



# **RESPONSE OF FABA BEAN GROWN ON TOSHA SOILS TO NITROGEN, PHOSPHORUS AND ORGANIC FERTILIZERS**

**By**

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# INTRODUCTION

## **INTRODUCTION**

Faba bean (*vici faba L.*) is one of the most important legumes in Egypt. People eat it frequently due to being a source of vegetable protein, which compensate the lack of animal protein, especially after skyrocketing prices of red meat and poultry where faba bean contains a large proportion of protein, iron and mineral salts. However, the quantities produced decreases constantly.

The cultivated areas of faba bean decreased significantly from 333 thousand feddans in 2000- 2001 to 184 thousand feddans only in 2009-2010, which led to decrease the domestic production from of 439 thousand tons in 2000 - 2001 to 232 thousand tons in season 2009 -2010.

In 1992 viral disease (Mosaic beans) and the problem of Orobanche caused reduction of the cultivated area of faba bean. In addition to, intense competition and a steady increase in the acreage of wheat and alfalfa and follow the free-market mechanisms and governed by supply and demand.

Despite of the sharp decline in acreage of faba bean the productivity per unit area increased significantly in 2009 - 2010 to 8.13 ardebs versus 5.60 ardebs in 1980 – 1981 as result of research and expansion in the use of certified seeds, also producing varieties resistant to Haluk and varieties with less water needs yield per feddan



ranging between 9 -12 ardebs. Egypt ranked in the worlds third largest for productivity of faba bean.

The aim of this work was to study the response of faba bean crop grown on toshka soils to nitrogen, phosphorus and organic fertilization.

# **REVIEW OF LITERATURE**

## **REVIEW OF LITERATURE**

**The literature concerning the present investigation has been discussed under the following main headings.**

### **1)-Effect of organic fertilization on growth, yield and yield components of faba bean plants.**

Faba bean (*vicia faba*) is an important feeding crop grown in winter season in Egypt. It's seed not only provide a cheap of protein but also a food of high caloritic and nutritive value especially in the diet of low income people.

Organic manures are used successfully to improve the chemical and physical properties of the soil, reducing pH, EC, increasing soil organic matter content and supply the nutrient elements for growing plants (**Mahmoud *et. al.*, 2004 and Saad, 1999**). There are numerous studies have been carried out to investigate the effect of different organic manures on the growth and yield of faba bean crop.

**Elsheikh and Elzidany (1997)** showed that, sulphur, nitrogen and chicken manure treatments significantly increased yield and the 100-seeds weight.

**El-Zawahry (2000)** studied the effect of organic manure (farmyard, goat, rabbits, poultry and pigeon) on the growth and root-knot nematode infection in faba bean. Results showed that organic manure increased plant growth and reduced nematode development by 51%.

**Al-Kahal et al. (2001)** conducted a pot experiment to determine the effect of olive oil waste water (OOWW) and olive cake (OC), both at 1, 2 and 3%, alone or in combination with *Rhizobium leguminosarum* inoculation on faba bean cv. Giza Blanca plants. Their results indicated that there were significant increase in nodulation, shoot dry weight and N and P contents, compared with uninoculated OOWW or OC at 1%.

**Attia and El-Dsouky (2001)** studied the effect of farmyard manure on yield and some nutrients contents in seeds of faba bean in field experiments. They added farmyard manure (FYM) levels (0, 10 and 20 m<sup>3</sup>/fed). Their results showed that farmyard manure increased straw and seed yields and total N, P and K seed content. Application of FYM at 10 m<sup>3</sup>/fed. produced the highest seed yield (3.51, 3.37 and 3.55 kg/plot) and N content (158, 155 and 160 g N/plot) for Giza cv: 674, Giza 2 and Giza 402, respectively.

**Mohamed (2001)** found that the increase in N, P and K content may be due to the interaction between organic manure and bio-fertilizers which consequently increased the uptake of nutrients.

**Ahmed et al. (2003)** in reclaimed sandy soil studied the impact of some fertilizers (biofertilizers phosphorine), chemical fertilizer (nitrogen, phosphorus and potassium and organic fertilizer) on the growth and yield of faba bean cv. Giza 614, chickpea cv. Giza 531 and lupin (*Lupinus termis* [L. albus]) cv. Giza 1 under field experiments. Their data showed significant differences for all the

characters between control and all treatments at the vegetative stages except the treatment of chemical fertilizer.

**Abdel-Hamid *et. al.* (2004)** studied the effects composting of rice straw with poultry manure and rape seed oil cake on the growth and yield of faba bean in a pot experiment in Japan in 2000/2002. They found that, application of compost at a rate of 20 g /pot significantly increased growth, yield, yield components and total crude protein of faba bean plants.

**Mahmoud *et. al.* (2004)** reported that application of organic manure gave a superiority in total pods yield and its components of broad bean.

**Mohamed and Gomaa(2005)** found that the biofertilization of faba bean with the combined inoculums of *Rhizobium* and *Candida* accompanied with either 5 m<sup>3</sup> or 10 m<sup>3</sup> of farmyard manure. Their resulted indicated that this treatment caused increases in pods number/plant, seeds number/pod and pod weight.

**Rizk *et al.* (2006)** carried out two field experiments to investigate the influence of organic manure as a total or partial replacement of mineral fertilizers on yield and yield components of faba bean. Three levels of organic manure (garbage compost) i.e., 0,20 and 40 m<sup>3</sup>/ fed., were applied. The results showed that 40 m<sup>3</sup>/fed of organic manure increased all studied harvest traits.

**Sabh and Shallan (2008)** tested the effect of different marine macroalgae as organic fertilizers on faba bean in a pot experiment . There findings showed that treating the soil with algae powders as

organic fertilizers improved the vegetative characters as well as structural characteristics of (*vicia faba*) faba bean plants and subsequently, yield components in comparison with untreated and chemically fertilized plants.

**Helall et. al. (2009)** executed two field experiments to investigate the impact of compost and town refuses (as organic amendments; OA) application combined with natural alternative fertilizer on growth and yield parameters nutrient availability and uptake by faba bean plant. Their data showed that application of OA with rock phosphate (RP) increased both yield and water efficiency of faba bean which were more in seeds and in case of straw.

## **2)- Effect of phosphorus fertilization on growth, yield and yield components of faba bean crop.**

Phosphorus is a major nutrient, especially for legumes. It considered the second essential nutrient element for both plants and microorganisms. It plays a key role in metabolic process such as the conversion of sugar into starch and cellulose . As a result, phosphorus deficiency causes stunning, delayed maturity and shriveled seeds.

**Abo-shetaia(1990)** the results showed that the maximum seed yield/fed. was obtained by nitrogen at a rate of 60 kg/fed and  $P_2O_5$  at a rate of 31 kg/fed. The second order interaction was significant on number of pods and seeds/plant, seed index and straw yield.

**Nayak and Dwived (1990)** found that increased S and P application significantly increased grain yield, the highest yield of

2.317 T/ha was obtained with 30 kg S and 80 kg P/ha. Total N, P, Ca, Mg, and S concentration increased with S and P application while K concentration was unaffected.

**El- Zeiny *et al.* (1990)** showed that at harvest number of branches , pods and seed / plant and biological yield increased with P application.

**Ibrahim and Esmail (1994)** reported that the highest values of plant height , number of branches / plant, number of leaves/plant, branches dry weight/plant, leaves dry weight/plant and leaf area index were achieved when faba bean plants received phosphorus at a rate of 15 or 30 kg P<sub>2</sub>O<sub>5</sub>/fed.

**Abd-El-Fattah (1997)** indicated that plant height, number of leaves and branches, leaf area, leaf dry matter content, green pod and seed yields and yield components generally increased with increasing rates of P, B and GA<sub>3</sub>, with combined applications having a greater effect than individual treatments. Green pod and seed yields were greatest with 45 kg P + 500 ppm B + 100 ppm GA<sub>3</sub>.

**Ali (1997)** studied the effects of different levels of phosphorus fertilizer (0, 16, 32 and 48) kg P<sub>2</sub>O<sub>5</sub>/fed. on different yield characters (plant height, branches per plant, pods per plant, seeds per plant, weight of pods per plant, weight of seeds per plant, seed index, protein percentage, protein yield, seed yield, straw yield and biological yield) of faba bean cv. Giza 2. The results showed that faba bean yield and its components increased with increasing levels of phosphorus fertilizer.

**Ahlam and Elsheikh (1998)** reported that VAM inoculation and phosphorus fertilization significantly increased the shoot and root fresh and dry weights, number of nodules and dry weight of nodules under normal and saline conditions. High levels of superphosphate (150 kg/ha) completely suppressed the enhancing effect of the VAM under normal conditions, and the effect was strong at 115 kg/ha under saline conditions

**Saghin (1998)** showed that the P fertilizers increased total nitrogen content, number, weight and crude protein content of root nodules progressively as P rates increased.

**Bolland *et al.*, (2000)** found that the addition of fertilizer phosphorus significantly increased grain yields by 50 and 100 % in the two experiments. In experiment the increase in grain yield due to addition of phosphorus fertilizer was due to an increase in the number of pods per plant; numbers of seed per pod and mean seed weight were unaffected by additions of phosphorus and zinc fertilizer. Adding phosphorus fertilizer increase concentration of (N) measured in grain.

**Ghizaw *et al.*, (2000)** reported that the location by fertilizer interaction indicated that the application of P significantly increased faba bean seed yield

**Sanchez *et al.*, (2001)** indicated that phosphorus increased the plant height but not the number of branches. The optimum fertilization rate was 70kg P<sub>2</sub>O<sub>5</sub>/ h.



**Soheir (2001)** found that the response of seed yield and yield attributes of faba bean plants to P fertilization followed the same trend as that of N fertilization. However, 31 kg P<sub>2</sub>O<sub>5</sub>/fed increased seed yield by 550 and 340 kg/fed compared to those receiving 15.5 and 23.25 kg P<sub>2</sub>O<sub>5</sub>/fed, respectively.

**Yakout and Greish(2001)** showed that the soil application of phosphorus with or without biofertilizer (microbein) along with foliar fertilization (stimphol) significantly increased the yield, yield components and quality of faba bean.

**Abd-Allah (2002)** pointed out that the contents of N, P, K, protein, total soluble sugars and ascorbic acid increased with biofertilizers treatments and with increasing rates of P from 100 to 200 kg superphosphate/fed.

**El-Douby and Mouhamed (2002)** found that the conventional ploughing and hand hoeing twice resulted in the highest values for plant height, number of branches, pods and seeds per plant, weight of pods and seeds per plant, 100-seed weight, seed yield/fed and biological yield/fed of faba bean crop. The values for the same parameters increased with increasing rates of P<sub>2</sub>O<sub>5</sub>.

**Hussien *et. al.*, (2002)** the obtained data showed that, dry matter yield of faba bean plants (g/pot) increased with the increase of added and growth period. The highest yield of dry matter was found with application rate of P at 40 ppm.

**Turk and Tawaha (2002)** reported that rate of phosphorus had significant effects on yield components.

**Hamed (2003)** found that the application of P fertilizer increased plant height, pod weight, seed weight, pod yield, seed yield, seed protein percentage and yield/fed.

**Ibrahim *et. al.*, (2003)** reported that the highest faba bean seed yield / fed., could be secured when plants fertilized with 15.5 kg P<sub>2</sub>O<sub>5</sub> / fed.

**Long L. *et. al.* (2003)** showed that the nitrogen uptake by intercropped faba bean was higher than 21 (no P fertilizer) or similar to (33 kg P/ ha of P fertilizer) that by sole faba bean during the early growth stages 21 (first to third sampling) of faba bean, and was similar to (no P fertilizer) or higher than (33 kg P/ ha of P fertilizer) that by sole faba bean at maturity.

**Majumdar *et. al.*(2003)**, pointed out that these fertilizers also increased the uptake of N, P, S and Zn. Synergistic interactions were found between P and S, P and Zn, and S and Zn, all of which increased grain yield and nutrient uptake.

**Khalil *et. al.*, (2004)** concluded that increasing phosphorus fertilization rate(0.00, 15 and 30 kg P<sub>2</sub>O<sub>5</sub>/fed )to faba bean increased plant height, number of pods /plant, number of seeds /plant, weight of seeds/plant, seed index, seed and straw yield /fed., where the maximum values were obtained by the addition also of 30 kg P<sub>2</sub>O<sub>5</sub>/fed., protein and P contain seed were higher when P was applied to highest rate.

**Nawar and Khalil (2004)**, found that increasing  $P_2O_5$ /fed., rate was associated with significant increases in all studied characters, except for plant height and number of branches /plant compared to 10.0  $P_2O_5$ /fed., phosphorus rate of 17.5 kg /fed., gave the highest values for number of pods and seed yield / plant, 100-seed weight and seed yield. In addition to cereal units/ fed., whereas, further addition of P up to 25.0kg /fed., was associated with reductions traits compared to 17.5  $P_2O_5$ /fed.

The application of 31.0 kg  $P_2O_5$ /fed increased the total seed yield by 32% in 2002 and by 18% in 2003 relative to the application of 15.5 kg  $P_2O_5$ /fed. The seed yield increased by only 11% in year 1 and by 4% in year 2 by increasing the P rate up to 46.5 kg/fed. **Tageldin and Mehasen (2004)**

Results obtained by **Abd El-Aziz (2005)** the obtained results indicated that applications of phosphorus fertilizer with 22.5 kg  $P_2O_5$ /fed. followed by 15.0 kg  $P_2O_5$ /fed., and 30.0 kg  $P_2O_5$ /fed induced significant increases in number of branches/plant, number of pods /plant, number of seeds /plant, 100-seed weight, seed and straw yields /plant as well as seed and straw yield /fed. Also, such treatment increased protein content of faba bean seeds.

**Ahmed et. al., (2005)**, concluded that all studied parameters seeds yield, straw yield, protein percentage in seeds and phosphorus uptake by the seeds significantly increased due to increasing the level of phosphorus fertilization from 0.0 to 30 or 45 kg  $P_2O_5$ /fed.

**Agegnehu *et. al.*, (2005)** found that the application of P fertilizer at the rates of 13, 26, 39 and 52 kg P/ ha resulted in a linear response with seed yield increments of 22, 29, 42 and 47% over the control respectively. They added that faba bean seed yield was positively correlated with total biomass, number of pods per plant and seeds per pod respectively.

**Radwan and Mohamed (2005)**, found that the addition of 25 kg P<sub>2</sub>O<sub>5</sub>/fed. was the best treatment to obtain the highest growth attributes, yield and yield components, phosphorus uptake of faba bean plants during the both seasons. The highest seed yield /fed.(1.75- 1.61 ton /fed.) and biological yield (4.10 -3.78 ton /fed.) were obtained from the highest plant density (105.000 plant /fed.) and fertilized with 25 kg P<sub>2</sub>O<sub>5</sub>/fed.

**Abd-Allah and Hamed (2006)** reported that increasing P fertilizer levels (10, 20, and 30 kg P<sub>2</sub>O<sub>5</sub>/ fed.) increased all the characters plant height, number of branches/ plant, leaves dry weight , number of pods /plant, seed yield /plant, seed index and seed yield /fed. except that of the number of seeds/pod.

**Agegnehu and Angaw (2006)**, results obtained indicated a positive linear response of faba bean seed yield to phosphorus fertilizer applications plant height and number of pods per plant.

**Agegnehu and Fessehaie (2006)** point out that the seed weight of faba bean was significantly ( $P \leq 0.05$ ) affected by P fertilizer application. Other agronomic attributes like plant height, number of

Pods per plant and seeds per pod were also significantly differed among levels of P fertilization.

**Abd El-Aziz(2007)** found that phosphorus rates 45, 90 and 130 kg P<sub>2</sub>O<sub>5</sub>/ h., caused a significant increases in plant height, number of branches and leaves area /plant and significantly increases in all yield components. A 130 P<sub>2</sub>O<sub>5</sub>/ h., rate significantly decreased plant height, number of branches, and all yield components maturity stage compared with 45 and 90 kg P<sub>2</sub>O<sub>5</sub>/ h., rates.

**Ahmed and El-Abagy (2007)** pointed out that the addition of mineral P. fertilizer at a rate of 46.5 kg P<sub>2</sub>O<sub>5</sub>/fed. resulted a significant increments in growth characters of faba bean plants and yield and its components in comparison with 15.5 and 31.0 kg P<sub>2</sub>O<sub>5</sub>/fed treatments.

**El Habbasha *et. al.*, (2007)** showed that increasing phosphorus levels from zero to 45 kg P<sub>2</sub> O<sub>5</sub> /fed significantly increased most of the studied characters except for number of branches and seeds/plant and showed significant increasing in growth parameters i.e., plant height and dry weight of stems and leaves of faba bean plants at 60 and 90 days after sowing with increasing phosphorus levels from zero to 45 kg P<sub>2</sub>O<sub>5</sub>/fed.

**El-Gizawy and Mehasen (2009)** found that adding 30 kg P<sub>2</sub>O<sub>5</sub> mixed with PDB markedly increased plant height, no. of branches and pods/plant, 100-seed weight, seed yield/plant, seed and straw yields/fed, protein%,N%, P%, N and P uptake.

**Tayel and Sabreen (2011)** data obtained indicated that GB surpassed G461 in all the growth characters except plant height. Skipping two irrigations and decreasing the applied phosphorus adversely affected the growth characters and the differences were significant at the 5% level.

**Bhowmik *et al.*, (2012)** found that N, P and K uptake increased with the increase in the level of phosphatic fertilizer upto 60 kg/ha.

**Weldua *et al.*, (2012)** their results showed that P fertilization significantly increased ( $p < 0.05$ ) yield and yield components and attributes in faba bean plant. This study concludes that grain yield and biomass yield increased with the increase in phosphorus fertilizer. Application of 60 kg P/ha gave statistically higher grain yield than 0 and 30 kg P/ha.

**Hashem abadi (2013)**, showed that the effect of this treatment was significant on the plant length, fresh weight and pod number and in comparison with other treatments (0, 40 and 120 kg ha<sup>-1</sup>) was better ( $p < 0.05$ ). Application of 80 kg ha<sup>-1</sup> P<sub>2</sub>O<sub>5</sub> increased yield production, but this increasing was not statistically significant.

### **3)-Effect of nitrogen fertilization on growth, yield and yield components of faba bean plant**

Nitrogen a plant nutrient is required by plant in comparatively larger amount than other elements. Nitrogen is essential component of many compounds of plant such as chlorophyll, nucleotides, proteins, alkaloids, enzymes, hormones and vitamins (**Marschner, 1995**). N

supply must be available according to the needs of the plant. Nitrogen deficiency generally results in stunted growth, chlorotic leaves because the lack of N limits the synthesis of proteins and chlorophyll. The presence of N in excess result in abundant dark green (high chlorophyll) tissues of soft consistency. This increase the risk of lodging and reduce the plant resistance to harsh climatic conditions and to soil diseases (**Lincoln and Edvardo, 2006**).

Biological nitrogen fixation has often been reported insufficient by many studies (**Vikman and Vessey, 1993; Ruszkowska *et al.*, 1992**). This raises the question whether we should apply some amount of nitrogen in addition to symbiotic nitrogen fixation of the crop to meet the need for potential crop production or not? Many authors showed a beneficial effect of adding ammonium nitrate on the seed yield of lusern faba bean (**Bochniarz *et al.*, 1987 and Pizto *et al.*, 1991**)

**El-Khawaga and Zeiton (1986)** concluded that, seed and straw yields, plant height, number of pods/ plant and seed yield/ plant were significantly increased by adding rates of 30 and 45 kg N/ fed.

**Ahmed (1987)** reported that optimum seed yield (2249 kg/fed) of faba bean, that may be obtained by addition of nitrogen at a rate of 30 kg/fed.

**Abo-Shetaia (1990)**, showed that faba bean received different N, P and K combination had no statistical significant effect on number of pods/plant and 100-seed weight and seed yield per plant fed.

**Diaz and Manrique (1995)** found that the application of 30 kg N/ha at the start of flowering increased mean seed yield only at the lowest plant density and in 1986, but 60 kg N/ha., increased yield by 135% on average over the 3 years. The highest N application rate resulted in consistently higher overall yields at each plant density

**Makram and Abdel-Malak (1997)** their results showed that final plant height and number of sympodia per plant increased as nitrogen rates increased. The highest yield per plant and per fed. were obtained by applying 60 kg N/fed. Lint percentage and seed index were slightly affected by nitrogen rates. Faba beans did not to the nitrogen content of the soil.

**Michalojc (1998)** studied that the influence of substrate, nitrogen and potassium fertilization on yield and chemical composition of broad-bean. His data showed that application of N increased shoot and seed yield but decreased nodulation.

**Ghizaw *et. al.*, (1999)** pointed out that the response of faba bean seed yield was noticed at all locations (except Debre Zeit and Burkitu) to P fertilization, while a significant quadratic response was also found at Holetta. In addition, plant height, above ground biomass and number of pods per plant were positively influenced by P application while the effect of N on these was mostly non significant. Faba bean seed yield response to N was noted at only two out of eight locations; in most cases, nonsignificant and inconsistent seed yield responses to N fertilization were obtained. There was non significant N  $\times$  P rate interaction



**Labuda (2001)** found that increasing of nitrogen fertilization up to 68 kg N/ha gave higher marketable yield of pods as compared with the check by 10.5% on average and of total seed yield by 16.2%.

**Soheir (2001)** investigated the response of yield and yield components of faba bean to increasing levels of nitrogen and phosphorus under two levels of plant stand density. She found that increasing nitrogen from 30 to 60 kg/fed., increased yield and yield attributes seed yield increased by adding 45kg N/fed., respectively.

**Sanchez. et. al., (2001)** found that the treatment with nitrogen, phosphorus and potassium increased the plant height but not the number of branches. The cultivar used had a positive response only for the yield components, 100-seed weight and yield per hectare. The optimum fertilization rate was 00-76-57 kg N, P and K/ha.

**Adam (2002)** pointed out that the addition 2 doses of Nitrobein combined with 200 kg ammonium sulfate/fed produced the highest nutritive value of (protein, nitrogen, potassium, phosphorus, total soluble solids and ascorbic acid).

**Sobkowicz and Parylak (2002)** in Poland investigated the effects of different N levels (0, 25 and 50 kg/ha) on the growth and yield of spring triticale and faba beans, in pure stands and in a mixture. The sowing rates in pure stands were 500 grains/m<sup>2</sup> for triticale and 90 grains/ m<sup>2</sup> for faba. Increasing N rate increased plant height, productive tillering and harvest index.

**Gutierrez *et. al.*, (2003)** showed that the highest bean yield was observed with the highest nitrogen fertilizer application rate (80-40-0 of NPK)

**Sobkowicz and Sniady (2004)** indicated that biomass yield increased with increasing N rates. N uptake in the grains was higher in the intercrops by 16.7 and 32% than sole triticale and faba bean crops, respectively.

**Mohmed (2005)**, found that the increasing N fertilizer level up to 45 kg N/fed. insignificantly increased growth, yield and its attributes. The increases in seed yield with fertilizing faba plant with 15, 30, and 45 kg N/fed. over unfertilized plants were 23.77, 23.77 and 24.47% in the first season, and 18.18, 28.67 and 30.07% in the second season respectively. Also showed that the N and P uptake of faba bean plants were significantly increased. Phosphorus (mg/plant) was increased with increasing nitrogen level from zero to 45 kg N/fed.

**Daur *et. al.*, (2008)** studied the effect of different levels of nitrogen on dry matter and grain yield of 12 faba bean genotypes under field condition. Nitrogen rates were as follows; 0, 50, 100, 150 and 200 kg N /ha. Their data showed that there were significant variations among the types geno, in grain yield and shoot dry weight. Grain yield and shoot dry weight indicated significant quadratic relation with the increasing N rates between 0 and 200 kg N /ha.

**Filek *et. al.*, (2008)** found that increased density of sowing as well as the high level of nitrogen fertilization inhibited the growth of

indeterminate and determinate of faba bean and development of root nodules and limited their nitrogenase activity in both cultivars

**Botos *et al.*, (2009)** their results showed that the increase in yield of faba bean due to N fertilizer application was between 21% (30 kg N/ha.) and 56% (90 kg N/ha.). The yield increased with increase in the N rates from 0 to 90 kg/ha. The protein content increased with the increase in the N rate.

**El-Aal (2010)** studied the effect of intercropping of broad bean (*Vicia faba L.*) with table beet and the second form of fertilizer treatments (20 m<sup>3</sup> chicken manure fed<sup>-1</sup>+20-15-20 kg N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O) significantly increased all the studied vegetative growth, most of the yield and its components characters.

**Azarpour *et al.*, (2011)** reported that the effect of nitrogen fertilization treatments on faba bean seed yield, straw yield, biological yield, harvest index, plant height, number of pod per plant, number of seed per pod and 100 seeds weight had significant differences at 1% probability level.

**Bozorgi *et al.*, (2011)** results of variance analysis showed that the effect of nitrogen fertilization on all studied traits had significant differences at 1% probability level. The highest grain yield (5369 kg/ha), plant height with 140.1cm, harvest index with 34.45%, 100-seed weight with 254.4g, number of pods per plant with 19.33 and number of seeds per pod with 6.65 was obtained by 30 kg/ha pure nitrogen+ nitroxin inoculation.

#### **4)Response of faba bean to N and P fertilization.**

The macronutrients which are essentially supplied as fertilizers and have internal effects on plant growth are nitrogen, phosphorous and potassium. Data related to the internal effects of N, P and K combined supply of faba bean are limited, however, those regarding the combination of P and N as fertilization regime are scarce.

**Althabt (2000)** showed that application of NPK fertilizer at 420 kg /fed resulted in a marked increases in plant height, number of leaves / plant, stem diameter, number of branches / plant. Also, number of pods / plant, 100 – seed weight and pod yield kg /fed were significantly increased with addition of 100 kg /fed compound fertilizer as compared with control treatment.

**Soheir (2001)** investigated the effect of N and P fertilization and plant density on yield and yield components of faba bean plant in two field experiment. Their finding indicated that seed yield increased by adding 31kg  $P_2O_5$  /fed by 550 and 340 kg / fed. composed with those received 15.5 and 23.25 kg  $P_2O_5$ / fed. respectively. The maximum value of seed yield /fed was obtained by plant density 133333 plant /fed, and fertilized by 45 kg  $P_2O_5$  /fed. and 31kg  $P_2O_5$ / fed. while the maximum straw yield / fed was obtained from N/fed and 31kg  $P_2O_5$  /fed.

**Awad et al. (2002)** indicated that application of 30 kg  $P_2O_5$ / fed, 15 kg N/fed to faba bean gave the best results for the most studied characters: pods weight / plant No. of pods/plant, 100 seed weight , seed yield / fed. and seed weight / plant.

**Mohamed (2005)** studied the response of faba bean to P fertilizer sources and four N levels in two field experiments in two seasons . Phosphorus at rate of 45 kg  $P_2O_5$  /fed. in the form of monocalcium super phosphate 15.0%  $P_2O_5$  triple super phosphate 37.5%  $P_2O_5$  and rock phosphate 14%  $P_2O_5$  . Nitrogen levels were:0, 15, 30and 45kg N/fed . The obtained results showed that in both seasons the highest values of growth, yield N and P uptake were produced from triple superphosphate . Their data also showed that increasing N fertilizer level up to 45kg /fed significantly increased growth, yield and yield component. The interaction between source of P and N levels had significant effects on plant height, number of branches, 100 seed weight, N and P uptake in both seasons as well as seed yield / plant in the first seasons . The highest seed yield/fed was produced by adding triple superphosphate (37.5 %  $P_2O_5$ )with 15 kg N /fed.

**Nawar *et al.* , (2010)** in a two-year field stud investigate the effect of three tillage systems three plant population densities and three fertilization regimes P, NP and NPK (15 kg N +22.5kg  $P_2O_5$  +48kg  $K_2O$ ) on growth and productivity of faba bean cultivar, Giza 843. Their findings indicated that seed yield per plant, 100-seed weight and seed yield per fed responded significantly to the fertilization regimes.

### **5)-Effect of organic fertilization on soil**

Soil application of biofertilizers is the most common method used in bioorganic farming systems. The inoculation of legumes crops with symbiotic N-fixing bacteria led to improve plant growth and yield (Sankasanayanan *et. al.*, 1995)

**Mohamed and Gomaa (2005)** in field trial studied the impact of application of bio-organic farming on faba bean growth and quality of green yield in comparison with the recommended doses of NPK as a positive control treatment. They found that the bio-organic treatment consisted of 10 m<sup>3</sup> FYM + *Rhizobium leguminosarum* + Soil yeast *Candida tropicalis* increased plant height by 3.4% over the positive control as an average for both growing seasons. The biofertilization of faba bean with the combined inoculum of *Rhizobium* and *Candida* when accompanied with either 5 m<sup>3</sup> or 10 m<sup>3</sup> of farmyard manure increased each of pods number/plant, seeds number/pod and pod weight. They added that the bio-treatment of 5 m<sup>3</sup> FYM + *Rhizobium* + *Candida* increased protein content in both growing seasons by 8.3% over the positive control

### **6)-Effect of phosphorus fertilization on soil**

Sandy soils may have some nutritional problems such as less fertility in general and less availability of some elements such as phosphorous in case of high pH value.

**Talaat and Abdallah (2008)** conducted two field experiments for two successive seasons to investigate the effect of seed inoculation with *Rhizobium* and/or soil inoculation with the vesicular-

arbuscular mycorrhizal fungus(*Glomus mosseae*) under different levels of N and/or P fertilization on the nodulation, growth, productivity and nutritional value of two faba bean cultivars. Their results indicated fungal infection and *Rhizobial* inoculation either alone or in combination with 50% or 75% of the recommended doses of N and/or P fertilizers increased nodules formation, plant growth and yield as well as the concentration of N, P, K, Fe, Zn, Mn, Cu, protein and total carbohydrate on both cultivars as compared to uninoculated plants.

### **7)-Effect of nitrogen fertilization on soil**

Growing faba bean on the sandy soils usually need an integration between the bacterial inoculation and mineral fertilization for producing high quality and quantity yield .

There are numerous studies concerning the effect of inoculation of faba bean with there proper rhizobium strains in addition to application of mineral nitrogen fertilization.

**Abdelhamid *et. al.*, (2004)** pointed out that the addition of compost (20 -200 g/pot) improved selected soil chemical (increased total N, total C and CEC, physical (decreased particle density) and biological (increased soil respiration rate) properties.

**Ying *et al.*, (2008)** found that the productivity, nitrogen uptake and utilization efficiency and soil inorganic nitrogen accumulation of intercropping increased with increased nitrogen application rate, indicating that over abundant nitrogen uptake exited under high nitrogen fertilizer and intercropping.

# **MATERIALS AND METHODS**



## **MATERIALS AND METHODS**

Two field experiments were conducted at the Agricultural Research Station Farm of the South Valley Research Station at Toshka, Aswan during the two successive winter seasons of 2010-2011 and 2011-2012. This work aims to study the effect of organic manure (filter mud cake), phosphorus and nitrogen fertilizers on growth, yield and yield components of faba bean (cv Msar-1) under drip irrigation system. It is laying out in the part of south valley of Egypt, about 1300 and 280 km south from Cairo and Aswan, respectively on latitude of 22<sup>0</sup> 25 north, 31<sup>0</sup>5- longitude East, and at elevation of 181 m above the sea level.

### **1- Soil sample**

A representative soil sample was collected from the experimental site at the depth 0.0 – 30 cm before cultivation. The soil samples were brought to the laboratory in a plastic bags as soon as possible, spread on a clean plastic sheet and blocks were broken to get the actual particle size. The samples were air-dried at the room temperature and sieved to pass through a 2mm stainless steel sieve. The sieved soil was mixed thoroughly and a sub-sample was taken and analyzed for pH, EC, organic matter, calcium carbonate , soluble cations and anions , available P and particle size distribution.

Some physical and chemical properties of the collected experimental soil sample presented in **Table( 1)**.

**Table( 1). Some physical and chemical properties of the experimental soil.**

<b>Properties</b>	<b>Value</b>
<b>Mechanical analysis (fraction,%):</b>	
<b>Clay</b>	<b>13.3</b>
<b>Silt</b>	<b>18.1</b>
<b>Sand</b>	<b>68.6</b>
<b>Texture grade</b>	<b>Sandy loam</b>
<b>Chemical analysis</b>	
<b>Total CaCO<sub>3</sub> %</b>	<b>5.25</b>
<b>EC ds/m<sup>-1</sup> (1:2.5)</b>	<b>0.93</b>
<b>pH(1:2.5suspension)</b>	<b>8.07</b>
<b>Organic matter %</b>	<b>0.07</b>
<b>Total N (ppm)</b>	<b>192</b>
<b>Available P (ppm)</b>	<b>2.7</b>
<b>Soluble cations and anions (meq/100 g soil):</b>	
<b>Ca<sup>+2</sup></b>	<b>0.38</b>
<b>Mg<sup>+2</sup></b>	<b>0.16</b>
<b>Na<sup>+</sup></b>	<b>0.30</b>
<b>K<sup>+</sup></b>	<b>0.13</b>
<b>CO<sub>3</sub><sup>-</sup> + HCO<sub>3</sub><sup>-</sup></b>	<b>0.24</b>
<b>Cl<sup>-</sup></b>	<b>0.25</b>
<b>SO<sub>4</sub><sup>-</sup></b>	<b>0.48</b>

\* Laboratories unit in Toshka [lab.(ARC)]

## 2- Organic fertilizer(Filter mud cake)

Filter mud cake are produced in a large quantities as by- product in Edfo sugar cane factory. **Table (2)** show chemical properties of the filter mud cake

**Table 2. Some chemical analysis of the filter mud cake.**

Properties	Values
PH	6.2
Moisture	26.5%
OM %	79.5 %
Total N %	2.62 %
Total P %	2.1%
Total K %	0.66%
Ca %	2.7%
Mg %	0.39%
Total Fe (ppm)	500
Total Mn (ppm)	310
Total Zn (ppm)	123
Total Cu (ppm)	185
C/N ratio	18.30

\* Laboratories unit in Toshka [lab.(ARC)]

## 3- Mineral fertilizers

Ordinary super phosphate (15.5%P<sub>2</sub>O<sub>5</sub>) was used as a source of mineral phosphorus fertilizer. On the other hand, ammonium sulfate (20% N-NH<sub>4</sub>) was used as a source of nitrogen fertilizer and added the recommend of K fertilizer about 50 kg/fed. potassium sulphate.

### **The experimental treatments**

- Zero, 10 and 20 m<sup>3</sup> FMC/fed.
- 15.5, 31.0 and 46.5 kg P<sub>2</sub>O<sub>5</sub>/fed.
- Zero, 15, 30 and 45 kg N/fed.

## **4- Experiments:**

### **4.1 Experimental design and plot area:**

The experiment was split plot design with three replicates. In the main pieces were distributed to three levels of organic manure (0, 10 and 20 m<sup>3</sup> / fed). Each main plot was divided in Twelve sub-plots as a width strips, which occupied by the treatments nitrogen and phosphorous fertilizers. In the split plot was distributed adaptations phosphate and nitrogen fertilizers. Has been added the treatments of phosphorus fertilization during the preparation of the land for agriculture. The treatments of nitrogen fertilization added on 6 doses after germination rate of dose every 10 days.

Total plot area 10 m<sup>2</sup>(Each plot consisted of 4 lines one- meter width and 2.5 m long equal to 1/420 of fed.) . The fourth ridge was used for collecting data of growth characters, while the two middle ridges were used for to estimating yield and yield components at harvesting. The seeds were planted on the 7 and 10 day of October in the two seasons.

#### **4.1.1 Faba bean plant:**

##### **A) Growth characters:**

Ten plants were chosen randomly from the fourth ridge of each plot after 70 days from planting for Number of branches / plant and Plant height (cm).

##### **B) Yield and yield components:**

At harvest (150 days from sowing), a random sample of ten plants were taken from each plot to determine the number of pods /plant. After harvest were determine weight of seeds yield, straw yield, biological yield kg/fed and weight of 100-seeds g.

##### **C) Chemical analysis:**

1. N, P and K content in seeds and straw (%).
2. Portion in content in seeds % (equal  $6.25 \times \% \text{ N in seeds}$ )
3. Total N, P and K uptake kg/ fed.

#### **4.1.2 Soil measurements :**

Soil samples were taken from each plot after harvesting and analysis some soil properties:

- 1- Soil pH.
- 2- Soil salinity as EC ( $\text{ds m}^{-1}$ )
- 3- Total nitrogen (ppm).
- 4- Available phosphorus (ppm).
- 5- Organic mater (%).

**Method of soil analysis:**

**5.1 Particle size distribution:** was determined using the pipette method (Jackson,1973) .

**5.2 Total soluble salts:** as EC were determined in 1:2.5 soil – water extract using conductivity meter according to (Jackson,1973).

**5.3 Soil reaction (pH):** was measured in 1:2.5 soil – water suspension using Beckman pH meter as reported by Page *et al.*, 1982.

**5.4 Total calcium carbonate:** was determined using Scheibier calcimeter (Jackson, 1973).

**5.5 Total N:** was determined according to method described by Page *et al.*, 1982.

**5.6 Available P:** was extracted by 0.5 M Na HCO<sub>3</sub> at pH 8.5. The extracted P was measured spectrophotometrically using stannous chloride phosphomolybdaic acid system as described by Jackson,1973.

**5.7 Total soluble ions:** was determined in water extract of soil past (Jackson, 1973).

Soluble Ca and Mg were determined by versene solution while soluble Na and K were determined by flame photometer (Jackson,1973).

Soluble carbonate and bicarbonate were titrated by 0.01 N H<sub>2</sub>SO<sub>4</sub>. Chloride was determined by titration with silver nitrate solution

(**Jackson, 1973**), while sulphate was calculated by difference between total soluble cations and anions .

## **5- Method of plant analysis:**

Half gram of ground plant faba bean was digested in 10 ml of H<sub>2</sub>SO<sub>4</sub> with 2 ml perchloric acid in a conical flask as described by **Chapman and Pratt, 1978**. The digested samples were under for measuring N, P and K.

**6.1 Total N:** was determined following the micro-kjeldahl method as described by **Page *et. al.*, 1982**.

**6.2 P:** was determined spectrophotometrically using the chorostannus-phosphomolybdic acid method in a sulfuric acid system (**Jackson,1973**).

**6.3 K:** was determined using the flame photometer method described by **Kalra 1998..**

## **7- Statistical Analysis:**

Data were subjected to statistical analysis of each season separately and combined analysis of variance for the two seasons was conducted testing the error homogeneity according to **Gomez and Gomez, 1984**. When the F-test showed significant differences among means, Least Significant Differences (LSD) test was performed at the 0.05 level of probability.

# **RESULTS AND DISCUSSION**



## **RESULTS AND DISCUSSION**

The presentation and analysis of the results in this investigation will be discussed in the following:

### **1- Growth characters.**

The main effect of application of filter mud cake (FMC), phosphorus and nitrogen fertilizers on growth characters of faba bean plants grown on Toshka soil during the seasons of 2010/2011 and 2011/2012 was summarized in Table 3.

Data indicate that the addition of filter mud cake, as an organic fertilizer has a significant effect on the number of branches / plant, number of pods / plant and plant height. The higher values of growth character was recorded in plants fertilized with filter mud cake in comparison to the control treatment. The increases percentage in number of branches / plant, number of pods / plant and plant height were 3.12%, 22%, 3.55% in 2010-2011 season and were 3.14%, 19% and 4.2% 2011-2012 season were found on plants amended with 20 m<sup>3</sup>/fed of filter mud cake. These results are in accordance with those found by **El-Zawahry (2000)**.

The mean values of the number of branches per plant , pods per plant and plant height were significantly affected by increasing phosphorus fertilizer level from 15.5 to 46.5 kg of P<sub>2</sub>O<sub>5</sub>/fed were 1.6%, 6.2% and 0.7% in 2010-2011 season and were 1.4%, 5.9% in 2011-2012 season . The highest value of plant height was obtained

from the application of at 31 kg P<sub>2</sub>O<sub>5</sub>/fed.

The positive effect of phosphorus fertilizer on growth characters, herein, may be due to the physiological role of P on the meristematic activity of plant tissues and consequently increasing plant growth, also, its function as a part of enzyme system having a vital role the synthesis of other foods from carbohydrate. It could be concluded that our results are in harmony with those obtained by **Abo-shetaia(1990)**, **Hamed (2003)**, **Khalil *et al.* (2004)**, **Abd-Allah and Hamed (2006)**, **Ahmed and El-Abagy(2007)** and **El-Gizawy and Mehasen (2009)**.

The number of branches per plant, number of pods per plant and plant height were generally increased by increasing nitrogen fertilizer levels from zero to 45 kg/fed. The corresponding increases were equal 6.8%, 16.1% and 7.7% in of 2010-2011 season and were 6.6%, 18.5% and 7.9% in 2011-212 season. This may be attributed to the effect of nitrogen in the metabolic processes and physiological activities of meristematic tissues, which are responsible for cell division and elongation in addition to formation of plant organs. These finding are in accordance with those freported by **Sobkowicz and Parylak, (2002)**, **Botos *et. al.* (2009)** and **El-Aal (2010)**.

**Table (3): The main effect of FMC, P and N fertilizers on number of branches / plant, pods/ plant and plant height.**

Treatments	2010-2011 Season			2011-2012 Season		
	Branch/ plant	Pods /plant	Plant height cm	Branches /plant	Pods /plant	Plant height cm
<b>0 org. m<sup>3</sup>/fed</b>	3.177	14.64	95.42	3.168	14.78	95.00
<b>10 org. m<sup>3</sup>/fed</b>	3.236	16.89	97.76	3.236	16.80	97.58
<b>20 org. m<sup>3</sup>/fed</b>	3.276	17.86	98.81	3.276	17.59	98.97
<b>F test</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>
<b>LSD 5%</b>	<b>0.029</b>	<b>0.37</b>	<b>0.41</b>	<b>0.028</b>	<b>0.73</b>	<b>0.77</b>
<b>15.5 P<sub>2</sub>O<sub>5</sub>kg/fed</b>	3.202	15.95	97.00	3.203	15.91	96.56
<b>31.0 P<sub>2</sub>O<sub>5</sub>kg/fed</b>	3.233	16.50	97.32	3.228	16.40	97.51
<b>46.5 P<sub>2</sub>O<sub>5</sub>kg/fed</b>	3.254	16.94	97.66	3.248	16.85	97.49
<b>F test</b>	<b>**</b>	<b>**</b>	<b>N.S</b>	<b>**</b>	<b>**</b>	<b>**</b>
<b>LSD 5%</b>	<b>0.016</b>	<b>0.43</b>	<b>--</b>	<b>0.021</b>	<b>0.32</b>	<b>0.67</b>
<b>00kg N/fed</b>	3.119	15.12	93.26	3.116	14.85	93.04
<b>15kg N/fed</b>	3.198	15.79	96.98	3.189	15.82	96.74
<b>30kg N/fed</b>	3.271	17.38	98.67	3.280	17.29	98.54
<b>45kg N/fed</b>	3.331	17.56	100.41	3.321	17.59	100.42
<b>F test</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>
<b>LSD 5%</b>	<b>0.019</b>	<b>0.50</b>	<b>0.76</b>	<b>0.024</b>	<b>0.37</b>	<b>0.77</b>

The interaction effect between the addition of filter mud cake and phosphorus fertilizer levels is shown in Table (4). In general, the number of branches / plant, number of pods / plant and plant height did not significantly affected by the interaction effect between the addition of FMC and phosphorus fertilizer. However, addition of 20 m<sup>3</sup> /fed of FMC and 46.5 P<sub>2</sub>O<sub>5</sub>/fed this treatment recorded the highest value of number branches / plant, number of pods / plant and plant height.

**Table (4): The interaction effect of FMC and P fertilizers on number of branches / plant, pods / plant and plant height.**

Treatments	2010-2011 Season			2011-2012 Season		
	Branches /plant	Pods /plant	Plant height cm	Branches /plant	Pods /plant	Plant height cm
0 org. m <sup>3</sup> & 15.5 P <sub>2</sub> O <sub>5</sub> kg/fed	3.14	13.9	95.0	3.15	14.4	94.2
0 org. m <sup>3</sup> & 31 P <sub>2</sub> O <sub>5</sub> kg /fed	3.18	14.6	95.5	3.18	14.5	95.6
0 org. m <sup>3</sup> & 46.5 P <sub>2</sub> O <sub>5</sub> kg /fed	3.21	15.4	95.8	3.18	15.4	95.3
10 org. m <sup>3</sup> & 15.5 P <sub>2</sub> O <sub>5</sub> kg /fed	3.21	16.5	97.3	3.21	16.4	97.0
10 org. m <sup>3</sup> & 31 P <sub>2</sub> O <sub>5</sub> kg /fed	3.24	16.9	97.8	3.23	16.9	97.9
10 org. m <sup>3</sup> & 46.5 P <sub>2</sub> O <sub>5</sub> kg /fed	3.26	17.2	98.1	3.26	17.2	97.9
20 org. m <sup>3</sup> & 15.5 P <sub>2</sub> O <sub>5</sub> kg /fed	3.25	17.4	98.7	3.25	17.0	98.5
20 org. m <sup>3</sup> & 31 P <sub>2</sub> O <sub>5</sub> kg /fed	3.27	18.0	98.7	3.27	17.8	99.1
20 org. m <sup>3</sup> & 46.5 P <sub>2</sub> O <sub>5</sub> kg /fed	3.30	18.2	99.1	3.30	17.9	99.3
<b>F test</b>	<b>N.S.</b>	<b>N.S.</b>	<b>N.S.</b>	<b>N.S.</b>	<b>N.S.</b>	<b>N.S.</b>
<b>LSD 5%</b>	--	--	--	--	--	--

- The interaction effect between FMC and nitrogen fertilizer on the number of branches / plant, number of pods / plant and plant height is shown in Table (5).

Data showed that the application of 45 kg N/fed alongside 0, 10 and 20 m<sup>3</sup> FMC/fed gave significant increases in number of pods / plant and plant height for faba bean plants compared with treatment received no FMC or nitrogen fertilizer. Application of 45 kg N/fed alongside with 20 m<sup>3</sup>/fed organic manure (FMC) caused increases by 41.9% and 12.1 in season of 2010-2011, 43.4% and 13.3% in season of 2011-2012 over zero organic and zero N kg/fed respectively.

**Table (5): The interaction effect of FMC and N fertilizers on number of branches / plant pods /plant and plant height.**

Treatments	2010-2011 Season			2011-2012 Season		
	Branch /plant	Pods /plant	Height cm	Branch /plant	Pods /plant	Height cm
0 org. m <sup>3</sup> & 0kg N/fed	3.06	12.9	89.9	3.06	12.9	89.2
0 org. m <sup>3</sup> & 15kg N/fed	3.14	13.4	94.8	3.12	13.9	94.3
0 org. m <sup>3</sup> & 30kg N/fed	3.22	15.9	97.1	3.23	16.1	96.8
0 org. m <sup>3</sup> & 45kg N/fed	3.29	16.3	99.9	3.26	16.2	99.7
10 org. m <sup>3</sup> & 0kg N/fed	3.13	14.9	94.0	3.13	15.0	93.9
10 org. m <sup>3</sup> & 15kg N/fed	3.22	16.6	97.5	3.21	16.4	97.2
10 org. m <sup>3</sup> & 30kg N/fed	3.27	17.9	99.0	3.29	17.8	98.7
10 org. m <sup>3</sup> & 45kg N/fed	3.33	18.1	100.6	3.32	18.1	100.5
20 org. m <sup>3</sup> & 0kg N/fed	3.16	17.5	95.9	3.15	16.7	96.0
20 org. m <sup>3</sup> & 15kg N/fed	3.24	17.3	98.7	3.24	17.2	98.7
20 org. m <sup>3</sup> & 30kg N/fed	3.32	18.3	99.9	3.33	18.0	100.1
20 org. m <sup>3</sup> & 45kg N/fed	3.38	18.3	100.8	3.38	18.5	101.1
<b>F test</b>	<b>N.S.</b>	<b>**</b>	<b>**</b>	<b>N.S.</b>	<b>**</b>	<b>**</b>
<b>LSD 5%</b>	<b>--</b>	<b>0.8</b>	<b>1.2</b>	<b>--</b>	<b>0.9</b>	<b>1.4</b>

- The interaction effect between of phosphorus and nitrogen fertilizers on number of branches per plant, pods per plant and plant height in Table (6) was not significant in the two seasons.

**Table (6): The interaction effect of P and N fertilizers on number of branches /plant, pods / plant and plant height.**

Treatments	2010-2011 Season			2011-2012 Season		
	Branch/ plant	Pods /plant	Height cm	Branches /plant	Pods /plant	Height cm
15.5 P <sub>2</sub> O <sub>5</sub> kg & 0kg N/fed	3.10	14.5	92.2	3.11	14.2	91.5
15.5 P <sub>2</sub> O <sub>5</sub> kg & 15kg N/fed	3.17	15.1	97.3	3.17	15.3	96.1
15.5 P <sub>2</sub> O <sub>5</sub> kg & 30kg N/fed	3.23	17.0	98.1	3.24	17.0	97.9
15.5 P <sub>2</sub> O <sub>5</sub> kg & 45kg N/fed	3.31	17.1	100.3	3.28	17.2	100.7
31 P <sub>2</sub> O <sub>5</sub> kg&0kg N/fed	3.12	15.2	93.1	3.10	14.8	93.4
31 P <sub>2</sub> O <sub>5</sub> kg & 15kg N/fed	3.20	15.6	96.6	3.19	15.7	97.0
31 P <sub>2</sub> O <sub>5</sub> kg & 30kg N/fed	3.28	17.5	99.0	3.29	17.4	99.1
31 P <sub>2</sub> O <sub>5</sub> kg & 45kg N/fed	3.33	17.7	100.6	3.32	17.7	100.4
46.5 P <sub>2</sub> O <sub>5</sub> kg & 0kg N/fed	3.13	15.6	94.4	3.13	15.6	94.1
46.5 P <sub>2</sub> O <sub>5</sub> kg & 15kg N/fed	3.23	16.7	97.0	3.20	16.5	97.1
46.5 P <sub>2</sub> O <sub>5</sub> kg & 30kg N/fed	3.31	17.6	98.9	3.30	17.5	98.6
46.5 P <sub>2</sub> O <sub>5</sub> kg & 45kg N/fed	3.35	17.9	100.3	3.36	17.9	100.2
F test	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
LSD 5%	--	--	--	--	--	--

- Regarding the interaction effect between of application of filter mud cake FMC, phosphorus and nitrogen fertilizers on number of branches per plant, pods per plant and plant height shown Table (7) was not significant.

Table (7): The interaction effect of FMC, P and N fertilizers on number of branches / plant, pods / plant and plant height.

Treatments			2010-2011 Season			2011-2012 Season		
org. m <sup>3</sup> /fed	P <sub>2</sub> O <sub>5</sub> kg/fed	N kg/fed	Branch/plant	Pods/plant	Height cm	Branch/plant	Pods/plant	Height cm
0	15.5	0	3.033	12.40	88.33	3.057	12.07	87.00
		15	3.090	12.37	95.33	3.077	13.60	93.00
		30	3.157	15.37	96.67	3.207	15.73	96.33
		45	3.287	15.60	99.67	3.243	16.00	100.33
	31	0	3.067	12.67	89.67	3.060	12.30	90.00
		15	3.153	12.70	94.67	3.147	13.33	95.67
		30	3.230	16.50	97.33	3.230	16.20	97.33
		45	3.283	16.43	100.33	3.267	16.30	99.33
	46.5	0	3.093	13.67	91.67	3.077	14.37	90.67
		15	3.163	15.23	94.33	3.127	14.73	94.33
		30	3.263	15.97	97.33	3.243	16.30	96.67
		45	3.300	16.73	99.67	3.283	16.37	99.33
10	15.5	0	3.123	14.12	93.00	3.130	14.30	92.56
		15	3.190	16.38	97.67	3.197	15.90	96.67
		30	3.230	17.73	98.33	3.243	17.38	98.11
		45	3.307	17.80	100.33	3.283	17.82	100.67
	31	0	3.143	15.20	94.00	3.110	15.15	94.33
		15	3.217	16.60	97.00	3.203	16.48	97.45
		30	3.280	17.68	99.45	3.307	17.65	99.11
		45	3.323	18.19	100.78	3.317	18.20	100.56
	46.5	0	3.120	15.42	95.00	3.143	15.54	94.78
		15	3.243	16.80	97.78	3.223	16.74	97.55
		30	3.310	18.32	99.22	3.310	18.23	99.00
		45	3.347	18.44	100.56	3.360	18.23	100.22
20	15.5	0	3.153	17.10	95.33	3.153	16.10	95.00
		15	3.223	16.70	99.00	3.240	16.33	98.67
		30	3.293	17.97	99.33	3.283	17.80	99.33
		45	3.337	17.90	101.00	3.327	17.87	101.00
	31	0	3.157	17.67	95.67	3.140	17.00	96.00
		15	3.230	17.37	98.00	3.233	17.33	98.00
		30	3.327	18.43	100.33	3.337	18.33	101.00
		45	3.380	18.57	100.67	3.380	18.53	101.33
	46.5	0	3.177	17.83	96.67	3.170	16.87	97.00
		15	3.270	17.97	99.00	3.257	17.93	99.33
		30	3.353	18.43	100.00	3.357	17.93	100.00
		45	3.413	18.40	100.67	3.430	19.00	101.00
F test			N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
LSD 5%			--	--	--	--	--	--

## **2- Yield and yield component.**

The main effects of application of FMC, P and N fertilizers on the weight of the seed, straw, biological yield ( kg/fed) and weight of 100 seed (g) were presented in Table (8).

The weight of the seeds, straw, biological yield (kg/fed) and 100-seed weight (g) were generally increased by increasing the levels of filter mud cake to the soil from zero to 20m<sup>3</sup>/fed. These increases went up to 15.1%, 25.9%, 21.3% and 1.6% in the season of 2010-2011 16.8%, 22%, 19.8% and 1.5% in the season of 2011-2012 respectively. These findings are in accordance with those obtained by **Helall *et al.*, (2009).**

Addition of phosphorus fertilizer had a significant effect on weight of the seeds , straw , biological yield ( kg/fed) and 100-seed (g) These increments were account to 10.3%, 6.9%, 8.3% and 0.4% in the season of 2010-2011 10.5%, 7.5%, 8.7% and 0.5% in the season of 2011-2012 respectively when 46.5 kg P<sub>2</sub>O<sub>5</sub>/fed. in comparison to the control. The yield improvement of faba bean by applying P could be attributed to an increase in the number of productive nodes and number of pods per plant. In fact, the number of pods per faba bean plant was found to correlate strongly with grain yield. These results are in agreement with those obtained by many investigators (**Turk and Tawaha (2002), El-Gizawy and Mehasen 2009 and Weldua *et al.* 2012).**



Table (8) indicate clearly that the mean values of the straw , biological yield ( kg/fed) and weight of 100-seed (g) was significantly affected when nitrogen fertilizer levels was increased from zero to 45 kg/fed. The increases were 38 %, 38.9% and 1.5% in the season of 2010-2011. 39.5 %, 39.9% and 2.2% in the season of 2011-2012 respectively. The highest percentage increases in the weight of seeds 51.9% well found when 30kg N/fed in the season of 2010-2011 and 51.3% in the season of 2011-2012. Similar results were also reported by El-Khawaga and Zeiton (1986), Diaz and Manrique (1995), Labuda (2001), Daur *et. al* (2008) and Botos *et. al.* (2009).

Table (8): The main effect of FMC, P and N fertilizers on the seed, straw and biological yields (kg/f) and 100-seed weight (g).

Treatments	2010-2011 Season				2011-2012 Season			
	Seed yield (kg/f)	Straw yield (kg/f)	Biological yield (kg/f)	100-seed weight (g)	Seed yield (kg/f)	Straw yield (kg/f)	Biological yield (kg/f)	100-seed weight (g)
0 org. m <sup>3</sup> /fed	1094	1469	2564	74.48	1082	1503	2585	74.39
10 org. m <sup>3</sup> /fed	1225	1769	2993	75.18	1233	1750	2983	75.20
20 org. m <sup>3</sup> /fed	1259	1850	3109	75.70	1264	1834	3098	75.53
F test	**	**	**	**	*	**	*	**
LSD 5%	38.74	50.59	60.10	0.33	152.99	124.89	275.42	0.50
15.5 P <sub>2</sub> O <sub>5</sub> kg/fed	1136	1636	2772	74.94	1135	1630	2765	74.82
31.0 P <sub>2</sub> O <sub>5</sub> kg/fed	1188	1703	2891	75.14	1190	1705	2895	75.07
46.5 P <sub>2</sub> O <sub>5</sub> kg/fed	1253	1749	3002	75.27	1254	1752	3006	75.22
F test	**	**	**	**	**	**	**	**
LSD 5%	15.56	38.51	42.66	0.14	36.44	33.86	49.47	0.11
00kg N/fed	914	1425	2339	74.52	916	1439	2356	74.17
15kg N/fed	1186	1598	2784	74.99	1182	1591	2773	74.88
30kg N/fed	1388	1794	3182	75.29	1386	1745	3131	75.28
45kg N/fed	1283	1966	3249	75.67	1287	2008	3295	75.81
F test	**	**	**	**	**	**	**	**
LSD 5%	17.97	44.47	49.26	0.17	42.08	39.09	57.12	0.13

The interaction effect between application of filter mud cake (FMC) and phosphorus fertilizer had non significant effects on the weight of seed, straw, biological yields ( kg/fed) and weight of 100-seed (g) in ( Table 9).

**Table (9): The interaction effect of FMC and P fertilizers on the weight of seed, straw, biological yield (kg/f) and 100- seed weight (g).**

Treatments	2010-2011 season				2011-2012 season			
	Seed yield (kg/f)	Straw yield (kg/f)	Biological yield (kg/f)	100-seed weight (g)	Seed yield (kg/f)	Straw yield (kg/f)	Biological yield (kg/f)	100-seed weight (g)
0 org. m <sup>3</sup> & 15.5 P <sub>2</sub> O <sub>5</sub> kg/fed	1039	1395	2433	74.23	1023	1421	2444	74.09
0 org. m <sup>3</sup> & 31 P <sub>2</sub> O <sub>5</sub> kg /fed	1090	1484	2574	74.53	1081	1507	2589	74.43
0 org.m <sup>3</sup> & 46.5 P <sub>2</sub> O <sub>5</sub> kg /fed	1154	1530	2683	74.68	1143	1581	2723	74.63
10 org.m <sup>3</sup> & 15.5 P <sub>2</sub> O <sub>5</sub> kg /fed	1176	1727	2903	75.06	1185	1714	2898	75.03
10 org.m <sup>3</sup> & 31 P <sub>2</sub> O <sub>5</sub> kg /fed	1223	1772	2995	75.18	1230	1751	2981	75.25
10 org.m <sup>3</sup> & 46.5 P <sub>2</sub> O <sub>5</sub> kg /fed	1275	1807	3082	75.29	1283	1786	3069	75.31
20 org. m <sup>3</sup> & 15.5 P <sub>2</sub> O <sub>5</sub> kg /fed	1195	1786	2980	75.54	1196	1757	2954	75.35
20 org. m <sup>3</sup> & 31 P <sub>2</sub> O <sub>5</sub> kg /fed	1250	1854	3104	75.71	1259	1857	3116	75.53
20 org. m <sup>3</sup> & 46.5 P <sub>2</sub> O <sub>5</sub> kg /fed	1332	1910	3242	75.86	1337	1889	3226	75.71
<b>F test</b>	<b>N.S</b>	<b>N.S</b>	<b>N.S</b>	<b>N.S</b>	<b>N.S</b>	<b>N.S</b>	<b>N.S</b>	<b>N.S</b>
<b>LSD 5%</b>	--	--	--	--	--	--	--	--

Data in Table (10) show the interaction effect between the application of filter mud cake (FMC) and nitrogen fertilizer on the seed yield, , biological yield and 100- seed weight was significant in 2010/2011 and 2011/2012 seasons. This interaction effect between FMC and nitrogen fertilizer on straw yield was not significant in both seasons. However, the interaction effect between FMC application at rate of 20m<sup>3</sup>/fed and nitrogen fertilization at a rate of 45 kg N/fed

produced the highest values of straw yield and 100-seed weight in both seasons. Application of nitrogen fertilizer at 30 kg N/fed and 20m<sup>3</sup> /fed of FMC produced the highest values of seed yield (1552-1550 kg/fed) and biological yield (3510 - 3453kg/fed) in 2010/2011 and 2012 season respectively. The interpretations for these results could be attributed the fact that both nitrogen fertilization and FMC supplied the plants with adequate and enough quantities of their requirements for nitrogen. Once nitrogen was found in suitable amounts in soil that could push the plant to grow vigorously lead to an increase vegetative growth and then seed yield.

**Table (10): The interaction effect of FMC and N fertilizers on the weight of seed, straw and biological yields (kg/f) and 100- seed weight (g)**

Treatments	2010-2011 season				2011-2012 season			
	Seed yield (kg/f)	Straw yield (kg/f)	Biological yield (kg/f)	100-seed weight (g)	Seed yield (kg/f)	Straw yield (kg/f)	Biological yield (kg/f)	100-seed weight (g)
0 org. m <sup>3</sup> & 0kg N/fed	855	1159	2014	73.49	845	1247	2092	73.33
0 org. m <sup>3</sup> & 15kg N/fed	1033	1350	2383	74.38	1011	1421	2433	74.08
0 org. m <sup>3</sup> & 30kg N/fed	1142	1575	2717	74.80	1125	1561	2686	74.63
0 org. m <sup>3</sup> & 45kg N/fed	1347	1793	3139	75.23	1349	1782	3130	75.50
10 org. m <sup>3</sup> & 0kg N/fed	940	1536	2476	74.75	944	1527	2471	74.51
10 org. m <sup>3</sup> & 15kg N/fed	1180	1681	2861	75.07	1183	1646	2829	75.13
10 org. m <sup>3</sup> & 30kg N/fed	1469	1850	3319	75.27	1484	1772	3256	75.40
10 org. m <sup>3</sup> & 45kg N/fed	1309	2009	3318	75.62	1319	2056	3375	75.74
20 org. m <sup>3</sup> & 0kg N/fed	946	1580	2527	75.33	960	1543	2503	74.66
20 org. m <sup>3</sup> & 15kg N/fed	1344	1763	3107	75.51	1352	1706	3058	75.43
20 org. m <sup>3</sup> & 30kg N/fed	1552	1958	3510	75.81	1550	1903	3453	75.82
20 org. m <sup>3</sup> & 45kg N/fed	1193	2098	3291	76.16	1193	2185	3379	76.20
<b>F test</b>	<b>**</b>	<b>N.S</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>N.S</b>	<b>**</b>	<b>**</b>
<b>LSD 5%</b>	<b>46.58</b>	<b>--</b>	<b>94.12</b>	<b>0.41</b>	<b>164.11</b>	<b>--</b>	<b>286.81</b>	<b>0.54</b>

Data in Table (11) showed the interaction effect between the phosphorus and nitrogen fertilizers on the weight of seed yield, straw yield, biological yield and 100- seed weight. Results in Table (11) indicated that weight of seed yield, straw yield, biological yield as well as 100- seed weight were not significantly affected by the above interaction

**Table (11): The interaction effect of P and N fertilizers on the weight of seed, straw, biological yield (kg/f) and 100- seed (g).**

Treatments	2010-2011 season				2011-2012 season			
	Seed yield (kg/f)	Straw yield (kg/f)	Biological yield (kg/f)	100-seed weight (g)	Seed yield (kg/f)	Straw yield (kg/f)	Biological yield (kg/f)	100-seed weight (g)
15.5 P <sub>2</sub> O <sub>5</sub> kg & 0kg N/fed	859	1367	2226	74.29	859	1372	2231	73.87
15.5 P <sub>2</sub> O <sub>5</sub> kg & 15kg N/fed	1133	1531	2664	74.87	1128	1542	2670	74.74
15.5 P <sub>2</sub> O <sub>5</sub> kg & 30kg N/fed	1338	1725	3063	75.17	1337	1683	3021	75.13
15.5 P <sub>2</sub> O <sub>5</sub> kg & 45kg N/fed	1215	1920	3135	75.44	1215	1925	3140	75.55
31 P <sub>2</sub> O <sub>5</sub> kg&0kg N/fed	896	1433	2329	74.60	902	1462	2365	74.22
31 P <sub>2</sub> O <sub>5</sub> kg & 15kg N/fed	1188	1620	2808	75.01	1185	1600	2785	74.91
31 P <sub>2</sub> O <sub>5</sub> kg & 30kg N/fed	1378	1794	3171	75.27	1377	1754	3131	75.31
31 P <sub>2</sub> O <sub>5</sub> kg & 45kg N/fed	1290	1967	3257	75.67	1296	2003	3299	75.84
46.5 P <sub>2</sub> O <sub>5</sub> kg & 0kg N/fed	986	1476	2462	74.68	987	1484	2471	74.40
46.5 P <sub>2</sub> O <sub>5</sub> kg & 15kg N/fed	1236	1643	2879	75.07	1234	1631	2865	75.00
46.5 P <sub>2</sub> O <sub>5</sub> kg & 30kg N/fed	1448	1864	3312	75.44	1445	1798	3243	75.41
46.5 P <sub>2</sub> O <sub>5</sub> kg & 45kg N/fed	1343	2013	3357	75.90	1350	2096	3446	76.05
F test	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
LSD 5%	--	--	--	--	--	--	--	--

The interaction effect between organic manure, phosphorus and nitrogen fertilizers as illustrated in Table (12) on seed, straw and biological yield was not significant. However data also show that the highest seed yield (1637 and 1632 kg/fed) was obtained when 20m<sup>3</sup> FMC/fed & 46.5 P<sub>2</sub>O<sub>5</sub>kg /fed & 30 N kg/fed, in were applied in the two season respectively similar trend was noticed concerning the biological yield in the two season (3360 and 33620 kg/fed) respectively.

Table (12): The interaction effect of FMC, P and N fertilizers on seed, straw and biological yield (kg/f) and 100- seed weight (g).

Treatments			2010-2011 season				2011-2012 season			
org. m³/fed	P₂O₅kg/fed	N kg/fed	Seed yield (kg/f)	Straw yield (kg/f)	Biological yield (kg/f)	100-seed weight (g)	Seed yield (kg/f)	Straw yield (kg/f)	Biological yield (kg/f)	100-seed weight (g)
0	15.5	0	806	1082	1888	72.97	796	1106	1902	73.07
		15	1002	1260	2262	74.27	979	1384	2363	73.97
		30	1106	1501	2606	74.60	1087	1516	2603	74.33
		45	1242	1735	2977	75.07	1231	1675	2906	75.00
	31	0	838	1196	2034	73.63	829	1285	2114	73.40
		15	1025	1372	2398	74.40	1004	1423	2428	74.07
		30	1158	1580	2738	74.80	1140	1564	2704	74.70
		45	1341	1786	3127	75.27	1351	1756	3108	75.57
	46.5	0	922	1199	2121	73.87	909	1350	2259	73.53
		15	1072	1418	2490	74.47	1051	1456	2507	74.20
		30	1163	1644	2807	75.00	1147	1603	2750	74.87
		45	1457	1857	3314	75.37	1464	1913	3377	75.93
10	15.5	0	869	1486	2355	74.64	872	1495	2367	74.22
		15	1123	1659	2781	74.99	1131	1629	2760	74.99
		30	1424	1762	3186	75.21	1441	1737	3178	75.29
		45	1287	2001	3288	75.41	1296	1993	3288	75.61
	31	0	957	1546	2503	74.74	960	1539	2499	74.63
		15	1187	1685	2872	75.08	1189	1645	2834	75.16
		30	1439	1862	3302	75.27	1455	1775	3231	75.42
		45	1309	1996	3304	75.65	1316	2044	3360	75.78
	46.5	0	993	1576	2569	74.87	1000	1547	2547	74.68
		15	1230	1698	2928	75.16	1230	1664	2894	75.26
		30	1544	1925	3469	75.32	1556	1803	3359	75.48
		45	1331	2030	3361	75.81	1345	2131	3476	75.82
20	15.5	0	903	1532	2435	75.27	910	1513	2423	74.33
		15	1275	1674	2949	75.37	1274	1613	2887	75.27
		30	1484	1914	3398	75.70	1484	1797	3281	75.77
		45	1117	2023	3140	75.83	1118	2106	3224	76.03
	31	0	893	1558	2450	75.43	918	1563	2481	74.63
		15	1350	1802	3153	75.57	1362	1732	3095	75.50
		30	1536	1938	3474	75.73	1535	1923	3458	75.80
		45	1221	2118	3339	76.10	1221	2208	3428	76.17
	46.5	0	1043	1652	2695	75.30	1053	1554	2606	75.00
		15	1406	1812	3218	75.60	1421	1772	3193	75.53
		30	1637	2023	3660	76.00	1632	1988	3620	75.90
		45	1241	2153	3394	76.53	1241	2243	3484	76.40
F test			N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
LSD 5%			--	--	--	--	--	--	--	--

### **3-Percentages of N, P, K and protein in seeds.**

Data in Table (13) summarize the main effects of application of filter mud cake (FMC), phosphorus and nitrogen fertilizers on content N%, P%, K% and protein% in seeds.

Addition of filter mud cake to the soil resulted in significant increases in N %, P %, and protein % in seeds by 12 %, 13.8%, 12% in 2010-2011 season and 8.4%, 4.5%, and 8.4% season 2011-2012 respectively. When 20m<sup>3</sup>/fed of FMC was applied. The highest increases in K% seed content 18.9% and 17.9% in the two seasons when 10m<sup>3</sup> FMC /fed was added. Similar results were also reported by **Attia and El-Dsouky(2001)** and **Abd-Allah, (2002)**.

Data reported in Table (13) show that N%, P% and protein% was generally increased by increasing phosphorus fertilizer from 15.5 to 46.5 kg P<sub>2</sub>O<sub>5</sub>/fed. These increases reached 31%, 101.3%, 31% in the season of 2010-2011 and 28%, 100%, 28% in the season of 2011-2012 respectively. These results are in agreement with those obtained by **Bolland *et al.* (2000)**.

Also, data in Table (13) show that both N% and P% in seeds were significantly increased with increasing N rates in comparison to the control. Addition of nitrogen fertilizer at a rate of 45 kg N/fed recorded the highest significant increases in N as well as P and protein in seeds. The increases were significant when compared to the control which equal 214 and 182%, 32 and 37%, 214 and 182% in the two seasons. These results are in agreement with those recorded by **Adam (2002)** and **Botos *et al.* (2009)**.

**Table (13): The main effect of application of FMC, P and N fertilizers on the percentages of N, P, K and protein in seeds.**

Treatments	2010-2011 season				2011-2012 season			
	N %	P %	K%	protein%	N %	P %	K%	protein%
<b>0 org. m<sup>3</sup>/fed</b>	2.17	0.210	1.80	13.58	2.50	0.217	1.79	15.62
<b>10 org. m<sup>3</sup>/fed</b>	2.33	0.235	2.14	14.58	2.60	0.224	2.11	16.22
<b>20 org. m<sup>3</sup>/fed</b>	2.44	0.239	2.10	15.22	2.71	0.234	2.08	16.93
<b>F test</b>	*	**	**	*	**	*	N.S	**
<b>LSD 5%</b>	<b>0.09</b>	<b>0.008</b>	<b>0.11</b>	<b>1.16</b>	<b>0.05</b>	<b>0.013</b>	--	<b>0.28</b>
<b>15.5 P<sub>2</sub>O<sub>5</sub>kg/fed</b>	2.00	0.151	2.02	12.52	2.29	0.149	2.00	14.29
<b>31.0 P<sub>2</sub>O<sub>5</sub>kg/fed</b>	2.31	0.229	2.04	14.43	2.59	0.226	2.05	16.22
<b>46.5 P<sub>2</sub>O<sub>5</sub>kg/fed</b>	2.63	0.304	1.96	16.42	2.92	0.301	1.94	18.27
<b>F test</b>	**	**	**	**	**	**	**	**
<b>LSD 5%</b>	<b>0.14</b>	<b>0.008</b>	<b>0.02</b>	<b>0.87</b>	<b>0.12</b>	<b>0.010</b>	<b>0.06</b>	<b>0.75</b>
<b>00kg N/fed</b>	1.19	0.197	1.98	7.45	1.41	0.195	1.97	8.81
<b>15kg N/fed</b>	1.71	0.219	2.01	10.70	2.08	0.213	1.99	12.99
<b>30kg N/fed</b>	2.60	0.237	2.02	16.27	2.94	0.233	2.00	18.38
<b>45kg N/fed</b>	3.75	0.260	2.03	23.42	3.98	0.260	2.02	24.85
<b>F test</b>	**	**	N.S	**	**	**	N.S	**
<b>LSD 5%</b>	<b>0.16</b>	<b>0.009</b>	--	<b>1.00</b>	<b>0.14</b>	<b>0.012</b>	--	<b>0.87</b>

Data in Table (14) showed the interaction effect between the application of filter mud cake (FMC) and phosphorus fertilizer on N%, P%, K% and protein% in seeds.

Results in Table (14) indicate that the N% and protein% in seeds were not significantly affected by the above interaction in both seasons. On the other hand, the interaction effect between FMC and phosphorus fertilization on the P% and K% in seeds were significant. The interaction effect between FMC application at rate of 20m<sup>3</sup>FMC/fed and phosphorus fertilization rate of 46.5 kg P<sub>2</sub>O<sub>5</sub>/fed produced the highest values of P% in seeds by an increases 137.7% and 122.8% over control in 2010/2011 and 2011/2012 respectively.

**Table (14): The interaction effect of (FMC) and P fertilizers on the percentages of N, P, K and protein in seeds.**

Treatments	2010-2011 season				2011-2012 season			
	N %	P %	K%	protein%	N %	P %	K%	protein%
0 org. m <sup>3</sup> & 15.5 P <sub>2</sub> O <sub>5</sub> kg/fed	1.86	0.138	1.74	11.64	2.21	0.145	1.73	13.80
0 org. m <sup>3</sup> & 31 P <sub>2</sub> O <sub>5</sub> kg /fed	2.20	0.213	1.96	13.76	2.48	0.222	1.97	15.53
0 org. m <sup>3</sup> & 46.5 P <sub>2</sub> O <sub>5</sub> kg /fed	2.45	0.279	1.69	15.34	2.81	0.284	1.68	17.54
10 org. m <sup>3</sup> & 15.5 P <sub>2</sub> O <sub>5</sub> kg /fed	2.02	0.168	2.19	12.60	2.27	0.155	2.16	14.21
10 org. m <sup>3</sup> & 31 P <sub>2</sub> O <sub>5</sub> kg /fed	2.32	0.233	2.07	14.53	2.60	0.223	2.07	16.23
10 org. m <sup>3</sup> & 46.5 P <sub>2</sub> O <sub>5</sub> kg /fed	2.66	0.306	2.14	16.61	2.92	0.295	2.11	18.23
20 org. m <sup>3</sup> & 15.5 P <sub>2</sub> O <sub>5</sub> kg /fed	2.13	0.148	2.14	13.33	2.38	0.146	2.12	14.86
20 org. m <sup>3</sup> & 31 P <sub>2</sub> O <sub>5</sub> kg /fed	2.40	0.241	2.09	15.02	2.70	0.234	2.10	16.90
20 org. m <sup>3</sup> & 46.5 P <sub>2</sub> O <sub>5</sub> kg /fed	2.77	0.328	2.05	17.31	3.05	0.323	2.03	19.04
F test	N.S	**	**	N.S	N.S	*	**	N.S
LSD 5%	--	0.014	0.111	--	--	0.019	0.285	--

Data in Table (15) indicate that both N , P and protein percentages in seed were not significantly affected by the interaction between the addition of filter mud cake and nitrogen fertilization. On the other hand the above interaction effect on K% in seeds was significant (Table 15). However, the addition of 20 m<sup>3</sup> of FMC /fed and 45 kg N/fed but recorded the highest value of protein percentage. This could be referred to the fact that the greatest value of N% was found in seeds under the same treatment.

The results presented in Table (16) show that there was non significant interactions effects between of application of P and N fertilizers on the percentages of N, P and protein percentages in seeds. Potassium percentages were significantly affected by the above interaction in both seasons.



Table (15): The interaction effect of FMC and N fertilizers on the percentages of N, P, K and protein in seeds.

Treatments	2010-2011 season				2011-2012 season			
	N %	P %	K%	protein%	N %	P %	K%	protein%
0 org. m <sup>3</sup> & 0kg N/fed	1.05	0.178	1.63	6.53	1.33	0.186	1.63	8.32
0 org. m <sup>3</sup> & 15kg N/fed	1.56	0.199	1.60	9.75	1.99	0.206	1.60	12.47
0 org. m <sup>3</sup> & 30kg N/fed	2.36	0.221	1.93	14.78	2.85	0.230	1.92	17.81
0 org. m <sup>3</sup> & 45kg N/fed	3.72	0.243	2.04	23.26	3.82	0.247	2.03	23.89
10 org. m <sup>3</sup> & 0kg N/fed	1.20	0.209	2.21	7.47	1.40	0.198	2.19	8.74
10 org. m <sup>3</sup> & 15kg N/fed	1.74	0.229	2.18	10.89	2.08	0.213	2.15	12.97
10 org. m <sup>3</sup> & 30kg N/fed	2.70	0.246	2.12	16.88	2.96	0.231	2.09	18.47
10 org. m <sup>3</sup> & 45kg N/fed	3.69	0.258	2.04	23.08	3.95	0.256	2.02	24.70
20 org. m <sup>3</sup> & 0kg N/fed	1.33	0.203	2.11	8.33	1.50	0.201	2.09	9.38
20 org. m <sup>3</sup> & 15kg N/fed	1.83	0.228	2.25	11.47	2.17	0.220	2.23	13.53
20 org. m <sup>3</sup> & 30kg N/fed	2.74	0.243	2.00	17.14	3.02	0.238	1.99	18.85
20 org. m <sup>3</sup> & 45kg N/fed	3.83	0.280	2.02	23.94	4.16	0.278	2.01	25.97
F test	N.S	N.S	**	N.S	N.S	N.S	**	N.S
LSD 5%	--	--	0.11	--	--	--	0.29	--

Table (16): The interaction effect of application of the P and N fertilizers on the percentages of N, P, K and protein in seeds.

Treatments	2010-2011 season				2011-2012 season			
	N %	P %	K%	protein%	N %	P %	K%	protein%
15.5 P <sub>2</sub> O <sub>5</sub> kg & 0kg N/fed	0.95	0.119	2.05	5.92	1.17	0.111	2.03	7.31
15.5 P <sub>2</sub> O <sub>5</sub> kg & 15kg N/fed	1.55	0.142	1.94	9.69	1.83	0.142	1.92	11.47
15.5 P <sub>2</sub> O <sub>5</sub> kg & 30kg N/fed	2.13	0.158	1.95	13.31	2.53	0.162	1.93	15.81
15.5 P <sub>2</sub> O <sub>5</sub> kg & 45kg N/fed	3.39	0.186	2.16	21.17	3.61	0.179	2.14	22.58
31 P <sub>2</sub> O <sub>5</sub> kg&0kg N/fed	1.21	0.203	2.05	7.54	1.44	0.203	2.05	9.03
31 P <sub>2</sub> O <sub>5</sub> kg & 15kg N/fed	1.70	0.219	2.11	10.60	2.07	0.213	2.11	12.97
31 P <sub>2</sub> O <sub>5</sub> kg & 30kg N/fed	2.58	0.240	2.04	16.13	2.96	0.237	2.04	18.48
31 P <sub>2</sub> O <sub>5</sub> kg & 45kg N/fed	3.75	0.253	1.98	23.47	3.90	0.252	1.98	24.40
46.5 P <sub>2</sub> O <sub>5</sub> kg & 0kg N/fed	1.42	0.268	1.85	8.88	1.62	0.270	1.83	10.10
46.5 P <sub>2</sub> O <sub>5</sub> kg & 15kg N/fed	1.89	0.294	1.97	11.81	2.33	0.283	1.95	14.54
46.5 P <sub>2</sub> O <sub>5</sub> kg & 30kg N/fed	3.10	0.312	2.06	19.37	3.34	0.300	2.03	20.85
46.5 P <sub>2</sub> O <sub>5</sub> kg & 45kg N/fed	4.10	0.342	1.96	25.63	4.41	0.349	1.94	27.59
F test	N.S	N.S	**	N.S	N.S	N.S	**	N.S
LSD 5%	--	--	0.043	--	--	--	0.117	--

The results presented in Table (17) show that there the interaction between filter mud cake, phosphorus and nitrogen fertilization rates on N, P and protein percentage in seeds was not significant. However the interaction between the FMC, phosphorus and nitrogen fertilization on K% in seed was significant in both seasons.

Table (17): The interaction effect of FMC P, and N fertilizers on the percentages of N, P, K and protein in seeds.

Treatments			2010-2011 season				2011-2012 season			
org. m <sup>3</sup> /fed	P <sub>2</sub> O <sub>5</sub> kg/fed	N kg/fed	N %	P %	K%	protein%	N %	P %	K%	protein%
0	15.5	0	0.80	0.090	1.80	4.98	1.04	0.097	1.79	6.52
		15	1.41	0.130	1.13	8.81	1.79	0.140	1.12	11.17
		30	1.88	0.157	1.87	11.77	2.45	0.167	1.87	15.33
		45	3.36	0.177	2.17	21.00	3.55	0.177	2.15	22.19
	31	0	1.10	0.187	1.85	6.90	1.40	0.203	1.86	8.77
		15	1.53	0.203	1.98	9.58	1.95	0.210	2.00	12.17
		30	2.39	0.220	2.04	14.94	2.86	0.230	2.05	17.85
		45	3.78	0.243	1.98	23.63	3.73	0.243	1.98	23.31
	46.5	0	1.24	0.257	1.24	7.73	1.55	0.257	1.24	9.67
		15	1.74	0.263	1.69	10.85	2.25	0.267	1.68	14.06
		30	2.82	0.287	1.87	17.63	3.24	0.293	1.85	20.25
		45	4.02	0.310	1.98	25.15	4.19	0.320	1.95	26.17
10	15.5	0	0.95	0.143	1.99	5.92	1.15	0.123	1.96	7.19
		15	1.58	0.163	2.25	9.88	1.81	0.147	2.22	11.33
		30	2.16	0.177	2.24	13.52	2.55	0.163	2.20	15.92
		45	3.37	0.187	2.29	21.08	3.58	0.187	2.26	22.40
	31	0	1.21	0.210	2.21	7.54	1.43	0.203	2.21	8.94
		15	1.72	0.220	2.12	10.77	2.09	0.210	2.12	13.08
		30	2.66	0.243	1.96	16.65	2.98	0.230	1.96	18.60
		45	3.70	0.257	2.00	23.15	3.89	0.250	2.00	24.29
	46.5	0	1.43	0.273	2.43	8.96	1.62	0.267	2.39	10.10
		15	1.92	0.303	2.16	12.02	2.32	0.283	2.13	14.50
		30	3.28	0.317	2.14	20.48	3.34	0.300	2.11	20.90
		45	4.00	0.330	1.82	25.00	4.39	0.330	1.80	27.42
20	15.5	0	1.10	0.123	2.36	6.88	1.32	0.113	2.33	8.23
		15	1.66	0.133	2.45	10.40	1.90	0.140	2.41	11.90
		30	2.34	0.140	1.74	14.63	2.59	0.157	1.72	16.19
		45	3.43	0.193	2.02	21.44	3.70	0.173	2.00	23.15
	31	0	1.31	0.213	2.09	8.19	1.50	0.203	2.09	9.38
		15	1.83	0.233	2.23	11.46	2.18	0.220	2.23	13.65
		30	2.69	0.257	2.11	16.79	3.04	0.250	2.11	18.98
		45	3.78	0.260	1.96	23.63	4.09	0.263	1.96	25.58
	46.5	0	1.59	0.273	1.88	9.94	1.68	0.287	1.85	10.52
		15	2.01	0.317	2.07	12.54	2.41	0.300	2.05	15.06
		30	3.20	0.333	2.17	20.00	3.42	0.307	2.14	21.40
		45	4.28	0.387	2.09	26.75	4.67	0.397	2.06	29.19
F test			N.S	N.S	**	N.S	N.S	**	N.S	
LSD 5%			--	--	0.074	--	--	0.203	--	

#### **4- Percentages of N, P and K in straw**

Data in Table (18). summarize the main effects of application of filter mud cake (FMC), P and N fertilizers on the percentages of N, P and K in straw of faba bean in the two seasons.

Table (18) indicate that the addition of filter mud cake to the soil resulted in significant increases in P and K percentage in straw in both season. The application of 20m<sup>3</sup>/fed of FMC caused increases in P% in straw by 12.2 and 17.8% over the control in 2010/2011 and 2011/2012 seasons respectively. Potassium percentages in straw increased by 16.3% and 15.6% compared to the control in both seasons respectively. On the other hand, N% in straw was not significantly affected by the application of FMC, P and N fertilizer in both season.

Table (18) illustrate that P% in straw was significantly increased by increasing phosphorus fertilizer from 15.5 to 46.5 kg P<sub>2</sub>O<sub>5</sub>/fed. up to 41.3 and 55.9% in the two seasons respectively

Also, data in Table (18) show that both N% and P% in straw were significantly increased with increasing N rates in comparison to the control. Addition of nitrogen fertilizer at the rate of 45 kg N/fed recorded the highest increases in P and K percentages in straw. The increases were 17.5%, 21.4% and 2.3%, 2.4% in the two seasons respectively.

Table (18): The main effect of FMC, P and N fertilizers on the percentages of N, P and K in straw.

Treatments	2010-2011 season			2011-2012 season		
	N %	P %	K%	N %	P %	K%
<b>0 org. m<sup>3</sup>/fed</b>	1.38	0.115	0.466	1.36	0.118	0.463
<b>10 org. m<sup>3</sup>/fed</b>	1.37	0.128	0.551	1.38	0.131	0.543
<b>20 org. m<sup>3</sup>/fed</b>	1.40	0.129	0.542	1.40	0.139	0.535
<b>F test</b>	<b>N.S</b>	<b>*</b>	<b>**</b>	<b>N.S</b>	<b>**</b>	<b>*</b>
<b>LSD 5%</b>	<b>--</b>	<b>0.011</b>	<b>0.026</b>	<b>--</b>	<b>0.007</b>	<b>0.067</b>
<b>15.5 P<sub>2</sub>O<sub>5</sub>kg/fed</b>	1.37	0.104	0.512	1.37	0.102	0.506
<b>31.0 P<sub>2</sub>O<sub>5</sub>kg/fed</b>	1.38	0.121	0.534	1.38	0.128	0.528
<b>46.5 P<sub>2</sub>O<sub>5</sub>kg/fed</b>	1.40	0.147	0.513	1.39	0.159	0.508
<b>F test</b>	<b>N.S</b>	<b>**</b>	<b>**</b>	<b>N.S</b>	<b>**</b>	<b>**</b>
<b>LSD 5%</b>	<b>--</b>	<b>0.005</b>	<b>0.003</b>	<b>--</b>	<b>0.004</b>	<b>0.008</b>
<b>00kg N/fed</b>	1.41	0.114	0.513	1.40	0.117	0.507
<b>15kg N/fed</b>	1.44	0.120	0.519	1.45	0.125	0.513
<b>30kg N/fed</b>	1.32	0.129	0.521	1.34	0.133	0.516
<b>45kg N/fed</b>	1.36	0.134	0.525	1.34	0.142	0.519
<b>F test</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>N.S</b>
<b>LSD 5%</b>	<b>0.059</b>	<b>0.005</b>	<b>0.003</b>	<b>0.056</b>	<b>0.004</b>	<b>--</b>

Data in Table (19) show the interaction effect between the application of filter mud cake (FMC) and phosphorus fertilizer on the nitrogen, phosphorus and potassium percentages in straw.

Results in Table (19) indicate that N% in straw were not significantly affected by the above interaction. On the other hand, the interaction effect between FMC and phosphorus fertilizer on P% and K% in straw were significant in two seasons. In addition to P % in straw increased by 65.3 and 89.2% in the two successive seasons respectively when 20 m<sup>3</sup> FMC/fed with 46.5 P<sub>2</sub>O<sub>5</sub>kg /fed were applied in comparison to the control.

Table (19): The interaction effect of FMC and P fertilizers on N, P and K percentages in straw.

Treatments	2010-2011 season			2011-2012 season		
	N %	P %	K%	N %	P %	K%
0 org. m <sup>3</sup> & 15.5 P <sub>2</sub> O <sub>5</sub> kg/fed	1.34	0.098	0.44	1.34	0.093	0.44
0 org. m <sup>3</sup> & 31 P <sub>2</sub> O <sub>5</sub> kg /fed	1.38	0.115	0.51	1.37	0.116	0.51
0 org. m <sup>3</sup> & 46.5 P <sub>2</sub> O <sub>5</sub> kg /fed	1.41	0.133	0.44	1.38	0.146	0.44
10 org. m <sup>3</sup> & 15.5 P <sub>2</sub> O <sub>5</sub> kg /fed	1.38	0.110	0.55	1.38	0.108	0.55
10 org. m <sup>3</sup> & 31 P <sub>2</sub> O <sub>5</sub> kg /fed	1.37	0.125	0.54	1.38	0.131	0.53
10 org. m <sup>3</sup> & 46.5 P <sub>2</sub> O <sub>5</sub> kg /fed	1.37	0.148	0.56	1.38	0.154	0.55
20 org. m <sup>3</sup> & 15.5 P <sub>2</sub> O <sub>5</sub> kg /fed	1.38	0.103	0.54	1.39	0.104	0.54
20 org. m <sup>3</sup> & 31 P <sub>2</sub> O <sub>5</sub> kg /fed	1.39	0.123	0.55	1.39	0.136	0.54
20 org. m <sup>3</sup> & 46.5 P <sub>2</sub> O <sub>5</sub> kg /fed	1.42	0.162	0.54	1.42	0.176	0.53
F test	N.S	**	**	N.S	**	**
LSD 5%	--	0.013	0.026	--	0.009	0.068

The interaction effect between the addition of filter mud cake and nitrogen fertilizer rates is shown in Table (20). Data indicate that N% and P% in straw were not significantly affected by the above interaction in the two seasons. Only K% was significantly affected by the interaction effect between FMC and nitrogen fertilization.

Table (20): The interaction effect of FMC and N fertilizers on N, P and K percentages in straw.

Treatments	2010-2011 season			2011-2012 season		
	N %	P %	K%	N %	P %	K%
0 org. m <sup>3</sup> & 0kg N/fed	1.38	0.11	0.42	1.34	0.11	0.42
0 org. m <sup>3</sup> & 15kg N/fed	1.45	0.11	0.42	1.43	0.11	0.41
0 org. m <sup>3</sup> & 30kg N/fed	1.35	0.12	0.50	1.35	0.12	0.50
0 org. m <sup>3</sup> & 45kg N/fed	1.33	0.12	0.53	1.32	0.13	0.52
10 org. m <sup>3</sup> & 0kg N/fed	1.40	0.12	0.57	1.41	0.12	0.56
10 org. m <sup>3</sup> & 15kg N/fed	1.44	0.12	0.56	1.46	0.13	0.55
10 org. m <sup>3</sup> & 30kg N/fed	1.30	0.13	0.55	1.33	0.13	0.54
10 org. m <sup>3</sup> & 45kg N/fed	1.34	0.14	0.53	1.33	0.14	0.52
20 org. m <sup>3</sup> & 0kg N/fed	1.45	0.12	0.54	1.45	0.12	0.54
20 org. m <sup>3</sup> & 15kg N/fed	1.42	0.12	0.58	1.45	0.13	0.57
20 org. m <sup>3</sup> & 30kg N/fed	1.31	0.14	0.52	1.33	0.14	0.51
20 org. m <sup>3</sup> & 45kg N/fed	1.40	0.14	0.52	1.38	0.15	0.52
F test	N.S	N.S	**	N.S	N.S	**
LSD 5%	--	--	0.025	--	--	0.069

The interaction effect between the addition phosphorus and nitrogen fertilization is shown in Table (21). The interaction effect between P and N fertilization was significant on N%, P% and K% in straw in the first season. In the second season P% was not significantly affect by the both interaction.

**Table (21): The interaction effect of P and N fertilizers on N, P and K percentages in straw.**

Treatments	2010-2011 season			2011-2012 season		
	N %	P %	K%	N %	P %	K%
15.5 P <sub>2</sub> O <sub>5</sub> kg & 0kg N/fed	1.35	0.092	0.52	1.34	0.09	0.51
15.5 P <sub>2</sub> O <sub>5</sub> kg & 15kg N/fed	1.46	0.102	0.49	1.47	0.10	0.49
15.5 P <sub>2</sub> O <sub>5</sub> kg & 30kg N/fed	1.38	0.109	0.49	1.39	0.10	0.49
15.5 P <sub>2</sub> O <sub>5</sub> kg & 45kg N/fed	1.29	0.111	0.55	1.28	0.11	0.54
31 P <sub>2</sub> O <sub>5</sub> kg&0kg N/fed	1.43	0.118	0.54	1.42	0.12	0.53
31 P <sub>2</sub> O <sub>5</sub> kg & 15kg N/fed	1.44	0.119	0.55	1.45	0.12	0.55
31 P <sub>2</sub> O <sub>5</sub> kg & 30kg N/fed	1.31	0.122	0.53	1.33	0.13	0.53
31 P <sub>2</sub> O <sub>5</sub> kg & 45kg N/fed	1.34	0.126	0.52	1.32	0.14	0.51
46.5 P <sub>2</sub> O <sub>5</sub> kg & 0kg N/fed	1.45	0.131	0.48	1.45	0.14	0.48
46.5 P <sub>2</sub> O <sub>5</sub> kg & 15kg N/fed	1.41	0.138	0.52	1.42	0.15	0.51
46.5 P <sub>2</sub> O <sub>5</sub> kg & 30kg N/fed	1.27	0.156	0.54	1.29	0.16	0.53
46.5 P <sub>2</sub> O <sub>5</sub> kg & 45kg N/fed	1.45	0.164	0.51	1.42	0.17	0.51
F test	**	**	**	**	N.S	**
LSD 5%	0.103	0.009	0.008	0.096	--	0.016

The interaction effect between the addition of filter mud cake, phosphorus and nitrogen fertilizers rates is shown in Table (22). In general, N% and P% in straw did not significantly affected by the triple interaction in the two seasons. Only K% in straw was significantly affect by the above mentioned interaction also the two seasons.

Table (22): The interaction effect of FMC, P and N fertilizers on N, P and K percentages in straw.

Treatments			2010-2011 season			2011-2012 season		
org. m <sup>3</sup> /fed	P <sub>2</sub> O <sub>5</sub> kg/fed	N kg/fed	% N	% P	% K	% N	% P	% K
0	15.5	0	1.28	0.083	0.46	1.27	0.083	0.46
		15	1.46	0.097	0.29	1.43	0.093	0.29
		30	1.41	0.103	0.48	1.39	0.097	0.48
		45	1.23	0.107	0.55	1.26	0.100	0.55
	31	0	1.39	0.113	0.48	1.35	0.107	0.48
		15	1.46	0.113	0.52	1.45	0.110	0.52
		30	1.35	0.117	0.53	1.35	0.117	0.53
		45	1.32	0.117	0.52	1.31	0.130	0.51
	46.5	0	1.46	0.123	0.33	1.40	0.130	0.33
		15	1.44	0.130	0.44	1.42	0.140	0.44
		30	1.29	0.137	0.49	1.30	0.150	0.49
		45	1.45	0.140	0.52	1.39	0.163	0.51
10	15.5	0	1.36	0.100	0.50	1.35	0.093	0.50
		15	1.47	0.107	0.57	1.49	0.107	0.56
		30	1.37	0.117	0.56	1.39	0.110	0.56
		45	1.32	0.117	0.58	1.31	0.120	0.57
	31	0	1.41	0.123	0.58	1.43	0.123	0.57
		15	1.43	0.123	0.55	1.45	0.127	0.55
		30	1.29	0.123	0.51	1.32	0.133	0.51
		45	1.34	0.130	0.52	1.34	0.140	0.52
	46.5	0	1.43	0.133	0.63	1.46	0.143	0.63
		15	1.41	0.137	0.56	1.44	0.150	0.56
		30	1.24	0.153	0.56	1.28	0.157	0.55
		45	1.37	0.167	0.48	1.35	0.167	0.47
20	15.5	0	1.40	0.093	0.60	1.39	0.093	0.59
		15	1.46	0.103	0.62	1.49	0.100	0.61
		30	1.35	0.107	0.44	1.39	0.107	0.44
		45	1.31	0.110	0.51	1.29	0.117	0.51
	31	0	1.48	0.117	0.55	1.47	0.123	0.54
		15	1.42	0.120	0.58	1.44	0.133	0.58
		30	1.30	0.127	0.55	1.31	0.140	0.55
		45	1.35	0.130	0.51	1.33	0.147	0.51
	46.5	0	1.46	0.137	0.49	1.48	0.157	0.49
		15	1.39	0.147	0.54	1.41	0.167	0.54
		30	1.27	0.177	0.57	1.28	0.187	0.56
		45	1.55	0.187	0.55	1.52	0.193	0.54
F test			N.S	N.S	**	N.S	N.S	**
LSD 5%			--	--	0.010	--	--	0.027

## **5- Nitrogen uptake .**

The main effects of application filter mud cake (FMC), P and N fertilizers on nitrogen uptake in seeds, straw and total uptake are shown in Table (23).

Data indicate that addition of 10 or 20 m<sup>3</sup> FMC/fed resulted in significant increases in the uptake of nitrogen by faba bean plants in comparison to the control treatment. Increasing FMC levels from 10 to 20 m<sup>3</sup>/fed did not significantly affect the total uptake of the three nutrients by faba bean plants in the two growing seasons.

It is obvious from Table (23) that P fertilizer had significant effect on nitrogen uptake in seeds, straw and total uptake. Addition of 46.5 P<sub>2</sub>O<sub>5</sub>kg/fed increased N uptake in seed by 43.8% and 40.3% in season 2010/2011 and 2011/2012 respectively compared to the lowest level of phosphorus fertilizers. These results are in harmony with those obtained by **Majumdar *et al.*, (2003) and Bhowmik *et al.* (2012).**

Increasing rates of nitrogen fertilizer from 15 to 45 kg N/fed significantly increased total uptake of N by faba bean plants when compared to the control treatment (Table 23). The application of 15, 30 and 45 kg N/fed led to increases in total N uptake up to (39.4, 93.3 and 140.9% in 2010 season),( 43.9,93.9 and 135.5% in 2011 season) respectively compared to the control. These results are in agreement with those found by **Sobkowicz and Sniady(2004).**



Table (23): The main effect of FMC, P and N fertilizers on N uptake (kg/f)

Treatments	2010-2011 season			2011-2012 season		
	seed	Straw	Total	seed	straw	Total
<b>0 org. m<sup>3</sup>/fed</b>	25.64	20.14	45.78	29.00	20.33	49.34
<b>10 org. m<sup>3</sup>/fed</b>	30.09	24.09	54.17	33.54	24.11	57.64
<b>20 org. m<sup>3</sup>/fed</b>	31.51	25.72	57.22	35.11	25.57	60.68
<b>F test</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>*</b>	<b>**</b>	<b>*</b>
<b>LSD 5%</b>	<b>3.88</b>	<b>1.21</b>	<b>3.83</b>	<b>3.98</b>	<b>2.02</b>	<b>5.47</b>
<b>15.5 P<sub>2</sub>O<sub>5</sub>kg/fed</b>	23.96	22.28	46.24	27.21	22.26	49.47
<b>31.0 P<sub>2</sub>O<sub>5</sub>kg/fed</b>	28.82	23.32	52.14	32.27	23.38	55.65
<b>46.5 P<sub>2</sub>O<sub>5</sub>kg/fed</b>	34.46	24.34	58.79	38.17	24.37	62.54
<b>F test</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>
<b>LSD 5%</b>	<b>1.79</b>	<b>1.15</b>	<b>2.52</b>	<b>2.14</b>	<b>1.05</b>	<b>1.67</b>
<b>00kg N/fed</b>	10.99	20.13	31.11	12.97	20.22	33.20
<b>15kg N/fed</b>	20.51	22.87	43.38	24.81	22.98	47.78
<b>30kg N/fed</b>	36.63	23.50	60.13	41.16	23.23	64.38
<b>45kg N/fed</b>	48.19	26.76	74.95	51.27	26.91	78.18
<b>F test</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>
<b>LSD 5%</b>	<b>2.07</b>	<b>1.33</b>	<b>2.91</b>	<b>2.47</b>	<b>1.21</b>	<b>1.93</b>

Table (24) show that the interaction between the application of filter mud cake (FMC) and P fertilizer did not show any significant effect on nitrogen uptake in seeds, straw and total uptake.

Table (24): The interaction effect of FMC and P fertilizer on N uptake (kg/fed).

Treatments	2010-2011season			2011-2012 season		
	Seed	Straw	Total	seed	straw	Total
<b>0 org. m<sup>3</sup> &amp; 15.5 P<sub>2</sub>O<sub>5</sub> kg/fed</b>	20.75	18.64	39.40	24.21	18.93	43.14
<b>0 org. m<sup>3</sup> &amp; 31 P<sub>2</sub>O<sub>5</sub> kg /fed</b>	25.82	20.32	46.13	28.60	20.39	48.99
<b>0 org. m<sup>3</sup> &amp; 46.5 P<sub>2</sub>O<sub>5</sub>kg /fed</b>	30.36	21.45	51.81	34.20	21.67	55.87
<b>10 org. m<sup>3</sup> &amp; 15.5 P<sub>2</sub>O<sub>5</sub>kg /fed</b>	25.10	23.66	48.76	28.44	23.62	52.06
<b>10 org. m<sup>3</sup> &amp; 31 P<sub>2</sub>O<sub>5</sub>kg /fed</b>	29.71	24.10	53.81	33.25	24.16	57.41
<b>10 org. m<sup>3</sup> &amp; 46.5 P<sub>2</sub>O<sub>5</sub>kg /fed</b>	35.45	24.50	59.95	38.92	24.55	63.47
<b>20 org. m<sup>3</sup> &amp; 15.5 P<sub>2</sub>O<sub>5</sub>kg /fed</b>	26.02	24.53	50.56	28.97	24.23	53.21
<b>20 org. m<sup>3</sup> &amp; 31 P<sub>2</sub>O<sub>5</sub>kg /fed</b>	30.93	25.56	56.49	34.97	25.58	60.55
<b>20 org. m<sup>3</sup> &amp; 46.5 P<sub>2</sub>O<sub>5</sub>kg /fed</b>	37.56	27.06	64.62	41.39	26.89	68.28
<b>F test</b>	<b>N.S</b>	<b>N.S</b>	<b>N.S</b>	<b>N.S</b>	<b>N.S</b>	<b>N.S</b>
<b>LSD 5%</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>--</b>

The interaction effect between FMC and nitrogen fertilization on the uptake of N by faba bean plants is shown in Table(25).

Data show that the application of 45 kg N/fed alongside 0, 10 and 20 m<sup>3</sup> FMC/fed gave a significant increases in total N uptake by faba bean plants compared with treatment control no FMC or nitrogen fertilizer. Application of 45 kg N/fed alongside with 0, 10 and 20 m<sup>3</sup>/fed organic manure caused increases by 197.8, 201.6 , 201.8%in 2010 season and 166.9, 182.2, 184.4% in 2011 season over zero organic and zero N kg/fed.

**Table (25): The interaction effect of FMC and N fertilizers on N uptake (kg/fed).**

Treatments	2010-2011 season			2011-2012 season		
	Seed	straw	total	seed	Straw	Total
0 org. m <sup>3</sup> & 0kg N/fed	8.97	15.98	24.95	11.38	16.76	28.14
0 org. m <sup>3</sup> & 15kg N/fed	16.16	19.47	35.63	20.39	20.30	40.69
0 org. m <sup>3</sup> & 30kg N/fed	27.08	21.15	48.23	32.53	20.88	53.41
0 org. m <sup>3</sup> & 45kg N/fed	50.36	23.94	74.30	51.71	23.39	75.10
10 org. m <sup>3</sup> & 0kg N/fed	11.27	21.51	32.79	13.19	21.59	34.78
10 org. m <sup>3</sup> & 15kg N/fed	20.64	24.12	44.76	24.69	24.02	48.70
10 org. m <sup>3</sup> & 30kg N/fed	40.05	23.87	63.91	44.10	23.58	67.68
10 org. m <sup>3</sup> & 45kg N/fed	48.39	26.85	75.24	52.17	27.24	79.40
20 org. m <sup>3</sup> & 0kg N/fed	12.71	22.88	35.59	14.35	22.32	36.67
20 org. m <sup>3</sup> & 15kg N/fed	24.73	25.02	49.75	29.34	24.62	53.95
20 org. m <sup>3</sup> & 30kg N/fed	42.77	25.48	68.24	46.83	25.23	72.06
20 org. m <sup>3</sup> & 45kg N/fed	45.82	29.50	75.31	49.94	30.10	80.04
<b>F test</b>	<b>**</b>	<b>N.S</b>	<b>**</b>	<b>**</b>	<b>N.S</b>	<b>**</b>
<b>LSD 5%</b>	<b>4.90</b>	<b>--</b>	<b>5.73</b>	<b>5.36</b>	<b>--</b>	<b>6.12</b>

The interaction effect between phosphorus and nitrogen fertilization on the uptake of N, by faba bean plants is shown in Table (26).

Data in Table (26) show that the interaction effect between phosphorus and nitrogen fertilizer on N uptake in seeds as well as total N uptake was significant. Application of 46.5 P<sub>2</sub>O<sub>5</sub>kg /fed & 45kg N/fed resulted increases in N uptake amounted to 216% and 212% respectively over the treatment 15.5 P<sub>2</sub>O<sub>5</sub>kg /fed & 0kg N/fed.

**Table (26): The interaction effect of P and N fertilizers on N uptake (kg/fed).**

Treatments	2010-2011season			2011-2012 season		
	Seed	straw	Total	seed	straw	Total
15.5 P <sub>2</sub> O <sub>5</sub> kg & 0kg N/fed	8.15	18.50	26.65	10.06	18.45	28.52
15.5 P <sub>2</sub> O <sub>5</sub> kg & 15kg N/fed	17.71	22.35	40.07	20.84	22.63	43.47
15.5 P <sub>2</sub> O <sub>5</sub> kg & 30kg N/fed	28.82	23.60	52.43	33.97	23.38	57.35
15.5 P <sub>2</sub> O <sub>5</sub> kg & 45kg N/fed	41.15	24.67	65.82	43.96	24.57	68.53
31 P <sub>2</sub> O <sub>5</sub> kg&0kg N/fed	10.75	20.47	31.22	12.92	20.75	33.67
31 P <sub>2</sub> O <sub>5</sub> kg & 15kg N/fed	20.31	23.17	43.48	24.73	23.10	47.83
31 P <sub>2</sub> O <sub>5</sub> kg & 30kg N/fed	35.80	23.40	59.20	40.97	23.25	64.21
31 P <sub>2</sub> O <sub>5</sub> kg & 45kg N/fed	48.42	26.27	74.69	50.48	26.41	76.89
46.5 P <sub>2</sub> O <sub>5</sub> kg & 0kg N/fed	14.06	21.41	35.47	15.93	21.46	37.40
46.5 P <sub>2</sub> O <sub>5</sub> kg & 15kg N/fed	23.51	23.09	46.60	28.84	23.20	52.04
46.5 P <sub>2</sub> O <sub>5</sub> kg & 30kg N/fed	45.26	23.49	68.76	48.53	23.06	71.59
46.5 P <sub>2</sub> O <sub>5</sub> kg & 45kg N/fed	55.01	29.35	84.35	59.37	29.75	89.12
F test	**	N.S.	*	*	*	**
LSD 5%	3.59	N.S.	5.04	4.28	2.10	3.35

The interaction effect between the addition of filter mud cake, phosphorus and nitrogen fertilizers levels on N uptake is shown in Table (27). In general, N%, P% and K% in straw did not significantly affected by the above mentioned interaction.

Table (27): The interaction effect of FMC P and N fertilizers on N uptake (kg/fed).

Treatments			2010-2011 season			2011-2012 season		
org. m³/fed	P₂O₅kg/fed	N kg/fed	Seed	straw	total	Seed	straw	total
0	15.5	0	6.3	13.9	20.2	8.3	14.1	22.4
		15	14.1	18.3	32.4	17.7	19.7	37.4
		30	20.8	21.0	41.9	26.9	21.0	47.9
		45	41.7	21.4	63.1	44.0	21.0	64.9
	31	0	9.1	16.6	25.8	11.6	17.3	28.9
		15	15.7	19.8	35.6	19.7	20.5	40.2
		30	27.7	21.2	48.9	33.0	21.0	54.0
		45	50.7	23.5	74.2	50.1	22.8	72.9
	46.5	0	11.4	17.4	28.8	14.2	18.9	33.1
		15	18.6	20.3	38.9	23.8	20.7	44.5
		30	32.7	21.2	53.9	37.7	20.6	58.3
		45	58.7	27.0	85.6	61.1	26.5	87.5
10	15.5	0	8.2	20.2	28.5	10.0	20.2	30.3
		15	17.7	24.4	42.2	20.4	24.2	44.7
		30	31.0	24.0	54.9	36.8	24.2	61.0
		45	43.4	26.1	69.6	46.5	25.8	72.3
	31	0	11.4	21.8	33.2	13.6	22.0	35.6
		15	20.5	24.1	44.6	24.9	23.9	48.8
		30	38.5	23.9	62.4	43.4	23.5	66.9
		45	48.5	26.7	75.2	51.1	27.3	78.4
	46.5	0	14.1	22.6	36.7	16.0	22.5	38.5
		15	23.7	23.9	47.6	28.7	24.0	52.7
		30	50.7	23.7	74.4	52.1	23.1	75.2
		45	53.3	27.8	81.1	58.9	28.6	87.5
20	15.5	0	9.9	21.4	31.3	11.9	21.1	32.9
		15	21.3	24.3	45.6	24.4	24.0	48.4
		30	34.7	25.8	60.4	38.2	24.9	63.1
		45	38.3	26.6	64.9	41.5	26.9	68.4
	31	0	11.7	23.0	34.7	13.5	23.0	36.5
		15	24.8	25.6	50.3	29.6	24.9	54.5
		30	41.3	25.1	66.3	46.5	25.3	71.8
		45	46.1	28.6	74.6	50.2	29.2	79.4
	46.5	0	16.6	24.2	40.8	17.6	22.9	40.6
		15	28.2	25.1	53.3	34.0	25.0	58.9
		30	52.4	25.5	77.9	55.8	25.4	81.3
		45	53.1	33.4	86.5	58.1	34.2	92.3
F test			N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
LSD 5%			--	--	--	--	--	--

## **6-Phosphorus Uptake.**

The main effects of application filter mud cake (FMC), P and N fertilizers on phosphorus uptake by seeds, straw and total uptake are shown in Table (28).

It is obvious from Table (28) that FMC had a significant effect on phosphorus uptake by seeds, straw and total uptake. It's gave the increase percentages (29.1 and 25.3%) , (41.1and 42.5%) and (34.6 and 32.7%) in the both season respectively when 20 m<sup>3</sup>/fed was added . These results are in agreement with those reported by **Attia and El-Dsouky (2001)**.

The mean values of phosphorus uptake by seeds, straw and total P uptake was significantly affected by phosphorus fertilization. phosphorus uptake by seeds, straw and total phosphorus uptake increased by (120.6, 53.2 and 87.3%) in the first season and (120.2, 67.9 and 94.4%) in the second season respectively when P was added ata rate of 46.5 kg P<sub>2</sub>O<sub>5</sub>/fed compared of the addition of 15.5 kg P<sub>2</sub>O<sub>5</sub>/fed. These results are in agreement with those reported by **Majumdar *et. al*, (2003), Ahmed, *et al.*, (2005) and Bhowmik *et. al.*, (2012)**.

Data in Table (28) show that the phosphorus uptake in seeds, straw and total P uptake was significantly increased by increasing nitrogen fertilizer rate from zero to 45 kg N/fed phosphorus uptake by seeds, straw and total uptake scored increases over the control up to 83.6, 61.6 and 73.25% in 2010/2011 season and 84.7, 68.8 and 77.1% in 2011/2012season respectively. These results might be

attributed to enhancing the ability of plant to develop which was reflected by increasing the uptake of those nutrients by plants. These results are in agreement with those obtained by **Russell. (1950)** and **Mohmed (2005)**.

**Table (28): The main effect of FMC, P and N fertilizers on P uptake (kg/fed).**

Treatments	2010-2011 season			2011-2012 season		
	Seed	straw	Total	seed	straw	Total
<b>0 org. m<sup>3</sup>/fed</b>	2.37	1.71	4.08	2.41	1.81	4.22
<b>10 org. m<sup>3</sup>/fed</b>	2.93	2.27	5.21	2.83	2.31	5.14
<b>20 org. m<sup>3</sup>/fed</b>	3.06	2.42	5.49	3.02	2.58	5.60
<b>F test</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>*</b>	<b>**</b>	<b>**</b>
<b>LSD 5%</b>	<b>0.11</b>	<b>0.22</b>	<b>0.26</b>	<b>0.40</b>	<b>0.17</b>	<b>0.55</b>
<b>15.5 P<sub>2</sub>O<sub>5</sub>kg/fed</b>	1.75	1.71	3.46	1.73	1.68	3.41
<b>31.0 P<sub>2</sub>O<sub>5</sub>kg/fed</b>	2.76	2.07	4.83	2.73	2.20	4.93
<b>46.5 P<sub>2</sub>O<sub>5</sub>kg/fed</b>	3.86	2.62	6.48	3.81	2.82	6.63
<b>F test</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>
<b>LSD 5%</b>	<b>0.10</b>	<b>0.10</b>	<b>0.15</b>	<b>0.18</b>	<b>0.08</b>	<b>0.20</b>
<b>00kg N/fed</b>	1.83	1.64	3.47	1.83	1.70	3.53
<b>15kg N/fed</b>	2.63	1.92	4.55	2.55	2.01	4.56
<b>30kg N/fed</b>	3.33	2.34	5.67	3.26	2.35	5.60
<b>45kg N/fed</b>	3.36	2.65	6.01	3.38	2.87	6.25
<b>F test</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>
<b>LSD 5%</b>	<b>0.11</b>	<b>0.11</b>	<b>0.17</b>	<b>0.20</b>	<b>0.09</b>	<b>0.23</b>

Table (29) show that the interaction between the application of filter mud cake (FMC) and P fertilizer on phosphorus uptake by seeds, straw and total P uptake was of significant effect. Application of 20 m<sup>3</sup>/fed FMC and 46.5 P<sub>2</sub>O<sub>5</sub>kg /fed. resulted increases in total P uptake amounted to 162% and 168% over its control in the first and the second seasons respectively.

Table (29): The interaction effect of FMC and P fertilizers on P uptake (kg/fed).

Treatments	2010-2011 season			2011-2012 season		
	Seed	straw	total	seed	straw	Total
0 org. m <sup>3</sup> & 15.5 P <sub>2</sub> O <sub>5</sub> kg/fed	1.49	1.38	2.87	1.53	1.34	2.86
0 org. m <sup>3</sup> & 31 P <sub>2</sub> O <sub>5</sub> kg /fed	2.36	1.71	4.07	2.42	1.76	4.18
0 org. m <sup>3</sup> & 46.5 P <sub>2</sub> O <sub>5</sub> kg /fed	3.26	2.04	5.30	3.29	2.32	5.61
10 org. m <sup>3</sup> & 15.5 P <sub>2</sub> O <sub>5</sub> kg /fed	2.00	1.91	3.91	1.88	1.86	3.74
10 org. m <sup>3</sup> & 31 P <sub>2</sub> O <sub>5</sub> kg /fed	2.87	2.22	5.09	2.78	2.30	5.08
10 org. m <sup>3</sup> & 46.5 P <sub>2</sub> O <sub>5</sub> kg /fed	3.93	2.69	6.63	3.83	2.77	6.60
20 org. m <sup>3</sup> & 15.5 P <sub>2</sub> O <sub>5</sub> kg /fed	1.76	1.85	3.62	1.77	1.85	3.62
20 org. m <sup>3</sup> & 31 P <sub>2</sub> O <sub>5</sub> kg /fed	3.04	2.29	5.34	2.98	2.54	5.52
20 org. m <sup>3</sup> & 46.5 P <sub>2</sub> O <sub>5</sub> kg /fed	4.39	3.13	7.52	4.31	3.36	7.67
F test	**	**	**	**	**	**
LSD 5%	0.18	0.26	0.33	0.46	0.20	0.61

Table (30) show that the interaction between the application of FMC and N fertilizer had non significant effect on phosphorus uptake by straw in the first season. Data also show that P uptake by seeds and total uptake were significantly affect by the effect of interaction between FMC and N fertilization on both seasons.

Table (30): The interaction effect of FMC and N fertilizers on P uptake (kg/fed).

Treatments	2010-2011 season			2011-2012 season		
	Seed	straw	Total	Seed	straw	Total
0 org. m <sup>3</sup> & 0kg N/fed	1.55	1.25	2.80	1.59	1.35	2.94
0 org. m <sup>3</sup> & 15kg N/fed	2.07	1.53	3.60	2.08	1.63	3.71
0 org. m <sup>3</sup> & 30kg N/fed	2.54	1.88	4.42	2.58	1.90	4.47
0 org. m <sup>3</sup> & 45kg N/fed	3.33	2.18	5.50	3.39	2.35	5.74
10 org. m <sup>3</sup> & 0kg N/fed	1.99	1.83	3.82	1.91	1.84	3.75
10 org. m <sup>3</sup> & 15kg N/fed	2.72	2.05	4.78	2.55	2.11	4.65
10 org. m <sup>3</sup> & 30kg N/fed	3.64	2.44	6.08	3.47	2.37	5.83
10 org. m <sup>3</sup> & 45kg N/fed	3.38	2.77	6.16	3.39	2.93	6.32
20 org. m <sup>3</sup> & 0kg N/fed	1.96	1.84	3.79	1.98	1.93	3.91
20 org. m <sup>3</sup> & 15kg N/fed	3.10	2.18	5.28	3.02	2.29	5.31
20 org. m <sup>3</sup> & 30kg N/fed	3.83	2.69	6.52	3.73	2.77	6.50
20 org. m <sup>3</sup> & 45kg N/fed	3.38	3.00	6.37	3.36	3.34	6.70
F test	**	N.S	**	**	**	**
LSD 5%	0.203	--	0.364	0.495	0.216	0.640

The interaction effect between phosphorus and nitrogen fertilization on the uptake of P by faba bean plants are shown in Table (31).

Data show that the application of 46.5  $P_2O_5$ kg/fed alongside 45 kg N/fed gave significant increases in total P uptake by faba bean plants compared with treatment received no phosphorus or nitrogen fertilizers these increases were 243% and 287% in the two seasons respectively.

**Table (31): The interaction effect of the P and N fertilizers on P uptake (kg/fed).**

Treatments	2010-2011 season			2011-2012 season		
	Seed	straw	total	seed	straw	total
15.5 $P_2O_5$ kg & 0kg N/fed	1.03	1.27	2.30	0.96	1.25	2.21
15.5 $P_2O_5$ kg & 15kg N/fed	1.61	1.57	3.18	1.60	1.55	3.15
15.5 $P_2O_5$ kg & 30kg N/fed	2.11	1.88	3.99	2.16	1.76	3.93
15.5 $P_2O_5$ kg & 45kg N/fed	2.25	2.14	4.39	2.17	2.17	4.35
31 $P_2O_5$ kg&0kg N/fed	1.82	1.69	3.52	1.84	1.73	3.57
31 $P_2O_5$ kg & 15kg N/fed	2.61	1.93	4.54	2.53	1.98	4.51
31 $P_2O_5$ kg & 30kg N/fed	3.33	2.20	5.53	3.27	2.29	5.56
31 $P_2O_5$ kg & 45kg N/fed	3.26	2.48	5.74	3.26	2.79	6.06
46.5 $P_2O_5$ kg & 0kg N/fed	2.65	1.95	4.59	2.68	2.13	4.82
46.5 $P_2O_5$ kg & 15kg N/fed	3.67	2.27	5.94	3.51	2.49	6.01
46.5 $P_2O_5$ kg & 30kg N/fed	4.56	2.93	7.49	4.34	2.98	7.31
46.5 $P_2O_5$ kg & 45kg N/fed	4.57	3.34	7.91	4.70	3.66	8.36
F test	**	**	**	N.S	**	**
LSD 5%	0.20	0.19	0.30	--	0.16	0.39

Data illustrated in Table (32) revealed that the triple interaction effect between FMC, P and N fertilizers on phosphorus uptake had non significant effect in the second season. Phosphorus uptake by seed and total uptake of phosphorous were significantly affected by the triple interaction between FMC, P and nitrogen treatment.



Table (32): The interaction effect of FMC, P and N fertilizers on P uptake (kg/fed).

Treatments			2010-2011 season			2011-2012 season		
org. m <sup>3</sup> /fed	P <sub>2</sub> O <sub>5</sub> kg /fed	N kg/fed	Seed	Straw	total	Seed	Straw	total
0	15.5	0	0.73	0.91	1.63	0.78	0.92	1.70
		15	1.31	1.21	2.51	1.37	1.29	2.65
		30	1.73	1.55	3.28	1.80	1.47	3.26
		45	2.19	1.85	4.04	2.17	1.67	3.84
	31	0	1.56	1.35	2.92	1.68	1.37	3.05
		15	2.08	1.55	3.63	2.09	1.56	3.65
		30	2.55	1.84	4.39	2.61	1.82	4.43
		45	3.26	2.08	5.34	3.30	2.27	5.57
	46.5	0	2.36	1.48	3.84	2.32	1.75	4.07
		15	2.82	1.84	4.66	2.78	2.04	4.82
		30	3.33	2.25	5.58	3.32	2.40	5.72
		45	4.52	2.61	7.13	4.72	3.10	7.81
10	15.5	0	1.25	1.48	2.73	1.08	1.40	2.47
		15	1.83	1.77	3.60	1.66	1.74	3.40
		30	2.52	2.06	4.58	2.36	1.91	4.27
		45	2.40	2.34	4.74	2.42	2.39	4.81
	31	0	2.01	1.91	3.91	1.96	1.90	3.86
		15	2.61	2.08	4.69	2.50	2.08	4.58
		30	3.50	2.30	5.80	3.36	2.37	5.73
		45	3.36	2.59	5.95	3.29	2.86	6.15
	46.5	0	2.73	2.10	4.83	2.70	2.22	4.91
		15	3.73	2.32	6.05	3.48	2.50	5.98
		30	4.89	2.96	7.85	4.68	2.82	7.51
		45	4.39	3.39	7.78	4.46	3.55	8.00
20	15.5	0	1.12	1.43	2.55	1.04	1.41	2.45
		15	1.70	1.72	3.42	1.77	1.61	3.39
		30	2.08	2.03	4.11	2.34	1.91	4.25
		45	2.16	2.23	4.38	1.93	2.45	4.38
	31	0	1.90	1.82	3.72	1.88	1.93	3.81
		15	3.15	2.15	5.30	3.00	2.30	5.30
		30	3.94	2.45	6.40	3.84	2.69	6.54
		45	3.17	2.75	5.92	3.20	3.24	6.44
	46.5	0	2.85	2.26	5.11	3.03	2.43	5.46
		15	4.45	2.65	7.10	4.28	2.95	7.23
		30	5.46	3.59	9.04	5.00	3.71	8.71
		45	4.80	4.01	8.81	4.94	4.33	9.27
F test			**	N.S.	*	N.S.	N.S.	N.S.
LSD 5%			0.345	--	0.513	--	--	--

## **7- Potassium uptake.**

The main effect of application filter mud cake (FMC), P and N fertilizers on potassium uptake by seeds, straw and total uptake are shown in Table (33).

Data in Table (33) show that potassium uptake by seeds, straw and total uptake were significantly affected by application of FMC. Increasing the rate of FMC addition from 0 to 20m<sup>3</sup>/fed resulted in increments in K uptake by seeds, straw and total uptake up to (32.0, 33.1 and 43.4) ( 37.8 , 34.9 and 34.6) in the first and the second seasons respectively.

It is clear from data in Table (33) that phosphorus fertilizer did get increased for potassium uptake in seeds, straw and total uptake. These finding are in accordance with those obtained by **Bhowmik *et al.* (2012)**.

Also data in table (33) show that increasing N fertilizer levels from 0 to 45 kg N /fed caused significant increases in K uptake by seeds, straw and total uptake. In the first season K uptake by seeds , straw and total uptake exhibited percentage increases up to 43.1, 39.1and 41.9% when 45 kg N/fed was applied comparatively to those found in the control treatment respectively. In the second season the corresponding increases equal to 41.5, 40.9 and 41.3% respectively.

Table (33): The main effect of FMC, P and N fertilizers on the K uptake (kg/fed).

Treatments	2010-2011 season			2011-2012 season		
	Seed	Straw	Total	seed	Straw	Total
0 org. m <sup>3</sup> /fed	19.95	6.96	26.91	19.72	7.04	26.76
10 org. m <sup>3</sup> /fed	26.06	9.70	35.75	25.83	9.44	35.27
20 org. m <sup>3</sup> /fed	26.34	9.98	36.32	26.24	9.77	36.01
F test	**	**	**	**	**	**
LSD 5%	1.48	0.39	1.73	3.05	0.90	3.83
15.5 P <sub>2</sub> O <sub>5</sub> kg/fed	23.17	8.48	31.65	22.86	8.33	31.19
31.0 P <sub>2</sub> O <sub>5</sub> kg/fed	24.30	9.09	33.40	24.39	8.98	33.37
46.5 P <sub>2</sub> O <sub>5</sub> kg/fed	24.88	9.07	33.94	24.55	8.94	33.49
F test	**	**	**	**	**	**
LSD 5%	0.41	0.21	0.46	0.99	0.22	1.06
00kg N/fed	18.21	7.42	25.63	18.26	7.36	25.62
15kg N/fed	24.11	8.42	32.54	23.86	8.25	32.11
30kg N/fed	28.09	9.36	37.45	27.79	9.01	36.80
45kg N/fed	26.05	10.32	36.36	25.83	10.37	36.20
F test	**	**	**	**	**	**
LSD 5%	0.47	0.24	0.53	1.15	0.25	1.23

The data present in Tables (34, 35, 36 and 37) show that all the interaction effect between the three factors under investigation had significant effects on potassium uptake by seeds, straw and total uptake during the two seasons.

Table (34): The interaction effect of FMC and P fertilizers on the K uptake (kg/fed).

Treatments	2010-2011 season			2011-2012 season		
	Seed	straw	total	seed	Straw	Total
0 org. m <sup>3</sup> & 15.5 P <sub>2</sub> O <sub>5</sub> kg/fed	18.35	6.31	24.66	18.07	6.34	24.41
0 org. m <sup>3</sup> & 31 P <sub>2</sub> O <sub>5</sub> kg /fed	21.46	7.63	29.09	21.39	7.69	29.08
0 org. m <sup>3</sup> & 46.5 P <sub>2</sub> O <sub>5</sub> kg /fed	20.03	6.95	26.98	19.70	7.08	26.78
10 org. m <sup>3</sup> & 15.5 P <sub>2</sub> O <sub>5</sub> kg /fed	25.94	9.57	35.52	25.55	9.35	34.90
10 org. m <sup>3</sup> & 31 P <sub>2</sub> O <sub>5</sub> kg /fed	25.20	9.55	34.74	25.27	9.28	34.55
10 org. m <sup>3</sup> & 46.5 P <sub>2</sub> O <sub>5</sub> kg /fed	27.03	9.97	37.01	26.68	9.69	36.37
20 org. m <sup>3</sup> & 15.5 P <sub>2</sub> O <sub>5</sub> kg /fed	25.21	9.55	34.76	24.96	9.28	34.24
20 org. m <sup>3</sup> & 31 P <sub>2</sub> O <sub>5</sub> kg /fed	26.25	10.11	36.36	26.51	9.98	36.49
20 org. m <sup>3</sup> & 46.5 P <sub>2</sub> O <sub>5</sub> kg /fed	27.56	10.27	37.84	27.26	10.05	37.31
F test	**	**	**	*	**	**
LSD 5%	1.576	0.484	1.831	3.325	0.940	4.086

**Table (35): The interaction effect of FMC and N fertilizers on the K uptake (kg/fed).**

Treatments	2010-2011 season			2011-2012 season		
	Seed	Straw	total	seed	Straw	Total
0 org. m <sup>3</sup> & 0kg N/fed	13.83	4.88	18.70	13.74	5.20	18.94
0 org. m <sup>3</sup> & 15kg N/fed	16.55	5.65	22.20	16.22	5.90	22.12
0 org. m <sup>3</sup> & 30kg N/fed	22.00	7.86	29.86	21.64	7.77	29.41
0 org. m <sup>3</sup> & 45kg N/fed	27.43	9.45	36.88	27.29	9.29	36.58
10 org. m <sup>3</sup> & 0kg N/fed	20.92	8.78	29.70	20.94	8.59	29.52
10 org. m <sup>3</sup> & 15kg N/fed	25.67	9.43	35.09	25.38	9.11	34.49
10 org. m <sup>3</sup> & 30kg N/fed	31.02	10.05	41.07	30.63	9.49	40.12
10 org. m <sup>3</sup> & 45kg N/fed	26.62	10.53	37.15	26.39	10.57	36.96
20 org. m <sup>3</sup> & 0kg N/fed	19.90	8.59	28.48	20.09	8.30	28.39
20 org. m <sup>3</sup> & 15kg N/fed	30.12	10.19	40.32	29.98	9.73	39.71
20 org. m <sup>3</sup> & 30kg N/fed	31.25	10.17	41.42	31.09	9.79	40.88
20 org. m <sup>3</sup> & 45kg N/fed	24.09	10.97	35.06	23.81	11.26	35.07
<b>F test</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>
<b>LSD 5%</b>	<b>1.624</b>	<b>0.527</b>	<b>1.883</b>	<b>3.461</b>	<b>0.963</b>	<b>4.211</b>

**Table (36): The interaction effect of P and N fertilizers on the K uptake (kg/fed).**

Treatments	2010-2011 season			2011-2012 season		
	Seed	straw	total	seed	Straw	Total
15.5 P <sub>2</sub> O <sub>5</sub> kg & 0kg N/fed	17.73	7.19	24.92	17.64	7.11	24.75
15.5 P <sub>2</sub> O <sub>5</sub> kg & 15kg N/fed	22.54	7.78	30.32	22.17	7.64	29.81
15.5 P <sub>2</sub> O <sub>5</sub> kg & 30kg N/fed	26.10	8.49	34.59	25.73	8.22	33.94
15.5 P <sub>2</sub> O <sub>5</sub> kg & 45kg N/fed	26.30	10.46	36.77	25.91	10.34	36.25
31 P <sub>2</sub> O <sub>5</sub> kg & 0kg N/fed	18.48	7.73	26.21	18.82	7.79	26.60
31 P <sub>2</sub> O <sub>5</sub> kg & 15kg N/fed	25.19	8.96	34.14	25.17	8.74	33.91
31 P <sub>2</sub> O <sub>5</sub> kg & 30kg N/fed	28.05	9.53	37.58	28.02	9.24	37.26
31 P <sub>2</sub> O <sub>5</sub> kg & 45kg N/fed	25.50	10.16	35.65	25.55	10.17	35.71
46.5 P <sub>2</sub> O <sub>5</sub> kg & 0kg N/fed	18.43	7.33	25.76	18.31	7.19	25.50
46.5 P <sub>2</sub> O <sub>5</sub> kg & 15kg N/fed	24.61	8.53	33.15	24.24	8.36	32.60
46.5 P <sub>2</sub> O <sub>5</sub> kg & 30kg N/fed	30.12	10.07	40.19	29.61	9.59	39.20
46.5 P <sub>2</sub> O <sub>5</sub> kg & 45kg N/fed	26.34	10.34	36.68	26.03	10.61	36.65
<b>F test</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>N.S.</b>	<b>**</b>	<b>**</b>
<b>LSD 5%</b>	<b>0.815</b>	<b>0.419</b>	<b>0.916</b>	<b>1.990</b>	<b>0.434</b>	<b>2.127</b>

Table (37): The interaction effect of FMC and N fertilizers on the K uptake (kg/fed).

Treatments			2010-2011 season			2011-2012 season		
org. m <sup>3</sup> /fed	P <sub>2</sub> O <sub>5</sub> kg /fed	N kg/fed	Seed	straw	total	Seed	straw	total
0	15.5	0	14.51	4.98	19.49	14.25	5.09	19.34
		15	11.32	3.65	14.98	10.96	4.01	14.98
		30	20.68	7.20	27.89	20.33	7.28	27.60
		45	26.95	9.54	36.49	26.47	9.21	35.68
	31	0	15.50	5.74	21.24	15.42	6.17	21.59
		15	20.30	7.13	27.43	20.08	7.40	27.48
		30	23.62	8.37	32.00	23.37	8.29	31.66
		45	26.55	9.29	35.84	26.75	8.96	35.71
	46.5	0	11.43	3.96	15.39	11.27	4.46	15.73
		15	18.12	6.24	24.36	17.66	6.41	24.06
		30	21.75	8.06	29.80	21.22	7.85	29.07
		45	28.85	9.66	38.51	28.55	9.76	38.30
10	15.5	0	17.29	7.43	24.72	17.09	7.48	24.57
		15	25.27	9.46	34.72	25.11	9.12	34.23
		30	31.90	9.87	41.76	31.70	9.73	41.43
		45	29.47	11.61	41.08	29.29	11.36	40.65
	31	0	21.15	8.97	30.12	21.22	8.77	29.99
		15	25.16	9.27	34.43	25.21	9.05	34.25
		30	28.20	9.50	37.70	28.52	9.05	37.57
		45	26.18	10.38	36.56	26.32	10.63	36.95
	46.5	0	24.13	9.93	34.06	23.90	9.75	33.65
		15	26.57	9.51	36.08	26.20	9.32	35.52
		30	33.04	10.78	43.82	32.83	9.92	42.75
		45	24.22	9.74	33.97	24.21	10.02	34.23
20	15.5	0	21.31	9.19	30.50	21.20	8.93	30.13
		15	31.24	10.38	41.62	30.70	9.84	40.54
		30	25.82	8.42	34.24	25.52	7.91	33.43
		45	22.56	10.32	32.88	22.36	10.74	33.10
	31	0	18.66	8.57	27.23	19.19	8.44	27.63
		15	30.11	10.45	40.56	30.37	10.05	40.42
		30	32.41	10.66	43.07	32.39	10.58	42.97
		45	23.93	10.80	34.73	23.93	11.26	35.19
	46.5	0	19.61	8.09	27.70	19.48	7.61	27.10
		15	29.10	9.78	38.89	29.13	9.57	38.70
		30	35.52	11.53	47.05	34.92	11.13	46.06
		45	25.94	11.84	37.78	25.56	12.11	37.68
F test			**	**	**	**	**	**
LSD 5%			1.411	0.726	1.587	3.447	0.725	3.683

### **8-Effect of application of FMC, P and N fertilizers on some soil properties.**

The main effect of application of filter mud cake (FMC), P and N fertilizers on some soil properties are show in Table (38).

It is obvious from Table (38) that addition of FMC had significant effect on EC, pH, total N, available P and organic matter in soil. The addition 20m<sup>3</sup>/fed., of FMC resulted in significant increases in EC, total nitrogen, available P and organic matter percentage in the two seasons compared with the control in soil. The addition of FMC led to significant decreases in pH. This was expected since the decomposition of FMC in soil always accompanied by releasing of organic acids which resulted in drops in soil pH. These results are in accordance with those found by **Abd-El hamid *et. al.*, (2004)**.

Data in Table (38) indicate that addition of P fertilizer to the soil significant effect on Ec, pH, total N, available P and OM% in soil in the second season. On the other hand, increasing P fertilizer up to 46.5 kg P<sub>2</sub>O<sub>5</sub>/fed., show non significant effect on total N second season.

Data in Table (38) show that the nitrogen fertilization was of significant effect on EC, pH, total N, available P and organic matter percentages in soil. The increasing nitrogen fertilizer rate increases in EC, total N, available P and organic matter percentage in the two seasons. Reduction in soil pH was found in the two seasons. These decreases in soil pH could be attributed to acidic effect of applied N fertilizer. These finding are in accordance with **Ying *et al* (2008)**.

Table (38): The main effect of FMC, P and N fertilizers on some soil properties.

Treatments	2010-2011 season					2011-2012 season				
	Ec (ds/m)	pH	Total N ppm	Avail. P ppm	O.M %	Ec (ds/m)	pH	Total N ppm	Avail. P ppm	O.M %
0 org. m <sup>3</sup> /fed	0.30	7.77	428	5.50	0.10	0.33	7.94	422	5.34	0.11
10 org. m <sup>3</sup> /fed	0.83	7.60	492	6.90	0.17	0.76	7.75	495	6.47	0.18
20 org. m <sup>3</sup> /fed	1.58	7.43	554	8.70	0.37	1.45	7.56	548	7.99	0.39
F test	*	**	*	**	**	**	**	**	**	**
LSD 5%	0.76	0.12	85	0.46	0.03	0.45	0.16	38	0.53	0.01
15.5 P <sub>2</sub> O <sub>5</sub> kg/fed	0.80	7.70	469	5.35	0.20	0.73	7.72	469	5.17	0.21
31.0 P <sub>2</sub> O <sub>5</sub> kg/fed	0.90	7.59	496	6.81	0.21	0.84	7.74	490	6.43	0.22
46.5 P <sub>2</sub> O <sub>5</sub> kg/fed	1.02	7.52	509	8.93	0.23	0.97	7.78	506	8.19	0.25
F test	**	*	N.S	**	**	**	**	**	**	**
LSD 5%	0.08	0.12	--	0.44	0.01	0.05	0.03	18	0.16	0.004
00kg N/fed	0.73	7.65	279	7.84	0.14	0.65	7.85	297	7.34	0.16
15kg N/fed	0.76	7.63	405	7.22	0.18	0.72	7.77	431	6.88	0.20
30kg N/fed	0.90	7.62	580	6.74	0.22	0.83	7.72	555	6.28	0.23
45kg N/fed	1.22	7.51	701	6.32	0.31	1.18	7.66	671	5.90	0.32
F test	**	N.S	**	**	**	**	**	**	**	**
LSD 5%	0.09	--	53	0.51	0.02	0.06	0.03	21	0.19	0.01

The interaction effect between of application of filter mud cake (FMC) and phosphorus fertilizer on pH and total N in soil was not significant in the first season and the second seasons (Table 39). This interaction exhibited significant effects on the EC (ds/m), available P and organic matter percentage in both seasons .

Table (39): The interaction effect of FMC and P fertilizers on some soil properties.

Treatments	2010-2011 season					2011-2012 season				
	Ec (ds/m)	pH	Total N ppm	Avail. P ppm	O.M %	Ec (ds/m)	pH	Total N ppm	Avail. P ppm	O.M %
0 org. m <sup>3</sup> & 15.5 P <sub>2</sub> O <sub>5</sub> kg/fed	0.25	7.87	399	4.14	0.10	0.28	7.89	403	4.23	0.10
0 org. m <sup>3</sup> & 31 P <sub>2</sub> O <sub>5</sub> kg /fed	0.31	7.75	443	5.49	0.10	0.34	7.92	429	5.43	0.11
0 org. m <sup>3</sup> & 46.5 P <sub>2</sub> O <sub>5</sub> kg /fed	0.34	7.70	441	6.85	0.11	0.37	8.00	435	6.36	0.12
10 org. m <sup>3</sup> & 15.5 P <sub>2</sub> O <sub>5</sub> kg /fed	0.75	7.63	466	5.30	0.16	0.70	7.74	476	5.23	0.17
10 org. m <sup>3</sup> & 31 P <sub>2</sub> O <sub>5</sub> kg /fed	0.86	7.62	493	6.84	0.17	0.77	7.75	492	6.26	0.18
10 org. m <sup>3</sup> & 46.5 P <sub>2</sub> O <sub>5</sub> kg /fed	0.88	7.55	518	8.55	0.18	0.81	7.76	518	7.93	0.19
20 org. m <sup>3</sup> & 15.5 P <sub>2</sub> O <sub>5</sub> kg /fed	1.39	7.59	541	6.61	0.34	1.22	7.53	529	6.06	0.36
20 org. m <sup>3</sup> & 31 P <sub>2</sub> O <sub>5</sub> kg /fed	1.53	7.40	553	8.09	0.36	1.40	7.57	550	7.59	0.39
20 org. m <sup>3</sup> & 46.5 P <sub>2</sub> O <sub>5</sub> kg /fed	1.83	7.31	568	11.39	0.41	1.72	7.59	565	10.30	0.43
F test	**	N.S	N.S	**	**	**	N.S	N.S	**	**
LSD 5%	0.77	--	--	0.77	0.03	0.45	--	--	0.58	0.01

The interaction effect between the application of filter mud cake (FMC) and N fertilizer on pH, total N and available P was not significant in the first season (Table 40). The addition of 20m<sup>3</sup>/fed of FMC + 45 kg N/fed was of significant influenced on both EC and OM% in the first season when compared to 0m<sup>3</sup>/fed of FMC + 0 kg N/fed control treatment (Table 40). In the second season, the interaction effect between FMC and N fertilization on all studied soil properties was significant.

**Table (40): The interaction effect of FMC and N fertilizers on some soil properties.**

Treatments	2010-2011 season					2011-2012 season				
	Ec (ds/m)	pH	Total N ppm	Avail. P ppm	O.M %	Ec (ds/m)	pH	Total N ppm	Avail. P ppm	O.M %
0 org. m <sup>3</sup> & 0kg N/fed	0.20	7.75	269	5.94	0.06	0.22	8.09	299	5.84	0.07
0 org. m <sup>3</sup> & 15kg N/fed	0.26	7.89	340	5.47	0.09	0.28	7.93	374	5.57	0.10
0 org. m <sup>3</sup> & 30kg N/fed	0.30	7.65	488	5.21	0.12	0.34	7.89	467	5.07	0.13
0 org. m <sup>3</sup> & 45kg N/fed	0.44	7.80	613	5.36	0.13	0.47	7.84	550	4.87	0.13
10 org. m <sup>3</sup> & 0kg N/fed	0.73	7.69	290	7.65	0.11	0.65	7.80	301	7.14	0.13
10 org. m <sup>3</sup> & 15kg N/fed	0.73	7.60	382	7.17	0.16	0.71	7.77	404	6.59	0.17
10 org. m <sup>3</sup> & 30kg N/fed	0.84	7.68	597	6.53	0.20	0.78	7.73	590	6.21	0.20
10 org. m <sup>3</sup> & 45kg N/fed	1.01	7.44	700	6.23	0.21	0.89	7.70	686	5.95	0.22
20 org. m <sup>3</sup> & 0kg N/fed	1.26	7.50	278	9.92	0.24	1.08	7.66	292	9.04	0.27
20 org. m <sup>3</sup> & 15kg N/fed	1.29	7.39	492	9.02	0.31	1.17	7.61	514	8.46	0.32
20 org. m <sup>3</sup> & 30kg N/fed	1.56	7.52	656	8.48	0.34	1.37	7.54	609	7.55	0.37
20 org. m <sup>3</sup> & 45kg N/fed	2.21	7.31	789	7.35	0.58	2.18	7.43	778	6.89	0.61
<b>F test</b>	<b>**</b>	<b>N.S</b>	<b>N.S</b>	<b>N.S</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>	<b>**</b>
<b>LSD 5%</b>	<b>0.77</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>0.04</b>	<b>0.46</b>	<b>0.16</b>	<b>48.7</b>	<b>0.60</b>	<b>0.01</b>

The interaction effect between of phosphorus and nitrogen fertilizers on the EC (ds/m), pH, Total N, available P and organic matter present .Table (41)

Data show that the interaction effect between P and N fertilizers on the pH, total N, available P and organic matter percentage in soil



was not significant in the first season. In the second season, all soil properties studied were significantly affected by the interaction between P and N fertilization except total N.

**Table (41): The interaction effect of P and N fertilizers on some soil properties.**

Treatments	2010-2011 season					2011-2012 season				
	Ec (ds/m)	pH	Total N ppm	Avail. P ppm	O.M %	Ec (ds/m)	pH	Total N ppm	Avail. P ppm	O.M %
15.5 P <sub>2</sub> O <sub>5</sub> kg & 0kg N/fed	0.64	7.75	257	6.16	0.14	0.56	7.79	281	5.78	0.15
15.5 P <sub>2</sub> O <sub>5</sub> kg & 15kg N/fed	0.68	7.81	380	5.47	0.17	0.62	7.76	404	5.47	0.18
15.5 P <sub>2</sub> O <sub>5</sub> kg & 30kg N/fed	0.82	7.69	533	5.07	0.21	0.76	7.70	548	4.96	0.22
15.5 P <sub>2</sub> O <sub>5</sub> kg & 45kg N/fed	1.05	7.54	704	4.70	0.27	0.99	7.62	644	4.49	0.29
31 P <sub>2</sub> O <sub>5</sub> kg&0kg N/fed	0.78	7.64	286	7.27	0.13	0.68	7.82	307	6.82	0.15
31 P <sub>2</sub> O <sub>5</sub> kg & 15kg N/fed	0.77	7.65	414	6.92	0.18	0.74	7.77	437	6.59	0.20
31 P <sub>2</sub> O <sub>5</sub> kg & 30kg N/fed	0.92	7.50	567	6.62	0.22	0.83	7.72	549	6.25	0.23
31 P <sub>2</sub> O <sub>5</sub> kg & 45kg N/fed	1.13	7.57	718	6.41	0.30	1.10	7.66	669	6.06	0.32
46.5 P <sub>2</sub> O <sub>5</sub> kg & 0kg N/fed	0.78	7.56	294	10.08	0.15	0.71	7.93	304	9.42	0.16
46.5 P <sub>2</sub> O <sub>5</sub> kg & 15kg N/fed	0.84	7.42	421	9.27	0.20	0.80	7.78	450	8.57	0.22
46.5 P <sub>2</sub> O <sub>5</sub> kg & 30kg N/fed	0.96	7.66	641	8.54	0.24	0.90	7.74	570	7.62	0.25
46.5 P <sub>2</sub> O <sub>5</sub> kg & 45kg N/fed	1.48	7.44	679	7.84	0.34	1.46	7.68	700	7.17	0.36
F test	*	N.S	N.S	N.S	N.S	**	*	N.S	**	**
LSD 5%	0.15	--	--	--	--	0.097	0.05	--	0.32	0.01

Data in Table (42) summarize the interaction effect between the three factors.

Total N and available P were not significantly affected by the interaction between the three factors. But , EC, pH and organic matter percentage were significantly affected by the interaction between FMC, P and N application.

Table (42): The interaction effect of FMC, P and N fertilizers on some soil properties.

Treatments			2010-2011 season					2011-2012 season				
org. m <sup>3</sup> /fed	P <sub>2</sub> O <sub>5</sub> kg/fed	N kg/fed	Ec (ds/m)	pH	Total N ppm	Avail. P ppm	O.M %	Ec (ds/m)	pH	Total N ppm	Avail. P ppm	O.M %
0	15.5	0	0.15	7.61	223	5.03	0.06	0.18	7.96	250	4.78	0.07
		15	0.21	8.20	345	4.00	0.07	0.23	7.92	378	4.48	0.08
		30	0.29	7.83	421	3.86	0.12	0.31	7.88	455	3.98	0.13
		45	0.36	7.85	605	3.67	0.13	0.40	7.82	528	3.68	0.13
	31	0	0.21	7.55	300	5.77	0.06	0.23	8.01	327	5.73	0.07
		15	0.27	7.84	338	5.53	0.08	0.30	7.94	371	5.66	0.09
		30	0.29	7.47	500	5.18	0.12	0.33	7.88	477	5.23	0.13
		45	0.45	8.11	633	5.48	0.13	0.49	7.84	542	5.10	0.13
	46.5	0	0.23	8.08	283	7.02	0.06	0.25	8.31	319	7.00	0.07
		15	0.30	7.62	338	6.87	0.12	0.32	7.94	371	6.58	0.13
		30	0.31	7.65	543	6.59	0.13	0.38	7.91	469	6.00	0.13
		45	0.52	7.43	600	6.93	0.13	0.53	7.85	579	5.84	0.13
10	15.5	0	0.58	7.91	277	5.56	0.12	0.56	7.79	303	5.64	0.13
		15	0.68	7.68	327	5.67	0.14	0.62	7.76	336	5.42	0.16
		30	0.77	7.49	543	5.03	0.19	0.75	7.72	583	5.07	0.20
		45	0.98	7.46	719	4.93	0.20	0.86	7.68	682	4.78	0.20
	31	0	0.82	7.71	292	7.24	0.11	0.68	7.80	301	6.58	0.13
		15	0.75	7.65	395	6.93	0.16	0.74	7.77	419	6.30	0.17
		30	0.82	7.78	587	6.70	0.19	0.77	7.73	587	6.16	0.20
		45	1.03	7.34	696	6.47	0.20	0.89	7.70	662	5.98	0.21
	46.5	0	0.81	7.46	301	10.14	0.12	0.71	7.81	300	9.19	0.14
		15	0.77	7.48	424	8.89	0.18	0.76	7.78	459	8.06	0.19
		30	0.93	7.76	659	7.87	0.21	0.84	7.74	600	7.39	0.20
		45	1.04	7.51	685	7.30	0.23	0.93	7.72	714	7.07	0.25
20	15.5	0	1.18	7.74	272	7.88	0.23	0.94	7.64	290	6.91	0.26
		15	1.16	7.56	469	6.74	0.31	1.03	7.60	498	6.51	0.32
		30	1.39	7.76	634	6.31	0.31	1.23	7.51	605	5.81	0.33
		45	1.82	7.31	789	5.50	0.49	1.70	7.37	724	5.01	0.53
	31	0	1.30	7.65	265	8.80	0.23	1.14	7.66	293	8.14	0.26
		15	1.27	7.46	508	8.29	0.31	1.18	7.61	523	7.80	0.33
		30	1.64	7.24	613	7.97	0.33	1.39	7.55	583	7.35	0.36
		45	1.91	7.25	825	7.29	0.58	1.90	7.45	803	7.09	0.61
	46.5	0	1.30	7.12	297	13.08	0.27	1.16	7.68	293	12.06	0.28
		15	1.45	7.16	500	12.03	0.30	1.31	7.63	522	11.07	0.33
		30	1.66	7.57	721	11.17	0.39	1.49	7.56	641	9.48	0.42
		45	2.89	7.37	752	9.28	0.68	2.93	7.48	807	8.58	0.70
F test			**	**	N.S	N.S	**	**	*	N.S	N.S	**
LSD 5%			0.26	0.43	--	--	0.49	0.17	0.09	--	--	0.02

### **9- Economic feasibility of the experiment and the return in Egyptian pound.**

Data present in Table (43) reveal that the highest cost was obtained from 20 m<sup>3</sup> organic matter followed by zero organic manure. These results due to differences in application organic fertilizer. Increasing gross income, net income and profit benefit cost ratio (B/C ratio) in the same trend. This increase due to increasing grain yield/fed.

The results cleared that the cost by mineral fertilizers with phosphorus and nitrogen increased by increasing P levels up to 46.5 P<sub>2</sub>O<sub>5</sub>kg /fed and N levels up to 45 N/fed, as well as gross income. While, net income and B/C ratio increased by increasing N levels up to 30 kg/fed. in both seasons. This increase being to N levels may be due to increase seed yield/fed. As to the interaction effect, the results show that the interaction between the studied factors in both seasons revealed clearly differences. The maximum cost and gross income were recorded from using 20 m<sup>3</sup> FMC and 46.5 P<sub>2</sub>O<sub>5</sub>kg/fed. with 45kg N/fad., while the highest net income and B/C ratio obtained from 20 m<sup>3</sup> organic fertilizer and 46.5 P with 30 kg N/fed. It was worthy to mentioned that this research aimed to reducing amount of mineral fertilizers N and P that applying in faba bean under Toshka conditions and exchange its with organic manure fertilizer in order to minimize pollution rate and maintenance of environment that consider as national goal. It could be concluded that, the same net income could be obtained by reducing mineral fertilizers (N) level from 45 kg N/fed., to 30 kg N/fed., with monetary value about 5043 L.E.

**Table (43): Effect FMC, P and N fertilizers and their interaction on net income and Profit ratio of faba bean (season 2011-2012).**

Fertilization treatments			Gross Income (pound/fed)	Total cost (pound/fed)	Net Income (pound/fed)	Profit ratio %	Average monthly income
FMC (A)	N (B)	P (C)					
Control			3990	3000	990	33	165
A <sub>0</sub>	B <sub>0</sub>	C <sub>1</sub>	4533	3120	1413	45	236
		C <sub>2</sub>	4788	3240	1548	48	258
		C <sub>3</sub>	5220	3360	1860	55	310
	B <sub>1</sub>	C <sub>1</sub>	5589	3345	2244	67	374
		C <sub>2</sub>	5733	3465	2268	65	378
		C <sub>3</sub>	5982	3585	2397	67	399
	B <sub>2</sub>	C <sub>1</sub>	6193	3570	2623	73	437
		C <sub>2</sub>	6484	3690	2794	76	466
		C <sub>3</sub>	6535	3810	2725	72	454
	B <sub>3</sub>	C <sub>1</sub>	6991	3795	3196	84	533
		C <sub>2</sub>	7635	3915	3720	95	620
		C <sub>3</sub>	8278	4035	4243	105	707
A <sub>1</sub>	B <sub>0</sub>	C <sub>1</sub>	5108	3270	1838	56	306
		C <sub>2</sub>	5571	3390	2181	64	364
		C <sub>3</sub>	5775	3510	2265	65	378
	B <sub>1</sub>	C <sub>1</sub>	6470	3495	2975	85	496
		C <sub>2</sub>	6766	3615	3151	87	525
		C <sub>3</sub>	6984	3735	3249	87	541
	B <sub>2</sub>	C <sub>1</sub>	8073	3720	4353	117	726
		C <sub>2</sub>	8164	3840	4324	113	721
		C <sub>3</sub>	8682	3960	4722	119	787
	B <sub>3</sub>	C <sub>1</sub>	7475	3945	3530	89	588
		C <sub>2</sub>	7602	4065	3537	87	590
		C <sub>3</sub>	7789	4185	3604	86	601
A <sub>2</sub>	B <sub>0</sub>	C <sub>1</sub>	5304	3420	1884	55	314
		C <sub>2</sub>	5372	3540	1832	52	305
		C <sub>3</sub>	6040	3660	2380	65	397
	B <sub>1</sub>	C <sub>1</sub>	7175	3645	3530	97	588
		C <sub>2</sub>	7678	3765	3913	104	652
		C <sub>3</sub>	7990	3885	4105	106	684
	B <sub>2</sub>	C <sub>1</sub>	8317	3870	4447	115	741
		C <sub>2</sub>	8637	3990	4647	116	774
		C <sub>3</sub>	9153	4110	5043	123	840
	B <sub>3</sub>	C <sub>1</sub>	6645	4095	2550	62	425
		C <sub>2</sub>	7207	4215	2992	71	499
		C <sub>3</sub>	7328	4335	2993	69	499

# SUMMARY

## **Summary**

The coincident application of organic fertilizer is frequently recommended firstly for improving biological, physical and chemical properties of soil and secondly to get clean agricultural products free of macro chemical fertilizers. Two field experiments were conducted at the Agricultural Research Center, South Valley Agricultural Research Station (Toshka), Aswan Governorate, Egypt. The experiment were executed during the two successive winter seasons (2010/2011 and 2011/2012) to investigate the addition of filter mud cake (zero, 10 and 20 m<sup>3</sup>/fed) associated with phosphorus and nitrogen fertilization on growth characters, yield and yield components of faba bean(*Vici faba L.*) plants grown (c.v masr 1) under drip irrigation system in Toshka soils.

The experiment was split plot design once with three replicates . In the main plot were distributed to three levels of organic fertilizer (0 , 10 and 20 m<sup>3</sup> /fed. ) in the split plot was distributed adaptations of levels phosphorus (15.5, 31 and 46.5 P<sub>2</sub>O<sub>5</sub> kg/fed.) with four levels nitrogen fertilizers(0, 15, 30 and 45 kg N/fed.).

**The most most important marks of finding can be summarized as follows:**

### **A- Growth parameters.**

Number of branches/plant was significantly affected by adding of FMC and phosphate and nitrogen fertilizers as it recorded the highest

values of branching at the highest level of fertilizer . All types of interaction were not significant effect on this trait in the two seasons.

The number of pods per plant recorded the highest values with increase addition the organic manure and mineral fertilizers. While all the interactions between elements have no significant effect on the number of pods per plant.

Plant height was significantly affected by the application of the three factors of the study. Where the use of 20 m<sup>3</sup> / fed. of filter mud cake , 45 kg N / fad and 46 kg P<sub>2</sub> O<sub>5</sub> / fed. of fertilizers gave the longest of plants in the study seasons. All interactions have no significant effect on plant height.

### **B- yield and yield component**

The addition of 20 m<sup>3</sup> of FMC /fed., gave the highest yield of seeds during the two seasons of the study, increase by 15.1% and 16.8 % reported not to add FMC. Similarly, in the phosphate fertilizer the highest level it recorded the highest value of seed yield increase by (10.3% and 10.5%) in both seasons. While the nitrogen fertilization recorded the highest value of seed yield when using 30 kg N/fed., an increase of (38% and 39.5%) in both seasons. Interaction between FMC and N fertilizer was significantly affected on seed yield.

Straw yield increase significantly affected by all levels of addition of organic and mineral fertilizers. All interactions did not have any significant effect on the straw yield.

The organic and mineral fertilization was significant effected on the total yield. Where it recorded the highest values when using the highest levels of organic and mineral fertilization (nitrogen and phosphate). While the highest value recorded from the biological yield on interaction between organic manure and nitrogen fertilizer at 20 m<sup>3</sup> FMC and 30 kg of N/fed. in both seasons.

One hundred seeds weight of faba bean significantly affected by organic, phosphate and nitrogen fertilizers. There was no significant effect of interaction was recorded.

### **C - Seed content of N, P and K percentages .**

Addition FMC or phosphate or nitrogen fertilizers have a significant effect on the percentage of nitrogen and protein in the seeds. The highest values of protein contents when adding higher levels of fertilizer, increase (12 and 8.4%) by organic fertilizer, (31 and 28%) by phosphorous fertilization and (214 and 182%) by nitrogen fertilization. All interactions have no significant effect on this trait.

The highest percentage of phosphorus in the seeds was observed used the highest levels of organic or mineral fertilizers. The Interaction between organic and phosphorus fertilizers was significant effected on the content of seeds for phosphorus in both seasons.

Applying 10 m<sup>3</sup>/fed of organic fertilizer gave the highest content the seeds of potassium Similarly, add the second level of phosphorus



fertilization. On another hand the all interaction effects were significantly affect on K% in seed nitrogen in both seasons.

### **D - Straw content of N, P and K percentages .**

The nitrogen fertilization was significantly affected on N% in straw in the two seasons.

The main effect of FMC, P and N fertilization were significant effect on the content straw for phosphorus in the both seasons. Also the interaction between FMC and P fertilization in the two season and P and N fertilizers were significantly affected on P% in straw during the first season.

Potassium percentage in straw was significantly affected by the all factors studied in the two seasons except the effect N fertilization in the second season.

### **E – Total N, P and K uptakes by faba bean.**

The total content of nitrogen uptake significantly affected by adding FMC, phosphorus and nitrogen fertilizers where the highest values of this attribute when using higher levels of fertilizer in both seasons, an increase (25-23%) to fertilize organic and (27-26%) to fertilize phosphate and (141-136%) to fertilize nitrogen. The interaction between FMC, nitrogen fertilizer, phosphate fertilizer and nitrogen fertilizer had a significant effect on the total content of nitrogen uptake in both seasons.

The factors studied were significantly affected on the phosphorus total uptake during the two seasons. Except the triple interaction effect

between FMC, P and N fertilization was not significant effected in the second season.

The potassium total up take was significantly affected by addition of FMC, P and N fertilization and all interaction effects during the two seasons.

### **E – some soil properties.**

The EC was significantly affected by increase organic and mineral fertilizers and all the interactions were recorded the highest values of the EC when using higher levels for each treatment.

Addition of FMC and phosphorus fertilizer were significantly effect on pH. The interaction effects between FMC+ N and P+ N fertilization in second season and the triple interaction in the both season were significantly affected on pH.

The total nitrogen in the soil was significantly affected by the addition of organic and nitrogen fertilizers in the both seasons. On another hand the phosphorus fertilization and the interactions effect between the FMC and N fertilization were significantly affected on total N in soil during second season.

The study three factors had a significant effect on the content of soil available phosphorus. Where it recorded the highest values when used the highest levels of the organic or phosphorus fertilization. But the highest content of available phosphorus in soil recorded when using the zero level of nitrogen fertilizer. The Interaction between FMC and P fertilizer had a significant effect on the available P in soil

during the two seasons. On another hand the available P in soil was significantly affected by the interaction effects between FMC+N and P+N fertilization in the second season.

The organic matter percentage in the soil increased, up addition organic and mineral fertilizers, where it's all have significant effect on this trait. The all interaction effects were significantly affected on the organic matter percentage in soil during two seasons. Except the interaction effect between P and N fertilization was not significant effect on the organic matter percentage in soil in first season.

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# ARABIC SUMMARY

## الملخص العربي

اجريت تجربتان حقليتان بمزرعة محطة البحوث الزراعية بجنوب الوادي (توشكى) بمركز البحوث الزراعية في موسمي ٢٠١٠-٢٠١١ و ٢٠١١-٢٠١٢ بهدف دراسة تأثير التسميد العضوي ( طينة المرشحات) والتسميد الفوسفاتي والنيتروجيني علي المحصول ومكونات الفول البلدي (صنف مصر ١) تحت نظام الري بالتنقيط في ارضي توشكى. تم تنفيذ التجربة بتصميم القطع المنشقة مع ثلاث مكررات . في القطع الرئيسية تم توزيع ثلاث مستويات من السماد العضوي ( ٠ و ١٠ و ٢٠ م<sup>٣</sup>/ فدان ) وفي القطع المنشقة تم توزيع توافيق مستويات السماد الفوسفاتي ( ١٥,٥ و ٣١ و ٤٦,٥ كجم فو<sup>٢</sup> اه / فدان مع مستويات السماد النيتروجيني (صفر و ١٥ و ٣٠ و ٤٥ كجم ن/ فدان) ويمكن تلخيص اهم النتائج المتحصل عليها كما يلي:

### أ- صفات النمو

- تفرع نموات الفول تآثر معنويا بأضافة السماد العضوي والسماد الفوسفاتي والنيتروجيني حيث سجل اعلى قيم التفرع عند اعلى مستويات من الاسمدة . جميع التفاعلات بين عناصر الدراسة لم يكن لها اثر معنوي علي هذه الصفة خلال موسمي الدراسة.
- عدد القرون للنبات سجلت اعلى قيم وذلك بزيادة اضافة السماد العضوي والاسمدة المعدنية . بينما لم يكن للتفاعلات بين جميع العناصر اي تأثير معنوي علي عدد القرون لكل نبات في كلا الموسمين.

- تآثر ارتفاع النبات معنويا بتطبيق عوامل الدراسة الثلاثة حيث ادي استخدام ٢٠ م<sup>٣</sup>/ فدان من طينة المرشحات و ٤٥ كجم نيتروجين/ فدان و ٤٦,٥ كجم فو<sup>٢</sup> اه / فدان من السماد الفوسفاتي اعطت اطول النباتات في موسمي الدراسة . جميع التفاعلات ليس لها اي تأثير معنوي علي طول النبات.

**ب- المحصول ومكوناته**

● أدى اضافة ٢٠ م<sup>٣</sup> من السماد العضوي / فدان الحصول علي اعلى محصول من البذور خلال موسمي الدراسة بزيادة قدرها (١٥,١% و ١٦,٨%) مقارنة بمعاملة بدون السماد العضوي. وبالمثل اضافة السماد الفوسفاتي اعلي مستوي منه سجلت اعلي القيم من محصول البذور بزيادة قدرها (١٠,٣% و ١٠,٥%) في كلا الموسمين . بينما اضافة السماد النيتروجيني سجل اعلي قيمة من محصول البذور عند استخدام ٣٠ وحدة نيتروجين للفدان بزيادة قدرها (٣٨% و ٣٩,٥%) في كلا الموسمين. وكان التفاعل بين السماد العضوي والسماد النيتروجين اثر معنويا علي محصول البذور .

● محصول التين تائرا معنويا بزيادة اضافة جميع مستويات الاسمدة العضوية والمعدنية وجمعها سجل اعلي محصول تبين . جميع التفاعلات لم يكن لها اي تاثير معنوي علي محصول التين.

● كان للتسميد العضوي والمعدني تائرا معنويا علي المحصول الكلي حيث سجلت اعلي قيم منه عند استخدام اعلي مستويات من التسميد العضوي والمعدني ( نيتروجيني وفوسفاتي ) . في حين اعلي قيمة سجلت من المحصول البيولوجي من التفاعل بين السماد العضوي والسماد النيتروجيني عند ٢٠ م<sup>٣</sup> طينة مرشحات للفدان و ٣٠ كجم نيتروجين للفدان في كلا الموسمين .

● وزن ١٠٠ بذرة من الفول البلدي تائرا معنويا بزيادة التسميد العضوي والسماد الفوسفاتي والنيتروجيني . ولم يسجل التفاعل اي تاثير معنوي .

**ت- محتوى البذور من عناصر النيتروجين والفسفور والبوتاسيوم**

● اضافة طينة المرشحات والسماد الفوسفاتي والسماد النيتروجيني جميعها لها تائرا معنويا علي النسبة المئوية للنيتروجين ونسبة البروتين في البذور. واعلي قيم سجلت من نسبة البروتين عند اضافة اعلي مستويات من الاسمدة بزيادة قدرها (١٢ و ٨,٤%) مع السماد العضوي و (٣١- ٢٨%) باستخدام التسميد الفوسفاتي و (٢١٤-١٨٢%) مع للتسميد النيتروجيني. جميع التفاعلات ليس لها اي تاثير معنوي علي هذه الصفة.

● تم الحصول علي اقصي قيم من النسبة المئوية للفسفور في البذور عند استخدام اعلي مستويات من السماد العضوي او المعدني . التفاعل بين السماد العضوي والسماد الفوسفاتي له تاثير معنوي علي محتوى البذور من الفوسفور في كلا اللومسمين.



• ادي اضافة ١٠م<sup>٢</sup> من طينة المرشحات للفدان تسجيل اعلي قيمة من محتوى البذور من البوتاسيوم وبالمثل اضافة ٣١ كجم فو<sup>٢</sup> اه / فدان من السمادي الفوسفاتي . في حين ان جميع التفاعلات لها تاثير معنوي علي محتوى البذور من البوتاسيوم في كلا الموسمين.

### ث- محتوي القش من عناصر النيتروجين والفسفور والبوتاسيوم

• النسبة المئوية للنيتروجين في التبن تاترة معنويا باضافة السماد النيتروجيني ولم تتاثر بباقي عوامل الدراسة خلال موسمي الدراسة.

• كان للتسميد العضوي والفوسفاتي والنيتروجيني تاثيرا معنويا علي النسبة المئوية لمحتوي التبن من الفوسفور في كلا الموسمين وكذلك التفاعلات بين السماد العضوي مع التسميد الفوسفاتي في الموسمين والتسميد الفوسفاتي مع السماد النتروجيني في الموسم الاول كان لهم تاثير معنوي علي نسبة الفوسفور في التبن .

• النسبة المئوية للبوتاسيوم في التبن تاترت معنويا بكل عوامل الدراسة باستثناء السماد النيتروجيني في الموسم الثاني لم يكن له اي تاثير معنوي.

### ج- الامتصاص الكلي لعناصر النيتروجين والفوسفور والبوتاسيوم

• المحتوى الكلي للنيتروجين الممتص تاتر معنويا باضافة التسميد العضوي والتسميد الفوسفاتي والتسميد النيتروجيني حيث سجلت اعلي قيم من هذه الصفة عند استخدام المستويات الاعلي من الازمدة في كلا الموسمين بزيادة قدرها (٢٥- ٢٣%) للتسميد العضوي و (٢٧- ٢٦%) للتسميد الفوسفاتي و(١٤١- ١٣٦ %) للتسميد النيتروجيني. كان التفاعل بين السماد العضوي والسماد النيتروجيني ، السماد الفوسفاتي والسماد النيتروجيني لهم تاثير معنوي علي المحتوى الكلي من النيتروجين الممتص في كلا الموسمين.

• جميع عوامل الدراسة كان لها تاثيرا معنويا علي المحتوى الكلي من الفوسفور الممتص خلال موسمي الدراسة باستثناء التفاعل الثلاثي بين التسميد العضوي والفوسفاتي والنيتروجيني لم يكن له اي تاثير معنوي علي هذه الصفة في الموسم الثاني .

• المحتوى الكلي للبوتاسيوم الممتص خلال موسمي الدراسة تاتر معنويا باضافة السماد العضوي او الفوسفاتي او النيتروجيني وايضا كان لجميع التفاعلات تاثيرا معنويا علي هذه الصفة.

## بعض خواص التربة.

●نسبة الاملاح تأثرت معنويا بزيادة التسميد العضوي والمعدني وجميع التفاعلات بينهم حيث تم الحصول علي اقصي قيم عند استخدام المستويات الاعلي لكل معاملة.

●اضافة السماد العضوي والفوسفاتي اثر معنويا علي درجة الحموضة خلال موسمي الدراسة . ايضا كان تاثير التفاعلات بين التسميد العضوي مع النيتروجيني والتسميد الفوسفات مع النيتروجيني في الموسم الاول وكذلك التفاعل الثلاثي في الموسمين كان لهم جميعا تاثير معنويا علي درجة الحموضة

●المحتوي الكلي للنيتروجين في التربة تاجر معنويا باضافة كلا من السماد العضوي والسماد النيتروجيني في كلا الموسمين. بينما كان لكلا من التسميد الفوسفاتي والتفاعل بين التسميد العضوي والنيتروجيني تاثيرا معنويا علي هذه الصفة في الموسم الثاني فقط.

●كان للثلاثة عوامل تحت الدراسة تاثيرا معنويا علي محتوى التربة من الفوسفور الميسر حيث سجلت اعلي قيم منه عند استخدام المستوي الاعلي من التسميد العضوي او الفوسفاتي في حين سجل اعلي محتوى من الفوسفور الميسر عند استخدام المستوي صفر من السماد النيتروجيني. التفاعل بين التسميد العضوي والفوسفاتي له تاثير معنوي علي محتوى التربة من الفوسفور الميسر خلال موسمي الدراسة . لكن في الموسم الثاني كان للتفاعلات بين التسميد العضوي مع النيتروجين والسماد الفوسفاتي مع النيتروجيني كان لهم تاثير معنوي علي محتوى التربة من الفوسفور الميسر.

●نسبة المادة العضوية في التربة زادت بزيادة اضافة السماد العضوي والاسمدة المعدنية حيث جميعها لها تاثير معنوي علي هذه الصفة . كان لجميع التفاعلات اثرا معنويا علي نسبة المادة العضوية في التربة في كلا الموسمين بعكس التفاعل بين الازمدة المعدنية لم يكن لها اي تاثير معنوي علي هذه الصفة في الموسم الاول.



# استجابة الفول البلدي للتسميد النيتروجيني والفوسفاتي والعضوي في اراضي توشكي.

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