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Soil Borne Fungi Associated with Different Vegetable Crops in Sindh, Pakistan

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Abstract. Different soil-borne fungi are responsible for reducing the yield of vegetables throughout the world including Pakistan. There are several soil borne fungal pathogens which aggressively infect vegetable crops. Surveys conducted during September 2010 to October 2011, demonstrated that a great diversity of soil borne plant pathogens associated with different vegetables prevail in vegetable growing areas of Sindh such as Tando Allahayar, Mirpurkhas, Ghotaki, Khairpur, Kunri, Umerkot and Karachi, etc. Our study noted in total thirteen different genera of fungi isolated from vegetable crops (cabbage, brinjal, tomato, radish and spinach). Isolated fungi identified included *Alternaria solani, Aspergillus flavus, A. fumigatus, A. niger, A. oryzae, A. terrus, Aeromonium fusidiocles, Cladosporium* sp., *Drechselra hawaiiensis, Eurotium berbanbrum, Fusarium oxysporum, Macrophomina phaseolina, Penicillium commune, Rhizoctonia solani, Trichoderma harzianum, Ulocladium* sp., and unidentified black mycelium from the soil and roots of vegetable crops. In addition, it was found that soil is commonly infected by soil-borne fungi and eventually results in heavy losses of vegetable yield in the vegetable growing areas of Sindh province. The infection rapidly increased due to many factors such as, presence of moisture, cxcess of water and infection may be caused by winds, gales and dust storms as well as by mechanical vectors.

Keyword: vegetables, root-rot, soil borne

Introduction

Vegetables included in daily schedule of diet *viz.* sweet pepper, cauliflower, carrot, cabbage, lettuce, spinach, tomato, potato, reddish, and bottle gourd are rich in proximate composition, vitamin and mineral contents. The soil and climatic conditions of Pakistan are congenial for the production of vegetables and widely diversified agro climatic zones (Hanif *et al.,* 2006). The nature has endowed Pakistan with diverse types of climatic conditions and land for vegetable crops. Therefore, a large variety of vegetables are cultivated in Pakistan throughout the year. In excess of 63 vegetable species are grown in various parts of the country as summer and winter vegetables particularly in Sindh province, Pakistan (Athar and Bokhari, 2006). In Sindh, Mirpurkhas division is positioned atop a fertile land making conditions suitable for cropping and vegetation. The major crops and vegetables are widely cultivated in this region (Hussain *et al.,* 2012). Vegetables are divided into two groups on the basis of season including winter vegetable (cultivated during the winter months of October-March) and summer vegetables (cultivated during the month of April-September). Some vegetables plants have no particular time for sowing including cucumber, radish etc. (Ali, 2000).

Vegetables are important food and highly beneficial ingredients which can be successfully utilised to build up and repair the body. They are valued mainly for their high carbohydrate, vitamin and mineral contents (Hanif *et al.,* 2006). The yield of vegetables is reducing gradually every year due to the soil-borne fungi. It is facing several biotic problems and is under threat due to soil borne pathogens in all over vegetable growing areas. Soil-borne plant diseases cause significant damage to almost all crops particularly to the vegetables (Usman *et al.,* 2013).

Infection of the vegetable plants in the field may occur at any time during the growing season. Early infections caused seedling blight and later infections caused foliar blight, stem lesion, vine rot, fruit rot and root and crown

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rot (Usman *et al.,* 2013). Islam and Babadoost (2002) and Lee *et al.* (2001) reported that in the vegetable crops of different areas of Sindh province including Karachi (Malir, Sharafi Goth, Memon Goth and Gadap Town), Kunri, Mirpurkhas, Ghotaki, Tando Allahyar and Digri show heavy losses and several symptoms including wilting stunted growth, chlorosis, and blotch on vegetable crops. Fatima *et al.,* (2009) indicated that *Alternaria alternata*, *A. citri*, *Aspergillus niger*, *A. flavus, Aspergillus* sp., *Cladosporium cladosporioides*, *Drechslera australeinsis*, *Fusarium solani*, *Fusarium* sp., *Geotrichum candidum, Penicillium* sp., *Phytophthora capsici* and *Rhizopus stolonifer* are responsible for postharvest deterioration of fresh fruits and vegetables.

The yield of vegetables is reducing gradually every year due to the soil-borne and root rot pathogens. Soil borne and root rot pathogens cause significant damage to almost all crops particularly to the vegetables. The association of root-knot with soil borne and root rot such as *Macrophomina phaseolina*, *Fuasrium* sp., and *Rhizoctonia solani* is causing diseases in different vegetable crops particularly chilli, brinjal, okra, tomato and spinach (Farzana *et al.,* 2013; Hussain *et al.,* 2013c; Maqbool *et al.,*1988). The soil borne root infecting fungi like *Macrophomina phaseolina* is reported to produce charcoal rot, damping off, root rot, stem rot, pod rot in more than 500 plant species (Sheikh and Ghaffar, 1992; Sinclair, 1982) with more than 67 hosts recorded from Pakistan alone (Mirza and Qureshi, 1978). Soil borne plant pathogens cause significant crop losses in chilli crop alone in Sindh. Root rot fungi including *Fusarium* sp., *Macrophomina phaseolina, R. solani*, *Phytophthora* root rot and *Alternaria* spp., are causing heavy losses in chilli and other crops (Hussain *et al.,* 2013a; 2013b; Hussain and Abid, 2011).

The objectives of the present study were; 1) to survey the various fungi infecting (soil borne and root) vegetables, 2) to compare the fungal composition of assemblages in soil borne and root rot of vegetables in seven different localities of Sindh province, and 3) to measure the infection % of the fungal assemblages.

Materials and Methods

Collection and isolation of fungi. The root rot fungi of vegetables including cabbage (*Brassica oleracea* L.), brinjal (*Solanum melongena* L.), tomato (*Lycopersicon esculentum* Mill.), radish (*Raphanus sativus* L.) and spinach (*Spinacia oleracea* L.) showing wilting, stunted growth, chlorosis and blotches were collected from Sindh province including Karachi, Tando Allahayar, Mirpurkhas, Ghotaki, Khairpur, Kunri and Umerkot from September 2010 to October 2011. The infected root samples were cut into small pieces up to 1.5 to 2 cm and surfaces were sterilised by 1% Ca $(OCl)_2$ for 1 min and these pieces were transferred on potato dextrose agar (PDA) medium and Czapek's agar medium containing antibiotic (Penicillin and Streptomycin) drops. The petri dishes were incubated for 3-6 days at 28 °C. Infection % was calculated with the help of following formula:

$$\text{Infection \%} = \frac{\text{Number of plants infected by a pathogen}}{\text{Total number of plants}} \times 100$$

Method of soil sampling. A total of 55 soil samples were collected between September 2010 and October 2011, from different locations of Sindh including Karachi, Tando Allahayar, Mirpurkhas, Ghotaki, Khairpur, Kunri and Umerkot. All samples were collected randomly from locations and they were associated with different vegetable fields particularly cabbage, brinjal, tomato, radish and spinach. About 300 g of soil was collected in polythene bags, tagged with name of vegetable and location, for each sample and taken to the laboratory for further analysis.

Soil dilution technique. One gram of soil was suspended in 9 mL of sterilised distilled water with the dilution of 1:10, followed by the dilutions of 1:100, 1:1000 and 1:10000. One mL aliquot sample was poured in sterilised petri plates containing potato dextrose agar (PDA) medium. Three replicates per sample were placed. The dishes were incubated at 30 °C. The colonies of fungi on plates were counted and identified with the help of Singh *et al.* (1991). The number of colonies of each fungus was multiplied by the dilution factor which shows total number of propagules/g of soil (Waksman and Fred, 1922).

Identification of fungi. Isolated fungi were examined by using 10 × and 40 × magnifications on the microscope to identify hyphae, sporangia, sporangiophores, conidia, conidiophores and some other morphological characters including growth pattern, colony texture and growth rate of the colonies on PDA (Promputtha *et al.,* 2005). Standard manuals or refernces including (Singh, 1991; Nelson *et al.,* 1983; Domsch *et al.,* 1980; Sutton, 1980; Ellis, 1976; 1971; Barnett and Hunter, 1972) were also used for the confirmation of various species.

Results and Discussion

Fungi isolated from roots. Twelve fungi were isolated from infected samples of soil collected from different vegetable crops (Table 1). Ten different fungi were

Table 1. Fungi isolated from infected soil and roots of different vegetables collected from different areas of Sindh province, Pakistan

Host		Name of fungi	
Scientific name	Common name	Root	Soil
Brassica oleracea L.	Cabbage	*Aspergillus oryzae, Aeromonium fusidiocles, Alternaria solani*, Cladosporium* sp., *Eurotium berbanbrum, Fusarium oxysporum*, Macrophomina phaseolina*, Rhizoctonia solani*, Ulocladium* sp.	*Aspergillus flavus*, A. fumigatus, A. niger*, Fusarium oxysporum*, Macrophomina phaseolina*, Penicillium commune*, Rhizoctonia solani**
Solanum melongena L.	Brinjal	*Alternaria solani*, Fusarium oxysporum*, Macrophomina phaseolina*, Rhizoctonia solani*, Penicillium commune*, Trichoderma harzianum**	*Aspergillus flavus*, A. niger*, A. terrus, Fusarium oxysporum*, Macrophomina phaseolina*, Penicillium commune*, Rhizoctonia solani*, Trichoderma harzianum**
Lycopersicon esculentum Mill.	Tomato	*Fusarium oxysporum*, Macrophomina phaseolina*, Rhizoctonia solani**	*Alternaria solani*, Aspergillus flavus*, A. niger*, Drechselra hawaiiensis, Fusarium oxysporum*, Macrophomina phaseolina*, Rhizoctonia solani**
Raphanus sativus L.	Radish	*Fusarium oxysporum*, Penicillium commune*, Rhizoctonia solani**	*Aspergillus niger*, Fusarium oxysporum*, Macrophomina phaseolina*, Rhizoctonia solani**
Spinacia oleracea L.	Spinach	*Fusarium oxysporum*, Macrophomina Rhizoctonia solani* phaseolina*,*	*Aspergillus flavus*, A. fumigates, Drechselra hawaiiensis, Fusarium oxysporum*, Macrophomina phaseolina**

= * major fungal disease.

isolated from roots of cabbage crop. Among these: *Fusarium oxysporum, Macrophomina phaseolina* and *Alternaria solani* were predominant with mean values of 65, 53 and 40.57%, respectively as compared to other species including *Rhizoctonia solani*, *Aspergillus orzae, Ulocladium* sp., *Aeromonium fusidiocles, Cladosporium* sp., and *Eurotium berbanbrum.* The occurrence of these three fungi was maximum in samples collected from Tando Allahyar (75%), Khairpur (71%) and Ghotaki (68%), respectively, and minimum (6%) from Mirpurkhas region. These fungi were maximum in samples collected from Kunri (67 and 65%), Tando Allahyar and Khairpur (66%), respectively, and minimum (7%) from Mirpurkhas (Table 2).

The combined infection result of tomato, radish and spinach roots (Fig. 1) showed that *Fusarium oxysporum* was predominant with mean value of 58% as compared to other species *Penicillium commune, Rhizoctonia solani* and *Macrophomina phaseolina.* On the basis of regions, comparison the occurrence of these fungi was maxi-mum in the samples from Kunri (69 and 63%), Tando Allahyar (67%) and Karachi (63%), respectively, and minimum (17%) from Khairpur region (Table 2).

Table 3 shows the results of ANOVA for the fungal infection % on roots samples collected from various

Table 2. Infection % of different fungi isolated from roots of vegetable at various localities of Sindh province, Pakistan

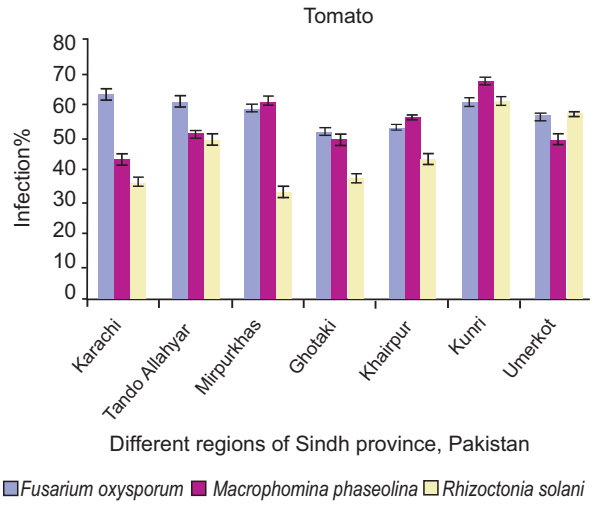
Isolated fungi	Root diseases infection %				
	Cabbage	Brinjal	Tomato	Radish	Spinach
Aeromonium fusidiocles	16.29	0	0	0	0
Alternaria solani	40.57	41.86	52.29	0	0
Aspergillus oryzae	32.70	0	0	0	0
Cladosporium sp.	15	0	0	0	0
Eurotium berbanbrum	12.43	0	0	0	0
Fusarium oxysporum	65	60.71	58	58	53.14
Macrophomina phaseolina	53	52.29	53.71	0	54.14
Penicillium commune	0	27.57	0	28.29	0
Rhizoctonia solani	40	39.57	45.14	45.86	42.29
Trichoderma harzianum	0	15.29	0	0	0
Ulocladium sp.	22.43	0	0	0	0
Unidentified black mycelium	12.86	10.86	0	0	0

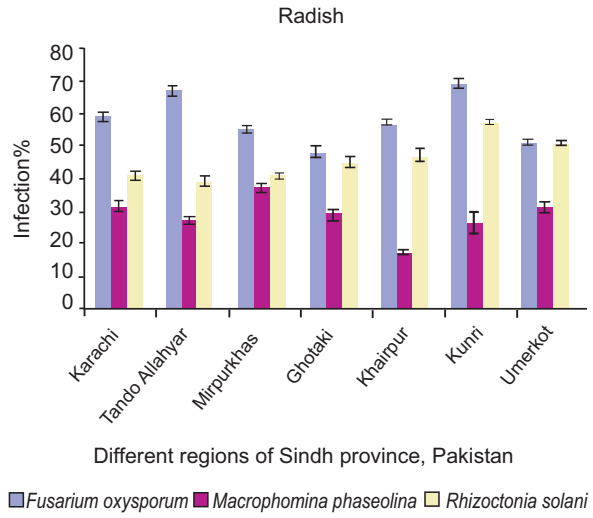
localities of Sindh. Twelve fungal species including *Alternaria solani, Aspergillus oryzae, Aeromonium fusidiocles, Cladosporium* sp., *Eurotium berbanbrum, Fusarium oxysporum, Macrophomina phaseolina, Penicillium commune, Rhizoctonia solani, Trichoderma harzianum, Ulocladium* sp., and unidentified black mycelium showed highly significant differences among localities.

The infection result of brinjal roots showed that *Fusarium oxysporum, Macrophomina phaseolina* and *Alternaria solani* were predominant with mean values of 60.71, 52.29 and 41.86%, respectively, as compared to other species including *Trichoderma harzianum, Penicillium commune* and *Rhizoctonia solani (*Fig. 2).

Table 3. F-ratios derived from ANOVA for fungal infection % of roots

Fungi species	F-ratio	P-value	$LSD_{0.05}$
	Cabbage		
Aspergillus oryzae	206.35	0.0000***	3.71
Aeromonium fusidiocles	70.11	0.0000***	2.92
Alternaria solani	72.67	0.0000***	3.81
Cladosporium sp.	98.84	0.0000***	2.63
Eurotium berbanbrum	28.03	0.0000***	2.24
Fusarium oxysporum	28	0.0000***	3.54
Macrophomina phaseolina	19.14	0.0000***	3.67
Rhizoctonia solani	76.16	0.0000***	3.65
Ulocladium sp.	46.02	0.0000***	2.65
Unidentified black mycelium	26.43	0.0000***	2.35
	Brinjal		
Alternaria solani	76.33	0.0000***	4.07
Fusarium oxysporum	12.48	0.0000***	3.47
Macrophomina phaseolina	74.75	0.0000***	3.05
Rhizoctonia solani	83.78	0.0000***	3.45
Penicillium commune	48.03	0.0000***	3.7
Trichoderma harzianum	27.29	0.0000***	2.37
Unidentified black mycelium	12.86	0.0000***	2.15
	Tomato		
Fusarium oxysporum	13.70	0.0000***	3.20
Macrophomina phaseolina	32.37	0.0000***	4.06
Rhizoctonia solani	55.46	0.0000***	4.12
	Radish		
Fusarium oxysporum	39.92	0.0000***	3.77
Penicillium commune	13.28	0.0000***	4.68
Rhizoctonia solani	23.86	0.0000***	3.71
	Spinach		
Fusarium oxysporum	44.5	0.0000***	3.48
Macrophomina phaseolina	29.42	0.0000***	3.63
Rhizoctonia solani	54.57	0.0000***	3.34





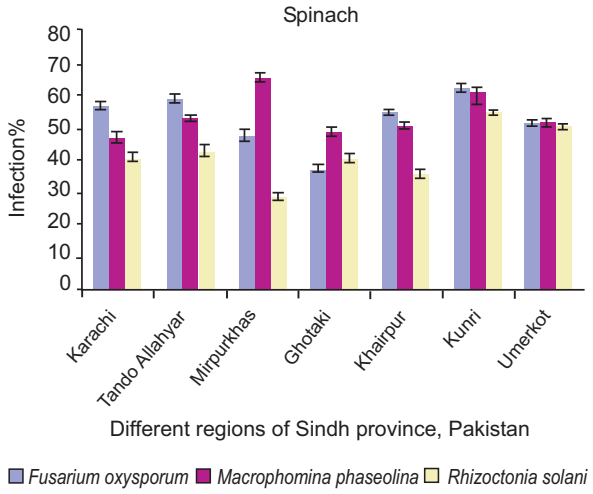


Fig. 1. Infection % of different fungi isolated from the roots of tomato, radish and spinach.

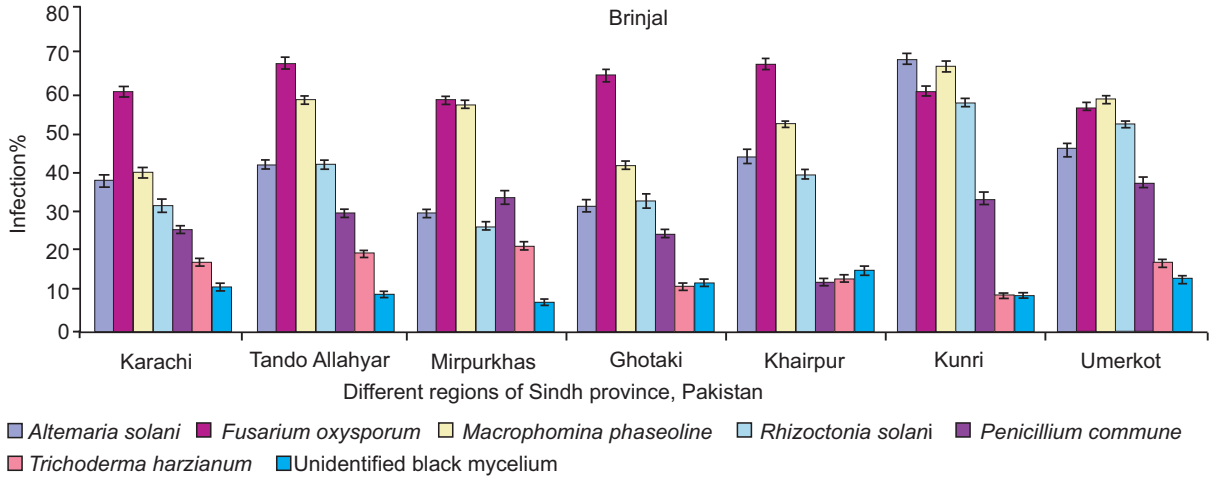


Fig. 2. Infection % of different fungi isolated from the roots of Brinjal.

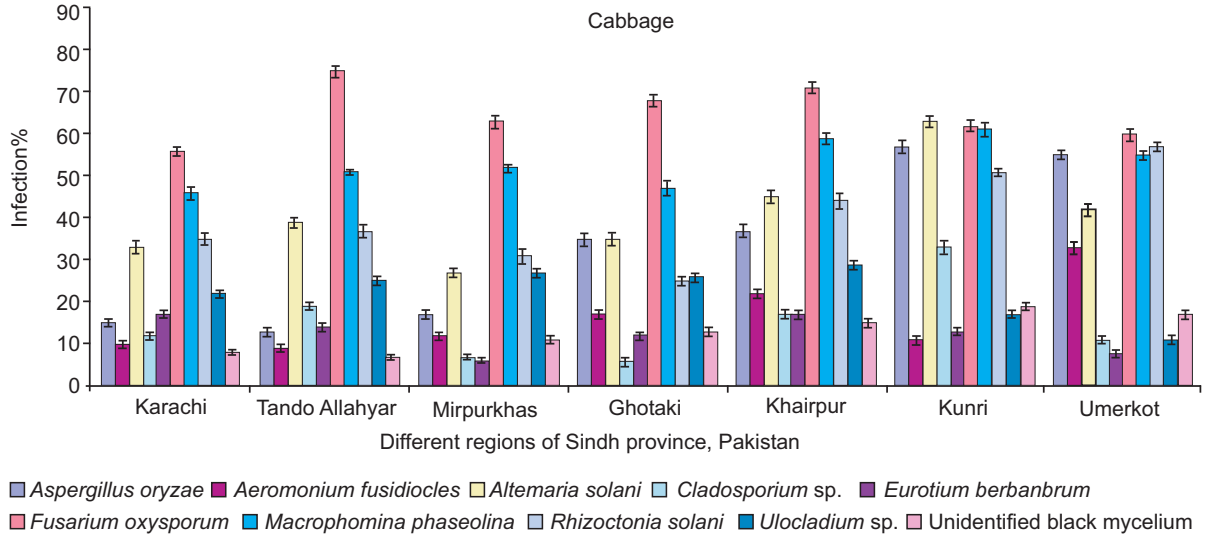


Fig. 3. Infection % of different fungi isolated from the roots of Cabbage.

All twelve species are pathogenic on all vegetable particularly tomato, radish, spinach brinjal and cabbage, crops. (Fig. 1-3).

Fungi isolated from soil. Twelve fungi were isolated from infected samples of soil collected from different vegetable crops. There are seven different fungi isolated from roots of cabbage crop. Among these *Aspergillus flavus, Fusarium oxysporum* and *Aspergillus niger* were predominant with mean values of 58, 56.29 and 38.43%, respectively, as compared to other species such as *Penicillium commune*, *Aspergillus fumigatus, Macrophomina phaseolina* and *Rhizoctonia solani.* The occurrence of these three fungi was maximum in samples collected from Umerkot (72 and 71%), Kunri (67%) and Mirpurkhas (66%), respectively, and minimum (11%) from Ghotaki region. The infection result of brinjal roots showed that *Aspergillus flavus, A. niger* and *Fusarium oxysporum* were predominant with mean values of 51.29, 39 and 37%, respectively, as compared to other species including *Aspergillus terrus, Penicillium commune, Trichoderma harzianum, Rhizoctonia solani* and *Macrophomina phaseolina.* These fungi were found maximum in samples collected from Kunri (61%), Umerkot (57%) and Karachi (56%), respec-tively, and minimum (10%) from Khairpur (Table 4).

The combined infection result of tomato, radish and spinach roots showed that *Fusarium oxysporum* and *Macrophomina phaseolina* were predominant with

Table 4. Mean and Standard error of different fungi isolated from soil of vegetable at various localities of Sindh province, Pakistan

Name of fungi	Different fungi isolated from soil							
	KHI	TAND	MPK	GHO	KHA	KUN	UME	Grand mean
			Cabbage					
Aspergillus flavus	34±1.61	57±2.12	61±2.17	52±2.37	63±2.67	67±2.16	71±1.90	58±4.50
A. fumigatus	41±1.69	22±2.83	17±2.04	11±0.75	21±2.83	13±0.75	9±0.75	19.14±4.08
A. niger	27±2.86	47±1.41	33±1.73	39±1.40	25±2.86	47±1.41	51±2.37	38.43±3.92
Fusarium oxysporum	56±2.12	61±2.17	66±2.16	39±1.40	34±1.74	66±2.16	72±1.90	56.29±5.46
Macrophomina phaseolina	31±2.86	23±2.86	34±1.74	29±2.86	37±1.40	41±1.69	23±2.86	31.14±2.57
Penicillium commune	23±2.86	12±0.75	11±0.75	17±2.04	21±2.86	19±2.04	16±2.04	17±1.68
Rhizoctonia solani	46±1.41	27±2.86	23±2.86	29±2.86	37±1.40	33±1.73	31±2.86	32.29±2.83
			Brinjal					
Aspergillus flavus	56±2.12	50±2.37	46±1.41	48±1.41	41±1.69	61±2.17	57±2.12	51.29±2.65
A. niger	41±1.69	35±1.40	34±1.40	37±1.40	31±2.86	42±1.69	53±2.37	39±2.75
A. terrus	19±2.04	11±0.75	17±2.04	16±2.04	10±0.75	13±0.75	17±2.04	14.71±1.29
Fusarium oxysporum	37±1.40	41±1.69	33±1.40	19±2.04	27±2.86	53±2.37	49±1.41	37±4.51
Macrophomina phaseolina	29±2.86	27±2.86	31±2.86	54±2.37	17±2.04	22±2.86	33±1.40	30.43±4.44
Penicillium commune	17±2.04	19±2.04	17±2.04	20±2.04	18±2.04	16±2.04	15±2.04	17.43±0.65
Rhizoctonia solani	33±1.40	29±2.86	27±2.86	24±2.86	19±2.04	35±1.40	41±1.69	29.17±2.77
Trichoderma harzianum	17±2.04	29±2.86	34±1.40	31±2.86	30±2.86	29±2.86	25±2.86	27.86±2.08
			Tomato					
Alternaria solani	35±1.40	19±2.04	22±2.86	27±2.86	29±2.86	33±1.40	41±1.69	29.43±2.88
Aspergillus flavus	56±2.37	53±2.37	50±1.41	57±2.37	47±1.41	53±2.37	44±1.41	51.43±1.78
A. niger	33±1.40	27±2.86	28±2.86	31±2.86	39±1.40	30±2.86	35±1.40	31.86±1.58
Drchselra hawaiiensis	29±2.86	27±2.86	31±2.86	25±2.86	17±2.04	11±0.75	19±2.04	22.71±2.74
Fusarium oxysporum	57±2.37	51±2.37	63±2.17	48±1.41	53±2.37	57±2.37	66±2.16	56.43±2.43
Macrophomina phaseolina	37±1.45	31±2.86	35±1.40	36±1.45	29±2.86	12±0.67	17±2.04	28.14±3.72
Rhizoctonia solani	65±2.17	57±2.37	44±1.41	41±1.69	48±1.41	33±1.40	39±1.40	46.71±4.17
			Radish					
Aspergillus niger	37±1.45	39±1.40	31±2.86	28±2.86	33±1.40	41±1.69	19±2.04	32.57±2.84
Fusarium oxysporum	57±2.37	45±1.41	61±2.17	35±1.40	37±1.45	31±2.86	36±1.45	43.14±4.41
Macrophomina phaseolina	27±2.86	19±2.04	18±2.04	27±2.86	26±2.86	39±1.40	48±1.41	29.14±4.08
Rhizoctonia solani	17±2.04	11±0.52	18±2.04	27±2.86	29±2.86	31±2.86	33±1.40	23.17±3.15
			Spinach					
Aspergillus flavus	78±2.50	65±2.17	57±2.37	67±2.16	71±1.90	47±1.37	61±2.17	63.71±3.78
A. fumigatus	29±2.86	15±2.04	11±0.52	10±0.52	27±2.86	35±1.40	31±2.86	22.57±3.89
Drechselra hawaiiensis	33±1.40	41±1.69	27±2.86	29±2.86	21±2.04	17±2.04	35±1.40	29±3.12
Fusarium oxysporum	57±2.37	82±2.50	71±1.90	69±2.16	78±2.50	66±2.17	61±2.17	69.14±3.35
Macrophomina phaseolina	31±2.86	47±1.37	45±1.41	40±1.69	38±1.45	41±1.69	36±1.45	39.71±2.04

KHI = Karachi, TAND = Tando Allahyar, MPK= Mirpurkhas, GHO = Ghotaki, KHA = Khairpur, KUN= Kunri, UME = Umerkot.

average mean value of 56 and 32%, respectively, as compared to other speciese i.e. *Alternaria solani, Aspergillus flavus, A. fumigatus, A. niger, Rhizoctonia solani* and *Drechselra hawaiiensis.* On the basis of regions' comparison, the occurrence of these fungi was maximum in the samples Tando Allahyar (82%), Khairpur (78%) and Mirpurkhas (71%), respectively, and minimum (10%) from Ghotaki region (Table 4).

Table 5 shows the results of ANOVA for the fungal infection % on soil samples collected from various localities of Sindh. Eleven fungal species including *Alternaria solani, Aspergillus flavus, A. fumigatus, A. niger, A. terrus, Drechselra hawaiiensis, Fusarium oxysporum, Macrophomina phaseolina, Penicillium commune, Rhizoctonia solani* and *Trichoderma harzianum* showed high significant differences among localities. Nine species are pathogenic on all vegetables particularly cabbage, brinjal, tomato, radish and spinach crops. In brinjal *Penicillium commune* showed non-significant difference than other vegetables.

Meteorological conditions such as high temperature and low humidity during the summer contribute to fewer fungi

Table 5. F-ratios derived from ANOVA for fungal infection % of soil

Fungi species	F-ratio	P-value	$LSD_{0.05}$
	Cabbage		
Aspergillus flavus	31.87	0.0000***	6.11
A. fumigatus	33.08	0.0000***	5.30
A. niger	24.40	0.0000***	5.93
Fusarium oxysporum	53.89	0.0000***	5.56
Macrophomina phaseolina	7.97	0.0000***	6.97
Penicillium commune	4.59	0.0006***	5.84
Rhizoctonia solani	9.94	0.0000***	6.71
	Brinjal		
Aspergillus flavus	13.16	0.0000***	5.46
A. niger	14.63	0.0000***	5.37
A. terrus	4.40	0.0009***	4.57
Fusarium oxysporum	37.38	0.0000***	5.52
Macrophomina phaseolina	21.77	0.0000***	7.11
Penicillium commune	0.70	0.6453ns	5.77
Rhizoctonia solani	10.58	0.0000***	6.35
Trichoderma harzianum	4.49	0.0007***	7.31
	Tomato		
Alternaria solani	11.45	0.0000***	6.35
Aspergillus flavus	5.49	0.0001***	5.69
A. niger	3.17	0.0087**	6.62
Drechselra hawaiiensis	8.86	0.0000***	6.88
Fusarium oxysporum	8.56	0.0000***	6.20
Macrophomina phaseolina	24.99	0.0000***	5.56
Rhizoctonia solani	40.39	0.0000***	4.90
	Radish		
Aspergillus niger	13.49	0.0000***	5.78
Fusarium oxysporum	35.79	0.0000***	5.51
Macrophomina phaseolina	22.16	0.0000***	6.47
Rhizoctonia solani	13.89	0.0000***	6.32
	Spinach		
Aspergillus flavus	22.34	0.0000***	5.98
A. fumigatus	23.82	0.0000***	5.96
Drechselra hawaiiensis	15.13	0.0000***	5.98
Fusarium oxysporum	15.35	0.0000***	6.38
Macrophomina phaseolina	9.30	0.0000***	5.01

while in the rainy season the concentration of fungi is significantly increased in the soil (Kakde *et al.,* 2001). It is interesting to note that in Karachi, located in southern Sindh, studies on airborne mycobiota (Rao *et al.,* 2009; Afzal *et al.,* 2004) have demonstrated that the aerospora is dominated by *Aspergillus flavus, A. niger* and *Alternaria solani*. Thus, the atmospheric mycobiota trend to correspond with the soil of vegetable fungal dominance.

These results confirms the findings of Hussain *et al.* (2013a); Usman *et al.* (2013);Islam and Babadoost (2002) and Lee *et al.* (2001) . The most frequent associated fungi isolated from the soil of vegetables are *Alternaria solani, Aspergillus flavus, A. fumigatus, A. niger, A. oryzae, A. terrus, Aeromonium fusidiocles, Cladosporium* sp., *Drechselra hawaiiensis, Eurotium berbanbrum, Fusarium oxysporum, Macrophomina phaseolina, Penicillium commune, Rhizoctonia solani, Trichoderma harzianum,* and *Ulocladium* sp., etc. These results prove that these fungi were most prevalent in the soil of fields and also found to be responsible for most of the decline of the vegetable crops.

This preliminary study provides basis for the determination of fungi from root and soil losses of vegetables which are most demanded in Pakistan. A detailed and investigative survey is required to establish the soil and root resistance strategies to reduce the losses both in terms of economic and food supply especially caused by fungi.

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