ON THE BREEDING OF A DAIRY ANIMAL FOR THE LOW COUNTRY WET ZONE OF CEYLON

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INTRODUCTION

ACCORDING to the Development Plans of the Ministry of Agriculture (1966) it is proposed to utilize the coconut lands around Colombo to produce the milk required for the metropolis. There are according to present estimates (Pannabokke 1966) about 350,000 acres of coconut lands in the low country wet zone which girdle the city of Colombo. It must however, be pointed out that with the present impetus for replanting senile coconut holdings, and for the cultivation of other crops such as pineapple, banana, vegetables etc. together with the unsatisfactory physical feature of some land, the actual area available for animal production would be very much less than the total estimated area.

In addition to being close to the City, these lands are provided with excellent roads which make transport easy and cheap. These features further minimise the time lag between collection and disposal of this perishable commodity. A well organised dairy industry, in addition, could profitably produce meat and other commodities as by products, which could again find a ready market in the City.

The Coconut Research Institute has been aware of these possibilities for some time now, and has carried out considerable research into the problems of pasture cultivation under coconuts. It has been shown by Santhirasegaram (1964 a) that within the wet zone, pasture and fodder grasses will not compete with the coconuts for soil moisture; competition for nutrients could be completely eliminated by the application of fertilizers. Among the nutrients, competition is most severe for nitrogen followed by potassium (Santhirasegaram 1965), and it has been suggested that the incorporation of an effectively nodulating legume into the pasture would at least reduce the amount of fertilizer nitrogen that has to be applied. Under the reduced light beneath coconuts Santhirasegaram and Ferdinandez (1965) found *Brachiaria miliiformis* to be a suitable grass and current work in progress at the Institute (Santhirasegaram 1966) suggests that legumes such as *Pureria phaseoloides, Centrosema pubecsens* and *Phaseolus atropurpurus* could be satisfactorily mixed with this grass, provided proper grazing practices are adopted.

Thus a high quality pasture can be grown in this area with no loss of coconut yields. The absence of a prolonged dry period would provide fresh feed the year round and eliminate the need to conserve. The economic success however, would depend on the efficiency of the grazing animal to convert this pasture into milk and meat. The area is hot and humid. This paper examines the available data on the breeding of an efficient dairy animal capable of withstanding the climatic conditions, and outlines a programme for future progress in the low country wet zone of Ceylon.

INDIGENOUS CATTLE

Nearly all coconut lands carry large numbers of indigenous cattle and buffaloe. The cattle are the descendents of a primitive type which have been indiscriminately crossed to various Indian breeds; and this population is called the "Sinhala Cattle". They are predominantly black in colour, but gradation from black to reddish brown is quite common; one would even encounter an occasional white animal. The "Dwarf Sinhala" *(Kuru harak)* found in the Natural Reserves and the remote areas of the south east sector of the island are believed to be the primitive forms. These animals are black in colour and are very much smaller than the estate cattle. The estate cattle have considerable amounts of Red Sindhi blood; the Red Sinhala in particular closely resembles the Red Sindhi. Other Indian breeds that have been crossed with the Sinhala are the Tharparkar and Sahiwal among milk breeds and Kangayam and Khillari among the draught breeds.

The average body weight of an adult Sinhala cow is 450 lbs. yielding 5 lbs./day over 250 days per lactation

(Santhirasegaram et al. 1966) under excellent management conditions. To produce this amount of milk the cows require good quality pasture plus concentrate feeding (Santhirasegaram and Goonesekera 1965), which make milk production with these animals rather uneconomical. Under normal estate conditions where the animals graze the natural weed growth, the milk yield is as low as 1.5 lb/day, and they are seldom milked.

EXOTIC BREEDS

Considering the possibilities of introducing temperate dairy breeds into the low country wet zone, Wright (1946) showed that the temperature and humidity of the area would be in excess of the tolerance limit of these breeds of cattle. Suggestions have been made at different times on the possibilities of introducing an established Indian breed such as the Red Sindhi. Large scale importation of this breed had not been possible for various reasons and as an alternative it had been suggested to gradually up grade the Sinhala to the Sindhi by back-crossing. As far as the performance of the Sindhi in Ceylon, a herd is being maintained at the Central Livestock Research Station, Polonnaruwa, in the Dry Zone. The herd average in 1961 was 2600 lb milk per lactation. (Dept. Agri. Ceylon, 1962) but it had dropped to 2200 lb in 1965 (Wijeratne personal communication) a similar observation has been made with the Red Sindhi in Malaya imported from Pakistan (Malaya Minist. Agric. 1962), and the decline in performance has been attributed to a more humid climate in Malaya compared to Pakistan. As far as efficiency of production, measured by yield/body weight ratio there would only be a slight improvement to be obtained from the Sindhi over the Sinhala.

CROSS BREEDING TO TEMPERATE CATTLE

A considerable number of attempts have been made in tropical countries to cross the Zebu to temperate breeds and in all instances considerable improvement in yield have been recorded in the F_1; some of these data where the yield of the Zebu are also known are presented in Table 1. The yield of the F_1 in every instance is higher than the mean of the two parents. This increase above the mean of the parents is due to heterosis or hybrid vigor and varies from 4 to 17 percent (Table 2). The number of records

TABLE 1.

MILK YIELD (lb / Lactation) OF CROSSBRED F_1 AND ZEBU PARENTS

Zebu	Crossbred (F_1)	% increase over Zebu	Source of data
4272	6977	63	Kartha (1941)
3000	6000	100	Matson (1929)
3798	6881	81	MacGuckin (1937)
3024	7651	53	Henderson (1927)
3000	4500	50	Matson (1929)
3084	4551	47	Indian Min. Agric. (1950)
3288	4294	30	Lecky (1949)
3000	5790	75	(Stonaker et al (1953)
2832	4764	68	Khisbin (1949)
2290	4200	83	Mahadevan & Hutchison (1964)
1620	3850	137	Armour et al (1961)
1259	5489	336	De Pinho Morgado (1961)
1100	3305	300	Santhirasegaram (unpub)
800	4493	461	Wijeratne (1962)
800	2974	272	Wijeratne (1962)

TABLE 2.

MILK YIELD (lb / Lactation) OF ZEBU, EUROPEAN AND F_1 CROSSES

Zebu	European	Mean of parents	F_1	Diff. between mean of parents & F_1	% increase
4272	8023 (F)	6147	6968	830	13.5
3798	9406 (F)	6603	6881	278	4.2
800	7062 (F)	3931	4493	562	14.3
1259	8344 (F)	4801	5489	688	14.3
3288	4137 (J)	3712	4294	582	15.7
800	4294 (J)	2547	2974	427	16.8

(F) = Friesian ; (J) = Jersey.

where the yield of the two parents are also published is limited. For a given European breed the increase in the yield of the crossbred over the Zebu parent depends on the yield of the Zebu. In Table 3 are given the yield of three types of Zebu ranging from 1100 lb/lact. to 4270 lb/lact. and their ¼ and ½ breds with Friesian; with increase in yield of the Zebu the percentage increase in the crossbred decreases.

TABLE 3.

MILK YIELD (lb/Lactation) OF ZEBU AND ¼ AND ½ CROSSES WITH FRIESIAN

Zebu	¼ bred	½ bred	Source of Information
1100	2219	3305	Santhirasegaram (unpublished)
2290	3710	4200	Mahadevan & Hutchison (1964)
4272	5982	9668	Kartha (1934)

There are three main lines available for further progress in this crossbreeding programme:—

(i) Back-cross to the European or upgrade.

(ii) Back-cross to the Zebu or downgrade.

(iii) Cross F_1 or maintain.

As far as upgrading or downgrading is concerned available literature suggests that the yield of the progeny would generally decrease. Maule (1953) reviewing the literature then available was inclined to favour upgrading to 5/8 European, but the increase to be obtained over the 4/8 or halfbred is wholly negligible and considered to be of no practical significance. In the few studies with downgrading the Zebu the results have been a progressive decline in yield. In Figure 1 the data of Kartha (1934) of downgrading F_1 to the Zebu and that of Lecky (1951) of upgrading F_1 to the European are plotted to give a complete spectrum from pure Zebu through varying proportions of the crossbreds to the pure European. Both data are for the Red Sindhi and

Friesian in India. Normally one would expect a progressive increase in yield as the percent of Friesian in the crossbred is increased. This is shown as expected and the area between the expected and observed curves is probably due to depression caused by the environment and is termed "environmental depression". The effect of the tropical environment increases with increase in the percent of Friesian blood and is greatest on the pure Friesian. It would then appear that the crossbred with 50% of each breed would be the most suitable animal from a practical point of view.

Diverse opinion has been expressed with respect to the milk yield of the F_2 and subsequent generations. The old view had been that F_2 would segregate widely resulting in mongrels. Opposed to this is the polygenic theory which suggests that there would be no such wide segregation. Mahadevan (1958) discussing this aspect of animal breeding demonstrated on theoretical grounds that if the standard deviation in the F_1 is 900 lb, then in the F_2 it would be 2300 lb. on the one gene hypothesis, but only 1120 lb. in the ten gene (polygenic) theory. There is no dispute as to the polygenic nature of milk yield inheritance, but, in the few instances where the F_2 has been studied the yield, without exception, has been disappointingly (Table 4) low compared to the F_1. It should also be noted that not only is there a reduction in the average yield but also a reduction in the maximum yields recorded. Unless the population tested were insufficient, even if there was wide segregation in the F_2, the spectrum of yield observed in the F_1 should at least be approached.

TABLE 4.

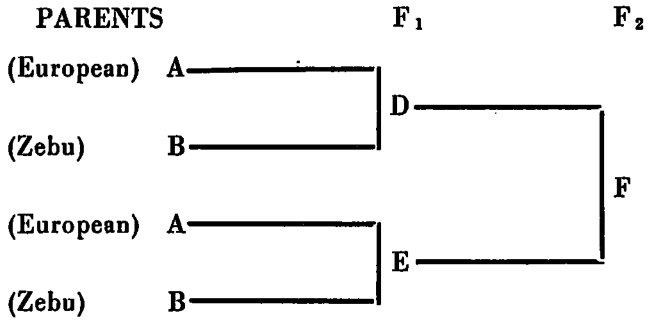
MILK YIELD (lb/Lactation) OF F_1 AND F_2 CROSSBREDS.

Generation	Ayr × Sindhi §		Fri × Sinhala*		Jer × Sinhala*	
	Av.	Max.	Av.	Max.	Av.	Max.
F_1	5122	9731	3513	5565	2508	3236
F_2	4068	8380	2187	3397	1907	2637

§ Littlewood (1933); * Wijeratne (personal comm.)

It has been suggested by various workers (Maule, 1953 and Mahadevan, 1958) that the reduction in yield of the F_2 and subsequent generations was due to an increase in the coefficient of inbreeding. According to some estimates reviewed by Rice et. al. (1957), the milk yield of cows could be depressed by as much as 80–210 lb. per 305 day lactation for every 1 percent increase in the coefficient of inbreeding.

Usually in a crossbreeding programme a small herd of fairly closely related animals are mated to one or at most-two imported bulls or artifically inseminated with semen from most probably a single bull. Under these circumstances it would not be uncommon to encounter F_2 generations which fit into the pedigree scheme shown below; which would have an inbreeding coefficient of 12.5% purely in relation to the exotic parent alone.



[Pedigree scheme of the F_2 crossbréd with inbreeding coefficient of 12.5% due to the European parent alone].

A rather striking example of inbreeding was provided by Bonadonna et al. (1966) where the number of inbred animals increased from 16% in 1958 to 55 percent in 1964, — within a matter of 8 years — with the inbreeding coefficient ranging from 4 to 25 percent. They believed that this was due to indiscriminate application of artificial insemination. Thus it is highly probable that inbreeding could to a large extent bring about the observed depressions in the F_2 and subsequent generations.

SELECTION OF THE EXOTIC BREED

In all tropical countries, including Ceylon, that there had been a tendency to favour the Friesian, is shown by the amount of published data available. There had been some attempt to use the Jersey and still fewer attempts with Ayrshire, Shorthorn and Brown Swiss. The main reason for the choice of Friesian appears to be the high yield of that breed compared to others.

In the choice of the exotic breed not only the total milk yield but such characters as efficiency, i.e. the yield/body weight ratio, ability to withstand the tropical environment including climate and disease, degeneration due to dwarfing, milk-ability, genetic combining ability etc. need to be considered.

In Ceylon considerable work has been carried out in crossbreeding the Friesian and Jersey with the Sinhala; these two breeds are contrasting to some extent in that the Friesian is a higher yielding and bigger animal but its milk has a low butter fat content compared to that of the Jersey. The discussion will be limited to these two breeds in assessing their suitability for further work and other breeds will be considered only as illustrations of the various factors.

Even though the Friesian is a higher yielding animal and its F_1 crosses with the Sinhala are also higher yielding than those of the Jersey, it has been shown that there is no advantage in one over the other from the point of view of the efficiency index (Santhirasegaram 1964 b). Examination of Table 5 will show that the indices of the common European breeds are practically the same and so are their crosses with the Sinhala. This would mean that a big animal yields more than a small animal. But from the point of

TABLE 5.

EFFICIENCY INDICES (gal./Lact./lb. body wt.) OF THREE EUROPEAN BREEDS AND THEIR CROSSES WITH THE SINHALA (Santhirasegaram 1964 b).

	European in England	European in Ceylon	European x Sinhala Crosses (F_1) in Ceylon
Friesian	0.72	0.58	0.66
Ayrshire	0.75	0.59	0.68
Jersey	0.74	0.58	0.70

view of percent butter fat content the Jersey is superior to the Friesian and in the F_1 crosses the total butter fat yield per lactation of the Jersey cross would be disproportionately higher than that of the others.

There is considerable evidence to show that the Jersey is better adapted to the tropical climate than the Friesian. Eckles (1939) considering the introduction and breeding of cattle in the United States of America suggested the success of the Jersey in the Southern States (and the Friesian in the Northern States) to be due to the better adaptability of the Jersey to the sub-tropical conditions there. The success in the evolution of the Jamaica Hope breed of cattle which comprise nearly 80 percent Jersey blood compared to the less successful progress in Trinidad with the Friesian is often quoted as another example of the superiority of the Jersey. In a study of heat tolerance in Greece, Allman (quoted by Philips 1949) obtained Iberia heat tolerance indices of 92, 84 and 76 for Brown Swiss, Jersey and Friesian respectively.

Within the Jersey breed itself there appears to be considerable difference in the ability of the individual animals to withstand the heat stress. In Australia, Barker and Nay (1964) showed that the characteristic small baggy glands of the Jersey resemble in shape those of Zebu – type breeds, and they suggested that "the small baggy gland of the Jersey may be the primitive type, from which the large baggy glands of the Zebu has developed". They further contend that "the higher heritabilities of gland diameter and volume further support the hypothesis that adaptive selection is favouring Jersey animals with large Zebu-type glands". This would then explain the observations of Allen (1962) that some of the Jersey crosses behaved similar to the pure Jersey while others behaved intermediate to the pure Zebu and Jersey, in his studies on sweating.

Ability to withstand disease is best measured by calf mortality. In the experiment in progress at Karagoda Uyangoda in Ceylon the percent mortality during the three year period ending September 1966, were 16.6 and 34.5 for the Jersey and Friesian crosses respectively. De Pinho Morgado (1961) recorded figures of 21.4 percent and 36.4 percent for

Jersey and Friesian crosses respectively in the low lands of Mozambique.

Dwarfing appears to be a character of animals in the hot and humid climate of the tropics (Epstein 1965). The cause has been attributed to a direct effect of the climate by Wright (1964), while Hammond (1947) was of the view that it was an indirect effect of the climate through the quality of the feed available. Whatever may be the cause, the bigger the animal at the initial stages the greater the degeneration in subsequent generations. This would again favour the Jersey over the Friesian. This might well be a possible explanation for the greater reduction in the average and maximum yield in the F_2 of the Friesian crosses compared to the Jersey crosses in Ceylon (see Table 4).

It will be noted that in all factors considered the Jersey is equal to if not superior to the Friesian in its suitability for crossbreeding with the local Sinhala cattle.

BUFFALOE

It wass earlier mentioned that in Ceylon there is a local breed of buffaloe. Just as the Sinhala cattle the Sinhala buffaloe is an inefficient and uneconomic animal. Attempts have been recently made to cross breed them to the Murrah breed imported from the Indian sub-continent. This animal under Ceylon conditions produces 3676 lb. milk/lact. and weighs 1128 lb.; its crosses with the local buffaloe produce 2389 lb. milk/lac. and weigh 888 lb. The efficiedcy indices are not far superior to the Sinhala cattle itself. It is suggested that while the Murrah and its crosses with the local buffaloe may be suitable for certain environmental conditions, they would not be sufficiently efficient for dairy production under coconuts tn the low country wet zone.

PROGRAMME OF BREEDING.

The foregoing discussion of available evidence has shown that the Jersay would be a suitable breed to cross the Sinhala, that the half-breed would perform satisfactorily and to maintain the level of production of the subsequent generations inbreeding should be kept at a minimum.

In the low country wet zone the majority of land holdings are relatively small and skill is limited as in the rest of the island, and the venture would be only secondary, to provide some additional income. Thus the programme should be simple and easy to follow and the animal so evolved should be able to withstand considerable amount of mismanagement and poor feeding for at least some time to come.

The presence of considerable variation to heat tolerance within the Jersey has already been pointed out. Careful selection has to be made by trained personnel. Within a breed itself high heat tolerance and low production appears to be associated (Epstein 1965) and a satisfactory selection criterion has to be worked out. This alone may greatly reduce the variation in performance to be obtained in the crossbreds.

Inbreeding may be eliminated by employing large herds in the breeding programme. This however is not possible due to the size of land holdings. In the alternative then, a large number of smaller holdings should work as a unit. If necessary the holdings in a village may form an effective unit. Each unit must have a stud centre. Appropriate measures should be worked out such that at the F_1 generation, mating does not occur within a unit. Bull calves should be exchanged among the units for the production of F_2 and subsequent generations.

Artificial insemination may be adopted, but under present conditions the results have been very disappointing (Santhirasegaram 1966). If these difficulties could be overcome, then necessary precautions must be taken to keep inbreeding at the minimum level possible.

If a large number of units as envisaged could be put into operation it should be possible to select and further minimise variation. This will lend a much greater chance of obtaining high producing families and lines which may then be followed up to stabilise a suitable type as has been done in Jamaica in producing the Jamaica Hope and as in Texas in producing the Santa Gertrudis.

Such a programme of breeding and selection is possible with a central organization such as the Department of Agriculture and or the Animal Husbandry Corporation to be set up.

These organisations should test and select the studs at all stages and eliminate inbreeding particularly at the early stages.

Regarding breeding for meat production in Ceylon one can do no better than to heartily endorse the views and programme put forward by Mahadevan (1966).

In both programmes, the co-operation and enthusiastic participation of the producers have to be sought after. In this respect the facilities and concessions for animal producers in the coconut areas announced recently by the Minister of Agriculture are most welcome.

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REFERENCES

Allen, T. E. (1962) Aust. J. Agric. Res. **13**.

Armor, J., Lee, R. P., Ross, J. G. (1961) Trop. Agriculture, Tind. **38**.

Barker, J. S. F., Nay, T. (1964) Proc. Aust. Soc. Ani. Prod. **5**.

Bonnadona, T., Curto, G. M., Carial, C., Mociardini, R., (1966) IX, Internat. Conf. Ani. Prod., Edinburg, Aug. 1966.

Ceylon Minist. Agric. (1966) Devlop. Plan.

Dept. Agric. Ceylon (1962) Ann. Rept. 1961.

De Pinho Morgado, F. (1961) An. Sev. Vet. Mocambique No. 7.

Eckles, C. H. (1939) Dairy cattle and Milk Production, 3rd Ed. 1945.

Epstein, H. (1965) A. B. A. **33**.

Hammond, J. (1947) Biol. Rev. **22**.

Henderson, G. S. (1927) Trop. Agriculture Trind. **21**.

Indian Minst. Agric. (1950) Govt. India, Press.

Kartha, K. P. R. (1934) Indian J. Vet. Sci. **4**.

Khishin, A. F. E. (1949) Emp. J, Exp. Agric. **17**.

Lecky, T. P. (1949) Bull. Dept. Agric. Jamaica. (N. S.), No. 42.

__________ *(1951)* Ph. D. thesis, Univ. Edinburg.

Littlewood, R. W. (1933) Indian J. Vet. Sci.. 3.

MacGuckin, C. E. (1937) Indian J. Vet. Sci. 7.

Mahadevan, P. (1958) C. B. A. B., Tech. Com. No. 11.

__________ *(1966)* Ceylon Daily News, Sept. 10, 1966.

__________., *Hutchison, H. G. (1964)* Anim. Prod., 6.

Malaya Minst. Agric. (1962) Malaya Govt. Press.

Matson, J. (1929) Quoted by Maule (1953)

Maule, J. P. (*1953*) A. B. A. 21.

Pannabokke, C. R. (*1966*) Milk Symp., National Milk Board, Colombo, July, 1966.

Phillips, R. W. (*1949*) Breeding livestock adapted to unfavourable enviornment. Washington, U. S. A.

Rice, V. A., Andrews, F. N., Warwick, E. J., Legates, J. E. (*1957*) Breeding and Improvement of Farm Animals, McCraw-Hill. Inc.

Santhirasegaram, K. (*1964 a*) Proc. Ann. Sess., Ceylon Ass. Adv. Sci. 20.

__________ (*1964 b*) 2nd F. A. O. Tech. Conf. Coconut Prod. Proct. Proc., Ct. 16/64. (1964 b)

__________ (*1965*) C. C. Q. 16.

Santhirasegaram, K. (*1966*) C. C. Q. 17.

__________., *Ferdinandez, D. E. F.* (*1965*) Proc. Ann. Sess. Ceylon Ass. Adv. Sci. 21.

__________ ., *Goonesekera, G. C. M.* (*1965*) Proc. Ann. Sess. Ceylon Ass. Adv. Sci. 21.

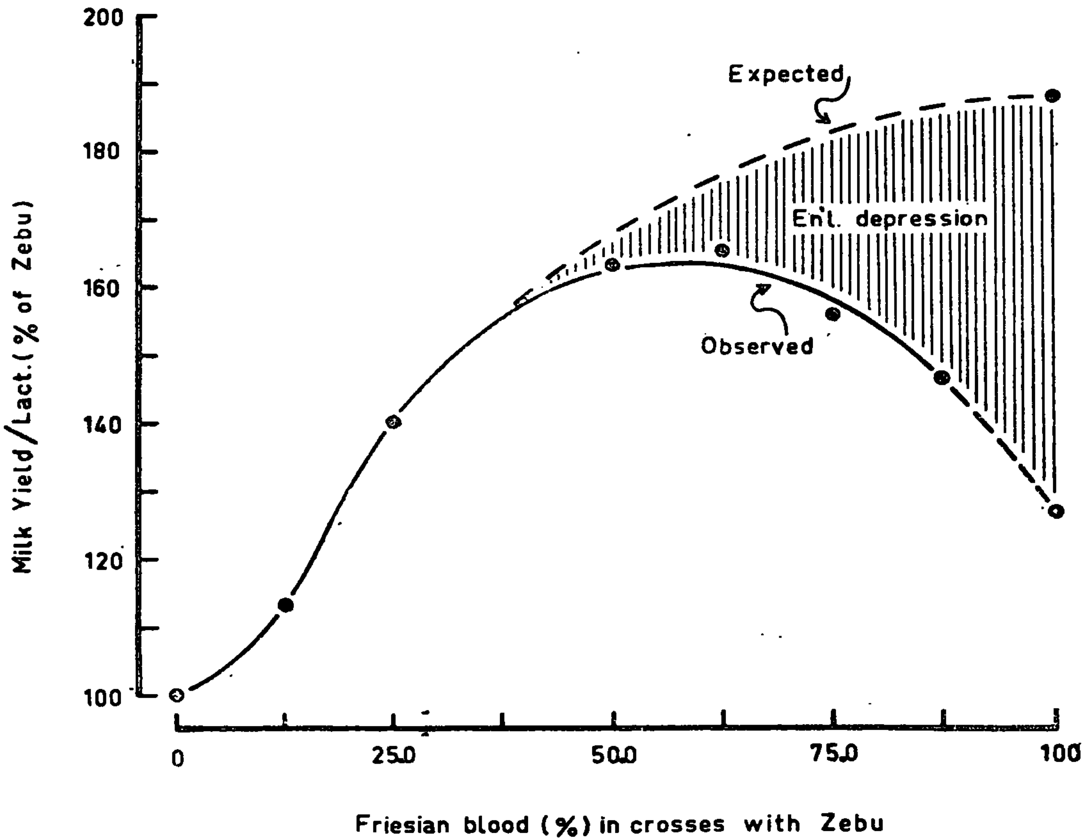
__________., *Abeywardena, V., Goonesekera, G. C. M.* (*1966*) Trop. Agriculture Trind. 43.

Stonaker, H. H., Agarwala, O. P., Sundaresan, D. (*1953*) (Quoted by Maule 1953)

Wijeratne, W. V. S. (*1962*) Ann. Rept., Dept. Agric. Ceylon (1961)

Wright, N. C. (*1946*) Sess. Paper XX., Ceylon Govt. Press.

FIGURE 1.


Expected
Ent. depression
Observed
Milk Yield/Lact.(% of Zebu)
200
180
160
140
120
100
0
25.0
50.0
75.0
100
Friesian blood (%) in crosses with Zebu