



Trait Evaluation of 9 Bird's Eye Chili (*Capsicum frutescens* L.) Hybrids on Coastal Area

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ABSTRACT

Soil in coastal areas are less suitable for agriculture due to various constraints causing low soil fertility. Until now, there has been no available bird's eye chili variety tolerant to coastal stress conditions. This research aims to characterize nine bird's eye chili hybrids grown on coastal land. The research was conducted on coastal land in Kuala Alam Nusa Indah, Ratu Agung District, Bengkulu, from August 2024 to February 2025. The experiment was arranged in a Randomized Complete Block Design (RCBD) with three replications. The traits observed consisted of both quantitative and qualitative variables related to bird's eye chili growth and yield. Quantitative data were analyzed using ANOVA at a 5% and 1% significance level, followed by a Scott-Knott test, $\alpha = 5\%$, to assess data grouping. Qualitative data were descriptively analyzed by comparing with reference to the descriptor for capsicum. The results showed that the tested hybrids differed in all traits. The results showed that the hybrid H3 (A11 $\times$ A7) showed the highest production potential with long fruit and large yields despite slower days to flower and a small stem diameter, while hybrid H8 (A39 $\times$ A29) excelled more equally in most traits, including fast days to flower, highest plant height and dichotomous height, large stem diameter, large number of branches, high leaf greenness, long fruit with large diameter, and a high fruit weight. Overall, H3 and H8 bird's eye chili hybrids are potential to be adapted varieties to coastal areas with improvements in several characteristics.

Keywords: adaptive varieties, bird's eye chili, chili breeding, sandy soil

INTRODUCTION

Bird's eye chili (*Capsicum frutescens* L.) is one of the important horticultural plants in Indonesia as it is used as an everyday cooking spice. Bird's eye chili is a short-lived or annual plant that can grow well in both highland and lowland areas. Besides being used as a cooking spice, bird's eye chili also has significant economic and health roles. The active compound capsaicin in bird's eye chili has pharmacological benefits, including as an antioxidant, anti-inflammatory agent, and metabolism stimulant (Azlan *et al.*, 2022).

Bird's eye chili cultivation faces three main problems, namely supply fluctuations due to plant sensitivity, decreased production due to limited fertile land, and the challenge of cultivation in coastal areas that are less supportive.

Bird's eye chili plants are highly sensitive to environmental changes such as unstable temperatures, drought, and light intensity that are un-

suitable for growth, resulting in fluctuations of production that effected in market supply. Besides climate factor, these supply fluctuations often occur due to unevenly distributed bird's eye chili production, which is concentrated around major occasions such as religious holidays. Consequently, when supply decreases, chili pepper prices surge sharply, significantly impacting inflation.

According to Central Bureau of Statistics Indonesia (2023), bird's eye chili production in Indonesia declined from 1.54 million tons in 2021 to 1.50 million tons in 2023. Inflation caused by price volatility in bird's eye chili has been recorded to contribute the highest share for this commodity, accounting for 0.04% (Fauzia, 2021). This production decline is influenced by the limited availability of fertile land due to increased land conversion, necessitating the expansion of chili pepper cultivation into marginal lands, including coastal areas.

Coastal lands represent one type of marginal land characterized by conditions that are less conducive to agriculture, such as limited nutrient content, high soil pH, dense or sandy soil texture, low water retention, and high salinity levels caused by excessive evaporation (Hardin *et al.*, 2025; Nurhayati *et al.*, 2018). The potential of saline land for agriculture in Indonesia huge, which is estimated to reach 440,300 ha (Narwiyana *et al.*, 2016) and continues to increase annually (Sukarman *et al.*, 2018; Qadir 2016).

There are no bird's eye chili varieties available in the market that are adaptive to coastal land. Plants adaptive to coastal land can be developed through plant breeding. Researchers at the University of Bengkulu have conducted various activities to develop new bird's eye chili varieties adaptive to coastal land. Germplasm selection has resulted in several salt-tolerant genotypes (Rustikawati *et al.*, 2023). Several new hybrids have been produced but their characteristics and potential have yet to be evaluated in coastal regions. As a comparison, the widely cultivated bird's eye chili variety by farmers, Dewata, was tested. The Dewata variety has several advantages, such as resistance to fusarium disease and bacterial wilt, abundant and spicy fruits, as well as short plant growth that facilitates harvesting.

Previous researchers classify plant characters into morphological and agronomic traits. Morphological traits refer to properties related to the structure and form of the plant body, such as fruit shape, seed coat color, leaf shape, and others (Wicaksana *et al.*, 2013). Meanwhile, agronomic traits are those that play a role in determining yield components of a plant, such as fruit number, fruit size, and so forth (Putra *et al.*, 2015).

This research aims to obtain character information and group 9 new types of bird's eye chili hybrids planted in coastal land.

MATERIALS AND METHODS

This research was conducted from August 2024 to February 2025 in the coastal land of Kuala Alam, Nusa Indah, Ratu Agung District, Bengkulu City, at an altitude of 8.5 meters above sea level. Soil analysis was conducted prior to planting to determine several soil characteristics such as salinity level, soil acidity (pH), cation exchange capacity (CEC), nitrogen (N), phosphorus (P), and potassium (K). Soil samples were collected from four different points within the research site at a depth of 20 cm, then combined and analyzed at the Soil Science Laboratory of the University of Bengkulu.

The experiment was arranged in Randomized Completely Block Design (RCBD) with a single factor consisting of 9 bird's eye chili hybrids. The

treatments were replicated 3 times, resulting in 27 experimental units. Each experimental unit consisted of 72 plants. From each experimental unit, 3 sample plants were randomly selected.

The materials used were 9 bird's eye chili hybrid seeds, namely H1 (A3 × A11), H2 (A3 × A18), H3 (A11 × A7), H4 (A11 × A29), H5 (A18 × A29), H6 (A29 × A11), H7 (A39 × A7), H8 (A39 × A29), H9 (Dewata). Other materials used included rice straw mulch, manure, furadan 3G, base fertilizer (Urea, TSP, and KCl), leaf fertilizer, insecticide, and fungicide. The tools used were hoes, machetes, shovels, stakes, netting, seeding trays, watering cans, and SPAD (*Soil Plant Analysis Development*), digital scales, sprayer, meter, camera, scissors and stationery.

Land preparation began with clearing the area from weeds and trash. The soil was first loosened using a hoe and then made into 3 blocks with a size of 6 m x 4 m and a distance between blocks of 1 m. The seeds were sown by soaking them in lukewarm water for one hour. They were then germinated on a damp paper towel until the radicle emerges. Germinated seeds were then transferred to seed trays filled with topsoil and placed under shade. Seedlings were cared for for four weeks with daily watering and weekly pest control. Healthy seedlings were then transplanted to the field. Transplanting was done in the afternoon to allow seedlings to adapt quickly to the new medium. Planting holes were made with a spacing of 60 cm x 40 cm using a 15-20 cm hole drill.

Plant maintenance included replanting, fertilization, staking, pest control, and watering. Replanting was carried out 1 week after planting (WAP) to replace dead or abnormally growing plants. Manure fertilization was carried out 2 weeks before planting at a dose of 20 tons ha⁻¹. In addition to manure, chemical fertilizers were also given including 200 kg ha⁻¹ of urea, 200 kg ha⁻¹ of TSP, and 150 kg ha⁻¹ of KCl. Chemical fertilizers were applied at the time of planting. At the age of 4 WAP, another 200 kg ha⁻¹ of urea was given. Fertilizer was applied around the plant at a distance of 10 cm from the plant stem. Foliar fertilizer was given when the plant enters the vegetative phase with a concentration of 2 g L⁻¹. Staking using 120 cm high bamboo was installed at the age of 2 WAP to prevent the plant from falling over. Pest and disease control was performed preventatively every seven days with the fungicide mancozeb (3 g L⁻¹), the insecticides diafenthiuron and profenofol, and the acaricide pyridaben (135 g L⁻¹). Weeds were controlled manually using a sickle. Watering was done twice daily, in the morning and evening, except during rainfall.

Quantitative variables observed included plant height, dichotomous height, stem diameter, number of branches, leaf greenness, days to flower, fruit length,

fruit diameter, fruit weight per plant, and number of fruits per plant. Plant height and dichotomous height were measured at 8 weeks after planting. Stem diameter and number of branches were measured at the last harvest. Leaf greenness was measured using a SPAD at 8 weeks after planting. Days to flower was calculated from the time each flowering hybrid was transplanted. Fruit length and diameter were measured from an average of 2 fruits per harvest over five harvests.

The qualitative variables observed follow the Descriptor for Capsicum guidebook (IPGRI, 1995), including stem color, leaf shape, leaf edge, leaf color, flower position, corolla color, anther color, fruit surface, young fruit color, ripe fruit color, and fruit shape.

Data analysis was conducted by analysis of variance (ANOVA). If the treatment has a significant effect, mean separation grouping was carried out by *Scott-Knott* test at $\alpha=5\%$. Meanwhile, qualitative data was analysis descriptively and presented in tables and figures.

RESULTS AND DISCUSSION

Initial soil analysis in the research area indicated content of (N) 0.17% (medium) using the Kjeldahl method, (P) 4.71 ppm (medium) using the Bray 1 method, (K) 0.23 me 100 g⁻¹ (low) using the Flamephotometry (extraction aluminum acetate 1N pH 7.0), pH 5.34 (acidic), CEC 15.47 me/100g (moderate) using the Titration method (extraction of aluminum acetate 1N pH 7.0), EC 3.33 dS/m (high) using the Conductivity meter method, so it has characteristics that are less suitable for plant growth.

The agroclimatic conditions at the time of the research based on climate data from the Bengkulu Climatology Station were an average temperature of 26.91 °C – 32.56 °C, average air humidity of 83.13% - 87.37%, rainfall of 106.3 mm – 430.4 mm, duration of sunlight of 4.13 hours – 6.6 hours, and the number of rainy days is 11 days to 24 days, and an average wind speed of 2.13 m s⁻¹ – 4 m s⁻¹. Chili plants should be planted at a temperature of 21–29 °C, air humidity of 40–70% and sunlight of 6–8 hours/day (Faisal et al., 2025). Conditions during the research caused plants to experience drought stress, especially when rainfall was low and evapotranspiration was high.

The survival rate of bird's eye chili plants in this research was 83%, reflecting the plants adaptability to marginal coastal conditions. However, plant growth was generally suboptimal, impacting the number of fruits produced and reducing their quality. Poor soil conditions, high salinity, and other environmental stresses exacerbated growth constraints (Nurhayati et al., 2018 ; Sukarman et al., 2018).

Besides environmental factors, biotic stresses such as mite infestations (*Tetranychus* spp.) also pose significant challenges in cultivation. This attack was detected in almost all hybrid, except for the H3 hybrid (A11 × A7), which showed no symptoms of attack, so it is suspected to have natural resistance to the pest. Initial symptoms include yellowing of young leaves, downward curling of leaf edges, and indentation of the leaf surface, which eventually leads to drying and falling. Mite pests tend to thrive in hot, dry environments such as coastal lands (Purbosari & Puspitasari, 2018). Control measures involve the application of insecticides containing Pyridaben at 135 g L⁻¹ with a dose of 2 mL L⁻¹ of water, which is known to effectively inhibit mite development on horticultural plants (Hasyim et al., 2018).

The analysis of variance results showed that the treatment of 9 bird's eye chili hybrids had a very significant effect on the characteristics of dichotomous height, leaf greenness, days to flower, fruit length, fruit diameter, and fruit weight per plant. The characters of plant height, stem diameter, and number of branches showed a significant effect. The character of the number of fruits per plant showed no significant effect on the treatments tested, indicating that environmental factors were more dominant than genetic factors (Table 1). The coefficient of variation (CV) values ranged from 3.12 to 14.68%, indicating that the accuracy of the data was classified as good. Wardiana (2016) states that the diversity value is divided into three categories, namely low (<10%), medium (10-20%) and high (>20%). The lower the CV value, the higher the accuracy of the experimental data (Diwangkari et al., 2016). The coefficient of variation can be interpreted as a representation of the extent of variability within a population in an experiment.

Table 1. Summary of variance analysis results

Variables	F-value		Coefficient of Variation (%)
Plant height	2.929	*	14.68
Dichotomous height	5.349	**	12.88
Stem diameter	3.378	*	6.53
Number of branches	2.942	*	12.93
Leaf greenness	5.458	**	12.37
Days to flower	14.821	**	3.44
Fruit length	66.384	**	3.95
Fruit diameter	46.190	**	3.12
Fruit weight per plant	37.429	**	10.23
Number of fruits per plant	0.803	ns	6.37

Notes: ns = not significant effect, * = significant effect ($\alpha= 5\%$), ** = highly significant effect ($\alpha= 1\%$).

Table 2. Mean values and results of Scott-Knott grouping on plant height, dichotomous height, stem diameter, number of branches, leaf greenness and days to flower

Hybrid	Plant height (cm)	Dichotomous height (cm)	Stem diameter (mm)	Number of branches	Leaf greenness	Days to flower (DAP)
H1 (A3 × A11)	37.53 a	26.37 a	10.31 a	57.78 a	37.83 a	39.33 b
H2 (A3 × A18)	35.58 a	24.67 a	09.12 b	55.56 a	37.71 a	38.33 b
H3 (A11 × A7)	34.01 a	25.51 a	09.18 b	43.33 b	39.19 a	43.67 a
H4 (A11 × A29)	34.20 a	24.30 a	10.03 a	47.11 b	33.68 a	36.33 b
H5 (A18 × A29)	39.86 a	27.37 a	10.10 a	61.11 a	40.27 a	37.67 b
H6 (A29 × A11)	35.31 a	23.69 a	09.12 b	49.44 b	33.74 a	43.67 a
H7 (A39 × A7)	35.73 a	27.23 a	11.14 a	58.67 a	31.81 a	37.00 b
H8 (A39 × A29)	44.35 a	29.34 a	10.36 a	64.72 a	38.82 a	37.67 b
H9 (Dewata)	25.02 b	14.43 b	0,421 b	52.06 b	21.47 b	43.33 a

Notes: Numbers followed by different letters in the same column are significantly different in the ANOVA follow-up test Scott-Knott 5%

Further analysis was performed using the test Scott-Knott 5% level. The plants groups that are classified as tall are H1, H2, H3, H4, H5, H6, H7, and H8 with a height of (34.01-44.35 cm). Meanwhile, plants classified as short (25.05 cm) are H9. The differences in each group of plant heights are influenced by genetic factors because each line or variety has genes that control specific characteristics. Differences in plant populations grown in the same environmental conditions are differences that originate from the genes of individual members of the population (Astutik *et al.*, 2017). However, environmental factors can also affect plant growth, such as light intensity and temperature, which play a crucial role in nutrient production and distribution. Each plant responds differently to these environmental conditions.

Based on the height of the dichotomy, it is classified as high (23.69-29.34 cm) including H1, H2, H3, H4, H5, H6, H7 and H8. While the lowest dichotomy height is H9 with a height of 14.43 cm. The difference in each dichotomy height group is caused by genetic and environmental factors. Kirana & Sofiari (2007) stated that the higher the dichotomy in chili plants, the position of the fruit will be further from the ground surface so that it can reduce fungal pathogens due to water splashes.

The stem diameter group was categorized as large, ranging from 10.03 to 11.14 mm, and included H1, H4, H5, H7, and H8. Conversely, the group was designated as small, comprising H2, H3, H6, and

H9, with stem diameters ranging from 9.12 to 9.66 mm. Differences between these groups were attributed to genetic factors, whereas stem diameter was also influenced by environmental conditions. According to Wulan Suci & Suwasono Heddy (2018), higher light intensity led to a wider stem diameter in plants.

Regarding the number of branches, the high-branch group included H1, H2, H5, H7, and H8, with branch numbers ranging from approximately 55.56 to 64.72. The low-branch group consisted of H3, H4, H6, and H9, with branch counts of about 43.33 to 52.06. Differences in branch numbers were caused by various factors, including genetic factors influencing growth potential, as well as environmental conditions such as light intensity, temperature, and nutrient availability (Astutik *et al.*, 2017).

The leaf greenness was designated as high for H1, H2, H3, H4, H5, H6, H7, and H8, with values ranging from 31.81 to 40.27. In contrast, H9 fell into the lowest category, with a value of 21.47. Differences in greenness were determined by genetic factors influencing chlorophyll content in leaf tissues. Genotypes with higher greenness typically possessed greater chlorophyll concentrations, thereby enhancing the photosynthetic process (Latifa *et al.*, 2019).

Some of the bird's eye chili plants tested flowered early (36.33-39.33 days after planting) and some flowered later (43.33-43.67 days after planting). Early-flowering bird's eye chilis were found at H1, H2, H4, H5, H7, and H8, while the long-flowering

Table 3. Mean values and results of Scott-Knott grouping on fruit length, fruit diameter, fruit weight per plant and number of fruit per plant.

Hybrid	Fruit length (cm)	Fruit (mm)	Fruit weight per plant (g)	Number of fruits per plant
H1 (A3 × A11)	5.15 b	6.43 b	47.37 b	21.78
H2 (A3 × A18)	4.31 c	4.83 c	25.07 d	22.11
H3 (A11 × A7)	5.03 a	6.64 b	63.39 a	21.56
H4 (A11 × A29)	5.02 b	6.47 b	39.30 c	21.56
H5 (A18 × A29)	5.33 b	6.62 b	49.14 b	22.83
H6 (A29 × A11)	5.33 a	6.51 b	21.01 d	20.89
H7 (A39 × A7)	5.45 a	6.65 b	50.58 b	20.78
H8 (A39 × A29)	5.64 a	7.05 a	54.86 b	22.72
H9 (Dewata)	2.73 d	5.05 c	24.53 d	22.17

Notes: Numbers followed by different letters in the same column are significantly different in the ANOVA follow-up test *Scott-Knott*.

ones were at days H3, H6, and H9. The differences in flowering age between each group are due to plant genetic factors, but environmental factors also play a role. Fitriana *et al.* (2022) stated that the flowering period of plants is largely determined by temperature and daily light duration.

Further analysis using the *Scott-Knott* test at the 5% level indicated that, in terms of fruit length, the long-fruited group consisted of H3, H6, H7, and H8, with values ranging from 5.33 to 5.64 cm. The medium-fruited group included H1, H2, H4, and H5, with lengths of 4.31 to 5.15 cm, while H9 was classified as short-fruited, with a length of 2.73 cm. For fruit diameter, H8 was identified as large, with a diameter of approximately 7.05 mm. The medium-fruited group comprised H1, H3, H4, H5, H6, and H7, with diameters between 6.43 and 6.65 mm, while the small-fruited group consisted of H2 and H9, with diameters of 4.83 to 5.05 mm. Differences among these groups were primarily attributed to genetic variation, as chili plants cultivated under identical environmental conditions but from different varieties possess distinct genes and characteristics. However, environmental factors also played a role.

Based on the weight of the fruit per plant, it is divided into large, medium, and light groups. The large groups H3 with fruit weights of 63.39 g, the medium group with a weight of around 39.30 g-54.86 g includes H1, H4, H5, H7, and H8. The light group is H2, H6 and H9 with a weight of around 21.01 g-25.07 g. The differences in each group are caused by

genetic factors, Inardo *et al.* (2014) stated that the fruit weight per plant in chili genotypes has different results according to the genes they have.

Significant differences were also observed in other yield components. The hybrid H8 exhibited the longest fruit length and the largest fruit diameter (5.64 cm and 7.05 cm), followed by H3 (5.60 cm and 6.64 cm), positioning both as superior candidates in terms of fruit size. In contrast, H9 recorded the smallest fruit dimensions, with a length of only 2.73 cm and a diameter of 5.05 cm. In terms of productivity, H3 ranked highest with the largest fruit weight per plant (63.39 g), followed by H8 (54.86 g).

Most genotypes exhibited green stems, except for H2, which displayed a green coloration with purple stripes, potentially indicating higher anthocyanin content (Purbosari & Puspitasari, 2018). Anthocyanins are secondary metabolites commonly associated with protective responses to environmental stressors such as ultraviolet (UV) radiation and drought.

Leaf morphology analysis revealed that the lanceolate shape predominated, occurring in H1, H2, H3, H5, H6, H7, and H9, while H4 and H8 possessed oval-shaped leaves. Leaf margins were predominantly entire; however, H3 exhibited serrated edges, representing a distinct morphological characteristic. Leaf coloration was generally green, with the exception of H8, which displayed a dark-green hue indicative of high chlorophyll content, and H9, which exhibited yellowing, potentially signaling physiological stress or nutrient deficiency.

Table 4. Observation data on the characteristics of stems, leaves and flowers of bird's eye chili plants

Hybrid	Stem color	Leaf shape	Leaf edge	Leaf color	Corolla color	Anther color
H1 (A3 × A11)	Green	Lancet	Flat	Green	Greenish white	Blue
H2 (A3 × A18)	Green with purple stripes	Lancet	Flat	Green	White	Purple
H3 (A11 × A7)	Green	Lancet	Jagged	Green	Greenish white	Blue
H4 (A11 × A29)	Green	Oval	Flat	Green	Greenish white	Blue
H5 (A18 × A29)	Green	Lancet	Flat	Green	Greenish white	Purple
H6 (A29 × A11)	Green	Lancet	Flat	Green	Greenish white	Blue
H7 (A39 × A7)	Green	Lancet	Flat	Green	Greenish white	Purple
H8 (A39 × A29)	Green	Oval	Flat	Dark green	Greenish white	Blue
H9 (Dewata)	Green	Lancet	Flat	Yellow	White	White

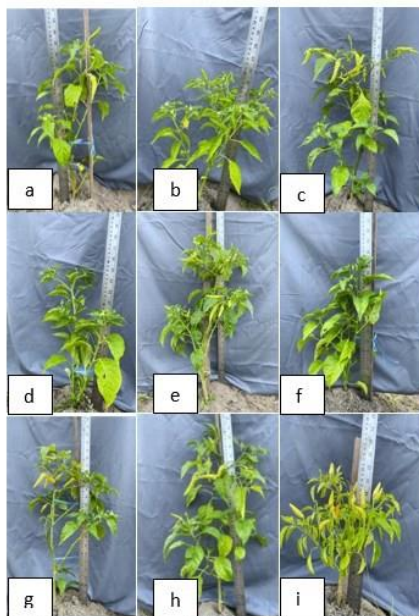


Figure 1. Appearance of the tested bird's eye chili hybrid plants

a = H1 (A3 × A11) b = H2 (A3 × A18) c = H3 (A11 × A7)
d = H4 (A11 × A29) e = H5 (A18 × A29) f = H6 (A29 × A11)
g = H7 (A39 × A7) h = H8 (A39 × A29) i = H9 (Dewata)

In terms of flower characteristics, all hybrids have upright flower stalks, which are beneficial for pollination because the flowers are more open and clearly visible to pollinating insects, and also reduce excess moisture in the petals and stamens. The corolla color is generally greenish white, except for H2 and H9, which are plain white. Variations in anther color are also seen, namely blue (H1, H3, H4, H6, H8), purple (H2, H5, H7), and white (H9). This color

is related to the potential for pollen viability and attractiveness to pollinators and can affect the reproductive efficiency of plants. Thus, this variation can be considered in breeding to improve the reproductive characteristics of chili plants (Pakerti *et al.*, 2021).

Fruit characteristics show that most hybrids have a slightly wrinkled skin surface, but H2 and H9 have smooth skin, which has the potential to affect the texture and shelf life.

The color of young fruit is generally white, except for H2 which is green and H9 which is yellow, making H9 visually attractive, although its productivity is low, and has the potential to be used as a special variety for the ornamental or processed chili market with specific color requirements (Chesaria *et al.*, 2018). Ripe fruit is predominantly bright red, but H9 deviates again with a light orange color. All hybrids have elongated fruit, which aligns with market preferences for both fresh and pro-cessed bird's eye chilis.

In general, the results of the observations indicate that there is quite significant diversity in vegetative and generative morphological characters among the tested hybrids. In terms of vegetative characters, the majority of hybrids have green stems and lanceolate leaves with flat edges. However, the H2 hybrid exhibits a distinctive green stem color with purple stripes, which may indicate high anthocyanin content (Purbosari & Puspitasari, 2018). Anthocyanins are often associated with plant protective responses to environmental stressors, such as UV radiation and drought. Meanwhile, the H3 hybrid

has serrated leaf edges and the H8 hybrid has oval leaves with a dark green color, which physiologically indicates a higher photosynthetic capacity. This has the potential to provide an adaptive advantage in dry and hot coastal lands.

Table 5. Observation data on the characteristics of bird's eye chili fruit

Hybrid	Fruit surface	Young fruit color	Ripe fruit color
H1 (A3 × A11)	Bit wrinkled	White	Bright red
H2 (A3 × A18)	Slippery	Green	Bright red
H3 (A11 × A7)	Bit wrinkled	White	Bright red
H4 (A11 × A29)	Bit wrinkled	White	Bright red
H5 (A18 × A29)	Bit wrinkled	White	Bright red
H6 (A29 × A11)	Bit wrinkled	White	Bright red
H7 (A39 × A7)	Bit wrinkled	White	Bright red
H8 (A39 × A29)	Bit wrinkled	White	Bright red
H9 (Dewata)	Slippery	Yellow	Light orange

Generative traits also show significant variation. All hybrids have a pendulous flower stalk position, but there are differences in corolla and anther color. Some hybrids, such as H2 and H9, have white corollas and purple or white anthers, while others tend to have greenish-white corollas and blue anthers. The color of these floral organs not only reflects morphological differences but also plays a role in attracting pollinating insects and can affect the plant's reproductive efficiency. Therefore, this variation can be considered in breeding for the purpose of improving the reproductive traits of chili plants (Pakerti *et al.*, 2021).

Fruit characteristics are a major focus of this research because they directly relate to the competitiveness and economic value of bird's eye chili. All hybrids have elongated fruit, but there are striking differences in the color and surface of the fruit skin. Most hybrids have a slightly wrinkled fruit surface and a bright red ripe fruit color, while the H9 hybrid exhibits a smooth fruit surface with a yellow young fruit color and a light orange ripe fruit color. These characteristics make H9 visually attractive, despite its low productivity, and have the potential to be utilized as a specialty variety for the ornamental or processed chili market with specific color requirements (Chesaria *et al.*, 2018).

The H8 hybrid showed better performance in terms of fruit length, fruit diameter, and fruit weight

per plant compared to other hybrids. These characteristics indicate that H8 has good physiological and agronomic capacity for growing in coastal lands. In contrast, the H9 hybrid showed the lowest yield, but had fruit and flower morphology aspects that are suitable as a genetic resource in crossbreeding programs (Wardhani *et al.*, 2022).

Overall, this study demonstrates the importance of morphological and agronomic evaluation in determining adaptive and productive hybrids in coastal environments. The H8 hybrid is recommended as a superior candidate for further development, both for direct consumption production and as a genetic resource in breeding programs. On the other hand, the H9 hybrid, although not outstanding in terms of yield, still has important value as a source of unique characters such as fruit shape and fruit color. These findings are expected to make a significant contribution to the conservation and development of bird's eye chili varieties suited to the specific needs of Indonesia's coastal lands, as well as enrich the national horticultural crop genetics (Pakerti *et al.*, 2021).



Figure 2. Appearance of the tested bird's eye chili hybrid fruit characters
a = H1 (A3 × A11) b = H2 (A3 × A18) c = H3 (A11 × A7)
d = H4 (A11 × A29) e = H5 (A18 × A29) f = H6 (A29 × A11)
g = H7 (A39 × A7) h = H8 (A39 × A29) i = H9 (Dewata)

CONCLUSION

This study showed significant agronomic and morphological characteristics among 9 bird's eye chili hybrids tested in coastal areas, where most of the hybrids (H1–H8) have better growth than the compared variety H9 (Dewata), which has low growth and yield but has a distinctive color and fruit shape with market value for ornamental plants. Hybrid H3 (A11 × A7) showed the highest production potential with long fruit and large yields despite slower days to flower and a small stem diameter, while Hybrid H8 (A39 × A29) excelled

more equally in most traits, including fast days to flower, highest plant height and dichotomous height, large stem diameter, large number of branches, high leaf greenness, long fruit with large diameter, and a high fruit weight. Overall, H3 and H8 bird's eye chili hybrids are the potential to be adapted varieties to coastal areas with improvements in several characteristics.

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