Crop Protection 116 (2019) 15–23

Contents lists available at ScienceDirect

Crop Protection

journal homepage: www.elsevier.com/locate/cropro

A review of alternatives to fenthion for quelea bird control

Robert A. Cheke[a,*], Mohamed El Hady Sidatt[b]

[a] Natural Resources Institute, University of Greenwich at Medway, Central Avenue, Chatham Maritime, Chatham, Kent, ME4 4TB, UK
[b] Secretariat of the Rotterdam Convention, Plant Production and Protection Division (AGP Food and Agriculture Organization of the United Nations (FAO), Viale delle Terme di Caracalla, 00153, Rome, Italy

ARTICLE INFO

Keywords:
Red-billed quelea
Quelea quelea
Fenthion
Fire-bombs
Integrated pest management

ABSTRACT

The red-billed quelea (*Quelea quelea*) is the most important avian pest of small grain crops in semi-arid zones of Africa. Fenthion, an organophosphate, is the main avicide used for controlling the pest but it is highly toxic to non-target organisms. The only readily available pesticide that could replace fenthion is cyanophos, but this chemical is also highly toxic to non-target organisms, although less so than fenthion, and may be more expensive; however, more research on its environmental impacts is needed. Apart from chemical avicides, the only rapid technique to reduce the numbers of quelea substantially is the use of explosives combined with fuel to create fire-bombs but these also have negative effects on the environment, can be dangerous and have associated security issues. The technique is labour intensive and in practice can only be deployed against small (< 5 ha) colonies and roosts. An integrated pest management (IPM) approach is the most environmentally benign strategy but, apart from when circumstances permit cultural control measures, most IPM activities only have realistic chances of succeeding in controlling quelea in small (< 10 ha) areas. For instance, mass-trapping, which also has the advantage of providing a food source, is suitable when quelea roosts and colonies are less than 5 and 10 hectares in area, respectively. Nevertheless with both traps and mist nets, care is needed to minimise non-target casualties. Other IPM measures are also reviewed and the advantages and disadvantages of different methods tabulated. A related figure provides a decision tree for choosing appropriate measures for different circumstances. If fenthion has to be used, means of minimising its use include ensuring that spraying is only conducted when crops are threatened and that the lowest dosages necessary are applied. Regular training of pest control workers in how to use equipment correctly and in what to do in the case of accidental contamination of operators, and training of farmers on IPM principles and quelea biology through farmer field schools are recommended.

1. Introduction

The red-billed quelea (*Quelea quelea* Linnaeus) is the most important avian pest of small grain crops in Africa, causing damage up to the equivalent of US$ 88.6 million per annum at 2018 prices throughout semi-arid zones (Elliott, 1989a; b). At present, control is mostly by aerial and/or ground-spraying of organophosphate avicides, with fenthion (Queletox®) being the pesticide of choice. As the red-billed quelea is recognised as a migratory pest, such control is conducted by international agencies, Governments and commercial companies, although subsistence farmers can undertake other measures, included in this review, to reduce the birds' depredations. Regrettably, fenthion is toxic to humans and to other non-target organisms so alternatives to its use, reviewed here, are urgently sought. The red-billed quelea feeds principally on native grasses but when these are scarce the birds will attack the seed heads of crops. Principal amongst the latter are millet, sorghum, wheat, rice and teff. There are three subspecies of red-billed quelea: the nominate form *Q. q. quelea* occurs in West Africa from Senegal in the west to Sudan in the east; *Q. q. aethiopica* (Sundevall) ranges in East Africa from Ethiopia to southern Tanzania and *Q. q. lathamii* (Smith) is restricted to southern Africa (Cheke, 2014). All three of the subspecies are migrant pests which follow rainfall systems. As meteorological conditions vary from year to year, the locations and severity of quelea infestations also vary between seasons. In general, the birds breed 2 or 3 times a year, but up to 5 times per annum in East Africa, during and just after rainy seasons. Quelea coming from huge communal breeding colonies may attack crops. Damage also occurs in dry seasons when the birds continue to flock together and may roost in very high numbers. Both breeding colonies and roosts are the targets of control operations that take place after dark when the birds have settled

* Corresponding author.
E-mail address: r.a.cheke@greenwich.ac.uk (R.A. Cheke).

https://doi.org/10.1016/j.cropro.2018.10.005
Received 30 July 2018; Received in revised form 28 September 2018; Accepted 3 October 2018

Table 1
Summary information on alternatives to use of fenthion for quelea control.

Method	Application	Mode of action	Advantages	Disadvantages	Socio-economic issues
Chemical Methods					
Cyanophos	Spray	Lethal organophosphate avicide.	Less toxic than fenthion. Colonies and roosts of any size can be treated	High risk of environmental impacts. (Mullié et al., 1999; Cheke et al., 2013) Killing action takes longer than fenthion, so could lead to more secondary poisoning than fenthion. (Allan, 1997)	More expensive than fenthion. (Fenthion costs approx. US$10 per litre [www.yufull.com]). Requires trained personnel and expensive equipment, e.g. applied by Government personnel or international control agencies.
Alphachloralose	Narcotic added to bait grain or water (Garanito et al., 2000)	Immobilises birds.	Minimal pollution.	Risk to non-target birds. Requires birds to be found and killed. Only possible for small sites (< 5ha)	Labour intensive.
Mesurol (Bruggers, 1989)	Sprayed on seed heads of crops or applied as seed dressing.	Carbamate pesticide, active ingredient methiocarb. Repellent. Deters birds from crops. (Allan, 1997)		Risk to non-target birds and mammals. Highly toxic to aquatic fauna. Now not recommended for direct use on crops, only as seed dressing. Now banned by the EU.	Expensive. Approx. US$300 per litre. Labour intensive.
Mechanical Methods					
Explosions (Cheke et al., 2013)	Diesel/petrol-eum firebombs detonated beneath birds.	Lethal	No organophosphates or aircraft involved.	Risk to non-target birds and mammals. Petroleum product residues pollute soil. Vegetation damage. Fire and security risks. Only possible for small sites (< 5ha)	Expensive. Requires trained personnel and expensive equipment, e.g. applied by Government personnel.
Nest destruction and chick harvesting (Bashir, 1989; Jaeger and Elliott, 1989)	Human intervention with sticks on poles or flame throwers	Lethal	No pollution. Provides source of protein.	Labour intensive. Often possible only on small scale (colonies < 10ha) but see Pelham (1998).	Profits possible, if surplus chicks sold as food or livestock feed.
Trapping with Chad or basket traps or other trapping methods (Mullié, 2000; Mtobesya, 2012)	Human intervention with various trap designs.	Lethal	No pollution. Provides source of protein.	Labour intensive. Often possible only on small scale (areas < 10ha).	Profits possible, if surplus birds sold as food or livestock feed, e.g. annual value of US$50,000 to 100,000 in Chad (Mullié, 2000).
Trapping with mist nets (Elliott et al., 2014)	Human intervention with various trap designs.	Lethal	No pollution. Provides source of protein.	Labour intensive. Often possible only on small scale (areas < 10ha). Needs supervision to avoid non-target mortalities.	Profits possible, if surplus birds sold as food or livestock feed. Locally sourced nets at cost of only US$5 each.
Roost traps (Jarvis and La Grange, 1989; Allan, 1997; Mtobesya, 2012).	Planting of fodder crops to attract birds to roost, followed by spraying.	Lethal		High risk of environmental impacts. Possible only on small scale (areas < 10ha).	Loss of area where crops could be planted.
Cultural Methods					
Planting and harvest date manipulation (Elliott, 1979, Bullard and Gebrekhidan, 1989)	Planting of fast-maturing crop varieties or early harvesting to minimise risk of quelea at harvest.	Avoidance of quelea attacks on crops.	No pollution.	Not always possible. Requires knowledge of likely quelea movements into and out of cropped zone.	Agronomic advice needed.
	Planting of crops that are not susceptible to attacks.		Can be done on large scale	Alternative crops may not flourish in zone, especially in very arid areas.	
Netting crops (Elliott and Bright, 2007)	Covering crops with netting	Protective	No pollution.	Only on small scale. May just divert birds to crops with no netting present.	Expenditure on nets and poles or gantry to rig them on
Scaring by people (Bashir, 1989)	Farmers and their children scare birds	Birds frightened away from crops by waving and noise.	No pollution.	Labour intensive. Often possible only on small scale. May just divert birds to crops with no scarers present.	Prevents children attending school. Labour intensive.
Scaring with falcons (Gaemengwe, 2014)	Release of falcons near quelea flocks.	Birds frightened away from crops.	No pollution.	Requires trained birds and bird handlers. May just move quelea to fields where falcons not deployed.	So far only used by large scale commercial farmers not by subsistence farmers.
Biological Methods					
No successful biological control agents identified to date.					