*Egyptian Journal of Biological Pest Control, 17(2), 2007, 131-137*

# New Approaches for Controlling Sucking Pests on Cucumber Plants and their Impact on the Crop Yield

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*(Received: October 28 and Accepted: November 19, 2007)*

## ABSTRACT

Field experiments were carried out at Sennourus, Fayoum Governorate, Egypt during the two successive seasons 2005 and 2006. Effective Microorganisms (EM), mixture of some chelated microelements (Zinc 12%, Copper (cupper) 12%, Manganese 12%, and Iron 12%) and a mixture of EM and microelements were used to study their effects on the populations of spider mite, aphids, thrips, whitefly, associated predators and resulting crop yield on cucumber plants. For the two seasons, mixture treatments induced maximum initial effect on spider mite, with mean numbers of 56.5 and 51.13 individuals /40 plants; followed by EM treatments (57.13 & 56.00 individuals /40 plants) and microelements treatments (96.25 & 63.38 individuals/40 plants) which were significantly lower than control (199.75 & 152.88 individuals/40 plants). The same trend occurred with aphids, thrips and whitefly. Obtained results showed no significant differences among predatory species in different treatments. The mixture treatments gave the highest yield (3.11 & 3.57 Kg/10 plants); followed by EM (3.00 & 3.15 Kg/10 plants) and microelements (2.92 & 3.14 Kg/10 plants) which all were significantly higher than the control (2.31 & 2 37 Kg/ 10 plants).

**Key Words:** Cucumber, Spider mite, Aphids, Thrips, Whitefly, Predators, Control, Yield, Egypt

## INTRODUCTION

Vegetables are very important commodities. Most vegetable crops have a high economical value and a source of nutritive food especially vitamins and minerals. The technical problems in vegetables production are soil fertility and disturbance by pests and diseases which have significantly economic implication. Most of the farmers suspect that using chemical pesticides and inorganic fertilizers will support high yields (Abdul Hamid, 1995).

Excessive agrochemical residues have been blamed for some human and animal deaths; water canals and ground water are contaminated by pesticides, nitrates and loosing of beneficial organisms. The high use of inorganic fertilizers and chemical pesticides for increasing vegetables productivity are not environmentally correct. The overuse of chemical pesticides is ecologically harmful, toxic to many vegetables and may lead to a development of pesticides resistance in most pests (Ozeretskovskaya, 1995).

Piercing sucking pests (spider mite, aphids, thrips and whitefly) are spread attacking a wide varieties of agricultural crops, causing considerable damage, either directly by sucking plant juice or indirectly as vectors transmitting plant diseases. (Carter 1990).

Management of soil fertility has several effects on plant quality which in turn can affect pest abundance and subsequent levels of herbivores damages. The reallocation of mineral amendments in crop plants can influence oviposition, growth rates, survival and reproduction in the pests that use these hosts (Jones 1976). Increased soluble N levels in plant tissue following N fertilization were found to generally decrease pest resistance (Phelan *et al.,* 1995). Chemical fertilizers influence dramatically the balance of nutritional elements in plants. Their excessive use will create nutrient imbalances which in turn will reduce resistance to pests. Besides nutrient concentrations, was optimum fertilization which provides a proper balance of elements, can stimulate resistance to pest attack (Luna, 1988). The lower pest's levels widely reported in organic farming systems.

Effective Microorganisms (EM) are mixed culture of photosynthetic and lactic acid bacteria, actinomycets, yeasts, and fermenting fungi developed in Japan to improve organic matter composting. EM are reported to have several other beneficial effects such as better germination and plant establishment, enhanced flowering, fruiting, ripening, weed and pest control (Higa and Parr, 1994 and Abdul Hamid, 1995). Letourneau (1998) showed an increase in insect growth, survival, reproductive rate, population densities or plant damage in response to increased N fertilizer. Some microelements (trace elements) have toxic effect on pests by losing a part of body water content of these pests as result of osmotic force (Tomlin 1994).

Buzuk (1986) stated that microelements especially Mn, Zn, Fe and Cupper (Cu) increased alkaloids in plant tissues. Alkaloids contain toxic

Table (1): Counts of sap-sucking pests on 40 cucumber leaves in different treatments throughout 2005 and 2006 seasons

| | Mite | | | | Aphids | | | | Thrips | | | | Whitefly | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Control | EM | Trace elements | EM+Trace elements | Control | EM | Trace elements | EM+Trace elements | Control | EM | Trace elements | EM+Trace elements | Control | EM | Trace elements | EM+Trace elements |
| 4/4/2005 | 3 | 1 | 4 | 4 | 16 | 9 | 11 | 8 | 15 | 8 | 12 | 7 | 1 | 0 | 1 | 1 |
| 11/4 | 15 | 10 | 12 | 14 | 26 | 14 | 17 | 12 | 379 | 63 | 65 | 61 | 82 | 9 | 39 | 12 |
| 18/4 | 68 | 29 | 72 | 22 | 43 | 28 | 32 | 26 | 413 | 221 | 222 | 71 | 188 | 82 | 115 | 39 |
| 25/4 | 207 | 53 | 164 | 40 | 62 | 38 | 47 | 33 | 1026 | 286 | 281 | 138 | 186 | 37 | 52 | 37 |
| 2/5 | 34 | 8 | 5 | 6 | 85 | 56 | 63 | 50 | 56 | 50 | 42 | 39 | 46 | 23 | 22 | 25 |
| 9/5 | 91 | 14 | 28 | 16 | 17 | 10 | 11 | 8 | 92 | 52 | 60 | 38 | 27 | 10 | 27 | 15 |
| 16/5 | 374 | 20 | 40 | 26 | 25 | 9 | 8 | 8 | 94 | 56 | 85 | 55 | 88 | 36 | 55 | 28 |
| 23/5 | 306 | 322 | 445 | 324 | 36 | 12 | 14 | 12 | 20 | 19 | 19 | 6 | 404 | 167 | 213 | 185 |
| Total | 1598 | 457 | 770 | 452 | 310 | 176 | 203 | 157 | 2095 | 755 | 786 | 415 | 1022 | 364 | 524 | 342 |
| Mean | 199.75 | 57.13 | 96.25 | 56.50 | 38.75 | 22.00 | 25.38 | 19.63 | 261.88 | 94.38 | 98.25 | 51.88 | 127.75 | 45.50 | 65.50 | 42.75 |
| L.S.D | | 45.93 | | | | 4.69 | | | | 73.06 | | | | 40.68 | | |
| 10/4/2006 | 24 | 8 | 9 | 6 | 26 | 10 | 12 | 9 | 95 | 36 | 47 | 30 | 0 | 0 | 0 | 0 |
| 17/4 | 61 | 19 | 21 | 17 | 53 | 19 | 20 | 13 | 281 | 109 | 121 | 87 | 41 | 27 | 30 | 24 |
| 24/4 | 123 | 38 | 43 | 31 | 56 | 36 | 33 | 29 | 365 | 123 | 132 | 111 | 98 | 58 | 62 | 51 |
| 1/5 | 242 | 71 | 86 | 63 | 89 | 45 | 45 | 41 | 896 | 242 | 314 | 210 | 83 | 52 | 59 | 48 |
| 8/5 | 94 | 32 | 41 | 21 | 119 | 66 | 67 | 60 | 233 | 134 | 165 | 129 | 42 | 36 | 38 | 31 |
| 15/5 | 130 | 40 | 37 | 39 | 78 | 39 | 39 | 33 | 122 | 78 | 87 | 69 | 29 | 19 | 21 | 17 |
| 22/5 | 157 | 49 | 54 | 47 | 52 | 28 | 29 | 26 | 91 | 42 | 46 | 39 | 86 | 58 | 62 | 55 |
| 29/5 | 392 | 191 | 216 | 185 | 98 | 43 | 40 | 32 | 32 | 20 | 18 | 19 | 185 | 99 | 122 | 93 |
| Total | 1223 | 448 | 507 | 409 | 571 | 286 | 285 | 243 | 2115 | 784 | 930 | 694 | 564 | 349 | 394 | 319 |
| L.S.D | | 31.03 | | | | 13.63 | | | | 28.82 | | | | 13.97 | | |

resistance might be attributed to the low protein and amino acid contents of leaves which provided a less nutrient diet for mites. Also, Habashy (2000) indicated that spraying of chelated Zn 14%to control *T. urticae* on bean plants resulted to the lowest numbers of eggs and immature stages. A relationship between mite infestation and phytochemical analysis of some elements in leaves was found (Darwish *et al.,* 1996 and Mohamed, 2003).

**b. Aphids, *Aphis gossypii* Glover**

In the untreated plants, the population density of aphids exhibited one activity period extended from April 4$^{th}$ until the end of May 2005, with a peak of 85 individuals/40 leaves recorded on May 2$^{nd}$. The same trend was observed in the subsequent year, which started on April 10$^{th}$ until the end of May 2006, with a peak of 119 individuals on May 8$^{th}$. The untreated plants showed the greatest mean numbers of aphids (38.75 & 71.63 individuals); followed by trace elements treatments (25.38 & 35.63 individuals), EM treatments (22.00 & 35.75 individuals), and mixture treatments (19.63 & 30.38 individuals) in 2005 and 2006 seasons, respectively. Obtained results agree with the findings of Hafez *et al.,* (1996) and Ebaid and Mansour (2006).

According to L.S.D values, there were significant differences between the untreated treatments and the other three treatments and insignificant differences between EM and the trace elements treatments, in both seasons, while there was a significant difference between mixture and the other three treatments in 2005 season.

Nasretidinov (1984) mentioned that the lowest incidence *of A. grossypii* and the highest yield of cotton were observed after application of 250Kg. nitrogen, 175Kg. phosphorus and 125Kg. potassium per hectare. In Guatemalan highlands, Morales *et al.* (2001) found that corn fields treated with organic fertilizer hosted fewer aphids *Rhopalosiphum maidis* than corn treated with synthetic fertilizer. Micro elements showed significant decrease in population density numbers of aphids than control (Ebaid and Mansour, 2006).

**c. Thrips, *Thrips tabaci* Lind.**

The population density of thrips on the untreated plants showed two active periods; the first period extended from April 4$^{th}$ until May 2$^{nd}$, with a peak of 1026 individual/40 leaves on April 25 $^{th}$, while the

second period extended until May 23rd, with a peak of 94 individuals/40 leaves on May 16th, 2005. In the subsequent season, 2006 one peak was recorded (896 individuals) on May 1st. These findings are in full agreement with Ebaid and Mansour (2006) on cotton plants.

Significant differences were detected between control treatments and the other three treatments in the two seasons of study. The highest effects on population was found in mixture treatments (51.88 & 86.75 individuals); followed by EM treatments (94.38 & 98.0 individuals), and trace elements treatments (98.25 & 116.25 individuals), while, the highest numbers of thrips were recorded in untreated treatments (261.88 & 264.38 individuals) in 2005 and 2006 seasons, respectively. Brodbeek *et. al.* (2001) found that populations of the thrips *Frankliniella occidentalis* were significantly higher on tomatoes that received higher rates of N fertilization. Ebaid and Mansour (2006) mentioned that Microelements (Zn, Mn, Fe and Cu) had significant differences in the reduction of thrips population on cotton plants.

**d. Whitefly, *Bemisia tabaci* (Gennadius)**

Whitefly nymphs started to appear with very few numbers (0 & 1 individuals / 40 leaves) and then their numbers increased sharply to reach the peaks (188 & 98 individuals) in the second half of April, then decreased to (27 & 29 individuals) on May 9th and sharply increased by the end of season in 2005 and 2006 seasons, respectively.

In both seasons of study, the mixture treatments showed the greatest effect on whitefly population with means of (42.75 & 39.88 individuals), followed by EM treatments (45.5 & 43.63 individuals) and trace elements (65.50 & 49.25 individuals) but without significant differences among them. On the other hand, the untreated treatments recorded the highest mean numbers (127.75 & 70.5 individuals) in 2005 and 2006 seasons, respectively and also significant differences between control treatments and the other three treatments were found. Sharaf and Nazer (1983) found that the use of $P_2O_5$ fertilizer had encouraged whiteflies' migration from tomato plants.

**Population abundances of common predatory species**

The following predatory species; *Amblyseius cucumirus, Orius* spp. and larvae of *Chrsoperla carnea* Steph. were the ones founded and counted during the study.

As shown in Table (2), on untreated cucumber plants for 2005 & 2006 seasons, the highest records were numbers of *Orius* spp. (83 & 171adults / 40 plants, respectively). The main period of activity showed almost the same trend in the two seasons of study followed by *A. cucumirus* (54 & 105 individuals / 40 plants). The period of activity extended from the second inspection till the last inspection, exhibited one activity period, with a peak of 25 & 36 individuals/40 plants recorded on April 25th 2005 and May 8th 2006, respectively, coincided with the spider mite, *T. arabicus* populations. The total seasonal numbers of *C. carnea* were (20 & 42 individuals/40 plants) showed one activity period, with a peak (6 & 12 individuals / 40 plants) in the third inspection in both seasons of study, respectively.

Regarding L.S.D values, there were no significant differences between untreated treatments and the other three treatments (trace elements, EM and their mixture) in the two seasons. The lowest mean total numbers of predators /40 plants was in trace elements treatments (18.25 & 38. 25 individuals), opposed to 19.88 individuals in the control in 2005 season, and 40.00 individuals in the mixture treatment in 2006 season. The mean total numbers of predators /40 plants was 18.50 & 38.75 individuals in EM treatment in 2005 & 2006 seasons, respectively. Ebaid and Mansour (2006) stated that there were insignificant differences between microelements (Fe, Mn, Cu and Zn) and untreated cotton plots numbers of some predacious species (lady beetles, aphid lion, rove beetle and true spiders).

**Total fruit yield (Kg. /treatment)**

From data in Table (3), the highest total cucumber fruit yield was obtained by applying the mixture of EM and trace elements treatments (24. 85 & 28.55 Kg/10 plants), followed by the EM treatments (24.25 & 25.20 Kg/10 plants) and the trace elements treatments (23.35 &25.15 Kg/10 plants), while the lowest total cucumber fruit yield was (18.45 & 18.95 Kg/10 plants) in the untreated treatments in 2005 & 2006 seasons, respectively. Means of harvested cucumber fruit yield per ten plants in the three previous treatments were significantly higher than the control treatments in the two seasons of study.

Mixture of Fe, Mn and Zn, singly or in (1996) reported that both cabbage and soybean plots treated with EM gave significantly higher yield compared with farmer's practice (NPK + chicken combination significantly increased cotton seed yield (Azab and El–Halawani, 1988 and Girgis, 1992). Effective

Table (2): Counts of predaceous species on 40 cucumber leaves in different treatments throughout 2005 and 2006 seasons

| | Treatments | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Control | | | | EM | | | | Trace elements | | | | EM+Trace elements | | | |
| | Predatory mite | *Orius* spp. | Aphid lion | Total | Predatory mite | *Orius* spp. | Aphid lion | Total | Predatory mite | *Orius* spp. | Aphid lion | Total | Predatory mite | *Orius* spp. | Aphid lion | Total |
| 4/4/2005 | 0 | 4 | 2 | 6 | 0 | 3 | 1 | 4 | 0 | 3 | 1 | 4 | 0 | 4 | 2 | 6 |
| 11/4 | 2 | 5 | 4 | 11 | 1 | 6 | 3 | 10 | 1 | 4 | 3 | 8 | 2 | 5 | 4 | 11 |
| 18/4 | 4 | 8 | 6 | 18 | 4 | 8 | 6 | 18 | 3 | 9 | 7 | 19 | 3 | 7 | 5 | 15 |
| 25/4 | 25 | 14 | 4 | 43 | 23 | 12 | 4 | 39 | 24 | 13 | 5 | 42 | 25 | 13 | 4 | 42 |
| 2/5 | 10 | 18 | 2 | 30 | 8 | 19 | 3 | 30 | 8 | 19 | 2 | 29 | 9 | 18 | 3 | 30 |
| 9/5 | 8 | 23 | 2 | 33 | 6 | 21 | 2 | 29 | 7 | 21 | 1 | 29 | 8 | 22 | 2 | 32 |
| 16/5 | 4 | 7 | 0 | 11 | 4 | 7 | 1 | 12 | 3 | 8 | 0 | 11 | 3 | 7 | 1 | 11 |
| 23/5 | 1 | 4 | 0 | 5 | 2 | 4 | 0 | 6 | 1 | 3 | 0 | 4 | 2 | 5 | 0 | 7 |
| Total | 54 | 83 | 20 | 159 | 48 | 80 | 20 | 148 | 47 | 80 | 19 | 146 | 52 | 81 | 21 | 154 |
| L.S.D | 1.4 | | | | | | | | | | | | | | | |
| 10/4/2006 | 0 | 8 | 4 | 12 | 0 | 9 | 4 | 13 | 0 | 8 | 7 | 15 | 0 | 10 | 5 | 15 |
| 17/4 | 5 | 10 | 9 | 24 | 6 | 11 | 10 | 27 | 5 | 10 | 9 | 24 | 7 | 12 | 9 | 28 |
| 24/4 | 9 | 15 | 12 | 36 | 8 | 16 | 12 | 26 | 9 | 14 | 11 | 34 | 9 | 14 | 13 | 36 |
| 1/5 | 17 | 27 | 8 | 52 | 15 | 26 | 7 | 48 | 16 | 26 | 7 | 49 | 16 | 25 | 9 | 50 |
| 8/5 | 36 | 36 | 5 | 77 | 37 | 38 | 5 | 80 | 35 | 35 | 4 | 74 | 37 | 35 | 4 | 76 |
| 15/5 | 21 | 48 | 3 | 72 | 21 | 48 | 2 | 71 | 20 | 47 | 2 | 69 | 22 | 44 | 4 | 70 |
| 22/5 | 11 | 16 | 1 | 28 | 10 | 15 | 1 | 26 | 10 | 14 | 2 | 26 | 11 | 14 | 3 | 28 |
| 29/5 | 6 | 11 | 0 | 17 | 6 | 12 | 1 | 19 | 5 | 10 | 0 | 15 | 6 | 10 | 1 | 17 |
| Total | 105 | 171 | 42 | 318 | 103 | 175 | 42 | 310 | 100 | 164 | 38 | 306 | 108 | 164 | 48 | 320 |
| Mean | 13.13 | | | | | | | | | | | | | | | |

Aphid lion: *Chrysoperla carnea* *Amblyseius cucumirus* : Predatory mite

Table (3): Means of cucumber crop weight of 10 plants/ treatment in kilogram in different treatments throughout 2005 and 2006 seasons

| Date | 2005 | | | | 2006 | | | |
|---|---|---|---|---|---|---|---|---|
| | Control | EM | Control | EM | Control | EM | Control | EM |
| 12/5 | 2.50 | 3.10 | 3.35 | 3.75 | 2.40 | 3.10 | 3.20 | 3.75 |
| 14/5 | 3.00 | 3.60 | 3.20 | 3.90 | 3.10 | 3.10 | 3.50 | 3.10 |
| 16/5 | 1.80 | 2.25 | 1.90 | 2.50 | 2.00 | 1.90 | 2.25 | 3.00 |
| 18/5 | 2.35 | 2.60 | 2.50 | 2.75 | 2.10 | 2.90 | 2.90 | 3.60 |
| 20/5 | 4.15 | 5.05 | 5.30 | 3.70 | 3.80 | 5.10 | 4.50 | 4.20 |
| 21/5 | 1.15 | 2.50 | 2.60 | 2.60 | 2.15 | 4.40 | 4.35 | 4.60 |
| 23/5 | 1.50 | 2.25 | 2.00 | 2.75 | 1.50 | 2.60 | 2.25 | 2.80 |
| 25/5 | 2.00 | 2.90 | 2.50 | 3.10 | 1.90 | 2.10 | 2.20 | 2.50 |
| Total | 18.45 | 24.25 | 23.35 | 24.85 | 18.95 | 25.20 | 25.15 | 28.55 |
| Mean | 2.31 | 3.00 | 2.92 | 3.11 | 2.37 | 3.15 | 3.14 | 3.57 |
| 12/5 | 2.50 | 3.10 | 3.35 | 3.75 | 2.40 | 3.10 | 3.20 | 3.75 |
| 14/5 | 3.00 | 3.60 | 3.20 | 3.90 | 3.10 | 3.10 | 3.50 | 3.10 |
| 16/5 | 1.80 | 2.25 | 1.90 | 2.50 | 2.00 | 1.90 | 2.25 | 3.00 |
| 18/5 | 2.35 | 2.60 | 2.50 | 2.75 | 2.10 | 2.90 | 2.90 | 3.60 |
| 20/5 | 4.15 | 5.05 | 5.30 | 3.70 | 3.80 | 5.10 | 4.50 | 4.20 |
| 21/5 | 1.15 | 2.50 | 2.60 | 2.60 | 2.15 | 4.40 | 4.35 | 4.60 |
| 23/5 | 1.50 | 2.25 | 2.00 | 2.75 | 1.50 | 2.60 | 2.25 | 2.80 |
| 25/5 | 2.00 | 2.90 | 2.50 | 3.10 | 1.90 | 2.10 | 2.20 | 2.50 |
| Total | 18.45 | 24.25 | 23.35 | 24.85 | 18.95 | 25.20 | 25.15 | 28.55 |
| L.S.D | 0.43 | | | | 0.45 | | | |

microorganisms (EM) play an important role in increasing crop yield. Escano manure). Also, Duriat and Hilman (1996) mentioned that the yield of cabbage was significantly increased by spraying EM-4 (consists of 90% *Lactobasillus* spp. and microorganisms producing lactic acid, cultured in a liquid medium at pH 4.5 ) on the leaves.

It could be concluded that field application of the trace elements (micronutrients) alone or in combination with effective microorganisms (EM) might protect cucumber plants from sucking pests attack, produce safe products and increase crop yield. Such materials still need further investigations before recommendations could be given.

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