Summary

SUMMARY

Bioassay studies were carried out to find out the efficacy of four entomopathogenic nematode species namely; *Steinernema abbasi* (from Sultanate of Oman), *S. riobravis* (from England), *Heterorhabditis bacteriophora* (from U.S.A.) and *H. tayserae* (from Nubariah, Egypt), against the full-grown larvae and one and three day old pupae of the Mediterranean fruitfly, *Ceratitis capitata*. Experiments were designed as laboratory and semi-field studies. The obtained results may be summarized as follows :

I- Laboratory studies :

In these studies, each of the tested 4 nematode species was applied in each of six concentrations (125, 250, 500, 1000, 2000 and 4000 infective juveniles/cm² of soil surface) on the sand surface containing the desired stage which was placed either every 10 individuals in sand in a 100 cc half filled plastic cup (first method), or each individual in sand in a 5 cm diameter Petri dish (second method).

I.1- Infectivity of entomopathogenic nematode species to *C. capitata* full-grown larvae and pupae :

A- First method :

The efficacy of all of the 4 entomopathogenic nematode species, on the full-grown larvae and the one and three day old pupae, was a concentration dependent; *i.e.*, the mortality percentage, due to treatment, increased by the increase in the applied concentration.

One week after exposure of *C. capitata* full-grown larvae to either of the six concentrations of the 4 nematode species, the means of mortality percentages were 70.5 (44-96), 62.7 (35-89), 70.5 (42-97) and

63 (39-88) % for application of *S. abbasi, S. riobravis, H. bacteriophora* and *H. tayserae*, respectively. On one day old pupae, the respective mortality percentages were 65 (36-93), 51.3 (23-80), 66 (36-95) and 55 (34- 78) %. While, in case of the three day old pupae of *C. capitata*, treatment by the mentioned species by the same concentrations caused 62.5 (33-90), 41.5 (18-65), 59.2 (30-88) and 48 (23-72) % mortalities, respectively.

As for the LC_{50} values of *S. abbasi, S. riobravis, H. bacteriophora* and *H. tayserae*, for the full-grown larvae of *C. capitata*, those were found to be 204, 308, 315 and 289 IJs/cm² of sand surface, respectively. On one day old pupae, the respective values of LC_{50} were; 282, 645, 281 and 462 IJs/cm². While, treatments of the three day old pupae revealed that the LC_{50} for the 4 nematode species were 321, 1350, 402 and 880 IJs/cm² of soil surface, respectively.

B- Second method :

The individual treatments of *C. capitata* full- grown larvae caused mean mortality percentages of 88 (60-100), 70.7 (40-96), 86.7 (60-100) and 66.7 (40-92) % due to application of *S. abbasi, S. riobravis, H. bacteriophora* and *H. tayserae*, respectively. In case of one day old pupal treatments, these values were 84 (52- 100), 63.4 (32-92), 81.4 (48-100) and 59 (36-88) % mortality, respectively. By application of the 4 nematode species on the surface of sand containing 3 day old pupae of *C. capitata*, the mortality percentages among treated pupae were 68 (40-96), 50 (28-76), 66 (36-92) and 56.7 (32-84 %), respectively.

Concerning the LC_{50} values for *S. abbasi, S. riobravis, H. bacteriophora* and *H. tayserae* on *C. capitata* full-grown larvae, after one

week of treatment; those were 47, 198, 82 and 240 infective juveniles/cm² of sand surface, respectively. While, on the one day old pupae of the same pest, these values were 103, 323, 140 and 365 IJs/cm², respectively. After one week of treatment of the 3 day old pupae of *C. capitata*, the LC_{50} values for the same entomopathogenic nematode species were found to be 241, 698, 267 and 446 IJs/cm², respectively.

From the obtained results, the following could be deduced :

a- The effect of either of the 4 tested nematode species, against the Mediterranean fruitfly, increased by increasing the applied concentration.

b- Among the tested stages, *C. capitata* full-grown larvae were the most susceptible (highest mortality rate and lowest LC_{50}) compared to the one and three day old pupae of the same pest species. While, on the contrary, the three day old pupae showed highest resistance.

c- Individual treatments of either of the used stages (second method) led to more efficacy of the applied nematode species (higher mortality rate and lower LC_{50}'s) that application of the same nematode species and concentration of every 10 individual placed in one cup (first method).

d- Generally, *S. abbasi* gave the highest efficacy against *C. capitata* tested stages, followed by *H. bacteriophora*, then *H. tayserae* (the Egyptian isolated species). While, *S. riobravis* was the least effective on full-grown larvae, one day and 3 day old pupae of *S. capitata*.

I.2- Host finding by entomopathogenic nematode species :

Laboratory experiment indicated that the infective juveniles of all the 4 entomopathogenic nematode species under study could reach *C. capitata* pupae placed in plastic cups at 5 cm height from the site of IJ's release (the bottom of the cup). While, by placing the pupae at 10 cm height, none of the IJs could reach the pupae which manifested no mortalities after 7 day of treatment. At 5 cm height from the site of release, *H. bacteriophora* and *S. abbasi* caused higher mortality rates among the exposed pupae (84 and 80 % mortality, respectively) than those recorded from *H. tayserae* and *S. riobravis* (60 and 58 %, respectively).

I.3- Production of IJs of the nematode species from *C. capitata* pupae :

In this experiment, the IJs of each of the 4 tested nematode species were applied at two concentrations; 2000 and 4000 IJs/cm² of sand surface. Data proved that the quantity of harvested juveniles increased by increasing the applied concentration. *S. abbasi* gave the highest production of juveniles (7155 and 14670 IJs/pupa after treatment at 2000 and 4000 IJs/cm² of soil surface, respectively). *H. bacteriophora* was the second in order (5550 abd 12710 IJs/pupa, respectively). *S. riobravis* and *H. tayserae* produced less amount of infective juveniles, being 554 and 1932 IJs/pupa in the former species against 391 amd 825 IJs/pupa in case of *H. tayserae* after treatment at 2000 and 4000 IJs/cm², respectively.

II- Semi-field experiments :

II.1- Infectivity of different entomopathogenic nematode species to *C. capitata* pupae in soil of different levels of water content :

One day old pupae were placed in pots filled with sandy soil of 4 moisture content levels (20, 15, 10 and 5 %), then treated with different concentrations of *S. abbasi, S. riobravis, H. bacteriophora* and *H. tayserae*. The mortality percentages were recorded and the LC_{50}'s were calculated. The recorded LC_{50}'s for *S. abbasi* were 365, 513, 1531 and 3969 IJs/cm² of soil surface on pupae placed in sand containing 20, 15, 10 and 5 % water, respectively. The respective values for *S. riobravis* were 1484, 2527, 5802 and 12362 IJs/cm². These values were 396, 384, 1538 and 3748 IJs/cm² for *H. bacteriophora* on *C. capitata* in sand of 20, 15, 10 and 5 % water content, respectively. The values were 812, 1276, 2354 and 4386 IJs/cm², respectively for *H. tayserae*. From the obtained data, the following points could be, generally, deduced :

a- The efficacy of entomopathogenic nematodes on *C. capitata* pupae increased by the increasing the applied concentration.

b- *S. abbasi* and *H. bacteriophora* were nearly of equal efficacy and, clearly, of higher efficacy on the mentioned pest than the *H. tayserae* which ranked the third efficacy and *S. riobravis* which showed the lowest mortality percentages and highest LC_{50} in cases of the 4 water content levels.

c- The percentages mortality increased and the LC_{50}'s decreased as the water content in soil increased. The higher water content may give better ability for the juveniles to search and infect the pest stage.

II.2- Infectivity of entomopathogenic nematodes to different stages of *C. capitata* in sandy and sandy-clay soil :

The four nematode species under investigation were tested for their efficacy against the full-grown larvae, and one day and three day pupae of *C. capitata* placed in two soil types (sandy and sandy clay soil). The mortality percentages were recorded and the LC_{50} values were calculated.

By placing the desired stages in sandy soil, the LC_{50} values for *S. abbasi* were 284, 365 and 336 IJs/cm² soil surface on *C. capitata* full-grown larvae, one day pupae and 3 day pupae, respectively, against 626, 1484 and 2560 IJs/cm², respectively in case of *S. riobravis*; 310, 398 and 701 IJs/cm² for *H. bacteriophora*; and 705, 812 and 1257 IJs/cm², respectively in case of *H. tayserae*. While in case of sandy-clay soil, the respective LC_{50}'s for *S. abbasi* on the same mentioned stages were 268, 362 and 351 IJs/cm² of soil surface. While, these respective values were 433, 893 and 2744 IJs/cm² in case of *S. riobravis* against 255, 334 and 491 IJs/cm² for *H. bacteriophora* and 230, 284 and 1348 IJs/cm² of sandy-clay soil surface in case of *H. tayserae*.

From the obtained results, the following points could be stated :

a- As occurred with all the previous experiments, the efficacy of entomopathogenic nematodes was a concentration-dependent.

b- *S. abbasi* and *H. bacteriophora* were, generally, the best against *C. capitata* stages, followed also by *H. tayserae*, but as usual *S. riobravis* manifested the lowest efficacy against the mentioned pest.

c- The sandy-clay soil gave better results; *i.e.*, the efficacies of the entomoparasitic nematodes were, generally, higher when the desired stages were placed in sandy-clay soil than those recorded from the sandy soil.