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Selectivity of some newer horticultural mineral oils and some insecticides on parasitoid complex of San Jose scale (*Quadraspidiotus perniciosus* Comstock) on apple in Kashmir

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Field trials were conducted during 2004 to study the effectiveness of five horticultural mineral oils (HMOs) viz., D.C. tron plus (O_1), P.D. spray oil (O_2), H.P. spray oil (O_3), Atso spray oil (O_4) and Diesel oil (O_5) @ 2 per cent alone and in combination with five chemical insecticides, viz., endosulfan (C_1), ethion (C_2), Chlorpyrifos (C_3), dimethoate (C_4) and quinalphos (C_5) @ 0.05, 0.05, 0.021, 0.03 and 0.03 per cent, respectively against the San Jose scale (*Quadraspidiotus perniciosus* Comstock) on apple trees used as dormant spray. All treatments were observed effective against the pest but at the same time all treatments were evaluated for their impact on emergence of predominant parasitoids of San Jose scale (*Encarsia perniciosus* and *Aphytis proclia*). It was observed from the caged twig samples that all insecticides have more or less deleterious effect on the bio-agents. In oils alone highest population (3.66) of parasitoids were found associated with O_5 (Diesel oil) and lowest with O_1 (D.C. tron plus) 1.22 per cm^2 while in combination highest (2.55) emergence of parasitoids were found associated with O_2C_2 (P.D. spray oil + ethion) and lowest (0.11%) with O_1C_3 (D.C. tron plus + chloripyrifos). It was observed from the data that all oils were found safe to both the parasitoids with D.C. tron plus (O_1) slightly more toxic than other oils, while oil-chemical combination have deleterious effect on emergence of parasitoids.

Key words: Horticultural mineral oils, Insecticides, Dormant spray, Parasitoids, Apple, Selectivity.

INTRODUCTION

Apple crop in Kashmir valley is damaged by many insect pests and several insecticides and oils are recommended for their control. San Jose scale *Quadraspidiotus perniciosus* Comstock (Homoptera ; Diaspididae) is the most destructive of all armoured scales and injurious to deciduous fruit orchards throughout the world (Buhroo, 2000). However, resurgence of the pest has been observed in some areas of Kashmir valley requiring evaluation of some newer oils alone and in combination with some insecticidal for the control of the pest. The present observations were taken with a view to evaluate the impact of new dormant sprays on the natural enemies complex i.e. parasitoids of the pest.

MATERIALS AND METHODS

The present investigation was carried out during 2004 in farmers orchard at Tailbal, Srinagar, Kashmir. The selected trees were marked and were pruned during winter. In the present investigation five oils alone and five insecticides in combination with oils were evaluated against the San Jose scale. The experiment was laid out in randomised block design in a factorial set up with 31 treatments including control (water spray). Each treatment was replicated thrice and one tree served as one replicate in the experiment. The HMOs viz., D.C tron plus (O_1), P.D spray oil (O_2), H.P spray oil (O_3), Atso spray oil (O_4) and Diesel oil (O_5) at 2 per cent each and chemicals used at one concentration viz., endosulfan (C_1), ethion (C_2), chloropyriphos (C_3), dimethoate (C_4) and quinalphos (C_5) at 0.05, 0.05, 0.21, 0.03 and 0.03 per cent, respectively. The samples (twigs) collected from four quadrants (15 cm) of a tree were taken randomly taken and brought to laboratory from treated orchard after 40, 50 and 60 days after treatments. Each twig (15 cm) was waxed and caged at 23 ± 2 ^oC for recording the emergence of parasitoid adults over a period of 10 days.

RESULTS AND DISCUSSION

The impact of these dormant sprays on the natural enemies of San Jose scale (*Quadraspidiotus perniciosus*), data was recorded by taking observations on treated infested

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Table-1: Effect of some horticultural mineral oils (HMO) alone and in combination with some insecticides sprayed during dormancy On parasitoid emergence San Jose scale (*Quadraspidiotus perniciosus*) infesting apple 40 days after application

Treatment		No. of parasitoid emerged/15 cm^2						
Chemicals		C_0	C_1	C_2	C_3	C_4	C_5	Pooled mean
Oils		(No chemical)	(endosulfan)	(ethion)	(chlorpyrifos)	(dimethoate)	(quinalphos)	
O_1	D.C tron plus	0.00^{a} (0.70)	0.00^{a} (0.70)	0.00^{a} (0.70)	0.00^{a} (0.70)	0.33^{b} (0.87)	1.00^{b} (1.17)	0.22^{a} (0.70)
O_2	P.D spray oil	0.33^{b} (0.87)	0.33^{a} (0.87)	1.66^{a} (1.38)	1.00^{a} (1.22)	1.00^{a} (1.17)	0.66^{a} (1.05)	0.83^{d} (1.09)
O_3	H.P spray oil	0.66^{b} (1.77)	0.00^{a} (0.70)	1.00^{a} (1.17)	0.00^{a} (0.70)	0.33^{a} (0.87)	1.33^{a} (1.34)	0.49^{b} (0.96)
O_4	Atso spray oil	0.66^{b} (1.07)	0.33^{a} (0.87)	0.00^{a} (0.70)	1.00^{a} (1.17)	0.00^{a} (0.70)	0.33^{a} (0.87)	0.38^{b} (0.89)
O_5	Diesel oil	2.00^{c} (1.55)	0.66^{a} (1.07)	1.00^{a} (1.17)	0.00^{a} (0.70)	0.33^{a} (0.87)	0.33^{a} (0.87)	0.72^{c} (1.03)
Pooled mean		0.73^{y} (1.10)	0.26^{x} (0.83)	0.66^{y} (1.02)	0.40^{x} (0.90)	0.39^{yx} (0.90)	0.73^{y} (1.06)	
Control (water)		2.66 (1.77)						

CD(p=0.05)	Oils	Chemicals	Oil x chemical	Control vs. others
	0.222	0.203	0.497	0.357

Figures in parentheses are Ön=0.5 transferormation; Each figure is mean of 3 replications

Table-2: Effect of some horticultural mineral oils (HMO) alone and in combination with some insecticides sprayed during dormancyOn parasite Emergence San Jose scale (*Quadraspidiotus perniciosus*) infesting apple 50 days after application

Treatment		No. of parasitoid emerged/15 cm^2						
Chemicals		C_0	C_1	C_2	C_3	C_4	C_5	Pooled mean
Oils		(No chemical)	(endosulfan)	(ethion)	(chlorpyrifos)	(dimethoate)	(quinalphos)	
O_1	D.C tron plus	0.66^{a} (1.05)	0.33^{a} (0.87)	0.56^{ba} (1.052)	0.00^{a} (0.70)	0.66^{a} (0.99)	1.33^{b} (1.34)	0.60^{a} (1.00)
O_2	P.D spray oil	3.00^{b} (1.85)	2.00^{a} (1.55)	2.33^{a} (1.64)	1.00^{a} (1.22)	1.33^{a} (1.34)	1.33^{a} (1.34)	1.83^{b} (1.49)
O_3	H.P spray oil	3.00^{b} (1.85)	2.00^{a} (1.55)	0.66^{a} (1.05)	0.66^{a} (1.05)	1.00^{a} (1.09)	1.33^{a} (1.34)	1.44^{b} (1.32)
O_4	Atso spray oil	3.66^{b} (2.01)	0.33^{a} (0.87)	0.66^{a} (0.99)	0.33^{a} (0.87)	1.00^{ba} (1.17)	2.00^{b} (1.55)	1.33^{ba} (1.25)
O_5	Diesel oil	4.00^{b} (2.08)	1.00^{a} (1.17)	2.00^{a} (1.58)	1.00^{a} (1.09)	0.66^{a} (1.05)	0.66^{a} (1.05)	1.55^{b} (1.339)
Pooled mean		2.864^{z} (1.77)	1.13^{y} (1.20)	1.26^{zy} (1.26)	0.59^{x} (0.91)	0.93^{yx} (1.13)	1.33^{y} (1.32)	
Control (water)		7.00 (2.72)						

CD(p=0.05)	Oils	Chemicals	Oil x chemical	Control vs. others
	0.251	0.2229	0.563	0.404

Table-3 : Effect of some horticultural mineral oils (HMO) alone and in combination with some insecticides sprayed during dormancy on parasite emergence San Jose scale (*Quadraspiaiotus perniciosus*) infesting apple 60 days after application

Treatment		No. of parasitoid emerged						Pooled mean
	Chemicals	C_0	C_1	C_2	C_3	C_4	C_5	
Oils		(No chemical)	(endosulfan)	(ethion)	(chlorpyrifos)	(dimethoate)	(quinalphos)	
O_1	D.C tron plus	3.00^{a} (1.87)	1.00^{a} (1.17)	1.33^{a} (1.28)	0.33^{a} (0.87)	1.33^{a} (1.26)	2.00^{a} (1.55)	1.49^{a} (1.33)
O_2	P.D spray oil	4.00^{a} (1.93)	3.00^{a} (1.87)	3.66^{a} (1.85)	2.66^{a} (1.71)	3.33^{a} (1.94)	1.66^{a} (1.44)	3.05^{b} (1.79)
O_3	H.P spray oil	3.00^{a} (1.87)	2.00^{a} (1.48)	0.66^{a} (1.05)	1.00^{a} (1.17)	1.33^{a} (1.17)	1.00^{a} (1.17)	0.56^{a} (1.32)
O_4	Atso spray oil	4.33^{a} (2.18)	1.00^{a} (1.17)	1.66^{a} (1.46)	0.66^{a} (1.05)	2.00^{a} (1.55)	2.33^{a} (1.56)	1.99^{a} (1.49)
O_5	Diesel oil	5.00^{a} (2.26)	2.66^{a} (1.73)	1.33^{a} (1.28)	3.66^{a} (1.85)	2.33^{a} (1.55)	1.66^{a} (1.46)	2.77^{bz} (1.69)
Pooled mean		3.86^{y} (2.02)	1.93^{x} (1.48)	1.72^{x} (1.39)	1.66^{x} (1.33)	2.06^{x} (1.50)	1.73^{x} (1.43)	
Control (water)		5.66 (2.36)						

CD(p=0.05)	Oils	Chemicals	Oil x chemical	Control vs. others
	0.393	0.359	0.879	0.632

Figures in parenthses are √n+0.5 transformation; Each firgures is mean of 3 replication

Table-4 : Effect of some HMO alone and in combination with some insecticides on San Jose scale (*Quadraspidiotus perniciosus*) parasitoid emergence at different intervals (40, 50 and 60 days)

Treatment		Emergence of parasitoids per 15 cm^2						Pooled mean
	Chemicals	C_0	C_1	C_2	C_3	C_4	C_5	
Oils		(No chemical)	(endosulfan)	(ethion)	(chlorpyrifos)	(dimethoate)	(quinalphos)	
O_1	D.C tron plus	1.22^{m} (1.20)	0.44^{a} (0.91)	0.66^{a} (1.01)	0.11^{a} (0.75)	0.77^{a} (1.04)	1.44^{b} (1.35)	0.77^{p} (1.04)
O_2	P.D spray oil	2.44^{n} (1.55)	1.77^{a} (1.43)	2.55^{b} (1.62)	1.55^{a} (1.38)	1.88^{ba} (1.48)	1.21^{a} (1.27)	1.90^{r} (1.45)
O_3	H.P spray oil	2.50^{on} (1.57)	1.33^{b} (1.24)	0.77^{a} (1.09)	0.55^{a} (0.97)	0.88^{a} (1.04)	1.22^{b} (1.28)	1.20^{p} (1.19)
O_4	Atso oil	2.88^{o} (1.74)	0.55^{a} (0.97)	0.77^{a} (1.05)	0.66^{a} (1.03)	1.00^{a} (1.14)	1.55^{a} (1.32)	1.23^{qp} (1.20)
O_5	Diesel oil	3.66^{p} (1.96)	1.44^{a} (1.29)	1.44^{a} (1.34)	1.55^{a} (1.21)	1.10^{a} (1.16)	0.88^{a} (1.12)	1.67^{rq} (1.34)
Pooled mean		2.54^{z} (1.60)	1.10^{yx} (1.16)	1.23^{y} (1.22)	0.88^{x} (1.06)	1.12^{z} (1.47)	1.26^{y} (1.26)	
Control (water)		5.10 (2.28)						

CD(p=0.05)	Oils	Chemicals	Oil x chemical	Control vs. others
	0.16	0.14	0.36	0.26

Figures in parenthese are √n transformation.c

with San Jose scale at different time intervals, *viz.*, 40, 50 and 60 days after the treatments were applied to observe their association with these treatments. The observations (Table 1-3) recorded on the population of natural enemies revealed that during all the observations, the highest and lowest population of parasitoids (*Encarsia perniciosus*, *Aphytis proclia*) in oils alone was associated with O_5 (Diesel oil) and O_1 (D.C tron plus) with 3.66 and 1.22/60 cm^2 twig, respectively while in combination of oils with different chemicals, the highest and lowest population of 2.55/60 cm^2 in O_2C_2 (P.D spray oil + ethion) and 0.11/60 cm^2 O_1C_3 (D.C tron plus + chlorpyrifos) [Table 4]. According to Nalepa and Mayer (1991) the dormant oil treatments on San Jose scale and its over wintering parasitoids mainly *Encarsia* sp. resulted in significant reduction both in San Jose scale and Hymenopteron parasitoids, however, mortality was not complete and a sufficient number of the parasitoids complex survived to repopulate the orchard. Thus, it is concluded that the impact of these dormant spray treatments on natural enemies of San Jose scale at different time intervals revealed that the highest population of parasitoids (*Encarsia perniciosus*, *Aphytis proclia*) was associated with scale twigs treated with O_5 (diesel oil) and combination O_2C_2 (P.D spray oil + ethion) and O_1C_3 (D.C tron + chlorpyrifos) which confirmed the superiority of these dormant spray oils alone and in combination with chemicals these treatments on others against the parasitoids.

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