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INTEGRATION BETWEEN SOIL AND FOLIAR APPLICATION OF PHOSPHORUS AND POTASSIUM ON THE PRODUCTIVITY OF SOME PEANUT CULTIVARS

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ABSTRACT: Two field experiments were conducted during the two successive seasons 2017 and 2018 on a private farm at El-Gazar village, Sadat City, Menoufia governorate, Egypt (latitude 30° 27'39" N, longitude 30°40'23" E). The presented study aimed to study the response of some introduced and local peanut cultivars (NC 9, Gregory, Giza 6, and Ismailia1) to integrate different levels of phosphorus and potassium fertilizers applied by soil and foliar application. Soil application of phosphorus (15, 30, and 45 kg P_2O_5 fed^{-1}) and potassium (24, 36, and 48 K_2O fed^{-1}) were applied either individually or mixed. Foliar application of P was applied as phosphoric acid at the rate of 2 ml-liter^{-1}, whereas K was applied as potassium sulfate at the rate of 3 g liter^{-1}. The nodulation and yield of the tested cultivars varied significantly across the two growing seasons. The forming of root nodules and their weight were increased by NC 9 cultivar followed by the Giza 6 cultivar. NC 9 cultivar was significantly superior to the other tested peanut cultivars for yield characters except for 100-seed weight and harvest index which was recorded by Giza 6 and Ismailia1, respectively. Giza 6 shared superiority with NC 9 without significant differences between them in the number and weight of seeds pod^{-1} traits. However, Gregory cv. was significantly inferior to the other cultivars in both seasons. It can be noticed that the highest rates of P and K either separately or their combination produced nodulation and yielded characters with the lowest rates of them and unfertilized plants which recorded the lowest values. The highest nodulation as well as yield and its components characters were registered by fertilized plants with 30 kg P_2O_5 + 36 kg K_2O + one Spray with 2 ml phosphoric acid + 3 g potassium sulfate/L or by 45 kg P_2O_5 + 48 kg K_2O + 0 spray without significant between them for all characters studied. In most of the traits examined in this study, the interactions between cultivars and fertilization systems were found to be significant. Fertilized NC 9 or Giza 6 plants with 30 kg P2O5 + 36 kg K2O + one spray with 2 ml phosphoric acid + 3 g potassium sulfate/L was the most effective treatment for increasing seed and pods yields per feddan compared to the other tested treatments and saved phosphate and potash fertilizers by 33.33% and 25%, respectively under the conditions of this experiment.

Keywords: *Arachis hypogaea*, Fertilization, Nodulation, and Yield.

INTRODUCTION

Peanut (Arachis hypogaea, L) is an oil crop that has significant economic and nutritional value. The peanut crop is a major cash crop in many countries worldwide, with exports and domestic sales (Abd El-Saber et al., 2020). Nutritionally, peanuts are high in protein, healthy fats, vitamins, and minerals, making them an important dietary component (Mouri *et al.* 2018). Seeds contain 45-50% oil, which is high in monounsaturated fatty acids (oleic acid, 40-55%), polyunsaturated fatty acids (linoleic acid, 25-30%) and has a high oleic to linoleic acid ratio (Chaiyadee et al., 2013; Zahran and Tawfeuk, 2019). Additionally, peanuts improve soil fertility through nitrogen fixation, which can benefit subsequent crops in rotation systems, especially in newly reclaimed soils. In Egypt, the cultivated area of peanuts was about 157 thousand feddans producing about 233 thousand tons of pods (Statistics of Agriculture Ministry, 2022). A significant deficit of edible oils has resulted in approximately 95% of local consumption being met through imports.

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Significant variation existed among the various peanut genotypes, attributed to genetic differences and their interactions with the environment. The varietal differences can significantly influence peanut growth (Samaha *et al*., 2019) yield (Abd El-Monem and Said, 2018), and nutritional composition (Abdel-Motagally *et al*., 2016). Understanding these differences is crucial for breeders aiming to develop improved varieties that meet consumer preferences and environmental challenges.

Phosphorus (P) and potassium (K) are essential nutrients that play vital roles in the growth and yield of peanut genotypes. Phosphorus is crucial for energy transfer, root development, and flowering, directly impacting the plant's ability to establish a robust root system and produce abundant pods (Silitonga *et al*., 2018). Adequate phosphorus levels enhance photosynthesis (Asante et al., 2020) and nodulation (Yaro *et al*., 2021), leading to improved yield potential (Mouri et al., 2018 and Mekdad, 2019). Similarly, potassium is important for regulating water use, enzyme activation (Mekki, 2015), and the synthesis of proteins and starches. It helps peanuts withstand water stress conditions as in newly reclaimed soils, ultimately contributing to higher quality and quantity (Meena *et al*., 2018). Balanced fertilization with these nutrients can significantly enhance growth performance, nodulation, nutrient uptake, yield, and seed quality. Previous studies in peanut showed various changes in yield attributed to P and/or K fertilization rates (Farag and Zahran, 2014; Abdel-Haliem *et al*., 2015; Abd El-Haliem *et al*., 2022).

Soil fertilization can be affected by environmental factors such as soil pH which can influence the effectiveness of soil fertilization, potentially reducing its impact on plant growth. Soil fertilization may not be fully absorbed by plant roots. This generally can occur when soil pH is un-optimal (Silitonga *et al*., 2018). Soil pH can create nutrient imbalances in the soil. Soil pH can influence chemical reactions that affect P and K nutrient availability. The ideal soil pH range for most plants is between 6.0 and 7.0, which is slightly acidic to neutral (Rusmayadi and Safruddin, 2024). Foliar nutrition offers significant advantages, with the most prominent being the swift correction of nutrient deficiencies, rapid growth response of plants, and enhanced nutrient absorption (Cagasan and Orbeta, 2020). This method can prove to be more advantageous and efficient than soil nutrient applications. Furthermore, it represents a cost-effective approach to improving crop yield, as only minimal investments are generally necessary (Campos et al., 2023). A balanced approach that includes both soil fertilization and foliar nutrition can provide the best results for plant growth and yield of crops.

Therefore, the objective of this investigation is to study the effect of P and/or K fertilizer levels through soil and foliar applications on the growth and productivity of some peanut cultivars, to find a way to maximize the peanut productivity in sandy soil with low inputs of fertilizers.

MATERIALS AND METHODS

Experimental procedures:

Two field experiments were conducted during the two successive seasons 2017 and 2018 in a private farm at El-Gazar village, Sadat City, Menoufia governorate, Egypt (latitude 30° 27'39" N, longitude 30°40'23" E). The study presented aimed to study the response of some peanut (*Arachis hypogaea* L.) cultivars to different levels of phosphorus and potassium fertilizers applied by soil and foliar application. Each experiment consisted of forty treatments resulting from the combinations of four cultivars and ten fertilization systems as follows:

A- Peanut cultivars:

Four peanut cultivars (2 local cultivars and 2 imported cultivars) varied in growth habit and their characteristics were evaluated in this study. The pedigree, origin, and characteristics of cultivars are shown in Table (1).

Table (1): The pedigree, origin, and characteristics of tested cultivars.

Cultivars	Origin	Pedigree	Growth habit	Characteristics
NC 9	U.S.A	NC 2 / Florigiant	Spreading	Late maturity and foliar disease resistant. Seed Size is large.
Gregory	U.S.A	NC7/NC9	Spreading	Early maturity and foliar disease resistant. Seed size is small.
Giza 6	Egypt	Local19 x N.A. 293	Erect	Early maturity and foliar disease resistant. Seeds have dormancy phase. Seed size is large.
Ismailia1	Egypt	Selected from Giza 4 × line 182	Semi-spreading	Early maturity and foliar disease resistant. Seeds have dormancy phase. Seed size is medium.

NC 9 and Gregory cultivars were obtained from Golden Seven Company for agricultural investment. Giza 6 and Ismailia 1 cultivars were obtained from Field Crops Research Institute, Agriculture research center, Giza.

B- Fertilization systems:

Fertilization treatments have consisted of soil application with three levels of phosphorus and/or three levels of potassium beside the unfertilized plants as control. The foliar application was added as one or two sprays beside untreated plants as shown in Table (2).

Table (2). Fertilizers systems tested in the study.

Treatment name		Nutrient	Soil application (kg fed^{-1})	Foliar application (No. of sprays)
T1	Control (without)	-	-	-
T2	15 P + 2 Spray	P_2O_5	15 P_2O_5	2
T3	30 P + 1 Spray		30 P_2O_5	1
T4	45 P + 0 Spray		45 P_2O_5	-
T5	24 K + 2 Spray	K_2O	24 K_2O	2
T6	36 K + 1 Spray		36 K_2O	1
T7	48 K + 0 Spray		48 K_2O	-
T8	15 P + 24 K + 2 Spray	P_2O_5 + K_2O	15 P_2O_5+24 K_2O	2
T9	30 P + 36 K + 1 Spray		30 P_2O_5+36 K_2O	1
T10	45 P + 48 K + 0 Spray		45 P_2O_5+48 K_2O	-

Soil phosphorus and/or potassium applications were assigned according to tested rates into two equal doses, whereas the first dose was added during soil preparing and the second dose was added at 35 days after sowing (DAS) with soil hoeing practice. P and K fertilizers were used in the form of calcium superphosphate (15.5% P_2O_5) and potassium sulfate (48% K_2O), respectively.

Foliar application of phosphorus was applied as phosphoric acid (85%) at a rate of 2 ml $liter^{-1}$, whereas potassium was applied as potassium sulfate (48% K_2O) at the rate of 3 g/liter. The first foliar application of phosphorus and/or potassium was applied at 36 DAS and the second at 50 DAS.

Experimental design

A split plot design was laid out in a randomized complete block design (RCBD) with three replications. The four peanut cultivars were presented in the main plots whereas fertilization treatments were occupied in the subplots.

Soil samples analysis

During soil preparation after harvesting the previous crops (wheat in the first season and barley in the second one), soil samples were randomly collected from several spots in the filed with depth 0-20 cm and mixed together to obtain soil sample to be analyze at the laboratory of soil fertility, Ministry of agriculture, Wadi El Natrun, El-Beheira Governorate. The analysis was done according to the methods described by Black (1965)**,** Jackson (1973), and Chapman and Pratt (1978). The chemical and physical properties of the experimental field soil over the two seasons are presented in Table (3).

Characterization of the experimental site

The experimental site was characterized as loamy sand soil. This texture enables soil to exhibit the optimal characteristics of all three soil types: (i) Sand facilitates effective drainage and aeration, (ii) silt retains moisture and nutrients, and (iii) clay helps in saving nutrients and providing soil structure. Thereby offering a suitable environment for the growth of plant roots. However, this soil contains low percent of organic matter and is characterized by a high pH degree.

Table (3): Chemical and physical properties of experimental field soil.

Properties		**2017 season**	**2018 season**
Soil texture		Loamy sand	Loamy sand
pH		8.10	8.07
Organic matter %		0.51	0.53
EC (ds/m)		0.39	0.46
$CaCO_3$ (%)		7.20	5.62
Soluble anions (meq./L)	CO_3^{2-}	-	-
	HCO_3^-	1.19	1.60
	Cl^-	1.01	1.10
	SO_4^{2-}	1.61	1.91
Soluble Cations (meq./L)	Ca^{2+}	4.40	3.80
	Mg^{2+}	1.10	1.90
	Na^+	0.42	0.53
	K^+	2.29	2.18
Macronutrients (ppm)	N	28.01	29.31
	P	12.24	12.83
	K	106.21	100.62
Micronutrients (ppm)	Fe	4.01	3.60
	Mn	2.07	2.41
	Zn	1.01	1.03
	Cu	0.80	0.73

Agronomic practices

The agronomic practices for the two seasons were as follows:

1- Soil preparation

During the two seasons, the soil was prepared by plowing twice with a normal plow and then making beds with an opener machine to achieve beds with a width of 1.8 meters. After the experimental field was prepared, each experimental plot was made up of four beds measuring 7.2 m wide by 7 m long (50.4 m^2 per plot). After applying soil fertilizers to each experimental plot, a rotavator machine was used to create a plant-friendly cradle free of clods and mix fertilizers into the soil surface zone.

2- Sowing

Experiments were planted on the 7th of May and the 3rd of May during the two seasons, respectively. The tested cultivars in this study were randomly distributed within the main plots. Seeds of four cultivars were treated with specific Rhizobium bacteria inoculants which were obtained from the Agricultural Research Center, Giza at the rate of 600g/fed before sowing immediately. Sowing was conducted manually on beds. Each bed had three rows with equal spacing between rows and 20 cm between hills. After sowing, weed control was applied by spraying Stomp herbicide (Pendimethalin 42.3%) at the rate of 1.5 L fed^{-1} then irrigation.

3- General fertilization program

During the two seasons, all experimental plots were fertilized with a unified fertilization program containing all macro and micronutrients (except P and K) as recommended in the experimental location.

4- Irrigation

The experimental field was irrigated using Permanent sprinkle irrigation system during the two seasons. Irrigation program during the two seasons consisted of two parts as follows:

- Part one (pre sowing): Irrigation was done by adding 300 m^3/fed during soil preparation to make soil preparation easier and to save water column about 14 cm under ground level.
- Part two irrigation (post sowing): Irrigation started after sowing and herbicide spraying directly by adding two consecutive irrigations. Each irrigation was done by adding 30 m^3/fed. After peanut germination, irrigation was started by adding 20 mm /week (1 mm = 4.2 m^3/fed) and increased gradually to reach 70 mm in the tenth week and fixed at this level up to the fourteenth week then decreased gradually to the end of the season. The amount of water applied during the week was divided according to No. of irrigations per week.

Measurements

I- Nodulation characters

At 90 DAS, six guarded plants were uprooted by mattock at random in each experimental plot. The roots were dipped in water to remove the soil and then washed with distilled water. Then number of nodules $plant^{-1}$ and their dry weight were determined.

II- Yield and its components:

At physiological maturity, yield and its components were estimated. Ten plants were randomly selected to determine the number of pods $plant^{-1}$, number of seeds pod^{-1}, seeds weight pod^{-1} (g), and seed yield $plant^{-1}$ (g). seed, pod, straw, and biological yields were estimated on plants in 12.6 m^2 (one bed 1.8 m width × 7 m length) in each plot, then converted to kg fed^{-1}. From a shelled sample of each plot, 100 seeds were randomly selected and weighed in grams. Harvest index (HI %) was computed by using the formula given by Singh and Stokopf (1971) which is expressed as: HI % = (seed yield / biological yield) × 100

Statistical analysis

The data were statistically analyzed utilizing the methodology outlined by Gomez and Gomez (1983) with the CoStat software program. The difference among the means of all treatments in this study were evaluated using the least significant difference (LSD) method. The mean values in each column that share identical letters are not significantly different at the 5% probability level.

RESULTS AND DISCUSSION

I. Nodulation:

This section mostly aims to investigate nodule traits, i.e., the number and dry weight of nodules $plant^{-1}$ as affected by peanut cultivars (Table 4), fertilization treatments (Table 5), and their interactions (Figs 1 and 2) at 90 DAS in both seasons.

I-A. Varietal differences:

Data presented in Table (4) showed significant differences among tested cultivars in their number and dry weight of nodules plant^{-1} during both seasons. The forming of root nodules and their weight were increased by the NC 9 cultivar followed by the Giza 6 cultivar in comparison with other cultivars. On the other hand, a decline in nodulation occurred by the Gregory cultivar. NC 9 and Giza 6 cultivars surpassed Gregory cultivars by 32.54 and 24.67% for the number of nodules, and by 72.55 and 51.10% for dry weight of nodules, respectively as an average of both seasons. These results may be related with the response degree of cultivar to *Rhizobium* strains that inoculated before sowing for all cultivars. The formation of roots helps the *Rhizobium* to colonize and infect the roots so that the *Rhizobium* mortality rate decreases (Adinurani *et al*., 2021). The differences among peanut cultivars for the number of nodules per plant were previously reported by Yaro *et al.* (2021) with the superiority of the Nkatie Sari variety, Noaman *et al.* (2022) in favor of the Sohag 110 variety and Ding *et al.* (2024) with preference to Taihua No.4 variety. Also, the varietal effect on the number of nodules and nodule's dry weight was outlined by Asante *et al.* (2020) in favor of the Smut 22 variety.

Table (4). Mean values for nodulation of peanut cultivars (90 DAS) in 2017 and 2018 seasons.

Cultivars	**No. of nodules plant^{-1}**		**Nodules dry weight plant^{-1} (g)**	
	2017 season	**2018 season**	**2017 season**	**2018 season**
NC 9	73.87 a	82.69 a	0.925 a	1.085 a
Gregory	56.80 d	61.24 c	0.514 d	0.657 c
Giza 6	70.62 b	76.55 b	0.821 b	0.936 b
Ismailia 1	65.43 c	71.59 b	0.668 c	0.874 b
LSD 0.05	2.37	5.80	0.03	0.13

I-B. Effect of fertilization systems:

Application of different tested fertilization systems resulted in an increasing number and dry weight of nodules plant^{-1} compared to untreated plants (T1) which produced the lowest values in the two growing seasons (Table 5). Moreover, it can be noticed generally that the highest rates of P and K either separately or their combination resulted nodulation more the lowest fertilizer rates. In comparison among the tested mineral fertilizers, the data showed that the highest increase in the number of nodules was recorded by the application of 45 kg P_2O_5 + 48 kg K_2O + 0 Spray (T10) followed by 30 kg P_2O_5 + 36 kg K_2O + one Spray with 2 ml phosphoric acid + 3 g potassium sulfate/L (T9) in the two seasons without significant differences between them. The increases in the number and dry weight of nodules /plant resulting from T10 amounted to 90.83 and 105.24% and from T9 amounted to 86.02 and 97.15% more than the unfertilized plants, as an average of both seasons. Hamissa *et al*. (2000) reported that nodulated legumes dependent on symbiotic nitrogen for growth may require more phosphorus than those dependent on combined nitrogen. Similar results were obtained by other investigators who reported that fertilized peanuts with the application of 30 kg P_2O_5 ha-1 (Sharma, 2012 and Asante *et al.*, 2020), 40 kg P_2O_5 ha^{-1} (Yakubu *et al.*, 2010) and 60 kg P_2O_5 ha^{-1} (Yaro *et al.* 2021) compared to other fertilizer rates.

Table (5). Mean values of peanut nodulation as affected by fertilization systems in 2017 and 2018 seasons.

Fertilization systems		No of nodules plant^{-1}		Nodules dry weight plant^{-1} (g)	
		2017 season	2018 season	2017 season	2018 season
T1	Control	47.89 f	51.36 f	0.508 f	0.602 e
T2	15 P +2Spray	58.48 cd	63.90 d	0.638 d	0.780 c
T3	30 P+1 Spray	75.07 b	81.67 c	0.816 b	0.951 b
T4	45 P+0 Spray	86.51 a	95.69 b	0.977 a	1.263 a
T5	24 K+ 2 Spray	52.67 e	57.03 e	0.561 e	0.652 de
T6	36 K+1Spray	52.76 e	58.46 e	0.569 e	0.659 de
T7	48 K+0 Spray	54.93 de	59.12 e	0.583 e	0.678 d
T8	15 P+24 K+2Spray	61.31 c	65.87 d	0.689 c	0.798 c
T9	30 P+36 K+1Spray	87.98 a	96.73 a	0.971 a	1.223 a
T10	45 P+48 K+0Spray	89.22 a	100.34 a	1.011 a	1.273 a
LSD 0.05		3.62	4.43	0.04	0.06

I-C. Effect of the interaction:

The interaction data of the number of nodules plant^{-1} (Fig 1) showed that the maximum values were obtained by NC 9 cultivar when fertilized with T9 and T10 (97.77 and 95.93) in the first season, and (109.17 and 110.43) in the second season, respectively. Nodules dry weight/plant (Fig 2) took the same trend of nodules numbers in both seasons. This superiority might be attributed to positive response of NC 9 to PK rates. However, Gregory cultivar plants which were unfertilized with any phosphorus and potassium fertilizers produced the lowest values of the two traits in both seasons. Similar findings were obtained by Asante *et al*. (2020) who found that nodulation was enhanced with Oboshie and Smut 22 varieties when fertilized with 30 kg P_2O_5 ha^{-1}, and Yaro *et al*. (2021) in favor of Nkatie variety when fertilized with 60 kg P_2O_5 ha^{-1}.

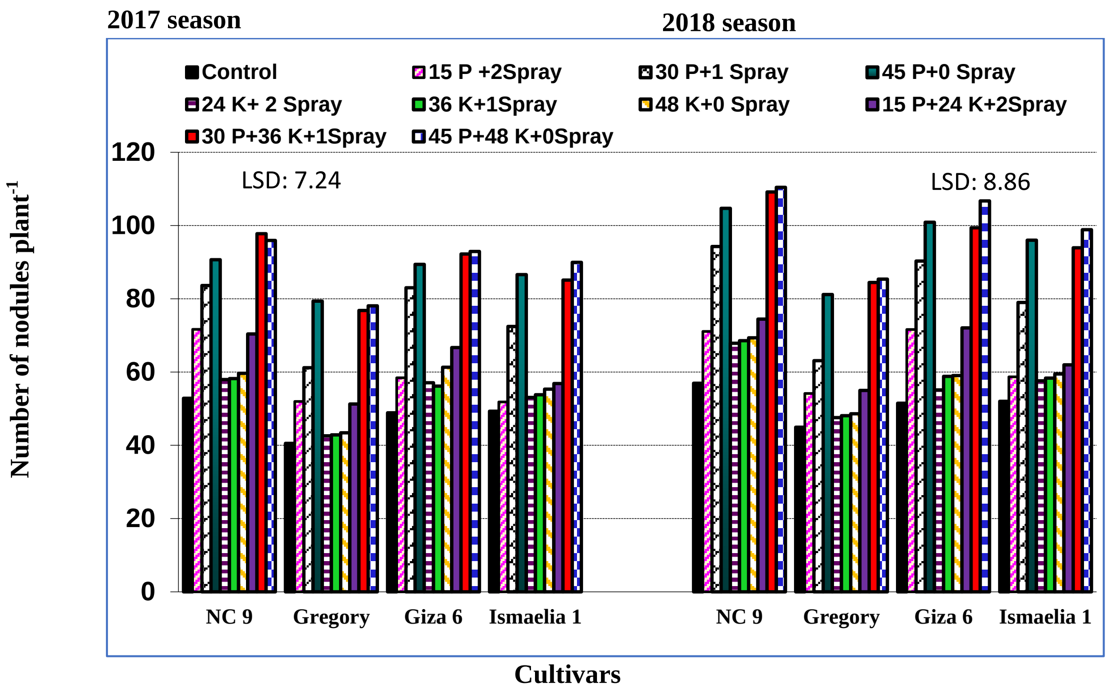

Fig (1). Effect of the interaction between peanut cultivars and PK fertilization on number of nodules plant^{-1} at 90 DAS during both growing seasons.

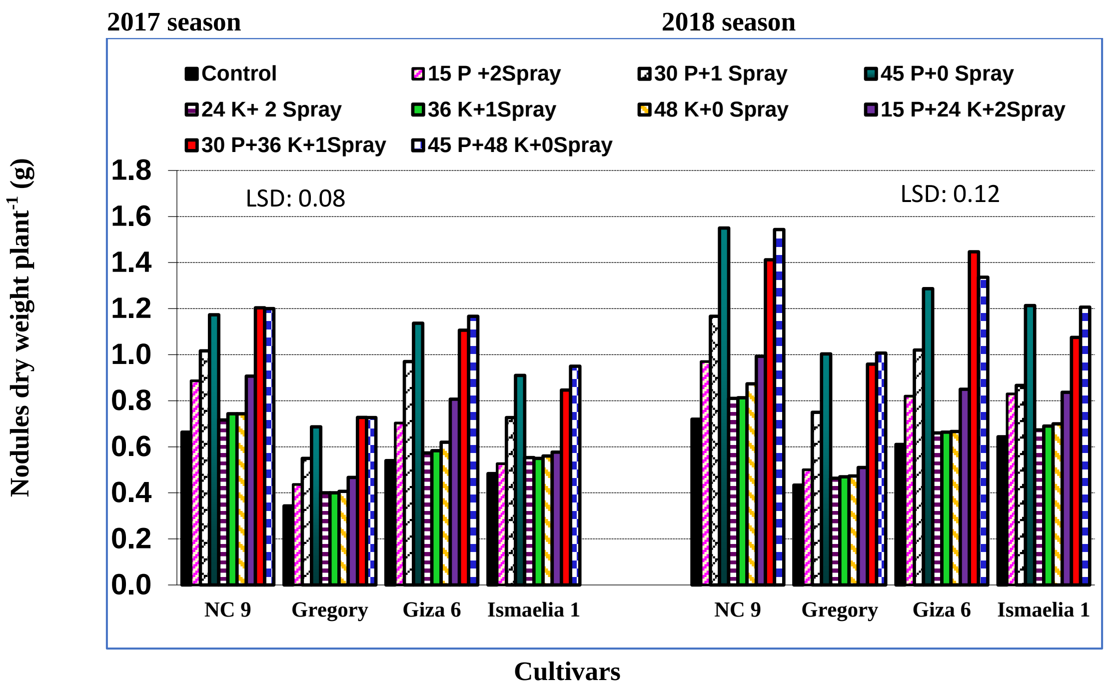

Fig (2). Effect of the interaction between peanut cultivars and PK fertilization on nodules dry weight plant^{-1} (g) at 90 DAS during both growing seasons.

II. Yield and its components:

The goal of this section is to examine yield and its components, which include the number of pods plant^{-1}, number of seeds pod^{-1}, 100-seed weight, seeds weight pod^{-1}, seed yield plant^{-1}, seed yield fed^{-1}, pod yield fed^{-1}, straw yield fed^{-1}, biological yield fed^{-1} and harvest index in the two growing seasons as affected by different peanut cultivars (Table 6) and fertilization systems (Table 7) and their interactions (Figs 3-9).

II-A. Varietal differences:

The data of the number of pods plant^{-1} in Table (6) showed that NC 9 cv. was significantly superior to the other tested peanut cultivars. However, Gregory cv. was significantly inferior to the other cultivars in both seasons. The superiority of NC 9 cv. may be attributed to the increase in number and dry weight of nodules plant^{-1} and nutrients uptakes (Table 4) which caused an increase in the amount of metabolites and synthesized and this in turn increased the plant capacity for pod production. In this respect, other researchers found high variation among some peanut cultivars in favor of NC 9 cv. (Abd El-Haliem *et al*., 2022), Giza 6 cv. (Samaha *et al*., 2019). Gregory cv. (Abdel-Haliem *et al*., 2015), Ismailia 1 cv. (Mahmowd *et al*., 2014) and Sohag 110 cv. (Abdel-Motagally *et al*., 2016).

Concerning the number of seeds pod^{-1}, it can be noticed that there is significant variation among tested cultivars in both seasons. The highest significant value was obtained by NC 9 and Giza 6 (in the first season) and by NC 9, Giza 6 and Ismailia 1 (in the second season). However, Gregory cv. recoded the lowest one. Similar trend was recorded by Argaw (2017) in favor of Sedi cv. and Zaki *et al*. (2017) with preference to Sohag-104 cultivar as compared with the other tested genotypes.

Varietal differences in 100-seed weight and seeds weight pod^{-1} of peanut plants were significant in both seasons. It can be noticed that the highest significant values of 100-seed weight (77.86 and 80.63 g) were obtained by Giza 6 followed by NC 9 (74.12 and 76.07 g) in the first and second seasons, respectively. However, NC 9 had the highest significant values of seed weight

Table (6). Mean values for yield and its components of peanut cultivars in 2017 and 2018 seasons.

Cultivars	No. of pods plant^{-1}	No. of seeds pod^{-1}	100-seed weight (g)	Seeds weight pod^{-1} (g)	Seed yield plant^{-1} (g)	Seed yield fed^{-1} (kg)	Pod yield fed^{-1} (kg)	Straw yield fed^{-1} (kg)	Biological yield fed^{-1} (kg)	Harvest index (%)
2017 season										
NC 9	25.20 a	1.83 a	74.12 ab	1.37 a	37.16 a	1333.86 a	1758.37 a	3094.67 a	4853.03 a	27.49 b
Gregory	17.02 d	1.51 c	70.30 b	1.06 b	20.76 d	763.70 d	973.60 d	1657.03 c	2630.63 d	29.03 b
Giza 6	22.87 b	1.75 a	77.86 a	1.33 a	34.64 b	1185.52 b	1514.60 b	2469.77 b	3984.37 b	29.75 ab
Ismailia 1	19.61 c	1.63 b	64.20 c	1.02 b	26.66 c	993.47 c	1237.43 c	1905.53 c	3142.97 c	31.61 a
LSD 0.05	1.32	0.09	4.19	0.05	1.38	54.08	54.54	397.31	410.40	2.21
2018 season										
NC 9	27.46 a	1.72 a	76.07 b	1.34 a	39.46 a	1442.57 a	1728.30 a	3110.40 a	4838.70 a	29.81 b
Gregory	18.42 d	1.54 b	74.43 c	1.13 b	23.66 d	847.90 d	1037.77 d	1820.97 d	2858.73 d	29.66 b
Giza 6	24.70 b	1.69 a	80.63 a	1.33 a	34.89 b	1336.48 b	1624.60 b	2587.53 b	4212.13 b	31.73 ab
Ismailia 1	20.67 c	1.65 ab	66.70 d	1.07 c	26.05 c	1104.47 c	1303.27 c	2015.93 c	3319.20 c	33.27 a
LSD 0.05	0.77	0.11	0.81	0.06	1.64	22.33	27.83	79.27	177.20	2.64

pod^{-1} followed by Giza 6 without significance between them in the two growing seasons. On the other side, Ismailia 1 had the lowest values of both traits than the other tested cultivars in both seasons. In previous studies, Abd El-Saber *et al*. (2020) and Iddrisu *et al*. (2024) mentioned that peanut cultivars differed widely in their 100-seed weight and seeds weight pod^{-1}.

Data presented in Table (6) showed that significant differences were detected among test cultivars for seed yield plant^{-1} in both seasons. It is worth noting that NC 9 outyielded the rest tested cultivars in seed yield plant^{-1} by 10.19, 45.43 and 72.89 % over Giza 6, Ismailia 1 and Gregory cultivars, respectively as an average of both seasons. This increase was positively associated with higher number of pods plant^{-1} and seeds weight pod^{-1} as previously discussed. Other investigators found varietal differences in seed yield of peanut plant in favor of Ismailia 1 cv. (Mahmowd *et al.,* 2014), Sohag-110 cv. (Abdel-Motagally *et al*., 2016), L35 genotype (Abd El-Monem and Said 2018), Ismailia 2, Intr. 182 and Intr. 267 Genotypes (Abd El-Saber *et al*., 2020) and NC 9 cv. (Ali *et al*., 2020).

Data in the same Table indicated that seed and pod yields fed^{-1} were significantly differed by varietal differences in both seasons. NC 9 cultivar had the highest values, while Giza 6 cultivar exhibited the second mean performance in both seasons. Gregory cultivar recorded the lowest one. The increase in seed and pod yields fed^{-1} amounted to 72.40 and 73.57% by NC 9 and 56.43 and 56.06% by Giza 6 more than Gregory, respectively as an average of both seasons. The superiority of NC 9 cv. could be attributed to its notability in nodulation characters, number of pods plant^{-1} and seed weight pod^{-1}. In this concern, other researchers found superiority of some peanut cultivars in seed and pod yields in favor of Sohag-110 cultivar (Abdel-Motagally *et al*., 2016), L 35 genotype (Abd El-Monem and Said 2018) and Giza 6 cultivar (Samaha *et al*., 2019).

Peanut cultivars significantly differed in their straw and biological yields fed^{-1} in both seasons (Table 6). Straw and biological yields were in parallel trend to seed yield fed^{-1}, where NC 9 cv. was higher in both traits than other tested cultivars especially Gregory which registry the last rank in both seasons. However, the differences between Gregory and Ismailia 1 cultivars were not significant in the first season for straw yield. The superiority of NC 9 may be related to its higher performance in vegetative growth as results of enhancing nodulation (Table 4). In this concern, other investigators found varietal differences in straw and biological yields in favor of Giza 6 cultivar (El-Far *et al*., 2013) and Sohag-104 (Zaki *et al*., 2017).

Significant differences in harvest index were detected in both seasons. Ismailia 1 and Giza 6 cultivars had significantly higher values of harvest index than the other two cultivars. However, NC 9 and Gregory cultivars recorded the lowest mean values. This was true in both seasons. It means that the ability of photosynthate mobilization to the seed at maturity was much higher in Ismailia 1 and Giza 6 cultivars than in the other two tested cultivars. In this concern, Sabra *et al*. (2020) reported that Gregory cultivar exceeds significantly the cultivar Giza 6 in the harvest index.

II-B. Effect of fertilization systems:

Data in Table (7) showed that the number of pods per plant was significantly affected by the different fertilization treatments in the two seasons. It can be noticed that applications of 30 kg P_2O_5 + 36 kg K_2O + one Spray with 2 ml phosphoric acid + 3 g potassium sulfate/L (T9) or 45 kg P_2O_5 + 48 kg K_2O + 0 Spray (T10) produced the highest significant values compared to the other treatments in both seasons. Meanwhile, the lowest value was obtained by the unfertilized plants. The increases in the number of pods resulting from the treatments of T9 and T10 amounted to 86.45 and 79.06 %, respectively more than the unfertilized plants as an average of both seasons. The increase observed herein by such treatments may be due to: (i) pronounced increases in number and dry weight of nodules plant^{-1} (Table 5). In this concern, other researchers reported that number of pods could be increased by increasing the application of P up to 31 kg P_2O_5

Table (7). Mean values of yield and its components as affected by fertilization systems in 2017 and 2018 seasons.

Fertilization systems		No. of pods $plant^{-1}$	No. of seeds pod^{-1}	100-seed weight (g)	Seeds weight pod^{-1} (g)	Seed yield $plant^{-1}$ (g)	Seed yield fed^{-1} (kg)	Pod yield fed^{-1} (kg)	Straw yield fed^{-1} (kg)	Biological yield fed^{-1} (kg)	Harvest index (%)
2017 season											
T1	Control	14.08 h	1.35 e	50.55 g	0.70 g	17.26 f	675.42 g	852.42 g	1680.33 d	2532.75 e	26.67 e
T2	15 P +2Spray	17.77 f	1.52 d	54.76 f	0.85 f	21.85 e	837.79 ef	1028.25 e	1874.33 d	2902.58 d	28.86 bcd
T3	30 P+1 Spray	22.05 d	1.75 bc	60.48 e	1.02 e	25.81 d	924.50 de	1184.33 d	2133.50 c	3317.83 c	27.86 cd
T4	45 P+0 Spray	25.02 b	1.79 ab	63.32 e	1.13 d	33.78 b	1137.25 c	1524.58 c	2389.42 b	3914.00 b	29.06 bcd
T5	24 K+ 2 Spray	16.68 g	1.52 d	68.88 d	1.01 e	21.55 e	791.00 f	953.42 f	1894.17 d	2847.58 d	27.78 de
T6	36 K+1Spray	18.48 f	1.69 c	80.58 c	1.26 c	27.51 d	964.29 d	1234.00 d	2261.17 bc	3495.17 c	27.59 cde
T7	48 K+0 Spray	20.83 e	1.76 bc	82.00 bc	1.35 b	30.73 c	1114.04 c	1457.92 c	2441.25 b	3899.17 b	28.57 bcd
T8	15 P+24 K+2Spray	24.06 c	1.78 ab	81.25 c	1.40 b	34.84 b	1242.50 b	1706.92 b	2420.92 b	4127.83 b	30.10 ab
T9	30 P+36 K+1Spray	26.82 a	1.85 a	85.44 ab	1.60 a	43.04 a	1544.40 a	1909.67 a	2821.17 a	4730.83 a	32.65 a
T10	45 P+48 K+0Spray	25.95 a	1.80 ab	88.95 a	1.66 a	41.68 a	1460.17 a	1858.50 a	2901.25 a	4759.75 a	30.68 ab
LSD 0.05		0.93	0.08	3.85	0.08	2.24	95.20	67.14	222.95	244.66	2.74
2018 season											
T1	Control	15.47 g	1.39 g	55.48 g	0.75 g	17.87 f	682.42 g	829.92 f	1764.33 e	2594.25 f	26.30 g
T2	15 P +2Spray	19.27 f	1.54 ef	62.67 f	0.94 f	21.50 e	785.71 f	966.83 e	1913.33 de	2880.17e	27.28 fg
T3	30 P+1 Spray	23.03 d	1.64 de	66.17 e	1.06 e	29.33 d	1050.83 d	1266.33 d	2287.50 c	3553.83 d	29.57 de
T4	45 P+0 Spray	26.13 bc	1.74 bc	68.08 e	1.17 d	36.48 b	1297.75 c	1582.42 c	2534.25 b	4116.67 c	31.52 bc
T5	24 K+ 2 Spray	18.80 f	1.49 fg	72.53 d	1.05 e	23.25 e	871.79 e	1022.67 e	1989.17 d	3011.83 e	28.95 ef
T6	36 K+1Spray	20.85 e	1.61 de	77.35 c	1.21 d	27.81 d	1038.71 d	1247.08 d	2202.50 c	3449.58 d	30.11 cde
T7	48 K+0 Spray	23.68 d	1.67 cd	84.08 b	1.37 c	33.00 c	1275.54 c	1546.08 c	2589.58 b	4135.67 bc	30.84 cd
T8	15 P+24 K+2Spray	25.81 c	1.75 bc	82.92 b	1.43 b	37.01 b	1435.04 b	1732.42 b	2560.92 b	4293.33 b	33.42 ab
T9	30 P+36 K+1Spray	28.23 a	1.85 a	87.03 a	1.57 a	43.36 a	1708.92 a	2034.42 a	2962.25 a	4996.67 a	34.20 a
T10	45 P+48 K+0Spray	26.89 b	1.80 ab	88.36 a	1.62 a	40.53 a	1681.83 a	2006.67 a	3033.25 a	5039.92 a	33.37 ab
LSD 0.05		0.99	0.10	2.79	0.06	2.83	82.46	88.04	153.53	167. 72	2.04

fed^{-1} (Abdel-Haliem *et al*., 2015), 60 kg P_2O_5 fed^{-1} (Hefny and Ahmed, 2017), and K up to 50 kg K_2O (Abd El-Haliem *et al*., 2022) as well as the mixture of PK at a rate of 30 kg P_2O_5 /fed + 24 kg K_2O/fed (Seadh *et al*., 2017) compared to other fertilizers rates.

There were significant differences in the number of seeds pod^{-1} among the tested fertilization treatments in both seasons. The T9 and T10 treatments produced the highest values, followed by 15 kg P_2O_5 + 24 kg K_2O + two Sprays (T8), while the unfertilized treatment (T1) produced the lowest values. The increase in the number of seeds pod^{-1} could be attributed to an increase in photosynthetic production, which results in more photoassimilates translocating to the seeds. These findings agree with that was mentioned by other researchers when applying nutrient rates such as 60 kg P_2O_5 ha^{-1} (Zoz *et al*., 2018), 100 kg K_2O ha^{-1} (Zaki *et al*., 2018), and 31 kg P_2O_5 + 48 kg K_2O fed^{-1} (Farag and Zahran, 2014).

Data in Table (7) indicated that the application of all fertilization treatments significantly increased 100-seed weight and seed weight pod^{-1} compared to unfertilized plants in both seasons. It can be observed that fertilization plants with T9 and T10 significantly produced heavier seed weights than that obtained by the rest treatments. It can be suggested that the translocation of photoassimilates from the vegetative plant tissues to the seeds was much affected by plant nutrition status which leads to the promotion of cell division, buildup of storage capacity, and attractive power of metabolic to sink tissues. These results were previously reported when peanut plants were fertilized with 23.25 kg P_2O_5 fed^{-1} (Abdel-Haliem *et al*., 2015), 31 kg P_2O_5 fed^{-1} (El-Far *et al*., 2013), 100 kg P_2O_5 ha^{-1} (Kumar *et al.* 2019), 30 kg K_2O ha^{-1} (Meena *et al*., 2018), 75 kg K_2O fed^{-1} (Abd El-Haliem *et al*., 2022), mixture of 31 kg P_2O_5 + 48 kg K_2O fed^{-1} (Farag and Zahran, 2014) and 31 kg P_2O_5 + 48 kg K_2O fed^{-1} (Mahmowd *et al*. 2014).

Seed yield plant^{-1} was significantly increased by the application of all tested fertilization treatments as compared with unfertilized plants in both seasons. Moreover, it is worth mentioning that the application of T9 caused a greater increase in seed yield per plant followed by T10 without significant between them. Seed yield is the out-product of its main components (number of pods plant^{-1} and seeds weight pod^{-1}). So, any increase in one or more of such components without any decrease, in the other will lead to an increase in seed yield per plant as previously discussed. In this respect, other investigators reported the importance of nutrients for enhancing seed yield/plant such as P up to 31 kg P_2O_5 fed^{-1} (Abdel-Haliem *et al*. 2015), 60 kg P_2O_5 fed^{-1} (Hefny and Ahmed, 2017), and K up to 115 kg K_2O ha^{-1} + two times foliar application with 36 % K_2O at the rate of 3 cm litre^{-1} (Mekki, 2015) as well as the mixture of PK at a rate of 45 kg P_2O_5 + 48 kg K_2O fed^{-1} (Mahmowd *et al*., 2014) compared to other fertilizer systems.

Significant increases in seed and pod yields per feddan were obtained by fertilized plants more than unfertilized plants in the two growing seasons (Table 7). Increasing the rates of phosphorus from 15 to 45 kg P_2O_5 fed^{-1} and potassium from 24 to 48 kg K_2O fed^{-1} either individual or mixed caused significant increases in seed and pod yields fed^{-1}. The highest seed yield fed^{-1} was registered by fertilized plants with 30 kg P_2O_5 + 36 kg K_2O + one spray (T9) followed by 45 kg P_2O_5 + 48 kg K_2O + 0 Spray (T10) without significant between them. The superiority of T9 and T10 in increasing seed yield fed^{-1} was a logical resultant of the increase in the seed yield/plant and its components. One of the key sustainable management practices for improving crop yield is the application of foliar treatments, which can also serve as a complement to soil fertilization and save fertilizers amount (Shahrajabian *et al*., 2022). Similar findings were mentioned by other investigators who found that seed yield and pod yield per unit area were increased when plants were fertilized with 60 kg P_2O_5 ha^{-1} (Mouri *et al*., 2018), 75 kg P_2O_5 fed^{-1} (Mekdad, 2019), 75 kg K_2O fed^{-1} (Abd El-Haliem *et al*., 2022) and 31 kg P_2O_5 + 48 kg K_2O fed^{-1} (Farag and Zahran, 2014).

It is evident from Table (7) that significant differences could be discerned among the tested fertilization treatments concerning straw yield fed^{-1} in both seasons. When compared to the other fertilization treatments, the application of T10 and T9 produced the highest significant values without a significant difference between them. The increases in straw yield/feddan due to the application of T10 and T9 over the control treatment (T1) amounted to 72.29 and 67.90%, respectively as an average of both seasons. This superiority may be owing to their effects on enhancing growth that was reflected finally on producing more dry matter production. These findings are in trend with those of other investigators who found that straw yield was increased by the application of nutrients such as 31 kg P_2O_5 fed^{-1} (El-Far *et al.*, 2013 and Abdel-Haliem *et al.*, 2015), 75 kg K_2O fed^{-1} (Abd El-Haliem *et al.*, 2022) and 31 kg P_2O_5 + 48 kg K_2O fed^{-1} (Farag and Zahran, 2014).

Biological yield fed^{-1} significantly and positively responded to fertilization treatments in both seasons (Table 7). The data showed that T10 and T9 treatments produced the highest significant value of biological yield, but without significant differences with them in the both seasons. This increase in biological yield by such treatments amounted to 91.10 and 89.70% more than unfertilized plants as an average of both seasons. On the other hand, the lowest values were recorded by unfertilized plants in both seasons. This superiority of such treatments might be attributed to their effects in increasing pod and straw yields fed^{-1}. These findings are in harmony with those of other workers who found that biological yield was increased by fertilization treatments such as 31 kg P_2O_5 fed^{-1} (El-Far *et al.*, 2013 and Abdel-Haliem *et al.*, 2015), 100 kg K_2O ha^{-1} (Zaki *et al.*, 2018) and 31 kg P_2O_5 + 48 kg K_2O fed^{-1} (Farag and Zahran, 2014).

Harvest index was significantly affected by fertilization treatments in both seasons as shown in Table (7). The data indicated that the T9 treatment gave the highest significant values of harvest index but without significant differences with T10 and T8 in both seasons. On the contrary, the lowest value was obtained by unfertilized plants (T1). The translocation of dry matter from vegetative plant organs (stem and leaf tissues) to the primary sink (seed) was augmented by these treatments. These findings align with those of Mouri *et al.* (2018).

II-C. Effect of the interaction:

The interaction between the cultivars and fertilization treatments were found to be significant for all yield characters except number of seeds pod^{-1}, 100-seed weight and harvest index, So, the data were excluded.

It is clear from Fig (3) that fertilized NC 9 plants with 30 P_2O_5 + 36 K_2O + one Spray (T9) followed by 45 P_2O_5 + 48 K_2O + 0 Spray (T10) or 45 P_2O_5 + 0 Spray (T4) produced the highest values of pods number plant^{-1}, while the lowest one was obtained by the unfertilized Gregory plants during both seasons. This finding seems to be in confirmation with that obtained by other researchers who found that the number of pods plant^{-1} was increased when fertilized BARI Cheenabadam-8 cultivar with 60 kg P_2O_5 ha^{-1} (Mouri *et al.*, 2018) fertilized NC 9 cultivar with 75 kg K_2O fed^{-1} (Abd El-Haliem *et al.*, 2022) as well as fertilized Ismailia 1 cultivar with 45 kg P_2O_5 + 48 kg K_2O fed^{-1} (Mahmowd *et al.*, 2014).

Data illustrated in Fig (4) show that NC 9 or Giza 6 plants which were fertilized with T9 or T10 produced the greatest number of seeds pods^{-1}. Meanwhile, the lowest values were found by the Gregory plants which were unfertilized with fertilization treatments in the two seasons. In this concern, Meresa *et al.* (2020) reported that the highest number of seeds pod^{-1} was obtained with Sedi peanut variety when fertilized with 30 kg P_2O_5 ha^{-1} in presence of spraying with zinc.

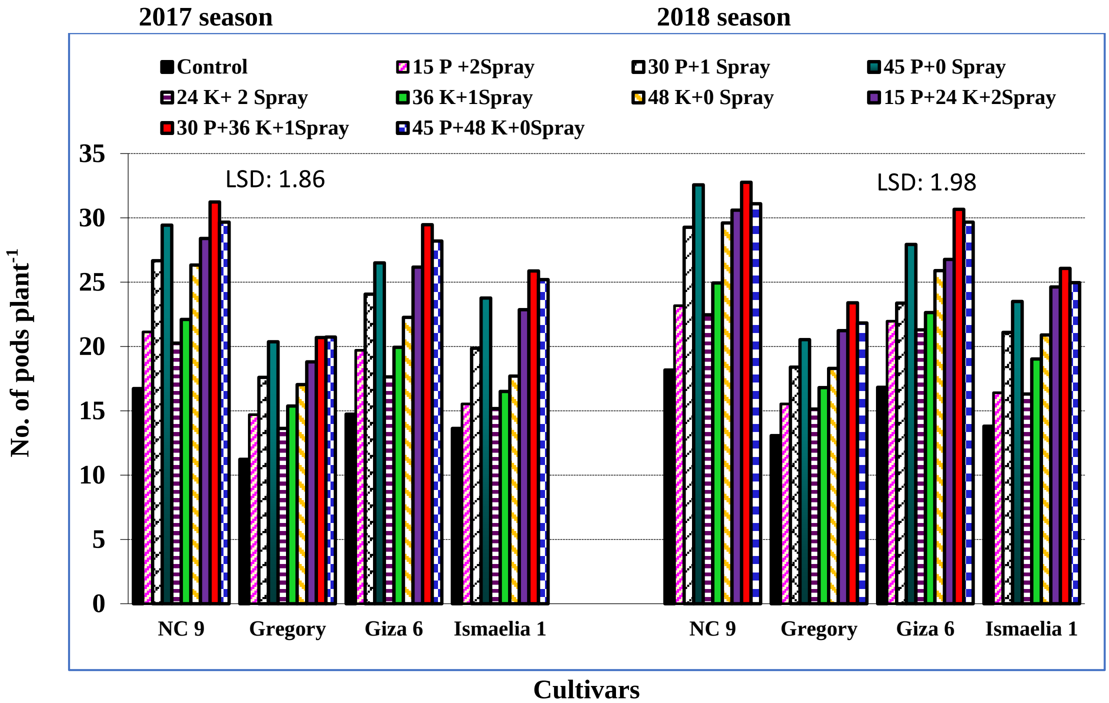

Fig (3). Effect of the interaction between peanut cultivars and PK fertilization on number of pods plant^{-1} during both growing seasons.

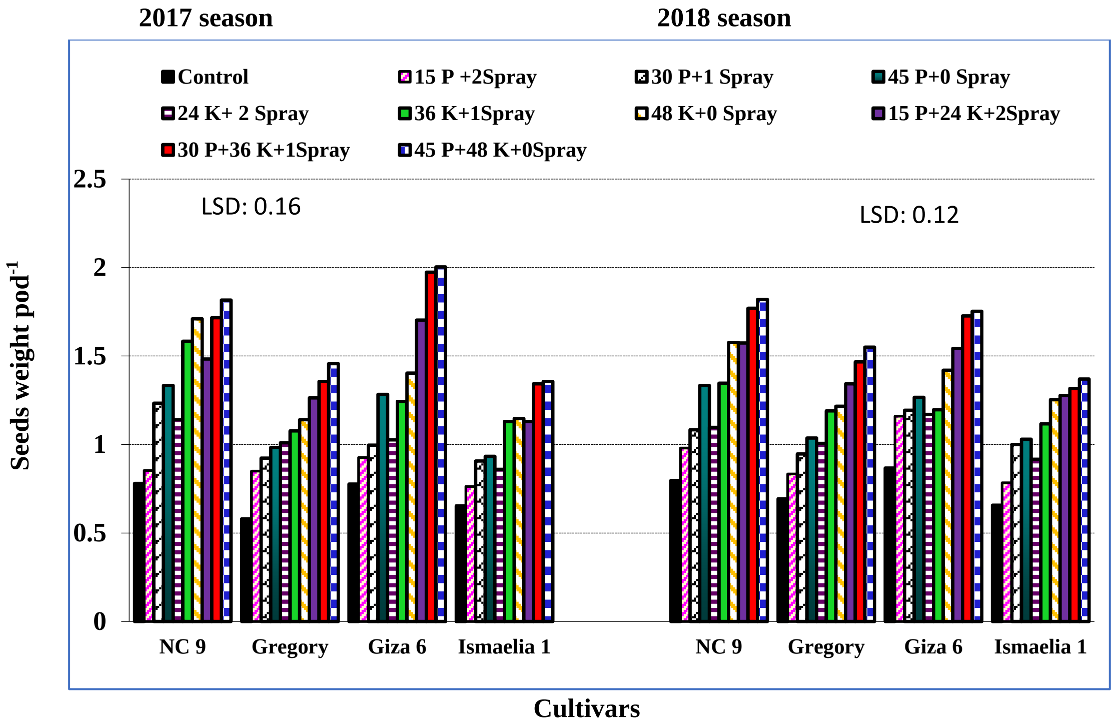

Fig (4). Effect of the interaction between peanut cultivars and PK fertilization on seeds weight pod^{-1} during both growing seasons.

It is interesting to note that the most pronounced interaction between cultivars and fertilization treatments for increasing seed yield plant^{-1} (Fig 5) had occurred generally when the plants of NC 9 or Giza 6 cultivars were fertilized with 30 P_2O_5 + 36 K_2O + one Spray (T9) followed by 45 P_2O_5 + 48 K_2O + 0 Spray (T10) in both seasons. These results may be due to the superiority of such interaction treatments in increasing nodulation characters, nutrients uptake, and seed yield components. On the other hand, the lowest significant value was obtained especially when the plants of Gregory cv. were untreated with any PK fertilization in both seasons. Similar results were obtained by Abd El-Haliem *et al.* (2022) indicated that the NC 9 cultivar, when fertilized with 75 kg K_2O fed^{-1} had the highest value of seed yield plant^{-1}.

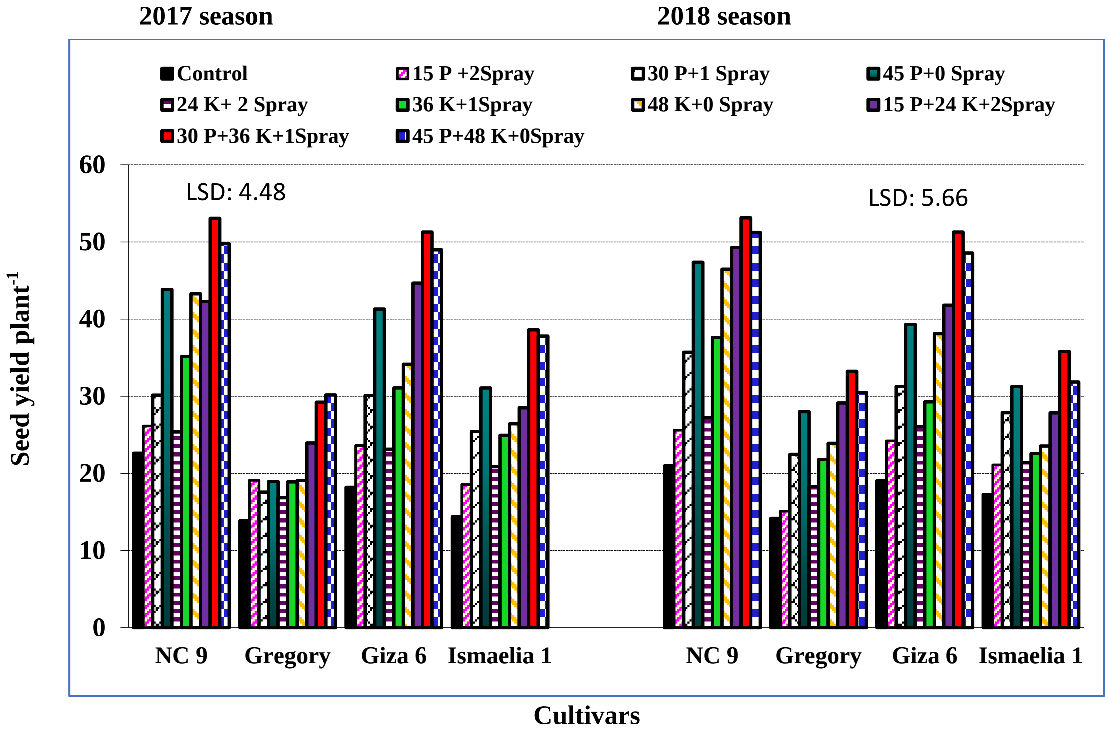

Fig (5). Effect of the interaction between peanut cultivars and PK fertilization on seed yield plant^{-1} during both growing seasons.

Data of the interaction effect are illustrated in Fig (6) for seed yield fed^{-1} and in Fig (7) for pod yield fed^{-1} during both seasons. The data indicated that the maximum values of the two traits were obtained when the plants of NC 9 or Giza 6 cultivars were fertilized with 30 kg P_2O_5 + 36 kg K_2O + one Spray (T9) followed by 45 kg P_2O_5 + 48 kg K_2O + 0 Spray (T10) in both seasons. Therefore, it can be noticed that soil application of medium levels of tested fertilization in the presence of foliar application with one spray was enough for increasing seed and pod yields / feddan more than their application at a high level without foliar application. From these results, it could be concluded that the application of combined treatment (T9) may be recommended for promoting the plant growth characteristics which led to an encouragement the pod formation owning to increasing the plant capacity in building metabolites, and this, in turn, increased pod and seed yields fed^{-1}, as well as save phosphate and potash fertilizers by 33.33% and 25%, respectively that equal 15 kg P_2O_5 + 12 kg K_2O fed^{-1}. On the other side, the lowest values of both traits were obtained by unfertilized Gregory plants in the two seasons. These findings are in harmony with those obtained by Lepcha *et al.* (2022) who found that Gangapuri cultivar when fertilized with 80 kg P_2O_5 ha^{-1} recorded the highest values of seed and pod yields fed^{-1} in comparison with other fertilization treatments.

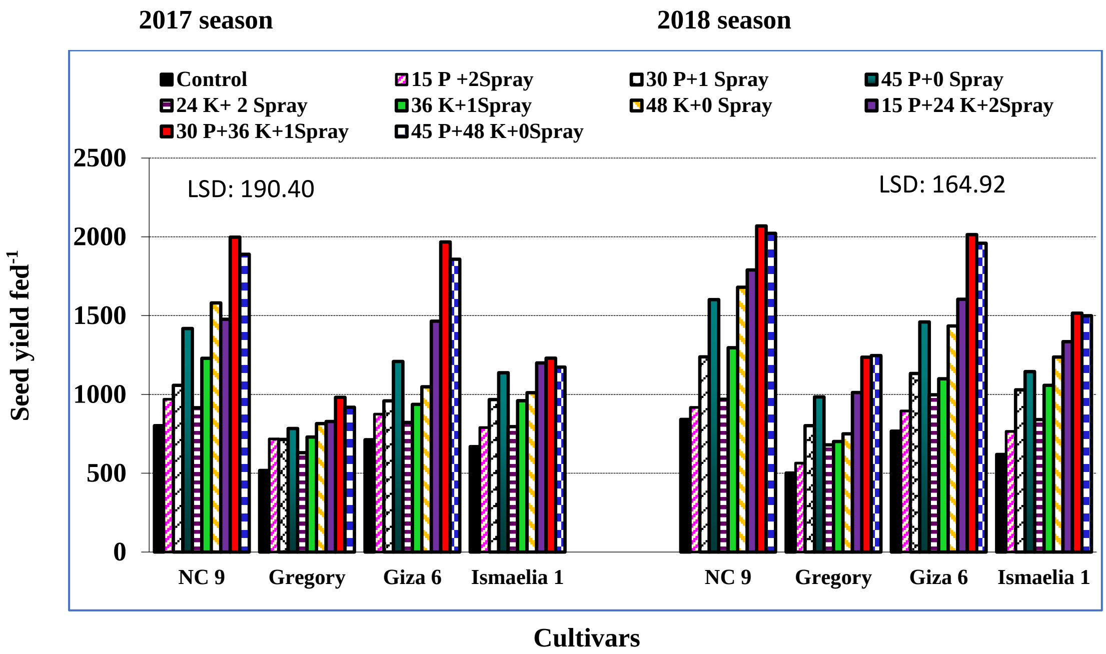

Fig (6). Effect of the interaction between peanut cultivars and PK fertilization on seed yield fed^{-1} (kg) during both growing seasons.

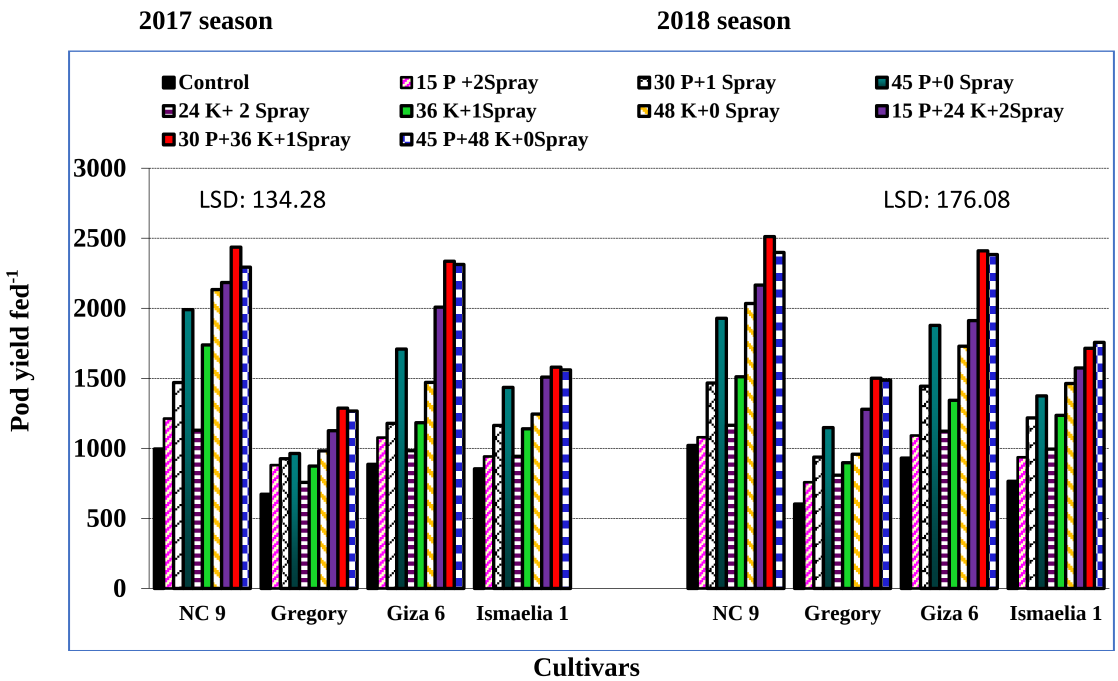

Fig (7). Effect of the interaction between peanut cultivars and PK fertilization on pod yield fed^{-1} (kg) during both growing seasons.

Regarding the variation in the straw and biological yields fed^{-1} gained from the interaction between peanut cultivars and tested fertilization treatments, the data illustrated in Figs (8 and 9) indicated that fertilized NC 9 plants with 30 P_2O_5 + 36 K_2O + one Spray (T9) or 45 P_2O_5 + 48 K_2O + 0 Spray (T10) caused significant increases in straw and biological yields fed^{-1} compared to other tested treatments. These increases could be due to the increases in vegetative growth and nutrient uptake. However, the lowest values of both traits were obtained by unfertilized Gregory plants in the two seasons. This finding seems to be in confirmation with that obtained by Zaki *et al.* (2018) who found that Giza 6 cultivar when fertilized with 100 kg K_2O ha^{-1} recorded the highest values of straw and biological yields.

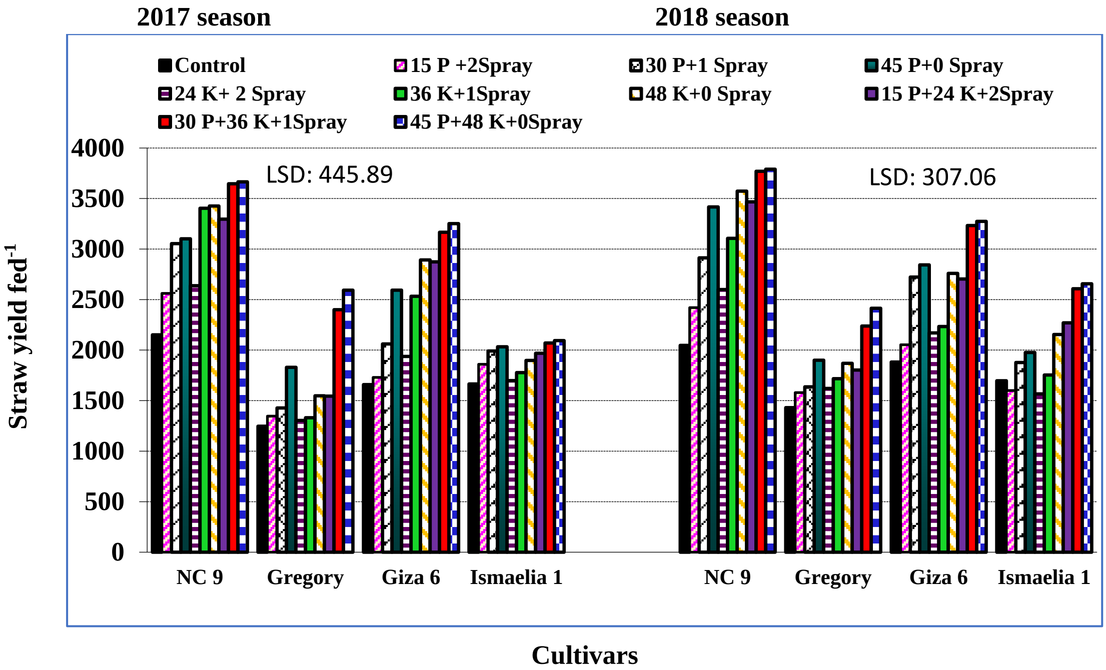

Fig (8). Effect of the interaction between peanut cultivars and PK fertilization on straw yield fed^{-1} (kg) during both growing seasons.

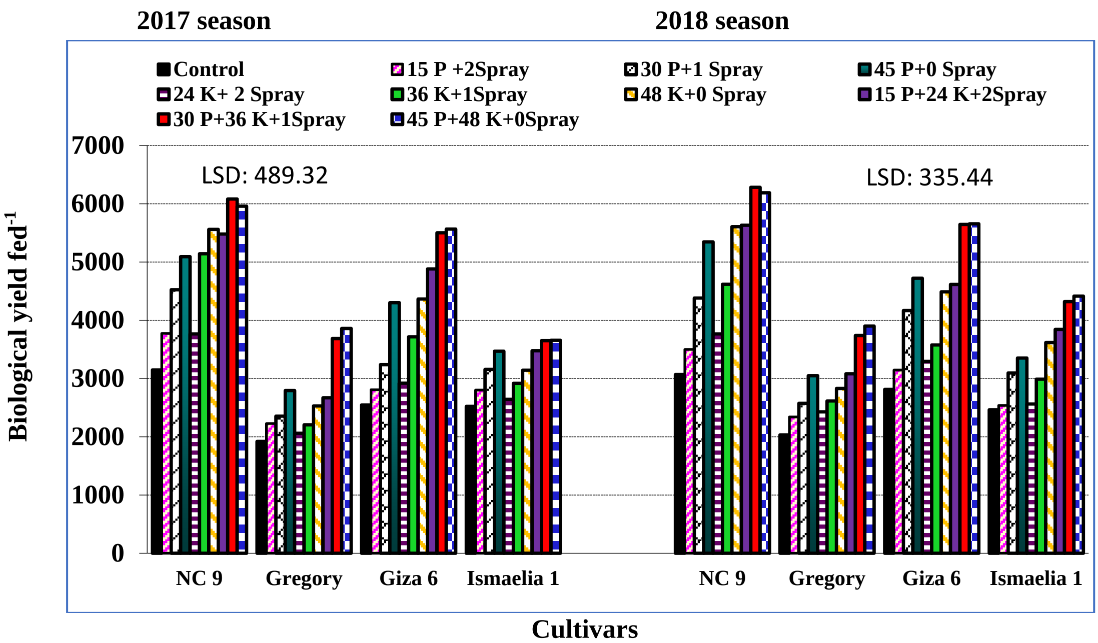

Fig (9). Effect of interaction between peanut cultivars and P K fertilization on biological yield fed^{-1} (kg) during both growing seasons.

Conclusion

From the abovementioned results, it can be concluded that fertilized NC 9 or Giza 6 cultivars with the combination of soil application at a rate of 30 kg P_2O_5 + 36 kg K_2O fed^{-1} in presence of one foliar application at 36 DAS with 2 ml phosphoric acid / L + 3 g potassium sulfate / L were found to be recommended for maximizing peanut productivity and saved phosphate and potash fertilizers by 33.33% and 25%, respectively under the conditions of this experiment.

REFERENCES

Abdel-Haliem, M.S.; Yakout, G.M.; Abdel-Motaleb, H.M.; Abdel-Wahab, A.M. and Nasef, A.A. (2015). Effect of biofertilization in increasing the efficiency of two peanut varieties in utilizing of phosphorus fertilization: 2- Effect on yield. Journal of Plant Production Sciences, 4(1): 12-18.

Abd El-Haliem, M. Sh.; El-Mottaleb, H.M.; Hamada, M.S. and Ali, M.Y. (2022). Potassium fertilization and micronutrients foliar Spray effects on peanut productivity and its export traits using Giza 6 and Nc 9 peanut varieties, in sandy soils. Journal of Plant Production, Mansoura Univ., 13(10): 791-798.

Abd El-Monem, A. and Said, M.T. (2018). Response of some peanut genotypes to phosphorus fertilization levels under New Valley conditions. Assiut Journal of Agricultural Sciences, 49(1): 1-9.

Abdel-Motagally, F.M.F.; Mahmoud, M.W.Sh. and Ahmed, E.M. (2016). Response of two peanut varieties to foliar spray of some micronutrients and sulphur application under East of El-Ewinat Conditions. Assiut J. Agric. Sci., 47(1): 14-30.

Abd El-Saber, A.; Ghareeb, Z.E. and Ahmed, M.A. (2020). Multivariate analyses of yield and its components in some peanut genotypes. Asian J. Adv. Agric. Res, 13(4): 1-15.

Adinurani, P.G.; Rahayu, S.; Purbajanti, E.D.; Siskawardani, D.D.; Stankevica, K. and Setyobudi, R.H. (2021). Enhanced of root nodules, uptake NPK, and yield of peanut plant (*Arachis hypogaea* L.) using Rhizobium and Mycorrhizae Applications. Sarhad Journal of Agriculture, 37(1): 16–24.

Ali, E.A.; Said, M.T.; Syed, M.A. and Sonosy, M. R. (2020). Impact of foliar spray by zinc oxide nanoparticles on peanut production under New Valley conditions. Assiut Journal of Agricultural Sciences, 51(4): 16-31.

Argaw, A. (2017). Development of environmental friendly bioinoculate for peanut (*Arachis hypogea* L.) production in eastern Ethiopia. Environ Syst. Res., 6-23 (1): 1-12.

Asante, M.; Ahiabor, B.D.K. and Atakora, W.K. (2020). Growth, nodulation, and yield responses of groundnut (*Arachis hypogaea* L.) as influenced by combined application of rhizobium inoculant and phosphorus in the Guinea Savanna zone of Ghana. International Journal of Agronomy, 2020 (1): 8691757: 1-7.

Black, C.A. (1965). Methods of Soil Analysis. Part 2. Chemical and Microbiological Properties. American Society of Agronomy, Madison, Wisconsin. USA.

Cagasan, U. and Orbeta, H. (2020). Enhancing yield and profitability of peanut (*Arachis hypogaea* L.) to application of different organic foliar fertilizer. Eurasian Journal of Agricultural Research, 4(2): 124-133.

Campos, J.V.L.; Luís Oliveira Cunha, M.; Do Nascimento, V.; De Figueiredo, P. A. M. and Ferrari, S. (2023). Can foliar application of nutrients increase the productive potential of peanuts?. Gesunde Pflanzen, 75(4): 1379-1383.

Chaiyadee, S.; Jogloy, S.; Songsri, P.; Singkham, N.; Vorasoot, N.; Sawatsitang, P.; Holbrook, C.C. and Patanothai, A. (2013). Soil moisture affects fatty acids and oil quality parameters in peanut. International Journal of Plant Production, 7(1): 81-96.

Chapman, H. and Pratt, P. (1978). Methods of Analysis for Soils and Waters, USA, University of California, Division of Agriculture Science, CA.

Ding, B.; Feng, M.; Wang, R.; Chang, L.; Jiang, Y.; Xie, J. and Tian, D. (2024). A study of growth and yield of four peanut varieties with rhizobia inoculation under field conditions. Agronomy, 14(7): 1410: 1-11.

El-Far, I.A.; Dawood, R.A.; Abd El-Rahim, H.M. and Senoosy, A.Y. (2013). Effect of nitrogen and phosphorus fertilization on yield and its attributes for some peanut varieties in sandy calcareous soil. Assiut Journal of Agricultural Sciences, 44(2): 1-12.

Farag, I.A. and Zahran, A.A. (2014). Groundnut (*Arachis hypogaea* L.) growth and yield responses to seed irradiation and mineral fertilization. IOSR Jour of Agri. and Veti. Sci., 7, 63-70.

Gomez, K. and Gomez, A. (1983). Statistical Procedures for Agricultural Research. Second Edition, John Wiley and Sons, Hoboken, 630 p.

Hamissa, A. M.; Hammouda, F. M. and Knany, R. E. (2000). Response of nodulated faba bean crop to phosphate solubilizing bacteria under phosphorus fertilization and copper foliar spray application. J. Agric. Sci. Mansoura Univ., 25(5): 2995-3007.

Hefny, Y.A.A.; and Ahmed, A.A. (2017). Study the effect of phosphorus fertilizer rates and plant densities on the productivity and profitability of peanut in sandy soil. Assiut Journal of Agricultural Sciences, 48(4): 15-28

Iddrisu, A.; Adjei, E.; Asomaning, S.K.; Santo, K.G.; Isaac, A.P. and Danson-Anokye, A. (2024). Effect of variety and plant spacing on growth and yield of groundnuts (*Arachis hypogaea* L.). Agricultural Sci, 15(01): 54-70.

Jackson, M.L. (1973). Soil Chemical Analysis, Prentice Hall of India Pvt. Ltd., New Delhi, India, 498: 151-154.

Lepcha, E.; Shyamal, K.; Haider, D.; Barman, S.K.; Kausik, M. and Panda, P. (2022). Effect of phosphorus on yield, nutrient acquisition and use efficiency of groundnut in West Bengal, India. Legume Research-An International Journal, 45(9): 1149-1154.

Mahmowd, M.W.Sh.; Sedeck, F.Sh.; Khafagy, E.E.E. and Mosaad, I. S. M. (2014). Effect of applied N, P and K on peanut yield, quality and nutrients uptake in sandy soils. Journal of Soil Sciences and Agricultural Engineering, 5(8): 1141-1154.

Meena, H.N.; Yadav, R.S. and Bhaduri, D. (2018). Effects of potassium application on growth of peanut (*Arachis hypogaea*) and ionic alteration under saline irrigation. Indian Journal of Agronomy, 63(1): 73-81.

Mekdad, A.A.A. (2019). Response of Arachis hypogaea L. to different levels of phosphorus and boron in dry environment. Egyptian Journal of Agronomy, 41(1): 21-28.

Mekki, B.B. (2015). Yield and yield components of groundnut (*Arachis hypogaea* L.) in response to soil and foliar application of potassium. American-Eurasian J. Agric. & Environ. Sci., 15(10): 1907-1913.

Meresa, H.; Assefa, D. and Tsehaye, Y. (2020). Response of groundnut (*Arachis hypogaea* L.) genotypes to combined application of phosphorus and foliar zinc fertilizers in Central Tigray, Ethiopia. Environmental Systems Res., 9: 1-9.

Mouri, S.J.; Sarkar, M.A.R.; Uddin, M.R.; Sarker, U.K.; kaysar, M.S. and Hoque, M.M.I. (2018). Effect of variety and phosphorus on the yield components and yield of groundnut. Progressive Agriculture, 29(2): 117-126.

Noaman, H.; Mohamed, A. H., Ibrahim, H., and Abdel Monsef, O. (2022). Influence of foliar application of some micronutrients levels on growth, yield, yield attributes, micronutrients content and fatty acids of two groundnut (*Arachis hypogaea* L.) varieties. Egyptian Journal of Agronomy, 44(1): 83-95.

Rusmayadi, G. and Safruddin, S. (2024). Effect of Soil pH Variation on Peanut Plant Growth. West Science Agro, 2(2): 63-69.

Sabra, D.M.; El-Bagoury, O.H.; El Habasha, S.F.; Fergani, M.A.; Mekki, B.B.; El-Housini, E.A. and Abou-Hadid, A.F. (2020). Effect of some micronutrients foliar application on chemical characters of two groundnut cultivars. Plant Archives, 20(1): 1367-1376.

Samaha, G.M.; Ahmed, M.A. and Abd El-Hameid, A.R. (2019). Assessment of growth and productivity of five peanut cultivars and genetic diversity using RAPD markers. Bulletin of the National Research Centre, 43: 1-11.

Seadh, S.E.; Abido, W.A.E.; Abd El-Al, A.N. and Ibrahim, Z.A.A. (2017). Effect of NPk levels on productivity and seed quality of some groundnut genotypes under newly reclaimed sandy soils conditions. Journal of Plant Production, 8(5): 605-609.

Shahrajabian, M. H.; Sun, W. and Cheng, Q. (2022). Foliar application of nutrients on medicinal and aromatic plants, the sustainable approaches for higher and better production.

Beni-Suef University Journal of Basic and Applied Sciences, 11(1): 1-10.

Sharma, S. (2012). Effect of fertility levels and biofertilizers on growth, yield and quality of groundnut (*Arachis hypogaea* L.), M.Sc. thesis, Swami Keshwanand Rajasthan Agricultural University, Bikaner S.K.N. College of Agriculture, Jobner. India.

Silitonga, L.; Turmudi, E. and Widodo, W. (2018). Growth and yield response of Peanut (*Arachis hypogaea* L.) to cow manure dosage and phosphorus fertilizer on ultisol. Akta Agrosia, 21(1): 11-18.

Singh, I.D. and Stokopf, N.C. (1971). Harvest index in cereals 1. Agronomy Journal, 63(2): 224-226.

Statistics of Agriculture Ministry (2022). https://www.agri.gov.eg/library/25.

Yakubu, H.; Kwari, J.D. and Sandabe, M.K. (2010). Effect of phosphorus fertilizer on nitrogen fixation by some grain legume varieties in Sudano–Sahelian Zone of North Eastern Nigeria. Nigerian journal of Basic and Applied science, 18(1): 44-49.

Yaro, R.N.; Mahama, A.R.; Kugbe, J. X. and Berdjour, A. (2021). Response of peanut varieties to phosphorus and rhizobium inoculant rates on Haplic Lixisols of Guinea Savanna zone of Ghana. Frontiers in Sustainable Food Systems, 5, 616033: 1-13.

Zahran, H.A. and Tawfeuk, H.Z. (2019). Physicochemical properties of new peanut (*Arachis hypogaea* L.) varieties. OCL, 26, 19: 1-7. https://doi.org/10.1051/ocl/2019018.

Zaki, N.M.; Ahmed, A.G.; Hassanein, M.S. and Mohamed, M.H. (2017). Effect of organic and bio-fertilizer on yield and some chemical composition of two peanut cultivars under newly reclaimed sandy soil condition. Middle East Journal of Applied Sciences, 7(4): 937-943.

Zaki, N.M.; Ahmed, A.G.; Hassanein, M.S. and Salem, A.K. (2018). Effect of water regime and potassium fertilization on productivity of two peanut cultivars under newly reclaimed sandy soil condition. Journal of Appl. Sci., (8): 483-491.

Zoz, T.; Fiorese, D.A.; Pivetta, L.A.; Zoz, A.; Zoz, J. and Zuffo, A.M. (2018). Phosphorus and potassium fertilization in creeping peanut. Scientia Agraria, 19(1): 153-159.

التكامل بين الإضافة الأرضية والورقية للفوسفور والبوتاسيوم على إنتاجية بعض أصناف الفول السوداني

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أجريت تجربتان حقليتان في مزرعة خاصة بقرية الجزار، مدينة السادات، محافظة المنوفية، مصر خلال موسمي ٢٠١٧ و٢٠١٨ بهدف دراسة استجابة بعض أصناف الفول السوداني المستوردة (NC 9 ، Gregory) والمحلية (جيزة ٦ وإسماعيلية ١) للتكامل بين مستويات مختلفة من الإضافة الأرضية للأسمدة الفوسفاتية والبوتاسية مع الرش الورقي. وقد تمت الاضافة الأرضية للفوسفور بمعدلات ١٥ ، ٣٠ و٤٥ كجم P_2O_5 للفدان والبوتاسيوم بمعدلات ٢٤ ، ٣٦ و٤٨ K_2O للفدان إما بشكل منفرد لكل عنصر أو مختلطان. وقد تمت الاضافة الورقية للفسفور فى صورة حمض الفوسفوريك بمعدل ٢ مل / لتر ماء بينما البوتاسيوم فى صورة كبريتات البوتاسيوم بمعدل ٣ جم / لتر ماء. ويمكن إيجاز أهم النتائج المتحصل عليها على النحو التالي:

أوضحت النتائج فروق معنوية بين الأصناف المختبرة في تكوين العقد الجذرية والإنتاجية في كلا الموسمين. زاد تكوين العقد الجذرية بنباتات الصنف NC 9 يليه الصنف جيزة ٦. هذا وتفوق الصنف NC 9 تفوقًا معنوياً على أصناف الفول السوداني الأخرى المختبرة فى الصفات المحصولية باستثناء صفتى وزن ١٠٠ بذرة ودليل الحصاد التى سجلهما صنفى جيزة ٦ وإسماعيلية ١ على التوالي. وقد شارك صنف جيزة ٦ التفوق مع صنف NC 9 دون اختلافات معنوية بينهما في صفات عدد البذور بالقرن ، وزن بذور القرن. وعلى الجانب الآخر، سجل صنف Gregory أقل القيم مقارنة بالأصناف الأخرى في كلا موسمي الزراعة.

أشارت النتائج إلى تفوق المعدلات العالية من الفسفور والبوتاسيوم عند اضافتها بشكل منفرد أو مختلط فى تكوين العقد الجذرية والصفات المحصولية مقارنة بالمعدلات الصغرى منها وكذلك النباتات غير المسمدة والتي سجلت أقل القيم. هذا وقد سُجلت أعلى قيم لصفات العقد الجذرية وكذلك المحصول ومكوناته عند التسميد بمعدل ٣٠ كجم P_2O_5 + ٣٦ كجم K_2O للفدان مع إجراء رشة واحدة بمعدل ٢ مل حمض الفوسفوريك + ٣ جم كبريتات البوتاسيوم / لتر أو عند التسميد بمعدل ٤٥ كجم P_2O_5 + ٤٨ كجم K_2O للفدان بدون رش ورقى وذلك بدون فروق معنوية بينهما لجميع الصفات المدروسة.

أشارت نتائج التفاعل إلى تأثر معظم الصفات المدروسة تأثراً معنوياً بالتفاعل بين الأصناف ونظم التسميد خلال موسمى الزراعة. أدى تسميد نباتات صنف NC 9 أو جيزة ٦ بمعدل ٣٠ كجم P_2O_5 + ٣٦ كجم K_2O للفدان مع إجراء رشة واحدة بمعدل ٢ مل حمض الفوسفوريك + ٣ جم كبريتات البوتاسيوم / لتر عند عمر ٣٦ يوم من الزراعة إلى تعظيم انتاجية الفول السودانى من محصول البذور والقرون للفدان مقارنة ببقية المعاملات الأخرى المختبرة مع توفير الأسمدة الفوسفاتية والبوتاسية بنسبة ٣٣,٣٣ و ٢٥٪ على الترتيب وذلك تحت ظروف هذه التجربة.

الكلمات المفتاحية: *Arachis hypogaea* – *التسميد – تكوين العقد الجذرية - المحصول*