

STUDY ON FERTILIZER RATES FOR GETTING MAXIMUM GRAIN YIELD AND PROFITABILITY OF RICE PRODUCTION

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ABSTRACT

Generally, fertilizer is the major factor affected on grain yield, quality and rice production cost. Intensive rice production in sustainable agriculture requires the appropriated fertilizer input that is not only for getting high grain yield but also for attaining maximum profitability. The experiments were conducted on two soil types of Mekong Delta: Alluvium soil at Chau thanh, An giang and slightly acid sulfate soil at Codo, Can tho. The experiment treatments were the combination of five N fertilizer rates (0, 30, 50, 70 and 90 kg N/ha), four phosphorus rates (0, 30, 50 and 70 kg P_2O_5 /ha) and four potassium rates (0, 30, 50 and 70 kg K_2O /ha) on the background of organic fertilizer of VIDAGRO (0.5t/ha) with the following composition: 45% of organic matter, 10%, of total N and extractable K of 3.5%. They were designed in a randomized completed block with three replications. The results showed that the grain yield varied from 5.77 to 6.05 t/ha on the slightly acid sulfate soil. The fertilizer rates of 80-120 kg N/ha, 30-70 kg P_2O_5 /ha, 30-50 kg K_2O /ha with the treatments of O.F+50-50-50, O.F+50-50-30 and O.F+50-30-30 kg N- P_2O_5 - K_2O /ha got high grain yield and maximum profit as compared to others. On the alluvium soil in An giang, the grain yield was higher than that of Can tho site. The high grain yield and maximum profitability were recorded at the following fertilizer doses: 100-120 kg N/ha, 30-50 kg P_2O_5 /ha, 30-70 kg K_2O /ha. The treatments of O.F+50-30-50, O.F+50-50-30, O.F+70-50-50, and O.F+50-50-70 kg N- P_2O_5 - K_2O /ha were the best for both grain yield and profitability.

Keywords: Fertilizer rate (FR), grain yield (GY), maximum profitability (Max P).

INTRODUCTION

Fertilizer is very important input for intensive rice production. The profitability of rice production systems depends on yields and input quantities (Moya et al. 2004). So, the appropriated fertilizer input that is not only for getting high grain yield but also for attaining maximum profitability. The researches on SSNM at Mekong Delta recognized that the good opportunities for increasing productivity and yield through improved nutrient management (Tan et al. 2004). Recently, the safety rice production that applied organic or partly organic fertilizer has been developed. It helped to stabilize the grain yield, improving rice milling quality, reducing use of chemical fertilizer for improving soil fertility and environment and simultaneously increased farmer's income (Khuong et al. 2006, Man et al. 2007). So, the objectives of this research are to determine the

combined fertilizer rates for getting highest grain yield and maximum profitability in intensive rice production.

MATERIALS AND METHODS

The experiment was carried out at two sites with two soil types as alluvium soil at Chau thanh District, An giang province and slightly acid sulfate soil at Codo District, Can tho City in 2007 dry season. The experiments were designed in a randomized completed block with three replications. The treatments were the combination of five N fertilizer rates (0, 30, 50, 70 and 90 kg N/ha), four phosphorus rates (0, 30, 50 and 70 kg P_2O_5 /ha) and four potassium rates (0, 30, 50 and 70 kg K_2O /ha) on the background of organic fertilizer (VIDAGRO 0.5 t/ha) with the following composition: 45% of organic matter, 10%, of total N and extractable K of 3.5% as the Table 1.

Table 1: The treatments of the experiment

No	Treatment	Total nutrient content in fertilizer treatments (kg N-P ₂ O ₅ - K ₂ O/ha)		
		N	P ₂ O ₅	K ₂ O
1	Organic Fertilizer (O.F) + 00 -50 - 50	50	50	67.5
2	O.F + 30 - 50 -50	80	50	67.5
3	O.F + 50 - 50 - 50	100	50	67.5
4	O.F + 70 - 50 -50	120	50	67.5
5	O.F + 90 - 50 - 50	140	50	67.5
6	O.F + 50 - 0 - 50	100	0	67.5
7	O.F + 50 - 30 - 50	100	30	67.5
8	O.F + 50 - 70 - 50	100	70	67.5
9	O.F + 50 - 50 - 00	100	50	17.5
10	O.F + 50 - 50 - 30	100	50	47.5
11	O.F + 50 - 50 - 70	100	50	87.5
12	O.F + 50 - 30 - 30	100	30	47.5
13	O.F + 50 - 70 - 70	100	70	87.5

The organic fertilizer and phosphorus were applied at 7-10 days after sowing (DAS). Nitrogen fertilizer as Urea and K fertilizer as Potassium

Chloride (KCl) were applied in two splits as the Table 2.

Table 2: The rates and timing for application of N and K fertilizers at 2 sites in 2007 DS.

N rates (kgN/ha)	Timing of App.		K rates (kg K ₂ O/ha)	Timing of App.	
	25 DAS	42 DAS		7-10 DAS	42 DAS
0	0	0	0	0	0
30	10	20	30	15	15
50	20	30	50	30	20
70	30	40	70	35	35
90	40	50	-	-	-

The collected data comprised of yield components and grain yield. They were collected and processed by IRRI Procedure.

Calculating the economic efficiency of the fertilizer rates for getting the maximum profitability of fertilizer input in rice production.

Data was statistically processed by IRRISTAT FOR WINDOW 5.0.

RESULTS AND DISCUSSION

Effect of fertilizer rates on yield components of rice

Table 3 and 4 showed that the pan /m² were

significantly different at 5% among the fertilizer treatments. They got highest value of pan /m² under the chemical treatments of 90-50-50 kg and 50-50-70 kg N-P₂O₅-K₂O for OM2718 and OM2517, respectively.

For filled grains / pan., the chemical treatments of 90-50-50 kg N-P₂O₅-K₂O obtained lower filled grains / pan. than those of others. The combination of NPK doses, especially at lower N rates, got lower unfilled grain percentage as compared to the chemical treatment of 90-50-50 kg N-P₂O₅-K₂O.

For both varieties, there were no difference in unfilled grain % and weight of 1,000 grains among treatments

Table 3: Effect of fertilizers on yield components of OM2718 in 2007 DS at Codo, Can tho.

No	Treatments	Pan/m ²	Filled grains/Pan.	Unfilled grain (%)	1,000 grain wgt (gr)
T1	O.F + 00 - 50 - 50	370	56	14.7	26.3
T2	O.F + 30 - 50 - 50	390	57	15.0	26.2
T3	O.F + 50 - 50 - 50	389	56	15.6	26.3
T4	O.F + 70 - 50 - 50	383	59	14.5	26.3
T5	O.F + 90 - 50 - 50	403	54	16.0	26.4
T6	O.F + 50 - 0 - 50	402	55	15.4	26.1
T7	O.F + 50 - 30 - 50	386	59	14.6	26.1
T8	O.F + 50 - 70 - 50	401	57	14.9	26.3
T9	O.F + 50 - 50 - 00	396	54	15.1	26.2
T10	O.F + 50 - 50 - 30	394	57	14.9	26.1
T11	O.F + 50 - 50 - 70	401	58	14.6	26.3
T12	O.F + 50 - 30 - 30	400	56	14.7	26.3
T13	O.F + 50 - 70 - 70	397	57	14.7	26.1
F		*	*	Ns	Ns
CV%		12.6	12.9	14.7	1.4
LSD5%		17.0	2.7	1.4	0.2

Table 4: Effect of fertilizers on yield components of OM2517 in 2007 DS at Chau Thanh, An giang.

No	Treatments	Pan/m ²	Filled grain/Pan.	Unfilled grain (%)	1,000 grain wgt (gr)
T1	O.F + 00 - 50 - 50	410	62	12.8	25.8
T2	O.F + 30 - 50 - 50	430	63	12.1	25.8
T3	O.F + 50 - 50 - 50	453	59	12.4	25.7
T4	O.F + 70 - 50 - 50	439	63	11.9	25.8
T5	O.F + 90 - 50 - 50	437	62	14.3	25.8
T6	O.F + 50 - 0 - 50	431	63	12.5	25.7
T7	O.F + 50 - 30 - 50	432	63	12.3	25.8
T8	O.F + 50 - 70 - 50	448	61	12.6	25.9
T9	O.F + 50 - 50 - 00	406	66	12.4	25.9
T10	O.F + 50 - 50 - 30	435	62	12.0	25.8
T11	O.F + 50 - 50 - 70	456	62	12.1	25.7
F		*	Ns	Ns	Ns
CV%		13.5	11.7	16.8	1.2
LSD5%		25.6	3.9	1.5	0.2

Effect of fertilizer rates on grain yield

Effect of the fertilizer doses on grain yield of OM2718 at Codo, Can tho was shown in Fig 1. Among N rates, grain yield was recorded at the

highest values (5.93-6.05t/ha) of 80, 100 and 120 kg N/ha (included N rate in 0.5 t/ha of organic fertilizer).

On the same basis of N and K rates, among phosphorus fertilizer rates (30, 50, and 70 kg

P₂O₅/ha) the grain yields were not different, but there were the remarkable differences between with phosphorus (at 50 and 70 kg P₂O₅/ha) and no P application. This data confirmed that important role of phosphorus on acid sulfate soil (Tan and Huan 1997).

On the same basis of N and P there were no differences on grain yields among potassium

fertilizer rates (30, 50 and 70 kg K₂O/ha).

The treatments that attained highest grain yield were O.F+50-50-50 kg N- P₂O₅-K₂O/ha; O.F+70-50-50 kg N- P₂O₅-K₂O/ha; O.F+50-70-50 kg N- P₂O₅-K₂O/ha; O.F+50-50-30 kg N- P₂O₅-K₂O/ha; O.F+50-50-70 kg N- P₂O₅-K₂O/ha; O.F+50-70-70 kg N- P₂O₅-K₂O/ha.

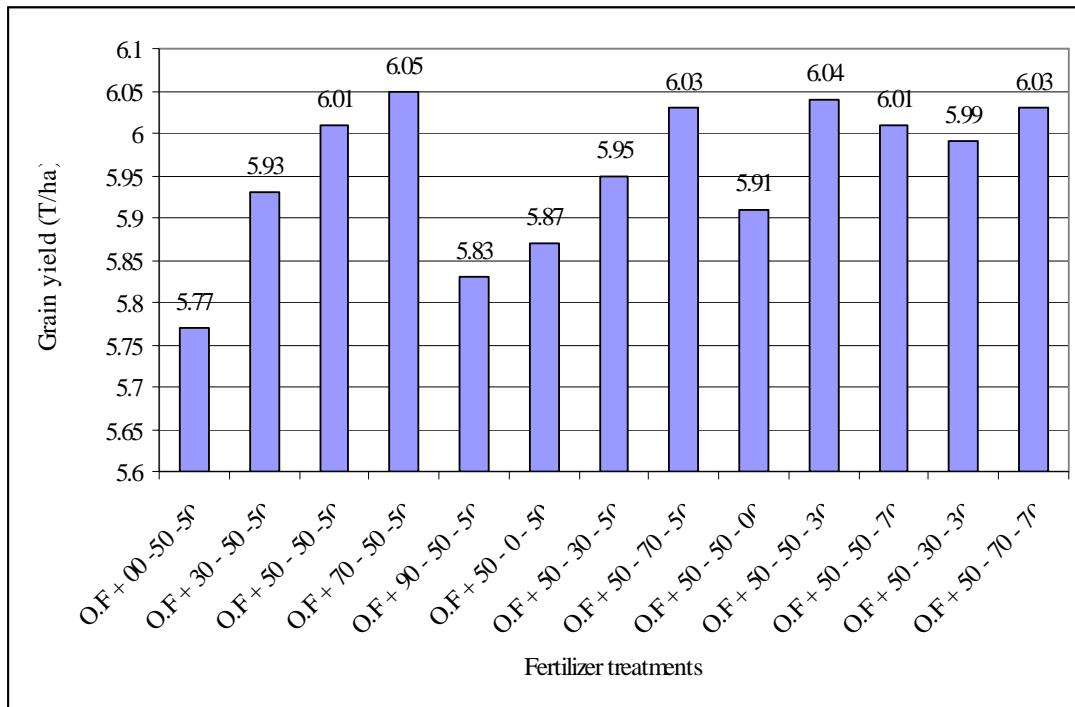


Fig.1: Effect of fertilizer rates on grain yield of OM2718 at Codo, Can tho in 2007 DS.

Effect of the fertilizer doses on grain yield of OM2517 at Chau thanh, An giang was shown in Fig 2. Among N rates, grain yield was recorded at the highest values (7.00-7.07t/ha) of 100 and 120 kg N/ha (included N rate in 0.5 t/ha of organic fertilizer).

On the same basis of N and K rates, among phosphorus fertilizer rates (30, 50, and 70 kg P₂O₅/ha) the grain yield were not different.

Similarly, there were no difference on grain yield

among potassium fertilizer rates (30, 50 and 70 kg K₂O/ha) on the same basis of N and P, but they were significantly different compared to no K application. The treatment that attained highest grain yield was O.F+50-50-70 kg N- P₂O₅-K₂O/ha (7.16 t/ha). This data showed the same tendency with the results of the SSNM research at An giang site in reducing N rate but increasing K fertilizer for intensive rice production (Tan et al. 2004).

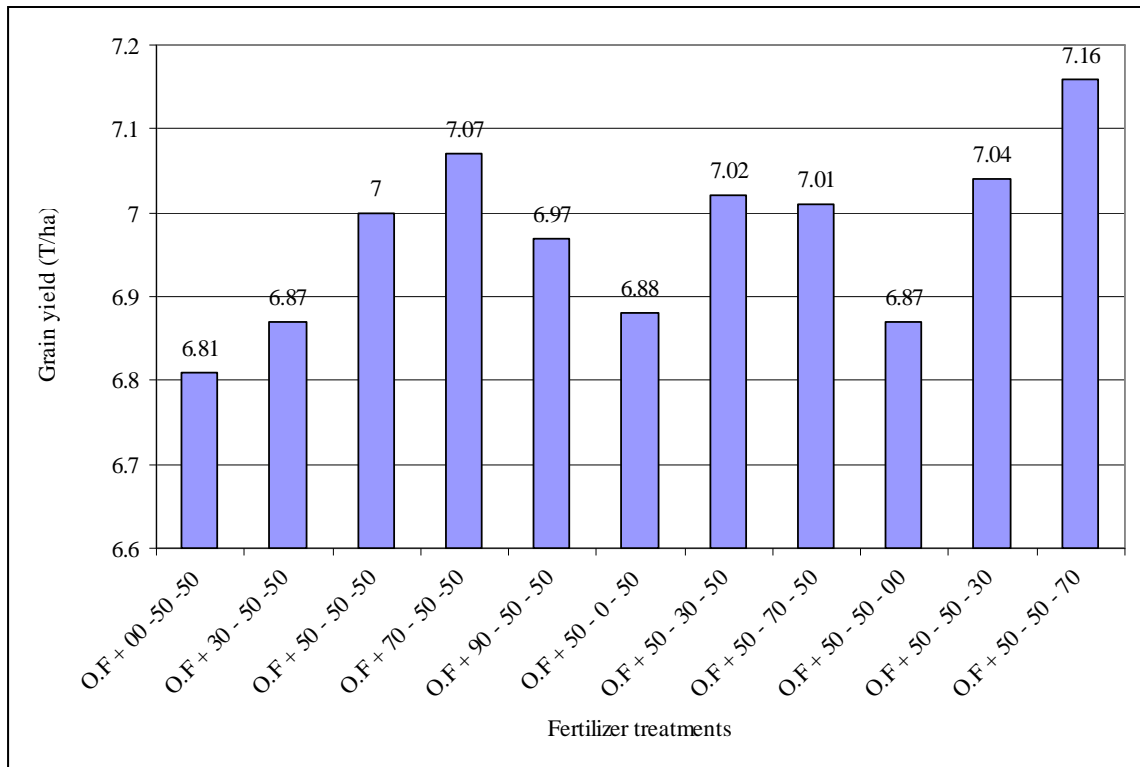


Fig. 2: Effect of fertilizer rates on grain yield of OM2517 at An giang in 2007 DS.

Effect of fertilizer rates on the profitability of rice production

The result of analysis of economic efficiency of fertilizer input in intensive rice production at Codo, Can tho was shown in Table 5. Due to the higher cost of fertilizer at the high N, P, K rates so their profit/ fertilizer cost ratio were the lower. The treatments that got maximum profitability were O.F+30-50-50 kg N- P₂O₅-K₂O/ha; O.F+50-50-50 kg N- P₂O₅-K₂O/ha; O.F+50-50-30 kg N- P₂O₅-K₂O/ha and O.F+50-30-30 kg N- P₂O₅-K₂O/ha.

The fertilizer treatments that simultaneously attained high grain yield and maximum profit compared to others were O.F+50-50-50, O.F+50-50-30 and O.F+50-30-30 kg N-P₂O₅-K₂O/ha.

In alluvium soil at An giang, the high grain yield and maximum profitability were recorded at the following fertilizer doses: 100-120 kg N/ha, 30-50 kg P₂O₅/ha, 30-70 kg K₂O/ha. The treatments of O.F+50-30-50, O.F+50-50-30, O.F+70-50-50, and O.F+50-50-70 kg N- P₂O₅-K₂O/ha were the best for both grain yield and profitability (Table 6).

Table 5: Evaluation and ranking of the fertilizer rates for getting high grain yield and maximum profitability of rice production in 2007 DS at Codo, Can tho.

Treatments	Grain yield (kg/ha)	Profit/Fertilizer cost ^a	Ranking based on	
			Grain yield	Profit
O.F + 00 -50 -50	5770	5.46	13	-
O.F + 30 - 50 -50	5930	4.73	9	1
O.F + 50 - 50 -50	6010	4.32	5	2
O.F + 70 - 50 -50	6050	3.93	1	3
O.F + 90 - 50 - 50	5830	3.31	12	4
O.F + 50 - 0 - 50	5870	5.13	11	-
O.F + 50 - 30 - 50	5950	4.61	8	2
O.F + 50 - 70 - 50	6030	4.03	3	3
O.F + 50 - 50 - 00	5910	5.14	10	-
O.F + 50 - 50 - 30	6040	4.21	2	1
O.F + 50 - 50 - 70	6010	4.02	5	2
O.F + 50 - 30 - 30	5990	5.06	7	1
O.F + 50 - 70 - 70	6030	3.75	3	3

^aProfit= Grain yield (kg/ha) x rice price (VND 2,850/kg).

Fertilizer costs as followed: Urea =VND 4,500 / kg; Super phosphate = VND 1,400/ kg;
KCl =VND 4,000/ kg, VEDAGRO= VND 2,000 /kg.

Table 6: Evaluation and ranking of the fertilizer rates for getting high grain yield and maximum profitability of rice production in 2007 DS at Chauthanh, An giang.

Treatments	Grain yield (kg/ha)	Profit/Fertilizer cost	Ranking based on	
			Grain yield	Profit
O.F + 00 -50 - 50	6810	7.10	11	-
O.F + 30 - 50 -50	6870	5.99	9	1
O.F + 50 - 50 - 50	7000	5.53	6	2
O.F + 70 - 50 -50	7070	5.08	2	3
O.F + 90 - 50 - 50	6970	4.50	7	4
O.F + 50 - 0 - 50	6880	6.60	8	-
O.F + 50 - 30 - 50	7020	6.01	4	1
O.F + 50 - 70 - 50	7010	5.15	5	2
O.F + 50 - 50 - 00	6870	6.52	9	-
O.F + 50 - 50 - 30	7040	5.40	3	1
O.F + 50 - 50 - 70	7160	5.35	1	2

^aProfit= Grain yield (kg/ha) x rice price (VND 2,850/kg).

Fertilizer costs as followed: Urea =VND 4,500 / kg; Super phosphate = VND 1,400/ kg;
KCl =VND 4,000/ kg, VEDAGRO= VND 2,000 /kg.

CONCLUSION

The grain yield of OM2718 varied from 5.77 to 6.05 t/ha in the slightly acid sulfates soil at Codo, Can tho. The appropriated fertilizer rates of 80-

120 kg N/ha, 30-70 kg P₂O₅/ha, 30-50 kg K₂O/ha in which the treatments of O.F+50-50-50, O.F+50-50-30 and O.F+50-30-30 kg N-P₂O₅-K₂O/ha got high grain yield and maximum profit compared to

others.

In alluvium soil at An giang, the grain yield of OM2517 varied from 6.81 to 7.16t/ha. The high grain yield and maximum profitability were recorded at the following fertilizer doses of 100-120 kg N/ha, 30-50 kg P₂O₅/ha, 30-70 kg K₂O/ha. The treatments of O.F+50-30-50, O.F+50-50-30, O.F+70-50-50, and O.F+50-50-70 kg N- P₂O₅-K₂O/ha were the best for both rice yield and profitability.

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Nghiên cứu liều lượng phân bón thích hợp cho năng suất và hiệu quả kinh tế tối đa trong sản xuất lúa cao sản ở ĐBSCL

Phân bón là một trong những yếu tố quyết định năng suất, chất lượng và giá thành nông sản nói chung. Thâm canh sản xuất lúa cao sản trong nền nông nghiệp bền vững cũng đòi hỏi phải đầu tư phân bón sao cho vừa đạt năng suất cao, ổn định vừa đạt hiệu quả kinh tế cao. Các thí nghiệm ngoài đồng thực hiện trên hai loại đất: đất phù sa đầu nguồn ở Châu Thành, An Giang và đất phèn nhẹ ở Cờ Đỏ, Cần Thơ nhằm tìm ra công thức phân bón vừa đạt năng suất lúa cao vừa đạt lợi nhuận cao nhất. Các nghiệm thức nghiên cứu là tổ hợp của 5 mức phân đạm (0, 30, 50, 70 và 90 kg N/ha), 4 mức phân lân (0, 30, 50 và 70 kg P₂O₅/ha) và 4 mức phân kali (0, 30, 50 và 70 kg K₂O/ha) trên nền phân hữu cơ VIDAGRO (0.5t/ha) có thành phần dinh dưỡng: 45% chất hữu cơ, N tổng số 10%, K₂O dễ tiêu 3.5%. Các thí nghiệm được bố trí theo khối hoàn toàn ngẫu nhiên, ba lần lặp lại. Năng suất lúa ghi nhận được biến động từ 5,77-6,05 t/ha trên chân đất phèn nhẹ Cần Thơ với liều lượng phân bón thích hợp cho vụ ĐX là từ 80-120 kg N/ha, 30-50 kg P₂O₅/ha, 30-50 kg K₂O/ha. Các công thức phân bón: HC+30-50-50 kg N- P₂O₅-K₂O/ha, HC+50-50-30 kg N- P₂O₅-K₂O/ha và HC+50-30-30 kg N- P₂O₅-K₂O/ha vừa đạt năng suất lúa cao vừa đạt hiệu quả kinh tế cao nhất. Trên chân đất phù sa đầu nguồn An Giang năng suất lúa đạt từ 6,81-7,16 t/ha với liều lượng phân bón thích hợp là từ 100-120 kg N/ha, 30-50 kg P₂O₅/ha, 30-70 kg K₂O/ha. Các công thức phân bón: HC+50-30-50 kg N-P₂O₅-K₂O/ha, HC+50-50-30 kg N-P₂O₅-K₂O/ha, HC+70-50-50 kg N-P₂O₅-K₂O/ha, và HC+50-50-70 kg N- P₂O₅-K₂O/ha vừa cho năng suất lúa cao vừa đạt lợi nhuận tối đa.