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Engelstad,O.P.; Kilmer,V.J.

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IRRI-TVA COOPERATIVE SOIL FERTILITY EXPERIMENTS IN THE PHILIPPINES 1970

I. Slow-release and other nitrogen fertilizers for rice

An experiment was conducted during the 1970 wet season to evaluate some slow-release and standard fertilizers for rice under three land and water management systems. Nitrogen at the rates of 40 and 80 kg/ha was applied to continuously flooded (irrigated) rice, to rainfed rice, and to upland rice. The different nitrogen fertilizers were applied in single or in split doses at different growth stages of rice. The improved variety IR22 was used in all the experiments.

The design of experiments was split plot; rate x time treatments were used as the main plots and nitrogen sources were used as the subplots. Each treatment was replicated three times.

Continuously flooded rice (irrigated)

The grain yield data did not show any significant difference between means of the different sources of nitrogen (Table 1). The split application treatments gave significantly higher grain yields than the basal application treatments. Some of the fertilizers gave higher grain yields when applied in multiple doses (ammonium sulfate nitrate, fast-releasing sulfur coated urea); some gave similar yields whether applied in single or in multiple doses (Table 1).

Early application of 80 kg/ha N from fast-releasing sulfur coated urea and IBDU gave low grain yields because of severe blast infection during the early growth stages of IR22.

In another test comparing the same materials under two methods of fertilizer application (basal application and split application at maximum tillering and panicle initiation stages), the fertilized plots gave equally higher yields over the control plot (Table 2).

Rainfed flooded rice (lowland)

In this experiment, the field was prepared wet and no further addition of water was made. The entire amount of water was provided by rains. Ammonium sulfate nitrate applied in 3 doses produced the highest grain yield of 4.2 t/ha but not significantly higher than either urea or ammonium sulfate (Table 3). Most treatments did not increase grain yields over the control. It was hard to evaluate these nitrogen fertilizers as the rice variety suffered from blast disease.

A second test comparing the same materials showed that the different nitrogen fertilizers equally increased grain yields over the unfertilized control when applied in split doses at maximum tillering and at panicle initiation (Table 4). No significant increase in grain yield was obtained over the control when ammonium sulfate or calcium ammonium nitrate was applied before transplanting probably due to high loss of nitrogen from these materials.

Upland rice (rainfed-nonpuddled soil)

An experiment was conducted to compare the different nitrogen fertilizers when applied one week after emergence of seedling or applied in split doses at maximum tillering and at panicle initiation of the rice crop. Most of the fertilizers yielded higher grain when applied in two split doses (Table 5). The two sulfur-coated urea materials, ammonium sulfate and urea, applied in two split doses gave significantly higher grain yields compared with the control.

The frequent occurrence of typhoons and the prevalence of diseases, particularly rice blast, prevented the production of grain yields higher than those obtained from the experiments conducted during this season.

Table 1. Effect of sources and times of nitrogen application on the grain yield of transplanted flooded IR22 rice (irrigated). IRRI, 1970 wet season[a].

Source of nitrogen	Grain yield[b] (t/ha)								
	Nitrogen applied (kg/ha)								
	40				80				Mean (Source)
	Time of application[c]				Time of application[c]				
	L	MT-PI	MT-PI-B	Mean	L	MT-PI	MT-PI-B	Mean	
Ammonium sulfate	3.5	3.8**	4.0**	3.8	3.8**	3.3	4.2**	3.8	3.8
Urea	3.4	4.2**	3.7**	3.8	3.4	3.9**	3.9**	3.7	3.8
Ammonium sulfate nitrate	3.7	3.9**	3.9**	3.8	3.5	3.7*	4.2**	3.8	3.8
Calcium ammonium nitrate	3.4	3.8**	4.0**	3.7	3.1	4.0**	4.2**	3.7	3.7
Sulfur-coated urea (26% R[d])	3.6	4.2**	4.2**	4.0	2.6	4.2**	3.7*	3.5	3.7
Sulfur-coated urea (5% R[d])	-	3.5	3.5	3.5	-	3.8**	3.8**	3.8	3.7
IBDU	2.8	3.9**	3.9**	3.5	2.3	4.1**	4.4*	3.6	3.6
Control mean				3.3					
Mean (time)	3.4	3.9	3.9		3.1	3.8	4.1	3.7	

Comparison between any two N-source mean at the same time x rate mean: LSD (0.05) = 0.6

Comparison between any two time x rate mean at same or different N-source: LSD (0.05) = 0.7

[a]Transplanted July 16, 1970.

[b]At 14% moisture = average of three replications.

[c] L = during land preparation; MT = at maximum tillering; PI = at panicle initiation; B = at booting.

[d]Release rate of nitrogen in 14 days.

* and ** = significantly different from the control mean at the 5% and 1% level, respectively.

Table 2. Effect of sources and times of nitrogen application on the grain yield of transplanted flooded IR22 rice (irrigated). IRRI, 1970 wet season[a].

Source of nitrogen[c]	Grain yield[b] (t/ha)		
	Method of application		
	Basal	Split application[d]	Mean (Source)
Ammonium sulfate	3.1**	3.3**	3.2
Urea	3.2**	3.3**	3.3
Ammonium sulfate nitrate	3.1**	3.2**	3.2
Calcium ammonium nitrate	3.2**	3.2**	3.2
Sulfur coated urea (23% R[e])	3.0**	3.2**	3.1
Sulfur coated urea (10% R[e])	2.9*	3.3**	3.1
I B D U	2.9	3.5**	3.2
Mean (method)	3.1	3.3	
Control mean	2.6		

[a]Transplanted August 19, 1970.

[b]At 14% moisture = average of three replications.

[c]60 kg/ha nitrogen was applied.

[d]At maximum tillering and panicle initiation stages.

[e]Release rate of nitrogen in 14 days.

* and ** = significantly different from the control mean at the 5% and 1% level, respectively.

Table 3. Effect of sources and times of nitrogen application on the grain yield of flooded IR22 rice (rainfed). IRRI, 1970 wet season[a].

Source of nitrogen	Grain yield[b] (t/ha)								
	Nitrogen applied (kg/ha)								
	40				80				Mean (Source)
	Time of application[c]				Time of application[c]				
	L	MT-PI	MT-PI-B	Mean	L	MT-PI	MT-PI-B	Mean	
Ammonium sulfate	3.1	3.5*	3.6**	3.4	3.4	2.8	3.0	3.1	3.2
Urea	3.3	3.4	3.6*	3.4	3.3	3.2	3.4	3.3	3.4
Ammonium sulfate nitrate	3.1	3.4	4.2**	3.6	3.4	3.0	3.3	3.2	3.4
Calcium ammonium nitrate	3.4	3.4	3.2	3.3	3.5*	3.1	3.3	3.3	3.3
Sulfur coated urea (26% R[d])	3.4	3.2	3.1	3.2	3.3	3.4	3.4	3.4	3.3
Sulfur coated urea (5% R[d])	-	3.4	3.3	3.4	-	3.5*	3.2	3.3	3.3
I B D U	2.9	3.7**	3.4	3.3	2.2	3.3	3.5	3.0	3.2
C D U	3.5	3.3	3.3	3.4	3.8**	3.2	3.4	3.5	3.4
Control mean	3.2								
Mean (time)	3.2	3.4	3.5		3.3	3.2	3.3		

Comparison between any two (N-source x rate) means: LSD (0.05) = 0.3
Comparison between any two N-source means at the same time x rate mean: LSD (0.05) = 0.5

[a]Transplanted July 17, 1970.

[b]At 14% moisture = average of three replications.

[c] L = during land preparation; MT = at maximum tillering; PI = at panicle initiation; B = at booting.

[d]Release rate of nitrogen in 14 days.

* and ** = significantly higher than the control mean at the 5% and 1% level, respectively.

Table 4. Effect of sources and times of nitrogen application on the grain yield of flooded IR22 rice (rainfed). IRRI, 1970 wet season[a].

Source of nitrogen[c]	Grain yield[b] (t/ha)		
	Method of application		
	Basal	Split application[d]	Mean (Source)
Ammonium sulfate	3.0	3.5**	3.2
Urea	3.2*	3.5**	3.4
Ammonium sulfate nitrate	3.3**	3.2**	3.3
Calcium ammonium nitrate	3.1	3.6**	3.3
Sulfur coated urea (23% R[e])	3.2*	3.7**	3.5
Sulfur coated urea (10% R[e])	3.3**	3.6**	3.4
I B D U	3.2*	3.5**	3.4
Mean (method)	3.2	3.5	
Control mean	2.8		

[a]Transplanted August 19, 1970.

[b]At 14% moisture = average of three replications.

[c]60 kg/ha nitrogen was applied.

[d]At maximum tillering and panicle initiation stages.

[e]Release rate of nitrogen in 14 days.

* and ** = significantly different from the control mean at the 5% and 1% level, respectively.

Table 5. Effect of basal and split application of different sources of nitrogen on the grain yield of IR22 rice under upland conditions (rainfed-nonpuddled). IRRI, 1970 wet season.

Source of nitrogen[b]	Grain yield[a] (t/ha) Method of application		
	Basal	Split application[c]	Mean (source)
Ammonium sulfate	2.8	3.6**	3.2
Urea	2.2	4.5**	3.3
Ammonium sulfate nitrate	2.9	2.7	2.8
Calcium ammonium nitrate	1.9	2.3	2.1
Sulfur coated urea (23% R[d])	2.3	4.1**	3.2
Sulfur coated urea (10% R[d])	2.6	3.2*	2.9
I B D U	2.7	2.7	2.7
Mean (method)	2.5	3.3	-
Control mean	1.6		

[a]At 14% moisture - average of three replications

[b]60 kg/ha N was added.

[c]At maximum tillering and panicle initiation stages.

[d]Release rate of nitrogen in 14 days.

* and ** - significantly different from the control mean at the 5% and 1% level, respectively.

II Sources of rock phosphate for flooded rice

An experiment to evaluate the effects of 8 sources of rock phosphate at varying rates (0, 25, 50, 100 and 200 kg/ha P_2O_5) was conducted during the 1970 wet season in a farmer's field in Barrio Masagana, Pandi, Bulacan where phosphorus response was reported to occur. The selection of the site was made through the help of the Bureau of Soils in the Philippines.

Soil analyses before installing the experiment showed the following chemical characteristics:

pH (1:1 soil:water ratio) ---------- 4.8

Available P (Bray No. 2 Method) -------- 2 ppm

Organic matter ---------- 1.54%

Total N ---------- 0.10%

A split-plot design (Phosphorus rates - main plot and phoshorus sources - sub-plot) with three replicates was used. IR22 (20-day-old) seedlings were transplanted at 20 x 20 cm spacing. All the phosphorus fertilizer together with 60 kg/ha N and 40 kg/ha K_2O were incorporated into the soil before planting. At panicle initiation, 20 kg/ha N was topdressed in all plots.

At 30 days after transplanting (DAT) up to 53 DAT (at panicle initiation) the plots applied with triple superphosphate at 25 to 200 kg/ha P_2O_5 were taller and had more tillers than the plots applied with the different rock phosphate fertilizers (Tables 1 and 2).

All the plots fertilized with triple superphosphate matured nine days ahead of any of the different rock phosphate and no phosphate fertilized plots. The plant height, tiller number and growth duration

of the different rock phosphate sources did not vary from the no phosphorus control plot.

At harvest, however, the grain yields did not show any significant difference regardless of phosphorus source or rate (Table 3).

These results indicate that phosphorus was limiting during the earlier growth stages but the crop absorbed sufficient amounts of phosphorus from the soil for normal yields.

Table 1. Plant height of IR22 at two growth stages as affected by different sources and rates of phosphate fertilizers. Pandi, Bulacan. 1970 wet season (First crop).

Phosphorus source	Plant height (cm) Applied P_2O_5 (kg/ha) 25		50		100		200		Mean (source)	
	30DAT[a]	53DAT[b]	30DAT	53DAT	30DAT	53DAT	30DAT	53DAT	30DAT	53DAT
Triple superphosphate	51	70	56	68	59	71	61	74	57	71
Idaho rock phosphate (RP)	48	65	44	65	47	66	48	66	47	66
North Carolina RP	47	66	47	65	48	65	49	66	48	66
North Florida RP	46	63	48	64	49	66	50	68	48	65
Central Florida RP	47	65	46	64	46	66	48	66	47	65
Tennessee RP	46	62	47	63	45	66	47	67	46	64
Missouri RP	44	67	46	65	46	66	47	68	46	66
Tunisia RP	47	63	47	66	48	67	47	67	47	66
Morocco RP	48	65	48	66	46	65	49	68	48	66
Mean (rate)	47	65	48	65	48	66	50	68	48	66
Control (NO P_2O_5) 1[c]	46	64	47	67	50	65	45	66	47	66
Control (NO P_2O_5) 2[d]	46	65	43	64	47	67	44	68	45	66
Mean (control)	46	64	45	66	48	66	44	67	46	66

[a]Days after transplanting.

[b]At panicle initiation.

[c]No phosphorus for two crops.

[d]No phosphorus for first crop only.

Table 2. Tiller number of IR22 at two growth stages as affected by different sources and rates of phosphate fertilizers. Pandi, Bulacan. 1970 wet season (First crop).

Phosphorus source	Tiller number/sq m									
	Applied P_2O_5 (kg/ha)								Mean (source)	
	25		50		100		200			
	30DAT[a]	53DAT[b]	30DAT	53DAT	30DAT	53DAT	30DAT	53DAT	30DAT	53DAT
Triple superphosphate	227	324	314	362	399	371	368	360	327	354
Idaho rock phosphate (RP)	188	282	160	290	155	235	189	274	173	270
North Carolina RP	173	233	152	262	174	291	228	272	182	264
North Florida RP	207	257	189	271	165	286	189	294	188	277
Central Florida RP	176	303	168	268	167	230	200	269	178	268
Tennessee RP	170	249	147	250	153	258	176	265	162	256
Missouri RP	185	259	197	273	154	271	191	261	182	266
Tunisia RP	163	249	181	275	198	275	208	286	188	271
Morocco RP	135	260	177	263	173	245	189	301	181	267
Mean (rate)	186	268	187	279	193	274	215	287	196	277
Control (NO P_2O_5) 1[c]	200	303	193	253	234	236	161	289	197	270
Control (NO P_2O_5) 2[d]	160	237	144	240	174	268	181	275	164	255
Mean (control)	180	270	168	246	204	252	171	282	180	262

[a]30 days after transplanting.

[b]At panicle initiation.

[c]No phosphorus for two crops.

[d]No phosphorus for first crop only.

Table 3. Grain yields of IR22 rice as affected by sources of rock phosphate at various levels of phosphorus. Pandi, Bulacan, 1970 wet season.

Phosphate source	Grain yield (t/ha)				Mean (source)
	P_2O_5 rate (kg/ha)				
	25	50	100	200	
Triple superphosphate	5.6	5.6	5.4	5.6	5.6
Idaho rock phosphate (RP)	5.3	5.4	5.2	5.3	5.3
North Carolina RP	5.4	5.6	5.3	5.4	5.4
North Carolina RP	5.3	5.1	5.2	5.5	5.3
Central Florida RP	5.2	5.2	5.3	5.5	5.3
Tennessee RP	5.3	5.3	5.3	5.5	5.3
Missouri RP	5.4	5.4	5.2	5.5	5.4
Tunisia RP	5.1	5.4	5.7	5.6	5.5
Morocco RP	5.3	5.2	5.4	5.4	5.3
Mean (rate)	5.3	5.4	5.3	5.5	
Control (NO P_2O_5) 1[b]	5.3	5.4	5.6	5.4	5.4
Control (NO P_2O_5) 2[c]	5.1	4.9	5.3	5.3	5.5
Mean (control)	5.2	5.1	5.4	5.4	-

[a]At 14% moisture - average of three replications

[b]No phosphorus for two crops.

[c]No phosphorus for first crop only.