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CROSSBREEDING AND NEW BEEF CATTLE BREEDS IN BRAZIL

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ABSTRACT

Data from both crossbreeding experiments and new breed development projects carried out in Brazil are reviewed in this paper, with the purpose of summarizing the results as far as the utilization of animal genetic resources is concerned. We consider the relative importance of differences, if any, among the strategies for utilizing animal genetic resources. These average relative differences (ARD) should be estimated for characters of economic importance to beef cattle producers and expressed in relation to the most commonly used genetic resources in a given region or country. The strategies of utilizing animal genetic resources for beef production (E = European breeds; Z = Zebu breeds; and NB = New breeds) may be classified, if one considers the different types of animals resulting from their utilization, into 5 classes: 1 - purebred breeding (E and Z breeds); 2 - F₁ production (E x Z, Z x E, E x E, Z x Z, NB x E, and NB x Z crossbreeding programs); 3 - backcross production (to either E or Z); 4 - three-cross production (three-breed crossbreeding systems); and 5 - new breed development and utilization.

Average relative differences (ARD), for a given characteristic, were estimated from data reported in the literature, as the relative difference (%) between means of different types of animals (purebred European, purebred Zebu, F₁, backcross, three-cross and new breed). These ARD estimates were then expressed as a proportion of that of purebred Zebu cattle (ARD = 100), without doubt the most common animal genetic resource for beef production in Brazil. Sufficient data were only available (for all types of animals and from at least two different experiments) for birth weight, weaning weight, liveweight at slaughter, carcass weight, and dressing percentage. Net average relative differences (NARD), obtained by averaging the ARD for these 5 characteristics of animals from the 5 classes of strategies defined above, were compared to that obtained by utilizing purebred Zebu cattle (NARD = 100) and the following results were obtained: three-cross production

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(132.30), backcross production (124.37), F_1 production (114.24), new breeds (111.19) and purebred European breeds (110.85). Similarly, the NARD for the 5 characteristics, as compared to that for purebred Zebu cattle (NARD = 100), were: birth weight (130.34), carcass weight (121.75), liveweight at slaughter (121.05), weaning weight (117.87), and dressing percentage (101.93). The total net average relative difference (118.59) indicated that, all strategies taken into account, the utilization of crossbreeding systems, new breeds and European breeds for beef production in Brazil would result in an advantage of 18.59% over the utilization of purebred Zebu cattle, if the 5 characteristics are considered. However, additional data on purebreds, crossbreds and new breeds of beef cattle are needed for a number of important characters, such as, for example, calving rate, calving difficulty, age at first calving, calving interval, calf survival at birth, calf survival to weaning, age at puberty, feed conversion rate, carcass quality and cattle tick resistance, in order to make possible the formulation of recommendations that will be useful to beef cattle producers on how to best utilize the beef cattle genetic resources available to them in Brazil. Nevertheless, the flexibility available through crossbreeding to match performance levels to specific conditions must be considered a real advantage. Three-cross production appears to be the best strategy as far as liveweight for age is concerned. However, due to legal limitations (healthy young females can not be slaughtered in Brazil), terminal crossbreeding systems for producing three-cross calves are difficult to justify. In this situation, backcross or F_1 production should be taken into account in continuous crossbreeding systems.

INTRODUCTION

A large number of beef cattle breeds are available to producers in Brazil. Differences in both physiological and morphological characteristics among them can be attributed to the varying natural and artificial selection pressures to which they have been subjected. Thus, it is expected that each of these breeds is probably endowed with a different hereditary make-up. Dickerson (1969) discussed three alternative methods for utilizing this genetic diversity among breeds: (1) grading-up to a superior breed, if one is available; (2) development of a new breed; and (3) utilization of crossbreeding systems. The first two alternatives may be used during a few generations, since the final objective is either to introduce a superior breed or to develop a new breed, both suited to the production-management-marketing conditions prevailing in a given region or country. The use of crossbreeding systems has been a widely utilized practice in commercial livestock production, especially in the developed countries.

The primary reasons for utilizing crossbreeding systems are: (1) to utilize hybrid vigor or heterosis; (2) to take advantage of breed effects; (3) to utilize complementarity (Cartwright, 1970); and (4) to provide flexibility in the production system. Although the utilization of breed effects and complementarity may be as important as the utilization of heterosis in commercial beef cattle production, the latter has been an often listed and discussed reason for the implementation of crossbreeding systems.

The use of either alternative for utilizing the expected genetic diversity among beef cattle breeds, to bring about improvement in the efficiency of production, depends heavily on the production conditions and resources available, as well as on the amount of heterosis, breed and complementarity effects retained in the secondary generations, as compared to the maximum effect that is attained when using a particular crossbreeding system or a new breed formation scheme.

The objective of this paper is to review the results obtained in Brazil with respect to both crossbreeding and new beef cattle breeds. To achieve this objective, the paper is divided into two main sections: (1) crossbreeding, considering experimental and practical results, and (2) new beef cattle breeds, including those already established as a breed and having a breeders society, those in the phase of development and, finally, new breeds developed elsewhere that were imported into Brazil and have been used for beef production in this country. This review is intended to be an up-to-date summary of the results obtained so far in Brazil with respect to both crossbreeding and new beef cattle breeds. Since there is a lack of comparative results in most cases, emphasis is given to biological characterization of new beef cattle breeds and crossbred animals. The names of breeds, types and varieties are based on the world dictionary of Mason (1988).

The strategies of utilizing animal genetic resources are summarized in terms of their average relative differences compared to the performance of Zebu cattle, for characters where sufficient data were available. These average relative differences are estimated as the relative difference (%) among means of different types of beef animals resulting from the utilization of the strategies outlined earlier: breeding of purebred breeds (European and Zebu cattle), F₁ production, backcross production, three-cross production, and new breed formation.

CROSSBREEDING FOR BEEF PRODUCTION IN BRAZIL

Experimental results

In Brazil, the first crossbreeding experiment was carried out from 1934 to 1942 at the Experiment Station of the Department of Animal Production, located in Sertãozinho-SP. The program was designed to evaluate the potential of *Bos taurus* (Charolais, Devon, Hereford, Brown-Swiss, Angus and Limousin) and *Bos indicus* (Nelore, Guzará and Gir) as paternal breeds in a continuous crossbreeding system with Caracú and Brazilian Polled foundation females. The results from this experiment were summarized by Jordão and Assis (1942) in a report, and published by Santiago (1975), giving data about losses due to death and other reasons from birth to 3 years of age, liveweight, carcass weight and dressing percentage (Tables I and II). The total losses were higher for European (47.1%) than for Zebu (18.8%) breedtypes (Table I),

Table I - Total losses from birth to 3 years of age of various breedtypes in Sertãozinho, SP.

Breedtypes	No. of animals	Total losses	
		No.	%
1/2 Brown-Swiss	—	—	44.4
1/2 Charolais	—	—	41.2
1/2 Devon	—	—	38.8
1/2 Hereford	—	—	46.3
3/4 Brown-Swiss	—	—	58.1
3/4 Charolais	—	—	62.6
3/4 Devon	—	—	57.5
3/4 Hereford	—	—	65.0
1/2 Gir	43	7	16.3
1/2 Guzerá	50	11	22.0
1/2 Nelore	42	5	11.9
3/4 Gir	55	6	10.9
3/4 Guzerá	65	19	29.2
Group averages:			
1/2 European	290	119	41.0
3/4 European	135	81	60.0
1/2 Zebu	135	23	17.0
3/4 Zebu	120	25	20.8
Total	680	248	36.5

Source: Adapted from Santiago (1975).

indicating that, under the management and environmental conditions prevailing at Sertãozinho, the crossbred Zebu cattle were more resistant than the European crossbreds. The results in Table II indicate that crossbred Zebu steers were 3.1%, 17.7% and 6.4% superior to European crossbreds in terms of liveweight, carcass weight and dressing percentage, respectively. Jordão and Assis (1942) concluded that crossbred calves sired by European bulls were more susceptible to foot-and-mouth disease, ticks and high temperatures than those sired by Zebu bulls. In addition, after considering the results obtained, they suggested the discontinuation of the experiment, and that the evaluation and selection of Zebu (*Bos indicus*) cattle for beef production should be emphasized from that point of time on.

Table II - Liveweight, carcass weight and dressing percentage means of various breedtypes raised on pastures in Sertãozinho, SP.

Breedtypes	No.	Liveweight, kg	Carcass weight, kg	Dressing percentage
1/2 European	—	508.0	257.2	58.3
3/4 European	—	504.8	293.1	58.1
1/2 Zebu	51	554.4	343.5	61.9
3/4 Zebu	50	490.2	304.1	62.0
Total	—	514.4	299.5	60.1

Source: Adapted from Santiago (1975).

The first results on reproductive efficiency of crossbred European x Zebu cows were reported by Vianna *et al.* (1962). Conception rates of crossbred Charolais x Zebu cows were 65.3% under grazing conditions and natural service, whereas Zebu (Indo-Brazilian, Guzera and Nelore) cows had an average conception rate of only 39.5%. Results obtained by Vianna *et al.* (1962) for conception rate of Charolais cows should not be compared to those for Zebu and crossbred Charolais x Zebu cows, since mode of evaluation, management procedures and type of breeding (hand mating) were different. However, the results show the superiority of crossbred Charolais x Zebu cows relative to purebred Zebu.

Pires and Freitas (1974) reported the results obtained in a crossbreeding experiment with Brown-Swiss and Guzera carried out in Araçatuba, São Paulo, with an average annual temperature of 25°C and 1,200 mm of annual rainfall. The program was initiated in 1968 and cows were milked twice a day, allowing calves to suckle 1 to 2 teats; calves were supplemented with concentrates and chopped Napier grass after the second daily milking. After weaning, all calves were raised on Pangola grass pastures. Liveweight means at various ages for Guzera, Brown-Swiss x Guzera (F₁), and F₂ (Brown-Swiss x Guzera mated *inter se*) are presented in Table III. All liveweight means taken into account, the F₁ males were, on average, 25.4% and 12.5% heavier than Guzera and F₂ calves, respectively. The F₂ calves were 12.1% heavier than Guzera calves. Similarly, F₁ females were 39.3% and 19.9% heavier than Guzera and F₂, respectively. The F₂ females were, on average, 16.7% heavier than the purebred Guzera females. However, F₂ males were heavier at birth (33.8 kg) than the F₁ calves (31.7 kg). Based on the results obtained, Pires and Freitas (1974) suggested the utilization of Brown-Swiss x Guzera crossings in production systems where crossbred females can be used for milk production and males raised and marketed as beef cattle.

Table III - Liveweight means (kg) at various ages for Guzerá, F₁ and F₂ cattle in Araçatuba, SP, by sex of calf.

Liveweight	Males			Females		
	Guzerá	F ₁	F ₂	Guzerá	F ₁	F ₂
Birth	27.6	31.7	33.8	26.3	33.8	31.9
6 months	124.8	155.5	138.1	109.8	151.3	114.5
12 months	193.8	252.2	224.1	171.9	239.2	193.2
18 months	272.2	350.6	285.3	235.2	332.8	280.4
24 months	332.8	428.5	355.2	280.7	419.1	352.4

Source: Adapted from Pires and Freitas (1974).

Chagas *et al.* (1973) reported that, in Bagé, Rio Grande do Sul, the weaning weight average of 3/4 Nelore + 1/4 Angus calves was 10% higher than that of 3/4 Angus + 1/4 Nelore calves. Both groups were out of F₁ Nelore x Angus cows. This result was considered unusual for the production conditions prevailing in Rio Grande do Sul (Chagas, 1986). In addition, F₁ Nelore x Angus cows were 11.9% more efficient than purebred Angus in terms of kg of weaned calves/kg of cows.

Experimental results of a crossbreeding project developed in Uruguaiana, Rio Grande do Sul, were reported by Padilha and Becker (1979). The objective was to evaluate Charolais, Holstein and Santa Gertrudis as paternal breeds and Hereford as

Table IV - Calving, dystocia, mortality and weaning rates of Charolais x Hereford (C x H), Holstein x Hereford (Ho x H), Santa Gertrudis x Hereford (SG x H) and purebred Hereford (H x H) breedtypes in Uruguaiana, RS.

Characteristic	Breedtypes			
	C x H	Ho x H	SG x H	H x H
Calving rate, %	52.63	55.26	64.91	61.40
Dystocia, %	13.24	7.58	8.11	4.17
Mortality, %	15.49	5.97	1.33	4.11
Weaning rate, %	52.63	54.39	63.16	57.89

Source: Padilha and Becker (1979).

maternal breed. The F_1 calves were compared to purebred Hereford; all breedtypes were raised on native range with supplementary feeding (silage and hay) during the winter. Results for some production traits (Table IV), based on 4 calf crops, showed that the Santa Gertrudis x Hereford breedtype was superior in all characteristics and weaned 9.1% more calves than the purebred Hereford. Carcass characteristics were evaluated on 33- and 43-month-old steers (Table V). The F_1 Santa Gertrudis x Hereford was superior to other breedtypes for almost all characteristics evaluated. Thus, the utilization of genetic resources with some *Bos indicus* genes (Santa Gertrudis cattle are approximately 5/8 Shorthorn + 3/8 Brahman) can contribute to increase beef production efficiency in crossbreeding systems, even in regions where Hereford cattle are traditionally used. This can be confirmed by the weaning (kg of calves weaned/number of pregnant cows) and slaughter (kg carcass/number of cows calving males) indices presented in Table VI. In addition, results concerning the efficiency of F_1 females were also obtained.

Table V - Number of steers, liveweight and carcass characteristics means of various F_1 breedtypes in Uruguaiana, RS, at two ages of slaughter.

Age at slaughter/ Characteristic	Breedtypes*			
	C x H	Ho x H	SG x H	H x H
33-month-old steers:				
Number of steers	18	15	24	18
Liveweight, kg	396	399	417	348
Carcass weight, kg	202	202	217	178
Dressing percentage	51.1	50.8	52.0	51.2
Conformation, 1-15	8.6	7.0	9.0	8.0
Marbling score, 1-9	8.5	8.0	7.8	7.0
Rib-eye area, cm squared	59.0	54.1	55.0	47.4
43-month-old steers:				
Number of steers	9	13	14	13
Liveweight, kg	492	476	491	424
Carcass weight, kg	257	246	262	223
Dressing percentage	52.3	51.5	53.4	52.5
Conformation score, 1-15	9.2	8.2	9.8	8.7
Marbling score, 1-9	7.0	7.2	7.0	7.4
Rib-eye area, cm squared	66.3	60.3	61.6	61.4

Source: Adapted from Becker (1978).

* See Table IV.

Table VI - Weaning and slaughter absolute (kg) and relative (%) indices of various breedtypes in Uruguaiiana, RS.

Breedytype	Weaning index		Slaughter index	
	Absolute	Relative	Absolute	Relative
S. Gertrudis x Hereford	149.1	118.7	221.6	141.6
Holstein x Hereford	139.9	111.4	200.9	128.3
Charolais x Hereford	133.6	106.3	175.0	111.8
Purebred Hereford	125.6	100.0	156.5	100.0

Source: Adapted from Padilha and Becker (1979).

The F₁ crossbred females were evaluated in the second phase of the Uruguaiiana experiment by mating them to Angus bulls for 3 years and to Nelore bulls for 2 years. The results were reported by Becker (1985) and are summarized in Tables VII and VIII. The productivity index (kg of calves weaned/number of cows inseminated) was higher for F₁ Holstein x Hereford cows (157.28 kg) than for Santa Gertrudis x Hereford (152.56 kg), Charolais x Hereford (133.86 kg) and purebred Hereford (109.17 kg) females. The F₁ crossbred cows were, on the average, 36.4% more productive than purebred Herefords.

The three-cross calves from the Uruguaiiana experiment, sired by Nelore bulls,

Table VII - Breedytype means for various characteristics of F₁ Santa Gertrudis x Hereford (SG x H), Charolais x Hereford (C x H) and Holstein x Hereford (Ho x H), and of purebred Hereford (H x H) females mated to Angus bulls in Uruguaiiana, RS.

Characteristic	Breedytypes*			
	SG x H	C x H	Ho x H	H x H
Age at first mating, days	940	904	911	1.104
Calving rate, %	93.94	84.37	85.71	78.50
Dystocia, %	6.25	3.57	3.85	2.86
Weaning rate, %	87.88	81.25	82.14	69.05
Birth weight of males, kg	34.64	34.12	35.17	33.09
205-day weight of males, kg	167	158	162	160

Source: Adapted from Becker (1985).

* See Table IV.

Table VIII - Breedtype means for various characteristics of F₁ Santa Gertrudis x Hereford (SG x H), Charolais x Hereford (C x H) and Holstein x Hereford (Ho x H), and of purebred Hereford (H x H) females mated to Nelore bulls in Uruguaiana, RS.

Characteristic	Breedtypes			
	SG x H	C x H	Ho x H	H x H
Calving rate, %	76.31	73.68	75.76	78.50
Dystocia, %	10.00	13.33	3.85	2.86
Weaning rate, %	71.05	68.42	75.76	69.05
Birth weight of males, kg	42.00	44.80	45.69	33.89
205-day weight of males, kg	227	194	228	160

Source: Adapted from Becker (1985).

were evaluated for carcass characteristics (Table IX) and the results were reported by Becker (1985). The three-cross steers were maintained on native range pastures, supplemented with hay during the winter and slaughtered at 30 months of age. The superiority of three-cross steers over purebred Hereford in carcass weight ranged from 53% to 58%.

A second crossbreeding experiment, including Guzerá, Santa Gertrudis, Limousin and Devon as paternal breeds, was initiated in 1975 at the Experiment

Table IX - Carcass characteristics of three-cross steers in Uruguaiana, RS.

Item	Breedtypes*			
	N x (SG x H)	N x (C x H)	N x (Ho x H)	H x H
Number of steers	8	8	10	5
Liveweight, kg	486	489	500	339
Carcass weight, kg	277	281	286	181
Dressing percentage	56.7	56.8	56.6	52.0
Fat thickness, mm	3.0	2.4	2.8	2.1
Rib-eye area, cm squared	66	70	67	47
Carcass length, cm	130	131	134	117

Source: Adapted from Becker (1985).

* N = Nelore; SG = Santa Gertrudis; H = Hereford; C = Charolais; Ho = Holstein.

Station located in São Gabriel, Rio Grande do Sul. Cattle were maintained on cultivated pastures and some results, reported by Becker (1985), are presented in Table X. The crossbred steers were, on the average, 26.5% superior to purebred Devon in carcass weight.

Table X - Liveweight, carcass weight and dressing percentage means of various breedtypes in São Gabriel, RS.

Breedtype	No. of animals	Live-weight, kg	Carcass weight, kg	Dressing percentage
Guzerá x Devon	36	461	269	58
S. Gertrudis x Devon	27	464	256	55
Limousin x Devon	29	413	230	56
Purebred Devon	32	371	199	53
Total	124	427	239	56

Source: Adapted from Becker (1985).

At São Gabriel, the F₁ females were mated to either Devon or Charolais bulls to produce backcross and three-cross calves, respectively. The calving rate means of F₁ breedtypes are given in Table XI.

Table XI - Calving rate means of F₁ and Devon females mated to Devon and Charolais bulls in São Gabriel, RS.

Sire breed	Cow breedtype*			
	G x D	L x D	SG x D	D x D
Devon	74.4	67.5	70.0	49.2
Charolais	69.4	61.5	48.7	—

Source: Becker (1985).

* G = Guzerá; D = Devon; L = Limousin; SG = Santa Gertrudis.

Reis *et al.* (1979), studying factors affecting birth weight of Chianina, Nelore and Chianina x Nelore crossbred calves in Goianópolis, Goiás, observed an increase in birth weight as the proportion of Chianina genes increased in the crossbred calves

(Table XII). Silva and Pereira (1986) reported that 5/8 Chianina + 3/8 Zebu were heavier at birth and at weaning than F₁ Chianina x Zebu, probably due to the higher maternal ability of their dams (Table XIII). In the postweaning phase, however, the F₁ Chianina x Zebu Calves had higher average daily gains (Table XIII) than the other breedtypes. The results on reproductive efficiency of crossbred Chianina x Zebu females are shown in Table XIV.

Table XII - Birth weight means (kg) of Chianina, Nelore and Chianina x Nelore calves in Goianópolis, GO.

Breedtype	No.	Males	Females
Nelore	122	25.94	24.82
3/8 Chianina + 5/8 Nelore	44	27.56	26.44
1/2 Chianina + 1/2 Nelore	242	29.98	28.86
5/8 Chianina + 3/8 Nelore	32	39.84	38.72
3/4 Chianina + 1/4 Nelore	54	39.84	38.72
Chianina	17	47.58	46.46

Source: Reis *et al.* (1979).

Table XIII - Number of animals and means for growth characters of Chianina x Zebu breedtypes.

Characteristic*	Breedtype**					
	1/2 C + 1/2 Z		1/4 C + 3/4 Z		5/8 C + 3/8 Z	
	No.	Mean	No.	Mean	No.	Mean
BW, kg	1130	32.0 c	1186	33.7 b	53	39.0 a
WW, kg	1098	197.0 b	969	211.6 a	22	212.9 a
ADG, kg/day	1055	0.693 b	641	0.720 a	9	0.685 b
W365, kg	338	219.7 a	46	219.3 a	—	—
W550, kg	306	312.7 a	36	288.0 b	—	—
W730, kg	239	372.2 a	13	364.3 a	—	—

Source: Adapted from Silva and Pereira (1986).

* BW = birth weight; WW = weaning weight; ADG = average daily gain from birth to weaning; W365, W550 and W730 = body weights at 365, 550 and 730 days of age, respectively. Means on the same row with different letters are significantly different.

** C = Chianina; Z = Zebu (mainly Nelore).

Table XIV - Reproductive performance of Zebu and Chianina x Zebu crossbred females.

Characteristic*	Breedytype**					
	1/2 C + 1/2 Z		1/4 C + 3/4 Z		Zebu (Z)	
	No.	Mean	No.	Mean	No.	Mean
AFB, days	1040	738 a	307	781 b	—	—
AFC, days	967	1043 a	72	1070 a	—	—
CI, days	886	432 a	21	394 a	1302	435 a
GL, days	1625	293.3 a	87	289.6 b	1399	290.0 b
SP, days	809	131 a	19	101 ab	1200	147 b

Source: Adapted from Silva and Pereira (1986).

* AFB = age at first breeding; AFC = age at first calving; CI = calving interval; GL = gestation length; SP = service period. Means on the same row with different letters are significantly different.

** See Table XIII.

A crossbreeding experiment was carried out at the Experiment Station in Andradina, São Paulo, with the objective of evaluating Guzerá, Nelore, Brown-Swiss, Chianina (Phase 1) and Caracú (Phase 2) as paternal breeds to be crossed with Guzerá and Brown-Swiss x Guzerá females. Cattle were raised on pastures. The results on growth and mortality from birth to weaning were reported by Trovo *et al.* (1982) and are presented in Tables XV (Phase 1) and XVI (Phase 2). Crossbred F₁ calves were 9.54% and 10.49% heavier at birth and at weaning, respectively, than the purebred Guzerá in Phase 1 (Table XV). The three-cross calves, however, were 36.5% and 30.9% superior to Guzerá at birth and at weaning, respectively, probably due to their individual heterosis and to the maternal heterosis of their Brown-Swiss x Guzerá crossbred dams. Similar results were also observed in Phase 2 (Table XVI), except for birth weight of F₁ Caracú x Guzerá calves; these calves, however, were 14.9% heavier at weaning than the purebred Guzerá.

Felten *et al.* (1988a) studied some growth characters of Charolais, Nelore and crossbred Charolais x Nelore steers in feedlot conditions. Animals were penned at 20 months of age weighing 318 kg, on the average, and were fed a 12% crude protein diet during a period of 112 days. Carcass characteristics were evaluated and results reported by Felten *et al.* (1988b). The results showed that, in general, the crossbred steers were superior to the average of purebreds (Tables XVII and XVIII). However, the feed conversion of purebred Nelore was higher (Table XVII) than that of Nelore x Charolais steers.

Table XV - Birth weight (BW), weaning weight (WW), weight gain from birth to weaning (GAIN) and mortality rate (MR) means of various breedtypes in Andradina, SP, (Phase 1).

Breedtype*		BW, kg	WW, kg	GAIN, kg	MR, %
Sire	Dam				
G	G	26.2	162	135.8	14
S	G	28.7	179	150.3	8
G	SG	33.8	205	171.2	5
N	SG	35.2	209	173.8	4
C	SG	38.3	222	183.7	10

Source: Trovo *et al.* (1982).

*G = Guzerá; S = Brown-Swiss; N = Nelore; C = Chianina;
SG = Brown-Swiss x Guzerá.

Table XVI - Birth weight (BW), weaning weight (WW) and weight gain from birth to weaning (GAIN) of various breedtypes in Andradina, SP (Phases 2).

Breedtype*		BW, kg	WW, kg	GAIN, kg
Sire	Dam			
G	G	27.3	169	141.7
S	G	29.1	189	159.9
K	G	26.2	189	162.8
G	SG	34.2	217	182.8
N	SG	34.9	219	184.1
C	SG	40.2	236	195.8
K	SG	31.6	218	186.4

Source: Trovo *et al.* (1982)

*G = Guzerá; S = Brown-Swiss; K = Caracú; SG = Brown-Swiss
x Guzerá; C = Chianina.

A crossbreeding project is being carried out at the National Beef Cattle Research Center of EMBRAPA, located in Campo Grande, Mato Grosso do Sul, with the objective of evaluating Nelore, Charolais, Chianina and Fleckvieh as paternal breeds

Table XVII - Performance of purebred Charolais (C), Nelore (N) and crossbred Charolais x Nelore steers in feedlot conditions at Santa Maria, RS.

Breedytype	Means*		
	ADG, kg	DDMI, kg	FC, kg/kg
Nelore (N)	1.022 a	0.096 a	6.98 a
Charolais (C)	1.211 b	0.105 ab	8.06 ab
1/2 C + 1/2 N	1.158 ab	0.104 ab	8.35 ab
1/2 N + 1/2 C	1.085 ab	0.110 a	9.12 b

Source: Adapted from Felten *et al.* (1988a).

* ADG = average daily gain; DDMI = average daily dry matter intake per kg of metabolic size; FC = feed conversion. Means on the same column followed by the same letter are not significantly different.

Table XVIII - Carcass characteristics of Charolais, Nelore and crossbred Charolais x Nelore steers slaughtered at 2 years of age after a 112-day feeding period in confinement (Santa Maria, RS).

Breedytype	Means*	
	Carcass weight, kg	Dressing percentage
Nelore (N)	199.7 b	53.89 ab
Charolais (C)	259.5 a	52.43 a
1/2 C + 1/2 N	259.7 a	53.92 ab
1/2 N + 1/2 C	247.5 a	55.45 b

Source: Adapted from Felten *et al.* (1988b).

* Means on the same column followed by the same letter are not significantly different.

on Nelore cows. The results obtained so far (K. Euclides Filho, personal communication) are summarized in Tables XIX and XX. The crossbred males were, on the average, 11.5% heavier than the purebred Nelore when all weights for age were considered, ranging from 9.9% (backcross calves) to 13.1% (F_1 calves). Feed conversion, average

Table XIX - Liveweight means of males at various ages of different breedtypes in Campo Grande, MS.

Breedtype*	Liveweight means, kg			
	Birth	180 days	12 mo.	18 mo.
Nelore (N)	29	126	187	238
1/2 F + 1/2 N	29	133	230	291
1/2 K + 1/2 N	33	131	220	281
1/2 C + 1/2 N	31	138	231	287
1/4 F + 3/4 N	37	139	228	281
1/4 K + 3/4 N	35	131	195	241
1/4 C + 3/4 N	32	124	201	244

Source: K. Euclides Filho (personal communication, unpublished data).

* N = Nelore; F = Fleckvieh; K = Chianina; C = Charolais.

Table XX - Means for age, weight at puberty and percentage of puberal animals up to the evaluation of purebred Nelore and crossbred males and females raised on pastures at the National Beef Cattle Research Center, Campo Grande, MS.

Breedtype*	Males			Females		
	Age, mo.	Weight, kg	%	Age, mo.	Weight, kg	%
Nelore (N)	20.1	259	33	24.0	277	36
1/2 F + 1/2 N	—	—	—	22.0	304	79
1/2 K + 1/2 N	19.6	281	100	22.0	308	63
1/2 C + 1/2 N	18.6	280	100	20.0	238	71
1/4 F + 3/4 N	—	—	—	22.0	285	60
1/4 K + 3/4 N	—	—	—	19.0	261	43

Source: K. Euclides Filho (personal communication, unpublished data).

* N = Nelore; F = Fleckvieh; K = Chianina, C = Charolais.

daily gain and feed intake of purebred Nelore and F₁ crossbred males from this project were studied by Cardoso and Silva (1986), for a 100-day feeding period at 30 months of age (Table XXI). The results showed a better average daily gain performance of

Table XXI - Initial liveweight (ILW), average daily gain (ADG), feed intake (FI) and feed conversion (FC) means of different breedtypes in feedlot conditions at Campo Grande, MS.

Breedtypes*	Means**			
	ILW, kg	ADG, kg/day	FI, kg/100 kg	FC, kg/kg
Nelore (N)	247	1.38 a	3.04 a	7.03 ab
1/2 C + 1/2 N	326	1.72 b	2.96 a	7.10 ab
1/2 K + 1/2 N	292	1.71 b	2.97 a	6.58 a
1/2 F + 1/2 N	334	1.68 b	2.99 a	7.48 b

Source: Adapted from Cardoso and Silva (1986).

* N = Nelore; C = Charolais; K = Chianina; F = Fleckvieh.

** Means on the same column followed by the same letter are not significantly different.

crossbred animals, when compared to purebred Nelore. In addition, Gomes *et al.* (1989) studied the cattle tick resistance of Nelore, Ibagé and European-Nelore crosses from the National Beef Cattle Research Center crossbreeding project. Cattle were raised on pastures and averages for number of ticks are given in Table XXII, showing that Nelore cattle were more resistant than crossbreds and Ibagé. The crossbred cattle were more resistant than Ibagé.

A crossbreeding project is currently being carried out at the Experimental Station in Andradina, SP. It was designed to evaluate the F₁ progeny of Canchim, Santa Gertrudis, Holstein, Brown-Swiss and Caracú sires, respectively, bred to Nelore

Table XXII - Average number of cattle ticks by breedtype in Campo Grande, MS.

Breedtype	Average \pm s.d.*
Nelore	3.3 \pm 0.12 a
1/2 Fleckvieh + 1/2 Nelore	25.2 \pm 2.83 b
1/2 Chianina + 1/2 Nelore	22.2 \pm 2.83 b
1/2 Charolais + 1/2 Nelore	21.0 \pm 2.38 b
Ibagé	59.7 \pm 18.90 c

Source: Adapted from Gomes *et al.* (1989).

* s.d. = standard deviation. Means with different letters are significantly ($P < 0.01$) different.

females, as compared to their contemporary purebred Nelore progeny (Phase 1). Razook *et al.* (1985) reported the results concerning some production characters (Table XXIII). The superior performance (productivity) of Canchim x Nelore (C x N) and of Caracú x Nelore (K x N) crossbred calves, respectively, were verified. As compared to Nelore, these breedtypes were 26.1% (C x N) and 12.2% (K x N) more productive (Table XXIII). Relative to the overall mean for productivity (163.4 kg), the more productive breedtypes were Canchim x Nelore (35.0%), Caracú x Nelore (20.1%) and purebred Nelore (7.0%). A sample of 18-month old males from each breedtype was fattened in feedlots for a period ranging from 120 to 220 days and evaluated for growth, feed efficiency and carcass characteristics (Table XXIV). Leme *et al.* (1985) concluded that crossbred animals were superior to Nelore with respect to liveweight gain, but in turn had a higher feed intake and lower feed conversion (Table XXIV). Carcass characteristics were similar among crossbred animals, except for Holstein x Nelore, with Nelore showing the lowest average for liveweight at slaughter (423 kg) and chilled carcass weight (244 kg). The second phase of the project involves the evaluation of F₁ females by mating them to Nelore bulls. The Canchim x Nelore cows are demonstrating an excellent maternal ability up to this point in time (R.F. Nardon, personal communication). Partial results for weaning weight of backcross calves were reported by Carvalho and Corrêa (1987) and indicate an average superiority, relative to purebred Nelore, ranging from 11% to 26% depending on breedtype and sex of calf.

Villares (1979) summarized the results of crossing Chianina with Zebu breeds

Table XXIII - Production characteristics means of various breedtypes in Andradina, SP (Phase 1).

Breedtype*	No. of cows	Averages**						
		CR, %	MR, %	BW, kg	WW, kg	W13, kg	W18, kg	PROD, kg
N x N	177	79.7	7.8	27.7	168.9	164.2	242.9	174.9
C x N	171	83.0	4.9	29.0	188.9	183.9	275.7	220.6
K x N	170	73.5	6.4	26.0	182.9	183.1	280.4	196.3
H x N	206	47.1	5.2	29.8	195.2	202.9	303.7	136.7
S x N	204	52.4	11.2	30.6	189.2	191.3	288.3	135.5
G x N	168	48.8	13.4	28.3	187.5	185.0	271.3	116.7

Source: Adapted from Razook *et al.* (1985).

*N = Nelore; C = Canchim; K = Caracú; H = Holstein; S = Brown-Swiss; G = Santa Gertrudis.

** CR = calving rate; MR = mortality rate; BW, WW, W13 and W18 = weights at birth, weaning, 13 mo. and 18 mo. of age, respectively; PROD = productivity (W18 x weaning rate).

Table XXIV - Growth, feed efficiency and carcass characteristics of several breedtypes in feedlot (Andradina, SP).

Item/Characteristic**	Breedtype*					
	N x N	C x N	K x N	H x N	G x N	G x N
No. of animals	21	21	21	23	20	19
Feedlot:						
Initial wt., kg	261 c	293 b	289 b	319 a	285 b	287 b
Final weight, kg	429 c	481 b	467 b	519 a	485 b	483 b
Average daily gain, kg/day	0.904 b	1.004 ab	0.943 b	1.060 a	1.080 a	1.039 ab
Feed conversion, kg/kg	8.6 b	8.2 b	8.8 ab	9.2 a	8.4 a	8.1 b
Carcass:						
Liveweight, kg	423 a	475 ab	461 ab	517 d	483 cd	477 cd
Weight, kg	244 a	276 c	259 b	294 d	273 c	271 c
Dressing, %	53.7 ab	58.1 b	56.2 a	56.8 a	56.8 a	56.8 a

Source: Leme *et al.* (1985) and Luchiaro Filho *et al.* (1985).

* N = Nelore; C = Canchim; K = Caracú; H = Holstein; S = Brown-Swiss; G = Santa Gertrudis.

** Means on the same row followed by different letters are significantly different.

in Botucatu, SP. Growth characteristic means from birth to 2 years of age of purebred Chianina and F₁ Chianina x Nelore calves are given in Table XXV. Results from a feedlot experiment are presented in Table XXVI. The crossbred Chianina x Nelore had higher average daily gains than both the purebred Chianina and Nelore, with an overall heterosis estimate of 16.9% for weight gain in confinement. Based on results of various experiments of crossbreeding, Villares (1979) pointed out an important aspect in evaluating purebred and crossbred cattle. In general, the expected genetic differences among breedtypes do not show up under limiting environmental factors; therefore, the evaluation of purebred and crossbred breedtypes should be repeated across different environmental and management conditions.

A crossbreeding project in diallel, including the Caracú, Gir and Nelore breeds, is being carried out in Pirassununga, SP, with the objective of evaluating breed and heterosis effects on reproduction, growth and maternal Ability, under two management procedures (grazing on pastures with and without supplementary feeding during the dry season, which extends from, approximately, July through September). The first calves were born in 1983 and only the grazing on pastures without supplementary feeding during the dry season has been implemented up to this point in time.

Table XXV - Means for growth characteristic of purebred Chianina and crossbred Chianina x Nelore calves in Botucatu, SP.

Liveweight, kg	Chianina		Chianina x Nelore	
	Males	Females	Males	Females
Birth	44.6	44.3	29.2	29.1
8 months	207.8	160.0	152.2	144.5
12 months	228.4	189.2	198.9	175.6
18 months	329.4	278.4	267.4	237.8
24 months	408.2	286.0	332.2	284.7

Source: Adapted from Villares (1979).

Table XXVI - Performance of Chianina, Nelore and their crosses in a 140-day feeding period (Botucatu, SP).

Breedtype	No. of animals	Age, mo.	Liveweight, kg	Avg. daily gain, kg
Chianina (C)	14	16.4	469	0.929
1/4 C + 3/4 N	12	18.3	413	1.055
1/2 C + 1/2 N	12	18.2	341	1.024
3/4 C + 1/4 N	12	18.3	375	1.113
Nelore	12	17.8	316	0.891
Total	62	17.8	383	1.002

Source: Adapted from Villares (1979).

Lôbo (1989) reported the first results obtained from this experiment (Table XXVII) with respect to growth of 496 purebred and crossbred calves from birth to two years of age. The superiority of crossbred animals, in terms of liveweight for age, ranged from 8.5% to 21.9% (Lôbo, 1989). The heaviest calves were from the Nelore x Caracú and Gir x Caracú breedtypes, suggesting that Caracú cattle are indicated as a maternal breed in crossbreeding systems with Nelore and Gir bulls. The least-squares means for growth characters by breed of sire and breed of dam are given in Table XVIII and indicate that Caracú dams produced the heaviest calves at all ages studied. Estimates of maternal, heterosis and breed effects on growth characters were obtained by Lôbo

Table XXVII - Least-squares means for growth characters of purebred and crossbred Caracú, Gir and Nelore cattle in Pirassununga, SP.

Breedytype	Least-squares means*, kg				
	BW	WW	LW365	LW550	LW730
Caracú (C)	29.5	128.9	167	228	303
Gir (G)	26.2	124.1	161	203	286
Nelore (N)	29.3	133.6	174	230	291
C x G	27.4	139.3	187	249	300
G x C	32.6	139.4	198	273	319
C x N	29.2	143.3	191	262	324
N x C	34.8	158.3	207	277	327
G x N	30.4	138.2	176	235	300
N x G	28.4	144.4	185	239	293
Total	29.7	138.8	183	244	305

Source: Adapted from Lôbo (1989).

* BW = birth weight; WW = weaning weight; LW365, LW550 and LW730 = liveweight at 365, 550 and 730 days of age, respectively.

(1989) and are presented in Table XXIX. The highest estimates of maternal effects were obtained for Caracú, of heterosis for crosses between Caracú and Nelore and of breed effects for Nelore cattle, indicating their respective potentials for utilization in crossbreeding systems for beef production on pastures. Results from a 112-day feedlot experiment, including 36 twenty-month-old males from the diallel crossbreeding project, receiving a per animal daily diet consisting of 2 kg of crude soybean, 2 kg of ground corn and approximately 15 kg of corn silage were reported by Lôbo (1989) and are summarized in Table XXX. The crossbred animals gained 22.8% more weight and consumed 7.1% less dry matter, on average, than purebred Caracú, Gir and Nelore.

Practical results

Beef cattle producers are concerned with carcass weight and age at slaughter of cattle they raise. Some of them use simple measures to evaluate the results of utilizing crossbreeding systems; they are, usually, interested in determining the relative differences in carcass weight and age at slaughter between purebred and crossbred beef cattle breedtypes. A few results are given in Table XXXI, which indicate that net

Table XXVIII - Least-squares means for growth characters of purebred and crossbred calves, by breed of sire and breed of dam, in Pirassununga, SP.

Item/Breed	Least-squares means*, kg				
	BW	WW	LW365	LW550	LW730
Breed of sire:					
Caracú	29	137	182	247	309
Gir	30	134	178	237	302
Nelore	31	145	189	249	303
Breed of dam:					
Caracú	32	142	191	259	316
Gir	27	136	178	231	293
Nelore	30	138	180	242	305

Source: Adapted from Lôbo (1989).

* BW = birth weight; WW = weaning weight (205-day weight); LW365, LW550 and LW730 = live-weight at 365, 550 and 730 days of age, respectively.

average relative differences (ARD for age plus ARD for weight) ranged from 15.57% (including all ARD estimates) to 19.91% (including only the estimates for both age and carcass weight). These percentages represent the net benefits from crossbreeding, which producers should take advantage of more frequently in Brazil.

NEW BEEF CATTLE BREEDS FOR BEEF PRODUCTION IN BRAZIL

"*Bos certus*"

Paralleling the species names of *Bos taurus* and *Bos indicus*, used to designate European and Zebu cattle respectively, Mr. Arno Huber coined the term "*Bos certus*" to identify his project of developing a new breed of beef cattle, suited to the environmental and production conditions prevailing in the Brazilian savanna. The word "certus" means correct in the Portuguese language. The project was initiated in 1985 and the production of "*Bos certus*" cattle is expected for the year 2,000 (Carvalho and Corrêa, 1987). The genetic make-up of "*Bos certus*", as planned up to this point in time, would be the following: 37.50% Nelore, 31.25% Red Angus, 12.50% Chianina, 12.50% Simmental and 6.25% Charolais. To achieve this objective, a sire line (62.5% Red Angus, 25% Chianina and 12.5% Nelore) and a dam line (62.5% Nelore,

Table XXIX - Estimates of maternal, heterosis and breed effects (in kg) on growth characters of purebred and crossbred Caracú, Gir and Nelore cattle from the diallel crossbreeding project at Pirassununga, SP.

Item/Effect	Characteristic*				
	BW	WW	LW365	LW550	LW730
Maternal:					
Caracú (C)	3.60	5.03	8.90	12.82	6.98
Gir (G)	- 2.41	2.04	- 0.45	- 6.27	- 8.72
Nelore (N)	- 1.19	- 7.07	- 8.45	- 6.55	1.74
Heterosis:					
Overall	2.12	14.95	23.34	34.38	16.90
C x G	2.12	12.84	28.38	45.40	14.85
C x N	2.59	19.56	28.46	40.09	28.26
G x N	1.65	12.44	13.16	20.64	7.59
Breed:					
Caracú	1.19	0.08	- 0.37	8.09	9.41
Gir	- 2.12	- 4.78	- 6.02	- 17.40	- 7.36
Nelore	0.93	4.70	6.39	9.31	- 2.05

Source: Adapted from Lôbo (1989).

* BW = birth weight; WW = weaning weight (205-day weight); LW365, LW550 and LW730 = live-weight at 365, 550 and 730 days of age, respectively.

25% Simmental and 12.5% Charolais) will be developed which, after being mated *inter se*, will result in the foundation stock for producing the "*Bos certus*" cattle. In summary, the project involves the production of 7/8 European + 1/8 Nelore (sire line) and 5/8 Zebu + 3/8 European (dam line) breedtypes that, after being mated *inter se*, will result in an approximately 5/8 European + 3/8 Nelore genetic make-up ("*Bos certus*"). The project is in its first phase and no results are available at this point in time. Details of sire and dam lines development are given by Carvalho and Corrêa (1987).

Brazilian Polled

The Brazilian Polled cattle are probably derived from the Primigenius type,

Table XXX - Means for initial (ILW) and final (FLW) liveweights, average daily gain (ADG) and drymatter intake (DMI) as percentage of total available, of purebred and crossbred Caracú, Gir and Nelore males in feedlot - Pirassununga, SP.

Breedtype	ILW, kg	FLW, kg	ADG, kg/day	DMI, %
Caracú (C)	207	322	1.027	87.7
Gir (G)	259	381	1.089	82.8
Nelore (N)	271	386	1.027	80.5
C x G	302	455	1.366	76.3
G x C	291	444	1.366	76.9
C x N	259	393	1.196	86.5
N x C	293	438	1.295	79.1
G x N	318	466	1.321	78.6
N x G	280	412	1.179	71.5
Total	275	411	1.205	80.0

Source: Adapted from Lôbo (1989).

contrary to other Brazilian breeds. The polledness may have come from a genetic mutation in the Criollo cattle (Santiago, 1970), which were found in the States of São Paulo, Goiás and Minas Gerais. Later, Brazilian Polled cattle were also crossed to China and other Zebu cattle, which were native breeds, and to Red Polled and Lincoln Red (Santiago, 1970). They have no similarity whatsoever with Caracú cattle.

Brazilian Polled have a uniform yellow coat color and were subjected to selection at Nova Odessa, São Paulo, from 1911 to the late 1960's. Santiago (1970) suggests that this breed contributed to the development of Polled Zebu cattle in Brazil, since there are no polled zebu cattle in India and Pakistan. The herd-book and breed society were established in 1939, but the breed is now nearly extinct (Mason, 1988).

Caiúá

Crossing between Chianina and Zebu cattle became a common practice in some regions of Brazil in the early 1970's. The F_1 products were, in general, superior to purebred Zebu in liveweight and carcass weight at similar ages at slaughter. After these observations and, also, because of the willingness of Chianina breeders to promote it, the Brazilian Chianina Breeders Association (ABCC) decided to develop a new breed based on a genetic make-up varying from 1/2 to 7/8 Chianina blood (Alves Netto, 1978), with the complement of 1/8 to 1/2 coming from Zebu. Three names are

of 100 animals, age at slaughter, carcass weight (CW) and average relative difference (ARD) between purebred and crossbred beef cattle ("on ranch research").

	No. of animals	Age, mo.	CW, kg	ARD, %		Authors
				Age	CW	
—	600	39	278	0	0	Barbosa and Silveira (1979)
— x Nelore	482	39	320	0	15.11	
—	20,808	33	251*	0	0	Fundação Bradesco —
— x Nelore	16	—	256	—	1.99	Pecplan (1988)
— x Nelore	88	—	257	—	2.39	
— x Nelore	20	—	254	—	1.20	
—	63	36	246	0	0	Matarazzo (1988)
— x Nelore	311	25	267	30.56	8.54	
Nelore	20,095	33	259	0	0	Agropecu. CFM Ltda. (1989)
European x Nelore	1,528	24	248	27.27	-4.25	
Nelore (N)	50	24	242	0	0	Santiago (1974)
Santa Gertrudis (SG)	64	20	276	16.67	14.05	
1/2 SG + 1/2 N	156	19	211	20.83	-12.81	
3/4 SG + 1/4 N	66	17	208	29.17	-14.05	

* Weighted average of results for carcass weight of Nelore cattle given in this table

given to differentiate the Caiuá groups: Caiuá 1 (1/2 Chianina), Caiuá 2 (5/8 Chianina), and Caiuá 3 (3/4 Chianina). Alves Netto (1978) gives a detailed description on how to obtain Caiuá cattle and some results obtained from some herds (Table XXXII).

Canchim

The Canchim breed (5/8 Charolais + 3/8 Zebu) was developed at the Ministry of Agriculture Experiment Station in São Carlos, São Paulo (Fazenda Canchim) in the 1940's (Vianna *et al.*, 1962). Although two mating plans have been used, this breed was based, initially, on the *inter se* mating of males and females of a 5/8 Charolais + 3/8 Zebu foundation stock. The foundation sires and dams were obtained through the utilization of a two-breed rotation crossbreeding system, where Charolais bulls were mated with Zebu females (Indo-Brazilian, Guzera and Nelore) and the resulting F₁ females were then mated to Zebu bulls (8 Indo-Brazilian and 4 Guzera) to obtain the

Table XXXII - Observed and expected characteristics of Caiuá and Zebu breedtypes.

Characteristics/condition*	Breedtypes			
	Zebu	Caiuá 1	Caiuá 2	Caiuá 3
	Observed		Expected	
Heat tolerance	XXXX	XXXX	XXXX	XXXX
Cattle tick resistance	XXXX	XXXX	XXX	XXX
Age at puberty	X	XXX	XXXX	XXXX
Response to feeding conditions:				
Low quality pastures	XX	XXX	XX	X
Good pastures	XXX	XXXX	XXXX	XXXX
Feedlot	X	XXX	XXX	XXXX

Source: Adapted from Alves Neto (1978).

* X = regular; XX = good; XXX = very good and XXXX = excellent.

first backcross females (3/4 Zebu + 1/4 Charolais). These first backcross females were then mated to Charolais bulls to generate the 5/8 Charolais + 3/8 Zebu foundation stock. Vianna and Jondet (1978) published a detailed description of the formation of the Canchim breed. For the development of the 5/8 Charolais + 3/8 Zebu foundation stock, 53 Charolais bulls were used as sires in the herd bred at the Experiment Station in São Carlos, SP (Alencar *et al.*, 1981). The history and growth performance from birth to 24 months of age of the Charolais cattle used in the breeding of Canchim were reported by Barbosa (1982).

In the development of the Canchim breed, all crossbred animals were raised on pastures and data on production and reproduction characters were obtained. Based on the results, Vianna *et al.* (1962) concluded that the 3/8 Charolais + 5/8 Zebu breedtype was not adequate to develop the new breed, since these animals lack uniformity in type and were less productive than the 5/8 Charolais + 3/8 Zebu breedtype. The first Canchim calves were born in 1953. The name of the new breed was given later, taken from a Euphorbiaceae tree, common in the region, that was also used to name the farm (Fazenda Canchim) and the train station.

After the first data on Canchim cattle were obtained, some beef producers decided to develop their own herds. A number of Charolais bulls from the São Carlos Experiment Station were used in these programs. Thus, on November 11, 1971 the bylaws of the Brazilian Canchim Breeders Association (ABCCAN) were approved and

the Ministry of Agriculture, after recognizing the Canchim as a new beef cattle type, registered the first animals on November 11, 1972. Additional results on various aspects of production and reproduction of Canchim cattle were then obtained and the cattle type was given the status of breed, on May 18, 1983, by the Ministry of Agriculture of Brazil.

The mating schemes approved by the Brazilian Canchim Breeders Association in 1977, are shown in Table XXXIII. Registration numbers from 1972 to 1988 can be seen in Table XXXIV.

Table XXXIII - Mating schemes approved by ABCCAN for obtaining Canchim cattle.

Alternate			Grading-up		Crossing and grading-up	
Sire*	x	Dam*	Sire x Dam		Sire x Dam	
CH		Z	CA	Z	CH	Z
Z		1/2 CH + 1/2 Z	CA	"A"	or Z	CH
CH		1/4 CH + 3/4 Z	CA	"T"	CA	"T"
5/8 CH + 3/8 Z		5/8 CH + 3/8 Z	CA	"V"	CA	"V"
Canchim (65.5% CH + 37.5% Z)			Canchim (58.6% CH + 41.4% Z)		Canchim (59.4% CH + 40.6% Z)	

* CH = Charolais; Z = Zebu; CA = Canchim; A, T and V = 1/2, 3/4 and 7/8 Canchim, respectively, in honor of Antonio ("A") Teixeira ("T") Vianna ("V"), breeder of the Canchim cattle.

Table XXXIV - Numbers of animals registered in the Brazilian Canchim Breeders Association by period, breedtype and sex of calf (M = males; F = females).

Period	5/8 Charolais + 3/8 Zebu			Canchim			
	M	F*	Total	M	F	Total	Total
1972-1976	264	7,301	7,565	492	1,003	1,495	9,060
1977-1980	185	7,810	7,995	751	1,832	2,583	10,578
1981-1984	157	7,684	7,841	1,151	3,059	4,210	12,051
1985-1988	21	8,099	8,120	1,665	5,296	6,961	15,081
Total	627	30,894	31,521	4,059	11,190	15,249	46,770

Source: Alencar (1988a) and ABCCAN (1989).

* Including animals of A, T and V groups.

Data on preweaning growth characters of Canchim cattle, raised on pastures, have been analyzed by a number of researchers and are summarized in Table XXXV. Canchim cattle are born weighing 36 kg (average of male and female calves) and are weaned weighing 187 kg at 217 days of age (Table XXXV). Calving difficulty has not been a problem; Novaes *et al.* (1989) reported only 0.91% of dystocia in 1,313 calvings in São Carlos, SP.

Table XXXV - Preweaning growth characters of Canchim cattle, raised on pastures, according to period of birth and author.

Author	Period	No. of animals	Liveweight, kg		Weaning age, d
			Birth	Weaning	
Novaes <i>et al.</i> (1974)	1953-73	1,850	—	186	210
Matos (1976)	1974-76	40	27	—	—
Oliveira (1977)	1958-73	840	35	217	237
Packer (1977)	1956-73	1,818	36	180	205
Barbosa <i>et al.</i> (1979)	1958-75	1,130	35	170	205
Oliveira (1979)	1958-73	1,290	36	166	180
Alencar and Barbosa (1982)	1971-79	1,404	38	211	270
Alencar <i>et al.</i> (1985)	1982	245	—	193	240
Weighted average	1953-82	8,617	36	187	217

The postweaning growth performance of Canchim cattle raised on pastures has been analyzed on several occasions (Table XXXVI).

Reproductive characters of Canchim females have been studied by several authors (Table XXXVII). The results indicate that reproductive efficiency of Canchim females is satisfactory under good management.

Vieira *et al.* (1988) reported age at puberty of Canchim males, raised on pastures with supplementary feeding during the dry season (June-September), as being 15.2 months. For 27-month-old males raised on pastures, Barbosa (1987) reported results for libido (6.6), serving capacity (2.6) and reaction time (12 minutes), superior to Nelore bulls in the same conditions of environment and management. These results show the good reproductive performance of Canchim males.

Canchim bull calves have been evaluated under feedlot conditions at the Experiment Station in Sertãozinho, São Paulo, and the results obtained (Table XXXVIII) indicate their potential for weight gain in confinement.

table XXXVI - Means of liveweight by age of Canchim males and females on pastures.

Author	No. of animals	Liveweight means, kg			
		12 mo.	18 mo.	24 mo.	30 mo.
Barbosa <i>et al.</i> (1979)	1,130	224	283	354	408
Oliveira (1979)	1,290	236	300	367	—
Alencar <i>et al.</i> (1988)	62	—	—	—	459
Weighted average	2,482	230	292	361	411

Table XXXVII - Means for some reproduction characters of Canchim females.

Author	First oestrus		First calving		Calving interval, mo.
	Age, mo.	Weight, kg	Age, mo.	Weight, kg	
Oliveira Filho <i>et al.</i> (1979)	—	—	45.7	—	20.3
Alencar <i>et al.</i> (1982 and 1984)	—	—	33.6	—	13.3
Alencar and Bugner (1987 and 1988)	—	—	38.5	414	14.5
Alencar <i>et al.</i> (1987)	24.0	293	—	—	—
Manzano <i>et al.</i> (1987)	18.5	252	38.4	379	18.3

With the objective of evaluating the performance of Canchim and Nelore females, an experiment was carried out at the EMBRAPA Experiment Station in São Carlos, SP. Animals of both breeds were raised and maintained together on pastures of *Paspalum notatum*, Flugge, *Digitaria decumbens*, Stent and *Panicum maximum*, Jacq. A detailed description of management procedures can be found in Alencar *et al.* (1987). The results obtained so far are summarized in Table XXXIX. These results indicate that Canchim females, as compared to Nelore under the same environmental conditions and management procedures in São Carlos, were 8.69% heavier, 7.16% younger, 48.40% higher milk producers and 6.63% more efficient in terms of calf weaning weight up to the second calving. They also had a shorter gestation length than Nelore cows, but were less resistant to cattle ticks (Table XXXIX).

Additional information on Canchim cattle can be found in a review prepared by Alencar (1986). Results of utilizing Canchim bulls in crossbreeding systems with Nelore cows are presented in Tables XXIII, XXIV and XXXI.

Table XXXVIII - Performance of Canchim males in feedlot - Sertãozinho, SP.

Characteristics	No. of animals	Time period		
		1971-78	1979-83	1984-85
Final weight, kg				
460-day weight	140	427	—	—
392-day weight	280	—	355	—
378-day weight	82	—	—	362
Average daily gain, kg				
140 days	140	0.924	—	—
112 days	362	—	0.893	0.911

Source: Alencar (1988a).

Carazebú

The Carazebú cattle are the result of crossing Zebu bulls with Caracú and Brazilian Polled females. According to Santiago (1970), this new breed is being developed by Mr. A. Lunardelli at Valparaíso, São Paulo. These cattle are polled and coat color varies from bay to dark yellow. The objective of the breeder is to develop a dual-purpose (beef and milk) breed with good temperament. There are no results available on this breed yet.

Ibagé

In the decade of 1940, a crossbreeding project between Nelore and Aberdeen Angus was initiated at the Ministry of Agriculture "Cinco Cruzes" Experiment Station, Bagé, Rio Grande do Sul, with the objective of developing a 5/8 European + 3/8 Zebu population (Chagas *et al.*, 1972a). However, it was only from 1955 on, after the first 5/8 Angus + 3/8 Nelore calves had been born, that the project received priority from the Department of Agricultural Research.

Four crossbreeding plans were used in obtaining the 5/8 Angus + 3/8 Nelore foundation stock, which mated *inter se* resulted in the Ibagé cattle (Table XL). These plans were evaluated with the objective of identifying which of them should be used in the Ibagé breeding program (Table XLI). The results showed that PA calves (Table XL) were lighter at weaning than all other crossbred calves. In addition, the heaviest calves at weaning were out of PZ dams (149.3 kg), as compared to those from AZ

Table XXXIX - Performance of Canchim and Nelore females raised on pastures at the EMBRAPA Experiment Station in São Carlos, SP.

Characteristics	Least-squares means		Difference, %	Authors
	Canchim	Nelore		
12-mo. weight, kg	164	155	5.81*	Alencar <i>et al.</i> (1987)
18-mo. weight, kg	230	216	6.48*	
24-mo. weight, kg	276	253	9.09*	
30-mo. weight, kg	389	333	16.82*	
Age at puberty, days	730	867	-15.80	
Weight at puberty, days	293	282	3.90	
Age at first breeding, days	867	899	-3.56	
Weight at first breeding, kg	347	323	7.43**	
Age at first calving, days	1170	1250	-6.40**	Alencar and Bugner (1987)
Gestation length, days	288.7	293.6	-1.67**	
210-day milk production, kg	972	655	48.40**	Alencar <i>et al.</i> (1988)
Age at second calving, days	1620	1668	-2.88	Alencar and Bugner (1989)
First calving interval, days	441	418	5.50	
Number of cattle ticks	9.51	4.05	134.81	Oliveira <i>et al.</i> (1988)
Calf weaning wt./ breeding cow, kg	138.1	129.2	6.89	Alencar (1988b)
Calf weaning wt./ dam weight, kg/kg	0.375	0.378	-0.79	
Calf weaning wt./ dam age, kg/day	0.099	0.087	13.79*	

* $P < 0.05$, ** $P < 0.01$.

(137.6 kg) and ZA (133.0 kg) dams (Chagas *et al.*, 1972b). Thus, based on these results, only the PZ crossbreeding plan has been used and recommended in the breeding of Ibagé cattle.

The breed society (Brazilian Ibagé Association) was established in January, 1979 and registered 6,000 animals until December, 1983 from 60 herds bred in the States of Rio Grande do Sul (RS) and São Paulo (SP). Every year, the EMBRAPA Experiment Station (UEPAE de Bagé, today National Sheep Research Center) promotes an auction of Ibagé cattle and has sold 142 bulls and 506 females to 75 breeders up to 1984 (Salomoni *et al.*, 1984).

Research projects on Ibagé have been carried out at the EMBRAPA

Table XL - Crossbreeding plans for obtaining the 5/8 Angus - 3/8 Nelore - Bagé, RS.

Crossbreeding plan	Generation*					
	First		Second		Third	
	Sire x Dam	Sire x Dam	Sire x Dam	Sire x Dam	Sire x Dam	Sire x Dam
PZ	N	A	N	1/2 N - 1/2 A	A	3/4 N - 1/4 A
PA	N	A	N	1/2 N - 1/2 A	3/4 N - 1/4 A	A
AZ	N	A	A	1/2 N - 1/2 A	1/4 N - 3/4 A	1/2 N - 1/2 A
ZA	N	A	A	1/2 N - 1/2 A	1/2 N - 1/2 A	1/4 N - 3/4 A

Source: Adapted from Salomoni *et al.* (1984).

* N = Nelore; A = Aberdeen Angus.

Table XLI - Weaning weight (205-day) means of Angus and Angus-Nelore breedtypes in Bagé, RS, by sex of calf.

Breedtype*	205-day weaning weight, kg	
	Males	Females
Angus	117.4 f	118.1 e
1/4 N - 3/4 A	188.8 a	175.3 a
5/8 A - 3/8 N: **		
PZ	180.4 b	165.0 b
PA	146.4 e	134.4 d
AZ	172.8 c	160.9 b
ZA	162.4 d	149.1 c

Source: Adapted from Chagas *et al.* (1972b).

* N = Nelore; A = Angus.

** See Table XL (Crossbreeding plans).

Experiment Station in Bagé, RS, and some results are described here. The Ibagé bull calves averaged 30.1 kg at birth and 176.3 kg at weaning (205 days) in the 1974-1982 period (Salomoni *et al.*, 1984). The Ibagé cattle were more resistant to cattle ticks than Hereford and, within the Ibagé, red coat-colored animals were more resistant than blacks (Branco *et al.*, 1987). Liveweight and carcass characteristics of steers were

studied by Del Duca *et al.* (1987) and means for three different carrying capacities of pastures are given in Table XLII.

Table XLII - Liveweight and carcass characteristics means of Ibagé steers raised on pastures with three different carrying capacities and slaughtered at 27 months of age.

Item/Characteristic	Carrying	Capacity	AU/ha*
	1.0	1.5	2.0
Number of steers	40	40	40
Liveweight at slaughter, kg	401.2 a	384.5 ab	366.7 b
Chilled carcass weight, kg	212.2 a	199.9 b	190.1 b
Dressing percentage	52.92 a	52.0 ab	51.8 b
Carcass length, cm	126.1 a	123.0 b	121.7 b

Source: Adapted from Del Duca *et al.* (1987).

* AU = animal unit; ha = hectare.

Means on the same row followed by the same letters are not significantly different ($P > 0.05$).

Indo-Brazilian

The Indo-Brazilian was the first Zebu breed developed in Brazil (Santiago, 1970), more exactly in the Triângulo Mineiro region, by crossing animals of different Zebu breeds, such as Gir, Guzerá, Ongole, Mysore, Hissar, Mewati, Red Sindhi and others (Mason, 1988). Due to the location of Uberaba in the Triângulo Mineiro region, the Indo-Brazilian cattle were called Induberaba in the 1920 decade. From the crossings mentioned above, a new type of beef cattle was obtained, which had a white or gray coat color, large ears, well developed hump and dewlap, and the animals were notably precocious.

The reason for the Indo-Brazilian popularity in the 1940's is believed to be their large ears, because Brazilian breeders were not aware, at that point in time, of the existence of short-eared Zebu cattle in India and Pakistan. Thus, ear size, hump size and implantation as well as dewlap development were considered indicative traits of purebred Zebu cattle (Santiago, 1975). However, after the foundation of the Brazilian Herd-Book in 1936, the popularity of Indo-Brazilian cattle diminished and nowadays they are not as important, in terms of numbers, as they were in the past.

Liveweight means at several ages of Indo-Brazilian cattle were reported by Rosa *et al.* (1984) and are summarized in Table XLIII.

Recently, Mattos and Rosa (1984) summarized research results on reproduction characters of Indo-Brazilian females (Table XLIV) and suggested that service

period appears to be too long (285.6 days), probably due to the high milk production of Indo-Brazilian cows.

Pampiano-Braford

Recently, Leal (1988) presented some results obtained in Rio Grande do Sul with 1/2 Nelore + 1/2 Hereford cattle, which have been called Pampiano in the South region of Brazil. The Brazilian Hereford-Polled Hereford Breeders Association has a

Table XLIII - Numbers of animals and least-squares means (kg) for liveweight at several ages of Indo-Brazilian cattle, by sex of calf.

Characteristic	Males		Females	
	No.	Mean	No.	Mean
Birth weight	2,861	31.9	2,864	30.2
205-day weight	1,900	158.6	1,686	147.7
365-day weight	1,130	236.4	1,264	212.5
550-day weight	549	309.9	815	262.8

Source: Adapted from Rosa *et al.* (1984).

Table XLIV - Number of animals and means for reproductive characters of Indo-Brazilian cows.

Author	Characteristic*					
	AFC, mo.		SP, days		CI, mo.	
	No.	Mean	No.	Mean	No.	Mean
Carneiro <i>et al.</i> (1958)	74	45.8	—	—	232	20.5
Tabarelli <i>et al.</i> (1965)	167	41.2	—	—	—	—
Pinheiro (1973)	236	45.7	377	220.5	377	17.1
Rabelo (1974)	108	47.4	447	340.6	447	21.0
Galvão <i>et al.</i> (1975)	—	—	—	—	296	17.4
Aroeira (1976)	400	44.7	—	—	—	—
Weighted average	986	44.7	824	285.6	1,352	19.0

Source: Adapted from Mattos and Rosa (1984)

program for developing the Pampiano-Braford (ABCHPH, 1987). Moglia and Moglia (1983) reported some results on 2-year old Pampiano steers at slaughter. These steers were raised on native range pastures and on cultivated pastures during the winter (June-September). The carcass weight and dressing percentage means are given in Table XLV. In another experiment, Pinheiro *et al.* (1988) concluded that it is possible to slaughter Pampiano steers at 2.5 years of age weighing 476 kg liveweight. This result is based on native range pastures with control of worms, adequate carrying capacity (0.7 AU/ha) and use of growth stimulant. In the traditional production system, steers are slaughtered at 3.5 years of age with similar liveweight means. Additionally, a small number of Pampiano steers were compared to Nelore in Bonito, Mato Grosso do Sul, for liveweight, carcass weight and dressing percentage. After being raised on cultivated pastures and managed under similar conditions, the steers were slaughtered at 28 months of age and results are given in Table XLVI.

Table XLV - Liveweight, carcass and dressing percentage means of Pampiano steers at 2 years of age, by year of slaughter - Rio Grande do Sul.

Year of slaughter	No.	Liveweight, kg	Carcass weight, kg	Dressing percentage
1978	116	416	232.96	56.0
1979	357	419	234.60	56.0
1980	458	432	241.92	56.0
1981	532	432	246.24	57.0
1982	658	413	231.28	56.0
1983	387	416	232.96	56.0
Overall	2,508	422	237.21	56.2

Source: Adapted from Moglia and Moglia (1983).

Polled Nelore

The occurrence of polled animals within the Nelore breed has been a very rare event (Santiago, 1970). In the past, polled Nelore cattle were culled because they could not be registered in the Nelore herd-book of the Brazilian Zebu Breeders Association (ABCZ). However, three different lines of Polled Nelore cattle were bred and are available to beef cattle producers in Brazil: Fazenda São Vicente (bull named Pau d'Alho), Fazenda Indiana (bull Netinho Junior) and Fazenda Vista Bonita (bulls named Turco, Cangaceiro and Monte Branco). Nowadays, the Polled Nelore cattle are considered a variety of Nelore and are registered in a separate herd-book at the Brazilian Zebu Breeders Association (ABCZ).

Table XLVI - Liveweight, carcass weight and dressing percentage means of Pampiano and Nelore steers at 28 months of age - Bonito, Mato Grosso do Sul.

Characteristic	Breedytype		Difference, %
	Pampiano	Nelore	
Liveweight, kg	440.0	359.2	22.49
Carcass weight, kg	237.4	201.0	18.11
Dressing percentage	54.4	55.9	-2.68

Source: Adapted from Meireles and Neto (1987).

Lima (1988) reported an average calving interval of 14.6 months for 930 cows and 6,789 calvings from Polled Nelore. Data on liveweight of these cattle at the National Zebu Livestock Shows held in Uberaba, MG, are presented in Table XLVII.

Table XLVII - Number of animals and liveweight means of Polled Nelore cattle at National Zebu Livestock Shows by sex and age classes.

Sex/age class, month	Year					
	1977		1982		1987	
	No.	kg	No.	kg	No.	kg
Males:						
27-30	12	599	10	660	13	676
42-48	12	788	6	865	12	889
54-60	8	871	4	935	6	943
Females:						
27-30	16	490	18	540	25	531
42-48	6	558	15	605	23	615
54-60	5	583	18	670	12	669

Source: Adapted from Lima (1988).

Santa Clara

This new breed of beef cattle is being developed, in a ranch (Santa Clara) located in Rosário do Sul, Rio Grande do Sul, by Mr. R.S. Vasconcelos (Battiston, 1985). The program has been carried out for approximately 30 years, after the first results obtained from crossing Brahman bulls with Polled Hereford females. The cross-bred calves were superior to purebred Polled Hereford calves and this observation led Mr. Vasconcelos to pursue the formation of a new breed. Upon observing results from a number of tentative Zebu-Polled Hereford combinations, the 5/8 Polled Hereford + 3/8 Zebu were chosen as the ideal cattle. Lately, the Zebu bulls used in breeding Santa Clara have been of the Nelore, Tabapuã and Polled Zebu breeds. Some data on growth characters were collected from 1980 to 1985 and were reported by Battiston (1985). The observed means are presented in Table XLVIII for three different breedtypes (Santa Clara, 1/2 Santa Clara + 1/2 Hereford, and 3/4 Santa Clara + 1/4 Tabapuã); the number of animals included in the average for each breedtype-sex of calf subclass ranged from 33 to 167.

Table XLVIII - Observed means for body weight (BW) at different ages (205, 365 and 730 days) of Santa Clara breedtypes, by sex of calf (M = male; F = female), in Rosário do Sul, RS.

Breedtype	BW205, kg		BW365, kg		BW730, kg	
	M	F	M	F	M	F
Santa Clara (SC)	180	160	191	186	315	292
1/2 SC + 1/2 Hereford	183	157	211	184	394	339
3/4 SC + 1/4 Tabapuã	187	165	180	150	320	280
Total/Mean	183	161	194	173	343	304

Source: Adapted from Battiston (1985).

Santa Gertrudis

The Santa Gertrudis (approximately 5/8 Shorthorn + 3/8 Brahman, according to Rhoad, 1949) was the first new breed developed elsewhere (King Ranch, Kingsville, Texas, USA) to be imported into Brazil (Santiago, 1974). The first importation occurred in 1954 and the Brazilian Santa Gertrudis Association (ABSG) was established on October 24, 1961.

The Santa Gertrudis have been used in grading-up programs, as a purebred

breed and also as a sire breed in crossbreeding programs (for details see Tables IV to IX, XXIII, XXIV and XXXI). Santiago (1975) reported data on preweaning growth of several grades of Santa Gertrudis cattle bred at the State Experiment Station in São José do Rio Preto, São Paulo (Table XLIX), indicating their potential for preweaning growth under good pastures and adequate management procedures.

Table XLIX - Liveweight means of Santa Gertrudis grades in São José do Rio Preto, SP.

Santa Gertrudis grade	No. of calves	Liveweight means, kg		
		Birth	4 months	7 months
3/8	46	30.4	112.0	179.1
1/2	112	31.2	114.9	186.1
5/8	38	31.7	127.9	189.9
3/4	183	31.5	115.7	180.7
7/8	54	29.6	108.6	169.0
Total	433	31.1	115.8	181.0

Source: Adapted from Santiago (1975).

Tabapuã

The best known origin of Tabapuã cattle is Fazenda Água Milagrosa, Tabapuã, São Paulo, which belongs to Dr. Alberto Ortenblad (Ledic, 1983a). The breed was formed from a polled crossbred Guzerá x Nelore bull born in 1940 and hot-branded T-O in 1943. Approximately 100 Zebu cows were bred to T-O and a close inbreeding program (sire-daughter mating) was then followed for a number of years to develop the Tabapuã (Ortenblad, 1975). The herd-book was created in 1970 by the Brazilian Zebu Breeders Association (ABCZ, Uberaba, Minas Gerais) and the first animals were registered in 1971 (Santiago, 1975). In terms of number of animals, the Tabapuã cattle have been the fourth breed in the Growth Performance Program (CDP) carried out by ABCZ all over Brazil. Rosa *et al.* (1984) reported the first results for Tabapuã cattle from a national evaluation of growth characters of Zebu breeds (Table L).

Today, Tabapuã cattle are bred in several regions of Brazil (South, Southeast, and Northeast). Ledic (1983b) reported calving interval averages of 13.4 and 14.2 months in two herds of Tabapuã cattle bred in the State of Minas Gerais. Based on data collected by the Brazilian Zebu Breeders Association (ABCZ), Lima (1988) reported an average calving interval of 15.9 months for 2,160 registered Tabapuã cows

Table L - Numbers of animals and least-squares means (kg) for liveweight at various ages of Tabapuã cattle, by sex of calf.

Characteristic	Males		Females	
	No.	Mean	No.	Mean
Birth weight	3,696	32.0	3,383	29.8
205-day weight	2,495	167.6	2,270	155.1
365-day weight	1,642	215.6	1,505	195.0
550-day weight	628	299.0	716	255.8

Source: Adapted from Rosa *et al.* (1984).

with a total of 11,998 calvings. The shortest calving interval average was observed in the South Region (Paraná and Santa Catarina) and the longest in the Northeast (Alagoas and Bahia). Liveweight means of Tabapuã cattle at the National Zebu Livestock Shows in Uberaba, Minas Gerais, from 1977 to 1987 are presented in Table LI.

Table LI - Number of animals and liveweight means of Tabapuã cattle at National Zebu Livestock Shows by sex and age classes.

Sex/Age class, month	Year					
	1977		1982		1987	
	No.	kg	No.	kg	No.	kg
Males:						
27-30 mo.	5	671	4	705	5	718
42-48 mo.	9	804	7	881	7	910
54-60 mo.	12	864	3	930	4	1,014
Females:						
27-30 mo.	8	554	6	557	9	562
42-48 mo.	6	629	5	624	7	680
54-60 mo.	17	602	6	651	3	642

Source: Adapted from Lima (1988).

RESUMO

Resultados de experimentos de cruzamentos e de projetos de desenvolvimento de novas raças, realizados no Brasil, foram revisados neste trabalho com o objetivo de sumarizar as informações referentes às diferentes estratégias de utilização de recursos genéticos animais para produção de carne. Uma maneira de sumarizar esses resultados experimentais e de natureza prática (obtidos nas fazendas de gado de corte), é considerar a importância relativa das diferenças entre as estratégias de utilização dos recursos genéticos disponíveis. Além disso, essas diferenças relativas médias (ARD) devem ser estimadas para características de importância econômica aos produtores de gado de corte e expressas em relação ao recurso genético comumente utilizado em uma região ou país. As estratégias de utilização de recursos genéticos animais para produção de carne (E = raças Europeias; Z = raças Zebuínas; e NB = Novas raças), quando se considera os diferentes tipos de animais resultantes de sua utilização, podem ser classificadas em 5 categorias: 1 - criação de raças puras (E ou Z); 2 - produção de F_1 (E x Z, Z x E, E x E, Z x Z, NB x E, e NB x Z); 3 - produção de retrocruzas (com E ou com Z); 4 - produção de "three-cross" (sistemas de cruzamento de três raças); e 5 - desenvolvimento e utilização de novas raças.

As diferenças relativas médias (ARD), para uma determinada característica, foram estimadas a partir dos dados relatados na literatura consultada como sendo a diferença relativa (%) entre as médias de diferentes tipos de animais (Europeu, Zebu, F_1 , Retro-cruza, "Three-cross", e Nova Raça). Estas ARD foram então expressas em relação àquela para o Zebu puro (ARD = 100). Dados em quantidade suficiente (para todos os tipos de animais produzidos e obtidos em pelo menos dois experimentos) foram encontrados apenas para peso ao nascimento, peso à desmama, peso ao abate, peso da carcaça e rendimento de carcaça. As diferenças relativas líquidas (NARD), obtidas como sendo a média para as 5 características consideradas, para as 5 estratégias, comparadas com aquela para o Zebu puro (NARD = 100), foram: produção de "three-cross" (132.30), produção de retrocruzas (124.37), produção de F_1 (114.24), utilização de novas raças (111.19), e utilização de raças europeias (110.85). Da mesma maneira, as NARD para as 5 características consideradas, em relação àquelas para Zebu puro (NARD = 100 para todas as características), foram: peso ao nascimento (130.34), peso da carcaça (121.75), peso ao abate (121.05), peso à desmama (117.87), e rendimento de carcaça (101.93). A diferença relativa líquida total (Zebu = 100) foi de 118.59, indicando que, considerando todas as estratégias, a utilização de cruzamentos, novas raças e raças europeias para produção de carne resultaria em uma vantagem de 18.59% sobre a utilização de Zebu puro, para as 5 características incluídas na avaliação. Entretanto, dados adicionais em animais puros, cruzados e de novas raças de gado de corte são necessários para um grande número de características importantes, tais como, por exemplo, taxa de natalidade, distocia, idade ao primeiro parto, intervalo entre partos, mortalidade perinatal, sobrevivência de bezerros até à desmama, idade à puberdade, eficiência de conversão de alimentos, qualidade da carcaça, resistência ao carrapato, a fim de que seja possível a transferência de recomendações úteis aos produtores de gado de corte sobre como melhor utilizar os recursos genéticos animais disponíveis no Brasil para produção de carne. No entanto, a flexibilidade disponível

através dos sistemas de cruzamento para adequar níveis de desempenho às condições específicas de produção, manejo e comercialização tem que ser considerada como uma vantagem real. Assim, a produção de "three-cross" parece ser a melhor estratégia, quando se considera apenas os pesos ao nascimento, à desmama, ao abate, da carcaça e o rendimento da carcaça. Contudo, devido às limitações legais que impedem o abate de fêmeas jovens (até 3 anos de idade) em condições saudáveis, as estratégias de produção de retro-cruzas e de animais F₁ devem ser consideradas em sistemas de cruzamento contínuo.

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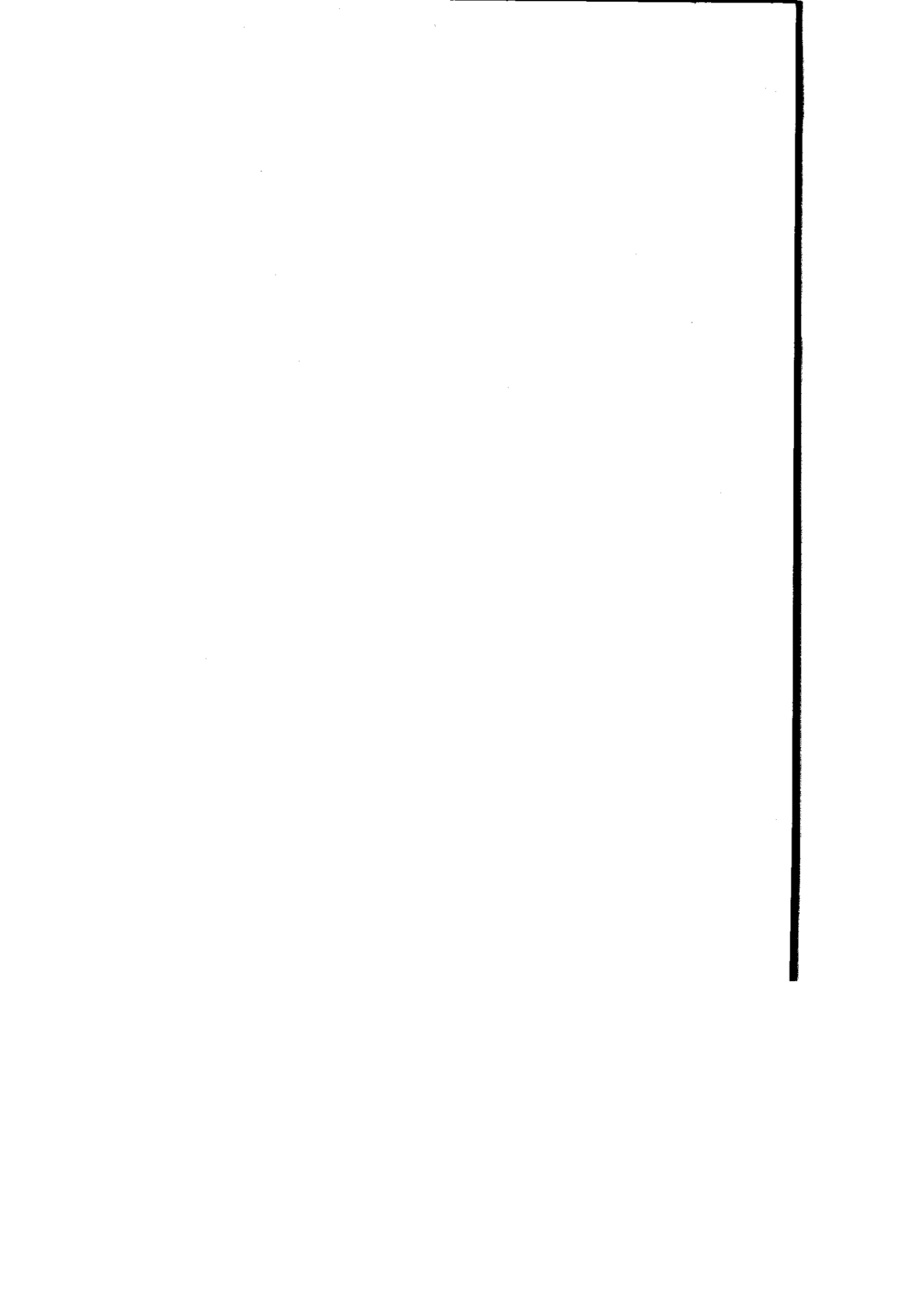
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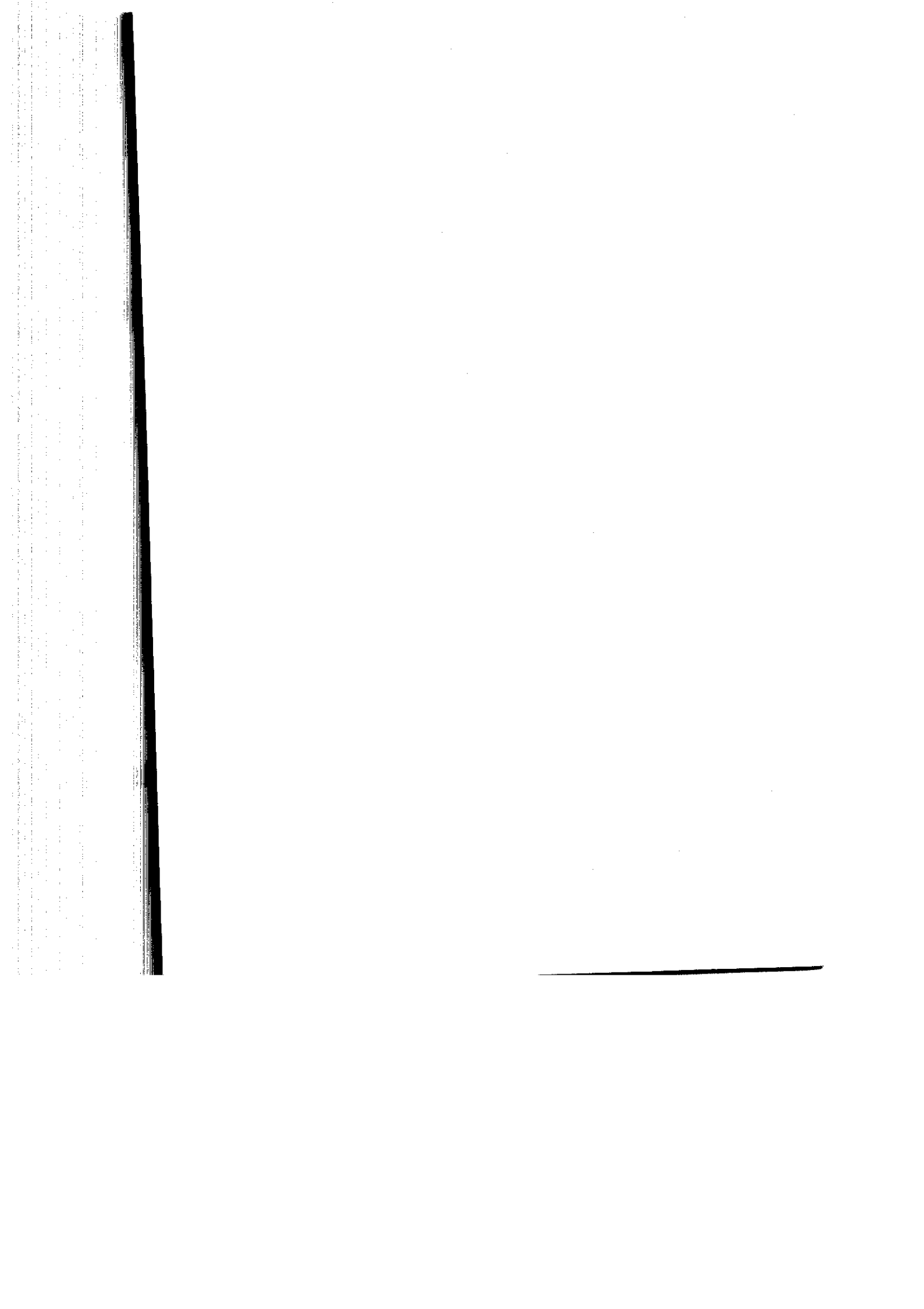
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