EFFECT OF AGE OF COMPOSTS ON QUALITY OF COMPOST TEAS

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ABTRACT

Among the non chemical means like bio control methods, use of compost teas as prophylactic protectants for disease management is becoming an important area of research. The key factors influencing the effectiveness of the compost tea were the age of the compost and nature of its source ingredients and components. Here in the present study the storability of compost on the quality of the compost teas in terms of pH, EC, micronutrient status, microbial load, disease suppressiveness is compared. All these parameters recorded changes among Compost teas extracted from 3 months old and 7 months old composts. There was significant increase in microbial population in CT1, CT2, CT7, CT8 and CT9 as the composts were 7 months old. The variation in PDI in compost teas extracted from 3MOC is from 4.67% (CT6) to 38.34% (Control). Where as for teas of 7MOC it varied from 10% (CT6, CT7, CT8 and CT9) to 45% (Control).

Key words : *Compost, storability, compost teas, disease, management, Alternaria alternata.*

Over the last two decades, there have been reports of the use of water extracts made from composts for control of foliar diseases. Extracts are prepared by mixing compost and water and incubating the resulting slurry with or with out agitation for several days. The slurry is filtered through cheesecloth and the filtrate, termed as compost tea or compost water extract, is sprayed onto the aerial surfaces of plants. This approach of biological control, if constantly effective in practice, is a potentially attractive alternative to fungicides that is consistent with sustainable agriculture (1). Compost tea can otherwise defined as an extract made from compost suspended in a barrel of water for 7-14 days (2).

Compost teas are very beneficial in plant disease management and they can be included in the integrated disease management strategies of field and horticultural crops (3). Even the addition of this organic extracts to growing media encourage the growth of benign organisms, which suppress the plant diseases (4).

The variables affecting the efficacy of compost tea are substrates, application rate, timing, fermentation period and weather conditions. The key factors influencing the effectiveness of the compost tea were the age of the compost and nature of its source ingredients and components (5).

(6) reported that the efficacy of aqueous extracts of composts used for foliar spraying depends on the method of composting and stabilisation time which varies from compost to compost.

In well managed compost there are millions of bacteria of thousands of species. In addition there are many types of protozoa, beneficial fungi and friendly nematodes that help to make up the soil food web. It is the range and diversity of microorganisms that make high quality compost. This is achieved only by careful control in the composting process, by paying particular attention to selection of the original plant material, critical maintenance of temperature and time to develop the humus content essential for the microorganisms to multiply and maintain populations.

(7) studied the chemical and biological properties of composts and reported that the chicken manure compost and cattle manure composts recorded pH of 6.6 and 7 and an electrical conductivity of 41.43 ms/cm and 14.15 ms/cm respectively and these factors effects the quality and storability of compost. Where as According to (8) composts were effective in suppressing dollar spot disease of turf and storage of composts for up to one year did not affect their ability to reduce dollar spot severity. Different chemicals released during the storage helps to maintains the efficacy of compost. The application of organic amendments, manures and composts that are rich in

Table-1 : Effect of storage period of compost on pH and electrical conductivity (EC) of compost teas.

S. No	Compost teas	pH			Electrical conductivity (ds/m^2)		
		Storage period			Storage period		
		3 Month	7 Month	Mean	3 Month	7 Month	Mean
1.	CT-1	8.20	6.20	7.20	10.45	8.10	9.28
2.	CT-2	8.80	7.12	7.96	10.08	8.56	9.32
3.	CT-3	8.10	6.47	7.29	11.48	8.70	10.09
4.	CT-4	8.40	6.76	7.58	16.27	6.20	11.24
5.	CT-5	8.80	7.30	8.05	17.01	8.12	12.57
6.	CT-6	8.90	7.10	8.00	11.57	5.96	8.77
7.	CT-7	8.68	7.90	8.29	8.52	6.12	7.32
8.	CT-8	8.76	7.50	8.13	12.51	5.93	9.22
9.	CT-9	8.76	7.03	7.89	10.30	5.62	7.96
	Mean	8.60	7.04		12.02	7.03	

	Comparison of pH		Comparison of EC	
Factors	**C.D.(0.05)**	**Sem+**	**C.D.(0.05)**	**SEm+**
Compost teas	0.22	0.076	0.38	0.13
Storage period	0.46	0.16	0.79	0.27
Interaction	N.S.	0.23	1.11	0.39

nitrogen, might reduce soil borne diseases by releasing allelochemicals generated during product storage or by subsequent microbial decomposition. As a result pH (9) thermophilic actinomycetes, thermophilic fungi (10), bacteria (11), enzyme activity (12) etc. changes during storage.

(13) reported that vermiculite improved diazotrophic microbiological activity phosphate solubilizing bacteria during storage markedly influenced the shelf life (14). Detection of ammonia oxidizing bacteria in the composts suggested that such bacterial agent effects nitrification and the fate of nitrogen during composting and compost storage (15).

Extracts of fresh composted municipal waste reduced mycelial growth in vitro whereas suppressiveness of composted municipal waste from the same batch was lost after storage because of the presence of acetic acid at higher concentration in fresh composted municipal waste than in stored composted municipal waste which suppressed colony growth (16). So the age of compost affects the quality of compost in plant disease management. Here in the present study the storability of compost or age of the compost on the quality of the compost teas is compared for effective disease management.

MATERIALS AND METHODS

Preparation Of Compost

The composts prepared from Vermicompost (CT1), Vermicompost + *Pseudomonas fluorescens* 1% (CT2), Vermicompost + *Trichoderma viride* 1% (CT3), Dung 75% + Paddy Straw 25% (CT4), Dung75% + Paddy Straw 25% + *Pseudomonas fluorescens* 1% (CT5), Dung75% + Paddy Straw 25% + *Trichoderma viride*1% (CT6), Dung 75% + Neem Powder 20% + Fish meal 5% (CT7), Dung75% + Neem Powder20% + Fish meal 5% + *Pseudomonas fluorescens* 1% (CT8) and Dung 75% + Neem Powder 20% + Fish meal 5% + *Trichoderma viride* 1% (CT9). The ingredients were thoroughly mixed and filled in plastic containers and wetted by sprinkling enough water to trigger the decomposition process. These containers were tightly covered with black polythene sheet and were allowed for 60 days for decomposition. These composts were remixed manually at 30 days for proper mixing and sprinkled with water to maintain moisture for better decomposition, and left for 30 days to get the ripe compost.

Table-2 : Effect of storage period of compost on copper, manganese, iron and zinc content in the compost teas.

S.No	Compost teas	Copper content in ppm			Manganese content in ppm			Iron content in ppm			Zinc content in ppm		
		Storage period			Storage period			Storage period			Storage period		
		3 M	7 M	Mean	3 M	7 M	Mean	3 M	7 M	Mean	3 M	7 M	Mean
1.	CT-1	0.17	0.08	0.13	0.17	1.12	0.65	0.19	0.64	0.42	0.15	0.00	0.08
2.	CT-2	0.15	0.08	0.12	0.05	1.96	1.01	0.21	0.56	0.39	0.11	0.00	0.06
3.	CT-3	0.14	0.08	0.11	0.12	1.12	0.62	0.34	0.52	0.43	0.12	0.00	0.06
4.	CT-4	0.15	0.16	0.16	0.08	2.52	1.3	0.41	1.85	1.13	0.17	0.16	0.17
5.	CT-5	0.09	0.16	0.13	0.06	2.52	1.29	0.17	1.69	0.93	0.19	0.16	0.18
6.	CT-6	0.16	0.24	0.20	0.09	2.24	1.16	0.50	1.40	0.95	0.18	0.28	0.23
7.	CT-7	0.33	0.20	0.27	0.67	7.84	4.26	5.96	7.32	6.64	0.58	0.36	0.47
8.	CT-8	0.20	0.20	0.20	1.10	5.32	3.21	19.18	4.44	11.81	0.87	0.20	0.54
9.	CT-9	0.20	0.36	0.28	0.74	5.88	3.31	11.31	7.84	9.58	0.51	0.52	0.52
	Mean	0.18	0.17		0.34	3.39		4.25	2.92		0.32	0.19	

	Copper content		Manganese content		Iron content		Zinc content	
Factors	C.D.(0.05)	SE m+	C.D.(0.05)	SE m+	C.D.(0.05)	SE m+	C.D.(0.05)	SE m+
Compost teas	N.S.	0.005	0.028	0.01	0.19	0.07	0.01	0.004
Storage period	0.03	0.01	0.059	0.02	0.4	0.14	0.02	0.008
Interaction	0.040	0.01	0.083	0.029	0.56	0.2	0.03	0.012

Preparation of Compost Teas

The compost teas were extracted from composts decomposed for three months. The teas were tested for the changes in pH, electrical conductivity, micronutrients like copper, manganese, iron and zinc. The microbial load and disease suppressiveness of the teas was also tested which are extracted from the decomposed for 3 and 7 months period.

Estimation of Ph, Electrical Conductivity, Micronutrients

For the estimation of pH, electrical conductivity (EC) and micronutrients in compost teas prepared from 3 and 7month old compost, pH meter ELICO L1610 model and EC meter ELICO CM 180 model were used. The micronutrients copper, manganese, iron and zinc content of the extracts was estimated by using atomic absorption spectrophotometer model varian FS 240.

Estimation of microbial population

One ml of compost tea was taken with pipette, serial diluted and transferred into petriplates. Later 15 ml of nutrient agar medium was transferred into each plate and incubated at 26+2oC. The number of colony forming units were counted using Coulter colony counter and the microbial population was described as cfu/ml.

Efficacy of compost teas on disease suppressiveness

Disease suppression ability of compost teas was tested in in vitro by the Detached Leaf Technique (20). In this, experiment, ten healthy leaves of each cultivar were collected and were dipped in the spore suspension of Alternaria alternata 50x103 spores/ml. The leaves dipped in the spore suspension were placed in the petriplate lined with moist blotting paper and sprayed with compost teas, incubated at 26 ± 2°C and observed for appearance of symptoms. The Percent Disease Index was calculated following 0-5 scale.

RESULTS AND DISCUSSION

pH, Electrical Conductivity and Micro Nutrients

The difference in the pH of compost teas extracted from 3 month old compost (3MOC) and 7 months old compost (7MOC) are presented in table-1. The pH values of compost teas from 3MOC varied from 8.9 (CT6) to 8.1 (CT3). For teas made from 7MOC the values varied from 6.2 (CT1) to 7.9 (CT7). pH of all compost teas has significantly reduced in compost teas made with 7MOC.

Table-3 : Effect of storage period of compost on microbial population in compost teas

S. No.	Treatment	Microbial Population (—x 106 *cfu /ml)		Mean
		Storage period		
		3 Month	7 Month	
1	CT-1	527.30	1192.00	859.65
2	CT-2	257.49	291.50	274.5
3	CT-3	126.41	67.00	96.71
4	CT-4	222.41	190.04	206.23
5	CT-5	830.47	727.2	778.83
6	CT-6	300.26	133.26	116.76
7	CT-7	100.45	176.06	138.26
8	CT-8	101.18	141.09	121.14
9	CT-9	315.45	116.53	215.99
	Mean	309.05	337.19	

Factors	C.D.(0.05)	Sem+
Compostteas	1.77	0.62
Storageperiod	3.76	1.31
Interaction	5.3	1.85

Similarly, the electrical conductivity (EC) values of compost teas of 3 MOC ranged from 8.52 ds/m^2 (CT7) to 17.01 ds/m^2 (CT5). For teas of 7MOC the values varied from 5.62 ds/m^2 (CT9) to 8.7 ds/m^2 (CT3). EC is decreased significantly in compost teas made with 7MOC compared to 3MOC (Table-1).

The amount of copper in compost teas of 3MOC varied from 0.09ppm (CT5) to 0.33ppm (CT9) (Table-2). For teas of 7MOC the values varied from 0.08ppm (CT3, CT2, CT1) to 0.36ppm (CT7). There was no significant difference in copper content of CT1, CT2, CT3, CT4, CT7 and CT8 between 7MOC and 3MOC. In the remaining compost teas the differences were significant between the storage periods. The zinc content is significantly increased upon storage.

Colony forming units

The differences in microbial population of compost teas made from 3MOC and 7MOC are presented in table 3. There was significant increase in microbial population in CT1, CT2, CT7, CT8 and CT9 as the composts were 7 months old while in other treatments there was a significant reduction.

Disease suppression ability

Disease suppression ability also reduced significantly in compost teas of 7MOC compared to 3MOC (Table-4). But all the teas were significantly superior over control, in suppressing the disease, which recorded 45 percent disease index. The variation in PDI in compost teas extracted from 3MOC is from 4.67% (CT6) to 38.34% (Control). Where as for teas of 7MOC it varied from 10% (CT6, CT7, CT8 and CT9) to 45%(Control).

The effect of age of the compost on the quality of compost teas extracted was studied after storing the compost for 3 and 7 months and were analysed for changes in pH, electrical conductivity (EC), micronutrients, colony forming units and disease suppressiveness.

The PH of all compost teas decreased in the compost teas made from 7 months old compost (7MOC) than compost teas made from 3 months old compost (3MOC) (Table-1). In case of EC also, it is decreased in all compost teas made from 7MOC compared to compost teas made from 3MOC (Table-1). But the difference in EC was higher in CT4, CT5, CT6, CT8 and CT9 compared to CT1, CT2, CT3, and CT7.

The copper content in compost teas decreased made from 7MOC than the teas made from 3MOC (Table-2) of CT3, CT2, CT1, and CT9 and the same was increased in CT5, CT4 and CT7. The differences in copper content of CT6 and CT8 were non significant.

The quantity of manganese in all compost teas increased in the compost teas made from 7MOC than compost teas made from 3MOC (Table-2). In case of compost teas made from 7MOC there was an increase in manganese content in CT4, CT5, CT6, CT7, CT8 and CT9.

Similarly, iron content also increased in compost teas made from 7MOC than in compost teas made from 3MOC (Table-2) except in CT9 and CT8, where significant reduction was recorded.

The amount of zinc in all compost teas decreased in the compost teas made from 7 MOC than compost teas made from 3MOC (Table-2) except in CT4 and CT7. CT4 recorded significantly less zinc content. The differences between teas extracted from 3MOC and 7MOC in CT7 were non significant.

The number of colony forming units decreased in compost teas extracted from 7 MOC CT3, CT6, CT5,

Table-4 : Effect of storage of composts on the performance of compost teas extracted in controlling the Alternaria blight of chrysanthemum.

S. No.	Treatment	Percent Disease Index		Mean
		Storage period		
		3 Month	7 Month	
1.	Control	8.34(38.23) *	45.00 (42.11)*	41.67 (40.17)*
2.	CT-1	8.00 (16.40)	15.00 (22.75)	11.50 (19.58)
3.	CT-2	8.14 (15.49)	20.00 (26.54)	13.57 (21.01)
4.	CT-3	8.64 (17.07)	20.00 (26.54)	14.32 (21.80)
5.	CT-4	10.34 (18.74)	15.00 (22.75)	12.67 (20.74)
6.	CT-5	7.71 (16.09)	15.00 (22.75)	11.35 (19.42)
7.	CT-6	4.67 (12.43)	10.00 (18.42)	7.34 (15.42)
8.	CT-7	8.48 (16.91)	10.00 (18.42)	14.24 (21.72)
9.	CT-8	8.00 (16.40)	10.00 (18.42)	16.50 (23.19)
10.	CT-9	9.30 (17.73)	10.00 (18.42)	17.15 (23.85)
	Mean	11.06 (18.55)	17.00 (24.35)	

Factors	C.D.(0.05)	SE m+
Compost teas	0.68	0.24
Storage period	1.53	0.54
Interaction	2.16	0.76

CT4 and CT9 and while it is increased in CT2, CT1, CT8 and CT7 (Table-3). In compost amended with Pseudomonas fluorescens and the teas extracted from 7 MOC showed an increase in number of colony forming units in CT2 and CT8. Among the composts not amended with biocontrol agents as the composts decomposed from 3 MOC to 7 MOC there was an increase in colony forming units in treatments CT1 and CT7.

Spraying of compost teas extracted from 7 MOC on chrysanthemum leaves has reduced the disease suppressiveness in all the treatment expect in CT7 and CT9 in comparison with compost teas extracted from 3 MOC (Table-3). Compost teas from 3 MOC recorded 75% disease reduction over control, where as compost teas from 7 MOC recorded 62% disease reduction. Although the PDI of compost teas of 7 MOC is higher than teas of 3 MOC, all of them were superior over control.

Changes in the characteristics of compost while in storage is quite common. Variation in pH occurs while decomposition as well as in storage. Sometimes pH of composts increases slowly by dissolution of calcium and magnesium (9) or can be decreased by the fixation of the same elements. Similarly composts can be stored up to one year with out affecting its disease suppressing ability (8). (10) reported that when the compost is stored at 15 or 24°C for 14 days the thermophilic actinonycetes, thermophilic fungi and pH decreased. A significant decline in the growth rate of seeded bacteria in compost was observed by (10) suggested that bio available nutrients decline with storage depending upon the conditions of compost and storage. Increased or decreased rates of respiration effect the gaseous composition in composts (17). Along with metabolites and secondary metabolites, the microbes also release allelochemicals during microbial decomposition and storage of composts (18).

Lifespan of microbes, nutrients available, climatic requirements for microbes and conditions required for above said chemical reactions like union or dissociation of molecules present in the teas affects their storability. Apart from the pH, microbes, nutrients, gases and chemicals present in composts, other parameters like enzyme activity also play important role in storage of compost. Declined or increased activity of stabilized or active enzymes like dehydrogenases (12) caseinase and proteinase (12), thermal denaturation or auto digestion during decomposition and storage have great importance in the mineralisation of complex molecules into basic molecules have significance in storage of compost, management of diseases and in establishment of systemic acquire resistance.

Hence from the present study it is concluded that composts are highly heterogeneous, changes in pH, EC, Micronutrients, Microbial load and Disease index are found. Between 3 month and 7 month old compost there is no significant difference in disease incidence. So till seven months the above compost can effectively be stored for preparation of compost tea for plant disease management.

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