ABUNDANCE AND POPULATION *FLUCTUATION OF E. MUNDUS & E.* LUTEA TWO PARASITOIDS OF *BEMISIA TABACI* (GENN.) ON ELEVEN PLANTHOSTS AT KAFR EL-SHEIKH REGION

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ABSTRACT

Two parasitoids *Eretmocerus mundus* Mercet and *Encarsia lutea* Masi were recorded on eleven planthosts of *B. tabaci* at Kafr El-Sheikh region. Parasitism percentages of *E. mundus* were ranged from 12.67-76.15% and 15.01 –74.96%, where those of *E. lutea* were from 2.88 to 19.29% and from 3.43 to 18.63%, and the combined percentages ranged between 15.55-95.44% and 18.44-93.60% during 2000 and 2001, respectively. The highest parasitism of the two parasitoids, singly or together, were found on hot-pepper followed by yellow leaf curl diseased (YLCD) tomato, eclipta (wild weed), and symptomless tomato. Percentage of *E. mundus* was ranged from 72.4 to 85.8% and from 71.6 to 84.5% during 2000 and 2001, respectively. Also, it was with maximum perecentages on jew's mallow, soy bean, kidney bean and venice mallow. Where, the percentage of *E. lutea* were from 14.2 to 28.4% during the two seasons and it was with higher percentages on cotton, symptomless tomato, eclipta, eggplant and YLCD tomato. Parasitism for the two parasitoids were recorded with maximum level during Sep. and Oct. Fluctuations of the two parasitoids coincided with *B. tabaci* infestation; enhanced with the planthost flowering, and it could be distinguished at three stages. Parasitism percentages of *E. Mundus* were always higher than those of *E. Lutea* on these planthosts during the two seasons of 2000 and 2001, respectively.

INTRODUCTION

The whitefly *Bemisia tabaci* (Gennadius) (Aleyrodidae: Homoptera) has increasingly become a serious pest of horticulture and agronomic crops; throughout warm regions of the world (**Brown *et al.*, 1995**); and it's a key pest in tropical and subtropical regions world-wide (**Hilje, 2001**). In addition to cause mechanical damage, *B. tabaci* has

been associated with several new plant disorders and dozens of new geminiviruses (**Polston and Anderson, 1997**). Although, greater awareness of the need to reduce pesticide use has concentrated more efforts on ways of conserving and enhancing natural enemies populations (**Anon, 1986**). The aim ofthis study was focused on the abundance and fluctuation of the parasitoids of *B. tabaci* infesting eleven planthosts.

MATERIALS AND METHODS

Abundance and population fluctuation of the two parasitoids of *B. tabaci*; *Eretmocerus mundus* Mercet and *Encarsia lutea* Masi were investigated during the two years of studies (2000 and 2001), on: Hot-pepper, *Capsicum annum*, L., cv. Long reed coyenne; tomato, *Lycopersicon esculentum* L. cv. Super Castle Rock both symptomless and YLCD plants, eggplant, *Solanum melongena* L. cv. Romy; kidney bean, *Phaseolus vulgaris* L. Giza 6; the wild weeds ; eclipta, *Eclipta alba* L.; jews mallow (Nalta Jute), *Corchorus olitorius* L; venice mallow, *Hibiscus trionum* L. The adjacent field crops: soybean, *Glycine max* Marr; cotton, *Gossypium barbadense* L. Giza 86 and the hedge plant: *Lantana camara* L. permanently existing in the Fac. of Agric. Kafr El-Sheikh. One feddan, at Farag El-Shamy village, El-Ryad Center, was prepared and the seedlings were transplanted and the kidney bean was sowed in alternative rows, with the other following crops: tomato, eggplant and hot-pepper adistance between each plant of 35 cm and a width of 125 cm.

Kidney bean was sowed and other vegetable plants were transplanted in 1st Jul. at the two seasons of study. Weekly biased samples were taken from 1st Aug. until 10th Oct. each sample consistes of 15 leaflets or leaves from *B. tabaci* infested plants. Selected samples were cut off, and then transferred to the laboratory where the sedentary *B. tabaci* nymphs were examined on the two leaf surfaces with the aid of a stereo-microscope and only live specimens were counted and recorded. Stalks of sampled leaflets or leaves were embedded in moistened cotton pieces and put in glass-tube cages. These cages were daily examined for parasitoids emergence. Parasitoid adults were acquired by an aspirator then identified and counted

Parasitism % = No. of parasitoid adults/No. of *B. tabaci* nymphs × 100

Owing to the variation of the leaf area and to compare these planthosts:

Modified mean no./sample = (T/n) × (P/B)

T = Total no. of *B. tabaci* nymphs on hot-paper.
n = no. of samples on hot-paper.
P = total no. of parasitoid on the planthost.
B = total no. of *B. tabaci* on the same planthost.

Sampled plants did not received pesticide treatments. Data were analysed by ANOVA and compared by Duncan's multiple range test. Temperature, RH% and wind velocity in Kafr El-Sheikh were kindly supplied by Dept. Entomol. Rice Res. and Training Center.

RESULTS AND DISCUSSION

The two parasitoids, *Eretmocerus mundus* Mercet and *Encarsia lutea* Masi (Aphelinidae: Hymenoptera) were detected on eleven planthosts of *B. tabaci* (Gennadius) during 2000 and 2001 at Kafr El-Sheikh region. Results revealed that: Total parasitism percentage, in season 2000 (Table 1), of *E. mundus* was the highest (76.15%) on hot-pepper, followed by 54.04% on yellow leaf curl diseased tomato (YLCDT), then, 46.03% on the wild weed eclipta, then after, 41.05% on symptomless tomato. However, the same parameter ranged between 33.10 and 38.48% on jew's mallow, lantana, eggplant and Kidney bean and it was less than 30.0% on soy bean, cotton and venice mallow. Total parasitism percentage of *En lutea* was the highest (19.29%) on hot-pepper, followed by 15.69, 14.93 and 14.21% on symptomless tomato, YLCD tomato and eclipta, respectively, then 10.09% on eggplant, and it was less than 10.00% on the remaining planthosts. Total parasitism percentage of the two parasitoids together was the highest 95.44% on hot-pepper, followed by 68.96% on YLCD tomato, then, 60.25% on eclipta, then after, 56.74% on symptomless tomato. Meanwhile, it ranged between 40.16 to 45.04%, in a descending order, on eggplant, jew's mallow, lantana and kidney bean; and between 15.55 to 35.58%, in the same order, on soy bean, cotton and venice mallow. Total parasitism percentages of the two parasitoids, singly and together, on these planthosts in 2001 (Table 2) showed the same trend as in 2000 with one exception in the case of *E. mundus* that jew's mallow, lantana and eggplant which occupied the 5^{th}, 6^{th} and 7^{th} ranks in 2000 became eggplant, jew's mallow and lantana, respectively, in 2001; and with two exceptions in the case of *En lutea* where eclipta, eggplant, kidney bean and cotton which occuped 4^{th}, 5^{th}, 7^{th} and 8^{th} ranks in 2000 were substituted by eggplant eclipta, cotton and kidney bean in the same ranks, respectively.

Table (1): Total number, mean, modified mean number and parasitism percentage of *E. mundus* and *E. lutea* found on eleven host plants of *B. tabaci* at Kafr El-Sheikh region during year 2000.

Host plants scientific & common names	No. of *B. tabaci* nymphs	*E. mundus*					*E. lutea*					Two parasitoid %
		No. parasitoid	%	Parasitism	Mean No. /sample	Modified mean No. /sample	No. Parasitoid	%	Parasitism	Mean No. /sample	Modified mean No. /sample	
C. annum Hot-pepper	4364	3323	79.78	76.15g	415.37	415.37	842	20.22	19.29f	105.25	105.25	95.44g
L. esculentum Tomato (TYLCD)	2304	1245	78.35	54.04f	113.18	294.77	344	21.65	14.93e	31.27	81.45	68.96f
Symtomless tomato	3359	1379	72.35	41.05de	125.36	223.95	527	27.65	15.69e	47.91	85.58	56.74e
S. melongena Eggplant	7846	2742	77.59	34.94bc	249.27	190.64	792	22.41	10.09d	72.00	55.06	45.04d
P. vulgaris kidney bean	9026	2988	82.43	33.10bc	271.64	180.58	637	17.57	7.06bc	57.91	38.50	40.16d
E. alba Eclipta	4201	1934	76.41	46.03e	175.82	251.13	597	23.59	14.21e	54.27	77.52	60.25e
C. olitorius Jews mallow	4283	1648	85.79	38.48cd	149.82	209.90	273	14.21	6.37b	24.82	34.77	44.85d
H. trionum venice Mallow	4269	541	81.48	12.67a	49.18	69.13	123	18.52	2.88a	11.18	15.72	15.55a
G. max Soy bean	3156	931	82.90	29.49b	84.64	160.92	192	17.09	6.08b	17.45	33.19	35.58c
G. barbadence Cotton	3541	613	72.03	17.31a	55.73	94.43	238	27.97	6.72bc	21.64	36.66	24.03b
L. camara Lantana	7433	2661	81.10	35.79c	241.91	195.29	620	18.90	8.34cd	56.36	45.50	44.14d

Means in each column followed by the same letters are not significantly differed at 5% level by DMRT.

Table (2): Total number, mean, modified mean number and parasitism percentage of *E. mundus* and *E. lutea* found on elven host plants of *B. tabaci* at Kafr El-Sheikh region during year 2001.

Host plants scientific & common names	No. of *B. tabaci* nymphs	*E. mundus*					*E. lutea*					Two parasitoid %
		No. parasitoid	%	Parasitism	Mean No. /sample	Modified mean No. /sample	No. parasitoid	%	Parasitism	Mean No. /sample	Modified mean No. /sample	
C. annum Hot-pepper	3998	2997	80.09	74.96g	374.63	374.63	745	19.91	18.63e	93.12	93.13	93.60f
L. esculentum Tomato (TYLCD)	1864	1124	78.38	60.30f	102.18	301.35	310	21.62	16.63cde	28.18	83.11	76.93e
Symtomless tomato	2738	1211	71.61	44.23de	110.09	221.04	480	28.39	17.53de	43.67	87.61	61.76d
S. melongena Eggplant	4827	2126	74.31	44.04de	193.27	220.11	735	25.69	15.23cd	66.82	76.09	59.27d
P. vulgaris kidney bean	7918	2998	81.49	37.86cd	272.54	189.22	681	18.51	8.60b	61.91	42.98	46.46c
E. alba Eclipta	3511	1736	78.41	49.44e	157.82	247.10	478	21.59	13.61c	43.45	68.04	63.06e
C. olitorius Jews mallow	3379	1446	84.46	42.79c	131.45	213.86	266	15.54	7.87b	24.18	39.34	50.66c
H. trionum venice Mallow	3178	477	81.39	15.01a	43.36	75.01	109	18.60	3.43a	9.91	17.14	18.44a
G. max Soy bean	2320	878	83.46	37.84cd	79.82	189.13	174	16.54	7.50b	15.82	37.48	45.34c
G. barbadence Cotton	3054	814	75.16	26.65b	74.00	133.20	269	24.84	8.81b	24.45	44.02	35.46b
L. camara Lantana	5100	1951	80.35	38.25cd	177.36	191.18	477	19.65	9.35b	43.36	46.74	47.61cd

Means in each column followed by the same letters are not significantly differed at 5% level by DMRT.

Results of the total parasitism percentages for the two parasitoids agreed with that obtained, in the same region, on cotton by **El Adl *et al.* (1998)**; and on cotton, eggplant, venice mallow and lantana by **Mesbah, (1999)**, but not on squash by **Kassem (2000)**. However, results were in agreement with those obtained elsewhere by **Vacante *et al.* (1995); Gonzales *et al.* (1996) and Kirk *et al.* (2000)**.

Mean no/sample of *E. mundus* in season 2000 (Table 1) was the highest (415.37 individuals/sample), followed by 271.64, 249.27 and 241.91 individuals/sample on kidney bean, eggplant and lantana, respectively. The same parameter ranged between 113.18 to 175.82 individuals/ sample on eclipta, jew's mallow, symptomless and YLCD tomato; where it was less than 100 individuals/ sample on the remaining tested planthosts. This parameter of *En lutea*, in 2000 (Table 1), was the highest on hot-pepper (105.25 individuals/ sample) followed by 72.00, 57.91, 56.36 and 54.27 individuals/sample on eggplant, kidney bean, lantana and eclipta, respectively, and it was less than 20.00 individuals/sample on the remaining tested planthosts. Mean no/sample of each parasitoid in 2001 (Table 2) showed the same trend as in 2000 on these plant hosts with the exception of lantana, symptomless tomato, jew's mallow and cotton occupying the 4^{th}, 6^{th}, 8^{th}, and 9^{th} ranks in 2000 were substituted by symptomless tomato, lantana, cotton and jew's mallow in the same ranks, respectively, in 2001. Results pointed out the attractiveness of such planthosts to *B. tabaci* and parasitoids.

Modified mean no./sample of each parasitoid in 2000 and 2001 showed the same arrangement as its parasitism percentages on these planthosts. However, modified mean no/sample of each parasitoid on lantana, kidney bean and eggplant in 2000, and kidney bean in 2001 were less than their mean no/sample which dealt with their high attractiveness to the adults of *B. tabaci* than those of the parasitoid.

Percentages of *E. mundus* individuals on these plant hosts were very high and ranged from 72.4 to 85.8% in 2000 (Table 1), and from 71.6 to 84.5% in 2001 (Table 2), whereas, those of *En lutea* averaged 14.2 to 28.0% and 15.5 to 28.4% during 2000 and 2001, respectively. Interestingly, percentage of each parasitoid on the same plant host in the two seasons were mostly similar as on hot-pepper, YLCD tomato, venice mallow and soy bean; or the difference was between 1.2 and 1.8% as on symptomless tomato, kidney bean, jew's mallow and lantana; and the highest difference was from 3.3 to 5.8% on eclipta,

eggplant and cotton, respectively. However, low numbers of *En lutea* to those of *E. mundus* suggest the effect of lethal interference competition on parasitoid co-existence and the pest suppression in biological control systems (**Collier and Hunter, 2001**). Although, parasitoid numbers were generally higher in 2001 than in 2000, except on hot-pepper, in spite of numbers of sampled *B. tabaci* nymphs in 2001 which were lower than those obtained in 2000 on these tested plant hosts.

Population fluctuation of the two parassitoids :

The population fluctuation of the two aphelinids on the eleven planthosts during 2000 and 2001 are indicated in Tables 1 and 2 and illustrated in Fig. 1-3.

In fact, *E. mundus* was more abundant on these planthosts than *E. lutea* throughout the study period 2000 and 2001.

E. mundus and sometimes *E. lutea*, when its numbers were relatively high, their fluctuations exhibited three stages, the 1st represented by gradual and slight increases from the beginning of parasitism and lasted one (i.e. venice mallow) or 2 (i.e. symptomless tomato) or 3 (i.e. eggplant) weeks, or apparently absent (i.e. YLCD tomato). This stage synchronized with start flowering of vegetables. The 2nd stage distinguished by rapid and great increases and it coincided with the highest flowering of vegetables and field crops. This stage happened directly after parasitism occurance (i.e. hot-pepper and YLCD tomato) or during (1 i.e. cotton) or 2 (i.e. soy bean) weeks. The 3rd stage was the longest one and mostly represented by a stable level (eclipta) or with slight changes (symptomless and YLCD tomato, eclipta in the two years; hot-pepper in 2001) or by pronounced changes (hot-pepper and cotton in 2000). Fluctuation of the two parasitoids on kidney bean were differed than those on the other plant hosts (Fig. 2A) which may be related to the flowering periods of this plant. Effect of flowers on the activity of parasitoid was recently suggested (**Baggen *et al.*, 1999**). Parasitism of *E. mundus* was always higher than those of *En lutea* on these planthosts. Later results may be related to the high searching rate of *Er mundus* and its killing power that relatively more correlated with the host density comparable to that of *En lutea* (**Abd El-Kareim, 1998**). Data indicated that the higher rates of parasitism caused by *E. mundus* on *B. tabaci* nymphs occurred on these planthosts during Sep. and Oct. in the tested two seasons.

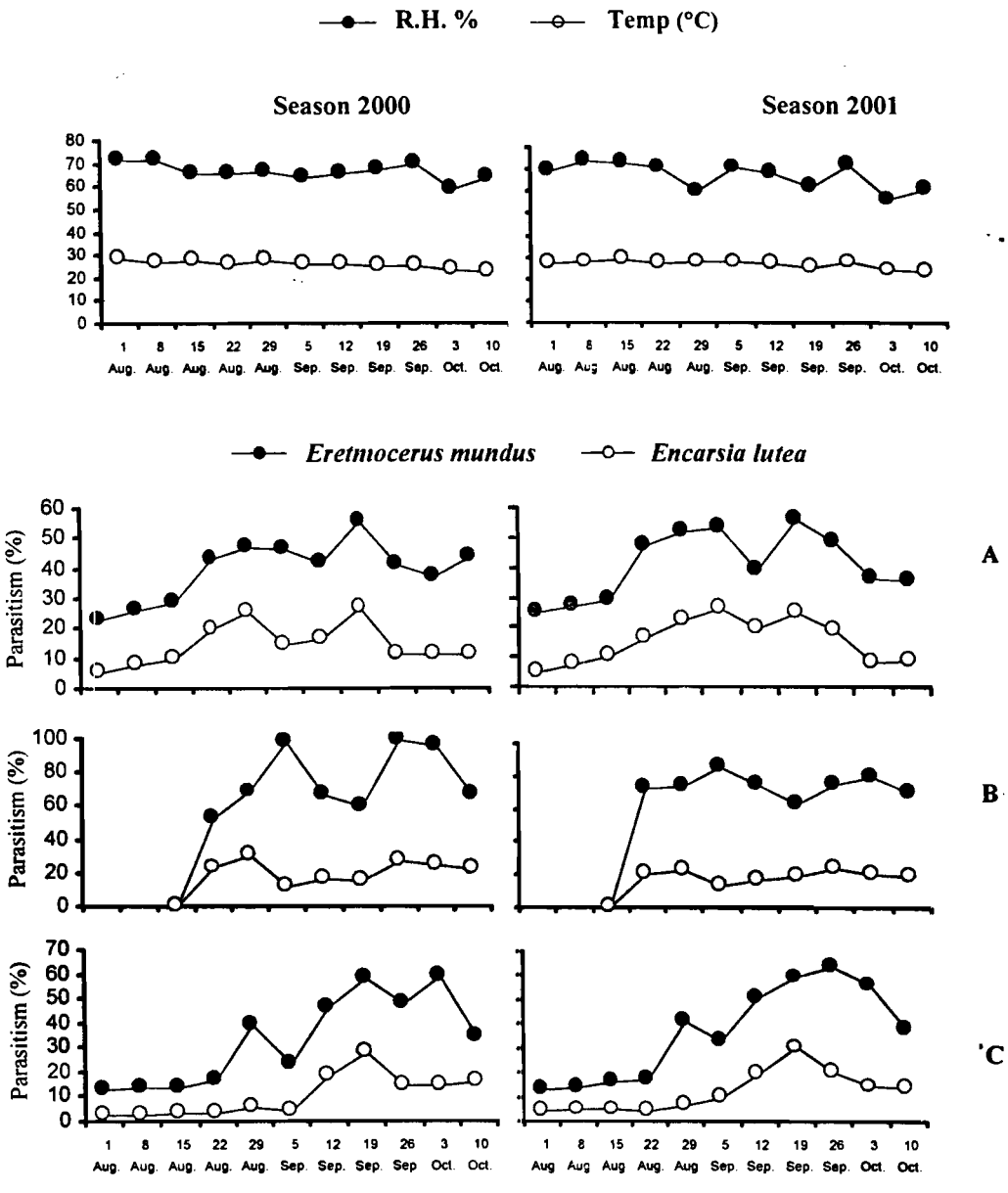

Fig. (1): Population fluctuations of *E. mundus* and *E. lutea* parasitism on symptomless tomato (A), hot-pepper (B) and eggplant (C) and the prevailing temperature and RH% at Farag El-Shamy village (El-Ryad) during 2000 and 2001 seasons.

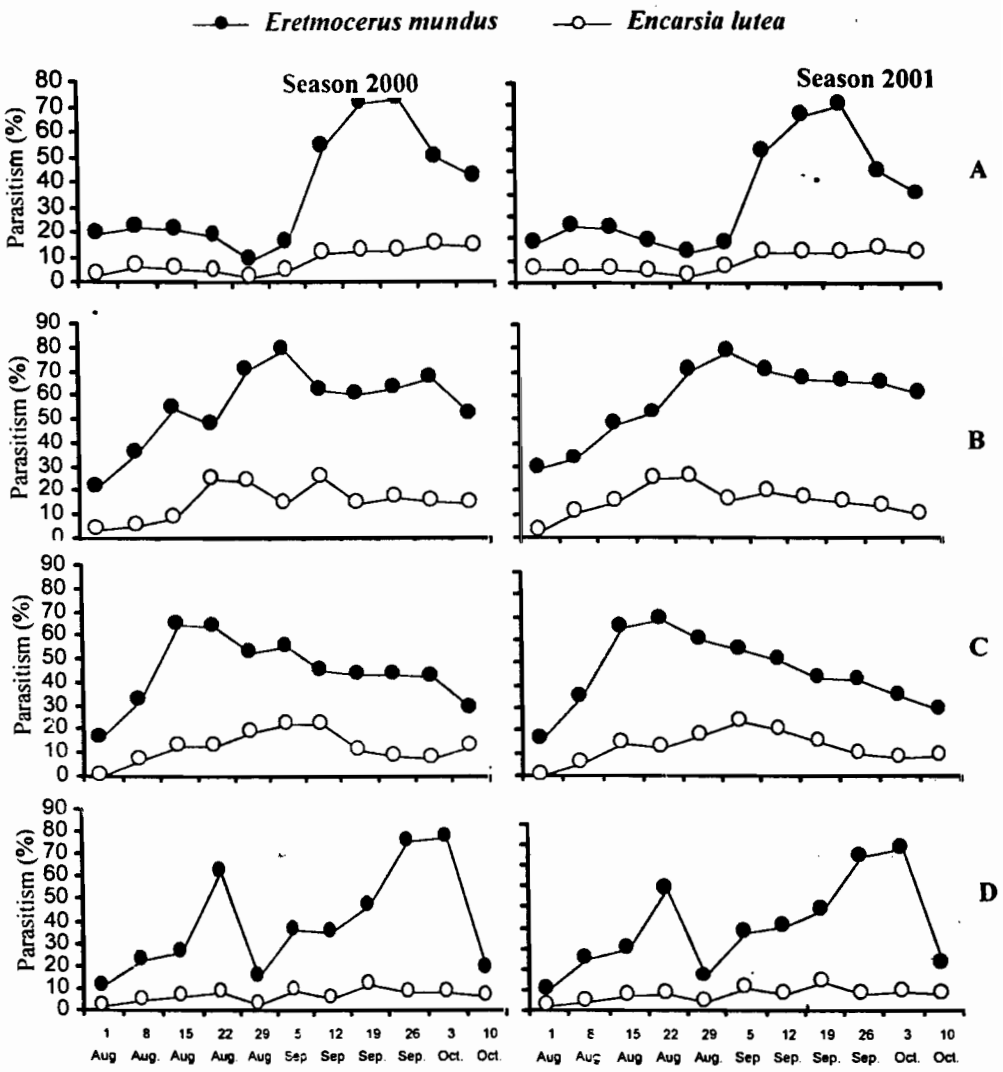

Fig. (2): Population fluctuations of *E. mundus* and *E. lutea* parasitism on kidney bean (A); YLCD tomato (B); eclipta (C) and jew's mallow (D) during 2000 and 2001 seasons at Farag El-Shamy village (El-Ryad).

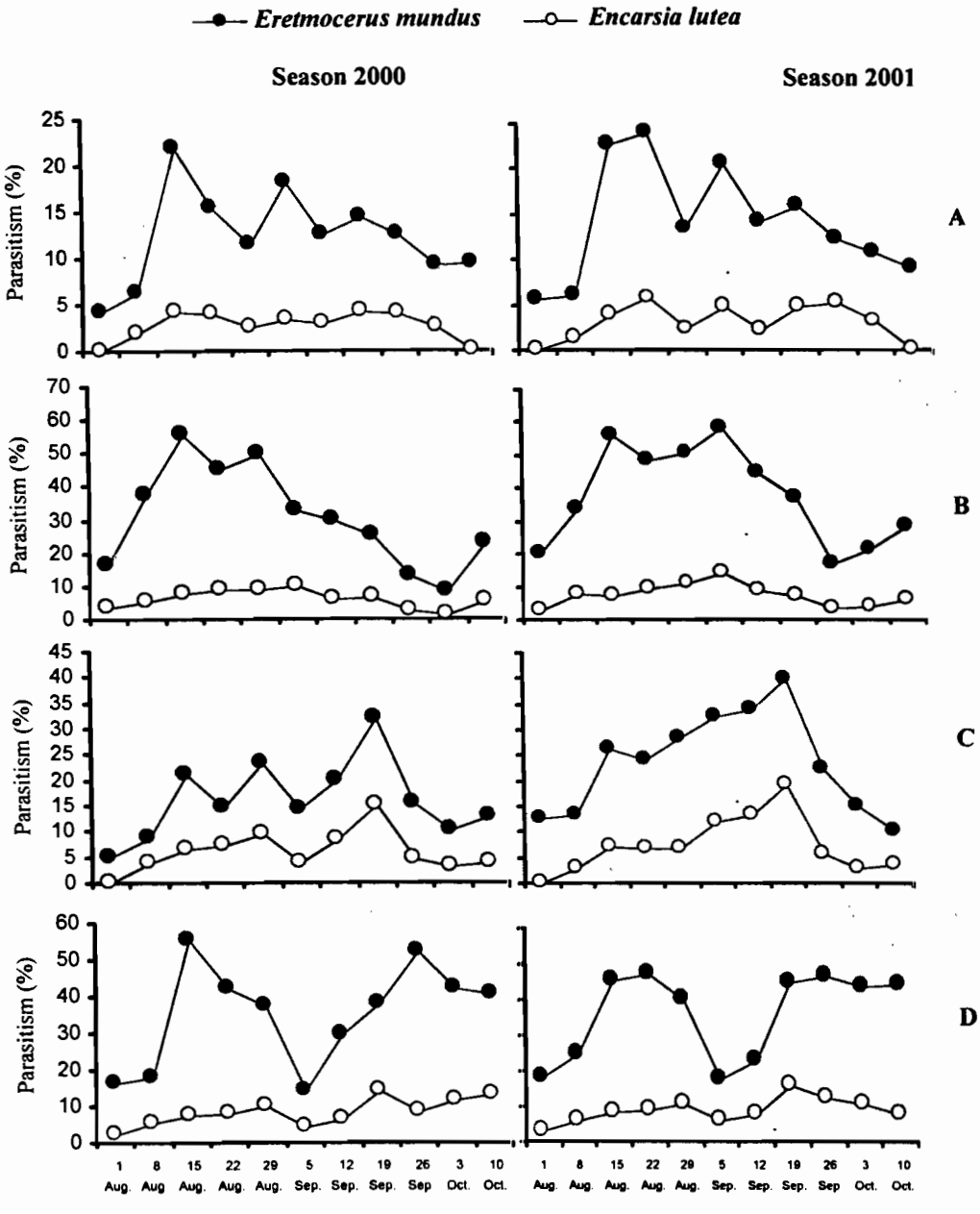

Fig. (3): Population fluctuations of *E. mundus* and *E. lutea* parasitism on Venice mallow (A); soy bean (B); cotton (C) and lantana (D) during 2000 and 2001 seasons at Farag El-Shamy village (El-Ryad).

Results pointed out that the two parasitoids maintained highest parasitism percentage on hot-pepper. Similar results for *E. mundus* were reported by **Vacante *et al.* (1995) and Gonzales *et al.* (1996).** YLCD tomato plants occupied the 2nd rank for parasitism after hot-pepper, and they were more attractant to *E. mundus* than symptomless tomato. Later result may be related to the yellowing of leaflets that could be more attractant firstly to *B. tabaci* adults (**Heinz *et al.*, 1992**) and later to the parasitoid (**Ekbom, 1980**) and/or to volatiles emitting from diseased tomato plants (**Monteith, 1964 & vet Lem and Dicke, 1992**).

Statistical analysis pointed out that:

The differences of parasitism percentages for the two parasitoids, singly and or together, were highly significant differed among these planthosts in the two seasons. They wsere significante only between the samples of each planthost for *E. lutea* and combined parasitoid in 2001, but not significante for *E. lutea* and combined parasitoid in 2000 and for *E. mundus* in the two tested seasons. Parasitism of each parasitoid was highly significant correlated with those of combined. Also, those of each parasitoid and the another except on eclipta, jew's mallow (in 2000) and lantana (in 2001). They were significantly correlated (at 1% or 5%), in few cases, with the numbers of *B. tabaci* nymphs.

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الوفرة والتذبذب العددى لطفيليين للذبابة البيضاء *Bemisia tabaci* على ١١ عائل نباتى فى كفرالشيخ

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اهـتمت الدراسة بتقدير الكفائة التطفلية وبيان الوفرة والتذبذب العددى لكـل مـن الطفيليين *Eretmocerus mundus* و *Encarsia lutea* على حوريـات الذبابة البيضاء الموجودة على كل من نباتات الطماطم فىحالتين أحدهمـا تظهـر عليها أعراض مرض التفاف واصفرار الأوراق الفيروسى والـتى لا تظهـر عـليها هـذه الأعراض، ونباتات الباذنجان وفلفل الشطة والفاصوليا، وكذلك على نباتات ثلاثة أنواع من الحشائش التى تنمو بكثرة فى الحقـول وتصـاب بالذبابـة البيضاء أيضاً وهم eclipta والملوخية والتيل الشيطانى، وأيضاً على نوعين من محاصيل الحقل وهما القطن وفول الصويا وذلك فى قرية فرج الشامى بمركز الرياض وكذلك نبات lantana الموجود كسياج دائم بكلية الزراعة بكفرالشيخ ويصاب بالذبابة البيضاء وتمت الدراسة فى موسمين فى عامى ٢٠٠٠ و٢٠٠١.

وعـلى مدى العامين بينت الدراسة أن النسبة المئوية للتطفل على هذه العوائـل النباتية للطفيل *E. nundus* كانت من ١٢,٦٧ الى ٧٦,١٥% ومن ١٥,٠١ الى ٧٤,٩٥%، ولـلطفيل *E. lutea* من ٢,٨٨ الى ١٩,٢٩% ومن ٣,٤٣ الى ١٨,٦٣%، واللطفيـليين معـاً من ١٥,٥٥ الى ٩٥,٤٤% ومن ١٨,٤٤ الى ٩٣,٦٠% فى موسمى ٢٠٠٠ و ٢٠٠١م، على الترتيب. وكانت أعـلى نسـب للتطفل لكل من الطفيليين على حدة أو كليهما معاً على نباتات فلفل الشطة، يليها على الطماطم التى تظهر أعراض مرض التفاف واصفرار الأوراق الفيروسـى ثـم حشيشـة eclipta فالطماطم التى لا تظهر عليها أعراض المرض. وكان أعلى متوسط لأعداد الطفيل الأول للعينة ٤١٥,٣٧ فـردا فى موسـم ٢٠٠٠ و ٣٧٤,٦٣ فرداً فى موسم ٢٠٠١ وللطفيل الثانى ١٠٥,٢٥ فـرداً فى موسم ٢٠٠٠ و ٩٣,١٢ فرداً فى موسم ٢٠٠١م وذلك عـلى نـباتات فـلفل الشـطة، يلى ذلك نباتات الفاصوليا ثم الباذنجان يلية lantana. والنسبة المئوية لافراد الطفيل *E. mundus* كانت من ٧٢,٤ الى ٨٥,٨% ومـن ٧١,٦ الى ٨٤,٥% خـلال الموسمين ٢٠٠٠م و ٢٠٠١م ، عـلى الترتيب. وكانت أعلى نسبة على الملوخية ثم فول الصويا فالفاصوليا يليها التيل الشيطانى. بينما النسب المئوية لطفيل *E. lutea* كانت بن ١٤,٢ و ٢٨,٤% خلال الموسمين. وكانت أعلى نسبة على القطن ثم الطماطم التى لا تظهـر عليها أعراض فحشيشة eclipta فالباذنجان يليه الطماطم التى تظهر عـليها أعـراض المـرض الفيروسى. وكانت أعلى نسب التطفل لكل من الطفيلين خلال شهرى سبتمبر واكتوبر فى الموسمين.

دراسة التذبذب بينت أن أعداد الطفيل *E. mundus* كانت دائماً أعلى مـن أعداد الطفيل الثانى *E. lutea* على جميع العوائل التى تم دراستها وفى خـلال الموسـمين. كما وجد أن بداية التذبذب تزامنت مع الإصابة بالذبابة البيضاء على هذه العوائل النباتية وأن نسب التطفل زادت بدرجة واضحة مع بداية التزهير لهذه النباتات. حيث أمكن تمييز ثلاث مراحل للتذبذب على هذه العوائل النباتية.