Annals of the Sri Lanka Department of Agriculture, 2002. 4: 95-108

REPONSE OF RICE TO ADDED PHOSPHORUS ON LOW HUMIC GLEY SOIL UNDER MAJOR IRRIGATION IN THE POLONNARUWA DISTRIC

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ABSTRACT

A field experiment was carried out on Low Humic Gley soils under irrigation in Polonnaruwa district to study yield response of rice to four fertilizer phosphorus levels (0, 25, 50 & 75 kg P_2O_5/ha) in 4 locations having 4 levels of available soil P as 3, 4, 15 and 16 mg/kg. Study was commenced in *yala* 1993 season and continued for three consecutive seasons except in site with 16 mg/kg of soil P, which was continued for 10 seasons. No yield response was observed at any soil P level in the 1st season but, a significant yield response was observed from the 2nd season onwards at 3 and 4 mg/kg of soil P levels, up to 55 and 70 kg P_2O_5/ha of P applications, respectively. Yield response of rice to phosphorus depends on initial soil P levels. Accumulation of soil P was observed at plots receiving 50 and 75 kg P_2O_5/ha at low P soils and between 25 - 75 kg P_2O_5/ha at medium P soils. Soil P was depleted at plots receiving 0 and 25 kg P_2O_5/ha at low P soils and zero level of P application at medium P soils. Addition of P fertilizer at the rate of 50, 40 and 15 kg P_2O_5/ha is adequate to sustained inherent soil P at 3, 4 and 16 mg/kg, respectively. The crop response, soil P status and their changes in relation to P application are important factors to be considered for quantification of P requirement for rice crop in these soils.

KEY WORDS: Rice, Av.Phosphorus, Irrigation, LHG Soils.

INTRODUCTION

Polonnaruwa District is one of the major rice producing areas of Sri Lanka. However, at present a declining trend in yield has been reported (Handawala, 1994) showing limitation for enhancement of rice production in this district. Total asweddumized paddy extent in this district is about 54,350 ha of which 94% and 4% of lands come under major and minor irrigations schemes respectively, while the balance is rainfed. The major irrigation sector dominates and has three land classes, namely, poorly drained Low Hiumic Gley soil (LHG), Imperfectly Drained (ID) Reddish Brown Earth (RBE) and Well Drained (WD) RBE in a catenary landscape. Imperfectly drained land class has a better environment for paddy cultivation, compared to other drainage members of the catena (Handawala, 1980). However, this land class is the smallest in extent. The most predominant rice growing soils in the district is LHG soils.

Panabokke and Nagarajha (1964) reported that the majority of rice soils in Sri Lanka are poorly supplied with phosphorus (P). Kendaragama *et al.*, (1998) found that, in 69% of the LHG soils in the Dry zone, the available soil P content is less than 10 mg/kg. Nagaraja *et al.*, (1979) reported poor crop growth in ID rice lands in the Wet zone due to P deficiency. Supply of P to plants depends on the concentration of soluble P ions in the soil solution, capacity of soil to maintain this concentration and diffusion of P to the roots (Olsen *et al.*, 1962). Soil solution P level depends on addition of fertilizer P, degree of submergence and soil temperature (Katyal *et al.*, 1983). Therefore, the aim of this study was to determine the effects of different levels of fertilizer P on growth and yield of rice crop, in respect to soil P availability and quantification of P requirement for rice crop in LHG soils under major irrigation in Polonnaruwa district.

MATERIALS AND METHODS

A field experiment was carried out at five sites having LHG soils in the command area of Parakkrama Samudra reservoir (Latitude 302.5 N, Longitude 225 E) in Polonnaruwa district. Sites were selected based on available soil P (soil P) level. The selected soil P levels were 3 mg/kg at Weerapedesa,
4 mg/kg at Onegama and Lakshauyana (site1), 15 mg/kg at Lakshauyana (site2) and 16 mg/kg at Polonnaruwa. With reference to Department of Agriculture recommendation (1993), selected rice soils in Weerapedesa, Onegama and Lakshauyana (site 1) are categorized as low level of soil P (less than 10 mg/ kg) and Polonnaruwa and Lakshauyana (site 2) are medium level of soil P (between 10-20 mg/kg). Some important soil properties of the experimental sites are given in the Table 1. The study was commenced in *yala* 1993 season and continued for three consecutive seasons at Weerapedesa, Lakshauyana (site1), Onegama and Lakshauyana (site 2). It was further continued in the site at Polonnaruwa for another consecutive 7 seasons. Treatments were four levels of fertilizer P (0, 25, 50, and 75 kg P_2O_5/ha) in the form of triple supper phosphate (TSP). In addition, nitrogen (150 kg N/ha) as urea and potassium (45 kg K_2O/ha) as muriate of potash (MOP) were applied to all treatments. All TSP, MOP and 17% urea were applied at planting. Rest of the urea was applied as 22% and 61% at 2^{nd} and 4^{th} weeks after planting, respectively. The treatments were arranged in a Randomized Complete Block Design (RCBD) and replicated twice in each location.

Table 1. Some soil characteristics of the experimental sites

Characteristic	*Location*				
	W. pedesa	*Onagama*	*L. uyana(1)*	*L. uyana (2)*	*Polonnaruwa*
PH (1:5 soil: water)	6.10	6.40	6.10	6.30	6.60
EC (ds/m)	0.09	0.11	0.09	nd	0.05
Olsen P (mg/ kg)	3.00	4.00	4.00	15.00	16.00
Exch.K(mg/ kg)	46.80	66.30	54.60	54.60	66.30
OM (%)	2.30	2.50	3.20	nd	2.10
Texture	LS	LS	LS	LS	LS

LS - Lomy sand. nd - Not determined OM - organic matter

A three-month rice variety (Bg 300) was used as the test crop in both *yala* and *maha* seasons and random transplanting was practiced with 14 days old seedling at about three seedlings per hill. Flood irrigation was practiced and plots were irrigated separately. All the other cultural practices in crop management were adopted as recommended. Plots were 4 m x 4 m in size and separated by bunds with 30 cm width.

Data collected were plant height, number of tillers/hill, effective tillers/ hill, number of grains/panicle, seed weight of 5 panicles, 1000 grain weight, number of hills/m^2 and grain yield. The grain weight was corrected to 14% moisture level. In addition, the soil samples were collected at harvest from all treatment plots in each location from 0-15 cm depth. Soils were analyzed for available P (Olsen *et al.,* 1954). Data were analyzed by using ANOVA for each location separately and combined over seasons and locations as factorial experiment. In addition, regression analysis was performed to quantify P requirement for the rice crop.

RESULTS AND DISCUSSION

Response of grain yield to added phosphorus

The yield response of rice to added P at all the sites during first three consecutive seasons and combine analysis of yield data over location and seasons is given in Table 2. Results show that a yield response was not observed at any location in the first season, irrespective of the soil P levels (Tables 2 & 3). However, 2nd season onwards the significant yield response was noticed at all sites where, soil P level is 4 mg/kg or less with an exception at Onegama during *maha* 1993/94 season (Table 2). Lack of yield response to P application and relatively low yield at Onegama during *maha* 1993/94 season could be due to poor crop performances caused by flood. Weerasinghe (1991) found similar pattern of yield response on Non Calcic Brown soil (NCB). In contrast, no yield response was observed at site having soil P levels of 15 and 16 mg/kg at 3rd and 10th consecutive season, respectively (Tables 4 & 5). These results revealed that addition of fertilizer P increased rice yield only in the experimental sites having soil P levels of 4 mg/kg or less.

The combined analysis of yield data over locations and seasons showed a significant interaction between soil P (L) x season (S), soil P x added P (P) and season x added P (Table 2). However, L x P x S interaction was not significant. Thus, it is clear that response of the rice yield to added P varies with interaction effects of soil P levels and seasons (Table 2). It could be attributed to the variations of both hydrological and soil conditions and climatic variations over locations and seasons. Separation of interaction effects of season x soil P on yield response to P application are given in the Tables
3 and 4. Table 3 shows the results of combined analysis of yield data over soil

P levels in each season. It indicates that there was no yield response to P application in the first season but there was a yield response during 2nd and 3rd seasons. Variations of soil P availability in different seasons lead to yield response differences in each season. It may be one of the reasons for the interaction effect between season and added P levels. Table 4 shows the results of the combined analysis of yield response to P applications over seasons in each soil P level. Results indicated that, the yield response to added P levels was not significant in the experimental sites having soil P levels of 15 and 16 mg/kg at Lakshauyana (site 2) and Polonnaruwa, respectively. Hence, the significant yield response and the interaction effect between soil P and added P levels were found at the sites having soil P levels of 3 and 4 mg/kg in Weerapedesa and Onegama, respectively. However, in Lakshauyana (site 1) where soil P level at 4 mg/kg, showed a significant yield response only to P applications.

Table 2. Yield response of rice to added P at different soil P levels in each season under major irrigation in Polonnaruwa District

Season	*Grain yield (t/ha) in different Soil P levels*					
	P level	*L.uyana(1) (4 mg/kg)*	*Onegama (4 mg/kg)*	*W. pedesa (3 mg/kg)*	*L. uyana(2) (15 mg/kg)*	*P. naruwa (16 mg/kg)*
Yala	0	7.2	7.7	7.4	7.6	6.8
93	25	7.5	8.0	7.1	7.4	6.6
	50	7.6	8.0	7.3	7.6	6.6
	75	7.7	7.9	7.6	7.5	6.6
	Mean	7.4	7.9	7.3	7.5	6.
Maha	0	4.5	2.9	3.3	4.3	3.1
93/94	25	5.6	2.8	4.3	4.2	3.4
	50	5.4	2.8	4.3	4.2	3.3
	75	5.3	2.9	4.6	4.0	3.1
	Mean	5.2	2.9	4.2	4.2	3.2
Yala	0	4.1	5.1	4.9	5.6	7.9
94	25	5.3	6.3	6.3	5.4	7.6
	50	5.3	6.6	6.4	5.2	7.5
	75	5.4	7.0	7.0	5.8	8.0
	Mean	5.0	6.3	6.1	5.5	7.8

CV(%) 6.7, LSD (5%)
Season s **, Soil P ns, P levels s **, Season x soil P s **, Season x P levels s **, Soil P x P levels s **
* - significant at 5% level, ** significant at 1% levels, ns - not significant

A regression analysis was made to quantify P requirement for rice and to determine relationships between yield and P application in different soil P levels and seasons. No significant yield response was obtained during the 1st season (Table 3) of the experiment even at lowest level of soil P. Hence, the results of the 2nd and 3rd seasons were used for the regression analysis to obtain relationships between the yield and the added P levels in different seasons and to quantify the P requirement for each season.

Table 3. Yield response of rice to added P levels over soil P levels in each season under

major irrigation in Polonnaruwa district

Factor A (kg P_2O_5/ ha)	*Grain yield (t/ha)*		
	Yala 93	*Maha 93/94*	*Yala 94*
0	7.33	3.62	5.50
25	7.33	4.07	6.19
50	7.41	4.00	6.18
75	7.40	3.96	6.62
Mean	7.36	3.91	6.12
CV (%) – 4.6			
LSD (5%)			
Factor A	ns	s**	s**
Season x Factor A	ns	s**	s**

Factor A – Added P levels

Table 4. Yield response of rice to added P levels over seasons in each soil P level under major irrigation in Polonnaruwa

Factor A (kg P_2O_5/ha)	*Grain yield (t/ha)*				
	L.uyana (1) (4 mg/ kg)	*Onegama (4 mg/kg)*	*W.pedesa (3 mg kg)*	*L.uyana (2) (15 mg/kg)*	*Polonnaruw (16 mg/kg)*
0	5.25	5.26	5.20	5.80	5.90
25	6.13	5.73	5.92	5.68	5.88
50	6.08	5.81	5.99	5.64	5.81
75	6.02	5.93	6.41	5.72	5.88
Mean	5.87	5.68	5.99	5.71	5.87
CV(%)- 4.5					
LSD (5%)					
Factor A	s**	s**	s**	ns	ns
L x A	ns	s**	s**	ns	ns

Factor-A – Added P levels, L – Available soil P

Table 5. Yield response of rice to added P at 16ppm of soil P, over ten seasons at Polonnaruwa under major irrigation in Polonnaruwa district.

Factor-A P_2O_5kg/ha	*Grain yield (t/ha)*									
	Yala 93	*Maha 93/94*	*Yala 94*	*Maha 94/95*	*Yala 95*	*Maha 95/96*	*Yala 96*	*Maha 96/97*	*Yal a 97*	*Maha 97/98*
0	*6.76*	*3.07*	*7.89*	6.09	6.10	6.13	6.90	6.44	7.04	5.52
25	*6.56*	*3.39*	*7.59*	6.43	6.40	6.03	7.28	6.45	7.32	6.19
50	*6.62*	*3.76*	*7.54*	6.01	6.20	5.96	7.17	6.32	6.87	5.69
75	*6.58*	*3.04*	*8.05*	6.22	6.28	5.84	7.15	6.04	7.47	5.65
Mean	*6.63*	*3.2*	*7.56*	*6.19*	*6.25*	*5.99*	*7.13*	*6.31*	*7.12*	*5.69*

CV (%) – 6, LSD (5%) –

Season – 0.240 (t/ha), Factor- A - ns, Season x Factor - ns

Results indicated that yield responses in relation to the added P levels were quadratic in both the 2nd (*maha* 1993/94) and the 3rd (*yala* 94) seasons (Figure 1). Maximum yield responses during the 2nd and the 3rd seasons were up to 54 and 52 kg P_2O_5 / ha of P applications (Figure 1) respectively. Differences of the maximum yield response in the two seasons could be due to seasonal variation of soil P availability. Seasonal variation of soil P were observed only at low levels of available soil P (Figure 4), however, it was not discernible at medium level of soil P (Figure 5).

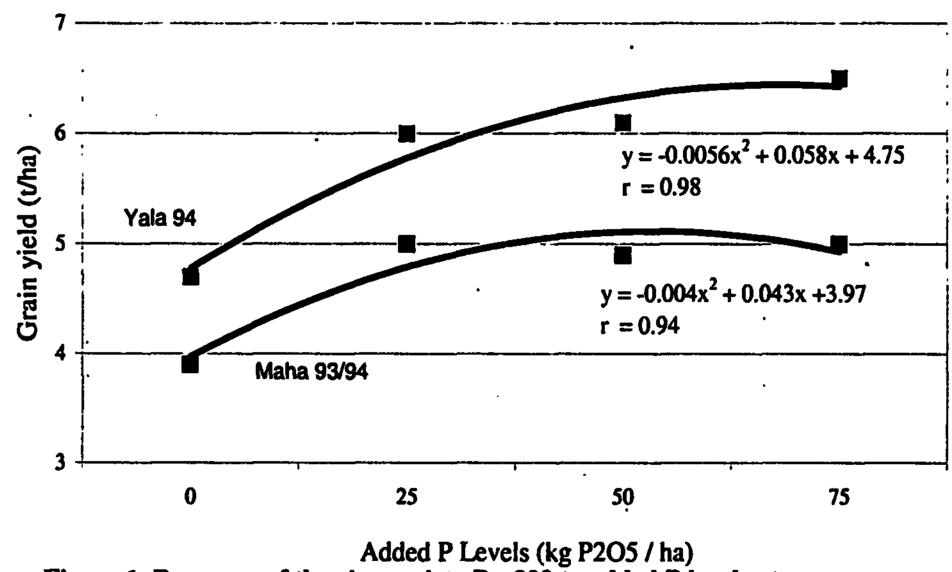

Figure 1. Response of the rice variety Bg-300 to added P levels at low P LHG soils in different seasons under major irrigation in Polonnaruwa.

Results showed that soil P at harvest in the *maha* season (wet season) was lower than that in the *yala* season (dry season) in low P soils (Figure 4). Katyal and Venkatramayya (1983) found that the seasonal variations of soil solution P in submerged vertisols during wet and dry rice seasons were due to effect of high temperature. Temperature in the *maha* season is slightly lower than that of *yala* season, which could affect the availability of soil P in these soils. Average ambient temperature per day during cultivation period of *maha* 93/94 from October to January was 24.95°C while it was 29.78^{0}C during *yala* 94 from May to August in same year according to climatic data at Palugasdamana in Polonnaruwa district. Further verification is needed to confirm these results and ascertain the possible causes. However, maximum of 55 kg P_2O_5 /ha is adequate for both seasons for rice crop in these soils (according to regression analysis).

Similar analysis was made to quantify P requirement and to identify yield response pattern in relation to added P levels at different levels of soil P (Figure 3). Since, the yield response was not significant to P application in medium levels of soil P sites, the regression analysis was done to quantify P requirements for the rice crop only at the sites having lower levels of soil P.

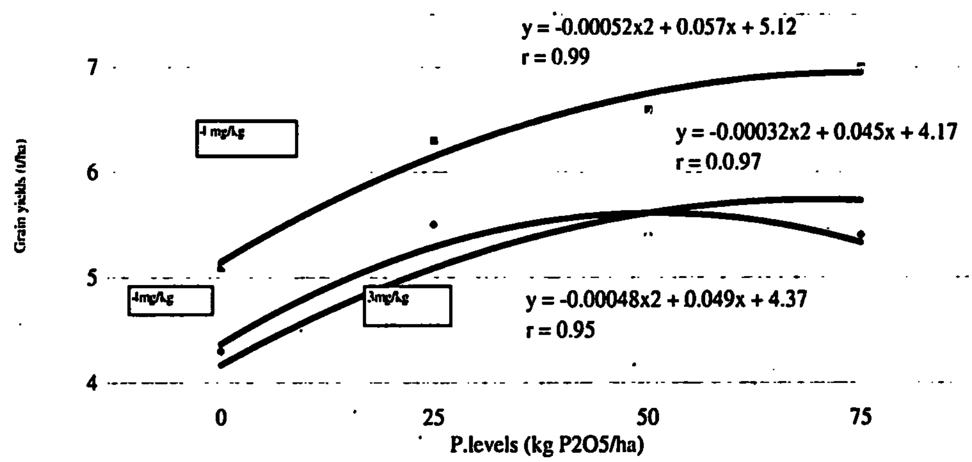

Figure 2. Responce of the rice variety Bg 300 to added P levels in LHG soil at differentavalable P levels under irrigation in Polonnaruwa district.

A quadratic pattern of relationship was observed with the yield in relation to P applications from second season onwards (Figure 4). The maximum yield response was obtained correspond to the P fertilizer application at rate of 70 kg P_2O_5 /ha in the site having soil P level at 3 mg/kg. The sites at Onegama and Lakshanauyana (site 1) having soil P level of 4 mg/kg showed the maximum yield response up to the application of 55 and 51 kg P_2O_5/ha respectively. These results revealed that fertilizer requirement for rice in these soils vary mainly with the soil P levels and the seasons. It shows that P fertilizer application at the rate of 70 kg P_2O/ha is adequate for the rice crop at the site containing 3 mg/kg of soil P level and maximum of 55 kg P_2O_5 /ha is adequate for site having 4 mg/kg of soil P with respect to grain yield. However, Department of Agriculture (DOA) has recommended only 30 kg P_2O_5 /ha of P application for low P soils at present. Hence, the results showed that 55-70 kg P_2O_5 /ha of P application, depending on the available soil P level is needed for better performances of rice crop with respect to grain yield in these soils. According to these results, revision of the present recommendation is an essential need to be considered to enhance productivity in this low P paddy soils. However, among the various factors, consideration of only the yield response alone is not sufficient for the revision of the fertilizer recommendation, particularly for a major nutrient like phosphorus. Behavior of soil P in relation to P addition is one of the major factors to be considered to quantify the P requirement. The changes of soil P in relation to P applications will be discussed later.

Yield performance of the rice varied with seasons (Table 3 & Figure 5). The *yala* season, being relatively drier than the *maha* season, produced a significantly higher grain yield than that of wet *maha* season at every location irrespective of soil P levels. Table 5 shows the yield performances of rice in the medium P soil. Result indicates that grain yields of all the *yala* seasons except *yala* 95 season were significantly higher than that of all the *maha* seasons. The yield performance of rice in *yala* 95 season was equal to both *maha* 94/95 and *maha* 96/97 season, could be due to prevailed favorable environmental conditions (Table 5). These results further show that, the yield performance of *yala* season is always greater than that of *maha* season in same year.

Response of yield factors to added phosphorus

The response of the yield factors (plant height, no. of tillers/hill, effective tillers/hill, no. of grains/panicle, grain weight/panicle, 1000 seed weight and no. of tillers/m^2) to added P levels during *maha* 1993/94 is given in Table 6. No. of hills/m^2 was not significantly different among soil P levels and added P levels. It is clear that neither the yield in different soil P nor the yield in added P levels was affected by the plant density.

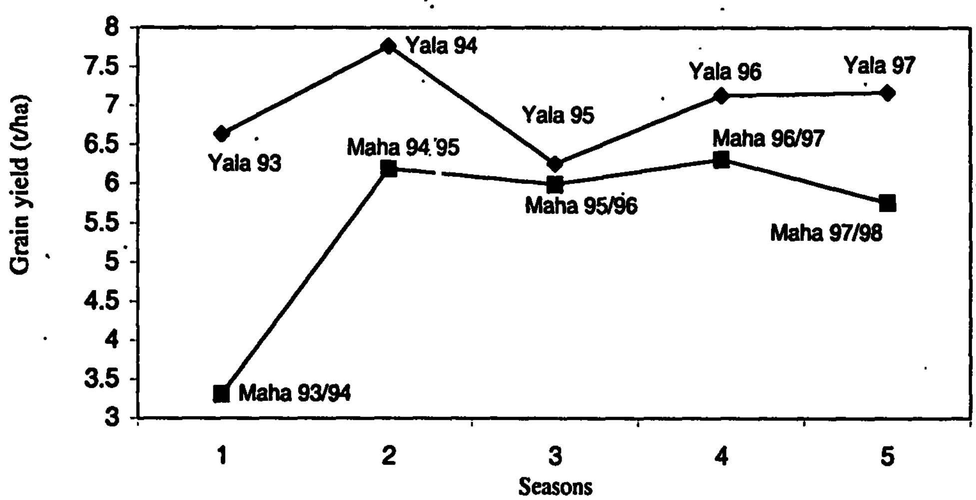

Figure 3. Variation of grain yield at LHG soil in different seasons under major irrigation in Polonnaruwa district

Table 6. Response of yields parameters of rice to added P levels over locations in *maha* 93/94 season

Yield parameters	*Soil P• levels (mg/ kg)*	*P. Levels (kg P_2O_5/ha)* 0	25	50	75	*elMean*	*CV (%)*
Plant height (cm)	1	86.5	90.5	89.5	89.0	88.8	
	2	86.0	88.5	89.0	90.5	88.0	
	3	87.0	93.5	93.5	93.5	91.8	
	4	92.0	96.0	95.0	96.5	94.8	
	5	91.0	87.5	91.0	89.0	89.6	2.37
Tillers /hill	1	8.5	9.5	9.0	8.4	8.8	
	2	8.3	8.1	8.8	7.7	8.2	
	3	6.4	7.0	8.3	5.9	7.0	
	4	7.0	8.5	8.0	8.0	8.0	
	5	9.4	9.1	8.5	8.2	8.8	10.6
Effective tiller/hill	1	6.0	8.0	7.0	6.5	6.9	
	2	4.0	5.5	5.0	4.5	4.8	
	3	5.0	6.5	5.0	4.5	5.3	
	4	4.5	5.0	5.0	5.5	5.0	
	5	4.3	4.7	4.15	4.7	4.5	11.3
Grains/panicle	1	103.5	124.0	128.0	125.0	117.6	
	2	101.5	126.0	124.0	124.0	118.0	
	3	96.1	124.0	120.0	127.0	116.7	
	4	119.5	126.5	128.5	132.0	124.4	
	5	96.5	113.5	113.0	116.5	112.4	8.0
Grains weight/10panicle (g)	1	23.5	29.5	27.0	26.0	26.5	
	2	32.5	36.5	36.5	38.0	36.0	
	3	24.5	31.5	32.5	32.5	30.2	
	4	36.5	41.0	41.5	39.5	39.6	
	5	33.5	36.0	36.0	37.0	35.6	12
1000 seed weight (g)	1	26.1	26.0	25.4	26.0	24.8	
	2	24.0	26.0	24.5	24.5	26.1	
	3	25.5	26.0	25.0	26.5	25.8	
	4	26.5	26.0	26.0	26.0	26.1	
	5	27.5	26.0	26.0	27.0	26.6	3.3
Hills/m²	1	52.0	51.0	51.0	51.0	51.3	
	2	54.0	48.0	54.0	51.0	51.9	
	3	79.0	69.0	72.0	71.0	72.5	
	4	52.0	52.0	51.0	51.0	51.3	
	5	49.0	52.0	52.0	56.0	51.9	9

LSD (5%)

Plant height	4.57cm
No of tillers/hill	ns
Effective tillers/hill	1.27
No of grains/panicle	20.0
Grain weight/panicle	5.4g
1000 seed weight	ns
No of tillers/m²	ns

• - Soil P levels
1. 4 mg/ kg (L.uyana 1)
2. 4 mg/ kg (Onegama)
3. 3 mg/ kg (W. pedesa)
4. 15 mg/ kg(L. uyana 2)
5. 16 mg/kg (P. naruwa)

No of tillers/hill and 1000 seed weight did not respond to P application irrespective of the soil P levels (Regression equations are given below). It indicates that grain filling was not affected by soil P availability. Response of the plant height to added P levels was significant only at the site having available soil P level of 3 mg/kg and the maximum response was 53 kg P_2O_5 / ha of P application. All the other yield factors (effective tillers/hill, no. of grains/panicle and grain weight of 10 panicles) showed significant yield response to P application at all sites, where soil P level was at 4 mg/kg or less (Regression equations are given below). Effective tillers/hill, grains/ panicle and grain weight of 10 panicles showed the maximum response up to 36, 53 and 50 kg P_2O_5 / ha respectively. This analysis also confirmed that maximum of 55 kg/P_2O_5 / ha is adequate for better performances of rice crop in these soils. Similar results were reported by Weerasinghe (1991) where the effective tillers were found to increase with the application of P in NCB soil.

Equations –

1. Y (hills/m2) = -0.004x + 55.9, (r = 0.102) [1].
2. Y (1000 seed weight.) = 0.004x + 25.9, (r = 0.258) [2].
3. Y (plant height) = -0.0026x2 + 0.273x + 87.3, (r = 0.966*) [3].
4. Y(eff. tillers/hill)= -.00092x2+0.0666x+5.16, (r = 0.858*) [4].
5. Y (grains/panicle)= -0.0093x2+0.99x +101.6, (r =0.959*) [5].
6. Y(gr.weight/ pani.)= -0.0028x2 +0.282x+26.4, (r =0.996*) [6].

*. Significant at 5% probability level.
Where,
Y = yield factors
x = added P levels

Available soil phosphorus

Figure 4 and 5 show the changes of soil P at harvest in each season in relation to P application at the sites having low and medium levels of soil P respectively. Results showed that the soil P at harvest varied in relation to level of P addition in each season. The soil P at harvest followed similar trend of depletion and accumulation in relation to added P levels at all sites having lower level of soil P (Figure 4). An accumulation of soil P was observed in plots receiving fertilizer P at the rate of 50 kg P_2O_5/ha or above, in soils having lower level of soil P (Figure 4) and, plots receiving 25 kg P_2O_5/ha or above in soils having medium level of soil P at harvest (Figure 5). A depletion of soil P was observed, in plots receiving fertilizer P at the rate of 0 and 25 kg P_2O_5/ha in the low P soils and zero level of P application in the medium P soils (Figures 4 & 5). According to the results on the grain yield the rate of P requirement for the paddy crop in low and medium soil P sites would be 70 and 55 kg P_2O_5 /ha respectively.

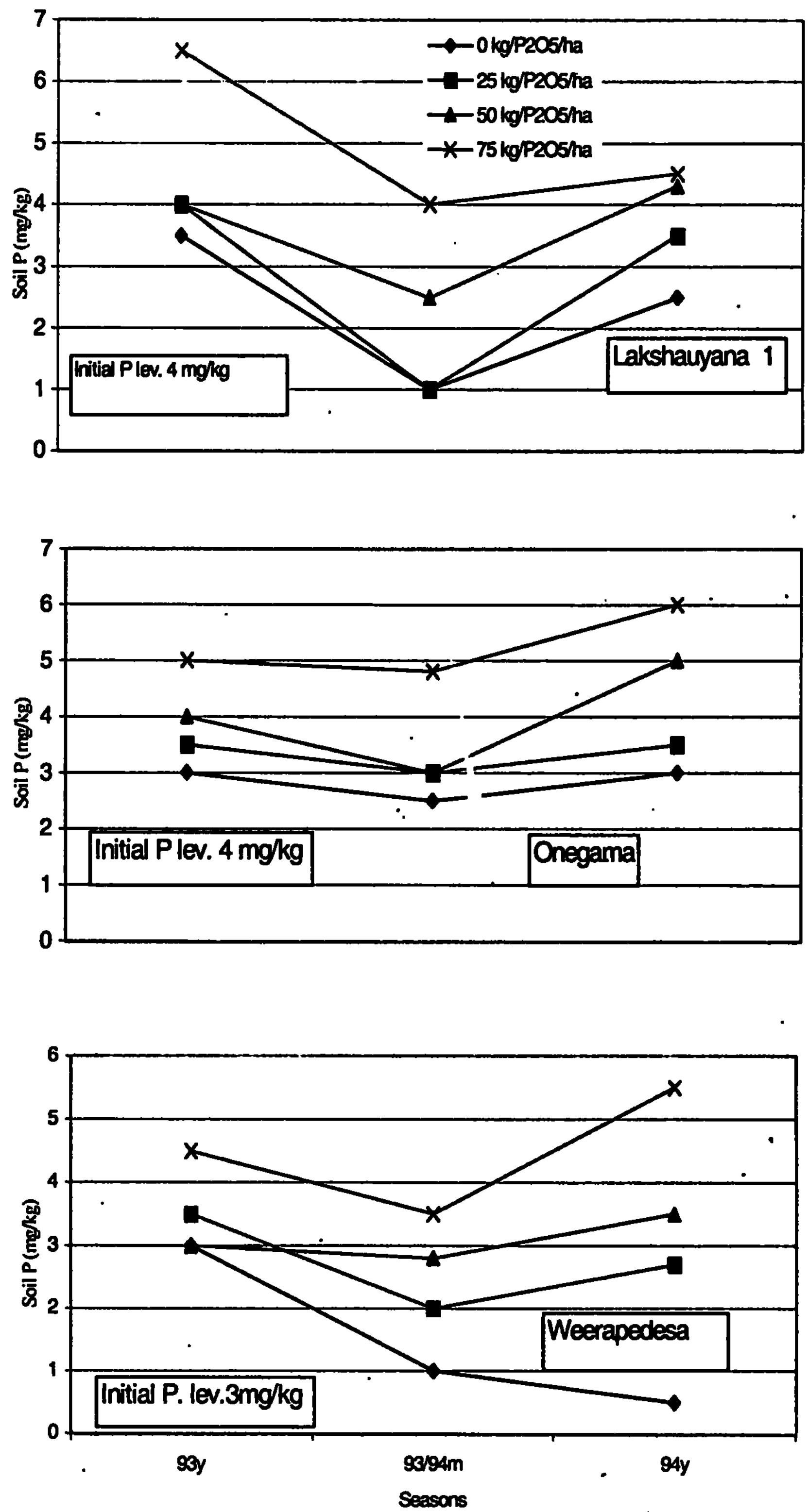

Figure . 4. Changes in available soil P at harvest in each season with respect to Phosphorus addition in LHG soils at low available P sites

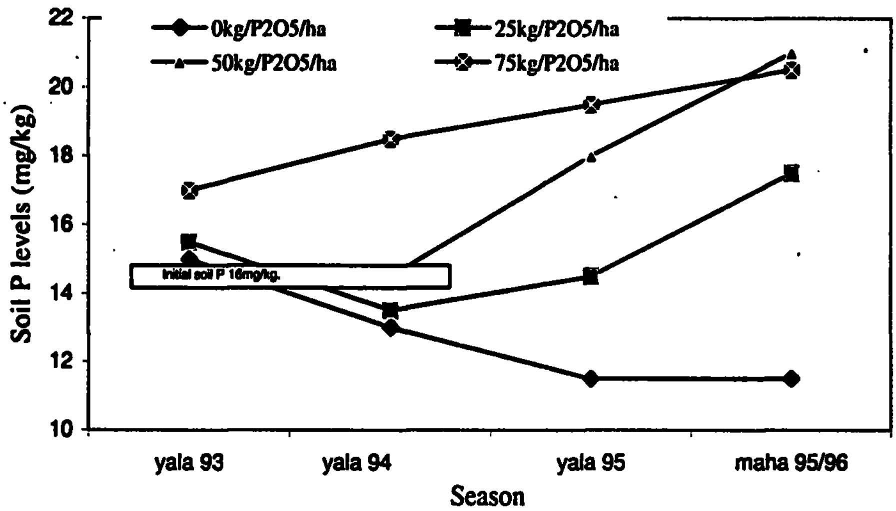

Figure 5. Changes of available soil P in relation to added P at Polonnaruwa in selected season under major irrigation in Polonnaruwa district

However, applications of fertilizer P greater than 25 and 50 kg P_2O_5/ha lead to accumulation of phosphorus in low and medium P soils, respectively. Results showed that an accumulation of soil P reached up to 21mg/kg in medium P soils. Rezania (1992) reported that, the available soil P is varying between 4-48.7 mg/kg in the paddy lands in the Low country Dry zone. Hence, it was not detrimental to paddy crop. However, long-term effects of P, particularly sorption and fixation should be investigated. Therefore, the addition of P at the rate between 25-50 kg P_2O_5/ha is adequate for low P soil while, it is between 0 and 25 kg P_2O_5/ha for medium P soil based on the above results. Figure 6 shows the status of soil P at the harvest in the 3rd season, in low P soil and at the 6th season in medium P soil with respect to added P levels. It indicates that, an application of inorganic fertilizer P at the rate of 50, 40 and 15 kg P_2O_5/ha is adequate to sustain inherent soil P at 3, 4 and 16 mg/kg respectively in these soils. Department of Agriculture (1995) has recommended 30 (65kg/ha as TSP) and 18 (40 kg/ha as TSP) kg P_2O_5 /ha for rice in low and medium P soils for same area. However, continuous application of current recommendation of P to the low P soil could lead to depletion of inherent soil P and the current recommendation of P for medium P soil is at acceptable level to maintain its inherent soil P level. Since low P soils are dominant in these areas, depletion of soil P could be a limiting factor to enhance rice production in these soils. Furthermore, there is a yield stagnation of rice in these soils at present. Therefore, it may be beneficial to revise the present recommendation of phosphorus application for low P soils, to sustain inherent soil P, and to enhance productivity of the soils.

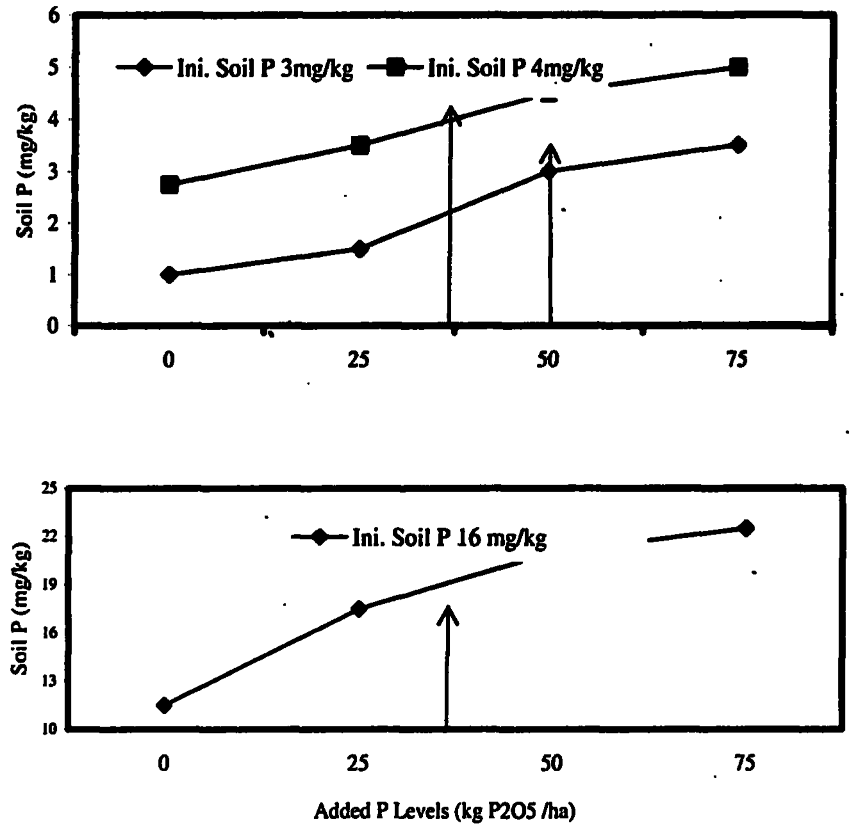

Figure 6. Available soil P at harvest, in relation to P addition at 3, 4 and 16 mg/kg of soil P under major irrigation in Polonnaruwa district.

CONCLUSIONS

Rice grain yield varied with season. *yala* season produced higher grain yield than that of *maha* season. Soil P could be a factor that effects the seasonal variation of yield in low P soils.

Among the yield parameters of rice, effective tillers/hill, grain weight/ panicle and grains/panicle were affected due to limitation of P supply. Result further revealed that grain filling is not affected by soil P levels.

Accumulation and depletion of soil P varied with available soil P level in these soils in relation to P application. Therefore, sustainability of inherent available soil P is an important factor to be considered to quantify P requirement of these soils. Phosphorus application of 15 kg P_2O_5 /ha for medium P soil (15 & 16 mg/kg) and 40 and 50 kg P_2O_5/ha for low P soils (4 and 3 mg/kg, respectively) are needed to sustained inherent soil P in these soil.

Low supply of phosphorus is one of the factors that limits rice yield in LHG soils under major irrigation in Polonnaruwa. Response of rice to P application depends on available soil P levels and seasons. Therefore, the crop response, soil P levels and their changes in relation to P application shoulld be considered for quantification of P requirement in these soils.

ACKNOWLEDGEMENT

The authors wish to express gratitude to scientist of the FCRDI, Maha Illuppallama and members of the staff of Adaptive Research Center, Polonnaruwa for their constant help, encouragement, advice and constructive criticism during the period of study. Finally, financial support provided by FAO Fertilizer Project (Phase 2), Department of Agriculture to conduct this study is acknowledged.

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