

Survey of insect pests infected Navelorange trees, population dynamic of some dominant insects and effect of cultivation and intercropping on population density

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ABSTRACT

This research was carried out on navel orange (Washington variety) located at Sharkia Governorate in Abo-Hammad and Belbis centeries during 2015 & 2016 seasons, to study survey the insect pests infested navel orange by using plant sampling and sweeping net, population dynamics of such dominant insech and relation to some meterolgical climate factors and effect of some Agricultural operations such as cultivation, non-cultivation and intercropping and non-intercropping on dominant insect i.e purple scale, cotton aphid and CLM, insect. The surveyed insects, revealed 20 species belonging to 17 genera, 14 species from Homoptera, 1 species from Lepidoptera, 2 species from Diptera and 3 species from Cleoptera. The dominant and high density of the surveyed insect species (purple scale insect, cotton aphid and CLM) were studied in details. Purple scale *Lepidosaphes beckii* have three peaks of generations were recorded per year. Three peaks of infestation were recorded in early May or late April, early or mid September and mid November in both seasons of studied. The relationships between the population density of insect stages and weather factors temperature and relative humidity were studied and found positive correlations between mean of temperature and insect population. While, *A. gossypii* on navel orange trees showed three peaks of population density. The first one occurred at the four week of November. The second peak was recorded at the four week of March for both seasons. The third peak was recorded at the four week of June (2014) and the two week of July (2015) on navel orange trees. The obtained results appeared that negative significant correlation between population density of *A. gossypii* and mean temperature in both seasons. The effect of relative humidity was positive and insignificant in the two seasons. CLM (*Phyllocnistis citrella*) infested navel orange and navel orange was the most preferable host, where it was infested throughout the year, with the highest population density of the pest during the period from March to December, coinciding with the appearance of different flushes. The abundance of pest population showed 7 peaks in the season. A positive high significant correlation was obtained between mean temperature, and pest population on navel orange in both seasons. Concerning the effect of cultivation and (purple scale insect, cotton aphid and CLM). It obviously the cultivation operation significant decrease the population density of dominant insects while, non- cultivation significant increase the dominant insect in both seasons. As for, the effect of intercropping mandarin interfiller trees between navel orange trees significant increase density number of purple scale insect, cotton aphid and CLM as compared with navel orange trees non- intercropping decrease such dominant insects in both seasons.

Keywords: survey insect pests on navel orange tree- population fluctuation some dominant insect – Agricultural operations.

Introduction

Citrus is one of the most important fruit crop in Egypt which characterized with high nutritive value, health for the human specially children, in addition the exported citrus quantity and or local citrus consumption beside several industries of fruits or other parts of the tree, make the citrus first crop in Egypt. However, navel orange trees cultivated in Egypt and reached to 100676 fed. and the fruit production reached to 1663284 ton(Ministry of Agriculture Egypt 2016).

The orchard of citrus trees in Egypt infested with several insect pests a year round. The dominant insect pests were citrus leaf miner CLM, scale insects species, Mealy bugs and Aphids, beside the insects infested citrus fruits, *Ceratitis capitata* and *Bacterocera zonata* (Shahein *et al.* 2004; Abdel-Galil *et al.* 2010 Tawfeek 2012 and Draz *et al.* 2016). Many investigators. Worked in citrus trees orchards and studied population fluctuation for different insect pests infested citrus varieties (Swailem 1973; El-Nagar *et al.* 1983, 1985; Farag *et al.* 1990; El-Agoze *et al.* 1994;

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Hammad and Jasmin 2000; Kamel 2010; Ali, Nadia 2011; Draz *et al.*, 2011 and Mustafa Mona 2012; Ahmed *et al.*, 2013 and El-Maghraby , Shimaa (2016).

Some agricultural operation effected the total number of insects and infestation with this insects such as intercropping by some field vegetables and fruits trees (Kenney and Chapman 1988; Sohail Ahmed *et al.*, 2013 and Sadia Afri *et al.* 2017).

The present study was carried out on fruiting trees of navel orange variety cultivated at El-Sharkia Governorate during 2014 and 2015 seasons to investigate and determine some objective .

Survey the insect pests infested navel orange trees. Seasonal fluctuation of some dominant insects such as purple scale insect (*Lepidocephes beckii*), cotton aphid (*Aphis gossypii*) and CLM insect (*Phyllocnistis citrella*) and its relation to some atmospheric factors, temperature and relative humidity.

Effect of some Agricultural operations such as cultivation and non cultivation, Intercropping on some insects dominant infested navel orange trees.

Material and Methods

This research was carried out on fruiting navel orange trees (Washington variety) located at Abo-Hammad and Belbis centieries Sharkia Governorate during 2014 and 2015, seasons. The selected trees cited in the orchards of Egyptian Agricultural company 2800 fed. and Ramsis Agricultural company 7000 Fd. The selected navel orange trees were gravited on sour orange, root- stock surrounded with different species and varieties of citrus. The age of such trees (18-20 years) as the starting of research, healthy and take the same vigour and size, received all agricultural management except pesticides control. The study was divided in three parts.

1. Survey of insect pests infested the selected navel orange trees in both season by using:

Plant samples, for this purpose, 5 fed. were selected from navel orange, one fed. was chosen for different samples, and 10 trees located (cited) on different directions and central orchard, the trees cultivated 5x6 meter apart. The samples size consists of 50 leaves taken from trees of different tree directions at 15 days intervals for insect population dynamics and survey study. The starting of samples began in early spring flush (early march) up to end of February, for both seasons.

Sweeping net:

A sweeping net (35 cm diameter and 60 cm. deep) was used and each sample consisted of 100 double strokes taken randomly. The samples were replicated 4 times in the orchard during the investigated seasons 2014 and 2015.

Fruit samples:

Twenty five fruits on trees or those dropping on the soil orchard up to ripping of the fruits to survey insect infested fruits.

The atmospheric data of the experimental area such as temperature °C and relative humidity RH% were recorded at every two weeks intervals, and simple correlation and regression in relation to insect population were studied. The obtained data were subjected to analysis by using Snedecor (1970).

The effect of cultivation and non- cultivation and beside the effect of intercropping management in navel orange orchard on density number of dominant insects (purple scale insect, cotton aphid and CLM) during both season of study, were studied.

For this purpose about 60 trees navel orange were selected which the first area was non cultivated and cultivation only during winter Nov. management, while other area was cultivation six times during the year as clean cultivation management.

The effect of intercropping operation on density number of dominant insects. Two areas of navel orange trees were selected to study the effect of intercropping, the first area contain 90 navel orange trees mixed with 30 trees of mandarin together, while the other area contain 120 navel orange trees only.

Results and Discussion

In this research using plant sampling and sweeping net on the selected navel orange trees growing in Sharkia Governorate (Abo-Hammed and Belbis centeries) during 2014 and 2015 season. The obtained data were tabulated and arranged as follows:

A. Survey of insect pests infested navel orange trees:

The surveyed insects during this period revealed that the collected insects were identified some species belonging to 17 genera table (1), of these 14 species from Homoptera, one species from Lepidoptera, 2 species from Diptera and three species from Coleoptera. These order could be arranged descendingly according to their abundance during the whole period of study as follows: Hemiptera, Lepidoptera, Diptera and Coleoptera

1. Order Homoptera:

The surveyed species could be arranged descendingly according to total number during the whole period of study as follows: *Aphis gossypii*, *Bemisia tabaci*, *Emopasca decipiens*, *Empasca decadens*, *Cicadullina chinai*, *Sogatella furcifera*, *Sogatella vibix* and *Aphis citricolla*. Five armoured Scale insects and one citrus mealy bug, these were: *Lepidosaphes beckii*, *Aonidiella aurantii*, *Chrysomphalus anoidium*, *Parlatoria ziziphi*, *Ceroplastes floridensis* and *Planococcus citri*.

Table 1: List of insect pests infested navel orange trees in Sharkia Governorate during 2014/2015 seasons

Order	Family	Insect species	Leaf	Damage plant		
				Flower	Fruits	Wood
Homoptera	Aphididae	<i>Aphis gossypii</i> Glover	+++	++	-	-
		<i>Aphis citricolla</i> V. D. Goot	+	+	-	-
	Aleyrodidae	<i>Bemisia tabaci</i> (Genn.)	+++	++	-	-
	Cicadellidae	<i>Emopasca decipiens</i> paoli	+++	+	-	-
		<i>Emopasca decadens</i> paoli	+++	+	-	-
	Delphacidae	<i>Cicadullina chinai</i> (Ghour)	++	+	-	-
		<i>Sogatella vibix</i> (Haput.)	++	+	-	-
		<i>Sogatella furcifera</i> (Horv.)	++	+	-	-
	Diaspididae	<i>Lepidosaphes beckii</i> Newman	+++	-	+	-
		<i>Anidiella aurantii</i> (Maskell)	++	-	+	++
		<i>Chrysomphalus anidum</i> (L.)	++	-	+	++
Lepidoptera	Coccidae	<i>Parlatoria ziziphi</i> (Lucas)	+	-	-	++
	Pseudococcidae	<i>Ceroplastes floridensis</i> comstack	++	-	-	+
	Phyllocnistidae	<i>Planococcus citri</i> (Risso)	+++	-	++	
	Tephritidae	<i>Phyllocnistis citrella</i> Stainton	+++	-	+	+
Diptera	Coleoptera	<i>Ceratitis capitata</i> Wiedemann	-	-	+++	-
		<i>Bacterocera zonata</i> (Saunders)	-	-	++	-
		<i>Carpophilus hemipterus</i> L.	-	-	++	-
Coleoptera	Nitidulidae	<i>Carophilus dimidiatus</i> F.	-	-	++	-
	Scolytidae	<i>Scolytus</i> sp.	-	-	-	+

+ Low population ++mid population +++high population

2. Order Lepidoptera:

Lepidopterous insects were the second most abundant species in navel orange trees during the two successive seasons. Order Lepidoptera was represented by one species *Phyllocnistis citrella*.

3. Order Diptera:

Dipterous insects were the third abundant species navel orange plantation. It included two species belonging to two genera and one family Tephritidae of these *Ceratitis capitata* and *Bacterocera zonata*.

3. Order Coleoptera:

Order coleoptera was represented by three species belonging 2 genera and two families of these *Capophilus dimidiatus*, *Capophilus hemipterus* and *Scolytus* sp.

The surveyed species could be arranged according to total number during the whole period of study.

Many investigators working on citrus insects and reported that; Farag *et al.* (1990) working on some citrus varieties beside naval orange variety and 9 species were recorded belonging to order Homopera *L. beckii*, *A. aurantii*, *C. ficus*, *P. ziziphi*, *C. floridensis*, *I. purchasi*, *I. aegyptiae*, *P. citri* and *A. citri*.

In addition, Draz *et al.* (2011) who reported that *L. beckii* was dominant species on navel orange variety. From another point of view Mostafa Mona, (2012) and Tawfeek (2012) recorded 7 species from scale insects and mealy bugs including *A. aurantii*, *C. floridensis*, *C. aonidum*, *I. seychellarum*, *Lepidosaphes beckii*, *P. ziziphi* and *Planococceus citri*. However, Abo-Alnor, Fatma *et al.*, (2016) recording 8 species from Homopterous species infesting some citrus varieties and guava trees.

2. Population dynamic for some dominant insect pests infesting navel orange trees:

Population dynamic was carried out on some dominant insect infested naval orange trees during 2014 and 2015 season, carried out on the basis of the density number , from the recorded data the dominant insects on navel orange trees were *Lepidosaphes beckii* *Aphis gossypii* and *phyllonciniis citrella*, on descending order.

Population density and seasonal abundance of *L. beckii* on navel orange trees:

The counts of adult and nymphal instars per 50 leaves of navel orange through two seasons, started from early March 2014 till February 2015 are tabulated in Tables (2 & 3).

Table 2: Seasonal population fluctuation of Purple scale insect, cotton aphid, and CLM, infesting naval orange trees at Sharkia Governorate during 2014 and 2015 seasons

Date of inspection	Total number of insects				Mean temp. °C	Mean R.H.%
	Purple scale insects		Cotton Aphid	CLM		
March,	15	202	953	29	20.00	44.00
	30	255	1296	45	20.50	44.11
April,	15	301	512	46	22.00	46.50
	30	345	105	79	21.55	44.80
May,	15	426	5	139	25.95	46.11
	30	351	3	145	27.41	40.10
June,	15	330	41	158	28.50	44.00
	30	305	105	182	28.60	50.00
July,	15	261	78	198	28.00	60.00
	30	230	39	205	28.15	55.68
August,	15	271	0	245	27.50	68.00
	30	468	0	315	28.22	67.00
September,	15	639	0	445	24.25	66.00
	30	475	14	612	24.75	67.00
October,	15	492	190	708	25.50	50.20
	30	571	125	759	23.50	54.25
November,	15	663	305	369	20.50	59.00
	30	602	710	266	18.30	61.00
December,	15	459	1120	56	16.25	64.00
	30	378	296	72	16.00	64.20
Jan.,	15	245	88	0.0	14.45	62.00
	30	210	126	0.0	15.66	55.00
Feb.,	15	180	298	0.0	16.93	51.50
	30	245	486	0.0	15.88	54.00
Total		8904	6895	5013		

Table 3: Seasonal population fluctuation of Purple scale insect, cotton aphid, and CLM, infesting naval orange trees at Sharkia Governorate during 2015 and 2016 seasons

Date of inspection		Purple scale insects	Total number of insects	Cotton Aphid	CLM	Mean temp. °C	Mean R.H.%
March,	15	446	783	38	19.49	45.44	
	30	533	1568	68	19.15	53.22	
April,	15	732	518	128	21.00	48.00	
	30	884	358	162	24.11	47.80	
May,	15	978	98	189	24.31	41.00	
	30	762	22	225	26.22	42.80	
June,	15	865	0	289	26.81	49.66	
	30	803	103	280	28.95	46.92	
July,	15	733	188	269	30.21	52.92	
	30	761	63	263	29.28	55.33	
August,	15	803	0	288	29.45	55.28	
	30	952	0	453	29.85	57.82	
September,	15	1099	0	547	28.85	55.85	
	30	1203	4.0	715	28.25	53.90	
October,	15	1190	4.0	920	24.25	66.00	
	30	1033	18.0	813	24.82	66.00	
November,	15	992	503	455	24.00	67.00	
	30	1192	611	236	22.70	68.00	
December,	15	994	2030	102	19.50	65.00	
	30	919	368	18	15.35	67.50	
Jan.,	15	688	20	0.0	15.15	66.56	
	30	316	65	0.0	16.25	62.00	
Feb.,	15	459	501	0.0	16.28	61.00	
	30	536	312	0.0	16.18	62.00	
Total		19874	7686		6458		

Data show that estimated fluctuating densities of the purple scale population indicated three peaks of infestation. These peaks occurred in early May, early September and mid November, throughout the first season with averages of 426, 639, 663 individuals, respectively. In the second season 2015, the three peaks were recorded on late April or early May (978 individuals) mid or late September (1203 individuals) and mid or late November (1192 individuals). The obviously depressive number in the first season were occurred during late July and late January recording 230 and 180 individuals respectively. In the second season were in mid July and late January recording 733 and 316 individuals (Tables 2 and 3).

Fadmiro *et al.* (2008) stated that the purple scale were present in the orchard year – round. Ali, Nadia (2011) and Draz *et al.* (2011) in Egypt stated that the purple scale have three generation and peaks per year on mango and navel orange fruit trees.

The measured relationship between the population density of *L. beckii* and the main weather factors i.e temperature and relative humidity proved that the population variability of the insect is markedly influenced by the mean temperature all parameters than relative humidity. As shown in Table (4) showed significant positive correlation values were noticed between the mean temperature and the population density of *L. beckii*. This results are agreement with Ali, Nadia (2011). Draz *et al.*, (2011) . stated that mean, minimum and maximum temperature was significant on the population of *L. beckii* and its parasitoid, while percent of relative humidity it is non significant.

Table 4: Simple correlation (r) and partial regression (b) coefficient between mean temperature, relative humidity and total number of *L. beckii* infested navel orange trees during 2014/2015 and 2015/2016 seasons.

Season	2014				2015			
	Mean temperature		Mean relative humidity		Mean temperature		Mean relative humidity	
	r	b	r	b	r	b	r	b
Total population	0.657*	6.211	0.288	2.654	0.676*	5.981	0.307	3.012

Seasonal population fluctuations of *Aphis gossypii* infested navel orange trees

The seasonal population abundances of *A. gossypii* on navel orange trees in 2014 and 2015 are shown in Tables (2 and 3). Three peaks of population density were recorded for *A. gossypii*. The first one occurred at the second week of December with total number of 1120 and 2030 insect / fifty leaves newly emerged shoots at means of 16.25°C , 19.5°C with 64% and 65% R. H. for the two seasons, respectively. The second peak occurred at the fourth week of March with total number 1296 and 1568 insects/ sample at means of 20.5°C and 19.15°C with 44.11% and 53.22% R.H. for both seasons , respectively. The third peak occurred at 4th week of June with total number of 105 insects/ sample at mean of 28.60°C with 50% R.H. for 2014 seasons and 15th of July with total number of 188 insects/ sample for 2015 seasons, occurred at means of 30.21°C with 52.92% R.H. The obtained results appeared that the correlation between population density of *A. gossypii* and mean temperature was negative and significant.

($r_1=-0.564^*$ and -0.487^*) in the two seasons, respectively (Table 5). Whereas, the effect of relative humidity was positive and insignificant ($r_2=0.225$ and 213) in both seasons.

Table 5: Simple correlation (r) and partial regression (b) coefficient between mean temperature, relative humidity and total number of *A. gossypii* infested navel orange trees during 2014/2015 and 2015/2016 seasons.

Season	2014				2015			
	Mean temperature		Mean relative humidity		Mean temperature		Mean relative humidity	
	r	b	r	b	r	b	r	b
Total population	-0.564*	-6.309	0.225 N.S	3.746	-0.487*	-0.405	0.213 N.S	1.294

Population fluctuations of *phylloncrosis citrella* on navel orange:

The population fluctuations of *P. citrella* on navel orange during 2014 and 2015 seasons as 15 days and numbers of the pest larvae and pupae per sample (100 leaves) were studied and the results obtained in Tables (2 and 3). In the first seasons, data presented in Table (2) showed that three scattered short period. The main period of activity was the longest which extended from 15th April till the beginning of August. The second periods continued from mid – September and the first week of November. During the main periods of insect activity, the population was greatly fluctuated showing 7 peaks. The first highest two peaks (612 and 759 individuals / sample). Occurred at late September and late October, respectively. The third peak (315 individuals / sample) was recorded during the third week of August. The fourth peak was moderate and occurred at fourth week of July with a total of 205 insect/ sample at means of temperatures ranged between 25.8°C – 29.9°C and relative humidifies varied from 63-68%. It is worth to mention that the navel orange trees were free from insect infestation during the periods especially that starts from the second week of December until the end of February. During this period, it was noticed that growth vegetative of navel orange trees become absent or low, which may be unsufficient for attraction. In the second season Table (3), the same trend was obtained. The insect infestation started to re-appear the first week of March and continued till the end of seasons. Its population was fluctuated showing 7 peaks. During the main period of pest activity recorded 715 and 920 insects/ sample at the end of September and mid of October, respectively. The corresponding means of temperature between 24.5°C and 28.5°C and relative humidities varied from 53-66%.

Statistical analysis of obtained data (Table 6) showed that the correlation between activity of *P. citrella* population and mean temperature was positively significantly ($r_1=0.857^*$ 0.649*) in 2014 and highly significant ($r_2=0.773^{**}$ -0.609*) in 2015 seasons. Concerning the correlation between *P. citrella* population and relative humidity, it was positively insignificant ($r_2=0.312$, $r_2=435$) in spring cycle in both seasons, respectively, These results agree with Patel *et al.* (1994); Wange Liand *et al.*, (1999) ; Hammad and Jasmien (2000); Kheder *et al.*, (2002) and Ahmed *et al.*, (2013), who mention that a positive high significant correlation was obtained between mean temperature and the *P. citrella* population on citrus varieties in both seasons. Minimum temperature of more than 18°C favored multiplication of the pest.

Table 6: Simple correlation (r) and partial regression (b) coefficient between mean temperature, relative humidity and total number of *P. citrella* infested navel orange trees during 2014/2015 and 2015/2016 seasons.

Season	2014				2015			
	Mean temperature		Mean relative humidity		Mean temperature		Mean relative humidity	
	r	b	r	b	r	b	r	b
Spring	0.449	1.53	0.312	0.48	0.473	4.18	0.435	1.02
Summer	0.857*	6.35	0.350	1.35	0.773*	5.82	0.495	1.39
Autumn	0.649*	6.59	0.463	0.54	0.609*	9.98	0.424	0.44

Effect of cultivation (Tillage) and non-cultivation on density number of some dominant insects infested navel orange orchards:

As for, the effect of cultivation and non- cultivation on the total number of *L. beckii* a year round on navel orange orchard. The experimental showed non-cultivation operation significant increase the insect as compared with cultivation 6times /year recording (3432, 3798 against 4739, 5898 insect) in both seasons, respectively.

The available literature concerning the effect of cultivation operation on numbers of *L. beckii* on navel orange or other citrus are very rare.

Concerning, the density number of *Aphis gossypii* are affected by cultivation navel orange orchard, and non- cultivation management, increased total number of Aphid as compared with cultivated (tillage) treatment orchard recording 3436, 3698 against 4221, 4470 individuals, and the available literature in this concern are not available now.

It is clearly that in (Table 7), total number of CLM / experimental trees as average/ year significantly increased on trees of non-cultivation orchard as compared with cultivated orchard trees (1991 against 2682 insect) in the first season and (2291 against 2986 insect) in the second season, with significant differences among averages of cultivation and non- cultivation differences of two season of study.

Concerning the available literature on the effect of cultivation and non-cultivation on density number of CLM in citrus orchards is very scarce.

It can be concluded that cultivation (tillage) operation in navel orange orchard tended to decreased population density of CLM a year round.

Table 7: Effect of cultivation and non- cultivation on density number of some dominant insects infested navel orange orchard during 2014 and 2015.

Treatments	Total number of insects					
	<i>L. beckii</i>		<i>Aphis gossypii</i>		<i>P. citrella</i>	
	2014/2015	2015/2016	2014/2015	2015/2016	2014/2015	2015/2016
Cultivation 6 times/ year	3432	3798	3436	3698	1991	2291
Non-cultivation	4739	5898	4221	4470	2682	2986
L.S.D.0.5	208.69	526.96	230.33	302.74	105.75	237.49
0.1	481.36	1115.42	531.28	698.22	243.85	547.76

It can be concluded that increasing insects of *L. beckii*, *A. gossypii* and CLM, a year round of non- cultivation orchard, might be attributed to moisture, temperature and or some hosts from the weeds in the orchard.

Effect of intercropping orchard on density number of some dominant insects infected navel orange trees:

Table (8) showed that the effect of some orchard management such as intercropping (with filler trees) and non-intercropping (without filler trees) on some dominant herein insects (purple scale insect, aphid and CLM) in both seasons of study . Mandarine (*Citrus deliciosa*) trees intercrop (as interfiller trees) between navel orange trees were studied. Results concerning with total number insects / year in dominant insects in the experimental trees showed population density

of (*L. beckii*, *A. gossypii* and CLM significantly increased in navel orange orchard mixed with mandarin, mean while, navel orange trees without inter filler trees operation showed a decrements in population density with significant differences among in averages of tested insects in both seasons (Table 8). The available literature concerning the effect of intercropping operation on total number of insects in fruit trees species not available now. While, literature on intercropping in other plants disagree with this results. Kenny and Chapman (1988), Sohail Ahmed *et al.*, (2013); Fraide Sulvai *et al.*, (2016) and Sadia Afrin *et al.*, (2017) proved that intercropped had low infestation of insect pests infested cabbage, CLM (intercropping of maize in citrus orchard), *Agrotis isilon* (intercropping of lettuce and onion) and intercropping systems mustard with onion, garlic, rachumi and coriander significantly reduced pest population over sole crop.

Table 8: Effect of intercropping and non- intercropping on density number of some dominant insects infested navel orange orchard during 2014 and 2015.

Treatments	Total number of insects					
	<i>L. beckii</i>		<i>Aphis gossypii</i>		<i>P. citrella</i>	
2014/2015	2015/2016	2014/2015	2015/2016	2014/2015	2015/2016	
Intercropped orchard of navel orange + mandarin	3249	3836	2280	2912	1889	1953
Non- intercropped of navel orange	2768	3221	1856	2325	1244	1393
L.S.D. 0.5	163.36	241.89	188.80	136.50	136.62	133.76
0.1	282.84	557.98	435.41	314.82	315.16	308.47

It can be concluded that intercropping management carried out in citrus orchard significantly increased the population density of insects such as *L. beckii*, cotton aphid and CLM, in navel orange orchard mixed with mandarin.

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