Uganda Journal of Agricultural Sciences, 2004, 9:672-679
ISSN 1026-0919

Dual control of ticks and tsetse flies using deltamethrin through community participatory methods

M. Ocaido, C.P. Otim . N.M. Okuna[1], C. Ssekitto[1], D. Kakaire[1], J. Erume[1], R.Z.O. Wafula, J. Walubengo[1], G. Musisi[1], Okello-Bwangamoi[1], S. Okure[2], W. Ebiaru[2] and G. Monrad[3]

Department of Wildlife and Animal Resource Management, Faculty of veterinary Medicine, Makerere University, P.O. Box 7062, Kampala, Uganda
[1] Livestock research Institute Tororo, P.O. Box 96 Tororo, Uganda
[2] Extension workers, Office of District Veterinary Office, Soroti District, Uganda Royal [3] Royal Veterinary and Agricultural
[3]University, Danish Centre for Experimental Parasitology, Department of Pathobiology, Drylaegevej 100, DK-1870 Frederiksberg C, Denmark.

Abstract

Transfer and adoption of use of deltamethrin spray on cattle for controlling both tsetse flies and ticks hence controlling trypanosomosis and tick-borne diseases was done among agropastoral communities in Serere County, Soroti district, Uganda. Farmers and extension staff were initially sensitised and trained on the use of the technology. Farmers formed farmer groups. The groups were given the inputs, which were initially fully met by the project during the first 6 months and fully met by the farmers during the last 3 months of the project. Three sites were selected for the experiment: Site I: where cattle were sprayed once every two weeks; Site II cattle were sprayed once a month and Site III was for a control. Nine farmer groups were selected for the study. There was an overall farmer adoption rate of 60.1% (n=146). Spraying of cattle brought significant physical changes in body condition ($P<0.001$), body weight gain ($P<0.05$ in Site II, $P<0.01$ in Site I), packed cellular volume ($P< 0.01$) in Site I and II as compared with the control Site (Site III). The mean tick counts per cow drastically reduced by 96.3 % (from 134 to 5) in Site I and 90.4% (from 83 to 8) in Site II and mean standard tick counts reduced by 100% in both sites. The incidence of TTBDs was reduced by 90.5%. Mean tsetse fly catches per trap were drastically reduced by 96.5 % (from 17.2 to 0.6) in Site I and 92.9% (from 2.8 to 0.2) in Site II. The incidence of trypanososmosis was reduced by 100% from incidence of 15.3% in Site I and 14% in Site II. From above observations, it was shown that cattle could be sprayed once a month at cost of Ug. Shs. 100 per head of cattle per spray (Ug. Shs 1,200 annually) and through community participation this project would be sustainable.

Key words: Cattle trypanosomosis, Uganda, tick borne diseases

Introduction

In Serere County, Soroti district, where agro-pastoral communities live, tick-borne diseases (especially East Coast Fever and anaplasmosis) and trypanosomosis are major hindrance to livestock production (Otim *et al*., 2001). Outbreaks of trypanososmsis were reported in both humans (Anon., 2002) and livestock (Otim *et al*., 2001) in Serere County. A high tsetse fly infestation density of 17.2. flies catches per trap per day and a high prevalence (15.2%) of trypanosomosis in cattle (Otim *et al*. 2001) and among sick humans (8%) in Serere hospital (Anon, 2002) were reported. During this time there were no established technologies deployed for controlling the above diseases.

It was against the above background that a strategic technology using a dual purpose acaricide like deltmethrin were deployed for controlling both tsetse files and ticks hence reducing incidence of trypanosomosis (both in humans and livestock) and tick-borne diseases (TBDs). Elsewhere it had been demonstrated that deltamethrin effectively controls both tsetse and ticks and thereby reducing the incidence of both trypanosomosis and TBDs (Okello-Onen *et al.*, 1994, Magona *et al*., 1998 and Okiria *et al.*, 2002).

This technology was introduced with a hope that the incidence of both TBDs and tryapnosomosis would be decreased leading to increased livestock productivity and herd growth. This would be translated to increased milk yields, weight gains, live livestock off-take sales, cattle available for re-stocking and traction power thereby

boosting food security, increasing household incomes and promoting gender equity. Besides, more man-hours will be available for production due to reduction of human trypanosomosis.

In order to ensure sustainability and reduce costs, this technology was transferred by involving farmers using community participatory approach advocated by Olubai *et al*. (1999).

Material and methods

The study was conducted from June 2002 to March, 2003 in Soroti district, Serere county in two parishes of Kateta sub-county namely: Kateta (Site I) and Kamusala (Site II). Control area was in Kakus village (Site III), in Okulonyo parish, Olio sub-county.

The study was done in 3 phases namely: sensitisation and training of stakeholders, baseline survey and technology transfer and adaptation.

The sensitisation and training of stakeholders phase lasted three months (June-August 2002). Initially extension workers were trained on methods of controlling tsetse and ticks, trypanosomosis and tick-borne diseases. The concept of community involvement in control of diseases and environmental considerations when controlling ticks and tsetse flies was emphasised. Then civic and other leaders were sensitised about the project through meetings. At these meetings, views were exchanged on implementation of the project and how to ensure sustainability. There was consensus that farmers should contribute 100/- per animal sprayed to ensure sustainability. They also agreed to meet and elect their own leaders. At these meetings also, farmers decided on what would constitute their operational cells. Farmers afterward convened meetings in their operational cells and chose their leaders. Farmers were also trained on spray pump maintenance, proper acaricide dilution, restraining of cattle, and proper application of the acaricide. Cell leaders were then trained by extension workers under the supervision of scientists, on the application of acaricides by spray pumps and in record keeping. Training continued until cell leaders were able to perform activities expected of them on their own.

The baseline survey was carried out in three parishes to establish the initial tsetse density, tick burdens, level of tick control and prevalence of trypanosomosis and TBDs in cattle. Initially, samples were taken from 200 head of cattle and were ear tagged for future monitoring. Stained blood smears were examined for TBDs. In addition, both the haematocrit centrifugation technique (HCT) and the buffy coat technique (BCT) were carried out to diagnose cattle with trypanosomosis (Murray *et al*., 1977). Tsetse trapping and tick counting was done to establish tsetse density and tick burdens respectively. In each village in Kateta and Kamusala parishes 20 head of cattle were ear-tagged for purposes of monthly monitoring. In Kakus, Okulonyo parish 50 cattle were ear tagged.

The technology transfer and adaptation lasted for six months (September 2002 - February 2003). Three parishes (sites), Kamusala and Kateta in Kateta Sub county, and Okulonyo in Olio Sub county were selected for this study. Cattle in Kateta (Site I) were sprayed with deltamethrin every two weeks, cattle in Kamusala (Site II) were sprayed once a month, while cattle in Okulonyo (Site III) were not sprayed with deltamethrin, but tsetse was being controlled using traps in the latter village. All the four villages (cells) of Kamusala parish: Kamusala A, Kamusala B, Pokot A and Pokot B were selected. In Kateta Parish five villages (cells): Okulukulun, Acomia, Aisin, Ocupo and Omagara were selected. In Okulonyo Parish, only one village, Kakus, was covered.

Extension workers made bi-monthly visits to the farmers to supervise spraying of the cattle. Extension workers were contacted by farmers to make a diagnosis (thin blood smears) and give supportive treatment to any sick cattle. With the assistance of cell leaders and extension workers farmers kept production, health and treatment records.

Monitoring was preceded by active mobilisation the day before sampling in a particular village. Farmers gathered at the chosen site on a day, which did not coincide with spraying day to avoid stressing the cattle. With active participation of farmers, the purpose of the project was recapitulated by scientists, extension workers and farmers. Farmers were encouraged to point out constraints they experienced and possible remedies discussed. These constraints included lack of money and other socio-economic issues.

At the onset of spraying cattle sampled were examined for TBDs using stained blood smears, and for trypanosomosis by HCT. All the cattle were treated with Berenil at the a dose rate of 7.00mg/kg body weight.

At the same time, ticks on half the body were identified and counted (total tick count per animal), out of which the number of engorged ticks was determined (standard tick count per animal). During this activity, 3 tsetse traps were set in each village and left in position for 48 hours. The flies caught were identified, counted, sexed and dissected and examined for infection. This procedure was repeated every subsequent month throughout the adaptation phase, except that only cattle found infected with trypanosomes were treated with Berenil.

Production records taken included: age and breed dynamics, calvings, milk output, weight gain, sales, new entries, herd growth and crop yields. The production records of other enterprises: crop, goat and poultry were also taken. The farmers were taking these records in close supervision by cell leaders and extension workers. Data was entered in record books or standard data collection sheets modified from Ocaido (2003). Geo-referenced data of households of farms selected for monitoring were taken using Geographical Positioning System (GPS).

Descriptive statistical analysis, Analysis of variance (ANOVA), Student t-test and correlation tests was performed using Excel Statistical Package. Villages (cells)

were taken as study units. The data of cells/ villages were then grouped into data representing the parishes (Sites). Values of PCV, total and standard tick counts, tsetse fly catches and BCT-based trypanosomosis incidences have statistically been analysed.

Results

The number of people sensitised, trained by and participating households at the launching of the project are shown in Table 1. The monthly variation of farmers who take their cattle for spraying, total number of cattle sprayed and money collected are summarised in Table. 2.

Spraying with deltamethrin products brought about changes in the general health of the animals, especially in body weight and packed cell volume (PCV.)

The trend of changes of body weight of cattle over a four-month period after spraying with Decatix was as shown in Fig. 1. Initially the cattle of Kateta (Site I) (sprayed twice a month), which had low average weight, gained weight and overtook cattle of Kamusala (Site II) (sprayed once a month) and Kakus (Site III) (control: which were not sprayed). The cattle of Site I had an overall weight gain of 40.5±4.32 Kg, which was significantly higher ($P<0.05$, $t=2.3$) than those of Site II (24.1±3.7 Kg) and very highly significantly different ($P<0.01$, $t=7.4$) from those of Site III (15.6±5.5 Kg). The weight gain for Site II and Site III were not significantly different ($P>0.05$). Details are as shown in Figs. 1. and 2.

The study has shown that cattle in Site I, which were sprayed twice a month, had significantly higher ($P<0.01$) mean PCV (32±1.2) than cattle in Site II (30.8±1.2, $t=5.1$) and of Site III (30.3±0.9, $t=3.6$). However, the PCV of cattle in Site III and Site II were not significantly different ($P>0.05$, $t=1.29$) from each other. The monthly variation of mean PCV in the three groups of cattle was as shown in Fig. 3.

The monthly variation of mean total tick counts observed in the three different groups of cattle sprayed with deltamethrin products at three different frequencies was as shown in Fig. 4. Cattle in Site III (control) had more mean tick counts (102±5.7) than cattle in Site II (49.2±8.9, $t=4.7$, $P<0.01$) and in Site I (47.5±19.1, $t=2.53$, $P<0.05$). The mean tick counts between Site II and Site III were not significantly different ($P>0.05$, $t=0.6$). There was a 90.9 % and 66.7% reduction of tick population in Site I and Site II respectively.

The monthly variation of mean counts of standard ticks on three groups of cattle was as shown in Fig. 5. The cattle in Site III (control) had more highly significant mean number of standard ticks (6.4±0.4) than in Site II (1.55±0.6, $t=7.92$, $P<0.001$) and Site I (1.09±0.9, $t=5.94$, $P<0.001$). The mean counts of standard ticks on cattle in Site II and Site I were not significantly different ($P>0.05$, $t=1.16$).

The monthly variation of mean tsetse fly catch per trap per day (F/T/D) in the parishes was as shown in Fig. 6. The mean tsetse fly catches were significantly higher ($P<0.05$) in Site I (6.3±2.6) than in Site II (1.6±0.4) but not with Site III (1.96±0.3, $t=1.85$, $P>0.05$). Meanwhile, catches between Site II and Site III were not significantly different ($t=1.44$, $P>0.05$). By January there was 95.3% and 78.6% observed population reduction of tsetse flies in Site I and Site II, respectively.

The monthly incidences of trypanosome infection recorded by BCT among the sentinel herd of cattle in three different areas under different spraying regiments is shown in Fig. 7. There was no significant difference ($P>0.05$) between mean incidences of trypanosome infection between sites. However there was no trypanosome infection(100% drop), which was detected in the sentinel herd in October. But there were sporadic cases in November in Site II and in December for Site I.

The monthly occurrence of clinical cases of trypanososmosis reported by farmers were significantly different ($P<0.05$), with more cases being reported in Site II (0.87±0.4%) than Site I (0.19±0.1%). The variation of occurrence of monthly cases of trypanosomosis as reported by farmers and extension workers is as shown in Fig.8.

The monthly variation of mortality of cattle in the three different sites were as shown in Fig.9. There were significantly more cases of mortality due to trypanosomosis in cattle in Site I (0.16±0.08%) than in Site II (0%). There was 100% reduction in mortality rate due to trypanosomosis by November.

The monthly occurrence of clinical cases of ECF as reported by farmers and extension workers were as shown in Fig. 10. In Site II (Kamusala), there were no clinical cases of ECF reported by November, whereas in Site I (Kateeta) the ECF clinical cases of ECF were reported up to January at very small but constant endemic occurrence.

The monthly occurrence of clinical cases due to other TBDs, i.e. anaplasmosis, babesiosis and heart water, are shown in Table 3.

The monthly variation of in the mortality rate of cattle due to ECF as reported by farmers and extension workers was as shown in Fig. 11. No mortality due to ECF occurred in Site II from September and in Site I from October. The monthly variation of monthly mortality rate of cattle due to anaplasmosis, heartwater and babesiosis as reported by farmers and extension workers were as summarised in Table. 4.

Discussion

It is evident that stakeholder were extensively trained (Table 1). The knowledge of farmers on the importance and methods of controlling tsetse flies, trypanosomosis , ticks and tick-borne diseases (TBDs) including clinical signs of trypanosomosis and TBDs was enhanced. The training was expected to have a positive disseminating effect in the community.

The initial response of farmers to spraying was massive (Table 2), but it had declined in by November. The initial

Table. 1. Number of people sensitised and trained by the project

Activity	Men	Women	Boys	Girls	Total
Trained extension workers	6	0	0	0	6
Civil leaders sensitised	21	6	0	0	27
Farmers sensitised	162	42	10	4	218
Cell leaders trained by extension workers	11	0	0	0	120
Farmers trained by extension workers	385	108	86	21	600
Farmers who participated in the launching of the cattle spraying project	162	42	10	4	218
Farmers whose cattle are used for monitoring	60	15	4	0	79

Table 2. Monthly number of farmers who spray their cattle, total number of cattle sprayed and money collected (Ug. Shs '000).

Month	Kamusala parish			Kateeta parish			Total money
	Farmers	Cattle	Money	Farmers	Cattle	Money	
September	126	788	78,800	98	1799	179,900	258,700
October	145	875	87,500	72	796	79,600	167,100
November	71	459	45,900	26	420	42000	87,900
December	88	541	54,100	54	275	27,500	81,600
January	82	501	50,100	45	415	41,500	91,600
Subtotal		3,164	316,400	295	3,708	370,800	687,200

Table 3. Monthly occurrence of clinical cases of anaplasmosis, heartwater and babesiosis as reported by farmers and extension workers.

TBDs	Study site	August	September	October	November	December	January
	Kamusala	0.87	0	0	0	0	0.44
Anaplasmosis	Kateeta	0	0	0.7	0.23	0	0.23
Heartwater	Kamusala	0	0	0	0	0.44	0
	Kateeta	0	0	0.46	0	0	0
	Kamusala	0	0	0	0	0	0
Babesiosis	Kateeta	0	0	0.23	0	0	0.23

Table 4. Monthly mortality rates of clinical cases of anaplasmosis, heartwater and babesiosis as reported by farmers and extension workers.

TBDs	Study site	August	September	October	November	December	January
	Site II	0.87	0	0	0	0	0
Anaplasmosis	Site I	0	0	0.23	0	0	0.23
	Site II	0	0	0	0	0.44	0
Heartwater	Site I	0	0	0.46	0	0	0
	Site II	0	0	0	0	0	0
Babesiosis	Site I	0	0	0	0	0	0.23

enthusiasm was probably due to the awareness created by training and sensitisation. The temporal drop could have been due to the slow reduction in ticks as shown in Fig. 4. Farmers expected ticks to disappear faster and had initially complained that the initial Tsetse Tick® a deltamethrin product given earlier, had no effect on ticks. Farmers then demanded for Decatix® to which some few had previous exposure of use before our intervention. The current level of response indicates that adoption rate in Kamusala (Site II) is 65.1% and 55.1% in Kateeta (Site I) The current reluctance to spray animals could be due to the reduced prevalence of vectors and good condition of the cattle. (See Figures 1-5.

Spraying of cattle with deltamethrin products had a marked positive effect on the condition of animals. This was due to removal of tick and biting fly worry (Figures 4-6); and reduced loss of blood through engorging ticks (Figure. 5). Cattle which were sprayed twice a month (Kateeta : Site I group) gained weight at a rate, which was almost 100% higher than that of the cattle sprayed once a month (Kamusala: Site II group) and three times higher than that of those not being sprayed (Kakus: Site III group) (see Figs 1 and 2). This study indicated that it is better to spray cattle twice a month as recommended by manufacturers (Magona *et al.*, 1998 and Okiria *et al.*, 2002) at cost of Ug.Shs 2,400 annually per head. The economics of weight gain visa-vis the cost of acaricide needs to be assessed. Similarly there was a positive correlation with frequency of spraying with improvement of PCV (Fig. 3). Cattle which were sprayed twice a month (Kateeta : Site I group) had a better PCV than those sprayed once a month or not at all. Meanwhile the PCV of cattle in Site II was not significantly different from cattle in Site III. This means that the frequency of spraying is important if the purpose is to increase body weight of cattle.

Fig. 1. Variation of mean weight of cattle sprayed with delmetharin with time of application over 4 month period.

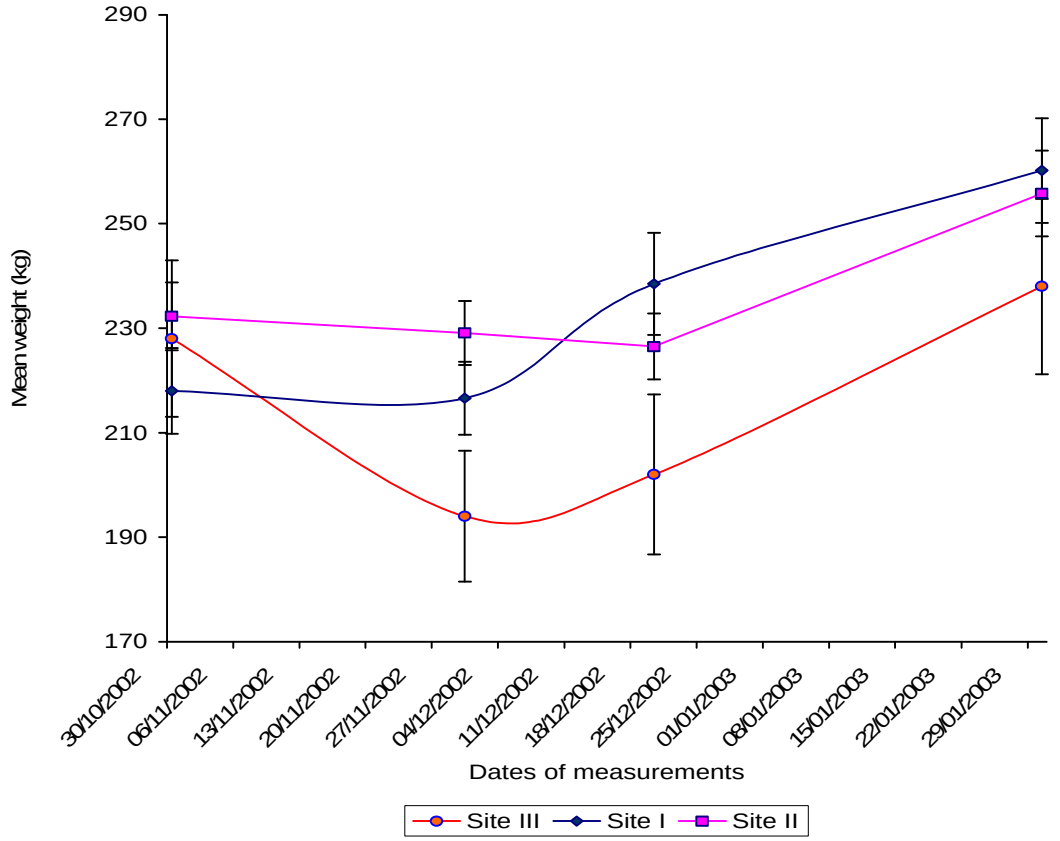


Fig. 3 . Variation of mean PCV of cattle which have being sprayed twice a month (Kateeta), once a month (Kamusala) and never (Kakus - control)

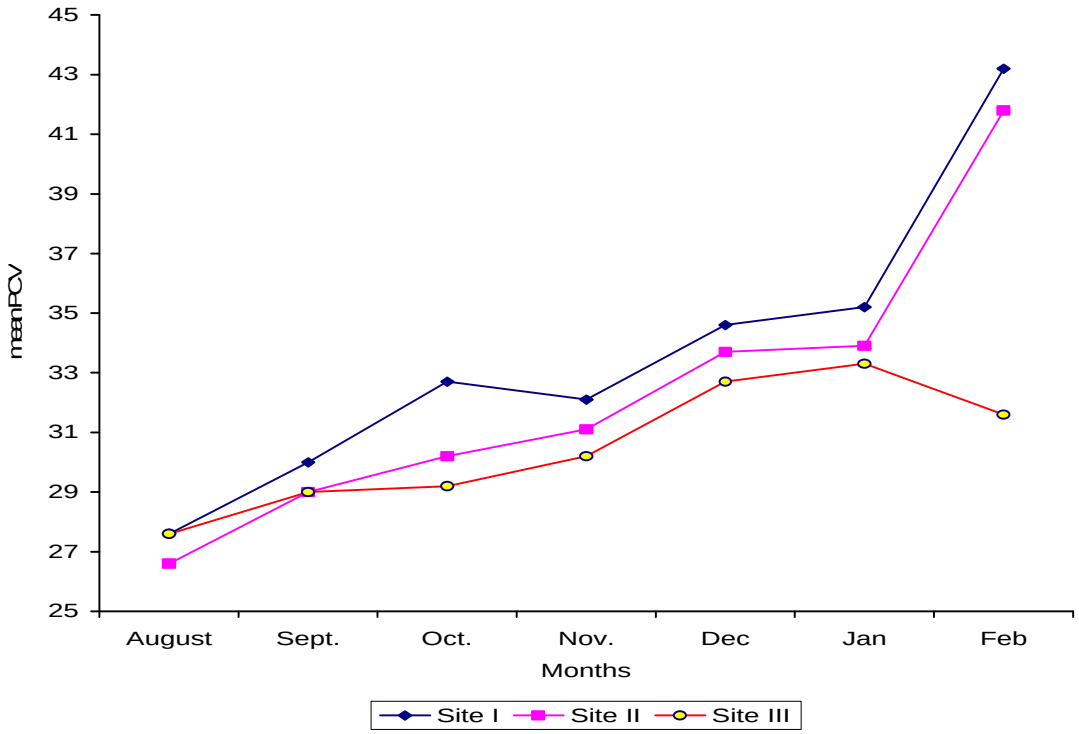


Fig. 4 . Tick mean total counts per animal in catlle which were not being sprayed (Kakus- control); those cattle sprayed twice a week (Kateeta) and once a week (Kamusala)

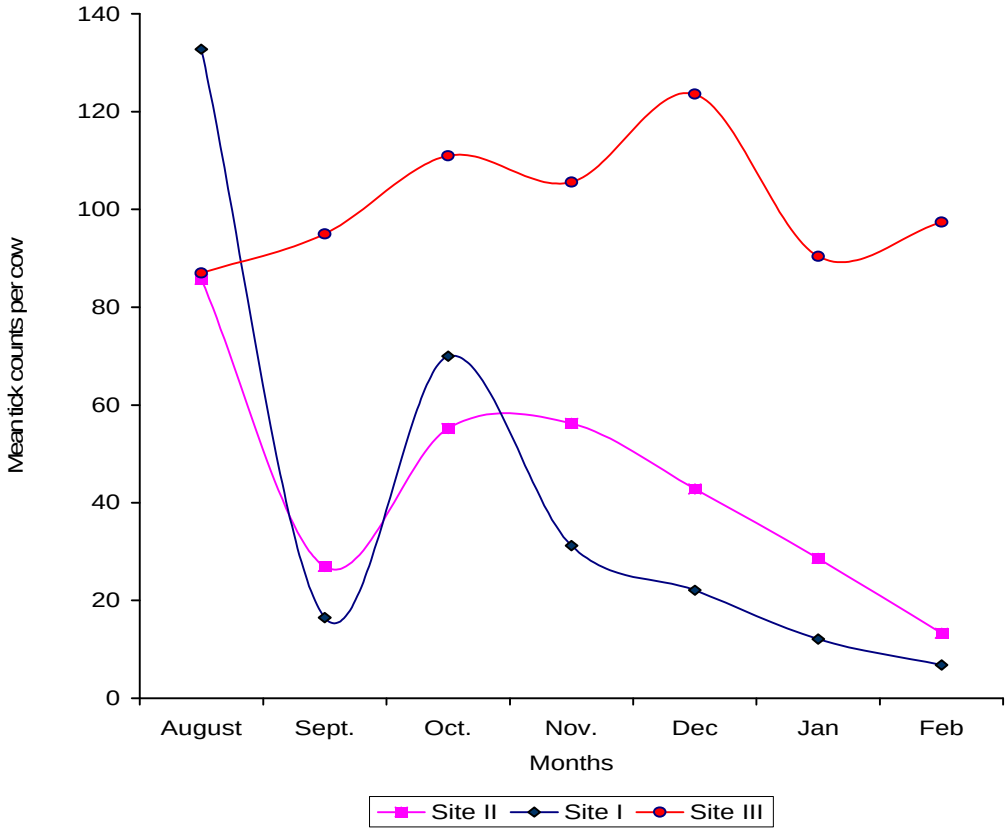


Fig. 5. Variation of mean standard tick counts per animal in cattle in control area (Kakus) and those sprayed once a month (Kamusala) and twice a month (Kateeta)

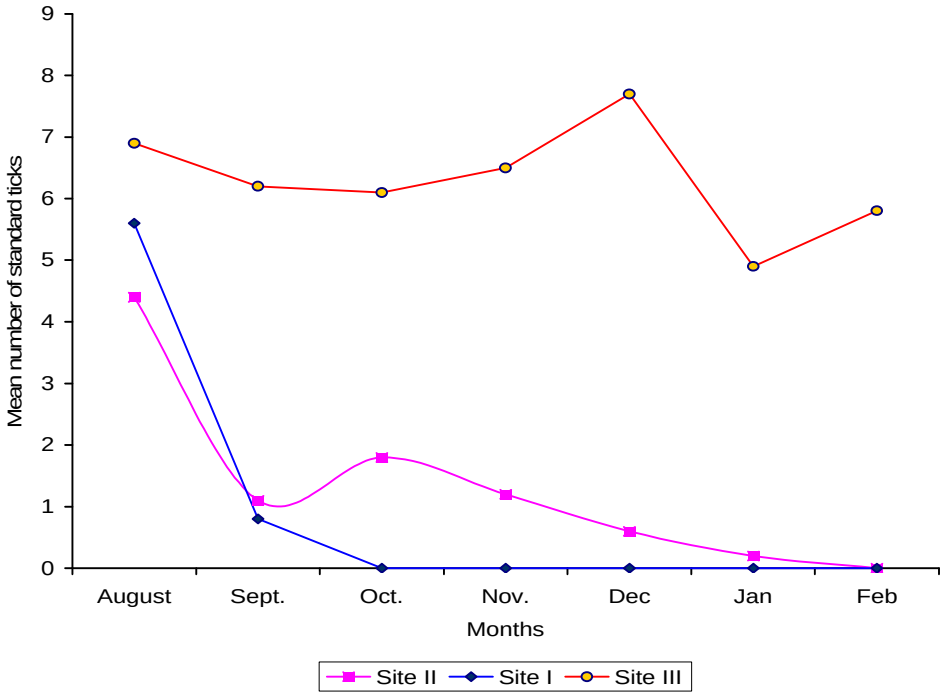
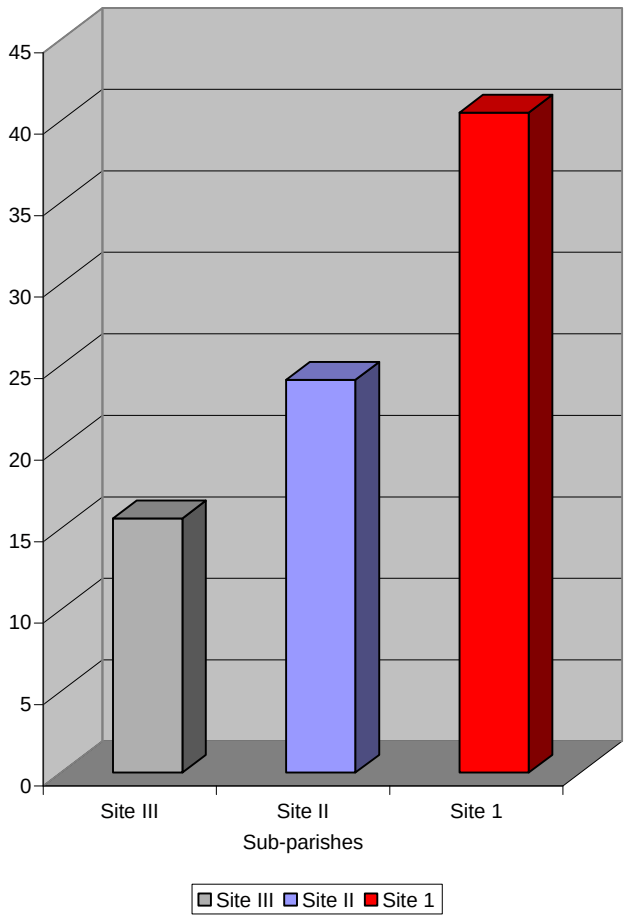


Fig. 2. Overall weight gain of cattle after 4 months under spraying with deltamethrin products: twice a month in Kateeta, once a month in Kamusala and without spraying in Kakus (control)



Spraying with deltamethrin products had a significant effect on reducing tick populations (Figs. 4 and 5). The total tick and standard tick counts on cattle in Site I and Site II were significantly lower than those of Site III. Both the total tick and standard tick counts on cattle in Site I and Site II were not significantly different. This suggests that, twice a month spraying did not have a significant advantage in reducing tick populations. Therefore if the purpose of tick control is to reduce tick population then it is more economical to spray once a month at a cost of Ug. Shs. 1,200 annually per head. This agrees with observations earlier made by Okello-Onen *et al.* (1994). Through community participation due to economies of scale enjoyed by the farmers, the cost of tick control is much cheaper than costs incurred by pastoral households in Mbarara for controlling ticks using conventional methods costing per head of cattle Ug. Shs. 5250 annually (Ocaido, 2003).

Results of tsetse fly catches (Fig.6) suggests that despite spraying twice a month, Site I still had more tsetse flies than Site II and Site III. This is probably because Site I (Kateeta) had initial a high density of flies and is more forested. However, by January the tsetse fly density had been reduced by 95.3% and 78.6% in Site I and Site II respectively.

There was a marked drop in the prevalence of trypanosome infection in the sentinel herd with no infection detected by October in both Site I and Site II (see Fig. 7). However there were minor sporadic cases in November in Site II (Kamusala) and in December in Site I. The sudden drop observed is attributable to Berenil® treatment which was administered to all cattle which were ear–tagged for monitoring. Therefore the prevalence of trypanosomosis animals is a measure of the monthly new cases occurring in the area. These cattle were used to monitor the rate of infection. Hence they were giving an indication of tsetse fly activity in the area. Reports made by farmers and extension workers, show that there were more clinical cases of trypanosomosis in Site II than Site I (Fig. 8), and yet , there were more deaths of cattle due to trypanosomosis in Site I (Fig. 9). The more clinical cases reported in Site II from September to December was most likely due to wrong diagnosis. However it should be noted that the study site is a crop/cattle farming system. The live bait technology cannot quickly wipe out tsetse since there are pockets where cattle can't reach because they have no where to pass because of crop gardens.

There was a drastic decline of clinical cases of ECF in Site II with no case reported in November. But in Site I there was a persistent though small endemic prevalence of ECF reported from September to December (see Fig. 10.). The decrease in the incidence of ECF, is most likely due to decline in tick populations. Similarly, no mortalities of calves were observed from September for Site II and October for Site I. This could be due to reduced number of ECF clinical cases as earlier explained, coupled with increased awareness of the farmers to clinical signs of ECF hence calves are treated in time. However other TBDs: anaplasmosis, babesiosis and heartwater continue to occur at sporadic levels (Table 3) and cause deaths (Table 4). Anaplasmosis seems to be causing significant economic losses by killing adult cattle. This is true in places where there is relaxed tick control (Dolan, 1985).

Conclusion

Spraying of cattle with deltamethrin products twice a month had a marked positive effect only on weight gain of the animals. However if the purpose of spraying is weight gain, then economics of weight gain visa-vis the cost of acaricide needs to be assessed.

Spraying twice a month had the same effect in reducing fly and tick populations as once a month spraying, hence the latter is cheaper, if the purpose is to control ticks and tsetse flies. Therefore through community participation, sustainable control of ticks and tsetse flies could be achieved by spraying cattle once a month in Serere County and

elsewhere with the similar tick and tsetse fly challenges, at a minimal cost.

Acknowledgements

Authors wish to acknowledge DANIDA-Livestock Systems Research Project (LRSP) through Agriculture Sector Program Support (ASPS) by the Danish government to Ugandan Government for funding the study. We are also grateful to Soroti District Local Administration and Veterinary Office for their cooperation and support, in provision of extension staff and mobilisation of farmers. Lastly we are indebted to farmer groups whom we jointly conducted this study.

References

Anon., 2002. Soroti district annual medical report.

Dolan, T.T., 1985. Immunisation against theileriosis OI Pejeta ranch, Laikipia, Kenya. In: *Immunisation against theileriosis in Africa (A.D. Irvin ed.). Proceedings of a joint workshop held in Nairobi 1st-5th October, 1984*. International Laboratory Research on Animal Diseases, Nairobi, 73-75.

Magona, J.W., Okuna, N.M., Katabazi, B.K., Omollo, P., Okoth, J.O. and Mayende, J.S.P., 1998. Control of tsetse and animal trypanosomosis using a combination of tsetse trapping, pour-on and chemotherapy along Uganda-Kenya border. *Rev. Elev. Med. Par. Trop.*, 51, 311-315.

Ocaido, M., 2003. Modelling economic impact of ticks and tick-borne diseases on developing mixed game and livestock production systems around Lake Mburo National Park, Uganda. Ph.D. thesis, Makerere University, Kampala 342pp.

Okello-Onen, J. Heinonen, R., Ssekitto, C.M.B., Mwayi, W., Kakaire, D. and Kabarema, M., 1994. Control of tsetse flies in Uganda by dipping cattle in deltamethrin. *Trop. Anim., Hlth Prod*., 26, 21-27.

Olubai, W.A., Kuloba, R., Oloo, F.B. and Lako, G.T., 1999. Community participation in tsetse and trypanosomosis control in Transmara District, Kenya. In: *OAU/STRC*, 484-489.

Otim, C.P., Ocaido,M., Erume M., J., Okuna N.M., Ssekitto C., Wafula R.Z.O., Kakaire, D., Walubengo J, Okello A., Nayeenya W., Okure S., Ebiaru, W., and Monrad J. 2001. Socio-economic and livestock disease survey of agro-pastoral communities in Serere County, Soroti District, Uganda. *In: proceedings of DANIDA-LSRP Annual Technical Review Workshop Held at Mbarara, from 28th to 30th November 2001*.

Okiria, R., Okuna, N.M., Magona, J.W., Mayende, J.S.P., 2002. Sustainability of tsetse control by subsequent treatment of 10% of a previously treated Ugandan cattle population with 1% w/v deltamethrin. Tropical Animal Health and production, 34, 105-114.