The optimal scheme of summer maize in Shandong under the control of water and fertilizer

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Abstract. In order to explore a set of summer corn water and fertilizer management scheme suitable for Shandong region. The effects of dry matter, yield and fertilizer partial productivity management of summer maize under different irrigation amount (69.5 mm, 120.5 mm, recorded as W1, W2), different nitrogen application (143, 190, 235 kg/hm², recorded as N1, N2, N3) and phosphorus (65, 95, 115 as P1, P2, P3) on yield were significant (0.05), among which the comprehensive score of W2N2P2 was much higher than that of other treatments. According to the above analysis, the W2N2P2 treatment can be used as the best water and fertilizer ratio in this study area.

Keywords: First Keyword, Second Keyword, Third Keyword.

1. Introduction

The first paragraph after a heading is not indented There are many factors affecting crop production, among which fertilizer and water are two important factors affecting crop growth [1-2]. Appropriate water can promote crops to absorb fertilizer nutrients, and excessive water may cause nutrient loss and [3]. Similarly, proper fertilization will increase the activity of microorganisms in the soil and increase the water-saving capacity of cultivated soil, but excessive fertilization will damage the soil ecosystem and lead to crop reduction. Therefore, only the coordination of water and fertilizer application can make soil water and fertilizer play an active role [4-7]. In recent years, the research on the synergistic effect of water and fertilizer in China has attracted much attention, and many scholars have paid more attention to it. The optimal water and fertilizer scheme of summer corn has been studied. Zhang Yuming and other [8] found that nitrogen and phosphorus application could significantly increase crop yield compared with other factors through multiple water and fertilizer coupling tests, and Song Mingdan and other [9] found that water and fertilizer played a positive role in the accumulation of dry matter in crops. In summary, it is considered that the optimal combination of water and fertilizer in different regions will promote the yield of summer corn in this region. Therefore, a set of water, nitrogen and phosphorus regulation scheme suitable for the efficient utilization of summer corn water and fertilizer in Shandong area is explored in view of meteorological and soil conditions.

2. Materials and Methods

2.1 Test design

The variety of summer maize tested was Zhengdan 958, Sowing on 3 June 2018, Harvest on 4
October. There were 10 treatments, three repetitions per treatment. The cell is arranged in a random way. The area of each cell is 6.67 m² (2.00 m×3.335 m), 5.997×10⁴ seedlings per hectare. Four ridges per plot, 40 cm, ridge width 30 cm. Plant spacing. The nitrogen fertilizer used in the experiment was urea (46.4%), calcium superphosphate (12%) and potassium chloride (60%).

The test setting factors are: irrigation amount, nitrogen fertilizer and phosphorus fertilizer. In which the amount of irrigation is 2 levels, of 69.5 mm (W1) and 120.5 mm (W2). A "low water" W1(69.5 mm) is irrigated during sowing, The "high water" W2(120.5 mm) irrigated 69.5 at sowing time and 51 mm; before and after August 3, respectively. Three levels of nitrogen fertilizer, of 143 kg/hm²(N1), 190 kg/hm²(N2) and 235 kg/hm²(N3), Base ratio. The base fertilizer was applied before sowing and the topdressing was carried out in the early stage of male fertilization. The phosphate fertilizer (calculated by P2O5) was three levels, 65 kg/hm²(P1), 95 kg/hm²(P2) and 115 kg/hm²(P3), respectively. All treatments were treated with potassium fertilizer 130 kg/hm², all base application, other management and general field consistent. The test factors and horizontal combination schemes for each treatment are shown in Table 1.

| Number | Treatment | Water irrigation/(mm) | Nitrogen application/(kg/hm²) | Phosphorus application/(kg/hm²) |
|---------|-----------|-----------------------|-------------------------------|--------------------------------|
| T1      | W₁N₁P₂   | 69.5                 | 143                           | 95                             |
| T2      | W₁N₃P₂   | 69.5                 | 235                           | 95                             |
| T3      | W₁N₂P₂   | 69.5                 | 190                           | 95                             |
| T4      | W₁N₂P₁   | 69.5                 | 190                           | 65                             |
| T5      | W₁N₂P₃   | 69.5                 | 190                           | 115                            |
| T6      | W₂N₁P₂   | 120.5                | 143                           | 95                             |
| T7      | W₂N₃P₂   | 120.5                | 235                           | 95                             |
| T8      | W₂N₂P₂   | 120.5                | 190                           | 95                             |
| T9      | W₂N₂P₁   | 120.5                | 190                           | 65                             |
| T10     | W₂N₂P₃   | 120.5                | 190                           | 113                            |

2.2 Determination items and methods.
(1) On-ground dry matter: in summer maize seedling stage, jointing stage, male extraction stage, pre-grouting stage, mature stage, 3 representative plants were randomly selected, the whole corn was cut off with scissors to the soil surface, the stems, leaves and ears of each maize plant were separated in bags and stored in laboratory with 105°C oven to kill green 30 min, and then weighed after drying to constant weight °C.
(2) Yield: after the corn matures, one center point and four diagonal points are selected in each plot, and 3 plants are randomly selected at each point to determine the index of ear length, ear diameter, row number and grain number of corn.
(3) Fertilizer partial productivity: nitrogen fertilizer partial productivity (NPFP) and phosphorus fertilizer partial productivity (PPFP), the formula is as follows:

\[
\text{Phosphorus (nitrogen) fertilizer partial productivity (kg/kg)} = \frac{\text{yield (kg/hm}^2\text{)}}{\text{phosphorus (nitrogen) (kg/hm}^2\text{)}}
\]

3. Results and analysis

3.1 Effects of Application Quantity of Water and Fertilizer on Dry Matter Accumulation on the Ground
Summer maize yield is closely related to the production and accumulation of dry matter. the
A fundamental way to increase the yield is to improve the quality of dry matter. If enough nitrogen fertilizer is used, dry matter will accumulate [10] as much as possible in the production process. Taking T3 as the object, the variation law of dry matter accumulation of summer maize with time was analyzed by Logistic fitting equation (Fig.1).

![Figure 1. Dry Matter Accumulation Curve of Summer Maize in Treatment W2N1P2](image)

From the diagram, we can see that the dry matter accumulation curve is S type curve, the dry matter quality begins to accumulate slowly from seedling stage to early jointing stage, and then to the filling stage, the dry matter quality accumulates rapidly. The rate of dry matter quality accumulation is slow from late grouting to mature stage. It can be seen that the period from the jointing stage to the filling stage is the main stage of dry matter accumulation. The large amount of dry matter accumulation in this period is mainly due to the second irrigation and the rapid growth of dry matter accumulation under the action of base fertilizer and topdressing. As can be seen from the diagram, the cumulative ranking of dry matter is T8>T6>T7>T10>T3>T9>T1>T2>T5>T4, T8 (dry matter accumulation is the largest in water), so only the application of reasonable water and fertilizer can increase crop yield.

3.2 Effect of Application Quantity of Water and Fertilizer on Partial Productivity of Fertilizer
Fertilizer partial productivity (NPFP, PPFP) of summer maize under different treatments is shown in Table 2.

| Treatment   | NPFP       | PPFP       |
|-------------|------------|------------|
| I1N1P2      | 44.57±0.50 | 71.32±0.95 |
| I1N3P2      | 28.86±0.21 | 76.97±0.35 |
| I1N2P2      | 36.91±0.60 | 78.71±1.30 |
| I1N2P1      | 35.81±0.56 | 109.14±1.22|
| I1N2P3      | 34.37±0.21 | 59.92±0.53 |
| I2N1P2      | 58.01±0.04 | 92.83±0.98 |
| I2N3P2      | 38.19±0.21 | 101.85±0.67|
| I2N2P2      | 50.58±1.54 | 108.12±4.74|
| I2N2P1      | 45.98±0.10 | 140.15±1.16|
| I2N2P3      | 44.06±0.18 | 75.53±0.33 |

It can be seen from the above that the partial productivity of nitrogen fertilizer in summer maize decreases with the increase of nitrogen fertilizer application under the same level of irrigation and phosphorus application. Under the condition of irrigation and nitrogen application, the partial productivity of nitrogen fertilizer in summer maize increased first and then decreased with the increase of phosphorus fertilizer application.

When other factors are not considered, the partial productivity of phosphate fertilizer will decrease
gradually with the increase of phosphorus fertilizer application. At the same water and phosphorus conditions, the partial productivity of summer maize phosphorus fertilizer increased first and then decreased with the increase of nitrogen fertilizer application. When the nitrogen fertilizer application amount was 190 kg/hm², the partial productivity of phosphorus fertilizer was the highest. It shows that when nitrogen fertilizer exceeds the threshold, it can inhibit phosphorus fertilizer partial productivity.

3.3 Effects of water and fertilizer management on summer maize yield

The effect of nitrogen and phosphorus fertilizer on summer maize yield was significant under different irrigation treatments (Table 3)

| Treatment | N1       | N2       | N3       | Average  |
|-----------|----------|----------|----------|----------|
| W1        |          |          |          |          |
| P1        | 6875.35  | f        |          | 6810.19  |
| P2        | 7085.53  | e        | 6926.99  | 6761.57  |
| P3        | 6598.97  | f        |          | 6598.97  |
| Average   | 6418.92  |          | 6853.03  | 6761.57  |
| W2        |          |          |          |          |
| P1        | 8829.01  | c        |          | 8829.01  |
| P2        | 9730.91  | a        | 9167.08  | 9084.11  |
| P3        | 8460.06  | d        |          | 8460.06  |
| Average   | 9005.89  |          | 9167.08  | 8902.04  |
| F Value   | W=360.146** N=7.604** P=35.117* |

The yield of summer maize under W2 treatment was higher than that of W1 treatment, and the effect of nitrogen and phosphorus fertilizer was more significant under W2 irrigation. Under the condition of same water and phosphorus, the maximum yield can be reached when the nitrogen application is 192 kg/hm², and the maximum yield can be reached when the phosphorus application is 90 kg/hm², which is the same as that of corn with the change of phosphorus application. The data showed that the yield of treatment W2N2P2, W2N3P2 and W2N2P1 was significantly higher than that of other treatments, that is, the yield of treatment with high water and medium high fertilizer combination was significantly higher than that of low water and low and medium fertilizer treatment. Among them, optimal water and fertilizer management the overall yield of treatment (W2N2P2) was higher (9731.01 kg/hm²). This study shows that proper amount of nitrogen and phosphorus fertilizer can increase yield, but when the amount of nitrogen fertilizer is higher than 192 kg/hm², the amount of phosphorus fertilizer is higher than 90 kg/hm², it will inhibit the increase of corn yield.

4. Conclusion

(1) In the yield analysis of summer maize, the yield of high water and medium and high fertilizer combination treatment was significantly higher than that of low water and low and medium fertilizer treatment.

(2) Through the calculation of partial productivity of nitrogen and phosphorus fertilizer, the following conclusions are obtained: the partial productivity of nitrogen and phosphorus fertilizer increases with the increase of irrigation water, and the NPFP decreases with the increase of nitrogen fertilizer application amount under the same irrigation. The PPFP increases first and then decreases with the increase of fertilizer application amount. Therefore, a reasonable water and fertilizer management scheme can improve the utilization of fertilizer efficiency. T8 treatment (irrigation amount: 121.5 mm; nitrogen application amount: 192 kg/hm²; phosphorus application amount: 90 kg/hm²) is the priority treatment of summer corn water and fertilizer management in this study area, which is produced in this area.

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