European Journal of Academic Essays 1(10): 23-28, 2014
ISSN (online): 2183-1904
ISSN (print): 2183-3818
www.euroessays.org

Determinations of the entomopathogenic fungus *Beauveria brongniartii* on three sugar beet pests

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Abstract: The entomopathogenic fungus *Beauveria brongniartii*, were evaluated against three sugar pests, *Phyllotreta cruciferae Pegomyia hyoscami Cassida vittata*, under laboratory and field conditions. Under laboratory conditions, LC50 recorded 100X10^4. 120 X10^4 and 131X10^4 spores/ml after *P. cruciferae*, *P. hyoscami* and *C. vittata* treated with different concentrations of *B. brongniartii.* The entomopathogenic fungus *B. brongniartii* against sugar beet insect pests, showed that the number of eggs laid /female were significantly decreased to 22±1.7, 33±8.9, and 35±2.6 individuals for *P. cruciferae*, *P. hyoscami* , and respectively as compared to 266±8.7 individuals in the control. The egg hatching for the corresponding pests were, 4,7,9 as compared to 99 % in the control that the weight of sugar beet were significantly increased to 2345± 54.66, 2337±66.11 and in the plots treated with the fungi for *P. cruciferae*, *P. hyoscami* , and *C. vittata* respectively as compared to1788±55.43 ton/feddaan in the control during season 2012. The corresponding data obtained during 2013 were 2567±67.91, 2443±54.98, and 2436±22.87 as compared to 1227±45.09 ton/feddan in the control the percentage of the sugar beet pests significantly decreased during both two successive season2012 and 2013 after fungi treatments.

Keywords: *Beauveria brongniartii, Phyllotreta cruciferae Pegomyia hyoscami Cassida vittata*

1. Introduction

Sugar beet is considered one of the most important crops in Egypt because it was used in the production of sugar as it contains 15-20% sugar. The sugar beet has currently been infested with many insect pests which cause high losses in the crop yield and decrease its sugar content [1], [2]. Among these insects, *Cassida vittata* (Vill*)* (Coleoptera: Chrysomelidae)*; Phyllotreta cruciferae* (Goeze) (Coleoptera: Chrysomelidae) and *Pegomyia hyoscami* (Witt) (Diptera: Anthomyidae). Chemical insecticides were used to control these insect pests, but they were always causing a lot of pollution to the environment. Thereafter microbial control agents were advocated to be used against such pests [*3*] ; [4]; [5] and [6]. [7,8,9]) control three sugar beets pests *by B. bassiana*. The entomopathogenic fungi have long been known to cause epizootics among certain insect pests under laboratory and field conditions [1]; [10]; [7]. [10], reported that the fungi is very effective in controlling many insect pests. Also, the use of many plant derivatives gave promising results for controlling many insect pests [11]; [12].

This study aims to evaluate the effect of the entomopathogenic fungus *Beauveria brongniartii*, on *C. vittata;* P. *hyoscami and P. cruciferae* pests under laboratory conditions and to explore how far they can protect the crop in the field and increasing its yield.

2. Materials and methods

2.1. Laboratory studies.

The sugar beet insects *C. vittata; P. hyoscami and P. cruciferae* were reared under laboratory conditions (26± 2 C^o and 60± 5 %RH) in cages 50X 50X 60 cm per each. The third larval stage was used in the experimental work .

2.2. Cultivation of the fungi

The fungus *Beauveria brongniartii*, was kindly obtained from Prof. Dr Alain Vey, Mycology unite, National De La Research Sientifique, Univ. Montpellier. (Apopka strain 97 and reproduced in Microbiology Dept., N. R. C. Cairo, Egypt. The fungi were primarily purified using the mono-spore technique. They were propagated in Petri-dishes (10cm) on potato dextrose agar medium (PDAM) enriched with 1% peptone, 4% glucose, and 0.2% yeast and incubated at 26 C^o. Seven-days old cultures with well developed spores were harvested by washing with 10 cc sterilized water then added

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3ml, Tween-80 and completed to 100 ml water and used as stock suspension with known spore concentration then kept in a refrigerator at 4 C°, from which the fungi were sub-cultured to be used in laboratory evaluation tests (infectivity and bioassay tests) adjusted as conidiophores concentration of $1X10^8$ /ml. Large amount of conidia spores, if needed, were produced by culturing the fungus on liquid medium in 1L cell culture glass bottles according to [13].

2.3. Evaluation of the fungi effects on the target insect pests

The fungi**,** *Beauveria brongniartii*, at concentrations ranged from 1X 10^2 to $1X10^8$ spores/ml were tested against *C. vittata; P. hyoscami and P. cruciferae* third instar larvae. Under laboratory conditions (26 ± 2° C and 65± 5 %RH.). Fresh leaves of sugar beet were sprayed with the desired diluted suspension to the point of run off, left to dry, then put in 1 L plastic container(5 containers were used/concentration/ treatment). Twenty newly larvae of each species were placed in each container and covered with muslin. Untreated leaves were sprayed by water only and used as control. The leaves were changed every other day. The experiment was repeated 4 times. The percentages of mortality were calculated after seven days and corrected according to [14]while LC_{50} s were calculated through probit analysis of [15].

2.4. Field trials

The field trials were carried out in the growing sugar beet during the two successive growing seasons 2012 and 2013. Sugar beet was cultivated at Eben-Malek farm at El – Nobaryia farm, N. R. C. The sugar beet was planted in November 15th in an area of about one feddan. The area was divided into plots (each about 40 m2). Four plots were assigned for each treatment and for control as well, two rows of plants were left untreated between plots. Application of the fungi occurred at the rate of 1X 108 spores/ml. sprayed at the sunset. Four applications were made at 4- weeks intervals during crop growing season. Control plots were left without any treatments. Examinations of 40 plants/plot/treatment were carried out just before the first application and seven days after last application to calculate the average reduction percentages in the target insect infestation percentages which was calculated in each treatment according to [16]. The agricultural practices followed the recommendations of the Ministry of Agricultural.

Twenty tubers were taken from the first 5 rows in each treatment and in the control as well. Sugar (sucrose) content per beet was determined in the Biochemistry Department in the National Research center.

3. Results

Data in table 1, show that the LC50 recorded 100X104. 120 X104 and 131X104 spores/ml after P. cruciferae , P. hyoscami and C. vittata treated with different concentrations of B. brongniartii.

Table 2 show that the entomopathogenic fungus B. brongniartii against sugar beet insect pests, which showed that the number of eggs laid /female were significantly decreased to 22±1.7, 33±8.9, and 35±2.6 individuals for P. cruciferae, P. hyoscami , and respectively as compared to 266±8.7 individuals in the control (Table 2). The egg hatching for the corresponding pests were, 4,7,9 as compared to 99 % in the control.

Table 3 show that the weight of sugar beet were significantly increased to 2345± 54.66, 2337±66.11 and in the plots treated with the fungi for P. cruciferae, P. hyoscami , and C. vittata respectively as compared to1788±55.43 ton/feddaan in the control during season 2012. The corresponding data obtained during 2013 were 2567±67.91, 2443±54.98, and 2436±22.87 as compared to 1227±45.09 ton/feddan in the control (Table3).

Figure 1 and 2 show the percentage of the sugar beet pests which significantly decreased during both two successive season2012 and 2013 after fungi treatments.

3.1. The Economic returns from the impact of using mushrooms Beauveria *brongniartii* on the target Pests such as P. cruciferae , P. hyoscami , C. vittata and its influences on the sugar beet production.

Table (2) show That the using of mushrooms Beauveria brongniartii on the target Pests such as P. cruciferae , P. hyoscami , C. vittata has many effects, these included the decrease in the number of eggs per Female by about 91% 0.88% 0.87% , The percentage of the cage in the eggs also fell by about 95 ، %92 ، %90% in compared with the control that represented about 266 egg , and about 99% for each of the three types respectively . The using of fungus has effects on the rate of deaths and damage the all larval, Where the death rate reached a maximum of 71% in the P. hyoscami kind with an increase of 10% and 16% in compared with the P. cruciferae, C. vittata respectively . While its effected on the larval damage was almost constant in the three types . Also the impact on fungus had an effects on the pupae damage with a maximum rate of 79% in pest C. vittata , and a minimum rate of 74% in pest P. hyoscami .

While its effects on the exit pests was amounted minimum of 3% of P. cruciferae with estimated a decline of 2% and 4% for each of the P. hyoscami, C. vittata, respectively, Finally its impact was almost fixed to the rate of damaged adults in the three types as illustrated in Table (2) . As shown in Table no. (3) the productivity average per feddan of beet crop during the 2012- 2013 seasons after treatment the fungus target pests B. brongniartii amounted of 61.29 tons / feddan, 60.55 tons / feddan, 44.79 tons / feddan for each of the P. cruciferae, P. hyoscami, C. vittata with increased in production quantity of 39.92 tons / feddan, 39.18 tons / feddan, 23.42 tons / feddan in compared with the productivity average of the Republic which reached about 21.37 Tons/ feddan. These lead to increased in productivity the Republic of the beet crop that estimated at 17.1 million tons, or about 16.74 million tons, or about 10 million tons which could contribute to the production of about 1.6 million tons of sugar, or about 1.5 million tons of sugar, or about 0.936 million tons of sugar for each of the three lesions after treatment with the fungus B. brongniartii respectively. The increase in production consequent on the shifted Egypt from imported to exported state with about 0.300 million tons, or about 0.200 million tons specially from the first and second treatment .While the consequences of the third treatment reduced the size of Egyptian imports of sugar, that amounted about 1.278 million tons in 2012 to about 0.342 million tons . This contributes lead to the decreased of the Egyptian imports of sugar bill by about $ 216 million .It can also lead to save about 2.5 billion cubic meters of irrigation water that resulting from the saving about 328 thousand feddan which are planted with sugar crop, or about 1.25 billion cubic meters of water for irrigation in agriculture that contributes with about 164 thousand feddan which are planted with sugar crop , these can using in the cultivation of crops with less of water.

4. Discussion

The same findings obtained by [7] found that the treatments with the fungi increased the yields and decrease the yield loss. [6] found that the yield loss of the potatoes were significantly decreased in the plots which treated with B. bassiana and B. anisopliae. Similar results were obtained by, [5and 7], [8] and [9]; [11] and [12]. The same results obtained by [4] who find that the potato tuber moth affected by the different formulations of the Bacillus thuringiensis and the fungus Metarhizium bassiana causes a higher mortality to the target pests. The same findings recoded by [17, 18] who control Earias insulana by the microbial control agents .[18 and 19] could to produce the microbial control agents on the coffee . and Dairy media. Sabbour, [20&21] could to enhance the microbial pathogen by added different additive to the microbial control agents. Sabbour 2001 study the biochemical of the microbial control agents bacteria and fungi against E, insulana , [11] control potato tuber moth by the combinations between the microbial control agents and the plant extract. [12] and [6] studied the effect of terpenes and microbial control agents against cotton bollworms can find that the cotton bollworms decreases after treatments in both laboratory and field conditions, [20],[21], [22], [23], [24],[26],[27]. [28] used the microbial control agents with plant extracts. The results obtained [23]. [7 &8], [28], [29], [28] also studding the nanotechnology and microbial control agents against stored products under laboratory and store conditions. [28],[29],[30],[31] found that the chemical additives enhance the microbial control agent against pests under field conditions ,also [31], [33]. [34], [35], [36] used UV to enhance the bacteria B. thuringiensis against the potato tuber moth. [8], [9], [33]. (34 and 25) find the same obtains. (37 , 38, 22 and [39]. [40] and [33], [41], [7], [42], [43], [44],[4]). [46] found that the entomopathogenic fungi and bacteria control the three sugar beet insect pests

5. Conclusion

The fungus B. brongniartii could decreased the infestation with three serious sugar beets to P. cruciferae , P. hyoscami and P. hyoscami under laboratory and field conditions

Table 1: Evaluation of the fungi *Beauveria brongniartii*, on the sugar beet pests under laboratory conditions

Target pest	LC_{50}	*S*	*V*	95% C*onfidence limits*
P. cruciferae	$100X10^4$	0.1	1.4	88-133
P. hyoscami	$120\ X10^4$	1.1	1.1	97-145
C. vittata	$131X10^4$	1.2	1.1	99-155

Table 2: Effect of the entomopathogenic fungus *Beauveria brongniartii* against the target insects biology

Target pest	*No of eggs laid/female*	*% of egg hatching*	*% of larval mortality*	*% of malformed larvae*	*% of malformed pupae*	*% of emerged adults*	*% of malformed adults*
P. cruciferae	22±1.7	4	61	66	77	3	78
P. hyoscami	**33**±8.9	7	71	67	74	5	77
C. vittata	35±2.6	9	55	69	79	7	77
Control	266±8.7	99	-	-	-	100	-
F value	33.4	2	5	5	22	21	21
Lsd5%	11.1	2	3	3	11	11	9

Table 3: Assessments of damage caused after treatment with the entomopathogenic*Beauveria brongniartii*

Target pest	Season 212 Wt of suger beet (Ton/ feddan)	Season 213 Wt of suger beet (Ton/ feddan)
P. cruciferae	2345± 54.66	2567±67.91
P. hyoscami	2337±66.11	2443±54.98
C. vittata	2266± 66.71	2436±22.87
Control	1788±55.43	1227±45.09

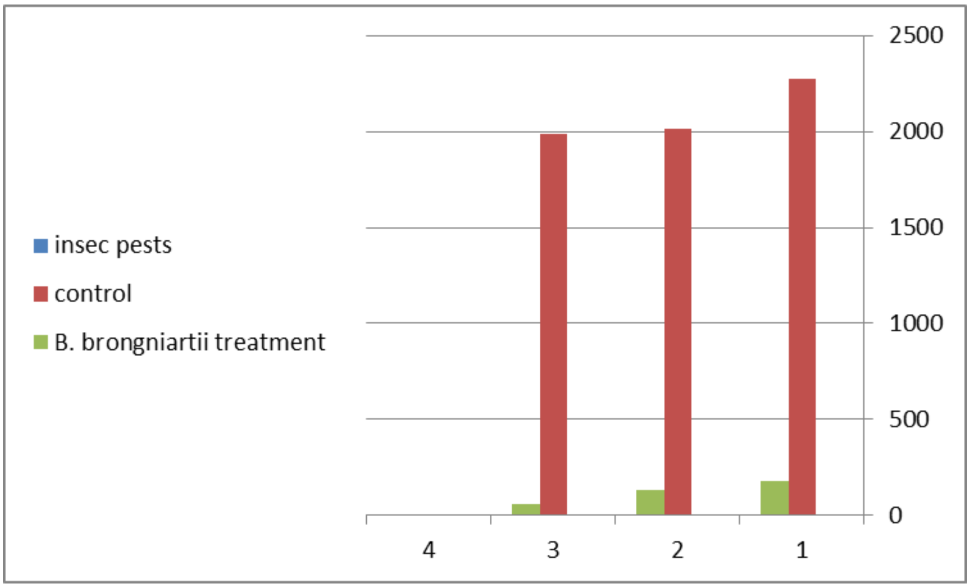

Figure 1: infestation percent during 2012 after fungi treatments

1.P. hyoscami 2. C. vittata 3. P. cruciferae

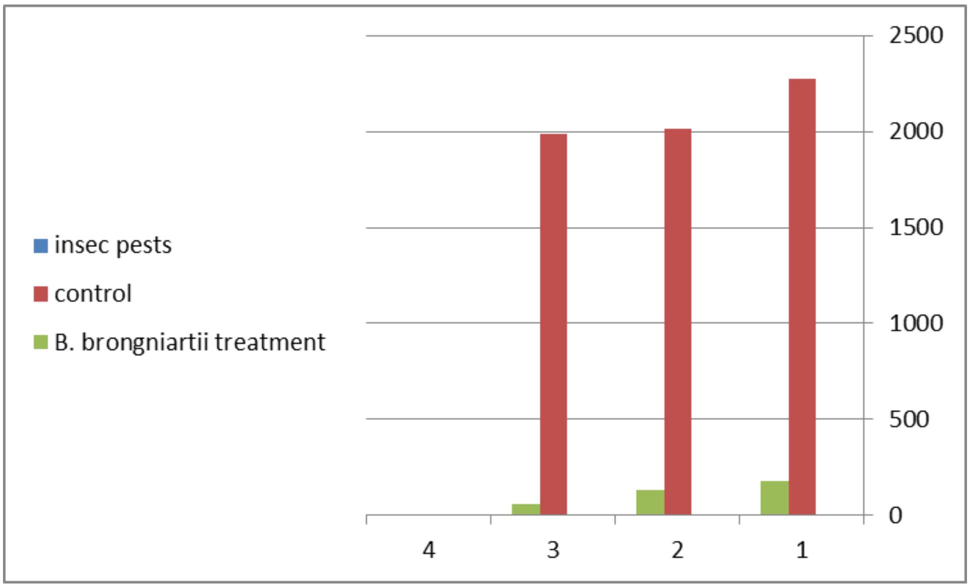

Figure 2: infestation percent during 2013 after fungi treatments

1.P. hyoscami 2. C. vittata 3. P. cruciferae

Acknowledgment

National research center supported project No 1020601

REFERENCES

[1] Bassyouny, A.M 1993. Studies on preferability and injury level of some main insects to certain sugar beet varieties in Egypt . J. Appl. Sci. 8: 213-219.

[2] El-Husseini , M. M.; A. H. Mesbah; Amal El-Zoghby and E. A. Agamy. 2003. Isolation, propagation and application of entomopathogenic fungi for controlling noctuid and cassidid pests in sugar beet. Egypt. J. Biol. Pest Control. 13: 95-100.

[3] Goodwin,B., T. Babb, S. Kaffka, and L. Godfrey. 2007. Biorational management of beet armyworms in sugar beets in the Central Valley, Larry Godfrey and Tom Babb. http//sugar beet. Ucdavis.edu.2007.

[4] Sabbour, M, M. 1992. Biology of some stored product pests as affected by microbial control agents. M. Sc. Thesis Faculty of Science. Cairo Uni. 198.

[5]Sabbour, M. M. 2003. The combined effects of some microbial control agents mixed with botanical extracts on some stored product insects. Pak. J. of Biol. Sci. 6 (1): 51-56.

[6] Sabbour, M. M. 2006. Effect of some fertilizers mixed with bioinsecticides on the potato tuber moth *Phthorimaea operculella* infesting potato in the field and store. . Pak. J of Biol. Sci. (1) 10: 1351-1356.

[7]Sabbour, M. M and Abdel-Rahman, A . 2007. Evaluations of some terpenes and entomopathogenic fungi on three sugar beet insect pests. J. Boil. Pest. Cont. 17:22-29

[8] Sabbour, M. M. and Sahab, A. 2005. Efficacy of some microbial control agents against cabbage pests in Egypt. Pak. J.of Biol. Sci. (8) 10: 1351-1356.

[9]Sabbour. M. M. and A. F. Sahab. 2007. Efficacy of some microbial control agents against *Agrotis ipsilon* and *Heliothis armigera* in Egypt. Bull. N. R. C. Egypt.13: 16-20.

[10] El-Husseini , M. M.; Shahira. S. Marei; A. Mesbah; Amal . El-Zoghby; Sahar, S. Ali; Naglaa, A. M. Omar; E. A. Agamy; H. E. Abou-Bakr; N. S. Nada; Sherin Tamer; Hannah, M. Kamal and A. M. I.brahim. (2004). Isolation production and use of entomopathogenic fungi for controlling sugar beet insect pests in Egypt. Egypt. J. Biol. Pest Control. 14: 262-275.

[11] Sabbour, and Ismail. A. Ismail. 2001. The combined effect of microbial control agents and plant extracts against the potato tuber moth *Phthorimaea operculella* Zeller. Bull. J. N.R.C. Egypt. 27 (4): (459-467).

[12]Ismail, A. I. and M. M. Sabbour, 2002. The role of certain terpenes in increasing the efficacy of microbial insecticides against cotton bollworms. J. Egypt. Ger. Soc. Zool. 37:1-11.

[13] Rombach, M. C.; R. M. Aguda; and D. W. Robert, 1988. Production of *Beauveria bassiana* in different liquid media and subsequent conditions mycelium. Entomol., 33:315-234.

[14] A bbott, W. S., 1925. A method of computing the effectiveness of an insecticide. *J. Econ. Ent., 18: 265-267.* (15) Finney, D. J., 1964. Probit analysis. 2nd Ed., Cambridge. Univ. Press. England. 318 PP.

[15] Finney, D. J., 1964. Probit analysis. 2nd Ed., Cambridge. Univ. Press. England. 318 PP.

[16] Henderson, C. G. and E. W. Tiltron 1955. Tests with acaricides against the brown wheat mite. J. econ. Entomol. 48: 157-161.

[17] Sabbour, M.M. 1995. Studies of some microbial insecticides on *Earias insulana* (Boised) (Lepidoptera: Noctuidae). PhD thesis Cairo university Fac of science. PP:

[18]Fadel M. M. and Magda Sabbour, 1998. Utilization of coffee waste for the production of bioinsecticides under solid stat fermentation. J. union. Arab Biol, Cairo. 6 (B), 295-305.

[19] Fadel, M. and Magda Sabbour, 2002. Utilization of dairy by product in production of bioinsecticides. Online. J. of. Biol. Sci. 2(2): 116-120.

[20] Sabbour, M. M.2002 a. The role of chemical additives in enhancing the efficacy of *Beauveria bassiana* and *Metarhizium anisopliae* against the potato tuber moth *Phthorimaea operculella* (Zeller) (Lepidoptera: Gelechiidae). Pakistan. J. of Biol. Sci. 5(11): 1155-1159.

[21]Sabbour, Magda M, 2002b.Evaluation studies of some bio-control agents against corn borers in Egypt.Annal Agric. Sci. Ain Shams Univ. Cairo, 47(3): 1033-1043

[22] Sabbour, M.M , 2007. Evaluations of some entomopathogenic fungi and the predator *Coccinella septempunctata* against cereal aphids in Egypt, 2007. Egypt**.** Bull. ent. Soc. Egypt.Econ. 33: 165-174.

[23]Magda M. Sabbour, Shadia E-Abd-El-Aziz (2010). Efficacy of some bioinsecticides against *Bruchidius incarnatus* (BOH.) (Coleoptera: Bruchidae) Infestation during storage. *J. Plant Prot. Res. 50, (1): 28-34.*

[24]Sabbour, M.M and Shadia E-Abd-El-Aziz 2007. Efficiency of Some Bioinsecticides Against Broad Bean Beetle, *Bruchus rufimanus* (Coleoptera: Bruchidae).Res. J. of Agric.and Biol. Sci. 3(2): 67-72.

[25]Sabbour, M.M.; Shadia El-Sayed Abd-El-Aziz, Marwa Adel Sherief. (2012). Efficacy of three entomopathogenic fungi alone or in combination with diatomaceous earth modifications for the control of three pyralid moths in stored grain. J of. Plant Pro. Res.. Vol. 52, No. 3 :359-363

[26] Magda Mahmoud Sabbour and Shadia El-Sayed Abd-El-Aziz. 2014. Control of *Bruchidius incarnatus* and *Rhyzopertha Dominica* using two entomopathogenic fungi alone or in combination with modified diatomaceous earth. Elixir Entomology 68 (2014) 22239-22242.

[27]Sabbour, H.S and Shadia .E. Abed El-Aziz Sabbour, M. M. 2003. The combined effects of some microbial control agents mixed with botanical extracts on some stored product insects. Pakistan. J. of Biol. Sci. 6 (1): 51-56

[28] Sabbour, M.M . 2012. Evaluations of some bioagents against the rice weevil *Sitophilus oryzae* under laboratory and store conditions. *Integrated Protection of Stored Products. IOBC-WPRS Bulletin Vol. 81, pp. 135-142*.

[29]Sabbour, M.M . 2012a. Evaluations of some bioagents against the rice weevil *Sitophilus oryzae* under laboratory and store conditions. *Integrated Protection of Stored Products. IOBC-WPRS Bulletin Vol. 81, pp. 135-142*.

[30]Sabbour M.M. 2012b. Entomotoxicity assay of two Nanoparticle Materials 1-(Al2O3and TiO2) Against *Sitophilus oryzae* Under Laboratory and Store Conditions in Egypt**.** Journal of Novel Applied Sciences. 1-4/103-108

[31]Sabbour, M.M., M. Ragei and A. Abd-El Rahman, 2011. Effect of Some Ecological Factors on The Growth of *Beauveria bassiana* and *Paecilomyces fumosoroseus* Against Corn Borers**.** Australian Journal of Basic and Applied Sciences, 5(11): 228-235, 2011

[32]Sabbour, M.M and Abbass, M.H.2007. Efficacy of some microbial control agents against onion insect pests in Egypt. Egypt. J. boil. Pest. Cont. 17: 23-27.

[33] Sabbour.M.M.and M. H. Abbass, 2006. The role of some bioagent mixed with some fertilizers for the control of onion pests. pak. J. Appl. Sci.2(9): 624-628.

[34]Asmaa, Z. El-Sharkawey; M. Ragei; Sabbour, M.M. Hassen Abel-Latif. A. Mohamed and Rasha Samy.(2009).Antioxidants as UV-protectants for *Bacillus thuringiensis*" photoprotection of *Bacillus thuringiensis*" . aus. J. basic and Appl. Sci, 3 (2): 358-370.

[35] Hassan Abdel-Latif A. Mohamed, M.M. Sabbour, M. Ragaei and Rasha Samy. 2012e. Characterisation of *Bacillus thuringiensis* mutant highly producing melanin pigment and active against potato tuber moth. Archives of Phytopathology and Plant Protection. Vol. 45, No. 5, March 2012, 547–560.

[36]Hassan Abdel-Latif A. Mohamed1*, Mohamed Ragaei Abd El-Fatah, Magda M. Sabbour, Asmaa Z. El-Sharkawey and Rasha Samy El-sayed (2010). Genetic modification of *Bacillus thuringiensis* Var *Kurstaki* HD-73 to over reduce melanin, UV resistance and their insecticida l potentiality against potato tuber moth. Int. J. Of Acad. Res.Vol. 2. No. 6. Nov. (I) : 73-83.

[37]Sabbour, M. M and Hany, A. 2007. Controlling of *Bemisia tabaci* by *Verticillium lecanii* and *Paecilomyces fumosoroseus* in potato field. Egypt**.** Bull. ent. Soc. Egypt, 33:135-141.

[38] Sabbour, M. M and Hany, A. 2007. Evaluations of some entomopathogenic fungi and *Trichogramma evanescens* on the potato tuber moth in the field Egypt**.** Bull. ent. Soc. Egypt. Egypt**.** Bull. ent. Sco. Egypt, 33: 115-123

[39]Sahab, A .F and Sabbour, M.M, (2011). Virulence of four entomopathogenic fungi on some cotton pests with especial reference to impact of some pesticides, nutritional and environmental factors on fungal growth. Egyp. J. biol pest cont. 21 (1): 61-67.

[40] Sahab ,A.F; Sabbour , M.M.,Attallah,A.G. and Abou-Serreh, Nivin. 2014. Genetic analysis of the entomopathogenic fungus *Beauvaria bassiana* to the corn borers tested by UV as physical mutagen. *International Journal of ChemTech Research Vol.6, No.5, pp 2319-7064*

[41] Sabbour, M. M.2007b. Effect of some natural bioagents and natural enemies against aphids in wheat fields J. Boil. Pest. Cont 33: 33-39.

[42] Sabbour, M.M. 2009. Evaluation of two entomopathogenic fungi against some insect pests infesting tomato crops in Egypt , IOBC/wprs Bulletin, Vol. 49: 273-278.

[43]Sabbour M.M. and M.A. Abd-El-Raheem. 2013. Repellent Effects of Jatropha curcas, canola and Jojoba Seed oil, against *Callosobruchus maculates* (F.) and *Callosobruchus chinensis* (L.). Journal of Applied Sciences Research, 9(8): 4678-4682, 2013

[44]Sabbour, M.M. 2013a. Efficacy of *Isaria fumosorosea* against olive pests under laboratory and field conditions in Egypt. I. J of development (1): 55-61.

[45]Sabbour, M.M. 2013b. Preliminary Investigations Into The Biological Control Of Red Palm Weevil *Rhynchophorus ferrugineus* By Using *Beauveria bassiana* In Egypt. Emerging Issues in the Natural and Applied Sciences 2013; 3(1), 85-99. DOI: 10.7813/einas.2013/3-1/7

[46] -Sabbour, M. M and Abdel-Rahman, A . 2007. Evaluations of some terpenes and entomopathogenic fungi on three sugar beet insect pests. J. Boil. Pest. Cont. 17:22-29