Study on the Pathogenicity of Micro-organisms in Coco-Peat Pellets

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ABSTRACT

Coco-peat pellet is made of compressed coir fibre pith and is gaining popularity as a good growing medium. However, the consumers are concerned about the presence of plant pathogens, specially *Fusarium* in the pellets, as it is a common fungus found in decaying material. An attempt was made to find out the the presence of *Fusarium* spp or any other fungal plant pathogen in the pellets and to evaluate the performance of three different media; coco-peat pellet, coir fibre pith, and common potting medium. A field experiment and a laboratory experiment were conducted. There were 12 treatments for the field experiment which was laid in Completely Randomized Design. During the experiment, samples from each treatment were cultured in laboratory for further investigation. It was found that no *Fusarium* spp or any of other fungal pathogen found in. Higher germination percentage of seeds and growth performances of seedlings were observed in coco-peat pellets.

KEYWORDS: Coco-Peat Pellet, Coir Fibre Pith, Potting Medium, *Fusarium Spp*

INTRODUCTION

Growing media ensure the plants proper ratio of water and oxygen which are critical for the healthy plant growth, and provide support for plant roots and protect roots from sunlight. They should also provide physical support for the plant, free passage of moisture (nutrient solution) to the root zone, proper drainage of surplus moisture and adequate air circulation to root.

Soil is the natural growing medium for cultivation of many crops. However, use of soil-based media has created problems such as soil born diseases, undesirable microbial activities, presence of nematodes, changing acidity levels, salinity, poor drainage, poor nutrient levels and other undesirable soil based properties. (Dayananda and Wahundeniya, 2002)

Other than that, the available extent for growing crops is being reduced due to the population growth and other massive development projects. Hence, people have tried to introduce different natural and artificial growing media as a solution for this problem.

Coco-peat pellets which are made of compressed coir fibre pith with an addition of essential plant nutrients are getting popularity among the growers throughout the world. These pellets are available in different sizes and supplied with plastic trays. Availability of coir fiber is not a problem in Sri Lanka. Therefore, manufacturing of compressed coir fibre pellets would be beneficial for the coconut industry, foliage and ornamental plant industry and many other industries of agriculture sector of Sri Lanka. There are many advantages of these pellets. Consistent medium optimized for germination and initial growth, absence of a rigid wall, no root deformation, and, very low storage space requirement are some of them. (Anon, 2005c) However, there are few problems that must be studied in relation to the coco-peat pellet industry. One important problem is that some growers are concerned about the possible transmission of propagules of plant pathogens that are recorded in decaying coir fibre pith to the pellets. *Fusarium, Pythium* and *Rhizoctonia* are the most important plant pathogens found in decaying coir fibre pith. Information on the biology of those fungi gives the idea that the temperature and pressure provided during production process of coco-peat pellet are at a higher level and as a result propagules of the fungi may be easily destroyed (Gamalath, 2005).

Fusarium spp can be classified under Division Eumycota, Subdivision Deuteromycotina, Class Hyphomycetes, Order Moniliaceae and Family Tuberculariaceae (Sharma, 1990). *Fusarium* is the largest genus of Tuberculariaceae, occurs either saprophytically or parasitically on many crop plants, fruits and vegetables (Duggar, 1998). Genus *Fusarium* is a very successful soil inhabitant and once established, persists for several years, rendering the soil unfit for profitable crop production (Bilgrami and Dube, 1997). Most species are more common in warmer and tropical countries and in soil with acidic pH (Bilgrami and Dube, 1997) while some inhabit in soil in cold climates. The *Fusarium* currently contains over 20 species out of which the most common are *Fusarium solani, Fusarium oxysporium* and *Fusarium chlamydosporum.* Their mycelium consists of branched septate, two or more celled thick walled, smooth and cylindrical or sickle shaped often colourless hyphe, which turn brown at maturity. *Fusarium* is one of the most drug resistant fungi which cause serious wilting in host plants as the mycelium invades the vascular tissue and finally blocks the xylem vessels (Anon, 2005a). Blocking of xylem vessels adversely affects the translocation of water, leading to wilting of plants (Bilgrami and Dube, 1997). *Fusarium* also produces some toxic secretion in to the vessels of the host, which might also be the cause of wilting (Barua *et.al.*1989). Some are capable of causing, crown rots, stem rots, root rots or fruit rots, while others are opportunists because they colonize plant tissues after some type of stress debilitates the plant (Anon, 2005a).

In this study, a preliminary investigation was carried out to test possible transmission of *Fusarium* spp or any other fungal plant pathogen to the pellets from coir dust.

MATERIALS AND METHODS

Experiment was carried out at the Fculty of Agriculture and Plantation Management of Wayamba University and Regional Agricultural Research and Development Center, Makandura from March to June, 2005.

Coco-peat pellets (Diameter 3 cm,Thickness 0.5 cm), a potting medium (Soil: Sand: Cow dung, 1:1:1) and coir fibre pith were used as growing media. A pure culture of *Fusarium* was used to inoculate media. 3a,4,7,7a-tetrahydro-2-[(trichloromethyl)thio]-1H-isoindole-1,3(2H)-dione N-trichloromethyl mercapta-4cyclohexene-1, 2-dicarboximide (Captan) (Anon, 2005d) was used as the fungicide. Coco-peat pellets and coir fibre pith were supplemented with the same nutrients in same concentration at the factory of Jiffy Products (Pvt.) Ltd., Mirigama. Seeds of *Capsicum annum* (variety-Hungariyan Yellow Wax) were used as the planting material.

Experiment was designed with 3 stages. In the 1st stage, pure culture of *Fusarium* was prepared. A field experiment was conducted in the 2nd stage and identification of *Fusarium* was done in 3rd stage.

a) Preparation of a pure culture of Fusarium

Five samples of potato tubers (5 tubers in each sample) that are reported as infected with *Fusarium* by National Plant Quarantine Service at Katunayaka were used for this purpose. Potato Dextrose Agar (PDA) medium was prepared as described by Johnston and Booth (1983) and autoclaved under 121° C and 15 psi pressure for 20 minutes. Glassware and other equipment were sterilized at 160°C for 2 hours (Dugger, 1998) 1mm-2mm size tuber parts were cultured on sterilized plates of PDA, in a laminar airflow cabinet. Three petri dishes were cultured by each sample to reduce the contamination and get the maximum purity. After 3 days of incubation period 3 slides were prepared from each petri dish and observed through the microscope. By using Commonwealth Mycological Institute (CMI) charts, cultures of *Fusarium* were identified. The cultures, which were not contaminated by other micro-organisms, were selected and sub cultured. After incubating for 3 days a pure culture of *Fusarium* was prepared.

b). Field experiment

This experiment was carried out at the Faculty of Agriculture and Plantation Management of Waymba University, from March to May, 2005. Experiment was laid out in a Completely Randomized Design (CRD). There were 12 treatments and 5 replicates. Five propagators (7 feet length and 3 feet width) were made using 45 gauge polythene and each propagator included 12 treatments as given in Table 1.

There were 3 types of growing media as coir fibre pith, Coco-peat pellet and potting medium (control). Coir fibre pith obtained from the *Cocos nucifera* mesocarp (coconut husk) is a blend of short fibres and spongy material that is left behind after long fibres are extracted.

Table 1. Treatments of the experiment

Treatment Number	Type of Media
T_1	Coir fibre pith
T_2	Coco-peat pellet
T_3	Potting medium (control)
T_4	Coir fibre pith +Fungicide
T_5	Coco-peat pellet +Fungicide
T_6	Potting medium +Fungicide
T_7	Coir fibre pith +Inoculation by *Fusarium*
T_8	Coco-peat pellet + Inoculation by *Fusarium*
T_9	Potting medium + Inoculation by *Fusarium*
T_{10}	Coir fibre pith+ Inoculation by *Fusarium* +Fungicide
T_{11}	Coco-peat pellet + Inoculation by *Fusarium* +Fungicide
T_{12}	Potting medium + Inoculation by *Fusarium* +Fungicide

The pellets were arranged in plastic trays with 20 cavities. Though the pellets could be enclosed in trays other media could not be used on trays. Therefore, black polythene bags of the size that is same as the size of pellets after water absorption (4cmx3cm) were prepared to fill with other media (potting medium and coir fibre pith) and those bags were kept in cavities of the trays made for the use with coco-peat pellets. Nine samples from each medium were kept in trays in a triangular arrangement.

After arranging pellets and polythene bags that are filled with the other media in trays they were treated by water, fungicide, and inoculated with *Fusarium* culture as to arrange 12 treatments. Pellets and other media in poly bags were inoculated by 10 drops (0.01ml) of the standard spore suspension ($20x10^4$ spores/ml) prepared by using pure cultures of *Fusarium*. Subsequently in each pellet or bag, two seeds of *Capsicum* were sown. Once in three days each medium was supplied with water or fungicide according to the treatment and data was recorded once in 3 days time interval up to 40 days.

C) Identification of Fusarium

Samples from each growing media were cultured for the identification of *Fusarium* 3 times; before the field experiment, during the experiment and at the end of the experiment.

RESULTS AND DISCUSSION.

a) At the first culturing stage some dark patches were observed in petri dishes while the whole petri dish was covered by wooly to cottony white colour spreading colonies. Microscopic observations and the identification using CMI charts revealed that white colour colony was consistent with *Fusarium*, while other black patches indicated streptomyses. After subculturing 3 times pure cultures of *Fusarium* were obtained.

b) I. Figure 3 shows the germination percentage under different treatments. T_2, T_5 and T_{11} showed the higher germination percentages (48.25%, 51.11%, and 27.94%). It revealed that seeds on coco-peat pellets were having higher germination percentage. T_2 and T_5 were having similar germination percentages and the

fungicide application on pellets gave only a slight increase of the germination percentage in coco-peat pellets.

Though T_4, T_5 and T_6 were having an application of fungicide, only T_5 showed a germination percentage higher than 20%. A higher number of seeds in T_7, T_8, and T_9 were infected while very few were survived. Though many seeds were sprouted, they all were deteriorated due to the infections. Affected seeds were having symptoms of *Fusarium* infection (Duggar, 1998).

Among three growing media coco-peat pellet showed the highest performance in germination while potting medium showed very poor performance in germination.

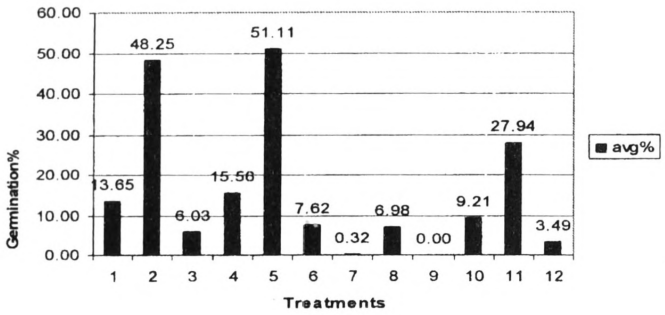

Figure 3 Germination percentage under different treatments

b) II, Figure 4 shows the time taken to develop two leaves on the seedlings under different treatments. According to that T_5 showed the lowest time to grow up to the 2 leaves stage. Growth performance of seedlings in coco-peat pellet is better than to other two media. During irrigation and application of fungicide, coco-peat pellets and coir fibre pith samples absorbed more water while potting medium absorbed less amount and dried quickly.Other than that, the seeds in soil samples were floated to the surface level of soil in those polythene bags after watering. Therefore, the seeds had to be covered by soil after each occasion of watering. This may have caused damages to the seeds. However, there was no incidence of *Fusarium* infection observed on the developed seedlings on T_1, T_2, T_4, T_5, T_6, T_{10} and T_{11}. Seedlings of the T_3,T_7,T_8,T_9 and T_{12} were not survived up to the two leaves stage.

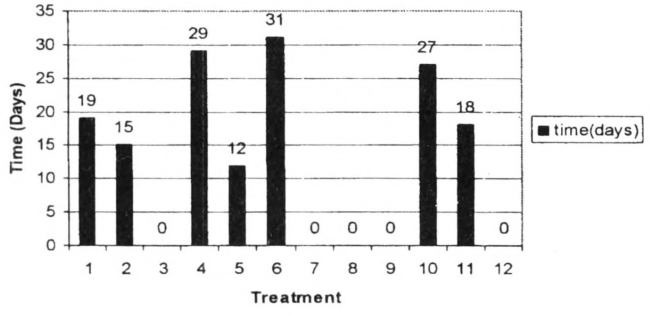

Figure 4. Time taken to develop two leaves on the seedlings under different treatments.

c) Identification of Fusarium in media

At the beginning of experiment *Fusarium* is recorded in T_3, T_7, T_8, and T_9. During the experiment there were no difference in results. However, more samples of T_3 were recorded with *Fusarium*. Even at the final stage of the experiment results were same. (Table 2). *Fusarium* had being identified in T_3, T_7, T_8, and T_9 at all identification stages.

Table 2. Identification of *Fusarium* in samples from the different treatments

Treatment	Stage		
	1	2	3
T_1	AB	AB	*AB*
T_2	AB	AB	*AB*
T_3	P	P	*P*
T_4	AB	AB	*AB*
T_5	AB	AB	*AB*
T_6	AB	AB	*AB*
T_7	P	P	*P*
T_8	P	P	*P*
T_9	P	P	*P*
T_{10}	AB	AB	*AB*
T_{11}	AB	AB	*AB*
T_{12}	AB	AB	*AB*

AB-Absence of Fusarium ***P****-presence of Fusarium*

CONCLUSION

The study gave no evidence of the presence of *Fusarium* or any other fungal plant pathogens in coco-peat pellets. That indicates the non-availability of the *Fusarium* inoculum in coco-peat pellets. However, further studies and experiments with longer growth period of plants can be recommended to obtain further conformation of these results.

In addition to that a notable higher growth performance of seedlings was observed in the coco-peat pellet medium.

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