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Efficacy of botanicals against jassid *Empoasca flavescens* F. (Homoptera: Cicadellidae) on mulberry and their biosafety to natural enemies

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ABSTRACT

Efficacy of some promising botanicals and the synergists were compared to the commonly used chemical dichlorvos (76EC) against jassid *Empoasca flavescens* F. infesting mulberry as well as their biosafety to natural enemies. Among the botanicals, sole application of neem oil (3%), FORS (2%) and pongamia oil (3%) recorded 48.73, 46.88 and 42.49% reduction in jassid population respectively, whereas the NSKE (5%) exhibited least among all (33.59% at 1 DAS).The synergistic effect of neem oil and FORS recorded the best, 72.64% reduction followed by Pongamia oil + FORS (62.81%) and neem oil + pongamia oil (60.16%). Though dichlorvos was effective than all treatments (88.57% reduction) the chemical also eliminated more than 90% population of predatory coccinellids and spiders but the botanicals found relatively safer. Hence, the combination of neem oil (3%) with fish oil rosin soap (2%) could be used as an alternate to dichlorvos to manage jassid menace in mulberry as well as to conserve the natural enemies.

Key words: Botanicals, *Empoasca flavescens*, jassid, mulberry, natural enemies

INTRODUCTION

Like agricultural crops, mulberry (*Morus alba* L.) the sole food plant of silkworm, (*Bombyx mori* L.) is also prone to attack by number of insect pests. They reduce the leaf yield and quality which reflects adversely on quantum of silkworm rearing and cocoon productivity. Therefore, routine application of insecticides is unavoidable to protect the plants from the pests with in short period after pruning to take up silkworm rearing in time. However, application of insecticides with high toxicity and prolonged residual effects in mulberry garden is restricted because of high sensitivity of silkworms. Dichlorvos (DDVP) is recommended commonly to combat the pests of mulberry and is widely used by the sericulture farmers (Dandin *et al*., 2003; Rajadurai and Thiagarajan, 2003; Samuthiravelu *et al*., 2003) due to its knockdown effect cum fumigant action as well as low persistence. (David and Ramamurthy, 2011). However, the chemical has been recorded to be highly toxic to the natural enemies of insect pests and eliminates their population (Sakthivel and Qadri, 2010).

In recent past, outbreak of some sucking pests on mulberry *viz*. papaya mealybug, thrips, jassids *etc,* have been noticed as they developed resistance to dichlorvos and due to destruction of natural enemy complex on routine application of this chemical in mulberry garden by the farmers. Therefore, development of ecofriendly IPM practices against the mulberry pests is the need of hour to sustain the industry. In this context, an effort has been made to investigate the efficacy of some promising botanicals against jassid *Empoasca flavescens* F. (Homoptera: Cicadellidae), the major sucking pest of mulberry in the tropical zones of south India and their bio-safety to the predatory coccinellids and spiders in mulberry ecosystem.

MATERIALS AND METHODS

The experiment was conducted in the mulberry field of Farmer's Training Center, Department of Sericulture, Srivilliputtur, Tamil Nadu, India during August-September 2010 when large number of jassid population was observed. Randomized block design was followed with eleven treatments and was replicated thrice. Each plot measured 7.3 X 3.6 m with 42 mulberry plants in a paired row *i.e.* (5'+3') X 2' spacing system. Mulberry variety, MR2 was used under irrigated conditions. The treatments were: T_1= 5% neem seed kernel extract (NSKE); T_2= 3% neem oil; T_3= 3% pongamia oil; T_4= 2% fish oil rosin soap(FORS); T_5= 5% NSKE+ 2% FORS; T_6= 3% neem oil + 2% FORS; T_7= 3% pongamia oil + 2% FORS; T_8= 5% NSKE+ 3% pongamia oil; T_9= 3% neem oil +3% pongamia oil; T_{10}= 0.076% dichlorvos (DDVP, 76EC), the commonly recommended insecticide was used as standard check and T_{11}=water spray as control. The spray was undertaken 30 days after pruning with the spray volume @ 300 liters per acre using a knapsack sprayer.

The population of jassids including live nymphs and adults were recorded a day prior to the spray (pre-treatment count) and 1, 3, 7 and 10 days after spray (DAS) from 3 leaves, one each located at top, middle and bottom of 5 randomly selected plants per plot. Simultaneously, the population of all predatory coccinellids and spiders irrespective of species per plant were also recorded. The counting was taken up during cooler hours preferably 6AM-7AM (Naranjo and Flint, 1995). Per cent reduction in population over control was calculated and the data were analyzed statistically.

RESULTS AND DISCUSSION

Efficacy of different treatments against jassid, *E. flavescens* is presented in Table 1. There was no significant difference among treatments with respect to mean population of jassids at one day before imposing treatments. All the treatments differed significantly over untreated control in reducing the jassid incidence at one, three, seven and ten days after spray (DAS).

Table1. Effect of botanicals on the population of jassid *Empoasca flavescens* in mulberry

Treatment	Mean number of jassid per leaf						Mulberry leaf yield (gm/Plant)
	PTC	1DAS	3DAS	7DAS	10DAS	Mean	
NSKE (5%)	7.86	5.00 (33.59)	4.40 (45.00)	5.66 (30.97)	6.80 (23.85)	5.46 (33.08)	487 (10.68)
Neem oil (3%)	8.20	3.86 (48.73)	3.33 (58.37)	4.46 (45.61)	5.86 (34.37)	4.37 (46.44)	590 (34.09)
Pongamia oil (3%)	8.33	4.33 (42.49)	4.20 (47.50)	4.80 (41.46)	6.73 (24.63)	5.01 (38.60)	533 (21.13)
FORS (2%)	7.86	4.00 (46.88)	4.20 (47.50)	4.80 (41.46)	6.53 (26.87)	4.88 (40.19)	576 (30.90)
NSKE+FORS (5:2)	8.00	3.33 (55.77)	3.80 (52.50)	4.20 (48.78)	5.86 (34.37)	4.29 (47.42)	600 (36.36)
Neem oil + FORS (3:2)	8.13	2.06 (72.64)	2.20 (72.50)	2.53 (69.14)	3.86 (56.77)	2.66 (67.40)	660 (50.00)
Pongamia oil + FORS (3:2)	8.00	2.80 (62.81)	2.93 (63.37)	3.86 (52.92)	5.33 (40.31)	3.73 (54.29)	608 (38.18)
NSKE+ Pongamia oil (5:3)	8.20	3.33 (55.77)	3.00 (62.5)	4.20 (48.78)	5.66 (36.61)	4.04 (50.49)	550 (25.00)
Neem oil + Pongamia oil (3:3)	7.93	3.00 (60.16)	3.06 (61.75)	3.93 (52.07)	4.80 (46.24)	3.69 (54.77)	588 (26.81)
DDVP(76EC) (0.076%)	8.06	0.86 (88.57)	1.73 (78.37)	2.93 (64.26)	3.80 (57.44)	2.33 (71.44)	666 (51.36)
Control (Water spray)	7.80	7.53	8.00	8.20	8.93	8.16	440
C.D.@5%	NS	0.32	0.27	0.31	0.38	--	48.00
C.V.%	9.25	9.63	6.42	6.23	8.39	--	10.27

PTC: Pre-treatment count, DAS: Days after spray
Figures in the parentheses are percent reduction over control

Among the natural products, the synergistic effect of neem oil and FORS recorded the best, 72.64% reduction at 1DAS followed by Pongamia oil + FORS and neem oil + Pongamia oil but were inferior to standard check, dichlorvos. The combination of both NSKE + FORS and NSKE + pongamia oil was at par with each other. The sole application of neem oil, FORS and Pongamia oil recorded 48.73, 46.88 and 42.49% reduction respectively where as the NSKE exhibited least among all. Neem oil + FORS maintained its effectiveness higher than dichlorvos at 7DAS but both were on par with each other at 10 DAS. This was followed by neem oil + Pongamia oil and pongamia oil + FORS. The synergistic effect of neem oil with FORS persisted longer than dichlorvos because of chemical degradation quickly after spraying in the garden. However, the pooled data revealed that the combination of neem oil and FORS found superior among the botanicals with the efficacy close to dichlorvos. Leaf yield in the plots treated with dichlorvos and neem oil + FORS were on par with each other (666 and 660 grams per plant) and recorded higher than rest of the treatments.

Similarly, Sujay *et al.* (2009) proved the effectiveness of eco-friendly approach comprising neem oil against the sucking pests of chilli compared to the chemical control measures practiced by the farmers. The azadirachtin present in the neem oil known to possess antifeedant activity as well as disturbs insect moulting by antagonizing the insect hormone ecdysone (Mordue and Blackwell, 1993.). Fish oil rosin soap is animal origin widely used to control sucking pests (Natrajan *et al.*, 1991) and it acts by causing spiracle blockage, cellular disruption and cuticle desiccation (Ware, 1994).

The dichlorvos was recorded as highly toxic to the coccinellids and spiders reduced 98.30 and 94.33% of population respectively at 1 DAS. Among botanicals the highest reduction was recorded in neem oil + FORS treated plots followed by neem oil + pongamia oil but FORS and NSKE exhibited low toxic to coccinellids and spiders reduced only 27.80 and 17.00 %, respectively. The persistent toxicity of neem oil + FORS was reduced significantly at 10DAS recorded only 23.66 and 18.01 % reductions in coccinellids and spiders population respectively whereas in dichlorvos recorded 53.43 and 44.14% reductions compared to control. The pooled data revealed that all botanicals and their synergists exhibited relatively safer than dichlorvos (Table 2 and 3). This was in agreement with the observations made by Sakthivel and Qadri (2010) in mulberry ecosystem. Similarly, Sharma and Adlakha (1986) and Tank *et al.* (2007) reported high toxicity of dichlorvos to the coccinellids predators *Cheilomenes sexmaculata* F. and *Coccinella septempunctata* L.

Table 2. Effect of botanicals on the population of predatory coccinellids in mulberry

Treatment	Mean number of coccinellids per plant					
	PTC	1DAS	3DAS	7DAS	10DAS	Mean
NSKE (5%)	6.86	5.00 (34.72)	5.55 (24.28)	6.27 (10.42)	7.03 (7.30)	5.96 (20.10)
Neem oil (3%)	7.00	3.86 (49.60)	4.00 (45.42)	5.33 (23.85)	6.20 (21.12)	4.84 (35.12)
Pongamia oil (3%)	6.73	4.78 (37.59)	5.00 (31.78)	6.00 (14.28)	6.88 (12.46)	5.66 (24.12)
FORS (2%)	6.66	5.53 (27.80)	5.20 (29.05)	5.80 (17.14)	7.00 (10.94)	5.88 (21.18)
NSKE+FORS (5:2)	6.93	4.33 (43.47)	4.29 (41.47)	5.20 (25.71)	6.86 (12.72)	5.17 (30.70)
Neem oil + FORS (3:2)	6.60	3.38 (55.87)	3.84 (47.61)	4.53 (35.28)	6.00 (23.66)	4.43 (40.61)
Pongamia oil + FORS (3:2)	6.66	4.45 (41.90)	5.00 (31.78)	6.06 (13.42)	6.86 (12.72)	5.59 (25.06)
NSKE+ Pongamia oil (5:3)	7.06	4.33 (43.47)	5.30 (27.69)	6.20 (11.42)	6.66 (15.26)	5.62 (24.66)
Neem oil + Pongamia oil (3:3)	6.80	3.86 (49.60)	4.13 (43.65)	4.93 (29.57)	5.80 (26.20)	4.68 (37.26)
DDVP(76EC) (0.076%)	7.00	0.13 (98.30)	0.46 (93.72)	2.08 (70.28)	3.66 (53.43)	1.58 (78.82)
Control (Water spray)	6.93	7.66	7.33	7.00	7.86	7.46
C.D.@5%	NS	0.45	0.38	0.43	0.49	--
C.V.%	8.17	9.73	7.74	10.12	7.15	--

PTC: Pre-treatment count; DAS: Days after spray; Figures in the parentheses are per cent reduction over control

respectively. The neem products registered far safer than chemical to the predatory coccinellids (Sakthivel and Qadri, 2010) and the spiders (Samiayyan and Chandrasekharan, 1998 and Joseph *et al*., 2010). Though dichlorvos exhibits low persistency in the field, its fumigant and penetrant action caused knock down effect to the natural enemies and wiped-out their population immediately after spray. At the same time, frequent and repeated application of a chemical often resulted in development of resistance in the pests followed by their resurgence (Dhawan and Simwat, 1997; David and Ramamurthy, 2011).

The present study suggests that repeated field application of dichlorvos could be reduced to a greater extent by the use of neem oil + FORS combination as an alternate to contain the jassids successfully as well as to conserve the natural enemy complex in mulberry ecosystem.

Table 3. Effect of botanicals on the population of spiders in mulberry

Treatment	Mean number of spiders per plant					
	PTC	1DAS	3DAS	7DAS	10DAS	Mean
NSKE (5%)	3.13	2.93 (17.00)	2.86 (14.11)	2.86 (10.62)	3.06 (8.10)	2.92 (12.57)
Neem oil (3%)	2.93	2.33 (34.00)	2.33 (30.03)	2.53 (20.93)	2.93 (12.02)	2.53 (24.25)
Pongamia oil (3%)	3.13	2.73 (22.66)	2.66 (20.12)	2.80 (12.50)	3.00 (9.91)	2.80 (16.16)
FORS (2%)	3.00	2.60 (26.34)	2.73 (18.01)	2.80 (12.50)	3.06 (8.10)	2.79 (16.46)
NSKE+FORS (5:2)	3.06	2.33 (34.00)	2.80 (15.91)	3.00 (6.25)	3.13 (6.00)	2.81 (15.86)
Neem oil + FORS (3:2)	3.13	2.20 (37.67)	2.26 (32.13)	2.53 (20.93)	2.73 (18.01)	2.43 (27.24)
Pongamia oil + FORS (3:2)	3.06	2.80 (20.68)	2.93 (12.01)	2.86 (10.62)	3.13 (6.00)	2.93 (12.27)
NSKE+ Pongamia oil (5:3)	3.00	2.86 (18.98)	2.80 (15.91)	3.00 (6.25)	3.20 (3.90)	2.96 (11.37)
Neem oil + Pongamia oil (3:3)	2.93	2.73 (22.66)	2.53 (24.02)	2.73 (14.68)	2.86 (14.11)	2.71 (18.86)
DDVP(76EC) (0.076%)	3.06	0.20 (94.33)	0.86 (74.17)	1.06 (66.87)	1.86 (44.14)	0.99 (70.35)
Control (Water spray)	3.00	3.53	3.33	3.20	3.33	3.34
C.D.@5%	NS	0.16	0.18	0.16	0.20	--
C.V.%	9.71	13.00	9.88	11.87	9.63	--

PTC: Pre-treatment count; DAS: Days after spray; Figures in the parentheses are per cent reduction over control

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