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MEASURING THE DISTRIBUTION OF PINK AND SPINY BOLLWORMS IN DIFFERENT GOVERNORATES IN EGYPT

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Abstract

Dispersion indices, including (K) the negative binomial distribution, Green's coefficient of dispersion (C_x) mean crowding (m*), Lioyd's (Patchiness index (m/m*) and variance mean ratio (v/m), were calculated for the populations of two cotton bollworm moths, *Pectinophora gossypiella* and *Earias insulana* using light traps allover 2 years (January 1997 to December 1998) at five different Governorates, El-Minia, El-Sharkia, Kafr El-Sheikh, Demeate and El-Kalubia. Comparison showed that: K, C_x and m/m* as well as slopes from regression, all indicated that under the conditions of this test (at densities tested), the populations of the two pests were random. The variance/mean (v/m) ratio fluctuated considerably more than other indices examined, which by comparison, appears less reliable than previously thought.

INTRODUCTION

The cotton bollworms; pink bollworm, *Pectinophora gossypiella* (Saunders), (PBW), and spiny bollworm, *Earias insulana* (Boisd.), (SBW), considered as a destructive pests in cotton fields in Egypt and many other countries, are spread world-wide. About one third of the yields lost annually are by the damage of these two pests. Under natural conditions they are spatially distributed in a non-random fashion (Waters, 1959). Sampling in such populations results in variance which is greater than the mean, indicating the insects are over-dispersed or aggregated. Behavioral responses of insects to their environment and other organisms increase the chance that if one insect is found in a sampling unit, another insect will occur in that unit (Edward and Sterling, 1974).

Various attempts have made to quantitatively express the degree of aggregation in populations. Waters (1959 proposed that the exponent (k) of the negative binomial distribution is a valid measure of aggregation. Its value can range from zero, where aggregation is extreme to infinite where the distribution is random. Morisita (1962 and 1964) described an index of dispersion (IP) which have the advantage of

being relatively independent of distribution, the number of samples, and the size of the mean. Mollet *et al.* (1984) reported that the best measure of dispersion, as evaluated by Myers (1978) from computer generated patterns of egg dispersion at different population densities, was Green's coefficient (1966), C_x the standardized Morisita's coefficient. IP (Smith-Gill 1975), the mean crowding (m*) (Lioyd, 1967) and Trumble *et al.* (1983) used Green's coefficient of dispersion (C_x) Lioyd, 1967 (Patchiness index) (m/m*) and the regression of m* against (m) to document seasonal variation in the spatial distribution patterns of aphids on strawberry. Cotton insects have been shown to be spatially distributed in a non-random manner (Allen *et al.* 1972; Sevacherian and Stern, 1972; Pieters and Sterling, 1973). Aggregation indices for bollworms on cotton was reported by (Allen *et al.* 1972; Amin et al. 1994; Foda, 1998).

The specific objectives in this work were to determine the seasonal distribution patterns of PBW and SBW moths in cotton and other crops using light traps. The study was designed to demonstrate the best measure of dispersion to use in investigating changes in moth adult patterns with changes in insect density.

MATERIALS AND METHODS

The experiments were conducted in five different locations, namely, El-Minia (Upper Egypt), El-Sharkia, Kafr El-Sheikh, Demeate and El-Kalubia (lower Egypt) during the period extended from January 1997 to December 1998 (all round two years). In each Governorate, three light traps (replicates), modified Robinson type, fitted with a 250 watt mercury vapour lamp acting as source of ligh was set on the roof of some buildings close to the growing fields, raised at about 3 meters above the ground level, at the boarder of areas where PBW and SBW are known to occur. The traps were operated between sunset and sunrise every night during the two treated years. Traps were examined every 3 days to collect captured moths. The catch of moths was counted, classified and recorded.

The mean, variance/mean (v/m) ratio, mean crowding (m); Lioyd's (Ptchiness index) (m/m*), and Green's coefficient of dispersion were used in this study. Regressions were then generated to determine the relationship of each index to (m). In addition, the regression equation of m* on (m) and log mean (Taylor, 1965) were calculated. The parameter of the negative binomial distribution, k, was used also.

RESULTS AND DISCUSSION

Fluctuations in the population density

1. Pink bollworm (PBW)

Data in Table 1 show the fluctuations in the number of captured moths of PBW during 1997 and 1998 years. The moths started to appear during 1997, in Kalubia, in February and one and three months later in Minia & Demeate and Sharkia & Kafr El-Sheik districts, respectively. The period of moths occurrence lasted from 8 to 11 months during 1997 and from 8 to 12 in 1998. The data determined also, that the moths were found active from March and increased gradually to reach a highest numbers during the period from July to October in 1997. For 1998 the moths appearance started first, in Kalubia during January with slight number following by Minia and Demeate (two months later) and El-Sharkia and Kafr El-Sheikh (three months later). The number of captured moths increased gradually reaching the highest numbers, in the different five locations, during the same period of previous year. At late season of 1997, Minia Governorate harboured the maximum percentage of total number of captured moths (49.86%) followed by Kalubia (25.26%), Kafr El-Sheikh (9.62%) Demeate (9%) and El-Sharkia (6.25%). For 1998, Minia also obtained the highest number of captured moths (40.37%) followed by Kalubia (29.24%), El-Sharkia (12.72%), Kafr El-Sheikh (11.54%) and Demeate (6.15%). The total number of captured moths of the five districts, collected, during 1997 (7308 moths) was higher than that of 1998 (6785 moths).

Fig.1 (a & b) show the fluctuation in the population of moths represented by number of peaks in the five locations during 1997 and 1998. The levels of occurrence for the pink bollworm, PBW moths were also demonstrated the wide distribution of PBW in Minia district, emphasizing the changes in the population dynamic of this insect existing during the two years under study.

2. Spiny Bollworm (SBW)

The data tabulated in Table 2, indicated that the moths of *E.insulana* was found all two years round, 1997 and 1998. The results demonstrated also, the changes in the population activity of insect moths during the whole period of study. The moths appearance, started first in January during 1997 in Demeate district with low number. The total catch of moths, indicated that, the light traps attracted 15290 *E.insulana* moths during 1997 in the five districts, collected, while it was 14184 moths during

Table 1. The fluctuations in the number of *Pectinophora gossypiella* captured moths as indicated by light traps in five different Governorates during 1997 and 1998 years.

1997																						
	Governorate																					
Month	El - Minia				El - Sharkia				Kafr El - Sheikh				Domiat				El - Kalubia				General total	General mean
	Trap number				Trap number				Trap number				Trap number				Trap number					
	1	2	3	Total	1	2	3	Total	1	2	3	Total	1	2	3	Total	1	2	3	Total		
Jan.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Feb.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	3	3	0.6
Mar.	60	71	81	212	0	0	0	0	0	0	0	0	3	2	2	7	3	3	3	9	228	45.6
Apr.	120	132	130	382	0	0	0	0	0	0	0	0	4	3	9	11	2	1	2	5	398	61.6
May	87	114	145	346	3	2	3	8	37	31	37	105	0	0	0	0	13	11	13	37	496	99.2
Jun.	157	176	196	529	10	10	13	33	28	24	23	75	14	15	14	43	103	86	99	288	968	193.6
Jul.	165	226	211	602	11	14	21	46	19	18	19	56	18	22	38	78	69	85	67	221	1003	200.6
Aug.	131	137	239	507	33	43	63	139	18	21	17	56	27	13	20	77	209	189	189	587	1366	273.2
Sept.	274	311	341	926	47	69	67	183	27	20	27	74	79	63	71	241	28	17	31	76	1500	300
Oct.	37	38	44	119	12	15	18	45	103	69	63	235	57	41	50	159	210	100	198	508	1066	213.2
Nov.	7	6	8	21	1	1	1	3	29	28	27	84	12	11	14	38	38	32	40	110	256	51.2
Dec.	0	0	0	0	0	0	0	0	7	4	7	18	1	2	1	4	1	0	1	2	24	4.8
Total	1038	1211	1395	3644	117	154	186	457	268	215	220	703	215	172	144	658	677	525	644	1846	7308	1461.6
Mean	86.5	100.9	116.3	303.7	9.8	12.8	15.5	38.1	22.3	17.9	18.3	58.6	17.9	14.3	12	54.8	56.4	43.8	53.7	153.8	609	
1998																						
Jan.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2	2	0.4
Feb.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	5	8	22	22	4.4
Mar.	37	29	31	97	0	0	0	0	0	0	0	0	1	0	1	2	13	9	11	33	132	26.4
Apr.	34	34	37	105	0	0	0	0	0	0	0	0	4	2	6	12	3	1	3	7	124	24.8
May	36	42	51	129	3	1	1	5	25	28	29	82	17	13	1	31	0	0	0	0	247	49.4
Jun.	44	78	78	200	6	8	11	25	26	29	21	76	22	31	22	75	65	47	71	183	559	111.8
Jul.	151	182	191	524	14	17	27	58	18	21	16	55	13	13	13	39	29	24	33	86	762	152.4
Aug.	128	136	141	405	58	62	60	180	24	25	22	71	28	18	28	74	228	191	243	662	1392	278.4
Sept.	306	321	355	982	71	96	106	273	46	52	48	146	40	53	40	133	111	131	133	375	1909	477.3
Oct.	88	96	101	285	67	89	99	255	93	121	87	301	13	8	13	34	198	181	211	590	1465	293
Nov.	4	2	6	12	14	17	22	53	15	15	16	46	4	3	4	11	19	24	33	76	198	39.6
Dec.	0	0	0	0	2	5	7	14	5	0	0	5	2	2	2	6	5	7	7	19	44	8.8
Total	828	920	991	2739	235	295	333	863	252	291	239	782	144	143	130	417	681	620	683	1984	6785	1375
Mean	69	76.7	82.6	228.3	19.6	24.6	27.8	71.9	21	24.3	19.9	65.2	12	11.9	10.8	34.8	56.8	51.7	56.9	165.3	565.4	

Table 2. The fluctuations in the number of *Earias insulana* captured moths as indicated by light traps in five different Governorates during 1997 and 1998 years.

1997																								
	Governorate																							
Month	El - Minia				El - Sharkia				Kafr El - Sheikh				Domiat				El - Kalubia				General total	General mean
	Trap number				Trap number				Trap number				Trap number				Trap number					
	1	2	3	Total	1	2	3	Total	1	2	3	Total	1	2	3	Total	1	2	3	Total		
Jan.	0	0	0	0	0	0	0	0	0	0	0	0	2	1	4	7	0	0	0	0	7	1.4
Feb.	5	3	8	16	0	0	0	0	0	0	0	0	3	2	4	9	0	2	5	7	32	2.7
Mar.	42	36	44	122	0	0	3	3	1	0	1	2	7	4	11	22	3	5	6	14	163	32.6
Apr.	127	138	119	384	2	1	1	4	3	3	3	9	5	4	4	13	5	8	9	22	432	86.4
May	214	219	313	746	4	5	3	12	5	3	5	13	13	15	19	47	12	23	22	57	875	175
Jun.	169	176	155	500	10	6	8	24	10	13	15	38	15	16	19	50	246	210	266	722	1334	266.8
Jul.	305	302	352	959	8	11	12	31	21	18	21	60	29	33	40	102	94	106	87	287	1439	287.8
Aug.	264	231	311	806	16	14	13	43	31	30	41	102	42	33	55	130	210	190	221	621	1702	340.4
Sept.	2070	2146	2341	6557	42	32	37	111	54	63	59	176	68	71	82	221	29	16	27	72	7137	1427.4
Oct.	77	84	114	275	47	39	38	124	61	43	61	165	89	73	101	263	118	126	133	377	1204	240.8
Nov.	92	97	88	277	34	22	25	81	11	9	11	31	22	32	45	99	27	34	44	105	593	118.6
Dec.	117	126	111	354	0	0	0	0	0	0	0	0	2	2	5	9	3	1	5	9	372	74.4
Total	3482	3558	3956	10996	163	130	140	433	197	182	217	596	297	286	389	972	747	721	825	2293	15290	3058
Mean	290.2	296.5	329.7	916.3	13.6	10.8	11.7	36.1	16.4	15.2	18.1	49.7	24.8	23.8	32.4	81	62.3	60.1	68.8	191.1	1274.2	
1998																						
Jan.	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.2
Feb.	4	5	6	15	0	0	0	0	0	0	0	0	1	0	1	2	8	7	9	24	41	8.2
Mar.	26	33	29	88	0	0	0	0	1	0	1	2	4	2	2	8	4	4	4	12	110	22
Apr.	62	66	59	187	6	6	6	18	6	5	6	17	5	3	7	15	13	11	15	39	276	55.2
May	86	86	95	267	18	21	21	60	14	13	17	44	15	9	18	42	22	18	20	60	473	94.6
Jun.	141	154	166	461	22	11	12	45	33	42	35	110	18	17	22	57	68	57	71	194	867	173.4
Jul.	191	227	188	606	47	35	25	107	41	46	49	136	29	21	36	86	45	43	59	147	1082	216.4
Aug.	446	636	701	1783	21	16	26	63	21	25	33	79	35	27	45	107	245	266	266	777	2809	561.8
Sept.	1924	1800	1902	5626	55	48	38	141	68	59	59	186	66	60	89	215	86	98	88	272	6440	1288
Oct.	81	72	88	241	20	24	22	66	14	21	23	58	77	58	88	223	132	131	141	404	992	198.4
Nov.	111	97	122	330	9	8	8	25	11	10	17	38	17	11	19	47	66	85	77	228	668	133.6
Dec.	131	140	129	400	1	0	1	2	1	0	3	4	3	1	3	7	6	2	4	12	425	85
Total	3204	3316	3485	10005	199	169	159	527	210	221	243	674	270	209	330	809	693	722	754	2169	14184	2836.8
Mean	267	276.3	290.4	833.8	16.6	14.1	13.3	43.9	17.5	18.4	20.3	56.2	22.5	17.4	27.5	67.4	57.8	60.2	62.8	180.8	1182	

1998. The period of moths activity extended from March to December during the two years under inspection. The maximum number of captured moths (7137 in 1997 and 6440 in 1998) of the five districts, collected, was counted during September of both 1997 and 1998.

At late season of 1997 and 1998 Minia district obtained the greatest percentage of total number of moths caught by light traps (71.92% and 70.54%), followed by Kalubia, Demeate, Kafr El-Sheikh and Sharkia locations.

As indicated from Fig. 2 (a & b) the fluctuations in the population activity of moths were represented by number of peaks in the five districts during 1997 and 1998. The levels of occurrence for the spiny bollworm, *E.insulana* moths were also determined the wide distribution of SBW in Minia location, indicating the changes in the population dynamic of this insect existing during the two years under study.

Finally, from the previous results, it could be concluded that cotton bollworms, *P.gossypiella* and *E.insulana* moths showed more wide distribution in Upper Egypt than in the North.

Dispersion Indices

K : The Negative Bionomial Distribution

As expected, the distribution of PBW and SBW for the two years tested fit the negative bionomial. The test for (k) in a good fit using the Bilss technique (1958). The (k) values for PBW were 0.05716, 0.61049, 0.0473, -0.7443 and -0.48435 for El-Minia, El-Sharkia, Kafr El-Sheikh, Demeate and El-Kalubia Governorates, respectively in 1997 and 0.7946, 0.4869, 0.4391, -0.90146 and -0.48295 for the five districts, respectively, during 1998, Table 3. This suggests that the population is random (Waters 1959; Kogan *et al.* 1974; Southwood, 1978). The correlation analysis between mean and (k) values in the two tested years showed highly significant relationship among the two tested insects, Table 3. All means associated with (k) of the negative binomial were strongly correlated to the density, particularly if (k) values for distribution which did not statistically fit the negative binomial were excluded (Myers, 1978).

Green's coefficient C_x

Using Green's coefficient C_x of dispersion indicated that the populations of the two insects were random distribution, Table 3 and 4. C_x values were consistently greater than zero. Populations are considered random when C_x is equal to zero and ag-

Table 3. Correlations between measures of dispersion and density of simulated population of *P. gossypiella* in five different governorates during 1997 and 1998.

Governorate	Year	Index	V	V/m	m*	m*/m	cx	K	IP
El-Minia	1997	r	0.5357520	0.430924	0.99932	0.65623	0.411072	0.057164	0.65623
		b	3.820004	0.017994	1.015192	0.002999	6.78E-05	0.291161	0.002999
		a	13.90478	0.530415	0.064034	0.444608	-0.00763	158.1672	0.444608
	1998	r	0.847264	0.315066	0.999947	0.4923	0.240745	0.794641	0.272868
		b	1.271812	0.003604	1.00141	0.002269	1.33E-05	1.067138	0.004509
		a	-6.57849	0.500529	-0.08252	0.56915	-0.00294	-178.626	0.409398
El-Sharkia	1997	r	0.897382	0.847737	0.999478	0.72806	-0.17858	0.610491	0.72806
		b	2.222625	0.042861	1.034442	0.01788	-0.00386	1.264227	0.01788
		a	-4.88166	0.021309	-0.62181	0.240723	0.161824	-0.89123	0.240723
	1998	r	0.8777	0.776721	0.99927	0.656628	-0.2982	0.486922	0.656628
		b	1.935589	0.019889	1.021647	0.009515	-0.00343	0.565535	0.009515
		a	-8.97444	0.171676	-1.00937	0.328764	0.238156	-9.71757	0.32864
Kafr El-Sheikh	1997	r	0.840292	0.86437	0.997573	0.749818	-0.39941	0.047311	0.749818
		b	3.32837	0.043316	1.048479	0.016804	-0.00697	0.045386	0.016804
		a	-36.6994	-0.42857	-1.77941	0.240822	0.297952	-14.5085	0.240822
	1998	r	0.866547	0.892447	0.999818	0.672992	-0.34476	0.439144	0.672992
		b	1.867323	0.019026	1.015791	0.011575	-0.00465	0.53067	0.011575
		a	-19.6365	-0.14978	-0.96839	0.314638	0.261816	-20.783	0.314638
Domiat	1997	r	0.70868	0.412126	0.999261	0.72349	-0.17447	-0.7443	0.238562
		b	0.793598	0.016541	1.0114	0.016751	-0.00234	-3.89341	0.007138
		a	3.474429	0.231321	-0.54325	0.214351	0.099084	20.64106	0.555309
	1998	r	0.688091	0.227495	0.995509	0.666737	0.278274	-0.90146	0.607954
		b	0.82816	0.021213	1.014511	0.025874	0.005952	-6.87602	0.022445
		a	1.462703	0.378616	-0.46043	0.27857	-0.16204	24.28579	0.394684
El-Kalubia	1997	r	0.573636	0.570467	0.998878	0.670195	0.373921	-0.48435	0.614462
		b	5.779639	0.033637	1.031357	0.00501	0.000425	-1.41396	0.003941
		a	-72.2928	-0.21896	-0.90781	0.326225	-0.05328	-26.3352	0.4765
	1998	r	0.871455	0.700736	0.99975	0.695576	-0.17488	-0.48295	0.5654
		b	1.499729	0.00671	1.008105	0.004555	-0.00065	-1.83281	0.003386
		a	-11.0541	0.223374	-1.04977	0.243694	0.103852	8.526304	0.448475

Table 4. Correlations between measures of dispersion and density of simulated population of *E.insulana* in five different governorates during 1997 and 1998.

Governorate	Year		V	V/m	m*	m*/m	cx	K	IP
El-Minia	1997	r	0.990537	0.535356	0.998409	0.361109	0.090653	0.615613	0.267479
		b	6.105551	0.002497	1.00785	0.000312	7.01E-07	0.222859	0.000202
		a	-432.212	1.185254	-11.0306	0.492606	0.000333	-9.75316	0.690924
	1998	r	0.422187	0.254344	0.99732	0.392551	0.292468	0.816165	0.275549
		b	2.712372	0.002688	1.00874	0.000384	2.77E-06	1.916908	0.000236
		a	517.9661	1.351906	-12.1887	0.478139	-0.0017	-470.379	0.68279
El-Sharkia	1997	r	0.859039	0.724076	0.999633	0.739313	0.358175	-0.42553	0.346354
		b	0.502568	0.013898	0.999262	0.023917	0.003861	-5.88772	0.013345
		a	-0.30404	0.057339	-0.51663	0.257788	-0.12925	-5.14922	0.582869
	1998	r	0.793445	0.67779	0.99911	0.792291	-0.28141	0.655539	0.751164
		b	1.331779	0.034341	1.021113	0.026293	-0.00538	16.60324	0.023487
		a	-4.8291	-0.00361	-0.61552	0.187402	0.153432	-141.451	0.297926
Kafr El-Sheikh	1997	r	0.758729	0.739086	0.999763	0.70845	0.275751	0.097826	0.673191
		b	0.743595	0.013664	1.003788	0.016201	0.003667	0.318474	0.014404
		a	-2.44026	0.022961	-0.56354	0.283032	-0.16572	-11.9551	0.368337
	1998	r	0.749584	0.369825	0.999757	0.755079	0.290919	-0.329	0.699636
		b	0.316969	0.006322	0.999312	0.018835	0.004113	-2.16981	0.016433
		a	2.232308	0.181904	-0.54796	0.219657	-0.16929	-29.6077	0.333826
Domiat	1997	r	0.807436	0.564146	0.99937	0.725518	0.370276	0.191804	0.57797
		b	1.229885	0.017302	1.016662	0.012757	0.00035	0.497019	0.008823
		a	-1.14177	0.185501	-0.79751	0.242114	-0.02106	-16.03	0.496401
	1998	r	0.97792	0.940784	0.999707	0.701008	0.36869	0.659091	0.577985
		b	2.157666	0.030232	1.027825	0.013773	0.000628	1.13496	0.009733
		a	-12.0998	0.077771	-0.81895	0.276496	-0.03219	-8.28231	0.506715
El-Kalubia	1997	r	0.830799	0.534912	0.999935	0.592719	0.592719	-0.46368	0.429212
		b	1.533984	0.004243	1.0063	0.003044	0.000116	-1.78936	0.001271
		a	-25.1252	0.471264	-0.86494	0.464609	-0.01978	31.42748	0.772386
	1998	r	0.847231	0.284198	0.999905	0.620211	0.341378	-0.31669	0.476433
		b	0.34302	0.001299	1.003259	0.004005	0.00012	-2.02367	0.002428
		a	13.85367	0.215617	-1.08452	0.367211	-0.02043	148.7752	0.621436

gregated when it is equal to 1 (Mollet *et al.* 1984). As it appears from Table 3, C_X values for PBW were 0.41107, -0.17858, - 0.39941, -0.17447 and 0.373921 for El-Minia, El-Sharkia, Kafr El-Sheikh, Demeate and El-Kalubia Governorates, respectively, in 1997 and 0.240745, -0.2982, -0.34476, 0.278274 and -0.17488 in the five districts, respectively in 1998, while these values for SBW were 0.0090653, 0.358175, 0.275751, 0.370276 and 0.592719, respectively, in 1997 and 0.2924268,-0.28141, 0.290919, 0.36869 and 0.341378, respectively in 1998.

Regression of C_X on (m) showed a negative relationship in Sharkia, Kafr El-Sheikh and Demeate, while it was positive in Minia and Kalubia and a significant effect in all tested trials for the two insects. The same trend was observed in 1998, Tables 3 and 4. Therefore, C_X can be considered the best candidate for use when analyzing actual changes in distribution of organisms with changes in (m).

Variance/mean Ratio (v/m)

The variance/mean ratio showed positive relationships in 1997 in all locations and 1998 for both insects, Tables 3 and 4.

Mean crowding (m*)

The mean crowding (m*) (Lioyed, 1967) is highly dependent on (m), for both years and insects, Tables 3, 4 and therefore, is not considered useful as a masure of clumping. The regression of (m*) on (m) described by Iwao and Kuno, 1971 has been compared with other techniques (Myers,, 1978) and is considered invalid.

Patchiness Index (m*/m)

The patchiness index m*/m (Lioyed, 1967) was used to document the seasonal variation in spatial dispersion patterns of PBW and SBW at Minia for two years, Tables 3 and 4. The conclusion was analogous to techniques, indicating that although m*/m may be influenced by density, this index nonetheless is in close agreement with C_X and Iwao's regression.

The obtained results demonstrate that C_X, m*/m, and k determined for regressions of either m* on m are all in agreement that the populations of PBW and SBW moths at Minia were uniformly distributed. These results agree with those of (Pieters and Sterling, 1974; Young and Price, 1975; Moawd *et al.* 1994; Foda, 1998). It is not easy to determine that any one index is best for all organisms under all circumstances. So, it is worthwhile to recommend the use of more than one index to determine if they agree with each other before drawing conclusions about the dispersion of populations.

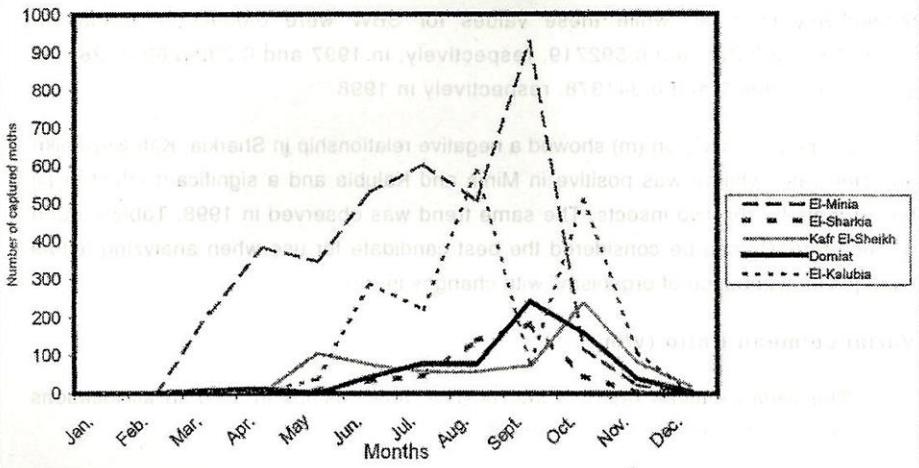

Fig. 1a. The fluctuations in the population density of *P.gossypiella* moths during 1997 in five different Governorates.

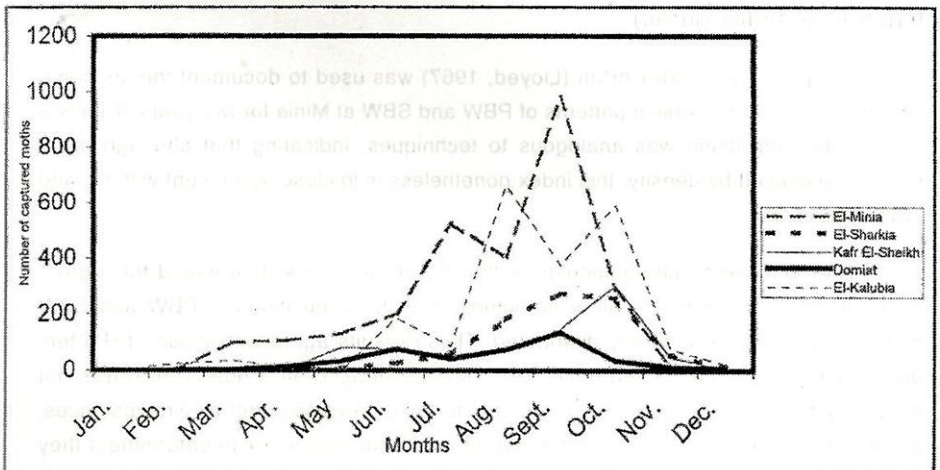

Fig. 1b. The fluctuations in the population density of *P.gossypiella* moths during 1998 in five different Governorates.

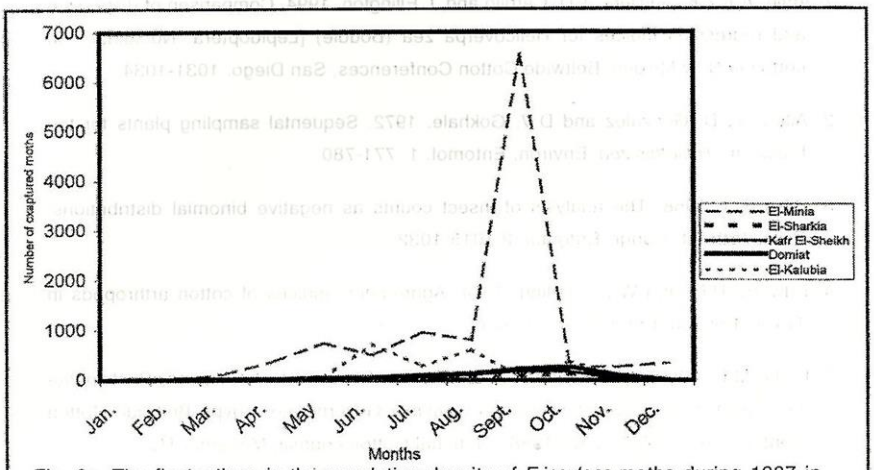

Fig. 2a. The fluctuations in the population density of *E.insulana* moths during 1997 in five different Governorates.

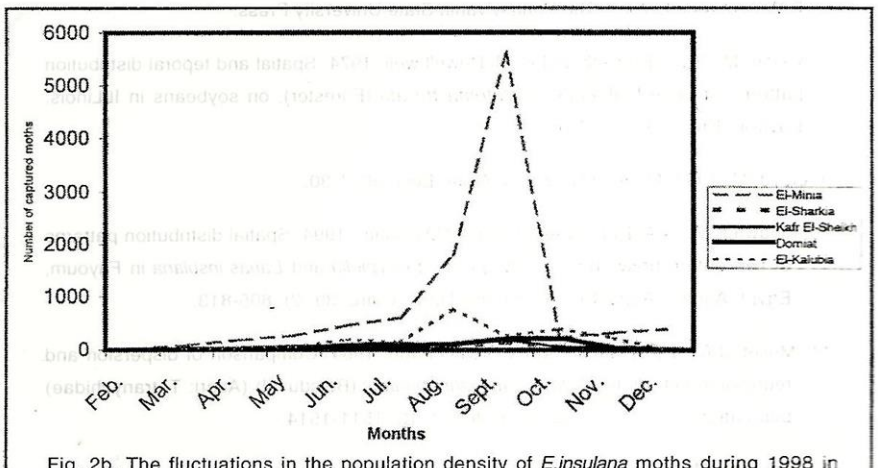

Fig. 2b. The fluctuations in the population density of *E.insulana* moths during 1998 in five different Governorates.

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قياس توزيع مجاميع ديدان اللوز القرنفلية والشوكية في خمس محافظات بمصر

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استخدمت عدة مقاييس لقياس درجة توزيع وانتشار كل من ديدان اللوز القرنفلية والشوكية في خمس محافظات مختلفة.

منها التوزيع الطبيعى (K) – معامل جرين للتشتت (C_x) – معامل التزاحم (m*) – مقياس باتشير (m*/m) – معدل الاختلاف ضد المتوسط (m) بالاضافة الى معامل الأنحدار الناتج من هذه المقاييس ضد المتوسط وذلك لمدة سنتين متصلتين فى الفترة من أول يناير ١٩٩٧ الي نهاية ديسمبر ١٩٩٨ باستخدام مصايد ضوئية وضعت لهذا الغرض. وقد أظهرت النتائج أن توزيع كل من الحشرتين كان توزيعا عشوائيا فى مجتمعاتها وأن أفضل المقاييس التي استخدمت بنجاح كان مقياس جرين للتشتت (C_x) ومعدل التوزيع والانتشار الطبيعى للمجموع (K).