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PHOSPHOROUS FERTILIZATION REQUIREMENT FOR RICE UNDER CLAYED ALKALINE SOILS.

Naeem, E.S.; T.F. Metwally; I.M. Hashem and T.M. AbdEl-Mgeed
Rice Research & Training Center, Field Crops Research Institute, Agricultural Research Center, 33717 Sakha - Kafrelsheikh, Egypt.

ABSTRACT

Phosphorus is a macronutrient that plays number of important roles in plants. It is a component of nucleic acids, so it plays a vital role in plant reproduction, of which grain production in an important result. Intensive cropping system, high phosphorus consumer crops, high yielding rice varieties and high soil pH restricted P availability resulted in low rice yield. The experiment was carried out at farm of Sakha Agriculture Research Station, Kafrelsheikh during 2014 and 2015 summer seasons, in clayed alkaline soil, the study aimed to find out the effect of different levels of phosphorus fertilizer on yield and yield attributes of rice in low soil phosphorus. The treatments consist of four cultivars; Egyptian hybrid rice one (EHR1), Sakha102, Sakha106 and Giza179 and five phosphorus (P) fertilizer levels Viz. 0, 12, 24, 36 and 48 kg P_2O_5. ha^{-1} as single super phosphate (15.5 % P_2O_5). Split plot experiment design with four replications was used. At heading some growth parameters were measured yield and yield attributes were estimated. Nitrogen and phosphorus uptake were determined.

The studied varieties were certainly differed regarding their yield and yield attributes as well as nitrogen and phosphorus uptake. The Egyptian hybrid rice one (EHR1) apparently surpassed others studied varieties in growth, grain yield and most of yield components characteristics.

All the studied parameters of rice varieties differed significantly with the application of phosphorus fertilizer. Plants grown without added phosphorus gave the lowest grain yield. The higher phosphorus levels exhibited higher grain yield. A significant interaction between varieties and phosphorus levels in respect of yield and yield attributes of rice were observed. The highest grain yield was recorded with Egyptian hybrid rice one at 48 kg P_2O_5. ha^{-1}.

It could be concluded that high yielding rice varieties, EHR1 and Giza 179 responded to phosphorus fertilizer up to 48 kg P_2O_5/ha^{-1}. Furthermore, the medium yielding varieties; Sakha102 and Sakha106 performed better with P level of 36 kg P_2O_5/ha^{-1}. The application of phosphorus for rice after heavy phosphorus consumer crop and high pH soil is imperative to fetch high rice grain yield.

Keywords : Rice crop, phosphorus fertilizer, grain yield, alkaline soil.

INTRODUCTION

Rice (*Oryza Sativa* L.) is one of the most important cereal crops of the world. There are Globally 111 rice growing countries in the area of 146.5 million hectares in which more than 90% out of them is in Asia. rice is an staple food for more than two billion people in Asia and many millions in Africa and Latin America (Alam *et al*., 2009). Rice crop is adversely affected by malnutrition resulting in poor panicle structure, spikelet sterility; uninform ripping of kernel and kernel chalkiness. In fact, there is no other alternative, then to use and balance plant nutrition for high productivity. Most of the rice yield comes from high yielding variety rice. Because of continuous growing of high yielding variety rice and injudicious fertilizer management, many soils are getting exhausted. Over the years P deficiency in rice soils is being observed in many areas which could be one of the reasons for low rice yield. Appropriate dose of phosphorus fertilizer to enhance crop productivity is imperative to fetch the maximum rice production after especially cereal crops cultivation. Judicious and proper use of fertilizer can markedly increase the yield and quality of rice.

Phosphorus is essential nutrient for plant life. Phosphorus plays a key role in energy transfer. Phosphorus is essential for photosynthesis and other chemical physiology processes in plant (Wasiullah *et al*., 1995). Without adequate supply of phosphorus plant, cannot reach its maximum yield. Phosphorus deficiency symptoms appear in the lower part of the plant and results decreased leaf number, decreased leaf blade length, reduced panicles $plant^{-1}$ and reduced filled grains $panicle^{-1}$ (Alam *et al*., 2009). Ali and Ansari (2006), Zayed *et al.,* (2010), Zayed (2012) under sodicity and saline sodic soils, discriminated that increasing phosphorus levels significantly increased dry matter, LAI, chlorophyll, plant height, panicle number, filled grains, panicle weight, grain yield and straw yield and reducing unfilled grains. As the soil of Egypt are known to be heterogeneous and poor in phosphorus.

This study was performed investigate the effects of phosphorus fertilizer on yield and yield attributes of some rice varieties.

MATERIALS AND METHODS

Two field experiments were conducted at the Farm of Sakha Agriculture Research Station at Kafrelsheikh during 2014 and 2015 seasons. Representative soil samples were taken and subjected to chemical analysis followed the standard procedures by Cottenie *et al* (1979) and Page *et al* (1982). The soil was clayey in texture with 1.5% and 1.6 % organic matter, pH 8.2 and 8.26, EC 1.8 and 1.45 $dS.m^{-1}$, 9 and 10 ppm available P during the year 2014 and 2015, respectively.

The experiments were carried out in a split-plot design with four replicates. Two sets of treatments included in the experiment are follows: Varieties {Egyptian Hybrid rice one (EHR1): V_1, Sakha 102: V_2, Sakha106: $V_3$and Giza 179: V_4} and five levels of P (P_0: control (without phosphorus), P_1: 12 kg P_2O_5 ha^{-1}, P_2: 24 kg P_2O_5 ha^{-1}, P_3: 36 kg P_2O_5 ha^{-1} and P_4: 48 kg P_2O_5 ha^{-1}). Varieties were randomly assigned to the main plots and fertilizer doses in the sub-plots. The plot size was 10 m^2.

The cultivated previous crop was barley: A common procedure was followed in seedling bed raising. Seedlings age 30 days were carefully uprooted from the nursery beds carefully. Seedlings were transplanted in the well puddled experimental plots. Spacing were given 20 cm $_X$ 20 cm. Nitrogen as urea at the rate of 165 kg N ha^{-1} was applied in two splits, two third as a basal application and one third at 30 days after transplanting (DAT) as top dressing. Full dose of phosphorus as a single superphosphate was applied as a basal dose at the time of final land preparation and merely incorporated into the soil. All intercultural operations were done carefully according to Rice program, ministry of Agriculture. From transplanting to twice weeks before harvesting, a thin layer of water (3-5cm) was kept on the plots. Water was removed from the plots two weeks before harvesting. The plants of six inner rows of each plot were harvested separately at full maturity. The studied characters include flag leaf area (cm^2) at heading, plant height (cm), number of panicles per m^2, panicle weight (g), panicle length (cm), number of filled $grains.panicle^{-1}$, number of unfilled $grains.panicle^{-1}$, 1000-grain weight (g), grain and straw yield (t/ha) and nitrogen and phosphorus uptake. The grain and straw weights for each plot were recorded after proper sun drying and then converter into t ha^{-1}. The grain yield was adjusted at 14% moisture level. Nitrogen and phosphorus uptake were calculated based on dry matter, nitrogen and phosphorus content. The data were statistically analysis according to Gomes and Gomes (1984). The main differences among the treatments were compared by multiple comparison tests using Duncan's Multiple Range Test (DMRT, 1955).

RESULTS AND DISCUSSION

Leaf area index

Rice varieties significantly varied in their leaf area index in both study seasons. The highest value of leaf area index was observed with EHR1 followed by Giza 179. Sakha102 came in the last order in LAI in first season, while was Sakha 106 rice variety in the second season. Phosphorus application significantly affected leaf area index. Maximum value of leaf area index was recorded when phosphorus was applied at the rate of 48 kg. ha^{-1} while the lowest value was observed when phosphorus was not applied. This mainly due to the favorable role of phosphorus in physiological process which promote growth rate and optimized plant canopy. High phosphorus leaf content ensure enough energy for optimum cell elongation and division resulted in large leaf area against soil unit area lead to proper LAI. These finding were indicatly with those reported by Zayed *et al*. (2010) and Zayed (2012).

Plant height

Significant differences in plant height were observed among the varieties (Table 1). Sakha 102 rice variety gave the longest plant followed by Sakha 106. Plant height of rice varieties also varied significant due to phosphorus fertilizer application (Table1). These differences between varieties in plant height might be due to their genetic background. Application of 48 kg $P_2O_5.ha^{-1}$ produced the longest plant in both seasons. Plant grown without phosphorus fertilizer addition had the shortest plant in both season. Significant variation of phosphorus fertilizer and varieties were observed (Table 2). Among the treatments, combination (V_2P_4) gave the highest value of plant height and lowest means from the combination V_4P_0. Increase in plant height due to phosphorus application could be attributed mainly to the positive role of phosphorus in the stimulation of cell division and elongation. The results are in conformity with those of Ayub *et al*. (2002), Zayed *et al*. (2010) and Zayed, (2012).

Table 1: Some growth characteristics at harvest as affected by rice varieties and different levels of phosphorus in 2014 and 2015 seasons.

Treatments	LAI		Plant height	
	2014	2015	2014	2015
Varieties:				
EHR1 (V_1)	8.350a	7.81a	103.47c	107.02c
Sakha102 (V_2)	5.433c	5.44c	112.67a	115.88a
Sakha106 (V_3)	5.532c	5.06c	109.80b	113.75b
Giza179 (V_4)	7.141b	6.80b	93.27d	97.02d
Kg P_2O_5 ha^{-1}:				
Zero (P_0).	5.11e	4.72e	97.42e	100.98e
12 (P_1)	6.24d	5.83d	102.75d	106.01d
24 (P_2)	6.79c	6.32c	106.17c	110.02c
36 (P_3)	7.34b	6.95b	107.92b	111.76b
48 (P_4)	7.59a	7.57a	109.75a	113.31a
Interaction	NS	NS	**	*

Table 2: Plant height cm as affected by the interaction between rice varieties and different levels of phosphorus in 2014 and 2015 seasons.

Kg P_2O_5 ha^{-1}	Varieties							
	EHR1 (V1)	Sakha102 (V2)	Sakha106 (V3)	Giza 179 (V4)	EHR1 (V1)	Sakha102 (V2)	Sakha106 (V3)	Giza 179 (V4)
	2014				2015			
Zero (P_0).	95.00h	103.7fg	101.7g	89.3j	98.6h	106.6fg	105.6g	93.10j
12 (P_1)	101.3g	112.7bc	105.7ef	91.3ij	104.8g	114.6cd	109.6ef	95.00ij
24 (P_2)	103.7fg	114.7ab	112.3bc	94.0hi	107.2 fg	118.7ab	116.3bc	97.80hi
36 (P_3)	107.7de	115.0ab	114.3ab	94.7h	111.9de	119.7ab	118.4ab	98.40h
48 (P_4)	109.7cd	117.3a	115.0ab	97.0h	113.3cd	120.6a	118.8ab	100.80h

Number of panicle

Number of panicle m^{-2} varied significantly among the rice varieties (Table3). Data in Table 3 indicated that phosphorus levels affected significantly number of panicle m^{-2}. Significantly the highest number of panicle was found in case of EHR1. Application of 48 kg P_2O_5 ha^{-1} produced the highest number of panicle.m^{-2} which was statistically at a par with 36 P_2O_5 ha^{-1} in two seasons. Plant grown without phosphorus fertilizer had the lowest effective panicle ha^{-1}. Similar results of applied P fertilizer were reported by Katyal. (1978). Matsuo *et al*. (1995) also, reported that it is necessary to apply much P fertilizers to help rice plants to accelerate the phosphate absorption for increased panicles. Phosphorus application increased phosphorus leaf content led to high ATP, RNA, DNA and NAPH that improve plant metabolism and catabolism resulting high relative growth rate and more tiller buds formation. Phosphorus had high affinity to improve rooting system that encourages more panicle formation development. These results are in agreement with those of Ali and Ansari (2006), Zayed *et al*. (2010) and Zayed (2012) came to identical findings.

Table 3: Number of panicle m^{-2} and panicle length cm as affected by rice varieties and different levels of phosphorus in 2014 and 2015 seasons.

Treatments	No. panicle m^{-2}		Panicle length cm	
	2014	2015	2014	2015
Varieties				
EHR1 (V_1)	682.9a	705.7a	23.29a	22.73a
Sakha102 (V_2)	569.5b	574.2c	19.72c	20.08c
Sakha106 (V_3)	504.7c	521.1d	20.02c	21.37b
Giza179 (V_4)	575.3b	598.3b	21.17b	21.60b
Kg P_2O_5 ha^{-1}				
Zero (P_0).	483.7d	500.8d	19.63c	19.56c
12 (P_1)	547.0c	564.6c	20.69b	20.97b
24 (P_2)	589.3b	607.0b	21.16b	21.49b
36 (P_3)	639.9a	655.3a	21.81a	22.43a
48 (P_4)	655.5a	671.3a	21.97a	22.76a
Interaction	NS	NS	NS	NS

Panicle length

Varieties show significant variation in respect of panicle length (Table 3). The longest panicle was observed from EHR1 and the shortest ones from Sakha102. Phosphorus had significant positive role in increasing the panicle length (Table 3). Panicle length of rice varieties increased with the increasing rate of phosphorus fertilizer. Application of 48 kg P_2O_5 ha^{-1} produced the longest panicle and it was statistically at a par with 36 kg P_2O_5 ha^{-1}. The untreated plants (without phosphorus addition) produced the shortest panicles. Similar results were reported by Sahar and Burbly (2003) and Zayed *et al.* (2010).

Panicle weight

Panicle weight differed significantly in all varieties (Table 4). The heaviest panicles were observed with EHR1, Sakha106 and Giza179 were at a par regarding panicle weight. The application of phosphorous increased significantly panicle weight Table 4. Plants which fertilized with 48 kg P_2O_5 ha^{-1} produced the heaviest panicle which was statistically at a par with 36 kg P_2O_5 ha^{-1}. The lighter panicle was produced by control treatment. Phosphorus fertilizer will ensure high ATP provided high photosynthesis rate and more assimilate in post and pre heading lead to improving panicle filling. Similar results were reported by Sahar and Burbly (2003), Zayed *et al*. (2010) and Zayed (2012).

Table 4: Some yield components as affected by rice varieties and different levels of phosphorus in 2014 and 2015 seasons.

Treatments	Panicle weight. g		No. filled grains panicle^{-1}		No. unfilled grain panicle^{-1}		1000-grain weight/g	
	2014	2015	2014	2015	2014	2015	2014	2015
Varieties:								
EHR1 (V_1)	4.33a	3.42a	154.89a	158.99a	11.11a	11.13a	25.06d	24.99d
Sakha102 (V_2)	3.22c	3.07b	107.09d	111.52d	9.88b	9.80b	28.23b	28.43b
Sakha106 (V_3)	3.87b	3.39a	119.17c	123.69c	10.57ab	10.53a	28.82a	28.91a
Giza179 (V_4)	3.87b	3.35a	131.87b	136.29b	10.91a	10.87a	27.67c	27.74c
Kg P_2O_5 ha^{-1}:								
Zero (P_0).	3.26c	3.07c	112.68e	116.71d	13.28 a	13.14a	26.91d	27.23c
12 (P_1)	3.63b	3.19b	117.29d	122.15c	11.92b	11.88 b	27.21cd	27.32bc
24 (P_2)	3.84b	3.31b	131.78c	136.84b	10.30c	10.29 c	27.42bc	27.44bc
36 (P_3)	4.12a	3.43a	136.27b	140.75b	9.27d	9.30d	27.69ab	27.64b
48 (P_4)	4.26a	3.52a	143.26a	146.65a	8.31e	8.31e	27.98a	27.95a
Interaction	NS	NS	**	**	**	*	NS	NS

Filled grain and unfilled grains Panicle^{-1}

Filled and unfilled grains panicle^{-1} significantly differed among tested rice varieties (Table 4). Rice variety EHR1 produced the maximum number of filled grains panicle^{-1} in both seasons followed by Giza179. The lowest number of filled grains panicle^{-1} was observed from Sakha102. Also, data showed that the highest numbers of unfilled grains were observed with EHR1, which was statistically at a par with Giza179 and Sakha106. Obaidullah (2007) reported that there were varietal differences in number of filled grains panicle^{-1}. Filled and unfilled grains panicle^{-1} numbers were also significantly affected by different phosphorous levels (Table 4). Phosphorus at 48 kg P_2O_5 ha^{-1} produced the highest number of filled grain panicle^{-1}. Control treatment produced lowest number of filled grains panicle^{-1}. In this experiment, it was observed that the highest numbers of unfilled grain panicle^{-1} were produced with P_0 (without P addition) due to lack of phosphorus. These findings are in agreement with those of Fageria and Barosa, Filho (1982). Sahar and Burbly (2003) showed that increasing the rate of phosphorus compound significantly affected the grains number panicle^{-1}. Integration of varieties and phosphorus treatments significantly affected the number of filled and unfilled grains panicle^{-1} (Tables 5 & 6).

Table 5: Number of filled grains. Panicle^{-1} as affected by the interaction between rice varieties and different levels of phosphorus in 2014 and 2015 seasons.

Kg P_2O_5 ha^{-1}	Varieties							
	(V_1) EHR1	(V2) Sakha102	(V3) Sakha106	(V4) Giza 179	(V1) EHR1	(V2) Sakha102	(V3) Sakha106	(V_4) Giza 179
	2014				2015			
Zero (P_0).	132.57df	92.83m	105.99kl	119.33g-i	136.60dg	96.86n	109.98lm	123.41h-j
12 (P_1)	135.63cd	98.40lm	111.80i-k	123.34f-h	139.49c-f	105.88m	115.86j-l	127.37g-i
24 (P_2)	160.07b	108.40jk	124.83e-h	133.80de	164.21b	113.42k-m	128.99g-i	140.74c-e
36 (P_3)	164.53b	117.33h-j	124.33e-h	138.87cd	168.65b	120.79i-k	130.52f-i	143.05cd
48 (P_4)	181.67a	118.47hi	128.90d-g	144.00c	185.97a	120.66i-k	133.08e-h	146.90c

Table 6: Number of unfilled grains. panicle^{-1} as affected by the interaction between rice varieties and different levels of phosphorus in 2014 and 2015 seasons.

Kg P_2O_5 ha^{-1}	Varieties							
	(V_1) EHR1	(V2) Sakha102	(V3) Sakha106	(V4) Giza 179	(V1) EHR1	(V2) Sakha102	(V3) Sakha106	(V_4) Giza 179
	2014				2015			
Zero (P_0).	13.07bc	11.60c-e	13.20bc	15.27a	13.09b	11.35cd	13.01b	15.12 a
12 (P_1)	13.29b	10.6d-g	11.79b-d	11.93b-d	13.25b	10.61c-f	11.76bc	11.88bc
24 (P_2)	10.86d-f	9.59f-h	10.63d-g	10.11e-g	10.88c-e	9.57e-g	10.63c-f	10.09d-f
36 (P_3)	9.33f-h	9.13g-i	9.06g-i	9.56f-h	9.47e-g	9.08f-h	9.07f-h	9.58e-g
48 (P_4)	9.00g-i	8.40hi	8.16h	7.67i	8.98f-h	8.41gh	8.17gh	7.70h

The variety EHR1 engaged with 48 kg P_2O_5 ha^{-1} produced the highest number of filled grains panicle^{-1}. The lowest number of filled grains panicle^{-1}, however produced by the combination of V_2P_0. This is might be due to larger panicle size and translocation of photosynthesis for the storing organs to grains setting as well as elevating current photosynthesis. The highest unfilled grains panicle^{-1} was found in combination of V_4P_0. This was mainly due to the lack of phosphorus as it is a limiting nutrient for grain filling. Similar results were obtained by Zayed *et al*. (2010) and Zayed (2012).

1000-grain weight

Varieties showed significant and different response in 1000-grain weight (Table 4). The highest 1000-grain weight was observed with Sakha106, which was significantly higher than other cultivars. EHR1 showed the lowest 1000-grain weight. Phosphorus levels influenced the 1000-grain weight significantly. Maximum 1000-grain weight was recorded with 48 kg P_2O_5 ha^{-1}, which was superior over rest of the treatments. Mehla and Panwar (2001) also, observed differences in yield components and yield of different basmati rice cultivars. Similar results were reported earlier by Balior *et al*. (1995). Increase in 1000-grain weight at high phosphorus rate might be primarily due to higher photosynthetic rate and providing an adequate of net photosynthesis rate during grain development and filling (Kausor *et al*., 1993).

Grain and Straw yields

The rice varieties differed significantly in respect of grain and straw yields t ha^{-1} (Table 7). The EHR1 variety produced the highest mean grain and straw yields followed by Giza179. Couple of Sakha 102 and Sakha106 rice varieties were not significantly differed in grain and straw yields. The results are in conformity with the observation of Obaidullah. (2007) and Zayed *et al*. (2010). Grain and straw yields increased linearly with the increment of the fertilizer doses of phosphorus up to 48 kg P_2O_5.ha^{-1}. Application of 48 kg P_2O_5 ha^{-1} gave the maximum grain and straw yields which was statistically at a par with 36 kg P_2O_5 ha^{-1} in the second year for straw and in the first year for grain. High yield under 48 kg P_2O_5 might be primarily due to more filled grains and high value of the panicle weight. Furthermore, linear response to phosphorus application up to the highest value of phosphorus of 48 kg P_2O_5 could be attributed very severs phosphorus deficiency as indicate in the material. The available phosphorus was 9 and 10 ppm that supported the phosphorus deficiency. Moreover, the target domain soil is characterized as alkaline soil with high pH resulted in phosphorus precipitation in the form of calcium triphosphate led to phosphorus deficiency Shah (2002) also reported the similar response of phosphorus on grain yield. Zaman *et al*. (1995), found significant increase in grain yield with phosphorus application over phosphorus control.

The interaction effect between varieties and phosphorus exerted significant influence on the grain and straw yields in both seasons (Tables 8 & 9) combination of V_1P_4 produced the highest grain and straw yields and it was statistically identical with V_1P_3 in the first season. The behavior of Sakha102 and Sakha106 rice varieties was identical regarding their response to phosphorus fertilizer in both seasons of study. The latter couple varieties significantly responded to phosphorus addition up to 36 kg P_2O_5 ha^{-1}. Interesting the high nutrient response varieties EHR1 and Giza179 significantly responded to phosphorus application up to higher level of 48 kg P_2O_5 ha^{-1}.

Table 7: Grain and straw yields t/ha^{-1}as affected by rice varieties and different levels of phosphorus in 2014 and 2015 seasons.

Treatments	Grain yield t.ha^{-1} 2014	Grain yield t.ha^{-1} 2015	Straw yield t.ha^{-1} 2014	Straw yield t.ha^{-1} 2015
Varieties:				
EHR1 (V_1)	11.52a	12.10a	12.69a	13.23a
Sakha102 (V_2)	9.19c	9.79c	10.53c	10.78c
Sakha106 (V_3)	9.55c	9.88c	10.86c	11.41bc
Giza179 (V_4)	10.64b	10.44b	11.68b	11.50b
Kg P_2O_5 ha^{-1}:				
Zero (P_0).	8.42d	8.84e	9.96e	10.17d
12 (P_1)	9.66c	9.99d	10.89d	11.24c
24 (P_2)	10.51b	10.91c	11.63c	12.17b
36 (P_3)	11.09a	11.32b	12.16b	12.39ab
48 (P_4)	11.42a	11.71a	12.55a	12.68a
Interaction	**	*	*	NS

Table 8: Grain yield t. ha^{-1} as affected by the interaction between rice varieties and different levels of phosphorus in 2014 and 2015 seasons.

Kg P_2O_5 ha^{-1}	(V_1) EHR1 2014	(V2) Sakha102 2014	(V3) Sakha106 2014	(V4) Giza 179 2014	(V1) EHR1 2015	(V2) Sakha102 2015	(V3) Sakha106 2015	(V_4) Giza 179 2015
Zero (P_0).	9.73ef	7.09i	8.37h	8.51gh	10.07f-h	8.09j	8.36ij	8.81i
12 (P_1)	10.68cd	8.77gh	9.10fg	10.11de	11.17d	9.54h	9.51h	9.74gh
24 (P_2)	11.35c	9.55ef	10.02de	11.13c	12.34c	10.18f-h	10.34e-g	10.79d-f
36 (P_3)	12.68ab	10.25de	10.12de	11.33c	13.07b	10.56d-f	10.72d-f	10.94de
48 (P_4)	13.13a	10.28de	10.16de	12.12b	13.85a	10.59d-f	10.47d-f	11.93c

The soil chemical analysis provides the phosphorus deficiency of soil resulting in high response of rice varieties and confirming the necessity of phosphorus fertilization. Zayed *et al*. (2010) and Zayed (2012) came to identical findings under saline sodic soil with varying rice varieties. It was observed that the lowest values of grain yield were produced with P_0 (without P) with Sakha 102 variety. This may be due to low soil phosphorus conditions that would delay root growth and ultimately crop establishment.

Table 9: Straw yield t. ha^{-1} as affected by the interaction between rice varieties and different levels of phosphorus in 2014 season.

Kg P_2O_5 ha^{-1}	Varieties			
	(V_1) EHR1	**(V2) Sakha102**	**(V3) Sakha106**	**(V4) Giza 179**
Zero (P_0).	11.39f-h	8.56k	9.92j	9.98j
12 (P_1)	11.91d-f	10.10j	10.59ij	10.99g-i
24 (P_2)	12.62cd	10.81h-i	11.05g-i	12.04d-f
36 (P_3)	13.59ab	11.49e-h	11.36f-h	12.20de
48 (P_4)	13.93a	11.67e-g	11.38f-h	13.20bc

Nitrogen and phosphorus uptake

The tested rice varieties markedly differed regarding N and P uptake in both seasons. Among all studied varieties EHR1 gave the highest values of nitrogen and phosphorus uptake followed by Giza179 (Table 10). It is important to notice that, all treatments increased phosphorus uptake compared to the control. This might be due to increasing the available phosphorus into the soil, which consequently increase phosphorus uptake by rice straw besides increasing the dry matter of this treatment as compared with unfertilized plot. These results are in agreement with those obtained by Naeem (2006). For nitrogen uptake, the highest value was observed in rice plants fertilized with 48 kg P_2O_5. ha^{-1} with no significant difference with rice plant fertilized with 36 kg P_2O_5. ha^{-1} in both seasons. Application of phosphorus at the rate of 48 kg P_2O_5. ha^{-1} gave the maximum value of phosphorus uptake in the couple seasons. In the second season the phosphorus levels of 24, 36 and 48 Kg P_2O_5 ha^{-1} were at a pair to N uptake. Similar results were developed by Zayed *et al* (2010).

Table 10: Nitrogen uptake and phosphorus uptake as affected by rice varieties and different levels of phosphorus in 2014 and 2015 seasons.

Treatments	N uptake		P uptake	
	2014	**2015**	**2014**	**2015**
Varieties:				
EHR1 (V_1)	14.79a	16.11a	2.880a	2.831a
Sakha102 (V_2)	10.75c	12.10c	1.835c	2.111c
Sakha106 (V_3)	11.03c	12.68c	2.027b	2.180bc
Giza179 (V_4)	13.43b	13.45b	2.793a	2.410b
Kg P_2O_5 ha^{-1}:				
Zero (P_0).	9.58d	10.65c	1.808e	1.817c
12 (P_1)	11.45c	12.47b	2.145d	1.913c
24 (P_2)	12.95b	14.93a	2.451c	2.465b
36 (P_3)	14.04a	14.82a	2.679b	2.659b
48 (P_4)	14.48 a	15.06a	2.834a	3.060a
Interaction	**	NS	**	**

The interaction effect between varieties and phosphorus exerted significant influence on the nitrogen uptake in the first season and phosphorus uptake in the two seasons (Tables 11 and 12). Combination of V_1P_4 gave the highest value of nitrogen and phosphorus uptake which was statistically at par with V_1P_3 and V_4P_4. The application of nitrogen with phosphorus have resulted an increased availability of nitrogen and phosphors in soil and also increased cation exchange capacity of roots which enhanced nitrogen and phosphorus absorption in plants, thus there was increased concentration of these nutrients in grain. Pandey and Aggarwal (1991) had the same opinion.

Table 11: Nitrogen uptake as affected by the interaction between rice varieties and different levels of phosphorus in 2014 season.

Kg P2O5 ha^{-1}	Varieties			
	(V1) EHR1	**(V2) Sakha102**	**(V3) Sakha106**	**(V4) Giza 179**
Zero (P0).	11.78ef	7.77 h	8.73h	10.04g
12 (P1)	13.63cd	9.99g	10.07g	12.13ef
24 (P2)	14.87b	10.97fg	11.83ef	14.14bc
36 (P3)	16.71a	12.47de	12.17ef	14.81b
48 (P4)	16.98a	12.54de	12.36e	16.04a

Table 12: Phosphorus uptake as affected by the interaction between rice varieties and different levels of phosphorus in 2013 and 2014 seasons.

Kg P_2O_5 ha^{-1}	Varieties							
	(V_1) EHR1	(V2) Sakha102	(V3) Sakha106	(V4) Giza 179	(V_1) EHR1	(V2) Sakha102	(V3) Sakha106	(V4) Giza 179
	2014				2015			
Zero (P_0).	2.14ef	1.23i	1.73gh	2.13ef	1.98e-g	1.48g	1.97e-g	1.82fg
12 (P_1)	2.56d	1.64h	1.79gh	2.59d	2.31d-f	1.78fg	1.78fg	1.78fg
24 (P_2)	2.7d	1.94fg	2.14ef	3.01c	2.68cd	2.00e-g	2.70cd	2.48de
36 (P_3)	3.43ab	2.12ef	2.18ef	3.00c	3.39ab	2.49de	1.97e-g	2.78cd
48 (P_4)	3.54a	2.26e	2.30e	3.23bc	3.79a	2.79cd	2.48de	3.18bc

CONCLUSION

Phosphorus application played a significant role in enhancing the yield and yield components of rice cultivars under clayey alkaline soil and cereals crops such as wheat and barley especially with HER1 and GZ 179. From the results of the present field experiments, it can be concluded that among all the four cultivars, Egyptian hybrid rice 1 was found best as it gave significantly highest grain yield that help for increase the net income so, we can say optimum level of phosphorus not only gave significantly higher grain yield but also fetched additional income. Briefly the high yielding rice varieties, EHR1 and Giza179 responded to phosphorus fertilizer up to 48 Kg P_2O_5 ha^{-1}. The medium yielding varieties significantly responded to phosphorus fertilization up to 36 kg P2O5 ha^{-1}.

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الأحتياجات السمادية للأرز من السماد الفوسفاتى تحت ظروف الأراضى القلوية الطينية

السيد سعد نعيم ، تامر فاروق متولى ، إبراهيم محمد هاشم و طاهر محمد عبدالمجيد.
قسم بحوث الأرز، معهد بحوث المحاصيل الحقلية، مركز البحوث الزراعية.

يعتبر الفوسفور من العناصر الضرورية التى تلعب دور هاماً فى النبات حيث يعتبر واحد من اهم المكونات التى تدخل فى تكوين الأحماض النووية لذلك فهو يلعب دور حيوى فى إنتاجية النبات وبالأخص إنتاج الحبوب. فهناك العديد من العوامل التى تسهم فى نقص الفوسفور لمحصول الأرز مثل التكثيف المحصولى والأصناف المستهلكة للفوسفور بشكل عالى وقلوية التربة. أقيمت تجربتان حقليتان خلال موسمى صيفى ٢٠١٤ و ٢٠١٥ بمزرعه مركز االبحوث والتدريب فى الأرز- كفرالشيخ. وكانت التربه طيينية قلويه ومنخفضة فى الماده العضوية ونسبة الفوسفور الميسر وذلك لدراسة تأثير أستخدام مستويات مختلفة من الفوسفور على محصول الأرز ومكوناتة وتم إستخدام أربعه أصناف وهم كالآتى: صنف هجين مصرى ١، سخا ١٠٢ ، سخا ١٠٦ وجيزه ١٧٩ كم ا تم إستخدام خمسة معاملات سماد السوبر فوسفات الأحادى (١٥% خامس أكسيد الفوسفور) وهى كالآتى صفر، 12، 24، 36، 48 كجم/ هكتار خامس أكسيد الفوسفور، إستخدم تصميم القطاعات المنشقه مع اربع مكررات. تم تقدير بعض صفات النمو عند مرحلة طرد السنابل وتقدير المحصول ومكوناتة كما تم تقدير النيتروجين والفوسفور الممتص. فقد إختلفت الأصناف تحت الدراسة فى المحصول ومكونات المحصول وكذلك النيتروجين والفوسفور الممتص حيث تفوق الصنف هجين مصرى واحد كل الأصناف تحت الدراسة فى الصفات الخضرية والمحصول ومعظم مكونات المحصول تحت الدراسة.

فقد إختلفت الأصناف تحت الدراسة معنوياً مع إضافة التسميد الفوسفاتى. فالنباتات النامية بدون أى إضافة السماد الفوسفاتى أعطت أقل محصول. والمستوى العالى من التسميد الفوسفاتى أعطى أعلى محصول. وكان هناك تفاعل معنوى بين الأصناف المستخدمة والمستويات المختلفة من السماد الفوسفاتى على المحصول ومكوناتة. فقد وجد اعلى محصول مع الصنف هجين مصرى واحد عند معدل ٤٨ كجم خامس أكسيد الفوسفور. نستنتج من ذلك الأصناف عالية المحصول مثل هجين مصرى واحد وجيزة ١٧٩ تستجيب حتى ٤٨ كجم خامس أكسيد الفوسفور فى حين نجد الأصناف ذات محصول متوسط مثل سخا ١٠٢ وسخا ١٠٦ تستجيب حتى ٣٠ كجم خامس أكسيد الفوسفور، لذلك فإن إضافة الفوسفور لمحصول الأرز بعد زراعة محصول سابق مستهلك للفوسفور وتربة ذات درجة حموضة عالية مهم للحصول على محصول عالى من الأرز.