The effect of the trench layout on the loss of nitrogen production and flow from the rainfall of oblique farmland

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Abstract: The oblique farmland in the northern part of China is often affected by rainfall, which arises out of the loss of a large amount of nitrogen, which causes the reduction of crop yield and the nutrient-rich pollution of river basins. Evaluating the impact of the trench farming layout on the loss of nitrogen production and flow of rainfall in sloping farmland can provide a scientific basis for the prediction and effective prevention and control of nitrogen loss in sloping farmland. Taking the oblique farmland of corn as the research object, nitrogen loss of distinctive ridges and the pitch of the ditches under natural rainfall conditions were continually observed by using the field prototype field observation test. According to the local farming tradition, three kinds of ridge and furrow trends should be set up, including horizontal ridge, vertical ridge and oblique ridge. The ridge and furrow spacing of the three tillage methods should be set at three levels, 40cm, 60cm and 80cm in turn. In addition, establish a field without ridge flat for blank control. Using the method of frequency statistics, it is calculated that the trench layout with the smallest nitrogen loss in each rainfall production stream is frequency in the annual rainfall production flow, and the trench layout with the smallest nitrogen loss is found from the overall trench layout and the same trench to different ridge spacing, and the same trench spacing to the three aspects of the trench layout. The results show that the optimal ridge and furrow layout with the minimum loss of nitrate nitrogen, ammonium nitrogen and total nitrogen is 60 cm ditch spacing in a horizontal ridge direction.

1. Introduction
Oblique arable land is the most important source of soil erosion, and the runoff caused by rainfall takes away the nutrients of particulate and water-soluble forms in the soil [1], which not only reduces soil fertility and fertilizer utilization efficiency, but also causes water pollution and other problems [2-3]. China’s hilly area of the existing slope arable land area of 24 million hm², accounting for 19.7% of the total area of cultivated land. With the increase of the utilization intensity of sloping farmland and the increase of fertilizer application, the problem of nitrogen loss and surface pollution caused by agricultural activities has gradually attracted widespread attention [4]. If the characteristics of nitrogen loss are explored and the best cultivation measures suitable for slope farmland are taken, the quality of
cultivated land will be maintained, the crop yield will be improved and the economic benefits will be boosted. What’s more, the pollution of agricultural sources will be effectively controlled, and the ecological environment will be protected.

For the study of the loss of rainfall-producing nitrogen and crop yield in sloping arable land, the current research at home and abroad focuses on the relationship between the loss of rainfall-producing nitrogen and crop yield in sloping arable land. Some scholars have done research on the mules of oblique farmland, such as Liu Y[5], Li R[6], Xu Y[7], Xie J[8], Zhang D[9], Zhang X[10], and Gu X[11], who have found that the use of plastic film-covered trench cultivation in arid and semi-arid areas can significantly improve crop yields and improve soil moisture utilization efficiency. Some scholars have also done research on sloping farmland trench covering materials, such as Zhang DK[12], etc. in order to explore the sustainability of rain collection and planting in the semi-arid loess plateau area, seeking the appropriate biochar cover type and optimal ridge width for the cultivation of red bean grass in the trench, using random area group field test, taking traditional flat as a control, to study the effects of different rain ridge covering materials and different ridge widths on runoff coefficients, soil water heat, red bean grass dry grass yield and water efficiency. In order to reveal the influence of soil moisture dynamics on the hydrological and ecological processes of the trench collection system in semi-arid areas, based on the dynamic random model of soil moisture, X W, etc. [13], analyzed the influence of different covering materials and different ridges on the soil moisture dynamics of the growth season oat root layer, studied the characteristics of the probability density function of soil moisture at the point scale, and made sensitivity analysis of the parameters involved in the model. There have also been scholars who have done different ridge direction or different trench density on the slope of farmland nitrogen loss research, such as Guo [14] and so on in China's hilly areas set horizontal ridges and vertical ridges of different ridge direction planting methods, found that horizontal ridge planting can significantly reduce surface runoff in Nitrogen loss, El-Sadek A [15], etc. Set up different trench spacing in Egypt's northwest coastal zone, and found that at the same water utilization efficiency, the trench ratio was 60cm:60cm. Crop yields are highest when 30cm ridges are pitched. Wang Q [16] and other studies have studied the best trench ratio and suitable trench covering materials produced by alfalfa in rainwater harvesting in semi-arid areas of China, and in the trench collection system, the optimal trench width of ordinary plastic film and biodegradable film cover is 35-36cm, and the best trench width is 60cm. The above research is only from the external environment of the trench, such as the coating of the trench or cover material to study the loss of rainfall-producing nitrogen or crop yield under the trench layout, but also some scholars on the internal structure of the trench, such as the direction of the trench or the gap spacing alone to study the loss of rain-producing nitrogen or crop yield under the trench layout. However, there are not many studies on the loss of nitrogen produced by rainfall or crop yield in the lower slope of the trench layout.

Corn, as one of the main oblique arable crops in northern China, has a high growth period and the main rainfall erosion period. Therefore, this study focuses on the oblique arable land of corn, discusses the influence of different ridge layout on the loss of nitrogen production and loss of oblique farmland under natural rainfall conditions, analyzes the characteristics of nitrogen loss in various forms under the conditions of the direction of different ridges and the spacing of the ridges, and reveals the layout of the ditches with the smallest amount of nitrogen loss. The research results are of great practical significance to reduce the loss of nitrogen in the soil of the sloping farmland, to avoid the pollution of a water body by nitrogen loss, and to improve crop yield.

2. Overview of the research area

Upper Luanhe River is typically semi-arid areas with an average annual precipitation of 300 to 450mm, mainly concentrated in June-September (75-85% of the total for the whole year), and prone to short-term, high-intensity rainstorms [17]. In addition, under the influence of climate change and the coupling of human activities, the pattern of precipitation time and space in China is changing significantly, the characteristics of the north elevation of the rain belt are obvious, and the intensity and frequency of heavy precipitation events in the upper Luanhe River are also increasing significantly [18]. In addition, agriculture in the upper Luanhe River is mainly planted, which is one of the important grain production
areas in China [19], of which the dry land area is about 6.6 million mu, and the slope is 5 to 15 degrees of slow-oblique farmland. Therefore, the upper Luanhe River is typical representative areas to carry out the analysis of the effects of sloping farmland trench farming on rainfall yield nitrogen production and reduce the study of soil nitrogen loss in sloping arable land. The research test site is located in the upper Luanhe River, located in Chongzhaohu City, Hebei Province, Zhangjiying Township Baizigou Village (117.90E, 41.31N), 428m above sea level, covers an area of 340m².

3. Materials and methods

3.1 Test design and observation indicators

A total of 10 fields of 4m * 8m specifications are set up at the test site, as shown in Figure 1. The fields are laid with aluminum plate, aluminum plate buried 1m deep into the soil, exposing the soil surface 20cm, to prevent the lateral movement of moisture on the surface and in the farming layer, each field under the formation of a collection tank to collect the corresponding field surface production flow, the test site design average slope of 10 degrees slope farmland.

![Figure 1 The floor plan of the test site](image)

According to the local planting habits, the selection of spring corn as a test crop, seeding system, fertilization system and planting density reference to local planning habits. According to local farming practices, farming methods are set to horizontal ridge farming, vertical ridge farming, oblique ridge farming three ways, the three farming methods of the trench spacing are set 40cm, 60cm, 80cm three levels, of which 1, 2, 3. No. 1 field horizontal ridge farming treatment, 4, 5, 6 field for vertical ridge farming treatment, 7, 8, 9 field block for oblique ridge farming treatment, No. 10 field block for no ridge flat treatment, as shown in Figure 2. During the rainfall process, the yield flow of each field is monitored, and after the rainfall, the collected water sample is stirred evenly to take the water sample, and the concentration of nitrous nitrogen, ammonium nitrogen and total nitrogen in the water sample is measured.

3.2 Analysis method

To study the effect of the trench layout on the loss of nitrogen production in oblique farmland, the method of frequency statistics can be used to find the trench layout with the smallest amount of nitrogen loss from the overall trench layout and the same trench to the different ridge spacing and the same trench spacing to the three aspects of the ditch. Here's how to analyze it:

3.2.1 The minimum nitrogen loss is analyzed from the overall trench layout.

From the water sample detection data of the annual rainfall production stream, find the experimental field blocks with the smallest loss of nitrogen in each rainfall yield, count the number of times these experimental fields with the smallest nitrogen loss occur, calculate the corresponding frequency, and the corresponding trench layout of the most frequent experimental fields is the overall optimal trench layout. The formula is as follows:

$$ P_1 = \frac{m}{n} $$

$ P_1 $ indicates the frequency at which the minimum nitrogen loss is analyzed from the overall trench.
3.2.2. The minimum nitrogen loss was analyzed from the same trench to the different ridge spacing.
From the water sample data of each rainfall production stream, find the distance between the ditches where the nitrogen loss is the smallest under the same trench to the different ridge spacing, count the number of times these nitrogen loss is the smallest trench spacing occurs, calculate the corresponding frequency, find the gap between the ditches with the highest frequency of these ridges, that is, the optimal trench spacing in the same trench to the different trench spacing. The formula is as follows:

\[ P_2 = \frac{m_{ij}}{n_i} \]  

Where, \( P_2 \) represents the frequency of the minimum nitrogen loss in different ridge and furrow spacing analysis from the same ridge and furrow direction; \( i \) represents the ridge and furrow direction, \( i=\) horizontal ridge, straight ridge, and diagonal ridge; \( j \) represents the ridge and furrow spacing, \( j=40\text{cm}, 60\text{cm}, 80\text{cm}; m_{ij} \) represents the number of occurrences of \( j \) corresponding to the smallest amount of nitrogen loss when the ridge and furrow direction is constant \( i \) and the distance between the ridges and furrows is \( j; n_i \) represents the total number of nitrogen loss detection times when the ridge and furrow direction is constant \( i \);

3.2.3. From the same ridge spacing different ridges to analyze the minimum nitrogen loss.
From the water sample data of each rainfall production stream, find the trend of each rainfall yield in the same trench spacing different ridges towards the lowest amount of nitrogen loss, count the number of times these ditches with the smallest loss of nitrogen occur, calculate the corresponding frequency, find the direction of these ditches towards the most frequent ridges is the optimal trench trend in the same trench spacing different ridges. The formula is as follows:

\[ P_3 = \frac{m'_{ij}}{n'_j} \]  

Where, \( P_3 \) represents the frequency of the minimum nitrogen loss in different ridges and furrows from the same distance between ridges and furrows; \( i \) represents the direction of ridges and furrows, \( i=\) horizontal ridges, straight ridges, and diagonal ridges; \( j \) represents ridge and furrow spacing, \( j=40\text{cm}, 60\text{cm}, 80\text{cm}; m'_{ij} \) represents the number of occurrences of \( i \) corresponding to the smallest amount of nitrogen loss when the distance between ridges and furrows is constant \( j \) and the direction of ridges and furrows is \( i; n'_j \) represents nitrogen when the distance between ridges and furrows is constant \( j \) The total number of detections of nutrient loss;

Finally, the optimal trench layout obtained by these three kinds of analysis is analyzed and integrated, and the trench layout with the smallest loss of nitrogen from rainfall in sloping farmland is obtained.

4. Results and discussions
The trial began in April 2019 and ended in November. During this period, the rainfall yield data of the whole fertility period of corn were monitored, a total of 11 rainfall yield data were monitored, and nitrogen concentration was detected on water samples of 10 rainfall production streams. The effect of the trench layout on nitrogen loss is analyzed according to the above method.

4.1 The minimum loss of nitrogen is analysed from the whole
The water sample data of 10 rainfall production streams were counted, and the experimental fields where the minimum loss of nitrous nitrogen, ammonium nitrogen and total nitrogen were counted in each rainfall were counted, and the results were shown in Table 1, and then the frequency calculation of the fields with the smallest loss of nitrous nitrogen, ammonium nitrogen and total nitrogen was calculated separately, as shown in Figure 4.
Table 1 The minimum loss of water-like nitrogen from 10 rainfalls corresponds to the fields

| Number | Time      | Minimum loss of nitrous nitrogen | Minimum loss of ammonium nitrogen | Minimum loss of total nitrogen |
|--------|-----------|---------------------------------|-----------------------------------|--------------------------------|
|        |           | Fields | Layout | Spacing | Fields | Layout | Spacing | Fields | Layout | Spacing |
| 1      | May 26    | 4      | vertical | 40      | 7      | Oblique | 40      | 2      | Horizontal | 60    |
| 2      | July 6    | 2      | Horizontal | 60      | 2      | Horizontal | 60      | 2      | Horizontal | 60    |
| 3      | July 7    | 3      | Horizontal | 80      | 3      | Horizontal | 80      | 3      | Horizontal | 80    |
| 4      | July 17   | 1      | Horizontal | 40      | 1      | Horizontal | 40      | 2      | Horizontal | 60    |
| 5      | July 29   | 2      | Horizontal | 60      | 1      | Horizontal | 40      | 1      | Horizontal | 40    |
| 6      | July 31   | —      | —       | —       | 3      | Horizontal | 80      | 1      | Horizontal | 40    |
| 7      | August 7  | 2      | Horizontal | 60      | 6      | Vertical | 80      | 4      | Vertical | 40    |
| 8      | August 9  | 1      | Horizontal | 40      | 10     | No       | No.     | 1      | Horizontal | 40    |
| 9      | August 20 | 2      | Horizontal | 60      | 2      | Horizontal | 60      | 2      | Horizontal | 60    |
| 10     | September 1 | 2     | Horizontal | 60      | 2      | Horizontal | 60      | 2      | Horizontal | 60    |

Note: Horizontal indicates horizontal ridge, vertical indicates vertical ridge, slope indicates oblique ridge, does not indicate no ridge, "—" indicates that it is impossible to judge (due to rainfall water-like nitrogen concentration detection limit is greater than or equal to 0.002 mg/L, may be too low detection concentration to judge the minimum nitrogen loss).

As can be seen from Figure 2, from the water quality data analysis of 10 rainfall production streams, nitrous nitrogen, ammonium nitrogen and the smallest loss of total nitrogen are located in the field block the highest frequency is the 2nd field block, the trench layout of this field is horizontal ridge to 60cm trench spacing.

Figure 2 Percentage of fields corresponding to the minimum loss of water-like nitrogen from 10 rainfalls
4.2 The minimum amount of nitrogen is analyzed from the same trench to the different ridge spacing
The gap between nitrous nitrogen, ammonium nitrogen and total nitrogen corresponding to the minimum loss in the horizontal, straight and oblique ridges in the 10 rainfall production streams was counted separately, and the results were shown in Table 2. Then, the frequency calculation is calculated for the distance of the ditch corresponding to the minimum loss of nitrous nitrogen, ammonium nitrogen and total nitrogen under the condition of the horizontal ridge direction, the smooth ridge direction and the oblique ridge direction, as shown in Figure 3, Figure 4, Figure 5.

Table 2 The distance between the same ridges and the minimum amount of nitrogen under the pitch of the different ridges corresponds to the gaps

| Number | Time         | The distance between the ditches with the smallest loss in the horizontal ridges(cm) | The distance between the ditches with the smallest loss in the sun ridge(cm) | The distance between the ditches with the smallest loss in the ramp (cm) |
|--------|--------------|---------------------------------------------------------------------------------|--------------------------------------------------------------------------|---------------------------------------------------------------------|
|        |              | Nitrous nitrogen | Ammonium nitrogen | Total nitrogen | Nitrous nitrogen | Ammonium nitrogen | Total nitrogen | Nitrous nitrogen | Ammonium nitrogen | Total nitrogen |
| 1      | May 26       | 80                | 80                | 60             | 40              | 80              | 40             | 40              | 40              | 40              | 40              |
| 2      | July 6       | 60                | 60                | 60             | 60              | 80              | 80             | 40              | 40              | 40              | 40              |
| 3      | 7 July       | 80                | 60                | 80             | 40              | 40              | 40             | 60              | 60              | 40              |
| 4      | July 17      | 40                | 40                | 60             | 40              | 60              | 60             | 40              | 40              | 40              |
| 5      | July 29      | 60                | 40                | 40             | 40              | 40              | 80             | 40              | 40              | 40              |
| 6      | July 31      | —                 | 80                | 40             | —               | 40              | 40             | —               | 40              | 40              |
| 7      | August 7     | 60                | 80                | 40             | 80              | 80              | 40             | 60              | 40              | 80              |
| 8      | August 9     | 40                | 40                | 40             | 80              | 60              | 60             | 60              | 60              | 40              |
| 9      | August 20    | 60                | 60                | 60             | 60              | 40              | 60             | 40              | 40              | 40              |
| 10     | September 1  | 60                | 60                | 60             | 80              | 60              | 60             | 40              | 40              | 40              |

Note: "-" indicates that it is not possible to judge (the minimum nitrogen loss may not be possible due to the low detection concentration due to the detection limit of 0.002 mg/L for the detection of water-like nitrogen concentrations in rainfall production)

As can be known from Figure 3, in the water quality data of 10 rainfall production streams, the distance between the ditches with the highest corresponding frequency of nitrogen minimum loss in the middle and different ridges is as follows: nitrous nitrogen, ammonium nitrogen and total nitrogen minimum loss correspond to the highest frequency of ridge spacing is 60cm.
Figure 3 Percentage of the distance between the ditches corresponding to the minimum loss of nitrogen between the different ridges in the horizontal ridge

As can be known from Figure 4, in the water quality data of 10 rainfall production streams, the distance between the ditches with the highest corresponding frequency of nitrogen minimum loss in the middle of the ridges and ditches is as follows: the maximum corresponding frequency of the minimum loss of nitrous nitrogen and ammonium nitrogen is 40cm or 60cm;

Figure 4 Percentage of the corresponding spacing of the minimum amount of nitrogen under the spacing of the different ridges in the straight ridge

As can be found from Figure 5, in the water quality data of 10 rainfall production streams, the minimum loss of nitrogen corresponding to the highest frequency of the ridge spacing in the middle of the ridge to the different ridges is as follows: nitrous nitrogen, ammonium nitrogen and total nitrogen minimum loss correspond to the highest frequency of the trench spacing is 40cm.

Figure 5 Percentage of the corresponding spacing of nitrogen in the middle of the pitch of the different ridges

As can be found from Figure 5, in the water quality data of 10 rainfall production streams, the minimum loss of nitrogen corresponding to the highest frequency of the ridge spacing in the middle of the ridge to the different ridges is as follows: nitrous nitrogen, ammonium nitrogen and total nitrogen minimum loss correspond to the highest frequency of the trench spacing is 40cm.
4.3 From the same ridge spacing different ridges to the analysis of the minimum loss of nitrogen

The trench layout corresponding to the minimum loss of nitrous nitrogen, ammonium nitrogen and total nitrogen in 10 rainfall production streams was counted, as shown in Table 3. Then, the distance between the ditch 40 cm, the gap 60 cm and the trench spacing 80 cm in the minimum loss of nitrous nitrogen, ammonium nitrogen and total nitrogen corresponding to the trench trend calculation, the results are shown in Figure 6, Figure 7, Figure 8.

Table 3 The layout of the trench corresponding to the minimum loss of nitrogen in the same trench spacing is different

| Number | Time       | 40cm trench spacing (minimum loss ridge layout) | 60cm ridge spacing (minimum loss ridge layout) | 80cm ridge spacing (minimum loss ridge layout) |
|--------|------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|
|        |            | Nitrous nitrogen | Ammonium   | Total nitrogen | Nitrous nitrogen | Ammonium   | Total nitrogen | Nitrous nitrogen | Ammonium   | Total nitrogen |
| 1      | May 26     | Vertical         | Oblique    | Horizontal    | Vertical         | Oblique    | Horizontal    | Vertical         | Oblique    | Horizontal    |
| 2      | July 6     | Horizontal       | Oblique    | Oblique       | Horizontal       | Oblique    | Horizontal    | Horizontal       | Oblique    | Horizontal    |
| 3      | July 7     | Oblique          | Oblique    | Oblique       | Vertical         | Oblique    | Horizontal    | Vertical         | Oblique    | Horizontal    |
| 4      | July 17    | Horizontal       | Oblique    | Oblique       | Vertical         | Oblique    | Horizontal    | Vertical         | Oblique    | Horizontal    |
| 5      | July 29    | Vertical         | Horizontal| Horizontal    | Vertical         | Horizontal| Vertical      | Horizontal       | Oblique    | Horizontal    |
| 6      | July 31    | No               | No         | No            | No               | No         | No            | No               | No         | No            |
| 7      | August 7   | Oblique          | No         | Vertical      | No               | No         | Vertical      | Oblique          | Oblique    | Vertical      |
| 8      | August 9   | Horizontal       | No         | No            | Oblique          | No         | No            | Oblique          | Oblique    | Vertical      |
| 9      | August 20  | Oblique          | Vertical   | Oblique       | Horizontal       | Vertical   | Oblique       | Horizontal       | Vertical   | Oblique       |
| 10     | September  | Oblique          | Oblique    | Horizontal    | Vertical         | Horizontal| Horizontal    | Vertical         | Horizontal| Horizontal    |

Note: Horizontal indicates horizontal ridge, vertical indicates vertical ridge, slope indicates oblique ridge, does not indicate no ridge, "-" indicates that it is impossible to judge (due to rainfall water-like nitrogen concentration detection limit is greater than or equal to 0.002 mg/L, may be too low detection concentration to judge the minimum nitrogen loss).

As can be known from Figure 6, in the water quality data of 10 rainfall production streams, the distance between the same ditches 40 cm, 60 cm and 80 cm in the minimum loss of nitrous nitrogen, ammonium nitrogen and total nitrogen corresponding to the highest frequency of the trench trend is as follows: the smallest loss of nitrous nitrogen corresponding to the highest frequency of the trend is horizontal ridge or slope.

Figure 6 The percentage of pitch corresponding to the minimum loss of nitrogen in the different ridges of the 40cm trench

As can be known from Figure 7, in the water quality data of 10 rainfall production streams, the corresponding trend of the highest corresponding frequency of nitrogen minimum loss in the same trench distance of 60 cm is as follows: the trend of the highest corresponding frequency of nitrous nitrogen, ammonium nitrogen and total nitrogen minimum loss is the horizontal ridge.
As can be known from Figure 8, in the water quality data of 10 rainfall production streams, the corresponding highest corresponding frequency of nitrogen minimum loss in the same trench distance of 80cm different ridges is as follows: nitrous nitrogen, ammonium nitrogen and total nitrogen minimum loss correspond to the highest frequency of the trend is horizontal ridge.

4.4 Comprehensive analyses

On the whole, the optimal trench layout corresponding to the minimum loss of nitrous nitrogen, ammonium nitrogen and total nitrogen is 60cm, which is consistent with the conclusion that the optimal trench layout under the same trench spacing situation is horizontal, so the best trench direction for nitrogen loss is horizontal ridge. Combined with the optimal trench spacing when the horizontal ridge, nitrous nitrogen, ammonium nitrogen and total nitrogen minimum loss corresponding to the optimal trench spacing is 60cm, so in the best possible consideration of nitrous nitrogen, ammonium nitrogen and total nitrogen loss of the optimal trench layout is the horizontal ridge to 60cm trench spacing, comprehensive analysis results as shown in Table 4.

| Nitrogen       | The overall optimal trench layout | The same ridges are spacing to different ridges | The same ridges are spacing different ridges |
|----------------|----------------------------------|-----------------------------------------------|--------------------------------------------|
|                |                                  | Optimal spacing when ridged                    | 40cm pitch optimal trench layout           |
|                |                                  | Optimal spacing when sloping                   | 60cm pitch optimal trench layout           |
|                |                                  | 80cm pitch optimal trench layout               |                                            |
| Nitrous nitrogen | Cross 60cm                      | 60cm                                          | Cross/Slope                                |
|                 |                                  | 40cm                                          | Cross-ridge                                |
|                 |                                  | 40cm                                          | Cross-ridge                                |
|                 |                                  | 40cm                                          | Cross-ridge                                |


5. Conclusion
This study mainly studies the effect of the trench layout on the loss of rainfall yield nitrogen in oblique farmland from two factors, from the overall trench layout and the same trench to different ridge spacing, the same trench spacing to different ridges to three aspects of comprehensive analysis, in the best possible consideration of nitrous nitrogen, ammonium nitrogen and total nitrogen loss of the optimal trench layout is horizontal ridge to 60cm ditch pitch. In the agricultural production of corn cultivation in oblique farmland, setting up the planting method of pitching the horizontal ridge to 60cm ditch can minimize the loss of nitrogen in the soil, intercept the rain flow and nitrogen, preserve water and fertilizer, improve crop yield, and reduce the pollution of rivers and lakes by the loss of nitrogen. There are some shortcomings in this study, such as due to this test process, the entire corn fertility period, rainfall is not a lot, in addition to the ridge direction and trench spacing set change gradient is not diverse enough, in the future test, we need to further study.

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| Ammonium nitrogen | Cross 60cm | 60cm | 40cm | 40cm | Cross-ridge | Cross-ridge | Cross-ridge |
|-------------------|------------|-----|-----|-----|-------------|-------------|-------------|
| Total nitrogen    | Cross 60cm | 60cm | 40cm/60cm | 40cm | Cross-ridge | Cross-ridge | Cross-ridge |


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