Indian Journal of Agricultural Sciences **82** (1): 59–62, January 2012

Feeding inhibitory effect of some plant extracts on jute hairy caterpillar (*Spilosoma obliqua*)

H CHOWDHURY[1], C S KAR[2], S K SARKAR[3] and M K TRIPATHI[4]

Central Research Institute for Jute and Allied Fibres, Nilganj, Barrackpore, Kolkata 700 120

Received: 3 February 2010; Revised accepted: 8 November 2011

ABSTRACT

Azadirachtin (50% pure), along with turmeric oil isolated from rhizome powder of *Curcuma longa* and leaf extracts of tulsi (*Ocimum sanctum*), eucalyptus (*Eucalyptus globulas*) and sisal (*Agave sisalana*) were tested for feeding inhibition effect on third instar larvae of jute hairy caterpillar, *S. obliqua*. About 44.84% to 69.78% feeding inhibition was exhibited by azadirachtin at 0.1% to 0.5% conc. At 0.5% and 0.4% conc., 67.25% and 52.29% feeding inhibition was exhibited by turmeric oil. Eucalyptus, tulsi, and sisal extracts were less active than azadirachtin and tumeric oil. At 0.5% conc., azadirachtin and turmeric oil exhibited around 40% larval mortality, whereas 30% to 48.14% larval mortality was recorded at 0.2% to 0.5% conc. of tulsi extract.

Key words: *Agave sisalana,* Azadirachtin, *Curcuma longa, Eucalyptus globulas,* Feeding inhibition, *Ocimum sanctum, Spilosoma obliqua*

Indiscriminate use of synthetic pesticides has adversely affected both biological and physical environment, leading to the pollution of biosphere and rapid build-up of resistance in important insect pests of various crops as well as evolving of new biotypes. It has been estimated that about 2.5 million tonnes of pesticides are used on crops each year and the world wide damage caused by pesticides reaches $100 billion annually. The damage is caused due to two reasons: (i) the high toxicity and non-biodegradable nature of the pesticides, and (ii) the residues in soil, water and crops that affect humans. Thus, efforts are needed to search new selective and biodegradable pesticides to solve the long term toxicity to mammals as well as more emphasis to be given on environment friendly pesticides to reduce the pesticide use while maintaining crop yields. Natural products are considered potential alternatives to the synthetic pesticides as a means to reduce adverse effects on the human health and the environment (Isman 1995). The move towards green processes and the continuing need for developing new crop protection tools with novel modes of action makes discovery and commercialization of natural products as green pesticides an attractive and profitable pursuit that is commanding attention.

After the discovery of azadirachtin (main active constituent of neem, *Azadirachta indica*) as antifeedant against the desert locust (*Schistocerca gregaria*), the feeding deterrents have attracted significant attention in pest control (Butterworth and Morgan 1968). Antifeedants are the behaviour modifying substances that act directly on the chemosensilla of an insect resulting in feeding deterrence. Antifeedants control crop damage mainly by inhibiting feeding on leaves and tender shoots of crop plants (Mehta *et al.* 2005).The use of plant extracts as feeding deterrents is vastly reviewed (Frazier 1986).

The hairy caterpillar, (*Spilosoma obliqua* Walk) is a major insect pest of jute in heavy rainfall areas like north Bengal and Asom. The caterpillar feeds on the tender leaves of jute and can cause total defoliation in case of severe attack to the crop.

In present study, azadirachtin (50%), along with turmeric oil isolated from rhizome powder of (*Curcuma longa*) and leaf extracts of tulsi (*Ocimum sanctum*.), eucalyptus (*Eucalyptus globulas*) and sisal (*Agave sisalana*) were tested for feeding inhibition effect on jute hairy caterpillar *(S. obliqua)*.

MATERIALS AND METHODS

Laboratory study was conducted at Central Seed Research Station for Jute and Allied Fibres, Bud Bud,

[1] Senior Scientist (Agricultural Chemistry) (e mail: hemantac1@rediffmail.com), [2] Senior Scientist (Plant Breeding) (e mail:cskar@crijaf.org.in), [3] Senior Scientist (Plant Pathology) (e mail:surjapath@gmail.com)), [4] Senior Scientist (Agronomy) (e mail: sanaipbh@yahoo.co.in), Sunnhemp Research Station (CRIJAF), Pratapgarh, Uttar Pradesh

Burdwan, West Bengal during April – September, 2007 to study antifeedant effect of the plant extracts on third instar larvae of jute hairy caterpillar *S. obliqua.* Azadirachtin sample was collected from Division of Agricultural Chemicals, IARI, New Delhi. Turmeric rhizome powder collected from local market was dried under shade. Air-dried rhizome powder was extracted in Soxhlet apparatus for 24hr with petroleum ether (40–60°), petroleum ether extract on removal of solvent under vacuum yielded turmeric oil residue (3.83%). Fresh eucalyptus leaves collected from the research farm were washed in water and dried under shade. Air-dried leaves were cut into small pieces and dipped into hexane for 72 hr with occasional shaking, after filtration hexane was dried over sodium sulphate, evaporation of hexane under vacuum yielded eucalyptus oil (0.62%). Air-dried leaves of tulsi and sisal were extracted with acetone for 72hr, filtered, filtrate was dried over sodium sulphate, evaporation of acetone yielded the tulsi (3.81%) and sisal (1.31%) concentrates.

Azadirachtin (125 mg, 50%) was dissolved in small quantity of acetone and the volume was made up to 25ml to obtain 0.5% solution. This was serially diluted to obtain 0.4%, 0.3%, 0.2%, 0.1% and 0.05% test solutions. Similarly, test solutions of the other plant extracts were also prepared in acetone.

Bioassay of the plant extracts for antifeedant activity was conducted on third instar larvae of jute hairy caterpillar, *S. obliqua*. The larvae of *S. obliqua* were collected from the field and reared in the laboratory on jute leaves (*Corchorus olitorius*.) in glass jars (20 cm × 15 cm) at 27 ± 1^{0}C and 60% relative humidity. Everyday remnant leaves and excreta from the jars were removed before providing fresh tender leaves for feeding. The larvae up to fourth instar were reared in the glass jars.

Fully-grown and about to pupate larvae were transferred to glass jars having a thick layer of sterilized soil. The moths emerging after a week were collected and transferred to clean jars containing a suspended cotton swab soaked in honey solution and pieces of folded papers at the bottom for oviposition. The eggs laid were separated and observed for hatching every day. The freshly hatched larvae of the same batch were removed and kept separately on fresh and tender jute leaves in a glass jar in order to have third instar larvae.

Antifeedant activity

Forced feeding method was followed for testing the antifeedant activity of the plant extracts on third instar larvae of S. *obliqua.* Jute leaf disc of approximately 6 cm diameter were treated on both sides with a particular test solution and dried under shade. One treated disc was placed in a clean glass jar (15cm × 10cm) and ten third instar larvae of *S. obliqua* pre starved for 12hr were released in the jar and treatment was replicated thrice. The extent of consumption of leaves after 24hr was measured on graph papers. Consumption data of acetone treated leaf disc was taken as control. Feeding Inhibition (%) was calculated following the formula:% Feeding Inhibition = (C-T)/(C+T) × 100 where C= consumption of leaf in control and T= consumption of leaf in treatment.

Larval mortality after 24hr of feeding was also counted and corrected larval mortality was calculated following the formula: Corrected mortality (%) = (T-C)/(100-C) × 100 where, T= mortality in treatment and C= mortality in control.

The per cent feeding inhibition and mortality (corrected) data were arcsine transformed and then Duncan Multiple Range Test was done.

RESULTS AND DISCUSSION

In control, when acetone treated leaves after drying off the solvent was fed to the starved larvae, 6.33% of treated leaves remained uneaten by the insects. The per cent consumption value in control and treatments were taken into consideration for calculating the per cent feeding inhibition values.

When the 12hr starved third instar larvae of *S. obliqua* were released on azadirachtin (50%) treated jute leaves, dose dependant feeding inhibition was recorded (Fig 1). About 44.84% to 69.78% feeding inhibition was exhibited by azadirachtin at 0.1% to 0.5% conc. Turmeric oil also produced dose dependant feeding inhibition. At 0.5% and 0.4% conc., 67.25% and 52.29% feeding inhibition was exhibited by turmeric oil, which was comparable to azadirachtin. But antifeedency of turmeric oil decreased faster as compared to azadirachtin at lower dose levels and feeding inhibition decreased to less than 50% at 0.3% conc. Feeding inhibition exhibited by tulsi and eucalyptus extracts was similar in trend and was comparatively less than azadirachtin and turmeric oil. At 0.4% to 0.5% conc., 30.39% to 37.73% feeding inhibition was exhibited by these two extracts. About 20% feeding inhibition was exhibited by sisal extract even at 0.5% conc.

From DMRT grouping (Table 1) it is evident that azadirachtin 0.5% and 0.4% along with turmeric oil 0.5%

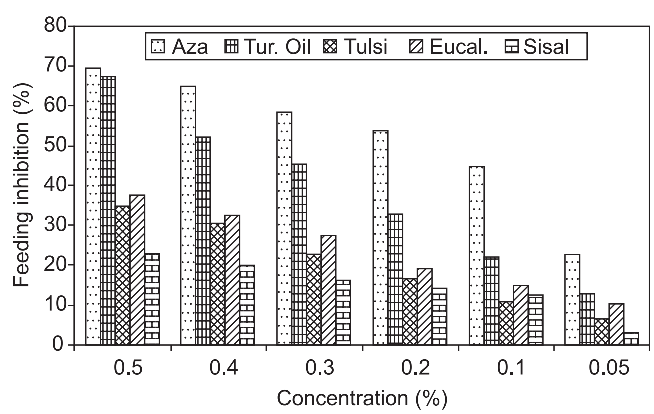

Fig 1 Comparison of feeding inhibition efficacy (corrected value) of the plant extracts on third instar larvae of *S. obliqua*

Table 1 DMRT grouping of feeding inhibition values (arcsine transformed mean) of plant extracts on third instar larvae of *S. obliqua*

Botanical	Feeding inhibition (%)					
	0.5% conc.	0.4% conc.	0.3% conc.	0.2% conc.	0.1% conc.	0.05% conc.
Azadiractin	65.92 a (83.33)	63.44 b (80.00)	60.23 c (75.33)	57.84 d (71.67)	53.35 e (64.33)	39.81 j (41.00)
Turmeric Oil	64.65 ab (81.67)	57.21 d (70.67)	53.73 e (65.00)	46.53 gh (52.67)	39.23 jk (40.00)	31.72 no (27.67)
Tulsi extract	47.68 fg (54.67)	45.00 hi (50.00)	39.81 j (41.00)	34.85 lm (32.67)	29.54 op (24.33)	25.08 n (18.00)
Eucalyptus oil	49.41 f (57.67)	46.34 gh (52.33)	43.09 i (46.67)	37.07 kl (36.33)	33.41mn (30.33)	29.29q (24.00)
Sisal extract	40.01 j (41.33)	37.66 jk (37.33)	34.64 m (32.33)	32.98 mn (29.67)	31.30 nop (27.00)	20.50 r (12.33)

[a]Values in parentheses indicate original mean values in percentage. Means followed by a common letter are not significantly different at 5% level. SE_d = 1.11, SE_m = ± 0.78, CD (5%) = 2.22, CV=3.16%

having similar and highest feeding inhibition effect. Similarly, in case of azadirachtin 0.2% and turmeric oil 0.4% equivalent feeding inhibition was recorded. Azadirachtin 0.05%, turmeric oil 0.1%, tulsi extract 0.3%, and sisal extract 0.4% and 0.5% resulted moderate feeding inhibition. Lower feeding inhibition effect was found in turmeric oil 0.05%, eucalyptus oil 0.1% and sisal extract 0.2% and 0.1%. The sisal extract at 0.05% conc. exhibited lowest feeding inhibition among the treatments.

When the starved insects were released in the glass jars, they were found to gather on the treated leaves for feeding. After feeding on the plant extracts treated leaves considerable mortality in the larvae was recorded. In control, when acetone treated leaves after drying the solvent under shade was fed to the starved larvae, 10% mortality was recorded. This control value was taken into consideration for calculating the corrected mortality values. Though there was significant feeding inhibition exhibited by azadirachtin and turmeric oil, but due to body contact with the chemicals on treated leaves considerable larval mortality was also recorded (Fig 2). Azadirachtin and turmeric oil at 0.5% conc. caused 37.03% and 40.73% mortality respectively. Mortality reduced gradually with decrease in concentration of the chemicals. And at 0.3 % conc. level of the chemicals, about 30% mortality was observed. When the insects were released on tulsi, eucalyptus and sisal extracts treated leaves, more feeding was recorded as compared to azadirachtin and turmeric oil treated leaves. However, after feeding of tulsi extract treated leaves about 30%–48% larval mortality was recorded at 0.2% –0.5% conc. Sisal and eucalyptus extracts caused less mortality in the insect. At 0.5% conc. 22.22% and 25.92% larval mortality was recorded by sisal and eucalyptus extracts respectively.

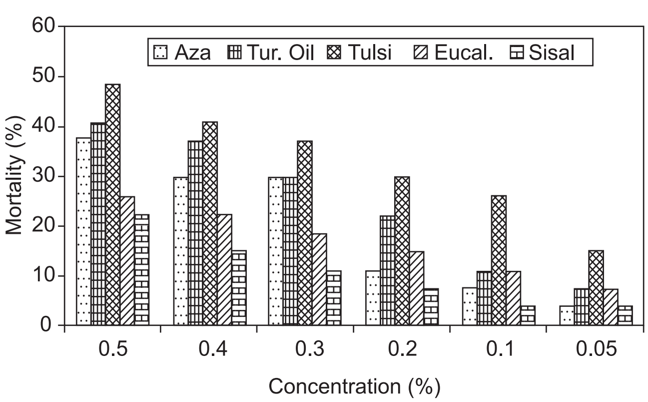

Fig 2 Comparison of mortality values (corrected) recorded by the plant extracts on third instar larvae of *S. obliqua*

When DMRT grouping was applied on treatment effects with respect to larval mortality values, tulsi extract at 0.5% conc. recorded highest larval mortality. Azadirachtin 0.5%, turmeric oil 0.5%, 0.4%, tulsi extract 0.4%, 0.3% exhibited considerably high larval mortality (Table 2). The third treatment group consisting azadirachtin 0.4% and 0.3%, turmeric oil 0.3% tulsi extract 0.2% and 0.1%, eucalyptus oil 0.5% caused moderate larval mortality. Less mortality values were recorded in remaining treatments.

Turmeric extractives are active as repellent (Jilani *et al*. 1998), insecticidal and antifeedant (Tripathi *et al*. 2002). When turmeric oil was mixed with azadirachtin, enhanced feeding inhibition and larvicidal effects of azadirachtin was recorded (Chowdhury *et al.* 2001). Leaf extracts of various sp. of eucalyptus and tulsi (Arputha and Narayansamy 2007) are also reported to exhibit antifeedant and larvicidal effects on several insects.

The extracts of turmeric, tulsi and eucalyptus like the azadirachtin exhibited dose dependant bioefficacy against the jute hairy caterpillar indicating that these plants extracts may be used for controlling the insect. The bioactivity exhibited by the plant extracts can be attributed to the presence of various bioactive allelochemicals. Hence, further phytochemical studies on these plants in ascribing these

Table 2 DMRT grouping of larval mortality values (arcsine transformed mean) of third instar larvae of *S. obliqua* after feeding on treated leaves

Botanical	Larval mortality[a]					
	0.5% conc.	0.4% conc.	0.3% conc.	0.2% conc.	0.1% conc.	0.05% conc.
Azadiractin	41.15 abc (43.33)	37.22 bcd (36.67)	37.22 bcd (36.67)	26.57 ghi (20.00)	23.86 hi (16.67)	21.14 i (13.33)
Turmeric oil	43.08 ab (46.67)	41.15 abc (43.33)	37.22 bcd (36.67)	33.21 def (30.00)	26.57 ghi (20.00)	23.86 hi (16.67)
Tulsi extract	46.92 a (53.33)	43.08 ab (46.67)	41.15 abc (43.33)	37.22 bcd (36.67)	35.22 cde (33.33)	28.78 fgh (23.33)
Eucalyptus oil	35.22 cde (33.33)	33.21 def (30.00)	31.00 efg (26.67)	28.78 fgh (23.33)	26.57 ghi (20.00)	23.86 hi (16.67)
Sisal extract	33.21 def (30.00)	28.78 fgh (23.33)	26.57 ghi (20.00)	23.86 hi (16.67)	21.14 i (13.33)	21.14 i (13.33)

[a]Values in parentheses indicate original mean values in percentage. Means followed by a common letter are not significantly different at 5% level. SE_d = 2.62, SE_m= ±1.85, CD at 5% = 5.24, CV=10.03%

efficacies against the hairy caterpillar of jute may provide lead(s) for the development of new botanical insecticide(s) to be utilized for controlling crop insects in an eco-friendly manner.

REFERENCES

Arputha Sankari S and Narayansamy P. 2007. Bioefficacy of flyash-based herbal pesticides against pests of rice and vegetables. *Current Science* **92**(6): 811–6.

Butterworth J H and Morgan E D. 1968. Isolation of a substance that suppresses feeding of locusts *Chemical Communication* 23–4.

Chowdhury H, Walia S and Dhingra S. 2001. Bioefficacy of azadirachtin, turmeric oil and their mixture against Bihar hairy caterpillar (*Spilosoma obliqua* Walk). *Pesticide Research Journal* **13**(2): 165–72.

Frazier J L. 1986. The perception of plant allelochemicals that inhibit feeding. (*in*) *Molecular Aspects of Insect-Plant Association,* pp 1–42. BrattstenL B and Ahmad S (Eds). Plenum Press, New York,

Isman M B. 1995. Leads and prospects for the development of new botanical insecticides. (*in*) *Reviews in Pesticides Toxicology* Vol. 3, pp 1–20. R M Roe and R J Kuhr (Eds), Toxicology Communications Inc., Raleigh, NC,.

Mehta P K, Sood A K, Patial A and Lal R. 2005. Evaluation of toxic and antifeedant properties of some plant extracts against major insect pests of cabbage. *Pesticide Research Journal* **17**(2): 30–3.

Tripathi A K, Prajapati V, Verma N, Bahl J R, Bansal R P, Khanuja S P S and Kumar S. 2002. Bioactivities of the leaf essential oil of *Curcuma longa* (Var. Ch-66) on three species of stored-product beetles (Coleoptera). *Journal of Economic Entomology* **95**(1): 183–9.