

VERTEBRATE PESTS OF CASSAVA IN AFRICA AND THEIR CONTROL

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ABSTRACT

Much attention has been given to almost all agents that cause losses to crops with the possible exception of vertebrate pests of which comparatively little is known in relation to farming activities. Due to the paucity of information on vertebrate pests there is very little or no indication of what damage is caused by which pest, how widely it is distributed, or how much damage is caused. The general nocturnal, secretive habits and high mobility of most vertebrates make it unlikely that they will readily be seen damaging crops. Indirect evidence has been used by researchers, farmers and agricultural workers to identify the vertebrate pests of cassava cited in this review. A diverse range of larger vertebrates (elephants, primates and ungulates), rodents and birds are considered as pests of cassava. The distribution, diagnostic features, damage symptoms and status of the major species are discussed and control measures practised by farmers, hunters and researchers are reviewed.

Key Words: *Manihot esculenta*, vertebrate pests, primates, rodents, ungulates, birds, control measures

RÉSUMÉ

Une grande attention est portée à presque tous les agents biologiques qui causent des dégâts aux cultures, à l'exception des ravageurs vertébrés pour lesquels on sait comparativement peu de choses sur leurs relations avec les activités agricoles. Du fait de la pauvreté de l'information sur les vertébrés déprédateurs, il y a très peu, voire aucune indication sur les dégâts causés par un ravageur donné, l'étendue de sa distribution et l'importance de ses déprédations. Le comportement en général nocturne, les mœurs discrètes et la grande mobilité de la plupart des vertébrés rendent improbable l'observation directe de leur activité déprédatrice dans les champs. Des preuves indirectes sont utilisées par les chercheurs, les agriculteurs et les ouvriers agricoles pour identifier les vertébrés ravageurs du manioc qui sont cités dans cette revue. Une gamme variée de grands vertébrés (éléphants, primates, ongulés), rongeurs et oiseaux sont considérés comme des ravageurs du manioc. La distribution, les éléments de diagnostic, les symptômes liés aux dégâts et le statut des principales espèces sont discutés et les mesures de contrôle, utilisées par les agriculteurs, les chasseurs et les chercheurs, sont passées en revue.

Mots Clés: *Manihot esculenta*, ravageurs vertébrés, primates, rongeurs, ongulés, les oiseaux, mesures de régulation

BACKGROUND

Pre- and post-harvest crop losses are conservatively estimated to be in the range of 30% or more of the potential yield in Africa and in developing countries elsewhere. The losses are caused by diverse species of arthropods,

pathogens, weeds, and vertebrate pests, and also by unfavourable weather conditions. Much attention has been given to most of the agents that cause crop losses with the possible exception of vertebrates of which comparatively little is known (Fall *et al.*, 1973). Most biological work on the ecology of mammals has tended to concentrate on

large prominent species. However, smaller mammals, such as rodents, are of considerable importance both as components of the natural ecosystem and as agricultural pests (Rosevear, 1949, 1950a, 1950b, 1950c; Taylor, 1961) Everard, 1966a, 1966b, 1968; Funmilayo, 1973; Key, 1985, 1990) and also as vectors of several diseases (Bellier, 1973). Funmilayo (1973) compiled a list of 'nuisance' vertebrates of major agricultural importance in south western Nigeria as a supplement to the notable works of Ellerman (1940, 1941, 1949), Rosevear (1969), Walker (1964) and Everard (1966a, 1966b, 1966c). The list includes several species of rodents, primates, ungulates and birds. Losses of rice due to birds and cane-rat (*Thryonomys swinderianus* Temminck) are estimated at 40% in south-western Nigeria (Funmilayo and Akande, 1977). The same authors estimated the frequency of damage by vertebrates to cassava to be about 40% of all surveyed fields.

Though the magnitude of crop losses due to vertebrate pests has not been adequately measured for most crops including cassava, they are recognised to be substantial for cereals, especially rice, and also for sugar cane, coconut, oil palm and cocoa (Rosevear, 1949, 1950a, 1950b, 1950c, 1969; Clark, 1958; Bates, 1960, 1969; Collado and Ruano, 1962; Hingorani, 1967; Lopez, 1968; Wood, 1971; Taylor, 1972, 1989; Hopf *et al.*, 1976; Funmilayo and Akande, 1977; Jackson, 1977; De Grazio, 1978). An important aspect of the vertebrate pest problems in Africa is that most species are important as a valuable source of consumable protein (Barnett and Prakash, 1976; Shafi, 1986). For instance cane rat or "grass cutters", a large rodent related to porcupines, is hunted for meat which is considered a delicacy and may sell at a price well above beef, mutton or pork (Asibey, 1974; Anadu *et al.*, 1988). In West Africa in particular, this rodent is hunted both as a source of food and income and to minimise damage to crops (Anonymous, 1976, 1985; Kyle, 1987). In areas where some species of the large rodents, especially the Giant African Rat (*Cricetomys gambianus* Waterhouse), are not used as a food source, damage to crops has exceeded 80% (Anonymous, 1976).

This paper discusses the most important vertebrate pests of cassava and their control in

Africa using information from available literature and farmer interviews.

DISTRIBUTION AND ORIGIN OF VERTEBRATE PEST SPECIES

The distribution of vertebrate pests is closely related to the environment and ecological factors, mainly climate, vegetation and the availability of their natural food (Fall *et al.*, 1993). Most vertebrate pest species in Africa are indigenous with the exception of some rat species (Rosevear, 1969; Taylor, 1972; Funmilayo, 1973; Jackson, 1977; Shafi, 1986, 1988). Vertebrates that dwell in dense grasses are more abundant in the savanna than in the rain forest, while arboreal vertebrates are more abundant in the rain forest.

The structure of the vegetation provides fossorial (burrowing), terrestrial (land-living) and arboreal (tree-climbing) habitats for animals. All three types of habitat occur and are occupied by vertebrates in the rain forest e.g. rodents such as "grass cutters", and several mouse-like rodents, primates and ungulates. Arboreal species are few or almost absent in the savanna grassland, except in the "forest outliers" or transitional areas. Swampy areas with vegetation (mangrove swamps) support primates including monkeys and baboon (Funmilayo, 1973; Funmilayo and Akande, 1977). The three world-wide commensal rodents (*Rattus rattus* L., *R. norvegicus* Berk. and *Mus musculus* L.) are closely associated with humans in houses and fields. Some savanna or forest dwelling rats may enter houses as transient visitors in search of food and occasionally squirrels and dormice may nest or live in the roofs of houses, especially when there are adjacent trees and shrubs (Everard, 1966a).

Cane rats and the giant African rat which are important pests of cassava are found in both savanna and rain forest zones of tropical Africa. The cane rat lives in thick vegetation and low dense weeds (e.g. *Aspilia* sp.) near water (Funmilayo, 1973). The giant African rat and most small rodents are fossorial. An example is the red-legged ground squirrel (*Xerus erythropus* Geoffrey) which usually lives singly in simple tunnels which have one entrance and one exit (Funmilayo and Akande, 1977). The most important vertebrate pest of cassava is considered

to be the cane rat and a large group can completely destroy an entire crop in a single visit.

Bush fowl, (*Francolinus bicalcaratus* L. and several other species), occur in open-land shrubs of both savanna and forest ecologies. These birds are the main avian pests of cassava. They are poor fliers but good runners. They usually feed in early morning and late afternoon.

IDENTIFICATION/DIAGNOSTIC FEATURES; DAMAGE SYMPTOMS AND STATUS OF PESTS

Due to the paucity of information about vertebrate pests, there is very little or no indication of the damage they cause or how widely it occurs. The general nocturnal and secretive habits of most vertebrates, especially the bigger rodents, and their mobility make it difficult to observe them causing damage to crops. Circumstantial evidence can be gathered by setting traps in fields where damage occurs, but such evidence must be treated cautiously since several species may live in the crop but not all cause damage (Taylor, 1972, 1975).

Indirect clues can be used to identify a vertebrate pest that is causing damage. The size of teeth/gnaw marks and height of damage on the crop can indicate whether a rodent, primate or an ungulate (bush pig, hog etc.) is involved. Signs of damage to the crop may be obvious, but often they are not. It may be necessary to make a detailed examination of a representative sample of individual plants in the field to determine vertebrate damage. Descriptions of mammalian pest species are given by Rosevear (1949, 1950a, 1950b, 1950c, 1969) and Booth (1960), while information on the external morphology of avian pest species is given by Bannerman (1930-1951) and Elgood (1960).

Indirect clues or diagnostic features to seek in a survey of vertebrate pest infestations include nests, burrows, runways and faeces for rodents and footprints for larger vertebrates (primates and ungulates).

Funmilayo and Akande (1977) identified vertebrate pest species directly from visual observations, trapping records, stomach content analysis, and indirectly from patterns of damage, teeth marks, faecal droppings, feet impressions

and dropped feathers. Dropped feathers and feet impressions were useful in establishing the presence of birds, particularly bush fowl, while teeth mark damage patterns and faecal droppings confirmed the occurrence of cane rats. Daily observations can only be useful to differentiate between damage caused by diurnal birds and ground squirrels. Characteristically, cane rats feed in all parts of their habitat where food is available. In all cases of cane rat damage, runways made mainly by pushing the vegetation apart and by cutting a few obstructing weeds and grasses may be observed. Thus traces of runways quickly disappear, except for the chopped plants and faecal droppings which persist for some time. Characteristic faecal pellets, usually oblong in shape and consisting of fibrous loosely packed indigestible remains, are left behind in areas where damage by cane rats occurs. In cassava fields, cut stems are chopped into bits, and partly dug and eaten roots with teeth marks are usually visible at feeding sites or platforms together with a lot of faecal droppings. Other rodents, notably the giant African rat and ground squirrels damage root crops, especially cassava, but losses are insignificant because the volume of crop per unit area is relatively high and a corresponding and unnaturally high density of rodents would be necessary to make a significant impact (Taylor, 1989). The smaller rodents, especially the Nile harsh-furred rat, (*Arvicanthis niloticus* Desmarest) also cause damage. They make distinctive runways which consist of neatly cut narrow paths through the bush. They do not always leave faecal pellets at feeding sites but if they do, the pellets are usually small and inconspicuous. Many estimates of damage to crops and stored food by vertebrates (especially rodents) may be found in vertebrate control literature. The majority of such estimates are unacceptable or are at least of highly questionable validity as they are to a greater or lesser extent guesses (Wood, 1971). Numerical estimates of damage by species of vertebrates presented as assertions and without supporting evidence are especially likely to be spurious.

CONTROL MEASURES

Large vertebrates do not usually pose very serious problems because they are routinely trapped and

hunted for food, thereby reducing their numbers to levels at which their activities are not very obvious. Small rodents, by contrast, are not usually hunted or trapped for food and often become serious pests, especially in food stores. Control can be by indirect or direct methods and is influenced by the importance of the large and small rodents as source of food.

Direct control is by using poisonous baits. This method can be applied in certain crop situations where the numbers of the pest species, especially rodents, become unacceptable and where they are not used as an important food source. The method is best applied to small rodents and is recommended only under the efficient supervision of qualified personnel. All animals killed by baits must be buried instantly to prevent poisoning of non-pest species that may feed on them.

Indirect control suppresses vertebrates through habitat management and their use for food. This approach poses no danger to man or the environment. The following recommendations should be considered when combating vertebrates, especially rodents:

Cultural Practices

Habitat management. Breeding populations of rodent pests which can affect the next crop cycle survive non-crop periods in adjacent waste areas containing vegetation and crop residues. Simple husbandry practices such as field sanitation, clearing of farm borders and removal of potential nest sites, continuous inspection of farms to identify and check damage and prompt harvesting can eliminate many rodent and other vertebrate pest problems.

Organised hunting and trapping for food.

Farmers and hunters trap or shoot offending animals primarily for food rather than to control crop pests. Hunting rats, for example by gangs of hunters and dogs, may be employed but these are not usually effective. Small snap-traps and large leg-holding traps are used by local farmers for killing rodents, bush fowl and larger vertebrates. Several types of snares made from twine, thread, steel or aluminum wire are used to kill small rodents, squirrels, giant rats, cane rats, primates

and ungulates. Everard (1986) provides an illustrated description of some of these snares.

Fencing of plots and snaring and/or scaring.

Use of physical barriers such as 2.5 cm mesh chicken wire is a preventative measure against most vertebrates including domestic animals such as goats, sheep, cattle and fowls where the fields are near settlements. Scarers ("scare-crows" resembling a man) are also employed to keep away vertebrate pests.

Flushing, smoking of holes and destruction of burrows.

Most fossorial rodents are flushed out of their burrows by hunters and farmers mainly for food purposes. Smoke generated from fires set at the entrance of burrows and blown into them is widely used to kill the giant rat and other mouse-like rodents. Artificial flooding of burrows with irrigation water at dam sites can also flush out most rodents. Digging or ploughing drives out rodents from their burrows to be killed by dogs and hunters.

Chemical Control

Rats are so loathed by man that few communities object to poisoning as a control measure. This method is seldomly applicable to other vertebrate pests and is little used by cassava farmers in Africa.

The acute rodenticide Zinc phosphide.

This chemical is used against rats in many countries. It is very useful for obtaining a rapid decrease of an initial high rat population. It is effective against both urban and field rodents. However, careless exposure of baits can be lethal to domestic poultry and, since the compound is highly toxic to all forms of animals including man, great care must be exercised in its use. According to Taylor (1968) efforts to control an outbreak of *Mastomys*, *Arvicanthis* and *Rhodomys* in Kenya by placement of maize meal containing 3% zinc phosphide at 5 metre intervals around the edges of wheat fields gave a kill of about 93%, whereas continuous baiting with warfarin at 500 ppm for 10 days had little effect. Eighty percent of the farmers who were questioned about the efficacy

of the baiting were satisfied with the results and only 11% stated that damage continued to occur in patches.

Second generation anticoagulants e.g. (Brodifacoum or Klerat). These chemicals are potent anticoagulant rodenticides that are effective against all field and commensal rats, including those resistant to first generation anticoagulants (Warfarin). Rodents die several days after a single feed on a small quantity of "Klerat" bait (5g). This is particularly advantageous where rodents will not readily take bait. Klerat does not cause bait 'shyness' and pre-baiting with non-toxic food is not necessary. It is a single-dose rodenticide which results in substantial savings in bait and labour for application. Like other anticoagulants "Klerat" acts by reducing the ability of blood to clot and death occurs a few days after ingesting a lethal dose. Exposure to rain will not spoil the wax blocks containing poison and this is an advantage over other formulations which usually deteriorate.

Use of fumigants e.g. aluminium phosphide (Phostoxin). This is recommended for burrow fumigation. Some rodent species are difficult to attract to bait placed on the surface of the ground because they feed in their burrows or forage very widely and unpredictably. In such situations control is only possible with fumigants. Phostoxin generates gas when it comes into contact with moisture in the atmosphere leading to hydrolysis and production of phosphine gas. This gas is poisonous to all mammals and in particular to rats. It is only effective as a rodent control measure if all the open burrow mouths are sealed and if the soil is neither highly porous nor very dry.

Use of narcotics (alpha-chloralose) to control bush fowl. As described by Funmilayo (1973), experimental attempts were made at Ilora Research Station in Nigeria to control bush fowl with a narcotic (alpha-chloralose). The narcotic mixed with whole or ground maize in the proportion 1:20 and placed in the field was expected to put bush fowls which took the bait into deep sleep so that they could be picked up. However, the bush fowls developed bait-shyness and soon refused to eat the narcotic bait.

Biological Control and Integrated Management. Attempts to use such biocontrol agents as pathogens or predators including domestic cats in the control of vertebrates, specifically rodents, have not been particularly successful (Wodzicki, 1973). Although further research may bring improvement, this method is not currently recommended. In the past, several carnivorous species have been introduced to islands where rats or other mammals were troublesome. For example, stoats, weasels and ferrets were introduced to New Zealand (Wodzicki, 1950) and mongooses to Hawaii, Fiji, and Caribbean islands (Hinton and Dunn, 1967). There are few cases where introduced predators have proved successful in controlling mammalian pests and often more harm than good has come of the introduction. Howard (1967) concludes that at best, predators act only on the 'symptom' of most vertebrate pest problems and cannot treat the underlying 'disease', which is the condition of the habitat. Other vertebrate biological control agents have been sought, chiefly pathogens. Efforts to infect rats with pathogenic bacteria were made in several countries including Mauritius at the end of the 19th century, but were unsuccessful as many of the bacterial strains used were inadequately characterised and possibly pathogenic to man. These efforts were abandoned when anti-coagulant poisons became available for rat control. Knowledge on rodent pheromones is limited and the possibilities of using such substances in biological control remains speculative. See Bronson (1971), and Eisenberg and Kleiman (1972) for reviews on pheromones of rodents.

CONCLUSION

At this stage of our knowledge and the limitation imposed by the sparse literature available on vertebrate pests, it is not possible to set out simple instructions for their control under different cropping patterns. More data are required on the species involved, their behaviour, ecology, biology and further evaluation is needed of various kinds of field and laboratory control trials. Meanwhile, large-scale control of vertebrate pests has been and still is based mainly on poison baiting. However, the capacity of most vertebrates,

especially rodents, to adapt to poisoning techniques makes it improbable that any one chemical method will succeed for an indefinitely prolonged period.

It is advocated that even where vertebrate pests are being controlled successfully by poisons, the search for other methods of control should be maintained and basic research should be pursued rather than merely applying established poisoning techniques. Much experience has emphasised the difficulty in applying biological control techniques developed for use with invertebrates which have a predictable stereotyped behaviour, to vertebrates which have the ability to adapt their behaviour to new circumstances and to learn from experience. In any case it seems likely that, in many instances, existing techniques of poison baiting if integrated with environmental manipulation or habitat management offer great promise for controlling vertebrate pests. From the view point of predation, the objectives of an integrated control programme will be to increase the vulnerability of vertebrate pests. Increased diversity can be obtained by increasing the heterogeneity of the environment with increased alternative food possibilities for introduced predators.

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