

## Plant biomass, N uptake, grain yield and protein content in response to plant N uptake and N topdressing rates at panicle initiation stage of rice

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### Objectives

This study investigated the response of plant variables at harvest to plant N uptake and N topdressing (Npi) at panicle initiation stage (PIS) and their potential use to predict yield, protein, and N uptake at harvest.

### Materials and Methods

An experiment in 2003 including 10 N-rate treatments and 4 varieties and the other in 2004 including 12 N-rate treatments and 2 varieties were conducted in Experimental Station, Seoul National University, Suwon, Korea. Shoot dry weight (PSDW), shoot N concentration (PSN), shoot N uptake (Pnup, g N in shoot m<sup>-2</sup>field) were measured at PIS and shoot N uptake (Hnup), shoot dry weight (HSDW), grain yield (g m<sup>-2</sup>), total number of spikelet (TSPK, 1000 m<sup>-2</sup>), filled spikelet (FSPK, %) 1000-grain weight (g) and milled rice protein content (%) were measured at harvest. Data were averaged over replicates before analysis. Correlation coefficients among crop parameters of the two stages were presented. Stepwise multipleregression was applied to predict some selected crop parameters at harvest using N uptake and N fertilizer applied at PIS (linear and quadratic).

### Results and Discussion

Most of crop variables at PIS except PSN had higher variations than those of crop variables at harvest (Table 1). The coefficient of variation of yield (15.6%) and milled rice protein content (8.2%) were higher than those reported by Nguyen (2005), potentially due to high variation in N rates of these experiments. Grain yield had high correlation with TSPK, HSDW, Hnup ( $r = 0.81, 0.91, 0.88$ , respectively) but low correlation with FSPK, 1000-grain weight, and protein content ( $r = -0.06, 0.27, 0.14$ , respectively). Yield and protein content had significant correlation with PSDW and Pnup but not PSN.

Although PSDW had a little higher correlation than Pnup with most of yield, yield components and protein content, we chose Pnup in combination with Npi as inputs for yield and protein prediction. The reasons were that Pnup was more frequently and conveniently used as crop N status indicator and could be predicted by nondestructive canopy reflectance method more precisely and accurately than PSDW (Nguyen and Lee, 2004). The resultant models of prediction were:

$$\text{Yield} = 223.1 + 49.9N_{pi} + 112P_{nup} - 7.54P_{nup}^2 - 4.17N_{pi}^2 \quad R^2 = 0.76 \quad (\text{Eq.1})$$

$$\text{Protein} = 7.51 + 0.187N_{pi} - 0.424P_{nup} + 0.031P_{nup}^2 \quad R^2 = 0.82 \quad (\text{Eq.2})$$

$$\text{Hnup} = 3.31 + 0.689N_{pi} + 1.68P_{nup} - 0.105P_{nup}^2 \quad R^2 = 0.74 \quad (\text{Eq.3})$$

The correlation between observed and predicted values was presented in Fig.1. The high coefficients of determination of the models promise that Pnup and Npi could be successful to predict yield, protein and Hnup. Moreover, these models can be used for N topdressing prescription at PIS based on precisely predicted Pnup and target yield or protein content

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## Key references

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Table 1. Correlation among crop variables (n = 81)

Crop variable	Unit	Mean	CV <sup>s</sup> (%)	Correlation coefficient									
				Yield	FSPK1	TSPK	1000grain	HSDW	Hnup	Protein			
Yield	g m <sup>-2</sup>	645	15.6	1									
FSPK	%	89.2	5.6	-0.06	1								
TSPK	1000 m <sup>-2</sup>	27.0	18.1	0.81	-0.62	1							
HSDW	g	1246	18.2	0.91	0.03	0.69	1						
1000-grain	g m <sup>-2</sup>	27.0	4.1	0.27	0.64	-0.25	0.31	1					
Hnup	g m <sup>-2</sup>	10.5	21.0	0.88	-0.37	0.89	0.81	0.03	1				
Protein	%	6.7	8.2	0.14	-0.71	0.50	-0.09	-0.39	0.44	1			
PSDW	g m <sup>-2</sup>	335	36.0	0.52	0.38	0.21	0.76	0.36	0.32	-0.53	1		
PSN	mg g <sup>-1</sup>	15.7	8.7	-0.13	0.07	-0.05	-0.06	-0.36	-0.12	-0.04	-0.04	1	
Pnup	g m <sup>-2</sup>	5.3	39.2	0.46	0.37	0.19	0.70	0.25	0.27	-0.49	-0.49	-0.49	1

<sup>s</sup>CV: Coefficient of variation, FSPK: filled spikelet, TSPK: total number of spikelet, HSDW: shoot dry weight at harvest, Hnup: N uptake at harvest, Protein: milled rice protein content, PSDW: shoot dry weight at PIS, PSN: shoot Nconcentration at PIS, Pnup: shoot N uptake at PIS.

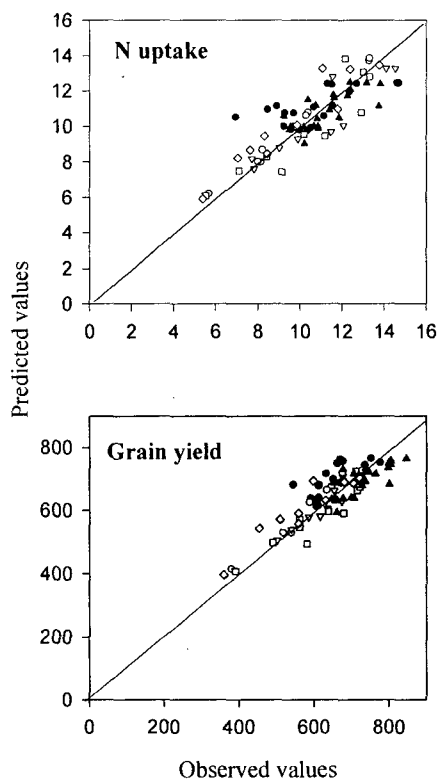


Fig. 1. Correlation between observed and predicted values by equation 1, 2 and 3 for grain yield, milled rice protein content and N uptake at harvest, respectively. Circle, Triangle down, square, diamond, and triangle up represent for Hwasungbyeo, SNU-SG1, Juanbyeo and Surabyeo, respectively. Unfilled and filled present data from year 2003 and 2004, respectively. Solid line is 1:1 line.