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Introduction

In the last decade, we have all seen the increasing concern about environmental pollution and have become aware of the long-term hazards of chemicals to man and other animals. Recently this concern and awareness have intensified and have resulted in much more stringent regulations governing the application of chemicals for bird control as well as for other purposes. Although most regulations have come from the Department of Agriculture and the Food and Drug Administration, the Department of the Interior and Bureau of Sport Fisheries and Wildlife have also scrutinized and tightened their policies, and as information concerning chemical effects on man and his environment accumulates, stricter regulations must be exercised.

For the past 10 years, the Denver and Patuxent Wildlife Research Centers of the Bureau have been developing chemicals to control bird damage to agricultural crops and to solve other nonagricultural problems in urban and suburban areas. Initially, research was limited to a few available chemicals and was restricted to small-scale tests in the laboratory and field. When modern pesticides were just becoming available, there were few regulations. Today, with the strict controls placed on chemicals, there are many factors that have to be considered when the usefulness of a compound is being determined.

Stages of Chemical Development

Within the Bureau, definite guidelines for the development of bird control chemicals divide the program into three major stages. Stage 1 initially consists of using various screening methods to find a promising chemical, and then gathering data on its toxicity, mode of action, and hazards. Finally, after laboratory data indicate that a particular compound has potential and is sufficiently safe, its efficacy is determined by the first limited field evaluations. This stage involves literature review, requests for chemicals, and initial studies on the following: chemical and physical properties; acute toxicity on target and nontarget species, mammals, and fish; dermal and inhalation toxicity on mammals; repellency or acceptance; phytotoxicity; stability of the proposed formulation; and secondary hazards to avian and mammalian predators. The most difficult problems encountered are with the designing of test programs and capturing and maintaining various species of wild birds. In the past 10 years, nearly 1,000 compounds have been tested on over 20,000 birds

of 25-30 wild species and 500-1,000 wild and domestic mammals of at least 4 species.

The attrition rate of chemicals is extremely high in this stage. About 1 compound in 20 passes the screening, 1 in 100 survives the remaining laboratory tests, and only about 1 in every 300 makes it through the initial field evaluation. For example, an extremely promising compound that was being investigated as an oral toxicant for pigeons and sparrows was shelved because of a regurgitation problem that appeared in preliminary field trials. Another compound, a promising repellent, was found to be extremely toxic and not repellent to some nontarget species. Other compounds planned for agricultural uses were shown to be phytotoxic.

Stage 2 involves a more thorough determination of the effectiveness and safety of a compound for a particular problem, and includes the following: field trials in different geographical areas, chronic and subacute feeding studies on birds and mammals, development of macro- and microanalytical methods for detecting the compound or its metabolites in plant and animal tissue, studies on the rate and mode of degradation in the environment, studies on translocation into plants or crops if applied in agricultural areas, and a completion of many studies started in Stage 1 that were not intensive enough to satisfy registration needs. Development of macro- and microanalytical methods for degradation and translocation studies is extremely complicated; it requires thousands of man-hours of effort, costly analytical instruments, and often the use of radioisotopes and the associated counting and monitoring systems. If a chemical does not meet any of these requirements, it will probably be rejected.

Stage 3 involves reporting all the available data on a compound in addition to gathering some or all of the following: 90-day to 2-year feeding studies on birds and mammals and a complete clinical and pathological examination of all test animals; studies of its effects on reproduction (including possible teratogenic effects on the young) in birds and mammals; studies on the metabolism of the compound in mammals and perhaps birds, including hazards of the metabolites; confirmation of an analytical method; studies of residues in treated crops or animals; and antidote studies on birds and mammals. Depending upon the nature of the chemical, other data may also be required.

The effort required in the final stage depends on the quantity and quality of the data already acquired and on the compound's intended use. Registering chemicals for nonagricultural uses, such as around feedlots and urban structures, is much easier than for uses on agricultural lands or near water. In Stages 1 and 2, field applications are made under controlled experimental conditions (e.g., crops are destroyed after treatment), but chemical field tests conducted under Stage 3 approach operational control. Not only is a temporary permit required from the USDA, but also the FDA has to establish a temporary tolerance if the compound is to be used in agricultural or watershed areas.

Costs and Manpower

The following outline of our progress with a few chemicals currently registered or being registered for bird damage control will give you an idea of just what all the above means in terms of time, manpower, and money.

DRC-1339 (Starlicide)[1] -In 1967, following approximately 6 years of development, DRC-1339 was registered for controlling starling populations at cattle and poultry feedlots. Over 10 man-years and $100,000 in direct costs went into its development. This does not include time and money spent in screening and testing other agents to develop information that contributed to the registration of DRC-1339. Inclusion of these costs could easily triple or quadruple the figure. Because DRC-1339 was registered for use in feedlots, it did not require the large amount of data needed for compounds that are to be used in agricultural areas. However, since almost all of the toxicity and efficacy data were gathered by the Bureau, it was an expensive undertaking.

DRC-1327 (Avitrol)[2] -Hopefully, within the next 12 months, DRC-1327 will be registered for controlling blackbird damage to ripening corn. More than 15 man-years and several hundred thousand dollars will have been directly expended on development of the compound by the time registration for this use is complete. Inclusion of indirect costs plus the money spent by Phillips Petroleum Company in testing, and assisting the Bureau in conducting laboratory and field efficacy studies would probably push the total amount of money spent to register DRC-1327 for this one use to over $1,000,000. However, if it is later registered for related uses (grain sorghum, peanuts), the development cost per registration should decrease substantially, since most of the necessary data are available.

DRC-736 (Measurol)[3] --Probably within the next 2 years, DRC-736 will be registered for use in controlling bird damage to sprouting corn. To date, its development has taken the Bureau about 9 years and cost over $100,000, primarily in efficacy studies. Additional costs have been borne by Chemagro Corporation, which is actively cooperating with the Bureau in the compound's development. In addition, our repellent screening program had operated for 6 years and evaluated some 800 compounds before DRC-736 was determined to be an effective compound. Although laboratory investigations of the compound could be rather limited because data to satisfy most of our preregistration requirements were readily available, our efficacy studies had to be conducted in as many as eight states for 1 to 5 years in order to satisfy registration needs. Even with an extensive knowledge of damage areas, less than a third of the efficacy tests yielded re-portable data because of a lack of bird pressure.

Program Redirection

As a result of our increasing exposure to, and concern with, registration problems, a number of changes have been made in our research programs that will allow us to more effectively and efficiently develop chemicals for the control of bird damage. For example, we are now extremely interested in compounds that are being investigated or developed for other uses and that may be widely used in controlling bird damage. Compounds that will require the Bureau to provide all or most of the data necessary for registration are being closely scrutinized because of the large expenditures of funds and manpower needed to accomplish this task. We are, however, expanding our cooperative efforts with other parts of the Bureau, other federal and state agencies, and universities in order to shorten development time of bird control agents.

Perhaps the biggest problem facing us right now is finding the methods and manpower to conduct intensive surveys of bird damage problems throughout the United States so that all bird damage problems can be put in proper perspective. When one considers that it may require $1,000,000 in chemical research to solve a $1,000 or $10,000 problem, it is evident that such problems will have to be solved in other ways. Only expensive, nationwide or, at least, regionwide problems appear to justify the development of new chemicals.

Conclusion

The development of chemicals to control bird damage in both agricultural and nonagricultural areas is becoming increasingly expensive and difficult. New priorities are being established to determine the usefulness of a control chemical. Because of the tremendous development costs, a closer working relationship between all interested parties is imperative if the development of chemicals to control bird damage in the United States is to continue.

DISCUSSION: of Ed Schaffer

D. SCHNEIDER: Is it true that Denver is no longer interested in working with DRC-1339 since Purina already has the product on the market for one particular use?

E. SCHAFFER: Well, this is a very hard question to answer. We are in a position where we have more than one compound we are working with, and we have a number of compounds that are very close to registration. Right now most of our effort is going to these other compounds. We are, however, still doing some work with DRC-1339, but it is somewhat limited at this time because we are short on man power and money.

R. SMITH: Will you enlighten the audience as to where you secure your chemicals for screening?

E. SCHAFFER: We do this a number of ways. Occasionally, a chemical company will write to us and ask us to test a particular compound for a particular use. Occasionally we see references to some compound in the literature we wish to test and we contact the company. Many times we go on the open market and purchase the compounds, also. Basically we get our chemicals from just about every conceivable source.

Registered trade name of Ralston Purina Co., St. Louis, Mo., for 3-p-toluidine HC1. Reference to trade names does not imply endorsement of commercial products by the Federal Government.

Registered trade name of Phillips Petroleum Co., Bartlesville, Okla., for 4-Aminopyrid-ine.

[3] Registered trade name of Chemagro Corp., Kansas City, Mo., for 4-(Methylthio)-3,5-xylyl N-methyl carbamate