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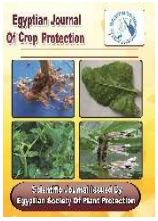

Survey and varietal reaction to early blight disease on potato in Egypt

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ABSTRACT

Early blight disease is one of the most important fungal diseases of potato. A survey of early blight disease caused by *Alternaria solani* was surveyed in different selected locations represent different soil types and different irrigation systems in El-Behira, El-Sharkia, New Valley, El-Menoufia and El-Gharbiya governorates, Egypt. The pathogenicity of different *A. solani* isolates (A1-A5) was carried out on commercially susceptible grown potato cultivar Herms. Percentage of disease incidence (PDI) and disease severity (PDS) were recorded. Results revealed that percentage of disease incidence and disease severity varied among the surveyed locations. The highest disease incidence values were recorded 98, 96, 98, 98 and 89%, respectively in El-Behira, El-Sharkia, New Valley, El-Menoufia and El-Gharbiya governorates. While the highest disease severity was recorded 57.2, 42.8, 40.8, 38.8 and 37.4%, respectively in El-Behira, El-Sharkia, New Valley, El-Menoufia and El-Gharbiya governorates. *Alternaria solani* isolate A3 and A1 were the most destructive isolates. Results indicate that selected potato cultivars i.e. Herms, Cara, Sponta and Mondial showed different susceptibility to early blight and the most susceptible cultivar was Herms.

Key words: Potato, Early Blight, *Alternaria solani*, Survey, Varietal Reaction.

INTRODUCTION

Potato (*Solanum tuberosum* L.) is the third most important food crop grown around the world (FAOSTAT, 2022). It is also one of the most widely produced and consumed tuberous crops in the world based on its nutrient capacity and potential for diverse uses form and easy availability to low-income consumers. In Egypt, potatoes are used largely as an essential food in many parts and serve as a national vegetable available throughout the year. It is a rich source of water, carbohydrates, vitamins, minerals, proteins, and fats, which accounts for 390 KJ 100g of baked potato (Zaheer and Akhtar, 2016). In Egypt, recent data indicate that potato production during 2022 was recorded 6155466.58 tones from an area of 213272 hectares (FAOSTAT, 2022). *Alternaria solani* causes early blight disease in a wide host of solanaceous vegetable plants leading to great loss in

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production yields (Zhang *et al.,* 2020) *Alternaria solani* causative agent of potato early blight disease is spread from sporangia which carried by wind and rain splash and survive from season to next season through plant residues (Zambolim and Duarte ,2012). The symptoms of early blight disease are described by dark concentric ring like lesions restricted by the leaf veins (Kaur *et al*.,2020). Infection can be seen on all plant parts on leaves, twigs and stems, under suitable conditions causes defoliation, drying of twigs and thus causing losses yield. The early blight is found wherever potato is cultivated, but the severity varies between year to year according to the weather conditions (mainly moisture and temperature), the age of the crop, and maturity of the potato. In general, the disease intensifies in old or ageing potatoes (Pelletier and Fry, 1990). Gwary and Nahunnaro (1998), revealed that early blight disease damages the leaves, stalks and stems causing severe destruction of the aerial part, resulting heavy losses in yield up to 79%. The total production depends upon different factors such as: nature of the disease, weather condition (especially when there are alternating dry and humid conditions with high temperature), irrigation type, and type of cultivar grown (Leiminger and Hausladen, 2012). In a previous study, five isolates of *A. solani* isolated and identified from naturally infected potato plants, collected from fields planted with the different varieties representing different governorates in Egypt (Minia, Giza, Menofyia, Behaira and Gharbia) (Abdel-Hamid *et al.,* 2023).

Therefore, the objectives of this study were conducted to 1) survey of early blight disease in five different governorates in Egypt, 2) Pathogenicity test with different *A. solani* isolates, and 3) Susceptibility of some commercial potato cultivars to some *A. solani* isolates.

MATERIALS AND METHODS

1- Survey of early blight disease in different locations:

1. A- Disease Incidance:

The current study was conducted at five governorates i.e., El-Behira, El-Sharkia, New Valley, El-Menoufia and El-Gharbiya, Egypt, during growing season (2020/2021) for surveying potato early blight disease. Plant samples collected based on visual disease symptoms from each field randomly. Sampling for smaller units ($25m^2$) was done along the diagonals of the fields at regular intervals each month during growing season. Following a zigzag pattern ten plants were taken from each selected unit. Percentage of Disease incidence (PDI) was estimated according to the formulae:

$$\text{Percentage of Disease Incidence(PDI)} = \frac{\text{Total Number of Infected Plants}}{\text{Total Number of Assesed Plants}} \times 100$$

1. B- Disease severity:

The disease severity was evaluated on 100 randomly selected plants / 10 smaller units /field. Then disease severity was estimated using the disease rating scale from 0-5 as described by Rao *et al.,* (2016), whereas: 0 = no visible symptoms apparent in the plant, 1 = A few minute lesions to about 10% of the total leaf area is blighted and usually confined to the 2 bottom leaves in the

plant, 2 = Leaves on about 25% of the total plant area are infected, 3 = Leaves on about 50% of the total plant area are infected, 4 = Leaves on about 75% of the total plant area are infected by the fungus and 5 = Leaves on the whole plant are blighted and plant is dead. The percentage of disease severity calculating according to the formula as follow:

$$\text{Percentage of disease severity(PDS)} = \frac{\text{Total of individual raitngs}}{\text{Number of plants assesed}} \times \frac{100}{\text{Maximum scale}}$$

2- Isolation, purification and Identification of the causal organism.

2. A - Isolation of *Alternaria solani* from Infected Potato Plants:

Naturally infected Potato plants showing early blight symptoms were collected from different potato growing areas in Egypt. Plant samples were carefully brought in a box samples to the laboratory and then processed immediately. Potato leaves and tubers of diseased plants were cut into small pieces, washed thoroughly with running tap water to remove any adhering soil particles. Surface sterilization of pieces was done by immersing in sodium hypochlorite with a final concentration of 0.25% for 4 minutes, followed by immersing in 70% ethanol for 2 minutes then washed several times in distilled sterilized water and transferred between two sterilized filter papers to remove the excess water. Sterilized samples were transferred to Petri dishes containing Potato Dextrose Agar medium [(PDA) Potato 200g ,Dextrose 20 g, Agar 15g then PH adjusted to 5-6] containing 40 ppm streptomycin sulfate to avoid bacterial contamination. Plates were incubated in darkness at 28 ± 2ºC for 5 days and checked daily for the occurrence of fungal growth.

2. B- Purification:

The growing isolated fungi were microscopically examined and then purified using the single spore or hyphal tip-technique as follow:

2. B.1- Single spore technique:

A dilute spore suspension of each isolate of the sporulation fungi was prepared by washing a pure culture of the fungus using 50 ml of distilled sterilized water. The spore suspension was poured into Petri dish over solid clear agar medium. Single spores were selected and marked using microscope. Plates were incubated until the germ-tube became just visible. The spores were then transferred to slant PDA medium in test tubes and/or in Petri dishes using a flatted end needle. The inoculated plates and/or tubes were then incubated at 27°C for 4-7 days for further studies. Pure cultures of each isolate were maintained on PDA slants and kept at 5°C for further experiments.

2. B.2- Hyphal tip technique:

Pure cultures were also obtained by selecting hyphal tips of the non-sporulating fungi, which were marked and cut off using a clear flamed flatted end sharp needle. The tips were transferred to PDA medium and incubated at 25°C for 7 days for further investigations (Dhingra and Sinclair 1977).

2. C- Identification of *A. solani:*

The pure cultures of the isolated fungi were examined microscopically and identified at the Agricultural Botany Department, Faculty of Agriculture, Menoufia University according to their

features described by Singh (1982) & Watanabe, (2010). Pure cultures of the fungus isolates were multiplied and maintained on PDA slants and kept at 5°C for further studies.

3- Pathogenicity Test:

Five representative isolates of *A. solani* from different localities were evaluated for their pathogenicity to the commercially grown susceptible potato cultivar Herms. Pathogenicity test was carried out by atomizing the conidial suspension (5×10^6 cfu/mL) at the rate of 10 mL/plant, prepared from 10-days-old culture to 4، days-old plants of moderately susceptible Potato cultivar Herms, grown under disease conditions. Conidia were harvested by dislodging the surface of fungal colony with glass rod, transferred to sterile distilled water and filtering through sterile cheese cloth. The resultant suspension was then adjusted to 5 x 10^6 cfu/mL using haemocytometer slide. Plants sprayed with sterile distilled water served as control. Each treatment was replicated ten times. Observations were recorded after ten days for symptoms development and re-isolation were made from test plants. Pots were watered as needed and fertilized with the recommended dose of fertilizers.

The disease severity percentage was recorded 10 days after inoculation. Disease severity was estimated according to a disease rating scale by (Rao *et al.,* 2016). The percentage of disease severity calculating according to the formulae mentioned previously.

4-Evaluation of different cultivars to early blight disease.

Four commercial Potato cultivars were evaluated for their susceptibility to the most virulent isolate of *A. solani* under greenhouse conditions. Four of the most common wide grown cultivars: Herms , Cara, Spounta and Mondial were evaluated under artificial inoculation. From the obtained result of pathogenicity test (A1) was the most virulent isolate of *A. solsni*,therfore chosen for this experiment. Potato tubers were sowing and after 40 days plants were inoculated by the conidial suspension (5×10^6 cfu / mL) at the rate of 10 mL/plant, prepared from 10-days-old culture. Control plants were sprayed with sterile distilled water. Each treatment replicated ten times. Observations were recorded after ten days for symptoms development and re-isolation were made from test plants. Pots were watered as needed and fertilized with the recommended dose of fertilizers.

The disease severity percentage was recorded 10 days after inoculation. Disease severity was estimated according to a disease rating scale by (Rao *et al.,* 2016). The Percentage of disease severity calculating according to the formulae mentioned previously.

Statistical analysis:

Data were analyzed using LSD test (P =0.05) with (Program: Costat-version: 6.311), analysis of variance was carried out using a general one-way randomized blocks used for comparison between means.

RESULTS

1- Survey of early blight disease in different locations:

Survey of early blight disease incidence was carried out in several potato fields at five different Governorates (El-Behira, El-Sharkia,

New Valley, El-Menoufia and El-Gharbiya) during growing summer season (2020/2021).

Potato plants are considered infected by the early blight when showing the initial symptoms appear first on the oldest foliage. Affected leaves develop circular to angular dark brown lesions 0.12 to 0.16 inch (3 – 4 mm) in diameter. Concentric rings often form in lesions to produce characteristic target-board effect. Severely infected leaves turn yellow and drop as presented in Fig (1).

Fig (1): Symptoms of early blight disease in potato plants infected with *A. solani.*

1- A- Disease Incidence.

Data in Table (1) and shown in Figs 3-10 show that, in El-Behira governorate (Wadi EL-Natron and Nubaria), the mean disease incidence values ranged from 73 to 98%. The highest disease incidence value (98%) was recorded on Cara and Spounta cultivars. The minimum disease incidence (73%) was recorded on Mondial cultivar.

In El-Sharkia governorate (Salhia), the mean disease incidence values ranged from 67 to 96%. The highest disease incidence value (96%) was recorded on Rozeta cultivar, whereas the e minimum disease incidence (67%) was recorded on Mondial cultivar.

In New Valley governorate (Farafra and East Owainat), the mean disease incidence values ranged from 69 to 98%. The highest disease incidence value (98%) was recorded on Herms cultivar while the minimum disease incidence (69%) was recorded on Ledi balafor cultivar.

In El-Menoufia governorate (Sadat, Menouf and Ashmon), the mean disease incidence values ranged from 83 to 98%. The highest disease incidence value (98%) was recorded on Spunta cultivar and the minimum one (83%) was recorded on Spunta cultivar.

In El-Gharbiya governorate (Santa), the mean disease incidence values ranged from 86 to 89%. The highest disease incidence value (89 %) as well as the minimum disease incidence (86%) were recorded on Cara cultivar.

1. B- Disease Severity.

The severity varies from little spot to many on potato plants which may turn into severe infections in the plant and the field appears in different status as shown in Fig. (2).

The data in Table (2) and shown in Figs 3-10 showed that, in El-Behira governorate (Wadi EL-Natron and Nubaria), the mean disease severity values of disease ranged from 23.8 to 57.2%. The highest value (57.2%) was recorded on Herms cultivar while the minimum value (23.8%) was recorded on Beleni cultivar. In El-Sharkia governorate (Salhia), the mean disease severity value ranged from 17.8 to 42.8%. The highest value (42.8%) was recorded on Rozeta cultivar whereas the minimum value (17.8%) was recorded on Mondial cultivar. In New Valley governorate (Farafra and East Owainat), the mean disease severity value ranged from 18.88 to 40.8%. The highest value (40.8%) recorded on Herms cultivar and the minimum value (18.8%) recorded on Sharlin and Bambino varieties. In El-Menoufia governorate (Sadat, Menouf and Ashmon), the mean disease severity values ranged from 28.8 to 38.8%. The highest value (38.8%) was recorded on Spunta cultivar. The minimum disease severity (28.8%) was recorded on Herms cultivar. In El-Gharbiya governorate (Santa), the mean disease severity value ranged from 34.4 to 37.2%. The highest and the minimum values were recorded on Cara cultivar.

Fig (2): Severe infection by early blight disease in potato plants under field conditions.

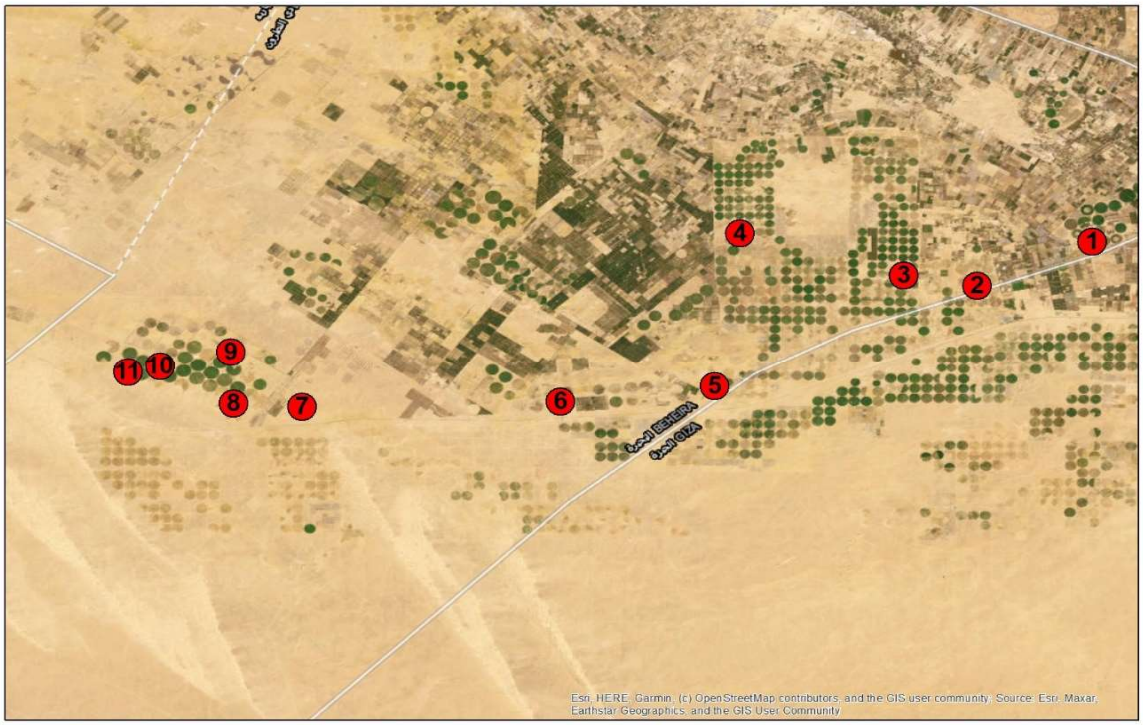
Table (1): Survey and percentage of disease incidence (PDI) of early blight disease on different potato cultivars from different governorates in Egypt.

Governorates	Locations	No	Cultivars	Irrigation system	Percentage of Disease Incidence (PDI)
El-Behira	Wadi EL-Natron	1	Spunta	Pivot	97
		2	Anabelle	Pivot	88
		3	Beleni	Pivot	82
		4	Herms	Pivot	95
		5	Mondial	Pivot	73
		6	Arizona	Pivot	94
		7	Banamera	Pivot	92
		8	Markies	Pivot	78
		9	Agria	Pivot	87
		10	Ditaa	Pivot	83
		11	Cara	Pivot	98
	Nubaria	1	Spunta	Pivot	92
		2	Arizona	Pivot	97
		3	Herms	Pivot	96
		4	Cara	Pivot	83
		5	Spunta	Pivot	98
		6	Beleni	Pivot	78
		7	Anabelle	Pivot	81
		8	Herms	Pivot	88
El-Sharkia	Salhia	1	Spunta	Pivot	95
		2	Herms	Drip irrigation	85
		3	Mondial	Pivot	67
		4	Rozeta	Pivot	96
		5	Cara	Pivot	79
New Valley	Farafra	1	Spunta	Pivot	92
		2	Renbo	Pivot	78
		3	Ledi balafor	Pivot	69
		4	Ditaa	Pivot	75
		5	Herms	Pivot	93
		6	Cara	Pivot	95
		7	Anabelle	Pivot	88
		8	Sharlin	Pivot	67
		9	Bambino	Pivot	72
	East Owainat	1	Herms	Pivot	98
		2	Cara	Pivot	96
		3	Santana	Pivot	82
		4	Herms	Pivot	95
El-Menoufia	Sadat	1	Herms	Drip irrigation	88
		2	Spunta	Drip irrigation	83
		3	Cara	Drip irrigation	95
	Ashmon	1	Herms	Flood irrigation	97
		2	Spunta	Flood irrigation	98
	Menouf	1	Herms	Flood irrigation	94
		2	Spunta	Flood irrigation	85
		3	Cara	Flood irrigation	91
El-Gharbiya	Santa	1	Cara	Flood irrigation	86
		2	Cara	Flood irrigation	89
		3	Cara	Drip irrigation	88

Table (2): Survey and percentage of disease Severity (PDS) of early blight disease on different potato cultivars from different governorates in Egypt.

Governorates	Locations	No	Cultivars	Irrigation system	Percentage of Disease Severity (PDS)
El-Behira	Wadi EL-Natron	1	Spunta	Pivot	43.4
		2	Anabelle	Pivot	32.6
		3	Beleni	Pivot	26.6
		4	Herms	Pivot	57.2
		5	Mondial	Pivot	24.2
		6	Arizona	Pivot	40
		7	Banamera	Pivot	31
		8	Markies	Pivot	26
		9	Agria	Pivot	24.8
		10	Ditaa	Pivot	27.6
		11	Cara	Pivot	37.6
	Nubaria	1	Spunta	Pivot	38.2
		2	Arizona	Pivot	34.6
		3	Herms	Pivot	43
		4	Cara	Pivot	31.6
		5	Spunta	Pivot	36.4
		6	Beleni	Pivot	23.8
		7	Anabelle	Pivot	29.4
		8	Herms	Pivot	37.6
El-Sharkia	Salhia	1	Spunta	Pivot	39.8
		2	Herms	Drip irrigation	32.6
		3	Mondial	Pivot	17.8
		4	Rozeta	Pivot	42.8
		5	Cara	Pivot	24.4
New Valley	Farafra	1	Spunta	Pivot	40
		2	Renbo	Pivot	27
		3	Ledi balafor	Pivot	16.4
		4	Ditaa	Pivot	22.4
		5	Herms	Pivot	40.8
		6	Cara	Pivot	30.4
		7	Anabelle	Pivot	27
		8	Sharlin	Pivot	18.8
		9	Bambino	Pivot	18.8
	East Owainat	1	Herms	Pivot	32
		2	Cara	Pivot	25
		3	Santana	Pivot	34.8
		4	Herms	Pivot	26.8
Menoufia	Sadat	1	Herms	Drip irrigation	32.4
		2	Spunta	Drip irrigation	31
		3	Cara	Drip irrigation	32.8
	Ashmon	1	Herms	Flood irrigation	29.8
		2	Spunta	Flood irrigation	38.8
	Menouf	1	Herms	Flood irrigation	28.8
		2	Spunta	Flood irrigation	35.8
		3	Cara	Flood irrigation	33.4
Gharbiya	Santa	1	Cara	Flood irrigation	35
		2	Cara	Flood irrigation	37.4
		3	Cara	Drip irrigation	34.2

Fig (3): Occurrence of *A. solani* in potato production locations at different governorates in Egypt.



Fig(4): Occurrence of *A. solani* in potato production locations in El-Beheira governorate (Wadi EL-Natron) on different potato cultivars.

Fig (5): Occurrence of *A. solani* in potato production locations in El-Beheira governorate (Nubaria) on different potato cultivars.

Fig (6): Occurrence of *A. solani* in potato production locations in El-Sharkia governorate (Salhia) on different potato cultivars.

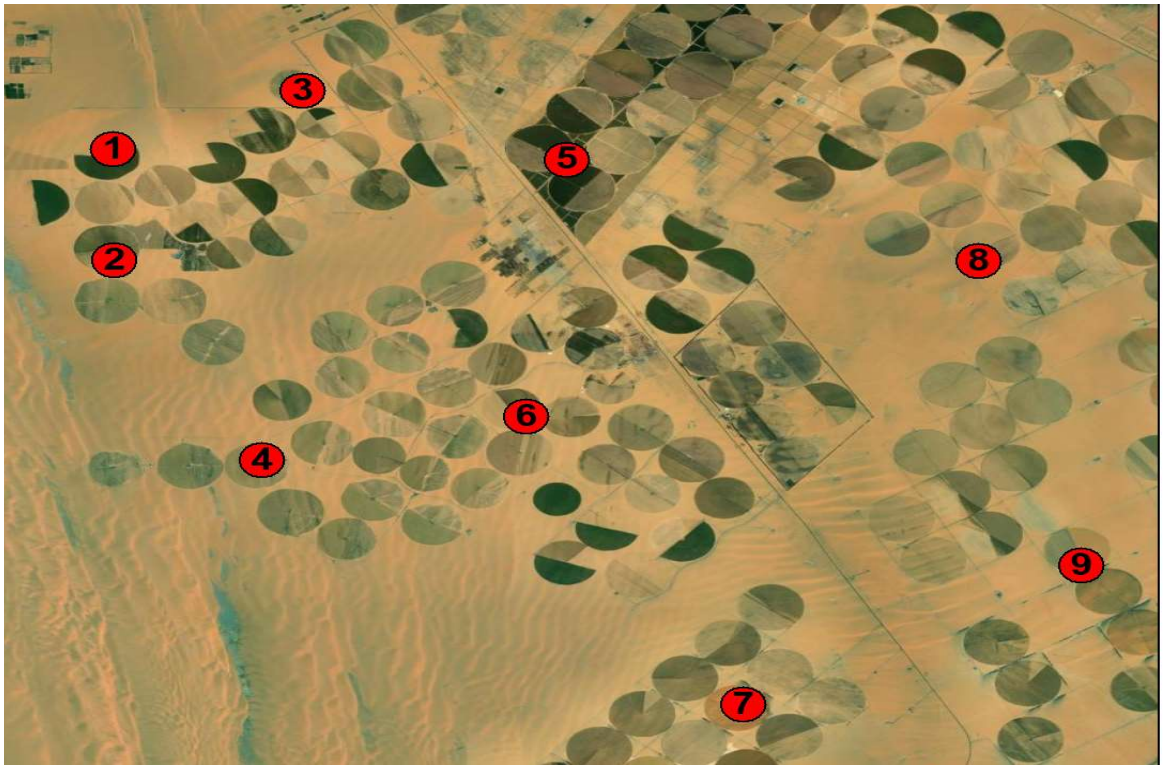


Fig (7): Occurrence of *A. solani* in potato production locations in New Valley governorate (Farafra) on different potato cultivars.

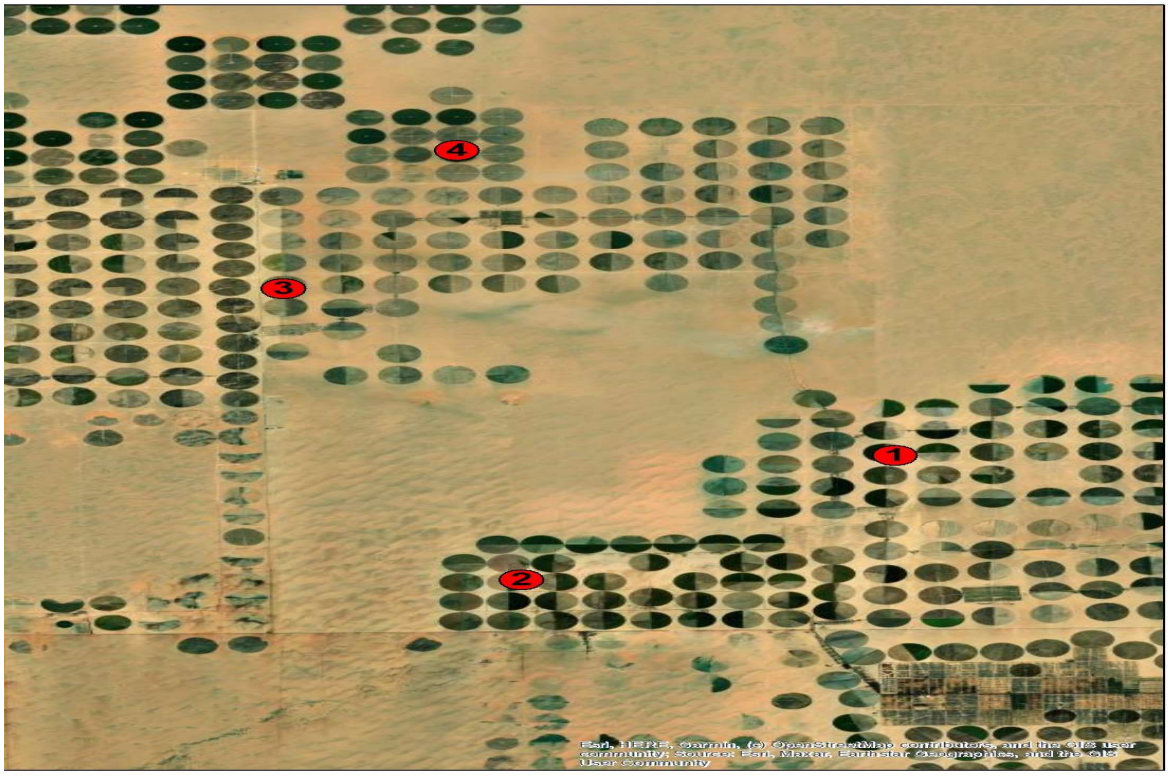


Fig (8): Occurrence of *A. solani* in potato production locations in New Valley governorate (East Owainat) on different potato cultivars.

Fig (9): Occurrence of *A. solani* in potato production locations in El-Menoufia governorate on different potato cultivars.

Fig (10): Occurrence of *A. solani* in potato production locations in El-Gharbiya governorate on different potato cultivars.

2-Isolation, purification and Identification of the causal organism.

Collected potato plants showing typical early blight symptoms from different five districts of five locations in five governorate (El-Behira, El-Sharkia, New Valley, El-Menoufia and El-Gharbiya) were used for isolation thedisease causal organism. Data presented in Table (3) indicated that *A. solani* was the main isolated pathogen from early blight infected plant materials from different growing potatoes areas. Other isolated pathogenic and non-pathogenic fungi were discarded according to the microscopic examination. Five isolates of *A. solani* coded A1, A2, A3, A4 and A5 were purified and identified according to their microscopical and morphological characters as A1-A5 were isolated from five different grown locations in governorates although Herms cultivar was the most presented, followed by Cara, Spounta and Mondial cultivars.

Table (3). Isolates of *A. solani* isolated from different areas from different Potato cultivars.

Isolates	Code	Geographic origin	Cultivars
1	A 1	El-Behira (Wadi EL-Natron)	Herms
2	A 2	El-Sharkia (Salhia)	Rozeta
3	A 3	New Valley (Farafra)	Anabelle
4	A 4	El-Menoufia (Menouf)	Spunta
5	A 5	ElGharbiya (Santa)	Cara

3-Pathogenicity Test:

Pathogenicity test of different isolates (A1-A5) of *A. solani* was carried out on commercially susceptible grown potato cultivar Herms to confirm their virulence and to define the most aggressive isolate causing the most serious damage of potato plants. Data presented in Table (4) indicate that, all tested isolates recorded significant differences in disease parameters and in their ability to cause plant disease on the tested cultivars as compared to control treatment.

The virulence of the tested isolates of *A. solani* was significantly varied in inducing disease severity. The most pathogenic isolate was A1 as they produced the highest percentage of infection (43.16%), followed by isolate A3 by (37.3 %), whereas the isolate A5 was the least pathogenic one by (35.2%) as illustrated in Fig (11). Control plants remained symptomless.

According to our results the selected isolates could be divided into three different groups concerning to its pathogenicity i.e.: Moderately pathogenic isolates (A2 and A5); highly pathogenic isolate (A1) and aggressive isolates (A3 and A4).

Table (4): Pathogenicity test of *A. solani* isolates on potato plants C.V. Herms under greenhouse conditions.

Isolate	Geographic origin	Disease Severity
A1	El-Behira (Wadi EL-Natron)	43.16 a
A2	El-Sharkia (Salhia)	36.18 bc
A3	New Valley (Farafra)	38.66 b
A4	El-Menoufia (Menouf)	37.30 bc
A5	El-Gharbiya (Santa)	35.2 c
Control	-	0 d

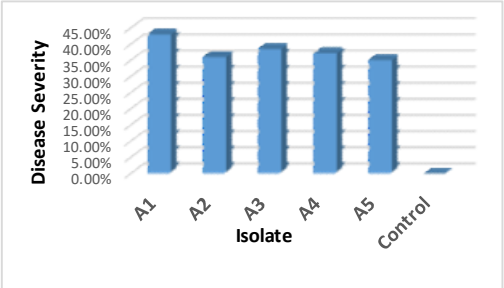


Fig (11): Pathogenicity test of *A. solani* isolates potato plants C.V. Herms under greenhouse conditions.

4-Studies on verities susceptibility.

The response of four potato cultivars to early blight disease infection by *A. solani* was carried out under greenhouse conditions. Four Potato cultivars i.e. Herms, Cara, Spounta and Mondial were evaluated against the most virulent isolate (A1) of *A. solani* for studying their response (resistance and suscep-tibility) to early blight infectio.

Results indicated that the tested cultivars showed different suscep-tibility to *A. solani* as presented in Table (5). Significant differences were noticed in early blight incidence among the four potato cultivars. The most susceptible cultivar was Herms with 58.48, followed by Spunta by 54.33 and Cara by 47.12. The least susceptible cultivar was Mondial by 40.44 as illustrated in fig. (12).

Table (5): Susceptibility of four potato cultivars to *A. solani* under greenhouse conditions.

Cultivar	Irrigation system	Disease Severity
Herms	Pivot	58.48 a
Cara	Pivot	47.12 c
Spunta	Pivot	54.33 b
Mondial	Pivot	40.44 d
LSD 0.05	3.6238	

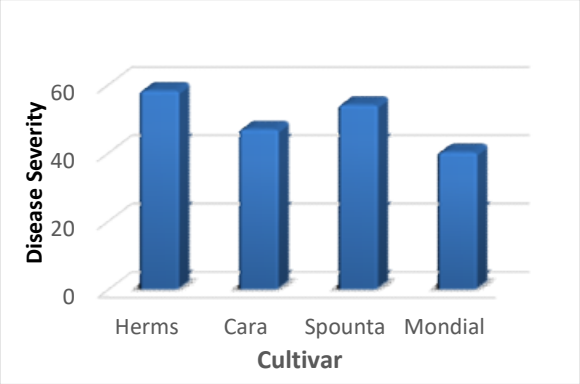


Fig (12): Susceptibility of four Potato cultivars to *A. solani* under greenhouse conditions.

DISCUSSION

Early blight disease caused by *A. solani*, is one of the most destructive diseases of potato all over the world. Spores can spread via wind, splashing rain, irrigation water, equipment, and workers. Infection occurs when spores of the fungus encounter susceptible leaves and sufficient free moisture is present. Spore germination and infection are favoured by alternately, wet and dry periods with relatively dry, windy conditions favour spore dispersal and disease spread. Tubers can be infected as they are lifted through the soil at harvest. If sufficient moisture is present, spores germinate and infect the tubers. Once the growing season is over, the pathogen can overwinter on infected soil-bound plant debris for several years.

Throughout the survey, incidence of early blight was reported in the potato. A high incidence of early blight of potato was recorded in production districts in the surveyed locations. Development of the disease generally may be enhanced by warm weather and wet conditions from dew, rain, or sprinkler irrigation (Kemmitt, 2002). The intensive agricultural system creates a suitable condition for *A. solani* development and multiplication. This confirms the presence of *A. solani* during the survey study. Therefore, the disease incidence and presence are totally different in the surveyed fields. The differences in disease incidence and severity are reflect the different of soil type, cultural practice, irrigation system, cultivars, rotation of potatoes or susceptible solanaceous crops or geographical site (humidity, prolonged leaf wetness and airflow) of the surveyed area (Bains *et al.*,2000).

In the present study *A. solani* was isolated from the collected potato samples. Five isolates of *A. solani* were isolated from potato varieties, Herms, Rozeta, Anabelle, Spunta and Cara Rosetta from different localities as above mentioned. These results are in consistency with those obtained by Abdel-Hamid *et al.,* (2023) who reported that the most pathogenic fungi isolated from leaves and tubers of potato were *A. solani.*

Alternaria solani was isolated from the collected potato samples. This fungus has been reported in different countries worldwide. Observation of the aggressiveness of the fungus isolates in commercial potato cultivars showed a significant difference between all tested isolates in disease severity. Moreover, data showed that the isolate A1 proved to be the highest aggressive isolate in El-Behira (Wadi EL-Natron) of the disease severity, whereas isolate A2 of El-Sharkia (Salhia), A3 in New Valley (Farafra), and isolate A4 in El-Menoufia (Menouf), governorates recorded the moderately disease severity. Meanwhile, El-Gharbiya (Santa) A5 recorded the lowest disease severity. And our results are similar like the results by Tymon *et al.*, (2016), (Ivanović *et al.*, 2022) and Abdel-Hamid *et al.*, (2023). The present data agree with those reported by Weber and Halterman

(2012). The level of genetic diversity among fungal isolates could be attributed tore combinations, mutations and the widespread movement of this pathogen over large distances. It has been hypothesized that asexual recombination through the parasexual cycle may be the source of genetic variation in *A. solani* (Petrunak and Christ, 1992). There are many studies have been conducted on the differences between the various isolates of *A. solani*.

Our research results give information about the differences in the selected potato susceptibility grads to *A. solani* infection under greenhouse conditions. Results indicate that Herms was the most susceptibility potato cv. to early blight followed by Spunta and Cara while Mondial was the least susceptible one to early blight. And our results are similar to the results of Shahbazi *et al*., (2010). The varieties of potato presented different susceptibility to early blight caused by *A. solani* affected by different factors such as, differences in the pathogenicity of the fungus isolate and plant genotype and the differences between the different cultivars can be attributed to the inherent resistance of the cultivar to early blight. Variation in resistance levels is related to plant age(Bakr and Hamad,2019).

Alternaria solani reported to showed physiological, morphological, genetic, and virulence variation and this may be refer to the ability of the fungal mycelia to interconnect by bridges created through anastomosis (hyphal fusion) that facilitate the dissemination of nutrients, water, and signalling molecules throughout the colony (Craven *et al*., 2008).

The Immature potato plants are relatively resistant to *A. solani* but, after tuber initiation, the plants susceptibility is increased gradually, while mature plants are very susceptible (Kemmitt, 2002).

CONCLOSION

This study presents an important information about the distribution of *A. solani* in the grown potato areas. Moreover, serve knowledge about the nature of potato commercial varieties susceptibility for use in wide cultivation area and looking forward to finding new more resistant varieties to *A. solani*.

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Conceptualization, RAB, ASH, EZK, GAA; data curation, RAB, ASH, EZK; formal analysis, RAB, ASH, ; Investigations, RAB, ASH;Methodology, RAB, ASH, EZK, GAA; writing original drafts, and writing and editing RAB, ASH, EZK, GAA, AHM; All authors have read and agreed to the purplish version of the manuscript.

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The author declares no conflict of interest.

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