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Preliminary Studies on Fungal Species Associated with Guava Fruit Drop Disease and Possible Management

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Four phytopathogenic fungi, *i.e. Alternaria alternata*, *Lasiodiplodia theobromae*, *Fusarium semitectum* and *Pestalotia psidii*, were isolated from the dropped guava fruits collected from different orchards located at Beheira Governorate during 2013 and 2014 growing seasons. Disease incidence recorded higher percentages during 2013 than that of 2014 season. Pathogenicity of the isolated fungi was carried out on apparently healthy guava fruits, attached to its branches, collected from 15-year-old trees. Data show that maximum disease intensity was occurred on either petioles and/or fruits inoculated with mixture of fungal pathogens. These results indict that guava fruit drop might be a fungal disease complex when caused by certain phytopathogenic fungi.

Four fungicides, *i.e*. Kemazed, Homai, Vacomil plus and Topas, were *in vitro* evaluated for their efficacies against the isolated pathogenic fungi. Moreover, the efficacy of four compounds, *i.e*. hydrogen peroxide, potassium sorbate, potassium bicarbonate and calcium chelate, was *in vitro* evaluated as alternative control means against the growth of tested pathogenic fungi. In this concern, hydrogen peroxide and potassium bicarbonate recorded the highest performance against the tested fungi.

Under natural field infection, chemical control trails cleared that the efficiency of Homai 80% WP and Kemazed 50% WP reached 69.0 and 78.8%, respectively, as compared to the check treatment. It is worth to note that the concerned disease could be controlled by applying either of Homai 80% or Kemazed 50% at the rate of 70 g/100 l water.

Keywords: *Alternaria alternata*, calcium chelate, fruit drop, *Fusarium semitectum*, guava, Homai, hydrogen peroxide, *Lasiodiplodia theobromae*, *Pestalotia psidii*, potassium bicarbonate, potassium sorbate, Topas and Vacomil plus.

Guava (*Psidium guajava* L.) is well-known as important tropical fruit that take position among the “super fruits” due to its nutrition values, when having 82% water, 0.7% protein, 11% carbohydrates and enough amounts of vitamins A, B, B2 and C plus some minerals (Bardi, 1975 and Valentino *et al*., 2015). The medicinal properties of guava fruit, leaves and other plant parts are also well-known in folk medicine (Joseph and Mini, 2014).

In Egypt, guava orchards occupy about 35606 feddan yielded around 9.8 ton fruits per feddan (Anonymous, 2014). However, guava is one of the popular fruits in Beheira Governorate. The cultivated guava varieties in this governorate are Balady and Maamora. The Egyptian farmers used to leave the trees without irrigation and this habit is called "fasting guava". The aim of this habit is to obtain the crop at different period than the normal harvesting time and accordingly to increase the income for the farmers.

Guava trees are vulnerable to attack by many pathogens, mainly fungi beside few bacteria, algae, as well as some physiological disorders or deficiencies. About 177 pathogens are reported on various parts of guava trees and/or associated with guava fruits, of which 167 are fungal pathogens, 3 bacteria, 3 algae, 3 nematodes and one epiphyte. Moreover, about 91 pathogens were reported on the fruits, 42 on foliages, 18 on twigs, 18 on roots as well as 17 fungi were isolated from surface wash of fruits (Misra, 2006). Thus, guava crop is known to be suffering from various fungal diseases, *i.e.* seed rot, anthracnose, Cercospora spot, stylar end rot, wilt and sooty mould (Younis *et al*., 2004; Ismail *et al*., 2010 and Dwivedi and Neetu, 2012).

Fruit drop disease is one of the major problems on guava crop, when leads to substantial loss in guava yield production. It is generally appears during October and November, when the fruit accomplished the lemon size. To the best of our knowledge, there are no pathological studies were performed in Egypt to determine the reasons of guava fruit drop disease. Therefore, this research was designed to determine the incidence and causal pathogen(s) of guava fruit drop and also to verify some means for controlling the disease.

Materials and methods

This study was conducted during two growing seasons of 2013 and 2014 in four locations at Beheira Governorate, *i.e.* El-Dsasna and Nekhela El-Bahareia as well as El-Nagah Village and Adam Village at Nubaria region.

1. Disease survey:

Percentages of naturally infected guava trees showing fruit drop disease were recorded in the abovementioned locations at Beheira Governorate. Disease incidence (DI%) was calculated using the following equation:

$$DI\ (\%) = A/B \times 100$$

Whereas: A= Guava trees showing fruit drop disease.
B= Total number of tested trees.

2. Isolation and identification of the causal organisms:

Isolation trails was carried out from different parts, *i.e.* rose end; stem end (pedicel) and internal parts, of fruit samples collected from guava trees showing fruit drop disease during October, 2013. Collected samples were washed under tap water then left on folds of filter papers at room temperature to remove excess of water. Small pieces, containing both diseased and healthy tissues, were surface sterilized by immersing in 1% sodium hypochlorite solution for two minutes, rinsed three times in sterilized distilled water, left to dry on folds of filter papers, then

transferred, under aseptic conditions, into 9-cm-diam. Petri dishes containing PDA medium and incubated at 24±1°C for 3-5 days. The growing fungal colonies were purified using hyphal tip technique. Purified fungi were identified on the basis of their morphological characteristics according to Barnett and Hunter (1986) and confirmed in Mycol. and Plant Dis. Survey Dept., Plant Pathol. Res. Inst., ARC, Egypt. Pure culture stocks of the isolated fungi were kept on PDA slants at 5°C for further study. Frequency (%) of the isolated fungi was calculated using the following equation:

$$\text{Frequency (\%)} = \frac{\text{No. of each fungal colonies}}{\text{Total number of all fungi}} \times 100$$

3. Pathogenicity test:

Apparently healthy guava fruits (cv. Balady) collected, at lemon size with their attached branches and petioles, from private guava orchard located at Beheira Governorate, were used to prove the pathogenic capability of the isolated fungi, under laboratory conditions. Collected guava materials were thoroughly washed under tap water, surface sterilized into 0.5% sodium hypochlorite solution for 2 minutes, followed by washing three times in sterilized water and then left on sterilized filter paper to get rid of the excess water. Finally, prepared branches were individually inserted into one litre sterilized glass bottles (Fig. 1), each contained 250ml nutrient solution (1% urea + 2% K_2SO_4 + 0.5% $ZnSO_4$ + 0.3% Borax) as recommended by Khamis *et al.* (2007). Spore suspensions of isolated fungi were empirically prepared from 7-day-old cultures grown on PDA plates (9-cm-diam.) according to the standard method of Last and Hamley (1956). Spore suspensions density was adjusted to 10^6 spore/ml. Inoculation was done by injecting either petioles or fruits, each with (50 µl) of the spore suspension using a micropipette. A set of petioles and fruits injected by sterilized water only and kept as check (control). The wounds were covered with melted (54°C) wax (Deverall, 1967). Bottles were then incubated under laboratory conditions (18-25°C) for 5-7 days. Five bottles, each contained 4-5 attached fruits to one branch, were used as replicates for each treatment. Dropped fruit (DF) percentages were calculated using the following equation:

$$DF\ (\%) = A\text{-}B/A \times 100.$$

Whereas, A= Total number of tested fruits.
B= Number of remained attached fruits to the branches.

Fig. 1. Pathogenicity test of guava fruits collected at lemon size with their attached branches and petioles, under laboratory conditions.

4. Chemical control:

4.1. In vitro experiment:

Seven concentrations, *i.e.* 0, 50, 100, 150, 200, 300 and 400 ppm, of four fungicides, *i.e.* Kemazed, Homai, Vacomil plus and Topas, were *in vitro* evaluated for their efficacy against the fungal mycelial growth on PDA plates incubated at 25^{o}C for two weeks. Five Petri dishes were used as replicates for each concentration, and the entire experiment was repeated twice. The fungal linear growth (mm) was calculated as the average of the orthogonal diameter.

4.2. In vivo experiment:

On the base of the *in vitro* experiment results, the most effective two fungicides, *i.e.* Kemazed and Homai, were chosen to evaluate their efficacy under the field natural infection. Tested fungicides were applied by spraying the recommended dose (70 gm/100 l water) at the beginning of fruit set. Both of set fruits and attached ones were counted directly before the fungicides application. The trees were divided in a randomized complete block design. Five trees; each one had three branches, were used as replicates for each fungicide treatment. Also, five trees sprayed with water only were kept as check (control) treatment. Percentage of dropped fruits (DF%) was calculated as previously mentioned. Moreover, the efficiencies of the tested fungicides were calculated according to the following formula:

$$\text{Efficiency (\%)} = \frac{\text{Fruit drop (\%) in the check - fruit drop (\%) in the treatment}}{\text{Fruit drop (\%) in the treatment}} \times 100$$

5. Alternative control methods:

Four compounds (Table 1) were evaluated as alternative control means against the tested mycelial growth. An aqueous solution of each compound was filtered (0.45 µm filters, Millipore, USA) and added to molten PDA (45^{o}C) before pouring into (9-cm-diam.) Petri dishes, to achieve final concentrations of 0.5 and 1% (w/v). Non-amended PDA plates were served as a check. Dishes were seeded in the center with a 10-day-old culture disc (5-mm-diam.) taken from the edge of actively growing colonies of each pathogen and incubated for two weeks at 24±1^{o}C. Five Petri dishes were used as replicates for each concentration, and the entire experiment was repeated twice. Reduction (%) in the colony diameter was calculated according to Youssef *et al*. (2014), using the following formula:

$$\text{Reduction (\%) of colony diameter} = ((dc - dt) / DC) \times 100$$

whereas: dc= Average colony diameter in the check.

dt= Average colony diameter in the compound-amended plates.

Table 1. Purity, chemical formula and manufacture of alternative control means

Tested compound	Purity (%)	Chemical formula	Manufacture
Calcium chelate	98%	$C_{10}H_{12}N_2O_8CaNa_2.2H_2O$	Vetec
Hydrogen peroxide	NA	H_2O_2	Belhasa BioTek Solution
Potassium bicarbonate	85%	K_2HPO_4	Certis Europe
Potassium sorbate	98-101%	$C_6H_7KO_2$	Vetec

Statistical analysis:

All experiments were setup in a complete randomized design. Data were subjected to one way analysis of variance (ANOVA) using Statistica Software (Ver. 6.0). Fisher's protected least significant difference was used at $P \leq 0.05$ levels to distinguish the differences among various treatments**.**

Results

Disease survey:

Data presented in Table (2) show that, on the average, the disease incidence (%) was higher during 2013 as compared to season 2014. Maximum disease incidence (54%) was recorded in El-Dsasna, followed by Nekhela El-Bahareia (48%), Adam Village (42%) and El-Nagah Village (38%) in season 2013; meanwhile it reached 49%, 42%, 39% and 35%, respectively, in 2014. However, recorded disease incidence at El-Dsasna was significantly higher than those of the other locations in both seasons. Disease symptoms on the dropped guava fruits are shown in Fig. (2).

Table 2. Disease incidence in the inspected locations at Beheira Governorate

Inspected location	Disease incidence (%)	
	2013	2014
El-Dsasna	54	49
Nekhela El-Bahareia	48	42
El-Nagah Village - Nubaria region	38	35
Adam Village - Nubaria region	42	39
L.S.D $_{0.05}$	3.4	4.2

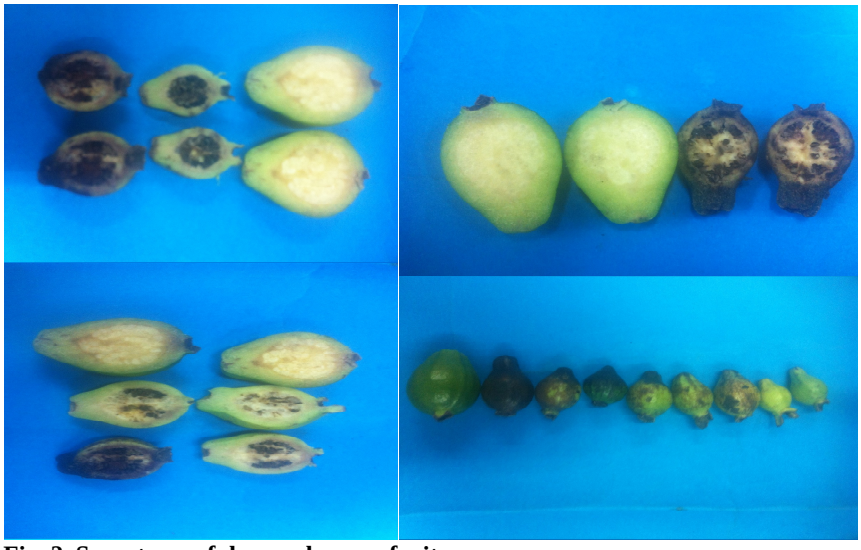

Fig. 2. Symptoms of dropped guava fruits.

Isolation and identification of the causal organisms:

Isolation and identification trails revealed that four different fungi, *i.e. Alternaria alternata, Lasiodiplodia theobromae, Fusarium semitectum* and *Pestalotia psidii*, were found to be associated with the naturally infected guava fruits, with averaged frequencies reached 34.4, 27.1, 21.9 and 16.6%, respectively. Moreover, the average fungal frequency varied from inspected location to another (Table 3).

Table 3. Frequency of fungi isolated from naturally infected guava collected from different locations at Beheira Governorate during 2013 and 2014 seasons

Isolated fungus	El-Dsasna	Nekhela El-Bahareia	El-Nagah Village (Nubaria)	Adam Village (Nubaria)	Mean
Pestalotia psidii	2.8	4.2	3.7	5.9	4.15
Lasiodiplodia theobromae	7.0	7.7	6.7	5.7	6.78
Alternaria alternata	8.1	9.9	7.8	8.6	8.60
Fusarium semitectum	5.2	5.9	4.8	6.0	5.48
Mean	5.78	6.93	5.75	6.55	6.25

Pathogenicity of the tested fungi:

Pathogenicity of the isolated pathogenic fungi, was carried out on apparently healthy guava fruits (cv. Balady), attached to its branches, collected from 15-year-old trees. Data presented in Table (4) show that maximum disease intensity was occurred on petioles and fruits inoculated with mixed fungal pathogens, being 65.0 and 53.3%, respectively. Meanwhile, the disease incidence on petioles reached 53.3, 43.3, 40.0 and 33.0% on guava branches inoculated with *L. theobromae, A. alternata, P. psidii* and *F. semitectum*, respectively. The same trend of disease intensity was recorded on fruits, being 41.3, 35.1, 32.3 and 26.1%, respectively.

Table 4. Pathogenicity of the isolated fungi on guava petioles and fruits (cv. Balady)

Pathogen	Dropped fruits (%)	
	Petioles	Fruits
Alternaria alternata	43.3	35.1
Lasiodiplodia theobromae	53.3	41.3
Fusarium semitectum	33.0	26.1
Pestalotia psidii	40.0	32.2
Mixed fungi	65.0	53.3
Check	12.0	10.8
L.S.D $_{0.05}$	3.9	4.3

Chemical control:

In vitro experiments:

The *in vitro* efficacy of four fungicides applied in seven concentrations against the isolated pathogenic fungi, was performed. Data presented in Table (5) show that Kemazed completely inhibited the growth of *A. alternata, L. theobromae, F. semitectum* and *P. psidii* when applied at 400, 150, 300 and 150ppm,

Table 5. *In vitro* effect of four fungicides against the pathogenic fungal growth

Commercial name	Common name	Conc. (ppm)	Fungal linear growth (mm)			
			A. alternata	*L. theobromae*	*F. semitectum*	*P. psidii*
Kemazed 50% WP	Carbendazim	0	90	90	90	90
		50	72	30	43	16
		100	42	16	27	11
		150	31	0.0	25	0.0
		200	26	0.0	15	0.0
		300	12	0.0	0.0	0.0
		400	0.0	0.0	0.0	0.0
Homai 80% WP	Thiophanate methyl 50% Thiram 30%	0	90	90	90	90
		50	54	8	13	7.5
		100	42	0.0	0.0	0.0
		150	30	0.0	0.0	0.0
		200	17	0.0	0.0	0.0
		300	10	0.0	0.0	0.0
		400	0.0	0.0	0.0	0.0
Vacomil plus 50% WP	Copper oxychloride + Metalaxyl	0	90	90	90	90
		50	78	90	90	90
		100	63	90	90	90
		150	57	90	90	68
		200	22	90	90	52
		300	17	90	64	27
		400	0.0	82	53	0.0
Topas (100) 10% EC	Penconazole	0	90	90	90	90
		50	34	36	65	65
		100	21	28	57	59
		150	14	24	52	54
		200	7	25	46	51
		300	0.0	19	40	41
		400	0.0	10	34	30
L.S.D $_{0.05}$ for: Fungicides (F)			3.34	4.2	3.52	4.6
Concentrations (C)			4.38	5.4	5.56	5.9
F X C			8.76	9.2	8.81	9.7

respectively. Also, Homai completely inhibited the growth of tested fungi, when applied at 400, 100, 100 and 100ppm, respectively. However, Vacomil plus inhibited the growth of *A. alternata* and *P. psidii* at the maximum dose (400 ppm), meanwhile no complete inhibition was recorded for the rest of tested fungi. Moreover, Topas only completely inhibited the growth of *A. alternata* at 300ppm. No complete inhibition was recorded for the rest of tested fungi.

In vivo experiments:

Under natural field infection, the effect of Kemazed and Homai at 70 gm/100 l water was evaluated against guava fruit drop disease. Data in Table (6) show that the efficiency of Kemazed and Homai reached 69.0 and 78.8%, respectively, as

Table 6. Effect of two fungicides against guava fruit drop (cv. Balady) under natural field infection

Tested fungicide	Applied dose (gm/100 l)	Drop fruits (%)	Efficiency (%) *
Kemazed 50% WP	70	7.6	69.0 %
Homai 80% WP	70	5.2	78.8%
Control	-	24.5	-
L.S.D $_{0.05}$	-	1.10	-

* Efficiency relative to the check treatment.

compared with the check treatment. Guava fruit drop recorded 24.5, 7.6 and 5.2% on trees treated with water only (check) as well as Kemazed and Homai.

Alternative control:

Four compounds, *i.e.* calcium chelate, hydrogen peroxide, potassium bicarbonate and potassium sorbate, were *in vitro* evaluated at doses of 0.5 and 1%, as alternative control means against the growth of isolated fungi. Data presented in Table (7) show that 1% hydrogen peroxide completely inhibited all the tested fungi. Also, 1% potassium bicarbonate completely inhibited *A. alternata*, *L. theobromae* and *P. psidii*. Meanwhile, reduction in *F. semitectum* growth reached 83.3% when potassium bicarbonate was applied at 1%. However, calcium chelate and potassium sorbate showed fewer efficacies against these fungi. No complete inhibition was recorded even at the maximum concentration used.

Table 7. *In vitro* effect of four alternative control means against the isolated pathogenic fungi

Compound	Concentration (%)	Growth reduction (%)			
		A. alternata	*L. theobromae*	*F. semitectum*	*P. psidii*
Calcium chelate	0.5	0	0	3.5	48.2
	1.0	14.4	0	31.5	54.4
Hydrogen peroxide	0.5	55.5	72.2	66.7	77.7
	1.0	100	100	100	100
Potassium bicarbonate	0.5	81.1	80.5	81	82.2
	1.0	100	100	83.3	100
Potassium sorbate	0.5	14.8	0	38.8	55.2
	1.0	30	0	57.7	63.8

D i s c u s s i o n

This research was designed to detect the incidence of guava fruit drop and to verify some means for controlling the disease. It is well known that guava trees and/or fruits are vulnerable to attack by many diseases such as decline, wilt, anthracnose, Botryodiplodia rot, fruit rot, Phoma rot, Rhizopus rot, collar rot, Pestalotia leaf spot, Cercospora leaf spot, stem canker and seedling blight (Bokhari, 2009 and Prakash, 2012). However, up to the available literatures, this is the first research dealing with guava fruit drop disease under Egyptian conditions (Ismail *et al*., 2010; Ammar and El-Naggar, 2014 and Abd El-Moneim, Eman *et al*., 2015).

Diseases infection has a major impact on fruit set. Also, a number of blossom diseases affect set especially during wet or humid weather. Effective prevention of this blossom disease complex should focus on contact and systemic fungicides during the blossom period. Guava fruit drop disease complex is becoming more common and severe in the crop orchards in Egypt and is inflicting substantial losses to the orchards. The disease incidence (%) was found to be higher during 2013 as compared to that of 2014 season. Also, the disease was recorded, in different degrees, on all surveyed guava orchards in Beheira governorate. It was more severe in El-Dsasna, whereas its severity was minimal in El-Nagah Village. Differences between the inspected locations may ascribed to different reasons, such as: (1) age of the orchard in the same area, (2) suitability of agricultural practices which were always performed, (3) duration of the fruits presence on the trees during year and (4) types and efficiency of the sanitary methods and control means protectant or curative treatments against pests (diseases and insects). Flowering and fruit set are probably the most critical of all the events occurring once a guava tree has reached the reproductive maturity. Giving favourable environmental and other growth conditions, the timing and intensity of flowering greatly determines when and how much fruit will be produced during the season. Despite adequate flowering and initial fruit set, severe fruit drop could be contributed to low yield in guava orchards and leads to great economic loss in many production areas such as lack of moisture which can delay bloom and cause the fruit to drop and fruit flies *Bactrocera* spp. (Guava fruit fly and Caribbean fruit fly) can also develop secondary rots often cause fruit to drop from tree (Morton, 1987). On the other hand, the trees may survive drought periods but they stop growing and there can be almost total fruit drop if it occurs during fruit maturation. Guava trees are moderately tolerant to saline soils and water; however growth and fruit production decrease. Symptoms of salinity stress include marginal and tip browning of leaves, leaf drop, stem dieback, small fruit size and fruit drop. Severe red alga infestation may result in leaf and fruit drop and loss of tree vigour. Guava is considered moderately tolerant of short durations (7 to 14 days) of continuously wet or flooded soil conditions. However, prolonged flooding may lead to fruit and leaf drop, leaf chlorosis, stem dieback, and tree death. Trees are generally more tolerant of flooding during cool weather (Crane and Balerdi, 2013).

Besides other factors, diseases have an important position in lowering the productivity of fruits. When the diseased samples collected from the surveyed areas were processed, a number of fungi were isolated. These fungi were *A. alternata*, *L. theobromae*, *F. semitectum* and *P. psidii*. The maximum disease intensity was occurred on petioles and fruits inoculated with mixed fungal pathogens. Thus, guava fruit drop is a fungal disease complex when caused by certain phytopathogenic fungi. The effect of Kemazed, Homai, Vacomil plus and Topas against the isolated pathogenic fungi was performed *in vitro*. The presented results confirmed that Homai (thiophanate-methyl + thiram) followed by Kemazed (carbendazim) recorded the best performance against all the tested fungi and completely inhibited their growth at relatively low concentration.

On the bases of *in vitro* results, Kemazed and Homai were selected to evaluate their efficacy under natural field infection. Obtained results showed that both tested fungicides were effective in reducing the incidence of the disease as compared with check treatment. In this concern, Homai was more effective than Kemazed. These results are in harmony with those of Yadav *et al*. (2014) who found that the minimum guava fruit drop percentages were recorded when applying foliar spray of zinc sulphate+borax 0.6% followed by zinc sulphate+borax 0.4%

Reduction in the chemical efficacy due to the pathogen resistant strains, has forced producers to evaluate safer alternatives for controlling plant diseases in the context of sustainable agriculture. These alternatives include natural compounds of animal and plant origin, organic and inorganic salts, antagonistic microorganisms, and physical methods, and represent the approaches recently evaluated to ensure optimal fruit quality (Ippolito and Sanzani, 2011; Youssef *et al*., 2012a and Youssef and Roberto, 2014). In the presented research, when natural compounds were *in vitro* evaluated against the tested fungal growth as alternative control means, obtained results showed that hydrogen peroxide and potassium bicarbonate recorded the best performance in this concern. However, calcium chelate and potassium sorbate showed less activity against the tested fungi. Tested compounds are gaining particular interest since they belong to the category "Generally Recognized As Safe" (GRAS) and, as such, are allowed in the agro-food industry. Ordóñez-Valencia *et al*. (2009) estimated the antifungal effect of increasing concentrations (0, 2, 4, 6, 8, 10, 25, and 50 mM) of potassium bicarbonate on the growth of *Trichoderma* sp. strain R39 and *Sclerotinia sclerotiorum* under *in vitro* systems. They demonstrated the potential benefits of potassium bicarbonate for controlling both growth and development of *S. sclerotiorum*, although it exerts negative effects on the *Trichoderma* strain that is a natural antagonist to *S. sclerotiorum*. Also, the most common *Penicillium* spp. attacking citrus fruit could be significantly controlled *in vitro* with very low doses of potassium bicarbonate (Youssef *et al*., 2014). Juven and Pierson (1996) reviewed research reports on the antimicrobial activity of H_2O_2 and its use in the food industry. In addition, hydrogen peroxide was tested *in vitro* at 2% against *Rhizopus stolonifer* and reduced the linear growth by 83.9% (Ismail *et al*., 2010). The low *in vitro* efficiency of calcium chelate was expected since previous researchers have shown that calcium has limited direct action on the pathogen (Nigro *et al*., 2006; Askarne *et al*., 2011 and Youssef *et al*., 2012b). Obtained results from the inspected locations indicated that guava fruit drop is a complex disease when caused by certain phytopathogenic fungi. Also, this disease could be controlled using a number of fungicides. Further investigations are needed to verify the potential of the tested alternative control means under natural field infection.

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دراسات أولية على الفطريات المصاحبة لمرض سقوط ثميرات الجوافه والحلول المقترحة لمكافحتها

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تم إجراء هذا البحث خلال موسمي ٢٠١٣ - ٢٠١٤ لدراسة مرض تساقط ثميرات الجوافه في محافظة البحيرة ومنطقه النوبارية حيث تم رصد النسبة المئوية لتساقط الثميرات والتى كانت أعلي خلال موسم ٢٠١٣ عنه خلال موسم ٢٠١٤.

تم عزل أربعة فطريات من ثميرات أشجار الجوافة المصابة بالمرض وهي: *Alternaria alternata, Lasiodiplodia theobromae, Fusarium semitectum, Pestalotia psidii*. وقد أوضحت النتائج أن الفطر *Alternaria alternata* هو الأكثر تكرارا. وقد تم اختبار قدرة هذه الفطريات علي إحداث المرض وذلك بحقن معلق هذه الفطريات في ثمار واعناق الجوافة المتصلة بالأفرع حيث كانت اشد المعاملات احداثاً للمرض هى المعاملة بخليط الفطريات مجتمعة وكذلك فقد اعطي كل فطر علي حده قدرة مختلفة علي إحداث المرض.

وتمت دراسة فعالية أربع مبيدات فطرية هي كيمازد وهوماي وفاكوميل بلص ومبيد التوباس معمليا علي تثبيط النمو الميسلومي للفطريات المعزولة وقد كان مبيدي الكيمازد والهوماي الأكثر كفاءة معمليا ولذلك تم إختبار قدرتهما علي مكافحه المرض حقليا تحت ظروف العدوي الطبيعية وكانت كفاءتهما لمكافحة المرض ٦٩.٠% و ٧٨.٨% علي الترتيب. وعلي الجانب الأخر اختبرت معمليا قدرة أربع مركبات (بيرواكسيديز الهيدروجين - سوربات البوتاسيوم - بيكربونات البوتاسيوم - كالسيوم مخلبي) كبدائل للمبيدات علي تثبيط النمو الميسليومي للفطريات المعزولة حيث أعطي مركبي بيروكسيديز الهيدروجين وبيكربونات البوتاسيوم أفضل النتائج.