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PJBS

ISSN 1028-8880

# Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 9 (10): 1929-1934, 2006
ISSN 1028-8880


# Effect of Some Fertilizers Mixed with Bioinsecticides on the Potato Tuber Moth *Phthorimaea operculella* Infesting Potato in the Field and Store

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**Abstract:** Five types of fertilizers were applied to potato plant cultivation. Namely: compost banana, livestock's manure, poultry wastes, urea and ammonium nitrate. The population densities of *Phthorimaea operculella* population infesting different fertilized potato cultivation were evaluated in both the field and the store. When the bioinsecticides *Bacillus thuringiensis*, *Beauveria bassiana*, *Metarhizium anisopilae*, margosan-O were added to the fertilizers during the fertilization periods; the densities of the potato tuber moth *P. operculella* were significantly reduced. Accordingly, spoiled potatoes were significantly decreased in the treated areas. The highest potatoes weights (399 and 439 kilos/fedan) were obtained when the fungus *B. bassiana* was mixed with compost banana fertilizer during season, 2003 and 2004 season, respectively. Addition of other bioinsecticides to the fertilizers also showed different levels of reductions in the weight loss of the potato crop during both seasons.

**Key words:** *Phthorimaea operculella*, *Bacillus thuringiensis*, *Beauveria bassiana*, *Metarhizium anisopila* margosan-O, fertilizers

## INTRODUCTION

Potato plant *Solanum tuberosum* (L.) was considered as a major export crop in Egypt (Abu El-Naser *et al*., 1971; Mariy *et al*., 1999). Its economic importance comes after cotton and rice crops. The potato tuber moth *P. operculella* (Lepidoptera-Gelechiidae) *et al* is a major pest of potatoes in Egypt. It causes sever damages to the potatoes during harvest and in the store (Hemeide, 1976). Chemical control caused a harmful damage to the environment, man and livestock. Anwar *et al*. (1993), Chakraborty and Maslem (1990) and Sundararaju and Rangajian (1987) found that the combinations between the fertilizers and chemical insecticides, decreased the infestations with the insect pests in the field.

On the other hand, biological insecticides (bacteria, fungi, viruses and plant extract) have been widely used due to their high specificity without harmful side effect on the surroundings (Sabbour, 1992; Amonkar *et al*., 1979).

Effects of the fertilizers on the soil system and especially on the soil organisms are poorly known. It was assumed that the nitrogen fertilizers stimulate the growth of the microorganisms and thus, indirectly, the soil fauna feeding on them. Several authors have found increased abundance of soil organisms after moderate fertilization (Hill *et al*., 1975). *P. operculella* pupae always past its pupation period in soil. This would lead to the contamination with different fertilizers in soil. The effect of fertilized potato cultivations on the quality and quantity of potatoes may reflected, in part on its tolerance ability to insects especially *P. operculella*. In other parts mixing fertilizers with bioagents (fungi, bacteria and plant extracts) caused various mortalities in the pupae, (Amonkar *et al*., 1979; Sabbour, 1992; Salama *et al*., 1994; Magda and Ismail, 2001) could to control the different stages of the insect pests by bacteria and fungi.

This research aimed to know how far mixing some biological control agents (bacteria, fungi and plant extract) with different fertilizers instead of insecticides, could affect the population density of *P. operculella* in the field and in the store, as field infestation levels might be inflicted on the spreading and consequently the population density of the pest in the store.

## MATERIALS AND METHODS

Potato plant was cultivated in the National Research Centre farm in El Nobaria (El- Esraa farm). The field trials were carried out during two successive seasons (2003 and 2004). The potato plants were planted in October 15th of every season in an area divided into twenty five plots 100 $m^2$/each. Five plots were used for each fertilizers

(alone or mixed with each bioinsecticide). The plots were arranged according to randomized plots design. Suitable distances were left between plots without cultivations. The agricultural practices were made according to the Ministry of Agricultural recommendation.

**Methods of fertilization:** Five types of fertilizers were used during the experiments; the compost banana, livestock's manure, chicken manure, urea and ammonium nitrate.

Compost is considered as one of the most important organic fertilizers, especially when it was produced by scientific methods. It contains the essential matter for growing healthy plants and easily absorbed.

Fertilization of the soil was achieved before cultivation of potato plant.

The fertilizer matter was added to the soil at the rate of 200 g/fedan.

**Impact of some fertilizers and some biological insecticides on *P. operculella* infestations:** The biological control agents were added to the fertilizers as follows:

1. *B. thuringiensis*, *B. bassiana* or *M. anisopilae* were applied with each fertilizer types at the rate of 50 g/10 L water/100 $m^2$. The plant extract margosan-O at 5% concentration level was applied to the fertilizer at the rate of 10%. Fifty samples of potato plant were collected, weakly, from each treatment (treated plot), at random and transmitted to the laboratory. This was replicated four times. The number of the potato tuber moths was recorded each time interval till harvest in both seasons. The mean number of individuals/treatment/fedan was estimated.

After harvest, the potatoes were collected in a sharlots and transferred to the store for each kind of fertilizers (alone or mixed with a biological insecticide). Twenty samples of tubers were collected each week at random, checked for *P. operculella* infestation and the number of insects were counted at each time interval in each treatment.

The mean number of *P. operculella* infesting potatoes during the whole season was calculated in each case.

**Yield assessment:** The yield in kg/fedan for each treatment was estimated. Yield loss was calculated according to the following equation:

$$\text{Yield loss} = \frac{\text{Potential yield} - \text{actual yield} \times 100}{\text{Potential yield}}$$

Potential yield was based on the highest yield obtained on using mixture of compost banana mixed with the *B. bassiana* in each season.

## RESULTS AND DISCUSSION

The means of *P. operculella* individuals/fedan infesting potato plants in plots fertilized with compost banana, livestock's manure, poultry wastes, urea and ammonium nitrate were 182.7, 174.9, 199.9, 163.6 and 186.4, respectively (Table 1).

These figures expect that of poultry wastes showed insignificant differences from control (cultivation without fertilizer) the same results obtained by Ware and Mc Collum (1980) and Dartt *et al.* (2002) who found that the different fertilizations levels of the crops may increase the infestation with inset pests. But Krauss (2005) reported that the useage of the fertilizers in the potato field increases the yield and decreases the infestation with the insect pests.

Mixing either of experimented bioagents *(B. thuringiensis*, *B. bassiana*, *M. anisopilae* or the margosan-O) with any of the tested fertilizers reveled either insignificant, slightly significant or highly significant reduction in the population density of *P. operculella* infesting potato plants. Addition of, *B.t* or marogas-O to any of the tested fertilizers caused slight or insignificant reductions ranged between (6.8-11.6%) in the pest population. While *B. bassiana* scored the highest significant reductions (26.4-36.15%); followed by *M. anisopilae* which achieved also high significant reduction ranged between 23 and 34.7% in the mean number of *P. operculella* infesting tubers as compared with those obtained from the corresponding nontreated fertilizers (Table 1).

Potatoes yield from each treatment, was transferred and placed separately, into the store. Different levels of field infestations were inflicted on the numbers of *P. operculella* during storage period in each type of treatment as shown in Table 2. The mean of *P. operculella* numbers in stored potatoes from plots fertilized with, compost banana, livestock's manure, poultry wastes, urea and ammonium nitrate, were 160.1, 154.8, 145.6, 134.7 and 122.3, respectively, which showed no significant difference decrease as compared with those in the control, Ware and Mc Collum (1980) and Dartt *et al.* (2002) who found that fertilization with nitrogen or phosphorous, would contribute to increase pest problems, the potatoes were more susceptible to storage pathogens in using excess nitrogen. Adequate ammonium nitrate, urea, potassium etc., levels are important in improving bulb quality and storage life. Organic matter in the form of either dry or green matter should be added to the soil to improve the quality of the crop.

Table 1: Effect of some fertilizers and some biological insecticides on the infestations with *P. operculella* larvae during season 2003 in the field

| | Mean No.±SE | | | | | | |
|---|---|---|---|---|---|---|---|
| Kind of fertilizers | Alone | +*B.t* | +*B. bassiana* | +*M. anisopilae* | +morgason-O | F-value | LSD 5% |
| Compost banana | 182.7±8.6$^{a}$ | 166.4±6.6$^{a}$ | 122.6±2.4$^{b}$ | 123.7±3.6$^{b}$ | 167.5±9.3$^{a}$ | 13.5 | 16.4 |
| % of reduction | - | 8.9 | 32.9 | 32.3 | 8.3 | | |
| Livestock's manure | 174.9±5.2$^{a}$ | 154.6±6.8$^{b}$ | 118.4±4.7$^{c}$ | 127.8±8.9$^{c}$ | 160.8±5.3$^{b}$ | 14.3 | 12.4 |
| % of reduction | | 11.6 | 32.3 | 26.9 | 8 | | |
| Poultry wastes | 199.6±6.8$^{a}$ | 178.8±7.5$^{b}$ | 127.5±3.6$^{c}$ | 130.2±5.2$^{c}$ | 180.6±4.4$^{b}$ | 20.4 | 18.46 |
| % of reduction | - | 10.4 | 36.1 | 34.7 | 9.5 | | |
| Urea | 163.6±8.4$^{a}$ | 145.1±3.8$^{b}$ | 120.4±3.9$^{c}$ | 125.6±7.4$^{c}$ | 151.3±7.3$^{b}$ | 16.7 | 16.1 |
| % of reduction | - | 11.3 | 26.4 | 23.2 | | 7.5 | |
| Ammonium nitrate | 186.4±4.7$^{a}$ | 70.7±4.4$^{a}$ | 136.5±4.3$^{b}$ | 143.5±3.6$^{b}$ | 173.4±5.6$^{a}$ | 18.7 | 17.6 |
| % of reduction | - | 8.4 | 26.7 | 23.0 | 6.9 | | |
| Control (unfertilized) | 170.9± 5.6$^{a}$ | | | | | | |
| Statistic analysis | F-value = 22.6 | | | | | | |
| | LSD 5% = 15.8 | | | | | | |

% of reduction in mixture based on the fertilizers density of *P. operculella*

Table 2: Effect of some fertilizers and some biological insecticides on the infestations with *P. operculella* during season 2003 during the storage period

| | Mean No.±SE | | | | | | |
|---|---|---|---|---|---|---|---|
| Kind of fertilizers | Alone | +*B.t* | +*B. bassiana* | +*M. anisopilae* | +margosan-O | F-value | LSD 5% |
| Compost banana | 160.1±4.3$^{a}$ | 145.2±3.9$^{b}$ | 111.9±1.7$^{e}$ | 116.7±7.7$^{d}$ | 133.8±8.8$^{b}$ | 20.1 | 13.8 |
| % of reduction | - | 9.3 | 30 | 27 | 16 | | |
| Livestock's manure | 154.8±6.9$^{a}$ | 133.5±1.7$^{b}$ | 120.4±3.6$^{b}$ | 123.5±8.7$^{b}$ | 144.6±4.6$^{a}$ | 35.7 | 13.3 |
| % of reduction | - | 13 | 22 | 20 | 6.5 | | |
| Poultry wastes | 145.6±8.4$^{a}$ | 122.2±2.8$^{a}$ | 103.9±5.8$^{b}$ | 111.1±6.3$^{b}$ | 22.6±8.3$^{a}$ | 20.7 | 30.6 |
| % of reduction | - | 16 | 28 | 23 | 15 | | |
| Urea | 134.7±6.6$^{a}$ | 120.6±2.9$^{a}$ | 101.6±7.9$^{a}$ | 121.3±3.9$^{a}$ | 121.4±7.3$^{a}$ | 10.8 | 37.6 |
| % of reduction | - | 10 | 24 | 9.9 | 9.8 | | |
| Ammonium nitrate | 122.3±5.4$^{a}$ | 110.1±5.4$^{a}$ | 112.6±3.5$^{a}$ | 109.9±8.9$^{a}$ | 112.3±4.5$^{a}$ | 11.7 | 19.6 |
| % of reduction | - | 9.9 | 7.9 | 8.9 | 8.1 | | |
| Control (unfertilized) | 151.5±7.8$^{a}$ | | | | | | |
| Statistic analysis | F-value = 29.7 | | | | | | |
| | LSD 5% = 18.7 | | | | | | |

% of reduction in mixture based on the fertilizers density of *P. operculella*

Table 3: Effect of some fertilizers and some biological insecticides on the infestations with *P. operculella* larvae during season 2004 in the field

| | Mean No. | | | | | | |
|---|---|---|---|---|---|---|---|
| Kind of fertilizers | Alone | +*B.t* | +*B. bassiana* | +*M. anisopilae* | +margosan-O | F-value | LSD 5% |
| Compost banana | 177.5±4.3$^{a}$ | 150.2±6.3$^{b}$ | 140.2±4.2$^{b}$ | 142.3±3.6$^{b}$ | 146.7±6.8$^{ab}$ | 20.4 | 35.1 |
| of reduction (%) | - | 15.3 | 21.0 | 19.8 | 17 | | |
| Livestock's manure | 155.7±8.3$^{a}$ | 141.1±4.8$^{b}$ | 122.2±5.9$^{b}$ | 133.4±5.5$^{b}$ | 144.6±5.2$^{a}$ | 13.2 | 30.3 |
| of reduction (%) | - | 9.3 | 21 | 14 | 7.1 | | |
| Poultry wastes | 149.3±5.6$^{a}$ | 130.1±3.7$^{a}$ | 112.3±3.9$^{b}$ | 122.4±3.6$^{b}$ | 133.4±3.7$^{a}$ | 19.3 | 31.2 |
| of reduction (%) | - | 12 | 24 | 18 | 10 | | |
| Urea | 166.7±4.7$^{a}$ | 138.7±5.7$^{b}$ | 101.3±5.8$^{b}$ | 116.3±1.6$^{b}$ | 149.5±4.7$^{a}$ | 18.6 | 32.6 |
| of reduction (%) | - | 8.3 | 39 | 30 | 10 | | |
| Ammonium nitrate | 144.8±5.8$^{a}$ | 140.6±6.7$^{a}$ | 124.7±7.3$^{b}$ | 123.5±3.8$^{b}$ | 132.4±5.7$^{a}$ | 19.5 | 26.7 |
| of reduction (%) | - | 2.9 | 13 | 14 | 8.5 | | |
| Control (unfertilized) | 160.76±4.9$^{a}$ | | | | | | |
| Statistic analysis | F-value = 25.8 | | | | | | |
| | LSD 5% = 17.7 | | | | | | |

% of reduction in mixture based on the fertilizers density of *P. operculella*

Those results disagree with Ettay and Coll (2005), Peirce (1987) and El-Kady *et al.* (1988) who reported that the useage of the fertilizers in the potato field increases the yield and decreases the infestation with the insect pests.

Addition of *B. thuringiensis*, or the margosan-O to fertilizers showed insignificant reduction in all cases except with livestock's manure fertilizer, while the addition of *B. bassiana* and *M. anisopilae* to the fertilizers caused significant reduction in all cases except mixing with urea and ammonium nitrate.

Similar results were almost obtained during the next season 2004 (Table 3).

It was shown that the mean of potato tuber moth numbers infesting different fertilized cultivations was ranged between 144.8 and 177.5/ fedan , which showed no different significant when compared with the 160.76, in the control (untreated) Addition of *B.t* or margosan-O

Table 4: Effect of some fertilizers and some biological insecticides on the infestations with *P. operculella* during season 2004 during the storage period

| | Mean No.±SE | | | | | | |
|---|---|---|---|---|---|---|---|
| Kind of fertilizers | Alone | +*B.t* | +*B. bassiana* | +*M. anisopilae* | +margosan-O | F-value | LSD 5% |
| Compost banana | 197.5±6.3$^{a}$ | 140.1±7.3$^{b}$ | 131.1±2.2c | 141.3±2.6$^{e}$ | 147.8±4.8$^{c}$ | 21.5 | 29.9 |
| % of reduction | - | 29 | 33 | 28 | 25 | | |
| Livestock's manure | 168.1±8.1$^{a}$ | 145.1±3.6$^{b}$ | 123.2±4.6$^{e}$ | 136.6±4.7$^{e}$ | 145.9±5.4$^{c}$ | 15.5 | 38.3 |
| % of reduction | - | 13 | 26 | 18 | 13 | | |
| Poultry wastes | 167.3±6.6$^{a}$ | 135.1±3.5$^{b}$ | 111.6±4.8$^{cd}$ | 125.3±3.9$^{e}$ | 139.6±3.8$^{b}$ | 19.1 | 31.4 |
| % of reduction | - | 19 | 33 | 25 | 16 | | |
| Urea | 169.8±2.7$^{a}$ | 134.3±4.7$^{c}$ | 100.5±3.8$^{b}$ | 118.4±2.5$^{e}$ | 146.6±2.5$^{b}$ | 14.8 | 33.6 |
| % of reduction | - | 20 | 40 | 26 | 13 | | |
| Ammonium nitrate | 153.6±4.7$^{a}$ | 129.4±8.4$^{a}$ | 130.6±9.3$^{b}$ | 127.8±4.7$^{e}$ | 135.5±6.6$^{b}$ | 17.2 | 36.9 |
| % of reduction | - | 15 | 14 | 16 | 11 | | |
| Control (unfertilized) | 171.6±6.4 | | | | | | |
| Statistic analysis | F-value = 21.5 | | | | | | |
| | LSD 5% = 19.7 | | | | | | |

% of reduction in mixture based on the fertilizers density of *P. operculella*

Table 5: Assessments of damage caused after fertilization of the potato and after adding the bioinsecticides to the fertilizer, 2003

| | Mean No. Wt. of potatoes kg$^{-1}$ | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Alone | | +*B.t* | | +*B. bassiana* | | +*M. anisopilae* | | +margosan-O | | | |
| Kind of fertilizers | Wt. of potatoes fed. | Yield loss (%) | Wt. of potatoes fed. | Yield loss (%) | Wt. of potatoes fed. | Yield loss (%) | Wt. of potatoes fed. | Yield loss (%) | Wt. of potatoes kg/fed. | Yield loss (%) | F-value | LSD 5% |
| Compost banana | 179$^{e}$ | 55.13 | 253$^{c}$ | 36.59 | 399$^{a}$ | 0 | 341$^{b}$ | 14.53 | 241$^{d}$ | 39.59 | 13.7 | 27.5 |
| Livestock's manure | 164$^{e}$ | 58.89 | 349$^{c}$ | 12.53 | 392$^{a}$ | 1.75 | 333$^{b}$ | 16.54 | 259$^{d}$ | 35.08 | 28.3 | 37.3 |
| Poultry wastes | 142$^{e}$ | 64.41 | 247$^{c}$ | 38.09 | 382$^{a}$ | 4.26 | 341$^{b}$ | 14.53 | 246$^{d}$ | 38.34 | 19.7 | 34.6 |
| Urea | 212$^{e}$ | 46.86 | 230$^{c}$ | 32.15 | 251$^{a}$ | 37.09 | 248$^{b}$ | 37.84 | 229$^{d}$ | 42.60 | 22.6 | 35.4 |
| Ammonium nitrate | 132$^{e}$ | 66.91 | 252$^{c}$ | 36.84 | 274$^{a}$ | 31.32 | 223$^{b}$ | 44.11 | 212$^{d}$ | 46.86 | 21.2 | 27.9 |
| Control (unfertilized) | 101 | 74.68 | | | | | | | | | | |

Table 6: Assessments of damage caused after fertilization of the potato and after adding the bioinsecticides to the fertilizer, 2004

| | Mean No. Wt. of potatoes kg$^{-1}$ | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Alone | | +*B.t* | | +*B. bassiana* | | +*M. anisopilae* | | +margosan-O | | | |
| Kind of fertilizers | Wt. of potatoes fed. | Yield loss (%) | Wt. of potatoes fed. | Yield loss (%) | Wt. of potatoes fed. | Yield loss (%) | Wt. of potatoes fed. | Yield loss (%) | Wt. of potatoes kg/fed. | Yield loss (%) | F-value | LSD 5% |
| Compost banana | 267$^{e}$ | 39.17 | 358$^{c}$ | 18.45 | 439$^{a}$ | 0 | 368$^{b}$ | 16.17 | 300$^{d}$ | 31.66 | 18.3 | 32.9 |
| Livestock's manure | 287$^{e}$ | 39.18 | 348$^{c}$ | 20.72 | 362$^{a}$ | 17.53 | 376$^{b}$ | 14.35 | 299$^{d}$ | 31.89 | 17.9 | 35.8 |
| Poultry wastes | 234$^{e}$ | 46.69 | 330$^{c}$ | 24.82 | 352$^{a}$ | 19.81 | 344$^{b}$ | 21.64 | 276$^{d}$ | 37.12 | 39.2 | 34.8 |
| Urea | 214$^{e}$ | 51.25 | 336$^{c}$ | 23.46 | 331$^{a}$ | 24.60 | 342$^{b}$ | 22.09 | 256$^{d}$ | 41.68 | 23.9 | 31.7 |
| Ammonium nitrate | 144$^{e}$ | 67.19 | 246$^{c}$ | 43.96 | 284$^{a}$ | 35.30 | 253$^{b}$ | 42.36 | 209$^{d}$ | 52.39 | 28.4 | 39.8 |
| Control (unfertilized) | 111 | 86.10 | | | | | | | | | | |

to different fertilizers in the field, caused insignificant reduction in *P. operculella* population density. Mixing *B. bassiana* with all tested fertilizers except ammonium nitrate achieved significant reduction ranged between 21-39%. In case of *M. anisopilae*, significant reduction was only obtained when mixed with urea; while reductions due to the addition of any biological agent to ammonium nitrate fertilizer (11-16%) were insignificant.

In the store, the means of *P. operculella* individuals were 197.5, 168.7, 167.3, 167.8 and 153.6 among stored potatoes from cultivations, fertilized with compost banana livestock manure, poultry manure and ammonium nitrate and it was 171.6 in the control, respectively (Table 4). Behan (1972), Abo-Korah *et al.* (1982), Peirce (1987) and El-Kady *et al.* (1988) reported that fertilizers caused a positive effect on populations growth of some insect pests in the field. It was found that the nitrogenous fertilizers increased the numbers of Tarsone mina in okra Marshall (1977), found that a moderate levels of nitrogenous fertilizers increase mite populations in agricultural soils.

The corresponding number of bioinsecticides treated fertilizers showed various reductions in *P. operculella* population were estimated. Reduction due to *B.t* or margosan-O were found insignificant in all cases except with compost banana fertilizer, while significant reductions were evaluated due to the addition of *B. bassiana* to any of the tested fertilizers except ammonium nitrate (Table 4). The same results obtained after addition of *M. anisopilae*.

Data shows that highest weight of the potatoes (399 kg/fedan) was obtained when using a mixture of compost banana and *B. bassiana* while it was 179 kg/fedan when the crop was fertilized with compost banana only. In all tested treatments the weight of the potatoes crop was ranged between 132 and 392 kg/fedans. The percentage of yield loss was ranged between 1.75- 66. 91% (Table 5).

Data in Table 6, shows that the highest yield (439 kg/fedans) was obtained when the fertilizer compost banana was mixed with the fungus *B. bassiana* on the potato plant during season 2004 as compared to 267 kg/fedans when the compost banana fertilizer was used alone. In all other biological treatments of fertilizers, the weight of the potatoes was ranged between 144 and 376 kg/fedan (Table 6). This led to a significantly decrease in reductions of the yield ranged between 17.53-67.19 kg/fedan, during table 2004 (Table 6).

Anwar *et al*. (1993) studied the efficacy of eleven insecticides mixed with two fertilizers against the potato tuber moth *P. operculella* in Egypt. They found that the potato yield increased considerably in treated plots. Accumulations during the cropping phase are regulated by nitrifications inhibitors.

In most studies carried out to date, on the effect of inorganic and organic fertilizers on the soil organisms, only changes in abundance of large group, such as total mites and spring tails, have been recorded and the changes in species diversely, dominance, distribution, and activities have been largely ignored. It was therefore decided to investigate the effect of soil fertilizers such as nitrogen and farmyard manure on some insect pests (Abo-Korah *et al*., 1985).

Sundararaju and Rangajian (1987) found that the combinations between the fertilizers and chemical insecticides, decreased the infestations with the insect pests in the field.

In India the IFA 2005 use of solubilizing bacteria to the biofertilizers increase the efficiency of the fertilizers.

Holly and Michel (2005) reported that the microbial insecticides infect and control the insect pests which found in the soil with fertilizers do not pose a threat to humans. John (2004) found that, microbial insecticides with ground equipments at the rate 5-15 gallons per acre is a good converge to control the insect pests.

## ACKNOWLEDGMENTS

The author is greatly indebted to Prof. Dr. Mamdouh Maher Mater, Prof of Entomology, National Research Center, Egypt, for reading the manuscript.

## REFERENCES

Abo-Korah, S.M., H.S.A. Radwa, M.R. Aboghar and S.E. Salem, 1982. Response of soil acari groups to certain adopted in cotton fields in Mnofeia Governorate, Egypt. (Abst. Egypt, National Conf. of Ent. Soc. of Egypt. Cairo. Dec., pp: 6-8.

Abo-Korah, S.M., A.A. Osman and S.E. Saadoom, 1985. Effect of certain soil fertilizers on soil acari inhibiting okra field in Minufia Governorate, Egypt. Bull. Soc. Ent. Egypt, 65: 59-64.

Abu El-Naser, S.E., S.M. Fahmy and A. EL-Sherif, 1971. Studies on the potato tuber worm *Phthorimaea operculella* Zeller. Bull. Soc. Ent. Egypt, 5: 158-191.

Amonkar, S.V., A.K. Pall, L. Vijayalakshmi and A.S. Poo, 1979. Microbial control of potato tuber moth *Phthorimaea operculella*. Indian. J. Exp. Biol., 17: 1127-1133.

Anwar, E.S., El-Sheikh, E.S. Gamal and Abo El- Ghar, 1993. The influence of selected insecticides and insecticides fertilizers combinations against the potato tuber moth *Phthorimaea operculella* (Zeller), potato plant. Bull. Ent. Soc. Egypt. Econ., 20: 15-23.

Behan, V., 1972. The effects of urea on American and other arthropods in Quebec Black Spruce (*Picea mariana)* Humus. M.Sc. Thesis, McGill. Univ. Montreal, pp: 175.

Chakraborty, D.P, N.R. Maslem and J. Holt, 1990. Effect of nitrogenous fertilizers insecticides and plant spacing on insect pests and yield on folded rice in Eastern India. Pest Manage. Rice, 4: 167-176.

Dartt, B., R. Black, J. Breinling and V. Morrone, 2002. Cost of onion productions in southern. Michigan, 37: 1-7.

El-Kady, W.A., I.F. El-Hawarey and S.E.D.A. Faizy, 1988. Effect of nitrogenous and potassium fertilizers on seed cotton yield and insect pest infestation. J. Agric. Press. Tanta. Univ., 14: 1426-1437.

Ettay, N. and M. Coll, 2005. Effect of nitrogen fertilizations on *aphis gossypii* (Homoptera- aphididae) variation in size colour and reproduction. J. Econ. Ent., 94: 27-32.

Hemeide, E.A., 1976. Biological and physiological studies on *Phthorimaea operculella* Zeller (Lepidoptera: Gelechiidae). M.Sc. Thesis, Ain Shams Univ., Egypt, pp: 104.

Hill, S.B., L.J. Metz and M.H. Farrier, 1975. Soil Mesofauna and Silviculture Practices. In Insect Soil and Forest Land Management. Bernier, B. and C.H. Winget (Eds.), Prot. 4th North America Forest Soil Conf., pp: 119-135.

Holly, A. and N. Michael, 2005. Effect of Some Microbial Control Agents and Fertilizers on Agriculture Insect Pests. http//www.fertilizer.org.

IFA, 2005. Best agricultural practices to optimize fertilizers use. http//www. Fertilizer. Org. John, A., 2004. Managing cotton insects in the lower valley in the lower Rio grand valley. Extension agent-IPM the Texas A and M Univ. system. http// insect. Tamu. Edu/extension/ ag and field. html.

Krauss, A., 2005. Balanced fertilization, the key to improve fertilizer use efficiency. IPI 0th International Annual Conference, Cairo Egypt, Jan. http//www.ipipotash.org/presntn/bftktif.html, pp: 20-22.

Magda, S. and I.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: 459-467.

Mariy, F.A., M.A. Doaoud, G.B. El-Saadany and M.Y. Ibrahim, 1999. Biological studies on potato tuber moth *Phthorimaea operculella*. Zeler. Annals. Agric. Ain Shams. Univ., 44: 363-378.

Marshall, V.G., 1977. Effect of manures and fertilizers on soil fauna. A review. CAB., Commonwealth Bureau of Soil Spiral Publications, 3: 1-77.

Peirce, L.C., 1987. Vegetables: Characteristics production and Marketing. John Wiley and Sons, New York, ISBN-13: 978-0471850229, pp: 276-280.

Sabbour, M.M., 1992. Biology of some stored product pests as affected by microbial control agents. M.Sc. Thesis, Faculty of science. Cairo Univ., pp: 167.

Salama, H.S., M. Ragaei and M. Sabbour, 1994. biochemistry of the heamolymph of *Phthorimae operculella* larvae treated with *Bacillus thuringiensis*. J. Islamic Acad. Sci., 7:163-166.

Sundararaju, D. and A.V. Rangarajian, 1987. Effect of insecticides in combinations with fertilizers in controlling yellow mosaic diseases and podborer of green gram. Pesticides, 21: 20-21.

Ware, G.W. and J.P. Mc Collum, 1980. Producing Vegetables Crops, Interstate Printer and Publicaters. 3rd Edn., Inc. Danivill, IL., pp: 367.