



Studies on the Entomopathogenic Fungi of Cereal Aphids (Homoptera: Aphididae) in Upper Egypt

By

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CONTENTS

Subject	Page
I- Introduction	1
II- Review of literature	3
1. Aphids and their damages	3
2. Entomopathogenic fungi infecting aphids	3
3. Survey and seasonal abundance of the entomopathogenic fungi on the cereal aphids spread on Wheat plants in three governorates in Upper Egypt	7
4. Virulence of the entomopathogenic fungi	12
III-Materials and methods	22
IV-Results and Discussion	30
1- Survey and morphological characters of entomopathogenic fungi recorded infecting cereal aphids in three governorates, Upper Egypt	30
1.1- Collection of cadavers	30
1.2- Isolation.....	30
1.3- Identification of entomopathogenic fungi	32
2- Seasonal abundance of the entomopathogenic fungi on the cereal aphids spread on wheat plants in three governorates in Upper Egypt:	41
Virulence studies	51
2.1- Rearing of test insects	51
2.2- Preparation of conidial suspension	51
2.3- Pathogenicity study	51
3- Mass production of entomopathogenic fungi recovered	67
3.1- Effect of certain culture media containing different carbon and nitrogen sources	67
3.2- Effect of certain liquid culture media containing different carbon and nitrogen sources	73
4- Scanning electron microscope (SEM) studies	75
5- Differentiation among entomopathogenic fungi isolated from cereal aphids Upper Egypt using PCR- RAPD “Random Amplified Polymorphic DNA”	81
V- Summary	90
VI- Conclusions	95
VII- References	98
VIII- Arabic Summary	---

LIST OF TABLES

Table No.	Title	Page
1	The selected localities of study from different districts of Assiut, Sohage and Qena governorates during 2014-2016 wheat growing seasons.	22
2	Entomopathogenic fungal isolates used for DNA extraction.	28
3	A list of fungi species associated with cereal aphids infesting wheat plants in three different localities.	32,33
4	Entomopathogenic fungi isolates recovered from different localities in Upper Egypt during 2014-2016 wheat growing seasons.	34
5	Seasonal abundance of the entomopathogenic fungi on the cereal aphids spread on wheat plants in three governorates in Upper Egypt during the 2014/2015 season.	42
6	Seasonal abundance of the entomopathogenic fungi on the grain aphids spread on wheat plants in three governorates in Upper Egypt in 2015/2016 season.	45
7	Pathogenicity of the recovered entomopathogenic fungi against the greenbug aphid, <i>S. graminum</i> .	53
8	LC ₅₀ and LC ₉₅ of the recovered entomopathogenic fungi against <i>S. graminum</i> after 2-Days.	54
9	LC ₅₀ and LC ₉₅ of the recovered entomopathogenic fungi against <i>S. graminum</i> after 4-Days.	55
10	LC ₅₀ and LC ₉₅ of the recovered entomopathogenic fungi against <i>S. graminum</i> after 6-Days.	56
11	Effect of nitrification (culture media) on the sporulation of five entomopathogenic fungi.	68
12	Effect of nutrition (culture media) on the colony diameter of five entomopathogenic fungi.	69
13	Effect of liquid culture media on the fungal biomass of five entomopathogenic fungi.	71
14	PCR fragments amplified by A11 primers.	81
15	PCR fragments amplified by Bo1 primers.	82

LIST OF FIGURES

Figure No.	Title	Page
1	Wheat plants suffering from heavy infestation of cereal aphids that cause deterioration (A) and cereal aphid species on stem, leaves and ear of wheat plants (B).	35
2	<i>C. cladosporioides</i> (entomopathogenic fungus) which was isolated from the cereal aphids at El-Namisa locality, Qena governorate. Note the conidiospores and conidiophores under light microscope X1000. However (B) Showing the <i>C. cladosporioides</i> colonies grown on rice solid medium.	36
3	The entomopathogenic fungus <i>B. bassiana</i> which was isolated from aphids at El-Massara locality, Assiut governorate.	36
4	A cereal aphid infected with the entomopathogenic fungus <i>B. bassiana</i> under binuclear light microscope enlargement (40X).	37
5	The entomopathogenic fungus <i>B. bassiana</i> grown on solid modified rice medium.	37
6	The entomopathogenic fungus <i>P. variotii</i> grown on modified PDA solid medium, (A and B).	38
7	The entomopathogenic fungus <i>P. variotii</i> that was isolated from the cereal aphids. Note the conidiospores and conidiophores under light microscope (X1000), (A and B).	38
8	The entomopathogenic fungus <i>V. lecanii</i> which was isolated from the cereal aphids at Howad El-Sabeel locality, Assiut governorate. (A and B).	39
9	The entomopathogenic fungus <i>M. anisopliae</i> that was isolated from cereal aphids at, Qena governorate. (A and B).	39
10	The entomopathogenic fungus <i>M. anisopliae</i> grown on solid modified rice medium.	40
11	Seasonal abundance of the entomopathogenic fungi on the grain aphids spread on wheat plants in three governorates in Upper Egypt during 2014/2015 season.	43
12	Seasonal abundance of the entomopathogenic fungi on the cereal aphids spread on wheat plants in three governorates in Upper Egypt during 2015/2016 season.	46
13	Pathogenicity of <i>Cladosporium cladosporioides</i> against <i>Schizaphis graminum</i> after 2-Days.	57
14	Pathogenicity of <i>Beauveria bassiana</i> against <i>S. graminum</i> after 2-Days.	57
15	Pathogenicity of <i>Verticillium lecanii</i> against <i>S. graminum</i> after 2-Days.	58
16	Pathogenicity of <i>Paecilomyces variotii</i> against <i>S. graminum</i> after 2-Days.	58

List of Figures

Figure No.	Title	Page
17	Pathogenicity of <i>Metarhizium anispoliae</i> against <i>S. graminum</i> after 2-Days.	59
18	Pathogenicity of <i>C. cladosporioides</i> against <i>S. graminum</i> after 4-Days.	59
19	Pathogenicity of <i>B. bassiana</i> against <i>S. graminum</i> after 4-Days.	60
20	Pathogenicity of <i>V. lecanii</i> against <i>S. graminum</i> after 4-Days.	60
21	Pathogenicity of <i>P. variotii</i> against <i>S. graminum</i> after 4-Days.	61
22	Pathogenicity of <i>M. anispoliae</i> against <i>S. graminum</i> after 4-Days.	61
23	Pathogenicity of <i>C. cladosporioides</i> against <i>S. graminum</i> after 6-Days.	62
24	Pathogenicity of <i>B. bassiana</i> against <i>S. graminum</i> after 6-Days.	62
25	Pathogenicity of <i>V. lecanii</i> against <i>S. graminum</i> after 6-Days.	63
26	Pathogenicity of <i>P. variotii</i> against <i>S. graminum</i> after 6-Days.	63
27	Pathogenicity of <i>M. anispoliae</i> against <i>S. graminum</i> after 6-Days.	64
28	Demonstrating the parasitism of the entomopathogenic fungus <i>B. bassiana</i> on the affected cereal aphid.	65
29	Collecting aphids for the pathogenicity test.	65
30	Cereal aphid infested wheat plants during March –April periods.	66
31	Cereal aphid species found infesting wheat plants and susceptible to the isolated entomopathogenic fungi.	66
32	Effect of nutrition (culture media) on the colony diameter of five entomopathogenic fungi.	70
33	The entomopathogenic fungus <i>B. bassiana</i> grown on solid modified murashige and Skoog medium illustrating the colony diameter.	70
34	The entomopathogenic fungus <i>B. bassiana</i> (A) grown on liquid non-modified Murashige Skoog medium. However, (B) and (C) are the same fungus on modified <i>Murashige Skoog</i> medium.	72

List of Figures

Figure No.	Title	Page
35	The entomopathogenic fungus <i>B. bassiana</i> (A) grown on liquid non-modified Murashige and Skoog medium. However, (B) and (C) are the same fungus on modified Murashige and Skoog medium.	73
36	The entomopathogenic fungus <i>M. anisopliae</i> grown on solid rice medium.	74
37	The entomopathogenic fungus <i>B. bassiana</i> under light microscopy (X 400) in order to show masses of conidiospores grown on modified Murashige and Skoog medium.	74
38	Scanning electron microscopy (SEM): <i>C. cladosporioides</i> , entomopathogenic fungus network forming hayphal mycelium which is covering the dead cereal aphid.	76
39	Scanning electron microscopy (SEM): <i>C. cladosporioides</i> fungal hyphae (fh) invading the larval cavity of the cereal aphid integument.	76
40	Scanning electron microscopy (SEM): Great proliferation of the cereal aphid due to the fungal invasion to the insect integuments by <i>B. bassiana</i> the entomopathogenic fungus.	77
41	Scanning electron microscopy (SEM): Network of fungal hyphae of <i>P. variotii</i> , covering the cereal aphid (<i>Sitobion avenae</i> F.) Surface cuticle.	77
42	Scanning electron microscopy (SEM): <i>P. variotii</i> , the entomopathogenic fungus infecting the cereal aphid.	78
43	Scanning electron microscopy (SEM): Fungal hyphae (fh) of <i>M. anisopliae</i> mycelium and mass of fungal conidiospores (mfc) are visible on the surface of the cuticle of the cereal aphid.	78
44	Agarose gel electrophoresis of <i>M. anisopliae</i> 1, 2, 3 and 4 and <i>P. variotii</i> 5, 6 and 7 PCR products.	82
45	Phylogenetic relationship among entomopathogenic fungi.	83

SUMMARY

The results could be summarized as follows:

1- Owing to survey studies through 2014-2015 and 2015-2016 wheat growing seasons in three governorates (Assiut, Sohage and Quena) five entomopathogenic fungi were isolated and identified. These fungi are *Cladosporium cladosporioides*, *Beauveria bassiana*, *Paecilomyces variotii*, *Verticillium lecanii* and *Metarhizium anisopliae*.

2- The results also showed a great diversity of entomopathogenic fungi found attacking cereal aphids in southern Egypt. Five species of entomopathogenic fungi were surveyed and identified infecting cereal aphids which infesting wheat plants in southern Egypt.

3- Incidence of the entomopathogenic fungi recovered attacking cereal aphids on wheat plants in three governorates in Upper Egypt during two seasons 2014/2015 and 2015/2016 and that *C. cladosporioides* had great abundance in February at the three governorates on cereal aphids in the season 2014/2015. However, the largest abundance was reported in Sohage with 77.4 % frequency in the same season.

4- *B. bassiana* was only superior in its abundance on cereal aphids in February with 28.4 % frequency. Meanwhile, *P. variotii*, showed its infecting abundance superiority on these aphids with 35.6 % only in March at Assiut governorate. Meanwhile, its abundance has reached 31.1% and 27.6 % frequency in Qena and Sohage governorates respectively in February and March.

5- In case of *M. anisopliae* the highest abundance on the cereal aphids was recorded with great abundance 36.0 % of frequency that was happened at Assiut in March. However, abundance the same fungus

Summary

reached to 18.6 % of frequency in April at Sohage and 32.0 % in February at Qena governorate.

6- *M. anispoliae* and *B. bassiana* had a great abundance in March and April month by 32.7 % and 36.34 % at Assiut governorate on the cereal aphids 2015/2016 season. However, *M. anispoliae* was superior in its abundance at Qena governorate in March and April months by 46.96 and 54.6 % respectively. Meanwhile, the other entomopathogenic fungi which were superior in there spread in the 2014/2015 season on the cereal aphids such as *C. cladosporioides*, showed the least distribution on the cereal aphids in three governorates in Upper Egypt in 2015/2016 season.

7- Results indicated that various entomopathogenic fungi caused aphid mycoses according to seasonal incidence of these fungi on cereal aphid species.

8- Entomopathogenic fungi appeared to be of high value in the natural control of cereal aphids infesting wheat plants in southern Egypt.

9- In conclusion, Entomophthoralean fungi played a principle role in natural suppression of cereal aphid populations in Upper Egypt, particularly at the time of their highest population level. It is necessary to consider that the decline of cereal aphid population results from a combination of an increased population of alate adults, decline host plant quality and the action of aphid natural enemies. Thus, proper methods of pest management in winter wheat crops, particularly in wheat field, should be applied to protect populations of natural enemies against the damaging effect of unnecessary application of pesticides.

10- The utilization of entomopathogenic fungi as a biological control agent could be complementary strategies in an integrated pest management program against cereal aphids in Upper Egypt.

Summary

11- *M. anisopliae* was superior in its effect and induced the percentage of cereal aphid mortality by 62.67 % and followed by *C. cladosporioides* with 56.00 %, respectively. However, *V. lecanii* and *P. variotii* induced the percentage of cereal aphid mortality by 52.67% and followed by *B. bassiana*, which induced cereal aphid mortality by 49.33 % after 4 days from exposure.

12- *M. anisopliae* was superior in its effect and induced the percentage of cereal aphid mortality by 65.33% and followed by *B. bassiana* and *C. cladosporioides* with 61.33%. However, *V. lecanii* induced cereal aphids by 60.00 % and followed by *P. variotii*, which induced cereal aphid mortality by 57.33% after 6 days from spraying.

13- The sporulation of the tested entomopathogenic fungi was greatly affected by the type of culture medium. Modified culture medium of potato dextrose (PDA) agar, rice agar medium and Murashige &Skoog showed a tangible effect on fungal growth. Data showed also that modified Murashige & Skoog was the best culture medium which accelerated the fungal growth of the five tested entomopathogenic fungi.

14- The entomopathogenic fungi were greatly affected by different liquid culture media. Modified liquid culture media of potato dextrose (PDA) agar, rice agar medium and Murashige &Skoog showed a tangible effect on fungal bio-mass growth and sporulation. Data showed also that modified Murashige & Skoog was the best liquid culture medium which accelerates fungal biomass growth and sporulation of five tested entomopathogenic fungi.

15- The modified PDA, rice and Murasieghe and Skoog medium produced more conidial fungal spores when the tested entomopathogenic fungi grown on it. Results also showed that modified Murasieghe and

Summary

Skoog medium was superior in its effect on the all five tested entomopathogenic fungi and enhancement its sporulation

16- Significant differences were found between the five tested fungi and the interaction between them in case of the effect of the three tested culture media on its sporulation at 1%.

17- Data of Scanning electron microscopy (SEM) revealed that cereal aphid insects when subjected to artificial inoculation with spore suspension of five tested entomopathogenic fungi with concentration of (5×10^9 spores/ml plus 0.03 ml /l of Tween 22) were sensitive to invasions and penetrations by the tested entomopathogenic fungi, and those fungi were able to induce mortality.

18- The close attachment as shown in the scanning electron micrograph of fungal mycelium to cereal aphid cuticle may be due to a secretion from insect host to fungal spores to accelerate its germination and conditions it for penetration as sensitive host. This may be considered as unique mechanism of the entomopathogenic fungus.

19- Scanning electron microscopy allowed us a tool to observe the mode of action of entomopathogenic fungi and to observe how they can colonize and infect the host insects.

20- Data obtained showed that by using primer A11 at 30° C there is no intraspecific variability between *M. anisopliae* isolates No. 1, 2, 3, and 4 of PCR amplified fragments. Meanwhile, when using primer Bo1 at the same temperature 30° C *M. anisopliae* isolates showed high level of similarity between 1, 2 and 3 isolates at 700, 400, and 300 and very little in case of isolate No. 4 at 700 base pairs. However, a little similarity has been found with the PCR-amplified fragment of *P. variotii* isolates No. 5 and 6 at 400 and 300 base pairs but not isolate No. 7.

Summary

21- Phylogenetic analysis showed close relation between *M. anisopliae* isolates 1, 2 and 3 when using primer Bo1 at the same temperature 30°C. However, a little similarity has been found with the PCR-amplified fragment of *P. variotii* isolates No. 5 and 6 at 400 and 300 base pairs but not isolate No. 7.