

## ALTERNATIVE MEANS FOR CONTROLLING *SYNANTHEDON MYOPAEFORMIS* BY MASS TRAPPING WITH SEX PHEROMONE, HORTICULTURAL, MECHANICAL AND LOCAL CHEMICAL TREATMENTS

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### Abstract

The clearwing moth *Synanthedon myopaeformis* (Lepidoptera: Sesiidae) is a serious boring pest of apple orchards in Egypt. To minimize the environmental pollution with insecticides and magnified the role of the natural enemies, alternative means of control (sex pheromone mass attraction, horticultural, mechanical and local chemical treatments) were evaluated at Nubaria district, Behera governorate during 1, 2, and 3 successive years (2000, 2001 and/or 2002).

Whole year pheromone treatment achieved reduction of infestation reached (66.40, 72.15, and 83.34%), pruning treatment (12.47, 20.40, and 29.87%), worming treatment (27.53, 35.50, and 42.64%), whole year local painting (70.90, 75.00, and 96.28%), whole year local spraying (62.60, 73.00, and 85.62%), whole year complete coverage spraying (81.07, 92.65 and 98.00%), partial pheromone and pruning (53.97, 58.85, and 62.91%), partial pheromone and worming treatments (63.47, 69.20, and 78.51%), partial pheromone and local painting (73.47, 80.95, and 89.17%), partial pheromone and local spraying (66.73, 73.30, and 81.62%), partial pheromone and complete coverage spraying (80.40, 85.25, and 94.39), when applied for 1, 2, and 3-successive years, respectively.

### INTRODUCTION

*Synanthedon myopaeformis* is a serious monophagous pest in Egypt, attacking apple tree species. Larvae bore tunnels under the bark of the tree stem and main branches and girdle them, reducing the production, weaken and finally death of trees.

Application of insecticides for the protection of fruit trees from borers' infestation used to be the main method of control and has been recently increased. Therefore, alternative methods must be concerned for environmental, human and animal safe.

Alternative means for controlling for *S. myopaeformis* was carried out by many workers, amongst are Will cocks (1924), Abdel-Rahman *et al.* (2002) and Tadros (1992) and (1994) in Egypt, Audemard and Monnet (1984), in France, Lozzia and Daolio (1984), Trematerra (1993), in Italy, Blommers and Freriks (1988), in the Netherlands, Onucar and Ulu (1999), in Turkey, Bosch *et al.* (2001), in Spain.

The aim of the present work was to prevent the yield losses due to this boring pest, decrease the pesticide residues, prevent the outbreaks of secondary species, decrease the environmental pollution, and support the role of the biological control agents to obtain better and healthy fruit production by using alternative means for controlling *S. myopaeformis* in apple orchards.

## MATERIALS AND METHODS

Experiments on *S. myopaeformis* were conducted during the whole season of moths' activity seasons of 2000, 2001 and 2002. Field trials were carried out in heavily infested apple orchards at Nubaria district, Behera governorate.

### 1. Effect of one-year treatments:

**1.1. Whole year mass attracting with a pheromone treatment:** Locally made bottles were suspended on trees at 2 meters above the ground at the rate of 1 trap per 5 trees. Each trap was baited with a polyethylene dispenser impregnated with 1 mg active ingredient (a. i.) of a blend of *S. myopaeformis* sex pheromone containing the following isomers: (Z, Z) 3, 13 – octadecadienyl acetate (84.29%), (Z, E) 3, 13 – octadecadienyl acetate (2.83%), (E, Z) 3, 13 – octadecadienyl acetate (9.69%) and (E, E) 3, 13 – octadecadienyl acetate (0.61%). Dispensers renewed at 6-week intervals, and the caught males were removed weekly during the period of February to December.

**1.2. Partial season mass attracting with pheromone and pruning treatments:** Pruning described in item 1.7. was applied, followed by partial pheromone from early February to mid July (flowering and fruiting period until last harvesting).

**1.3. Partial season mass attracting with pheromone and worming treatments:** Partial pheromone was conducted during flowering and fruiting period simultaneously with worming described in item 1.8.

**1.4. Partial season mass attracting with pheromone and partial complete coverage spraying treatments:** Partial pheromone was conducted during flowering and fruiting period. After harvesting, two complete coverage sprays with Basudin (Diazinon) and Cidial (Phenthoate) at the rate of 300 cc/100 liters of water were applied on August and September.

**1.5. Partial season mass attracting with pheromone and partial local spraying treatments:** Partial pheromone was conducted during flowering and fruiting period. After harvesting, two local spraying of the trunk and main branches with Basudin and Cidial (300 cc/100 liters of water) were applied on August and September.

**1.6. Partial season mass attracting with pheromone and partial local painting treatments:** Partial pheromone was conducted during flowering and fruiting period. After harvesting, two local painting of the tree trunk using Stemex (item 1.11.) were applied on August and September.

**1.7. Pruning treatment:** During the horticultural winter pruning in December 1999, 2000, and 2001, infested branches were pruned and immediately got rid of them.

**1.8. Warming treatment:** Using a plastic brush and a pieces of palm raffia to mash and kill eggs, larvae and pupae under the very thin layer of infested bark was applied 4 times each season (December, March, June, September).

**1.9. Whole year complete coverage-spraying treatment:** The recommended four alternative sprays with Basudin 60% E.C. and Cidial L 50% E.C. each at the rate of 300 cc /100 liters water were applied. Before harvesting, two sprays were conducted on mid March, mid April and early May, and then one sprays after harvesting on mid August.

**1.10. Whole year local spraying treatment:** The same insecticides, same dates and number of applications as in complete coverage spray (item 1.9) were carried out but spraying was concentrated only on the trunk and main branches.

**1.11. Whole year local painting treatment:** Local painting was concentrated only to the trunk using Stemex insecticide (3% Anthracine + 18% Naphthalene), using a brush, four times on the same dates of complete coverage spraying.

**1.12. Untreated check:** Trees of this treatment did not receive any pheromone, horticultural mechanical or insecticidal treatments.

## **2. Effect of two and three years treatments:**

The same twelve previously mentioned one - year treatments that applied during 1999/2000 were repeated in other apple orchards during 2000/01 and 2001/02 seasons to confirm the results for the 2<sup>nd</sup> and 3<sup>rd</sup> years. In addition, the same previously one-year treatments of 1999/2000 were repeated in the same apple orchard during 2000/01 and 2001/02 seasons to studying the cumulative effect of two and three successive years.

## **3. Statistical analysis:**

The experimental design was completely randomized (Duncan's multiple range test) at significance level 5% split design with 25 trees each split replicated 3 times. Evaluation of the different treatments was carried out at the end of the year (during December) by counting the alive larvae in the treated and untreated trees. The percentage reduction of infestation was calculated according to the following formula:

$$\% \text{ Reduction of infestation} = [(C - T) / C] \times 100$$

Where: C: Mean number of alive larvae in the untreated trees.

T: Mean number of alive larvae in the treated trees.

Analysis of variance (F- test) and LSD were used for differentiation between treatments.

## RESULTS AND DISCUSSION

The effect of mass attraction of *S. myopaeformis* male moths with sex pheromone, horticultural, mechanical and local chemical treatments on the reduction of infestation was studied in apple orchards at Nubaria district, Behera governorate during 1, 2 and 3 successive seasons (1999/2000 to 2001/02). Data obtained the following results:

**1. Effect of one single year treatments (direct effect): (Table, 1)**

Statistical analysis of variance and LSD resulted in the following groups:

**1.1. The superior group (71.00 – 100.00% reduction of infestation):**

- a) **Whole year complete coverage-spraying treatment** achieved a good percentage reduction of infestation reached 81.07% (range, 79.8–82.3%).
- b) **Partial mass attraction with pheromone then complete coverage spraying treatments** after harvesting resulted in excellent control, showing 80.40% (range, 77.5–82.5%) reduction of infestation.
- c) **Partial mass attraction with pheromone then local painting treatments** led to a good reduction of infestation. These treatments reduced infestation by 73.47% (range, 69.3-76.5%).
- d) **Whole year local painting treatment** was of great value due to its efficient action as well as reducing insecticidal application. The percent reduction of infestation reached 70.90% (range, 69.6 - 73.0%).

**1.2. The moderate group (51.00 - 70.00% reduction of infestation):**

- a) **Partial mass attraction with pheromone then local spraying treatments** gave moderate percentage reduction of infestation, averaged 66.73% (range, 65.2–68.6%).
- b) **Whole year mass attraction with pheromone traps** all over the year round reduced the borer infestation with 66.40% (range, 64.4–69.7%).
- c) **Partial mass attraction with pheromone and worming treatments** together as an integrated environmentally safe pest control gave satisfactory effect (a mean of 63.47% and range, 62.5 to 64.1%) on the reduction of infestation.
- d) **Whole year local spraying treatment** reduced infestation by 62.60% (range, 59.6 – 65.3%). This treatment was much efficient, easy to apply, reduce the quantity and hazards of insecticides used, and safe effort and time in addition to the reduction of crop pollution with insecticides.
- e) **Partial mass attraction with pheromone and pruning treatments** together as an integrated environmentally safe pest control showed a very good effect on the reduction of infestation reached 53.97% (range, 51.7 to 57.3%).

### 1.3. The less group (25.00 - 50.00% reduction of infestation):

**Worming treatment** indicated more or less good results showing 27.53% reduction of infestation (range, 24.8 – 30.3 %).

### 1.4. The least group (less than 25.00% reduction of infestation):

**Pruning treatment** in winter resulted in 12.47% (range, 10.9 – 15.4%) reduction in infestation. The low reduction of infestation was due to the concentration of larvae in the stem and main branches that were not included in pruning percentage.

Table 1. Effect of one single year treatments on the reduction of infestation of *S. myopaeformis* in apple orchards at Nubaria, Behera governorate during 1999/2000, 2000/01 and 2001/02

Treatment	Mean no. of alive larvae per tree (L/T) and percent reduction of infestation (%RI)								Grouping
	1999/2000		2000/01		2001/02		Mean		
	L/T	%RI	L/T	%RI	L/T	%RI	L/T	%RI	
Pheromone only	4.69	69.7	4.31	64.4	4.92	65.1	4.64	66.40	bc
Pheromone + Pruning	7.29	52.9	5.17	57.3	6.81	51.7	6.42	53.97	c
Pheromone + Worming	5.60	63.8	4.35	64.1	5.28	62.5	5.08	63.47	bc
Pheromone + Complete coverage spray	3.48	77.5	2.12	82.5	2.65	81.2	2.75	80.40	a
Pheromone + Local spray	5.39	65.2	3.80	68.6	4.73	66.4	4.64	66.73	bc
Pheromone + Local painting	3.93	74.6	2.85	76.5	4.33	69.3	3.70	73.47	ab
Pruning only	13.79	10.9	10.76	11.1	11.92	15.4	12.16	12.47	e
Worming only	11.23	27.5	8.44	30.3	10.60	24.8	10.09	27.53	d
Complete coverage spray only	2.92	81.1	2.44	79.8	2.49	82.3	2.62	81.07	a
Local spraying only	5.37	65.3	4.49	62.9	5.69	59.6	5.18	62.60	bc
Local painting only	4.63	70.1	3.27	73.0	4.28	69.6	4.06	70.90	ab
Untreated (check)	15.48		12.11		14.90		14.16		f

## 2. Effect of two successive years treatments (cumulative effect): Table (2)

Statistical analysis of variance and LSD resulted in the following groups:

### 2.1. The superior group (81.00 – 100.00% reduction of infestation):

- a) **Whole year complete coverage spraying treatments** reduced infestation by 92.65% (range, 90.80–94.50%). Repeating these treatments for the second year increased the reduction of infestation by 5.35%.
- b) **Partial mass attraction with pheromone then complete coverage spraying treatments** reduced infestation by 85.25% (range, 83.30–87.20%). Repeating these treatments for the second year increased the reduction of infestation by 4.85%.
- c) **Partial mass attraction with pheromone then local painting treatments** reduced infestation by 80.95% (range, 78.20–83.70%). Repeating these treatments for the second year increased the reduction of infestation by 7.48%.
- d) **Whole year local painting treatments** reduced infestation by 75.00% (range 68.30–81.70%). Repeating these treatments for the second year increased the reduction of infestation by 4.10%.

**2.2. The moderate group (61.00 – 80.00% reduction of infestation):**

- a) **Partial mass attraction with pheromone then local spraying treatments** reduced infestation by 73.30% (range, 70.60–76.00%). Repeating these treatments for the second year increased the reduction of infestation by 6.57%.
- b) **Whole year local spraying treatments** reduced infestation by 73.00% (range, 69.40–76.60%). Repeating these treatments for the second year increased the reduction of infestation by 10.40%.
- c) **Whole year mass attraction with pheromone treatment** reduced *Z. pyrina* infestation by 72.15% (range, 69.70–74.60 %). Repeating this treatment for the second year increased the reduction of infestation by 5.75%.
- d) **Partial mass attraction with pheromone and worming treatments** reduced infestation by 69.20% (range, 65.90–72.50%). Repeating these treatments for the second year increased the reduction of infestation by 5.73%.

**2.3. The less group (31.00 – 60.00% reduction of infestation):**

- a) **Partial mass attraction with pheromone and pruning treatments** reduced infestation by 58.85% (range, 56.30–61.40%). Repeating these treatments for the second year increased the reduction of infestation by 4.06%.
- b) **Worming treatments** reduced infestation by 35.50% (range, 33.50–37.50%). Repeating these treatments for the second year increased the reduction of infestation by 7.14%.

**2.4. The least group (less than 30.00% reduction of infestation):**

**Pruning treatments** reduced infestation by 20.40% (range, 19.20–21.60%). Repeating these treatments for the second year increased the reduction of infestation by 7.93%.

**3. Effect of three successive years treatments (cumulative effect): Table (2)**

Statistical analysis of variance and LSD resulted in the following groups:

**3.1. The superior group (81.00 – 100.00% reduction of infestation):**

- a) **Whole year complete coverage spraying treatments** reduced infestation by 98.00%. Repeating these treatments increased the reduction of infestation by 11.58%. The total reduction for 3 years reached 16.93%.
- b) **Whole year local painting treatments** reduced infestation by 96.28%. Repeating these treatments increased the reduction of infestation by 21.28%. The total reduction for 3 years reached 25.38%.
- c) **Partial mass attraction with pheromone then complete coverage spraying treatments** reduced infestation by 94.39%. Repeating these treatments increased the reduction of infestation by 9.14%. The total reduction for 3 years reached 13.99%.

Table 2. Effect of two and three successive years treatments on the reduction of infestation of *S. myopaeformis* in apple orchards at Nubaria, Behera governorate during 1999/2001 and 2000/2002.

Treatment	Mean no. of alive larvae per tree (L/T) and percent reduction of infestation (%RI)							
	2- successive years						3- years	
	1999/01		2000/02		Mean		Mean (1999/03)	
	L/T	%RI	L/T	%RI	L/T	%RI	L/T	%RI
Pheromone only	4.13	74.60	4.45	69.70	4.29 <sub>bc</sub>	72.15	3.00 <sub>ab</sub>	83.34
Pheromone + Pruning	7.09	56.30	5.67	61.40	6.38 <sub>d</sub>	58.85	6.68 <sub>bc</sub>	62.91
Pheromone + Warming	5.53	65.90	4.04	72.50	4.79 <sub>cd</sub>	69.20	3.87 <sub>ab</sub>	78.51
Pheromone + Complete coverage spray	2.08	87.20	2.45	83.30	2.27 <sub>a</sub>	85.25	1.01 <sub>ab</sub>	94.39
Pheromone + Local spray	4.77	70.60	3.53	76.00	4.15 <sub>bc</sub>	73.30	3.31 <sub>ab</sub>	81.62
Pheromone + Local painting	2.64	83.70	3.20	78.20	2.92 <sub>ab</sub>	80.95	1.95 <sub>ab</sub>	89.17
Pruning only	13.12	19.20	11.51	21.60	12.32 <sub>f</sub>	20.40	12.63 <sub>d</sub>	29.87
Warming only	10.15	37.50	9.76	33.50	9.96 <sub>e</sub>	35.50	10.33 <sub>cd</sub>	42.64
Complete coverage spray only	1.49	90.80	0.81	94.50	1.15 <sub>a</sub>	92.65	0.36 <sub>a</sub>	98.00
Local spraying only	4.96	69.40	3.44	76.60	4.20 <sub>bc</sub>	73.00	2.59 <sub>ab</sub>	85.62
Local painting only	2.23	68.30	2.68	81.70	2.46 <sub>ab</sub>	75.00	0.67 <sub>a</sub>	96.28
Untreated (check)	16.23		14.68		15.46 <sub>g</sub>		18.01 <sub>e</sub>	

d) **Partial mass attraction with pheromone then local painting treatments** reduced infestation by 89.17%. Repeating these treatments increased the reduction of infestation by 6.22%. The total reduction for 3 years reached 13.70%.

e) **Whole year local spraying treatments** reduced infestation by 85.62%. Repeating these treatments increased the reduction of infestation by 12.62%. The total reduction for 3 years reached 23.02%.

f) **Whole year mass attraction with pheromone treatment** reduced infestation by 83.34%. Repeating this treatment increased the reduction of infestation by 11.19%. The total reduction for 3 years reached 16.94%.

### 3.2. The moderate group (61.00 – 80.00% reduction of infestation):

a) **Partial mass attraction with pheromone then local spraying treatments** reduced infestation by 81.62%. Repeating these treatments increased the reduction of infestation by 8.32%. The total reduction for 3 years reached 14.89%.

b) **Partial mass attraction with pheromone and worming treatments** reduced infestation by 78.51%. Repeating these treatments increased the reduction of infestation by 9.31%. The total reduction for 3 years reached 15.04%.

c) **Partial mass attraction with pheromone and pruning treatments** reduced infestation by 62.91%. Repeating these treatments increased the reduction of infestation by 4.88%. The total reduction for 3 years reached 8.94%.

**3.3. The less group (31.00 – 60.00% reduction of infestation):**

**Worming treatments** reduced infestation by 42.64%. Repeating these treatments increased the reduction of infestation by 7.97%. The total reduction for 3 years reached 15.11%.

**3.4. The least group (less than 30.00% reduction of infestation):**

**Pruning treatments** reduced infestation by 29.87%. Repeating these treatments increased the reduction of infestation by 9.47%. The total reduction for 3 years reached 17.40%.

**4. Conclusion and discussion: (Table 3)**

Although statistically the environmentally safe means of control mostly resulted in relatively low reduction of *S. myopaeformis* infestation, yet, applying the treatments yearly on the same trees magnified the reduction of infestation (Table 3). Results of whole year were 66.40, 72.15, and 83.34% for pheromone, 27.53, 35.50, and 42.64% for worming, 12.47, 20.40, and 29.87% for pruning, when applied for 1, 2, and 3 successive years, respectively.

Table 3. Grouping of different treatments applied to control *S. myopaeformis* larvae on apple trees during one, two and three successive years (1999/2000, 2000/2001 and 2001/2002).

Treatment	% Reduction of infestation (RI)					
	One year		Two years		Three years	
	% RI	RO	% RI	RO	% RI	RO
Pheromone only	66.40	bc	72.15	bc	83.34	ab
Pheromone + Pruning	53.97	c	58.85	d	62.91	bc
Pheromone + Worming	63.47	bc	69.20	cd	78.51	ab
Pheromone + Complete coverage spray	80.40	a	85.25	a	94.39	ab
Pheromone + Local spray	66.73	bc	73.30	bc	81.62	ab
Pheromone + Local painting	73.47	ab	80.95	ab	89.17	ab
Pruning only	12.47	e	20.40	f	29.87	d
Worming only	27.53	d	35.50	e	42.64	cd
Complete coverage spray only	81.07	a	92.65	a	98.00	a
Local spraying only	62.60	bc	73.00	bc	85.62	ab
Local painting only	70.90	ab	75.00	ab	96.28	a

RO = Ranked order



As pheromone traps are costly, and to increase the efficiency of this treatment, other environmentally safe control treatments (dormant pruning and worming) were also applied in combination with mass pheromone attraction treatment. Mass attraction treatment with pheromone was applied during the first half of the tree growth season (flowering and fruiting until harvesting). This period coincided with the first activity season of the pest, thus decreased the pest population and resulted in adequate decrease in the target borer's infestation (Table 3). Results of partial pheromone and worming were 63.47, 69.20, and 78.51%, while partial pheromone and pruning were 53.97, 58.85, and 62.91% when applied for 1, 2, and 3 successive years, respectively.

Insecticide treatments, however, considered effective in IPM programs (Table 3) and obligatory used in plant protection especially in controlling severe infestation of the target pest threatening the crop production. Therefore, the use of pheromone mass attraction treatment was carried out during the flowering, fruiting until harvesting which coincided with the first activity season of the pest. Insecticide application, however, were used after harvesting during the second half of the activity period of the pest. To increase the safety of insecticides used and eliminate the environmental pollution, insecticides were sprayed or painted locally to the trunk and main branches of trees only to accommodate the 2<sup>nd</sup> period of moths' activity season, while the 1<sup>st</sup> period was checked by mass attraction with pheromone trap. Results of partial pheromone and local painting were 73.47, 80.95, and 89.17%, and partial pheromone and local spraying were 66.73, 73.30, and 81.62% when applied for 1, 2, and 3 successive years respectively. Moreover, the effects of applying partial pheromone was applied during the first activity season of the pest then the recommended complete coverage spraying of insecticides during the second activity season. The respective results were 80.40, 85.25, and 94.39% when applied for 1, 2, and 3 successive years. Application of whole year local painting and local spraying was effective as well as environmentally safe and of low cost. The respective results were 70.90, 75.00, and 96.28%, and 62.60, 73.00, and 85.62% when applied for 1, 2, and 3 successive years.

The present results were somewhat in agreement with several researches such as Willcocks (1924), who recommended horticultural and mechanical means of controlling fruit tree borers in fruit orchards. Abdel-Rahman *et al.* (2002) and Tadros (1992) and (1994) in Egypt, Audemard and Monnet (1984), in France, Lozzia and Daolio (1984), Trematerra (1993), in Italy, Blommers and Freriks (1988), in the Netherlands, Onucar and Ulu (1999), in Turkey, Bosch *et al.* (2001), in Spain.

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الطرق البديلة لمكافحة حفار ساق الحلويات رائق الأجنحة  
*Synanthedon myopaeformis* باستخدام المعاملات بالمصائد الفرمنية  
 الجنسية والمعاملات البستانية والميكانيكية والكيميائية الموضوعية

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في مصر يعتبر حفار ساق الحلويات رائق الأجنحة من الآفات الخطيرة في حدائق التفاح. وللد من التلوث البيئي بالمبيدات وتعظيم دور الأعداء الحيوية تم تقييم فعالية بعض الطرق البديلة للمكافحة مثل جذب الحفار بأعداد كبيرة باستخدام الفرمونات، والمعاملات البستانية والميكانيكية والكيميائية الموضوعية في منطقة النوبارية محافظة البحيرة خلال سنة وستان وثلاث سنين متتالية (٢٠٠٠، ٢٠٠١، ٢٠٠٢). أدت هذه المعاملات إلي.

أظهرت النتائج ما يلي:

أدت المعاملة طوال العام بالفرمون فقط إلي تقليل الإصابة بنسبة ٦٦,٤٠، ٧٢,١٥، ٨٣,٣٤% وبالتقليم فقط إلي ١٢,٤٧، ٢٠,٤٠، ٢٩,٨٧%؛ وبقتل اليرقات بالسلك فقط إلي ٢٧,٥٣، ٣٥,٥٠، ٤٢,٦٤%؛ وبالدهان الموضوعي فقط إلي ٧٠,٩٠، ٧٥,٠٠، ٩٦,٢٨%؛ وبالرش الموضوعي فقط إلي ٦٢,٦٠، ٧٣,٠٠، ٨٥,٦٢%؛ وبالرش الكلي فقط إلي ٨١,٠٧، ٩٢,٦٥، ٩٨,٠٠%؛ في حين أدت المعاملة الجزئية بالفرمون مع التقليم إلي ٥٣,٩٧، ٥٨,٨٥، ٦٢,٩١%؛ والمعاملة الجزئية بالفرمون مع قتل اليرقات بالسلك إلي ٦٣,٤٧، ٦٩,٢٠، ٧٨,٥١%؛ والمعاملة الجزئية بالفرمون مع الدهان الموضوعي إلي ٧٣,٤٧، ٨٠,٩٥، ٨٩,١٧%؛ والمعاملة الجزئية بالفرمون مع الرش الموضوعي إلي ٦٦,٧٣، ٧٣,٣٠، ٨١,٦٢%؛ والمعاملة الجزئية بالفرمون مع الرش الكلي إلي ٨٠,٤٠، ٨٥,٢٥، ٩٤,٣٩%؛ عندما أجريت المعاملات لمدة سنة وستان وثلاث سنين متتالية، علي الترتيب.