

THE EFFECTS OF POTASSIUM ON THE GROWTH OF STICKY CORN HN92 AND ITS YIELD IN PHU THO

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Abstract

Potassium is a macronutrient that plays an essential role in the growth and productivity of maize. A study on the effects of potassium on the development and yield of HN92 maize to determine the appropriate dosage of potassium fertilization for adequate growth and high output by Phu Tho province's natural conditions is necessary. The experiment was arranged in a full randomized block with five treatments. The results showed that the treatment of potassium significantly affected the yield of HN92. The actual product was the highest with 100 kg K₂O/ha fertilizing (48,71 quintals/ha). Besides, potassium is involved in producing the protein, starch, and adenosine triphosphate (ATP) production. Therefore, potassium's dosage affects the seed quality of sticky corn HN92, which the most appropriate is 100 kg K₂O/ha.

Keywords: *Potassium, yield, quality, maize.*

1. Introduction

In recent years, Phu Tho province has made many positive changes in the crop transformation, ensuring high-quality crop varieties, including maize. Sticky corn is the maize variety that is encouraged to be planted in the provincial seasonal structure guidelines. The cultivated area is about 6% of the total cultivated maize area of the province, concentrated mainly in districts such as Thanh Ba, Phu Ninh, Cam Khe, Ha

Hoa, Viet Tri, with popular varieties such as Hanoi 68, HN 88, HN 92, VN 556, TBM₁₈.

The sticky corn variety HN92 was developed and selected by the Center for Research and Development of the Vietnam Seed Group Joint Stock Company (VRDC). The variety has medium growth time, healthy growth and development, big body fat, good anti-dumping. Potential yield of fresh corn 14-16 tons/ha. HN92 is a newly introduced variety of sticky corn in Phu Tho province.

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Potassium is one of the principal plant nutrients underpinning crop yield production and quality determination. While involved in many physiological processes, potassium's impact on water relations, photosynthesis, assimilate transport, and enzyme activation and can directly affect crop productivity. Potassium has a primary role in photosynthesis, water storage control, and stomatal opening in leaves. Potassium deficiency significantly reduces the number of leaves and leaf size and, as a result, affects the photosynthetic activity of the plant. Grain yields increase with increased potassium uptake under arid conditions [1]. Potassium is required to reinforce plant swelling and maintain cell permeability in protective cells, to inhibit stomatal opening and closing [2]. Potassium is involved in creating the high-energy compound ATP concerned in starch and protein synthesis [3]. Potassium has essential functions in plant water relations. It regulates ionic balances within cells and plays a significant role in activating more than 60 enzymes that catalyze various metabolic processes and uptake and translocation of nitrates from root to aerial parts of plants. Potassium fertilization significantly improved water retention in the plant tissues even under conditions of severe water stress [4]. Many authors reported the positive effect of potassium on maize growth, yield, and quality parameters [5-9].

The overall objective was to study the impact of different potassium dosages on the yield and quantity of maize HN92 to find out suitable foliar-applied potassium levels for increasing maize productivity under the natural conditions of Phu Tho province.

2. Methods

2.1. Research object and materials

- HN92 maize variety: Sticky maize variety developed and selected by the Center for Research and Development (VRDC) - Vietnam National Plant Seed Joint Stock Company.

- Fertilizer Kalichloride: (KCl - abbreviated as MOP).

2.2. Study time and place

- Location: Son Cuong commune, Thanh Ba district, Phu Tho province.

- Time: Summer-autumn crop (June 2020 - October 2020).

2.3. Research Methods

The experiment was arranged in a randomized complete block, consisting of 5 treatments; each treatment includes 3 replicates. The density of 57.000 plants/ha (the rows were 70 cm apart with the plant to plant distance of 25 cm).

The experiments were arranged in a Randomized Complete Block Design (RCBD) with five treatments; each treatment was repeated three replicates with the experimental plot area of 30 m². The density of 57.000 plants/ha (the rows were 70 cm apart with the plant to plant distance of 25 cm). The total area for implementation is 750 m², of which the test area is 450 m²; there is a protective tape around the test area; the width of the tape is two rows of corn with an area of 300 m².

Foundation = 2 tons of organic Song Gianh fertilizer + 120 kg N + 70 kg P₂O₅ /ha

- T1: Foundation + 20 kg K₂O/ha.
- T2: Foundation + 40 kg K₂O/ha.
- T3: Foundation + 60 kg K₂O/ha (Controlled).
- T4: Foundation + 80 kg K₂O/ha.
- T5: Foundation + 100 kg K₂O/ha.

Fertilizing methods: (1) The basal fertilizing: All organic Song Gianh fertilizers and phosphate fertilizers + 1/4 of nitrogen. (2) The additional fertilizing: The first fertilizing: Maize with 4-5 leaves: 1/4 of nitrogen + 1/2 of potassium; The second fertilizing: Maize having 8-9 leaves: 1/2 of nitrogen + 1/2 of potassium.

The following indicators were monitored: Crop yield, number of grain rows per cob, number of grains per cob, 1000-grain weight, grain yield, biological yield, fertilizer use efficiency, and harvest index were recorded.

Data were processed by IRRISTAT 4.0 and Excel software.

3. Results and discussion

3.1. Effects of potassium dosage on morphological indicators of sticky corn variety HN92 in the Summer-Autumn crop of 2020 in Thanh Ba, Phu Tho

Plant height reflects the vegetative growth behavior of crop plants to applied inputs. In the Summer-Autumn crop of 2020, the results of this study showed that the dose of potassium had a significant effect on the height of the sticky corn HN₉₂, and there was a significant difference with $P < 0,05$ when increasing the dose of potassium up to 100 kg K₂O/ha (206cm) compared to the control (60 kg K₂O/ha) was 198,50 cm. Plant height decreased significantly, and there was a significant difference with $P < 0,05$ when reducing the dose of potassium to 40 kg K₂O/ha (189,07cm) and predominantly 20 kg K₂O/ha (188,30 cm) with the control 60 K₂O/ha (Table 1).

Table 1. Effects of potassium dosage on morphological parameters of sticky corn variety HN92 in the summer-autumn crop 2020 in Thanh Ba, Phu Tho

Treatment	Plant height (cm)	Real leaves (leaves)	Height with corn (cm)	Corn bag (Point)
T1	188,30	18,77	83,07	2,00
T2	189,07	18,80	83,73	2,00
T3	198,50	18,83	88,97	1,00
T4	204,30	18,87	91,63	1,00
T5	206,03	18,90	98,27	1,00
LSD _{0,05}	7,16	0,35	3,54	
CV%	1,9	1,0	1,9	

Potassium (K) had a significant effect on the plant height of HN92. The plant height increased remarkably when the potassium was applied to soil when K₂O was increased from 20 kg/ha up to 100 kg/ha. The plant

culminated at the highest height with the highest treatment of K₂O (100 kg K₂O/ha). The height of maize decreased notably when the dosage of K was reduced to 20 kg K₂O/ha.

The husk cover slightly decreased to an excellent level, and the husk covered the ear when potassium was applied at 40 kg K₂O/ha (treatment 2). The height of stalks and corn ears grew significantly when the dose of applied potassium increased compared to the control group; and vice versa, the height significantly decreases when the amount of potassium decreased compared to the control group.

3.2. Effects of potassium dosage on yield and yield constituent factors of sticky corn variety HN₉₂ in the summer-autumn crop 2020 in Thanh Ba, Phu Tho

The results of the evaluation of the effects of potassium dosage on yield and yield factors of sticky corn HN92 were shown in Table 2:

Table 2. Effects of potassium dosage on yield and yield constituent factors of sticky corn variety HN92 in the summer-autumn crop 2020 in Thanh Ba, Phu Tho

Treatment	Ear length (cm)	Ear size (cm)	Number of Grain Rows per Cob (Rows)	Number of Grains per Cob	1000-Grain Weight (g)	Grain Yield (quintal/ha)
T1	16,56	4,27	13,00	40,43	225,96	37,37
T 2	17,17	4,37	13,47	41,00	228,29	41,55
T 3	17,99	4,52	13,73	42,00	229,69	42,57
T 4	18,75	4,57	14,33	41,63	236,82	46,89
T 5	18,84	4,62	14,53	40,80	245,04	48,71
LSD _{0,05}	0,62	0,66	0,49	1,50	2,27	3,26
CV%	1,8	0,8	0,0007	1,9	0,5	4,0

The data (Table 2) showed that the length of the corn had a significant difference in the confidence level $P < 0,05$ when increasing the dose of applied potassium to 80 kg K₂O/ha or decreasing to 40 kg K₂O/ha compared to the control 60 K₂O/ha.

The dose of potassium fertilization had a significant effect on the diameter of corn. Corn diameter was highest in treatment 5 (4,62 cm) and lowest in treatment 1 (4,27 cm). In treatment 4 (80 kg K₂O / ha) and treatment 5 (kg 100 K₂O / ha), corn diameter did not have a significant difference at the confidence level $P < 0,05$.

The number of grain rows per cob revealed a significant difference among treatments. The comparison of treatment’s means exposed that foliar application of potassium

was beneficial in terms of grain rows per cob as showing significant variation from 13,00 to 14,53. The number of grain rows per cob increased from 13,73 rows to 14,53 rows when increasing the dose of potassium fertilizing from 60 kg K₂O/ha (treatment 3) to 100 kg K₂O/ha (treatment 5). The lowest number of grain rows per cob was 13.00 when reducing the dose of potassium to 20 kg K₂O/ha(treatment 1). The number of grain rows per cob had a significant difference at the confidence level of $P < 0,05$ when reducing potassium’s dose to 20 kg K₂O/ha or increasing to 80 kg K₂O/ha.

Mean grain weight is a vital yield contributing factor, which plays a decisive role in showing the potential of a variety. The data regarding the 1000-grain are presented in

table 2. The results confirmed the significant influence of potassium on grain weight. The potassium exerted a positive influence on grains' weight because elements participate in the transportation of carbohydrates to the sink organs. The weight of 1000 seeds increased significantly when the K_2O/ha increased to 80 kg K_2O/ha (treatment 4) and 100 kg K_2O/ha (treatment 5) compared to the control 60 kg K_2O/ha . The increased weight of 1000 seeds had a significant difference in the confidence level $P < 0,05$ in the two treatments 4 and 5 compared with the control. The weight of 1000 grains decreased significantly and was the lowest in treatment 1 (225,96g).

Data regarding grain yield in table 2 showed significant enhancement in the yield of maize plants. The comparison of means for the grain yield of maize plants at different potassium treatments showed: The net yield increased significantly, and there was a significant difference when increasing

the amount of potassium applied from 80 kg K_2O/ha or more and at the same time, there was a significant decrease in net yield when reducing the dose of potassium to as low as 20 kg K_2O/ha . The results show that the dose of potassium fertilization is the key to the yield of sticky corn HN92. The increase of grain yield of maize crop may be due to mainly it was attributed to plant height, ear length, number of grains/ear, number of rows/ear, and 1000- grain weight.

3.3. Effect of potassium dosage on quality indicators of sticky corn variety HN92 in 2020 in Thanh Ba, Phu Tho

For sticky corn varieties harvested with fresh corn, the quality criteria of the grain and corn are decisive to the quality and price of the product. The results of quality and sensory evaluation of the sticky corn HN92 were summarized in Table 3.

Table 3. Effects of potassium dosage on quality indicators of sticky corn variety HN92 in 2020 in Thanh Ba, Phu Tho

Treatment	Plasticity	Aroma	Corn grain density
T1	3,00	3,00	3,00
T 2	2,00	2,00	2,00
T 3	1,00	1,00	1,00
T 4	1,00	1,00	1,00
T 5	1,00	1,00	1,00

Note: Point 1: Good; Point 2: Fair; Point 3: Average

The plasticity, aroma, and density of seeds in treatment 3, treatment 4, and treatment 5 were similar. However, the plasticity, aroma, and density of the seeds from treatment 2 were quite good, and those from treatment 1 was only average (Table 3). The evaluation results showed that the dose of potassium fertilization affected the seed quality of sticky corn HN92 which is consistent with Tisdale's results [3].

4. Conclusions

Potassium significantly influenced the criteria of plant height, corn stacking height, length and diameter of maize, number of rows of seeds/corn, and number of seeds/row. The growth and morphological indicators were highest at 100 kg K_2O/ha .

Potassium significantly affected the yield of sticky corn HN92. The actual product was the highest with 100 kg K₂O/ha fertilizing (48,71 quintals/ha). Potassium is involved in producing the protein, starch, and adenosine triphosphate (ATP) production, so the dosage of potassium affects the seed quality of sticky corn HN92, in which the most appropriate is 100 kg K₂O/ha.

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ẢNH HƯỞNG CỦA KALI ĐẾN SINH TRƯỞNG, NĂNG SUẤT CỦA GIỐNG NGÔ HN92 TẠI PHÚ THỌ

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Tóm tắt

Kali là nguyên tố dinh dưỡng đa lượng có vai trò quan trọng đối với sự phát triển và tăng năng suất của cây ngô. Nghiên cứu ảnh hưởng của liều lượng kali đến sinh trưởng và năng suất của giống ngô HN92 nhằm xác định liều lượng bón kali thích hợp để giống ngô HN92 sinh trưởng tốt và đạt năng suất cao phù hợp điều kiện tự nhiên tỉnh Phú Thọ. Thí nghiệm được bố trí theo khối ngẫu nhiên đầy đủ gồm 5 công thức. Kết quả nghiên cứu cho thấy liều lượng kali ảnh hưởng đáng kể đến năng suất của giống ngô nếp HN92. Năng suất thực thu đạt cao nhất với lượng bón 100 kg K₂O/ha (48,71 tạ/ha). Bên cạnh đó Kali tham gia vào quá trình tạo ra hợp chất cao năng ATP, liên quan đến sự tổng hợp tinh bột cũng như protein, vì vậy liều lượng bón kali có ảnh hưởng đến năng suất, chất lượng hạt của giống ngô nếp HN92. Chất lượng đạt cao nhất với lượng bón 100 kg K₂O/ha.

Từ khóa: Kali, năng suất, chất lượng, ngô.