# Response of Potassium Fertilizer Application to Production and Sugar Content of Several Varieties of Sweet Corn (*Zea mays saccharata* Sturt.)

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**Abstract.** This research aims to obtain the optimum dosage of potassium fertilizer for each variety of sweet corn (*Zea mays saccharata* Sturt.) for production and quality. This research was conducted from June 2023 to September 2023 in the Jatimulyo Experimental Garden, Faculty of Agriculture, Brawijaya University in Jatimulyo, Lowokwaru District, Malang City, East Java. This research used a factorial randomized block design (RBD); the first factor was the dosage of potassium fertilizer with 4 treatments, and the second factor was the variety with 3 treatments. The first factor is K0 = Control (Without potassium addition); K1 = Potassium 50 kg $ha^{-1}$; K2 = Potassium 100 kg $ha^{-1}$; and K3 = Potassium 150 kg $ha^{-1}$. The second factor is V1 = Bonanza Variety, V2 = Jamboree Variety, and V3 = Talent Variety. Potassium treatment can increase growth, production, and sugar content at additional dosages of up to 150 kg $ha^{-1}$ and provides a significant response in all three varieties. Talenta has the highest response to potassium fertilization compared to the Bonanza and Jamboree varieties.

**Keywords:** sweet corn, potassium, sugar, Variety

## 1 Introduction

Sweet corn is a type of horticultural plant that is very popular in Indonesia. Cultivating sweet corn is quite easy, with a harvest period that tends to be short and a fairly wide market share, giving it its own advantages in the cultivation business. Apart from that, this plant has a sweet fruit taste with a crunchy texture and contains quite complete nutrients such as vitamins and minerals. These nutrients include 73 % of water, 96 kcal of calories, 3.4 g of protein, 21 g carbohydrates, 4.5 g sugar, 2.4 g fiber, 1.5 g fat, and 0.2 g saturated fat (100 g corn boiled). The sugar content in sweet corn varies, with a low starch content of around 28%. The sugar content of local varieties is 9% - 11%, while hybrid varieties have 16% - 18%, with sucrose sugar around 18% [1], [2].

Every business in the agricultural sector basically aims to obtain the highest productivity with the best quality. Land is increasingly narrowing, and production costs are increasing, thus greatly limiting farmers' space to get maximum agricultural results [3]. Apart from that, demand for sweet corn tends to increase yearly in line with population growth and changes in people's consumption patterns. One way to minimize some of these problems is to improve cultivation technology, including proper fertilization and the use of superior varieties. Nutrient elements that are important for plant growth and development consist of macronutrients and microelements. Plants need relatively large amounts of macronutrients, and plants need

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micronutrients in small amounts. These essential nutrients are needed by plants for their growth process and are very important in completing their life cycle. Plants can lack one of the nutrients needed in certain conditions, resulting in the appearance of deficiency symptoms, which are sometimes very typical for a particular element, although these symptoms can occur due to a deficiency of several certain elements simultaneously [2], [4].

One of the macronutrients is potassium. Potassium is the third main nutrient that is needed in large quantities after nitrogen and phosphorus. Potassium functions in the formation and transport of carbohydrates, increasing carbohydrate and sugar levels in fruit. Plants that lack potassium will easily collapse, the tips of the leaves will turn brown or necrotic, and the carbohydrate content and sweet taste of the fruit will decrease, which can cause production to decrease [4]. Potassium (K+) is very important in regulating ion balance, controlling plant air status, and stomatal cell activity in preventing air loss in the transpiration process. Potassium gives a significant boost in the photosynthesis process, production and translocation of carbohydrates to the meristematic growth zone, storage, and development of fruit, and helps activate more than 60 enzymes in catalyzing various metabolic processes [5]. Based on several research results, it was concluded that fertilization was proven to increase sweet corn yields [6]. Production of sweet corn increases by 30% - 47% if the plants are fertilized with inorganic fertilizer (urea, SP 36, and KCl) and granulated compost compared to without a combination of fertilizers [7]. Potassium fertilization of 100 kg $ha^{-1}$ can increase the weight and quality of fresh stover in sweet corn plants [8].

A solution other than fertilization is the use of the right variety. Variety can determine plant growth, yield, and quality. The use of superior varieties is highly recommended in sweet corn cultivation. Some of the advantages of using superior varieties include harvest times that tend to be faster, resistant to pests and diseases, and produce high productivity and wide environmental adaptation. Selecting the right variety is expected to increase production and quality. Many superior varieties of sweet corn are on the market, and farmers widely use them. Some of the superior varieties include Super Sweet, Bonanza, Sweet Boy, Sagita, Sweet Lady, Jamboree, and Talent. Each variety has its own advantages regarding nutrition, production, and quality. Based on research results, sweet corn of the Bonanza variety produces cob weight per hectare and sugar content of 22.83º brix at harvest age 65 days after planting [1], [9], [10]. Other research results state that sweet corn varieties Jamboree and Talenta are the best varieties planted in the lowlands with grumusol soil types [11]. The Talenta variety produces the highest plant height and the largest number of leaves [12]. Based on recommendations for potassium fertilization and the use of superior varieties, it is hoped that the production and quality of sweet corn plants can increase.

## 2 Method and Materials

This research was conducted from June 2023 to September 2023 in the Jatimulyo experimental garden, Faculty of Agriculture, Brawijaya University in Jatimulyo, Lowokwaru District, Malang City, East Java, at an altitude of ± 460 meters above sea level, temperature between 20ºC - 28ºC and Andosol soil type.

### 2.1 Research Design

Factorial randomized block design (RBD) was used in this research. The first factor is the dosage of potassium fertilizer with 4 treatments, namely K0 = Control (Without added potassium), K1 = Potassium 50 kg $ha^{-1}$, K2 = Potassium 100 kg $ha^{-1}$, and K3 = Potassium 150 kg $ha^{-1}$. The second factor is Variation with 3 treatments, namely V1 = Bonanza Variety, V2 = Jamboree Variety, and V3 = Talent Variety.

This research was repeated 3 times to obtain 36 treatment combinations. Each treatment combination contained 80 border plants and 24 sample plants (destructive and non-destructive), so the total plant population was 2880.

### 2.2 Observation Variables

The observation variables observed were plant length, leaf area, stem diameter, production, and total sugar content. Plant length, leaf area, and stem diameter were observed 8 weeks after planting (WAP), while production and total sugar content were observed 11 weeks after planting.

### 2.3 Statistical Analysis

The results of the observation data obtained were analyzed using ANOVA at the 5% level. If the test results show a real difference (F Calculated > F Table 5%), then proceed with a comparison test using the Duncan Multiple Range Test (DMRT).

## 3 Results and Discussion

Sweet corn is widely planted throughout the world; many species can easily adapt from dry to very humid areas, so they can grow in various environmental conditions. In Indonesia, sweet corn began to be cultivated commercially in the 1980s, initially only known as an imported commodity in canned packaging [13]. Sweet corn is a type of corn that is formed due to the accumulation of saccharides due to gene mutations in starch anabolism. An important phenotype in sweet corn is the sugar content in the kernel [14].

### 3.1 Growth

#### 1. Plant Length (cm)

There is no interaction between the application of potassium fertilizer and different varieties on the variable plant length of sweet corn plants based on the analysis of variance. The effect of plant length due to the application of potassium fertilizer and different varieties is shown in Figure 1.

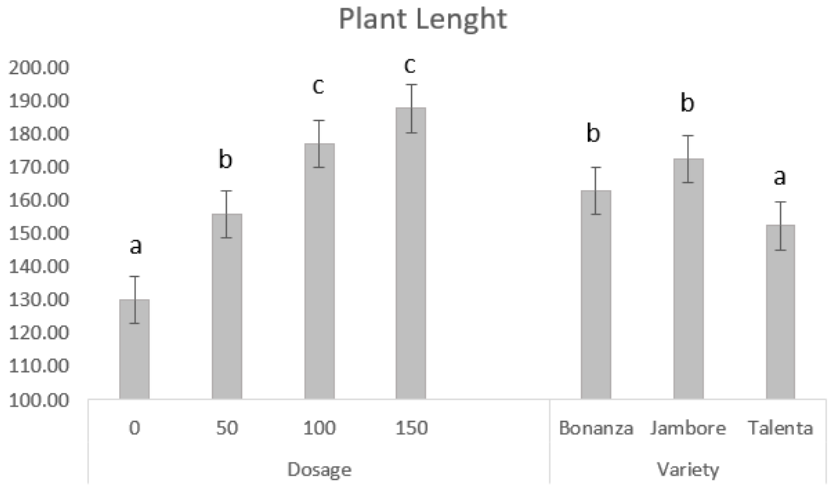


**Fig 1.** Effect of different potassium fertilizer doses and varieties on the plant length of sweet corn plants

Plant length increased with increasing dosages of potassium fertilizer with the highest plant length at increasing potassium dosages up to 150 kg $ha^{-1}$ but had values that were not significantly different from fertilizing 100 kg $ha^{-1}$ and significantly different from the control and fertilizing 50 kg $ha^{-1}$. The Jamboree variety has the highest plant length but has a value that is not significantly different from the Bonanza variety and significantly different from the Talenta variety.

## 2. Leaf Area ($cm^2$)

Based on the analysis of variance, there is no interaction between the application of potassium fertilizer and different varieties on the variable leaf area of sweet corn plants. The effect of leaf area due to the application of potassium fertilizer and different varieties is shown in Figure 2.

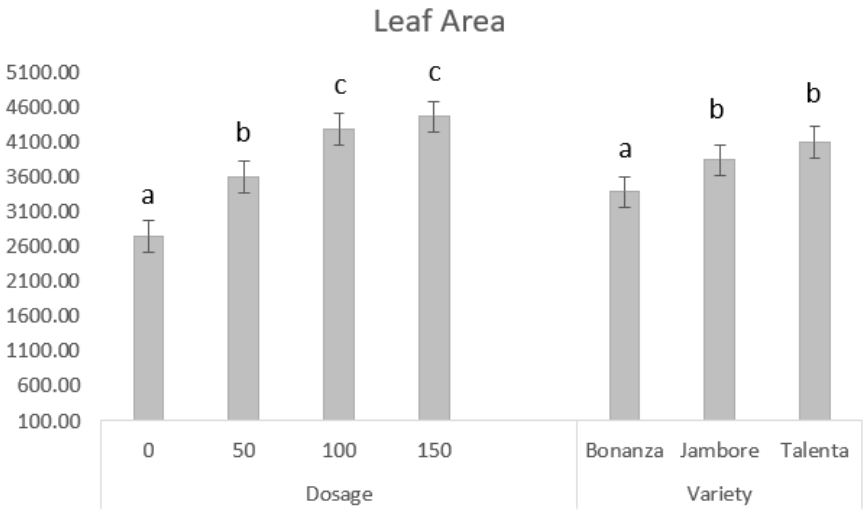


**Fig 2.** Effect of different potassium fertilizer doses and varieties on the leaf area of sweet corn plants

Increasing the dosage of potassium fertilizer to 150 kg $ha^{-1}$ was able to increase leaf area and had a significant effect compared to control and 50 kg $ha^{-1}$ fertilization, but was not significantly different from 100 kg $ha^{-1}$ fertilization. The Talenta variety has the highest leaf area and is significantly different from the Bonanza variety but not significantly different from the Jambore variety.

### 3. Stem Diameter (cm)

There is an interaction in the stem diameter observation variable based on the variance analysis results. The interaction between the application of potassium fertilizer and different varieties on the stem diameter variable is presented in Fig 3.

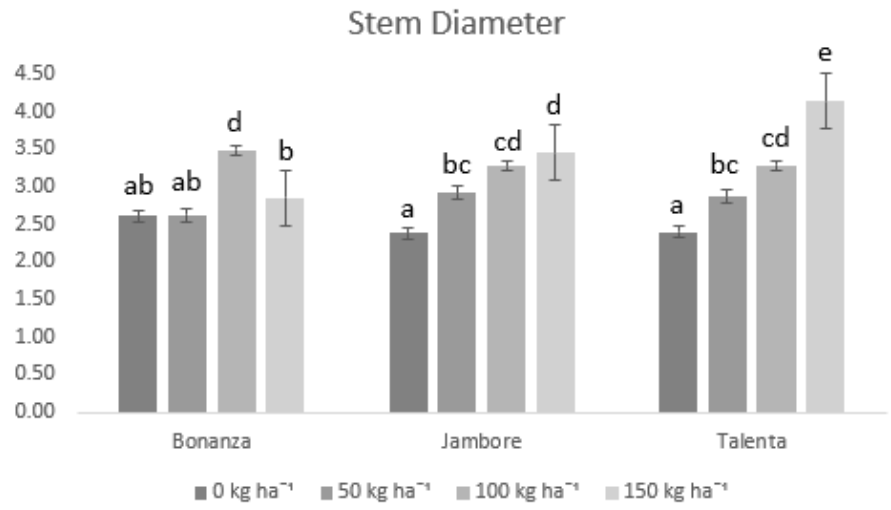


**Fig 3.** Interaction of different potassium fertilizer doses and varieties on stem diameter of sweet corn plants

The stem diameter of the Bonanza variety increased with the addition of 100 kg $ha^{-1}$ of potassium fertilizer and decreased with the addition of a dosage of 150 kg $ha^{-1}$ by 22.11%. Fertilization of 150 kg $ha^{-1}$ did not have a real effect on the control and 50 kg $ha^{-1}$ but had a real effect on 100 kg $ha^{-1}$. In the Jamboree variety, stem diameter increased with an additional dosage of 150 kg ha-1 by 12.33% and 5.18% compared to without additional fertilizer. Fertilizing 100 kg $ha^{-1}$ has a value that is not significantly different from fertilizing 50 kg $ha^{-1}$ and 150 kg $ha^{-1}$ but is significantly different from the control. In the Talenta variety, stem diameter increased with an additional dosage of 150 kg $ha^{-1}$ and had significantly different values for all fertilizer treatments. At this observation age, the Talenta variety had the largest stem diameter compared to the other two varieties.

### 3.2 Production (kg)

There was no interaction between the application of potassium fertilizer and different production varieties. The average production resulting from the use of potassium fertilizer and different varieties is presented in Fig 4.

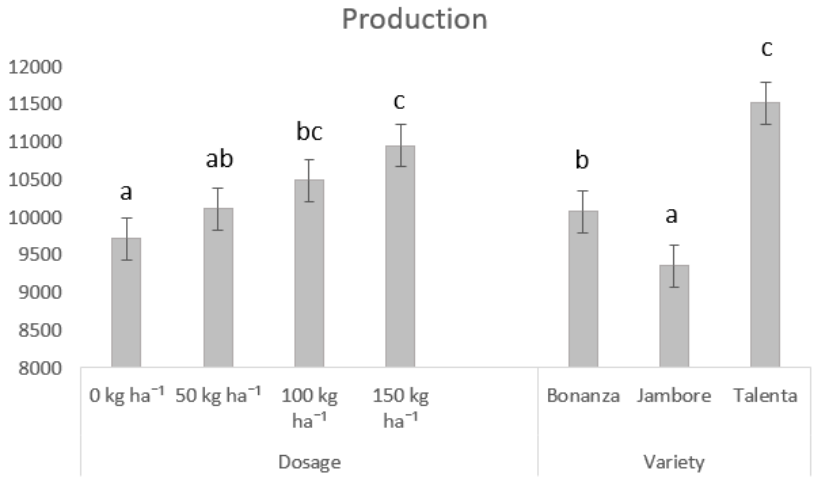


**Fig 4.** Effect of different potassium fertilizer doses and varieties on the production of sweet corn plants

Providing potassium fertilizer and different varieties significantly affects the production of sweet corn plants. Increasing the dosage of potassium fertilizer to 150 kg $ha^{-1}$ can increase the production of sweet corn plants. Potassium fertilization of 50 kg $ha^{-1}$ did not have a real effect on control and fertilizer application of 100 kg $ha^{-1}$ but had a significant effect with fertilization of 150 kg $ha^{-1}$, while fertilization of 150 kg $ha^{-1}$ did not have a real effect with fertilization of 100 kg $ha^{-1}$, but the real effect on control and fertilization on land 50 kg $ha^{-1}$. The Talenta Variety has a real impact value compared to the Bonanza Variety and Jamboree Variety. Variety treatment has a value that significantly affects each variety, with the highest variety being the Talenta Variety.

Adding potassium fertilizer can increase the growth, production, and sugar content of sweet corn plants based on the results of this research. According to [15], an increase in plant height and stem diameter of sweet corn plants was due to the application of potassium fertilizer, while husk ash application did not have a significant effect. Fertilizer is an inorganic or organic material of synthetic origin or natural that is given to plants or soil to supply important elements for plant growth and development [16]. Providing a balanced dose of fertilizer can increase the growth and yield of sweet corn plants, namely by fertilizing with potassium.

Potassium is the nutrient most likely to limit plant growth after nitrogen and phosphorus. Potassium is required for photosynthesis, energy metabolism, starch synthesis, sugar degradation, and nitrogen fixation [17]. In the efficient transformation of solar energy into chemical energy needed by plants, potassium is needed for plant development and to improve plant quality and yield through the process of photosynthesis, which plays an important role. [18].

### 3.3 Sugar Content (ºbrix)

There is an interaction between the application of potassium fertilizer and different varieties on total sugar content. The average total sugar content resulting from applying potassium fertilizer and different varieties is presented in Fig 5.

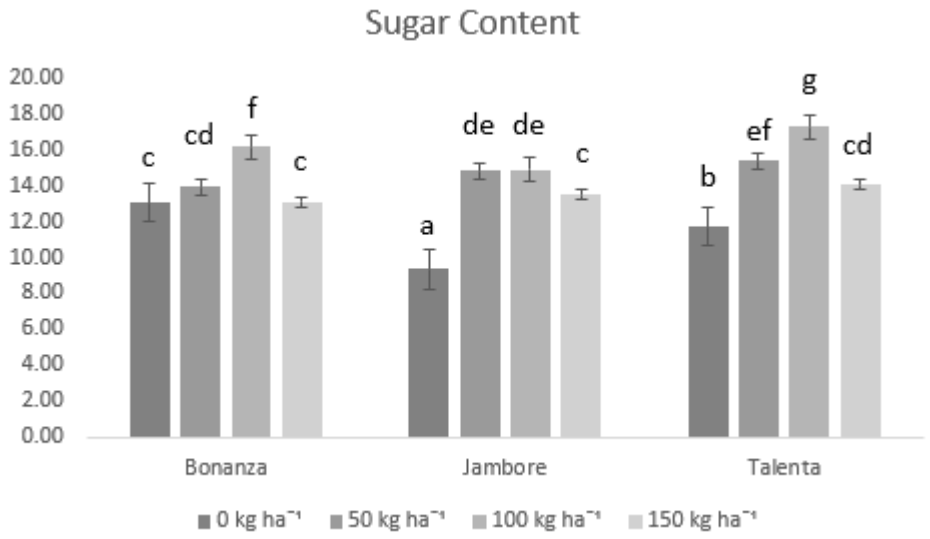


**Fig 5.** Interaction of different potassium fertilizer doses and varieties on the sugar content of sweet corn plants

The total sugar content of Bonanza variety plants increased with 100 kg $ha^{-1}$ potassium fertilizer but decreased by 23.51% with the addition of 150 kg $ha^{-1}$ potassium fertilizer. Fertilizing 100 kg $ha^{-1}$ had a real effect on control, as did fertilizing 50 kg $ha^{-1}$ and 150 kg $ha^{-1}$. In the Jamboree variety, total plant sugar content also increased at an additional dosage of 100 kg $ha^{-1}$ and decreased by 10.45% at an additional dosage of 150 kg $ha^{-1}$. Fertilizing 100 kg $ha^{-1}$ has a value that is not significantly different from fertilizing 50 kg $ha^{-1}$ but is significantly different from the control and 150 kg $ha^{-1}$. In the Talenta variety, each fertilizer treatment had significantly different values, and the total plant sugar content increased with an additional dosage of 100 kg $ha^{-1}$ and decreased by 22.98% with an additional dosage of 150 kg $ha^{-1}$. In this observation, the Talenta variety has the highest total plant sugar content compared to the other two varieties when fertilizer is added at 100 kg $ha^{-1}$.

According to [19], potassium can increase the photosynthesis process by optimizing the photosynthate translocation process to the cob so that optimal sugar levels are formed. One of the roles of the element potassium is to form cellulose, starch, and sugar and translocate these sugars to the cobs of sweet corn plants. Based on [20], potassium has a role in increasing plant yields and determining plant quality. The function of potassium in plants is involved in many photosynthesis and physiological processes, and it has an impact on water relations, assimilation transport, and enzyme activation, so it can directly impact plant productivity. A reduction in the number of leaves produced and the size of individual leaves results from potassium deficiency.

Sweet corn of the Bonanza variety has several advantages, namely having large cobs weighing between 300-480 grams/cob, a potential harvest that can reach 14-18 tonnes/ha, and a fairly short harvest age of 70-85 DAP (Days after Planting) [21]. Other varieties, namely the Jamboree variety, produce ± 23 tonnes/ha with a harvest age of 65-75 days with a sugar content of 13.5º brix, and the Talenta variety produces 18-25 tonnes/ha with a harvest age of 70-76 days, with a sugar content of 12-14º brix. Based on the research results of [11], the sugar content in

the Talenta variety of sweet corn can reach 15.75% brix, and the Jamboree and Talenta varieties are the best varieties planted in the lowlands with grumusol soil types, while based on research by [1], the Talenta sweet corn variety can produce a sugar content of 20.83º brix at harvest age 65 days after planting.

### 3.6 Responses of Three Varieties to Potassium Dosage

Responses between potassium fertilizer doses and different varieties on sweet corn production are presented in Fig 6.

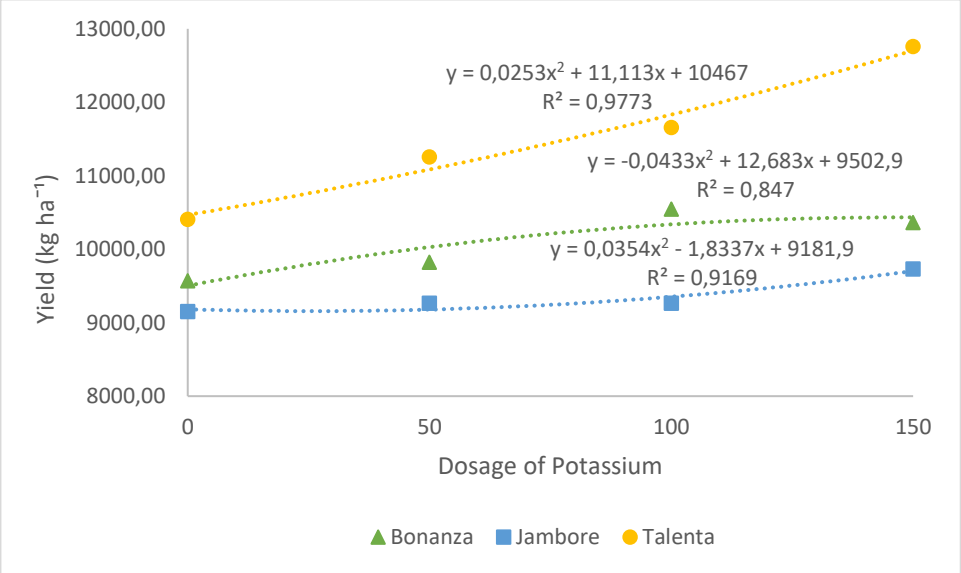


**Fig 6.** Responses between potassium fertilizer doses and different varieties on sweet corn production

Potassium fertilization provides different responses to each sweet corn variety. The graph shows that the Talenta variety has the highest response to potassium fertilization compared to Bonanza and Jamboree. Based on the regression results above, the optimum dosage of potassium fertilizer for the Bonanza variety is 147.47 kg $ha^{-1}$ with $R^2$ = 0.847, for the Jambore variety 25.90 kg $ha^{-1}$ with $R^2$ =0.9169, and for the Talenta variety 219.62 kg $ha^{-1}$ with $R^2$ =0.9773. The Jamboree variety is a variety that responds slowly to potassium fertilization compared to the other two varieties. Based on the results of research [22], The Talenta variety tends to be the highest, followed by the Asian Honey and Jamboree varieties, because potassium levels and absorption have different patterns. Jamboree variety consistently provided the lowest observed nutrient content and absorption. The Jamboree variety in this study had the lowest K content uptake and yield. Differences in nutrient uptake between varieties are related to variations in genetic control in absorbing nutrients from the soil [23].

## 4 Conclusion

Potassium treatment can increase growth, production, and sugar content at additional dosages of up to 150 kg $ha^{-1}$ and provides a significant response in all three varieties. Talenta has the highest response to potassium fertilization compared to the Bonanza and Jamboree varieties.

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