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RESPONSE OF GARLIC (*ALLIUM SATIVUM* L.CV.EGASEED1) TO ORGANIC FERTILIZATION AND PHOSPHORUS LEVELS

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ABSTRACT

Two field trials were conducted during the two winter seasons of 2013/2014 and 2014/2015 on garlic cv."Egaseed1" at the Experimental Farm of Mallawi Agriculture Research Station; Agriculture Research Center, Giza, Egypt. To investigate the effect of different sources of organic fertilizers [Poultry manur (PM), Humic acid (HA), Sulfur (S), PM+S, PM+HA, PM+S+HA and HA+S] at the rate of 6.00 tone fed^{-1}, 5.0 kg fed^{-1} and 100kg fed^{-1} respectively. Moreover four levels from Phosphorus as super phosphate calcium (P0, P40, P60 and P80 kg fed^{-1}) as p_2o_5 inorganic fertilizers and their combinations on growth, and yield of garlic crops .The studied results revealed that:

Increasing the levels of Phosphorus (P) up to 80 kg P_2O_5.fed^{-1} showed the most significant increase in plant growth parameters, fresh and cured yield as ton.fed-1,bulb diameter, and bulb head weight, as well as it causes a significant reduction in weight loss% during curing process.

Regarding to the organic fertilizer treatments, most of the obtained characters had a significant positive The mixed treatment (PM+S+HA) in the two growing seasons gave the best treatment for improving plant height, No. green leaves / plant, fresh and cured yield (ton.fed-1), bulbing ratio and bulb diameter. The best treatment for decreasing weight loss%

during curing process was recorded with S treatment at rate (100Kg. fed) in the two growing season which gave (23.36%, and 24.36%) as compared to the control treatment (26.79%), (24.80%) in the first and second seasons respectively.

The interaction between P levels and organic fertilizer treatments indicated, significant effect. In some studied characters, the effect of these treatments was differed for its effect in the first and second season. The best combined treatment for gaining the heaviest tonnage of fresh and cured yield, as well as bulb diameter was recorded with the combined treatment (P60kg.fed-1 + (PM+S+HA) in the two growing winter seasons. The lowest values were recorded with the organic fertilizer treatments when combined with P0 and also with the lowest level of P application rate (P40kg.fed).

Key words*: Garlic ,Phosphorus (P), Poultry manur (PM), Humic acid (HA) Sulfur (S)*

INTRODUCTION

Garlic (*Allium sativum* L.) is an annual bulb crop, aromatic bulb and herbaceous annual spice crop (Kurian, 1995). In terms of production garlic is ranked second after onion (Valadez, 1992) and has higher nutrition and medical value than onion (Bachamann, 2001)and one of the main vegetable crops in Egypt. It is widely used for its culinary and medicinal attributes.

Uptake of sufficient nutrient, N, P, and S by the garlic crop is important to improve growth, yield and marketable proportions.(Nai- hua *et al.,* 1998). Excessive usage of chemical fertilizers in agriculture has caused environmental problems such as physical destruction of the soil and nutritional substances imbalance in the soil (Sebahattin *et al.,* 2005). Also, the use of inorganic fertilizers alone cannot guarantee optimum yield that can meet demand, hence the need for organic fertilizers (Alasiri, 2002). According to Islam *et al.* (2007),manures supply all the essential nutrient elements as well as improve physical, chemical and biological properties of soils and may help in boosting production of garlic leaving a healthy environment at the end.

Nutrient plays a significant role in improving productivity and quality of crops (AL- Fraihat, 2009).Phosphorus deficiency causes important nutritional problems specially in new reclaimed soils (Abd El-Salam *et al*. 2005). The necessity of phosphorus as a plant nutrient is emphasized by the fact that it is an essential constituent of many organic compounds that are very important for metabolic processes, blooming and root development (Purekar*et al.,* 1992).

High amounts of inorganic fertilizers are applied to vegetables in order to achieve a higher yield (Stewart *et al*., 2005) and maximum value of growth (Arisha and Bardisi, 1999). Inorganic

fertilizer is considered a major source of plant nutrients (Naeem*et al*., 2006). Organic manure can serve as alternative practice to mineral fertilizers (Naeem *et al*., 2006) for improving soil structure (Dauda *et al*., 2008) and microbial biomass (Suresh *et al*., 2004). It plays a direct role in plant growth as a source of all necessary macro and micronutrients in available forms during mineralization and improves physical and chemical properties of soils (Chaterjee *et al*., 2005). Anant-Bahadur *et al*., (2006) pointed that organic matter plays an important role in the chemical behavior of several metals in soils throughout its active groups (Flavonic and humic acids) which have the ability to retain the metals in complex and chelate forms.

Also, Poultry manure is an excellent source of nutrients. The value of poultry manure varies not only with its nutrient composition and availability, but also with management and handling costs (Zublena *et al*., 1997).

Abou El- Magd*et al*.,(2012) showed that the reasons for the low yield of garlic are mainly due to depletion of macro and micro-nutrients from the soil and using organic manure is important for obtaining safe and healthy production than using inorganic fertilizers.

Therefore, the present study was undertaken to assess the response of garlic plants to low levels of phosphorus (inorganic fertilizers) separatly or in combined with three organic fertilizers (humic acid, sulphur and poultry manure) to improve garlic production.

MATERIALS AND METHODS

The present study was carried out during the two successive winter seasons of 2013/2014 and 2014/2015 at the Experimental Farm of Mallawi Agriculture Research Station; Agriculture Research Center, Giza, Egypt. The aim of this study was to investigate the effect of three sources of organic fertilizers [Poultry manure (PM), Humic acid (HA) and Sulfur (S)] at the rate of 6.00 tone fed^{-1}, 5.0 kg fed^{-1} and 100kg fed^{-1} respectively and four levels of Phosphorus (P0, P40, P60 and P80 kg fed^{-1}) as inorganic fertilizers. Also, the combinations between organic and inorganic fertilizers on growth and yield of garlic crop.

Soil samples (0 -30 cm in depth) were randomly collected from plots, for determining the initial nutrient status of the soil. The physical and chemical soil properties of the experimental field were presented in Table 1.

Source and composition of organic amendments:

a) **Poultry manure:** was collected from private fattening poultry farm at Mallawy district, El-Minia Governorate, Egypt. The manure was dried and sieved to remove feathers and foreign substances. The chemical properties of the poultry manure were determined at the laboratory of the Soil, Water, Environment,

Res. Ins., Giza, Egypt and listed in Table 2.

Table (1): Some physical and chemical properties of the soil at depth of 0-30 cm during 2014 and 2015 winter seasons.

Seasons	properties						Available nutrient (ppm)			
	Sand %	Silt %	Clay %	pH	E.C	CaCo3 %	O. M	N %	P.ppm	K. mm
First season	1.60	1.93	1.52	7.80	54.71	1.93	1.60	0.18	19	340
Second season	1.72	1.81	1.59	7.75	49.32	1.81	1.72	0.18	22	390

E.C = Electric conductivity (ds/m, 1:5 soil water extract). O.M= Organic matter

Table 2: Chemical analysis of poultry manure.

Element	N %	P%	K%	Fe%	OM	Mn, mg /kg^{-1}	Zn, mg /kg^{-1}	Cu, mg /kg^{-1}
Conc.	4.63	0.21	0.68	0.11	40	388.3	319.5	112

O.M= Organic matter

b) - Humic acid and c). Sulfur was purchased from local pesticide company.

Experimental design:

The experiment was arranged in split plot layout as Randomized Complete Blocks Design (RCBD) with three replicates. The four levels of phosphors (P) were arranged at random in main plots. While the organic fertilizers were distributed in the sub plots to obtain 32 treatment. The treatments used in this experiment were arranged in Table (3).

Table 3: Organic and inorganic fertilizer treatments used in this study.

Treatments			
P_0	P_{40}	P_{60}	P_{80}
Control	40 kg P. fed^{-1}	60 kg P. fed^{-1}	80 kg P. fed^{-1}
PM	PM	PM	PM
HA	HA	HA	HA
S	S	S	S
PM + HA	PM + HA	PM + HA	PM + HA
PM + S	PM + S	PM + S	PM + S
HA + S	HA + S	HA + S	HA + S
PM + HA + S	PM + HA + S	PM + HA + S	PM + HA + S

Organic fertilizers (Poultry manure (PM), Humic acid (HA), Sulfur (S).
Inorganic fertilizers (Phosphorus (P), (0.0, 40, 60, 80 kg fed^{-1})

Land preparation and pre-planting soil treatments amendments:

Land preparation was done with a medium sized farm tractor, and the field was marked out into 96.0 plots of 3.0×3.5m. The total area of each plot was 10.5 m^2 (1/400 fed.) having rows (North–south direction) spaced at 60.0 cm apart. Before 15 days of planting, action longitudinal incision was done at the top of the row and treatments of organic soil amendments were added, mixed with the soil then backfill and back to the usual form of the furrow and then irrigated immediately.

Climate: Weather information such as air temperature, relative humidity that prevailed at the experimental site during growth seasons was given in Table (4).

Table (4): Monthly maximum and minimum temperature in centigrade at Mallawi Agriculture Research Station, El-Minia Governorate during the experimental seasons, calculated from the daily weather report of the Metrological Authority of the ARE.

Seasons	Temperature	Month						
		Oct.	Nov.	Dec.	Jan.	Feb.	March	April
2013/2014	Max..	29.3	27.3	21.1	21.8	23.6	26.4	31.5
	Min..	14.5	11.9	6.1	4.6	6.3	9.4	12.8
2014/2015	Max..	30.5	25.9	22.6	19.9	21.7	26.5	28.9
	Min..	15.3	10.9	6.9	3.3	5.3	10.2	11.1

Planting of garlic cloves

Mature garlic bulbs of chosen garlic variety (Egaseed 1) were used (Fig, 1). The bulbs of largest size were chosen, free from all defects and the cloves were sorted to select the harmony biggest cloves .Plots were pre-irrigated a day to planting. Cloves were sown on 10th of October in both season at the west side of the furrow; on one side of the raw. plant to plant distance was 10.0 cm apart . The other agricultural practices were followed according to the recommend action of the Ministry of Agriculture, Egypt.

Data collection:

Vegetative growth characters:

Four weeks before harvest, ten plants were randomly taken from each experimental plot to determine: - Plant height (cm), - Number of green leaves /plant

- Yield characters:

Garlic was harvested (180 days from planting) on 10th and 15th of April 2014 and 2015, respectively. Fresh yield (kg/plot) at harvesting dates was recorded. All data were calculated as ton/fed.

- Fresh yield characters:
- Fresh yield (ton/fed.)
- Bulbing ratio: was estimated according to Mann (1952) formula.
- Cured yield characters:

The harvested garlic plants were left to be cured for 21 days as curing process and the following data were recorded:

Cured samples were weighted to determine the percentage of weight loss % during curing period (3 weeks from the harvest). The following data were recorded;

- Bulb head weight (g/plant)
- Bulb diameter (cm)
- Cured yield (ton/fed.).

Statistical analysis: Data were compared using analysis of variance (ANOVA) procedures according to Gomez and Gomez (1984) and mean differences were performed using Duncan multiple range test (1955).

Fig, 1: Garlic cv. "Egaseed1" (hard neck type and skin color)

RESULTS AND DISCUSSION

Vegetative growth characters:

1- Plant height (cm): significantly

Plant height, (cm) of garlic plants was affected by phosphorus levels during the two growing seasons (Table 5). The obtained data revealed that P80 kg.fed^{-1}gave the tallest plants in the two seasons (75.8 cm and 59.8 cm) compared to the treatment of Po (71.3 cm and 55.9 cm). These results are in close to the findings of Mesut *et al*., (2010). Regarding to organic fertilizers effect on plant height, data clearly showed that high significant differences among treatments in both season were registered. The treatments of (PM+ S+ HA) in both seasons (75.9 cm and 620 cm), (PM+S) and PM only at the second season (62.7 cm and 6o.1 cm) recorded the tallest plants with insignificant differences between them. The increase in plant height due to application of organic fertilizers may be due to the more availability of nutrients, which exerted beneficial effect on vegetative growth of plant. These results are in harmony with the finding of Mandal *et al.* (1992).

The interaction of A x B showed highly significant effect on plant height, (cm) in both seasons (Table 6). The highest significant

increase was obtained with P80 kg.fed^{-1} (79.3 cm) in the first season and P80 kg.fed^{-1} + (PM+S) (66.1 cm) in the second season compared to the control treatment (Po) which produced (70.6 cm and 50.9 cm) in the first and second season respectively. Using organic fertilizers without mixing with phosphorus (P0) gave the lowest values for plant height, (cm) in both seasons. These trends could be ascribed to the improvement of soil structure which was reflected on water movement by applying organic fertilizers (Batal, 1991 and El-Emam, 1999).

2- No. green leaves / plant:

The effect of P levels on No. green leaves / plant was shown in Table (5). The obtained data show insignificant differences among treatments in the two winter seasons.

Concerning to the effect of organic fertilizers on No. green leaves / plant, the data showed that the highest significant increase in No. green leaves / plant was recorded with the PM, PM+S and PM+S+HA treatments in the first season compared to the untreated treatment (control) with insignificant differences among them. All treatments in the second season had insignificant effect except for the (HA+S) treatment gave the lowest value 42.3.

Table (5): Plant height, cm and No. green leaves /plant of garlic plants cv. "Egaseed1" as affected by phosphorus levels and some sources of organic fertilizers during 2013 – 2014 and 2014 - 2015 seasons.

Phosphorus levels (P) kg\fed^{-1} (A)	Plant height, cm		No. green leaves /plant	
	Seasons		Seasons	
	2013 - 2014	2014 - 2015	2013 - 2014	2014 - 2015
P0	71.3 d	55.9 b	13.5 a	12.8 a
P40	73.4 c	58.0 a	13.3 a	12.8 a
P60	74.9 b	59.4 a	13.3 a	12.7 a
P80	75.8 a	59.8 a	13.4 a	12.6 a
Organic Fertilizers (B)				
PM	72.6 c	60.1 ab	13.8 a	12.9 a
S	74.6 b	58.8 bc	13.4 b	12.8 ab
HA	73.8 b	56.6 cd	13.3 b	12.6 ab
PM+S	73.9 b	62.7 a	13.5 ab	12.6 ab
PM+HA	72.3 c	58.2 bc	13.1 b	12.7 ab
PM+S+HA	75.7 a	62.0 a	13.5 ab	13.1 a
HA+S	72.2 c	53.5 e	13.2 b	12.3 b
Control	75.6 a	54.5 d	13.3 b	12.9 a

Phosphorus (P), Poultry manure (PM), Sulphur (S), Humic acid (HA)
Means with similar alphabetical letter in the same column aren't significantly different, using Duncan's Multibe Range test at 0.05 level.

Table (6): Interaction effects of phosphorus levels and some sources of organic fertilizer treatments on plant height (cm) and No. green leaves / plant of garlic cv. "Egaseed1" during 2013 – 2014 and 2014 - 2015 seasons.

Treatments		Plant height (cm)				No. green leaves /plant			
Phosphorus levels (P) kg\fed^{-1} (A)	Organic fertilizers (B)	Season				Season			
		2013- 2014		2014 - 2015		2013 - 2014		2014 - 2015	
P0	PM	71.9	jk	57.5	c-h	13.5	cde	13.1	ab
	S	76.1	cd	58.4	b-h	13.1	c-f	12.9	abc
	HA	72.5	g-k	55.1	e-i	13	def	12.8	abc
	PM+S	69.8	lmn	59.0	b-h	13.6	b-e	12.2	bc
	PM+HA	68.5	n	56.3	d-i	13.5	b-e	12.4	abc
	PM+S+HA	72.1	h-k	59.1	b-h	14.3	ab	12.9	abc
	HA+S	69.1	mn	51.0	i	13.9	a-d	12.7	abc
	Control	70.6	klm	50.9	i	13.3	c-f	13.5	a
P40	PM	71.5	jkl	59.7	b-h	13.3	c-f	12.7	abc
	S	72.8	f-k	61.9	a-d	13.9	abc	12.9	ab
	HA	72.0	ijk	55.5	d-i	13.3	c-f	12.5	abc
	PM+S	74.2	d-i	61.5	a-e	13.1	c-f	13.2	ab
	PM+HA	72.6	f-k	57.4	c-h	13.1	c-f	12.8	abc
	PM+S+HA	76.9	bc	60.6	a-f	12.9	ef	13.1	ab
	HA+S	72.1	h-k	53.4	hi	13.2	c-f	12.5	abc
	Control	75.5	cde	54.3	f-i	13.4	c-f	12.4	abc
P60	PM	73.6	e-j	62.8	abc	13.7	b-e	13	ab
	S	74.3	d-h	56.6	c-i	13.3	c-f	12.9	ab
	HA	74.7	def	59.2	b-h	13.1	c-f	12.7	abc
	PM+S	77.1	bc	64.1	ab	13.5	cde	12.1	bc
	PM+HA	73.5	e-j	60.1	a-g	13.3	c-f	13	ab
	PM+S+HA	76.2	cd	64.1	ab	13.3	c-f	13.2	ab
	HA+S	71.7	jkl	54.0	ghi	13	def	11.7	c
	Control	78.4	ab	54.3	f-i	13.3	c-f	13.2	ab
P80	PM	73.5	e-j	60.5	a-g	14.6	a	12.9	abc
	S	75.3	cde	58.1	b-h	13.1	c-f	12.4	abc
	HA	75.9	cd	56.6	c-i	13.8	bcd	12.5	abc
	PM+S	74.5	d-g	66.1	a	13.7	b-e	12.7	abc
	PM+HA	74.5	d-g	58.8	b-h	12.5	f	12.5	abc
	PM+S+HA	77.4	abc	64.1	ab	13.5	cde	13.2	ab
	HA+S	75.9	cd	55.7	d-i	12.9	ef	12.2	bc
	Control	79.3	a	58.4	b-h	13.2	c-f	12.3	abc

Phosphorus (P), Poultry manure (PM), Sulphur (S), Humic acid (HA)

Means with similar alphabetical letter in the same column aren't significantly different, using Duncan's Multibe Range test at 0.05 level At harvest time (After 180 days):

Regarding to the interaction effect between phosphorus levels and organic fertilizer treatments for No. green leaves / plant, data in Table (6) showed significant effect only in the first season. The best value was recorded with P80 kg.fed^{-1}+PM (14.6) in the first season. This increase may be attributed to increased quantity of nutrients from this level of poultry manure as shown by Adewale *et al*., (2011).

1] Bulbing ratio:

Data illustrated in Table (7) show that P levels had significant effect on bulbing ratio at harvest time only at the first season. The values were achieved with the treatments of P60 and P80 kg.fed^{-1} in the first season without significant differences between the values. This indicate that application of P levels had accelerate the maturity of bulbe.

Bulbing ratio was significantly affected by Organic fertilizer treatment in the two growing seasons Table (7). The best treatments was recorded with (PM+S+HA) (0.16 and 0.15) in the first and second season compared to the control treatment (0.18) in both seasons.

Concerning to the interaction between P levels and organic fertilizer treatments data in Table (8) showed significant effect only in the first season. The best results was recorded with the treatment of P40 kg.fed^{-1} + (PM+S+HA), P60 kg.fed^{-1}+ (PM+S), P80 kg.fed^{-1} + (HA+S) and P80 kg.fed^{-1}+ (PM+HA) in the first season with insignificant differences among them. Also, the obtained data showed that the combinations of the low level of phosphorus (P40 kg.fed^{-1}) and without phosphorus (P0) with organic fertilizers gave the lowest values in the first and second season. These results are in agreement with those reported by (Fredeen, *et al*., 1989 and Rao *and terry*., 1989) whose showed that the growth of several plant species tested was greatly reduced by P deficiency.

2] Fresh total yield (ton.fed^{-1}):

Data presented in Table (7) showed that fresh total yield (ton.fed^{-1}) was significantly affected by the level of phosphorus application in the two winter seasons. Phosphorus amendments at 80 kg.fed^{-1} showed the highest significant increase in both seasons (6.37 and 5.22 ton.fed^{-1}) followed by P60 kg\p2o5 with insignificant differences between their values of fresh total yield in both season. compared to the control treatment (5.36 and 4.56 ton.fed^{-1}) in the first and second season respectively. Minard, (1978)

attributed this effect to the influence of phosphorus on root development, which led to effective nutrient uptake and water absorption.

Also, organic fertilizer treatments gave a significant increase in fresh yield (ton.fed^{-1}) in the first and second season. The highest values (6.28 and 5.58 ton.fed^{-1}) were recorded with the treatment (PM+S+HA) in the first and second season respectively. Also, in the second season, the treatments of PM, S and (PM+S) gave the highest values (5.39, 5.18 and 5.15 ton.fed^{-1}) with insignificant differences among them as compared with PM+S+HA. Carol *et al*., (1999) indicated that the reasons of high yield of plants that were received organic fertilizers can be explained by the greater capacity of treated soils with organic manures to retain the nutrients in forms that can easily be taken up by plants over a long period of time. Conversely, the lower performance of mineral fertilizers could be attributed to the fact that nutrients released from mineral fertilizers are for short period of time because of leaching problems.

The effect of combined interaction between phosphorus levels and organic fertilizer treatments was significant in the two growing seasonsTable(8). The interactions between P60kg.fed^{-1}+ (PM+S+HA) and between P80kg.fed^{-1}+ S were more effective for increasing fresh yield (ton.fed^{-1}) (6.85, and 5.97 ton.fed^{-1}) in the first and (6.86 and 6.23 ton.fed^{-1}) second season respectively. These increments in fresh yield may be attributed to more availability of nutrients by mixing of P with the treatment PM+S+HA. Also, Srivastava *et al*., (1998) reported that phosphorus has an enhancing impact on plant growth and biological yield through its importance as energy storage and transferee necessary for metabolic process.

Also, in the same Table, data show that the highest decrease in fresh yield (ton.fed^{-1}) was recorded with the control treatment (P0) and with the combination of the low level of phosphorus (P40 kg.fed^{-1}) + organic fertilizer treatments in the first and second season.

Cured yield characters :

Weight loss% after curing:

Data reported in Table (9) showed that the percentage of weight loss % after curing was highly significant affected by application of phosphorus levels in both seasons. The lowest values for weight loss % was recorded with P80 kg.fed^{-1}in the first season (22.59%) and (24.83%) in the second season.

The effect of organic fertilizer treatments on weight loss % after curing was highly significant, in both seasons. The obtained data

revealed that S and HA was the best treatments for decreasing weight loss % in the two seasons (23.36% and 24.36 for S treatment and 22.88 and 25.14 for HA treatment) in the first and second season respectively. The highest weight loss% was recorded with the treatment (HA+S) in the two seasons and also with control treatment in the first season.

Table (7): Bulbing ratio and Fresh total yield (ton\fed.) at harvest time (180 days from planting) of garlic plants cv. "Egaseed1" as affected by phosphorus levels and some organic fertilizer treatments during 2013 – 2014 and 2014 - 2015 seasons.

Phosphorus levels (P) kg\fed^{-1} (A)	Bulbing ratio		Fresh total yield (ton\fed.)	
	Season		Season	
	2013 - 2014	2014 -2015	2013 - 2014	2014 -2015
P0	0.17 a	0.18 a	5.36 c	4.56 b
P40	0.17 a	0.17 a	5.89 b	4.89 ab
P60	0.16 b	0.16 a	6.32 a	5.21 a
P80	0.16 b	0.16 a	6.37 a	5.22 a
Organic Fertilizers (B)				
PM	0.16 bc	0.15 bc	5.78 ef	5.39 a
S	0.16 bc	0.17 abc	5.84 de	5.18 a
HA	0.17 b	0.17 abc	5.66 f	4.56 b
PM+S	0.16 c	0.16 abc	6.07 bc	5.15 a
PM+HA	0.17 bc	0.17 abc	5.95 cd	4.73 b
PM+S+HA	0.16 bc	0.15 c	6.28 a	5.58 a
HA+S	0.17 b	0.18 ab	6.12 b	4.47 b
Control	0.18 a	0.18 a	6.18 ab	4.69 b

Phosphorus (P), Poultry manure (PM), Sulphur (S), Humic acid (HA)
Means with similar alphabetical letters in the same column aren't significantly different, using Duncan's Multibe Range test at 0.05 level.

The interaction between phosphorus levels and organic fertilizer treatments was highly significant on weight loss%, in both seasons (Table10). The best values concerning the decrease in weight loss% were obtained with P80 + control treatment (20.73 and 18.85%) and P0+S (19.54 and 20.10%) in the first and second season respectively. While, P0+PM had the highest combined treatment for increasing weight loss % in the two seasons (31.61 and 32.30%). Physiological weight loss was the most important factor contributing towards weight loss during curing (Ammar, 2007).

Table (8): Interaction effect of phosphorus levels and some organic fertilizer treatments on bulbing ratio and fresh total yield (ton.fed^{-1}) at harvest time of garlic cv. "Egaseed1" during 2013 – 2014 and 2014 - 2015 seasons.

Treatments		Bulbing ratio		Fresh total yield (ton.fed^{-1})	
Phosphorus levels (P) kg\fed^{-1} (A)	Organic Fertilizers (B)	2013 – 2014 season	2014 – 2015 season	2013 – 2014 season	2014 – 2015 season
P0	PM	0.17 c-f	0.17 ab	5.41 i-l	5.28 b-e
	S	0.16 c-h	0.17 ab	5.22 kl	4.50 efg
	HA	0.16 c-h	0.19 ab	5.26 jkl	4.47 efg
	PM+S	0.16 c-h	0.17 ab	5.51 h-k	4.92 c-g
	PM+HA	0.18 bcd	0.19 ab	5.50 h-k	4.35 efg
	PM+S+HA	0.18 bc	0.15 ab	5.58 g-i	4.55 d-g
	HA+S	0.18d b	0.20 ab	5.27 gkl	4.12 g
	Control	0.19 ab	0.21 a	5.14 i	4.29 fg
P40	PM	0.16 c-h	0.15 ab	5.62 g-i	5.22 b-f
	S	0.17 b-e	0.16 ab	5.40 i-l	4.53 d-g
	HA	0.16 c-h	0.18 ab	5.64 ghi	4.50 efg
	PM+S	0.17 c-g	0.16 ab	6.03 def	5.13 b-f
	PM+HA	0.17 c-g	0.17 ab	5.91 efg	4.86 c-g
	PM+S+HA	0.15 fgh	0.15 ab	6.23 cde	5.78 abc
	HA+S	0.18 bc	0.18 ab	6.04 def	4.43 efg
	Control	0.20 a	0.18 ab	6.23 cde	4.68 d-g
P60	PM	0.16 c-h	0.15 ab	6.17 c-f	5.81 abc
	S	0.16 d-h	0.16 ab	5.88 efg	5.48 a-d
	HA	0.17 c-g	0.17 ab	5.91 efg	4.74 d-g
	PM+S	0.15 fgh	0.17 ab	6.36 bcd	5.28 b-e
	PM+HA	0.16 d-h	0.15 ab	6.03 def	4.73 d-g
	PM+S+HA	0.17 c-h	0.15 ab	6.85 a	5.97ab
	HA+S	0.17 c-h	0.18 ab	6.67 ab	4.80 d-g
	Control	0.16 e-h	0.18 ab	6.69 ab	4.86 c-g
P80	PM	0.16 e-h	0.14 ab	5.93 efg	5.26 b-f
	S	0.16 c-h	0.18 ab	6.86 a	6.23 a
	HA	0.18 bcd	0.14 b	5.84 fgh	4.54 d-g
	PM+S	0.15 gh	0.16 ab	6.40 bc	5.30 b-e
	PM+HA	0.15 fgh	0.18 ab	6.35 bcd	4.97 c-g
	PM+S+HA	0.16 e-h	0.15 ab	6.46 bc	6.02 ab
	HA+S	0.15 h	0.17 ab	6.49 bc	4.53 d-g
	Control	0.18 bcd	0.17 ab	6.65ab	4.91 c-g

Phosphorus (P), Poultry manure (PM), Sulphur (S), Humic acid (HA)
Means with similar alphabetical letter in the same column aren't significantly different, using Duncan's Multibe Range test at 0.05 levels.

Cured yield (ton\fed.):

Presented data in Table (9) showed that cured yield (ton.fed^{-1}) was significantly affected by the rate of phosphorus application used in this trial. Phosphorus amendments at 80 kg.fed^{-1} had the highest significant increase in cured yield in the both seasons (4.93 and 3.86 ton.fed^{-1}) compared to the control treatment (P0) (3.90 and 3.33 ton.fed^{-1}) in the first and second seasons respectively.

Concerning organic fertilizer treatments, data showed that pre-panting soil amendments of organic fertilizer treatments gave a significant increase in cured yield (ton.fed-1) in both growing seasons. The highest significant increase in cured yield as ton.fed-1 was recorded with the treatment (PM+S+HA) (4.70 and 4.18 ton.fed-1) in the first and second seasons respectively.

Regarding to the interaction effect of phosphorus levels and organic fertilizer treatments on cured yield (ton.fed^{-1}), results in Table (10) showed significant effect in both growing seasons. The interaction between phosphorus levels at 60kg.fed^{-1}+ (PM+S+HA) and at 80kg.fed^{-1} + S were more effective for increasing cured yield (ton.fed^{-1}) (5.27, 4.48, 5.22 and 4.19 ton.fed^{-1}) in the first and second season respectively. These results are in harmony with those reported by Carol *et al*., (1999) and Srivastava *et al*., (1998).

The highest decrease in cured yield (ton.fed^{-1}) was recorded with the organic fertilizer treatments without amendments of phosphorus (P0) in both seasons. These results can be attributed to the same reason mentioned by Fredeen, *et al*., (1989) and Rao *and terry*., (1989).

Results illustrated in Table (11) indicated that bulb head weight (g)/plant was significantly affected by phosphorus levels in both seasons. P80 kg.fed^{-1}was more effective for increasing bulb head weight (g)/plant in both seasons (71.42 and 55.32,g) than the control treatment which gave the lowest values (62.55 and 44.93,g) in both seasons. These results agree with those reported by Srivastava *et al*., (1998)

Concerning the effect of organic fertilizer treatments, it was clear from the obtained data in Table (11) that there was significant effect on bulb head weight (g)/plant in both seasons. The treatment of PM+HA was more effective only in the first season (72.11(g)/plant) but in the second season, the treatments of PM+S and PM+S+H gave the best values (59.05 and 59.14(g)/plant) without significant differences between them compared to the control treatment (68.27 and 45.14(g)/plant) in the first and

second season respectively. The increase in bulb head weight by mixing PM with HA or with S or with HA+S may be attributed to the finding by Yahaya, (2008) who showed that the ability of poultry manure to increase the performance of garlic could also be attributed to the fact that organic manures improves both physical and chemical soil properties).

Table (9): Weight loss %, and cured yield (ton.fed-1) of garlic cv. "Egaseed1" as affected by phosphorus levels and some organic fertilizer treatments during 2013 – 2014 and 2014 - 2015 seasons.

Phosphorus levels (P) kg\fed^{-1}(A)	Weight loss % after curing		Cured yield (ton.fed^{-1})	
	Season		Season	
	2013- 2014	2014 - 2015	2013- 2014	2014 - 2015
P0	27.24 a	26.75 a	3.90 d	3.33 c
P40	24.98 b	27.01 a	4.42 c	3.57 b
P60	23.91 b	26.26 b	4.81 b	3.84 a
P80	22.59 c	24.83 c	4.93 a	3.86 a
Organic Fertilizers (B)				
PM	25.36 ab	27.03 bc	4.32 d	3.88 ab
S	23.36 c	24.36 e	4.48 bc	3.79 b
HA	22.88 c	25.19 de	4.37 cd	3.41 cd
PM+S	24.20 bc	26.25 cd	4.61 ab	3.80 b
PM+HA	23.81 c	27.79 b	4.54 b	3.41 cd
PM+S+HA	25.36 ab	25.09 de	4.70 a	4.18 a
HA+S	25.69 a	29.17 a	4.56 ab	3.17 d
Control	26.79 a	24.80 e	3.90 d	3.33 c

Phosphorus (P), Poultry manure (PM), Sulphur (S), Humic acid (HA)
Means with similar alphabetical letters in the same column aren't significantly different, using Duncan's Multibe Range test at 0.05 level.

Interaction of phosphorus levels and organic fertilizer treatment on bulb head weight showed a significant effect in both growing seasons Table (12). The best values was achieved with the treatment of P60 kg.fed^{-1}+(PM+S) (78.20 (g)/plant) in the first season and P80 kg.fed^{-1}+(PM+S) (69.45 (g)/plant) in the second seasons. These results are in agreement with those reported by, Singh and Pandy, (1974), Abou El-Magd *et al.,* (2006) and Akande, *et al*. (2010). The lowest values were obtained with the treatments of P0 and when combined the organic fertilizer treatments with the low level of phosphorus (P40kg.fed.$^{-1}$).These results may be attributed to the same reason mentioned by Alasiri, (2002) who reported that

the use of inorganic fertilizers alone cannot guarantee optimum yield that can meet demand, hence the need for organic fertilizers.

Table (10): Interaction effect of phosphorus levels and some organic fertilizer treatments on weight loss %, and cured yield (ton.fed^{-1}) of garlic cv. "Egaseed1" during 2013 – 2014 and 2014 - 2015 seasons.

Treatments		Weight loss %		Cured yield (ton.fed^{1})	
Phosphorus levels (P) kg\fed^{-1} (A)	Organic Fertilizers (B)	Season		Season	
		2013-2014	2014 – 2015	2013-2014	2014 - 2015
P0	PM	31.61 a	32.3 0 a	3.69 op	3.35 f-i
	S	19.54 o	20.10 jk	4.20 klm	3.59 c-h
	HA	25.30 e-k	23.67 ghi	3.93 mno	3.41 e-i
	PM+S	26.33 d-h	27.20 c-f	4.05 k-n	3.57 c-h
	PM+HA	27.07 c-f	27.40 b-f	4.01 l-o	3.16 hi
	PM+S+HA	28.98 a-d	24.66 f-i	3.96 mno	3.42 e-i
	HA+S	29.34 a-d	32.23 a	3.73 op	2.78 i
	Control	29.77 abc	26.41 c-g	3.61 p	3.30 f-i
P40	PM	23.36 g-n	26.12 c-g	4.30 jkl	3.84 b-h
	S	28.30 b-e	27.94 bcd	3.88 nop	3.26 ghi
	HA	23.00 i-n	25.75 c-h	4.34 ijk	3.34 f-i
	PM+S	24.00 f-n	27.13 c-f	4.58 e-i	3.73 c-h
	PM+HA	22.63 j-o	31.96 a	4.57 f-j	3.31 f-i
	PM+S+HA	23.67 g-n	20.75 jk	4.76 c-g	4.58 a
	HA+S	24.70 f-l	28.14 bcd	4.54 g-j	3.19 hi
	Control	30.20 ab	28.28 bcd	4.35 h-k	3.358 f-i
P60	PM	25.38 e-k	26.42 c-g	4.60 e-j	4.28 abc
	S	21.76 l-o	24.69 f-i	4.60 e-j	4.129 a-e
	HA	21.41 l-o	23.68 ghi	4.64 e-j	3.617 c-h
	PM+S	24.23 f-m	28.49 bc	4.82 c-g	3.773 b-h
	PM+HA	22.68 j-o	26.30 c-g	4.66 d-i	3.484 d-i
	PM+S+HA	23.11 h-n	24.91 e-h	5.27 a	4.482 ab
	HA+S	26.26 d-i	29.92 ab	4.92 b-e	3.366 f-i
	Control	26.47 d-g	25.66 d-h	4.92 b-e	3.618 c-h
P80	PM	21.08 mno	23.29 hi	4.68 d-h	4.03 a-f
	S	23.86 f-n	24.71 f-i	5.22ab	4.19 a-d
	HA	21.82 l-o	27.65 b-e	4.56 f-j	3.28 ghi
	PM+S	22.23 k-o	22.18 ij	4.98 a-d	4.11 a-e
	PM+HA	22.85 j-n	25.49 d-h	4.89 c-f	3.70 c-h
	PM+S+HA	25.68 e-j	30.02 ab	4.80 c-g	4.21 abc
	HA+S	22.46 j-o	26.41 c-g	5.03 abc	3.33 f-i
	Control	20.73 no	18.85 k	5.27 a	3.98 a-g

Phosphorus (P), Poultry manure (PM), Sulphur (S), Humic acid (HA)
Means with similar alphabetical letters in the same column aren't significantly different, using Duncan's Multibe Range test at 0.05 level.
Bulb head weight (g) after curing:

Bulb diameter (mm):

Data presented in Table (11) showed that bulb diameter was significantly affected by phosphorus levels application. The highest significant increase in bulb diameter was registered at P80 kg.fed^{-1} (57.66 and 57.07mm in the first and second season respectively and also, with P60 kg.fed^{-1}(57.64mm) only in the second season.

Concerning organic fertilizer treatments, the results showed a significant effect on bulb diameter in the two seasons. Data clearly revealed that the pre-planting treatment by (PM+S+HA) was effective for enhancing garlic bulb diameter in the two seasons (57.41 and 59.04mm) compared to control treatment.

Table (11): Bulb head weigh (g), and bulb diameter (mm) of garlic cv. "Egaseed1" as affected by phosphorus levels and some organic fertilizer treatments during 2013 – 2014 and 2014 - 2015 seasons.

Phosphorus levels (P) kg\fed^{-1}(A)	Bulb head weight (g)		Bulb diameter (mm)	
	Season		Season	
	2013- 2014	2014 - 2015	2013- 2014	2014 - 2015
P0	62.55 c	44.93 d	53.78 d	51.14 c
P40	66.59 b	49.42 c	54.70 c	54.32 b
P60	72.79 a	52.65 b	56.81 b	57.64 a
P80	71.42 a	55.38 a	57.66 a	57.07 a
Organic Fertilizers (B)				
PM	65.82 c	55.15 b	55.02 d	57.57 b
S	67.49 bc	49.22 c	54.77 d	55.72 c
HA	68.83 b	44.73 d	54.70 d	53.15 de
PM+S	68.57 b	59.05 a	56.26 bc	55.91 c
PM+HA	72.11 a	50.28 c	55.49 cd	54.54 cd
PM+S+HA	68.42 bc	59.14 a	57.41 a	59.04 a
HA+S	67.18 bc	42.04 e	56.57 ab	52.29 e
Control	68.27 bc	45.14 d	55.67 bcd	52.12 e

Phosphorus (P), Poultry manure (PM), Sulphur (S), Humic acid (HA)
Means with the similar alphabetical letters in the same column aren't significantly different, using Duncan's Multibe Range test at 0.05 level.

Table (12): Interaction effect of phosphorus levels and some organic fertilizer treatments on bulb head weigh (g), and bulb diameter (mm) and after curing garlic cv. "Egaseed1" during 2013 – 2014 and 2014 - 2015 seasons.

Treatments		Bulb head weigh (g)		Bulb diameter (mm)	
Phosphorus levels	Organic	Season		Season	
(P) kg\fed^{-1} (A)	Fertilizers (B)	2013- 2014	2014 - 2015	2013- 2014	2014 - 2015
P0	PM	58.16 j	45.57 jkl	51.24 l	56.00 c-j
	S	61.02 ij	42.85 k-n	51.24 l	52.06 k-n
	HA	62.35 hij	43.03 k-n	52.66 kl	50.30 mno
	PM+S	62.50 hij	49.24 hij	55.20 e-j	50.07 no
	PM+HA	70.52 b-e	44.86 jkl	54.52 g-k	51.60 imn
	PM+S+HA	62.54 hij	55.75 ef	57.03 b-f	56.87 b-i
	HA+S	64.70 f-i	39.19 n	57.48 b-f	47.33 op
	Control	58.64 j	38.92 n	50.86 l	44.89 p
P40	PM	64.68 f-i	56.99 de	53.96 h-k	56.63 p-i
	S	65.54 e-i	48.93 hij	52.39 kl	54.91 gk
	HA	70.32 b-f	44.0 klm	53.66 jik	52.75 j-n
	PM+S	64.11 ghi	53.61 efg	55.91 d-j	55.43 e-j
	PM+HA	69.35 c-j	51.7 fgh	55.56 d-j	53.51 i-m
	PM+S+HA	65.15 e-i	58.02 cde	55.91 d-j	58.44 b-e
	HA+S	64.66 f-i	41.74 lmn	56.77 b-g	50.94 mn
	Control	68.86 c-g	40.35 mn	53.44 jk	51.93 k-n
P60	PM	66.44 e-i	57.88 cde	57.36 b-f	57.72 b-g
	S	73.02 abc	54.78 ef	55.10 f-j	59.21 abc
	HA	70.13 b-f	44.97 jkl	56.91 b-f	55.35 e-j
	PM+S	78.20 a	63.9 b	57.05 b-f	58.34 b-f
	PM+HA	75.85 ab	46.96 ijk	56.25 c-h	57.28 b-h
	PM+S+HA	73.14 abc	60.65 bcd	57.78 bcd	61.91 a
	HA+S	72.17 bcd	42.88 k-n	55.63 d-j	55.90 c-j
	Control	73.39 abc	49.15 hij	58.39 abc	55.44 e-j
P80	PM	74.01 abc	60.15 bcd	57.53 b-e	59.92 ab
	S	70.40 b-f	50.34 ghi	60.34 a	56.73 b-i
	HA	72.53 bcd	46.91 ijk	55.57 d-j	54.20 h-l
	PM+S	69.50 bcd	69.45 a	56.88 b-f	59.80 ab
	PM+HA	72.71 a-d	57.61 de	55.61 d-j	55.78 d-j
	PM+S+HA	72.85 a-d	62.12 bc	58.93 ab	58.94 a-d
	HA+S	67.20 d-h	44.35 klm	56.40 c-g	54.98 f-k
	Control	72.20 bcd	52.14 fgh	60.01 a	56.21 c-i

Phosphorus (P), Poultry manure (PM), Sulphur (S), Humic acid (HA)
Means with similar alphabetical letters in the same column aren't significantly different, using Duncan's Multibe Range test at 0.05 level.

The interaction between phosphorus levels and organic fertilizer treatments was significantly effective on bulb diameter (mm) in both growing seasons Table (12). The highest significant increase was recorded with the application of P80 kg.fed^{-1}+S (60.34mm), P80+control

(60.01mm) in the first season and with P60 kg.fed^{-1}+ (PM+S+H) (61.91mm) in the second season without significant differences between them. Also, the combination of P80 kg.fed^{-1}+(PM+S+H) gave the best values in the first and second season (58,93 and 58.94mm). These results maybe attribute to the application of poultry manure which provide a source of all necessary macro-and micro-nutrients in available forms (Abou El-Magd et al., 2006), sulphur which performs many physiological functions like synthesis of sulphur containing amino acids. Overall increase in growth attributes may be due to sulphur increasing the root system of the plants which might have resulted in an increased uptake of nutrients and were used in photosynthesis. Jaggi (2004),

The lowest values were recorded with the interaction of organic fertilizers with (P0) and with the low level of phosphorus application used (P40 kg.fed^{-1}). These results can be attributed to the same reason mentioned by Fredeen, *et al*., (1989) and Rao *and terry*., 1989).

CONCLUSION:

It could be concluded from the obtained results that mixing organic and inorganic fertilizers (phosphorus) enhanced garlic crop yield than useing either organic or inorganic fertilizers alone. In many countries this strategy was used for enhancing crop yield and improvement of soil structure and fertility management.

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الملخص العربى

استجابة صنف الثوم ايجاسيد1 للتسميد العضوي ومستويات من الفوسفو ر

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أقيمت تجربتان خلال موسمين شتويين متتاليين 2013و2014/2014و2015 على محصول الثوم بالمزرعة البحثية لمحطة البحوث الزراعية بملوى– – مركز البحوث الزراعية – الجيزة –مصر لتقييم تأثير استخدام بعض الأسمدة العضوية (زرق الدواجن– حمض الهيوميك – والكبريت الزراعي) بمعدلات إضافة 6 طن للفدان بالنسبة لزرق الدواجن و 5كيلوجرام بالنسبة لحمض الهيوميك و 100 كيلوجرام للفدان بالنسبة للكبريت الزراعي مع 4 مستويات إضافة من الفوسفور فو2ا5 (غير عضوي) (صفر – 40– 60 –80 كجم فوسفور للفدان) على صورة فو2أ5وكذلك التفاعل بينهم لتصبح عدد المعاملات ***28*** معاملة . وقد تمت إضافة تلك المعاملات

للتربة قبل الزراعة. لتقييم تأثير استخدام تلك المعاملات على النمو و المحصول الكلى لصنف الثوم ايجاسيد1

وتضمنت اهم نتائج الدراسة مايلى:

1] وجد انه بزيادة معدل الإضافة للتسميد الفوسفورى إلى مستوى 80كجم للفدان ان قيم قياسات النمو الخضري(ارتفاع النبات – عدد الأوراق الخضراء \ نبات) قد ازدادت وازداد معها الصفات المحصولية (المحصول الكلى الأخضر والمعالج (طن/فدان) – قطر ووزن البصلة) وأيضا حدث انخفاض معنوي في النسبة المئوية للفقد في الوزن إثناء العلاج التجفيفى خلال موسمي الدراسة.

2] فيما يتعلق بمعاملات التسميد العضوي فقد بينت الدراسة ان معظم الصفات المأخوذة قد تأثرت معنويا بها و إن معاملة الخلط (زرق دواجن+كبريت زراعي+حمض الهيوميك) كانت الأفضل فيما يتعلق بزيادة وتحسين صفات النمو الخضري (ارتفاع النبات –عدد الأوراق) المحصول الأخضر والمعالج (طن/فدان)– معامل التبصيل – قطر البصلة في الموسمين الزراعيين بالإضافة إلى الزيادة في متوسط وزن البصلة خلال الموسم الثاني فقط. إضافة الأسمدة العضوية بصورة منفردة ادى الى زيادة معنوية فى بعض الصفات المأخوذة حيث أن الكبريت الزراعي أعطى أفضل المعاملات انخفاضا في النسبة المئوية للفقد فى الوزن للمحصول المعالج (23.36%)، (24.36 %) مقارنة بمعاملة الكنترول (26.79%) ، (24.8%) فى الموسم الأول والثاني على التوالي.

3] أظهرت نتائج تأثير التفاعل بين الأسمدة العضوية ومستويات الفوسفور المضافة إلى أن الصفات المدروسة قد تأثرت معنويا بتلك المعاملات وكان أفضلها في إحداث الزيادة فى وزن المحصول الأخضر والمعالج (طن للفدان) وكذلك قطر البصلة هى معاملة[(فوسفور + (زرق دواجن+كبريت زراعي+حمض هيوميك)]بمعدلات اضافة للتربة قبل الزراعة(60 كجم فوسفور +6 طن زرق دواجن + 100كجم كبريت زراعى + 5كجم حمض هيوميك) للفدان .

4] اقل القيم للصفات المدروسة تم الحصول عليها مع إضافة الأسمدة العضوية بصورة منفردة و بدون إضافة لعنصر الفوسفور او مع المستوى المنخفض للفوسفور بمعدل 40 كجم للفدان.

الخلاصة:

يمكن ان نستخلص من نتائج الدراسة انه من الأهمية عملية خلط السماد المعدني (فوسفور) مع السماد العضوي لزيادة تيسير العناصر وتراكمها وزيادة النمو وكذلك الصفات المحصولية للثوم عنه فى حالة استخدام اى منهم بصورة منفردة. وفى العديد من دول العالم هذه الإستراتيجية يتم استخدامها لتحسين وزيادة نمو المحصول وكذلك تحسين بناء وخصوبة التربة.