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POPULATION DENSITY AND THE SEVERITY OF THE INFECTION TO THE TOMATO BORER LEAVES *Tuta absoluta* (Meyrick) WITH THE PRESENCE OF A PREDATOR *Nesidiocoris tennuis* REUTER AND INFLUENCE OF CHEMICAL AND BIOLOGICAL PESTICIDES ON THEM.

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ABSTRACT

Results of the Search showed that the highest population density and the severity of infection insect *Tuta absoluta* (Meyrik) was in the variety Randy during the month of April, reaching 5.99 larva / leaf and 37.52%, respectively. The Results for eggplant the highest was 3.98 larvae / leaf in the variety Jawahr during the month of April.

The results indicate that the highest population density nymphs and adults predator *Nesidiocoris tennuis* Reuter was 1.42 and 1.3 nymph and adult / plant respectively, in the month of April in the variety Randy. and least 0, nymph and adult / plant during October and 0.26 nymph / plant and 0.1 adult/ plant in the variety Shahyrh. the predatory efficiency in the case of grouped and single of eggs and second and third larval of insect *T. absoluta*, the results were 23.8 and 23.2 eggs and ratio 95.3 and 93.2%, respectively, and the stage of second larval 5.7 and 8.6 larva and ratio 22.8 and 34. 4% of the grouped and single , respectively, and the third larval 4.2 and 5.2 larva and ratio 16.8 and 20.85% of the grouped and single respectively. the comparison between the stages shows that the trend of predator was toward the eggs increased to 70.62%.

The results showed that pesticide Proclaim was the highest killing in adults of *T. absoluta* were 96.35 and 76.05% when direct spray and spray the leaves (preventive spray) respectively, on during the overlap 100% after a week of direct workshop. and 91.44% after three days and 44.86% after two weeks of the workshop .extract of Neem oil was the second after Proclaim the killing ratio 51.36% of direct sparying and 19.62% for preventive sparying. As for the influence of pesticides on the nymphs and adults predator *N. tennuis* notes that pesticide Prochlaim had killing ratio 97.68, and 95.06%, respectively, when the direct spraying As for the intervention of

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up to 100% after a week spraying each of nymphs and adults. the extract of Neem oil was influence on nymphs and adults reached 43.76 and 43.3%, respectively, and the overlap of 60.6 and 58.11%, respectively, and growth regulator Match kill 10.45% and overlap 8.46% while bacterium *Bacillus thuringiensis* was 10.45% and the overlap 22.8%. the best combination to control the insect *T. absoluta* is the use the extract of neem oil and extract of *Bacillusthuringiensis* and after two weeks use predator as the integrated control when less influence pesticide on predator.

Keywords: Tuta absoluta, Pesticides, Predator, Nesidiocoris tennuis

INTRODUCTION

The borer tomato leaves *Tuta absoluta* Meyrick that imported to Iraq, which back to the family of Gelechiidae: Lepidoptera (Russell,2009). The original home of the insect in Latin America in the country of Peru and then spread to most of the continent, and then moved to the European continent by importing tomato crop, especially the Mediterranean basin countries and Arabean countries which are surrounding it (Eppo 2008, Urboneja 2005).

The larvae of borer tomato leaf lesion serious crops of family Solanaceae after hatching of larva from egg, it was feeding on the leaves tissue is unstructured consumer layer leaving skin layer with their feces increases the affected area of the larger larvae in the case of severe infection, they consume all tissue of leaf and become transparent and a large quantity of waste. And infected stems, flowers and small fruits, as they develop harmfulness in the second and third phase (Botto 2011 Eppo 2005). tomato pests that have the economic effect especially in agriculture protected so many of the producing countries were used integrated pest management programs through monitoring, control and use of pesticides elected and factors of resistance biogenic of parasites and predators through absolutely and pheromone traps as well as the use of biogenic causes that have a direct impact the roles of the insect with the use of a method of agricultural circulation and removing the remains of plants (2008, Robredo and Cardenoso). The case of compatibility between most of the factors mentioned require tests applied so as to avoid any antagonism in the application sequence, especially the impact of chemical pesticides.

Most of these studies are still in their infancy for the insect to the fact that *T. absoluta* pest entered Iraq in 2009 must be to know the most important natural enemies of parasites and predators

Record predator *N. tenuis* Router (Mohammed and Jabbar 2013) for the first time in Iraq's Basra province .that is predator of the eggs and larvae of the insect *T. absoluta* on tomato crop.

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The lack of study on the pest through its infect on some crops of the family Solanaceae and the lack of any study of the predator on the pest in Iraq effect, so the study focused on the knowledge of presence seasonal as well as predatory efficiency and use of some modern pesticides in the control against the pest, as well as its impact predator *N. tennuis.*

Diagnosis: borer tomato leaves *Tuta absoluta* Meyrick and also predator *Nesidiocoris tennuis* Rueter diagnosis in the natural History Museum / Baghdad University for the first time in Iraq by p. Dr. Mohammed Saleh Abdul Rasul.

Environmental study:

Population density of larvae of *T. absoluta* and the severity of the infection. Four varieties of crop planting tomatoes these were Randy Newton, wejdan and shhera and two varieties of eggplant crop these were jewoher and Marshall in the research station of College of Agriculture . University of Basra .

The seeds planted in the beginning of the month of September in the holes, the distance between hole and another 40 cm and the distance between rows and another 60 cm in greenhouses measuring 50 and 9 m in length and width, respectively. After a month of Agriculture took samples of the crop leaves that was five leaves from five plants of every rows randomisly every two weeks until the season ends in May. Calculated the numbers of larvae as well as the severity of the infection by the way Kasper (Ali and Abdullah, 1984).

Population density of nymphs and adult of predator *N. tennuis* population density is taken to nymphs and adult of predator are taking 15 plants from each rows randomisly by taking 60 plants of all plastic house and all the varieties of the crop of tomatoes starting from the month of November until the month of May to twice a month.

The work of the Culter.

Working the Culter through cultivation of six pots to crop of tomatoes and placed inside a wooden cages, capacity m^3 covered metallic net, three-side views and the upper, and the anther side view is blocked with a piece of wood with an hole diameter of 30 cm are blocked with a cloth.In order to input the pests and predators which taked from environment of infection plants.

Predatory efficient predator *N. tennuis.*

Conducted in two ways:

the first way: taking 25 eggs on tomato leaves and 25 larvae per Phase II and III of the insect larvae *T. absoluta* separately. Characterized through the length and width of the head capsule as

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well as the measurement of body length and color. put the leaves in a glass dish containing a wet filter paper and then placed over it the dish lantern glass, and put plasticdish, same diameter opened from the top and cloth covered. Put inside the predator and calculated the preparation of eggs and larvae damaged by the predator as a result of feeding experiment repeated four times. The second way: the same numbers collected in the first way but put all phases in one dish and counted the number of eggs and larvae prey by the predator and repeated the experiment four times.

The period of time (seconds) to feed the predator:

Calculated the time period from the beginning of the predator in the dish and put too recognize the host and nutrition of predation first egg or larva on the crop of tomato leaves..

Control of the adults insect *T. absoluta* by pesticides and their impact on the nymphs and adults of predator *N. tennuis*.

It has two ways. The first way direct spray of insect adults *T. absoluta* and nymphs and adults predator, use a large metal platter diameter of 15 cm and a height of 10 cm surrounded the Supreme dish has the same diameter his centrist slot blocked with a cloth, placed inside the bottom dish tomato leaves and fifteen adult of an insect *T. absoluta,* another dish specifications which put fifteen of the nymphs and fifteen adults of predator, taked from culter in laboratory by sepretor to experiment repeated four times and comparison with control treatment (water).

Spray the dishes by six kinds of pesticides. The second way (preventive spraying) conducted by Spray the leaves after that input adults of insect *T. absoluta* and nymphs and adults of predators after one day that is first stage and repeated input after three days ,seven days, ten days and twelve days .the replications were four times with comparison control treatment (water). and calculated the proportion of killing after one day and corrected the results by using the oirel and Schneider equation corrected equation Abbott (Shaaban and Al malah, 1993).

Pesticides used are as follow:

1-Neem Oil the active ingredient Azadirachtin used 2.1 ml / liter of water production Russell Company.

2-Prochlaim the active ingredient Emamectin benzoate is used 3-1gram / liter of water produced by Syngenta company

3-Match the active substance used Lufenuron 1 ml / liter of water to produce Russell.

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4-Bacillus thuringiensis of B.t.var kurstaki strain used Mn5-2.5 grams / liter of water. The company produced probelta fito.

5-*Trichoderma harzianum* used 2.5-2gram / liter of water production company. Al roai.

6-Admeral the active substance priproxyfen used 75-25ml / liter of water produced by Sumitomo chemical company..

Statistical analysis

using complete randomized design CRD in the factorial experience in population density of *T. absoluta* and insect predator N. *tennuis* and experience of pesticides. The experience of predatory efficiency using randomized complete design and comparison RLSD (Ali, 2010).

Results and Discussion

The results of the statistical analysis in Table 1 that the highest rate of population density of larvae of *T. absoluta* was at variety Randy reaching 2.2 larvae / leaf and severity of infection % 12.88 Table3, while the lowest rate was 1.28 larvae / leaf and severity of infection 6.33% at variety wejdan and when was compare the rates between planting season show that the numbers of larvae increased from the beginning of month November until it reached a maximum in the month of April 4.3 larvae / leaf and severity of infection 27.19% and then declined in the month of May.

Table 1: population density of larvae of *T. absoluta* on four varieties of tomato crop larvae /leaf.

Variety month	Newton	Randy	wejdan	shhera	Average of month
October	0.00	0.00	0.00	0.00	0.00
November	0.10	0.34	0.27	0.34	0.26
December	0.91	1.42	0.67	0.92	0.98
January	0.77	1.22	0.60	1.12	0.93
Fabruary	1.42	1.90	1.11	1.74	1.54
March	3.11	4.62	2.96	3.75	3.61
Apral	3.90	5.99	3.40	3.91	4.30
May	1.40	2.44	1.22	1.63	1.67
Average of Variety	1.45	2.24	1.28	1.68	

Less significant difference to months= 0.82 to Variety =0.54

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Through the overlap can be seen that the maximum density of population in the variety Randy at the month of April reaching 5.99 larva / leaf and severity of infection 37.52%. Khudair (2013) showed that the infection increase in temperature within the range between 27-14 ◦C and relative humidity between 75 -20%. while Vargas (1970) pointed that the best conditions for insect *T. absoluta* within the range of 28-24°C and relative humidity 75-25%. To provide the appropriate conditions make the pest put large amounts of eggs up to 260 eggs and have more than ten generations per year (EPPO, 2005). Results show that the highest population density of larvae in the crop of eggplant was 3.65 larvae / leaf while the lowest was 0.13 larvae / leaf in the October.

Table 2: severity of the infection % *T. absoluta* on four varieties of tomato crop

Variety month	Newton	Randy	Wejdan	Shhera	Average of month
October	0.00	0.00	0.00	0.00	0.00
November	1.67	3.10	3.22	3.41	2.85
December	6.42	8.44	3.71	7.32	6.47
January	6.43	8.01	4.11	7.10	6.41
Fabruary	6.22	8.00	4.00	7.21	6.36
March	12.00	15.21	9.46	12.67	12.33
Apral	28.22	37.52	20.00	23.20	27.19
May	7.10	22.78	6.10	8.23	11.05
Average of Variety	8.51	12.88	6.33	8.64	

Less significant difference to months = 2.4 to varieties = 1.71 to overlap=2.55

Statistical analysis show no significant differences between two varieties Jwaher and Marshall while observed significant differences in the overlap as it was the highest 3.98 larvae / leaf in the variety Jwaher in the month of April.

The results showed in Tables 4 and 5 that the population density of nymphs and adults of predator *N. tennuis* their numbers began to rise until tomato harvest it reached maximum of 1.01 and 0.93 nymph and adult/ plant respectively in April. Franco etal (2011) showed that the high reproductive of predator *N. tennuis* at temperature between 27-23 ◦C and relative humidity 75-65% also Wheeler (2001) pointed that the increase in the density of the predator may be due to the presence of preys in large numbers when were conditions become best . Then it declined in the month of May.

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Through the overlap between varieties and months of sampling that the highest population density of the predator was in vaerity Randy in the month of April, it was reaching 1.42 and 1.3 nymph and adult / plant respectively. that is returned to exchange of surface area of leave (Rice et al., 2011), while it is low in the first months and In the May.

Table 3: population density of larvae of *T. absoluta* on two Varieties of eggplant crop larvae /leaf.

Variety month	Marshall	Jewoher	Average of month
0.13	0.11	0.15	0.13
0.22	0.22	0.21	0.22
0.95	1.00	0.90	0.95
0.77	0.81	0.73	0.77
0.84	0.88	0.79	0.84
1.49	1.32	1.66	1.49
3.65	3.32	3.98	3.65
1.07	0.82	1.31	1.07
Average of Variety	1.12	1.18	

Less significant difference to months = 0.72 to overlap= 0.78

Table 4: population density of nymphs predator *N. tenuis* on varieties of tomato crop nymph / plant.

Variety month	Newton	Randy	Wejdan	Shhera	Average of month
October	0.00	0.00	0.00	0.00	0.00
November	0.31	0.33	0.26	0.33	0.31
December	0.42	0.44	0.35	0.46	0.42
January	0.40	0.42	0.35	0.38	0.39
Fabruary	0.33	0.39	o.28	0.33	0.3 3
March	0.67	0.76	0.46	0.64	0.64
Apral	0.97	1.42	0.56	1.08	1.01
May	0.66	1.11	0.4 6	0.77	0.50
Average of Variety	0.47	0.61	0.34	0.5	

Less significant difference to months = 0.32 to overlap = 0.37

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Tables 6 and 8 that efficiency predatory of predator *N. tennuis* to eggs were at a rate of 23.8 and 23.3 egg and ratio 95.2 and 93.2% (Tables 7 and 9) when the predator feed grouped and single of eggs, respectively. the results showed that the predator feeding on second phase larval was 5.7 and 8.6 larva and ratio reached 22.8 and 34.4% of grouped and single respectively.

Table 5: population density of predator *N. tenuis*on varieties of tomato crop

Variety month	Newton	Randy	Wejdan	Shhera	Average of month
0.00	0.00	0.00	0.00	0.00	October
0.12	0.12	0.15	0.12	0.10	November
0.48	0.51	0.57	0.37	0.45	December
0.40	0.43	0.45	0.41	0.32	January
0.17	0.17	0.21	0.11	0.18	February
0.66	0.66	0.91	0.49	0.56	March
0.93	0.93	1.30	0.63	0.85	April
0.59	0.68	0.81	0.27	0.59	May
Average of Variety	0.44	0.55	0.32	0.38	

Less significant difference to months = 0.29 to overlap = 0.33

The third phase was 4.2 and 5.2 larva and ratio 16.8 and 20.8% for grouped and single respectively. By studying the behavior of a predator in through the results shows that was trend toward the eggs by ratio 70.62% and 62.8% for grouped and single respectively.

Table 6: efficiency predatory of predator *N. tenuis* on the eggs and larvae of the second and third phase of *T. absoluta* (clustered).

The egg		The phases of larvae							
		First		Second		Third		Fourth	
Rate	Rang	Rate	Rang	Rate	Rang	Rate	Rang	Rate	Rang
23.8	25-23	0	0	5.7	7-4	4.2	5-3	0	0

Least significant difference =0.55

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Table 7: percentage predation on eggs and larvae of the second and third phase of *T. absoluta* (clustered).

The ratio prey phase %		The ratio of phase of the total%	
95.2	The egg	70.62	The egg
22.8	Second larval phase	16.93	Second larval phase
16.8	Third larval phase	12.46	Third larval phase

Mohammed (2013) showed that the eggs stage of insect *T. absoluta* more preference to predators. Urbanegi atel (2009) mentioned that the predator *N. tennuis* in Spain and that the Predator prey more than 30 eggs and two larvae per day. USDA (2011) Showed that the life of the larvae inside the tunnels and in the second phase can leave the tunnel and exposed to predators and parasites as well as pesticides in direct.

Table 8: efficiency predatory of predator *N. tennuis* on the eggs and larvae of *T. absoluta* (sangle).

The egg		The phases of larvae							
		First		second		Third		Fourth	
Rate	Rang	Rate	Rang	Rate	Rang	Rate	Rang	Rate	Rang
23.3	18-25	0	0	8.6	6-10	5.2	4-7	0	0

Least significant difference =0.77

Table 9: percentage predation on eggs and larvae of the second and third phase of *T. absoluta* (sangle).

The ratio prey phase %		The ratio of phase of the total%	
93.2	The egg	62.80	The egg
34.4	Second larval phase	23.18	Second larval phase
20.8	Third larval phase	14.07	Third larval phase

In the experiment for search the predator to find about host , calculated the time period to find the first egg, it was 18.4 seconds while it was in the second phase and the third phase of larvae 10.1 and 9.5 seconds respectively. The time period for eating one egg was 13.1 seconds while the period was 42.2 and 65.2 seconds for the second phase and the third phase of larvae . it's easier

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to predator finding the prey, especially the egg and the efforts predator that feeding by hole through the egg And absorb their contents much easier compared to the second phase and the third phase of larvae. Urbanangi (2005) said that the predator *N tennuis* in feeding behavior enters the mouth parts of piercing sucking through the egg shell and the wall of the body larvae of an insect *T. absoluta* and absorbs the contents of body fluids. In the nature the existence of some species, such as aphids, white flies and Mites may make the predator needs a longer period to find prey and especially if it was laying eggs on the lower surface of the leaves.

Table 10: period of time (in seconds) research and feed the predator *N. tennuis* for immature stages *T. absoluta.*

The phase of larvae				The egg		The time peroud
Third		Second				
Rate	Rang	Rate	Rang	Rate	Rang	
11-8	9.5	12-8	10.1	20-13	18.4	Search
70-63	65.2	48-33	42.2	15-6	13.1	Feeding

L S D for search = 2.58.L S D for feeding = 3.41

Results shown in Table 11 that the highest of killing ratio in the insect *T. absoluta* was 96.35% by using pesticide prochlaim and the second comes the extract Neem oil 51.36%. Mohammed (2013) showed that the pesticide prochlaim have a significant reducing the insect population density of *T. absoluta*. While the lowest was 5.18% for the fungal extract *T. harzianum*.

Table 11: Effect of some chemical pesticides, growth regulators and biogenic(killing ratio%) on adult insect *T. absoluta* (direct spray)

Pesticide peroud	Day	3Days	7Days	10Days	Pesticide Rate
Neem Oil	30.70	41.57	66.11	67.12	51.36
Prochlaim 5 SH	90.44	95.00	100.00	100.00	96.35
Match	2.60	10.20	14.62	14.62	10.51
B. thuringiensis	0.00	3.86	17.93	23.71	11.38
T.harzianum	0.00	0.00	4.52	16.21	5.18
Ademral	0.00	4.66	11.2	11.67	6.88
Period Rate	20.62	23.98	32.39	34.39	

Less significant difference to pesticide = 4.55 to period L S D = 5.2 to overlap = 10.

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As for the influence of the period noted that whenever the more stay of the pesticide the effect was even higher up even reacted 34.39% after ten days of the spraying process. For the overlap pesticide and the period was killing ratio 100% in the pesticide prochlaim after week from spraying. through overlap clearly that there were some pesticides did not affect only after a period of time of the spraying, especially extracts biogenic and even insect growth regulators compared with pesticide prochlaim. Extract of Neem oil took high proportions in one day after the spraying 30.7% and up to 67.12% after ten days of the spraying process.

Table 12: Effect of some chemical pesticides, growth regulators and biogenic on the adults of insect *T. absoluta* (sprayed on plant leave).

Pesticide	Day	Three days	Week	Ten days	Two weeks	Pesticide Rate
Neem Oil	21.50	30.43	27.45	15.70	3.00	19.62
Prochlaim	77.20	91.44	87.46	79.3	44.86	76.05
Match	0.00	2.11	5.55	0.00	0.00	1.53
B. thuringiensis	0.00	0.00	10.00	11.80	0.00	4.36
T.harzianum	0.00	0.00	2.41	2.54	0.00	0.99
Ademral	0.00	2.90	1.20	0.00	0.00	0.9
Period Rate	16.45	18.22	22.35	21.15	7.98	

Less significant difference to pesticide = 4.37 to Period = 3.09 to overlap= 4.99

The results appear in Table 12 that spraying used is preventive before the incidence of the insect *T. absoluta* and the highest killing ratio was 76.05% for the pesticide prochlaim while after that the Neem Oil extract came by killing ratio 19.62%, as forthe lowest was 0.9% for the regulter growth Ademral..

When comparing the pesticide spraying from the beginning until two weeks the level of killing ratio observed increasing after week of spraying to 22.35% but after two weeks reached 7.98%. The overlap shows that some pesticides in particular extracts biogenic needs time to increase the effectiveness .the influence confined between a week and ten days. And that is the strongest pesticide prochlaim reached 91.44% after three days of spraying and then decreases to 44.86% after two weeks. in overlap also notes that the neem oil extract came second, but reduced to a large degree until it reaches 3% after two weeks. from through the results note low killing ratio of preventive Spray compared to direct spray values.

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Table 13 and 14 shows that the pesticides which used in the control against *T. absoluta* have a significant and high killing ratio on the predator N. tennuis by using pesticide prochlaim 97.68 and 95.06% of the nymphs and adults respectively, while the least 9.54 and 4.2% in nymphs and adults in the fungal extract *T. harzianum* and growth regulator Ademral respectively.

Table 13: Effect of some pesticides , chemical growth regulators and biogenic on nymphs predator *N. tennuis* (direct spray).

Pesticide period	Day	3Days	7Days	10Days	Pesticide Rate
Neem Oil	22.3	31.55	60.60	60.60	43.76
Prochlaim	91.51	99.2	100.00	100.00	97.68
Match	10.71	31.4	33.63	37.52	28.32
B. thuringiensis	0.00	0.00	18.20	35.82	13.51
T.harzianum	0.00	0.00	16.95	21.20	9.54
Ademral	9.21	23.40	23.90	33.33	22.46
Period Rate	22.29	30.93	42.21	48.08	

Less significant difference to pesticide = 5.41 to Period = 4.56 to overlap = 5.17

During the period, the results show an increase in rates until it reaches 48.08 and 34.9% of the nymphs and adults respectively, in Ten days after spraying .when compared to the results of overlap that show the maximum had pesticide prochlaim and extract of neem oil by killing ratio 100 and 58.11% respectively after week of spraying. Despite the effectiveness of the pesticide prochlaim and oil extracted in the killing ratio against the harmful pest but they were also high on the predator. Lahm (2009) pointed must be pesticides use highly-selective against the harmful insects but enactive to natural enemies and pollinators. Wheeler (2001)showed that the lack of intensity predator in the early stages of the pesticide spraying may lack of prey as a result.

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Table 14: Effect of some chemical pesticides, growth regulators on the predator *N.* tennuis (direct spray).

Pesticide period	Day	3Days	7Days	10Days	Pesticide Rate
Neem Oil	21.77	35.19	58.11	58.11	43.30
Prochlaim 5 SH	87.60	92.62	100.00	100.00	95.06
Match	0.00	3.10	6.65	8.46	3.06
B. thuringiensis	0.00	0.00	19.00	22.80	10.45
T.harzianum	0.00	0.00	8.27	12.52	5.20
Ademral	0.00	3.94	5.00	7.50	4.11
Period Rate	18.29	22.48	32.84	34.9	

Less significant difference of the pesticide = 4.3 to Period = 3.25 to overlap= 5.7

Table 15 shows that preventive spray had high on the Predator also an effect in the same pesticides influential.

Table 15: Effect of some pesticides and chemical growth regulators on the predator *N. tennuis* (sprayed on plant leaves).

Pesticide	Day	Three days	Week	Ten days	Two weeks	Pesticide Rate
Neem Oil	19.56	22.4	18.33	12.00	4.56	15.37
Prochlaim	89.10	90.44	81.80	70.11	20.00	70.29
Match	0.00	5.10	4.12	3.77	0.00	2.60
B. thuringiensis	0.00	0.00	17.30	15.40	0.00	6.54
T.harzianum	0.00	0.00	10.92	8.53	0.00	3.89
Ademral	0.00	3.41	3.00	1.62	0.00	1.60
Period Rate	18.11	20.23	22.08	18.57	4.09	

Less significant difference to pesticide = 6.43 to Period = 3.33 to overlap= 5.82

observing the results of Tables 12 and 15 to be the best combination to killing the adults of *T. absoluta* on crop of tomatoes is the use of neem oil extract and bacterial extract of *B.*

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thuringiensis first and after two weeks from spraying period use predator *N. tennuis*as integrated control. Riquelme etal (2006) show that using of the extract bacterial *B. thuringiensis* with parastoids a big role in integrated pest management .Mallia (2009) use of *B. thuringiensis* with pesticide Lufenuro gave good results against *T. absoluta*.

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