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EFFECT OF SOME ORGANIC, CHEMICAL AND BIOFERTILIZERS ON GARLIC (*Allium sativum* L.): 1- Cattle manure

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ABSTRACT

Two experiments were carried out on garlic clone Sids 40, in the vegetable private farm at Tawila village Dakahlia Governorate during the two successive seasons of 2003/2004 and 2004/2005 to study the effect of two cattle manure levels ($20m^3$ and $30m^3$/fed), three phosphorus levels (25, 50 and 75 kg P2O5/fed), phosphorien (with 3kg/fed and without) and potassium fertilization (soil fertilization 72 kg K_2O/fed and 60 kg K_2O/fed + 1% K_2O/fed as foliar fertilization) on growth, yield and its components, chemical composition and storability of garlic.

The results indicated that treatment of 30 m^3/fed cattle manure +50 kg P_2O_5/fed + with phosphorien (3 kg/fed) + 60 kg K_2O/fed + 1% K_2O/fed foliar fertilization gave the best results for (fresh weight/plant, dry weight /plant, leaf area/plant, diameter of bulb at 160 days after planting, weight of bulb, bulb yield/fed, N, P and K percentage and total chlorophyll content) during the two seasons. But, it had the lowest values of bulbing ratio at 120 and 160 days after planting at the two seasons, the same treatment had the lowest value of weight of loss percentage of bulbs in the second season. While the treatment of 30 m^3/fed cattle manure + 75 kg P_2O_5/fed + with phosphorien + 60 kg K_2O/fed + 1% K_2O/fed foliar fertilization gave lowest value of weight of loss percentage of bulbs in the first season.

Therefore, the treatment of 30 m^3 /fed cattle manure + 50 kg P_2O_5/fed + with phosphorien (3 kg/fed) + 60 kg K_2O/fed + 1% K_2O/fed foliar fertilization could be recommended for raising garlic yield with good quality bulbs.

INTRODUCTION

Garlic (*Allium sativum* L.), is one of the most important bulb vegetable crops and is next to onion in importance. It is commonly used as a spice or in the medicinal purposes. In Egypt, it has been generally cultivated for both local consumption and export.

The importance of using organic fertilizer decrease using chemical fertilizer in plant production is one of the important ways in health protection. Organic manure serve two purposes in soil, its supply both major and minor nutrients for plant and microorganisms. It also improve the physical conditions in soil (Cook 1972 and 1982).

Several investigators reported that the application of (organic manure) i.e. cattle manure increase the vegetative growth, yield and its components, NPK content and storability (El-Mansi *et al.* (1999), Abou El-Magd *et al*. (2003), Patil *et al*. (2005), Yassen and Khalid (2009).

El-Mansi *et al*. (1999) under sandy soil conditions, found that adding 20 or 40 m^3 FYM/fed significantly increased chlorophyll a, b, total (a + b) and carotenoids in leaf tissues of pea plants. Abou El-Magd *et al*. (2003) indicated that higher vegetative growth (plant height, number of leaves and fresh

weight of plants) was obtained by cattle manure or mineral fertilization on garlic. El-Mansi *et al*. (2004) worked on garlic, they found that addition of 45 m^3 FYM/fed recorded maximum values of yield of both first and second grades, total and marketable yield as well as average bulb weight. And N, P and K content in cloves. Patil *et al*. (2005) showed that with the increasing level of FLY ash and FYM there was a corresponding increase in the up take of nitrogen, phosphorus and potassium of onion. Yassen and Khalid (2009) on onion, found that all organic fertilizer treatments is mixture of farmyard treatment (recommended NPK) and improved the vegetative growth, essential oil and NPK content.

Phosphorus is considered the second essential nutrient element for plant growth and development, it plays an important role in certain prevalent steps in plant growth, such as accumulation and release of energy celluar metabolism, in addition, it is main constituent of many organic compounds in plant (Russell, 1950). Several researchers reported that P-nutrient is very important for garlic plant growth. Setty *et al.* (1989) showed that P fertilization was needed for garlic plant growth and development. They added that application of P (0, 50 and 100 kg/ha) progressively increased the number of leaves/plant, neck thickness and shoot dry matter. In general, the results indicated that application of P fertilizers exerted apparent increases in plant growth of garlic or onion viz. number of leaves, foliage fresh and dry weight as well as bulbing ratio, bulb yield/fed, its components, bulb weight, dry matter and NPK contents El-Kalla *et al*. (1997), Abd El-Rehim (2000), Jakse and Mihelic (2001), Turk and Tawaha (2001), Muthuramalingam *et al*.(2002) and Lee-Jong Tae *et al*. (2003).

Lee-Jong Tae *et al*. (2003) found that on onion leaves chlorophyll content increased with increasing N rate. P_2O_5at 80 kg/ha recorded that highest chlorophyll content (0.47 mg/kg) compared with the other rates of the same fertilizer, total yield, marketable bulbs and yield components was significantly increased with increasing phosphorus level up to 60 kg P_2O_5 or 75 P_2O_5/fed Santhi *et al*. (2005) found that nutrient uptake increased with increasing rates of N, P and K in combination.

Phosphorien content *Bacillus megatherium* a phosphate dissolving bacteria. Many investigators reported that application of phosphobacterium are involved in the availability of phosphorus and other elements in soils, through the decomposition of organic compounds, which may lead to a change in the soil reaction (Mahmoud and Abdel-Hafez, 1982; Forster and Freter, 1988 and El-Dahtory *et al*. (1989).

El-Sheekh (1997) found that the highest values of dry weight/plant, total yield/fed, diameter of bulb and weight bulb of onion plant were obtained by adding phosphorien at 400 gm/ fed El-Kalla *et al*. (1999) reported that application of biophosphatic fertilizer (phosphorien) to onion plants at 400 g/fed resulted an increase in number of leaves/plant as well as fresh and dry weight/plant over the uninoculated treatment moreover, phosphorien application increased neck thickness, gave best bulbing ratio, total yield/fed and bulb quality.

Several investigators reported that the application of phosphorien or mycorrhizae (VAM) increase the vegetative growth, yield and its components,

N, P and K contents and storability on garlic or onion plants. (Al-Karaki, 2002; Alok-Singh *et al*., 2002; Sari *et al*., 2002; El-Shaikh, 2005 and Jha *et al*., 2006).

Potassium element is very important in over all metabolism of plant enzymes activity, it was found to serve a vital role in a photosynthesis by direct increasing in growth, leaf area and hence Co_2 assimilation potassium also has a beneficial effect of water consumption. (Mengel and Kirkby, 1982; Gardener *et al*., 1985; Abd El-Aal, 1990 and Said, 1997).

Foliar fertilization of potassium is more economical than root application due to the higher degree of applied nutrients utilization and the continuous increases in the costs of using chemical fertilizers (Franke, 1986).Ciecko *et al*. (2000) showed that increasing of the K rate significantly increased total chlorophyll biosynthesis in potato leaves. El-Morsy *et al*. (2004) on garlic, found that plant height, shoot dry weight/plant, bulbing ratio, total yield, bulb weight, bulb diameter, number of cloves and clove weight in both seasons only were significantly increased with supply 50% K fertilizer as a soil application and foliar application 2% K_2O solution in comparison with other treatment. Also, increased concentration of N, P, K and increasing of the storability of garlic plants. Similar results were obtained by Nikardi (2009) on potato and Shaheen *et al*. (2009) on pea plants.

MATERIALS AND METHODS

Two filed experiments were carried out at Tawila Village Dakahlia Governorate during two successive seasons (2003/2004 and 2004/2005) on garlic cultivar sids-40 to study the effect of two levels cattle manure, three phosphorus levels, phosphorien and potassium fertilization on growth, yield and its components, chemical composition and storability of garlic. The soil of the experimental field was clay loam in texture with organic matter% (1.95, 1.88), EC 3.7 ds/cm, PH 7.7 Available N, P and K contents were 50-70, 10-12 and 330-390 ppm during the first and second seasons.

Cattle manure was added at levels of 20 and 30 m^3 / fed it was broadcasted during soil preparation and phosphorus fertilizer with three rates at 25, 50 and 75 kg P_2O_5 / fed in two equal doses (30 and 60 days after planting). Phosphorus was used in the form of super-phosphate (15.5% P_2O_5). Phosphorien was mixed with wet cloves at rate of 3 kg/fed before planting. Nitrogen fertilizer was used as Ammonium- Sulfate (20.5% N) at the rate of 120 kg/fed in two equal doses (30 and 60 days after planting). Potassium fertilizer as Potassium Sulfate (48% K_2O), it used two form soil fertilization 72 kgK_2O/fed and soil fertilization 60 kg K_2O/fed + 1% K_2O/fed foliar spray fertilization.

Soil application was applied for two equal times 30 and 60 days later after planting while, foliar application was spared at 50, 70 and 90 days after planting. The experimental design was randomized complete block design with three replicates in these experimental.

Treatments of experimental.

1- 20 m^3 /fed cattle manure+25 kg P_2O_5/fed + without phosphorien + 72 kg K_2O/fed
2- 20 m^3 /fed cattle manure + 25 kg P_2O_5/fed + without phosphorien + (60 kg K_2O/fed + 1% K_2O foliar application).
3- 20 m^3 /fed cattle manure + 25 kg P_2O_5/fed + with phosphorien + 72 kg K_2O /fed
4- 20 m^3 /fed cattle manure + 25 kg P_2O_5/fed + with phosphorien + (60 kg K_2O /fed + 1% K_2O foliar application).
5- 20 m^3 /fed cattle manure + 50 kg P_2O_5/fed + without phosphorien + 72 kg K_2O /fed
6- 20 m^3 /fed cattle manure + 50 kg P_2O_5/fed + without phosphorien + (60 kg K_2O /fed + 1% K_2O foliar application).
7- 20 m^3 /fed cattle manure + 50 kg P_2O_5/fed + with phosphorien + 72 kg K_2O /fed
8- 20 m^3 /fed cattle manure + 50 kg P_2O_5/fed + with phosphorien + (60 kg K_2O /fed + 1% K_2O foliar application).
9- 20 m^3 /fed cattle manure + 75 kg P_2O_5/fed + without phosphorien + 72 kg K_2O /fed
10- 20 m^3 /fed cattle manure + 75 kg P_2O_5/fed + without phosphorien + (60 kg K_2O /fed + 1% K_2O foliar application).
11- 20 m^3 /fed cattle manure + 75 kg P_2O_5/fed + with phosphorien + 72 kg K_2O /fed
12- 20 m^3 /fed cattle manure + 75 kg P_2O_5/fed + with phosphorien + (60 kg K_2O /fed + 1% K_2O foliar application).
13- 30 m^3 /fed cattle manure + 25 kg P_2O_5/fed + without phosphorien + 72 kg K_2O /fed
14- 30 m^3 /fed cattle manure + 25 kg P_2O_5/fed + without phosphorien + (60 kg K_2O /fed + 1% K_2O foliar application).
15- 30 m^3 /fed cattle manure + 25 kg P_2O_5/fed + with phosphorien + 72 kg K_2O /fed
16- 30 m^3 /fed cattle manure + 25 kg P_2O_5/fed + with phosphorien + (60 kg K_2O /fed + 1% K_2O foliar application).
17- 30 m^3 /fed cattle manure + 50 kg P_2O_5/fed + without phosphorien + 72 kg K_2O /fed
18- 30 m^3 /fed cattle manure + 50 kg P_2O_5/fed + without phosphorien + (60 kg K_2O /fed + 1% K_2O foliar application).
19- 30 m^3 /fed cattle manure + 50 kg P_2O_5/fed + with phosphorien + 72 kg K_2O /fed
20- 30 m^3 /fed cattle manure + 50 kg P_2O_5/fed + with phosphorien + (60 kg K_2O /fed + 1% K_2O foliar application).
21- 30 m^3 /fed cattle manure + 75 kg P_2O_5/fed + without phosphorien + 72 kg K_2O /fed
22- 30 m^3 /fed cattle manure + 75 kg P_2O_5/fed + without phosphorien + (60 kg K_2O /fed + 1% K_2O foliar application).
23- 30 m^3 /fed cattle manure + 75 kg P_2O_5/fed + with phosphorien + 72 kg K_2O/fed

24- 30 m^3 /fed cattle manure + 75 kg P_2O_5/fed + with phosphorien + (60 kg K_2O /fed + 1% K_2O foliar application).

NPK percentages of cattle manure used were 0.69% N, 0.31% P and 1.08% K.

Garlic cloves were selected uniformly in shape and size. The cloves were planted on the 12th and 9th of October in the first and second seasons, respectively. The cloves were planted on both sides of each ridge at 10 cm apart. The plot area was 11.2 m^3, which contained 4 rides, with 4 m length and 0.7 m width.

The harvest was done 180 days after planting for both seasons. The following characters were determined:-

A. Vegetative growth characters

Five plants from each plot were chosen randomly in both seasons after 120 days from planting date to study the following characteristics:-

1- Fresh weight/plant. (g)

2- Dry weight/plant. (g)

3- Leaf area (cm^2)/plant.

4- Bulbing ratio = $\frac{\text{Neck diameter (cm)}}{\text{Bulb diameter (cm)}}$ Mann (1952) after 120 and 160 days from planting.

5- Bulb diameter (cm) after 160 days from planting.

B. Yield and its components

1- Total yield ton/ feddan before curing treatment.

2- Average bulb weight (g).

C. Chemical composition

1. Total chlorophyll (was estimated by spectrophotometrically by using the method of Macking (1941).

2.Nitrogen, phosphorus and potassium percentage in the dry matter of cured cloves were determined according to methods described by AOAC (1990) for nitrogen, phosphorus and potassium by Ranganna (1979).

D. Storability

After curing random samples (each 10 kg) were taken from every treatment and stored at the normal room conditions.

The samples were weight after one, three and six months later and percentage of loss weight were calculated.

The obtained data were subjected to statistical analysis using technique of the randomized complete block design according to Snedecor and Cochran (1982) using MSTAT-C, computer. The treatment means were compared using Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

A- Vegetative growth characters

Data on vegetative growth characters i.e. Fresh weight/plant, dry weight/plant , Leaf area (cm^2)/plant and bulbing ratio were present in Table 1. The highest values (Fresh weight/plant, dry weight/plant, Leaf area (cm^2)/plant)were recorded with 30 m^3 /fed cattle manure + 50 kg P_2O_5/fed + with phosphorien (3 kg/fed) + 60 kg K_2O/fed + 1% K_2O/fed foliar fertilization.

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This significantly overcome other treatments but this treatment had the lowest value of bulbing ratio in the first season.

The application of cattle manure and phosphorien on vegetative growth often due to improving the structure of soil and increase total count of botany as well as, improving soil biological and chemical properties. Moreover, the supplied organic manure amended the microorganisms with necessary nutrient elements and increased the microbial respiration and CO_2 out put (Cook 1972 and 1982).

On the other hand, the favorable effect of potassium fertilizer on the plant growth may be due to that potassium element is very important in the overall metabolism of plant (Mengel and Kirkby, 1982). Moreover, foliar fertilization of potassium is more economical than root application due to the higher degree of applied nutrient utilization and the continuous increases in the costs of using chemical fertilizers (Franke, 1986). Similar results were obtained by, El-Sheekh (1997), Al-Kaff *et al*. (2002), Muthuramalingam *et al*. (2002), Prabu *et al*. (2003), Lee Tong Tae *et al*. (2003), El-Morsy *et al*. (2004), El-Shaikh (2005), Jha *et al*. (2006), Nikardi (2009), Shaheen *et al*. (2009) and Yassen and Khalid (2009).

B- Yield and its components

Data presented in Table 2 show that application of 30 m^3 /fed cattle manure + 50 kg P_2O_5/fed + with phosphorien (3 kg/fed) + 60 kg/fed K_2O + 1% K_2O/fed foliar fertilization resulted in the highest values (diameter of bulb at 160 days from planting, weight of bulb and bulb yield/fed). However, bulbing ratio at 160 days after planting was significantly affected by 30 m^3 /fed cattle manure/fed + 25 kg P_2O_5/fed + without phosphorien + 72 kg/fed K_2O during both seasons. The results are similar to those reported by Al-Kaffe *et al*. (2002), Muthuramalingam *et al*. (2002), Prabu *et al*. (2003), El-Mansi *et al*. (2004), El-Morsy *et al*. (2004), Nikardi (2009), Shaheen *et al*. (2009) and Yassen and Khalid (2009).

The enhancing effect of such treatments on yield and its components are mainly attributed to the ameliorative effect on vegetative growth Table 1.

C- Chemical composition

Results recorded in Table 3 reveal that Nitrogen, phosphorus and potassium in garlic cloves and chlorophyll contents in leaves had the highest values at the treatment of 30 m^3 /fed cattle manure + 50 kg P_2O_5/fed + with phosphorien + 60 kg K_2O/fed + 1% K_2O/fed foliar fertilization during both seasons of study. Such increments are connected with the increasing in vegetative growth parameter also it may be attributed to the highest content and more as well easily decomposition of cattle manure, phosphorien and availability of such macro elements N, P, K and total chlorophyll for absorption by plant roots compared with treatments. Obtained results as in agreement with those reported by Muthuramalingam et al. (2002), Prabu *et al*. (2003), El-Shaikh (2005) and Jha *et al*. (2006).

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In addition, the increment up take of N, P and K by different plants parts may be due to higher availability of the nutrients with increase in the fertilizer application NPK which ultimately resulted in better root growth and increased physiological activity of roots to absorb the nutrients and thereby nutrient up take was found closely linked with productivity (Veeranna *et al*. 1997). Similar results were obtained by Ciecko *et al*. (2000), El-Morsy *et al*. (2004), Nikardi (2009), Shaheen *et al*. (2009) and Yassen and Khalid (2009).

D- Storability

Data presented in Table 4 showed that the response of weight loss percentage of bulbs to the different treatments. The data indicated that 30 m^3 /fed cattle manure + 75 kg P_2O_5/fed + with phosphorien + 60 kg K_2O + 1% K_2O/fed foliar fertilization gave the lowest weight loss percentage during storage period at the first season. But, the application of 30 m^3 /fed cattle manure + 50 kg P_2O_5/fed + with phosphorien + 60 kg K_2O/fed + 1% K_2O/fed foliar fertilization gave the lowest values at the second season.

Table 4: Weight loss percentage after one, three and six months of garlic as affected by combination among cattle manure, phosphorus levels, phosphorien and potassium fertilizer during 2003/2004 and 2004/2005 seasons.

Characters / Treatments	Weight loss percentage after one month		Weight loss percentage after three months		Weight loss percentage after six months	
	2003/ 2004	2004/ 2005	2003/ 2004	2004/ 2005	2003/ 2004	2004/ 2005
20 m^3 CM+P_1+Wt.Ph+Ks	2.75 a	2.75 j	7.50 f	8.00 h	14.50 n	14.50 l
20 m^3 CM+P_1+Wt.Ph+K(s+f)	1.04 f	2.65 k	6.19 j	7.70 i	15.63 i	17.00 h
20 m^3 CM+P_1+W.Ph+Ks	2.00 b	5.20 d	8.00 e	10.20 d	16.62 f	23.60 b
20 m^3 CM+P_1+W.Ph+K(s+f)	1.50 d	4.60 e	6.25 j	10.67 c	13.50 q	18.50 g
20 m^3 CM+P_2+Wt.Ph+Ks	1.00 f	0.60 t	5.75 l	6.00 s	15.00 l	14.30 m
20 m^3 CM+P_2+Wt.Ph+K(s+f)	1.00 f	1.60 o	6.00 k	6.55 no	14.00 o	14.50 l
20 m^3 CM+P_2+W.Ph+Ks	2.00 b	2.15 m	8.50 c	8.60 g	19.25 c	19.34 f
20 m^3 CM+P_2+W.Ph+K(s+f)	2.75 a	5.32 bc	9.75 a	12.00 b	20.25 a	24.00 a
20 m^3 CM+P_3+Wt.Ph+Ks	0.78 g	2.02 n	5.16 n	6.60 mn	13.61 p	15.28 j
20 m^3 CM+P_3+Wt.Ph+K(s+f)	1.31 e	3.35 h	7.43 f	6.20 q	16.32 g	14.25 m
20 m^3 CM+P_3+W.Ph+Ks	1.50 d	4.15 g	6.50 i	12.80 a	15.50 j	21.20 c
20 m^3 CM+P_3+W.Ph+K(s+f)	0.50 h	1.10 r	5.00 o	6.55 no	13.50 q	14.00 n
30 m^3 CM+P_1+Wt.Ph+Ks	1.75 c	2.05 n	9.25 b	6.00 s	19.75 B	20.00 e
30 m^3 CM+P_1+Wt.Ph+K(s+f)	0.78 g	2.35 l	5.47 m	7.00 k	15.75 h	17.08 h
30 m^3 CM+P_1+W.Ph+Ks	0.77 g	1.40 q	5.09 no	6.68 lm	15.08 l	15.60 i
30 m^3 CM+P_1+W.Ph+K(s+f)	1.50 d	4.30 f	7.25 g	9.00 f	18.25 d	20.61 d
30 m^3 CM+P_2+Wt.Ph+Ks	1.25 e	5.25 cd	8.25 d	6.40 p	18.00 e	13.40 o
30 m^3 CM+P_2+Wt.Ph+K(s+f)	1.25 e	1.00 s	5.50 m	6.00 s	14.75 m	12.20 p
30 m^3 CM+P_2+W.Ph+Ks	1.50 d	1.50 p	7.25 g	6.70 l	14.50 n	14.00 n
30 m^3 CM+P_2+W.Ph+K(s+f)	1.50 d	0.50 u	6.75 h	5.00 t	14.73 m	10.50 r
30 m^3 CM+P_3+Wt.Ph+Ks	1.31 e	1.00 s	5.76 l	6.10 r	15.20 k	11.50 q
30 m^3 CM+P_3+Wt.Ph+K(s+f)	1.50 d	5.50 a	6.25 J	10.00 e	14.79 m	18.50 g
30 m^3 CM+P_3+W.Ph+Ks	1.47 d	5.40 b	5.75 l	6.50 o	13.22 r	17.06 h
30 m^3 CM+P_3+W.Ph+K(s+f)	0.78 g	3.15 i	4.53 p	7.40 j	12.67 s	14.75 k

CM Cattle manure P_1 25 kg/fed P_2o_5 P_2 50kg/fed P_2o_5 P_3 75 kg /fed P_2o_5

Wt.Ph Without phosphorien W.Ph With phosphorien Ks 72 kg/fed K_2O (soil fertilization) K(s+f) 60 kg K_2O/fed (soil fertilization + 1% K_2O/fed foliar fertilization)

These results may be due to increase dry weight in plant Table 1 and K element in Table 2 the reduction in percentage of weight loss during storage may be due to low moist content in bulb reflected as observed in the dry matter percentage. Also, phosphorus is required for the production of high energy phosphate molecules, produced in both photosynthesis and respiration processes therefore higher content of ATP reduced the degradation of clove content for respiration and hence less lose from bulb during storage period. The presence of the micro-organisms found cattle manure and phosphorien may secrete antioxidant and suppressed pests and diseases which could be the major reason for reducing weight loss during storage (Cook 1982; Mengel and Kirkby, 1982 and Gardener *et al*., 1985).

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تأثير بعض الأسمدة العضوية و الاسمدة الكيماوية و الحيوية على محصول الثوم:
١- سماد الماشية

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أجريت تجربتان حقليتان على الثوم (سلالة سدس-٤٠) فى مزرعة خاصة بالطويلة بمحافظة الدقهلية خلال موسمي الزراعة ٢٠٠٤/٢٠٠٣ و٢٠٠٥/٢٠٠٤ لدراسة تأثير سماد الماشية بمستويين (٢٠ م^3 و ٣٠ م^3 / فدان) وثلاث مستويات للفوسفور (٢٥ ، ٥٠ و٧٥ كجم فو$_2$ا$_5$/فدان) والفوسفورين (بدون ومع فوسفورين بمعدل ٣ كجم /فدان) والتسميد البوتاسى بمعدل ٧٢ كجم بو$_2$ا/فدان ، ٦٠ كجم بو$_2$ ا/فدان مع ١% بو$_2$ا/فدان تسميد بالرش على النمو و محصول الأبصال ومكوناته وكذلك المحتويات الكيماوية فى الفصوص ونسبة الفقد فى وزن الأبصال خلال فترة التخزين.

ويمكن تلخيص النتائج المتحصل عليها فيما يلى:-

* وجد أن استخدام المعاملة ٣٠ م^3/فدان سماد الماشية + ٥٠ كجم فو$_2$ا$_5$/فدان مع الفوسفورين (٣ كجم/فدان) + ٦٠ كجم بو$_2$ ا/فدان مع ١% بو$_2$ا/فدان سماد رش ورقى تعطى أفضل نتائج للوزن الطازج/نبات، الوزن الجاف/نبات ، المساحة الورقيه/نبات وقطر البصلة عند ١٦٠ يوم من الزراعة، وكذلك متوسط وزن البصلة، المحصول الكلى/فدان، نسبة محتوى العناصر (نتروجين ، الفوسفور والبوتاسيوم) ومحتوى الكلوروفيل الكلى أثناء موسمى الزراعة.
ولكن حدث انخفاض فى قيم نسبة التبصل عند ١٢٠ و١٦٠ يوم من الزراعة مع نفس المعاملة فى كلا الموسميين.
* مع نفس المعاملة حدث انخفاض فى نسبة الفقد الكلية فى وزن الأبصال المخزنة فى الموسم الثانى بينما المعاملة ٣٠ م^3/فدان سماد الماشية + ٧٥ كجم فو$_2$ا$_5$/فدان مع الفوسفورين (٣ كجم/فدان) + ٦٠ كجم بو$_2$ا / فدان سماد أرضى + ١% بو$_2$ا/فدان سماد رش ورقى يعطى انخفاض فى قيم نسبة فقد الوزن الأبصال خلال فترة التخزين خلال الموسم الأول للزراعة.
* توصى هذه الدراسة باستخدام المعاملة (٣٠ م^3/فدان سماد الماشية +٥٠ كجم فو$_2$ا$_5$/فدان مع الفوسفورين (٣ كجم/فدان) + ٦٠ كجم بو$_2$ ا/فدان سماد أرضى + ١% بو$_2$ا/فدان سماد رش ورقى) لرفع إنتاجية الثوم وتحسين جودة الأبصال وقابليتها للتخزين.

قام بتحكيم البحث

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Table 1: Fresh and dry weights/plant, leaf area /plant and bulbing ratio of garlic as affected by combination among cattle manure, phosphorus levels, phosphorien and potassium fertilizer at 120 days after planting during 2003/2004 and 2004/2005 seasons.

Characters / Treatments	Fresh weight/plant (g)		Dry weight/plant (g)		Leaf area /plant (cm^2)		Bulbing ratio	
	2003/2004	2004/2005	2003/2004	2004/2005	2003/2004	2004/2005	2003/2004	2004/2005
20 m^3 CM+P_1+Wt.Ph+Ks	67.92 bcdefg	83.11 De	5.43 d	8.00 e	150.40 h	195.52 j	0.432 a	0.388 a
20 m^3 CM+P_1+Wt.Ph+K(s+f)	68.29 bcdefg	84.00 Cde	5.50 d	8.76 abcde	150.91 h	199.18 ij	0.428 a	0.391 a
20 m^3 CM+P_1+W.Ph+Ks	70.63 abcdef	87.00 Bcd	6.15 bcd	8.45 cde	151.12 h	202.18 hij	0.408 ab	0.384 a
20 m^3 CM+P_1+W.Ph+K(s+f)	69.06 bcdefg	87.00 Bcd	6.51 bcd	8.70 abcde	152.50 gh	219.80 bcde	0.410 ab	0.321 a
20 m^3 CM+P_2+Wt.Ph+Ks	71.33 abcdef	83.00 De	7.07 abcd	8.47 bcde	155.31 fgh	211.80 efgh	0.405 ab	0.323 a
20 m^3 CM+P_2+Wt.Ph+K(s+f)	72.46 abcde	86.00 Bcde	6.38 bcd	8.81 abcde	156.52 fgh	221.26 abcd	0.393 ab	0.370 a
20 m^3 CM+P_2+W.Ph+Ks	64.40 fg	78.33 E	6.46 bcd	8.04 e	157.10 efgh	203.16 ghij	0.335 ab	0.380 a
20 m^3 CM+P_2+W.Ph+K(s+f)	68.73 bcdefg	91.66 abc	6.53 bcd	8.12 de	154.70 fgh	205.04 fghij	0.379 ab	0.362 a
20 m^3 CM+P_3+Wt.Ph+Ks	63.33 fg	85.33 bcde	6.78 bcd	8.54 bcde	154.52 fgh	218.56 bcde	0.375 ab	0.356 a
20 m^3 CM+P_3+Wt.Ph+K(s+f)	73.63 abc	88.00 abcd	7.49 abc	9.42 abc	164.32 defgh	219.80 bcde	0.355 ab	0.337 a
20 m^3 CM+P_3+W.Ph+Ks	63.90 fg	88.33 abcd	6.46 bcd	8.46 cde	175.41 abc	209.54 efghi	0.332 ab	0.361 a
20 m^3 CM+P_3+W.Ph+K(s+f)	73.12 abcd	86.00 bcde	6.55 bcd	9.25 abcde	173.91 abcde	214.05 cdefg	0.318 b	0.345 a
30 m^3 CM+P_1+Wt.Ph+Ks	62.53 g	93.33 ab	5.91 cd	8.92 abcde	156.50 efgh	203.31 ghij	0.328 ab	0.353 a
30 m^3 CM+P_1+Wt.Ph+K(s+f)	66.33 cdefg	85.66 bcde	6.21 bcd	8.68 abcde	157.61 efgh	206.84 fghi	0.341 ab	0.355 a
30 m^3 CM+P_1+W.Ph+Ks	66.08 cdefg	89.33 abcde	6.51 bcd	9.06 abcde	162.10 defgh	205.94 fghij	0.331 ab	0.360 a
30 m^3 CM+P_1+W.Ph+K(s+f)	75.20 ab	93.33 ab	7.79 ab	9.66 ab	184.93 ab	226.99 ab	0.311 b	0.332 a
30 m^3 CM+P_2+Wt.Ph+Ks	64.20 fg	85.66 bcde	6.38 bcd	8.83 abcde	163.32 defgh	219.01 bcde	0.339 ab	0.352 a
30 m^3 CM+P_2+Wt.Ph+K(s+f)	65.13 efg	89.33 abcd	6.57 bcd	9.12 abcde	159.81 cdefgh	210.90 defgh	0.333 ab	0.347 a
30 m^3 CM+P_2+W.Ph+Ks	65.26 defg	84.00 cde	6.80 bcd	8.41 cde	169.92 cdefgh	219.80 bcde	0.337 ab	0.364 a
30 m^3 CM+P_2+W.Ph+K(s+f)	78.01 a	95.66 a	8.65 a	9.74 a	187.31 a	213.17 a	0.303 b	0.317 a
30 m^3 CM+P_3+Wt.Ph+Ks	71.02 abcdef	86.00 bcde	6.72 bcd	8.52 bcde	167.30 defgh	215.85 cdef	0.343 ab	0.347 a
30 m^3 CM+P_3+Wt.Ph+K(s+f)	71.05 abcdef	88.66 abcd	6.50 bcd	8.81 abcde	166.92 cdefgh	220.54 bcde	0.342 ab	0.349 a
30 m^3 CM+P_3+W.Ph+Ks	70.92 abcdef	89.33 abcd	7.19 abcd	9.12 abcde	174.80 abcd	215.40 cdef	0.327 ab	0.341 a
30 m^3 CM+P_3+W.Ph+K(s+f)	69.72 cdefg	88.33 abcd	7.21 abcd	9.00 abcde	171.41 abcdef	223.06 abc	0.339 ab	0.346 a

CM Cattle manure **P_1** 25 kg/fed P_2o_5 **P_2** 50kg/fed P_2o_5 **P_3** 75/fed kg P_2o_5

Wt.Ph Without phosphorien **W.Ph** With phosphorien **Ks** 72 kg/fed K_2O (soil fertilization) **K(s+f)** 60 kg K_2O/fed (soil fertilization + 1% K_2O/fed foliar fertilization)

Table 2: Bulb diameter, bulbing ratio at 160 days after planting, weight of bulb and bulb yield (ton/fed) of garlic as affected by combination among cattle manure, phosphorus levels, phosphorien and potassium fertilizer at harvest during 2003/2004 and 2004/2005 seasons.

Characters / Treatments	Bulb diameter (cm)				Bulbing ratio				weight of bulb (g)				Bulb yield (ton/fed)			
	2003/2004		2004/2005		2003/2004		2004/2005		2003/2004		2004/2005		2003/2004		2004/2005	
20 m^3 CM+P_1+Wt.Ph+Ks	4.83	j	6.04	j	0.184	a	0.237	a	73.79	hi	64.66	g	8.173	g	9.532	i
20 m^3 CM+P_1+Wt.Ph+K(s+f)	4.89	ij	6.09	ij	0.184	a	0.227	ab	74.74	ghi	66.44	fg	8.266	fg	9.861	hi
20 m^3 CM+P_1+W.Ph+Ks	4.91	hij	6.09	hij	0.185	ab	0.227	ab	76.71	efghi	67.78	efg	8.603	efg	10.305	ghi
20 m^3 CM+P_1+W.Ph+K(s+f)	4.92	hij	6.10	hij	0.177	ab	0.224	ab	77.00	defghi	69.67	cdefg	9.221	cdefg	11.360	Def
20 m^3 CM+P_2+Wt.Ph+Ks	4.92	hij	6.12	hij	0.175	ab	0.226	ab	73.48	i	68.55	defg	8.791	defg	10.762	Efgh
20 m^3 CM+P_2+Wt.Ph+K(s+f)	4.94	ghij	6.15	ghij	0.174	ab	0.221	ab	78.07	cdefghi	69.67	cdefg	9.257	cdefg	11.469	Bcdef
20 m^3 CM+P_2+W.Ph+Ks	4.68	k	6.18	k	0.180	ab	0.219	ab	79.08	cdefghi	73.55	bcdef	9.412	bcdef	11.448	Cdef
20 m^3 CM+P_2+W.Ph+K(s+f)	5.04	defgh	6.19	defgh	0.165	ab	0.216	ab	78.42	cdefghi	72.77	bcdefg	9.550	bcdefg	11.103	Efg
20 m^3 CM+P_3+Wt.Ph+Ks	5.06	defgh	6.21	defgh	0.162	ab	0.216	ab	76.79	efghi	75.11	abcde	9.726	abcde	10.705	Efgh
20 m^3 CM+P_3+Wt.Ph+K(s+f)	5.06	defgh	6.41	defgh	0.153	ab	0.196	ab	83.34	bcde	80.78	ab	9.895	ab	12.372	Abc
20 m^3 CM+P_3+W.Ph+Ks	5.26	abc	6.18	abc	0.148	ab	0.214	ab	83.82	bcd	77.33	abc	11.297	abc	10.592	Fgh
20 m^3 CM+P_3+W.Ph+K(s+f)	5.17	cde	6.37	cde	0.153	b	0.198	ab	83.74	bcd	76.88	abcd	10.921	abcd	12.305	Abcd
30 m^3 CM+P_1+Wt.Ph+Ks	5.08	defg	6.20	defg	0.159	ab	0.215	ab	80.41	cdefgh	76.77	abcd	10.409	abcd	10.608	Fgh
30 m^3 CM+P_1+Wt.Ph+K(s+f)	5.09	defg	6.22	defg	0.161	ab	0.212	ab	78.77	cdefghi	78.11	abc	10.496	abc	10.896	Efg
30 m^3 CM+P_1+W.Ph+Ks	5.31	ab	6.25	ab	0.157	ab	0.202	ab	76.00	fghi	73.11	bcdef	9.641	bcdef	10.557	fgh
30 m^3 CM+P_1+W.Ph+K(s+f)	5.19	bcd	6.44	bcd	0.148	b	0.192	ab	89.92	ab	82.55	a	11.437	a	12.448	Ab
30 m^3 CM+P_2+Wt.Ph+Ks	4.98	fghi	6.29	fghi	0.163	ab	0.205	ab	80.62	cdefgh	75.77	abcde	10.169	abcde	11.497	Bcdef
30 m^3 CM+P_2+Wt.Ph+K(s+f)	4.95	ghij	6.33	ghij	0.165	ab	0.204	ab	81.59	cdefg	70.11	cdefg	9.756	cdefg	12.201	Abcd
30 m^3 CM+P_2+W.Ph+Ks	5.02	efghi	6.28	efghi	0.166	ab	0.198	ab	82.76	cdef	70.66	cdefg	10.052	cdefg	11.375	Def
30 m^3 CM+P_2+W.Ph+K(s+f)	5.38	a	6.45	a	0.136	b	0.189	b	90.63	a	82.88	a	12.227	a	12.687	A
30 m^3 CM+P_3+Wt.Ph+Ks	5.08	defg	6.32	defg	0.162	ab	0.204	ab	83.40	bcde	80.22	ab	10.283	ab	11.683	Bcde
30 m^3 CM+P_3+Wt.Ph+K(s+f)	5.09	defg	6.31	defg	0.164	ab	0.205	ab	84.00	bc	75.22	abcde	10.247	abcde	11.407	Cdef
30 m^3 CM+P_3+W.Ph+Ks	5.11	def	6.38	def	0.167	ab	0.198	ab	84.86	abc	76.66	abcd	10.809	abcd	12.288	Abcd
30 m^3 CM+P_3+W.Ph+K(s+f)	5.06	defgh	6.31	defgh	0.166	ab	0.201	ab	84.16	bc	76.66	abcd	10.676	abcd	12.117	Abcd

CM Cattle manure P_1 25 kg/fed P_2o_5 P_2 50kg/fed P_2o_5 P_3 75 kg /fed P_2o_5
Wt.Ph Without phosphorien W.Ph With phosphorien Ks 72 kg/fed K_2O (soil fertilization) K(s+f) 60 kg K_2O/fed (soil fertilization + 1% K_2O/fed foliar fertilizationn)

Table 3: Total chlorophyll at 120 days after planting, the percentage of N, P and K in cloves of garlic as affected by combination among cattle manure, phosphorus levels, phosphorien and potassium fertilizer at harvest during 2003/2004 and 2004/2005 seasons.

Characters / Treatments	Total chlorophyll mg/g.f.w.				N%				P%				K%			
	2003/2004		2004/2005		2003/2004		2004/2005		2003/2004		2004/2005		2003/2004		2004/2005	
20 m^3 CM+P_1+Wt.Ph+Ks	0.351	cdef	0.284	a	2.45	k	3.54	ab	0.36	fg	0.33	ab	1.37	bc	2.15	ef
20 m^3 CM+P_1+Wt.Ph+K(s+f)	0.375	bcdef	0.344	a	2.49	jk	4.25	a	0.34	g	0.34	ab	1.65	abc	2.15	ef
20 m^3 CM+P_1+W.Ph+Ks	0.327	def	0.286	a	2.64	j	4.20	a	0.34	g	0.35	ab	1.40	bc	2.17	def
20 m^3 CM+P_1+W.Ph+K(s+f)	0.276	ef	0.265	a	2.97	i	3.92	ab	0.38	efg	0.39	ab	1.47	abc	2.22	cdef
20 m^3 CM+P_2+Wt.Ph+Ks	0.365	cdef	0.310	a	3.24	h	3.59	ab	0.39	defg	0.36	ab	1.62	abc	2.07	f
20 m^3 CM+P_2+Wt.Ph+K(s+f)	0.384	bcde	0.257	a	3.28	gh	3.82	ab	0.43	bcdefg	0.42	ab	1.37	bc	2.15	ef
20 m^3 CM+P_2+W.Ph+Ks	0.267	f	0.267	a	3.58	bcde	3.68	ab	0.41	bcdefg	0.43	ab	1.40	bc	2.40	abcde
20 m^3 CM+P_2+W.Ph+K(s+f)	0.308	def	0.357	a	3.54	cdef	4.25	a	0.39	defg	0.43	ab	1.55	abc	2.12	ef
20 m^3 CM+P_3+Wt.Ph+Ks	0.374	bcdef	0.249	a	3.45	defg	3.73	ab	0.40	cdefg	0.41	ab	1.30	c	2.12	ef
20 m^3 CM+P_3+Wt.Ph+K(s+f)	0.374	bcdef	0.296	a	3.26	gh	4.30	a	0.49	abcd	0.46	ab	1.50	abc	2.40	abcde
20 m^3 CM+P_3+W.Ph+Ks	0.454	abc	0.356	a	3.59	bcde	3.83	ab	0.42	bcdefg	0.44	ab	1.32	c	2.32	bcdef
20 m^3 CM+P_3+W.Ph+K(s+f)	0.326	def	0.297	a	3.57	bcde	3.97	ab	0.46	abcdef	0.42	ab	1.32	c	2.35	abcdef
30 m^3 CM+P_1+Wt.Ph+Ks	0.365	cdef	0.326	a	3.35	fgh	3.68	ab	0.43	bcdefg	0.34	ab	1.45	abc	2.57	ab
30 m^3 CM+P_1+Wt.Ph+K(s+f)	0.338	def	0.245	a	3.29	gh	4.20	a	0.42	bcdefg	0.38	ab	1.40	bc	2.45	abcd
30 m^3 CM+P_1+W.Ph+Ks	0.341	def	0.263	a	3.39	efgh	3.59	ab	0.44	bcdefg	0.35	ab	1.50	abc	2.40	abcde
30 m^3 CM+P_1+W.Ph+K(s+f)	0.479	ab	0.352	a	3.74	abc	3.73	ab	0.51	ab	0.39	ab	1.70	abc	2.22	cdef
30 m^3 CM+P_2+Wt.Ph+Ks	0.384	bcde	0.311	a	3.68	abc	3.92	ab	0.41	bcdefg	0.45	ab	1.50	abc	2.47	abc
30 m^3 CM+P_2+Wt.Ph+K(s+f)	0.381	bcde	0.322	a	3.70	abc	3.83	ab	0.40	cdefg	0.37	ab	1.50	abc	2.40	abcde
30 m^3 CM+P_2+W.Ph+Ks	0.416	abcd	0.249	a	3.72	abc	3.87	ab	0.45	abcdef	0.32	b	1.62	abc	2.35	abcdef
30 m^3 CM+P_2+W.Ph+K(s+f)	0.510	a	0.402	a	3.83	a	4.25	a	0.55	a	0.45	ab	1.82	a	2.40	abcde
30 m^3 CM+P_3+Wt.Ph+Ks	0.404	bcd	0.256	a	3.76	ab	3.44	ab	0.50	abc	0.48	a	1.71	abc	2.32	bcdef
30 m^3 CM+P_3+Wt.Ph+K(s+f)	0.321	def	0.313	a	3.73	abc	4.01	a	0.47	abcde	0.39	ab	1.77	ab	2.27	cdef
30 m^3 CM+P_3+W.Ph+Ks	0.282	ef	0.284	a	3.75	abc	3.78	ab	0.48	abcde	0.42	ab	1.50	abc	2.62	a
30 m^3 CM+P_3+W.Ph+K(s+f)	0.291	ef	0.293	a	3.64	abcd	4.35	a	0.44	bcdefg	0.39	ab	1.43	abc	2.30	bcdef

CM Cattle manure **P_1** 25 kg/fed P_2o_5 **P_2** 50kg/fed P_2o_5 **P_3** 75 kg /fed P_2o_5

Wt.Ph Without phosphorien **W.Ph** With phosphorien **Ks** 72 kg/fed K_2O (soil fertilization) **K(s+f)** 60 kg K_2O/fed (soil fertilization + 1% K_2O/fed foliar fertilization)