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Inducing Yield Productivity and Nutrients Content of Peanut Plant Grown on Sandy Soil Under Different Rates of Remnants of Freeze Vegetable Factories Compost and P Fertilization

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Abstract : A field experiment was carried out at Ismailia Agriculture Research Station during summer 2014, to evaluate productivity and nutrients content under combination rates betweenRemnants of Freeze VegetableFactoriesCompost (RFVFC) and P fertilization. Treatments were representing all combinations of(RFVFC) (10 and 15 ton fed^{-1}) and P fertilization rates (0, 40, 60 and 80 kg P_2O_5 fed^{-1}) in randomized complete block design with three replicates.

Results showed that the most promising treatment of straw yield could be: Those of (10 ton (RFVFC) + 60 kg P_2O_5 fed^{-1}) which showed an increment of (+ 25.9 %); (10 ton (RFVFC) + 80 kg P_2O_5 fed^{-1}) with increment of (27.6 %) and (15 ton (RFVFC) + 60 kg P_2O_5 fed^{-1})with increment of (+ 30.4 %). The most promising treatment of pod yield could be: Those of (10 ton (RFVFC) + 60 kg P_2O_5 fed^{-1}) which showed an increment of (+ 9.97 %) and (15 ton (RFVFC) + 60 kg P_2O_5 fed^{-1}) with increment of (12.2 %).The most promising treatment of kernel yield could be: Those of (15 ton (RFVFC) + 60 kg P_2O_5 fed^{-1}) which showed an increment of (+ 14.0 %) and (15 ton (RFVFC) + 80 kg P_2O_5 fed^{-1}) with increment of (11.3 %). The maximum values of total income were achieved with (10 ton (RFVFC) + 60 kg P_2O_5fed^{-1}) of strawand pod yield but (15 ton (RFVFC) + 60 kg P_2O_5 fed^{-1}) of kernel yield.

Nutrients content of peanut plant organs increased under high rate of RFVFC and P fertilization (15 ton (RFVFC) + 80 kg P_2O_5 fed^{-1}) because RFVFC improved the efficiency of nutrients utilization by beany plants.

Key Word: Freeze Vegetable Factories Compost, P fertilization, Peanut, Yield, Nutrients content.

Introduction

Freeze vegetables processing is a major industry that is rapidly growing because of a demand for packaged foods in urban areas. The companies of food processing have large processing facilities where vegetables, such as lettuce, cabbage, mallow, okra, taro, pea and artichoke, etc. are cleaned, chopped, mixed and packaged. In a typical operation, the amount of wastes generated equal in quantity (by weight) to the amount of product shipped. Presently, these wastes are land disposed or land filled. Vegetable wastes do not provide any known concerns relating to pathogens or human health issues, however, they are prone to potential odors during decomposition and are expensive to dispose because of their high moisture content leading to high landfill tip fee and transportation cost[1].

Composting can be defined as being the breakdown of organic materials by large numbers of microorganisms in a moist, warm and aerated environment leading to the production of carbon dioxide, water, minerals and stabilized organic matter. The process generally starts by stacking the organic wastes in piles. The mixture is then composted in the presence of air for a period of 4-12 weeks depending on the type of system used, followed by a maturation phase (curing) of approximately the same duration [2]. Jovičić *et al* [3] showed that the creation of compost has become a more popular option of waste management as a waste and reduce pressure on landfill. Because of the importance of composting in order to achieve the objectives of waste management in the world.

Phosphorus is critical in the metabolism of plants, playing a role in cellular energy transfer, respiration, and photosynthesis. It is also a structural component of the nucleic acids of genes and chromosomes and of many coenzymes, phosphoproteins and phospholipids [4]. Phosphorus is one of the most important nutrients for crop production and emphasis is being given on the sufficient use of P fertilizer for sustainable crop production [5].

The present study aim to effect of different rates of Remnants of Food Factories Compost (RFVFC) and phosphorus fertilization on yield and N, P and K content of peanut cultivated in sandy soil.

Materials and Methods

A field trial was conducted on a loamy sand soil at Ismailia Agriculture Research Station, by cultivating peanut (*Arachishypogaea* L., cv Giza 5) in the summer season of 2014. The experiment was carried out in a randomized complete block design, with three replicates. Compost has been prepared using remnants of Montana factory and the remnants of plant waste for each of pea, artichoke and cabbage. The Remnants of Freeze Vegetable Factories Compost (RFVFC) was added by through mixing with the surface soil layer in a 10 and 15 ton fed^{-1}, which combined with four P fertilization rates (0, 40, 60 and 80 kg P_2O_5 fed^{-1}). Compost was added at a high rate in order to suffice the needs of the plants of nitrogen. One K fertilization rate (24 kg K_2O fed^{-1})in the form of potassium sulfate.The field of experiment was sampled before peanut planting to determine physical and chemical properties according to the standard procedures outlined by Cottenie[6]. (Table, 1).

Table (1): Some physical and chemical properties of the soil used.

Soil property	Value	Soil property	Value
Particle size distribution %		**pH (1:2.5 soil suspension)**	7.52
Coarse sand	69.9	**EC (dS m^{-1}), soil paste extract**	1.26
Fine sand	14.2		
Silt	5.7	**Soluble ions (mmol L^{-1})**	
Clay	10.2	**Ca^{++}**	6.12
Texture	Loamy sand	**Mg^{++}**	4.60
$CaCO_3$ %	2.50	**Na^{+}**	1.94
Saturation percent %	23.30	**K^{+}**	0.12
Organic matter%	0.01	**CO_3^{--}**	nd
Available N (mg kg^{-1})	9.3	**HCO_3^{-}**	2.20
Available P (mg kg^{-1})	1.8	**Cl^{-}**	4.98
		SO_4^{--}	5.60
Available K (mg kg^{-1})	67.5	**CEC (cmol kg^{-1})**	6.50

Chemical properties of RFVFC were measured according to the standard methods described by Cottenie[6] and shown in (Table, 2).

Table (2): Chemical properties of the compost (on dry weight basis).

	pH*	**Organic carbon**	**C/N ratio**	**N**	**P**	**K**	**Fe**	**Zn**	**Mn**
		%		**g kg^{-1}**			**mg kg^{-1}**		
RFVFC	6.65	33.8	16:1	2.11	1.36	2.27	1948.8	292	288.0

Plant samples were taken from mature peanut plants and recorded at harvest. Plant samples were dried at 65C° for 48 hrs, ground and wet digested using H_2SO_4: H_2O_2 method[6]. The digests were then subjected to measurement of N using Micro-Kjeldahl method; P was assayed using molybdenum blue method, while, K was determined by Flame Photometer [7].

Results and Discussion

Results (Table, 3) indicated that increasing P fertilization rate under the two RFVFC rates increased both yield and yield components. The increase was marked under heavy P application with respect to straw, pod and kernel yield but slight with dry weight of stem, root and leaf as well as oil content of kernel. Such pattern may reveal some sort of synergistic effect between P fertilization rate and RFVFC utilization of peanut crop. Such interaction effect continued acting with increasing RFVFC rate on P utilization by peanut crop. Dahroug and Gendy[8] observed that the combined addition between P fertilization and organic compost increased plant growth and yield components of soybean, and concluded that P fertilization are particularly important for oil crop production.

However the average values of straw yield and stem dry weight were increased insignificantly and significantly, respectively, under lower RFVFC rate, compared with higher one, when P fertilization level increased. On the other hand the average values of pod and kernel quantity yield increased significantly under higher RFVFC rate compared with the lower rate when P fertilization rate increased, but the average values of kernel quality (100 kernel weight) and oil content of kernel as well as dry weight of root and leaf, increased insignificantly under higher RFVFC rate compared with lower rate hen P fertilization rate increased. Sangeeta *et al* [9] reported that P has a vital role in energy storage, root development and early maturity of crop. The availability of soil P was increased by addition of organic compost, presumably due to chelation of cation by humic and fulvic acids and other decay products.

Table (3): Effect of Remnants of Freeze Vegetable Factories Compost (RFVFC) and P fertilization rates on yield and yield components of peanut plant.

RFVFCt on fed-1	P fertilization P_2O_5 Kg fed^{-1}									
	0	40	60	80	Mean	0	40	60	80	Mean
	Straw yield (ton fed^{-1})					Pod yield(ton fed^{-1})				
10	8.250	9.327	11.72	11.88	10.30	4.437	4.767	5.957	5.460	5.155
15	8.260	9.500	12.14	10.97	10.22	4.447	5.540	6.077	5.570	5.408
Mean	8.255	9.414	11.93	11.43		4.442	5.154	6.017	5.515	
	L.S.D.$_{0.05}$ RFVFC = 0.146 P=0.263 RFVFC*P= 0.373 Control= 9.31					L.S.D.$_{0.05}$ RFVFC =0.076 P=0.284 RFVFC*P= 0.401 Control= 5.417				
	Kernel yield (ton fed^{-1})					100 kernel weight (g)				
10	3.610	3.910	4.710	4.690	4.230	95.16	97.38	100.1	95.34	96.99
15	3.743	4.360	4.997	4.880	4.495	96.65	94.46	101.6	101.0	98.43
Mean	3.677	4.135	4.854	4.785		95.91	95.92	100.9	98.17	
	L.S.D.$_{0.05}$ RFVFC = 0.124 P=0.143 RFVFC*P= 0.202 Control= 4.383					L.S.D.$_{0.05}$ RFVFC= 4.541 P=2.467 RFVFC*P= 3.488 Control= 92.56				
	Oil content (%)					Stem dry weight(g/plant)				
10	50.71	50.71	51.09	51.06	50.89	17.76	22.31	28.20	29.29	24.39
15	50.69	51.88	52.60	51.94	51.78	19.15	20.76	22.67	22.15	21.18
Mean	50.70	51.30	4.854	4.785		18.46	21.54	25.44	25.72	
	L.S.D.$_{0.05}$ RFVFC = 1.222 P=1.385 RFVFC*P= 1.959 Control= 53.91					L.S.D.$_{0.05}$ RFVFC= 1.391 P=1.630 RFVFC*P= 2.305 Control= 21.88				
	Root dry weight (g/plant)					Leaf dry weight (g/plant)				
10	2.397	2.790	2.820	2.783	2.700	28.31	29.61	33.83	36.86	32.15
15	2.460	2.980	3.230	3.450	3.030	30.85	31.55	33.56	37.47	33.36
Mean	2.429	2.885	3.025	3.117		29.58	30.58	33.70	37.17	
	L.S.D.$_{0.05}$ RFVFC = 1.913 P=1.835 RFVFC*P= 0.186 Control= 3.693					L.S.D.$_{0.05}$ RFVFC= 1.222 P=1.385 RFVFC*P= 2.595 Control= 37.18				

Data in Table (4) revealed that under the lower rate of added RFVFC (10 ton fed^{-1}), the straw yield was changed by about -11.4, + 0.18, +25.9 and +27.6% versus -11.3, +2.04, +30.4 and +17.8% under the higher RFVFC rate (15 ton fed^{-1}), and P fertilization at the rates of 0, 40, 60and 80 kg P_2O_5 fed^{-1}, respectively, as compared to the control.

The most promising treatments could be: Those of (10 ton (RFVFC) + 60 kg P_2O_5 fed^{-1}) which showed an increment of +25.9%, (10 ton (RFVFC) + 80 kg P_2O_5 fed^{-1}) with an increment of +27.6% and (15 ton (RFVFC) + 60 kg P_2O_5 fed^{-1}) with an increment of +30.4%. Translating these values into considerations the price of added fertilizer and expected price of straw yield, the calculations reveal that the net income for the three treatments could be: 920, 148 and 85 Egyptian pound for these treatments, respectively, the treatments of (10 ton (RFVFC) + 60 kg P_2O_5 fed^{-1}) followed by(10 ton (RFVFC) + 80 kg P_2O_5 fed^{-1}) and (15 ton (RFVFC) + 60 kg P_2O_5 fed^{-1}) could be recommended for obtaining the highest rate of income from the straw yield of peanut crop.

Under the lower RFVFC rate (10 ton fed^{-1}), the pod yield was changed by about -18.1, -12.0, +9.97 and +0.79% versus -17.9, +2.27, +12.2 and +2.82 under the higher RFVFC rate (15 ton fed^{-1}), combined with P fertilization at the rate 0, 40, 60 and 80 kgP_2O_5 fed^{-1}, respectively, as compared to control.

Accordingly, the most promising treatments could be: Those of (10 ton (RFVFC) + 60 kg P_2O_5 fed^{-1}) which showed an increment of +9.97% and (15 ton (RFVFC) + 60 kg P_2O_5 fed^{-1}) with anincrement of +12.2%. Translating these values into considerations the price of added fertilizerand expected price of pod yield, the calculations reveal that the net income for the three treatments could be: 6413 and 5989 Egyptian pound for these treatments, respectively, the treatments of (10 ton (RFVFC) + 60 kg P_2O_5 fed^{-1}) followed by (15 ton (RFVFC) + 60 kg P_2O_5 fed^{-1}) could be recommended for obtaining the highest rate of income from the pod yield of peanut crop.

Table (4): Surplus (+) or deficit (-) values for yield relating the different rates of Remnants of Freeze Vegetable Factories Compost (RFVFC) and P fertilization over or under those obtained by control.

Treatment		Yield ton fed^{-1}		
RFVFC ton fed^{-1}	P fertilization kg fed^{-1}	Straw	Pod	Kernel
10	0	- 11.4	- 18.1	- 17.6
	40	+ 0.18	-12.0	- 10.8
	60	+ 25.9	+ 9.97	+ 7.64
	80	+ 27.6	+ 0.79	+ 7.00
15	0	-11.3	- 17.9	- 14.6
	40	+ 2.04	+ 2.27	- 0.52
	60	+ 30.4	+ 12.2	+ 14.0
	80	+ 17.8	+ 2.82	+ 11.3

Under the lower RFVFC rate (10 ton fed^{-1}), the kernel yield quantity was changed by about -17.6, -10.8, +7.46 and +7.0% versus -14.6, -0.52, +14.0 and +11.3% under the higher RFVFC rate (15 tonfed^{-1}), combined with P fertilization at the rate 0, 40, 60 and 80 kgP_2O_5 fed^{-1}, respectively, as compared to control.

Finally, the most promising treatments could be: Those of (15 ton (RFVFC) + 60 kg $P_2O_5fed^{-1}$) which showed an increment of +14.0% and (15 ton (RFVFC) + 80 kg P_2O_5 fed^{-1}) with an increment of +11.3%. Translating these values into considerations the price of added fertilizer and expected price of kernel yield, the calculations reveal that the net income for the three treatments could be: 8396 and 7011 Egyptian pound for these treatments, respectively, the treatments of (15 ton (RFVFC) + 60 kg P_2O_5 fed^{-1}) followed by(15 ton (RFVFC) + 80 kg $P_2O_5fed^{-1}$) could be recommended for obtaining the highest rate of income from the kernel yield of peanut crop.

Results in (Table, 5) show that under the lower RFVFC rate, N content of root, stem, leaf and kernel were significantly increased by increasing P fertilization rate. Under the higher RFVFC rate, N content of stem and root was significantly decreased by increasing P fertilization rate, which is probably attributed to N translocation to others organs of peanut plant, especially at maturity stage. Kumar and Rao [10] recorded a decrease in N content by increasing P fertilization level that was attributed to N mobilization from vegetative organs to seeds at the time of maturity. While N content of leaf and kernel increased with increasing P fertilization rate under the higher RFVFC rate. El-Habbasha *et al*.,[11] found that addition of 30 kg P_2O_5 fed^{-1} improved the growth and yield as well as N content in peanut plants.

Increasing of RFVFC from the low rate to the high rate increased N content in peanut root, stem, leaf and kernel showing average values of 0.949, 1.859, 1.794 and 3.291%, respectively. The maximum N content of root and stem (2.097 and 1.007%, respectively) occurred under the higher RFVFC rate and second P fertilization rate (40 kg P_2O_5 fed^{-1}), while the maximum N content of leaf and kernel (1.857 and 3.510%, respectively) occurred under the higher RFVFC rate + the highest P fertilization rate.

Table (5): Effect of Remnants of Freeze Vegetable Factories Compost (RFVFC) and P fertilization rates on nutrients content of root, stem, leaf and kernel of peanut plant at maturity stage.

RFVFC ton fed^{-1}	P kg fed^{-1}	Root			Stem			Leaf			Kernel		
		Nutrients content (%)											
		N	P	K	N	P	K	N	P	K	N	P	K
10	0	1.263	0.088	1.083	0.755	0.10	1.437	1.480	0.125	0.980	3.137	0.363	0.713
	40	1.607	0.094	1.090	0.500	0.108	1.753	1.737	0.148	1.313	3.157	0.397	0.733
	60	1.908	0.125	1.230	0.590	0.115	1.780	1.773	0.167	1.333	3.210	0.430	0.760
	80	1.997	0.139	1.427	0.927	0.129	1.583	1.833	0.174	1.310	3.430	0.441	0.813
mean		1.694	0.111	1.207	0.693	0.113	1.638	1.706	0.153	1.234	3.233	0.408	0.755
15	0	1.307	0.091	1.220	0.933	0.112	1.477	1.710	0.143	1.113	3.203	0.376	0.753
	40	2.097	0.097	1.220	1.007	0.146	1.753	1.780	0.155	1.433	3.203	0.398	0.850
	60	2.027	0.133	1.293	0.997	0.173	1.750	1.830	0.174	1.363	3.250	0.431	0.860
	80	2.007	0.153	1.653	0.860	0.176	1.750	1.857	0.184	1.233	3.510	0.443	0.940
mean		1.859	0.118	1.346	0.949	0.152	1.682	1.794	0.164	1.286	3.291	0.412	0.851
Control		2.113	0.125	1.453	1.013	0.174	1.397	1.497	0.093	1.113	3.270	0.414	0.977
$L.S.D._{0.05}$		0.097	0.017	0.056	0.056	0.017	0.056	0.017	0.017	0.079	0.056	0.017	0.017

Under both two rates of RFVFC, increased P content of all peanut organs (root, stem, leaf and kernel) were mostly significantly under increasing P fertilization rate. P content values in peanut root, stem, leaf and kernel steadily increased as the rate of applied P increases, showing average values of 0.152, 0.118, 0.164 and 0.412%, respectively, under higher RFVFC rate as compared with lower applied RFVFC rate (average values 0.113, 0.111, 0.153 and 0.164 %, respectively). The maximum P content of root, stem, leaf and kernel (0.153, 0.176, 0.184 and 0.443%, respectively) occurred under the higher RFVFC rate and highest P fertilization rate (80 kg P_2O_5 fed^{-1}). Kamal [12] applied $30m^3$farmyard manure + 31 kg P_2O_5 per feddan and obtained the highest yield values of both seeds and dry matter as well as P content of seasam.

Under the lower RFVFC rate, slight increase in K content of root and kernel occurred under increasing P fertilization rate applied; but K significant increase occurred in stem and leaf up to third rate of P fertilization (60 kg P_2O_5 fed^{-1}). Under the higher RFVFC rate, slight increase in K content occurred in root and kernel under increasing P fertilization rate, also K content of stem and leaf decreased slightly under increasing P fertilization rate applied.

Potassium content values in peanut root, stem, leaf and kernel steadily increased as the rate of applied P increases, showing average values of 1.682, 1.346, 1.286 and 0.851 %, respectively, under higher RFVFC rate as compared with lower RFFC rate (average values 1.638, 1.207, 1.234 and 0.735 %, respectively). The maximum K content of root and kernel (1.653 and 0.940 %, respectively) occurred under the higher RFVFC and highest P fertilization rate, but the maximum K content of stem (1.780) occurred under the lower RFVFC (10 ton fed^{-1}) and third rate of P fertilization (60 kg P_2O_5 fed^{-1}). The maximum K content of leaf occurred under the higher RFVFC rate (15 ton fed^{-1}) and second P fertilization rate (40 kg P_2O_5 fed^{-1}).

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