Persian J. Acarol., 2020, Vol. 9, No. 1, pp. 57–66.
http://dx.doi.org/10.22073/pja.v9i1.55513
Journal homepage: http://www.biotaxa.org/pja

ISSN 2251-8169
PERSIAN JOURNAL OF ACAROLOGY

Article

Foliar amendment of silicic acid on population of yellow mite, *Oligonychus sacchari* (Acari: Tetranychidae) and its predatory beetle, *Stethorus gilvifrons* (Col.: Coccinellidae) on two sugarcane commercial varieties

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ABSTRACT
Sugarcane (interspecific hybrids of *Saccharum*) is a strategically important cash crop that has an economic and social impact in many countries. Sugarcane mite, *Oligonychus sacchari* is one of the most detrimental arthropod pests associated with sugarcane during summer. Control of this pest is mainly based on chemical pesticides and cultural practices as well as the application of silicon as a nutritional component of an integrated crop management. In this study, effects of silicon were evaluated on *O. sacchari.* Experiments were carried out during 2014–2015 and 2015–2016 at Salman Farsi Agro Industry Farms, Ahwaz-Iran. The two varieties (CP57-614 and CP48-103) were treated by silicic acid fertilizer as foliar application. Five treatments including one spray (0.5 lit/ha), two sprays (0.5 and 1 lit/ha 3 weeks after spray 1), three sprays (0.5, 1 and 1 lit/ha 4 weeks after spray 2), four sprays (0.5, 1, 1 and 1 lit/ha 4 weeks after spray 3) and Control were applied. In each plot, 15 leaves were randomly selected from bottom, mid and top of plant and number of living mites and dry leaves were recorded. Samples were collected 7, 14, 21 and 28 days after the forth application of silicic acid. The results showed that all treatments had significant effects in mite population and leaf dryness versus Control. Among different treatments of silicic acid, four spray application of silicic acid was more efficient than other treatments on mite damage and leaf dryness. It seems that the silicic acid would be a promising product for management of mite damage and could be incorporated with other management strategies in sugarcane IPM.

KEY WORDS: Ladybird; mite damage; mortality; silicon; sugarcane IPM.

PAPER INFO.: Received: 28 June 2019, Accepted: 3 December 2019, Published: 15 January 2020

INTRODUCTION

Sugarcane (interspecific hybrids of *Saccharum*) is widely used for production of sugar and several by-products such as bagasse, vinasse, molasses, paper, animal food as well as bio-diesel from energy canes in tropical and subtropical climates (James 2004). This crop is considered as a perennial industrial plant which has a profound role in socio-economic issues. The majority of sugarcane commercial production in Iran occurs in Khuzestan province on > 100,000 hectares in 10 agro-industrial complexes under fully irrigated systems (Sadeghzadeh-Hemayati *et al.* 2011). As a mono-

How to cite: Nikpay, A. & Laane, H.-M. (2020) Foliar amendment of silicic acid on population of yellow mite, *Oligonychus sacchari* (Acari: Tetranychidae) and its predatory beetle, *Stethorus gilvifrons* (Col.: Coccinellidae) on two sugarcane commercial varieties. *Persian Journal of Acarology*, 9(1): 57–66.

culture, sugarcane is vulnerable to a wide range of biotic stresses including insect and mite herbivores which can negatively affect both sugarcane quantity and quality (Goebel and Nikpay 2017). Sugarcane is affected by a wide-range of mite species with the most invasive and harmful species belonging to the genus *Oligonychus*. In addition to sugarcane, *Oligonychus* spp. may also infest wild relatives of *Saccharum* as well as annual and perennial grass weeds (Beard *et al.* 2003). Sugarcane mite, *Oligonychus sacchari* McGregor (Acari: Tetranychidae) is one of the most notorious arthropod pests associated with sugarcane in Iran, beginning its activity in early-May and continuing during summer (Nikpay and Goebel 2016). Early populations of *O. sacchari* may build up on grass weeds in field borders and then colonize on lower leaf surfaces of the crop (Askarianzadeh *et al.* 2002). Infested leaves become pale and chlorotic and in severe cases the entire plant will desiccate (Ziaee and Nikpay 2016). Under field conditions, control of sugarcane and other Tetranychidae mites is multi-strategic including synthetic and botanical acaricides (Singh *et al.* 2003; Nikpay *et al.* 2012, 2016; Mohammadi *et al*. 2016; Ziaee *et al.* 2017), varietal resistance (Nikpay and Goebel 2018), biological control (Biddinger *et al.* 2009) and cultural control (Nikpay and Goebel 2016). One relatively new approach for management of pests in sugarcane is application of silicon as a nutritional amendment (Reynolds *et al.* 2009; Liang *et al.* 2015; Nikpay *et al.* 2015). Among agricultural and horticultural crops, sugarcane is efficient in its uptake of silicon. Silicon, the second most abundant element on earth surface, is absorbed by plants in the form of monosilicic acid ($Si(OH)_4$) (Epstein 1994; Tubaña and Heckman 2015). Silicon has been considered as a beneficial agronomic element for sugarcane production, and different silicon formulations including solid (calcium silicate) and liquid (in the form of potassium silicate) have been widely used in various sugarcane producing countries (Savant *et al.* 1999; Bent 2014; Reynolds *et al.* 2016; Laane 2017). In sugarcane, silicon is applied for control of stalk borers (Kvedaras and Keeping 2007; Keeping *et al.* 2009, 2013; Nikpay 2016; Nikpay *et al*. 2017), management of spittle bugs (Korndörfer *et al.* 2011) and mites (Nikpay and Soleyman Nejadian 2014). An increased physical barrier produced by silicon deposition under leaf cuticles has been largely attributed to perform as a main component underlying silicon-mediated plant resistance to arthropod pests (Reynolds *et al.* 2016). One new formulation of silicon produced by Rexil-Agro Company is marketed as a bio-stimulant and recommended as a foliar spray in various agricultural and horticultural products (Laane 2017). However, there is little information on the impact of silicon on sugarcane mite management. Hence, the aim of this study was to evaluate the impact of silicic acid on mite and predatory beetle populations, and on different quality characteristics of sugarcane (%pol, brix and %purity).

MATERIAL AND METHODS

Silicon formulation

The Silicic Acid Agro Technology (SAAT) is the applicable form of stabilized silicic acid. AB Yellow ® is a new silicic acid patent which is developed by Rexil-Agro Company (The Netherlands). It is stabilized silicic acid in which polymerization of silicon is prevented. AB Yellow® is containing 2.5% plant-available silicic acid (0.8% Si) in combination with 0.3% boron, 1.5% zinc, 0.15% copper and 0.1% molybdenum.

Experimental site and cultivation of varieties

Field experiments were carried out during 2014–2015 (March-July) and 2015–2016 (March-July) at Salman Farsi Agro Industry Farms (48° 35' E, 31º 08 'S), Ahwaz-Iran. The two varieties used in this research are CP57-614 and CP48-103 which are considered as susceptible to *O. sacchari* infestation (Nikpay and Goebel 2018). A randomized complete block design with four blocks was used. Each experimental plot consisted of four rows, 10 meter long and 1.8 meter spaced (between two furrows) in different locations in the field (54 m^2 for each plot). This plot arrangement was used for our experiment because plots for trials in sugarcane are recommended to be at least 20 m^2

(Laycock 2004). All varieties were planted under standard tillage, complete plough-out of previous crop remaining, followed by ridging at 1.8 m row spacing through the field. Before planting of sugarcane varieties, phosphorous fertilizer (super phosphate triple/300 kg per hectare) was added with a pneumatic fertilizer machine based on standard procedures for sugarcane nutrient treatments in Iran. Each sugarcane variety was planted as billets (50–70 cm and free from pest infestation) and subsequently, all rows were treated with Atrazine and Sencor herbicides (2 + 2 kg per hectare) based on local recommendations for suppression of annual weeds. All plots received the same irrigation regime according to local recommendations.

Silicon treatment, sampling procedure and evaluation of sugarcane quality characteristics

Five treatments including one spray (on 10 March; 0.5 lit/ha), two sprays (0.5 and 1 lit/ha 3 weeks after spray 1), three sprays (0.5, 1 and 1 lit/ha 4 weeks after spray 2), four sprays (0.5, 1, 1 and 1 lit/ha 4 weeks after spray 3) and Control were applied. All treatments were applied as foliar applications with a 15 liter volume knapsack sprayer (Hardi International, England). Control plots did not receive silicic acid or water. In each plot, 15 leaves were randomly selected from bottom, mid and top of plant. Leaves were kept in plastic bags, returned to laboratory and number of living mites was counted under a stereomicroscope (STZ800 Nikon, Tokyo, Japan). Samples were collected 7, 14, 21 and 28 days after the fourth application of silicic acid. Moreover, after the final sampling period, total number of non-infested and infested leaves (necrosis) was recorded and the percentage of necrosis leaves (mentioned as dry leaf) for each variety was calculated. In order to assess the side effects of different silicic acid treatments on the predatory beetle, *Stethorus gilvifrons* (Mulsant) (Coleoptera: Coccinellidae) populations, the number of living beetles (both larvae and adults) was counted following the same procedures for determining mite numbers. Because adult beetles were very active, recording of predatory beetles was performed in the field. Predatory beetles were sampled on 1 June and 1 July 2015 and 2016. For evaluation of the effects of silicic acid treatment (only treatment of four applications of silicic acid evaluated) on sugar quality, prior to harvest (2015 and 2016), 10 whole stalks (in each plot) were randomly selected. Collected stalks were topped by hand at the natural breaking point (behind the last fully expanded internode). For sugar quality assessments, six replications were used. Each bundle of 10 stalks was fed through a chipper disintegrator and sub-samples were analyzed for cane juice quality (%Pol, Brix and %Purity). The polarity (%Pol) and Brix of sugarcane juice were determined by a polarimeter (Optical Activity Ltd, England) and refractometer (Index Instruments, England). Purity was determined with the following formula: Pol/Brix×100.

Data analysis

All data were analyzed for normality and homogeneity of variance (Bartlett's test), and appropriate transformations [arcsin, or log (x+1)] were applied where these conditions were not met, before analysis of variance was performed. However, untransformed data is presented in the tables. All analyses were performed with SPSS software (SPSS version 16, SPSS International, Chicago, USA). Tukey HSD test was used for means comparisons between treatments at 0.05 significance levels. For sugar quality assessments a T-test analysis was performed.

RESULTS

In 2015, on CP57-614 variety, number of *O. sacchari* ranged from 14.5 mites per leaf, 7 days after four-time application of silicon, to 128.5 mites per leaf in the untreated control on 28th sampling date. Results indicated that the mean number of mites increased over time from spraying silicon. The highest percentage of dry leaves was observed in control (48%) followed by one-time application of silicon with 41.7% dry leaves on CP57-614 sugarcane variety (Table 1).

Table 1. Mean number of living mite, *Oligonychus sacchari* per leaf on different sampling period and %dry leaf on variety CP57-614 (2015).

	7 day	14 day	21 day	28 day	% Dry leaf
1	31.5 ± 1.55c	52.7 ± 2.28d	78.2 ± 2.32d	101.5 ± 1.55d	41.7 ± 1.18c
2	23.7 ± 0.75b	41.5 ± 1.32c	68.2 ± 0.85c	84.7 ±1.71c	37.2 ±1.11c
3	19.0 ± 0.91ab	35.0 ± 1.08b	48.0 ± 1.08b	59.5 ± 1.55b	29.2 ± 1.25b
4	14.5 ± 1.04a	22.0 ± 1.08a	34.5 ± 1.55a	44.7 ± 2.56a	19.7 ± 0.85a
Control	34.0 ± 1.68d	62.7 ± 1.11e	92.7 ± 2.29e	128.5 ± 3.30e	48.0 ± 1.08d
$F_{4,19}$; P	43.7; 0.000	117.6; 0.000	181.9; 0.000	219.5; 0.000	99.7; 0.000

Means followed by the same letter in each column are not significantly different using Tukey's Test at $P < 0.05$.

Table 2. Mean number of living mite *Oligonychus sacchari* per leaf on different sampling period and %dry leaf on variety CP57-614 (2016).

	7 day	14 day	21 day	28 day	% Dry leaf
1 application	30.7 ± 1.25c	51.7 ± 0.85d	70.5 ± 2.10d	96.2 ± 1.75d	41.2 ± 0.75c
2 application	22.7 ± 1.11b	41.2 ± 1.38c	64.5 ± 1.32c	82.2 ± 1.11c	36.5 ± 1.19c
3 application	19.5 ± 1.44ab	33.2 ± 0.75b	44.5 ± 1.04b	58.5 ± 0.96b	27.5 ± 1.04b
4 application	13.7 ± 1.31a	20.0 ± 0.82a	32.0 ± 1.08a	43.5 ± 1.85a	18.0 ± 1.47a
Control	33.5 ± 2.33d	56.5 ± 1.55e	91.5 ± 3.97e	130.7 ± 3.59e	46.7 ± 1.38d
$F_{4,19}$; P	27.3; 0.000	170.6; 0.000	110.9; 0.000	267.9; 0.000	91.2; 0000

Means followed by the same letter in each column are not significantly different using Tukey's Test at $P < 0.05$.

In the experiment which was conducted in 2016, the number of living mite *O. sacchari* was 30.7 mites per leaf in one-time application of silicon at 7-day sampling time, while 13.7 mites per leaf was observed when silicon was sprayed for four times. The mites' population recovered over time up to 28-day sampling time, and the number went up to 96.2 and 43.5 mites per leaf, respectively. The percentage of dry leaves was greatest in the control group of CP57-614 where 46.7% of leaves were dried. In contrast, percentage of dry leaves was only 18.0% on CP57-614 sugarcane variety treated with four sprays of silicon formulation (Table 2).

In 2015, total mite population in CP48-103 variety was 31.2 mites per leaf on untreated control, at 7-day sampling period and reached a maximum of 111.0 mites per leaf at 28-day sampling time. However, the lowest number of mites on CP48-103 was 13.2 mites per leaf at silicon four-application after 7 days and evidently increased to 41.2 mites per leaf after 28 days. The dry leaves percentage significantly reduced with an increase in the number of silicon foliar applications, indicating that silicon protected CP48-103 sugarcane variety from *O. sacchari* damage (Table 3).

Table 3. Mean number of living mite *Oligonychus sacchari* per leaf on different sampling period and %dry leaf on variety CP48-103 (2015).

	7 day	14 day	21 day	28 day	% Dry leaf
1 application	27.5 ± 1.04c	48.0 ± 1.08d	74.0 ± 2.27d	86.2 ± 1.75d	39.7 ± 0.63c
2 application	22.5 ± 0.87b	41.2 ± 0.48c	65.5 ± 1.55c	76.2 ± 1.31c	35.7 ± 0.48c
3 application	18.5 ± 0.96b	33.5 ± 0.64b	45.2 ± 0.85b	56.0 ± 1.82b	27.5 ± 1.03b
4 application	13.2 ± 0.48a	21.2 ± 1.11a	30.7 ± 1.11a	41.2 ± 1.49a	16.2 ± 0.75a
Control	31.2 ± 1.11c	59.7 ± 1.38e	85.0 ± 2.27e	111.0 ± 1.47e	44.7 ± 1.70d
$F_{4,19}$; P	60.3; 0.000	214.3; 0.000	163.5; 0.000	291.6; 0.000	121.3; 0.000

Means followed by the same letter in each column are not significantly different using Tukey’s Test at $P < 0.05$.

The results of silicon foliar application on CP48-103 sugarcane variety in 2016 are shown in Table 4. The abundance of *O. sacchari* was low on four-time silicon application, but increased significantly with a reduction in silicon spray number. The highest dry leaves percentage occurred in the control (43.0%) and decreased by 15.2% when silicon was applied for four sprays (Table 4).

Table 4. Mean number of living mite *Oligonychus sacchari* per leaf on different sampling period and %dry leaf on variety CP48-103 (2016)

	7 day	14 day	21 day	28 day	% Dry leaf
1 application	28.0 ± 1.47c	46.0 ± 1.87d	71.2 ± 1.49d	82.5 ± 1.04d	38.0 ± 0.41c
2 application	21.5 ± 0.65b	39.0 ± 0.91c	62.7 ± 1.11c	73.2 ± 1.38c	35.0 ± 0.41c
3 application	18.2 ± 0.75b	32.5 ± 0.87b	42.5 ± 0.64b	51.7 ± 0.85b	26.2 ± 0.75b
4 application	13.7 ± 0.63a	20.0 ± 0.41a	29.2 ± 0.75a	38.7 ± 0.75a	15.2 ± 0.25a
Control	32.5 ± 1.19d	56.0 ± 1.19e	82.7 ± 1.11e	105.0 ± 2.12e	43.0 ± 1.22d
$F_{4,19}$; P	56.8; 0.000	142.2; 0.000	414.1; 0.000	384.9; 0.000	243.2; 0.000

Means followed by the same letter in each column are not significantly different using Tukey's Test at $P < 0.05$.

We found *Stethorus gilvifrons* in the sugarcane fields on June 15. The mean number of 2.25 and 1.75 coccinellids per leaf was recorded from control plots of CP57-614 and CP48-103 on 2015, respectively. Number of predator *S. gilvifrons* increased approximately four times in both sugarcane varieties on July 15. The population of *S. gilvifrons* predator was not significantly influenced by application of silicon in both tested varieties. Similar results were obtained in 2016 (Table 5).

Table 5. Mean number of living stages of predatory beetle, *Stethorus gilvifrons* per leaf on varieties CP57-614 and CP48-103 (2015 and 2016).

Variety		**2015**		**2016**	
		15 June	**15 July**	**15 June**	**15 July**
CP57-614	1 application	2.25 ± 0.25a	9.25 ± 0.25a	2.0 ± 0.41a	8.0 ± 0.41a
	2 application	2.0 ± 0.41a	8.75 ± 0.25a	1.75 ± 0.25a	7.25 ± 0.48a
	3 application	1.5 ± 0.48a	8.5 ± 0.29a	1.75 ± 0.48a	7.25 ± 0.48a
	4 application	1.75 ± 0.48a	9.25 ± 0.25a	2.25 ± 0.25a	7.25 ± 0.25a
	Control	2.25 ± 0.17a	9.5 ± 0.29a	2.5 ± 0.28a	8.25 ± 0.25a
$F_{4,19}$; P		0.69; 0.61	2.38; 0.09	0.88; 0.49	3.12; 0.06
CP48-103	1 application	1.5 ± 0.29a	6.5 ± 0.28a	1.75 ± 0.25a	7.5 ± 0.29a
	2 application	1.5 ± 0.5a	6.25 ± 0.25a	1.5 ± 0.25a	7.0 ± 0.41a
	3 application	1.25 ± 0.29a	6.25 ± 0.25a	1.5 ± 0.29a	7.25 ± 0.25a
	4 application	1.5 ± 0.29a	6.25 ± 0.25a	2.0 ± 0.41a	6.75 ± 0.48a
	Control	1.75 ± 0.25a	7.0 ± 0.41a	2.0 ± 0.58a	7.75 ± 0.25a
$F_{4,19}$; P		0.29; 0.88	1.21; 0.35	0.75; 0.57	1.29; 0.32

Means followed by the same letter in each column are not significantly different using Tukey's Test at $P < 0.05$.

Our results showed that the pol percentage, brix quantity and purity percentage was higher in the silicon treated varieties when compared with untreated control in 2015. Similarly, the average pol, brix and purity level was also higher in silicon treated sugarcane varieties in 2016 (Table 6).

Table 6. Effects of silicon treatment on sugarcane quality characteristics.

Variety		2015			2016		
		% Pol	Brix	% Purity	% Pol	Brix	% Purity
CP57-614	Silicon	18.2 ± 0.22a	20.4 ± 0.21a	89.2 ± 0.14a	18.9 ± 0.2a	21.1 ± 0.22a	89.5 ± 0.12a
	Control	16.4 ± 0.34b	18.9 ± 0.3b	86.7 ± 0.48b	16.5 ± 0.27b	18.9 ± 0.27b	87.6 ± 0.28b
t_{10}; ***P***		4.53; 0.002	4.15; 0.002	4.91; 0.003	7.35; 0.001	6.51; 0.001	6.56; 0.001
CP48-103	Silicon	18.5 ± 0.26a	20.6 ± 0.29a	89.8 ± 0.12a	18.4 ± 0.29a	20.4 ± 0.31a	90.4 ± 0.35a
	Control	17.0 ± 0.11b	19.2 ± 0.11b	88.6 ± 0.28b	17.2 ± 0.09b	19.3 ± 0.09b	89.2 ± 0.11b
t_{10}; ***P***		5.45; 0.001	4.68; 0.001	3.79; 0.007	4.13; 0.006	3.46; 0.014	3.39; 0.014

Means followed by the same letter in each column are not significantly different using Tukey's Test at $P < 0.05$.

DISCUSSION

The results of our study in two successive years proved that foliar application of silicic acid could decrease yellow mite populations on the two tested sugarcane varieties. It should be considered that two tested varieties (CP57-614 and CP48-103) were ranked as susceptible and semi-susceptible cultivars under field conditions (Nikpay and Goebel 2018). However, there were lower persistent mite population levels on both sugarcane varieties treated with silicic acid in comparison with control. In CP57-614 variety, there were significant differences between different applications of silicic acid and control even after at the end of sampling periods. With increase in number of silicic acid application, the number of mites in treated sugarcanes was decreased and percentage of dry leaves reduced in comparison with control. Another variety, CP48-103, showed the same trend but we did not observe a significant difference on mite population levels between one number of silicic acid spray and control on first sampling date.

Sugarcane yellow mite *O. sacchari* may affect susceptible varieties drastically under extreme population levels and periodical outbreaks (Nikpay and Goebel 2016). An effective integrated crop management program for sugarcane mite could encompass various ecologically-sounds tactics. One potential new strategy in sugarcane as well as other graminaceous ecosystems world-wide is the application of silicon fertilization to alleviate biotic stresses such as herbivorous arthropods (Nikpay and Goebel 2015; Reynolds *et al.* 2016; Goebel and Nikpay 2017). Silicon soil and foliar fertilization amendment would provide various positive and beneficial aspects for plant resistance to different insect herbivore categories including chewing and sap-sucking pests (Reynolds *et al.* 2009; Korndörfer *et al.* 2011; Nikpay and Soleyman Nejadian 2014; Catalani *et al.* 2017; Goebel and Nikpay 2017). The main mechanism of action of silicon is physical and it is due to deposition of silica in plant tissues including leaves and stems. Among agricultural, horticultural and ornamental plants, sugarcane is major and high-ranked in its capability to absorption of silicon in leaves and stalks (Savant *et al.* 1999). In a research trial in sugarcane, Nikpay and Soleyman Nejadian (2014) found that application of different silicon-based formulations as foliar spray could reduce the population of *O. sacchari* in different varieties. However, there were no significant differences between control and silicon formulations after 10 and 20 days after final silicon spray on mite population on CP69-1062 variety. In our current study, we tested silicic acid as bio-stimulant which provided better control of mites in lower dose rates (Maximum 3.5 liters) in comparison with our past study (Nikpay and Soleyman-Nejadian 2014) in which Agri-Sil, NTS and Silamol formulations (maximum 4.5 liters) were applied.

The results from experiments on other crops than sugarcane showed that the positive effect of silicon on reduction of spider mite populations. Gatarayiha *et al.* (2010) reported that application of potassium silicate formulation (KSil^{TM}) in combination with *Beauveria bassiana* (Balsamo-Crivelli) could decrease the population of *Tetranychus urticae* Koch on bean, cucumber, maize and eggplant. Application of potassium silicate can also reduce the number of eggs laid per female of *T. urticae* on leaves of treated strawberry (Vicentini 2010) and papaya (Silveira 2013). In a recent study, Catalani *et al.* (2017) found that the net reproduction rate (R_0), survival and fertility of females of *T. urticae* were significantly reduced in papaya plants treated with potassium silicate. Moreover, they reported that application of silicon could accelerate the amount of free amino acids and hydrogen peroxide concentrations which would be responsible for activation of plant defense's system. Our results confirmed that using silicic acid as a source of bio-stimulants reduces the *O. sacchari* population on both sugarcane varieties tested on 2015 and 2016. Furthermore, four sprays of acid silicic significantly differed with other treatments in terms of reduction of mite population. These findings indicated that the highest concentration of silicon could result in lower mite population and crop damage as shown by percentage of dry leaf. With regard to side effects of silicon on biological control agent *S. gilvifrons*, there were no significant differences in the number of beetles on treated and untreated varieties. In fact, it seemed that silicon did not have any negative impact on biological control agents.

The results on effectiveness of silicic acid on quality characteristics of canes indicated that application of silicon could reduce the percentage of dry leaves in sugarcane, increasing %pol, brix and % purity on both tested varieties. Previous studies showed that high population density of *O. sacchari* could increase the percentage of dry leaf and this leads to reduction of chlorophyll content (Ziaee and Nikpay 2016). In conclusion, the application of silicic acid could reduce the mite population, percentage of dry leaves and increase the quality parameters of sugarcane in both varieties. It could be suggested that silicic acid (as a source of silicon) may be successfully incorporated in integrated mite management programs with lower hazard risk to environment and beneficial arthropods. However, additional and long-term semi and field surveys are still needed to evaluate the effect of silicic acid on non-target organisms.

ACKNOWLEDGMENTS

We are very grateful to Mr. Peyman Sharafizadeh and other staff of plant protection laboratory for assisting in sampling program. Our gratitude also extended to Dr. Masumeh Ziaee (Department of Plant Protection, Shahid Chamran University of Ahvaz, Iran) for advisory comments on data analysis.

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محلول‌پاشی برگی اسید سیلیسیک در مدیریت جمعیت کنهٔ زرد نیشکر *Oligonychus sacchari* (Acari: Tetranychidae) و کفشدوزک شکارگر *Stethorus gilvifrons* (Col.: Coccinellidae) در دو رقم تجاری نیشکر

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چکیده

نیشکر محصولی با اهمیت راهبردی است که در بسیاری از کشورها تأثیر اقتصادی و اجتماعی دارد. کنهٔ نیشکر *Oligonychus sacchari* یکی از زیان‌آورترین آفات مرتبط با نیشکر در تابستان است. کنترل این آفت بیشتر مبتنی بر آفت‌کش‌های شیمیایی و راهکارهای زراعی و هم‌چنین استفاده از سیلیکون به عنوان یک جزء تغذیه‌ای مدیریت تلفیقی محصولات زراعی است. در این مطالعه اثر سیلیکون بر کنهٔ *O. sacchari* بررسی شد. آزمایش‌ها در طی سال‌های ۲۰۱۴–۲۰۱۵ و ۲۰۱۵–۲۰۱۶ در مزارع کشت و صنعت نیشکر سلمان فارسی اهواز– ایران انجام شد. دو رقم CP57-614 و CP48-103 با استفاده از کود اسید سیلیسیک به عنوان کاربرد محلول‌پاشی برگ تیمار شدند. پنج تیمار شامل یک بار محلول‌پاشی (۰/۵ لیتر در هکتار) ، دو بار محلول‌پاشی (۰/۵ و ۱ لیتر در هکتار ۳ هفته پس از محلول‌پاشی ۱) ، سه بار محلول‌پاشی (۰/۵، ۱ و ۱ لیتر در هکتار ٤ هفته پس از محلول پاشی ۲)، چهار بار محلول‌پاشی (۰/۵، ۱ ، ۱ و ۱ لیتر در هکتار ٤ هفته پس از محلول پاشی ۳) و شاهد استفاده شد. در هر کرت آزمایشی، ۱۵ برگ به طور تصادفی از قسمت زیر، وسط و بالای گیاه انتخاب و شمار کنه‌های زنده و برگ‌های خشک ثبت شد. نمونه‌ها ۷، ١٤، ۲۱ و ۲۸ روز پس از محلول‌پاشی چهارم از اسید سیلیسیک جمع‌آوری شدند. نتایج نشان داد که همه تیمارها در کاهش جمعیت کنه و خشکی برگ در مقابل تیمار شاهد تأثیر معنی‌داری داشتند. در بین تیمارهای مختلف اسید سیلیسیک، چهار کاربرد محلول‌پاشی اسید سیلیسیک نسبت به سایر تیمارها در ارتباط با کاهش جمعیت کنه و خشکی برگ کارایی بیشتری داشت. به نظر می‌رسد که اسید سیلیسیک محصولی امیدوارکننده برای مدیریت آفت کنهٔ نیشکر است و می‌تواند با دیگر راهکارهای مدیریتی در مدیریت آفات نیشکر ترکیب شود.

واژگان کلیدی: کفشدوزک؛ خسارت کنه؛ مرگ و میر؛ سیلیکون؛ مدیریت تلفیقی نیشکر.

اطلاعات مقاله: تاریخ دریافت: ۱۳۹۸/٤/۷، تاریخ پذیرش: ۱۳۹۸/۱۲/۹، تاریخ چاپ: ۱۳۹۸/۱۰/۲۵