Efficacy of Horticultural Mineral Oil Against Tetranynchus truncatus Ehara

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ABSTRACT

Laboratory bioassays were carried out to evaluate the efficacy of horticultural mineral oil (HMO) alone and in combination with neem oil, at different concentrations against egg and gravid female of Tetranynchus truncatus. HMO alone, at concentrations of 1.5, 2.0, 2.5 and 3.0% and combinations of HMO with neem oil viz., HMO (2.5%) + neem oil (2.0%), HMO (3.0 %) + neem oil (2.0%) and HMO (1.0%) + neem oil (1.0%) gave 100% mortality of eggs. Adulticidal effect was concentration and time dependent. Significantly more mortality of adult was obtained with HMO 3.0% (92%) followed by its 2.5% (84%), neem oil 2%(81.33%) and the treatment combination HMO 3%+ neem oil 2% (77.33%), which were on par with each other. The study revealed that HMO possesses appreciable ovicidal and adulticidal action and is suitable for mite management.

Key words: Tetranynchus truncatus, mortality, egg, adult, horticultural mineral oil, neem oil, dose, time, adults, eggs, combinations

Spider mites of the family Tetranychidae are serious pests of horticultural crops demanding suitable control measures. Though conventional pesticides offer good control, they leave high residue levels and cause resurgence and resistance (Khajehali et al., 2011; Sharma and Bhullar, 2018). Moreover, these cannot be recommended during the later stages of the crop, when mite damage typically intensifies. Consequently, safer alternatives like biocontrol agents, botanicals and mineral oils are increasingly being evaluated against the mites. Horticultural mineral oils have been used for centuries to control insect and mite pests (Egho and Emosairue, 2010). Use of highly refined horticultural mineral oils and agricultural mineral oils is an important tool in managing certain pest problems (eg., scales, aphids, mites) on fruit trees, shade trees and woody ornamental plants (Agnello et al., 1994).

With recent advances in technology, refinement of petroleum oil to summer spray oils commonly called as horticultural mineral oils (HMOs) or agricultural mineral oils (AMOs) has made it possible to use them all the year round, without any risk of phytotoxicity (Davidson et al., 1991; Agnello, 2002). Oils have several advantages over conventional pesticides, such as low mammalian toxicity, low residual toxicity, minimal risk of resistance development and limited effects on beneficial organism (Beattie et al., 2002). In order to explore the possibility of using horticultural mineral oil (HMO) against T. truncatus, the predominant species of spider mite infesting vegetable crops of Kerala, the present study was undertaken in the Department of Agricultural Entomology, College of Horticulture, Kerala Agricultural University, Vellanikkara during 2017-2018.

MATERIALS AND METHODS

To evaluate the efficacy of HMO against T. truncatus, laboratory bioassays were carried out separately on egg and adult. Mass culture done in the acarology laboratory on mulberry leaves placed in plastic trays (40×25cm²) lined with moistened synthetic absorbent sponge was used. The commercial formulation of horticultural mineral oil, Cristol TSO manufactured by Krishna Antioxidants Pvt. Ltd. Mumbai was used. It was evaluated at different concentrations viz., HMO alone (0.5,1.0, 1.5,2.0, 2.5 and 3.0%) and in combination with neem oil viz., HMO (0.5%) + neem oil (0.5%), HMO (1.0%) + neem oil (1.0%), HMO (1.5%) + neem oil (1.5%), HMO (2.0%) + neem oil (2.0%), HMO (2.5%) + neem oil (2.0%) and HMO (3.0%) + neem oil (2.0%) along with neem oil alone at 2%. The experiment was laid out in Completely Randomized Design (CRD) with fourteen treatments and three replications.

To evaluate the ovicidal effect, eggs of uniform age were obtained by transferring ten gravid females of T. truncatus each from laboratory culture using moistened
camel hair brush (zero size) on to three mulberry leaf bits (5×5cm²) placed in petri plates lined with moistened cotton pad. A thin layer of wet cotton was provided all around the leaf bits to prevent the escape of mites. The female mites were removed after 24 hr. Twenty-five eggs were retained per leaf bit after removing the excess eggs. Leaf bits containing eggs were sprayed with appropriate treatments using a hand atomizer (2ml/bit) (Krishna and Bhaskar, 2013). All the treatments were replicated thrice. Observations on hatchability of eggs were recorded at 24, 48, 72 and 96 hr of treatment under a stereozoom microscope (LEICA EZ4 HD) and % mortality computed.

For studying the effect of different treatments on gravid females, leaf dip bioassay method was followed (Krishna and Bhaskar, 2013). Aqueous preparation of HMO at required concentrations were made in different beakers and leaf bits of 5×5 cm² were dipped in respective aqueous solution for 10 sec and air dried for 30 min. Ten gravid females of uniform age taken from the laboratory culture were released on to the treated leaf bits kept on wet cotton pad in petri plate. Each treatment was replicated thrice. Leaf bits dipped in water served as control. Observations on mortality were made at 24 hr interval for seven days under a stereozoom microscope and % mortality computed, and these transformed into arcsine values for ANOVA.

**RESULTS AND DISCUSSION**

**Ovicidal effect**

The eggs did not hatch up to 48 hr in any of the treatments. At 72 hr after treatment application, significantly higher egg hatchability was recorded in control treatment (94.66%) followed by HMO 1.0% (2.66%), HMO 0.5% (1.33%) and the combination of HMO 0.5%+neem oil 0.5% (1.33%) which were on par with each other. However, no hatching was observed in other treatments at 72 hr (Table 1). Control treatment recorded significantly more hatchability of 98.67% after 96 hr as well. This was followed by neem oil 2.0% (6.67%), HMO 1.5%+neem oil 1.5% (4.0%), HMO 0.5%+neem oil 0.5% (4.0%), HMO 1.0% (2.66%) and HMO 0.5 1.33%) which were on par with each other. But at 96 hr, eggs did not hatch in other treatments.

Based on the egg hatchability at 96 hr, % mortality revealed that significant mortality was observed in all the treatments except control, which ranged from 93.33% to a maximum of 100%; 100% mortality was in HMO 1.5% to 3.0% and the combinations HMO 1.0% +neem oil 1.0%, HMO 2.5%+ neem oil 2.0%, HMO 3.0%+ neem oil 2.0%. The treatments HMO 0.5% (98.67%), HMO 1.0% (97.33%) and the combinations; HMO 2.0%+neem oil 2.0% (97.33%), HMO 1.5%+neem oil 1.5% (96%) and HMO 0.5%+neem oil 0.5% (96%) also gave mortality on par with the above. However, these treatments were also on par with neem oil 2.0% (93.33% mortality).

**Adulticidal effect**

One day after treatment, HMO 3.0% recorded significant mortality of 65.33%, followed by HMO 2.5% (54.67%) (Table 1). On second day of treatment also, maximum mortality was observed with HMO 3.0% (73.33%), followed by HMO 2.5% and neem oil 2.0% and both recorded 58.67% mortality. After three days of treatment, HMO 3.0% gave significantly maximum mortality of 77.33%; while HMO 0.5% alone gave only 18.67% mortality. On fourth day of treatment, maximum mortality was observed in HMO 3.0% (81.33%), while its 0.5% gave only 20.00% mortality. Five days after treatment also, HMO 3.0% was the best (88.00% mortality), while HMO 0.5% was the least effective (20.00%). On sixth day of treatment, HMO 3.0% recorded the highest mortality of 90.67%. Mortality recorded in treatments neem oil 2.0% (78.67%), HMO 2.5% (77.33%) and HMO 3.0%+neem oil 2.0% (76.00%) were on par with each other. HMO 0.5 % recorded 25.33% mortality. After seven days of treatment, HMO 3.0% recorded significantly higher mortality of 92.00%. The lowest mortality was recorded by HMO 0.5 % (26.67%).

The acaricidal activity of HMO was concentration and time dependent. HMO exhibited very high ovicidal action against *T. truncatus* at all the concentrations evaluated. While it recorded 100% kill of eggs at concentration of 1.5% and above, of greater significance could be the fact that HMO induced near total mortality of eggs even at a relatively low concentration of 0.5% (Table 1). Ovicidal effect of HMO against *T. urticae* was investigated by Roy et al. (2015). They evaluated the efficacy of HMO (servo agro spray oil) at concentrations of 0.5, 1.0 and 1.5% in the laboratory against different stages of *T. urticae*, and reported 98.86% mortality of eggs at the highest concentration of 1.5%. The findings of the present study agree with the above observations.

The efficacy of HMO against adult mites showed a marked variance as compared to that against eggs. The mortality of 92%, seven days after treatment, differed with previous report by Roy et al. (2015) who reported
<table>
<thead>
<tr>
<th>Treatments</th>
<th>Mean hatchability (%)</th>
<th>Mortality (%)</th>
<th>Adults</th>
<th>Efficacy of horticultural mineral oil against Tetranychus truncatus</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>24 hr</td>
<td>48 hr</td>
<td>72 hr</td>
<td>96 hr</td>
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<tr>
<td>T1 - HMO 0.5%</td>
<td>(0.76)</td>
<td>(0.76)</td>
<td>(4.35)</td>
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<tr>
<td>T2 - HMO 1.0%</td>
<td>(0.76)</td>
<td>(0.76)</td>
<td>(5.98)</td>
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<td>T3 - HMO 1.5%</td>
<td>(0.76)</td>
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<tr>
<td>T4 - HMO 2.0%</td>
<td>(0.76)</td>
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<tr>
<td>T5 - HMO 2.5%</td>
<td>(0.76)</td>
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<td>T6 - HMO 3.0%</td>
<td>(0.76)</td>
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<tr>
<td>T7 - HMO 0.5% + neem oil 0.5%</td>
<td>(0.76)</td>
<td>(0.76)</td>
<td>(4.35)</td>
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<tr>
<td>T8 - HMO 1.0% + neem oil 0.5%</td>
<td>(0.76)</td>
<td>(0.76)</td>
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<tr>
<td>T9 - HMO 1.5% + neem oil 0.5%</td>
<td>(0.76)</td>
<td>(0.76)</td>
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<td>T10 - HMO 2.0% + neem oil 0.5%</td>
<td>(0.76)</td>
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<tr>
<td>T11 - HMO 2.5% + neem oil 0.5%</td>
<td>(0.76)</td>
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<tr>
<td>T12 - HMO 3.0% + neem oil 0.5%</td>
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<tr>
<td>T13 - Neem oil 2.0%</td>
<td>(0.76)</td>
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<td>(0.76)</td>
<td>(0.76)</td>
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<tr>
<td>T14 - Control</td>
<td>(0.76)</td>
<td>(0.76)</td>
<td>(79.14)</td>
<td>(85.64)</td>
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</table>

DAT= Days after treatment. Means followed by same letter in the column do not differ significantly; Figures in parentheses arcsine transformed values.
100% mortality at 1.0% concentration, 24 hr after exposure. However, this difference could be due to the differences in bioassay methods followed. While the above study followed topical application against both eggs and adults, the present study used leaf dip bioassay for adults which limited the exposure of adult mites to HMO considerably. The active adults absorb only a fraction of HMO applied on the leaf surface which would explain their lower mortality.

The modes of action of petroleum oil against arthropods had been investigated by several workers. Interference with hormonal activity, water balance and coagulation of protoplasm had been proposed as reason for mortality of eggs (O’kane and Baker, 1934). A more recent study by Al Dabel et al. (2008) suggested that ovicidal action could be due to the adverse effect of oil, on respiration by eggs. Asphyxiation following blocking of spiracles had been suggested as the most plausible cause for adult mortality (Roy et al., 1943; Taverner et al., 2001; Stadler and Buteler, 2009) though cell level disruption (van Overbeek and Blondeau, 1954; Najar-Rodriguez et al., 2007) also was not ruled out.

Smith and Pearce (1948) observed that the concentration of oil as well as duration of exposure were critical for mortality of mites. The above fact has been underlined by the linear relationship between time as well as concentration and mortality of gravid females. Mortality of *T. truncatus* has been consistently higher at higher concentration. Similarly, at the same concentration, the mortality increased from day one to day seven across all treatments involving HMO. Sherwani et al. (2018) reported a higher concentration 2.5% Horticultural Mineral Oil (MAK all season) as effective concentration for the control of European red mite in apple orchard.

The significantly maximum mortality due to combinations of HMO and neem oil than that recorded by neem oil alone suggests synergistic effect against eggs of *T. truncatus*. However, the values being compared with that of HMO alone negates such a claim. This holds true against adult mites as well. Combination of HMO with neem oil did not cause any significant increase in mortality of adult and for most part, were less effective than HMO or neem oil (2%) alone. The high efficacy of HMO against *T. truncatus* brought out in the study suggests that HMO can be an effective tool for mite management in vegetable crops.

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REFERENCES


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