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# Reflective Effect of Mango Variety and Fenarimol Fungicide on Powdery Mildew Disease Incidence and Fungicide Residues Persistence in Mango Fruits

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FOUR FAMOUS Egyptian mango varieties (Zebda, Improved Alphonso, Fajri Kalan, and Langara) were evaluated for their susceptibility to powdery mildew (*Oidium mangiferae* Berthet) during 2005 and 2006 growing seasons. In addition, the reflective effect of mango variety and Rubigan fungicide (12% fenarimol EC) on the incidence of powdery mildew and fungicide residues in mango fruit with special reference to pre-harvest interval (PHI) were evaluated. Trees from all varieties in one part of the orchard were did not receive any disease control procedure and weekly inspected for infection with powdery mildew disease. Results showed that Langara was found to be the most resistant variety followed by Zebda. When Rubigan was applied as foliage spray (30 ml/100 liters) to control the powdery mildew disease at the rest part of the orchard, it was highly effective against the disease on Zebda and Langara varieties, but less efficacy was found on Fajri Kalan and Improved Alphonso varieties. A positive correlation was found between the variety resistance grades and the fungicide efficacy. Assessment of fenarimol fungicide residues periodically in the mango fruits showed that, highest amount of residues after an hour of application were found in Zebda followed by Fajri Kalan (0.09 and 0.08 mg/kg, respectively), while least amount was found in fruits of Langara variety (0.02 mg/kg). Improved Alphonso showed moderate amount (0.06 mg/kg). No fungicide residues were detected after three days of application in Langara, and after five days of application in Fajri Kalan and Improved Alphonso, whereas, it was required 7 days to disappear from Zebda variety. $Lt_{50}$ was very short, it ranged from 24 to 48 hours in the different varieties; that was reflected on the PHI since it ranged from one day for Langara variety to 4 days for Zebda variety.

**Keywords:** Mango variety, Rubigan, Fenarimol, Powdery mildew, fungicide residues.

Mango (*Mangiferae indica* L.) is one of the finest fruits and the most important fruit crops in tropical and subtropical areas of the world. Increasing commercial acreage and improved handling methods and shipping throughout the world have

increased the mango's popularity and availability in Europe and US markets. Over the years, mango groves have spread to many parts of the tropical and sub-tropical world, where the climate allows the mango to grow best, and where most of the developing countries located. To date, developing countries are facing massive economic and social problems. One possible way out of this misery seems to be the opening of the economy in order to participate in the gains arising from international trade. By increasing export volume and export revenues, developing countries expect to create a momentum and, thus, the impetus to stimulate the overall economy (Borchert, 2001).

Since Egypt is located at mango production area, it is a big chance to share in the international mango market by improving mango production quantity and quality.

All life stages (trunk, branches, twigs, leaf, petiole, flower and fruit) of mango are attacked by a number of pathogens including fungi, bacteria and algae. They cause several kinds of rot, die back, anthracnose, scab, necrosis, blotch, spots, mildew, etc. (Ploetz, 2004 and Kaiser & Saha, 2005). Some of these diseases, such as powdery mildew, which caused by *Oidium mangiferae* Berthet, are of great economic importance as they caused heavy losses in mango production (Misra, 2001 and Li-GuiZhen *et al.,* 2003). Many of these diseases can be adequately controlled with good management and judicious use of fungicides and bactericides (Bally, 2006).

At present, there are more than 1,000 different mango varieties throughout the world (Bally, 2006); and the resistant varieties are the cornerstone in integrated pest management programs. In India, when 44 mango cultivars were evaluated to powdery mildew, disease incidence was ranged from 0 to 75%. Eight cultivars (Baigan Phalli, Barbalia, Dabari, Dilpasand, Khirama, Nagarideeh, Oloor and Totapari) were highly resistant, recording 0% disease incidence (Tiwari *et al.,* 2006).

Field surveys of five mango cultivars in five Governorates in Egypt, revealed that infection level was higher on cvs. Alphonso and Seddek than on cvs. Zebda, Hendi Besenara and Ewise (Nofal and Haggag, 2006).

Many studies were carried out to control mango powdery mildew disease throughout the world, and many fungicides belonging to numerous chemical groups were found to be adequate or highly effective against mango powdery mildew disease *i.e.* Flint [trifloxystrobin] (Reuveni, 2000), Indar [0.04% fenbuconazole] (Dag *et al.,* 2001), Anvil 5 SC [hexaconazole], Spotless 12.5 WP [fenarimol], Bayleton 25 WP [triadimefon], benomyl 50 WP, Score 250 EC [difenoconazole] and Folicur WG 25 [tebuconazole] (Iqbal and hasn, 2001), dinocap, tridemorph, wettable sulfur, carbendazim and thiophanate-methyl (Sinha and Anupam, 2002), and Rubigan [fenarimol] (Ihsan *et al.,* 1999 and Tavares *et al.,* 2004).

Rubigan [fenarimol] is one of the recommended fungicides to control mango powdery mildew disease in Egypt (Annonymous, 2001), it is trusted and favorable by most farmers. However, pesticides residues in the treated plants are one of the most limiting factors affect the trade and export of all edible products.

This work is aiming to shed light upon the reflective effect of Rubigan fungicide and the most famous mango varieties in Egypt on the incidence of mango powdery mildew disease, side by side with the persistence of this fungicide and the residues amount in the fruit with special reference to pre-harvest interval.

## Material and Methods

This study was carried out on four mango varieties (Zebda, improved Alphonso, Fajri Kalan, and Langara), 10 years old trees grown in E-khatatba, Menoufia governorate during 2005 and 2006 growing seasons.

*Evaluation of mango varieties to powdery mildew disease*

All the aria (312 trees) of the orchard were left for natural infection. A part of the orchard represented the four varieties were left without any disease treatment. From March to June, the trees were weekly inspected for infection with powdery mildew disease. Panicles samples were classified into 6 categories according to the panicles infected area using a rating scale 0-5 (where: 0 = no mildew and 5 = the panicle completely covered). Disease incidence was calculated using the following formula (Townsend and Heuberger, 1943):

$$Di = \sum(n * v) * 100 / 5N$$

Where: Di = diseases incidence; n = number of samples in each categories; v = numerical value of each category; N = total sample number

Area under disease progress curve (AUDPC) during the inflorescences period for each variety was calculated by trapezoidal integration, as described by Campbell and Madden (1990):

$$Y = \sum [(X_i + X_{i+1})/2](t_{i+1} - t_i)$$

Where: $Y$= AUDPC; $X_i$ = disease incidence of the $i^{th}$ inspection; $X_{i+1}$ = disease incidence of the $i + 1^{th}$ evaluation; and $(t_{i+1} - t_i)$ = number of days between two evaluations.

In addition, relative resistance (Rr) for each variety was calculated considering the most susceptible variety represents zero resistance.

$$Rr = [(AUDPC^{MS} - AUDPC) / AUDPC^{MS}]* 100$$

Where: Rr = relative resistance of the studded variety; $AUDPC^{MS}$ = Area under disease progress curve for the most susceptible variety; and AUDPC = Area under disease progress curve for the studied variety.

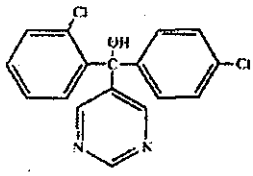
*Reflective effect of mango variety and fenarimol fungicide on powdery mildew disease incidence*

Rubigan (12% fenarimol EC) [α-(2-chlorophenyl)-α-(4-chlorophenyl)-5-pyrimidine-methanol (CAS)] was applied as foliage spray at the recommended dose (30 ml/100 liters) to control the powdery mildew disease at the rest area of the orchard. The application was repeated at 14 days intervals from March through June. Disease incidence was estimated and AUDPC was calculated as mentioned before, in addition, fungicide efficacy for each variety was calculated as follows:

$$\text{Fungicide efficacy} = [(AUDPC^{ut} - AUDPC^{t}) / AUDPC^{ut}]^* 100$$

Where: $AUDPC^{ut}$ = Area under disease progress curve of untreated trees; $AUDPC^{t}$ = Area under disease progress curve of trees treated with fenarimol.

Correlation coefficiency between fenarimol efficiency and relative resistance of the fungicide for both growing seasons (2005 and 2006) was also calculated.




*Estimation of fenarimol residues in mango fruits*

Fruit samples from each mango variety were randomly picked up after one hour, and 1, 3, 5 and 7 days after the last fungicide application where fenarimol residues were estimated .

*Fenarimol extraction*

A representative weight of 50 g (M) of mango fruit of each variety was mixed in a high speed blender with 100 ml acetone for two min., and then filtered through a Buchner funnel containing filter paper fitted on a sidearm flask. The blender was rinsed with 50 ml acetone which was then added to the same funnel and the volume was recorded ($V_{tot.}$) (Luke *et al.*, 1981).

Forty ml of filtrate (Va) were transferred into a 500 ml separatory funnel, then 50 ml petroleum ether and 50 ml dichloromethane were added. The separatory funnels were shaken for 2 min. The layers were allowed to separate and the lower aqueous layers were transferred into a 100 ml conical flasks, while the organic layers were passed through anhydrous sodium sulfate supported on

washed cotton in 10 cm funnels mounted on the receiving flask. Two grams of sodium chloride was added to each aqueous layer and shacked vigorously for 1 min, then transferred to the same 500 ml separatory funnel again and washed with two consequent 50 ml portions of dichloromethane and shacked for 1 min. The lower dichloromethane layers were passed through the anhydrous sodium sulfate to the receiving flasks. The received volume was evaporated using a rotary evaporator at 35-40 °C. Ten-ml aldrin standard (0.1 µg/ml aldrin in mixture of hexane : acetone 9 : 1 v/v) to serve as a calibration agent were added immediately after evaporation. Then the sample was ready for GLC analysis.

*GLC procedures*

Assessment of fenarimol residues was carried out according to the Official Methods of Analysis (Anonymous, 1995) using Hewlett Packard gas liquid chromatography (HP 6890N) equipped with an electron capture detector (ECD), two columns, HP PAS-5, ECD tested Ultra 2 Silicone, 0.32 mm i.d., 0.52 µm film thickness and 25.0 m length and HP PAS-1701(ECD Tested 1701 Silicone), 0.32 µm i.d., 0.25 µm film thickness and 25 m length, HP autosampler and HP computer under the following operating parameters:
Injector temperature = 225 °C, Detector temperature =300 °C, Flow rate of nitrogen 60 ml/min (carrier + makeup), Column head pressure 80 kPa, Splitless time 0.7 min.
The oven was programmed as follow:
Initial oven temperature: 90 °C, Initial oven time 2 min. using two ramps, Ramp (1) Rate 20°C / min, Temp 150 °C, Time 0 min. and
Ramp (2) Rate 6°C / min, Temp 270 °C Time 15 min.

The analyzed concentration in sample Cs (mg/kg) was calculated as follows :

$$Cs = \frac{As / Ais}{Ast / Aist} \times Cst \times \frac{Vf \times V_{tot.}}{Va \times M}$$

Where: As = Peak area of analyte in sample; Ais = Peak area of aldrin standard in sample; Ast = Peak area of analyte in standard run; Aist= Peak area of aldrin standard in standard run; Cst = Concentration of standard (mg/l); Vf = Final volume (ml); $V_{tot.}$= Total extraction volume (ml); Va = 40 ml; M = Sample weight in final volume (g)

Half life time ($Lt_{50}$) was calculated using Exile computer program and pre-harvest interval (PHI) was determined considering the MRL for fenarimol on mango = 0.02 ppm according to Annex II Regulation of European Union (Anonymous, 2005).

## Results

*Evaluation mango varieties to powdery mildew disease*

After ten days of inflorescence beginning during 2005 season, Langara variety showed the least disease incidence (22.67%), followed by Zebda variety

with 28.33% compared with 32.67% for Fajri Kalan and 38.67% for Improved Alphonso (Table 1).

After 30 days, cv. Improved Alphonso showed the highest disease incidence (62%) followed by Fajri Kalan (50%) compared with only 34% by Langara and 40% by Zebda. This data were reflected on the AUDPC, since Langara variety was the most resistant tested variety (AUDPC = 566.7) followed by Zebda (683.3), meanwhile, Alphonso variety was the most susceptible one (1006.7) followed by Fajri Kalan variety (826.7).

Similar data were obtained during the 2006 season, however, the powdery mildew disease was less aggressive (Table 1)

**TABLE 1. Reaction of four mango varieties to natural infection with powdery mildew disease represented as disease incidence 10 and 30 days after beginning of inflorescences, Area under disease-progress curve (AUDPC) during this period and relative variety resistance (RVR) during 2005 and 2006 growing seasons.**

| Mango variety | 2005 | | | | 2006 | | | |
|---|---|---|---|---|---|---|---|---|
| | After 10 days | After 30 days | AUDPC | RVR | After 10 days | After 30 days | AUDPC | RVR |
| Fajri Kalan | 32.67 | 50 | 0826.7 | 17.8 | 28 | 40 | 680 | 19.0 |
| Langara | 22.67 | 34 | 0566.7 | 43.7 | 18.67 | 28 | 466.7 | 44.4 |
| Improved Alphonso | 38.67 | 62 | 1006.7 | 0.0 | 32 | 52 | 840 | 0.0 |
| Zebda | 28.33 | 40 | 0683.3 | 32.1 | 22 | 34 | 560 | 33.3 |
| LSD at P= 5% | 1.84 | 2.29 | 41.3 | - | 1.22 | 2.75 | 39.7 | - |

*Reflective effect of mango variety and fenarimol fungicide on powdery mildew disease incidence*

Rubigan was highly effective against powdery mildew disease on Zebda and Langara varieties with 74.62% and 72.93%, respectively with no significant difference during 2005 season. On Fajri Kalan and Improved Alphonso varieties, the fungicide efficacy was 62.5% and 59.6%, respectively without significant difference (Table 2).

During 2006 season, the fungicide showed the highest efficacy on Langara variety (68.56%) followed by Zebda variety (64.28%) with significant difference between the two varieties (Table 2). Least fungicide effect was recorded on Fajri Kalan variety (58.82%) and Improved Alphonso variety (60.075) without significant difference. Correlation coefficient between fenarimol efficiency and relative resistance of each variety during 2005 and 2006 growing seasons showed high positive correlation (r 0.91 and 0.849), respectively.

**TABLE 2. Reflective effect of mango variety and fenarimol fungicide treatment on powdery mildew disease incidence during 2005 and 2006 growing seasons.**

| Mango variety | 2005 | | | | | | | 2006 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Treated | | | Untreated | | | Fenarimol efficacy % | Treated | | | Untreated | | | Fenarimol efficacy % |
| | After 10 days* | After 30 days** | AUDPC | After 10 days | After 30 days | AUDPC | | After 10 days | After 30 days | AUDPC | After 10 days | After 30 days | AUDPC | |
| Fajrikalan | 13.33 | 17.67 | 310.0 | 32.67 | 50 | 0826.7 | 62.50 | 11.67 | 16.33 | 280.0 | 28 | 40 | 680.0 | 58.82 |
| Langara | 6.67 | 8.67 | 153.4 | 22.67 | 34 | 0566.7 | 72.93 | 6.00 | 8.67 | 146.7 | 18.67 | 28 | 466.7 | 68.56 |
| Alphonso | 18.67 | 22.00 | 406.7 | 38.67 | 62 | 1006.7 | 59.60 | 14.87 | 18.67 | 335.4 | 32 | 52 | 840.0 | 60.07 |
| Zebda | 10.67 | 6.67 | 173.4 | 28.33 | 40 | 0683.3 | 74.62 | 7.33 | 12.67 | 200.0 | 22 | 34 | 560.0 | 64.28 |
| LSD at P= 5% | 1.30 | 1.62 | 29.2 | 1.84 | 2.29 | 41.3 | 2.92 | 0.86 | 1.94 | 28.0 | 1.22 | 2.75 | 39.7 | 2.94 |

Correlation coefficient between fenarimol efficiency and relative resistance of each variety in 2005 = 0.91
Correlation coefficient between fenarimol efficiency and relative resistance of each variety in 2006 = 0.849
* = Disease incidence after 10 days of inflorescence beginning
** = Disease incidence after 30 days of inflorescence beginning
AUDPC = Area under disease-progress curve

*Estimation of fenarimol residues in mango fruits*

After one hour of application, the highest residue amount was found in fruits of Zebda variety (0.09 mg/kg), followed by Fajri Kalan (0.08 mg/kg) and Improved Alphonso variety (0.06 mg/kg) (Table 3). One day after fungicide application the fungicide residues in different varieties was drastically dissipated. Highest and fastest dissipation was recorded in fruits of Langara variety, since after one day of application, only 0.01 ppm were detected with dissipation rate of 50% after 3 days of application no residues were detected in the Langara fruits.

Improved Alphonso fruit, after one day of application, showed only 0.03 ppm with dissipation rate of 50%. After 3 days of application only 0.02 ppm were recorded with dissipation rate of 66% and after 5 days no residues were detected.

Fungicide residues in fruits of Fajri Kalan variety decreased gradually from 0.08 ppm after one hour of application to 0.05 ppm after one day of application and only 0.02 ppm after three days of application. After 5 days of application no residues were detected in these fruits.

Zebda fruits persist the highest amount of fenarimol residues. After one hour of fungicide application 0.09 ppm were detected in this variety fruits. After one day of application, the residue amount decreased to reach 0.06 ppm. After three days of application, the residue amount reached only 0.03 ppm and after 5 days of application only 0.01 ppm was detected. After 7 days of application no residues were detectable.

**TABLE 3 . Fenarimol residues, dissipation % in different mango varieties fruits after different intervals from treatment, half life time ($Lt_{50}$), and pre-harvest interval (PHI).**

| Mango variety | Time of sampling after application | | | | | | | | | $Lt_{50}$ in hours | PHI in days |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | One hour | 1 day | | 3 days | | 5 days | | 7 days | | | |
| | mg/kg (ppm) | mg/kg (ppm) | dissipation % | mg/kg (ppm) | dissipation % | mg/kg (ppm) | dissipation % | mg/kg (ppm) | dissipation % | | |
| Fajri Kalan | 0.08 | 0.05 | 37.5 | 0.02 | 75 | nd | 100 | nd | 100 | 44 | 3 |
| Langara | 0.02 | 0.01 | 50.0 | nd | 100 | nd | 100 | nd | 100 | 24 | 1 |
| Improved Alphonso | 0.06 | 0.03 | 50.0 | 0.02 | 66.6 | nd | 100 | nd | 100 | 24 | 3 |
| Zebda | 0.09 | 0.06 | 33.3 | 0.03 | 66.6 | 0.01 | 88.8 | nd | 100 | 48 | 4 |

nd = Un detectable

$Lt_{50}$ was very short, it ranged from 24 hr to 48 hr in the different varieties. That was reflected on the pre-harvest interval (PHI) since it ranged from one day for Langara variety to 4 days for Zebda variety.

## Discussion

Resistant varieties are the cornerstone in integrated pest management programs. In Egypt, more than 24 mango varieties are available (Al-Khrabi, 1998). Fajri Kalan, Langara, Improved Alphonso and Zebda are widespread varieties in Egypt. In this study four varieties were evaluated for their susceptibility resistance to powdery mildew disease. Since this disease is very destructive on flower cluster, it was very important to evaluate the varieties during the inflorescence period, and since the infection don't accrued on the different varieties at the same time, therefore calculating the area under disease progress curve (Campbell and Madden, 1990) was very important to get a realistic indicator for the disease incidence on the different varieties and calculate the relative variety resistance. Improved Alphonso variety was the most susceptible one, Langara and Zebda were highly resistant, meanwhile Fajri Kalan was moderate resistant. This results are in accordance with what was found by Nofal and Haggag (2006), they stated that incidence of infection was higher on cvs. Alphonso and Seddek than on Zebda, Hendi Besenara and Ewise and in partial with Mahrous and Kamhawy (2006), they found that, Fajri Kalan and Alphonso were highly susceptible to floral malformation, Langara was moderate susceptible while Zebda was resistant.

Rubigan is one of the recommended fungicides to control mango powdery mildew disease in Egypt (Anonymous, 2001). In this study it was important to find if there is a reflective effect or in another word correlation between the different mango varieties and fenarimol efficacy. The data showed that, the fungicide efficacy differed according to the treated variety; a positive correlation between the resistance grad and the fungicide efficacy was found, which leads to an integral relationship (Table 2). However, in 2005 the disease severity was higher than in 2006, the fungicide efficacy in 2006 was lesser than in 2005, which indicated that, other factors may play a role in the fungicide efficacy. These factors may be the climatic factors such as high humidity which enhance the disease and at the same time enhance the fungicide efficacy by enhancing the penetration of the fungicide in plant tissues; or may enhance the redistribution of the fungicide on the plant surface; which in turn enhance the fungicide efficacy (Nene and Thaplyal, 1979)

Pesticides residues in food stuff are one of the most limiting factors affect the trade and export of all edible products. Analytical results clarified that, fenarimol residues in mango fruits picked from the treated trees were very low even after one hour of treatment, however residues amounts differed markedly from variety to other (Table 3). These results are in harmony with that obtained by Eldakar (2007), she attributed the scarcity of pesticide residues in the fruit and their

variability to the waxy smooth leathery mango fruit skin,which contains two morphologically and chemically distinct wax parts. Crystalline aliphatic compounds protrude from an amorphous layer in which long-chain aliphatic, aromatic and unsaturated compounds are present . These layers may decrease the amount of the fungicide residues by two mechanisms, increasing the fungicide run off due to the wax electrical charge, and/or decreasing the amount of fungicides absorbed into the fruits as a result of the wax that poses a natural physical barrier (Nene and Thapliyal, 1979). These residues were rapidly decreased (Table 3). Estimated $Lt_{50}$ was very short, it ranged from 24 – 48 hours. This rapid dissipation may be due to photolysis process (Mosier and Saunders, 1976), Smith and Saunders (1982), reported that the major metabolite is 2'-chloro-2-(5-pyrimidyl)-4-chloro-benzo- phenone. and Saunders (1991) calculated half-lives ranging from 0.93 days in summer at 30° N to 5.3 days in winter at 50° N.

Referring to the Maximum Residue Limits list of the European Union (Anonymous, 2005) fenarimol MRL on mango is 0.02 ppm., thus pre-harvest interval (PHI) is very short, it ranged from one day for Langra variety to 4 days for Zebda variety. Since mango fruits take several days or more on shelf for the fruit to ripen once it is picked (Jonathan *et al.*, 1994) fenarimol can be considered very safe, and the fruits can be marketed.

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# التأثير المتبادل لأصناف المانجو والمبيد الفطري فيناريمول على شدة الإصابة بمرض البياض الدقيقي ومتبقيات المبيد في ثمار المانجو

**نادية عوض شنودي**
قسم بحوث المكافحة المتكاملة ، معهد بحوث أمراض النباتات ، مركز البحوث الزراعية ، القاهرة ، مصر .

تعتبر المانجو من أهم المحاصيل في المناطق الاستوائية وشبه الاستوائية. ورغم أن أشجار المانجو عرضة للإصابة بالعديد من الأمراض، إلا أن مرض البياض الدقيقي يعتبر من أخطر الأمراض التي تهدد زراعات المانجو حيث يتسبب في خسائر شديدة للمحصول.

ورغم أن المقاومة المتنورة لهذا المرض باستخدام المبيدات تؤدي إلى نتائج جيدة،، إلاّ أن زراعة الأصناف المقاومة يعتبر حجر الأساس في جميع برامج المكافحة المتكاملة.

يهدف هذا البحث إلى تقييم حساسية أربعة أصناف من المانجو الشائعة في مصر لمرض البياض الدقيقي (زبدة والفونس المحسن وفجري كلان ولانجرا) ، ودراسة التأثير المتبادل بين هذه الأصناف والمبيد الفطري الروبيجان (١٢٪ فيناريمول) في مقاومة مرض البياض الدقيقى خلال سنتين متتاليتين (٢٠٠٥ و ٢٠٠٦) ، كما تم دراسة متبقيات هذا المبيد في ثمار المانجو وفترة الأمان له.

تركت جميع أشجار المانجو فى البستان للعدوى الطبيعية، وتم استقطاع جزء من البستان يشتمل على جميع الأصناف وترك دون اتخاذ أية إجراءات لمقاومة مرض البياض الدقيقى. تم فحص النباتات أسبوعياً أثناء فترة التزهير وتم حساب شدة الإصابة بمرض البياض الدقيقى والمساحة تحت منحنى تطور المرض وكذلك درجة المقاومة النسبية لكل صنف. أظهرت النتائج أن الصنف لانجرا كان أكثر الأصناف مقاومة لهذا المرض تلاه الصنف زبدة، فى حين أن الصنف الفونسو المحسن كان أشدهم حساسية تبعه الصنف فجرى كلان.

تم رش الأشجار فى الجزء المتبقى من البستان بمبيد الفيناريمول بنفس الجرعة الموصى بها (٣٠سم$^3$/١٠٠ لتر ماء) وكرر الرش كل أسبوعين من أذار/مارس وحتى حزيران/يونيو. تم حساب شدة الإصابة بمرض البياض الدقيقى والمساحة تحت منحنى تطور المرض وكذلك فعالية المبيد ومعامل الإرتباط بين فعالية المبيد ودرجة مقاومة الأصناف للمرض. وجد أن فعالية المبيد اختلفت بإختلاف الصنف، حيث وجد أن أعلى فعالية للمبيد كانت على صنفي الزبدة و لانجرا، في حين كانت أقل فعالية على الصنف فجري كلان والفونس المحسن. كما وجد إرتباط موجب قوي مابين مقاومة الأصناف للإصابة وفعالية المبيد. مما يشير إلى أن هناك تأثير لصفة المقاومة لمرض البياض الدقيقي في المانجو والمبيد، مما أدى إلى زيادة كفاءة هذا المبيد الذي أدى إلى التكامل فيما بينهم لمقاومة المرض.

أظهرت نتائج تقدير الآثار المتبقية لمبيد الفيناريمول في ثمار المانجو على فترات مختلفة، انه بعد ساعة واحدة من أخر رشة كانت أعلى كمية للآثار المتبقية من المبيد موجودة في ثمار الأصناف زبدة و فجري كلان حيث بلغت كمية هذه

المتبقيات ٠,٠٩ و ٠,٠٨ ملليجرام/ كجم، على التوالى. أما أقل كمية فكانت فى ثمار الصنف لانجرا (٠,٠٢ ملليجرام/ كجم) أما الصنف الفونس المحسن فأعطى كمية متوسطة (٠,٠٦ ملليجرام/ كجم). بعد ثلاثة أيام لم يتم تسجيل أي آثار للمبيد في الصف لانجرا، وبعد ٥ أيام لم يمكن تسجيل أية آثار للمبيد في الصنفين فجرى كلان والفونس المحسن في حين فترة ٧ أيام كانت لازمة لاختفاء المبيد من ثمار الصنف زبدة. وجد أن فترة نصف العمر للمبيد كانت قصيرة جداً، حيث تراوحت مابين ٢٤ و ٤٨ ساعة في الأصناف المختلفة، مما انعكس على طول فترة الأمان لهذا المبيد على المانجو حيث تراوحت ما بين ١٠ م واحد في الصنف لانجرا و ٤ أيام في الصنف زبدة.

**كلمات مفتاحية**: مانجو، روبيجان، فيناريمول، بياض دقيقي، الآثار المتبقية.