

Insecticide-treated cattle against tsetse (Diptera: Glossinidae): what governs success?

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Abstract

The distributions of insecticide-treated cattle from sites in Tanzania and Zimbabwe were assessed from interviews with livestock owners, analysis of secondary livestock data and mapping technologies. The time-course of tsetse control operations at these sites were then simulated using a mathematical model that assumed diffusive movement and logistic growth in fly populations. A simulation of a tsetse control operation in Mudzi district, north-east Zimbabwe, was in accord with observations that the use of insecticide-treated cattle was unable to prevent substantial re-invasion of tsetse from Mozambique, consequent on the patchy distribution of cattle. The simulation was also consistent with the observed efficacy of a 10-km wide barrier of insecticide-treated targets deployed evenly at 4 km². Simulation of a control operation on Mkwaja Ranch in Tanzania was in accord with the observation that the use of insecticide-treated cattle reduced the tsetse population on the ranch by *c.* 90%. Insecticide-treated cattle were used to better effect in the Kagera Region of Tanzania. Simulation of this operation predicts that the deployment of 35,000 treated cattle in the area would result in > 99% control of the tsetse population, consistent with the observed decline, by 1–2 orders of magnitude, in cases of trypanosomiasis in the region. The greater success of the Kagera operation was due to the size and shape of the treated area and, particularly, to the restriction of re-invasion to 20% of the perimeter, compared with > 80% on Mkwaja. Simulation was used to assess how tsetse control could have been improved at Mkwaja. The results suggest that splitting herds into smaller, more numerous, units could have achieved some improvement but, in general, the disease problem would not have been solved by the use of insecticide-treated cattle alone. Only by deploying odour-baited targets in ungrazed areas, or in a 1–3-km barrier around the ranch, could substantially better control (99–99.9%) have been achieved. Sensitivity analyses of the Mkwaja simulation showed that the general conclusions were robust to assumptions regarding cattle distribution and the rates of fly movement and growth. Properly managed and appropriately applied insecticide-treated baits are powerful weapons for tsetse control but should not be used without regard to potential levels of re-invasion, consequent largely on considerations of the size and shape of the treatment area and the density and distribution of the baits.

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