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Effect of cultural management methods against fake butterfly [*Ricania japonica* (*Hemiptera*: *Ricaniidae*)]

Yalancı kelebek [Ricania japonica (Hemiptera: Ricaniidae)]'e karşı bazi kültürel mücadele yöntemlerinin etkisi

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Abstract

This study was conducted between 2017 and 2018 to determine the cultural measures that are applied in the control against Ricania japonica (Hemiptera: Ricaniidae), which has caused damage in the Eastern Black Sea Region of Turkey for approximately 10 years as an important pest. Pests are widespread in this region but there is no other important pest that requires significant chemical control in crop plants, in particular tea plants. Furthermore, this pest population, whose population has grown since 2009, may cause significant losses in vegetables especially for traditional family needs during its nymph period. The fact that vegetable fields have been almost interwened with tea plants and synthetic pesticides are not used in tea plant production, has caused us to focus on cultural methods, which are among alternative pest-fighting methods. With this study, the purpose was to determine the effects of kaolin, refined salt and ash applications against the nymphs of the pests, and to investigate how to destroy the infected plant materials in which the pest lay eggs until the middle of May. As a result of the study, it was determined that the destruction of the infected plants and plant wastes in the areas decreased the pest population by 90% because it was the winter months which is the egg-laying period of the pest. Other applications (kaolin, refined salt and ash) were not found effective against the nymphs of this pest.

Özet

Bu çalışma, yaklaşık 10 yılı aşkın Türkiye'nin Doğu Karadeniz Bölgesi'nde önemli bir zararlı olan *Ricania japonica* (*Hemiptera: Ricaniidae*)'ya karşı mücadelede uygulanabilecek kültürel tedbirleri belirlemek amacıyla 2017-2018 yılları arasında yürütülmüştür. Zararlının bulunduğu bu bölgede başta çay olmak üzere önemli kültür bitkilerinde kimyasal mücadeleyi gerektirecek önemli zararlı bulunmamaktadır. Ancak 2009 yılından itibaren popülasyonu artan bu zararlı özellikle nimf döneminde geleneksel aile ihtiyacına yönelik sebzelerde önemli zararlar yapabilmektedir. Bu zararlı türe karşı, sebze alanlarının çaylıklar ile iç içe olması ve çayda herhangi bir hastalık veya zararlıya karşı sentetik pestisit kullanılmaması alternatif mücadele yöntemlerinden biri olan kültürel mücadeleye yoğunlaşmamıza neden olmuştur. Bu çalışma ile zararlıya karşı kültürel mücadelede amacıyla denenen; zararlının yumurtadan çıkmaya başladığı mayıs ayı ortalarına kadar yumurta koyduğu bulaşık bitki materyallerinin imhası, zararlının nimflerine karşı kaolin, rafine tuz ve kül uygulamalarının zararlının nimflerine karşı etkileri belirlenmeye çalışılmıştır. Çalışma sonucunda zararlının kışı bulaşık bitkilerde yumurta döneminde geçirmesi nedeniyle bahçelerdeki bulaşık bitkilerin ve bitki atıklarının yok edilmesinin zararlının popülasyonunu yaklaşık %90 azalttığı tespit edilmiştir. Diğer uygulamalar olan kaolin, rafine tuz ve kül uygulamalarının zararlının nimflerine karşı etkili olamadıkları belirlenmiştir.

INTRODUCTION

Tea, nuts and kiwifruit are among the most important agricultural crops in the Eastern Black Sea region of Turkey. Although the hazelnut cultivation of Turkey varies year by year, it covers 65.78% of total world production with approximately 600 thousand tons of yearly hazelnut production. Turkey ranks 5th in the world for tea cultivation with 1.36 million tons, and ranks 6th for kiwifruit cultivation with 37 thousand tons (Bostan and Günay, 2014; Mendi, 2015; Engin 2017; Güner and Güney, 2018).

The fruits, vegetables and field crops grown as main crops other than tea, hazelnut and kiwi, in the Eastern Black Sea region do not have economical value. These crops are only grown for traditional family needs. However, the area where the pest exists is covered with tea plants (and other products merged with tea), chemical pesticides cannot be applied to this pest, and cultural and biological control methods come to the forefront. Globally, tea cultivation that does not involve using any other chemicals except for chemical fertilizers is realized only in Turkey. Since there are no chemical controls against harmful pests in this area where tea cultivation is at its most intense, different control methods must be investigated and put into practice.

In studies conducted on *R. japonica* in Turkey, the harmful pest was reported to be *R. simulans* however, it was later reported that this pest was *R. japonica* (Demir, 2009). Two species of the family are known in Europe, both from the nominate genus Ricania Germar, 1818. *Ricania hedenborgi* Stal, 1865, is spread in the Palaearctic and Afrotropic regions. In the Palaearctic it occurs in North Africa and the Mediterranean, reaching up to Armenia to the east. It is known in the Northern Aegean islands of Greece and Southeast Anatolia (Demir, 2009). Avidzba and Bobokhidze (1982) stated that the pest was detected in Abkhazia (Russia) in 1956, and spread through the subtropical coast of the Black Sea to the Caucasus. It fed on blackberry, tea, grapes, citrus fruits, peach and soybeans. Dzhashi et al. (1982) on the other hand, reported that the pest yielded offspring on an annual scale in southern Georgia, and spent the winter as the egg-laying period. It is understood that this pest, which originates from the Far East, has existed in Russia and Georgia for more than 35 years (Avidzba and Bobokhidze 1982; Dzhashi et al. 1982). Gjonov (2011) investigated mature specimens that were collected at the mouth of the Veleka river in the most Southeastern part of Bulgaria, nearly 200 m from the Black Sea coast. It is considered that this pest spread to Turkey with infected plant material from neighbouring Georgia (Ak et al. 2013 and 2015). Gjonov and Shishiniova (2014) reported that *R. japonica* was a polyphagous species, introduced to the Caucasus a long time ago, ending up in the Ukraine and the Black Sea coast in Turkey. Apparently the spread of this species reaches near by the Black Sea coast.

Imura (2003) and Ak et al. (2015) reported that the nymphs and adults of *R. simulans* existed in a variety of weed families and on many plants, feeding on stems and fresh shoots by absorbing the plant juice in plants, and the adults causing harm with their egg laying. Studies reported that *Scolypopa australis*, which belongs to the same family as *R. japonica,* in Australia and New Zealand, which has similar biological features and exists on kiwis and some other crops, was commonly found in many weed species and was a significant pest to kiwis; and it was also reported that broad-spectrum insecticides were used against this pest (Logan et al. 2002; Charles et al. 2004). Ak et al. (2013 and 2015) and Göktürk and Aksu (2014) reported that the pest had hosts that were annual and perennial, woody and herbaceous, cultivated plants and weeds. They also found that nymphs caused significant damage in beans, cucumbers and decreased the quality of kiwi fruits by causing fumagine.

Studies on the controls of this pest are mostly made on usage of biological preparations and different trap types. Göktürk and Mihli (2015) conducted a study in 2013-2014 on the control against *R. simulans* using light traps and colored sticky traps. They found that there was a significant difference between the number of insects caught in the light traps than in the sticky tape traps, where the number insects caught by the light traps was more. In contrast, Ak et al. (2013) saw some success with a biopesticide in their study conducted between 2009 and 2011 in Hopa (Kemalpasa) and Rize (Center), Turkey. Their study was to determine the biological activities and effectiveness of biopesticides that had the Azadirachtin and Spinosad effective substances, used against *R. simulans*, and found that the highest dose of Azadirachtin (400 ml/100 L) had a low effect in terms of biological activity (30%), and the Spinosad (35 ml/100 L) dose was effective at a rate of 71.2-78.7%. Göktürk et al. (2018); totally 10 bacterial strains including 2 strains of *Brevibacillus brevis* (CP-1, FD-1), 1 strain of *Bacillus thuringiensis* (FDP-1), 2 strains of *Bacillus thuringiensis* subsp. kenyae (FDP-8, FDP-42), 2 strains of *Bacillus thuringiensis* subsp. kurstakii (FDP-41, BAB-410), 1 strain of *Bacillus subtilis* (EK-7), 1 strain of *Pseudomonas chlororaphis* (NEM-28) and 1 strain of *Bacillus sphaericus* GC sub-group D (FD-49) and additionally 1 *Beauveria bassiana* (ET 10) fungus isolate were examined for their insecticidal activities. İn this study, they found that *B. bassiana* was more effective compared to control, while it showed less efficacy when compared to the studied bacterial strains.

This study was conducted to determine the chemical control methods against the pest because the area where *R. japonica* exists untrodden in terms of pests and no chemicals are used aside from fertilizers. It was found that the nymph population decreased at a rate of approximately 90% due to the application of the chemical which also destroyed the plant materials that were infected. No positive results could be obtained from the study to determine the effect of smoke, obtained from plant residues, against nymphs. The highest efficiency against the pest was obtained with the kaolin-clay-salt concentration with 20% and a low effect was detected at a rate of 25% in refined saline concentration, which caused phytotoxicity in plants. In addition, there is no results on the kaolin-clay-ash application.

MATERIAL AND METHOD

The main material of this study consisted of the 1-4th nymphal period and adult individuals of *Ricania japonica*. Other materials were atraps, cages, bellows, salt, water, kaolin, ash, pruning shears and scythe.

The Effect of Destroying the Infected Plant Materials on the Nymph and Adult Population

For the purpose of destroying the infected plant materials, two areas with similar characteristics that were infected with this pest in Rize, Turkey were selected in 2017 and 2018. No applications were applied against the pest in the area, which was selected as the control, and the plants infected with the eggs of the pest in the other area were cleaned and destroyed. *R. japonica* mates at the beginning of July and late August and leaves eggs in single-year, perennial and bushy plants, spends the winter in host plants for the period of the eggs, and the nymphs start to appear from the eggs in the middle of May. For this reason, in the area where the cultural application would be applied, the plants infected with the harmful eggs were cleaned and destroyed up until May. In the control and application areas, the pest population was detected during the 1st and 2nd nymphal period and during the 3rd and 4th nymph period. For this purpose, nymphs of *R. japonica* were counted in four hosts in 2017, and in 7 different host plants in 2018 (beans, citrus, grape, kiwifruit, wormwood, corn and curled dock) on 10 cm of 10 shoots, and thus nymph density was determined in both areas. In mid-August, when the adults appeared, the number of adults was determined by counting the number of adults in both areas. Average numbers of the nymph and adults, which were counted in the areas where the application was made and not made, were compared and the effectiveness of the cultural control was determined. The effectiveness of the applications was determined by Abbott Formula.

Determining the Effect of the Smoke Obtained from the Plant Wastes on Nymphs

In this study, 5 cages with 80 x 80 x 80 cm dimensions, one was control and four were application, were used in 2017 in Rize, Turkey. Two mandarin seedlings were placed in each cage, and a black mulch cover was placed under the cages for weed control. Fifty nymphs were released into each cage. To apply the smoke, a smoker was used and rotten tree roots, cardboard and straw were burnt to create smoke inside the smoker. Three different applications with the same intensity of smoke were made to all the cages containing with nymphs.

1. Application: Smoke was sent once to the cage from two sides with a smoker.

2. Application: Smoke was sent twice to the cage from two sides with a smoker.

3. Application: Smoke was sent three times to the cage from two sides with a smoker.

The alive and dead nymphs were counted 1 day after each application, and the efficiency of the smoke on nymphs was determined with the Abbott Formula.

Determining the Effect of Kaolin-Clay-Refined Salt Concentration and Wood Ash Application on Nymphs

This experiment was conducted in the Hayrat Nursery that belongs to Çaykur located in the Hayrat neighbourhood of Rize in 2018. Two cages with 40 cm diameter and 80 cm height were used in the study. One tubed mandarin seedling was placed in each cage, and black mulch was placed on the ground where the cages were placed for weed control. 1st-2nd nymphal period were released into each host.

Different kaolin and ash concentrations (25 g/100 L, 50 g/100 L, 75 g/100 L, 100 g/100 L and control) were applied to each nymph in the cages. In the salt concentration application, five themes where one of which was the control application (5, 10, 15, 20 and 25% (w/v) concentrations) were tested.

The trial was conducted on 30 May 2018 when the first period of nymphs emerged (1st and 2nd nymphal period). Alive and dead nymphs were counted in the cages 1 day after the application, and the efficiency of the applications were determined with the Abbott Formula.

RESULTS

Determining the Destruction of Infected Plant Materials on the Changes in the Population

The cold and irregular climatic conditions of the year 2017 caused irregularities in nymph emergence. The population was determined to be very low on June 6, 2017 and the population was counted again on June 30, 2017. The results of the nymphs that were counted in the application area and in the control area for the cultural control are given in Tables 1 and 2. The effect of the application on the nymph population of the pest is given in Table 3.

Table 1. Number of nymph in the field where cultural control was applied against Ricania japonica (2017).

Hosts	Number of Nymph/Host										Average
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	
Beans	4	5	9	10	4	6	0	0	0	2	4.0
Citrus	0	0	1	0	5	0	0	1	0	0	0.7
Grapes	10	0	1	0	10	0	24	0	0	7	5.2
Wormwood	0	1	0	0	0	0	0	0	0	0	0.1

Table 2. Number of Nymph in the control field (2017)

Hosts	Number of Nymph/Host										Average
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	
Beans	13	10	57	51	41	113	46	320	119	266	103.6
Citrus	1	17	30	55	3	15	12	3	0	31	16.7
Grapes	17	36	0	4	51	6	3	0	0	0	11.7
Wormwood	1	0	1	4	0	15	14	18	16	24	9.3

Table 3. The effect of the application on *Ricania japonica* nymph population (2017)

Hosts	Cultural Control Field	Control Field	Efficiency Rate (%)
	Number of Total Nymph (Pcs)	Number of Total Nymph (Pcs)	
Beans	40	1036	96.14
Citrus	7	167	95.81
Grapes	52	117	55.56
Wormwood	1	93	98.92

When Table 3 is examined, it is seen that the destruction of the plant materials that were infected with the eggs of the pest in 2017 the cultural control was effective on beans at a rate of 96.13%, on citrus at a rate of 95.80%, on grapes at a rate of 55.55%; on hemp at a rate of 98.92%.

The results of the adult population count of the pest on September 13, 2017 after the cultural control are given below (Tables 4, 5 and 6).

When Tables 4 and 5 are examined, it is seen that the average number of adults in 4 different hosts in the application area and in the control area were 17.5 of adults in average in the application area, and 11.8 of adults were determined in the control area. Consequently, this means that there were less than ca 50% of adults.

Table 4. Number of the adults in the field where cultural control was made against *Ricania japonica* (2017)

Hosts	Number of Adult/Host										Average
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	
Beans	7	43	23	32	24	5	25	36	26	31	25.2
Citrus	2	4	8	0	3	4	15	9	1	6	5.20
Grapes	0	2	1	3	2	18	3	3	8	9	4.90
Wormwood	0	0	0	0	0	0	0	0	0	0	0.00

Table 5. Number of the adult in the control field

Hosts	Number of Adult/Host										Average
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	
Beans	67	33	60	46	20	64	37	94	75	38	53.4
Citrus	11	3	3	10	6	17	6	4	7	6	7.30
Grapes	9	2	4	9	4	5	20	9	4	9	7.50
Wormwood	0	0	0	0	0	0	0	0	0	0	0.00

Table 6. The effect of the application on adult period of *Ricania japonica* (2017)

Hosts	Cultural Control Field		Control Field		Efficiency Rate (%)
	Number of Total Adult	Average Adult	Number of Total Adult	Number of Total Adult	
Beans	252	25.2	534	53.4	52.80
Citrus	52	5.20	73	7.30	28.76
Grapes	49	4.90	75	7.50	34.66
Wormwood	0	0.00	0	0.00	0.00

When Table 6 is examined, it is seen that the effects of the cultural control on the adult population was 52.8% in beans, 28.76% in citrus and 34.66% in grapes in 2017. In the adult period, no adults could be detected in the wormood. The reason why the effect of the cultural fight against *R. japonica* was low in the adult period than the nymph period is considered to be the fact that the pest easily changes the host because cultural control was not applied in almost any area, including the area where the present study was conducted.

Applications conducted in 2018 show that there have been differences in the nymph emergence times from eggs because of the irregularity in the climatic conditions when compared to previous years. Since the second year of the application field being carried out, it was observed that there were decreases in the nymph count of the pest when compared to the other areas. Subsequently, the nymph emergence was not recorded on the 14th of May, 2018. For this reason, the results of the first counting were not taken into consideration.

The second counting was conducted on 4 June, 2018 and the results of the nymph counting in the application field and in the control field are given below (Table 7, 8, 9).

Table 7. Number of nymp in the field where cultural control was done against *Ricania japonica* (2018)

Hosts	Number of Nymph/Host										Average
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	
Beans	3	5	0	4	1	2	8	7	1	9	4.00
Citrus	0	5	3	0	0	6	2	10	0	0	2.60
Grapes	5	2	2	0	0	0	0	1	1	2	1.30
Kiwifuit	1	0	0	0	0	0	0	0	1	0	0.20
Curled dock	0	0	0	0	0	2	4	3	9	1	1.90

Table 8. The nymph counts in the control field (2018)

Hosts	Number of Adult/Host										Average
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	
Beans	29	14	22	81	10	17	22	20	17	11	24.3
Citrus	5	1	6	0	0	0	0	6	0	17	3.5
Grapes	0	0	0	0	1	7	30	21	1	5	6.5
Kiwifruit	1	8	0	0	0	20	1	6	9	0	4.5
Curled dock	10	25	6	5	7	6	1	1	0	4	6.5

Table 9. The effects of the application on nymph population of *Ricania japonica* (2018)

Hosts	Cultural Contraol Field	Control Field	Efficiency Rate (%)
	Number of Total Nymph (Pcs)	Number of Total Nymph (Pcs)	
Beans	40	243	83.54
Citrus	26	35	25.71
Grapes	13	65	80.00
Kiwifruit	2	45	95.55
Curled dock	19	65	70.77

Examining Tables 7 and 8 and when the average adult count in 5 different hosts in the application area and in the control area is evaluated, it is seen that 5 adults were detected in average in the application area, and 9 adults were determined in the control area. This means there were less than approximately 45% adults.

When Table 9 is examined, it is seen that the cultural control that was carried out by burning the infected plant materials and the eggs of the pest, was effective in beans at a rate of 83.54%, 25.71% in citrus, 80.00% in grapes, 95.55% in kiwifruit, and 70.77% in weeds in 2014.

The results of the counting on July 30, 2018, which was based on the effectiveness of the cultural control in the adult period, are given below (Table 10, 11 and 12).

Table 10. Number of adult in the field where cultural control was done against *Ricania japonica* (2018)

Hosts	Number of Adult/Host										Average
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	
Beans	72	52	24	55	39	92	21	39	29	68	49.10
Citrus	2	2	1	1	8	9	3	30	10	15	8.1
Grapes	2	2	12	3	8	2	3	5	1	0	3.8
Kiwifruit	11	22	46	2	20	2	13	37	26	36	21.5
Corn	29	27	10	58	15	66	17	15	6	74	31.7

Table 11. Number of adult in the Control field (2018)

Host	Number of Adult/Host										Average
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	
Beans	250	151	130	500	500	300	500	500	600	600	4031
Citrus	18	26	4	12	31	53	20	28	20	26	23.8
Grapes	26	111	72	36	31	63	52	82	50	92	61.5
Kiwifruit	42	50	12	52	27	48	38	45	12	47	37.3
Corn	210	160	155	239	98	139	155	128	85	98	146.7

Table 12. The effect of the application in adult period of *Ricania* japonica (2018)

Hosts	Cultural Control	Control Field	Efficiency Rate (%)
	Number of Total Adult (Pcs)	Number of Total Adult (Pcs)	
Beans	491	4031	87.82
Citrus	81	238	65.97
Grapes	38	615	93.82
Kiwifruit	215	373	42.36
Corn	317	1467	78.39

According to the 2018 results, the effectivity rates in the cultural control in adult period was found as 87.82% in beans, 65.97% in citrus, 93.82% in grapes, 42.36% in kiwifruit and 78.39% in corn. A higher (50%) effect rate was determined when compared to the results of 2017 against the adult pests.

Determining the Effect of the Smoke Obtained from Plant Wasted on Nymphs

The results showing the effect of the smoke that was obtained from the plant wastes against *R. japonica* nymphs are given in Table 13.

Table 13. The effects of the smoke application on the 1st and 2nd nymph period of *Ricania japonica* (2017)

App.	Number of Nyph/Cage)	1. cage		2.cage		3.cage		4.cage		Average		Control Cage		Efficiency Rate %
		Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead	
1	50	48	2	49	1	49	1	48	2	48.5	1.5	50	0	2.5
2	50	49	1	49	1	50	0	47	3	48.7	1.0	50	0	2.5
3	50	50	0	49	1	46	4	46	4	47.8	2.6	50	0	4.5

In the 1st and 2nd period nymphs of the pest, three different densities were applied, and counting was carried out 1 day after the application. The highest efficiency was detected in the application performed on both sides of the cage by 4.5%. As can be understood in the counting results, it was found that smoke application had very low effects against the nymphs of 1st and 2nd periods of *R. japonica*.

The results obtained from the smoke applied against the nymphs of the 3rd and 4th periods of the pest are given in table 14.

Table 14. The effect of the smoke application on 3rd and 4th nymph period of *Ricania japonica*

App.	Number of Nyph (/Cage)	1. cage		2.cage		3.cage		4.cage		Control Cage	
		Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead
1	50	50	0	50	0	50	0	50	0	50	0
2	50	50	0	50	0	50	0	50	0	50	0
3	50	50	0	50	0	50	0	50	0	50	0

Examining Table 14 it is seen that the smoke application did not have any effect on the nymphs of the pest in the 3rd and 4th periods.

Determining the Effect of Kaolin-Clay-Salt Concentration and Ash Application Against the Nymphs

The efficiency of the kaolin-clay-salt and ash application on the nymphs of *R. japonica* in the mandarin seedlings in the cages are given in the chart below (Table 15).

Table 15. The effect of Kaolin-Clay-Salt Concentration and Ash Application on the 1st and 2nd nymph periods of *Ricania japonica a*nd the efficiency rates.

Preparations	Dose (g/L; w/v)	Alive	Dead	Efficiency Rate (%)
Kaolin-Clay	25	20	0	0
	50	20	0	0
	75	20	0	0
	100	17	3	17.65
	Control	20	0	0
Salt	5	20	0	0
	10	19	1	5.26
	15	20	0	0
	20	20	0	0
	25	16	4	25.0
	Control	20	0	0
Ash Water	5	20	0	0
	10	20	0	0
	15	20	0	0
	20	20	0	0
	25	20	0	0
	Control	20	0	0

Three different natural materials were applied against nymphs of 1st and 2nd period of the pest at different doses/concentrations and the results were evaluated after one day. It was determined that the highest efficiency was at 25% salt concentration at a rate of 20%. However, it was also determined that this dose caused phytotoxicity in the plant. As can be seen from the counting results, kaolin-clay-salt concentration and ash application did not yield promising results against the 1st and 2nd period nymphs of *R. japonica*.

DISCUSSION

As the most important agricultural product is tea in the area where the pest was in intense amounts and caused damage, no synthetic pesticides are used in tea production and there is a natural balance in terms of tea pests. Therefore, it is necessary to investigate the methods of environmental, natural and cultural fight against *R. japonica*. For this reason, in this study conducted in 2017-2018, the purpose was to determine the effectiveness of cultural measures and some organic materials against nymphs, which could be applied against harmful pests without the use of any synthetic pesticides. As a result of the study, it was determined that the plant wastes that had the eggs of the pests, and were cleared and destroyed, caused decreases in the nymph population of 86% and 71%, respectively. Ak et al. (2015) conducted a study on the spread, density and biology of the pests between 2010 and 2013, and based on the biological results it was determined that cleaning of the areas and the destruction of the eggs and infected plants / branches will reduce the population of the pests in the following year before the nymphs emerge. This is due to the winter period where the pests of the host plants are about to dry. The effect on the adult population was determined as 29% and 74% in 2017 and 2018, respectively. The reason why the effect that was determined in the nymph period was higher than the adult period is that since the cultural fight is not applied in the area, including the area in which the study was conducted, nymphs can fly and infect surrounding plants. However, according to the averages of the two-year data, it was determined that the adult population decreased by approximately 50%.

In this study, in addition to the cultural control, which was determined to be effective in the destruction of infected plants, the plant wastes were burnt and the smoke was applied against the nymphs to test the efficacy of smoke against the nymphs. It was determined that smoke had a very low effect (2.5%-4.5%) on the 1st and 2nd nymphal period, and it did not have any effect on the nymphs of the 3rd and 4th periods.

As the area where the pest is intense is untrodden in terms of chemical pesticide use; and since chemical pesticides cannot be used against pests in this area, kaolin-clay and salt concentration with organic content and as were tested against the pest; however, an effective dose against nymphs could not be determined. Ak et al. (2013) tested 400 mg/100 L dose of azadirachtin against the nymphs of this pest; and reported a 30% biological effect. In the same study, it was also reported that Spinosad 35 ml/100 L dose was effective at a rate of 71-78%. However, it is not suggested in the tea production areas because the application of tea pests may cause negative effects on natural enemies because of the natural balance under natural enemy pressure. However, for the biological control of the pest, Güçlü et al. (2010) conducted an *in vitro* and *in vivo* study on the efficacy of *Lecanicillium muscarium*, which is an entomopatojen fungus, and reported that the effect of *L. muscarium* on nymphs was more than in the adults; and that Lm4 isolate of *L. muscarium* could be used as a potential against nymphs of *R. simulans* in natural conditions. In the studies that were conducted by Göktürk and Mıhlı (2015) in 2013-2014 on biotechnical control against pests, they tried light traps and colored sticky traps; they concluded that light traps could be used in the fight against this harmful pest.

As a result, it was concluded based on the results of this and of previous studies that the most effective, practical and feasible method for the fight against the harmful effects of pests were cultural measures, which include cleaning and destruction of the plant wastes that are infected with the eggs of the pest. Since this control method has been widely used for several years, the population of the pest can be brought under the level of economic damage. Subsequently, producers in the Eastern Black Sea region of Turkey can grow crops including beans, cucumbers and tomatoes for traditional family needs, and losses can be minimized.

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