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EFFECT OF CERTAIN AGRICULTURAL PRACTICES AND NON-CHEMICAL MATERIALS ON INSECT PESTS, PREDATORS AND YIELD OF ROSELLE PLANTS IN MINIA REGION

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ABSTRACT

The effect of plant variety, planting date and hoeing of roselle plants on the occurrence of certain insect pests and their associated predators were studied during the two successive seasons of 1997 and 1998 in Minia Governorate. Also, the efficiency of some non-chemical materials against the main sucking pests on roselle during a third season (1999) was evaluated under field conditions.

During the whole season (in both 1997 and 1998), four sucking insects were found commonly infesting roselle leaves, i.e. *Empoasca spp.; Bemisia tabaci; Thrips tabaci* and *Lygus spp.* Moreover, during fruiting stage, *Earias insulana* and *oxycarinus hyalinipennis* were also found to infest roselle bolls. Two common predators, i.e. *Coccinella undecimpunctata* and *Orius spp.* were recorded and associated with the sucking pests. Generally, Baladi variety proved to be more favorable to the sucking pests (including *O. hyalinipennis*) than Sabahia 17. Meanwhile, the latter variety was highly attacked by *E. insulana* than the first. Also, it was evident that the peak of the predators coincided with that of the sucking mixed pests infesting roselle plants, especially during the period from July till September. In addition, roselle plants (Sabahia 17) cultivated on the 2nd and 3rd planting dates (22nd April and 2nd May, respectively) relatively harboured more sucking pests than those of the 1st planting date (12th April). Hoeing (Baladi variety) had slightly reduced the number of the sucking insect pests in both growing seasons. The yield of sepals for Sabahia 17 was markedly higher than for Baladi, and this was accompanied by higher infestation of sucking pests on Baladi than Sabahia 17. The yield was also affected by planting date, where the highest yield of sepals and the lowest number of sucking pests were recorded for the earlier (12th April) cultivation of Sabahia 17. A similar trend was recorded for the treatment of hoeing of Baladi variety.

In the third season during 1999, soft soap and the microbial (fungal) preparations were effective against *Empoasca spp.* and *B. tabaci*, while soft soap and the mineral oil Capel 2 were effective on the *Lygus spp.* and *O. hyalinipennis*.

INTRODUCTION

In recent decades, cultivation of medicinal and aromatic plants in Egypt has noticeably increased. Their production under the prevailing climatic conditions is quite promising and simultaneous increase in cultivated areas is expected (Hamouda, 1987).

Roselle (*Hibiscus sabdarifa* L.) is one of the most economic medicinal plants. Many sucking pests were recorded to attack this crop in Egypt, hence affecting the quantity and quality of the yield (Mesbah *et al.*, 1983; Abdel-Galil *et al.*, 1987; El-Sayed *et al.* , 1990 and Abd El-Naby *et al.*, 1995 and 1999). To avoid chemical control of such pests, several studies were conducted on the influence of different agricultural practices against

sucking insects infesting different host plants (Soliman *et al.*, 1985; Perring and Farrar, 1988; Stoner and Shelton, 1988; Aly, 1990; Hassan and Aly, 1990; Abdel-Alim *et al.*, 1995 and Abdel-Hafez *et al.*, 1997). In addition, new compounds showed to be of low mammalian toxicity and possess effective residual activity against several insect species attacking medicinal and aromatic plants (Larew, 1988).

The objective of the present investigation aimed to study the effect of plant variety, planting date and hoeing of roselle on the occurrence of insect pests and their associated predators. Moreover, the efficiency of certain non-chemical materials in controlling roselle key pests was determined.

MATERIALS and METHODS

The effect of plant variety, planting date and hoeing of roselle, *Hibiscus sabdarifa* L. on the occurrence of insect pests and their associated predators were studied at the Experimental Farm of the Faculty of Agriculture, Minia University during the two successive summer seasons of 1997 and 1998. In addition, the efficiency of certain non-chemical materials in controlling the key pests of this crop was determined in the third season of 1999.

Experimental Procedure:

I. Agricultural practices:

a. Planting date:

The variety Sabahia 17 was cultivated in three different planting dates (12th April, 22nd April and 2nd May) in the two successive seasons of 1997 and 1998.

b. Hoeing:

Seeds of the variety Baladi were sown on 12th April, in two treatments, the first with hand hoeing three times throughout the season, while the second was left without hoeing.

c. Plant variety:

Comparing the results of the population density of insects on the varieties, Baladi and Sabahia 17 cultivated on 12th April was taken into consideration, based on the results of the previous experiments.

Generally, the other recommended agricultural practices, i.e. irrigation, fertilization … etc. were followed in the experimental areas. Also, no pesticidal treatment was adopted. Each treatment included three replicates (each 42 m^2) in block randomized design.

Sampling of Insects:

Sucking pests:

In all treatments, sampling started as soon as plants appeared above ground and continued until harvest. Nymphs and adults of leafhoppers, *Empoasca spp.;* thrips, *Thrips tabaci* Linn. mirrid bugs, *Lygus spp.* and adults

of whitefly, *Bemisia tabaci* Genn. were counted in situ early in the morning at one week intervals on 30 leaves chosen randomly per treatment (10/replicate) according to Southwood (1978).

Predators:

Numbers of predators were counted weekly on nine randomly selected plant branches (3/replicate) from the treatments of both Baladi and Sabahia 17 cultivated on 12th April.

Pests of fruiting stage:

At the fruiting stage, 45 bolls were randomly collected weekly per treatment (15/replicate) of both Baladi and Sabahia 17 varieties cultivated on 12th April. Bolls were inspected for the number of the cotton seed bugs, *Oxycarinus hyalinipennis* (Costa.) and spiny bollworm, *Earias insulana* (Boisd.). Data of the first pest was presented as average weekly number, while for the second was estimated as percentage of infestation.

Yield:

At the end of each growing season, the yield of roselle sepals was determined for each treatment and expressed as kg/feddan.

The obtained data were statistically analyzed for variance according to Snedecor and Cochran (1967). The mean values were compared at 5% level of least significant differences (L. S. D.) for each treatment. Also, correlation coefficient values were calculated for the relationship between the total numbers of sucking pests and the yield of sepals in all treatments.

II. Efficiency of some non-chemical materials against certain sucking pests

During the third season of 1999, four different materials, i.e. soft soap (300 ml/fed); the mineral oil Capel 2 (2 and 3 L/fed), as well as the fungal bio-insecticides, Biofly (*Beauveria bassiana,* 300 ml/fed.) and Micotal (*Verticillium lecanii,* 1.25 kg/fed.) were evaluated against sucking pests infesting roselle plants (Sabahia 17) cultivated on 12th April. Each material was applied in four replicates (42 m^2/replicate) using a kanp-sack sprayer, and four replicates were left as check.

Counts of leafhoppers, lygus bugs, cotton seed bugs and adults of whitefly were taken immediately before spray and 3, 7 and 10 days post treatment. Samples of 10 plants/replicate were examined randomly in the field and numbers of pest individuals were recorded Post-treatment reductions were calculated according to Henderson and Telton (1955).

RESULTS AND DISCUSSION

I. Effect of certain agricultural practices:

A. Plant Variety:

Data of the monthly population density of the main pests on two roselle varieties (namely; Baladi and Sabahia 17) during 1997 and 1998 seasons are presented in Table (1).

a. Sucking pests:

The jassid, *Empoasca spp.*:

Occurrence of this jassid was recorded at obviously highly density levels on both roselle varieties during the two successive seasons. The maximum population density was recorded in July on Sabahia 17 (23 individuals) and August on Baladi (25.6 individuals) during 1997 season and in September on both varieties in 1998 season (20.1 and 30.7 individuals, respectively). It also seemed that Baladi variety (total of 72.1 and 99.3 individuals) was significantly favorable to jassid infestation than Sabahia 17 variety (52.8 and 57.1 individuals) in 1997 and 1998 seasons, respectively (Table 1).

The whitefly, *B. tabaci*:

On both varieties, Baladi and Sabahia 17, the whitefly infestation extended allover the whole season. The maximum population density for this pest on Baladi was recorded in July (8.1 and 5.3 individuals/10 leaves), while on Sabahia 17 it was in September and July (6.0 and 6.2 individuals/10 leaves) during 1997 and 1998 seasons, respectively. In addition, the total number of the adults was 22.5 and 14.9 for Baladi and 15.6 and 18.2 individuals for Sabahia 17 in 1997 and 1998, respectively, with insignificant differences (Table 1). Generally, the abundance of this pest on roselle was less than that observed for the jassids.

The thrips, *T. tabaci*:

The occurrence of *T. tabaci* in the first season was very rare (<1 individual) and restricted to two months only (June and July) on both varieties, then it disappeared till the end of the season. Meanwhile, the population of this pest was highly abundant on both varieties in the second season, where the maximum density was 18.6 and 9.4 individuals on Baladi and Sabahia 17 in August and September, respectively. It was obvious that Baladi was 2-fold more favorable than Sabahia 17 (Table 1).

The mirrid bugs, *Lygus spp.*:

The mirrid bugs did not exist in June in both seasons except for Sabahia 17 with a very low number (1 individual), then the population occurred suddenly at very high numbers (over 17 individuals) in July for both varieties. On Baladi, the maximum density reached 21.0 and 37.8 individuals/10 leaves in August and September, while on Sabahia 17 variety, it reached 20.6 and 32.0 individuals/10 leaves in July and August during 1997

1

and 1998 seasons, respectively. In general, it was obvious that the infestation level was relatively higher in the second season than in the first on both roselle varieties with insignificant differences.

These results are in agreement with those obtained by Mesbah *et al.*, 1983; Abdel-Galil *et al.*, 1987; El-Sayed *et al.*, 1990 and Abd El-Naby *et al.*, 1995 and 1999 who found that the sucking insect pests of roselle plants included jassids, whitefly and thrips.

b. Predators:

Data in Table (2) indicated that both roselle varieties harboured two common predator species, i.e. ladybeetle, *Coccinella undecimpunctata* and anthocorid bugs, *Orius spp.* Based on the general monthly means, it seemed that *Orius spp.* was more abundant on both varieties than the ladybeetle, except on Baladi during the second season. In addition, the numbers of both predators were almost similar on both varieties during the first season, meanwhile, the number was remarkably higher on Baladi than on Sabahia 17 in the second season, although the differences were insignificant. As for the maximum of both predators, the highest number on Baladi (25.1 and 54.2) was recorded in August, while on Sabahia 17 (18.0 and 18.8) was in July during the two successive seasons, respectively.

The relationship between the population density of total sucking pests and their associated predators on two roselle varieties during the growing seasons of 1997 and 1998 is illustrated in Fig. (1). It is evident that the maximum abundance of the total number of predators coincided with the abundance of the total number of sucking pests infesting roselle plants, especially during the period from July till September. In agreement of these results, Hamouda (1987) and Abdel-Alim *et al.* (1995) mentioned that the maximum abundance of predators coincides with the abundance of the sucking insects associated with medicinal and aromatic plants. Moreover, the first author reported that the predators can play an effective role in controlling the sucking pest populations during certain time of abundance and could be considered as a biological control factor under the field conditions.

c. Pests of fruiting stage:

As shown in Table (3), two common harmful pests, i.e. *Earias insulana* and *Oxycarineus hyalinipennis* were detected in the bolls of both roselle varieties late in the season, starting from 24th September until 22nd October (for 5 weeks). The mean infestation by *E. insulana* proved to be significantly higher on Sabahia 17 (43.43 and 29.98%) than on Baladi variety (13.3 and 12.04%) in 1997 and 1998 seasons, respectively. Meanwhile, Baladi variety markedly harboured higher numbers of *O. hyalinipennis* (178.1 and 49.2 individuals/15 bolls) as compared to Sabahia 17 variety (26.0 and 31.83 individuals/15 bolls) in the two seasons, respectively. Generally, it is obvious that Sabahia 17 variety was highly attacked by *E. insulana*, while Baladi variety was highly more favorable to *O. hyalinipennis* infestation. El-Sayed *et al.* 1990 and Abd El-Naby *et al.* , 1995 found that *E. insulana* and *O. hyalinipennis* were among the most abundant pests of roselle plants.

Fig

Table (3): Infestation rate by *E. insulana* and mean numbers of *O. hyalinipennis* infesting bolls of two varieties of roselle during the growing seasons of 1997 and 1998.

Inspection	1997 season				1998 season			
	Baladi		Sabahia 17		Baladi		Sabahia 17	
Date	*E.*(1)	*O.*(2)	*E.*	*O.*	*E.*	*O.*	*E.*	*O.*
24th September	0.0	0.9	0.0	0.0	0.0	1.3	3.3	6.3
1st October	0.0	0.0	67.0	17.0	3.3	18.7	23.3	20.7
8th October	0.0	0.9	40.0	19.0	10.3	25.0	40.0	31.3
15th October	33.3	123.9	66.7	68.0	23.3	58.0	53.3	69.0
22nd October	33.3	765.9	-	-	23.3	143.0	-	-
Mean	13.3	178.14	43.43	26.0	12.04	49.2	29.98	31.83

(1) ***E.*: % Infestation by *E. insulana*, (F value = 5.83 * and LSD $_{0.05}$ = 22.6).**
(2) ***O.*: Mean No. of *O. hyalinipennis*/15 bolls**

b. Planting date:

Results in Table (4) summarize the population density of four sucking insects infesting Sabahia 17 variety sown at three different dates (12th April, 22nd April and 2nd May) during 1997 and 1998 seasons.

The jassid, *Empoasca spp.*:

The infestation by this pest reached its maximum numbers for the three planting dates in July during the first season, while it was later in September during the second season. However, the maximum numbers for the three planting dates in both seasons did not show considerable differences (ranged between 23.0 and 25.5 individuals and 20.1 and 25.3 individuals, as monthly mean numbers/10 leaves, in 1997 and 1998, respectively). Nevertheless, when comparing the general means of infestation, it was obvious that the 2nd planting date showed relatively higher means than the 1st or the 3rd dates, with insignificant differences in both seasons.

The whitefly, *B. tabaci*:

Concerning the whitefly adults, during 1997 season, almost similar trends were recorded for all three planting dates, where the general means ranged between 3.0 to 3.1 individuals. However, in 1998 season both the 2nd and 3rd planting dates showed remarkably higher general means (5.3 and 5.7 individuals, respectively) than the 1st planting date (3.6 individuals).

The onion thrips, *T. tabaci*:

In the first season, the infestation of thrips for all planting dates was restricted to only two months (June and July) and was relatively at very low numbers then, it disappeared completely till the end of the season. Meanwhile, in 1998 season, the situation was very much different, where the infestation occurred during the whole season with significantly higher mean numbers than those of the first season (Table 4). When comparing the effect of planting dates, the 3rd date showed the highest general mean number (7.9) over those of the 1st or 2nd dates (4.7 and 3.7, respectively).

The mirrid bugs, *Lygus spp.*:

In general, the obtained data revealed that *Lygus spp.* was the most abundant pest on roselle plants as compared to the other sucking pests, and the infestation in the second season was relatively higher than in the first. In addition, the monthly average number for the three planting dates reached its maximum in July in the season of 1997, while it was one month later (in August) in the season of 1998. In specific, the first planting date showed the lowest level of infestation than both the second and third planting dates, however, the differences were insignificant during the two growing seasons.

On different host plants, Perring and Farrer (1988) and Stoner and Shelton (1988) mentioned that planting date affected the population density of the potato aphid and the onion thrips, respectively. Also, Aly (1990) reported that significant increase in the whitefly adults occurred in the last planting date of Squash plants.

c. Hoeing:

Table (5) presents the effect of hoeing on population density of the key pests infesting Baladi variety during the two successive seasons of 1997 and 1998.

The obtained data revealed that hoeing significantly reduced the total numbers of the four sucking pests in both 1997 and 1998 seasons (total of 153.2 and 245.3 for hoeing, and 188.2 and 309.6 for without hoeing, respectively). In general, the highest infestation levels were recorded for jassids followed by the lygus bugs (average of 17.3, 13.2 and 22.0, 20.0 for without hoeing and 14.4, 11.3 and 19.9, 18.3 for hoeing in both seasons, respectively). Meanwhile, the least infestation was shown by thrips in the first season and by the whitefly in the second season for both hoeing and without hoeing treatments. Moreover, the total sucking pests infestation was apparently higher during the second season as compared with the first season.

Yield of sepals:

The yield of roselle sepals in all the experimental treatments in relation to the total numbers of four sucking pests was determined in the two seasons of 1997 and 1998 (Table 6).

During both seasons, the yield of sepals for Sabahia 17 (714.8 and 577.9 kg/fed.) was markedly higher than for Baladi variety (660.5 and 428.3 kg/fed.), respectively. This was accompanied by higher infestation of sucking pests on Baladi than Sabahia 17.

As for the effect of planting date, the highest yield of sepals and the lowest number of sucking pests (in both seasons) was recorded for the earlier (12^{th} April) cultivation of Sabahia 17. Meanwhile, the later two cultivations were accompanied by a remarkable reduction in the yield of sepals and increase in the total sucking pests. A similar trend was recorded for the treatment of hoeing, where higher yield and lower numbers of insects were obtained as compared to the treatment without hoeing.

Table (6): Summation of the total number of four sucking pests in relation to yield of roselle sepals during two successive seasons

Treatment	1997		1998 season	
	Total sucking pests	Yield (kg/fed)	Total sucking pests	Yield (kg/fed)
Plant variety(1)				
Baladi	153.2	660.5	245.3	428.3
Sabahia 17	121.6	714.8	180.8	577.9
Planting date(2)				
12th April	121.6	714.8	180.8	577.9
22nd April	178.5	553.2	212.7	521.5
2nd May	174.8	479.3	229.7	479.9
Hoeing(3)				
Hoeing	153.2	660.5	245.3	428.3
Without hoeing	188.2	557.0	309.6	365.7

(1): Correlation Coefficient " r "= - 0.997*
(2): Correlation Coefficient " r "= -0.841*
(3): Correlation Coefficient " r "= -0.976*

In general, statistical analysis showed that there were significant negative correlation coefficient values between the total numbers of sucking pests and the yield of roselle sepals.

II. Application of non-chemical materials:

Data in Table (7) summarize the reduction percentages in the population density of certain sucking pests on roselle plants following application of Soft soap; Capel 2; the fungus; *Beauveria bassiana* Vill. and *Verticillium lecanii* materials.

On jassids, only soft soap (300 ml/fed) and the fungus *Verticillium lecanii* (1.25 kg/fed) were moderately effective resulting about 56% reduction within 3 days. Meanwhile, the best reductions within10 days was obtained by the fungus *Beauveria* (76.7% reduction) followed by *Verticillium* (64.9%), then Capel 2 and Soft soap.

As for the *Lygus* bugs, the most effective material after 3 days was soft soap (92.9% reduction), followed by Capel 2 at both rates, while the least effective material was *Verticillium* (27.6%). The reduction for all materials used decreased and ranged between 14.4 and 49.5% after 10 days.

In case of *O. hyalinipennis*, the mineral oil Capel 2 at the higher rate (3 L/fed) proved to be the highly effective material producing 86% red. after 3 days, which reached 100% red. after 10 days. This was followed by soft soap (87.7% red. after 7 days). On the other hand, both the fungus preparations were either less than moderately effective or had no effect against this pest.

The effect of the applied materials on the *Bemisia tabaci* scales seemed to be somewhat different, where the fungus materials were the most effective. The fungus *Verticillium* gave 68-69.2% red. within 7-10 days, followed by *Beauveria* which gave 59% red. after 10 days, then came soft soap (48.7% red. after 10 days).

In agreement with our results on whitefly, Abd El-Naby *et al.* (1999) reported that the microbial insecticide M-beed gave the highest percentage of

reduction in the population of *B. tabaci* on roselle, followed by natural oils then jujoba.

In general, the obtained results indicated that soft soap and the microbial (fungal) materials were effective against the jassids and the whitefly, while soft soap and the mineral oil Capel 2 were effective on the Lygus and the cotton-seed bugs.

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تـأثير بعـض العمليـات الزراعيـة والمـواد الغيـر كيميائيـة علـى الآفـات الحشـرية والمفترسات ومحصول نباتات الكركديه فى منطقة المنيا

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قسم وقاية النبات – كلية الزراعة – جامعة المنيا – مصر

تم دراسة تأثير الصنف النباتى ومواعيد الزراعة والعزيق لنباتات الكركديه على تواجد بعض الآفات الحشرية ومفترساتها المصاحبة لها خلال موسمين متتاليين 1997 ، 1998 فى محافظة المنيا . قدرت أيضا كفاءة بعض المواد الغير كيميائية ضد الآفات الحشرية الرئيسية على نباتات الكركديه وذلك خلال الموسم الثالث 1999 .على مدار الموسم (فى كل من 1997 و 1998) سجلت أربعة أنواع حشرية ثاقبة ماصة تصيب أوراق الكركديه بصورة شائعة وهى نطاطات الأوراق والذبابة البيضاء وتربس القطن وبقة الليجس . بالإضافة الى ذلك وجد أن حشرتى دودة اللوز الشوكية وبقة بذرة القطن تصيب لوز الكركديه أثناء مرحلة الإثمار كما سجل نوعين من المفترسات هما أبو العيد ذو الإحدى عشر نقطة وبق الأوريس مصاحبة للحشرات الثاقبة الماصة . وبصفة عامة ، ثبت أن الصنف البلدى كان أكثر قابلية للإصابة بالحشرات الثاقبة الماصة (مشتملا على بق بذرة القطن) عن صنف صباحية 17 . بينما وجد أن الصنف الأخير كان أكثر قابلية للأصابة بشدة بدودة اللوز الشوكية عن الصنف الأول (البلدى) . أظهرت النتائج أيضا أن أعلى تواجد لمجموع المفترسات كان متزامنا مع أعلى تواجد لمجموع الآفات الثاقبة الماصة التى تصيب نباتات الكركديه ، خاصة خلال الفترة من يوليو الى سبتمبر . علاوة على ذلك ، وجد أن نباتات الكركديه (صنف صباحية 17) المنزرعة فى الميعادين الثانى والثالث (22 أبريل و 2 مايو على التوالى) كانت مأوى لكثافة عددية أكبر من الحشرات الثاقبة الماصة بالمقارنة عن تلك النباتات التى زرعت فى الميعاد الأول (12 أبريل) .

كما أظهرت النتائج أن معاملة العزيق (فى الصنف البلدى) قد خفضت بدرجة طفيفة أعداد الآفات الثاقبة الماصة فى كل من موسمى الدراسة . كما كان محصول السبلات للصنف صباحية 17 أعلى بدرجة ملحوظة عنه للصنف البلدى وكان هذا مصاحبا لإصابة عالية بالحشرات الثاقبة الماصة على الصنف البلدى عنه على صنف صباحية 17 . تأثر المحصول أيضا بميعاد الزراعة حيث سجل أعلى محصول من السبلات وأقل تعداد من الآفات الثاقبة الماصة للزراعة المبكرة للصنف صباحية 17 (فى 12 أبريل) . كما سجل نفس الإتجاه فى حالة معاملة العزيق للصنف البلدى .

فى الموسم الثالث 1999 ، أظهرت النتائج أن الصابون الطرى والمستحضرات الميكروبية (الفطرية) كانت أكثر كفاءة ضد نطاطات الأوراق والذبابة البيضاء ، بينما كان الصابون الطرى والزيت المعدنى كابل 2 أكثر كفاءة ضد بقة الليجس وبق بذرة القطن .

Table (2): Monthly mean numbers of the most common predators on two roselle varieties (Baladi and Sabahia 17) during the two successive seasons of 1997 and 1998.

Month	1997 season						1998 season					
	Baladi			Sabahia 17			Baladi			Sabahia 17		
	C. undecimpunctata	*Orius spp.*	Total	*C. undecimpunctata*	*Orius spp.*	Total	*C. undecimpunctata*	*Orius spp.*	Total	*C. undecimpunctata*	*Orius spp.*	Total
June	1.3	1.0	2.3	2.6	3.0	5.6	0.0	0.0	0.0	0.0	0.0	0.0
July	3.0	6.3	9.3	3.7	14.3	18.0	11.3	9.6	20.9	7.1	11.7	18.8
August	9.4	15.7	25.1	5.0	3.6	8.6	24.6	29.6	54.2	4.7	12.7	17.4
September	2.4	4.3	6.7	0.3	17.1	17.4	28.0	14.8	42.8	4.0	2.7	6.7
October	2.0	4.0	6.0	0.0	0.7	0.7	0.0	0.0	0.0	0.7	0.7	1.4
Grand total	18.1	31.3	49.4	11.6	38.7	50.3	63.9	54.0	117.9	16.5	27.8	44.3
Mean	3.6	6.3	9.9	2.3	7.7	10.1	12.8	10.8	23.6	3.3	5.6	8.9

F values at 0.05 level for: 1- *C. undecimpunctata* = 3.21 (N.S), 2- *Orius spp*. =0.70 (N.S) , 3- Total predators=2.79 (N.S).

Table (1): Monthly means numbers of certain sucking pests on two roselle varieties during the two successive seasons of 1997 and 1998.

Month	Monthly mean of insect individuals/10 leaves															
	1997 season								1998 season							
	Baladi				Sabahia 17				Baladi				Sabahia 17			
	J.	Wh.	Th.	L.	J.	Wh.	Th.	L.	J.	Wh.	Th.	L.	J.	Wh.	Th.	L.
June	0.7	0.7	1.0	0.0	0.0	4.3	1.0	1.0	0.7	1.3	0.3	0.0	0.6	2.4	0.7	0.0
July	18.0	8.1	1.0	17.6	23.0	3.3	0.3	20.6	21.9	5.3	3.6	17.6	16.7	6.2	1.7	31.6
August	25.6	1.6	0.0	21.0	11.3	0.6	0.0	20.0	28.0	4.4	18.6	34.7	13.7	5.3	6.0	32.0
September	19.3	4.4	0.0	15.3	15.1	6.0	0.0	9.3	30.7	2.3	9.3	37.8	20.1	3.7	9.4	13.7
October	8.5	7.7	0.0	2.7	3.4	1.4	0.0	1.0	18.0	1.6	7.6	1.6	6.0	0.6	5.7	4.7
Total	72.1	22.5	2.0	56.6	52.8	15.6	1.3	51.9	99.3	14.9	39.4	91.7	57.1	18.2	23.5	82.5
Mean	14.4	4.5	0.4	11.3	10.6	3.1	0.3	10.4	19.9	3.0	7.9	18.3	11.4	3.6	4.7	16.4

J.: Jassid; Wh.: Whitefly; Th.: Thrips; L.: Lygus

F values at 0.05 level for:1- Jassid=4.34* and $L.S.D_{0.05}$ =6.27 , 2-Whitefly=0.43 (N.S), 3-Thrips=5.04* and $L.S.D_{0.05}$=5.05
4-Lygus= 1.56 (N.S).

Table (5): Effect of hoeing on the population density of certain sucking pests infesting roselle plants (Baladi variety) during the two successive seasons of 1997 and 1998.

Month	Monthly mean of insect individuals/10 leaves																			
	1997 season										1998 season									
	Without hoeing					Hoeing					Without hoeing					Hoeing				
	J.	Wh.	Th.	L.	Total	J.	Wh.	Th.	L.	Total	J.	Wh.	Th.	L.	Total	J.	Wh.	Th.	L.	Total
June	2.0	1.3	0.9	0.7	4.9	0.7	0.7	1.0	0.0	2.4	2.7	3.4	1.0	0.0	7.1	0.7	1.3	0.3	0.0	2.3
July	25.7	3.6	0.3	27.7	57.3	18.0	8.1	1.0	17.6	44.7	25.7	3.0	7.7	23.0	59.4	21.9	5.3	3.6	17.6	48.4
August	28.0	1.0	1.0	16.4	46.4	25.6	1.6	0.0	21.0	48.2	35.0	6.0	17.4	38.0	96.4	28.0	4.4	18.6	34.7	85.7
September	18.6	14.4	0.0	18.6	51.6	19.3	4.4	0.0	15.3	39.0	37.8	3.0	35.3	38.4	114.5	30.7	2.3	9.3	37.8	80.1
October	12.0	13.6	0.0	2.4	28.0	8.5	7.7	0.0	2.7	18.9	8.8	6.3	16.6	0.7	32.2	18.0	1.7	7.6	1.6	28.8
Total	86.3	33.9	2.2	65.8	188.2	72.1	22.5	2.0	56.6	153.2	110.0	21.7	78.0	100.1	309.6	99.3	15.0	39.4	91.7	245.3
Mean	17.3	6.8	0.4	13.2	37.6	14.4	4.5	0.4	11.3	30.6	22.0	4.3	15.6	20.0	61.9	19.9	3.0	7.9	18.3	49.1

J.: Jassid; Wh.: Whitefly; Th.: Thrips; L.: Lygus

F values at 0.05 level for: 1- Jassid =2.52 (N.S), 2-Whitefly=0.88 (N.S), 3-Thrips=5.49* and L.S.D$_{0.05}$=9.51, 4-Lygus=1.72 (N.S) , 5-Total sucking pests =4.03* and L.S.D$_{0.05}$=21.04

Table (4): Effect of planting date on the population density of certain sucking pests infesting roselle plants (Baladi variety) during the two successive seasons of 1997 and 1998.

Month	Monthly mean of insect individuals/10 leaves																							
	1997 season												1998 season											
	1st date				2nd date				3rd date				1st date				2nd date				3rd date			
	J.	Wh.	Th.	L.	J.	Wh.	Th.	L.	J.	Wh.	Th.	L.	J.	Wh.	Th.	L.	J.	Wh.	Th.	L.	J.	Wh.	Th.	L.
June	0.0	4.3	1.0	1.0	4.7	0.6	1.0	2.0	3.3	1.0	5.6	2.7	0.6	2.4	0.7	0.0	0.3	1.0	0.0	0.0	2.0	1.3	1.3	0.0
July	23.0	3.3	0.3	20.6	25.5	1.3	1.4	30.4	24.3	1.3	0.3	42.0	16.7	6.2	1.7	31.6	14.4	8.4	1.9	12.4	10.1	5.4	10.9	12.4
August	11.3	0.6	0.0	20.0	21.7	2.3	0.0	28.4	13.3	0.7	0.0	20.7	13.7	5.3	6.0	32.0	14.3	6.7	6.6	61.4	14.3	12.3	4.0	64.4
September	15.1	6.0	0.0	9.3	23.0	4.6	0.0	21.6	16.0	7.3	0.0	25.7	20.1	3.7	9.4	13.7	25.3	10.4	4.6	22.3	21.0	6.7	10.6	17.3
October	3.4	1.4	0.0	1.0	3.0	6.3	0.0	0.7	4.7	4.7	0.0	1.3	6.0	0.6	5.7	4.7	8.7	0.0	5.4	8.6	10.4	2.6	12.7	10.0
Total	52.8	15.6	1.3	51.9	77.9	15.1	2.4	83.1	61.6	15.0	5.9	92.4	57.1	18.2	23.5	82.0	63.0	26.5	18.5	104.7	57.8	28.3	39.5	104.1
Mean	10.6	3.1	0.3	10.4	15.6	3.02	0.5	16.6	12.3	3.0	1.2	18.5	11.4	3.6	4.7	16.4	12.6	5.3	3.7	20.9	11.6	5.7	7.9	20.8

J.: Jassid; Wh.: Whitefly; Th.: Thrips; L.: Lygus

F values at 0.05 level for: 1- Jassid =1.01 (N.S), 2-Whitefly =0.86 (N.S) ,3-Thrips =6.98* and L.S.D$_{0.05}$=3.36, 4-Lygus =0.59 (N.S)

Table (7): Field evaluation of certain non-chemical materials against sucking pests on roselle plants (Sabahia 17 variety) during the third season of 1999.

Treatment		% Reduction*															
		Empoasca spp.				*Lygus spp.*				Oxycarenus hyalinipennis				Bemisia tabaci			
	Rate/	Pre	Post treatment			Pre	Post treatment			Pre	Post treatment			Pre	Post treatment		
	Feddan	treat.	3	7	10	treat.	3	7	10	treat.	3	7	10	treat.	3	7	10
Soft soap	300 ml	(5.3)	55.6	54.3	56.6	(5.3)	92.9	73.0	49.5	(31.3)	78.4	87.7	65.2	(1.2)	33.3	13.3	48.7
Capel 2	2 L.	(3.7)	-27.2	-86.7	60.5	(5.0)	64.7	37.8	14.4	(6.7)	56.1	52.6	56.1	(1.8)	-240.7	-33.3	-55.6
Capel 2	3 L.	(5.0)	-17.7	20.0	46.0	(2.0)	65.2	-77.2	-52.4	(6.3)	86.0	84.7	100.0	(0.2)	-566.7	-500.0	-146.2
Beauveria bassiana	300 ml	(4.3)	7.0	-4.3	76.7	(3.0)	51.9	17.1	34.0	(5.0)	-117.7	-59.6	-76.5	(1.2)	-11.1	-200.0	59.0
Verticillium lecanii	1.25 kg	(3.7)	55.5	11.6	64.9	(1.7)	27.6	-9.7	-47.9	(6.7)	25.4	28.2	42.9	(2.0)	-326.7	68.0	69.2
Check	-	(4.0)	(1.7)	(3.3)	(4.0)	(2.3)	(4.3)	(3.7)	(4.3)	(5.0)	(1.7)	(5.2)	(1.7)	(0.8)	(0.3)	(1.0)	(1.3)

*** The values for pretreatment and the check in parentheses are average number of individuals/plant.**