Population Densities of the Plum scale Insect, *Parlatoria oleae* (Colvee) (Hemiptera: Diaspididae) in relation to the Resultant yield of Mango Fruits

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Abstract— *The main objective of this work is to evaluate the relationship between the pest population, Parlatoria oleae (Colvee), through pest activity peaks in October/November; April and July on the yield loss of seedy Balady mango trees at Esna district, Luxor Governorate, Egypt through two seasons (2016/2017 and 2017/2018). Data revealed that the increment of population density caused gradual decrease of the yield of mango fruits, consequently increased the percentage of yield loss when the data of the yield were colligated with the pest population peaks in October/November; April and July months through 2016/2017 and 2017/2018 seasons. Increasing one individual of pest per leaf caused a reduction of the mango yield by 2.53, 2.51 and 4.59 kg/tree and 2.25, 2.19 and 2.88 kg/tree through the periods of population abundance of the two seasons, respectively. Accordingly, increased yield loss percentages by 1.05, 1.04 and 1.90% and 0.87, 0.84 and 1.10% occurred during the mentioned periods of the two consecutive seasons (2016/2017 and 2017/2018), respectively. These results confirmed that P. oleae population during the peak of April resulted the least expected amount of mango fruits yield and the greatest loss in mango yield. On contrary, the peak during July was less effective, causing the highest expected yield and the lowest reduction in mango fruits yield of the two seasons.*
Generally, the reduction in yield of mango fruits is known to be a summation of many factors including the rate of infestation, time of infestation and variety ability to infestation.

Keywords— *Parlatoria oleae, pest population, mango yield and reduction.*

I.   INTRODUCTION

Mango fruits, *Mangier indica* L. (Anacardiaceae) are considered of the most popular in Egypt. Egyptian mango occupied economic importance in the world market for rich flavor and tasty. Mango trees are liable for infestation by several pests. Among which *P. oleae* is considered one of the main destructive pests **(Bakr *et al*., 2009)**. This armored scale species injures the shoots, twigs, leaves, branches and fruits by sucking the plant sap with its mouth parts, causing thereafter deformations, defoliation, drying up of young twigs, dieback, poor blossoming, death of twig by the action of the toxic saliva and so affecting the commercial value of fruits where it causes conspicuous pink blemishes around the feeding sites of the scales. A characteristic symptom of infestation by this pest species is the visible accumulations of scales on the attacked mango parts **(El-Amir, 2002 and Hassan *et al*., 2009)**.

The target of this study was to find out the relationship between *P. oleae* population density during three peaks of its seasonal activity (independent factors) on percentage of mango yield loss (dependent factor) during two seasons (2016/2017 and 2017/2018).

II.   MATERIALS AND METHODS

This investigation was carried out on mango trees in a private orchard situated at Esna, Luxor Governorate during the period from September, 2016 until mid of August, 2018., to clarify the effect of the rate of infestation by *P. oleae* on the yield of seedy Balady mango variety.

The samples consisted of twenty seedy Balady mango trees (ten almost uninfested and ten severely infested. Trees representing each group were chosen to be of homogeneous infestation rate as far as possible. These trees were of the same age (about twelve years old) and of almost, the same size, shape, height and vegetative growth. All trees in this orchard received the normal agricultural practices, except for being free from any chemical treatment, before and during the period of investigation. Regular bimonthly samples consisted of 20 leaves, were randomly chosen per tree representing the four directions and heights of mango trees. Samples were picked regularly and placed in polyethylene bags and immediately transferred to the laboratory where the leaves of each sample were throughly inspected using a

binocular microscope. Numbers of alive *P. oleae* individuals on upper and lower surfaces of mango leaves were counted and recorded. The monthly mean counts of *P. oleae* scales per leaf was considered in this study to express the population size of pest. The yield of each uninfested and severely infested mango trees was assessed.

Simple regression was used to elucidate the variability of yield loss that could be mostly caused by the pest during the three peaks of seasonal activity. Partial regression was used to find out the simultaneous effects of insect activity peaks in October, November, April and July on mango yield. The equation of linear regression was calculated according to the following formula of **Fisher (1950)** and **Hosny *et al.* (1972)**:

$$Y = a \pm bx$$

Where:

Y = Prediction value (Dependent variable)

a = Constant (y - intercept)

b = Regression coefficient

x = Independent variable

This method was helpful in obtaining basic information about the amount of variability in the yield that could be attributed to these peaks of activity, together, which was calculated as percentage of explained variance (E.V.%). The partial regression values indicate the average rate of change in yield due to a unit change in any of the three peaks of insect activity. Statistical analysis in the present work was carried out by **MSTATC Program, 1980.** All figures were done by Microsoft Excel 2010.

The amount of yield losses and damage due to scale insect were calculated according to the following equation:

$$\%\text{Yield loss} = \frac{A - B}{A} \times 100$$

Which:

A = Yield from uninfested trees

B = Yield from infested trees.

* Average of yield from mango uninfested trees were 198 and 210 kg/tree during the first and the second seasons of this study, respectively.

III.   RESULTS AND DISCUSSION

A- Seasonal activity of *P. oleae* on mango trees:

The half-monthly counts of alive stages of *P. oleae* that infested seedy Balady mango trees by pest at the region of study were recorded during the seasons of 2016/2017 and 2017/2018. Accordingly, it's better to discuss the peaks of seasonal abundance on basis of the monthly mean numbers for every season.

As shown in Table (1), three peaks of total population abundance of *P. oleae* on mango trees, at the region of study, occurred during October, April and July, as the general means of population density were 151.39, 106.46 and 136.59 individuals/leaf in the first season, and were 154.73, 131.46 and 147.19 individuals/leaf during November, April and July in the second season, respectively. The first peak of the pest in October for the first season and November during the second season was the highest, compared to the two other peaks, but the peak of April was the lowest in the two seasons. Also, the peaks of the total population means of the pest through the second season were higher than those recorded in the first season, that might be the attributed to more favorable environmental conditions that occurred during the second season.

B- Relationship between yield and the pest population of *P. oleae*:

Data in Table (1) and illustrated in Figs. (1 and 2) revealed that the mango (seedy Balady variety) yield decreased gradually with the increase of *P. oleae* total population density during the three peaks of seasonal activity in the two seasons. These results confirmed the reciprocal relation between mango yield and the total population density in the three peaks of insect activity during both seasons. However, in the same Table (1), the relationship between the percentages of reduction in mango yield (dependent variable) and the population density of *P. oleae* per leaf of mango as independent factors was positive relations in all peaks of seasonal activities during the two seasons (2016/2017 and 2017/2018). An increase of the percentages of reduction of yield occurred with increasing of the total population density in all peaks during the both seasons (Table, 1 and Figs., 1 and 2).

C- Effect of the total population density of *P. oleae* on the yield:

Statistical analysis of data in Table (2) revealed a highly significant negative correlation between the mango yield and the three peaks of the pest population which were -0.92, -0.96 and -0.96; and -0.96, -0.94 and -0.91 during October or November; April and June peaks during each of the two seasons, respectively. The regression coefficient (b) of the unit effect indicated that an increase of one insect per leaf would decrease the yield of mangos by 2.53, 2.51 and 4.59 kg. per tree through the first season and 2.25, 2.19 and 2.88 kg. per tree during the second season, respectively.

The exact relationship between the peaks of insects abundance and the yield of mango was determined by the partial regression coefficient values (Table, 2). It was insignificantly positive during the peak of October in the first season (P. reg. was +1.13), and negatively insignificant (P. reg. was -0.91) during the peak of November in the second season. While, this relation was insignificant negative (P. reg.; -1.81 and -0.91) during the

peaks of April in the two seasons. However, it was insignificantly negative (P. reg. was -3.32) in the first season and insignificantly positive (P. reg. was +1.97) in the second season when statistical analysis was calculated for the peak of July in relation to *P. oleae* population density through the two successive seasons. Likewise, the partial correlations were + 0.47, - 0.70 and -0.70 during the peaks of October, April and July in the first season and it -0.63, -0.31 and 0.44 through the peaks of November, April and July, respectively in the second season,. The calculated partial regression values indicated simultaneous effects of the three peaks of insect population on the mango yield during the two seasons.

The obtained results showed that the combined effect of the pest activity peaks on the mango yield was highly significant where the "F" values were 49.62 and 27.46 during the 1st and 2nd seasons, respectively (Table 2). The amount of the variability that could be attributed to the combined effect of these peaks on the mango yield was expressed as explained variance percentage (E.V.%), which was 96.13 and 93.21% during the two seasons, respectively. The remaining unexplained variances are assumed to be due to other undetermined factor influences.

These findings are in harmony with those reported by **Hernandez *et al.* (2002)** who found a positive correlation between fruit infestation and yield loss at harvest among consecutive seasons, when they studied the relationship between the population densities of *Aonidiella aurantii* (Mask.) in relation to the yield of citrus trees.

D- Prediction of mango yield and its loss:

Prediction equations for yield of mango and its losses by the action of *P. oleae* infestation were concluded according to the statistical analysis between the two accumulated seasons data. Results of calculations may be presented as follows:

1- The total population density of *P. oleae* during the three peaks versus the yield of mango:

$$Y= 526.26^{**} – 3.47 \ X_1^{**} + 0.37 \ X_2 + 1.16 \ X_3;$$
$$E.V.\% = 86.05\%$$

2- The total population density of *P. oleae* during the three peaks versus the percentages of reduction in mango yield:

$$Y= – 102.24^{**} + 1.10 \ X_1^{**} + 0.12 \ X_2 – 0.43X_3;$$
$$E.V.\% = 87.24\%$$

Where: Y= Prediction value

E.V.% = Explained variance

X_1= Means of peak in October / November altogether

X_2= Means of peak in April

X_3= Means of peak in July

* Significant at P ≤ 0.05

** Highly significant at P ≤ 0.01

The aforementioned results on the effect of the three peaks of the pest population peaks of abundance on the yield of mango and its losses during the two successive seasons emphasize that the effect of these factors varied from season to another. This might be due to many factors *i.e.* environmental conditions, rate of infestation, time of infestation and variety ability to infestation.

E- The calculated yield:

The simple linear regression equations were applied to estimate the expected yield of mango Results in Table (3) indicated that the heaviest weight of yield (225 and 240 kg. per tree) was recorded at the lowest values of total density of population of *P. oleae* in all peaks of seasonal activity through the two seasons. While, the minimum yield (168 and 180 kg. per tree) was estimated with the highest values of the total population density of *P. oleae* in the three peaks of activity during the two seasons, respectively (negative correlation).

These results are similar to those obtained by **Mohamed and Asfoor (2004),** in Egypt, the anthors studied the effect of the California red scale, *A. aurantii* infestation on the citrus yield loss and found that the reduction in Valencia orange was higher than that of Navel. They estimated the damage caused as 31.14 and 27.15% reduction in the yield, respectively.

F- The calculated reduction in yield:

The simple linear regression equations were used to determine the expected reduction in yield of mango. Data are presented in Table (4). These data showed that the least loss percentage in yield (6.56 and 7.62%) were recorded with the lowest rates of *P. oleae* population densities in all periods of seasonal abundance during the two seasons. While, the highest loss percentages in yield (30.23 and 30.72%) occurred with the highest values of the total population density by *P. oleae* in the three peaks of the seasonal activity during the two seasons, respectively (positive relation).

These results agree with those obtained by **Salman and Bakry (2012)** in Egypt, they found that the increase in population density of the mealybug, *Icerya seychellarum* decreased the yield by 3.6, 6.5 and 4.3 kg/tree and 2.5, 4.1 and 2.3 kg/tree. Thus confirming the negative relationship between the pest population density and the resultant yield of mango during two successive season, respectively. the same authors found, also, that the percentage of the yield loss by 1.47, 2.64 and 1.77 % and 1.47, 1.97 and 1.08 % occurred when the yield data were correlated with the peaks of insect population in October, May and August, respectively through the two successive seasons. Also, **Bakry and Mohamed (2015)** mentioned that the increase in population density of *A. aurantii* in the four peaks of the pest population decreased the mango yield gradually by 1.37, 1.47, 4.25 and 1.77 kg/tree and 1.45, 1.53, 4.66 and 1.85 kg/tree during two

successive seasons, respectively and increased the percentage of the yield loss by 0.55, 0.59, 1.70 and 0.71 % and 0.60, 0.63, 1.90 and 0.76 %; when the mango yield data were linked with the periods of population abundance in October, December, April and July through two successive seasons, 2016-2017 and 2017-2018, respectively.

G- Expected values in the yield and its loss with increasing the pest population:

Concerning, the comparison between the peaks of the pest population of *P. oleae* and their effect on the yield of mango during the two successive seasons (2016/2017 and 2017/2018), was depending on the total number of the pest per leaf for all periods of population abundance (Table, 5).

The results revealed that the total population density of pest in peak of April was more effective causing the lowest expected values in mango yield with averages of 258.08 and 316.62 kg/tree through the two successive seasons, respectively. While, the peak of total population in July was the least effective causing the highest expected values in mango yield with averages of 446.04 and 395.88 kg/tree during the two successive seasons, respectively (Table, 5).

As regarding, the prospective values with (increase or decrease) in the percentage of yield loss with increasing the infestation rates by *P. oleae* during the two successive seasons (Table, 5). The results showed that the total population density during July peak was least effective causing the least percentages of reduction in mango yield with an average of -85.24 and -52.38% during the two successive seasons, respectively. But, the pest population was more effective during April peak causing the greatest loss in mango yield with an average of -7.17 and -21.87% during the two successive seasons, respectively.

Generally, it seems that the population density of *P. oleae* during April peak was the most serious one, during the two seasons, causing the greatest loss in mango yield which that coincided with the newly spring growth cycle for the vegetative growth of mango trees. These results are accordance with the findings of **El-said (2006)** who found that the high infestation levels by *Icerya seycellarum* and the feeding of this pest species caused a serious damage resulting in early leaves drop and mango yield reduction. **Bakry (2009)** reported that the early season infestation with the Maskell scale insect, *Insulaspis pallidula* during May was more effective than other months causing the greatest loss in mango yield. Also, **Salman and Bakry (2012)** stated that the early infestation with the mealybug, *Icerya Seychellarum* during May was more effective than other months causing the greatest loss in mango yield. **Bakry and Mohamed (2015)** reported that the infestation by *Aonidiella aurantii* (Mask.) (during April was more effective than other time causing the greatest loss in mango yield.

Generally, it could be concluded that the reduction in mango fruits is known to be a summation of many factors including the rate of infestation, time of infestation and variety ability to infestation. These results are similar to those obtained by **Reddy-Seshu (1992)** who found a linear relationship between infestation rate and yield loss, and more increasing in yield loss occurred as a result of the earlier infestation. **Also, Selim (2002)** studied the effect of Maskell scale insect, *Insulaspis pallidula* (Green) infestation on the yield of mango trees. He stated that the yield decreased gradually with increasing the population density of this pest. The same author added that the yield decreased gradually with increasing the population density of *I. pallidula* (Green) in four peaks (September, April, July and August).

Table.1: Effect of infestation by P. oleae total population on the yield of seedy Balady mango variety during three peaks of the seasonal activity of the pest during the two seasons (2016/2017 and 2017/2018).

Season	Inspected trees	Yield (kg)	Yield reduction (%)	Peaks of *P. oleae* total population			Average of population density
				Oct./Nov.	April	July	
2016/2017	1	225.0	6.56	136.30	93.44	129.79	119.84
	2	224.0	6.98	145.94	99.63	133.28	126.28
	3	210.0	12.79	148.36	102.42	133.48	128.09
	4	208.0	13.62	151.39	104.33	134.97	130.23
	5	196.0	18.60	151.39	106.46	136.29	131.38
	6	195.0	19.02	151.52	106.46	136.97	131.65

	7	192.0	20.27	154.82	110.24	137.39	134.15
	8	182.0	24.42	156.42	110.80	139.66	135.62
	9	180.0	25.25	158.13	111.08	142.04	137.08
	10	168.0	30.23	159.60	119.73	142.09	140.47
	Average	**198.0**	**17.77**	**151.39**	**106.46**	**136.59**	**131.48**
2017/2018	1	240.0	7.62	139.06	114.94	133.32	129.11
	2	234.0	9.93	146.31	122.89	143.66	137.62
	3	225.0	13.39	150.31	126.26	144.36	140.31
	4	224.0	13.78	151.63	128.83	146.06	142.18
	5	210.0	19.17	154.73	131.46	146.44	144.21
	6	210.0	19.17	154.73	131.46	146.49	144.23
	7	196.0	24.56	156.20	136.60	149.48	147.43
	8	195.0	24.94	158.76	136.97	149.48	148.40
	9	182.0	29.95	164.77	137.15	154.00	151.98
	10	180.0	30.72	170.78	148.05	158.60	159.14
	Average	**210.0**	**19.32**	**154.73**	**131.46**	**147.19**	**144.46**

Average of yield from mango uninfested trees were 198 and 210 kg/tree during the first and the second seasons of this study, respectively.

Table.2: Different correlation models and regression analyses for describing the relationship between P. oleae population density and the mango yield during the two seasons (2016/2017 and 2017/2018).

Season	Tested counts	Simple correlation and regression values				Partial correlation and regression values				Analysis variance			
		r	b	S.E	t-test	P. cor.	P. reg.	S.E	t-test	F values	MR	R²	E.V.%
2016 / 2017	Average no. of individuals/leaf (Oct.)	- 0.92	-2.53	0.39	-6.48 **	0.47	1.13	0.87	1.29	49.62 **	0.98	0.96	96.13
	Average no. of individuals/leaf (April)	-0.96	-2.51	0.25	-9.92 **	-0.70	-1.81	0.76	-2.39				
	Average no. of individuals/leaf (July)	-0.96	-4.59	0.46	-9.88 **	-0.70	-3.32	1.39	-2.38				
2017 / 2018	Average no. of individuals/leaf (Nov.)	-0.96	-2.25	0.24	-9.24 **	-0.63	-2.79	1.44	-1.94	27.46 **	0.97	0.93	93.21
	Average no. of individuals/leaf (April)	-0.94	-2.19	0.27	-8.02 **	-0.31	-0.91	1.17	-0.77				
	Average no. of individuals/leaf (July)	-0.91	-2.88	0.45	-6.34 **	0.44	1.97	1.68	1.17				

r = Simple correlation; P. cor. = Partial correlation; MR = Multiple correlation; b = Simple regression; P. reg. = Partial regression; R² = Coefficient of determination; E.V% = Explained variance; S.E = Standard error; * Significant at P ≤ 0.05 and ** Highly significant at P ≤ 0.01.

Table.3: Gradual decrease in mango fruits yield in relation to population density increase of P. oleae total population of during three peaks of insects abundance during the two successive seasons.

Season	Inspected trees	Yield (kg)	Oct. / Nov. infestation		April infestation		July infestation		Means of	
			No. of insects / leaf	Expected yield	No. of insects / leaf	Expected yield	No. of insects / leaf	Expected yield	No. of insects / leaf	Expected yield
2016/2017	1	**225**	136.3	**236.2**	93.4	**230.6**	129.8	**229.2**	119.8	**233.6**
	2	**224**	145.9	**211.8**	99.6	**215.1**	133.3	**213.2**	126.3	**213.9**
	3	**210**	148.4	**205.7**	102.4	**208.1**	133.5	**212.3**	128.1	**208.4**
	4	**208**	151.4	**198.0**	104.3	**203.3**	135.0	**205.4**	130.2	**201.8**
	5	**196**	151.4	**198.0**	106.5	**198.0**	136.3	**199.4**	131.4	**198.3**
	6	**195**	151.5	**197.7**	106.5	**198.0**	137.0	**196.3**	131.6	**197.5**
	7	**192**	154.8	**189.3**	110.2	**188.5**	137.4	**194.4**	134.1	**189.8**
	8	**182**	156.4	**185.3**	110.8	**187.1**	139.7	**183.9**	135.6	**185.3**
	9	**180**	158.1	**180.9**	111.1	**186.4**	142.0	**173.0**	137.1	**180.8**
	10	**168**	159.6	**177.2**	119.7	**164.7**	142.1	**172.8**	140.5	**170.5**
2017/2018	1	**240**	139.1	**244.9**	114.9	**245.7**	133.3	**249.5**	129.1	**247.1**
	2	**234**	146.3	**228.5**	122.9	**228.3**	143.7	**219.8**	137.6	**226.3**
	3	**225**	150.3	**219.5**	126.3	**221.0**	144.4	**217.8**	140.3	**219.8**
	4	**224**	151.6	**216.6**	128.8	**215.3**	146.1	**212.8**	142.2	**215.2**
	5	**210**	154.7	**209.6**	131.5	**209.6**	146.4	**211.8**	144.2	**210.2**
	6	**210**	154.7	**209.6**	131.5	**209.6**	146.5	**211.6**	144.2	**210.2**
	7	**196**	156.2	**206.3**	136.6	**198.4**	149.5	**203.0**	147.4	**202.3**
	8	**195**	158.8	**200.5**	137.0	**197.6**	149.5	**203.0**	148.4	**200.0**
	9	**182**	164.8	**187.0**	137.2	**197.2**	154.0	**190.0**	152.0	**191.2**
	10	**180**	170.8	**173.5**	148.0	**173.4**	158.6	**176.7**	159.1	**173.7**

Table.4: Gradual increase in yield loss with the population density increase of the total population of P. oleae during three peaks of the seasonal activity during the two successive seasons.

Season	Inspected trees	% Yield reduction	Oct. / Nov. infestation		April infestation		July infestation		General average	
			No. of insects / leaf	% Calculated reduction	No. of insects / leaf	% Calculated reduction	No. of insects / leaf	% Calculated reduction	No. of insects / leaf	% Calculated reduction
2016/2017	**1**	**6.6**	136.3	**1.91**	93.4	**4.2**	129.8	**4.8**	119.8	**2.98**
	2	**7.0**	145.9	**12.06**	99.6	**10.7**	133.3	**11.5**	126.3	**11.17**
	3	**12.8**	148.4	**14.59**	102.4	**13.6**	133.5	**11.8**	128.1	**13.46**
	4	**13.6**	151.4	**17.78**	104.3	**15.6**	135.0	**14.7**	130.2	**16.19**
	5	**18.6**	151.4	**17.78**	106.5	**17.8**	136.3	**17.2**	131.4	**17.65**
	6	**19.0**	151.5	**17.92**	106.5	**17.8**	137.0	**18.5**	131.6	**17.99**

	7	**20.3**	154.8	**21.39**	110.2	**21.7**	137.4	**19.3**	134.1	**21.17**
	8	**24.4**	156.4	**23.06**	110.8	**22.3**	139.7	**23.6**	135.6	**23.05**
	9	**25.2**	158.1	**24.87**	111.1	**22.6**	142.0	**28.1**	137.1	**24.90**
	10	**30.2**	159.6	**26.41**	119.7	**31.6**	142.1	**28.2**	140.5	**29.22**
2017/2018	1	**7.62**	139.1	**5.75**	114.9	**5.4**	133.3	**4.0**	129.1	**4.9**
	2	**9.93**	146.3	**12.0**	122.9	**12.1**	143.7	**15.4**	137.6	**12.9**
	3	**13.39**	150.3	**15.5**	126.3	**14.9**	144.4	**16.2**	140.3	**15.4**
	4	**13.78**	151.6	**16.6**	128.8	**17.1**	146.1	**18.1**	142.2	**17.2**
	5	**19.17**	154.7	**19.3**	131.5	**19.3**	146.4	**18.5**	144.2	**19.1**
	6	**19.17**	154.7	**19.3**	131.5	**19.3**	146.5	**18.5**	144.2	**19.1**
	7	**24.56**	156.2	**20.6**	136.6	**23.6**	149.5	**21.9**	147.4	**22.1**
	8	**24.94**	158.8	**22.8**	137.0	**24.0**	149.5	**21.9**	148.4	**23.0**
	9	**29.95**	164.8	**28.0**	137.2	**24.1**	154.0	**26.9**	152.0	**26.4**
	10	**30.72**	170.8	**33.2**	148.0	**33.3**	158.6	**32.0**	159.1	**33.1**

Table.5: Expected values (increase or decrease) in the yield and its loss with increasing the population density of P. oleae during three peaks of the seasonal activity during 2016/2017 and 2017/2018 seasons.

| Season	No. of insects / leaf	Calculated yield			% Yield reduction		
		Oct. / Nov. peak	April peak	July peak	Oct. / Nov. peak	April peak	July peak
2016/2017	15	543.28	427.35	755.56	-125.62	-77.47	-213.78
	30	505.31	389.73	686.78	-109.85	-61.85	-185.21
	45	467.33	352.12	617.99	-94.08	-46.23	-156.65
	60	429.36	314.50	549.21	-78.31	-30.61	-128.08
	75	391.38	276.89	480.43	-62.54	-14.98	-99.52
	90	353.41	239.28	411.65	-46.76	0.64	-70.95
	105	315.43	201.66	342.86	-30.99	16.26	-42.39
	120	277.46	164.05	274.08	-15.22	31.88	-13.82
	135	239.48	126.43	205.30	0.55	47.50	14.74
	150	201.51	88.82	136.52	16.32	63.12	43.31
Mean	**82.50**	**372.39**	**258.08**	**446.04**	**-54.65**	**-7.17**	**-85.24**
2017/2018	15	524.02	464.15	590.26	-101.70	-78.66	-127.19
	30	490.26	431.37	547.06	-88.71	-66.04	-110.57
	45	456.51	398.58	503.87	-75.72	-53.42	-93.94
	60	422.76	365.80	460.67	-62.72	-40.80	-77.32
	75	389.01	333.01	417.48	-49.73	-28.18	-60.69
	90	355.25	300.23	374.29	-36.74	-15.56	-44.06
	105	321.50	267.44	331.09	-23.75	-2.94	-27.44
	120	287.75	234.66	287.90	-10.76	9.68	-10.81
	135	253.99	201.87	244.70	2.23	22.30	5.81
	150	220.24	169.09	201.51	15.23	34.92	22.44
Mean	**82.50**	**372.13**	**316.62**	**395.88**	**-43.24**	**-21.87**	**-52.38**
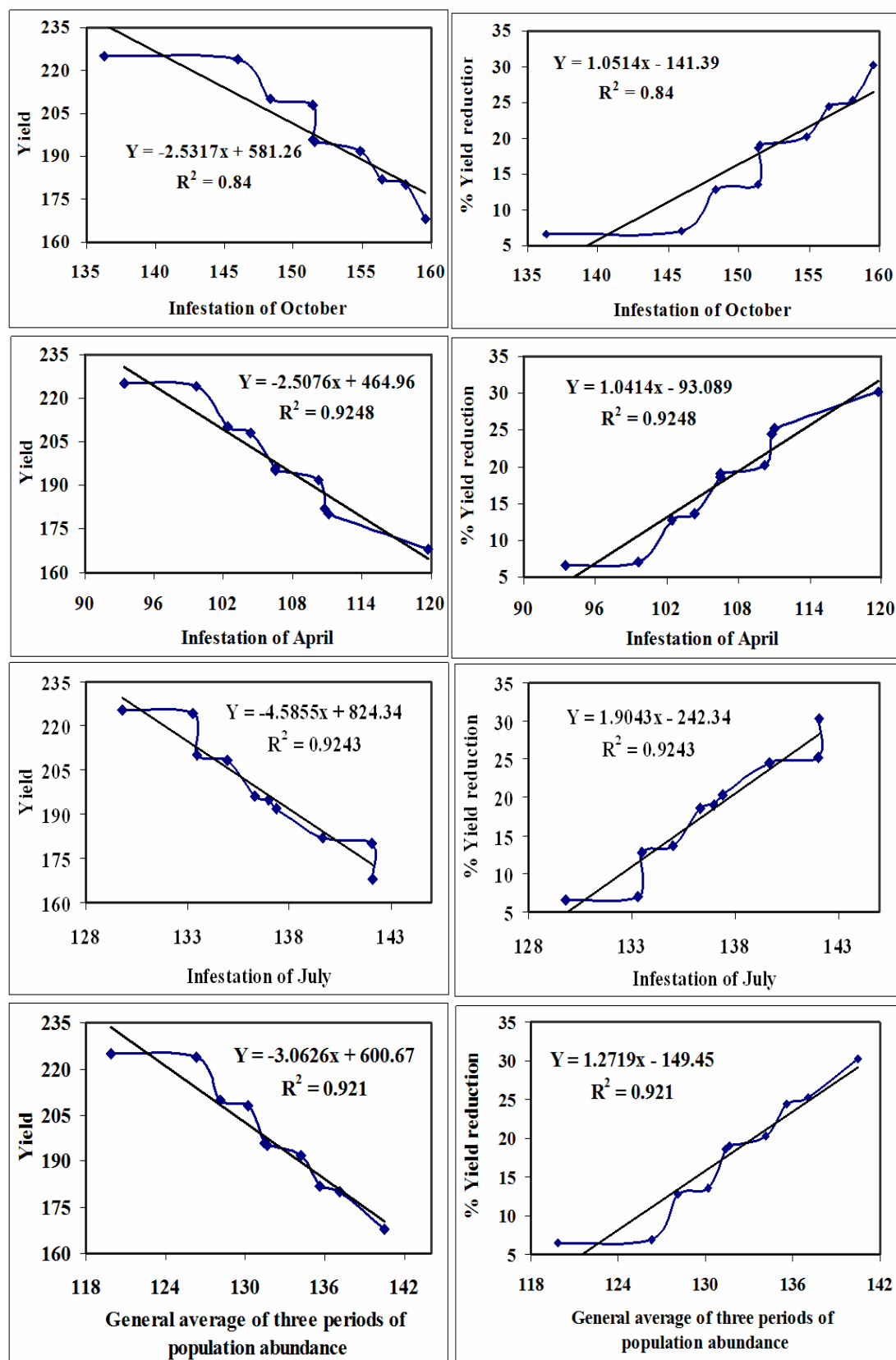
Fig.1: Relationship between the total population of P. oleae and mango yield (seedy Balady variety) and yield reduction during the first season (2016/2017).
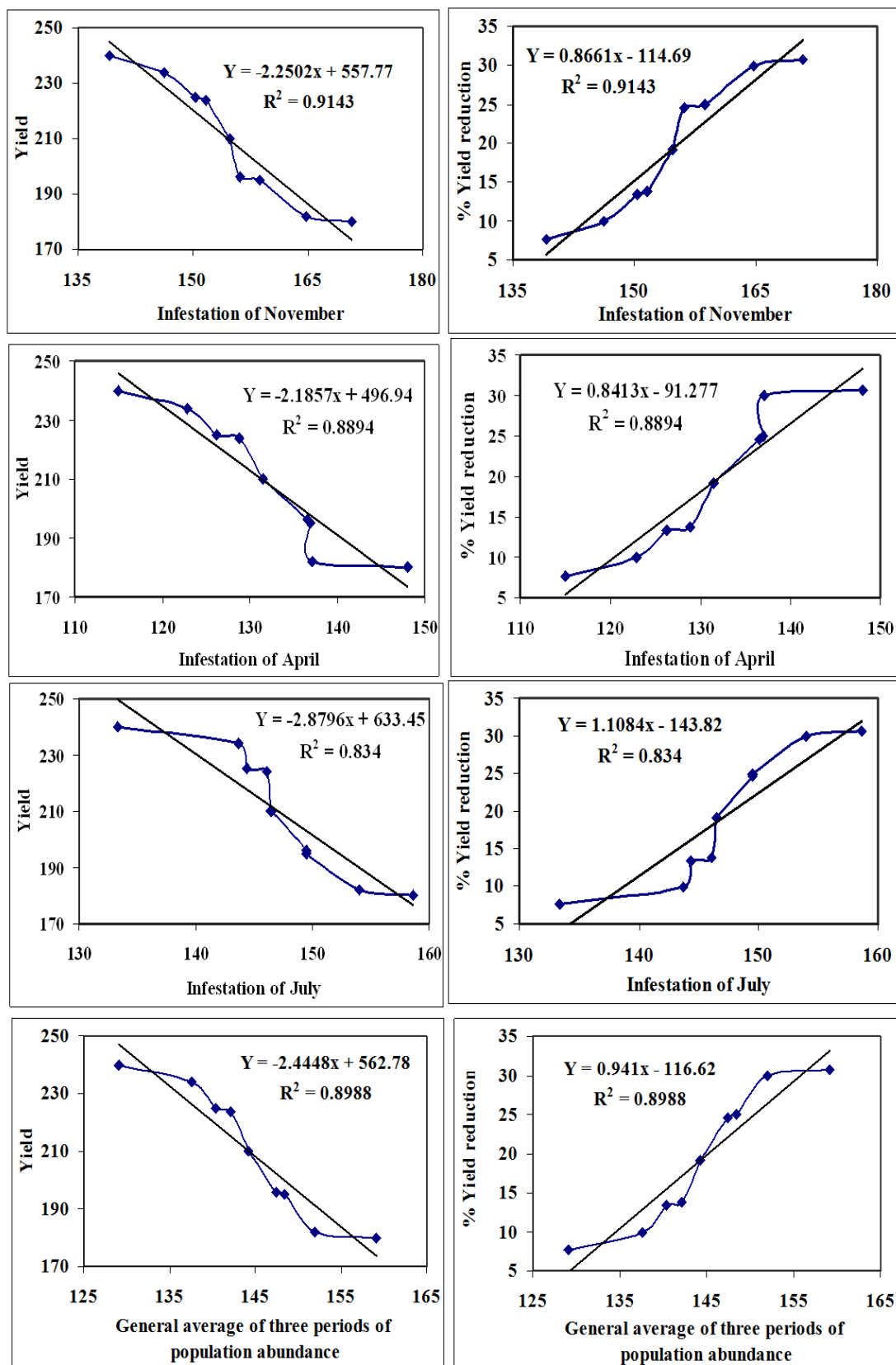
Fig.2: Relationship between population abundance of P. oleae and mango yield (seedy Balady variety) and its reduction during the second season (2017/2018).
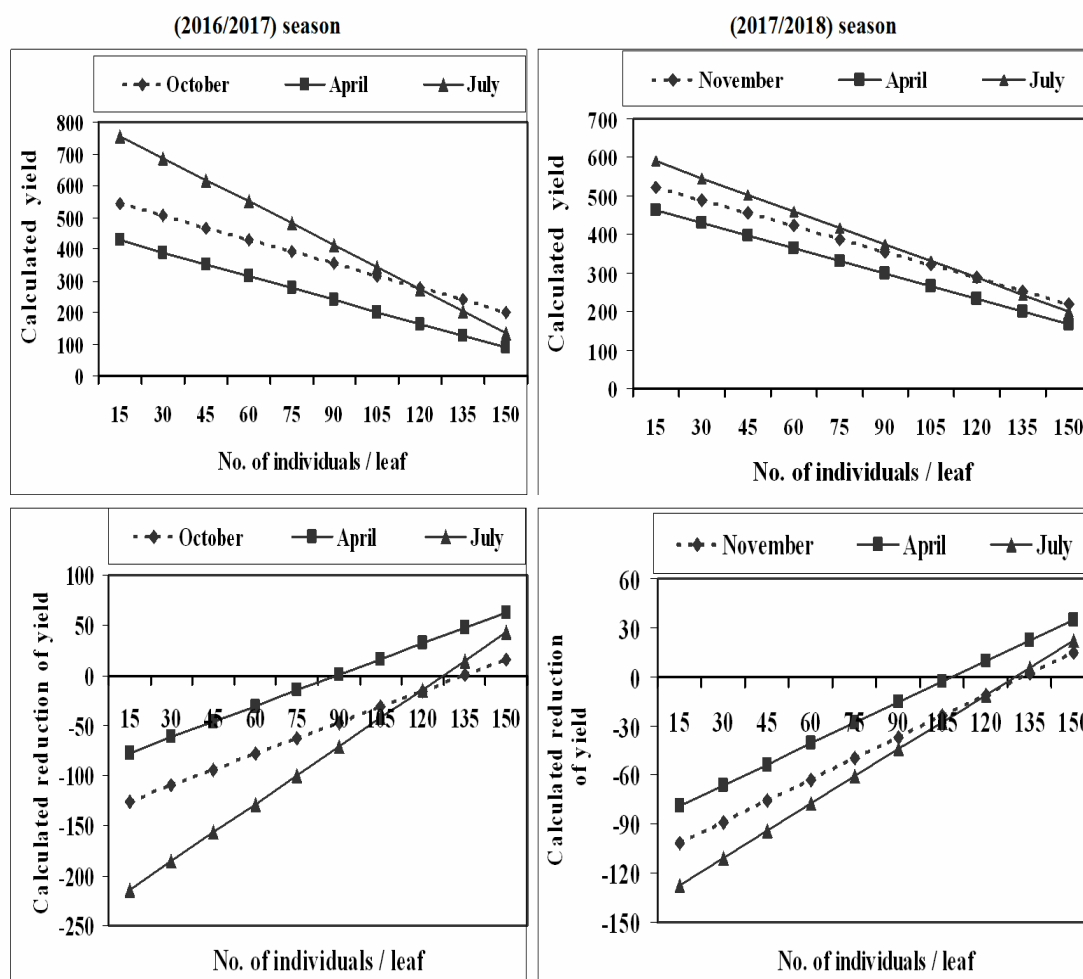
Fig.3: Expected values (increase or decrease) in mango yield fruits and its loss with increasing of population density by P. oleae during three peaks of abundance during the two seasons (2016/2017 and 2017/2018).

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