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Research Note

Selectivity of Mak All Season Horticulture Mineral Oil against chrysopid, *Mallada desjardinsi* (Navas) and coccinellid predator, *Cheilomenes sexmaculata* (Fabricius)

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ABSTRACT: The selectivity of Mak All Season Horticultural Mineral Oil (MAS-HMO) at different doses (0.1%, 0.5%, 1%, 1.5%, 2.0% , 2.5%) and imidacloprid @ 0.009% was studied against *Mallada desjardinsi* (Navas) (Neuroptera: Chrysopidae) and *Cheilomenes sexmaculata* (Fabricius) (Coleoptera: Coccinellidae), important predators of sucking pests of citrus in Vidarbha region of Maharashtra, under laboratory conditions during 2009, 2010 and 2011. Of the different doses tested, MAS-HMO @ 0.1%, 0.5%, 1.0% and 1.5% recorded significantly high mean egg hatchability (100%) of *M. desjardinsi* whereas imidacloprid @ 0.009 % recorded significantly low mean egg hatchability (67.2%). Mean grub mortality of *M. desjardinsi* was significantly low (0%) in doses 0.1%, 0.5% and 1.0% MAS-HMO. However, imidacloprid @ 0.009 % recorded significantly high mean grub mortality (52.2%) of *M. desjardinsi* whereas, adult mortality was nil in all the doses of MAS-HMO tested. MAS-HMO @ 0.1 %, 0.5% and 1.0% was found safe to the grubs of *C. sexmaculata* as mortality of the treated grubs was nil. Imidacloprid @ 0.009% recorded significantly high mean grub mortality (41.1%) of *C. sexmaculata*..

KEY WORDS: Citrus, Mak All Season Horticulture Mineral Oil, selectivity *Mallada desjardinsi, Cheilomenes sexmaculata*

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About 250 insects and mites were reported to attack citrus species in India (Srivastava and Butani 1999). Among them, important insect and mite pests are Asian Citrus psyllid (ACP), *Diaphoriana citri* Kuwayama (Hemiptera: Psyllidae), citrus leaf-miner, (*Phyllocnistis citrella* Stainton) (Lepidoptera: Gracillaridae),), thrips (*Scritothrips dorsalis* Hood) and rust mites (*Phyllocoptruta oleivora* Ashmead). Of the management measures adopted to combat these pests, using petroleum spray oils is one of the important components of citrus IPM (Rae *et al.*, 1997, Beattie, 1995, Chen *et al.*, 2009). On these lines, MAS-HMO a product of Bharat Petroleum Corporation Limited, Mumbai was evaluated and found effective @ 1.5% to citrus leaf miner, 2% to ACP, thrips and rust mites (Rao and Shivankar, 2012a). A chrysopid, *Mallada desjardinsi* (Navas) and a coccinellid, *Cheilomenes sexmaculata* (Fab.) are found active in citrus orchards of Vidarbha region of Maharashtra during spring season followed by monsoon and autumn which are reported to feed on insect pests like ACP (*D. citri*), blackfly, (*Aleurocanthus woglumi* Ashby), aphids (*Aphis* sp.), mealy bugs (*Plannococcus citri* Risso), leaf miner, (*P. citrella*) etc. (Rao and Shivankar, 2002, Rao and Shivankar 2012b). Selectivity studies of MAS-HMO against *M. desjardinsi* and *C. sexmaculata* are lacking. Keeping this in view, a study was conducted to assess the selectivity of MAS- HMO to *M. desjardinsi* and *C. sexmaculata*.

Laboratory experiments were conducted during 2009, 2010 and 2011 at National Research Centre for Citrus, Nagpur using 0.1%, 0.5%, 1%, 1.5%, 2.0% and 2.5% of MAS-HMO and imidacloprid @ 0.009% (most commonly used insecticide in citrus orchards) against *M. desjardinsi* and *C. sexmaculata*. The experiments were laid out in completely randomized design and each treatment was replicated 4 times.

The chrysopid, *M. desjardinsi* was reared in the laboratory as described by Shivankar, 1997. Laboratory reared eggs, grubs and adults of *M. desjardinsi* were used as test insects. The experiments were conducted at $25^0 \pm 2^0$C and 60 ± 5 % relative humidity. Selectivity of MAS- HMO on the eggs of *M. desjardinsi* was studied to know the ovicidal action, if any, during 2009, 10 and 11. The eggs of *M. desjardinsi* on black paper strip were sprayed with 5 ml of each concentration (0.1% , 0.5%, 1.0%, 1.5%, 2.0% and 2.5%) of MAS-HMO using Potter's Tower (Model No. 0523-703Q-ER32X, Burkard Manufacturing Co. Ltd., Hertfordshire, England). There were four replications/

treatment and 10 eggs / replication. Untreated check was maintained by spraying distilled water. Observations on the number of grubs hatched / treatment was recorded and per cent hatching was worked out.

MAS-HMO at different doses (0.1, 0.5, 1.0, 1.5, 2.0 and 2.5%) was evaluated to study its selectivity against grubs of *M. desjardinsi* during 2009, 10 and 11. Five ml of each dose was sprayed on 5 cm twig of Nagpur mandarin (*Citrus reticulata* Blanco) with first instar grubs of *M. desjardinsi* kept in petri plates (13 cm dia.) using Potter's tower. After shade drying, the treated grubs were immediately transferred to homoeopathic vials containing inactivated *C. cephalonica* eggs as feed, with four replications, each with 10 grubs and observations on grub mortality were recorded 24 hours after the treatment.

MAS-HMO at different doses (0.1, 0.5, 1.0, 1.5, 2.0, and 2.5%) was evaluated to study its selectivity against newly emerged adults of *M. desjardinsi* during 2009, 10 and 11. Accurate dilutions of the MAS-HMO were made and fresh 25cm Nagpur mandarin twigs were taken and dipped in the respective doses of MAS-HMO for 5 seconds and then the twigs were shade dried and fixed in conical flask (25 ml) containing water with the help of cotton plug. These conical flasks were then placed inside plastic jars (21 cm x 9.5 cm) which were covered with muslin cloth. The *M. desjardinsi* adults were provided with a diet (70 g fructose + 40 g protinex + 250 ml distilled water) as described by Shivankar 1997. There were four replications each with 5 adult pairs and observations on adult mortality were recorded at 24 hours interval till 5 days.

MAS-HMO at different doses (0.1, 0.5, 1.0, 1.5, 2.0 and 2.5%) was studied against grubs of *C. sexmaculata* during 2009, 2010 and 2011. The immature stages of *C. sexmaculata* were collected from citrus aphid infested Nagpur mandarin trees during spring season and infested twigs were kept in incubator (Programmable Environmental Test Chamber, Remi Instruments, Mumbai). On emergence, the adults were provided with the aphid (*A. gossypii*) nymphs and were allowed to lay the eggs on the aphid infested twig kept in conical flask (25 ml capacity) with its cut end dipped in water secured in plastic jar (21cm x 9.5cm). Twigs of 5 cm length with the grubs of *C. sexmaculata* were kept in petri-plates (13 cm dia.) and were treated with five ml of each concentration (0.1%, 0.5%, 1.0%,1.5%, 2.0% and 2.5%) of MAS-HMO with four replications (10 grubs/ replication) using Potter's Tower. The grubs were immediately transferred to homeopathic vials after shade drying and were kept in incubator at $25^0 \pm 2^0$ C temperature and 65 $\pm$ 5% relative humidity and aphids, *A. gossypii* were given as feed and observations on grub mortality were recorded 24 hours after the treatment.

Mean egg hatchability of *M. desjardinsi* recorded was significantly high (100%) in 0.1%, 0.5% and 1.0% MAS-HMO treatments along with the control, whereas mean egg hatchability of 89.96%, 85.06% and 80.83% in 1.5%, 2.0% and 2.5%, respectively was recorded. Imidacloprid @ 0.009 % recorded significantly low mean egg hatchability (67.2%) of *M. desjardinsi* than MAS-doses (Table 1). Mean grub mortality of *M. desjardinsi* was significantly low (0%) in 0.1%, 0.5% and 1.0% MAS-HMO along with control. Of the other treatments, the dose 1.5% (8.6% grub mortality) followed by 2.0% (15.23% grub mortality) and 2.5 % (26.8% grub mortality) recorded significantly low mean grub mortality. Imidacloprid @ 0.009 % recorded significantly high mean grub mortality (52.2%) of *M. desjardinsi* (Table 1). None of the treatments of MAS-HMO recorded adult mortality up to 5 days. However, imidacloprid @ 0.009 % recorded 29.9% mean adult mortality at 5 days after treatment.

Table. 1 Effect of different doses of MAS HMO on mean egg hatching, grub mortality of *Mallada desjardinsi* and on mean grub mortality of *Cheilomenes sexmaculata* during 2009, 2010 and 2011

Treatments	*Mallada desjardinsi*		*Cheilomenes sexmaculata*
	Mean Egg Hatchability (%)	Mean Grub Mortality (%)	Mean Grub Mortality (%)
T_1 (0.1%)	100 (85.94)[a]	0.5 (4.05)[a]	0.5 (4.05)[a]
T_2 (0.5%)	100 (85.94)[a]	0.5 (4.05)[a]	0.5 (4.05)[a]
T_3 (1.0%)	100 (85.94)[a]	0.50 (4.05)[a]	0.5 (4.05)[a]
T_4 (1.5%)	89.96 (73.45)[b]	8.60 (15.27)[b]	10 (16.35)[b]
T_5 (2.0%)	85.06 (67.77)[bc]	15.23 (23.85)[c]	18.86 (22.77)[c]
T_6 (2.5%)	80.83 (64.83)[c]	26.80 (30.70)[c]	27.76 (30.97)[d]
T_7 (0.009%)*	67.20 (55.11)[d]	52.20 (44.30)[d]	41.10 (39.77)[e]
T_8 (Control)	100 (85.94)[a]	0.5 (4.05)[a]	0.5 (4.05)[a]
CD *(P=0.05)*	5.91	6.46	5.44

* imidacloprid, Figures in parentheses are arcsine (x+0.5) transformed values, Values followed by same letter in a column are not significantly different (P= 0.05) Each value is mean of four replications of 3 years data.

Mean grub mortality *C. sexmaculata* was significantly low in MAS-HMO @ 0.1 %, 0.5% and 1.0% (0% grub mortality) along with control. Among the other treatments, the dose 1.5% (10% grub mortality) followed by 2.0% (18.86% grub mortality) recorded significantly low mean grub mortality of *C. sexmaculata* than imidacloprid @ 0.009% (41.1%) (Table 1).

The foregone results showed that imidacloprid @ 0.009 % were found to have an adverse effect on eggs, grubs and adults of *M. desjardinsi* and grub of *C. sexmaculata*. The results are in congruent with Kumar and Santharam (1999) who reported that a significant adverse effect on *Chrysoperla carnea* (Stephans) grubs and longevity when they were fed with imidacloprid.

MAS-HMO at 0.1, 0.5 and 1.0 % followed by 1.5% are found safe to the bio-agents, *Mallada desjardinsi* and *Cheilomenes sexmaculata.* However, the doses 2.0 and 2.5% caused low to moderate grub mortality of these bio-agents. On these lines, Chen *et. al* (2009) reported use of petroleum spray oils played a positive role not only in reducing chemical pesticide use but also in increasing the species richness of natural enemies in navel orange orchard in South China. Foliar application of HMO was reported to have less impact on ACP parasitoids, *Tamarixia radiata* Waterstone and *Diaphorencyrtus aligarhensis* (Shafee, Alam and Argarwal) in citrus orchards in Malaysia (Stephan *et al.,* 2012). Beneficial insects may be released in the orchards a few days after an oil application, once the oil film has dried to minimize the adverse effects, if any (Campbell, 1975).

Keeping in view of the least adverse effects of MAS-HMO on the prominent bio-agent predators, *M. desjardinsi* and *C. sexmaculata* and having efficacy against the major insect pests and mites use of HMO is an eco friendly option to contain these pests and may play an important role in formulation of safe and effective citrus IPM modules.

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