TRADITIONAL APPROACHES FOR PROTECTING CEREAL CROPS FROM BIRDS IN AFRICA

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ABSTRACT: Despite the recent emphasis in Africa by national and regional plant protection organizations to control pest birds, traditional farmers usually are still left to their own initiative, as they have been for centuries, to protect their crops. These farmers employ many ingenious visual and oratory frightening techniques, barriers, agronomic planting or harvesting modifications, and bird population-suppression methods. Under some circumstances these methods can reduce damage. However, their effectiveness is subject to such variables as the season of the year, the type and maturation stage of the crop, the pest species and its abundance, the size and ownership of the field, and the diligence and enthusiasm of the bird scarers. The inability of farmers to consistently and successfully protect their crops from birds encourages feelings of frustration, and often leads to their abandoning farming. Clearly practical, economical, and applicable solutions are needed by traditional farmers if future food production goals are going to be met. Research and extension can provide these solutions.

INTRODUCTION

Bird damage to cereal crops has been a chronic problem to African farmers for centuries. Damage caused by the red-billed quelea (Quelea quelea) was noted by early Portuguese explorers and began to cause official concern in the 1980s (Anon. 1975). International attention in the form of bilateral and multilateral assistance programs to governments began in the late 1940s and early 1950s as bird pests began threatening the continent's many new, large-scale grain production schemes. The goals of many countries for meeting their population's food requirements increasingly are dependent on these large, often mechanized schemes. However, with the emphasis since the late 1960s and early 1970s by national and regional plant protection organizations on trying to protect these production centers, the traditional farmers, for priority and logistical reasons, usually have been left to their own initiative to protect their crops. This is unfortunate, because traditional farming is still the mainstay of agricultural production in many developing countries.

Farmers rely on numerous innovative techniques intended to frighten birds. Many of the techniques frequently are mentioned in discussions of African bird pest problems (Park 1974, Funmilayo and Akande 1979), but only with general comments concerning their effectiveness. The purpose of our paper is to describe and document the effectiveness of methods used by traditional, subsistence farmers in Africa to protect their cereal crops from bird pests.

METHODS

We evaluated traditional crop protection methods in Africa between 1974 and 1981. Additional information was obtained from discussions with farmers and government plant protection personnel during the course of crop loss evaluations and as part of crop protection trials. The effectiveness of the particular techniques was based primarily on objective assessments of cereal losses at or near harvest (Anon. 1980a, Bruggers and Ruelle 1981), supplemented by subjective appraisals of the performance of the scarers. Observations were made on the pest birds that attacked the cereal crops. The literature on traditional crop protection methods, much of which exists in unpublished reports, also was summarized.

RESULTS AND DISCUSSION

Two general approaches are used in African countries to reduce cereal losses to birds: population-suppression techniques including aerial and terrestrial avicidal applications, explosives, and manual nest destruction; and crop-protection techniques including bird scarers, chemical repellents, protective nets, and agricultural practice modifications (Table 1). Avicidal applications and explosives techniques are employed by national or regional crop protection units, traditional nest destruction and bird-scaring methods by individual farmers, and repellents, nets, and agricultural modification methods, experimentally (at least initially) by research scientists.

Within these categories, farmers in different parts of Africa have developed ingenious methods for dissuading pest birds from their fields. These traditional methods include many visual or oratory frightening or scaring techniques (vocalizations, rattles, whip-cracking, slings, flags, shooting) (Figs. 1-3), barriers (cloth or natural vegetation covers for ripening heads) (Fig. 4), agronomic planting or harvesting modifications (crop calendar changes, less susceptible varieties), and bird population suppression (nest destruction, nestling removal, poison baiting).

Bird Scaring Methods

Under many circumstances, bird scarers can reduce damage. Bird scarers usually are positioned in the middle of a field, often on a platform from where they shout, throw rocks or plant stems, and crack whips or rattle cans as birds enter the field. Noise-making objects (cans or calabas gourds) often are attached to lines of cord stretching from this central location throughout the field. By tugging on the cord, a scarer can cover a larger area. In Gambia during 1979, damage averaged only

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Table 1. Approaches used by African countries to alleviate bird damage to ripening cereals (Table reproduced but revised from Anon. 1980a).

Countries	Principal cereal	Population reduction: Aerial/ terrestrial avicide	Population reduction: Explosives	Population reduction: Nest destruction	Crop protection: Bird scarers	Crop protection: Repellents, nets, agronomic
North Africa	wheat					
Morocco		+		+	+	
Tunesia			+	+	+	
Lybia				+	+	(+)*
Egypt		+		+	+	
Sahel	sorghum/millet					
Mali		+	+	+	+	
Upper Volta			+		+	
Niger			+	+	+	
Chad			+	+	+	(+)
Tanzania		+	+		+	(+)
Ethiopia		+			+	(+)
Senegal		+	+		+	(+)
Gambia					+	(+)
Mauritania		+	+		+	
Sudan		+		+	+	(+)
Somalia		+			+	(+)
Nigeria		+		+	+	
Cameroon		+		+	+	(+)
Uganda				+	+	+
West Africa	rice					
Guinea					+	(+)
Sierra Leone					+	
Liberia					+	(+)
Ivory coast					+	
East Africa	maize					
Kenya		+	+	+	+	(+)
Zambia		+			+	
Malawi					+	
Swaziland		(+)	+		+	
Lesotho					+	
Botswana					+	
Ghana					+	(+)
Benin					+	(+)
Togo					+	
Central African Republic					+	

*Parentheses indicate experimental use.

2.9% in a field of millet in which a network of rattles was used to scare birds. Contrastingly, damage in a similar size plot without rattles was 10.6%. Losses ranged from 17% to 38% in five other fields on the farm in which no bird scaring occurred (Gambia Crop Protection Service, personal communication). DaCamara-Smeets and Manikowski (1975) observed differences of 4% and 35% between guarded and nonguarded sorghum fields in Chad. Similar observations were noted on rice in Chad and Benin (Bortoli, personal observation); damage was invariably less in guarded than unguarded fields. However, the success of the traditional methods, particularly scaring or frightening techniques, is subject to many variables, including the time of year, type and stage of the crop, pest species and its abundance, size and ownership of the field, and diligence of the bird scarers.

Time of year. It is much more difficult to frighten birds from dry-season irrigated crops than wet-season crops. Areas under dry-season irrigated cultivation often provide the only seed (both cultivated and wild) and water in a region and, therefore, act as "oases" to birds. In the middle Senegal River Valley, a complex of several bird species composed mainly of black-headed weavers (Ploceus melanocephalus) and golden sparrows (Passer luteus), caused >5% damage to irrigated rice each dry season compared to <1% in the main cropping season of October/November. During 1977 in Senegal, several species of birds completely destroyed an 0.04-ha field of millet before it reached the milk stage (Bruggers 1979). In Chad, bird damage also is heaviest during the dry season to irrigated and flood-recession crops (DaCamara-Smeets 1978). However, wet-season crops adjacent to large nesting colonies of quelea can be just as heavily damaged by the fledglings. In Sudan, these fledglings are termed "deaf ones" because they do not respond to the efforts of the scarers.

Type and stage of crop. In Nigeria, quelea, the most abundant bird pest in Africa, are reported to prefer small seed (Ward 1965). In cage studies, seeds of 8-15 mg have been preferred (Manikowski

Fig. 1. Many farmers rely on noise-making devices such as calabas gourd rattles which are positioned throughout a field to frighten birds.

Fig. 2. Bird Scarers often "crack" whips of leather or cord to frighten birds.

Fig. 3. Windblown noise-making devices can discourage both preharvest and postharvest losses to birds.

Fig. 4. Grass, leaves, and cloth frequently are used to cover sorghum heads against bird damage.

and DaCamara-Smeets 1979), which correspond to the size of millet, rice, and sorghum. Millet and rice often are the most severely attacked cereals and are eaten throughout their maturation period (milk to hard-dough stages). Sorghum, which is the primary crop with millet in the Sahelian countries (the range of quelea), often is heavily damaged, but usually during the early stages (milk and soft-dough) when it is squeezed from between the glumes. In both Nigeria (Ward 1965) and Ethiopia (Erickson 1979), cultivated grains, particularly sorghum, are important food items of quelea.

Pest species and abundance. Small cereal grains also are eaten by other species of pest birds, many of which weigh only 12-20 g, and often are extremely numerous. These species include quelea, sparrows, bishops (Euplectes spp.), Ploceus weavers, and mannikins (Lonchura spp.). Damage to maize, which has a larger grain and a protective husk is, however, almost entirely caused by village weavers (Ploceus cucullatus), buffalo weavers (Bubalornis albirostris), starlings (Lamprotornis spp.), doves (Streptopelia spp.), and long-tailed parakeets (Psittacula krameri). Pest populations of these species are smaller and more dispersed so that damage attributed strictly to them seldom exceeds >5% on large schemes.

Field size, ownership, enthusiasm. Although it is difficult to objectively document the effectiveness of bird scarers because of differences in the number of scarers/ha and their age and enthusiasm, it generally is recognized that traditional scaring methods are more effective on small, privately-owned fields than on large, agricultural schemes or research stations. This was particularly evident in Somalia, Tanzania, Senegal, and Cameroon. In Somalia, damage was significantly greater to crops in the nonprivate than private sector (Table 2). Also, in Tanzania during 1978 and Somalia during 1979, one to four bird scarers/ha at government and research farms were unable to prevent less than 60% and 90% damage to wheat and rice, respectively (Mmari, personal communication; Bruggers 1980). In Senegal during 1975, 38% losses occurred in a 2-ha research field of seed multiplication rice despite the efforts of 32 man-hours/day of bird scarers costing US $350/ha; an unguarded 2-ha plot in the scheme

Table 2. Comparison of bird damage to ripening cereals on nonprivate (government schemes and research centers) and private (traditional) farms in Somalia and Senegal. Data collected between 1975 and 1981.

		Nonprivate		Private	
Country	Crop	No. fields	Avg. % damage	No. fields	Avg. % damage
Somalia					
	sorghum	16	25	66	9
	rice	14	27	0	0
	maize	5	30	10	2

had a nearly identical 43% damage. In Cameroon, the costs of hiring people for 2 months to scare birds at rice production schemes and experimental farms of 0.5 ha to 700 ha ranged from $65/month/ha to $175/month/ha. Losses on these farms ranged from 0 to 15% and occasionally rose as high as 80%. Yields of 2 tons/ha (range 1.8-4.0 tons/ha) valued at $237/ton of paddy (DaCamara-Smeets and Affoyon 1980) generally were achieved. In Somalia, these costs at Government schemes were as great as $750/ha (Bruggers 1980). In general, the cost of guards at research stations and government schemes often ranges between $800 and $1,600/ha (Dome, West African Rice Development Association, personal communication), because these stations must pay minimum government wages to the scarers.

It appears that the area which can be most efficiently protected by one bird scarer is between 0.5 ha and 0.75 ha, although the age and enthusiasm of the bird scarers greatly influences their success. In Chad, an elderly farmer and his daughter suffered 30% loss to a 1-ha wheatfield while an adjacent 1-ha field protected by five active guards lost $\leq$5% (Park 1974). Costs generally prohibit hiring a comparable number of adult guards (two or three per ha) as used on private farms to protect larger schemes. Jaeger (personal communication), however, has observed many heavily guarded national and private fields completely destroyed by quelea in Ethiopia. Children often are hired since they are less expensive. In Benin during the mid-1970s, the cost of five children and one supervisor was approximately $70/ha.

In most countries, part of the harvest is retained by the farmer for food and seed; the rest usually is sold to the government. The enthusiasm and diligence of the farmer is, therefore, often related to the market value of his crop. In Somalia during 1979, farmers stopped protecting their fields when they found they could obtain a greater profit by privately selling the stalks as fodder rather than by selling the grain to the government; scaring birds all day for 30 days became unnecessary. Pepper (1973), studying traditional crop protection in Chad, concluded that well-conducted guarding can be effective, but that fields guarded by disinterested parties were more heavily damaged than fields guarded by their owners (irrespective of the number of birds), and that damage was greater along edges of fields with peripheral vegetation. In sorghum fields in northern Senegal, damage to 596 and 2,956 heads sampled from edges and interiors of 18 fields averaged 18% and 11%, respectively. Interestingly, most guards recognize the limitations of their activities and do not attribute any failure to themselves; damage to a guarded field is inevitable!

A variation of the scaring methods that has been practiced in the Senegal River Valley involves frightening birds from their dry-season roosting sites at night (Busnel and Grosmaire 1958). Between January and March, 1,000 to 3,000 villagers make noise continuously throughout the night, using noise-making devices such as tambourines, drums, and cans, so as not to allow the birds to rest. Near dawn, gunpowder explosions are set off causing the birds to depart, with the hope that they will not return. The effectiveness apparently depends on the number of villagers involved and the intensity of their noises. Participation is an obligatory social duty, punishable by fines. The technique is still being practiced against night roosts of golden sparrows in the absence of national control operations.

Covering Heads

Another traditional method used in several African countries involves covering the individual ripening heads with cloth, grass, or leaves. In Senegal, nearly all heads of flood-recession sorghum along vast distances (several kilometers) of the Senegal River Valley are regularly covered by the villagers with grasses, sorghum leaves, or cloth. These covers provide nearly complete protection to the heads. During 1975, only 2% of the covered heads in several transects were attacked with only 1-5% loss per head; 33% of the uncovered heads were attacked with losses ranging from 5% to 90%. Similar damage patterns on 81 heads were observed in 1981; 53% of the covered heads were attacked and sustained 10.8% loss, whereas 62% of the uncovered heads attacked were suffering 17.6% losses. In another field, damage to covered heads was 5.7% compared to 10.9% for uncovered heads. The method was introduced to several farmers in Somalia in 1979. Although no bird damage occurred to cloth-covered heads of sorghum, insect and mold damage ranged from 2% to 37% on the covered heads. However, bird damage to the rest of the fields ranged from 10% to 85% (Bruggers 1980).

In Chad, a novel variation of the method is used. Villagers weave grass sheaths into which millet heads are inserted (Park 1974). Although this is more time-consuming, the sheaths can be removed and reused on several heads since maturation of the millet is nonhomogeneous.

Nest Destruction

In Senegal, during the early 1960s, nest destruction by flamethrowers was considered the only practical method of controlling quelea. Individual backpacks and vehicle-mounted flamethrowers were developed by a control organization (Mallamaire 1961). In addition, farmers were paid for any eggs or nestlings that they collected. Setting fire to nesting colonies in dry river beds has been practiced in Chad, and flamethrowers also were used in Morocco (Bachkiroff 1953). Government organizations have discontinued using the method due to cost, limited application, and a preference for aerially applied avicide sprays. However, manual destruction of nests by villagers is widely practiced, economical, and efficient in terms of crop protection. It can be particularly effective when nesting colonies threaten nearby cereals. Nests need to be destroyed during the latter stages of incubation to ensure that the birds do not renest, as they often do if the colony is destroyed during laying period.

Nest destruction is accomplished by cutting the trees or support vegetation or by removing the nests or nestlings (as is practiced in Mali) of quelea nesting in sugarcane, where the nestlings often are used as a food source. However, nest removal can be very tedious and impractical in large quelea colonies established in dense Acacia thornbush, which typically can cover 100 ha and comprise over a million birds. Likewise, tree cutting can contribute to desertification in the Sahel region where regrowth of woody vegetation is slow. Nevertheless, nest destruction has been encouraged in Benin and Gambia in recent years against red-headed quelea (Quelea erythrops) and village weavers. However, no data have been collected to evaluate the relationship of nest destruction to the population level of the pest birds or the reduction in damage to cereals.

The efficacy of nest destruction operations depends on the species of bird and the species of tree in which it is nesting. About 125 nests/h (equivalent to 2 ha) were removed in a 300- to 600-ha colony of golden sparrows nesting in Balanites aegyptiaca by one individual using a 4-m long pole (an average cost of $0.30/ha). After 1 week only six nestlings were found per 100 nests in the destroyed part of the nesting colonies; 68 nestlings per 100 nests were found in the rest of the colony. A team of 25-50 villagers could eliminate the colony in 1-2 days.

In Mauritania during 1979, 500 nests/ha of red-billed quelea could be destroyed by one individual when the birds nested in Acacia senegal (an average cost of $30/ha), but only 100-200 nests/ha were dislodged when the colony was situated over water in Parkinsonia spp. The technique is undoubtedly more practical for the less dense, more dispersed colonies of golden sparrows. However, in the large, dense quelea colonies, the task of removing nests is immense. Nest removal was attempted on such a quelea colony in Somalia during 1979, and although several thousand nests were removed, everyone gave up in frustration at the magnitude of the task after a couple days (Ash, personal communication).

Agronomic Technique

Agronomic techniques such as using less susceptible varieties (Jackson 1971a, 1971b), and wide planting dates including staggering or intercropping, also are practiced by traditional farmers to reduce losses to birds. Although damage may occur, it usually does not result in disaster in these situations. Farmers are very aware of differences in damage levels related to varietal differences and plant breeders are continuing to investigate improved varieties (Bullard 1979, Bullard and Elias 1980). In Kenya, a "mombassa" variety is widely planted and incurs less damage than other varieties (Pinto, personal communication). In Ethiopia, varieties with high tannin content often are planted around the more preferred varieties (Jaeger, personal communication). Similar cropping combinations

are used in the Senegal River Valley. Less damage occurred to high tannin (red) varieties (5% and 9% in two fields), than to the preferred (white) varieties (33% and 18% in two fields) in this river valley during 1976 (Bortoli and Bruggers 1976). However, when "less susceptible" varieties with characteristics like loose and pendant heads, large glumes, awns, and astringent tastes (Doggett 1957) are planted in areas of high bird pressure and little alternate food, they usually are heavily damaged.

FUTURE TRENDS AND CONCLUSIONS

Improving the effectiveness of traditional methods of crop protection has been neglected in most bird damage control efforts in Africa. The seriousness of the problem to many farmers, and their inability to consistently and successfully resolve it, generates feelings of frustration and helplessness, and often leads to their abandoning farming. Presently, governments of African countries are beginning to encourage the improvement of traditional crop protection approaches to help meet their food production goals. Nonetheless, many farmers have found that it is easier and it requires less manpower and effort to raise a crop simply by cultivating additional land for birds. Farmers are beginning to cultivate larger surfaces than necessary to compensate for the "unavoidable" bird damage.

Clearly practical, economical, and applicable solutions are needed by traditional farmers. These solutions most likely will come from increased knowledge of the behavior of the pest species (Anon. 1980b), and from the modification and extension of recently investigated methods such as chemical repellents (Bruggers et al. 1981), nets (Bruggers and Ruelle 1982), nest dislodging, partial poisoning of buffer crops (Ruelle 1982), poisoned baits, improved agricultural practices, crop phenology changes (Elliott 1979), and less susceptible varieties (Bullard and Elias 1980). Under the supervision of extension agents, enthusiastic farmers can become acquainted with the safe use of these newer methods which should lead to increased production.

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