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Article

A note on pesticide induced resurgence of two spotted spider mite, *Tetranychus urticae* (Acari: Tetranychidae) on grape

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ABSTRACT
Recently incidence of *Tetranychus urticae* is a widespread issue in grape orchards in India. The possibility of a pesticide induced resurgence of mites was explored by applying field recommended doses of commonly used pesticides. The field trial revealed no resurgence with respect to dicofol, abamectin, spiromecifen, dichlorovos + fish oil resin soap, and dinocap usage consecutively. Sulphur induced heavy resurgence (16.55%) with resurgence ratio of 1.05, followed by thiamethoxam (8.89%), acetamiprid (6.97%), imidacloprid (6.15%) and buprofezin (5.46%) with resurgence ratios of 0.81, 0.89, 0.87, and 0.88 respectively.

KEY WORDS: Abamectin; dichlorovos + fish oil resin soap; dicofol; dinocap; pesticides; resurgence; spiromecifen.

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INTRODUCTION

Grape (*Vitis vinifera* L.) is one of the most important fruit crops of the temperate zone which has acclimatized to tropical and subtropical agro-climatic conditions prevailing in Indian sub-continent. It was introduced to India by the Persian invaders in 1300 AD. Karnataka is the largest state growing grapes in India after Maharashtra, with an area of 20.46 thousand ha with a production of 302.39 thousand MT and productivity of 14.78 tons/ha (Anonymous 2014). In 2014–15, Vijayapur district (North interior region) contributed an area of 8906 ha, production of 106536 tons, with average productivity 20 t/ha. Large acreages of grape cultivation are quite evident in the district along with resin and wine industry. Apart from fungal diseases, many insect pests bother profitable grape growing in this region. Among non-insect pests, six species of mites *viz.*, *Tetranychus urticae* Koch, *T. neocaledonicus* Andre, *Oligonicus mangiferus* Rahmen & Sapra, *O. punicae* Baker and *Eutetranychus orientalis* Klein are found causing damage to grapevine in India (Kulkarni *et al.* 2008). Of these mites, the infestation of *T. urticae* is quite considerable designating it as emerging sucking pests of grape these days (Chandra Sekhar *et al*. 2008). In recent years among six species, red spider mite, *Tetranychus urticae* Koch (Acariformes: Tetranychidae) is causing enormous damage to grapevine in Andhra Pradesh and Karnataka. Though *T. urticae* is a polyphagous mite infesting many crops, the information pertaining to grapes has not been generated so far.

The problem of mite infestation has been increased a lot since last five of years in Vijayapur district. The severity of mite menace may be due to changing pest scenario, preference of grape as a new host in the area (Veerendra *et al.* 2015), changing climate which is favorable for their abundant increase. The pesticide induced resurgence of sap feeders is a detrimental phenomenon operating in agro ecosystem posing a potential threat to management. The heavy usage of pesticides *viz*., fungicides, and insecticides to manage mildews, thrips, mealy bugs, girdlers etc. might have lead to disruption in natural control which would have been operating against the mites. The pesticides especially sulphur, organophospates, imidachloprids have a proven tendency of causing a resurgence in many crops (Kumar *et al*. 2002; Prischmann *et al*. 2005; Szczepaniec 2009) through the destruction of natural enemies, hormesis, and altered leaf chemistry. Since acaricide usage in grapes has just begun except sulphur which is being used as fungicide the resistance to various acaricdes as a cause for the heavy incidence of mites was not appreciated. Thus for effective management of *T. urticae*, it was essential to understand the basic causes of heavy incidence which mostly could have been a resurgence. To schedule the best management practices with acaricides it is essential to know whether resurgence or resistance is cause for the heavy incidence of this pest in grape (Chandra Sekhar *et al*. 2008) and hence the present study was initiated.

MATERIAL AND METHODS

The field experiment was conducted in a randomized complete block design (RCBD) at Dyaberi village (Tq and Dt: Vijayapur) in a four year old commercial farm on Thompson seedless cultivar during *Rabi-summer* season from November 2014 to March 2015. The experimental site was at an altitude of 629 m MSL with co-ordinates of N 16° 42.855' and E 75° 14.594'. There were 14 treatments replicated thrice where in 13 commonly used pesticides have been tested along with an untreated check (Control) for their resurgence effects on spider mite, *T. urticae*. The different pesticides used were dicofol 18.5 EC @ 2.5 ml/l, sulphur 80 WP @ 2.0 g/l, abamectin 1.9 EC @ 0.5 ml/l, spiromesifen 240 SC @ 0.5 ml/l, monocrotophos 36SL @ 1.25 ml/l, dichlorovos 76EC @ 2.0 ml + Fish Oil Resin Soap (FORS) 0.5 g/l, buprofezin 25 SC @ 1.0 ml/l, thiamethoxam 25 WG @ 0.25 g/l, acetamiprid 20 SP @ 0.3 g/l, imidacloprid 17.8 SL @ 0.3 ml/l, fipronil 80 WG @ 0.05 g/l, methomyl 40 SP @ 1.0 g/l and dinocap 48 EC @ 1.0 ml/l. All these pesticides were available as commercial products in the market. The size of the plot was 15.24 m × 53.34 m. Row to row and plant to plant distance was 3.04 and 1.52 m respectively. Each treatment was separated 3.0 m to avoid cross influence. The crop was maintained by following the recommended package of practices and plant protection measures were taken up for the other pests except for spider mites. The pesticides were applied as foliar sprays by using 16 L knapsack sprayer having solid cone nozzle and 50–60 (lb/sq, 2.5cm) pressure of spray application. The spray applications were made using 250 liters of water/acre and a total of two sprays were taken at an interval of 20 days based on infestation. The observations were recorded on the incidence of mites a day before (pretreatment count) and after one, 10 and 15 days after application. Mites were counted with the help of hand (7×) magnifying lens. The mite infestation was recorded on five plants from each treatment, three canes per vine, five leaves per cane representing canopy properly. The number of mites per 2.5 cm^2 area in each leaf, predatory mites per leaf and predatory insect population (per plant) were considered as representative units.

Data analysis

The data on mites count was transformed to $\sqrt{(X+1)}$ before subjecting for analysis. The transformed data were analyzed with RCBD statistical design to know the decrease or increase over control in the mite population. Further the resurgence percentage calculated by using the Henderson and Tilton's (1955) formula as mentioned below:

$$E_{ht} = 100\ [(N_{ta}/N_{ca}\ X\ N_{cb}/N_{tb}) -1]$$

Where E_{ht} = Henderson resurgence index.
N_{cb} = Live individuals in the control before the treatment.
N_{tb} = Live individuals in the treatment before the treatment.
N_{ca} = Live individuals in the control after the treatment.
N_{ta} = Live individuals in the treatment after treatment.

The resurgence ratio was calculated by using following formula as suggested by Heinrichs *et al.* (1981):

$$\text{Resurgence ratio} = \frac{\text{No of mites on treated plants}}{\text{No of mites on untreated plant}}$$

RESULTS

Effect of the first spray

A day before the first spray, no significant difference was observed among the treatments, and the mite population was uniform throughout the experimental area which ranged between 16.33 to 24.33 mites/2.5 cm^2 leaf area. However, population found to vary under the influence of treatments further as presented in Table 1.

A day after the first spray, a significant difference was observed among the treatments. Acetamiprid 20 SP recorded significantly highest population of 21.33 mites/2.5 cm^2 leaf area compared to other treatments, but was on par with monocrotophos 36 SL @ 1.25 ml/l, dinocap 48 EC, buprofezin 25 SC @ 1.0 ml/l, and fipronil 80 WG @ 0.05 g/l. The significantly lowest population of 13.33 mites/2.5cm^2 leaf area was recorded in dichlorovos 76 EC + Fish Oil Resin Soap (FORS) @ 2.0 ml + 5.0 ml/l treatment. Dicofol, sulhur, abamectin and spiromesifen application effect were statistically on par to dichlorovos + FORS impact in containing mite population in 24h.

At 10 days after first spray, highest mite population of 26.67 mites/2.5 cm^2 leaf area was recorded in sulphur 80 WP @ 2.00 g/l and followed by acetamiprid 20SP @ 0.3 g/l, fipronil 80WG @ 0.05 g/l, buprofezin 25SC @ 1.0 ml/l, and imidacloprid 17.8 SL @ 0.3 g/l, recorded 25.00, 24.00, 24.00 and 23.00 mites/ 2.5cm^2 leaf area, respectively. However, all these acaricides were on par statistically in suppressing the mite population. Untreated check which recorded 28.00 mites/ 2.5 cm^2 leaf area. Whereas, spiromesifen 240 SC 18.5% EC 0.50 ml/l recorded significantly lowest population of 7.00 mites/2.5 cm^2 leaf area and was found on par with abamectin 1.9 EC @ 0.50 ml/l which recorded 8.33 mites/2.5 cm^2 leaf area.

However, after 15 days after first spray, highest population of 30 mites/2.5 cm^2 leaf area was recorded in sulphur 80 WP @ 2.00 ml/l and followed by acetamiprid 20 SP @ 0.3 g/l, fipronil 80 WG @ 0.05 g/l, buprofezin 25 SC @1.0 ml/l, imidacloprid 17.8 SL @ 0.3 ml/l, and untreated check which recorded 26.00, 25.00, 25.00, 24.67 and 28.00 mites/2.5cm^2 leaf area, respectively. Whereas, spiromesifen 240 SC @ 0.50 ml/l recorded significantly lowest population of 5.00 mites/ 2.5 cm^2 leaf area and was found on par with abamectin 1.9 EC @ 0.50 ml/l which recorded 5.33 mites/2.5 cm^2 leaf area.

Table 1. Changes in *Tetranychus urticae* Koch population due to pesticides usage in grape (after 1st spray).

Pesticides	*Number of mites/2.5 cm² leaf area					Percent Increase/ Decrease	
	PTC	1 DAS	10 DAS	15 DAS	C.M	over C.M	over UTC
Dicofol	21.00 (4.68)	18.00 (4.35) bcd	14.33 (3.91) b	10.67 (3.40) d	14.33 (3.83) de	– 31.75	– 45.79
Sulphur	20.33 (4.62)	16.67 (4.20) bcd	26.67 (5.26) a	30.00 (5.56) a	24.44 (4.95) ab	+ 20.22	+ 7.55
Abamectin	22.33 (4.80)	16.00 (4.12) bcd	8.33 (3.04) c	5.33 (2.51) e	9.89 (3.16) f	– 55.71	– 62.60
Spiromecifen	21.67 (4.74)	14.67 (3.95) cd	7.00 (2.81) c	5.00 (2.43) e	8.89 (2.98) f	– 58.97	– 66.38
Monocrotophos	24.33 (5.00)	20.00 (4.58) abc	14.67 (3.92) b	16.33 (4.15) c	17.00 (4.11) cd	– 30.14	– 35.70
Dichlorovos + Fish Oil Resin Soap (FORS)	17.33 (4.24)	13.33 (3.75) d	10.00 (3.29) bc	11.67 (3.55) cd	11.67 (3.27) ef	– 32.69	– 55.87
Buprofezin	21.00 (4.69)	19.00 (4.46) abc	24.00 (5.00) a	25.00 (5.10) ab	22.67 (4.77) ab	+ 7.95	+ 14.27
Thiamethoxam	16.33 (4.15)	14.67 (3.93) cd	20.33 (4.62) a	22.00 (4.80) b	19.00 (4.37) bcd	+ 16.35	+ 28.14
Acetamiprid	19.67 (4.54)	21.33 (4.72) ab	25.00 (5.10) a	26.00 (5.11) ab	24.11 (4.91) ab	+ 22.57	+ 8.81
Imidacloprid	18.67 (4.39)	17.33 (4.28) bcd	23.00 (4.90) a	24.67 (5.05) ab	21.67 (4.65) abc	+ 16.06	+ 18.05
Fipronil	22.00 (4.72)	19.33 (4.51) abc	24.00 (5.00) a	25.00 (5.10) ab	22.78 (4.78) ab	+ 3.54	+ 13.85
Methomyl	19.33 (4.39)	16.67 (4.20) bcd	21.00 (4.62) a	23.00 (4.87) b	20.22 (4.50) bc	+ 4.60	+ 23.52
Dinocap	23.33 (4.92)	20.00 (4.58) abc	13.67 (3.82) b	10.33 (3.33) d	14.67 (3.82) de	– 37.14	– 44.53
Untreated control (water spray)	22.67 (4.85)	24.33 (5.02) a	27.00 (5.28) a	28.00 (5.38) ab	26.44 (5.14) a	+ 16.67	0.00
S.Em±	0.35	0.19	0.22	0.22	0.26	-	-
CV (%)	13.36	7.65	8.56	8.51	7.26	-	-

* Figures in the parentheses are √(x+1) transformed values.
Means followed by same letters in a column do not differ significantly by DMRT (p = 0.05).
The resurgence percentage was calculated by using the Henderson and Tilton's formula.
PTC- Pre Treatment Count. DAS- Days After Spraying. CM- Cumulative Mean (Mean of post treatment counts).

At 15 days after the first spray, sulphur 80 WP has caused highest resurgence percentage of with 18.77 highest resurgence ratio of 1.07 followed by thiamethoxam, acetamiprid, and imidacloprid which 8.97, 6.95 and 6.85 percent resurgence with resurgence ratios of 0.78 and 0.93, respectively over untreated check. However, abamectin reduced the mite population by 83.85 per cent instead of increase as indicated in Table 2.

After first spray, by observing the mean of all data of observation, it was evident from the Table 1 that sulphur 80 WP @ 2.00 g/l recorded highest mite population (24.44 mites/2.5 cm² leaf area) which was on par with acetamiprid 20 SP @ 0.3 g/l, fipronil 80 WG @ 0.05 g/l, imidacloprid 17.8 SL @ 0.3 g/l and buprofezin 25SC @ 1.0 ml/l which recorded 24.11, 22.78, 21.67 and 22.67 mites/2.5cm² leaf area over untreated check. Spiromesifen 240 SC 18.5% EC 0.50 ml/l is being the standard check proved its superiority and reduced the mite population to an extent of 66.38 percent

followed by abamectin 1.9 EC @ 0.50 ml/l with 62.60 per cent reduction of mite population over untreated check.

Table 2. Resurgence indicators in different treatment (after 1st spray).

Pesticides	Dosage (ml or g/l)	Resurgence % at 15 DAS	Resurgence Ratio at 15 DAS
Dicofol	2.50	– 59.22	0.38
Sulphur	2.00	18.77	1.07
Abamectin	0.50	– 83.85	0.19
Spiromesifen	0.50	– 81.37	0.17
Monocrotophos	1.25	– 46.06	0.58
Dichlorovos + Fish Oil Resin Soap (FORS)	2.00 + 5.0	– 45.58	0.42
Buprofezin	1.00	5.79	0.89
Thiamethoxam	0.25	8.97	0.78
Acetamiprid	0.30	6.95	0.93
Imidacloprid	0.30	6.85	0.88
Fipronil	0.05	– 8.28	0.92
Methomyl	1.00	– 3.83	0.82
Dinocap	1.00	– 64.23	0.37

Effect of the second spray

As presented in Table 3 the pre-treatment count for the second spray was taken based on the incidence after the first spray to know resurgence of mites after spraying with pesticides. The mean mite population at 5 days after the 15 days of first spray observation was taken as the pre-treatment count and the mite population ranged from 17.33 to 28.67 mites/ 2.5cm^2 leaf area.

The first day after the second spray revealed no significant difference in all the treatments. However, at 10 days after the second spray, sulphur 80 WP @ 2.00 g/l recorded significantly highest mite population of 28.00 mites/ 2.5cm^2 leaf area followed by buprofezin 25 SC @ 1.0 ml/l imidacloprid 17.8 SL 0.3. Sulphur 80 WP @ 2.00 g/l was found on par with an untreated check which recorded 28.0 mites/2.5 cm^2 leaf area. Abamectin 1.9 EC @ 0.50 ml/l recorded lowest mite population of 5.33 mites/2.5cm^2 leaf area.

At 15 days after second spray, sulphur 80 WP recorded significantly highest mite population of 31.0 mites/2.5 cm^2 leaf area and was on par with buprofezin 25 SC @ 1.0 ml/l 26.33, acetamiprid 20 SP @ 0.3 g/l, imidacloprid 17.8 SL @ 0.3 ml/l, thiamethoxam 25 WG @ 0.25 g/l, fipronil 80 WG @ 0.05 g/l which recorded, 25.67, 25.67, 25.33 and 24.67 mites/2.5 cm^2 leaf area respectively. Sulphur 80 WP treatment was on par with untreated check also. However, spiromesifen 240 SC 18.5% EC 0.50 ml/l proved its superiority by recording lowest mite population of 3.00 mites/2.5 cm^2 leaf area.

At 15 days after second spray, again sulphur 80WP @ 2.00 g/l caused resurgence to the tune of 14.32 with highest resurgence ratio of 1.03, followed by thiamethoxam 25 WG @ 0.25 g/l caused resurgence of 8.81 percentage and observed with resurgence ratio of 0.83 and where in abamectin has recorded maximum reduction of 76.33 per cent followed by spiromesifen which gave 75.49 per cent reduction over untreated check (Table 4).

After the second spray, by observing the mean of all data of observation, it was evident from the Table 2 that sulphur 80 WP @ 2.00 g/l recorded highest mite population (27.22 mites/2.5 cm^2 leaf area) over untreated check which was followed by buprofezin 25 SC @ 1.0 ml/l, imidacloprid 17.8 SL @ 0.3 ml/l and acetamiprid 20 SP @ 0.3 g/l which recorded 24.89, 24.22 and 24.11 mites/ 2.5 cm^2 leaf area, respectively over untreated check. Abamectin 1.9 EC @ 0.50 ml/l proved its superiority and reduced the mite population to an extent of 76.33 per cent followed by spiromesifen 240 SC @ 0.50 ml/l with 75.49 per cent reduction of mite population over untreated check.

Table 3. Changes in *Tetranychus urticae* Koch population due to pesticides usage in grape (after 2nd spray).

Pesticides	* Number of mites/square 2.5 cm					Percent Increase/ Decrease	
	PTC	1 DAS	10 DAS	15 DAS	C.M	over C.M	over UTC
Dicofol	28.33 (5.42)	21.33 (4.72) ^{b}	17.00 (4.24) ^{cde}	11.67 (3.55) ^{d}	16.67 (4.20) ^{d}	– 41.18	– 43.52
Sulphur	25.33 (5.07)	22.67 (4.86) ^{b}	28.00 (5.38) ^{a}	31.00 (5.66) ^{a}	27.22 (5.31) ^{ab}	+ 7.46.	+ 8.17
Abamectin	20.00 (4.58)	11.67 (3.55) ^{d}	5.33 (2.50)^{g}	3.33 (2.08) ^{ef}	6.78 (2.78) ^{f}	– 66.10	– 76.33
Spiromesifen	17.33 (4.25)	12.67 (3.69) ^{d}	5.67 (2.56) ^{g}	3.00 (1.99) ^{f}	7.11 (2.84) ^{f}	– 58.97	– 75.49
Monocrotophos	24.33 (5.02)	20.33 (4.60) ^{bc}	14.33 (3.88) ^{de}	16.33 (4.15) ^{cd}	17.00 (4.23) ^{d}	– 30.14	– 42.56
Dichlorovos + Fish Oil Resin Soap (FORS)	20.33 (4.58)	17.67 (4.31) ^{bc}	12.67 (3.61) ^{ef}	14.67 (3.87) ^{cd}	15.00 (3.95) ^{d}	– 26.23	– 48.37
Buprofezin	23.67 (4.95)	23.00 (4.89) ^{b}	25.33 (5.12) ^{ab}	26.33 (5.22) ^{ab}	24.89 (5.08) ^{ab}	+ 5.15	+ 16.36
Thiamethoxam	22.00 (4.78)	20.33 (4.62) ^{bc}	24.33 (5.03) ^{ab}	25.33 (5.13) ^{ab}	23.33 (4.93) ^{bc}	+ 6.04	+ 21.31
Acetamiprid	22.67 (4.86)	22.00 (4.79) ^{b}	24.67 (5.06) ^{ab}	25.67 (5.16) ^{ab}	24.11 (5.01) ^{abc}	+ 6.35	+ 19.00
Imidacloprid	23.00 (4.88)	22.00 (4.79) ^{b}	25.00 (5.09) ^{ab}	25.67 (5.16) ^{ab}	24.22 (5.02) ^{abc}	+ 5.30	+ 18.51
Fipronil	24.00 (4.94)	20.00 (4.56) ^{bc}	23.67 (4.96) ^{abc}	24.67 (5.06) ^{ab}	22.78 (4.87) ^{bc}	– 5.08	+ 23.27
Methomyl	23.67 (4.90)	19.00 (4.46) ^{bc}	18.33 (4.39) ^{bcd}	20.33 (4.59) ^{bc}	19.22 (4.49) ^{cd}	– 18.80	+ 35.07
Dinocap	21.33 (4.72)	15.33 (4.04) ^{cd}	8.67 (3.11) ^{fg}	6.67 (2.77) ^{e}	10.22 (3.35) ^{e}	– 52.08	– 65.04
Untreated control (water spray)	28.67 (5.44)	29.00 (5.48) ^{a}	30.00 (5.57) ^{a}	30.33 (5.60) ^{a}	29.78 (5.55) ^{a}	+ 3.88	0.00
S.Em±	0.32	0.19	0.24	0.24	0.18	-	-
CV (%)	11.32	6.71	8.40	7.84	6.11	-	-

* Figures in the parentheses are √(x+1) transformed values.
Means followed by same letters in a column do not differ significantly by DMRT (p = 0.05).
The resurgence percentage was calculated by using the Henderson and Tilton's formula.
PTC- Pre Treatment Count. DAS- Days After Spraying. CM- Cumulative Mean (Mean of post treatment counts).

After pooling the data of both the sprays, it was observed that after first and second spray, sulphur 80 WP caused the highest resurgence of 16.55 % (Table 5), followed by thiamethoxam and acetamiprid with 8.89 and 6.97 per cent resurgence.

DISCUSSION AND CONCLUSSION

The enhancement of mite population in sulpur, imidachlporid and thaimethoxam treated plots was evident in the study indicating the resurgence. The present findings confirm the reports of a sulphur induced resurgence of *T. urticae* in cowpea (Kumar *et al*. 2003) and in okra (Kumar *et al*. 2002). In

present investigation imidacloprid, 17.8 SL and thiamethoxam 25 WG have also caused resurgence and these results are in conformity with Szczepaniec (2009) who reported imidacloprid application induced outbreaks tetranychid mites in elms and boxwoods. The abundance of mites on imidacloprid treated elms was 10-folds greater than on untreated plants. Neonicotinoides especially imidachloprid and thiamethoxam have a tendency of enhancing the fecundity of different pests and also growth enhancing effects making plants succulent which are much relished by the sap feeders (Patil *et al.* 2003). Imidachloprid mediated resurgence has also been proved to be through hormesis (Yueshu *et al*. 2010).

Table 4. Resurgence indicators in different treatment (after 2nd spray).

Pesticides	Resurgence % at 15 DAS	Resurgence Ratio at 15 DAS
Dicofol	− 61.54	0.38
Sulphur	14.32	1.03
Abamectin	− 84.37	0.11
Spiromesifen	− 83.78	0.10
Monocrotophos	− 36.62	0.54
Dichlorovos + Fish Oil Resin Soap (FORS)	− 31.74	0.48
Buprofezin	5.13	0.86
Thiamethoxam	8.81	0.83
Acetamiprid	6.99	0.85
Imidacloprid	5.45	0.85
Fipronil	− 2.88	0.87
Methomyl	− 18.84	0.86
Dinocap	− 70.43	0.33

Table 5. Mean impact of different pesticides on the resurgence of *Tetranychus urticae* Koch in grape.

Pesticides	Resurgence % of 1st spray	Resurgence % of 2nd spray	Mean	Resurgence ratio of 1st spray	Resurgence ratio of 2nd spray	Mean
Dicofol	− 59.22	− 61.54	− 60.38	0.38	0.38	0.38
Sulphur	18.77	14.32	16.55	1.07	1.03	1.05
Abamectin	− 83.85	− 84.37	− 84.11	0.19	0.11	0.15
Spiromesifen	− 81.37	− 83.78	− 82.58	0.17	0.10	0.14
Monocrotophos	− 46.06	− 36.62	− 41.34	0.58	0.54	0.56
Dichlorovos + Fish Oil Resin Soap	− 45.58	− 31.74	− 38.66	0.42	0.48	0.45
Buprofezin	5.79	5.13	5.46	0.89	0.86	0.88
Thiamethoxam	8.97	8.81	8.89	0.78	0.83	0.81
Acetamiprid	6.95	6.99	6.97	0.93	0.85	0.89
Imidacloprid	6.85	5.45	6.15	0.88	0.85	0.87
Fipronil	− 8.28	− 2.88	− 5.58	0.92	0.87	0.90
Methomyl	− 3.83	− 18.84	− 11.34	0.82	0.86	0.84
Dinocap	− 64.23	− 70.43	− 67.33	0.37	0.33	0.35

Prischmann *et al*. (2005) opine that organophosphate insecticide in wine grapes lead to an increased abundance of spider mites linked to lower numbers of predatory phytoseiid mites. Similarly in the present study also predatory arthropod population observed was nil. Further, according to Ripper (1956), Croft and Brown (1975), and Pimentel and Edwards (1982), outbreaks

of tetranychids often follow when pesticides remove predators and release mites from their regulating pressure. According to Roush and Hoy (1978) monocultures of host plants along with synthetic organic pesticides contribute to high mite densities indirectly through the elimination of natural enemies. This phenomenon is quite evident in the grape ecosystem as revealed by pesticide usage pattern and resurgence studies. The other insecticides used in the study which could not show the resurgence *viz.*, methomy, buprofezin, fipronil, etc. are less used compared to neonicotinoides. Further, with respect to selected insecticides, induced resurgence of *T. uticae* in grapes detailed investigations are essential to know the underlying mechanism and to develop suitable strategies for management.

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یادداشتی بر بازطغیان القایی کنهٔ تارتن دو لکه‌ای، *Tetranychus urticae* (Acari: Tetranychidae) توسط آفت‌کش‌ها روی انگور

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چکیده

به‌تازگی شیوع *Tetranychus urticae* به مشکلی عمومی در باغ‌های انگور در هند تبدیل شده است. احتمال بازطغیان القایی کنه‌ها توسط آفت‌کش‌ها با کاربرد دزهای توصیه شده مزرعه‌ای آفت‌کش‌های پر مصرف بررسی شد. آزمون مزرعه‌ای بازطغیانی را در مورد استفاده پیاپی دیکوفول، آبامکتین، اسپیرومسیفن، دیکلروس + صابون رزینی روغن ماهی و دینوکاپ نشان نداد. گوگرد بازطغیانی شدید (۱۶/۵۵٪) با نسبت ۱/۰۵ نشان داد و پس از آن تیامتوکسام (۸/۸۹٪)، استامیپرید (۶/۹۷٪)، ایمیداکلوپرید (۶/۱۵٪) و بوپروفزین (۵/۴۶٪) به ترتیب با نسبت بازطغیانی ۰/۸۱، ۰/۸۹، ۰/۸۷، و ۰/۸۸ قرار گرفتند.

واژگان کلیدی: آبامکتین؛ دیکلروس + صابون رزینی روغن ماهی؛ دیکوفول؛ دینوکاپ؛ آفت‌کش‌ها؛ بازطغیان؛ اسپیرومسیفن.

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