A05

Site-specific spatial variation management of rice yield and protein content using basic information of soil and plant variables

Nguyen Tuan Anh[1], Nguyen T. Hung[1], Nguyen T. Lan[1],Jin-Chul Shin[2] and Byun-Woo Lee[1]
[1]*School of Plant Science, Seoul National University, Republic of Korea*
[2]*NationalInstitute of Crop, RDA, Republic of Korea*

Objectives

Site-specific spatial management, particularly in a paddy field,is an important issue of precision agriculture here in Korea. There are several approaches available to get the optimum N recommendations for a field scale. In this research, the spatial variation information of soil chemical properties, yield, plant status, and canopy reflectance measurement were taken intoaccount for prescribing the amount of N fertilizer application amount site-specifically so that the spatial variability of rice yield and protein content could be reduced

Materials and Methods

A paddy field in experimental farm of National Institute of Crop Science, RDA (37016'N) was used for this research. The field size was 60m110m and divided into 66 plots with 10m 10m for each plot. The experiment was carried out in the year of 2002, 2003 and 2004 under different cultivation methods and fertilizer application. In 2004, 30 plots of the fieldwere subjected to uniform management and the other 30 plots were treated with variable amount of N fertilizer. For the prescription of panicle N fertilizer, equation regressing the rice protein content to nitrogen nutrition index (NNI), shoot dry weight (SDW) and shoot nitrogen (SN) at panicle stage (PIS) and nitrogen uptake (Nup) from PIS to harvest was obtained from data in 2003 as shown in Table 1. From these equations, Nup required for securing protein content less than 7.3% of rice protein content wasdetermined for each plot based on the NNI, SN and SDW estimated from canopy reflectance at PI 2004. The fertilizer amount for each plot was finally determined by estimated Nup considering N fertilizer recovery and natural supply of N.

Result and Discussion

Panicle N fertilizer amount determined for each plot based on predicted NNI and SN from canopy reflectance (Fig.2.) ranged from 0 to 2394 (g urea/plot) and 1246 (g urea/plot) on an average. A high significant correlation was shown between the N fertilizer amount estimated from predicted NNI and that from SN (Fig.2).

Table 1. Regression equation of protein content (P) to plant variables at PI and N uptake from PIS to harvest required for targeted protein content.

Parameter	Equation	R^2	N uptake
NNI	P=5.17+0.016Nup+0.707NNI	0.9499	Nup=1/0.016(P-5.19-0.707NNI)
SDW	P=5.54+0.016Nup-0.264DWP+0.090DWP2	0.9560	Nup=(P-5.55+0.264DW-0.091DW2)/0.016
SN	P=4.904+0.020Nup-0.000Nup2+0.261 SNP	0.9419	Nup=(P-4.904+0.000Nup2-0.261Nup)/0.0206

* Nitrogen nutrition index (NNI), shoot dry weight (SDW) and shoot nitrogen, (SN)

The result of spatial variation of yield and protein contents of variable N fertilizer treatment (VT) and uniform management (UN) was shown in table 2. The coefficient variation showed that both rice yield and protein content have significantly reduced at VT field which treated with estimated N fertilizer amount compared to UN

field. The spatial variation of rice yield and protein content in 2003 and 2004 experiments were presented in Fig.3.

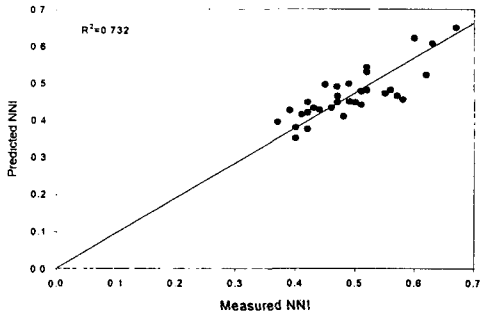

Fig.1. Relationship of predicted NNI usingcanopy reflectance measurement at PI 2004 and measured NNI of 2004

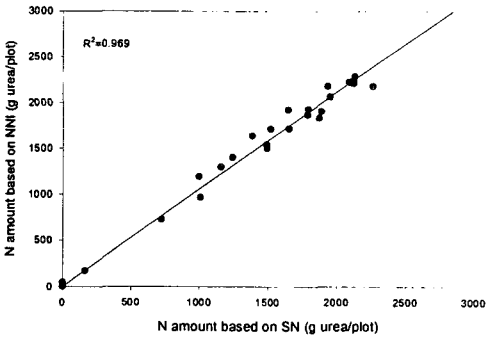

Fig.2. Relationship between estimated N fertilizer amounts (g urea/plot) based on predicted NNI and SN from canopy reflectance data in 2004

Table 2. Descriptive statistical analysis for rice yield (kg/ha) and protein contents (% of milled rice)

	Yield at field A1			Yield at field A2			Protein at A1		Protein at A2	
	2002	2003	2004	2002	2003	2004	2003	2004	2003	2004
Min	1509	3323	6413	4018	3204	5546	6.70	6.44	6.10	5.21
Max	6563	6179	9249	6440	5541	8672	8.04	8.86	7.90	8.59
Mean	4665	4460	7954	5378	4207	6994	7.52	7.76	7.13	6.89
Standard deviation	1263	954.0	647.9	713	656	1025	0.49	0.54	0.46	0.95
C.V.	**27.0**	**21.3**	**8.13**	**13.2**	**15.5**	**14.6**	**6.51**	**6.91**	**6.45**	**13.7**
Fertilizer application	UN	UNN	VT	UN	UNN	UN	UNN	VT	UNN	UN

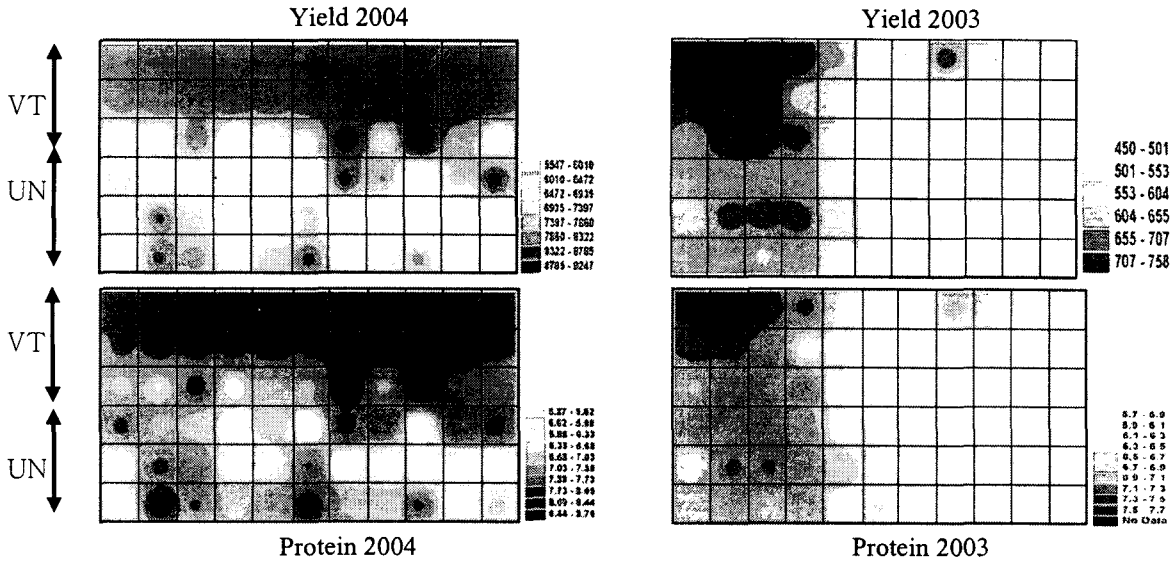

Fig.3. Mapping of spatial variation of rice yield and protein in 2003 and 2004. Variable rate of nitrogen application (VT), uniform nitrogen application (UN)