



Appearance of Quantitative Characters and Character Correlation in Corn Lines Resulting from Selfing under Dryland Conditions

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Abstract: This study investigates the quantitative characteristics of several generations of self-pollinated lines and the F2 population, as well as the correlation between these characteristics and leaf angle, harvest age, and yield in corn plants. The experiment was carried out in Gumantar village, North Lombok, from May to September 2024, and was designed using a Complete Randomized Block Design with treatments including the F2 population, 15 S1 lines, 15 S2 lines, 15 S3 lines, and 15 S4 lines. The study examined 14 quantitative characteristics. The experimental data were analyzed using analysis of variance. Further testing was conducted using the DMRT test at a 5% level. Correlations between traits were calculated using the Pearson correlation test. The research results demonstrate that the quantitative characteristics of several generations of selfing lines and the F2 population differ, except for ASI and cob diameter. The selfing from the first through fourth generations exhibit lower values compared to the F2 population, with the exceptions of anthesis-tasseling age, silk emergence, and harvest age. Most traits are associated with the medium harvest age category. The yield is correlated with most quantitative characters in the medium to strong category. The selection of plants to be selfed to form the S5 lines and increase yields should use plant height as a selection criterion.

Keywords: Corn yield; Medium harvest; Selfing lines; Strong correlation; The S5 line

Introduction

Corn production continues to increase through intensification and extensification (Maskumambang et al., 2021; Farida et al., 2022; Yoskader et al., 2023; Arfan et al., 2024; Muhanniah, 2024; Sitorus et al., 2024; Yasin et al., 2025). Both approaches necessitate the development of hybrid varieties (Elmyhun et al., 2020; Erawati et al., 2020; Cyplik et al., 2022; Bahtiar et al., 2023). Hybrid varieties are crucial for boosting maize productivity in Indonesia (Syahrudin et al., 2020; Syahrudin et al., 2023; Suwarno et al., 2023). Hybrid corn varieties exhibit a substantial yield capacity, ranging from 8 to 12 metric tons per hectare (Bahtiar et

al., 2022). The ultimate goal of corn cultivation is yield. Priyanto et al. (2023) argue that yield is a trait that is related to other traits, especially in corn cultivation on dry land. Enhancing production can be achieved on non-irrigated land (Sukmawati et al., 2022; Jaya et al., 2024). Hence, initiatives are required to develop advanced hybrid cultivars that are well-suited to arid conditions (Ismaiel et al., 2024; Walne et al., 2024). The development of ultra-early, super-early, and early maturing hybrid varieties is necessary to increase maize production in Indonesia, particularly in dryland areas (Syahrudin et al., 2020; Syahrudin et al., 2023). Corn cultivated on dry land can influence plant height, leaf area, ear length, ear diameter, ear weight, and husking percentage. These

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characteristics significantly influence the final yield of the corn crop (Amas et al., 2021). Sudika & Anugrahwati (2021) have undertaken efforts to develop a maize population with the aim of generating superior ultra-early hybrid varieties. The study generated an F2 population, and the genetic variance components were quantified. The findings reveal that the dominant variance exceeds the additive variance for leaf angle and yield attributes, while the two variances are equivalent for harvest time. Consequently, the development of a hybrid cultivar is recommended (Sudika et al., 2022).

The formation of hybrid varieties begins with the formation of inbred lines using the F2 population. The formation of inbred lines is achieved through repeated self-fertilization until homozygous lines are obtained (Ekawati et al., 2021; Steeg et al., 2022). Selfing is the most extreme form of this process and reduces the number of heterozygous loci by 50%, which typically leads to a decrease in performance (Pangestu et al., 2023; Scott et al., 2024). Populations tend to narrow genetic diversity as a result of continuous selection and inbreeding (Foote et al., 2021). On the other hand, increasing homozygosity is caused by the expression of detrimental genes previously masked by dominant alleles (Fang et al., 2021). These traits can arise because recessive genes that control undesirable traits in the homozygous state will express those traits (Cao et al., 2020; Zhang et al., 2021). Corn plants are cross-pollinating plants, so when self-pollination is performed, it results in inbreeding depression (Poyato-Bonilla et al., 2020; Ferreira et al., 2025). Kisman et al. (2020) posit that the degree of inbreeding depression is closely linked to the number of heterozygous genetic loci governing a specific trait. In maize, the inbreeding of self-pollinated lines leads to a pronounced manifestation of inbreeding depression. This phenomenon is observed through a variety of plant phenotypic changes, including diminished stature, impaired responsiveness, deteriorating quality, and an increase in traits indicative of overall physiological impairment. Nabila & Wahyu (2023) found that the phenotypic characteristics of corn from the two sibling generations studied were more vigorous than those from selfing. The grain weight of selfed lines was better due to a greater number of rows, longer kernels, and higher 100-kernel weight. The study conducted by Cantika & Sugiharto (2022) revealed variations in the characteristics of S2 lines, including plant height, silking age, anthesis age, cob height, cob weight with husk, cob weight without husk, cob length, and number of rows. The research results of Nabila & Wahyu (2023) also reported that two selfing generations (S1 and S2) increased genetic diversity in the 8 corn genotypes tested. Ige et al. (2023) reported that inbreeding depression affected yield components. Many

tests on selfing corn lines have been carried out, but no research has tested the three selfing lines S1, S2 and S3 simultaneously for selection based on yield, leaf angle, and harvest age. In the long term, hybrid varieties will be focused on high yields, early maturity, and narrow leaf angles. This will allow all quantitative traits of corn to be correlated with these three traits.

Superior corn cultivars have early maturity and high yields (Andiman & Murti, 2020). Early maturity significantly helps minimize the risk of crop failure due to short rainy seasons in dry areas. According to Ruswandi et al. (2020), early maturity is crucial in dryland areas. Furthermore, early maturity can also increase corn productivity (Ruswandi et al., 2021). Corn varieties with high yields are preferred by farmers. High productivity leads to increased farmer income due to abundant harvests. Research by Soleh et al. (2024) shows that productivity and yield are factors influencing farmer preference for corn varieties. This is reinforced by research by Darmayati & Sugiarti (2023) which found that high production is a benchmark for farmer preference for quality seeds. Narrow leaf angles can be used as an indirect selection criterion (Priyanto & Subechan, 2023), where selection can be carried out earlier, namely during the vegetative phase. According to Cao et al. (2022), corn production can be increased through the selection of corn genotypes with narrow leaf angles. Upright leaves are a form of land optimization because they will increase the plant population per unit area. In addition, upright leaves increase light reception, photosynthesis efficiency, and tolerance to wide canopy stress, resulting in denser planting and higher yields. This is emphasized by the opinion of Magfira et al. (2023), who stated that leaf angle size is influenced by genetic factors, so selection will be effective on this character.

Research is directed at selfing plants with narrow leaf angles, early maturity, and high yields. Selfing of plants from S1 to S3 is focused on these three traits. Selfing continues until a pure line of corn is obtained, which will serve as the parent for crossbreeding to produce superior hybrid corn varieties with high yields, early maturity, and narrow leaf angles. For this reason, it is necessary to know the plant characteristics that have a positive correlation with these three characteristics (Prayogo et al., 2021). This research aimed to determine the performance of quantitative traits across several generations of selfing lines and the F2 population, as well as the correlation between characteristics such as leaf angle, harvest age, and yield in maize plants. This research is important to determine the characters that will be used in selecting plants for fifth-generation selfing.

Method

The study utilized various materials, including seeds of the F2 corn population and S1, S2, S3, and S4 lines, as well as raffia ropes, urea fertilizer, Phonska fertilizer, Saromyl 35 SD, Furadan 3G, Meurtieur 30 EC, Calaris 550 SC, bamboo stakes, plastic bags, casing paper, and staplers. Additionally, the following tools were employed: a hand tractor, hoe, dibble, bucket, analytical balance, meter, sickle, caliper, large protractor, winnowing basket, and stationery.

This study employed an experimental research approach involving field experiments, specifically conducted on dryland with a pump well. The investigation was carried out in the Amor-Amor Hamlet, Gumantar Village, located in North Lombok Regency. The experimental activities commenced in early May and concluded in early September 2024.

The study employed a Randomized Complete Block Design with a single experimental factor, namely genotype. A total of 61 genotypic entries were evaluated, encompassing 1 F2 population, 15 S1 lines, 15 S2 lines, 15 S3 lines, and 15 S4 lines. Each genotypic treatment was replicated twice, yielding a total of 122 experimental observations.

The field experiment involved a series of activities, including seed preparation, land preparation, planting, maintenance, harvesting, and post-harvest observations. The seeds were first treated with Saromyl 35 SD at a dose of 5 g/kg. Soil tillage was accomplished through a single round of plowing and harrowing using a hand tractor. The study area was prepared using a hoe to level the ground and divide it into two distinct sections with a 1-meter gap between them. A dibble was utilized for planting, maintaining a 60-cm row spacing and a 20-cm plant spacing, with two seeds placed in each planting hole. During 12 days of post-planting, thinning was conducted, retaining the plant exhibiting optimal growth by leaving one plant per hole.

Fertilization was implemented twice: at the time of planting and 28 days after planting. Each fertilization application utilized 100 kg of urea and 150 kg of Phonska. Irrigation was scheduled for one day prior to planting, as well as on the 10th, 20th, 28th, 35th, 42nd, 49th, 56th, 63rd, and 70th days post-planting. Irrigation was conducted using water from a pump well in a controlled manner. Pest management was implemented through the application of Furadan 3G to the planting holes. After 35 days, a foliar spray of a 3 cc/L aqueous solution of Meurtieur 30 EC was applied to control pests affecting the male flower buds. Weed management was implemented through the application of a Calaris 550 SC solution at 14 days post-planting, followed by hilling at 28 days. Downy mildew disease was controlled through

seed treatment using Saromyl 35 SD at a dosage of 5 g/kg of seed. Harvesting was carried out when the cob met the harvesting criteria, namely when the husk and kernels were dry. The sample size was 5 cobs. The harvested cobs, with their husks removed, were then dried until they reached 14% moisture content and were shelled (Zhang et al., 2023).

The study examined various agronomic traits, encompassing the timing of silk and tassel emergence, anthesis silk interval (ASI), days to harvest, plant height, leaf number, leaf angle, stem diameter, leaf area, ear length and diameter, dry ear weight per plant, 1,000-grain weight, and final yield. The experimental data were analyzed using analysis of variance at a 5% significance level. The correlation coefficient between two characters was obtained using the Pearson correlation formula (Chen et al., 2021). To assess the significance of the correlation coefficient, the r-table was utilized at a 5 percent significance level. Additionally, the correlation coefficient value was used to determine the criteria for the strength of the relationship, as proposed by Nugroho (2005), as follows.

Table 1. The correlation coefficient value is employed to determine the criteria for the strength of the relationship

Range of Correlation Coefficient Values(r)		The strength of the relationship between variables
Positive	Negative	
$0.00 < r < 0.20$	$-0.20 < r \leq 0.00$	Very Weak
$0.20 \leq r < 0.40$	$-0.40 < r \leq -0.20$	Weak
$0.40 \leq r < 0.70$	$-0.70 < r \leq -0.40$	Moderate
$0.70 \leq r < 0.90$	$-0.90 < r \leq -0.70$	Strong
$0.90 \leq r < 1.00$	$-1.00 < r \leq -0.90$	Very Strong

Result and Discussion

The experimental data for treatments S1, S2, S3, and S4 presented in the tables below are the averages of 15 lines. Most of the observed characters differed between selfed lines and the F2 population, as shown in Table 2. The analysis of variance revealed significant differences, which were further explored using a DMRT test at a 5 percent significance level. The results of this follow-up test for the variables of flowering and harvest time, growth and yield component variables, and yield, are presented in Tables 3, 4, and 5, respectively. Correlation analysis was also conducted on the observed data. The correlation coefficient values between quantitative characteristics and leaf angle, harvest age, and yield are presented in Table 6.

The emergence of plant traits is influenced by genetic and environmental factors. One component responsible for trait diversity is differences in genetic composition (Zhan et al., 2022; Dewi et al., 2023). Table 2 shows that anthesis-panicle age, silking age, harvest age,

plant height, total leaves per plant, leaf angle, stem diameter, leaf area, cob length, dry cob weight per plant, 1,000-grain weight, and yield parameters are significantly different between the F2 population and lines derived from selfing, whereas the ASI character and cob diameter are not significantly different among the treatments. ASI is the time difference between the appearance of male flowers (anthesis) and the appearance of female flowers (silking). The smaller the difference between the two, the greater the chance of selfing in corn plants. Characters with significantly different treatments were subjected to further testing using the DMRT_{0.05} test.

Table 2. Results of the analysis of variance of all observed characters

Observed characters	Result
Anthesis-panicle age	S
Silking age	S
Anthesis silking interval	NS
Harvest Age	S
Plant height	S
Total leaves per plant	S
Leaf angle	S
Branch Diameter	S
Leaf area	S
Cob length	S
Cob diameter	NS
Dry cob weight per plant	S
Weight of 1,000 seed grains	S
Yield (dry shelled seed weight per plant)	S

Note: S, significantly different from F0.05 test and NS, not significantly different.

Table 3. The average variables of flowering and harvest maturity for each Inbred Lines and F2 population

Treatments**)	Flowering Variables and Harvest Age *)			
	APA	SA	ASI	HA
Line S1	43.40c	46.70c	3.30	76.40b
Line S2	42.35b	45.65b	3.30	75.80b
Line S3	42.03b	44.85ab	2.83	75.07ab
Line S4	40.65a	44.00a	3.35	74.00a
F2 Population	40.75a	44.00a	3.25	73.75a

Note: The numbers in the same column that share the same letters are not statistically different, according to the Duncan's Multiple Range Test. DMRT_{0.05}; **), S1, S2, S3 dan S4 are lines from the average of 15 lines; APA, anthesis-panicle age (days); SA, silking age (days); ASI (days) dan HA, harvest age (days).

Anthesis-panicle age in lines S1, S2, and S3 was slower compared to the F2 population, whereas line S4 had the same anthesis-panicle age as the F2 population. Anthesis-panicle age in line S1 was slower than in lines S2 and S3 (Table 3). In line with research by Adiwijaya et al. (2021), the speed of panicle anthesis is influenced

by the genetic characteristics of each species. The time interval between male and female flowers is 1-3 days (Junaidi, 2022). The shorter the time difference, the smoother the pollination and seed filling process. Conversely, if the time difference is longer, the pollination process is disrupted and seed filling is less than optimal (Rani et al., 2022).

The silking age of the S1 line emerged the latest among the lines tested and the F2 population. Line S2 was slower to produce silk compared to line S4 and the F2 population; however, it was similar to line S3. The age of silk emergence of inbred line S3 was similar to line S4 and the F2 population. There were no differences between treatments in ASI. Lines S1 and S2 exhibited a slower harvest timeframe compared to line S4 and the F2 population. Nevertheless, they showed the same harvest maturity as S3.

As shown in Table 3, the additional analyses of the growth variable reveal that all the lines from selfing display plant heights that are shorter than those observed in the F2 population, as well as the number of leaves, where each selfing lines (S1, S2, S3, S4) had slightly fewer leaves than the F2 population. Shorter plants and fewer leaves also reflect the variety's adaptability to the growing environment (Zhang et al., 2023). Compared to the F2 population, the leaf angle of all the lines derived from selfing is smaller. Furthermore, the leaf angle of S3 and S4 is smaller than that of S1 and S2. The stem diameters of line S4 and the F2 population are comparable, yet they are larger than those of lines S1, S2, and S3. In contrast, the stem diameters of the three lines derived from selfing are equivalent. Furthermore, the leaf area of all lines is smaller than that of the F2 population, with line S2 exhibiting the smallest leaf area.

The cobs of all selfing-derived lines were the same length, but shorter compared to the F2 population. Revilla et al. (2021) emphasized that the length of the cob will be uniform according to its type. As shown in Table 5, the cob diameter was also the same across treatments. The dry cob weight per plant of all selfing-derived lines was lower compared to the F2 population, with the lowest being line S1. Besides genetic factors, ear weight can also be influenced by environmental factors such as seed planting depth. This is consistent with research by Lestari et al. (2023), which found that to achieve high ear weight, seeds should be planted at a depth of 5 cm (Soeroso et al., 2021). Similarly, for 1,000-grain grain weight and yield, the F2 population was higher than all of the self-derived lines. The 1,000-grain weight of lines S1 and S2 was lower than that of lines S3 and S4. Meanwhile, the yield of lines S1, S2, and S3 was lower than that of line S4. A high 1,000-seed weight indicates the amount of endosperm in the seeds, as stated by Humoen et al. (2020). Watering or irrigation treatments

affect the 1,000-seed weight. If watering is not carried out, the 1,000-seed weight will decrease, and vice versa (Nazirah et al., 2022). One of the most important

environmental conditions is temperature, as it affects the size of the seeds. Maximum seed size can be achieved at an average temperature of 25°C (Rahmania et al., 2025).

Table 4. Average growth variables for each selfing lines and F2 population

Treatment**)	Growth variables *)				
	PH	TL	LA _g	BD	LA
Line S1	171.49a	12.10a	43.80b	1.68a	371.51b
Line S2	177.51a	13.39a	41.32b	1.80a	329.82a
Line S3	174.46a	13.40a	31.33a	1.77a	379.24b
Line S4	181.96a	13.73a	29.53a	2.02b	378.17b
F2 population	202.80b	14.63b	48.44c	2.17b	424.80c

Note: Numbers in the same column followed by the same letter are not significantly different based on DMRT_{0,05} test; **), S1, S2 dan S3 are lines from the average of 10 lines and S4 lines is the average from 29 lines; PH, Plant height (cm); TL, Total leaves per plant; LA_g, Leaf a_gle; BD, Branch Diameter (cm) dan LA, leaf area (cm²).

Table 5. Average yield component variables and yields for each selfing line and F2 population

Treatment**)	Yield component variables *)				
	CL	CD	DCWP	W1000	Yields (g/plant)
Line S1	11.41a	4.33	132.40a	227.80a	56.74a
Line S2	12.31a	4.42	150.85b	224.15a	63.92a
Line S3	12.43a	4.26	151.56b	242.68b	66.55a
Line S4	12.58a	4.45	154.28b	250.54b	78.18b
F2 population	13.68b	4.49	168.80c	262.00c	93.15c

Note: Numbers in the same column followed by the same letter are not significantly different based on DMRT_{0,05} test; **), S1, S2 dan S3 are lines from the average of 10 lines and S4 lines is the average from 29 lines; CL, Cob Length (cm); CD, Cob Diameter (cm); DCWP, Dry cob weight per plant (g) dan W1000, Weight of 1,000 seed grains (g).

Table 6. Correlation coefficient values between quantitative characters, leaf angle, harvest age, and yields of selfing-derived lines of maize plants in dryland areas

Observed characters	The correlation coefficient value with					
	Leaf angle	Criteria	Harvest age	Criteria	Yields	Criteria
Anthesis-panicle age	0.163ns	Very weak	0.598*	Moderate	-0.791*	Strong
Silking age	0.261ns	weak	0.630*	Moderate	-0.769*	Strong
ASI	0.172ns	Very weak	0.036ns	Very weak	0.069ns	Very weak
Harvest Age	0.074ns	Very weak	1.000	Very strong	-0.548*	Moderate
Plant height	0.362ns	Weak	-0.435*	Moderate	0.766*	Strong
Total leaves per plant	0.049ns	Very weak	-0.675*	Moderate	0.362ns	Weak
Leaf angle	1.000	Very strong	0.074ns	Very weak	0.187ns	Very weak
Branch Diameter	0.201ns	Weak	-0.602*	Moderate	0.835*	Strong
Leaf area	0.262ns	Weak	-0.489*	Moderate	0.677*	Moderate
Cob length	0.212ns	Weak	-0.599*	Moderate	0.674*	Moderate
Cob diameter	0.180ns	Very weak	0.073ns	Very weak	0.522*	Moderate
Dry cob weight per plant	0.109ns	Very weak	-0.387ns	Weak	0.780*	Strong
Weight of 1,000 seed grains	0.027ns	Very weak	-0.598*	Moderate	0.783*	Strong
Yield (dry shelled seed weight per plant)	0.187ns	Very weak	-0.548*	Moderate	1	Very strong

Note: *, significantly different; ns, not significantly different with r_{0,05} test.

Correlation between characters does not occur independently, but occurs simultaneously or in conflict so that an increase in one character can cause a decrease in another character (Mulyani & Waluyo, 2020). Table 6 indicates that all the quantitative characters examined were correlated with leaf angle, exhibiting very weak to weak correlations. Anthesis-panicle age, silking age, plant height, leaf area, number of leaves per plant, stem diameter, cob length, and 1,000-grain weight showed

significant moderate correlations with harvest age. In contrast, anthesis-silking interval, cob diameter, and dry cob weight per plant exhibited very weak to weak correlations. The results also demonstrate that maize yield is significantly associated with numerous quantitative traits, such as days to tassel and silk emergence, harvest age, plant height, stem diameter, leaf area, ear dimensions, dry ear weight per plant, and 1,000-grain weight, as indicated by moderate to strong

correlation coefficients. Conversely, the anthesis-silking interval, number of leaves per plant, and leaf angle exhibited very weak to weak correlations with yield.

The performance of quantitative characters from the first selfing generation was evaluated, and it was found that most of these characters exhibited significant differences (Table 2). Selfing leads to changes in the expression of relevant traits. This process results in homozygosity at previously heterozygous loci (Mackay et al., 2021; Stetsenko & Roze, 2022; Merrick et al., 2025). If the variant becomes homozygous for the recessive allele, a reduction in the associated trait's expression may occur (Merrick et al., 2025). Self-fertilization can lead to a reduction in desirable traits, a phenomenon known as inbreeding depression (Surtinah, 2020). Variations in flowering and harvest age were observed across selfing-derived maize lines, whereas the ASI characteristic remained relatively consistent (Table 3). The timing of tassel and silk emergence was prolonged in lines S1, S2, and S3 relative to line S4 and the F2 population. Likewise, the time to maturity was increased in S1 and S2 lines compared to line S4 and the F2 population. The characters of tasseling age, cob silk emergence age, and harvest age were delayed. These characters exhibit signs of inbreeding depression due to self-pollination in the first and second generations (Mabin et al., 2021; Shojaiefar et al., 2021; Chen & Pannell, 2024). For sweet corn, it was also found that the age of tassel emergence and silking was slower in the inbred line than in the half-sib lines. Selfing causes vigor, silking time, anthesis time, physiological maturity age, number of seed rows per ear, length and diameter of the ear to decrease compared to open pollination (Ekawati et al., 2021). According to the research by Nabila & Wahyu (2023) first-generation selfing has higher inbreeding depression compared to half-sib populations. Growth variables have been observed to experience deleterious effects from inbreeding. This is manifested in the diminished values of these traits in the generations derived from selfing, from the first to the fourth, in comparison to the F2 population. Cantika & Sugiharto (2022) also reported similar findings regarding plant height. Likewise, Jian et al. (2025) observed consistent results for plant height and leaf number in *Gymnocarpos przewalskii*. Furthermore, the study conducted by Jian et al. (2025) revealed that the plant height of selfed lines was reduced, and the number of leaves per plant was diminished in comparison to the initial population.

The length of the cobs, the dry weight of the harvested cobs per plant, the weight of 1,000 seeds, and the yields across the first, second, third, and fourth generations of selfing lines were lower compared to the F2 population. This suggests the presence of inbreeding

depression in the yield components and overall yield. Kaleri et al. (2022) and Ige et al. (2023) discovered that inbreeding depression impacted yield component traits. Similarly, Cantika & Sugiharto (2022) found the same effect on the cob weight without the husk and the cob length in the S2 line. Full-sib lines increased ear diameter and ear quality by increasing ear length and the number of seed rows compared to S2 lines. The cob lengths of the S6 lines differed, as reported by Aichholz et al. (2024). Nabila & Wahyu (2023) found that the yields were lower in the first selfing generation of sweet corn compared to the second generation.

Correlation refers to the closeness of the relationship between two variables. The correlation coefficient is the measure used to quantify the strength of this relationship (Yuwariah et al., 2023). The obtained correlation coefficient values are categorized into criteria of relationship strength, namely very weak, weak, moderate, strong, and very strong (Nugroho, 2005).

The data presented in Table 6 demonstrate that the measured quantitative traits displayed only negligible to modest correlations with leaf angle, suggesting no substantial relationships. This implies that the leaf angle of maize inbred lines is independent of the other quantitative traits examined. Consequently, selection of plants based solely on leaf angle can be conducted without the need to consider additional traits. Hikmah et al. (2023) found that the leaf angle of S1 lines derived from self-pollination did not exhibit significant correlations with other traits, being characterized by very weak associations. In contrast, harvest age demonstrated substantial correlations with multiple characteristics, including days to tasseling, days to silk emergence, plant height, number of leaves per plant, stem diameter, leaf area, cob length, 1,000-grain weight, and yield. All these traits displayed a moderate degree of association.

The time to tassel emergence and the time to silk emergence are positively correlated with the harvest time, meaning that delayed tassel and silk emergence corresponds to a later harvest. Conversely, other traits exhibit negative correlations, suggesting that an increase in their values can shorten the harvest time. The study by Hikmah et al. (2023) found consistent results regarding the timing of corn silk emergence. Most characters are strongly correlated with yield, and those that are negatively correlated are also valuable predictors, such as days to silk emergence and days to tassel emergence, which have correlation coefficients of -0.791 and -0.769, respectively. Conversely, plant height, dry cob weight per plant, and 1,000-grain weight are positively and significantly correlated with yield, making them strong criteria with values of 0.766 and 0.783, respectively. As the number of days to silk

emergence and days to tassel emergence increase, the yield decreases. The abbreviated duration of grain development may contribute to this trend. As the crop plants increase in height, the dry mass of the harvested cobs and the mass of 1,000 individual grains rise, culminating in a greater overall yield. This phenomenon can occur because taller plants have an enhanced probability of generating additional leaves, thereby augmenting the photosynthetic output and ultimately resulting in a higher yield. This phenomenon can occur because taller plants have a greater opportunity to produce additional leaves, thus increasing photosynthesis, in term of light interception, taller plants have wider leaves, more horizontal leaf angle and ultimately higher yields (Walter & Kromdijk, 2022). In line with the opinion of Lestari & Sukri (2020), increased seed weight is associated with greater translocation of photosynthesis into the seed, resulting in optimal seed formation and filling and larger seed size. Yustisia et al. (2021) also obtained the same thing for plant height, that yield is strongly positively correlated with plant height, and dry cob weight at harvest. The higher the weight of the dry corn cob harvested, the more potential seeds are produced, so the harvest yield is higher (Bapaimu et al., 2024). The higher the dry cob weight at harvest, the more seeds it can potentially produce, resulting in a higher yield. Sudika et al. (2022) reported that the dry cob weight of the harvest is strongly positively correlated with yield. The weight of 1,000 grains indicates the size and health of the grain (Helilusiatiningsih et al., 2022). The weight of 1,000 grains indicates grain size and soundness. The higher the weight of 1,000 grains, the greater the yield due to larger and more complete grains. Hikmah et al. (2023) reported that higher 1,000-grain weight of S1 lines was associated with greater yield. Similarly, Mousavi & Nagy (2021) and Kerawing et al. (2024) observed a positive correlation between yield, number of leaves, plant height, the weight of the ear, outer ear diameter, and weight of the cob.

Conclusion

The quantitative characters of several generations of selfing-derived lines and the F2 population differed, except for ASI and cob diameter. The first, second, third, and fourth selfing generations had lower values compared to the F2 population, except for days to tassel emergence, days to silk emergence, and harvest age. While most characters were not correlated with leaf angle, harvest age was moderately correlated with several traits. Similarly, yield was moderately to strongly correlated with most quantitative characters. The selection of plants to be selfed to form the S5 lines

and increase yields should use plant height as a selection criterion.

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Author Contributions

Collecting data, writing original drafts, N.W.S.S.; analysing data, methodology, I.W.S.; data curation, I.W.S.; visualization, N.H.N.; review writing, W.O.N.

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Conflicts of Interest

The authors declare no conflict of interest.

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