Effect of One Fertilizer Application on Different Cropping Systems

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Improved cropping systems designed to grow two or three crops annually provide the farmer opportunity to capture residual fertilizer applied initially to the most responsive crop. In so doing the farmer increases the efficiency of fertilizer use, cuts inputs costs and conserves resources.

The purpose of this paper is to present the results from fertilizer studies on four different cropping systems.

The cropping systems under study were as follows :

System I	Field Corn - Soybean - Sweet Corn
System II	Rice - Soybean - Sweet Corn
System III	Soybean - Soybean - Sweet Corn
System IV	Wheat - Mungbean

ELEMENTS COMMON TO ALL FOUR SYSTEMS :

(1) Each irrigated cropping system included a legume

(2) Three crops (Two for system IV) were included in each system

(3) Only the first crop was fertilized using a factorial N: P: K desing

Table 1 presents the chemical analysis of the surface soil taken from the Lampang sandy loam located on the Multiple Cropping Project Experiment Station site where system I was used.

Table 1. Chemical Analysis of Surface Soil Sample (0-15 cm Depth)

pH^e	Total N^a (%)	Extractable elements			
		Phosphorus[b] (ppm)	Potassium[c] (ppm)	Calcium[d] (meq/ 100 g)	Magnesium[d] (meq/ 100 g)
7.2	0.0311	39.7	35.3	3.29	0.14

a Kjedhal method.
b Bray II method.
c NH_4OAc, pH 7 extraction with flame photometer method.
d NH_4OAc, pH 7 extraction with atomic absorption method.
e Soil : H_2O = 1.1

System I

FIELD CORN GRAIN YIELD Corn grain yield as influenced by nitrogen and phosphate fertilizer is presented in Table 2. Corn grain yields following nitrogen fertilization ranged from 1.07 to 5.35 tons/ha. The combination of 120 kg N/ha and 80 kg P_2O_5/ha produced the highest grain yield of 5.35 tons/ha, although this was not significantly greater than the yield produced by 180 kg N/ha without added phosphate (5.29 tons/ha).

Application of 60 kg N/ha of nitrogen fertilizer increased the average grain yield by 122 percent over the zero nitrogen treatment (1.42 to 3.16 tons/ha). The 120 kg N/ha rate resulted in a further 39 percent yield increase (3.16 to 4.45 tons/ha). Phosphate fertilizer had no influence on corn grain yield (Table 2).

Table 2. Effect of Different Rates of N and P Fertilizers on Corn Grain Yields

Nitrogen (kg/ha)	Corn grain yields[a] (ton/ha) at three rates of phosphorus (kg/ha)			
	0	40	80	Average
0	1.07	1.50	1.69	1.42
60	2.98	3.30	3.16	3.16
120	3.99	3.87	5.35	4.40
180	5.29	4.44	3.62	4.45
Average	3.33	3.29	3.46	$\bar{\bar{X}}$ = 3.36

% CV = 21.00

	For treatment	For N	For P_2O_5
LSD.05	1.21	0.70	NS
LSD.01	1.65	0.95	NS

[a] Data taken at 14% moisture content.

SOYBEAN YIELD No difference was noted in soybean yields resulting from the residual effect of nitrogen and/or phosphate fertilizer applied to a prior corn crop (Table 3). Soil test results of samples taken from variously fertilized plots before the second crop of soybeans was planted indicated important differences. Soil phosphorus values showed an increase following phosphate fertilization (Table 4), while higher rates of applied nitrogen fertilizer decreased soil pH from 6.5, 5.9, 5.7 to

5.5 with 60, 120, and 180 kg N/ha. Moreover, N fertilizer had the effect of decreasing the amount of extractable soil P. This was particularly apparent in the absence of applied P fertilizer. Plant removal and increased soil acidity probably accounted for the lower soil P status.

Table 3. Residual Effect on Soybean Grain Yields of N and P Fertilizers Applied to Previous Corn Crop

Nitrogen (kg/ha)	Soybean yields (ton/ha) at three rates of phosphorus (kg/ha)			
	0	40	80	Average
0	1.66	1.51	1.90	1.69
60	1.49	1.83	1.99	1.77
120	1.47	1.66	1.37	1.50
180	1.93	1.49	1.95	1.74
Average	1.64	1.62	1.80	$\bar{\bar{X}}$ = 1.69

% CV = 24.32

LSD.05 = NS for both N and P_2O_5

LSD.01 = NS for both N and P_2O_5

Table 4. Effect of Nitrogen and Phosphorus Applied to First Crop on Extractable Phosphorus Levels Before Planting Second Crop

Nitrogen (kg/ha)	Extractable phosphorus (ppm) at three rates of phosphorus (kg/ha)			
	0	40	80	Average
0	26.3	31.3	33.8	30.5
60	23.8	22.5	30.0	25.4
120	15.0	18.8	45.0	26.3
180	17.5	23.8	30.0	23.8
Average	20.7	24.1	34.7	$\bar{\bar{X}}$ = 26.5

SWEET CORN YIELD Neither the sweet corn yield nor the number of ears per hectare increased as a result of residual N and/or P fertilization. Apparently soil nitrogen not utilized by the initial field corn crop had been lost by leaching or volatilization. Soil phosphorus, on the other hand, remained adequate under the conditions of the experimant for both successive soybean and sweet corn crops.

System II

RICE YIELD Rice, the first and only crop fertilized in the rice-soybean-sweet corn system, responded to both applied nitrogen and phosphate (Table 5). Rice yield increased as nitrogen fertilizer was added

Table 5. Effect of N and P Fertilizers on Rice Grain Yield

Nitrogen (kg/ha)	Yield (ton/ha)[a] at three levels of P_2O_5 (kg/ha)			
	0	40	80	Average
0	3.35	3.13	3.46	3.31
40	4.11	3.78	5.25	4.38
80	5.95	4.99	5.60	5.51
120	5.79	5.92	6.06	5.92
Average	4.80	4.46	5.09	4.78

% CV = 11.57

	For treatment	For N	For P_2O_5
LSD.05	0.94	0.54	0.47
LSD.01	1.27	0.74	0.64

[a]Data taken at 13.2% moisture content.

up to 80 kg N/ha. A small but nonsignificant response to 120 kg N/ha over the 80 kg rate was recorded. Rice yield was also significantly increased following P fertilization at a rate equivalent to 80 kg P_2O_5/ha, but only after N fertilization. Indeed, it would appear that, provided 80 kg N/ha was added, the soil P status was adequate without added P fertilizer.

SOYBEAN YIELD Residual fertilizer phosphate from the previous rice crop significantly increased soybean yield (Table 6) over that in control in the plots that had previously received rates equivalent to 40 and 80 kg

P_2O_5/ha. There was no significant difference between these two rates of

Table 6. Residual Effect on Soybean Grain Yield Resulting from N and P Fertilizer Applied to Previous Rice Crop

Nitrogen (kg/ha)	Soybean yield (ton/ha)[a] at three levels of phosphate (kg/ha)			
	0	40	80	Average
0	1.94	2.31	2.89	2.38
40	1.96	2.38	2.23	2.19
80	2.23	2.30	2.89	2.47
120	1.83	2.39	1.91	2.04
Average	1.99	2.35	2.48	$\bar{\bar{X}}$ = 2.27

% CV = 15.19

	For treatment	For N	For P_2O_5
LSD.05	0.58	NS	0.29
LSD.01	0.80	NS	0.40

[a]Data taken at 14% moisture content

added fertilizer phosphate. On the other hand, residual nitrogen from the previously nitrogen fertilized rice appeared to have no effect on soybean yield (Table 5). The increase in extractable P (Table 7) reflected a

Table 7. Effect of N and P Applied to a Previous Crop on Levels of Extractable P Before Planting a Succeeding Crop

Nitrogen (kg/ha)	Extractable phosphate (ppm) at three levels of applied phosphate (kg/ha)			
	0	40	80	Average
0	30.0	27.5	30.0	29.2
40	22.5	32.5	30.0	28.3
80	17.5	22.5	30.0	23.3
120	22.5	37.5	40.0	33.3
Average	23.1	30.0	35.0	$\bar{\bar{X}}$ = 29.2

buildup in potentially available phosphate, and no doubt accounted for the soybean response. In this sense, P recovery, and thus efficiency of use, was improved by the growing of soybeans, the second crop in system II.

<u>SWEET CORN YIELD</u> Neither sweet corn fresh ear weight nor number of ears was influenced by residual fertilizer nitrogen and phosphate. It appeared that the phosphate fertilizer applied to paddy rice at 80 kg P_2O_5/ha had significantly increased soil residual phosphorus (Table 7). In fact, soil from the rice plots that originally received the high rate of P fertilizer appeared to increase in the amount of extractable P with time (Tables 7, 8)

Table 8. Effect of N and P Applied to Two Previous Crips on Levels of Extractable Phosphorus Present Before Planting a Third Crop

Nitrogen (kg/ha)	Extractable phosphate (ppm) at three levels of appoied phosphate (kg/ha)			
	0	40	80	Average
0....................	31.3	36.3	65.0	44.2
40....................	40.0	42.5	52.5	45.0
80....................	33.8	31.3	56.3	40.5
120....................	27.5	36.3	46.3	36.7
Average.................	32.2	36.6	55.0	41.6

System III

The growing of two soybean crops prior to planting sweet corn provided the opportunity to evaluate the initial and residual effect of applied phosphate and potash fertilizers on soybean yield and the residual effect on sweet corn resulting from soybeans so fertilized. Chemical analysis of surface soil taken at the initiation of system III is presented in Table 9.

Table 9. Chemical Analysis of Surface Soil Sample (0-15 cm)

pH[e]	Total N[a] (%)	Extractable elements			
		Phosphorus[b] (ppm)	Potassium[c] (ppm)	Calcium[d] (meq/100 g)	Magnesium[d] (meq/100 g)
6.6.............	0.0343	43.2	49.7	1.76	0.11

[a] Kjeldhal method.

[b] Bray II method.

[c] NH_4OAc, pH7 with flame photometry method.

[d] NH OAc, pH 7 with atomic absorption method.

[e] Soil : H_2O = 1.1.

<u>FIRST CROP SOYBEAN YIELD</u> Soybean yield as influenced by phosphate and potash fertilizers is presented in Table 10. The application of

Table 10. Effect of P and K Fertilizers on Soybean Grain Yields

Phosphate as P_2O_5 (kg/ha)	Soybean yield (ton/ha)[a] at three levels of potassium as K_2O (kg/ha)			
	0	40	80	Average
0	1.31	1.38	1.67	1.45
30	1.48	1.61	1.67	1.59
60	1.44	1.51	1.70	1.55
90	1.25	1.54	1.67	1.44
Average	1.37	1.51	1.68	$\bar{\bar{X}}$ = 1.52

	For P_2O_5	For K_2O
LSD.05	NS	0.22
LSD.01	NS	0.35

[a]Data taken at 14% moisture content

80 kg K_2O/ha increased the average grain yield by 18.4 percent (from 1.37 to 1.68 tons/ha) over zero potash treatment. Certainly, only 49.7 ppm extractable K (Table 9) might be considered low for the growth of soybeans in this soil. A gradual soybean yield increase was noted as potash fertilizer rates were increased. Soybeans showed no response to applied phosphate fertilizer (Table 10). The soil test extractable P of 43.2 ppm (Table 9) appeared adequate for the growth of soybeans on this soil.

SECOND CROP SOYBEAN YIELD Residual potash from previously applied fertilizer influenced the yield of the second cropping of soybeans (Table 11)

Table 11. Effect of Phosphorus and Potassium Applied to a Previous Crop on Soybean Grain Yields from the Second Crop

Phosphorus (P_2O_5) (kg/ha)	Soybean yield (ton/ha) at three levels of potassium as K_2O (kg/ha)			
	0	40	80	Average
0	1.74	2.13	2.05	1.97
30	1.44	2.21	2.30	1.98
60	1.72	2.09	2.19	2.00
90	1.93	2.34	2.58	2.28
Average	1.71	2.19	2.28	$\bar{X}$ = 2.06

	For P_2O_5	For K_2O
LSD.05	NS	0.333
LSD.01	NS	0.452

An average of half a ton grain yield increase over the control (1.71 to 2.28 tons/ha) was obtained from the residual effects of potash fertilizer applied at a rate equivalent to 80 kg K_2O/ha. The residual effect on soybean yield from previously applied potash fertilizer appeared to be significantly greater at 80 kg K_2O/ha than at 40 kg K_2O/ha.

Extractable soil K from soil samples taken after the first soybean crop is presented in Table 12. It is of interest to note that average

Table 12. Effect of Phosphorus and Potassium Fertilizers Applied to First Soybean Crop on Extractable Potassium Levels Present After Harvest

Phosphorus (P_2O_5) (kg/ha)	Extractable soil potassium (ppm) at three levels of potassium as K_2O (kg/ha)			
	0	40	80	Average
0	33.9	47.3	69.1	50.1
30	56.9	43.4	56.9	52.4
60	40.8	50.0	61.0	50.6
90	40.8	39.3	66.3	48.8
Average	43.1	45.0	63.3	$\bar{\bar{X}}$ = 50.4

extractable K (43.1 ppm) from the control plot was not much lower than the initial (49.7 ppm) soil K level (Table 9). However, the residual effect of 80 kg K_2)/ha applied potash increased the average extractable K to 63.3 ppm (Table 12). The increase in extractable K was associated with a significant second crop soybean grain response over the check.

As in the first soybean crop, no response to applied phosphate fertilizer was observed. Failure of the second soybean crop to respond to added phosphate supports the first crop results and thus confirms the hypothesis that a soil with more than 43 ppm extractable P provides adequate availability of this nutrient.

SWEET CORN YIELD Neither sweet corn yield nor ears per hectare appeared to be influenced by the previous fertilization of soybeans. These results suggest that previous phosphate and potash fertilization had not differentially affected the soybeans to fix atmospheric nitrogen in such a way that the succeeding sweet crop might benefit. It could have been hypothesized that soybean response to applied potash would result in increased residual soil N, which would be reflected in greater sweet corn yield. Soil extractable K appeared to be less affected following fertilization than soil extractable P. In other words, soil P status could be more readily increased by P fertilization than could soil K status be increased by potash fertilization.

COMPARISON OF THREE-CROPPING SYSTEM

General Comments

Since sweet corn was the last crop in each of the three cropping systems under study, comparative corn yields provide one measure of comparing the different systems relative to residual and accrued soil fertility. The mean yield of sweet corn fresh ear weight was computed for each cropping system and compared (Table 13). It was found that

Table 13. Sweet Corn Fresh Ear Weight Computed as Treatment Means for Each of Three Cropping Systems

Cropping system	Yield (ton/ha			Treatment total	Treatment mean
Soybean-soybean-sweet corn...............	10.88	12.76	14.19	37.83	12.61
Field corn-soybean-sweet corn...............	10.11	8.38	8.44	26.93	8.98
Rice-soybean-sweet corn	10.10	10.33	8.58	29.01	9.67

LSD 5% = 2.47
1% = 3.74

the mean sweet corn ear weight from system III (soybean-soybean-sweet corn) was about 30 percent higher than in the other cropping patterns. Observations made during the study also revealed longer ears and a higher percentage of marketable sweet corn from system III.

Nitrogen fertilization is recognized as a critical factor in crop production, especially because of its recent elevated cost. Change in soil nitrogen supply resulting from different cropping systems suggests a re-evaluation of mangement techniques. Thus, the higher yields of sweet corn noted above might be interpreted as an increase in soil N brought about by two crops of soybeans. A soybean crop has been estimated to biologically fix about 75 kg N/ha annually (Hardy et al., 1971) and to remain unchanged by nitrogen fertilization (Stewart, 1966).

Fertilizer Efficiency

Our results from studies of various cropping systems show not only varying degrees of residual buildup in soil phosphorus and potash following fertilization, but also an increase in soil acidity due to N fertilization, and possibly even more important changes in soil productivity. It is interesting, for instance, that cropping system III (soybean-soybean-sweet corn), which received no application of N fertilizer (other cropping systems initially received from 120 to 180 kg N/ha), produced significantly higher yields and better quality sweet corn. It would appear that fertilizer use efficiency was different among the cropping systems under study and that fertilizer use was most efficient in system III.

Some investigators have reported reduced yields when certain legumes are planted in immediate sequence. Studies at the International Rice Research Institute (Herrara and Harwood, 1975) have indicated that a second mung bean crop gives depressed yields when planted immediately after a previous mung bean crop. Our results with soybeans do not show a similar effect. Indeed, soybean yields appeared a little higher when soybean followed soybeans (Table 10 and 11). It is also interesting to note that highest mean soybean yield (2.27 tons/ha) was obtained in the rice-soybean-sweet corn cropping system in which soybeans were hand -planted directly into the rice stubble. In other words, in this treatment soybeans were unfertilized and received no tillage. A further reduction in production costs therefore was attained in this rice-soybean-sweet corn

Table 14. Soybean Grain Yields from Three Cropping Systems Influenced by the First Crops

Cropping system	Yield[a] (ton/ha)			Treatment total	Treatment mean
Soybean-soybean-sweet corn....	1.84	1.79	2.55	6.18	2.06
Field corn-soybean-sweet corn.	1.77	1.64	1.65	5.06	1.69
Rice-soybean-sweet corn.......	1.18	2.33	2.31	6.82	2.27
Total and mean........... CV = 13.16 %				18.06	2.01

[a]Data taken at 14% moisture content.

system. An economic analysis of these data, examining the net farm income from the different cropping systems, deserves study.

System IV

The wheat-mungbean system of similar design was conducted in a separate trial but also at the Multiple Cropping Experiment Station Chemical analysis of the soil samples taken prior to planting wheat (va. Inia) is given in Table 15.

Table 15. CHEMICAL ANALYSIS OF THE SURFACE SOIL SAMPLE (0-15 CM)

pH^1	$O.M^2$ (%)	Extractable			
		P^3 (ppm)	K^4	Ca^4 (mg/100 gm)	Mg^4
6.6	0.57	38.7	38.0	2.34	0.07

1. Soil : H_2O = 1:1
2. Walkley & Black method
3. Bray II
4. NH_4OAc, pH 7 extraction with atomic absorption method.

Wheat was fertilized at rates indicated in Table 16 after planting in 15 cm wide rows. Nitrogen and potash were broadcast but phosphate fertilizer was banded.

Mungbeans (CES 55) were planted in 45 cm wide rows into seed beds containing turned under wheat residues.

Wheat Yield

Wheat yield as influenced by nitrogen, phosphate and potash fertilizers is presented in Table 16. A significant response to applied nitrogen was noted while wheat also yielded significantly higher in the presence of added phosphate fertilizer. No difference in wheat yield as influenced by potash was observed.

Table 16. Average Grain Yield of Wheat (at 14% moisture) as Infuenced by Nitrogen, Phosphate and Potash Fertilizers.

$N - P_2O_5 - K_2O$ (kg/ha)	Grain Yield (tons/ha)
0 - 0 - 0	0.46
0 - 0 - 50	0.65
0 - 50 - 0	0.42
0 - 50 - 50	0.74
0 - 100 - 0	0.99
0 - 100 - 50	0.70
50 - 0 - 0	1.85
50 - 0 - 50	1.83
50 - 50 - 0	1.99
50 - 50 - 50	2.17
50 - 100 - 0	2.24
50 - 100 - 50	1.72
100 - 0 - 0	1.92
100 - 0 - 50	1.76
100 - 50 - 0	2.77
100 - 50 - 50	2.36
100 - 100 - 0	2.51
100 - 100 - 50	2.54
150 - 0 - 0	2.29
150 - 0 - 50	2.71
150 - 50 - 0	2.20
150 - 50 - 50	2.85
150 - 100 - 0	2.92
150 - 100 - 100	3.33
Average	1.91

$LSD_{.05} = 0.70$

$LSD_{.01} = 0.94$

% CV = 22.34

Grain yield ranged from 0.42 to 3.33 tons/ha (Table 16) with an average of 1.91 tons/ha for all treatments. Wheat yield increased as nitrogen fertilizer was increased with the greatest yield being obtained from treatments receiving the highest rates of both nitrogen and phosphate fertilizers.

Response of wheat to nitrogen and phosphate fertilizers are summarized in Table 17. Nitrogen fertilizer markedly influenced wheat grain yield. The application of 50 kg N/ha resulted in a 200% average yield increase over the zero nitrogen treatment (increased from 0.66 to 1.97 tons/ha). A small but significant yield increase was obtained as nitrogen fertilizer rates were increased from 50 to 100 and 100 to 150 kg N/ha. Average yields for 0, 50, 100 and 150 kg N/ha were 0.66, 1.97, 2.31 and 2.72 tons/ha respectively.

Table 17. Average Grain Yield of Wheat (tons/ha) as Influenced by Nitrogen and Phosphate Fertilizers

kg N/ha	kg P_2O_5/ha			Average
	0	50	100	
0	0.55	0.58	0.84	0.66
50	1.84	2.08	1.98	1.97
100	1.84	2.57	2.53	2.31
150	2.50	2.53	3.13	2.72
Average	1.68	1.94	2.12	$\bar{\bar{X}}$ =1.91

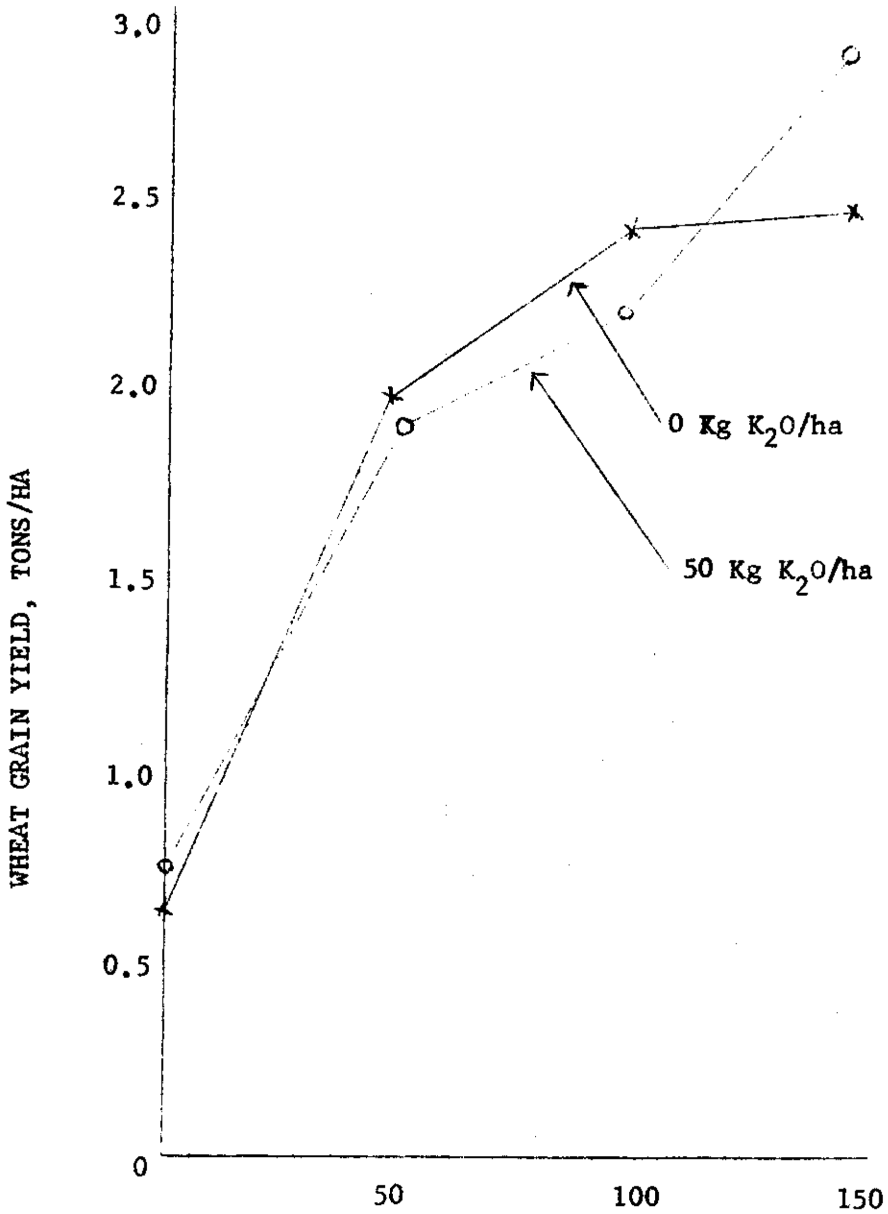
	For N	For P_2O_5
$LSD_{.05}$	0.29	0.25
$LSD_{.01}$	0.38	0.33
% CV	22.34	

Phosphate fertilizer significantly increased wheat grain yield (Table 17). The application of 100 kg P_2O_5/ha increased yield by 26% over the zero phosphate treatment (from 1.68 to 2.12 tons/ha). A gracual yield increased was noted as phosphate fertilizer was increased from 0 to 50 and 50 to 100 kg P_2O_5/ha.

Wheat yield obtained from 100 kg N/ha applied in absence of applied phosphate (1.84 tons/ha) was less than yield following 50 kg N/ha where fertilizer phosphate had been added (2.08 tons/ha). Likewise, wheat yields following 100 kg N/ha exceeded yields from the 150 kg N/ha treatment provided phosphate was also added. These results clearly show the increased dfficiency of wheat responsiveness to fertiliz nitrogen in the presence of adequate phosphorus. As shall be seen later the succeeding mungbean crop also benefits from the residual phosphate and nitrogen fertilizers.

Wheat yield showed no response from applied potash (Fig. 1). Average yields for 0 and 50 kg K_2O/ha were 1.88 and 1.95 tons/ha, respectively.

An interesting aspect of the experiment was the apparent wheat response to applied phosphate when the extractable soil P (Table 15) amounted to 38.7 ppm. This would suggest that wheat on the Lampang series with a soil test 40 ppm will likely respond to added phosphate esecially when fertilizer nitrogen is applied. Equally interesting was the failure for wheat to respond to the application of potash



Fugure 1 : Wheat grain yield as influence by Nitrogen and Potash Fertilizers.

fertilizer with a soil extractable K level of only 38.0 ppm. At the 150 kg N/ha rate a suspicion of wheat response to added potash was observed)Fig. 1). Other experiments conducted on this soil with numerous crops suggest a slow release source of potassium in the Lampang series, a hypothesis which deserves investigation.

Mungbean Yield

Mungbean grain yield as influenced by residual nitrogen, phosphate and potash fertilizers previously applied to the wheat crop is presented in Table 18.

Grain yields ranged from 0.68 to 1.55 tons/ha with an average of 1.15 tons/ha all treatments.

The residual effects from both nitrogen and phosphate fertilizers applied to the previous wheat crop significantly increased yield of mungbean. For instance 100 kg N/ha applied to wheat provided sufficient nitrogen to account for a 22% mungbean response (0.98 to 1.20 tons/ha) over the zero nitrogen treatment (Table 19). The residual effects from nitrogen were greater following the 100 and 150 kg N/ha rates applied to the previous wheat crop than the 50 kg N/ha rate.

Considerable residual effect from 50 kg P_2C_5/ha applied to the previous wheat was evident. Thus, the increased mungbean yield from 0.81 (0 kg P_2O_5/ha treatment) to 1.25 tons/ha amounted to 50% more beans. Only a slight mungbean response at the higher rate of applied

Table 18. Mungbean yield as influenced by residual Nitrogen, Phosphate and Potash fertilizers applied to a prior wheat crop.

$N - P_2O_5 - K_2O$ (kg/ha)	Grain Yield (tons/ha)
0 - 0 - 0	0.68
0 - 0 - 50	0.69
0 - 50 - 0	0.85
0 - 50 - 50	1.17
0 - 100 - 0	1.27
0 - 100 - 50	1.25
50 - 0 - 0	0.82
50 - 0 - 50	0.75
50 - 50 - 0	1.24
50 - 50 - 50	1.24
50 - 100 - 0	1.40
50 - 100 - 50	1.31
100 - 0 - 0	0.82
100 - 0 - 50	0.84
100 - 50 - 0	1.35
100 - 50 - 50	1.33
100 - 100 - 0	1.53
100 - 100 - 50	1.30
150 - 0 - 0	1.02
150 - 0 - 50	0.88
150 - 50 - 0	1.16
150 - 50 - 50	1.62
150 - 100 - 0	1.55
150 - 100 - 100	1.49
Average	1.15

$LSD_{.05} = 0.40$ $LSD_{.01} = 0.53$ % CV = 20.94

Table 19. Mean Grain Yield of Mungbean (gons/ha) as Influenced by Residual Nitrogen and Phosphate Fertilizers.

Kg N/ha	Kg P_2O_5/ha			Average
	0	50	100	
0	0.68	1.01	1.26	0.98
50	0.79	1.24	1.35	1.13
100	0.83	1.34	1.42	1.20
150	0.93	1.39	1.52	1.29
Average	0.81	1.25	1.39	$\bar{\bar{X}}$ =1.15

	For N	For P_2O_5
$LSD_{.05}$	0.16	0.14
$LSD_{.01}$	0.22	0.19
% CV =	20.94	

phosphate 100 kg P_2O_5/ha was realized. Average mungbean yields for 0 to 50 and 100 kg P_2O_5/ha were 0.81, 1.25 and 1.39 tons/ha, respectively.

It is of interest to note that the highest mungbean yields were recorded from plots where the previous wheat crop had been fertilized by high rates of both nitrogen and phosphate fertilizers. In such treatments the combined residual effect produced mungbean yields exceeding 1.5 tons/ha. Mungbean indicated no response from previously applied potash fertilizer.