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Study on the Change of Soil Nutrients in Drip Irrigation Farmland

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Abstract: Soil total N, total P, total K organic matter and soil available N, P and K are the three elements that provide fertility for crop growth. The former characterizes soil basic nutrients and the latter can effectively absorb and utilize soil available nutrients for crops. In order to understand soil total amount, soil available nutrients change, nutrient utilization and production effect of drip irriga-tion crops, 12 crops (spring wheat, spring wheat, soil available nutrients, soil available nutrients) are based on drip irrigation. The 1008 test data of 144 fixed-point samples from paddy, potato, millet, soybean, rape, sunflower, beet, melon, tomato, carrot and alfalfa fields were collected. The results showed that the content of soil total N was stable in 95% confidence interval, and the con-tent of soil total P, K and organic matter changed obviously. Soil available N, P and K had similar characteristics. The results showed that the N absorption of drip irrigation soil was stable, and the P and K utilization fluctuated greatly. With the non-linear increase of drip irrigation unit water consumption and yield, soil total and available nutrients decreased from high to low, soil total nu-trients decreased by 42.6% - 25.8%, soil available nutrients decreased by 58.5% - 34.8%, and the decline rate was significantly greater than that of soil total nutrients, reflecting the soil available nutrient capacity. The average soil available nutrient consumption of 12 drip irrigation crops was 19.6%. Among them, 11.2% - 55.2% was used as low yield drip irrigation crops (rape, melon, sun-flower, soybean, spring wheat, rice, millet), and 1.3% - 5.5% was used as drip irrigation crops (tomato, carrot, sugar beet, potato, alfalfa) with relatively high yield. The results showed that the soil water and fertility potential of drip irrigation farmland was friendly to the ecological envi-ronment. Good regulation and control can provide reference.

1. Introduction

Submulch drip irrigation is the main irrigation mode of high-efficient agricultural water use in arid areas of Xinjiang. It plays an important role in the coordinated development of social economy and ecology in water and fertilizer regulation, water saving and yield increase. The input of water and fertilizer for crop growth and the change of soil nutrients in drip irrigation are the new state of irrigation agriculture. Therefore, experimental studies on soil nutrient uptake under drip irrigation have been reported in recent years. In terms of soil nutrient accumulation and variation under drip irrigation, some scholars mostly analyzed wheat and cotton under drip irrigation. Statistical analysis of field sampling of wheat under drip irrigation for 1 to 3 years showed that most soil nutrients in different soil layers showed moderate intensity variation, while some available nitrogen and phosphorus nutrients showed weak variation. For heterosexuality, the coefficient of variation ranged from 7.68% to 45.6%. In addition to available potassium, available nitrogen and available phosphorus in vertical direction decreased gradually from surface to bottom, while available nitrogen and available potassium in horizontal direction increased first and then decreased with the increase of distance from drip irrigation, which provided a reference for rational drip irrigation fertilization scheme. When the fertilization is relatively insufficient in wheat growing season, the soil nitrogen supply is basically balanced in the early stage, but the soil available nitrogen content decreases to a certain extent in the late stage of wheat growth. The soil available phosphorus content generally shows a downward trend. The deficit of soil phosphorus supply is obvious, and the soil available potassium content is stable and basically balanced in wheat growing season. The

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spatial variability of soil nutrients in drip irrigation cotton field was analyzed by geostatistical method. The results showed that the spatial variability of organic matter, available nitrogen, available phosphorus and available potassium was 25%~75%, which was mainly caused by structural and random factors. The content of available nitrogen and available phosphorus in soil was at a low and medium level, and the content of available potassium was relatively high. The opposite sex is not obvious. Distribution characteristics of soil available nutrients in drip irrigation cotton field showed that the change trend of soil available nitrogen nutrients in three treatments was the same, and the three treatments were 0 cm~60 cm vertical. Variation of available phosphorus nutrients increased first and then decreased with the advance of cotton growth period. The spatial and temporal variation trend of available phosphorus nutrients in all treatments was basically the same, showing the trend of first rising and then falling [1]. The available potassium nutrients in all treatments showed a relatively flat trend with the growth period. These analyses helped to understand the variation of available N, P and K in different soil depths. Cloth provides a basis for the growth of cotton field under drip irrigation, the dynamic change of soil nutrients and the requirement of fertilization. In the study of nutrient absorption and utilization in drip irrigation crop soil, the results of different formula fertilization on rice yield under drip irrigation under mulch showed that high yield could be obtained by high water and fertilizer treatment, and formula fertilizer could significantly increase 1000-grain weight and aboveground biomass of rice. The results of nitrogen, phosphorus and potassium nutrient uptake experiment of spring wheat under drip irrigation in arid area showed that with the increase of fertilizer application, the nutrient uptake of spring wheat under drip irrigation increased [2]. The beginning time of rapid nitrogen uptake was the earliest, followed by potassium and phosphorus, and the total absorption of N, P and K from jointing to heading was 66% to 79% respectively. 62%-69%, 66%-70%. The results of sampling analysis by two methods of drip irrigation and drip irrigation under mulch showed that the contents of available nitrogen and potassium increased with the distance of drip head, but the trend of available phosphorus was opposite. The contents of available potassium and phosphorus under mulch drip irrigation were the same as those under mulch drip irrigation, and the content of available nitrogen was the highest near drip head. The soil nutrient residues in 0 cm~100 cm soil under drip irrigation are generally higher than those under subsurface drip irrigation, especially nitrogen residues. In the study of the effects of soil nutrient supply on drip irrigation crops, the results of drip irrigation with water and Fertilizer on jujube showed that the soil nitrogen was obviously accelerated during the growth of new shoots and jujube fruits, and the soil available phosphorus was rapidly increased during the ripening stage of jujube fruits, jujube fruit growth and maturity stage, and soil quick effect during the growth of jube fruits under drip irrigation. Potassium content changes most dramatically [3]. Statistical analysis of continuous cropping of cotton under drip irrigation and insufficient soil fertility showed that the continuous cropping of cotton under drip irrigation for many years resulted in unbalanced absorption of soil nutrients, resulting in mottled yellow flowers, curly leaf margins, shrinkage of leaf surface and so on in the later stage of some drip irrigation cotton fields. There were more empty fruit branches in the upper part of cotton, more stiff petals and lower yield of bolting in advance.

Based on 144 soil samples collected from drip irrigation crop growing environment in three years, the characteristics of soil total amount and soil available nutrients of 12 drip irrigation crops, including spring wheat, rice, potato, millet, soybean, rape, sunflower, sugar beet, melon, tomato, carrot and alfalfa, were analyzed by investigation and statistical analysis [4]. Water and fertilizer use efficiency and soil nutrient use efficiency can provide reference for the sustainable use of soil nutrient ecology in drip irrigation farmland.

2. Materials and Methods

2.1. Overview of irrigation district

The investigation and analysis are located in Changji Agricultural Irrigation District, Xinjiang, 87_18'E, 44_01'N, with an average altitude of 600 m. Located in the southern margin of the alluvial and diluvial basin of the Toutun River Basin on the northern slope of Tianshan Mountains, the annual average precipitation is 181.7 mm, evaporation is 1739.1 mm, sunshine is 7.8 h, the temperature is 13.1 (> 0 (> 0 (> 0 (> 3834.3). It is a typical inland arid climate. The brown desert soils were distributed in the test area. The texture of the soils was medium and light. The dry bulk density of the soils ranged from 0 cm to 120 cm was 1.46 g/cm 3 to 1.65.

G/cm3, tillage layer 1.50 g/cm3~1.60 g/cm3, 0 cm~120 cm field water holding capacity (dry soil weight) 18.8%~23.9%, tillage layer 20.1%~23.4%. The groundwater depth is 3.0 m~4.5 m, the salinity of surface and groundwater is 0.2 g/L and 0.6 g/L, respectively, and the total salt content of the tillage soil is 0.2 g/L and 0.6 g/L.

The soil pH value was 8.7 alkaline. The average soil organic matter was 1.51% in the tillage layer for many years, and the total nitrogen, total phosphorus and total potassium in the soil were 0.09% and 0.09% respectively.

0.07%, 1.51%, available (or effective) nitrogen, phosphorus and potassium were 0.0054%, 0.0069% and 0.0479%, respectively. The fertility was moderate to low.

It is characterized by lack of nitrogen, less phosphorus and potassium.

2.2. Analytical methods

There are more than 20 kinds of drip irrigation crops planted in the irrigation area. In this study, the changes of soil nutrients of 12 kinds of drip irrigation crops were studied and analyzed. The 12 kinds of drip irrigation crops were spring wheat, rice, potatoes, millet, soybean, rape, sunflower, beet, melon, tomato, carrot and alfalfa. In order to understand the physical and chemical state of soil before and after harvest, 12 kinds of drip irrigation crops were used as basic units to carry out the investigation and statistics of soil bulk density, fertilizer application during crop growth period and crop yield. Five-point diagonal method was applied to the soil of farmland topsoil of 12 kinds of drip irrigation crops, and the topsoil of farmland topsoil was regularly changed from 0 cm to 20 cm in November 2016 to 2018 after harvest. Soil samples were sampled and sent to soil physical and chemical analysis room for soil organic matter, total nutrients (N, P, K), available nutrients (N, P, K). Soil samples were analyzed by potassium dichromate volumetric method. Soil N, P and K contents were determined by Kjeldahl method, 0.5 mol/L NaHCO 3 extraction-molybdenum-antimony anti-colorimetric method, respectively. Method and flame photometer [5]. The variation of soil nutrients (nutrient absorption components) during the growth period of drip irrigation crops was analyzed by Excel 2007 for the difference between the measured values of soil nutrients after harvest and those before growth, and the fertilization amount during the growth period was deducted.

3. Results and Analysis

3.1. Overall changes of soil nutrients under drip irrigation

Based on the investigation of different irrigation water quotas and yields of drip irrigation crops after harvest, four soil samples were taken from the soil tillage layer (20 cm) of each drip irrigation crop, 48 soil samples were taken from 12 drip irrigation crops, and 144 soil samples were formed from three-year regular drip irrigation crop soil samples. Total soil nutrients (N, P, K, organic matter) were analyzed by laboratory. 1008 test data were obtained with soil available nutrients (N, P, K). Statistical data in 95% confidence interval showed that the maximum and minimum values of soil total N were 1.758 g/kg and 0.210 g/kg, respectively.

Average 0.829 g/kg, standard deviation 0.378 g/kg, variance 0.143. The maximum and minimum available nutrient N were 163.6 mg/kg and 5.9 mg/kg.

The average value was 49.9 mg/kg, the standard deviation was 32.3 mg/kg, and the variance was 1044.7. From the analysis results, it can be seen that the overall changes of soil nutrients of drip irrigation crops show that: soil total nutrients, total N content is stable, soil total P, total K and soil organic matter content change greatly, especially soil organic matter content change significantly; soil available nutrients, available N, available P, available K content far away. It is lower than the total soil nutrients, but the nutrients have similar changes in general. This shows that the nutrient uptake of crop growing soil in drip irrigation environment is stable, while the P and K uptake and utilization of soil change greatly and unsteadily.

3.2. Variation of water consumption, yield and soil nutrients in drip irrigation

Based on the investigation and statistics of different irrigation water quotas and yields of drip irrigation crops and the results of soil total nutrients and soil available nutrients, the following changes can be clearly seen from the analysis results:

1) The yield of 12 drip irrigation crops increased nonlinearly with the increase of water consumption, while the soil total and available nutrients increased.

The water consumption of spring wheat increased from 2505 m3/hm2 to 4380 m3/hm2, and the yield increased from 4755 kg/hm2.

At the same time, the corresponding soil total N decreased from 1.15 g/kg to 0.48 g/kg; soil total P decreased from 0.91 g/kg to 0.51 g/kg; soil total K rebounded to 16.79 g/kg from 17.97 g/kg to 16.56 g/kg; soil organic matter decreased from 20.43 g/kg to 8.57 g/kg. The corresponding soil available N increased from 52.2 mg/kg to 69.9 and then decreased to 20.1 mg/kg; soil available P decreased from 99.3 mg/kg to 17.0 mg/kg; and soil available K decreased from 532 mg/kg to 599 and then rebounded to 370 mg/kg.

2) Computing the decrease rate of soil nutrients by the ratio of the maximum to the minimum and the ratio of the maximum to the minimum, it can be seen that the decrease rate of soil nutrients of different drip irrigation crops has different degrees: the comprehensive decrease of soil nutrients by drip irrigation is 42.6%~25.8%, and sunflower is the smallest drip irrigation crop with the largest decrease of soil nutrients. In order to beat melon, the average decline rate was 36.1%. The comprehensive decline rate of drip irrigation crops changed from big to small: sunflower, tomato, carrot, soybean, alfalfa, sugar beet, millet, spring wheat, rape, potato, rice and watermelon; the comprehensive decline rate of soil available nutrients in drip irrigation was 58.5%-34.8%. The lowest drop rate of drip irrigation crops was rape. The average decline rate was 49.9%. The comprehensive decline rate of drip irrigation crops changed from big to small: sunflower, potato, soybean, beet, carrot, tomato, alfalfa, rice, melon, millet, spring wheat and rape.

According to the decrease degree of soil total nutrients and available nutrients, the decline rate of soil available nutrients of drip irrigation crops was significantly higher than that of soil total nutrients, but the overall range of decline of different crops was not very different. This reflects the basic characteristics that drip irrigation crops absorb and utilize more soil available nutrients than total soil nutrients.

3.3. Analysis of soil nutrient utilization under drip irrigation

Soil available nutrients are available nutrients for drip irrigation crops during their growing period. Therefore, based on the difference between the measured values of soil available nutrients in the tillage layer (20 cm) after the harvest of drip irrigation crops and those in the early growing period, the amount of fertilizer applied during the growing period of crops is deducted. Meanwhile, the circular knife method is used to determine the parameters of soil quality in the tillage layer per unit volume of farmland. The results of calculation and analysis of soil bulk density showed that different drip irrigation crops had different absorption and utilization of soil available nutrients. The average utilization of soil available N, P and K by 12 drip irrigation crops was 142 kg/hm2, 343 kg/hm2 and 664 kg/hm2, respectively, and the combination of the three was 11. 50 kg/hm2. From the structure of soil available nutrient utilization under drip irrigation, the maximum amount of available N was 213 kg/hm2 for soybean and 102 kg/hm2 for millet, 650 kg/hm2 for beet, 212 kg/hm2 for spring wheat, 888 kg/hm2 for sunflower and 888 kg/hm2 for drip irrigation. The amount of available nutrients N, P and K in drip irrigation was 1340 kg/hm2 for sunflower and 924 kg/hm2 for potato. Further analysis shows that dicotyledon drip irrigation crops consume more soil available N and P, while monocotyledon drip irrigation crops consume less soil available N and P.

Analysis of soil available nutrient consumption by average yield of drip irrigation crops showed that soil available nutrient (N, P, K) consumption was different for each 100 kg yield of drip irrigation crops: average soil available nutrient consumption rate of 12 drip irrigation crops was 19.6%, rape consumption of drip irrigation crops was 55.2%, and consumption of 11.2%~55.2%. In drip irrigation crops (rape, melon, sunflower, soybean, spring wheat, rice, millet) with relatively low yield per unit, 1.3%~5.5% of the consumption is mainly for drip irrigation crops (tomato, carrot, beet, potato, alfalfa) with relatively high yield per unit.

4. Conclusion and Discussion

4.1. Conclusion

Preliminary analysis of soil nutrient changes of drip irrigation crops showed that soil total N content was stable, soil total P, K and soil organic matter content varied significantly. Soil available nutrient N, P, K content was lower than soil total nutrient, but had similar change characteristics, indicating that soil N absorption was stable and soil P, K absorption was beneficial. With the increase of water consumption and yield of drip irrigation crops, the total amount of soil and available nutrients decreased from 42.6% to 25.8%, the available nutrients of soil decreased from 58.5% to 34.8%, and the decrease degree was significantly greater than that of total soil nutrients; the use of available N, P and K by drip irrigation crops was higher than that of total soil nutrients. The amount of soil available N and P consumed by dicotyledon crops was 142 kg/hm2, 343 kg/hm2 and 664 kg/hm2, respectively. According to the structure of drip irrigation crops, dicotyledon crops consumed more soil available N and P, while monocotyledon drip irrigation crops consumed less soil available N and P. The yield of drip irrigation crops was 100 kg, and the average soil available nutrient consumption of 12 crops was 1. 9.6%. 11.2%~55.2% of soil available nutrients were consumed mainly by crops with relatively low yields and 1.3%~5.5% less by crops with relatively high yields.

4.2. Discussion

The results of this paper are helpful to understand the interaction between soil fertility and soil available nutrients and the growth of drip irrigation crops under drip irrigation.

It is of practical significance to change and absorb the total and available nutrients of the soil formed by crop yield, pay attention to the soil water and fertilizer momentum of drip irrigation farmland and eco-environment friendliness, give full play to the soil ecological effect of drip irrigation water-saving farmland, and improve the quality of land use and comprehensive output capacity. Based on this project, drip irrigation needs to be further developed. Study on the efficient utilization of soil nutrients, input-output of fertilization and sustainable soil ecology of drip irrigation farmland.

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