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EFFICACY OF BOTANICALS AGAINST MULBERRY WHITEFLY *DIALEUROPORA DECEMPUNCTATA* (QUAINTANCE AND BAKER) AND THEIR SAFETY TO NATURAL ENEMIES

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ABSTRACT

In the evaluation of efficacy of seven biopesticides, two foliar sprays done at fifteen days interval were effective in reducing whitefly *Dialeuropora decempunctata* (Quintance and Baker) incidence in mulberry. Neem oil (3%) was the most effective (71.10% reduction over control) followed by pongamia oil (3%) and Torpedo (plant extract of *Sophora* and *Stemona* sp.-1ml/ l) by 65.14% and 59.61%, respectively. Tobacco decoction (5%), ginger rhizome extract (15%) and chilli-garlic extract were the least effective. All the evaluated botanicals were safe to natural enemies observed on mulberry. Chilli-garlic extract and ginger rhizome extract were the safest against coccinellids and spiders, respectively.

Key words: Mulberry, *Dialeuropora decempunctata*, neem oil, pongamia oil, tobacco decoction, ginger rhizome extract, toxicity, coccinellids, spiders, safety

Mulberry (*Morus alba* L.) is the sole food source of silk worm *Bombyx mori* L. However luxuriant growth of mulberry invites > 300 species of insect and non-insect pests resulting in considerable reduction in leaf yield and quality. These are the major constraints in silk worm rearing and cocoon productivity (Reddy and Kotikal, 1988). In addition, poor quality mulberry leaves lead to disrupted growth of larvae, high larval mortality, small and thin-walled cocoons and adult deformities (Dadd, 1973). Whitefly *Dialeuropora decempunctata* (Quaintance and Baker) (Homoptera: Aleyrodidae) is a major pest infesting mulberry during July- November. Its infestation leads to 10-24% loss in leaf yield during major silk worm cocoon crop (October-November) (Bandyopadhyay et al., 2001). Sucking of plant juice by nymphs and adults and growth of sooty mould renders the leaves unfit for feeding (Patnaik et al., 2009). Sucking pests are the major production constraints in mulberry and among the sucking pests whiteflies are serious (Hosamani et al., 2020). Hence, routine insecticide application is unavoidable to protect the plants from infestation. The application of insecticides with high toxicity and prolonged residual effects in mulberry gardens is restricted because of the high sensitivity of silk worms to insecticides. Besides, the whiteflies tend to develop resistance very fast against repeated application of insecticides having the same mode of action. Hence, the present study was focused to find an effective and ecofriendly botanical pesticide to combat the whitefly infestation in mulberry.

MATERIALS AND METHODS

The experiment was conducted at the experimental plot of Central Sericulture Research and Training Institute (CSRTI) at Berhampore, Murshidabad, West Bengal during kharif season (August-October, 2016 and 2017). The trail was laid out with variety S1 in plots measuring 6x 5 m in randomized block design with eight treatments and three replications, with spacing maintained at 60x 60 cm. All agronomic practices were uniform in all experimental plots except the pest management options. Two sprays were given at fortnightly intervals with a knapsack sprayer from one month after pruning. The treatments comprised- T_1 = pongamia oil (3%), T_2 = neem oil (3 %), T_3 = NSKE (5%), T_4 = Torpedo (plant extract of *Sophora* and *Stemona* sp. @1ml/ l), T_5 = chilly-garlic extracts (5%), T_6 =15% rhizome extract of ginger, T_7 =tobacco decoction 5%, T_8 = untreated Control. Observations on *D. decempunctata* were made one day before treatment (pretreatment count) and 1, 3, 7 and 10 days after spray (DAS) from 3 leaves, one each from top, middle and bottom of 5 randomly selected plants/ plot. Simultaneously, all

Table 1. Efficacy of botanicals against adult *D. decempunctata* (2016 & 2017, pooled)

	Treatments	PTC	I Spray				II Spray				Mean
			1 DAS	3 DAS	7 DAS	10 DAS	1 DAS	3 DAS	7 DAS	10 DAS	
T_1	Pongamia oil (3%)	38.67	20.07± 1.51 (4.53)^{bc}	16.40± 0.80 (4.11)^{ab}	14.88± 0.30 (3.92)^{b}	17.47± 0.70 (4.24)^{b}	14.31± 1.09 (3.85)^{a}	12.07± 1.87 (3.54)^{ab}	11.27± 1.05 (3.43)^{b}	12.77± 1.72 (3.64)^{ab}	14.89
T_2	Neem oil (3%)	39.33	18.50± 1.10 (4.36)^{a}	12.83± 1.43 (3.65)^{a}	11.33± 0.91 (3.44)^{a}	14.70± 1.01 (3.90)^{a}	12.63± 1.04 (3.62)^{a}	9.57± 0.33 (3.17)^{a}	8.50± 1.01 (3.00)^{a}	10.60± 1.00 (3.33)^{a}	12.34
T_3	NSKE (5%)	40.67	25.80± 1.85 (5.13)^{d}	19.53± 2.10 (4.47)^{b}	17.83± 1.05 (4.28)^{c}	21.23± 1.29 (4.66)^{c}	21.03± 0.64 (4.64)^{bc}	16.43± 0.80 (4.11)^{cd}	15.40± 1.21 (3.99)^{cd}	18.27± 1.40 (4.33)^{c}	19.54
T_4	Torpedo (1ml/l)	38.33	23.75± 1.06 (4.92)^{cd}	17.43± 1.10 (4.23)^{b}	15.93± 1.21 (4.05)^{bc}	19.87± 1.00 (4.51)^{bc}	18.27± 1.74 (4.33)b	14.17± 1.88 (3.82)^{bc}	12.97± 0.57 (3.67)^{bc}	15.73± 1.10 (4.03)^{bc}	17.25
T_5	Chilli-Garlic extracts (5%)	38.67	25.79± 3.70 (5.12)^{d}	19.61± 1.91 (4.48)^{b}	18.20± 1.25 (4.32)^{c}	21.78± 1.11 (4.72)^{c}	21.93± 2.21 (4.73)^{bc}	17.47± 0.99 (4.24)^{cd}	16.23± 1.50 (4.09)^{d}	19.07± 2.93 (4.42)^{c}	20.03
T_6	15% Rhizome extract of Ginger	41.67	26.00± 1.60 (5.15)^{d}	20.30± 0.61 (4.56)^{b}	18.70± 0.75 (4.38)^{c}	22.37± 0.68 (4.78)^{c}	21.77± 2.36 (4.71)^{bc}	17.60± 1.06 (4.25)^{d}	16.43± 1.15 (4.11)^{d}	19.08± 1.10 (4.42)^{c}	20.26
T_7	Tobacco decoction 5%	41.33	26.90± 1.05 (5.23)^{d}	20.25± 1.75 (4.55)^{b}	18.57± 0.65 (4.37)^{c}	22.57± 0.58 (4.80)^{c}	22.90± 1.28 (4.84)^{c}	18.00± 0.72 (4.30)^{d}	16.80± 0.87 (4.16)^{d}	19.87± 2.59 (4.51)^{c}	20.77
T_8	Untreated Control	39.67	38.87± 1.53 (6.27)^{e}	40.70± 1.41 (6.42)^{c}	41.80± 2.27 (6.50)^{d}	45.37± 0.97 (6.77)^{d}	41.60± 1.06 (6.49)^{d}	43.43± 1.21 (6.63)^{e}	43.87± 1.80 (6.66)^{e}	45.33± 1.27 (6.77)^{d}	42.71
S. Em.±			0.10	0.10	0.08	0.06	0.10	0.09	0.09	0.12	
CD at 5%			0.30	0.31	0.22	0.18	0.29	0.27	0.25	0.36	

Mean values of three replications represented as mean± standard deviation; Figures in parentheses √(x+0.5) transformed values; Values followed by same letter not significantly different from each other, Tukey HSD ($p \leq 0.05$); S. Em: Standard error of mean; CD: Critical difference, PTC-pretreatment cum.

Table 2. Impact of botanicals against predatory fauna in mulberry (2016 & 2017, pooled; mean of 1st and 2nd sprays)

	Treatments	No. coccinellids/ plant						No. spiders/ plant					
		PTC	1 DAS	3 DAS	7 DAS	10 DAS	Mean	PTC	1 DAS	3 DAS	7 DAS	10 DAS	Mean
T_1	Pongamia oil (3%)	4.00	2.72 (1.79)^{ab}	2.32 (1.68)^{ab}	3.01 (1.87)^{a}	3.69 (2.05)^{ab}	2.93	3.83	2.91 (1.85)^{a}	3.45 (1.99)^{a}	3.58 (2.02)^{a}	3.58 (2.02)^{a}	3.38
T_2	Neem oil (3%)	4.33	2.34 (1.69)^{a}	1.68 (1.48)^{a}	2.67 (1.78)^{a}	3.32 (1.95)^{a}	2.50	4.03	3.24 (1.93)^{ab}	3.29 (1.95)^{a}	3.49 (2.00)^{a}	3.72 (2.05)^{a}	3.43
T_3	NSKE (5%)	4.67	3.69 (2.05)^{b}	2.32 (1.68)^{ab}	3.32 (1.95)^{ab}	3.99 (2.12)^{ab}	3.33	4.0	3.20 (1.92)^{ab}	3.53 (2.01)^{a}	3.66 (2.04)^{a}	3.81 (2.08)^{a}	3.55
T_4	Torpedo (1ml/l)	4.33	3.01 (1.87)^{ab}	2.72 (1.79)^{ab}	3.83 (2.08)^{ab}	4.17 (2.16)^{ab}	3.43	4.20	3.85 (2.09)^{ab}	3.66 (2.04)^{a}	3.78 (2.07)^{a}	4.02 (2.13)^{a}	3.83
T_5	Chilli-Garlic extracts (5%)	4.67	2.81 (1.82)^{ab}	3.37 (1.97)^{b}	3.90 (2.10)^{ab}	4.31 (2.19)^{ab}	3.60	3.90	3.26 (1.94)^{ab}	3.29 (1.95)^{a}	3.61 (2.03)^{a}	3.83 (2.08)^{a}	3.50
T_6	15% Rhizome extract of Ginger	3.67	3.01 (1.87)^{ab}	2.19 (1.64)^{ab}	2.95 (1.86)^{a}	3.34 (1.96)^{a}	2.87	4.00	3.63 (2.03)^{ab}	3.58 (2.02)^{a}	3.91 (2.10)^{a}	3.74 (2.06)^{a}	3.72
T_7	Tobacco decoction 5%	4.33	3.38 (1.97)^{ab}	2.72 (1.79)^{ab}	2.76 (1.81)^{a}	3.72 (2.05)^{ab}	3.14	3.80	3.24 (1.93)^{ab}	3.35 (1.96)^{a}	3.37 (1.97)^{a}	3.61 (2.03)^{a}	3.39
T_8	Untreated Control	4.00	5.42 (2.43)^{c}	5.68 (2.49)^{c}	4.88 (2.32)^{c}	5.29 (2.41)^{b}	5.32	4.12	4.52 (2.24)^{b}	4.65 (2.27)^{b}	4.22 (2.17)^{a}	4.31 (2.19)^{a}	4.43
S. Em.±			0.11	0.10	0.13	0.12			0.12	0.07	0.10	0.10	
CD at 5%			0.32	0.30	0.37	0.37			0.34	0.20	0.28	0.28	l

Figures in parentheses √(x+0.5) transformed values; Values followed by same letter not significantly different from each other, Tukey HSD ($p \leq 0.05$); S.Em: Standard error of mean; CD: Critical difference.

predatory coccinellids and spiders, irrespective of species were counted/ plant. These counts were taken up during the morning hours (Naranjo and Flint, 1995). The incidence of *D. decempunctata* observed before and after sprays were converted to % reduction as per the modified Abbot's formula (Flemings and Ratnakaran, 1985). The data were subjected to ANOVA whereas means with significant difference were differentiated using Tukey HSD (honestly significant difference; p=0.05) with SPSS® version 25.0.

RESULTS AND DISCUSSION

Efficacy of botanical extracts evaluated against *D. decempunctata* on mulberry fields as given in Table 1 reveals that there was no significant difference in pretreatment counts. However, all the treatments differed significantly in reducing the incidence after one, three, seven and ten day after spraying (DAS). The pooled data revealed that maximum reduction (71%) was observed with 3% neem oil; it is followed by 3% pongamia oil and with plant extract of *Sophora* and *Stemona* sp. @1ml/ l; NSKE (5%) gave 54.25% reduction on par with plant extract of *Sophora* and *Stemona* sp., and 15% rhizome extract of ginger. The treatments comprising of tobacco decoction (5%) (T7) was the least effective. Maximum occurrence of predatory coccinellids and spiders was observed with chilly-garlic extracts (3.60/ plant); neem oil causes up to 53.01% mortality of coccinellids, while with spiders, pongamia oil (3%) followed by 5% tobacco decoction led to reduction of 23.70% and 23.48%, respectively. The predatory coccinellids and spiders got least affected with by the application of plant extract of *Sophora* and *Stemona* sp.

These findings are in line with those of Sharma and Summarwar (2017), on cotton with whitefly- maximum with neem oil + liquid soap. Naik et al. (2012) observed that the plant product chilly-garlic extracts was the least effective compared to the neem products. Jha and Kumar (2017) also confirmed that tobacco decoction is less effective over neem in reducing whiteflies. The present study confirmed that the botanicals are slightly or least toxic towards the predatory fauna which concurs with the findings of Ranga Rao et al. (2007). Thus, it is concluded from the present study that field application of botanicals like neem oil, pongamia oil and plant extract of *Sophora* and *Stemona* sp. are efficient against mulberry whitefly, and were also less toxic to the predators.

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