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Study on Reducing Fertilization Technology of Sweet Corn

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Abstract. Based on the nutritional characteristics of fresh corn and the fertilizer supply characteristics of new fertilizers (controlled release fertilizer and bio-organic special fertilizer), the total amount of fertilizer applied was reduced and different new fertilizers were applied. The one-time application technology was used to explore the reduced fertilization technology of Sweet corn. The results showed that the yield of Sweet corn was not affected by using bio-organic special fertilizer and slow controlled release fertilizer. Reduce the total amount of fertilizer application by 20 %, and the yield of Sweet corn will not be affected. There is a difference in soil available nutrients between different fertilization treatments after the completion of the two planting seasons. Using the same amount of controlled release fertilizer and 20 % less dosage of controlled release fertilizer has the tendency to reduce soil NO₃ -N, the difference is significant. The soil available P and K in each treatment were different, but there was no regular pattern.

Key words: Fresh corn; high effect fertilization; yield; new type of fertilizer.

INTRODUCTION

Sweet corn, also known as vegetable corn, because of its rich nutrition, sweet, fresh, crisp, tender characteristics and favored by consumers from all walks of life. The growth period of fresh corn is shorter than that of conventional corn or fodder corn. Reasonable water and fertilizer management is the premise of sweet corn to achieve high quality, stable yield and high yield [1, 2]. In the production practice, the fertilization mode of fresh corn is usually based on the base fertilizer and then applied the second available fertilizer[3]. Controlled release fertilizer (CRF) and organic-inorganic compound fertilizer (organic-inorganic compound fertilizer) are the physicochemical products which can improve the fertilizer utilization efficiency[4]. Controlled-release fertilizer (CRF) and organic-inorganic compound fertilizer (OICF) are the best choice for one-off fertilization, which can meet the requirements of high yield and high efficiency at the same time of light and simplified cultivation. The research indicated that the biological organic fertilizer and the organic fertilizer nitrogen substitution for the chemical fertilizer nitrogen can increase the corn yield [5, 6]. Previous studies have shown that slow-controlled-release fertilizer is closer to the law of maize fertilizer requirement than traditional fertilization. The nutrient utilization rate of releasing maize by stages was better than that of chemical fertilizer. After applying slow-release fertilizer or controlled-release fertilizer, the agronomic characters and yield of maize were superior to those of traditional chemical fertilizer, and it had obvious effect of increasing yield and economic benefit [7-9], and it also reduced the links of applying fertilizer in the middle stage of farmers and saved the labor force. At present, there are few reports on the study of the simplified fertilization model in which slow-release urea is combined with quick-acting chemical nitrogen fertilizer and organic-inorganic compound fertilizer is substituted for chemical fertilizer. The purpose of this study was to study the application of different new fertilizers (slow-release / controlled-release fertilizer and bio-organic special fertilizer) and conventional fertilizer in order to provide optimal and efficient cultivation techniques for the industrialization of fresh corn.

MATERIALS AND METHODS

Experimental Design

Treatment 1: control (CK): did not apply any fertilizer;

Treatment 2: nitrogen, phosphorus and potassium fertilizer (center item): total amount of NPK 360kg/hm², in which N 225 kg/hm², P₂O₅ 45 kg / hm², K₂O 90kg /hm²;

Treatment 3: special bio-inorganic fertilizer: the total amount of NPK is 300 kg/hm². The fertilizer is a biological-inorganic special fertilizer (15-4-6) 1200kg/ hm²;

Treatment 4: coated urea + PK (the total amount of nutrient is equal to the center item): total amount of NPK 360kg/hm²;

Treatment 5: coated urea + PK (reducing fertilization): The amount of fertilizer used is 80% of the total amount of fertilizer used in treatment 4.

Experiment treatment repeat 3 times. Plot area is 20 m². Plot is Random block arrangement. The transplanting density of maize was 49950 plants/hm². Spring maize was planted in nutrient bowl on February 12, 2017, and transplanted on March 8, 2017. Summer maize was planted in nutrient bowl on July 25, 2017, and transplanted on August 18, 2017. Spring maize harvest on June 20, 2017. Summer maize harvest on October 27, 2017.

The tested fertilizers were urea (N 46%), superphosphate (P₂O₅ 16%), potassium sulfate, biological-inorganic fertilizer (15-4-6%) and controlled-release urea (coated).

After harvest of summer maize, 0-20cm soil was collected in each plot to analyze the contents of nitrate nitrogen, ammonium nitrogen, available phosphorus and available potassium in the soil.

Data Processing

Data were analyzed using Microsoft Excel 2007 and SAE 5.10. The significant difference of $P < 0.05$ level between treatments was examined by LSD method.

RESULT ANALYSIS

Effects of Different Fertilization Treatments on Yield Components of Sweet Corn

The investigation results of yield characters of spring maize (Table 1) showed that the ear length of fertilization treatment was 1.4-2.8 cm longer than that of CK, and the ear diameter of fertilization treatment was 8-8.9 cm longer than that of CK. The length of bald tip of fertilization treatment was 0.6-1.4 cm, shorter than that of control. The single panicle weight of fertilization treatment was 183.5-218.5g heavier than that of CK, and the grain dry weight of fertilization treatment was 4.9-6.1g. the difference of yield characters between fertilization treatments was not significant. The number of rows per panicle in each treatment was 12.1-13.2, and the difference was not significant.

The investigation of yield characters of summer maize, showed that the ear length of fertilization treatment was 1.4-2.8 cm longer than that of CK, the ear diameter of fertilization treatment was 8-8.9 cm longer than that of CK, and the length of bald tip of fertilization treatment was 2.8-3.9 cm, shorter than that of CK. The single panicle weight of fertilization treatment was 68.3-125.1g higher than that of the control. The number of rows per panicle was 11.9-12.8, and there was no significant difference among the treatments.

Effects of Different Treatments on Sweet Corn Yield

Table 2 the results of actual harvest yield showed that the yield of spring maize fertilizing treatment was 95.25% -103.82% higher than that of the control. The yield of treatment 2 was more than twice as high as that of CK in fertilization treatment, and nearly double in other treatments. The results of ANOVA showed that the difference was significant. The highest yield was obtained in the conventional fertilization treatment, which was 105.22% higher than the control, but there was no significant difference between the conventional fertilization treatment and the other fertilization treatments.

TABLE 1. Yield traits of sweet corn

Treatment	Ear length cm	Ear diameter cm	Barren ear tips length cm	Number of rows	Ear weight g	Dry weight of grain g
spring sowing						
A1	22.0	16.1	4.8	12.1	209.1	19.0
A2	24.5	24.1	1.5	13.1	420.6	24.3
A3	24.8	25.0	1.6	12.8	412.7	24.9
A4	24.6	24.4	1.7	12.8	392.6	24.3
A5	24.2	24.7	1.2	13.2	421.1	24.4
Summer sowing						
A1	17.4	23.1	4.0	11.9	227.17	8.35
A2	18.9	30.1	3.5	12.6	323.0	9.52
A3	19.3	30.4	2.9	12.1	327.17	9.58
A4	18.7	28.4	3.0	12.8	321.31	9.37
A5	18.4	29.0	3.0	12.0	295.47	9.68

TABLE 2. Yield of sweet corn

Treatment	kg/plot	spring sowing		kg/plot	Summer sowing	
		kg/hm ²	Increase %		kg/hm ²	Increase %
A1	10.73b	10725		7.04c	7043	
A2	21.87a	21870	103.82	10.95ab	10950	55.47
A3	21.43a	21432.5	99.72	10.81ab	10807	53.44
A4	21.40a	21402.5	99.44	10.62b	10617	50.75
A5	20.95a	20947.5	95.25	10.29b	10290	46.10

The yield of summer maize fertilized treatment was higher than that of the control. Fertilizer treatment increased yield by 46.1% -55.47%. The results of ANOVA showed that the difference was significant. Treatment 2 had the highest yield, but there was no significant difference between treatment 2, treatment 3, treatment 4 and treatment 5. The results showed that reducing the amount of fertilizer did not affect the yield of maize.

Changes of Soil Available Nutrients in Different Fertilization Treatments

Table 3 investigation results of soil available nitrogen showed that nitrate nitrogen and ammonium nitrogen in topsoil of each fertilization treatment were higher than those of the control. There were significant differences in ANOVA. Treatment 3, treatment 4 and treatment 5 with organic fertilizer and coated urea had lower nitrate content in soil than treatment 2. There was no significant difference in the content of ammonium nitrogen in topsoil under different fertilization treatments.

Table 3 the investigation results of soil available P and K showed that the soil available P of fertilization treatment was significantly higher than that of control treatment. There was no significant difference between fertilization treatments. The soil available K of fertilization treatment was significantly higher than that of control treatment. There was no difference in soil available K between treatments 2, treatment 3, treatment 4, treatment 5.

TABLE 3. Soil nutrient content in different fertilization treatments

Treatment	NO ₃ -N mg/kg	NH ₄ ⁺ -N mg/kg	Available P mg/kg	Available K mg/kg
A1	10.95c	1.53b	20.1b	69.1b
A2	54.31a	12.48a	29.1a	94.8a
A3	40.59b	11.71a	28.1a	88.5a
A4	37.56b	13.07a	31.4a	94.8a
A5	34.14b	13.57a	30.9a	89.1a

DISCUSSION

Fertilization can increase the yield of maize to a certain extent, but the type, amount and method of fertilizer can affect the yield of maize. Many studies have shown that nitrogen management has a great effect on maize yield [10-12]. Dong [13] study showed that the reduction of 20% nitrogen fertilizer had no effect on the yield of spring maize for three consecutive years. The results of Hao study showed that the reduction of nitrogen fertilizer application rate of 20% did not affect the grain yield of maize [11] at the level of 185 kg/hm² nitrogen fertilizer used by farmers. Under the condition of this experiment, reducing the total amount of 20%NPK fertilizer had little effect on maize yield.

The results showed that the application of bio-organic fertilizer could significantly increase the yield of sweet corn, and compared with conventional fertilization, it could improve the fertilizer efficiency of N, P, K [5]. Xie[6] showed that the substitution of organic fertilizer nitrogen for 50% fertilizer nitrogen significantly increased the economic yield and biological yield of maize, and increased the stability and sustainability of maize yield at the same time. Under the condition of this experiment, the special organic and inorganic fertilizer with the same total amount of NPK had little effect on maize yield, which was similar to the results of previous studies.

Many studies have shown that the use of controlled fertilization can also ensure the yield of maize [3, 4, 8, 9]. Zhao study showed that moderate slow control fertilization can improve and optimize the physiological indicators of the middle and late growth of summer maize, and then increase the yield [7]. Under the experimental conditions, using the same amount of slow-release fertilizer and reducing the amount of 20% slow-release fertilizer did not affect the yield of maize.

The experiment of Li [14] showed that the application of organic fertilizer to maize could promote the growth of maize and improve the soil quality, but had little effect on the change of soil available nutrients. Dong [13] study showed that reducing nitrogen application rate by 20% for three consecutive years significantly reduced the residual amount of NO₃-N in soil profile. At the same nitrogen application rate, adding nitrification inhibitor or applying slow-release fertilizer had no obvious effect on the reduction of nitrate residue. Sun [15] study showed that 30% of nitrogen reduction by controlled-release nitrogen fertilizer did not significantly reduce the content of nitrate nitrogen in surface soil. Under the condition of this experiment, using the same amount of slow-release fertilizer and reducing the amount of slow-release fertilizer by 20% have the tendency to reduce soil NO₃-N.

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