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Effects of Water-Retaining Agent on Ammonia Volatilization under Different Moisture Conditions

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Abstract

In order to investigate the influence of the application amount of water retaining agent (PAM) on the volatilization loss of ammonia in urea, this study adopted laboratory culture experiment. The water retaining agent was treated with 0 %(P0), 0.08% (P1), 0.16% (P2) and 0.24%(P3) for 32d, and the influence of different application amount of water retaining agent on the volatilization of ammonia was studied. The results showed that the volatilization of urea ammonia decreased after the application of water retention agent in soil, and the volatilization of urea ammonia increased first and then decreased with the extension of culture time, and the volatilization of ammonia in the 6th, 7th, 8th and 11d of the culture period was larger. The cumulative ammonia volatilization of P0, P1, P2 and P3 treatments was 23.06mg, 19.69mg, 17.13mg and 14.56mg after 32d culture, showing P0>, P1>, P2> and P3. Compared with P0 treatment, the total amount of ammonia volatilization in P1, P2 and P3 treatment decreased by 14.61%, 25.72% and 36.86%, respectively. The higher the amount of water-retaining agent, the less the ammonia volatilization in soil.

Keywords

Super absorbent polymers, Seems, Ammonia volatilization.

1. Introduction

Nitrogen is one of the essential elements for crop growth. The application of nitrogen fertilizer can promote crop growth and development, improve crop yield and improve soil environment [1]. However, nitrogen fertilizer in soil is lost in a large amount through runoff, leaching and ammonia volatilization. In China, the nitrogen use efficiency is around 35%, and the loss rate is as high as 45%, so the economic loss is quite serious [2-3]. Among them, ammonia volatilization has become one of the main ways of nitrogen loss. How to effectively reduce nitrogen ammonia volatilization and improve nitrogen use efficiency is an urgent problem to be solved.

Improving n use efficiency on the one hand is to increase soil nitrogen retention capacity, on the other hand is to reduce nitrogen ammonia volatilization loss. Based on this, predecessors have carried out a series of studies on nitrogen reduction combined with application of organic substances [4], different irrigation modes [5] and addition of nitrification inhibitors [6] to

retain nitrogen in the soil and reduce nitrogen loss. In recent years, water retaining agent has attracted more and more attention in soil improvement. Water retaining agent has strong water retention and water release characteristics of providing plant water, and is known as "micro reservoir" of soil [7].

Application of water retaining agent in soil can reduce the leaching loss of N, P and K nutrients [8]. And with the increase of the dosage of water retention agent, the nitrogen retention capacity of soil increases [9]. Due to the wide variety of water retention agents, the water retention and fertilizer retention functions of different water retention agents vary greatly. Therefore, the interaction degree between the types and dosage of water retention agents and soil and the mechanism of action on nutrient retention and sustained release need further study. Therefore, this study studied the effect of the amount of water retaining agent on ammonia volatilization of sand soil with poor water and fertilizer retention through laboratory simulation experiment, so as to provide theoretical basis for better use of water retaining agent to reduce fertilizer pollution from the source.

2. Materials and Methods

2.1. Test Materials

The sandy soil of farmland in Jingbian County, Yulin City was used as the test soil. The main component of water retaining agent (PAM) was polyacrylamide, and the nitrogen content of urea was 46%. The experiment was carried out in the greenhouse of Qinling Field Monitoring Center station (107°53'E, 34°8'N).

2.2. Experimental Design

Water retaining agent was set at 0 %(P0), 0.08% (P1), 0.16% (P2) and 0.24%(P3). Indoor pot culture method was adopted in the experiment. 500g of air-dried soil screened by 2mm was weighed in each plastic basin and 0.7g of urea was added. Add water retaining agent, mix with 100g soil, add into basin, compacting and leveling. Deionized water is then added to 75% of field capacity to moisten the soil sufficiently and cultured in a greenhouse.

2.3. Index Determination Method

The "static absorption method" [5] was used to measure the amount of ammonia volatilization. A small beaker of 25ml was placed on the soil surface of each plastic pot, filled with a mixed solution of 2% boric acid and nitrogen determination indicator, and sealed with transparent tape on the cover. The beakers were taken out on the 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, 11th, 14th, 17th, 20th, 26th and 32nd days respectively, and the ammonia absorption was titrated with 0.1mol•L-1 sulfuric acid.

2.4. Data Processing and Analysis

Excel2010 was used for data processing and Origin 2018 was used for drawing.

3. Results

As shown in Figure 1 (a), ammonia volatilization ranges from 0.32 to 4.90mg, 0.24 to 4.21mg, 0.32 to 4.35mg and 0.27 to 3.68mg in P0, P1, P2 and P3 treatments within 32 days of incubation period, respectively. On the 2nd, 3rd, 4th, 6th, 7th, 8th, 11th, 14th, 17th and 26th days, the ammonia volatilization was P0> (P1, P2 and P3), indicating that the application of water retaining agent could reduce the ammonia volatilization. With the increase of culture time, the ammonia volatilization of each treatment firstly increased and then decreased, and the ammonia volatilization of the 6th, 7th, 8th and 11th day of culture period was larger.

Figure 1 (b) shows the effect of the amount of water retaining agent on the cumulative ammonia volatilization of urea. After 32 days of culture, the cumulative ammonia volatilization of P0, P1, P2 and P3 were 23.06mg, 19.69mg, 17.13mg and 14.56mg, in the order of P0>P1>P2>P3. The total amount of ammonia volatilization in treatments P1, P2 and P3 with water retaining agent decreased by 14.61%, 25.72% and 36.86%, respectively, compared with that without water retaining agent P0, indicating that the greater the amount of water retaining agent, the less ammonia volatilization in soil.

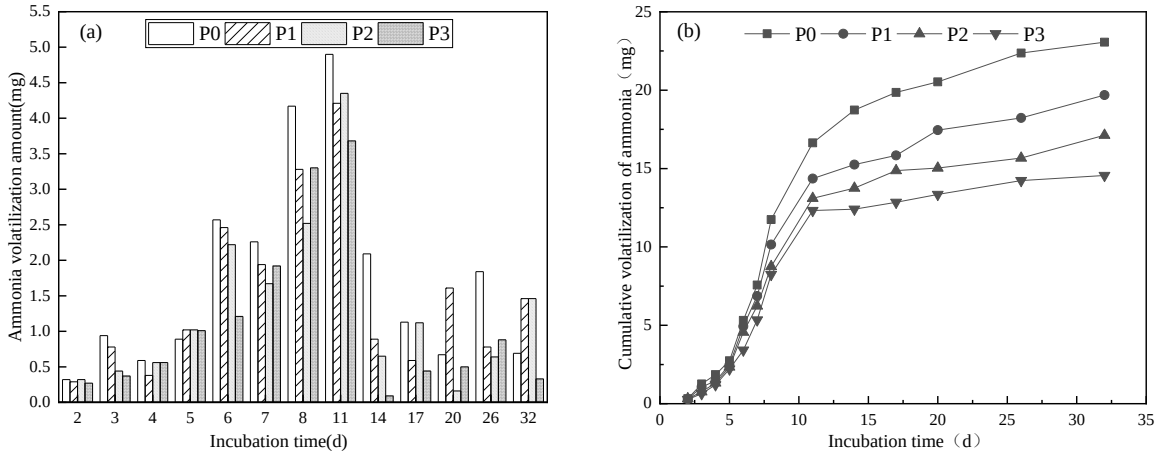

Figure 1: Effect of application amount of water-retaining agent on urea ammonia volatilization and cumulative volatilization.

4. Conclusion

The ammonia volatilization of urea treated by different water retaining agents increased first and then decreased with the extension of culture time. The application of water retaining agent could reduce the ammonia volatilization of soil, and the ammonia volatilization of soil decreased with the increase of the application amount of water retaining agent.

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