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PURPLE WAXY CORN (*ZEA MAYS* VAR. CERATINA KULESH) RESPONSE TO POTASSIUM SUPPLEMENTATION FOR MORPHO-YIELD TRAITS AND ANTHOCYANINS

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SUMMARY

The following study aimed to determine the effects of potassium fertilization on the growth and anthocyanin content of purple waxy corn (*Zea mays* L.). This research proceeded in a split-plot design with factorial arrangements, two factors, and three replications. The first factor comprised four purple waxy corn genotypes designated as main plots, i.e., two cultivars (Pulut URI and Srikandi Ungu) and two strains [1-3-1-2-B-II-(C4)-II, and 162.1-1-II-(C4)-II]. The second factor was the four levels of potassium fertilizer used as subplots: 0, 50, 100, and 150 kg ha^{-1}. The findings revealed the cultivar Pulut URI exhibited superior performance in the number of leaves and 1000-seed weight. The cultivar Srikandi Ungu showed the best performance in producing more anthocyanin content. The maize genotype 1-3-1-2-B-II-(C4)-II gave the best results for plant height, peeled cob weight, seeds per cob, and seed yield. On average, the potassium fertilizer at 150 kg ha^{-1} appeared with the maximum plant height, number of leaves, cob weight, seeds per cob, and seed production. The cultivar Srikandi Ungu with potassium fertilizer 150 kg ha^{-1} emerged as the best strategy by giving superior results for anthocyanin content and 1000-seed weight.

Keywords: *Zea mays* var. Ceratina Kulesh, cultivars, potassium fertilization, genotype, anthocyanin content

Key findings: Purple waxy corn (*Z. mays* L.) genotypes showed varied performance in anthocyanin content. Cultivar Srikandi Ungu with potassium fertilization of 150 kg ha^{-1} was the best strategy for giving superior results for anthocyanin content and 1000-seed weight. Therefore, purple waxy corn with the highest anthocyanin content requires further development as a food alternative.

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INTRODUCTION

In Indonesian community, the lifestyle changes rapidly with time. Such changes range from unhealthy diets to a lack of physical activity and exercise. Consuming snacks high in fat and low in fiber, however, causes an imbalance with physical activity. All these unhealthy foods lead to various diseases, such as diabetes mellitus, coronary heart disease, cholesterol, and hypertension. Food diversification is an effort to encourage people to vary the staple foods consumed so as not to focus on one food type. Diversifying food also aims to enhance the supply of various food commodities to provide a diversity of community food consumption. Food security through diversification needs to pay attention to local resource-based food. In turn, it is diverse, nutritionally balanced, improving food consumption patterns, food quality, and safety, and utilizing appropriate technology and efforts to enhance the benefits of traditional foods (Nainggolan, 2004; MAFSA, 2021).

Purple waxy corn (*Zea mays* L.) is unique with purple seeds. According to the CRC (2017), the higher content of anthocyanins causes the seed's purple color. Anthocyanins are phenolic compounds found in some colored purple plants. Anthocyanins are a class of organic chemical compounds that can dissolve in polar solvents, affecting the provision of orange, red, purple, blue, and black shades in higher plants, such as flowers, fruits, seeds, vegetables, and tubers (Du *et al*., 2015). Waxy corn with anthocyanin content works as an antioxidant in the body, prevents atherosclerosis and blood clogging disease, protects the stomach from damage, inhibits tumor cells, improves eyesight, and functions as an anti-inflammatory compound protecting the brain from damage (CRC, 2013).

According to Jones (2005), the average anthocyanin content of the waxy corn is around 1,640 mg/100 g fresh weight. Jing (2006) added that the anthocyanin content of purple waxy corn is great, at 290 to 1,323 mg/100 g dry weight, with 35% to 54% anthocyanin acylation. According to Salinas *et al*. (2016), in corn plants, the anthocyanin content also varies in both seeds and corn cobs. The white corn seeds per kilogram of dry matter contain 9–15.8 mg of anthocyanins, 163.9 mg in young corn seeds, 342.2 mg in blue corn seeds, 1.270 mg in red corn seeds, 1.277 mg in purple corn seeds, and 5.290 mg in black corn seeds (Ramirez *et al*., 2018). However, according to Nursa'adah *et al.'s* (2017) findings, 100 g of purple corn seeds contain 185.1 mg of anthocyanins.

Purple waxy corn (*Zea mays* L. var. Ceratina Kulesh) is one of the local corns developed in Indonesia. Waxy corn has germplasm of various colors, ranging from orange, yellow, purple, red, and black. The purple color of waxy corn indicates active components, such as β-carotene, anthocyanins, especially the Chrysanthemin type (cyanidin-3-O-glucoside and pelargonidin 3-O-B-D-glucoside), and other flavonoids, functioning as antioxidants (CRC, 2019).

In purple waxy corn, its production constraints are similar to those of yellow or white waxy corn, namely, poor cultivation techniques, inadequate fertilization, and continuous planting of local cultivars. In South Sulawesi, Indonesia, purple waxy corn is rarely available for cultivation; therefore, purple waxy corn's development is currently in progress to an approved cultivar with high anthocyanin content and popular flavor. One expects that purple waxy corn can become ready for food diversification. The Cereals Research Center in Maros Regency has discovered a purple waxy corn cultivar, Srikandi Ungu, and currently, they are developing various purple waxy corn strains to obtain high-yielding purple waxy corn cultivars. In 2018, the focus was on the ongoing supervision of areas in six provinces of Indonesia, viz., Jambi, West Nusa Tenggara, East Nusa Tenggara, South Sulawesi, Central Sulawesi, and Southeast Sulawesi (CRC, 2019).

South Sulawesi is one of the best waxy corn producing regions in Indonesia, as its waxy corn has a high amylopectin content

(>90%) with a low amylose content, as compared to other regions; the taste of South Sulawesi waxy corn is more savory, fluffy, and soft (Juhaeti *et al*., 2013). In line with the development of superior cultivar technology, land and water management, soil fertility dynamics, and nutrient status mapping, fertilizer recommendations must continue their refinement for their effective and efficient uses. Fertilizer efficiency is vital in increasing production and farmers' income, as well as better sustainability of the production system, the environment, and saving energy resources (MAR, 2007).

In waxy corn, the recommended potassium (K) fertilization has a rate of 50 to 100 kg ha^{-1}. The K's primary role is to work as an enzyme activator in the anthocyanin biosynthesis process, serves to reduce the negative effects of N fertilizer, and strengthens plant stems. Moreover, it increases the formation of green leaves and carbohydrates in fruit and plant resistance to disease, transports glucose and starches, and enhances protein. In the flowering phase, the K accumulation has reached 60% to 75% of its needs. K deficiency before and at the flowering phase will cause the plant leaf tips to look yellow until dry, as seen especially on lower leaves, causing stunted plants. Consequently, disrupting the process of transporting nutrients and photosynthesis and, eventually, affecting production. In crop plants, the K deficiency can also impair several physiological and biochemical processes, such as water balance, enzyme activity, and decreased tolerance of plants to biotic and abiotic stress conditions (Tu *et al*., 2017). Based on the research in grape plants, not using K or moderate K conditions with increasing N levels will reduce anthocyanin content, while a high K and N will reduce anthocyanin content (Delgado *et al*., 2006).

Corn kernels contain about 25% of potassium after harvest, with the rest found in the stems and cobs. More potassium is essential at the generative phase, and especially when the panicles come out, the need for potassium increases by about 75%. Potassium deficiency can result in a low corn yield of about 10%. Potassium participates in plant physiological processes, affecting transpiration, other mineral uptake, and controlling the plant parts for general growth (Alfian and Purnamawati, 2019). Likewise, potassium manages the photosynthetic activity and supports the carbohydrate translocation, thus influencing the anthocyanin content (Pirie and Mullins, 1977). Based on the above discussion, a study commenced to assess the anthocyanin content and grain yield of purple waxy corn cultivars and strains with the addition of several doses of potassium. Therefore, the presented study aimed to determine the effects of potassium fertilization on the growth, production, and anthocyanin content of purple waxy corn.

MATERIALS AND METHODS

Experimental site and procedure

The timely research on purple waxy corn (*Z. mays* L.) began in 2023 in Kalaserena Village, District Bontonompo, Gowa Regency, South Sulawesi, Indonesia. This research proceeded in a split plot design with factorial arrangements, two factors, and three replications (Table 1). Based on these two factors, 16 treatment combinations materialized, with each treatment combination repeated three times, thus totaling 48 experimental units.

Crop husbandry

Before sowing the waxy corn, the land preparation consisted of cleaning, plowing, and forming into beds. Tillage sought to make the soil layer loose to improve soil aeration and remove weeds and previous crop debris. After

Table 1. The main plots and subplots used in the study.

The waxy corn genotypes (g) placed in the main plots	
G1	Pulut URI
G2	Srikandi Ungu
G3	1-3-1-2-B-II-(C4)-II
G4	162.1-1-II-(C4)-II
The potassium (K) fertilizer levels used in the subplots	
K0	No potassium
K1	50 kg ha^{-1}
K2	100 kg ha^{-1}
K3	150 kg ha^{-1}

the loosening of the soil, the making of beds continued, measuring 3 m × 2 m and ±30 cm high. The distance between beds was 100 cm. After the beds' preparation, manure application ensued by sprinkling it on the soil surface and then allowing it to stand. After two weeks, the land was ready for use.

The waxy corn four genotypes used were the local germplasm. Healthy seeds' selection required being free from pests and diseases, had a growth rate of at least 80%, and was nutritious and shiny. Seeds' treatment with fungicide (metalaxyl) occurred before their planting. Each genotype's planting was in four rows along three meters, with a spacing of 75 cm × 20 cm. Each hole received one corn seed planting; each hole sustained treatment with insecticide/nematicide (carbofuran) to avoid pest attack before being covered with soil. The beds, planted with waxy corn seeds, then received proper labeling.

Potassium fertilization continued by burying it between the two plants. The first fertilization transpired 10 days after planting by applying potassium fertilizer with four different doses, i.e., no potassium/control (K0), 50 kg ha^{-1} (K1), 100 kg ha^{-1} (K2), and 150 kg ha^{-1} (K3). The second fertilization ensued when the plants were 35 days old, with the same doses of potassium as the first fertilization. Moreover, NP fertilizer application to each experimental unit included urea (300 kg ha^{-1}), phosphate (100 kg ha^{-1}), and ammonium sulfate (100 kg ha^{-1}). Irrigation occurred three times in a week. Irrigation progressed by watering all the waxy corn plants using a pump. Weeding continued manually using a hoe. Weeding sought to prevent the weed growth from inhibiting corn growth. In addition, hilling took place to restore eroded soil.

Harvesting succeeded when the maize plants reached physiological maturity; the cob turns brownish yellow, a black layer becomes visible, and some parts of the plant have shown a brownish shade. Harvesting continued manually by breaking the corn stalks. After harvesting, placing the corn into plastic bags separately was according to each genotype and treatment.

Data recorded and statistical analysis

The recorded data comprised the production parameters of purple waxy corn, i.e., plant height, number of leaves, anthesis silking interval, kernel weight, kernels per cob, grain yield, 1000-seed weight, production, and anthocyanin. Plant height measuring began from the ground level to the base of the last male flower; the number of leaves' calculation relied on the number of fully opened leaves. The weight of the peeled kernels was all the kernels in each plot, removing the kernel

$$\text{The result t/ha} = \frac{10.000\ \text{m}^2}{\text{Harvest area m}^2} \times \text{Harvested cob weight}$$

clobber before weighing per plot. Calculating the number of seeds per cob depends on the seeds formed in each cob. The rate of grain's measurement was by weighing the wet husked cobs, then shelled, and then weighing the kernels again to know the yield value. The 1000-seed weight with 15% moisture content, as measured, was by weighing 1000 corn kernels shelled earlier using analytical scales.

The productivity data obtained was in a unit area of one hectare, then calculated by the following formula by Smith (2020).

Anthocyanins

Observing anthocyanins using a spectrophotometer on corn seeds and applying the differential pH method. It comprised the following steps: a) preparation of pH 1.0 buffer; b) preparation of pH 4.50 buffer; c) sample extraction; and d) measurement and calculation of total anthocyanin concentration. Determining the absorbance of the sample obtained employed the formula. The presented method was a modification of the method used by Giusti and Wrolstad (2001) and Kristiana *et al*. (2012).

$$A = [(A_{530} - A_{700})_{\text{pH } 1.0} - (A_{530} - A_{700})_{\text{pH } 4.5}]$$

The anthocyanin pigment content of the sample, as calculated, used the formula below.

$$Total\ anthocyanin\ (\text{mg/L}) = \frac{\text{A } x \text{ BM } x \text{ FP } x \text{ 1000}}{\varepsilon\ x\ 1}$$

Where, A = Absorbance, BM = Molecular weight = 449.20 (expressed as cyanidin-3-glycoside), FP = Dilution factor, and ε = Molecular absorption coefficient = 26900 (expressed as cyanidin-3-glycoside).

All the recorded data's analyses used the analysis of variance (Steel *et al*., 1997). Employing the least significant difference ($LSD_{0.05}$) test helped further in the comparison and separation of the treatment means.

RESULTS AND DISCUSSION

Plant height

For plant height in purple waxy corn, the genotypes and potassium fertilizer levels had a very significant effect, while their interaction had a nonsignificant effect on the trait (Table 2). Results revealed the genotype 1162.1-1-II-(C4)-II produced taller plants (119.45 cm) but were nonsignificantly different from two other waxy corn genotypes, Srikandi Ungu and 1-3-1-2-B-II-(C4)-II. However, it is notably different from the cultivar Pulut URI (91.13 cm).

Genotypic factors are primarily managing the genetic diversity. Plant height is an inherited trait, and therefore, the genotypes showed varied performances. According to Artha (2017), each type of plant has a unique genetic diversity, and the ability to grow and develop was also different. The composition of genes owned by a genotype has an influential role in determining plant height in corn plants. Maize has several genes regulating stem growth and can produce shorter plants if the mutation occurs.

The potassium fertilizer dose (150 kg ha^{-1}) produced the tallest plants (112.81) and was nonsignificantly different from potassium fertilizer (100 kg ha^{-1}). Although it was remarkably distinct from the control (0 kg ha^{-1}) and the 50 kg ha^{-1} dose. Potassium fertilizer has an important effect on the growth and development of corn plants, which functions to increase the translocation of carbohydrates in the plants. According to Marsono and Sigit (2001), potassium plays a vital role in the growth because it affects photosynthesis in

Table 2. Effect of genotypes and potassium levels on the plant height in purple waxy corn.

Genotypes	Potassium fertilizer (kg ha^{-1})				Means
	0 (K0)	50 (K1)	100 (K2)	150 (K3)	
Pulut URI (g1)	88.26	89.70	91.29	95.25	91.13 b
Srikandi Ungu (g2)	110.15	108.18	108.55	111.72	109.65 a
1-3-1-2-B-B-II-(C4)-II (g3)	109.76	112.44	120.70	123.07	116.49 a
162.1-1-II-(C4)-II (g4)	118.43	120.79	117.36	121.20	119.45 a
Means	106.6 q	107.78 q	109.48 p	112.81 p	

$LSD_{0.05}$ Genotypes = 10.51, Potassium levels = 3.74, G x P Interactions = N.S.

chlorophyll formation and energy production, allowing plants to grow taller. Potassium can increase the absorption of water and nutrients, which supports stem and leaf growth. Syakir and Gusmaini (2012) reported the application of K fertilizer can enhance the plant height and number of branches compared to the control. This aligns with this study results where the control treatment (K fertilizer 0 kg ha^{-1}) has a plant height of 88.26 cm, which significantly differed from the tallest plants produced with K fertilizer at 150 kg ha^{-1}.

Leaves per plant

The observations on the number of leaves showed potassium fertilizer treatments had a substantial effect, while the waxy corn genotypes and their interaction with potassium levels had a nonsignificant effect on the leaves per plant (Table 3). With potassium fertilizer dose of 150 kg ha^{-1}, the average number of leaves in the best waxy corn was 6.92 and appeared significantly different from the plants of three other doses of potassium fertilizer (0, 50, and 100 kg ha^{-1}).

Potassium contributes to the process of photosynthesis in forming chlorophyll, and with an increased number of leaves, the rate of photosynthesis rises, with more sunlight being absorbed by plant leaves. Salisbury and Ross (1995) reported that an increased number of leaves in corn plants also enhances photosynthetic capacity. Tisdale and Nelson (1975) added that the maximum uptake of sunlight would result in the optimal uptake of nutrients, causing photosynthesis to run optimally. With potassium's ability to increase photosynthesis and energy production, plants produce more leaves. The rate of photosynthesis enhances with the increase in the number of leaves because the wider the leaves, the more sunlight they can absorb. Therefore, one can conclude that with more leaves, the optimal leaves will perform the photosynthesis process, causing better growth in plants.

Anthesis silking interval

The observations on anthesis silking interval (ASI) showed that waxy corn genotypes, potassium levels, and their interaction had nonsignificant effects on the ASI in plants (Figure 1). The ASI with the highest average value (9.0) tends to appear in genotype 1-3-1-2-B-II-(C4)-II with potassium fertilizer of 50 kg ha^{-1}, while the lowest average ASI (6.67) was evident in the waxy corn genotype Srikandi Ungu with potassium fertilizer of 100 kg ha^{-1}.

ASI is the time difference between the appearance of male (anthesis) and female (silking) flowers in corn plants. Corn genotypes play an instrumental role in the ASI of plants. In corn plants, the ASI duration has a considerable influence on grain yield and its quality. The genotype determines several plant physiological and morphological factors that affect the ASI, including growth speed. Genotypes with faster growth generally have shorter ASI. This is because the corn plants adjust their vegetative phase faster and enter the reproductive phase earlier.

Table 3. Effect of genotypes and potassium levels on the number of leaves in purple waxy corn.

Genotypes	Potassium fertilizer (kg ha^{-1})				Means
	0 (K0)	50 (K1)	100 (K2)	150 (K3)	
Pulut URI (g1)	6.59	6.96	6.30	7.08	6.73
Srikandi Ungu (g2)	6.37	6.59	6.37	6.78	6.53
1-3-1-2-B-B-II-(C4)-II (g3)	6.81	6.78	6.93	6.96	6.87
162.1-1-II-(C4)-II (g4)	6.89	6.33	6.63	6.85	6.68
Means	6.67 q	6.67 q	6.56 q	6.92 p	
$LSD_{0.05}$ Genotypes = N.S., Potassium levels = 0.23, G x P Interactions = N.S.					

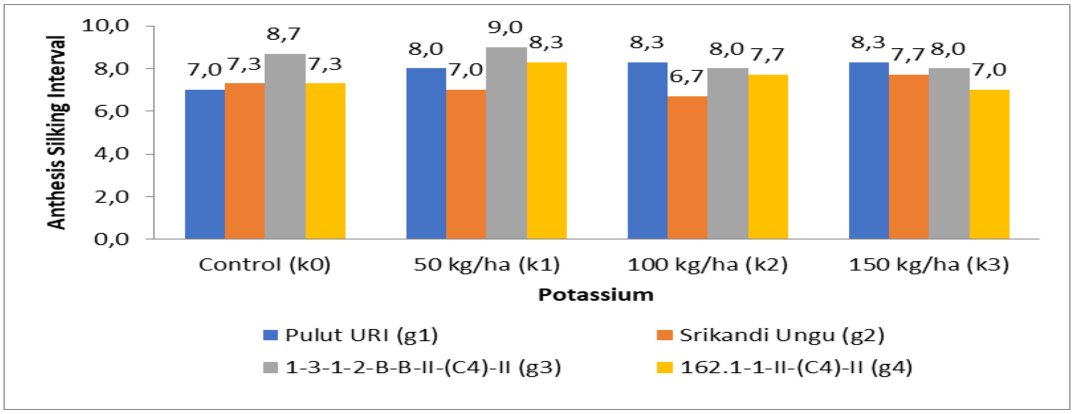

Figure 1. Diagram of average anthesis silking interval (days) of several corn genotypes at various doses of potassium fertilizer

Furthermore, potassium plays a remarkable role in increasing plant photosynthesis, thus extending the duration of milk and eventually producing more energy for plant growth and development. This can help plants extend the duration of milk. Longer milk allows maize plants to have more time for pollination and seed formation, giving longer time for maize kernels to develop and fill, resulting in larger, more nutritious, and higher nutrient content kernels. It has the potential to enhance the number of seeds produced with good quality. Murni and Arief (2014) reported that providing nutrients causes a better effect on plants during their life cycle. The plants can respond well with an increased number of seeds, and the accurate fertilizer doses have a real effect on all phases of plant growth in corn (Martajaya *et al.*, 2010).

Peeled cob weight

The findings on production parameters showed that waxy corn genotypes had a significant effect, while potassium fertilizer levels and their interaction had nonsignificant effects on the peeled cob weight (Table 4). The results revealed the genotype 1-3-1-2-B-II-(C4)-II produced the heaviest peeled cob weight (4155.00 g) and was nonsignificantly different from the cultivar Pulut URI. However, it is noticeably unequal from the waxy corn genotypes, Srikandi Ungu and 162.1-1-II-(C4)-II. The lowest peeled cob weight occurred in the cultivar Srikandi Ungu genotype (2508.33 g).

Plants possessed by each waxy corn genotype affect the photosynthesis, and photosynthesis produces the energy needed for plant growth and development. Genes increasing photosynthetic efficiency can produce larger and heavier cobs. Martajaya *et al.*'s (2010) findings detailed that growth, production, and seed quality in corn receive influences from genetic and environmental factors, such as fertilizer application. Optimal nutrient supply at each phase of corn growth, where active rooting conditions and sufficient nutrients positively alter the cell division, cob weight gain, seed row formation, and cob length in corn.

Kernels per cob

The analysis showed potassium fertilizer levels had a prominent effect, while the waxy corn genotypes and their interaction had nonsignificant influence on the kernels per cob (Table 5). The results further indicated the potassium (150 kg ha^{-1}) produced the most number of seeds per cob (276.40), which was nonsignificantly different from 100 kg ha^{-1}. However, it was considerably varied from the control treatment and potassium level of 50 kg ha^{-1}. The fewest seeds per cob were visible with the control treatment (potassium at 0 kg ha^{-1}) with an average of 256.11 kernels per cob.

Table 4. Effect of genotypes and potassium levels on the weight of peeled cob in purple waxy corn.

Genotypes	Potassium fertilizer (kg ha^{-1})				Means
	0 (K0)	50 (K1)	100 (K2)	150 (K3)	
Pulut URI (g1)	3403.33 (58.21)	3338.67 (57.72)	3530.00 (59.34)	3226.67 (56.77)	3374.67[ab] (58.01)
Srikandi Ungu (g2)	2260.00 (47.51)	2390.00 (48.80)	2370.00 (48.63)	3013.33 (54.81)	2508.33[c] (49.94)
1-3-1-2-B-B-II-(C4)-II (g3)	4013.33 (63.20)	4330.00 (65.81)	3913.33 (62.28)	4363.33 (66.03)	4155.00[a] (64.33)
162.1-1-II-(C4)-II (g4)	2889.33 (53.62)	3043.33 (55.08)	3586.67 (59.33)	3480.00 (58.99)	3250.83[bc] (56.75)
Means	3142.50 (55.63)	3275.00 (56.85)	3350.00 (57.40)	3520.83 (59.15)	
$LSD_{0.05}$ Genotypes = 749.663 (6.835), Potassium levels = N.S., G x P Interactions = N.S.					

Table 5. Effect of genotypes and potassium levels on the number of cobs in purple waxy corn.

Genotypes	Potassium fertilizer (kg ha^{-1})				Means
	0 (K0)	50 (K1)	100 (K2)	150 (K3)	
Pulut URI (g1)	252.00	256.07	262.78	271.26	260.53
Srikandi Ungu (g2)	258.15	264.41	263.19	272.67	264.60
1-3-1-2-B-B-II-(C4)-II (g3)	274.59	264.11	260.26	284.85	270.95
162.1-1-II-(C4)-II (g4)	239.70	255.59	264.63	276.81	259.19
Means	256.11 q	260.05 q	262.71 pq	276.40 p	
$LSD_{0.05}$ Genotypes = N.S., Potassium levels = 14.25, G x P Interactions = N.S.					

Potassium is crucial in seed formation because potassium participates in carbohydrate formation and enzyme activities. Kasniari and Supadma (2007) mentioned that potassium contributes to increasing seed size and weight. Likewise, potassium is crucial in photosynthesis and energy production. If photosynthesis takes place optimally, it will produce more seeds. Besides, potassium can help the absorption of water and nutrients, which can support the development of seeds.

Grain yield

The outcomes on grain yield signified waxy corn genotypes had a highly notable effect, while the potassium fertilizer levels and their interaction with genotypes had nonsignificant effects (Table 6). Results revealed the corn genotype 1-3-1-2-B-II-(C4)-II (g3) produced the maximum grain yield (49.83%) and was nonsignificantly varied from the cultivar Pulut URI and 162.1-1-II-(C4)-II. However, it was remarkably different from the cultivar Srikandi Ungu. The minimum average grain yield emerged in the waxy corn genotype Srikandi Ungu (36.32%).

A higher grain yield managed by a higher seed weight ratio than the cob weight ratio implied translocating more photosynthate to seed formation and enlargement than to the cob. Genotypes regulate the seed development, and the mutated genes will produce smaller and lighter seeds, eventually reducing the corn yield. Photosynthesis produces the energy needed for plant growth that can create more seeds, thus increasing the grain yield in corn genotypes. Potassium fertilizer plays an instrumental role in plant growth, especially in the plant maturation phase because it affects the photosynthesis in chlorophyll formation and seed filling while also being essential in carbohydrate formation (Janick *et al*., 1974).

The 1000-seed weight

The observations on the 1000-seed weight displayed that waxy corn genotypes and potassium fertilizer levels had nonsignificant

Table 6. Effect of genotypes and potassium levels on the grain yield in purple waxy corn.

Genotypes	Potassium fertilizer (kg ha^{-1})				Means
	0 (K0)	50 (K1)	100 (K2)	150 (K3)	
Pulut URI (g1)	47.20	45.06	44.43	45.41	45.53 a
Srikandi Ungu (g2)	33.81	35.84	36.49	39.12	36.32 b
1-3-1-2-B-B-II-(C4)-II (g3)	48.79	48.67	55.33	46.54	49.83 a
162.1-1-II-(C4)-II (g4)	48.60	50.59	46.80	46.93	48.23 a
Means	44.60	45.04	45.76	44.50	
$LSD_{0.05}$ Genotypes = 6.44, Potassium levels = N.S., G x P Interactions = N.S.					

Table 7. Effect of genotypes and potassium levels on the weight of 1000 seeds in purple waxy corn.

Genotypes	Potassium fertilizer (kg ha^{-1})				Means
	0 (K0)	50 (K1)	100 (K2)	150 (K3)	
Pulut URI (g1)	189.68^{a}_{p}	201.61^{a}_{p}	195.79^{a}_{p}	206.50^{a}_{p}	198.39
Srikandi Ungu (g2)	176.68^{a}_{p}	168.82^{a}_{q}	154.11^{a}_{q}	169.94^{a}_{p}	167.39
1-3-1-2-B-B-II-(C4)-II (g3)	189.65^{a}_{p}	194.17^{a}_{p}	182.22^{a}_{p}	192.09^{a}_{q}	189.53
162.1-1-II-(C4)-II (g4)	179.61^{a}_{p}	166.86^{b}_{r}	199.31^{a}_{p}	185.18^{a}_{r}	182.74
Means	183.90	182.86	182.86	188.42	
$LSD_{0.05}$ Genotypes = N.S., Potassium levels = N.S., G x P Interactions = 29.08;19.71					

effect, while their interaction revealed a noteworthy one (Table 7). The results exhibited the average 1000-seed weight was heaviest (206.50 g) in the waxy corn cultivar Pulut URI with the addition of potassium fertilizer (150 kg ha^{-1}). However, it was nonsignificantly different from the cultivar Pulut URI with other potassium levels (100, 50, and 0 kg ha^{-1}) and Srikandi Ungu at a potassium of 150 kg ha^{-1}. Although the above promising interaction of waxy corn cultivar Pulut URI with potassium fertilizer of 150 kg ha^{-1} emerged significantly different from the genotypes 1-3-1-2-B-II-(C4)-II and 162.1-1-II-(C4)-II, with a potassium level of 150 kg ha^{-1}. The interaction between the waxy corn cultivar Srikandi Ungu and a potassium fertilizer dose (100 kg ha^{-1}) produced the lowest average of 1000 seed weights (154.11 g).

The interaction of the genotypes with the environment resulted in the ability of different genotypes to utilize the existing environmental conditions. Potassium has an important role in increasing seed size and weight. Kasniari and Supadma (2007) concluded that potassium immensely contributes to increasing the seed size and weight because it affects the formation and translocation of carbohydrates. The potassium dosage of 150 kg ha^{-1} is in accordance with the recommendation of potassium fertilizer application in corn. It proved much better in the processes of formation and translocation of carbohydrates needed for the growth of generative organs in corn. Potassium is vital in the vegetative growth of plants, especially in the actively growing part of the meristem. Optimal rooting will support the supply of nutrients to all parts of the plant, enabling support in the growth of corn plants (Djalil, 2003).

Production

The findings on production parameters showed the waxy corn genotypes and potassium fertilizer remarkably affected the production of corn plants, while their interaction had a nonsignificant effect (Table 8). The corn genotype 1-3-1-2-B-II-(C4)-II produced the maximum yield (6.40 t/ha), which differed significantly from cultivar Pulut URI. However, it was nonsignificantly different from cultivar Srikandi Ungu and strain 162.1-1-II-(C4)-II. The lowest production occurred in the cultivar Srikandi Ungu (3.98 t/ha). The potassium fertilizer dose of 150 kg ha^{-1} provided the

Table 8. Effect of genotypes and potassium levels on the production in purple waxy corn.

Genotypes	Potassium fertilizer (kg ha^{-1})				Means
	0 (K0)	50 (K1)	100 (K2)	150 (K3)	
Pulut URI (g1)	5.12 (2.47)	4.93 (2.43)	5.91 (2.63)	4.74 (2.39)	5.18 ab (2.48)
Srikandi Ungu (g2)	3.40 (2.10)	3.29 (2.06)	2.99 (1.99)	4.69 (2.38)	3.59 b (2.13)
1-3-1-2-B-B-II-(C4)-II (g3)	5.47 (2.54)	6.71 (2.77)	6.49 (2.73)	6.93 (2.81)	6.40 a (2.71)
162.1-1-II-(C4)-II (g4)	3.56 (2.13)	3.72 (2.14)	4.04 (2.21)	4.59 (2.34)	3.98 b (2.21)
Means	4.39 q (2.31)	4.66 p (2.35)	4.86 p (2.39)	5.24 p (2.48)	
$LSD_{0.05}$ Genotypes = 1.69, Potassium levels = 0.59, G x P Interactions = N.S.					

Table 9. Effect of genotypes and potassium levels on the anthocyanin content in purple waxy corn.

Genotypes	Potassium fertilizer (kg ha^{-1})				Means
	0 (K0)	50 (K1)	100 (K2)	150 (K3)	
Pulut URI (g1)	58.69^{b}_{p} (7.72)	59.67^{c}_{p} (7.77)	46.72^{c}_{p} (6.85)	31.64^{d}_{p} (5.68)	49.18 (11.19)
Srikandi Ungu (g2)	196.79^{a}_{q} (13.98)	311.17^{a}_{p} (17.53)	332.45^{a}_{p} (18.25)	416.79^{a}_{p} (20.01)	314.30 (11.93)
1-3-1-2-B-B-II-(C4)-II (g3)	71.91^{b}_{p} (8.51)	60.70^{c}_{p} (7.84)	58.52^{c}_{p} (7.71)	99.33^{c}_{p} (9.67)	72.62 (12.20)
162.1-1-II-(C4)-II (g4)	210.92^{a}_{p} (14.54)	212.56^{b}_{q} (14.57)	254.23^{b}_{q} (15.97)	231.23^{b}_{p} (15.21)	227.24 (12.64)
Means	134.58 (11.19)	161.02 (11.93)	172.98 (12.20)	194.75 (12.64)	
$LSD_{0.05}$ Genotypes = 77.39 (2.31), Potassium levels = N.S., G x P Interactions = 94.45; 85.67					

topmost crop production (5.24 t/ha), which appeared notably unequal from the potassium control treatment (0 kg ha^{-1}) and nonsignificantly different from the potassium doses (50 and 100 kg ha^{-1}). Overall, the minimum production was evident in the control treatment of potassium fertilizer (4.39 t/ha).

The superior corn production emerged with the highest potassium dose (150 kg ha^{-1}), which could be due to the availability of potassium in sufficient conditions, causing optimal formation of cobs and filling of corn seeds. Sofyan and Sara (2018) also reported that the availability of nutrients during the grain-filling phase affects the number of kernels formed, which eventually influences corn production. Maize does not really need the potassium in its early stages of growth; however, potassium is earnestly necessary before the release of panicles, with potassium absorbed for the flowering process and cob formation. Potassium plays a critical role in the photosynthesis process, where more than 50% of potassium in the leaves occurs in chloroplasts. The increased potassium causes the rate of photosynthesis to rise, and the formation of dry weight will also elevate, resulting in a higher plant growth rate (He *et al*., 2022).

Anthocyanin level

The observation on the anthocyanin revealed the waxy corn genotypes and their interaction with potassium levels had an immense substantial effect, while potassium levels alone had a nonsignificant effect on the anthocyanin content (Table 9). The results showed the interaction of the cultivar Srikandi Ungu with a potassium fertilizer (150 kg ha^{-1}) (g2k3) the leading for the average anthocyanin content (416.79 µg/g) and was alike with the cultivar Srikandi Ungu with other potassium levels (50 and 100 kg ha^{-1}). However, the above promising interaction appeared significantly different from waxy corn cultivars Pulut URI, 1-3-1-2-B-II-(C4)-II, and 162.1-1-II-(C4)-II with a potassium dose of 150 kg ha^{-1} and Srikandi Ungu with the potassium control treatment (0 kg ha^{-1}). Meanwhile, the least anthocyanin content (31.64 μg/g) resulted in the cultivar Pulut URI with a potassium fertilizer of 150 kg ha^{-1}.

In crop plants, the anthocyanin content incurs strong influences from their genetic makeup and the existing environment, with a varied content of anthocyanins found in different species and plant types. Potassium plays a remarkable role in carbohydrate formation and starch translocation. Suelter (1985) reported the use of potassium by plants as catalysts for the activation of enzymes and co-enzymes in several biochemical reactions. The anthocyanin content was different from genotype to genotype, and a considerable diversity existed in anthocyanin contents. The different colors for seeds of each waxy corn genotype are available in Figures 2 and 3. According to Mangoendidjojo (2003), genetic and environmental influences caused diversity. In crop plants, the anthocyanin content can be distinct based on the purple coloring in plant parts, which spread throughout the plants.

a b c d

Figure 2. Corn seeds (a) Pulut URI, (b) Srikandi Ungu, (c) 1-3-1-2-b-B-B-II-(C4)-II, and (d) 162 .1-1-II-(C4)-II.

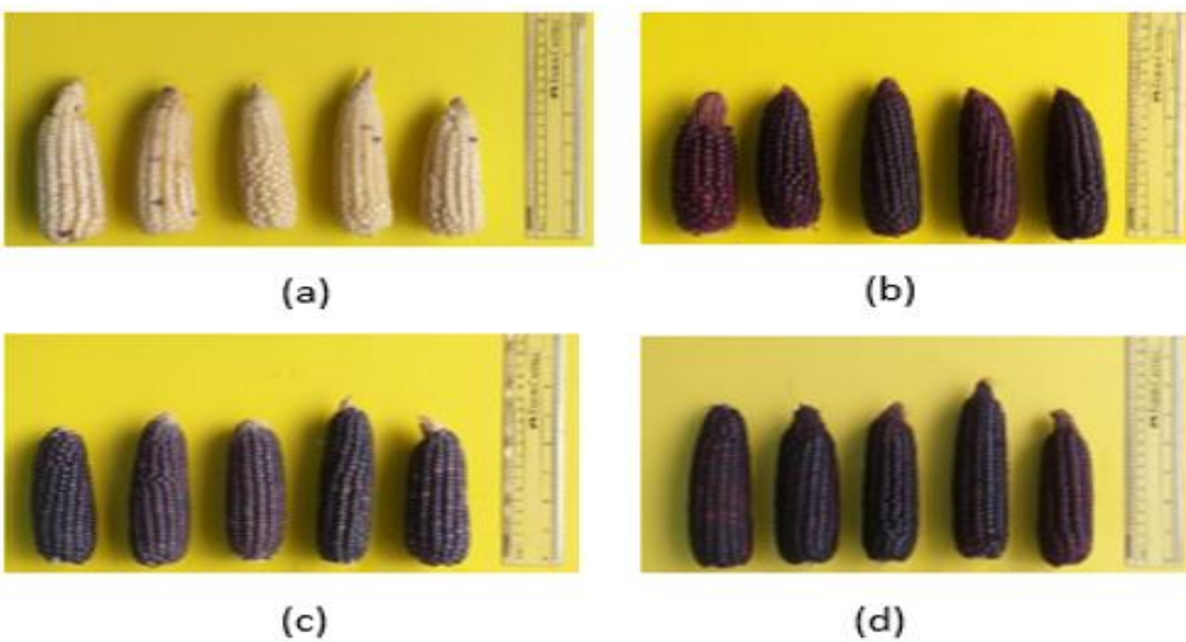

Figure 3. Corn seeds (a) Pulut URI, (b) Srikandi Ungu, (c) 1-3-1-2-b-B-B-II-(C4)-II, and (d) 162 .1-1-II-(C4)-II.

CONCLUSIONS

In the purple waxy corn, with the addition of potassium fertilizer (150 kg ha^{-1}), the cultivar Srikandi Ungu produced the highest anthocyanin content, while cultivar Pulut URI showed the heaviest 1000-seed weight. Cultivar Srikandi Ungu provided the leading values for anthesis silking interval, shelled cob weight, and grain yield. Adding potassium fertilizer (150 kg ha^{-1}) revealed the best results for plant height, the number of leaves, cob weight, seeds per cob, production, and anthocyanin content in purple waxy corns.

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