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Effect of Ammonium Sulfate Rates on Growth, Yield, and Total Soluble Solids of Waxy Corn *(Zea mays var. ceratina)*

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Abstract
Productivity and quality of waxy corn remain important aspects that require improvement through appropriate fertilization practices. Research evaluating the effects of ammonium sulfate on the growth, yield, and total soluble solids of waxy corn remains insufficiently explored. This research was conducted to investigate the effects of different ammonium sulfate application rates on the growth, yield, and total soluble solids of waxy corn *(Zea mays var. ceratina)*. The research was arranged according to a Randomized Complete Block Design (RCBD) consisting of six ammonium sulfate fertilizer rates, namely 0, 75, 150, 225, 300, and 375 kg ha^{-1}, with four replications, resulting in 24 experimental units. The observed parameters included plant height, number of leaves, stem diameter, husked ear diameter and length, number of ears per plant and plot, ear weight per plant and plot, and total soluble solids. Collected data were analyzed using analysis of variance (ANOVA), followed by Duncan's Multiple Range Test (DMRT) at a 5% significance level when significant differences were detected. The results indicated that ammonium sulfate fertilizer significantly affected all observed parameters. The application rate of 300 kg ha^{-1} demonstrated superior performance compared with the other fertilizer treatments. This treatment produced a maximum plant height of 214,05 cm, 12,05 leaves per plant, a stem diameter of 3.00 cm, and a TSS content of 16,65 °Brix. Furthermore, this application rate also improved yield components, husked ear diameter and length, number of ears per plant and plot, and ear weight per plant and plot. In conclusion, ammonium sulfate fertilizer applied at 300 kg ha^{-1} was the most effective rate for improving the growth, yield, and quality of waxy corn under the conditions of this study.

Keywords— Ammonium Sulfate Fertilizer; Growth; Yield; Total Soluble Solids; Waxy Corn

Introduction

Waxy corn (*Zea mays var. ceratina*), also known as glutinous corn, was Initially applied through the discovery of J. M. W. Farnham, an American missionary in Shanghai, China. The maize seed samples were subsequently studied by G. N. Collins, who successfully cultivated the plants through to harvest. This research laid the foundation for the identification and development of waxy corn as a maize variety with distinctive agronomic and grain characteristics (Julianto, Sugiharto, and Soegianto 2017).

The main characteristic of waxy corn lies in its amylopectin content, which accounts for nearly 100% of the starch in its kernels, resulting in a soft, sticky texture and a distinctive taste. This characteristic gives waxy corn high economic value, as it is widely consumed fresh or processed into various food products. The growing market demand for waxy corn has encouraged efforts o enhance crop productivity and improve harvested product quality, which nitrogen and sulfur play significant roles in promoting the growth and development of waxy corn cultivation (Safrina et al. 2023).

Waxy corn has relatively low yield potential, producing less than 2 ton ha^{-1}, with small ears measuring approximately 10–11 mm in diameter. One of the factors contributing to its low productivity is

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inadequate fertilizer management. The application of appropriate fertilizer types at the correct rates and optimal timing is expected to improve soil fertility and enhance crop yield, both in terms of quantity, consequently, facilitating the development of waxy corn cultivation (Tansidi 2023).

Therefore, one approach to improving the growth and yield of waxy corn is through fertilization. Ammonium sulfate, commonly known as ZA fertilizer, is widely used because it contains nitrogen (N) and sulfur (S), both of which are essential elements required for plant development. Nitrogen plays a vital role in chlorophyll synthesis and supports photosynthesis, while sulfur contributes to protein biosynthesis and plant growth. Therefore, ammonium sulfate has the potential to improve the growth, yield, and quality of waxy corn, warranting further investigation into its application in waxy corn cultivation (Suwardi and Suwarti 2020)

A study by (Marwiyah and Aziz 2024) Previous studies have shown that application of ammonium sulfate influences maize growth and production. ZA can increase plant height, leaf number, stem diameter, leaf greenness, and crop productivity. Previous studies have generally focused on plant growth and yield. Waxy corn on the other hand, is evaluated not only in terms of yield but also of quality, as it is widely consumed as boiled corn, grilled corn, and various processed food products. A key parameter for assessing the quality of waxy corn is total soluble solids, which are associated with sugar content and sweetness. Higher TSS levels may contribute to a sweeter taste, thereby enhancing consumer acceptability.

The sweetness of waxy corn is influenced by the photosynthates produced by the plant during its growth. Efficient photosynthesis can enhance sugar accumulation in the kernels, thereby potentially increasing total soluble solids. Although ammonium sulfate is known to improve maize growth and yield, research on the effects of different ZA application rates on TSS in waxy corn remains limited. Previous investigations have primarily focused on plant growth characteristics and yield performance, leaving insufficient information regarding the role of ZA fertilizer in improving the quality of waxy corn yield. The existing research gap underscores the importance of evaluating information on waxy corn quality and the findings of existing studies (Adiyoga, Sulistyono, and Djarwatiningsih 2025).

Studies on the effects of ZA on waxy corn have primarily focused on plant growth and yield, whereas its effects on crop quality, particularly total soluble solids content, remain relatively underexplored. Yield quality is an important factor influencing consumer acceptance of waxy corn. Therefore, this study was conducted to obtain information on the effects of different ammonium sulfate rates on the growth, yield components, and total soluble solids content of waxy corn.

Literature Review

Waxy Corn

Waxy corn (*Zea mays var. ceratina*) is recognized as a valuable food crop with considerable economic value and potential for development to support food diversification. It is extensively utilized in food processing owing to its savory taste and soft, tender, and sticky texture. These characteristics are associated with its high amylopectin content, which approaches 100% due to the presence of the recessive *waxy* (*wx*) gene that limits amylose accumulation. Starch is the primary component of maize kernels, accounting for approximately 72–73% of their composition, with amylopectin being the main component responsible for the distinctive characteristics of waxy corn (Astiko et al. 2024). Despite its potential, waxy corn cultivation continues to encounter constraints, particularly in efforts to enhance crop productivity and quality yield quality. Productivity is influenced by genetic characteristics, environmental conditions, and cultivation practices, including nutrient management. Vegetative growth characteristics, such as plant height, leaf number, and stem diameter, are important indicators of crop development because they are associated with photosynthetic capacity and assimilate production.

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Adequate vegetative growth supports the development of reproductive organs, including ear formation and kernel filling. Therefore, improving nutrient availability through appropriate fertilization is essential to support plant growth and increase waxy corn productivity.

Previous research by (Marwiyah and Aziz 2024) demonstrated that ammonium sulfate fertilizer application at a rate of 675 kg ha^{-1} could improve the reproductive development of waxy corn. This finding indicates that nutrient management, particularly the supply of nitrogen and sulfur, is an important factor in supporting ear development and yield formation. However, the appropriate fertilizer rate may vary depending on soil fertility, environmental conditions, and crop nutrient requirements. Therefore, evaluating different ammonium sulfate application rates is necessary to determine their effects on waxy corn growth and yield.

Ammonium Sulfate

Ammonium sulfate (ZA) is an inorganic fertilizer containing approximately 21% nitrogen (N) and 24% sulfur (S), both of which play important roles in plant growth and development. Nitrogen is an essential component of chlorophyll, amino acids, proteins, and enzymes involved in photosynthesis and plant metabolism. Sulfur contributes to the synthesis of sulfur-containing amino acids, proteins, and other essential compounds required for normal plant growth. The combined availability of these nutrients can support vegetative development and reproductive processes, although plant responses depend on the fertilizer application rate and the nutrient status of the soil (Saputri 2026).

The effects of ammonium sulfate fertilization on maize growth and yield are closely related to ensuring an adequate supply of essential nutrients during the entire crop growth cycle is crucial for achieving optimal plant development. Adequate nitrogen supports leaf development, chlorophyll formation, and photosynthetic activity, while sulfur contributes to protein synthesis and nitrogen utilization. These processes may improve plant height, leaf development, and stem growth, which subsequently support assimilate production and reproductive development. (Marwiyah and Aziz 2024) reported that ZA application at 675 kg ha^{-1} had the potential to improve the reproductive growth of waxy corn. This finding provides a basis for further evaluating ZA fertilizer rates in relation to vegetative growth traits and yield-related parameters including ear number, ear diameter, ear length, and ear weight.

However, excessive fertilizer application does not necessarily result in a parallel improvement in crop growth and yield. Effectiveness of fertilization depends on the balance between nutrient supply and crop requirements, as well as soil and environmental conditions. Therefore, determining an appropriate ZA application rate is important to improve nutrient-use efficiency and achieve favorable growth and yield responses in waxy corn.

Total Soluble Solids (TSS)

Total soluble solids (TSS) are a key indicator for assessing the chemical characteristics and quality of harvested corn. TSS values, expressed in degrees Brix (°Brix), represent the concentration of soluble substances in plant extracts, including sugars, various soluble compounds, organic acids and amino acids, and other dissolved substances. In maize kernels, the accumulation of these compounds is influenced by genetic characteristics, maturity stage, and nutrient availability during crop development. Therefore, TSS can reflect alterations in kernel composition and soluble compound accumulation (Bharathi et al. 2020),

Nutrient availability, particularly nitrogen and sulfur, may influence TSS accumulation through their roles in photosynthesis and plant metabolism. Nitrogen supports chlorophyll formation and the synthesis of proteins and enzymes involved in photosynthetic processes, whereas sulfur contributes to amino acid and protein synthesis and nitrogen metabolism (Zhao et al. 2013). Adequate nutrient availability may

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promote leaf development and photosynthetic activity, thereby supporting assimilate production and its subsequent allocation to developing ears and kernels. These processes may contribute to changes in the concentration of soluble compounds and, consequently, TSS values.

The relationship between kernel composition and TSS is also influenced by the genetic characteristics of maize. Waxy corn contains a high proportion of amylopectin due to the recessive *wx* gene, whereas sweet corn carrying the *sh₂* gene is characterized by increased sugar accumulation and reduced starch accumulation in the kernels. These differences in carbohydrate metabolism contribute to variations in kernel composition and soluble solids content between maize types (Mehta et al. 2017). Accordingly, evaluating TSS in waxy corn under different ZA application rates it is essential to determine whether nutrient management can influence not only crop growth and yield but also kernel quality.

Research Method

The field experiment was performed between March and June 2026 at a designated research site in Larangan Subdistrict, Harjamukti District, Cirebon City, West Java, Indonesia, and at the Postharvest Laboratory of Universitas Swadaya Gunung Jati. Experimental site was situated at an elevation of 16 m above sea level. The materials used in this study included waxy corn seeds (Kumala F1), ammonium sulfate (ZA) fertilizer, goat manure, NPK fertilizer, and insecticide. The equipment included soil preparation tools such as hoes, shovels, and hand hoes, as well as rulers or measuring tapes, buckets, weighing scales, stationery, and a camera. Study employed a Randomized Complete Block Design (RCBD) with six ammonium sulfate application rates, each replicated four times, resulting in a total of 24 experimental units. The six ZA fertilizer treatments were as follows: Z_0 = 0 kg ha^{-1}, Z_1 = 75 kg ha^{-1}, Z_2 = 150 kg ha^{-1}, Z_3 = 225 kg ha^{-1}, Z_4 = 300 kg ha^{-1}, and Z_5 = 375 kg ha^{-1}. Data obtained from the primary observations were statistically analyzed using analysis of variance (ANOVA), with the F-test based on a single-factor linear model under the Randomized Complete Block Design (RCBD). When the ANOVA indicated a statistically significant treatment effect, the analysis was followed by Duncan's Multiple Range Test (DMRT) at the 5% significance level.

Land Preparation

The experimental procedures involved several phases, commencing with seed preparation and land preparation, planting, ZA fertilization, crop maintenance, and harvesting. Healthy, intact Kumala F1 waxy corn seeds with high germination potential were selected for planting. Land preparation began with the removal of weeds and debris, followed by soil tillage involving turning and loosening the soil at two weeks before planting (−2 WAP) and one week before planting (−1 WAP). During the second tillage operation, the experimental area was divided into 24 plots, each measuring 2.1 m × 2.0 m, with drainage channels 0.2 m wide. Subsequently, goat manure was applied uniformly to each plot at a rate of 2 t ha^{-1}, incorporated thoroughly into the soil, and left for seven days before planting.

Planting

Planting was carried out by dibbling seeds into holes at seeds were placed at a depth of 3 cm, with 70 cm × 20 cm. One seed was placed in each planting hole, resulting in a total of 576 seeds. The planting holes were then covered with rice husk charcoal. The germination rate of Kumala F1 waxy corn was 96.88%, with 558 seeds successfully germinating.

Crop Maintenance

Crop maintenance included irrigation, replanting, fertilization, and weed, pest, and disease management. Irrigation was performed twice daily, in the morning and afternoon. Replanting was conducted at 7 days after planting (DAP) using reserve seedlings. NPK fertilizer was applied at 200 kg ha^{-1} at planting and 14 DAP, while ZA fertilizer was applied according to the respective treatment rates at 7 and 21 DAP.

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Weeding was performed manually on a weekly basis, starting at 14 DAP until shortly before harvest. Pest control measures were implemented at 40 DAP using Regent insecticide at 1 mL L^{-1} to control armyworms, aphids, stem borers, and corn earworms.

Harvesting

Waxy corn was harvested at 65 DAP based on the maturity indicators, including yellowish-green husks, dark-brown and drying silks, and fully filled, firm ears. Harvested ears were separated according to sampled plants and experimental plots for yield evaluation. After yield measurements, kernels were shelled for total soluble solids analysis, which was conducted one day after harvest.

Observation Parameters

The evaluated variables encompassed vegetative growth traits, yield components, and total soluble solids content. Vegetative growth parameters included plant height, number of leaves, and stem diameter, measured at 28, 35, and 42 DAP. Plant height was determined by measuring the distance from the soil surface to the tip of the longest leaf, whereas leaf number was determined by counting fully developed leaves, and stem diameter was measured 10 cm above the soil surface using a caliper.

Yield components were assessed based on the total number of ears produced per plant and per experimental plot., husked ear diameter, ear length, and ear weight plant and plot. Ear diameter was measured at the middle section of the ear using a caliper, while ear length was measured from the base to the tip using a ruler. Ear numbers were determined by counting harvested ears, their respective ear weights were determined using a digital balance.

A refractometer was employed to assess total soluble solids, with the measurements expressed in °Brix. Measurements were performed on 24 samples, comprising six fertilizer treatments and four replications. Kernels from each sample were ground using a mortar and pestle, and the extracted juice was filtered. Three drops of filtered juice were placed on the refractometer prism, and the TSS value was recorded.

Results and Discussion

Plant Height (cm)

This study showed that different ammonium sulfate fertilizer application rates had a significant effect on waxy corn plant height at 28, 35, and 42 days after planting (DAP), as the plants were transitioning from the late vegetative stage to the early reproductive stage. Duncan's Multiple Range Test (DMRT) was subsequently applied to assess variations in average plant height across the experimental.

Tabel 1. Effect of ZA Fertilizer Plant Height Rates at 28, 35, and 42 Days After Planting (DAP)

Treatment	Plant Height (cm)					
	28 DAP		35 DAP		42 DAP	
Z_0 (ZA 0 kg ha^{-1})	84,40	a	120,85	a	168,00	a
Z_1 (ZA 75 kg ha^{-1})	87,45	ab	127,35	ab	178,00	ab
Z_2 (ZA 150 kg ha^{-1})	102,75	bc	141,50	bc	185,45	bc
Z_3 (ZA 225 kg ha^{-1})	100,95	c	152,45	c	203,80	c
Z_4 (ZA 300 kg ha^{-1})	117,70	d	172,10	d	214,05	d
Z_5 (ZA 375 kg ha^{-1})	109,40	c	150,70	c	201,00	c

Description: Means with the same letter in each column indicate no statistically signaticant difference, as determined by Duncan's Multiple Range Test (DMRT) at a 5% significance level.

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The data presented in Table 1 reveal that ammonium sulfate application had a significant effect on waxy corn plant height. Treatment Z_4 (300 kg ZA ha^{-1}) Achieved the maximum plant height of 214,05 cm, whereas treatment Z_0 (without ZA fertilizer application) resulted in the shortest plants, at 168,00 cm. These results indicate that a ZA application rate of 300 kg ha^{-1} was optimal for promoting plant height. ZA fertilizer contains 21% nitrogen (N) and 24% sulfur (S), which are essential for protein synthesis, essential amino acid formation, and nitrogen metabolism. These nutrients can improve nitrogen utilization efficiency, thereby promoting better vegetative growth.

Increasing the ZA application rate to treatment Z_5 (375 kg ha^{-1}) did not further increase plant height. The observed response may be attributed to fertilizer application rate exceeded the plant's optimal nutrient requirements, resulting in reduced nutrient use efficiency and less optimal vegetative growth (Adiyoga et al. 2025).

Number of Leaves (leaves)

The number of leaves was determined by counting all fully developed and intact leaves on each sampled plant. Leaf counts were recorded at 28, 35, and 42 days after planting. The results showed that leaf number was significantly influenced by the ammonium sulfate application rate. The mean number of leaves for each treatment was further analyzed using Duncan's Multiple Range Test (DMRT).

Tabel 2. Effect of ZA Fertilizer Application on Number of Leaves Rates at 28, 35, and 42 Days After Planting (DAP)

Treatment	Number of Leaves (leaves)		
	28 DAP	35 DAP	42 DAP
Z_0 (ZA 0 kg ha^{-1})	6,95 a	8,65 a	9,90 a
Z_1 (ZA 75 kg ha^{-1})	7,35 ab	9,00 ab	10,50 b
Z_2 (ZA 150 kg ha^{-1})	8,00 b	9,60 bc	10,75 bc
Z_3 (ZA 225 kg ha^{-1})	8,85 c	10,35 d	11,00 c
Z_4 (ZA 300 kg ha^{-1})	9,65 d	11,05 e	12,05 d
Z_5 (ZA 375 kg ha^{-1})	7,95 b	10,05 cd	10,75 bc

Description: Means with the same letter in each column indicate no statistically signaticant difference, as determined by Duncan's Multiple Range Test (DMRT) at a 5% significance level.

The presented in Table 2 reveal that, ammonium sulfate fertilizer treatment significantly affected leaf development in plants waxy corn at 28, 35, and 42 days after planting. Treatment Z_4 (300 kg ZA ha^{-1}) produced the highest number of leaves, with an average of 12,05 leaves plant, whereas treatment Z_0 (without ZA fertilizer application) produced the lowest number, averaging 9,90 leaves per plant. These results indicate that ZA fertilizer application at a rate of 300 kg ha^{-1} provided nitrogen and sulfur in a balanced supply to support leaf development during the plant's vegetative development stage. Nitrogen plays an important role in chlorophyll and protein synthesis, while sulfur supports the formation of amino acids, cysteine and methionine, thereby contributing to plant metabolic processes. These two nutrients promote leaf formation, increase the photosynthetic surface area, and support vegetative growth and the development of yield components. In terms of fertilizer use efficiency, increasing the ZA application rate to 300 kg ha^{-1} enhanced leaf production, indicating that this rate provided a more optimal nutrient supply. However, increasing the application rate to 375 kg ha^{-1} did not result in a higher number of leaves compared with the 300 kg ha^{-1} rate. This suggests that additional ZA fertilizer beyond this rate did not provide a proportional benefit to leaf development. Therefore, the application rate of 300 kg ha^{-1} povided the most favorable response among the rates tested to promote leaf development in waxy corn plants waxy corn (Putra, Ikhsan, and Virdaus 2021).

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Stem Diameter (cm)

Stem diameter was determined using a vernier caliper at a standardized position 10 cm above the soil surface. The results showed that ammonium sulfate fertilizer rates had a significant effect on stem diameter at 28, 35, and 42 days after planting (DAP). Duncan's Multiple Range Test (DMRT) was further applied to assess variations in the mean values stem diameter among the different fertilizer treatments.

Tabel 3. Effect of ZA Fertilizer Application on Stem Diameter Rates at 28, 35, and 42 Days After Planting (DAP)

Treatment	Stem Diameter (cm)		
	28 DAP	35 DAP	42 DAP
Z_0 (ZA 0 kg ha^{-1})	1,65 a	2,02 a	2,21 a
Z_1 (ZA 75 kg ha^{-1})	1,81 ab	2,14 ab	2,33 a
Z_2 (ZA 150 kg ha^{-1})	2,02 bc	2,18 b	2,52 b
Z_3 (ZA 225 kg ha^{-1})	2,18 c	2,35 c	2,64 b
Z_4 (ZA 300 kg ha^{-1})	2,45 d	2,66 d	3,00 c
Z_5 (ZA 375 kg ha^{-1})	2,13 c	2,33 c	2,58 b

Description: Means with the same letter in each column indicate no statistically signaticant difference, as determined by Duncan's Multiple Range Test (DMRT) at a 5% significance level.

The data presented in Table 3, indicate that ammonium sulfate application had a significant effect on the stem diameter of waxy corn at 28, 35, and 42 days after planting (DAP). Treatment Z_4 (300 kg ZA ha^{-1}) produced the largest stem diameter, measuring 3,00 cm, whereas Z_0 (without ZA application) produced the smallest stem diameter, measuring 2,21 cm. These results indicate that ZA application at 300 kg ha^{-1} was the optimal rate for promoting the development of thicker and stronger stems. Nitrogen and sulfur play important roles contributing to protein biosynthesis and the formation of supporting stem tissues, thereby improving the mechanical strength of plants and the efficiency of water, nutrient, and photosynthate transport (Nuryah, Astiko, and Muthahanas 2023).

Husked Ear Diameter and Length (cm)

Husked ear diameter was determined using a vernier caliper at the central section of the ear, while husked ear length was determined using a ruler by measuring the distance from the apical end to the basal end of the ear. The results showed that ammonium sulfate fertilizer rates had a significant effect on husked ear diameter and length. Duncan's Multiple Range Test (DMRT) was subsequently Conducted to assess variations in the mean diameter and length of husked ears among the different fertilizer treatments.

Tabel 4. Effect of ZA Fertilizer Application on Husked Ear Diameter and Length

Treatment	Husked Ear Diameter (cm)	Husked Ear Length (cm)
Z_0 (ZA 0 kg ha^{-1})	4,82 a	22,30 a
Z_1 (ZA 75 kg ha^{-1})	5,81 b	26,35 b
Z_2 (ZA 150 kg ha^{-1})	6,11 b	28,40 bc
Z_3 (ZA 225 kg ha^{-1})	6,39 bc	29,30 c
Z_4 (ZA 300 kg ha^{-1})	7,24 d	37,10 e

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Z_5 (ZA 375 kg ha^{-1})	6,74	cd	33,05	d

Description: Means with the same letter in each column indicate no statistically signaticant difference, as determined by Duncan's Multiple Range Test (DMRT) at a 5% significance level.

The data presented in Table 4 indicate that ammonium sulfate application had a significant effect on the husked ear diameter of waxy corn. Treatment Z_4 (300 kg ZA ha^{-1}) produced the largest ear diameter, measuring 7,24 cm, whereas Z0 (without ZA application) produced the smallest diameter, measuring 4,82 cm. These results indicate that the application of ZA at 300 kg ha^{-1} provided an optimal nutrient supply to support ear enlargement. The nitrogen and sulfur contents of ZA fertilizer support cell division and cell expansion by enhancing protein synthesis and plant metabolic activity, thereby increasing ear diameter (Marwiyah and Aziz 2024).

As shown in Table 4, ammonium sulfate application had a significant effect on the husked ear length of waxy corn. Treatment Z_4 (300 kg ZA ha^{-1}) produced the longest ears, measuring 37,10 cm, whereas Z_0 (without ZA application) produced the shortest ears, measuring 22,30 cm. The findings suggest that ZA application at 300 kg ha^{-1} adequately supplied nitrogen and sulfur, which play important roles in ear tissue formation and elongation, thereby promoting increased ear length (Rifaldi and Barus 2023).

Ear length decreased slightly under treatment Z_5 (375 kg ZA ha^{-1}). This decrease was presumably due to excessive fertilizer application, which may have disrupted nutrient balance and reduced the efficiency of photosynthate translocation to reproductive organs.

Number of Ears Plant and Plot (ears)

In this study, corn ears were harvested individually and collected in separate plastic bags for each plant when determining the number of ears per plant, and in sacks for each plot when determining the number of ears per plot to prevent sample mixing. The ears were then counted. The results showed that ammonium sulfate fertilizer rates had a significant effect on the number of ears plant and plot. Duncan's Multiple Range Test (DMRT) was subsequently performed to compare the mean number of ears plant and plot among the different fertilizer treatments.

Tabel 5. Effect of ZA Fertilizer Application on the Number of Husked Ears Plant and Plot

Treatment	Number of Husked Ears			
	Plant		Plot	
Z_0 (ZA 0 kg ha^{-1})	1,10	a	30,00	a
Z_1 (ZA 75 kg ha^{-1})	1,30	b	30,75	a
Z_2 (ZA 150 kg ha^{-1})	1,35	bc	32,50	b
Z_3 (ZA 225 kg ha^{-1})	1,40	bc	33,00	b
Z_4 (ZA 300 kg ha^{-1})	1,60	d	34,75	c
Z_5 (ZA 375 kg ha^{-1})	1,50	cd	33,25	b

Description: Means with the same letter in each column indicate no statistically signaticant difference, as determined by Duncan's Multiple Range Test (DMRT) at a 5% significance level.

The experimental findings presented in Table 5, demonstrated that ammonium sulfate fertilizer application had a significant effect on the number of ears waxy corn plant. Treatment Z_4 (300 kg ZA ha^{-1}) produced the highest number of ears, with an average of 1,60 ears plant, whereas Z_0 (without ZA application) produced the lowest number, with an average of 1,10 ears plant. These results indicate that treatment Z_4 (300 kg ZA ha^{-1}) may enhance photosynthesis, protein synthesis, and nutrient-use efficiency, thereby optimizing the role of ZA fertilizer in ear formation and development (Tabri, Aqil, and Efendi 2018).

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As shown in Table 5, ammonium sulfate fertilizer applied treatment significantly influenced the number of ears waxy corn plot. Treatment Z_4 (300 kg ZA ha^{-1}) produced the highest number of ears, with an average of 34,75 ears per plot, whereas Z_0 (without ZA application) produced the lowest number, with an average of 30,00 ears per plot. These results indicate that treatment Z_4 (300 kg ZA ha^{-1}) may promote ear formation and kernel filling, thereby increasing ear weight and crop productivity plot. The number of ears plot decreased slightly under treatment Z_5 (375 kg ZA ha^{-1}). This decrease was presumably due to excessive fertilizer application, which may have reduced nutrient-use efficiency and limited further improvements in crop productivity (Lihiang and Lumingkewas 2020).

Ear Weight Plant and Plot (g/kg)

Ear weight plant refers in terms of the mean weight of ears harvested from an individual plant, whereas ear weight plot refers to the total ear weight harvested from each experimental plot. Weighing was conducted after harvest. The experimental findings indicated that ammonium sulfate fertilizer rates had a significant effect on ear weight plant and plot. Duncan's Multiple Range Test (DMRT) was subsequently performed to compare the mean ear weight plant and plot among the different fertilizer treatments.

Tabel 6. Effect of ZA Fertilizer on Husked Ear Weight Plant and Plot

Treatment	Husked Ear Weight	
	Plant (g)	Plot (kg)
Z_0 (ZA 0 kg ha^{-1})	286,90 a	8,55 a
Z_1 (ZA 75 kg ha^{-1})	349,25 b	10,38 b
Z_2 (ZA 150 kg ha^{-1})	365,85 b	11,78 b
Z_3 (ZA 225 kg ha^{-1})	368,60 b	12,38 c
Z_4 (ZA 300 kg ha^{-1})	452,65 d	14,85 e
Z_5 (ZA 375 kg ha^{-1})	409,90 c	13,62 d

Description: Means with the same letter in each column indicate no statistically signaticant difference, as determined by Duncan's Multiple Range Test (DMRT) at a 5% significance level.

Ammonium sulfate application rate Z_0 (without ZA application) produced the lowest ear weight, at 286,90 g plant. These results indicate that ZA application at 300 kg ha^{-1} may provide an adequate nutrient supply to support ear formation and kernel filling, thereby increasing ear weight. Ear weight decreased slightly under treatment Z_5 (375 kg ZA ha^{-1}). This decrease was presumably due to excessive fertilizer application, which may have disrupted nutrient balance and reduced the efficiency of photosynthate translocation to the ears (Anwar et al. 2023).

The data presented in Table 6 indicate that, ammonium sulfate fertilizer application significantly affected ear weight plot of waxy corn. Treatment Z_4, with an application rate of 300 kg ha^{-1}, produced the highest ear weight of 14,85 kg plot, representing an increase of approximately 73.68% compared with treatment Z_0 8,55 kg plot, which received no ZA fertilizer. This increase indicates that adequate nitrogen and sulfur availability can support crop growth and ear development. Nitrogen contributes to chlorophyll formation and photosynthetic activity, thereby enhancing assimilate production and its translocation to developing ears. Meanwhile, sulfur plays an important role in amino acid and protein synthesis, supporting plant metabolism and nutrient utilization.

The present findings are consistent with previous research conducted by (Silva et al. 2012), who reported that ammonium sulfate fertilization increased maize productivity and ear production components compared with the unfertilized treatment. Their findings further indicated that nitrogen and sulfur

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accumulation in maize plants was positively associated with crop productivity. Similarly, (Amanullah et al. 2016) found that nitrogen fertilization, particularly ammonium sulfate, improved maize yield and its components compared with the unfertilized control. Differences in the magnitude of yield responses may occur due to variations in maize genotypes, fertilizer application rates, soil nutrient status, and environmental factors. This is supported by (Goyal et al. 2021), who reported that sulfur application did not consistently increase maize grain yield across different experimental locations, indicating that crop responses to sulfur fertilization depend on site-specific conditions and existing soil sulfur availability.

In the present study, the highest ear weight was obtained at 300 kg ha^{-1} ZA, whereas increasing the application rate to 375 kg ha^{-1} did not result in further yield improvement, indicating that the crop response to ZA fertilizer was influenced by the availability of nutrients and the effectiveness of fertilizer application rates. Therefore, the 300 kg ha^{-1} treatment provided the most favorable response in terms of ear weight per plot under the experimental conditions.

Total Soluble Solids (°Brix) of Waxy Corn

Total soluble solids (TSS) were determined through refractometer analysis, with the results reported in °Brix. The waxy corn kernels were separated from the ears and crushed to extract the kernel juice. A drop of the extracted juice was placed on a calibrated refractometer, and the TSS value was then read and recorded. The results of the analysis showed that ammonium sulfate fertilizer rates had a significant effect on the total soluble solids content of waxy corn kernels. Duncan's Multiple Range Test (DMRT) was subsequently performed to compare the mean TSS values among the different fertilizer treatments.

Tabel 7. Total Dissolved Solids (°Brix) of Waxy Corn

Treatment	Total Soluble Solids (°Brix)	
Z_0 (ZA 0 kg ha^{-1})	13,05	a
Z_1 (ZA 75 kg ha^{-1})	14,10	b
Z_2 (ZA 150 kg ha^{-1})	14,70	bc
Z_3 (ZA 225 kg ha^{-1})	14,95	c
Z_4 (ZA 300 kg ha^{-1})	16,65	e
Z_5 (ZA 375 kg ha^{-1})	15,65	d

Description: Means with the same letter in each column indicate no statistically signaticant difference, as determined by Duncan's Multiple Range Test (DMRT) at a 5% significance level.

Data presented in Table 7 indicate that, ammonium sulfate fertilizer application had a significant effect on total soluble solids content. This effect was associated with assimilate availability, which influences the formation and accumulation of soluble compounds in the kernels, as reflected by the TSS values. Treatment Z_4 (ZA at 300 kg ha^{-1}) produced the highest TSS value of 16,65 °Brix. This indicates that the availability of nitrogen and sulfur may have supported photosynthetic activity and plant metabolism, thereby promoting more optimal ear development, kernel filling, and the accumulation of soluble compounds. In contrast, treatment Z_0 (without ZA application) produced the lowest TSS value of 13,05 °Brix. These results suggest that ZA application at a rate of 300 kg ha^{-1} may enhance sugar accumulation in the kernels, resulting in a higher TSS value (°Brix) (Zubaidi 2021).

The highest °Brix value obtained in this study was 16,65 °Brix, which recorded a lower value compared with the reported range of 17,6 – 26,6 °Brix for super-sweet corn (sh_2). This difference was presumably attributable to the genetic characteristics of waxy corn, which carries the wx (waxy) gene, resulting in an endosperm dominated by amylopectin, whereas super-sweet corn carrying the sh_2 gene accumulates higher levels of soluble sugars (Mehta et al. 2017).

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Conclusion

The findings indicated that ammonium sulfate fertilizer application significantly affected growth, yield, and total soluble solids content of waxy corn. Treatment Z_4, with a ZA application rate of 300 kg ha^{-1}, produced the highest plant height (214,05 cm), number of leaves (12,05 leaves plant), and stem diameter (3,00 cm) at 42 days after planting (DAP). Regarding yield components, this treatment resulted in an ear diameter of 7,24 cm, a husked ear length of 37,10 cm, 1,60 ears per plant, 34,75 ears plot, an ear weight of 452,65 g plant, and a total ear weight of 14,85 kg plot. Furthermore, the highest TSS content was recorded at 16,65 °Brix. These findings indicate that the application of ZA fertilizer at 300 kg ha^{-1} provided the best response in terms of vegetative growth, yield, and quality of waxy corn under the environmental conditions of this study. This response was presumably associated with adequate nitrogen and sulfur availability, which supported chlorophyll synthesis, photosynthetic activity, plant metabolism, and kernel development. Future investigations should evaluate the agronomic performance of different ammonium sulfate application rates in improving waxy corn growth, yield, and quality. ZA fertilizer at different locations and during different growing seasons to determine the consistency of crop performance under diverse environmental conditions. In addition, testing a wider range of ZA application rates, particularly around 300 kg ha^{-1}, is necessary to identify the optimum application rate more precisely and assess fertilizer use efficiency for waxy corn cultivation.

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