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# Efficacy of Two Entomopathogenic Fungi against Corn Pests Under Laboratory and Field Conditions in Egypt

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**Abstract:** The effect of the twoentomopathogenic fungi Paecilomyces carneus and Paecilomyces farinosuss tested under laboratory green house and field conditions. The results showed that, the LC50 of the entomopathogenic fungi P. carneus ,149X104, 166X104 and 176X104 spores/ ml for Ostrinia nubilalis, Sesamia cretica and Chilo agamemnon., respectively. under green houseconditions, the corresponding LC50, 156 X104 , 189 X104 and 195 X104 spores/ml. The effect of the entomopathogenic fungi under corn field conditions , detected that during season 2013 the means number of infestation with O. nubilalis significantly decreased to 15±3.1, 20±2.2 and 23±3.2 individuals after 20, 50 and 90 days of post applications as compared to 42 ±5.2, 69±4.3 and 88±2.3 individuals in the control. In all treatments the infestations significantly decreased after the fungi applications (Table 3). Table 4 show that the weight of corn were significantly increased to 3820± 51.6 and 3981 ±60.4 kg/feddans in the plots treated with P. lilacinus in season 2013 and 2014 ., as compared to 2511 ± 50.9 and 2210 ± 73.2 kg/ feddan in the control respectively..

**Keywords:** Paecilomycescarneus, Paecilomyces farinosuss,Ostrinia nubilalis,Chilo agamemnon, Sesamia cretica.

## 1. Introduction

Paecilomyces carneus is found on a wide range of material, and especially in soil. It is sometimes isolated from insects, though it appears to be a weak insect pathogen. Some isolates produce several metabolites of the antibiotic group cephalosporins. P. farinosus is also commonly isolated from soil. It is a well-known insect pathogen, and there has been interest in its use as an agent of biological control. Maize (Zea mays.) is an important crop all over the world and also in Egypt. Its demand continuously increases. Corn is subjected to attack by many insect pests that affect the yield quality and quantity. Among the most common pest species surveyed in Egypt are: Ostrinia nubilalis, Sesamia cretica and Chilo agamemnon. O. nubilalis is the one of key pest damaging corn in Egypt [1]. O. nubilalis is native to Mediterranean countries which has 98% of the world's cultivated corn [2]. Nomuraea rileyi (N.r) and Paecilomyces farinosuss(P.f) proved highly pathogenic to aphids and whiteflies [3]. The fungus (N. rileyi) exhibit host preferential infections in lepidopterous larvae, the fungi penetrate the integuments, spread rapidly blocked the respiratory pores lead to pest death [4] .Spinosad is a broad-spectrum, organic insecticide. It is, however, relatively non-toxic to mammals and beneficial insects. If used carefully only against insects that actually eat something that has been treated, such as a leaf, are affected. This is different than a lot of other broad-spectrum insecticides that are toxic if the insect merely comes in contact with dry insecticide residues [5] .The entomopathogenic P. carneus is found on a wide range of material, and especially in soil. It is sometimes isolated from insects, though it appears to be a weak insect pathogen. Some isolates produce several metabolites of the antibiotic group cephalosporins. Paecilomyces carneusis also commonly isolated from soil. It is a well-known insect pathogen, and there has been interest in its use as an agent of biological control. [6], [7], [8], [9] control the corn borers by different entomopathogenic fungi under laboratory and field conditions. Entomopathogenic fungi are found worldwide associated to insects and phytophagous mite populations, contributing to biological control of these arthropods on several economically important crops [10] . Commercial products have been developed with entomopathogenic fungi

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[11], [12] reported that fungal concentrations of 106 and 107 conidia/ml of B. bassiana and N. rileyi affected the larval development, movement and mobility of corn borers larvae during the seedlings and vegetative stages of corn plant under laboratory; greenhouse and field conditions. Success of a pest control program using [13], [14], [15], [16][17], [18], [19] [20] . [21] and [22] could to control lepidopterous insect pestsby the entomopathogenic fungi. [23] Controlthe corn borers by the entomopathogenic fungi.Fungi however depends on conidia survival in the field environment [24].Conidia survival may be affected either by environmental factors[25] or chemical products used to protect plants [26] and [27]. [28] Controlled the cereal aphids with the fungus B. bassiana and found that the infestation was reduced after fungal applications under laboratory and field conditions. It is necessary to find alternative safe insecticides to reduce the heavy doses of chemical insecticides which is using for the control of corn pests [29] ,[30]
and[5].
The present study aims to evaluate the pathogenicity of the two soil isolates of entomopathogenic fungus, Paecilomyces farinosussand Paecilomycescarneusagainst corn insect pests under laboratory and field conditions.

## 2. Materials and Methods

**2.1. Tested Insects**:

Sesamia cretica; Ostrinia nubilalis; Chilo agamemnon rearedon corn leaves under laboratory conditions 26 ± 2o C and 60± 5 RH. Leaves changed every two days.

Entomopathogenic Fungi:

The fungus, Paecilomyces carneus, and Paecilomyces farinosuss isolated from the Egyptian soil from Ismailia governorate. They were reproduced on potato dextrose agar (PDA) plus 0.4% yeast extracts (PDAY) and poured onto sterilized Petri-dishes [11]. Plating was performed according to the full dish method. The conidia were transferred from the Eppendr of vial to dish containing medium by platinum loop and then streaked. Plates were incubated at 25°C with 12 hours photo phase for fungus growth and sporulation. After ten days, conidia were scraped and transferred to conical flasks (200 ml) containing 200 ml sterilized distilled water with 0.02% the speeder sticker (tween, 80). Conidial concentrations in the suspensions were quantified directly under the optical microscope with a haemacytometer. Then the suspensions were standardized until the direct concentration 1x107 conidia/ ml was obtained.

**2.2.Efficacy of Entomopathogenic Fungi against Pests Larvae:**

Spores of the entomopathogenic fungi; Paecilomyces carneusand Paecilomyces farinosuss, collected from the surface of mycelium growth and spore suspensions with 2 drops of tween 80 were prepared and adjusted at 1x107 conidia/ ml. Conidial viability was determined by counting germ tubes produced on PDAY medium after 18 hrs, using light microscope at 400 x. Conidial viability was 95-100%. The surface of cultures was gently brushed in the presence of 20ml of sterilized water in order to free the spores and the suspension was filtered through muslin. Six concentrations of spore suspensions were prepared i.e., 107, 106, 105, 104, 103, and 102 conidia/ml. Piece of corn leaves were dipped in the prepared suspensions and left for drying under laboratory conditions then placed in Petri-dishes (one/dish). For each concentration (4 replicates/ each), ten L3 larvae of each of the tested insects were transferred into each Petri-dish. Control larvae were fed on untreated castor leaves. Percentages of mortality were calculated according to Abbot, while LC50 was calculated throughout probit analysis. The experiment was carried out under laboratory conditions at 26°C± 2 and 60-70 % RH. Physiological and metabolic characteristics of P. farinosuss and P. carneus.

**2.3. Field Trials:**

Field trials were carried out at Nobaria region (Behera Governorate), Egypt during the two successive corn seasons 2013 and 2014 to study the effectiveness of the tested fungi on corn borers. Corn (variety Giza 2) was cultivated by end of May during the two seasons in an area of about half feddan. Fungi were applied as single treatments in randomize plots. Regular agricultural practices were performed and no chemical control was used during the study period. Weeds were removed by hand. Five plots were sprayed with water as control. Samples from each treatment were collected weekly and transferred to the laboratory for investigation. Percentages of infection were estimated.

**2.4. Yield Assessment:**

Yield data in treated and untreated plots in the corn harvest seasons (2013and 2014), represented by weight in kgs were determined. Yield loss was estimated according to the following equation:Yield loss = Potential yield – Actual yield X 100

Potential yield

Potential yield is Paecilomyces carneus treatment (the best result among the tested pathogens) was considered the standard for comparison with the other ones (Actual yield).

## 3. Results

Data in Table 1 ,show that the LC50 of the entomopathogenic fungi P. carneus , 149X104, 166X104 and 176X104 spores/ ml for Ostrinia nubilalis, Sesamia cretica and Chilo agamemnon., respectively. under green house conditions, the corresponding LC50, 156 X104 , 189 X104 and 195 X104 spores/ml (Table 2).The effect of the entomopathogenic fungi under corn field conditions , detected that during season 2013 the means number of infestation with O. nubilalis significantly decreased to 15±3.1, 20±2.2 and 23±3.2 individuals after 20, 50 and 90 days of post applications as compared to 42 ±5.2, 69±4.3 and 88±2.3 individuals in the control. In all treatments the infestations significantly decreased after the fungi applications (Table 3). Table 4 show that the weight of corn were significantly increased to 3820± 51.6 and 3981 ±60.4 kg/feddans in the plots treated with P. carneus in season 2013 and 2014 ., as compared to 2511 ± 50.9 and 2210 ± 73.2 kg/ feddan in the control respectively. At the harvest time the corn weight obtained 3822±54.6 and 3941±60.4

kg/Feddan among the harvested plots treated with N. rileyi as compared to 2810±40.9 and 1710±73.2 (Table 4).

## 4. Discussion

The same results obtained by [23] reported that under laboratory conditions results showed that the LC50 ofPhyllotreta cruciferaem, Pegomyia hyoscami and Cassidavittataof the tested fungi Verticillium lecanii (V.l), Nomuraea rileyii (N.r) andPaecilomyces farinosuss (P.f), respectively against the three pests ranged between 5.4x106 and 1.43x107 spores/ml. Satisfactory results with the entomopathogenic fungi were reported by [31] and [32] [33], [8] as they found that the fungi; B. bassiana and M. anisopliae reduced the LC50 of S. littoralis under laboratory conditions.

The obtained results are similar to other studies carried out by[33] [22]andon their work onC. Capitata and increased the yield. These results agree with [8], [14], and [35], who proved that the application with bioinsecticides increased the yield and decreased the infestation with insect pests. Also, results were in accordance with [30] who reported that the virulence of B. bassiana against C. capitata ranged between 8 to 30% and decrease the infestation among the olive fruits.[36] recorded that C. capitata mortality ranged between 69 and 78% after bioinsecticides treatments.

kg/Feddan during seasons 2011 1nd 2012, respectively Table 4. The same results [41] control the potato tuber moth by two entomopathogenic Paecilomyces sp. [43], [44].[42], controlled cereal aphids with entomopathogenic fungi. They found that the infestation was reduced after fungi applications under laboratory and field conditions [39], [10] , [40]and [36] found that the fungi B. bassiana, M. anisopliae, Pacilomyces fumosoroseus Verticillium lecanii; reduced insect infestations of cabbage and tomato pests under laboratory and field conditions.

The same findings obtained by ([39], [10] ,[38] , [39] [40] and [13], found that the fungi B. bassiana, M. anisopliae, Pacilomyces fumosoroseus Verticillium lecanii; reduced insect infestations of cabbage and tomato pests under laboratory and field conditions. [6] found that,in all treatments the number of corn pests were significantly decreased. loss of the yield by [8] and 15), proved that applications with bioinsecticides increased the yield and decreased the infestations. Sabbour & Sahab ([39], [10] and [36]) found that the fungi reduced insect infestations of cabbage and tomato pests under laboratory and field conditions. These results agree with , ([8] and [35]), proved that applications with bioinsecticides increased the yield and decreased the the infestation with insect pests.

**Table 1.** Effect of the entomopathogenic fungi *Paecilomyces carneus*, against the target insect pests larvae under laboratory conditions.

| *Insects* | $LC_{50}$ | *slope* | *variance* | *95%confidence limits* |
|---|---|---|---|---|
| *Ostrinia nubilalis* | $149X10^4$ | 0.1 | 1.01 | 99-166 |
| *Sesamia cretica* | $166X10^4$ | 0.2 | 1.00 | 110-189 |
| *Chilo agamemnon* | $176X10^4$ | 0.1 | 1.03 | 135-199 |

**Table 2**.Effect of the entomopathogenic fungi *Paecilomyces farinosuss*, against the target insect pests larvae under laboratory green house conditions.

| *Insects* | $LC_{50}$ | *slope* | *variance* | *95%confidence limits* |
|---|---|---|---|---|
| *Ostrinia nubilalis* | $156X10^4$ | 0.01 | 0.02 | 111-176 |
| *Sesamia cretica* | $189\ X10^4$ | 0.1 | 1.01 | 134-187 |
| *Chilo agamemnon* | $195X10^4$ | 0.1 | 1.01 | 145-239 |

**Table 3**.Effect of different treatments on the target insect pests under field conditions.

| Post 1st application date | Treatments | Number of infestation (means)±s.e during both two seasons | | | | | |
|---|---|---|---|---|---|---|---|
| | | *Ostrinia nubilalis* | | *Sesamia cretica* | | *Chilo* agamemnon | |
| | | 2013 | 2014 | 2013 | 2014 | 2013 | 2014 |
| Control | 20 | 42 ±5.2 | 49±3.1 | 65±2.8 | 70±2.3 | 68±3.4 | 72±2.2 |
| | 50 | 69±4.3 | 70±3.1 | 79±3.4 | 83±2.5 | 86±3.4 | 91±5.3 |
| | 90 | 88±2.3 | 96±2.1 | 88±5.1 | 97±2.1 | 98±3.3 | 99±6.3 |
| *P. carneus* | 20 | 15±3.1 | 20±2.1 | 20±4.4 | 24±5.1 | 20±4.3 | 18±1.2 |
| | 50 | 20±2.2 | 23±2.1 | 21±4.7 | 22±3.2 | 21±3.4 | 21±4.4 |
| | 90 | 23±3.2 | 19±1.2 | 21±2.4 | 19±2.3 | 24±2.3 | 21±4.2 |
| *P.farinosuss* | 20 | 35±3.3 | 31±2.1 | 20±4.4 | 24±5.1 | 41±3.4 | 37±2.2 |
| | 50 | 40±4.2 | 35±1.2 | 21±4.7 | 22±3.2 | 34±2.3 | 31±4.2 |
| | 90 | 39±7.2 | 30±1.3 | 21±2.4 | 19±2.3 | 27±1.3 | 25±3.3 |
| F value | | 25.4 | 17.1 | 33.9 | 20.1 | 36.1 | 20.4 |
| Lsd5% | | 11.4 | 17.8 | 14.9 | 16.9 | 15.9 | 16.9 |

**Table 4**. Assessments of damage caused in cotton field after the fungi treatment

| Treatments | Season 2013 | | Season 2014 | |
|---|---|---|---|---|
| | Wt of corn crop (kg/ feddan) | yield loss% | Wt of corn crop (kg/ feddan) | yield loss% |
| *P. carneus* | *3820± 51.6* | - | 3981 ±60.4 | - |
| *P. farinosuss* | *3400 ± 80.7* | 21 | 3724 ± 89.1 | 20 |
| *Control* | 2511 ± 50.9 | *26* | 2210 ± 73.2 | 31 |
| F value | 30.6 | | 32.9 | |
| Lsd5% | 121.7 | | 125.5 | |

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