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EVALUATION OF CULTIVARS AND FUNGICIDES ROLE IN CONTROLLING MANGO POWDERY MILDEW

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ABSTRACT: Mango (*Mangifera indica* L.) is one of the highly demanded fruit in Egypt. Mango is susceptible to several diseases at all stages of its development. Among these diseases, is powdery mildew, which caused by the fungus *Oidium mangiferae* Berthet. It was first reported in Brazil 1914 by Berthet, and subsequently, was reported in several other countries. The losses caused by this pathogen vary from 5-20% depending on the weather conditions. Disease incidence percentage was increased from February (2-5%) until May in the different investigated districts of Sharqia and Ismailia Governorates but with higher values especially during March and April in Ismailia during 2016 and 2017 growing seasons. The highest value of mango powdery mildew disease was obtained during May where it ranged from 43% to 73% when the temperature averaged 26.8°C and relative humidity valued 43.04%. Lengara cultivar proved to be the least affected mango cultivar by the pathogen in season 2016. However, Balady cultivar was highly susceptible and the remained cultivars seemed to be moderately susceptible. All the fungicides screened were found significantly superior in inhibiting the pathogen, *O. mangiferae* with different degrees and decrease disease incidence and severity rather than non-treated mango trees during seasons 2016 and 2017. Evconel, Apache, Nasr Zool, Super talc, and Bingo significantly decreased disease incidence with equal effects compared to the control. However, fungicide Sopulo displayed the highest disease incidence.

Key words: Mango, *Oidium mangiferae*, fungicides, cultivars, temperature, relative humidity.

INTRODUCTION

Mango (*Mangifera indica* L.), the king of the fruits, is considered the most important fruit among millions of people worldwide, particularly in Egypt. Among all diseases, powdery mildew caused by *Oidium mangiferae* Berthet is emerging as one of the most common, wide spread and serious diseases throughout the world causing significant yield losses. The most serious losses occur when flowering and growth flushes are infected during cool and dry conditions (**Mehta *et al.*, 2018**). A biotrophic fungus *Oidium mangiferae* is the most common, widespread and serious pathogen throughout the world and in Egypt (**Nofal and Haggag, 2006; Muhammad *et al.*, 2014).** It can cause injuries that, later, will favor infection by anthracnose (**Junqueira *et al.*, 2001).** *O. mangiferae* attacks mango panicles, young fruits, and leaves and causing considerable crop loss. Mango is the only known host of this pathogen (**Reuveni *et al.*, 2018).** The losses caused by this pathogen vary from 5-20% depending on the weather conditions and the affected fruits do not grow and may drop before attaining pea size (**Rawal and Saxana, 1997**). A positive correlation was found between rising temperatures, relative humidity (RH) and the number of spores in the air. The maximum of spore incidences was found around 25°C and 40-60% of relative humidity and took 5-8 days for the emergence of disease symptoms after the first detection of conidia **(Akhtar *et al.*, 1999)**.

Powdery mildew infection was variable among mango cultivars (**Naqvi *et al.*, 2014).** The use of moderate susceptible cultivars is the

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acceptable control measure for this disease. In the very susceptible mango cultivars most of the flowers, very young fruit, and young leaves were severely infected (**Tiwari *et al.*, 2006; Galli *et al.*, 2012; Muhammad *et al.*, 2014; Mamta and Singh, 2015**). In Egypt, the disease was higher on cvs. Alphonso and Sedeka than on Zebda, Hendi Sinara and Awis. The highest disease incidence was recorded the Behera Governorate (**Nofal and Haggag, 2006**). Also, **Abo Rehab *et al.* (2014)** found that the highest disease severity of mango powdery mildew was observed in Ismailia and the lowest in Giza Governorates. In Punjab **Chanana *et al.* (2005)** found that Abohar was the highest infected cultivar followed by Alphonso, Dashehari, and Langra.

Sulfur and derivatives are natural products that is very effective in preventing and controlling powdery mildew. Sulfur can be bought as a dust or as a liquid and can be added to sulfur vaporizers. **Reza and Mortuza (1997)** concluded that the prevalence and severity of powdery mildew were found to be reduced effectively by 2 foliar sprays with sulfur at 2000 ppm followed by propiconazole (Tilt) at 500 ppm. The highest fruit retention was also recorded from sulfur treated plants. **Torre *et al.* (2004)** found that good results against powdery mildew on marrows were obtained when using sulfur and potassium permanganate in the first and the second year of the trial, using sulfur alone or in mixture with sodium bicarbonate, did not show any phytotoxic symptoms in the products. Also, **Bourbos and Barbopoulou (2007)** reported that the effectiveness of the sulfur was 97.1% and 98 to 98.1% for sodium bicarbonate on olive powdery mildew caused by *Leveillula taurica*.

Fungicides can be used to treat powdery mildew on mangoes. For optimal effect, the treatment should start before flowering or at a very early flowering stage. Continuous applications at regular intervals of 7-14 days, are recommended. Several fungicides significantly controlled mango powdery mildew and increased fruit yield *i.e.* Punch (**Brooks, 1991; Dang *et al.,* 1997; Hemant *et al.,* 2012**), Flusilazole or Pyrazophos (**Lonsdale and Kotze, 1991**), Topas (**Haq *et al.*, 1994**), Thiophanat-methyl and sulfur (**Akhtar *et al.*, 1998**), Hexaconazol (**Chavan *et al.*, 2009**), Amistar 25 SC (**Fugro *et al.*, 2012**) and Penconazole, Myclobutanil, Tetraconazole (**Reuveni *et al.*, 2018**). Repeated application one mode action of the different fungicides often results in the selection of pathogen strains that are a challenge with the fungicides (**Brooks, 1991**).

Score and Barb fungicides showed to be the most effective at three sprays of these fungicides after blossoming stage each at 10 days interval, gave the best control of the powdery mildew of mango. These fungicides had no harmful effect on flower and fruit setting. **McGrath (2004)** mentioned that knowledge of exactly how a fungicide affects a fungus is helpful for selecting products. Firstly, mode of action determines which fungi will be affected by a fungicide and thus which diseases can be controlled by using the fungicide. Secondly, fungicides with different mode of action are needed in a disease management program to delay fungicide resistance development races.

Also, **Abo Rehab *et al.* (2014)** found that Punch fungicide showed the highest efficiency in controlling mango powdery mildew whereas biocide (AQ 10) was the lowest one among five different tested fungicides (Punch, Bayleton, Kema-Z, Colis, Billis) and one biocide (AQ 10). *In vitro* evaluation of seven fungicides and two bioagents against *O. mangiferae* showed that Hexaconazole at 0.01% and wettable sulfur at 0.3% were highly effective and inhibited the conidial germination of the pathogen (**Mehta *et al.,* 2018**).

The present investigation aimed to study and evaluate the reaction of some mango cultivars to powdery mildew and the effectiveness of some fungicides to control mango powdery disease.

MATERIALS AND METHODS

Survey of Mango Powdery Mildew Disease

Survey of mango powdery mildew disease incidence and severity has been carried out in two governorates in Egypt (Sharqia and Ismailia) from February until May of both successive growing seasons 2016 and 2017. Four districts of each governorate were selected and taken into consideration to detect the disease incidence and its severity symptoms on the different plant parts. The diseased, inflorescences, panicles and leaves were photographed and visible symptoms, were also described. Panicles were rated on a scale of 0-4 for the disease severity using the following scale described by **Lonsdale and Kotze (1993)** where: 0= panicle free of disease, 1=1-25%infection, 2=26-50% infection, 3=51-75% infection and 4= more than 75% infection.

Percentages of disease incidence and sum of all the disease rating are calculated using the following equations:

$$\text{Disease incidence (\%)} = \frac{\text{No. of diseased plants}}{\text{Total No. of examined plants}} \times 100$$

$$\text{Percent of disease intensity (PDI)} = \frac{\text{Sum of plant x degree of disease scale}}{\text{No. of plants investigated x maximum disease grade}} \times 100$$

Inspected diseased samples of reddish mango leaves were collected carefully and placed in paper bags. Bags were tied carefully, labeled and carried to Plant Pathol. Lab., Plant Pathol. Dept., Fac. Agric., Zagazig University. Cuticle removed technique was conducted using colorless adhesive tape onto infected leaf spots that were pasted over mildew spots and pressed by fingers. After few seconds, slater tapes were removed far from infected leaf containing the enameled cuticle with the conidiophores bearing conidiospore chains of the fungus. Tape with the cuticle containing conidiophores and conidiospors were then inverted on a microscope slide using lactophenol then contrasted (**Moriera *et al.*, 2014**). The details of the shape and size of both conidiophores and conidia were recorded and photographed using the research microscope (Lica Dm 500).

Relationship between Weather Condition and Disease Incidence

Averages of the recorded temperatures and relative humidity were calculated to evaluate their effect on the incidence of mango powdery mildew in all districts of both Sharqia and Ismailia Governorates. Data of temperature and relative humidity were received from Agricultural Research Center, Early Warning Unit, Ministry of Agriculture, Giza, Egypt.

Mango Powdery Disease as Affected by Cultivar Reactions

Field inspection has been carried out at different orchard districts in two governorates *i.e.* Sharqia and Ismailia in growing seasons 2016 cultivated with different mango cultivars. Seven mango cultivars Balady, Keet, Sedeka, Zebda, Awis, Langara and Fagr-Klan, were inspected for the detection of powdery mildew incidence and severity. Four trees being 10-15 years old of every cultivar grown in an area of 6x6 square meters, were inspected. Four evaluation were done (incidence and severity) for each tree of a randomized position to serve as replicates. The inspection has been carried out from the beginning of February until the end of May for each season and all cultivars. The selected orchards were well administered by following conventional cultural practices.

Disease incidence and severity were estimated under the natural infection conditions during growing season 2016, every seven days. The disease severity was determined from the beginning of symptoms appearance every seven days intervals as mentioned.

Powdery mildew was evaluated by the visual observations of symptoms on the young flowers. The experiment was conducted in a randomized complete block design (RCBD); comprising of three replicate. Ten inflorescences per tree served as one replicate. The disease severity index and the average produce of the three trees of each variety, were evaluated as previously mentioned.

Mango Powdery Mildew Disease as Affected by Chemical Fungicides

Recommended eleven fungicides are used to control mango powdery mildew disease were designed to evaluate their efficacy against the disease under natural infection conditions in two consecutive growing seasons 2016 and 2017 in Fakoos District, Sharqia Governorate. Mango trees of 15 years old planted at 6x6 meters were selected, fungicides were tested undertaken and sprayed mango trees. The investigated fungicides, concentration, chemical symbols, active ingredient, and rate of application are tabulated in Table 1. Four replicates were used for each investigated fungicide.

Foliar spraying application has been carried out at the end of March then repeated three times every 15 days. Disease severity percentage and fungicides efficiency percent were assessed randomly one week after each spraying and averaged. The disease severity was assessed following the scale described by **Lonsdale and Kotze (1993)** as mentioned above.

The efficiency of fungicides in controlling the disease was calculated according to the following formula mentioned by **Abo Rehab *et al.* (2014)**:

Efficiency (%) =

$$\frac{\text{Disease severity (\%) in the control - Disease severity (\%) in the treatment}}{\text{Disease severity (\%) in the control}} \times 100$$

Statistical Analysis

The previously obtained results were statistically analyzed according to the methods reported by **Gomez and Gomez (1984)** and **Duncun (1955).**

RESULTS AND DISCUSSION

Survey of Mango Powdery Mildew

A survey study has been carried out in two successive seasons 2016 and 2017. Results presented in Table 2 indicate that the disease incidence percentage was increased from February (2-5%) until May (43-73%) in the different investigated districts of Sharqia Governorate in the growing season 2016. The same trend was obtained in the same season of Ismailia Governorate but with higher values, especially during March and April. Most districts of Sharqia Governorate revealed lower values comparing with Ismailia Districts. February revealed the least values in Sharqia Governorate. Fakoos district exhibited the highest value being 73% at the end of May. However, Qantara East, Ismailia Governorate indicates the highest percent 67% in the third week of May. In general, Abu Hammad district revealed the least values from February until May (0-43%).

The explanation of the infection percentage varied between both governorates and also through the investigated time from February to May might be affected by the environmental conditions and cultivar genotypes interactions.

Results obtained (Table 2) also shows that there are variations between districts of both investigated Egyptian governorates *i.e.* Sharqia and Ismailia in the second mango growing season 2017. Abu Hammad districts exhibited the least infection percentage ranging from zero during February up to 40% during May. However, El-Hosinia District displayed the highest values ranging from 5% in February ended with 60% during May.

However, Ismailia Governorate as shown from the same table exhibited higher disease incidence rather than of Sharqia Governorate in most districts except those of El-Kasaseen, Qantara East and Abu Swir during May. Thus, a fluctuation might be observed because of the common fluctuation of alternate temperature degrees and the rainy times especially during February and March that might affect such fluctuations.

These results are in harmony with those obtained by **Gupta (1989), Verma and Kaur (1996), (1998), Akhtar *et al.* (1999), Sinha *et al.* (2001) and Guillen-Sanchez *et al.* (2004)**. Thus, the results showed that the mean temperature had significant positive effects on the disease incidence for both growing seasons. Also, relative humidity might have the same effect. Such results might indicate that climate change including temperature and RH can have a positive effect on the pathogen because of the interaction of mango cultivars and the pathogen *O. mangiferae*. Also, climate change might affect the geographical and plant growth in both governorates.

The Causal Organisms, Symptomatology and Epidemiology

The pathogen characteristics

Powdery mildew caused by *Oidium mangiferae* which is an external obligate parasite pathogen living intercellular in host tissues epidermis (**Nofal and Haggag, 2006).** The examined fungal vegetative parts under the light microscope in Fig. 1 showed that fungus causing powdery

Table 1. Trade name, concentration, chemical symbol, active ingredient and rate of use for tested fungicides

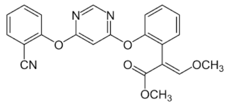
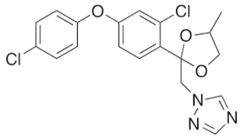
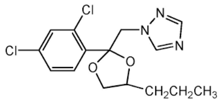
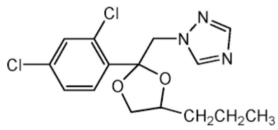
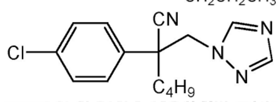
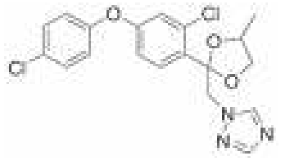
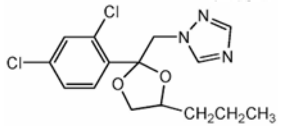
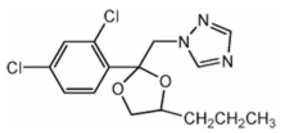
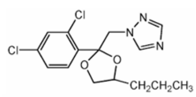
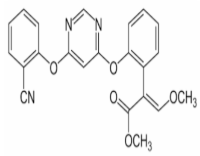
Trade name	Concentration (%)	Chemical symbol	Active ingredient	Rate of use/l
Sopulo	WG80%	S	Sulfur	250g
Dynoxie	SC32.5%	 + 	Azoxystrobin + Difenoconazole	60cm
Telesed	EC25%		Propiconazole	15cm
Zolex	EC25%		Propiconazole	17cm
Evconnel	EC25%		Myclobutanil	22cm
San Gold	EC25%		Difenoconazole	50 cm
Apache	EC25%		Propiconazole	15cm
Nasr Zool	EC25%		Propiconazole	15cm
Sorel MicrophonesKZ	WP70%	S	Sulfur	250g
Super Taltk	EC25%	 + 	Di-fenoconazole + Azoxystrobin	20cm3
Bingo	SC30%		Propiconazole	50cm

Table 2. Survey percentage of mango powdery mildew disease incidence during growing seasons 2016 and 2017

The district	Growing season 2016				Growing season 2017			
	February	March	April	May	February	March	April	May
	Sharqia Governorate (disease incidence %)							
Abu Hammad	0	5	24	43	-	4.5	25	40
Belbis	2	13	32	49	3	10	37	52
Fakoos	2	17	29	73	-	14	45	55
El-Hosinia	5	17	46	52	5	15	46	60
	II- Ismailia Governorate (disease incidence %)							
El-Tal El-Kbeer	5	24	39	48	4	15	35	50
El-Ksaseen	10	15	27	42	7	25	37	46
Abu Swir	10	15	25	43	3	10	35	51
Qantara East	15	44	56	67	5	22	31	54

Fig. 1. Conidiophores and condiospors of *Oidium mangiferae* fungus(10x40)=400

mildew produces hyaline septate mycelium, which ramified over the surface of the host, forming a white dense short, un-septate, coating of branched hyphae consists of short conidiophore carrying chain of spores basipetally, the largest on the top and the smallest at the bottom (**Datar, 1992; Joubert *et al.*, 1993; Naqvi *et al.*, 2014).** The spores are smooth and ellipsoidal of 29.7 x 19.8 µm. Such conidiospores are without fibrosin body as observed through several microscopic fields. Conidiophores are also short, hyalime, un-septate of dimensions 158.4µm in length and 9.9 µm in width (Fig. 1).

Symptoms

A velvety powdery appeared to be white dusty deposit on a dark to the smoky gray background is the characteristic symptoms, appeared. The fungus mycelium completely covers the newly, vegetative growth and white powdery growth appear. Infected inflorescence mostly produces disease as wefts of white powdery from tip to downward and infected panicles covered with white mycelium appeared on the affected parts (Fig. 2). Infected flowers fail to open and dry to cause complete loss of fruits.

Fig. 2. Powdery mildew symptoms of leaves and panicles

In the case of fresh red leaves, the disease appears as small scattered water-soaked lesions on the lower surface (Fig. 2). A white powdery of fungal growth develops directly under these spots to cause necrosis in advanced stages. Irregular necrotic lesions may enlarge and coalesce to form large dead areas on the leaf (**Mossler and Crane, 2009**). The main axes changed into a dark brown ending with a pea-size stage of fruits (Fig. 2). The appearance of powdery mildew symptoms occurred on mango tissues of all parts: flowers and leaves (**Schoeman *et al*., 1993)** inflorescence (**Schoeman, 1996)** and fruits **(Naqvi *et al*., 2014)**.

Disease epidemiology

Results presented in Table 3 reveal the least values of disease incidence in Sharqia Governorate (0-5%) during February where temperature averaged 18.6°C and RH valued 51.56% in season 2016. In the same season disease incidence was of (5%-17%) during March where temperature averaged 20.6°C and RH valued 46.02%. However, in April the disease averaged (24%-46%) as the temperature recorded 25.4°C and RH was 43.78%. The highest value of the powdery mildew disease of mango was obtained during May where it ranged (43%-73%) when temperature averaged 26.8°C and RH valued 43.04%. Results also indicate mango powdery mildew disease incidence in season 2017. Similar results were recorded in season 2017 as in 2016 except for disease incidence in May where it ranged 40-60% when temperature averaged 26.8°C and RH valued 44.86%.

The obtained results of the extreme temperature and relative humidity during both successive inspected growing seasons of mango in the different districts of Sharqia Governorate indicated that there was a positive correlation between disease severity and weather conditions where the disease incidence displayed the highest values with increasing temperature and RH during May.

In Ismailia Governorate the temperature average was 22.8°C during May and the average air humidity was 62% (Table 4). However, the temperature average in February reveals the least disease incidence when the temperature average was 16.4°C and air humidity average was 69.84% in season 2016. During season 2017 the temperature average was 22.2°C in May and humidity average was 63.38%. Meanwhile, the temperature average in February revealed the least disease incidence being (3-7%) where the temperature was 14°C and air humidity average was 70.1%. These results are in harmony with those obtained by **Gupta (1989), Verma and Kaur (1996), (1998), Akhtar *et al.* (1999), Sinha *et al.* (2001) and Guillen-Sanchez *et al.* (2004)**. Thus, the results showed that the mean temperature had significant positive effects on the fungal growth and subsequently disease incidence for both growing seasons. Also, relative humidity might have the same effect.

Table 3. Relationship between weather conditions and disease incidence in Sharqia Governorate

Month	Season 2016						Season 2017					
	Weather conditions		Districts disease incidence (%)				Weather conditions		Districts disease incidence (%)			
	RH (%)	Temperature average °C	Abu Hammd	Belbis	El-Hosinia	Fakoos	RH (%)	Temperature average °C	Abu Hammd	Belbis	El-Hosinia	Fakoos
February	51.56	18.6	-	2	5	2	56	15.2	-	3	5	-
March	46.02	20.6	5	13	17	17	49.02	19.8	4.5	10	15	14
April	43.78	25.4	24	32	46	29	47.22	22.6	25	37	46	45
May	43.04	26.8	43	49	52	73	44.86	26.8	40	52	60	55

Table 4. Relationship between weather conditions and disease incidence in Ismailia Governorate

Month	Season 2016						Season 2017					
	Weather conditions		Districts disease incidence (%)				Weather conditions		Districts disease incidence (%)			
	RH (%)	Temperature average °C	El-Tal El-Kebeer	El-Ksassen	El-Qntra East	Abw Sweer	RH (%)	Temperature average °C	El-Tal El-kebeer	El-Ksassen	El-Qntra East	Abw Sweer
February	69.84	16.4	5	10	15	10	70.1	14	4	7	5	3
March	76.14	16.4	24	15	44	15	68.28	16.4	15	25	22	10
April	64.54	20.8	39	27	56	25	64.22	18.8	35	37	31	35
May	62	22.8	48	42	67	43	63.38	22.2	50	46	54	51

Such results might indicate that climate change including temperature and RH can have a positive effect on the pathogen because of the interaction of mango cultivar and the weather requirement for *Oidium mangiferae* growth. Also, climate change might affect the geographical and plant growth in both governorates as previously mentioned.

Cultivar Reactions

Results presented in Table 5 and illustrated by Fig. 3 show the disease incidence (%) and severity of seven mango cultivars of Sharqia Governorate naturally infected with powdery mildew disease and grown in 2016 under natural conditions. Lengara cultivar proved to be the least affected mango cultivar where it recorded a 13.7% injury rate and 4.8% disease severity of the injury. Such results are following those obtained by **Chanana *et al.* (2005) and Jambhulkar and Singh (2012)** who reported that Lengara cultivar was found to be resistant to powdery mildew. However, Balady cultivar was highly susceptible where scored incidence rate of 97.8% and the severity of incidence value scored 68%. The remained cultivars seemed to be moderately susceptible.

Concerning Ismailia Governorate mango cultivars grown in the different districts Table 5 and Fig. 4 indicate the highest percent of disease incidence 73.6% of Balady cultivar with consequence disease severity being 63.7%. However, the least percentages of both disease incidence and severity were recorded of different cultivars namely: Sedeka, Zebda, and Lengara being 14.8%, 14.3% and 17.5%, respectively for disease incidence and 15.3%, 16.2% and 14.7% for disease severity, respectively. On the contrary, **Nofal and Haggag (2006)** mentioned that Sedeka, cultivar and others reveal a high incidence of mango powdery mildew infection. The remained Keet, Awis and Fajr Klan cultivars exhibit moderate susceptibility for mango powdery mildew disease.

Table 5. Mango cultivars as affected by powdery mildew disease parameters of Sharqia and Ismailia Governorates in season 2016

Cultivar	Sharqia Governorate		Ismailia Governorate	
	Disease incidence (%)	Disease severity (%)	Disease incidence (%)	Disease severity (%)
Balady	97.8	68	73.6	63.7
Keet	47	28.7	21.3	29.3
Sedeka	31.3	11.5	14.8	15.3
Zebda	37.8	29.3	14.3	16.2
Awis	31.4	11.2	29.3	48.4
Lengara	13.7	4.8	17.5	14.7
Fajr Klan	26.7	19.7	31.2	24.6

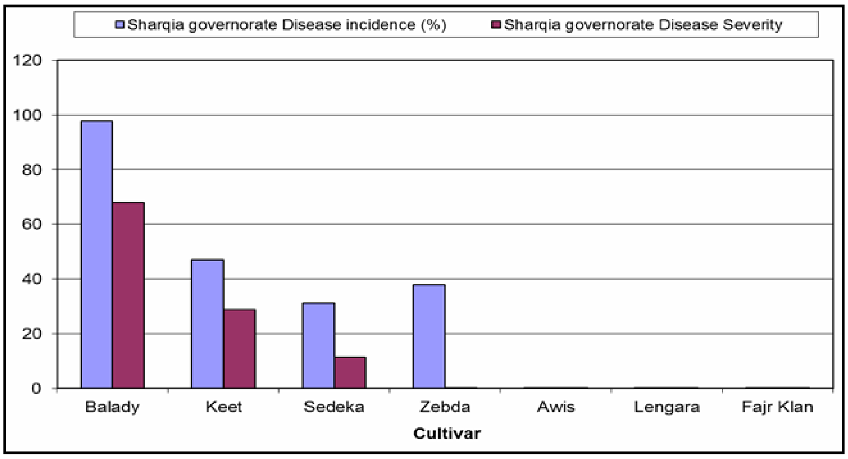


Fig. 3. Mango cultivars as affected by powdery mildew disease parameters of Sharqia Governorate in season 2016

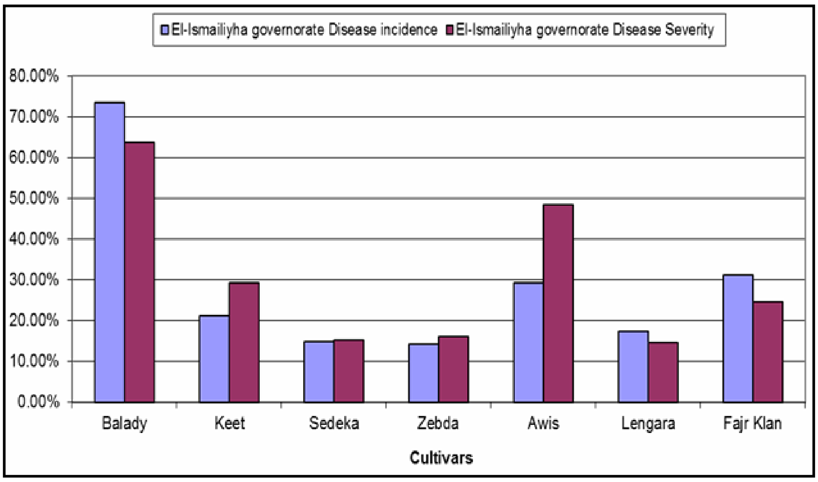


Fig. 4. Mango cultivars as affected by powdery mildew disease parameters of Ismailia Governorate in season 2016

The present study indicated that mango cultivars vary in response to natural infection with powdery mildew disease. However, Balady cultivar proved to be the most susceptible to infection while Lengara exhibit the least infection percentages either cultivated in both Sharqia and/or Ismailia Governorates.

The explanation of such results might be attributed to the differences of the genetic features and the chemical constituents of each cultivar that differ from one to another (**Mamta and Singh, 2015).** The obtained results are also following those of **Akhtar *et al.* (1999), Nofal and Haggag (2006), Jambhulkar and Singh (2012)** and **Muhammed *et al.* (2014).**

Mango Powdery Mildew Disease as Affected by Chemical Fungicides

The effect of some chemical fungicides on mango powdery mildew in two successive seasons 2016 and 2017, in Fakoos District in Sharqia Governorate was investigated. Results presented in Table 6 and Fig. 5 show that all investigated fungicides significantly could decrease disease incidence rather than non-treated mango trees in season 2016. The inhibition was of different degrees. In season 2016, some fungicides showed to be significantly of equal effects *i.e.* Evconel, Apache, Nasr-Zool, Super Talc, and Bingo compared with untreated control.

Apache as a fungicide seemed to be superior in decreasing disease incidence rather than the other investigated fungicides with the highest efficiency being 81.51%. However, the fungicide Sopulo displayed the highest disease incidence 12.87% and Sorel Microphones KZ exhibited similar values with Sopulo reveal the least efficiency 46.03%. Nasr Zool revealed almost equal values of Apache while the remained tested fungicides showed highly moderate efficiencies ranged 62.22% of Dynoxie and 77.03% of Evconnel.

Results in Table 6 and Fig. 6 also show that all tested fungicides significantly reduced mango powdery mildew disease incidence and consequently increased the efficiency rather than the control one in season 2017. The highest disease incidence (13.78) was obtained when the fungicide Sopulo, was applied. However, Nasr Zool and Apache revealed the least non-significant values of disease incidence being 4.60 and 5.00%, respectively. The highest efficiencies were also obtained with Nasr Zool and Apache being 82.32% and 80.92% without significant differences between them.

In general, percentages of disease incidence in the second successive season 2017 revealed higher disease incidence rather than the first successful one 2016 but without significant differences among them except for some of them *i.e.* San Gold, Apache, Nasr Zool, and Bingo.

Concerning the effect of the different fungicides *in vivo* conditions, results indicated, that Apache and Nasr Zool decreased significantly mango powdery mildew disease incidence in both investigated successive seasons compared with the other tested fungicides. It could be concluded that application of such fungicide reduced significantly the disease incidence percent and in consequence improved the efficiency. The great reduction in disease incidence thus could be obtained through rotational application materials rather than repeating spraying from season to another in order to reduce the risk of intensive use of synthetic fungicides *in vivo* conditions. This effect was obviously as the disease severity values increased in the second season rather than in the first one especially when the best fungicides Apache and Nasr Zool, were applied. The obtained results are in harmony with those of **Tahir *et al.* (2009).** Several fungicides significantly controlled mango powdery mildew and increased fruits yield *i.e.* Punch (**Brooks, 1991; Dang *et al.,* 1997; Hemant *et al.,* 2012),** Flusilazole or Pyrazophos (**Lonsdale and Kotze 1991),** Topas (**Haq *et al.*, 1994),** Thiophanat-methyl and sulfur (**Akhtar *et al.*, 1998),** Hexaconazol (**Chavan *et al*., 2009),** Amistar 25 SC (**Fugro *et al*., 2012)** and Penconazole, Myclobutanil, Tetraconazole (**Reuveni *et al.*, 2018)**

Powdery mildew affects all mango tree parts and causes severe problems for the plant. Although utilization of the fungicides in the most effective way to reduce the disease incidence due to frequent application leads to severe damage for the tree and its production and resulted in a resistant population of the pathogen. Thus, it must exclude the negative

Table 6. Effect of some fungicides on the incidence of mango powdery mildew of 2016 and 2017 growing seasons

Fungicide	Growing season 2016		Growing season 2017	
	Disease incidence (%)	Efficiency (%)	Disease incidence (%)	Efficiency (%)
Sopulo	12.87 b	46.03 d	13.78 b	47.50 f
Dynoxie	8.95 cd	62.22bc	10.18cd	62.16 de
Telesed	6.93 de	71.21 ab	8.05 de	69.23 cd
Zolex	6.88 de	71.37 ab	7.4 ef	71.93 bc
Evconnel	5.65 e	77.03 a	8.23 de	73.88 abc
San Gold	6.10 de	74.02 ab	6.68 efg	75.14 abc
Apache	4.55 e	81.51 a	5.00 g	80.92 a
Nasr Zool	4.65 e	81.13 a	4.60 g	82.32 a
Sorel Microphones KZ	11.55 bc	53.05 cd	11.18 c	57.10 e
Super Taltk	5.78 e	75.75 a	6.05 efg	76.99 abc
Bingo	5.55 e	75.65 a	5.35 fg	79.28 ab
control	24.43 a		26.35 a	

Similar letter in the same column indicate insignificant among treatments. *LSD at level 0.05

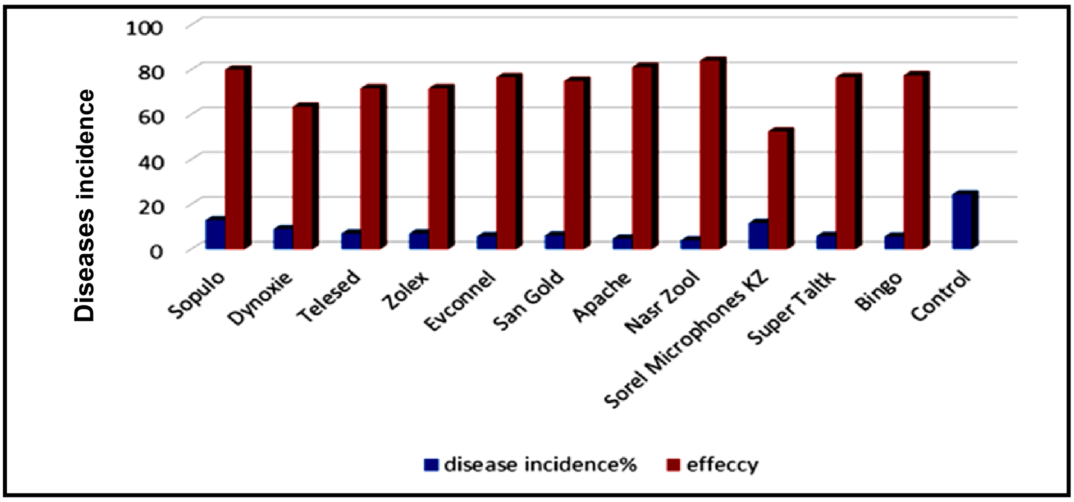


Fig. 5. Effect of some fungicides on the incidence of mango powdery mildew of 2016 growing season

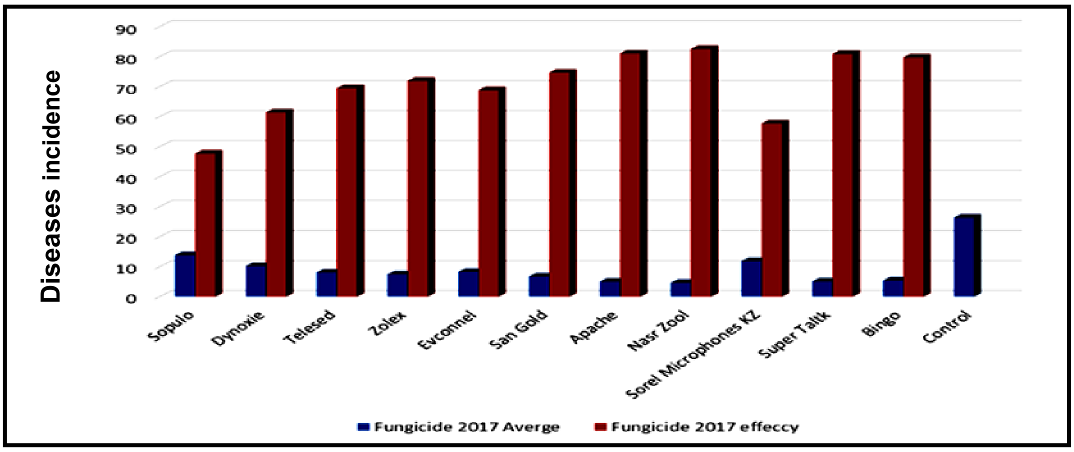


Fig. 6. Effect of some fungicides on the incidence of mango powdery mildew of 2017 growing season

effect of chemical applications through applying different types of such chemicals, using the recommended dose, applying the protective fungicides instead of the eradicator ones and also improving the use of chemicals with a different mode of actions through the season **(Brent and Holloman, 2007).**

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تقييم دور الأصناف والمبيدات الفطرية في مكافحة البياض الدقيقي في المانـجو

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المانجو (*Mangifera indica* L.) ملكة الفواكه وهي أحد أهم محاصيل الفاكهة ذات الإقبال العالي في مصر، وتصاب المانـجو بالعديد من الأمراض في جميع مراحل نموها ومن ضمن تلك الأمراض مرض البياض الدقيقي والذي سجل للمرة الأولى في البرازيل عام ١٩١٤ويسببه الفطر *Oidium mangiferae* Berthet ثم تم تسجيله في العديد من دول العالم الأخرى، وتتراوح الخسائر التي يسببها الفطر الممرض بين (٥ – ٢٠%) وذلك طبقا للظروف المناخية المتاحة. أوضحت الدراسة أن نسبة حدوث المرض من شهر فبراير حتى شهر مايوكانت (٢-٥%) في المناطق المختلفة التي تم حصر المرض فيها في محافظتي الشرقية والإسماعيلية أثناء موسمي النمو عامي ٢٠١٦ ، ٢٠١٧ وسجلت أعلى قيمة لمرض البياض الدقيقي في المانجو أثناء شهر مايو والتي كانت تتراوح بين (٤٣-٧٣%) عندما كان متوسط درجة الحرارة ٢٦,٨°م والرطوبة ٤٣,٠٤%، أثبت الصنف لانـجارا أنه أقل أصناف المانـجو التي تأثرت في موسم ٢٠١٦، إلا أن الصنف بلدي كان الأكثر قابلية للإصابة أما بقية الأصناف فقد بدت متوسطة القابلية للإصابة، تفوقت جميع المبيدات الفطرية التي تم إختبارها معنويا في تثبيط الممرض بدرجات متفاوتة وخفضت من حدوث الإصابة عن أشجار المانـجو التي لم تعامل أثناء الموسمين المختبرين ٢٠١٦، ٢٠١٧. خفضت مبيدات إيفكونيل، أباتشي، نصر زول، سوبر تالك، وبينجو نسبة المرض بصورة معنوية عند مقارنتها بالأشجار التي لم تعامل (المقارنة).

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