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New challenges in schistosomiasis control in Morocco

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Abstract

Cases of schistosomiasis were first detected in 1914. However, there is strong evidence that it was prevailing in the southern part of Morocco long before then. As reported from different African countries, over the last three decades, the development of irrigation has led to the spread of the disease to the north and centre of the country. Thereafter, a national programme of schistosomiasis control was launched by the Ministry of Health in 1983. The programme was based on case detection and treatment, snail control using chemicals, and health education. It has succeeded in reducing the prevalence and intensity of infection to a level low enough to allow an elimination programme to be launched in 1994. The aim is to reach a complete elimination of the disease by the year 2004 in all provinces affected. Though substantial progress was made since the programme started, there is a potential risk of outbreaks in many affected provinces. Therefore, an integrated approach including measures against the intermediate host is needed to reach the goal of elimination. The present paper sheds some light on the features of schistosomiasis in Morocco and presents an evaluation of environmental methods of control of *Bulinus truncatus* in Tessaout Amont and Akka oasis irrigation schemes. The role of community involvement in planning and implementing environmental measures against the snail intermediate host in modern and traditional irrigation schemes is also discussed. © 2000 Published by Elsevier Science B.V.

Keywords: Schistosomiasis; Control; Environmental methods; Irrigation; Morocco

1. Introduction

Cases of urinary schistosomiasis in Morocco were first detected in 1914 in the Marrakech province (Doumenge et al., 1987). Thereafter, several focal studies reported the occurrence of schistosomiasis in the southern part of the country especially in oases along the pre-Saharan belt, including the valleys of Tafilalet, Draa and Souss.

The introduction of extensive irrigation to arid and semi-arid areas and upgrading of older irrigation schemes accelerated the spread of the disease to regions such as Nador (Kamri, 1975), Kelaa Sraghna (Laaziri and Benouna, 1982) and Beni Mellal (Camerlynck et al., 1974) where schistosomiasis was unknown before.

Different experiences in the field of environmental control of snails intermediate hosts of schistosomiasis in irrigated areas were reported. These included, increased water velocity (Jones, 1993), fluctuation of water level (Jobin, 1970; Ofoezie and Asaolu, 1997), periodic drying of

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canals (Pike, 1987) and removal of aquatic macrophytes and algae (Oomen et al., 1990). Preliminary studies of snail ecology and control in a modern and traditional irrigation scheme in Morocco led to promising results (Khallaayoune and Laamrani, 1992; Khallaayoune et al., 1998b). Thereafter, the present investigation was done both in a modern and a traditional irrigation schemes in order to come up with simple and feasible methods that could strengthen the programme of schistosomiasis elimination in Morocco.

2. Specific features of schistosomiasis transmission in Morocco

The only form of human schistosomiasis in Morocco is *Schistosoma haematobium*. Transmission of schistosomiasis takes place under diverse geographical, geological and socio-economical conditions. Snail habitats consist in ponds, reservoirs, puddles and trickles in oases in southern Morocco. *Bulinus truncatus* is also found in rivers and irrigation systems in the north and centre. Infection is mainly due to recreational activities and school age children are the most affected. However, cases of infection during irrigation and domestic activities are known among adult males and females (Ministry of Health, 1995). In most of the infected areas, transmission is focal and seasonal (Khallaayoune and Laamrani, 1992). The peak of transmission occurs in summer (May to September) when the highest density of snail intermediate host is recorded and the contact with cercariae infested water is highest.

3. The national programme of schistosomiasis control

Since 1982, the schistosomiasis control programme was integrated in the health system (Laaziri and Benouna, 1982) and started operating, in 1983 in all provinces where cases of schistosomiasis were reported. Annual mass surveys of case screening at schools and villages were organised in all foci and cases detected were treated. Parallel to this, regular selective case detection and treatment was done at health centres and villages. In addition to case screening and treatment, health education was done in schools and villages. Measures to control the snail intermediate host (*B. truncatus*) consisted of focal application of niclosamide.

After the start of the national programme of schistosomiasis control, the total number of cases detected annually declined from 10 653 in 1983 to 1108 in 1994 (Fig. 1). Thereafter, the number of cases decreased more slowly and tended to be stable over time. It was relatively easier to reduce the number of cases from thousands to a few

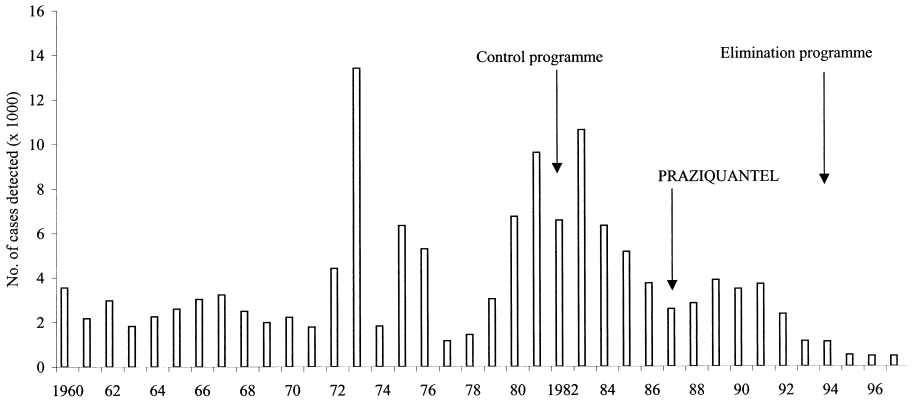

Fig. 1. Total number of cases of schistosomiasis before and after the operation of the National Programme of Schistosomiasis control (Ministry of Health, 1998).

Table 1
Indicators of achievement of the national control and elimination programmes (Source: Ministry of Health, 1998)

	1982	1994	1997
Population exposed	799284	519818	309425
Affected localities	477	210	97
Urine samples examined	105541	233711	149046
Annual Incidence /1000	8.2	2.1	1.5
Positivity rate (%)	6.2	0.5	0.3
Coverage (%)	13.2	45	48.2

hundreds, but apparently more effort is required to reach the break point, where transmission could be stopped. Results presented in Table 1 demonstrate the achievements of the national programme that led to the remarkable decrease in exposed population, the affected localities and the annual incidence (Ministry of Health, 1998).

The goal for the control programme shifted ultimately from transmission control to elimination in 1994. Significant progress towards the achievement of this goal has been made. Schistosomiasis is no longer a threat to public health. Nevertheless, it is reasonable to admit that the risk of outbreak remains and continuous surveillance is required more than ever before, considering the continued occurrence of cases of schistosomiasis in most of the affected provinces.

The relatively fewer cases detected reflect the success of the national programme, but the low coverage of the exposed population (Table 1) should be taken into consideration. Underestimation of the actual prevalence, due to the method of diagnosis and the conditions under which urine samples were collected or transported to the health centre, should not be overlooked, as previously stated (Nhammi, 1997).

4. Evaluation of environmental methods to control the snail intermediate hosts

It is established that schistosomiasis control requires an integrated approach with special reference to the role of snail control (WHO, 1993; Appleton and Madsen, 1998). In Morocco, the second national meeting to evaluate the elimination process, organised in February 1999 reiterated the importance of the control of the intermediate host in the schistosomiasis elimination process. Emphasis was put on environmental methods aiming at the modification of snail habitats. Based on studies of the ecology of the intermediate host, environmental methods of control were implemented and evaluated in a modern and a traditional irrigation scheme, respectively, in Tessaout Amont and Akka oasis.

4.1. In a modern irrigation scheme in central Morocco

The irrigation system consists of a large dam with a storage lake and an extensive network of cement lined canals. Primary canals are embedded, with a trapezoidal cross-section. Secondary and tertiary canals are elevated above the ground level and consist of semi-circular conduits of different sizes. Canals elevated above the ground necessitate special provisions to give access to fields and villages; i.e. siphons. These structures found at secondary and tertiary canals consist of two boxes connected by an underground pipe. Typical dimensions of tertiary siphon boxes are 0.8×0.8 (or 1.1 m) and 2 m depth. Being below the ground level, the siphon boxes contain water almost permanently and therefore constitute an important habitat for *B. truncatus* (Khallaayoune et al., 1998a). Furthermore, they constitute important water sources for the human population (Watts et al., 1998).

Based on results previously obtained in the area (Khallaayoune et al., 1998b), two environmentally safe measures to control the snail intermediate host in siphon boxes were evaluated. One method involved covering the siphon boxes to exclude light and reduce growth of algae. The second method aimed at increasing water velocity in order to hinder the establishment of the intermediate hosts.

The results showed that covering had a pronounced effect on snail (Fig. 2) and egg mass density. This intervention was accepted by the local community and prevented water contact. Increasing water velocity by reducing the dimensions of siphon boxes delayed the re-colonisation

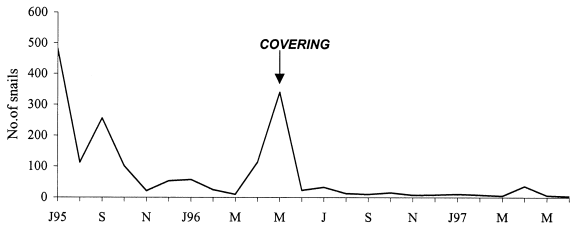

Fig. 2. Seasonal changes in density of *B. truncatus* (mean no. in four drag scoops) before and afer covering the siphon boxes in Tessaout Amont irrigation system (Covering was implemented in May 1996).

(Fig. 3). This control measure can be applied only in specific situations where it does not lead to hydraulic problems such as overflow in the upstream parts of the canal. Therefore covering the siphon boxes would be the most promising method that could sustain the elimination programme launched by the Ministry of Public Health in its efforts to eliminate schistosomiasis in Morocco.

The outcome of the present investigation showed that environmentally safe methods to control snails were put into effect and one of them led to results comparable to those which could be obtained using chemicals.

4.2. In a traditional irrigation scheme in southern Morocco

The present study was conducted in the Akka oasis, province of Tata, in southern Morocco between 1996 and 1998. The area is one of the oldest foci of urinary schistosomiasis in Morocco where transmission is still taking place. Results of

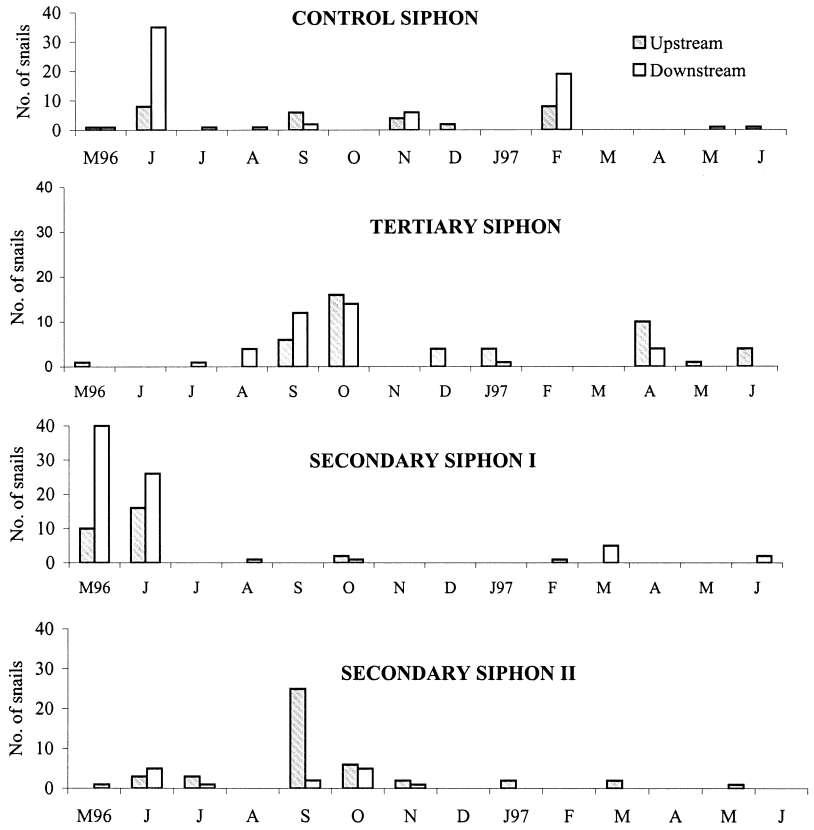

Fig. 3. Seasonal changes in density of *B. truncatus* in control and modified siphons (Re-dimensioning of the siphon boxes was done in May 1996).

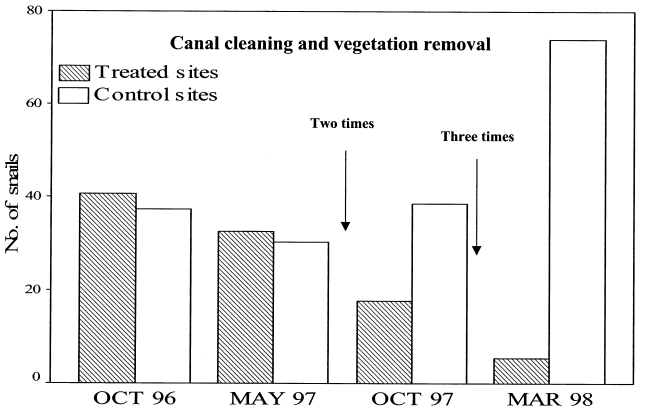

Fig. 4. Density of *B. truncatus* (No./m^2) in intervention and control sites (The arrows indicate the timing of interventions).

two investigations are reported by Laamrani (1999). The first consisted of a cross-sectional snail survey in order to study the distribution of *B. truncatus* in relation to habitat factors in the Akka traditional irrigation system. The presence of aquatic vegetation, especially *Potamogeton sp.* was identified as a key factor determining snail occurrence and abundance in canals, reservoirs, ponds and isolated small puddles and trickles located in the Akka riverbed. Furthermore, a participatory rapid appraisal study was done in the area and snail control was among the suggestions formulated by the villagers in order to control transmission of schistosomiasis. Thereafter, a longitudinal study was done to evaluate the effect of repeated cleaning and vegetation removal scheduled and implemented by the villagers on populations of *B. truncatus*. Snail and egg mass density showed a significant reduction after repeated cleaning in the study sites (Fig. 4).

Effect of vegetation removal and cleaning of irrigation canals on snails could be partly due to the removal of *B. truncatus* and its egg masses attached to vegetation, but it could also be indirectly due to the increased water velocity in some of the intervention sites. Oomen et al. (1990) mentioned that increased velocity following canal cleaning and sediment removal is due to increased hydraulic radius and the reduction of resistance to flow due to vegetation. A synergetic effect would also be due to silt removal that renders snail habitats unsuitable for aquatic vegetation, which in turn affects availability of food and shelter for snails (Thomas and Tait, 1984).

In the Rahad irrigation scheme in the Sudan, Meyer-Lassen (1992) observed the disappearance of *B. truncatus* after the removal of aquatic plants, and in the Philippines, Abcede (1973) demonstrated that draining of swamps and vegetation clearing led to significant reductions in population density of the amphibious snail *Oncomelania quadrasi*. In contrast, less impressive results were reported by Hilali et al. (1985) who showed that in the Gezira irrigation scheme, mechanical weed removal alone did not lead to a significant reduction of the snail population due to rapid re-colonization of the canals by weeds. Therefore, the effect of this measure of snail control depends on the local settings, and results obtained in Akka could not be extrapolated to other oases in the south.

5. Conclusion

In conclusion, schistosomiasis in Morocco is no longer a threat to public health. However, efforts made to achieve the goal of elimination by the year 2004 need an integrated approach including snail control. Studies conducted both in modern and traditional irrigation schemes have shown that some of the evaluated environmental methods of control of the intermediate hosts are effective, sustainable and accepted by the local

community. Such measures were successful partly because they took a starting point in understanding the ecology of the intermediate host in the local settings. Moreover, the implementation of these methods could be an 'entry point' to community involvement in water related diseases more in general.

The intervention tested in Akka had a double advantage. It optimized the operation of the canal system and could also have some positive impact on schistosomiasis control. However, this measure was effective in the short term but was not sustainable. Nevertheless, it could be useful in local settings in Akka for two reasons. Firstly, the method was suggested, planned, scheduled and implemented by the local population as an alternative to the chemical molluscicides formerly used by the Ministry of Health in the area. The second reason is that no single control strategy has proven effective on its own in the control of schistosomiasis. Therefore, as mentioned by Thomas (1987), there is a general consensus that an integrated approach, involving the application of several measures simultaneously, is needed to control or even to eliminate schistosomiasis.

The local population is keen to participate when the benefit of the contribution is clear to them and the actions to be taken are defined in a participatory rather than a top-down approach. During this study, villagers even suggested an integrated approach to schistosomiasis and trachoma control. Such an approach could have far reaching implications for the health status of the population in the Akka oasis.

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