Insect Repellent Activity of Fatty Acid Derivatives

A. W. RALSTON and J. P. BARRETT
RESEARCH LABORATORY, ARMOUR AND COMPANY, CHICAGO, ILLINOIS

Introduction

Although the property of certain chemicals to repel insects has long been recognized, the fundamental principles involving such activity are not as yet clearly understood. It is well known that repellency has little in common with lethal properties and that chemicals possessing a high degree of repellency for insects are frequently non-toxic to the insects and also that toxic substances are often attractive to them. Repellent properties and insecticidal activity are, therefore, separate and distinct functions and it does not follow that a compound possessing one of these properties possesses the other. Bunker and Hurschfelder[1] and later Mail[2] made a study of the repellent activities of a large number of organic compounds in an attempt to correlate insecticidal activity with chemical constitutions.

The field for insect repellents has been rather generally limited to their use in various lotions, creams and solutions for human use. There exists, however, a large potential use for repellents in the agricultural field if cheap and highly effective repellents can be developed. Many insecticides, particularly those used for leaf eating insects, depend upon a certain amount of damage to the plant before a sufficient quantity of the insecticide is consumed to be effective. They are, of course, rather generally applied as a protective measure which often reduces the plant injury to a minimum. In the life cycle of some insects the adult deposits eggs in the bud or other tender portions of the plant where the further development of the bud or plant part serves as a protection to the eggs until they are hatched. A serious amount of damage may be done by these insects before an insecticide can be effective against them. If the plant was sprayed with a repellent, the adult insect would avoid contact with it, and this cycle with its subsequent damage would be avoided. For this purpose the repellent could be either absorbed upon an inert dust or upon a solid insecticide, such as lead arsenate, or it could be applied in the form of a spray. The method of application chosen would, of course, depend upon the particular problem at hand. This method of insect control depends upon the development of highly repellent compounds which can be produced at nominal costs.

It is the object of this paper to study the repellent properties of a number of fatty acid derivatives and to correlate repellent activity with the particular functional group or groups present.

Method of Conducting Repellent Tests

The test insect used throughout this investigation, unless specially noted, was the common house fly, Musca domestica. This insect is extremely difficult to repel, since it is continuously moving about in search of food. The flies were reared under carefully controlled laboratory conditions.

The test flies, numbering from three to four hundred, were confined in a wood cage (19.5″ high, 9.5″ wide, and 14.5″ long) surrounded with 16 mesh copper wire screening on the two broad sides of the cage. The cage was equipped with a trap door for the introduction of food, water and the test samples. Bait attractants for the test work were made by spreading two grams of diastatic malt extract (Fleischmann) in the center of a seven centimeter filter paper so that an even, thin film covered the paper leaving a one-quarter inch margin around the circumference. The coated paper was baked for eighteen hours at 37°C. in order to dry the malt film. Upon removal from the oven, one drop of the test chemical was placed upon the malt film and spread as evenly as possible over the surface. Three or four chemically treated malt papers were usually included in each test along with an untreated malt paper which served as a control. The papers were pinned to the inside screened surface of the cage in such a manner that the light fell on the rear or untreated surface of the paper. The natural tendency of the flies in the cage was to be attracted to the malt extract as a source of food. The repellent properties of the test chemical were measured by its ability to protect the malt extract from attack by the flies. The degree of repellency of the various compounds tested is derived from counts of the number of flies feeding on the treated malt surfaces compared to the number feeding upon the untreated surface. It was observed that the usual response of the flies to the introduction of the malt papers was a mass migration. After depletion of the food upon the control, the flies moved to the paper containing the chemical possessing the least repellent properties, then to the next least repellent and so on. Counts of the number of flies feeding on the test samples were made fifteen minutes after the introduction of the papers into the cage, and all counts thereafter were made at thirty-minute intervals for a period of three hours or more.

Repellent Action of Some Fatty Acid Derivatives

The repellent activities of some derivatives of lauric acid are shown in Table I. Each cage contains three to four hundred flies. The table shows the results obtained when an untreated malt paper was placed into the cage along with a malt paper treated with the chemical designated in the table.

TABLE I.—THE REPELLENT ACTIVITIES OF LAURIC ACID AND SOME OF ITS DERIVATIVES
(Musca domestica)

Time Min.	Laurone		Lauralde-hyde		Dodecyl Amine		Dodecyl Alcohol		Lauro-nitrile (L,ho+T)		Lauric Acid	
	Control	Treated	Control	Treated	Control	Treated	Control	Treated	Control	Treated	Control	Treated
15	27	14	107	19	80	0	19	0	59	0	19	14
45	24	19	110	14	10	0	19	1	30	0	19	2
75	15	10	74	52	6	6	20	0	31	0	20	5
105	12	16	87	48	3	14	18	0	16	0	18	9
135	10	12	102	29	1	16	17	0	28	0	17	4
165	9	8	.....	.....	0	12	13	0	9	0	13	1
195	5	6	.....	.....	.....	....	.....	....	10	0	.....	....
225	9	2	.....	.....	.....	....	.....	....	.....	....	.....	....
Total	111	87	480	162	100	48	106	1	183	0	106	35