MIKAILALSYS
Journal of Multidisciplinary Sciences

e-ISSN : 2987-2286
p-ISSN : 2987-3924

Index : Dimensions, Scilit, Crossref, Garuda, Semantic, Lens,Google Scholar,Base, etc

https://doi.org/10.58578/mikailalsys.v4i2.10008

The Effect of Plant Spacing and Number of Seeds per Planting Hole on the Growth and Yield of Sweet Corn (*Zea mays saccharata* Sturt)

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Article Info:

Submitted:	Revised:	Accepted:	Published:
Mar 24, 2026	Apr 21, 2026	May 3, 2026	May 8, 2026

Abstract

Sweet corn productivity is strongly influenced by cultivation techniques, particularly plant spacing and the number of seeds per planting hole. This study aims to analyze the effects of plant spacing and the number of seeds per planting hole on the growth and yield of sweet corn (*Zea mays saccharata* Sturt). A quantitative approach was employed using a factorial Randomized Block Design with two treatment factors. The first factor was plant spacing, consisting of three levels: J1 = 50 cm × 25 cm, J2 = 60 cm × 25 cm, and J3 = 80 cm × 25 cm. The second factor was the number of seeds per planting hole, consisting of three levels: B1 = one seed, B2 = two seeds, and B3 = three seeds. The study was conducted from April to June 2025 at the Experimental Field of the Faculty of Agriculture, Universitas Samudra. Data were collected through direct observation and measurement of plant height, number of leaves, stem diameter, cob length, cob weight, cob weight without husk, and production per hectare. The data were analyzed using analysis of variance followed by the Least Significant Difference test. The findings indicate that plant spacing had a highly significant effect on plant height, cob length, cob weight, cob weight without husk per sample, cob weight without husk per plot,

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and production per hectare, but had no significant effect on the number of leaves and stem diameter. The best plant height was obtained from J3, whereas most yield parameters were best obtained from J2. The number of seeds per planting hole had a highly significant effect on all observed parameters, with B1 producing the best results. The interaction between plant spacing and number of seeds per planting hole significantly affected plant height at 30 and 45 days after planting and cob weight. The best plant height was obtained from J3B1, while the best cob weight was obtained from J2B1. This study concludes that the use of one seed per planting hole combined with appropriate plant spacing can improve sweet corn growth and yield. These findings provide practical implications for optimizing cultivation strategies to enhance sweet corn productivity.

Keywords: Sweet Corn; Plant Spacing; Seed Number; Growth; Yield

INTRODUCTION

Sweet corn (*Zea mays saccharata* Sturt) is one of the agricultural commodities that has a close relationship with people's daily consumption (Revilla et al., 2021; Sidahmed et al., 2025). Its sweet taste, soft texture, and relatively short harvesting period make this crop widely cultivated and favored by consumers. In Indonesia, sweet corn is not only consumed as a fresh vegetable but is also processed into various food products, such as corn fritters, vegetable soup, roasted corn, corn cakes, and other processed foods (Harnany & Fadlilah, 2022)(Winarti et al., 2023). This condition shows that sweet corn has promising economic value and continues to have good market opportunities.

The importance of sweet corn is also supported by its nutritional content. Sweet corn contains carbohydrates, glucose, protein, fat, minerals, water, and vitamins that are beneficial for the human body. These nutrients can function as energy sources, support tissue formation, and help regulate body metabolism. In addition, almost all parts of the corn plant can be used, both for human needs and livestock feed. Therefore, sweet corn is considered a crop that has broad benefits in supporting food needs and agricultural development (Karim et al., 2023).

The demand for sweet corn continues to increase along with the development of people's consumption patterns. Sweet corn is increasingly found in traditional markets, supermarkets, roadside stalls, and various culinary businesses. This situation indicates that

sweet corn is not only a household food ingredient but has also become part of a growing food business. Aziz et al. (2023) explained that sweet corn is widely used as fresh food and processed into various food products because of its sweet taste and nutritional value.

However, the high demand for sweet corn is not always followed by optimal production. In several conditions, domestic corn supply is still unable to fully meet market needs, creating opportunities for increased corn imports. This issue shows that sweet corn cultivation still needs improvement, especially in terms of cultivation techniques that are simple, efficient, and applicable for farmers. One effort that can be done is to improve plant management, particularly through the regulation of plant spacing and the number of seeds per planting hole.

Plant spacing is an important factor because it determines how each plant obtains sunlight, water, nutrients, and growing space. If the spacing is too close, plants will compete with each other, especially in absorbing nutrients and receiving sunlight. The leaves may overlap, photosynthesis can be disrupted, and cob formation may not occur optimally. On the other hand, spacing that is too wide can reduce plant population and make land use less efficient. Suwardi et al. (2023) stated that proper plant population and spacing can support better crop productivity because plants have enough space to grow while the land is still used efficiently.

Several previous studies have shown that plant spacing affects the growth and yield of sweet corn. Khairani et al. (2023) reported that plant spacing had an effect on sweet corn growth and production, with a spacing of 60 × 25 cm producing the best result. Ainy and Ahmad (2017) also found that sweet corn plants showed better growth and yield at a spacing of 60 × 25 cm. These findings indicate that proper plant spacing can create a more suitable growing environment for sweet corn.

In addition to plant spacing, the number of seeds per planting hole also needs attention. The number of seeds planted in one hole can influence plant density and competition among plants. If too many seeds are planted in one hole, the plants may compete for sunlight, water, nutrients, and root space. This condition can cause uneven growth and reduce production. Wirawan (2022) explained that regulating the number of seeds per planting hole is useful for reducing competition among plants, supporting uniform growth, and making crop maintenance easier.

Research conducted by Samsiyah et al. (2022) showed that the number of seeds per planting hole affected several growth and yield components of sweet corn, such as leaf length, leaf width, cob length, cob weight with husk, cob weight without husk, and productivity. Their study found that one seed per planting hole produced higher productivity than two seeds per planting hole. Similar findings were reported by Septia et al. (2025), who stated that one seed per planting hole significantly affected plant height, stem diameter, cob length, and cob diameter.

Based on these previous studies, plant spacing and the number of seeds per planting hole are both important in sweet corn cultivation. However, studies that discuss both factors together are still needed, especially to see how the combination of plant spacing and seed number influences sweet corn growth and yield. This is important because both factors are directly related to plant population, competition, and land-use efficiency. Therefore, this study aims to analyze the effect of plant spacing and the number of seeds per planting hole on the growth and yield of sweet corn (*Zea mays saccharata* Sturt). The results of this study are expected to provide practical information for farmers in determining more appropriate cultivation techniques to increase sweet corn production.

METHODS

This study used a quantitative approach with an experimental method because the research was intended to examine the effect of plant spacing and the number of seeds per planting hole on the growth and yield of sweet corn. The research was conducted at the experimental field of the Faculty of Agriculture, Universitas Samudra, for three months, from April to June 2025. The main material used in this study was sweet corn seed of the Bonanza F1 variety, supported by water, cattle manure, urea fertilizer, KCl fertilizer, insecticide, and other cultivation materials. The tools used included a hoe, machete, raffia rope, measuring tape, caliper, dibble, digital scale, soil pH meter, watering can, stationery, research labels, and camera. This experimental approach was considered appropriate because the study directly tested treatment combinations under field conditions to observe their effects on plant growth and production.

The study was arranged using a factorial Randomized Block Design consisting of two treatment factors. The first factor was plant spacing, consisting of three levels: 50 × 25 cm, 60 × 25 cm, and 80 × 25 cm. The second factor was the number of seeds per planting

hole, consisting of three levels: one seed, two seeds, and three seeds per planting hole. Therefore, there were nine treatment combinations, and each treatment was repeated three times, resulting in 27 experimental units. Each plot measured 240 × 75 cm, with a distance of 50 cm between plots and 70 cm between blocks. The total number of sweet corn plants used in this study was 648 plants, and four plants from each plot were selected as sample plants. The observed parameters included plant height, number of leaves, stem diameter, cob length per sample, cob weight per sample, cob weight without husk per sample, cob weight without husk per plot, and production per hectare.

The research procedure included land preparation, plot formation, basic fertilization, seed preparation, planting, plant maintenance, pest and disease control, and harvesting. Plant height, number of leaves, and stem diameter were observed at 15, 30, and 45 days after planting, while yield components were measured after harvest at 70 days after planting. The collected data were analyzed using analysis of variance based on the factorial Randomized Block Design model. If the treatment showed a significant effect at the 5% level, the analysis was continued using the Least Significant Difference test at the 5% level to determine differences among treatments. This analysis was used to identify the most effective combination of plant spacing and number of seeds per planting hole in improving sweet corn growth and yield.

RESULTS

1. Effect of Plant Spacing

a. Plant Height (cm)

The observation data on corn plant height at 15, 30, and 45 DAP are presented in Appendices 1, 3, and 5, while the analysis of variance is presented in Appendices 2, 4, and 6. The results of the analysis of variance showed that plant spacing had a highly significant effect on corn plant height at 15, 30, and 45 DAP. The effect of plant spacing on plant height is presented in Table 1.

Table 1. Average corn plant height as affected by plant spacing

Treatment	15 DAP	30 DAP	45 DAP
J1	16.46 a	60.65 a	125.52 a
J2	19.48 b	69.14 b	137.50 b
J3	21.46 b	68.44 b	144.59 b
LSD 0.05	2.71	2.76	2.64

Note: Numbers followed by the same letter in the same column are not significantly different based on the LSD test at the 0.05 level.

Table 1 shows that at 15 and 45 DAP, the highest plants were found in the J3 treatment. Based on the LSD test at the 0.05 level, this treatment was significantly different from J1 but not significantly different from J2. Meanwhile, at 30 DAP, the highest plants were found in the J2 treatment, which was significantly different from J1 but not significantly different from J3.

This condition is assumed to occur because wider plant spacing allows corn plants to grow taller due to lower competition in absorbing nutrients and sunlight. This is in line who stated that plants grown with wider spacing receive more sunlight than plants grown with narrower spacing.

b. Number of Leaves

The observation data on the number of corn leaves at 15, 30, and 45 DAP are presented in Appendices 7, 9, and 11, while the analysis of variance is presented in Appendices 8, 10, and 12. The results of the analysis of variance showed that plant spacing had no significant effect on the number of leaves at 15, 30, and 45 DAP. The average number of corn leaves as affected by plant spacing is presented in the figure below.

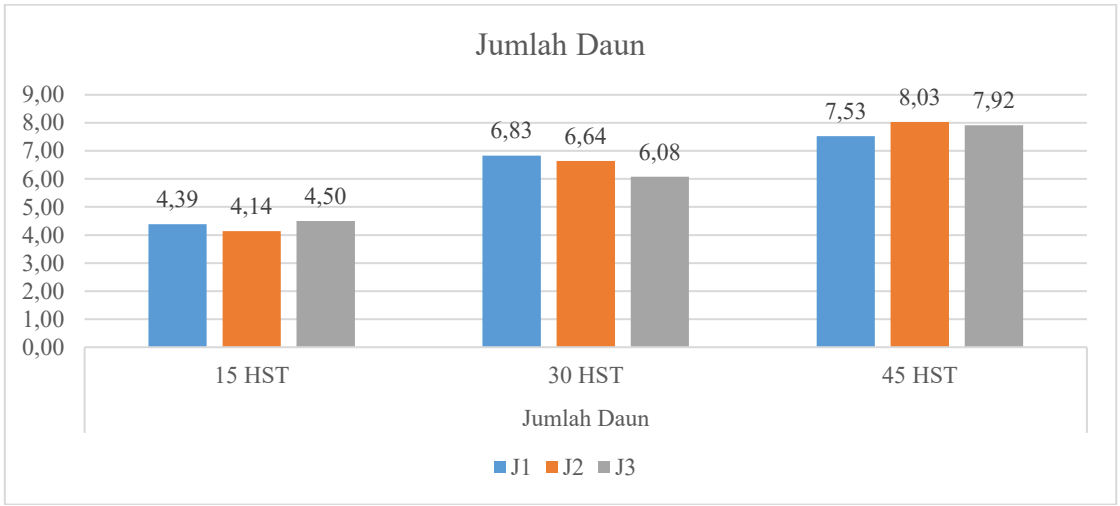


Figure 1. Average number of corn leaves at 15, 30, and 45 DAP as affected by plant spacing

The figure shows that plant spacing did not significantly affect the number of leaves. This is assumed to occur because the plant spacing treatment did not yet produce differences in leaf number. In addition, the number of leaves is also influenced by the

genetic characteristics of the plant itself. Kusmiadi et al. (2015) added that plant spacing may have no significant effect because nutrients, water, and light are still available for plant growth, resulting in a relatively similar number of leaves.

c. Stem Diameter (cm)

The observation data on corn stem diameter at 15, 30, and 45 DAP are presented in Appendices 13, 15, and 17, while the analysis of variance is presented in Appendices 14, 16, and 18. The results of the analysis of variance showed that plant spacing had no significant effect on stem diameter at 15, 30, and 45 DAP. The average stem diameter of corn plants as affected by plant spacing is presented in the figure below.

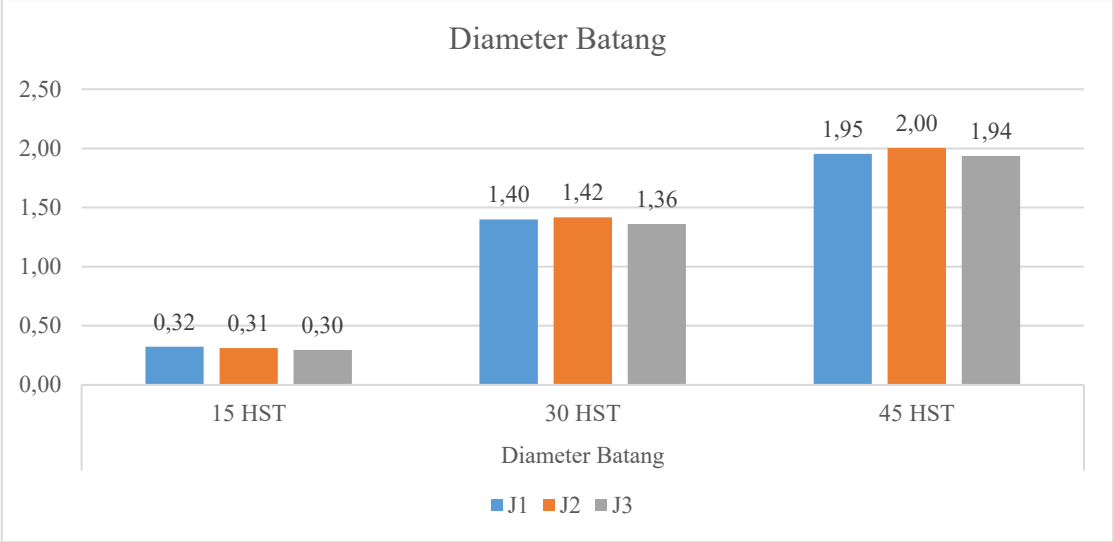


Figure 2. Average stem diameter of corn plants at 15, 30, and 45 DAP as affected by plant spacing

The figure shows that plant spacing had no significant effect on stem diameter. This may be due to the fact that the plant spacing used was not sufficiently efficient in influencing corn stem diameter. This is related to the effectiveness of plant photosynthesis, which increases photosynthate production and determines plant growth and development (Arwani et al., 2013).

d. Cob Length per Sample (cm)

The observation data on corn cob length are presented in Appendix 19, while the analysis of variance is presented in Appendix 20. The results of the analysis of variance showed that plant spacing had a highly significant effect on cob length. The effect of plant spacing on cob length is presented in Table 2.

Table 2. Average cob length per sample as affected by plant spacing

Treatment	Cob Length per Sample (cm)
J1	16.79 a
J2	18.19 b
J3	17.65 b
LSD 0.05	0.78

Note: Numbers followed by the same letter in the same column are not significantly different based on the LSD test at the 0.05 level.

Table 3 shows that the highest average cob length per sample was found in the J2 treatment. Based on the LSD test at the 0.05 level, J2 was significantly different from J1 but not significantly different from J3.

This is assumed to occur because the J2 plant spacing treatment, namely 60 cm × 25 cm, was suitable for producing longer cobs. Cob length is determined by photosynthetic activity, which transfers photosynthates from leaves to kernels as food reserves. This is in accordance with Williams, as cited in Bolly (2018), who stated that plant spacing strongly affects plant growth and yield.

e. Cob Weight per Sample (g)

The observation data on corn cob weight are presented in Appendix 21, while the analysis of variance is presented in Appendix 22. The results of the analysis of variance showed that plant spacing had a highly significant effect on cob weight. The effect of plant spacing on cob weight is presented in Table 3.

Table 3. Average cob weight per sample as affected by plant spacing

Treatment	Cob Weight per Sample (g)
J1	224.33 a
J2	286.79 c
J3	250.70 b
LSD 0.05	15.15

Note: Numbers followed by the same letter in the same column are not significantly different based on the LSD test at the 0.05 level.

Table 3 shows that the highest average cob weight per sample was found in the J2 treatment. Based on the LSD test at the 0.05 level, J2 was significantly different from all

other treatments, with a cob weight of 286.79 g. The lowest cob weight was found in J1, with a cob weight of 224.33 g at a spacing of 50 cm × 25 cm.

This result is assumed to occur because the J2 spacing was optimal for cob growth, resulting in higher cob weight. Wider spacing allows plants to receive more sunlight compared to the J1 treatment, which had closer spacing and caused plants to compete more intensely for sunlight. This is in line with Mahyono et al. (2022), who stated that different plant spacing treatments affected plant height and corn yield at 42 and 52 days after planting. Furthermore, Desyanto et al. (2014) stated that plant spacing had a significant effect on cob weight, leaf area index, cob weight per hectare, and forage weight per hectare.

f. Cob Weight without Husk per Sample (g) and Cob Weight without Husk per Plot (kg)

The observation data on cob weight without husk per sample and cob weight without husk per plot are presented in Appendices 23 and 25, while the analysis of variance is presented in Appendices 24 and 26. The results of the analysis of variance showed that plant spacing had a highly significant effect on cob weight without husk per sample and cob weight without husk per plot. The effect of plant spacing is presented in Table 5.

Table 4. Average cob weight without husk per sample and cob weight without husk per plot as affected by plant spacing

Treatment	Cob Weight without Husk per Sample (g)	Cob Weight without Husk per Plot (kg)
J1	147.52 a	2.15 a
J2	181.22 c	2.08 b
J3	163.56 b	1.46 b
LSD 0.05	10.16	0.13

Note: Numbers followed by the same letter in the same column are not significantly different based on the LSD test at the 0.05 level.

Table 4 shows that the highest average cob weight without husk per sample was found in J2. Based on the LSD test at the 0.05 level, J2 was significantly different from all treatments, with a production result of 181.22 g at a spacing of 60 cm × 25 cm. Meanwhile, the highest average cob weight without husk per plot was found in J1, which was highly significantly different from all other treatments.

This is assumed to occur because wider spacing allows plants to absorb more sunlight, so photosynthesis can take place optimally. According to Wahyudin et al. (2017), dense plant canopies can cover the soil surface from sunlight, causing lower soil temperature and maintaining soil moisture. Proper plant spacing can also reduce competition among plants, allowing larger cobs to develop. Plant spacing affects sunlight absorption and photosynthesis, which then influences photosynthate production for kernel filling.

g. Production per Hectare

The observation data on corn production per hectare are presented in Appendix 27, while the analysis of variance is presented in Appendix 28. The results of the analysis of variance showed that plant spacing had a highly significant effect on net weight per hectare. The effect of plant spacing is presented in Table 5.

Table 5. Average production per hectare as affected by plant spacing

Treatment	Net Weight per Hectare (ton)
J1	11.94 b
J2	11.56 b
J3	8.10 a
LSD 0.05	0.69

Note: Numbers followed by the same letter in the same column are not significantly different based on the LSD test at the 0.05 level.

Table 5 shows that the highest average net weight per hectare was found in the J1 treatment. Based on the LSD test at the 0.05 level, this treatment was highly significantly different from all other treatments. This is assumed to occur because spacing that is not too narrow can increase sweet corn production. Harjadi, as cited in Machhfudz (2017), stated that the use of ideal plant spacing can reduce competition among plants and contribute to optimal production.

2. Effect of Number of Seeds per Planting Hole

a. Plant Height (cm)

The observation data on corn plant height at 15, 30, and 45 DAP are presented in Appendices 1, 3, and 5, while the analysis of variance is presented in Appendices 2, 4, and 6. The results of the analysis of variance showed that the number of seeds per planting hole

had a significant effect on corn plant height at 15 DAP and a highly significant effect at 30 and 45 DAP. The effect of the number of seeds per planting hole is presented in Table 7.

Table 6. Average corn plant height as affected by number of seeds per planting hole

Treatment	15 DAP	30 DAP	45 DAP
B1	21.06 b	75.20 c	142.75 b
B2	19.57 b	70.62 b	141.20 b
B3	16.77 a	52.60 a	123.74 a
LSD 0.05	2.71	2.76	2.64

Note: Numbers followed by the same letter in the same column are not significantly different based on the LSD test at the 0.05 level.

Table 6 shows that the highest average corn plant height at 15 and 45 DAP was found in the B1 treatment. Based on the LSD test at the 0.05 level, B1 was highly significantly different from B3 but not significantly different from B2. Meanwhile, at 30 DAP, the highest average plant height was found in B1, which was highly significantly different from all other treatments.

This is assumed to occur because a smaller plant population allows plants to grow without shading each other and absorb nutrients more easily without competing with other corn plants. Berkelaar (2011) stated that the number of seeds per planting hole affects growth because it is directly related to competition among plants within one clump. Fewer seedlings per planting hole provide more space for plants to expand and deepen their roots.

b. Number of Leaves

The observation data on the number of corn leaves at 15, 30, and 45 DAP are presented in Appendices 7, 9, and 11, while the analysis of variance is presented in Appendices 8, 10, and 12. The results of the analysis of variance showed that the number of seeds per planting hole had no significant effect on leaf number at 15 and 30 DAP but had a significant effect at 45 DAP. The effect of the number of seeds per planting hole is presented in Table 8.

Table 7. Average number of corn leaves as affected by number of seeds per planting hole

Treatment	15 DAP	30 DAP	45 DAP
B1	4.33	6.72	8.25 b
B2	4.39	6.72	7.75 ab
B3	4.31	6.11	7.47 a
LSD 0.05	-	-	0.56

Note: Numbers followed by the same letter in the same column are not significantly different based on the LSD test at the 0.05 level.

Table 7 shows that the highest average number of corn leaves at 45 DAP was found in B1. Based on the LSD test at the 0.05 level, B1 was significantly different from B3 but not significantly different from B2.

This is because one seed per planting hole can absorb sunlight optimally, thereby increasing the number of leaves. According to Bilman (2011), the formation of new leaves increases the total number of leaves and total leaf area per plant, although the individual leaf area may be small. An increase in leaf area also increases light absorption by the leaves. Leaves, as the biological site of photosynthesis, strongly determine the absorption and conversion of light energy in kernel formation and crop yield.

c. Stem Diameter (cm)

The observation data on corn stem diameter at 15, 30, and 45 DAP are presented in Appendices 13, 15, and 17, while the analysis of variance is presented in Appendices 14, 16, and 18. The results of the analysis of variance showed that the number of seeds per planting hole had no significant effect on stem diameter at 15 DAP but had a highly significant effect at 30 and 45 DAP. The effect of the number of seeds per planting hole is presented in Table 8.

Table 8. Average corn stem diameter as affected by number of seeds per planting hole

Treatment	15 DAP	30 DAP	45 DAP
B1	0.33	1.63 c	2.28 c
B2	0.30	1.37 b	1.90 b
B3	0.30	1.17 a	1.71 a
LSD 0.05	-	0.14	0.10

Note: Numbers followed by the same letter in the same column are not significantly different based on the LSD test at the 0.05 level.

Table 8 shows that the highest average corn stem diameter was found in the B1 treatment. Based on the LSD test at the 0.05 level, B1 was highly significantly different from all other treatments.

This is because the treatment with one seed per planting hole was more optimal than treatments with more than one seed. Plants were able to absorb soil nutrients more easily, resulting in better growth. This is related to the effectiveness of plant

photosynthesis, which increases photosynthate production and determines plant growth and development (Arwani et al., 2013).

d. Cob Length per Sample (cm)

The observation data on cob length per sample are presented in Appendix 19, while the analysis of variance is presented in Appendix 20. The results of the analysis of variance showed that the number of seeds per planting hole had a highly significant effect on cob length. The effect of the number of seeds per planting hole is presented in Table 10.

Table 9. Average cob length per sample as affected by number of seeds per planting hole

Treatment	Cob Length per Sample (cm)
B1	20.01 c
B2	17.31 b
B3	15.32 a
LSD 0.05	0.78

Note: Numbers followed by the same letter in the same column are not significantly different based on the LSD test at the 0.05 level.

Table 9 shows that the highest average cob length per sample was found in the B1 treatment. Based on the LSD test at the 0.05 level, B1 was highly significantly different from all other treatments. This is assumed to occur because plant density affects both plant growth and production. This is in line with Hasrizal and Ani, as cited in Regyta et al. (2023), who stated that planting one seed per planting hole can produce higher yields.

d. Cob Weight per Sample (g)

The observation data on cob weight per sample are presented in Appendix 21, while the analysis of variance is presented in Appendix 22. The results of the analysis of variance showed that the number of seeds per planting hole had a highly significant effect on cob weight. The effect of the number of seeds per planting hole is presented in Table 11.

Table 10. Average cob weight per sample as affected by number of seeds per planting hole

Treatment	Cob Weight per Sample (g)
B1	356.75 c
B2	232.92 b
B3	172.16 a

Treatment	Cob Weight per Sample (g)
LSD 0.05	15.15

Note: Numbers followed by the same letter in the same column are not significantly different based on the LSD test at the 0.05 level.

Table 10 shows that the highest average cob weight per sample was found in the B1 treatment. Based on the LSD test at the 0.05 level, B1 was highly significantly different from all other treatments. This was influenced by the lower corn plant population, which reduced competition for nutrient absorption and sunlight, resulting in better cob weight. In contrast, the lowest cob weight was found in B3 because the use of more seeds increased competition for nutrients and sunlight, resulting in lower cob weight.

According to Nainggolan et al. (2016), the number of seeds per planting hole affects plant population per unit area. Population density determines the level of competition among plants in obtaining essential growth resources, such as nutrients and sunlight.

3. Cob Weight without Husk per Sample (g) and Cob Weight without Husk per Plot (kg)

The observation data on cob weight without husk per sample and cob weight without husk per plot are presented in Appendices 23 and 25, while the analysis of variance is presented in Appendices 24 and 26. The results of the analysis of variance showed that the number of seeds per planting hole had a highly significant effect on cob weight without husk per sample and cob weight without husk per plot. The effect of the number of seeds per planting hole is presented in Table 11.

Table 11. Average cob weight without husk per sample and cob weight without husk per plot as affected by number of seeds per planting hole

Treatment	Cob Weight without Husk per Sample (g)	Cob Weight without Husk per Plot (kg)
B1	233.97 c	2.79 c
B2	150.80 b	1.62 b
B3	107.52 a	1.28 a
LSD 0.05	9.98	0.13

Note: Numbers followed by the same letter in the same column are not significantly different based on the LSD test at the 0.05 level.

Table 11 shows that the highest average cob weight without husk per sample and cob weight without husk per plot were found in B1. Based on the LSD test at the 0.05 level, B1 was highly significantly different from all other treatments. This is assumed to occur because the number of seeds used was optimal, resulting in better production. This is in line with Regyta et al. (2023), who stated that planting one seed per planting hole can produce higher yields.

a. Production per Hectare

The observation data on corn production per hectare are presented in Appendix 27, while the analysis of variance is presented in Appendix 28. The results of the analysis of variance showed that the number of seeds per planting hole had a highly significant effect on net weight per hectare. The effect of the number of seeds per planting hole is presented in Table 12.

Table 12. Average net weight per hectare as affected by number of seeds per planting hole

Treatment	Net Weight per Hectare (ton)
B1	15.51 c
B2	8.98 b
B3	7.12 a
LSD 0.05	0.69

Note: Numbers followed by the same letter in the same column are not significantly different based on the LSD test at the 0.05 level.

Table 12 shows that the highest average net weight per hectare was found in B1. Based on the LSD test at the 0.05 level, B1 was significantly different from all other treatments. This is because the treatment of one seed per planting hole produced higher yield compared to three seeds per planting hole. The treatment with three seeds per planting hole showed a higher level of competition for growing space. This is supported by Abdurrazak, as cited in Machhfudz (2017), who stated that using too many seeds in one planting hole affects production quality in one planting hole.

4. Interaction Effect between Plant Spacing and Number of Seeds per Planting Hole

a. Plant Height (cm)

The observation data on corn plant height at 15, 30, and 45 DAP are presented in Appendices 1, 3, and 5, while the analysis of variance is presented in Appendices 2, 4, and

6. The results of the analysis of variance showed that the interaction between plant spacing and number of seeds per planting hole had no significant effect on corn plant height at 15 DAP but had a highly significant effect at 30 and 45 DAP. The interaction effect is presented in Table 13.

Table 13. Average plant height as affected by the interaction between plant spacing and number of seeds per planting hole

Treatment Combination	15 DAP	30 DAP	45 DAP
J1B1	18.54	71.81 d	131.04 bc
J1B2	18.60	64.40 c	134.69 cd
J1B3	12.23	45.74 a	110.83 a
J2B1	20.43	74.06 de	143.72 ef
J2B2	19.50	72.82 de	141.43 e
J2B3	18.53	60.54 c	127.35 b
J3B1	24.21	79.73 f	153.49 g
J3B2	20.60	74.65 de	147.25 f
J3B3	19.57	50.93 b	133.05 cd
LSD 0.05	-	4.77	4.57

Note: Numbers followed by the same letter in the same column are not significantly different based on the LSD test at the 0.05 level.

Table 13 shows that the highest average plant height at 30 and 45 DAP was found in the J3B1 treatment combination. Based on the LSD test at the 0.05 level, this treatment was highly significantly different from all other treatments. This is assumed to occur because the combination of plant spacing and number of seeds per planting hole was suitable for supporting plant growth.

b. Cob Weight per Sample (g), Cob Weight without Husk per Sample (g), and Cob Weight without Husk per Plot (kg)

The observation data on cob weight, cob weight without husk per sample, and cob weight without husk per plot are presented in Appendices 21, 23, and 25, while the analysis of variance is presented in Appendices 22, 24, and 26. The results of the analysis of variance showed that the interaction between plant spacing and number of seeds per planting hole had a significant effect on cob weight and a highly significant effect on cob weight without husk per sample and cob weight without husk per plot. The interaction effect is presented in Table 14.

Table 14. Average cob weight, cob weight without husk per sample, and cob weight without husk per plot as affected by the interaction between plant spacing and number of seeds per planting hole

Treatment Combination	Cob Weight per Sample (g)	Cob Weight without Husk per Sample (g)	Cob Weight without Husk per Plot (kg)
J1B1	332.25 e	221.26 d	3.267 f
J1B2	187.00 bc	119.41 b	1.652 cd
J1B3	153.74 a	101.88 a	1.540 bc
J2B1	398.83 f	256.13 e	3.103 f
J2B2	266.33 d	174.56 c	1.810 de
J2B3	195.22 c	113.79 ab	1.338 b
J3B1	339.17 e	224.53 d	2.014 e
J3B2	245.42 d	159.26 c	1.397 b
J3B3	167.52 ab	106.88 ab	0.973 a
LSD 0.05	26.24	17.29	0.22

Note: Numbers followed by the same letter in the same column are not significantly different based on the LSD test at the 0.05 level.

Table 14 shows that the highest average cob weight per sample and cob weight without husk per sample were found in the J2B1 treatment combination. Based on the LSD test at the 0.05 level, this treatment was highly significantly different from all other treatments. Meanwhile, the highest average cob weight without husk per plot was found in the J1B1 treatment combination, which was not significantly different from J2B1 but was highly significantly different from the other treatments.

This is assumed to occur because the combination of plant spacing and number of seeds per planting hole was ideal for increasing sweet corn yield. A less dense plant population and less narrow spacing allowed plants to produce better cob weight, cob weight without husk per plot, and cob weight without husk per sample.

Proper plant spacing and seed number are closely related to the photosynthesis process, especially the efficient use of sunlight. Photosynthesis is the process by which carbon dioxide and water, under the influence of sunlight, are converted into organic compounds that contain carbon and are rich in energy (Nia & Fowo, 2019). Jalil et al. (2015) stated that plants grown with one seedling per planting hole produce higher yields because the use of fewer seedlings reduces competition in nutrient absorption compared to the use of too many seedlings.

c. Production per Hectare (ton)

The observation data on corn production per hectare are presented in Appendix 27, while the analysis of variance is presented in Appendix 28. The results of the analysis of variance showed that the interaction between plant spacing and number of seeds per planting hole had a highly significant effect on production per hectare. The interaction effect is presented in Table 15.

Table 15. Average net weight per hectare as affected by the interaction between plant spacing and number of seeds per planting hole

Treatment Combination	Production per Hectare
J1B1	18.13 d
J1B2	9.16 b
J1B3	8.53 b
J2B1	17.22 d
J2B2	10.04 bc
J2B3	7.42 b
J3B1	11.17 bc
J3B2	7.75 b
J3B3	5.39 a
LSD 0.05	1.20

Note: Numbers followed by the same letter in the same column are not significantly different based on the LSD test at the 0.05 level.

Table 15 shows that the highest average production per hectare was found in the J1B1 treatment combination. Based on the LSD test at the 0.05 level, this treatment was not significantly different from J2B1 but was significantly different from the other treatments. The combination of plant spacing and number of seeds per planting hole was effective in increasing sweet corn production. This is assumed to occur because the determining factors of corn productivity are plant population, plant spacing, and seed quality. Silaban (2018) stated that plant spacing in corn is related to growing space, which determines the availability of nutrients, water, and light.

DISCUSSION

The results of this study show that plant spacing and the number of seeds per planting hole played important roles in determining the growth and yield of sweet corn.

Plant spacing had a highly significant effect on plant height, cob length, cob weight per sample, cob weight without husk per sample, cob weight without husk per plot, and production per hectare. However, plant spacing did not significantly affect the number of leaves and stem diameter. This indicates that plant spacing mainly influenced the parameters directly related to plant competition, light interception, and yield formation rather than all vegetative components.

The highest plant height was generally found in wider plant spacing, particularly in the J3 treatment at 15 and 45 days after planting. This condition suggests that wider spacing reduced competition among plants for sunlight, nutrients, water, and growing space. When the distance between plants is wider, each plant has better access to environmental resources, allowing more optimal vegetative growth. This finding is in line with Kantikowati et al. (2022), who stated that plants grown with wider spacing receive more sunlight than those grown with narrow spacing. Similarly, Imawati et al. (2025) explained that overly dense spacing can reduce plant growth and production due to higher competition for nutrients and easier pest movement among plants.

Although wider spacing supported plant height, the best cob length and cob weight per sample were obtained from the J2 treatment, namely 60 cm × 25 cm. This result indicates that the most effective spacing is not always the widest spacing, but the spacing that creates a balance between plant population and individual plant growth. The J2 treatment likely provided sufficient growing space while still maintaining an efficient plant population in the field. This finding is consistent with Khairani et al. (2023), who reported that plant spacing significantly affected sweet corn growth and production, with 60 cm × 25 cm producing the best result. Ainy and Ahmad (2017) also found that the best growth and yield of sweet corn were obtained at 60 cm × 25 cm, showing that this spacing can support more optimal cob development.

The insignificant effect of plant spacing on the number of leaves and stem diameter suggests that these parameters may be more strongly influenced by genetic factors, nutrient availability, and environmental conditions than by spacing alone. In this study, the availability of nutrients, water, and sunlight may still have been sufficient for leaf formation and stem development, resulting in relatively similar values among spacing treatments. This is supported by Helmi et al. (2026), who stated that plant spacing may not significantly affect the number of leaves when nutrients, water, and light are still available for plant

growth. Arwani et al. (2022) also explained that stem development is closely related to photosynthetic effectiveness, which depends not only on spacing but also on the plant's ability to produce and distribute photosynthates.

The number of seeds per planting hole also had a strong influence on sweet corn growth and yield. The B1 treatment, or one seed per planting hole, consistently produced the highest values for plant height, number of leaves at 45 DAP, stem diameter at 30 and 45 DAP, cob length, cob weight, cob weight without husk, and production per hectare. This result shows that reducing the number of plants in one planting hole can reduce competition within the same growing point. With only one plant in each hole, the root system can develop more freely, nutrient uptake becomes more efficient, and the plant receives more sunlight without excessive shading from nearby plants.

The superiority of one seed per planting hole can also be explained through the concept of plant competition. When two or three seeds are planted in the same hole, the plants grow very close to each other and compete directly for the same resources. This condition may limit root expansion, reduce light interception, and decrease photosynthetic efficiency. As a result, the plants may grow less vigorously and produce smaller cobs. Berkelaar et al. (2022) stated that the number of seeds per planting hole affects plant growth because it directly determines the level of competition among plants within one clump. Nainggolan & Karunia (2022) also emphasized that the number of seeds per planting hole affects plant population per unit area, which then determines competition for nutrients and sunlight.

The results of this study are in line with Mulyani et al. (2022), who found that the number of seeds per planting hole affected leaf length, leaf width, cob length, cob weight with husk, cob weight without husk, and sweet corn productivity. Their study also showed that one seed per planting hole produced higher productivity than two seeds per planting hole. Similar results were reported by Simanjuntak et al. (2022), who found that one seed per planting hole had a significant effect on plant height, stem diameter, cob length, and cob diameter. These findings strengthen the evidence that planting one seed per hole is more effective in supporting sweet corn growth and yield than planting more than one seed per hole.

The interaction between plant spacing and number of seeds per planting hole also showed significant effects on several important parameters, especially plant height at 30

and 45 DAP, cob weight per sample, cob weight without husk per sample, cob weight without husk per plot, and production per hectare. The combination of J3B1 produced the highest plant height, while J2B1 produced the highest cob weight per sample and cob weight without husk per sample. Meanwhile, J1B1 and J2B1 showed high production per hectare. This indicates that the best treatment may differ depending on the parameter observed. Wider spacing may support taller plants, but moderate spacing combined with one seed per hole is more effective for cob formation and yield quality.

The high yield obtained from the J2B1 treatment suggests that a spacing of 60 cm × 25 cm combined with one seed per planting hole can create a favorable balance between plant population and resource availability. This combination allows each plant to grow with low competition while still maintaining a sufficient number of plants per unit area. In sweet corn cultivation, this balance is important because yield is determined not only by individual cob size but also by total production per plot or per hectare. Noor et al. (2022) stated that plant spacing and number of seeds per planting hole can interact to influence plant height, stem diameter, and production per plot. This supports the finding that the combination of spacing and seed number should be considered together rather than separately.

The relationship between spacing, seed number, and yield is closely related to photosynthesis. Proper spacing allows better light distribution within the plant canopy, while the appropriate number of seeds per hole reduces competition among plants. When plants receive enough sunlight and nutrients, photosynthesis can run more effectively, producing more photosynthates for vegetative growth and cob filling. Hoerniasih et al. (2023)explained that photosynthesis converts carbon dioxide and water into energy-rich organic compounds under sunlight. Therefore, better light interception and lower competition can improve the movement of photosynthates from leaves to cobs, resulting in better cob weight and yield.

From a practical perspective, the findings of this study provide useful information for sweet corn farmers. The results suggest that the use of one seed per planting hole is more efficient because it produces better plant growth and yield while also reducing seed use. In addition, the spacing of 60 cm × 25 cm can be recommended as an effective spacing for improving cob quality, especially cob length and cob weight. However, when the target is total production per hectare, closer spacing with one seed per hole may also

provide high yield because of the higher plant population. Therefore, farmers need to consider whether their production goal is larger cob size, better cob quality, or higher total yield per land area.

Scientifically, this study contributes to the understanding of how plant population management affects sweet corn performance. The findings confirm that plant spacing and number of seeds per planting hole are not merely technical cultivation factors but are closely related to plant physiological processes, especially competition, nutrient uptake, canopy development, and photosynthate distribution. The study also strengthens previous research showing that proper spacing and one seed per planting hole can improve sweet corn productivity.

Nevertheless, this study has several limitations. The research was conducted in one location and within one planting season, so environmental factors such as soil fertility, rainfall, temperature, and pest pressure may have influenced the results. The study also used only one sweet corn variety, namely Bonanza F1, so the findings may not fully represent other sweet corn varieties with different growth characteristics. In addition, the observed parameters focused mainly on growth and yield components, while physiological parameters such as leaf area index, chlorophyll content, and nutrient uptake were not measured. Future studies are recommended to examine different varieties, planting seasons, soil conditions, and additional physiological variables to obtain a more comprehensive understanding of sweet corn productivity.

CONCLUSION

This study concludes that plant spacing and the number of seeds per planting hole significantly influenced the growth and yield of sweet corn (*Zea mays saccharata* Sturt). Plant spacing had a highly significant effect on plant height, cob length, cob weight, cob weight without husk per sample, cob weight without husk per plot, and production per hectare, but did not significantly affect the number of leaves and stem diameter. The best treatment for plant height was found at J3, namely 80 cm × 25 cm, while the best results for most yield parameters were obtained at J2, namely 60 cm × 25 cm. The number of seeds per planting hole had a highly significant effect on all observed parameters, with B1, or one seed per planting hole, giving the best results.

The interaction between plant spacing and number of seeds per planting hole also showed a highly significant effect on plant height at 30 and 45 days after planting, with the best result found in the J3B1 combination, namely 80 cm × 25 cm with one seed per planting hole. Meanwhile, the best results for cob weight, cob weight without husk per sample, and cob weight without husk per plot were obtained from the J2B1 combination, namely 60 cm × 25 cm with one seed per planting hole. These findings provide practical information that the use of one seed per planting hole combined with appropriate spacing can improve sweet corn productivity. Future research is recommended to test these treatment combinations in different locations, planting seasons, and soil conditions to obtain broader and more consistent cultivation recommendations.

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