

Response of Some Peanut Genotypes to Phosphorus Fertilization Levels Under New Valley Conditions

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Abstract

A field experiment was conducted at Faculty of Agriculture Farm, Assiut University, New Valley branch during 2015 and 2016 summer season to study the response of five peanut genotypes to phosphorus fertilization levels. This experiment was laid out in a randomized complete block design (RCBD) in a split plot arrangement with three replications. Phosphorus levels (P) were distributed randomly on the main plot and peanut genotypes at sub plot. The obtained results show that peanut plants fertilized with 45 kg fed.⁻¹ P₂O₅ significantly gained the highest mean values of most studied traits in the two growing seasons. Furthermore, peanut genotypes had a significant effect on most studied traits in both seasons. Thus, L35 peanut genotype surpassed the others tested genotypes in most studied traits in both seasons. Moreover, the highest mean values of seed yield and oil yields were obtained from 45 kg fed.⁻¹ P₂O₅ and L35 peanut genotype surpassed all other genotypes in seed and oil yields in both seasons.

Keywords: Peanut Genotypes, Phosphorus Fertilization, New Valley Conditions

Introduction

Peanut (*Arachis hypogaea* L.) is one of the major sources of edible oil and the third most fundamental source of protein (Sorrensens *et al.*, 2004; Taru *et al.*, 2008). The cultivated area of peanut in Egypt during 2016 season was about 58000 ha with the total yield production of 190865 tons (FAO, 2016). Therefore, we need to improve peanut production, especially in desert areas, through new genotypes, sowing methods and organo-mineral fertilizers. Many investigators found significant variation between peanut genotypes in growth, yield, yield components and quality due to genetic variability and interaction with environmental conditions (Meena *et al.*, 2014; Mahrous *et al.*, 2015; Sarkees, 2015 and El-Far *et al.*, 2016).

Nutrient deficiency, especially phosphorus, has been reported as a major abiotic factor limiting groundnut production, especially in Africa where production is characterized by low fertilizer inputs (Bationo *et al.*, 2006; Vara Prasad *et al.*, 2009).

Phosphorus is one of the major essential nutrients for crop growth, yield and quality. There is a higher requirement for phosphorus in nodulating legumes compared to non-nodulating crops as it plays a significant role in nodule formation and fixation of nitrogen (Brady and Weil, 2002). Due to the important role played by P in the physiological processes of plants, adequate supply of P to soil deficient in this nutrient enhances groundnut yield and its income. Furthermore, phosphorus is an essential constituent of nucleic acids

and stimulates root growth as well as increase nodule activity in plant. Also, phosphorus is essentially required for healthy growth with efficient root system and profuse nodulation which, in turn can affect the N₂-fixation potential (Kwari, 2005). Deficiency of phosphorus due to in-availability of soluble phosphate in soil solution is considered as a limiting factor in plant nutrition (Uma and Sathiyavani, 2012). Phosphorus fertilization affected vegetative growth and biomass of groundnut as it is vital for the growth and yield (Kamara *et al.*, 2011a).

This investigation was conducted to study the response of some peanuts genotypes to different levels of phosphorus fertilization under New Valley Governorate conditions.

Materials and Methods

The investigation was conducted at Faculty of Agriculture

Farm, Assiut University, New Valley branch during 2015 and 2016 summer season to study the response of some peanut genotypes i.e., NC, L3, L10, L35 and L27R which introduced from America, Brazil, Malawi, China and Israel, respectively to phosphorus fertilization levels i.e., 15, 30 and 45 kg fed⁻¹. The previous peanut genotypes belong to semi-erect types. This experiment was carried out using randomized complete block design (RCBD) in a split plot arrangement with three replications. Phosphorus levels were distributed randomly on the main plot and peanut genotypes at sub plot. Sub plot included four rows, a single row was 3 m long and spaced 0.50 m apart with 0.25 m (plot size 6 m²). The physical and chemical analyses of soil field trials are presented in Table 1.

Table 1. Analysis of soil field experiment

pH	EC (ds m ⁻¹)	OM (g kg ⁻¹)	Nutrient content, mg kg ⁻¹						Particle size distribution			Textural class
			N		P		K		Clay	Silt	Sand	
			Total	available	Total	Available	Total	Available				
7.97 ± 0.06	0.26 ± 0.04	1.10 ± 0.2	159.60 ± 11.30	29.20 ± 2.45	62.30 ± 6.74	4.66 ± 0.92	243.0 ± 13.23	154.00 ± 8.76	6.84 ± 0.48	11.24 ± 0.47	81.92 ± 0.31	Sandy

Mono calcium super phosphate (15%P₂O₅) used as a source of phosphorus and added before planting. Planting date was at April, 20 and 25 in 2015 and 2016 season, respectively. All other cultural practices were carried out as recommended for peanut production.

At harvest time, five guarded plants were taken randomly from each subplot for measuring plant height (cm), number of branches plant⁻¹, number of pods plant⁻¹, pods weight plant⁻¹(g), seed number plant⁻¹, seeds weight plant⁻¹(g) and 100-

seed weight were determined. Pods yield was determined at harvest on plot basis. Seed oil content was determined by Soxhlet apparatus according to A.O.A.C. (1995). Multiplication of oil percentage by seed yield in kg fed⁻¹ to obtain oil yield in kg fed⁻¹.

The collected data were analyzed using analysis of variance (ANOVA) with SAS Statistical Software Package (v.9.2, 2008). Means were compared by revised Least significant difference (RLSD) at 5%

level of significant (Gomez and Gomez, 1984).

Results and Discussion

Vegetative traits:

Data presented in Table 2 reveal that the phosphorus levels had a significant effect on plant height and number of branches plant⁻¹ traits in both seasons. Thus, the tallest peanut plants (37.11 and 37.18 cm in the first and second seasons, respectively) and the highest mean values of branches number plant⁻¹ (9.91 and 9.87 in the first and second seasons, respectively) were obtained from peanut plants fertilized by 45 kg P₂O₅ fed.⁻¹ in both seasons while, the lowest mean values of mentioned traits were registered for the lowest phosphorus fertilization level (15 kg P₂O₅ fed.⁻¹). Phosphorus is essentially required for healthy growth with efficient root system and profuse nodulation which, in turn can affect the N₂-fixation potential (Kwari, 2005). Similar trend was obtained by Uma and Sathiyavani (2012) and Kamara *et al.* (2011b).

Here too, the studied peanut genotypes had a significant influence on plant height in the first season, meanwhile number of branches plant⁻¹ was affected significantly in the two growing seasons (Table 2). L3 genotypes surpassed the other tested genotypes and produced the maximum mean values of plant height (35.52 and 35.74 cm in the first and second seasons, respectively) while, L27R gave the highest mean values of branches number plant⁻¹ (9.67 and 9.78 in the first and second season, respectively). This is may be due to the genetic variation among studied genotypes and their interaction with

environmental factors. These findings are in agreement with those obtained by Meena *et al.* (2014), Mahrous *et al.* (2015), Sarkees (2015) and El-Far *et al.* (2016).

Furthermore, the interaction between phosphorus fertilization and genotypes had a significant influence on plant height in the first season only. While the effect of this interaction on plant height in the second season and number of branches in both seasons not significant. Thus the tallest peanut plants (39.11 cm) in the first season where obtained from L3peanut genotype fertilized by 45 Kg/Fed. P₂O₅.

Yield components traits:

Number of pods plant⁻¹, pods weight plant⁻¹, number of seed plant⁻¹ and seed weight plant⁻¹ traits were affected significantly by phosphorus fertilization levels in both seasons (Table 3). Peanut plants fertilized with 45 kg/fed. P₂O₅ produce the maximum mean values in this respect, which were 52.7, 81.5 g, 91.3 and 55.5 g of number of pods plant⁻¹, pods weight plant⁻¹, number of seed plant⁻¹ and seed weight plant⁻¹, respectively, in the first season being, 54.4, 86.3 g, 88.8 and 57.3 in the same order in the second season. This is to be expected since the same high phosphorus fertilization levels produced the highest mean values with regard to plant height and number of branches per plant and consequently produced the highest mean values of yield components traits. Similar trend was obtained by Uma and Sathiyavani (2012) and Kamara *et al.* (2011b).

Concerning genotypes effect in this respect, data illustrated in Table 3

focus that the all studied yield components traits were significantly affected by tested genotypes in the first season only except number of pods plant⁻¹ and seed index traits which was reacted significantly in both seasons. L35 surpassed all genotype in this respect and registered 72.3g, 78.2, and 50.0 g of pods weight plant⁻¹, number of seed plant⁻¹ and seed weight plant⁻¹, respectively as well as the heights mean values of number of pods plant⁻¹ and seed index (49.4 and 65.1 in the first season, became higher for both traits (52.1 and 69.4 g) in the second season. This may be due to the genetic variation between studied genotypes and their interaction with environmental factors. These findings are in agreement with those obtained by Meena *et al.* (2014), Mahrous *et al.*(2015), Sarkees (2015) and El-Far *et al.*(2016).

Regarding the interaction effect, data exhibited in Table 3 reveal that pod weight per plant, seed number per plant and seed weight per plant were affected significantly by the interaction between phosphorus fertilization levels and peanut genotypes in the first season only. Thus, planting L35 peanut genotype subjected to 45 kg/fed. P₂O₅ recorded the maximum mean values of previous treats, which were 104.4 g, 117.2 and 71.2 g respectively. Moreover, seed index was significantly affected in the second season only. On the other hand, number of pods plant⁻¹ reacted significantly to the interaction between phosphorus fertilization levels and peanut genotypes in both seasons. The highest mean values of number of pods plant⁻¹ (70.0 and 69.0 in the first and second season respectively)

were obtained from L35 peanut plants fertilized with 45 kg/fed. P₂O₅ while, the heaviest seed index (68.3 and 73.2 in the first and second season respectively) were obtained from L35 peanut plants fertilized with 15 kg/fed. P₂O₅.

Pods and seed yields:

The influence of phosphorus fertilization level on pods and seed yields of peanut were significant in both seasons (Table 4). Increasing phosphorus fertilization levels from 15 to 45 kg/fed P₂O₅ increased pods and seed yields by the rate of 73.3 and 88.5%, respectively in the first season being 83.0 and 95.3% in the second season in the same order. The same trend was observed with regard to yield components traits. Similar trend was obtained by Uma and Sathiyavani (2012) and Kamara *et al.* (2011a).

Studied peanut genotypes varied significantly with regard to pods and seed yields in both seasons. L35 genotype produced the highest mean values in this respect, which, were 1418 and 910 kg/fed. of pods and seed yields in the first season being 1353 and 929 kg/fed in the second season in the same order. This is to be logic since the same peanut genotype (L35) registered the maximum mean values with regard to most yield components traits as mentioned before and consequently produced the highest mean values of pods and seed yields. These findings are in agreement with those obtained by Meena *et al.* (2014), Mahrous *et al.*(2015), Sarkees (2015) and El-Far *et al.* (2016).

Concerning the interaction effect, data exhibited in Table 4 reveal

that the interaction between phosphorus fertilization levels and peanut genotypes had a non-significant effect on pods and seed yields in the two growing seasons except pods yield in the first season. Cultivated L35 peanut genotype and fertilized it by 45 kg/ fed. P₂O₅ gained the highest mean value of pods yield in the first season (1945 kg/ fed.). This is to be logical as the same trend was observed with regard to most yield components traits.

Oil percentage and oil yield:

Illustrated data in Table 4 note that the tested phosphorus fertilization levels had a significant influence on oil percent in the first season only, while; the effect was significant on oil yield in both seasons. Peanut plants, which fertilized with 45 kg/fed. P₂O₅ produced the highest mean values of oil percent (47.8%) and oil yield (455 kg/fed) in the first season, being 481 kg/fed of oil yield in the second season. This is to be logical since the same phosphorus fertilization level gained the highest mean values with regard to seed yield and consequently gained the maximum oil yield. Similar trend was obtained by Uma and Sathiyavani (2012) and Kamara *et al.* (2011b).

Regarding peanut genotypes, the presented data in Table 4 focus that the tested peanut genotypes had a significant effect on oil percentage in the second season only whereas, the effect was significant on oil yield in both seasons. L27R peanut genotype surpassed the others tested genotypes with regard to seed oil percentage in the second season and recorded 47 % oil percentage. On the other hand, L35 peanut genotypes produced the

maximum oil yield (416 and 414 kg/ fed in the first and second seasons, respectively). This is to be due to the superiority of L35 peanut genotype with regard to seed yield as mentioned before. These findings are in a good line with those obtained by Meena *et al.* (2014), Mahrous *et al.* (2015), Sarkees (2015) and El-Far *et al.* (2016).

Furthermore, the interaction did not achieve any significant effect in this respect except the effect of interaction on oil percentage in the second season, which was significant. The maximum seed oil content in the second season was 48.5%, which was achieved from L27R peanut genotype subjected to 30 kg/fed of P₂O₅ (Table 4).

Conclusion

From the obtained results, the investigators could be recommending by planting L35 peanut genotype and fertilized it with 45 kg fed.⁻¹ P₂O₅ to obtain the highest values of seed and oil yield under the same conditions.

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استجابة جـن التراكيب الوراثية من الفول لسودني لمستويات التسميد الفوسفاتي تحت ظروف الوادي الجديد

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المخلص:

تم اجراء تجربة حقلية بمزرعة كلية الزراعة - جامعة أسيوط - فرع الوادي الجديد خلال موسمي ٢٠١٥ و ٢٠١٦ لدراسة استجابة بعض التراكيب الوراثية من الفول السوداني لمستويات التسميد الفوسفاتي. نفذت التجربة بتصميم القطاعات كاملة العشوائية بترتيب الاحواض المنشقة في ثلاث مكررات. تم وضع مستويات التسميد الفوسفاتي في القطع الرئيسية بينما تم وضع التراكيب الوراثية في القطع المنشقة. وتشير النتائج إلي استجابة جميع الصفات محل الدراسة معنويا لمستويات التسميد الفوسفاتي لكلا موسمي الدراسة عدا معامل البذور، حيث تم الحصول علي اعلي قيم لمتوسطات معظم الصفات بإضافة التسميد الفوسفاتي بمعدل ٤٥ كجم للفدان. كما توضح النتائج ان هناك تأثيرا معنويا للتراكيب الوراثية للفول السوداني على معظم الصفات محل الدراسة، حيث تفوق التركيب الوراثي L35 على باقي التراكيب الوراثية في معظم الصفات محل الدراسة. تم الحصول علي اعلي قيم متوسطات محصول البذور والزيوت للفدان من التسميد بمعدل ٤٥ كجم خامس اكسيد الفسفور للفدان و تفوق التركيب الوراثي L35 على باقي التراكيب الوراثية في محصول الزيت والبذور للفدان.

Table 2. Effect of phosphorus fertilization levels and peanut genotypes on plant height and number of branches plant⁻¹ in 2015 and 2016 seasons

Seasons	Genotype	Plant height (cm)				Number of branches plant ⁻¹			
		P ₁₅	P ₃₀	P ₄₅	Mean	P ₁₅	P ₃₀	P ₄₅	Mean
2015	NC	28.89	36.22	37.44	34.18	8.22	8.11	9.00	8.44
	L3	31.22	36.22	39.11	35.52	8.44	8.78	9.78	9.00
	L10	26.56	29.00	35.34	30.30	6.78	7.89	9.11	7.93
	L35	27.89	36.56	38.89	34.45	8.11	8.33	10.67	9.04
	L27R	28.00	33.44	34.78	32.07	8.45	9.56	11.00	9.67
	Mean	28.51	34.29	37.11	33.30	8.00	8.53	9.91	8.82
Phosphorus		F teste				F teste			
Genotypes		**				*			
Phosphorus × Genotypes		**				**			
		RLSD				RLSD			
		2.13				1.31			
		1.88				0.57			
		2.44				NS			
2016	NC	30.78	33.89	35.44	33.37	7.22	8.22	8.56	8.00
	L3	32.67	36.00	38.56	35.74	8.78	9.11	9.22	9.04
	L10	31.59	32.33	37.89	33.94	7.22	8.33	10.11	8.55
	L35	30.11	35.56	39.11	34.93	7.45	8.67	10.56	8.89
	L27R	29.34	34.11	34.89	32.78	9.11	9.33	10.89	9.78
	Mean	30.90	34.38	37.18	34.15	7.96	8.73	9.87	8.85
Phosphorus		F teste				F teste			
Genotypes		**				**			
Phosphorus × Genotypes		NS				**			
		RLSD				RLSD			
		2.28				0.64			
		---				0.78			
		NS				NS			

Table 3. Effect of phosphorus fertilization levels and peanut genotypes on pods number plant⁻¹, pods weight plant⁻¹, seed number plant⁻¹, seed index and seed weight plant⁻¹ in 2015 and 2016 seasons

Seasons	Genotype	Pods number plant ⁻¹				Pods weight / plant				Seed number plant ⁻¹				Seed index (gm)				Seed weight plant ⁻¹			
		P ₁₅	P ₃₀	P ₄₅	Mean	P ₁₅	P ₃₀	P ₄₅	Mean	P ₁₅	P ₃₀	P ₄₅	Mean	P ₁₅	P ₃₀	P ₄₅	Mean	P ₁₅	P ₃₀	P ₄₅	Mean
2015	NC	28.7	38.0	44.0	36.9	45.0	57.4	64.3	55.5	53.0	66.0	70.5	63.2	55.5	57.7	60.0	57.8	29.0	38.1	41.8	36.3
	L3	30.3	40.7	49.0	40.0	39.8	65.1	84.8	63.2	45.7	66.7	99.1	70.5	52.9	63.3	58.1	58.1	23.9	42.3	57.6	41.3
	L10	32.7	38.3	44.7	38.6	27.9	55.1	72.0	51.7	33.0	58.8	72.6	54.8	57.0	63.1	67.9	62.7	18.6	37.5	49.6	35.2
	L35	32.3	46.0	70.0	49.4	46.6	66.0	104.4	72.3	48.0	69.4	117.2	78.2	68.3	66.0	60.9	65.1	32.9	45.8	71.2	50.0
	L27R	37.0	40.6	55.9	44.5	33.2	56.9	81.9	57.4	50.4	71.1	96.9	72.8	46.2	56.0	59.2	53.8	23.5	39.9	57.5	40.3
	Mean	32.2	40.7	52.7	41.9	38.5	60.1	81.5	60.0	46.0	66.4	91.3	67.9	56.0	61.1	61.2	59.5	25.6	40.7	55.5	40.6
		F teste				F teste				F teste				F teste				F teste			
Phosphorus		**				**				**				NS				**			
Genotypes		**				**				**				**				**			
Phosphorus × Genotypes		**				**				**				NS				*			
		RLSD				RLSD				RLSD				RLSD				RLSD			
		4.5				7.8				7.1				---				6.78			
		2.8				6.6				8.2				4.83				5.67			
		5.1				13.1				15.6				NS				12.24			
2016	NC	29.7	36.0	42.7	36.1	43.8	53.2	73.2	56.7	49.6	58.1	72.5	60.1	58.6	59.6	64.5	60.9	28.6	34.4	47.1	36.7
	L3	30.5	41.0	50.3	40.6	48.6	72.8	112.0	77.8	50.4	73.4	109.1	77.6	58.8	62.3	64.2	61.8	30.2	45.7	71.3	49.0
	L10	31.9	37.3	47.4	38.9	49.4	72.4	64.6	62.1	46.2	67.9	61.8	58.6	64.3	69.1	70.8	68.1	31.5	47.4	43.3	40.8
	L35	35.3	52.0	69.0	52.1	75.6	58.2	98.0	77.3	65.2	58.8	102.8	75.6	73.2	69.4	65.5	69.4	48.8	39.9	66.0	51.6
	L27R	33.2	41.8	62.7	45.9	37.4	57.0	83.9	59.4	54.1	68.4	93.7	72.1	49.8	57.2	63.6	56.9	26.2	39.0	58.7	41.3
	Mean	32.1	41.6	54.4	42.7	51.0	62.7	86.3	66.7	53.1	65.3	88.0	68.8	60.9	63.5	65.7	63.4	33.1	41.3	57.3	43.9
		F teste				F teste				F teste				F teste				F teste			
Phosphorus		**				*				NS				---				15.58			
Genotypes		**				NS				---				**				---			
Phosphorus × Genotypes		**				NS				---				**				---			
		RLSD				RLSD				RLSD				RLSD				RLSD			
		9.1				21.5				21				---				---			
		3.4				---				---				2.97				---			
		6.8				---				---				5.92				---			

Table 4. Effect of phosphorus fertilization levels and peanut genotypes on pods yield, seed yield, oil percentage and oil yield in 2015 and 2016 seasons

Seasons	Genotype	Pods yield (kg)				Seed yield (kg)				Oil percentage (%)				Oil yield (kg)			
		P ₁₅	P ₃₀	P ₄₅	Mean	P ₁₅	P ₃₀	P ₄₅	Mean	P ₁₅	P ₃₀	P ₄₅	Mean	P ₁₅	P ₃₀	P ₄₅	Mean
2015	NC	874	1131	1305	1104	489	653	782	641	43.5	46.1	47.8	45.8	212	302	372	295
	L3	1012	1236	1566	1271	535	782	909	742	44.4	47.0	48.4	46.6	239	368	440	349
	L10	825	1206	1565	1199	472	762	1064	766	43.7	47.8	47.6	46.3	206	366	508	360
	L35	982	1327	1945	1418	670	877	1184	910	44.3	45.1	47.1	45.5	296	394	558	416
	L27R	796	1004	1400	1067	366	562	832	587	45.5	46.5	47.8	46.6	167	261	397	275
	Mean	898	1181	1556	1212	506	727	954	729	44.3	46.5	47.8	46.2	224	338	455	339
		F teste		RLSD		F teste		RLSD		F teste		RLSD		F teste		RLSD	
Phosphorus		**		87		**		95		*		2.2		**		45	
Genotypes		**		87		**		76		NS		---		**		39	
Phosphorus × Genotypes		**		177		NS		---		NS		---		NS		---	
2016	NC	781	1062	1487	1110	460	632	965	686	42.8	48.1	45.2	45.3	198	304	439	313
	L3	964	1342	1609	1305	567	836	1038	814	45.4	43.6	45.6	44.9	256	363	475	365
	L10	915	1091	1609	1205	589	756	1140	828	45.9	45.6	43.6	45.0	270	345	498	371
	L35	1025	1278	1755	1353	750	894	1144	929	45.2	45.0	43.7	44.6	341	402	500	414
	L27R	802	1000	1751	1184	396	571	1104	690	48.0	48.5	44.6	47.0	190	277	492	319
	Mean	897	1155	1642	1231	552	738	1078	789	45.5	46.2	44.5	45.4	251	338	481	357
		F teste		RLSD		F teste		RLSD		F teste		RLSD		F teste		RLSD	
Phosphorus		**		116		**		72		NS		---		**		50	
Genotypes		**		140		**		89		*		1.5		**		39	
Phosphorus × Genotypes		NS		---		NS		---		**		2.6		NS		---	