Zinc Accounting for Lowland Rice (*Oryza sativa* L.) Under Different Methods of Zinc Application with Green Leaf Manuring

Prakash P[1*], Hemalatha M[2] and Joseph M[2]

[1]*Department of Agronomy, Agricultural College and Research Institute, Madurai, TNAU, Tamil Nadu, India*

[2]*Department of Agronomy, Agricultural College and Research Institute, Killikulam, TNAU, Tamil Nadu, India*

[*]**Corresponding author:** Prakash P, Department of Agronomy, Agricultural College and Research Institute, Madurai, TNAU, Tamil Nadu, India-625 104, Tel: 8870069038; E-mail: prakasharivu.tnau@gmail.com

Rec date: May 31, 2018; **Acc date:** June 09, 2018; **Pub date:** June 16, 2018

Abstract

Zinc is the common micronutrient; its availability is reduced under lowland rice cultivation. Field investigation was carried out at during winter (*Rabi*) season of 2016-17 at Agricultural College and Research Institute, killikulam, Tamil Nadu Agricultural University. The zinc use efficiencies were positively influenced the by the application of zinc as basal and foliar spray at critical stages of rice. The higher physiological efficiency recorded by zinc applied as basal with green leaf manuring. The zinc induced nitrogen use efficiency was noted higher at zinc applied as soil plus foliar application with green leaf manuring. The agronomic efficiency, partial factor productivity and zinc recovery fraction (apparent recovery) was higher under application of zinc as foliar spray twice with green leaf manuring. Incorporation of green leaf manure of *Glricidia maculate* was favorable influence of increasing use efficiency of applied zinc.

Keywords: Lowland rice; Zinc; Green leaf manure; Zinc use e f ciency

Introduction

Rice (*Oryza sativa* L.) is a staple food for more than 50% of the world's population, including regions of high population density and rapid growth. T e global population is 7.55 billion presently and is expected to reach 9.77 billion by the year 2050. Human consumption accounts for 85 percent of total production for rice, compared with 72 percent for wheat and 19 percent for maize. Among the Asian countries, India and china is leading in rice area, production and productivity. Even though the production is higher due to escalating of world population, need to produce more food grain to meet out the requirement. At present rice production alone consumes nearly 24.7 Mt. of fertilizer ($N+P_2O_5+K_2O$) which accounts for approximately 14.0% of the total global fertilizer consumption in a year and in India it accounts for 31.8% of the total fertilizer consumption [1].

Chemical fertilizer and organic manure application provide su f cient nutrient for better growth and development. Among them, micronutrients plays key role in production of rice in particularly zinc. Zinc is the macro micronutrient; it involves various metabolic activities of rice growth. Increasing the use e f ciency applied zinc, various

0.5% as foliar spray (T_4), 1.0% as foliar spray (T_5). The treatment T_6 to T_8 consist of 100% RDF+GLM @ 6.25 t ha^{-1}+$ZnSO_4$ @ 12.5 kg ha^{-1} as basal (T_6), 25.0 kg ha^{-1} as basal (T_7) and 37.5 kg ha^{-1} as basal (T_8). For treatment T_9 and T_{10} instead of basal application, the $ZnSO_4$ was given as 0.5% foliar spray (T_9) and 1.0% foliar spray (T_{10}) with 100% RDF +GLM @ 6.25 t ha^{-1}. The treatment T_{11} and T_{12} consist of all combination in 100% RDF+GLM @ 6.25 t ha^{-1}+$ZnSO_4$ @ 12.5 kg ha^{-1} as basal+0.5% $ZnSO_4$ as foliar spray (T_{11}) and 1.0% foliar spray (T_{12}).

The recommended dose of fertilizer viz., 150:50:50 kg NPK ha^{-1} was applied to all the plots. In the form of DAP (18% N and 46% P_2O_5). The N fertilizer was applied in the form of urea (46% N) the basal dose N was adjusted with N supplied by DAP. The K fertilizer was applied in the form of MOP (60% K_2O). N and K applied in four equal splits viz., one at basal and remaining at active tillering, panicle initiation and heading stages along with N.

Leaves and twigs of *Glyricidia maculata* @ 6.25 t ha^{-1} was collected from the farm and incorporated in the respective plots at ten days before transplanting. After incorporation the field was puddled two times and leveled two days prior to planting. Zinc sulphate 12.5, 25, 37.5 kg ha^{-1} was mixed with sand to uniform distribution and applied as basal before the transplanting to the respective plots as per the treatment. Zinc sulphate at 0.5 and 1% foliar spray was given in two times viz., at active tillering and panicle initiation. The estimated values of partial factor productivity (PFP), agronomic efficiency (AE), recovery efficiency (RE), physiological efficiency (PE) and of applied Zn were computed using the following expressions as suggested by Pooniya and Shivay [3].

$$PFP=Y_t/Zn_a$$

$$AE=(Y_t-Y_{Ac})/Zn_a$$

$$RE=[(U_{Zn}-U_{Ac})/Zn_a] \times 100$$

$$PE=(Y_t-Y_{Ac})/(U_{Zn}-U_{Ac})$$

Where, Y_t and U_{Zn} refer to the grain yield (kg/ha) and total Zn uptake (g/ha), respectively of different wheat varieties in Zn applied plots; Y_{Ac} and U_{Ac} refer to the grain yield (kg/ha) and total Zn uptake (g/ha), respectively of wheat in control (Zn_0) plots; Zn_a refers to the Zn applied (kg/ha); GU_{Zn} refers to Zn uptake (g/ha) in grain. The Zn induced nitrogen recovery efficiency (ZniNRE) was calculated as following the equation proposed by Prasad and Shivay:

ZniNRE=[N uptake (kg/ha) in Zn treatment-N uptake (kg/ha) in control plots (Zn_0)]/ N applied (kg/ha)

Results and Discussion

Nutrient uptake is a product of nutrient concentration and dry matter accumulation of the crop plant. Nutrient uptake determines the crop growth, development and yield of the crops. In the present investigation nutrient uptake has more significance with the application of 100% RDF+GLM @ 6.25 t/ha+$ZnSO_4$ @ 12.5 kg/ha as basal+1.0% foliar spray (Table 1). Soil plus foliar application of zinc with green leaf manure results in greater nutrient availability. The conjunctive use of green leaf manures and zinc which might have helped in gradual mineralization processes and the balanced supply of nutrients are the reason for the higher uptake of nutrient by the crop. This is corroborated with the earlier findings made by Turkhede et al. [4].

	Treatments	Grain yield (kg ha^{-1})	Nutrient uptake		ZAR* (%)	ZnAE* (kg kg^{-1})	PFP* (kg kg^{-1})	PE*	ZnINE*
			N (kg ha^{-1})	Zn (g ha^{-1})					
T_1	100% RDF	5776	91.0	115.3	0.0	0	0.0	0.0	0.0
T_2	T_1+$ZnSO_4$ @ 25.0 kg ha^{-1} as basal	6166	98.9	442.4	1.4	16	247	1.1	5.7
T_3	T_1+$ZnSO_4$ @ 37.5 kg ha^{-1} as basal	6322	99.5	445	1	15	169	1.4	

T_{12}	T_1+GLM @ 6.25 t ha^{-1}+$ZnSO_4$ @ 12.5 kg ha^{-1} as basal+f.s. $ZnSO_4$ @ 1.0%	7105	119.6	567.9	2.6	76	406	2.9	15.5
	SEd	217	2.5	11.0					
	CD (P=005)	452	5.1	22.9					

5. Rajkumar C (2003) Study on the e f ect of di f erent sources of nitrogen on growth and yield of rice. MSc (Ag.) T esis, Tamil Nadu Agricultural University, Coimbatore.
6. Yaseen M, Hussain T, Hakeem A, Ahmad S (1999) Integrated nutrient use including Zn for rice. Pak J Biol Sci 2: 614-616.
7. Roberts TL (2008) Improving nutrient use e f ciency. Turkish Journal of Agriculture and Forestry 32: 177-182.
8. Pilbeam DJ (2015) Breeding crops for improved mineral nutrition under climate change conditions. Journal of Experimental Botany 66: 3511-3521.
9. Srinivasarao C, Sudha Rani Y (2013) Zinc de f ciency: A productivity constraint in rainfed crop production. J SAT Agric Res 11: 1-11.
10. Fageria NK, Dos Santos AB, Cobucci T (2011) Zinc nutrition of lowland rice. Communications in Soil Science and Plant Analysis 42: 1719-1727.
11. Yadav B, Khamparia RS, Kumar R (2013) E f ect of zinc and organic matter application on various zinc fractions under direct-seeded rice in vertisols. Journal of the Indian Society of Soil Science 61: 128-134.
12. Muthukumararaja TM, Sriramachandrasekharan MV (2012) E f ect of zinc on yield, zinc nutrition and zinc use e f ciency of lowland rice. Journal of Agricultural Technology 8: 551-561.
13. Muthukumararaja TM, Sriramachandrasekharan MV (2014) Enhancing rice productivity through integration of organics and zinc in a zinc de f cient soil. Journal of International Academic Research for Multidisciplinary 2: 359-368.
14.