The Future of Agriculture

FSA

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Different methods of releasing *Phytoseiulus persimilis* and *Neoseiulus californicus* to control *Tetranychus cucurbitacearum* (Sayed) (Acari: Tetranychidae) on two melon cultivars

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Future Science Association

Available online free at www.futurejournals.org

Print ISSN: 2687-8151

Online ISSN: 2687-8216

DOI: 10.37229/fsa.fja.2025.05.6

Received: 5 March 2025
Accepted: 25 April 2025
Published: 6 May 2025

Publisher's Note: FA stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Abstract: The dispersal of natural enemies throughout the crop is essential for biological control in crop management. Pests must be quickly reduced to extremely low levels in many crops, typically through preventative measures. The release strategy of predacious mites, *Phytoseiulus persimilis* and *Neoseiulus californicus* was investigated using various manual releasing methods against *Tetranychus cucurbitacearum* on two melon cultivars (Sakata and MacG5) throughout two seasons (2022-2023) at El-Beheira Governorate. Furthermore, the correlations between the two predacious mites and the phytophagous mite were studied. *P. persimilis* and *N. californicus* provided adequate control of *T. cucurbitacearum* after being released on both melon cultivars using three different ways over two seasons. The manually releasing methods (leaf, vermiculate, or pure) did not significantly differ in *P. persimilis* and *N. californicus* treatments separately. Pearson correlation tests between the mean numbers of two predacious mites and *T. cucurbitacearum* moving and egg stages show that *N. californicus* pure releasing methods have the highly significant negative correlation and the highest effect.

Key words: *P. persimilis*, *N. californicus*, *Tetranychus cucurbitacearum*, melon cultivars, release strategy, correlation.

1. Introduction

Watermelon, *Citrullus lanatus*, and muskmelon, *Cucumis melo*, belong to the Cucurbitaceae family and are two of the most important vegetable crops for Egyptian farmers. Melon quality is influenced by the amount of sugar in the fruits. Avoiding all stress during the growing season to achieve a high sugar content. Stress can be caused by a variety of factors, including phytophagous mites, insect pests, weeds, foliar diseases, inadequate or excessive watering, and low nutrition. (**Abou-Awad *et al.* 2017, a).** The majority of the Tetranychidae family is regarded as a serious phytophagous pest; according to **Hoque *et al.* (2010),** they directly harm field crops and greenhouses by attacking some vegetables and other agricultural crops. One of the primary pests that target a variety of agricultural products, such as soybeans, vegetables, and ornamentals, is the two-spotted spider mite, *T. urticae*, and *T. cucurbitacearum* **(Migeon and Donkeld 2007).** The lower leaf surface is the preferred feeding area for spider mites, which insert their piercing and sucking mouthparts into plant tissues. According to **Attia *et al.* (2013),** necrotic spots appear on the leaf surface of infected plants and are caused by the introduction of toxic compounds known as "phytotoxic" that harm and destroy plant tissues.

According to **McCurtry *et al.* (2013),** *P. persimilis* is a specialized predator of *Tetranychus spp*., which includes the two-spotted spider mites. **Ali and El-Laithy (2005)** reported that *T. urticae* and *T. cucurbitacearum* eggs, immature, and adult stages were the food source for the predatory mite species *N. californicus* and *P. persimilis.***Elbasheir *et al.* (2017)** came to the conclusion that the predatory mite *Phytoseiulus macropilis* can be employed in biological control programs because it can proliferate quickly and effectively control the tetranychid mite species *T. cucurbitacearum* and *E. zacheri*. The predatory mite *P. macropillis* (Bank) was reported by **Abd Elrahman and Ibrahiem (2007)** to feed on the eggs, nymphs, and adult stages of *T. urticae* Koch and *T. cucurbitacearum* (Sayed). On *T. urticae* and *T. cucurbitacearum*, the rates of reproduction were almost similar. The distance that the predators move from the release site should be considered in the release method. Predatory mites typically move between plants via ambulatory and aerial means **(Croft and Jung 2001)**. Because of aerial dispersal, predatory mites in outdoor crops can spread quickly across a crop **(Jung and Croft 2001).** The application of natural enemies in a greenhouse is still nearly always done manually even if the application of mechanical release devices would undoubtedly benefit from reducing distribution times and safeguarding operator health **(Opit *et al*. 2005; Pezzi *et al.* 2015)**.

The primary restriction of mechanical release is that beneficial organisms may be harmed during handling and distribution due to contact with mechanical elements and abrasion against carrier materials **(Pezzi *et al*., 2015).** Various release mechanisms can also be utilized, depending on the purpose. A popular strategy is the employment of bottle-maintained predatory mites, which are designed to spread quickly throughout plants **(Opit *et al.* 2005; Buitenhuis *et al.* 2010).** Predator and prey mites in slow-release sachets (breeding sachets) and a substratum composed of wheat bran are employed in another popular method **(Buitenhuis *et al.* 2014; Calvo *et al.* 2015).** Since a large number of predators are released from sachets over a prolonged period of time, this technique can be used to create predator populations before pests arrive in crops, according to **Buitenhuis *et al.* (2015) and Kumar *et al.* (2015).** *P. persimilis* is normally released using one of two methods: either a concentrated release, which releases predators mainly in areas where prey patches are found, or a broadcast release, which disperses predators uniformly over the whole greenhouse crop **(Shea and Possingham, 2000).** Predatory mites are dispersed either by air blast or direct introduction into crops using bran or vermiculite carriers sprinkled on leaves or substrates **(Buitenhuis *et al.* 2010, Opit *et al*. 2005).**

Objectives: Assess how various manual release methods of *Phytoseiulus persimilis* and *Neoseiulus californicus* affect the population of *Tetranychus cucurbitacearum* (Sayed) (Acari: Tetranychidae) in watermelon (*Citrullus lanatus* L.), and muskmelon, *Cucumis melo* L. (Family: Cucubitaceae) throughout two consecutive seasons in 2022–2023, Then, investigate the correlations between the stages of the phytophagous mite *T. cucurbitacearum* and the predatory mites (*Phytoseiulus persimilis* & *Neoseiulus californicus*) by different releasing methods at El-Beheira Governorate.

2. Materials and Methods

This study was conducted on a one-feddan plot in Badr Center, El-Beheira Governorate. The area was divided into two equal parts, with one melon cultivar in each half, each divided into seven plots (*N.*

californicus or *P. persimilis* in three releasing methods and control). Cultivars of watermelon (Sakata) and muskmelon (Mac G5) were grown in an open field for two seasons, 2022–2023. *T. cucurbitacearum* population dynamics at all stages, as well as the phytoseiid predatory mites *N. californicus* and *P. persimilis*, were recorded and tracked weekly on two melon cultivars over two seasons. Melon cultivars were transplanted in the third week of December of the years 202١ and 202٢, under plastic low tunnels, and the plastic was completely removed from the plants on the 5^{th} of February of the years 2022 and 2023, respectively. Transplanting of the seedlings is done in a single row in each bed at a planting distance of 75 cm and 50 cm for watermelon and muskmelon cultivars, respectively. The width of the bed was 2.5 and 2 meters for the same melon cultivars. The plastic is typically covered in the afternoon to promote plant development by warming the air surrounding the plants. The recommended nutrients are applied using drip irrigation. The first and second seasons began on 20^{th} January and ended on 4^{th} June. Thirty leaves/one melon cultivar/plot were randomly picked up weekly. Samples of leaves were placed directly into labeled perforated polyethylene bags, sealed with elastic bands, and transferred to the laboratory for stereomicroscope analysis.

P. persimilis and *N. californicus* were raised in a 3.5×8 m plastic-net greenhouse with 22 mesh porosity on *Phaseolus vulgaris* L. beans. After two weeks, beans were inoculated with *T. cucurbitacearum* infested leaves, and two weeks later, the two predatory phytoseiid mites on kidney bean leaves were transferred from the laboratory in an icebox and released in the greenhouse, which was partitioned into two isolated regions. The predatory mites were released at a rate of 10,000 per feddan on to watermelon and muskmelon plants. The release was carried out about 1-2 hours before nightfall. Following release, weekly samples were collected, and *T. cucurbitacearum* was evaluated alongside the two predatory mite species. Predatory mites can be released using one of three manual methods:

1. **Leaf:** Bean leaves containing the predator and a small number of prey were collected in a paper bag and transported to the field in an icebox, where the predator was released on watermelon and muskmelon plants. Each bean leaf has 100 predators, distributed at a rate of one leaf per 40 m^2, 100 leaves per feddan.

2. Vermiculate: Predator individuals are spread over vermiculite in a jar with a perforated lid; each jar holds 10,000 predators, one per feddan. Individuals are dispersed among melon leaves, flowing from the perforated container symmetrically between plants. Sprinkle them straight on plants.

3. Pure: Predators are enclosed in a small tube with a narrow nozzle. Each 40 m^2 tube housed 100 persons and was placed beneath the plants. One tube /40m^2 with 100 individuals was inserted beneath the plant, near the root above the soil surface. 100 tubes per feddan.

Statistical Analysis

The obtained data of mite numbers were subjected to the analysis of variance test [ANOVA] with a mean separation at a 5% level of significance; Tukey significant differences were used for comparison, and a Pearson correlation test was conducted using SPSS 20.

3. Results and Discussion

Two predatory mite species, *N. californicus* and *P. persimilis*, with three different releasing methods (leaf, vermiculate, and pure), were used to determine the most effective technique against *T. cucurbitacearum* infesting two melon cultivars (Sakata and Mac G5) over two consecutive seasons, 2022 and 2023.

1. The effect of predacious mites, *Phytoseiulus persimilis* and *Neoseiulus californicus*, in different releasing methods on *Tetranychus cucurbitacearum* counts in watermelon and muskmelon fields throughout the 2022-2023 seasons

T. cucurbitacearum infestation of the two melon cultivars watermelon “Sakata” and muskmelon “Mac G5” began in the third week of January under plastic low tunnel conditions, and it grew steadily in the open field conditions until the end of the seasons. Sakata watermelon and Mac G5 muskmelon cultivars had greater densities of *T. cucurbitacearum* moving stages, measuring 120.21 and 93.79 in 2022 and 130.66 and 95.35 in 2023, respectively. In a similar vein, Sakata watermelon and Mac G5 muskmelon cultivars had greater *T. cucurbitacearum* egg densities, reaching 114.58 and 108.1 in the first season and 116.37 and 111.92 in the second, respectively (Tables 1-2). The mean numbers of *T. cucurbitacearum* on both melon cultivars are significantly impacted by the two phytoseiid predatory mites, *P. persimilis* and *N. californicus*, with varying releasing methods (leaf, vermiculite, and pure). Similarly, **Wahba and Ghallab (2015)** found that the release of predatory mites, *Esieus scutalis* and *phytoseiulus persimilis*, had a good influence against phytophagous mites, *Tetranychus urticae*, and *T. cucurbitacearum* on Zena hybrid, a type of cucumber plant. Bean leaflets that contained the predator individuals released the predators. *P. persimilis*, a phytoseiid mite, had a greater impact on the aforementioned pests than *Esieus scutalis. T. urticae* eggs and mobile stages showed a reduction percentage of 90.75 and 73.76%, respectively, while *T. cucurbitacearum* showed a reduction of 66.62 and 94.76% at the same stages.

Low mean numbers of *T. cucurbitacearum* moving and egg stages in the current investigation indicate that *P. persimilis* and *N. californicus* had great efficacy. The similar outcome was reached by **Abou-Awad *et al.* (2017b)** who evaluated the efficiency of *P. persimilis* against the two-spotted spider mite *T. urticae* Koch when infesting two cultivars of both watermelon (Giza (6) & Sakata) and muskmelon (Gal (3) & Dahabi) under plastic low tunnels and open field conditions at Beheira Governorate, Egypt, in the year 2015. A highly reduced percentage was achieved by the predatory mite *P. persimilis*, which had a higher reproductive capacity and the longest possible period of the biological control. **Hassan *et al.* (2007)** came to the same conclusion when they employed *N. californicus*, *P. macropilis*, *N. cucumeris*, and *N. zaheri* to decrease the number of *T. urticae* and other sucking insect pests on cucumber plants. On strawberries, *N. californicus* and *P. persimilis* were the most effective predators for reducing *T. urticae*, where the reduction percentages ranged from 71.78 to 97.20% **(El-Saiedy 2003).** Previously, three predatory mite species, *P. persimilis*, *N. cucumeris*, and *N. californicus*, were investigated by **El-Saiedy *et al.* (2008)** in order to suppress the TSSM on two cultivars of eggplant in an open field. They discovered that *N. cucumeris* had the lowest percentages of decrease. **El-Saiedy *et al.* (2015)** assessed the effectiveness of two predatory mite species, *Amblyseius swirskii* and *N. californicus*, against the tetranychid mite, *T. cucurbitacearum* infesting six eggplant cultivars in both open field and greenhouse conditions. The predatory mite *N. californicus* achieved a very high reduction percentage, while *A. swirskii* gave the lowest.

There was no significant difference in the mean numbers of *T. cucurbitacearum* in the three distinct releasing methods (leaf, vermiculite, and pure) on each cultivar in two consecutive seasons, 2022 and 2023, as shown in Tables 1-2. Even though the leaf mode had the lowest mean numbers on melon cultivars throughout 2022 and 2023, there was a slight difference between the three treatments (leaf, vermiculite, and pure) on the mean number of *T. cucurbitacearum* sampled in the two phytoseiid predatory mites released. Previous researchers have tested different release methods and their effects on pest control, **Lanzoni *et al.* (2017)** investigated various methods of application of release, including hand-spraying, separate mechanical release, combined mechanical release, and paper sachets of *P. persimilis* and *A. swirskii* against *T. urticae* and *Frankliniella occidentalis* on protected crops.The mechanical release allows for a considerable reduction in distribution time when compared to hand application while showing equal pest control effectiveness. In all treatments, *P. persimilis* was able to effectively control *T. urticae*, but in the case of *A. swirskii* release, successful control of *F. occidentalis* required the use of a final spinosad application. **Casey and Parrella (2005)** examined the use of interplant bridges and a mechanical dispenser. In comparison to controls without dispersal help, the amount of *T. urticae*-infested leaves was reduced by around 50% utilizing interplant bridges or a mechanical dispenser after three weeks in the greenhouse; nevertheless, there was no difference between the dispersal techniques. **Alatawi *et al.* (2011)** assess the impact of predator release pattern and prey distribution on the rate of suppression of *T. urticae*. Spider mite numbers decreased in all treatments nine days following the introduction of the predator, but they were only undetectable in the clumped pest-clumped predator treatment. The treatment involving clumped spider mites (C: equally distributed among the four central plants) and even predators (E: equal numbers on all plants) had the least effective pest reduction. Spider mites were eliminated in all treatments eighteen days following the release of the predator. However, the densities of spider mites dropped more quickly when the predator and prey had the same starting distribution (E–E or C–C) than when they diverged (E–C or C–E).

The density of eggs and mobile stages of *T. cucurbitacearum* was lower in *P. persimilis* than in N. *californicus* treatments. *P. persimilis* release proved to be the most effective in reducing *T. cucurbitacearum* population. So the most effective strategy in our experiments was *P. persimilis* leaf-releasing methods in two melon cultivars. These findings can be explained by the wide variations in phytoseiid predatory mite dispersal distances. Compared to generalist species, specialist species *P. persimilis* appear to travel more and disperse aerially. However, the mean travel distances of *A. swirskii* in the dispersal research were less than 10 cm, which was comparable to the generalist predatory mites after five days in a patch of bean plants **(Jung and Croft, 2001).** In a chrysanthemum greenhouse, for instance, **van de Vrie (1985)** observed that *P. persimilis* could spread 10–15 m in 1 week if the canopy was closed and across open gaps between beds.

Table (1). The predation efficiency of *Phytoseiulus p*ersimilis on *Tetranychus cucurbitacearum* in watermelon and muskmelon fields during the 2022 and 2023 seasons

plant	Releasing methods	Stages	Mean± SE 2022	Mean± SE 2023	F 2022	F 2023
Sakata watermelon	Leaf	Moving	11.57 ± 1.81 b	11.57 ± 1.81 b	51.55***	51.55***
	Vermiculite		13.58 ± 1.78 b	13.58 ± 1.78 b		
	Pure		15.6 ± 1.78 b	15.6 ± 1.78 b		
	Control		120.21 ± 14.56 a	120.21 ± 14.56 a		
	Leaf	Egg	9.11 ± 1.5 Y	9.11 ± 1.5 y	59.95***	59.95***
	Vermiculite		16.21 ± 2.27 Y	16.21 ± 2.27 y		
	Pure		17.56 ± 2.14 Y	17.56 ± 2.14 Y		
	Control		114.58 ± 12.51 X	114.58 ± 12.51 X		
Mac G5 muskmelon	Leaf	Moving	10.74 ± 1.25 b	10.74 ± 1.25 b	45.28***	45.28***
	Vermiculite		11.84 ± 1.34 b	11.84 ± 1.34 b		
	Pure		12.49 ± 1.23 b	12.49 ± 1.23 b		
	Control		93.79 ± 11.99 a	93.79 ± 11.99 a		
	Leaf	Egg	12.78 ± 1.38 Y	12.78 ± 1.38 Y	81.88***	81.88***
	Vermiculite		14.09 ±1.34 Y	14.09 ±1.34 Y		
	Pure		14.47 ± 1.32 Y	14.47 ± 1.32 Y		
	Control		108.1 ± 10.16 X	108.1 ± 10.16 X		

Means with the same letter (a,b) Or (X, Y) are not significantly different in the same column for each stage and melon cultivar separately. *** means highly significant

Table (2). The predation efficiency of *Neoseiulus californicus* on *Tetranychus cucurbitacearum* in watermelon and muskmelon fields during the 2022 and 2023 seasons

Plant	Releasing methods	Stages	Mean± SE		F	
			2022	2023	2022	2023
Sakata watermelon	Leaf	Moving	15.07± 1.53 b	15.19 ± 1.56 b	49.55***	68.17***
	Vermiculite		16.04 ± 1.53 b	15.80 ± 1.40 b		
	Pure		17.37± 1.42 b	16.74 ± 1.32 b		
	Control		120.21± 14.56 a	130.66 ± 13.68 a		
	Leaf	Egg	14.67± 1.64 Y	16.01 ± 1.14 Y	59.94***	62.06***
	Vermiculite		15.51± 1.5 Y	17.22 ± 0.99 Y		
	Pure		17.31± 1.19 Y	18.24 ± 0.89 Y		
	Control		114.58 ± 12.51 X	116.38 ± 12.47 X		
Mac G5 muskmelon	Leaf	Moving	13.22± 1.2 b	15.57 ± 0.86 b	42.88***	42.16***
	Vermiculite		14.10± 1.19 b	16.59 ± 0.66 b		
	Pure		14.89 ± 1.17 b	17.23 ± 0.68 b		
	Control		93.79 ± 11.99 a	95.35 ± 12.08 a		
	Leaf	Egg	13.01± 1.13 Y	16.86 ± 1.03 Y	87.37***	81.25***
	Vermiculite		14.37± 1.11 Y	18.21 ± 0.97 Y		
	Pure		15.74± 0.99 Y	19.34 ± 0.91 Y		
	Control		111.92± 10.27 X	111.92 ± 10.27 X		

Means with the same letter (a,b) Or (X, Y) are not significantly different in the same column for each stage and melon cultivar separately. *** means highly significant

2. The relationship between *Tetranychus cucurbitacearum's* moving and egg stages and the two predatory mites

On watermelon, the mean numbers of *T. cucurbitacearum* moving and egg stages during 2022–2023 were significantly correlated negatively with the release of *P. presimilis* using three different methods; the r value varied between -0.48 and -0.721, and the significance ranged between 0.026 and 0.001. The explained variance, on the other hand, shows a 23.02 to 51.98% effect on *T. cucurbitacearum* stages (Table 3). The greatest impact was produced by the pure releasing method.

On muskmelon cultivars the mean number of *T. cucurbitacearum* stages was negatively correlated with *P. presimilis* releasing techniques; the explained variation ranged from 0.64 to 13.75% in 2022 season, On the other hand, the pure releasing strategy produced notable negative relationships with moving and egg stages in 2023; these effects varied from 25.47 to 46.47%. The mean number of *T. cucurbitacearum* moving stages is adversely non-significantly affected by leaf and vermiculite releasing techniques (9.49-16.9), whereas the mean number of egg stages is negatively significant (24.69-36.4), table (3).

N. californicus release on watermelon using three different methods was significantly correlated negatively with the mean numbers of *T. cucurbitacearum* moving and egg stages during 2022–2023; the explained variance varied between 20.41 and 74.2% effect on *T. cucurbitacearum* stages, table (4). The process of pure release has the greatest impact.

In the muskmelon cultivar, there was a non-significant negative correlation between *N. californicus* leaf-releasing method and moving and egg stages in 2022, while in 2023 the same relation showed a significant negative correlation with an explained variance of 21.79 and 21.67, respectively. Pure and vermiculite-releasing methods have a negatively significant correlation with mean numbers of *T. cucurbitacearum* moving and egg stages during 2022-2023; their effect value ranged between 25.10 and 83.65. The highest effect was achieved by the pure releasing technique (Table 4).

Many previous studies have discussed this relationship; **Nascimento *et al.* (2022)** concluded that *N. californicus* and *T. urticae* individuals are strongly correlated with each other regardless of the environmental variables. **Wilson *et al.* (1998)** discovered significant positive relationships between predators and the lag period required for *T. urticae* outbreaks to develop in cotton, as well as significant negative relationships between the mid-season abundance of *T. urticae* and the abundance of predators (a theridiid spider, a phytoseiid mite, a lacewing larva, predatory thrips, several Coccinellidae, and several Hemiptera). Predation is an important factor affecting *T. urticae's* early-season survival. **Wilson *et al.* (1991)** found that omnivorous predators (*F. occidentalis*, *Orius tristicolor*, *Geocoris pallens*, and *G. punctipes*) may be useful in postponing the accumulation of spider mites, with the adult *F. occidentalis* showing (r^2=0.65) correlation. The ability of Geocoris to slow the rate of expansion in the spider mite population was demonstrated (r^2 = 0.73). The ability to reduce the quantity of early-season spider mites was demonstrated by all three studied predator species, with Geocoris and Orius showing the greatest capacity to do so (r^2 = 0.62). In addition, mid- to late-season spider mite numbers may have been suppressed by predators. The results of multiple regression analysis showed a strong inverse relationship between the quantity of spider mites in the mid- to late season and the predators in the early season. According to **Colfer *et al.* (2003),** there was a strong correlation between the densities of predatory mites and spider mites, indicating that plants with higher prey availability were the sites of the highest recruitment of predatory mites. The abundance of predatory mites was significantly impacted by the population of spider mites (F = 4.4, df = 1, P = 0.043). **Fitzgerald *et al.* (2008)** discovered that *T. urticae* and *N. californicus* were more common on older plant leaves, as evidenced by a significant positive correlation between both. However, **Reis *et al*. (2008)** did not find any significant associations between the population levels of *Aceria guerreronis* Keifer (Acari: Eriophyidae) and phytoseiids.

Table (3). Pearson Correlation test between the predacious mite, *Phytoseiulus persimilis* (different releasing methods), and *Tetranychus cucurbitacearum* in watermelon and muskmelon fields during 2022 and2023 seasons

Plant	Releasing methods	Stages	Correlation Coefficient				Explained Variance %	
			2022		2023			
			r	Sig.	r	Sig.	2022	2023
Sakata watermelon	Leaf	Moving	-0.495	0.022	-0.53	0.014	24.49	28.41
	Vermiculate		-0.564	0.009	-0.61	0.005	31.76	36.89
	Pure		-0.696	0.001	-0.69	0.001	48.47	48.06
	Leaf	Egg	-0.480	0.026	-0.541	0.012	23.02	29.25
	Vermiculate		-0.576	0.008	-0.625	0.004	33.16	39.01
	Pure		-0.721	0.001	-0.672	0.002	51.98	45.22
Mac G5 muskmelon	Leaf	Moving	-0.08	0.380	-0.31	0.115	0.64	9.49
	Vermiculate		-0.19	0.236	-0.40	0.055	3.49	16.09
	Pure		-0.33	0.101	-0.51	0.019	10.59	25.47
	Leaf	Egg	-0.23	0.187	-0.50	0.021	5.30	24.69
	Vermiculate		-0.31	0.116	-0.60	0.005	9.39	36.40
	Pure		-0.37	0.071	-0.68	0.001	13.75	46.47

Table (4). Pearson Correlation test between the predacious mite, *Neoseiulus californicus* (different **releasing methods), and *Tetranychus cucurbitacearum* in watermelon and muskmelon fields during 2022 and2023 seasons**

plant	Releasing methods	Stages	Correlation Coefficient				Explained Variance %	
			2022		2023			
			r	Sig.	r	Sig.	2022	2023
Sakata watermelon	Leaf	Moving	-0.584	0.007	-0.68	0.001	34.09	46.43
	Formeculite		-0.674	0.002	-0.75	0.000	45.39	56.23
	Pure		-0.794	0.000	-0.86	0.000	63.03	74.20
	Leaf	Egg	-0.452	0.034	-0.60	0.006	20.41	35.87
	Formeculite		-0.688	0.001	-0.77	0.000	47.31	59.26
	Pure		-0.765	0.000	-0.79	0.000	58.48	62.56
Mac G5 muskmelon	Leaf	Moving	-0.351	0.084	-0.47	0.029	12.31	21.79
	Formeculite		-0.549	0.011	-0.74	0.000	30.13	54.23
	Pure		-0.847	0.000	-0.92	0.000	71.81	83.65
	Leaf	Egg	-0.287	0.132	-0.47	0.030	8.26	21.67
	Formeculite		-0.501	0.020	-0.74	0.000	25.10	55.24
	Pure		-0.798	0.000	-0.88	0.000	63.72	76.75

4. Conclusion

The two predatory mite species *P. persimilis* and *N. californicus* exhibited varying decline percentages of egg and moving stages of TSSM in the two melon cultivars (Mac G5 and Sakata). With the lowest mean number of moving and egg stages, *T. cucurbitacearum* population was generated using the *P. persimilis* leaf release method. While studying the relationship between releasing techniques and *T. cucurbitacearum* population on two melon cultivars, we found that pure releasing methods of *N. californicus* have the biggest effect and the most significant negative correlation with *T. cucurbitacearum* movement and egg stages.

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