Zagazig J.Agric. Res., Vol .30 No.(2) 2003 *335-358*

EFFECT OF DIFFERENT LEVELS OF POTASSIUM AND PHOSPHORUS FERTILIZERS WITH THE FOLIAR APPLICATION OF ZINC AND BORON ON PEANUT IN SANDY SOILS (*)

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Received 19 / 2 / 2003 ***Accepted 1 / 3 / 2003***

ABSTRACT: Two field experiments were conducted in the Experimental farm, Faculty of Agriculture, Zagazig University at Khattara, Sharkia Governorate, Egypt during 2000 and 2001 seasons to study the effect of potassium levels (24, 48 and 72 kg K_2O/fad.), phosphorus levels (15.5 and 31.0 kg P_2O_5/fad.) and sprying with micronutrients (control, 2% Zinc, 1% Boron and 2% Zinc + 1% Boron) on yield and yield attributes of peanut (Giza 6 cv).

Adding potassium fertilizer significantly increased each of leaf chlorophyll content, plant height, number of branches and pods/plant, weight of pods and seeds/plant, 100-seed weight, Pod and seed yields /fad., shelling percentage, fodder yield/fad., seed oil percentage and oil yield/fad.

Addition of phosphorus fertilizer caused significant increase in seed and fodder yields and all their attributes with the exception of plant height in the first season, 100-seed weight and seed oil percentage in the two season and their combined as well as shelling percentage in the second season and combined analysis.

Application of foliar spray with Zn and Bo or its combination slightly improved yield and its attributes as well as seed quality in the two seasons and their combined.

Results of interaction between potassium and phosphorus fertilizer and between phosphorus and spraying with micronutrients

(*) Research was funded by Regional Council Research and Extension (French side fund No. 13/M/SH).

recommended that peanut should be fertilized with 72 kg K_2O/fad. and 31.0 kg P_2O/fad.

Seed yield (kg/fad.) was positively correlated with each of leaf chlorophyll content, plant height, number of branches/plant, number of pods/plant, pods weight/plant, 100-seed weight, pods yield/fad., shelling percentage and fodder yield and correlation coefficients were 0.847, 0.937, 0.849, 0.929, 0.908, 0.913, 0.898, 0.983, 0.948 and 0.966, respectively.

Path analysis revealed that, the main sources of seed yield variation according to their relative importance were, 100-seed weight (34.305), seed weight/plant (30.125) and number of pods/plant (27.20). since, the direct and indirect effects of these three characters valued 91.63% from seed yield variation.

INTRODUCTION

The peanut is an important warm- season oil seed crop and food grain legume, it contain about 50% oil, 25-30% protein, 20% carbohydrate and 5% fiber and ash and make a substantial contribution to human nutrition (Fageria *et al.*, 1997). This crop has been given great attention from the Government and scientific institutes due to its importance for the new reclaimed sandy areas. Under sandy soil conditions, peanut may need P, K fertilizers and micronutrients to improve pods production and its quality.

Regarding potassium fertilizer Eweida *et al.*, (1980) and Angadi *et al.*, (1989) showed a positive response in yield of peanut to K fertilizer. Saha *et al.*, (1994) and Patra *et al.*, (1996) indicated that pod yield and yield components were increased by K application. In addition, Patra *et al.*, (1995) found that application of 45 K_2O/fad. increased yield and yield attributes as well as oil content in seeds of peanut. Ghatak *et al.*, (1997) indicated that pod yield of peanut increased significantly with K up to 30kg K_2O/ha. However, Anton and Bassiem (1998) and Gabr (1998) observed that adding 48 K_2O/fad. significantly increased each of plant height, number of pods/plant, weight of pods and seeds/plant, 100-seed weight, yield of pods and seeds/fad. Moreover Dahdouh (1999) showed that application K fertilizer up to 48kg K_2O /fad. increased significantly pods yield/fad., shelling percentage and seed oil percentage. Furthermore, El-far and Ramadan (2000) observed that application of 36kg K_2O /fad. significantly increased each of number of branches/plant, pods weight/plant, 100-seed weight, shelling percentage and pods yield/fad. Recently, Darwish *et al*., (2002) noticed that adding 48 kg K_2O /fad. significantly increased seed and oil yields/fad.

Concerning P fertilizer, adding P fertilizers tended to improve yield and yield attributes of peanuts. Peanut yields appeared to be gradually increased as P level increased under the most conditions as reported by Geweifel and Ali (1990); Patel (1992); Yakadri *et al*., (1992); Bhatol *et al*., (1994); Singth *et al*., (1994); Ali *et al*., (1995) and Anton and Bassiem (1998). In addition, Nasr-Alla *et al*., (1998) indicated that increasing the rate of PK individual or in combination increased number of branches/ plant, yield of pods/plant and per fad. of peanut. Moreover EL-far and Ramadan (2000) showed that 46.5kg P_2O_5/fad. and 36 kg K_2O /fad. application had highly significant effect on yield and its attributes.

With respecting to the influence of micronutrients, Patil *et al*., (1983) and Abdel Aziz *et al*., (1985) found that foliar spraying of boron increased pod and seed yields and seed oil content. In addition, Malewar *et al*., (1993) when used four levels of zinc sulphate (0, 10, 20 and 30 kg/ha) found that 20 kg Zn/ha gave the highest dry weight yield and 100-seed weight. Moreover, Darwish *et al*., (2002) used 1000 ppm zinc sulphate and 100 ppm boric acid, found that fertilized peanut by 48kg K_2O /fad. combined with spraying zinc obtained the highest values of seed yield and oil yield/fad.

Therefore, the objective of this investigation was to study the influence of P and K fertilizers as well as boron and zinc application on yield and yield attributes of peanut grown under sandy soil conditions.

MATERIALS AND METHODS

This investigation was conducted at the Agricultural Research Station of the Faculty of Agric., Zagazig University at Khattara during two growing seasons (2000 and 2001). The soil of the Experimental site is sandy in texture, it had an average pH value of 7.9 and organic matter content of 0.48%. The available N, P and

K contents were 10.5, 2.99 and 89 ppm, respectively (averaged over the two seasons for the upper 30cm of soil depth).

The experiment included three factors as follow:

A : Potassium fertilizer levels:

1- 24kg K_2O /fad.

2- 48kg K_2O / fad.

3- 72kg K_2O /fad.

B : Phosphorus fertilizer levels:

1- 15.5kg P_2O_5/fad.

2- 31.0kg P_2O_5/fad.

C : Micronutrients :

1- Control.

2- Zn (2%).

3- Bo (1%).

4- Combination of Zn (2%) + Bo (1%)

Phosphorus fertilizer in form of ordinary calcium superphosphate (15.5% P_2O_5) was added at sowing and after 25 days after sowing (DAS). Potassium sulphate (48% K_2O) was added at sowing,20 and 40 DAS and nitrogen fertilizer in form ammonium sulphate (20.5% N) at rate of 30kg N/fad. was applied at sowing. In addition, gypsum was applied at the beginning of flowering stage at rate of 0.5 ton/fad.

After 42 and 62 DAS plants were sprayed with boron in the form of boric acid at the concentration of 1% and zinc in the form of zinc sulphate at the concentration of 2%.

A split- split plot design with three replicates was followed. Potassium fertilizer levels were assigned to the main plots whereas phosphorus fertilizer levels and micronutrients were allotted in the 1st and 2nd sub- plots, respectively. The area of plot was 15m^2 (3x5m) included six rows 50cm apart, two plant/hill and 20cm between hills, Giza 6 cultivar seeds were sown on may 3rd and 5th in the first and second seasons, respectively. The preceding crop was wheat in the two seasons. The normal cultural practices for peanut fields were followed.

After 75 DAS leaf chlorophyll content of 10 plants of the third row was determined using chlorophyll meter (SPAD- 502, soil- plant analysis Development (SPAD) section Minolta camera co., Oska, Japan) according to Castelli *et al.*, (1996).

At harvest, the following characters were estimated on ten plants taken randomly from every plot in both seasons:

1- Plant height (cm).

2-Number of branches/plant.

3- Number of pods/plant.

4- Pods weight/plant.

5- Seed weight/plant.

6-100-seed weight.

7- Shelling percentage.

In addition 7.5 square meter were harvested from the middle of experimental plots and the following characters were recorded after pod drying, except forage yield (ton/fad.) which recorded after harvested directly :

1- Pods yield (kg/fad.).

2- Seed yield (kg/fad).

3- Seed oil percentage.

4- Oil yield (kg/fad.).

Dried mature seeds were ground into very fine powder to determine oil percentage using soxhelt apparatus and diethyl ether according to A.O.A.C (1980). Oil yield was estimated by multiplying seed oil percentage by seed yield/fad. Analysis of variance and combined analysis for the two seasons were carried out as described by Snedecor and Cochran (1982). The differences among treatments were compared using Duncan's multiple range test Duncan (1955), where means had the different letters were statistically significant, while those means followed by the same letters were statistically insignificant. In the interaction tables, capital and small letters were used to compare between means in rows and columns, respectively. The combined analysis of variance of the two seasons was used to calculate the simple correlation coefficients and path analysis as described by Svab (1973).

RESULTS AND DISCUSSION

Illustrated data in tables 1, 2 and 3 show the effect of potassium, phosphorus and micronutrients application on leaf chlorophyll content, yield, yield attributes and quality of peanut.

1. Leaf chlorophyll content (LCC):

Potassium application significantly affected Lcc in both seasons and combined, when it tended to be increase as K fertilizer application increased from 24 to 72 kg K_2O /fad. Then, the highest Lcc was obtained by 72 kg K_2O /fad. application indicating the great role of K in peanut growth and its activity in the function of enzyme needed for biological processes. Concerning the effect of phosphorus fertilizer, the results showed the superiority of high level of P (31.0 kg P_2O_5/fad.) in this respect, confirmed the positive response of Lcc to P-fertilizer application. In other words, increasing both K and P fertilizer levels appeared to be increased Lcc of peanut plants. Micronutrients had no significant effect on Lcc of peanut plants, however a little increase was observed when the combination of Zn+Bo was applied.

In addition, the significant interaction between K and P levels on Lcc (Table 1-a) indicate that Lcc tended to be increased as either K or P levels increased then, the highest Lcc (43.93) was achieved when 72 kg K_2O /fad. and 31.0 kg P_2O_5/fad. were applied. Otherwise, the lowest Lcc was recorded with the low levels of both fertilizers.

2- Yield attributes:

Potassium fertilizer levels had significant effect on all yield attributes including plant height, number of branches/plant, number of pods/plant, pods weight/plant, seed weight/plant and 100-seed weight (Tables 1 and 2). Increasing K level from 20 to 72 kg K_2O/fad. significantly increased the abovementiond yield attributes. Such beneficial effect of K fertilizer could be attributed to its essential role in growth and establishment of peanut plants in addition to its activity in the function of enzymes for the biological processes in plants which lead to increase in yield components. These results are in agreement with those reported by Abdel-Wahab *et al.*, (1986), Thimmegowdd (1995), Patra *et al.*, (1996), Roy *et al.*, (1996), Gabr (1998) and Anton and Bassiem (1998), who found that K application appeared to be improved the yield attributes of peanut plants.

Concerning phosphorus application, the results indicated significant or highly significant differences either during both seasons or its combined, when high level of 31.0 kg P_2O_5/fad. Produced longer plants, higher number of branches, number of pods and pod and seed weights / plant. However, the differences did not reach the level of significance, regarding 100-seed weight. Such favourable effects on growth and yield attributes could be attributed to the stimulation effects of P on number and weight of nodules and nitrogen activity as reported by Sankar *et al.*, (1984), which in turn reflected positively on peanut yield attributes. Similar results were reported by several investigators among them Eweida *et al.*, (1980); Das (1982), Patil *et* *al*., (1982); Abdel-Wahab *et al*., (1986); Geweifel and Ali (1990); Madkour *et al*., (1990); Ali *et al*., (1995); Anton and Bassiem (1998) and El-Far and Ramadan (2000).

Regarding the influence of micronutrients on yield attributes of peanut (Tables 1 and 2), no significant differences could be detected either during both seasons or their combined in this respect. However, application of Zn+Bo combination tended to improve the most yield attributes of peanut, but the differences could not reach the level of significance. In this connection, Veeranna *et al*., (1982) indicate that, the response to application of 50kg $ZnSo_4$ over N_{20} P_{40} K_{30} kg/ha was significant (2.7 q/ha). Also, Malewar *et al*., (1993) used four levels of Zinc sulphate (0, 10, 20 and 30 kg/ha), found that 20 kg Zinc sulphate/ha gave the highest dry weight yield and 100-seed weight of peanut.

With respecting to the significant interaction between K and P levels on number of branches, number of pods and seed weight/plant (Table 1-a) the results followed the same patterns of the main effects, whereas increasing both fertilizer levels appeared to be increased the abovementioned yield attributes. Therefore, the highest number of branches/plant (10.48), number of pods/plant (16.76) and seed weight/plant (11.68gm) were obtained when the high levels of both fertilizer (72kg K_2O and 31.0kg P_2O_5) were applied. In this connection, Anton and Bassiem (1998) showed that pods weight/ plant, seed weight/plant, straw weight/plant and 100-seed weight were increased significantly when peanut plants fertilized with the high levels of P and K (30kg P_2O_5+48kg K_2O /fad.) compared with the lower levels of both elements. These results may be due to the beneficial effect of P and K on both rhizobium activity and plant growth which in turn reflected positively on peanut yield attributes.

3- Pod and seed yields kg/fad.

Increasing P from 24 to 72kg K_2O /fad. significantly increased both pod and seed yields/fad. Then, the highest pod and seed yields/fad. were obtained when 72kg K_2O /fad. was applied. Pod and seed yields/fad. gradually increased when K level was increased from 24 to 48 and 72kg K_2O /fad. The high level (72kg K_2O /fad.) outyielded both low and mid K-levels by around 24.71;

6.79% and 39.45; 10.59%, regarding combined results of pod and seed yields/fad. for the same followed order. The results followed the same patterns of other yield attributes confirmed the vital role of K element in growth and improvements of productivity of peanut. Such results may be due to adequacy of K applied that in turn favors the plant growth and productivity of peanut. This means that K soil content is not fairly enough to face the requirements of peanut under such conditions. Similar results were obtained by Gabr (1998); Madkour *et al.*, (1992); Dahdouh (1999) who found that application of K resulted in a significant positive increase in pods yield and Ahmed and Zeidan (2001) who reported that K application increased pod yield by 40 and 39.6% in both seasons, respectively. Also, Darwish *et al.*, (2002) stated that application of K at the rate of 48kg K_2O /fad. gave the highest seed yield/fad. in 1999 and 2000 seasons.

Moreover, P results showed highly significant difference in both seasons and their combined when the high level of P (31.0kg P_2O_5/fad.) produced higher pod and seed yields/fad. compared with low P level (15.5 kg P_2O_5/ fad.). Meanwhile, high P level overyielded low P level by 8.91% and 10.42% for pod and seed yields/fad., respectively concerning the combined results. These results followed the same patterns of other yield attributes, whereas P application improved the productivity of peanut, since P fertilization had promising effects on growth and yield attributes which resulted in produce more pods and seeds per unit area. Similar results were reported by Geweifel and Ali (1990); Madkour *et al.*, (1990); Ali *et al.*, (1995); Anton and Bassiem (1998); Ghatak *et al.*, (1997); Kumar and Raychudhuri (1997); Nasr-Alla *et al.*, (1998) and El-far and Ramadan (2000) who indicate that increasing P fertilizer increased pod and seed yields per unit area of land.

Regarding the effect of foliar spray with Zn and Bo or its combination on pod and seed yields/fad. (Table 2), the results indicate insignificant differences either during both seasons or the combined. These results followed the same patterns of growth and yield attributes (Tables 1 and 2) of peanut plants indicating to either no positive response to such micronutrients or little low doses applied or present enough level of those elements which needed more trials and investigations in this respect. In this connection, Veeranna *et al*., (1982) showed that 50kg $ZnSo_4$ increased yield and yield attributes of peanut during two seasons. Also, Malewar *et al*., (1993) indicated that high level of 20kg Zn/ha gave the highest dry weight of peanut compared with lower levels of Zn. In addition, Darwish *et al*., (2002) showed that spraying zinc (K_2+Zn) combined with 48kg K_2O /fad. obtained the highest seed yield of peanut in 1999 and 2000 seasons. Also, Patil *et al*., (1983) found that foliare spraying of boron increased yield of peanut.

The significant interaction effects between K and P fertilizer level on pod and seed yields/fad. (Table 2-a) indicate that increasing either of K or P level tended to increase both pod and seed yields of peanut. Therefore the highest yield of pods (887.2 kg/fad.) and seed (469.1kg/fad.) were achieved by high level of 72 kg K_2O /fad. when 31.0 kg P_2O_5/ fad. was applied. Otherwise, low levels of both fertilizers produced the lowest pod and seed yields.

4- Shelling percentage

Shelling percentage as influenced by K, P and micronutients application during both seasons and combined analysis are given in Table (3). Meanwhile, application of K as well as increasing its rates resulted in significant increase in shelling percentage during both seasons, while it reached highly significant increase at combined. The lowest shelling percentage was obtained by the lower K level indicating the vital role of potassium in increasing seed weight on account of pod hulls. Similar results were obtained by Nasr-Alla *et al*., (1998) and Dahdouh (1999).

Likely, P application tended to improve shelling percentage, but the differences could not reach the level of significance in the second season and the combined. These results are in agreement with those reported by Geweifel and Ali (1990). However, Abdel-Wahab *et al*., (1986) indicated that P decreased shelling percentage significantly in 1980, and increased it significantly in 1981, while it was not affected by P application in 1982. Also, Anton and Bassiem (1998) reported that shelling percentage was not significantly affected by P application.

Regarding the effect of micronutrients on shelling percentage, no significant differences could be detected either when Zn and Bo was applied alone or in combination of both. In spite of the insignificant differences, the combined of Zn and Bo tended to improve shelling percentage. The results followed the same patterns of growth and yield attributes.

5- Fodder yield (ton/fad.):

Fodder or straw yield which could be used as animal feeding forage or get involved in other several products or practices responded highly significantly during both seasons and the combined to application as well as increasing K level up to 72kg K_2O /fad. Therefore, fodder yield tended to be gradually increased as K level increased from level to another. These results are in agreement with those reported by Madkour *et al.*, (1990) and Anton and Bassiem (1998). However, Huber (1956) and Abdel-Wahab *et al.*, (1986) reported that straw yield did not respond significantly to the application of K fertilizer.

Likely, increasing P level tended to be increased fodder yield/fad. and such increment confirmed highly significantly during both seasons and its combined. These results are in a good line with those reported by Patil *et al.*, (1983); Patel *et al.*, (1988); Geweifel and Ali (1990); Quadri *et al.*, (1991); Fathi *et al.*, (1992) and Ali *et al.*, (1995).

Otherwise, no significantly differences could be detected between micronutrients either when applied alone or in combined, regarding fodder yield or straw yield / fad. Such result was expected since those micronutrients and its combined had no significant effect on the most aforementioned growth and yield attributes measured during this investigation.

6- Seed oil % and oil yield (kg/fad.)

With respective to the influence of potassium fertilizer on seed oil percentage, the results showed that increasing K level tended to be significantly decreased seed oil % either through both growing seasons or the combined. Then, the lowest seed oil % was obtained by the high level of K (72kg K_2O /fad.). Otherwise, the reverse direction was observed when oil yield kg/fad. was calculated by multiplying seed oil % X seed yield kg/fad., whereas the highest oil yield/fad. was achieved by the high level of K as compared with other two lower K levels. The high level overyielded low and mid-K levels by around 34.99 and 8.39%, in the same followed order, regarding combined data of oil yield kg/fad. Such results were confirmed significantly throughout growing seasons and the combined. Decreasing seed oil percentage resulted from increasing K level might be attributed to dilute effect as a result of increasing seed size and weight by increasing K level. In this connection, Anton and Bassiem (1998) reported that seed oil percentage was slightly increased when peanut plants received the high rate of K fertilizer (48kg K_2O /fad.). However, Dahdouh (1999) indicated that increase K from zero to 48kg K_2O/fad. caused a decrease in oil percentage. Otherwise, Abdel-Wahab *et al.*, (1986) found that there was no relevance between seed oil percentage and applying K fertilizer.

Likely, increasing P level appeared to be significantly increased oil yield kg/fad. during both growing seasons and the combined, however it has no significant effect on seed oil percentage. These results are in agreement with those reported by Naphade *et al.*, (1991) and Anton and Bassiem (1998), who reported that the increase in P fertilizer rate from 30 to 50kg P_2O_5/ha increased the seed oil content of peanut plant.

Concerning the effect of micronutrients on seed oil percentage and oil yield kg/fad., the results revealed insignificant differences. However slight increase in oil yield kg/fad. was observed when the combined of Zn+Bo was applied, but the differences could not reach the level of significance. In this connection, Darwish *et al.*, (2002) reported that application of K +Zn increased seed yield and oil yield kg/fad.

7- Yield analysis:

7-a- Simple correlation:

Data of simple correlation coefficients between seed yield of peanut and its contributing characters are presented in Table (4). Seed yield appeared positive and significant correlation with each of leaf chlorophyll content, plant height, number of branches and pods/plant, pod and seed weight/plant, 100-seed weight, pod yield, shelling percentage and fodder yield. In this respect Basha (1994) found that seed yield appeared positive and significant correlation with each of plant height, pod yield/fad. and oil yield/fad., while it was negatively correlated with number of pods/ plant and weight of seed/plant and correlation coefficient was significant.

Also, leaf chlorophyll content recorded positive and highly significant associations with plant height, number of branches and pod/plant, pod and seed weights/ plant, 100-seed weight, pod yield, shelling percentage and fodder yield.

Likewise, plant height was strongly correlated with number of branches and pods/plant, pod and seed weight/plant, 100-seed weight, pod yield, shelling percentage and fodder yield.

Moreover, number of branches /plant, had positive and significant correlation with number and weight of pods / plant, seed weight /plant, 100-seed weight, pod yield/ fad., shelling percentage and fodder yield.

Meanwhile, number of pod/plant indicated positive and significant relationship with pod and seed weights/plant, 100-seed weight, pod yield/fad., shelling percentage and fodder yield.

Similarly, pod weight/plant gave positive and significant correlation with seed weight/plant, 100-seed weight, pod yield/fad., shelling percentage and fodder yield.

Furthermore, seed weight/plant was closely correlated with 100-seed weight, pod yield/fad., shelling percentage and fodder yield.

100-seed weight was strongly correlated with pod yield/fad., shelling percentage and fodder yield.

Pod yield/fad. showed positive and significant relationship with shelling percentage and fodder yield.

Ultimately, positive and significant interrelationship was recorded between shelling percentage and fodder yield.

The present results indicate that seed yield and its contributing characters were positively and significantly associated. Thus, it seems evident that all these characters contribute to the final peanut seed and pod yields. In this respect Geweifel and Ali (1990) found significant and positive association between different attributes and seed yield/fad., indicate its importance of different characters, via, weight of pods, yield of pods, seed weight/plant and 100-seed weight.

7-b- Path analysis:

The methods of path coefficient included the yield components i.e. number of pods/plant, seed weight /plant and 100-seed weight. The effects of direct and indirect path analysis of yield components are presented in Table (5).

It is obvious from the results that direct effect of number of pods/plant as well as that indirect effect via seed weight/plant and 100-seed weight were positive and valued about 0.2929, 0.3096 and 0.3260, respectively. For seed weight/plant, the data observed that the direct effect as well as the indirect via number of pods/plant and 100-seed weight were positive and valued 0.33, 0.2748 and 0.3082, respectively.

Hundred seed weight showed positive direct effect with about 0.3819, while the indirect effects via number of pods / plant and seed weight / plant were positive and valued 0.2501 and 0.2665, respectively.

The relative importance in contributing seed yield recorded as percentage of variation for number of pods/plant, seed weight/plant and 100-seed weight and their interactions shown in Table (6). The calculation of path coefficient observed that 100-seed weight had the greatest direct effect with about 14.58% followed by seed weight/plant with about 10.89% and number of pods/plant was the lowest in this respect with about 8.58%. Concerning the indirect effects, it is clear also that 100-seed weight was the highest followed by seed weight/plant and the lowest was number of pods/plant. Also, R^2 recorded herein reached 91.63% of the total yield variation. However, the residual effect of the other seed yield components included in the present study was 8.37%. This residual variation could be attributed to other yield contributing characters. Finally, according to the relative importance, the studied characters could be arranged as follows, 100-seed weight (34.305), seed weight /plant (30.125) and number of pods/plant (27.20).

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Table (1): Leaf chlorophyll content, plant height, number of branches/plant and number of pods/plant as influenced by potassium and phosphorus levels and micronutrients in the two seasons and their combined.

Main effects and interaction	♦Leaf chlorophyll content			Plant height (cm)			Number of branches/plant			Number of pods/plant		
	2000	2001	Combined	2000	2001	Combined	2000	2001	Combined	2000	2001	Combined
Potassium fertilizer level (K):												
($kg\ K_2O$ /fad.)												
24 K_2O	35.60c	34.95c	35.28c	29.79b	27.28b	28.54b	7.459	6.422b	6.940b	12.18c	10.06c	11.12c
48 K_2O	39.00b	38.63b	38.82b	32.09ab	30.06ab	31.07ab	8.182	7.525ab	7.854ab	14.68b	12.40b	13.54b
72 K_2O	41.69a	41.54a	41.61a	33.37a	31.60a	32.49a	9.802	8.853a	9.328a	16.35a	13.78a	15.06a
F. test	**	**	**	*	**	*	N.S	**	**	*	*	**
Phosphorus fertilizer level (P):												
($kg\ P_2O_5$/fad.)												
15.5 P_2O_5	37.39b	36.51b	36.95b	31.21	28.95b	30.08b	7.318b	6.948b	7.133b	12.97b	10.97b	11.97b
31.0 P_2O_5	40.14a	40.24a	40.19a	32.29	30.34a	31.32a	9.645a	8.253a	8.949a	15.83a	13.19a	14.51a
F. test	**	**	**	N.S	*	*	*	*	**	**	**	**
Micronutrients (M):												
Check	38.17	38.31	38.24	31.59	29.32	30.45	8.355	7.507	7.931	14.33	12.08	13.20
Zn	38.51	38.21	38.36	31.80	29.70	30.75	8.439	7.604	8.021	14.40	12.06	13.23
Bo	38.66	38.17	38.42	31.75	29.83	30.79	8.513	7.621	8.067	14.43	12.08	13.26
Zn+Bo	39.70	38.81	39.26	31.86	29.74	30.80	8.619	7.669	8.144	14.45	12.10	13.27
F. test	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
Interactions :												
K × P	*	N.S	*	N.S	N.S	N.S	N.S	N.S	*	N.S	N.S	*
K × M	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
P × M	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

♦ Determined using chlorophyll meter (SPAD).

*, ** and N.S indicate significant at 0.05, 0.01 and insignificant, respectively.

Table (2): Pod and seed weights/plant (gm), 100-seed weight (gm), pod yield (kg/fad.) and seed yield (kg/fad.) as influenced by potassium and phosphorus levels and micronutrients in the two seasons and their combined.

Main effects and interaction	Pod weights/plant (gm)			Seed weight/plant (gm)			100-seed weight (gm)			Pod yield (kg/fad.)			Seed yield (kg/fad.)		
	2000	2001	Combined	2000	2001	Combined	2000	2001	Combined	2000	2001	Combined	2000	2001	Combined
Potassium fertilizer level (K):															
(kg K_2O /fad.)															
24 K_2O	13.75c	11.61c	12.68c	7.575b	6.016c	6.795c	53.86b	52.46	53.16b	714.4c	677.7c	696.0c	343.2c	309.7c	326.5c
48 K_2O	15.26b	12.73b	14.00b	8.638b	7.836b	8.237b	56.17a	54.86	55.51a	829.8b	795.8b	812.8b	433.8b	389.6b	411.7b
72 K_2O	17.59a	15.56a	16.57a	11.176a	10.10a	10.635a	57.84a	55.80	56.82a	902.4a	833.6a	868.0a	488.6a	421.9a	455.3a
F. test	*	*	**	**	**	**	*	N.S	*	**	**	**	**	**	**
Phosphorus fertilizer level (P):															
(kg P_2O_5/fad.)															
15.5 P_2O_5	14.21b	12.57b	13.39b	8.098b	6.950b	7.524b	55.99	53.97	54.98	784.3b	732.8b	758.5b	401.1b	355.1b	378.1b
31.0 P_2O_5	16.85a	14.03a	15.44a	10.16a	9.014a	9.588a	55.91	54.78	55.35	846.8a	805.3a	826.1a	442.7a	392.4a	417.5a
F. test	**	**	**	**	**	**	N.S	N.S	N.S	**	**	**	**	**	**
Micronutrients (M):															
Check	15.37	13.23	14.30	9.096	8.009	8.553	55.90	54.33	55.12	816.0	771.6	793.8	421.1	371.9	396.5
Zn	15.59	13.23	14.41	9.095	7.932	8.513	55.96	54.35	55.16	814.4	770.7	792.5	420.8	373.7	397.2
Bo	15.56	13.32	14.44	9.099	7.969	8.534	55.97	54.39	55.18	815.7	767.5	791.6	421.8	374.2	398.0
Zn+Bo	15.60	13.42	14.51	9.227	8.019	8.623	55.98	54.42	55.20	815.9	766.4	791.2	423.9	375.3	399.6
F. test	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
Interactions :															
K × P	N.S	*	N.S	*	N.S	*	N.S	N.S	N.S	**	*	**	N.S	N.S	*
K × M	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
P × M	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

*, ** and N.S indicate significant at 0.05, 0.01 and insignificant, respectively.

Table (3): Seed yield (kg/fad.), shelling percentage, fodder yield (ton/fad.), seed oil percentage and oil yield (kg/fad.) as influenced by potassium and phosphorus levels and micronutrients in the two seasons and their combined.

Main effects and interaction	Shelling percentage			Fodder yield (ton/fad.)			Seed oil percentage			Oil yield (kg/fad.)		
	2000	2001	Combined	2000	2001	Combined	2000	2001	Combined	2000	2001	Combined
Potassium fertilizer level (K):												
($kg\ K_2O$ /fad.)												
24 K_2O	48.02b	45.73b	46.87b	3.429c	3.135c	3.282c	43.32a	44.09a	43.71a	148.7c	136.5c	142.6c
48 K_2O	52.26a	49.02a	50.64a	3.878b	3.573b	3.726b	42.76b	43.59b	43.18b	185.4b	169.7b	177.6b
72 K_2O	54.14a	52.61a	52.37a	4.122a	3.880a	4.001a	41.72c	42.94c	42.33c	203.8a	181.2a	192.5a
F. test	*	*	**	**	**	**	*	*	*	**	**	**
Phosphorus fertilizer level (P):												
($kg\ P_2O_5$/fad.)												
15.5 P_2O_5	50.88b	48.33	49.61	3.623b	3.381b	3.502b	42.79	43.72	43.26	171.2b	155.0b	163.1b
31.0 P_2O_5	52.06a	48.57	50.32	3.996a	3.677a	3.830a	42.41	43.36	42.89	187.3a	169.9a	178.6a
F. test	*	N.S	N.S	**	**	**	N.S	N.S	N.S	**	**	*
Micronutrients (M):												
Check	51.33	48.02	49.67	3.802	3.517	3.660	42.64	43.67	43.16	179.0	162.0	170.5
Zn	51.42	48.30	49.86	3.809	3.533	3.671	42.44	43.43	42.94	178.3	162.1	170.2
Bo	51.44	48.63	50.03	3.815	3.533	3.674	42.52	43.40	42.96	178.9	162.2	170.6
Zn+Bo	51.69	48.86	50.27	3.813	3.533	3.673	42.80	43.66	43.23	180.9	163.5	172.2
F. test	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
Interactions :												
K × P	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
K × M	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	*	N.S
P × M	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

*, ** and N.S indicate significant at 0.05, 0.01 and insignificant, respectively.

Table (1-a): Leaf chlorophyll content, number of branches/plant, number of pods/plant and seed weight/plant as affected by P × K interaction (combined analysis).

Phosphorus levels (kg P_2O_5/fad)	Potassium levels (kg K_2O/fad)		
	24	48	72
		Leaf chlorophyll content	
15.5	B 33.84 b	A 37.70 b	A 39.30 b
31.0	C 36.71 a	B 39.93 a	A 43.93 a
		Number of branches /plant	
15.5	B 5.869 b	A 7.352 b	A 8.177 b
31.0	B 8.012 a	B 8.356 a	A 10.48 a
		Number of pods/plant	
15.5	B 10.35 a	A 12.20 b	A 13.37 b
31.0	B 11.89 a	A 14.88 a	A 16.76 a
		Seed weight /plant	
15.5	B 6.046 b	B 6.938 b	A 9.587 b
31.0	C 7.544 a	B 9.535 a	A 11.684 a

Table (2-a): Pod yield / fad. and seed yield / fad. as affected by P × K interaction (combined analysis).

Phosphorus levels (kg P_2O_5/fad.)	Potassium levels (kg k_2O/fad)		
	24	48	72
		Pod yield (kg/fad.)	
15.5	C 653.2 b	B 773.6 b	A 848.8 b
31.0	C 738.8 a	B 852.1 a	A 887.2 a
		Seed yield (kg/fad.)	
15.5	C 304.9 b	B 388.0 b	A 441.5 b
31.0	C 348.1 a	B 435.4 a	A 469.1 a

Table (4): Simple correlation coefficients between seed yield of peanut (kg/fad.) and its attributes (combined).

Parameters	1	2	3	4	5	6	7	8	9	10
Y-seed yield/fad.	0.8469**	0.9368**	0.8486**	0.9285**	0.9080**	0.9130**	0.8983**	0.9825**	0.9481**	0.9664**
1- Leaf chlorophyll content		0.8084**	0.8658**	0.8489**	0.8143**	0.8992**	0.7943**	0.8783**	0.7257**	0.8614**
2- Plant height			0.8279**	0.9302**	0.8938**	0.8912**	0.8929**	0.8922**	0.9405**	0.9501**
3- Number of branches/plant				0.9181**	0.9386**	0.9251**	0.7156**	0.8542**	0.4816**	0.8977**
4- Number of pods/plant					0.9454**	0.9380**	0.8536**	0.9085**	0.8747**	0.9422**
5- Pods weight/plant						0.9367**	0.8156**	0.8838**	0.8621**	0.9346**
6- seed weight/plant							0.8070**	0.9216**	0.8104**	0.9384**
7- 100-seed weight								0.8599**	0.8873**	0.8323**
8- Pods yield/fad.									0.8730**	0.9541**
9- Shelling percentage										0.9177**
10- Fodder yield										

Table (5): Partitioning of simple correlation coefficients between seed yield of peanut and its components.

Source of variation	Value
Number of pods/plant:	
Direct effect	0.2929
Indirect effect via seed weight/plant	0.3096
Indirect effect via 100-seed weight	0.3260
Total (ry_1)	0.9285
Seed weight/plant:	
Direct effect	0.3300
Indirect effect via number of pod/plant	0.2748
Indirect effect via 100-seed weight	0.3082
Total (ry_2)	0.9130
100-seed weight:	
Direct effect	0.3819
Indirect effect via number of pod/plant	0.2501
Indirect effect via seed weight/plant	0.2665
Total (ry_3)	0.8983

Table (6): Direct and joint effect of seed yield components as percentage of seed yield variation of peanut.

Source of variation		C.D.	%
Number of pods/plant		0.0858	8.58
Seed weight/plant		0.1089	10.89
100-seed weight		0.1458	14.58
Number of pods/plant × seed weight/plant		0.1813	18.13
Number of pods/plant × 100-seed weight		0.1911	19.11
Seed weight/plant × 100-seed weight		0.2034	20.34
R^2		0.9163	91.63
Residual		0.0837	8.37
Total		1.000	100.00
	Direct	**Indirect**	**Total**
Number of pods/plant	8.58	18.62	27.200
Seed weight/plant	10.89	19.235	30.125
100-seed weight	14.58	19.725	34.305
Total	34.05	57.58	91.63

تأثير مستويات مختلفة من التسميد البوتاسي والفوسفاتي مع الرش بالزنك والبورون على الفول السوداني بالأراضي الرملية

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أقيمت تجربتان حقليتان بمزرعة كلية الزراعة - جامعة الزقازيق بمنطقة الخطارة - محافظة الشرقية خلال موسمي ٢٠٠٠ و ٢٠٠١ لدراسة تأثير ثلاث مستويات من التسميد البوتاسي (٢٤ ، ٤٨ ، ٧٢ كجم بو٢أ/فدان) ، مستويان من التسميد الفوسفاتي (١٥,٥ ، ٣١ كجم فو٢أ٥/فدان) والرش بالزنك والبورون (كنترول ، زنك ٢% ، بورون ١% ، زنك ٢% + بورون ١%) على المحصول ، ومساهماته وجودة البذور لصنف الفول السوداني جيزة ٦ تحت ظروف الأراضي الرملية ويمكن تلخيص أهم النتائج فيما يلي:

١ - أدت إضافة وزيادة السماد البوتاسي لزيادة معنوية في كل من محتوى الورقة من الكلوروفيل ، ارتفاع النبات ، عدد الأفرع والقرون/النبات ، وزن القرون والبذور / النبات ، وزن ١٠٠ بذرة ، محصول القرون والبذور/فدان ، نسبة التقشير ، محصول العرش / فدان ، محتوى البذور من الزيت ومحصول الزيت/فدان.

٢ - أدت إضافة السماد الفوسفاتي بمعدل ٣١ كجم فو٢أ٥ لزيادة معنوية في كل من محصول البذور ومساهماته فيما عدا ارتفاع النبات (الموسم الأول) ، وزن ١٠٠ بذرة ومحتوى البذور من الزيت (خلال موسمي النمو والتحليل التجميعي للموسمين) ونسبة التقشير بالموسم الثاني والتحليل التجميعي للموسمين.

٣ - لوحظ تحسن طفيف عند الرش بالزنك أو البورون أو بكليهما على محصول البذور ومساهماته وكذلك جودة بذور الفول السوداني خلال موسمي النمو والتحليل التجميعي للموسمين.

٤ - أظهرت نتائج التداخل الفعل المعنوي بين مستويات البوتاسيوم والفوسفور تفوق المستويات العالية من كلا السمادين (٧٢ كجم بو٢أ/فدان ، ٣١ كجم فو٢أ٥/فدان) في إنتاج أعلى المعدلات من محصول القرون والبذور والتي بلغت [illegible] كجم قرون و [illegible] كجم بذور/فدان .

٥ - أظهرت البيانات وجود ارتباط موجب ومعنوي بين محصول البذور وكل من محتوى الورقة من الكلوروفيل ، ارتفاع النبات ، عدد الأفرع / النبات ، عدد القرون / النبات ، وزن القرون / النبات ، وزن بذور النبات ، محصول القرون (كجم/فدان) و نسبة التقشير ومحصول العرش (طن/فدان) حيث كان معامل الارتباط [illegible] ، ٠,٨٤٧ ، ٠,٩٣٧ ، ٠,٨٤٩ ، ٠,٩٢٩ ، ٠,٩٠٨ ، ٠,٩١٣ ، ٠,٨٩٨ ، [illegible] ، ٠,٩٨٣ ، ٠,٤٨٨ ، [illegible] ، ٠,٩٦٦ على الترتيب .

٦ - أوضحت نتائج تحليل معامل المرور أهمية وزن ١٠٠ بذرة ، وزن بذور النبات وعدد القرون / النبات حيث ساهمت بحوالي [illegible] ، [illegible] ، ٢٢,٥٢% [illegible] ، ٢٧,٢٠% من التباين الكلي في محصول البذور للفدان .