INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
ISSN Print: 1560–8530; ISSN Online: 1814–9596
15–027/2015/17–6–1083–1090
DOI: 10.17957/IJAB/15.0036
http://www.fspublishers.org

Full Length Article

Polyolefin-coated Urea Improves Nitrogen Use Efficiency and Net Profitability of Rice-rice Cropping Systems

Dongchu Li[1, 2], Minggang Xu[2*], Daozhu Qin[2], Huaping Shen[2], Nan Sun[2], Yasukazu Hosen[3] and Xinhua He[4]
[1]*Hunan Agricultural University, Changsha, Hunan 421001, China*
[2]*Ministry of Agriculture Key Laboratory of Crop Nutrition and Fertilization, Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences, Beijing 100081, China*
[3]*Japan International Research Center for Agricultural Sciences, 1-1 Ohwashi, Tsukuba, Ibaraki 305-8686, Japan*
[4]*School of Plant Biology, University of Western Australia, Crawley, WA 6009, Australia*
[*]For correspondence: xuminggang@caas.cn

Abstract

An effective N management could match N availability with crop demand to maximize nitrogen use efficiency (NUE) and to optimize N application rate. Using polyolefin-coated urea (POCU) to replace regular or non-coated urea (NCU) might be an option to achieve such objectives. A 2-year field study with five fertilization treatments was conducted in a rice-rice cropping system, in Qiyang, Hunan, southern China. The treatments include a control, both NCU and POCU at 150 and 300 kg N ha^{-1} yr^{-1}. The results showed that average annual NUE and grain yield over 2-years were significantly greater under POCU (50% and 11.4 t ha^{-1} yr^{-1}, respectively) than under NCU (36% and 10.6 t ha^{-1} yr^{-1}, respectively). Based on their price of both rice grains and fertilizers in 2014 with a quadratic model, an optimal N rate was calculated as 178–203 kg N ha^{-1} yr^{-1} under POCU but 364–374 kg N ha^{-1} yr^{-1} under NCU. A decrease of 46–50% N inputs could be thus achieved under POCU than under NCU. The use of slow release urea fertilizer such as POCU could maintain high grain yield and grower's income, increase NUE and decrease N losses in such rice-rice cropping systems in southern China. Application of POCU was hence agronomically practical and cost-effective over NCU in rice plantation. © 2015 Friends Science Publishers

Keywords: Agronomic-nitrogen efficiency; Grain yield; Grain value and net profitability; Partial factor productivity; Slow release N fertilizer

Introduction

Rice (*Oryza sativa* L.) is an important cereal for two-third of the global population (Patil *et al*., 2010). In general ~15% of total nitrogenous fertilizer in agriculture are used in rice production (Heffer, 2009). At present China has the second-largest rice cultivation and the biggest rice production in the word (~19% and ~29%, respectively) (FAO, 2010), which is achieved by high input of external nitrogen (N) fertilizers (Zhu and Chen, 2002). Farmlands in the southern China have a typical rice-rice (two cultivation seasons yearly called early rice and late rice) cropping system, where the average grain yield is 5.5 t ha^{-1} each season (China Statistical Yearbook, 2011) against the rice-wheat cropping system of South Asia with better system productivity (Farooq and Nawaz, 2014; Rehman *et al*., 2014). The local farmers prefer to apply high N rate for high crop yields. The N application rate per season ranges from 234–267 kg ha^{-1} and higher than the average 180 kg N ha^{-1} in China (Zhu and Chen, 2002; Ji *et al*., 2007; Zhang *et al*., 2008). The most common rice cultivation practice in local farmers is seedling transplanting and basal fertilization, which has a 20–40% of nitrogen use efficiency (NUE) in Chinese paddy soils (Zhu and Chen, 2002; Wang *et al*., 2007). Such a low NUE is mainly attributed to rapid losses of applied N from NH_3 volatilization and denitrification (Xu *et al*., 2013), which has contributed to severe environmental problems including eutrophication, groundwater nitrate, soil acidification and greenhouse gas emissions (Ju *et al*., 2009).

An effective N management could match N availability with crop demand to maximize NUE, to optimize N application rate and to minimize the negative impact of N on the environment (Malhi *et al*., 2001; Grant *et al*., 2002; Soon *et al*., 2011). The improvement of NUE could be achieved by synchronizing N release from applied N fertilizers for plant N requirement. Different field N management strategies have been employed to improve NUE (Cassman *et al*., 1998; Ohnishia *et al*., 1999; Zhu and Chen, 2002; Ju *et al*., 2009; Haefele *et al*., 2010; Chen *et al*., 2011), or decreasing N losses such as emission of N_2O and NH_3, and leaching of NO_3^- (Shoji *et al*., 2001; Hayashi *et al*., 2008; Soon *et al*., 2011). Meanwhile, reducing the retention time that inorganic N stays in soil prior to crop uptake could decrease the risk of N losses while increasing NUE (Grant *et al*., 2012).

To cite this paper: Li, D., M. Xu, D. Qin, H. Shen, N. Sun, Y. Hosen and X. He, 2015. Polyolefin-coated urea improves nitrogen use efficiency and net profitability of rice-rice cropping systems. *Int. J. Agric. Biol*., 17: 1083–1090