41 - Evaluation of criteria of trypanotolerance

J.C.M. TRAIL, C. COLARDELLE, G.D.M. d'IETEREN, P. DUMONT, P. ITTY, P. JEANNIN, J.H.H. MAEHL, S.M. NAGDA, G. ORDNER, R. W. PALING, J.M. RARIEYA, W. THORPE and G. YANGARI

Introduction

It has been established in recent years that the trypanotolerant breeds of cattle, namely N'Dama and West African Shorthorn, are much more productive than originally believed, despite their small stature. They are therefore increasingly being considered for livestock development programmes in tsetse-affected areas.

Murray (article 15 of these Proceedings) has noted that trypanotolerance appears to be associated with at least three possibly related but genetically independent characteristics, namely the ability to control parasitaemia, the ability to control anaemia and the ability to develop an effective immune response. It would appear that under natural tsetse challenge, parasitaemia aspects could in practice be best measured by factors such as number of infections per unit time, trypanosome-species effects and parasitaemia-score effects. Anaemia control aspects could be measured by the ability to maintain PCV levels, by the size of drop from "normal" PCV levels or by the recovery rates of PCV. Immune response could be evaluated by measuring the effects of varying numbers of previous infections.

Materials and methods

At the Government ranch of the OGAPROV in southeastern Gabon, 179 N'Dama female cattle, born between June 1985 and January 1986, were exposed to a high natural trypanosome challenge from October 1986 to January 1987. Each month, animals were weighed, the darkground/phase contrast buffy coat technique was used to detect trypanosome presence and species and quantification of parasitaemia, while anaemia was estimated by measuring the PCV. The analysis approach was to estimate the phenotypic relationships between parasitaemia aspects, anaemia-control aspects and daily liveweight change.

All traits were analysed by least-squares fixed- and mixed model procedures (Harvey, 1977), the effects fitted being indicated in each section. Interaction effects fitted were those that preliminary analyses had indicated were significant or approached significance for any of the matching traits involved.

Results

The average monthly trypanosome prevalence (the percentage of animals determined as

being parasitaemic at a monthly examination) over the four months was 25.5%. Of the 179 N'Dama females, 36.6% never had trypanosomes detected, 36.3% had trypanosomes detected in one month, 18.4% in two months, 9.3% in three months and 1.7% in all four months. Least-squares analyses were carried out, fitting number of months when trypanosomes were detected, trypanosome species, parasitaemia score, PCV level and presence of previous trypanosome infection as fixed effects.

Parasitaemia aspect

The effect of number of trypanosome infections on daily liveweight gain and average PCV over the three month period is shown in Table 1.

Table 1. Effect of number of trypanosome infections on growth and PCV.

Number of months when trypanosomes detected	Number of animals	Daily liveweight gain (g)		PCV (%)	
		Mean	s.e.	Mean	s.e.
0	65	381	10.6	34.0	0.41
1	65	329	9.9	30.7	0.38
2	33	260	13.8	27.5	0.54
3 or 4	16	194	20.7	24.0	0.80

There was a linear effect of number of months when trypanosomes were detected, on both traits, one infection reducing gain and PCV by 52g and 3.3% respectively, two infections by a further 69g and 3.2% and three or four infections by a further 66g and 3.5%.

The effect of trypanosome species on daily liveweight gain and average PCV over the three-month period is indicated in Table 2.

The comparison of the effects of the two species, *T. congolense* and *T. vivax*, was only possible in animals where trypanosomes were detected in one month only. In this case, a *T. vivax* infection reduced gain and PCV by 32g and 2.7%, respectively compared with 86g and 4.4% for a *T. congolense* infection.

Table 2. Effect of trypanosome species on growth and PCV.

Number of months when trypanosomes detected	Trypanosome species	Number of animals	Daily liveweight gain (g)		PCV (%)	
			mean	s.e.	mean	s.e
0	-	65	381	10.5	34.0	0.40
1	T. vivax	40	349	12.4	31.3	0.48
1	T. congolense	25	295	16.7	29.6	0.64
2	T.c. or T.c. + T.v. or mixed	33	260	13.7	27.5	0.53
3 or 4	T.c. or T.c. + T.v. and/or mixed	16	195	20.4	24.0	0.79

The effect of parasitaemia score on daily liveweight gain and PCV over the three-month period is shown in Table 3.

Table 3. Effect of parasitaemia score on growth and PCV.

Number of months when	Trypanosome	Average	Number of	Daily live	PCV (%)

trypanosomes detected	species	score	animals	weight gain (g)			
				mean	s.e.	mean	s.e.
0	-	-	-	382	10.3	34.0	0.40
1	T. vivax	1	9	340	27.5	30.8	1.07
1	T. vivax	2	22	344	16.2	31.4	.63
1	T. vivax	3.4	9	369	25.1	31.7	.90
1	T. congolense	1	6	316	34.8	30.4	1.36
1	T. congolense	2	13	296	21.8	29.5	.85
1	T. congolense	3.4	6	278	31.4	29.0	1.23
2	T. congolense +	1.7	15	302	19.3	28.6	.76
2	T. vivax or mixed	2.9	18	221	18.3	26.4	.72
3 or 4	T. congolense +	2.2	9	192	27.3	24.2	1.07
3 or 4	T. vivax and/or mixed	3.4	7	200	28.5	23.8	1.11

Each monthly trypanosome grouping was divided into those above and those below average for parasitaemia score. Only in the group where trypanosomes were detected in two months, was there a significant effect of score on both gain and PCV, the above-average score group having significantly lower growth and PCV than the below-average.

Anaemia control aspect

Each monthly trypanosome grouping was divided into those maintaining their PCV levels above the average for the group and those whose PCV level fell below the average. The average PCV levels in each of these categories and their growth over the three month period, are shown in Table 4.

Table 4. Effect of ability to maintain PCV level on growth.

Number of months when trypanosomes detected	Trypanosome species	Number of animals	Mean PCV (%)	Daily live weight gain (g)	
				mean	s.e.
0	-	30	31.8	390	14.3
0	-	35	36.1	373	13.7
1	T. vivax	19	28.9	336	17.4
1	T. vivax	21	33.6	360	16.5
1	T. congolense	12	26.8	285	24.1
1	T. congolense	13	31.8	303	21.7
2	T. congolense +	16	25.1	225	18.8
2	T. vivax or mixed	17	29.8	294	18.8
3 or 4	T. congolense +	9	22.4	179	24.9
3 or 4	T. vivax and/or mixed	7	26.9	223	33.5

The mean difference in PCV levels in each of the five groups was 4.6 percentage units. When no trypanosomes were detected, there was no indication of any linkage between a higher PCV level and growth. In all other cases, animals maintaining their PCV levels above the average

of their parasitaemia group had superior growth.

Immune response aspect

The very limited data on previous trypanosome infection, as an indication of the ability to mount an immune response, are shown in Table 5. There was no indication of a previous infection having an effect on growth or PCV.

Table 5. Effect of previous trypanosome infection on growth and PCV.

Previous trypanosome infection	Number of animals	Daily liveweight gain (g)		PCV (%)	
		Mean	s.e.	Mean	s.e.
No	148	296	7.7	29.6	.29
Yes	31	297	16.3	28.6	.61

Discussion

Key points from the study designed to indicate phenotypic relationships between aspects of parasitaemia, anaemia control and immune response with animal performance are indicated in Table 6.

Table 6. Indications of comparative sizes of influences on daily liveweight gain (g), over three months of exposure to trypanosomiasis risk at OGAPROV Ranch.

1.	Average daily liveweight gain of non-infected cattle	381g
Parasitaemia aspect		
2.	Each monthly *T. congolense* of mixed infection detected	-60g
3.	Each monthly *T. vivax* infection detected	-22g
4.	Above-average parasitaemia score recorded within a monthly infection relative to a below-average score	-26g
Anaemia control aspect		
5.	Below-average PCV level reached within each monthly infection relative to an above-average level	-23g
Immune response aspect		
6.	A trypanosome infection detected in the eight months prior to study, relative to no infection detected	0g

The results in Table 6 indicate that phenotypic variance in growth associated with parasitaemia aspects can be at least as large as that associated with anaemia-control aspects. One important implication relates to the use of artificial challenge in research on management and breeding methods for the exploitation and improvement of trypanotolerant cattle. As in artificial challenge, either by syringe or by infection with captured flies, virtually all animals become parasitized; in research using artificial challenge a significant proportion of the variance in animal growth is being ignored.

References

Harvey, W.R. 1977. *User's Guide for Least-Squares and Maximum Likelihood Computer Program*. Columbus: Ohio State University.