QUANTITATIVE AND QUALITATIVE TRAITS
OF FIVE LOCAL MAIZE VARIETIES FOR BABY CORN VARIETY BREEDING

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Abstract. *In Indonesia, the production of baby corn is generally derived from composite varieties because not many varieties have been exclusively bred for baby corn purposes. This study aimed to determine the quantitative and qualitative traits of five local maize varieties to obtain potential parent materials for baby-corn-purposed lines. The research was conducted at the Experimental Field of State Polytechnic Jember using a non-factorial randomized block design with five local maize varieties ('Kretek Madura', 'Bisma', 'Provit A1', 'Srikandi Kuning', and 'Sukmaraga'). The data obtained were analyzed with ANOVA and followed by the Fisher's Least Significant Difference Test at a 5% error level. The results indicated that all five varieties tested met the standards of Codex for baby corn in terms of diameter, length, and qualitative traits. In terms of plant height, female flowering, and number of ears, V1 'Madura Kretek' was observed to have the most potential as it had the shortest plant height (173.60 cm), the fastest female flowering (43.64 days), and harvest age (47.67 days), as well as the highest number of ears (2.55). However, this variety showed a lower baby corn weight, which might affect the total yield. It is suggested that the next quest of parent material for the baby-corn-purposed line can be also focused on the weight of the baby corn.*
Keywords: *baby corn; characterization; maize; plant breeding; prolificacy*

1. Introduction

Baby corn is the immature, unfertilized ear of fully grown standard cultivars which is harvested at the silk emergence phase (Pal *et al.*, 2020). Baby corn is consumed as a fresh vegetable or canned and it is very popular in Asia, including Indonesia. It is highly nutritious with high levels of folic acid and minerals such as phosphate, potassium, calcium, zinc, and iron, as well as vitamins A, B, and C (Babu *et al.*, 2020), yet it is low-caloric with high fiber content (Rani *et al.*, 2017). The by-products of baby corn such as silk, stalk, tassel, and husk can also be used as cattle feed in some areas (Singh *et al.*, 2019). Baby corn is seen as highly profitable for farmers, due to the high demand and its fast harvest at 6-7 weeks after planting (Araújo *et al.*, 2017). The largest consumers of baby corn are the USA, Japan, the Netherlands, and Taiwan (Hossain *et al.*, 2023).

In Indonesia, however, the production of baby corn is generally derived from composite varieties (Sobarudin *et al.*, 2015) since there are not many varieties that have been exclusively bred for baby corn purposes in Indonesia. Thus, baby corn is mostly harvested only as the side product of normal corn resulting in a low-standard quality and low production (Ferdiansyah *et al.*, 2022).

The production of baby corn has the potential to be improved by plant breeding to create a variety that has promoting properties for baby corn production, such as a short time for flowering

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and a high number of ears (prolific). According to Wills *et al.* (2013), the prolific trait of maize is controlled by recessive genes. There are numerous components responsible for prolificacy, such as the growth of the axillary bud, elongation of the branch, axillary primordial initiation, ear development, and female flower development which indicate that prolificacy is also polygenes-controlled (Prakash *et al.*, 2019). Indonesia has a rich and diverse maize genetic resource that is spread in every region of the country. These genetic resources have the potential to be developed and utilized to increase the productivity of baby corn.

The initial step in plant breeding is the characterization of the potential parents for the target traits. Several studies all over the world have reported the assessment of numerous maize lines for their potential and performance as baby-corn-purposed lines (Ahmed *et al.*, 2016; Islam *et al.*, 2022; Kumar *et al.*, 2022; Saptorini & Sutiknjo, 2021). East Java has also abundant germplasm resources that have not been explored as the potential parents of baby corn plant breeding, such as 'Madura Kretek', 'Bisma', 'Provit A1', 'Srikandi Kuning', and 'Sukmaraga'. 'Madura Kretek' is a landrace maize variety from Madura island which is known as a waxy corn with a flavorful taste. This local variety is also known to have prolific ears, tolerant to drought, but smaller in size and weight (Julianto, 2015). 'Bisma' was developed purposedly as a drought-tolerant waxy corn variety which is known to have prolific ears, high yield potential, and high tolerance to salinity (Balai Pengkajian Teknologi Pertanian Ungaran, 2000). 'Provit A1' is known to have a high content of vitamin A and prolific ears as well as early maturity (Direktorat Jenderal Tanaman Pangan, 2022). 'Srikandi Kuning' is classified as Quality Protein Maize (QPM) due to its high protein content (Direktorat Jenderal Tanaman Pangan, 2022). This variety also has prolific ears, a palatable taste and it is tolerant to leaf blight diseases (Latuharhary & Saputro, 2017). 'Sukmaraga' is a maize variety with a high potential yield in dry and marginal areas, prolificacy, and it is tolerant to downy mildew diseases (Jakoni & Hatimah, 2007). Thus, the objective of this research is to assess the five local corn varieties in East Java to determine their quantitative and qualitative traits to obtain potential parent materials for baby corn-proposed line.

2. Methods

This research was conducted from January to May 2021 at the State Polytechnic of Jember experimental field, East Java, Indonesia. The study was designed in a non-factorial randomized block design. The seeds of five local varieties, namely 'Madura Kretek' (V1), 'Bisma' (V2), 'Provit A1' (V3), 'Srikandi Kuning' (V4), and 'Sukmaraga' (V5) were planted directly on the field with 80 cm x 30 cm planting distance. Each variety was designed with 5 replications and 5 plants per experimental unit. Each planting hole was treated with Furadan insecticide and covered with manure. The plants were first fertilized at 14 days after planting (DAP) with urea fertilizer and

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after the reproductive phase (30 DAP), the plants were fertilized with NPK 15-09-20 and SP36. The baby corns were harvested around 4-5 days after the appearance of the female flowers.

Observation parameters include qualitative traits (the taste of baby corn, seed row arrangement, and the color of baby corn) and quantitative traits (plant height, stem diameter, male flowering age, female flowering age, baby corn harvest age, number of ears, cob length, cob diameter, and cob weight). The data obtained were analyzed using ANOVA and followed with the Least Significant Difference test at a 5% error level. The size of baby corn was also compared to the Codex Standard For Baby Corn (FAO, 2005) as shown in Table 1.

Table 1. Codex standard for baby corn sizing

Size Code	Length (cm)	Diameter (cm)
A	5.0 – 7.0	1.0 – 2.0
B	7.0 – 9.0	1.0 – 2.0
C	9.0 – 12.0	1.0 – 2.0

3. Results and Discussion

3.1. Qualitative traits

Table 2. Baby corn qualitative traits of five varieties of maize

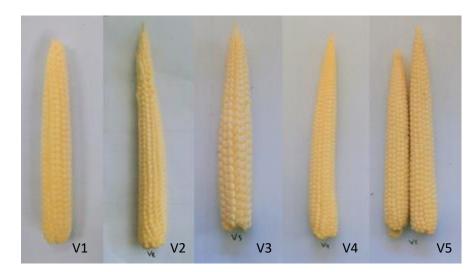| Varieties	Baby corn taste	seed row arrangement	baby corn color
V1 'Madura Kretek'	sweet	straight	yellow
V2 'Bisma'	sweet	straight	yellow
V3 'Provit A1'	sweet	straight	yellow
V4 'Srikandi Kuning'	sweet	straight	yellow
V5 'Sukmaraga'	sweet	straight	yellow

Figure 1. Baby corn of five varieties. V1: 'Madura Kretek', V2: 'Bisma', V3: 'Provit A1', V4:'Srikandi Kuning', and V5: 'Sukmaraga'

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As shown in Table 2, the qualitative characteristics of the baby corn were similar for the five varieties tested. It is observed that the taste of all varieties were similarly sweet with straight seed row arrangement and yellow in color. Although, as seen in Figure 1, there was a slight difference in V3 'Provit A1' in which the size of kernels was slightly bigger than the others. These qualities, however, have met the minimum requirement for the baby corn to be worthy of selling in the market, such as a fresh sweet taste with a straight seed row arrangement and no discoloration (FAO, 2005).

3.2. Quantitative traits

Table 3. Plant height, stem diameter, and flowering age of five varieties of maize

Varieties	Plant height (cm)	Stem diameter (mm)	Female flowering age (days)	Harvest age (days)
V1 'Madura Kretek'	173.60 a	18.46 a	43.64 a	47.67 a
V2 'Bisma'	214.92 b	24.34 b	54.24 b	63.47 b
V3 'Provit A1'	208.00 b	23.15 b	50.60 b	61.17 b
V4 'Srikandi Kuning'	230.96 c	24.76 b	54.84 b	68.56 b
V5 'Sukmaraga'	206.04 b	24.22 b	54.60 b	63.80 b

Description: The number followed by the same letter indicates insignificant differences based on Fisher's Least Significant Difference (LSD) test at $\alpha = 5\%$.

Table 3 describes the agronomic characteristics of each maize variety. In terms of plant height, V1 'Madura Kretek' was observed as the shortest with 173.60 cm, while V4 'Srikandi Kuning' was the tallest with 230.96 cm. Plant height is often used for assessing plant vigor, biomass, and yield (Qiu et al., 2022). However, there is no direct correlation between plant height and yield in maize, as long as they were grown to reach the normal potential of each variety (Liu & Wiatrak, 2011). The plant height of maize is often correlated with the population density, in which the taller the plant, the more space is needed between plants (Sangoi & Salvador, 1998). It is also often connected with the sturdiness to withhold the wind and harvest convenience since Indonesian still use manpower in the harvest. Thus, the desired plant height character in baby corn crops is a plant of medium height. According to Widowati (2015), maize can be grouped according to their height into 5 groups, namely very tall (>250 cm), tall (200.1-250 cm), medium (150.1-200 cm), short (100.1-150 cm), and very short (<100 cm).

A good maize plant should have a strong stem so that it does not fall easily. The stem is also important for plant growth because of its function as a channel for transporting water and nutrients to all parts of the plant. One of the characteristics determining a strong stem is the diameter of the stem. Based on Table 3, V1 'Madura Kretek' had the smallest stem diameter amongst the other

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varieties, while the other 4 varieties were not significantly different from each other.

The female flowering age is mostly correlated with the age of harvest. The faster the emergence of female flowers, the faster the age of harvest. In baby corn, harvest age is very crucial because one of the charming properties of baby corn culture to farmers is the fast harvest age. As described in Table 3, of the five local maize varieties observed, V1 'Madura Kretek' had the fastest female flowering age and harvest age at 47.67 days or about 6-7 weeks. This was much faster than the other 4 varieties in which the harvest age ranged from 61.17 68.56 days or about 8 to 10 weeks.

Table 4. Baby corn cob quantitative characters of five local varieties of maize

Varieties	Baby corn cob gross weight (g)	Baby corn cob net weight (g)	Baby corn cob length (cm)	Baby corn cob diameter (cm)	Number of ears	Net yield per plant (g)
V1 'Madura Kretek'	19.67 a	4.19 a	7.78 a	0.97 a	2.55 b	10,67 a
V2 'Bisma'	60.94 bc	14.54 b	10.45 b	1.39 b	1.15 a	16,31 b
V3 'Provit A1'	58.99 bc	14.86 b	10.68 b	1.68 b	1.10 a	16,34 b
V4 'Srikandi Kuning'	70.45 c	12.67 b	11.19 b	1.40 b	1.40 a	16,63 b
V5 'Sukmaraga'	52.93 b	11.79 b	10.45 b	1.43 b	1.35 a	18,20 b

Description: The number followed by the same letter indicates insignificant differences based on Fisher's Least Significant Difference (LSD) test at α = 5%.

Table 4 shows the quantitative characteristics of the baby corn cob, including the gross weight, net weight, length, diameter, and the number of ears. Gross weight is referred to as the weight of the baby corn cob along with the husk and the silk, while net weight is referred to as the weight of the baby corn cob without the husk and silk. In terms of weight, both gross and net, V1 'Madura Kretek' was observed to be the lightest among the five varieties with 19.67 g (gross weight) and 4.19 g (net weight). Among the yield components, the weight of corn cob is one of the key defining factors that influences the total yield, as it is positively correlated with the total yield (Munawar *et al.*, 2013). The weight of baby corn cob is also positively correlated with the length and diameter of a corn cob (Arsyad & Basunanda, 2020). As a result, similarly, for the length and diameter, V1 'Madura Kretek' was also observed to be the smallest of all varieties tested. With reference to the Codex standard, all five varieties have met the standard regarding the size of the baby corn cob. V1 'Madura Kretek' was categorized as grade B (7.0 – 9.0 cm), while the other 4 varieties were categorized as grade C (9.0 – 12.0 cm).

In terms of the number of ears, however, V1 'Madura Kretek' resulted in the highest number of ears among the five varieties. Prolificacy (multiple ears per plant) is one of the most important characteristics of maize because of its positive correlation with yield (Burk & Magoja, 1990; Singh

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et al., 2019). Prolificacy in maize is controlled by polygenes (Prakash *et al.*, 2019). However, prolificacy alone can not help with the yield. As it is mentioned the weight of the cob is also a key defining factor in total yield. It is shown in the results of net yield per plant that V1 'Madura Kretek' was still the lowest with 10,67 g per plant. On the other hand, Bisht & Mani (2016) addressed that the number of ears per plant in maize is a very useful character to aid the selection process since it has a positive correlation with yield and can be measured with less work and error. Especially in baby corn production, the number of ears plays the same importance as the cob weight, as the preference for the weight or size of the baby corn can vary from person to person.

4. Conclusions

In conclusion, the five varieties tested have met the Codex Standard for Baby Corn in terms of size and qualitative characteristics. Hence, all of the five varieties tested have the potential to be developed further depending on which of their characters need to be pursued. However, in terms of plant height, female flowering, and number of ears, V1 'Madura Kretek' was observed to have the most potential as it had the shortest plant height (173.60 cm), the fastest female flowering (43.64 days) and harvest age (47.67 days) as well as the highest number of ears (2.55). However, this variety showed a lower baby corn weight which might affect the total yield. It is suggested that the next quest of parent material for the baby-corn-purposed line can be also focused on the weight of the baby corn.

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