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Prescription of N topdressing rates at panicle initiation stage of rice

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Objectives

We intended to formulate N topdressing prescription at panicle initiation stage (PIS) of rice based on N uptake at PIS and N uptake from PIS to harvest.

Materials and Methods

Two experiments, one in 2003 and one in 2004 were conducted in Experimental Station, Seoul National University, Suwon, Korea with variable N rates applied at tillering (Ntill) and PIS (Npi). Shoot N uptake at PIS (Psnd, g N in shoot m-2 field), from PIS to harvest (Nup), grain yield (g m-2) and milled rice protein content (%) were recorded for formulation of N topdressing rates at PIS of rice. Stepwise multipleregression was applied to predict yield and protein using Psnd and Nup (linear and quadratic) and then predict Nup using Psnd and Npi (linear and quadratic). Based on predicted equations and target yield and protein content, we may estimate required N rates at PIS.

Results and Discussion

The stepwise multiple regression models to predict grain yield, protein content and N uptake from PIS to harvest were presented in Table 1, and the correlation of observed and predicted values were presented in Fig.1. Rice grain yield had quadratic relationship with both Psnd and Nup (Eq. 1, Table 1). The highest grain yield would be expected at Psnd and Nup of 15.35 and 14.66 g m-2, respectively. If grain yield were fitted to multiple linear regression of Psnd and Nup only, parameters estimates for Psnd and Nup were 48.6 and 37.2, respectively. That means one increased unit of Psnd was more effective than that of Nup in terms of increasing grain yield. However, recovery of N applied at tillering was frequently reported lower than that of N applied at PIS.

Milled rice protein content had quadratic relationship with Psnd and Nup (Eq.2, Table1). Result from solution of Eq.2 showed that increase of Psnd up to 5.98 g m-2 reduced protein content (optimum Psnd for protein), potentially due to dilution effect from high increase of grain yield with increased Psnd. As a result, increase of N uptake until PIS would promise to increase grain yield but reduce milled rice protein content. In contrast, linear relationship between protein content and Nup2indicated that increase of Nup would rapidly increase protein content. Therefore, it will be difficult to obtain high grain yield but low protein from adjusted N topdressing rate at PIS. N uptake from PIS to harvest depended on crop N uptake and N applied at PIS (Eq.3, Table1). Recovery of N applied at PIS was 69.2% and natural N supply was 3.31 g m-2. These were similar to those reported by Kim (2004) for year 2001 and 2002 in the same field.

To estimate optimum N rate at PIS to obtain target protein content of 7.1%, for example, we chose Psnd of 5.98 (the optimum Psnd for protein) to substitute into Eq.2 and got Nup value of 7.90. Substitution of Psnd of 5.98 and Nup of 7.90 into Eq.3, we found that required N rate at PIS was 4.3 g N m-2. If the same values of Psnd and Nup were substituted into Eq.1, calculated yield was 8.0ton ha-1. Therefore, optimum N rate at PIS would be 4.3 g m-2if Psnd were about 6.0. Otherwise, it should be calculated from Eq.1 to 3.

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Key references

Kim M.H. 2004. Nitrogen Topdressing at Panicle Initiation Stage Based on Nondestructive Diagnosis of N-Status and Vegetative Growth of Rice. PhD thesis, Seoul National University, Korea.

Table 1. Stepwise multiple regression model to predict yield, protein and N uptake from PIS to harvest

Equations for yield[$], protein and Nup prediction		R^2	REP
Yield = 75.4 + 82.57*Psnd* + 56.31*Nup* 1.92Nup^2 - 2.69$Psnd^2$	(Eq.1)	0.87	5.7
Protein = 7.09 + 0.016Nup^2 - 0.347*Psnd* + 0.029$Psnd^2$	(Eq.2)	0.73	4.4
Nup = 3.31 + 0.692*Npi* - 0.105$Psnd^2$ + 0.678*Psnd*	(Eq.3)	0.82	21.6

$ Yield: grain yield (g m-2), Protein: milled rice protein (%), Nup: N uptake from PIS to harvest (g m-2), Npi: N applied at PIS (g m-2), Psnd: N uptake at PIS (g m-2), R2: coefficient of determination, REP: relative error in prediction (%).

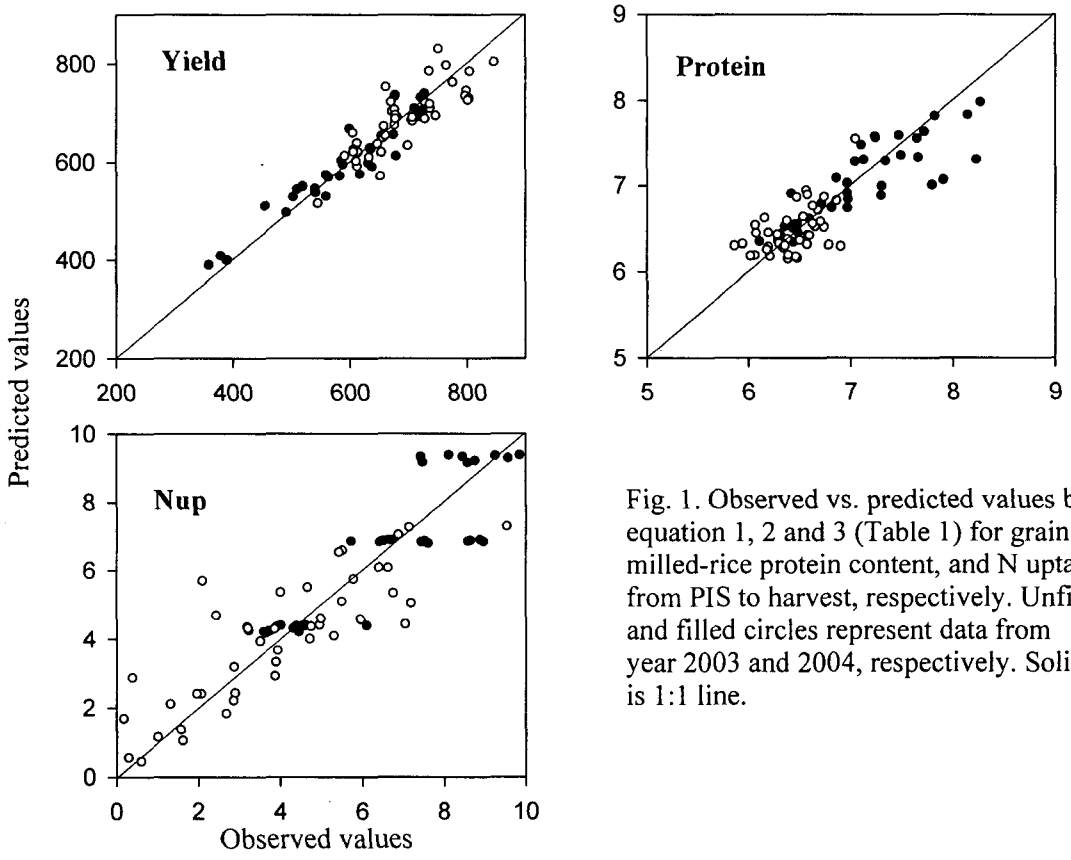

Fig. 1. Observed vs. predicted values by equation 1, 2 and 3 (Table 1) for grain yield, milled-rice protein content, and N uptake from PIS to harvest, respectively. Unfilled and filled circles represent data from year 2003 and 2004, respectively. Solid line is 1:1 line.