

# THE EFFECTS OF PLANT WAXES ON INSECTS

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**ABSTRACT.**—The epicuticular wax from two varieties of *Sorghum bicolor* (L) at four stages of growth have been presented to *Locusta migratoria migratooides* (R. & F.) in a bioassay which showed that the wax from younger plants is more deterrent. The wax was fractionated to give a hydrocarbon and an ester fraction of which only the esters showed some deterrent activity.

As part of our studies into insect/plant interactions (1,2,3) the present report shows how the surface waxes of *Sorghum bicolor* L influence the behaviour of *Locusta migratoria migratooides*. Studies of the feeding habits of locusts showed that non-preference or deterrence occurs before tasting but after "sensing" with maxillary palps (4). It was felt that a comparison of the deterrence at different ages might be useful. Since the first layer of the plant that the insect comes in contact with is the epicuticular waxes, it was thought appropriate to isolate these waxes and present them to locusts.

## RESULTS AND DISCUSSION

It is known that the waxes from different parts of *Sorghum bicolor* have different compositions, viz., sheath wax is not identical to the blade wax (5). In the present study, it was felt to be inappropriate to examine the waxes from different parts of the plant as *Locusta* will feed on whole plants. Instead waxes were extracted with chloroform from the surfaces of complete plants of *Sorghum bicolor* var CSH1, which is susceptible to insect attack, and of var IS1082, which is a known resistant strain.

The results in the preceding paper (9) showed that the amount of wax extracted from *Sorghum bicolor* decreases as the plants get older. It is likely that the actual weight of wax on the surface of the plant will affect the insect and when these crude (unfractionated) waxes are bioassayed, the young plant is more deterrent than the older wax. The bioassay consists of presenting *Locusta migratoria* with glass fibre discs coated with plant extract and determining the proportion of the disc left uneaten (table 1). This deterrence is significant at the 1% confidence level for CSH1 and for IS1082 at age 7 days and 14 days.

Recently *p*-hydroxybenzaldehyde which is present in the epicuticular layer of the *Sorghum* cultivar 65-D was found to cause 90% inhibition of locust feeding (7). The surface waxes were separated by thin layer and column chromatography into hydrocarbons, esters, aldehydes, free alcohols, free acids and *p*-hydroxybenzaldehyde, and each fraction was bio-assayed. Though it might be thought that these alkanes were unlikely candidates as allelochemicals, yet some alkanes are reported in this role, e.g., 13-methyl-hentriacontane has been identified as the kairomone from *Heliopsis zea* influencing larvae of *Trichogramma* (8). However, when sorghum alkanes for the 4 time periods were tested in the bioassay, there was no significant deterrence noted for any of the 8 fractions (table 1).

From table 1 it can be seen that the ester fraction of IS1082 is active towards the insect at day 7 and day 14 but not at day 28 or at day 52; it may be that the unusual combinations of esters reported in the preceding paper are acting as allelochemicals for locusts. The ester fraction of CSH1 is only active at day 7. Further examination of these ester fractions is underway.

## EXPERIMENTAL

**INSECT BIOASSAYS.**—Third instar *Locusta migratoria migratooides* (R. & F.) were used in a choice feeding experiment described fully elsewhere (6 and 7) which consisted of offering

TABLE 1. Feeding tests with CSH 1 and IS1082 extracts.

CULTIVAR	CSH 1						IS1082					
	Crude Wax		Hydrocarbon Fraction		Ester Fraction		Crude Wax		Hydrocarbon Fraction		Ester Fraction	
Compound Tested	(A%)*	(P) <sup>b</sup>	(A%)	(P)	(A%)	(P)	(A%)	(P)	(A%)	(P)	(A%)	(P)
Age in Days												
7	11.5	0.001	34.5	—	34.0	0.01	10.3	0.001	55.8	—	31.5	0.01
14	18.4	0.001	50.5	—	45.7	—	16.6	0.005	44.0	—	33.6	0.01
28	43.0	—	43.4	—	57.8	—	47.3	—	46.1	—	40.9	—
52	31.9	—	45.8	—	55.4	—	56.9	—	35.7	—	39.8	—

\* (A%) Amount of test disc eaten given as a percentage of the total eaten (Test and Control disc), 50% is equivalent to zero effect.

<sup>b</sup> (P) Level of significance of sign test applied to control and test disc areas for the 20 insects tested on each extract.

each insect two glass fibre discs both treated with 5% w/w sucrose; one disc was used as the control and the other was treated with extract at the dry weight level found in each cultivar. When roughly 40% of either disc had been eaten, the test was terminated; the areas of each disc were measured with a LiCor area measurer. Twenty insects were used to test each extract and fraction, and the sign test was used to determine the significance of any effects of the sample on the insects.

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#### American Chemical Society Southeastern Regional Meeting

The 35th ACS Southeastern Regional Meeting will be held from November 9-11, 1983, in Charlotte, North Carolina. The program will include a two-day Symposium on Natural Products, with papers on Structure, Biosynthesis, and Synthesis of Natural Products. Any ASP members interested in presenting a paper at this symposium should contact Dr. David G. I. Kingston, Department of Chemistry, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061. The deadline for receipt of abstracts is June 15, 1983.