

Controlling of mango powdery mildew by some salts, growth regulators and the biofungicide AQ10 compared with Punch fungicide in Egypt

Azza M. K. Azmy

Plant Pathol. Res. Instit., Agric. Res. Center, Giza, Egypt

Email address:

azmy_azza@yahoo.com

To cite this article:

Azza M. K. Azmy. Controlling of Mango Powdery Mildew by some Salts, Growth Regulators and the Biofungicide AQ10 Compared with Punch Fungicide in Egypt. *American Journal of Life Sciences*. Special Issue: Role of Combination Between Bioagents and Solarization on Management of Crown-and Stem-Rot of Egyptian Clover. Vol. 2, No. 6-2, 2014, pp. 33-38. doi: 10.11648/j.ajls.s.2014020602.15

Abstract: Two experiments on 10 years old mango trees, Saddeka cv. (high susceptible cultivar) were conducted under field condition during 2012 and 2013 growing seasons for management of powdery mildew at El Adleia district, Belbees county, El-Sharkia governorate. In these trials, mango trees were sprayed with two potassium phosphate salts, calcium chloride, three commercial growth regulators, i.e. Agrotone (NAA), Cultar (paclobutrazol), and Berelex (GA3), the bio-fungicide AQ10 (*Ampelomyces quisqualis*), the commercial systemic fungicide Punch (flusilazole) and an alternate among Cultar (paclobutrazol), monobasic phosphate and the fungicide Punch. The aforementioned treatments were applied at 14 days intervals during both growing seasons starting at bud flower burst stage till full bloom stage in order to evaluate their efficiency on management mango powdery mildew disease. The obtained results showed that spraying of mango trees (Saddeka cv.) during 2012 and 2013 growing seasons with any of the tested treatments significantly reduced the severity of powdery mildew with significant increase to the produced fruit yield compared with control treatment. In addition, results of both seasons revealed that alternation spray among Cultar (paclobutrazol), mono basic potassium phosphate and the fungicide Punch was the most superior treatment in reducing severity of the disease and producing the highest fruit yield followed by spraying of the fungicide Punch then spraying of mono basic potassium phosphate. Meanwhile, Brelex was of the lowest efficiency treatment in this regard followed by spraying of Agrotone. The other treatments recorded intermediate figures. Control treatment recorded 44.3 % disease severity and produced poor fruit yield.

Keywords: Disease Management, Growth Regulators, Mango, Potassium Phosphate, The Bio-Fungicide ("AQ10") and The Fungicide Punch

1. Introduction

Mango (*Mangifera indica*. L.) is one of the most favorable and delicious fruit in Egypt for local consumption and exportation. The area under this economic mango crop was about 240804 feddan and the total amount of mango production reached about 786528 ton during 2013 (Anonymous, 2013).

Under Egyptian conditions, mango is liable to attack by several fungal diseases, among those blossom blight (anthracnose), die-back, fruit-rot; root-rot, malformation, and powdery mildew (Haggag, 2010). However, powdery mildew is among the most constrain diseases which has a great economic importance (Nofal and Haggag, 2006).

Worldwide, mango powdery mildew caused by the fungus

Pseudoidium anacardii (Noack) Braun & Cook (formerly known as *Oidium mangiferae* Berthet) is one of the most common, widespread and serious diseases throughout the world and causes significant yield losses (Nasira *et al.*, 2014). The disease is an easily recognizable problem; the symptoms are very apparent and are diagnostic. However, it is not easily controlled with cultural practices alone. If susceptible mango cultivars are grown in mildew-prone areas, growers should expect the disease to recur yearly or seasonally. To achieve good yields, such growers must act with control measures during flowering, before it is too late to prevent the loss of the current season's crop.

In view of the increasing demands of mangoes in the world, control of powdery mildew is gaining importance. Disease management is generally achieved by the use of fungicidal

chemical, including sulfur and sterol bio – synthesis inhibitors. Several workers used different fungicides successfully in order to control powdery mildew disease of mango accompanied with a high yield/ tree compared with the control (Reuveni *et al.*, 1993 ,1995 and 1998) .However, fungicide – resistant races of powdery mildew pathogens have been reported on cucumber and grape vines (Schroeder and Provvidenti, 1969; Schepers, 1983; Steva and Clerjeau, 1990 and Mc Grath, 1991). The fungicide Punch was the most effective on mango and mustard when tested to managing powdery mildew disease in India (Kaushik and Mishra, 1997). Once resistant strains appeared, most of them survived for several years, therefore the risk of re-enhancing a resistant population with further applications of ineffective.

Fungicides mostly are of high efficiency in management of plant diseases (Dekker, 1987). However, the need for reducing pesticide residues in food crops, pressures to maintain a healthy environment and often the unavailability of commercially acceptable resistant plants intensify the need for alternative methods for disease control. One of the potential methods of reducing the severity of powdery mildew in an environmentally safe manner is the use of inorganic salts like foliar spray by potassium salts (Menzies *et al.*, 1992 and Mahrous,2003) as biocompatible fungicides. Mono- potassium phosphate , potassium di- hydrogen phosphate sprayed alone ,or in alternation with fungicides has been successful in the control of powdery mildew diseases in apples, grapes, peaches, nectarines, greenhouse cucumbers, roses, melons , and mangoes (Napier and Ooshuyse,2000). Any of the two phosphate salts ($K_2 HPO_4$ and $KH_2 PO_4$ of 9.3pH) have a potential for controlling powdery mildew disease of grapevines and inhibited disease development (Mahrous, 2003).

A previous study demonstrated the effectiveness of phosphate salts in inducing local and systemic protection against powdery mildew, in suppressing the disease on cucumber plants (Agapov *et al.*, 1993) and in controlling powdery mildew of mango (Reuveni *et al.*,1993 ; Oosthuyse,2000 and Nofal and Haggag,2006) .

Potassium monobasic phosphate , and Zinc sulfate (inducing resistance chemicals) were of significant reduction to the severity of powdery mildew of pea with significant increase in plant height , number of green pods and weight of green pods per plant (Abada *et al.*, 2009) . Applying spray treatments with any of potassium mono- hydrogen phosphate or calcium chloride as a control agents (resistance chemical inducers) were able to reduce foliar diseases of many vegetable crops such powdery mildew and downy mildew diseases on cucumber (Abdel-Kader *et al.*,2012) .

Ampelomyces quisqualis “AQ10” is considered the first bio-fungicide developed, especially for controlling powdery mildew disease. *A. quisqualis* is a naturally occurring pycnidial hyperparasite of powdery mildew fungi. The mycoparasite is wholly internal within the mycelium , conidiophores, conidia and ascocarps of several important species of Erysiphaceae, including the powdery mildew of pear (Marboutie *et al* ,1997) and on peaches (Marboutie *et*

al ,1993 and 1995) and on grape vine (Mahrous, 2001) and many vegetable and horticultural crops (Kiss *et al.*,2004).

Growth regulators and naturally hormones play a major role in fruit growth and fruit drop of mango (Ram,1992) which powdery mildew disease one of the several causes of it (Majumder and Sharma ,1990) . Application of NAA (Rawash *et al.*,1983 and Singh and Ram,1983) and application of GA_3 (Singh *et al.*,1986) have been found in reducing the fruit drop, also reducing powdery mildew too and the exogenous application antagonize the disease effect. Beside the main effect of paclobutrazol as a strong growth retardant, it is also considered a systemic fungicide because it belongs to the triazole fungicides such as triadimefon (Buchenauer & Rohner,1981). From this stand point, very few investigators pointed out the side effect of certain growth regulating chemicals, specially GA_3 , on the severity of mango fungal diseases. Any of growth regulators; GA_3 , NAA, IBA , was best reducer to the incidence of mango malformation disease when sprayed on malformed floral tree in the next flower season (Mahrous,2004) .

The present study was planned to evaluate two potassium phosphate salts, *i.e.* K_2HPO_4 and KH_2PO_4 , calcium chloride ($CaCl_2$) ,three commercial growth regulators *i.e.* Agrotone (NAA), Cultar (paclobutrazol) , and Berelex (GA_3), the bio-fungicide AQ10 (*Ampelomyces quisqualis*) , the commercial systemic fungicide Punch (flusilazole) and an alternate among Cultar, mono basic potassium phosphate and the fungicide Punch on management of mango powdery mildew .

2. Materials and Methods

Field experiments were carried out during 2012 and 2013 growing seasons on 10 years old mango trees Saddeka cv. (high susceptible cv.) grown in commercial mango orchard at El Adleia district , Belbees county , El-Sharkia governorate, Egypt.

The trees were left to the natural infection by powdery mildew and distributed in a complete randomized block design, where three trees were used as a replicate and three replicates were used for each treatment.

Ten treatments were conducted as follows:

1. Foliar applications with the systemic fungicide Punch (flusilazole) at the rate of 6 ml. /100 liter water,
2. Mono basic potassium phosphate $K_2 HPO_4$ (pH 9.3) at 25 mM (435 g./100 liter water),
3. Dibasic potassium phosphate KH_2PO_4 (PH 9.3) at 40 mM (544g/100 liter water) ,
4. Calcium chloride ($CaCl_2$) at the rate of 0.02%.
5. The commercial growth regulator Agrotone (NAA) at the rate of 60g./100 liter water,
6. The commercial growth regulator Cultar (paclobutrazol) at the rate of 200 ppm (60g./100 liter water,
7. The commercial growth regulator Berelex (GA_3)at the rate of 50 ppm. (5g./100 liter water),
8. Alternation treatments, where paclobutrazol (Cultar) was sprayed two times and each of mono basic

potassium phosphate (K_2HPO_4) and the fungicide Punch (flusilazole) were sprayed three times ,

9. Spraying with the bio-fungicide AQ10 (*Ampelomyces quisqualis*) at the rate of 0.005% after harvesting the crop and

10. Control (untreated) sprayed with water only.

All the trees were sprayed with micronized sulphur at bud swelling (prior to bud burst) at the rate of 250 g./ 100 liter water. Triton (B 1956) was added to all the sprayed materials at the rate of 25 ml./100 liter water. Spraying was applied at 14 days interval during each growing season, starting at flushing the inflorescences.

2.1. Assessment of Powdery Mildew Severity on Inflorescence

Naturally infected inflorescences by mango powdery mildew were examined to estimate disease severity at the end of the bloom season. Ten inflorescences were randomly selected from each tree, examined to assess the severity of the disease depending on the devised scale 0-4 by Reuveni and Reuveni (1995) where:

- 0 = No powdery mildew colonies observed,
- 1 = 1–10% of the inflorescence infected,
- 2 = More than 10–25% of the inflorescence infected,
- 3 = More than 25–50% of the inflorescence infected,
- 4 = More than 50% of the inflorescence infected.

The severity of the disease was calculated using the following formula:

$$\text{Disease severity \%} = \frac{\sum(n \times v)}{4N} \times 100$$

Where:

n = Number of the infected inflorescence in each category.

v = Numerical values of each category.

N = Total number of the examined inflorescence.

The efficiency of the treatments were calculated

according

to the following formula :

$$\% \text{ Efficiency} = \frac{\% \text{ Infection in the control} - \% \text{ Infection in the treatment}}{\% \text{ Infection in the control}} \times 100$$

2.2. Estimation of Fruit Yield

The produced fruits of each treatment were harvested periodically and the weight of the fruits (kg.) per tree was determined and recorded in both growing seasons, where tree yield in kg. was estimated by multiplying number of fruits / tree x average fruit weight at harvest time (Abou- Rawash *et al.*, 1992).

2.3. Statistical Analysis

The obtained data were statistically analyzed according to Snedecor (1980) and significance among means of the treatments was determined according to Duncan's Multiple Range (1955).

3. Results

Data presented in Tables (1 and 2) show the effect of spraying of mango trees (Saddeka cv.) with two potassium phosphate salts, calcium chloride, three commercial growth regulators, the bio-fungicide AQ10 (*Ampelomyces quisqualis*) and the commercial systemic fungicide Punch (flusilazole) , each alone as well as the alternation among Cultar, mono basic potassium phosphate and the fungicide Punch on management of the natural infection by powdery mildew during 2012 and 2013 growing seasons.

Table (1) shows that spraying of any of the aforementioned tested treatments significantly reduced the severity of powdery mildew with significant increase to the produced fruit yield compared with control treatment. In addition, alternation spray among Cultar (paclobutrazol), mono basic

Table (1). Effect of spraying of mango trees (Saddeka cv.) with some Salts , three growth regulators, the bio- fungicide AQ10 and the Fungicide Punch on the severity of powdery mildew and the produced fruit yield during 2012 growing season .

Treatments	Disease Severity %	Efficiency %	Yield (kg.) / tree
Mono basic potassium phosphate ($K_2 HPO_4$)	8.0 c	82.0	82.1 b
Dibasic potassium phosphate (KH_2PO_4)	8.7 c	80.4	78.4c
Calcium chloride ($CaCl_2$)	10.0 d	77.4	64.3 f
Agrotone (NAA)	10.7 d	75.9	69.4 e
Cultar (Paclobutrazol)	9.3 e	79.0	70.7 de
Berelex (GA_3)	12.7 b	71.4	64.3 f
Punch (flusilazole)	5.0g	88.7	83.1 b
Alternation among Cultar , K_2HPO_4 and Punch	4.0g	91.0	87.0a
AQ10 (<i>Ampelomyces quisqualis</i>)	9.7 e	78.2	73.2 d
Control (Untreated)	44.3a*	-----	30.5 a

* Values in the same column with different superscripts were significantly Differed at $P < 0.05$.

potassium phosphate and the fungicide Punch was the superior treatment in this regard, being 91.0 % efficiency and 87.0 kg. fruits / tree followed by spraying of the fungicide Punch (88.7 % efficiency and produced fruit yield of 83.1 kg. / tree) then spraying of mono basic potassium phosphate (82.0% efficiency and produced fruit yield of 82.1 kg. / tree)

as a most effective salt.. Meanwhile Calcium chloride was the lowest efficient salt in reducing the severity of the disease and the produced fruit yield being 77.4 and 64.3 kg. / tree .In addition,, Cultar (paclobutrazol) was the most effective growth regulator in reducing the severity of the disease, which recorded 79.0% efficiency and produced good fruit

yield (70.7 kg. / tree)..On the other hand, Berelex was of the lowest effective growth regulators in reducing the severity of the disease and the produced fruit yield, being 71.4% efficiency and 64.3 kg.fruits / tree , followed by spraying of Agrotone (75.9% efficiency and 69.4 kg. fruits / tree) . Results indicate, also , that AQ10 showed good result in reducing the severity of the disease, which recorded 78.2%

efficiency and produced good fruit yield (73.2 kg. / tree) . Control treatment recorded 44.3 % disease severity and produced poor fruit yield (30.5 kg. / tree).

Concerning the results of the second season of 2013, it is clear (Table 2) that all the sprayed treatments showed the same trend of the data obtained in the first season of 2012.

Table (2). Effect of spraying of mango trees (Saddeka cv.) with some salts , three growth regulators, the bio- fungicide AQ10 and the fungicide Punch on the severity of powdery mildew and the produced fruit yield during 2013 growing season.

Treatments	Disease Severity %	Efficiency %	Yield (kg.) /tree
Mono Potassium phosphate (K ₂ HPO ₄)	8.7 f	83.4	84.3 b
Dibasic potassium phosphate (KH ₂ PO ₄)	9.7 d	81.5	79.5 c
Calcium chloride (CaCl ₂)	14.7 b	72.0	64.4 e
Agrotone (NAA)	12.4 c	76.2	69.3 d
Cultar (Paclobutrazol)	11.3 e	78.4	70.7 d
Berelex (GA ₃)	12.7 c	75.7	63.6 e
Punch (flusilazole)	5.0 g	90.4	85.2 b
Alternation among Cultar , K ₂ HPO ₄ and Punch	4.6 g	92.4	87.5 a
AQ10 (<i>Ampelomyces quisqualis</i>)	10.3 de	80.3	78.5 c
Control (Untreated)	52.3 a	-----	33.7 f

* Values in the same column with different superscripts significantly differed at P<0.05.

4. Discussion

Mango powdery mildew is one of the most serious diseases of mango affecting almost all the cultivars (Haggag, 2010).

In this study, it has been found that salts of K₂HPO₄, KH₂PO₄, CaCl₂, the growth regulators Agrotone (NAA), Cultar (paclobutrazol) ,Berelex (GA₃), the fungicide Punch (flusilazole) and the bio-fungicide AQ10 (*Ampelomyces quisqualis*) were evaluated for their efficiency on management of mango powdery mildew under field conditions during 2012 and 2013 growing seasons at Skarkia governorate. The obtained data showed that spraying of mango trees (Saddeka cv.) in both seasons with any of the tested treatments significantly reduced the severity of powdery mildew with significant increase to the produced fruit yield compared with control treatment. In addition, results of both seasons revealed that alternation spray among the Cultar (paclobutrazol), mono basic potassium phosphate and the fungicide Punch. was the most superior treatment in reducing severity of the disease and producing the highest fruit yield followed by spraying of the fungicide Punch then spraying of mono basic potassium phosphate. Meanwhile, Berelex was of the lowest efficiency treatment in this regard followed by spraying of Agrotone . The other treatments recorded intermediate figures. Control treatment recorded 44.3 % disease severity and produced poor fruit yield.

Application of different chemical substances play as plant resistance inducers in foliar spray , which result in reducing disease severity and positively reflected on plant yield. The obtained results showed that the mono basic potassium phosphate (K₂HPO₄) was high efficacy and most effective salt . This results are confirmed with those obtained by several investigators (Abada *et al.*,2009 and Abdel-Kader *et al.*,2012).

The obtained reduction in mango trees with powdery mildew pathogen may be attributed to the role of the sprayed induced resistance chemicals which act as elicitors of plant defense reactions against pathogenic fungi (Abdel-Kader *et al.*, 2012), where K₂HPO₄ and KH₂PO₄ have a potential for controlling powdery mildew of mango. Evidently bi-weekly foliar applications of phosphates inhibited disease development on fruits of mango tree and were active on this crop in controlling the fungus. This confirms the previous findings on capability of phosphates in controlling powdery mildew in mango. (Reuveni and Reuveni, 1995). Overall, foliar spray with systemic fungicides was more effective than salt solutions in controlling powdery mildew.

Other salts which have biocompatible fungicidal potential, has been reported to effectively control powdery mildew disease on various crops (Homma *et al.*, 1981 and Ziv and Zitter, 1992). A collapse of hyphal walls and shrinkage of conidia and conidiophores as a result of potassium salts application has been observed by Homma *et al.* (1981). In addition, an inhibitory influence on conidial formation and germination of *Sphaerotheca fuliginia* has been reported (Homma *et al.*, 1981).These findings explain the inhibitory properties of phosphate salts obtained in this study. Application of potassium salts in combination with silicon and phosphates reduced the number of powdery mildew colonies on cucurbits and grape leaves (Bowen *et al.*, 1992 and Menzies *et al.*, 1992). The obtained results by using foliar spray with phosphate salts in controlling the powdery mildew fungus has been clearly determined and are in line with the findings of the previous reports. Phosphate salts might be ideal biocompatible fungicides due to their efficiency in suppressing and controlling powdery mildew on cucumber (Agapov *et al.*, 1993 and Reuveni *et al.*, 1993) and on various crops, as reported previously. The rapid absorption of phosphate by the plant tissues and their extreme mobility within tissues, as well as their low cost, low

animal toxicity, comparative environmental safety and their nutrient value, make them ideal foliar fertilizers which can be used for disease control

Calcium chloride might reduce fungal infection through direct inhibition of spore germination and growth (Wisniewski *et al.*, 1995). *In vitro*, calcium chloride significantly reduced pear fruit decay caused by *Alternaria* sp. and *Penicillium* sp., when used at 4 and 6 % (Maouni *et al.*, 2007). Furthermore, calcium chloride was reported to suppress growth of the citrus mould pathogen *Penicillium digitatum* (Droby *et al.*, 1997 and Abdel-Kader *et al.*, 2012)

Also, the obtained results showed that spraying of any of the tested growth regulators was of good effect in reduction of disease severity of mango powdery mildew and Cultar was the most efficient one. Naturally growth regulators or hormones play a major role in fruit growth and fruit drop of mango (Ram, 1992) as powdery mildew is one of the several causes of fruit drop (Majumder and Sharma, 1990). Application of growth regulators; NAA (Rawash *et al.*, 1983; Singh and Ram, 1983 and Sharma *et al.*, 1990) and GA₃ (Singh *et al.*, 1986) have been found in reducing the fruit drop. Also, the exogenous application of such hormones increase their concentration in the panicle and antagonize the disease effect by endogenous inhibitors and this may be the main cause of disease escape.

Using of alternation spray of growth regulators, phosphates with application of conventional fungicides for powdery mildew control could be of low cost – effective than the use of fungicides alone and / or reduce the development of fungicidal resistance during the season.

A. quiscalis showed good reduction for the severity of powdery mildew on mango trees with increasing of the produced fruit yield. This reduction may be due to its action as a bioagent for powdery mildew on many vegetable and horticultural crops (Kiss *et al.*, 2004) by its occurring hyperparasitism on powdery mildew pathogen of several important species of Erysiphaceae including the powdery mildew of pear (Marboutie *et al.*, 1997), on peaches (Marboutie *et al.*, 1993 and 1995) and on grape vine (Mahrous, 2001).

From the obtained data it could be recommend by using the alternation spray among Cultar (paclobutrazol), mono basic potassium phosphate and the fungicide Punch as a superior treatment for managing of mango powdery mildew and producing high fruit yield.

References

- [1] Abada K. A.; Abdel- Alim A. I.; Abd-Elbacki A. M. and Ashour A. M. A. (2009). Management of pea powdery mildew disease using some resistance inducing chemicals and systemic fungicides. Egypt J. Phytopathol., 37(2): 95-104.
- [2] Abdel-Kader M.M.; El-Mougy, Nehal S. and Embaby E.I. (2012). Resistance inducers treatment against downy and powdery mildew of cucumber under commercial plastic houses conditions. Australian Journal of Basic and Applied Sciences, 6(5):249-259.
- [3] Abou-Rawash, M.; El-Masry, H.; Shaltout, A. and Ebeed, Sanaa (1992). Effect of some growth regulators sprays on chemical constituents of leaves, shoots and buds of Pairi & Ewai mango. Ann. Agric. Sci., Moshtohor, 30 (1): 509-523.
- [4] Agapov V.; Reuveni, M. and Reuveni, R. (1993) Eradication of cucumber powdery mildew by phosphate and potassium salts. Abstracts of Papers. 6th Int. Cong. Plant Pathol. (Montreal, Canada). P214.
- [5] Anonymous (2013). Annual Report of Agric. Statistical Dept. Egyptian Min. of Agric. and Land Reclamation. A.R.E. (in Arabic).
- [6] Bowen P.; Menzies, J.; Ehret, D.; Samuels, L. and Glass, A.D.M. (1992). Soluble silicon sprays inhibit powdery mildew development on grape leaves. J. Am. Soc. Hort. Sci. 117. 906 - 912
- [7] Buchenauer H. and Rohner, E. (1981). Effect of triadimefon and triadimenol on growth of various plant species as well as on gibberellins content and sterol metabolism in shoots of barley seedlings. Pesticide Biochemistry and Physiology, 56-70
- [8] Dekker, J. (1987) Build-up and persistence of fungicide resistance. In National Pesticide Use. (Ed. by E. J. Brend and E.K. Atkin) pp 153-168. Cambridge University Press. Cambridge. U.K.
- [9] Droby S.; Wisniewski M.E.; Cohen L.; Weiss B.; Toutou D.; Eilam Y. and Chlutz E. (1997). Influence of CaCl₂ on *Penicillium digitatum* grape fruit peel tissue and biocontrol activity of *Pichia guilhermondii*. Plant Dis., 87:310 – 315.
- [10] Duncan D.B. (1955). Multiple range and multiple F-tests. Biometrics, 11:1-42
- [11] Haggag, Wafaa M. (2010). Mango diseases in Egypt. Agric. Biol. J. N. Am., 1(3): 285-289.
- [12] Homma Y.; Arimoto Y. and Misato T. (1981). Studies on the control of plant diseases by sodium bicarbonate formulation. 2. Effect of sodium bicarbonate on each growth stage of cucumber powdery mildew fungus (*Sphaerotheca fuliginea*) in its life cycle. J. Pesticide Sci., 6: 201-209.
- [13] Kaushik C. D. and Mishra B. P. (1997). Flusilazole (Punch), a potential fungicide for the control of different powdery mildews. Annals of Agric. Bio. Res., 2(1):15-19.
- [14] Kiss L.; Russell J. C.; Szentivanyi, Xu O. and Jeffries X.P. (2004). Biology and biocontrol potential of *Ampelomyces mycoparsites*, natural antagonists of powdery mildew fungus. Biocontrol Science and Technology, 14, 635-646
- [15] Mahrous H.A.H. (2001). Biological control of grape vine powdery mildew by *Ampelomyces quiscalis* Congr. Proc. of 11th Congress of the Mediterranean Phytopathological Union, Evora, Portugal, 17-20 September.
- [16] Mahrous H.A.H. (2003). Effectiveness of foliar spraying with phosphates salts fertilizer, sodium bicarbonate and a fungicide in controlling powdery mildew disease of grape vine. J. Agric. Sci. Mansoura Univ., 28 (9) : 7043 – 7049.
- [17] Mahrous H. A. H. (2004). Effect of spraying some chemical substances on a floral malformation disease in mango. Acta Horticulture, No.645, ISHS.
- [18] Majumder P. K. and Sharma D. K. (1990). Mango. In : Fruits – Tropical and Subtropical. T.K. Bose and S.K. Mitra. pp:1-62 Naya Prokash, Calcutta.

- [19] Maouni A. ; Lamarti A.; Aidoun A.; Khaddor M. and Badoc A. (2007). Effect of benzimidazole fungicide and calcium chloride on *Alternaria alternata* and *Penicillium expansum* rot during storage of pears. Afr.J. Biotech.,6:1289-1292 .
- [20] Marboutie G.; Hugueney, Viret C.; Combe F. and Deference H. (1993). Some results of preliminary studies with *Ampelomyces quisqualis* used to control powdery mildew on peach leaves. Bulletin, OILB- SROB., 4, 53 - 56.
- [21] Marboutie, G.; Combe F.; Boyer E.; Berne A. and Cravedi P. (1995). Work on *Ampelomyces quisqualis* (1993-1994). Proceedings of the Meeting on Integrated Plant Protection in Stone Fruit; Nimes France, 6-8 Sep., Bulletin, OILB, SROP. 18 : 2, 75-78.
- [22] Marboutie G.; Combe F.; Cravedi P.; Hartfield C. and Mazzni E. (1997). Taxonomy of *Ampelomyces quisqualis* on *Sphaerotheca pannosa* on Var. Bailey and contribution to the study of its use in the control of powdery mildew of pear in mid-Rhane valley. Proceedings of the Meeting at Zaragoza, Spain, 24-26 Gotheran September. Bulletin, OILB.SROP, 20 : 6, 79-83.
- [23] Menzies J.; Bowen, P.; Ehret D. and Glass A.D.M. (1992) Foliar applications of potassium silicate reduce severity of powdery mildew on cucumber, muskmelon. and zucchini squash. J. Am. Soc. Hort. Sci. 117. 902 – 905
- [24] Mc Grath M.T. (1991) Reduced effectiveness of traidimefon of controlling cucurbit powdery mildew associated with fungicide resistance in *Sphaerotheca fuliginea*. Phytopathology, 81. 1191 (Abstract).
- [25] Nasira M.; Mughalb S.M.; Mukhtarb T. and Muhammad Zaman A. M.Z. (2014). Powdery mildew of mango: A review of ecology, biology, epidemiology and management. Crop Protection,24: 19–26
- [26] Napier D. R. and Ooshyse S. A. (2000). Use of mono potassium phosphate in the integrated control of powdery mildew. Rivista di Fruttiicoltura e di Ortofloricoltura, 62(6):57,60..
- [27] Nofal M.A., and Haggag, Waffa M. (2006). Integrated management of powdery mildew of mango in Egypt. Crop Protection , 25: 480–486.
- [28] Oosthuysen S.A.(2000). Cost reduction of powdery mildew control in mango with mono potassium phosphate. Acta Horticulture, 509:719-723.
- [29] Ram S.(1992). Naturally occurring hormones of mango and their role in growth and drop of fruit. Acta Hort., 321:400-11
- [30] Rawash M.A. ; El-HammadyA. ; El-Nabawy S.; Khalifa A. S. and El-Masry H. (1983). Regulation of flowering and fruiting in mango trees by using some growth regulators . Ann. Agric. Sci., 28:227-240.
- [31] Reuveni M.; Agapov V. and Reuveni R. (1993). In systemic resistance to powdery mildew and growth cucumber by phosphates. Biol. Agric. Hort., 9: 305-315.
- [32] Reuveni M. and Reuveni R. (1995). Efficacy of foliar sprays of phosphates in controlling powdery mildew in field-grown nectarine, mango trees and grape vines . Crop Protection, 14:311-314
- [33] Reuveni M.; Harpaz M. and Reuveni R. (1998) :Integrated control of powdery mildew on field-grown mango trees by foliar sprays of mono-potassium phosphate fertilizer, sterol inhibitor fungicides and the strobilurin kresoximmethyl. Europ. J. of Plant Pathol.,104 :853-860.
- [34] Schepers H.T.A.A: (1983) Decreased sensitivity of Funliginea to fungicides which inhibit ergosterol biosynthesis. Plant Pathol., 89. 185-187.
- [35] Schroeder, W.T. and Prowidenti, R. (1969) Resistance in powdery mildew of cucurbits. Plant Dis. Rept., 53: 27 .
- [36] Sharma T.R.; Niar P.K. and Nema M.K. (1990). Effect of foliar spray of urea, KNO₃ and NAA on fruiting behaviour of mango Cv. Langra. Orissa J. Hort., 18:42-7.
- [37] Snedcor G.W. (1980). Statistical Methods. 5th ed Ames, Iowa, The Iowa State Univ. Press.
- [38] Singh I.P.; Singh B.P. and Singh S.P. (1986). Effect of 2 , 4 – D and GA3 on fruit drop and fruit quality of mango (*Mangifera indica* L.) Cv. Samar Bahisht chausa. Haryana J. Hort. Sci., 15:29-32.
- [39] Singh R.S. and Ram S. (1983). Studies on the use of plant growth substances for fruit retention in mango cv. Dashehari .Indian J. Hort.,40:188-94
- [40] Steva, H. and Cherjeau. M. (1990) Cross resistance biosynthesis inhibitor Meded. Fac.L. Rijks Univ. Cent., 55: 983-988
- [41] Wisniewski M.E.; .Droby S.; Chqlutz E. and Eilam Y. (1995). Effect of Ca²⁺ and Mg²⁺ on *Botrytis cinerea* and *Penicillium expansum* *in vitro* and on the biocontrol activity of *Candida oleophila* .Plant Pathol., 44:1016 -1024
- [42] Ziv sO. and Zitter T. A. (1992). Effect of bicarbonates and film-forming polymers on cucurbit foliar diseases. Plant Dis., 76: 513-517.