ISSN: 2319-6505

Available Online at http://journalijcar.org

International Journal of Current Advanced Research
Vol 5, Issue 1, pp 566-568, January, 2016

International Journal of Current Advanced Research

ISSN: 2319 - 6475

RESEARCH ARTICLE

EFFECT OF ACARICIDES ON EGGS AND SUBSEQUENT DEVELOPMENT OF TEA RED SPIDER MITE, OLIGONYCHUS COFFEAE NEITNER

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ARTICLE INFO

Article History:

Received 19th, December, 2015
Received in revised form 28th, December, 2015
Accepted 13th, January, 2016
Published online 28th, January, 2016

Key words

Bio-efficacy, acaricide, red spider mite, ovicide, tea

ABSTRACT

The tea red spider mite, *Oligonychus coffeae* Neitner (Acarina: Tetranychidae) is one of the major pests of tea in North East India causing 17-20% crop loss annually. Acaricides having ovicidal action are of great importance to manage this pest as they also limit the next progeny. Consequently nine acaricides, viz., propergite 57 EC, hexythiazox 5.45% EC, spiromesifen 240 SC, fenazaquin 10% EC, etoxazole 10%EC, ethion 50 EC, fenpyroximate 5EC dicofol 18.5 EC Sulphur 80 WG, recommended for use in tea in India were evaluated for their ovicidal action as well as their effect on subsequent development of *Oligonychus coffeae* under the laboratory conditions. Propergite 57 EC, hexythiazox 5.45% EC, spiromesifen 240 SC, fenazaquin 10% EC and etoxazole 10%EC showed cent per cent egg mortality when treated at their recommended dosages. The ovicidal activity exhibited by ethion, fenpyroximate and dicofol were 64.8, 57.9 and 21.3 per cent respectively. Sulphur 80 WG however did not show any ovicidal activity. Adult emergence was significantly reduced compared to 92% in the control. Thus the tested acaricides can alternately be used for effective and sustainable management of red spider mite in tea plantation.

INTRODUCTION

The tea red spider mite, *Oligonychus coffeae* Neitner (Acari: Tetranychidae), having a wide distribution in most of the tea growing countries of Asia, Africa and South America, is a serious pest of tea in North-east India and causing considerable economic loss to the tune of 17 – 20 % (Das, 1959 ; Banerjee, 1966, 1971). The red spider mite generally attacks the upper surface of mature leaves but in severity, young leaves are also equally attacked and spread to the under surface of the leaf also. The attack starts along the mid-rib and veins, at the deflected tip and incurved margins. The damage is characterised by reddish brown spots which develop at the points of feeding and as a result of repeated sucking, brown patches are formed. The badly damaged leaves dry up and fall off. Different groups of acaricides are being used to manage this pest but acaricides having ovicidal action are of great importance as they also limit the next progeny. Thus the present experiment aims to assess the ovicidal action of some acaricides as well as their effect on subsequent development of *O. coffeae* at field dosages.

MATERIALS AND METHODS

Culture and maintenance of Oligonychus coffeae Nietner

An initial population of Red Spider mite was collected in February 2013 from experimental tea field of North Bengal regional Research and Development Centre (NBRRDC), Tea Research Association, Nagrakata, Jalpaiguri, West Bengal, India. The collected mites were shifted to fresh mature leaves of clonal tea (TV 1) and allowed them to lay eggs for 24 hours. Those eggs were maintained as culture by following the modified method of Helle and Sabelis (1985). This set up was kept under laboratory conditions at the temperature of 25± 2^{o} C, 70-80% RH and a 16:8 LD photoperiod for a period of two months. The eggs laid by the laboratory reared mites were used for the present study.

Acaricides

Nine acaricides recommended for use in tea were taken for the study. Details of the acaricides used are presented in Table 1.

Ovicidal Activity

For the assessment of ovicidal action, leaf discs of mature TV 1 (2.5cm diameter) were placed into 15cm diameter Petri-dishes lined with water saturated cotton wool. Fifteen gravid females of red spider mite were introduced and allowed to lay eggs for 24 hr and then they were removed. The eggs laid on tea leaves were counted under microscope and tea leaves containing 30 eggs were taken for the study with five such replicates. 150 eggs were considered for each treatment. After counting, the eggs are subjected to spraying with different treatments using glass atomizer. Water was sprayed on the control eggs.

Table 1 Trade name, common name, and application rate of acaricides used in the experiment

Trade name	Common name	Acaricide class/group	Manufacturer/supplier	Application rate
Borneo	Etoxazole 10 SC	Diphenyl oxazoline	Sumitomo Chemical Co. Ltd.	0.66ml/L
Magister	Fenazaquin 10 EC	Quinazoline group	E. I. Dupont Industries Pvt. Ltd.	2.5ml/L
Maiden	Hexythiazox 5.45 EC	Thiazolidine Group	Biostad India Ltd.	0.4ml/L
Omite	Propargite 57 EC	Sulfite Ester Group	Dhanuka, Agritech Ltd., Jammu and Kashmir	2.5ml/L
Oberon	Spiromesifen 240 SC (22.9 w/v)	Tetronic Acid Derivatives	Bayer Crop Science	1.0ml/L
Mitigate	Fenpyroximate 5 EC	Pyridazinones	Isagro Asia	0.5ml/L
Diumite	Dicofol 18.5 EC	Organochlorine	Ankar Industries Pvt. Ltd.	2.5ml/L
Ethion	Ethion 50EC	Organophosphates	Ankar Industries Pvt. Ltd.	2.5ml/L
Wokovit	Sulphur 80 WDG	Sulphur	Biostadt India Ltd., Mumbai	5.0gm/L

Hatchability of eggs was determined for a period of 12 days after oviposition. Those eggs that did not hatch after this period were regarded as non-viable (Sarmah *et al*., 1999). Per cent reduction in hatchability was calculated by using the following formula:

$$\text{Per cent reduction in hatchability} = \frac{\text{No.unhatched eggs/treatment}}{\text{Total No. of eggs/treatment}} \times 100$$

Post-embryonic development and survival of Oligonychus coffeae

From the larvae that emerged from the eggs treated with different acaricides, 10 individuals were randomly picked, placed carefully on fresh mature tea leaf disc (2.5cm diameter) with the help of fine brush and allowed to feed. The tea leaf discs were padded with water soaked cotton pads and kept in the petri dish.

Mortality of the larvae and nymphs, duration of development of larval and nymphal stages, total post-embryonic development period of surviving individuals and the number of adults that eventually emerged were recorded (Gurusubramanian and Krishna, 1996). Observations were made for three times.

Statistical analysis

Data (per cent egg mortality) were transformed into angular values and analysed using analysis of variance (ANOVA). Mortality in the control were corrected using Abbott's formula (Abbott, 1925), Means (± SE) of untransformed data are reported.

RESULTS AND DISCUSSION

Ovicidal effect, larval/nymphal mortality, developmental period and adult emergence in tea red spider mite following exposure of their eggs to nine different acaricides are presented in tables 2-3. Ovicidal activity of all the acaricides were significantly higher compared to control except Sulphur80 WG. Five acaricides viz. etoxazole, propargite, spiromesifen, fenazaquin and hexythiazox exhibited cent per cent mortality of eggs at the recommended dosages. The ovicidal activity exhibited by ethion, fenpyroximate and dicofol were 64.8, 57.9 and 21.3 per cent respectively. However sulphur did not possess any significant ovicidal effect (Table 2).

Table 2 Ovicidal effect of acaricide against tea red spider mite

Treatment	% Ovicidal effect Mean±SE)
Etoxazole 10%SC	100.0 ± 0.00a
propergite 57 EC	100.0 ± 0.00a
Spiromesifen 240 SC	100.0 ± 0.00a
Fenazaquin 10% EC	100.0 ± 0.00a
Hexythiazox5.45% EC	100.0 ± 0.00a
Ethion50EC	64.82 ± 0.92b
Fenpyroximate5% EC	57.93 ± 0.44c
Dicofol18.5EC	21.37 ± 0.76d
Sulphur80 WG	0.68 ± 0.01e
Control	0.00 ± 0.00e

Means followed by the same letter do not differ significantly (P<0.01)

Relatively significant higher larval and nymphal mortality (p<0.01) were obtained when larvae emerging from eggs treated with ethion (80%), fenpyroximate (93%), dicofol (83%) and sulphur (53%) in comparison with 8% mortality in untreated control. There was however no significant (P<0.01) variation in the larval and nymphal duration and total post embryonic development time among individuals treated with different acaricides (Table 3).

Table 3 Effect of acaricide on post embryonic development of tea red spider mite following exposure to their eggs during embryogenesis

Treatment	Mortality (%)		Adult emergence (%)		Mean L-N duration (days)	Total PED duration (days)
	L	N	M	F		
Control	5	3	36	56	1.7±0.08a	7.2±0.10a
Ethion50EC	57	23	7	13	2.1±0.07bc	8.3±0.17c
Fenpyroximate5% EC	80	13	2	5	2.2±0.09c	8.2±0.13bc
Dicofol18.5EC	68	15	7	10	2.0±0.07bc	8.0±0.09bc
Sulphur80 WG	29	24	18	29	1.9±0.05ab	7.8±0.13b
Etoxazole 10%SC	-	-	-	-	-	-
propergite 57 EC	-	-	-	-	-	-
Spiromesifen 240 SC	-	-	-	-	-	-
Fenazaquin 10% EC	-	-	-	-	-	-
Hexythiazox5.45% EC	-	-	-	-	-	-

Means within a column followed by the same letter do not differ significantly (P<0.01)

Salim and Al-Antary, 2011 reported the higher ovicidal activity of etoxazole against two spotted spider mite, *Metatetranychus urticae* Koch while Nauen and Smagghe, 2006 reported significant transovarial ovicidal activity of etoxazole. Similarly hexythiazox a thiazolidine Group of acaricide was found to be very active on the eggs of *Panonychus ulmi* in the laboratory (Welty *et al*., 1988) and in field (Bower, 1990). Our results are corroborating the findings of Kavya *et al.* 2015 where they have reported the ovicidal activity of hexythiazox, fenazaquin, propargite, spiromesifen, fenpyroximate and dicofol against *Tetranychus urticae* of

brinjal. Spiromesifen, derivatives of tetronic acid inhibits the lipid biosynthesis in mites and insects are reported to be effective against the egg and juvenile stages of spider mites and whiteflies (Dekeyser, 2005). Similarly, Kumar and Singh, 2005 reported that ethion was found effective against the eggs of *Tetranychus macfarlanei.* Our findings are also in agreement with the findings of Deep and Dhooria, 2012, where they have found that diafenthiuron, propargite, dicofol, monocrotophos, ethion and oxydemeton methyl exhibited significant ovicidal action against the eggs of *Tetranychus cinnabarinus* (Boisd.) but Sulphur did not show any ovicidal action.

In the present study, etoxazole, propargite, spiromesifen, fenazaquin and hexythiazox were found the best ovicidal whereas fenpyroximate ethion, dicofol & sulphur exhibited significantly higher larval and nymphal mortality when larvae emerging from eggs treated with these acaricides. Present study revealed that all these acaricides can alternately be used for effective and sustainable management of red spider mite in tea plantation.

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