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Application of Bio-Organic Farming and its Influence on certain Pests Infestation, Growth and Productivity of Potato Plants

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Abstract: A pot trial was implemented in the greenhouse of National Research Centre, Cairo, Egypt to investigate the associative influence of certain composted agricultural residues i.e., egg-plant; okra, pepper and maize stalks and the foliar application of yeast culture *(Candida tropicalis)* on the infestation of potato plants with white fly (*Bemisia tabaci*) and thrips (*Thrips tabaci*) as well as its effect on some growth and yield parameters of potato. Organic fertilization of potato plants with egg-plant compost significantly reduced the infestation numbers of potato plants either with white fly or thrips. For white fly infestation, the reduction percent reached 54 in comparison with the control and 24 when compared with the recommended doses of NPK treatment. Concerning thrips infestation, the reductions amounted to 80% in comparison with the control and 73% when compared to the recommended doses of NPK treatment. The reduction percentages in white fly infestation numbers ranged from 21 to 54 due to the organic fertilization with either various types of composted agricultural residues or the traditional chicken manure and farm yard manure. These reduction percentages ranged from 11 to 80 for thrips infestation numbers. The foliar application of yeast reduced the infestation numbers of white fly and thrips in comparison with the corresponding untreated treatments with yeast. The reduction percentages ranged from 0.2 to 17.9 for white fly and from 33 to 64 regarding thrips. A synergistic effect was recorded between organic fertilization and the foliar application of yeast on potato yield, where the combined application of organic fertilizers and yeast resulted in significant variations in comparison with the organic fertilizers as such. The increasing percentages in potato yield ranged from 21 to 73.

Keywords: Organic farming, Potato yield, White fly, Thrips, composted agricultural residues.

INTRODUCTION

Recently, a great attention was drown towards the application of bio-organic farming to avoid the heavy use of agrochemicals that resulted in numerous environmental troubles[5]. The coincident application of organic manures and biofertilizers is frequently recommended for improving soil properties and obtaining clean agricultural products[4]. Proponents of organic agriculture have asserted that plant grown with biological sources of nutrients, such as manures and composted organic waste, are less susceptible to insects than conventionally grown plants[7,3,9,6]. This investigation aims at evaluating the effect of various types of composted agricultural residues i.e., egg plant, maize stalks, okra plants and pepper plants in addition to the traditional organic manure (Farmyard and chicken manures) and the foliar application of soil yeast (*Candida tropicalis*) on growth, productivity and insects population of potato plants.

MATERIALS AND METHODS

A pot trial was implemented during the growing season of 2003/2004 to study the impact of composted agricultural residues of egg plant, maize, okra and pepper in addition to certain organic manures i.e., chicken manure and farm yard manure either alone or combined with the foliar application of soil yeast *Candida tropicalis* on pests infestation, growth and productivity of potato plants. The obtained results from the bio-organic treatments were compared to those obtained due to the application of recommended doses of mineral fertilizers NPK (150 N unit as urea 46.5%, 75 P_2O_5 unit as super phosphate 15.5% and 100 K_2O unit as potassium sulfate). The various composted organic materials and organic manures were added to the pots before cultivation on the base of their nitrogen contents equivalent to N-units of the applied urea fertilizer, namely 19 gm egg-plant compost (0.51%) , 18 gm maize compost (0.55%), 17 gm

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Okra compost (0.56%), 17 gm pepper compost (0.56%), 4 gm chicken manure and 31 gm farm yard manure. Plastic pots of 30 cm diameters were filled with 5 kg clay soil for each and then cultivated with 2 potato tubers variety *Nicola* that brought from the Association of Potato Production, Menufeya. The agricultural residues of egg plant , maize, okra and pepper were gathered separately, chopped and then subjected to composting process using the cellulose-decomposer *Candida humicola*. Regardless of the type of agricultural residues, the composted materials reached their maturity after 65 days. The applied rates of various types of compost were calculated on the basis of their nitrogen content.

A liquid culture of soil yeast (*Candida tropicalis*) containing $8.1x10^5$ CFU/ml was used for foliar spraying of potato plants according to the proposed treatments as follows:

- Control.
- Foliar application of yeast.
- Positive control (100% NPK).
- Positive control + yeast.
- Chicken manure.
- Chicken manure + yeast.
- Farm yard manure.
- Farm yard manure + yeast.
- Egg-plant compost.
- Egg-plant compost + yeast.
- Maize compost.
- Maize compost + yeast.
- Okra compost.
- Okra compost + yeast.
- Pepper compost.
- Pepper compost + yeast.

Potato plants were sprayed with the yeast culture three times during the growth period, the first was after one month of the cultivation, the second was after two weeks of the first and the third was applied after two weeks of the second one. Infestation of potato plants with immature stage white fly was determined one week intervals starting from the second half of December up to the end of February. Ten leaves were randomly collected from each treatment and then the mean numbers of infestation were calculated. Also, leaves number per plant, plant height and yield fresh weight per plant were determined.

RESULTS AND DISCUSSIONS

Table (1) shows the effect of fertilization with various types of composts on infestation of potato leaves with the white fly at one week intervals during the period from December to February. In general, the highest number of infestation was recorded during January regardless of the type of applied compost followed by February, while the least number of infestation was recorded at December. In comparison with full dose of NPK treatment, the organic fertilization of potato plants with egg-plant compost resulted in remarkable reduction in white fly (*Bemisia tabaci*) infestation. Further, comparable results to the positive control were obtained due to the organic fertilization with pepper compost or farm yard manure, while the organic fertilization with maize compost, okra compost or chicken manure induced infestation values resemble to the control treatment.

The combined effect between the diverse types of composted agricultural residues in addition to the traditional organic and chemical fertilizers in comparison with the control treatment was shown in Table (2). It is worthy to mention that a general trend was observed irrespective of the treatment type, where the highest values of infestation with the white fly were recorded in January while the lowest values were in December. The yeast including treatments of maize, egg-plant and pepper composts and NPK treatment as well revealed insignificant reduction in the white fly infestation in comparison with the control treatment. Moreover, the foliar application of yeast as such insignificantly reduced the infestation of potato leaves with the white fly. On the other hand, Table (2) also indicates that organic manuring of the potato plants with okra compost, farm yard manure and chicken manure treatments that foliar sprayed as well with yeast showed values of infestation surpassed that recorded with the control treatment. In addition, these differences were significant concerning okra compost + yeast and chicken manure + yeast treatments while the variation was not significant for farm yard manure + yeast treatment.

Table (3) demonstrates the influence of various tested organic treatments, against the recommended doses of NPK and the control treatments, on infestation of potato leaves with thrips. Generally, the least numbers of thrips (*Thrips tabaci*) infestation were recorded in December while the highest numbers were found in February irrespective of the treatments. Furthermore, highly significant reductions in comparison with the control were observed in thrips individuals infestation due to the organic fertilization with pepper, okra, and egg-plant composts and chicken manure. Also, Table (3) shows that a highly significant reduction in thrips infestation was registered owing to fertilization with the recommended doses of NPK. In comparison with the recommended doses of NPK, as a positive control, it was

Table 1: Effect of various types of composted agricultural residues on infestation of potato leaves with the immature stage of the white fly, *Bemisia tabaci* during winter season of 2003/2004.

Date		Control	Chemical (NPK)	Chicken manure	Farm yard manure	Egg-plant compost	Maize compost	Okra compost	Pepper compost
		The mean numbers of infestation of immature stage of the white fly / 10 leaves							
Dec.	14	172	82	292	144	77	198	221	109
	21	296	107	415	246	193	341	437	214
	28	335	115	719	493	281	666	603	417
Mean		268	101	475	294	184	402	420	247
Jan.	4	1217	286	955	992	315	945	845	785
	11	1291	747	878	1183	622	827	1702	986
	18	1544	1009	1140	1039	904	1635	1306	898
	25	1894	885	1680	856	763	1837	1025	966
Mean		1485	732	1163	1018	651	1311	1220	909
Feb.	1	1226	957	1325	960	525	1779	1597	650
	8	751	879	1080	824	530	1140	1158	866
	15	984	535	1149	795	365	720	1266	512
	22	509	331	846	426	212	365	914	474
	29	278	476	564	372	95	269	614	188
Mean		750	636	993	675	345	855	1110	538
General Mean ±S.E (min.-max.)		874.8^{a}+163.7 (172-1894)	534.1^{b}+101.5 (82-1009)	920.3^{a}+113.3 (292-1680)	694.2^{a}±98.9 (144-1183)	407^{c}±76.1 (77-904)	893.5^{a}±170.4 (198-1837)	974^{a}+131.8 (221-1702)	588.8^{a}±91.06 (109-986)

$L.S.D_{0.05}$ = 292.3 $L.S.D_{0.01}$= 387.8

* Means with the same letters have no significant differences P < 0.05.

Table 2: The combined effect of various types of compost and the foliar application of soil yeast (*Candida tropicalis*) on infestation of potato leaves by the white fly immature stages of *Bemisia tabaci* during winter season of 2003/2004.

Date		Control	Chemical (NPK)	Chicken manure	Farm yard manure	Egg-plant compost	Maize compost	Okra compost	Pepper compost
		The mean numbers of infestation of immature stage of the white fly / 10 leaves							
Dec.	14	172	72	349	147	87	24	154	31
	21	296	104	607	269	162	151	446	88
	28	355	321	1183	323	367	342	712	125
Mean		268	166	713	246	205	172	437	81
Jan.	4	1217	435	1340	815	473	518	1601	416
	11	1291	845	3768	1971	691	1215	1867	1080
	18	1544	1105	2735	2153	550	1342	3915	1187
	25	1894	752	2887	1337	466	1863	2623	942
Mean		1487	784	2683	1569	545	1234	2502	960
Feb.	1	1226	641	3081	717	436	1039	3186	854
	8	984	510	1542	663	525	845	1291	741
	15	751	396	986	746	410	681	997	644
	22	509	408	1196	945	119	528	782	317

Table 2: Continued.

	29	278	157	914	578	147	257	345	291
Mean		750	422	1544	730	327	670	1320	569
General Mean ±S.E		874.7[a]+163.7	477.9[a]±90.5	1715.6[c]+319.6	888.7[a]±183.2	369.42[a]±56.5	733.8[a]±158.1	1493.3[c]+345.6	559.7[a]±116.1
(min.-max.)		(172-1894)	(72-1105)	(349-3768)	(147-2153)	(87-691)	(24-1863)	(154-3915)	(31-1187)

$L.S.D._{0.05}$ = 559.5 $L.S.D_{0.01}$ = 737.6

* Means with the same letters have no significant differences P < 0.05.

Table 3: The impact of different types of composts on potato leaves infestation with thrips(*Thrips tabaci*)against the chemical fertilization treatment during winter season of 2003/2004.

Date		Control	Chemical (NPK)	Chicken manure	Farm yard manure	Egg-plant compost	Maize compost	Okra compost	Pepper compost
		The mean numbers of infestation of immature stage of the white fly / 10 leaves							
Dec.	14	0	0	0	0	0	0	0	0
	21	1	1	2	1	0	3	2	1
	28	5	2	1	3	1	5	5	1
Mean		2	1	1	1	0	3	2	1
Jan.	4	5	4	1	4	0	7	1	4
	11	6	3	0	2	2	4	4	3
	18	7	4	4	5	4	6	3	4
	25	9	6	6	3	1	8	1	6
Mean		7	4	3	4	2	6	2	4
Feb.	1	10	6	1	9	6	19	7	3
	8	24	5	25	16	2	37	6	11
	15	27	21	28	25	3	24	14	31
	22	16	18	23	38	4	22	25	26
	29	13	13	17	27	2	11	21	20
Mean		18	92	19	23	3	23	15	18
General Mean ±S.E		10.3[a]±2.4	7.7[a]±2.1	9.0[a]±3.2	11.1[a]±3.6	2.08[b]±0.5	12.2[a]±3.2	7.4[a]±2.4	2.9[a]±3.1
(min.-max.)		(0-27)	(0-21)	(0-28)	(0-38)	(0-4)	(0-37)	(0-25)	(0-31)

$L.S.D_{0.05}$ = 7.6 $L.S.D_{0.01}$= 10.1

* Means with the same letters have no significant differences P < 0.05.

found that the organic fertilization with egg-plant compost induced highly significant reduction in thrips infestation. Contrarily, the organic fertilization of potato plants with either maize compost or farm yard manure augmented infestation of potato leaves with thrips.

The combined influence of the diverse organic fertilizers and the foliar application of yeast and its effect on numbers of thrips individuals on potato leaves was shown in Table (4). Once again, a general trend was observed irrespective of the treatment where the highest infestation numbers of potato leaves with thrips were recorded in February while the lowest numbers were found during December. Moreover, reasonable reductions in the infestation numbers with thrips were recorded owing to the application of either various composted agricultural residues supplemented with the foliar spraying with yeast or both types of organic manures supported with yeast foliar spraying in comparison with the control. Both bio-organic treatment of composted egg-plant residues + yeast and farm yard manure + yeast were the only treatments that induced significant reductions in thrips infestation numbers.

The associative impact of different composted agricultural residues and the foliar application of yeast on plant height, leaves number and yield of potato was presented in Table (5). Regarding plant height, highly significant increases were obtained in comparison with the control treatment due to the diverse tested organic or bio-organic treatments. In comparison with the recommended doses of NPK treatment, all the organic fertilization either as such or supported with yeast as a foliar application induced highly significant increases.

Table 4: The associative effect of various types of composts and the foliar application of soil yeast on infestation of potato leaves with thrips(*Thrips tabaci*) during winter season of 2003/2004.

Date		Control	Chemical (NPK)	Chicken manure	Farm yard manure	Egg-plant compost	Maize compost	Okra compost	Pepper compost
		The mean numbers of infestation of immature stage of the white fly / 10 leaves							
Dec.	14	0	0	0	0	0	0	0	0
	21	4	2	0	0	1	2	1	2
	28	6	1	1	0	0	1	0	3
Mean		3	1	0	0	0	1	0	2
Jan.	4	2	0	3	1	2	3	3	1
	11	5	5	9	2	3	8	6	1
	18	6	1	12	5	1	7	9	4
	25	13	3	5	2	2	6	10	6
Mean		7	2	7	3	2	6	7	3
Feb.	1	14	24	13	4	8	12	28	2
	8	24	27	10	11	6	18	33	9
	15	25	17	9	15	4	7	19	14
	22	16	11	4	9	2	6	6	15
	29	11	5	2	3	1	2	6	12
Mean		18	17	8	8	4	9	92	10
General Mean ±S.E (min.-max.)		10.5^{a}±2.4 (0-25)	8.0^{a}±2.8 (0-27)	5.7^{a}±1.4 (0-13)	4.3^{c}±1.4 (0-15)	2.5^{b}±0.7 (0-8)	6.0^{a}±1.4 (0-18)	10.1^{a}±3.1 (0-33)	5.8^{a}±2.6 (0-15)

$L.S.D_{0.05}$ = 5.5 $L.SD_{0.01}$ = 7.4

* Means with the same letters have no significant differences P < 0.05.

Table 5: Influence of different types of composts alone or combined with the foliar application of yeast culture on plant height, leaves number and fresh yield of potato during winter season of 2003/2004.

Treatment	Plant height (cm)	Leaves number per plant	Yield (gm/plant)
Control	25^{a}±1.1	17.7^{a}±0.3	9.4^{a}±1.3
Control + yeast	38^{c}±2.3	18^{a}±1.1	14.4^{c}±2.02
control (NPK)	36^{c}±0.6	17^{a}±1.7	19.1^{c}±0.6
control (NPK) + Yeast	39^{c}±2.8	12^{b}±0.6	22.1^{c}±1.1
Pepper compost	53^{d}±2.3	15^{b}±1.2	18.1^{c}±1.7
Pepper compost + yeast	65^{d}±1.7	22^{b}±1.7	24.4^{d}±1.5
Egg plant compost	55^{d}±4.04	21^{b}±1.2	18.7^{c}±1.8
Egg plant compost + yeast	63.3^{d}±2.6	20^{b}±1.2	25.7^{d}±1.1
Okra compost	62^{d}±1.7	21^{b}±1.2	19.6^{c}±2.2
Okra compost + yeast	55.3^{d}±3.2	21^{b}±1.7	23.7^{d}±1.2
Maize straw compost	59.3±2.03	17^{a}±1.2	21^{d}±0.9
Maize straw compost + yeast	72^{d}±1.5	21^{b}±1.2	26.5^{d}±1.04
Farm yard manure	47^{c}±2.9	17^{a}±1.2	12.04^{a}±1.3
Farm yard manure + yeast	70.7^{d}±5.8	30^{c}±1.7	20.8^{c}±1.6

Table 5: Continued.

Chicken manure	$56^{d}\pm1.7$	$22.3^{b}\pm0.9$	$11.7^{a}\pm0.6$
Chicken manure + yeast	$48.3^{c}\pm4.3$	$17^{a}\pm1.7$	$17.7^{b}\pm0.8$
Statistical Analysis	$L.S.D_{0.05}=7.99$ $L.S.D_{0.01}=10.6$	$L.S.D_{0.05}=2.1$ $L.S.D_{0.01}=5.8$	$L.S.D_{0.05}=3.9$ $L.S.D_{0.01}=5.1$

* Means with the same letters have no significant differences $P < 0.05$.

Table 6. Infestation of potato leaves with immature stage of white fly and thrips as affected by various tested organic fertilizers in the presence or absence of yeast.

Treatments	White fly			Thrips		
	Without yeast	With yeast	Reduction %	Without yeast	With yeast	Reduction %
Control	875	764	12.7	10.3	6.9	33.0
NPK	534	478	10.5	7.7	8.0	-
Chicken manure	920	916	0.4	9.0	5.7	36.7
Farm yard manure	694	889	-	11.1	4.3	64.0
Egg-plant compost	407	369	9.3	2.1	2.5	-
Maize compost	894	734	17.9	12.2	6.0	50.8
Okra compost	974	972	0.2	7.4	10.1	-
Pepper compost	589	560	4.9	9.2	5.8	37.0
General mean	736	710	3.5	8.6	6.2	27.9

The foliar treatment with yeast of potato plants that organically fertilized with composts of pepper and maize and farm yard manure as well increased significantly potato leaves number / plant when compared to these organic fertilizers as such. For potato yield (gm/plant), both treatments of farm yard manure and chicken manure treatments the only ones that did not implement significant increases in comparison with control. Inclusion the foliar application of yeast to the organic fertilization with pepper, egg-plant, okra and maize composts in addition to farm yard and chicken manures implemented additional significant increases in potato yield in comparison with either the positive control (100% NPK) or the corresponding organic treatments as such. The foliar application of yeast as such produced reduction in infestation numbers of potato leaves with thrips but did not reach the significant level.

DISCUSSION

Proponents of organic agriculture have asserted that organic fertilization make plants less susceptible to insects than conventionally grown plants[3,9,6]. The data within hand confirm the previous finding where remarkable significant infestation reductions either for white fly (*Bemisia tabaci*) or trips (*Thrips tabaci*) due to organic fertilization with egg-plant compost. The reduction percent of infestation with the individuals of white fly immature stage reached 54 in comparison with the control treatment and 24 compared to the recommended doses of NPK treatment concerning the infestation with trips the reductions reached 80% in comparison with the control and 73% when compared to the recommended doses of NPK treatment. The foliar application of yeast induced more reduction in white fly infestation that reached 52% in comparison with the control and 9% when compared with the same treatment without yeast application (Table 6). Moreover, the reduction percentages of white fly infestation due to the foliar application with yeast ranged from 0.2 to 17.9 being the lowest with okra compost and the highest with maize stalks compost, the general mean of infestation reduction due to yeast application reached 3.5% irrespective of organic or inorganic treatments. Regarding thrips infestation, the highest reduction percent in comparison with the control ranged from 9.7 to 79.6 due to the organic fertilization with various types of composts. Furthermore, the foliar application of yeast liquid culture induced reduction percent of thrips individuals reached 27.9 against 6.2 for the non-sprayed treatments. The effect of yeast in reducing either white fly or thrips individual numbers on potato leaves could be attributed to some biologically active materials secreted by yeast and have a repellent effect for insects. With regard to the combined

effect of organic fertilization and the foliar application of yeast culture on growth and yield of potato plants, it was found that a synergistic influence between both of them was observed. A synergistic effect was recorded between organic fertilization and the foliar application of yeast on potato yield, where the combined application of organic fertilizers and yeast resulted in significant differences in comparison with the effect of organic fertilizers as such. The percentages of increases in potato yield ranged from 21 to 73. This promoting could be ascribed to the good nutritional value of composted agricultural residues under investigation and the biologically active substances and growth hormones produced by yeast[5,4,2,1].

In conclusion, the application of well composted agricultural residues in addition to spraying potato plants with the liquid culture of yeast could be applied in the bio-organic farming as an integrated system to reduce the infestation percent of white fly and thrips and increasing growth and yield of potato as well.

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