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Control of Tsetse Flies and Trypanosomiasis in Ethiopia

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Abstract

Animal trypanosomiasis is an economically devastating disease and a major constraint to livestock production in tropical Africa. Trypanosomiasis is a parasitic disorder caused by haemoprotzoan belonging to the genus, Trypanosoma of the family Trypanosomatidae, that multiply in the blood stream, lymphatic vessels and tissues including the cardiac muscles and the central nervous system. The causative agents mainly circulate in parts of Africa that contain the biological vector, the tsetse fly; however, they can also be found in nearby regions due to mechanical transmission and the movement of infected animals. Three species of trypanosome are recorded in Ethiopia and the most important trypanosomes, in terms of economics loss in domestic livestock, are the tsetse transmitted species: *T. Congolese*, *T. vivax* and *T. brucei* group. Tsetse fly eradication programmes are complex and logistically demanding activities and usually involve the integration of different control tactics, such as Trypanocidal drugs, impregnated treated targets (ITT), insecticide-treated cattle (ITC), aerial spraying (Sequential Aerosol Technique - SAT) and in some situations the release of sterile males (sterile insect technique – SIT). The disease can be managed by controlling the vector and thus reducing the incidence of the disease by disrupting the transmission cycle.

Keywords: Sit; Tsetse fly; Trypanosomiasis

INTRODUCTION

Animal trypanosomiasis is an economically devastating disease and a major constraint to livestock production in tropical Africa [1]. Trypanosomiasis is a parasitic disorder caused by haemoprotozoan belonging to the genus, *Trypanosoma* of the family Trypanosomatidae, that multiply in the blood stream, lymphatic vessels and tissues including the cardiac muscles and the central nervous system [2]. African trypanosomiasis in cattle represents a major constraint to agricultural and socio-economic development in vast areas of Africa. The disease is caused principally by three species of trypanosome (*Trypanosoma congolense*, *T. vivax* and *T. brucei*), which are transmitted by several species of tsetse flies (*Glossina*).

The causative agents mainly circulate in parts of Africa that contain the biological vector, the tsetse fly; however, they can also be found in nearby regions due to mechanical transmission and the movement of infected animals. One organism, *Trypanosoma vivax*, has become established in South America, where it is mainly transmitted by biting flies acting as mechanical vectors [3]. Tsetse flies in Ethiopia are confined to southwestern and northwestern regions between longitude 33° and 38° E and latitude 5° and 12° N covers an area of 240,000km^2 [4]. Around 14 million head of cattle are at the risk of contracting trypanosomosis at any one time [5]. Three species of trypanosome are recorded in Ethiopia and the most important trypanosomes, in terms of economics loss in domestic livestock, are the tsetse transmitted species: *T. congolense*, *T. vivax* and *T. brucei* group [6]. However, only five species namely, *Glossina pallidipes*, *G. m. submorsitans*, *G. f. fuscipes*, *G. tachinoides* and *G. longipennis* are known in different parts of Ethiopia (Amhara, Benishangul Gumuz, Oromia, Southern and Gambella) region of Ethiopia are infested with more than one species of tsetse fly [7]. No field vaccine is available for bovine Trypanosomosis and the methods currently employed for control includes chemotherapeutic and chemo prophylactic drugs, tsetse eradication or control and the use of Tryanotolerant cattle. Therefore the objectives of this seminar are

To review high light on the effective control and preventive strategies against the disease in Ethiopia.

DISTRIBUTION OF TSETSE AND TRYPANOMOSIS IN ETHIOPIA

Tsetse infests around 240,000 km^2 of fertile land in south and southwestern parts of Ethiopia [8]. Five species of flies are epidemiologically important in the country: *G. fuscipes fuscipes*, *G. morsitans submorsitans*, *G. pallipides G. tacnoieds* and *G. longipennis*. Bovine Trypanomosis is thought to be the most important livestock disease in terms of economic development and influence on settlements. *T. congolense*, *T. vivax* and *T. Bruce* species reported in Ethiopia. Bovine Trypanomosis has also been reported as an important disease in other species especially in equines and goats. The surveys were conducted in the Jimma zone of the Oromia region which is known for its large cattle numbers and the economy is also heavily reliant on crop production. In this region cattle farmers attribute reductions in draft power and meat and milk off take, increased calving intervals and mortalities and impacts on breeds kept and cattle management to AAT. The morsitans group is distributed in Didessa valley near the village of Wonago and Lado on the eastern side of Lake Abaya, Shambo, on the Mugher River, on the Dabous River (Wollega), on the Baro and Gilo Rivers (Gambella district), Illubabor associated with Akobo River, in the Savannah near Turmi and near Mizan Teferi. *G. pallidipes* in Rift valley is connected with those in Omo River area, likely to be across the narrow strip which separates the upper part of the Galana Dulei valley (Woitto) with the Maze River valley (Daramalo)

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[9]. The *G. fuscipes fuscipes* is found in Maze, Gorgora, Bazo and Cuccia Rivers (GamoGofa), on the Ketto tributary and at Degeno of the Birbir (Wellega), on the tributary of the Gojeb (Kaffa), and near the bridge on the Omo River and Addis Ababa to Jimma high way [10].

IMPORTANCE OF THE DISEASE

Economic-Importance

Tsetse flies infest 10 million square kilometers of Africa involving 38 countries. Hence, nagana is today the most important disease of livestock in the continent [11]. Since nagana is a wasting disease, affected animals are chronically unproductive in terms of milk, meat, manure and traction and the high. The disease in Africa costs livestock producers and mortality rate can be consumers an estimated US$1340 million each year. The anticipated losses due to *T. vivax* in South America exceed $160 million. Furthermore, the disease may impact on various immunization campaigns in endemic areas due to the fact that it can cause immune-suppression [12].

Zoonosis Importance

The animal pathogens do not infect humans, but animals can serve as reservoirs of *T. brucei rhodesiense* and *T. brucei gambiense*, the causes of human sleeping sickness, which are morphologically human sleeping sickness, indistinguishable from *T .brucei brucei*. Human infections result from tsetse bites, generally in game parks, forest reserves and along streams or other rural setting [13]. The Glossina Species that is important as vectors of bovine trypanosomosis includes *G. morsitans*, *G. palpalis*, *G. longipalpalis*, *and G.pallidipes* and *G. austeni*. Since they do not feed on any other food rather than blood, they suck blood infected with the *Trypanosoma* species and transmit this disease to previously uninfected animals [14]. Although, the infection rate of Glossina with trypanosomosis is usually low, ranging from 1to 20% of the tsetse flies, each is infected for life and their presence in any number makes the rearing of livestock extremely difficult. These infection rates are determined by the parasite, the vector, the host and the environmental factors [15].

PREVENTION OF VECTOR AND TRYPANOSOMOSIS

Bovine Trypanosomosis have no vaccines are available nor likely in the near future because of the ability of trypanosomes to rapidly change their surface glycoprotein's to avoid the immune response [16]. The disease can be managed by controlling the vector and thus reducing the incidence of the disease by disrupting the transmission cycle. Another tactic to manage the disease is to target the disease directly using surveillance and curative or prophylactic treatments to reduce the number of hosts that carry the disease. Economic analysis indicates that the cost of managing Trypanosomosis through the elimination of important populations of major tsetse vectors will be covered several times by the benefits of tsetse-free status [17]. Area-wide interventions against the tsetse and Trypanosomosis problem appear more efficient and profitable if sufficiently large areas, with high numbers of cattle, can be covered. Vector control strategies can aim at either continuous suppression or eradication of target populations. Tsetse fly eradication programmes are complex and logistically demanding activities and usually involve the integration of different control tactics, such as Trypanocidal drugs, impregnated treated targets (ITT), insecticide-treated cattle (ITC), aerial spraying (Sequential Aerosol Technique - SAT) and in some situations the release of sterile males (sterile insect technique – SIT). To ensure sustainability of the results, it is critical to apply the control tactics on an area-wide basis, i.e. targeting an entire tsetse population that is preferably genetically isolated [18].

CONTROL METHODS

Chemical Control Methods

1. Live Bait Techniques: This method is based on insecticide treatment of livestock and exploits the blood sucking behavior of both sexes of tsetse fly. Tsetse flies, attempting to feed on cattle or other treated domestic livestock are killed by picking up a lethal deposit of insecticide on the ventral tarsal spines and on pre-tarsi whilst feeding [19]. The application of insecticides directly to cattle, the insecticide can be either is applied as a dip spray or as a pour-on formulation. The pour-on approach, applied monthly, is less error prone, and has been proven more flexible and adaptable in more remote regions, while allowing herders to adapt the approach as necessary [17]. The spraying solution of deltamethrin is prepared by adding, for example, 50 milliliter of the concentration to every 10 Litter of water in the knapsack sprayer and sprayed on the entire body of the animal. The insecticide treated animals are said to be mobile targets and are more attractive than the stationary targets and traps [18]. However, this pour on method is relatively costly. The lower cost of the dip spray, and the ability to combine it with tick control, makes this a very cost-effective measure to curb animal Trypanosomiasis [20].

2. Aerial application of non-persistent insecticides: An alternative method to ground spraying is the use of fixed wing aircraft (helicopters can also be used but are too expensive) to emit an aerosol of fine droplets containing insecticides over the tsetse habitat. As the droplets are small, they do not leave a persistent deposit in the habitat. The insecticide is dispersed 10-15 m above the tree canopy in swaths of 200-300 m in repeated treatments (5-6 times) with an interval of 9-10 days. Although the method can only be used on f l at terrain during temperature inversion conditions and requires sophisticated navigational equipment, it is not restricted to the dry season and does not require the deployment of large ground teams. Absolute perfect weather conditions are a prerequisite for the success with no margin for error (in case of imperfect inversion, mechanical failure etc. the entire spraying cycle has to be restarted). In comparison to spraying of residual insecticides, this technique is less. Contaminating for the environment and cheaper per km^2. Insecticide drift however, remains a problem as the principle is still poorly understood. In the seventies, considerable success was achieved in Botswana, Zambia, Nigeria, Zimbabwe and Uganda using fixed wing aircraft [21].

3. Ground Spray: Trials with insecticides against tsetse fly started in 1945, when DDT and BHC (HCH) were the only synthetic compounds available. The application of residual deposits of persistent insecticides to tsetse fly resting sites was very widely used, but is now discouraged due to concerns about effects on non-target organisms. The first residual applications have been done against riverine species, like *G. palpalis* and *G. fuscipes*, with habitats restricted to water edge [22]. In larger gallery forests, it is sometimes possible to open paths in the forest, which will be extensively used by moving tsetse flies, and to treat then for controlling flies. DDT suspensions and emulsions, which have been used in the first experiments, have usually been replaced by dieldrin emulsions, which are assumed to be efficient almost one year and sometimes more than one year if applied at 4% [23]. Tsetse fly control by residual insecticides has not been carried out against high forest species and is only promising when the fly habitats are restricted.

4. Sequential Aerial Technique (SAT): The Sequential Aerosol technique is a ULV spray drift technique that amount of insecticide from aerosol generator fixed to low flying aircraft or helicopter. Because of the tsetse flies exquisite susceptibility to modern insecticides, high levels of tsetse control can be achieved by sequential aerial spraying, the use of aircraft for the application of insecticide has obvious advantages, the chief of which is their ability to cover large areas quickly [24]. Aerial applications of insecticides to control tsetse by the areas where tsetse live is sprayed with non-residual insecticide at interval designed to kill all adults initially and then subsequently to kill young adults after they emerge [25]. Insecticides aerosols have a very short residual effect and kill tsetse flies. It is essential that the area to be sprayed has economic potential and also negative impacts on the environment.

Use of attractive devices: traps, targets, animals treated with insecticides

1. Targets (Insecticide Treated Cloth): It has been shown that the low reproductive rates of tsetse fly mean that the kill rate needs only to be relatively low in order to have a major control effect (31). This can be achieved with targets. The aim was to control tsetse flies by attracting them to visual targets, which are baited with odor attractants and coated with insecticide. The control of tsetse flies using cost-effective and practical devices target was initiated in 1970s [26]. Targets are pieces of insecticide treated cloth measuring about1.15 m^2 which are deployed in tsetse habitats. They are supported with either thin steel or wooded poles [27]. The color of the target is either black or a combination of blue black and deployed either hanged on the branches of a short tree, fixed to supporting poles or fixed to a thin stem of a plant [28]. Tsetse Flies are attracted by the blue segments and land on the black segment. The technique is quite simple, effective; non-pollutant, cost effective used for barrier establishment, integrated with other techniques and requires less frequent maintenance, but needs the use of insecticides and sometimes damaged bush fire, animals and people [29].

2. Traps (Insecticide Impregnated): Tsetse traps are a device made up of apiece of blue and black fabrics with white netting on the top created a sharp cone function by attracting the flies to that collects and/or kills them. Traps can be used for entomological surveillance, and also for control. Targets are simpler than traps, but are not used for surveillance. They are impregnated with biodegradable insecticides in order to kill any flies that alight on them. Traps and targets can both be used to eliminate a fraction of the tsetse population [30]. Traps are devices made up of apiece of blue and black fabrics with white netting on the top creating a sharp corner, and act as an effective means of tsetse control. They are used to catch flies both for control and monitoring purpose [31]. The blue screens of the traps are consternated with black screens to make flies settle. The flies subsequently move towards the upper parts of the trap in the direction of the light [32]. Effective traps attract all the flies from a distance of approximately 50m. Tsetse flies that enter the trap may die because of exposure to an insecticide impregnated in the trap material or because they are exposed to the sun [33]. Impregnated traps have the extra advantage of flies settling on the outside, but not entering is also killed. Attractive odors are available for the control of the flies that transmit animal Trypanosomiasis. These attractants includes cow urine, acetone octenol and phenols. They are non-pollutant, and relatively cost effective.

Sterile Insect Techniques (SIT)

The SIT relies on the production of large numbers of the target insect in specialized production centers, the sterilization of the males (or sometimes both sexes), and the sustained and systematic release of the sterile males over the target area in numbers large enough in relation to the wild male population to out-compete them for wild females. Mating of sterile insects with virgin, native female insects, results in no offspring [34].

The principle of the SIT is that fertile female insects are unable to produce normal offspring when they have mated with sterile male. Therefore, male flies are mass reared in the laboratory, sterilized by irradiation, and released to mate with wild females [35]. Sterilized males are still able to do their "job" the insemination of females with sterile sperm. As sterilized flies should not differ too much from wild flies laboratory-reared and irradiated flies are checked for their quality and behavior as compared to their wild counterparts. When sufficient sterile males are released over a long enough period, fertile mating does not occur and the pupation is eliminated. SIT has no effect on non-target organisms. Also, unlike other techniques, SIT becomes more efficient at lower fly densities, and is ideally suited to the final phase of local tsetse eradication [36]. It requires detailed knowledge on the biology and ecology of the target pest, and the insect should be amenable to mass-rearing. The SIT has been successfully used in combination with other control tactics to eradicate, suppress, or contain pest populations of Diptera Coleoptera and Lepidoptera i.e. eradication of the New World screwworm fly Cochliomyia hominivorax in the USA, Mexico, Central America and Libya [37-40].

TREATMENT

Early diagnosis and proper treatment, trypanosomiasis is curable. Treatment depends on what type of protozoa caused the infection and whether the infection has spread to other areas of your body. A small number of drugs have been licensed as veterinary treatments for trypanosomiasis. Diminazene aceturate and isometamidium chloride are used most often, but resistance to these agents is common in some regions. Various systems to maximize effectiveness and reduce the development of resistance, such as alternating drugs that are unlikely to induce cross-resistance, have been proposed for livestock. Drug resistance or inadequate treatment (or poor-quality drugs), can result in clinical cure but persistence of the infection. Drugs such as suramin, prothridium and isometamidium chloride (as a prophylactic) and diminazene aceturate (curative) can be used although drug résistance has been reported For camels melarsomine (cymelarsan) is very effective(curative) against *T. evansi* - so far this drug is only registered for use in camels

CONCLUSION

Tsetse flies are hematophagous insects of the family Glossinidae and are biological vectors of African trypanosomosis in both animals and man. The distribution of the genus *Glossina* is restricted to lowland rainforest and wooded savannah regions of sub-Sahara Africa. Among 31 species of tsetse flies, and five species *Glossina G, pallidipes*, *G. morsitans*, *G. fuscipes*, *G. tachinoides* and *G. longipennis* are known in different regions of Ethiopia (Amahara, Benishangul Gumuz, Gambella, Oromia and Southern Ethiopia. No field vaccine is available for bovine Trypanosomosis and the methods currently employed for control includes chemotherapeutic and chemo prophylactic drugs, tsetse eradication or control and the use of Tryano tolerant cattle. The disease can be managed by controlling the vector and thus reducing the incidence of the disease by disrupting the transmission cycle. Another tactic to manage the disease is to target the disease directly using surveillance and curative or prophylactic treatments to reduce the number of hosts that carry the disease. Vector control strategies can aim at either continuous suppression or eradication of target populations and usually involve the integration of different control tactics, such as impregnated treated targets (ITT), insecticide-treated cattle (ITC), aerial spraying (Sequential Aerosol Technique - SAT) and in some situations the release of sterile males.

Ø Effective control, prevent and treatment of bovine Trypanomosis is conducted by applying proper management (Restriction of pasture grazing in the tsetse belt), vector control and treatment of the infected animal.

Ø In endemic areas detailed study must be performed to know the communities perception to control the Trypanosomosis and other protozoa disease, Trypanosomosis and other protozoan disease.

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