

## INSECT STERILANTS FROM *CATHARANTHUS ROSEUS*

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THE apocynaceous plant *Catharanthus roseus* has gained considerable reputation in recent years since the discovery of anti-cancer properties of its alkaloids<sup>1</sup>. Research on anti-cancer agents has provided many leads in the development of insect chemosterilants<sup>2</sup>, although a direct relationship between the two biological activities has not been established conclusively<sup>3</sup>. The rapidly dividing cells of the insect reproductive system bear in some respect a close resemblance to those in a growing tumour. It is conceivable that a compound effective in one system could also affect the other. With this presumption, work was initiated and we report here that alkaloids of *Catharanthus* could be advantageously used as sterilants against red cotton bug, *Dysdercus cingulatus* F. (Heteroptera-Pyrrhocoridae).

*D. cingulatus* was reared in the laboratory as described earlier<sup>4</sup> and unmated adult insects within 24 hr were used for experimentation. The total leaf-alkaloids were extracted from air-dried leaves with methane in a soxhlet apparatus, methanol removed and the residue treated with chloroform. The chloroform soluble portion was treated with 1% HCl and to the acid soluble portion 20% ammonia added (pH 9.0). The liberated total alkaloid was extracted with chloroform<sup>5</sup>. 182 g of leaf powder yielded 0.53 g of total leaf alkaloid. The total root alkaloid was obtained as a gift from Dr. M. Gopal Rao of Central Institute of Medicinal and Aromatic Plants, Bangalore, India.

The root and leaf alkaloids were dissolved in chloroform and graded concentrations were made. 10 insects of one sex within 24 hr age were topically applied ventrally with desired concentrations of the alkaloid solutions. The applied volume was kept constant at 1  $\mu$ l. The treated insects were caged with 10 untreated, unmated insects of the opposite sex of the same age. In another set of experiments both sexes were treated with the same concentration and caged together. Eggs were collected, counted and hatchability recorded in all sets of experiments. Each experiment done in triplicate continued for 20 days. Control experimental insects received chloroform applications. Percentage sterility was evaluated as described earlier. The sterility data was subjected to probit/log transformation<sup>6</sup> so as to obtain the required dosage to produce 50% sterility, which is expressed in terms of sterilant dosage—SD<sub>50</sub>.

The results show (Table I) that *Catharanthus* alkaloids hold promise to be good sterilants against *D. cingulatus*. The leaf alkaloid gave better sterilant action than the root alkaloid when compared at SD<sub>50</sub> levels. The SD<sub>50</sub> for males with leaf alkaloid was only 0.398% while that of root alkaloid was 1.99%. The SD<sub>50</sub> for females with leaf alkaloids was 1.0% and with that of root alkaloid was 1.25%. Svoboda reported that the activity of the plant was found entirely in its alkaloidal constituents and the leaf alkaloids were far more active than those contained in either stems or roots<sup>7</sup>. Joshi and Ambaye<sup>8</sup> also found that the leaf alkaloids of *Catharanthus* affect the male spermatogenesis of rats adversely. As with other alkylating sterilants<sup>9</sup>, with leaf alkaloids also, the males were more susceptible, getting sterilized easily. But in the case of root alkaloids, although their action was in general inferior to that of leaf alkaloids, it showed some specificity to the females

TABLE I  
Sterility in *Dysdercus cingulatus* F. following topical treatment with *Catharanthus roseus*

% Dose-total leaf alkaloid	% sterility			% Dose-total root alkaloid	% sterility		
	Treated male	Treated female	Treated both sexes		Treated male	Treated female	Treated both sexes
0.25	42	35.0	51	0.25	15	20	42
0.5	53	40.4	72	0.5	22	31	53
1.0	74.1	50.0	100	1.0	36	45	100
2.0	100.0	58.0	100	2.0	60	87*	100*

\* Some females did not lay eggs for quite sometime and died subsequently.

SD<sub>50</sub> calculated after data was subjected to probit/log dose transformation

Leaf alkaloid		Root alkaloid	
SD <sub>50</sub> for female	1.0%	SD <sub>50</sub> for female	1.25%
SD <sub>50</sub> for male	0.398%	SD <sub>50</sub> for male	1.99%



FIG. 1. Normal adult insect.

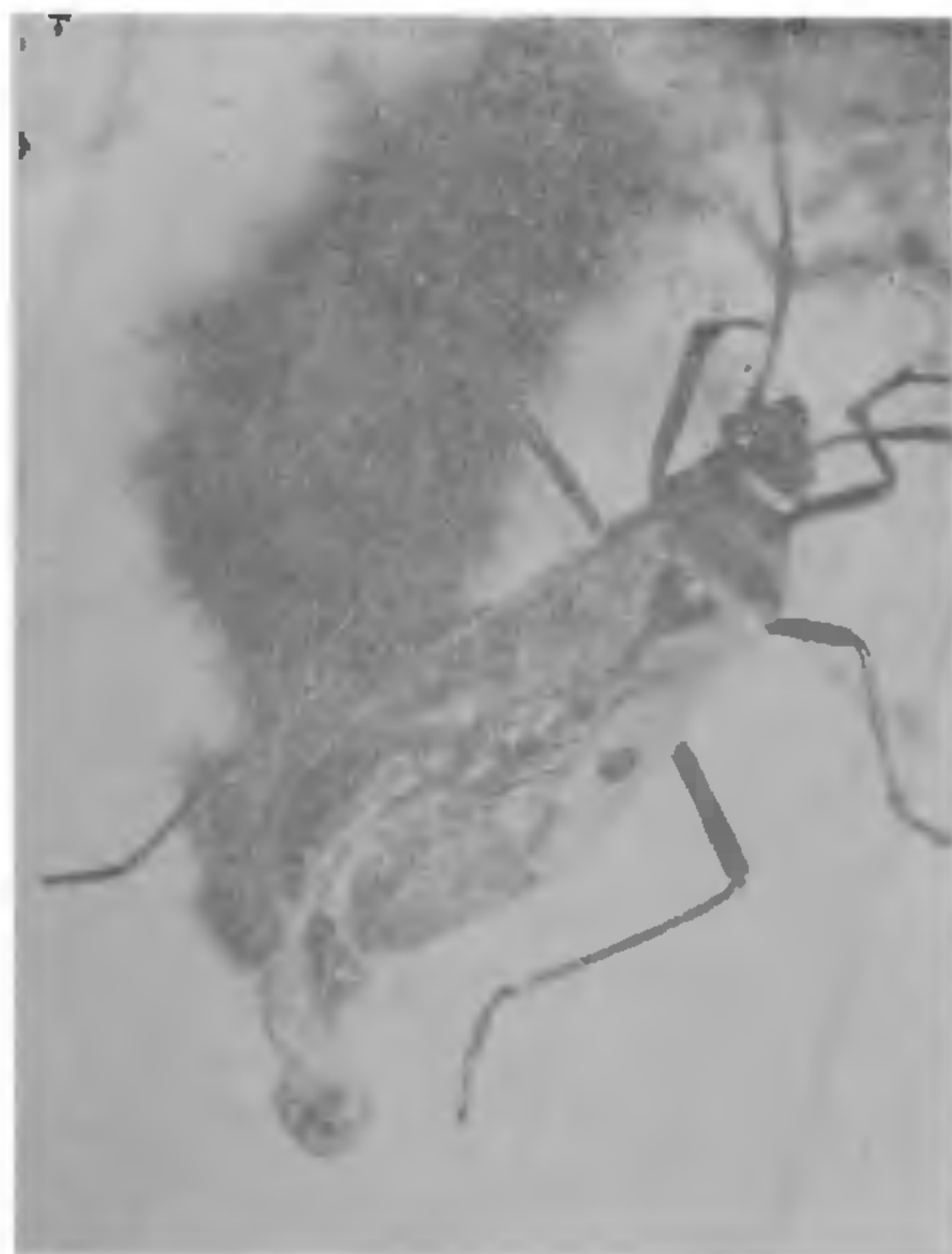


FIG. 2. Male showing black pigmentation and abnormal genital protrusion after treatment with alkaloids.

since the same dosage produced more sterility in females than in males. The  $SD_{50}$  of the male for root alkaloid was 1.99% while for female it was only 1.25%. This plant with a reputation of possessing nearly 75 alkaloids has about 50 alkaloids in the roots alone<sup>9</sup>. It is difficult, at this stage to pinpoint which alkaloid is responsible for the selective sterilitant action on females. The only possible explanation is that root alkaloids contain some constituent which is a good female sterilitant.

One noticeable factor with the alkaloid treated cotton bugs was the effect on pigmentation. The wings and body of the treated insects showed dominant black patches. The production of melanin is sometimes regarded as a mechanism for disposing off toxic phenols arising as breakdown products in metabolism<sup>10</sup>. In some cases its distribution seems to be related with the intensity of metabolism in the subjacent tissues and more often melanin is incorporated in the substance of the cuticle. The second factor was the abnormal protrusions of the genitalia of the males after alkaloid treatment when compared with control (Figs. 1 and 2). The insect seems to lose the contractile mechanism of the genital muscles and is unable to retract it back into position. But, the mating capability was not adversely affected since the treated males mated for long hours and mating capacity was comparable with that of control males. Another observation was the toxicity encountered in higher concentrations. Nearly 40-50% mortality results after 2% alkaloid administration.

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