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Ammonia Volatilization and Denitrification Losses in Rice under Continuous and Intermittent Flooded Rice

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Abstract—*An experiment for field screening of rice genotypes for higher nitrogen use efficiency was carried out during kharif 2016 by growing 10 rice genotypes under control, 50% recommended and recommended dose of fertilizer in sandy clay-loam soil at the ICAR-Indian Agricultural Research Institute, New Delhi. Five treatments were selected for this experiment and they were Neem coated urea, Leaf colour chart based Neem coated urea application, Prilled urea, 50%N through FYM+ 50% N through NCU+ biofetilizer and unfertilized control growing one rice cultivar of Pusa -44. The measurement of ammonia losses were measured by chamber and forced draft method. NH_3 was emitted effectively up to the 4-5 days from the date of fertilizer application as compared to control. It was found that prilled urea emitted highest whereas Neem coated urea and biofertilizer had comparable ammonia volatilization. Field quantification of denitrification was done by actetylene inhibition methods and considered the temporal difference among the nitrogen treatments and irrigation. It was found that denitrification was higher in continuous flooded rice as compared to the intermittent flooded rice may be due to denitrification of nitrite by nitrifying organism under oxygen stress.*

1. INTRODUCTION

Agricultural production has been increased tremendously to meet the demand of ever increasing world population. Hence, worldwide consumption of N fertilizers has been increased to seven fold over the last 4 decades to increased agricultural food production [1].Ammonia volatilization is the major N loss [2,3] which globally contribute 17.3% of total loss of fertilizer N from the crop field [4]. The magnitude of ammonia volatilization is widely dependent on quantity of applied N fertilizer , temperature, wind speed, plant condition, and soil pH along with some other factors[5]. N-loss via Ammonia volatilization takes place through hydrolysis of N fertilizer in to NH_3 gas. The applied urea in the soil undergoes hydrolysis and converted to NH_3 in the presence of urease enzyme produced by microorganisms. Thus the NH_3 is released in the atmosphere and form aerosol and also contributes to other precipitation process and cloud chemistry [6]. About 54 Mg N $year^{-1}$ as NH_3 gas has been emitted globally [7,8] which plays an important role in N cycle as it cause significant impact on structural and functional process [9,10].

2. MATERIAL AND METHODS

An experiment for field screening of rice genotypes for N losses was carried out during kharif 2016 by growing 10 rice genotypes (namely Jaya, MTU 1010, Pusa 44, BPT 5204, Kala Dhan, Swarna, TKM6, Himdhan, Nagina22, Taipe 309) under control, 50% recommended and recommended dose of fertilizer in sandy clay-loam soil (Main Block 14C) at the ICAR-Indian Agricultural Research Institute, New Delhi. Soil initially contained 225 kg available N/ha; 21.2 kg available P/ha; 235 kg available K/ha; Organic carbon 0.79% and 2.2 ppm zinc, soil pH 8.1. The 25 days old seedlings of all varieties were planted on 15th July 2016 under puddled conditions. Recommended doses of P (60 kg P_2O_5/ha) and K (40 kg K_2O/ha) were basally applied at the time of puddling in all plots uniformly. Five treatments were selected for this experiment and they were Neem coated urea, Leaf colour chart based Neem coated urea application, Prilled urea, 50%N through FYM+ 50% N through NCU+ biofetilizer and unfertilized control growing one rice cultivar of Pusa -44. All the common cultural practices including weed management and irrigation were followed uniformly in all plots. The maturity dates of different varieties/ genotypes were recorded. All the varieties were harvestedwhen more than 90% grains turned yellow.

The measurement of ammonia losses were measured by chamber and forced draft method. NH_3 was emitted effectively up to the 4-5 days from the date of fertilizer application as compared to control. Field quantification of denitrification was done by actetylene inhibition methods [11] and considered the temporal difference among the nitrogen treatments and irrigation.

3. RESULTS AND DISCUSSION

This study was conducted to evaluate the effect of irrigation and different N treatments on ammonia volatilization and denitrification losses. It was found that prilled urea emitted highest whereas Neem coated urea and biofertilizer had comparable ammonia volatilization. After fertilizer is applied in the field, the rate of ammonia volatilization showed increasing trend with the increase in N application level and the result was supported with the findings of other researchers [12,13,14,15,16]. The applied nitrogen fertilizer influences the ammonia volatilization by increasing NH_4^+ in soil [17] along with the shift of the ionic balance to ammonia from NH_4^+ as pH of soil increases in response to a high demand for proton in hydrolysis process [18]. Our results revealed that an effective ammonia emission was takes place upto the 4-5th day of fertilizer application and thus, it indicates that the ammonia emission depends on the fertilizer timing. Song et al, 2004 [19] and Ye et al, 2011 [20] also showed the ammonia volatilization is closely related to the duration after fertilizer is applied. Ammonia losses were highest on day 3 after urea application and after this it decreases gradually [21]. The data on ammonia volatilization indicated that earlier the emission was very slow and it increases 2 days after fertilizer was applied. Bernardi et al, 2010 [22], observed maximum ammonia volatilization in the period of fourth to tenth day after N application which was similar with Campana et al, 2009 [23]. It was found that denitrification was higher in continuous flooded rice as compared to the intermittent flooded rice may be due to denitrification of nitrite by nitrifying organism under oxygen stress.

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