

EFFECT OF CHICKEN MANURE AND MANURE COMPOST TEA ON POTATO YIELD AND SOIL FERTILITY.

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ABSTRACT

To evaluate the effect of chicken compost and compost tea on vegetative growth, yield components and chemical composition of potato crop (*Solanum tuberosum* L.) cultivar Spunta grown on a clayey soil and then study the effect of aforementioned factors on soil quality during the successive season of 2004/2005 winter a field experiment was performed out in Monshat El-Badawi Village, Talkha District, Dakahlia Governorate (North Nile delta region). Five treatments were arranged in a complete randomized block with three replicates, Four application methods (ore compost, sediment, sediment and extract combination and compost tea). Compost tea, foliar significantly increased dry shoot yield and fresh tuber yield. Also, application of compost tea increased dry matter (as %), crude protein (as %) and specific gravity of tubers in both seasons. As so, sediment and extract combination addition increased dry matter (as %) in tubers, and crude protein (as %) significantly. The addition of chicken manure into the soil increased both of total and available nitrogen, phosphorus and potassium in the soil. In spite of the highest values for all studied parameters under investigation were realized due to the compost tea treatment.

INTRODUCTION

Potato (*Solanum tuberosum* L.) is one of the most important vegetables in Egypt. It gained a considerable importance as an export crop to European markets and one of the national income resources. Potatoes require high amounts of nitrogen, potassium and phosphorus fertilizers for optimum growth, production and tuber quality. The nutrients management plans including their economic cost and return were frequently kept to be discussed to obtain optimum yield and maximum profit. In this frame, change of the potatoes fertilization by chicken compost and compost tea from traditional system to an integrated one consists of soil and foliar applied may be needed.

Compost tea, in modern terminology, is a compost extract brewed with a microbial food source molasses, kelp, rock dust, humic and fulvic acids. The compost tea brewing technique, an aerobic process, extracts and grows populations of beneficial micro-organisms. Compost tea was used as the source of organic substances. As so in recent years, compost tea have emerged as an important component of the integrated nutrients supply system and hold a great promise to improve crop yields through environmentally better nutrient supplies. Extracts of the finished composts were reduced bacterial toxicity. Ana *et al.*, (1995) showed that is the best quality compost from a fertilizer perspective was starting from an initial C:N ratio equal to about 20:1, but starting from this C:N ratio could bring problems with the content of cadmium, so the recommended starting conditions must

be about 30:1. However, the application of compost tea in practice, somehow, has not achieved constant effects.

Organic farming systems that are based on three practical pillars; (1) the maintenance and increase of soil fertility by the use organic manures;(2) the omission of synthetic fertilizers and synthetic pesticides; (3) the lower use of high energy consuming feedstuff (FlieBbach, *et al.*, 2006 and El-Wehedy 2008). The organic matter content of the Egyptian soils is usually less than 2% in cultivated area. Frequent and high application of organic manure are necessary to maintain soil fertility. In Egypt chicken manure is usually used as organic fertilizer. This organic fertilizer vary greatly in their composition. Generally, soil organic matter is considered as an important factors for improving physical, chemical and biological properties of soil (Abd-el moez *et al.*,1999).

The objectives of this study are to evaluate the effect of chicken manure composted and its compost tea on the growth, yield, yield components, and chemical composition of Potato plants along with avoiding the environmental pollution from chemical fertilizers usage which lead to bad effects on potential health of plants, animals and humans.

MATERIALS AND METHODS

A field experiment was conducted during the successive growing season of winter 2004/2005 on potato (*Solanum tuberosum*, L.) cultivar Spunta. Soil analysis has been carried out according to (Jackson, 1967).

Table (1): Some soil properties of the studied soil

property	Mechanical analysis				Physico properties						
	Sand %	Silt %	Clay %	texture	SP %	OM %	CaCO3 %	pH	EC dSm-1		
Values	14.01	25.97	60.02	Clayey	79.93	1.39	2.77	7.4	1.63		
property	Soluble Cations (meq/L soil)				Soluble Anions (meq/L soil)				Available nutrients (p		
	Ca ⁺⁺	Mg ⁺⁺	K ⁺	Na ⁺	CO ₃ ⁻	HCO ₃ ⁻	Cl ⁻	SO ₄ ⁻	N	P	K
Values	2.46	2.39	0.31	0.87	0.00	0.79	2.27	2.97	37.16	9.03	365.17

Table (2): Some chemical properties of chicken manure:

Chicken Manure	pH*	EC** dS/m	O.C. %	Total N %	C:N ratio	Total K%	Total P %	Adding rate
Ore Compost	8.37	0.91	24.53	1.72	14.26	0.71	0.67	6.98 (t/fed)
Extract	7.40	0.61	7.09	1.24	5.72	0.47	0.43	9.68 (L/fed)
Sediment	7.79	0.73	21.05	0.79	26.65	0.39	0.29	15.19 (t/fed)

*pH was measured in 1: 1suspension.

** EC was measured in (1: 1) watery extract.

The experiment was designed in a complete randomize block with three replicates. Treatments were as follow: (ore compost, sediment, sediment and extract combination and compost tea). The ore compost and the sediment were applied before the last tillage, then soil was irrigated and left for 14 days before planting. Control plots received the recommended dose by the ministry of agriculture for the N, P and K nutrients. Calcium super-phosphate was applied before planting irrigation at the rate of

recommended dose of (75kg P₂O₅/fed). Ammonium nitrate fertilizer was applied at the rate of recommended dose (120kg N/fed) in two doses, the 1st dose was added with the 1st irrigation and the 2nd dose with the 2nd after planting. Potassium was applied in one dose with the 2nd irrigation after planting at the recommended dose (95kg K₂O/fed). Compost tea was applied as foliar application on plant shoot at 2 times after 45 and 60 days from planting. Potatoes plants were irrigated 7 irrigations after planting. Potatoes were harvested after 110 days from planting date. Potato tuber pieces were planted in October 13th 2004 and harvested in January 28th 2005, and the following parameters were recorded at the midseason and harvest stages: (1) Fresh tubers yield (t/fed). (2) Tuber quality parameters: dry matter (%) ; specific gravity and crud protein (%). (3) Chemical constituents: N, P and K (%) were determined in leaf, stem and tuber dry matter according to (Jackson, 1967). (4) Soil chemical properties: total and available nitrogen, phosphorus and potassium was determined, as described by (Hesse, 1971).

The statistical analysis of the obtained data was done according to the methods described by (Gomez and Gomez, 1984) using LSD to compare the means of treatments values.

RESULTS AND DISCUSSION

The discussion will include the effect of soil and foliar applied of chicken manure compost and compost tea on yield, yield quality, chemical constituents of N, P, K and some soil chemical properties.

1-Plant Growth:

Plant Height:

Data in Table (3) illustrate the effect of chicken manure, lowest value was shown with ore compost (42.83cm), increased to be (43.86cm) with sediment, and more increased to be (45.26cm), the highest value was (48.51cm). The control treatment was the highest value as it was (51.38cm). These results are in agreement with those obtained by; El-Dissoky (2008) and El-Shazly (2008).

Leaf Area:

Data in table (3) indicated that there were a significant differences between the composts tea and the control treatment. The superiority was due to composts tea in the foliar forms. Mineral fertilizers (control treatment) obtained (0.3289m² plant⁻¹). The values of leaf area (m² plant⁻¹) were (0.3502m² plant⁻¹) with chicken compost tea. Also, data illustrated the significantly differences in the leaf area between the various treatments. The value of leaf area with chicken sediment and compost tea was (0.3266m² plant⁻¹). As obtained in the table, sediment leaf area value was (0.3167m² plant⁻¹). But the ore compost had lowest record where gave (0.2849m² plant⁻¹). These effects of organic manures on potato leaf area may be related to the important role of Nitrogen, Phosphorus and Potassium in the plant tissues that reflect on vegetative growth. they plays vital role in photosynthesis, carbohydrate transport, protein formation, control of ionic balance, regulation

of plant stomata and water use activation of plant enzymes and other processes, El-Sawy, *et al* (2000), El-Dissoky (2008) and El-Shazly (2008).

2- Tubers quality:

Yield Fresh Weight:

About the effect of chicken manure, as shown clearly in table (3) there was a significant differences between the treatments together. Highest records obtained with chicken compost tea (14.46 ton fed-1), respectively. Whereas, the same lowest mean recorded of total fresh weight which was (11.90 ton fed-1) as obtained with the chicken ore compost treatment. Sediment alone and when combined with compost tea gave higher means than ore compost. As obtained in table (3) tuber fresh yield was (12.34 ton fed-1) and (13.32 ton fed-1) with sediment and combination, respectively.

Table (3): Effect of applying chicken manure compost and compost tea on potato plant height (cm), leaf area (m2), Fresh Weight (ton/fed) and Tubers humidity (%)

Parameter	Plant Height (cm)	Leaf Area (m2)	Fresh Weight (ton/fed)	Tubers humidity (%)
Control	51.38	0.3289	13.19	76.85
Ore Compost	42.83	0.3049	11.90	72.90
Compost Tea	48.01	0.3002	14.46	78.63
Sediment	43.86	0.3167	12.34	73.98
Sed. + ext.	40.26	0.3268	13.32	70.38
LSD 5%	0.4380	0.0012	0.1140	0.2890

Tubers humidity percentage (%):

Referring to the effect of chicken manure, differences between the organic applications were high significant. Considering mean values of humidity percentage of tubers, data in table (3) could be observed that values of the relative increase over the compost tea treatments using watery extracts of chicken compost was (78.63%). The mineral fertilizers (control treatment) given a high value of humidity percentage which was (76.85%). However, the addition of organic manures increase tuber humidity percentages at harvest (after 110 days after planting). The minimum mean values of tuber humidity percentage was (72.90%) which obtained from the addition of chicken ore compost. Whereas the percentage of tuber humidity gone higher twice. Firstly with applying sediment which was (73.98%). Secondly heightens was occurred with the combination between sediment and extract, as the value was (70.38%).

Tuber humidity due to the ability of the inner tissues for storing water molecules between cells, this ability was improving by the roles of essential nutrients in encouraging cell elongation and cells divisions which increasing the vegetative parameters and activation of metabolic which reflected increases in tissues buildings and improving walls permeability for water and solution transportations. These effects of chicken, sheep and chicken manures on humidity percentages in tubers are in accordance with those reported by El-Banna *et al.*, (2001), El-Dissoky (2008) and El-Shazly (2008).

3- Chemical constituents in potato plant leaves:

Nitrogen:

As obtained in Table (ε) The mean values of nitrogen concentration in potato leaves at the midseason stage become higher from (3.99%) at ore compost from chicken manure, to be (4.21%) at sediment treatment, (4.50%) when treating by combination between sediment and extract and were (4.76%) with chicken compost tea. Control treatment occurred a moderate means which was (ε, 37%).

Chicken manure treatments appear the same line at the harvest stage as shown in table (ε). Means gone higher from applying chicken ore compost treatment to be higher with sediment and more higher with the combination between sediment and extract until get highest with chicken compost tea. As observed in the table, lowest means were (1.53%) found by adding chicken ore compost, then increased to be (1.83%) with sediment, and continue increasing with combined sediment and extract to be (2.19%), and the highest values were (2.60%) when applying chicken compost tea.

These results may be attributed to the high capacity of the plants received such treatments in building metabolites which reflect on more vigorous plant growth and rooting system which in turn contributes to increase in nitrogen concentration. These results are in accordance with those obtained by Abou-Hussein (2005), Selim and El-Mancy (2007) and El-Shazly (2008).

Phosphorus :

Concerning to the effect of chicken compost treatments on phosphorus concentration in potato leaves, data in Table (ε) reveal that, there was a general increase in phosphorus values and its content with treating of chicken compost tea better than the other applications to potato plants at 70days after planting. Data in table (5) pointed out that phosphorus content in potato leaves at the midseason stage was (1.01%), (1.03%), (1.06%) and (1.14%) with the chicken ore compost, the sediment, the combination and the compost tea, respectively. As control treatment occurred a moderate means which were (1.08%).

Similarly, The mean values of phosphorus concentration in potato leaves at the harvest stage become higher from (0.273%) at ore compost from chicken manure, to be (0.432%) at sediment treatment, (0.537%) when treating by combination between sediment and extract and were (0.707%) with chicken compost tea.

Mineral fertilizers (control treatment) occurred (0.581%) in phosphorus concentration in potato leaves. And regarding to the statistical analyses for the data reported during the experiment seasons, it is clearly that there is a high significantly differences among the organic applications and the inorganic treatment.

Table (4): Effect of applying chicken manure and manure compost tea on Leaves Nitrogen, Phosphorus and Potassium at the midseason and harvest times.

Parameter	Nitrogen (%)		Phosphorus (%)		Potassium (%)	
	midseason	harvest	Midseason	harvest	midseason	harvest
Control	4.37	2.08	1.08	0.581	6.73	4.60
Ore Compost	3.99	1.53	1.01	0.273	6.90	3.86
Compost Tea	4.76	2.60	1.14	0.707	7.09	4.82
Sediment	4.21	1.83	1.03	0.432	6.30	4.08
Sed. + ext.	4.50	2.19	1.06	0.537	6.60	4.41
LSD 5%	0.892	0.792	0.114	0.111	0.168	0.140

Potassium :

Regarding the effect of chicken compost treatments on potassium concentration in potato leaves, data in Table (4) obtained that, there was a general increase in potassium values and its content with treating of chicken compost tea better than the other applications to potato plants at the midseason stage.

As obtained in Table (4) potassium concentration in midseason, control treatment presented a moderate value which was (6.73%).

About the midseason potassium concentration, data in the table reported that there is an increasing from (6.90%) with chicken ore compost to (6.30%), (6.60%) and (7.09%) with the sediment, combination between sediment and extract and compost tea of chicken manure, respectively.

Data in the same table showed that potassium content in potato leaves at the harvest stage were (4.60%) with applying the minerals fertilizers as control treatment. The statistical analysis of potassium concentrations data at the harvest stage indicate that applying the chicken manure significantly increased the differences among the treatment and the control.

With chicken treatments, data in table (4) revealed that values were (3.86%), (4.08%), (4.41%) and (4.82%) with chicken ore compost, sediment, combination and compost tea, respectively.

These increases of nutrient concentrations in plant parts with organic manure addition may be attributed to that organic matter is a good sources of plant nutrients and also growth promoting substances, which improve plant growth and plant tissues development. Similar results were reported by Awad and Griesh (1992) and Bitro and Hadley (1993). Moreover, El-Koumy *et al.* (2000) and El-Wehedy (2008) observed that the addition of organic manure increased the availability of soil nutrients. And so Toderi *et al.* (1999)) and El-Wehedy (2008) indicated that the use of organic materials increased P₂O₅ concentration in the plant tissues.

3- Chemical constituents in potato tubers:

Data presented in Table (5) showed the effect of applying chicken compost and compost tea on nitrogen, phosphorus and potassium concentration in potato tubers. Data showed that the applications gave differences with a high significant values in nitrogen, phosphorus and potassium percentages in tubers with the application methods in the experimental seasons.

Table (5): Effect of applying chicken manure and manure compost tea on tubers Nitrogen, Phosphorus and Potassium at the midseason and harvest times.

Parameter	Nitrogen (%)	Phosphorus (%)	Potassium (%)
Control	1,20	0,86	3,08
Ore Compost	0,78	0,57	1,90
Compost Tea	1,48	0,94	3,71
Sediment	0,93	0,75	2,04
Sed. + ext.	1,17	0,84	3,11
LSD 5%	0,0886	0,0339	0,1087

Nitrogen (%):

The mean values of the nitrogen percentages as affected by chicken manure were (0.78, 0.93, 1.17 and 1.48%) when the chicken manure added as chicken ore compost, sediment, combination and compost tea, respectively. As control treatment gave concentrations as (1.20%). It could be noticed that the means of absorbed nitrogen by potato tuber tissues were higher than the means of absorbed nitrogen by potato top tissues at the different growth stages. These results could be enhanced by those obtained by El-Shazly (2008).

Phosphorus (%):

The mean values presented in Table (5) showed the percentages of total phosphorus in potato tubers which were (0.57, 0.75, 0.84 and 0.94%) as treated by chicken ore compost, sediment, combination and chicken compost tea in the first season, respectively. So data of the second season gave the same trends, where the values were (0.54, 0.62, 0.71 and 0.84%) as influenced by the same ways of additions in the first season, respectively. As the control treatment gave (0.86%).

Potassium (%)

The influence of chicken manure on potassium concentration in potato tubers in the present experiment which are occurred also in table (5). As the control treatment gave (3.08%). And the mean values of phosphorus concentration in potato tubers become higher from (1.90%) with ore compost from chicken manure to be (2.54%) at sediment treatment, (3.11%) when treating with the combination between sediment and extract and were (3.71%) with chicken compost tea.

The steady release of the nitrogen, phosphorus and potassium from chicken manure may have resulted that they have been taken up mainly in the form of available forms which probably caused nutrients accumulations in the plants tissues (Kolbe *et al.*, 1995). Our results are in accordance with those reported by El-Banna *et al.*, (2001), Tawfik (2001); Awad (2002); Ibrahim *et al.*, (2006), El-Mancy and Selim (2007) and El-Shazly (2008).

4-Soil fertility:

Nitrogen:

There is no doubt that nitrogen concentration and availability in the experimental soil will be increased due to applying organic fertilizers enriched in nitrogen. Data presented in table (6) showed the effect of using chicken manure in fertilizing potato field. As reported the total nitrogen concentrations

were (1.17%) when chicken manure added as an ore compost, but the nitrogen values gone lower with sediment to be (0.94%) and more lower to be (0.39%) with combination between sediment and extract. Lowest concentrations occurred by the compost tea which were (0.16%).

Talking about total nitrogen concentration in potato experimental field at the harvest stage, data reported in table (٦) that there is a significant differences among the treatment in total nitrogen concentration as influenced by applying organic manure. Table (٦) pointed out that total nitrogen concentrations in potato field at the harvest stage were (0.52%), (0.33%), (0.17%) and (0.09%) with the chicken ore compost, the sediment, the combination and the compost tea, respectively. When applying the fertilizers as minerals in the control treatments, means were (0.18%).

Phosphorus:

Data obtained in table (٦) showed the effect of adding chicken manure into potato field. As reported the total potassium percentages were (0.90%) when chicken manure added as an ore compost, but the nitrogen values gone lower with sediment to be (0.71%) and more lower to be (0.50%) with the combination. Lowest potassium concentration at midseason stage occurred by the compost tea which were (0.30%). Control treatment values were (0.44%). However these value was decreased at harvest to be (0.17%).

The same trends in, total phosphorus percentage were obtained when the plants get chicken manure treatments, as it was (0.40%) with ore compost, which decreased to be (0.30%) with sediment, and decreased more to be (0.14%) as affected by the sediment combined with extract dose, until become the lowest by applying chicken compost tea to be (0.10%).

Table (٦): Effect of applying chicken compost and compost tea on soil total Nitrogen, Phosphorus and Potassium at the midseason and harvest times.

Parameter	Nitrogen (%)		Phosphorus (%)		Potassium (%)	
	midseason	harvest	midseason	harvest	midseason	harvest
Control	٠,٢٧	٠,١٨	٠,٤٤	٠,١٧	٠,٦٧	٠,٣٨
Ore Compost	١,١٧	٠,٥٢	٠,٥٦	٠,٤٠	٠,٩٠	٠,٦١
Compost Tea	٠,١٦	٠,٠٩	٠,١٨	٠,١٠	٠,٣٠	٠,٢١
Sediment	٠,٩٤	٠,٣٣	٠,٤٠	٠,٣٠	٠,٧١	٠,٤٨
Sed. + ext.	٠,٣٩	٠,١٧	٠,٢٨	٠,١٤	٠,٥٠	٠,٣١
LSD 5%	٠,١٠٥	٠,٠٥٧	٠,٠٦٣	٠,٠٤٦	٠,٠٦٨	٠,٠٦٨

Potassium:

There is a high significant reduction in potassium concentrations of both total and available forms as influenced by chicken manure in the experimental field reported also in Tables (8-9). Data observed show that in both total and available phosphorus were differenced high significant with applying various types of organic manures in potato field. Control treatment values were (0.67%) when the plants get midseason.

Data obtained in table (8) showed the effect of adding chicken manure into potato field. As reported the total potassium percentages were (0.90%) when chicken manure added as an ore compost, but the nitrogen values gone lower with sediment to be (0.71%) and more lower to be (0.50%)

with the combination. Lowest potassium concentration at midseason stage occurred by the compost tea which were (0.30%). Regarding to effect of adding organic fertilizers on available potassium concentration in the experimental field show the same tends as shown in table (9).

When chicken manure added can also obtained differences in a highly significant in total potassium in the experimental soil at harvest stage, these concentration were (0.61%) with ore compost, and be (0.48, 0.31 and 0.21) with sediment, combination and compost tea, respectively.

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تأثير إضافة سماد الدواجن ومستخلص الكمور علي محصول البطاطس وخصوبة التربة.

إبراهيم محمود الطنطاوي ، أيمن محمد الغمري و أحمد حسن محمد عبد الرحيم حبيب.
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أجريت تجربة حقلية خلال الموسم الشتوي لعام ٢٠٠٤/٢٠٠٥ في قرية منشأة البدوي بمركز طلخا - محافظة الدقهلية لتقييم تأثير سماد الدواجن في صور مختلفة حيث يتم إضافته أرضياً علي الصورة الصلبة وورقياً للصورة السائلة الناتجة عن استخلاص الكمور علي محصول البطاطس صنف سبونتا و التربة. وكانت النتائج كما يلي:-

- ١- تسببت معاملة نباتات البطاطس بالمستخلص المائي للكمور إلى زيادة ارتفاع النبات ونسبة الرطوبة في الأوراق والسيقان وعدد الأوراق وكذلك في المساحة الورقية والكلوروفيل.
- ٢- أدت إضافة الصورة الصلبة للكمور إلى التربة إلى زيادة تركيز كل من النيتروجين والفسفور والبوتاسيوم في التربة في الصورتين الكلية والميسرة.
- ٣- وجد أن أعلى القيم المتحصل عليها نتجت من إضافة المستخلص المائي للكمور.
- ٤- أدى دفن الصورة الصلبة لسماد الدواجن على عمق ٢٠ سم إلى زيادة تركيزات المغذيات الكبرى.
- ٥- أدت المعاملة بسماد الدواجن إلى زيادة المحصول الكلي ورطوبة الدرنات وكذلك ارتفعت نسبة البروتين الخام والكثافة النوعية في الدرنات عند معاملة النباتات بالمستخلص المائي.
- ٦- ارتفعت تركيزات النيتروجين والفسفور والبوتاسيوم ارتفاعاً حاداً في الدرنات بالمعاملة بالمستخلص المائي للكمور.
- ٧- يرتفع محتوى مستخلص الكمور من المغذيات الكبرى بناء علي محتوى الأسمدة العضوية عليها.