Effectiveness of Kaolin Clay Particle Film in Managing Helopeltis collaris (Hemiptera: Miridae), a Major Pest of Cacao in the Philippines

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Effectiveness of kaolin clay particle film in managing *Helopeltis collaris* (Hemiptera: Miridae), a major pest of cacao in The Philippines

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Helopeltis collaris Stal (Hemiptera: Miridae), commonly known as cacao mirid or capsid bug is one of the major pests of cacao (*Theobroma cacao* L.; Malvales: Malvaceae) in Southeast Asia (Samiyanto 1987). Damage on pods appears as dark, circular lesions, which usually harden as scars on the husk (Laigo 1961). Heavy infestations can result in pod malformation and premature drop. Feeding on young pods sometimes results in pod wilting, since the feeding puncture provides an avenue for secondary invasion of microorganisms. Similar to other *Helopeltis* spp., feeding on cacao shoots by *H. collaris* occurs primarily on the midribs of leaves and on the stems, and severe infestations often result in shoot die-back and production of flushes (Smith 1979). Moreover, a recent survey of cacao pests in the Philippines showed that cacao mirid bug is causing significant yield loss particularly in cacao growing areas in Luzon (Amalin, unpublished data).

Kaolin is a naturally occurring clay resulting from weathering of aluminous minerals such as feldspar with kaolinite as its principal constituents (ATTRA 2004). It is regarded as non-toxic as it is used as an anti-caking agent in processed foods and as an additive in cosmetics, toiletries, and health products. It is also used as an inert carrier in some pesticide formulations, and it enhance**s** the performance of some microbial products (Rasad & Rangeshwaran 2000). All particle films consist of small-sized mineral particles, which can affect insect behavior through contact with treated surfaces or by producing a highly reflective surface. Like other particle films, kaolin has several modes of activity (Stanley 1998). Particle film action against insects may be lethal or nonlethal (i.e., repellency or avoidance of treated plants). Mortality results from ingestion of mineral particles, or desiccation through abrasion of the cuticle or adsorption by the cuticular waxes.

Kaolin is known as a non-synthetic chemical product (alternative to synthetic insecticides) with insect repellent property, and currently it is included in particle film technology for pest management programs of many agricultural crops (Glenn et al. 1999; Puterka et al. 2000; Haggag 2002), and stored grains (Mustafa & Al Moajel 1991). Also kaolin acts as an anti-transpirant, reducing drought stress of plants (Puterka et al 2000), and it ameliorates solar injury of various crops (Jiregna & Wand 2005). Thus far, no report on the efficacy of kaolin against pests of cacao has been reported.

This preliminary study aimed to determine the potential of locally available kaolinite in managing a population of the cacao mirid bug.

Immature stages of *H. collaris* were collected from the cacao demonstration farm of Quezon Agricultural Experiment Station (QAES), Tiaong, Quezon, Philippines. Cacao pods (approximately 26.2 × 50 mm) were obtained from the same farm. Local kaolin in the form of a cake was provided by the Mariano Marcos State University (MMSU) located in the southernmost part of Luzon, whereas the soybean oil sticker-spreader was provided by Stoller Products Philippines.

Choice and no-choice tests were conducted. In the choice test, one kaolin-treated pod and one control sprayed with water were put inside a clear plastic rectangular container (180 × 70 × 110 mm) with ventilated mesh lid. The pods were 100 mm apart. Using a small paint brush two 3rd-instars of *H. collaris* 5-6 mm in size and with black wing pads were then placed inside the container in between the two pods to provide equal access to both pods.

In the no-choice test, pods treated with kaolin and pods treated with water were placed singly in a clear plastic round container (120 × 700 mm) with ventilated mesh lid, and as with the choice test two 3rd-instars of *H.collaris* were introduced inside each container. A total of 10 pods were treated with the kaolin clay mixture using a multipurpose compressed air pump sprayer (ACE®) and another 10 pods were sprayed with water as control pods. Kaolin clay mixture consisted of 2.5% kaolin suspension and 1% soybean oil as sticker-spreader. All the pods were air dried before being subjected to efficacy tests. Both tests were replicated 5 times. After 24 h, the insects were removed and insect damage was observed in each pod for both tests.

Two experiments were conducted on separate dates for both choice and no-choice tests following the procedure as mentioned above. In the first experiment, insect feeding was assessed using damage ratings on a scale from 0 to 4, where, 0 = no damage (no lesions observed); 1 = 1 quadrant with lesions (1–25% damage); 2 = 2 quadrants with lesions (26–50% damage); 3 = 3 quadrants with lesions (51 to 75% damage), and 4 = 4 quadrants with lesions (76–100% damage). Damage rating was done in the exposed side of the pod, which was divided into 4 quadrants and the rating was based on the number of quadrants with insect feeding. In the second experiment the number of black lesions produced by the *H. collaris* 3rd instars were counted on each test pod. In both experiments, the data were recorded and analyzed statistically using PROC ANOVA (SAS 9.2, 2002-2008).

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Results showed positive repellent action of the test insects on kaolin-treated pods for both experiments (Table 1 and Table 2). In both choice and no-choice tests, significantly less feeding was observed in kaolin-treated pods compared to pods sprayed with water. Moreover, visual observation revealed more frequent visits of the test insects on the control pods compared to kaolin-treated pods in the choice test. No insect feeding was recorded on some pods treated with kaolin in the choice test. In the no-choice test, all pods treated with kaolin showed insect feeding and no significant difference from the control pods; however, the lesions were relatively fewer and smaller compared to the control pods sprayed with water, suggesting an incomplete reaction of the feeding wounds or punctures. Similar effects were reported by Khan & Quade (2006), who found that kaolin coating successfully repelled mirids and stink bugs affecting cotton bolls and squares (buds).

Follow up field applications are on-going to confirm the efficacy of kaolin clay on *H. collaris*. The confirmation tests are being conducted at different cacao growing areas in Luzon in addition to the QAES cacao techno-model farms. If proven as an effective management tool under field conditions, the principles underlying the effectiveness of kaolin against cacao mirid bug may be extrapolated to other invertebrate pests of cacao.

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Summary

The use of particle film technology has not been documented previously to protect cacao (*Theobroma cacao* L.; Malvales: Malvaceae) against insect feeding. Laboratory assessment of the use of local kaolin against the cacao mirid bug, *Helopeltis collaris* Stal (Hemiptera: Miridae), revealed a highly positive and statistically significant repellence of this insect pest on kaolin-treated cacao pods. This result warrants follow up field studies to evaluate further the potential of kaolin clay to control cacao pests in the Philippines.

Key Words: cacao mirid, capsid bug; particle film; repellent,; soybean oil as sticker-spreader

Sumario

No se ha documentado el uso de la tecnología de partículas de arcillas de caolin para proteger el cacao (*Theobroma cacao* L.; Malvales: Malvaceae) en contra de la alimentación de insectos. Los exámenes de laboratorio de caolín local contra el chinche mírido del cacao, *Helopeltis collaris* Stal (Hemiptera: Miridae), reveló una repelencia altamente positiva y estadísticamente significativa de esta plaga en las vainas de cacao tratadas con caolín. Este resultado merece estudios de seguimiento de campo para evaluar el potencial de arcilla de caolín para el control de plagas del cacao en Filipinas.

Palabras Clave: mírido de cacao; chinche cápsido; partículas de película; repelente; aceite de soja como rociada pegajosa

Table 1. The efficacy of local kaolin against the cacao mirid bug, *Helopeltis collaris*, using choice and no-choice tests. Assessment based on damage rating.

	Damage Rating* (average ± S.E.)		
Efficacy Test	Kaolin treated	Control (water only)	Statistics
Choice test	0.2 ± 0.13	3.6 ± 0.15	df = 1, *F* = 115.60, *P* = 0.0001
No-Choice test	1.8 ± 0.18	3.8 ± 0.16	df = 1, *F* = 22.22, *P* = 0.0015

*Damage was rated as follows: 0 = no damage, 1 =1 quadrant with lesions, 2 = 2 quadrants with lesions, 3 = 3 quadrants with lesions, 4 = 4 quadrants with lesions.

Table 2. The efficacy of local kaolin against the cacao mirid bug, *Helopeltis collaris,* in choice and no-choice tests. assessment based on numbers of black lesions.

	Black Lesion Count (average ± S.E.)		
Efficacy Test	Kaolin treated	Control (water only)	Statistics
Choice test	0.6 ±0.23	67.2± 0.99	df = 1, *F* = 17.81, *P* = 0.0029
No-Choice test	24.2 ±1.18	44.4 ± 1.24	df = 1, *F* = 0.94, *P* = 0.3603

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