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The Effect of Cultivation Patterns and Compound Fertilizer Types on Physiological Characteristics of Leaf and Stem of Longping 206

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ABSTRACT

This paper has studied the effect of four cultivation patterns and two compound fertilizer types on the root morphology index at seedling stage, the volume and the dry weight of root at elongation stage, the physiological property of root, leaf and stem, the agronomic traits and dry matter accumulation, grain filling and NPK accumulation, photosynthetic characteristics and yield components. It illustrated that different cultivation patterns and compound fertilizer types makes important effect on the growth of Longping 206 and provided some basis for cultivation management and fertilization of Longping 206. This experiment was done at the science and technology garden in Anhui Science and Technology University and designed by two-factor split block design. The main plot was row-spacing allocation and double plants a hole. The four seeding styles were equal row spacing ($A_1$60 cm), equal row spacing and double plants a hole ($A_2$60 cm), wide and narrow row spacing (A_3 70 cm+50 cm), wide and narrow row spacing (A_4 90 cm+30 cm), respectively. The vice plot was base fertilizer type and used Stanley compound fertilizer (B_1NPK=18:18:180) and Difuyuan special compound fertilizer (B_2NPK=26:12:10) for corn. The experiment has eight treatment groups and four repetitions for each group. The seeding density is 67500 cobs·hm^{-1}, the width of each plot is 3 m, and the length is 6.67 m. The underground fertilization amount is 750kg·hm^{-1}. The activity of leaf nitrate reductase had all reached maximum at pustulation period in Longping 206. During the whole growth period, the activity of leaf nitrate reductase had all reached maximum in the treatment of A_3 and reached minimum in the treatment of A_2. The soluble sugar accumulation amounts of ear knob and upper ear knob have significant difference between various cultivation patterns at tasseling stage in Longping 206. The soluble sugar accumulation amounts of ear knob have not significant difference between treatment A_1 and treatment A_3 at pustulation initial period. The starch content of ear knob and upper ear knob at tasseling stage was more than that at pustulation initial period under the same cultivation pattern. The content of N of ear knob has significant difference between various cultivation patterns at tasseling stage and has not significant difference between various compound fertilizer styles in all treatments except A_4. The soluble sugar accumulation amounts of ear knob and upper ear knob have maximum in test A_3B_2 and reached minimum at tasseling stage and pustulation initial period. All the component content of bleeding sap at the stem basal part has significant difference between different compound fertilizer kinds, except the soluble sugar and soluble protein in treatment A_1 and amino acid total and nitrate nitrogen in treatment A_4, in Longping 206 at elongation stage.

Keywords: Cultivation Patterns; Maize; Stem; Physiological Characteristics

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INTRODUCTION

Corn is the second largest food crop in China, the average planting area is about 25 million hectares, the annual output reached 1.2 tons, planting area and production are in the world second. Of our country corn were widely distributed, National more than 20 provinces, municipalities and autonomous regions have grown, the main producing areas is northeast China, North China and Huang Huai Hai corn, the main producing areas and the northwest part of the area. Experts predict that China's total corn production in the future for a long period of time will remain relatively stable. Corn implement "wide and narrow" and "wide and so the line" cropping patterns, can effectively improve the field light and ventilation conditions, and improve the utilization of carbon dioxide and light, without increasing the cost of investment, bringing in around 10% of the yield of corn, this planting model except the light transmitting performance with superior ventilation, not only saving labor to pick the straw, but also may be spaced xiaomaijishou left "straw ridge", also played a straw cover to soil moisture, drought, grass, straw returning to field, ground, soil, fertilizing soil comprehensive increase synergy. According to the soil nutrient status, and yield of maize demand, scientific fertilization should be in the promotion of measuring formula fertilization by soil foundation to achieve the organic and inorganic combined, large elements and trace elements in combination, the combination of base fertilizer and topdressing, root fertilization and foliar nutrition combined to develop maize balance fertilization technology, fertilizer application is harmonize crop such as nitrogen, phosphorus and potassium nutrient accumulation and allocation is an important means, and also to the realization of maize super high yield and the most effective method. In this study, the production of large area promotion of Hybrid Maize Longping 206 for materials testing, for the varieties with high density tolerance, resistance to high fat, establish 4 kinds of different cultivation modes, two kinds of different compound fertilizer application to study Longping 206 leaf and stem physiological characteristics, to provide theoretical and technical basis for further improving the yield of maize.

MATERIALS AND METHODS

Experimental Design

The experiment was carried out on $32^0$52'($N117^0$33' E) in Anhui Science and Technology University in 2013. Test for neutral loam topsoil of 0 ~ 20 cm soil containing organic matter 24. 62 G. kg^{-1}, total 193 G. kg-^{1}, alkali solution nitrogen 120. 1mg. kg^{-1}, available phosphorus 48. 6 mg .kg^{-1}, available potassium 243. 2 G .kg^{-1}, pH 6.8.

Under high production conditions, two factor split plot design was used in the experiment and a main area for the plants spacing, line spacing classification ($A_1$60 cm), spaced a hole double strains ($A_2$60 cm and a hole double strain), wide narrow row spacing ($A_3$70 cm+50 cm), wide narrow row spacing (A_4 90 cm+30 cm) 4 kinds of way, deputy district in basal types, divided into compound fertilizer Shi Danli(B_1NPK=18:18:18), rich compound fertilizer special raw corn (B_2NPK=26:12:10) a total of 8 treatment groups, repeat 4 times;. Planting density were 67500 plants, respectively),a cell width of 3m, length 6.67 m. Basal conditions are 750 kg, respectively, all the basal, in accordance with high-yield field management, in Longping 206 in the whole growth period of guarantee good water supply, timely watering, weeding, pest control, in order to ensure plants have good growth environment. June 13th, 2013, October 11th harvest.

Test Items and Methods

Nitrata Reductase Activity was Measured

Sampling 2 copies, each 0.49g around, a into a bowl with 5 M L distilled water and 5 ml of 0.1 mol / L phosphate buffer solution in a test tube and another into 5 ml of 0.2 mol / L KNO_2 solution and 5 ml of 0.1 mol / L phosphate buffer solution, placed in the temperature of 30 thermostat, insulation for 30 minutes. Then supernatant was 1 ml add 2ml α—chennaiamine, stir the mixture, standing for 30 min, after the color to be add 2 ml sulphonamide reagent, at 520nm colorimetry.

Determination of He Zhaofan's Method

Soluble sugar and starch content, determination of total nitrogen content by using the method of determination of the content of total nitrogen by using the method of flame photometric determination of potassium content.

NK Accumulation

Respectively in jointing stage, flowering stage, filling stage, and harvest period take consistent maize plant shoot, 5 strains of each treatment, 30 minutes under 105℃ oven fixing, 80℃ dried to constant by SpectraStar2500 nir near infrared quality analyzer respectively on the leaf, sheath, stem, bud leaf and grain NPK accumulation were measured.

Bleeding Sap Sampling and Method for Measuring Bleeding Sap

Each treatment was repeated for 4 times, and 5 strains were repeated at each time, and the samples were taken from the 1cm of the spike and stem nodes. Self into the cotton bag, cotton pre drying high temperature sterilization, using electronic balance weighing counting. Used vernier caliper to measure the diameter of the stem bleeding sampling at. After sampling, the scissors should be washed with distilled water bottle, and then dried with dry gauze to prevent pollution. The bag set to the stem section, with a thin rubber band tied. The day before 17:00 sampling, the next day early 6:00 to recover, weighing and finding the intensity of the flow of the unit time unit of the unit time and the volume of traffic. In the test tube, the soluble sugar, soluble protein, inorganic phosphorus, total amino acid and nitrate nitrogen content were determined by reference to Li Hesheng's method.

RESULTS AND ANALYSIS

Influence of Cultivation Mode and Compound Fertilizer Types on Leaf Nitrate Reductase Activity Longping 206

The cultivation model and compound fertilizer types on Longping 206 leaf nitrate reductase activity in the filling stage and reached the maximum value. In the whole growth period, the A_3 Longping 206 leaf nitrate reductase activity were highest, A_2 Longping 206 leaf nitrate reductase activity was the lowest, and between A_1 and A_3 without significant difference, between A_2 and A_4 no significant difference; in the silking stage, different cultivation patterns, Longping 206 leaf nitrate reduction enzyme activity is $B_1 > B_2$; in the filling stage and milk ripe stage and dough stage, Longping 206 leaf nitrate reductase activity is $B_2 > B_1$. In the silking stage, the same cultivation mode B_1 than B_2 206 long leaf nitrate reductase activity value (below by A_1, A_3, A_4, A_2) were 6.47%, 13.49%, 3.87%, 3.60%, and the leaf nitrate reductase activity increased 27.54% than the maximum minimum value; in the filling stage, the same cultivation mode, B_2 more than 206 B_1 long leaf nitrate reductase activity value were 9.16%, 10.60%, 8.62%, 6.91%, and leaves the maximum value of nitrate reductase activity increased 41.78% than the maximum minimum value; in the milk stage, the same cultivation mode, B_2 compared with B_1 Longping 206 long leaf nitrate reductase activity value were 4.13%, 2.34%, 3.02%, 4.94%, and leaves the maximum value of nitrate reductase activity increased 29.76% than the minimum value; in the same stage, cultivation mode, B_2 compared with B_1 Longping 206 long leaf nitrate reductase activity value were 4.59%, 2.55%, 10.78%, 6.29%, and leaf nitrate The maximum value of acid reductase activity was increased by 28.03%(Table1).

Table1. *The effect of cultivation patterns and compound fertilizer types on the variations of leaf nitrate reductase of Longping 206 nmolNO_2·dm^{-2}·h^{-1}*

Cultivation mode	Fertilizer Types of	Silking	Filling Stage	Milky stage	Dough stage
A_1	B_1	12.51±0.02ab	19.68±0.03b	18.17±0.03ab	15.46±0.03b
	B_2	11.74±0.01b	21.48±0.01ab	18.92±0.02a	16.17±0.02a
A_3	B_1	13.80±0.04a	22.46±0.02ab	19.26±0.01a	16.88±0.02a
	B_2	12.16±0.03b	24.84±0.04a	19.71±0.03a	17.31±0.02a

A_4	B_1	12.08±0.01b	18.22±0.02bc	15.87±0.02b	14.19±0.02bc
	B_2	11.63±0.02b	19.79±0.04b	16.35±0.02b	15.72±0.01b
A_2	B_1	11.21±0.01b	17.52±0.03c	15.19±0.01b	13.52±0.02c
	B_2	10.82±0.03b	18.73±0.01bc	15.94±0.03b	14.37±0.03bc

Effect of Cultivation Patterns and Fertilizer Types on Soluble Sugar and Starch Content of 206 Varieties Had

Rice stem soluble sugar accumulation amount and can promote the number of maize stalk cellulose and semi cellulose synthesis, can enhance the corn stalk thickening and elasticity, improve the lodging resistance. From table 2 we can see that in the tasseling stage, ear section, 206 section upper ear Longping soluble sugar accumulation in significant differences in the processing of different cultivation patterns, the same cultivation mode, different types of compound fertilizer treatments were not significant; in the early filling stage, the ear section Longping 206 soluble sugar accumulation the amount of A_1 and A_3 had no significant differences in A_2 and A_4, had no significant difference, but the difference of A_1, A_3 and A_2,A_4 were significant, and the same cultivation mode, different fertilizer types between the soluble sugar accumulation was not significantly different; the upper ear section of the soluble sugar accumulation in significant differences in processing different cultivation patterns between, and the same cultivation mode, different fertilizer types between the soluble sugar accumulation was not significantly different.

From table 2 we can see that Longping 206 ear section ,spike upper section in the content.Same cultivation pattern neading of strach was higher than the starch content of the initial filling .Among them the filling stage was 27.72% ,28.08%, 30.21%, 30.96%, 27.04%, 29.72%, 21.21%, 23.48%, higer than that of the filling stage.Strach content ear section biggest differece was the heading of A_3 B_2 higher than the filling of A_4B_2.Spike upper section heading of the starch content higher than the grain filling stage were seling filling stage than were 10.67% 13.91%, 12.14%, 11.11%, 8.30%, 7.85%, 2.25%, 1.84% .The upper section spike strach content biggest difference was the heading of A_3B_2 higher than the filling of $A_4B_1$29.72%.

Table2. *The effect of cultivation patterns and compound fertilizer types on the content of soluble sugar and starch of Longping 206*

Cultivation mode	Fertilizer Types of	Soluble sugar content				Starch content			
		Tasseling		Early grouting		Tasseling		Early grouting	
		Ear section	Spike upper section	Ear section	Spike upper section	Ear section	Spike upper section	Ear section	Spike upper section
A_1	B_1	26.42±0.01b	23.27±0.02c	21.79±0.02a	20.35±0.02ab	79.29±0.03b	64.28±0.06b	62.08±0.06a	58.08±0.06b
	B_2	27.85±0.03b	24.68±0.07b	21.92±0.11a	20.04±0.00ab	80.45±0.04b	66.75±0.01b	62.81±0.20a	58.60±0.00b
A_3	B_1	28.68±0.01a	25.61±0.06a	22.34±0.04a	21.49±0.01a	82.24±0.05a	68.61±0.03a	63.16±0.04a	61.18±0.04a
	B_2	29.37±0.13a	26.37±0.02a	22.97±0.03a	21.27±0.03a	83.46±0.03a	69.72±0.00a	63.73±0.16a	62.75±0.02a
A_4	B_1	25.17±0.08b	23.73±0.07c	20.06±0.01b	19.07±0.02b	77.38±0.01c	61.44±0.03c	60.91±0.14b	56.73±0.00c
	B_2	25.94±0.01b	24.81±0.01b	19.46±0.04b	18.61±0.01c	78.18±0.13c	62.09±0.01c	60.27±0.03b	57.57±0.04c
A_2	B_1	24.98±0.14c	22.97±0.03c	18.27±0.03c	18.94±0.04c	76.19±0.11c	59.64±0.04c	62.86±0.03a	58.33±0.03b
	B_2	24.16±0.05c	22.39±0.06c	18.85±0.01c	19.76±0.02b	76.77±0.04c	60.36±0.03c	62.17±0.00a	59.27±0.04b

Effect of Cultivation Patterns and Fertilizer Types on the Content of N and Content of K on Longping 206

Table 3 shows that, in the tasseling stage, different cultivation patterns, different Longping 206 ear segment N content significantly, in addition to A_4, other cultivation patterns of different fertilizer differences among different types of ear N content was not significant difference, the difference between the different cultivation patterns, Longping 206 spike was not significantly superior N, in addition to A_3, other cultivation patterns of different fertilizer differences among different types of ear N content was not significant; in the early filling stage, Longping 206 ear section N content difference between A_4 and A_1, A_2 and A_3 were significant, and in addition to A_3, other cultivation patterns of different fertilizer differences among different types of ear N content the upper section is not significant, spike N content in the cultivation mode of no significant difference, and A_3 and A_4 treatment, different types of compound fertilizer N in the upper ear section significantly; in tasseling stage, the content of N was the upper ear ear section section of the high proportion higher rates were 33.07%, 21.61%, 18.77% respectively, 13.14%, 25.33%, 36.19%, 12.23%, 17.41%, content of A_3B_2 the maximum of N content of A_3B_2 was increased 55% than the minimum of A_4B_1; the content of N at the early filling stage, the ear section of the upper section of the high spike were higher, respectively 17.02%, 19.25%, 14.96%, 15.37% 16.25%, 3.92%, 11.60%, 14.64%, the maximun N content of A_3B_2 in upper ear was increased 33.4% than the minimum of A_4B_1; in addition to A_2, other treatments were tassel ear segment of N was higher than that of grain filling period, higher proportion was 15.93%, 9.90%, 16.20%, 13.69%, 8.36%, 32.34%. -2.09%, -2.76; in addition to A2, tasseling and N content is higher than that of upper section of ear filling stage, higher proportion was 1.94%, 7.76%, 12.46%, 0.49%, 0.50%, 0.98%, -2.66%, -5.24%.

Potassium promoted activity of various enzymes in maize, improve maize photosynthesis and photosynthate operation ability, have an important role to improve the lodging resistance in maize. . As can be seen from the table 3, the K content of the spike node and the upper segment of the spike was highest in the A_3B_2, and the lowest in the A_2B_1.

Table3. *The effect of cultivation patterns and compound fertilizer types on the content of N and K of Longping 206*

Cultivation mode	Fertilizer Types of	Nitrogen content				Potassium content			
		Tasseling		Early grouting		Tasseling		Early grouting	
		Ear section	Spike upper section	Ear section	Spike upper section	Ear section	Spike upper section	Ear section	Spike upper section
A_1	B_1	8.37±0.02b	6.29±0.03b	7.22±0.02b	6.17±0.03b	25.73±0.04b	23.26±0.11b	19.47±0.05b	17.61±0.01b
	B_2	8.44±0.02b	6.94±0.01ab	7.68±0.01b	6.44±0.01b	26.24±0.01a	24.73±0.04a	20.30±0.01b	17.94±0.03b
A_3	B_1	9.11±0.01a	7.67±0.02b	7.84±0.00b	6.82±0.06b	26.01±0.03a	25.94±0.04a	21.81±0.04a	18.53±0.04a
	B_2	9.30±0.06a	8.22±0.07a	8.18±0.04a	7.09±0.04a	27.56±0.01a	26.91±0.06a	21.90±0.03a	19.38±0.00a
A_4	B_1	7.52±0.04c	6.00±0.02b	6.94±0.00c	5.97±0.00c	23.79±0.04c	21.09±0.07c	17.39±0.08c	15.19±0.06c
	B_2	8.43±0.07b	6.19±0.03b	6.37±0.03c	6.13±0.02b	24.21±0.07c	21.53±0.02c	18.27±0.04c	15.80±0.13c
A_2	B_1	7.16±0.00c	6.38±0.05b	7.31±0.00b	6.55±0.01b	22.74±0.04c	21.48±0.03c	17.44±0.03c	13.75±0.05d
	B_2	7.62±0.04c	6.49±0.00b	7.83±0.05b	6.83±0.06b	23.31±0.03c	22.11±0.08c	18.06±0.02c	14.22±0.01d

The Impact of Cultivation and Fertilizer on the Content of Each Component Type Ryuhei 206 Jointing Stem Base Sap Flow

As shown in Table 4, in addition to the treatment of soluble sugar and soluble protein in A_1, amino acid, nitrate nitrogen in A_4 treatment, other cultivation modes, types of compound fertilizer at jointing stage Longping 206 stem base asp components content did not show significant effects at jointing stage; stem sap flow components the content of soluble sugar, soluble protein, total amino acids, inorganic phosphorus and nitrogen was in the highest value of A_3B_2 were 434.91 ug/mL, 24.96 ug/mL, 41.27 ug/mL, 268.47 ug/mL, 40.53 ug/mL; the addition of soluble protein in A4B1 value is the minimum value of 21.37ug/mL, soluble sugar, amino acids, inorganic phosphorus, nitrate A_2B_1 is the minimum in nitrogen were respectively 318.33ug/mL, 32.76ug/mL, 210.66 ug/mL, 28.66 ug/mL, and the soluble sugar, soluble protein, total amino acids, inorganic phosphorus, nitrate maximum and minimum values of the change were 36.22%, 16.80%, 25.98%, 27.44%, 41.41%.

Table4. *The effect of cultivation patterns and compound fertilizer typeson the component content of bleeding sap at the stem basal part of Longping 206 at elongation stage*

Cultivation mode	Fertilizer Types of	Soluble sugar	Soluble protein	Total amino acids	Inorganic phosphorus	Nitrate
A_1	B_1	384.16±0.04b	22.94±0.03b	37.29±0.18a	241.39±0.24a	33.19±0.18b
	B_2	397.08±0.16a	23.27±0.04a	38.61±0.13a	253.67±0.21a	35.04±0.04b
A_3	B_1	412.89±0.05a	24.24±0.02a	39.08±0.17a	264.09±0.01a	38.91±0.16a
	B_2	434.91±0.02a	24.96±0.06a	41.27±0.05a	268.47±0.28a	40.53±0.04a
A_4	B_1	371.67±0.01b	21.37±0.11b	35.23±0.01b	221.68±0.30b	30.54±0.07c
	B_2	384.46±0.00b	21.68±0.01b	37.19±0.04a	228.67±0.06b	32.37±0.16b
A_2	B_1	318.33±0.06c	22.38±0.09b	32.76±0.07c	210.66±0.17b	28.66±0.04c
	B_2	333.64±0.14c	22.94±0.02b	33.19±0.15c	214.83±0.14b	30.73±0.06c

DISCUSSION

In terms of crop yield formation process, leaves, and roots are all belong to the category of corn source, leaf of synthetic carbohydrate stem is mainly responsible for the transport of nutrients to the function, so the physiological characteristics of leaf and stem have significant effects on Maize Yield and adjust spacing and type of fertilizer could increase maize yield, reasonable spacing of maize individual ventilated and pervious to light, contribute to the improvement of photosynthesis in leaves and stems of physiological indexes. This study showed that the cultivation model and compound fertilizer types on Longping 206 leaf nitrate reductase activity in the filling stage and reached the maximum value. In the whole growth period, the A_3 Longping 206 leaf nitrate reductase activity were highest, A_2 Longping 206 leaf nitrate reductase activity was the lowest, and between A_1 and A_3 without significant difference, between A_2 and A_4 without significant difference.

In recent years, studies have proved that the important physiological index of corn "flow" organs such as soluble sugar and starch content, N and K contents can fully reflect the speed of transportation of stem, Li Guochen research pointed out that under the same conditions, based on the time course of sufficient moisture and drought conditions of sap flow curve size can reflect the lack of moisture content in maize. This study showed that Longping 206 addition of soluble sugar and soluble protein in the A_1 treatment, amino acid, nitrate nitrogen in A_4 treatment, other cultivation modes, compound fertilizer types of Longping 206 at jointing stage stem base injured flow liquid groups were divided into content had no significant difference; jointing stage stem base injury flow liquid groups content can be soluble sugar, soluble protein, amino acid, inorganic phosphorus, nitrate nitrogen was A_3B_2 value reached the maximum.

CONCLUSION

Different cultivation patterns and different types of compound fertilizer had a significant effect on Longping 206 leaf nitrate reductase activity, in the whole growth period, the A_3 Longping 206 leaf nitrate reductase activity were highest, A_2 Longping 206 leaf nitrate reductase activity was the lowest and between A_1 and A_3 no significant difference, between A_2 and A_4 without significant difference; jointing stage stem base injury flow liquid groups content can be soluble sugar, soluble protein, amino acid, inorganic phosphorus, nitrate nitrogen were in a3b2 value reached the maximum, respectively 434.91 ug / ml, 24.96 ug / ml, 41.27 ug / ml, 268.47 ug / ml, 40.53 ug / ml.

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