



شبكة المعلومات الجامعية  
التوثيق الإلكتروني والميكروفيلم

# بسم الله الرحمن الرحيم



**MONA MAGHRABY**



شبكة المعلومات الجامعية  
التوثيق الإلكتروني والميكروفيلم



# شبكة المعلومات الجامعية التوثيق الإلكتروني والميكروفيلم



**MONA MAGHRABY**



شبكة المعلومات الجامعية  
التوثيق الإلكتروني والميكروفيلم

# جامعة عين شمس

## التوثيق الإلكتروني والميكروفيلم

### قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها  
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات



### يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار



**MONA MAGHRABY**

**CURATIVE AND PROTECTIVE ACTIVITIES OF  
STROBILURIN FUNGICIDES AND THEIR  
MIXTURES ON POWDERY MILDEW  
DISEASE IN CUCURBIT CROPS**

By

**TAMER VICTOR NOSHY LABIB**

B. Sc. Agric. (Plant Protection), Fac. Of Agric., Ain Shams Univ. 2006.

**A thesis submitted in partial fulfillment  
Of  
The requirements for the degree of**

**MASTER OF SCIENCE  
in  
Agricultural Sciences  
(Pesticides)**

**Department of Plant Protection  
Faculty of Agriculture  
Ain Shams University**

**2020**

## **Approval Sheet**

# **CURATIVE AND PROTECTIVE ACTIVITIES OF STROBILURIN FUNGICIDES AND THEIR MIXTURES ON POWDERY MILDEW DISEASE IN CUCURBIT CROPS**

By

**TAMER VICTOR NOSHY LABIB**

B. Sc. Agric. (Plant Protection), Fac. Of Agric., Ain Shams Univ. 2006.

**This thesis for master degree has been approved by:**

**Dr. Mohamed Bassem Mokbel Ashour** .....

Prof. Emeritus of Pesticides, Faculty of Agriculture, Zagazig  
University.

**Dr. Waala Mohamed Abd El-Ghany** .....

Prof. of Pesticides and Vice Dean For Graduate & Research Affairs,  
Faculty of Agriculture, Ain Shams University.

**Dr. Sayed Mohamed Abd El-Latif Dahroug** .....

Prof. Emeritus of Pesticides, Faculty of Agriculture, Ain Shams  
University.

**Dr. Mohamed Ibraheam Abd El-Mageed** .....

Prof. Emeritus of Pesticides, Faculty of Agriculture, Ain Shams  
University.

**Date of Examination:** 27 / 2 / 2020

# **CURATIVE AND PROTECTIVE ACTIVITIES OF STROBILURIN FUNGICIDES AND THEIR MIXTURES ON POWDERY MILDEW DISEASE IN CUCURBIT CROPS.**

By

**TAMER VICTOR NOSHY LABIB**

B. Sc. Agric. (Plant Protection), Fac. Of Agric., Ain Shams Univ. 2006.

**Under the supervision of:**

**Dr. Mohamed Ibraheam Abd El-Mageed**

Prof. Emeritus of Pesticides, Faculty of Agriculture, Ain Shams University. (Principal Supervisor).

**Dr. Sayed Abd El-Latef Dahroug**

Prof. Emeritus of Pesticides, Faculty of Agriculture, Ain Shams University.

**Dr. Marian Shokry Thabet.**

Prof Assistant of Phytopathology, Faculty of Agriculture, Ain Shams University.

## ABSTRACT

**Tamer Victor Noshy Labib "Curative and Protective Activities of Strobilurin Fungicides and Their Mixtures on Powdery Mildew Disease in Cucurbit Crops." unpublished M.Sc. Thesis, Department of Plant Protection, Faculty of Agriculture, Ain Shams University, 2019.**

Squash is a significant crop of cucurbits family. The powdery mildew *Podosphaera xanthii* (syn. *Sphaerotheca fuliginea*) causes serious damage on leaves, stems and fruits of plant this reduce the amount of yield every year. Strobilurin group is common fungicides used to control powdery mildew disease. Many studies have indicated for powdery mildew resistance of the strobilurin fungicides group, which indicated the importance of mixing the strobilurin with other chemical compounds such as triazols to face the fungus resistance for the effect of strobilurin fungicides group. This study focusses on effectiveness of azoxystrobin as one of important strobilurin active ingredients, three application, ten days interval, alone and in mixture with difenoconazole and tebuconazole. Besides knowing the induction of resistance for plants by using Mono-potassium Phosphate ( $\text{KH}_2\text{PO}_4$ ) and dipotassium phosphate ( $\text{K}_2\text{HPO}_4$ ) as foliar fertilization treatments against powdery mildew on squash and extent the benefits that will accrue to the yield. In addition to evaluate the protective and curative applications effect for these treatments. The results showed that, all of fungicides were applied provided controlling of powdery mildew on squash and achieved increases in yield compared to untreated. Azoxystrobin alone and in mixture were most effective against powdery mildew on squash compared to difenoconazole, tebuconazole, in both protective and curative applications. However, the protective method was better in activity compared to the curative method. The mixture of azoxystrobin with difenoconazole was superior effectiveness and recorded the highest yield compared to all tested treatments followed by the mixture of azoxystrobin with tebuconazole and both treatments were

slightly better or comparable in activity to azoxystrobin alone. In addition, the foliar application by  $\text{KH}_2\text{PO}_4$  and  $\text{K}_2\text{HPO}_4$  showed inferior effect to the induction of resistance for plants to powdery mildew infection under the field conditions.

**Key words:** Azoxystrobin, strobilurin, powdery mildew, curative, protective, activity, cucurbits, induction of resistance, *Podosphaera xanthii*,  $\text{KH}_2\text{PO}_4$ , effectiveness.

## ACKNOWLEDGMENT

"I wish to express my deep thanks to **God** who fulfilled my hopes, offered every possible aid for any one in need to it"

I wish to express my deep thanks to late **Prof. Dr. Mohamed Ibraheam Abd EL-Megeed** Prof. of Pesticides Chemistry, Department of Plant Protection, Faculty of Agriculture, Ain Shams University for suggest to my subject and plan of study for this thesis.

I would like to express my sincere gratitude and deep appreciation to **Prof. Dr. Sayed Abd El-Latef Dahroug**. Prof. of Pesticides and Vice Dean For Graduate & Research Affairs, Faculty of Agriculture, Ain Shams University for facilities he offers, close supervision, reading the manuscript, helpful suggestion, constructive criticism and unfailing help during the whole of this work.

I wish to express my special thanks to **Dr. Marian Shokry Thabet**. Assistant Prof of Plant pathology, Faculty of Agriculture, Ain Shams University, for his helpful guidance during this study, patient guiding and faithful advising and the cooperation through the whole work.

I am also indebted to **Dr. Walaa Mohamed Abd El-Ghany** Prof. of Pesticides, Plant Protection Department, Faculty of Agriculture, Ain Shams University for his encouragement, helpful suggestions and support me in materials and methods.

I am also indebted to **Dr. Emad Samir** Assistant Prof of Pesticides, Plant Protection Department, Faculty of Agriculture, Ain Shams University for his support in preparing and writing the papers of master.

Finally, I am indebted forever to **my family** for their help, support and continuous encouragement.

# CONTENTS

|                                                                                                 | <b>Page</b> |
|-------------------------------------------------------------------------------------------------|-------------|
| <b>LIST OF TABLES.....</b>                                                                      | <b>III</b>  |
| <b>LIST OF FIGURES.....</b>                                                                     | <b>V</b>    |
| <b>INTRODUCTION.....</b>                                                                        | <b>1</b>    |
| <b>REVIEW OF LITTERATURE.....</b>                                                               | <b>7</b>    |
| 1. Powdery mildew overview.....                                                                 | 7           |
| 1.1. Pathogenicity and classification.....                                                      | 7           |
| 1.2. Effect of powdery mildew on crops.....                                                     | 9           |
| 1.3. Evaluation of powdery mildew.....                                                          | 10          |
| 1.4. Control methods of powdery mildew.....                                                     | 10          |
| 1.4.1 Chemical control.....                                                                     | 10          |
| 1.4.2 Biological control.....                                                                   | 11          |
| 1.4.3 Biological with chemical control.....                                                     | 12          |
| 2. Strobilurin overview.....                                                                    | 13          |
| 2.1. Strobilurin resistance.....                                                                | 14          |
| 2.2. Diseases controlling by strobilurin.....                                                   | 16          |
| 3. Survey the formulated products which used in the markets.....                                | 19          |
| 4. Effect of strobilurin group fungicides and their mixtures.....                               | 20          |
| 4.1. Azoxystrobin.....                                                                          | 20          |
| 4.2. Azoxystrobin and Difenconazole.....                                                        | 22          |
| 4.3. Azoxystrobin and Tebuconazole.....                                                         | 26          |
| 5. Determine the period of protection for these pesticides.....                                 | 28          |
| 6. Induction of resistance by using $\text{KH}_2\text{PO}_4$ and $\text{K}_2\text{HPO}_4$ ..... | 29          |
| <b>MATERIAL AND METHODS.....</b>                                                                | <b>34</b>   |
| 1. Squash cultivars used.....                                                                   | 34          |
| 2. Plantation techniques.....                                                                   | 34          |
| 3. Plot size and replicates number.....                                                         | 34          |
| 4. Applications and Type of soil.....                                                           | 34          |
| 5. Application equipment.....                                                                   | 34          |
| 6. Treatments.....                                                                              | 35          |

|                                   |                                                                                                                                                         |           |
|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| 7.                                | Evaluations.....                                                                                                                                        | 35        |
| <b>RESULT AND DISCUSSION.....</b> |                                                                                                                                                         | <b>37</b> |
| 1.                                | Effectiveness of strobilurin group fungicides and their mixture.....                                                                                    | 37        |
| 1.1.                              | Effectiveness of Azoxystrobin alone and in mixtures compared to other treatments against powdery mildew on squash                                       | 37        |
| 1.2.                              | Protective treatment effectiveness of Azoxystrobin alone and in mixture compared to curative treatment against powdery mildew on squash plants.....     | 41        |
| 2.                                | Effectiveness of strobilurin group fungicides and their mixtures impact on yield.....                                                                   | 43        |
| 3.                                | Determine the period of protection for these pesticides.....                                                                                            | 47        |
| 3.1.                              | Time period of Azoxystrobin protection against powdery mildew on squash after last application in both protective and curative application methods..... | 47        |
| 3.2.                              | Azoxystrobin effectiveness after 5 days of last application at day 25 of evaluation in protective and curative application methods.....                 | 47        |
| 3.3.                              | Azoxystrobin effectiveness after 10 days of last application at day 30 of evaluation in protective and curative application methods.....                | 48        |
| 3.4.                              | Azoxystrobin effectiveness after 15 days of last application at day 35 of evaluation in protective and curative application methods.....                | 50        |
| 4.                                | Induction of resistance for powdery mildew by using $K_2HPO_4$ and $KH_2PO_4$ .....                                                                     | 51        |
| <b>SUMMARY.....</b>               |                                                                                                                                                         | <b>53</b> |
| <b>REFERENCES.....</b>            |                                                                                                                                                         | <b>55</b> |
| <b>ARABIC SUMMARY.....</b>        |                                                                                                                                                         |           |

## LIST OF TABLES

| Table No. |                                                                                                                                                      | Page |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| Table 1   | Strobilurin value per million dollars in Egyptian market in 2015 – 2017.....                                                                         | 3    |
| Table 2   | The common diseases and the recommended Strobilurins in Egypt.....                                                                                   | 5    |
| Table 3   | List of commercial products used for field trials and their rates.....                                                                               | 35   |
| Table 4   | Mean % effectiveness of Azoxystrobin alone and in mixtures as curative application against powdery mildew on squash.....                             | 38   |
| Table 5   | Mean % effectiveness of Azoxystrobin alone and mixture as protective application compared to other treatments against powdery mildew on squash.....  | 39   |
| Table 6   | Mean % effectiveness of protective application treatments compared to the same curative application treatments against powdery mildew on squash..... | 42   |
| Table 7   | Total weight of yield in ton / acre at protective application method.....                                                                            | 43   |
| Table 8   | Total weight of yield in ton / acre at curative application method.....                                                                              | 44   |
| Table 9   | Total weight of yield increased over the check in ton per acre for treatments in protective and curative methods.....                                | 46   |
| Table 10  | Azoxystrobin effectiveness after 5 days of last application at day 25 of evaluation in protective application method.....                            | 47   |
| Table 11  | Azoxystrobin effectiveness after 5 days of last application at day 25 of evaluation in curative application method.....                              | 48   |

| <b>Table No.</b> |                                                                                                                            | <b>Page</b> |
|------------------|----------------------------------------------------------------------------------------------------------------------------|-------------|
| Table 12         | Azoxystrobin effectiveness after 10 days of last application at day 30 of evaluation in protective application method..... | 49          |
| Table 13         | Azoxystrobin effectiveness after 10 days of last application at day 30 of evaluation in curative application method.....   | 49          |
| Table 14         | Azoxystrobin effectiveness after 15 days of last application at day 35 of evaluation in protective application method..... | 50          |
| Table 15         | Azoxystrobin effectiveness after 15 days of last application at day 35 of evaluation in curative application method.....   | 50          |

## LIST OF FIGURES

|          |                                                                                                              |    |
|----------|--------------------------------------------------------------------------------------------------------------|----|
| Fig. (1) | Strobilurin value/ million dollars in Egyptian market.....                                                   | 3  |
| Fig. (2) | Mean % effectiveness of Azoxystrobin alone and in mixtures as curative application.....                      | 37 |
| Fig. (3) | Mean % effectiveness of Azoxystrobin alone and mixture as protective application.....                        | 40 |
| Fig. (4) | Mean % effectiveness of protective application compared to the same curative application.....                | 42 |
| Fig. (5) | Azoxystrobin effect on increases of yield at protective application method.....                              | 44 |
| Fig. (6) | Azoxystrobin effect on increases of yield at curative application method.....                                | 45 |
| Fig. (7) | Azoxystrobin effect on increases of yield over the check at protective and curative application methods..... | 46 |
| Fig. (8) | Time period of Azoxystrobin protection against powdery mildew protective application methods.....            | 51 |
| Fig. (9) | Time period of Azoxystrobin protection against powdery mildew curative application methods.....              | 51 |

## INTRODUCTION

Azoxystrobin is one of the most important active ingredients of the fungicide strobilurin group. It is leading the worldwide fungicides possessing broad spectrum systemic activity against the four major disease classes of pathogenic fungi (**Bartlett et al., 2002**). In Egypt, strobilurin holds from 15% to 17% of total market value of fungicides from 2015 to 2017, azoxystrobin compounds holds around 36% to 68% of strobilurin market value. In 2017 the value of strobilurin and their mixtures reached 7.9 million dollars of 48.1 million dollars of total fungicides value in Egyptian market. The strobilurin group of fungicides was detected by derivation of b-methoxyacrylic acid from natural fungicidal group and the production of it by wood-rotting of *Strobilurus tenacellus*. The mode of action of the strobilurins against fungi is the ability to inhibit mitochondrial respiration by binding these-called Qo site of cytochrome b. located in cytochrome bc<sub>1</sub> complex and that part of the inner mitochondrial membrane of fungi. This inhibition blocks the electron transfer between cytochrome b and cytochrome c<sub>1</sub>, that causes disruption of the fungus energy cycle, within halting the production of ATP (**Dave et al., 2002**).

Cucurbitaceae is an important family, which supplies humans with lot of edible products and useful fibers. Plants of cucurbits family are very similar in vegetative development, but they have a high genetic diversity for fruit shape and characteristics, resulting in a variety range of uses (**Dilson, 2002**). Powdery mildew disease causes devastation in cucurbits and yield can decline with increases disease severity (**Kabir, 2011**). However, the plants may resist the disease by using some non-chemical products like KH<sub>2</sub>PO<sub>4</sub> and K<sub>2</sub>HPO<sub>4</sub>. The foliar fertilizers of phosphates and potassium salts are convenient to use with a potential useful impact in controlling the disease (**Reuveni et al., 1995**). Powdery mildew caused by *Erysiphe cichoracearum* (**Bardin, 1999**) and *Podosphaera fusca* (synonyms: *P. xanthii*, syn. *Sphaerotheca fuliginea*