Pestalotia leaf Spot a New Disease affect Guava Trees in Egypt

Moustafa M.S.H. , Hala A.M. El – Dakar and Asmaa M. A.Alkolaly
Integ. Cont. Res. Dept., Plant Pathol. Res. Inst., A.R.C., Giza, Egypt.

Abstract — During March of 2009 uncommon leaf spot was noticed on guava trees scattered in an orchard (35 feddan) located at El-Sadat district , Menofeia governorate, Egypt. The diseased leaves showed cup shape. Eexamination of these leaves showed powdery mildew like spots on the lower surface, especially on leaf margins. Microscopic examination showed acervuli covered with spores of multi cells and spindle shape. Later the diseased spots turn into brown color and expanded, especially on the leaf margins and covered most of the leaf surface and turned into dark brown. At later stage the infected leaves become dry and defoliated . The causal fungus was isolated, purified and identified as Pestalotia psidii. Pathogenicity test and reisolation from the inoculated leaves revealed that Pestalotia psidii is the causal organism. Fungicides evaluation under field conditions for four successive years (2010-2013) revealed that, Amistar Top 32.5% SC and Folio Gold 53.75% SC were the most effective ones for controlling this disease followed by Kocide 2000 53.8% WP then Del Cup 6% SL and Tridex 80% WP. Spraying a mixture of any of the tested fungicides with the insecticide Challenger resulted in significant increase to the efficacy of these treatment in management of the disease . The role of degrees of temperature and relative humidity as environmental conditions on disease initiation and disease development under the natural infection of the field was investigated. The obtained data showed that 64.0% of the disease initiation was correlated with the degrees of temperature and 60.0 % of the disease initiation was correlated with the degrees of relative humidity with 4.0% interaction between the two factors. Furthermore, one week with mean temperature of 20oC or higher and 50 % or more of mean relative humidity (RH) were required for disease initiation. As for disease development, 56.0 % of infection could be correlated with temperature and 46.0 % of infection could be correlated with RH . Two mathematical models were developed; the first to calculate the possibility of disease initiation under different field temperature and relative humidity and the second is to calculate the expected disease severity under different field temperature and relative humidity.

Key words — Guava , acervulus, chemical control, environmental conditions , Pestalotia psidii.

1 INTRODUCTION

Guava (*Psidium guajava* Linn.) is an important fruit of subtropical countries. Guava has been produced in Egypt since 1825. From that time, guava is considered one of the most popular fruits because of it's cheaper price, highly nutritious contains and the highest percentage of vitamin C compared to other fruits. Moreover, guava leaves have medical benefits, where they could be used in the treatment of coughs and diarrhea and dental pain. In addition, it is used in industrial like leather tanning and textiles dyeing (Al-Sherif *et al.,* 2007). Guava grows will all over the Egyptian regions, especially in delta provinces. It is subjected to infection by about 177 pathogens of which, 167 are fungi, 3 bacteria, 3 algae, 3 nematodes and one epiphyte (Misra , 2004). In Egypt, many fungal diseases were recorded on guava trees , i.e. root-rot incited by *Botryodiplodia theobromae, Macrophomina phaneolina Fusairum oxysporum, F. solani, , Rhizoctonia solan*i; *Fusarium* wilt caused by *F. oxysporum* f.sp. psidi; seedling blight caused by *Rhizoctonia* spp .; stem canker caused by *Physalospora psidii* ; *Cercospora* leaf spot caused by *Cercospora psidii* and *Cercospora sawadae* and sooty mould caused by *Cladosporium* sp. and *Copnodium* sp. In addition, the fruits are subjected to infection by some fungi such as Pestalotia psidii, Aspergillus niger and Phoma psidii (Al-Sherif *et al.,* 2007). During the last few decades, many complains are received from guava growers of El-Sadat district, Menofeia governorate due to the infection by leaf spot , which resulted in great deterioration for many orchards .This work was planned to determine the nature of guava leaf spot and the role of some fungicides on management of the disease . The work was expanded to evaluated the effect of environmental conditions on the incidence or initiation and severity of the disease.

2 MATERIALS AND METHODS

Isolation of the causal organism

Leaf samples showed leaf spots were collected from a guava orchard located at El-Sadat district, Menofeia governorate during spring and summer of 2009. The leaves were rinsed several times with sterilized water, air dried and the spots were cut into pieces with a healthy margins, surface sterilized by immersing in 2.0% sodium hypochlorite for two minutes then rinsed three times in sterilized water and dried by filter paper. The sterilized

pieces placed on PDA medium containing 1000 ppm. of streptomycin sulfate and incubated at 23±1ºC for one week with daily observation. The isolated fungus was purified using the single spore technique on water agar. The pure culture was identified by Fungi Identification Research Dept, Plant Pathol. Res. Inst. ARC, Egypt.

Pathogenicity test

Forty young healthy guava suckers tips about 15 cm. long were cut from guava trees. All leaves were detached except three leaves were left. About 7 cm. of base of all branches were immersed in Hogland's solution (Arnon., 1939) and divided into four groups, each grope contained 10 branches (30 leaves). The leaves were surface sterilized using 70% ethanol, then rinsed in sterilized distilled water. The first group was sprayed with spore suspension of the isolated fungus (each leaf received 1ml of spore suspension contained 104 spores). The second group was sprayed with spore suspension of the fungus (104 spores + 100 ppm. silicium carbide micro F400 / leaf). The third group was sprayed with 100 ppm. silicium carbide suspension (1ml. / leaf). The fourth group was sprayed with sterilized distilled water only (1 ml./leaf). The suckers in each group were covered with plastic bags to maintain high relative humidity responsible for disease infection and daily observed for two weeks.

Disease control

This experiment was carried out during four successive years from 2010 through 2013 using 9 fungicides belonging to different fungicide groups at the recommended application rates. These fungicides were :

1. Kocide 2000 53.8% WP (Copper hydroxide) at the rate of 180 g. /l00 l water.
2. Rovral 50% WP (Iprodione) at the rate of 90 g. /100 l water.
3. Antracol 70% WP (Propinebe) at the rate of 300 g. /100 l water.
4. Polyrame DF 80% DF (Metiram complex) at the rate of 400g /100 l water.
5. Tridex 80% WP (Mancozeb) at the rate of 250 g. / 100 l water.
6. Del cup 6% SL (Copper sulfate) at the rate of 250 ml. /100 l water.
7. Amistar Top 32.5% SC (Azoxystrobin + Difenoconazole) at the rate of 300 g. /100 l water.
8. Folio Gold 53.75% SC (Metalaxil +Chlorothalonil) at the rate of 300 g. /100 l water.
9. Cure M 72% WP (Mancozeb- Metalaxyl) at the rate of 250 g. /100 l water.

In addition , Challenger (Chlorfenapyr) at the rate of 40 ml. /l00 l water was used in 2012 and 2013 growing seasons against the insects. Each replicated was resembled by three trees and four randomized replicated were used for each treatment. The fungicides were applied 4 times at 15 days intervals, beginning just before flushing the buds in the spring, while the pesticide Challenger was applied one time at the first week of April.

Disease severity assessment

Twenty leaves were randomize collected from each tree (three trees in each replicate). The infection on each leaf was rated using a numerical index (containing 5 infection category) ranged from 0 which represented no infection on the leaf, and 4 which represented infection that covered > 1/2 of the leaf area, or the leaf is destroyed. Disease severity was calculated using the equation developed by Towsend and Heuberger, (1943).

% , Disease severity = $[\Sigma(n\times v)/4N]\times 100$

where:

n = Number of leaves within infection category.

v = Numerical value of each category.

N = Total number of leaves.

Fungicide efficacy was calculated using Abbott equation (Frölich, 1979)

$$\% \text{ Fungicide efficacy} = \frac{C - T}{C} \times 100$$

Where :

C = Disease severity in the control

T = Disease severity in the treatment**.**

Correlation between temperature and relative humidity on disease initiation and severity

Daily minimum and maximal degrees of temperature and relative humidity were recorded from 1st March until 30th Jun for four successive years of 2010 to 2013 using mini weather station (Pro WS1) mounted among the trees at the height of one meter in guava orchard located at El-Sadat district , Menofeia governorate. Daily and weekly mean temperature and relative humidity and accumulated weekly mean temperature were calculated. At the same time, disease severity was weekly assessed. Multi regression of the calculated meteorological data and disease severity was calculated using IPM SPSS computer program.

Statistical analysis

Data were statistically analyzed and treatments were determined according to Duncan's multiple range test (Duncan ,1955).

3 RESULTS

Isolation of the causal fungus

Disease symptoms

Leaf sots appear on the diseased leaves , which take the cup shape . Examination of these leaves showed

powdery mildew like spots on the lower leaf surface . Microscopic examination showed acervulus covered with spores of multi cells and spindle shape. Later the diseased spots turn into brown color and expanded , especially from the leaf margins and covered most of the leaf surface and turned into dark brown. At later stage the infected leaves become dry and defoliated (Figs. 1 and 2).

Fig. 1. Symptoms on the leaves , which turned into brown then to dark brown color.

Fig. 2. Dead and defoliated leaves as the result of the later stage of the infected.

Isolation of the causal fungus

Fourteen fungal isolates for one genus were isolated from the same orchard of El-Sadat district, Menofia governorate. All the isolates showed the same microscopy and cultural characters. The isolated fungus was identified as Pestalotia psidii. The young culture on PDA medium showed white mycelium, later scattered grayish zonation developed, which later developed to acervuli and turned into black. Conidia, typically five celled, oblong, erect 26-35 x 6-8µ; basal cell obtuse, erect, with a small hyaline pedicel central cells thickest and gradually bulged; end cells hyaline, apical cell is of conic shape drawn out into two or three hyaline, elongated appendages, 17-21 µ.

Pathogenicity test

Pathogenicity test (Table, 1) evinced the capability of the fungus to infect guava leaves causing typical symptoms of leaf spot . However, the fungus was more aggressive when the leaves were scratched as a result of spraying with silicium carbide, which recorded 48.0 % disease severity compared with only 15.3% disease severity on untreated leaves with silicium carbide. The fungus re-isolated from the infected leaves.

Table(1): Disease severity in pathogenicity test as a result of treating guava leafs with the spores suspension of the isolated fungus with or without sterilized silicium carbide.

Treatment	Fungus alone	Fungus + silicium carbide	silicium carbide	Sterilized water
%, Disease severity	15.3	48.0	0	0

Disease control:

In 2010, spraying guava trees with 6 different fungicides, each alone (Table, 2) resulted in significant reduction to the severity of the disease , being 22.0, 24.0, 24.0, 26.0, 23.0, and 22.0 % for Kocide, Rovral, Antracol, Polyram DF, Tridex and Del Cup, respectively compared with 51.9 % in the control treatment.However, the tested fungicides were differed in their disease control efficacy. In this respect, Kocide, and Del Cup resulted in the highest efficacy (58.41% for both fungicides) followed by Tridex ,being 56.52 % the both Rovral and Antracol , being 54.63% .

Table (2): Effect of six different fungicides on severity of guava leaf spot caused by Pestalotia psidii and fungicides efficacy in two successive year of 2010 and 2011.

Fungicides	2010		2011	
	Disease severity	Fungicide efficacy	Disease severity	Fungicide efficacy
Kocide	22.0 c	58.41	25.67 b	56.86
Rovral	24.0 c	54.63	27.00 b	54.62
Antracol	24.0 c	54.63	27.50 b	53.78
Polyram DF	26.0 b	50.85	28.13 b	52.72
Tridex	23.0 c	56.52	26.27 b	55.85
Del cup	22.0 c	58.41	26.07 b	56.19
Control	52.9 a	0.00	59.50 a	0.00

Duncan multiple range significant at Alpha (0.05). Means with the same letter are not significantly different. a,b,c., values in the same column with different superscripts differed significantly.

The lowest effective fungicide was Polyram DF which resulted in only 50.85% efficacy. This data were confirmed when this experiment was repeated in 2011, science all the tested fungicides resulted in significant reduction to the severity of the disease .This reduction was ranged from 28.13 to 25.67% infection compared with 59.50% in the untreated treatment. The efficiency of the tested fungicides

ranged from 56.86% resulted byspraying of Kocide and Del Cup and 52.72% by spraying of Polyram DF.

In another step, in two other successive years of 2012 and 2013, in addition to the six aforementioned tested fungicides, three other fungicides were involved in the experiment in addition to the insecticide Challenger (Table, 3). In the year of 2012, all the tested fungicides in addition to the used insecticide resulted in significant reduction to disease severity. These fungicides could be divided into two groups; The first group contained two fungicides ,i.e. Folio-Gold and Amistar Top , being 18.79 and 19.60 % disease severity of 71.69 and 70.75% efficacy , respectively compared with 67.0% in untreated treatment (control treatment) . The second group comprised Del-Cup and Kocide 2000, being 26.60 and 26.7 % disease severity of 60.3 and 58.61 % efficacy, respectively. Moreover, Polyram DF, Cure M and Tridex recorded 27.97, 27.73 and 27.07 % disease severity of 58.26 , 58.61 and 59.06 % efficacy, respectively. Meanwhile, Rovral and Antracol recorded 28.43 and 28.37 % disease severity of 57.65 and 57.66% efficacy, respectively. On the other hand, the insecticide Challenger resulted in low reduction to the disease severity, which recorded 56.27% disease severity of 16.27% efficacy .

Applying the same fungicides in combination with the insecticide Challenger on guava trees resulted in more significant reduction to the severity of the disease and increased the fungicides efficiency. It has been noticed that, however most of the fungicides were in the same order. However, spraying Amistar-Top in combination with the insecticide Challenger resulted in great reduction to disease severity followed by Folio Gold , being 12.83 and 14.57 % of 80.85 and 68.26 % efficacy , respectively .On the other hand, no significant difference was found between Kocide and Del Cup when they were sprayed alone , being 26.73 and 26.60 % disease severity of 60.10 and 60.30% efficacy, respectively. However, spraying of both fungicides in combination with Challenger resulted in significant increase in their efficiency, being 19.74 and 22.0% disease severity of 70.53 and 67.16% efficacy, respectively.

In the year of 2013, also, all the sprayed fungicides resulted in significant reduction to the disease severity. The obtained data were in the same trend when they were used without application of the insecticide Challenger. On the other hand, the lowst disease severity was recorded when Folio Gold and Amistar Top were sprayed , being 18.97 and 20.83 % of 72.83 and 70.15% efficacy, respectively followed by Del Cup (26.10 %disease severity) and 62.61% efficacy, then Kocide, Polyram DF and Tridex , being 27.73, 27.80 and 27.80 % disease severity of 60.27, 60.17 and 60.17% efficacy, respectively. Meanwhile, Cure M was the lowest effective fungicide , being 27.73 % disease severity of 58.64% efficacy.

Applying the same fungicides during 2013 growing season in combination with the insecticide Challenger resulted in more significant reduction to the severity of the disease. In this regard, Amistar Top and Folio Gold in combination with the insecticide Challenger resulted in the highest efficiency , being 79.23 and 77.22%, respectively followed by Kocide then Tridex and Del cup , being 68.86 , 66.38 and 66.09%, respectively %. On the other hand, Rovral, Antracol and Polyram DF were the lowest effective fungicides , being 64.37, 64.47 and 64.61% efficacy , respectively

Table(3): Effect of spraying guava trees with nine different fungicides combined or not with the insecticide Challenger on the severity of leaf spot disease caused by Pestalotia psidii, and fungicides efficacy during 2012 and 2013 growing seasons.

Fungicide	2012				2013			
	Fungicide alone		Fungicide + insecticide		Fungicide alone		Fungicide + insecticide	
	%,Disease severity	Fungicide efficacy %	%,Disease severity	Fungicide efficacy %	%,Disease severity	Fungicide efficacy %	%,Disease severity	Fungicide efficacy %
Kocide	26.73 c	60.10	19.74 d	70.53	27.73 c	60.27	21.73 d	68.86
Rovral	28.43 c	57.56	23.53 c	64.88	29.10 c	58.31	24.87 c	64.37
Antracol	28.37 c	57.66	24.03 c	64.13	28.37 c	59.36	24.80 c	64.47
Polyram	27.97 c	58.26	23.70 c	64.63	27.80 c	60.17	24.70 c	64.61
Tridex	27.07 c	59.60	22.8 cd	65.97	27.80 c	60.17	23.47 c	66.38
Del Cup	26.60 c	60.30	22.00 d	67.16	26.10 c	62.61	23.67 c d	66.09
Amistar T	19.60 d	70.75	12.83 f	80.85	20.83 e	70.15	14.50 d	79.23
Folio Gol	18.97 d	71.69	14.57 e	78.26	18.97 e	72.83	15.90 d	77.22
Cure M	27.73 c	58.61	22.43 c	66.52	28.87 c	58.64	24.43 c	65.00
Challeng	56.10 b	16.27	56.1 b	16.27	60.17 b	13.80	60.17 b	13.80
Control	67.00a	--------	67.00 a	---------	69.80 a	--------	69.80 a	------

Duncan multiple range significant at Alpha (0.05). Means with the same letter are not significantly different. a,b,c,d,e,f, values in the same column with different superscripts differed significantly.

Factors affect disease initiation and severity

Disease initiation

Data in presented in Table (3) and illustrated by figs. (3,4,5 and 6) indicate that in 2010 the disease began to initiate at the end of the forth week, while in 2011 the disease began to initiate at the end of the third week. In 2012 the disease began to initiate at the end of the forth week too, but in 2013 the disease began to initiate very later since the first symptoms could be seen at the end of the seventh week. Mathematically, multi regression analysis showed 64% of the disease initiation could be due to the temperature, while 60% of the disease initiation could be due to the relative humidity with 24% interaction between the two factors. A mathematical model could be generated from the last analysis as follow:

Y= (0.170X temp + 0.008X Rh) -3.967

Where:

Y = Disease initiation possibility

X temp = Weekly mean of temperature

X HR = Weekly mean of relative humidity.

0.170 and 0.008 and -3.967 are constants.

If application of this model resulted in zero or negative number, that mean that the temperature and relative humidity in this week are not favorable for disease initiation . If the result is a positive number, that mean that the temperature and relative humidity in this week are favorable for disease initiation and infection is expected.

Visually, giving a look at Table (3) and figs. (3,4,5 and 6), it is noticed that, at all those weeks in which the disease symptoms began to be noticed (4th week 2010, 3rd week 2011, 4th week 2012 and 7 th week 2013), there is a common factor; weekly mean temperature was 20oC or higher and weekly mean relative humidity was 50 % or more.

Disease severity development

In order to clear the role of field temperature and relative humidity on the development of disease severity after disease initiation, multi regression analysis was carried out using three factors, accumulated temperature hour degrees, weekly mean of relative humidity and disease severity. Analysis showed that 56.0 % of infection is explained by temperature, and 46.0 % of infection is explained by RH. The following model was generated:

Y= (0.175X temp + 0.273X Rh) - 29.869

Where:

Y = Expected disease severity

X temp = Accumulated Weekly mean of temperature.

X Rh = Weekly mean of relative humidity.

0.175 and 0.273 and -29.869 are constants.

Table (4): Weekly mean of temperature in oC, relative humidity % and Pestalotia leaf spot severity during 17 weeks up 1st March through end of June for four successive years of 2010, 2011, 2012 and 2013.

Weeks up 1st March	2010			2011			2012			2013		
	Weekly mean	Mean RH	Disease severity	Weekly mean	Mean RH	Disease severity	Weekly mean	Mean RH	Disease severity	Weekly mean	Mean RH	Disease severity
1th	19.6	47.2	0.0	18.4	57.4	0.0	14.6	76.4	0.0	17.0	47.4	0.0
2nd	27.2	46.7	0.0	14.4	50.9	0.0	18.8	64.6	0.0	22.4	41.9	0.0
3rd	17.5	53.5	0.0	20.4	52.9	2.1	14.3	53.4	0.0	18.9	51.4	0.0
4th	19.9	55.9	1.3	17.2	53.0	2.5	20.1	60.6	3.7	19.1	49.3	0.0
5 th	22.5	43.9	1.8	19.9	63.3	2.5	20.3	51.6	6.2	20.8	48.9	0.0
6 th	22.0	58.4	5.7	20.0	49.5	3.2	24.9	44.0	8.2	22.0	47.9	0.0
7 th	22.6	45.8	9.2	25.1	36.4	3.5	23.1	41.9	12.1	21.5	51.6	7.7
8 th	24.3	43.1	12.7	19.7	51.8	5.2	21.6	51.1	22.5	22.6	48.7	13.7
9 th	23.6	51.7	22.1	24.6	45.6	6.5	23.7	46.4	27.2	24.0	46.4	15.2
10 th	27.1	40.6	25.2	24.6	41.9	7.7	26.4	48.1	31.2	26.1	55.2	22.2
11 th	28.8	43.4	35.2	22.4	49.5	11.7	27.2	46.4	36.7	24.6	47.6	23.7
12 th	24.3	53.0	43.1	24.9	50.1	19.2	26.1	48.4	39.7	28.0	43.6	25.2
13 th	25.6	46.3	46.2	27.9	43.0	22.7	26.9	49.9	43.5	27.1	37.4	32.2
14 th	29.4	45.2	48.9	26.3	55.8	30.2	27.4	51.3	49.5	29.2	45.9	35.7
15 th	27.4	53.9	52.2	28.9	46.6	33.5	28.2	50.1	61.2	28.8	45.6	51.5
16 th	31.8	49.1	52.5	27.0	54.3	41.7	28.9	56.9	67.0	28.0	51.2	61.5
17 th	28.9	47.3	52.9	28.6	56.9	59.5	30.2	51.4	67.8	29.3	50.2	69.8

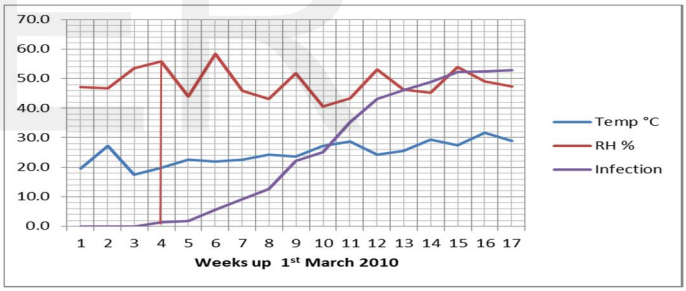

Fig. 3. Weekly mean temperature, relative humidity and diseases severity measured and calculated for seventeen weeks up first March to end of June 2010.

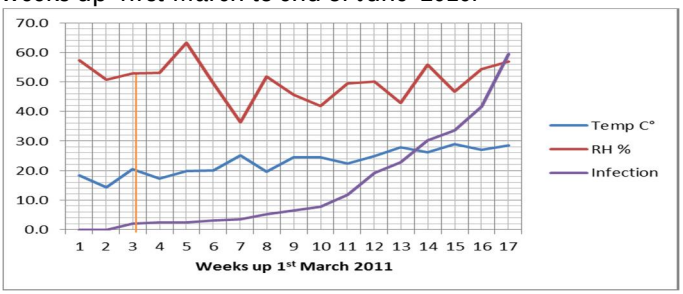

Fig. 4 . Weekly mean temperature, relative humidity and diseases severity measured and calculated for seventeen weeks up first March to end of June 2011.

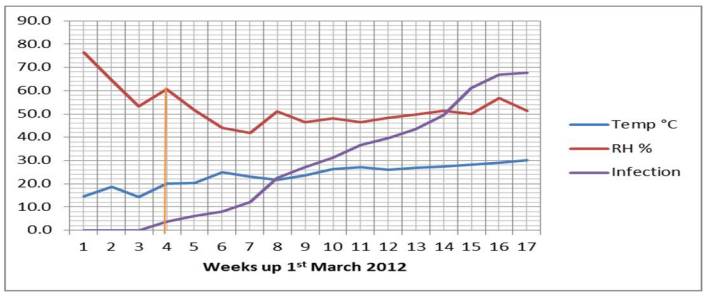

Fig. 5 . Weekly mean temperature, relative humidity and diseases severity measured and calculated for seventeen weeks up first March to end of June 2012.

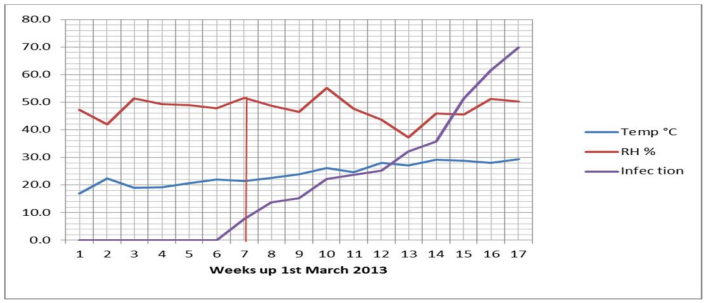

Fig. 6. Weekly mean temperature, relative humidity and diseases severity measured and calculated for seventeen weeks up first March to end of June 2013.

During March of 2009 uncommon leaf spots was noticed on scattered trees in an guava orchard (35 feddan) in El-Sadat district , Menofeia governorate, Egypt. At the last decade, guava trees in different other orchards were heavily infected with the same leaf spot disease, which resulted in deterioration of many orchards. Diseased leaves showed powdery mildew like spots on the lower leave surface specially on leaf margins; microscopically examination showed acervuli covered with multi cells spindle shape spores, later the disease spots turn into brown color expand specially from the leave margins and cover most of the leave surface and turn into dark brown. At the later stage the infected leaves fall.These symptoms are in accordance with that described by Cloutrer (1975) on Chinese Junipers, Keith,et al . (2006 a and b) on guava and tea trees and Chliyeh, et al. (2014) on olive trees.

Isolation, purification , identification and pathogenicity test revealed that the causal of guava leaf spot is Pestalotia psidii. Pestalotia spp. took at the last years great attention, where it was isolated from many different plants, i.e. guava leaves and fruits (Keith et al . , 2006); from pecan tree (Mazarotto et. Al , 2014), from strawberry fruits (Embaby , 2007) from olive trees and fruits (Chliyeh et al., 2014) and from many other plants. However the symptoms of this fungus are the same on guava , but it differed from host to another and from a fungus species to another. As early as 2004, Mc Quilken and Hopkins (2004) reported that all the isolates of genus Pestalotiopsis isolated from ericaceous plants were not host-specific and affected other species of ericaceous plants, with typical symptoms including browning of foliage, stems, and roots, and the presence of black or greenish black acervuli on diseased tissue. Keith et al. (2006) observed symptoms of Pestalotiopsis spp. causing scab disease of guava were gray to light brown lesions surrounded by dark brown borders on leaves and brown, raised, corky on the fruits. Richard (2009) described grey leaf-spot of mango caused by Pestalotiopsis mangiferae (Henn) Steyaert (synonym: Pestalotia mangiferae (Henn) as light grey spot on leaves, usually 2-20 mm. in diameter, these coalesce to form large patches , as lesions age turn black. On the other hand, Chen et al. (2012) published first report of Pestalotiopsis mangiferae and P. vismiae causing twig die-back of Myrica rubra in China. They added that, the disease firstly appeared as chlorosis of leaves and leaf drop, followed by the formation of dark brown lesions covered with white mycelium surrounding leaf scars. The lesions extend to the whole twig and tree causing discoloration of the xylem. In most cases, infected trees die within 1 to 4 years.

During 2010 and 2011 growing seasons the tested fungicides significantly reduced the severity of guava leaf spot compared with control treatment .In addition, the fungicides Kocide and Del-Cup (copper group) and Tridex (dithiocarbamate group) were the most efficient. Joshi (2004) and Richard (2009) recommended the dithiocarbamate fungicides for control of leaf blight of cashew incited by Pestalotia heterocornis and grey leaf-spot on mango caused by Pestalotiopsis mangiferae . However, the obtained data during 2010 and 2011 growing seasons revealed that the tested fungicides reduced the severity of the disease significantly, but their efficiency ranged from 50.85 to 58.40% , where this rate is not satisfactory. In the next two successive years (2012 and 2013) three additional fungicide were involved in the test in addition to combination with insecticide . Two of the three additional fungicides (Amistar top and Folio Gold) proved to be more effective than the two cupper fungicides Kocide and Del-cup and the dithiocarbamate fungicide (Tridex); Vivan, et al. (2010) evaluated different fungicides as Foliar application on the reduction of Pestalotia leaf spot on strawberry, Azoxystrobin the Mancozeb (dithiocarbamate) and reduced disease severity by 56.3 and 43.8%, respectively, in comparison to the control treatment. Combining, the fungicide treatment with insecticide Challenger resulted in obvious increased of all the tested fungicides efficacy, in addition, the insecticide Challenger alone resulted in low significant decreased of the disease incidence. We did not found any reference deal with fungicidal activity of this insecticide; where it could be referred this activity to the effect of this insecticide on some biotic environmental factors. Many investigators described many Pestalotia spp. as a weak pathogen attack plants that have been weakened by improper care or adverse environmental conditions, or

were under biotic or a biotic stress, injured or wounded which help the predisposition to infection (Cloutrer, 1975, Holliday, 1980, Horst, 2001 and Keith et al 2006); specially, in the pathogenicity test in this study the plants in the second group those were sprayed with spore suspension of the fungus + silicium carbide, showed highly significant disease severity compared with those sprayed with spore suspension of the fungus only.

Studying the effect of temperature and relative humidity on the disease initiation and disease development, revealed that there is high correlation between disease initiation and disease development on one side and temperature and relative humidity on the other side. One week with mean temperature more than 20oC and mean relative humidity more than 50% are required for disease initiation. Younis, et al. (2004) reported that temperature of 30°C favored maximum colony growth and maximum acervuli production, however, Ibrahim, et al. (1976) found that, the optimum temperature for growth and sporulation of Pestalotia spp. was 25°C. According to Ramaswamy et al. (1984) and Naqvi (2004), germination of spores of Pestalotia psidii maximum at 30oC and it don't germinate below 15oC or above 40oC, high Rh (98%) is required for germination; later Suterman, et al (2011) found that, rain fall, relative humidity and temperature are the weather components significantly affect the increase of the needle blight disease severity on Pinus merkusii seedlings incited by Pestalotia theae . They found too that a nursery with 26.5 – 30.5 oC and RH: 92-98 %, is the most optimal location for the development of the disease. The aforementioned findings are in harmony with our data.

5 REFERENCES

[1] Al-Sherif , A. A. H; Khalil, F. A. A. and Mourad, M. Y. (2007). Planting and production of guava in Egypt. Agriculture Research Center , Extension Publication No. 640/2007 (in Arabic).

[2] Arnon, D. I. (1939). A Comparison of Water Culture and Soil as Media for Crop Production. Science, 89:512-514.

[3] Chen, F. Y.; Lu L. M.; Ni H. Z. and Wang, Y.(2012). First report of Pestalotiopsis mangiferae and P. vismiae causing twig die-back of Myrica rubra in China. Plant Dis., 96 : 588

[4] Chen, F. Y.; Lu L. M.; Ni H. Z. and Wang, Y.(2012). First report of Pestalotiopsis mangiferae and P. vismiae causing twig die-back of Myrica rubra in China. Plant Dis., 96 : 588

[5] Cloutrer , E.(1975). Heavy Damage to Chinese Junipers, Juniperus chinensis L., associated with Pestalotia funereal. Laboratory of Science service, Forest Biology College, Dept. of Agric. , Ottawa Univ.

[6] Duncan, D. B. (1955). Multiple range and multiple f-test Biometrics, 11:1-42.

[7] Embaby, E. M. (2007). Pestalotia fruit rot on strawberry plants in Egypt. Egypt. J. Phytopathol., 35(1): 99-110

[8] Frölich, G. (1979). Phytopathologie und Pflanzenschutz VEB Gustay Fischer Verlag, Jena. 295pp.

[9] Holliday, P.(1980). Fungus disease of topical crops. P313. Cambridge University Press.

[10] Horst, K. K.(2001). Westcott's Plant Diseases Handbook, 6th edition, Vol. 1 p.272. Kluwer Academic Publisher.

[11] Ibrahim, A. N.; Satour, M. M. and Elakkad, E. M..(1976). Variability of Pestalotia spp. with special reference to the effect of media, temperature and light on their growth, sporulation and spore germination. Acta Mycologica, 12: 141-151

[12] Joshi, M. S.(2005). Leaf blight of cashew incited by Pestalotia heterocornis Guba. Indian Phytopath., 58: 252

[13] Keith, L. M.; Velasquez, M. E. and Zee, F. T. (2006a). Identification and characterization of Pestalotiopsis spp. causing scab disease of guava, Psidium guajava, in Hawaii. Plant Dis., 90:16-23.

[14] Keith , L. M.; Wen-Hsiung , Ko and Dwight M. S. (2006b). Identification Guide for Diseases of Tea (Camellia sinensis). Cooperative extension service , College of Tropical Agriculture and Human Resources, University of Hawaii, Plant Dis., PD-33

[15] Mazarotto, M.; Bovolini, M. P.; Muniz M. F. B.; Ricardo Harakawa, R.; Reiniger, L. R. S. and Álvaro Figueredo dos Santos, A. F. S..(2014). Identification and characterization of pathogenic Pestalotiopsis species to pecan tree in Brazil. Brasília, 49 : 440-448

[16] Mc Quilken, M. P. and Hopkins, K. (2004). Biology and integrated control of Pestalotiopsis on container-grown ericaceous crops. Pest Manag. Sci., 60:135-142

[17] Misra, A. K. (2004). Guava Diseases , their Symptoms, Causes and Management in Diseases of Fruits and Vegetables. 2: 81-119. Springer Netherlands.

[18] Naqvi, S. A. M. H . (2004). Diseases of Fruits and Vegetables. Volume 2: Diagnosis and Management. P. 97. Springer Science & Business Media.

[19] Ramaswamy, G. R.; Sohi, H. S.; Govindu, H. C. (1984). Studies on spore germination in Pestalotia psidii, the causal organism of guava canker. Indian J. of Mycol. and Plant Pathol., 14(3): 289

[20] Richard E. L.(2009). The mango, 2nd edition, Botany, Production and Uses. Page 259. CAB International.

[21] Sutarman ; Soetrisno Hadi; Asep Saefuddin; Achmad and Ani Suryani (2011). Epidemiology of Needle Blight on Pinus Merkusii seedlings incited by Pestalotia theae. J. Manajemen Hutan Tropika, 10 (1) :1-10.

[22] Towsend, G. K. and Heuberger , T. W. (1943). Methods for estimating losses caused by diseases experiments. Plant Dis. Rept., 27: 340 – 343.

[23] Vivian C. M.; Fabrício Á. R.; Daniel A. S.; Dalilla C. R.; Natália, B. R. and Laércio, Z. (2010). Foliar application of potassium silicate, acibenzolar-S-methyl and fungicides on the reduction of Pestalotia leaf spot on strawberry. Trop. plant pathol.,35: 182-185.

[24] Younis, M.; Mehamood,K.; Rashid, A. and Waseem, M. A.(2004). Studies on Pestalotia psydii and its chemical control. Inter. J. of Agric. & Biol., 6 :1107–1109.