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Comparative study of medicinal plants on feeding behaviour of seven day old larvae of Tobacco caterpillar, *Spodoptera litura* (Fab.) and Bihar hairy caterpillar, *Spilarctia obliqua* (Walk.)

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Abstract Eight medicinal plants viz., Sinduri, *Bixa orellana* (Bixaceae); Dalchini, *Cinnamomum zelanicum* (Lauraceae); Camphora, *Cinnamomum camphora* (Lauraceae); Gular, *Ficus racemosa* (Moraceae); Arjun, *Terminalia arjuna* (Combretaceae); Nagkesar, *Messua ferrea* (Calophyllaceae); Sarpgandha, *Rauwolfia serpentina* (Apocynaceae); Putranjeeva, *Putranjeeva roxburghii* (Euphorbiaceae) at 5% and 10 % concentrations were tested for the feeding against larvae of *Spodoptera litura* and *Spilarctia obliqua*. At 10% conc. *C.camphora* (hexane, diethyl ether, and acetone) was found extremely antifeedant against the larvae of both insects (*S.litura* and *S.obliqua*) while *C.zeylanicum* (hexane, diethyl ether, and acetone) and *P.roxbughii* (diethyl ether, and acetone), *B.orellana* (Acetone) showed extremely antifeedant activity only against the larvae of *S.litura*. At 5% concentration, the same plants were also effective against the larvae but their efficacy was less than at 10% concentration. The observation showed promising results with these plant extracts against the feeding and management of these two insect pests of agricultural importance.

Key words: Antifeedant, feeding behaviour, medicinal plants, *Spodoptera litura* and *Spilarctia obliqua*

INTRODUCTION

Plants are the storehouse of a variety of bioactive chemicals such as secondary plant metabolites that are used in defense mechanism against herbivores. These secondary metabolites such as terpenes, alkaloids, steroids, phenolics, tannins etc (Orozco *et al.*, 2006, Mazid *et al.,* 2011, Tugizimana, *et al.,* 2013) have multiple modes of action and deleterious to insects in multiple ways, as acute toxicity, affecting insect behavior (Sanchez *et al.,* 2010) disrupting growth and development of insects and acting as repellents, anti-feedants and oviposition deterrents (Ullah *et al.*, 2010). Now a day's indiscriminate use of synthetic insecticides creates a series of problems and in this situation introducing plant products can be a better alternative to synthetic chemical insecticides. In recent years the use of botanicals and bio-rational pesticides for protecting crops from insect pests has assumed great importance (Chauhan *et al.,* 2011). Several researchers have reported to possess pest control properties in various plant species. Their observations revealed that the plant derived insecticides possess antifeedant effect, growth retardation toxicity, oviposition deterrence and bio-chemical effects also (Sahayaraj, 2011, Jeyasankar *et al.,* 2012. Kaur *et al.,* 2014). Plants with antifeedant properties are increasingly being used against phytophagous insect pests for protection of crops (Tapondjou *et al.,* 2005, Bakavathiappan*, et al.,* 2012). In this context we intend to observe the antifeedant activity of different plant extracts against two polyphagous insect pest, *Spodoptera litura* and *Spilarctia obliqua.*

MATERIALS AND METHODS

Maintenance of insect culture: Wild population of *S. litura* and *S.obliqua* were collected from Norman E. Borlaug Crop Research Centre (NEBCRC), Pantnagar. Rolling culture of test insects was maintained on castor leaves, under laboratory conditions (Temperature 28 ºC and relative humidity 88%). Then the seven day old larvae were taken from the culture, as and when required. All the experiments were conducted in the Integrated Pest Management Laboratory of the Department of Entomology, College of Agriculture, and Govind Ballabh Pant University of Agriculture and Technology Pantnagar.

Preparation of plant extracts: The fresh plant parts of plants viz., *Bixa orellana*; *Cinnamomum zelanicum*; *Cinnamomum camphora*; *Ficus racemosa*; *Terminalia arjuna*; *Messua ferrea*; *Rauwolfia serpentina*; *Putranjeeva roxburghii* were washed in running tap water and dried in shade for a week. The dried plant samples were weighed and macerated in electric grinder into a fine paste, each powdered plant materials were sieved using strainer, and 100 gm powdered plant

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material was sequentially extracted with hexane, diethyl ether for a period of 72 hours each and then filtered. The filtered content of plant extracts was then subjected to rotary vacuum evaporator until solvents were completely evaporated to get the solidified crude extracts. The crude extracts thus obtained were stored in sterilized amber colored bottles maintained at 4°C in a refrigerator. Standard one per cent stock solution (1000 ppm) was prepared by dissolving 100 mg of crude extract in 100 ml of acetone. (Arivoli and Tennyson, 2012).

Experimentation

Feeding activity: Two concentrations (5% and 10%) of above mentioned medicinal plants were tested using 'choice feeding' bioassay method. Control consisted of *Ricinus communis* leaf discs. The treated leaf discs (5x5 cm^2) were kept in the centre of presterilized corning glass petri dishes (dia.meter 9cm) containing an inner lining of moist filter paper. All the treatments were replicated three times. Control consisted of *Ricinus communis* leaf disc treated with distilled water. Prestarved (3h) and freshly moulted larvae (n=2) of same age were released in each petridish and were allowed to feed until more than 75% of the leaf disc area was eaten away in control. The observations on leaf area consumed was recorded on graph paper sheets and used for calculations of other parameters viz., Mean leaf area consumed (MLAC, cm^2), Feeding percentage (%), Antifeedant activity, Feeding inhibition (%), Preference index (C-value) and Antifeedant category were determined following standard methods.

(i) Antifeedant activity (A.A.) (Singh and Pant, 1980)

$$\frac{\text{Leaf protectionin treated disc [\%]} - \text{leaf protectionin control disc [\%]}}{100 - \text{leaf protectionin control disc [\%]}} x100$$

(ii) Feeding inhibition (F.I.) (Pande and Srivastava, 2003)

$$\frac{C - T}{C + T} x100$$

Where, C=consumption of control disc; T = consumption of treated disc

iii) Feeding percentage (F.P.) (Purwar and Srivastava, 2003)

$$\frac{\text{(Initial leaf are provided for feeding)} - \text{(Leaf area left after feeding)}}{\text{Initial leaf area provided}} x100$$

(iv) C- Value (Preference index) (Kogan and Goeden, 1970)

$$C = \frac{2M}{M + A}$$

Where, A = Eaten area of control leaf disc; M = Eaten area of treated leaf disc; On the basis of C- values following categories of experimental plant extract were determined.

Category C-value: 1. Extremely antifeedant plant; extracts 0.1-0.25; 2. Strongly antifeedant plant extracts 0.26-0.50; 3. Moderately antifeedant plant extracts 0.51-0.75; 4. Slightly antifeedant plant extracts 0.76 -0.99; 5. Preferred plant extracts >1

Statistical analysis: The experiment was conducted in completely randomized design (CRD) and the data was analyzed by angular transformation. The means were separated by using STPR3 (Standard programme, generated by Department of Statistics, Govind Ballabh Pant University of Agriculture and Technology Pantnagar) programme.

RESULTS AND DISCUSSION

Effect of plant extracts (5 and 10% concentrations) on feeding behavior of *S.litura:* Against *S. litura* lowest feeding was observed with *C. camphora*, (Table 1) acetone (3.01cm^2) and maximum in *T. arjuna*, acetone (14.02 cm^2) over control (MLAC=18.78 cm^2) at p=0.05. *C. camphora*, acetone and *T. arjuna*, acetone showed feeding percentage (12.04 and 56.08 %), antifeedant activity (83.97 and 25.34 %) and inhibition of feeding (72.37 and 14.51%) respectively. On the basis of preference index *B. orellana* (hexane), *C. zeylanicum* and *C. camphora* (hexane, diethyl ether, and acetone) and *P. roxbughii* (hexane, diethyl ether, and acetone) proved to be strongly antifeedant, while *T. arjuna* (hexane and acetone), *M. ferrea* (hexane) slightly antifeedant and other were found to be moderately antifeedant. At 10% concentration minimum feeding was observed with *C. camphora*, acetone (1.52 cm^2) and maximum in *T. arjuna*, diethyl ether (11.27 cm^2) over (MLAC=18.78 cm^2) at p=0.05. *C. camphora*, acetone and *T. arjuna*, diethyl ether showed feeding percentage (6.08 %) (45.08), antifeedant activity (91.90 %) (39.98%) and feeding inhibition (85.02 %) (24.99%) respectively. On the basis of preference index *C. camphora* and *C. zelanium,* (hexane, diethyl ether, acetone), *P. roxburghii* (diethyl ether and acetone) and *B. orellana*, acetone was found to be extremely antifeedant while *B. orellana* (hexane and diethyl ether), *F. racemosa*, acetone, *R. serpentina*, acetone and *P. roxburghii*, hexane, strongly antifeedant while others were found to be moderately antifeedant.

Effect of plant extracts (5 and 10% concentrations) on feeding behavior of *S.obliqua*: Minimum and maximum feeding was found with *C. camphora*, (Table 2) acetone (1.67cm^2) and *T. arjuna*, acetone (12.25cm^2) against larvae of *S. obliqua* over control (MLAC=18.78 cm^2) at p=0.05. Feeding percentage (6.68 %) (49 %), antifeedant activity (91.09 %) (34.70 %) and feeding inhibition (83.65 %) (20.99 %) respectively were found in *C. camphora*, acetone and *T. arjuna*, acetone. On the basis of preference index *C. camphora* (hexane, diethyl ether and acetone) was found to be extremely antifeedant. *B. orellana* (Hexane and acetone), *C. zelanium,* (hexane, diethyl ether and acetone), *F. racemosa*, acetone, *R. serpentina*, hexane and *P. roxburghii* (hexane, diethyl ether and acetone) were found strongly antifeedant while *T. arjuna*, acetone, slightly antifeedant and remaining were

Table 1. Effect of eight medicinal plants on feeding behaviour of seven day old larvae of tobacco caterpillar, *S. litura*

S. No.	Plant species Scientific name (Common name and Family)	Plant part used	Solvents used	MLAC (cm2)		Feeding percentage (%)		Antifeedant activity (%)		Feeding Inhibition %		Preference index		Antifeedant category	
				5%	10%	5%	10%	5%	10%	5%	10%	5%	10%	5%	10%
1.	Sinduri, (*B. orellana)*	seeds	Hexane	5.47 (13.52)	2.94 (9.87)	21.88	11.76	70.87	84.34	54.88	72.92	0.45	0.27	Strongly Antifeedant	Strongly Antifeedant
			Diethyl ether	9.70 (18.14)	2.87 (9.76)	38.8	11.48	48.34	84.71	31.88	73.48	0.68	0.26	Moderately Antifeedant	Strongly Antifeedant
			Acetone	8.90 (17.36)	2.51 (9.12)	35.6	10.04	52.60	86.63	35.69	76.42	0.64	0.23	Moderately Antifeedant	Extremely Antifeedant
2.	Dalchini, (*C. zelanicum*)	leaves	Hexane	5.90 (14.06)	2.05 (8.24)	23.6	8.2	68.58	89.08	52.18	80.31	0.47	0.19	Strongly Antifeedant	Extremely Antifeedant
			Diethyl ether	3.80 (11.24)	1.67 (7.43)	15.2	6.68	79.76	91.10	66.34	83.66	0.33	0.16	Strongly Antifeedant	Extremely Antifeedant
			Acetone	4.60 (12.38)	1.78 (7.67)	18.4	7.12	75.50	90.52	60.65	82.68	0.39	0.17	Strongly Antifeedant	Extremely Antifeedant
3.	Camphora, (*C. camphora*)	leaves	Hexane	3.98 (11.51)	1.95 (8.03)	15.92	7.8	78.80	89.61	65.02	81.18	0.34	0.18	Strongly Antifeedant	Extremely Antifeedant
			Diethyl ether	3.24 (10.37)	1.69 (7.47)	12.96	6.76	82.74	91.00	70.57	83.48	0.29	0.16	Strongly Antifeedant	Extremely Antifeedant
			Acetone	3.01 (9.99)	1.52 (7.09)	12.04	6.08	83.97	91.90	72.37	85.02	0.27	0.14	Strongly Antifeedant	Extremely Antifeedant
4.	Gular, (*F. racemosa*)	leaves	Hexane	9.27 (17.73)	7.58 (15.98)	37.08	30.32	50.63	59.63	33.90	42.48	0.66	0.57	Moderately Antifeedant	Moderately Antifeedant
			Diethyl ether	8.92 (17.38)	6.50 (14.77)	35.68	26	52.50	65.38	35.59	48.57	0.64	0.51	Moderately Antifeedant	Moderately Antifeedant
			Acetone	7.24 (15.61)	5.35 (13.37)	28.96	21.4	61.44	71.51	44.35	55.65	0.55	0.44	Moderately Antifeedant	Strongly Antifeedant

Contd…….

Table 1. *Cont.*

5.	Arjun, (*T. arjuna*)	bark	Hexane	11.95 (20.22)	10.04 (18.47)	47.8	40.16	36.36	46.53	22.22	30.32	0.77	0.69	Slightly Antifeedant	Moderately Antifeedant
			Diethyl ether	10.98 (19.35)	11.27 (19.62)	43.92	45.08	41.53	39.98	26.20	24.99	0.73	0.75	Moderately Antifeedant	Moderately Antifeedant
			Acetone	14.02 (21.99)	10.25 (18.67)	56.08	41	25.34	45.42	14.51	29.38	0.85	0.70	Slightly Antifeedant	Moderately Antifeedant
6.	Nagkesar, (*M. ferrea*)	leaves	Hexane	12.98 (21.11)	10.45 (18.86)	51.92	41.8	30.88	44.35	18.26	28.49	0.81	0.71	Slightly Antifeedant	Moderately Antifeedant
			Diethyl ether	11.07 (19.43)	9.28 (17.73)	44.28	37.12	41.05	50.58	25.82	33.85	0.74	0.66	Moderately Antifeedant	Moderately Antifeedant
			Acetone	10.02 (18.45)	9.67 (18.11)	40.08	38.68	46.64	48.50	30.41	32.02	0.69	0.67	Moderately Antifeedant	Moderately Antifeedant
7.	Sarpgandha, (*R. serpentine*)	leaves	Hexane	10.21 (18.63)	7.48 (15.87)	40.84	29.92	45.63	60.17	29.56	43.03	0.70	0.56	Moderately Antifeedant	Moderately Antifeedant
			Diethyl ether	10.01 (18.44)	7.28 (15.65)	40.04	29.12	46.69	61.23	30.46	44.12	0.69	0.55	Moderately Antifeedant	Moderately Antifeedant
			Acetone	9.28 (17.73)	5.45 (13.50)	37.12	21.8	50.58	70.97	33.85	55.01	0.66	0.44	Moderately Antifeedant	Strongly Antifeedant
8.	Putranjeeva, (*P. roxburghii*)	leaves	Hexane	5.97 (14.14)	3.05 (10.06)	23.88	12.2	68.21	83.75	51.75	72.05	0.48	0.27	Strongly Antifeedant	Strongly Antifeedant
			Diethyl ether	5.48 (13.53)	2.47 (9.04)	21.92	9.88	70.82	86.84	54.82	76.75	0.45	0.23	Strongly Antifeedant	Extremely Antifeedant
			Acetone	4.98 (12.90)	2.35 (8.82)	19.92	9.4	73.48	87.48	58.08	77.75	0.41	0.22	Strongly Antifeedant	Extremely Antifeedant
	Control			18.78 (25.68)	18.78 (25.68)	-	-	-	-	-	-	-	-	Preferred plant	Preferred plant
	SEM±			0.15 (0.14)	0.97 (0.10)	-	-	-	-	-	-	-	-	-	-
	CD at 5%			0.42 (0.40)	0.27 (0.30)	-	-	-	-	-	-	-	-	-	-
	F value			**	**	-	-	-	-	-	-	-	-	-	-

MLAC= Mean leaf area consumed, Antifeedant category following Kogan & Goeden, (1970), **= highly significant

Table 2. Effect of eight medicinal plants on feeding behaviour of seven day old larvae of Bihar hairy caterpillar, *S. obliqua*

S. No.	Plant species Scientific name (Common name and Family)	Plant part used	Solvents used	MLAC (cm2)		Feeding Percentage (%)		Antifeedant Activity (%)		Feeding Inhibition %		Preference index		Antifeedant category	
				5%	**10%**	**5%**	**10%**	**5%**	**10%**	**5%**	**10%**	**5%**	**10%**	**5%**	**10%**
1.	Sinduri, (*B. orellana*)	seeds	Hexane	8.90 (17.36)	5.38 (13.41)	35.6	21.52	52.55	71.32	35.64	55.42	0.64	0.44	Moderately Antifeedant	Strongly Antifeedant
			Diethyl ether	7.53 (15.93)	6.70 (15.01)	30.12	26.8	59.86	64.28	42.71	47.36	0.57	0.52	Moderately Antifeedant	Moderately Antifeedant
			Acetone	5.23 (13.22)	3.08 (10.11)	20.92	12.32	72.12	83.58	56.39	71.79	0.43	0.28	Strongly Antifeedant	Strongly Antifeedant
2.	Dalchini, (*C. zelanicum*)	leaves	Hexane	5.40 (13.44)	3.94 (11.45)	21.6	15.76	71.21	78.99	55.29	65.28	0.44	0.34	Strongly Antifeedant	Strongly Antifeedant
			Diethyl ether	3.89 (11.92)	2.85 (9.72)	15.56	11.4	79.26	84.80	65.65	72.90	0.34	0.27	Strongly Antifeedant	Strongly Antifeedant
			Acetone	4.27 (11.37)	2.94 (9.87)	17.08	11.76	77.23	84.32	62.91	73.62	0.37	0.26	Strongly Antifeedant	Strongly Antifeedant
3.	Camphora, (*C. camphora*)	leaves	Hexane	4.06 (11.63)	2.04 (8.21)	16.24	8.16	78.35	89.12	64.41	80.38	0.35	0.19	Strongly Antifeedant	**Extremely Antifeedant**
			Diethyl ether	3.89 (11.37)	1.79 (7.68)	15.56	7.16	79.26	90.45	65.65	82.57	0.34	0.17	Strongly Antifeedant	**Extremely Antifeedant**
			Acetone	3.08 (10.11)	1.67 (7.42)	12.32	6.68	83.58	91.09	71.79	83.65	0.28	0.16	Strongly Antifeedant	**Extremely Antifeedant**
4.	Gular, (*F. racemosa*)	leaves	Hexane	8.90 (17.36)	6.51 (14.78)	35.6	26.04	52.55	65.29	35.64	48.47	0.64	0.51	Moderately Antifeedant	Moderately Antifeedant
			Diethyl ether	9.05 (17.51)	6.59 (14.87)	36.2	26.36	51.75	64.87	34.91	48.00	0.65	0.51	Moderately Antifeedant	Moderately Antifeedant
			Acetone	8.32 (16.76)	5.02 (12.95)	33.28	20.08	55.65	73.24	38.55	57.77	0.61	0.42	Moderately Antifeedant	Strongly Antifeedant
5.	Arjun, (*T. arjuna*)	bark	Hexane	12.15 (20.40)	10.02 (18.45)	48.6	40.08	35.23	46.58	21.38	30.36	0.78	0.69	Slightly Antifeedant	Moderately Antifeedant
			Diethyl ether	10.21 (18.63)	9.92 (18.36)	40.84	39.68	45.57	47.12	29.51	30.82	0.70	0.69	Moderately Antifeedant	Moderately Antifeedant
			Acetone	13.12 (21.24)	12.25 (20.48)	52.48	49	30.06	34.70	17.69	20.99	0.82	0.79	Slightly Antifeedant	Slightly Antifeedant
6.	Nagkesar, (*M. ferrea*)	leaves	Hexane	10.23 (18.65)	9.68 (18.13)	40.92	38.72	45.46	48.40	29.42	31.92	0.70	0.68	Moderately Antifeedant	Moderately Antifeedant
			Diethyl ether	12.26 (20.49)	9.85 (18.29)	49.04	39.4	34.64	47.49	20.95	31.14	0.79	0.68	Moderately Antifeedant	Moderately Antifeedant
			Acetone	10.02 (18.46)	9.24 (17.70)	40.08	36.96	46.58	50.74	30.36	34.00	0.69	0.66	Moderately Antifeedant	Moderately Antifeedant

Table 2. *Cont.*

7.	Sarpgandha, (*R. serpentine*)	leaves	Hexane	7.29 (15.67)	5.60 (13.69)	29.16	22.4	61.14	70.14	44.03	54.02	0.55	0.45	Moderately Antifeedant	Strongly Antifeedant
			Diethyl ether	8.21 (16.65)	7.60 (16.00)	32.84	30.4	56.23	59.48	39.11	42.33	0.60	0.57	Moderately Antifeedant	Moderately Antifeedant
			Acetone	7.95 (16.37)	7.35 (15.73)	31.8	29.4	57.62	60.82	40.47	43.69	0.59	0.56	Moderately Antifeedant	Moder-ately Antifeedant
8.	Putranjeeva, (*P. roxburghii*)	leaves	Hexane	5.92 (14.08)	3.85 (11.31)	23.68	15.4	68.44	79.47	52.02	65.94	0.47	0.34	Strongly Antifeedant	Strongly Antifeedant
			Diethyl ether	4.75 (12.59)	2.95 (9.89)	19.00	11.8	74.68	84.27	59.59	72.82	0.40	0.27	Strongly Antifeedant	Strongly Antifeedant
			Acetone	4.87 (12.75)	3.10 (10.15)	19.48	12.4	74.04	83.47	58.78	71.63	0.41	0.28	Strongly Antifeedant	Strongly Antifeedant
	Control			18.78 (25.67)	18.78 (25.68)	-	-	-	-	-	-	-	-	Preferred plant	Preferred plant
	SEM±			0.12 (0.12)	0.10 (0.10)	-	-	-	-	-	-	-	-	-	-
	CD at 5%			0.35 (0.35)	0.30 (0.29)	-	-	-	-	-	-	-	-	-	-
	F value			**	**	-	-	-	-	-	-	-	-	-	-

MLAC= Mean leaf area consumed, Antifeedant category following Kogan & Goeden, (1970), **= highly significant moderately antifeedant. At 10 % conc. *C. camphora*, acetone (3.08cm^2) also showed minimum feeding against *S. obliqua* and maximum feeding in *T. arjuna*, acetone (13.12 cm^2) over control (MLAC=18.78 cm^2) at p=0.05. Acetone extract of *C. camphora* and *T. arjuna* showed feeding percentage (12.32 and 52.48%), antifeedant activity (83.58 and 30.06%) and inhibition of feeding (71.79 and 17.69%) respectively. In case of *S. obliqua* same plant extracts viz., *C. zeylanicum*, *C. camphora* and *P. roxbughii* (hexane, diethyl ether, and acetone) and *B. orellana* (acetone) proved to be strongly antifeedant and *T. arjuna* (hexane and acetone) and *M. ferrea* (diethyl ether) proved to be slightly while other plant extracts were found to be moderately antifeedant.

In the present investigation, different plant extracts exhibited antifeedant activity against *S. litura* and *S. obliqua*. This finding coincides with the finding of various other authors as; Ramangauda and Srivastava (2008) were reported aqueous extracts of *Jatropha curcas, Syzygium cumini, Plantago ovata, Artemisia annua, Pogostemon patchouli [P. cablin], Stellaria media, Cinnamomum camphora, Cymbopogon winterianus and Cnicus benedictus* to be effective against feeding 6-day-old larvae of *S. litura*. Sonowal *et al.* (2008) were found insecticidal activities in acetone plant extracts of *Azadirachta indica*, *Acorus calamus*, *Pongamia pinnata*, *Adhatoda vasica* [*Justicia adhatoda*], *Cinnamomum zeylanicum*, *Cinnamomum tamala* and *Ocimum sanctum* [*O. tenuiflorum*] against *S. obliqua*. Pandey (2011) conducted studies on 5d old larvae of *S. litura* and reported methanol extract of *B. orellana* (83.33%) to be most toxic followed by *Jatropha curcas* (53.33%). (Chauhan, 2012) Five medicinal plants species viz., *Ocimum sanctum*; *Cinnamomum tamala*; *Cinnamomum zelanicum, Eucalyptus citriodora* and *Pongamia pinnata*, were tested against 6d old larvae of *S. litura*. Among the Plant extracts, *C. tamala*, *C. zelanicum*, *E. citriodora* and *P. pinnata* proved to be detrimental against the larvae showing lethal effects at later developmental stages. The fresh leaves of *Madhuca indica* and *B. orellana* proved strongly antifeedant and detrimental to the growth and development of tobacco caterpillar, *S. litura* (Bhatt, 2013). Some other plants are also tested with similar type of bioassay method such as laboratory experiments were conducted to evaluate the bio-insecticidal activity of solvent extracts of latex from, *Thevetia nerifolia, Artocarpus heterophyllus, Ficus glomerata, Calotropis procera* on neonate larvae of *S.litura*. The hexanoic, methanoloic, petroleum ether and chloroform extracts of each plant latex have caused very high larval mortality (90-95%), causing significant reduction in larval weight (10.69-62.56%) (Upadhyay, 2013). Along with the plant extracts of *C. camphora* and *C. zelanicum,* their essential oil also showed good antifeedant and insecticidal activities against insect pests (Elumalai *et al.,* 2010). (Mdoe *et al.,* 2014) found the larvicidal activity in *Cinnamomum osmophloeum* oil. Mortality ranged from 13% to 100% in the laboratory while in semi-field environments it ranged between 43% to 100%. As in our study *C. camphora, C. zelanium, P. roxburghii* and *B. orellana* were found to be effective antifeedant against *S. litura* and *S. obliqua* and on the basis of above mentioned references we can say that antifeedant can play a better role in IPM but there is need to aware the farmers about their utility and most importantly focus towards the commercialization of the plant products.

Conclusion

In the present investigation *C. camphora* (hexane, diethyl ether and acetone), *C. zelanium,* (hexane, diethyl ether and acetone), *P. roxburghii* (diethyl ether and acetone) and *B. orellana*, acetone against *S. litura* and in case of *S. obliqua* extracts of *C. camphora* (hexane, diethyl ether and acetone) were found to be most effective. These plant extracts can be used as a management tool in the insect pest management programme of *S. litura* and *S. obliqua*

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