

Original Research Article

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Field Evaluation of New Ovicidal Acaricide (Tafethion) against Two Major Insect Pests of Apple in Kashmir, India

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ABSTRACT

Evaluation of newer acaricide Tafethion against San Jose scale *Quadraspidiotus perniciosus* Comstock and European red mite *Panonychus ulmi* Koch was evaluated for bio efficacy, phytotoxicity and effect on natural enemies in apple orchards at two locations in Kashmir during the year 2014 and 2015. Ethion was used as standard check for conducting the experiment. Both the acaricides were sprayed during dormant and summer seasons to suppress different stages of the pests. The acaricides were sprayed with the concentrations viz., 1.25, 1.0 and 0.75 % in both the seasons. All the concentrations significantly reduced the insect pest populations over the standard check. Highest percent mortality of 68.21 and 77.41 were recorded against San Jose scale and 77.13 and 82.49 against European red mite at a concentration of 1.25 % during dormant and summer seasons respectively. None of the phytotoxicity effects were seen on the apple trees. *Amblyseius*, *Stethorus punctum* and *Coccinellids* were the key predators found feeding on European red mite and San Jose scale respectively. Maximum cumulative mean mortality of natural enemies was found to be 36.79 % at 1.25 % concentration of Tafethion. The findings of the study revealed that spraying of the acaricide results in considerable reduction in the rate of infestation of European red mite and San Jose scale on apple trees at both the locations.

Keywords

Quadraspidiotus perniciosus,
Malus domestica.

Article Info

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Introduction

Apple *Malus domestica* (Borkh) is remarkably predominant among all other temperate fruits in Jammu and Kashmir. However, the production and quality of apple is affected by a number of serious pests causing heavy economic loss to the crop. The major insect pests attacking this crop are San Jose scale, European Red Mite, Two spotted mite and Apple wooly aphid. Among all these pests San Jose scale and European red mite has established itself as a serious pest of apple trees in Jammu and Kashmir (Anonumous, 2014; Bhalla and Gupta, 1993). Since these

pests have been accidentally introduced to many countries and are considered major pests in most regions of the world where deciduous fruits are grown (Madson and Morgan, 1970). The damage by San Jose scale *Quadraspidiotus perniciosus* (Comstock) is caused by nymphs and female scales, which suck the sap from branches, twigs and fruits, weakens the plant and leaves, render the fruit unacceptable and unmarketable. European Red Mite, *Panonychus ulmi* (Koch) is another serious pest feeding on foliage and thereby reducing

the yield of the plant. Keeping in view the severity of the pests the experiment was undertaken to test the bio efficacy of Tafethion, its phytotoxicity, impact on quality of apple yield and effect on natural enemies in the apple ecosystem of Kashmir Valley.

Materials and Methods

To evaluate the effectiveness of Tafethion against San Jose scale and European red mite on apple, field trial was carried out in the farmer holding apple orchard at Wakura and Zaznah locations of Ganderbal district of Kashmir during the year 2014 and 2015. The orchard had apple trees of Red Delicious cultivar having uniform size and age of 15 years. The orchard was selected taking into account the outbreak and damage caused by the insect pests. The experiment was laid in a randomized block design (RBD) with seven treatments and three replications. Three treatments of Tafethion @ 0.75, 1.0 and 1.25 per cent were compared with three treatments of standard check of Ethion @ 0.75, 1.0 and 1.25 per cent in both the seasons. Water Sprayed apple trees were kept as control. Spraying was done by high volume power sprayer @10 liter spray solution per tree in dormant season and @ 15 liter spray solution per tree in summer season. Pre-treatment count of the pest population recorded one day before the treatment. Post treatment

observations were recorded after 1, 3, 7, 15 and 30 days post spray for the active populations of San Jose scale (SJS) and European red mite (ERM). The pest counts were recorded using hand lens during morning hours. The observations on SJS were recorded from 12 twigs /tree from different directions. 1cm² area (bottom, middle and top) was marked on each twig. The number of crawlers of SJS in dormant season, females and nymphs in summer season were recorded from each twig. In case of ERM 12 twigs/tree, each twig of 10 cm long were marked for recording the eggs of ERM in dormant season, while as in summer season 20-leaves/trees were taken for observation on adult and immature stages of ERM. Bio efficacy and phytotoxicity observations were also recorded after spray in summer season at both the locations. Phytotoxicity data such as leaf injury on tips/surface, yellowing, wilting, necrosis, hyponasty and epinasty were recorded after 3,7,15 and 30 days post spraying using (1-10) scale. Yield was calculated on the basis of A grade apple boxes /tree/ treatment at harvesting time. Similarly the observations on natural enemies were also recorded one day before spraying and 1, 5, 7 and 10 days post treatment for each replication. The percent reduction in SJS and ERM population was calculated using the formula given below:

$$\text{Per cent reduction (P)} = 100 \times 1 - \frac{(\text{No. of insects present after treatment} \times \text{No. of insects present before control})}{(\text{No. of insects present before treatment} \times \text{No. of insects present after control})}$$

Results and Discussion

Bio efficacy

San Jose Scale (dormant season of 2014 & 2015)

The results presented in table 1 reveal that all the acaricide treatments were better than the untreated control. Data recorded revealed that

at Wakura pooled mean mortality of 68.21 per cent was recorded in Tafethion @ 1.25 per cent concentration, followed by 62.29 per cent @ 1.0 per cent concentration and 55.28 per cent @ 0.75 per cent concentration. Standard check (Ethion) recorded highest cumulative mean mortality of 64.48 per cent @ 1.25 per cent concentration, followed by 58.40 per cent @ 1.0 per cent concentration

and 49.98 per cent @ 0.75 per cent concentration, respectively. Water sprayed plants (control) recorded the lowest pooled mean mortality of 12.17 per cent. In Zaznah pooled mean mortality of 67.69 per cent was recorded in Tafethion @ 1.25 per cent concentration, followed by 59.08 per cent @ 1.0 per cent concentration and 51.21 per cent @ 0.75 per cent concentration, respectively. Standard check (Ethion) recorded highest cumulative mean mortality of 66.06 per cent @ 1.25 per cent concentration, followed by 61.06 per cent @ 1.0 per cent concentration and 53.86 per cent @ 0.75 per cent concentration, respectively. Water sprayed plants (control) recorded the lowest pooled mean mortality of 9.40 per cent. All the treatments were significantly different from untreated control, whereas the treatments of Tafethion @ 1.25, 1.0 and 0.75 per cent were statistically at par with standard check (Ethion) @ 1.5, 2.0 and 2.5 per cent when tested at $P=0.05$ at 30 days after application of treatment. Among the treatments of Tafethion and standard check (Ethion) @ 1.25, 1.0 and 0.75 per cent were at par with each other when tested at $P=0.05$ at 30 days after application of treatment.

San Jose scale (summer season of 2014 & 2015)

Perusal of the data in table 2 revealed that at Wakura highest pooled mean mortality of 77.41 per cent was recorded in Tafethion @ 1.25 per cent, followed by 71.17 per cent @ 1.0 per cent and 59.39 per cent @ 0.75 per cent. Standard check (Ethion) recorded highest cumulative mean mortality of 75.40 per cent @ 1.25 per cent, followed by 71.23 per cent @ 1.0 per cent and 55.89 per cent @ 0.75 per cent, respectively. Water sprayed plants (control) recorded the lowest cumulative mean mortality of 11.18 per cent. In Zaznah pooled mean mortality of 77.17 per cent was recorded in Tafethion @ 1.25 per

cent, followed by 70.83 per cent @ 1.0 per cent and 60.45 per cent @ 0.75 per cent, respectively. Standard check (Ethion) recorded highest cumulative mean mortality of 76.32 per cent @ 1.25 per cent, followed by 71.58 per cent @ 1.0 per cent and 58.91 per cent @ 0.75 per cent, respectively. Water sprayed plants (control) recorded the lowest pooled mean mortality of 9.30 per cent. All the treatments were significantly different from untreated control, whereas the treatments of Tafethion @ 0.75, 1.0 and 1.25 per cent were statistically at par with standard check (Ethion) @ 0.75, 1.0 and 1.25 per cent when tested at $P=0.05$ at 30 days after application of treatment.

European red mite (dormant season of 2014 & 2015)

The results presented in table 1 reveal that all the acaricide treatments were better than the untreated control. Data recorded revealed that at Wakura pooled mean mortality of 76.52 per cent was recorded in Tafethion @ 1.25 per cent concentration, followed by 71.81 per cent @ 1.0 per cent concentration and 64.60 per cent @ 0.75 per cent concentration. Standard check (Ethion) recorded highest cumulative mean mortality of 77.13 per cent @ 1.25 per cent concentration, followed by 73.14 per cent @ 1.0 per cent concentration and 64.22 per cent @ 0.75 per cent concentration, respectively. Water sprayed plants (control) recorded the lowest pooled mean mortality of 7.91 per cent. In Zaznah pooled mean mortality of 75.71 per cent was recorded in Tafethion @ 1.25 per cent concentration, followed by 71.08 per cent @ 1.0 per cent concentration and 63.61 per cent @ 0.75 per cent concentration, respectively. Standard check (Ethion) recorded highest cumulative mean mortality of 76.21 per cent @ 1.25 per cent concentration, followed by 68.93 per cent @ 1.0 per cent concentration and 59.13 per cent @ 0.75 per cent

concentration, respectively. Water sprayed plants (control) recorded the lowest pooled mean mortality of 9.40 per cent. All the treatments were significantly different from untreated control, whereas the treatments of Tafethion @ 1.25, 1.0 and 0.75 per cent were statistically at par with standard check (Ethion) @ 1.5, 2.0 and 2.5 per cent when tested at $P=0.05$ at 30 days after application of treatment. Among the treatments of Tafethion and standard check (Ethion) @ 1.25, 1.0 and 0.75 per cent were at par with each other when tested at $P=0.05$ at 30 days after application of treatment.

European red mite (summer season of 2014 & 2015)

Perusal of the data in table 2 revealed that at Wakura highest pooled mean mortality of 82.74 per cent was recorded in Tafethion @ 1.25 per cent, followed by 76.77 per cent @ 1.0 per cent and 68.93 per cent @ 0.75 per cent. Standard check (Ethion) recorded highest cumulative mean mortality of 79.92 per cent @ 1.25 per cent, followed by 77.27 per cent @ 1.0 per cent and 69.75 per cent @ 0.75 per cent, respectively. Water sprayed plants (control) recorded the lowest cumulative mean mortality of 14.65 per cent. In Zaznah pooled mean mortality of 82.49 per cent was recorded in Tafethion @ 1.25 per cent, followed by 75.76 per cent @ 1.0 per cent and 73.06 per cent @ 0.75 per cent, respectively. Standard check (Ethion) recorded highest cumulative mean mortality of 80.72 per cent @ 1.25 per cent, followed by 78.42 per cent @ 1.0 per cent and 72.38 per cent @ 0.75 per cent, respectively. Water sprayed plants (control) recorded the lowest pooled mean mortality of 9.73 per cent. All the treatments were significantly different from untreated control, whereas the treatments of Tafethion @ 0.75, 1.0 and 1.25 per cent were statistically at par with standard check (Ethion) @ 0.75, 1.0 and 1.25 per cent

when tested at $P=0.05$ at 30 days after application of treatment.

Phytotoxicity on apple plants

The test doses of Tafethion were sprayed at three concentrations in summer as 0.75, 1.0 and 1.25 for phytotoxicity study. The phytotoxicity observations were recorded on 3, 7, 15 and 30 days post spray. Observations were recorded as leaf injury, yellowing, wilting, necrosis, hyponasty and epinasty. No adverse effect on apple trees were recorded after spray and there were no phytotoxicity symptoms recorded during the evaluation programme in both the years at two locations of Wakura and Zaznah.

Toxicity to Natural Enemies

Location Wakura

Toxicity of Tafethion was evaluated against three important natural enemies *Amblyseius*, *Stethorus punctum* and *Coccinellids* associated with San Jose scale and European red mite in the Kashmir Valley. Highest cumulative mean mortality of natural enemies was recorded as 36.79 per cent in case of Tafethion @ 1.25 per cent followed by 26.79 per cent @ 1.0 per cent and 22.79 per cent @ 0.75 per cent respectively. Standard check (Ethion) recorded highest cumulative mean mortality of 29.92 per cent @ 1.25 per cent followed by 25.43 per cent @ 1.0 per cent and 20.96 per cent @ 0.75 per cent. Pooled mean mortality of 32.90 per cent of *Amblyseius* was recorded in Tafethion @ 1.25 per cent followed by 25.96 per cent @ 1.0 per cent and 24.10 per cent @ 0.75 per cent. The pooled mean mortality of 30.52 per cent of *Amblyseius* was recorded in standard check (Ethion) @ 1.25 per cent followed by 25.96 per cent @ 1.0 per cent and 23.04 per cent @ 0.75 per cent respectively. Highest pooled mean mortality of 36.07 per cent of *Stethorus*

punctum was recorded in Tafethion @ 1.25 per cent followed by 30.10 per cent @ 1.0 per cent and 24.79 per cent @ 0.75 per cent. The pooled mean mortality of 33.78 per cent of *Stethorus punctum* was recorded in standard check (Ethion)@ 1.25 per cent followed by 26.06 per cent @ 1.0 per cent and 23.61 per cent @ 0.75 per cent respectively. Perusal of data in table 3 revealed that highest pooled mean mortality of 36.80 per cent of *Coccinellids* was recorded in Tafethion @ 1.25 per cent followed by 29.68 per cent @ 1.0 % and 24.25 per cent @ 0.75 per cent. The pooled mean mortality of 33.16 per cent of *Coccinellids* was recorded in standard check (Ethion)@ 1.25 per cent followed by 28.61 per cent @ 1.0 per cent and 23.48 per cent @ 0.75 per cent respectively.

Location Zaznah

Perusal of data in table 3 shows highest cumulative mean mortality of natural enemies was recorded as 35.05 per cent in Tafethion @ 1.25 per cent followed by 27.02 per cent @ 1.0 per cent and 24.19 per cent @ 0.75 per cent respectively. Standard check (Ethion) recorded highest cumulative mean mortality of natural enemies 33.68 per cent @ 1.25 per cent followed by 29.29 per cent @ 1.0 per cent and 23.83 per cent @ 0.75 per cent. Pooled mean mortality of 32.36 per cent of *Amblyseius* was recorded in Tafethion @ 1.25 per cent followed by 24.61 per cent @ 1.0 per cent and 25.05 per cent @ 0.75 per cent. The pooled mean mortality of 31.88 per cent of *Amblyseius* was recorded in standard check (Ethion) @ 1.25 per cent followed by 28.63 per cent @ 1.0 per cent and 22.91 per cent @ 0.75 per cent respectively. Highest pooled mean mortality of 37.51 per cent of *Stethorus punctum* was recorded in Tafethion@ 1.25 per cent followed by 27.75 per cent @ 1.0 per cent and 25.91 per cent @ 0.75 %. The pooled mean mortality of 35.45 per cent of *Stethorus punctum* was recorded in standard check (Ethion) @ 1.25 per cent followed by 29.43

per cent @ 1.0 per cent and 23.96 per cent @ 0.75 per cent respectively. Highest pooled mean mortality of 35.28 per cent of *Coccinellids* was recorded in Tafethion@ 1.25 per cent followed by 28.72 per cent @ 1.0 per cent and 24.62 per cent @ 0.75 per cent. The pooled mean mortality of 33.51 per cent of *Coccinellids* was recorded in standard check (Ethion)@ 1.25 per cent followed by 29.80 per cent @ 1.0 per cent and 24.61 per cent @ 0.75 per cent respectively.

Impact on Yield

Location Wakura

The yield in Tafethion treated trees were recorded as 5.88, 4.63 and 4.30 boxes of A grade apple/tree for the three different concentrations respectively which was statistically at par with that of standard check (Ethion) treated trees where yield of A grade apple/tree were 5.52,4.74 and 4.33 boxes in three different concentrations respectively. However, water spray (control) trees recorded the lowest yield of 3.29 boxes of A grade apple/tree as shown in tables 1-4.

Location Zaznah

The yield in Tafethion treated trees were recorded as 5.58, 4.57 and 4.45 boxes of A grade apple/tree for the three concentrations respectively which was statistically at par with that of standard check (Ethion) treated trees where yield of A grade apple/tree were 5.83, 4.65 and 4.51 boxes in three different concentrations respectively. However, water spray (control) trees recorded the lowest yield of 3.18 boxes of A grade apple/tree as shown in tables 1-4. The results revealed (pool data of the locations and years) significant differences in mean percent mortality of the target pests of apple in Kashmir due to Tafethion and standard check (Ethion) under trial at different concentrations as compared to the control.

Table.1 Bioefficacy of Tafethion as dormant spray against San Jose scale *Quadraspidiotus perniciosus* on apple cv.Red Delicious at Wakura and Zaznah (District Ganderbal) Kashmir (J&K) during 2014 and 2015

Wakura									
Treatment	Conc. %	Pre-treatment count/cm²	Per cent corrected mortality of San Jose Scale/cm² (DAT)					Pooled Mean	*Yield (A grade apple)
			1	3	7	15	30		
Tafethion	0.75	33.77	24.66	41.93	55.48	77.02	82.21	55.28	4.30
	1.0	33.54	41.44	49.25	59.28	75.12	86.35	62.29	4.63
	1.25	31.83	45.41	55.85	67.75	79.92	91.99	68.21	5.88
Ethion(Check)	0.75	30.87	22.37	29.11	45.68	71.64	81.12	49.98	4.33
	1.0	30.04	32.18	44.72	54.46	72.91	87.74	58.40	4.74
	1.25	28.62	40.68	47.40	64.10	79.25	91.00	64.48	5.52
Control	-	30.84	4.32	9.06	13.07	15.68	18.75	12.17	3.29
C.D (0.05)			1.01	0.89	0.95	1.25	1.11		
Zaznah									
Tafethion	0.75	26.78	14.45	31.01	48.52	70.99	81.09	51.21	4.45
	1.0	31.27	33.79	44.60	58.11	73.09	85.81	59.08	4.57
	1.25	31.60	46.28	54.60	65.72	80.14	91.73	67.69	5.58
Ethion(Check)	0.75	32.59	23.82	39.53	52.17	72.19	81.61	53.86	4.51
	1.0	32.35	38.60	47.95	55.77	74.98	88.01	61.06	4.65
	1.25	30.50	44.52	49.55	65.87	80.16	90.20	66.06	5.83
Control	-	37.50	3.31	7.43	9.78	11.11	15.36	9.40	3.18
C.D (0.05)			1.05	0.99	0.76	0.87	0.92		

DAT= Days after treatment

*= Boxes/tree

Table.2 Bioefficacy of Tafethion as summer spray against San Jose scale *Quadraspidiotus perniciosus* on apple cv.Red Delicious at Wakura and Zaznah (District Ganderbal) Kashmir (J&K) during 2014 and 2015

Wakura									
Treatment	Conc. %	Pre-treatment count/cm ²	Per cent corrected mortality of San Jose Scale/cm ² (DAT)					Pooled Mean	*Yield (A grade apple)
			1	3	7	15	30		
Tafethion	0.75	8.87	38.02	46.06	63.81	76.81	84.26	59.39	4.30
	1.0	10.02	47.07	61.95	75.60	83.88	87.33	71.17	4.63
	1.25	9.84	61.84	68.62	81.50	85.08	90.00	77.41	5.88
Ethion(Check)	0.75	8.25	36.70	42.52	59.53	73.63	82.10	55.89	4.33
	1.0	8.62	47.22	61.95	76.47	81.98	88.56	71.23	4.74
	1.25	10.25	57.27	67.24	78.46	84.66	89.35	75.40	5.52
Control	-	9.50	6.10	8.01	10.30	13.88	17.66	11.18	3.29
C.D (0.05)			1.12	1.01	0.85	0.96	0.79		
Zaznah									
Tafethion	0.75	8.70	24.39	49.84	67.05	76.80	84.16	60.45	4.45
	1.0	9.59	51.03	58.71	73.80	83.77	86.85	70.83	4.57
	1.25	9.70	61.71	67.05	80.77	85.26	91.08	77.17	5.58
Ethion(Check)	0.75	8.69	27.92	47.44	61.94	74.90	82.35	58.91	4.51
	1.0	10.17	49.51	62.67	74.24	83.25	88.22	71.58	4.65
	1.25	9.34	61.15	67.31	79.17	84.05	89.90	76.32	5.83
Control	-	9.58	5.03	6.77	8.32	11.08	15.29	9.30	3.18
C.D (0.05)			1.00	1.25	1.34	1.14	1.87		

DAT= Days after treatment

*= Boxes/tree

Table.3 Bio efficacy of Tafethion as dormant spray against European red mite *Panonychus ulmi* on apple cv. Red Delicious at Wakura and Zaznah (District Ganderbal) Kashmir (J&K) during 2014 and 2015

Wakura									
Treatment	Conc. %	Pre-treatment count per twig	Percent mortality of European Red Mite/twig (DAT)					Pooled Mean	*Yield (A grade apple)
			1	3	7	15	30		
Tafethion	0.75	44.50	30.84	47.02	67.90	85.84	91.39	64.60	4.30
	1.0	41.72	41.24	59.86	74.34	89.05	94.57	71.81	4.63
	1.25	41.62	48.08	65.06	80.90	91.71	96.87	76.52	5.88
Ethion(Check)	0.75	43.72	29.92	46.79	67.71	85.57	91.13	64.22	4.33
	1.0	43.80	44.04	61.84	75.39	89.71	94.70	73.14	4.74
	1.25	42.59	49.41	66.01	81.62	91.71	96.87	77.13	5.52
Control	-	44.33	3.86	6.08	8.17	9.07	12.39	7.91	3.29
C.D (0.05)			0.84	0.76	0.99	1.05	1.14		
Zaznah									
Tafethion	0.75	39.62	29.11	48.82	66.67	83.93	89.53	63.61	4.45
	1.0	38.42	45.50	58.17	71.09	87.37	93.30	71.08	4.57
	1.25	37.05	50.84	63.40	78.21	90.05	96.07	75.71	5.58
Ethion(Check)	0.75	37.30	26.55	37.97	59.46	82.60	89.06	59.13	4.51
	1.0	37.98	40.19	55.63	69.20	85.85	93.76	68.93	4.65
	1.25	38.40	49.97	65.31	78.62	90.84	96.29	76.21	5.83
Control	-	37.50	3.46	6.88	10.05	11.34	15.23	9.40	3.18
C.D (0.05)			0.94	1.16	1.20	0.97	0.87		

DAT=Days after treatment

*= Boxes/tree.

Table.4 Bio efficacy of Tafethion as summer spray against European red mite *Panonychus ulmi* on apple cv. Red Delicious at Wakura and Zaznah (District Ganderbal) Kashmir (J&K) during 2014 and 2015

Wakura									
Treatment	Conc. %	Pre-treatment count per leaf	Per cent corrected mortality of European red mite per leaf (DAT)					Pooled Mean	*Yield (A grade apple)
			1	3	7	15	30		
Tafethion	0.75	8.82	32.92	63.56	76.66	84.59	86.95	68.93	4.30
	1.0	9.40	54.90	70.23	81.95	87.46	89.30	76.77	4.63
	1.25	9.74	68.45	76.98	86.09	89.70	92.46	82.74	5.88
Ethion(Check)	0.75	8.94	36.61	65.06	76.42	84.17	86.49	69.75	4.33
	1.0	8.97	57.27	70.43	81.40	87.44	89.83	77.27	4.74
	1.25	9.65	61.92	75.03	83.82	88.56	90.29	79.92	5.52
Control	-	9.50	6.83	10.98	15.43	18.53	21.43	14.65	3.29
C.D (0.05)			0.76	1.01	1.25	0.85	0.74		
Zaznah									
Tafethion	0.75	10.04	51.45	70.60	74.88	80.49	87.86	73.06	4.45
	1.0	10.04	52.69	74.78	78.14	84.37	88.81	75.76	4.57
	1.25	9.84	68.11	81.51	84.38	87.45	91.00	82.49	5.58
Ethion(Check)	0.75	9.50	46.06	69.66	76.83	82.21	87.17	72.38	4.51
	1.0	10.07	55.78	77.85	82.15	86.33	90.00	78.42	4.65
	1.25	8.42	63.48	78.53	83.45	87.45	90.70	80.72	5.83
Control	-	9.43	5.27	7.38	8.47	12.03	15.54	9.73	3.18
C.D (0.05)			0.79	0.99	0.89	1.20	1.01		

DAT= Days after treatment

*= Boxes/tree.

Table.5 Toxicity of Tafethion as summer spray against natural enemies of San Jose Scale and European red mite on apple cv. Red Delicious at Wakura and Zaznah, (District Ganderbal) Kashmir (J&K) during 2014 and 2015

Treatments	Conc. %	Pre-treatment count			Post treatment count* (Mean population of Natural Enemies (DAT))												Pooled mean % mortality of NE			Cumulative Mean % mortality of NE
		A	S	C	A				S				C				A	S	C	
		1	5	7	10	1	5	7	10	1	5	7	10	1	5	7	10	A	S	
Wakura																				
Tafethion	0.75	1.82	1.45	1.00	1.59 (12.39)	1.41 (22.31)	1.30 (28.37)	1.21 (33.33)	1.34 (8.1)	1.17 (18.74)	0.99 (31.20)	0.84 (41.08)	0.88 (12.00)	0.80 (20.00)	0.70 (30.00)	0.65 (35.00)	1.38 (24.10)	1.09 (24.79)	0.76 (24.25)	22.79
	1.0	1.82	1.00	0.99	1.50 (17.58)	1.41 (22.53)	1.30 (28.57)	1.18 (35.16)	0.84 (15.52)	0.74 (25.58)	0.63 (36.64)	0.57 (42.68)	0.87 (11.65)	0.74 (24.85)	0.62 (37.04)	0.54 (45.16)	1.35 (25.96)	0.70 (30.10)	0.69 (29.68)	26.79
	1.25	1.76	0.98	1.01	1.40 (20.18)	1.23 (30.15)	1.36 (37.96)	1.00 (43.30)	0.84 (13.73)	0.69 (29.14)	0.52 (46.59)	0.44 (54.81)	0.84 (16.40)	0.69 (31.32)	0.54 (46.25)	0.47 (53.22)	1.18 (32.90)	0.62 (36.07)	0.64 (36.80)	36.79
Ethion (Check)	0.75	1.79	1.08	0.99	1.59 (11.17)	1.41 (21.23)	1.30 (27.37)	1.21 (32.40)	0.97 (10.19)	0.89 (17.59)	0.77 (28.70)	0.67 (37.96)	0.88 (11.11)	0.80 (19.19)	0.70 (29.29)	0.65 (34.34)	1.38 (23.04)	0.83 (23.61)	0.76 (23.48)	20.96
	1.0	1.82	0.94	0.97	1.50 (17.58)	1.41 (22.53)	1.30 (28.57)	1.18 (35.16)	0.84 (10.64)	0.74 (21.28)	0.63 (32.98)	0.57 (39.36)	0.87 (10.31)	0.74 (23.71)	0.62 (36.08)	0.54 (44.33)	1.35 (25.96)	0.70 (26.06)	0.69 (28.61)	25.43
	1.25	1.72	0.94	0.95	1.39 (19.19)	1.21 (29.65)	1.44 (31.98)	1.01 (41.28)	0.84 (10.64)	0.69 (26.60)	0.52 (44.68)	0.44 (53.19)	0.86 (11.58)	0.69 (27.37)	0.54 (43.16)	0.47 (50.53)	1.20 (30.52)	0.62 (33.78)	0.64 (33.16)	29.92
Water (Control)	-	1.77	0.97	0.95	1.70 (3.95)	1.67 (5.65)	1.64 (7.34)	1.60 (9.6)	0.95 (2.06)	0.93 (4.12)	0.90 (7.22)	0.90 (7.22)	0.92 (3.16)	0.90 (5.26)	0.86 (9.47)	0.84 (15.43)	1.63 (6.64)	0.91 (5.15)	0.84 (8.32)	6.70
C.D(P≤0.05)					1.31	0.58	1.05	1.14	1.06	1.13	1.05	1.46	0.88	0.78	0.35	0.74				
Zaznah																				
Tafethion	0.75	1.77	1.10	1.00	1.58 (10.73)	1.42 (19.77)	1.30 (26.30)	1.21 (31.40)	0.97 (12.28)	0.88 (20.46)	0.76 (30.91)	0.66 (40.00)	0.87 (13.00)	0.80 (20.50)	0.70 (29.80)	0.65 (34.99)	1.38 (25.05)	0.82 (25.91)	0.76 (24.62)	24.19
	1.0	1.79	0.96	0.98	1.64 (8.43)	1.36 (23.54)	1.26 (29.64)	1.14 (36.33)	0.83 (13.08)	0.73 (23.56)	0.63 (34.03)	0.57 (40.32)	0.88 (9.75)	0.73 (25.12)	0.62 (36.41)	0.55 (43.60)	1.35 (24.61)	0.70 (27.75)	0.70 (28.72)	27.02
	1.25	1.72	0.99	0.99	1.34 (22.16)	1.19 (30.90)	1.14 (33.82)	0.99 (42.57)	0.83 (15.67)	0.68 (30.91)	0.52 (47.14)	0.43 (56.33)	0.86 (12.68)	0.68 (30.97)	0.54 (45.18)	0.47 (51.53)	1.16 (32.36)	0.62 (37.51)	0.64 (35.28)	35.05
Ethion (Check)	0.75	1.79	1.09	1.01	1.60 (10.89)	1.42 (20.95)	1.30 (27.37)	1.21 (32.40)	0.97 (10.60)	0.89 (17.97)	0.77 (29.03)	0.67 (38.25)	0.88 (12.42)	0.80 (20.38)	0.70 (30.33)	0.65 (35.31)	1.38 (22.91)	0.83 (23.96)	0.76 (24.61)	23.83
	1.0	1.79	1.37	1.37	1.55 (13.08)	1.34 (25.27)	1.20 (32.86)	1.02 (43.30)	1.22 (10.85)	1.02 (24.54)	0.87 (35.94)	0.71 (46.41)	1.24 (10.16)	1.00 (26.45)	0.87 (36.55)	0.74 (46.03)	1.28 (28.63)	0.96 (29.43)	0.96 (29.80)	29.29
	1.25	1.76	0.97	0.96	1.39 (20.99)	1.21 (31.22)	1.17 (33.49)	1.01 (42.59)	0.84 (12.90)	0.69 (28.45)	0.52 (46.08)	0.44 (54.38)	0.84 (12.04)	0.69 (27.75)	0.54 (43.46)	0.47 (50.79)	1.20 (31.88)	0.62 (35.45)	0.64 (33.51)	33.68
Water (Control)	-	1.77	1.39	0.97	1.71 (3.95)	1.67 (5.38)	1.64 (7.08)	1.61 (9.06)	1.33 (4.04)	1.24 (9.25)	1.11 (16.86)	1.05 (20.41)	0.93 (4.11)	0.90 (7.68)	0.87 (10.29)	0.85 (16.72)	1.66 (6.23)	1.18 (12.64)	0.89 (9.66)	9.5 1
C.D(P≤0.05)					1.05	0.68	0.75	0.57	1.03	1.00	1.04	1.08	1.29	1.47	0.68	0.78				

*Mean of 3 replicates, Figures in Parenthesis are % Mortality of Natural enemies; A= Amblysius, S=Stethorus punctum, C=Coccinellids, N.E= Natural enemies
The population of A and S recorded on the basis of per 6 leaves and C on the basis of 4 branches.

The pooled data (2014 and 2015) indicated significant reduction in SJS and ERM populations at 1.0 per cent and 0.75 per cent in dormant and summer. It is concluded from the present investigation that Tafethion @ 1.25 per cent recorded highest mean mortality 68.21 per cent against SJS and Ethion @ 1.25 % recorded 77.13 per cent against ERM as dormant spray at Wakura location and that of 77.41 per cent and 82.49 per cent pooled mean mortality @ 1.25 per cent of SJS and ERM as summer spray at Wakura and Zaznah location respectively. The maximum yield of (5.88 boxes/tree) of A grade apple was found in Tafethion sprayed @ 1.25 per cent at Wakura location. None of the phytotoxicity effects were recorded on apple leaves during 2014 and 2015. Maximum pooled mortality of natural enemies was recorded as 36.79 per cent @ 1.25 per cent against the Tafethion at Wakura location. The studies are more or less in conformity with the studies of Lal (1952), and Hix *et al.*, (1999) who reported the similar results. Khajuria and Sharma (1999) reported that San Jose scale infestation was significantly reduced by the application of 2.0 per cent miscible oil. These results are also in agreement with that of Sahu *et al.*, 2008. They reported Dicofol as the most toxic chemical to tea red spider mite, *Amblyseius longispinosus* with an LC₅₀ of 0.0156 per cent. Bhanu *et al.*, (2006) has reported Dicofol and Ethion resulted in the lowest number of sheath mite (10.3 and 11.3/10 spikelets) in rice. As conclusion, Tafethion is found very effective against pest's viz., San Jose scale and European red mite in apple orchards with a unique mode of action, and thus a potential acaricide in integrated management of SJS and ERM on Apple.

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