauliflowers and Broccoli.* Rome: Food and Agriculture Organization.

Fewless, G. 2006. *Phenology*. Retrieved from http://www.uwgb.edu/biodiversity/phenology/index.html.

Hanifah, N. F., dan Ruswandi, D. 2018. *Variabilitas Fenotipik Komponen Hasil Galur Jagung Manis Padjajajran SR Generasi S3di Arjasari*. *Jurnal Agrotek Indonesia*, 39-43.

Kristina, N. 2011. *Pengaruh Penggunaan Beberapa Macam Pupuk Susulan dan Batuan Fosfat Terhadap Pertumbuhan dan Hasil Kubis Bunga pada Inceptisol.* Yogyakarta: Thesis Pasca Sarjana Universitas Gadjah Mada.

Suryani, E., dan Nurmansyah. 2009. In*ventarisasi dan Karakterisasi Tanaman Kayu Manis Seilon (Cinnamomum zeylanicum Blume) di Kebun Percobaan Laing Solok*'. *Buletin Penelitian Tanaman Rempah dan Obat*, 99-105.

Syukur, M., Sujiprihati, S., dan Yunianti, R. 2015. *Teknik Pemuliaan Tanaman.* Jakarta: Penebar Swadaya.