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EFFECT OF COMPOST AND POTASSIUM PHOSPHATE APPLICATIONS TO A CALCAREOUS SOIL CULTIVATED WITH VEGETABLE CROPS ROTATION ON THEIR PRODUCTION AND SOIL FERTILITY

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ABSTRACT

A field experiment was carried out on a calcareous soil at Abou massou village (٤٨ km south-west to Alexandria) with four vegetable crops cultivated in succession (garlic, , cauliflower and jews mallow) was conducted to investigate how application rates of plants residues trim farm operations compost and potassium phosphate, also, the vegetable dry matter & their NPK uptake can affect the yield. The study also investigated the resultant effects on soil fertility. Irrigation was up to field capacity using canal water.

Results indicated that soil salinity, soluble chlorides and sodium decreased sharply after garlic and gradually after that, while bicarbonates increased sharply during the first months and decreased gradually at a level higher than the start point. Sulphates, calcium, magnesium and potassium decreased over the time. Rates of compost application were without pronounced effect on total soluble salts or soluble cations and anions with the exception of bicarbonates.

Rates of plants residues trim farm operations compost and potassium phosphate included also vegetable dry matter and their NPK uptake in addition to soil properties and vegetable yields through ٢٠-months were also studied.

Results indicate that each of the use compost rates were effective in increasing dry matter, N and P uptake by the three vegetable crops over the control. The same trend was noticed also at the phosphate and potassium treatments. It may be concluded that vegetable crop production in calcareous soil depend on the direct and residual effect of organic and mineral N and P fertilization for ٢٠ months period and K fertilization for about three quarters of this period.

Also, the compost application might improve the soil properties while the addition of phosphorus and potassium enhances the availability of nutrients in the soil throughout the cropping period.

Key words: Calcareous soil, plants residues trim farm operations compost, Phosphorous, Potassium and Vegetable crops.

INTRODUCTION

Soils under intensive production are commonly subject to fertility syndromes as a result of nutrients deficiency which leads in turn to a marked decline in its productivity. Addition of fertilizers and soil amendments improve productivity levels and conserves the soil to a greater extent. Weak and poor soils might require special attention and interventions. Abdel-Hady *et al* (٢٠٠٠).

Composts at high quality ready organic manures were suggested for long time ago and still under investigation. Kaddous and Morgans (١٩٨٦) studied the effect of spent mushroom compost and deep litter fowl manure as a soil amendment for vegetables in sandy loam soil. They noticed that soil thermal conductance and bulk density decreased and its water-stable aggregates (>٠,٢٥mm), hydraulic conductivity, water retention, *N, P, K* and organic *C* increased with increasing rates of applications without increases in soil salinity to the harmful level. Kanwar *et al* (٢٠٠٢) used ٢٥ ton/ha vermicomposting to low fertile soil planted with cauliflower resulted in a marked increase in the soil organic content when organic fertilizers were added alone compared to *NPK* fertilizers alone. Negm *et al* (٢٠٠٣) applied ٤ ton/fed compost to calcareous soil at Noubaria cultivated with squash and table-beets. They found after ١٠ months of application slight increase in W.H.C. and T.S.S. due to increases in $HCO_{٣}$, Cl and Na. Soil pH was reduced just after addition and in a small range by the advance of time. CEC increased and decreased by time. Meanwhile, NPK in soil increased after compost application and reduced gradually by time. It was also found that the OM, total N content counts of total and cellulose decomposer bacteria and dehydrogenase activity increased after the compost application where the curve was at its peak after squash and gradually reduced.

Concerning *P* and *K* status in such calcareous soil, Abd-El-Hadi *et al* (٢٠٠٠) reported that fertility status in terms of the available soil NPK content was improved by increasing the fertilizer levels. Under proposed crop rotation with intensive cropping patterns, soil contents of *N, P* and *K* increased due to the higher amounts of the applied *N, P* and *K* fertilizers. Potassium phosphate was suggested as a soluble phosphate form by Mengel and Kirkby (١٩٧٩), Oosterhuis (١٩٩٧) and Hamdia *et al* (٢٠٠٠) as soil or foliar application to multi cut vegetables and maize, respectively. The latter was under salt stress.

Khalaf and Taha (١٩٨٨), Sono *et al* (١٩٩٤), Mohammad and Zuraiqi (٢٠٠٣) and Naik and Hosamani (٢٠٠٣), respectively recommended in case of garlic, the application of ٥٠ $m^{٣}$/ha of organic manure, ٣٠ ton/ha of compost, ١٢٠ and ١٥٠ kg/ha of mineral *N* were found to be better than other treatments. Phosphorus application rate was also recommended for garlic by ٤٥٠ and ٧٥ kg $P_{٢}O_{٥}$/ha according to Sono et al. (١٩٩٤) and Naidu et al. (٢٠٠٠), respectively. Naidu et al. (٢٠٠٠) and Nagoich *et al* (٢٠٠٣) gave a rate of ٥٠ and ١٢٠ kg K٢O/ha, respectively as the best rate for garlic.In spite of its leguminous nature, Cowpea was classified as N fertilization requiring crop as noted by Selvi *et al* (٢٠٠٢), Lehmann *et al* (٢٠٠٣), Oliveira *et al* (٢٠٠٣) and Patidar *et al* (٢٠٠٣),.

For Cauliflower, Jakse and Mihelic (٢٠٠١) using FYM and three different composts one of them was consisted of shredded wood and barks, Kumar and Choudhary (٢٠٠٢) comparing ٢٥ ton/ha FYM with ١٠٠٪ recommended *NPK* and both of them. On the other hand, Mishra (١٩٩٢), Gupta *et al* (٢٠٠٢) and Jana and Mukhopadhyay (٢٠٠٢) found that ١٥٠, ٢٠٠ and ١٠٠ kg mineral N/ha, respectively were the best under the experiment condition of each. The latter reference recommend ١٢٠ kg $P_{٢}O_{٥}$/ha for high quality seed yield. Kanwar et al. (٢٠٠٢) and Jim (٢٠٠٢) investigated the effect of complete or half-recommended doses of *NPK* to minimize the mineral fertilizer applications.

Tindall (١٩٨٣) and Rubatzky and Yamagucbi (١٩٩٩) reported that Jews mallow is an intensive and densely growing plant requiring the application of complete fertilizers dose before sowing additional surface dressings of N fertilizer may be required to stimulate leaf production once plants are well established.

From all these literatures, vegetable crops are considered as good test plants to study the effect of fertilizers and soil amendments on increasing crop productivity. The target of the current work was to study the effect of the suggested The compost in combination with rates and forms of phosphorus and potassium fertilizers on high consumption plants has be recommended for calcareous soils.

MATERIALS AND METHODS

Compost preparation:

Four ton plants residues trim farm operations chopped, ٨ $m^{٣}$ fresh cattle dung, ٢٠٠ kg ammonium sulphate and ٢٠٠ kg calcium super phosphate was composted as suggested by Bertron and Andreas (١٩٩٤) for four months where the final analyses of that compost was shown in Table (١) following the methods described by Brummer and Wasmer (١٩٧٨).

Soil

A field experiment was carried out during the seasons of ٢٠١٣/٢٠١٤ on a calcareous soil at Abou Masooud farm (٤٨ Km south-west to Alexandria) Alexandria Governorate, Egypt. Some physical and chemical properties of the studied soil are presented in Table (٢) analyzed according to Black et al. (١٩٦٥).

Studied crops

Seeds of Garlic (*Allium sativum, L.*), cowpea (*Vigna sinensis Savi*.), cauliflower (*Brassica oleracea var. botrytis L*.) and jews mallow (*Corchorus olitorius, L*.). Seeds were sown in plots (٣ x ٣,٥ m) area. Before sowing the plots were settled.

Experimental plots

The experiment was designed in a split-split plot design with four replicates. The treatments included the following:

The main treatments:

١) Three levels of compost fertilizers, i.e. O, ٢,٥٪ and ٥٪ (of the ١٥ cm depth plot soil weight) control treatment.

Sub- main treatment:

١) $K_{٢}SO_{٤}$ applied at a rate of ٤٠ kg *K/fed* and ١٨ kg *S/fed*.

٢) Adding the double rate of the previous treatment (٨٠ kg *K/fed*. and ٣٦ kg *S/ fed*.).

٣) Add monohydrogen dipotassium phosphate ($HK_{٢}PO_{٤}$) with rate ٤٠ kg *K/fed* corresponding ٨ kg *P/fed*.

٤) The double dose of $HK_{٢}PO_{٤}$ was applied corresponding (٨٠ kg *K/fed* and ١٦ kg *P/fed)*

٥) From each compost treatments were left without any *P* or *K* application as a control.

Field experiment conduct:

The lobes of garlic (*Allium sativum, L*.) were sown on the ١st of October ٢٠١٢ plots. One third of plots were mixed with ٥٪ plant farm compost, another one third mixed with ٢,٥٪ plant farm compost and the rest plots was left without compost as a control. On the ٢١th of October and ١٢th of November ٢٠١٢ plots were received two equal doses of phosphorus potassium fertilization according to the following arrangement. (A) ١٢ plots (٤ ones from each compost treatment) were left without any *P* or *K* application as a control, (B) ١٢ plots received in each dose corresponding ٤٠ kg *K/fed*. and ١٨ kg *S/fed*. (C) ١٢ plots received to the double rate ٨٠ kg *K/fed*. and ٣٦ kg *S/ fed*. (D) ١٢ plots received the rate ٤٠ kg *K/fed* in the form of monohydrogen dipotassium phosphate ($HK_{٢}PO_{٤}$) corresponding ٨ kg *P/fed* and (E) ١٢ plots received the double dose of $HK_{٢}PO_{٤}$. Irrigation was stopped at ١٨th of February ٢٠١٣ where garlic was harvested on the ١th of March ٢٠١٣.

Soil samples were collected from each plot for analyses. The plots were clearing then the soil of every four replicate plots was settled and seeds of cowpea (*Vigna sinensis Savi*.) were sown on the ٧th of March ٢٠١٣. After two weeks from planting seedlings were thinned to stand two plants ones only per hill. Irrigation was done four times up to plant maturity. Plants of each plot were harvested on the ١٢th of August ٢٠١٣ where each plant was divided into seeds and straw.

The same technique of soil sample taking and four replicates was followed then the filed clearing therefore the soil of every four replicate plots was settled and ٢ seedlings (٣٠-day age) of cauliflower (*Brassica oleracea var. botrytis L*.) were transplanted in each plot on ١٠th of September ٢٠١٣. After three weeks one plant only stayed in each hill. On the ١٠th of October and ٥th of November ٢٠١٣, the same programme of *P* and *K* fertilization was followed in the same plots. The plants were irrigated when they need, after ١٥٠ days from planting (١١th of February ٢٠١٤) plants was cut, where soil sample was collected from each plot for analyses.

The filed clearing then the soil of every four replicate plots was settled, where seeds of jews mallow (*Corchorus olitorius, L*.) were planted on the ١٧st of March ٢٠١٤. Plants were left without thinning and only treated, its where irrigation when they need. Plant cutting was on the ١st of June ٢٠١٤ where soil sample was taken from each plot.

Total soluble salts by estimating soil electrical conductivity (EC), soluble anions, cations, cation exchange capacity (CEC), organic matter (O.M.), were determined by the methods described by Black *et al* (١٩٦٥). Total *N* contents, available *P* and *K* in soil were determined according to Jackson (١٩٧٣).

After cutting of each vegetable, plants were ٧٥ ˚C oven dried, ground and wet digested by the method described by Sommers and Nelson (١٩٧٢) and their contents of *N, P* and *K* were determined according to Chapman and Pratt (١٩٦١) Available N, P and K in soil were determined according to Jackson (١٩٧٣).. Data were statistically analyzed according to Petersen (١٩٧٦).

Tables ١ and ٢ showed the compost and soil analyses according to

Brummer and Wasmer (١٩٧٨) for compost and Black *et al* (١٩٦٥) for soil.

Table (1): Characterizing analyses of the prepared compost.

Determination	Value	Determination	Value
Colour	Redden brown	Organic matter %	59.13
Moisture %	39.70	Organic carbon %	34.29
Water holding capacity %	110.00	Total N %	1.02
Total soluble salts %	0.51	Total P %	0.35
pH (1:10 water suspen.)	7.10	Total K %	0.63
CEC (me/100g compost)	68.24	C/N ratio	33.62

Table (٢): Some physical and chemical properties of the soil under investigation.

Practical size distribution in presence of *CaCO* $_{٣}$				
Clay	(%)	١٥,٢٠	EC (dS/m)	١٢,٣٦
Silt	(%)	٢٠,٧٠	*Cations meq /L :*	
Fine sand	(%)	٤٣,٢٠	*Ca* $^{٢+}$	٤٤,٨٨
Coarse sand	(%)	٢٠,٩٠	*Mg* $^{٢+}$	٢١,٨٥
Textural class : Sandy clay loam			*Na* $^{+}$	٩٢,٤٠
CaCO $_{٣}$	(%)	٣٣,٤٠	*K* $^{+}$	٣,٧٣
O.M.	(%)	١,٠٩	*Anions meq /L :*	
O.C.	(%)	٠,٥٣	*CO* $_{٣}^{٢-}$	Nil
W.H.C.	(%)	٤٢,٦٠	*HCO* $_{٣}^{-}$	٠,٨٢
Total porosity	(%)	٤٧,٢٠	*Cl* $^{-}$	٩٩,٢٤
FC	(%)	٢٥,٥٦	*SO* $_{٤}^{٢-}$	٦٢,٨٠
Bulk density (gcm$^{-٣}$)		١,٤٠		
Available macronutrients			pH (١:٢,٥) susp.	٧,٦٥
Available N mmol$_c$ /١٠٠g soil		٦٤,٠٠	C/N ratio	٩,٦٤
Available P mmol$_c$ /١٠٠g soil		١٠,٧٠	CEC me/١٠٠g soil	١٧,٤٠
Available K mmol$_c$ /١٠٠g soil		٣١٥		

EC and soluble ions were determined in soil past extract.

RESULTS AND DISCUSSION

A) Soil salinity:

Tables (١) and (٢) show that total soluble salts percent compost and the soil sample were approximately the same (about ٠,٥٪). The behavior of soil salinity through ٢٠ months (the experiment period) was graphically illustrated in Fig. (١). It could be observed that sharp depression was occurred after garlic harvesting. The decrease was gradually. The rate ٥٪ was the fastest in decreasing salinity followed by the rate ٢,٥٪ and unmanured plots were at least. This trend may be attributed to salt recovery by plants enhanced by more water retention due to more compost addition.

From Fig. (١) also, it could be observed that bicarbonates were increased sharply after the early ٢ months and still at the same high level for about ٣ or ٣,٥ months and decreased gradually to be after ٢٠ months at a level higher than the start. Those early increases were due to the maximum garlic root activity under relative salinity stress.

Chlorides were sharply reduced after about ٢ months and ranged between small differences up to ١٦ months and tended to little increase after that. Sulphates which were calculated by difference between cations and anions included logically all the other anions as nitrates, phosphates and so on. They reduced gradually at the early ٦ months, sharply after another ٢ months and still low up to ١٧ months. A little increase occurred by the experimental end. Applications of ٢,٥ and ٥٪ of compost were without real effect in case of bicarbonate but they were more effective in decreasing chlorides and sulphates. In all cases, there was no soluble carbonate. Thus, the soil was not alkali due to $CaCO_٣$ buffering capacity.

Soluble cations as Fig. (٢) illustrated decreased by time in general. The alkaline or basic cations $Ca^{٢+}$ and $Mg^{٢+}$ were as the same trend as Sulphates while Na^+ followed the same trend of Chlorides. Regarding the soluble *K*, it reached to soil solution in this experiment from three ways:

١) The native *K*, ٢) *K* released from compost (contained ٠,٦٣٧ % *K*) and ٣) Added mineral *K* as sulphate or phosphate. Soluble *K* increased in case of ٠ and ٢,٥٪ rate of compost through the early ٤ months than the start at ٠ times but the rate of ٥٪ compost decreased it due to more microbiology activity and more *K* absorption by them. All compost treatments (٠, ٢,٥ and ٥ %) reduced *K* in soil solution sharply in the next two months and were stable after that till the experiment end. The more compost rate was the more active in reducing *K* but in narrow differences.

B) Cation exchange capacity (CEC):

Fig. (٣) graphically illustrated cation exchange capacity (CEC) behavior which was clearly affected by compost applications where ٥٪ compst revealed no pronounced change through ٢٠ months while with ٥٪ compost application and relatively less with ٢,٥٪, CEC increased in the early two months, still high for about ٦ months and gradually decreased to near the value with which the experiment started. This could be due to the decomposition of the compost added which is mainly organic matter. It is well known that organic matter has a higher CEC which is reflected on soil CEC.

C) Organic matter content (O.M.):

In Fig. (٣) the trend of organic matter content (O.M.) could be described as sharp increasing in ٢,٥٪ and ٥٪ compost treatments at first two months,as a result of compost addation stability for another four months and gently decreasing. The increases in O.M. were more pronounced at ٥٪ rate of application than that at ٢,٥٪. That trend was ascribed of course to the quantities added of organic matter to soil and the slow decomposition of that used compost. That result confirmed those obtained by Kaddous and

Morgans (١٩٨٦), Kanwar Kamla et al. (٢٠٠٢), Negm et al. (٢٠٠٣) and Khalefa *et al* (٢٠٠٥).

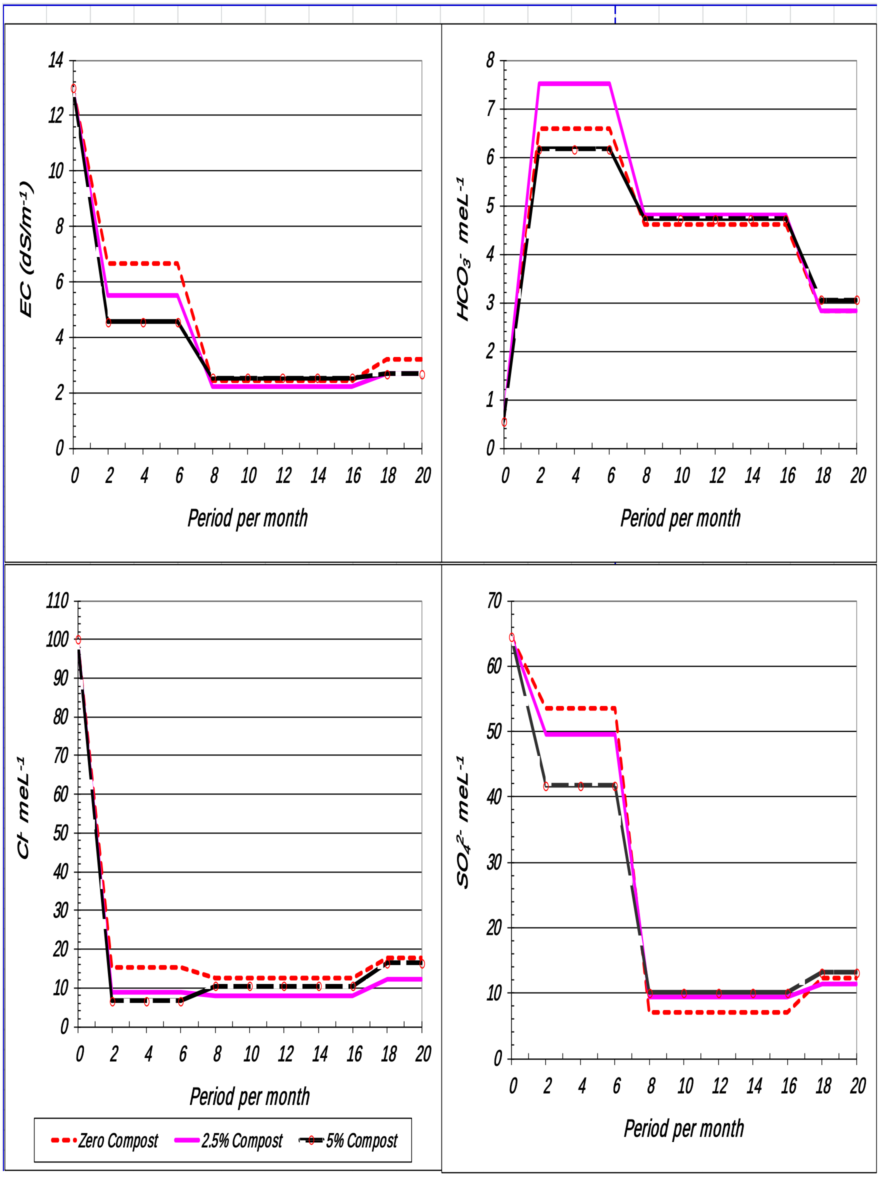

Fig. (١): The behavior of electrical conductivity and soluble anions of saturation paste extract through experiment period.

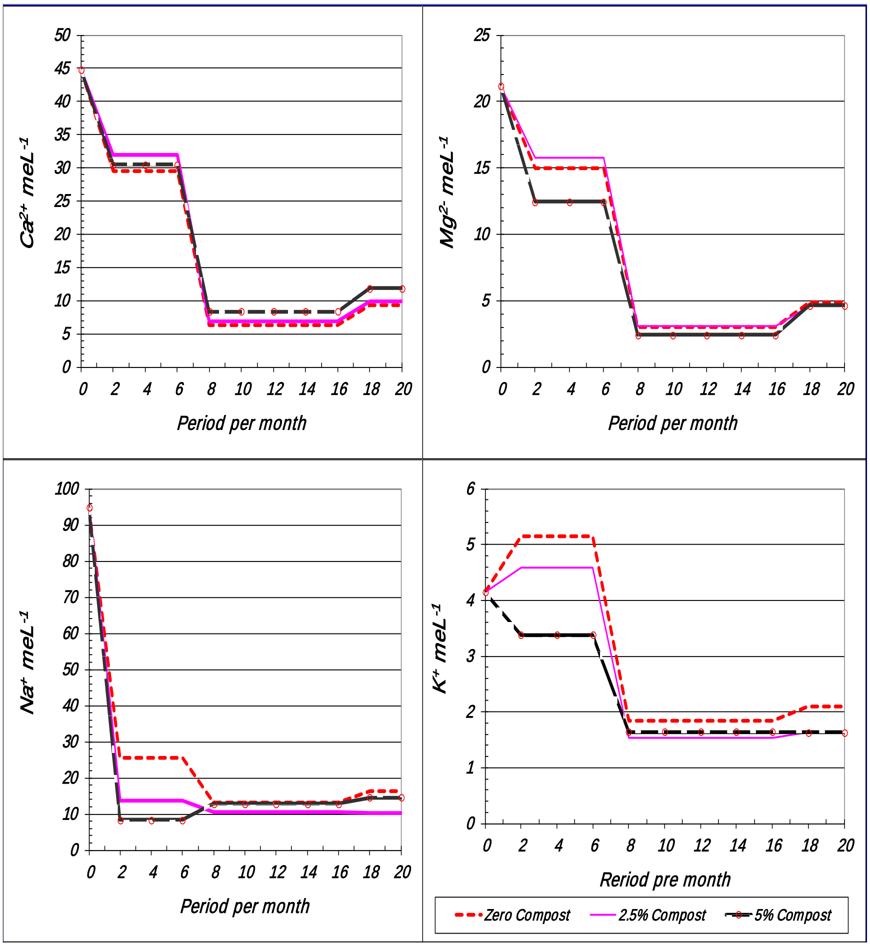

Fig. (٢): The behavior of soluble cations of saturation paste extract through experiment period.

D) Total nitrogen content:

In Fig. (٣) also total nitrogen content was illustrated to clarify the continuous decreases in all cases. The dramatic decreases were noticed for control curve followed with that of ٢,٥٪ compost appearing long stable period at ٢٥٠ mg/kg soil from the ٨th month and up to the ١٦th. That stability by using ٥٪ compost was between ٣٧٠ and ٣٩٠ mg/kg soil from the ٢nd month up to the ١٦th. Total *N* means all organic, minerals ammoniacal and nitrate *N* forms. The stability period in presence of plants absorbing nitrogen means regular N release. Thus, the longer stable *N* content period is the more regular *N* released manure. That results were in accordance with those reported by Kaddous and Morgans (١٩٨٦), Lehmann *et al*. (٢٠٠٣), Negm *et al*. (٢٠٠٣) and Khalefa *et al* (٢٠٠٥).

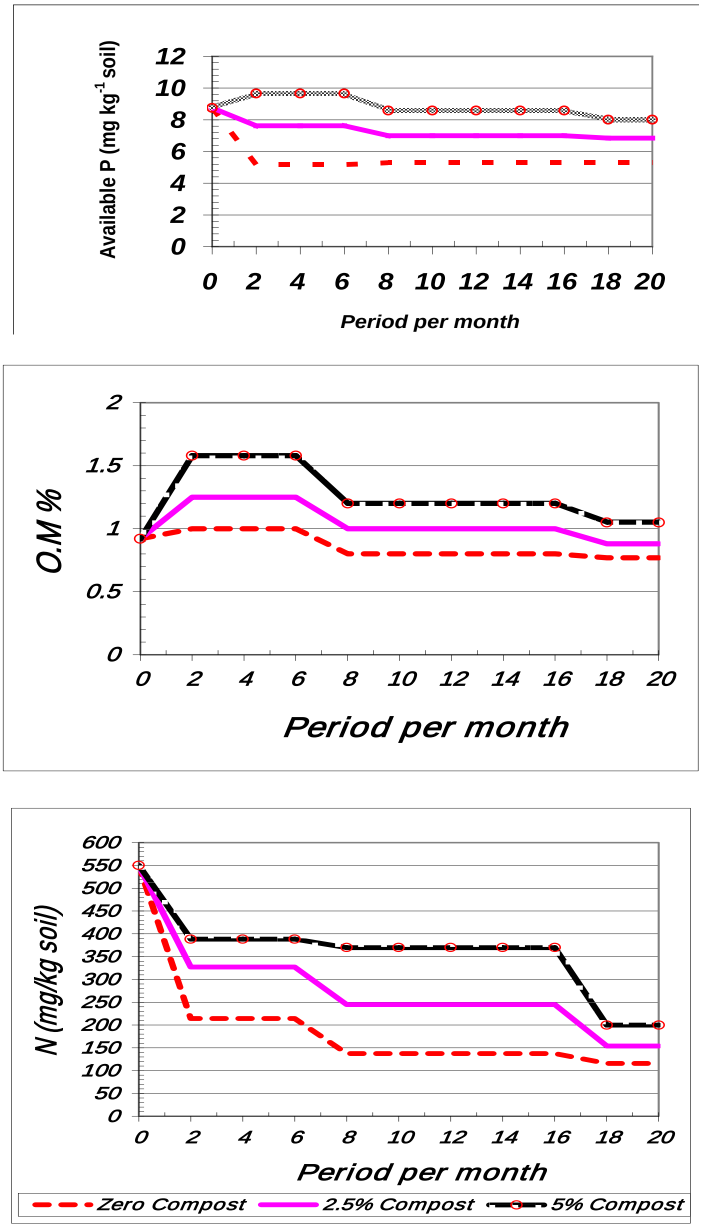

Fig. (٣): The behavior of cation exchange capacity, organic matter and total nitrogen in soil due the experiment of period.

E) Available phosphorus:

The experiment soil sample was supplied according to the arrangement design with two *P* sources; organic and mineral. Fig. (٤) and Fig (٥) illustrated the effect of each source on available *P*.

Concerning plants residues trim farm operations compost, there was proportion increase in available *P* by increasing the rate of application. The decrease by time was relatively faster in the higher compost rate followed with the low one and the unmanured pots were approximately stable around the lowest available *P* value during the experimental period lower than the beginning point. This result was in agreement with the findings of Kaddous and Morgans(١٩٨٦), Lehmann et al. (٢٠٠٣), Negm et al. (٢٠٠٣) and Khalefa *et al* (٢٠٠٥).

The mineral *P* applications differed in their effects on available *P* according to their sources. Additions of diluted $H_٣PO_٤$ were generally as the same as control with ٠,٢٢ or – ٠,٣٨ mg/kg soil more or less, respectively. Monohydrogen dipotassium phosphate application increased available *P* over the control by using the level corresponding ٨ kg *P/fed.* The increases were more by using the doubled level. All of them reduced available *P* by time. As for the effect of *P* level of application on increasing available *P*, Mengel and Kirkby (١٩٧٩) and Abd El-Hadi *et al* (٢٠٠٠) found nearly the same. As for the superiority of potassium phosphate in increasing available *P* in soil, Mengel and Kirkby (١٩٧٩), Oosterhuis (١٩٩٧) and Hamidia *et al.* (٢٠٠٠) obtained similar results.

F) Available potassium:

Potassium also was provided by two sources organic and mineral. The mineral was sulphate or phosphate. Its effect on available *K* was graphically illustrated in Fig. (٤) and Fig (٥).

Firstly, available *K* in the soil sample before the experiment was between middle and high limits but under the programme of intensive cultivation, application of *K* from the studied sources raised available *K* to the sufficient level through about ١٦ months and return to the start limit after ٢٠ months when compost was used and less to that limit in unmanured plots.

The high rate of compost increased available *K* up to ٦ months and decreased it gradually to the start point value. Also, the low compost rate raised available *K* for ٦ months and gradually decreased it to a value relatively lower than that of beginning. The control faced at the early ٦ months increase in available *K* due to association of mineral *K* subtreatments but after ١٦ months it decreased to the beginning value and lower than that beginning value after ٢٠ months. Results of Kaddous and Morgans (١٩٨٦), Lehamnn *et al*. (٢٠٠٣) and Negm *et al.* (٢٠٠٣) were confirmed with that finding.

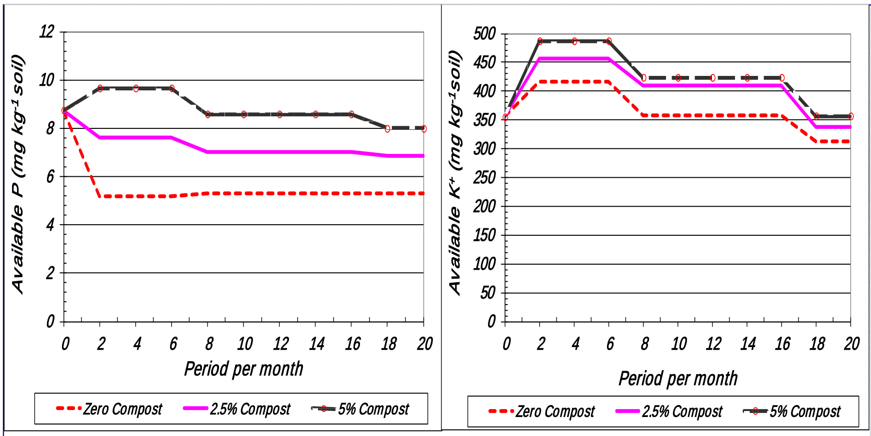

Fig. (4): The behavior of available P and K as affected by compost treatments through the experiment period.

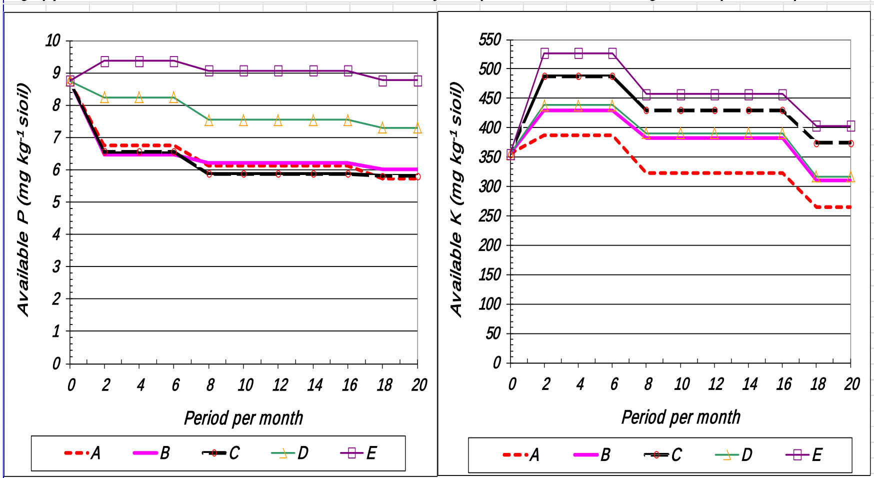

Fig. (5): The behavior of available P and K as affected by potassium sulphate and monohydrogen dipotassium phos treatments through the nexperiment period.

Application of mineral *K* increased available *K* over the control (A). The increase of *K* level of application increased available *K*. That trend was true although the values decreased by time, Mengel and Kirkby (١٩٧٩) and Abd El_Hadi et al. (٢٠٠٠) obtained similar results.

Among each level, dipotassium phosphate was superior to potassium sulphate in increasing available *K* in soil through all the experiment intervals. That finding was in agreement with Oosterhuis (١٩٩٧) and Hamdia et al. (٢٠٠٠).

G) Dry matter yields:

Data in Table (٣) indicated that dry matter yields of the studied vegetable graduated along with compost decomposition as the following.

In garlic, application of ٥٪ compost reduced significantly dry matter yield than that of ٠ or ٢,٥٪ cowpea seeds responded significantly to application of ٢,٥٪ compost while its straw responded significantly to ٢,٥٪ and

٥٪ compost with significant difference between each. Thus, cowpea whole plant increased with ١٧ and ٥٢٪ by addition of ٢,٥ and ٥٪ compost over the control indicating that the used plants residues trim farm operations compost start to feed plants after at least the maximum growth period of the ١st crop i.e. after about ٢ months of application. The significant superiority of ٢,٥٪ compost to control and that of ٥٪ to ٢,٥٪ rate of application were shown in dry matter yields with cauliflower, the ٣rd crop and jews mallow, the ٤th one. These results are in agreements of Kaddous and Morgans (١٩٨٦) for the negative effect of organic manure at first, Jakse and Mihelic (٢٠٠١) and Kumar and Chaudhary (٢٠٠٢) for the latter trend.

Using potassium phosphate in both levels was found to be significantly superior to the control in increasing the four crops dry matter yields. Potassium sulphate and phosphoric acid solution in the both levels were also as the same as $HK_{٢}PO_{٤}$ trend for the latter three vegetables and the low level of them was as the same as the control. Thus, the studied calcareous soil was in need to *P* and *K* fertilization whatever the added form of each beside released from compost. That finding confirmed with those obtained by Sono et al. (١٩٩٤), Jana and Mukhopadhyay (٢٠٠٢) for phosphorus and Naik and Hosamani (٢٠٠٣) and Nagoich et al. (٢٠٠٣) for potassium. From other wise dipotassium phosphate caused significant increases over potassium sulphate and phosphoric acid in increasing dry matter yields of cowpea straw, cauliflower and jews mallow by any level of application and the higher $HK_{٢}PO_{٤}$ level over the lower level of $K_{٢}SO_{٤}$ and $H_{٣}PO_{٤}$ in case of garlic and cowpea seed dry matter.

Concerning the interaction effect of compost and *P* and *K* mineral fertilization on dry mater yields of that studied vegetables, the highest values were of $HK_{٢}PO_{٤}$ without compost for garlic, $K_{٢}SO_{٤}$ and $H_{٣}PO_{٤}$ *or* $HK_{٢}PO_{٤}$ with ٢,٥٪ compost for cowpea seeds, $K_{٢}SO_{٤}$ and $H_{٣}PO_{٤}$ with ٥٪ compost for cowpea straw and $HK_{٢}PO_{٤}$ with ٥٪ compost for others at level ٢ in all cases.

H) Nitrogen uptake:

From data of Table (٤), nitrogen uptake by garlic plants was significantly reduced by compost application especially at the higher rate of application. Referring to the high total nitrogen content in soil at that period. It could attribute that to nitrogen assimilation by microorganisms bodies in the soil or due to decline in available *N* and not in total *N* as found by Jakse and Mihelic (٢٠٠١). That behavior was completely converted to significant effect of ٥٪ compost over ٢,٥٪ and the latter over unmanured pots on increasing nitrogen uptake by cowpea, cauliflower and jews mallow vegetables. The proportion increases coordinated with Kaddous and Morgans (١٩٨٦) Khalaf and Taha (١٩٨٨) and Hanafy et al. (١٩٩٧).

Phosphorus and potassium applications proportionally increased *N* uptake by plants with significant differences that their favorite effects on dry matter production caused effect. Generally, the more healthy plants are the more able to absorb nutrients.

Table (3): Dry matter yields of the studied vegetable crops in g/kg soil affected b and potassium sulphate and monohydrogen dipotassium phosphate a

Plant	Composi rate %	Control	K2SO4 Level 1	K2SO4 Level 2	HK2PO4 Level 1	HK2PO4 Level 2	Mean	L.S.D (at 0.05 level)
Garilc	0.00	16.45	16.75	21.30	26.65	30.00	22.23	Compost: 0.28
	2.50	11.40	16.35	19.95	18.25	28.30	18.85	Treatmnts: 0.36
	5.00	11.10	12.60	14.75	15.60	17.15	14.24	Comp.*Treat.: 0.62
	Mean	12.98	15.23	18.67	20.17	25.15	18.44	
Cowpea see	0.00	19.55	26.30	28.65	27.75	33.85	27.22	Compost: 4.50
	2.50	27.35	29.15	35.50	35.10	35.45	32.51	Treatmnts: 5.81
	5.00	25.15	30.35	29.60	34.70	35.35	31.03	Comp.*Treat.: 10.06
	Mean	24.02	28.60	31.25	32.52	34.88	30.25	
Cowpea stra	0.00	46.20	56.55	73.85	76.80	84.05	67.49	Compost: 5.17
	2.50	54.75	77.25	81.10	89.05	89.40	78.31	Treatmnts: 6.68
	5.00	86.55	111.15	125.60	119.20	120.50	112.60	Comp.*Treat.: 11.57
	Mean	62.50	81.65	93.52	95.02	97.98	86.13	
Cauliflower	0.00	48.25	56.00	73.65	61.00	77.55	63.29	Compost: 2.81
	2.50	56.15	61.75	72.90	66.00	108.50	73.06	Treatmnts: 3.63
	5.00	75.50	99.15	110.50	105.80	114.00	100.99	Comp.*Treat.: 6.29
	Mean	59.97	72.30	85.68	77.60	100.02	79.11	
Jews mallo	0.00	18.75	22.47	30.40	38.25	46.27	31.23	Compost: 1.67
	2.50	39.83	44.63	45.12	47.08	49.18	45.17	Treatmnts: 2.15
	5.00	40.10	46.18	49.02	50.75	53.20	47.85	Comp.*Treat.: 4.55
	Mean	32.89	37.76	41.51	45.36	49.55	41.42	

Table (4): Nitrogen uptake by the studied vegetable crops in mg/kg soil asaffected by compost and potassium sulphate and dipotassium phosphate applications.

Plant	Compost rate %	Control	K_2SO_4 Level 1	K_2SO_4 Level 2	HK_2PO_4 Level 1	HK_2PO_4 Level 2	Mean	L.S.D (at 0.05 level)
Garilc	0.00	276.25	311.55	447.25	527.65	698.90	452.32	Compost: 4.09
	2.50	173.25	279.55	384.90	333.95	594.30	353.19	Treatmnts: 5.28
	5.00	155.40	204.35	271.30	271.40	333.90	247.27	Comp.* Treat.: 9.14
	Mean	201.63	265.15	367.82	377.67	542.37	350.93	
Cowpea seeds	0.00	375.50	643.10	757.85	659.55	843.55	655.91	Compost: 72.92
	2.50	703.30	834.85	1169.95	961.75	1084.75	950.92	Treatmnts: 94.14
	5.00	708.55	1007.00	1237.10	1086.95	1273.00	1062.52	Comp.* Treat.: 163.06
	Mean	595.78	828.32	1054.97	902.75	1067.10	889.78	
Cowpea straw	0.00	999.80	1144.15	1470.00	1567.15	1686.65	1373.55	Compost: 68.31
	2.50	1083.40	1402.95	1579.95	1664.30	1676.30	1481.38	Treatmnts: 88.19
	5.00	1393.15	1767.35	1904.45	2022.80	2023.55	1822.26	Comp.* Treat.: 152.74
	Mean	1158.78	1438.15	1651.47	1751.42	1795.50	1559.06	
Cauliflower	0.00	534.70	620.55	883.15	670.40	922.25	726.21	Compost: 31.43
	2.50	707.05	869.60	1083.50	890.30	1506.70	1011.43	Treatmnts: 40.58
	5.00	1049.20	1476.05	1789.35	1551.00	1766.15	1526.35	Comp.* Treat.: 70.29
	Mean	763.65	988.73	1252.00	1037.23	1398.37	1088.00	
Jews mallow	0.00	378.75	467.30	710.75	822.40	1115.05	698.85	Compost: 6.63
	2.50	868.35	941.75	974.50	943.75	1175.50	980.77	Treatmnts: 8.55
	5.00	785.95	1020.65	1147.00	1060.65	1212.95	1045.44	Comp.* Treat.: 14.82
	Mean	677.68	809.90	944.08	942.27	1167.83	908.35	
Total uptake	0	2565.00	3186.65	4269.00	4247.15	5266.40	3906.84	Compost: 21.07
	2.5	3535.35	4328.70	5192.80	4794.05	6037.55	4777.69	Treatmnts: 27.20
	5	4092.25	5475.40	6349.20	5992.80	6609.55	5703.84	Comp.* Treat.: 47.11
	Mean	3397.53	4330.25	5270.33	5011.33	5971.17	4796.12	

That result was in agreement with Jana and Mukhopadhyay (٢٠٠٢) for phosphorus, Naidu et al. (٢٠٠٠) and Nagoich et al. (٢٠٠٣) for potassium and Naik and Hosamani (٢٠٠٣) for phosphorus and potassium.

Among each level of *P and K* potassium phosphate was significantly superior in increasing *N* uptake by cowpea straw, cauliflower and Jews mallow to $K_{٢}SO_{٤}$ and $H_{٢}PO_{٤}$.

Total nitrogen uptake followed the current trends of its components giving compost efficiency about ٨٢ and ٨٥,٥٪ for the application rates of ٢,٥ and ٥,٠ % respectively on the lassies that each plot of the lower compost rate contained ٣٧٥ g N from compost and ٧٥٠ g *N* from the higher rate excluding nitrogen taken up by plants of no compost.

I) Phosphorus uptake:

Table (٥) revealed that phosphorus uptake by plants was also significantly affected by compost application as the following.

Table (5): Phosphorus uptake by the studied vegetable crops in mg/kg soil as affected by compost and potassium sulphate and dipotassium phosphate applications.

Plant	Compost rate %	Treatments					Mean	L.S.D (at 0.05 level)
		Control	K_2SO_4		HK_2PO_4			
			Level 1	Level 2	Level 1	Level 2		
Garlic	0.00	31.20	38.50	53.20	55.95	92.95	54.36	Compost: 1.04
	2.50	23.95	34.30	59.80	62.05	96.20	55.26	Treatmnts: 1.35
	5.00	27.75	41.60	54.55	59.25	71.60	50.95	Comp.* Treat.: 2.33
	Mean	27.63	38.13	55.85	59.08	86.92	53.52	
Cowpea seeds	0.00	30.35	62.90	68.65	74.90	101.50	67.66	Compost: 3.74
	2.50	57.05	69.50	88.45	94.75	113.45	84.64	Treatmnts: 4.83
	5.00	56.85	70.70	83.35	99.95	115.70	85.31	Comp.* Treat.: 8.36
	Mean	48.08	67.70	80.15	89.87	110.22	79.20	
Cowpea straw	0.00	87.55	141.15	205.75	214.10	234.65	176.64	Compost: 3.28
	2.50	130.90	191.40	208.10	265.30	277.50	214.64	Treatmnts: 4.23
	5.00	241.40	365.75	413.65	356.15	468.35	369.06	Comp.* Treat.: 7.33
	Mean	153.28	232.77	275.83	278.52	326.83	253.45	
Cauliflower	0.00	71.90	88.90	117.55	103.20	154.90	107.29	Compost: 5.05
	2.50	100.95	116.85	151.95	144.85	248.45	152.61	Treatmnts: 6.25
	5.00	150.65	197.90	220.50	221.55	261.80	210.48	Comp.* Treat.: 11.29
	Mean	107.83	134.55	163.33	156.53	221.72	156.79	
Jews mallow	0.00	28.15	31.45	42.55	53.55	69.40	45.02	Compost: 0.46
	2.50	59.75	66.95	63.15	67.40	68.85	65.22	Treatmnts: 0.59
	5.00	64.15	69.30	73.55	71.05	85.10	72.63	Comp.* Treat.: 1.03
	Mean	50.68	55.90	59.75	64.00	74.45	60.96	
Total uptake	0.00	249.15	362.90	487.70	501.70	653.40	450.97	Compost: 70.24
	2.50	372.60	479.00	571.45	634.35	804.45	572.37	Treatmnts: 90.68
	5.00	540.80	745.25	845.60	807.95	1002.55	788.43	Comp.* Treat.: 157.06
	Mean	387.52	529.05	634.92	648.00	820.13	603.92	

Compost in the early months of decomposition produced garlic week plants especially at ٥٪ rate of application. These plants were low in their *P* uptake, which were significantly decreased than total of ٢,٥ and the control treatments. After that compost proportionally increased ***P*** uptake by the other vegetables. The difference between ٥٪ and ٢,٥٪ as well as between ٢,٥٪ and the control were significant with one exception that between ٥ and ٢,٥٪ which was insignificantly in case of cowpea seeds. The good supplying compost with *P* was in agreement with Kaddous and Morgans (١٩٨٦), Khalaf and Taha (١٩٨٨) and Lehmann *et al.* (٢٠٠٣).

Regarding *P* uptake by plants as affected by mineral *P* sources, it could be noticed that all the studied vegetable responded to the mineral *P* fertilization significantly. The high level of application was the more effective among each from ($H_٣PO_٤$ or $HK_٢PO_٤$) with significant differences. Naidu et al. (٢٠٠٠) Jana and Muklopadhyay (٢٠٠٢) and Naik and Hosamani (٢٠٠٣) obtained similar results. The comparison between mineral P sources indicated the dipotassium phosphate was significantly superior to diluted H٣PO٤ in increasing P uptake by any of the studied vegetables among each level of application.

Interaction effect of compost and mineral P fertilization revealed that combination of ٢,٥٪ compost and HK٢PO٤ in garlic and combination of ٥٪ compost and $HK_٢PO_٤$ in the following crops each at the higher level of $HK_٢PO_٤$.

J) Potassium uptake:

Table (٦) clarified values of *K* uptake by different vegetables. Compost reduced *K* taken up by garlic significantly due to previously explanation The proportion increases by increasing rate of compost application were pronounced in all the other vegetables above significance level. That results were in accordance with Kaddous and Morgans (١٩٨٦), Khalaf and Taha (١٩٨٨) and Lehmann *et at.* (٢٠٠٣).

Although *K* uptake by jews mallow as affected by compost and / or *P* and *K* applications followed the same trend of that resulted in case of cowpea and cauliflower, the differences between treatments were insignificant. That observation indicated that storage of *K* from compost added to the beginning of the experiment of mineral *K* added to cauliflower, the pervious crop, was less to give Jew's mallow the significant high supply over the untreated plots. Potassium fertilization caused significant magnitude of *K* uptake by the all studied crops and raising its level of application raised the *K* amount taken up significantly. Naidu *et al.* (٢٠٠٠) and Nagoich *et al*. (٢٠٠٣) obtained nearly similar trends

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Table (6): Potassium uptake by the studied vegetable crops in mg/kg soil as affected by compost and potassium sulphate and dipotassium phosphate applications.

Plant	Compost rate %	Control	K_2SO_4 Level 1	K_2SO_4 Level 2	HK_2PO_4 Level 1	HK_2PO_4 Level 2	Mean	L.S.D (at 0.05 level)
Garlic	0.00	189.05	219.40	296.05	251.70	401.90	271.62	Compost: 2.16
	2.50	137.95	206.00	275.25	231.75	400.45	250.28	Treatmnts: 2.78
	5.00	139.90	163.80	212.40	213.70	246.90	195.34	Comp.* Treat.: 4.82
	Mean	155.63	196.40	261.23	232.38	349.75	239.08	
Cowpea seeds	0.00	328.15	461.90	544.10	510.55	649.95	498.93	Compost: 40.90
	2.50	479.40	528.60	675.10	656.35	733.80	614.65	Treatmnts: 52.81
	5.00	481.20	609.30	675.20	673.95	751.30	638.19	Comp.* Treat.: 91.46
	Mean	429.58	533.27	631.47	613.62	711.68	583.92	
Cowpea straw	0.00	566.80	717.95	1014.30	1053.15	918.15	854.07	Compost: 56.25
	2.50	687.25	1006.30	1052.35	1212.75	1324.00	1056.53	Treatmnts: 72.62
	5.00	1237.05	1620.45	1961.10	1679.00	1828.75	1665.27	Comp.* Treat.: 125.78
	Mean	830.37	1114.90	1342.58	1314.97	1356.97	1191.96	
Cauliflower	0.00	698.25	888.70	1262.50	981.15	1364.60	1039.04	Compost: 34.32
	2.50	925.80	1078.45	1403.40	1193.25	2123.65	1344.91	Treatmnts: 44.30
	5.00	1366.30	1862.15	2286.45	2040.50	2404.55	1991.99	Comp.* Treat.: 76.73
	Mean	996.78	1276.43	1650.78	1404.97	1964.27	1458.65	
Jews mallow	0.00	585.00	700.95	1138.80	1193.40	1841.40	1091.91	Compost: N.S*
	2.50	1171.10	1312.20	1339.95	1415.60	1460.75	1339.92	Treatmnts: N.S
	5.00	1182.95	1326.45	1455.80	1507.25	1771.55	1448.80	Comp.* Treat.: N.S
	Mean	979.68	1113.20	1311.52	1372.08	1691.23	1293.54	
Total uktake	0.00	2367.25	2988.90	4255.75	3989.95	5176.00	3755.57	Compost: 78.46
	2.50	3401.50	4131.55	4746.05	4709.70	6042.65	4606.29	Treatmnts: 101.29
	5.00	4407.40	5582.15	6590.95	6114.40	7003.05	5939.59	Comp.* Treat.: 175.44
	Mean	3392.05	4234.20	5197.58	4938.02	6073.90	4767.15	

* N.S = Not significant

The mineral *K* sources were also with significant effect on *K* uptake where dipotassium phosphate was superior to potassium sulphate for all the studied plants among each level of application.

Combination of the higher levels of compost and $HK_٢PO_٤$ produced the highest *K* uptake value by cowpea; cauliflower and jews mallow while the higher level of $HK_٢PO_٤$ with or without ٢,٥٪ to compost was the best treatment in case of garlic.

So it can be concluded that the rates of applying compost with levels of phosphorus and potassium improve the properties of calcareous soil and provide nutrients phosphorus and potassium for four seasons for vegetable crops, and increase crop production vegetable in calcareous soils due to the direct impact and resdual to fertilize organic and mineral nitrogen and phosphorus during the ٢٠ month and fertilization potassium through three-quarters of that period.

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تـأثير الكمبوست وفوسفات البوتاسيوم المضـاف لأرض جيريـة منزرعه بمحاصيل خضر متتالية على الانتاجية وخصوبة التربة.

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إجريت تجربة حقلية فى أرض جيرية بقرية أبو مسعود جنوب الاسكندرية ب ٤٨ كم زرعت بأربعة محاصيل خضر بشكل متعاقب هى (ثوم ولوبيا وقرنبيط وملوخية) على التوالى مع إضافة معدلات من كمبوست ناتج عمليات التقليم النباتية بالمزرعة بعد فرمها وفوسفات البوتاسيوم وذلك لتقييم تأثير معدلات الاضافة على خصوبة التربه والمادة الجافة للخضر وامتصاصها لعناصر النتروجين والفوسفور والبوتاسيوم بالاضافة الى ناتج محاصيل الخضر خلالفترة التجربة.

المعاملات الرئيسية للأرض هى إضافة الكمبوست بمعدلات صفر ، ٢,٥ ، ٥% من كتلة الكمبوست (٦٠% مادة جافة) مع فوسفات أحادى الهيدروجين ثنائى البوتاسيوم مع كبريتات البوتاسيوم بما يعادل صفر ،٢٠ ، ٤٠ كجم بوتاسيوم للفدان و (٨ ، ١٦ كجم فوسفور للفدان) مع اضافة حامض الفوسفوريك (٨ ، ١٦ كجم فوسفور للفدان) كمعاملة ثانوية للثوم والقرنبيط ،ولقد تمت الإضافة الى قطع التجارب باستخدام التصميم التام العشوائية ،وكان الرى فى حدود السعة الحقلية.

وقد أوضحت النتائج الأتى:

١ - ملوحة التربة وأيونات الكلوريد والصوديوم الذائبة انخفض بشدة بعد زراعة الثوم ، وتدريجياً بعد ذلك ، كما زادت البيكربونات بشدة خلال الشهور الأولى للتجربة ثم حدث نقص بشكل تدريجى إلى مستوى أعلى من نقطة البداية ،كذلك حدث أيضا نقص بشكل تدريجى لأيونات الكبريتات والكالسيوم والماغنسيوم والبوتاسيوم خلال فترة التجربة.

٢ - معدلات إضافة الكمبوست ليست لها تأثير واضح على الأملاح الكلية الذائبة والانيونات والكاتيونات الذائبة باستثناء البيكربونات.

٣ - السعة التبادلية الكاتيونية ومحتوى الأرض من المادة العضوية زاد خلال الشهور الأولى للتجربة بسبب إضافات الكمبوست خصوصاً عند معدل الأضافة الأعلى (٥%).

٤ - تأثر الفوسفور والبوتاسيوم الميسر بمعدلات إضافة الفوسفور والبوتاسيوم حيث زاد الفوسفور الميسر بدرجة ملموسة ونقص بنفس الدرجة بعد ثلث فترة التجربة أما البوتاسيوم الميسر زاد بعد الشهور الأولى ونقص مع الوقت إلى مستوى أعلى من نقطة بدايته بعد حوالى ثلاثة أربع زمن التجربة ،كما حدث نقص بشكل تدريجى للنتروجين الكلى مع الوقت.

٥ - لوحظ أن التناقصات النسبية للمادة العضوية والنتروجين الكلى والفوسفور والبوتاسيوم الميسر تتغير تدريجياً مع معدلات إضافات الكمبوست (صفر ، ٢,٥ ،٥%).

٦ - أن معدلات اضافة الكمبوست المستعملة كانت فعالة فى زيادة المادة الجافة والنتروجين والفوسفور الممتص بواسطة محصول الثوم وبذور اللوبيا والقش ومحصول القرنبيط والملوخية بدرجة اعلى من الكنترول وهذا التأثير توقف بالنسبة لمتصاص القرنبيط للبوتاسيوم. ونفس الاتجاة قد لوحظ لمعماملات الفوسفات والبوتاسيوم.

وهكذا يمكن ان نستنتج أن معدلات إضافة الكمبوست مع معدلات إضافة الفوسفور والبوتاسيوم تحسن من خواص التربة الجيرية وتوفير المغذيات من الفوسفور والبوتاسيوم لاربع مواسم زراعية لمحاصيل الخضر، وزيادة انتاج محصول الخضر فى الأراضى الجيرية يرجع الى التأثير المباشر والمتبقى للتسميد العضوى والمعدنى للنتروجين والفوسفور خلال ٢٠ شهر والتسميد البوتاسى خلال ثلاثة ارباع تلك الفترة.