A SURVEY OF PHYTOPATHOGENIC FUNGI AND OOMYCETES IN RIYADH, SAUDI ARABIA

Survey Jamur Pathogen Tanaman dan Oomycetes di Riyadh, Kingdom of Saudi Arabia

Arya Widyawan[1,2], Boy Valenza Damiri[3], Adyatma Irawan Santosa[4], Haris Setyaningrum[5]

1) Plant Protection Department, College of Food and Agricultural Sciences, King Saud University, Riyadh, Saudi Arabia
2) Rumah Ilmu, Dumai, Riau, Indonesia
3) East West Seed Indonesia, Purwakarta, Indonesia
4) Department of Plant Protection, Faculty of Agriculture, University of Ankara, Ankara, Turkey
5) Agrotechnology Department, University of Darussalam Gontor, Indonesia
Corresponding email: aryawidyawan@yahoo.com.au

Abstract: A survey of phytopathogenic fungi and Oomycetes was conducted in Riyadh, Kingdom of Saudi Arabia during October 2008 – May 2009. Total of 223 samples were collected from four regions; Al-Kharj, Oyaynah, Old Diriyah, and Al-

Amariyah. Isolation was done using Potato Dextrose Agar (PDA). Infected parts were cut then sterilized in chlorox (10%), then were put in petridish that contain PDA and incubated at 25-27 °C. A total twelve genera of fungi and single genera of Oomycetes were isolated from the infected plants and identified as *Fusarium* spp., *Alternaria* spp., *Helmintosphorium* (*Bipolaris*) spp., *Sclerotium* spp., *Rhizoctonia* spp., *Cladosporium* spp., *Mauginiella scattae*, *Erysiphe* spp., *Leveillula* spp., *Macrophomina phaseolina*, *Ustilago* spp., *Ulocladium* spp., and *Phytium* spp.

Keywords: Phytopathogenic, Oomycetes, Riyadh, Al-Kharj, Oyaynah, Old Diriyah, and Al-Amariyah

Abstrak: Survey jamur patogen tanaman dan Oomycetes telah dilakukan di Riyadh, Kerajaan Saudi Arabia pada Oktober 2008 – Mei 2009. Sebanyak 223 sampel telah dikoleksi dari empat daerah; Al Kharj, Oyaynah, Diriyah Kuno dan Al Amariyah. Isolasi jamur dilakukan dengan menggunakan media Potato Dextrose Agar (PDA). Bagian tanaman yang terinfeksi dipotong kemudian disterilisasi dalam larutan Cholox 10%, kemudian diletakkan di petridish yang berisi media PDA dan diinkubasi pad suhu 25 – 27°C. Dua belas marga jamur dan satu marga Oomycetes telah diisolasi dari tanaman terinfeksi, teridentifikasi sebagai *Fusarium* spp., *Alternaria* spp., *Helmintosphorium* (*Bipolaris*) spp., *Sclerotium* spp., *Rhizoctonia* spp., *Cladosporium* spp., *Mauginiella scattae*, *Erysiphe* spp., *Leveillula* spp., *Macrophomina phaseolina*, *Ustilago* spp., *Ulocladium* spp., and *Phytium* spp.

Kata kunci: Patogen Tanaman, Oomycetes, Riyadh, Al-Kharj, Oyaynah, Diriyah Kuno, and Al-Amariyah

1. Introduction

Diseases on plants could be divided into two groups; infectious diseases and non-infectious diseases (Physiological disorder). During October 2008 until May 2009, several field trips to survey phytopathogenic fungi and Oomycetes causing plant diseases in Riyadh, Saudi Arabia were conducted.

Fungi are similar to plants in many ways, except for the absence of chlorophyll in their cells. As consequences, fungi cannot perform photosynthesis to produce sugar from carbon dioxide and water, and therefore must obtain all of their required nutrients from organic matters. A fungus is a small (usually microscopic) organism which body, made of many filaments (*hyphae*), is called the mycelium (Rane and Sellers, 1996). Most fungi produce reproductive structures (*spores*) that different among one species to others, thus can be used to identify them. However, some species of fungi have no spores at all, so they must be identified using other methods. *Rhizoctonia* spp., for example, can be identified by the unique right-angle branches of its fungal threads (Streets, 1972).

The fungi group that draws most gardeners and farming industry interest, however, are the plant pathogenic fungi - those that cause plant diseases. Fungi are the most numerous and most destructive of all plant pathogen types. About 85 percent of plant diseases are caused by fungi. Some

plant pathogenic fungi even able to attack many plant species (non host-spesific). Others, however, are host-specific; only able to invade one or a few closely related plants (Rane and Sellers, 1996).

2. Material and Method

2.1 Experimental site and time

Sample collections were carried out ten times during October 2008 until May 2009 from several farms on Al-Kharj, Oyaynah, Old Diriyah, and Al-Amariyah (Riyadh Province, Kingdom of Saudi Arabia).

2.2 Plant Material

Total of 223 plants samples, including vegetable, crop, fruits, and trees, were collected from the regions (Table 1).

2.3 Procedure

1. Sample Collection
   Samples were taken by cutting the diseased parts or whole plants and then put it in plastic bag. They were then immediately brought to laboratory. They would be following isolation and identification for phytopathogenic fungi and Oomycetes.
2. Isolation of fungi and Oomycetes from plant
   Samples were cleaned in running tap water and then, using a sterile scalpel, cut into small pieces exactly between the diseased area and the healthy one. The surface of section was sterilized with Clorox (NaOCl

10%) for 3 minutes and then rinsed well in clean water before blotted dry on clean filter paper. The sections were placed on Potato Dextrose Agar (PDA) aseptically and incubated at 25-27 °C (Agrios, 2005). Observation was recorded three days after incubation.

3. Identification of the pathogen
   Identification of the pathogen was determined on the morphological traits, hyphae and spore. It was assessed the mature fungal using a light microscope at 10, 40, and 100× magnifications.

3. Result and Discussion

Number of samples collected since October 2008 until May 2009 was 223 samples. Result of isolation and identification from those samples indicated at least 12 genera of phytopathogenic fungi; *Fusarium* spp., *Alternaria* spp., *Helmintosphorium* (*Bipolaris*) spp., *Sclerotium* spp., *Rhizoctonia* spp., *Cladosporium* spp., *Mauginiella scattae*, *Erysiphe* spp., *Leveillula* spp., *Macrophomina phaseolina*, *Ustilago* spp., and *Ulocladium* spp.; and 1 genera of Oomycetes: *Phytium* spp.

Phytopathogenic fungi and Oomycetes which identified during our survey were discussed, including descriptions and figures.

Fusarium spp**.**

Fusarium spp. colony is cottony in culture, usually white but sometimes also pink, yellow, or purple in color. It has three types of spore; chlamydopsore, microconidia, and

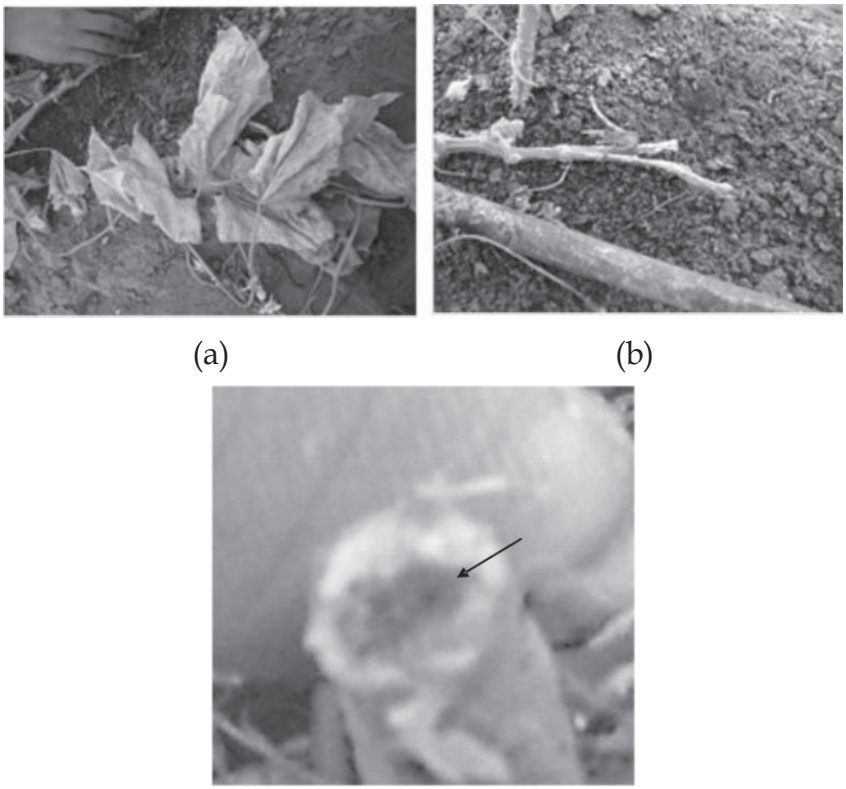
macroconidia. Macroconidia is slightly curved (canoe shaped) (Barnett and Hunter, 1972). *Fusarium* spp. is a soilborne fungus. It could be saprophytic on decaying plant or parasitic on higher plant. As a parasitic fungus, *Fusarium* spp. causes diseases in many crops. It may also attack at the early stage or in the middle of plant development. If the phytophatogenic fungi attack at the early stage, it can cause a damping off.

Fusarium spp. was one of the most common pathogenic fungi found in this survey and was found in all regions of Riyadh. It mainly infects Cucurbitaceae, but it was also isolated from tomato and pepper. *Fusarium* spp. infection in the cucumber root caused wilting of the whole plant. Other symptoms, such as discoloration, also appeared in tomato and pepper root (Figure 1).

Table 1. List of identified fungi and oomycetes from Riyadh Region, Saudi Arabia

Date	Area	Farm name	No. of Samples	Fungi and Oomycetes
October 27, 2008	Al Kharj	-	22	*Fusarium* spp., *Alternaria* spp., *Helmintosphorium* spp., *Rhizoctonia* spp., *Macrophomina phaseolina*
November 10, 2008	Oyaynah	Omahmar Al Shahwan Abdul Azis Al Hadlaq	18 3 3 12	*Fusarium* spp., *Alternaria* spp., *Mauginiella scattae*, *Helmintosphorium* spp., *Rhizoctonia* spp., *Phytium* spp.
November 24, 2008	Oyaynah	Omahmar Al Hadlaq	7 7	*Fusarium* spp., *Alternaria* spp., *Phytium* spp.
December 1, 2008	Old Diriyah	-	7	*Fusarium* spp., *Alternaria* spp.
December 22, 2008	Oyaynah	Al Shahwan Syadidah 1 Abdurahman bin Khalid Al Daaj 1	7 2 1 9	*Fusarium* spp., *Alternaria* spp., *Phytium* spp.

Date	Area	Farm name	No. of Samples	Fungi and Oomycetes
January 12, 2009	Oyaynah	Al Saleh Al Shahwan -	45 6 2	*Fusarium* spp., *Alternaria* spp., *Helmintosphorium* spp., *Sclerotium* spp., *Phytium* spp., *Erysiphe* spp., *Leveillula* spp., *Ulocladium* spp.
March 25, 2009	Old Diriyah	Abdullah Daud Al Dakisr	11 6	*Fusarium* spp., *Alternaria* spp., *Erysiphe* spp.
April 1, 2009	Al Kharj	Ar-Roofak Syadidah 2 Mushreefah Al Daaj 2	9 2 3 13	*Fusarium* spp., *Alternaria* spp., *Rhizoctonia* spp., *Cladosporium* spp., *Macrophomina phaseolina*, *Ustilago* spp.
April 20, 2009	Old Diriyah Al Amariya	An-Noofod Al Waseel	10 3	*Fusarium* spp., *Alternaria* spp., *Erysiphe* spp.
May 13, 2009	Oyaynah	Abdul Latief Al Shahwan Al Hadlaq	4 3 8	*Fusarium* spp., *Alternaria* spp.
Total			223	



(a) (b)

(c)

Figure 1. Wilting on cucumber as a result of *Fusarium* spp. infection (a); Damage on the crown area in cucumber wilt (b); Discoloration on the root of tomato (c);

Alternaria spp.

Alternaria spp. has a darkish colony when it is grown in the media as result of its conidiophores color. The spore color is black, typically with both cross and longitudinal septa, with various shape of *obclavate*, from elliptical to ovoid (Barnett and Hunter, 1972). *Alternaria* spp. may be live as saprophytic

or parasitic. It also causes disease symptom in many plants such as leaf dark spot symptom of Slick.(Figure 2). As a saprophytic fungus, *Alternaria* spp. may life on plant's organic material.

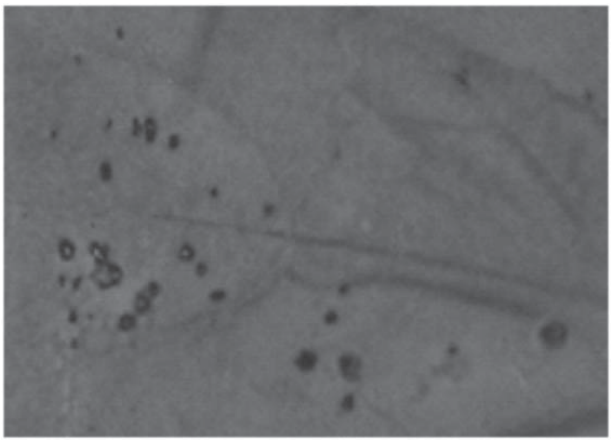


Figure 2. Leaf spots on Silck infected by *Alternaria* spp.at Al Saleh Farm.

The fungus was common in Riyadh and was found in all four surveyed regions. Most of isolates were isolated from infected Silck plant with leaf spots symptom. The abundance of *Alternaria* spp. was probably correlated with abundance of one of its host, Silck plant, which was widely planted throughout Riyadh.

Helmintosphorium **(***Bipolaris***)** spp.

Helmintosphorium spp. has a dark colony. Its Conidophore is brown, mostly simple, fusoid, straight, or curved, and consists of several cells (*phragmosporous*) (Barnett and Hunter, 1972). *Helminthosporium* spp. could grow either as parasitic or

saprophytic fungi. The fungal genus was only isolated from potato samples with symptoms on their tubers collected in Al Kharj and Oyaynah. *Helminthosporium solani* causes silver scurf disease on potato (Errampalli *et al*., 2001).

Sclerotium spp.

Sclerotium spp. is a *mycelia sterilia*; it does not have any spore. Asexual reproduction is done by forming fruiting bodies (Figure 3a). *Sclerotia* is brown or black in color, globose or irregular (Figure 3b) (Barnett and Hunter, 1972). *Sclerotium* spp. is parasitic, particularly on underground parts of plants (Barnett and Hunter, 1972). *Sclerotium* spp. also infect fruits that have a contact with soil. This was observed on the soft root symptom of cucumbers that lay on soil surface (Figure 3c). During the survey, *Sclerotium* spp. was only isolated from samples collected in Oyaynah.

Rhizoctonia spp.

Rhizoctonia spp. is also *mycelia sterilia* which produces black sclerotia. It is a soilborne parasitic fungus that mainly infects roots and other underground parts of plants. *Rhizoctonia* spp. can be isolated from the crown area of root. Plants infected by *Rhizoctonia* spp. show discoloration on root and an overall poor development (Barnett and Hunter, 1972).

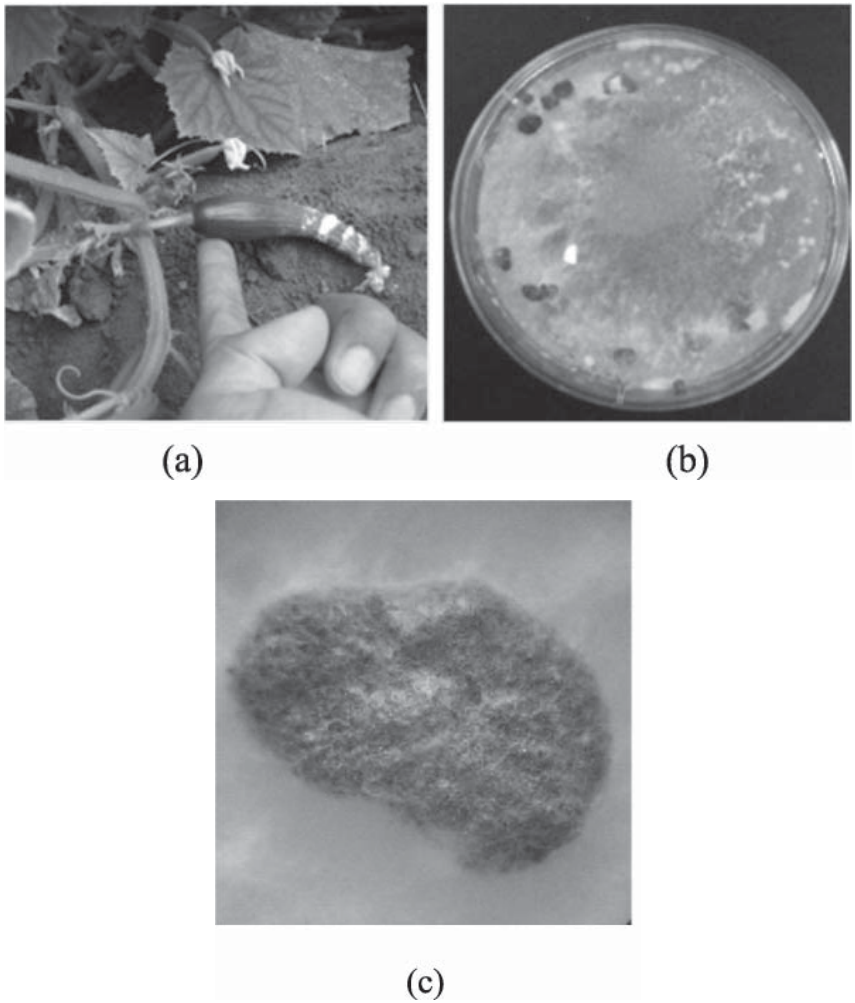


Figure 3. Cucumber infected by *Sclerotium* spp. (a); Sclerotia *Sclerotium* spp. grown in PDA (b); Sclerotia of *Sclerotium* spp. (c).

The fungus was found only in Al Kharj and Oyaynah, isolated from several different hosts: potato, tomato, cucumber, and

wheat. *Rhizoctonia solanii* causing stem canker and black scurf on potato (Demirci *et al*., 2011) and seedling damping off on tomato (Asaka and Shoda, 1996).

Pythium spp.

Pythium spp. is an important soilborne plant pathogenic Oomycete. It causes a serious disease if the fungus attacks on early stage of plant development. Damping off and root rot of tomato are some of the diseases caused by *Pythium* spp. (Patil *et al*., 2012).

It has elongate mycelium without cross wall and produces *oospore* as their resting spore and *zoospore* as their asexual spore (Agrios, 2005). *Pythium* spp. was the only Oomycete collected in our survey. It was only isolated from tomato samples collected in Oyaynah. It was found four out five times of our visits to the region. This indicates that the Oomycete is probably abundant. Persistent tomato cultivation problem in the region caused by *Phytium* spp. needs a intensive tactic.

Cladosporium spp.

Conidiophore of *Cladosporium* spp. is tall and dark; consist of either 1 or 2 cells. Although typically lemon shaped, it can be varied in size and shape, anywhere from ovoid to cylindrical. Some of it species infect plants; some others live as saprophytic fungi (Barnett and Hunter, 1972). *Cladosporium* spp. was isolated from infected tomato samples which were found in Al Kharj only. The fungus is causal agent of leaves brown spots disease on tomato (Matthieu *et al*., 1997).

Ulocladium spp.

The fungus grows as saprophytic (Barnett and Hunter, 1972). *Ulocladium* spp. likely was not among serious phytopatogenic fungi in Riyadh since it was only isolated from a cucumber sample collected in Oyaynah region. *Ulocladium cucurbitae* causes leaf spot disease on cucumber (Zitter and Hsu, 1990).

Mauginiella scattae

M. scattae is a pathogenic fungus species that causes a disease in Date palm. Discoloration on the petiole of Date palm leaf may appear as a result of infection of this fungus (Figure 4). The fungus was isolated from Oyaynah region. The presence of this fungus in Riyadh and its association with date palm disease has been reported before by other researchers (M. Al-Sharidi and Al-Shahwan, 2003).

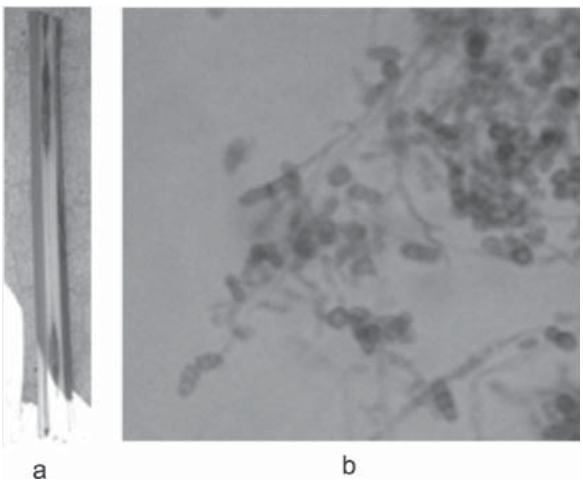
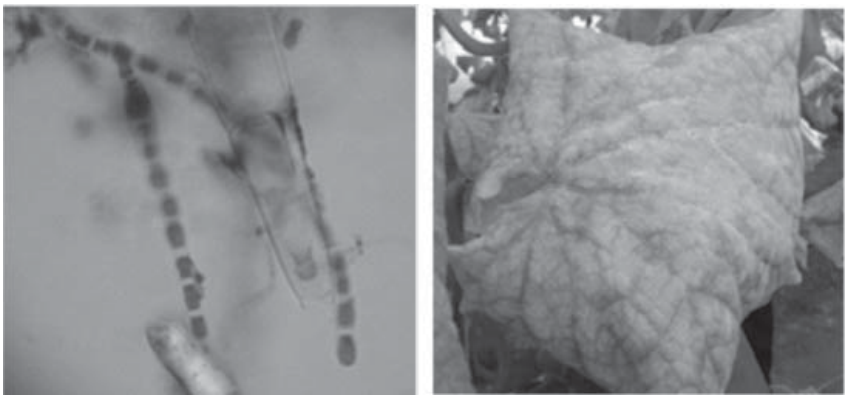


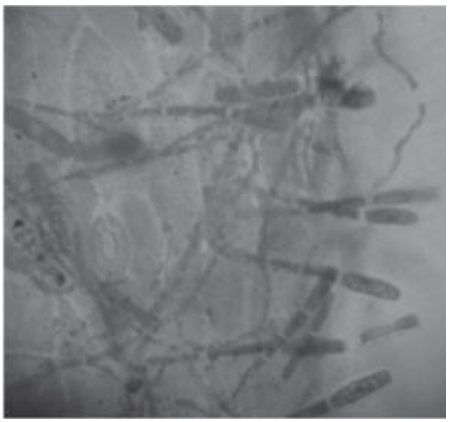
Figure 4. The leaf of date palm appeared discolororation symptom on the petiole. (a); *M. scattae* isolated from the date palm (b).

Powdery mildew

Powdery mildew may be found in cultivated plant and weed. Four genera of powdery mildew were reported to be present in the central region of Riyadh; *Erysiphe* spp., *Leveillula* spp., *Oidium* spp., and *Sphaeroteca* spp. (Abul Hayja *et al*., 1980). However, only two genera of powdery mildew were found in this survey: *Erysiphe* spp. and *Leveillula* spp. (Figure 5). *Erysiphe* spp. was observed on cucurbit samples collected in Oyaynah, Old Diriyah, and Al Amariyah; while *Leveillula* spp. was observed only from pepper collected in Oyaynah region (Table 1). Cucurbits were actually also cultivated in Al Kharj region, but but disease symptomps causing powdery mildew was not found in this region during the survey. it could be probably that the farmers managed the disease, such as using fungicide.



(a) (b)



(c)

Figure 5. *Erysiphe* spp. (a); Powdery mildew on cucumber caused by *Erysiphe* spp. (b); *Leveillula* spp. (c).

Macrophomina phaesolina

Macrophomina spp. is pathogenic fungi that belong to Basidiomycetes. This fungi cause root and stem rot disease (Agrios, 2005). There was one isolate of *Macrophomina* spp.

obtained during this survey. The fungus was isolated from bottle gourd (*Lagenaria siceraria*) that was collected in Al Kharj.

4. Conclusions

There were 12 genera of phytophatogenic fungi in Riyadh. *Fusarium* spp. and *Alternaria* spp. were the most common ones since they were found in all four surveyed regions. They were isolated from many different hosts. *Pythium* spp. isolated from symptomatic tomatoes was the only Oomycete found in Riyadh.

Acknowledgments

We would like to express a great gratitude to Prof. Dr. Ibrahim Al-Shahwan for field and laboratory information. We would also like to give our gratitude to Mr. Eid Ahmad Abu Tholib, M.Sc. for his great help in the fungi and Oomycete identification. Special appreciation is extended to all the members of Microbiology Research lab., College of Food and Agricultural Science, King Saud University.

5. References

Abul Hayja, Z.M., I.Y. Trabulsi, M. Fathi, and A. Bahi. 1980. Powdery mildew in the central region of Saudi Arabia. *Proceeding of Saudi Biological. Society* (4): 207-217.

Agrios, G.N. 2005. *Plant Pathology*. 5th ed. Academic Press, New York.

Al-Sharidi, M. and I. M. Al-Shahwan. 2003. Fungi associated with rot disease of inflorescence and fruit of date palm in Riyadh region, Saudi Arabia. *Proceeding of Eighth Arab Congress of Plant Protection*.

Asaka, O. and M. Shoda. 1996. Biocontrol of *Rhizoctonia solani* damping-off of tomato with *Bacillus subtilis* RB14. *Applied and Environmental Microbiology* 62(11): 4081-4085.

Barnett, H.L. and B.B. Hunter. 1972. *Illustrated genera of imperfect fungi* 3rd ed. Burgess Publishing Company, Minneapolis.

Demirci, E., E. Dane, and C. Eken. 2011. In vitro antagonistic activity of fungi isolated from sclerotia on potato tubers against *Rhizoctonia solani*. *Turkish Journal of Biology* (35): 457-462.

Errampalli, D., J.M. Saunders, and J.D. Holley. 2001. Emergence of silver scurf (*Helminthosporium solani*) as an economically important disease of potato. *Plant Pathology* (50): 141-153.

Matthieu, H., A.J. Joosten, R. Vogelsang, T.J. Cozijnsen, M.C. Verberne, and P.J.G.M. De Wit. 1997. The biotrophic fungus *cladosporium fulvum* circumvents cf-4 mediated resistance by producing unstable AVR4 Elicitors. *The Plant Cell* (9): 367-379.

Patil, A., A. Laddha, A. Lunge, H. Paikrao, and S. Mahure. 2012. In vitro antagonistic properties of selected *Trichoderma* species against tomato root rot causing *Pythium* species. *International Journal of Science, Environment and Technology* 1(4): 301-315.

Rane, K. and P. Sellers. 1996. *Grape Vine: Is there a Fungus Among Us?*. Down the garden path, plant & pest diagnostic laboratory. Issue No. 92. Purdue University Cooperative Extension Service: Indiana.

Streets, R.B. 1972. *Diagnosis of plant diseases*. The University of Arizona Press. Tucson: Arizona.

Zitter, T.A. and L.W. Hsu. 1990. A leaf spot of cucumber cause by *Ulocladium cucurbitae* in New York. *Plant Disease* 74(10): 824-827.