Journal of Tropical Agriculture 53 (2) : 187-190, 2015

Short communication

Efficacy of novel acaricide molecules and botanicals against rice leaf mite *Oligonychus oryzae* (Hirst) (Prostigmata: Tetranychidae)

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Received 13 July 2015; received in revised form 15 December 2015; accepted 22 December 2015

Abstract

Laboratory bioassay was conducted to evaluate the relative toxicity of four new acaricide molecules viz., fenazaquin 10 EC, spiromesifen 240 SC, fenpyroximate 5SC and propargite 57SC, two botanicals, azadirachtin 0.005 per cent and neem oil 2 per cent and wettable sulphur along with a standard check dicofol 18.5 EC against rice leaf mite, *Oligonychus oryzae*. Fenazaquin was found to be the most effective molecule which recorded 100 per cent mortality of gravid females 24h after treatment application. It recorded an egg mortality of 86.60 per cent at 72 h. At 72h, spiromesifen recorded 80 per cent egg mortality and 100 per cent mortality of gravid females. Propargite recorded a mortality of 83.30 per cent of eggs and 90 per cent of gravid females. Efficacy of fenpyroximate though found to be superior over standard check, dicofol, was found to be inferior to other novel molecules and on par with wettable sulphur. The efficacy of botanicals was found to be inferior to standard check, dicofol.

Key words: Bioassay, *Oligonychus oryzae,* Novel acaricides, Botanicals

India is the second largest producer of rice in the world with an average production of 95.32 million tonnes. Mites have emerged as serious pests of rice causing considerable damage, particularly in South India (Muthiah, 2007). The rice leaf mite *Oligonychus oryzae* (Hirst) (Acari: Tetranychidae), and sheath mite *Steneotarsonemus spinki* (Hirst) are the major mite pests in rice. Sporadic incidence of rice leaf mite, *Oligonychus oryzae* (Hirst) has been reported recently from many rice growing tracts of Kerala where intensive cultivation is being practiced (Bhaskar and Thomas, 2011). Farmers depend mostly on conventional insecticides and acaricides for managing the mite. This can lead to several problems such as resurgence and adverse effects on native natural enemy fauna. Increased concern over the commonly used conventional insecticides in rice ecosystem has focused on the need for identifying safer, more effective acaricide molecules for management of the mite. A laboratory study was conducted to evaluate the efficacy of four novel acaricide molecules, two botanicals and wettable sulphur against rice leaf mite, *O. oryzae*.

Oligonychus oryzae collected from mite infested rice fields of Nenmara, Palakkad district, was mass multiplied in the laboratory on rice seedlings raised in plastic pots after confirming the species identity using standard taxonomic key (Gupta, 1985). Bioassay studies were conducted separately on egg and gravid female of *O. oryzae* in the Acarology laboratory, Department of Agricultural Entomology, College of Horticulture, Vellanikkara at a temperature of 27$\pm$ 3^{0}C and 70$\pm$7 per cent relative humidity using the laboratory reared mite culture. The acaricide molecules and botanicals evaluated for bioassay against eggs and gravid females in the study are furnished in Table 1.

To evaluate the ovicidal effect, eggs of uniform age were obtained by transferring gravid female of *O. oryzae* individually; using moistened zero size

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Table 1. Treatments evaluated against *Oligonychus oryzae* on rice under laboratory conditions

Treatments	Dose (Quantity/ 10 ml)
Fenazaquin 10 EC@ 125g a.i. ha^{-1}	25 µL
Spiromesifen 240 SC@ 100g a.i. ha^{-1}	8 µL
Fenpyroximate 5 SC@ 30g a.i. ha^{-1}	20 µL
Propargite 57 EC @ 600g a.i. ha^{-1}	20 µL
Neem oil 2%	200 µL
Azadirachtin 0.005%	50 µL
Wettable sulphur 80 WP @ 600g a.i. ha^{-1}	30 µg
Standard Check (Dicofol 18.5 EC @ 250g a.i. ha^{-1})	25 µL
Untreated Control	Water spray

camel hair brush on to three rice leaf bits (4×1 cm^2) placed in Perti plates lined with moistened cotton pad. The females were removed after 24 hours. Nine eggs were retained per Petri plate after removing the excess eggs. Leaf bits containing *O. oryzae* eggs were sprayed with required concentration of treatments to be tested using a hand atomizer (2ml/bit) (Krishna and Bhaskar, 2013). All treatments were replicated three times. Observations on mortality of eggs were recorded at 24, 48 and 72 hours interval under a stereo binocular microscope.

For studying the effect of different treatments on gravid females, leaf dip bioassay method was followed (Krishna and Bhaskar, 2013). Aqueous preparation of the acaricides at required concentrations were made in different beakers and leaf bits of 4×1 cm^2 were dipped in respective aqueous solution for ten seconds and air dried for two hours.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, while those dipped in dicofol 18.5 EC served as standard check. Observations on mortality of mites were recorded at 24, 48 and 72 hours interval under a stereo binocular microscope and per cent mortality was calculated.

Data were transformed using square root transformation and subjected to one- way analysis of variance ($P < 0.05$). Means were compared by Duncan's Multiple Range Test (DMRT) to determine significant differences at $P < 0.05$.

The results of the bioassay studies are presented in Table 2. The bioassay studies revealed that ovicidal activity of all the treatments increased from 24 hours to 72 hours. At 24 hours, fenazaquin showed the highest egg mortality recording a mean of 30.00 per cent. Spiromesifen recorded an egg mortality of 23.30 per cent and was on par with fenazaquin. Per cent egg mortality recorded by propargite (16.66%), wettable sulphur (16.66%) and fenpyroximate (13.33%) were on par with the standard check, dicofol (13.33%). The botanicals, neem oil and azadirachtin recorded significantly lower mortality of 6.66 per cent at 24 hours. The mortality was found to have increased from 24 to 48 hours in all the treatments except in neem oil. At 48 hours, fenazaquin continued to be the best treatment causing 40.00 per cent egg mortality. Both Spiromesifen and fenpyroximate recorded a mean mortality of 33.30 per cent and were statistically on par with fenazaquin. Neem oil showed the least mortality per cent of 6.66. At 72 hours, fenazaquin showed highest ovicidal action (86.60%) followed by propargite (83.30%) and spiromesifen (80.00%) and were on par with one another. Both fenpyroximate and wettable sulphur resulted in a mortality of 70 per cent and was statistically on par with dicofol (76.60%). Lowest

Table 2. Treatments evaluated against the rice leaf mite *Oligonychus oryzae*

Treatments	Mortality (%)					
	Ovicidal effect			Adulticidal effect		
	24h	48h	72h	24h	48h	72h
Fenazaquin 10 EC 25 µL $10ml^{-1}$	30.00 (5.52)^{a}	40.00 (6.36)^{a}	86.6 (9.33)^{a}	100 (10.02)^{a}	100 (10.02)^{a}	100 (10.02)^{a}
Spiromesifen240 SC 8 µL $10ml^{-1}$	23.30 (4.43)^{ab}	33.30 (6.08)^{a}	80.00 (8.98)^{abc}	73.30 (8.59)^{b}	83.30 (9.15)^{b}	100 (10.02)^{a}
Fenpyroximate 5 SC 20 µL $10ml^{-1}$	13.33 (3.67)^{bc}	33.30 (6.08)^{a}	70.00 (8.57)^{cde}	70.00 (8.40)^{b}	76.60 (8.78)^{bc}	80.0 (8.97)^{c}
Propargite 57 EC 20 µL $10ml^{-1}$	16.66 (4.00)^{abc}	26.60 (5.19)^{ab}	83.3 (9.15)^{ab}	70.00 (8.40)^{b}	83.30 (9.14)^{b}	90.0 (9.51)^{b}
Neem oil 2% 200 µL $10ml^{-1}$	6.66 (2.40)^{cd}	6.66 (2.40)^{c}	60.6 (7.78)^{f}	23.30 (4.71)^{c}	40.00 (6.33)^{e}	53.30 (7.53)^{f}
Azadirachtin 0.05% 50 µL $10ml^{-1}$	6.66 (2.40)^{cd}	23.33 (4.76)^{b}	66.6 (8.19)^{ef}	30.0 (5.52)^{c}	53.30 (7.33)^{d}	63.30 (7.98)^{e}
Wettable sulphur 80 WP 35 µL $10ml^{-1}$	16.66 (4.00)^{abc}	26.66 (5.19)^{ab}	70.00 (8.39)^{de}	60.0 (7.78)^{b}	73.30 (8.58)^{bc}	80.0 (8.97)^{c}
Standard Check (Dicofol 18.5 EC) 25 µL $10m^{-1}l$	13.33 (3.67)^{bc}	26.66 (5.19)^{ab}	76.60 (8.78)^{bcd}	63.30 (7.98)^{b}	70.00 (8.40)^{c}	73.30 (8.59)^{d}
Untreated control	0.00 (0.70)^{d}	0.00 (0.70)^{d}	0.00 (0.70)^{g}	0.00 (0.70)^{d}	0.00 (0.70)^{f}	0.00 (0.70)^{g}

Values in the parenthesis are square root transformed values
Means followed by same letters do not differ significantly by DMRT (p = 0.05)
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mortality was recorded by neem oil 2 per cent (60.60%), but it was on par with azadirachtin (66.60%).

Fenazaquin showed 100 per cent mortality of gravid females within 24 hours of treatment application. The next best treatment was spiromesifen (73.30%), followed by fenpyroximate (70.00%), propargite (70.00%), wettable sulphur (60.00%) and dicofol (63.30%) which were statically on par with one another. Neem oil and azadirachtin recorded significantly lower mortality of 23.30 and 30.00 per cent respectively at 24 hours. Forty eight hours after the application, per cent mortality increased in spiromesifen (83.30%) and propargite (83.30%) and were significantly superior to standard check dicofol (70.00%). Fenpyroximate (76.60%) and wettable sulphur (73.30%) were found to be on par with dicofol. Though at 48 hours, neem oil (40.00%) and azadirachtin (53.30%) showed an increase in mortality from 24hours, significantly lower mortality was recorded by the botanicals compared to other treatments. At 72 hours, propargite emerged as the next best candidate with a mortality record of 90.00 per cent. Both fenpyroximate and wettable sulphur recorded mortality of 80 per cent and were significantly superior over the standard check, dicofol (73.3%). The botanicals were found to be inferior to the standard check, dicofol. However, azadirachtin recorded a significantly higher mortality of 63.30 per cent compared to neem oil (53.30%).

In the present study, the novel acaricide molecules, fenazaquin, spiromesifen and propargite showed significantly higher ovicidal and adulticidal activity against *O. oryzae* compared to the standard check, dicofol. However, fenazaquin recorded the highest mortality of eggs and gravid female mites. Fenazaquin is an acaricide which belongs to quinazoline class of chemicals which inhibits mitochondrial electron transport (MET) at complex I. It has high efficacy against eggs and motile stages of tetranychid mites (Marcic et al., 2011). In laboratory bioassay studies conducted earlier against *Tetranychus urticae* Koch also, the acaricides, fenazaquin, spiromesifen and propargite recorded high mortality of eggs and gravid females (Krishna and Bhaskar, 2013; Reddy et al., 2014,).

The study proved fenpyroximate superior to dicofol in its action against gravid female, while it was on par with dicofol in ovicidal action. Fenpyroximate is a mitochondrial electron transport inhibitor with similar mode of action as fenazaquin. (Kodandaram et al., 2010). The efficacy of wettable sulphur was found to be on par with fenpyroximate. In a field trial conducted earlier in the Department, wettable sulphur was identified as an effective acaricide against *T. urticae* on bhindi and was found to be on par with fenazaquin and spiromesifen in efficacy (AINPAA, 2013).

The study identified a number of novel acaricide molecules namely, fenazaquin, spiromesifen, propargite and fenpyroximate for the effective management of rice leaf mite. These molecules, due to their unique target specific mode of action can be considered as safer alternatives to conventional acaricides for use in rice ecosystem. However, field trials are to be carried out to validate the findings of the study against *O. oryzae*.

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