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Prospects for the Improved Control of Field Rodents in North Africa and the Middle East.

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Abstract

Rodent control has been a relatively neglected area of plant protection in the past, because the problems have been underestimated and the available solutions have been inadequate. The rodents which cause most damage to field crops in North Africa and the Middle East are jirds, voles, Nile and roof rats and molerats (*Meriones, Microtus, Arvicanthis, Rattus* and *Spalax*). Although cultural practices can reduce some of these problems, existing non-chemical methods cannot give adequate control on their own and considerable reliance must be placed on rodenticides. Rapid progress has been made in rodenticide technology over the last few years but the application of poison must be based on laboratory and field tests against the rodent species involved. The development of convenient bait formulations acceptable to the rodents is also important. Good organisation is as important as good technology. The most appropriate measures will depend on the pattern of rodent damage.

Introduction

Increasing attention has been paid in recent years to the problems of field rodent control, both because of increased awareness of the damage caused and because advances in technology offer the potential for more cost-effective control. Much of this technology, however, has been developed primarily against commensal rodents in temperate regions, whereas the countries of North Africa and the Middle East are subject to different problems. Techniques therefore need to be adapted to local conditions if they are to be effective and then compared with existing methods before being used on a wide scale. This paper outlines the species involved and considers control methods which give the best prospects for improving rodent control in the region.

The Species

The most widespread field rodents of North Africa and the Middle East are the jirds, *Meriones* spp, which are one of the world's most damaging groups of rodents (Drummond, 1978). *M. shawi* occurs in North Africa, *M. tristrami* in the Middle East; both are found in nearly all environments where annual rainfall exceeds about 100 mm. *M. libycus* is found throughout the region where rainfall is less than 100 mm (Harrison, 1972). Jirds are primarily seed and insect feeders but will also eat plant foliage. They can devastate cereal crops and also attack orchards, particularly intercrops such as cucurbits (Bernard, 1977).

The social vole, *Microtus socialis* (= *guentheri* =

palestinus; Corbet, 1978), is the most significant rodent pest of Palestine, Jordan, Syria and Iraq. It occurs in most environments receiving more than 250 mm rainfall annually and in irrigated areas. Cereals and perennial forage crops are particularly vulnerable to attack (Bodenheimer, 1949; Wolff, 1977). Another species in the same area is the mole-rat (*Spalax leucodon*), which causes severe damage by collecting and storing planted seed, especially in summer crops (Richards, 1982a).

In the well-watered coastal areas, the roof rat (*Rattus rattus)* attacks vegetable crops and both fruit and trees in orchards (Taylor, 1982).

A series of special problems occur in the intensively cultivated and densely populated Nile valley. The principal field rodent is the Nile rat, *Arvicanthis niloticus,* but all the commensal species (the Norway and roof rats, *Rattus norvegicus* and *R. rattus,* the house mouse, *Mus musculus,* and the spiny mouse, *Acomys cahirinus*) can be damaging to almost every crop (Taylor, 1982).

Non-Chemical Control

Ecological methods may offer potentially cheap, safe, effective means of plant protection. This approach, however, has so far made limited progress against field rodents. Parasites and pathogens, for instance, can be used against insects but the problem of cross-susceptibility between target rodents on the one hand and domestic animals on the other has yet to be overcome; their use against rodents is therefore strongly discouraged by the World Health Organisation (WHO 1967).

The use of predators to control rodent populations is often suggested. Some success has been claimed in limiting the numbers of rats (*Rattus tiomanicus, R. argentiventer* and *R. exulans*) in Malaysian oil palm plantations, by encouraging an introduced predatory bird, the barn owl (*Tyto alba*) (Lenton, 1980). Promising results were achieved recently in Denmark when male stoats (*Mustela erminea*) were introduced onto a small island to control water voles (*Arvicola terrestris*), although a potential danger to non-target sea-birds was recognised (Kildemoes, 1982). While predators may have a part to play in restricting the growth of very small rodent populations, there are many theroretical reasons, especially the wide differences in birth rates between predator and prey, for believing that predators are unlikely to form the basis of a practical control method suitable for widespread use (Erlinge, 1975).

In one respect, however, rodents do lend themselves to ecological control. Although seasonal environments regulary produce unfavourable conditions at certain times of the year, rodents, unlike many pests of the region, do not pass through a dormant stage. Cultural practices can often be used to increase the impact of these conditions such that rodent numbers are reduced to the point where they cannot rise to levels causing economic damage in the following season. For example, the survival of both voles and jirds during the summer months depends, in winter rainfall areas, on 'refuges' on weedy or fallow land and on grain collected and stored before harvest (Bodenheimer, 1949; Hoppe, 1978). Cultivation and weed control at this time can reduce numbers substantially. Such cultural methods, however, may conflict with other land usage, for instance the grazing of stubble after harvest and techniques of minimal tillage. The integration of cultural control methods into complex farming systems is not always straight forward.

While research is needed to develop ecological control methods in the medium term, the immediacy of field rodent problems in the region requires quicker answers. Chemical control methods can be developed within short term research programmes and heavy reliance must be placed on rodenticides for the time being.

Chemical Control

Acute poisons are still widely used in the region but there is a trend towards replacing them by anticoagulants. This trend, however, is based upon the assumption that the high levels of control achieved with anticoagulants against commensal rodents in temperate regions can be transfered directly to field control elsewhere. A single application of an acute poison kills roughly half of a rodent population - for Norway rats in the UK, results may vary between 40% and 80%, depending on bait palatability and the mode of application (Rennison, 1977). Against relatively dense commensal Norway rat infestations, 24 hours exposure to an anticoagulant can be more effective than an acute poison (Gorenzel et al, 1982) but this is not always the case (Richards, 1981).

Anticoagulants represent an altogether more complex technology than acutes and their use will only pay dividends if proper attention is paid to the choice of poison, the bait formulation and to the mode of application.

Laboratory studies show that individual anticoagulants may have quite different toxicity spectra. It cannot be assumed that comparative toxicity data based on Norway rats will hold true for other species, even within the same genus. *R. rattus,* for instance, is less susceptible to warfarin than is *R. norvegicus* (Greaves, 1982). Voles are susceptible to a wide range of anticoagulants but jirds are much less susceptible (Byers, 1978; Gill & Redfern, 1983). The most extreme example of all is the Egyptian spiny mouse, which seems to have considerable tolerance to all anticoagulants (Mahmoud & Redfern, 1981). Laboratory toxicity data are needed for each species and, to allow monitoring of any suspected resistance in the future, for each major rodent area.

The objective of achieving control close to 100% can only be obtained with a bait which is sufficiently palatable to even the most delicate and cautious feeders within the rodent population. While the efficiency of acute poisons can be greatly improved by using a good formulation (see eg Brooks, 1982), this becomes crucial with anticoagulants. This means, in effect, the meticulous laboratory evaluation of cheap, convenient (usually cereal) baits. Bait preparation can no longer be left to the farmer and must be done centrally. Much work remains to be done in the development of acceptable baits which are suitable for industrial-scale production (Myllymaki, 1979). In particular, the need for a long shelf-life and durability in the field requires the selection of fungicides, insecticides and dyes which do not reduce palatability. Conversely, a bait which takes a very long time to break down in the field may present a hazard if it is not eaten by the target animals.

The need for high-quality baits, together with the relatively high cost of the active ingredients, generally result in anticoagulant baits being more expensive than acutes by the time they reach the field. Application methods must therefore exploit their full effectiveness.

Conventional use of traditional 'multiple-feed' anticoagulants requires repeated visits to replenish baits, with the aim of maintaining surplus quantities available to the rodents (Rennison, 1977). Surplus baiting is laborious and therefore not usually practicable in the field and, moreover, does not utilise the potential cost-effectiveness of the more toxic 'single-feed' anticoagulants. New application methods are now being developed to optimise the use of these anticoagulants (Dubock, 1979; Richards, 1982b). The first results with these methods, known as 'pulsed' baiting, show that the safety and cost-effectiveness of anticoagulants can be greatly improved. They also illustrate the advantage of using the most potent poison for the particular target species (Richards, 1982b).

The Organisation of Control

Good organisation is as important as good technology. Thorough planning and evaluation, nicely illustrated by urban control schemes such as those in Amman and Kuwait (Adnan A. Abdellmajeed, personal communication; Al-Sanei, Zaghloul and Balba, 1982), is essential for effective control. One of the most important factors determining the appropriate form of organisation is the pattern of damage which occurs. There is very little quantitative information on yield losses caused by rodents and this remains one of the most important gaps in our knowledge (WHO, 1975). There are, however, certain generalisations which can be made.

Rodent damage to field crops in North Africa and the Middle East can be classified into three broad types. Firstly, there are relatively moderate losses (i.e. up to 5% yield loss) which occur in most years; these can be referred to as continual losses. Secondly, there are outbreaks which occur in the intensively cultivated irrigated or higher rainfall areas where a range of different crops are grown, such as the Nile valley. Thirdly, there are the outbreaks which are characteristic of the lower rainfall areas, where extensive cultivation, particularly of cereals, predominates.

Continual losses occur in both intensively and extensively cultivated areas. Whether the damage represents a significant economic loss depends largely on the value of the crop. With the greater cost-effectiveness of the more toxic anticogulants, the costs of control can be reduced and the economic threshold can be lowered correspondingly. For instance, yield losses as low as 0.3% can justify rodenticide use in rice, although a practical threshold may be somewhat higher (Buckle, 1982).

The economic threshold, however, must be determined for each situation. Once determined it is necessary to monitor damage so that control can be implemented when that threshold is reached.

It is clear therefore, that good control of continual losses cannot be achieved by individual farmers on their own but requires some kind of central monitoring and then co-ordination of control. This relatively complex organisation will usually need government support, such as through extension services. A central board will need to establish economic thresholds, monitor damage levels and determine when control should be applied. This board should also evaluate the most effective rodenticide and distribute carefully formulated baits with detailed instructions for their use. Schemes of this type are already being developed in certain major rice-growing areas of South-east Asia (Buckle, 1982).

Outbreaks in intensively cultivated areas build up over months or years. A recent example is in Egypt, in 1980-1982 (Taylor, 1982). Experience in Northern Europe and South-east Asia suggests that outbreaks of this type will tend to die out if control is consistently applied to continual losses as described above (Myllymaki, 1979; Wiroatmodjo, personal communication). By controlling rodent populations when they are small, they are never given the opportunity to start the phase of rapid increase in numbers which leads to an outbreak. This approach is preferable to mounting a major control campaign once the outbreak has occurred because severe damage will be done before the control can take effect.

Outbreaks in the extensively cultivated areas can appear within weeks. The numbers of both jirds and voles go through cycles in which periods of low density are followed by outbreaks, which then subside of their own accord. These cycles in the highly seasonal low rainfall areas of North Africa and the Middle East share some features in common with cycles in the temperate and arctic regions, where there is a large seasonal variation in temperature. These temperate and arctic cycles have been studied for more than 40 years and their causes are still unknown. Complex models are being developed to predict increases in vole numbers in Scandinavia but as yet these can only suggest that an outbreak becomes more likely as time passes from the previous one (Myllymaki, 1982). While periodic increases in rodent numbers may have different causes in the region which concerns us here, it is likely that they too are the result of many factors. While long-term prediction of outbreaks is therefore unlikely to be feasible, forecasts can be given relatively simply by monitoring an index of rodent abundance, such as burrow density, on small plots or perhaps from simple weather records.

With such a forecasting scheme, a two-tier system can be implemented. When rodent numbers are low, farmers may continue to use locally formulated acute poisons against local problems, with variable effects. When high numbers are forecast, provincial or national resources should be deployed in a major control effort, as in the intensively cultivated areas, which will lessen the effect of the outbreak.

Conclusions

There is a general awareness amongst agricultural scientists and administrators that rodents are a major problem in many field crops of North Africa and the Middle East. Great interest is always expressed in the subject of rodent control. On the other hand, there is very little research on rodent control in the region, compared with most other areas of plant protection. This relative neglect stems partly from a lack of scientists experienced in this field. Training in the biology and control of rodents must be a high priority.

By drawing lessons from other parts of the world, together with the research which has been done in the region, it is possible to point out promising avenues for further work. This paper highlights the need for more knowledge of damage, its distribution and resultant yield losses and for simple monitoring techniques. Work will be needed also both on formulations and to find the most cost-effective way to apply rodenticides. The technology is now available and holds out excellent prospects for improved control of rodents. What is needed now is adaptation of this technology to the needs and problems of the region.

الملخص

تعتبر مكافحة القوارض من الفروع المهملة نسبيا في وقاية النبات نظرا لعدم اعطائها الاهمية المستحقة ولعدم توافر طرق المعالجة الناجحة حتى الآن. ان اغلب الاضرار التي تتسبب عن القوارض في شمالي افريقيا والشرق الاوسط يسببها الجرذ، فأر الزرع، فأر النيل، الفأر المتسلق والخلد (*Meriones, Microtus, Arvicanthis, Rathus, Spatax*) ومع ان العمليات الزراعية المختلفة قد تقلل من اعداد هذه القوارض الّا انها لا تكفي لمكافحتها، ويظل الاعتماد على استعمال مبيدات القوارض هو افضل السبل. ولقد تطورت في الآونة الاخيرة تكنولوجيا مبيدات القوارض للحصول على افضل انواع الاطعمة السامة ضدها. الا انه يجب ان يعتمد التطبيق على نتائج الاختبارات المسبقة بالنسبة لنوع القارض الموجود ونوعية الضرر الحاصل.

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