PEST CONTROL METHODS AND PEOPLE

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Thank you, Mr. Chairman, ladies and gentlemen. I find myself in a rather unique position of speaking at the hour of 7:30 a.m. This is a formidable task and I question if I am up to it.

Frankly I am not sure what "Pest Control Methods and People" really means. When I asked what I should cover, I was told to give a general discussion on pesticides.

I am not sure this is appropriate even though the laws and regulations that pertain to other pesticides apply equally to those materials used in vertebrate pest control; the conditions of use, the types of chemicals used, their effect upon various animal species, and the number of chemicals available are so different from the pesticides used in controlling invertebrate pests that generalizations may not cover the topic. There are, however, a few basic principles that do pertain and I will discuss these.

Mr. Cummings suggested that I cover the University's policy in regards to the use of and recommendations for pesticides by our experiment station and Extension Service personnel and I will do this a little later.

Looking back to your last conference in February of 1962 we find that a number of topics were discussed at that time which is being further elaborated upon during the present conference and some of these lend themselves to the discussion this morning. Dean Aldrich pointed out the importance of several bird and rodent species as enemies of our agriculture. Further, he brought out the point that many of these pests are the result of our intensified agricultural practices. When we plant certain crops over a wide area we change the environmental and ecological conditions and frequently bring about a situation that is conducive to large populations of organisms which, under the natural conditions that prevailed before the land was put into crop production, would not have occurred and, furthermore, these animals would not have been considered pests under ordinary population densities.

Field mice in our orchards and sugar beet fields, gophers in alfalfa, starlings in feed lots and grapes are examples of vertebrates that fall into this category. Some imported species such as the starling have found conditions good. Others are native species which have adapted to these changed conditions. There are many such examples among insects. One striking case is that of the alfalfa butterfly. This insect is native to the United States. It lived upon various legumes and was considered a pretty but unimportant butterfly for many years.

However, when we started planting large acreages of alfalfa, this insect soon adapted itself to the growing cycle of alfalfa and is now a very damaging pest of this crop. The cotton leaf perforator and various species of lygus bugs are similar examples.

The point I am emphasizing is that many of our pest problems are the direct result of our agricultural practices and our living habits. We cannot, in many instances, fall back upon the concept that if we would work for the re-establishment of a balance of nature between our activities and those of the pest species we would achieve a solution for our problems without having to resort to special pest control measures. I believe we should recognize at this point, that when we planted cotton or alfalfa or established orchards we changed the environment and upset the natural balance that previously existed; and, furthermore, frequently the organisms that are now living under the new environment in our fields are in balance or equilibrium with the new surroundings. For example, a given area may have supported only certain numbers of individuals of a particular species under original natural conditions; but when we changed the environment and made it more favorable for this species, we provided it with a greater food supply, more habitats in which to live, possibly eliminated some of its natural enemies and thus made it possible for the area to support a greater population. Under this higher population density the species may still be in balance with its environment, but this new balance is at a much higher population density than previously existed. Thus, if this animal attacks one of our crops we consider it a pest and take measures to reduce its numbers below an economic level. This precise situation does not occur under all conditions but it is not an infrequent occurrence.

In other situations we have had for various reasons outbreaks of pest species which have resulted in populations above the normal for the area and these have caused us serious economic losses. Regardless of the reason for the population of pests, if they destroy our crops we must, if we wish to farm profitably, develop control measures.

In certain instances an organism may be a nuisance or a menace to public health and control under these conditions is not entirely dependent upon population density but upon the fact that any population, regardless of size, if it occurs in an area of human habitation may be a nuisance or result in an outbreak of disease, and this control may be necessary.

A third type of problem we are confronted with are those populations of pest species in our natural wildland areas and which threaten our natural resources. This situation poses special problems because control measures can often bring about undesired results on other residents of this wild area.

Under any of the conditions mentioned, if a species is a hazard to health, crop production, or a threat to natural resources, we may feel control measures are necessary and there are a number of pest control methods that can be considered. For vertebrate control the use of traps, fences, gun sounds, and so forth, are sometimes applied and many times very effectively. But often the species involved does not lend itself to these procedures.

Biological control is an effective tool in some cases, but to my knowledge this has not been developed as highly for vertebrate pest control as it has for the control of insects and mites. There are undoubtedly many good reasons for this and probably further research may open this field up in the future.

This leaves us, at this time, for some of our important problems, only chemical control and I presume this is the reason for my being asked to attend your conference. I do not pretend to have any specific knowledge about the chemical control of vertebrate pests, but since the chemicals are used as baits, dusts, gases, repellents, attractants or sterilizing agents, many of the principles involved and the problems encountered are the same as those in the control of invertebrate pests.

Those engaged in vertebrate pest control, in some cases, face problems we *are* not confronted with in the control of insects, mites, weeds, nematodes, plant diseases, etc. For example, you ordinarily use and need compounds that have a high degree of toxicity to vertebrate animals, while in invertebrate pest control we look for materials with the lowest toxicity to vertebrates, this is a disadvantage. On the other hand, you have some advantages we do not have. The relatively small number of chemical compounds you have available for control of pests is both an advantage and a disadvantage. It is an advantage if you do not have to evaluable 100 to 200 different materials on several hundred different pests and crops and determine the effect of a particular usage on the total biota. However, it is a disadvantage to not be able to have several different materials to select from and use that which is most effective under the particular set of circumstances that may prevail.

While there is some selectivity among the chemicals you have available, this is sometimes so specific that it may limit effectiveness. For example, red squill and Antu are most effective against some species of rats and show poor results against other species. In many cases the alternative to the selective compound is a broad spectrum poison such as 1080, thallium salts, zinc phosphide or cyanide. These materials, because of their persistence and their toxicity to most species of vertebrates, present problems that limit their usage and in some cases even their purchase and use is closely regulated by law.

Certain pests or noxious forms of vertebrates, especially those in urban areas, can be controlled by carefully regulated practices that cause a minimum of adverse side effects such as undue hazards to health, injury to non-target species or residues on agricultural commodities, but control practices against those species which attack our agricultural crops, foods in storage or our forest trees present more difficult problems.

The control of mice in orchards, sugar beet fields or alfalfa result in problems that are similar to those we face in controlling insects. These animals may be generally distributed throughout a field or orchard and baiting or trapping frequently are not effective. Control under these conditions necessitates a full coverage of the field with a compound highly toxic to mice. This increases the possibility of residues on a food crop as well as severe side effects on non-target organisms in the area. For example, endrin, a highly toxic chlorinated hydrocarbon insecticide, has been used for mouse control. The rates required *are* usually much higher than those which are used in insect control and this presents problems we ordinarily do not encounter when we use the material to control insects. At these higher rates (sometimes as much as 8 to 16 times greater than the amounts used to control insects) one of the problems is the effect of this chemical at this high rate upon the insect population. This is disastrous as far as upsetting the balance of the insect population is concerned because many of the insects *are* killed, especially the beneficial forms. As a result a pest species such as mites, which had been held in check by natural insect enemies, may develop a large population and cause serious damage. Residues on the growing crop are another serious consideration. Endrin is persistent and when used even at low rates its application is carefully regulated to avoid residue problems; therefore, when it is used in mouse control on a growing crop, the possibility of an illegal residue is very real. In addition to this, endrin will accumulate in the soil and present a hazard in the form of an illegal residue on subsequently planted root crops. Accumulation of endrin in the soil has shown a phytotoxic action on such crops as lima beans and certain cucurbits and this poses another problem to contend with.

In addition to the residue problem and possible phytotoxic action, endrin is poisonous to most vertebrates. When fields are treated at these high rates a hazard exists for the applicator, field workers, pets, livestock and wildlife. If the application is made to a crop that is under irrigation, an additional hazard to fish is caused by run-off of the tail water into drains or streams.

Toxaphene has also been used for mouse control at rates as high as 20 pounds actual toxaphene per acre. The same problems exist when this chemical is used as those which have been described for endrin, with the additional problem that a number of crops are sensitive to damage from toxaphene when applied at this high rate.

In controlling vertebrate pests in an agricultural crop you are faced with the same problems we entomologists face during the development of an insect control program. You must consider residues, phytotoxicity, accumulation of the pesticide in the soil, effect on beneficial species of insects and mites, the effect on wildlife species, hazards to humans, pests and livestock and the problem of environmental contamination. I believe the development of your chemical programs will have to follow a pattern similar to that used in developing an insect control program.

Occasionally a pesticide has been applied to a food or feed crop for rodent, control without regard for problems mentioned above. In these cases it has appeared that since the control program was aimed at a vertebrate pest rather than an insect, consideration was not given to the registered use of the compound, the possibility of a residue on the crop at harvest, or the possible adverse side effects upon other organisms considered. For example, in one case a pesticide was registered for use at a certain rate per acre, but since this rate was not effective against mice a higher rate was used, presumably under the impression that because the application was for the control of mice rather than an insect the registration did not apply. Unfortunately, this is not the case as you heard yesterday, the registration is for a specific crop and pest and must be used accordingly. Furthermore, if a residue of a pesticide on a crop exceeds the legal tolerance, that crop may be seized and destroyed regardless of the reason for the application of the pesticide. This situation has existed among some of our farmers for several years. A farmer may be extremely careful and critical of the amount of a material used to control his insect problems, but when the control is aimed at a rodent or some other vertebrate he considers this a different situation and willingly applies **many times** the amount that is considered safe to use on a crop.

Vertebrate pest control specialists working in the field of pests control in or around agricultural commodities will have to think in terms of the overall effect of a pesticide. In a few instances some of the highly toxic insecticides have been selected for trial or use and applied at rates that would not be considered safe as an insecticide application. I believe this procedure can lead to serious difficulty unless the investigator considers as part of his project residue analyses, effect of the chemical on non-target organisms, accumulation in the soil, hazards to the applicator and farm workers in the field, phytotoxicity and run-off into streams in the drainage water. The investigator should also be prepared to destroy the treated portion of the crop if residue analyses show it to be above the legal tolerance.

At the University of California we have a policy which places the burden of these determinations upon the individual research worker. If he works with an experimental compound or is using a registered compound in a way that is different from the federal and state registration he must be prepared to destroy the crop unless he can prove by analyses that an illegal residue does not exist. Further, he must investigate as far as possible the various side effects the chemical might cause in terms of phytotoxicity, effects on bees and other beneficial species and wildlife. This has resulted in slowing some of our shotgun screening programs but it has lead to more carefully planned research programs and acceptance for testing only those products that show considerable promise and whose use can be controlled.

We must face the fact that pesticides do not have a good or favorable image in the eyes of much of the general public. We, who use or advocate the use of these chemicals, have been accused of contributing to all sorts of problems involving human health, destruction of wildlife and generally contaminating the environment.

We cannot afford to work in the field of pest control without considering every aspect of the problem. Our programs should be founded first upon a basic knowledge of the ecology, biology and behavior of the species we are concerned with. We should also definitely consider biological controls. In using chemicals we have no alternative but to learn what they may do in relation to other species of animals, their effect on human health and a knowledge of residues they might cause. Whenever possible we should determine the possibility of incorporating biological and chemical control. In the field of entomology we call this integrated control and at present have made some significant advances in this area. For the most part we have put aside the concept that biological and chemical control are incompatible and have found that they can complement each other when they are used with a full knowledge of species involved and the effect of chemicals on both the pest and beneficial species. I do not know if this would be workable in vertebrate pest control, but it is worth an effort.

Vertebrate pest control is no different than any other kind, but you do have some more difficult problems than we have in other control practices because as I mentioned earlier the chemicals you use must usually have a high degree of toxicity to vertebrates. The problem is solvable, but the solution will be based upon various considerations I have referred to earlier and upon a complete knowledge of the fundamental behavior of the species to be controlled.

In addition to understanding the behavior of the pest species, we should, if we are to be effective, have an understanding of human behavior, as far as pesticide chemicals are concerned. Some people appear to be completely irrational when this subject is mentioned. They are convinced that their food and the environment are completely poisoned and that those who use or suggest the use of pesticides have no regard for others. It is our duty to point out to these people the need for these chemicals if we wish to maintain our agricultural production and show them that the use of pesticide chemicals is regulated by laws which insure safe use of these compounds.