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Original Research Article

Ecotechnology of Compost from Biodegradables Inoculated By *Trichoderma* and Its Effects On Growth Of Medicinal Plant *Ocimum gratissimum* L.

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Abstract: Microbiological applications of industrial waste (PMC & DSW) and aquatic weed (*Azolla*) into compost inoculated by *Trichoderma viride* in T1 (PMC+Azolla+Water), T2 (PMC+Azolla+DSW) T3 (PMC+Azolla+DSW+Trichoderma) than control have been investigated. PMC distillery spent wash and *Azolla* were mixed and inoculated by Trichoderma and observed microbial succession during decomposition. Variations of temperature pH, EC, OC, NPK, have been observed on 8th, 16th, 24th 32nd day and compost maturity was evaluated by odour, appearance, moisture content, dipping in water and C/N ratio. Temperature based phases (Psychrophilic, Mesophilic, Thermophilic, Stablization & Poikilothermic) were observed on 32nd day during composting. Trichoderma hasten the decomposition process and improved the quality of biocompost. Seeds of ocimum gratisimum, medicinal herb, were sown in patriplates with compost extract and polybag culture with 5 kg soil +159 gm biocompost @ 125kg / hec during 2006, 07, 08, 09. The results were discussed that germination %, GRI, growth index of root and shoot, phytomoss were significantly increase in compost extract and compost treated soil than control.

Keywords: DSW, PMC, biocompost, Trichoderma, C/N ratio

Introduction

Sugar factories (595) generate nearly 10 million tones of solid press mud cake and second major agro based industries next to cotton textiles in India. They produce about 8-10 million tonnes of molasses and 45-50 @ tonnes of bagasse as a valuable by-product. Molasses based distilleries (319+) produce about 14-15 litres of spent wash @ per liter of alcohol production, which create major disposal problem (Basker *et al.,* 2004) and causing "Ecological Time Bomb" affecting aquatic and terrestrial biodiversity and can be trigger off through waste management (Ali, 2007).

Distillery spent wash is hazardous, but contains many plant nutrients. Press Mud Cake (PMC) mixed with distillery spent wash (DSW) and other biodegradables can be degraded in short period technologically, Theopate *et al.,* (1991) prepared compost by adding spent wash PMC in different proportion with and without culture gave the compost of high quality. "Ch. Charan Singh Compost" was prepared in 1994 that is being manufactured as som & ramban by S.S. Mill, Simbhaoli & JOL, Gajraula, respectively (Ali Khan 2008).

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It inhibits growth of weeds, adds organic humurs and enhances soil fertility that encourages healthy root development. It will be ecologically sound, environmental friendly and economically viable for sustainable development (Ali, 1998, Ali Khan *et al.,* 2009; Ali Khan and Kashyap, 2010). Farmyard manure (FYM) a traditional source of organic matter may be replaced by managing PMC of sugar mills distillery effluent into bio compost. Composting is a controlled microbiological conversion of organic waste to sustainable humus form, which can be used to nutrients balance and organic matter to simulate soil microbes, these help to build up soil texture, structure, and manage saline & alkaline situations for soil health.

Compost is not only an alternative to chemical fertilizers but is also one of nature's best protective covering to increase the soil's water holding capacity in clay as well as sandy soils (Masood, 2006). However, no comparative assessment is available in literature to hasten decomposition process for composting. Indeed, it has been taken to study the effect of Trichoderma in decomposition and compost effect on plant growth. *Ocimum gratissimum* L. (Lamiceae),

a medicinal plant, commonly grown in pasture and west land in India known as 'alfavaca' and naturally used in the treatment of different disease *viz.* respiratory tract infection, diarrhoea, headache, fever, ophthalmic, skin and pneumonia (Onajobi, 1986, Iiori *et al.,* 1996). *Ocimum leaves* are used in chutney for worm in children and its oil is also active against bacteria (Lopez *et al.,* 2005).

Materials and Methods

Compost was prepared by mixing PMC, DSW, *Azolla* and *Trichoderma* with bioinoculent, which covered by black polythene sheet in plastic trays (Heap Method) for monitoring humidity, temperature and decomposition process Substrates were mixed in following treatments T_1, T_2, T_3 and Control (Flow Sheet):

Control PMC (5 kg) + Water (3 litres)

Tray (T1) PMC (5 kg) + *Azolla* (1.5 kg) + Water (3 Litres)

Tray (T_2) PMC (5 kg) + *Azolla* (1.5 kg) + distillery spentwash (3 litres)

Tray (T_3) PMC (5 kg) + Azolla (1.5 kg) + distillery effluent (3 litres) + *Trichoderma viride* (250 gms)

During the process of composting, variations were studied in temperature, pH, moisture content that was recorded at regular intervals and C/N ratio was calculated after 32 days. Changes in temperature of the compost were observed by inserting thermometer in sub-surface layer of bio-resources in heap treatment under five temperature phases (Psychrophillic, Mesophillic, Thermophillic, Stabilizatin and Poikilothermic). The pH of the compost is determined by glass electrode method and pH strip for determination of pH of each day.

Phytomass & moisture content were recorded in electric oven at 80° C after every ten-day. Prediction of the maturity of compost has been evaluated by odour, appearance, moisture content, C/N ratio (Kadalli et al., 2004, Chauhan et al., 2007). Biocompost extract were prepared by shaking compost samples with deionized water (solid: water = 1:2 (s/v)) in 180 rpm for 1 hour followed by centrifugation at 3000 rpm for 10 min and than filtered through 0.5 µm membrane filter. Seeds of Ocimum gratissimum were pre-treated with 0.1% mercuric chloride solution for five minutes for sterilization. 10 seeds were sown in large petriplates of 20 cm diameter having a depth of 3 cms in compost extract in dark.

Observations were recorded on 3rd, 5th, 7th, 10th and 15th day germinated % seeds, GRI (Ali Khan & Siddhu, 2006) length of radicle and plumule. Growth Index was estimated as under (Rauser, 1984).

$$G.I = \frac{\text{Growth (cm/day) in Treatment}}{\text{Growth (cm/day) in content}}$$

Seedling vigure index (S.V.I.) has been calculated by following formula.

S.V.I. = (Root +Shoot) x Germination %

Chlorophyll was estimated following the method of Smith and Benitez (1955).

The data were analyzed statically CD at 5% level.

Result and Discussion

Metrological data were recorded to know about the variations in temperature, rainfall and humidity. Different communities of microorganisms (bacteria, actinomyctes and fungi) predomenent during the five temperature based composting phases viz (initial) Psychcrophilic, mesophilic (moderate) thermophilic (hightempreture), stabilization (cooling down) and (maturation) poikilothremic (Ali Khan *et al.,* 2009; Ali Khan and Kashyap, 2010).

Temperature changes in psychrophilic phases, which increases immediately. It was recorded minimum in T_1 (23.3ºC), T_2 (24.5ºC), T_3 (26.0ºC) and control (22.0ºC) during decomposition period. The mesophilic microorganisms metabolized readily degraded compound and temperature enhances maximum in T_3 (31ºC), T_1 (27ºC) and than control (26ºC).

Mesophilic microorganisms do most of the work and these microbes replaced by thremophilic one and these microorganisms caused high metabolic rates when the readily available carbon is metabolized and easily degraded in at treatment of compost over control. The ideal thermophilic temperature was raised T_1 (35.3ºC), T_2 (40.0ºC), T_3 (43.5ºC) than control (30.0ºC). These were

recorded on 16th days of decomposition (Fig-2) as the supply of these high energy compound gradually decrease after 23 days stabilize and the mesophiles (II mesophic phase) would again populate in composts and in the finishing phase of decomposition (Eicond and Iverson 2001). Now, it was renamed as stabilization phase to remove confusion (Ali Khan and Kashyap, 2009). The temperature was observed at 28th days, which revealed the growth of bioinnoculant Trichoderma in T_3 that accelerated decomposition rate over T_1 & T_2 than control. The final finishing product has a dark color, excumbly texture on over the smell of mature compost.

The high pH 7.5 value for decomposition of compost which gradually decline has been recorded in T_1 (6.5), T_2 (6.0), T_3 (7.2) & control (7.0) on 8th day. The high pH in compost is caused by interplay of physical, Chemical and factors. High pH with NH_3 concentration in thermophilic stage added to NH_3 volatilization consequently pH dropped near neutrality (Eiland *et al.,* 2001; and Chatterjee *et al*. 2005). The high pH (8.3, 8.2) value in compost just before 16th days were caused by ammonia liberated from composting substrate (Fig-3). However it gradually decrease to neutrality at 32 days (Table 1). Highest mineralization of N were observed T_3 (2.66%), T_2 (0.7%), T_1 (1.2%) over control (.8%) while significantly increased in T_1 (0.7%, 0.69%), T_2 (.08%, 1.44%), T_3 (.07%, 1.28%) then control (0.04 & 0.69%) P & K respectively. The data revealed that these tremendous improvement in the quality of compost being higher value of NPK and lower organic carbon content due to inoculation with *Trichoderma viride* because the narrow C:N of T_3 (5.20) less then T_2 (6.4) was observed on 30th days for maturity which revealed the decomposition efficiency of fungus *Trichoderma.*

The carbon to nitrogen (C/N) ratio affects the speed of composting process and the volume of material finished. The C/N ratio of five to six (5 to 6) could be used as an good indicator of compost maturity (Fig.- 4). Similarly Kavita and Ali Khan, 2008, Kashyap, 2010 evaluated maturity of compost by C/N ratio & bioassay test. For a compost to be correctly and efficiently formed it is necessary to have right amount of carbon to nitrogen (C/N) ratio (approximately 4:1 by volume). Carbon gave backbone of the4 macro and microorganism energy for maintaining proper heat in heap and nitrogen for framing protein. It was main character in turning garbage into compost. High carbon had slow down decomposition and high nitrogen would have caused unpleasant odours due to release of excessive nitrogen into the air in the form of ammonia and nitrous oxide. Significant effect of compost on seed germination% was maximum in T_3 (85% germination) and minimum T_1 (60% germination) over control (50%) on 15th day in compost extract GRI is represents in Fig. 3. Average length of radicle and plumule revealed significant higher results in T_3 radicle (2.86 cm) Shoot (3.82 cm) than T_2 (2.30 & 3.40 cm) and T_1 (.86 and 1.75 cm) than control (.86 and 1.82 cm) root & shoot length respectively (Table -2).

The growth index improved in T_3 treatment in comparison to T_2 and T_1 than control. The increased index in T_3 due to *Trichoderma viride* inoculated is presumably on recount of the growth promoting substances and readily available nutrients produced by the fungus and good quality of compost. The results are on in conformity in the Girija *et al.,* (1994) and Ali Khan et al. (2009), Ali Khan and Kashyap (2010). The increased growth index observed has a result of breakup seed dormancy in comparison to other treatment & control, which reflects in increase of radical & shoot length and ultimately the vigour of seedling. Similar improvement in seedling vigour index has been achieved through compost extracts in treatment. Higher significant result has been recorded in T3 (385.90) and lower in T1 (207.60) than control (134). Similar results were recorded in vigna mungo cucumis sativa and Ocimum gratissimum (Rehman, 2008).

The variants in phytomas the proportion of fresh weight and dry matter produced were observed higher T3 (3.80 and 1.80 gm) and lower T1 (1.91 and 1.30 gm) than control (1.75 & 1.00). Residual effect of compost revealed that NPKs significantly increase in compost treated soil than control (table). It can be concluded that distillery effluent *Trichoderma* hasten the decomposition of bio resources. Compost extracts effects on Ocimum gratissimum seed germination % radicle & plumule length growth vigour index, seedling vigour indexm phytomos, chlorophyll content revealed significant result of mature compost (C/N ratio), which indicates good quality, and compost. Encouragement,

valuable suggestions and providing facility during the investigation. Environmental friendly management of DSW and other biodegradable into biocompost not only solve its desposed problem but will also arrange marriage among environment, economy and energy (C3). Indeed it will generate jobs to youths in 11th 5-year plan to fulfill worthy PM Manmohan Singh's of developed New India.

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