Influence of Different Nitrogen Application Levels on Dry Matter Accumulation and Distribution of Silage Corn

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Abstract. The clarification of the dry matter accumulation, distribution law and yield differences of silage corn under different nitrogen application rates will provide theoretical basis for determining the optimal nitrogen application rates of silage corn under drip irrigation in central Inner Mongolia. In this study, Zhongxing silage 1 was selected as the experimental variety. This paper systematically analyzes the dry and fresh weight accumulation and growth rate, dry matter distribution and yield index of silage corn in the whole growth period under the condition of six different nitrogen application amount in two consecutive years of 2018 and 2019. The results indicated that the application of nitrogen fertilizer increased the whole plant fresh weight and dry matter content in different growth stages after the seedling stage of silage corn, and the whole growth period from the seedling stage to the harvest stage, the fresh weight and dry matter accumulation rate of N16 and N20 treated plant were higher than other treatments in 2018 and 2019. Except for the leaves at the trumpet period, the dry matter distribution ratio of each organ was not affected by nitrogen application level before tasseling stage. In the silage harvest period, the biological fresh weight and biomass yield of silage corn were the highest in N16. It can be concluded that N16 (240kg N ha−1) is the best nitrogen application rate for silage corn under drip irrigation in central Inner Mongolia by means of comprehensively comparing the dry matter accumulation rate, distribution and yield under different nitrogen rates.

1. Introduction

Silage corn is one of the main silage. The straw of green fodder and silage corn is rich in nutrition, with the characteristics of sour smell and good palatability. In recent years, animal husbandry industrialization has entered a rapid development period. The silage presents a strong market demand
and a serious shortage of supply, which has become a bottleneck restricting the rapid development of animal husbandry industrialization. Accelerating the development of silage industrialization speed and breaking through the traditional mode has become one of the most important ways to improve the economic benefits of animal husbandry\cite{1}. Nitrogen is the essential nutrient element for plants and a limiting element affecting plant growth and development in most terrestrial ecosystems. Nitrogen application has a positive effect on plant growth\cite{2}. The growth and development of corn cause a large amount of dry matter accumulation through further transformation in vivo. Dry matter is the material basis for the formation of biological yield, and the dry matter content of the whole plant is an important character of forage corn. Some studies have found that in a certain range, the dry matter accumulation is closely and positively correlated with the yield\cite{3}. The application of nitrogen fertilizer can promote the increase of dry matter accumulation of corn, among which the dry matter accumulation is the largest and the fastest within 10 days after anthesis\cite{4}; and the rational nitrogen management is an important measure to achieve high yield and quality. Some studies have found that the yield of silage corn increases first and then decreases with the increase of nitrogen application rate, and excessive nitrogen application will inhibit the growth of crops\cite{5}. Li Jia\cite{6} et al. found that the dry matter accumulation of corn increased with the increase of nitrogen application rate, among which, the dry matter accumulation of corn reached the highest value when the nitrogen fertilizer application rate was 360 kg/hm$^2$; The silage corn is one of silage which can be harvested with the whole plant. Therefore, studying the accumulation and distribution of dry and fresh weight in different organs of silage corn in the whole growth period has a positive influence on yield accumulation and precision fertilization. At present, there are more researches on yield formation of grain corn under different nitrogen application levels. However, there are few reports on dry matter accumulation and distribution of silage corn in middle maturity region of Inner Mongolia. Based on the existing situation of silage corn production in Inner Mongolia, this study researches the influence of different nitrogen application levels on the accumulation, transfer and distribution of aboveground dry matter of silage corn, and provides theoretical basis and technical support for high yield and high quality cultivation of silage corn.

2. Materials and methods

2.1 Field experimental design

This experiment was set in the experimental field in the Inner Mongolia Agriculture Academy of Sciences (40° 45′ N, 111° 40′ E, 1040 m above sea level), Hohhot City, Inner Mongolia Province, China. The area belongs to the typical Mongolia plateau continental climate, with apparent differences in average annual temperature and average daily temperature. The average annual temperature and precipitation are 6.7℃ and 399.3 mm during the last 30 years (1998-2017), and the frost-free period is 113-134 d. The precipitation during the silage maize growth period was 518.2 mm in 2018. The soil is brown loam. Basic properties of soil before the experiment started were: pH 9.02, organic matter 22.63g kg$^{-1}$, total nitrogen 1.08g kg$^{-1}$, total phosphorus 0.77g kg$^{-1}$, total kalium 0.36g kg$^{-1}$, alkali nitrogen 59.5mg kg$^{-1}$, available phosphorus 15.92 mg kg$^{-1}$, and available kalium 117.50 mg kg$^{-1}$.

2.2 Materials and experimental design

The experiment adopted a split zone setting, with 6 treatments in 3 replicates. The previous crop was quinoa, and experimental variety was Zhongxing silage 1 (obtained from the variety selection experiment of 2016-2017). Six nitrogen fertilization treatments were: 0 (N0), 120 (N8), 180 (N12), 240 (N16), 300 (N20), and 360 (N24) kg N ha$^{-1}$, with N0 as control. The sowing density was 5,000 plants/mu and the plot area was 28m$^2$. All treatments received with the same dose of phosphate fertilizer (138 kg P ha$^{-1}$) and potash fertilizer (38.25 kg K ha$^{-1}$), and the resin-coated urea was selected for nitrogen fertilizer (45% nitrogen content). All fertilizers were applied as basal fertilizer before sowing, and no topdressing was applied in the later stage. Drip irrigation is adopted, and other...
field management was the same as that of general production field. The sowing dates in 2018 and 2019 were May 4, 2018, and April 23, 2019, respectively.

2.3 Determination index and method
The dry and fresh weight of organs was classified. The samples were collected at the seedling stage, jointing stage, trumpet period, tasseling stage and maturity stage. Randomly select 3 plants from each plot, put the samples in kraft paper bags according to the stems, leaves, bracts, ears, and put them into the oven. The green was killed at 105 °C for 30 min and dried to constant weight at 80 °C. Weigh them with electronic balance.

Yield. When the milk line of silage corn reached 1/2, the whole plant was cut from 20 cm above ground. The fresh weight was converted into hectare yield according to the weight of the plot; the biological yield was weighed by the drying method, 10 corn plants were randomly selected for killing green at 105 °C for 30 min, then dried to constant weight at 60 °C for weighing, and then converted into yield per hectare.

2.4 Statistical analysis
Microsoft Excel software was adapted to process data and making graphics, and IBM SPSS statistics 25.0 was used for data analysis.

3. Result
3.1 Effects of different nitrogen application levels on fresh weight and dry matter accumulation of silage corn

Table 1: Comparison of Fresh Weight Accumulation Rate of Silage Corn under Different Nitrogen Application rates in Different Growth Periods (g/d)

| N application rates | Seedling stage | Jointing stage | Trumpet period | Tasseling stage | Seedling stage-maturity stage |
|---------------------|----------------|----------------|---------------|----------------|-------------------------------|
|                     | 2018 2019      | 2018 2019      | 2018 2019     | 2018 2019      | 2018 2019                     |
| N0                  | 8.65C 1.56e    | 21.53A 11.84b | 17.49B 26.45a | -6.21B -0.71a  | 5.48E 4.71c                  |
| N8                  | 9.74BC 3.80cd  | 31.06A 19.34a | 16.44B 20.22b | -6.60B 2.10a   | 8.25D 6.57abc                |
| N12                 | 14.19AB 5.23ab | 27.27A 16.23ab| 36.35A 26.36a | -5.43B 1.16a   | 10.23CD 7.19abc              |
| N16                 | 16.73A 4.68abc | 26.23A 19.63a | 24.44AB 30.34a| 7.10A 4.79a    | 14.60A 9.46a                 |
| N20                 | 2.63ABC 6.03a  | 34.11A 16.38ab| 14.35B 25.59ab| 3.92A 3.43a    | 12.61AB 8.37ab               |
| N24                 | 14.32AB 3.26d  | 25.31A 17.30a | 9.78AB 24.84ab| 4.37A 1.12a    | 12.7BC 5.50bc                |

Significance of ANOVA: N ** * ** ** ** Y ** ** * ** ns * N*Y ** ns ** ns ns

Note: Different upper and lower case letters indicated significant difference in 2018 and 2019 different treatments at P<0.05 level; N represent Nitrogen application rate, Y represent years; * means significant different at P<0.05 level, ** means significant different at P<0.01 level, ns means no significant difference; The same as below.

Table 2: Comparison of Dry Matter Accumulation Rates of Silage Corn under Different Nitrogen Application Levels in Different Growth Period (g/d)

| N application rates | Seedling stage | Jointing stage | Trumpet period | Tasseling stage | Seedling stage-maturity stage |
|---------------------|----------------|----------------|---------------|----------------|-------------------------------|
|                     | 2018 2019      | 2018 2019      | 2018 2019     | 2018 2019      | 2018 2019                     |
| N0                  | 1.11B 0.21c    | 2.01B 1.35b    | 5.04AB 4.35c  | 2.26C 2.28d    | 2.39C 1.64d                   |
| N8                  | 1.12B 0.44b    | 4.13A 2.00ab   | 5.06AB 5.31bc | 3.17BC 3.80bc  | 3.25BC 2.61bc                |
| N12                 | 1.88AB 0.64a   | 3.54A 1.69b    | 6.80A 5.13bc  | 3.84BC 4.26b   | 3.89AB 2.87b                  |
| N16                 | 2.33A 0.56ab   | 3.09A 2.57a    | 3.66B 6.36a   | 6.12A 3.86bc   | 4.66A 2.92b                   |
| N20                 | 1.82AB 0.67a   | 3.70A 2.49a    | 5.65AB 5.51ab | 5.82A 5.13a    | 4.72A 3.40a                   |
In addition to the dry matter at the seedling stage, nitrogen treatment had significantly affected on fresh weight and dry matter content of the whole plant in other growth stages of silage corn (P < 0.05), and compared with the control, the nitrogen fertilizer application increased the fresh weight and dry matter content of the whole plant in different degrees (Fig. 1, 2). The fresh weight and dry matter content of N8 at seedling stage was the highest in 2018-2019, which was 12.97 % higher than other treatments, and there was no significant difference among the nitrogen application treatments in 2018 (P > 0.05); the fresh weight and dry matter content increased first and then decreased with the increase of nitrogen application rates from jointing stage to maturity stage, and the highest fresh weight of N16 treatment was 1516.00 g; there was no significant difference in dry matter content between N12-N24 except tasseling stage (P > 0.05), and the highest dry matter content of N12 was 207.84 g at the tasseling stage; and in 2019, fresh weight and dry matter content were the highest in N20 from jointing stage to tassel period, and the change trend from tasseling stage to maturity stage was firstly increased and then decreased with the increase of nitrogen application rates. Among them, the fresh weight and dry matter content of N16 were the highest at tasseling stage, which was 1,092.33 g and 182.08 g respectively, and the maximum fresh weight and dry matter content of N16 and N20 respectively was the highest at maturity stage.

Under different nitrogen application rates, the fresh weight accumulation rate of plants at each growth stage showed a trend of increase first and then decrease with the extension of the growth period. In 2018, except for that the highest of the plant fresh weight accumulation rate of N12 was 22.44 g/d from trumpet period to tasseling stage, other treatments were the highest from jointing stage to trumpet period; and in 19, each nitrogen application treatment had the highest accumulation rate of plant fresh weight from trumpet period to tasseling stage (Table 1). In 2018, the dry matter accumulation rate of N16-N24 increased with the extension of the growth period, and the dry matter accumulation rate of N0-N12 in 2018 and each nitrogen treatment in 2019 showed the trend of increase first and then decrease with the extension of growth period; the dry matter accumulation rate of N0-N12 and each nitrogen treatment in 2019 had the highest accumulation rate in the period from trumpet period to tasseling stage, and in 2018, N16-N24 had the highest dry matter accumulation rate during the tasseling period-harvest period (Table 2). It can be seen by comparing different nitrogen application treatments that except for the period from trumpet period to tasseling stage from 2018 to 2019, the fresh weight accumulation rate of N16 or N20 was always higher than that of other nitrogen treatments, and there was no significant difference between them (P > 0.05); in the stage from seedling stage to maturity stage, the fresh weight and dry matter accumulation rate of N16 and N20 were higher than other treatments for two consecutive years. Except that the dry matter accumulation rate of N20 in 2019 was significantly higher than that of other nitrogen treatments (P < 0.05), there was no significant difference between them (P > 0.05). From 2018 to 2019, the fresh weight accumulation rates of N16 were 4.72 g/d and 3.40 g/d respectively, which were 1.29% and 16.44 % higher than that of other treatments.

### Table 3 Significance analysis of fresh weight and dry matter content of the silage corn

| Significance of ANOVA | Seedling Stage | Jointing Stage | Trumpet period | Tasseling Stage | Maturity Stage |
|-----------------------|----------------|----------------|----------------|----------------|---------------|
| fresh weight          | **             | **             | **             | **             | **            |
| matter content        | ns             | ns             | ns             | ns             | ns            |

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| N         | ** | ** | ns | ** | ** | ** | ** | ** | ** |

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3.2. Distribution of dry matter in different organs of silage corn under different nitrogen application rates

The growth of corn includes two stages: vegetative growth and reproductive growth. Before tasseling, the vegetative growth is dominant, especially the corn plant grows rapidly from jointing stage to silking stage; and after silking stage, the reproductive growth is dominant. The maturity period of silage corn is in the middle filling stage, and the "source" and "sink" of silage corn will change in different growth stages. Different nitrogen application treatments will affect the dry matter accumulation and its distribution in different organs. From jointing stage to maturity stage, leaf was the main "source" of dry matter accumulation of silage corn, and its distribution in total dry matter decreased gradually. The distribution in total dry matter for leaves at seedling stage and jointing stage was higher than that in stems. With the extension of growth period, leaves act as "source" exported dry matter to other organs, and leaf distribution in total dry matter was lower than that in other organs except for bracts. The stem is an important supporting organ of corn, as an important storage "sink" for material accumulation from jointing to tasseling stage, it gradually becomes an important "source" organ after filling, which gradually transports the accumulated dry matter to the grain, and the distribution of dry matter in the grain was higher than that in other organs. It can be seen through the significant analysis on the distribution factors of dry matter in different organs that nitrogen fertilizer had no significant effect on the total dry matter distribution of stems and leaves at seedling stage and
jointing stage (P > 0.05), the distribution of total dry matter of leaves was significantly affected by the amount of nitrogen applied at the trumpet period (P < 0.05), tasseling stage had significant influence on the dry matter distribution of stem and bract (P < 0.01). Among them, the stem reached the limit level (P < 0.01). During the maturity stage, except bracts and cob, nitrogen fertilizer significantly affected the distribution of stems, leaves and grain in total dry matter (Table 4).

Compared with different nitrogen application treatments, there was no significant difference in the distribution of individual dry matter among different organs at seedling stage and trumpet period in 2018 (Figure 3). At jointing stage, except for N8, the proportion of leaves in total dry matter of other nitrogen application treatments was less than that of N0, among which N16, N20 and N24 were significantly lower than N0 (P < 0.05). After tasseling stage, the "sink" organs of bract and ear crops perform substance accumulation. After applying nitrogen fertilizer, the distribution proportion of bracts in total dry matter was significantly higher than that of N0, and the highest of N16 was 5.72 %, which indicates that the storage capacity of the "sink" is large under this treatment. At maturity stage, the order of stem distribution proportion in total dry matter was N16>N12>N0>N24>N20>N8. There was no significant difference in the distribution proportion of leaves, bracts and cob among different nitrogen application levels (P > 0.05). The grain allocation proportion of N16 was significantly higher than that of other nitrogen application treatments (P < 0.05). Compared with different nitrogen application rates in 2019, the distribution proportion of stem in total dry matter at seedling stage, jointing stage and trumpet period was the highest under N12, N16 and N20, which were 24.71 %, 43.21 % and 53.32 % respectively. There was no significant difference in the distribution of dry matter among different nitrogen treatments at jointing stage; The distribution proportion of stems and leaves in the total dry matter of N0 in tasseling stage and maturity stage was higher than that of other nitrogen treatments, and there was no significant difference between N8-N24 at maturity stage. The distribution proportion of leaves in total dry matter of N16 was significantly lower than that of other nitrogen treatment at tasseling stage, and the highest distribution amount of dry matter in bract was 15.2 %, which was significantly higher than that in N0 and N20. The distribution proportion of dry matter in N8-N24 was significantly higher than that in N0, and there was no significant difference among them. The order of distribution was N24 > N12 > N8 > N16 > N20.

Through the analysis of the distribution of dry matter in different organs of silage corn, it can be seen during seedling stage in 2018 and jointing stage in 2018 and 2019, the distribution ratio of leaves in total dry matter of N0 and N8 were higher than that of other nitrogen treatments. With the extension of growth period, silage corn turned to reproductive growth. In 2018 and 2019, N16 had the highest distribution proportion of dry matter in the total dry matter, which was 5.80% higher than that of other treatments, while grain has the highest distribution of the total dry matter in maturity stage, accounting for more than 46% of the whole plant dry weight in addition to the control, and was the highest in N12 for two consecutive years.

![Fig. 3 Distribution of organs in total dry matter in 2018](image)

Note: Different lowercase letters indicate that the distribution of each organ in the total dry matter at the 0.05 level is significantly different. Same below.
Fig. 4 Distribution of organs in total dry matter in 2019

### Table 4. Significance analysis of organ distribution factors in total dry matter

| Significance of ANOVA | Seeding Stage | Jointing Stage | trumpet period | Tasseling Stage | Maturity Stage |
|-----------------------|---------------|----------------|---------------|----------------|---------------|
|                       | Stem          | Leaves         | Stem          | Leaves         | Stems         |
| N                     | ns            | ns             | ns            | ns             | **            |
| Y                     | **            | ns             | **            | **             | ns            |
| N*Y                   | ns            | ns             | *             | ns             | *             |

3.3. Effects of different nitrogen application levels on silage yield

### Table 5. Effects of different treatments on fresh yield and dry matter yield of silage corn

| Treatments | 2018 Fresh yield (t hm⁻²) | 2019 Dry matter yield (t hm⁻²) | 2018 Dry matter yield (t hm⁻²) | 2019 Dry matter yield (t hm⁻²) |
|------------|---------------------------|--------------------------------|--------------------------------|--------------------------------|
| N0         | 55.24±8.55B               | 49.46±0.74c                    | 21.06±4.55C                    | 15.92±0.24c                    |
| N8         | 76.85±1.78A               | 69.68±1.05b                    | 28.31±1.20BC                   | 26.45±0.40b                    |
| N12        | 84.79±2.94A               | 71.47±1.07ab                   | 32.07±0.37AB                   | 28.43±0.43ab                   |
| N16        | 91.63±10.01A              | 79.06±1.19a                    | 38.75±3.99A                    | 31.96±0.48a                    |
| N20        | 81.28±7.45A               | 73.81±1.11ab                   | 32.15±4.45AB                   | 30.38±0.46ab                   |
| N24        | 80.50±9.41A               | 66.12±0.99b                    | 32.24±3.33AB                   | 27.20±0.41b                    |

**Note:** Different upper and lower case letters indicated significant difference in 2018 and 2019 different treatments at P<0.05 level; N represent Nitrogen application rate, Y represent years; * means significant different at P<0.05 level, ** means significant different at P<0.01 level, ns means no significant difference.

The nitrogen fertilizer application has a very significant effect on the biological fresh weight and biological yield of silage corn (P < 0.01) (Table 5). During the silage maturity period in 2018 and 2019, the biological fresh weight and biomass yield of silage corn were the highest in N16, and the lowest in N0, among which there was no significant difference among N12, N16 and N20; the sequence of biological fresh weight in 2018 and 2019 were as follows: N16>N12>N20>N24>N8>N0, and N16>N20>N12>N8>N24>N0. The biological fresh weight of N16 was the highest, which was 91.63 t hm⁻² and 79.06 t hm⁻² in 2018 and 2019, and 8.07 %−65.88 % and 7.11 %−59.84 % higher than that of other treatments. The biological yield of N16 in 2018 and 2019 was N16>N24>N20>N12>N8>N0 and N16>N20>N24>N12>N8>N0. The biological yield of N16 treatment was the highest, which was
38.75 and 31.96 t.hm⁻² in 2018 and 2019 respectively, 20.20% - 93.97% and 5.21% - 100.72% higher than that of other treatments, and significantly higher than that of N0 and N8 (P < 0.05).

4. Discussion

Nitrogen fertilizer is the main source of crop nitrogen, and the appropriate nitrogen application level and period are conducive to high yield of crops[7]. Through a large number of studies, it can be seen that increasing dry matter accumulation per unit area of corn population is an important prerequisite for improving corn yield, and there is a positive correlation between corn yield and dry matter accumulation[8]. In this study, it can be seen that except for the seedling stage in 2018, the application of nitrogen fertilizer could increase the plant fresh weight and dry matter content of silage corn to varying degrees at different growth stages. Studies have shown that nitrogen application can promote crop growth by increasing soil nitrogen accumulation. Besides, the root length of corn also increased with the increase of nitrogen application rates. Increasing nitrogen application can effectively improve the absorption of nutrients by corn roots[9], which is conducive to the accumulation of nutrients. However, it is not that the higher the nitrogen application rates, the more conducive to the yield accumulation of silage corn. A large number of studies indicate that with the increase of nitrogen application rates, the dry matter accumulation of silage corn presents a trend of first increase and then decrease[10]. Wei et al (2013) reported that under the condition of three-dimensional cultivation of silage corn and alfalfa in Inner Mongolia, the yield of silage corn presented a trend of first increase and then decrease with the increase of nitrogen application rates. Excessive nitrogen application would inhibit the growth of crops, and the optimal nitrogen application rates was 278.4-291.8 kg/hm²[11]. In this study, the maximum fresh weight and dry matter content of the whole plant in the seedling stage was N8. The jointing stage and trumpet period in 2019 were the highest under N20, the jointing stage and maturity stage in 2018, tasseling stage and maturity stage in 2019 showed a trend of increase first and then decrease with the increase of nitrogen application rate. When harvesting the silage, the fresh weight and biomass yield of silage corn showed a trend of increase first and then decrease with the increase of nitrogen application rates, it was highest at N16 and the lowest in the control. This result is consistent with the previous research results. In this study, excessive nitrogen application will reduce the fresh weight and dry matter yield of silage, which may be caused by the significant decrease of photosynthetic potential and net assimilation rate due to the further increase of nitrogen application[6]. It is not conducive to the accumulation of yield. Besides, some studies have found that nitrogen is the dominant factor affecting microbial biomass, and the negative effect of low nitrogen on microbial biomass is lower than that of high nitrogen, that is, the negative effect of nitrogen on microbial biomass increases with the increase of nitrogen application rates[12].

The accumulation, distribution and transportation of dry matter are the important premises of yield formation[13-14]. The dry matter distribution of individual corn will transfer with the change of growth center, and the increasing of nitrogen fertilizer application can promote the transfer and reasonable distribution of dry matter in corn[15]. Some studies have found that the nitrogen application rates had no significant effected on dry matter distribution proportion before corn physiological maturity stage[9]. In this study, except dry matter distribution of leaves at trumpet period is significantly affected by nitrogen application rate, the dry matter distribution proportion of stems and leaves before tasseling stage was not affected by nitrogen application rates, which may be due to the difference of silage corn varieties, climate and soil in planting area soil and other environmental factors. Silage corn is one of the silage forage that can be harvested by the whole plant. When harvesting, except no nitrogen application, the grain accounts for more than 46% of the dry weight of the whole plant. It is generally considered that under appropriate conditions, promoting the transfer of dry matter to reproductive organs is one of the important ways to improve yield[16], while the yield of corn grain comes from the photosynthetic products formed from tasseling stage to maturity stage and the photosynthate transported from the "temporary" storage organs of leaves, stems and sheaths to the grain[17]. In this study, grain dry matter content of N16 and N20 were the highest. After tasseling stage, the "sink" organs of bracts and ear crops accumulate materials. At tasseling stage,
dry matter content in stems and leaves of N16 and N20 were the highest, which was more conducive to transport the accumulated dry matter to grains. Through a large number of studies, it can be seen that the dry matter accumulation of corn follows the logistic equation-s curve equation[18-19]. In this study, N16-N24 high nitrogen treatment still had higher dry matter accumulation rate from tasseling stage to maturity stage. This may be because silage corn has a longer growth period and earlier maturity stage than ordinary corn varieties, and high nitrogen treatment can provide silage corn with more nitrogen supply, which delays leaf senescence, promotes dry matter accumulation of aboveground organs, and converts more biological yield into economic yield[20].

5. Conclusion
The results indicated that the nitrogen fertilizer application could increase the whole plant fresh weight and dry matter content of silage corn in different growth stages after seedling stage, and the fresh weight and dry matter accumulation rate of N16 and N20 were higher than other treatments in 2018 and 2019 during the whole growth stage from seedling stage to maturity stage. Except for the leaves of Zhongxing silage 1 in the trumpet period, the dry matter distribution proportion of stem and leaf were not affected by nitrogen application level before tasseling stage. In the maturity period of silage, the biological fresh weight and biomass yield of silage corn were the highest in N16, the biological fresh weight was 91.63 t·hm-2 and 79.06 t·hm-2, and the biological yield was 38.75 t·hm-2 and 31.96 t·hm-2 respectively in 2018 and 2019. Comprehensively comparing the dry matter accumulation rate, distribution and yield of each nitrogen application treatment, it can be seen that the fresh weight and dry matter accumulation rate of N16 (240 kg N ha-1) were higher in the whole growth period, at harvest time, the dry matter content and yield of grain were the highest, which was the most suitable nitrogen application rate for silage corn in the middle of Inner Mongolia.

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