Technical Report No. CP-2

SUMMARY OF THE AGRONOMIC TRIALS CONDUCTED AT THE TRIAL FARM

in

WET SEASON 1984
DRY SEASON 1983-84
WET SEASON 1983

CHAO PHYA PILOT PROJECT

LAD BUA LUANG DISTRICT
AYUDHYA PROVINCE
THAILAND

THAI IRRIGATED AGRICULTURE DEVELOPMENT PROJECT
ALRO MOAC
MARCH 1985

Toshio Shibata
Krisdawut Wongpiboonwatana

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PREFACE

It is obvious that the objective of an agronomic trial is to develop or to improve an appropriate technology suitable and adaptable for the actual farmer's socio-economic and agro-climatic conditions.

This is a seasonally summarized report of applied agronomic trials on rice cultivation conducted at Trial Farm of the Chao Phya Pilot Project in three cropping seasons of 1983 Wet, 1983-84' Dry and 1984 Wet Season.

Basic concept of agronomic trial is not to find out the highest production technology but to formulate appropriate technology in order to maximize the benefit of farmers in consideration of production cost, product price, cost of capital, risk probability, marketability of the product and other related factors.

In accordance with the basic concept mentioned above, the trial site was selected in the Trial Farm considered to be similar to the averaged condition of farmer's field in the pilot project area so as to accumulate practical and useful datas in order to make the best use of trial results applicable to the area.

It is hoped that this information would be of some reference to those who are engaged in the field of practical agronomic research and agriculture extension.

Toshio Shibata
Krisdawud Wangpiboonwatana

Agronomy Section
Chao Phya Pilot Project
IADP, ALRO, MOAC

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Wet Season 1984

Dry Season 1983 - 84

Wet Season 1983

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ABSTRACTS OF THE TRIAL RESULTS CONDUCTED IN WET SEASON 1984

Trial I. Varietal Comparative Study (Transplanting)

Among RD-Varieties, mean grain yield of RD-23 (872 kg/rai), RD-21 (870 kg/rai) and RD-7 (840 kg/rai) were significantly superior to RD-25 (629 kg/rai).

Some of the SPR-Entries were found to be promising. Varieties of RD-23 and RD-21 were observed to be still recommendable in this locality.

Trial II. Nitrogen x Phosphorus Fertilizer Trial (Transplanting)

Clear response of nitrogen on the grain yield was observed. The grain yield was significantly increased along with the increment of nitrogen levels. Whereas no significant effect of phosphorus was found in this trial. Total nitrogen of 18 kg N/rai (basal application of 12 kg N/rai plus 6 kg N/rai top dressed at panicle initiation stage) without phosphorus appeared to be the most profitable with extremely high marginal rate of return.

Trial III. Planting Method Comparative Study

Transplanting method either mechanical and manual produced higher mean grain yield than the that of direct sowing method though difference was not significant at 5% level. Transplanting method was found to be profitable even additional variable cost is required.

Judging from the trial results including previous study, transplanting method is adapted in wet season and direct sowing is superior in dry season in general conditions.

Trial IV. Green manure Application Trial (Transplanting)

The effect of green manure (sesbania) and nitrogen fertilizer on the grain yield was statistically observed. Effect of nitrogen was more distinctly recognized than the effect of green manure.

The economic response of green manure and nitrogen was also observed based on the given variable cost assumed in this report.

Futher study on green manure cultivation is absolutely needed especially for the areas where double cropping of rice is repeated under complete flo control condition.

Trial V. Seedrate x Nitrogen Fertilizer Trial (Direct sowing)

Seedrate of 16 kg and 8 kg/rai produced significantly higher grain yield than the that of 4 kg/rai.

Grain yield was significantly increased along with the increment of basal nitrogen levels.

Yield differences among different basal nitrogen levels were significant. 8 kg N/rai top dressed at panicle initiation stage produced significantly better grain yield than the 4 kg N/rai applied at the same time.

Seedrate of 8 kg/rai with basal nitrogen of 8 kg N/rai plus 8 kg N/rai top dressed at panicle initiation stage appeared to be profitable combinations with acceptable level of marginal rate of return.

Trial VI. Nitrogen Source x Dose Comparative Trial (Direct Sowing)

The quantity of nitrogen was highly associated with grain yield whereas different sources of nitrogen did not influence to grain yield statistical Split application of basal and top dressing at panicle initiation stage appeared to be better for yield and economy when the same quantity of nitrogen is applied.

Trial VII. <u>Variety x Production Inputs Trial</u> (Direct Sowing)

All of the production inputs (Variety, Nitrogen, Insect control, Weed control) were closely correlated to grain production since significant effects of all production inputs were clearly observed at 1% level of significance.

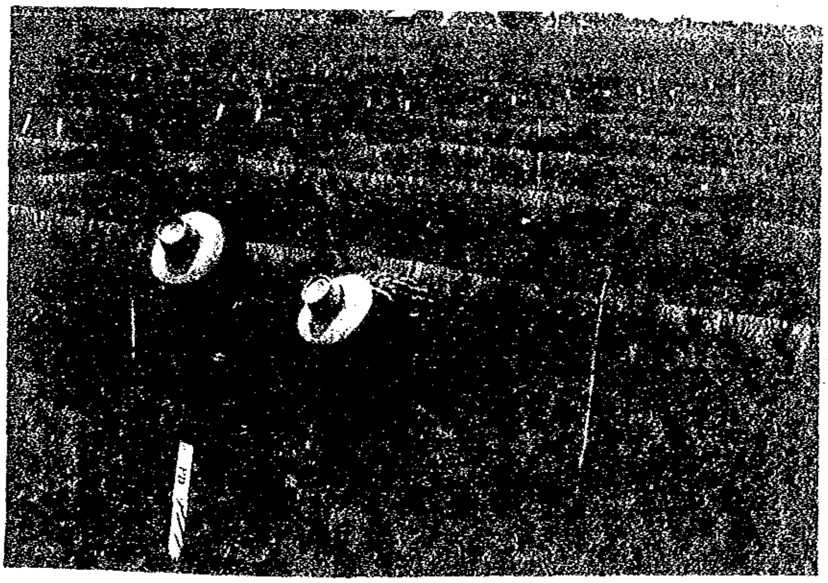
Variety of RD-23 planted with nitrogen (12 kg N/rai) and Weed control (Saturn G 5 kg/rai + Manual weeding) without insecticide appeared to be profitable combination economically since high cost of insecticide (10 kg of Furadan) was not compensable with the yield increment.

Trial No. VII
Violent growth of Weeds appeared at trial plot.

V : Apple Thong
N : With nitrogen
I : No insecticide
W : No weed control

Weeds are mainly :

Sphenoclea Zeylanica Gaertn and Cyperus difformis Linn.



Growth observation (Tillers & Height) at Varietal Comparative Study.

General Introduction and Experimental Conditions

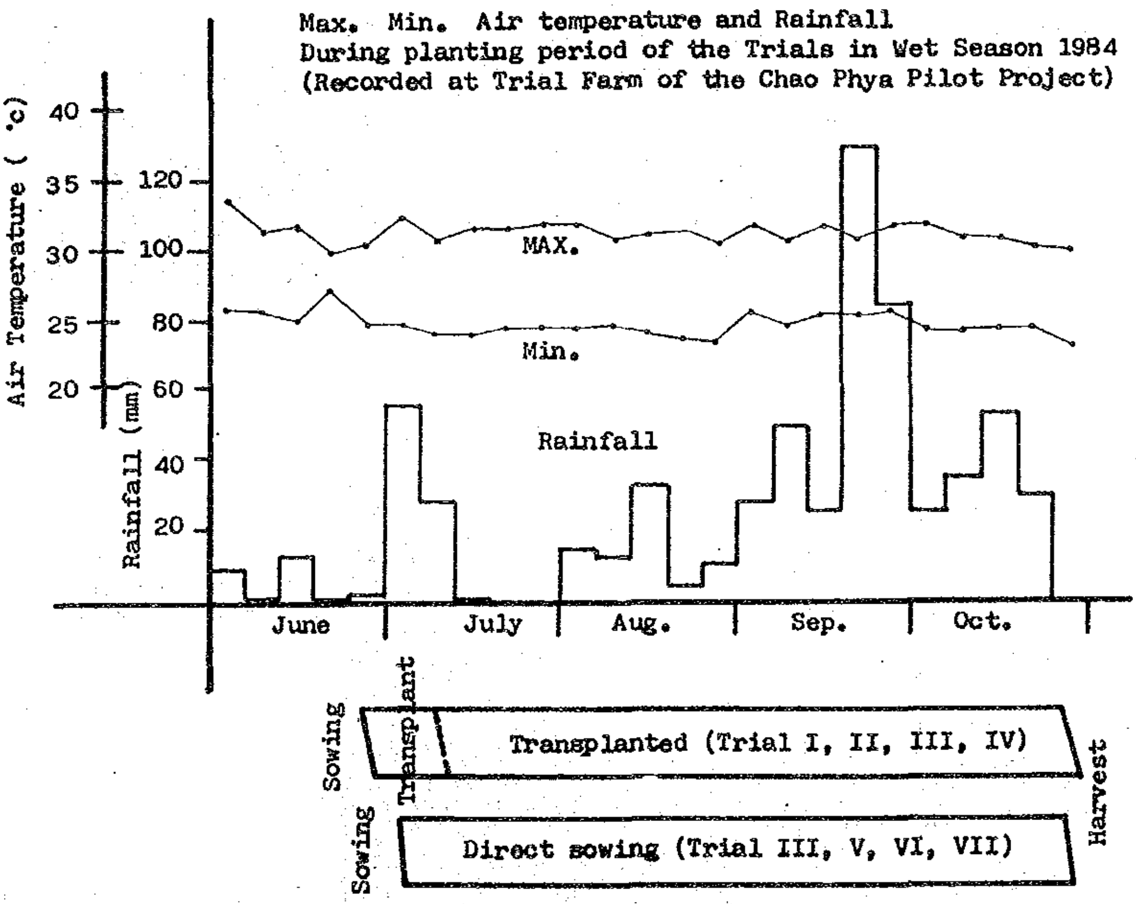
The double cropping of rice cultivation with considerably high level of grain production has been come true and to ensure the better benefit for rice growers in the Chao Phya Project area since 1982-83' Dry Season.

Introduction of RD-23 and RD-21 having good resistance against brown plant hopp[er] contributed to minimize the problem of Rice Ragged Stunt Virus (RRSV) with satisfactory level of yield potentiality.

Especially RD-23 has been accepted and planted by the most of farmers in this area. The superiority of this variety has also been proven in consequence of variet[y] comparative study conducted at the Trial Farm.

For the agronomic trials, variety of RD-23 was mainly used because of above reason.

Germinated direct sowing method has been widely practiced by farmers. In this wet season, transplanting method was applied for the trial No. I,II, and IV and direct sowing method was adapted for V,VI and VII.



The agronomic trials were organized and managed by Agronomy Section in collaboration with other related sections in the project.

All of the inputs used for the trials such as seed, fertilizer, chemicals were locally available and actually used by the farmers.

Grain yield of each experimental unit were measured within the central part of 3.75 m^2 (60 hills) in case of transplanting. Grain yield of 4.0 m^2 were observed for direct sowing trials. In the bigger plot of 40 m^2 (Trial No. III & V), central part of 8 m^2 were investigated.

Number of tillers and plant height of trial No. I & V were observed every week until heading stage.

Yield components & related figures were investigated in every trials at harvest time.

10% of harvest and storage loss was assumed and deducted from the grain yield when result was economically examined.

The following assumptions on the variable inputs and output were assumed for economic study of the trial results.

Inputs	: Rice seed (dry grain)	:	3.3 B/kg
	Fertilizer		
	Ammonium sulphate (21-0-0)	:	2.3 B/kg
	Triple super phosphate (0-46-0)	:	6.0 B/kg
	Ammo-phos (16-20-0)	:	4.2 B/kg
	GML (Glutamic Mother Liquor)	:	0.44 B/litre
	Chemicals		
	Furadan Granule	:	21.0 B/kg
	Saturn G	:	18.0 B/kg
	Opportunity cost of labour	:	55.0 B/day/person
Output	: (price of dry grain : 14% H_2O)	:	2.85 B/kg

N

Chao Phya Pilot Project

Allocation and Plot Layout of The Trials (Transplanting)
Wet Season, 1984

Field No. 150

I. Varietal Comparative Study
RCBD
15 Entries x 3 Reps.
(45 plots)

9 41	6 40	3 31	8 30	9 21	15 20	13 11	8 10	1 1
15 42	11 39	14 32	1 29	11 22	7 19	4 12	3 9	6 2
13 43	1 38	4 33	2 28	14 23	3 18	10 13	11 8	7 3
5 44	2 37	10 34	6 27	10 24	12 17	14 14	12 7	15 4
12 45	7 36	8 35	13 26	5 25	4 16	5 15	2 6	9 5

IV. Green Manure x Nitrogen Trial
RCBD Factorial
4 levels x 4 levels
x 2 Reps.
(32 plots).

G_2 N_3 32	G_1 N_0 25	G_1 N_1 24	G_2 N_1 17	G_0 N_1 16	G_0 N_0 9	G_2 N_0 8	G_1 N_0 1
G_3 N_2 31	G_0 N_1 26	G_1 N_3 23	G_2 N_0 18	G_3 N_2 15	G_2 N_3 10	G_3 N_0 7	G_0 N_2 2
G_3 N_1 30	G_0 N_2 27	G_2 N_2 22	G_3 N_3 19	G_1 N_1 14	G_1 N_2 11	G_2 N_2 6	G_2 N_1 3
G_0 N_0 29	G_1 N_2 28	G_3 N_0 21	G_0 N_3 20	G_3 N 13	G_1 N_3 12	G_0 N_3 5	G_3 N_1 4

II. Nitrogen x Phosphorus Fertilizer Trial
RCBD Factorial
4 levels N. x 3 levels P. x 2 Reps.
(24 plots)

N_2 P_1 24	N_0 P_0 17	N_2 P_0 16	N_0 P_2 9	N_0 P_1 8	N_0 P 1
N_0 P_2 23	N_3 P_1 18	N_2 P_2 15	N_1 P_2 10	N_1 P_1 7	N_1 P 2
N_1 P_1 22	N_1 P_2 19	N_0 P_1 14	N_2 P_2 11	N_2 P_1 6	N_2 P 3
N_3 P_2 21	N_3 P_0 20	N_1 P_0 13	N_3 P 12	N_3 P_1 5	N_3 P 4

III. Planting Method Comparative Study
RCBD
3 Treatments x 3 Reps.
(9 plots)

Mechanical T. 7	Manual T. 6	Direct Sowing 1
Direct Sowing 8	Mechanical T. 5	Manual T. 2
Manual T. 9	Direct sowing 4	Mechanical T

Chao Phya Polot Project

Allocation and Plot Layout of The Trials (Direct Sowing)

Wet Season, 1984.

N

Field No. 160

VI. Nitrogen Source x Dose Comparative Trial. Split Plot 3 x 4 x 3 Reps. (36 plots)

N_1 1	N_3 8	N_2 9	N_4 16	N_3 17	N_4 24	N_1 25	N_2 32	N_4 33
N_4 GM 2	N_4 OSC 7	N_1 AS 10	N_3 OSC 15	N_2 GM 18	N_1 [illegible] 23	N_2 [illegible] 26	N_4 [illegible] 31	N_3 [illegible] 34
N_3 3	N_1 6	N_4 11	N_2 14	N_1 19	N_2 22	N_3 27	N_1 30	N_1 35
N_2 4	N_2 5	N_3 12	N_1 13	N_4 20	N_3 21	N_4 28	N_3 29	N_2 36

VII. Variety x Production Inputs Trial RCBD 2^4 (V x N x I x W) (32 plots)

1000 1	0010 8	0101 9	0000 16	1010 17	1001 24	0001 25	1110 32
1011 2	0111 7	1001 10	0011 15	1111 18	0000 23	1101 26	0100 31
0001 3	1110 6	0110 11	1100 14	0101 19	1100 22	0111 27	1000 30
0100 4	1101 5	1010 12	1111 13	0011 20	0110 21	1011 28	0010 29

V. Seedrate x Nitrogen fertilizer L_{27} (3 factors x 3 level[illegible] + 5 Extra plots (27+ 5 = 32 plots)

8 0 8-0 11	16 4 4-0 4	16 8 4-4 9	4 0 0-0 E28	8 0 0-0 E29	16 0 0-0 E30	12 8 8-0 E31	20 8 8-0 E32
4 8 4-4 27	16 0 8-0 2	4 8 8-0 26	4 4 4-0 22	16 4 4-4 6	8 8 8-0 17	16 0 4-0 [illegible]	4 4 4-4 24
16 8 4-0 7	4 0 4-4 21	4 0 4-0 19	8 4 4-0 13	4 4 8-0 23	8 4 8-0 14	16 0 4-4 3	4 8 4-0 25
8 0 4-0 10	16 8 8-0 8	8 4 4-4 15	8 8 4-4 18	4 0 8-0 20	8 0 4-4 12	8 8 4-0 16	16 4 8-0 5

I. Varietal Comparative Study

Objectives :

To study the performance and productivity of different varieties/entries for future selection of promising lines under Chao Phya area conditions.

Materials and Method :

Experinental Design :

RCBD with 3 replications.

Treatments :

No.	Varieties/Entries
1.	RD-7
2.	RD-21
3.	RD-23
4.	RD-25
5.	SPR77205-3-2-1-1
6.	SPR75007-16-3-1
7.	SPR76102-26-1-1
8.	SPR75001-68-2-2
9.	SPR75005-352-2-1
10.	SPR78002-80-1-1
11.	IR-44
12.	IR-46
13.	Apple Thong
14.	O-por
15.	Sabitri

Plot Size : 5 m. x 4 m. = 20 m^2

Cultural Practices :

1. Seed rate : 4.0 kg/rai (dry seed)
2. Planting density : 25 x 25 cm. (16 hills/m^2)
3. Weed Control : Manual Weeding
4. Fertilizer Application :

   Basal : 7 kg of Nitrogen and 8.75 kg of Phosphorus/rai as a form of 16-20-0 fertilizer

   Top dressing : 6 kg of N/rai as ear manuaring as a form of Ammonium sulphate. (panicle initiation stage)

5. Plant Protection :

   (1) Furadan G : 15 days after transplanting (5 kg/rai)
   (2) Padan Mipcin G : 35 days after transplanting (5 kg/rai)

Duration :

Sowing : June 27, 1984
Transplanting : July 17, 1984
Harvest : October 5 - November 3, 1984

RESULTS :

Trial No. I

Grain Yield (kg/rai)

Treatments No.	Treatments	Replications I	II	III	Mean ($\bar{X}$)
1.	RD-7	710	941	868	839.7
2.	RD-21	847	843	922	870.7
3.	RD-23	864	909	843	872.0
4.	RD-25	734	533	621	629.3
5.	SPR77205-3-2-1-1	849	794	969	870.7
6.	SPR75007-16-3-1	804	909	924	879.0
7.	SPR76102-26-1-1	779	815	826	806.7
8.	SPR75001-68-2-2	828	830	834	830.7
9.	SPR75055-352-2-1	723	892	772	795.7
10.	SPR78002-80-1-1	792	826	915	844.3
11.	IR-44	657	730	678	688.3
12.	IR-46	811	804	672	762.3
13.	Apple Thong	740	691	736	722.3
14.	O-Por	862	800	811	824.3
15.	Sabitri	783	751	815	783.0
	Mean ($\bar{X}$)	785.5	804.5	813.7	801.3

Table I-1

ANOVA

SV	DF	SS	MS	F	Required F 5%	1%
Total	44	351793				
Treatments	14	227579	16255	3.857**	2.06	2.80
Blocks	2	6204	3102	0.736	3.34	5.45
Error	28	118010	4214			

LSD for Treatment : 5% = 108.56 (kg/rai)
1% = 146.46 (kg/rai)

CV = 8.10 (%)

Duncan's Multiple Range Test

Varieties/Entries	Mean Yield (kg/rai)	DMRT 5%	1%
SPR75007-16-3-1	879.0	a	a
RD-23	872.0	a	a
RD-21	870.7	a	a
SPR77205-3-2-1-1	870.7	a	a
SPR78002-80-1-1	844.3	ab	ab
RD-7	839.7	ab	ab
SPR75001-68-2-2	830.7	ab	ab
O-Por	824.3	ab	ab
SPR761-2-26-1-1	806.7	abc	ab
SPR75055-352-2-1	795.7	abc	ab
Sabitri	783.0	abc	abc
IR-46	762.3	abc	abc
Apple Thong	722.3	bcd	abc
IR-44	688.3	cd	bc
RD-25	629.3	d	c

Table I-2

Yield Components and related figures on different variaties/entries

Varieties Entries	50 % Heading		Maturity		Yield Components				Estimated yield (g/m^2)	Panicle length (cm)	Stem length (cm)	Grain/ straw ratio	% of productive tillers(%)	Plant height (cm)
	Date	DAT	Date	DAT	Panicles/ m^2	Grains/ panicle	Ripened grain (%)	1000 grains weight(g)						
1. RD-7	Sep. 29	73	Oct. 27	101	230.0	115.3	67.9	27.3	491.6	22.8	76.6	74.2	50.3	114.0
2. RD-21	Oct. 2	76	Oct. 29	103	243.2	115.7	69.2	27.8	541.5	24.2	78.3	74.2	64.4	114.2
3. RD-23	Sep. 25	69	Oct. 24	98	225.6	117.8	72.0	27.7	530.0	24.6	81.1	73.9	50.2	116.7
4. RD-25	Sep. 8	53	Oct. 5	80	182.4	69.5	88.4	27.7	310.3	22.3	70.3	107.3	84.4	100.3
5. SPR77205-3	Sep. 29	73	Oct. 27	101	218.0	114.9	81.6	26.7	545.7	21.5	80.7	74.6	70.0	116.6
6. SPR75007-16	Sep. 29	73	Oct. 27	101	248.0	108.2	77.2	26.1	540.8	26.4	96.0	72.2	50.1	138.9
7. SPR76102-26	Sep. 27	71	Oct. 24	98	221.7	91.9	76.5	28.7	447.6	24.6	75.8	81.0	57.5	108.8
8. SPR75001-68	Sep. 20	64	Oct. 20	94	267.2	88.6	75.8	27.1	486.5	22.5	69.5	77.5	66.5	100.6
9. SPR75055-352	Sep. 25	69	Oct. 24	98	236.8	87.1	77.0	29.2	463.6	25.0	77.8	63.0	55.4	111.2
10. SPR78002-80	Sep. 20	69	Oct. 23	97	289.6	98.7	75.2	24.3	522.3	22.1	74.0	86.0	65.8	114.5
11. IR-44	Sep. 28	72	Oct. 27	101	278.4	87.5	65.8	25.4	407.2	22.7	70.9	62.8	54.5	118.6
12. IR-46	Sep. 24	68	Oct. 23	97	249.6	105.0	73.4	23.0	442.3	21.4	74.6	72.7	62.2	115.6
13. Apple Thong	Oct. 1	75	Oct. 28	102	215.2	102.2	68.1	27.6	413.3	20.3	83.8	70.2	43.5	116.9
14. O-Por	Sep. 25	69	Oct. 23	97	238.4	98.0	77.6	27.0	489.3	22.5	66.8	76.7	75.2	104.0
15. Sabitri	Oct. 5	80	Nov. 3	108	238.4	113.6	76.4	20.3	419.8	22.1	77.1	63.4	44.9	113.6
Mean ($\bar{X}$)		75.8		98.4	239.8	100.9	74.8	26.4	470.1	23.0	76.9	75.3	59.7	113.6
S.D.		6.1		6.1	26.6	14.0	5.8	2.3	65.4	1.6	7.1	10.9	11.6	9.1

Table I-3

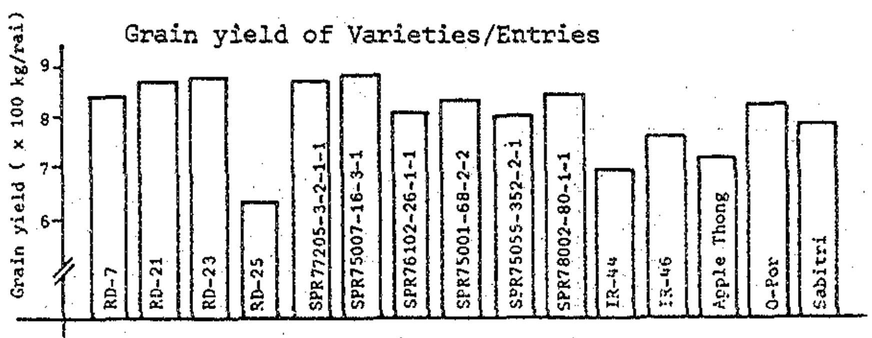
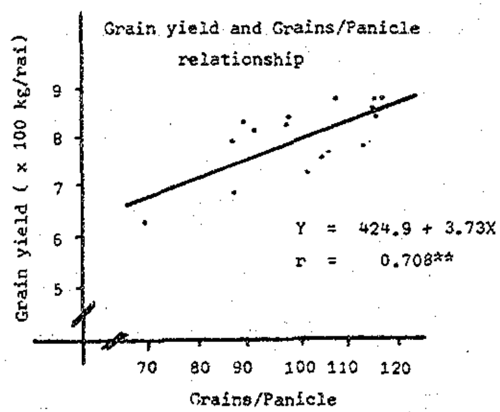


Fig. I-1

Fig. I-2



THE RESULTS OF GROWTH OBSERVATION
IN NUMBER OF TILLERS/M²

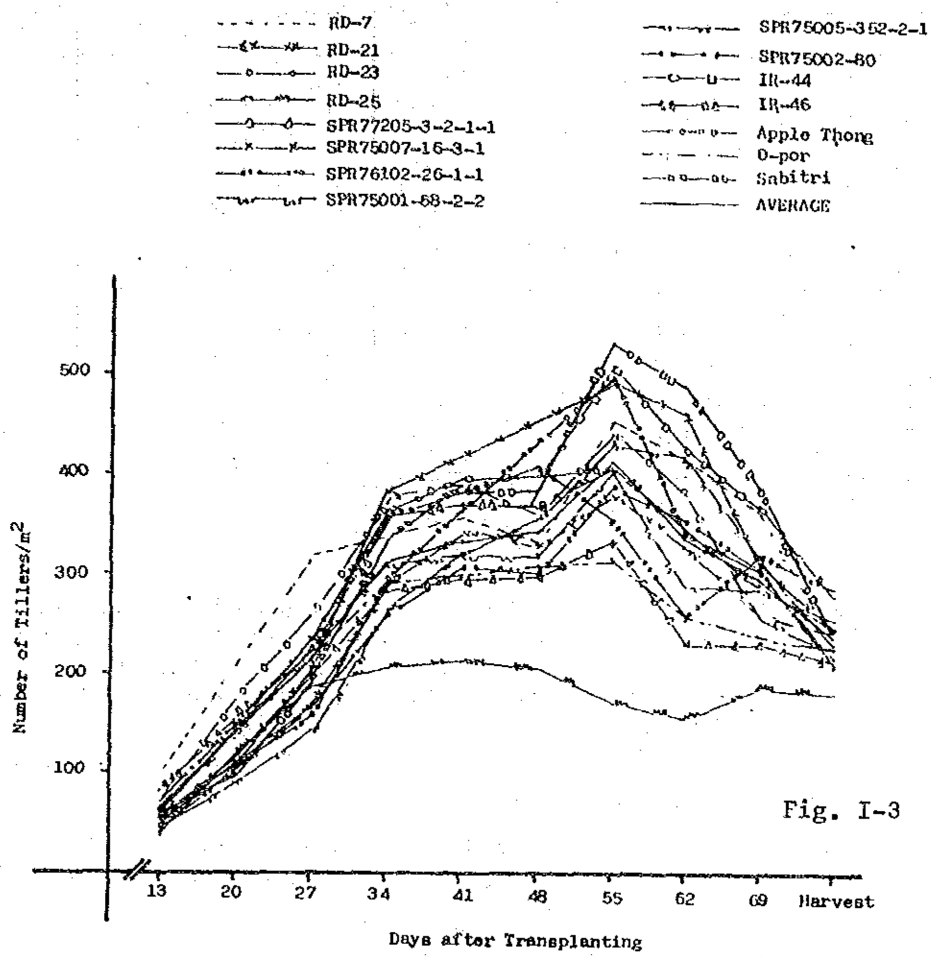


Fig. I-3

Observation of Number of Tillers (m^2)

Treatments (Varieties/ Entries)	Days after Transplanting									Harvest time
	13	20	27	34	41	48	55	62	69	
1. RD-7	104.0	208.0	321.6	347.2	356.8	331.2	457.6	420.8	369.6	230.0
2. RD-21	48.0	105.6	174.4	296.0	331.2	329.6	377.6	328.0	267.2	243.2
3. RD-23	75.2	179.2	264.0	379.2	392.0	364.8	449.6	385.6	265.6	225.6
4. RD-25	64.0	121.6	179.2	206.4	216.0	214.4	174.4	166.4	188.8	182.4
5. SPR77205-3-2-1-1	52.8	115.2	190.4	272.0	291.2	297.6	312.0	232.0	228.8	218.0
6. SPR75007-16-3-1	52.8	107.2	209.6	379.2	419.2	369.6	494.4	468.8	316.8	248.0
7. SPR76102-26-1-1	54.4	97.6	166.4	257.6	307.2	299.2	385.6	353.6	310.4	221.7
8. SPR75001-68-2-2	70.4	145.6	225.6	305.6	321.6	320.0	401.6	284.8	278.8	267.2
9. SPR75055-352-2-1	51.2	84.8	142.4	264.0	323.2	353.6	427.2	422.4	324.8	236.8
10. SPR78002-80	68.8	148.8	235.2	360.0	376.0	411.2	440.0	264.0	321.6	289.6
11. IR-44	60.8	140.8	235.2	363.2	396.8	400.0	510.4	427.2	366.4	276.4
12. IR-46	78.4	150.4	225.6	356.8	371.2	337.6	401.6	329.6	292.8	249.6
13. Apple Thong	49.6	113.6	169.6	294.4	356.8	432.0	494.4	347.2	316.8	215.2
14. O-Por	64.0	123.2	211.2	289.6	297.6	307.2	316.8	261.6	240.0	238.4
15. Sabitri	54.4	99.2	190.4	331.2	385.6	380.8	531.2	481.6	364.0	238.4
Mean ($\bar{X}$)	63.3	129.4	209.4	313.5	336.8	343.3	411.6	344.9	295.9	238.8
S.D.	14.9	33.2	44.9	51.2	59.5	54.3	92.4	91.2	56.8	26.6

Table I-4

Observation results of Plant Height (cm)

Treatments (Varieties Entries)	Days after Transplanting									Harvest time
	13	20	27	34	41	48	55	62	69	
1. RD-7	25.7	34.1	42.8	49.7	56.2	62.7	72.9	84.3	100.6	114.0
2. RD-21	22.6	30.6	38.0	46.1	55.7	61.8	75.6	85.4	94.8	114.2
3. RD-23	26.1	33.8	44.5	53.4	63.9	73.7	84.5	96.8	114.0	116.7
4. RD-25	29.7	39.6	48.8	57.9	67.8	83.0	97.0	99.3	99.8	100.3
5. SPR77205-3-2-1-1	24.6	31.8	41.9	53.4	65.3	74.5	83.0	87.8	105.1	116.6
6. SPR75007-16-3-1	26.0	32.0	41.5	40.9	63.4	72.3	87.2	99.2	114.8	138.9
7. SPR76102-26-1-1	26.8	34.4	43.2	52.6	62.3	67.9	79.6	84.8	104.4	108.6
8. SPR75001-68-2-2	27.4	36.5	45.2	53.9	62.8	70.5	80.7	89.5	99.6	100.6
9. SPR75055-352-2-1	25.7	30.7	38.3	48.1	57.5	66.8	77.0	90.0	104.3	111.2
10. SPR78002-80-1-1	25.4	34.7	45.8	51.1	60.6	69.4	78.4	90.4	103.3	114.5
11. IR-44	25.5	32.2	42.3	47.2	55.6	63.6	75.4	79.7	101.5	118.6
12. IR-46	25.1	32.4	43.2	53.4	64.9	72.9	80.7	94.7	109.4	115.6
13. Apple Thong	31.0	37.8	45.0	51.9	61.0	65.5	76.6	86.1	93.7	116.9
14. O-Per	27.3	35.4	43.1	55.2	65.5	73.7	83.8	86.8	102.3	104.0
15. Sabitri	23.4	31.2	40.0	45.8	54.6	60.6	73.9	84.4	91.5	113.6
Mean ($\bar{X}$)	26.2	33.8	43.1	50.7	61.1	69.3	80.4	89.3	103.0	113.6
S.D.	2.1	2.7	2.8	4.4	4.2	6.0	6.2	5.9	6.9	9.1

Table I-5

Results and Discussion :

1. Grain yield

Among 15 varieties/entries, SPR75007-16-3-1 produced the highest mean yield (879 kg/rai) though statistically no differences found among upper yielding of 12 varieties/entries at 5% level of significance. RD-23, the most popular variety in this locality recorded second highest grain yield (872 kg/rai) followed by RD-21 (870 kg/rai).

Among RD-varieties, mean grain yield of RD-23, 21 and 7 were significantly superior to RD-25 (629 kg/rai) even at 1% level.

Five SPR-entries produced satisfactory level of grain yield also.

(Table I-1,2, Fig. I-1)

2. Observation, yield components & related figures

The incidence of RRSV (Rice Ragged Stunt Virus) was much less than last Wet Season. Even RD-7, RRSV susceptible variety was not suffered from infection.

Rice gall midge appeared at around maximum tillering stage to panicle formation stage. Infected tiller percentage was observed to be 2-9% at panicle formation stage. Short maturity variety such as RD-25 was less infection and longer one was more. Abnormal shape of curves in tillering shown in Fig. I-3 was due to rice gall midge infection.

Yield components & related figures are shown in Table I-3.

Panicles/m^2 and grains/panicle of RD-25 was the lowest among 15 varieties/entries, thus yield was the lowest.

The grain yield and grains/panicle was closely correlated as shown in Fig. I-2 ($n = 15$, $r = 0.708^{**}$).

Plant height of the higest yielding entry (SPR75007-16-3-1) seemed to be too high (138.9 cm) in general conditions. Plant height observation results is shown in Table I-5.

Conclusion :

Varieties of RD-23 and RD-21 were still recommendable in terms of grain production in this locality.

Some of the SPR-entries were found to be quite promising in this season. In order to select suitable promising lines in addition to RD-23- 21 for this area, continuous study is obsolutely needed.

II. Nitrogen x Phosphorus Fertilizer Trail

Objectives :

1. To study the effect of Nitrogen and Phosphorus fertilizer on the growth and yield of transplanted rice.
2. To determine an optimun economic fertilizer rate under Chao Phya Pilot area conditions.

Materials and Method

Experimental Design :

RCBD factorial with 2 replications.

In the first block (replication) only, the treatments were arranged for demonstration purposes with Nitrogen increasing along one direction and Phosphorus along the other direction. (see plot layout)

Treatments :

Nitrogen (as A.S.)	N_0 : No N. applied N_1 : 6 kg N/rai N_2 : 12 kg N/rai N_3 : 18 kg N/rai
Phosphorus (as T.S.P.)	P_0 : No P. applied P_1 : 5 kg P/rai P_2 : 10 kg P/rai

Application method : (n kg/rai)

N. level	Basal	Top dressing (P.I.S.)	Total N.
N_0	0	0	0
N_1	3	3	6
N_2	6	6	12
N_3	12	6	18

Phosphorus applied as a basal before transplanting

Plot Size : 5 m x 4 m. (20 m^2)

Variety used : RD-23

Cultural Practices :

1. Seed rate : 4 kg/rai(dry seed)
2. Seedling age : 20 days
3. Planting density : 25 x 25 cm. (16 hills/m^2)
4. Weed Control : Saturn G applied at 15 days after transplanting (5 kg/rai)
5. Plant Protection :

   (1) At a rate of 5 kg/rai of Furadan Granule applied at 15 days after transplanting.

   (2) Padan Mipcin applied at 35 days after transplanting at a rate of 5 kg/rai.

Duration :

Sowing : June 27, 1984
Transplanting : July 17, 1984
Harvest : October 24, 1984

RESULTS :

Trial No. II

Grain Yield (kg/rai)

Treatments No.	Trentment	Replications I	II	Mean ($\bar{X}$)
1.	N_0 P_0	422	531	467.5
2.	N_0 P_1	681	715	698.0
3.	N_0 P_2	672	565	618.5
4.	N_1 P_0	657	853	755.0
5.	N_1 P_1	858	719	788.5
6.	N_1 P_2	681	774	727.5
7.	N_2 P_0	804	830	817.0
8.	N_2 P_1	945	924	934.5
9.	N_2 P_2	883	900	891.5
10.	N_3 P_0	932	1033	982.5
11.	N_3 P_1	962	928	945.0
12	N_3 P_2	943	1018	980.5
	Mean ($\bar{X}$)	786.7	815.8	801.3

Table II-1

ANOVA

SV	DF	SS	MS	F	Required F 5%	1%
Total	23	592743				
Blocks	1	5104	5104	1.134	4.84	9.65
Treatments	11	538113	48919	10.866**	2.82	4.46
N	(3)	468098	156032	34.658**	3.59	6.22
P	(2)	28183	14091	3.130^{NS}	3.98	7.20
N x P	(6)	41832	6972	1.548^{NS}	3.09	5.07
Error	11	49526	4502			

LSD for N : 5% = 85.26 (kg/rai)
: 1% = 120.32 (kg/rai)

P : 5% = 73.84 (kg/rai)
1% = 104.20 (kg/rai)

NxP : 5% = 147.68 (kg/rai)
1% = 208.40 (kg/rai)

CV : 8.37 (%)

Treatment means Grain yield : kg/rai

Nitrogen levels (kg N./rai)	Phosphorus levels			Nitrogen mean	Test for significance(5%)
	P_0(0)	P_1(5)	P_2(10)		
N_0 (0)	476.5	698.8	618.5	597.7	d
N_1 (6)	755.0	788.5	727.5	757.0	c
N_2 (12)	817.0	934.5	891.5	881.0	b
N_3 (18)	982.5	945.0	980.5	969.3	a
Mean ($\bar{X}$) NS	757.8	841.5	804.5	801.3	

Table II-2

Effects of Nitrogen and Phosphorus

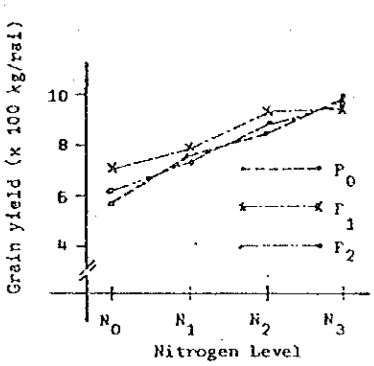


Fig. II-1

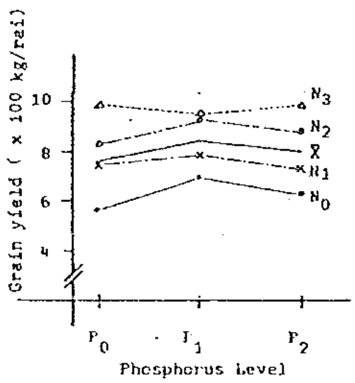


Fig. II-2

Duncan' Multiple Rang Test

Treatments	Mian Yield (kg/rai)	DMRT 5%	DMRT 1%
N_3 P_0	982.5	a	a
N_3 P_2	980.5	a	a
N_3 P_1	945.0	ab	ab
N_2 P_1	934.5	ab	ab
N_2 P_2	891.5	abc	abc
N_2 P_0	817.0	bcd	abcd
N_1 P_1	788.5	bcd	abcd
N_1 P_0	755.0	cde	abcd
N_1 P_2	727.5	de	bcd
N_0 P_1	698.0	de	cd
N_0 P_2	618.5	ef	de
N_0 P_0	467.5	f	e

Table II-3

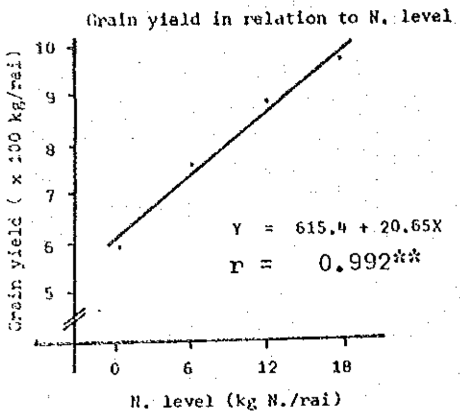


Fig. II-3

Grain yield and amount of nitrogen is closely correlated.

Number of panicles per unit area is an important yield component.

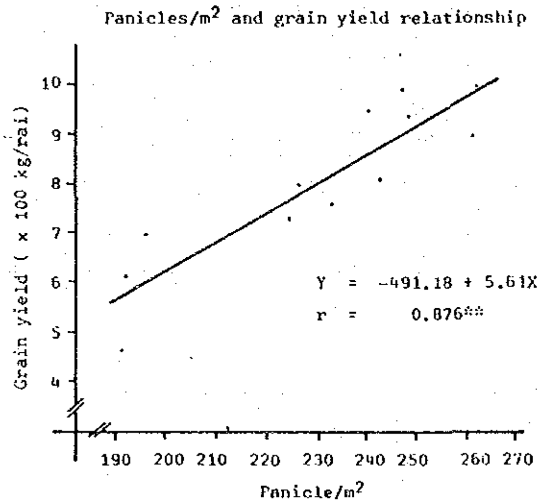


Fig. II-4

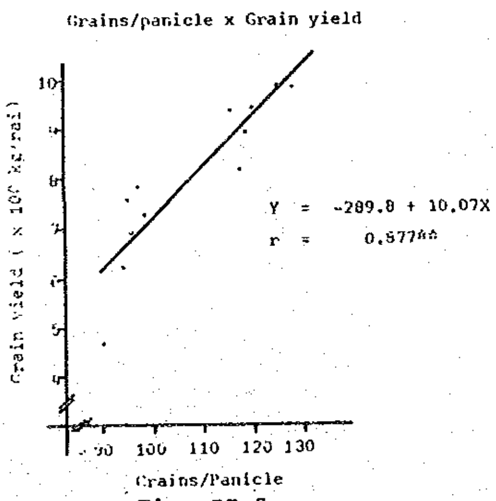


Fig. II-5

Greater number of grains/panicle contributed for higher grain yield.

Yield Component and related figures on different treatments

Treatments	Yield Components				Estimated yield (g/m^2)	Panicle length (cm)	Stem length (cm)	Grain/straw ratio	Plant height (cm)
	Panicle/m^2	Grain/panicle	Ripened grain (%)	1000 grains weight(g)					
1. N_0 P_0	191.3	89.7	67.0	25.4	292.0	21.2	58.2	86.9	86.0
2. N_0 P_1	196.0	97.1	67.5	26.6	339.7	22.1	66.4	92.5	101.3
3. N_0 P_2	192.4	94.0	70.3	26.5	336.9	22.4	62.5	96.4	102.5
4. N_1 P_0	233.2	94.8	66.9	26.4	390.5	21.4	66.7	85.4	104.1
5. N_1 P_1	227.2	97.4	69.8	26.8	414.0	22.4	72.6	83.4	117.3
6. N_1 P_2	223.6	99.3	61.1	26.7	362.2	21.8	71.7	69.4	111.1
7. N_2 P_0	243.2	117.7	66.5	27.0	513.0	22.3	69.9	92.6	107.4
8. N_2 P_1	248.0	115.7	69.2	26.7	530.1	23.0	78.3	95.3	117.6
9. N_2 P_2	260.8	118.7	61.4	26.7	507.5	23.2	79.1	78.1	120.9
10. N_3 P_0	262.4	127.9	66.2	27.6	613.2	22.2	78.8	74.4	117.5
11. N_3 P_1	240.0	121.2	69.9	28.0	569.3	23.7	83.1	81.3	124.9
12. N_3 P_2	247.1	126.4	64.7	27.1	547.4	22.9	80.5	78.5	122.7
Mean ($\bar{X}$)	230.4	108.3	66.7	26.8	451.3	22.4	72.3	84.5	111.1
S.D.	25.3	14.1	3.1	0.6	102.7	0.7	7.8	8.6	11.3

Table II-4

Yield Components and Related Figures

Fertilizer levels		Yield Components: Panicles/m^2	Grains/ panicle	Ripened grain (%)	1000 grain weight (g)	Estimated grain yield	Panicle length (cm)	Stem length (cm)	Grain/ straw	Plant height (cm)
Nitrogen	N_0	193.2	93.6	68.3	26.2	322.9	21.9	63.3	91.9	96.6
	N_1	228.0	97.2	65.9	26.6	388.9	21.9	70.3	79.4	110.8
	N_2	250.7	117.4	65.7	26.8	516.9	22.8	75.8	88.7	115.3
	N_3	249.8	125.2	66.9	27.6	576.6	22.9	80.8	78.2	121.7
Phosphorus	P_0	232.5	107.5	66.7	26.6	452.2	21.8	68.4	84.9	108.8
	P_1	227.8	107.9	69.1	27.0	463.3	22.8	75.1	88.1	115.3
	P_2	231.0	109.6	64.4	26.8	438.5	22.5	73.4	80.6	114.3
Mean ($\bar{X}$)		230.4	108.3	66.7	26.8	451.3	22.4	72.3	84.5	111.1

Table II-5

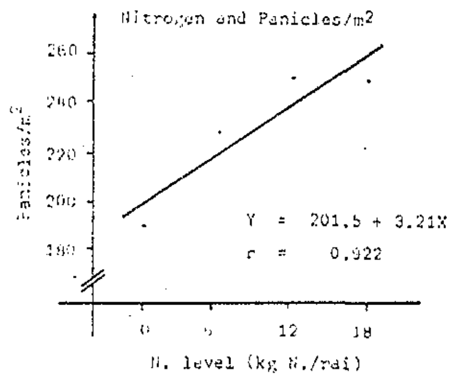


Fig. II-6

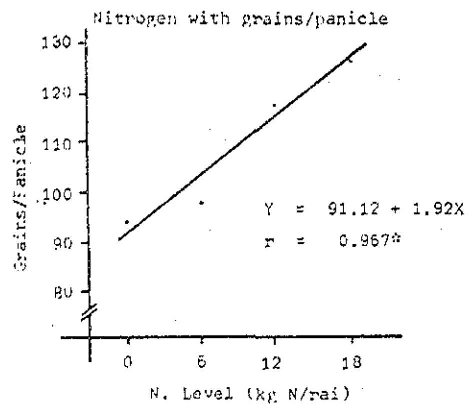


Fig. II-7

Partial Budget Analysis

(1) Dominance analysis

Treatments No.	Treatment	Grain yield (kg/rai)	Gross benefit (B/rai)	Variable Cost (B/rai)			Net benefit (B/rai)
				Fertilizer	Opportunity cost	Total	
1.	N_0 P_0	428.0	1199	-	-	-	1199.0
2.	N_0 P_1	628.8	1790	65.2	16	81.2	1708.8
3.	N_0 P_2	556.6	1586	130.4	16	149.4	1439.6*
4.	N_1 P_0	679.5	1973	65.7	32	97.7	1839.3
5.	N_1 P_1	709.7	2023	130.9	32	162.9	1860.1
6.	N_1 P_2	654.8	1866	196.1	32	228.1	1637.9*
7.	N_2 P_0	735.3	2096	131.4	32	163.4	1932.6
8.	N_2 P_1	841.1	2397	196.6	32	228.6	2168.4
9.	N_2 P_2	802.4	2287	261.8	32	293.8	1993.2*
10.	N_3 P_0	884.3	2520	197.1	32	229.1	2290.9
11.	N_3 P_1	850.5	2424	262.3	32	294.3	2129.7*
12.	N_3 P_2	882.5	2515	327.5	32	359.5	2155.5*
Mean ($\overline{X}$)		721.2	2055	-	-	-	-

Note : * = Dominated treatments

Table II-6

(2) Marginal analysis among undonminated treatments

Undominated treatments	Net benefit (B/rai)	Variable cost (B/rai)	Marginal rate of return	
			V.S. next highest benefit	V.S. next N_0 P_0 (check)
10. N_3 P_0	2290.9	229.1	24500.0 (%)	476.6 (%)
8. N_2 P_1	2168.4	228.6	361.7	424.1
7. N_2 P_0	1932.6	163.4	14500.0	448.9
5. N_1 P_1	1860.1	162.9	31.9	407.3
4. N_1 P_0	1839.3	97.7	709.9	655.4
2. N_0 P_1	1708.8	81.2	627.8	627.8
1. N_0 P_0	1199.0	-		

Table II-7

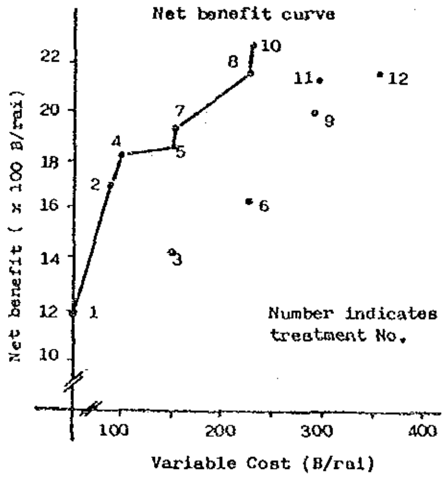


Fig. II-8

Treatment No. 10 (18 kg N/rai without phosphorus) recorded the highest net benefit with high marginal rate of return.

Results and Discussion :

1. Grain yield

The effect of nitrogen was remarkable since the mean grain yield was increased along with the increment of nitrogen levels.

Grain yield were significantly different between every nitrogen levels.

(Table II-2, Fig. II-1)

Estimated linear regression indicates clear relationship between grain yield and nitrogen level ($n = 4$, $r = 0.992^*$). The effect of every 1 kg of additional nitrogen (4.76 kg of ammonium sulphate) contributed to produce 20.7 kg of grain within the nitrogen level of 0-18 kg N/rai.

(Fig. II-3)

On the contrary, no significant effect of phosphorus fertilizer was observed for grain yield.

(Fig. II-2, Table II-2)

2. Observation of yield components and related figures

The effect of nitrogen on grain yield was especially clear in increasing number of panicles per unit area and number of grains per panicle.

1000 grain weight was slightly increased along with the nitrogen level, but ripened grain % was not influenced.

The application of phosphorus did not act on the any of the yield component factors.

(Table II-5)

Relationship between nitrogen level and panicle/m^2 (Fig. II-6) and nitrogen with grains/panicle (Fig. II-7) shows correlation of 2 factors.

It is quite clear that if panicle/m^2 was increased then yield was increased.

(Fig II-4, $n = 12$. $r = 0.876^{**}$)

Similarly in case of grains/panicle and yield

(Fig. II-5, $n = 12$, $r = 0.877^{**}$)

3. Economy of Nitrogen and Phosphorus application

Economic effect of nitrogen application was remarkable. Treatment No. 10 (N_3P_0 : 18 kg N/rai without phosphorus) gave the highest net benefit with extremely high marginal rate of return. N_2P_0 (12 kg N/rai, no P.) was also found to be profitable when amount of nitrogen is limited.

(Table II-6,7 Fig. II-8)

Conclusion :

The effect of nitrogen on the grain yield was remarkable, whereas no significant effect of phosphorus was observed.

Investment for nitrogen fertilizer was quite profitable. Total nitrogen of 18 kg N/rai (12 kg for basal and 6 kg top dressed) found to be the most profitable level among the treatments compared in this trial. 12 kg N/rai (6 kg for basal and 6 kg top dressed) gave good economic response also.

III. Planting Method Comparative Study

Objectives :

1. To compare the performance of different planting methods i.e. Mechanical transplanting, Manual transplanting and Direct sowing on the grain yield and economy of rice production.

2. To study the suitability/adaptability of planting methods under Chao Phya Pilot area conditions.

Materials and Method

Experimental Design :

RCBD with 3 replications.

Treatments :

No. 1 : Mechanical Transplanting
No. 2 : Manual Transplanting
No. 3 : Direct Sowing (Broadcast)

Plot Size

Each experimental unit consists of 5 m. x 8 m. = 40 m^2

Cultural Practices :

1. Seed rate : Selected dry seed of 4.0 kg/rai for Mechanical & Manual Transplanting and 12.0 kg/rai for Direct Sowing.
2. Variety : RD-23
3. Weed Control : Apply Saturn G at 15 days after transplanting and broadcasting at a rate of 5 kg/rai.
4. Fertilizer Application :

   (1) Mechanical & Manual Transplanting

   Basal : 7 kg of N and 8.75 kg of P/rai with 16-20-0

   Top dressing: 6 kg of N/rai at panicle initiation stage as a form of Ammonium Sulphate.

   (2) Direct Sowing

   No fertilizer applied before sowing.

   Basal : 7 kg of N and 8.75 kg of P/rai at 15 days after sowing with 16-20-0

   Top dressing : 6 kg of N/rai at panicle initiation stage as a form of Ammonium Sulphate.

5. Plant Protection :

   (1) Furadan G : 15 days after transplanting/broadcasting at a rate of 5 kg/rai

   (2) Padan Mipcin : 35 days after transplanting/broadcasting at a rate of 5 kg/rai

Date of planting and harvesting.

Sowing seed (box)	:	June 27, 1984
Transplanting	:	July 18, 1984
Broadcasting (Direct)	:	July 20, 1984
Harvest : Transplanted	:	October 24, 1984
: Direct Sowing	:	October 26, 1984

RESULTS :

Trial No. III

Grain Yield (kg/rai)

Treatments No.	Treatment	Replications I	II	III	Mean ($\bar{X}$)
1.	Mechanical Transplanting	817	810	894	840.3
2.	Manual Transplanting	815	913	809	845.7
3.	Direct Sowing	697	753	764	738.0
	Mean ($\bar{X}$)	776.3	825.3	822.3	808.0

Table III-1

ANOVA

SV	DF	SS	MS	F	Required F 5%	1%	10%
Total	8	35838					
Treatments	2	22092	11046	4.792^{NS}	6.94	18.00	4.32
Blocks	2	4526	2263	0.982^{NS}	6.94	18.00	4.32
Error	4	9220	2305				

LSD for Treatment

10% = 83.57 (kg/rai)

5% = 108.82 (kg/rai)

1% = 180.47

CV : 5.94 (%)

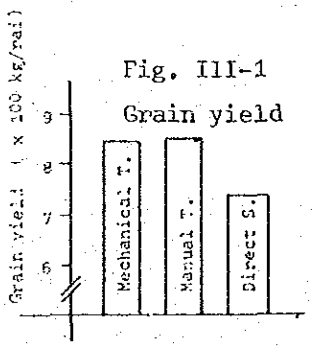


Fig. III-1
Grain yield

Results and Discussion :

1. Grain yield

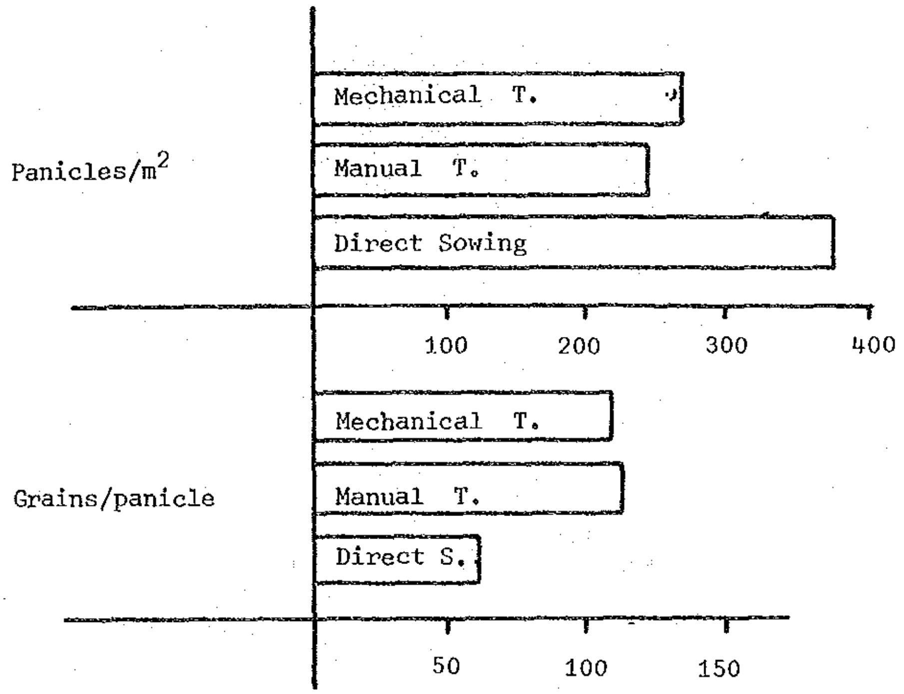
When mean grain yield was compared at 5% level of significance, no difference was found among planting methods. However, transplanting method either mechanical or manual produced higher mean yield than the direct sowing method, and this difference was significant at 10% level. (Table III-1, Fig. III-1)

In general conditions, direct sowing method is highly adapted in dry season and transplanting method is good in wet season. This tendencey was also recognized from the result of previous trials.

Yield Component and related figures on different treatments

Treatments	Yield Components				Estimated yield (g/m^2)	Panicle length (cm)	Stem length (cm)	Grain/straw ratio	Plant height (cm)
	Panicle/m^2	Grain/panicle	Ripened grain (%)	1000 grains weight(g)					
1. Mechanical Transplanting	268.0	103.1	70.8	27.1	530.2	22.4	70.6	89.0	109.7
2. Manual Transplanting	244.8	108.3	71.9	27.6	526.1	23.6	76.7	82.7	118.2
3. Direct Sowing	376.0	60.5	68.2	28.0	433.1	19.9	61.7	65.7	95.5
Mean ($\bar{X}$)	296.3	90.6	70.3	27.6	496.5	22.0	69.7	79.1	107.8
S.D.	70.0	26.2	1.9	0.5	54.9	1.9	7.5	12.1	11.4

Table III-2



2. Observation of yield components and related figures

Among the yield components, number of panicle/m^2 and number of grains/panicle were very much influenced by the planting method (Transplanting VS Direct Sowing).

Direct sowing produced more number of panicles/m^2 than that of transplanting, On the contrary, panicle size (number of grains/panicle) is much smaller than that of transplanting.

Ripened grain % and 1000 grains weight were not affected by planting method, Plant height tend to be higher when rice is transplanted.(Table III-2, Figure)

Partial Budget Analysis

(1) Dominance

Treatments No.Treatment	Grain yield (kg/rai)	Gross benefit (B/rai)	Variable cost			Net benefit (B/rai)
			Seeds & Nursery	Transplanting Sowing etc.	Total	
1. Mechanical Transplanting	756.3	2155	101	142	243	1912
2. Manual Transplanting	761.1	2169	101	175	251	1918
3. Direct Sowing	664.2	1893	43	34	77	1816
Mean ($\bar{X}$)	727.2	2072	-	-	-	1882

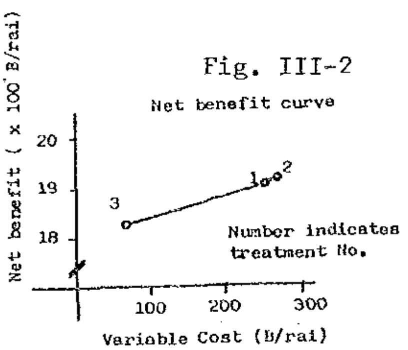
Table III-3

(2) Marginal

Treatment	Net benefit (B/rai)	Variable cost (B/rai)	Marginal rate of return V.S. Direct Sowing
Manual Transplanting	1918	251	58.6 (%)
Mechanical Transplanting	1912	243	57.8
Direct Sowing	1816	77	

Table III-4

Fig. III-2



3. Economical comparison

Even though higher variable cost required for nursery and transplanting, transplanting method either manual or mechanical found to be still profitable than the direct sowing method in this trial.

In the case that labour is short or high cost for transplanting, direct sowing can be accepted with more caution on field levelling, water management and weed control.

Conclusion :

Mean grain yield of transplanting method was higher than the that of direct sowing method.

No difference was observed on the grain yield of mechanical and manual transplanting.

In consequence of the trial results including previous one, transplanting found to be better in wet season and direct sowing was appropriate in dry season in general circumstances.

IV. Green Manure Application Trial

Objectives :

1. To study the effect of green manure (Sesbania) on the growth & yield of rice in relation to nitric chemical fertilizer.
2. To study the economy of green manure application for profitable double cropping of rice cultivation and its effect to soil fertility under the Chao Phya Pilot Project circumstances.

Materials and Method

Experimental Design :

RCBD Factorial with 2 replications.

Treatments :

Green Manure (Sesbania)	G_0 : No green manure applied G_1 : 1.0 t/rai of green manure applied G_2 : 2.0 t/rai of green manure applied G_3 : 3.0 t/rai of green manure applied
Nitrogen (Ammonium Sulphate)	N_0 : No Nitrogen applied N_1 : 5.0 kg. Nitrogen/rai N_2 : 10.0 kg Nitrogen/rai N_3 : 15.0 kg Nitrogen/rai

Application Method :

Fresh/raw green manure applied and incorporated with soil 10 days prior to transplanting.

½ of Nitrogen applied as a basal dose and rest of ½ top dressed at panicle initiation stage.

5 kg of Phosphorus/rai applied as a form of T.S.P. over entire plots at a time of basal Nitrogen application.

Plot Size :

5 m x 4 m (20 m^2)

Variety Used : RD-23

Other Cultural Practices :

1. Age of seedlings : 20 days
2. Planting density : 25 x 25 cm. (16 hills/m^2)
3. Weed Control : 5 kg of Saturn G applied at 15 days after transplanting.
4. Plant Protection :
   (1) Furadan Granule : 5 kg/rai (15 days after transplanting)
   (2) Padan Mipcin G : 5 kg/rai (35 days after transplanting)

Duration

Sowing : June 27, 1984
Transplanting : July 17, 1984
Harvesting : October 26, 1984

RESULTS :

Trial No. IV

Grain Yield (kg/rai)

Treatments No.	Treatment	Replications I	II	Mean ($\bar{X}$)
1.	$G_0\ N_0$	540	685	612.5
2.	$G_0\ N_1$	757	762	759.5
3.	$G_0\ N_2$	715	834	774.5
4.	$G_0\ N_3$	990	917	953.5
5.	$G_1\ N_0$	608	845	726.5
6.	$G_1\ N_1$	913	907	910.0
7.	$G_1\ N_2$	858	954	906.0
8.	$G_1\ N_3$	1077	915	996.0
9.	$G_2\ N_0$	717	772	744.5
10.	$G_2\ N_1$	734	862	798.0
11.	$G_2\ N_2$	913	841	877.0
12.	$G_2\ N_3$	939	1011	975.0
13.	$G_3\ N_0$	792	830	811.0
14.	$G_3\ N_1$	1009	888	948.5
15.	$G_3\ N_2$	911	954	932.5
16.	$G_3\ N_3$	934	958	946.0
	Mean ($\bar{X}$)	837.9	870.9	854.4

Table IV-1

ANOVA

SV	DF	SS	MS	F	Required F 5%	1%
Total	31	453110				
Blocks	1	8712	8712	1.603	4.54	8.68
Treatments	15	362864	24190	4.450**	2.43	3.56
G	(3)	82298	27432	5.047*	3.29	5.42
N	(3)	241998	80666	14.840**	3.29	5.42
GxN	(9)	38568	4285	0.788	2.59	3.89
Error	15	81534	5435			

LSD for G : 5% = 78.55 (kg/rai)
: 1% = 108.64 (kg/rai)

N : 5% = 78.55 (kg/rai)
: 1% = 108.64 (kg/rai)

GxN : 5% = 157.11 (kg/rai)
: 1% = 217.27 (kg/rai)

CV : 8.62 (%)

Treatment means Grain yield : kg/rai

Nitrogen levels (kg N./rai)	Green manure levels (Ton/rai) $G_0(0)$	$G_1(1)$	$G_2(2)$	$G_3(3)$	Nitrogen means	Test for significance(5%)
N_0 (0)	612.5	726.5	744.5	811.0	723.6	c
N_1 (5)	759.5	910.0	798.0	948.5	854.0	b
N_2 (10)	774.5	906.0	877.0	932.5	872.5	b
N_3 (15)	953.5	996.0	975.0	946.0	967.6	a
Mean ($\bar{X}$)	775.0	884.6	848.6	909.5	854.4	
Teat for significance (5%)	b	a	a b	a		

Table IV-2

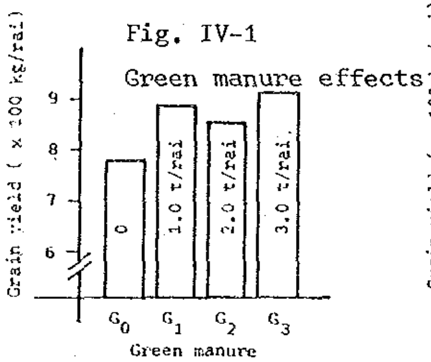


Fig. IV-1

Green manure effects

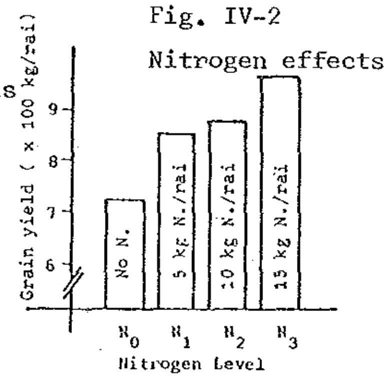
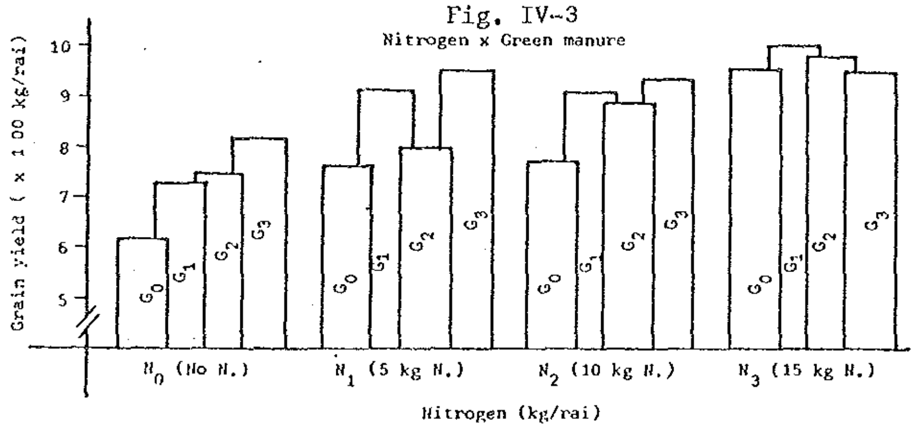


Fig. IV-2

Nitrogen effects

Fig. IV-3

Nitrogen x Green manure

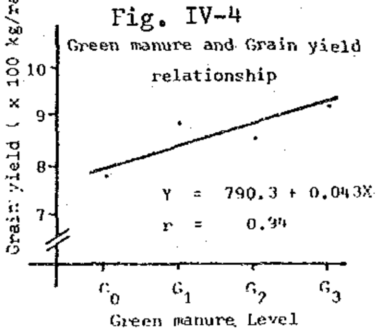


Duncan's Multiple Range Test

Treatments	Grain Yield (kg/rai)	DMRT 5%	DMRT 1%
$G_1 N_3$	996.0	a	a
$G_2 N_3$	975.0	ab	ab
$G_0 N_3$	953.5	abc	abc
$G_3 N_3$	946.0	abc	abc
$G_3 N_1$	948.5	abc	abc
$G_3 N_2$	932.5	abcd	abc
$G_1 N_1$	910.0	abcde	abc
$G_1 N_2$	906.0	abcde	abc
$G_2 N_2$	877.0	abcdef	abc
$G_3 N_0$	811.0	bcdef	abcd
$G_2 N_1$	798.0	bcdef	abcd
$G_0 N_2$	774.5	cdefg	abcd
$G_0 N_1$	759.5	defg	abcd
$G_2 N_0$	744.5	efg	bcd
$G_1 N_0$	726.5	fg	cd
$G_0 N_0$	612.5	g	d

Table IV-3

Fig. IV-4



Results and Discussion :

1. Grain yield

4 levels of green manure (Sesbania : 0, 1,2, and 3 t/rai) and 4 levels of nitrogen (0,5,10 and 15 kg N/rai) were tested in RCBD factorial arrangement.

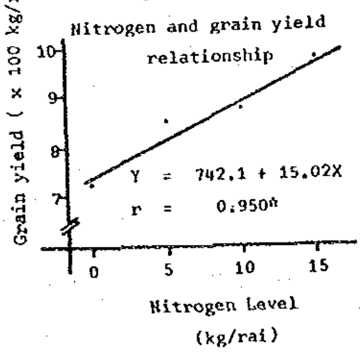
The results indicated that the grain yield of no green manure treatment was significantly lower than the that of G_1 (1 t/rai) and G_3 (3 t/rai).

No significant differences were observed among the grain yield of green manure applied treatments (G_1, G_2 and G_3). (Table IV-2, Fig. IV-1)

The effect of nitrogen on the grain yield was more distinctly observed than the that of green manure. Obviously, the grain yield was influenced by the amount of nitrogen. (Table IV-2 Fig, IV-2,3,4,5)

Though significant interaction of green manure and nitrogen was not observed, green manure seemed to be effective when nitrogen is absent or lower level. Effect of green manure was not recognized when nitrogen level was 15 kg N/rai. (Table IV-2, Fig. IV-3).

Fig. IV-5



Yield Component and related figures on different treatments

Treatments	Yield Components: Panicle/m²	Grain/panicle	Ripened grain (%)	1000 grains weight(g)	Estimated yield (g/m²)	Panicle length (cm)	Stem length (cm)	Grain/straw ratio	Plant height (cm)
$G_0 N_0$	193.2	89.3	69.6	24.6	317.7	21.5	67.4	77.0	97.7
$G_0 N_1$	229.2	93.7	61.5	27.7	365.9	24.1	80.5	88.9	109.3
$G_0 N_2$	225.6	99.1	66.4	27.6	409.7	22.3	72.2	83.1	109.8
$G_0 N_3$	233.6	116.3	66.9	27.8	505.4	23.4	80.9	78.4	123.0
$G_1 N_0$	206.4	110.5	66.8	27.2	414.4	21.5	72.6	75.0	108.9
$G_1 N_1$	228.8	105.0	69.6	27.7	463.2	22.6	78.1	88.9	115.6
$G_1 N_2$	244.8	110.5	66.2	27.6	494.2	23.1	77.9	80.9	117.5
$G_1 N_3$	248.0	123.1	64.6	28.0	552.2	23.4	81.3	84.8	124.5
$G_2 N_0$	195.2	106.3	64.5	27.1	362.7	21.0	71.7	62.3	107.7
$G_2 N_1$	219.2	111.3	65.4	27.6	440.4	22.6	74.1	78.5	111.9
$G_2 N_2$	217.6	122.9	64.7	27.7	479.3	23.2	80.5	66.6	121.5
$G_2 N_3$	288.0	118.5	67.8	27.5	636.3	23.2	78.0	88.0	120.2
$G_3 N_0$	243.2	98.9	66.9	27.8	447.3	21.9	76.2	82.3	113.5
$G_3 N_1$	230.8	116.5	71.1	28.4	542.9	22.7	79.9	71.1	118.1
$G_3 N_2$	239.0	120.4	69.0	26.8	532.1	22.2	71.2	83.7	124.3
$G_3 N_3$	276.8	128.6	66.0	26.8	629.6	22.9	83.0	70.9	128.7
Mean ($\bar{X}$)	232.5	110.7	66.7	27.5	474.6	22.6	76.6	78.8	115.8
S.D.	25.4	11.3	2.4	0.5	91.0	0.8	4.5	7.9	8.0

Table IV-4

Mean effects of green manure and nitrogen on the yield component and related figures

Treatment levels		Yield Components: Panicles/m²	Grains/panicle	Ripened grain (%)	1000 grain weight (g)	Estimated grain yield	Panicle length (cm)	Stem length (cm)	Grain/straw	Plant height (cm)
Green manure	G_0	220.5	99.6	66.1	27.4	399.7	22.8	75.2	81.9	110.0
	G_1	232.0	112.3	66.8	27.6	481.0	22.7	77.5	82.4	116.6
	G_2	230.0	114.8	65.6	27.5	479.7	22.5	76.1	73.9	115.3
	G_3	247.5	116.1	68.3	27.5	538.0	22.4	77.6	77.0	121.2
Nitrogen levels	N_0	209.6	101.3	67.0	27.1	385.5	21.5	72.0	74.2	107.0
	N_1	227.0	106.6	66.9	27.9	453.1	23.0	78.1	81.9	113.7
	N_2	231.8	113.2	66.6	27.4	478.8	22.7	75.5	78.6	118.3
	N_3	261.6	121.6	66.3	27.5	580.9	23.2	80.8	80.5	124.1
Mean ($\bar{X}$)		232.5	110.7	66.7	27.5	474.6	22.6	76.6	78.8	115.8

Table IV-5

Fig. IV-6

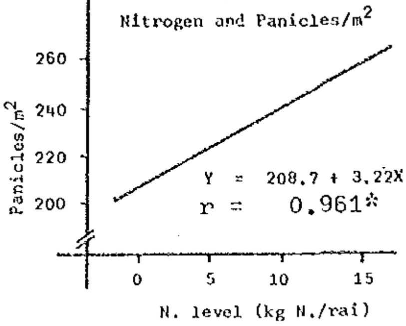


Fig. IV-7

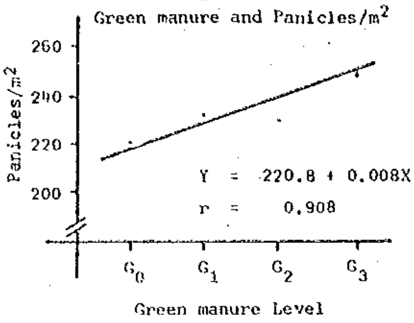
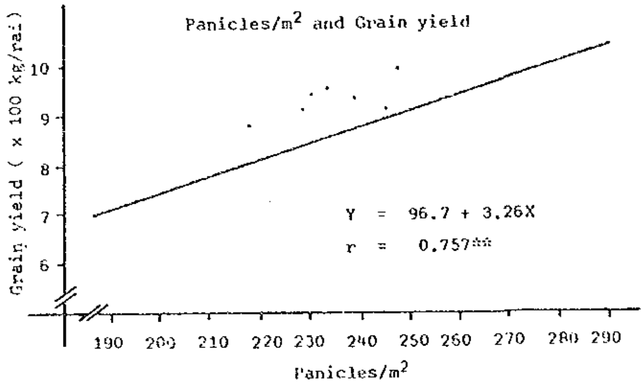
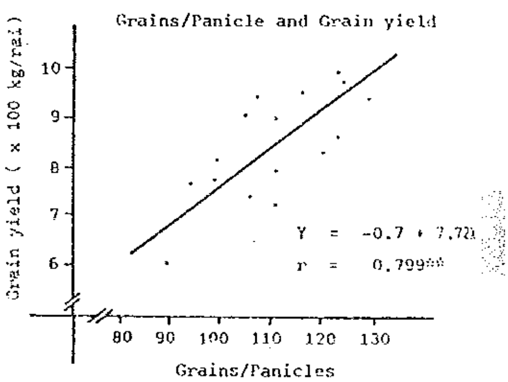


Fig. IV-8



2. Yield components and related factors

Fig. IV-9



Significant relationship between green manure and yield components was not observed in this trial. However, there was a tendency that panicles/m^2 and grains/panicle were increased along with the green manure levels.

Significant correlation between nitrogen level and panicle/m2 was oberved at 5% level. (Fig. IV-6)

The grain yield with panicles/m^2 and grain yield with grains/pancile were highly correlated. (Table IV-4,5, Fig. IV-8,9)

The effects of nitrogen and green manure or the grain yield was mainly carried by increasing in number of panicles/unit area and number of grains/ panicle.

Clear influence of nitrogen and green manure on the ripened grain % and 1000 grains weight was not recognized. (Table IV-4,5)

Partial Budget Analysis

(1) Dominance analysis

Treatments No. Treatment	Grain yield (kg/rai)	Gross benefit (B/rai)	Variable cost (B/rai)				Net benefit (B/rai)
			Green manure	Fertilizer	Opportunity cost	Total	
1. $G_0 N_0$	551	1517	-	-	-	-	1571.0
2. $G_0 N_1$	684	1948	-	54.8	32	86.8	1861.2*
3. $G_0 N_2$	697	1987	-	109.5	32	141.5	1845.5*
4. $G_0 N_3$	858	2446	-	164.3	32	196.3	2249.7*
5. $G_1 N_0$	654	1863	30	-	34	64.0	1799.0
6. $G_1 N_1$	819	2334	30	54.8	34 + 32	150.8	2183.2
7. $G_1 N_2$	815	2324	30	109.5	34 + 32	205.5	2118.5*
8. $G_1 N_3$	896	2555	30	164.3	34 + 32	260.3	2294.7
9. $G_2 N_0$	670	1910	40	-	34	74.0	1836.0
10. $G_2 N_1$	718	2047	40	54.8	34 + 32	160.8	1886.2*
11. $G_2 N_2$	789	2250	40	109.5	34 + 32	215.5	2034.5*
12. $G_2 N_3$	878	2501	40	164.3	34 + 32	270.3	2230.7*
13. $G_3 N_0$	730	2080	50	-	34	84.0	1996.0
14. $G_3 N_1$	854	2433	50	54.8	34 + 32	170.8	2262.2
15. $G_3 N_2$	839	2392	50	109.5	34 + 32	225.5	2166.5*
16. $G_3 N_3$	851	2426	50	164.3	34 + 32	280.3	2145.7*
Mean ($\bar{X}$)	769	2129					

Table IV-6

Note : * = Dominated treatments
Seeds cost of green manure were assumed as :
G_0 = 0, G_1 = 30, G_2 = 40, G_3 = 50 B/rai)
And seeds broadcast cost was 34 B/rai for G_1, G_2 and G_3.

(2) Marginal analysis

Undominated treatments	Net benefit (B/rai)	Variable cost (B/rai)	Marginal rate of return	
			V.S. next highest benefit	V.S. check ($G_0 N_0$)
8. $G_1 N_3$	2294.7	260.3	36.3 (%)	278.0 (%)
14. $G_3 N_1$	2262.2	170.8	395.0	404.7
6. $G_1 N_1$	2183.2	150.8	280.2	405.9
13. $G_3 N_0$	1996.0	84.0	1600.0	506.0
9. $G_2 N_0$	1836.0	74.0	370.0	358.1
5. $G_1 N_0$	1799.0	64.0	356.3	356.3
1. $G_0 N_0$	1571.0		-	-

Table IV-7

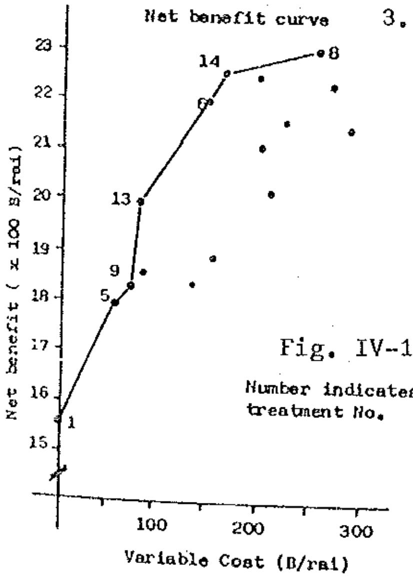


Fig. IV-10

Number indicates treatment No.

3. Economy of green manure and nitrogen application

It is considered to be profitable when green manure crop ("Sesbania" in this trial) is planted in between rice crops with low cost as it is assumed (seed broadcast without fertilizer for green manure crop).

1.0 t of green manure plus 15 kg N/rai (G_1 N_3) provided the highest net benefit among combinations.

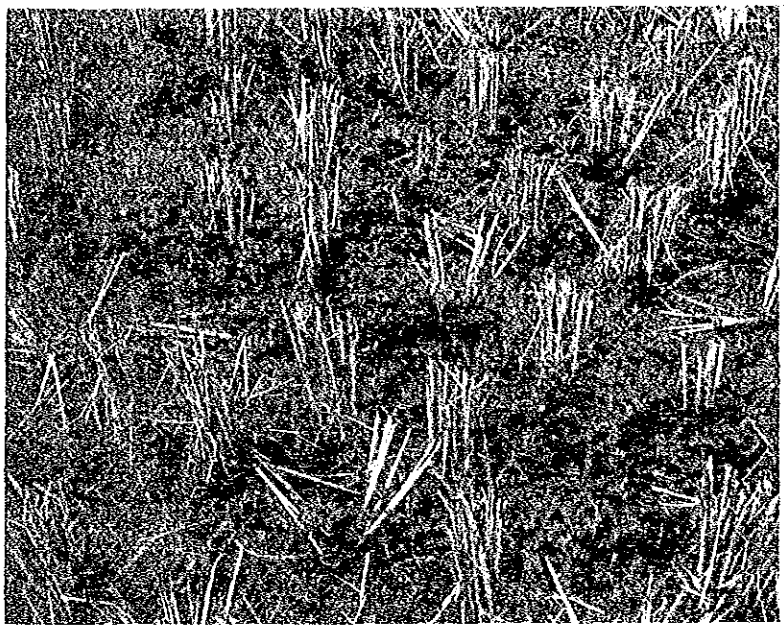
3.0 t or 1.0 t of green manure together with 5 kgN/rai recorded good economic responses. 3.0 t of green manure without nitrogen showed high profitability due to low variable cost assumed in this trial (Table IV-6,7. Fig. IV-10)

Conclusion :

The effect of green manure application and obvious effect of nitrogen was statisticaly observed. The economic response of green manure as well as nitrogen was also recognized. And if green manure crop is composed in the rice crop rotation in cheaper and easier way, fertilizer cost may be reduced from standard level.

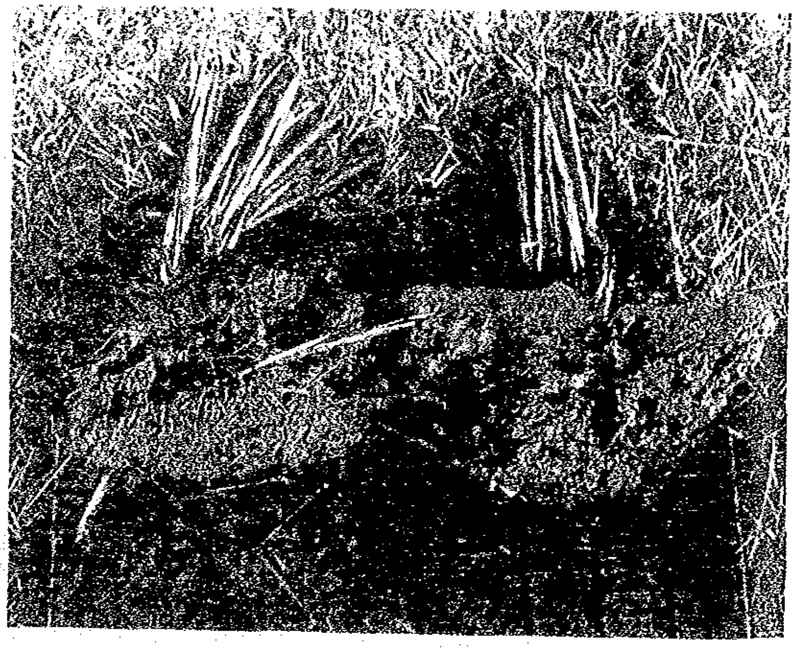
However, there are several limitations in green manure cultivation such as picking and collection seed, enough vegetation within the crop rotation without fertilizer, plowing down and incorporated with soil with ordinary way of field preparation done by farmers. Obviously, those limitations and conditions should be fixed up in practical way.

Futher study on green manure cultivation is absolutely needed especially for the areas where double cropping of rice is repeated within polder under complete flood control condition.



One of the cheapest & easiest way of sesbania cultivation.

The seed of sesbania broadcasted at 12 days prior to rice harvest. (no tillage, no fertilzer)



Effect of green manure (sesbania) on the paddy soil structure and root system of rice plant.

Left : green manure applied treatment.

Right : no green manure applied.

V. Seedrate x Nitrogen Fertilizer Trial (Direct Sowing : Cooperative Trial of IADP)

Objectives :

To clarify the effects of different seedrate levels and quantities and split application of Nitrogen fertilizer on the growth and yield of germinated broadcast rice cultivation at Chao Phya, Mae Klong Pilot Project and Suphan Buri Training Center experiment field.

Materials and Method

Experimental Design :

L_{27} (3 x 3 x 3) : 3 Factors x 3 Levels

Treatments :

(1) Seedrate : Dry seed of 4,8 and 16 kg/rai.
(2) Basal Nitrogen : 0,4 and 8 kg N/rai at 15 days after sowing with Ammonium Sulphate.
(3) Top dressing N. : At panicle initiation stage and heading stage as 4-0, 8-0 and 4-4 kg N/rai with Ammonium Sulphate.

Plot Size :

4 m x 8 m (32 m^2)

Variety Used : RD-23

Cultural Practices :

(1) Fertilizer application

- Apply Phosphorus to entire plots at puddling time at a rate of 6 kg P/rai as a form of T.S.P.
- Nitrogen fertilizer was applied according to the treatments.

(2) Plant Protection :

5 kg of Furadan G/rai applied at the last puddling and 35 days after sowing seeds.

(3) Weed Control :

Saturn G applied at 14 days after sowing at a rate of 5 kg/rai.

Observations and Investigations :

- Number of tillers and plant height were observed every week until heading stage.
- Datas on yield components and culm, panicle length and grain/straw ratio were investigated.

Duration :

Sowing : July 5, 1984
Harvest : October 26, 1984

RESULTS :

Treatment Means

Grain Yield (kg/rai)

Seed rate (kg/rai)	Basal N (kg/rai)			Top dressing N (kg/rai)			Seed rate Mean (X̄)
	0	4	8	4-0	8-0	4-4	
16	809.7	837.7	909.3	829.7	864.0	863.0	852.2
8	805.7	868.0	898.0	818.7	883.0	870.0	857.2
4	723.3	851.3	911.0	805.3	850.0	830.3	828.5
Mean (X̄)	779.6 c	852.3 b	906.1 a	817.9 b	865.7 a	854.4 a	846.0

Table V-1

ANOVA

SV	DF	SS	MS	F	Required F 5%	Required F 1%
Seed rate	2	4220	2110	8.08*	4.46	8.65
Basal N	2	72614	36307	139.11**		
Top dress N	2	11234	5617	21.52**		
Seed rate x Basal N	4	11713	2928	11.22**	3.84	7.01
Seed rate x Top dress N	4	1008	252	0.97		
Basal N x Top dress N	4	1534	383	1.47		
Error	8	2089	261			
Total	26	104412				

LSD : 5% = 21.52 (kg/rai)
: 1% = 31.30 (kg/rai)

CV : 1.91 (%)

Fig. V-1
Main effects of Seedrate & Nitrogen Application

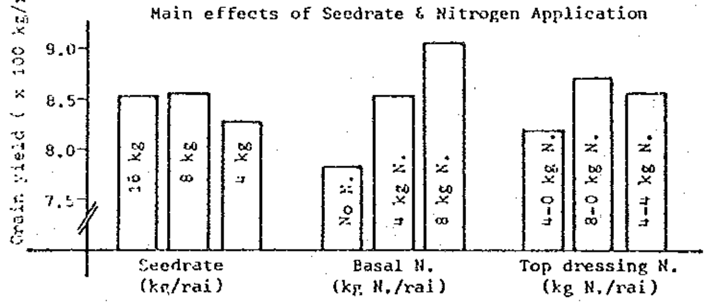
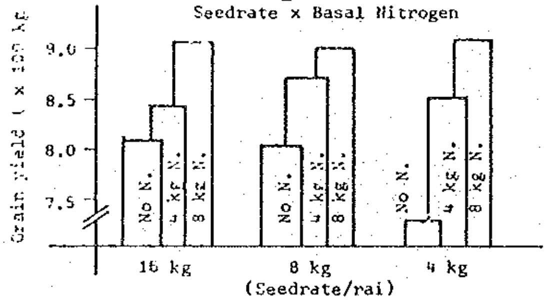


Fig. V-2
Seedrate x Basal Nitrogen



The lowest seedrate without basal nitrogen showed the lowest grain yield.

When seedrate is low, basal nitrogen should be heavier.

Yield Components

Plot No.	Treatments: Seed rate (kg/rai)	Basal N (kg/rai)	Top dress N (kg/rai)	Grain yield (kg/rai)	Yield components: Panicles/ m^2	Spikelets/ panicle	Ripened grain (%)	1000 grains weight (g)	Estimated grain yield (g/m^2)
1	16	0	4-0	781.0	440.0	61.9	52.3	29.7	422.8
2	16	0	8-0	813.0	408.0	62.3	57.2	28.9	422.3
3	16	0	4-4	835.0	408.0	61.6	58.6	29.5	430.7
4	16	4	4-0	830.0	404.0	60.1	58.9	29.7	424.7
5	16	4	8-0	841.0	592.0	68.7	54.8	28.6	637.5
6	16	4	4-4	842.0	472.0	52.2	63.1	30.4	472.5
7	16	8	4-0	978.0	396.0	58.7	67.5	29.5	462.8
8	16	8	8-0	938.0	524.0	53.0	60.0	30.3	504.4
9	16	8	4-4	912.0	500.0	59.7	51.7	30.3	467.2
Mean ($\bar{X}$)				852.2	460.4	59.8	58.2	29.7	470.2
10	8	0	4-0	763.0	300.0	66.1	64.0	29.0	367.9
11	8	0	8-0	832.0	304.0	59.3	66.8	29.1	350.1
12	8	0	4-4	822.0	332.0	72.0	62.5	28.4	424.1
13	8	4	4-0	829.0	396.0	62.3	61.4	29.4	445.2
14	8	4	8-0	889.0	344.0	72.3	58.0	31.3	451.5
15	8	4	4-4	886.0	352.0	71.7	56.1	29.4	416.0
16	8	8	4-0	864.0	388.0	67.0	61.7	29.5	473.4
17	8	8	8-0	928.0	376.0	71.1	62.5	29.7	496.4
18	8	8	4-4	902.0	382.0	64.4	73.4	30.8	533.5
Mean ($\bar{X}$)				857.2	352.4	67.4	62.9	29.6	439.8
19	4	0	4-0	685.0	296.0	76.7	58.0	28.9	380.5
20	4	0	8-0	764.0	200.0	76.7	76.2	28.5	331.1
21	4	0	4-4	721.0	196.0	75.3	73.3	28.7	310.[illegible]
22	4	4	4-0	857.0	244.0	66.1	75.3	31.7	385.9
23	4	4	8-0	856.0	272.0	68.5	66.1	29.2	355.4
24	4	4	4-4	841.0	296.0	80.6	60.0	29.0	411.1
25	4	8	4-0	874.0	360.0	77.4	55.8	29.5	458.6
26	4	8	8-0	930.0	280.0	83.9	71.8	30.1	507.8
27	4	8	4-4	929.0	312.0	75.2	70.4	29.3	484.6
Mean ($\bar{X}$)				828.5	272.9	75.6	67.4	29.4	403.5
Total				22842.0	9772.0	1825.0	1697.0	798.0	11839.0
Over all Mean ($\bar{X}$)				846.0	361.9	67.6	62.9	29.6	438.5
S.D.				63.4	83.7	8.2	7.0	0.8	68.7

Table V-5

Mean effect of factors on the yield compnonents and ralated figures

Treatment levels		Yield Components: Panicles/ m^2	Grains/ panicle	Ripened grain (%)	1000 grain weight (g)	Estimated grain yield	Panicle length (cm)	Stem length (cm)	Grain/ straw	Plant height (cm)	% of productive tillers
Seed rate	15	460.4	59.8	58.2	29.7	472.1	21.0	67.2	77.2	104.2	45.2
	8	352.4	67.4	62.9	29.6	439.8	21.8	67.5	86.3	102.5	44.1
	4	272.9	75.6	67.4	29.4	403.6	22.0	67.6	87.0	98.7	49.4
Basal N	0	320.4	68.0	63.2	29.0	382.6	21.3	64.0	90.3	95.7	46.7
	4	374.7	66.9	61.5	30.0	445.2	21.6	68.0	80.1	103.3	46.0
	8	390.7	67.8	64.0	30.0	487.6	21.7	70.3	80.1	106.5	46.0
Top dress N	4-0	358.2	66.3	61.7	29.7	424.6	21.4	67.0	95.4	102.0	48.6
	8-0	366.7	68.4	63.7	29.5	451.2	21.8	66.9	90.5	104.1	41.1
	4-4	361.0	67.0	63.2	29.5	439.7	21.5	68.4	84.6	99.3	45.8
Mean ($\bar{X}$)		361.9	67.6	62.9	29.6	438.5	21.6	67.4	83.5	101.8	46.2

Table V-6

Correlation Coefficient

	Panicles/ m^2 (1)	Spikelets/ panicle (2)	Ripened grain % (3)	1000 grains weight (4)	Estimated grain yield (5)	Spikelets/ m^2 (6)	Actual yield (7)
(1)	1.000	-0.613	-0.669	0.512	0.738	0.876	0.356
(2)	-0.613	1.000	0.233	-0.290	-0.134	-0.017	-0.122
(3)	-0.670	0.233	1.000	0.092	-0.265	-0.711	-0.012
(4)	0.152	-0.290	0.092	1.000	0.267	0.011	0.523
(5)	0.738	-0.134	-0.265	0.267	1.000	0.841	0.620
(6)	0.876	-0.170	-0.711	0.011	0.841	1.000	0.369
(7)	0.356	-0.122	-0.012	0.533	0.620	0.369	1.000

Table V-2

Panicles/m^2 and spikelets/panicle having reverse correlation. The more panicles tend to have less number of spikelets/panicle. Obviously, when spikelets/m^2 (panicles/m^2 x spikelets/panicle) is more, then grain yield increased even ripened grain % is lower.

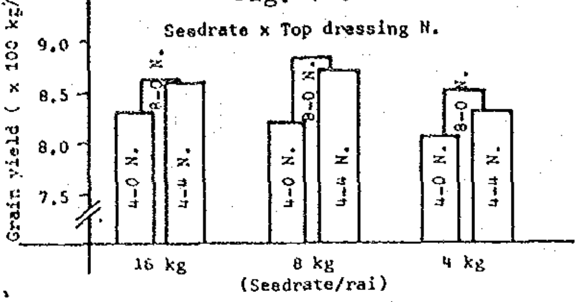


Fig. V-3

Top dressing of 8 kg N/rai at panicle initiation stage produced higher grain yield in any seedrate levels.

Observation Resuts of Plant Height (cm)

		Days after Sowing									Harvest
		26	33	40	47	54	61	68	75	82	
Seedrate (kg/rai)	16	24.9	35.8	43.4	53.7	59.9	54.4	73.6	89.6	104.2	104.[illegible]
	8	25.7	36.0	42.6	51.3	58.0	63.3	75.3	86.5	102.5	102.[illegible]
	4	25.7	38.2	45.0	51.6	58.4	62.7	73.6	84.3	98.7	[illegible]
Basal N. (kg N/rai)	0	24.3	34.3	41.1	47.0	52.2	58.8	70.6	83.0	95.7	95.[illegible]
	4	25.5	37.2	44.6	53.1	60.2	65.2	74.8	87.7	103.3	103.[illegible]
	8	26.4	38.5	46.2	56.5	63.9	66.9	77.1	90.3	106.5	106.[illegible]
Top dress N. (kg N/rai)	4-0	25.2	36.3	43.9	52.1	59.0	62.5	73.0	85.7	102.0	102.[illegible]
	8-0	25.2	36.3	43.5	51.2	58.2	63.8	75.4	89.1	104.1	104.[illegible]
	4-4	25.8	37.3	44.5	53.3	59.1	64.0	71.4	85.5	98.3	98.[illegible]
Means ($\bar{X}$)		25.4	36.7	43.9	52.2	58.8	63.5	73.9	86.9	101.7	101.[illegible]
S.D.		0.6	1.3	1.5	2.5	3.0	2.3	2.0	2.5	3.4	[illegible]

Table V-3

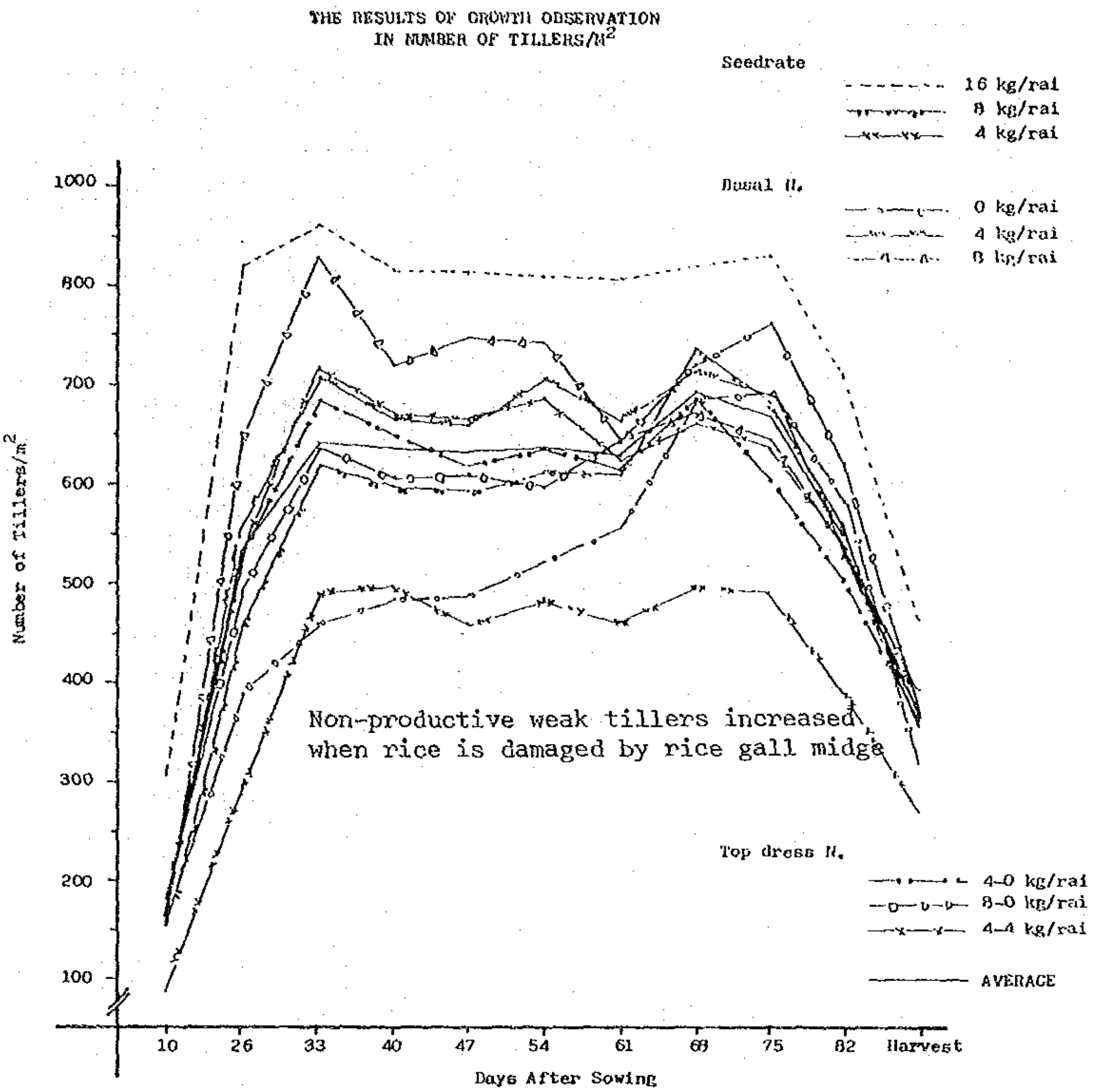


Fig. V-4

Observation of Number of Tillers (m^2)

		Days after Sowing										Harvest
		10	26	33	40	47	54	61	68	75	82	
Seedrate (kg/rai)	16	304.0	844.4	918.8	832.0	832.8	823.2	914.8	841.6	852.8	702.7	460.4
	8	152.0	454.4	618.8	598.8	595.2	614.4	603.2	732.0	678.8	556.4	352.4
	4	76.0	291.2	483.6	491.2	458.4	476.0	459.6	493.2	485.2	387.6	272.9
Basal N. (kg N/rai)	0	152.0	382.8	466.8	478.8	480.0	477.6	568.0	680.8	688.4	578.7	320.4
	4	152.0	559.2	703.2	663.2	657.2	701.6	668.4	715.2	688.8	532.0	374.7
	8	152.0	648.0	851.2	720.4	749.6	733.2	640.8	670.8	640.0	536.0	390.7
Top drss N. (kg N/rai)	4-0	177.2	532.0	676.4	649.6	618.8	635.2	611.6	677.6	609.6	501.0	358.2
	8-0	177.2	492.0	628.0	601.6	607.6	599.2	640.8	721.2	767.6	620.4	366.7
	4-4	177.2	532.0	716.4	670.4	660.8	678.8	624.8	668.0	639.6	525.3	361.0
Mean ($\bar{X}$)		168.8	526.2	673.7	634.0	628.9	637.7	625.8	688.9	672.3	548.9	361.9
S.D.		59.4	157.8	149.3	109.5	117.7	113.5	93.3	90.9	102.0	85.9	50.6

Table V-4

Partial Budget Analysis

(1) Dominance analysis

Plot No.	Treatments: Seed rate (kg/rai)	Treatments: Basal N (kg/rai)	Treatments: Top dress N (kg/rai)	Grain yield (kg/rai)	Gross benefit (B/rai)	Variable cost (B/rai): Seed	Variable cost (B/rai): Fertilizer	Variable cost (B/rai): Opportunity cost	Variable cost (B/rai): Total	Net benefit (B/rai)
1.	16	0	4-0	703	2003	52.8	43.8	16	112.6	1890.4
2.	16	0	8-0	732	2085	52.8	87.6	16	156.4	1928.6*
3.	16	0	4-4	752	2142	52.8	87.6	32	172.4	1969.6*
4	16	4	4-0	747	2129	52.8	87.6	32	172.4	1956.6*
5.	16	4	8-0	757	2157	52.8	131.4	32	216.2	1940.8*
6.	16	4	4-4	758	2160	52.8	131.4	48	232.2	1927.8*
7.	16	8	4-0	790	2252	52.8	131.4	32	216.2	2035.8*
8.	16	8	8-0	844	2406	52.8	175.2	32	260.0	2146.0*
9.	16	8	4-4	821	2339	52.8	175.2	48	276.0	2063.0*
10.	8	0	4-0	678	1957	25.4	43.8	16	86.2	1870.8
11.	8	0	8-0	749	2134	26.4	87.6	16	130.0	2004.0
12.	8	0	4-4	740	2108	26.4	87.6	32	146.0	1962.0*
13.	8	4	4-0	746	2126	26.4	87.6	32	146.0	1980.0*
14.	8	4	8-0	800	2280	26.4	131.4	32	189.8	2090.2
15.	8	4	4-0	797	2273	26.4	131.4	48	205.8	2067.2*
16.	8	8	4-0	778	2216	26.4	131.4	32	189.8	2026.2*
17.	8	8	8-0	835	2380	26.4	175.2	32	233.6	2146.4*
18.	8	8	4-4	812	2314	26.4	175.2	48	249.6	2064.4*
19.	4	0	4-0	617	1757	13.2	43.8	16	73.0	1684.0
20.	4	0	8-0	698	1960	13.2	87.6	16	116.8	1843.2*
21.	4	0	4-4	649	1849	13.2	87.6	32	132.8	1716.2*
22.	4	4	4-0	771	2198	13.2	87.6	32	132.8	2065.2
23.	4	4	8-0	770	2196	13.2	131.4	32	176.6	2019.4*
24.	4	4	4-4	757	2157	13.2	131.4	48	192.6	1964.4*
25.	4	8	4-0	787	2242	13.2	131.4	32	176.6	2065.4*
26.	4	8	8-0	837	2385	13.2	175.2	32	220.4	2164.6
27.	4	8	4-4	836	2383	13.2	175.2	48	236.4	2146.6*
	Mean (X̄)			761.4	2170	-	-	-	-	-

Note : * = Dominated treatments

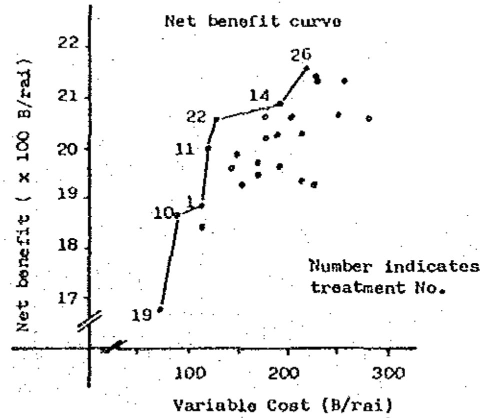
Table V-7

(2) Marginal analysis

Undominated treatments		Net benefit (B/rai)	Variable cost (B/rai)	Marginal rate of return: V.S. next highest benefit	Marginal rate of return: V.S. lowest variable cost
26.	4-8-8-0	2164.6	220.4	243.1 (%)	326.1 (%)
14.	8-4-8-0	2090.2	189.8	43.8	347.8
22.	4-4-4-0	2065.2	132.8	2185.7	637.5
11.	8-0-8-0	2004.0	130.0	652.9	561.4
1.	16-0-4-0	1890.4	112.6	74.2	521.2
10.	8-0-4-0	1870.8	86.2	1415.2	1415.2
19.	4-0-4-0	1684.0	73.0		

Table V-8

Fig. V-5



The treatments connected with line are undominated treatments.

Treatment No. 26 shows the highest net benefit.

Partial Budget Analysis (Average of 9 Treatments)

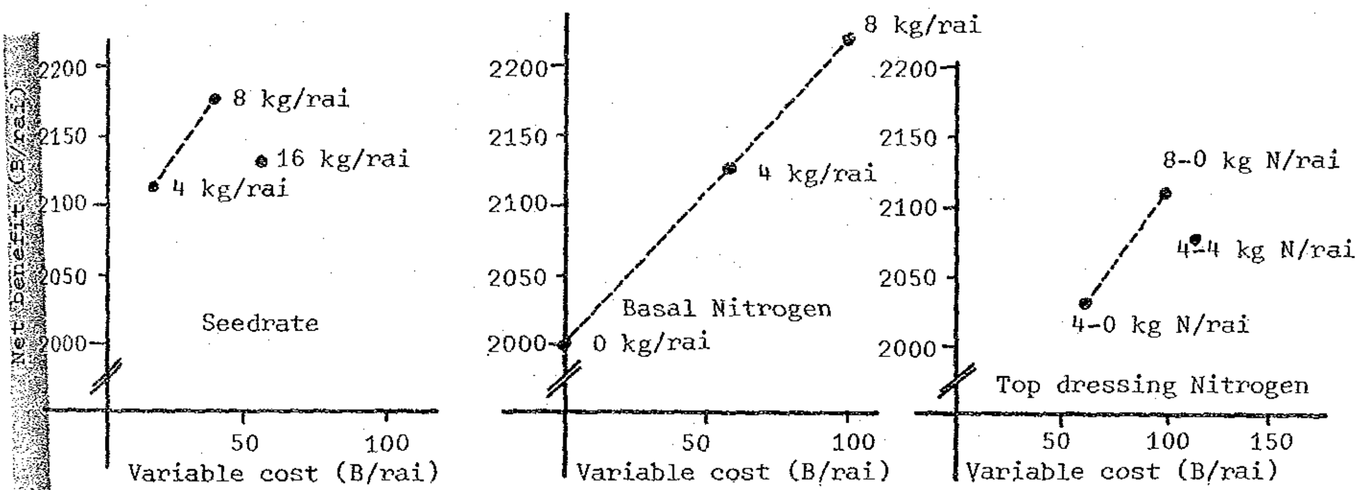
(1) Dominance Analysis

		Grain yield (kg/rai)	Gross benefit (B/rai)	Variable cost (B/rai)			Net benefit (B/rai)
				Input	Opportunity	Total	
Seedrate	16	767.0	2186	52.8	-	52.8	2133*
	8	771.5	2199	26.4	-	26.4	2173
	4	745.6	2125	13.2	-	13.2	2112
Basal N.	0	701.6	2000	-	-	-	2000
	4	767.1	2186	43.8	16	59.8	2126
	8	815.5	2324	87.6	16	103.6	2220
Top dress N.	4-0	736.1	2098	43.8	16	59.8	2038
	8-0	779.1	2220	87.6	16	103.6	2116
	4-4	769.0	2192	87.6	32	119.6	2072*

Table V-9

Note : Treatments with * mark are dominated.

Fig. V-6



(2) Marginal Analysis among Undominated Treatments

Undominated Treatments		Net benefit (B/rai)	Variabel cost (B/rai)	Marginal rate of return (%)
Seedrate	8 kg	2173	26.4	458.6
	4 kg	2112	13.3	-
Basal N.	8 kg	2220	103.6	214.6
	4 kg	2126	59.8	210.7
	0 kg	2000	-	
Top dress N.	8-0 kg	2116	103.6	178.1
	1-0 kg	2038	59.8	

Table V-10

Results and Discussion :

1. Grain yield (Table V-1, ANOVA, Fig. V-1,2,3)

(1). Seedrate

The mean grain yield of 16 kg seeds/rai (852 kg/rai) and 8 kg seeds/rai (857 kg/rai) were significantly higher than the yield of 4 kg seeds/rai (825 kg/rai).

Seedrate of 16 kg/rai and 8 kg/rai produced the same level of grain yield.

Judging from the practical view point, the higher seedrate seedmed to be better when growth competition of rice and weed is taken into consideration.

(2). Basal application of Nitrogen

The higher amount of nitrogen produced significantly higher grain yield.

The grain yield of different levels of basal nitrogen were : 780 kg (no N.), 852 kg (4 kg N/rai), 906 kg (8 kg N/rai) respectively. And those differences were statistically significant each other.

(3). Top dressing of Nitrogen

Amount of nitrogen clearly influenced To grain yield. 8 kg N/rai top dressed either single (8-0) or split application (4-4) produced significantly higher grain yield than the 4 kg N/rai (4-0).

Top dressing at panicle initiation stage (55 days after sowing in this case) found to be appropriate time for application.

Split application of top dressing (panicle initiation & heading stage) is not necessarily needed from this trial results.

2. Yield components and related figures

The higher seedrate obviously produced the more number of panicles/m^2. On the contrary, the lower seedrate produced the more number of grains/panicle.

Lower seedrate levels tended to obtain the higher ripenened grain % since the higher seedrate produced the more number of grains(spikelets) per unit area.

1000 grains weight was not influenced by the different seedrate levels.

Amount of basal nitrogen especially facilitated to increase number of panicles/unit area. The heavier nitrogen produced the more number of panicles.

Nitrogen effect to other yield component factors was not clearly seen. (Table V-5,6)

Plant height (Table V-3) and number of tillers (Fig V-4, Table V-4) were observed every week until heading stage.

Due to the rice gall midge incidence, the number of tillers increased and decreased in abnormal shape shown in Fig. V-4. Thus number of panicles observed at harvest time was much less in comparison with greater number of tillers observed. As a results, % of productive tillers resulted very poor (46.2% in average, Table V-6).

3. Economy of seedrate & nitrogen fertilizer

When every treatment combinations were economically compared, the 20 treatments were dominated since they are higher variable cost with lower net benefit than the undominated treatments.

The results of marginal analysis shows that the treatment of 4-8-8-0 (4 kg seed/rai, 8 kg N/rai for basal, 8 kg N/rai top dressed at panicle initiation stage) provided the highest net benefit with acceptable level of marginal rate of return. (Table V-7, 8, Fig. V-5)

The Table V-9,10 and Fig. V-6 shows the results of economic comparison besed on the mean grain yield of every factors,(average of 9 treatments of 3 factors) and main factors are compared independently regardless other two factors.

The results indicate that the most profitable seedrate level was 8 kg/rai. And the best level of basal nitrogen was 8 kg N/rai. For top dressing , 8 kg N/rai at panicle initiation found to be the most profitable amount and time for application.

Conclusion :

Seedrate of 16 kg and 8 kg/rai produced significantly higher mean grain yield than the that of 4 kg seed/rai.

Basal nitrogen applied at 15 days after sowing at a rate of 8 kg N/rai recorded significantly better grain yield than no N. and 4 kg N/rai.

8 kg N/rai top dressed at panicle initiation stage or 4 kg at panicle initiation plus 4 kg at heading stage recorded significantly higher mean grain yield than the 4 kg N/rai top dressed at panicle initiation stage.

The more seeds broadcasted the more number of panicles per unit area obtained though panicle size became smaller. The heavier basal nitrogen produced the more number of panicles per unit area too.

When the main factors were economically compared independently, seedrate of 8 kg/rai, basal nitrogen of 8 kg N/rai and 8 kg N/rai top dressed at panicle initiation stage found to be the most profitable level among three levels tested in this trial.

VI. Nitrogen Source x Dose Comparative Trial

Objectives :

1. To determine the effect of GML*, OSC** and Ammonium Sulphate on the growth and yield of germinated direct sowing rice under the Chao Phya Pilot Project conditions.
2. To study the best fertilizing method for profitable and economical rice production.

Materials and Method

Experimental Design

Split Plot Design with 3 replications.
Main plots were Nitrogen Sources and Sub-plots were Nitrogen levels.

Treatments :

Main plot (Nitrogen Sources)

NS_1 : GML* (Glutamic Mother Liquor : 4.6% N)
NS_2 : OSC** (Organic Soil Conditioner : 2.9% N)
NS_3 : A.S. (Ammonium Sulphate : 21% N)

Sub plot (Nitrogen Levels : N. kg/rai)

	Basal	Top dressing	Total N.
N_1	6	0	6
N_2	12	0	12
N_3	6	6	12
N_4	12	6	18

Application Method

GML and OSC were applied prior to sowing.
Ammonium Sulphate was applied at 15 days after sowing.
Top dressing of nitrogen at panicle initiation stage as a form of Ammoumium sulphate.

Plot Size : 5 m x 4 m = 20 m^2

Variety Used : RD-23

Cultural Practices

1. Seed rate : 12 kg. of dry seed/rai
2. Weed Control : 5 kg of Saturn G/rai (15 days after sowing)
3. Plant Protection :
   (1) 5 kg of Furadan G/rai (15 days after sowing)
   (2) 5 kg of Padan Mipcin G/rai (35 days after sowing)

Duration

RESULTS

Trial No. VI — Grain Yield (kg/rai)

Treatments No.	Treatment		Replications I	II	III	Mean (X)
1.	GML	N_1	688	646	664	666.0
2.	GML	N_2	812	652	622	695.0
3.	GML	N_3	754	852	688	764.7
4.	GML	N_4	838	896	840	858.0
5.	OSC	N_1	524	702	616	614.0
6.	OSC	N_2	726	630	872	742.7
7.	OSC	N_3	756	734	768	752.7
8.	OSC	N_4	752	812	726	763.3
9.	A.S.	N_1	598	612	702	637.3
10.	A.S.	N_2	742	604	838	728.0
11.	A.S.	N_3	798	838	862	832.7
12.	A.S.	N_4	756	914	908	859.3
	Mean ($\bar{X}$)		728.7	741.0	758.8	742.8

Table VI-1

ANOVA

SV	DF	SS	MS	F	Required F 5%	1%
N. Sourece x N level (Sub-Plot)	35	355763				
N. Source (Main)	8	54978				
Blocks	2	5520	2760	0.032	6.94	18.0
N. Source	2	12968	6484	0.711	6.94	18.0
Error (a)	4	36490	9122.5			
N. level treatment	3	179081	59693	10.994**	3.16	5.09
N. Source x N. level	6	23972	3955	0.376	2.66	4.01
Error (b)	18	97732	5429.5			

LSD for N. level treatment : 5% = 72.98 (kg.rai)
: 1% = 99.97 (kg/rai)

CV)a) = 12.86 (%)
CV (b) = 9.92 (%)

Treatment means Grain yield : kg/rai

Nitrogen levels	N. Sources			Nitrogen mean	Test for significance (5%)
	GML	OSC	A.S.		
N_1 (6-0)	666.0	614.0	637.7	639.1	c
N_2 (12-0)	695.3	742.7	728.0	722.0	b
N_3 (6-6)	764.7	752.7	832.7	783.4	ab
N_3 (12-6)	858.0	763.3	859.3	826.9	a
Mean ($\bar{X}$) NS	746.0	718.2	764.3	742.8	

Table VI-2

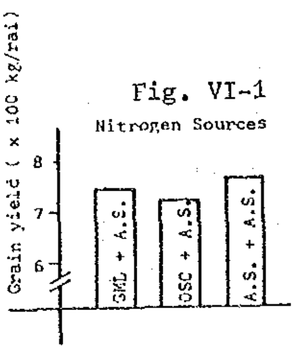


Fig. VI-1
Nitrogen Sources

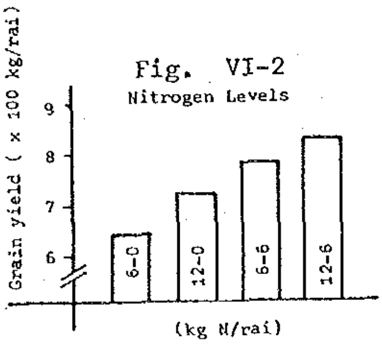


Fig. VI-2
Nitrogen Levels

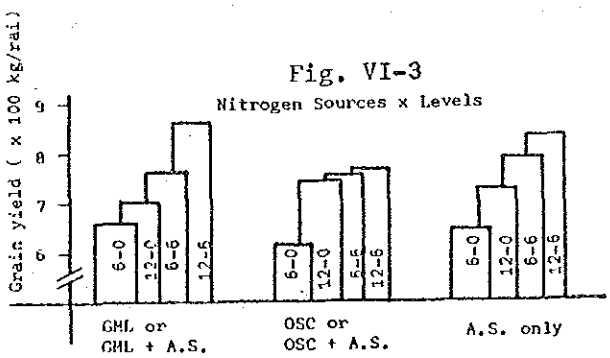


Fig. VI-3
Nitrogen Sources x Levels

Results and discussion :

1. Grain yield

The grain yield was not affected by the different sources of nitrogen statistically. Whereas the amount of nitrogen was closely associated with the grain yield.

The grain yield increased along with the increment of nitrogen level. The highest dose produced the highest yield.

When the same amount of nitrogen was used, (12 kg N/rai in this trial) grain yield was higher when nitrogen is applied as split dose of basal and top dressing at panicle initiation stage even difference is not significant.
(Table VI-1, ANOVA, VI-2, Fig. VI-1,2,3)

Yield Component and related figures on different treatments

Treatments	Yield Components				Estimated yield (g/m^2)	Panicle length (cm)	Stem length (cm)	Grain/ straw ratio	Plant height (cm)
	Panicle/m^2	Grain/ panicle	Ripened grain (%)	1000 grains weight(g)					
1. GML (N_1)	464.0	46.9	76.9	28.3	473.6	17.2	56.3	72.7	94.2
2. GML (N_2)	332.0	69.0	77.1	29.2	515.7	20.9	69.2	91.0	98.0
3. GML+A.S. (N_3)	504.0	54.7	69.1	29.3	558.2	19.6	68.3	97.5	107.6
4. GML+A.S. (N_4)	448.0	56.7	70.1	29.4	523.5	20.0	65.7	102.6	114.2
5. OSC (N_1)	460.0	51.4	70.6	28.4	474.1	17.2	60.9	76.5	95.2
6. OSC (N_2)	408.0	70.4	65.2	28.7	537.5	20.9	71.4	93.4	106.1
7. OSC+A.S. (N_3)	436.0	56.3	66.3	28.3	460.1	18.9	57.0	76.4	110.7
8. OSC+A.S. (N_4)	496.0	64.1	61.9	29.0	570.7	21.1	69.3	90.7	115.4
9. A.S. (N_1)	328.0	58.6	68.5	29.4	387.1	17.4	59.1	89.1	100.6
10. A.S. (N_2)	366.0	51.0	72.2	30.0	410.5	19.7	68.4	75.5	106.2
11. A.S.+A.S.(N_3)	436.0	59.2	65.9	27.8	472.8	18.5	60.4	83.5	112.7
12. A.S.+A.S.(N_4)	460.0	61.5	61.9	29.2	511.3	21.3	72.8	77.0	118.8
Mean ($\bar{X}$)	428.2	58.3	69.0	29.0	491.3	19.4	64.9	85.5	106.7
S.D	56.6	7.1	5.1	0.6	55.8	1.5	5.8	10.0	8.0

Table VI-3

Mean effect of N. source and levels on the yield components and related figures

Treatment levels		Yield Components				Estimated grain yield	Panicle length (cm)	Stem length (cm)	Grain/ straw	Plant height (cm)
		Panicles/ m^2	Grains/ panicle	Ripened grain (%)	1000 grain weight (g)					
Sources	GML.	437.0	56.8	73.3	29.1	517.8	19.4	64.8	91.0	103.5
	OSC.	450.0	60.0	66.0	28.6	510.6	19.5	64.7	84.3	107.1
	A.S.	397.5	57.6	67.4	29.1	445.4	19.2	65.2	81.3	109.6
Nitrogen	N_1	417.3	52.3	72.0	28.7	444.9	17.3	58.7	79.4	97.0
	N_2	365.7	63.5	71.8	29.3	487.9	20.5	69.7	86.6	103.4
	N_3	458.7	56.7	67.1	28.5	497.0	19.0	61.9	85.8	110.3
	N_4	468.0	60.8	64.6	29.2	535.2	20.8	69.2	90.2	116.1
Mean(X)		428.2	58.3	69.0	29.0	491.3	19.4	64.9	85.5	106.7

Table VI-4

Partial Budget Analysis

(1) Dominance analysis

Treatments No. Treatment	Grain yield (kg/rai)	Gross benefit (B/rai)	Variable cost (B/rai)			Net benefit (B/rai)
			Fertilizer	Opportunity cost	Total	
1. GML N_1	599	1708	57.4	16	73.4	1634.6
2. GML N_2	626	1783	114.8	16	130.8	1652.2
3. GML N_3	688	1916	123.1	16 + 16	155.1	1805.9
4. GML N_4	772	2201	180.5	16 + 16	212.5	1988.5
5. OSC N_1	553	1575	-	-	-	-
6. OSC N_2	668	1905	-	-	-	-
7. OSC N_3	677	1931	-	-	-	-
8. OSC N_4	687	1958	-	-	-	-
9. A.S. N_1	574	1635	65.7	16	81.7	1553.3*
10. A.S. N_2	655	1867	131.4	16	147.4	1719.6
11. A.S. N_3	749	2136	131.4	32	163.4	1972.6
12. A.S. N_4	773	2204	197.1	32	229.1	1974.9*
Mean ($\bar{X}$)	668.5	1905	-	-	-	-

Note : * = Dominated treatments

OSC is excluded since it is not commercialized yet.

Table VI-5

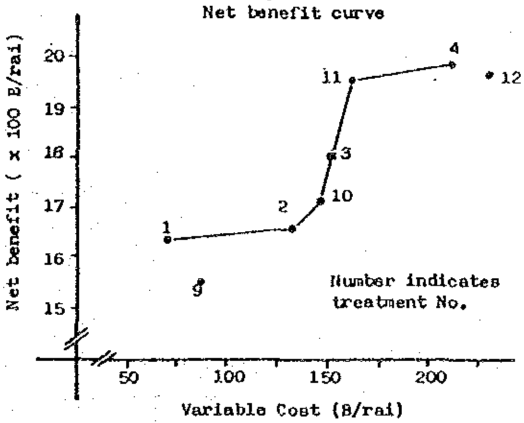
(2) Marginal analysis

Undominated treatments	Net benefit (B/rai)	Variable cost (B/rai)	Marginal rate of return	
			V.S. next highest benefit	V.S. lowest variable cost
4. GML N_4	1988.5	212.5	32.4 (%)	254.4 (%)
11. A.S. N_3	1972.6	163.4	2008.4	375.5
3. GML N_3	1805.9	155.1	1120.8	209.7
10. A.S. N_2	1719.6	147.4	406.0	114.9
2. GML N_2	1652.2	130.8	30.7	30.7
1. GML N_1	1634.6	73.4	-	-

Table VI-6

Fig. VI-4

Net benefit curve



2. Economy

Due to the lower cost of GML, treatment (GML N_4 : 12 kg N/rai for basal as a fo GML plus 6 kg N/rai top dressed at panic initiation stage as a form of ammonium s phate) provided the highest net benefit among treatments.

But the marginal rate of retun of 32.4% seem to be not high enough to ensure th reliable profit when the cost of capital (interest) and risk premium are consider

Because of said reason, A.S. N_3 (6 kg N for basal plus 6 kg N/rai top dressed) termined to be safety alternative with tremely high marginal rate of return (Table VI-5,6 Fig. VI-4

Conclusion :

The grain yield was not influenced by the nitrogen sources statistically, but d ferent amount of nitrogen was significantly associated with the grain yield.

The heavier nitrogen produced the higher grain yield. Split application of nit (basal and top dressing at panicle initiation stage) found to be advantageous.

VII. Variety x Production Inputs Trial

Objectives :

1. To test for yield responses for various production inputs and interactions between these inputs.
2. To identify critical production factors or combinations of practices for germinated direct sowing rice under the Chao Phya Pilot Project conditions.

Materials and Method

Experimental Design :

RCBD arranged as a 2^4 factorial with 2 replications.

Treatments :

V : Varieties	V_0	:	Apple Thong
	V_1	:	RD-23
N : Nitrogen	N_0	:	No Nitrogen applied
	N_1	:	6 kg N/rai (Basal) + 6 kg N/rai (Top dressing)
I : Insect Control	I_0	:	No insecticide applied
	I_1	:	5 kg of Furadan G/rai applied at 15 & 40 days after sowing.
W : Weed Control	W_0	:	No weed control
	W_1	:	5 kg of Saturn G/rai applied at 15 days after sowing plus manual weeding.

Plot Size : 5 m x 4 m = 20 m^2

Cultural Practices :

1. Seed rate : 12 kg of dry seed/rai
2. Weed Control : 5 kg of Saturn G/rai (15 days after sowing) W_1 only
3. Plant Protection :

   (1) 5 kg of Furadan G/rai (15 days after sowing)
   (2) 5 kg of Furadan G/rai (40 days after sowing) } I_1 only

4. Fertilizer Application :

   Nitrogen (N) : Ammonium Sulphate was used.
   Basal N (15 days after sowing)
   Top dressing N (panicle initiation stage } N_1 only

   Phosphorus : 6 kg phosphorus/rai applied as basal (T.S.P.) over entire plots.

Duration :

Sowing : July 5, 1984
Harvest : October 26, 1984

RESULTS :

Trial No. VII — Grain Yield (kg/rai)

Treatments	Replications I	Replications II	Mean ($\bar{X}$)
$V_0\ N_0\ I_0\ W_0$	126	180	153
$V_1\ N_0\ I_0\ W_0$	134	246	190
$V_0\ N_1\ I_0\ W_0$	258	398	328
$V_0\ N_0\ I_1\ W_0$	292	226	259
$V_0\ N_0\ I_0\ W_1$	518	274	396
$V_1\ N_1\ I_0\ W_0$	444	324	384
$V_1\ N_0\ I_1\ W_0$	354	362	358
$V_1\ N_0\ I_0\ W_1$	498	400	449
$V_0\ N_1\ I_1\ W_0$	516	478	497
$V_0\ N_1\ I_0\ W_1$	654	754	704
$V_0\ N_0\ I_1\ W_1$	536	494	515
$V_1\ N_1\ I_1\ W_0$	366	590	478
$V_1\ N_1\ I_0\ W_1$	894	848	871
$V_1\ N_0\ I_1\ W_1$	634	668	651
$V_0\ N_1\ I_1\ W_1$	680	690	685
$V_1\ N_1\ I_1\ W_1$	974	824	899
Mean ($\bar{X}$)	492.4	484.8	488.56

Table VII-1

ANOVA

SV	DF	SS	MS	F	Required F 5%	Required F 1%
Replications	1	465.1		0.065	4.60	8.86
Blocks in Rep.	2	7603.2	3801.6	0.535	3.74	6.51
V (Variety)	1	69006.1		9.724**	4.60	8.86
N (Nitrogen)	1	439453.1		61.929**		
I (Insect)	1	93961.1		13.241**		
W (Weed)	1	795691.1		112.131**		
VN	1	1081.1		0.152		
VI	1	1711.1		0.241		
VW	1	19701.1		2.776		
NI	1	13041.1		1.838		
NW	1	22155.1		3.122		
IW	1	5356.1		0.755		
VNI	1	3741.1		0.527		
VNW	1	10585.1		1.492		
VIW	1	2556.1		0.360		
NIW	1	11325.1		1.596		
Error	14	99345.2	7096.1			
Total	31	1596777.9				

Differential responses : (kg/rai)

Factors	Mean response	Response with							
		Variety (V)		Nitrogen (N)		Insect Control (I)		Weed Control (W)	
		V_0	V_1	N_0	N_1	I_0	I_1	W_0	W_1
Variety (V)	92.87	-	-	81.25	104.50	78.25	107.50	43.25	142.5
Nitrogen (N)	234.37	222.75	246.0	-	-	247.75	194.0	181.75	287.0
Insect C. (I)	108.37	93.75	123.0	148.75	68.5	-	-	134.25	82.5
Weed C. (W)	315.37	265.75	365.0	262.75	368.0	341.25	289.5	-	-

Table VII-2

Summary of the Results : Table VII-3

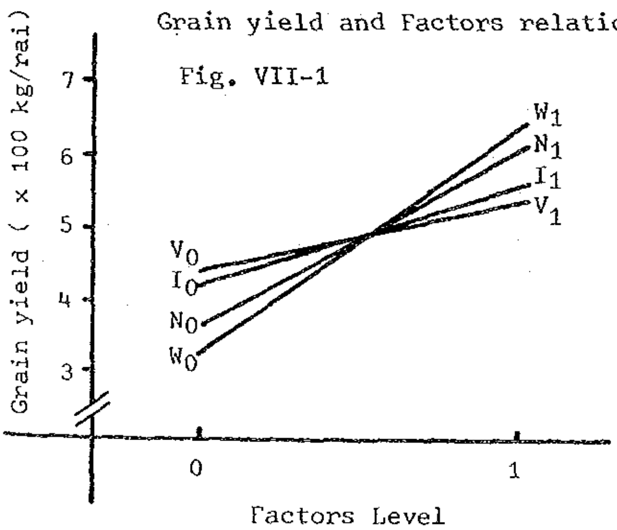
Factors		Treatments	Grain Yield (kg/rai)
Variety	V_0	Apple Thong	442.12 **
	V_1	RD-23	535.00
Nitrogen	N_0	No N. applied	371.37 **
	N_1	12 kg N/rai (6+6)	605.75
Insect Control	I_0	No Insecticide applied	434.37 **
	I_1	5 kg Furadan/rai x 2 times	542.75
Weed Control	W_0	No Weed Control	330.87 **
	W_1	5 kg Saturn G/rai + Manual Weeding	646.25
Over all Mean			488.56

Significant interaction : None

CV (%) : 17.24

Grain yield and Factors relationship

Fig. VII-1



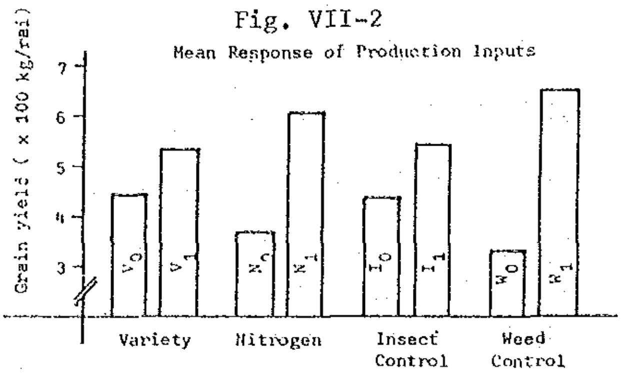
The all of four factors are important production factors.

The priority is in order of :

Weed control
Nitrogen
Insect control
Variety

Fig. VII-2

Mean Response of Production Inputs



The relationship between grain yield and production factors can be formularized as mentioned below.

$$Y = 113.063 + 92.875X_1 + 234.375X_2 + 108.375X_3 + 315.375X_4$$

Where :

Y = Grain yield

X_1 = Variety

X_2 = Nitrogen

X_3 = Insect control

X_4 = Weed control

Results and Discussion :

1. Grain yield

(1). Factor 1 : Variety (V)
Grain yield of RD-23 (535 kg/rai) was significantly superior to Apple Thong (442 kg/rai)

(2). Factor 2 : Nitrogen (N)
12 kg N/rai (6 kg for basal + 6 kg top dressed) produced significantly higher grain yield (606 kg/rai) than the that of no nitrogen (371 kg/rai).

The difference was 234 kg/rai. Average effect of every 1 kg of nitrogen was equivalent to produce 19.5 kg of grains.

(3). Factor 3 : Insect control (I)
Grain yield of no insect control treatment (434 kg/rai) was significantly lower than the treatment with 10 kg Furadan/rai (5 kg x 2 times application : yield 543 kg/rai). The major insects observed in the trial plot were : Rice thrips, Yellow rice borer, Rice leaf roller and Rice gall midge.

(4). Factor 4 : Weed control (W)
Weed control is especially important in direct sowing method. The grain yield of weed control treatment (5 kg Saturn G/rai plus manual weeding) was 646 kg/rai, and no weed control treatment produced nearly ½ (330 kg/rai).

(Table VII-1, ANOVA, Table VII-2,3, Fig. VII-1,2)

Yield Component and related figures on different treatments

Treatments	Yield Components				Estimated yield (g/m^2)	Panicle length (cm)	Stem length (cm)	Grain straw ratio	Plant height (cm)
	Panicle/m^2	Grain/panicle	Ripened grain (%)	1000 grains weight(g)					
1. $V_0\ N_0\ I_0\ W_0$	224.0	23.3	66.5	25.4	91.5	13.4	46.5	57.3	65.9
2. $V_1\ N_0\ I_0\ W_0$	208.0	26.3	71.1	27.7	107.7	13.1	36.9	100.0	56.3
3. $V_0\ N_1\ I_0\ W_0$	276.0	35.0	75.3	27.6	200.8	15.7	57.0	40.2	88.1
4. $V_0\ N_0\ I_1\ W_0$	244.0	36.0	69.2	27.2	165.3	14.6	57.4	62.2	73.7
5. $V_0\ N_0\ I_0\ W_1$	280.0	39.6	77.8	27.7	239.0	16.2	57.8	51.6	91.8
6. $V_1\ N_1\ I_0\ W_0$	376.0	47.6	51.4	27.3	251.1	19.7	64.9	93.0	100.0
7. $V_1\ N_0\ I_1\ W_0$	200.0	60.6	62.8	29.7	216.4	20.7	61.2	63.0	90.0
8. $V_1\ N_0\ I_0\ W_1$	268.0	49.0	65.9	27.7	239.7	18.2	55.6	95.5	93.1
9. $V_0\ N_1\ I_1\ W_0$	408.0	32.2	75.7	28.6	284.4	14.7	59.3	57.2	85.6
10. $V_0\ N_1\ I_0\ W_1$	444.0	48.7	75.6	28.8	470.8	18.6	67.1	66.5	95.0
11. $V_0\ N_0\ I_1\ W_1$	360.0	40.5	63.8	27.8	321.8	16.0	55.9	66.7	81.6
12. $V_1\ N_1\ I_1\ W_0$	320.0	56.1	64.1	28.8	331.4	20.4	64.6	80.7	101.2
13. $V_1\ N_1\ I_0\ W_1$	340.0	68.5	71.1	28.5	471.9	19.7	59.7	105.1	96.5
14. $V_1\ N_0\ I_1\ W_1$	312.0	47.6	74.8	27.5	305.5	17.0	48.2	98.5	75.9
15. $V_0\ N_1\ I_1\ W_1$	392.0	57.2	60.0	24.9	399.5	17.1	66.1	52.3	93.3
16. $V_1\ N_1\ I_1\ W_1$	504.0	61.0	65.3	29.1	584.2	19.1	68.8	74.0	103.5
Mean ($\bar{X}$)	322.3	45.6	68.2	28.1	292.7	17.1	58.0	73.0	85.4
S.D.	87.7	13.1	7.0	0.8	135.4	2.5	8.4	20.3	12.4

Table VII-4

Mean effect of production factors on the yield components and related figures

Treatment levels	Yield Components				Estimated grain yield	Panicle length (cm)	Stem length (cm)	Grain/straw	Plant height (cm)
	Panicles/m^2	Grains/panicle	Ripened grain (%)	1000 grain weight (g)					
V_0	328.5	39.1	70.6	27.9	271.7	15.8	58.5	56.8	83.8
V_1	316.0	52.1	65.8	28.2	313.7	18.5	57.5	88.9	87.0
N_0	262.0	40.4	69.0	27.6	211.1	16.1	52.5	74.6	76.8
N_1	382.5	50.8	67.4	28.5	374.3	18.1	63.4	71.3	94.0
I_0	302.0	42.3	67.7	27.7	259.1	16.8	55.6	76.4	82.3
I_1	342.5	48.9	68.6	28.4	326.3	17.4	60.3	69.3	88.5
W_0	282.0	39.6	67.0	27.8	206.3	16.5	55.9	69.3	83.1
W_1	362.5	51.5	69.4	28.3	379.1	17.7	60.0	76.4	87.7
Mean ($\bar{X}$)	322.3	45.6	68.2	28.1	292.7	17.1	58.0	73.0	85.4

Table VII-5

Fig. VII-3

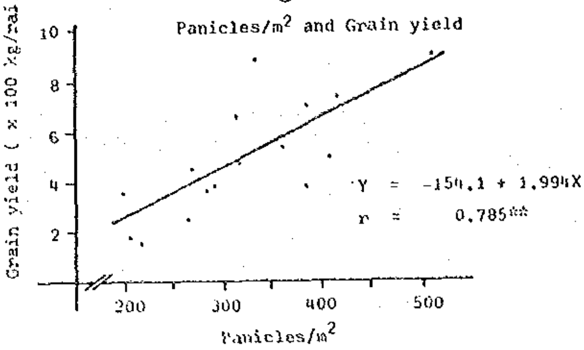
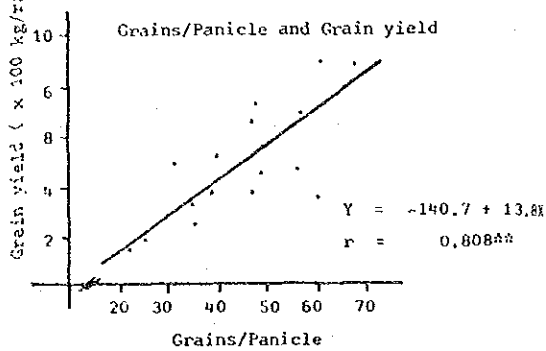


Fig. VII-4



2. <u>Yield components and related figures</u>

Grains/panicle of Apple Thong variety was much less than RD-23 though panicles/m^2 was higher.

Panicles/m^2 and grains/panicle were greatly influenced by the application of nitrogen, insecticide and herbicide. The effects of those inputs on the ripened grain % was not clearly observed. 1000 grains weight was slightly increased by the application of those inputs.

It is determined that the effects of production inputs were mainly appeared in increasing number of panicles and number of grains/panicle. And these yield components were closely correlated with grain yield.

(Table VII-4,5, Fig. VII-3,4)

Partial Budget Analysis

(1) Dominance analysis

Treatments	Grain yield (kg/rai)	Gross benefit (B/rai)	Variable cost (B/rai) V	N	I	W	Opportunity cost	Total	Net benefit (B/rai)
1. V_0 N_0 I_0 W_0	138	392	39.6	-	-	-	-	39.6	352*
2. V_1 N_0 I_0 W_0	171	487	39.6	-	-	-	-	39.6	447
3. V_0 N_1 I_0 W_0	295	841	39.6	131.4	-	-	32	203.0	638*
4. V_0 N_0 I_1 W_0	233	664	39.6	-	210.0	-	32	281.6	382*
5. V_0 N_0 I_0 W_1	356	1016	39.6	-	-	90.0	71	200.6	815*
6. V_1 N_1 I_0 W_0	346	985	39.6	131.4	-	-	32	203.0	782*
7. V_1 N_0 I_1 W_0	322	918	39.6	-	210.0	-	32	281.6	636*
8. V_1 N_0 I_0 W_1	404	1152	39.6	-	-	90.0	71	200.6	951
9. V_0 N_1 I_1 W_0	447	1275	39.6	131.4	210.0	-	64	445.0	830*
10. V_0 N_1 I_0 W_1	634	1806	39.6	131.4	-	90.0	103	364.0	1442*
11. V_0 N_0 I_1 W_1	464	1321	39.6	-	210.0	90.0	103	442.6	878*
12. V_1 N_1 I_1 W_0	430	1226	39.6	131.4	210.0	-	64	445.0	781*
13. V_1 N_1 I_0 W_1	784	2234	39.6	131.4	-	90.0	103	364.0	1870
14. V_1 N_0 I_1 W_1	586	1670	39.6	-	210.0	90.0	103	442.6	[illegible]
15. V_0 N_1 I_1 W_1	617	1758	39.6	131.4	210.0	90.0	135	606.0	1152*
16. V_1 N_1 I_1 W_1	809	2306	39.6	131.4	210.0	90.0	135	606.0	1700*
Mean ($\bar{X}$)	439.7	1253	-	-	-	-	-	-	-

Note : * = Dominated treatments

Table VII-6

(2) Marginal analysis

Undominated treatments	Net benefit (B/rai)	Variable cost (B/rai)	Marginal rate of return: V.S. next highest benefit	V.S. lowest (V_0 N_0 I_0 W_0)
13. V_1 N_1 I_0 W_1	1870	364.0	562.4 (%)	467.9 (%)
8. V_1 N_0 I_0 W_1	951	200.6	313.0	372.0
2. V_1 N_0 I_0 W_0	447	39.6		
1. V_0 N_0 I_0 W_0	352	39.6	-	-

Table VII-7

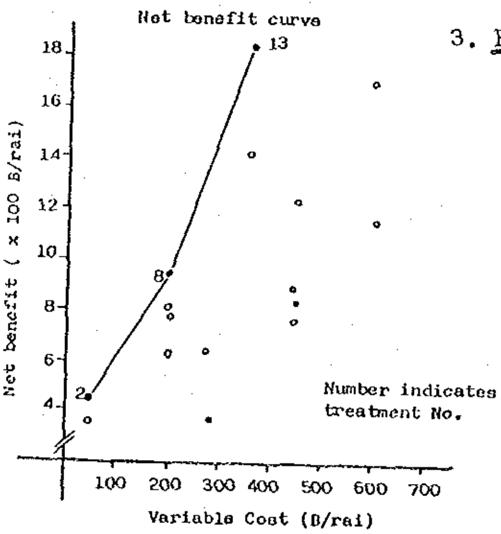


Fig. VII-5

3. <u>Economical comparison of production inputs</u>

All of the four factors studied in this trial were determined to be important critical factors for production. Among 16 combinations of inputs, V_1 N_1 I_0 W_1 treatment(Variety : RD-23, Nitrogen : 12 kg N/rai, No Insecticide, Weed control) was found to be the most profitable combinations. Though significant effect of insecticide application was clearly observed, the cost of insecticide (Furadan G. 10 kg) is relatively higher than the that of other inputs. (Table VII-6,7, Fig. VII-5)

Partial Budget Analysis
(Based on the mean grain yield of 16 plots)

		Grain yield (kg/rai)	Gross benefit (B/rai)	Variable cost (B/rai)			Net benefit (B/rai)	Marginal rate of return (%)
				Inputs	Oppor-tunity	Total		
Variety	V_1	482	1372	-	-	-	1372	
	V_0	398	1134	-	-	-	1134	
Nitrogen	N_1	545	1553	131	32	163	1390	268.1
	N_0	334	952	-	-	-	952	
Insect control	I_1	488	1392	210	32	242	1150	14.9
	I_0	391	1114	-	-	-	1114	
Weed control	W_1	582	1658	90	71	161	1497	402.5
	W_0	298	849	-	-	-	849	

Table VII-8

When mean grain yield of inputs(mean of 16 plots) was independently compared, marginal rate of return of nitrogen application was 268.1% and weed control provided as high as 402.5%. But in case of insecticide, marginal rate was only 14.9% due to high variable cost. This low return was not acceptable when cost of capital and risk premium are taken into consideration.

In connection with insect control, there is a probability that cost of insecticide may be reduced to ½ (5 kg Furadan) if application is done in right time in order to obtain higher marginal rate of return. (Table VII-8)

Conclusion :

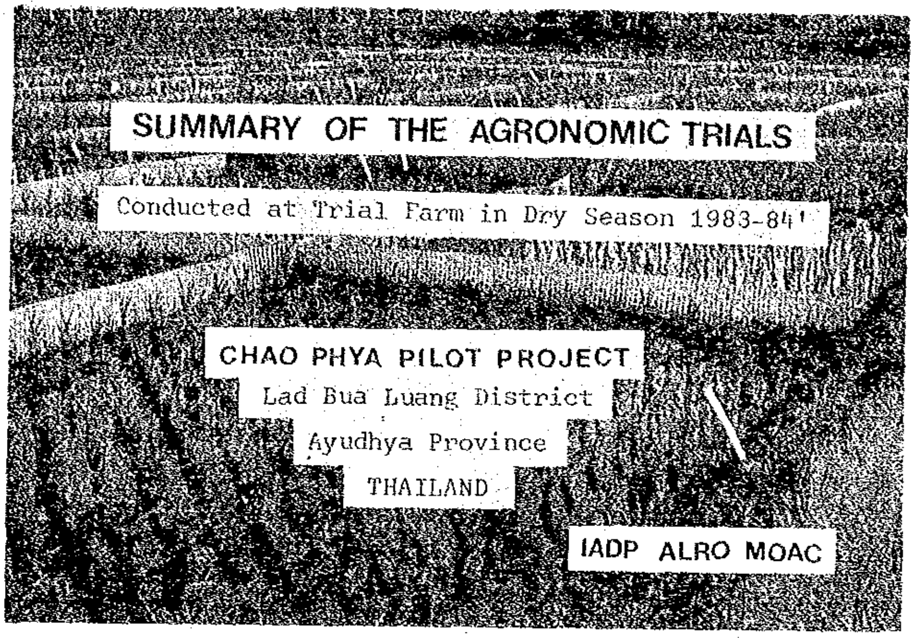
All of the production inputs tested in this trial were found to be very important and critical factors for production of germinated direct sowing rice cultivation.

Significant effects of all production inputs on the grain yield were clearly observed at 1% level of significance.

The importance of those imputs were in order of Weed control, Nitrogen, Insect control, variety and mean response of those inputs were 315, 234, 108 and 93 kg of grain yield/rai respectively.

The effects of nitrogen, insect control and weed control on the grain yield were mainly appeared in increasing number of panicles per unit area and number of grains/panicle.

From the economic points, variety of RD-23 planted with nitrogen and weed control without insecticide was found to be profitable combination. However the way to minimize the cost of insecticide should be found out since all of the production inputs involved in this trial were found to be very important.



IRRIGATED AGRICULTURE DEVELOPMENT PROJECT

September 1984

Krisdawut Wongpiboonwatana
Toshio Shibata

ABSTRACTS OF THE TRIAL RESULTS
CONDUCTED IN DRY SEASON 1983-84'

Trial I. Varietal Comparative Study

The grain yield of RD-21 was significantly higher than the that of other RD-varieties. (5% level) RD-21 and RD-23 produced significantly better grain yield than RD-9-7, RD-19, RD-25 at 5% level of significance.

Trial II. Nitrogen Source Comparative Trial

The amount of nitrogen was significantly associated to the grain yield. However nitrogen source (types of nitrogen) did not influence statistically to the yield. Split application of nitrogen found to be better than the basal only for yield and economic responses.

Trial III. Nitrogen X Phosphorus Fertilizer Trial

The nitrogen response to grain yield was remarkable whereas no phosphorus effect was observed. Significant differences were observed between mean grain yield of every nitrogen levels. Total nitrogen of 18 kg/rai applied as split dose without phosphorus appeared to be the most profitable among treatments.

Trial IV. Planting Method Comparative Study

The grain yield of direct sowing method was significantly superior to transplanting method both mechanical and manual. Judging from the study results, direct sowing was found to be much more profitable than transplanting method with distinct advantage of cost saving. However, more cost factors needed to be considered regarding planting methods.

Trial V. Seedrate X Nitrogen Trial (Direct Sowing)

The grain yield was significantly increased along with the increment of nitrogen levels, whereas no significant differences observed between grain yield of different seedrate levels. 8 kg of dry seed with 15 kg N/rai appeared to be the most economical level.

Trial VI. Fertilizer (Nitrogen) rate and Time of Application Trial (Direct Sowing)

The higher dose of nitrogen tended to produce higher grain yield. Top dressing of nitrogen at panicle initiation stage seemed to have good effect to grain yield since number of grains/panicle was greatly increased by top dressing in this stage. Basically, basal application of nitrogen at 15 days after sowing plus top dressing at panicle initiation stage appeared to be good combination.

Trial VII. Seedrate X Nitrogen Fertilizer Trial (Direct Sowing)
= Cooperative Trial of I.A.D.P. =

Statistically no significant differences were observed between/among the grain yield of different seedrate levels, different time and proportion of the nitrogen application for basal and top dressing . (the same amount of nitrogen applied).
However, seedrate of 16 kg/rai with 6 kg N/rai applied at 15 days after sowing plus another 6 kg N/rai applied at panicle initiation stage appeared to produce the higher grain yield and it was found to be the most profitable among the treatments compared.

GENERAL INTRODUCTION AND EXPERIMENTAL CONDITIONS

The Chao Phya Pilot Project is situated at Lad Bua Luang District in Ayudhya Province in the middle of Greater Chao Phya Basin.

The topographical gradient of the project area is extremely gentle ranging from 1/5,000 to 1/10,000 and the average plot elevation is ± 2.0 meters above sea level.

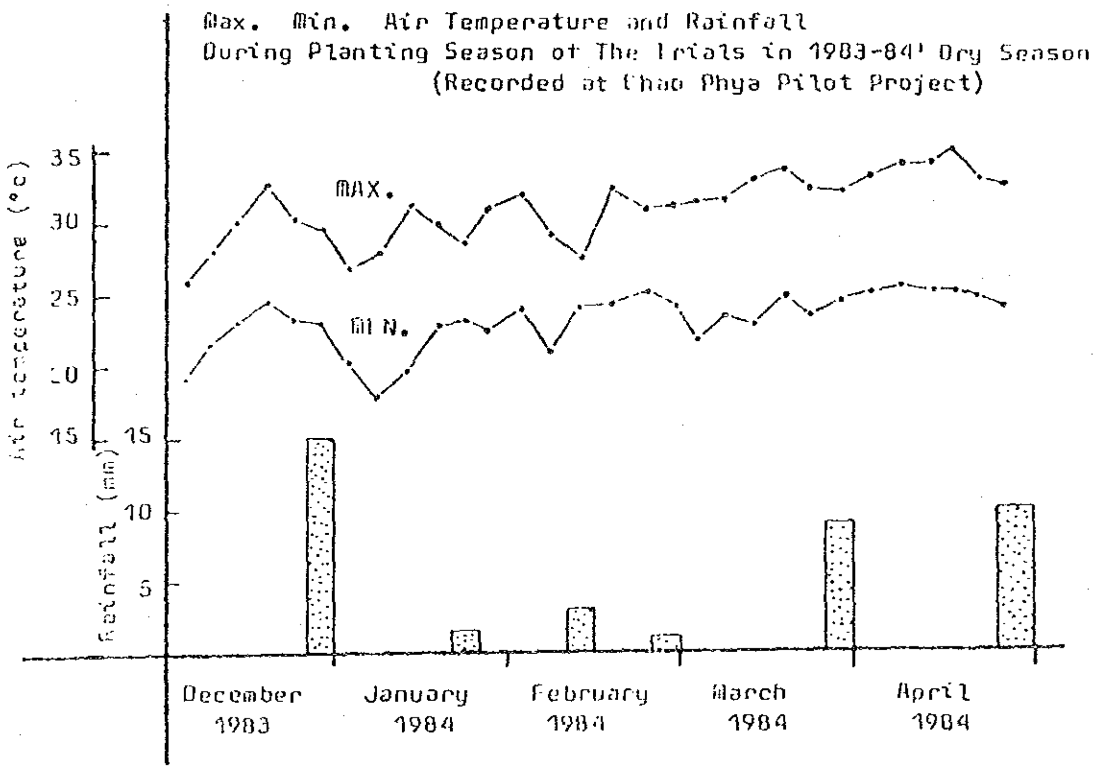
The soil had been formed by the alluvial action of the Chao Phya River, is the clayey acid sulphate soil PH of 4.5-5.0.

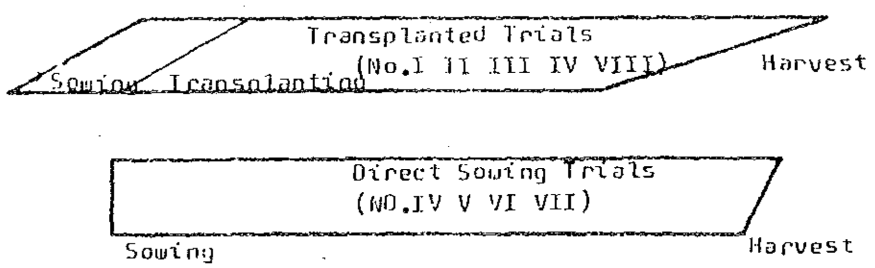
Much contents of the clay allow the soil hardness to vary to the large extent in dry and moist condition.

The rainfall has a big seasonal and annual fluctuation but average annual rainfall is about 1,300 mm. of which 88 percent falls in the wet season (May-October) and remaining 12 percent in the dry season (November-April).
(14 years average at Sing Ha Nat)

During the rice growing period of the agronomic trials in dry season 1983-84' only 39.5 mm. of rainfall was recorded at Chao Phya Pilot Project. (December- April)

The figure below shows the max. min. temperature and rainfall during planting period of the trials.





The agronomic trials were organized and managed by Agronomy Section in collaboration with other related sections in the project.

All of the trials stated in this report were planted in the month of December 1983 and harvested in March to April 1984. The variety of RD-23 was used for the trials except Varietal Comparative Study since this variety has been successfully accepted by an overwhelming majority in the project area.

Regarding planting method, trials No. I,II and III were transplanted and IV was both transplanting and direct sowing.

Since direct sowing method has been wide-spread among the farmers in the area, Trial No. V,VI and VII were directly seeded.

Number of tillers and plant height were investigated every 10 days interval for trial No. I and VII.

Yield Components and related figures were observed in every trials in order to study the effects and the influences of the treatments to yield component factors in relation to production and to find out relationship among factors.

Grain yield of each experimental unit (20 m^2/plot) were measured from central part of 3.75 m^2 (60 hills) in case of transplanting and grain yield of 4.0 m^2 were observed for direct sowing trials. For the bigger plot of 40 m^2 (Trial No. IV, VII), central part of 8 m^2 were harvested for yield datas.

For data analysis, F test and Duncan's Multiple Range Test were applied to examine statistical significance among/between treatments. Simple linear regression was also shown in same cases to find out the relationships between two factors.

The treatments were economically compared through partial budget analysis (dominance & marginal analysis) considering only the variable cost factors vary from one treatment to another. Because the cost factors which are not affected by the choice of treatment are known as fixed cost, since these costs are incurred regardless of which treatment, they can not affect the choice of treatment and can be ignored for the purpose of decision.

The following assumptions on the variable inputs and output were assumed for economic study of the trials.

Inputs :	Rice seed (dry grain)	:	3.3	B/kg
	Fertilizer			
	Ammonium Sulphate (21-0-0)	:	2.3	B/kg
	GML (Glutamic Mother Liquor)	:	0.44	B/l
	Triple Super Phosphate (0-46-0)	:	6.0	B/kg
	Ammo-Phos (16-20-0)	:	4.175	B/kg
	Opportunity cost of labour	:	56.00	B/day/person
	Fertilizer application cost	:	16.00	B/time/rai
Output :	Price of dry grain (14% H_2O)	:	2.915	B/kg

10% of harvest and storage loss was assumed and deducted from the grain yield harvested from the trial plot when yield was examined economically.

THE ALLOCATION AND PLOT LAYOUT OF THE TRIALS (I, II, III, IV)

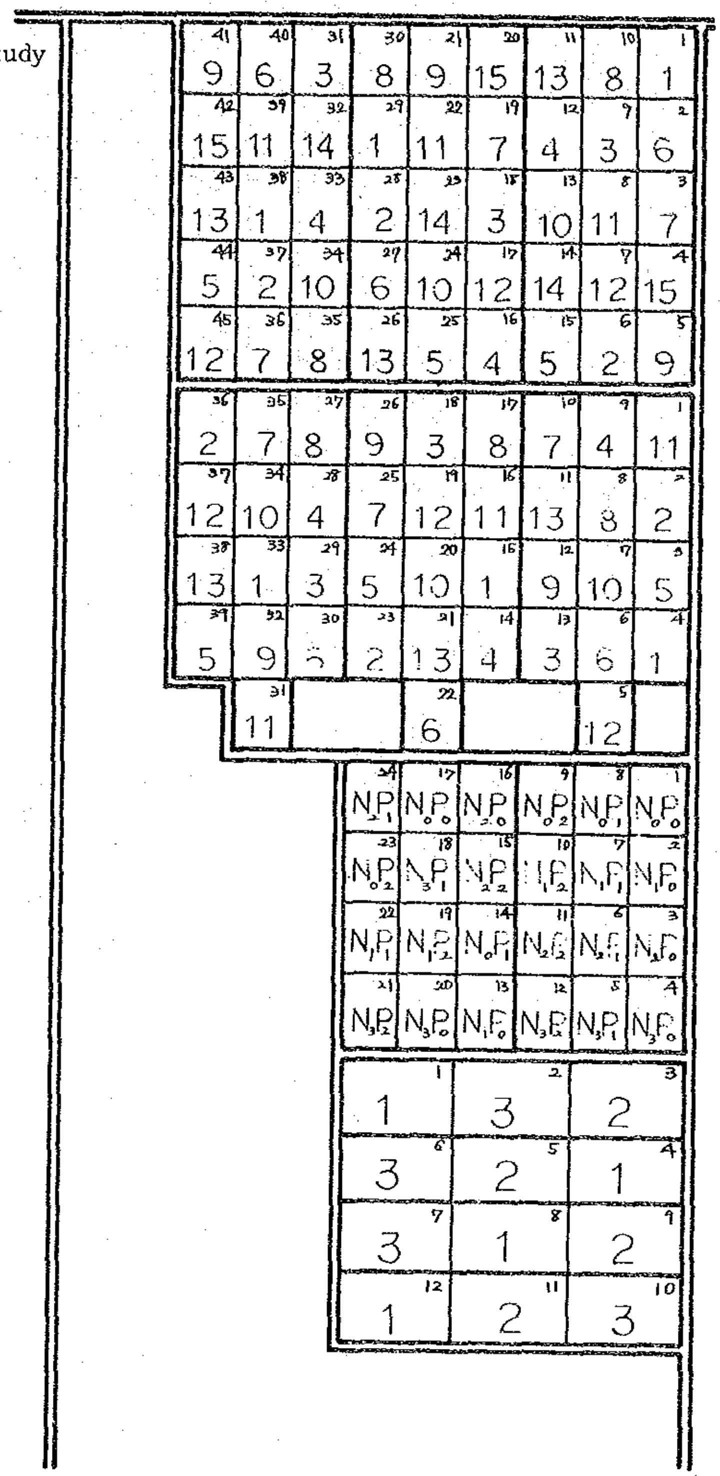
Dry Season 1983-84' : Field No. 120

I. Varietal Comparative Study
RCBD,
15 Varieties/Entries x
3 Replications

II. Nitrogen Source
Comparative Trial.
RCBD,
13 Treatments x
3 Replications

III. Nitrogen x Phosphorus
Trial.
RCBD, Factorial,
4 Nitrogen Levels x
3 Phosphorus Levels x
2 Replications

IV. Planting Methods
Comparative Study.
RCBD,
3 Treatments x
4 Replications

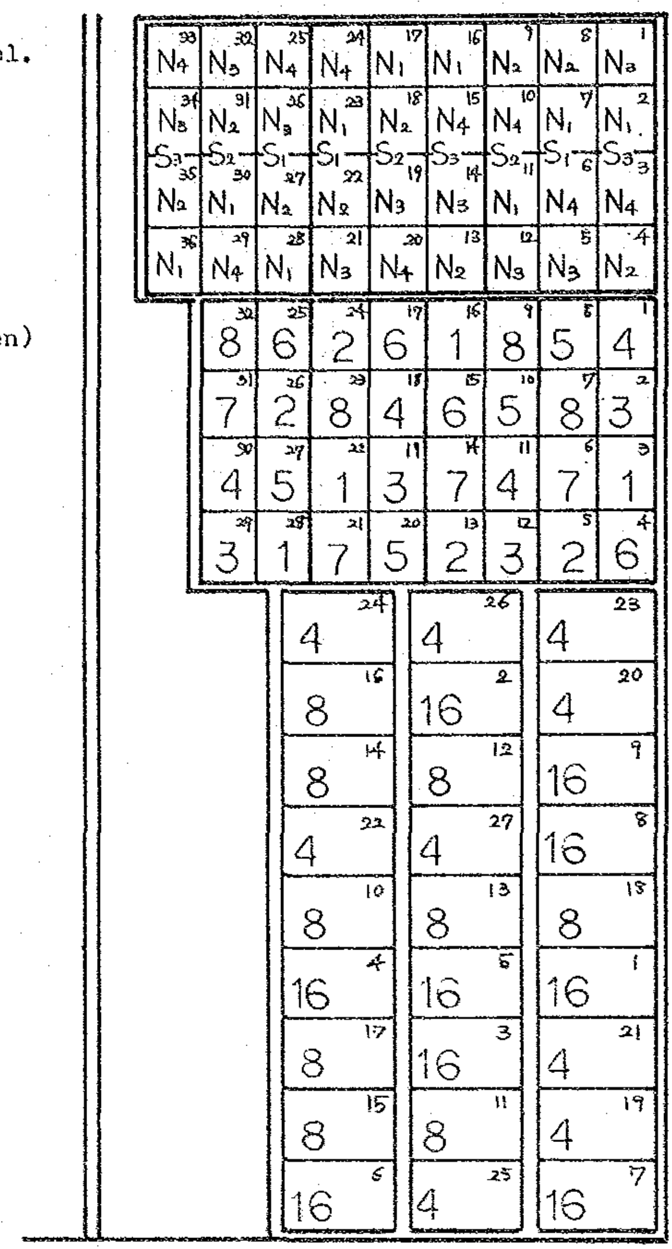


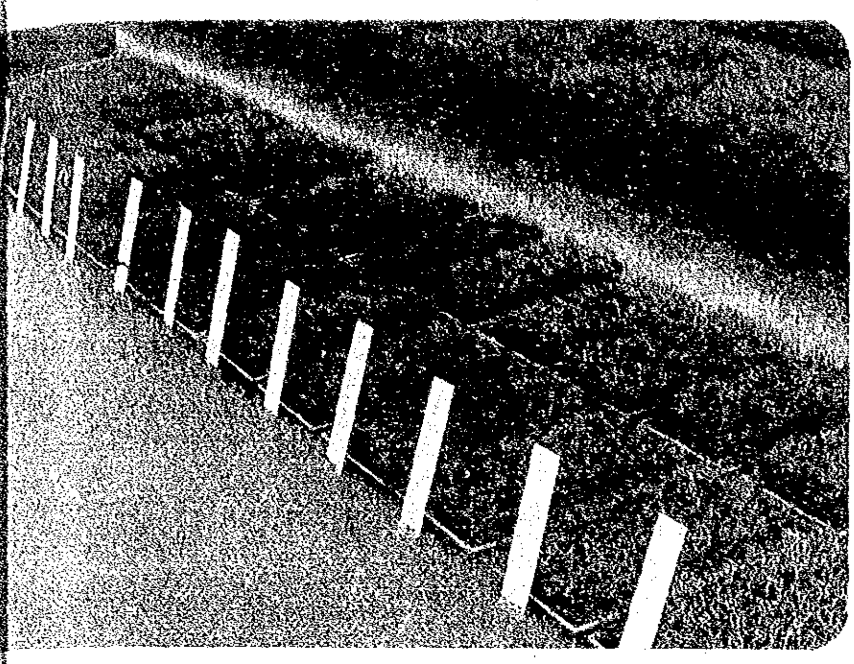
THE ALLOCATION AND PLOT LAYOUT OF THE TRIALS (V, VI, VII)
Dry Season 1983-84' : Field No. 140

V. Seedrate x Nitrogen Level. (Direct Sowing) Split Plot Design, 3 Seedrate Levels x 4 Nitrogen Levels x 3 Replications

VI. Fertilizer rate (Nitrogen) and Time of Application Trial, (Direct Sowing) RCBD, 8 Treatments x 4 Replications

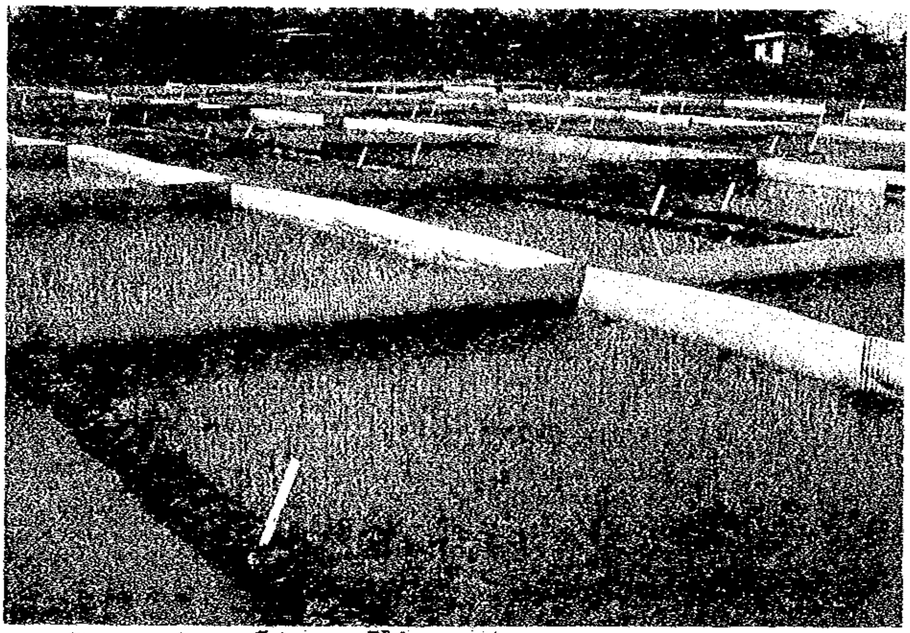
VII. Seedrate x Nitrogen Fertilizer Trial (Direct Sowing) L_{27} (3 x 3 x 3)





Seedling prepared for
Varietal Comparative
Study

ial plots were diveded by
astic waved board.
rect sowing trial plots at
days after sowing.



Trial plots at early stage
(Transplanted)

Chao Phya Pilot Project

Dry Season, 1983-84'

I. Varietal Comparative Study

Objectives :

To study the performance and productivity of different varieties/entries under Chao Phya Area conditions.

Experimental Design :

RCBD with 3 replications.

Treatments :

No.	Varieties/entries
1.	SP. 75001-68
2.	SP. 78002-80
3.	SP. 75004-5
4.	SP. 75004-37
5.	SP. 77097-62
6.	RD-7
7.	RD-9-7
8.	BKNBR 1141-2-4-2-2-2-1
9.	RD-9-14
10	RD-21-3
11.	RD-23
12.	IR-44
13.	IR-46
14	RD-25
15	RD-19

Plot Size : 5 m. X 4 m. = 20 m^2.

Cultural Practices :

1. Seed rate : 4.0 kg./rai (dry seed)
2. Planting density : 25 X 25 cm. (16 hills/m^2.)
3. Weed control : Manual weeding
4. Fertilizer application :

   Basal : NPK 10 kg./rai as a form of complete fertilizer (15 - 15 - 15)

   Top dressing : 3kg. of N/rai as ear manuaring as a form of Ammonium Sulphate. (panicle initiation stage)

5. Plant protection

   Furadan G : 15 days after transplanting (5 kg./rai)

   Padan Mipcin G : 35 " " " (5 kg./rai)

6. Duration

   Sowing : December 1, 1983

   Transplanting : December 22, 1983

   Harvest : March 14-27, 1984

Trial No. I Grain Yield (kg/rai)

Treatments No.	Treatment	Replications I	II	III	Mean ($\bar{X}$)
1.	SP75001-68	677	657	605	646.3
2.	SP78002-80	630	780	782	730.6
3.	SP75004-5	773	852	707	777.3
4.	SP75004-37	756	750	766	757.3
5.	SP77097-62	825	776	768	789.7
6.	RD-7	637	786	701	708.0
7.	RD-9-7	576	713	709	666.0
8.	BKNBR1141-2-4-2-2-2-1	710	693	778	727.0
9.	RD-9-14	702	720	649	690.3
10.	RD-21-3	882	922	877	893.7
11.	RD-23	825	763	774	787.3
12.	IR-44	887	788	787	820.7
13.	IR-46	866	874	764	834.7
14.	RD-25	590	622	558	590.0
15.	RD-19	713	585	565	621.0
	Mean ($\bar{X}$)	736.6	752.1	719.3	736.0

Table I-1

ANOVA

SV	DF	SS	MS	F	Required F 5%	1%
Total	44	392820				
Treatments	14	299703	21407	7.05**	2.06	2.80
Block	2	8044	4022	1.32	3.34	5.45
Error	28	85073	3038			

LSD for treatment : 5% = 92.2 (kg/rai)
1% = 124.3 (kg/rai)

CV = 7.49 (%)

Duncan's Multiple Range Test

Varieties/Entries	Mean Yield (kg/rai)	DMRT 5%	1%
10. RD-21-3	893.7	a	a
13. IR-46	834.7	ab	ab
12. IR-44	820.7	abc	abc
5. SP77097-62	789.7	bcd	abcd
11. RD-23	787.3	bcd	abcde
3. SP75004-5	777.3	bcd	abcde
4. SP75004-37	757.3	bcde	bcdef
2. SP78002-80	730.6	bcdef	bcdef
8. BKNBR1141-2-4-2-2-2-1	727.0	cdef	bcdefg
6. RD-7	708.0	defg	bcdefg
9. RD-9-14	690.3	defgh	cdefg
7. RD-9-7	666.0	efgh	defg
1. SP75001-68	646.3	fgh	efg
15. RD-19	621.0	gh	fg
14. RD-25	590.0	h	g

Table I-2

Grain yield of varieties/Entries

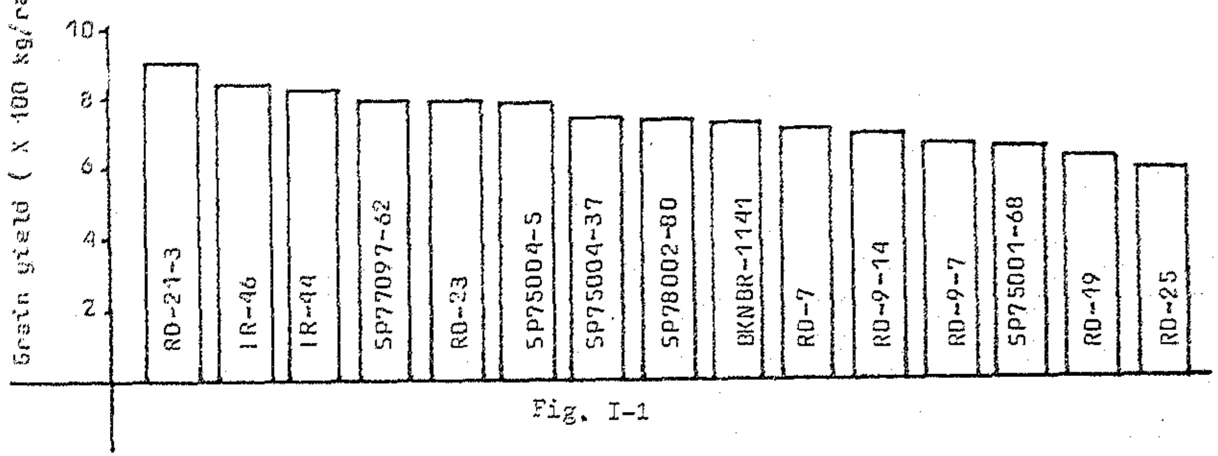


Fig. I-1

Yield Components and related figures on different variaties/entries

Varieties Entries	50% Heading		Maturity		Yield Components				Estimated yield (g/m²)	Panicle length (cm)	Stem length (cm)	Grain/ straw ratio	% of productive Tillers(%)	Plant Height (cm)
	Date	DAT	Date	DAT	Panicles/ m²	Grains/ panicle	Ripened grain (%)	1000 grains Weight(g)						
1. SP75001-68	Feb. 20	60	Mar. 17	86	200.0	80.9	81.7	27.4	362.2	21.7	57.9	119	86.8	87.5
2. SP78002-80	Feb. 27	67	Mar. 23	92	195.2	102.4	88.0	24.0	422.1	25.9	65.6	97	75.8	94.9
3. SP75004-5	Feb. 26	66	Mar. 21	90	222.4	95.7	74.5	28.5	470.8	24.3	75.2	87	69.1	107.1
4. SP75004-37	Feb. 26	66	Mar. 21	90	160.0	123.4	72.8	29.6	446.1	24.2	69.2	145	75.2	101.9
5. SP77097-62	Feb. 28	68	Mar. 26	95	224.0	134.2	70.3	26.5	560.0	24.6	85.1	117	69.3	119.9
6. RD-7	Mar. 2	71	Mar. 27	96	169.6	106.8	74.4	27.0	363.8	24.0	71.3	91	67.1	103.2
7. RD-9-7	Feb. 27	67	Mar. 21	90	156.8	107.8	69.6	28.6	336.5	23.9	67.6	102	72.0	99.4
8. BKNBR-1141	Feb. 27	67	Mar. 23	92	180.8	113.3	79.1	29.2	473.1	27.3	88.7	115	87.6	124.0
9. RD-9-14	Feb. 28	68	Mar. 23	92	174.4	98.5	67.1	28.0	322.7	22.6	65.6	100	72.2	98.6
10. RD-21-3	Feb. 28	68	Mar. 24	93	137.6	152.1	74.1	28.0	434.2	24.9	76.7	98	76.8	110.6
11. RD-23	Mar. 1	70	Mar. 26	95	179.2	127.2	71.2	27.6	448.0	24.8	71.7	55	67.5	108.2
12. IR-44	Mar. 1	70	Mar. 26	95	160.0	81.9	88.1	26.8	309.4	22.0	58.2	116	54.6	89.1
13. IR-46	Feb. 27	67	Mar. 24	93	180.8	126.0	83.1	24.0	454.3	22.1	69.8	129	60.5	101.5
14. RD-25	Feb. 13	53	Mar. 14	83	132.8	97.4	89.8	29.3	340.3	23.0	62.4	159	80.6	95.3
15. RD-19	Feb. 29	69	Mar. 27	96	153.6	93.5	66.5	32.2	307.5	20.9	65.1	122	51.1	93.6
Mean ($\bar{X}$)		66.5		92.0	175.1	110.1	76.7	27.8	403.4	23.7	70.0	112.1	71.08	102.3
S.D.		4.5		3.7	27.0	20.1	7.8	2.1	74.6	1.7	8.7	21.1	10.4	10.4

Table I-3

Fig. I-2

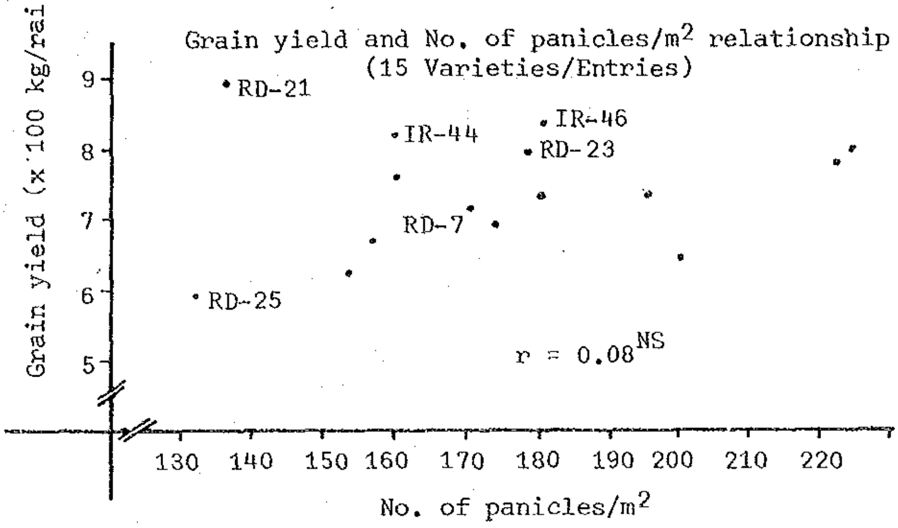
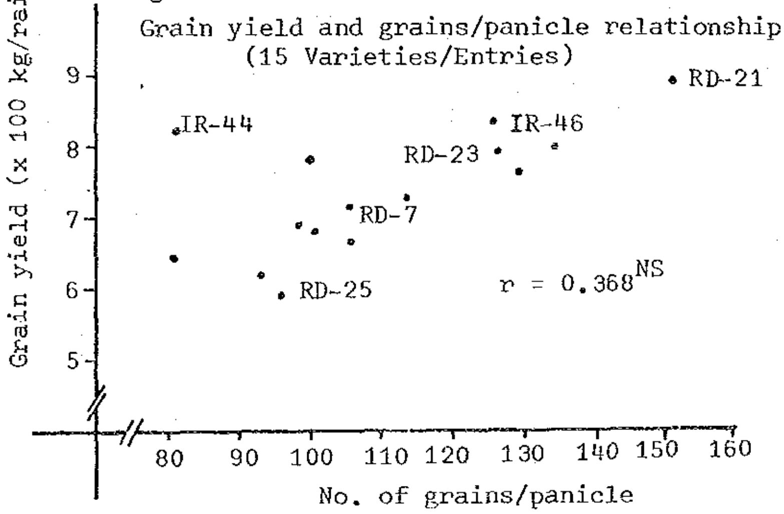


Fig. I-3



The different varieties or entries are having different characteristics and different manners to grow.

Fig. I-2 and I-3 shows relationship between grain yield and number of panicles/m^2 and number of grains/panicles.

Some varieties having higher tillering capacity or produced more panicles/m^2 than others or Viceversa. Similarly in panicle size or number of grains/panicle.

Low computed r-value (correlation coefficients) indicate that there is no significant relationship between mean grain yield and panicles/m^2 or grain/panicle of different varieties/entries since they have their own characteristics.

(Table I-3)

(15 Varieters/Entries)

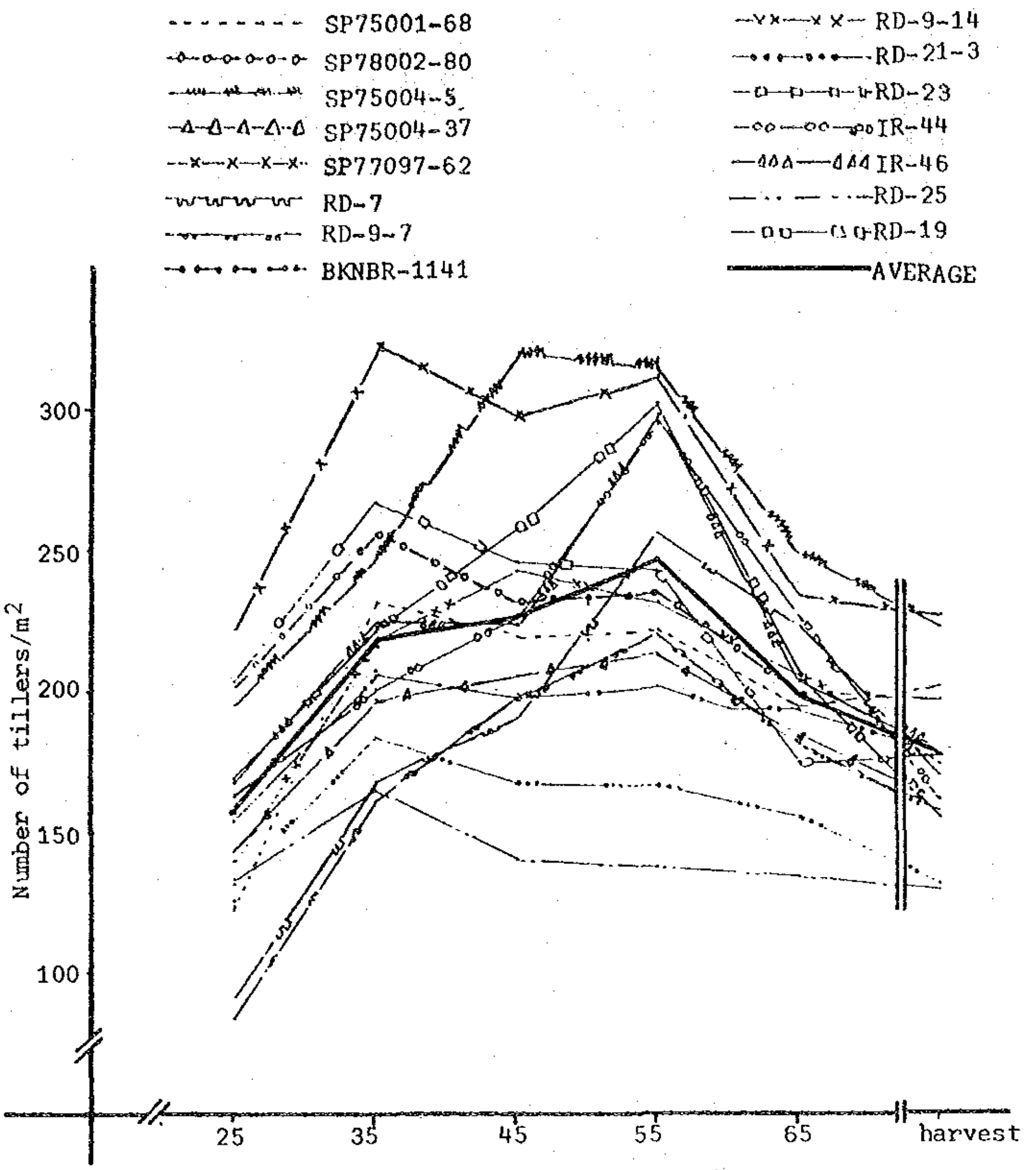


Fig. I-4

Growth observation of Varietal Comparative Study

Dry Season 1983-84

Treatments (Entries)	Days After Transplanting										Harvest Panicle/m²
	25 DAT		35 DAT		45 DAT		55 DAT		65 DAT		
	Tillers/ m²	Plant Height	Tillers/ m²	Plant Height	Tillers/ m²	Plant Height	Tillers/ m²	Plant Height	Tillers/ m²	Plant Height	
1. SP75001-68	123.2	37.1	230.4	48.8	222.4	61.4	228.8	76.2	211.0	87.5	200.0
2. SP78002-80	201.6	38.3	257.6	50.5	232.0	67.7	238.4	68.7	198.4	94.9	195.2
3. SP75004-5	193.6	37.4	248.0	59.9	321.6	68.8	313.6	83.7	248.0	107.1	222.4
4. SP75004-37	142.4	30.9	196.8	50.7	204.8	61.0	212.8	79.7	185.6	101.6	160.0
5. SP77097-62	225.6	38.2	323.2	52.7	294.4	64.3	310.4	80.4	230.0	115.6	224.0
6. RD-7	91.2	36.1	168.0	43.8	216.0	52.6	252.8	65.9	208.0	88.8	169.6
7. RD-9-7	84.8	40.8	160.0	50.7	196.8	61.8	217.6	73.4	182.8	99.3	156.8
8. BKNBR-1141	152.0	43.3	206.4	55.6	196.8	75.4	200.0	92.1	184.0	124.0	180.8
9. RD-9-14	140.8	42.4	216.0	52.3	241.6	63.6	236.8	69.2	203.2	98.6	174.4
10. RD-21-3	137.6	43.9	179.2	54.5	166.4	70.8	164.8	84.4	152.0	109.6	137.6
11. RD-23	203.2	40.0	265.6	55.4	244.8	73.1	243.2	85.2	197.0	108.2	179.2
12. IR-44	161.6	32.4	200.0	44.2	225.6	58.1	292.8	67.9	222.4	89.1	160.0
13. IR-46	168.0	38.2	232.0	51.1	224.0	66.4	297.6	79.1	201.6	101.5	180.0
14. RD-25	131.2	42.7	164.8	57.5	133.2	72.1	136.0	93.6	134.4	87.5	132.8
15. RD-19	160.6	36.3	204.8	47.9	256.0	52.8	300.8	63.4	203.2	93.1	[illegible]
Mean($\overline{X}$)	155.1	39.1	215.8	51.4	225.5	64.7	243.1	77.9	197.4	[illegible]	[illegible]
S.D.	40.2	3.2	44.3	4.0	45.3	7.0	53.2	9.3	28.3	10.9	23.0

Table I-4

Resutls and Discussion :

1. Grain yield

Productivity of 15 varieties/entries were compared in terms of mean grain yield at 14% moisture.

Among 15 varieties, RD-23 is the most popular variety in the Chao Phya Pilot Project area covering nearly all of the farmer's field within the project. RD-21 is occasonally planted by few farmers.

The results of comparative study shows that RD-21-3 produced highest mean grain yield in this season. It is significantly higher grain yield over RD-23 at 5% level of significance. This is converse result from last Wet season.

IR-46 and IR-44 were belong to high yielding group.

Among RD- varities, the yield of RD-25, 19, 9 and 7 were significantly lower than the yield of RD-21-3 even at 1% level of significance.
(refer to Table I-1, 2 Fig. I-1)

2. Observation of yield components & related figures

The incidence of RRSV (Rice Ragged Stunt Virus) was much less than last Wet season crop. It is judged that RRSV infection did not influence much to the grain yield in this Dry season.

Yield components and related figures are shown in Table I-3. RD-21-3 with greater number of grains/panicle is evident cause for high yield even number of panicles/m^2 is low. RD-23 was observed to be moderate level of tillering capacity with relatively bigger panicles among varieties tested.

Conclusion :

In consequence of the trial results, varieties of RD-21 and RD-23 were found to be superior to other RD-varieties in this locality.

It is concluded that these two varieties can be kept as a recommended varieties in this area at present.

So far recommendation of rice varieties of RD-23 and RD-21 have been quite successful and production level of farmer's field has been increased up to satisfactory level especially after introduction of RD-23.

However, there is no perfect varieties against every factors related to production. Continuous study is absolutely needed to assess and to select promising varieties suited in the locality in addition to RD-23 and RD-21.

AT least 3-4 promising varieties should be selected and multiplied at Trial Farm ready to supply for the farmers.

Dry Season, 1983-84

II. Nitrogen Source Comparative Trail

Objectives :

1. To determine the effect of GML*, HSC** and Ammonium Sulphate on the growth and yield of rice under Chao Phya Pilot Project conditions.

2. To Study the best fertilizing method for profitable and economical rice production.

Experimental Design : RCBD with 3 Replications.

Treatments : (kg. N/rai)

Treatments :	Basal	Topdress	Total
1	0	0	0
2	6 (GML)	0	6
3	6 (HSC)	0	6
4	6 (A.S.)	0	6
5	6 (GML)	6 (A.S.)	12
6	6 (HSC)	6 (A.S.)	12
7	6 (A.S.)	6 (A.S.)	12
8	12 (GML)	0 (	12
9	12 (HSC)	0	12
10	12 (A.S.)	0	12
11	12 (GML)	6 (A.S.)	18
12	12 (HSC)	6 (A.S.)	18
13	12 (A.S.)	6 (A.S.)	18

Top dress of Nitrogen applied at panicle initiation stage.

Variety used : RD-23

Plot Size : 5 m. X 4 m. = 20 m^2.

Cultural Practices :

1. Seed rate : 4.0 kg. of dry seed/rai
2. Seedling age : 20 days
3. Planting density and number of seedlings/hill
   25 X 25 cm. (16 hills/m^2) 3 seedlings/hill
4. Weed control : Saturn G applied at 5 days before transplanting at a rate of 5 kg./rai
5. Plant Protection :
   (1) Furadan G : 2 weeks after transplanting at a rate of 5 kg./rai
   (2) Padan Mipcin : 5 weeks after transplanting " " "
6. Duration

Sowing	:	December 1, 1983
Transplanting	:	December 22, 1983
Harvesting	:	March 28, 1984

Note : * GML : Glutamic Mother Liquor (4.6% N. in Volume)
** HSC : Humus Soil Conditioner (4.0% N. in weight)

Trial No. II   Grain Yield (kg/rai)

Treatments No.	Treatment	Replications I	II	III	Mean ($\bar{X}$)
1.	Control (0-0)	418	504	480	467.3
2.	6 (GML)-0	639	589	617	615.0
3.	6 (OSC)-0	560	544	496	533.3
4.	6 (A.S.)-0	581	623	558	587.3
5.	6 (GML)-6 (A.S.)	726	833	810	789.7
6.	6 (OSC)-6 (A.S.)	811	828	718	785.7
7.	6 (A.S.)-6 (A.S.)	653	821	826	766.7
8.	12 (GML)-0	671	702	592	655.0
9.	12 (OSC)-0	698	709	645	684.2
10.	12 (A.S.)-0	792	831	681	768.0
11.	12 (GML)-6 (A,S.)	707	958	825	830.0
12	12 (OSC)-6 (A.S.)	858	958	924	913.3
13.	12 (A.S.)-6 (A.S.)	790	910	859	853.0
	Mean ($\bar{X}$)	684.9	754.6	694.7	711.4

Table II-1

ANOVA

SV	DF	SS	MS	F	Required F 5%	1%
Total	38	745248				
Treatments	12	638059	53171	18.19**	2.18	3.03
Block	2	37021	18510	6.33**	3.40	5.61
Error	24	70168	2923			

LSD for treatment : 5% = 91.1 (kg/rai)
1% = 123.4 (kg/rai)

CV = 7.60 (%)

Duncan's Multiple Range Test

Treatments		Mean Yield (kg/rai)	DMRT 5%	1%
12.	12(OSC)-6(A.S.)	913.3	a	a
13.	12(A.S.)-6(A.S.)	853.0	ab	ab
11.	12(GML)-6(A.S.)	830.0	ab	ab
5.	6(GML)-6(A.S.)	789.7	b	abc
6.	6(OSC)-6(A.S.)	785.7	b	abc
10.	12(A.S.)-0	768.0	bc	bc
7.	6(A.S.)-6(A.S.)	766.7	bc	bc
9.	12(OSC)-0	684.2	cd	cd
8.	12(GML)-0	655.0	d	cde
2.	6(GML)-0	615.0	de	de
4.	6(A.S.)-0	587.3	de	def
3.	6(OSC)-0	533.3	ef	ef
1.	Control (0-0)	467.3	f	f

Table II-2

Yield Components and related figures on different treatments

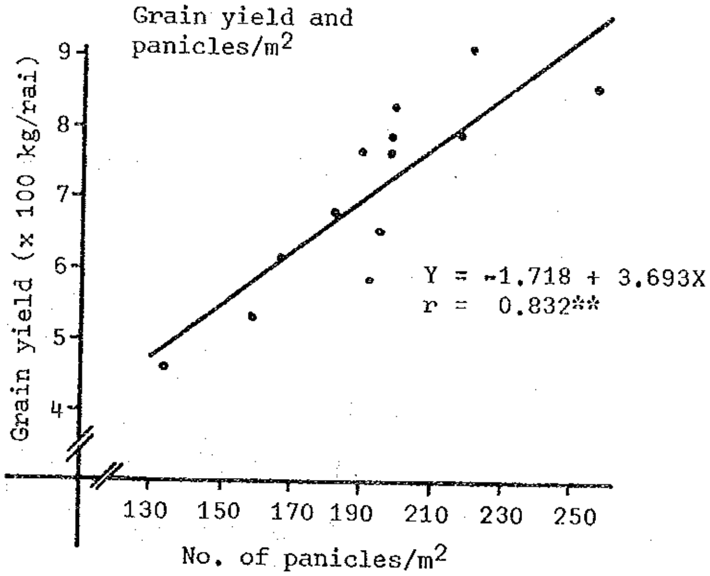
Treatments	Yield Components				Estimated Yield (g/m2)	Panicle length (cm)	Stem length (cm)	Grain/ straw ratio
	Panicle/m2	Grain/ panicle	Ripened grain (%)	1000 grains weight (g)				
1. Control (0-0)	132.8	85.9	75.7	26.0	224.5	22.0	60.0	107
2. 6(GML)-0	168.0	101.4	80.1	27.0	368.4	24.3	67.7	101
3. 6(OSC)-0	164.8	122.4	74.8	26.1	393.7	24.6	67.8	116
4. 6(A.S.)-0	192.0	109.3	69.4	27.7	403.4	24.2	70.6	102
5. 6(GML)-6(A.S.)	217.6	109.3	75.8	27.6	497.6	24.6	66.8	114
6. 6(OSC)-6(A.S.)	193.6	139.5	74.3	27.6	554.2	26.7	73.4	130
7. 6(A.S.)-6(A.S.)	198.4	124.1	77.2	27.7	526.5	26.2	71.7	109
8. 12(GML)-0	195.2	100.5	78.7	27.3	421.3	24.2	69.0	109
9. 12(OSC)-0	182.4	112.7	77.8	26.8	429.0	24.4	67.5	109
10. 12(A.S.)-0	188.8	113.2	73.7	28.0	441.3	24.4	72.7	114
11. 12(GML)-6(A.S.)	198.4	102.6	72.0	27.3	400.3	23.3	66.0	102
12. 12(OSC)-6(A.S.)	220.8	132.2	73.2	27.6	592.9	25.7	73.4	114
13. 12(A.S.)-6(A.S.)	257.6	[illegible]	72.2	27.8	728.0	26.8	79.4	[illegible]
Mean ($\overline{X}$)	193.1	115.0	75.0	27.3	460.1	24.8	69.7	113.6
S.D.	30.0	16.3	3.0	0.6	123.1	1.4	4.7	13.3

Table II-5

Nitrogen (kg N./rai) Basal - Top Dressing	Yield Component				Estimated Yield (g/m2)	Panicle length (cm)	Stem length (cm)	Grain/ Straw ratio
	Panicle/m2	Grains/ panicle	Ripened grain (%)	1000 grains weight				
12 - 6	225.6	125.4	72.5	27.6	573.7	25.6	72.9	122.0
6 - 6	203.2	124.3	75.8	27.6	526.1	25.8	70.6	117.7
12 - 0	188.8	108.8	76.7	27.4	430.5	24.3	69.7	110.7
6 - 0	174.6	111.0	74.8	27.0	388.5	24.4	68.7	106.3
Control	132.8	85.9	75.7	26.0	224.5	22.0	60.0	107.0
Mean ($\overline{X}$)	185.0	111.1	75.1	27.1	428.7	24.4	68.4	112.7

Table II-6

Fig. II-4
Grain yield and panicles/m2



Comparison among mean yield of Nitrogen levels regardless N. source

Nitrogen levels (kg N./rai)	Mean yield (kg/rai)	DMRT	
		5%	1%
12 - 6	865	a	a
6 - 6	781	ab	ab
12 - 0	702	b	bc
6 - 0	578	c	c

Table II-3

LSD (5%) : 101.7 (kg/rai)
(1%) : 136.9 (kg/rai)

CV : 8.33 (%)

Comparison among mean yield of Nitrogen Sources & Levels
(kg/rai)

Nitrogen Sources	Nitrogen levels (kg/rai)				Mean ($\bar{X}$)
	6 - 0	6 - 6	12 - 0	12 - 6	
GML + A.S.	615	789	655	830	722.2
OSC + A.S.	533	785	684	913	728.7
A.S.+ A.S.	587	766	768	853	743.5
Mean ($\bar{X}$)	578	781	702	865	731.5

Table II-4

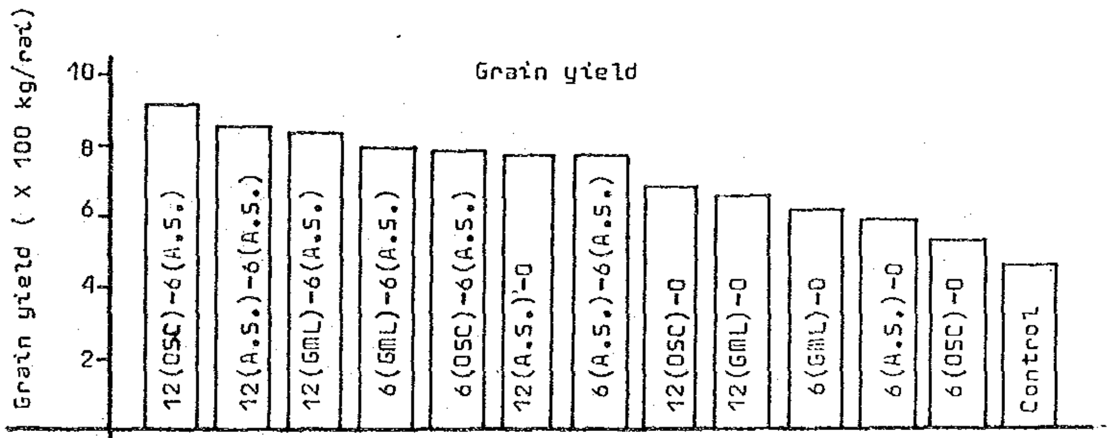


Fig. II-1

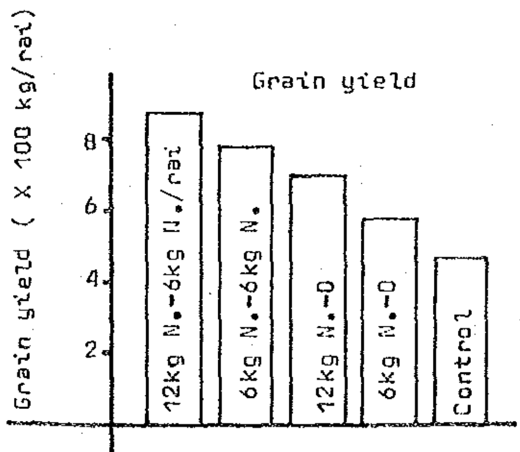


Fig. II-2

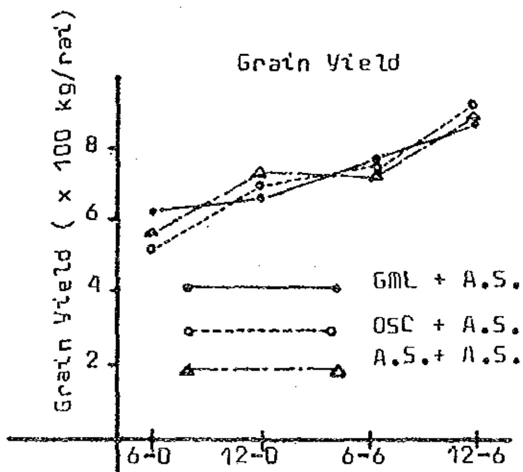
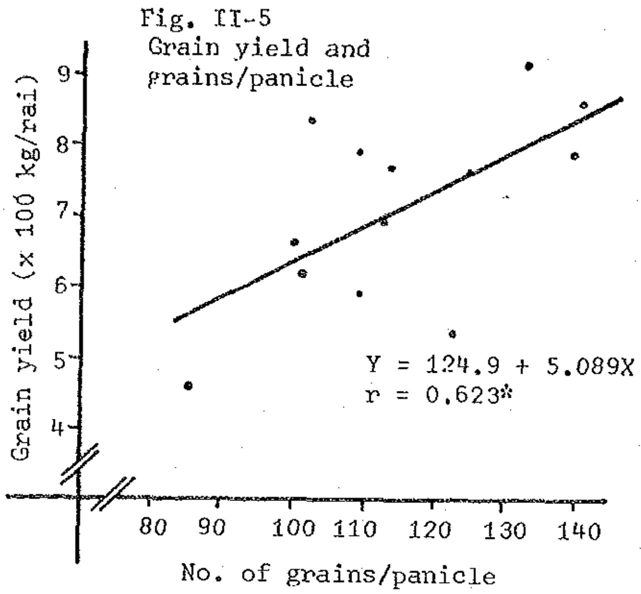


Fig. II-3



Results and Discussion :

1. Grain yield

The mean grain yield were not influenced by the Nitrogen source itself, since no significant difference were observed among the grain yield of different sources of Nitrogen.

However, amount of Nitrogen is significantly related to the mean grain yield regardless N. sources; i.e., the yield of highest dose of N. (12-6kgN./rai) was significantly higher than the yield of (12-0kgN./rai), (6-0kgN./rai) and control(0-0).

When the same amount of N. applied, split application was observed to be better grain yield than the basal application only though difference is not significant (6-6kgN./rai VS. 12-0kgN./rai). 6kg of additional N. top dressed at panicle initiation stage significantly increased the mean grain yield even 1% level of significance.

(Table II-2-4, Fig. II-1-3)

2. Yield components and related figures

Panicles/m^2 and grains/panicle are closely related to Nitrogen level; i.e. both of two factors increased in parallel with Nitrogen levels. Thus grain yield increased.

Top dressing of N. at panicle intiation stage seemed to promote particularly in increasing number of grains/panicle.

% of ripened grain and 1000 grains weight were not very influenced by the Nitrogen application in this case.

(Table II-5-6, Fig. II-4-5)

Partial Budget Analysis
(1) Diminance analysis

Treatments	Grain yield (kg/rai)	Gross benefit (B/rai)	Variable cost (B/rai)			Net benefit (B/rai)
			Fertilizer	Opportunity cost	Total	
1. Control (0-0)	421	1226	-	-	-	1226
2. 6(GML)-0	554	1613	57.4	5.0	62.4	1551
3. 6(OSC)-0	480	1399				
4. 6(A.S.)-0	529	1541	65.7	16.0	81.7	1459*
5. 6(GML)-6(A.S.)	711	2072	123.1	21.0	144.1	1926
6. 6(OSC)-6(A.S.)	707	2061				
7. 6(A.S.)-6(A.S.)	690	2011	131.4	32.0	163.4	1848*
8. 12(GML)-0	590	1718	114.8	5.0	119.8	1598
9. 12(OSC)-0	616	1794				
10. 12(A.S.)-0	691	2015	131.4	24.0	155.4	1859*
11. 12(GML)-6(A.S.)	747	2178	180.5	21.0	201.5	1977
12. 12(OSC)-6(A.S.)	822	2396				
13. 12(A.S.)-6(A.S.)	768	2238	197.1	40.0	237.1	2001
Mean (X)	640	1866				

Table II-7

Note : The Treatments with * mark were dominated.

(2) Marginal analysis
Marginal rate of return of undominated treatments

Undominated Treatments	Net benefit (B/rai)	Variable cost (B/rai)	Marginal rate of return	
			VS. next highest benefit	VS. check (control)
13. 12(A.S.)-6(A.S.)	2001	237.1	67.4(%)	326.9(%)
11. 12(GML)-6(A.S.)	1977	201.5	85.4	372.7
5. 6(GML)-6(A.S.)	1928	144.1	1358.0	487.2
8. 12(GML)-0	1598	119.8	81.9	310.5
2. 6(GML)-0	1551	62.4	520.8	520.8
1. Control(0-0)	1226	-		

Note : OSC is excluded in economic analysis since it is not commercialized yet.

Table II-8

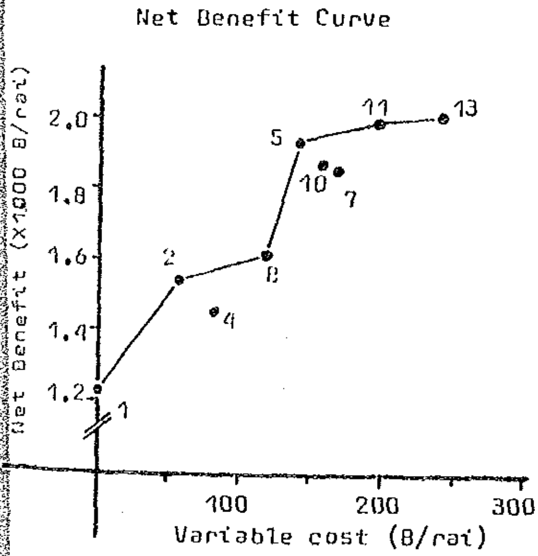


Fig. II-6

From the econmic point, in consequence of partial budget analysis indicate that the highest marginal rate of return among undominated treatments was obtained from the treatment of 6(GML)-6(A.S.).

Heavier application 12(GML)-6(A.S.) and 12(A.S.)-6(A.S.) further increased net benefit over 6(GML)-6(A.S.). However marginal rate is not very high.

It is safe to judge that 6kg of Nitrogen/rai as a form of GML applied as basal plus 6kg of N/rai top dressed at panicle initiation stage as a form of Ammonium Sulphate was found to be very profitable and secure application way of Nitrogen fertilizer.

(Table II-7-8, Fig. II-6)

Conclusion :

Nitrogen source did not influence to the grain yield. Quantity of Nitrogen was significantly associated to the grain yield. Split application (basal & top dressing at panicle initiation stage) of Nitrogen seemed to be more profitable than the application of basal only.

Right amount of Nitrogen fertilizer applied at right time greatly contribute in increasing grain yield as well as net benefit.

Basal application of 6kgN./rai plus top dressing of the same amount of Nitrogen at panicle intiation stage was found to be safety and highly profitable. More Nitrogen applied as basal dose provided little more net benefit increment.

III. Nitrogen X Phosphorus Fertilizer Trial

Objectives :

1. To study the effect of Nitrogen and Phosphorus fertilizer on the growth and yield of rice.

2. To determine an optimum economic fertilizer rate under Chao Phya Pilot area conditions.

Experimental Design :

RCBD Factorial with 2 Replications.

In the first block (Replication) only, the treatments were arranged for demonstration purposes with Nitrogen increasing along one direction and Phosphorus along the other direction.

Treatments :

Nitrogen	N_0	: No N.applied
(as A.S.)	N_1	: 6 kg. N/rai
	N_2	: 12 kg. N/rai
	N_3	: 18 kg. N/rai
Phosphorus	P_0	: No P. applied
(as TSP)	P_1	: 5 kg. P/rai
	P_2	: 10 kg. P/rai

Application method : (N. kg./rai)

N. Level	Basal	1st T.D. (15 D.A.T.)	2nd T.D. (P.I.S.)	Total N
N_0	0	0	0	0
N_1	6	0	0	6
N_2	6	3	3	12
N_3	10	4	4	18

Phosphorus applied as a basal before transplanting

Plot Size : 5 m. X 4 m. (20 m^2)

Variety used : RD-23

Cultural Practices :

1. Seed rate : 4 kg./rai (dry seed)
2. Seedling age : 20 days
3. Planting density : 25 X 25 cm. (16 hills/m^2)
4. Weed control : Manual Weeding
5. Plan Protection :
   (1) At a rate of 5 kg./rai of Furadan Granule applied at 15 days after transplanting.
   (2) Padan Mipcin applied at 35 days after transplanting at a rate of 5 kg./rai.

6. Duration

Sowing	:	December 1, 1983
Transplanting	:	December 22-23, 1983
Harvesting	:	March 28, 1984

Trial No. III Grain Yield (kg/rai)

Treatments No.	Treatment		Replications I	II	Mean ($\bar{X}$)
1.	$N_0 P_0$	(0-0)	472	482	477.0
2.	$N_0 P_1$	(0-5)	454	494	474.0
3.	$N_0 P_2$	(0-10)	491	396	443.5
4.	$N_1 P_0$	(6-0)	485	707	596.0
5.	$N_1 P_1$	(6-5)	597	599	598.0
6.	$N_1 P_2$	(6-10)	585	639	612.0
7.	$N_2 P_0$	(12-0)	881	911	896.0
8.	$N_2 P_1$	(12-5)	1044	858	951.0
9.	$N_2 P_2$	(12-10)	903	1110	1006.5
10.	$N_3 P_0$	(18-0)	1066	1165	1115.5
11.	$N_3 P_1$	(18-5)	1043	1149	1096.0
12.	$N_3 P_2$	(18-10)	1152	1131	1141.5
	Mean ($\bar{X}$)		764.4	803.4	783.9

Table III-1

ANOVA

SV	DF	SS	MS	F	Required F 5%	1%
Total	23	1742966				
Treatment	11	1661590	151053	23.0**	2.82	4.46
Block	1	9126	9126	1.39	4.48	9.65
Nitrogen	(3)	1645617	548539	83.5**	3.59	6.22
Phosphorus	(2)	3748	1874	0.28	3.98	7.20
N X P	(6)	12225	2037	0.31	3.09	5.07
Error	11	72250	6568			

LSD : Between Nitrogen Means 5% = 103.00 (kg/rai)
1% = 145.33 (kg/rai)

Between Phosphorus Means 5% = 89.19 (kg/rai)
1% = 125.86 (kg/rai)

CV = 14.62 (%)

Treatment means : (Grain Yield : kg/rai)

Nitrogen	Phosphorus P_0	P_1	P_2	Nitrogen mean	DMRT (5%)
N_0	477.0	474.0	443.5	468.8	a
N_1	596.0	598.0	612.0	602.0	b
N_2	896.0	951.0	1006.5	951.1	c
N_3	1115.5	1096.0	1141.5	1117.6	d
Mean ($\bar{X}$)	771.12	779.75	800.87	783.75	

Table III-2

Fig. III-1
Mean Grain Yield in relation to Nitrogen and Phosphorus

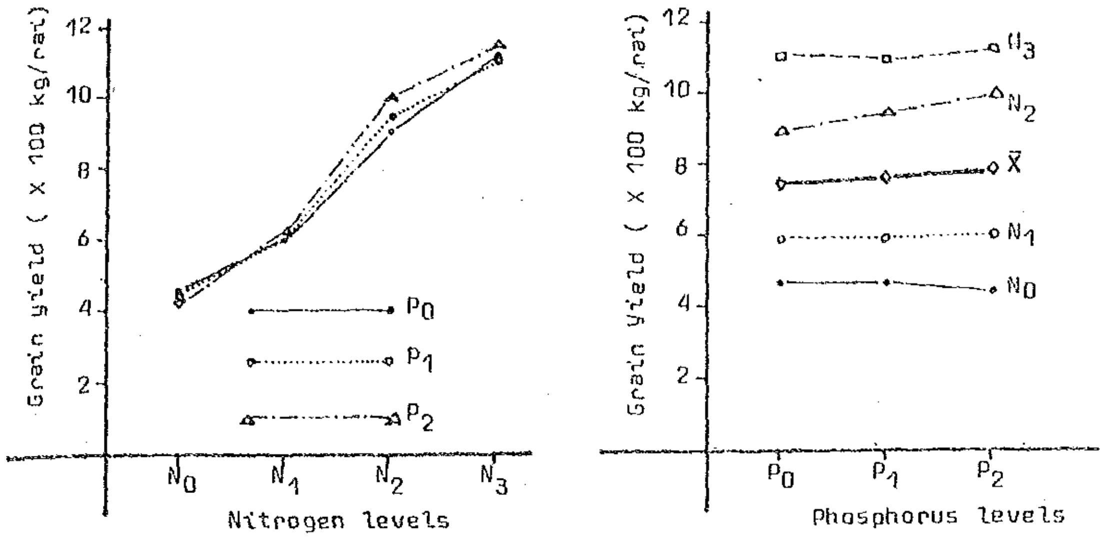


Fig. III-2
Nitrogen X Phosphorus

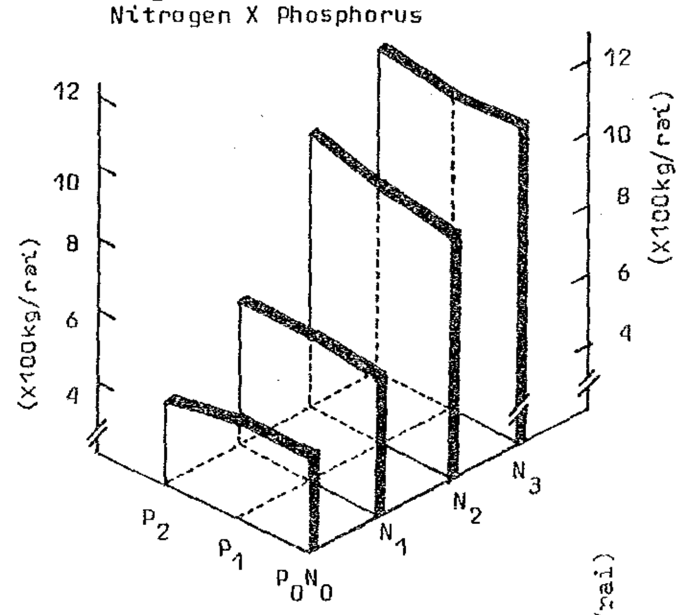
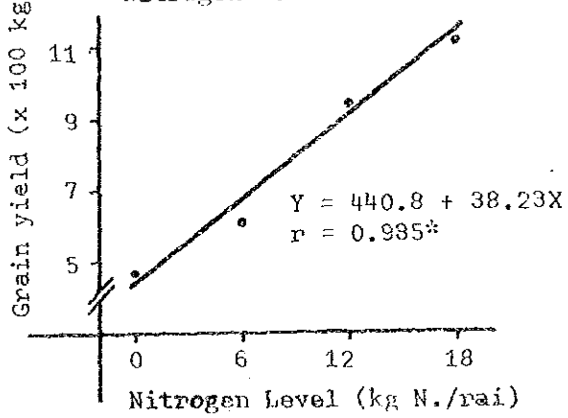


Fig. III-3
Grain yield and
Nitrogen correlation



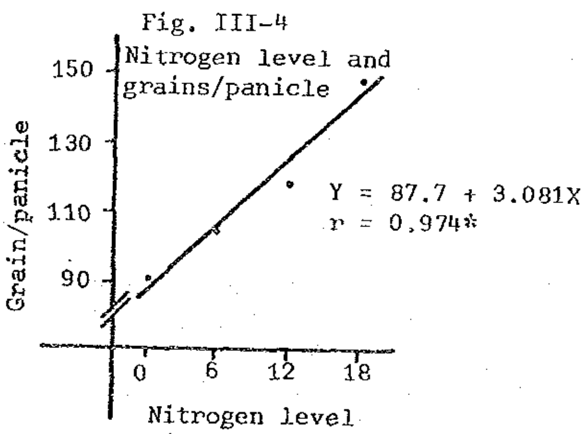
Yield Component and related figures on different treatments

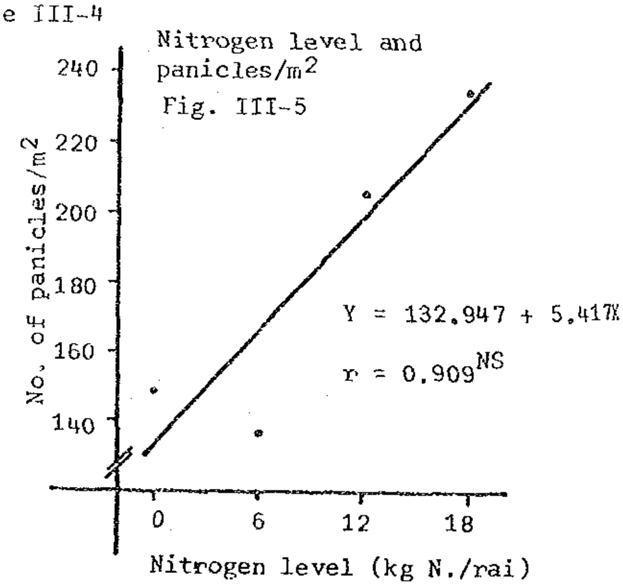
Treatments	Yield Components				Estimated Yield (g/m^2)	Panicle length (cm)	Stem length (cm)	Grain/straw ratio
	Panicle/m^2	Grain/panicle	Ripened grain (%)	1000 grains weight (g)				
1. N_0 P_0	150.4	86.8	79.8	26.1	272.0	22.0	63.8	91
2. N_0 P_1	155.2	88.4	78.0	25.0	267.5	23.7	60.8	113
3. N_0 P_2	140.8	96.6	81.2	25.0	276.1	22.6	60.1	115
4. N_1 P_0	142.4	113.2	76.1	25.0	306.7	23.6	65.4	98
5. N_1 P_1	140.8	101.1	74.3	26.6	281.3	22.4	63.2	99
6. N_1 P_2	129.6	102.3	80.0	27.0	286.4	23.4	62.0	111
7. N_2 P_0	190.4	120.3	73.4	26.1	472.4	24.6	75.2	107
8. N_2 P_1	208.0	124.8	70.9	29.1	517.2	25.2	79.2	114
9. N_2 P_2	220.8	109.4	69.2	28.0	465.0	24.5	76.7	90
10. N_3 P_0	232.0	133.2	74.9	29.0	549.1	25.0	94.2	110
11. N_3 P_1	230.4	164.7	72.8	28.1	776.3	26.4	83.8	126
12. N_3 P_2	240.0	145.9	80.5	28.5	803.3	26.3	85.1	129
Mean ($\overline{X}$)	181.7	115.5	76.0	27.0	448.0	24.2	71.6	108.6
S.D.	42.5	23.6	4.0	1.4	201.5	1.6	10.0	12.4

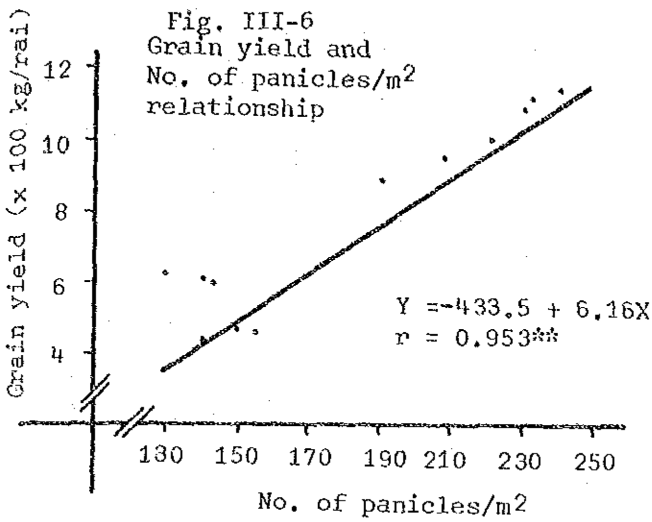
Table III-3

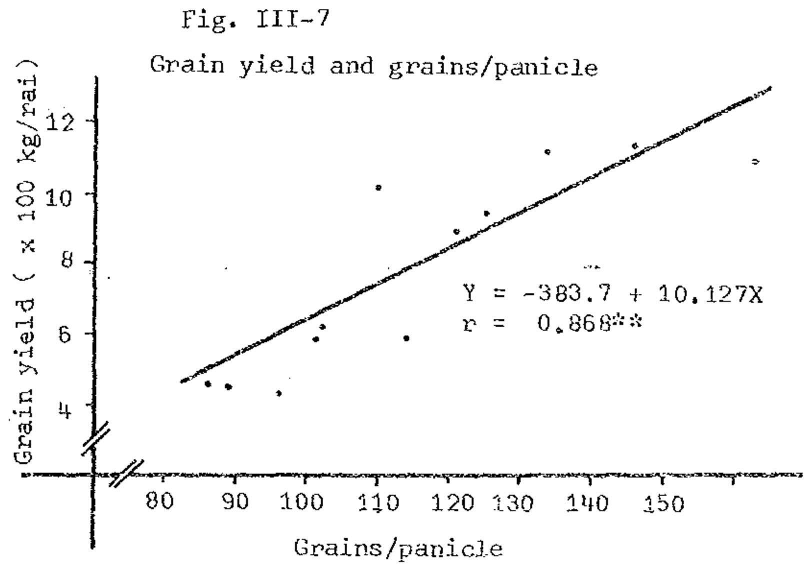
Fertilizer levels	Yield Component				Estimated grain yield (g/m^2)	Panicle length (cm)	Stem length (cm)	Grain/Straw ratio
	Panicles/m^2	Grains/panicle	Ripened grain (%)	1000 grains weight				
N_0	148.0	90.6	79.7	25.4	272.0	22.8	61.6	106.3
N_1	137.6	105.5	76.8	26.2	291.5	23.1	63.5	102.7
N_2	206.4	118.2	71.2	28.1	486.0	24.8	77.0	104.0
N_3	234.1	148.0	76.1	28.2	742.6	26.2	84.4	121.7
P_0	178.7	113.4	76.0	26.8	424.8	24.0	72.2	101.5
P_1	183.6	119.7	74.0	27.0	461.3	24.4	71.7	113.0
P_2	182.8	113.5	77.7	27.1	458.4	24.2	71.0	111.2
Mean (X)	181.7	115.5	76.0	27.0	448.0	24.2	71.6	108.6

Table III-4









<u>Results and Discussion</u> :

1. Grain yield

The mean grain yield was very much related with Nitrogen quantity. The effect of Nitrogen was great since the <u>grain yield was increased along with the increment of Nitrogen levels.</u>

Between every Nitrogen levels, significant differences were observed on the grain yield. Whereas <u>no siginificant effect of Phosphorus</u> obtained for yield.

Grain yield was especially increased when Nitrogen level increased from N_1(6kgN./rai) to N_2 (12kgN./rai). Between N_1 and N_2 58kg of grain increased in every 1kg of additional Nitrogen.

(Table III-2, Fig. III-1-2)

Estimated linear regression based on the actual grain yield indicates clear relationship between grain yield and Nitrogen level. From this equation effect of <u>every 1kg of additional Nitrogen produced 36kg of dry grain within the N. level of 0-18kgN./rai</u>

(Fig. III-3)

- Cont.-

Partial Budget Analysis
(1) Dominance Analysis

Treatments	Grain yield (kg/rai)	Gross benefit (B/rai)	Variable cost (B/rai)			Net Benefit (B/rai)
			Fertilizer	Opportunity cost	Total	
1. N_0P_0	429	1251	-	-	-	1251
2. N_0P_1	427	1244	65.2	16	81.2	1163*
3. N_0P_2	399	1163	130.4	16	146.4	1017*
4. N_1P_0	536	1564	65.7	16	81.7	1482
5. N_1P_1	538	1569	130.9	16	146.9	1422*
6. N_1P_2	551	1696	196.1	16	212.1	1394*
7. N_2P_0	806	2351	131.4	48	179.4	2172
8. N_2P_1	856	2495	196.6	48	244.6	2250
9. N_2P_2	906	2641	261.8	48	309.8	2331*
10. N_3P_0	1004	2927	197.1	48	245.1	2682
11. N_3P_1	986	2875	262.3	48	310.3	2565*
12. N_3P_2	1027	2995	327.5	48	375.5	2620*

Note : * : dominated treatments

Table III-5

(2) Marginal analysis

Undominated Treatments	Net benefit (B/rai)	Variable cost (B/rai)	Marginal rate of return	
			VS. next highest benefit	VS. check (control)
10. N_3P_0	2682	245.1	86400.0 (%)	538.8 (%)
8. N_2P_1	2250	244.6	119.6	408.4
7. N_2P_0	2172	179.4	706.2	513.4
4. N_1P_0	1482	81.7	282.7	282.7
1. N_0P_0	1251	-	-	-

Table III-6

Net benefit curve

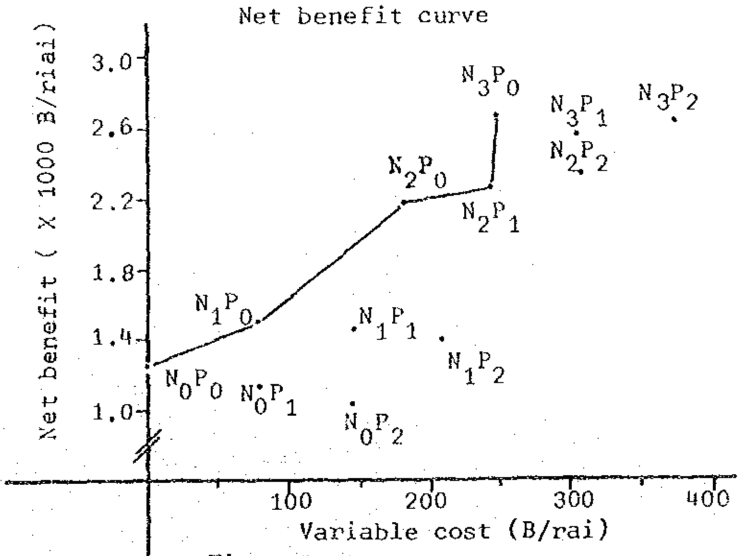


Fig. III-8

2. Observation of Yield components and related figures

The effect of Nitrogen to grain yield was mainly in incresasing number of panicles per unit area and number of grains per panicle.

Whereas ripened grain% was not affected by the Nitrogen application and 1000 grains weight was slightly increased while Nitrogen level increased.

Simple linear regression shows the clear evidence of close relationship between grain yield and panicles/m^2 and grains/panicle due to the Nitrogen application.

On the contrary, Phosphorus application did not influence to any of the yield component factors at all.

(Table III-3-4, Fig. III-4-7)

3. Economy of Nitrogen and Phosphorus application

Great effect of Nitrogen application appeared to be very profitable from this trial results.

N_3P_0 (Total N. of 18kg/rai) without Phosphorus) treatment gave the highest net benfit with extremely high marginal rate of return.

In this trial the application of Phosphorus fertilizer was not profitable.

(Table III-5-6, Fig. III-8)

Conclusion :

Nitrogen response to grain yield was remarkable, whereas no Phosphorus effect was recognized.

The most profitable treatment was found to be 18kgN./rai (10kgN. for basal, 4kgN. at 15 days after transplanting and another 4kgN. top dressed at panicle initiation stage) without Phosphorus fertilizer. 12kgN./rai provided satisfactory production level also.

In general circumstances, Nitrogen level of around 12kg/rai seemed to be suitable and profitable when risk factor and production stability are taken into consideration.

IV. Planting Method Comparative Study

Objectives :

1. To compare the performance of different planting methods i.e. Mechanical transplanting, manual transplanting and direct sowing on the grain yield and economy of rice production.
2. To study the suitability/adaptability of planting methods under Chao Phya Pilot area condition.

Experimental Design :

RCBD with 4 replications

Treatments :

No. 1 : Mechanical Transplanting
No. 2 : Manual Transplanting
No. 3 : Direct Sowing (Broadcast)

Plot Size :

Each experimental unit consists of 5 m. X 8m. = 40 m^2.

Cultural Practices :

1. Seed rate : Selected dry seed of 4.0 kg./rai for Mechanical & Manual Transplanting and 12.0 kg./rai for direct sowing.
2. Variety : RD-23
3. Weed Control : Apply Saturn G at 15 days after transplanting and broadcasting at a rate of 5 kg./rai.
4. Fertilizer Application :
   (1) Mechanical & Manual Transplanting
   Basal : 6 kg. of N and 7.5 kg. of P/rai with 16-20-0
   1st topdress : 5 kg. of N/rai at 15 days after transplanting (A.S.)
   2nd topdress : 4 kg. of N/rai at panicle initiation stage (A.S.).
   (2) Direct Sowing
   No fertilizer applied before sowing.
   1st application : 6 kg. of N and 7.5 kg. of P/rai at 15 days after sowing with 16-20-0.
   2nd application : 5 kg. of N/rai at 20 days after 1st application (A.S.)
   3rd application : 4kg. of N/rai at panicle initiation stage (A.S.)
5. Plant Protection :
   (1) Furadan G : 15 days after transplanting/broadcasting at a rate of 5 kg./rai
   (2) Padan Mipcin : 35 days after transplanting/broadcasting at a rate of 5 kg./rai
6. Date of planting and harvesting.

Sowing seed (box)	:	December 1, 1983
Transplanting	:	December 23, 1983
Broadcasting (Direct)	:	December 23, 1983
Harvest : Transplanted	:	March 28, 1984
Direct Sowing	:	April 7, 1984

Trial No. IV

Grain Yield (kg/rai)

Treatments No. Treatment	Replications I	II	III	IV	Mean ($\bar{X}$)
1. Mechanical Transplanting	807	821	806	838	818.0
2. Manual Transplanting	802	830	733	854	804.7
3. Direct Sowing	1014	914	943	972	960.7
Mean ($\bar{X}$)	874.3	855.0	827.3	898.0	861.2

Table IV-1

ANOVA

SV	DF	SS	MS	F	Required F 5%	1%
Total	11	74208				
Treatment	2	59852	29926	22.08**	5.14	10.92
Block	3	6228	2076	1.53	4.76	9.78
Error	6	8128	1355			

LSD for treatment : 5% = 63.7 (kg/rai)
1% = 96.45(kg/rai)

CV = 4.27 (%)

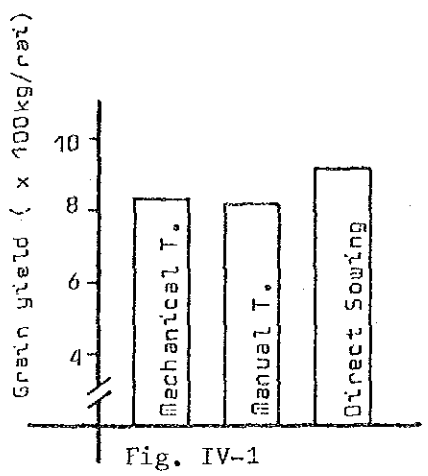


Fig. IV-1

Yield Component and related figures on different treatments

Treatments	Yield Components Panicle/m^2	Grain/ panicle	Ripened grain (%)	1000 grains weight (g)	Estimated Yield (g/m^2)	Panicle length (cm)	Stem length (cm)	Grain/ straw ratio
1. Mechanical Transplanting	214.0	121.3	81.5	26.3	556.4	25.2	71.4	101
2. Manual Transplanting	171.2	120.7	78.5	26.4	428.2	24.7	70.7	110
3. Direct Sowing	366.0	92.9	70.2	28.1	670.7	24.3	69.0	96
Mean($\bar{X}$)	250.4	111.6	76.7	27.0	551.8	24.7	70.4	102.3

Table IV-2

Partial Budget Analysis
(1) Dominance analysis

Treatments	Grain Yield (kg/rai)	Gross benefit (B/rai)	Variable cost (B/rai)			Net benefit (B/rai)
			Seed & nursery	Transplanting Broadcasting	Total	
1. Mechanical T.	736	2146	101	142	243	1903*
2. Manual T.	724	2111	101	150	251	1860*
3. Direct Sowing	865	2520	43	34	77	2443

Note : * : dominated treatments

Table IV-3

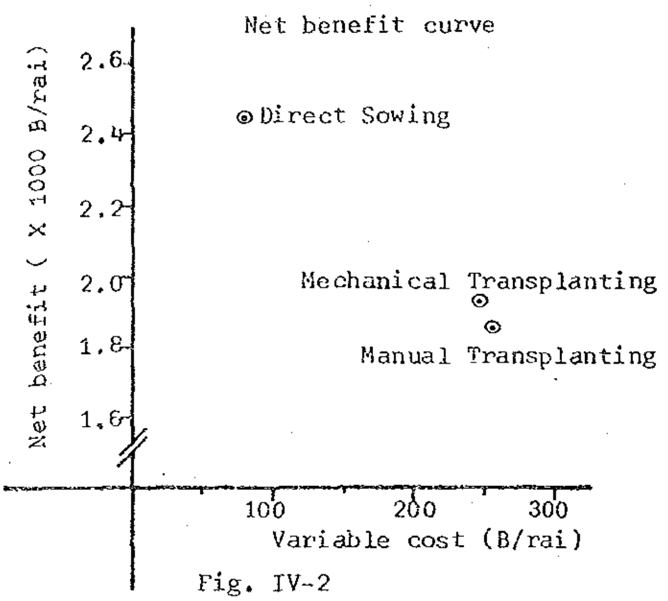


Fig. IV-2

Results and Discussion :

1. Grain yield

The mean grain yield of direct sowing method was significantly higher than the yield of transplanting method both mechanicl and manual.

In last year 1983 Wet season, transplanting method produced significantly higher grain yield than direct sowing method. On the contrary results of this Dry season became vice versa. (Table IV-1, ANOVA, Fig. IV-1)

2. Yield components

Direct sowing method obviously produced more number of panicles/unit area than transplanting method.

Transplanting method tend to produce bigger panicle(number of grains/panicle) than direct sowing.

However, as a total number of grains/unit area, because of much greater panicles/m^2, direct sowing method recorded significantly better yield even panicle size and ripened grain % was lower than transplanting method. (Table IV-2)

3. Econmical comparison among planting method

Judging from the results of this particular trial, direct sowing method appeared to be much more profitable than transplanting method.

The higher production with lower cost of direct sowing was obviously superior to transplanting method in this results.

Though more seed required for direct sowing method. Variable cost is estimated approximately 1/3 of the transplanting method.

Though it is not counted in this trial probably some more variable cost factors related to planting method should be considered such as field leveling, irrigation water management or weed control, because more caution is generally required for direct sowing.

Conclusion :

The results indicate that the grain yield and net benefit obtained from direct sowing method was much superior to transplanting method in this Dry season 1983-84'

Cost saving of direct sowing method is distinct advantage if production level is not inferior to transplanting method.