SUMMARY

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I-laboratory studies:

The effect of mixing the nematode strains ***Steinernema carpocapsae*** (All), ***Heterorhabditids bacteriophora*** (HP88) and ***Heterorhabditids bacteriophora*** (H t) with four nematicides (Nemacur, Rugby, Temik and Vydate) against the 6**th** instar larvae, prepupae and pupae of both ***Spodopetra littoralis*** and ***Agrotis ipsilon*** were investigated.

The nematicide Rugby alone or combined with ***S. carpocapsae*** or ***H. bacteriophora*** (HP88) gave 100 %mortality, whereas its combinations with ***H. bacteriophora*** (H t) gave 93.3%. These mortality percentages were similar to those resulted by the nematode alone against ***S. littoralis***. The combination of Oxamyl (Vydate) and nematodes gave mortality rates more than the Vydate alone, but mixing Nemacur and HP88 or Ht strains gave mortality rates more than in case of ***S. carpocapsae*** (All). Mortalities of the three tested concentrations of Temik, evidently differed when they were combined with nematodes. All concentrations of Rugby, combined with H t, S c and HP88, gave maximum standard of mortality (100%), that were more than either the pesticide or each species of nematodes alone against ***A. ipsilon***.

Combinations of nematode strains and nematicides were more lethal against ***S. littoralis*** prepupae than nematicides, but their efficiency were less or equal to those of nematodes alone which gave 100 % mortality for each strain. The mixtures of ***S.***

carpocapsae or ***H. bacteriophora*** (HP88) with the four tested nematicides resulted in an increase in the mortality percentage of ***A. ipsilon*** prepupae than did pesticides, alone. On the other hand the nematode strains yielded higher mortalities percentage of ***A. ipsilon*** prepupae (100, 100 and 91.7% for Ht, Sc and HP88, respectively).

Concerning toxicity of the pesticides alone or combined with nematode strains against pupae of ***S. littoralis***, it was found that Rugby alone was the most potent pesticide giving mortalities ranged between 83.3 - 97.7%, while insect mortalities resulted from the other pesticides ranged between 3.3 - 25.5%. On the other hand the potency of the four tested pesticides combined with the entomopathogenic nematodes, increased recording mortality percentages (35.4 - 100, 41.7- 83.3 and 41.7-100 %) when combined with Ht, Sc and HP88, respectively.

In case of ***A. ipsilon*** pupae, Rugby (Cadusafos) alone or combined with Ht, Sc or HP88, gave the highest mortality rates which ranged between 70.8-100% that were nearly similar to those of nematodes alone (89.6 for Ht, 100 for Sc and 91.7 for HP88). With respect to other three tested pesticides (Nemacur, Temik and Vydate) their combinations with entomopathogenic nematode enchanced their effectiveness more than using them alone. Their mortalities ranged between 8.4-18.8% (pesticides alone), 29.2-79.2 % (with Ht) 27.1-72.9 % (with Sc) and 4.2-54.2 % (with HP88).

The pesticides varied in their toxicity to the infective stages of nematode strains. The effect of nematicides and

insecticides on activity of ***H. bacteriophora*** (Ht) resulted in raising mortality rates to a level ranged between 1.8 to 19.4% respectively. On the other hand, nematicides killed only 1.1%, while the insecticides killed 13.8% of the imported strain ***H. bacteriophora*** (HP88).

Different degrees of dispersal (expressed as % individuals migration (%m) and distances covered by these individual [E (D)] were observed among the tested nematode strains. ***S. glaseri*** strain recorded the highest migration rate (89.28%), covering an average distance of 6.88 cm. The other tested strains could be arranged in a descending order as follows: ***H. bacteriophora*** (Ht), ***H. bacteriophora*** (HP88), ***S. carpocapsae*** (All) and ***S. carpocapsae*** (agriotis), recording migration rates of 79.7, 76.48, 29.85 and 21.45%, respectively. The corresponding E (D) values were 12.62,13.07,5.97 and 3.23 cm, for the four strains, respectively, in case of the presence of, ***Galleria mellonella*** as a host. In case of presence of ***S. littoralis***, the migration rate of ***S. glaseri*** was better than those of the other strains, achieving 91.12% and E(D) was 16.15 cm.

Several factors were found to affect dispersal and migration as follows:

1- The presence or absence of the host, since the dispersal and migration of the infective stages were better in the presence of the host.

2- The nematicides improved migration and average net distance of all tested nematode strains, except the S.g strain,

with which a remarkable inhibition in its mobility, was obviously, observed.

3- Feces of ***S. littoralis*** increased the migration and dispersal than the host itself.

4- Most nematode strains were attracted to ***S. littoralis*** more than to ***G. mellonella*** larvae.

II- Field studies:

Application method and nematode concentrations:

Field trials were conducted for managing to control some fruit tree borers. The employed techniques and nematode concentrations were very important in application of entomopathogenic nematodes. It could be mentioned that the used two methods (spraying and injection) were effective for the tested insects. Morality of ***Zeuzera pyrina*** ranged between 70.7 and 74.5 % for spraying, and 69.4 to 80.03% for the injection techniques. However, the mortality rates of ***Synanthedon myopaeformis*** ranged between 45.9-59.3 for spraying technique while for injection, it ranged between 53.8 –76%. It was found that the tested nematode strains were more effective against ***Z. pyrina*** than against ***S. myopaeformis***.

The cotton plugs and the injection techniques were, statistically equal in their, effect giving ***S. myopaeformis*** larval mortalities of 68.4 and 59.6 %, respectively. On the other hand, the spray technique induced 30.5 % larval mortality of ***S. myopaeformis***. Regarding ***Z. pyrina***, the cotton plugs and the

spray techniques were statistically equal in their effect giving larval mortalities of 86.1 and 87.98 %, successfully. On other hand the injection technique induced 76.95%larval mortality.

Comparing the nematodes and the recommended insecticides in controlling ***S. myopaeformis*** and ***Z.pyrina***, results showed that the combination between nematodes and insecticides, were the best, giving the greatest values of mortality. Both nematodes and insecticides alone achieved least mortality rates, ranging between 45.9-59.23%.

Also, the performance of the entomopathogenic nematodes alone or combined with conventional nematicides had been comparatively, evaluated in an other experiment against ***S. myopaeformis*** and ***Z. pyrina*** on apple trees, in 1998 seasons. ***S. myopaeformis*** mortality rates ranged between 20-68.1%, whereas combination with insecticides achieved mortality rates between 34.3-64.3%. However, the insecticides alone, achieved 30-31.1% against ***S. myopaeformis***. Combination of nematodes and insecticides achieved mortality rates ranged between 36.7-79.3% but insecticides alone achieved 30-31.3% against ***Z. pyrina***.

Comparing between entomopathogenic nematodes and ***B. thuringiensis*** in controlling ***Z. pyrina*** had been studied. Results showed that using nematodes against ***Z. pyrina***, individually resulted in higher percentages of mortality than combination of nematodes and bacterium and /or the bacterium alone except in case of ***S. carpocapsae*** + ***B. thuringiensis*** in spring .It could also be stated that strain ***S. carpocapsae*** (all) was more effective

against the borers in autumn than in spring. While the strain of ***H. bacteriophora*** was more effective in high temperatures.

Result showed that strain ***S. carpocapsae*** (all) in November (21°C) tended to give better control than in May (26.1°C) because of the high sensitivity of such strain to high temperatures whereas the two strains of ***H. bacteriophora*** (HP88) and ***H. bacteriophora*** (Ht) achieved mortality rates of 67.95 and 74.8%, respectively in November. However, in high temperature of May, ***Heterorhabditis*** were the best in Killing ***Z. pyrina,*** larvae which achieved mortality rates of 77.4 and 78.1% against 62.3% for ***S. carpocapsae.***

Conclusion & Recommendation

It is a matter of fact that, the recent state of the international environment, especially the Egyptian one, reflect a high level of fully destroyed ecosystem, because of the extensive use of toxic pesticides against pests. People were severely injured from pesticide residues, taken with the agricultural source food, on which humans feed, thus we must links our point of view, towards new concept dealing with safe pest population management for preventing man, domestic animals and the environment from being severely injured.

Internationally, the traditional methods of control, appeared to be neglected and replaced by more safe ones which cause no environmental pollution, no ecosystem destroy, and no injuries to man or his domestic animals. This method doubtedly appear to be the sole one which help in realizing our object, which is known as " the biological control " which may start as integrated control.

Going on with such modern concept, it felt necessary to conduct such research work, dealing with the use of some biological control agents, in which both entomopathogenic nematodes in combination with the famous entomopathogenic bacteria " ***Bacillus thuringiensis***".

Simultaneously, certain nematicides and insecticides were tested, for exploring their effects on such biological control organisms that were used against some insect pests, which infest some field crop and fruit trees in Egypt.

The following are the obtained results, which are supported with some recommendations:

1-Supplying mixture of both entomopathogenic nematodes with some nematicides against some insect stages (larvae-prepupae–pupae) of some field crop pests which are found in soil, resulted in an increase in their managemental potentiality of the pest population. Such finding may help in utilizing such species of nematodes safely within integrated pest population management.

2-It was observed that both of the imported and local entomopathogenic nematode strains, are highly tolerant, rather to high concentrations of pesticides which reached 800ppm for nematicides and about 1600ppm for insecticide. This finding can throw light on the applicability of such biological control agent, irrespect of the level of pesticide residues in soil.

3-Studying dispersal and migration of the entomopathogenic nematodes, it was found that it differ according to some factors, especially the presence or absence of the host, the level of pest population, host species and finally to both quality and quantity of pesticides residues accumulated in soil. It was found that such residues have positive effect on such research point.

4-The use of nematode cotton plugs method proved to be most effective one over all treatments, especially in decreasing populations of the stem borer species of fruit trees. Thus, they

must be preferred, when setting up new application programmes for controlling such pests.

5-Variability in the efficiency of different nematode species, was observed according to the host species, as they were more efficient against ***Zeuzera pyrina*** than against ***Synanthedon myopaeformis.*** In this respect, it is suggested to conduct more research works dealing with such point for recognizing certain selective biological control agent, to be used in application.

6-It was found that the abiotic factors in the environment, especially temperature, had significant effect on the activity and efficiency of such entomopathogenic nematodes. Such results indicate that species belonging to genus ***Heterorhabditis*** prefer high temperature degrees, while ***Steinernema*** in contrast prefer low temperature degrees. Thus, species of the first genus is suggested to be used only during spring season while species of the second genus are recommended to be applied only during autumn and winter seasons.

7-It was found that, mixing of both entomopathogenic nematodes and entomopathogenic bacteria (***B. thuringiensis***) had negative effect on the efficiency of the nematodes, especially against ***Z. pyrina***. However nematode alone had a level of efficiency exceeded that was obtained from the mixture. Thus, it must be suggested to avoid mixing the aforementioned biological control agents. Entomopathogenic bacteria may suppress activity of the nematode, reflected in

low level of efficiency. If they were blended in a same control programme, each of them must be applied, individually, with enough period intervals.

Final necessary word

From the previously mentioned results, in addition to what me know and feel about the recent level of ecosystem destroy because of the extensive use of toxic pesticides during the foregoing time, which caused lethal dangerous diseases symptoms which had dispersed among people and domestic animals because within tissues agricultural products, that are used as food.

Thus we find it necessary to call all humans all over the world to stop, instantaneously, the use of " chemical control" and replace it with the prolyphic "biological control" method. That, surely, will be useful for preventing environment from being polluted, man and animal from being toxicated, and finally a state " natural balance dominance".