REPEATABILITY OF TICK COUNTS AND THE RELATIONSHIP BETWEEN TICK COUNT AND LIVEWEIGHT CHANGE IN GROWING *BOS INDICUS* X *BOS TAURUS* CATTLE

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SUMMARY

Tick count and liveweight change data from growing *Bos indicus x Bos taurus* cattle challenged by field infestation of *Boophilus microplus* were studied at four sites in coastal Queensland.

Mean tick counts were low, 3.9 to 5.5 ticks/side, but peak counts reached 58 ticks at one site. Overall repeatabilities of tick counts at the four sites, 0.57, 0.49, 0.42 and 0.25, were significant (P <0.01) but only moderately useful as a basis for a selection programme. From interclass correlations and correlations with the total count over the experimental period, no time of the year could be identified as superior to any other for ranking animals on the basis of tick resistance. However, the mean of two consecutive tick counts 21 days apart gave a more reliable assessment. Mean tick counts were very poorly related (P > 0.05) to liveweight gain over the period at all sites.

INTRODUCTION

Selection for tick resistance within *Bos indicus* infused genotypes has been recommended as a means of increasing the overall resistance of herds (Utech et *al*. 1978). Animals are ranked on the basis of the tick burden they carry. If genetic progress is to be made, identification of resistant individuals must be accurate and the trait must be heritable. A high repeatability of resistance ranking of an individual relative to its contemporaries is essential. Seifert (1971) found low repeatabilities (-0.22 to 0.58) for single tick counts but high interclass correlations (0.59 to 0.998) for a mean of four counts with Zebu cross weaners in central Queensland. Turner and Short (1972) also found good interclass correlations between grouped tick counts.

The benefit of increasing the tick resistance and reducing tick burden of a herd depends on the relationship between tick burden and liveweight performance or reproductive rate. Turner and Short (1972) and Holroyd and Dunster (1978) reported significant negative relationships between mean tick counts and liveweight gain in young, growing *Bos indicus* cross cattle. However, Johnston and Haydock (1969), Seifert (1971) and Sutherst et *al*. (1979) found no relationship in groups of comparable animals.

This paper examines the repeatability of tick counts, their relationship to liveweight gain and their use in selection programmes for growing *Bos indicus* infused cattle in Queensland.

MATERIALS AND METHODS

Data from four studies in the tick infested region of coastal Queensland were used - site A at Utchee Creek in the wet tropics, site B at Swan's Lagoon in the dry tropics and sites C and D at Eskdale and Peak Crossing in the sub-tropics. Mean annual rainfall is 3,400 mm at site A and 800 mm at the other three sites, all with a marked summer incidence. Improved grass-legume pastures were grazed at site A and native pastures at the other sites.

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Weaner *Bos indicus* x *Bos taurus* cattle aged 8-12 months were used as follows - Site A, 30 steers with 50-75% Brahman blood and mean liveweight 150.9 ± 3.73 kg (± SE); Site B, 45 heifers with 40-60% Brahman blood and liveweight 167.0 ± 2.15 kg; Site C, 12 steers and 11 heifers with 50% Brahman blood and liveweight 181.1 ± 5.47 kg; Site D, 42 steers with 30-50% Brahman or Africander blood and liveweight 182.6 ± 3.28 kg. Animals were undipped for the periods shown in Table 1. At sites A and B, animals were grazed separately from other stock while at sites C and D, the animals were grazed with comparable numbers of dipped animals.

Every three to four weeks cattle were weighed and engorging female ticks (4.5-8 mm) were counted on one side of each animal. Tick counts were transformed, log (count + 1), prior to analysis. Overall mean tick counts for all animals and the range in mean counts on different days were also calculated in this transformed scale. Repeatability of tick count was estimated by intraclass correlation with estimates pooled across other classifications, such as sex and genotype, when appropriate (Turner and Young 1969). Since separate estimates for wet seasons, dry seasons, first year and second year were consistent, repeatabilities over the whole experimental period are used. Interclass correlations were calculated in the transformed scale between each tick count and each other tick count. Each single count, mean of consecutive pair of counts, and mean of consecutive triple of counts was correlated with the total tick count over the experimental period to identify the most efficient time of the year for a selection programme. Relative efficiency of selection for lifetime performance based on the mean of two or three consecutive counts compared with selection on a single count was estimated as the ratio of the median of the correlations calculated as above (Turner and Young 1969). The relationship between tick count and average daily gain in liveweight was estimated by regression of liveweight gain on the mean transformed tick count for each animal.

RESULTS AND DISCUSSION

The experimental period, rates of liveweight gain, mean tick counts and range, repeatability estimates and correlation coefficients for tick counts are given in Table 1.

As the cattle were not treated for tick control throughout the experimental period, the tick burdens would represent the natural or field infestation for growing *Bos indicus* infused cattle at these four sites for the particular climatic conditions prevailing. At sites C and D the presence of dipped animals in the paddocks could have reduced tick populations overall. There was no marked seasonality in tick numbers but moderate peaks were recorded in October, 1976 at Site B and in April, 1976 at Site C. Mean burdens were much lower than those reported elsewhere: 5 to 22 on Droughtmaster weaners (Johnston and Haydock 1969), 19 to 34 on Africander cross and Brahman cross weaners (Turner and Short 1972) and 22 to 38 on Droughtmaster weaners (Johnston et *al.* 1981). Peak tick counts in this study were comparable with those in the former two studies.

The repeatability of tick counts was significant ($P < 0.01$) at all sites, falling into the moderate range at sites A, B and C and into the low range at site D (Turner and Young 1969). The lower values for repeatability of single counts quoted by Seifert (1971) could be a function of the small cell size of 4 to 6 animals per group. Some authors quote interclass correlation, often based on the average of several consecutive tick counts, as the measure of consistency. Turner and Short (1972) found interclass correlations of 0.459 to 0.629 for data averaged over three consecutive counts; but mention heterogeneity across breed and sex groups. In this study interclass correlations between each tick count and any other tick count varied widely but tended to be higher with counts made closer together in time than those made further apart. The median interclass correlation agreed closely with the overall estimate of repeatability (Table 1).

Table 1 Liveweight change, tick counts and correlations for growing *Bos* indicus x *Bos taurus* cattle at four sites in coastal Queensland

	Site A	Site B	Site C	Site D
Experimental period	Oct 74-Feb 76	Aug 75-Jun 77	Nov 75-May 76	Oct 76-Jan 78
Average daily gain (g/d)	470 9.9[ϕ]	273 7.0	627 22.6	211 6.3
Log tick count per side	1.6 0.04	1.9 0.02	1.9 0.05	1.7 0.02
Tick count per side†	3.9	5.5	5.4	4.3
Range of mean tick† counts	1.4 to 21.9	1.5 to 24.7	0.1 to 57.9	1.3 to 19.8
Repeatability of tick counts	0.57 0.069	0.49 0.057	0.42 0.092	0.25 0.048
Median correlation between tick counts	0.59	0.51	0.46	0.27
Correlation of single with total tick count	0.52 to 0.91	0.36 to 0.89	0.29 to 0.84	-0.01 to 0.76
Correlation of pairs with total tick count	0.61 to 0.93	0.46 to 0.93	0.69 to 0.93	0.25 to 0.80
Correlation of triples with total tick count	0.71 to 0.95	0.48 to 0.95	0.82 to 0.97	0.51 to 0.84
Relative efficiency of 2 tick counts	1.10	1.14	1.13	1.18
Relative efficiency of 3 tick counts	1.15	1.15	1.16	1.28
Regressions of average daily gain on tick count	7 9.8	-10 9.2	-60 38.0	-2 16.0

[ϕ]Mean $\pm$ standard error

[t] Numbers back transformed from log (count + 1).

Correlations with total tick count over the experimental period covered a wide range for single counts, but these ranges were much narrower for means of two or three consecutive counts (Table 1). Although the higher correlations in this range indicate that selection could be highly efficient, no specific and consistent periods with high correlations were identified. This was despite marked variation in tick burdens at different times of the year. On the basis of these data, no time of the year can be nominated as superior to any other for ranking this class of animal on tick resistance. Efficiency calculations based on median correlations indicate that selection based on the mean of two consecutive counts 21 days apart would give improvements at all four sites but that further improvement would only occur for the mean of three consecutive counts at Site D where repeatability of tick count was low. Hewetson and Utech (1979) report on the use of tick counts on at least three consecutive weeks at times when mean counts are likely to be at least 20 per side to ensure that reliable and repeatable rankings of resistance are obtained.

Regression coefficients of liveweight gain on mean tick count were low and non-significant ($P > 0.05$) indicating a poor relationship between tick burden and liveweight change. This is in agreement with the findings of Johnston and Haydock (1969), Seifert (1971) and Sutherst et *al.* (1979). The higher tick burdens could account for the significant negative relationship reported by Turner and Short (1972). This poor relationship implies that selection for tick resistance for growing *Bos indicus* x *Bos taurus* cattle would need to be justified on grounds other than liveweight performance. The studies of Johnston et *al.* (1981), R. G. Holroyd (pers. comm.) and K. S. Waters (pers. comm.) indicate that effects of ticks on breeding animals could justify a selection programme.

Based on the results obtained, no time of year stands out as being better than any other for ranking animals for tick resistance. The repeatability estimates suggest that ranking on a single count with natural infestation is inadvisable. The mean of two consecutive counts 21 days apart gives a more reliable assessment.

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