2-Naphthalenesulfonic acid, R ester	3	2
Acetaldehyde		
n-Butyl R acetal	4	2
Isobutyl R acetal	4	2
Chrysanthemumic acid, R ester	4	2
Ether		
2-*n*-Octyl R	4	2
Benzyl R	5	2
2-Ethylhexyl R	5	3
Pyran, tetrahydro-, 2-(RO)-	5 (1:5)	3 (1:5)
Acetaldehyde, ethyl R acetal	6	3.5 or greater
Ether, cyclopentyl R	6	3
p-Toluenesulfonic acid, R ester	6	3.5 or greater
Acetaldehyde, 2-chloroethyl R acetal	7	3
Benzenesulfonic acid, *p*-chloro-, R ester	8	3.5 or greater
Acetaldehyde		
2-(2-*n*-butoxyethoxy)-ethyl R acetal	9 or greater	3.5 or greater
2-*n*-Butoxyethyl R acetal	9 or greater	3.5 or greater
2-(2-Ethoxyethoxy)-ethyl R acetal	9 or greater	3.5 or greater
2-Methoxyethyl R acetal	9 or greater	3.5 or greater
Benzenesulfonic acid, R ester	9 or greater	3.5 or greater
p-Dioxane, 2-(RO)-	9 or greater	3.5 or greater
Ether		
2-(2-*n*-Butoxyethoxy)-ethyl R	9 or greater	3.5 or greater
2-*n*-Butoxyethyl R	9 or greater	3.5 or greater
2-(2-Chloroethoxy)-ethyl R	9 or greater	3.5 or greater
Cyclohexyl R	9 or greater	3.5 or greater
2-Cyclohexylethyl R	9 or greater	3
2-(2-Ethoxyethoxy)-ethyl R	9 or greater	3.5 or greater
Furan, tetrahydro-, 2-ethoxy-5-(RO)-	9 or greater	3.5 or greater

The last 18 compounds listed approach the effectiveness of the best commercial synergists—sulfoxide (*11*), sulfone (*9*), piperonyl butoxide (*10*), propyl isomer (*10*), and piperonyl cyclonene (*6*)—as judged with the same method of application and against the housefly. Further work with the new compounds designed to make more precise comparison of such strong effects is therefore warranted.

Discussion

Safrole was included for comparison with allyl 3,4-methylenedioxyphenyl ether. As the compounds differ structurally only in the ether linkage and the ether was established as synergistic whereas safrole was not, the comparison furnishes another example of the importance of this linkage. However, the possession of this linkage alone does not give assurance of synergistic effect. With a compound related to the highly synergistic tetrahydropyran derivative but not containing the 3,4-methylenedioxy group—2-(*p*-methoxyphenoxy)-tetrahydropyran—synergism was not found with either insecticide. In this case the replacement of the methylenedioxy group with the *p*-methoxy group destroyed synergistic effect.

In so far as comparisons could be made, the more synergistic a compound was with pyrethrins the more synergistic it was in general with allethrin. However, the intensity of synergism had a pronounced trend to be greater with pyrethrins.

The only esters found to have an appreciable synergistic effect were those of certain aromatic sulfonic acids. With each insecticide the intensity was only moderate for the ester of 2-naphthalenesulfonic acid, but relatively high for the others.

With but one exception, synergism was demonstrated in mixtures containing the ethers. The exception was the trimethylsilyl compound, which is, in fact, not a true ether, containing the linkage C—O—Si instead of C—O—C. In general, the greater the number of carbon atoms in the substituting group the greater was the intensity, especially when the group was cyclic or contained an alkoxy group. Introduction of a bromine or chlorine atom into a chain did not increase the intensity; in fact, for the benzyl analog and its halogenated derivatives (and a nitro derivative as well) there was a decrease.

The acetals were highly synergistic, those containing an alkoxy group in the substituted chain resulting in the highest intensity with either insecticide.

The urethan derivatives—that is, the esters of carbamic acids—resulted in little or no synergism.

Conclusions

Forty-three compounds were demonstrated to be synergistic with either pyrethrins or allethrin. Certain ethers, acetals, and esters of aromatic sulfonic acids had strong effect, whereas esters of carboxylic and carbamic acids had slight or no effect. The intensity of synergism was so high for 18 compounds—the toxicity of the mixtures was at least six times that expected for pyrethrins alone or three times that expected for allethrin alone—that further work is recommended with them.

At the concentrations tested knockdown of flies in 25 minutes was complete with all sprays containing the insecticides. Sprays containing the compounds alone caused no or negligible knockdown and mortality.

Literature Cited

(1) Beroza, Morton, J. AGR. FOOD CHEM. **4**, 49 (1956).
(2) Beroza, Morton, *J. Am. Chem. Soc.* **77**, 3332–4 (1955).
(3) Beroza, Morton, *J. Am. Oil Chemists' Soc.* **31**, 302–5 (1954).
(4) Campbell, F. L., Sullivan, W. N., *Soap* **14** (6), 119 (1938).
(5) Finney, D. J., "Probit Analysis," University Press, Cambridge, 1952.
(6) Gersdorff, W. A., Mitlin, Norman, *J. Econ. Entomol.* **45**, 519–23 (1952).
(7) Gersdorff, W. A., Mitlin, Norman, Beroza, Morton, *Ibid.*, **47**, 839–42 (1954).
(8) Gersdorff, W. A., Mitlin, Norman, Gertler, S. I., U. S. Dept. Agr., Bur. Entomol. and Plant Quarantine **E-848** (1952).
(9) Gersdorff, W. A., Mitlin, Norman, Nelson, R. H., *J. Econ. Entomol.* **48**, 9–11 (1955).
(10) Gersdorff, W. A., Nelson, R. H., Mitlin, Norman, *Ibid.*, **44**, 921–7 (1951).
(11) *Ibid.*, **45**, 905–8 (1952).
(12) Schroeder, H. O., Jones, H. A., Lindquist, A. W., *Ibid.*, **41**, 890–4 (1948).

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Microbiological and Chick Assay of Vitamin B_{12} Activity in Feed Supplements and Other Natural Products—Correction

In the article on "Microbiological and Chick Assay of Vitamin B_{12} Activity in Feed Supplements and Other Natural Products" [J. AGR. FOOD CHEM. **4**, 364 (1956)] the following corrections should be made in Table II. In Diet I 30 grams of soybean meal were used, and 2.3 grams of Mico mix instead of calcium carbonate. In Diet II 2.0 grams of calcium carbonate were used.

Footnote *b* of Table II should read, beginning with the second line: phosphate, 225; magnesium sulfate, 125; manganese sulfate monohydrate, 20; potassium iodide, 0.3; zinc acetate, 0.7; aluminum sulfate (alunogenite), 0.8; ferric citrate, 25; copper sulfate pentahydrate, 1.0; cobalt acetate, 0.2; and nickel chloride, 0.1 gram.

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