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A Feeding Deterrent Effect of a Water Extract of Tansy (*Tanacetum vulgare* L., Compositae) on Three Lepidopterous Larvae[1]

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ABSTRACT: A tansy (*Tanacetum vulgare* L.) extract was made by grinding fresh tansy leaves in distilled water. The extract, when "painted" on broccoli leaf discs, was found to deter feeding of two of three lepidopterous larvae studied. When the tansy extract was "painted" on the entire body surfaces of the larvae of three lepidopterous species, no deleterious reactions were observed.

Plants have long been cultivated by herbalists for their culinary and medicinal uses, fragrances, and for sources of dyes. Tansy (*Tanacetum vulgare* L.) has been used for all these purposes and has been prescribed as an agent to deter vermin from beds and to repel flies at windows (Macleod, 1968). Tansy is closely related taxonomically to the chrysanthemums and pyrethrums, both of which are known for their insecticidal properties (Wodehouse, 1971). Great numbers of plant products have been shown to be insect repellents, some of which are actually feeding deterrents (Munakata, 1970; Wright, 1967). Soo Hoo and Fraenkel (1964) reported water soluble feeding deterrents in ferns. Contrariwise, water soluble substances have been found in plants which stimulate insects to feed on their natural host plants (Keller et al., 1962; Keller and Davich, 1965).

The essential oil, oil of tansy, found in the seeds, herb, and flowers of tansy consists principally of thujone, borneol, and camphor. These substances have long been known for their biological activity; camphor has been used as a moth, mosquito, and screwworm repellent (Spector, 1956; Dawson et al., 1969; Windholz et al., 1976). Oil of tansy, mixed with oils of fleabane and pennyroyal and diluted with alcohol, has been used as a mosquito repellent (Georgia, 1914; Crockett, 1977). Tansy oil, however, is toxic to man if taken in sufficient quantity (Lewis and Elvin-Lewis, 1977). Two thiopenes have been detected in the roots of tansy which are similar to the thiopenes of *Tagetes* spp. which have nematocidal properties (Sorensen, 1961).

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Methods

Third and fourth instar larvae of the cabbage looper (*Trichoplusia ni* (Hubner)), the diamondback moth (*Plutella xylostella* (L.)), and the imported cabbage worm (*Pieris rapae* (L.)) were used in the following tests. In the first test, one broccoli leaf disc 1.5 cm in diameter was placed in a petri dish lined with moist filter paper. One half of each leaf disc was "painted" with either a tansy extract prepared by grinding 0.5 g of fresh tansy leaf in 1.5 ml of distilled water or with distilled water only. The other half of the leaf disc was left unpainted and served as a control. A larva of one of the above species was then introduced into the petri dish and allowed to feed for 4 h. Following the feeding period, each half of each leaf disc was arbitrarily rated as follows: 0–25% consumed, rated 1; 25–50% consumed, rated 2; 51–75% consumed, rated 3; and, 76–100% consumed, rated 4. Twenty-four, 43, and 51 cabbage looper, imported cabbage worm, and diamondback moth larvae, respectively, were tested to ascertain feeding preference with the tansy extract. With distilled water, 16 imported cabbage worm and 15 cabbage looper larvae were tested to determine feeding preference; not enough diamondback moth larvae were available for testing. The sign test was used to analyze the ranked, paired feeding indices.

A second series of tests were made to determine whether the tansy extract was irritating or toxic to and might be avoided by larvae of the aforementioned species. Topical applications of the tansy extract were made by painting the dorsal surface of the larvae for 3 consecutive days. Each "painted" larva was maintained in a separate petri dish lined with moist paper and fed cabbage or broccoli. Thereafter, observations were made daily to determine the possible effects of the tansy extract. Larvae of the diamondback moth, the cabbage looper, and the imported cabbage worm were tested as indicated above; 12, 17, and 29 larvae, respectively, were tested.

Results

The relative feeding response of the imported cabbage worm, diamondback moth, and cabbage looper larvae to broccoli leaf disc halves painted with either a water extract of tansy or distilled water is shown in Table 1. "Painting" with distilled water slightly increased, although not significantly, the feeding response of the larvae tested. Application of the tansy extract significantly (0.5) reduced feeding of the imported cabbage worm and diamondback moth larvae on the "painted" halves of the leaf discs. Cabbage looper larvae fed less extensively on the tansy-extract half of the leaf discs with a significance approaching the 5% level. However, when diamondback moth and imported cabbage worm larvae were left in their respective test petri dishes for more than 4 h, the control half of the disc was consumed first with feeding then continuing to the "painted" half until the entire disc was eaten.

Table 1. Relative feeding response by indicated species of the cabbage worm complex resulting from painting one-half of broccoli leaf discs with the indicated test solution.

		Median feeding index[1]		
	Test solution	Painted	Control	P^2
P. rapae	Tansy extract	1.60	3.12	<0.5
	Water	3.25	2.81	>5.0
T. ni	Tansy extract	2.04	2.46	>5.0
	Water	2.13	1.93	>5.0
P. xylostella	Tansy extract	1.24	2.34	<0.5

[1] Feeding index: 1.0 = slight feeding; 4.0 = heavy feeding (see text for expanded explanation).

[2] Sign test.

No adverse reactions were observed for any of the larvae treated with 3 consecutive applications of the tansy extract. All test larvae survived to pupation.

Discussion

Feeding was significantly reduced for imported cabbage worm and diamondback moth larvae in the presence of the tansy extract and to a lesser extent for the cabbage looper. This took place despite a slight enhancement of feeding noted for the broccoli leaf halves exposed to brushing with distilled water.

In general it is thought that polyphagous insects, such as the cabbage looper, accept any plant as a host except those which are repellent, whereas oligophagous species, like the imported cabbage worm and the diamondback moth, determine a proper host by the presence or absence of token stimulants (Dethier, 1954; Dadd, 1960; Soo Hoo and Fraenkel, 1966).

It is conceivable that the cabbage looper, because of its broad host plant range, is more capable of utilizing a host food in the presence of an alien chemical extract than either the imported cabbage worm or diamondback moth larvae which have more restricted host ranges. If this conception holds true for the insects used in this study, then the tansy extract functioned not as a repellent but rather to mask the token stimuli necessary for initiating and maintaining feeding. Thus, feeding deterrence would be more pronounced for the oligophagous imported cabbage worm and diamondback moth larvae than for the polyphagous cabbage looper larvae.

The short life of the feeding deterrent effect of the tansy extract may be due to the volatility or breakdown of the extract. Tansy oil is known to be altered on exposure to air and light (Windholz et al., 1976). It is also possible that the feeding deterrent in the tansy extract was relatively dilute and its

effects were therefore ignored when no other food was available. Further studies using a more concentrated extract may show increased activity as a larval feeding deterrent and a possibility for being used as a natural control agent in the field.

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Observations on the Predation of Mosquitoes Breeding in Tires by the Spider *Agelenopsis naevia* (Walckenaer).*—Data collected on a number of mosquitoes breeding in tires in the absence or presence of the spider *Agelenopsis naevia* is presented. Also included is a list of the Araneae present in ten tire communities during early and mid-summer collecting trips, and an introduction to *A. naevia* (Agelenidae), its means of restricting mosquito flight, and its very interesting method of capture.—R. A. SWEET AND W. A. RAMOSKA, Kansas State University, Manhattan

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