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Effects of Nitrogen Fertilizer Synergists on Nitrogen Transformation and Functional Microorganisms in Acidic Soils

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ABSTRACT: Excessive use of chemical fertilizers exacerbates acidification of acidic soils and increases nitrogen loss. Nitrogen fertilizer synergists can delay soil nitrogen transformation and reduce the negative effects of soil active nitrogen on the environment, but nitrogen fertilizer synergists hinder the activity of microbial populations. The effect of nitrogen fertilizer synergists was affected by soil pH value, and the bacteriostatic effects of different nitrogen fertilizer synergists in different regions were different. Therefore, it is of great significance to propose nitrogen fertilizer synergist treatment measures suitable for acidic soil in Hunan. This paper briefly analyses the relationship between nitrogen fertilizer synergists and soils with different properties, the relationship between nitrogen fertilizer synergists and nitrogen transformation and transport, the relationship between nitrogen fertilizer synergists and nitrogen transformation functional microorganisms. The research on the effect of nitrogen fertilizer synergists on the functional microorganisms of nitrogen transformation in acidic soil was also prospected.

KEYWORDS: Acid soil, nitrogen fertilizer synergist, nitrogen transformation and transport, nitrogen transformation functional microorganism.

I. INTRODUCTION

The area of acidic soils in China is constantly expanding, with the area of strongly acidic soils (pH <5.5) increasing from the original 169 million mu to 226 million mu now [1]. Excessive use of chemical fertilizers exacerbates the acidification of acidic soils and increases nitrogen losses [2]. The application of organic materials can increase the nitrogen content in the soil, while the addition of nitrifying inhibitors can regulate the transformation of nitrogen in the soil and increase the utilization efficiency of nitrogen. However, whether nitrifying inhibitors can effectively inhibit the nitrification process and ammonia-oxidizing microbial abundance in red soil under combined application of organic and inorganic fertilizers remains unclear [3]. The effect of the inhibitor is influenced by the pH of the soil [4-5]. The inhibitory effect of different types of inhibitors in different regions varies with the different acidity and alkalinity of the soil, and it is of great practical significance to find inhibitors suitable for acidic soils in Hunan to improve the fertilizer utilization efficiency in Hunan.

Although the large amount of nitrogen fertilizer applied in agricultural production increases the yield of food crops and the economic benefits of farmers, it also affects our normal farmland ecological environment[6], including increasing

the loss of soil nitrogen in farmland and increasing greenhouse gas emissions[7], while nitrogen synergists are often used to inhibit the key conversion process of soil nitrogen to improve fertilizer utilization efficiency and reduce soil nitrogen pollution to the environment [8]. Nitrogen conversion processes are driven by soil microorganisms not only by nitrification, but also by denitrification [8], which in turn are driven by soil microorganisms [9], while nitrogen fertilizer synergists such as nitrification inhibitors and urease inhibitors can hinder the activity of microbial populations and inhibit microbial activity [10], and different studies have shown that inhibitors have different inhibitory effects on microorganisms [11-12]. Therefore, it is of great practical significance to study the nitrogen fertilizer enhancer treatment measures in terms of nitrogen conversion functional microorganisms, which can also provide a scientific basis for improving the ecological environment of rice fields.

II. STUDY ON THE RELATIONSHIP BETWEEN NITROGENOUS FERTILIZER SYNERGIST AND DIFFERENT SOIL PROPERTIES

Nitrogen nitrification is more intense on alkaline soil with high pH value, and nitrification inhibitor has a stronger inhibitory effect. The mineralization rate of dicyandiamide added in neutral soil is higher than that of dicyandiamide in acidic soil. The mineralization rate is much higher, the degradation rate of dicyandiamide increases with the increase of pH, and the effect of nitrification inhibition decreases [13]. Some studies have investigated the emission of nitrous oxide when nitrogen fertilizer synergists are added to different soils such as purple soil, yellow-brown soil paddy soil, and green mud fields. Co-application of nitrification inhibitors or combined application of nitrification inhibitors and urease inhibitors in brown soil paddy soils can reduce nitrous oxide emissions [14], and urea was reduced or chicken manure was used to replace 20% of urea on northern brown soil paddy soils. Adding nitrogen fertilizer inhibitors can improve the supply of soil nitrogen and improve fertilizer utilization [15]. The application of nitrification inhibitors and their combined application with urease inhibitors in the soil of yellow mud fields can significantly reduce the leaching loss of nitrate nitrogen in the soil, reduce the risk of nitrogen leaching, and improve the utilization rate of fertilizers [16]. Studies have shown that nitrification inhibitors (3,4-dimethylpyrazole phosphate) are more effective in slowing down the nitrification process than nitrification inhibitors (dicyandiamide) in black soil in Northeast China, and have the best effect on inhibiting soil nitrification. It is the combination of nitrification inhibitor (DMPP) + urease inhibitor and urea. In cinnamon soil, the highest nitrification inhibition rate is the combination of nitrification inhibitor (DCD) + urease inhibitor and urea [17].

III. STUDY ON THE RELATIONSHIP BETWEEN NITROGEN FERTILIZER SYNERGIST AND NITROGEN TRANSFORMATION AND TRANSPORT

Many scholars have found that adding nitrogen fertilizer synergists to fertilizers can solve many problems caused by the large-scale application of nitrogen fertilizers. For example, the addition of nitrogen fertilizer synergists can change the transformation and transportation process of nitrogen in the soil and reduce the leakage of nitrogen in the soil. Leaching loss, improve nitrogen utilization efficiency and reduce environmental pollution, etc. [18-19]. At present, nitrogen fertilizer synergists are widely used mainly including nitrification inhibitors, urease inhibitors and polyaspartic acid [20-21].

3.1 Study on the relationship between urease inhibitors and nitrification inhibitors and nitrogen transformation and transport

Nitrogen reduction (20%) combined with urease inhibitors can reduce nitrogen loss, make crop absorption fuller, further improve nitrogen use efficiency, and further maintain soil nutrients [22]. Chemical nitrogen fertilizer or organic and inorganic fertilizer combined with urease inhibitors and nitrification inhibitors can produce a stable new fertilizer [23], which can significantly delay urea hydrolysis [24] and inhibit soil nitrification [25]. Replacing 40% of conventional nitrogen dosage with organic fertilizer and adding urease inhibitors and nitrification inhibitors significantly reduced soil microbial biomass and enzyme activities related to organic carbon mineralization [26]. Replacing 20% urea with chicken manure and adding inhibitors can improve nitrogen supply in the soil and increase fertilizer utilization rate [15].

Urease inhibitors have the effect of reducing the activity of urease, which causes the release rate of ammonia and the hydrolysis speed of urea [5], which in turn controls the nitrogen loss caused by nitrifying reactions and ammonia [27]. which has a nitrification effect on ammonium nitrogen in the soil, reduce the dilute losses of nitrate nitrogen, reduce the amount of nitrogen oxide in the atmosphere, and reduce the poisoning of nitrate nitrogen to the root system of the seedlings [5], which may be the main way to alleviate the nitrification reaction; It is safe and reliable for the ecological environment of the soil [8].

By using nitrifying inhibitors in the soil, the activity of nitrifying bacteria and nitrifying bacteria is reduced, and nitrogen is also migrated and transformed, which increases the time of ammonium nitrogen in the soil. Use nitrogen and reduce the amount of nitrogen loss [28]. Studies have shown that both dicyandiamide and DMPP can well inhibit the nitrification process and reduce N_2O emissions and nitrate leaching losses [29]. However, the effect of DMPP is significantly better than DCD. DMPP can significantly inhibit the reproduction of ammonia oxide bacteria, reduce the number of nitrifying bacteria, thereby reducing N_2O emissions and increasing fertilizer utilization [30]. The addition of nitrification inhibitors in loess paddy fields can inhibit urease activity [31], inhibit nitrification, and reduce the leaching loss and seepage loss of nitrate nitrogen in the soil [32-34], thereby inhibiting ammonium nitrogen in the field surface water. transformation, increase the concentration of ammonium nitrogen in the field water, and reduce the loss of nitrogen in the field water [35]. Nitrification inhibitors inhibit the activity of soil microorganisms, thereby regulating the transformation and transport process of nitrogen, mainly in that nitrification inhibitors inhibit nitrification in soil, delay the conversion process of ammonium nitrogen to nitrate nitrogen, and make ammonium nitrogen in the soil. The content of nitrate remained at a high level, and the nitrate content in the soil decreased, reducing the leaching loss of nitrate [36-37].

3.2 Study on the relationship between polyaspartic acid and nitrogen transformation and transport

Polyaspartic acid is a kind of environmentally friendly chemical synergist with good biodegradability, non-toxic and non-polluting [38]. Polyaspartic acid/salt can be used as a fertilizer synergist in agriculture, gathering nutrients in water around the roots of crops, thereby promoting the absorption of nutrients by crops, reducing the loss of nutrients in the soil, and improving the utilization rate of fertilizers [39-40]. Polyaspartic acid can effectively control nitrogen concentration in field water [41]. Reduce the leaching loss of ammonium nitrogen in the soil and delay the nitrification process of the conversion of ammonium nitrogen to nitrate nitrogen [42]. The application of polyaspartic urea can reduce the content of nitrate nitrogen and ammonium nitrogen in the surface water, thus playing a certain role in preventing and controlling the loss of nitrogen in paddy fields [43]. It can delay the hydrolysis process of urea, so that the concentration of ammonium nitrogen in the field water increases slowly, reducing the risk of nitrogen loss and increasing the effect of pollution control [44].

IV. STUDY ON THE RELATIONSHIP BETWEEN NITROGEN FERTILIZER SYNERGISTS AND NITROGEN TRANSFORMATION FUNCTIONAL MICROORGANISMS

Many scholars believe that ammonia oxidizing bacteria and ammonia oxidizing archaea dominate the nitrification in the key transformation process of nitrogen [45-46], and the reason for the decrease in the speed of nitrification reaction under the action of nitrification inhibitors is that nitrification inhibitors It inhibits the growth and activity of ammonia-oxidizing bacteria in the soil, and delays the conversion of ammonium to nitrite in the soil, resulting in a reduction in the loss of nitrogen in the soil [47]. The inhibitory effect of dicyandiamide on ammonia-oxidizing microorganisms is affected by soil properties, and the inhibitory effect varies greatly in soils of different environments. In neutral and weakly acidic environments, the nitrogen content is high, and dicyandiamide can significantly inhibit ammonia. The growth of oxidizing archaea [49], the inhibition of ammonia oxidizing bacteria is not obvious [48]. In strongly acidic soil, dicyandiamide completely inhibited the nitrification activity of ammonia-oxidizing archaea, and the gene abundance of archaea decreased, but the effect on the gene abundance of ammonia-oxidizing bacteria was not significant [50]. DMPP inhibits the transcriptional activity of ammonia monooxygenases produced by ammonia oxidizing bacteria and archaea in soil [10]. The co-application of dicyandiamide and urea significantly inhibited the growth of ammonia oxidizing bacteria, reduced greenhouse gas emissions, and promoted the growth of bacterial communities [51]. However, studies by some scholars have shown that dicyandiamide cannot inhibit soil nitrification and cannot promote the growth of ammonia oxidizing microorganisms [52].

Under aerobic conditions, urease inhibitors will first convert to the oxidized product NBPT, and then form a tridentate bond with the urease active site [53], thereby reducing the rate of urease hydrolysis of urea [54-55]. The number of ammonia monooxygenase genes of ammonia oxidizing archaea and ammonia oxidizing bacteria was significantly reduced in the soil after the application of urease inhibitors, indicating that urease inhibitors can inhibit the activity of urease in ammonia oxidizing bacteria cells, thereby inhibiting intracellular ammonia oxidation. The nitrification effect of bacteria [56], but there are also related studies that the abundance of ammonia oxidizing bacteria is not affected by urease inhibitors [57].

V. CONCLUSION AND OUTLOOK

There have been many studies on the combined application of nitrogen fertilizers and nitrogen synergists, but the effectiveness of nitrogen fertilizer synergists varies greatly on soils with different properties, and the nitrogen fertilizer synergists suitable for different soil environments are different. Therefore, it is necessary to find the nitrogen fertilizer

synergist measures suitable for the acid soil rice in this area in Hunan area, to provide a scientific basis for making full use of nitrogen fertilizer and reducing ecological environment pollution.

Different nitrogen fertilizer synergists have different effects on nitrogen form transformation in the process of nitrogen transformation and transportation, and have different inhibitory effects on nitrogen transformation functional microorganisms. It is of great significance to study the response mechanism of nitrogen transformation functional microorganisms to different nitrogen fertilizer synergists in the acidic soil of Hunan, and to provide a scientific basis for in-depth understanding of the behaviour of microorganisms in the process of nitrogen transformation and the rational use of nitrification inhibitors.

REFERENCES

- [1] Xu Renkou, Li Jiuyu, Zhou Shiwei, Xu Minggang, Shen Renfang. Scientific issues and technical measures for the regulation of farmland soil acidification in my country [J]. Proceedings of the Chinese Academy of Sciences, 2018, 33(02): 160-167. DOI: 10.16418/j. issn.1000-3045.2018.02.005.
- [2] Guo JH,LiuXJ,ZhangY,etal.Significant acidification in major Chinese croplands[J].Science,2010,327:1008-1010.
- [3] Das S,AdhyaTK.Effect of combine application of organic manure and inorganic fertilizer on methane and nitrous oxide emissions from a tropical flooded soil planted to rice[J].Geoderma,2014,213:185-192.
- [4] Ma Fen, Yang Rongquan, Guo Liping. Controlling reactive nitrogen gas emissions caused by nitrogen fertilizer application: Research progress and prospect of urease/nitrification inhibitors[J].Journal of Agricultural and Environmental Sciences,2020,39(4):908-922.
- [5] Tian Faxiang, Ji Xionghui, Guan Di, et al. Research progress on nitrogen fertilizer synergists[J].Hybrid Rice, 2020,35(5):7-13.
- [6] Dong Shijie, Lu Yi, Tang Wanying, et al. Effects of calcium polyaspartate on dynamic changes of trinitrogen in surface water of paddy fields [J]. Journal of Soil and Water Conservation, 2018, 32(6): 208-213.
- [7] Song Tao, Yin Junhui, Hu Zhaoping, et al. Effects of urease/nitrification inhibitors on reducing nitrogen loss in farmland soil [J]. Journal of Agricultural Resources and Environment. 2020: 1-17.
- [8] Zhang Wenxue, Wang Shaoxian, Xia Wenjian, et al. Effects of urease inhibitors and nitrification inhibitors on soil nitrification and denitrification functional bacteria in paddy fields [J]. Journal of Plant Nutrition and Fertilizers, 2019, 25(6): 897-909.
- [9] He Jizheng, Zhang Limei.Key microbial processes and mechanisms of soil nitrogen transformation[J].Bulletin of Microbiology,2013,40(1):98-108.
- [10] Florio A,MaienzaA,Dell'Tabate M T,etal.Changes in the activity and abundance of the soil microbial community in response to the nitrification inhibitor 3,4-dimethylpyrazole phosphate(DMPP)[J].J Soil Sediment,2016,16:2687-2697.
- [11] Luchibia A O,Lam S K,SuterH,etal.Effects of repeated applications of urea with DMPP on ammonia oxidizers,denitrifiers,and nontargeted microbial communities of an agricultural soil in Queenslad,Australia[J].Appl Soil Ecol,2020,147:103392.
- [12] Li C,Hu H W,Chen Q L,etal.Growth of comammoxNitiospira is inhibited by nitrification inhibitors in agricultural soils[J].J Soil Sediment,2020,20:621-628.
- [13] Zhang Chengdong. Research on the application effect of nitrogen fertilizer synergist in drip irrigation wheat field[D]. Shihezi University, 2021.
- [14] Liu Manxia, Xing Zhiqiang, Zhang Xin, et al. Effects of polyaspartic urea and biochemical inhibitors on N₂O emissions from typical soils in the Yangtze River Basin[J]. China Soil and Materials, 2021(3):110-118.
- [15] Yu Chunxiao, Zhang Lili, Yang Lijie, et al. Nitrogen reduction combined with inhibitors and chicken manure to improve the transformation and utilization of urea nitrogen in paddy soil[J].Journal of Plant Nutrition and Fertilizers, 2021,27(9):1581-1591.
- [16] Zhou Xuan, Wu Lianghuan, Dong Chunhua, et al. Effects of nitrogen fertilizer combined with biochemical inhibitor combination on soil nitrogen leaching characteristics in yellow mud fields[J].Acta Ecology.2019.39(5):1804-1814.
- [17] Li Xuehong, Li Dongpo, Wu Zhijie, et al. Regulation effect of urease/nitrification inhibitor on urea nitrogen transformation in black soil and cinnamon soil[J]. Chinese Journal of Applied Ecology. 2021,32(4):1352-1360.
- [18] Yang Lijie, Zhang Lili, Li Dongpo, et al. Short-term effects of nitrification inhibitors and straw on carbon and nitrogen transformation and microbial community characteristics in tide brown soil. China Soil and Fertilizer, 2017(1): 86-91.
- [19] Wang Yilun. Operational effect of nitrogen fertilizer and its physiological basis in super high-yield summer maize[D]. 2010, Henan Agricultural University.

- [20] Gill S L, Spurlock F C, Goh K S, Ganapathy C. Vegetated ditches as a management practice in irrigated alfalfa. *Environmental Monitoring & Assessment*, 2008, 144(1-3): 261-267.
- [21] Weiske A, Benckiser G, Herbert T, et al. Influence of the nitrification inhibitor 3,4-dimethyl pyrazolephosphate (DMPP) in comparison to dicyandiamide (DCD) on nitrous oxide emissions, carbon dioxide fluxes and methane oxidation during 3 years of repeated application in field experiments. *Biology and Fertility of Soils*, 2001, 34: 109-117.
- [22] Wang Wei, Zhang Yaoling, Hao Xingshun, et al. Application effect of different synergists and nitrogen fertilizer reduction combined application on rice [J]. *Jiangsu Agricultural Science*, 2020, 48(5): 84-87.
- [23] Jia C, Zhang X, Li Y, et al. Synthesis and characterization of biobased PA/EP interpenetrating network polymer as coating material for controlled release fertilizers [J]. *Journal of Applied Polymer Science*, 2017, 135(13): 1-10.
- [24] Zheng W K, Liu Z G, Zhang M, et al. Improving crop yields, nitrogen use efficiencies, and profits by using mixtures of coated controlled-release and uncoated urea in a wheat-maize system [J]. *Field Crops Research*, 2017, 205: 106-115.
- [25] Sanz-Cobena A, Abalos D, Mejjide A, et al. Soil moisture determines the effectiveness of two urease inhibitors to decrease N₂O emission [J]. *Mitigation and Adaptation Strategies for Global Change*, 2016, 21(7): 1131-1144.
- [26] Hu Juanjuan, Tao Rui, Chu Guixin. Organic and inorganic fertilizers combined with biochemical inhibitors inhibit the transformation of soil organic carbon [J]. *Journal of Plant Nutrition and Fertilizers*, 2020, 26(1): 19-31.
- [27] Zhang Wenxue, Yang Chengchun, Wang Shaoxian, et al. Effects of urease inhibitors and nitrification inhibitors on soil nitrogen transformation in paddy fields [J]. *China Rice Science*, 2017, 31(4): 417-424.
- [28] Li Zhaojun, Song Alin, Fan Fenliang, et al. Effects of novel nitrification inhibitors on migration, transformation and leaching loss of exogenous ammonium nitrogen in soil [J]. *Southwest Agricultural Journal*, 2011, 24(3): 995-998.
- [29] Menéndez S, Barrera I, Setien I, et al. Efficiency of nitrification inhibitor DMPP to reduce nitrous oxide emissions under different temperature and moisture conditions [J]. *Soil Biology and Biochemistry*, 2012, 53: 82-89.
- [30] Li Jie, Shi Yuanliang, Wang Lingli, et al. Effects of nitrification inhibitors on N₂O emission and the number of nitrifying and denitrifying bacteria in paddy soil [J]. *Journal of Plant Nutrition and Fertilizers*, 2019, 25(12): 2095-2101.
- [31] Yu Qiaogang, Chen Yingxu. Effects of DMPP on nitrogen transformation and loss potential of paddy field surface water [J]. *China Environmental Science*, 2010, 30(9): 1274-1280.
- [32] Li H, Chen Y, Liang X, et al. Mineral-nitrogen leaching and ammonia volatilization from a rice-rapeseed system as affected by 3,4-dimethylpyrazole phosphate [J]. *Journal of Environmental Quality*, 2009, 38(5): 2131-2137.
- [33] Fei Pinpin. Effects of urease/nitrification inhibitors on nitrogen flow in paddy ecosystem [D]. Zhejiang University, 2011.
- [34] Hong Yu, Liu Jinxia, Liu Yue, et al. Effects of different amounts of dicyandiamide on soil nitrogen leaching in paddy fields [J]. *Journal of Soil and Water Conservation*, 2015(1): 116-120.
- [35] Li H, Liang X, Chen Y, et al. Effect of nitrification inhibitor DMPP on nitrogen leaching, nitrifying organisms, and enzyme activities in a rice-oilseed rape cropping system [J]. *Journal of Environmental Sciences*, 2008, 20(2): 149-155.
- [36] Cui M, Sun X, Hu C, et al. Effective mitigation of nitrate leaching and nitrous oxide emissions in intensive vegetable production systems using a nitrification inhibitor, dicyandiamide [J]. *Journal of Soils and Sediments*, 2011, 11: 722-730.
- [37] Cui Lei, Li Dongpo, Wu Zhijie, et al. Effects of different nitrification inhibitors on nitrogen nitrification in red soil and maize yield and nitrogen use efficiency [J]. *Chinese Journal of Applied Ecology*, 2021, 32(11): 3953-3960.
- [38] Lu S, Chen F, Cao C, et al. Multifunctional environmental smart fertilizer based on L-aspartic acid for sustained nutrient release [J]. *Journal of Agricultural and Food Chemistry*, 2016, 64(24): 4965-4974.
- [39] Deng F, Wang L, Ren W J, et al. Enhancing nitrogen utilization and soil nitrogen balance in paddy fields by optimizing nitrogen management and using polyaspartic acid urea [J]. *Field Crops Research*, 2014, 169: 30-38.
- [40] Xu Jiayi, Niu Shiwei, Sui Shijiang, et al. Effects of polyaspartic acid/salt on nitrogen changes and nutrient utilization in paddy field surface water [J]. *Journal of Agricultural and Environmental Sciences*, 2019, 38(8): 1696-1703.
- [41] Dong Shijie, Lu Yi, Tang Wanying, et al. Effects of calcium polyaspartate on dynamic changes of trinitrogen in surface water of paddy fields [J]. *Journal of Soil and Water Conservation*, 2018, 32(6): 208-213.
- [42] Chen Bingyi. Study on the synergistic mechanism of polyaspartic acid/salt (PASP) urea and modified urea on crops [D]. Shijiazhuang Railway University, 2016.
- [43] Ni Chengfan, Zhang Fulin, Wu Maoqian, et al. Effects of polyaspartic urea on nitrogen concentration and yield in paddy field surface water [J]. *China Soil and Fertilizer*, 2020, (6): 234-239.
- [44] Wang Na, Xu Jiayi, Zhang Xin, et al. Comprehensive effects of polyaspartic urea on rice yield and nitrogen changes in field water [J]. *Journal of Agricultural Resources and Environment*, 2021, 38(1): 96-103.

- [45] Shen JP,ZhangLM,ZhuYG,etal.Abundance and composition of ammonia-oxidizing bacteria and ammonia-oxidizing archaea communities of an alkaline sandy loam[J]. Environmental Microbiology,2008,10(6):1601–1611.
- [46] Nicol G W, Leininger S, Schleper C, et al. The influence of soil pH on the diversity, abundance and transcriptional activity of ammonia oxidizing archaea and bacteria[J].Environmental Microbiology,2008,10(11):2966–2978.
- [47] Lam S K,SuterH,Mosier A R,etal.Using nitrification inhibitors to mitigate agricultural N₂O emission:a double-edged sword?[J].Global change biology,2016,23(2):485–489.
- [48] Meng X,Liy,YaoH,etal.Nitrification and urease inhibitors improve rice nitrogen uptake and prevent nitrification in alkaline paddy soil[J].Applied Soil Ecology,2020,154.
- [49] Di H J,Cameron K C,PodolyanA,RobinsonA.Effect of soilmoisture status and a nitrification inhibitor,dicyandiamide,on ammonia oxidizer and denitrifier growth and nitrous oxide emissions in a grassland soil[J].Soil Biology and Biochemistry,2014,73:59-68.
- [50] Zhang L M,Hu H W,Shen J P,etal.Ammonia-oxidizing archaea have more important role than ammonia-oxidizing bacteria in ammonia oxidation of strongly acidic soils[J].The ISME Journal,2012,6(5):1032-1045.
- [51] Shen Xiaoyi, Xia Weiwei, Zhang Jie, et al. Effects of combined application of nitrification inhibitors and urea on greenhouse gas emissions and nitrifying microorganisms in dryland soils[J]. Soil, 2021, 53(3): 512-52.
- [52] Dai Y,Di H J,Cameron K C,et al.Effects of nitrogen application rate and a nitrification inhibitor dicyandiamide on ammonia oxidizers and N₂O emissions in a grazed pasture soil[J].Science of the Total Environment,2013,465:125-135.
- [53] Song Tao, Yin Junhui, Hu Zhaoping, et al. Effects of urease/nitrification inhibitors on reducing nitrogen loss in farmland soil[J]. Journal of Agricultural Resources and Environment, 2021, 38(4): 585-597.
- [54] Engel R E,JonesC,WallanderR.Ammonia volatilization from urea and mitigation by NBPT following surface application to cold soils[J].Soil Science Society of America Journal,2011,75:2348-2357.
- [55] Engel R E, Williams E, Wallander R,et al. Apparent persistence of N-(n-butyl) thiophosphorictriamide is greater in alkaline[J].Soil Science Society of America Journal,2013,77:1424-1429.
- [56] Shi X, Hu H W, Kelly K,etal.Response of ammonia oxidizers and denitrifiers to repeated applications of a nitrification inhibitor and a urease inhibitor in two pasture soils[J].Journal of Soils and Sediments,2017,17:974-984.
- [57] Xi R,Long X E,HuangS,et al. pH rather than nitrification and urease inhibitors determines the community of ammonia oxidizers in a vegetable soil[J].AMB Express,2017,7(1):129.



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