Physiological factors affecting recovery efficiency of applied nitrogen

Kakuda Ken-ichi[a], Nozoe Takuhito[b], Ando Ho[a]

[a]Faculty of Agriculture, Yamagata University

[b]CSWS, International Rice Research Institute

Objectives

To improve nitrogen use efficiency, the application rate of N fertilizer must be balanced with plant N requirements, which are affected by climate, crop management practices, and genotype. Our objectives were to evaluate (1) the N requirements of two genotypes (a new plant type, NPT, and IR72) at each growth stage under different planting densities, and (2) the effect of plant N requirements and planting densities on the recovery efficiency of N fertilizer.

Materials and Methods

Field experiments were conducted at IRRI during the dry and wet seasons (DS and WS) in 2002. Labeled basal N and topdressing N (at the mid-tillering and panicle initiation stages) were applied in four treatments: two genotypes of irrigated rice, and two planting densities.

Treatment	Genotype	Planting density hills m^{-2}	Basal N	Topdressing N	
				MT	PI
			kg N ha^{-1}		
				DS	
IR-H	IR72	50	40	40	40
IR-L	IR72	25	40	40	40
NPT-H	NPT	50	40	40	40
NPT-L	NPT	25	40	40	40
				WS	
IR-H	IR72	50	30	30	30
IR-L	IR72	25	30	30	30
NPT-H	NPT	50	30	30	30
NPT-L	NPT	25	30	30	30

MT, Mid tillering; PI, Panicle initiation

Results

Table 1 Recovery efficiency of fertilizer N evaluated at flowering

Treatment	applied N	
	DS	WS
Basal N	%	
IR-H	37.6 a	22.8 ab
IR-L	37.7 a	23.7 a
NPT-H	25.5 b	17.6 bc
NPT-L	26.7 b	17.2 c
TopdressingN at MT		
IR-H	33.5 a	39.7 a
IR-L	27.9 a	36.3 ab
NPT-H	27.8 a	34.1 bc
NPT-L	23.1 a	30.0 c
Topdressing N at PI		
IR-H	46.4 a	58.4 a
IR-L	44.3 a	61.2 a
NPT-H	47.8 a	48.3 a
NPT-L	46.0 a	49.5 a

Means within treatment group followed by the same letter are not significanly different at P =0.05.

Table 2. Slopes, intercepts, and r^2 values for the data lines for ln (N absorbed g m^{-2}) vs. ln (dry matter accumulation g m^{-2}) during the period of the mid tillering - flowering.

Treatment	Slope § 1	intercept § 0	r^2	Equation
			DS	
IR-H	1.40	2.96	0.97	$Y = 19.3 X^{1.40}$
IR-L	1.31	3.21	0.98	$Y = 24.8 X^{1.31}$
NPT-H	1.42	3.14	0.96	$Y = 23.0 X^{1.42}$
NPT-L	1.28	3.28	0.99	$Y = 26.6 X^{1.28}$
			WS	
IR-H	1.47	2.91	0.97	$Y = 18.3 X^{1.47}$
IR-L	1.43	3.02	0.99	$Y = 20.4 X^{1.43}$
NPT-H	1.65	2.91	0.96	$Y = 18.4 X^{1.65}$
NPT-L	1.42	3.23	0.99	$Y = 25.3 X^{1.42}$

† Exponential equation for dry matter accumulation (Y) vs. the amount of N absorbed by plants (X) calculated from *ß1* and *ß 0*.

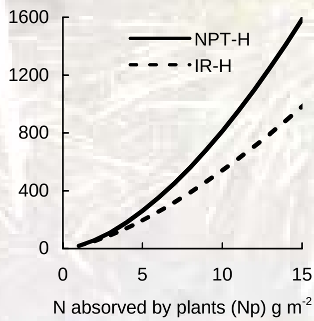

Fig. 1 Relationship between aboveground mass (Dp, g m^{-2}) and N absorbed by plants (Np g m^{-2}) in WS, as estimated from the exponential equations.

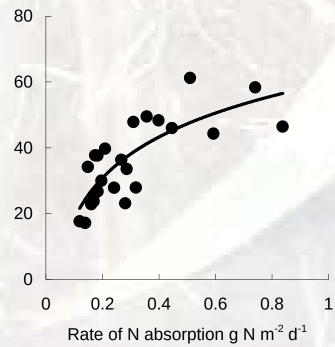

Fig. 2 Relationship between the rate of N absorption and recovery efficiency of applied N

Summary

- Recovery efficiency of applied N was higher in the IR 72 than in the NPT (Table 1).
- Planting density did not affect the recovery efficiency of applied N across gentypes (Table 1).
- Exponential equations for the relationship between absorbed N and aboveground mass let us evaluate the N requirement of rice at each growth stage (Table 2).
- Nitrogen requirements of the NPT were greater than those of the IR72 (Fig. 1).
- Recovery efficiency of applied N was influenced by plant N requirements and by thier N uptake rate (Fig. 2).