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Bio-efficacy report of Specol-OSO horticultural mineral oil against major insect pests of apple in Kashmir (J&K)

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Abstract

Apple (*Malus domestica*) holds a significant position in Jammu and Kashmir's export sector, playing a vital role in the region's economic development. However, apple orchards face substantial losses due to various factors that include insect pests and different diseases. Among these challenges, the San Jose Scale (*Quatraspidiotus perniciosus*) and the European red mite (*Panonychus ulmi*) pose significant threats to apple production. We conducted a study in the year 2017 and 2018 at two locations in J&K, namely Manigam, Khalmulla (District Ganderbal), and Chogul (District Kupwara), and evaluated the effectiveness of horticulture mineral oil (Specol-OSO HMO) and MAK All Season at different concentrations. The research found that all treatments, including Specol-OSO HMO and MAK All Season, were significantly effective in terms of controlling the San Jose Scale and European red mite populations compared to the untreated controlled groups. At the recommended dose of 750 ml/100 litres of water, both Specol-OSO HMO and MAK All Season achieved substantial cumulative mortality rates for the San Jose Scale (77.95% and 70.77%) and European red mite (74.45% and 68.70%), respectively. Additionally, Specol-OSO HMO at 1000 ml/100 litres of water demonstrated the highest cumulative mortality rates for *Amblyseius spp.* (36.71%) and Coccinellids (38.61%). Notably, the application of Specol-OSO HMO at 1500 ml/100 litres of water did not result in any phytotoxicity symptoms such as leaf injury, yellowing, wilting, necrosis, hyponasty, or epinasty. Moreover, the highest yield (5.43 boxes/tree) was achieved using MAK All Season at a concentration of 750 ml/100 litres of water. Thus, integrating Specol-OSO HMO with the standard check MAK All Season presents a promising approach to enhance pest control strategies in apple farming. This collaborative approach has the potential to significantly contribute to the agricultural prosperity of the Kashmir region.

Keywords: Bio-efficacy, Specol-OSO Horticultural Mineral Oil, Insect pests, Apple, San Jose Scale, European Red Mite, Pest Management, Phytotoxicity

1. Introduction

India's diverse agroclimatic conditions create a fertile ground for the cultivation of various fruits, showcasing the country's agricultural richness ^[1]. Among these fruits, apples (*Malus domestica*) are particularly prominent, finding their roots in the foothills of the Himalayas. This cultivation stretches across several regions, from Shillong in Assam to Darjeeling in Bengal, the Kumaon Hills of Uttar Pradesh, the hills of Punjab, the Kullu Valley in Himachal Pradesh, and the entire expanse of Jammu and Kashmir ^[2]. Notably, Jammu and Kashmir stand out as the leading producer of apples in India, boasting a substantial production volume of 1,882,774 metric tons ^[3]. Apples, being the most commonly domesticated fruit tree in temperate regions, hold a significant commercial position, ranking fourth among the most widely produced fruits globally ^[4]. However, the apple industry in these regions faces daunting challenges in the form of insect pests, causing substantial economic losses both directly and indirectly ^[4]. Among the array of pests, the San Jose scale (*Quatraspidiotus perniciosus*) and the European red mite (*Panonychus ulmi*) pose particularly serious threats to apple trees in Jammu and Kashmir ^[5]. The San Jose scale, in its nymph and female adult forms, feeds on sap from branches, twigs, and fruits, weakening the plant and rendering the

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fruit unacceptable and unmarketable [6]. Similarly, the European red mite feeds on foliage, further reducing the yield of apple plants. Recognizing the severity of these pests, an experiment was initiated to evaluate the bio efficacy of Tafethion [7]. This study not only examined its effectiveness but also assessed its phytotoxicity, impact on the quality of apple yield, and its influence on natural enemies in the apple

ecosystem of the Kashmir Valley. Such research endeavors are crucial in developing sustainable agricultural practices and ensuring the robustness of India's fruit cultivation industry against these formidable challenges [8].

2. Material and Methods

2.1. Study Area

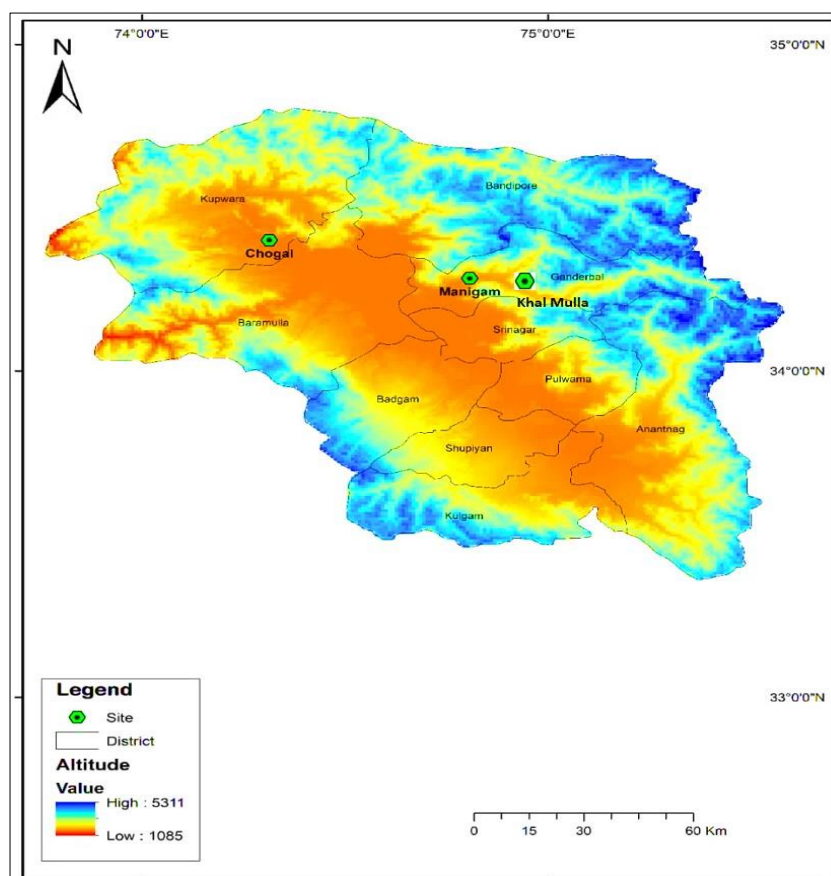


Fig 1: Study Area Map depicting the Kashmir district locations where Field Trials were executed in Chogal (Kupwara), Khal Mulla, and Manigam (Ganderbal) to assess the bioefficacy of Specol-OSO HMO (Spray oil) against the San Jose scale (SJS) and European red mite (ERM) infestations on apple trees.

The study area encompassed various locations in Kashmir, specifically Chogal in Kupwara district, Khal Mulla, and Manigam in Ganderbal district (Figure 1), with the objective of evaluating the effectiveness of Specol-OSO HMO bioefficacy against two significant apple pests, the San Jose scale (SJS) and European red mite (ERM). By focusing on these locations, the study aimed to provide crucial insights into the efficacy of Specol-OSO HMO in controlling these pests, vital information for apple cultivation in the Kashmir region, aiding farmers and researchers in implementing sustainable pest management practices for improved agricultural outcomes.

2.2. Field Trials and treatment doses

Field trials were conducted in Kashmir at Chogal (Kupwara), Khal Mulla, and Manigam (Ganderbal). The study aimed to assess the effectiveness of Specol-OSO HMO against two major pests, San Jose scale (SJS) and European red mite (ERM), infesting apple orchards in Kashmir (J&K). Specifically, it sought to evaluate the bio-efficacy of Specol-OSO HMO on both pests, analyze its impact on natural enemies of SJS and ERM, measure its influence on the quality and yield of Red Delicious apples, and investigate its phytotoxic effects. The research was conducted during the

summers of 2017 and 2018 in two locations: Chogal, Kupwara, and Manigam, Khalmulla (District Ganderbal). Employing a Randomised Block Design (RBD) with 5 treatments, including a control, and 4 replications. During the summer stage of Fruit Development Stage II, the study applied Specol-OSO HMO using a fine mist spray method facilitated by a 4HP power sprayer. The treatment solution, prepared at a rate of 10 litres per tree, was administered at two different locations. At Location 1, the treatment was applied on the 5th and 11th of June in 2017 and the 10th and 9th of June in 2018. At Location 2, the application dates were the 7th and 9th of June in 2017 and the 16th and 12th of June in 2018. The fruit harvest occurred on 5th October and 10th October in 2017 for Location 1 and 12th October and 16th October in 2018 for Location 2. The orchard selected for the trial was 18 - 22 years old and in good bearing condition. The selected orchard had previous history of SJS and ERM infestation. SJS population was counted on 1 cm² area/ twig at three spots (bottom, middle, and top). Four twigs (15 cm length) were taken randomly from all four quadrants of each tree, 1 day before spraying as pre-treatment count and at subsequent intervals of 1, 3, 7, 10, 14, and 21 days after spraying as post-treatment count. The ERM population was counted on 20 leaves from all four sides (one each from the

northern, southern, eastern, and western side of the tree's periphery) of each selected tree, 2-3 hours before treatment and at subsequent intervals of 1, 3, 5, 7, 10, 14 and 21 days after spray. The treatments included various concentrations of Specol-OSO HMO (500 ml, 750 ml, and 1000 ml per 100 L of water), a standard check with MAK All Season at 750 ml per 100 L of water, a control group treated with water only, and a special concentration (1500 ml per 100 L of water) for phytotoxicity evaluation. Phytotoxicity data on leaf injury on tips/surface, yellowing, wilting, necrosis, hyponasty, and epinasty were recorded after 0, 1, 3, 5, 7, 14, and 21 days after spray using (1-10) scale. The yield was also calculated based on A-grade apple boxes/trees, and treatment wise at harvesting time. The study aimed to comprehensively evaluate the efficacy and impact of Specol-OSO HMO on apple crops infested with San Jose scale and European red mites in Kashmir (J&K).

2.3. Observation recorded

2.3.1 San Jose Scale (SJS) (Bio efficacy)

The population of the San Jose scale was counted on 1 cm² area/ twig at three spots (bottom, middle, and top) on four twigs (15 cm length) taken randomly from all four quadrants of each tree during pre- and post-treatment observations.

2.3.2 European red mite (ERM) (Bio efficacy)

European red mites (ERM) were counted on 20 leaves from all four sides (one each from the northern, southern, eastern, and western side of the tree's periphery) of each selected tree during pre- and post-treatment observations.

2.3.3 Phytotoxicity

Phytotoxicity describes the harmful effects of chemicals or environmental factors on plants. This leads to various visible symptoms in plants, and during the summer, the following symptoms were observed which includes Leaf injury on tips/surface margins (L), Yellowing (Y), Wilting (W), Necrosis (N), Hyponasty (E), Epinasty (H).

2.3.4 Toxicity against Natural Enemies

Coccinellids population on 4 randomly selected branches/trees and *Amblyseius* sp. population on 20 randomly leaves/trees were recorded.

2.4 Yield

Harvesting 'A' grade apple boxes (20 kg)/tree on the basis of colour, size, and shape.

3. Results and Discussion

The current study on "bio-efficacy report of specol- OSO HMO Spray oil against major insect pests of apple in Kashmir (J&K)" has made it clear that pests and crop diseases have contributed to poor apple quality and production in J&K. There are many pests that attack apple crops in Kashmir, but some of them are very excessive and need to be controlled. Several pests attack apple trees at almost all phenological stages of growth, adversely affecting the population's quality and quantity. Thus, the bio-efficacy analysis of Specol-OSO HMO Spray Oil in relation to the primary insect pests affecting Apple crops in the region of Kashmir showcases its efficacy and ability to selectively manage SJS and ERM. This study emphasizes the potential of Specol-OSO HMO Spray Oil as an insecticidal formulation that shows promise in effectively managing pests in apple farming in the Kashmir region.

3.1 Pooled Data

Bio efficacy of Specol-OSO HMO Spray Oil against San Jose scale and European red mite at Chogal, Kupwara and Manigam, Khal Mulla, Ganderbal (2017 and 2018).

3.1.1 San Jose scale and European Red Mite; Location – Chogal district Kupwara and Manigam, Khal Mulla district Ganderbal (2017 and 2018)

Analysis on bio-efficacy studies of Specol-OSO HMO Spray Oil against the San Jose scale at Kupwara and Ganderbal for both the years 2017 and 2018 presented in Table 1 revealed that at location Kupwara and Ganderbal highest cumulative mean mortality of SJS as 77.95 % was recorded with standard check MAK All Season, and lowest kill of SJS as 65.65percent was recorded with a spray application of Specol-OSO HMO Spray Oil at dose of 500 ml per 100 lt of water. The Specol-OSO HMO Spray Oil at doses of 750 and 1000 ml per 100 lt of water recorded cumulative mean mortality of SJS as 70.77 and 77.27percent, respectively. However, the order of efficacy for both locations and both years is as under: MAK All Season > Specol-OSO HMO Spray Oil @1000 ml > Specol-OSO HMO Spray Oil @ 750 ml > Specol-OSO HMO Spray Oil @ 500 ml per 100 lt of water.

Table 1: Bioefficacy of Specol-OSO HMO against San Jose scale (*Quadraspidiotus perniciosus*) on Red Delicious variety of apple at Kupwara and Ganderbal

Treatment	Dose (ml/100 L of water)	Mortality % of <i>Q. perniciosus</i>				Cumulative % Mortality of SJS
		Chogal, Kupwara (2017)	Manigam, Ganderbal (2017)	Chogal, Kupwara (2018)	Khalmulla, Ganderbal (2018)	
Specol-OSO HMO	500	64.20 (53.35)	70.00 (57.01)	64.10 (53.29)	64.30 (53.41)	65.65
Specol-OSO HMO	750	71.80 (58.20)	70.50 (57.34)	68.70 (56.17)	72.10 (58.40)	70.77
Specol-OSO HMO	1000	77.70 (62.40)	80.80 (64.91)	74.10 (59.78)	76.50 (61.50)	77.27
MAK All season (Standard check)	750	80.10 (64.32)	75.50 (60.77)	76.00 (61.13)	80.20 (64.40)	77.95
Control		7.70 (16.07)	8.05 (16.44)	9.80 (18.20)	7.11 (15.43)	
C.D (P=0.05)		6.12	6.03	5.07	6.08	
SE (m)		1.84	1.82	1.53	1.83	
CV		6.29	6.14	5.33	6.28	

Each value is mean of four replications

Figures in parenthesis are arcsine transformed values

Perusal of pooled data in Table 2 on bio-efficacy studies of Specol-OSO HMO Spray Oil against European red mites at Kupwara and Ganderbal for both the years 2017 and 2018 revealed that at Chogal district Kupwara and Manigam district Ganderbal the highest cumulative mean mortality of ERM as 74.45 was recorded with Standard check MAK All Season at recommended dose; and lowest mortality of ERM as 61.92 percent was recorded with a spray application of Specol-OSO HMO Spray Oil at a dose of 500 ml per 100 lt

of water. The Specol-OSO HMO Spray Oil at doses of 750 and 1000 ml per 100 lt of water recorded cumulative mean mortality of SJS as 68.7 and 73.77percent, However, the order of efficacy of treatments against ERM for both locations and both years is as under MAK All Season > Specol-OSO HMO Spray Oil @ 1000 ml > Specol-OSO HMO Spray Oil @ 750 ml > Specol-OSO HMO Spray Oil @ 500 ml per 100 lt of water.

Table 2: Bioefficacy of Specol-OSO HMO against European Red mite (*Panonychus ulmi*) on Red Delicious variety of apple at Kupwara and Ganderbal

Treatment	Dose (ml/100 L of water)	Mortality % of <i>Panonychus ulmi</i>				Cumulative % Mortality of ERM
		Chogal, Kupwara (2017)	Manigam, Ganderbal (2017)	Chogal, Kupwara (2018)	Khalmulla, Ganderbal (2018)	
Specol-OSO HMO	500	62.40 (52.25)	58.60 (49.99)	64.90 (53.78)	61.80 (51.89)	61.92
Specol-OSO HMO	750	68.90 (56.29)	65.80 (54.34)	70.10 (57.08)	70.00 (57.01)	68.70
Specol-OSO HMO	1000	76.70 (61.64)	70.70 (57.47)	73.20 (59.15)	74.50 (60.05)	73.77
MAK All season (Standard check)	750	78.00 (62.63)	70.10 (57.08)	72.00 (58.33)	77.70 (62.40)	74.45
Control		8.30 (16.70)	9.20 (17.61)	7.60 (15.97)	14.70 (22.49)	
C.D (P = 0.05)		5.63	4.37	4.89	5.05	
SE(m)		1.70	1.32	1.47	1.52	
CV		5.90	4.83	5.24	5.20	

Each value is the mean of four replications
 Figures in parenthesis are arcsine transformed values

4. Phytotoxicity studies

4.1 Location: Chogal, Kupwara, Year- 2017 and 2018

For phytotoxicity studies, Specol-OSO HMO Spray Oil at a dose of 1500 ml/100 L of water was sprayed on apple trees at Chogal, Kupwara during the years 2017 and 2018, to observe the phytotoxicity symptoms such as Chlorosis, Necrosis, Wilting, Scorching, Hyponasty and Epinasty (Table 3). The observations regarding phytotoxicity were recorded on 1, 3,

5, 7, and 10 days after spray. There were no apparent phytotoxicity symptoms (such as Chlorosis, Necrosis, Wilting, Scorching, Hyponasty, and Epinasty) on apple trees tested with Specol-OSO HMO Spray Oil at a dose of 1500 ml/100 L of water. Thus, the phytotoxicity of product Specol-OSO HMO Spray Oil at both locations were rated as '0' on the phytotoxicity scale from 0 to 10.

Table 3: Phytotoxicity studies of Specol-OSO HMO on apple tree (against San Jose scale, *Quadraspidiotus perniciosus* and European red mite, *Panonychus ulmi* (Koch)

Treatment	Dose (ml/100 L of water)	Phytotoxicity observations (DAT)*																													
		At spray					1				3				5				7				10								
		C	N	W	S	H	E	C	N	W	S	H	E	C	N	W	S	H	E	C	N	W	S	H	E	C	N	W	S	H	E
Specol-OSO HMO	1500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

C=Chlorosis, N=Necrosis, W=Wilting, S=Scorching, H=Hyponasty, E=Epinasty, (DAT)= Days after treatment

5. Toxicity of Specol-OSO HMO Spray Oil to Natural Enemies

5.1 Pooled Analysis of Toxicity to Natural Enemies of ERM and SJS

Similarly, data presented in Table 4 and 5 with respect to toxicity of Specol-OSO HMO Spray Oil against natural enemies associated with the San Jose scale revealed that the highest pooled mean mortality of Coccinellid predators and parasitoids (*Encarsia sp*) was 36.71percent with coded molecule at dose of 1000 ml. However, cumulative pooled mortality of Coccinellid predators and parasitoids (*Encarsia*

sp) of SJS at the recommended dose of 750 ml per 100 lt of water both for Specol-OSO HMO Spray Oil and Standard check MAK were more or less in close proximity with each other at 28.03 and 29.71 percent; and 33.63 and 33.65percent respectively. A perusal of data presented in Table 5as analysis for both location and years with respect to toxicity of Specol-OSO HMO Spray Oil against natural enemies associated with European Red Mite revealed that the highest pooled mean mortality of Coccinellid predators and that of predatory mite was 38.61percent with Specol-OSO HMO Spray Oil at a dose of 1000 ml per 100 lt of water. However, cumulative pooled

mortality of Coccinellid predators and predatory mite, *Amblyseius sp.* associated with SJS at the recommended dose of 750 ml both for Specol-OSO HMO Spray Oil and Standard

check MAK were more or less in close proximity with each other at 34.93 and 34.81%.

Table 4: Toxicity of Specol-OSO HMO against natural enemies of San Jose scale (*Quadraspidiotus perniciosus*) on apple cv. Red Delicious

Treatment	Dose (ml/100 L of water)	Mean % mortality of <i>Q. perniciosus</i>				Cumulative % Mortality of SJS
		Chogal, Kupwara (2017)	Manigam, Ganderbal (2017)	Chogal, Kupwara (2018)	Khalmulla, Ganderbal (2018)	
Specol-OSO HMO	500	26.21 (30.74)	27.73 (31.72)	29.70 (32.97)	28.85 (32.43)	28.123
Specol-OSO HMO	750	31.53 (34.10)	33.64 (35.39)	34.17 (35.72)	35.18 (36.32)	33.63
Specol-OSO HMO	1000	35.06 (36.25)	35.71 (36.64)	37.95 (37.98)	38.15 (38.09)	36.71
MAK All season (Standard check)	750	31.88 (34.32)	34.08 (35.66)	33.42 (35.26)	35.23 (36.36)	33.65
Control		2.61 (9.27)	3.58 (10.88)	3.16 (10.22)	3.86 (11.30)	
C.D (P=0.05)		1.92	1.91	2.01	1.98	
SE(m)		0.58	0.57	0.60	0.60	
CV		3.47	3.33	3.46	3.36	

Figures in parenthesis are arcsine transformed values Coccinellid predators and parasitoids (*Encarsia sp.*)

Table 5: Toxicity of Specol-OSO HMO against natural enemies of ERM (*Panonychus ulmi*) on apple cv. Red Delicious

Treatment	Dose (ml/100 L of water)	Mean % mortality of <i>P. ulmi</i>				Cumulative % Mortality of SJS
		Chogal, Kupwara (2017)	Manigam, Ganderbal (2017)	Chogal, Kupwara (2018)	Khalmulla, Ganderbal (2018)	
Specol-OSO HMO	500	30.82 (33.66)	30.58 (33.51)	29.70 (32.97)	28.85 (32.43)	29.98
Specol-OSO HMO	750	33.73 (35.45)	36.65 (37.20)	34.17 (35.72)	35.18 (36.32)	34.93
Specol-OSO HMO	1000	38.33 (38.20)	40.04 (39.21)	37.95 (37.98)	38.15 (38.09)	38.61
MAK All season (Standard check)	750	33.83 (35.51)	36.78 (37.28)	33.42 (35.26)	35.23 (36.36)	34.81
Control		2.30 (8.70)	3.37 (10.55)	3.16 (10.22)	3.86 (11.30)	
C.D (P=0.05)		2.13	2.13	2.01	1.98	
SE(m)		0.64	0.64	0.60	0.60	
CV		3.67	3.54	3.46	3.36	

Figures in parenthesis are arcsine transformed values Coccinellid predators and predatory mite, *Amblyseius sp.*

6. Yield Analysis

6.1 Location: Chogul, Kupwara

Perusal of pooled data presented in Table 6 revealed that at location Chogul, Kupwara, Specol-OSO HMO Spray Oil recorded mean yield of 4.45, 5.15 and 5.45 boxes of "A" grade apple/tree at doses of 500, 750, and 1000ml per 100 lt of water, respectively. The standard check MAK All Season at recommended dose recorded yield of "A" grade apple/tree as 5.12 boxes; whereas, water (Control) recorded the lowest yield of 2.12 boxes of "A" grade apple/tree.

6.2 Location: Manigam, Khal Mulla; Ganderbal

At the location, Manigam, Khal Mulla; Ganderbal Specol-OSO HMO Spray Oil recorded pooled mean yield of 4.65,

5.07, and 5.42 boxes of "A" grade apple/tree at a dose of 500, 750, and 1000ml per 100 lt of water, respectively. The standard check MAK All Season at recommended dose recorded a yield of "A" grade apple as 5.02 boxes/tree; whereas, water (Control) recorded the lowest yield of 2.15 boxes of "A" grade apple/tree (Table 6). However, cumulative pooled analysis of apple yield for both the locations and years revealed that the highest yield of "A" grade apple/tree was 5.43 boxes with spray application of SPECOL-OSO HMO at a dose of 1000 ml. At the recommended dose of 750 ml for Specol-OSO HMO and standard check MAK All Season, the yield of A-grade apple was more or less in close proximity to each other as 5.11 and 5.07 boxes/tree, respectively.

Table 6: Effect of Specol-OSO HMO against European Red Mite (*Panonychus ulmi*) and San Jose scale (*Quadraspidiotus perniciosus*) on yield (number of boxes) of apple variety cv. Red Delicious collected at Chogul Kupwara and Manigam, Khalmulla, and Ganderbal, during summer season (2017 and 2018)

Treatment/Chemical	Dose (Per 100 lit of water)	Yield of A grade Apples/tree (Number of boxes)				
		Chogul, Kupwara		Manigam, Khalmulla, Ganderbal		Pooled (Both locations and both years)
		2017	2018	2017	2018	
Specol-OSO HMO	500	4.55 (12.28)	4.35 (12.01)	4.35 (12.01)	4.95 (12.82)	4.55
Specol-OSO HMO	750	5.25 (13.22)	5.05 (12.95)	5.15 (13.08)	5.00 (12.89)	5.11
Specol-OSO HMO	1000	5.65 (13.72)	5.25 (13.22)	5.30 (13.28)	5.55 (13.59)	5.43
MAK All season	750	5.30 (13.28)	4.95 (12.82)	4.95 (12.82)	5.10 (13.02)	5.07
Control		2.10 (8.32)	2.15 (8.41)	2.25 (8.61)	2.05 (8.21)	2.15
C.D (P=0.05)		0.33	0.30	0.29	0.32	
SE(m)		0.10	0.09	0.08	0.09	
CV		1.41	1.32	1.27	1.40	

7. Conclusion

The comprehensive study conducted over the span of two years (2017 and 2018) in various orchard locations in Kashmir (Chogul district Kupwara; Manigam, Khalmulla district Ganderbal) provided valuable insights into the efficacy of different treatment applications against San Jose scale (SJS) and European red mite (ERM) infestations on apple trees. All treatments, including the standard check MAK All Season and the coded molecule Specol-OSO HMO, exhibited significant effectiveness in reducing SJS and ERM populations compared to the untreated control group. Notably, the application of MAK All Season at the recommended dose of 750 ml per 100 litres of water proved to be highly efficient, closely trailed by Specol-OSO HMO at a dose of 1000 ml per 100 litres of water in most instances. Besides this, Phytotoxicity studies assured regarding the safety of Specol-OSO HMO for apple trees at a dose of 1500 ml per 100 litres of water. Moreover, Specol-OSO HMO at the dosage of 1000 ml per 100 litres of water demonstrated the highest mortality rates among natural enemies like Coccinellids, parasitoids (*Encarsia* sp.), and predatory mites (*Amblyseius* sp.) at both locations. The comparable mortality rates of natural enemies associated with SJS and ERM following the application of Coded molecule Specol-OSO HMO and the standard check MAK All Season at the recommended dose of 750 ml per 100 litres of water indicate the pesticide's potential for integrated pest management. Additionally, the study revealed that while both Coded molecule Specol-OSO HMO and the standard check MAK All Season at the recommended dose of 750 ml per 100 litres of water produced similar apple yields, the application of Coded molecule Specol-OSO HMO at a higher dose of 1000 ml per 100 litres of water maximized the yield of top-quality 'A' grade apples, emphasizing its practical applicability in commercial orchards. These findings collectively underscore the promising potential of the Coded molecule Specol-OSO HMO as an effective and safe solution for managing SJS and ERM infestations, ultimately enhancing the productivity and quality of apple crops in Kashmir.

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