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DAMAGE LOSS ASSESSMENTS AND ECONOMIC DESCISON LEVELS OF *TROPINOTA SQUALIDA* SCOP. ADULTS POPULATION. (COLEOPTERA: SCARABAIDAE)

SHERIEF E.A.H.[2], M.A. EL-DEEB[1], M.M. EL-ZOHAIRY[1] AND W.M.H. DESUKY[2]

1 Faculty of Agriculture, Zagazig University, Egypt

2 Plant Protection Research Institute, Agricultural Research Centre, Dokki- Giza, Egypt

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Abstract

In the Arab Republic of Egypt, many insect pests attack both fruit trees and field crops in newly reclaimed areas. Family Scarabaeidae comprises several representative species more or less injurious to agriculture. In recent years, the population of *Tropinota suqalida* Scop. increasing greatly causing great damage to various plantations.

Percentage of damaged flowers, average number of adults/plant and their relations, with yield of each host, on apple, pear, navel orange, and broad bean have been estimated.

The average percentage of infested flowers of apple during four seasons was 19.10%, when percentage of infestation reached 22.8%, a significant drop in yield occurred; the level (22%) could be considered as economic damage threshold level. For 1996 a number of 25.2 adults/ tree decreased the yield to 13.2 kg/tree, while only 13 adults/tree was achieved for 1995, 15.20 kg/tree.

The average percentage of infested pear flowers for the four seasons combined was 20.8%, then causing corresponding damage when it was 27.6%, a significant drop in the yield occurred. The level (27%) could be considered as economic damage threshold (E.D.T). The maximum 21.4 number of infested adults/tree during 1994 decreased the yield to 152.7 kg/tree, while the minimum of number 12.9 adults/tree occurred during 1995 increased the yield average to 156.1 kg/tree.

The average percentage of infested navel orange flowers during the four seasons was 17.53%, when it reached 22.2%, a significant drop in yield occurred, the level (17.2%) could be considered as damage threshold. The damage threshold of number of insects/m^2/tree ranged between 0.73 to 0.80 beetles/m^2/tree.

The sowing dates of first season of broad been harbored higher infestation level than those of the second one. The percentage of infestations were 22.8% and 12.55%, respectively. The emerged flowers of the second sowing date (Oct. 15 for both seasons were subjected to more higher infestation (20.4%) than flowers emerged in other sowing dates. Up to 11.8% percentage of infestation can be considered as dam-

age threshold. The average number of 7.50 adults/m^2 during the two seasons, the first and the second sowing dates which caused yield reduction ranged from 5.03 to 4.63 ton/f. Up to 8.167 adults/m^2 can be considered as damage threshold.

It has been found also, that the adults of *T. squalida* caused serious damage to the flowers of the field crops such as, wheat, broad bean, lupine and wild mustard. Hosts can be arranged according to the infestation in a descending order as the following wild mustard (3.18%), broad bean (2.66%), wheat (2.48%) and lupine (2.26%). The maximum percentage of infestation in all seasons for all host plants occurred during the first week of March.

INTRODUCTION

In newly reclaimed areas of El-Khattara and New-Salhia, Sharkia Governorate districts, Nubaria, El-Behara Governorate, Ismailia district, Ismailia Governorate, the beetles of *Tropinota squalida Scop.* attack flowers of all plants, which emerge during mid January until mid May causing considerable damage and great losses. The flowers of field crops (broad bean, lupine, wheat), fruit trees (apple, pear, citrus), vegetables (cabbage, radish, turnip, rocket) and weeds between (wild mustard, wild radish) are severely attacked by this pest. In recent years, the population of *T. squalida* increased obviously, thus causing great damage to various plantations. Although this scarabaeid pest has a wide host plant range (Ali and Ibrahim, 1988), little is known about its ecological niche and biofeature aspect.

According to Jannone (1947) *T. squalida* caused injury to almond, peach, stems of lupine, ears of wheat flowers, young fruits of citrus. Abd El-Fatah (1991) estimated the damage caused by *T.squalida* on leguminous plants and found that adult beetles attack and destroy the flowers of several plant species during their flowering periods in newly reclaimed sandy areas at EL-Khattara, Sharkia Governorate. Mohamed (1992) evaluated the rate of injury expressed as damage to flowers of mandarin, orange and pear by *T. squalida.* He mentioned that the rate of damage depends upon host kind and the time elapsing after first appearance of beetles.

MATERIAL AND METHODS

Damage assessment and estimation of injury levels caused by *T. squalida* on some fruit trees, field crops and associated weeds at New Salhia during 1994-1997 seasons

To estimate the relationship between yield and *T. squalida* numbers, a regression analysis was carried out in full model with the objectives of determining the depen-

constant representing, the average yield of non infested plants, b = slope of the regression line, x = the number of *T. squalida* adults /tree.

To deduce an economic injury level, it well be necessary estimating the following parameters, the rate of yield reduction, number of insects, the cost of insect control and the market price of the crop.

Statistical analysis for ETL & EIL: Data were subjected to a certain scheme of statistical analysis; according to Hosny, *et al.* (1972) Salem and Zaki (1985).

1. On fruit trees

Two orchards were selected each include three species of fruit trees (pear, apple and navel orange) during the flowering period which extend from March to April, in 1994, 1995, 1996, 1997 seasons.

a. Percentage of infested flowers: Weekly samples of dropped flowers were randomly collected under 10 trees during the flowering period, sampling procedures lasted for continuous five weeks in both season. The samples were transferred to the laboratory for examination. The damage was assessed carefully according to damage score method and one or all three symptoms on the flowers such as chewing pollen or ovary or petals (corollá) of the flower and the mean of damaged flowers were estimated.

b. Number of adults infested each tree: Number of adults on ten trees was observed weekly and counted individually. The visual direct count was completed at mid-noon and then relative numbers to the whole area of each tree were extrapolated (according to Maurizio formula 1954);

$$\text{Area } m^2 \quad \frac{a \times b}{2} \times \mu$$

a = maximum length b = maximum width $\mu = 3.14$

The number of adults was estimated for each 1 m^2 / tree. The yield of each tree was weighted in kilograms. Values corresponding calculation of yield per tree represented by straight-line equation $y=a\pm bx$ and designing regression line by "chi- χ^2 " were assessed to calculate the economic injury levels.

$$\chi^2 = \frac{\Sigma ai \times pi - (\Sigma ai \times p')}{p' \times q'}$$

ai = Infested flowers % (or) number insect/m^2

R = Size of sample

$pi = \frac{ai}{R}$ n = Number of treatment $p' = \frac{\Sigma pi}{n}$ $q' = 1-p'$

d.f. = (No. of rows – 1) (No. of columns – 1)

2. On broad bean

This experiment was carried out in the farm experimental agricultural of attached to the Faculty of Agriculture Zagazig University at El-Khattara from Feb. to end March during two successive seasons 1996-1997 and 1997-1998.

Broad bean crop was sown in four planting dates from early of October with 15 days intervals until 15 November. Six rows were planted in each sowing date and separated well. The length of each row was 20 m. with 0.60 m. width (Total area of each row = 12 m^2). Plants were sowed in 20-cm. distances between each other. Samples were taken weekly with two methods:

(a) One hundred flowers from ten plants for each sowing date was examined to observe the damage (estimation as percentage of infested fruit flowers before) during end January to end April.

(b) The number of adults found in each sowing date was counted weekly at 12-2 pm. The yield of each sowing date was assessed in ton per feddan.

The same statistical method was adapted as mentioned before. The partial regression was used to show the variation in the yield that could be caused by infestation during the whole seasons. Samples correlation (r) and sample regression (b) were calculated. The slop (b) of the straight regression line was carried out to obtain the corrected values for the yield.

3. Estimating the percentages of infestation in flowers of other field crops and weeds

Experiments were carried out in 4 fields at New Kassassien and El-tell El Kebier during four seasons 1994-1997, wheat, broad bean, lupine, and wild mustard. One hundred flowers of each crop were collected weekly and examined to estimate the percentage of damaged flowers.

RESULTS AND DISCUSSION

Damage assessment and injury levels: Adult stage of *T. sqaulida* was considered as the most destructive stage causing considerable yield losses, while larvae cause less injury to host plant (Ali *et al*, 1988).

Experiments were conducted to assess the damage of adult stage on flowers of different host plants include three fruit crops, apple, pear and navel orange, three beside field crops, viz. broad bean, wheat, lupine and the wild mustard as weed plant which are normally grown in newly reclaimed areas, New Salhia, Sharkia Governorate. The damage assessment was carried out during the activity period of the adult stage on these hosts, which extended seasonally from late of December until the end of April.

The following points were determined as damage assessment parameters;

1- Percentage of damage flowers. 2- Mean number of adults/plant and their relations with yield of each host. Weekly samples were taken during four successive growing seasons from 1994 to 1997 and results obtained are given in Tables, 4, 7 and 12. Also, the different levels of infestation of tested host plants and the corresponding yield weight figures in every season are given in Tables, 2, 5, 8 and 14. Variation in the host yield owing to the infestation by adults *T. squalida* were detected through application of the liner regression formula $y = a + bx$ (Goulden 1960)

Thus "b" represent the decrease in "y" for an increase in "X", the linear regression coefficient "b" was helpful in determining until effect of y/x Tables, 2, 5, 8 and 13

Apple

1. Damage threshold level (DTL) as indicated by percentage of flowering infestation: Data obtained in Tables, 1, 2, 3 and 11 revealed that the average percentage of infested flowers during the four tested seasons was 19.10% ie. ranged between 16.88-20.72 %, Table 11. When the relationship of parameters curse out it negative correlation and regression values between of infestation expressed as number of adult and yield weight liqueurs were negative and highly significant. The values of χ^2 (4.41, 4.46, and 9.51) were insignificant during 1994, 1995, 1997, respectively and was highly significant 22.82 during 1996 season, Table1. The damage threshold differed from season to season and recorded only when the values of χ^2 were significant, therefore DTL was determined for one season only 1996 as follows: During 1996 season: Up to 22 % percentage of infestation on apple, the value of χ^2 (2.08) indicate yield reduction from 20 to 6 kg./tree, as a result of infestation increased from

16.6 to 22 %, while at percentage of infestation 22.8 %, the χ^2 values became highly significant 58.04, Table 3.

Another words, when test place percentage of infested flowers reached 22.8 %, significant drop in yield. A 22% could be considered as economic damage threshold level (DTL).

2. Damage threshold level as indicated by number of adults: Data obtained in Tables 1 & 11 revealed that the mean numbers of adults during the tested four seasons 18 adults/tree ranged between 13-25.2 adults.

The maximum number of adults/tree 25.2 occurred during 1996, thus decreasing the yield by 13.20 kg/tree, while the minimum 13 beetles/tree during 1995, increased the yield averaged to 15.20 kg./tree.

Both correlation and regression values between number of adults and yield were negative and highly significant for the whole tested seasons.

Table 1. Percentage of infested apple flowers the corresponding number of *T. Squalida* adults and apple yield weight figures during seasons 1994 – 1997 apple growing seasons.

Year	1994			1995			1996			1997		
Trees number	% infested. of flowers	No. of ins./m^2	Yield (kg)	% infested. of flowers	No. of ins./m^2	Yield (kg)	% infested. of flowers	No. of ins./m^2	Yield (kg)	% infested. of flowers	No. of ins./m^2	Yield (kg)
1	12.8	0.49	21	17	0.344	19	16.6	0.62	20	14.8	0.295	22
2	13.6	0.52	19	14.6	0.243	21	16.8	0.81	20	15	0.485	16
3	15.2	0.55	18	19.8	0.443	18	18	1	18	16.8	0.516	13
4	15.8	1.03	17	22	1.146	14	18.2	1.15	16	17.4	0.603	13
5	16.4	1.05	17	14.8	0.419	18	19.8	1.15	15	17.4	0.681	13
6	17.6	1.27	16	20.8	0.483	17	20	1.21	21.4	21.4	1.206	10
7	18	1.38	15	22	1.072	16	20	1.77	12	19.2	1.072	13
8	18.4	1.77	14	23	1.68	9	21.4	2.17	10	20.2	1.15	12
9	20.4	1.86	11	22.2	1.207	13	22	2.99	6	23.2	1.448	10
10	20.6	2.92	10	25.6	1.724	7	22.8	3.32	3	28	1.989	8
Total	168.8	12.84	158	207.2	8.762	152	195.6	16.19	132	193.4	9.445	130
Mean	16.88	1.284	15.8	20.72	0.8762	15.2	19.56	1.619	13.2	19.34	0.9445	13
s.d.	± 2.62	± 0.754	± 3.425	± 2.852	± 0.559	± 4.467	± 2.013	± 0.927	± 5.73	± 4.059	± 0.524	± 4.09

Table 2. Simple correlation coefficient (r), regression apple (b) values and χ^2 between percentage of infested flowers and number of captured adults/tree and yield of ten apple trees during four seasons (1994-1997) apple growing seasons at New-Salhia.

	% infestation			Number of adults		
Year	r (0.01)	b (0.01)	X^2 (0.05)	r (0.01)	b (0.01)	X^2 (0.05)
1994	-0.98**	-1.28**	4.41	-0.59**	-4.29**	7.93
1995	-0.93**	-1.45**	4.46	-0.97**	-7.7**	5.21
1996	-0.98**	-2.62**	-22.82**	-0.96**	-5.95**	9.27
1997	-0.82**	-0.78**	9.51	-0.82**	-6.04**	9.43

Table 3. Damage threshold for the percentage of infested flowers of apple trees determined during 1996 season, at New-Salhia district .

Treat.	Yield kg/tree.	Ai	R	Pi=si/R	ai x pi	X^2		
						cal.	Tabulated	
							0.05	0.01
1	20	16.6	100	0.166	2.7556			
2	20	16.8	100	0.168	2.8224	0.02	3.841	6.635
3	18	18	100	0.18	3.24	0.2	5.991	9.21
4	16	18.2	100	0.182	3.3124	0.14	7.815	11.345
5	15	19.8	100	0.198	3.9204	0.45	9.488	13.277
6	12	20	100	0.2	4	1.27	11.07	15.086
7	12	20	100	0.2	4	1.1	12.59	16.8
8	10	21.4	100	0.214	4.5796	1.34	14.08	18.49
9	6	22	100	0.22	4.84	2.08	15.51	20.09
10	3	22.8	100	0.228	5.1984	58.04**	16.919	21.67

Damage threshold started at 22% infested flowers

ai = infested flowers % R = size of sample (flowers) $pi = \frac{ai}{R}$

Pear

1. Damage threshold level as indicated percentage of infested pear flowers: Data obtained in Tables, 4-6 and 11 revealed that the average percentage of infested flowers, during the four tested seasons was 20.8 % (18.98 – 22.98 %) when the correlation and regression values were estimated it yielded negative and highly significant for values in all tested pear growing season.

The estimated of χ^2 were insignificant for 1994, 1995 and 1996 seasons, the χ^2 value (25**) was significant for 1997 season. The damage threshold differed from season to another one and recorded only when the values of $\chi^2$was significant, therefore DTL was determined for 1997 season as follow:

Up to 27 % percentage of infested pear flowers, the value of χ^2 (11.84) indicated that reduction occurred in yield from 126 to 24 kg./tree, as a result of increased infestation percentage from 11.8 % to 27 %, while at percentage of increased infestation 27.6 %, the χ^2 values became significant (14.67*).

In other word, when percentage of infestation reached 27.6 %, significant drop in yield occurred and the insignificant value below 27% could be considered as damage threshold level.

2. Damage threshold level as indicated by number of adults: Data obtained in Tables 4-6 & 11 revealed that the average number of adults during the tested four seasons 16.08 adults/tree and ranged between 12.90 to 21.40 adults. The maximum mean number of adults/tree 21.40 occurred during 1994 season, thus decreasing the yield to 152.7 kgs./tree, while the minimum mean 12.9 adults/tree during 1995 increased the yield average to 156.1 kgs./tree. Both correlation and regression values were negative and highly significant for the tested seasons.

Table 4. Percentage of infested pear flowers the corresponding number of adults and relation to pear yield weight figures during 1994 – 1997 seasons:

Year	1994			1995			1996			1997		
Trees number	% infested. of flowers	No. of ins./m²	Yield (kg)	% infested. of flowers	No. of ins./m²	Yield (kg)	% infested. of flowers	No. of ins./m²	Yield (kg)	% infested. of flowers	No. of ins./m²	Yield (kg)
1	16.4	0.165	170	20.2	0.174	155	19.2	0.211	140	11.8	0.156	126
2	17.2	0.19	160	17.4	0.1	180	17.2	0.067	160	15.4	0.178	73
3	17.4	0.227	157	19.6	0.136	160	17.4	0.068	160	17.4	0.201	60
4	17.4	0.23	155	19	0.105	160	19	0..115	150	19.8	0.227	55
5	17.6	0.298	155	20.6	0.199	150	19.2	0.17	148	20.4	0.238	49
6	19.2	0.303	155	18.6	0.101	180	18.2	0.101	155	26.6	0.27	41.5
7	19.8	0.335	150	20.4	0.191	150	21	0.271	135	27	0.287	24
8	20.4	0.743	150	21.2	0.46	143	22.4	0.743	125	27.6	0.531	22
9	21.2	2.002	140	26.8	1.121	140	22	0.721	128	30.8	1.441	22
10	23.02	2.212	135	29.8	1.593	139	21.8	0.708	130	33	1.593	7.5
Total	189.6	6.705	1527	213.6	4.18	1557	197.4	2.522	1431	229.8	5.122	480
Mean ± s.d.	18.96 ± 2.126	0.671 ± 0.775	152.7 ± 9.866	21.36 ± 3.88	0.418 ± 0.517	155.7 ± 14.795	19.74 ± 1.92	0.2522 ± 0.257	143.1 ± 13.27	22.98 ± 7.01	0.5122 ± 0.5408	48 ± 34.17

Table 5. Simple correlation coefficient (r), regression (b) values and χ^2 between percentage of infested pear flowers and number of captured adults/tree and yield of ten pear trees during four tested seasons (1994-1997) pear growing seasons at New-Salhia.

	% infestation			Number of adults		
Year	r (0.01)	b (0.01)	X^2 (0.05)	r (0.01)	b (0.01)	X^2 (0.05)
1994	-0.93**	-4.62**	2.74	-0.88**	-11.14**	13.12
1995	-0.78**	-2.91**	8.08	-0.97**	-19.17**	8.96
1996	-0.98**	-6.77**	2.11	-0.91**	-42.12**	3.59
1997	-0.93**	-4.53	25**	-0.62**	-39.35**	8.9

Table 6. Damage threshold for the percentage of infested flowers of pear trees determined during 1997 season, at New-Salhia.

Treat.	Yield kg/tree.	Ai	R	Pi=si/R	ai x pi	x^2		
						cal.	Tabulated	
							0.05	0.01
1	126	11.8	100	0.118	1.3924			
2	73	15.4	100	0.154	2.3716	0.55	3.84	6.63
3	60	17.4	100	0.174	3.0276	1.26	5.991	9.210
4	55	19.8	100	0.198	3.9204	2.54	7.81	11.34
5	49	20.4	100	0.204	4.1616	3.94	9.49	13.28
6	41.5	26.6	100	0.266	7.0756	8.35	11.07	15.09
7	24	27.0	100	0.270	7.2900	11.84	12.59	16.80
8	22	27.6	100	0.276	7.6176	14.67*	14.08	18.49
9	22	30.8	100	0.308	9.4864			
10	7.5	33.0	100	0.330	10.8900			

Damage threshold started at 27% infested flowers

ai = infested flowers % R = size of sample (flowers) $pi = \frac{ai}{R}$

Table 7. Percentage of infested navel orange flowers the corresponding number of adults and relation to navel orange yield weight figures coefficient during 1994 – 1997 seasons:

Year	1994			1995			1996			1997		
No.of trees	% infested. of flowers	No. of Adults/ m^2	Yield (kg)	% infested. of flowers	No. of Adults/ m^2	Yield (kg)	% infested. of flowers	No. of ins./m^2	Yield (kg)	% infested. of flowers	No. of ins./m^2	Yield (kg)
1	15	0.34	8.2	16.2	0.091	7.8	17	0.205	6.4	8.4	0.75	7
2	16.2	0.66	8	19.2	0.172	6	18.6	0.31	6.4	9.2	0.83	6.2
3	16.8	0.71	7	20.4	0.177	5.8	16.6	0.177	6.8	9.8	1.28	6
4	17.8	0.73	6.4	19	0.168	7.4	18.6	0.335	5.6	9.8	1.35	6
5	17.8	0.8	6	21.2	0.332	5.8	22.4	0.796	3.2	10	1.46	6
6	18.2	0.88	5	20.6	0.186	5.8	18.2	0.466	5.4	11.6	1.73	5.8
7	18.8	1	5	17.4	0.125	7.4	20	0.562	5	12.4	1.81	5.4
8	18.8	149	4.8	21.8	0.415	5.4	21	0.58	3.4	12.6	1.82	5
9	20.2	1.95	4	23.6	0.442	5	19.4	0.531	5.4	17.2	2.48	3.6
10	20.4	1.81	3	23.8	0.603	4	22.2	0.724	3.4	22.2	2.65	3.4
Total	180	10.01	57.4	203.2	2.711	60.4	194.6	4.686	51	123.2	16.16	54.4
Mean	18	1.001	5.74	20.32	0.2711	6.04	19.46	0.4686	5.1	12.32	1.616	5.44
	±	±	±	±	±	±	±	±	±	±	±	±
s.d.	1.68	4.72	1.69	2.45	0.168	1.18	1.97	0.2094	1.337	4.28	0.622	1.14

Navel orange

1. Damage threshold level as indicated by percentage of flowers infestation: Data obtained in Tables, 7- 9 and 11 revealed that the average percentage of infested flowers during the four experimented seasons was 17.53 % with the range 12.32 - 20.32 %. Both of correlation and regression value between percentage of infestation and yield were negative and highly significant in all experimented seasons. The values of χ^2 (1.7, 3.36, 2.33) were insignificant during 1994, 1995 and 1996, respectively, while the value of χ^2 (21.5*) was significant during 1997 season. The damage threshold differed from greatly to another one and recorded only when the values of χ^2 were significant; therefore DTL was determined for one season only 1997 as follow:

During 1997 season: up to 17.2 % percentage infestation on navel orange, the value of χ^2 (5.93) indicated that a reduction occurred in yield from 7 to 3.6 kg. / tree, as a result of percentage of infestation increased from 8.4 % to 17.2 %, while at percentage of infestation 22.2 %, the χ^2 values became significant (17.09*).

In other word, when percentage of infestation reached 22.2 %, significant drop in yield occurred and the value before (17.2%) could be considered as damage threshold.

2. Damage threshold level as indicated by number of adults: Data obtained in Tables 8 & 10 - 11 revealed that the average number of adults during the whole experimental seasons was 13.5 adults/tree with range 4.20-25.90 adults. The maximum number of infested adults/tree 25.90 during 1997 season decreased the yield to 5.44 kg./tree, while the minimum 4.20 adults/tree during 1995 season increased the yield average to 6.04 kgs./tree. Both of correlation and regression values between number of insects and yield weigh figures were negative and highly significant during the whole experimented seasons.

Table 8. Simple Correlation coefficient (r), regression (b) values and χ^2 between both average percentage of infested navel orange flowers and number of captured adults/tree and yield of ten navel orange trees during four tested seasons (1994-1997) navel orang growing seasons at New-Salhia.

	% infestation			Number of adults		
Year	r (0.01)	b (0.01)	X^2 (0.05)	r (0.01)	b (0.01)	X^2 (0.05)
1994	-0.97**	-0.98**	1.7	-0.92**	-3.29**	39.00**
1995	-0.94**	-0.45**	3.36	-0.88**	-6.18*	1.68
1996	-0.96**	-0.65**	2.23	-0.93**	-5.95**	1.33
1997	-0.95**	-0.26**	21.5*	-0.96**	-1.76**	4.82

Table 9. Damage threshold for the percentage of infested flowers, of navel orange trees determined during 1997 season, at New-Salhia.

Treat.	Yield kg/tree.	ai	R	Pi=si/R	ai x pi	X^2		
						cal.	Tabulated	
							0.05	0.01
1	7.0	8.4	100	0.84	0.7056			
2	6.2	9.2	100	0.92	0.8464	0.04	3.84	6.63
3	6.0	9.8	100	0.098	0.9604	0.23	5.991	9.210
4	6.0	9.8	100	0.098	0.9604	0.16	7.81	11.34
5	6.0	10.0	100	0.100	1.000	0.20	9.49	13.28
6	5.8	11.6	100	0.116	1.3456	0.63	11.57	15.09
7	5.4	12.4	100	0.124	1.5376	1.26	12.59	16.81
8	5.0	12.6	100	0.126	1.5876	1.77	14.8	18.49
9	3.6	17.2	100	0.172	2.9584	5.93	15.59	20.09
10	3.4	22.2	100	0.222	4.9284	17.09*	16.92	21.67

Damage threshold started at 17.2% infested flowers

ai = infested flowers % R = size of sample (flowers) $pi = \frac{ai}{R}$

Table 10. Damage threshold for the insects number of infested flowers of navel orange trees determined during 1996 season, at New-Salhia district.

Treat.	Yield kg/tree.	ai	R	Pi=ai/R	aixpi	X^2		
						Cal	$T_{0.05}$	$T_{0.01}$
1	8.2	0.34	43.96	0.008	0.003			
2	8.0	0.66	29.01	0.023	0.015		3.48	6.63
3	7.0	0.71	22.61	0.031	0.022		5.991	9.210
4	6.4	0.73	17.90	0.041	0.030	5.96	7.81	11.34
5	6.0	0.80	15.07	0.053	0.042	9.95*	9.49	13.28
6	5.0	0.88	21.48	0.041	0.036			
7	5.0	1.00	16.02	0.062	0.062			
8	4.8	1.49	12.06	0.124	0.184			
9	4.0	1.59	11.30	0.141	0.224			
10	3.0	1.81	8.29	0.218	0.395			

Damage threshold started at 0.73 insect/m^2 tree

ai = mean number insect/m^2 R = size of sample $pi = \frac{ai}{R}$

Table 11. Average percentages of infested flowers, number of capture adults/tree and the yield of three fruit trees during four study (1994-1997), seasons at New-Salhia.

Crop	Apple			Pear			Navel orange		
Data / Year	% infested. of flowers	No. of insect per tree	Yield (kg) per tree	% infested. of flowers	No. of insect per tree	Yield (kg) per tree	% infested. of flowers	No. of insect per tree	Yield (kg) per tree
1994	16.88	19.3	15.8	18.98	21.4	152.7	18	16.1	5.74
1995	20.72	13	15.2	21.36	12.9	156.1	20.32	4.2	6.04
1996	19.56	25.2	13.2	19.74	12.1	143.1	19.46	7.8	5.1
1997	19.34	14.5	13	22.98	17.9	48	12.32	25.9	5.44
Total	76.5	72	57.2	83.06	64.3	499.9	70.1	54	22.32
Mean	19.10	18.00	14.3	20.80	16.08	125.0	17.53	13.50	5.58
	±	±	±	±	±	±	±	±	±
s.d.	1.61	5.50	1.40	1.77	4.38	51.61	3.59	9.65	4.002

Broad bean

1. Damage threshold as indicated by percentage of infested broad bean: Data obtained in Tables 12 – 16 revealed that the percentage of infested flowers during the two experimented seasons averaged 17.7% (ranged between 14.8 % at the first sowing date October, 1 to 21.9% at the fourth sowing date November, 15). The average of infested flowers percentage for all sowing dates was about 22.8% during the first season, 1996/1997, while during the second season 1997/1998 it was decreased to 12.55%. The emerged flowers of fourth sowing date (Nov., 15 for both season was subjected to more infestation (22.8%) than flowers emerged before others. Generally, all sowing dates of the first season were more subjected to high infestation levels than those in the second one, where the percentages of infestation were 22.8% and 12.55%, receptively.

An important observation was noticed that there were inversely effects between the infestation occurred for sowing dates on the two respective seasons, where the third and fourth sowing dates during the first season, were subjected to more infestation and it became less in the second one, this may be due to many factors such as the environmental effects on both number of flowers and insects. Also, flowers of the forth sowing date planted in November, 15, was subjected to more infestation because this time is more suitable date for the emergence of flowers and adults which started during January.

Both of correlation and regression values between percentage infestation and yield weight figures were negative and significant during both experimented seasons, except the correlation of season 1997/1998 was insignificant. The χ^2 value during 1997/1998 appeared significant value (8.20*), at the level of infestation on 20%, therefore, the damage threshold up to 11.8% percentage of infestation, value of χ^2 (1.65) insignificant. The increasing of infestation from 11.8 to 20% caused a reduction in yield from 4.622 to 4.127 Ton/F. In other word, when percentage of infestation reached 20% significant drop in yield occurred the level (11.8%) could be considered as damage threshold.

Table 12. percentage of infested broad been flowers the corresponding numbers of captured T. squalida adults /m^2 on four broad bean sowing dates during two 1996/1997 seasons and 1997/1998 at El-Khattra.

No. of sowing date	Date	1996/1997			1997/1998			Mean of field ton/f. for two seasons
		Aver. flower of infestation %	Number of insects/m^2	Yield ton/f.	Aver. flower of infestation %	Number of insects/m^2	Yield ton/f.	
1st	1 – 10	20.8	4.03	5.43	8.8	7.667	4.622	5.03
2nd	15 – 10	22.8	4.82	4.93	9.6	8.125	4.334	4.63
3rd	1 – 11	23.8	5.67	3.82	11.8	8.167	4.127	3.97
4th	15 – 11	23.8	6.4	3.81	20	15.083	3.877	3.84
Total		91.2	20.92	17.99	50.2	39.042	16.969	17.84
Mean		22.8	5.23	4.4975	12.55	9.7605	4.24225	4.37
s.d.		± 1.414	± 1.028	± .0814	± 5.126	± 3.556	± 0.3158	± 0.5609

Area/row = 0.60 x 20 = 12.00 m^2 (average number of plants/m^2 = 20 – 25 plants).

Table 13. Values of χ^2 for average percentage of infested flowers and number of captured adults of broad bean during 1996/1997 and 1997/1998 seasons at El-Khattara district.

Season	Flower infestation %	Number insects
	$\chi^2(0.05)$	$\chi^2(0.05)$
1996/1997	0.34	1.33
1997/1998	8.20*	7.96*

Table 14. Arranged raising for infested broad been flowers number of adults *T. squalida* and comparison with yield weight figures of broad bean during 1996/1997 and 1997/1998 seasons.

No. of sowing date	Date	1996/1997			1997/1998			Mean of field ton/f. for two seasons
		Aver. flower of infestation %	Number of insects/m^2	Yield ton/f.	Aver. flower of infestation %	Number of insects/m^2	Yield ton/f.	
1st	1 – 10	20.8	4.03	5.43	8.8	7.667	4.622	5.03
2nd	15 – 10	22.8	4.82	4.93	9.6	8.125	4.334	4.63
3rd	1 – 11	23.8	5.67	3.82	11.8	8.167	4.127	3.97
4th	15 – 11	23.8	6.4	3.81	20	15.083	3.877	3.84
Total		91.2	20.92	17.99	50.2	39.042	16.969	17.84
Mean s.d.		22.8 ± 1.414	5.23 ± 1.028	4.4975 ± .0814	12.55 ± 5.126	9.7605 ± 3.556	4.24225 ± 0.3158	4.37 ± 0.5609

Table 15. Simple correlation coefficient (r), regression (b) values between both average of infested broad been flowers and number of captured *T. squalida*/ m^2 and yield of broad bean plants during 1996/1997 and 1997/1998 at El-Khattara.

	Flower infestation %		Number of insects	
	Correlation (r) (0.05)	(b) 0.05, 0.01	Correlation (r) (0.05)	Regression (b) (0.05, 0.01)
Season	r	b	r	b
1996/1997	- 0.95*	- 0.54*	- 0.96*	-0.76*
1997/1998	-0.9	- 0.06**	-0.81	-0.072**

2. Damage threshold as indicated by number adults: Data obtained in Tables 12 – 15 & 17 and illustrated in Figs. 57 & 58 revealed that the average number of infested adults during the two experimented seasons were 7.50 adults/m^2 ranged between (5.85– 10.74 adults/m^2). The minimum and maximum numbers of infested adults/m^2 were 5.85 and 10.74 during the first and the fourth sowing dates which causing reduction in yield from 5.03 to 3.84 Ton/F. Both of correlation and regression values between number of insects and yield were weight figures calculated and found that they are negative and significant during both experimented seasons, except the correlation of season 1997/1998 was insignificant.

The χ^2 value during 1997/1998 appeared significant value (7.96*), at the level of infestation with 15.082 adults/m2, therefore, the damage threshold up to 8.167 insects/m^2, value of χ^2 (1.45) insignificant. The increasing of infestation from 8.167 to 15.083 caused a reduction in yield from 4.622 to 3.877 Ton/F.

Table 16. Damage threshold for the percentage of infested flowers of broad bean plants determined during 1997/1998 season at New-Salhia.

Treat.	Yield Ton/f.	ai	R	Pi= ai/R	ai x pi	χ^2		
						cal.	Tabulated	
							0.05	0.01
1	4.622	8.8	100	0.088	0.080			
2	4.343	9.6	100	0.096	1.00	1.28	3.84	6.63
3	4.127	11.8	100	0.118	1.40	1.65	5.991	9.210
4	3.877	20	100	0.200	4.00	8.2*	7.81	11.34

Damage threshold started at 11.8% infested flowers.

ai = flowers infestation % R = size of sample (flowers)

Table 17. Damage threshold for the number of insects of broad bean plants determined during 1997/1998 season at New-Salhia district.

Treat.	Yield Ton/f.	ai	R	Pi= ai/R	ai x pi	χ^2		
						Cal.	$T_{0.05}$	$T_{0.01}$
1	4.622	7.667	24	0.3195	2.50			
2	4.343	8.125	24	0.3385	2.80	0.47	3.84	6.63
3	4.127	8.167	24	0.3403	3.00	1.45	5.991	9.210
4	3.877	15.082	24	0.6285	9.50	7.96*	7.81	11.34

Damage threshold started at 8.167 insect / m^2 for broad bean plants. ai = mean of number insect/m^2 for plants. R = size of sample m^2/plants

Table 18. Percentage flower infestation occurred by *T. squalida* on different crop hosts and weeds during 1994 – 1997 seasons (100 flowers/10 plant/sample).

Season	Host		Wheat	Wild mustard	Lupine	Broad bean	G. Total	G. mean
	Obs.	Date						
1994	1	21 – 2	1.5	1.9	1.3	2.3	7.00	1.75
	2	28 – 2	2.7	3.7	2.3	4.2	12.90	3.225
	3	7 – 3	2.8	3.9	3.0	4.0	13.70	3.425
	4	14 – 3	2.9	3.8	1.9	2.8	11.40	2.850
	5	21 – 3	1.6	2.8	1.2	1.9	7.50	1.875
	Total		11.5	16.1	9.70	15.2	52.50	13.125
	Mean		2.3	3.22	1.94	3.04	10.50	2.625
1995	1	20 – 2	1.6	2.1	1.5	1.5	6.70	1.675
	2	27 – 2	3.0	3.1	2.1	2.7	10.90	2.725
	3	6 – 3	3.3	3.5	3.4	4.0	17.20	3.550
	4	13 – 3	1.9	4.2	2.3	2.5	10.90	2.725
	5	20 – 3	1.3	2.1	1.7	1.3	6.40	1.600
	Total		11.1	15.0	11.0	12.0	49.10	12.275
	Mean		2.22	3.0	2.20	2.4	9.82	2.455
1996	1	24 – 2	1.7	2.2	1.4	1.4	6.70	1.675
	2	2 – 3	2.5	3.6	3.0	3.3	12.40	3.100
	3	9 – 3	4.3	4.1	3.5	3.6	15.50	3.875
	4	16 – 3	2.6	3.4	2.2	2.9	11.10	2.775
	5	23 – 3	1.5	1.9	1.0	1.3	5.70	1.425
	Total		12.6	15.2	11.10	12.5	51.40	12.850
	Mean		2.52	3.04	2.22	2.5	10.28	2.570
1997	1	25 – 2	1.8	2.0	1.8	1.5	7.10	1.775
	2	4 – 3	3.7	4.2	3.3	3.5	14.70	3.675
	3	12 – 3	3.7	4.9	3.8	4.1	16.50	4.125
	4	19 – 3	3.5	4.1	2.6	2.9	13.10	3.275
	5	26 – 3	1.6	2.1	1.8	1.5	7.00	1.750
	Total		14.3	17.3	13.30	13.5	58.40	14.600
	Mean		2.86	3.46	2.66	2.7	11.68	2.920
General total			49.50	63.60	45.10	53.20	211.40	52.850
General mean			9.90	12.72	9.02	10.64	42.28	10.570
Mean G.T.			12.375	15.9	11.275	13.3	52.58	13.2125
M. G. Mean s.d.			2.475 ± 0.286	3.180 ± 0.209	2.255 ± 0.298	2.660 ± 0.282	10.57 ± 0.792	2.6425 ± 0.198

5. Estimating the percentage of infestation in flowers of other field crops, and associated weeds: Web rose scarabaeid beetle, *T. squalida* caused serious percentage infestation for flowers of other three flowering field crops and one weed between, (namely wheat, broad bean, lupine and wild mustard) planted in newly reclaimed area at New El-Kassassien and El-tell el kebir districts, Ismailis Governorate, Egypt. Changes in the population activity of adults on three hosts were commonly observed from the end of December to the end of March.

The percentage of damage of flowers were determined in field crops and weeds between 1994 to 1997. Data obtained in Table 18 revealed that the maximum mean percentage of infested flowers was 3.18% in wild mustard for all seasons, while the minimum 2.255% was recorded in lupine. These hosts can be arranged according to the infestation in descending order as follows: wild mustard, broad bean, wheat and lupine where they were 3.18%, 2.66% 2.48% and 2.26%, respectively. These results can be used as a monitoring method or as plant traps especially wild mustard plants, which considered the most preferable host for the adults than other hosts. The infestations in different seasons were nearly similar, where the differences between the maximum and minimum, were insignificant. The maximum infestation percentage in all seasons occurred during the first week of March for all hosts.

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تقدير الضرر ومستويات الإصابة بجعل الورد الزغبى على بعض المحاصيل

السيد على حسن شريف ٢ ، محمد على الديب ١ ، منصور محمد منصور الزهيرى ١ ، وحيد محمود دسوقى ٢

١ *كلية الزراعة – جامعة الزقازيق – مصر*
٢ *معهد بحوث وقاية النبات – مركز البحوث الزراعية الدقى – الجيزة – مصر*

ينتشر فى المناطق المستصلحة حديثاً فى جمهورية مصر العربية عديد من الآفات الحشرية أهمها بعض أنواع الجعال والتى تسبب كثيراً من الأضرار للزراعات مثل أنواع جعل الخوخ والجعل ذو الظهر الجامد والجعل الزمر دى وجعل النخيل وجعل الورد الزغبى التابعة لعائلة الجعال – رتبة غمدية الأجنحة ، وقد تمت الدراسة على جعل الورد الزغبى وهو من أكثر الآفات ضرراً لمناطق الإستصلاح بمحافظتى الشرقية والإسماعيلية ودلت النتائج على ما يأتى :

قدر الضرر بـ : (أ) نسبة إصابة الأزهار ، (ب) متوسط عدد الحشرات الكاملة / نبات ، وعلاقة كل منها بكمية المحصول فى التفاح والكمثرى والبرتقال أبو صرة والفول البلدى خلال أعوام ١٩٩٤ ، ١٩٩٥ ، ١٩٩٦ ، ١٩٩٧ ، وموسم ٩٩ / ٢٠٠٠ .

١ – التفاح : (أ) بلغ متوسط النسبة المئوية لإصابة الأزهار خلال الأربع مواسم ١٩,١٪ ، وعندما وصلت نسبة الإصابة إلى ٢٢,٨٪ حدث هبوط معنوى فى المحصول وعلى هذا تعتبر النسبة السابقة لها فى جدول التحليل (٢٢٪) هى الحد الإقتصادى الحرج للضرر .

(ب) الحد الأقصى للتعداد ٢٥,٢ حشرة / شجرة (١٩٩٦) يؤدى الى نقص المحصول إلى ١٣,٢ كجم/ شجرة ، بينما العدد الأقل ١٣ حشرة / شجرة (١٩٩٥) يزيد متوسط المحصول إلى ١٥,٢ كجم / شجرة .

٢ – الكمثرى : (أ) بلغ متوسط النسبة المئوية لإصابة الازهار خلال الأربع مواسم ٢٠,٨٪، وعندما وصلت إلى ٢٧,٦ ٪ حدث هبوط معنوى فى المحصول ولذلك إعتبرت النسبة ٢٧٪ هى الحد الإقتصادى الحرج للضرر .

(ب) عند وجود ٢١,٤ جعل / شجرة (١٩٩٤) نقص المحصول إلى ١٥٢,٧ كجم / شجرة ، بينما إزداد المحصول وبلغ ١٥٦,١كجم/ شجرة عند وجود ١٢,٩ جعل / شجرة (١٩٩٥).

٣ – البرتقال إبو صرة : (أ) بلغت النسبة المئوية لإصابة الازهار خلال الأربع مواسم ١٧,٥٣ ٪ وعندما وصلت إلى ٢٢,٢٪ حدث هبوط معنوى فى المحصول وبذا فإن النسبة ١٧,٢٪) يمكن إعتبارها الحد الإقتصادى الحرج للضرر .

(ب) تحدد الحد الإقتصادى الحرج للضرر عندما تراوح تعداد الجعال بين ٠,٧٣ - ٠,٨٠ خنفساء/م٢ /شجرة .

٤ - الفول البلدى :

(أ) جميع مواعيد الزراعة للموسم الأول كانت أكثر عرضه للإصابة العالية عن المواعيد الأخرى فى الموسم الثانى، حيث كانت النسبة المئوية للإصابة ٢٢,٨٪ و ١٢,٥٥٪ على التوالى . الازهار التى ظهرت فى موعد الزراعة الرابع (١٥ نوفمبر) لكل موسم كانت قد تعرضت للإصابة أكثر (٢١,٩٪) عن الازهار التى ظهرت لمواعيد الزراعة الأخرى . وكان الحد الإقتصادى الحرج للضرر عند وصول النسبة المئوية للإصابة الى ١١,٨٪ .

(ب) متوسط عدد الإصابة بالحشرات خلال الموسمين كان ٧,٥ حشرة كاملة /م٢ ، وأقل وأكثر عدد للإصابة هو ٥,٨٥ و ١٠,٤٧ حشرة /م ٢ خلال موعدى الزراعة الأول والرابع الذى أحدث نقص فى المحصول من ٥,٠٣ إلى ٣,٨٤ طن/ فدان ، الحد الإقتصادى الحرج للضرر كان عند ٨,١٦٧ حشرة /م ٢ .

(ج) التأثير المتجمع للعوامل المناخية الرئيسية (درجة الحرارة - الرطوبة النسبية - عدد ساعات سطوع الشمس) . أحدثت تأثيرات مختلفة (E.V بمقدار ١٠,٩٪ و ٤٢,٦ ٪ خلال مواعيد موسمى الزراعة على التوالى (٩٧/٩٦ ، ٩٨/٩٧)، .

أما تأثير العوامل الأخرى (UNE. V. فكانت ٨٩,١٪ ، ٥٧,٤٪ على التوالى) .

٥ - تقدير النسب المئوية لاصابة الازهار و لمحاصيل الحقل و الحشائش الأخرى:

يسبب جعل الورد الزغبى إصابة لأزهار ثلاث محاصيل حقلية (القمح ، الفول البلدى ، الترمس) وحشيشة الكبر ويمكن ترتيب الإصابة كالتالى : الكبر (٣,١٨٪) و الفول البلدى (٢,٦٦٪) و القمح (٢,٤٨٪) والترمس (٢,٢٦٪) . بلغت أقصى نسبة مئوية للإصابة فى جميع المواسم خلال الأسبوع الأول من شهر مارس لجميع العوائل النباتية.