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Tea Compost Application for Controlling Potato Late Blight under Field Conditions

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Abstract - Potatoes (Solanum tuberosum L.) are considered one of the most important vegetable crops in Egypt. Late blight caused by Phytophthora infestans is the most important foliar disease attacking potato plants. Three types of compost, i.e. animal, plant and Mixture of animal plus plant applied either as soil or foliar treatments alone or in combinations for controlling late blight disease of potato plants under field conditions was evaluated. All types of compost applied either soil or foliar treatments significantly reduced the late blight incidence. The highest reduction was obtained with combined treatments between soil treatment with animal compost and foliar spray with mixture of plant plus animal tea compost which reduced the disease incidence by 84.4% during two successive seasons. Followed by combined treatments between soil treatment with animal compost and foliar spray with plant or animal tea compost and finally soil treatments with a mixture of animal plus plant compost combined with foliar spray with the mixture of plant plus animal tea compost which reduced the disease incidence more than 75.0 % during two successive seasons. As for potato yield, all types of compost applied either soil or foliar treatments significantly increased the tuber yield. The highest increase was obtained with combined treatments between soil treatment with animal compost and foliar spray with mixture of plant plus animal compost or animal tea compost followed by combined treatments between soil treatment with mixture of animal plus plant compost and foliar spray with mixture of plant plus animal tea compost which increased the tuber yield more than 66.7% during two successive seasons. The other treatments showed moderate effect on disease incidence and yield increase as well comparing with fungicide treatment and untreated control.

***Index Terms*- Animal compost- Compost tea- Late blight disease – Potatoes- Plant compost.**

I. INTRODUCTION

Potatoes (*Solanum tuberosum* L.) are considered one of the most important vegetable crops in Egypt. Late blight caused by *Phytophthora infestan*s is the most important disease attacking potato plants [1,2,3,4,5]. Many soil-borne pathogens can be reduced by application of composts made of different raw materials [6]. Currently it is believed that a combination of antagonistic microorganisms with mature compost may be more efficient in inhibiting disease than using single antagonistic microbial strains or compost alone [6,7,8,9]. Recently, one alternative approach has been reported to treat plants with non aerated compost teas (NCT), [10] or watery-fermented compost extracts [11]. Production and use of NCT is typically done by mixing compost, water, and optional nutrient additives in an open container, leaving it undisturbed for a defined number of days, and then applying it to plants [11]. Application of NCT has been shown to be significantly suppress several foliar plant diseases [12,13,14]. Compost tea, applied as a foliar spray, is also reported to suppress late blight of potato plants [11]. He added that compost tea made from either horse manure or cow manure was sprayed on potato foliage as a control measure against late blight. These teas were used either alone or with additional microorganisms added to the mix. Results revealed that compost + microbes were equal to application of Ridomil MZ fungicide for reducing late blight disease**.**

The objective of the present research is to study the effect of different types of compost application either as soil or foliar spray treatments alone or in combination against late blight disease incidence of potato plants under field conditions.

II. MATERIALS AND METHODS

Evaluation of different types of compost applied either as soil or foliar treatments alone or in combinations for controlling late blight disease of potato plants was carried out under field conditions. A field study was carried out at the Researches and Experimental station of National Research Centre (NRC) in Nubaryia region, Beheira Governorate, Egypt for two successive growing seasons. The influence of different types of compost applied either soil or foliar treatments alone or in combinations for controlling late blight disease of potato was evaluated. Field experiments consisted of plots (4x8 m) each comprised of 8 rows and 32 holes / row was conducted in a Complete Randomized Block design with three replicates (plots) for each particular treatment as well as untreated check control plots. The fungicide Ridomil Gold MZ applied as foliar spray at the rate of 2g/L was used as comparison treatment. Traditional agricultural practices were followed throughout the two cultivation seasons.

All plots were cultivated with potato seeds *cv*. Diamond. The following procedures are carried out:

Three types of compost *i.e.* animal, plant and mixture of animal plus plant were purchased from El- Nile Company, Giza, Egypt.

Animal or plant –based compost tea preparation

Compost tea, in modern terminology, is a compost extract brewed with a microbial food source. Compost watery extract made from compost suspended in a barrel of water for 7 to 14 days, usually soaking in a burlap sack. Soluble nutrient source made from raw animal manure or plant soaked in water. For all practical purposes, animal or plant tea is prepared in the same way as the compost extracts previously described. The animal or plant debris are placed individually in a burlap sack and suspended in a barrel of water for 7 to 14 days. The primary benefit of the

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tea will be a supply of soluble nutrients, which can be used as a liquid fertilizer.

Treatments

Application of compost, *i.e.* animal, plant and mixture of animal plus plant was carried out as follows:

Soil treatment	Foliar spray
Animal compost	Animal compost
	Plant compost
	Mixture of animal plus Plant compost
Plant compost	Animal compost
	Plant compost
	Mixture of animal plus Plant compost
Mixture of animal plus Plant compost	Animal compost
	Plant compost
	Mixture of animal plus Plant compost
Animal compost	water
Plant compost	water
Mixture of animal plus Plant compost	water
----	Animal compost
----	Plant compost
----	Mixture of animal plus Plant compost
----	Fungicide (Ridomil Gold MZ)
Control	water

Application

Soil treatments was carried out 15 days before planting at rate of 10 Ton/ feddan meanwhile, foliar spray with tea composts as well as fungicide was carried out twice after 30 and 60 days started from 15 days of germination (seedling date).

Disease assessment

Late blight scale from 0 to 4 according to [15] was used, as follows:

0 = No leaf lesions; 1 = 25 % or less; 2 = 26 – 50; 3 = 51 –75 and 4 = 76-100 % infected area of plant leaf.

Disease assessment and yield determination

Late blight disease incidence was monitored and scouted throughout the growing season up to 90 days of planting. Percentage of diseased plant was recorded at the end of each growing season. Tuber yield of potato (kg/m2) for each treatment was also determined. All the previous procedures were followed at the two successive growing seasons at the same field.

Statistical analysis

Tukey test for multiple comparisons among means was utilized [16].

III.RESULTS AND DISCUSSION

Different approaches of composts either as soil drench or foliar spray were applied alone or in combinations for controlling late blight disease of potato plants under field conditions. Results in Table (1) indicate that all types of composts application significantly reduced the late blight disease incidence comparing with fungicide treatment and untreated control throughout the two successive growing seasons.

The lowest disease incidence was recorded as 1.5% and disease reduction as 71.6% at treatment of soil drench with animal compost combined with foliar spray with mixture of plant plus animal compost tea. Data also showed that the mean disease incidence was recorded as 1.8 and 1.9% at combined treatments between soil drench with animal compost and foliar spray with tea compost of plant or animal, respectively.

Moreover, combined treatments between mixture of animal plus plant compost as soil drench and foliar spray with tea compost of each mixture of animal plus plant compost, plant compost and animal compost, respectively. They recorded disease incidence in mean as 1.8, 2.2 and 2.3% with disease reduction calculated as 66.0, 58.45 and 56.6%, in respective order. Similar records was also observed concerning the combined treatments of plant compost when applied as soil drench and foliar spray with tea compost of animal compost, plant compost and mixture of animal plus plant compost, respectively.

It is interesting to note that the actual effect on disease incidence referred to plant spray with different tea composts that individual spray with tea composts of mixture of animal plus plant compost, plant compost and animal compost caused higher disease reduction calculated as 60.3, 58.4 and 56.6% comparing disease reductions of 54.7, 54.7 and 52.7% at treatments of soli drench only with mixture of animal plus plant compost, plant compost and animal compost, respectively.

In this regards, it was reported that solid compost prepared from remain stocks high in C, such as yard waste, wood chips, straw, or dry stalks, mixed with materials high in N, such as manure, freshly cut grass, plant residues, or food wastes.

The compost-tea brewing technique, an aerobic process, extracts and grows populations of beneficial microorganisms. Compost teas and herbal teas are tools that can be made on the farm to enhance crop fertility and to inoculate the phyllosphere and rhizosphere with soluble nutrients, beneficial microbes, and the beneficial metabolites of microbes. Therefore, application of compost or compost tea has been reported to be used for the purpose of plant fertilizers and disease control as well.

Table (1) Late blight incidence of potato plants treated with different types of composts applied as soil or foliar treatments alone or in combinations under field conditions

Compost application		Late plight incidence %			
Soil treatment	Foliar spray	First season	Second season	Mean	Reduction %
Animal	Animal ompost	1.8 e	1.9 gf	1.9 f	64.1

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compost	Plant compost	1.8 e	1.8 g	1.8 f	66.0
	Mixture of animal plus Plant compost	1.5 f	1.4 h	1.5 g	71.6
Plant compost	Animal ompost	2.1 d	2.2 f	2.2 e	58.4
	Plant compost	2.2 c d	2.3 f	2.3 de	56.6
	Mixture of animal plus Plant compost	2.5 c	2.7 e	2.6 d	50.9
Mixture of animal plus Plant compost	Animal ompost	2.2 c d	2.2 f	2.2 e	58.4
	Plant compost	2.2 c d	2.3 f	2.3 e	56.6
	Mixture of animal plus Plant compost	1.8 e	1.8	1.8 f	66.0
Animal compost	water	2.3 b	2.6 b	2.5 b	52.8
Plant compost	water	2.2 b	2.6 b	2.4 b	54.7
Mixture of animal plus Plant compost	water	2.8 c	2.0 d	2.4 e	54.7
----	Animal ompost	2.2 b	2.4 bc	2.3 bc	56.6
----	Plant compost	2.1 b	2.3 bc	2.2 bc	58.4
----	Mixture of animal plus Plant compost	2.0 b	2.2 cd	2.1 c	60.3
-----	Fungicide (Ridomil Gold MZ)	2.8 e	2.8 g	2.8 f	47.1
Control	water	5.2 a	5.4 a	5.3 a	——

Figures with the same letter for each column are not significantly different (P≤ 0.05)

In this concern, several researchers have been recorded that bio compost application as soil amendment could suppress diseases caused by *R. solani* and *Fusarium* spp. on many economic crops [17,18,19]. Also, [20] Organic fertilizers such as compost, compost tea and seaweed extracts (Algean) combined with the fungicide (BTH)) showed significant effect on the powdery mildew-infected cucumber leaves with *Sphaerotheca fuliginea*. The suppressive activity of different compost types toward several plant pathogens is well documented in the recent review by [21]. Further, the investigation on the biological activity of these materials on antagonistic soil-borne fungi is of great interest, in that their contribution to biological control should be safeguarded. Very few information is reported in the literature on the suppressive effects of HS and HS-like fractions (the two main fractions of humic substances) on phytopathogenic fungi [21,22]. Although some information is available on the mechanisms responsible for the suppressive action of compost and compost extracts on plant pathogenic fungi [21] very limited information exists on the relationship between chemical properties of HS and HS-like fractions and fungal suppressive capacity. In particular, results of a recent investigation by our group [22] have shown the existence of significant relationships between the extent of the inhibitory action of various HS on Fusarium oxysporum and some chemical and functional properties of HS.

Table (2) Potato tuber yield increase in response to different types of composts applied as soil or foliar treatments alone or in combinations under field conditions

Compost application		Potato yield Yield (kg /m^2)			
Soil treatment	Foliar spray	First season	Second season	Mean	Increase %
Animal compost	Animal compost	4.5 a	4.8 a	4.7 a	74.1
	Plant compost	4.0 b	4.4 b	4.2 b	55.6
	Mixture of animal plus Plant compost	4.5 a	4.8 a	4.7 a	74.1
Plant compost	Animal compost	3.5 cd	3.8 c	3.7 c	37.0
	Plant compost	3.5 c d	3.6 cd	3.6 cd	33.3
	Mixture of animal plus Plant compost	3.3 d	3.5 d	3.4 d	25.9
Mixture of animal plus Plant compost	Animal compost	3.8 b	3.9 c	3.9 c	44.4
	Plant compost	4.0 b	4.2 b	4.1 b	51.9
	Mixture of animal plus Plant compost	4.3 a	4.6 a	4.5 a	66.7
Animal compost	water	3.2 ef	3.3 e	3.3 d	22.2
Plant compost	water	2.9 f	2.8 f	2.9e	7.4
Mixture of animal plus Plant compost	water	3.0 f	3.0 f	3.0 e	11.1
----	Animal compost	2.8 g	2.9 f	2.9e	7.4
----	Plant compost	2.8 g	2.9f	2.9e	7.4
----	Mixture of animal plus Plant compost	2.9 g	2.8f	2.9e	7.4
-----	Fungicide (Ridomil Gold MZ)	3.4 f	3.6 f	3.5f	29.6
Control	water	2.5 h	2.8f	2.7 f	---

Figures with the same letter for each column are not significantly different (P≤ 0.05)

Furthermore, reduction in potato infection with late blight disease, indicate increase in the numbers of healthy plants, resulted in high quantity of produced tubers yield (Table, 2). The obtained results show that all types of compost applied either as soil drench or foliar spray significantly increased the tuber yield comparing with fungicide treatment as well as untreated check control treatments throughout the two cultivation seasons. The efficacy of applied treatments on potato tuber yield similar trend as shown concerning disease incidence. The highest

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increase in tuber yield 66.7% was obtained at treatment of soil drench with mixture of animal plus plant compost combined with foliar spray with tea compost of mixture of animal plus plant. This treatment followed by increase in potato tuber yield calculated as 51.9 and 44.4% at combined treatments of mixture of animal plus plant compost as soil drench and tea compost of plant and animal, respectively. In this concern, some investigators indicated that addition of organic manures as opposed chemical fertilizers increased vegetative growth characters, yield and fruit quality of vegetable crops [23,24]. On squash, [25] showed that plants had increased yields when planted in municipal solid waste compost amended soil in spite of application of NPK fertilizers at recommended rates. On pepper, [26] stated that early and total yields of all organic sources were significantly higher than that of chemical fertilizer. In the same line on cucumber, [27] found that organic treatment (compost) produced significantly greater early yield (1.85 kg/m2) and total yield (4.49 kg/m2) than chemical treatment which produced 1.38 kg/m^2 and 3.51 kg/m^2 for early and total yields, respectively.

On the light of obtained results in the present study it could be suggested that utilization of composts for the purpose of controlling of such diseases and to minimize organic waste pollution and to reduce the addition of chemical fertilizers and fungicides in crop production is a promising strategy for both the present and the future.

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