Peach Canker Caused by Nectria mauritiicola and its Control in Egypt

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ABSTRACT—Trees of Florida Prince peach cv. grown at Nobaria, El-Behera governorate during 2011 growing season showed typical symptoms of Necteria canker mainly on the branches and often on the twigs.Symptoms of the infection are observed at nodes and appeared as deeply dug ofelliptical sunken areas. The infected areas appeared darker than healthy tissue. Isolation trails from the infected branches yielded many fungal isolates. The isolated fungi were purified and identified as : Alternariaalternata ,Cladosporium sp.,Curvularia lunata , Helminthosporium sp.,Necteria mauritiicola and Stemphylium sp.Pathogenicity test of the isolated fungi revealed that the causal pathogen of these symptoms was Nectria mauritiicola (anamorph :Rhizostilbella hipisci), which typical canker symptoms were observed and no infection by the other tested fungi were occurred.All the three tested peach cvs.,i.e.Desert , Early Grand and Florida Prince were liable to infection by N.mauritiicola . Moreover, Florida Prince was the most susceptibleone followed by cv. Early Grand. Meanwhile, Desert cv. was the lowest susceptible one. Seven commercial fungicides; i.e. Captan Ultra, Coprous-KZ ,Kema-Z , Mancoper , Saprol, Topas and Topsin M-70 were evaluated for their efficiency to management the disease under greenhouse and field conditions. Data indicated the ability of all the tested fungicides to reduce the incidence of the disease under greenhouse conditions. In addition, these fungicides caused significant reduction to the severity of the disease with significant increase to the produced fruit yield in the open field during 2011 and 2012 growing seasons. In this respect, Saprol ,Topas , and kema-Z were the most effective fungicides either in the greenhouse or in the open field evaluations for decreasing the disease and increasing the produced fruit yield. Also, these fungicides markedly increased leaf content from macro-nutrients (N, P, K, Ca and Mg)as well as photosynthetic pigments (chlorophyll a, b and carotene).

Keywords— Peach , canker , varietal reaction ,chemical control , fruit yield, chemical properties.

1 INTRODUCTION

Peach [*Prunus persica* (L.) Batsch] is one of the most important deciduous fruits grown in Egypt with high economic potentiality. It is a member of the family Rosaceae, which contains several other important fruit species belonging to the same genus like apricot (*Prunus armeniaca*L.), almond (*P. amegadalus* L.), plum (*P. domestica* L.), and other genera like apple (*Malus domestica* Borkh) and pear (*Pyrus communis* L.).

During the last decade many complaints have been received from peach growers , especially in the new reclaimed desert lands at the North areas of Egypt , due to the great deterioration to peach trees from the infection by canker that appear on the trees ,which cause stunting and drought to the infected trees then dying within three years . Peach fruit yield was also greatly decreased mainly due to the infection by many diseases including canker, which the total production was about 427639 ton with an average of 5.5 ton/ feddan during 2006 growing season. Thistotal yield was decreased to about 285194 ton with an average of 4.5 ton/ feddan during 2012, 2013 growing season **(Statistic Dept. reports, Minis. of Agric. and Land Reclamation, 2013)**

Canker is one of the most aggressive diseases that injured fruit trees, which cause considerable decrease for crop production. Cankers are localized damage to the stems and branches of the trees caused by a number of factors including abiotic causal such as frost damage, sunscaldand wounding and biotic causal suck as bacteria and fungi. However, fungi are the most constrain, which the cankers could be expand and girdle the tree or branches, especially when the tree is under drought stress. With annual cankers, the fungus is active for only one season usually when the tree is dormant and when the tree begins to be active growth in the spring and summer. Canker may produces a callus layer that lead to grow a new layer of bark, if canker enlarges faster than the radial growth of the tree . Finally, the tree can be girdled and die within few years**(Marianne, 2010)**. Many species of genera *Nectria* and *Leuecostoma* cause cankers on many hosts such as apple, peach, pear ,apricot and other deciduous fruit trees and hard wood trees causing major economic losses**(Togashi 1931;Tekauz 1974; Biggs,1993; Renee, 2008 and Jacobi, 2014).Peach canker is a fungal disease common on apricot, prune, plum, and sweet cherry as well as on peach (Ellis,2008) .**

Nectria pathogen have many devices to enter plant tissue , such as through natural and artificial wounds,or by important entry sites into shoots and branches are scars of leaf petioles **(Crowdy, 1952;Dubin and English, 1975)** and fruit pedicels, growth cracks **(Swinburne , 1971)** or through the cut surfaces exposed by pruning infection of deciduous fruit trees. Canker symptoms and signs include die-back of affected branches, reduced foliageand yellow foliage **(Jacobi, 2014)**. The visible symptoms of infection are observed at nodes and appear as elliptical, sunken areas. When the cycle of healing and reinvasion occurs annually, the cankers develop a concentric or zone ate appearance. Gelatinous sporodocia of the fungus are common on cankers during wet weather and the bright red to orange perithecial stage often appears on older cankers in late fall or winter **(Biggs, 1993and Ellis, 2008).**

The nomenclature of the fungus *Nectria mauritiicola* takes many synonyms, *i.e.Corallomyces mauritiicola* (Henn.,1904) = ***Corallomycetella repens*** (Rossman and samules , 1999) = ***Corallomycetella elegans*** (**Herrera *et.al.* (2013**), it has a synnematous anamorph : ***Rhizostilbella hipisci*, (Samuels and Seifert 1985)**.

It is found in alargepart of the world; Asia, America and Africais considered the origin source for this fungus and isolated from bark and died bark of many hard wood trees in many countriesand from plum in Senderotres Rios and Camino. Also, it isolated from leaf, bark, and twigas a new species causing canker **(Herrera *et.al.*, 2013 and Vacant, 2013)** andidentified as an endophytic fungus which did not fruit in culture **(Sunayana *et al.*, 2014; Sergio *et.al.*, 2011)**.

One to three protective sprays of copper compounds (Bordeaux mixture, copper oxychloride or copper dioxide) or copper compounds alternated with benzimidazole fungicide (benomyl, carbendazime or methyl thiophanate) are widely used during leaf fall **(Lolas and latorre, 1997).**

Sterol demethylation inhibiting fungicides (Hexaconazole, Myclobutanil, Penconazole) had a similar effect on canker. Autumn application of copper oxychloride at 5% at 50% leaf-fall reduced numbers of new cankers, **(Cooke, 1999).**Carbendazim, fenpropimorph and prochloraz, were applied to pruned shoots as curative treatments on potted apple trees **(Xu and Butt. 1996).** Fungicide treatments applied during leaf fall significantly reduced infection in the next season suggesting that leaf scars are important infection courts for Necteria. **(Latorre*et al.*, 2002).**

The objective of this work is to isolate the responsible fungus for causing peach canker . Also, studying the reaction of three peach cvs. toNectria canker and controlling this disease with different fungicides under greenhouse and field conditions to minimize disease hazard for peach growers. The work was expanded to assess the effect of canker infection on the leaf component from maroelements and photosynthesis .

2MATERIALS AND METHODS

Isolation, purification and identification of the causal pathogen:-

Naturally infected peach samples showing typical symptoms of canker were collected from Nobaria , El-Behera governorate during 2011 growing season. The collected samples washed thoroughly and cut into small pieces then surfaces sterilized by immersing into 2.0% sodium hypochlorite solution for two minutes, rinsed three times in sterilized water and dried between folds of sterilized filter papers. Samples were aseptically placed on potato dextrose agar (PDA) medium containing 1000 ppm of streptomycin sulfate and incubated at 25-27^{o} C for one week with daily observation.The emerged fungi were picked up , purified using either single spore or hyphal tip techniques as mentioned by**Dhingra and Sinclair (1985)** and identified based on their morphological and cultural characters **(Seifert,1985)** .The identification was confirmed by DNA sequencing in **Korea** by mycological center , Fac. of Sci. , Assiut Univ., Assiut, Egypt. Pure cultures stocks of the isolated fungi were kept on 5 ^{o}C for further studies.

Pathogenicity test :

Five transplants of peach Florida Prince cv. (one year old) were transplanted during mid of February of 2011in each pot (60 cm in diameter) filled with a formalin sterilized soil consisted of a mixture from sand and clay soil (v: v). Three replicates were used for each treatment. The tested fungal isolates ***,i.e.Alternariaalternata ,Cladosporium* sp., *Curvularia lunata* , *Helminthosporium* sp. ,*Necteria mauritiicola* , and *Stemphylium* sp., were used to investigate their pathogenic capabilities under greenhouse conditions.**

Varietal reaction:

Fivetransplants of any of Desert , Early Grand and Florida Prince peach cvs. (one year old) were transplanted during mid ofFebruary of 2011in each pot (60 cm in diameter) filled with a formalin sterilized soil consisted of a mixture from sand and clay soil (v: v). Three replicates were used for each treatment.

Inoculums preparation and stock inocula :-

Potato dextrose agar and / or Potato dextrose medium were inoculated with the fungus *N.mauritiicola*or any of another tested fungi, and incubated for 7 days at 25-27^{o}C . After incubation period thefungal growth was shake well and filtered through 3 layers of cheesecloth to remove mycelial fragments . The obtained spore suspension adjusted to 10^{6} spores / ml water using a haemocytometer **(Feather *et al.*, 1989 and Rashed *et al.* , 2009).**

Inoculation technique:

Two method of inoculation were used to inoculate peach stems three months after transplanting:

- Transplants stem was wounded using sterilized scalpel andone disk of 5 mm from the fungal growth (grown on PDA medium for 5 days) or from PDA medium (control treatment) was put on each wound tissue as described by **Zaher *et.al.* (2012)**.
- Transplants stem were injected with 0.5 ml spore suspension (10^{6} spores / ml water) or with sterilized distilled water (control treatment) as mentioned by **Rashed *et al.* (2009).**

The inoculated transplants were covered with plastic bags for three days after inoculation to provide high humidity level responsible for infection process. The inoculated and un-inoculated transplants were examined for canker incidence one and two months after inculcation and the average was recorded. The pots were irrigated when it was necessary and fertilized with five g. of compound fertilizer two months after transplanting.

The number of the infected transplants was counted as disease incidence and the severity of the disease was assessed depending on the devised scale (0-5) by **Townsend and Heuberger (1943).**

Disease assessment :

Disease scoring was determined using the devised 0-5 scale by **Townsend andHeuberger (1943)** based on the visible symptoms as follows:

0 = No visible symptoms,

1= Few scattered cankers covering 1-25 % of the transplant or tree growth (branch ,stem and twig).

2 = Cankers covering about 26- 50 % of the transplant or tree growth (branch ,stem and twig).

3 = canker covering about 51-75% of the transplant or tree growth (branch ,stem and twig).

4 = canker covering more than 75% of the transplant or tree growth (branch ,stem and twig).

Disease severity (%) was calculated according to the following formula:

$$\text{Disease severity \% (DS)} = \frac{\sum(n \times v)}{5N} \times 100$$

Where :

n = No. of transplants or trees in in each category.

v = Numerical values of each category.

N = Total No. of the examined transplants or trees.

Chemical control :

a-Greenhouse experiment :

Fivetransplants of Florida Prince peach cv. (one year old) were transplanted during mid of February of 2012in each pot (60 cm in diameter) filled with a formalin sterilized soil consisted of a mixture from sand and clay soil (v: v)as replicate .Three replicates were used for each treatmentand kept in the greenhouse.

Seven fungicides namely Captan Ultra (captan) , Coprous KZ (coprous oxide), Kema-Z (carbandazim), Mancoper(mancozeb + metalic cooper), Saprol(triforine), Topas(penconazole) and Topsin M-70 (thiophanatemethyle) were used for controlling peach canker under the greenhouse conditions to evaluate their ability for reducing the incidence and severity of peach canker caused by *N. mauritiicola*. Three months after transplanting , each fungicide was applied 10 days before artificial inoculation and replicated twice with 10 days interval..

The transplants stem were inoculated with injection or wounding methods as mentioned before . The transplants were examined for disease incidence and severity as mentioned before and the percentage of fungicide efficiency was calculated as follows :

% Efficiency = C-t / C x100

Where:

C = Disease incidence or severity in control treatment and

t= Disease incidence or severity in each treatment.

b- Field experiments :-

The same seven fungicides used in the greenhouse experiment were also used to evaluate their efficiency in reducing the severity of peach canker on trees (Florida Prince cv.) of 10 years old in the open field during 2011 and 2012 growing seasons at Nobaria , El-Behera governorate. Each fungicide was sprayed with the recommended dose . Nine trees for each treatment in three replicates were used.

All the used fungicides were applied three times as foliar spray. The first spray was achieved during leaf fall of each seasonaccording to**Lolas and latorre (1997)**. The second at beginning of bud flushing and the third two weeks after the second spray.

The severity of the disease wasassessed and recorded as mentioned before.

Also,fruit yield of each tree was harvested , counted and weighed and the obtained data were recorded.

Chemical properties :

Leaf content of macro-nutrients:

Leaf content of macro-nutrients was determined in leaf samples taken from the sixth node from the base of the current shoots. Samples were collected at beginning of July of each season. Nitrogen percentage was estimated by Micro-Kjeldahl according to **Pregel (1945)**. Also, phosphorus percentage was estimated as described by **Chapman and Parker (1961)**, while potassium percentage was estimated according to **Brown and Lillel (1945).**

Photosynthetic pigments:

At the beginning of July of each season, thirty leaves were leaf samples taken from the sixth node from the base of the current shoots. Photosynthetic pigments content were determined using a SPAD 502 spectrophotometer (Minolta Co., Osaka, Japan) according to **Stino *et al.* (2010)**.

Statistical analysis:

The complete randomized block design was adopted. The obtained data were tabulated and statistically analyzed according to **Duncan's Multiple Range Test (1955)** and **Snedecor and Chochran(1980).**

3RESULTS

Disease symptoms:

Symptoms of canker infection are observed at nodes and appeared as dug deeply and elliptical sunken areas. The infected areas appeared darker than healthy tissues. Cankers on the trees are , also, visible of necrotic periderm, cortex, phloem, and vascular cambium tissues (Fig.1) .

Isolation, purification and identification of the associated fungi:

Isolation trials from naturally cankered samples (Fig.1) of Florida Prince peach cv. collected from Nobaria, El-Behera governorate during growing season 2011 were carried out. Isolation trails yielded many fungal isolates. The isolated fungi were purified and identified as: ***Alternaria alternata* , *Cladosporium* sp., *Curvularia lunata* , *Helminthosporium*sp.,*Stemphylium* sp., and *Necteriamauritiicola*** which confirmed by DNA sequencing in **Korea**.

The fungus ***N.mauritiicola*** produces conidial mass white to yellow or green becoming red-brown or black when dried with asynnematousanamorph:***Rhizostilbellahipisci*** .Conidia are ellipsoid , ovoid, fusiform ellipsoid or oblong ellipsoid **(Fig.2).**

Pathogenic test :

This experiment was carried out under greenhouse conditions to evaluate the pathogenic capability of the isolated fungi on peach Florida Prince cv. using two methods of inoculation ,*i.e.* wounds and injection.

Pathogenic capability of the isolated fungi (Table 1) reveal that only ***N.mauritiicola*** was able to infect stems of peach transplants causing canker symptoms, either wounds or injection were used for inoculation . No infection or canker symptoms were noticed in case of control treatments and the other tested fungi.

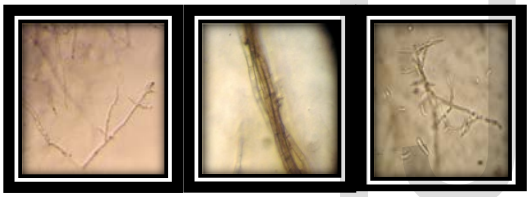
A B C

Fig .(1): Typical symptoms of peach canker (Florida Prince **cv.)**

A-Note the nodes at the beginning of the canker.

B-Canker development made deeply sunken in peach bark.

C- Bark has been removed showing diffuse enlarges canker discolored outer and inner tissues.



A B C

Fig.(2): Shape of synnematous of the anamorph: ***Rhizostilbella hipisci*** of the causal fungus ***N. mauritiicola.*** A.White aerial mycelium B. Synnematal hyphae and C. Ellipsoid, fusiform or ovoid conidia.

Varietal susceptibility:

Data presented in Table (2) indicate that all the tested peach cvs., *i.e.* Desert, Early Grand, and Florida Prince were susceptible to infection by the canker pathogen ***N.mauritiicola***, but without significant differences. Injection method was more suitable for the infection than wounding method. Florida Prince cv. was the most susceptible one , either wounding or injection methods were used , being 53.3 and 86.7% for disease incidence and 21.3 and 35.3 % for disease severity followed by Early Grand, being 40.0 and 73.3 % for disease incidence and 16.0 and 26.7 % for disease severity. Meanwhile, Desert cv. was the lowest susceptible one, being 33.3 and 53.3 % for disease incidence and 6.7 and 16.7 % for disease severity, respectively.

TABLE 1

PATHOGENIC CAPABILITY OF THE ISOLATED FUNGI ON FLORIDA PRINCE CV., GREENHOUSE EXPERIMENT.

The tested fungi	% Disease incidence using	
	Wounds	Injection
Alternaria alternata	-	-
Cladosporium sp.	-	-
Curvularia lunata	-	-
Helminthosporium sp.	-	-
Necteria mauritiicola	+	+
Stemphylium sp.	-	-
Control*	-	-
Control**	-	-
Control***	-	-

(-):-No infection , (+):-Occurrence infection , (*):- Un wounded , Un injected peach transplants ,

(**):-wounded and inoculated withagar disc without inoculum ,

(***):- Un wounded but injected and inoculated only with sterilized water.

TABLE 2

PATHOGENIC CAPABILITY OF N.MAURITIICOLA ON THREE PEACH CVS., GREENHOUSE EXPERIMENT.

The tested CVS.	% Disease incidence using				% Disease severity using			
	Wounds		Injection		Wounds		Injection	
	Inoculated	Control	Inoculated	Control	Inoculated	Control	Inoculated	Control
Desert	33.3^{b}	0.0	53.3^{b}	0.0	6.7^{b}	0.0	16.7^{c}	0.0
Early Grand	40.0^{ab}	0.0	73.3^{ab}	0.0	16.0^{a}	0.0	26.7^{b}	0.0
Florida Prince	53.3^{a}	0.0	86.7^{a}	0.0	21.3^{a}	0.0	35.3^{a}	0.0

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

Chemical control:

a- Greenhouse experiment:

Table(3) shows that all the tested fungicides, *i.e.*Captan Uultra, Coprous-KZ, Kema-Z , Mancoper, Saprol, Topas and Topsin M-70 resulted in significant reduction to the incidence and severity of the disease under greenhouse conditions compared with the control. In addition, Saprol and Topas were the most effective fungicides in reducing the incidence of the disease , being 92.8 % for both fungicides and disease severity , being 96.3 and 95.2%, respectively. Meanwhile, Coprous- KZ and Captan Ultra were the lowest effective fungicides, being71.4 and 78.6 % disease incidence and 86.7 and 87.8% disease severity, respectively. The rest fungicides recorded intermediate reduction. Control treatment recorded 93.3% disease incidence and 35.3 % disease severity

b- Field experiments:

Data shown in Table (4) demonstrate the effect of the tested 7 fungicides on controlling Nectria canker in the open field during 2011 and 2012 growing seasons. Data

showed the same trend of the obtained data in Table (3) , where all the tested fungicides resulted in successful decrease to the severity of the disease in both seasons compared with control treatment . Also Saprol and Topas had the highest reduction to the severity of the disease, being 91.9 and 91.1 % and 92.6 and 92.3% , respectively . Also, Coprous-KZ and Captan Ultra were of the lowest activity through the two seasons 86.5 and 87.3 % and 86.4 and 88.2 % , respectively, and the rest fungicides were of intermediate effect, control treatment recorded 37.0 % and 39.0 % during 2011 and 2012 respectively.

TABLE 3

EVALUATION THE EFFICACY OF SOME FUNGICIDES ON REDUCING DISEASE INCIDENCE AND SEVERITY OF INFECTION BY N. MAURITIICOLA CANKER ON PEACH, FLORIDA PRINCE CV., GREENHOUSE EXPERIMENT.

Fungicides	% Disease incidence	% Efficacy	% Disease severity	% Efficacy
Captan Ultra	20.0^{bc}	78.6^{c}	4.3^{b}	87.8^{e}
Coprous-KZ	26.7^{b}	71.4^{c}	4.7^{b}	86.7^{f}
Kema-Z	13.3^{bc}	85.7^{b}	2.0^{b}	94.3^{c}
Mancoper	20.0^{bc}	78.6^{c}	4.0^{b}	88.7^{d}
Saprol	6.7^{c}	92.8^{a}	1.3^{b}	96.3^{a}
Topas	6.7^{c}	92.8^{a}	1.7^{b}	95.2^{b}
Topsin M-70	13.3^{bc}	85.7^{b}	2.0^{b}	94.3^{c}
Control	93.3^{a}	------	35.3^{a}	----

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 .

TABLE (4

EFFECT OF SOME FUNGICIDES ON THE NATURAL INFECTION BY CANKER ON PEACH TREES (FLORIDA PRINCE CV.), FIELD EXPERIMENTS DURING 2011 AND 2012 GROWING SEASONS.

Fungicides	%Disease severity during		% Efficacy during	
	2011	2012	2011	2012
Captan Ultra	4.7^{bc}	4.6^{bc}	87.3^{f}	88.2^{f}
Coprous KZ	5.0^{b}	5.3^{b}	86.5^{g}	86.4^{g}
Kema-Z	3.4^{bc}	3.3^{c}	90.8^{c}	91.5^{c}
Mancoper	4.3^{bc}	4.3^{bc}	88.4^{e}	89.0^{e}
Saprol	3.0^{c}	2.9^{c}	91.9^{a}	92.6^{a}
Topas	3.3^{bc}	3.0^{c}	91.1^{b}	92.3^{b}
Topsin M-70	3.7^{bc}	3.5^{bc}	90.0^{d}	91.0^{d}
Control	37.0^{a}	39.0^{a}	----------	--------

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.

Data presented in Table (5) present the effect of the tested fungicides on yield component of Florida Prince peach cv. due to the infection by the causal of Nectriacanker. All of the tested fungicides significantly increased the produced fruit yield , *i.e.* number of fruits /tree , average weight(g) of one fruit and weight of fruit yield (kg)/ tree.

TABLE 5

EFFECT OF THE TESTED FUNGICIDES ON THE FRUIT YIELD DURING 2011 AND 2012 GROWING SEASONS ON FLORIDA PRINCE PEACH CV.

Fungicides	Average No. of Fruits/ tree		Average weight of one fruit (g)		Average fruit yield (Kg) /tree	
	2011	2012	2011	2012	2011	2012
Captan Ultra	403.2	409.3	86.5	95.7	34.9	39.2
Coprous-KZ	402.3	407.4	76.3	88.2	30.7	35.9
Kema-Z	404.1	412.1	98.2	108.1	39.7	44.6
Mancoper	403.2	410.2	88.7	99.9	35.8	41.0
Saprol	404.6	411.3	97.2	107.7	39.3	44.3
Topas	406.4	413.4	102.6	111.5	41.7	46.1
Topsin M-70	403.1	411.2	94.0	102.6	37.9	42.2
Control	398.3	404.3	68.5	71.0	27.3	28.7
New L.S.D (0.05)	2.9	3.7	9.4	7.5	4.5	3.1

The variability in the number of fruits /tree was not greatly differed during both seasons due to spraying the tested fungicides through both seasons. Meanwhile, the difference in the average weight(g) of one fruit and weight of fruit yield (kg)/ tree was significantly differed. In addition, the highest averages were obtained by Topas, being 102.6 and 111.5 g. /fruit and 41.7 and 46.1 kg./ tree during 2011 and 2012 growing seasons, respectively. On the other hand, Coprous-KZ was the lowest efficient one in this regard, being 76.3 and 88.2 g./ fruit and 30.7 and 35.9 kg./tree, respectively. Poor yield was produced in case of control treatment, being 68.5 and 71.0 g. / fruit 27.3 and 28.7 kg./ tree during both seasons, respectively.

Effect on macro-nutrients content :

Results (Table,6) demonstrate the effect of the tested fungicides on leaf macro-elements content in both seasons.

The tested seven fungicides resulted in significant increase in the leaf content from macro-elements compared with control treatment. In this respect, the highest macro-elements content was obtained in case of spraying of Topas followed by Kema-Z then Saprol . Meanwhile, the lowest macro-elements content was obtained in case of spraying Coprus-KZ. The remained treatments recorded inter-mediate values of the estimated macro-elements.

Effect of the tested fungicides on leaf content of photosynthetic pigments:

Data shown in Table (7) show the effect of the tested fungicides on leaf content of photosynthetic pigments. In this respect, chlorophyll a and b as well as carotene were significantly increased by the tested treatments compared with the control. The highest effects was occurred from spraying Topas, Kema-Z and Saprol in both seasons.

TABLE 6

EFFECT OF THE TESTED FUNGICIDES ON LEAF MACRO-ELEMENTS DURING 2011 AND 2012 GROWING SEASONS

Treatments	% N content during		%P content during		%K content during		%C content during		%Mg content during	
	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
CaptanUaltra	0.56	0.51	0.32	0.35	0.94	1.02	1.13	1.24	0.53	0.59
Coprous-KZ	0.55	0.51	0.26	0.29	0.71	0.78	1.10	1.21	0.51	0.56
Kema-Z	0.88	0.81	0.57	0.62	1.48	1.61	1.34	1.46	0.93	1.01
Mancoper	0.57	0.52	0.38	0.41	1.19	1.29	1.17	1.27	0.77	0.84
Saprol	0.74	0.68	0.53	0.58	1.44	1.57	1.24	1.35	0.88	0.97
Topas	0.97	0.89	0.87	0.95	1.57	1.71	1.45	1.58	0.97	1.05
Topsin M-70	0.58	0.53	0.40	0.44	1.37	1.49	1.21	1.32	0.85	0.92
Control	0.50	0.46	0.21	0.23	0.43	0.47	0.99	1.08	0.47	0.51
L.S.D (0.05)	0.03	0.04	0.04	0.05	0.23	0.29	0.08	0.11	0.03	0.02

TABLE 7

EFFECT OF DIFFERENT TREATMENTS ON LEAVES PIGMENTS IN 2011 AND 2012 GROWING SEASONS ON FLORIDA PRINCE PEACH CV.

Treatments	Chlorophyll A mg/g during		Chlorophyll B mg/g during		Carotene mg/g during	
	2011	2012	2011	2012	2011	2012
Captan Ultra	0.42	0.46	0.17	0.19	0.22	0.25
Coprous-KZ	0.37	0.40	0.11	0.12	0.19	0.21
Kema-Z	0.89	0.97	0.43	0.47	0.33	0.36
Mancoper	0.46	0.50	0.23	0.25	0.23	0.25
Saprol	0.63	0.69	0.31	0.34	0.29	0.32
Topas	1.09	1.19	0.57	0.62	0.37	0.40
TopsinM-70	0.54	0.59	0.24	0.26	0.27	0.29
Control	0.31	0.34	0.07	0.08	0.15	0.16
L.S.D (0.05)	0.05	0.04	0.03	0.02	0.02	0.03

4 Discussion

Canker disease of peaches, hard wood trees and other deciduous fruit trees is one of the most aggressive disease injured plants, capable of killing trees in short time .Cankers on trees are the visible manifestation of necrotic periderm, cortex, phloem, and vascular cambium tissues . Generally, cankers can be either annual or perennial in occurrence and, if perennial, can be either diffuse or target-shaped. In reality, canker symptomatology is extremely diverse, often with gradations among the distinct types. The observed symptoms are similar to that reported by Biggs (1993) ; Ned (2004) and Marianne (2010) . However, the biological basis for the varying expression of disease symptoms is due to the interaction of several factors, including pathogen virulence, host resistance, influence of environment, and time (Tartar, 1978).

Isolation trials from naturally cankered samples of Florida Prince peach cv. collected from Nobaria, El-Behera governorate during growing season 2011 yielded many fungal isolates. The isolated fungi were purified and identified as: *Alternariaalternata ,Cladosporium sp., Curvularialunata , Helminthosporium sp.,Stemphylium sp.,* and *Necteriamauritiicola.* The identification was confirmed by DNA sequencing in Korea .

The fungus *N.mauritiicola* produced conidial mass white to yellow or green becoming red-brown or black when dried , conidia ellipsoid , ovoid, fusiform ellipsoid or oblong ellipsoid (Seifert and Samuels, 1985).

Genus Nectria have many species that infect peach and other deciduous fruit trees (Biggs,1993). In this respect, N. galligena can infect apple and cause canker (Xu and Butt, 1996), *Nectria cinnabarina , N. pseudotricha, N. ditissiam, N. radicicola,* and *N. mauritiicola* are plant pathogens that cause cankers on many tree species (Books, 2010).

Nectria infection is dependent on weather conditions in autumn (Grove, 1990; Ogawa and English, 1991 ;Xu and Butt, 1994).

N. mauritiicola is one of nectria canker causal grows saprophytically without symptoms on a large number of woody trees and is an opportunistic pathogen, colonizing the wood when the plant is injured by frost, sun scald or wounding. The fungus enters plants mainly through natural and artificial wounds. Symptoms can develop when the host is under stress, such as transplant stress or drought .It has a synnematousanamorph :*Rhizostilbellahipisci,* (Samueles and Seifert 1985), and found in a large part of the world specially; in Asia, Africa and America (Latifaet.al., 2011 and Herrera et al., 2013).

N. mauritiicola cause canker of hard wood trees (Samueles and Seifert, 1987). It is mildly parasitic or saprobe on bark and roots and isolated from stem end of plant in Zaire of woody trees (Rossman et al, 1999) and it was isolated by Anabella et. al.(2010) and identified as *N.mauriticola*by using ITS technique .

Pathogenicty test of the isolated fungi revealed that thefungus *N.mauritiicola*was only the responsible pathogen for causing peach canker. In addition, varietal susceptibility of three peach cvs., i.e. Desert, Early Grand and Florida Prince indicated that the fungus *N. mauritiicola* wasable to infect the three peach cvs., with different degrees of disease incidence and severity. In this respect, Florida Prince was the most susceptible cultivar to infection by the causal fungus by any of the two tested methods of inoculation (wounds and injection) followed by Early Grand cv. then Desert cv.

All the tested seven fungicides significantly reduced Necteria canker of peach compared with control treatment. In addition, Saprol and Topas were the most superior treatments in reducing the disease either in the greenhouse or in the open field during the two tested seasons (2011 and 2012). These results are in agreement with the obtained results by Cook (1999) ; Latorre *et al*. (2002) and Lolas and latorre (1997) . The effect of the two fungicides (Saprol and Topas) may be due to their inhibitory effect on spore germination or to their effect on the fungus development (Zaher *et al*., 1986). Xu and Butt (1996) applied carbendazim, and other fungicides, to pruned shoots as curative treatments on potted apple trees in a polythene tunnel and obtained adequate control.these fungicides, slightly reduced the incidence of cankered shoots and lengthened the incubation period when applied 36 h after inoculation of 1-day-old pruning cuts.

Lolas and latorre (1997) mentioned that one to three protective sprays of copper compounds (Bordeaux mixture, copper oxychloride or copper dioxide) or copper compounds alternated with benzimidazole fungicide (benomyl, carbendazime or methyl thiophanate) are widely used during leaf fall .Also, Cooke (1999) reported that sterol demethylation inhibiting fungicides (hexaconazole, myclobutanil, penconazole) had a similar effect on canker. Autumn application of copper oxychloride at 5 and 50% leaf-fall reduced numbers of new cankers. Latorreet al. (2002) found that fungicide treatments applied during leaf fall significantly reduced infection in the next season suggesting that leaf scars are important infection courts for Nectria.

It has been found that all the tested fungicides were able to increase macro-nutrient andphytosynthetic pigments in peach leaves compared with control treatment. In addition, the fungicidesTopas,Kema-Z and Saprol in both seasons recorded the highest increase in both chlorophyll and carotenoids and Coprou- KZ was the lowest effective one. This increase may be due to the treated trees with these fungicides reduced the hazard effect of the infection by the canker on the grown trees and let the treated trees to grow well. Therefore, the leaves of these trees contain high level from the macroelements as well as photosynthesis pigments in both seasons . Tejada*et al.* (2004) mentioned that carotenoids have a very important role in photosynthesis and biosynthesis of carotenoids in plants is a genetic characteristic, but environmental conditions also have an essential role.

REFERENCES

[1.] Anabella, Z. M.; Hernández ; C.T. Rodríguez ; J.A. Sabat; A.M. Bayman, P.(2010).Spatial variation in fungal communities isolated from healthy and diseased seafans *Gorgonia ventalin a*and seawater. Aquatic Biology..8:151-160.

[2.] Biggs , A. R. (1993). Pathological anatomy and histochemistry of leucostoma canker on stone fruits and other selected fungal cankers of deciduous fruit trees. Ed. CRC Press, 169-189.

[3.] Latifa B. ; T. B. Rachid.; M. Martin; H. Jos; M. H. Jamal.; R. A. Samson; A. E. Martinez and J. P. Villar (2011).Mycobiota associated with *Platypus cylindrus* (Coleopteran:Curculionidae, Platypodidae) in Cork oak stands of North West Algeria. Africa. J.Microbiol.Res..,5 (25), 4411-4423 Nov.,2011 .

[4.] Books, L.L. C. (2010).Chapters:*Nectriacinnabarina*. General , Books LLC, 28 pp.

[5.] Brown, S.D. and F.H. Lilleland(1945).Rapid determination of potassium and sodium in plant material and soil extracted by flam photometer. Proc. Amer. Soc. Hort. Sci., 48: 341 -346.

[6.] Chapman, H.D. and F. Parker (1961).Methods of Analysis for Soil, Plant and Water.California Univ., Division of Agricultural Sciences.

[7.] Cooke , L. R. (1999). The influence of fungicide sprays on infection of apple cv. Bramley's seedling by *Nectriagalligena*. Euro.J. of plant Pathol., 105 (8): 783-790.

[8.] Crowdy , S. H. (1952). Observations on apple canker. 111. the anatomy of the stem canker. Ann. Appl. Biol., 36: 483-495.

[9.] Dhingra, D.D. and J. B. Sinclair (1985). Basic plant pathology methods CRC press Inc. Boca, Florida.

[10.] Dubin, H. J. and H. English (1975).Effects of temperature, relative humidity and desiccation on germination of *Nectria galligena* conidia, Mycologia, 67.83-88.

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

[12.] Ellis, M.A. (2008). Peach canker. Agriculture and Natural Resources, Ohio State University Extension website (Ohioline) – fact / 3000 pdf / 401-407.

[13.] Feather , T.V.; H. D. Ohr; D. E. Munnecke and J. B. Carpenter (1989). The occurrence of *Fusariumoxsporum* on *Phoenix canariensis* , a potential danger to date production in California. Plant Dis., 73 : 78-80.

[14.] Grove, G. G. (1990). Nectriacanker.In : Jones, A. L. and H. S. Aldwinckle (Eds.). Compendium of Apple Diseases. The AmericanPhytopathologicalSociety . St. Paul, M N, pp. 35-36.

[15.] Herrera, C. S.; A. Y. Rossman; G. J. Samuels and P. Chaverri (2013).Revision of genus *Corallomycetella* with *Corallonectria* genus. Nov.For *C. jatrophae* (Nectriaceae, Hypocreales). Mycosystema, 32 (3): 518-544.

[16.] Jacobi, W. R. (2014). Honeylocust diseases. Colorado state University Extension, Bioagricultural Sciences and Pest Management 6194 Revised No. 2.939(12/13) CSU .

[17.] Latorre, B. A.; M. E. Rioja ; C. Lillo and M. Munoz (2002). The effect of temperature and wetness duration on infection and warning system for European canker (*Nectria galligena*) of apple in Chile. Crop Prote. ,21 :285-291.

[18.] Lolas, M. and B. A. Latorre(1997). Effect comparativo de fangicidas en el control delcancro europeodel manzano causadopor *Nectria galligena*. Fitopatologia, 32, 131-136.

[19.] Marianne, Elliott (2010). Canker diseases. Washington State University wibside, October 18.

[20.] Ned, A. T. (2004). Canker disease of trees. Kansas State University Agricultural Experiment Station and Cooperative Extension Service .

[21.] Ogawa, J. M. and H. English (1991). Diseases of temperate zone tree fruit and nut crops. University of California. Div. Agric. Nat. Res. Publication 3345. San Pablo, CA, 461 pp.

[22.] Pregel, F. (1945). Quantitative Organic Micro Analysis.4th Ed. S.A. Churchill Ltd., London, pp: 53.

[23.] Rashed , M. F.; H. S. El-Shimy ; M. A. M. Kamhawy and M. A. El-Morsi (2009). Inner leaves blight of tissue culture date-palm (Barheevariety) caused by *Fusarium solani* after acclimatization stage and its control J. Biol. Chem. Environ. Sci.,4 (1): 951-966.

[24.] Renee, M. (2008). Canker fungus in trees .websites and the 'community press" news paper.

[25.] Rossman A.Y. ; G. J. Samuels ; C. T. Rogerson and R. Lowen (1999). Genera of bionectriaceae, hypocreaceae and nectriaceae (Hypocreales ,Ascomycetes). Studies in Mycology, 42:1- 248.

[26.] Samuels, G. J. and K. A. Seifert (1987).Taxonomic implications of variation among Hypocrealeananamorphs. In pleomorphic fungi: the diversity and its taxonomic implications, pp.29-56. Edited by J. Sugiyama. Tokyo: Kodansha.

[27.] Seifert , K. A. (1985). Amonograph of stilbella and some allied hyphomycetes. Stud.Mycol. , 27: 1-235.

[28.] Seifert, K. A. and G. J. Samuels (1985).Studies in Mycology 27: 160-162{MB#104547} , {MB#104718}. .

[29.] Sergio M.L.; C. Lilia ; H.Sarah ; A. Elizabeth ; S. Carmenza ; I. Alicia ; H.G. William ; C.R. Luis (2011). Screening and evaluation of antiparasitic and in vitro anticancer activities of Panamanian endophytic fungi. International Microbiology, 14:95-102.

[30.] Snedecor, GA. and W.G. Cochran (1980).Statistical Methods. Iowa state Univ. Press, U.S.A.

[31.] Stino,R.G. ;T.A. Fayed; M.M.Ali and S.A.Alaa (2010).Enhancing fruit quality of Florida Prince peaches by some foliar treatments. Journal of Horticulture Science & Ornamental Plants, 2(1):38-45.

[32.] Sunayana, N.; M.S.Nalini ; K. K. Sampathkumara and H. S. Prakash (2014). Diversity studies on the endophytic fungi of *Vitexnegundo*L.Mycosphere, 5 (4): 578-590.

[33.] Swinburne, T. R. (1971) the seasonal release of spores of Nectriagalligenafrom apple cankers in Northern Ireland . Ann. Appl. Biol., 69. 97-104

[34.] Tejada-Zarco, P. J.; J.R. Miller ; A. Morales ; A. Berjon and J. Aguera (2004). Hyperspectral indices and simulation models for chlorophyll estimation in open-canopy tree crops. Remote Sensing of Environment, 90: 463-476.

[35.] Tartar, T.A. 1(978). Diseases of shade trees. Academic Press, N.Y.

[36.] Tekauz, A. and Z. A.Patrick (1974).The role of twig infection on the incidence of perennial canker of peach. Phytopathology 64 , 683 .

[37.] Togashi , K. (1931).Studies of the pathology of peach canker , Bull. Imp. Coll. Agric. for., morioka, Japan, 16 178 pp.

[38.] Townsend , G. R. and J. W. Heuberger (1943). Method for estimating losses caused by diseases in fungicide experiments. Plant Dis. Reptr., 27: 340.

[39.] Vacant R.I. (2013). Revision of the genus *Corallomycetella* with *Corallonectria* genus nova for *C.jatrophae* (Nectriaceae, hypocreales- (peer reviewed journal). Mycosystema, 32 (3): 518-544.

[40.] Xu , X.M.and D. J. Butt (1994).The biology and epidemiology of *Nectria galligena* and an infection warning system. Nor. J. Agric Sci. Suppl., 17: 317-324.

[41.] Xu , X.M.and D. J. Butt (1996).Tests of fungicides for post-germination activity against *Nectria galligena*, causal agent of canker and fruit rot of apple. Crop Protec.,15(6):513-519.

[42.] Zaher-Effat,A.; M.Y. Mourade and Fatma M. Radwan (1986).Studies of grapevine fruit rot in Egypt . Agric. Res. Rev., 64(2):305-315.

[43.] Zaher-Effat, A. ;M.F.Attia and Nouer-Elhoda, A.Reyad (2012) :.Rose stem canker caused by *Coniothyriumfuckelii*Sacc. in Egypt. Egypt. J. Phytopathol., 40(2):39-55 .