V. Seed Rate X Nitrogen Trial (Direct Sowing)

Objectives :

1. To find out optimum seed rate level for promising varieties used by farmers.
2. To examine the interactions between seed rate levels and Nitrogen levels.

Experimentals Design :

Split plot with 3 replications.
Main plots are seed rate levels and sub plots are Nitrogen levels.

Treatments :

Main plot (seed rate)

S_1 : 8 kg. of dry seeds/rai

S_2 : 12 kg. of dry seeds/rai

S_3 : 16 kg. of dry seeds/rai

Sub plot (Nitrogen levels)

N_0 : no Nitrogen applied

N_1 : 5 kg. N/rai

N_2 : 10 kg. N/rai

N_3 : 15 kg. N/rai

Plot Size :

Each experimental unit consists of 4 X 5 m. ($20m^2$).
Variety used : RD-23

Cultural Practices :

1. Weed Control : Saturn G at 15 days after sowing at a rate of 5 kg./rai

2. Fertilizer Application :

1st application : 5 kg. N/rai at 15 days after sowing (21-0-0) N_1, N_2, N_3

2nd " " : 5 kg. N/rai at 20 days after 1st application (21-0-0) N_2, N_3

3rd " " : 5 kg. N/rai at panicle initiation stage (21-0-0) N_3

6 kg. of Phosphorus/rai applied for entire plots at the time of 1st application of N. (0-46-0)

3. Plant Protection :

Furadan G : 20 days after sowing (5 kg./rai).

Padan Mipcin : 50 days after sowing (5 kg./rai).

4. Duration

Sowing : December 23, 1983

Harvesting : April 11, 1984

Trial No. V

Grain Yield (kg/rai)

Treatments No.	Treatment	Replications I	II	III	Mean ($\bar{X}$)
1.	S_1N_0	681	457	475	537.7
2.	S_1N_1	766	640	566	657.3
3.	S_1N_2	936	800	731	822.3
4.	S_1N_3	1110	918	974	1000.6
5.	S_2N_0	498	559	523	526.6
6.	S_2N_1	624	555	557	578.6
7.	S_2N_2	722	770	760	750.6
8.	S_2N_3	955	1073	774	934.0
9.	S_3N_0	530	479	460	489.6
10.	S_3N_1	579	610	504	564.3
11.	S_3N_2	890	795	608	764.3
12.	S_3N_3	1020	964	994	992.6
Mean ($\bar{X}$)		775.9	718.3	660.5	718.2

Table V-1

ANOVA

SV	DF	SS	MS	F	Required F 5%	1%
Seedrate x N (Sub)	35	1347811				
Seedrate (Main)	8	149924	18740	1.62	6.04	14.80
Block	2	79926	39963	3.46	6.94	18.00
Seedrate	2	23818	11909	1.03	6.94	18.00
Error (a)	4	46180	11545			
N Treatment	3	1116733	372244	96.40**	3.16	5.09
Seedrate x N	6	11656	1942	0.50	2.66	4.01
Error (b)	18	69498	3861			

Treatment Means : Grain Yield : kg/rai)

Table V-2

Seedrate	Nitrogen levels N_0	N_1	N_2	N_3	Seedrate Means
(S_1) 8 kg/rai	538	657	822	1001	754.5
(S_2)12 kg/rai	527	579	751	934	697.5
(S_3)16 kg/rai	490	564	764	993	696.0
Nitrogen means	518.0	600.0	770.1	975.8	718.2

LSD for Main Plot Treatment (Seedrate means) : 5%=121.8 kg/rai

LSD for Sub Plot Treatment (Nitrogen means) : 5%= 61.5 kg/rai

: 1%= 84.8 kg/rai

LSD for between Nitrogen means at same Seedrate level : 5%=106.6 kg/rai

LSD for between Nitrogen levels at different Seedrate levels or same Nitrogen level at different Seedrate levels : 5%=151.4 kg/rai

CV (a) = 14.96 (%)

CV (b) = 8.65 (%)

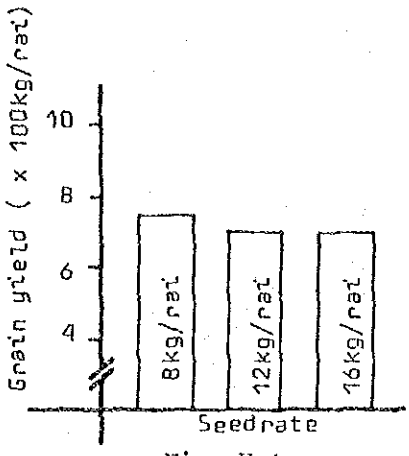


Fig. V-1

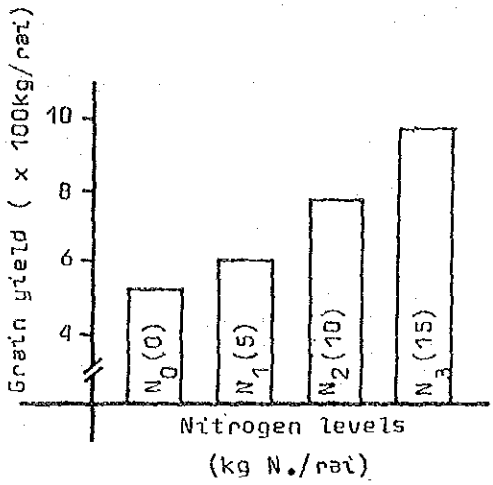


Fig. V-2

Fig. V-3
Seedrate x Nitrogen level

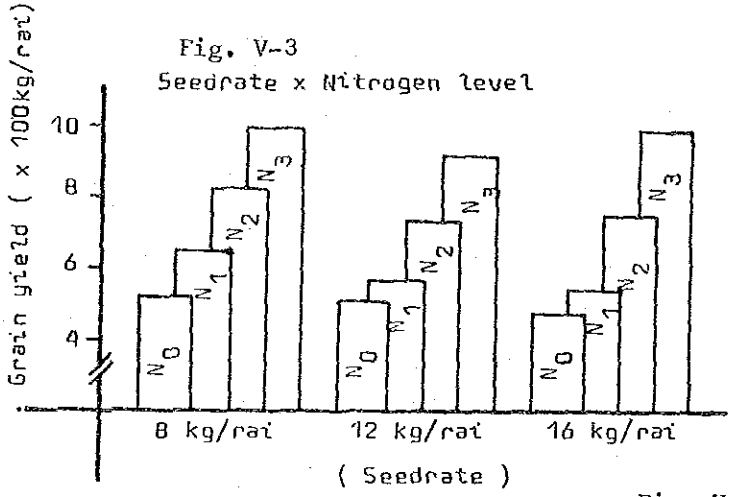
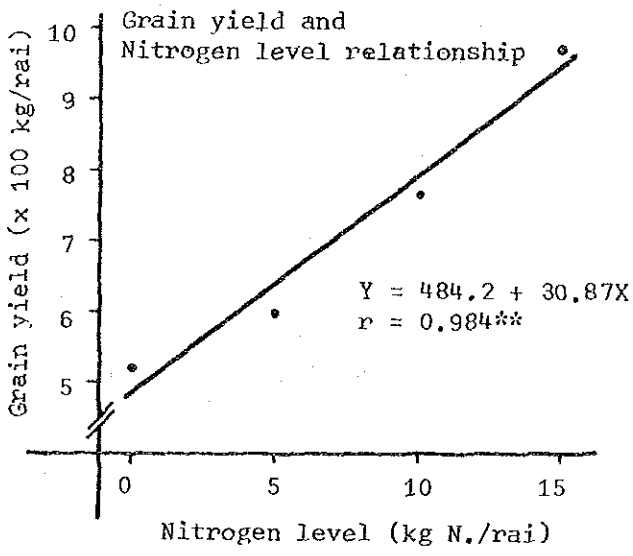


Fig. V-4



Yield Components 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. S_1 N_0	336.0	82.8	64.3	26.4	472.3	20.5	65.1	103
2. S_1 N_1	364.0	85.5	62.4	27.1	526.3	21.2	66.8	98
3. S_1 N_2	428.0	101.6	64.1	29.2	814.0	24.7	77.2	106
4. S_1 N_3	380.0	104.9	53.9	28.5	612.3	25.1	73.2	105
5. S_2 N_0	316.0	48.5	72.0	26.4	291.3	18.6	54.3	94
6. S_2 N_1	328.0	61.0	67.7	26.9	364.4	20.8	61.5	96
7. S_2 N_2	416.0	73.5	70.0	27.9	597.1	21.0	71.0	85
8. S_2 N_3	436.0	103.8	65.4	28.2	834.7	23.6	71.3	96
9. S_3 N_0	300.0	58.2	70.9	25.3	300.7	18.2	52.2	113
10. S_3 N_1	324.0	53.7	68.6	26.6	312.7	20.3	60.1	98
11. S_3 N_2	384.0	77.3	71.5	27.6	585.8	21.0	68.5	85
12. S_3 N_3	412.0	70.5	65.4	28.8	547.1	22.5	70.4	112
Mean ($\bar{X}$)	367.1	76.8	66.3	27.4	521.5	21.4	66.0	98.4
S.D.	49.1	19.6	5.0	1.2	184.6	2.2	7.6	9.6

Table V-3

Treatment levels	Yield Component				Estimated grain Yield (g/m^2)	Panicle length (cm)	Stem length (cm)	Grain/ Straw ratio
	Panicle/m^2	Grains/ panicle	Ripened grain (%)	1000 grains weight				
S_1	377.0	93.7	61.2	27.8	606.2	23.0	70.6	103.0
S_2	374.0	71.7	68.8	27.3	522.0	21.0	64.5	92.7
S_3	352.0	65.0	69.1	27.1	436.6	20.5	62.8	99.5
N_0	313.3	63.2	69.0	26.0	354.8	19.1	57.2	103.3
N_1	338.7	66.7	66.2	27.0	401.1	20.8	62.8	94.0
N_2	409.3	84.1	68.5	28.2	665.6	22.2	72.2	92.0
N_3	409.3	93.1	61.6	28.5	664.7	23.7	71.6	104.3
Mean (X)	367.6	76.8	66.3	27.4	521.6	21.4	66.0	98.4

Table V-4

Fig. V-5
Nitrogen level and panicles/m^2

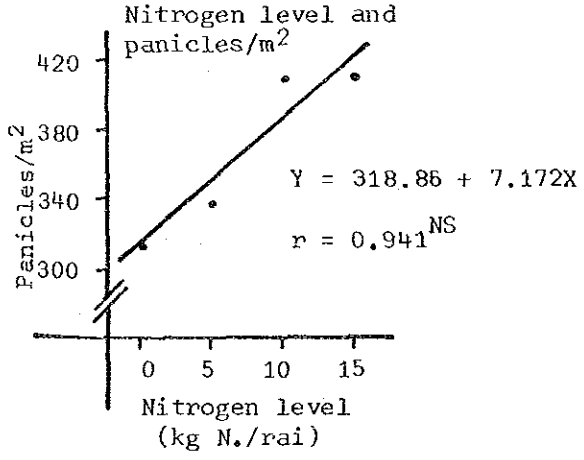


Fig. V-6
Nitrogen and grains/panicle correlation

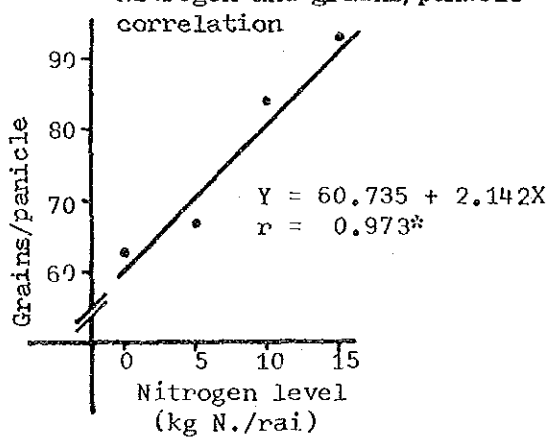


Fig. V-7
Grain yield and panicles/m^2
Correlation

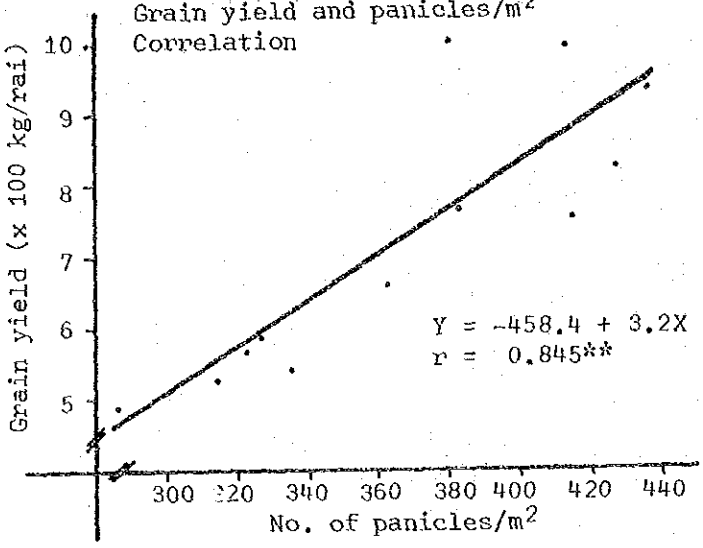
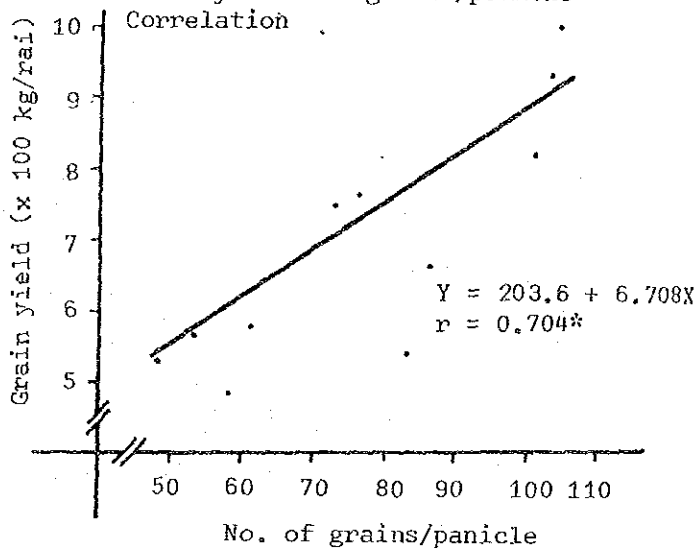


Fig. V-8
Grain yield and grains/panicle
Correlation



Results and Discussion :

1. Grain yield

The different seedrate levels did not influence to the grain yield significantly. However seedrate of 8 kg/rai produced better yield than seedrate of 12 and 16 kg/rai even mean yield differences between seedrate levels were not significant.

On the other hand, the different amount of Nitrogen produced different grain yield and its yield differences were significant in between every Nitrogen levels.

(Table V-2, Fig. V-1-4)

Fig. V-4 shows close relationship between grain yield and Nitrogen levels in a linear way; i.e., the grain yield increased along with the increment of Nitrogen level, and vice versa.

No significant interaction observed between seedrate and Nitrogen levels. In any seedrate levels, grain yield increased from lowest level of Nitrogen to highest (N_0-N_3).

-Cont.-

Partial Budget Analysis

(1) Dominance analysis

Treatments	Grian yield (kg/rai)	Gross benefit (B/rai)	Variable cost (B/rai)				Net benefit (B/rai)
			Seeds	Fertilizer	Opportunity cost	Total	
1. S_1N_0	484	1411	26.4	-	-	26.4	1385
2. S_1N_1	592	1724	26.4	54.8	16	97.2	1627
3. S_1N_2	740	2157	26.4	109.5	32	167.9	1989
4. S_1N_3	901	2625	26.4	164.3	48	238.7	2386
5. S_2N_0	474	1382	39.6	-	-	39.6	1342*
6. S_2N_1	521	1518	39.6	54.8	16	110.4	1408*
7. S_2N_2	676	1969	39.6	109.5	32	181.1	1788*
8. S_2N_3	841	2450	39.6	164.3	48	251.9	2198*
9. S_3N_0	441	1284	52.8	-	-	52.8	1231*
10. S_3N_1	508	1480	52.8	54.8	16	123.6	1356*
11. S_3N_2	688	2005	52.8	109.5	32	194.3	1811*
12. S_3N_3	893	2604	52.8	164.3	48	265.1	2339*

Table V-5

Note : * : dominated treatments

(2) Marginal analysis

Undominated Treatments	Net benefit (B/rai)	Variable cost (B/rai)	Marginal rate of return	
			VS. next highest benefit	VS. Check (S_1N_0)
4. S_1N_3	2386	238.7	560.7 (%)	471.5 (%)
3. S_1N_2	1989	167.9	512.0	426.9
2. S_1N_1	1627	97.2	341.8	341.8
1. S_1N_0	1385	26.4	-	-

Table V-6

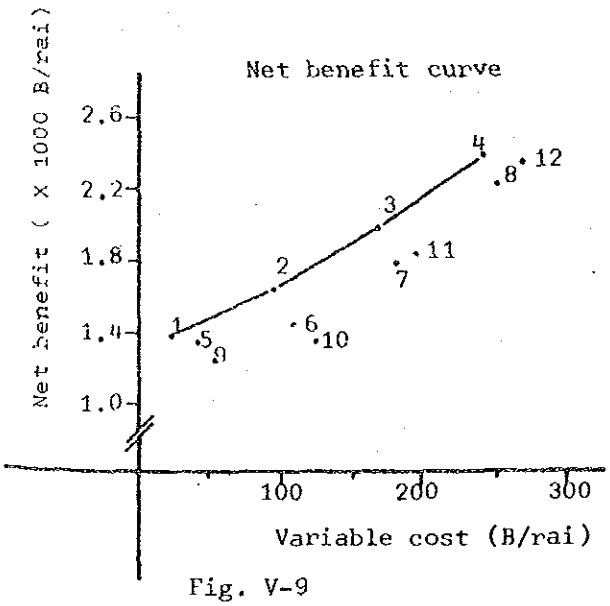


Fig. V-9

* : No. indicates treatment numbers

2. Yield components and related figures

The better grain yield of S_1 (8 kg seed/rai) treatment due probably to more grains/panicle than other seedrate levels even ripenened grain% was lower.

Obviously, the Nitrogen effects to the yield components factors were observed espeically to the grains/panicle. Panicles/m^2 increased by the Nitrogen application also though relation between Nitrogen and panicles/$m^2$was not significant.

Ripened grain% was not effected by the Nitrogen application since there is a general tendency that ripened grain % is apt to be lower when more number of grains/unit area are produced.

1000 grains weight increased slightly along with the Nitrogen increment.

(Table V-3-4, Fig. V-5-8)

3. Economical Study

The results of dominance and marginal analysis shows that the most profitable treatment was minimum level ofseedrate (S_1 : 8 kg/rai) with maximum level of Nitrogen.

The estimated correlation between grain yield and Nitrogen level indicated that 15 kg of Nitrogen increased grain yield of 463 kg. It means 164 Bath of Ammonium Sulphate contributed to increase additional grain yield equivalent to 1350 Bath. (Every 1 kg of Nitrogen or 4.76 kg of Ammonium Sulphate increased about 30 kg of dry grain).

Conclusion :

The grain yield was significantly increased in parallel with Nitrogen level increment, whereas no significant differences observed between mean grain yield of different seedrate levels.

8kg of dry seed with 15 kg Nitrogen/rai appeared to be the most profitable combination.

Application of Nitrogen seemed to be good investment.

Chao Phya Pilot Project

Dry Season, 1983-84'

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

Objectives :

1. To compare the yield responses due to different Nitrogen rate and time of application on direct broadcasted rice.

2. To study profitable level and time of Nitrogen application.

Experimental Design :

RCBD with 4 Replications.

Treatment :

Top dressing of Nitrogen as a form of Ammonium Sulphate (21-0-0)

Treatments No.	1st	2nd	3rd	4th	Total N.
1.	5	0	0	0	5
2.	5	0	5	0	10
3.	5	5	0	0	10
4.	7	0	3	0	10
5.	5	4	3	3	15
6.	10	0	5	0	15
7.	5	5	5	0	15
8.	7	0	5	3	15

Note :

1st application : 15 days after sowing
2nd " " : 20 days after 1st application
3rd " " : panicle initiation stage
4th " " : just before heading stage

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

Variety used : RD-23

Cultural Practices :

1. Seed rate : 12 kg./rai (dry seed).
2. Weed Control : Saturn G applied at 15 days after sowing at a rate of 5 kg./rai.
3. Fertilizer application of P_2O_5
: 6 kg./rai of Phosphorus applied at a time of 1st application as a form of TSP.
No Potassium fertilizer applied.
4. Plant Protection :
Furadan G : 20 days after sowing (5 kg./rai)
Padan Mipcin G : 50 days after sowing (5 kg./ rai)
5. Duration
Sowing : December 23, 1983
Harvesting : April 11, 1984

Trial No. VI

Grain Yield (kg/rai)

Treatments No.	Treatment	Replications I	II	III	IV	Mean ($\bar{X}$)
1.	5-0-0-0	552	479	620	530	545.25
2.	5-0-5-0	1007	876	773	918	893.50
3.	5-5-0-0	574	720	631	633	639.50
4.	7-0-3-0	640	712	781	730	715.75
5.	5-4-3-3	1121	882	875	951	957.25
6.	10-0-5-0	829	839	790	1035	873.25
7.	5-5-5-0	966	929	870	734	874.75
8.	7-0-5-3	993	868	1008	878	938.75
Mean ($\bar{X}$)		835.2	788.2	793.5	801.1	804.50

Table VI-1

ANOVA

SV	DF	SS	MS	F	Required F 5%	1%
Total	31	825558				
Treatment	7	642869	91838	11.20**	2.49	3.65
Block	3	10768	3589	0.44	3.07	4.87
Error	21	171921	8186			

LSD for treatment : 5% = 133.07
1% = 181.12

CV = 11.25 (%)

Duncan's Multiple Range Test

Treatments	Grain Yield (kg/rai)	DMRT 5%	1%
5. 5-4-3-3	957.2	a	a
8. 7-0-5-3	938.7	a	a
2. 5-0-5-0	893.5	a	ab
7. 5-5-5-0	874.7	a	ab
6. 10-0-5-0	873.2	a	ab
4. 7-0-3-0	715.7	b	bc
3. 5-5-0-0	639.5	bc	c
1. 5-0-0-0	545.2	c	c

Table VI-2

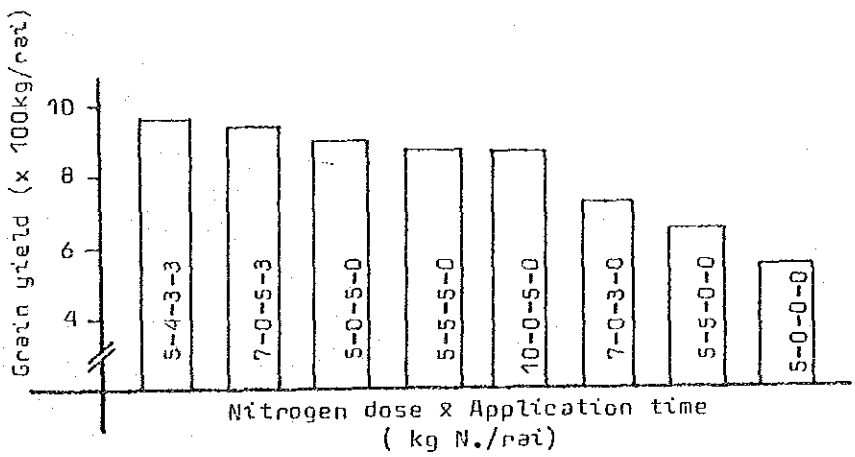


Fig. VI-1

Yield Components 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. 5-0-0-0	344.0	47.8	68.0	26.0	290.7	20.7	56.0	89
2. 5-0-5-0	408.0	96.8	55.8	28.8	634.7	20.4	73.9	115
3. 5-5-0-0	328.0	55.4	61.0	27.2	301.5	20.9	64.1	81
4. 7-0-3-0	288.0	65.8	62.4	26.1	308.6	21.9	65.7	84
5. 5-4-3-3	376.0	90.8	65.5	28.0	626.1	22.2	72.3	121
6. 10-0-5-0	316.0	76.3	68.0	27.9	457.4	23.6	67.5	105
7. 5-5-5-0	376.0	84.0	63.3	28.5	569.8	22.1	68.3	102
8. 7-0-5-3	384.0	76.5	63.8	28.2	528.5	22.3	64.8	108
Mean ($\bar{X}$)	352.5	74.2	63.5	27.6	464.7	21.8	66.6	100.6
S.D.	40.2	17.0	4.0	1.0	147.1	1.0	5.5	14.6

Table VI-3

Fig. VI-2

Grain yield and panicle/m^2

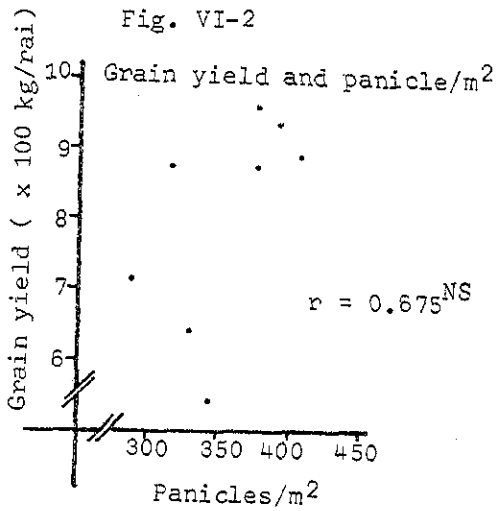
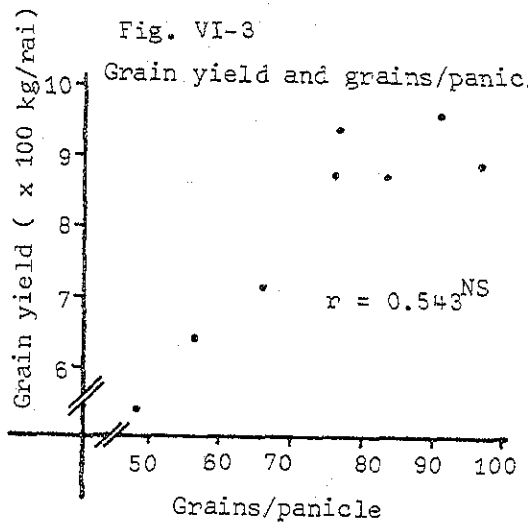


Fig. VI-3

Grain yield and grains/panicle



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. 5-0-0-0	491	1430	54.8	16	70.8	1359
2. 5-0-5-0	804	2344	109.5	32	141.5	2203
3. 5-5-0-0	576	1678	109.5	32	141.5	1537*
4. 7-0-3-0	644	1878	109.5	32	141.5	1737*
5. 5-4-3-3	862	2511	164.3	64	228.3	2283
6.10-0-5-0	786	2291	164.3	32	196.3	2095*
7. 5-5-5-0	787	2295	164.3	48	212.3	2083*
8. 7-0-5-3	845	2463	164.3	48	212.3	2251

Table VI-4

Note : * : dominated treatments

(2) Marginal analysis

Undominated Treatments	Net benefit (B/rai)	Variable cost (B/rai)	Marginal rate of return	
			VS. next highest benefit	VS. check (5-0-0-0)
5. 5-4-3-3	2283	228.3	200.0 (%)	586.7 (%)
8. 7-0-5-3	2251	212.3	67.8	630.4
2. 5-0-5-0	2203	141.5	1193.8	1193.8
1. 5-0-0-0	1359	70.8	-	-

Table VI-5

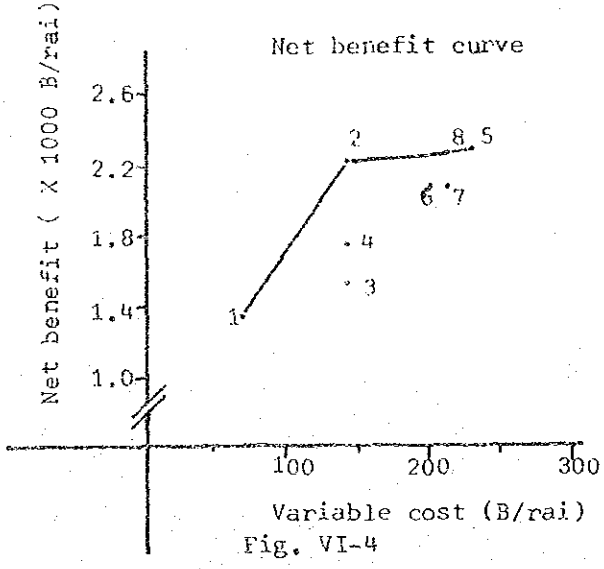


Fig. VI-4

* : No. indicates treatment numbers

Results and Discussion :

1. Grain yield

The grain yeild of lowest level of Nitrogen was the lowest yield among treatments. When total Nitrogen was 10 kg/rai, the (5-0-5-0) treatment produced significantly higher yield than the (7-0-3-0) and the (5-5-0-0) at 5% level of significance.

It seemed 5 kg N/rai top dressed at panicle initiation stage greatly increase number of grains/panicle to produce higher production.

When total Nitrogen increased to 15 kg N/rai mean grain yield was not significantly different among same levels of Nitrogen. However (5-4-3-3) recorded highest yield.

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

2. Economy of Nitrogen application

In consequence of the partial budget analysis, the highest net benefit was obtained from the highest yield treatment of (5-4-3-3) followed by (7-0-5-3).

(5-0-5-0) treatment provided the highest marginal rate of return.

5 kg N/rai applied at 15 days after sowing plus top dressing of 5 kg N/rai at panicle initiation stage (5-0-5-0) seemed to be profitable way of Nitrogen application. However more benefit obtained by intensive split application of (5-4-3-3).

(Table VI-4,5, Fig. VI-4)

Conclusion :

The higher level of Nitrogen application tended to produce higher grain yield.

When total amount of Nitrogen was more than 10 kg/rai, split application of 2 or 3 times seemed to be better for higher yield and benefit.

Top dressing of Nitrogen at panicle initiation stage should not be ignored since effects of Nitrogen at panicle initiation stage seemed to be appeared in most cases.

VII. Seedrate x Nitrogen Fertilizer Trial (Cooperative Trial of I.A.D.P.)

Objectives :
To clarify the effect of different seedrates and quantities and split times of Nitrogen fertilizer application to yield of germinated broadcast rice cultivation at Chao Phya Pilot Project, Mae Klong Pilot Project and Suphan buri Training Center experiment fields.

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

Treatments :
Accordingly, this trial was done on three seedrates (as 4, 8 and 16 kg/rai) basal Nitrogen fertilizer application (as 6, 6 and 3-3 kg/rai) and top dressing fertilizer application (as 6, 6 and 3-3 kg/rai).
(see attached paper)

Plot Size : 5m x 8m ($40m^2$)

Variety Used : RD-23

Cultural Practices :

1. Fertilizer application
   (1) Apply Phosphate fertilizer to all plots at puddling time at a rate of 6 kg. P./rai as a form of TSP.
   (2) Nitrogen fertilizer was applied as a form of Ammonium Sulphate according to the treatment.
2. Plant Protection
   5 kg. of Furadan G./rai applied at the last puddling. And 5 kg. of Padan Mipcin/rai applied at 30 days after sowing.
3. Weed Control
   Saturn G was applied at a rate of 5 kg./rai at 10 days after sowing.

Observations & Investigations :

1. Number of tillers and plant height were investigated at 25, 35, 45 55 and 65 days after sowing.
   (Table VII-6, Fig. VII-7)
2. Culm and panicle length
   Measuring the culm, panicle length and plant height at harvest time.
   (Table VII-3,4)
3. Yield components
   Pulling up the samples for yield components analysis from 50 x 50 cm frame at harvest time.
   (Table VII-3,4,5)
4. Grain Yield
   Yield investigation was done within the center area of the each plot. (4m x 2m)

Duration :
Sowing : December 23, 1983
Harvest : April 11, 1984

Treatment

Plot No.	Seed rate Kg/rai	Basal		Top dressing		
		Puddling	+15 days*	P.I(+55)*	Y.P.(15 mm)* (+62)	Heading (+80)
1	16	6	-	6	-	-
2	16	6	-	-	6	-
3	16	6	-	-	3	3
4	16	-	6	6	-	-
5	16	-	6	-	6	-
6	16	-	6	-	3	3
7	16	3	3	6	-	-
8	16	3	3	-	6	-
9	16	3	3	-	3	3
10	8	6	-	6	-	-
11	8	6	-	-	6	-
12	8	6	-	-	3	3
13	8	-	6	6	-	-
14	8	-	6	-	6	-
15	8	-	6	-	3	3
16	8	3	3	6	-	-
17	8	3	3	-	6	-
18	8	3	3	-	3	3
19	4	6	-	6	-	-
20	4	6	-	-	6	-
21	4	6	-	-	3	3
22	4	-	6	6	-	-
23	4	-	6	-	6	-
24	4	-	6	-	3	3
25	4	3	3	6	-	-
26	4	3	3	-	6	-
27	4	3	3	-	3	3

Table VII-1

* +15 15 days after sowing
* P.I Panicle initiation stage
* Y.P Young panicle (15 mm. long)

Trial No. VII

Grain Yield (kg/rai)

Seedrate (kg/rai)	Basal N. (kg/rai)			N. Top dressing (kg/rai)			Seedrate Mean ($\bar{X}$)
	6-0	0-6	3-3	6-0-0	0-6-0	0-3-3	
16 kg	703	855	820	842	808	727	792
8 kg	740	744	750	773	720	740	745
4 kg	727	806	726	761	791	707	753
Mean ($\bar{X}$)	723	802	765	792	773	725	763

Table VII-2

ANOVA

SV	DF	SS	MS	F	Required F 5%	1%
Seedrate	2	11705	5852	1.21	4.46	8.65
Basal N.	2	27864	13932	2.88		
Top dressing N.	2	21921	10960	2.27		
Seedrate x Basal N.	4	23156	5789	1.20	3.84	7.01
Seedrate x Top dress N.	4	14484	3621	0.75		
Basal N. X Top dress N.	4	11240	2810	0.58		
Error	8	38624	4828			
Total	26	148994				

LSD for treatment : 5% = 92.5 (kg/rai)
1% = 134.6 (kg/rai)

CV = 9.1 (%)

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

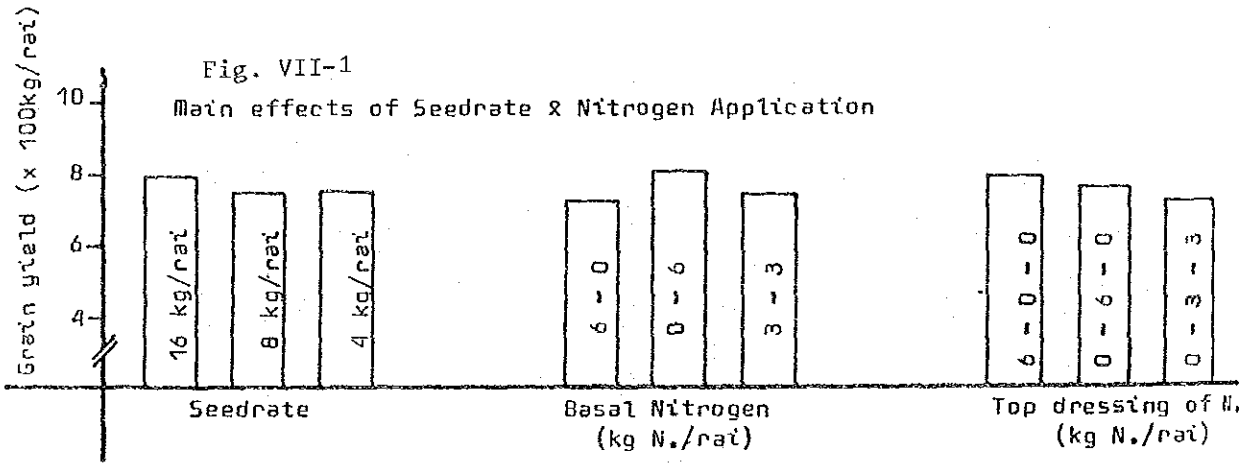


Fig. VII-2
Seedrate x Basal N.

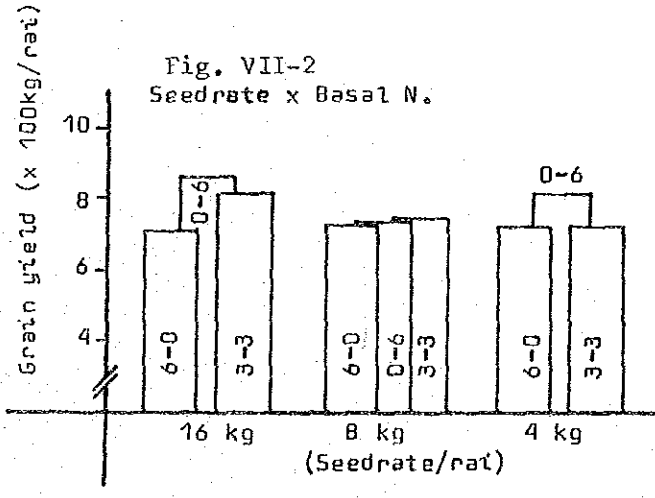


Fig. VII-3
Seedrate x Top dressing N.

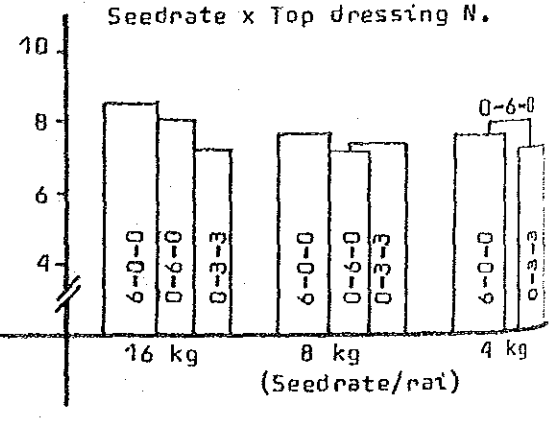


Fig. VII-4
Basal X Top dressing N.

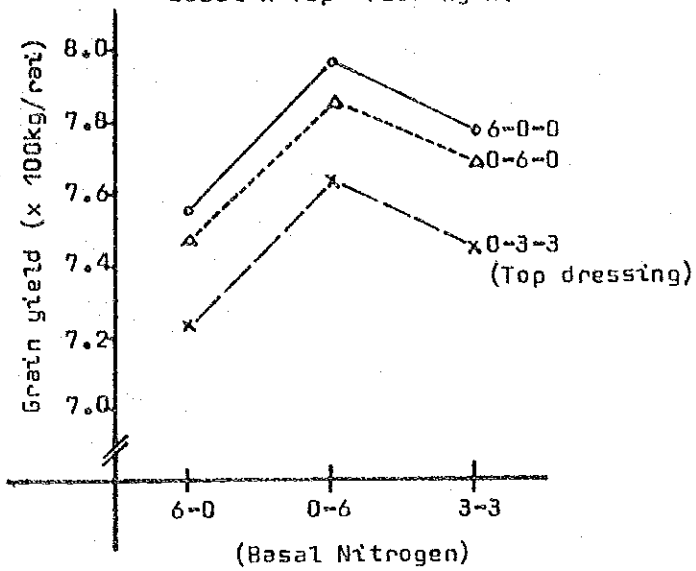
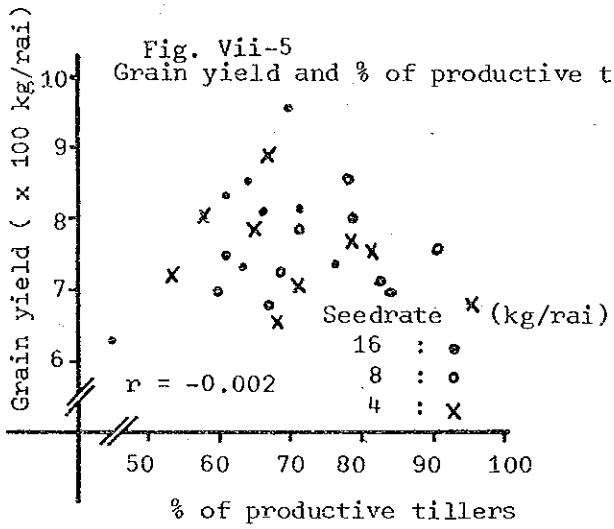


Fig. Vii-5
Grain yield and % of productive tillers



Yield Components of the Treatments

Plot No.	Treatment	Yield Components: Panicles/m^2	Grains/panicle	Ripened grain %	1000 grains weight (g)	Estimated grains yield (g/m^2)	% of productive tillers
1.	6-0-6-0-0	448	63.1	78.3	27.5	609.6	60.8
2.	6-0-0-6-0	408	43.9	78.2	26.6	373.1	64.1
3.	6-0-0-3-3	324	49.1	86.8	27.2	375.5	44.8
4.	0-6-6-0-0	372	64.4	74.3	28.0	497.6	68.9
5.	0-6-0-6-0	372	68.2	69.5	28.2	417.4	64.1
6.	0-6-0-3-3	396	61.8	77.3	26.6	502.7	77.3
7.	3-3-6-0-0	424	52.7	76.0	27.3	466.9	70.7
8.	3-3-0-6-0	440	53.1	87.4	27.9	569.8	60.8
9.	3-3-0-3-3	456	48.0	82.3	26.7	481.6	66.7
Mean ($\bar{X}$)	16 kg/rai	404.4	56.0	79.0	27.3	486.0	64.2
10.	6-0-6-0-0	284	75.9	82.3	28.2	548.2	70.3
11.	6-0-0-6-0	352	49.8	75.7	27.1	359.2	83.0
12.	6-0-0-3-3	280	55.7	84.4	26.6	349.7	68.6
13.	0-6-6-0-0	328	75.0	72.2	27.7	492.6	66.7
14.	0-6-0-6-0	340	60.5	89.3	28.2	548.4	90.4
15.	0-6-0-3-3	360	74.5	76.1	28.0	571.6	78.3
16.	3-3-6-0-0	332	61.9	76.1	27.7	476.9	77.5
17.	3-3-0-6-0	252	72.6	76.8	27.2	351.5	82.9
18.	3-3-0-3-3	244	69.5	76.9	27.5	346.3	59.2
Mean ($\bar{X}$)	8 kg/rai	308.0	66.2	77.9	27.6	448.0	75.2
19	6-0-6-0-0	224	77.2	73.0	27.0	342.8	57.8
20	6-0-0-6-0	256	102.1	69.1	27.0	491.0	57.6
21	6-0-0-3-3	264	66.9	73.1	26.5	338.7	68.7
22	0-6-6-0-0	308	105.0	62.6	27.9	565.1	77.8
23.	0-6-0-6-0	264	88.6	78.2	26.7	488.9	66.6
24.	0-6-0-3-3	336	92.7	62.3	27.2	527.3	81.5
25.	3-3-6-0-0	272	91.1	70.0	26.6	493.1	65.4
26.	3-3-0-6-0	248	77.1	81.7	26.1	412.4	99.3
27	3-3-0-3-3	272	79.4	70.5	26.9	442.8	70.8
Mean ($\bar{X}$)	4 kg/rai	271.6	86.7	72.7	26.9	455.4	70.7
Over all Mean ($\bar{X}$)		328.0	69.6	76.5	27.3	458.8	70.0
S.D.		68.9	16.3	6..	0.8	75.1	11.2

Table VII-3

Yield Components and related figures

Treatment levels		Yield Components: Panicles/m^2	Grains/panicle	Ripened grain (%)	1000 grains weight	Estimated grain yield (g/m^2)	Panicle length (cm)	Stem length (cm)	Grain/Straw ratio	% of productive tillers	Actual yield (g/m^2)
Seedrate levels (kg/rai)	16	404.4	56.0	79.0	27.3	486.0	20.4	65.0	101.0	64.2	495
	8	308.0	66.2	77.9	27.6	435.0	22.0	62.6	114.8	75.2	465
	4	271.6	86.7	72.7	26.9	455.4	22.7	59.7	116.8	70.7	470
Basal (kg N./rai)	6-0	345.5	64.7	79.0	27.1	420.3	21.0	60.7	109.1	63.4	452
	0-6	341.8	76.7	72.6	27.6	512.4	22.8	64.7	116.0	74.6	501
	3-3	326.7	67.3	77.9	27.1	443.7	21.3	62.0	107.4	72.1	470
Top dress (kg N./rai)	6-0-0	332.4	74.0	74.4	27.5	487.9	22.4	64.4	114.7	68.0	495
	0-6-0	325.8	68.4	77.3	27.2	447.4	21.2	61.4	111.7	74.0	483
	0-3-3	325.8	66.4	77.7	27.0	441.1	21.5	61.5	106.2	68.4	453
Mean ($\bar{X}$)		328.0	69.6	76.6	27.3	458.8	21.7	62.4	110.8	70.0	476.9
LSD* : 5%		49.8	15.4	6.3	0.8	98.4					57.6
1%		71.0	22.5	9.2	1.2	143.1					84.1
CV : (%)		11.2	16.6	6.2	2.3	16.1					9..

*LSD for different levels within the same factor

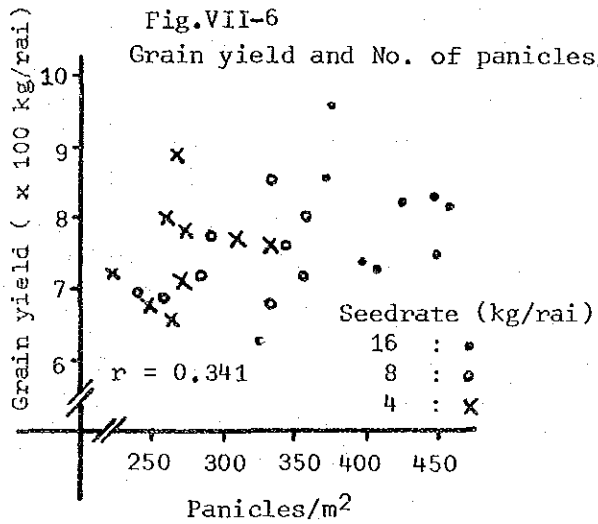
Table VII-4

Correlation Coefficient

	Panicles/m^2 (1)	Spikelets/panicles (2)	Ripend grain(%) (3)	1000 grians weight (4)	Estimated grain yield (5)	Spikelets/m^2 (6)	Actual yield (kg/rai) (7)
(1)	1.000	-0.585	0.149	0.260	0.512	0.235	0.314
(2)	-0.585	1.000	-0.702	0.012	0.307	0.576	0.107
(3)	0.149	-0.702	1.000	-0.146	-0.300	-0.624	-0.194
(4)	0.260	0.021	-0.146	1.000	0.501	0.238	0.403
(5)	0.512	0.307	-0.300	0.501	1.000	0.794	0.522
(6)	0.235	0.576	-0.624	0.238	0.794	1.000	0.204
(7)	0.341	0.107	-0.194	0.403	0.522	0.204	1.000

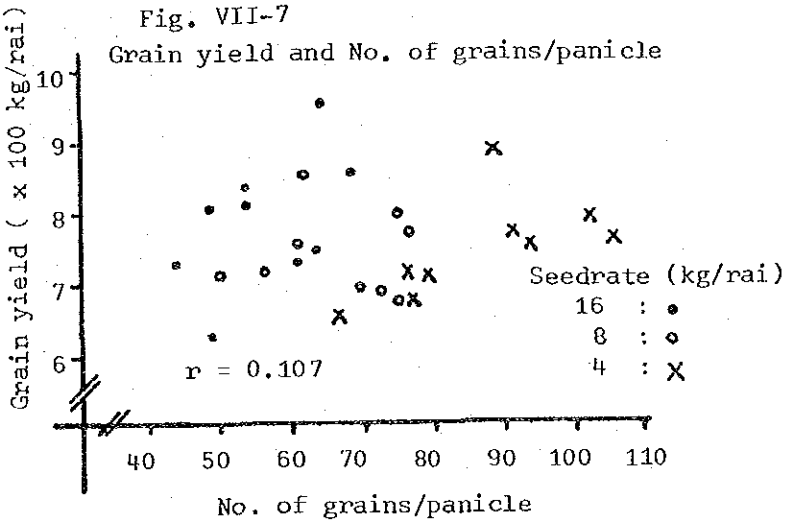
Table VII-5

Fig.VII-6
Grain yield and No. of panicles/m^2



Higher seedrate level tended to produce more number of panicles/m^2

Fig. VII-7
Grain yield and No. of grains/panicle



Lower seedrate level tended to produce more number of grains/panicle

Curves in Increasing Number of Tillers/m^2

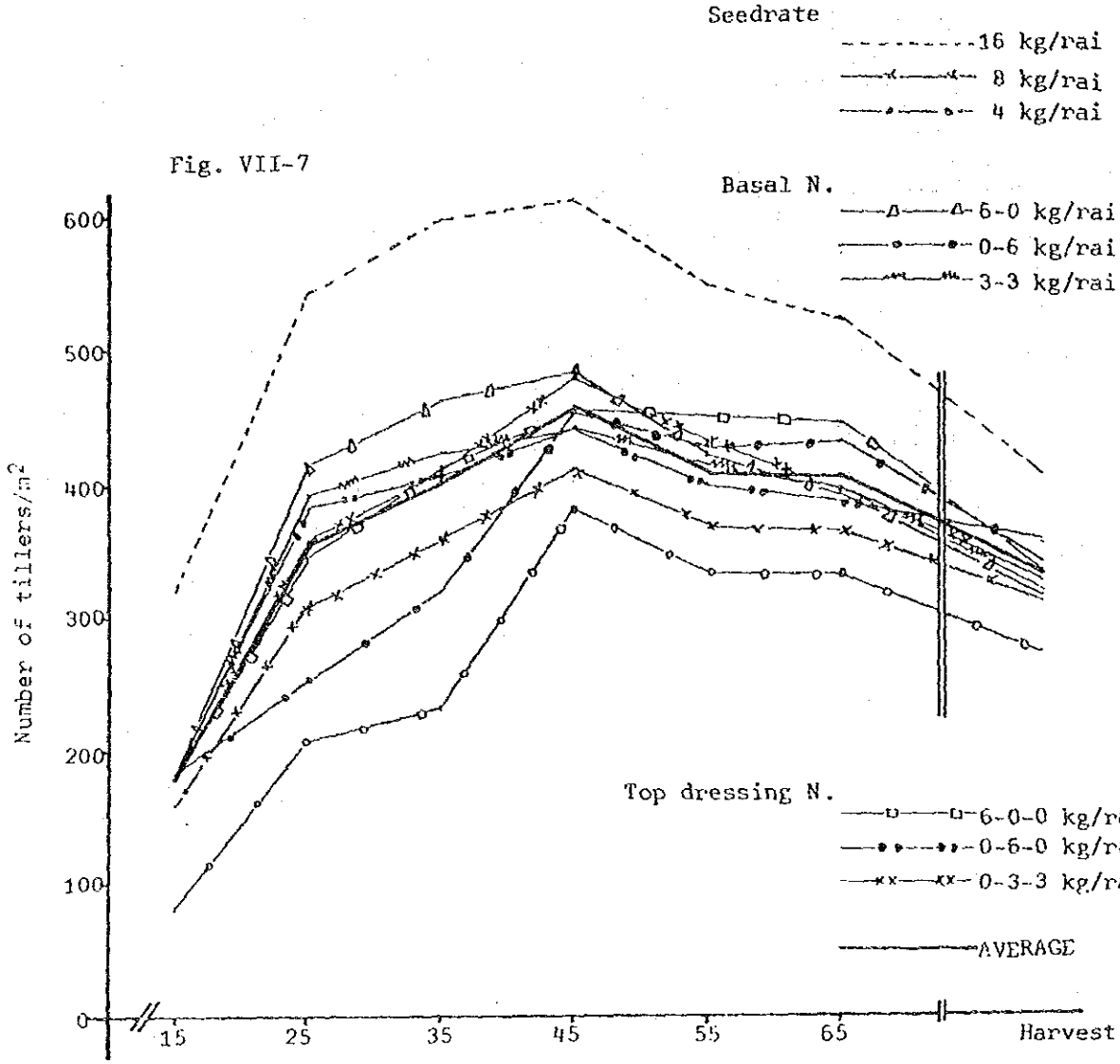


Fig. VII-7

Seedrate x Nitrogen (L^{27})

Dry Season 1983-84

Growth observation results

Treatment levels		Days After Sowing										Harvest
		25 DAS		35 DAS		45 DAS		55 DAS		65 DAS		
		Tillers/ m^2	Plant Height	Tillers/ m^2	Plant Height	Tillers/ m^2	Plant Height	Tillers/ m^2	Plant Height	Tillers/ m^2	Plant Height	Panicle/m
Seedrate	16 kg/rai	544.0	24.1	597.8	33.8	612.9	44.4	548.4	53.6	520.4	72.5	404.4
	8 kg/rai	308.9	23.7	356.0	33.3	410.2	44.5	369.8	52.6	364.4	69.6	308.0
	4 kg/rai	209.3	24.2	256.9	33.6	354.2	44.0	338.7	53.3	337.8	72.5	271.6
Basal N	6-0 kg/rai	414.7	24.2	468.0	34.1	482.2	44.5	421.3	53.0	396.0	71.0	315.5
	0-6 kg/rai	253.8	22.7	321.3	32.2	451.1	42.5	423.6	52.4	429.8	72.5	341.8
	3-3 kg/rai	333.6	25.2	421.3	34.0	444.0	45.8	412.0	54.2	396.9	71.1	328.7
Top dressing	6-0-0 kg/rai	340.0	24.0	417.0	33.3	452.4	44.1	420.3	53.8	448.4	80.0	332.4
	0-6-0 kg/rai	357.8	24.6	388.9	34.0	444.0	45.3	398.7	53.7	382.7	68.2	325.8
	0-3-3 kg/rai	356.4	23.6	404.4	33.0	480.9	44.0	437.3	52.0	391.5	66.5	325.8
	Mean($\bar{X}$)	354.1	24.0	403.6	33.4	459.1	44.3	419.0	53.2	407.5	71.5	328.0

Table VII-6

Partial Budget Analysis
(1) Dominance analysis

Treatments				Grain yield (kg/rai)	Gross benefit (B/rai)	Variable cost (B/rai)				Net benefit (B/rai)
Plot No.	Seedrate (kg/rai)	Basal N. (kg N/rai)	Top dressing (kg N/rai)			Seed	Fertilizer	Opportunity cost	Total	
1.	16	6-0	6-0-0	675	1968	52.8	131.4	32	216	1752*
2.	16	6-0	0-6-0	655	1910	52.8	131.4	32	216	1694*
3.	16	6-0	0-3-3	567	1653	52.8	131.4	48	232	1421*
4.	16	0-6	6-0-0	865	2521	52.8	131.4	32	216	2305
5.	16	0-6	0-6-0	774	2256	52.8	131.4	32	216	2040*
6.	16	0-6	0-3-3	670	1952	52.8	131.4	48	232	1720*
7.	16	3-3	6-0-0	734	2141	52.8	131.4	48	232	1909*
8.	16	3-3	0-6-0	752	2193	52.8	131.4	48	232	1961*
9.	16	3-3	0-3-3	726	2117	52.8	131.4	64	248	1869*
10.	8	6-0	6-0-0	707	2062	26.4	131.4	32	190	1872*
11.	8	6-0	0-6-0	641	1868	26.4	131.4	32	190	1678*
12.	8	6-0	0-3-3	649	1892	26.4	131.4	48	206	1686*
13.	8	0-6	6-0-0	611	1781	26.4	131.4	32	190	1591*
14.	8	0-6	0-6-0	678	1975	26.4	131.4	32	190	1785*
15.	8	0-6	0-3-3	721	2101	26.4	131.4	48	206	1895*
16.	8	3-3	6-0-0	770	2243	26.4	131.4	48	206	2037*
17.	8	3-3	0-6-0	626	1826	26.4	131.4	48	206	1620*
18.	8	3-3	0-3-3	629	1834	26.4	131.4	64	222	1612*
19.	4	6-0	6-0-0	653	1905	13.2	131.4	32	177	1728*
20	4	6-0	0-6-0	720	2099	13.2	131.4	32	177	1922*
21.	4	6-0	0-3-3	590	1721	13.2	131.4	48	193	1528*
22.	4	0-6	6-0-0	695	2025	13.2	131.4	32	177	1848*
23.	4	0-6	0-6-0	801	2335	13.2	131.4	32	177	2158
24.	4	0-6	0-3-3	681	1986	13.2	131.4	48	193	1793*
25.	4	3-3	6-0-0	707	2062	13.2	131.4	48	193	1869*
26.	4	3-3	0-6-0	616	1794	13.2	131.4	48	193	1601*
27.	4	3-3	0-3-3	636	1855	13.2	131.4	64	209	1646*

Note : * : dominated treatments

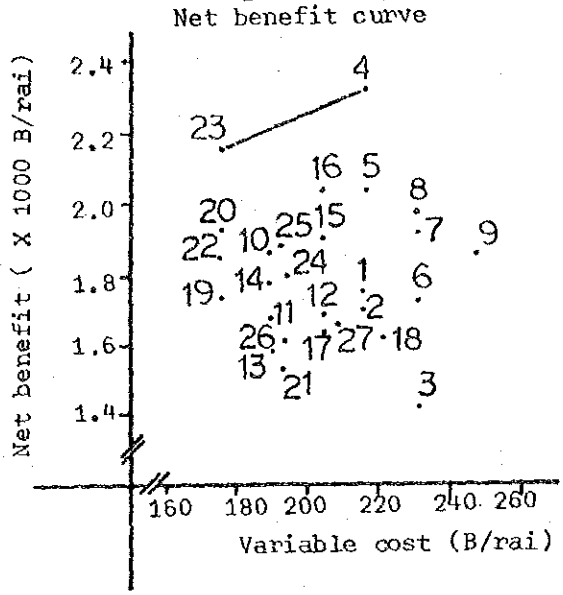
Table VII-7

(2) Marginal analysis

Undominated Treatments				Net benefit (B/rai)	Variable cost (B/rai)	Marginal rate of return
Plot No.	Seedrate	Basal N.	Top dress N.			
4.	16	0-6	6-0-0	2305	216	376.9 %
23.	4	0-6	0-6-0	2158	177	-

Table VII-8

Fig. VII-8
Net benefit curve



Results and Discussion :

1. Grain yield

Statistically, no significant differences were recognized between/among the mean grain yield of different seedrate levels, different time and proportion of the Nitrogen application for basal and top dressing.

However, 16 kg of dry seed/rai produced higher grain yield among seedrate levels.

For basal application of Nitrogen, 6 kg N/rai applied at 15 days after sowing (0-6) provided better yield than the same amount applied before sowing (6-0) or split application of before & after sowing (3-3).

In case of top dressing, 6 kg N/rai at panicle initiation stage (55 days after sowing) recorded higher grain yield than the application at panicle formation stage (62 days after sowing in this trial) or split application of panicle formation and heading stage (80 days after sowing). Table VII-2, Fig. VII-1-4)

2. Observation of yield components and related figures (refer to Table VII-3,4,5)

(1) Panicles/m^2 :

The more seeds tended to produce the more number of panicles/m^2.
Basal application of Nitrogen at 15 days after sowing produced little higher number of panicles/m^2.
Top dressing of Nitrogen did not influence to panicles/m^2.

(2) Grains/panicle :
less number of grain/panicle observed when seedrate is higher. Similarly, panicle size apt to be bigger when number of panicles/m^2 is smaller or vice versa.

Basal Nitrogen of (0-6) treatment produced bit more grains/panicle, late application of basal Nitrogen (15 days after sowing) probalbly influenced to panicle size in some extent.

Top dressing of Nitrogen at panicle initiation stage seemed to have more grains/panicle.

(3) Ripened grain % and 1000 grains weight :
The different seedrate, basal and top dressing of Nitrogen did not show close relationships with ripened grain % and 1000 grains weight.

* Table VII-5 shows correlation coefficient among yield component factors.

3. Growth observation results

The number of tillers and the plant hight were measured every 10 days interval started from 15 days after sowing. (Fig. VII-7, Table VII-6)

As it is shown, the more tillers produced from more seedrate levels, thus more panicles were obtained from high seedrate levels.

The maximum number of tillering stage appeared around 45 days after sowing in any seedrate levels.

The interesting findings from the growth observation was the time of end stage of effective tillering.

The growth observation results shows that the end stage of effective tillering came earlier around 20-25 days after sowing when 16 kg seeds/rai was used. The stage was in between 25-30 days after sowing when 8 kg seeds/rai was broadcasted. The effective tillering stage was 35-40 days after sowing in case of minimum seedrate level of 4 kg/rai.

This findings provide meaningful idea for us regarding fertilizer application especially Nitrogen that the number of panicles (number of productive tillers) are determined earlier when higher seedrate is used.

The time and amount of Nitrogen application should be considered with this tendency.

4. Economic study of Trial results

Among 27 combinations of seedrate and Nitrogen application, the best result was obtained from the treatment of 16 kg seeds/rai with basal application of 6 kg N/rai at 15 days after sowing plus 6 kg N/rai top dressed at panicle initiation stage. (Treatment No. 4)

The dominated treatment are due to higher variable cost associated with lower net benefit.

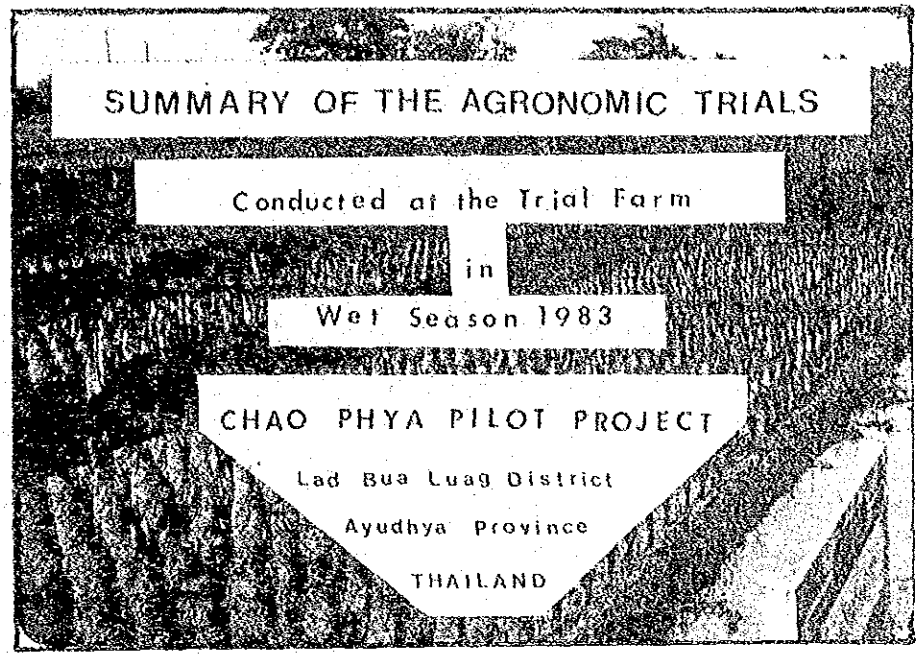
377 % of marginal rate of return resulted from treatment No. 4 appeared to be the most profitable alternative.

(Table VII-7,8 Fig. VII-8)

Conclusion :

The results indicate that there were no significant differences between/among the mean grain yield of main factors of seedrate levels, basal & top dressing of Nitrogen applications as well as interactions between main factors.

Although, seedrate of 16 kg/rai with 6 kg N/rai at 15 days after sowing plus 6 kg N/rai top dressed at panicle initiation stage produced the highest grain yield and it was found to be the best economically also.



IRRIGATED AGRICULTURE DEVELOPMENT PROJECT

ALRO MOAC

Toshio Shibata

Krisdawut Wongpiboonwatana

Abstracts of the Trial Results
Conducted at Trial Farm
of Chao Phya Pilot Project
in Wet Season 1983

Trial No. I. Planting Method Comparative Study

The mean grain yield of direct sowing method was significantly lower than that of mechanical and manual transplanting method even at 1% level of significance, whereas no difference was observed between mechanical and manual transplanting.

From the economic point, the transplanting methods either mechanical or manual were found to be more profitable than direct sowing method even additional variable cost is required.

Trial No. II. Varietal Comparative Study

The grain yield was very much influenced with incidence of RRSV (Rice Ragged Stunt Virus).

The yield of RD-23 was second highest next to IR-46 among 14 varieties. It is safe to conclude that the most popular variety (RD-23) among farmers in the project area is recommendable at present stage with high productivity and satisfactory level of resistance to virus diseases.

Grain yield of RD-7 was significantly lower than any other varieties mainly due to susceptibility to both virus diseases of RRSV and RGSV (Rice Grassy Stunt Virus)

Varieties RD-7, RD-9-14 and KDML 105 were found to be very susceptible to RRSV, and RD-7, BKNBR-1141 and RD-9-14 were susceptible to RGSV and/or RGSV-2.

Trial No. III. Seedrate x Variety Trial (direct sowing)

Different amount of seed (8 kg, 12 kg and 16 kg/rai) did not influence significantly to the grain yield.

Grain yield of RD-23 was significantly superior to RD-21 in any seedrate levels.

From the economic point, 12 kg/rai of RD-23 seed was found to be the best economically.

Trial No. IV. Fertilizer rate and time of Application Trial (Direct Sowing)

No significant differences was observed on the mean grain yield of different quantity of Nitrogen (5 kg N, 10 kg N, and 15 kg N /rai) and different time of application.

Though statistically no different among treatment. 10 kg Nitrogen/rai (5 kg N/rai at 15 days after sowing and 5 kg N/rai at panicle initiation stage) recorded highest net benefit with reasonably high marginal rate of return.

Trial No. V. Nitrogen x Phosphorus Fertilizer Trial

Grain yield was significantly increased by Nitrogen application even at 1% level of significance, whereas no significant effect of phosphorus observed.

The results of Marginal analysis indicated that minimun level of Nitrogen (6 kg N/rai) without phosphorus was found to be profitable under trial site conditions.

Trial No. VI. Nitrogen Source Comparative Trial

The rice planted without Nitrogen, the yield was significantly lower than the treatment with Nitrogen even at 1% level of significance. However, no difference among different level of Nitrogen application. Also, the grain yield of GML (Glutamic Mother Liquor) and Urea regardless amount was not differ statistically.

From the economic point of view, great increment of net benefit over control (no Nitrogen) was recorded in treatment 2 (6 kg N/rai applied before transplanting as a form of GML).

Futher increase of net benefit over treatment 2 was obtained from the treatment 6 (12kg N/rai applied before transplating as a form of GML).

Since the cost of GML is lower than Urea, application of GML was observed to be more profitable than Urea.

Experimental Conditions

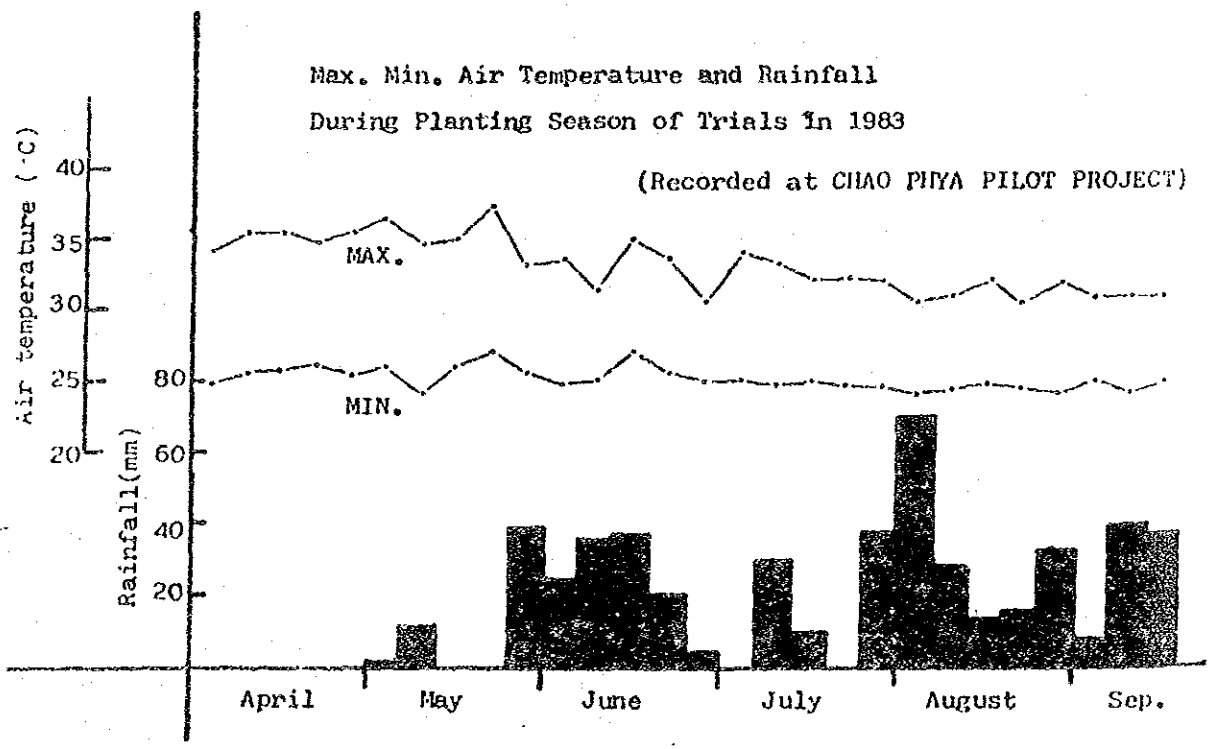
The Chao Phya Pilot Project is situated at the Lad Bua Luang district in Ayudhya province in the middle of Greater Chao Phya Basin. (N. lat. 14^{o} $9^{'}$ $30^{''}$, E. lon. 100^{o} $23^{'}$ $48^{''}$)

The average plot elevation in the area is ± 2.0 meters above sea level and its topographical gradient is extremely gentle ranging 1/5,000 - 1/10,000.

The soil had been formed by the alluvial action of the Chao Phya River, is the clayey acid sulphate soil with PH of 4.5 - 5.0. Much contents of the clay allow the soil hardness to vary to the large extent in dry condition and moist condition.

Rainfall has a big reasonal and annual fluctuation, 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).(average of 14 years at Sing Ha Nat)

The figure below shows the max. min. temperature and rainfall during planting season of the trials in 1983.



The trials were organized and managed by agronomy section in collaboration with other related sections in the project.

For statistical analysis, F test and Duncan's Multiple Range test were adopted to examine statistical significance among/between mean grain yield of different treatment/alternatives at 5% and 1% level of significance.

Growth observation of number of tillers and plant height was carried out every week for trial No. 2 and 6 as stated. Datas on yield compenents were also shown for the trials 1.2.5 and 6.

Partial budget analysis (dominance and Marginal analysis) was adopted for economic comparison of treatments onsidering only the variable cost factors vary from one treatment to another. Because the cost factors which are not affected by the choice of treatments 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 assumption on the variable inputs and output were applied in order to study economy of trials.

Inputs:	rice seed (dry grain)	: 3.3 B/kg
	Fertilizers	
	Ammonium Sulphate (21-0-0)	: 2.4 B/kg
	Urea (46-0-0)	: 6.0 B/kg
	Triple Super Phosphate (0-46-0)	: 6.0 B/kg
	GML (Glutamie Mother Liquor)	: 0.44 B/litre
	Opportunity cost of labour	: 6.8 B/hour
Outputs:	price of dry grain (at 14% moisture)	: 3.3 B/kg

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

The allocation and plot layout of trials are shown in next page.

In addition to an agronomic trials, Trial Farm has an important rôle to multiply recommended seed and to demonstrate appropriate technology suitable for the project area.

The informations on seed multiplication programme is also attached at the last part of this report.

ALLOCATION AND PLOT LAYOUT OF TRIALS (Wet season, 1983)

Field No. 220

VI. Nitrogen Source Comparative Trial

GML VS Urea

RCBD, 9 Treatments X 4 Reps.

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

IV. Fertilizer rate (Nitrogen) and Time of opplication Trial (Direct sowing)

RCBD, 8 Treatments X 4 Reps.

1 2	2 8	3 6	4 3	5 1	6 5	7 4	8 7
16 6	15 2	14 8	13 5	12 3	11 4	10 1	9 7
17 3	18 2	19 8	20 7	21 4	22 5	23 6	24 1
32 2	31 8	30 4	29 5	28 7	27 1	26 6	25 3

II. Varietal Comparative study

RCBD, 16 Varieties/Entries X 3 Reps.

1 15	2 6	3 14	4 5	5 16	6 4	7 12	8 1
16 2	15 9	14 10	13 13	12 3	11 11	10 8	9 7
17 10	18 13	19 11	20 16	21 4	22 2	23 5	24 14
32 3	31 1	30 9	29 6	28 7	27 8	26 12	25 14
33 13	34 11	35 10	36 6	37 7	38 14	39 1	40 3
48 9	47 2	46 8	45 5	44 16	43 15	42 12	41 4

V. Nitrogen X Phosphorus Trial

RCBD, Factorial
4 Nitrogen levels
X 3 phosphorus levels
X 2 Reps.

1 N_0P_0	8 N_0P_1	9 N_0P_2	16 N_2P_0	17 N_0P_0	24 N_2P_1
2 N_1P_0	7 N_1P_1	10 N_1P_2	15 N_2P_2	18 N_3P_1	23 N_0P_2
3 N_2P_0	6 N_2P_1	11 N_2P_2	14 N_0P_1	19 N_1P_2	22 N_1P_1
4 N_3P_0	5 N_3P_1	12 N_3P_2	13 N_1P_0	20 N_3P_0	21 N_3P_2

III. Seedrate X Variety Trial (Direct sowing)

Split Plot Design,
3 Seedrate levels
X 2 Varieties X 3 Reps.

1 S_1V_1	6 S_1V_2	7 S_3V_2	12 S_3V_1	13 S_2V_1	18 S_2V_2
2 S_3V_2	5 S_3V_1	8 S_2V_1	11 S_2V_2	14 S_1V_2	17 S_1V_1
3 S_2V_2	4 S_2V_1	9 S_1V_1	10 S_1V_2	15 S_3V_1	16 S_3V_2

I. Planting Methods Comparative Study

RCBD, 3 Treatments X 4 Reps.

3 2	4 3	9 3	10 3
2 3	5 2	8 2	11 2
1 1	6 1	7 1	12 1

I. 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 reciplications. However, mechanical transplanting treatment plots were arranged to one side of each replications in order to allow transplanter to exhibit its capacity.

Treatments :

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

Plot Size :

Each experimental unit consists of 5 m. X 4 m. = 20 m^2.

Cultural Practices :

1. Seed rate : Selected dry seed of 4.0 kg./rai for Mechanical & Manual Transplanting and 13.0 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 16 days after transplanting(A.S.).
   2nd topdress : 4 kg. of N/rai at panicle formation stage (A.S.).

   (2) Direct Sowing
   No fertilizer applied before sowing.
   1st topdress : 6 kg. of N and 7.5 kg. of P/rai at 15 days after sowing with 16 - 20 - 0.
   2nd topdress : 5 kg. of N/rai at 20 days after 1st topdressing(A.S.)
   3rd topdress : 4 kg. of N/rai at panicle formation stage (A.S.).

5. Plant Protection :

   (1) Furadan G : 21 days after transplanting/broadcasting at a rate of 5 kg./rai
   (2) Padam Mipcin: 56 days after transplanting/broadcasting at a rate of 5 kg./rai
   (3) Sumithion EC: 58 days after transplanting/broadcasting at a rate of 100 cc./rai (X 1000).

6. Date of planting and harvesting.

   Sowing seed (box) : April 21, 1983
   Transplanting : May 11,(20 D.A.S)
   Broadcasting (Direct) : May 12.
   Harvest : Transplanted ... Aug. 30 (111 D.A.T.)
   Direct Sowing... Sept. 9 (119 D.A.S.)

RESULTS: Trial No. I Grain Yield (kg/rai)

Treatments	Replications				Mean ($\bar{X}$)
	I	II	III	IV	
1.Mechanical transplanting	1188	1194	1199	1125	1176
2.Manual transplanting	1275	1216	1184	1203	1219
3.Direct sowing	809	926	818	866	855
Mean ($\bar{X}$)	1090	1112	1067	1034	1083

Table-1

ANOVA

SV	DF	SS	MS	F	Required F 5%	Required F 1%
Total	11	334754				
Blocks	3	4471	1490	0.72	4.76	9.78
Treatments	2	317886	158943	76.93**	5.14	10.92
Error	6	12397	2066			

LSD for Treatment : 5% level = 90.8 (kg/rai)
1% level =137.6 (kg/rai)

CV = 4.2 (%)

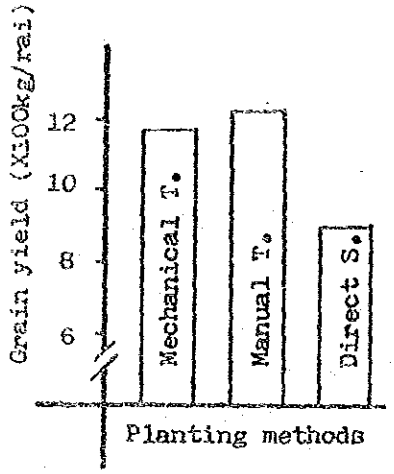


Figure-1

The mean grain yield of direct sowing was significantly lower than that of mechanical and manual transplanting methods even at 1% level of significance, whereas no difference was observed between mechanical and manual transplanting.

(Table-1 & ANOVA)

Judging from the results of this particular trial, yield of transplanting method is superior to direct sowing method.

Datas on Yield Components

Treatments	Yield components			
	Panicles per m^2	Grains per panicle	% of ripened grain	1000 grains weight (g)
1. Mechanical T.	291.2	131.4	71.9	26.6
2. Manual T.	288.3	126.1	69.5	25.9
3. Direct Sowing	336.0	80.4	76.0	28.2
Mean ($\bar{X}$)	305.2	112.6	72.5	26.9

Table-2

PARTIAL BUDGET ANALYSIS

Dominance Analysis

Treatments	Grain Yield (kg./rai)	Gross benefit (฿/rai)	Variable cost (฿/rai)			Net benefit (฿/rai)
			Nursery bed and seed	Transplanting Broadcasting	Total	
1. Mechanical T.	1058	3492	101	149	250	3242
2. Manual T.	1097	3620	101	204	305	3315
3. Direct sowing	769	2539	43	34	77	2462

Table-3

Marginal Analysis

Undominated Treatments	Net benefit (฿/rai)	Variable cost (฿/rai)	Marginal rate of return	
			VS. next highest benefit	VS. Direct Sowing
2. Manual T.	3315	305	132.7	374.1
1. Mechanical T.	3242	250	450.8	450.8
3. Direct Sowing	2462	77	-	

Table-4

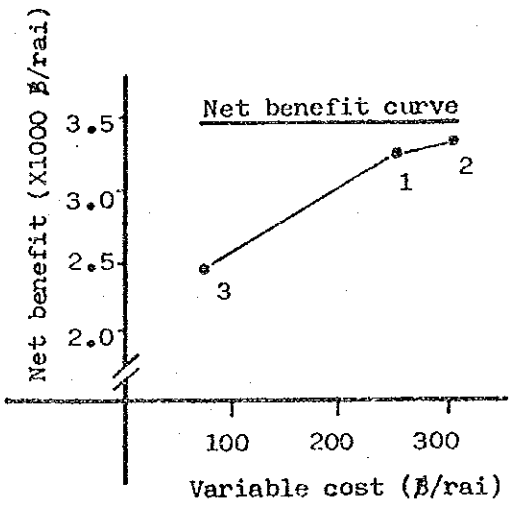


Figure-2

The transplanting method either mechanical or manual was found to be more profitable than direct sowing even additional variable cost is required.
(Table-3,4 & Figure-2)

Direct sowing method tend to have more panicles/unit area than transplanting method. However its panicle size (number of grains/panicle) was much smaller. (Table-2)

II. 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

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 : 3 kg. of N/rai as ear manuaring as a form of Ammonium-Sulphate.
5. Plant protection :
   Furadan G : 21 days after transplanting (5 kg./rai)
   Padan Mipcin G : 35 " " " (5 kg./rai)
   Sumithion EC : 57 " " " (100 cc./rai)
   Padan Mipcin G : 71 " " " (5 kg./rai)
   Furadan G : 77 " " " (5 kg./rai)
6. Duration :
   Sowing : April 28, 1983
   Transplanting : May 11. (13 D.A.S.)
   Harvest : July 29 - Aug. 31
   depending on the varieties/entries.

RESULTS : Trial No. II Grain yield (kg/rai)

Treatments	Replications			Mean($\bar{X}$)
	I	II	III	
1.SP75001-68	707	797	883	794.3
2.SP78002-80	1081	978	996	1018.3
3.SP75004-5	796	846	792	811.3
4.SP75004-37	688	684	945	772.3
5.SP77097-62	1115	1139	925	1059.7
6.RD-7	326	355	456	379.0
7.RD-9-7	682	435	415	510.7
8.BKNBR1141-2	615	647	891	717.7
9.RD-9-14	567	530	727	608.0
10.RD-21-3	958	1025	909	964.0
11.RD-23	1015	1158	1191	1121.3
12.IR-44	778	916	903	865.7
13.IR-46	1234	1149	1121	1168.0
14.RD-25	701	895	712	769.3
Mean ($\bar{X}$)	804	825	847	825.7

Table-5

ANOVA

SV	DF	SS	MS	F	Required F 5%	Required F 1%
Total	41	2330542				
Blocks	2	13162	6581	0.63	3.37	5.53
Treatments	13	2046622	157432	15.12**	2.15	2.96
Error	26	270757	10413			

LSD for treatment : 5% = 79.3 (kg/rai)
1% = 107.2 (kg/rai)

CV = 12.3 (%)

Duncan's Multiple Range Test

Treatments	Mean yield(kg/rai)	DMRT 5%	DMRT 1%
13.IR-46	1168	a	a
11.RD-23	1121	ab	ab
5.SP77097-62	1060	bc	abc
2.SP78002-80	1018	cd	bc
10.RD-21-3	964	d	cd
12.IR-44	866	e	de
3.SP75004-5	811	ef	ef
1.SP75001-68	794	efg	ef
4.SP75004-37	772	fg	ef
14.RD-25	769	fg	ef
8.BKNBR1141-2	718	g	f
9.RD-9-14	608	h	g
7.RD-9-7	511	i	g
6.RD-7	379	j	h

Table-6

Grain yield of Varieties / Entries

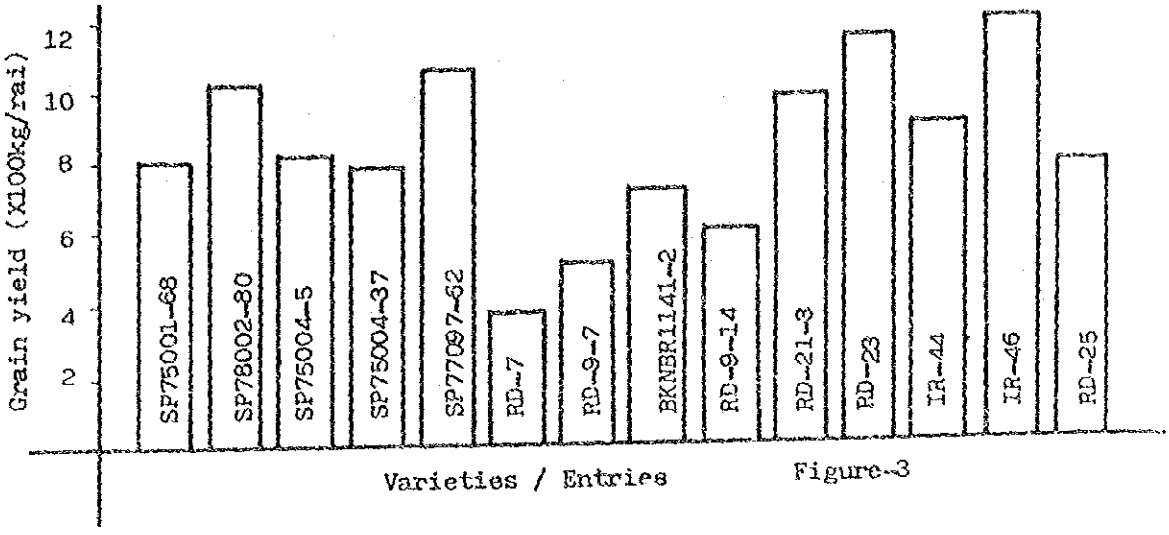


Figure-3

The mean grain yield of different varieties/entries vary from one another. The yield of RD-7 was significantly lower than any other varieties mainly due to susceptibility to both virus diseases of RRSV(Rice Ragged Stunt Virus) and RGSV(Rice Grassy Stunt Virus). (Table-6,7 and Figure-4)

IR-46 recorded the highest grain yield, but no significant difference between RD-23.

Variety of RD-21-3 was significantly lower grain yield than RD-23.

The grain yield was very much influenced with incidence of RRSV and RGSV.

The trial results verify that RD-23 has high productivity with satisfactory level of resistance to virus diseases.

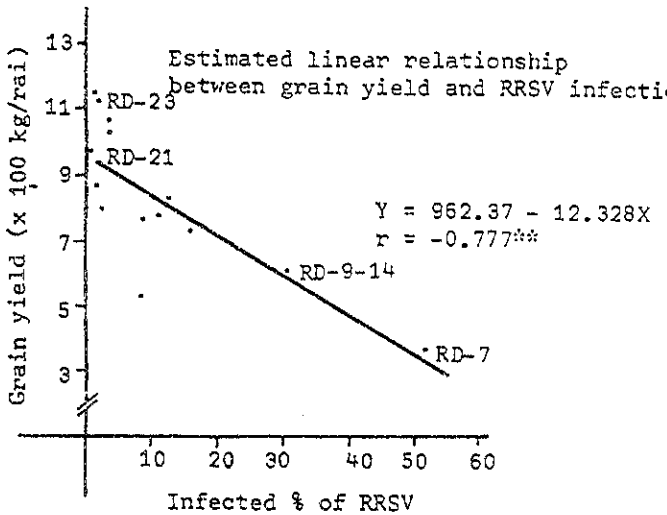
It is safe to conclude that most popular variety (RD-23) among farmers in the pilot project area is recommendable at present stage.

The results of growth observation are shown in Table-9,10 & Figure-5.

A careful observation on rice virus diseases was made by short term expert (Dr. Morinaka) as shown in Table-1 and Figure-4.

Varieties RD-7, RD-9-14 and KDML 105 were found to be very susceptible to RRSV, and RD-7, BKNBR 1141 and RD-9-14 were susceptible to RGSV and/or RGSV-2.

Varietal differences in population of brown planthopper (Nilaparrata - lugens) are shown in Table 8. As it is shown, higher population of brown planthopper was observed on the susceptible varieties to rice viruses. (For more informations, refer to " Report on Rice Diseases in the Field of Irrigated Agriculture Development Project " Tadashi Morinaka, August 11, 1983.)



Varietal resistance to rice virus diseases

Variety (entries)	Number of hills infected with RRSV (%)	Number of hills infected with RGSV (%)
1. IR46	4 (1.3)	1 (0.3)
2. RD-7	160 (52.6)	23 (7.5)
3. IR-44	2 (0.7)	3 (1.0)
4. SP.77097-62	12 (3.9)	0 (0)
5. RD-25	29 (9.5)	0 (0)
6. SP.75004-37	33 (10.9)	9 (2.9)
7. RD-19	4 (1.3)	8 (2.6)
8. SP.75001-68	7 (2.3)	3 (1.0)
9. RD-9-7	28 (9.2)	10 (3.3)
10. BKNBR 1141-2-4-2-2-2-1	49 (16.1)	30 (9.9)
11. RD-23	5 (1.6)	1 (0.3)
12. SP.75004-5	39 (12.8)	0 (0)
13. KDML105	53 (17.4)	6 (1.9)
14. RD-21-3	1 (0.3)	2 (0.7)
15. RD-9-14	92 (30.1)	21 (6.9)
16. SP.78002-80	12 (3.9)	0 (0)

Date of observation : July 18 and 19, 1983 Table-7
Number of hills observed in each variety : 304
RRSV : rice ragged stunt virus.
RGSV : rice grassy stunt virus and/or rice grassy stunt virus-2

Varietal difference in population of brown planthopper on rice plant

Variety	No. of brown planthopper per hill
RD-7	15.7
BKNBR 1141-2-4-2-2-2-1	16.8
RD-21-3	9.3
RD-23	0.8
RD-25	5.6

Table-8

Number of hill observed : 10

Distribution of hills infected with viruses on 16 varieties/entries

Observation made : July 4 - Aug. 3, 1983

Observation was made over entire plot of replication I, and each small square indicate one hill in the plot.

When rice plant is infected either entire hill or partially, following marks show the type of virus disease respectively.

■ : RRSV ○ : RGSV and/or RGSV-2 X :Orange leaf

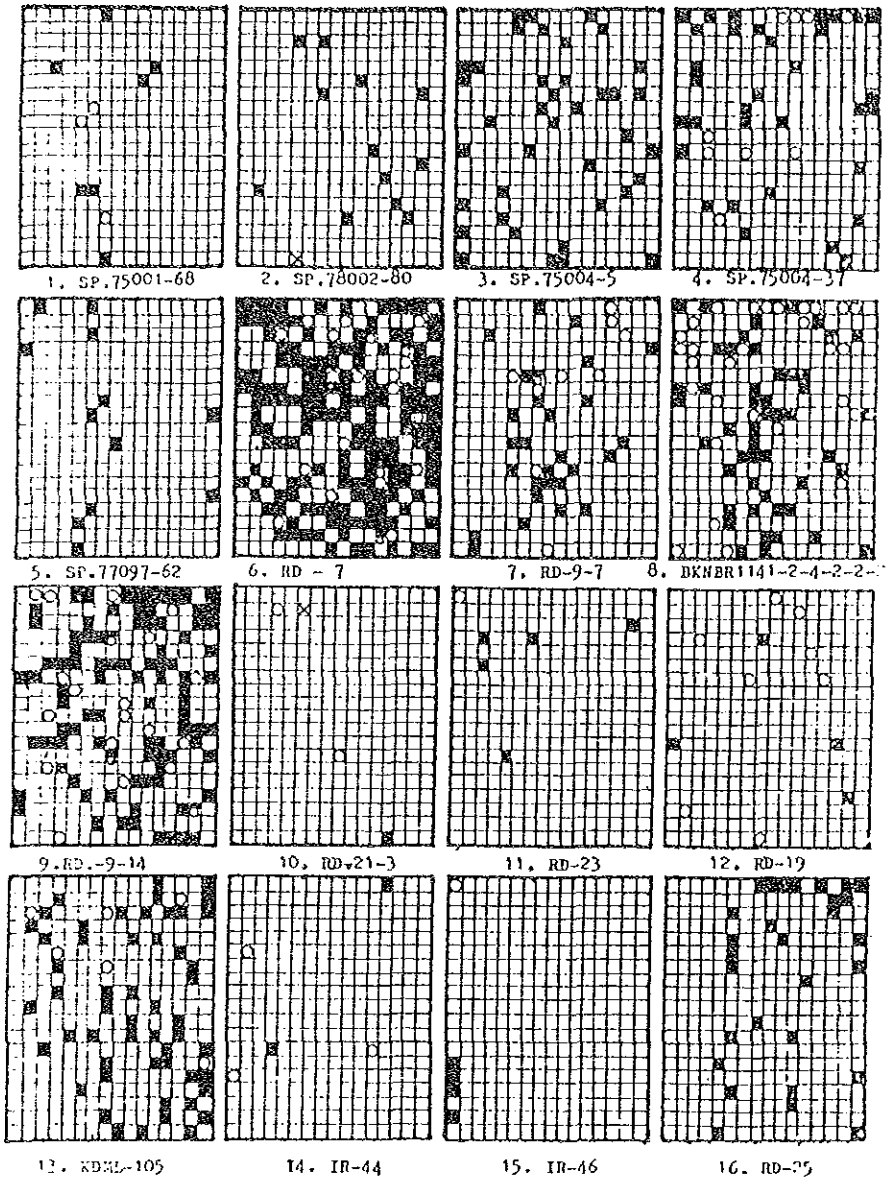


Figure-4

Curves in Increasing Number of Tillers / hill

(16 Varieters/Entries)

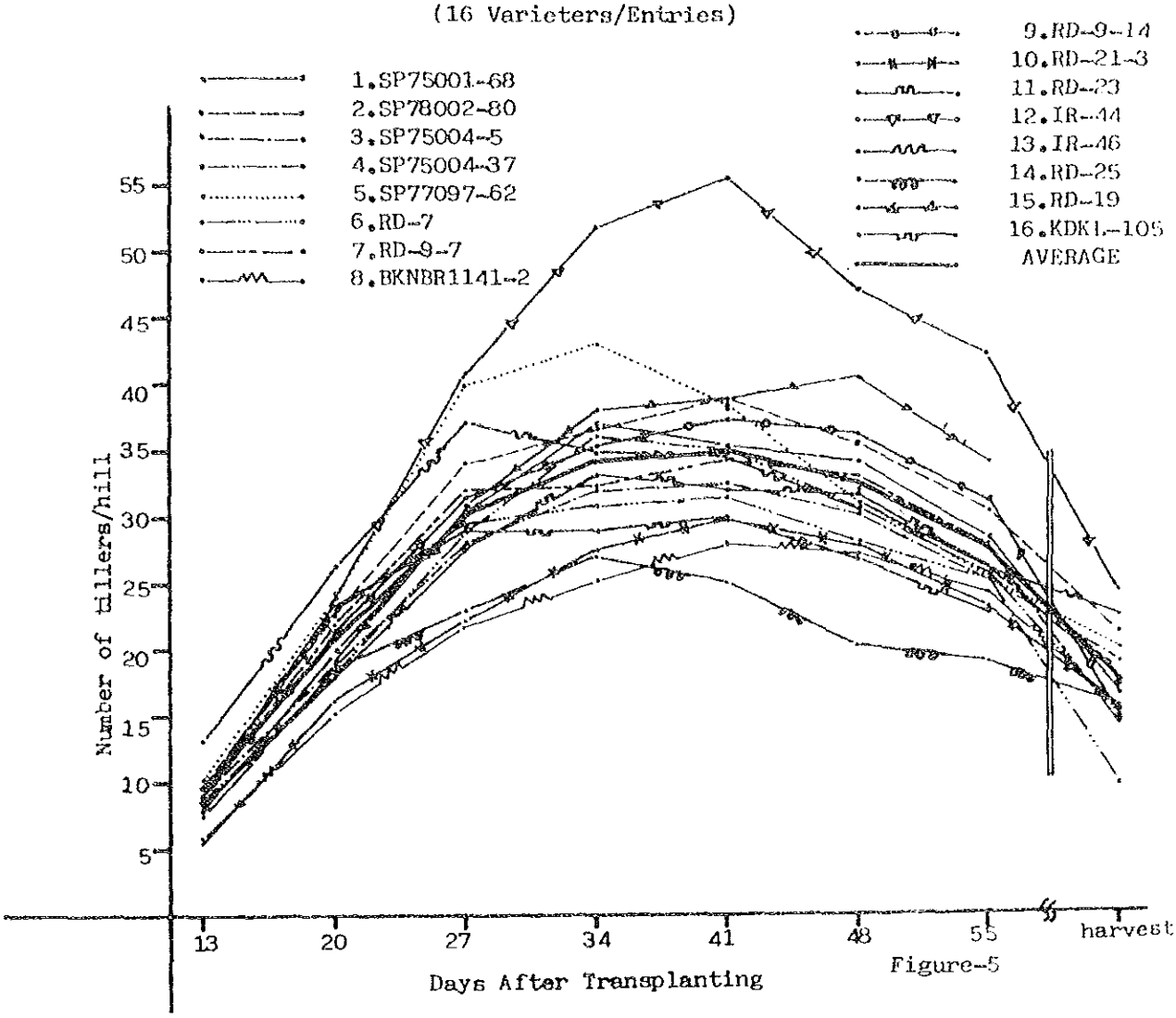


Figure-5

Records of growth observation on plant height and No. of tillers

Treatments (Entries)	13 DAT		20 DAT		27 DAT		34 DAT		41 DAT		48 DAT		55 DAT		HARVEST	
	P.H.	T.	P.H.	T.	P.H.	T.	P.H.	T.	P.H.	T.	P.H.	T.	P.H.	T.	P.H.	Pan.
1.SP75001-68	31.1	7.8	44.3	20.0	52.3	30.8	62.2	37.0	74.2	35.6	81.4	34.4	88.0	28.5	123.9	16.5
2.SP78002-80	32.3	9.8	44.8	22.7	52.8	33.8	64.7	36.9	77.5	38.6	86.9	35.9	93.6	30.5	122.8	21.1
3.SP75004-5	29.9	8.4	38.5	18.8	49.1	27.7	61.2	31.9	73.3	32.5	84.3	30.3	92.7	25.1	122.9	18.5
4.SP75004-37	30.4	8.2	43.0	18.2	50.1	28.8	62.2	35.2	73.8	35.0	83.7	31.6	91.4	25.6	122.3	14.9
5.SP77097-62	31.0	10.1	44.2	23.7	53.1	39.8	67.2	43.1	80.0	38.0	89.6	31.3	97.6	25.6	153.1	15.6
6.RD-7	27.7	8.1	40.8	22.8	48.5	29.4	57.6	30.8	68.5	31.7	75.9	27.7	83.6	25.6	-	9.6
7.RD-9-7	31.5	8.7	41.9	22.1	54.2	31.6	65.4	31.9	77.6	33.9	84.5	33.3	92.5	28.0	120.2	13.9
8.BKNBR1141-2	31.4	6.4	41.5	15.2	49.8	21.8	63.4	25.2	80.3	27.7	90.2	27.4	97.1	24.0	148.5	13.2
9.RD-9-14	33.7	8.4	42.8	21.7	54.0	31.5	65.3	35.4	76.1	37.2	83.2	36.3	90.9	31.3	122.8	14.7
10.RD-21-3	32.3	6.3	42.6	16.5	52.3	22.3	65.2	27.6	74.9	29.5	82.9	27.6	91.5	23.3	148.6	19.4
11.RD-23	29.4	8.2	40.8	18.1	48.6	27.8	58.5	32.6	73.2	31.9	84.8	32.2	94.8	26.1	130.3	17.35
12.IR-44	28.2	9.8	40.9	23.7	44.8	41.0	54.0	51.8	64.0	56.0	70.7	47.2	79.1	41.9	127.8	23.9
13.IR-46	30.9	13.2	44.3	31.5	53.3	36.7	65.7	34.9	77.2	34.6	84.0	30.9	89.0	25.9	123.5	22.4
14.RD-25	28.4	8.1	43.1	17.8	51.7	22.9	62.2	27.1	71.9	25.1	83.0	20.6	99.0	18.7	111.6	19.2
15.RD-19	26.1	8.0	39.7	19.1	45.1	31.0	54.1	38.0	63.2	38.7	68.5	40.3	80.0	33.9	-	-
16.KDML-105	35.6	9.2	48.8	23.0	64.3	29.0	82.2	28.8	100.8	30.0	111.2	26.9	126.4	22.9	-	-
Mean ($\bar{x}$)	30.7	8.7	42.6	20.9	51.5	30.4	63.2	34.3	75.4	34.8	84.1	32.1	93.0	27.3	129.1	16.9

Table-10

DAT : Days after transplanting

P.H.: Plant height (cm) T : Tillers Pan. : Panicles

Yield components and related figures on different varieties/entries

Trial No. II

Treatments	Heading Stage 50% Date	DAT	Maturity Date	DAT	Yield Components: Panicles/ m^2	Grains/ Panicle	% of ripened grain	1,000 grains weight(g)	Panicle length (cm.)	Stem length (cm.)	Grain/ Straw ratio	%of effective/ Productive tillers	Plant height (cm.)
1. SP.75001-68	18 July	68	17 Aug.	98	264.0	109.5	60.5	26.9	24.65	77.86	77	44.6	123.9
2. SP.78002-80	16 July	66	14 Aug.	95	337.6	104.6	80.6	25.5	23.83	80.55	81	54.7	122.8
3. SP.75004-5	15 July	65	13 Aug.	94	296.0	91.9	67.6	27.2	24.17	82.62	81	56.9	122.9
4. SP.75004-37	18 July	68	14 Aug.	95	238.4	92.8	66.0	28.7	24.19	80.67	97	42.3	122.3
5. SP.77097-62	28 July	78	25 Aug.	111	313.6	120.4	65.8	28.3	26.96	108.69	79	45.5	153.1
6. RD - 7	27 July	77	25 Aug.	106	153.6	145.9	45.9	27.7	27.54	84.98	42	30.3	-
7. RD 9 - 7	23 July	73	19 Aug.	100	222.4	150.3	39.1	29.9	26.79	84.34	49	41.0	120.2
8. BENER 1141 - 2-4-2-2-2-1	27 July	77	23 Aug.	104	211.2	155.9	62.7	28.8	30.72	98.34	72	47.6	148.5
9. RD 9 - 14	23 July	73	19 Aug.	100	235.2	142.8	43.1	28.8	25.75	78.40	54	39.5	122.8
10. RD 21 - 3	4 Aug.	85	31 Aug.	112	246.4	125.1	46.3	28.2	26.49	97.87	66	52.2	148.6
11. RD - 23	25 July	75	22 Aug.	103	277.6	130.1	63.2	28.4	28.26	87.70	91	53.2	130.3
12. IR 44	28 July	78	23 Aug.	104	382.4	90.4	46.0	26.8	25.89	77.17	59	42.7	127.8
13. IR 46	25 July	75	23 Aug.	104	358.4	112.1	74.5	23.7	23.20	83.85	102	61.0	123.5
14. RD - 25	3 July	53	29 July	79	242.4	83.3	77.7	29.0	21.36	72.31	106	56.1	111.6
Mean ($\bar{X}$)	-	72.2	-	100.4	269.9	118.2	59.9	27.7	25.70	85.38	75.4	47.7	129.1

Table-9

III. Seed Rate X Variety Trial (Direct Sowing)

Objectives :

1. To find out optimum seed rate level for promising varieties used by farmers.

2. To examine the interactions between seed rate levels and varieties.

Experimental Design :

Split plot with 3 replications.
Main plots are seed rate levels and sub plots are varieties.

Treatments :

Main plot (seed rate)

S_1 : 8 kg. of dry seeds/rai

S_2 : 12 kg. of dry seeds/rai

S_3 : 16 kg. of dry seeds/rai

Sub plot (varieties)

V_1 : RD-23

V_2 : RD-21

Plot Size :

Each experimental unit consists of 4 X 5 m. (20 m^2.).

Cultural Practices :

1. Weed Control : Saturn G at 15 days after sowing at a rate of 5 kg./rai

2. Fertilizer Application :

1st top dress	:	5 kg./rai of NPK at 15 days after sowing (15 - 15 - 15).
2nd " "	:	4 kg. N/rai at 20 days after 1st top dressing (21 - 0 - 0).
3rd " "	:	3 kg. N/rai at panicle initiation stage (21 - 0 - 0).
4th " "	:	3 kg. N/rai at heading stage (21 - 0 - 0)

3. Plant Protection :

Furadan G	:	29 days after sowing (5kg./rai).
Sumithion EC	:	55 days after sowing (100 cc./rai).
Padan Mipcin G	:	75 days after sowing (5 kg./rai).

4. Duration :

Sowing	:	May 17, 1983
Harvesting	:	Sept. 9. (RD-23)
		Sept.14. (RD-21)

RESULTS : Trial No. III Grain Yield (kg/rai)

Treatments	Replications			Mean ($\bar{X}$)
	I	II	III	
1. S_1V_1	907	804	1073	928
2. S_1V_2	648	730	782	720
3. S_2V_1	880	1068	1192	1046
4. S_2V_2	614	764	789	722
5. S_3V_1	944	975	837	918
6. S_3V_2	709	751	707	722
Mean ($\bar{X}$)	783	848	896	843

Table-11

ANOVA

SV	DF	SS	MS	F	Required F 5%	Required F 1%
Total	17	421002				
Seed rate(Main)	8	118442				
Blocks	2	38596	19298	1.20	6.94	18.00
Seed rate	2	15537	7768	0.48	6.94	18.00
Error(a)	4	64309	16077			
Variety	1	265477	265477	72.21**	5.99	13.74
Seedrate X Variety	2	15027	7513	2.05	5.14	10.92
Error (b)	6	22056	3676			

LSD for main-plot treatment (seed rate means): 5% = 203.2 (kg/rai)
LSD for sub-plot treatment (variety means) : 5% = 69.9 (")
1% = 105.9 (")
LSD for between variety means at same seed rate levels
5% = 121.1 (")
LSD for between varieties at different seedrate levels or same variety at different seedrate levels. 5% = 191.4 (")

CV(a) = 15 (%), CV(b) = 7.2 (%)

Treatment means (kg/rai)

Seed rate	Varieties		Mean ($\bar{X}$)
	RD-23	RD-21	
8 kg/rai	928	720	824
12 kg/rai	1046	722	884
16 kg/rai	918	722	820
Mean ($\bar{X}$)	964	721	843

Table-12

GRAPHIC PESENTATION ON GRAIN YIELD

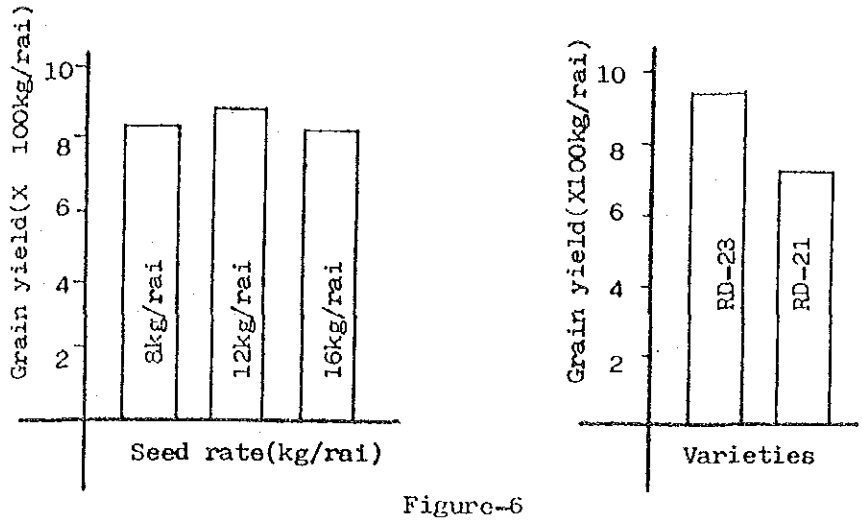


Figure-6

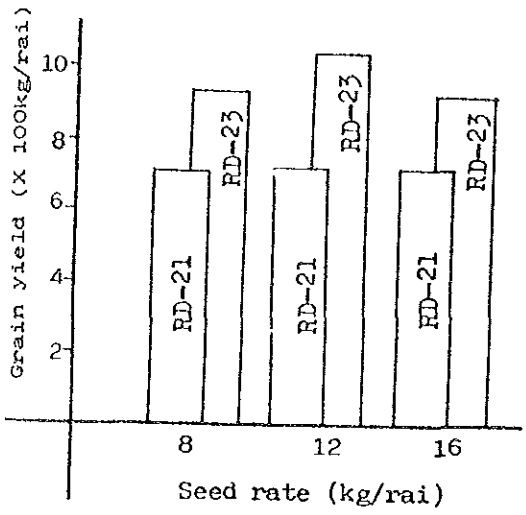


Figure-7

Different amount of seed sown for direct sowing did not influence significantly to the grain yield.

When two varieties are compared, grain yield of RD-23 was significantly superior to RD-21 in any seed rate levels. (Table-11, 12, ANOVA & Figure-6,7) Interaction effect of seedrate X variety was not recognized.

High yield potentiality of variety RD-23 was proved not only direct sowing but also transplanting method in varietal trial and seed multiplication farm.

Further study to determine relationship between seedrate and grain yield is needed in order to find out optimum amount of seed for direct sowing method.

PARTIAL BUDGET ANALYSIS

Dominance Analysis

Treatments	Grain Yield (kg./rai)	Gross benefit (฿/rai)	Variable cost (Seed)	Net benefit (฿/rai)
1. S_1V_1	835	2756	26.4	2729
2. S_1V_2	648	2138	26.4	2112*
3. S_2V_1	941	3106	39.6	3067
4. S_2V_2	650	2145	39.6	2105*
5. S_3V_1	826	2726	52.8	2673*
6. S_3V_2	650	2145	52.8	2092*

Table-13

Note : The treatments with * mark were dominated.

Marginal Analysis

Undominated Treatments	Net benefit (฿/rai)	Variable cost (฿/rai)	Marginal rate of return
3. S_2V_1	3067	39.6	2560 (%)
1. S_1V_1	2729	26.4	

Table-14

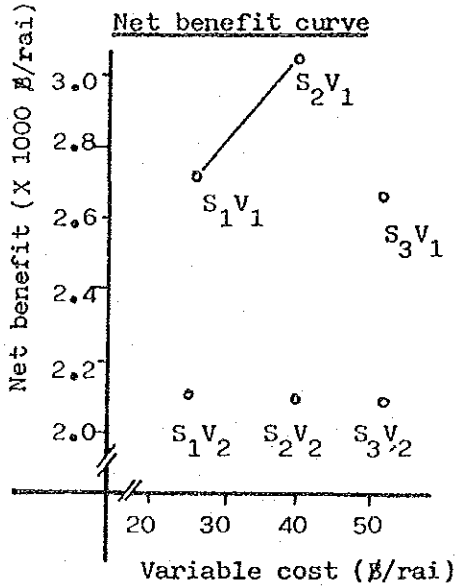


Figure-8

The cost of seed is relatively low if it is compared with other inputs such as fertilizers or chemicals. Naturally, the treatment with higher grain yield has higher chance to provide higher net benefit.

In consequence of this trial results indicate that there is no perplexity to choice variety RD-23, since the mean grain yield of variety RD-21 was interior to RD-23.

Variety of RD-23 with intermediate level of seed rate (12 kg/rai) was found to be the best economically.

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

Objectives :

1. To compare the yield responses due to different Nitrogen rate and time of application on direct broadcasted rice.

2. To study profitable level and time of Nitrogen application.

Experimental Design :

RCBD with 4 Replications.

Treatments :

Top dressing of Nitrogen as a form of Ammonium Sulphate (21 - 0 - 0).

Treatments No.	1st	2nd	3rd	4th	Total N.
1.	5	0	0	0	5
2.	5	0	5	0	10
3.	5	5	0	0	10
4.	7	0	3	0	10
5.	5	4	3	3	15
6.	10	0	5	0	15
7.	5	5	5	0	15
8.	7	0	5	3	15

Note :

1st top dress : 15 days after sowing
2nd " " : 20 days after 1st top dressing
3rd " " : panicle initiation stage
4th " " : just before heading stage.

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

Variety used : RD-23

Cultural Practices :

1. Seed rate : 12 kg./rai (dry seed).

2. Weed Control : Saturn G applied at 15 days after sowing at a rate of 5 kg./rai.

3. Fertilizer application of P_2O_5

: 6 kg./rai of Phosphorus applied at a time of 1st top dressing as a form of TSP.
No Potassium fertilizer applied.

4. Plant Protection :
Furadan G : 29 days after sowing (5 kg./rai)
Sumithion EC : 55 days after sowing (100 cc./rai)
Padan Mipcin G : 75 days after sowing (5 kg./rai)

5. Duration :

Sowing : May 17, 1983
Harvesting: Sept. 9.

RESULTS : Trial No. IV Grain yield (kg/rai)

Treatments (N.kg/rai)	Replications I	II	III	IV	Mean ($\bar{X}$)
1. 5-0-0-0	1021	982	929	827	939.8
2. 5-0-5-0	814	997	1133	1192	1034.0
3. 5-5-0-0	877	861	627	793	789.5
4. 7-0-3-0	1072	934	910	1164	1020.0
5. 5-4-3-3	849	976	866	923	903.5
6.10-0-5-0	763	993	644	1153	888.3
7. 5-5-5-0	792	827	810	1026	863.8
8. 7-0-5-3	1148	960	1009	1031	1037.0
Mean($\bar{X}$)	917	941	866	1013	934.4

Table-15

ANOVA

SV	DF	SS	MS	F	Required F 5%	1%
Total	31	636578				
Blocks	3	90438	30146	1.99	3.07	4.87
Treatments	7	227499	32499	2.14	2.49	3.65
Error	21	318641	15173			

CV = 13.18 (%)

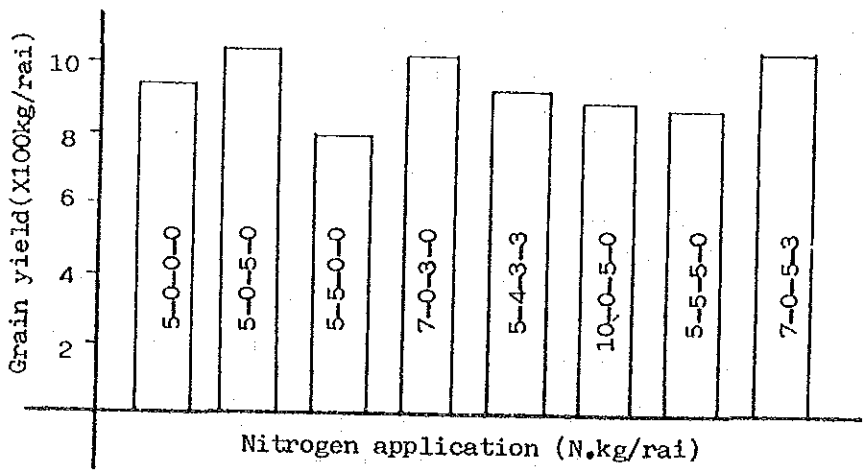


Figure-9

PARTIAL BUDGET ANALYSIS

Dominance analysis

Treatments	Grain Yield (kg./rai)	Gross benefit (฿/rai)	Variable cost (฿/rai)			Net benefit (฿/rai)
			Fertilizer	Opportunity cost	Total	
5-0-0-0	846	2791	57	16	73	2718
5-0-5-0	930	3071	114	32	146	2925
5-5-0-0	710	2345	114	32	146	2199*
7-0-3-0	918	3029	114	32	146	2883*
5-4-3-3	813	2683	171	64	235	2448*
10-0-5-0	799	2638	171	32	203	2435*
5-5-5-0	777	2565	171	48	219	2346*
7-0-5-3	933	3079	171	48	219	2860*

Table-16

Note : The treatments with * mark were dominated.

Marginal analysis

Undominated Treatments	Net benefit (฿/rai)	Variable cost (฿/rai)	Marginal rate of return
2. 5-0-5-0	2925	146	283.6 (%)
1. 5-0-0-0	2718	73	

Table-17

Net benefit curve

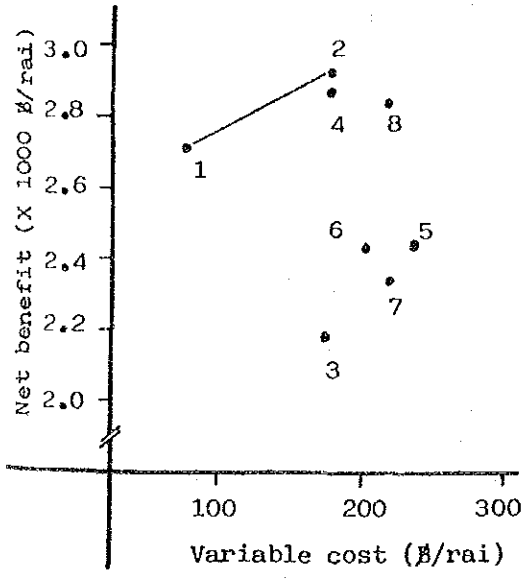


Figure-10

No significant differences was observed on the mean grain yield of different treatments. The different amount of Nitrogen and different time of split application of Nitrogen did not affect significantly to the grain yield due probably to high potential soil fertility at the trial site.

In consequence of the results of economic analysis of this paticular trial, 5-0-5-0 treatment (5 kg. of Nitrogen applied at 15 days after sowing and panicle initiation stage respectively) was found to be profitable with reasonably high marginal rate of return.

V. 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 Urea)	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-21

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. 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.
   (3) Sumithion EC applied at 77 days after transplanting at a rate of 100 cc./rai. (X1000)
6. Duration :
   Sowing : April 21, 1983 , Transplanting : May 11.
   Harvesting : Aug. 30. (111 D.A.T.)

RESULTS : Trial No. V Grain yield (kg/rai)

Treatments	Replications		Mean ($\bar{X}$)
	I	II	
1. N_0P_0	894	904	899.0
2. N_0P_1	859	961	910.0
3. N_0P_2	958	945	951.5
4. N_1P_0	1257	1056	1156.5
5. N_1P_1	1208	1038	1123.0
6. N_1P_2	1030	1084	1057.0
7. N_2P_0	1238	1060	1149.0
8. N_2P_1	1105	1091	1098.0
9. N_2P_2	1068	967	1017.5
10. N_3P_0	1188	1011	1099.5
11. N_3P_1	1056	1036	1046.5
12. N_3P_2	1060	1088	1074.0

Table-18

ANOVA

SV	DF	SS	MS	F	Required F 5%	Required F 1%
Total	23	248736				
Blocks	1	19266	19266	3.56	4.84	9.65
Treatments	11	169994	15454	2.86*	2.82	4.46
Nitrogen	(3)	136228	45409	8.40**	3.59	6.22
Phosphorus	(2)	10612	5306	0.98	3.98	7.20
N X P	(6)	23154	3859	0.71	3.09	5.07
Error	11	59476	5406			

LSD (1). Between Nitrogen means : 5% = 93.4(kg/rai)
1% =131.8(")
(2). Between Phosphorus means : 5% = 80.9(")
(3). Interaction (N X P) : 5% =161.8(")

CV = 7.01 (%)

Treatment means: (Grain yield : kg/rai)

Nitrogen levels	Phosphorus levels			Nitrogen means
	P_0	P_1	P_2	
No Nitrogen	899	910	951	920
6 kg N/rai	1156	1123	1057	1112
12 kg N/rai	1149	1098	1017	1088
18 kg N/rai	1099	1046	1074	1073
Mean ($\bar{X}$)	1075	1044	1024	1048

Table-19

GRAPHIC PESENTATION

Mean Grain Yield in relation to Nitrogen and Phosphorus

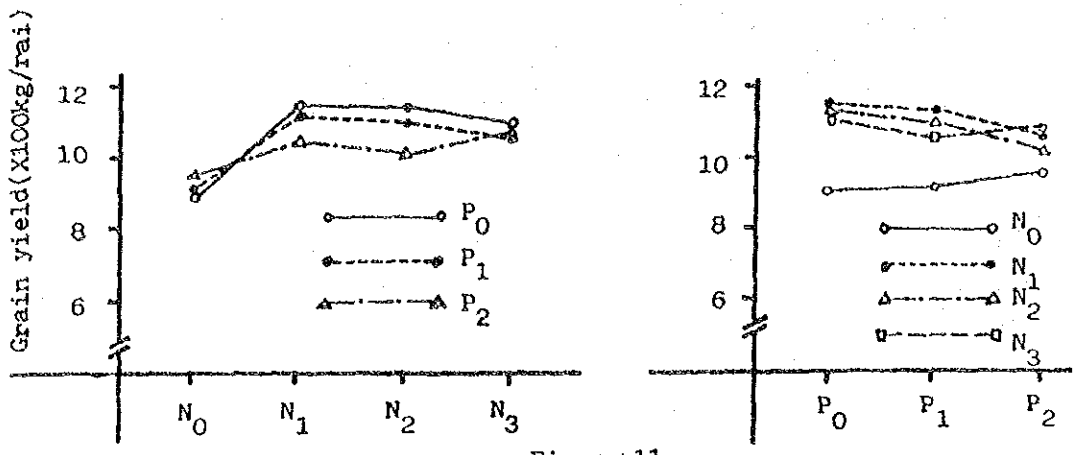


Figure-11

Nitrogen X Phosphorus

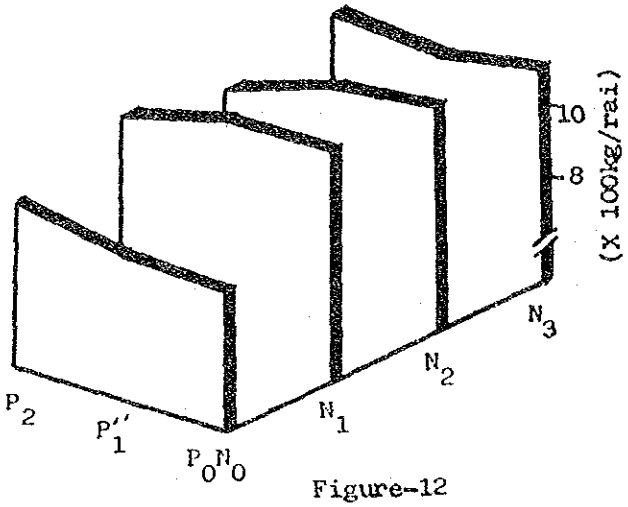


Figure-12

The statistical result shows that the Nitrogen application contributed to increase grain yield significantly even at 1 % level of significance whereas no significant effect of Phosphorus application was observed.

Among the mean grain yield of Nitrogen levels, the yield of No nitrogen treatment was significantly lower than the treatment involving Nitrogen regardless amount.

Different amount of Nitrogen (6,12 & 18 kg. N/rai) did not influence to grain yield.

(Table - 18, 19 ANOVA, Figure - 11 & 12)

PARTIAL BUDGET ANALYSIS

Dominance Analysis

Treatments	Grain Yield (kg./rai)	Gross benefit (฿/rai)	Variable cost (฿/rai)			Net benefit (฿/rai)
			Fertilizer	Opportunity cost	Total	
1. N_0P_0	809	2670	-	-	-	2670
2. N_0P_1	819	2702	65.2	16	81.2	2621*
3. N_0P_2	856	2826	130.4	16	146.4	2679*
4. N_1P_0	1040	3434	78.3	16	94.3	3340
5. N_1P_1	1010	3335	143.5	16	159.5	3175*
6. N_1P_2	951	3139	208.7	16	224.7	2914*
7. N_2P_0	1034	3412	156.5	48	204.5	3208*
8. N_2P_1	988	3261	221.7	48	269.7	2991*
9. N_2P_2	915	3022	286.9	48	334.9	2687*
10. N_3P_0	989	3264	234.8	48	282.8	2981*
11. N_3P_1	942	3108	300.0	48	348.0	2760*
12. N_3P_2	966	3189	365.2	48	413.2	2776*

Table-20

*Note : The treatments with * mark were dominated.*

Marginal Analysis

Undominated treatments	Net benefit (฿/rai)	Variable cost (฿/rai)	Marginal rate of return
4. N_1P_0	3340	94.3	710.5 (%)
1. N_0P_0	2670	-	

Table-21

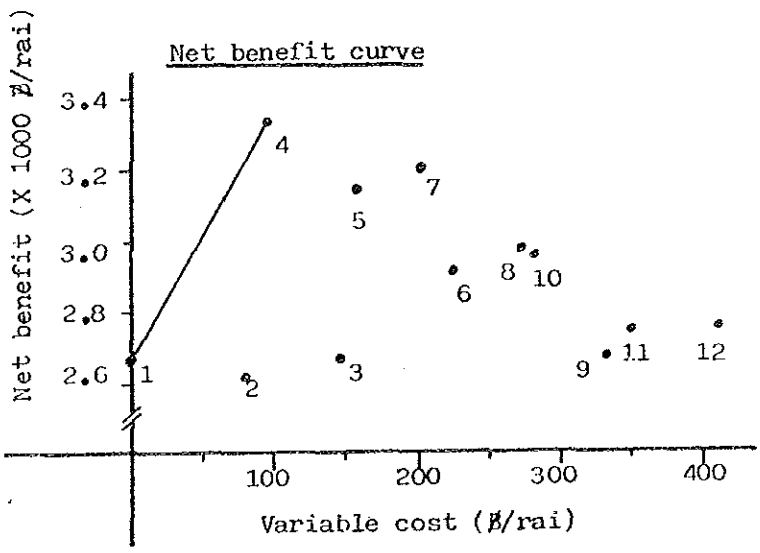


Figure-13

The results of economic comparison made among different levels of Nitrogen, minimum level of Nitrogen (6 kg. N/rai) without Phosphorus was found to be the most economical fertilizer application under trial site conditions.

(Table-20, 21 & Figure-13)

The results of observation of yield components are shown in Table-22.

Trial No. V

Variety : RD - 21

Treatments No.	Yield Components			
	Panicles/ m^2	Grains/ Panicle	% of ripened grain	1,000 grains weight (g)
1. N_0P_0	243.2	108.4	77.9	26.8
2. N_0P_1	224.0	102.8	71.3	27.9
3. N_0P_2	272.0	127.3	70.0	26.7
4. N_1P_0	252.8	118.0	71.8	27.9
5. N_1P_1	220.8	117.6	74.1	28.7
6. N_1P_2	297.6	113.9	66.9	26.9
7. N_2P_0	272.0	118.5	73.3	28.8
8. N_2P_1	246.4	123.0	81.6	28.0
9. N_2P_2	246.4	131.0	64.2	28.3
10. N_3P_0	316.8	117.9	72.6	28.1
11. N_3P_1	275.2	125.0	61.4	28.1
12. N_3P_2	278.4	121.6	57.6	28.0
Mean ($\bar{X}$)	262.1	118.8	70.2	27.9

Table-22

VI. Nitrogen Source Comparative Trial = Effect of GML VS Urea =

Objectives :

1. To determine the effect of GML and Urea 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 4 Replications.

Treatments : (kg. N/rai)

Treatments No.	Basal	Topdress	Total N.
1.	0	0	0
2.	6 (GML)	0	6 (GML)
3.	6 (Urea)	0	6 (Urea)
4.	6 (GML)	6 (GML)	12 (GML)
5.	6 (Urea)	6 (Urea)	12 (Urea)
6.	12 (GML)	0	12 (GML)
7.	12 (Urea)	0	12 (Urea)
8.	12 (GML)	6 (GML)	18 (GML)
9.	12 (Urea)	6 (Urea)	18 (Urea)

8 kg./rai of Phosphorus applied over every plots before transplanting as a form of TSP.

Top dressing of Nitrogen applied at panicle initiation stage.

Variety used : RD-23

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

** GML : " Glutamic Mother Liquor " containing 4.6% Nitrogen.

Cultural Practices :

1. Seed rate : 4.0 kg. of dry seed/rai.
2. Seedling age : 19 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 arate of 5 kg./rai
5. Plant Protection :
   (1) Furadan G : 2 weeks after transplanting at a rate of 5 kg./r
   (2) Padan Mipcin : 5 weeks after transplanting " " "
   (3) Sumithion Ec : 8 weeks after transplanting (100 cc./rai).
6. Duration :
   Sowing : April 21, 1983
   Transplanting : May 10.
   Harvesting : Aug. 29. (111 D.A.T., 130 D.A.S.)

RESULTS : Trial No. VI

Grain yield (kg/rai)

Treatments	Replications				Mean ($\bar{X}$)
	I	II	III	IV	
1. Control	1078	1151	1062	962	1063.3
2. GML (6-0)	1399	1307	1134	1165	1251.3
3. Urea(6-0)	1297	1195	1254	1155	1225.3
4. GML (6-6)	1297	1344	1324	1291	1314.0
5. Urea(6-6)	1316	1350	1239	1269	1293.5
6. GML (12-0)	1182	1470	1263	1281	1299.0
7. Urea(12-0)	1182	1304	1198	1196	1220.0
8. GML (12-6)	1227	1237	1306	1376	1286.5
9. Urea(12-6)	1386	1248	1221	1205	1265.0
Mean ($\bar{X}$)	1262	1289	1222	1211	1246.4

Table-23

ANOVA

SV	DF	SS	MS	F	Required F 5%	Required F 1%
Total	35	359046				
Blocks	3	35563	11854	2.05	3.01	4.72
Treatments	8	184882	23110	4.00**	2.36	3.36
Error	24	138600	5775			

LSD for treatments : 5% = 73.9 (kg/rai)

1% =100.2 (kg/rai)

CV = 6.1 (%)

Duncan's Multiple Range Test

Treatments	Mean yield (kg/rai)	DMRT 5%	DMRT 1%
4. GML (6-6)	1314	a	a
6. GML (12-0)	1299	ab	a
5. Urea (6-6)	1293	ab	a
8. GML (12-6)	1287	ab	a
9. Urea(12-6)	1265	ab	a
2. GML (6-0)	1251	ab	a
3. Urea (6-0)	1225	b	a
7. Urea(12-0)	1220	b	a
1. Control	1063	c	b

Table-24

Mean Grain Yield

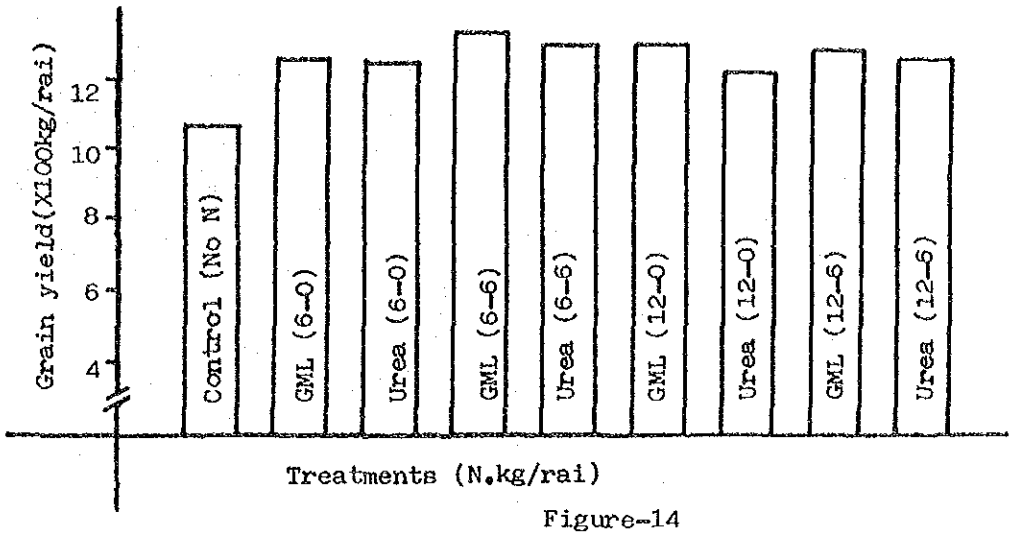


Figure-14

Trial No. VI Yield Component Datas Variety : RD - 23

Treatments No.	Yield Components				% of effective/ Productive tillers
	Panicles/ m^2	Grains/ Panicle	% of ripened grain	1,000 grains weight(g)	
1. 0 - 0	290.4	86.7	84.4	26.9	54.8
2. 6 - 0 GML	300.8	113.9	85.8	26.6	56.1
3. 6 - 0 Urea	324.0	94.5	90.4	26.9	63.3
4. 6 - 6 GML	286.4	109.3	80.5	27.2	50.7
5. 6 - 6 Urea	309.6	100.3	82.0	27.2	56.3
6. 12 - 0 GML	365.6	100.7	88.8	27.0	63.5
7. 12 - 0 Urea	321.6	111.3	78.1	27.2	46.5
8. 12 - 6 GML	310.4	93.4	83.3	26.9	47.4
9. 12 - 6 Urea	326.4	102.9	81.9	26.5	59.3
Mean ($\bar{X}$)	315.0	101.4	83.9	26.9	55.3

Table-25

PARTIAL BUDGET ANALYSIS

Dominance Analysis

Treatments	Grain Yield (Kg./rai)	Gross benefit (฿/rai)	Variable cost (฿/rai)			Net benefit (฿/rai)
			Fertilizer	opportunity cost	Total	
1. Control	956	3158	-	-	-	3158
2. GML (6-0)	1126	3715	57.4	-	57.4	3658
3. Urea (6-0)	1102	3636	78.3	16	94.3	3542*
4. GML (6-6)	1182	3902	114.8	32	146.8	3756
5. Urea (6-6)	1164	3841	156.5	32	188.5	3653*
6. GML (12-0)	1169	3858	114.8	-	114.8	3744
7. Urea (12-0)	1098	3623	156.5	16	172.5	3451*
8. GML (12-6)	1157	3820	172.0	32	204.0	3616*
9. Urea (12-6)	1138	3757	234.8	32	266.8	3490*

Note : The treatments with * mark were dominated.

Table-26

Marginal Analysis

Undominated Treatments	Net benefit (฿/rai)	Variable cost (฿/rai)	Marginal rate of return	
			VS. next highest benefit	VS. Check (control)
4. GML (6-6)	3756	146.8	37.5 (%)	407.3 (%)
6. GML (12-0)	3744	114.8	149.8	510.4
2. GML (6-0)	3658	57.4	871.0	871.0
1. Control	3158	-		

Table-27

Net benefit curve

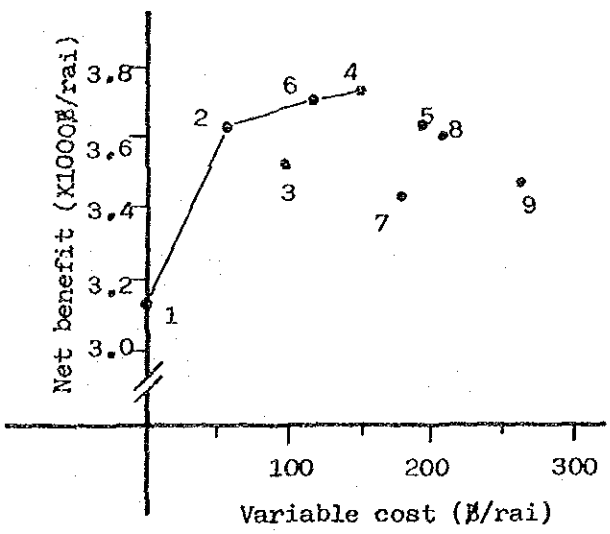


Figure-15

Records of Growth Observation on Plant Height and No. of Tillers

Note : DAT = Number of Days after Transplanting

P.H. = Plant Height (cm)

T. = Number of Tillers

Treatments	13 DAT		21 DAT		27 DAT		34 DAT		41 DAT		48 DAT		55 DAT		No.of panicle/hill
	P.H.	T.	P.H.	T.	P.H.	T.	P.H.	T.	P.H.	T.	P.H.	T.	P.H.	T.	
1, Control	29.0	4.4	41.3	10.7	46.3	22.5	50.0	31.2	69.2	33.1	79.1	28.5	92.7	27.2	18.15
2, GML (6-0)	30.1	4.0	41.5	11.0	46.6	19.6	55.8	30.1	69.3	33.5	81.6	31.0	94.8	29.2	18.80
3, UREA (6-0)	32.0	4.7	43.8	12.1	48.2	22.6	55.9	28.2	68.2	32.0	79.1	28.4	91.0	27.0	20.25
4, GML (6-6)	30.4	5.6	42.2	14.5	48.9	25.3	60.0	34.9	75.2	35.3	85.8	35.0	97.8	27.7	17.9
5, UREA (6-6)	29.2	5.5	39.7	14.8	47.7	24.1	56.2	32.1	70.3	34.4	80.9	34.0	93.6	29.9	19.35
6, GML (12-0)	28.4	6.2	38.5	15.5	46.7	25.9	58.2	35.5	70.2	36.0	80.4	35.3	90.1	31.7	22.85
7, UREA (12-0)	29.5	6.0	40.8	17.4	46.6	29.5	58.1	38.3	73.7	43.2	84.4	38.0	96.0	31.5	20.10
8, GML (12-6)	28.8	6.4	41.2	17.5	47.3	31.5	59.6	40.0	76.4	40.9	87.8	40.0	99.1	30.0	19.40
9, UREA (12-6)	30.2	4.3	43.3	11.8	48.3	22.6	57.1	31.0	69.7	34.4	82.0	30.0	94.2	27.7	20.40
Mean ($\bar{x}$)	29.7	5.2	41.4	13.9	47.4	24.8	56.5	33.5	71.4	35.9	82.3	33.4	94.4	29.1	19.69

Table-28

Due to high fertility of soil, mean grain yield harvested from this trial was extremely high even no Nitrogen (control) treatment. However, effect of Nitrogen was still observed between the treatment with Nitrogen and without Nitrogen.

The rice planted without Nitrogen application (control), the grain yield was significantly lower than the treatments with Nitrogen even at 1 % level of significance.

(Table-24, ANOVA)

The mean yield of GML (1,287 kg/rai) and Urea (1,250 kg/rai) regardless amount of Nitrogen was not differ statistically.

The yield components data indicated that number of panicles/unit area and number of grains/panicle tend to be lower when Nitrogen is not applied.

(Table-25)

From the economic point, great increment of net benefit over control treatment was recorded in Treatment No.2 (6kg N/rai applied before transplanting as a form of GML). Futher increase of net benefit over treatment No.2 was obtained from the treatment of GML(12-0).

Top dressing of GML at panicle intiation stage seemed to have some effect. However, from the practical point of view, it is considered to be not very applicable.

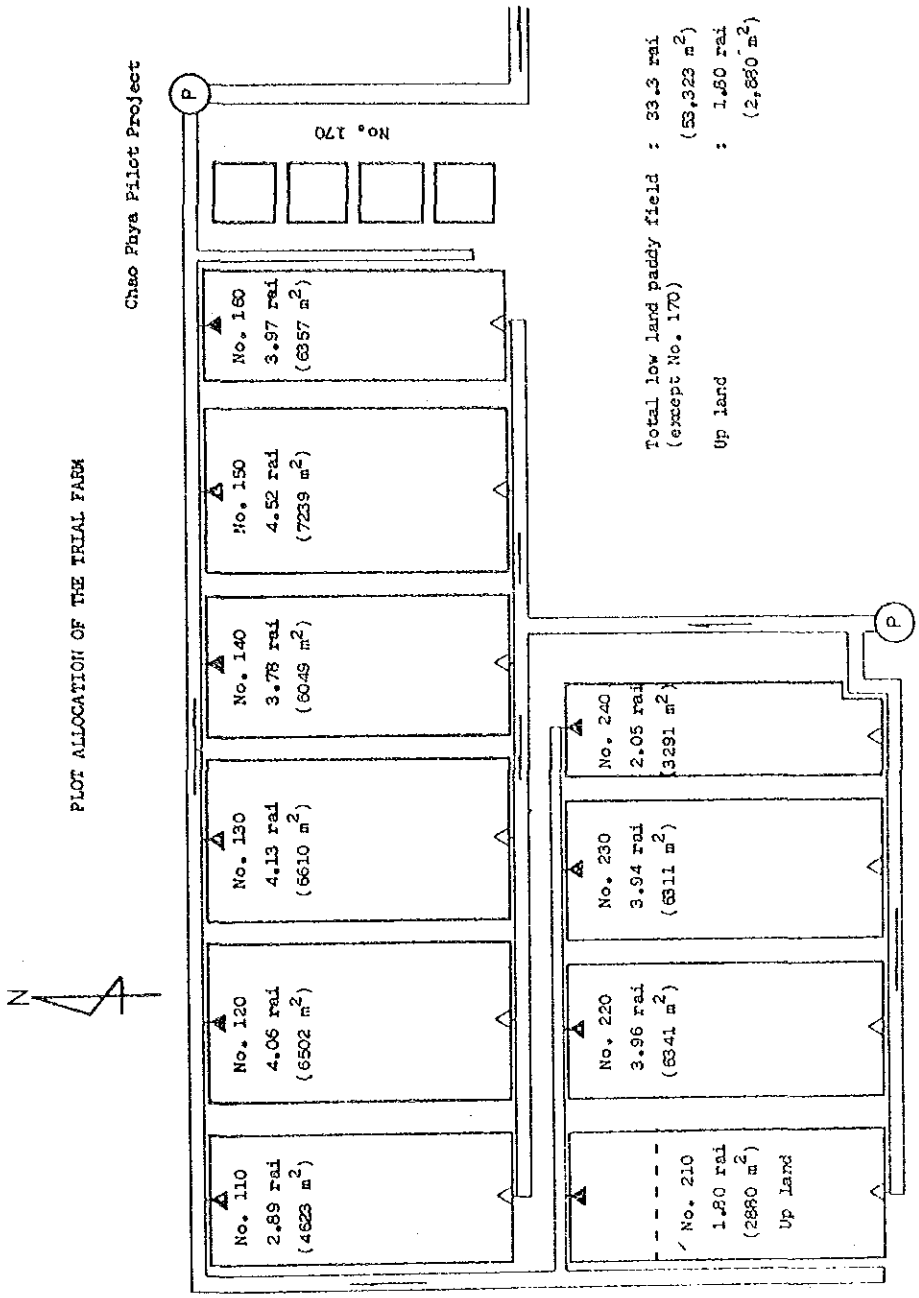
(Table-26, 27 & Figure-15)

ABSTRACTED FINDINGS AND GENERAL RECOMMENDATIONS ON RICE CULTIVATION

There are more than sixty agronomic trials conducted during cooperation period, but the results obtained were forty-nine out of them due to severe damage of field rat or Rice Ragged Stunt Virus.

The following abstracted findings and general recommendations were derived in consequence of the agronomic trials conducted at Trial Farm of the Chao Phya Pilot Project with the consideration of socio-economic and agro-climatic conditions in the project area or similar circumstances.

- The variety of RD-23 the most popular rice variety in the area has been proven as a suitable and recommendable with high yielding and good resistance to RRSV.
- The varieties susceptible to RRSV should not be recommended in the area.
- Nursery duration of 18-30 days appeared to be adequate age for transplanting.
- Degree of susceptibility to RRSV was found to be very important in selecting varieties since the grain yield was closely accociated.
- "Red Burning Symptoms" may occur partially where land has just been consolidated. But it would be recovered by the application of either nitrogen or phosphorus.
- Significant yield reduction was not observed when surface field water was drained at 10 days or more days after full heading stage.
- Significant effects and good economic responses of Nitrogen fertilizer were observed in most trials.
- Effects of Phosphorus fertilizer were not significant in most cases in the trial farm.
- Relationship between grain yield and deep water condition was very much depend on the varieties. RD-23 was not adapted to deep water condition.
- Significant effect of green manure (Sesbania) on the grain yield was observed.
- Basal nitrogen application at around 2 weeks after sowing found to be better than the application before sowing for the yield and weed control of direct sowing method.
- Dry seed of 12-16 kg/rai appeared to be recommendable seed rate level.
- The grain production of direct sowing in Wet Season was observed to be inferior to transplanting method. But in dry season, it was equal or even better than the transplanting method either mechanical or manual.
- Varieties of RD-7, RD-9 and KDML 105 were found to be very susceptible to RRSV.
- Different nitrogen sources did not influence significantly to grain yield, but the amount of nitrogen was closely correlated.
- Top dressing of nitrogen at panicle initiation stage should not be neglected in general conditions.
- Low cost of GML (Ami Ami) found to be advantageous especially for transplanting method. Effective weed control measures should be associated with direct sowing method.
- Total nitrogen of 11-13 kg N/rai appeared to be safety and profitable level with split dose of basal and top dressing at panicle initiation stage. More profit can be obtained with heavier application if every managements are properly done.


PLOT ALLOCATION OF THE TRIAL FARM
Chao Phya Pilot Project
N
P
No. 170
No. 110
2.89 rai
(4623 m²)
No. 120
4.06 rai
(6502 m²)
No. 130
4.13 rai
(6610 m²)
No. 140
3.78 rai
(6049 m²)
No. 150
4.52 rai
(7239 m²)
No. 160
3.97 rai
(6357 m²)
No. 210
1.80 rai
(2880 m²)
Up land
No. 220
3.96 rai
(6341 m²)
No. 230
3.94 rai
(6311 m²)
No. 240
2.05 rai
(3291 m²)
Total low land paddy field (except No. 170) : 33.3 rai (53,323 m²)
Up land : 1.80 rai (2,880 m²)

AGRONOMIC ACTIVITIES DURING EXTENDED PERIOD — Chao Phya Pilot Project

Items \ Year / Month	1982 – 83								1983 – 84								1984 – 85							
	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1. Trials and Tests :																								
1). Trials on rice cultivation																								
(1). Varietal Comparative Study							T						T				T				T			D
(2). Fertilizer rate Comparative trial (Nitrogen)				D																				
(3). Drainage Time Comparative Study	T						T																	
(4). Seedling Age Sensitivity Test							T																	
(5). Fertilizer rate and Application Time				T				T					D				D							
(6). Deep water Rice Cultivation Trial	T						T																	
(7). Green manure Cultivation																					T			
(8). Fertilizer rate, Green manure and Compost Application Trial							T																	
(9). Seedrate x Variety Trial								T					D											
(10). Nitrogen x Phosphorus Trial													T				T				T			
(11). Nitrogen Source Comparative													T				T				D			
(12). Seedrate x Nitrogen Level																	D							
(13). Seedrate x Nitrogen Application																	D				D			
(14). Variety x Production Inputs																					D			
(15). Weed Control Comparative Trial																								D
(16). Production Input Comparative Trial																								D
2). Associated Trials																								
Planting Method Comparative Trial							T	D					T	D			T	D			T	D		
Field Rats Control Trial																								
2. Training :																								
Rice cultivation techniques																								
Applied research system																								
Agronomic Data Analysis																								
Formulation of Recommended technology																								
3. Supporting activities :																								
1). Demonstration																								
2). Seed Multiplication																								
3). Others																								

Note : T indicates Transplanting Method
D indicates Direct Sowing Method

SEASONAL TRANSITION OF RICE PRODUCTION AT SEED MULTIPLICATION AND DEMONSTRATION FARM
(CHAO PHYA TRIAL FARM, 1981 - 1984)

Field No.		1981-1982		1982-1983		1983-1984		1984-1985
		Dry	Wet	Dry	Wet	Dry	Wet	Dry
110	Area planted (rai)	1.4		2.8	2.89	2.89	2.89	2.89
	Variety	RD-25	Trial conducted	RD-21	RD-23 (D)**	RD-23 (D)	RD-23 (T)	RD-23 (D)
	Production (kg)	784		1693	2151	2289	1303	
	Yield (kg/rai)	560		565	744	792	451	
120	Area planted	4.1	4.1		4.06	1.97+Trials	4.06 (T)	4.06
	Variety	RD-25	RD-23		RD-21 (T)*	RD-23 (T)	RD-21, Apple Thong	RD-21 (D)
	Production (kg)	2573	3621		2557	1303	1407,1217	
	Yield (kg/rai)	627	883		639	732	693, 600	
130	Area planted (rai)	4.1		4.1	4.13	4.13	4.13	4.13
	Variety	RD-25	Green manure	RD-23	RD-21 (T)	RD-23 (T)	RD-23 (D)	SPR79205-3 (T)
	Production (kg)	2950		2430	2887	3554	2568	
	Yield (kg/rai)	719		593	700	823	622	
140	Area planted (rai)	3.8		3.8	3.78	1.75+Trials	3.78	2.00+Trials
	Variety	RD-9	Green manure	RD-21	RD-23 (D)	RD-23 (D)	RD-23 (T)	RD-23 (D)
	Production (kg)	1907		2740	4218	1154	2629	
	Yield (kg/rai)	501		721	1115	659	695	
150	Area planted (rai)	3.4	3.4	3.6	4.52	4.52	2.52+Trials	4.52
	Variety	RD-23	RD-21	RD-23	RD-21-3 (D)	RD-23 (T)	RD-23 (T)	RD-23 (D)
	Production (kg)	3051	558	1548	3491	2979	1796	
	Yield (kg/rai)	897	164	430	772	659	713	
160	Area planted (rai)	3.8	3.8	3.8	3.97	3.97	2.18+Trials	3.97
	Variety	RD-23	RD-23	RD-23	RD-23 (D)	RD-23 (T)	RD-23 (D)	RD-23 (D)
	Production (kg)	3462	no grain harvested	1328	3425	3534	1448	
	Yield (kg/rai)	911	(rat damage)	349	863	890	664	
220	Area planted (rai)	4.0	4.0		1.86+ Trials	3.96	3.96	3.96
	Variety	RD-9	RD-23		RD-23 (T)	RD-23 (D)	RD-23 (T)	SPR75001-68(T) SPR75055-352 (T)
	Production(kg)	1259	1461		1868	3534	2800	
	Yield (kg/rai)	315	365		1002	892	707	
230	Area planted (rai)	4.0	4.0		3.94	3.94	1.94	2.34+Trials
	Variety	RD-9	RD-23		RD-23 (D)	RD-23 (D)	RD-23, RD-21 (T)	RD-23 (T)
	Production (kg)	2000	1377		2739	4327	1400	
	Yield (kg/rai)	500	344		695	1098	722	
240	Area planted (rai)	1.5			2.05	1.72	1.52	1.19+0.47
	Variety	RD-9	Trial conducted		RD-23 (T)	RD-23, Apple Thong	RD-23, 21 Apple Thong	RD-23+RD-21
	Production (kg)	500			1611	1531	1009	
	Yield (kg/rai)	333			805	890	663	
Total	Area planted (rai)	30.1	19.3	18.2	31.2	28.85	26.98	29.53
	Production (kg)	18486	7017	9684	24948	24205	17576	
Mean	$\bar{X}$ (kg/rai)	641	364	532	799	839	651	
	$\bar{X}$ (kg/rai)	3838	2272	3326	5000	5241	4071	

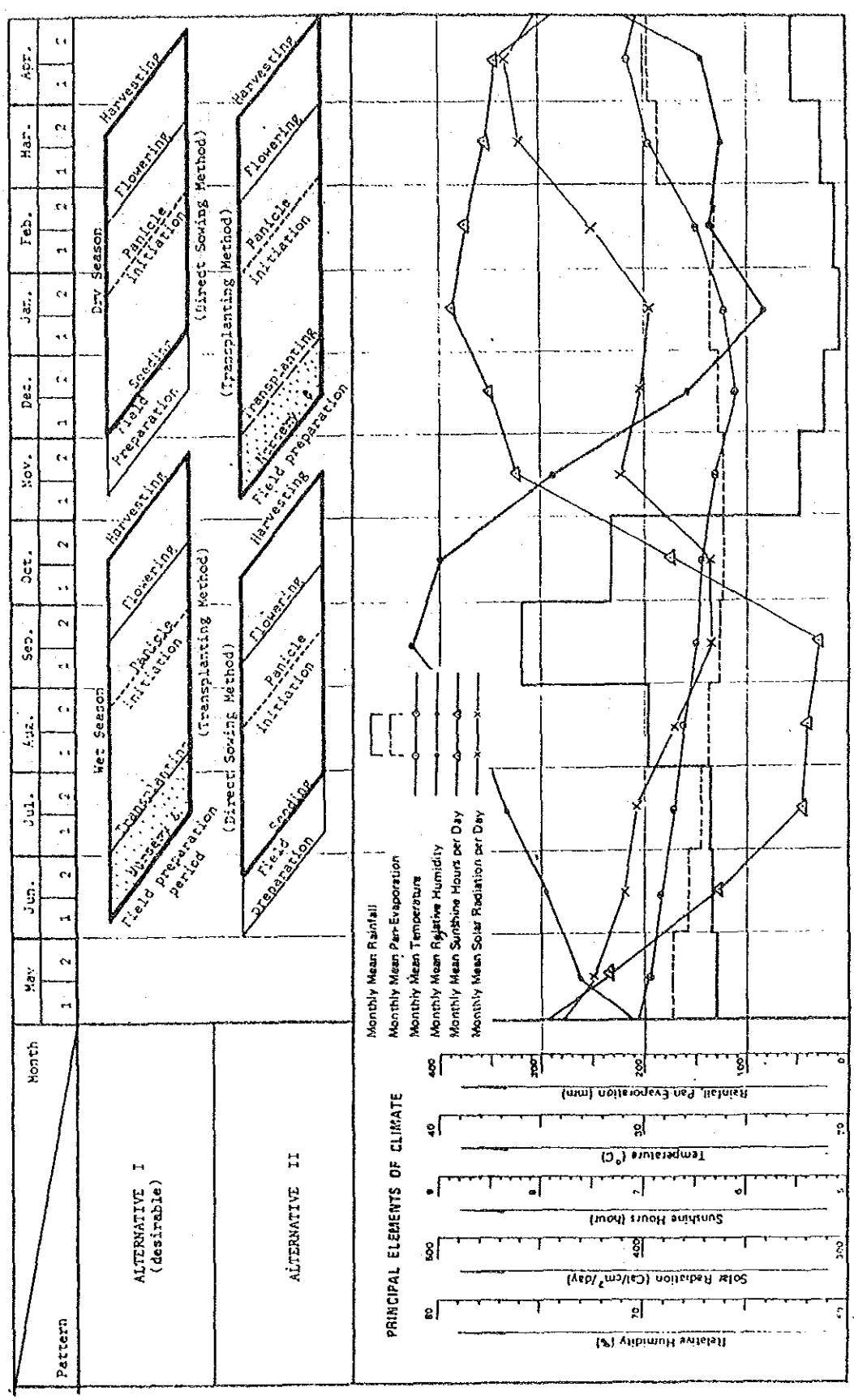
1 rai = 1,600 m^2 (16 a)
* (T) : Transplanting
** (D) : Direct Sowing
1984-85 Dry Season : Being planted

Mechanical broadcating of germinated seed in the standing water condition.

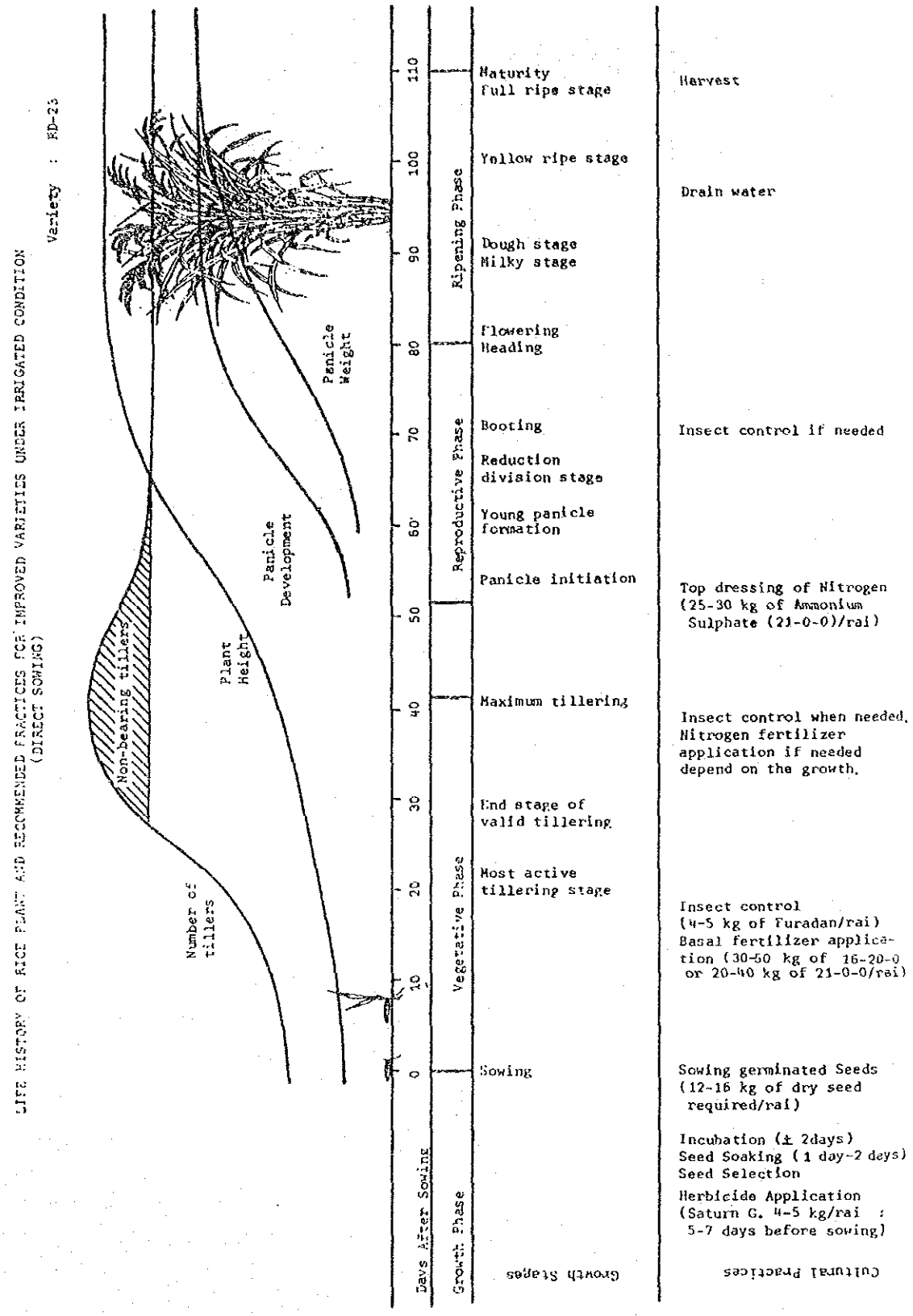
Mechanical transplanting (5 rows transplanter)

Variety RD-23 ready for harvest.

RICE CULTIVATION CALENDER & CLIMATIC CONDITIONS
CHAO PHYA PROJECT AREA

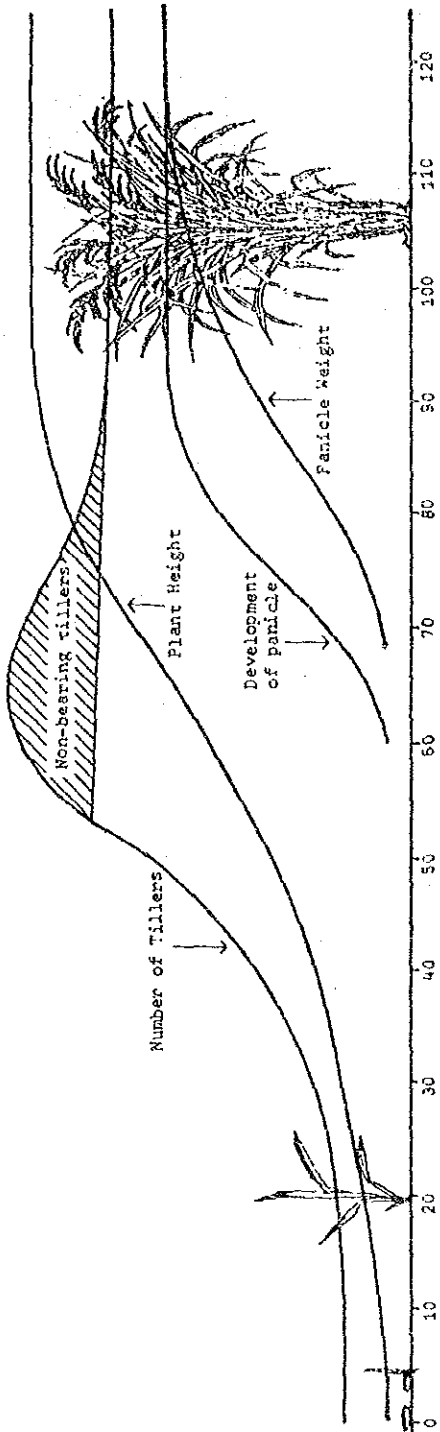


APPENDIX-6-1


LIFE HISTORY OF RICE PLANT AND RECOMMENDED PRACTICES FOR IMPROVED VARIETIES UNDER IRRIGATED CONDITION
(DIRECT SOWING)
Variety : KD-25
Non-bearing tillers
Plant Height
Panicle Development
Panicle Weight
Number of tillers
Days After Sowing
0
10
20
30
40
50
60
70
80
90
100
110
Growth Phase
Vegetative Phase
Reproductive Phase
Ripening Phase
Growth Stages
Maturity
Full ripe stage
Yellow ripe stage
Dough stage
Milky stage
Flowering
Heading
Booting
Reduction division stage
Young panicle formation
Panicle initiation
Maximum tillering
End stage of valid tillering
Most active tillering stage
Sowing
Cultural Practices
Harvest
Drain water
Insect control if needed
Top dressing of Nitrogen (25-30 kg of Ammonium Sulphate (21-0-0)/rai)
Insect control when needed. Nitrogen fertilizer application if needed depend on the growth.
Insect control (4-5 kg of Furadan/rai)
Basal fertilizer application (30-50 kg of 16-20-0 or 20-40 kg of 21-0-0/rai)
Sowing germinated Seeds (12-16 kg of dry seed required/rai)
Incubation (± 2days)
Seed Soaking (1 day-2 days)
Seed Selection
Herbicide Application (Saturn G. 4-5 kg/rai : 5-7 days before sowing)

LIFE HISTORY OF RICE PLANT AND RECOMMENDED PRACTICES FOR IMPROVED VARIETIES UNDER IRRIGATED CONDITION
(TRANSPLANTING)

Variety : RD-23



After Sowing	Days after Transplanting	Phase	Growth Stages	Cultural Practices
120	100	Ripening Phase	Maturity Full ripe stage	Harvest
110	90		Yellow ripe stage	Drain water
100	80		Dough stage Milky stage	
90	70	Reproductive Phase	Flowering Heading	
80	60		Booting	Insect control if needed
			Reduction division	
70	50		Young panicle formation	
60	40		Panicle initiation Maximum tillering	Top dressing of Nitrogen. (25-30 kg of Ammonium Sulphate (21-0-0)/rai)
50	30		End stage of valid tillering The most active tillering stage	Insect control when needed.
40	20	Vegetative Phase		Top dressong of N. if needed. Insect control (4-5 kg of Furadan/rai) Weed control Herbicide application (Saturn G : 4-5 kg/rai)
30	10		Rooting	
20	0		Transplanting	Transplanting Shallow transplanting recommended. Final leveling Basal fertilizer application (30-50 kg of 16-20-0 or 20-40 kg of 21-0-0/rai)
10			Emergence	
0			Sowing/Seeding	Seeding/sowing (5-6 kg of dry seed required/rai) Incubation (± 1day) Seed soaking (± 1day) Seed selection

Standard Recommended Practices on Rice Cultivation

Chao Phya Pilot Project

Based on the experiences of the project and the results obtained from the agronomic trials, the following recommended practices are considered to be appropriate in the project area or similar vicinity areas.

The direct sowing method has widely been practiced by the farmers in the project area in both season of dry and wet. However, the direct sowing method performed better in dry season, and the transplanting method is recommendable for wet season or alternate transplanting in wet season.

	Planting Method	
	Direct Sowing	Transplanting
Variety	RD-23 or other non-photosensitive varieties.	- do -
Seed required	12-16 kg/rai (dry seed)	5-6 kg/rai
Seed preparation (pre-sowing)	Gravity seed selection Soaking : 1-2 days Incubation : ±2 days	- do - - do - 1-2 days
Nursery bed	---	1/20 of main field (20 wa^2 / rai : 80 m^2/rai)
Fertilizer for nursery bed	---	20-30 g of Ammo-Phos(16-20-0)/m^2 (80-120 g/wa^2)
Seeding density for seed bed	---	60-75 g/m^2 (240-300 g/wa^2)
Seedling age	---	18-25 days
Main field		
Planting density		20- 25 hills/m^2 (80-100 hills/wa^2), shallow transplanting is recommended.
Seeding density	7.5-10 g of dry seed/m^2 (30-40 g/wa^2) Broadcast germinated seeds evenly.	
Fertilizer Application		
Basal	30-50 kg of Ammo-phos(16-20-0)/rai or 20-40 kg of Ammonomium Sulphate (21-0-0)/rai applied at ± 2 weeks after sowing. A bit of Nitrogen may be reduced in wet season.	The same amount as direct sowing or 300 l of Ami Ami/rai applied prior to final puddling. - do -
Top dressing	25-30 kg of Ammonium Sulphate (21-0-0)/rai applied at panicle initiation stage (± 55 days after sowing). Additional Nitrogen may be applied accordingly depend on the growth and stage.	20-30 kg of Ammonium Sulphate (21-0-0)/rai applied at panicle initiation stage (± 45 days after transplanting - do -
Weed control	Apply 4-5 kg of Saturn G/rai at 5-7 days before sowing or + 2 weeks after sowing over standing water, and keep water at least 3 days after application. Other herbicides may be used with care when needed.	Apply 4-5 kg of Saturn G/rai at 5-7 days after transplanting - do - - do -
Plant protection	Apply 4-5 kg of Furadan G/rai at around 15 days after sowing. Additional countermeasures will be taken when needed.	The same amount as direct sowing applied at ±15 days after transplanting. - do -

	Rodent control should be conducted in between every after harvest to planting time of next crop. Timely application of poison baits at field preparation period (flooding condition without crop) is effective. Joint control is recommended.	- do -
Water management in the field	After final leveling : 1). Keep standing water then apply herbicide. Water should be kept for at least 3 days after application. 2). Drain water 1-2 days before sowing or after sowing. 3). Irrigate water at 10-15 days after sowing when rice plant are fully established. 4). Then continuous submerged irrigation until ± 15 days before harvest.	Continuous submerged irrigation. Maintain irrigation water until ± 15 days before harvest in general conditions.
Others	Attention should be paid to confirm the dormancy period of seed if seed is used just after harvest. At least 5 weeks are required after harvest to use as a seed in case of RD-23 when seed is kept in natural conditions.	- do -

Major insects, diseases & rats observed in the project :

1. Insects

Yellow rice borer (Tryporyza incertulas Walker)
Brown planthopper (Nilaparvata lugens Stal)
Rice leaf roller (Cnaphalocrosis medinalis Guenee)
Rice hispa (Dicladispa armigera Oliveier)
Rice thrips (Baliothrips biformis Bagnall)
Rice gall midge (Orseoia oryzae Wood-Mason)
Rice Stem borer (Chilo suppressalis Walker)
Green rice leafhopper (Nephotettix virescens Distant)

2. Diseases

(1). Virus diseases

Rice gagged stunt virus (RRSV)
Rice grassy stunt virus (RGSV)
Rice orange leaf

(2). Others

Rice blast (Pyricularia oryzae Cavara)
Brown spot (Cochliobolus miyabeanus)
Cercospora leaf sopt (Sphaeurlina oryzina Hara)
Sheath blight (Phizoctonia solani kuhn)
Dirty panicle
Kernal smut (Tilletia horrida Takahashi)
Bacterial leaf blight (Xanthomonas oryzae Dowson)
Sheath rot (Acrocylindrium Oryzae)

3. Field rat

Rattus orgentiventer
Bandicota indica

VARIETAL CHARACTERISTIC AND CROSSING COMBINATION
of
RD-VARIETIES

Varieties	Crossing combination	Non glutinous or glutinous	Photo-sensiti-vity	Growing period or maturity	Seed dormancy period (weeks)	Year released
1. RD-1	LT/IR-8 (BKN56-1-2)	NG	NS	130	3	1969
2. RD-2	GPI5*/TN-1 (IR253-4-2-1)	G	NS	130	4	1969
3. RD-3	LT/IR-8 (BKN12-2-2)	NG	NS	128	3	1969
4. RD-4	LT/IR-8/W1252// /RD-2 (BKN6805-22-12)	G	NS	127	4	1973
5. RD-5	PN16/Sigadis (BKN6517-9-2-2)	NG	NS	140	6	1973
6. RD-6	Irradiated mutation ($KDML\ 65G_2U$-69-254)	G	S	Nov. 21	5	1977
7. RD-7	C4-63/GR//Sigadis (SPR6726-134-2-26)	NG	NS	120-130		1973
8. RD-8	IR262/NSPT (KKN6721-5-7-4)	G	S	Nov. 23		1978
9. RD-9	LY34/TN1//W1256// /RD-2 (BKN6809-74-40)	NG	NS	115-125	5	1975
10. RD-10	Irradiated mutation ($RD\text{-}1\ 69\text{-}NF_1\ U\text{-}G6\text{-}6$)	G	NS	130	4	1981
11. RD-11	IR661/KDML105 (WP153-BKN 72)	NG	NS	135	4	1977
12. RD-13	Nahng Paya 132/ Pak Sian 39(BKN6402-352)	NG	S	Feb. 26	3	1978
13. RD-15	Irradiated mutation ($KDML65G_1\ U\text{-}45$)	NG	S	Nov. 10	6	1978
14. RD-17	IR262/Pin Gaew 56 (BKN6986-66-2)	NG	NS	140	6	1979
15. RD-19	IR262/Pin Gaew 56 (BKN6986-147-2)	NG	S	Dec. 15	4	1979
16. RD-21	KDML105/NMS-4//IR26 (SPR7419-86-2-5)	NG	NS	120-130	4	1981
17. RD-23	RD-7/IR32/RD-1 (SPRLR76002-168-1-1)	NG	NS	120-130	5	1981
18. RD-25	KDML105/IR2061-214-2-3-3// KDML105/IR26(BKNLR75091-CNT-133-RST40-2-2)	NG	NS	100	3	1981
19.RD-27	KTO/KTH17(BKN6113-79)	NG	S	Dec. 10	8	1981

Note : LT : Leuang Tawng
PN16 : Puang Nahk 16
NSPT : Niaw San-pahtawng
TN1 : Taichung Native 1
NMS-4 : Nahng Mon S-4
KTH17 : Khao Tah Haeng 17
GPI5 : Gam Pai 15
GM8 : Gow Hueng 88
LY34 : Leuang Yai 34
KTO : Khao Tah Go
KDML105 : Khao Dawk Mali 105
NG : Non-glutinous
G : Glutinous
NS : Non-photosensitive
S : Photosensitive

VARIETAL RESISTANCE OF RD-VARIETIES AGAINST DISEASE AND INSECT

Varieties	Rice blast	Brown spot	Sheath blight	Sheath rot	Bacterial leaf bight	Rice tungro	Rice Ragged stunt virus	Root-Knot nematode	Brown plant-hopper	Rice leaf-hopper	White-backed planthopper	Rice borer	Rice gall midge
RD-1	S	MS	S	MS	S	S	S	MS	S	S	S	S	S
RD-2	S	MS	S	MS	S	MS	S	MS	S	R	S	S	S
RD-3	S	-	-	-	S	S	S	S	S	S	S	S	S
RD-4	S	S	MS	MR	S	S	S	-	R	R	MS	S	R
RD-5	S	MS	-	S	MR	S	S	S	S	S	S	S	S
RD-6	MR	MR	-	-	S	S	MS	MR	S	R	S	S	S
RD-7	MR	MS	MS	MS	R	S	S	MS	S	S	S	S	S
RD-8	S	MR	-	-	S	S	MS	S	S	R	S	S	S
RD-9	S	S	MS	MR	S	MS	MS	S	R	R	MS	MR	R
RD-10	MR	-	-	-	-	S	S	-	S	S	S	S	S
RD-11	MR	MS	R	S	S	S	S	S	S	S	S	S	S
RD-13	MR	-	-	-	S	S	S	S	S	S	S	S	S
RD-15	S	MR	MR	-	S	S	S	MS	S	S	S	S	S
RD-17	S	-	-	-	MS	S	S	S	S	S	S	S	S
RD-19	MR	S	S	S	MS	S	MS	S	S	S	S	S	S
RD-21	S	S	S	S	MR	S	MR	-	R	MR	MS	-	-
RD-23	S	MS	MS	S	R	S	MR	-	R	MR	R	-	-
RD-25	S	S	S	MR	MR	S	MR	-	R	MR	R	-	-
RD-27	S	-	-	-	S	S	MR	-	S	MS	MS	-	-

Note :

R : Resistant
MR : Moderately resistant
MS : Moderately susceptible
S : Susceptible