

Parasitization efficiency of Kairomonal dust formulations against egg parasitoid *Trichogramma* spp (Hymenoptera: Trichogrammatidae)Madhulika Srivastava^{1*}, A. K. Singh², Sudhida G. Parihar³, R. D. Gautam⁴¹Central Agroforestry Research Institute (CAFRI) Jhansi 284 003 (U.P) India²Zoology Department, Delhi University, Delhi, India³Zoology Department, Gargi College, Delhi University, Delhi, India⁴Emeritus Scientist, (DST-USERS), NCIPM (PUSA), New Delhi, India

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Agriculture arose independently in many different regions, as people gradually lived closer together, became less nomadic, and focussed their food production on plants that were amenable to repeated sowing and harvesting. Historically, insects have been the most significant herbivores, and the evolution of plants is closely associated with the evolution of insects. The study of plant defences against herbivory is important, not only from an evolutionary view point, but also in the direct impact that these defences have on agriculture, including human and livestock. Success of natural enemies particularly well recognized egg parasitoid, Trichogrammatid (Balakrishnan *et al.*, 2004) in pest management depends upon its host acceptance and searching efficiency in a highly complex crop environment due to release of several volatile compounds termed as allelochemicals (synomones and kairomones). Grasses planted around the perimeter of the crop attract and trap the pests, *Desmodium*, planted between the rows of maize repel the pests and control the parasitic plant *Striga*, via Push- Pull technology in which the target crop is intercropped with herbivore repellent plants (push), while attractant plants (pull) are planted around this intercrop. The intercrop, in addition to repelling the herbivores, attracts and conserves natural enemies thereby ensuring continued suppression of the pests. Thus, volatile compounds released by sudan grass, napier grass and other highly attractive hosts were captured by absorption into a porous polymer to enable identification of semiochemicals likely to have attractant activity at the levels released by the plant. This is exploited by smallholder farmers in eastern Africa in the management of cereal stem borers in maize and sorghum (Khan, *et al.*, 2007). Modifying insect behaviour in pest management programs through the utilization of non-toxic semiochemicals is recognized as a promising alternative to conventional approaches. The purpose of a formulation comprising kairomone is the dilution of the highly concentrated compound down to a level at which it will be effective in orientation of a natural enemy towards host insects or its niche without causing harm to the non-target organisms and the natural habitat. It is important to note that the pesticide formulation is a physical mixture of one or more biologically active chemicals and inert ingredients, which provide effective and economical control of the pests, while kairomonal formulation is aimed to enhance the parasitism or predation capacity of a target natural enemy. However, concerted efforts on the application aspects of kairomones especially development of suitable kairomonal formulation against *Trichogramma* spp. is extremely scanty. The present study was carried out to identify effective kairomonal compound, optimum concentration and appropriate application technique to increase the parasitizing efficiency of *T. chilonis*.

Materials and Methods

This study was conducted at Biological Control Laboratory, Division of Entomology, Indian Agricultural Research Institute (PUSA), New Delhi, India under laboratory conditions. Five kairomonal dust formulations were prepared using three different clays *viz.*; Kailonite, China clay and Fuller's earth. A total of three formulations were prepared using straight chain saturated hydrocarbons namely pentacosane (P), docosane (D) and tricosane (T) in three different combinations *viz.*, 125 ng/cm² (1), 250 ng/cm² (2) and 375 ng/cm² (3). Formulated products were abbreviated as C₁ (Pentacosane 250 ng/cm²+Docosane 250ng/cm²+Tricosane 250 ng/cm², or P₂+D₂+T₂), C₂ (Pentacosane 125 ng/cm² + Docosane 125ng/cm² + Tricosane 250 ng/cm² or P₁+D₁+T₂), C₃ (Pentacosane 375 ng/cm² + Docosane 250ng/cm² + Tricosane 250 ng/cm² or P₃+D₂+T₂), C₄ (*Corcyra cephalonica* scale extract, @10⁶ ng/cm²), C₅ (Tricosane @500 ng/cm²) and C₆ (Control - *C. cephalonica* eggs washed with hexane). These were tested against five species of *Trichogramma viz.*, *T. chilonis* (Ishii), *T. brasiliensis* (Ashmead), *T. achae* (Nagarkatti & Nagaraja), *T. exiguum* (Pinto, Platner & Oatman) and *T. japonicum* (Ashmead) for the parasitization efficiency. The dust formulations were prepared by impregnating the respective clay with the appropriate concentration of the kairomonal solutions @ 2 ml/g. The slurry was thoroughly mixed

powdered using a pestle and mortar and passed through sieve (60 meshes) and dried overnight. The nucleus culture of the host insect used in the present studies was maintained on the eggs of the rice meal moth, *C. cephalonica* on crushed sorghum grains. Culture of the parasitoid was maintained in glass vials of 10 cm x 2.5 cm size at 25±1°C and 65±5% RH in a culture room on UV sterilized, 0-24 h old *C. cephalonica* eggs. Tricocard treated with different formulations along with one control card (plain egg card impregnated with the solvent hexane) was arranged equidistantly in the experimental arena, which consisted of a 150 mm diameter glass petridish, the base of which was covered with Whatman No.1 filter paper disc of the same diameter in five replications. Six 1.0 cm² filter paper (egg card) containing 30, UV sterilized, 0-24 h old *C. cephalonica* eggs were placed equidistantly on the periphery, which formed the experimental arena. Extracts were applied at different concentrations on five egg cards at the rate of 50 µl. Ten healthy, 0-24 h old, anaesthetized and fast reviving *Trichogramma* females were released at the centre of each Petri dish. The parasitoids were allowed to search in the experimental arena for a total period of 45 minutes from the time of recovery. Number of parasitoid that visited the cards was counted at five minutes interval, which is referred as 'Parasitoid Activity Index' (PAI). After 45 minutes, the parasitoids were removed carefully from each egg card and these cards were kept individually in glass vials for development at 25±1°C and 65±5% RH. Data on PAI, % parasitism and emergence recorded in eight replications were subjected to statistical analysis.

Results and Discussion

Effect kairomonal dust formulation on PAI and parasitization are presented in Table 1 and comparative emergence of egg parasitoid on different clays is depicted in Fig. 1. A perusal of the Table 1 and Fig. 1 reveals that Kailonite clay showed the maximum value of Parasitoid activity index (6.19) and parasitism (9.96) in case of *T. japonicum*, and China clay showed maximum value of emergence (9.79) in case of *T. brasiliensis*, when formulations from all the three clays were compared, whereas, Fuller's Earth showed lowest value of PAI (1.44), parasitism (0.77) and emergence (0.63). These differences in effectiveness among all the three clays can be due to differential release of kairomones from the respective clay. Natural enemies including egg parasitoid like Trichogrammatids respond towards chemical cues present in the environment to locate their hosts. Many a times these cues are associated with host and host by products itself. Particularly host scales and host eggs have kairomonal properties. The eggs of insect pests (*Helicoverpa armigera*, root, crown, and leaf-feeding caterpillars; grubs, larvae of scarab beetles, masked chafers (white grubs); billbugs, weevils, grublike larvae; chinch bugs, and leafhoppers among many others infesting fodder crops and grasses can be successfully controlled by using these kairomonal dust formulations.

Species	Kailonite		China clay		Fuller's Earth	
	PAI	Parasitism	PAI	Parasitism	PAI	Parasitism
<i>T. chilonis</i>	5.65 (2.12)	6.48 (2.55)	4.30 (1.71)	7.56 (2.12)	2.82 (1.53)	3.55 (1.56)
<i>T. brasiliensis</i>	4.77 (1.90)	8.44 (6.41)	5.02 (1.86)	9.79 (2.45)	3.48 (1.66)	4.04 (1.64)
<i>T. japonicum</i>	6.19 (13.33)	9.96 (2.69)	3.44 (1.61)	3.88 (1.63)	4.00 (1.71)	3.94 (1.65)
<i>T. achae</i>	5.73 (2.21)	9.92 (2.74)	3.67 (1.67)	5.46 (1.93)	1.44 (1.22)	0.77 (0.99)
<i>T. exiguum</i>	5.17 (1.95)	8.30 (2.36)	4.07 (1.75)	9.25 (2.39)	2.69 (1.45)	4.27 (1.66)
Figures in the parenthesis are the square root transformed values						
PAI & Parasitism values are mean of C ₁ to C ₆ concentrations						

Conclusion

The emission rate of the synthetic kairomone was fastest from kailonite clay as compared to china clay and fuller's earth in a given limit of time. The dust formulations can be more effective in the IPM programme because of their unique mode of release into field conditions. This study has demonstrated the utility of formulations in chemical communications and indicated the importance of formulation performance on efficacy.

References

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