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Reducing Fertilizer Application and Rice Growth and Yield Mapping by Variable Rate Treatment in Paddy Fields

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논에서 변량시비를 통한 비료 절감과 벼 생육 및 수확량 변이 지도의 작성
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Objectives

The variable rate fertilization technique is a part of precision agriculture and that can reduce amount of fertilizer and environmental pollution and improve rice grain quality. Fertilizer recommendation amount was decided by soil chemical properties and plant growth, and optimum amount of fertilizer were spread into each site of each fields. This study was conducted to investigate the effect of reduced fertilizer through variable rate application on growth and yield of paddy rice.

Materials and Methods

The plant variety was *Oryza sativa* L. cv. Haepyeongbyeo. We used three fields, and divided each field into control and variable rate treatment (VRT) plot. In each plot, grid sampling was conducted with each of the 10m×10m size thirty cells. We decide amount of basal fertilizer and topdressing at tillering stage in each cell based on soil chemical analysis, and decided amount of topdressing at panicle initiation stage in each cell based on plant leaf area index (LAI) and chlorophyll meter value and leaf area index(LAI)×chlorophyll meter value. We collected soil infiltration water for environmental analysis and sampled rice grain for grain quality analysis.

Results and Discussion

Field 1: We could reduce fertilizer N-P-K=7.1-100-64.8% at VRT plot than control, and growth characteristics of control and VRT plot were similar. Yield was 4.3% higher than control in VRT plot, and variations of growth and yield were similar in each plot. There was no yield decrease by reduced fertilizer, but there was experimental error by lodging, and variation of yield didn't decrease.

Field 2: We could reduce fertilizer N-P-K=23.6-100-47.5% at VRT plot than control, and growth characteristics of control were better than VRT plot. Yield of VRT plot was 2% lower than control, but was not significant difference. Variations of plant height and chlorophyll meter value of VRT plot were lower than control, and variations of other growth characteristics and yield were similar. There was a little yield decrease by reduced fertilizer, and variation of chlorophyll meter value was decreased by the effect of variable rate fertilization.

Field 3: We could reduce fertilizer N-P-K=32.2-100-53.6% at VRT plot than control, and the most of growth characteristics of control were higher than VRT plot, but chlorophyll meter value was lower. Yield was 0.5% higher than control in VRT plot than was no significant difference. Variations of growth characteristics and yield of control and VRT plot were similar, and variation of yield in VRT plot was very low. There was no yield decrease by reduced fertilizer, and variation of yield was decreased by the effect of variable rate fertilization.

Nitrate contents of soil water and rice quality: There was not much difference in nitrate contents of soil infiltrated water between control and VRT plot. Quality of rice grain was measured by protein, fatty acid and amylose contents of brown rice grain. And quality of rice grain in VRT plot was improved as compared to control by low amount of nitrogen fertilizer application.

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Table 1. Fertilizer application of each plot

Application timing	Fertilizer	Amount of fertilizer (kg/10a)					
		Field 1		Field 2		Field 3	
		Control	VRT	Control	VRT	Control	VRT
Basal	N	10.9	4.53	10.9	6.21	10.3	6.12
	P	8.8	0	7.3	0	5.6	0
	K	8.8	1.39	7.3	2.12	5.6	0.89
TS	N	0	4.52	0	2.48	7.2	2.45
PIS	N	2.4	3.3	4.8	3.3	0	3.3
	K	0	1.71	0	1.71	0	1.71
Total	N	13.3	12.35	15.7	11.99	17.5	11.87
	P	8.8	0	7.3	0	5.6	0
	K	8.8	3.1	7.3	3.83	5.6	2.6

* TS: Tillering stage PIS: Panicle initiation stage

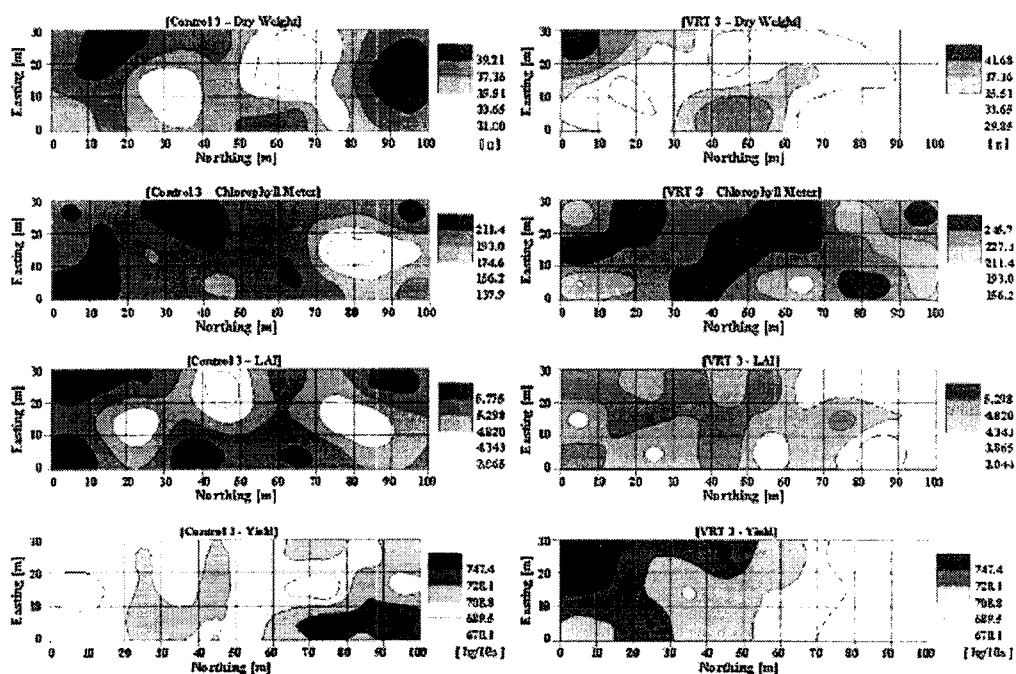


Fig. 1. Maps of growth characteristics and yield of control and VRT plot in field 3.

Table 2. Protein, amylose and fatty acid contents of rice grain

Component	Contents (%)					
	Field 1		Field 2		Field 3	
	Control	VRT	Control	VRT	Control	VRT
Protein	8.95*	8.392	8.45	8.71	6.87	6.47
	8.6-9.3**	8.6-9.2	8.4-8.6	8.6-8.8	5.65-8.7	5.6-6.8
Amylose	20.07	19.77	19.51	19.26	20.79	20.30
	20.0-20.1	19.7-19.8	19.4-19.6	19.2-19.3	19.7-22.3	20.0-20.9
Fatty acid	20.3	19.62	18.55	17.71	22.29	20.87
	20.1-20.5	19.1-20.0	18.0-18.9	17.3-18.1	19.9-27.6	19.9-23.1

* : mean ** : range