IV- RESULTS AND DISCUSSION

IV.1. Natural role played by Trichogramma evanescens against Ostrinia nubilalis eggs:

IV.1.1. Percentage of parasitism under field condition;

Data recorded in Table (1) indicate that, in 1981 corn season, the natural percentage of parasitism at Kafr El-Sheikh governorate ranged from 36.79% in the first of September (at 25.3 °C and 70.5% R.H.) to 59.66% amongst the eggs of the last sample (of October, 15th, at 23.6°C and 63.5% R.H.). Records of the weekly percentage of parasitism showed that this percentage increased gradually as the season advanced, where the successive percentages of parasitism were 36.79, 52.94, 53.28, 53.77 and 54.26% amongst the eggs collected on September, 1st, 7th, 15th, 22nd and 29th, respectively, and 56.47 and 59.66% for the following samples of October, 7th and 15th (Table 1). From a total number of 3490 O. nubilalis eggs, collected during September 1981 (Table 1), 1821 eggs were found parasitised, indicating an average percentage of 52.18% parasitism. During October, 1981, 717 eggs were found parasitised from a total number of 1236 collected eggs (58.01% parasitism; Table 1). Thus indicating higher effectiveness of the parasite in the late season (October). The total number of O. nubilalis eggs, collected from Kafr El-Sheikh corn plantations in 1981

Table (1): Percentages of parasitism by T. evanescens on O. nubilalis eggs and natural mortality amongst the parasitised eggs during 1981 corn season at Kafr El-Sheikh Governorate.

Sampling date	No. of collected egg masses	Total No. of inspected eggs	Number of: Parasitised eggs	Eggs containing dead parasites	Dead parasites	Emerged adults	% of: Parasitism	Natural mortality	Av. No. of adults/ host egg	Mean: Temp. °C	Mean: % R.H.
September:											
1st	25	280	103	12	12	94	36.79	11.32	1.03	25.3	70.5
8th	50	850	450	14	16	441	52.94	3.50	1.01	26.2	80.0
15th	50	884	471	18	18	460	53.28	3.77	1.02	23.25	71.0
22nd	50	783	421	11	11	418	53.77	2.56	1.02	22.6	82.0
29th	45	693	376	10	13	375	54.26	3.35	1.02	24.7	85.5
Overall	220	3490	1821	65	70	1788	52.18	3.77	1.02	24.4	77.8
October:											
7th	50	641	362	15	17	360	56.47	4.51	1.04	23.7	77.5
15th	35	595	355	21	22	354	59.66	5.85	1.06	23.6	63.5
Overall	85	1236	717	36	39	714	58.01	5.18	1.05	23.7	70.5
Overall for two months	305	4726	2538	101	109	2502	53.70	4.17	1.03	24.2	75.7

was 4726 eggs (305 egg masses), of which 2538 eggs were found parasitised, indicating a mean percentage of 53.7% parasitism during this year.

In regard to the data obtained on the percentages of parasitism by T. evanescens on O. nubilalis eggs in 1982 corn season, under the field conditions of Kafr El-Sheikh governorate. Data in Table (2), clearly,show that the role of T. evanescens on O. nubilalis eggs took the same trend of the previous season (1981), where the percentage of parasitism increased successively as the season advanced. The first sample of O. nubilalis eggs, collected on September, 3rd (27.7°C and 83% R.H.) showed the lowest percentage of parasitism (38.7%; 113 parasitised eggs from 292 collected eggs). The highest percentage of parasitism that occurred in this year (60.98%; 350 parasitised eggs from a total number of 574 counted eggs) was recorded, on the other hand, amongst eggs of the last sample, i.e.; of October, 15th(25.1 °C and 74.5 % R.H.). The successive percentages of parasitism, recorded in this year were 38.7, 54.96, 54.5, 54.8 and 57.28% amongst the samples of September, 3rd, 10th, 17th, 24th and 30th, and 60.88 and 60.98 amongst the samples of October, 7th and 15th, respectively (Table, 2). The average percentage of parasitism that recorded on eggs collected during September (53.83%; 1797 parasitised eggs from a total number of 3338

Table (2): Percentages of parasitism by T. evanescens on O. nubilalis eggs and natural mortality amongst the parasitised eggs during 1982 corn season at Kafr El-Sheikh Governorate.

Sampling date	No. of collected egg masses	Total No. of inspected eggs	Number of: Parasitised eggs	Eggs containing dead parasites	Dead parasites	Emerged adults	% of: Parasitism	Natural mortality	Av. No. of adults/ host egg	Mean: Temp °C	Mean: % R.H.
September:											
3rd	20	292	113	20	20	96	38.70	17.24	1.03	27.7	83.0
10th	50	826	454	14	17	450	54.96	3.64	1.02	25.3	75.5
17th	50	855	466	20	22	461	54.50	4.55	1.03	24.7	83.5
24th	50	719	394	15	15	388	54.80	3.72	1.02	24.0	73.5
30th	40	646	370	14	17	362	57.28	4.49	1.02	24.1	76.5
Overall	210	3338	1797	83	91	1757	53.83	4.92	1.03	25.2	78.4
October:											
7th	50	800	487	23	26	477	60.88	5.17	1.03	27.2	77.5
15th	33	574	350	19	20	348	60.98	5.43	1.05	25.1	74.5
Overall	83	1374	837	42	46	825	60.92	5.28	1.05	26.1	76.0
Overall for two months	293	4712	2634	125	137	2582	55.90	5.04	1.03	25.4	77.7

collected eggs) was also lower than that recorded on the eggs collected during October (60.92%, 837 parasitised eggs from 1374 collected eggs). As shown in Table (2), a total number of 4712 O. nubilalis eggs (293 egg masses) were collected from Kafr El-Sheikh corn plantations in 1982 season. Amongst these eggs, 2634 eggs were found parasitised by T. evanescens, showing an average percentage of 55.9% parasitism in this year. It is also clear from Tables (1 & 2) that the percentages of parasitism were generally higher in 1982 corn season, than those recorded in 1981 season.

With respect to the data obtained on the percentages of parasitism by T. evanescens in O. nubilalis eggs at Qalubia corn plantations in 1981 and 1982 (Table, 3). The present results indicate that these percentages were, generally in the two seasons, higher than those recorded at Kafr El-Sheikh govemorate. In 1981 corn season, the successive percentages of parasitism recorded on the collected O. nubilalis eggs were 56.86 and 57.02% on September, 7th and 23rd (average 56.95; 742 parasitised eggs from 1303 collected eggs), and 58.94 and 59.9% on October, 8th and 23rd, (average 59.4%, 771 parasitised eggs from 1298 collected O. nubilalis eggs), respectively. In 1981 season, a total number of 2601 O. nubilalis eggs (155 egg masses)were

Table (3): Percentages of parasitism by T. evanescens on O. nubilalis eggs and natural mortality amongst the parasitised eggs during 1981 and 1982 corn seasons at Qalubia governorate.

Sampling date	No. of collected egg masses	Total No. of inspected eggs	Number of: Parasitised eggs	Eggs containing dead parasites	Dead parasites	Emerged adults	% of: Parasitism	Natural mortality	Av. No. of adults/ host egg	Mean: Temp. °C	Mean: % R.H.
1981 season: September											
7th	35	612	348	18	20	336	56.86	5.62	1.02		
23rd	40	691	394	16	17	395	57.02	4.13	1.04		
Overall	75	1303	742	34	37	731	56.95	4.82	1.03	27.6	71.5
October:											
8th	40	682	402	23	27	399	58.94	6.34	1.05		
23rd	40	616	369	20	23	371	59.90	5.84	1.06		
Overall	80	1298	771	43	50	770	59.40	6.10	1.06	25.9	67.0
Overall for two months	155	2601	1513	77	87	1501	58.17	5.48	1.05	26.75	69.3
1982 season September											
5th	30	531	296	8	11	291	55.74	3.64	1.01		
20th	40	653	374	14	16	369	57.27	4.16	1.03		
Overall	70	1184	670	22	27	660	56.59	3.93	1.02	28.1	75.0
October											
5th	40	680	396	21	23	383	58.23	5.67	1.02		
20th	40	517	317	20	25	310	61.32	7.46	1.04	26.8	71.0
Overall	80	1197	713	41	48	693	59.57	6.48	1.03	27.45	73.0
Overall for two months	150	2381	1383	63	75	1353	58.08	5.25	1.03		

collected; from these eggs, 1513 eggs (58.17%) were found parasitised by T. evanescens (Table, 3). In 1982 corn season, the obtained data on the percentages of parasitised eggs that were detected amongst O. nubilalis eggs collected in the four successive samples (of September, 5th and 20th, and October, 5th and 20th) were 55.74, 57.27, 58.23 and 61.32%, respectively. Thus indicating the same trend of increasing activity of the parasite as the season advanced. Also, the mean percentage of parasitised eggs was higher in October (59.57%; 713 parasitised eggs from a total number of 1197 collected eggs) than that recorded in September (56.59%; 670 parasitised eggs from 1184 collected eggs). During 1982 corn season, a total number of 2381 O. nubilalis eggs (150 egg masses) were collectéd from corn plantations, and from these eggs 1383 eggs were found parasitised. Thus indicating, nearly, the same average percentage of parasitism (58.08) recorded in the previous season (Table, 3).

The present data on the percentage of parasitism by T. evanescens on the European corn borer eggs,under field conditions, at Kafr El-Sheikh and Qalubia governorates (Tables 1, 2 & 3), clearly show that the egg parasite under investigation plays an important role in suppressing the population of the ECB in Egyptian corn fields. Although the recorded percentages of parasitism at Qalubia governorate

(Table, 3) were higher than those recorded at Kafr El-Sheikh governorate (Tables 1 & 2); these percentages, amongst all the collected samples of O. nubilalis eggs exceeded 50%, except for the sample of September, 1st 1981 at Kafr El-Sheikh governorate (38.7% parasitism).

The increase in the rate of parasitism by T. evanescens on O. nubilalis eggs, under Egyptian field conditions, as the season of corn plantation advanced, agree with that previously recorded by Farghaly (1974) on the rate of parasitism of both corn borer eggs, O. nubilalis and Chilo agamemnon Bless. by T. evanescens in Qalubia and Alexandria governorates. The recorded percentages of parasitism recorded by the later author at Qalubia governorate (59.4, 62.7 and 83.3% on average during August, September and October, 1970) are higher than those recorded in the present investigation (56.95 and 59.4% in 1981 and 56.59 and 59.57% in 1982 season, in September and October, respectively). This may pronounce the bad effect of the indiscriminate applications of corn-borer insecticides in Egypt.

The active and effective natural role of Trichogramma spp. in suppressing the eggs population of O. nubilalis was previously recorded by several authors in different parts of the world (Farghaly, 1974 for T. evanescens in Egypt; Radeva, 1978 for T. euproctidis in Bulgaria; Nguyen

et al., 1982 for Trichogramma sp. in Vietnam, and Rosca, 1983 for T. evanescens in Romania.

IV.1.2. Natural mortality percentage of T. evanescens in O. nubilalis eggs:

The numbers and percentages of dead T.evanescens inside the parasitised eggs of O. nubilalis, collected from corn fields at Kafr El-Sheikh and Qalubia governorates, were counted, calculated and recorded in Tables (1, 2&3).

As shown in Tables (1 & 2); at Kafr El-Sheikh governorate, the highest percentage of natural mortality was detected amongst parasitised eggs of the first sample of O. nubilalis eggs, collected at the beginning of September ((11.32% in 1981 season, at 25.3 °C and 70% R.H.,and 17.24% in 1982 season, at 27.7 °C and 83 % R.H.) . The percentage of parasite mortality, then, sharply dropped amongst parasite individuals counted in eggs of the next sample of September, 8th 1981 (at 26.2 °C and 80 % R.H.) to 3.5% (Table 1) and the sample of September, 10th 1982 at 25.3 °C and 75.5 % R.H.) to 3.64% (Table 2). Amongst T. evanescens individuals that counted in parasitised ECB eggs of the remaining three samples of September, the recorded data show that the percentages of natural mortality were, relatively, low (3.77, 2.56 and 3.35% in September,

15th, 22nd and 29th 1981, and 4.55, 3.72 and 4.49% in September, 17th, 24th and 30th, 1982, respectively). The means in percentage of natural mortality recorded during September were 3.77 and 4.92% in 1981 and 1982, respectively (Tables 1 & 2). A slight increase in the parasite mortality percentage occurred during October in both years. The recorded percentages were 4.51 and 5.85% (mean 5.18%) in October, 7th and 15th 1981, and 5.17 and 5.43% (mean 5.28%) in October, 7th and 15th 1982, respectively. The variations in the recorded percentages of natural mortality may be due to the differences in temperature and relative humidity associated with each sampling date. Data in Tables (1 & 2) also indicate that the average percentage of natural mortality of the parasite was generally higher in 1982 corn season (5.04%) than that recorded in 1981 season.

At Qalubia goveronrate, data in Table (3) show that the percentage of natural mortality amongst T. evanescens parasitising O. nubilalis eggs, in 1981 and 1982, were generally higher in October than September. In September 1981, the recorded percentages of mortality were 5.62 and 4.13% (mean 4.82%) in September 7th and 23rd, respectively. In the next month, the percentages of 6.34 and 5.84%(mean 6.1%) mortality were detected in October, 8th and 23rd, respectively. In 1982 corn season, the percentages of 3.64

and 4.16% (mean 3.93%) were, respectively, detected amongst T. evanescens individuals counted in September, 5th and 20th . In October, 5th and 20th of the same season, the recorded percentages of mortality were 5.67 and 7.46% (mean 6.48%) (Table 3).

On the contrary to that recorded at Kafr El-Sheikh governorate, the percentage of natural mortality amongst T. evanescens individuals at Qalubia governorate were , slightly, higher in 1981 (5.48% on the average) than that recorded in 1982 season (average 5.25). The present data, also, indicate that the averages in percentage of natural mortality, amongst the counted T. evanescens individuals, were generally higher at Qalubia governorate (Table 3) than those recorded at Kafr El-Sheikh governorate (Tables 1 & 2).

IV.2. Effect of field application of several insecticides, commonly used for the control of corn pests on T. evanescens:

The effect of field application of each of five insecticides Carbaryl (Sevin w.p. 85%), Endosulfan granules 4 %, Dicofol (Kelthane 18.5%), Malathion 57% and Methomyl(Lannate 90%), at the rates recommended by the Egyptian Ministry of Agriculture, on the percentage of parasitism of O. nubilalis eggs by T. evanescens and the percentage of dead parasites inside the host eggs, was estimated on corn plants at Sakha district (Kafr El-Sheikh governorate).

IV.2.1. Effect on the percentage of parasitism:

Data recorded in Table (4) indicate that, 24 hours after treatment of corn plants with corn pests insecticides, a pronounced decrease in the percentage of O. nubilalis eggs parasitised by T. evanescens occurred. The bad effect varied according to the applied insecticide. The drastic drop in the percentage of parasitism was associated with the application of Carbaryl w.p.85%, where the percentage of parasitised eggs dropped from 57.1% amongst the ECB eggs collected from the control plants to 9.4% in eggs from sprayed plots, indicating a highly significant effect of insecticidal application. The contrast occurred in plots treated with Endosulfan granules 4 %, where the percentage of parasitised eggs decreased from 57.1% in the control to 49.6% amongst eggs collected from treated plots (Table 4), the difference in percentage of parasitism between eggs of treated and untreated plots was found, statistically, insignificant. The percentages of 17.6, 15.3 and 15.5% parasitism by T. evanescens were recorded after 24 hours of application of Malathion 57%, Dicofol 18.5% and Methomyl 90%, respectively, and these percentages indicated highly significant reductions when compared with the control. According to Table (4) , the descending order of effectiveness on the percentages of parasitism after 24 hours of insecticidal application is, Carbaryl w.p. 85%, Dicofol 18.5 and Methomyl 90%, Malathion 57% and Endosulfan granules 4 %.

Table (4): Effect of insecticidal application on corn plants on the percentage of parasitism of O. nubilalis eggs with T. evanescens and parasite mortality inside the host eggs. (data after 24 hours of treatment).

Tested insecticides	Total No.of collected host eggs	No.of para-sitised eggs	% of parasi-tism (P)	Av.% P trans-formed by Arc Sin formula	No.of eggs contain-ing dead parasites	% of eggs containing dead para-sites (D)	Av. (D) trans-formed by Arc Sin formula
Carbaryl w.p.85%	2449	231	9.4	17.55	95	41.1	35.8
Malathion 57% EC	2475	435	17.6	24.68	95	21.8	27.98
Dicofol 18.5% EC	2480	379	15.3	22.95	114	30.1	33.53
Endosulfan granules 4 %	2493	1236	49.6	44.85	52	4.2	11.18
Methomyl 90% s.p.	2527	392	15.5	22.97	113	28.8	32.78
Control	2537	1448	57.1	50.13	42	2.9	9.98
F value				50.10**			42.60**
L.S.D. 1%				7.935			7.50
5%				5.740			5.43

Comparing the percentages of parasitism with T. evanescens amongst O. nubilalis eggs collected from corn plants after 24 hrs. of treatment with different insecticides; the difference was insignificant between Methomyl and Carbaryl Malathion or Dicofol , and between Carbaryl and Dicofol Malathion; significant between Carbaryl and Malathion; and highly significant between Endosulfan and Carbaryl, Malathion Dicofol or Methomyl (Table 4).

Seven days after insecticidal application, although the recorded percentages of parasitism by T. evanescens on the ECB eggs were higher than those recorded after 24 hrs. of treatment, the severe effect, compared with the control, existed (highly significant reduction in the percentage of parasitism than control) with Carbaryl (only 10.4% parasitism), Malathion (25.7%) and Dicofol (29%). The reductions in percentages of parasitism when Endosulfan and Methomyl were applied (51.3 and 52.4% parasitism amongst collected eggs, respectively, compared with 59.2% parasitism in ECB eggs collected from control plots) were found, statistically, insignificant (Table 5). As shown in the mentioned Table , the discending order of effectiveness of different insecticides, after 7 days of application is Carbaryl (10.4% parasitism), Malathion (25.7%), Dicofol (29%), Endosulfan (51.3%) and Methomyl (52.4% parasitism).

Table (5): Percentage of parasitised ECB eggs by T.evanescens and mortality percentages of parasite individuals inside the host eggs 7 days after application of corn pests insecticides

Tested insecticides	Total No.of collected host eggs	No. of parasitised eggs	% of parasitism (P)	Av.% P transformed Arc Sin formula	No. of eggs containing dead parasites	% of eggs containing dead parasites (D)	Av. (D) transformed by Arc Sin formula
Carbaryl w.p.85%	2538	264	10.4	18.68	71	26.9	31.88
Malathion 57% EC	2515	646	25.7	30.43	101	15.6	23.43
Dicofol 18.5% EC	2522	730	29.0	32.38	167	22.9	29.08
Endosulfan granules 4 %	2550	1308	51.3	45.75	56	4.3	11.68
Methomyl 90% s.p.	2567	1345	52.4	46.23	58	4.3	12.00
Control	2518	1490	59.2	50.28	51	3.4	10.60
F value				52.20**			32.40**
L.S.D. 1%				7.01			7.001
5%				5.068			5.063

Comparing the percentages of parasitism in plots treated with different insecticides, data in Table (5) indicate that the differences were insignificant between Malathion and Dicofol and between Methomyl and Endosulfan, and highly significant between Carbaryl and Malathion, Dicofol , Endosulfan or Methomyl, Malathion and Endosulfan or Methomyl, and between Dicofol and Endosulfan or Methomyl.

After 14 days of insecticidal application, the recorded percentages of parasitism by T. evanescens amongst ECB eggs were 13, 33.1, 35.1, 45.8, 55.6 and 61% in plots treated with Carbaryl w.p.85%, Malathion 57%, Dicofol 18.5%, Endosulfan granules 7.5% and Methomyl 90%, and the control plots, respectively (Table 6). Although these percentages are generally higher than those recorded in Table (5), the most drastic reduction in the percentages of parasitism was, still, associated with Carbaryl application. The reductions in percentages of parasitism due to the applications of Malathion and Dicofol were, also, highly significant when compared with that estimated in the control plots. However, on the other hand, Methomyl showed, nearly, complete recovery of the insecticidal effect on the percentage of parasitism with T. evanescens on O. nubilalis eggs, where the percentage of parasitised eggs was 55.6% indicating, statistically insignificant difference than control (61% parasitism).

Table (6): Effect of corn pests insecticides, 14 days after application of corn plants on the percentages of parasitised O. nubilalis eggs by T. evanescens and dead individuals amongst the counted parasites.

Tested insecticides	Total No.of collected host eggs	No. of para-sitised eggs	% of parasi-tism (P)	Av.% P trans-formed by Arc Sin formula	No. of eggs contain-ing dead parasites	% of eggs containing dead para-sites (D)	Av. (D) trans-formed by Arc Sin formula
Carbaryl w.p.85%	2478	322	13	20.95	60	18.60	25.68
Malathion 57% EC	2493	826	33.1	35.08	130	15.70	23.60
Dicofol 18.5% EC	2472	869	35.1	63.28	150	17.30	24.25
Endosulfan granules 4 %	2489	1139	45.8	42.50	51	4.50	11.65
Methomyl 90% s.p.	2492	1385	55.6	48.28	78	5.6	13.73
Control	2507	1530	61.0	51.35	58	3.8	10.73
F value				37.10**			17.50**
L.S.D. 1%				7.46			6.91
5%				5.39			4.995

Comparing the effect of different insecticides on the percentage of parasitism by T. evanescens, after 14 days of treatment, data in Table (6) indicate insignificant reduction between Malathion and Dicofol , significant difference between Endosulfan and Malathion, Dicofol or Methomyl, and highly significant difference between Carbaryl and Malathion, Dicofol , Endosulfan or Methomyl and between Methomyl and Malathion or Dicofol .

The explained data on the effect of different corn pests insecticides on the percentages of O. nubilalis eggs parasitised by T. evanescens and those illustrated in Fig. (1) show, clearly , that insecticidal treatment, generally, caused a reduction in the percentage of parasitised ECB eggs than control. In all cases, Carbaryl w.p.85% treatments caused the most drastic effect on the parasite population, where the recorded percentages of parasitism were 9.4, 10.4 and 13.4% after one, 7 and 14 days of application, respectively, compared with 57.1, 59.2 and 61% parasitism amongst eggs collected from the control plots (Fig. 1). Malathion 57 % and Dicofol 17.5% manifested lower effect than Carbaryl (Fig.1), but these insecticides, also, had bad effect on the parasite, where in all cases, after one, 7 and 14 days of insecticidal application, highly significant reductions in the percentage of parasitised O. nubilalis eggs occurred (Tables 4,5 & 6). These results agree with those recorded by Fuzl et al.(1976)

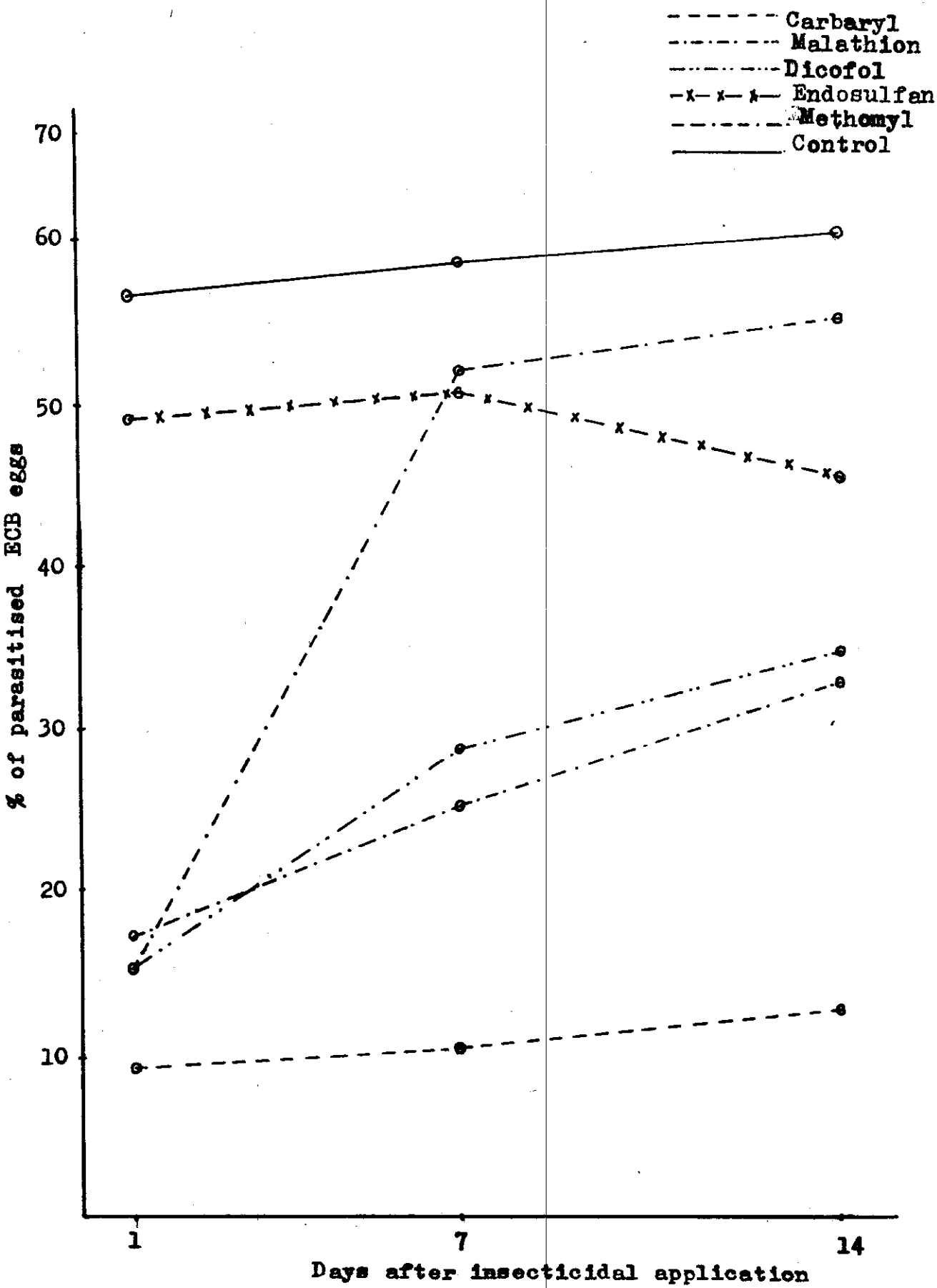

Fig.(1): Effect of application of corn pests insecticides on percentages of O. nubilalis eggs parasitised by T. evanescens.

as they indicated that spraying Malathion at the rate of 0.1% and exposing T. australicum and T. japonicum to spray residues caused mortality of the former species for up to 10 days and the later one for 21 days.

In contrast to the effect of the aforementioned insecticides (Carbaryl, Malathion and Dicofol), Endosulfan granules 7.5% showed the least efficiency on the parasite, where the percentages of parasitised ECB eggs after one and 7 days of insecticidal application were, statistically, insignificant (Tables 4 & 5). This agree with Paul et al. (1976) who indicated that Endosulfan and BHC were the least toxic insecticides on T. australicum and T. japonicum, and Patel (1983) as he reported that judicious use of Endosulfan at low dosages during October and November in Giyart (India) did not, adversely, affect Trichogramma spp. However, on the other hand, Kim-Chi (1978) recorded that spraying water emulsion of Endosulfan (Thiodan 35) killed 87% of T. evanescens adults up to the third day after spraying. The author , also, reported that the viability and fertility of insects originating from eggs , sprayed with the insecticide, were reduced.

Methomyl 90%, on the other hand, showed a short residual effect on the parasite, where a highly significant reduction in the percentage of parasitism by T. evanescens

occurred after 24 hours of treatment (Table 4), but 7 and 14 days after application, no significant reduction in the percentage of parasitised O. nubilalis eggs, compared with the control, was recorded. It is worthy to mention that Hernadez and Carrilos (1973) reported that methomyl (Lannate) caused a sharp reduction in parasitism of H. zea by Trichogramma spp. Bull and Hause(1983), also, indicated that methomyl, permethrin and methyl-parathion , severaly inhibited parasitism by T. pretiosum (by about 70 - 100%) if host eggs were treated prior to parasite exposure.

IV.2.2. Effect on parasite mortality inside the host eggs:

The percentages of O. nubilalis eggs that contained dead parasites of T. evanescens were estimated after 1, 7 and 14 days of application of corn pests insecticides on corn plants, and the obtained results are recorded in Tables (4, 5 & 6). Twenty four hours after insecticidal application, highly significant increases in the percentages of parasite mortality were recorded with Carbaryl w.p. 85% (41.1% mortality), Dicofol 18.5% (30.1%), Methomyl 90% (28.8%) and Malathion 57% (21.8%) than those recorded with parasitised ECB eggs collected from plots treated with Endosulfan granules 4 % (4.2%) and from corn plants in

control plots (2.9%,natural mortality). The effect of Endosulfan treatment on the parasite mortality percentage in host eggs was, statistically, insignificant (Table 4).

Comparing the effect of the tested insecticides, 24 hours after treatment, on the percentage of E.C.B. eggs containing dead parasites, data in Table(4)show that Carbaryl caused the severest effect on parasite mortality showing highly significant increase in the mortality percentage than Malathion and Endosulfan. Malathion, Dicofol and Methomyl caused highly significant effect than Endosulfan. Significant increase in mortality percentage occurred by application of Methomyl or Dicofol than Malathion. However, the difference in mortality % was insignificant between Carbaryl and Methomyl or Dicofol and between Methomyl and Dicofol.

After seven days of insecticidal treatment, the recorded percentages of ECB eggs containing dead parasites decreased than that recorded after 24 hrs.of application (Table 5).Carbaryl,also, caused the highest mortality rates of T. evanescens inside O. nubilalis eggs (26.9 %).Dicofol ranked the second in severity of effect on the parasite , followed by Malathion (22.9 and 15.6% of the parasitised eggs contained dead parasites, respectively). The increase

in percentage mortality, due to application of the mentioned three insecticides, than control (3.4%) was found, statistically, highly significant. Percentages of T. evanescens mortality inside the host eggs, after 7 days of Methomyl and Endosulfan applications (4.3% for each of the two insecticides) were insignificant when compared with mortalities in the control.

The increase in mortality percentage, 7 days after application of Carbaryl 85 % , was highly significant than that caused due to Malathion, Methomyl or Endosulfan application, and insignificant when compared with that caused due to Dicofol 18.5% application. Dicofol caused significant increase in the percentage mortality than that caused by Malathion spraying, and highly significant increase than Methomyl and Endosulfan. Also, Malathion 57% caused highly significant increase in mortality %, after 7 days of application, when compared with Methomyl or Endosulfan. However, no difference in the percentage of ECB parasitised eggs containing dead parasites could be detected between Methomyl and Endosulfan treatments after 7 days of insecticidal treatment (Table 5).

After 14 days of insecticidal applications, although another decrease in the percentages of dead T. evanescens inside O. nubilalis eggs occurred in plots sprayed with Carbaryl

w.p. 85% or Dicofol 18.5%, the same order of effectiveness of the tested insecticides, after 7 days of treatment, was recorded, where the percentages of eggs containing dead parasites were 18.6%(Carbaryl treatment),17.3% (Dicofol treatment), 15.7% (Malathion treatment), 5.6% (Methomyl treatment), 4.5% (Endosulfan treatment) and 3.8% (amongst parasitised eggs collected from control plots) (Table 6). As shown in Table (6) the increase in percentage mortality after 14 days of insecticidal application, due to spraying with Carbaryl,Malathion or Dicofol compared with control, was highly significant. While, on the contrary, insignificant increase in percentage mortality of T. evanescens was detected in plots of corn plants sprayed with Methomyl or Endosulfan .

Comparing the effectiveness of the tested insecticides, 14 days after insecticidal application, data in Table (6) indicate that Carbaryl,Malathion or Dicofol highly significantly increased the percentage of parasite mortality than Endosulfan or Methomyl. However, the differences in the recorded percentages of parasite mortality between Carbaryl and Malathion or Dicofol ; Dicofol and Malathion; and between Methomyl and Endosulfan were, statistically insignificant (Table 6).

Data illustrated in Fig. (2) clearly show that the application of corn pests insecticides on corn plants increased, generally, the mortality percentages of T. evanescens parasitising eggs of the European corn borer. These data, also, indicate that the parasite mortality% decreased as the period after insecticidal treatment lengthened.Carbaryl w.p.85%,after one , 7 and 14 days of treatment, showed the severest effect, i.e., highest Percentages of parasite mortality.Carbaryl,Dicofol and Malathion showed the longest residual effect, where the increase in percentages mortality in plots treated with either of the three insecticides remained highly significant than control during all the 14 days after treatment. However,Methomyl showed short residual effect, where application of the insecticide caused highly significant increase in the percentage of parasite mortality after 24 hrs. of application, but no significant difference than control could be detected after 7 and 14 days of treatment. Endosulfan, on the other hand, did not show any significant increase in mortality percentages, than control, after 1, 7 and 14 days of treatment. Paul et al. (1976) reported that emergence of T. australicum and T. japonicum was not much affected when sprays of 0.1% malathion or 0.1% Endosulfan were applied directly to parasitised host eggs. The results of Kim-Chi (1978) agree,to some extent,with the present results, as he indicated that

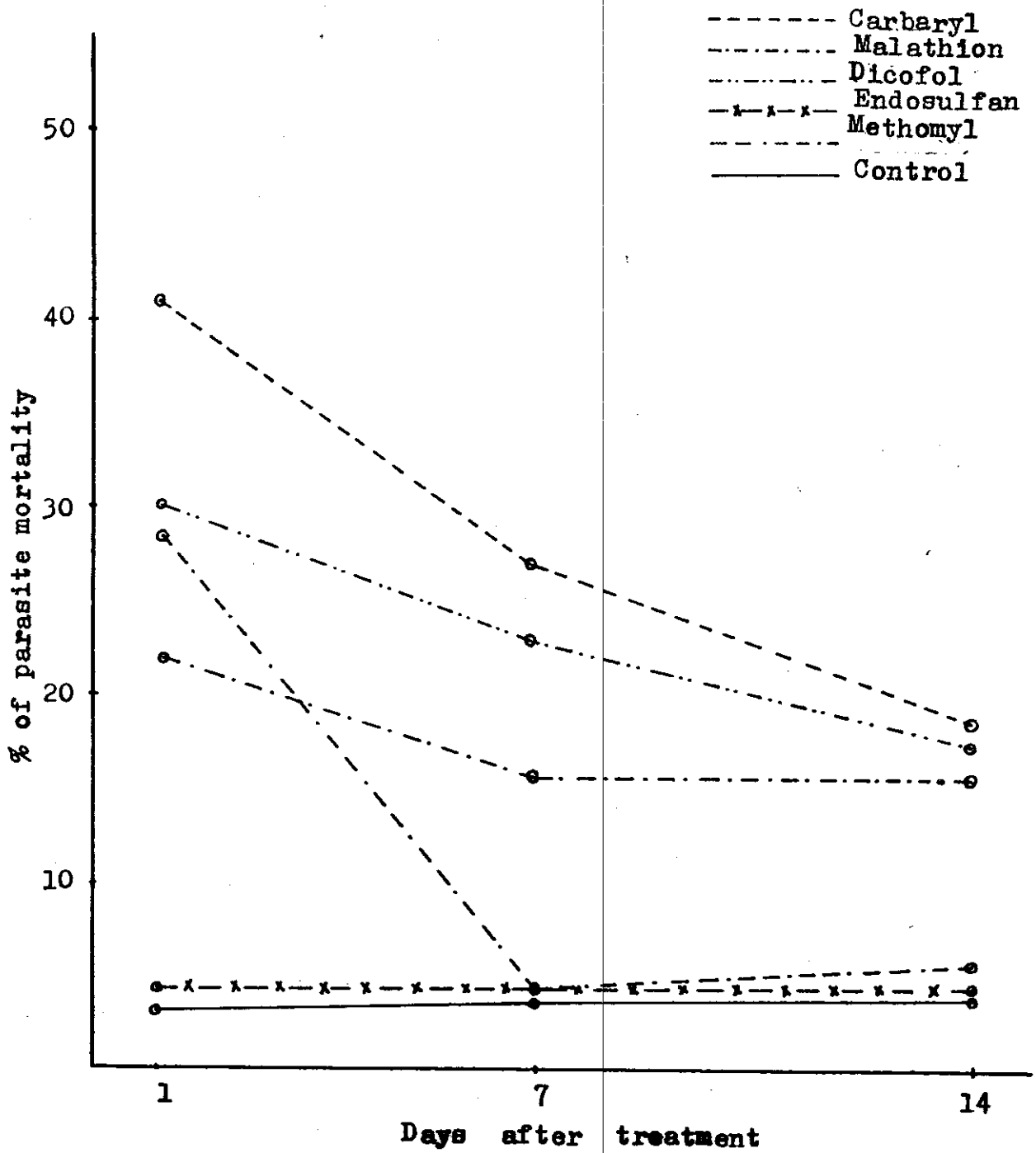

Fig.(2): Percentages of T.evanescens mortality inside the ECB eggs after different periods of insecticidal application.

Endosulfan (Thiodan 35) did not affect the larval stage of T. evanescens, but slightly affected the pupal stage (up to 14%).

In connection between the explained results on the percentages of O. nubilalis eggs containing dead parasites, after 1, 7 and 10 days of application of different insecticides, and those obtained on the effect of these insecticides on the percentages of parasitism by T. evanescens; it could be noticed that after 24 hrs. of insecticidal treatment, the same order of effectiveness was detected in both estimations, i.e.;Carbaryl w.p.85%,Dicofol 18.5%,Methomyl 90%, Malathion 57% and Endosulfan granules 4 % (Table 4). Thus indicating that the insecticide which severely affected the percentage of parasitism, manifested higher efficiency on the percentage of parasite mortality and vice versa.Seven days after treatment,Carbaryl, Dicofol and Malathion caused highly significant decrease in the percentage of parasitised ECB eggs, than Methomyl and Endosulfan treatments and control, and the same insecticides caused highly significant increase in the percentage of parasitised O. nubilalis eggs containing dead parasites. However,Methomyl and Endosulfan showed insignificant effect on percentages of parasitism and parasite mortality, after the same period of treatment. After 14 days of insecticidal application, the same trend of effectiveness was, nearly, detected on both the percentage of

parasitised eggs and that of those contained dead parasites. Thus indicates, generally, a direct relationship between the effectiveness of insecticides on the parasite populations and their effect of mortality of immature stages inside the parasitized eggs.

IV.3. Effect of the density of O. nubilalis eggs in relation to the number of T. evanescens females on the occurrence of superparasitism and effects on the resulting progeny:

The averages in numbers of T. evanescens adults which emerged from a single parasitised O. nubilalis egg under field conditions of Kafr El-Sheikh and Qalubia governorates are recorded in Tables (1, 2 & 3). However, data on the effect of exposing a fixed number of freshly laid ECB eggs to different numbers of T. evanescens couples for 24 hrs. on the number of parasitised eggs and occurrence of superparasitism are recorded in Table (7). The effect of the occurrence of superparasitism on longevity and reproductivity of the resulting progeny is recorded in Table (8).

IV.3.1. Occurrence of superparasitism under field conditions:

Data recorded in Tables (1, 2 & 3) indicate that superparasitism rarely occurs under field conditions, where the average number of adults emerged/parasitised host egg at Kafr El-Sheikh governorate ranged between 1.01 - 1.05 in

1981 corn season (Table 1),and 1.02 - 1.05 in 1982 season (Table 2). At Qalubia governorate,this number ranged between 1.02 and 1.06 in 1981 corn season and between 1.01 and 1.04 in 1982 season (Table 3). Thus indicating that under natural conditions a single parasite develops in each of the parasitised eggs of O.nubilalis, while , superparasitism rarely occurs. This rarity of superparasitism occurrence,under field conditions, may be due to natural distribution of host eggs in wide area and this may help the parasite to select the unparasitised eggs,only, for parasitism.

IV.3.2.Effect on the number of parasitised eggs and the occurrence of superparasitism:

As shown in Table (7), a direct relationship could be detected between the number of parasitised O.nubilalis eggs during 24 hrs. and the number of released T. evanescens couples / 60 host eggs. The highest number of parasitised eggs (total of 291 eggs from 300 eggs totally exposed; 97% parasitism) was recorded when 15 pairs of the parasite adults were allowed to parasitize 60 host eggs for 24 hrs. The lowest record (total of 77 parasitised eggs from 300 host eggs totally exposed; average 25.7% parasitism) was, on the other hand, detected when the 60 host eggs were exposed to one pair of the parasite. The recorded total numbers of parasitised eggs when 3, 5 and 10 pairs of the parasite were

Table (7): Relationship between the density of host eggs per T. evanescens females and percentages of parasitism, mortality and superparasitism.

No.of parasite couples / 60 host eggs	Total exposed host eggs in 5 replicates	No. of parasite couples in 5 replicates	Total No. of parasitised eggs (P.E.)	% parasitism (P)	Av. (P) transformed by Arc Sin formula	No.of eggs containing dead parasites (E.D.)	No. of dead parasites (D)	% D amongst counted parasites	Av. % D transformed by Arc Sin formula	Total emerging offspring (T)	Offspring per 100 host eggs containing surviving adults (O)	% occurrence of superparasitism
1. 15 pairs	300	75	291	97	83.62	27	36	9.8	18.40	332	125.76	25.76
2. 10 pairs	300	50	261	87	71.52	15	28	8.3	16.88	308	125.20	25.20
3. 5 pairs	300	25	271	90.3	74.30	18	18	5.9	14.28	255	100.79	0.79
4. 3 pairs	300	15	239	79.7	61.7	12	13	5.1	13.20	228	100.44	0.44
5. 1 pair	300	5	77	25.7	30.1	3	3	3.9	8.46	74	100.00	0.00
F value					35.09**				5.13**			
I.S.D. 1%					14.38				6.988			
5%					10.44				5.072			

$$\% D = \frac{D}{D+T} \times 100 \qquad O = \frac{T}{PE-ED} \times 100$$

allowed to parasitize 60 host eggs (five replicates)were 239 (79.7%), 271 (90.3%) and 261 (87%) eggs, respectively (Table 7). From Table (7), it could be, also, concluded that exposing the ECB eggs to T. evanescens couples at the rate of 15 pairs / 60 eggs, increased the total number of parasitised eggs (percentage of parasitism) than exposing the same number of eggs to one, three, five or ten pairs, and the difference was highly significant than treatments with one or three pairs, insignificant than treatment of 5 pairs, and significant than treatment of 10 pairs. Exposing the 60 host eggs to 10 pairs of the parasite,highly significantly, increased parasitism than exposing to one pair, however, the increase in parasitism was insignificant when compared with treatment of 3 pairs of the parasite. Exposure of the host eggs to 5 pairs of the parasite increased parasitism than exposing to one pair of T. evanescens (highly significant increase) and than exposing to 3 pairs of the parasite (significant increase). Also, exposing the 60 host eggs to three couples of the parasite, highly significantly, increased the percentage of parasitised eggs than exposing to one pair of the parasite(Table 7).

On the effect of the density of host eggs in relation to the number of released parasites on the percentage of parasite mortality inside the parasitised host eggs, it is evident from Table (7) that the lowest mortality percentage

(3.9%) was associated with the lowest density (one pair of the parasite/60 host eggs), however, the highest percentage mortality (9.8%) occurred with the highest density (15 couples of T. evanescens / 60 host eggs). Data in Table (7), also indicate that the percentage mortality amongst the developing T. evanescens individuals inside the host eggs increased, successively, as the number of released parasites in relation to the number of exposed host eggs increased. Exposing 60 host eggs to 15 couples of T. evanescens resulted in, highly significant, increase in percentage mortality amongst the developing parasites inside host eggs than when exposing the same number of eggs to one pair of the parasite, significant increase occurred when compared with exposure to three pairs, however, the increase in percentage mortality was insignificant when compared with other treatments (5 and 10 pairs of T.evanescens/ 60 host eggs). Also, exposing the same number of host eggs to 5 or 10 pairs of T. evanescens for 24 hrs., significantly increased the percentage of parasite mortality than exposing to one pair of the parasite. Comparing all other treatments was, on the other hand, insignificant.

About the effect of exposing a fixed number of the ECB eggs (total of 300 eggs in five replicates of 60 eggs each) to different numbers of T. evanescens couples on the occurrence of superparasitism, it is worth mentioning that dissecting host eggs from different treatments indicated that parasitised O. nubilalis eggs never contain more than two

parasites developing inside. From data in Table (7), it could be concluded that the probability of occurrence of superparasitism inside O.nubilalis eggs increased as the number of T. evanescens couples / 60 host eggs increased. Exposing 60 eggs to one pair of the parasite did not cause superparasitism, i.e.; each of the parasitised eggs contained, only, one parasite. Low percentages of superparasitism occurred when the 60 host eggs were exposed to 3 and 5 pairs of the parasite (0.44 and 0.79%, respectively) . However, on the other hand, the percentages of superparasitism amongst parasitised eggs increased when the host eggs were exposed to 10 or 15 couples of T. evanescens (25.2 and 25.76%, respectively).

It could be also concluded from Table (7)the presence of a direct relationship between the percentage of occurrence of superparasitism and that of parasite mortality inside the parasitised eggs, where the percentage mortality increased as the percentage of occurrence of superparasitism increased. Thus, indicating that superparasitism by T. evanescens in O. nubilalis eggs is an undesirable phenomenon as it suppresses the parasite population by increasing mortality. This may confirm the previous results on superparasitism under field conditions where, in most cases, only one parasite develops in a single host egg, and the occurrence of superparasitism in the field is, naturally, rare to insure successful parasitism.

The present data on the occurrence of superparasitism in the field (rare occurrence) and in the laboratory(maximum of two parasites develop per a single egg of O.nubilalis) are in contrast to those recorded by Hase (1929) who indicated that two individuals of T. evanescens (on average)can develop in a single O. nubilalis egg, and in some cases 3, and rarely 4 have been observed.

IV. 3.3. Effect on the resultant progeny:

Data in Table (8), clearly, show that the occurrence of superparasitism affected the efficiency of the resultant progeny in parasitising O. nubilalis eggs, and the total productivity of T. evanescens adults. However, the effect on the adult life-span, amongst the resultant progeny, was slight. The number of parasitised eggs of the ECB, generally, decreased as the occurrence of superparasitism increased, i.e.; as the number of parasite couples/ 60 host eggs increased. The lowest percentage of parasisitism (47.9%) occurred by adults resulting from eggs exposed at the density of 15 parasite couples / 60 host eggs, and in this case the number of the obtained offspring (473 adult parasites) was also the lowest. The highest percentage of parasitism (73.9%) was, on the other hand,recorded on adults resulted when the same number of eggs were ex-

Table (8): Effect of the rate of occurrence of superparasitism on percentage of parasitism, total productivity and longevity of the resultant progeny.

Tr.	No. of parasite pairs	Total No.of exposed host eggs	Total No.of parasitised eggs	Av. % of parasitism	Emerged parasite adults	Longevity (days) ♂	Longevity (days) ♀
1	10	1000	479	47.9	473	2.5	6.1
2	10	1000	552	55.2	562	2.5	6.1
3	10	1000	694	69.4	711	2.5	6.5
4	10	1000	686	68.6	702	2.7	6.5
5	10	1000	739	73.9	712	2.3	7.1

posed to one pair of the parasite, and the total productivity was also the highest (712 adults during the whole life-span of the tested adults). Other treatments showed intermediate values where the recorded percentages of parasitism were 68.6, 69.4 and 55.2%, and the numbers of resulting progeny were 702, 711 and 562 adults for adults resulting from densities of 3, 5 and 10 couples of the parasite / 60 host eggs, respectively. These results are in accordance with those recorded by Chacko (1969a) who found that females of T. evanescens minutum Riley that developed singly in the eggs of Corcyra cephalonica, had the maximum fecundity, but when two parasites developed in one host egg , the fecundity of the resultant females was reduced.

On the effect of the host density on longevity of resulting T. evanescens adults , the present data (Table 8) show that the longevity of males, ranged from 2.3 to 2.7 days, however, females lived 6.1 to 7.1 days indicating that females lived longer than males, from one hand, and that the effect of the occurrence of superparasitism on the adult parasites life-span was slight.

The aforementioned results on the effect of host eggs density in relation to the number of released T. evanescens couples on the percentage of parasitism, the occurrence of superparasitism, and the subsequent effect on the total productivity of the resulting offspring, indicate that the percentage of parasitism, generally, increased with the increase of the released couples of the parasite / fixed number of host eggs. But, increasing the number of parasite adults to the rate of 10 or 15 pairs/ 60 host eggs increased the occurrence of superparasitism and this, subsequently resulted in lower productivity of adults (Tables 7 & 8). The density of 5 pairs of the parasite / 60 host eggs caused slight occurrence of superparasitism (0.79%), lower percentage of parasite mortality amongst the developing parasites (5.9%), high percentage of parasitism amongst the exposed eggs (90.3%) and, relatively, high productivity of the resulting offspring (711 adults/ 10 pairs of the emerged parasites). Accordingly, this density (5 pairs of T. evanescens / 60 O. nubilalis eggs for an exposure time of 24 hours) may be recommended for either laboratory mass rearing of the parasite, or field release of the parasite adults for the pest control.

IV.4. Suitability of the European corn borer egg age for parasitism by T. evanescens:

Eggs of O. nubilalis were exposed for parasitism by T. evanescens females at 4 ages, i.e.; freshly laid eggs and after 24, 48 and 60 hours of deposition. The effect of parasitism on eggs of each of these ages on the parasite activity for parasitism, parasite mortality inside the host eggs and total productivity, and also on the longevity and productivity of the resultant offspring was estimated.

IV.4.1. Effect on adults activity, parasite mortality and total productivity:

Data recorded in Table (9) show that the mean total number of parasitised eggs / 10 mated females, during the three hours of exposure, varied considerably according to the host egg age. The highest parasite activity occurred on eggs of 24 hrs. old (mean of 131.2 eggs/10 parasite females), followed by treatment with freshly laid eggs (129.2 parasitised eggs), but no significant difference between both treatments was detected. When host eggs were exposed to parasite attack, for 3 hours, after 48 and 60 hrs. of oviposition, the

parasite activity was, highly significantly, reduced than the previous treatments (averages of 86 and 39.8 parasitised eggs/10 parasite females). These data indicate that O. nubilalis eggs, at all the mentioned degrees of embryonic development, were liable to be attacked and parasitised by T. evanescens, but the parasite activity was reduced as the embryonic development advanced. Generally, the highest activity of the parasite occurred on the ECB eggs of 0-24 hrs. old (Table 9), thus, the host eggs during this period after oviposition are the most suitable for parasite oviposition.

The percentage of parasite mortality inside the host eggs, on the other hand, increased as the embryological development, at the time of parasitism advanced. As shown in Table (9), rearing the parasite on O. nubilalis eggs after 60 hours of their deposition (just before the black head stage), highly significantly, increased the percentage of parasite mortality (27.5%) than all other treatments. Rearing the parasite on eggs of 48 hrs. old caused highly significant increase in mortality percentage (14.5%) than that occurred on freshly laid or 24 hrs. old eggs. However, the lowest mortality percentages of the developing parasites (6.1 and 6.8%) were obtained when T. evanescens females were allowed to lay their eggs in the freshly laid host eggs or in those of 24 hours old, respectively (Table 9).

Regarding the effect of the host egg age on the total offspring resulting/a single mated female, data in Table (9) show that freshly laid O. nubilalis eggs and those of 24 hours old were associated with the highest productivity of females (12.42 and 12.4 parasite adults, respectively). Whereas, the least number of parasitised adults produced/female (3.14 adults on the average) occurred when parasites were allowed to attack the host eggs, for 3 hours, at the age of 60 hrs. after deposition. Exposing the host eggs after 48 hours of oviposition, also, reduced the number of parasitoid progeny/female (7.7 adults) (Table 9).

The mentioned results, generally, indicate that decreased activity of T. evanescens adults to parasitise O. nubilalis eggs, increased parasite mortality inside the host eggs and less total number of parasitoid progeny occurred as the host egg age, at the time of parasitism, got older. Similar results were, previously, recorded by several authors. Iatomi and Yamshita (1937) found that the rate of development and survival rate of T. japonicum was reduced on older Ephestia cautella eggs; Lewis and Redlinger (1969) indicated that old Cadra cautella eggs were less suitable for parasitism with T. evanescens; El-Sherif (1974) indicated that eggs of Chilo agamemnon and O. nubilalis were suitable for development of T. evanescens except at the black head stage which proved not to be suitable for parasitism, Tawfik et al. (1980) reported that the number of attacked Anagasta kuehniella

by T. evanescens decreased as the host eggs got older; and Juliano (1982) found that the percentage of parasitised eggs of Sepedon fuscipennis by Trichogramma and the total number of parasitoid progeny decreased significantly with the increase of the host egg age.

IV.4.2. Effect on fecundity and longevity of the offspring:

As shown in Table (10), exposing the host eggs, at different stages of embryonic development, affected the activity and productivity of the resultant offspring. The total number of parasitised O. nubilalis eggs (during the whole life-span of 10 parasite couples fed on bee honey droplets) by T. evanescens females resulting from host eggs parasitised when freshly laid or at 24 hours old was, relatively, high (1182 and 1163 eggs, respectively). Parasite adults, resulting from older eggs (of 48 or 60 hours old) showed reduced activity on O. nubilalis eggs (511 and 308 parasitised eggs/10 females, respectively).

The percentages of mortality amongst the parasites developing inside the host eggs varied also according to the host egg age on which the parents were reared (Table 10). These percentages increased when the parasite parents were reared on older eggs (12.1 and 18.5% when rearing occurred on host eggs of 48 and 60 hours, respectively). On freshly laid eggs and those of 24 hrs. old, the recorded mortality

Table (10): Effect of host eggs age on the resultant offspring.

Treatments	No. of pairs	Total No. of exposed eggs	Parasitised eggs	Emerged adults	%	Dead parasites	%	No. of survived progeny/ female	Adults longevity (Days) ♂	Adults longevity (Days) ♀
Newly laid	10	2000	1182	1132	95.8	50	4.2	113.2	2.9	10.8
24 hrs.old	10	2000	1163	1110	95.4	53	4.8	111.0	2.9	9.1
48 hrs.old	10	2000	511	449	87.9	62	12.1	44.9	1.3	7.2
60 hrs.old	10	2000	308	251	81.5	57	18.5	25.1	1.1	6.1

percentages amongst individuals developing from the offspring were, considerably lower (4.2 and 4.8%,respectively).

Parasite females that resulted from freshly laid O. nubilalis eggs and from those parasitised after 24 hours of deposition produced the highest numbers of progeny (113.2 and 111 parasite adults, respectively). The total progeny / female decreased, on the other hand, as the host egg age, on which the parasite parents were reared, increased (44.9 adults for females resulted from eggs parasitised at 48 hrs. age, and 25.1 adults / female resulted from host eggs parasitised at 60 hours age) (Table 10).

About the longevities of adults that resulted from different treatments (when fed on 100% bee honey during the whole life-span), an inverse relationship could be detected between the adults life-span and the egg age on which parasites developed (Table 10). The longest life-spans were associated with adults resulted from freshly laid O. nubilalis eggs and from those parasitised after 24 hrs. of deposition (2.9 and 10.8; and 2.9 and 9.1 days for males and females, respectively). Shorter life-spans of males and females (1.3 and 7.2 days, respectively)occurred with adults resulted from eggs parasitised at 48 hours old. While, the shortest life-spans of the two sexes (1.1 and 6.1 days, respectively) were detected on males and females resulted from host eggs parasitised after 60 hours of their deposition (Table 10).

The present results on the effect of the host egg age on which parasite parents were reared on the activity, productivity and longevity of the resulting offspring, clearly, indicate that all decreased with the increase of O. nubilalis egg age at the time of parasitism. These results agree with Juliano (1982) who reported that the survivorship of the resulting progeny of Trichogramma decreased significantly with the increase of the host egg age.

IV.5. Effect of food on T. evanescens adults and the resultant progeny:

The effect of feeding of T. evanescens adults on five regimes of nutrition, i.e.; 100% and 50% bee honey, 20 and 10% sugar solution, and tap water, for 24 hours , on the rate of parasitism on O. nubilalis eggs, parasite mortality inside the host eggs and the total number of parasitoid progeny was estimated and the obtained data are recorded in Table (11). The effect of different nutrient solutions on fecundity and longevity of the resultant offspring(when fed 100% bee honey droplets) was also investigated (Table 12).

IV.5.1. Effect on the parasite adults:

As shown in Table (11), the descending order of effectiveness of different regimes of nutrition on the total number of parasitised O. nubilalis eggs/5 mated T. evanescens females during 24 hours exposure was as follows, sugar solution 20% (average of 61.6 parasitised eggs), 100% bee honey

Table (11): Effect of nutrition on parasitism and parasite mortality, progeny per female and total productivity of T. evanescens.

Treatment	No.of pairs	Total no.of exposed host eggs (50 egg masses)	Parasitised eggs	$\bar{x}$ of 10 replicates	Eggs containing dead parasite	% eggs containing dead parasites (D)	Av.(D)transformed by Arc Sin formula	Total no.of counted adults	Av. progeny per female
1. Tap water	50	1194	223	22.3	18	8.1	16.37	206	4.12
2. Bee honey 100%	50	1207	553	55.3	39	7.1	14.70	514	10.28
3. " " 50%	50	1223	496	49.6	45	9.1	16.89	451	9.02
4. Sugar sol. 20%	50	1232	616	61.6	40	6.5	14.16	576	11.52
5. Sugar sol. 10%	50	1240	343	34.3	35	10.2	17.77	308	6.16
6. Starvation	50	1257	189	18.9	21	11.1	18.76	168	3.36
F. value				74.42**			1.3		75.85**
L.S.D. 1%				7.8					1.5
5%				5.8					1.1

(55.3 eggs), 50% bee honey (49.6 eggs), 10% sugar solution (34.3 eggs) and tap water (22.3 eggs). However, starved adults oviposited in a mean number of 18.9 O.nubilalis eggs, indicating the lowest activity. Comparing the effect of different regimes of nutrition on parasite activity , it is clear from Table (11) that sugar solution 20% , significantly, increased the average number of parasitised eggs than 100% bee honey, and caused highly significant increase than all the remaining treatments. Pure bee honey caused highly significant increase in the percentage of parasitised eggs than 10% sugar solution, tap water or starvation, and the increase was insignificant when compared with 50% bee honey. The later solution, highly significantly increased the parasites activity than 10% sugar solution, tap water and starvation. Also, higher numbers of the ECB eggs were parasitised by adults fed on tap water or starved without feeding, and the differences were always highly significant (Table 11).

On the mortality percentages of developing T.evanescens in O. nubilalis eggs, Table (11) indicates that these percentages varied according to the applied nutritive solution. The least percentage (6.5%)was associated with feeding on 20% sugar solution. However, the highest mortality percentage (11.1%) occurred amongst parasites developing from starved adults. Other solutions caused intermediate values, but

according to Table (11), all the differences in percentages mortality were, statistically, insignificant.

The final parasitoid progeny that resulted from exposure of host eggs, for 24 hours, when different regimes of nutrition were followed for adults, differed according to the applied food. As shown in Table (11), the highest number of parasite adults/female (average 11.52 adults) was obtained from adult parasites fed on 20% sugar solution, followed by feeding on 100% bee honey (average 10.28 adults/female) indicating a significant difference between the two groups . Sugar solution (20%) caused highly significant increase in the number of resultant progeny than that obtained from adults fed on 50% bee honey, 10% sugar solution or tap water, or starved without nutrition. Bee honey 100%, significantly increased the progeny than that diluted to 50% (9.02 adults/female parasite), however, the increase was highly significant than those produced by adults fed on 10% sugar solution (6.16 adults), tap water (4.12 adults) or starved adults (3.36 adults). Comparing between all other treatments took the same trend of significancy of the effect of the type of food on the number of parasitised host eggs.

IV.5.2. Effect on the resulting progeny:

Data recorded in Table (12), clearly, indicate that the type of food on which the parasite adults were fed, considerably, affected the activity and fecundity of the

Table (12): Effect of food on the resulted progeny.

Treatments	No. of T. evanescens pairs	Total productivity	Eggs containing: Survived adults	%	Eggs containing: Dead parasites	%	No. of survived progney/ female	Adults longevity (Days) ♂	Adults longevity (Days) ♀
Tap water	5	169	155	91.7	14	8.3	31	1.2	2.0
100% bee honey	5	493	479	97.2	14	2.8	95.8	2.8	9.6
50% bee honey	5	357	338	94.7	15	4.2	67.6	2.1	7.9
20% sugar sol.	5	504	488	96.8	16	3.1	97.6	3.1	10.2
10% sugar sol.	5	284	261	91.9	23	8.1	52.2	1.9	6.3
Starved	5	151	128	84.8	23	15.2	25.6	1.1	1.7

resultant offspring. The highest activity (504 parasitised eggs during the whole life-span of 5 couples of the progeny) was recorded from adults resulting by parasites fed on 20% sugar solution. Adults resulting from parents fed on 100% bee honey, also, parasitised high number of host eggs (493 eggs). That was followed by feeding on 50% bee honey (357 parasitised eggs), 10% sugar solution (284 eggs) and tap water (169 parasitised eggs). However, the lowest activity (151 parasitised eggs/5 females)occurred by adults resulted from starved parents.

The percentages of dead parasites inside the host eggs amongst individuals developing from the resulting offspring were also affected by the type of food offered for the parents. This percentage was the highest (15.2% , 23 dead parasites from a total number of 151 developing individuals) from the offspring resulted from starved parasites. The lowest percentage mortality (2.8%) occurred, on the other hand, when parents were fed on 100% bee honey, followed by feeding on 20% : sugar solution (3.1% mortality), 50% bee honey(4.2%), 10% sugar solution (8.1%) and tap water (8.3% mortality).

The number of survived offspring / female of the progeny, varied according to the type of food applied to the parasite parents (Table 12). The highest number of parasitoid progeny (mean of 97.6 adults/female) was obtained when parents were

fed on 20% sugar solution. Feeding of the parasite parents on 100% bee honey, also resulted in high fecundity of the progeny (95.8 adults), followed by 50% bee honey (67.6 adults), 10% sugar solution (52.2 adults) and tap water (31 adults). However, the lowest number of parasitoid progeny (25.6 parasitoid adults/female) was produced by females resulting from starved parents (Table 12).

The longevity of T. evanescens adults (fed on bee honey) was the longest with those resulted from parents fed on 20% sugar solution (averages; 3.1 days for males and 10.2 days for females). That was followed by those resulted from parents supplied with 100% bee honey (2.8 and 9.6 days, respectively), 50% bee honey (2.1 and 7.9 days), 10% sucrose solution (1.9 and 6.3 days), and tap water (1.2 and 2 days,respectively). Males resulted from offspring of starved parents showed the shortest longevity (1.1 days), and the same effect was detected on females (1.7 days on the average).

From the previously elucidated data on the effect of the type of food on activity and productivity of T.evanescens adults and the resulting progeny, it could be concluded that 20% sugar solution or 100% bee honey were the most suitable for increasing the mentioned characters. Thus, these solutions may be recommended as suitable for adults nutrition during laboratory mass rearing, and before liberation of the parasite in the field to obtain the highest efficiency of the

parasite on the pest eggs. This agree with Ragab (1979) who indicated that in order to obtain more progeny, during mass rearing of T. evanescens, the adults should be fed continuously on 20% sugar solution with or without dry yeast. However, El-Sherif (1974) recommended feeding of T. evanescens adults on 10% sugar solution to obtain most progeny, and the author, also, recommended the same solution for adults nutrition before field release of the parasite and he added that this will increase the parasite efficiency by increasing both longevity and productivity.