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Assessment of postharvest soil fungal population with special reference to *Trichoderma* in eggplants

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Abstract

The research work was done to assess the postharvest soil fungal population and to find out the relation between population dynamics of *Trichoderma* and soil borne disease of 41 eggplant cultivars. Soil samples collected from IPM lab germplasm maintenance field at post-harvest stage were analyzed for microbes in dilution plate technique. Fungal colonies appeared in each plate were counted and made their average. Incidence and severity of Fusarium wilt and Sclerotium collar rot in the plot of 41 eggplant varieties were recorded at flowering-fruiting stage. The highest total soil fungal population was estimated from the plot soil of eggplant var. Singnath S (IPM- 42) that was 40.75×10^4. The var. Bijoy had the lowest fungal population that was 7.5×10^4. A comparison between *Trichoderma* population and other fungal population was made. Different eggplant cultivars had variation in the population of two important soil fungi- *Trichoderma* and *Fusarium*. The total populations of *Trichoderma* and *Fusarium* in the plot soil of 41 eggplant varieties were 129.75 and 348.75 × 10^4 per gram of soil, respectively. The average number of colonies of *Trichoderma* varied with the range (1-8.25) per plate. *Fusarium* varied with the range from (2-22.50). In 20 important eggplant varieties out of 41, both *Fusarium* wilt and *Sclerotium* collar rot incidence ranged between 0.00 to 40.00%. The variety Puta begun had the highest incidence of *Fusarium* wilt with the highest soil population of *Fusarium oxysporum* against the absence of *Trichoderma harzianum*. The disease incidence at flowering-fruiting stage was negatively correlated with the population of *Trichoderma*. Disease severity decreased with the increase in *Trichoderma* population. Increase of *Trichoderma* population, decreased the population of other fungi (*Fusarium oxysporum* and *Sclerotium rolfsii*). These results are clearly indicating that *Trichoderma* might have the antagonistic potential and might contribute to the reduction of incidence of soil-borne diseases.

Key words: Soil fungal population, *Trichoderma*, eggplant cultivars, wilting, IPM

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Introduction

The eggplant or brinjal (*Solanum melongena* L.) is an important vegetable world -wide (Bose and Som, 1986). Being a subtropical country, it is widely grown throughout Bangladesh in both Rabi and Kharif seasons (Haque, 2006).

The most devastating disruption in sound eggplant production, usually farmers suffer, is the disease management problem. In Bangladesh, eggplant suffers from 12 diseases. Most of the serious disease-causing organisms are soil borne. Soil-borne diseases are mainly caused by soil inhabiting fungi, nematode and bacteria. They survive in the soil as conidia, spore, mycelia, sclerotia, etc. They live mainly saprophytically in the soil. There are a good number of

soil- inhabiting and soil- invading fungi, influenced by a number of factors with respect to their growth, reproduction, survival, microbial activities and in their overall level of population (Shahjahan, 1973 and Hossain, 1972). It is well known that the soil harbored microbes live in a state of dynamic equilibrium.

Diseases (collar rot, root rot and wilting) caused by soil-borne plant pathogens such as *Sclerotium rolfsii, Fusarium oxysporum* are major problem for vegetable production in Bangladesh (Talukder, 1974). Soil microbial groups exert great antagonistic and associative effects on the growth of plants. Root exudates influence the proliferation and survival of root infecting pathogens in soil either through fungistasis or inhibition of pathogens in the rhizosphere. Many instances have been reported where the rhizosphere of resistant varieties harboured more numbers of *Trichoderma* than that of the susceptible varieties. Such observations have been recorded with reference to Fusarium wilt of plants (Rao, 1986). Presence of *Trichoderma*, an antimicrobial bio-agent, in the soil is an indicative of the population status of plant pathogenic fungi. Its dominance indicates a pathogen-suppressive soil means a better crop growth. Therefore, relative abundance of soil-borne plant pathogenic fungi including *Trichoderma* is to be known. As chemical fungicides are ineffective and costly, Biopesticide, an organic formulation of *Trichodema* which is comparatively cheaper can be used as an alternative. *Trichoderna*-based IPM Lab biopesticide has been reported to be effective against many soil-borne pathogens (Meah and Islam, 2005).

Antagonist like *Trichoderma harzianum* was added several times in the form of formulation or directly or suspension for experimental purposes. Population of soil fungi particularly that of *Trichoderma* in this field was estimated for flowering and fruiting stages of eggplant. Attempts were made to drawing a relation between the *Trichoderma* population and other fungi at those two stages (Islam, 2009). However, post-harvest population of the soil fungi of the Plant Pathology Field Laboratoty eggplant field was never estimated. It is thought post–harvest soil status of microbial strength especially of antagonists is of paramount importance for the next crops. This helps in soil permanent manipulation for maintaining soil microbe antagonist equilibrium for better eco-friendly crop growth. Therefore, present study was undertaken to determine the relationship between soil borne pathogenic fungi, soil antagonist population and soil-borne diseases and determine the post-harvest soil fungal population of eggplant, determine varietal difference in harboring soil fungal population as well.

Materials and Methods

***Experimental place*:** Field experiments were conducted at Plant Pathology Research Field during September 2010 to July 2011. The land of the experimental field was medium high in topography and the soil belonged to the old Brahmaputra Flood Plain of the Agro- ecological zone (AEZ-9). It is characterized by non-calcareous dark gray flood plain. The experimental field was located at 24^{o} 45` N latitude and $90^{o}$ 5` longitude at an altitude of 18m above the mean sea level (Karim 2003). The land type was medium high with loamy soil texture near neutral soil p^{H} range 5.5-6.8, low organic matter and medium K status (Anonymous, 1997). Laboratory experiments were done at Plant Diseases Diagnostic Clinic (PDDC), Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh.

***Eggplant varieties*:** Forty-one varieties of eggplant grown in the field for the maintenance of IPM lab Germplasm were used for this experiment.

***Collection and preparation of soil samples*:** The soil samples were collected from the IPM Lab germplasm maintenance field at postharvest stages of the crop. Five soil samples were randomly collected from the plot of each eggplant variety. The five samples were mixed thoroughly to get composite samples which were used as working samples. Soil collection was made at a depth of 6 inches with the help of an auger.

At the time of collection, the surface of the soil was scrapped to remove dry topsoil and other superficial plant debris. Each composite sample was kept in cellophane bag with proper labeling. After collection, the bags were kept under shade.

***Design of experiment*:** The experiment was laid out in Completely Randomized Block Design (RCBD) with 4 replications.

***Isolation of soil fungi*:** Dilution Plate technique (Dhingra and Sinclair, 1985) was used for the isolation of soil microbes and the following steps were followed.

***Preparation of working area*:** Since the bacteria and fungi are always present as contaminants in the soil, it is important to exclude them as much as possible from the surface of the working area and the equipment to be used. The surface of the working area was disinfected with cotton swabs (methylated spirit (70%). The hands were disinfected by the same. The glass wares (test tubes, Petri dishes, pipettes, beakers etc.) were sterilized in dry oven.

***Preparation of working sample*:** For every dilution of soil samples, working sample was prepared from the composite sample that was made after the soil sample collection at post-harvest stage of eggplant field. One-gram soil sample was taken with the help of electric balance.

***Making soil suspension (soil dilution)*:** One gram of soil was placed in the test tube containing 9 ml of sterile water and stirred thoroughly for few minutes in order to obtain a uniform 1:10 dilute soil suspension. This was used as stock solution. One ml of that 1:10 stock suspension was transferred with the help of sterile pipette into the 2nd test tube containing 9 ml sterile water and shaken thoroughly thus resulting 10^{-1} dilution. Then 1 ml of 10^{-1} dilution is transferred to 3rd test tube containing 9 ml sterile water by sterile pipette thus making 10^{-2} dilution. This way dilution was made up to 10^{-4}.

***Preparation of culture media*:** Potato Dextrose Agar (PDA) was used all through in the experiment for the culture of soil-borne microbes. The PDA was prepared as per procedure described by Ashrafuzzaman (1976) (Table 1).

Table 1. The composition of Potato Dextrose Agar (PDA).

Ingredients	Amounts
Potato (peeled and sliced)	200g
Dextrose	20g
Agar	17g
Water	1000ml

The prepared standard PDA was poured in 500ml glass bottles and sterilized (121^{o}C, 121 psi for 15 min). The media were acidified with 30 drops of 50% lactic acid per 250 ml medium. The acid was added to avoid bacterial contamination, if any.

***Isolation of micro-organisms (fungi) from soil*:** One ml of diluted soil sample was placed at the center of PDA plate and spread with spreader. Four Petri-dishes were inoculated for each the sample with 1 ml of diluted soil sample. This is repeated with every soil sample. The inoculated PDA plates were then incubated for 7-10 days at room temperature (26±2^{o}C). The colonies grew up in the petri -plates were recorded after 3-7 days. The color and the colonies in different plates were counted for each eggplant variety. Sub cultures were made by transferring a small colony to a new PDA plate on the basis of color and morphology of the colony. Further transfers were made for purification and identification of the microbe. During purification the contaminated plates were discarded.

***Observations*:** The fungal colonies emerged on PDA plates were observed for color, consistency and shape. On the basis of the properties especially the color, the colonies in different plates were counted.

***Estimation of fungal population in soil samples*:** The number of the colonies developed in each plate was counted and average value was calculated for each sample**.** Number of the colonies per ml of soil

suspension was calculated by its colony forming units (CFU) (Islam, 2009). Population of individual fungus in each soil sample for each eggplant variety was estimated following the formula given below:

Population of fungi = Average number of total colonies/ml in 4 petridishes x Dilution factor (10^4).

Number of colonies per ml of soil suspension was calculated on the basis of average of four PDA plates.

***Identification of soil-borne fungi*:** Most of the isolated fungi were identified up to genera level with the help of the book "Illustrated Genera of Fungi Imperfecti" (Barnett, 1960) and a manual of soil fungi (Gilman, 1957) based on their morphological structures under microscope. The manual of *Aspergillus* (Raper and Fennel, 1965) and the Class work with fungi (Dade and Gunnell, 1969) were also consulted to identify the species of *Penicillium* and *Aspergillus*. Moreover, morphology and taxonomy of fungi (Bessay, 1964), Fungi in Agricultural soils (Domsch and Gams, 1972) were also consulted to identify other fungi.

***Observation on the incidence of soil borne diseases in the eggplant germplasm field*:** The incidence of soil borne diseases especially *Fusarium* wilt and *Sclerotium* collar rot in the IPM germplasm field of 41 eggplant varieties were recorded individually for eggplant variety and the percentage incidence was calculated, the observation was made under natural field conditionat flowering-fruiting stage.

***Analysis of data*:** Data collected during experimental period were tabulated and analyzed following MSTATC, a complete statistical method. Treatment means were compared with Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

Results

***Fungal population in different eggplant varieties*:** Total fungal population in 41 eggplant plot soils varied significantly. The range was 40.75-7.5 × 10^4 (Table 2). The highest fungal population was estimated in the plot soil of eggplant var. Singnath S (IPM- 42). The second highest fungal population was estimated in the soil of eggplant var. Uttara BARI. Iribegun soil had the third highest fungal population. Other eggplant varieties which had >20.0 × 10^4 soil fungi (per g of soil) were Laffa B, Laffa BAU, Thamba, Dohazari G, Khatkhatia BAU, Islampuri BADC, Dharala, Marichbegun S, Marichbegun L, Eg 190, Puta begun, Menter and Salta (Table 2).

***Colonies developed in PDA plates inoculated with plot soil of 41 eggplant cultivars*:** Black colonies representing the fungus *Aspergillus niger* dominated the plates of 22 eggplant varieties. White and pink-white colonies representing *Fusarium oxysporum* and *Fusarium sp* occupied dominately plates of 14 eggplant varieties. *Trichoderma harzianum* predominantly occupied the plates of 11 eggplant varieties viz. Jhumki, ISD-006, Thamba, Khatkhatia BAU, Kaika-Nandina, Jossore L, Botli Begun, Marich Begun L, China-oblong Paba, Ishardi BS and Deem Begun with deep green colour (Photograph 1).

***Fungi isolated from post-harvest soil of eggplant field*:** Fungi isolated from eggplant plot soils are presented in Table 3. Four fungal genera were recorded at post-harvest field soils of 41 eggplant varieties. The recorded genera were *Trichoderma, Fusarium, Aspergillus and Penicillium*. *Trichoderma* was identified at species level and that was *Trichoderma harzianumand. Trichoderma* formed deep green color in PDA plates. *Fusarium*was identified at species level. *Fusariumo xysporum* showed white color, *Fusariummoniliforme* showed yellow color and *Fusarium*sp showed pink color (Table 3). Two species of *Aspergillus* were recorded. *Aspergillus flavus* showed green color and *Aspergillus niger* showed black color. *Penicillium* was not identified at species level and it showed ash color (Table 3).

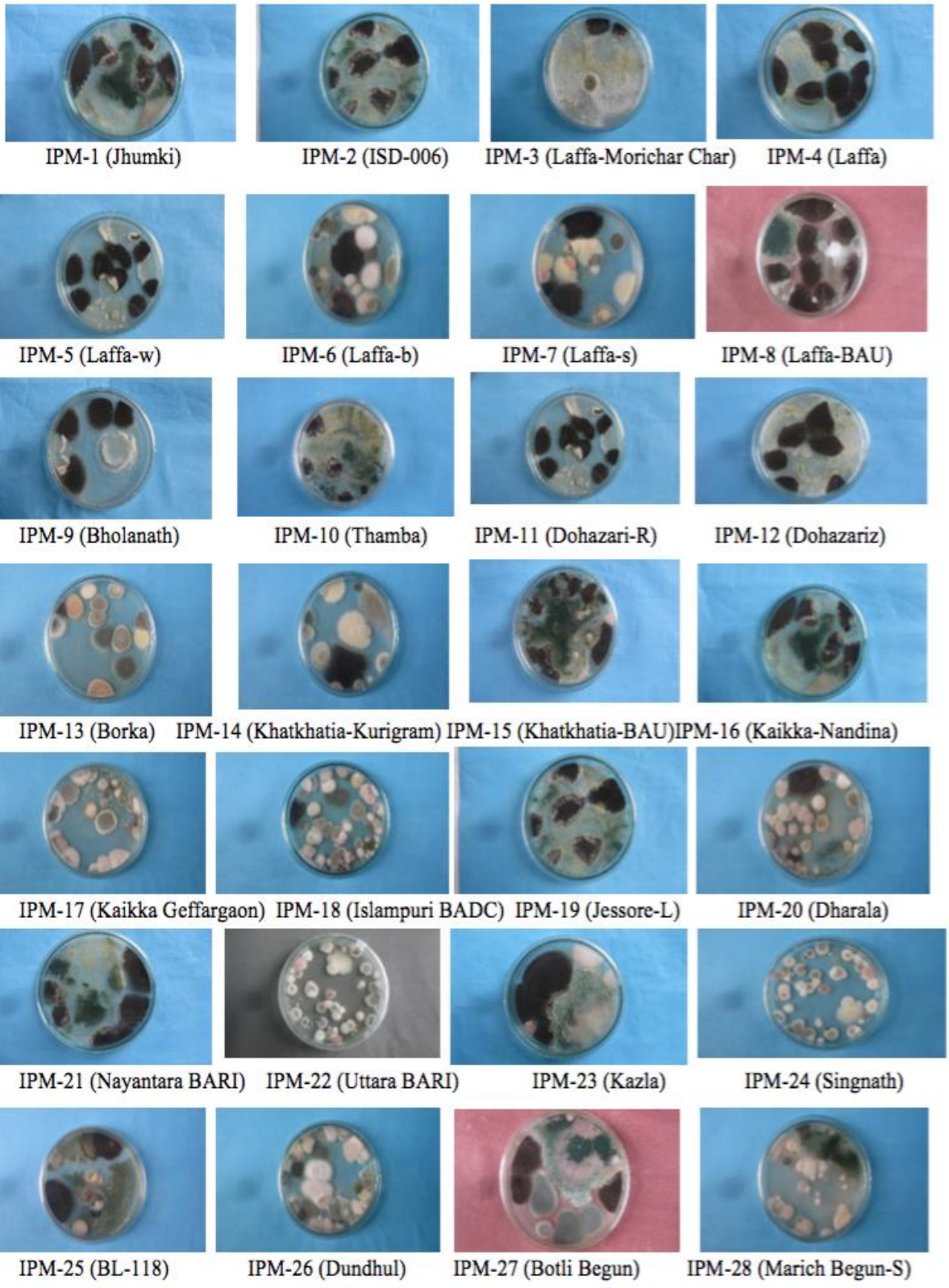
Prevalence of *Trichoderma* and *Fusarium* in eggplant soil: Different eggplant cultivars had variation in the population of two important soil fungi-*Trichoderma* and *Fusarium*. The average number of colonies of *Trichoderma* varied with the range (1.0-

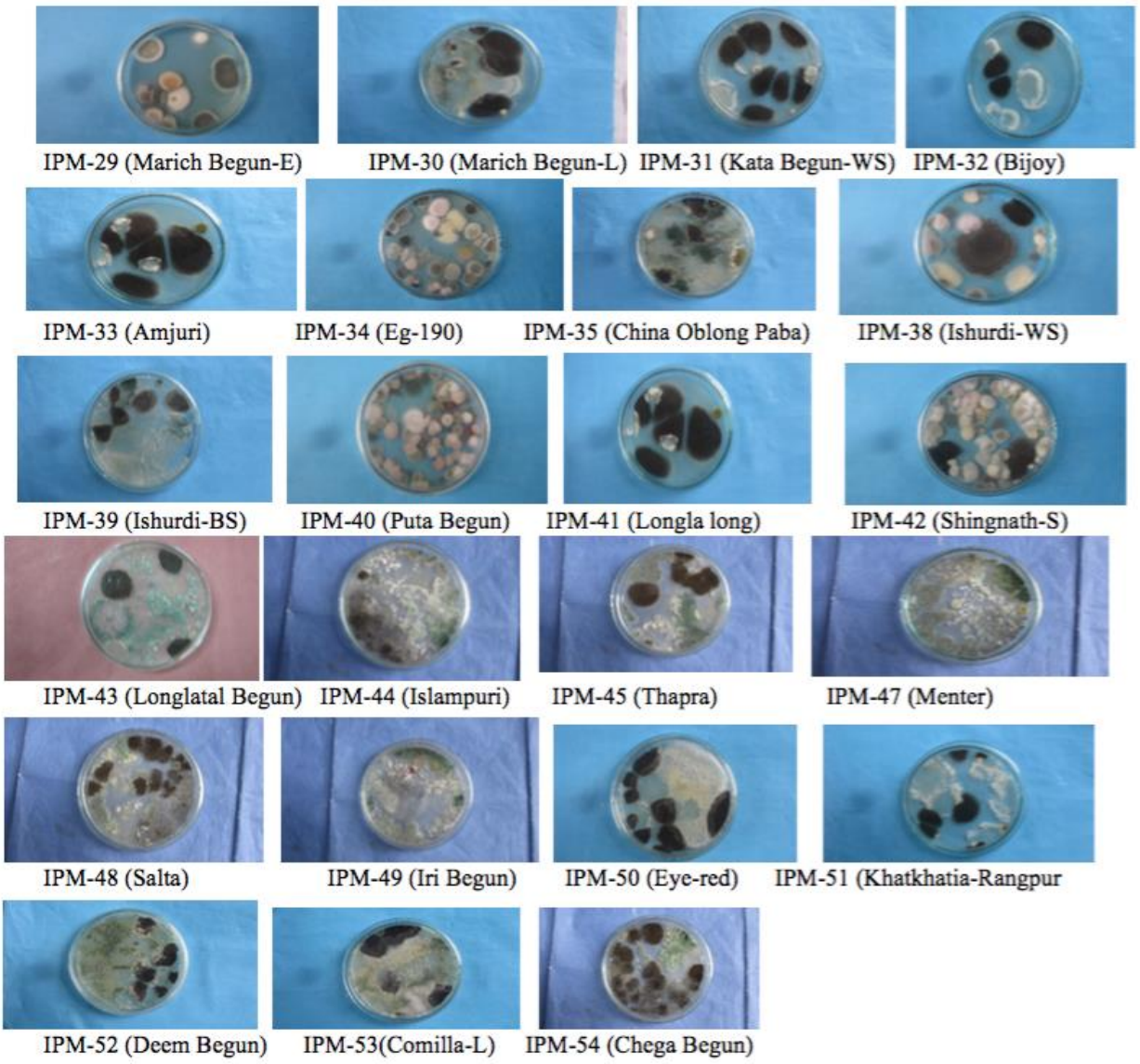
8.25 x 10^4) per plate. IPM-18 (Islampuri BADC) had the lowest average number of colonies of *Trichoderma* per plate and that was 1 and IPM-35 (China oblong Paba) had the highest average number of colonies that was 8.25x 10^4 (Table 4). *Fusarium* varied with the range (2.0-22.50 x 10^4) where IPM-31 (Kata begun-WS) had the lowest average number of colonies of *Fusarium* that was 2. The highest average number of colonies of *Fusarium* was recorded at IPM-40 (Puta begun) that was 22.50x 10^4 (Table 4).

Table 2. Total Fungal population estimated in the plots of 41 eggplant cultivars.

Plot	**Eggplant cultivars**	**Fungal population per g of soil (10^4)**	**Plot**	**Eggplant cultivars**	**Fungal population per g of soil (10^4)**
IPM-01	Jhumki	12.25 vw	IPM-33	Amjuri	10.75 xy
IPM-02	ISD-006	16.00 pq	IPM-34	Eg-190	25.25 f
IPM-03	Laffa (Morichar char)	17.25 no	IPM-35	China-oblong Paba	19.75 kl
IPM-04	Laffa (Gaffargaon)	13.00 uv	IPM-38	Ishurdi-WS	19.50 kl
IPM-05	Laffa-W	16.00 pq	IPM-39	Ishurdi-BS	10.75 xy
IPM-06	Laffa-B	21.75 hi	IPM-40	Puta begun	27.05 e
IPM-07	Laffa-S	14.25 st	IPM-41	Longla long	7.750 z
IPM-08	Laffa-BAU	23.50 g	IPM-42	Shingnath-S	40.75 a
IPM-09	Bholanath	9.000 z	IPM-43	Longlatal begun	13.50 tu
IPM-10	Thamba	20.50 jk	IPM-44	Islampuri	17.75 no
IPM-11	Dohazari-R	17.25 no	IPM-45	Thapra	19.25 l
IPM-12	Dohazari-G	20.50 jk	IPM-47	Menter	21.00 ij
IPM-13	Borka	14.75 rs	IPM-48	Salta	20.50 jk
IPM-14	Khatkhatia (Kurigram)	14.25 st	IPM-49	Iri begun	29.50 c
IPM-15	Khatkhatia-BAU	21.25 hij	IPM-50	Eye-red	19.50 kl
IPM-16	KaikkaNandina	17.25 no	IPM-51	Khatkhatia (Rangpur)	10.25 y
IPM-17	KaikkaGaffargaon	15.25 qrs	IPM-52	Deem begun	11.50 wx
IPM-18	Islampuri BADC	28.50 cd	IPM-53	Comilla-L	11.50 wx
IPM-19	Jessore L	19.75 kl	IPM-54	Chega begun	15.75 pq
IPM-20	Dharala	23.75 g	$LSD_{0.05}$	1.066	
IPM-21	Nayantarta BARI	16.75 op	Level of significance	**	
IPM-22	Uttara BARI	35.75 b	CV%	4.71	

** = Significant at 1% level of probability, CV= Coefficient of variation, Average of four plates (each plate was inoculated with 1ml diluted soil samples).


IPM-1 (Jhumki)
IPM-2 (ISD-006)
IPM-3 (Laffa-Morichar Char)
IPM-4 (Laffa)
IPM-5 (Laffa-w)
IPM-6 (Laffa-b)
IPM-7 (Laffa-s)
IPM-8 (Laffa-BAU)
IPM-9 (Bholanath)
IPM-10 (Thamba)
IPM-11 (Dohazari-R)
IPM-12 (Dohazariz)
IPM-13 (Borka)
IPM-14 (Khatkhatia-Kurigram)
IPM-15 (Khatkhatia-BAU)
IPM-16 (Kaikka-Nandina)
IPM-17 (Kaikka Geffargaon)
IPM-18 (Islampuri BADC)
IPM-19 (Jessore-L)
IPM-20 (Dharala)
IPM-21 (Nayantara BARI)
IPM-22 (Uttara BARI)
IPM-23 (Kazla)
IPM-24 (Singnath)
IPM-25 (BL-118)
IPM-26 (Dundhul)
IPM-27 (Botli Begun)
IPM-28 (Marich Begun-S)



Photograph 1. Colonies developed in PDA plates inoculated with plot soil of 41 eggplant cultivars.

Table 3. List of Fungi isolated from plots of 41 eggplant cultivars.

Serial No.	Fungal Genus	Fungal Species	Colony color
1.	*Trichoderma*	*Trichoderma harzianum*	Deep green
2.	*Fusarium*	*Fusarium oxyporum*	White
		Fusarium moniliforme	Yellow
		Fusarium sp.	Pink
3.	*Aspergillus*	*Aspergillus niger*	Black
		Aspergillus flavus	Green
4.	*Penicillium*	*Penicillum* spp.	Ash

Table 4. Variation in the population of *Trichoderma* and *Fusarium* in 41 eggplant cultivars.

Plot	Eggplant cultivars	Average colony per g soil (10^4)	
		Trichoderma	***Fusarium***
IPM-01	Jhumki	3	5
IPM-02	ISD-006	3.5	5
IPM-03	Laffa (Morichar Char)	2	2.5
IPM-04	Laffa (GaffarGaon)	1.25	3.25
IPM-05	Laffa-W	2.5	5.25
IPM-06	Laffa-B	-	9.5
IPM-07	Laffa-S	-	6.25
IPM-08	Laffa-BAU	2.25	4.5
IPM-09	Bholanath	2.25	3
IPM-10	Thamba	8	7.75
IPM-11	Dohazari-R	2.75	4.75
IPM-12	Dohazari-G	5	9.5
IPM-13	Borka	-	6.5
IPM-14	Khatkhatia(kurigram)	-	3.75
IPM-15	Khatkhatia-BAU	6.25	4.75
IPM-16	KaikkaNandina	6	6.25
IPM-17	KaikkaGaffargaon	-	3.75
IPM-18	Islampuri BADC	1	12.25
IPM-19	Jessore L	4.25	7.25
IPM-20	Dharala	3.5	25.5
IPM-21	Nayantarta BARI	4.75	3.25
IPM-22	Uttara BARI	-	16.25
IPM-23	Kazla	4.25	5
IPM-24	Singnath	-	17.25
IPM-25	BL-118	3.25	6
IPM-26	Dundhul	1.5	7
IPM-27	Botli Begun	6	3.5
IPM-28	Marich begun-S	4.75	12.75
IPM-29	Marich begun-E	-	7.25
IPM-30	Marich begun-L	4.5	7.50
IPM-31	Kata begun-WS	-	2
IPM-32	Bijoy	-	3.25
IPM-33	Amjuri	-	3.75
IPM-34	Eg-190	-	7.75
IPM-35	China-oblong Paba	8.25	4.25
IPM-38	Ishurdi-WS	-	5.25
IPM-39	Ishurdi-BS	2.75	2.75
IPM-40	Puta begun	-	22.50
IPM-41	Longla long	-	3
IPM-42	Shingnath-S	-	23.5
IPM-43	Longlatal begun	7	2.75
IPM-44	Islampuri	3	4.25
IPM-45	Thapra	5	5
IPM-47	Menter	1.5	-
IPM-48	Salta	2.75	6.75
IPM-49	Iri begun	3.25	12.25
IPM-50	Eye-red	-	5.5
IPM-51	Khatkhatia(Rangpur)	-	5
IPM-52	Deem begun	3.25	4.25
IPM-53	Comilla-L	3.25	3
IPM-54	Chega begun	3.5	-

*Average of five plates (each plate was inoculated with 1ml diluted soil sample).

***Population of Trichoderma and Fusarium in eggplant soils*:** The total population of *Trichoderma* and *Fusarium* in the plot soil of 41 eggplant varieties were 129.75 and 348.75 × 10^4 per gram of soil respectively (Figure 1).

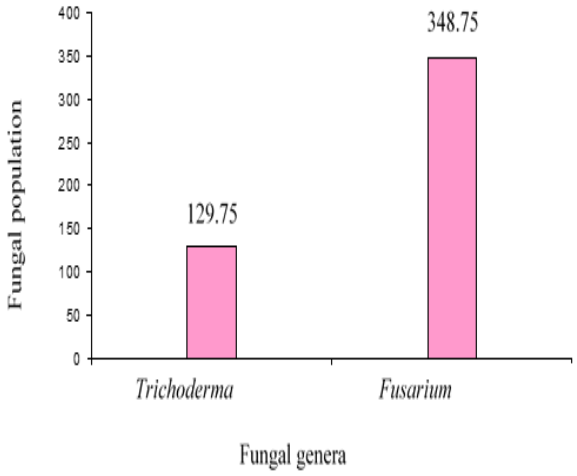


Figure 1. Total population of *Trichoderma* and *Fusarium* in soils of 41 eggplant varieties.

***Prevalence of Fusarium wilt and Sclerotium collar rot of some important eggplant varieties*:** In 20 important eggplant varieties out of 41, both Fusarium wilt and Sclerotium collar rot incidence ranged between 0.00 to 40.00% (Table 5). Overall, the incidence of these two diseases (Photograph 2) were at low level. Sclerotium collar rot was recorded in plot soils of eight varieties against no reporting of the detection of *Sclerotium rolfsii* in the soil samples analysed. In the variety Jhumki, no *sclerotium* collar rot was detected. A moderate incidence of Fusarium wilt was recorded against the presence of almost equal amount of soil population of *Trichoderma* and *Fusarium* (Table 5). In variety ISD-006, no *Fusarium* wilt was recorded though population of *Fusarium oxysporum* slightly outnumbered that of *Trichoderma harzianum* (Table 4). In variety Laffa S, a moderate level of wilting was recorded in the presence of low population of *Fusarium oxysporum* and absence of *Trichoderma harzianum* (Table 5).

Table 5. Prevalence of *Fusarium* wilt and S*clerotium* collar rot in the plot soil of some important eggplant varieties.

Eggplant varieties	**Fungal population (× 10^4)**		**Disease incidence (% percent plant infected)**	
	T. harzianum	***F. oxysporum***	***Fusarium*wilt**	***Sclerotium*collar rot**
Jhumki	3.00	5.00	13.33	0.00
ISD-006	3.50	5.00	0.00	6.67
Laffa S	0.00	2.50	13.33	13.33
Bholanath	2.25	3.00	0.00	0.00
Thamba	8.00	4.25	0.00	0.00
Dohazari G	5.00	6.00	40.00	40.00
Borka	0.00	3.15	20.00	0.00
Jessore local	4.25	4.75	0.00	0.00
Dharala	3.50	4.75	13.33	0.00
Nayatara BARI	4.75	3.25	0.00	40.00
Kazla	4.25	3.25	0.00	0.00
Botlibegun	6.00	3.50	0.00	0.00
Marich begun S	4.75	8.75	6.67	0.00
Marich begun E	0.00	4.25	13.33	0.00
Marich begun L	4.50	4.25	6.67	0.00
Kata begun WS	0.00	2.00	0.00	13.33
China-oblong Paba	8.25	4.25	0.00	6.67
Ishurdi WS	0.00	0.00	0.00	0.00
Puta begun	0.00	12.5	40.00	33.33
Chega begun	3.50	0.00	0.00	13.33

A. White mycelial mat base of the plant.

B. Typical collar rot at the symptom with sclerotia at the base of eggplant.

C. Infected eggplant showing wilting symptom due to *Sclerotium* collar rot

D. Infected eggplant showing *Fusarium* wilting symptom

Photograph 2. A-C: Sign and symptoms of Sclerotium collar rot of eggplant, D: Fusarium wilt symptoms of eggplant in the IPM Lab eggplant germplasm maintenance field.

In varieties, Bholanath, Thamba, Jossore L, Nayantara BARI, Kazla , Botli Begun, Kata begun WS, China oblong, IshurdiWS and Chega Begun no *Fusarium*wilt diseases was recorded. In all these cases the population of *Fusarium oxysporum* was either lower than that of *Trichoderma harzianum* or absent (Table 5). In varieties, Dohazari G, Borka, Dharala, Marichbegun S, Marichbegun E, Marichbegun L and Puta begun the *Fusarium*wilt disease incidence ranged between 6.67-40.00 %. It is noted 40.00% and 20% wilting were recorded respectively in Dohazari G and Borka where the population of *Fusarium oxysporum* outnumbered the population of *Trichoderma harzianum or Trichoderma harzianum* was absent (Table 5). The variety Puta begun had the highest incidence of *Fusarium* wilt with the highest soil population of *Fusarium oxysporum* against the absence of *Trichodermaha rzianum* (Table 5).

Discussion

Different species of fungi like *Sclerotium rolfsii, Fusarium oxysporum, Fusarium moniliforme, Penicillium spp. Aspergillus niger, A, flavus and Trichoderma harzianum*as isolated from eggplant field soils have been reported long before by many researchers (Abbott, 1926; Jensen, 1931; Roy *et al*. 1989; Shahjahan, 1973; Rana and Gupta, 1982; Abdulla and Elgingy, 1988; Begum and Hossain, 1989; Bridge and Dureiller, 2001; Ilhan and Asan, 2001). Population dynamics of *Phomopsis vexans, Sclerotium rolfsii, Fusarium oxysporum* f. sp. *lycopersici* and *Trichoderma* in the soil of eggplant field also have been reported by Islam (2009).

Status of fungal population in the eggplant field soil was estimated at post-harvest stage in the present study. Earlier fungal population in the same field soil was estimated by Islam (2009) at both flowering and fruiting stages of eggplant. Both the studies had similarity in terms of fungi and their population.

The seven fungi isolated from soil of almost all 41 eggplant varieties have tremendous importance in relation to the incidence of soil borne diseases like wilt and collar rot as it has been shown by finding of the present study. Similar views have been expressed by Islam (2009).

The co-existence of soil borne fungi like *Sclerotium rolfsii* and *Fusarium* spp. and antagonist *Trichoderma* sp. have been clearly demonstrated by the findings of the present study which is having the support of Islam (2009) and Alam (2003) who reported similar views. That size of the population of *Trichoderma* sp. in the soil governs the occurrence of soil borne diseases has been the finding of the present study as demonstrated through the occurrence or non-occurrence of

*Sclerotium*collar rot and *Fusarium.* It is supported by the report of Islam (2009) who recorded the decline of such soil borne diseases upon enrichment of soil with anatagonist *Trichoderma*.

An equilibrium between the soil borne pathogens and antagonist here *Trichoderma harzianum* may or may not support a soil borne disease. However, a predominant presence of *Trichoderma* is necessary for creating a pathogen suppressive soil has been clearly demonstrated by the findings of the present study. Post-harvest estimation of soil fungal population reflects an idea of the status of both soil-borne pathogen and antagonist in the immediate past cropping season. This helps the grower to identify his soil as either pathogen suppressive or conducive. The grower can thereby decide to add antagonist to make his field soil ready for healthy cultivation of the next crop.

Conclusion

It was observed that with the increase of *Trichoderma* population other soil borne fungi including *Sclerotium rolfsii* and *Fusarium oxysporum* were decreased. Incidence of *Fusarium* wilt and *Sclerotium* collar rot were lower or absent in those eggplant varieties where the population of *Trichoderma* was higher. That means *Trichoderma* population in the soil can be helpful in reducing population of other pathogenic soil fungi. So, the *Trichoderma* population in the soil can reduce other pathogenic soil borne fungal populations, and can be used in controlling these soil pathogenic fungi. So IPM Lab Bio-pesticide may be used in the form of formulated *Trichoderma*. This will help the farmers to reduce the production cost avoiding haphazard and excess application of toxic chemicals which often have their residual effects in the soil, in plants, in fruits and also in the farmers' body.

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