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Control of tsetse and animal trypanosomosis using a combination of tsetse trapping, pour-on and chemotherapy along the Uganda-Kenya border

J.W. Magona [1*] N.M. Okuna [1] B.K. Katabazi [1]
P. Omollo [1] J.O. Okoth [1] J.S.P. Mayende [1]
D.C. Drabile [1]

■ PATHOLOGIE PARASITAIRE

Key words

Cattle - *Glossina fuscipes fuscipes* - *Trypanosoma* - Trypanosomosis - Insect controls - Pest control equipment - Trap - Drug therapy - Uganda - Kenya.

Summary

A joint tsetse and trypanosomosis control program has been carried out along the Uganda-Kenya border since July 1991. A combination of tsetse trapping, pour-on and chemotherapy has been used. Different combinations of control strategies were tried in the project area divided into three zones (A, B and C). In zone A, large-scale applications of pour-on, tsetse trapping (8-10 traps/km^2) and chemotherapy were used. In zone B, only tsetse trapping (8-10 traps/km^2) and chemotherapy were used. In zone C, block treatment of cattle in the entire area with diminazene aceturate was carried out followed by less intensive tsetse trapping (4-5 traps/km^2). During monitoring, 400 cattle in each zone were screened every three months and the tsetse apparent density determined every month. From July 1991 to March 1997 reductions in the prevalence of trypanosomosis and apparent tsetse density of 94 and 99.5% in zone A, 89 and 99.5% in zone B and 79 and 95% in zone C, respectively, were achieved and maintained. The predominant *Trypanosoma* species found in cattle during the control period were: *T. vivax* in zone A, *T. vivax* and *T. congolense* in zone B, and *T. vivax*, *T. congolense* and *T. brucei* in zone C. *Glossina fuscipes fuscipes* was the only tsetse fly species caught. The most effective control strategy was an initial large-scale application of pour-on, followed by trapping and regular chemotherapy. However, control effectiveness seemed to be influenced by the level of trypanosome challenge, speed of initial reduction in tsetse density and sustainability of tsetse and trypanosomosis control inputs during the campaign.

■ INTRODUCTION

Tsetse flies (*Glossina* spp.) infest approximately 40% (9.5 million/km^2) of the land resources of Tropical Africa covering 37 countries (5). Tsetse belts and therefore the distribution of trypanosomosis often extend beyond national boundaries.

1. Livestock Health Research Institute (LIRI), PO Box 96, Tororo, Uganda
* Author for correspondence (Fax: 256 45 42135)

Currently, no effective vaccine against trypanosomosis has been developed and natural infection generally fails to result in protective immunity. The control of animal trypanosomosis therefore relies on vector control, use of trypanocidal drugs and keeping genetically resistant or trypanotolerant breeds of livestock. Effective implementation of chemoprophylaxis and chemotherapy requires accurate diagnosis of trypanosomosis based on modern diagnostic methods (1).

All available control methods have their advantages and disadvantages. Hence, no single control method can be the best option in any situation. The choice of the method for use in a given area is influenced by the local situation, disease epidemiology, availability and cost-effectiveness of the method. There is a need therefore to develop integrated control strategies involving vector control, chemotherapy and chemoprophylaxis, and to keep trypanotolerant livestock breeds. Since the distribution of tsetse and trypanosomosis is independent of national boundaries, implementing integrated control strategies should be carried out through regional campaigns involving two or more countries. This paper presents the Ugandan side outcome of the tsetse and trypanosomosis program carried out jointly by Uganda and Kenya along the common border.

■ MATERIALS AND METHODS

Study area

The project area is located in Tororo district, South-East Uganda, between latitudes 0° and 0° 45' N and longitudes 34° and 34° 15' E. It covers an area about 90 km long and 15 km wide. At the beginning of the control program in 1991, the livestock population in the project area was estimated at 50,000 cattle, 40,000 goats, 15,000 sheep and 2000 pigs. The project area receives 1200-1500 mm of rainfall annually. The rainfall pattern is bimodal with two wet seasons (March-May and September-November) and two dry seasons (December-February and June-August). The mean relative humidity is 65% and the daily mean temperature ranges between 15°C (minimum) and 27°C (maximum). The vegetation cover is mainly savannah grassland. *Glossina f. fuscipes* is the commonest tsetse species infesting the area along the vegetation fringing rivers and streams.

Tsetse and trypanosomosis control

Several tsetse control methods were integrated in the prevention/treatment of trypanosomosis in livestock (cattle, goats, sheep and pigs), depending on which combinations were deemed appropriate for a particular situation. However, the use of deltamethrin impregnated pyramidal traps for tsetse control and chemotherapy were the most applied methods, mainly for maintaining tsetse and trypanosomosis control in the entire project area. The study area was divided into three zones (A, B and C). Different strategies were tried out in these zones at the beginning of the control program with the purpose of obtaining a quick suppression of both tsetse and trypanosomosis.

In zone A, deltamethrin pour-on was initially applied once on 600 head of cattle at a rate of 1 ml per 10 kg body weight in the entire zone in July 1991. This was followed by the use of deltamethrin impregnated pyramidal traps (9) at the rate of 8-10 traps per square kilometer. Then livestock was regularly screened for trypanosomosis using the hematocrit centrifugation technique (HCT) (13) and thin and thick blood smears. Cattle detected positive for trypanosomosis were treated with diminazene aceturate at a dosage of 7.0 mg/kg body weight.

In zone B, deltamethrin impregnated pyramidal traps were used at the rate of 8-10 traps per square kilometer in the entire zone, and the livestock was screened regularly and treated as in zone A.

In zone C, 1791 head of cattle were treated with diminazene aceturate at a dosage of 7 mg/kg body weight in July 1991. Then deltamethrin impregnated pyramidal traps were used at a rate of 4-5 traps per square kilometer. Thereafter, the livestock was regularly examined for trypanosomosis and treated as in zone A.

Tsetse and trypanosomosis control monitoring

To monitor animal trypanosomosis, 400 cattle from each zone were examined every three months for trypanosomosis by the buffy-coat technique (BCT) (10), and the percentage of animals found positive was determined. The term "prevalence" was used to mean the percentage found positive for trypanosomosis by the buffy-coat technique. Trypanosome species identification was confirmed based on their morphology on thin blood smears.

To monitor the tsetse apparent density, tsetse trapping was performed monthly in each of the zones A, B and C. Twenty biconical traps were set up in the field for 48 h and were checked twice a day. The tsetse apparent density was calculated based on the number of tsetse flies caught per trap per day (F/T/D).

■ RESULTS

In zone A, an initial reduction of 94% (from 6.7 to 0.4%) and 99.5% (from 0.55 to 0.003 F/T/D) in the trypanosomosis prevalence and tsetse apparent density, respectively, was achieved and maintained from July 1991 to June 1995. From June 1995 to March 1997, the trypanosomosis prevalence increased slightly but the tsetse population was maintained at a low level (figure 1).

In zone B, the trypanosomosis prevalence declined gradually by 89% (from 12 to 1.3%) from July 1991 to June 1996 then rose and remained high until March 1997. The tsetse apparent density dropped by 99.3% (from 0.44 to 0.003 F/T/D) and remained low up to December 1995, when it increased slightly until March 1997 (figure 2).

In zone C, the trypanosomosis prevalence and tsetse apparent density dropped by 79% (from 17 to 3.0%) and 95% (from 0.65 to 0.03 F/T/D), respectively, from July 1991 to December 1992. From December 1992 to March 1993 there was an upsurge in both trypanosomosis and tsetse apparent density. A single application of pour-on followed by reinforced trapping at a rate of 8-10 traps per square kilometer coupled with chemotherapy led to a decline in the detected cases of trypanosomosis and tsetse apparent density from March 1993 to June 1995. The tsetse apparent density remained low but the detected cases of trypanosomosis increased beyond pre-control levels (figure 3).

According to figure 4, *Trypanosoma vivax* was the predominant species infecting cattle in zone A during the control program. In zone B, both *T. vivax* and *T. congolense* were predominant trypanosome species (figure 5). In zone C, all three trypanosome species, *T. vivax*, *T. congolense* and *T. brucei*, were observed throughout the control program (figure 6).

■ DISCUSSION

Tsetse flies infest about 41% of the entire landmass of Uganda and 70% of the livestock population graze with a risk of developing trypanosomosis, of which 40% are under high challenge (11). Consequently, trypanosomosis severely constrains livestock production causing direct losses such as mortality, chronic effects of the disease, abortions, loss of draft power and lowered fertility.

In an attempt to control tsetse and trypanosomosis in Uganda, vector control was tried using ground spraying (12), tsetse trapping (7, 8), chemotherapy and chemoprophylaxis (4). Reliance on a single control method resulted in few benefits in the past since each method has its own advantages and disadvantages.

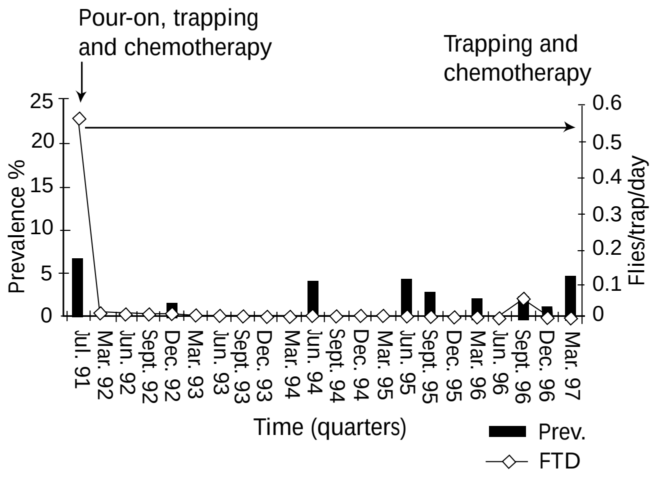

***Figure 1**: Detected prevalence of trypanosomosis in cattle (n = 400) and apparent tsetse density in zone A of the Uganda-Kenya border, 1991-1997.*

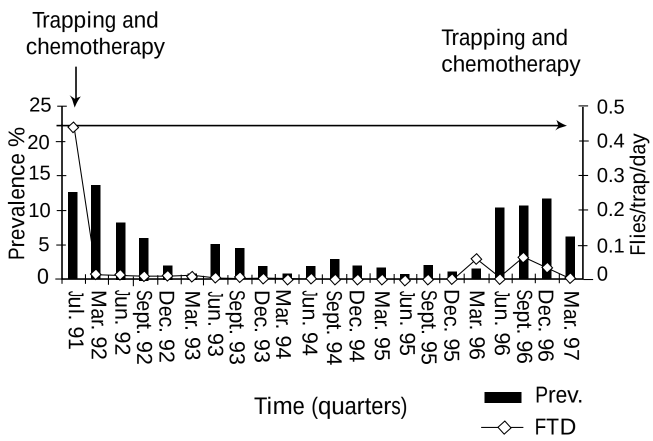

***Figure 2**: Detected prevalence of trypanosomosis in cattle (n = 400) and apparent tsetse density in zone B of the Uganda-Kenya border, 1991-1997.*

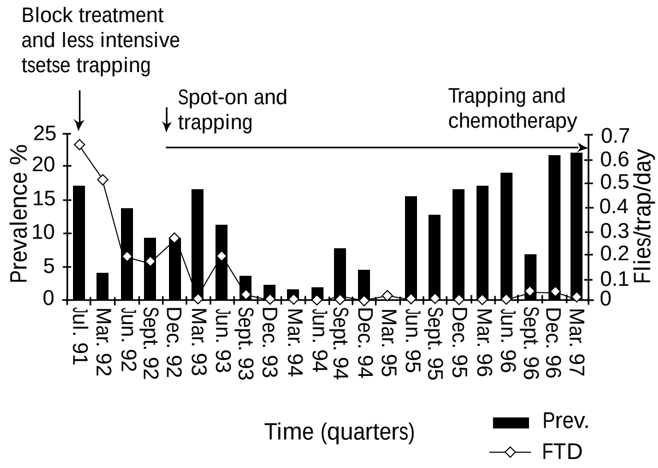

***Figure 3**: Detected prevalence of trypanosomosis in cattle (n = 400) and apparent tsetse density in zone C of the Uganda-Kenya border, 1991-1997.*

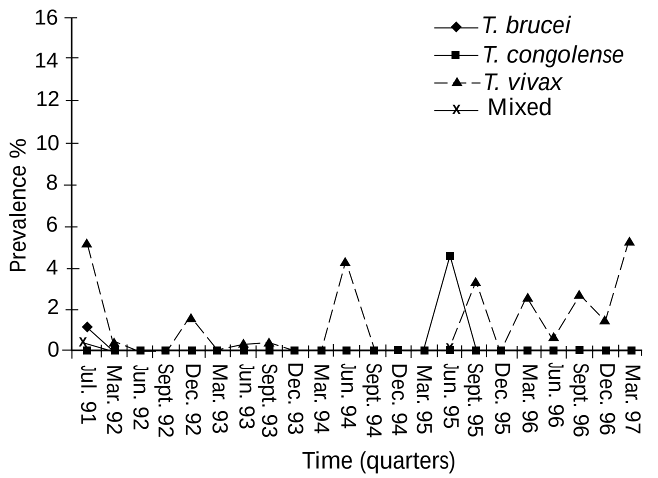

***Figure 4**: Detected prevalence of different trypanosome species in zone A of the Uganda-Kenya border during control.*

For example, ground spraying is a proven method for large-scale tsetse eradication but it has major logistical problems such as maintaining a fleet of vehicles and spraying equipment (6). Traps and targets have the advantage of being cheap, simple and suitable for community-based tsetse control programs. However, they require regular supervision to prevent damages and thefts. In addition, their effectiveness varies with the species and geographic subspecies of *Glossina* (6). Live bait technology based on insecticide sprays, dips and pour-on for cattle using synthetic pyrethroids has the advantage of resulting in a rapid reduction of tsetse (2), reducing the number of nuisance flies and ticks and being suitable for community-based tsetse and trypanosomosis control programs. However, the chemicals need to be regularly applied and are relatively expensive for resource-poor farmers. Trypanocidal drugs are the most widespread method of trypanosomosis control, and a number of benefits are associated with livestock treatment. However, this method is limited by the increasing occurrence of drug-resistant trypanosome strains, limited availability of drugs and sale of fake drugs on local markets, as almost 60% of the drugs are fake (3).

In view of the limitations affecting the various control methods, integration of tsetse and trypanosomosis control by combining tsetse trapping, live bait technology and chemotherapy has been applied in Uganda. Initial application of deltamethrin pour-on once, followed by long-term trapping using insecticide impregnated pyramidal traps at the rate of 8-10 traps per square kilometer and regular chemotherapy along the Kenya-Uganda border area led to the best results with a reduction of the detected prevalence of animal trypanosomosis by 94% and tsetse apparent density by 99.5% as compared to trapping (8-10 traps per square kilometer) combined with regular chemotherapy alone or block treatment combined with less intensive trapping (4-5 traps per square kilometer) alone. However, after the initial five years

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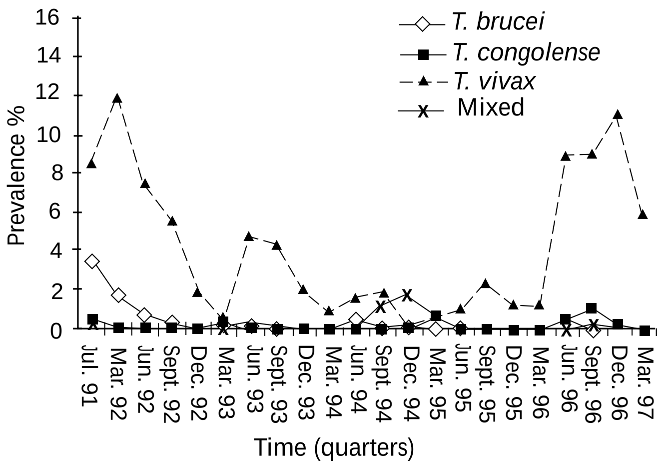

***Figure 5**: Detected prevalence of different trypanosome species in zone B of the Uganda-Kenya border during control.*

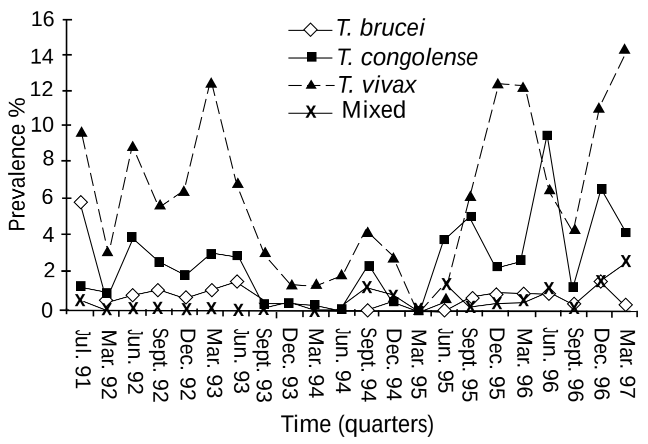

***Figure 6**: Detected prevalence of different trypanosome species in zone C of the Uganda-Kenya border during control.*

(1991-1995) the control program was affected by a shortage of control inputs (drugs, materials for trap manufacturing and funds for logistics) as donor support came to an end. The situation required community participation in terms of meeting the costs and implementing the program augmented by government financial and technical back-up support. In general, tsetse and animal trypanosomosis control in the area changed the epidemiology of the disease in cattle in terms of prevalence of the trypanosome species: *Trypanosoma vivax* became more predominant than *T. congolense* and *T. brucei* as the control program went on.

■ CONCLUSION

Initial large-scale application of pour-on followed by trapping and regular treatment of cattle appeared to be the most effective control strategy. However, the effectiveness of the control program seemed to be influenced by the level of trypanosome challenge in the area, speed of initial reduction in tsetse density and sustainability of tsetse and trypanosomosis control inputs during the campaign. To ensure sustainability of such a control program, the farming community should financially and morally support it.

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Résumé

Magona J.W., Okuna N.M., Katabazi B.K., Omollo P., Okoth J.O., Mayende J.S.P., Drabile D.C. Lutte contre les glossines et la trypanosomose animale en utilisant, avec des combinaisons différentes, le piège à tsé-tsé, la méthode du *pour-on* et la chimiothérapie, le long de la frontière entre l'Ouganda et le Kenya

Un programme de lutte commun contre les glossines et la trypanosomose a été mis en place le long de la frontière entre l'Ouganda et le Kenya depuis juillet 1991. Des combinaisons différentes utilisant piège à tsé-tsé, méthode du *pour-on* et chimiothérapie ont été utilisées. Ces différentes combinaisons de stratégie de lutte ont été testées dans la région de l'étude divisée en trois zones (A, B et C). Dans la zone A, la méthode du *pour-on* a été appliquée à une grande échelle, et les pièges à tsé-tsé (8-10 pièges/km^2) et la chimiothérapie ont également été utilisés. Dans la zone B, seuls les pièges à tsé-tsé (8-10 pièges/km^2) et la chimiothérapie ont été utilisés. Dans la zone C, l'ensemble du bétail a été traité dans toute la zone avec de l'acéturate de diminazène. Des pièges moins nombreux ont ensuite été posés (4-5 pièges/km^2). Lors du suivi, le dépistage de 400 bovins dans chaque zone a eu lieu tous les trois mois et la densité apparente des tsé-tsé a été déterminée tous les mois. De juillet 1991 à mars 1997, des réductions dans la prévalence des trypanosomoses et dans la densité apparente des tsé-tsé, respectivement de 94 et 99,5 p. 100 dans la zone A, de 89 et 99,5 p. 100 dans la zone B et de 79 et 95 p. 100 dans la zone C ont pu être obtenues et conservées. Les espèces de trypanosomes prédominantes observées chez le bétail pendant la période étaient : *T. vivax* dans la zone A, *T. vivax* et *T. congolense* dans la zone B, et *T. vivax*, *T. congolense* et *T. brucei* dans la zone C. *Glossina fuscipes fuscipes* a été la seule espèce de mouche tsé-tsé attrapée. La stratégie de lutte la plus efficace a été l'application de *pour-on* à une grande échelle dans un premier temps, suivie par l'utilisation de pièges et une chimiothérapie régulière. Cependant, l'efficacité de la lutte a semblé être dépendante du niveau de la pression parasitaire, de la vitesse de réduction initiale de la densité glossinienne et de la durabilité de l'apport de matériel de lutte contre les mouches tsé-tsé et la trypanosomose pendant la campagne.

Mots-clés : Bovin - *Glossina fuscipes fuscipes* - *Trypanosoma* - Trypanosomose - Lutte anti-insecte - Matériel de lutte antiparasitaire - Piège - Thérapeutique médicamenteuse - Ouganda - Kenya.

Resumen

Magona J.W., Okuna N.M., Katabazi B.K., Omollo P., Okoth J.O., Mayende J.S.P., Drabile D.C. Control de la mosca tse-tsé y de la tripanosomosis animal mediante el uso de una combinación de trampas tse-tsé, baños *pour-on* y terapia química a lo largo de la frontera entre Uganda y Kenya

Desde de julio 1991, se lleva a cabo un programa conjunto para el control de la tripanosomosis y la mosca tse-tsé a lo largo de la frontera entre Uganda y Kenya. Se utilizó una combinación de trampas, baños *pour-on* y terapia química. Se probaron diferentes combinaciones para las estrategias de control, en las zonas A, B y C del área del proyecto. En la zona A, se utilizó una aplicación en amplia escala por *pour-on,* trampas tse-tsé (8-10 trampas/km^2) y terapia química. En la zona B, se utilizaron únicamente trampas tse-tsé (8-10 trampas/km^2) y terapia química. En la zona C, se llevó a cabo un tratamiento en bloque del ganado en toda el área con aceturato de diminazeno, seguido por una instalación menos intensiva de trampas tse-tsé (4-5 trampas/km^2). Durante el seguimiento, se registraron 400 cabezas de ganado cada tres meses, determinándose la densidad aparente mensual de moscas tse-tsé. Entre julio 1991 y marzo 1997, se logró reducir y mantener la prevalencia de la tripanosomosis y la densidad aparente de tse-tsé, en 94 y 99,5% en la zona A, 89 y 99,5% en la zona B y 79 y 95% en la zona C, respectivamente. Las principales especies de *Tripanosoma* encontradas en el ganado durante el período de control fueron: *T. vivax* en la zona A, *T. vivax* y *T. congolense* en la zona B y *T. vivax*, *T. congolense* y *T. brucei* en la zona C. *Glossina fuscipes fuscipes* fue la única especie de mosca tse-tsé identificada. La estrategia de control más eficaz fue la de una aplicación inicial en amplia escala por *pour-on,* seguida por trampas y una quimioterapia periódica. Sin embargo, la eficiencia en el control parece estar influenciada por el nivel de tripanosomas, la velocidad de la reducción inicial en la densidad de la tse-tsé y por el mantenimiento en el esfuerzo de control en el nivel de tse-tsé y de tripanosomosis utilizados durante la campaña.

Palabras clave: Ganado bovino - *Glossina fuscipes fuscipes* - *Trypanosoma* - Trypanosomosis - Control de insectos - Equipo para control de plagas - Trampa - Terapeutica mendicamentosa - Uganda - Kenia.