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Effectiveness of plant oils for increasing the efficacy of insecticides and acaricides against chilli mite

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Abstract
The present experiment was conducted to assess the effectiveness of plant oils for increasing the efficacy of insecticides and acaricides under both laboratory and field condition at Main Agricultural Research Station, University of Agricultural Sciences, Raichur during 2014-15. Among the plant oils used, castor oil emerged as the best material for increasing the efficacy of pesticides against sucking pests of chilli. The mite population at lab condition was influenced at different plant oils indicated that the treatment castor oil + dicofol proved to be superior among all the treatments with least mite population. The mortality levels recorded at different intervals were 56.67 per cent, 70 per cent, 83 per cent and 93.33 per cent at 24, 48, 72 and 96 hours, after treatment respectively. Under field condition also, the treatment castor oil + dicofol recorded lowest population counts.

Key words: acaricides, castor oil, dicofol, mites

Introduction
Chilli is one of the important spice and vegetable crop of India and being widely cultivated throughout warm temperate, tropical and subtropical countries. It is a fascinating spice, it has got two important commercial qualities namely capsanthin responsible for red colour and capsaicin for pungency, good source of vitamins; minerals and beta-carotene. The capsaicin is an antioxidant having medicinal properties. It is grown in almost all the country covering an area of 1.9 million hectares with a production of 29.9 million tonnes averaging a productivity of 15.8 tonnes per ha. India is the major and highly erratic producer, consumer and exporter of chilli, covering an area of 0.77 million hectares with a production of 0.659 million tonnes averaging a productivity of 0.86 tonnes per ha Anon., 2013 [2]. India is the largest exporter of chilli in the world and contributes one-fourth of the total quantity of chilli exported in the world.

The pest spectrum of chilli crop is complex with more than 293 insects and mite species debilitating the crop in the field as well as in storage Anon., 1987 [1]. Amongst these, thrips, *Scirtothrips dorsalis* Hood; yellow mite, *Polyphagotarsonemus latus* Banks are the most vital production constraints. The yield loss caused by thrips (*S. dorsalis*) and mites (*P. latus*) was more than 90 per cent in Karnataka Dhandapani *et al.,* 2003 [4]. Keeping these points and facts in view, the following objectives were framed for studies on the management of sucking pests of chilli.

To evaluating the effectiveness of plant oils for increasing the efficacy of insecticides and acaricides.

Materials and methods
Chilli seedlings were raised in earthen pots. In each earthen pot, two healthy seedlings were maintained. The pots were caged by using muslin cloth. Initially mites infested chilli leaves were collected from field and used for initiating the pure culture for lab study. The infested leaves were tagged to healthy seedlings and allowed for the population build up and then were used for the experiment.

Bioassay studies were carried out by using leaf dip method. The leaves were collected from untreated plots for bioassay study. These leaves were dipped in spray solution to test insecticides and acaricides with and without plant oils for 30 seconds. Excess fluid was drained off and the leaves were dried under shade for 10 minutes before transferring to

petriplate. Twenty mites were released on each leaf as described by Tabashnik and Cushing 1987. Mortality counts were taken at 24, 48, 72 and 96 hours after treatment. The chemicals *viz.*, fenpyroximate 5 SC (25 g *a.i.*/ ha), fipronil 5 SC (25 g *a.i./* ha), dicofol 18.5 EC (92.5 g *a.i./* ha) and spinosad 45 SC (67.5 g *a.i.*/ ha) and the plant oils *viz.*, castor oil, pongamia oil, mustard oil and sesamum oil (2 ml/l) and their combinations were used for testing the efficacy both under laboratory and field conditions.

The field trial was laid out in MARS, Raichur during 2014-15 for testing the effectiveness of new insecticides (fipronil and spinosad) and acaricides (dicofol and fenpyroximate) with and without plant oil v/s sucking pests of chilli. Based on the results of laboratory evaluation, only one best plant oil was selected for the field studies. 30 to 35 days old seedlings were transplanted in the main field with a spacing of 90 × 15 cm between rows and plants, respectively with a plot size of 4.5 × 1.2 m in a randomized complete block design (RCBD) consisting of nine treatments and are replicated thrice. The crop was raised following all agronomic practices except plant protection measures.

Observations on the pest incidence were recorded on sucking pests one day before imposition of treatments, which gave initial population and pest density at one, three, seven and 14 days after treatment imposition.

Results and discussion

Increased efficiency of both insecticides and acaricides was evident due to addition of different oils combinations *viz.*, castor oil, pongamia oil, sesamum oil and mustard oil at different intervals of time in the present investigation. The data on mite population as influenced at different plant oils indicated that the treatment castor oil + dicofol proved to be superior among all the treatments with least mite population. The mortality levels recorded at different intervals were 56.67 per cent, 70 per cent, 83 per cent and 93.33 per cent at 24, 48, 72 and 96 hours, respectively. Whereas, the untreated control showed less mortality accounting to 20 per cent, 26.67 per cent, 36.67 per cent and 46.67 per cent at 24, 48, 72 and 96 hours, respectively (Table 1). This indicated the differential response of mite mortality to different combinations of plant oils. Such studies on this aspect under laboratory conditions are lacking.

The population of mites observed at different intervals after spraying revealed that castor oil + dicofol recorded least mite count which was in agreement with the findings of Smitha and Giraddi 2003 [7] who reported that synergistic effect of plant oils with dicofol and castor oil in particular increased the efficacy of dicofol against chilli mite (Table 2). Besides, the effectiveness of castor oil alone on mites as well as other sucking pests has also been reported by many authors like Puri *et al.* 1991 [3-6], Butler *et al.* 1991 [3-6] and Umamaheswari *et al.* 1999 [9].

Table1. Effectiveness of plant oils for increasing the efficacy of insecticides and acaricides on mite, *P. latus* under laboratory condition

Sl. no.	Treatment	Dosage	Mortality (%)			
			24h	48 h	72 h	96 h
1	Castor oil	2 ml/l	46.67^{b} (43.09)	56.67^{b} (48.83)	60.00^{d} (50.7)	76.67^{e} (61.12)
2	Castor oil + Dicofol 18.5EC	2+2.5 ml/l	56.67^{a} (48.83)	70.00^{a} (56.79)	83.33^{a} (65.91)	93.33^{a} (75.04)
3	Castor oil + Spinosad 45SC	2+0.3 ml/l	43.33^{c} (41.17)	46.67^{e} (43.09)	66.67^{b} (54.74)	80.00^{d} (63.43)
4	Castor oil + Fipronil 5 SC	2+1 ml/l	40.00^{d} (39.23)	56.67^{b} (48.83)	63.33^{c} (52.73)	83.33^{c} (65.91)
5	Castor oil + Fenpyroximate 5SC	2+1 ml/l	56.67^{a} (48.83)	56.67^{b} (48.83)	66.67^{b} (54.74)	86.67^{b} (68.58)
6	Pongamia oil	2 ml/l	26.67^{h} (31.09)	36.67^{h} (37.27)	46.67^{h} (43.09)	56.67^{j} (48.83)
7	Pongamia oil + Dicofol 18.5EC	2+2.5 ml/l	33.33^{f} (35.26)	53.33^{c} (46.91)	53.33^{f} (46.91)	63.33^{h} (52.73)
8	Pongamia oil + Spinosad 45SC	2+0.3 ml/l	26.67^{h} (31.09)	36.67^{h} (37.27)	46.67^{h} (43.09)	56.67^{j} (48.83)
9	Pongamia oil + Fipronil 5 SC	2+1 ml/l	40.00^{d} (39.23)	43.33^{f} (41.17)	63.33^{c} (52.73)	73.33^{f} (58.91)
10	Pongamia oil + Fenpyroximate 5SC	2+1 ml/l	36.67^{e} (37.27)	46.67^{c} (43.09)	56.67^{e} (48.83)	66.67^{g} (54.74)
11	Mustard oil	2 ml/l	30.00^{g} (33.21)	50.00^{d} (45.00)	60.00^{d} (50.77)	66.67^{g} (54.74)
12	Mustard oil + Dicofol 18.5EC	2+2.5 ml/l	23.33^{i} (28.88)	33.33^{i} (35.26)	43.33^{i} (41.17)	53.33^{k} (46.91)
13	Mustard oil + Spinosad 45SC	2+0.3 ml/l	23.33^{i} (28.88)	33.33^{i} (35.26)	43.33^{i} (41.17)	53.33^{k} (46.91)
14	Mustard oil + Fipronil 5 SC	2+1 ml/l	36.67^{e} (37.27)	46.67^{e} (43.09)	56.67^{e} (48.83)	66.67^{g} (54.74)
15	Mustard oil + Fenpyroximate 5SC	2+1 ml/l	23.33^{i} (28.88)	36.67^{h} (37.27)	46.67^{h} (43.09)	56.67^{j} (48.83)
16	Sesamum oil	2 ml/l	23.33^{i} (28.88)	33.33^{i} (35.26)	40.00^{j} (39.23)	50.00^{i} (45.00)
17	Sesamum oil + Dicofol 18.5EC	2+2.5 ml/l	23.33^{i} (28.88)	33.33^{i} (35.26)	43.33^{i} (41.17)	53.33^{k} (46.91)
18	Sesamum oil + Spinosad 45SC	2+0.3 ml/l	26.67^{h} (31.09)	36.67^{h} (37.27)	46.67^{h} (43.09)	56.67^{j} (48.83)
19	Sesamum oil + Fipronil 5 SC	2+1 ml/l	26.67^{h} (31.09)	43.33^{f} (41.17)	53.33^{f} (46.91)	63.33^{h} (52.73)
20	Sesamum oil + Fenpyroximate 5SC	2+1 ml/l	33.33^{f} (35.26)	46.67^{e} (43.09)	56.67^{e} (48.83)	66.67^{g} (54.74)
21	Fenpyroximate 5SC	1 ml/l	30.00^{g} (33.21)	43.33^{f} (41.17)	53.33^{f} (46.91)	63.33^{h} (52.73)
22	Fipronil 5SC	1 ml/l	43.33^{c} (41.17)	53.33^{c} (46.91)	63.33^{c} (52.73)	73.33^{f} (58.91)
23	Spinosad 45SC	0.3 ml/l	33.33^{f} (35.26)	43.33^{f} (41.17)	53.33^{f} (46.91)	63.33^{h} (52.73)
24	Dicofol 18.5EC	2.5 ml/l	30.00^{g} (33.21)	40.00^{g} (39.23)	50.00^{g} (45.00)	60.00^{i} (50.77)
25	Control	2 ml/l	20.00^{j} (26.57)	26.67^{j} (31.09)	36.67^{k} (37.27)	46.67^{m} (43.09)
S.Em±			0.321	0.156	0.153	0.176
CD @ 1%			1.217	0.592	0.578	0.668

Means followed by same letter in a column do not differ significantly by DMRT (P=0.01)

Figure in Parentheses are arcsine transformed values.

Table 2. Efficacy of acaricides and insecticides with and without castor oil against chilli mite under field condition

S. No	Treatment	Dosage	Number of mites/ leaf											
			I Spray DAS					II Spray DAS				III Spray DAS			
			Pre count	1	z	7	14	1	3	7	14	1	3	7	14
1	Fenpyroximate 5SC	1 ml/l	1.49 (1.41)	0.83^{bcd} (1.15)	0.49^{bc} (0.99)	0.39^{bc} (0.94)	0.99^{bc} (1.22)	3.30^{c} (1.95)	2.77^{c} (1.94)	2.27^{c} (1.93)	3.40^{d} (1.97)	1.23^{b} (1.32)	0.59^{abc} (1.04)	0.45^{abc} (0.98)	1.32^{cd} (1.35)
2	Dicofol 18.5EC	2.5 ml/l	1.83 (1.53)	0.80^{bc} (1.14)	0.46^{abc} (0.98)	0.36^{abc} (0.93)	0.87^{abc} (1.17)	5.17^{e} (2.38)	4.63^{e} (2.37)	4.13^{e} (2.37)	5.27^{f} (2.40)	1.07^{ab} (1.25)	0.49^{ab} (0.99)	0.43^{ab} (0.96)	1.20^{bc} (1.30)
3	Spinosad 45SC	0.3 ml/l	1.87 (1.54)	0.97^{cd} (1.21)	0.53^{c} (1.02)	0.43^{c} (0.97)	1.00^{c} (1.22)	4.83^{de} (2.31)	4.30^{de} (2.30)	4.13^{de} (2.29)	4.93^{ef} (2.33)	1.57^{c} (1.44)	0.73^{bc} (1.11)	0.50^{bc} (1.00)	1.33^{cd} (1.35)
4	Fipronil 5SC	1 ml/l	1.70 (1.48)	1.00^{d} (1.22)	0.50^{bc} (1.00)	0.40^{bc} (0.95)	1.07^{b} (1.25)	4.50^{d} (2.24)	3.97^{d} (2.23)	3.47^{d} (2.22)	4.60^{e} (2.26)	1.87^{b} (1.54)	0.77^{c} (1.13)	0.47^{c} (0.98)	1.40^{d} (1.38
5	Castor oil + Fenpyroximate 5SC	2+1 ml/l	1.73 (1.49)	0.60^{ab} (1.05)	0.32^{ab} (0.90)	0.22^{ab} (0.85)	0.63^{ab} (1.06)	1.37^{a} (1.37)	0.83^{a} (1.35)	0.33a (1.34)	1.47^{a} (1.40)	0.93^{ab} (1.20)	0.45^{ab} (0.97)	0.28^{ab} (0.89)	0.97^{ab} (1.21)
6	Castor oil+ Dicofol 18.5EC	2+2.5 ml/l	1.79 (1.51)	0.57^{a} (1.03)	0.27^{a} (0.88)	0.17^{a} (0.82)	0.57^{a} (1.03)	3.20^{c} (1.92)	2.67^{c} (1.91)	2.17^{c} (1.91)	2.97^{c} (1.86)	0.83^{a} (1.15)	0.43^{a} (0.97)	0.23^{a} (0.86)	0.90^{a} (1.18
7	Castor oil + Spinosad 45SC	2+0.3 ml/l	1.77 (1.51)	0.67^{ab} (1.08)	0.33^{ab} (0.91)	0.23^{ab} 0.86)	0.63^{a} (1.06)	1.43^{a} (1.39)	0.90^{a} (1.38)	0.40^{a} (1.37)	1.53^{a} (1.43)	0.97^{ab} (1.21)	0.50^{ab} (1.00)	0.30^{ab} (0.89)	0.97^{ab} (1.21)
8	Castor oil + Fipronil 5SC	2+1 ml/l	1.83 (1.53)	0.70^{ab} (1.10)	0.43^{abc} (0.97)	0.33^{abc} (0.91)	0.73^{ab} (1.11)	2.17^{b} (1.63)	1.63^{b} (1.62)	1.13^{b} (1.61)	2.27^{b} (1.66)	0.99^{ab} (1.22)	0.53^{abc} (1.02)	0.40^{abc} (0.95)	1.07^{ab} (1.25)
9	Control	-	1.44 (1.39)	1.53^{e} (1.42)	2.20^{d} (1.64)	2.27^{d} (1.66)	2.43^{d} (1.71)	8.15^{f} (2.68)	8.30^{f} (2.67)	8.50^{f} (2.66)	8.59^{g} (2.70)	3.70^{d} (1.56)	3.75^{d} (1.65)	3.89^{d} (1.69)	3.99^{e} (1.81)
S.Em±		-	0.05	0.06	0.06	0.10	0.11	0.14	0.13	0.12	0.14	0.10	0.08	0.08	0.06
CD @ 5%		NS	0.15	0.19	0.19	0.29	0.33	0.42	0.40	0.36	0.43	0.31	0.24	0.23	0.18

DAS - Days after spray
NS - Non- significant

Figures in parentheses are $\sqrt{x+0.5}$ values
Mean followed by same letter in a column do not differ significantly by DMRT (P=0.05)

Conclusion

From the results obtained in the present investigation following conclusion are made

Among the plant oils used, castor oil emerged as the best material for increasing the efficacy of pesticides v/s sucking pests of chilli.

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