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RESPONSE OF DIFFERENT RICE VARIETIES TO PHOSPHOROUS FERTILIZER UNDER NEWLY RECLAIMED SALINE SOILS

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ABSTRACT

For optimizing rice grain yield under saline conditions; the current trail has been performed during 2009 and 2010 seasons at El-Sirw Agriculture Research Station, Damietta province, Egypt. The main objective of this attempt is to find out the response of six different rice varieties namely, Sakha101, Sakha102, Sakha104, Giza177, Giza 178 and Egyptian hybrid one (Sk2034H) to various phosphorous rates i.e. 0, 30, 60 and 90 kg P_2O_5 ha^{-1} under newly reclaimed saline soil. The experiments were performed in a split plot design with four replications where, rice varieties were arranged in the main plots and phosphorous rates were occupied the sub plots. The salinity levels of the experimental site were 8.0 and 7.50 dSm-1in 2009 and 2010 seasons, respectively with clay soil texture. Growth parameters, nitrogen and phosphorous leaf contents at heading as well as grain yield and yield attributing characteristics were measured at harvest.

The obtained results could be summarized as following, the tested rice varieties were significantly differed in their salt tolerance and in their response to phosphorous rates under saline conditions. Giza 178 and SK2034H hybrid one were the most salt tolerant varieties.

Phosphorous application significantly improved rice growth parameters (dry matter, LAI and chlorophyll content). Nitrogen and phosphorous leaf content were significantly increased by increasing phosphorous rates up to 90 kg P_2O_5 ha^{-1}. Phosphorous application was found to be effective in enhancing rice grain yield and all yield attributing characteristics. Grain yield respond to P application up to 90 kg P_2O_5 ha^{-1}, while most of yield component up to 60 kg P_2O_5 ha^{-1}

Interestingly, the high yielding rice varieties in the terms of Giza 178 and Sk2034H significantly responded to application of phosphorous up to 90 kg P_2O_5 ha^{-1}. In addition, the rest rice varieties were significantly responded to phosphorous application up to 60 kg P_2O_5 ha^{-1}.

So, in case of newly reclaimed saline soil conditions, it could be recommended to grow Giza 178 and Egyptian hybrid one rice varieties under the same conditions with adding 90 kg P_2O_5 ha^{-1}.

Keywords: Rice, Phosphorous, saline soil

INTRODUCTION

Salinity is major noxious environmental factor that poses a major threat to crop productivity mainly in arid and semi-arid regions of the world (Munns, 2005). Soil salinity causes adverse effects on different physiological processes which are responsible for reduction of growth of plants (Ashraf, 2004 and Munns *et al*., 2006).

So, increasing salt tolerance of crops is necessary to sustain food production in different saline regions (Pitman and Lauchli, 2002). Among cereal crops, rice is a major source of food after wheat for more than 2.7 billion people on a daily basis. It is planted on about one-tenth of the earth's arable land and is the single largest source of food energy to half of humanity. About 130 million hectares of land where rice is grown and about 30 % contain levels of salt too high to allow normal rice yield (Mishra, 2004). According to Qayyum and Malik (1988) the reduction in yields of rice, wheat, cotton and sugarcane cultivated on such moderately salt-affected soils were 68, 64, 59 and 62 %, respectively. Crop performance may adversely be affected by salinity induced nutritional imbalances (Hu and Schmidhalter, 2005)

Rice occupies a conspicuous position in the predominately agricultural economy of Egypt thus attention is required to improve its grain yield and quality. Zayed *et al.* (2006) recorded varietal difference in growth, grain yield and its components under saline soil conditions. Gautam (2004) reported that significantly better growth performance of hybrids than conventional varieties, particularly in LAI, dry mater (at heading and grain filling) plant height and panicle length. In addition, Gautam (2004) and Abou Khalifa (2005) emphasized superiority of rice hybrid over inbred ones in panicles number plant^{-1}, filled grains/panicle, fertility percentage, panicle weight, 1000-grain weight, harvest index as well as straw and grain yields. On the other hand, Zayed *et al*. (2007) and Alam *et al.* (2009) recognized variation between inbred rice and hybrid varieties regarding growth, grain yields and its attributing characteristics under normal and saline soils.

Most of the applied phosphorus (P) becomes unavailable to growing plants due to alkaline in the northern parts of Egypt. The low availability of P is caused by its fixation on colloidal complex or formation of insoluble compounds as carbonate, appetite, hydroxyl appetite and flour appetite. The efficient use of phosphate fertilizers depends on the crop requirements, rate, time of application and placement methods. Phosphorus after its absorption interacts in a complex manner with Zn, Mn, Fe and Cu affecting their mobility and translocation in the plant system (Warnock, 1970).

Supplementary phosphorus has a role in alleviation of the adverse effects of high salinity on whole plant biomass for a variety of crop plants (Kaya *et al*., 2003). Wilson *et al*. (1999) stated that phosphorous uptake and content was decreased as pH value increased beyond 7 and phosphorous application significantly increased rice grain yield and P tissue content. Panda *et al.* (1995) and Heluf and Seyoum (2006) reported that increased dry matter production including grain yield and yield attributing characters of rice (number of panicles per m^2, number of spikeletspanicle^{-1}, panicle length, dry matter accumulation, plant height and straw yield) due to P uptake in response to external supply P fertilizers.

Ali and Ansari (2006) indicated that under high sodicity, increasing phosphorous levels significantly increased dry mater, LAI, chlorophyll content, panicles number, filled grains, panicle weight grain and straw yields as result of increasing rice salt tolerance and reducing Na uptake. Shah (2002) and Ehsan *et al.* (2009) reported that grain yield and its attributing characters were significantly increased by phosphorous application and rice varieties significantly varied in their response to phosphorous fertilizer. Alam *et al*. (2009) reported that rice growth parameters, grain yield, straw yield and harvest index as well as yield attributing characteristics significantly increased by phosphorous application up to 72 kg P_2O_5 ha^{-1}, and beyond this level these traits started to decrease. Also, they reported that a significant interaction between rice varieties involving inbreed and hybrid ones and phosphorous rates regarding grain yield and most of its attributing characteristics.

The main objective of this attempt is to find out the response of six contrasting rice varieties (Sakha101, Sakha102, Sakha104, Giza177, Giza 178 and Egyptian hybrid one) to various phosphorous rates (0, 30, 60 and 90 kg P2O5 ha-1) under newly reclaimed saline soil conditions.

MATERIALS AND METHODS

The field experiments were conducted during 2009 and 2010 rice seasons at the Research Farm of El–Sirw Agricultural Research Station, Damietta, Agricultural Research Center (ARC), Egypt. The treatments comprised the response of Sakha101, Sakha102, Sakha104, Giza177, Giza 178 and Egyptian hybrid one (Sk2034H) to four Phosphorous rates namely: 0, 30, 60, and 90 Kg P_2O_5 ha^{-1}. The experimental soil was clay and the chemical analysis is presented in Table (1).

Table (1): Soil chemical analysis of experimental sites.

Season	ECe (dS m^{-1})	pH	Na^{+1}	Ca^{+2} + Mg^{+2}	K^{+1}	HCo^{-}	Cl	So_4^{-2}	N (%)	Available ppm	
			meg l^{-1}							P	K
2009	8.0	8.40	48	31	0.32	8.0	43	23.5	0.028	12	250
2010	7.5	8.25	45	29	0.31	6.7	33	25.6	0.026	11	240

The experiment was laid out in split plot design, with four replications, keeping rice varieties in the main plots and phosphorous levels in the sub-plots. Seedling (30 days old) of rice varieties were transplanted in 20 x 20 cm with three seedlings $hill^{-1}$ on May, 30. Whereas, the sowing was done on April, 30. Nitrogen fertilizer were imposed in 4 equal doses at 15 days after transplanting (DAT), mid-tillering, panicle initiation and late booting stages associated with each variety as recommended under saline soil. All plots were given 57 kg K_2O ha^{-1} as basal application. Phosphorous was applied according to the treatments as basal application during land preparation. The plot area was 10 m^2 (5 x 2 m).

At 50% heading, ten hills from each sub plot were taken to estimate the dry mater and leaf area index (LAI). Chlorophyll content was recorded using chlorophyll meter 5 SPAD-502 Minolta Camera Co. Ltd., Japan. The days from sowing to heading was also estimated. Dried rice leaves of sub-plot were analyzed for Kjeldahls to assessment of N content in leaf. Phosphorus content in leaves was also measured according to Yoshida *et al.* (1976).

At harvest, plant height was estimated and total number of panicles of ten hills for each plot was counted to determine the panicles number m^{-2}. Ten main panicles from each sub-plot were packed to the laboratory to determine panicle length (cm), number of filled and unfilled grains panicle $^{-1}$, panicle weight and 1000-grain weight. The plants of the six inner rows of each sub-plot were harvested, dried, threshed and then grains and biological yields were determined and adjusted to 14 % moisture content as well as converted into t $ha^{-1.}$

The data of each season were imposed to the statistical analysis of variance and differences among treatments means of the studied traits were judged by LSD at P ≤ 0.05% level of significance according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

1- Growth parameters:

Data in Table 2 showed that varietal differences detected in the growth of the tested rice varieties involving hybrid and inbred ones in both seasons.

Table 2: Dry matter, LAI and chlorophyll content (SPAD value) of rice varieties as affected by P rate during 2009 and 2010 seasons.

traits Treatment	Dry matter (m^{-2})		LAI		Chlorophyll content		Days to heading	
	2009	2010	2009	2010	2009	2010	2009	2010
Varieties (V):								
Sakha 101	591.25	585.92	٤,17	٣,٤٩	٤٣,١٢	٤٣,٢2	١٠٨,٩	١٠٩,٠
Sakha 102	539.9٢	540.83	٣,٣3	٣,٢8	٤٠,٩1	٣٩,٧٣	٩٣,6	٩١,١
Sakha 104	616.2٦	619.74	٤,١2	٣,٩2	٤٠,٨2	٤١,٠2	١٠٣,٢	١٠٢,٦
Giza 177	510.89	513.24	٢,٧٨	٢,٦٩	٤٠,٩4	٤١,٤6	93.3	٩٢,٦
Giza 178	800.39	792.03	٤,٨٢	٤,90	٤٥,٩٩	٤٤,7٢	٩٩,٠	٩٩,٩
SK2034H	843.9٦	910.71	٥,٣3	٥,54	٤٤,٠٢	٤4.6٦	٩٩,٧	١٠٠,٩
LSD 0.*05*	١٩,٩٦	١٩,١٩	٠,٢٥	٠,٣3	١,19	١,٤٧	١,٤	٢,٢
P Kg P_2O_5 ha^{-1} (P):								
0	579.57	٥٨٢,٢4	٣,٣٨	٣,١8	٤١,٢7	٤٠,٧٧	١٠٠,١	١٠٠,٠
30	623.19	٦٣٢,٦3	٣,٩٤	٣,٧8	٤٢,٠6	٤١,60	٩٩,٢	٩٩,4
60	671.00	٦٩١,٢7	٤,4٥	٤,36	٤٣,٣٩	٤٣,70	٩٩,٤	٩٩,٣
90	727.9٩	٧٣٥,٥2	٤,6٩	٤,57	٤٣,٨٢	٤٣,79	٩٩,٢	٩٨,٧
LSD 0.05	16.33	١١,٦4	٠,24	٠,٣0	٠,٥7	١,50	٠,٧	٠,٧
Interaction V x P	NS	**	**	**	**	**	NS	NS

**** = highly significant at 0.01 levels and NS= not significant**

It seems that Sk2034H surpassed the other investigated varieties regarding dry matter production and leaf area index (LAI) while, Giza 178 (elite salt tolerant rice variety) came in the second order followed by Sakha 104. Giza 177 followed by Sakha 102 (salt sensitive variety) had the minimum values of dry mater and LAI. Sakha 101 and Sakha 104 could be considered as intermediate salt tolerant varieties, while, Sakha 102 and Giza 177 more sensitive, however, SK2034H and Giza 178 more salt tolerant ones. The tested rice varieties significantly differed in their chlorophyll content (Table 2). Giza 178 gave the highest values of chlorophyll without any significant differences with those produced by hybrid variety (SK2034H).

On the other hand, Sakha102 gave the minimum value of chlorophyll content without any significant differences with those recorded by both Giza 177 and Sakha 104 in both seasons. High dry matter production of SK2034H hybrid rice variety with largest leaf area and high chlorophyll content might be mainly contributed its high heterosis and its affinity for salt tolerance and that was fact with rice inbred variety of Giza 178. On the other side, Giza 177 and Sakha 102 behaved badly under saline soil because their salt sensitivity and produced low dry matter production ,low LAI and low leaf chlorophyll content. The last reason might be reducing photosynthesis giving low dry matter formation in salt sensitive varieties (Giza 177 and Sakha102). On the other hand, SK2034H and Giza 178 were keeping high chlorophyll content in their tissue providing high photosynthesis under saline soil leading to high dry matter production with optimum LAI. High seedling vigor and good growth with optimum dry matter and LAI are associated with salt tolerance and higher grain yield for hybrid or inbred variety under saline soil. Concerning days to heading, as shown in Table 2 the investigated rice varieties significantly varied in their days to heading in both seasons. Sakha 101 recorded the longest period up to heading followed by Sakha 104 without any significant differences in aforementioned characters. Meanwhile, Sakha102 showed the shortest period followed by Giza177 without any significant differences between each other, while, Giza 178 and hybrid one ranked between in this aspect. Similar data have been reported by Gautam (2004), Abou Khalifa (2005), Zayed *et al*. (2006) and Zayed *et a.l* (2007).

Phosphorous treatments significantly influenced the growth parameters (dry matter, LAI and chlorophyll content) of rice in both seasons (Table 2). Dry matter production m^{-2} significantly increased as phosphorous application increased up to 90 kg P_2O_5 ha^{-1} and there was a progressive improvement on growth of rice. Interestingly, LAI and chlorophyll content were gradually increased by increasing phosphorous levels up to 90 kg P_2O_5 ha^{-1} without any significant differences with those produced by 60 kg P_2O_5 ha^{-1}. On the other side, the control treatment (none of P application) gave the lowest values of abovementioned traits. This could be attributed to low available of P status of soil and ion imbalance under saline soil. Furthermore, P application could ameliorate the undesirable effect of salts where, it encourage extensive root growth, large leaf area, more dry matter production and considerable net photosynthesis. The data in Table 2 observed that increasing P level up to 90 kg ha^{-1} significantly accelerated heading. The period needed to heading was significantly decreased by increasing P levels compared to control treatment, where, application P fertilizer shortened the vegetative growth period. Similar findings were reported by Ali and Ansari (2006) and Alam *et al*. (2009).

The interaction between rice varieties and P rates had significant effect on dry matter production during first season, however, LAI and chlorophyll content were affected significantly in both seasons (Table 3). With respect to dry matter production, data showed that both Sakha 104 and SK2034H significantly responded to P application up to 90 kg P_2O_5 ha^{-1} while, the rest of tested varieties were significantly responded to 60 kg P_2O_5 ha^{-1}. By the way, the combination of SK2034H and 90 kg P_2O_5 ha^{-1} gave the highest values of dry matter, while the combination of Giza 177 and 0 kg P_2O_5 ha^{-1} gave the lowest dry matter production. As for LAI, in both seasons, only SK2034H significantly responded to P application up to 90 kg P_2O_5 ha^{-1}, while, the rest varieties significantly responded to 60 kg P_2O_5 ha^{-1}. LAI of Giza 177 started to decreased beyond the level of 60 kg P_2O_5 ha^{-1} that was due to its sensitivity for both salt and zinc deficiency in which increasing P rate up to 90 kg P_2O_5 ha^{-1} might be induced more zinc unavailability under such conditions because the antagonism phenomena between P and Zn. In both seasons, chlorophyll content had the same trend of LAI under. Little reduction in chlorophyll content in Giza 177 and Sakha104 with 90 kg P_2O_5 ha^{-1} rather than obtained by 60 kg P_2O_5 ha^1. Generally, the best combination was obtained when SK2034H received 90 kg P_2O_5 ha^{-1} and the worst one was Giza 177 with 0 kg P_2O_5 ha^{-1}. Alam *et al.*(2009) came to similar results.

Table 3: Dry matter, LAI and chlorophyll content (SPAD value) as influenced by the interaction between rice varieties and P rate during 2009 and 2010 seasons.

Varieties		P rates Kg P_2O_5 ha^{-1}			
		٠	٣٠	60	٩٠
Dry matter (m^{-2}) 2010	Sakha101	٥٢٧,٠٠	٥٧٣,٣٣	٦١٠,٠٠	٦٣٣,٣٣
	Sakha102	٤٨٠,٠	٥١٥,٠٠	٥٦٥,٠٠	٦٠٣,٣٣
	Sakha104	٥٦٤,٩٧	٥٨٦,٢٦	٦٢٨,٣٣	٦٩٩,٤٠
	Giza177	٤٥٦,٩٦	٥٠٢,٢٠	٥٤٥,٢٩	٥٤٨,٥٠
	Giza178	٦٩٩,٠٠	٧٥٠,٧٣	٨٤٩,٢٠	٨٦٩,٢٠
	SK2034H	٧٦٥,٥٠	٨٦٨,٢٣	٩٤٩,٧٧	١٠٥٩,٣٥
	LSD 0.05	٢٧,٨٤			

Varieties		2009				2010			
		٠	٣٠	60	٩٠	٠	٣٠	60	٩٠
LAI	Sakha101	3.27	4.16	4.43	4.80	2.86	3.30	3.73	4.06
	Sakha102	2.70	3.10	3.60	3.90	2.70	3.10	3.50	3.70
	Sakha104	3.46	4.06	5.39	5.40	2.93	3.90	4.36	4.48
	Giza177	2.40	2.73	3.14	2.83	2.30	2.70	3.16	2.80
	Giza178	3.97	4.43	5.39	5.46	3.90	4.35	5.66	5.83
	SK2034H	4.43	5.11	5.60	6.16	4.36	5.23	6.06	6.50
	LSD 0.05	0.34				0.44			
Chlorophyll content	Sakha101	42.23	42.83	43.73	43.68	42.46	43.00	43.93	43.46
	Sakha102	39.76	40.73	41.80	41.33	38.53	39.13	40.73	40.53
	Sakha104	39.96	41.00	41.44	40.86	39.80	41.23	42.00	41.03
	Giza177	39.02	39.80	42.85	42.07	39.73	40.26	43.30	42.53
	Giza178	44.80	45.10	46.55	47.53	41.51	42.03	46.95	47.99
	SK2034H	41.80	42.78	44.08	47.43	42.56	43.96	45.30	47.23
	LSD 0.05	1.39				1.67			

2- N and P leaf contents at heading:

Data listed in Table 4 revealed that the tested rice varieties had significant variation in their N and P contents in both seasons of study. SK2034H showed its significant superiority and gave the highest values of N and P contents followed by Sakha 104 for N leaf content and Giza 178 for P leaf content at heading. The lowest values of N and P leaf contents were recorded by Giza 177 followed by Sakha 102. Sakha 101 intermediated both sensitive varieties and salt tolerant ones. The results confirmed that salt tolerant varieties (Giza 178) and hybrid one (SK2034H) with high heterosis behaved better regarding its ability to uptake more N and P under stress conditions rather than sensitive ones (Giza 177 and Sakha 102). Zayed *et al*. (2006), Zayed *et al*. (2007) and Alam *et al.* (2009) indicated similar results.

Table 4: Leaf N and P (%) of rice varieties as affected by P rate during 2009 and 2010 seasons.

Traits	N (%)		P (%)	
Treatment	2009	2010	2009	2010
Varieties				
Sakha 101	٢,٥٣	٢,52	٠,١٧٤	٠,١٨٣
Sakha 102	٢,٣٧	٢,4٣	٠,١٦٢	٠,١٧٧
Sakha 104	٢,٦٦	٢,٨0	٠,١٧٤	٠,١٧٠
Giza 177	٢,٣٢	٢,٤1	٠,١٥٦	٠,١٧٤
Giza 178	٢,٦١	٢,٧٤	٠,١٩٠	٠,١٩١
SK2034H	٢,79	٢,94	٠,٢٢٠	٠,٢٢٩
LSD0.05	٠,١2	٠,٠٨	٠,٠٢٠	٠,٠٠٦
P Kg P_2O_5 ha^{-1} (P):				
0	٢,٣١	٢,٣6	٠,١٣٨	٠,١٤٣
30	٢,٥١	٢,٥٧	٠,١٧١	٠,١٧٦
60	٢,٥8	٢,71	٠,١٩٣	٠,٢٠٢
90	٢,٧٨	٢,٨9	٠,٢١٦	٠,٢٢٨
LSD.0.05	٠,٠٦	٠,٠٩	٠,٠١١	٠,٠٠٦
Interaction V x P	**	**	**	**

**** = highly significant at 0.01 levels and NS= not significant**

For P application effect on N and P leaf content, it was found that increasing P rate up to 90 kg P_2O_5 ha^{-1} significantly boosted up N and P leaf contents (Table 4). The highest values of both N and P leaf contents at heading were significant exhibited by 90 kg P_2O_5 ha^{-1}, in both seasons. On contrary, none of P application gave the lowest values of N and P leaf contents. It was obviously that P application improved nutrients availability including P and N elements. Calcium super phosphate, as source for P, under current trail contain 40 % gypsum that might improved chemical and physical soil prosperities resulting in reducing Na^{+1}, pH and increasing nutrient availability. In addition, P application might be suppressed Cl^{-1} uptake and minimized its toxicity. The current results had same similarity with those reported by Wilson *et al*. (1999), Ali and Ansari (2006) and Alam *et a.l*. (2009).

The interaction between studied factors had significant effect on N and P leaf contents in both seasons (Table 5). Nitrogen and P leaf contents of all tested varieties were significantly responded to P application up to 90 kg P_2O_5 ha^{-1}. The best combination was obtained by SK2034H with 90 kg P_2O_5

ha^{-1}. However, the lowest values were obtained by Giza 177 with zero kg P_2O_5 ha^{-1}. The results are in conformity with the findings of (Alam *et al.*, 2009).

Table (5): Nitrogen and P leaf content as influenced by the interaction between rice varieties and P rate during 2009 and 2010 seasons.

Varieties		2009				2010			
		P rates Kg P_2O_5 ha^{-1}							
		٠	٣٠	60	٩٠	٠	٣٠	60	٩٠
N (%)	Sakha101	2.40	2.57	2.44	2.71	2.10	2.33	2.50	2.71
	Sakha102	2.06	2.31	2.40	2.68	2.35	2.55	2.75	2.81
	Sakha104	2.46	2.63	2.74	2.80	2.45	2.59	2.81	2.85
	Giza177	1.96	2.29	2.37	2.46	2.08	2.41	2.48	2.69
	Giza178	2.32	2.59	2.69	2.83	2.44	2.71	2.81	2.98
	SK2034H	2.46	2.66	2.80	3.00	2.76	2.80	2.93	3.26
	LSD0.05	0.16				0.19			
P (%)	Sakha101	0.116	0.155	0.206	0.220	0.125	0.212	0.212	0.218
	Sakha102	0.129	0.164	0.177	0.180	0.131	0.206	0.206	0.214
	Sakha104	0.134	0.171	0.185	0.208	0.125	0.172	0.179	0.206
	Giza177	0.890	0.151	0.174	0.212	0.124	0.159	0.200	0.213
	Giza178	0.165	0.179	0.195	0.220	0.166	0.181	0.196	0.221
	SK2034H	0.194	0.207	0.221	0.259	0.185	0.211	0.222	0.300
	LSD0.05	0.023				0.027			

3- Grain yield and its attributing characteristics:

Data documented in Table 6 clarified that the tested varieties greatly varied in their grain yield and its attributing traits i.e. plant height, panicle numbers, panicle length, number of filled grains, unfilled grains panicle $^{-1}$ and 1000–grain weight in both seasons. The shortest plants were produced by Giaz177, meanwhile, the tallest plants were recorded by Sakha104 followed by SK2034H without any significant differences between each other. The hybrid variety Sk2034H showed its superiority over inbred ones and gave the highest values of panicles number $hill^{-1}$, panicle length, and number of filled grains $panicle^{-1}$. However, Giza 177 gave the highest unfilled grains followed by Sakha 102, while Giza 178 recorded the lowest values of unfilled grains that prove its relevance to saline soil. Moreover, Giza 178 gave the lowest values of 1000- grain weight because high number of filled grains $panicle^{-1}$. In both seasons, the lowest values of panicle numbers $hill^{-1}$ were produced by Giza 177 followed by Sakha102. In 2010 season, Sakha 102 and Giza 177and Giza 178, Sakha104 and Sakah101 in 2009 season were comparable regarding panicles number. The longest panicle was recorded by SK2034H followed by Giza 178, while, the shortest one was recorded by Sakha 102 and Giza 177 in both seasons.

The tested varieties significantly showed big variation in their filled grain $panicle^{-1}$, where SK2034H (hybrid) recorded the maximum values followed by Giza 178 (inbred). However, the minimum values of filled grains $panicle^{-1}$ were recorded by Giza 177. Furthermore, Sakah101 and Sakha 104 were at the same level of significance for filled grains $panicle^{-1}$, in the first season.

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The lowest values of unfilled grains panicle^{-1} were recorded by Giza178 followed by Saka104. While, Giza 177 gave the highest values of unfilled grains panicle^{-1} followed by Sakha102. Coming to the 1000- grain weight, Sakha102 exerted the heaviest 1000-grain weight while the lightest 1000-grain weight was produced by Giza 178.Couple rice varieties of Giaz177 and Sakha104 in first season and Giza 177 and Sakha101 in second season were at the same level of significance in their 1000–grain weight.

The tested rice varieties markedly varied in their grain and biological yields as well as harvest index in both seasons (Table 6). Sk2034H recorded higher heterosis in grain and biological yields over others inbred rice varieties under saline condition. However, SK2034H gave the maximum harvest index in the first season without any significant differences with Sakha 101 and Giza 178. Meanwhile, in the second season, Sakha102 and Giza 178 gave the same and the highest means of harvest index. Giza 177 gave the lowest values of grain and biological yields as well as harvest index in both seasons. Based on the current finding, Sk2034H hybrid variety and Giza178 inbred one confirm their salinity tolerance followed by Sakha104. this variation might be due to genetic makeup and high heterosis of hybrid rice. Similar results were obtained by Gautam (2004**)**, Abou Khalifa (2005), Zayed *et al*. (2006), Zayed *et al*. (2007), Alam *et al.* (2009) and Ehsan *et al*. (2009).

Regarding phosphorous levels impact, data in Table 6 showed that P treatments had significant and positive impact on grain yield and its attributes in both seasons except harvest index in 2009 season. Increasing P level up to 90 kg P_2O_5 ha^{-1} increased plant height, panicle numbers hill^{-1}, panicle length, filled grains panicle^{-1}, and 1000 -grain weight without any significant differences with 60 kg P_2O_5 ha^{-1} except 1000 grain weight. Generally, 90 kg P_2O_5 ha^{-1} recorded the highest means of all above-mentioned traits except filled grains in the first seasons which lightly reduced. In both seasons, zero phosphorous application recoded the lowest values of grain yield and yield attributes, while gave maximum value of unfilled grains.

There was a significant increase in grain yield with increasing phosphorous levels (Table 6). The response of grain yields to P levels was linear up to 90 kg P_2O_5 ha^{-1}. Subsequently, the highest values of grain and biological yields were produced by 90 kg P_2O_5 ha^{-1} and the lowest means were obtained by zero phosphorous. In first season, 60 kg P_2O_5 ha^{-1} failed to exert any significant increase of harvest index over zero P level, whereas the response was insignificant. In second season, harvest index was significantly responded to P up to 60 kg P_2O_5 ha^{-1} without any significant differences with 90 kg P_2O_5 ha^{-1}. The rate of 60 kg P_2O_5 ha^{-1} gave the highest means of harvest index, meanwhile the lowest value were produced by control treatment. The favorable effect of P might be owing to better N and P uptake and keeping optimum dry matter partitioning, enhanced synthesis of RNA and enhanced the efficiency of PSII photochemistry and ATP compound in rice plants resulted in high dry production content, high assimilates rate during pre and post heading (Saleque *et al*., 2002 and Yang and Sun., 1992 and Xu *et al*., 2007). In addition P fertilizer might the vigorous growth superficial roots, increased growth, photosynthesis and its partitioning as well as delaying leaf senescence under salt stress as increasing nitrogen leaf content leading to high yield componets. P supplementary might be alleviated the adverse effects of salinity on whole plant biomass for a variety of rice plants (Kaya *et al*., 2003). These findings are in a good accordance with those reported by Wilson *et al*. (1999), Shah, (2002), Ali and Ansari (2006) Ehsan *et al*., (2009) and Alam *et al* (2009).

The interaction between rice varieties and P levels had a significant effect on panicles number hill^{-1}, panicle length, filled grains panicle, unfilled grains panicle, and 1000-grain weight (Table 7) as well as grain and biological yields (Figs. 1 and 2). Regarding panicles number all cultivars significantly responded to P application up to 60 Kg P_2O_5 ha^{-1}, wherever, some cultivars showed little bed decrease in their panicles number under high P rate of 90 Kg P_2O_5 ha^{-1} as Giza 177. Sakha104 responded significantly only to 30 kg P_2O_5 ha^{-1}. The rates of 30, 60 and 90 Kg P_2O_5 ha^{-1} were at par regarding panicles number of Giza 178. The combination of Sk2034H and 90 kg P_2O_5 ha^{-1} gave the maximum values of panicles number hill^{-1} without any significant differences with those produced by the same variety under 60 kg P_2O_5 ha^{-1}.

The combination of Sk2034H and 90 kg P_2O_5 ha^{-1} gave the longest panicle in both seasons. Data in Table 7 showed that the combination of SK2034H and 90 kg P_2O_5 ha^{-1} gave the maximum means of filled grains panicle^{-1} without any significant differences with the same variety under 60 kg P_2O_5 ha^{-1} and Giza 178 under the same level of P in the second season. Most of rice cultivars except Giza 178 and SK2034H significantly responded to P application up to 60 kg P_2O_5 ha^{-1} regarding filled grains panicle$^{-1.}$ However, Giza 177 and Sakha102 showed some reduction under high rate of 90 kg P_2O_5 ha^{-1}. With respect to unfilled grains panicle^{-1}, the results clarified same trend of pervious mentioned traits. Continuously, the combination of SK2034H and 90 kg P_2O_5 ha^{-1} gave the lowest means of unfilled grains panicle^{-1} without any significant differences with the same variety under 60 kg P_2O_5 ha^{-1} and with Sakha101 and Sakha102 under the same level of P, in the second season. High P level was failed to decrease the number of filled grains with some rice cultivar whereas, the number of unfilled grains of Giza 177 started to decrease beyond the level of 60 kg P_2O_5 ha^{-1}. The lowest values of panicles number hill^{-1}, filled grains panicle^{-1} and the shortest panicle were obtained when Giza 177 was grown under zero phosphorous application. On the other hand, the same combinations (Giza 177 with zero P) gave the maximum unfilled grains panicle^{-1}. Results documented in Table 7 indicated that the combination of Sakha102 and 90 kg P_2O_5 ha^{-1} gave the heaviest 1000-grain weight without any significant differences with the same variety under 60 kg P_2O_5 ha^{-1}. While, the lightest 1000-grains weight was recorded when Giza 178 was received zero phosphorous. The results came to confirm the superiority of the P rate of 60 and 90 kgP_2O_5 ha^{-1} with most cultivar and most traits. The current results are in a good accordance with those reported by Alam *et al*. (2009).

The combination of Sk2034H and 90 kg P_2O_5 ha^{-1} gave the maximum values of grain and biological yields (Table8).The lowest values of grain and biological yields were obtained when Giza 177 was grown under none of P application. Most of tested cultivars significantly responded to P application up to 60 Kg P_2O_5 ha^{-1} regarding grain and biological yields, however, some cultivars showed decrease in their grain and biological yields such as Giza177 and Sakha 102 under 90 Kg P_2O_5 ha^{-1} in second season. These current findings are similar to those reported by Alam *et al*. (2009).

Table 7: Number of panicles, panicle length, number of filled grains panicle^{-1}, unfilled grains panicle^{-1} and 1000 grain weight as influenced by the interaction between rice varieties and P rate during 2009 and 2010 seasons.

Varieties		2009				2010			
		P rates Kg P_2O_5 ha^{-1}							
		٠	٣٠	60	٩٠	٠	٣٠	60	٩٠
Panicles number	Sakha101	12.43	13.66	14.66	15.00	12.76	13.96	15.16	15.40
	Sakha102	10.90	12.20	14.20	14.76	10.00	11.60	12.36	13.50
	Sakha104	13.23	14.10	15.16	15.13	12.90	14.86	15.30	15.23
	Giza177	9.69	12.43	13.60	13.10	9.78	10.81	11.53	10.90
	Giza178	14.53	14.66	15.81	16.23	13.33	14.53	15.30	15.46
	SK2034H	15.58	16.65	17.78	18.36	15.56	16.63	17.96	19.23
	LSD 0.05	1.20				1.50			
Panicle length(cm)	Sakha101	18.50	19.06	20.33	19.80	18.23	19.06	19.76	19.16
	Sakha102	17.73	18.13	19.34	19.43	17.83	18.83	19.56	19.30
	Sakha104	19.38	19.50	19.80	19.88	18.53	19.43	19.48	19.30
	Giza177	16.63	17.97	18.91	19.55	16.03	18.33	19.33	18.40
	Giza178	19.42	20.00	21.26	21.41	19.23	19.28	20.06	21.06
	SK2034H	19.75	20.96	22.46	23.57	19.38	20.55	21.16	23.00
	LSD 0.05	1.00				0.58			
No. of filled grains	Sakha101	113.0	122.0	132.3	134.6	116.7	126.0	133.7	134.7
	Sakha102	102.0	112.3	123.0	122.0	104.0	114.3	123.0	122.3
	Sakha104	120.2	125.9	129.6	124.6	106.7	115.5	125.2	125.4
	Giza177	86.4	92.0	108.8	99.6	78.9	84.4	94.8	91.9
	Giza178	123.1	130.7	133.5	135.8	129.4	136.9	152.3	155.2
	SK2034H	128.2	135.5	139.7	144.6	136.4	144.4	155.2	156.3
	LSD 0.05	3.2				4.3			
Unfilled grains panicle^{-1}	Sakha101	24.5	16.7	6.6	4.1	8.3	7.6	5.5	3.9
	Sakha102	21.6	16.9	8.6	9.9	12.0	10.0	7.0	5.0
	Sakha104	11.4	11.0	4.1	6.2	9.1	7.9	3.2	4.7
	Giza177	27.5	24.1	15.2	15.5	18.5	9.2	7.3	7.5
	Giza178	9.2	6.3	6.3	7.9	5.9	5.2	4.3	4.1
	SK2034H	15.0	12.4	7.5	7.0	12.3	7.0	4.7	3.6
	LSD 0.05	2.0				2.4			
1000 grain weight (g)	Sakha101	24.26	24.86	25.53	25.90	23.58	24.66	24.15	23.93
	Sakha102	25.13	25.56	26.60	26.63	24.26	24.86	25.20	25.63
	Sakha104	23.90	24.67	25.03	24.73	23.73	23.53	23.73	24.73
	Giza177	24.16	24.30	24.86	24.80	23.01	24.71	25.89	25.50
	Giza178	17.80	18.60	19.55	22.68	18.00	19.50	20.60	20.26
	SK2034H	22.06	22.32	23.10	23.30	19.73	21.09	21.46	22.48
	LSD 0.05	0.90				1.20			

Table8: Grain and biological yield t ha^{-1} of rice as affected by the interaction between rice varieties and P rate during 2009 and 2010 seasons

Varieties		2009				2010			
		P rates Kg P_2O_5 ha^{-1}							
		٠	٣٠	60	٩٠	٠	٣٠	60	٩٠
Grain yield	Sakha101	3.36	3.97	4.27	4.20	3.52	3.80	4.43	4.61
	Sakha102	2.88	3.31	3.52	3.19	3.37	4.13	4.50	4.32
	Sakha104	3.48	4.08	4.39	4.51	3.62	4.14	4.50	4.73
	Giza177	2.76	3.12	3.58	3.04	2.70	3.08	3.47	3.24
	Giza178	4.04	4.36	4.51	5.16	3.96	4.49	5.39	6.05
	SK2034H	4.66	5.08	5.47	6.00	4.39	4.68	5.69	6.70
	LSD0.05	0.44				0.36			
Biological yield	Sakha101	7.44	8.76	9.39	9.62	9.11	9.76	10.50	10.84
	Sakha102	6.5	7.48	8.47	8.68	7.99	9.30	9.58	10.80
	Sakha104	7.84	9.47	10.14	10.67	9.47	10.73	11.34	10.98
	Giza177	6.24	7.03	8.20	8.32	7.44	8.10	9.13	9.04
	Giza178	9.76	10.09	10.32	10.72	9.59	11.03	11.40	12.90
	SK2034H	10.52	10.99	11.76	12.48	12.17	12.86	13.50	13.90
	LSD0.05	0.53				0.72			

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استجابة أصناف متباينة من الأرز للتسميد الفوسفورى تحت ظروف الأراضي الملحية المستصلحة حديثا

بسيونى عبدالرازق زايد، إسماعيل سعد الرفاعى و صابر السيد محمد صديق
مركز البحوث والتدريب في الأرز-معهد بحوث المحاصيل الحقلية-مركز البحوث الزراعية

أجريت هذه الدراسة بمزرعة محطة بحوث السرو- دمياط- مصر إثناء موسمي ٢٠٠٩ و ٢٠١٠ لدراسة استجابة ستة أصناف من الأرز وهى سخا ١٠١، سخا ١٠٢، سخا ١٠٤ ،جيزة ١٧٧، جيزة ١٧٨ وهجين مصري واحد(SK2034H) لدراسة استجابة هذه الأصناف لأربعة معدلات مختلفة من السماد الفوسفورى وهى صفر، ٣٠، ٦٠ و ٩٠ كجم فو٢أ٥/هكتار تحت ظروف الاراضى الملحية المستصلحة حديثاً. استخدم تصميم القطاعات المنشقة مرة واحدة. في أربعة مكررات حيث احتوت القطع الرئيسية على أصناف الأرز و القطع الشقية على معدلات التسميد الفوسفورى. و كانت التربة طينية و مستوي الملوحة ٨,٠و ٧,٥ ديسسمنزم-١ في موسمي الدراسة، علي التوالي. تم قياس صفات النمو و محتوى النيتروجين والفوسفور في الورقة عند مرحلة التزهير و كذلك تم تقدير محصول الحبوب ومكوناته.

ويمكن تلخيص النتائج المتحصل عليها كما يلي: اختلفت الأصناف المدروسة معنويا في تحملها للملوحة و كذلك في استجابتها لمعدلات التسميد الفوسفورى، فقد استجابت الأصناف عالية المحصول مثل صنفي جيزة ١٧٨ وهجين مصري واحد معنويا لمعدلات الفوسفور حتى ٩٠ كجم فو٢أ٥/هكتار إما باقي الأصناف فقد استجابت معنويا للتسميد الفوسفورى حتى معدل ٦٠ كجم/هكتار فقط. و بصفة عامة، و تحت ظروف الدراسة أدت إضافة السماد الفوسفورى حتى معدل ٩٠ كجم فو٢أ٥/هكتار إلى التحسين المعنوي في صفات النمو و كذلك زيادة محتوى النتروجين و الفوسفور في الورقة، كما وجد أن إضافة السماد الفوسفورى له تأثير فعال في تحسين محصول الحبوب ومكوناته علي الرغم من وجود اختلافات في مدي استجابة الأصناف للتسميد الفسفوري.

لذلك توصى الدراسة و فئ نفس الظروف المماثلة بزراعة صنفي الأرز جيزة ١٧٨ وهجين مصري واحد في الأراضي الملحية المستصلحة حديثا و التسميد بـ ٩٠ كجم فو٢أ٥/هكتار.

قام بتحكيم البحث

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Table 6: Grain yield and its attributing characteristics of rice varieties as affected P rate during 2009 and 2010 seasons.

Treatment	Plant height (cm)		No. of panicles hill^{-1}		Panicle length (cm)		No. of filled grains		No. of unfilled		1000-grain (g)		Grain yield (t/ha)		Biological yield (t/ha)		HI	
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010
Varieties (V):																		
Sakha 101	٩١,٨	٨٥,٨	١٣,٩٤	١٤,٣3	19.4	19.1	١٢٥,٥	١٢٧,٨	١٣,٠	٦,٣٣	٢٥,٢	٢٤,٣	٣,٩٤	٤,٠٩	٨,٨١	١٠,١٤	٠,٤٥	٠,٤٠
Sakha 102	٩٥,١	٩١,٨	١٣,٠2	١1.90	18.3	18.9	١١٤,8	١١٥,٩	١٤,٣	٨,٥٠	٢٦,٠	٢٥,٠	٣,٢٣	٤,٠٨	٧,٧٩	٩,٤٨	٠,٤٢	٠,٤٣
Sakha 104	٩٩,٠	93.4	١٤,٤1	١٤,٥8	19.4	19.2	١٢5٢.	١١٨,٢	٨,٣	٦,١٩	٢٤,٦	٢٣,٩	4.12	4.25	٩,٥٣	١٠,٦٣	٠,٤٣	٠,٤٠
Giza 177	٩١,٣	٨٢,٤	١1.60	١١,26	18.3	17.8	٩٦,7	٨٧,٥	١٩,١	١2.1٣	٢٤,٥	٢٤,٨	٣,١٢	٣,١٣	7.45	8.43	٠,٤٢	٠,٣٧
Giza 178	٩٢,١	٨٤,٤	١٥,06	١٤,٨٤	20.5	19.9	١30.6	١٤٣,٤	٧,٤	٤,٨٦	١٩,٧	١٩,٥	4.52	4.98	١٠,٢٢	١1٢٤.	٠,٤٤	٠,٤4
SK2034H	٩٦,٦	٩٣,١	١٧,10	١٧,٣٥	21.7	21.0	١٣7٢.	١٤٨,١	١٠,٦	٦,٩١	٢٢,7	٢١,٢	٥,٣٠	5.38	11.44	13.08	٠,46	٠,٤١
LSD 0.05	١,٦	٤,٧	٠,٧٨	١,3٧	0.6	0.4	٢,١	٣,٤	١,٦	٠,٩٥٥	٠,٤	٠,٦	٠,١٩	٠,١١	٠,٤١	٠,77	٠,٠٣	٠,٠٢
P Kg P_2O_5 ha^{-1} (P):																		
0	٩٠,١	٨7.0	١٢,60	١2.97	18.6	18.2	112.2	١١٢,٠	١٨,2	١١,٠	٢٢,٩	٢٢,١	٣,٥٣	٣,٦٠	٨,٠٥	٩,٣١	٠,٤٤	٠,٣٩
30	٩٣,٧	٨8٨.	١٣,٩٥	١٣,٧4	19.2	19.3	١19.7	١٢٠,٣	١٤,٧	٧,٨	٢٣,3	٢٣,٢	٣,98	4.06	8.98	10.21	٠,٤4	٠,٤٠
60	٩٦,٤	9١,٤	١٥,٢1	١٤,٦١	20.4	19.7	١٢7.8	١٣٠,٧	٨,١	٥,٣	٢٤,1	٢٣,2	4.30	4.67	9.67	10.97	٠,٤5	٠,٤٣
90	٩٧,١	9١.١	١٥,٤٣	١٤,٩١	20.5	20.0	126.9	١٣١,٠	8.١	٤,٨	٢٤,7	24.0	٤,٥٦	٤,٩٤	٩,٩٦	١١,٥٤	٠,٤٦	٠,٤٣
LSD 0.05	١,٣	٢,١	٠,٤٩	٠,٧٦	0.4	0.2	١,٨	١,٩	٠,٨	١,٠	٠,4	٠,٥	٠,١٨	٠,20	٠,22	٠,53	NS	٠,٠٢
Interaction V x P	NS	NS	**	**	**	**	**	**	**	**	**	**	**	**	**	**	NS	NS

**** = highly significant at 0.01 levels and NS= not significant**