

## Senepol Symposium, St. Croix, USVI November 8-10, 2002

### **GROWTH OF SENEPOL-SIRED CALVES AT ZULIA STATE, VENEZUELA**

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#### **Summary**

As a second phase of a genetics improvement project looking forward to investigating the combining ability of Senepol upon both selection and breeding plans with crossbred *Bos taurus* dairy cows at Zulia state, Venezuela, a total of 185 Senepol-sired calves born between 2000-2001 were evaluated for pre- and postweaning growth as well as for estimating productivity of the dam (**POD**) at weaning. The mathematical model included the fixed effects of farm (**FM**), sire (**SR**), dam's breed of sire (**DS**), cow age (**CA**), **SR\*FM** interaction, calf sex (**CS**) and calf hair coat (**CC**), the results indicated large differences ( $P < 0,05$  to  $P < 0,001$ ) among FM, SR, SR\*FM, CS and CC. DS and CA were unimportant. General means for weights and ADG adjusted at 205-d and 365-d of calf age were, 111,6 kg y 0,400 kg/d, and 211 kg and 0,621 kg/d, respectively. POD varied from 63,3 kg to 124 kg of calf for cow exposed to breeding. Research generating in Venezuela upon Senepol performance for growth will help both breeders and producers to orientate their systems to new alternatives of production for improving dual purpose cattle in tropical conditions.

**Key words:** Senepol, growth, crossbreeding, cow productivity.

#### **Introduction**

Since the year 2000, the Senepol germplasm is being incorporated to a combination of *Bos taurus* genotypes (cows  $\geq 62,5\%$  Holstein x Brown Swiss x Criollo) specially selected for milk production in the Zulia region of Venezuela [18]. Imported USA bulls as well as national bulls are being tested on the transmission of meat and milk traits to their progenies within tropical climate, not only to demonstrate the combining ability of Senepol into dual purpose herds but also as a possible alternative to the excessive use of Brahman in commercial breeding plans.

This study was design to discover some possible interactions between the animal and its production environment by evaluating the performance for growth from birth through yearling of 50% Senepol-sired calves, achieved by A.I. of crossbred dairy cows in 4 different microclimates, and by avoiding production of animals exhibiting *Bos indicus* characteristics. On the other hand, a second objective of this research was to estimate the dam's productivity, in terms of total kg of calf weaned per cow exposed to breeding.

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## Materials and Methods

By the end of the year 2000 and all year round 2001, a total of 185 growth, weaning and yearling records corresponding to a progeny of 50% Senepol-sired calves cropped in 4 dual purpose commercial farms at Zulia state, Venezuela, were analyzed as part of a breeding project by A.I. of dairy crossbred cows ( $\approx 62,5\%$  *Bos taurus*) and a small group of cows phenotypically classified as *taurus x indicus* component (50% x 50%) within distinct microclimates and different handling and feeding conditions [18].

Both weights and gains were adjusted at 205-d and 365-d of age of the calf and analyzed [25] through a model including the fixed effects of farm, dam's breed of sire, Senepol bull, bull\*farm interaction, sex and hair coat of the calf and age of dam. In addition, a descriptive statistics upon productivity of the dam was done, as an index that determines total kilograms of calf weaned per cow exposed to breeding by farm.

The final mathematical model was:

$$Y_{ipjklsm} = \mu + F_i + R_p + T_j + \beta (x-X) + T_j * F_i + S_l + C_s + \epsilon_{ipjklsm}$$

Where:

$Y_{ipjklsm}$  = birth, weaning and yearling weight, and average daily gain adjusted;

$F_i$  = fixed effect of the  $i^{\text{ésimo}}$  farm ( $i=1-4$ );

$R_p$  = fixed effect of the  $p^{\text{ésimo}}$  dam's breed of sire ( $p=1-7$ );

$T_j$  = fixed effect of the  $j^{\text{ésimo}}$  bull ( $j=1-6$ );

$\beta$  = regression of the  $k^{\text{ésimo}}$  age of the dam ( $k=4-10$ );

$T_j * F_i$  = fixed effect of the bull\*farm interaction ( $ji=1-15$ );

$S_l$  = fixed effect of the  $l^{\text{ésimo}}$  sex of the calf ( $l=1-2$ );

$C_s$  = fixed effect of the  $s^{\text{ésimo}}$  hair coat of the calf;

$\epsilon_{ipjklsm}$  = random error associated with the dependent variable, assumed normally and independently distributed with media zero and homogeneous variance,  $\sigma^2$ .

## Results

The percent distribution for the progeny of the 6 bulls evaluated is depicted in FIG. 1, where it can be observed how the sires SE07A (28%) and CN5664 (26%) produced a lot more offspring as compared to others. This was because both bulls were utilized in a major proportion of services, simply for greater availability of straws of frozen semen donated by Genproca de Venezuela for the project. The doses of semen from the other 4 bulls utilized for insemination of the cows, CN5562, WC947, RAB125 and CRSC23F, were donated by the SCBA from the USA with minor inventory of straws. The offspring percent differences have nothing to do with possible differences on fertility of the sires.

FIG. 2 shows the percent distribution of progeny by dam's breed of sire (maternal grandsires), where a major percentage of calves born from Holstein (29%) as well as Holstein-Brahman (25%) dams is noticed, and attributed to the fact that a great number of these breed type of bulls were most commonly utilized for refoundation of dual purpose herds in the Zulia farms since 1990. The small percentage of calves born out of Senepol cows (4%) observed in the graph is attributed to a little bunch of heifers obtained

experimentally during the year 1997 in only one of the farms, as property of La Universidad del Zulia.

### **Productivity of the cow.**

This index of efficiency or productivity of the dam, as calculated by total kilograms of calf per cow exposed at weaning appears indicated in Table I. Despite Puerto Nuevo farm had the greatest calf weight mean at weaning, its own low weaning rate meant a difference of - 58,5% for cow's productivity; in contrast, El Rincón and San Pedro farms, with smaller means for weaning weight than Puerto Nuevo, had the highest indexes of productivity (124,1 y 99,5 kg) respectively, due to greater weaning rates. The Yapacana farm was intermediate in productivity with a low index of 65,3 kg and a difference of - 47,7%. Productivity of the cow is a more practical and objective index, which comparatively measures the efficiency of the dam at weaning time of her calf, in terms of calf weight by cow exposed per farm.

### **Statistical Analyses.**

The analyses of variance for pre- and postweaning growth traits are presented in Table II. With exception of the effects by dam's breed of sire as well as age of cow ( $P > 0,20$ ), the rest of sources of variation in the model influenced ( $P < 0,05$  a  $P < 0,001$ ) weights and ADG adjusted at weaning and yearling time; by observing a great significance by effects of farm and the bull\*farm interaction, and in lower grade by the effects of bull, sex and hair color of the calf. The model used resulted highly significant ( $P < 0,001$ ) with  $R^2 > 0,40$  and  $VC < 22\%$  in the lowest analysis of all for growth.

## **Discussion**

### **Farm effect**

The least squares means for weights and gains at weaning and yearling times are presented in Table III, where great differences ( $P < 0,01$ ), particularly between farms El Rincón and Yapacana as compared to Puerto Nuevo and San Pedro for preweaning growth. By regarding to postweaning growth, differences among farms were attributed to the low performance of calves from El Rincón, with 174 kg yearling weight and 0,317 kg/d, respectively, in comparison to the other good performing farms ( $P < 0,01$ ). The effect of farm was not only attributed to climate variability in the zones under study but also to differences in handling practices used in the farms, by coinciding with report of [18] for birth weight of Senepol crossbred calves Zulia state, and with report of [29], working with 12 dual purpose herds at Apure, Guárico and Falcón states, when observing that farm effect was the main cause of variation for birth weight and other production traits. A very low efficiency of nursing systems of calves was attributed to deficient feeding practices, when detected in 26 dual purpose farms in the zones of Aroa and Bajo Tocuyo [24] with irregular ADG from birth to weaning, and exhibiting a range of variation between 84 and 125 kg live weight at weaning, due to few constraints for development, growth and survival of the calf. Differences in distinct geographic zones in Venezuela with apparently similar resources reset the importance that represents an appropriate handling of herds within farms in order to increase productivity levels.

### **Dam's breed of sire effect**

A possible effect of the sire breed of dam (maternal grandsire) did not result in an important source of variation ( $P > 0,20$ ) on growth performance of Senepol crossbred calves. Nevertheless, calves from F<sub>1</sub> Senepol cows (132 kg and 230 kg), respectively at weaning and yearling age, relatively were heavier than calves from Brahman, Holstein, Swiss and Criollo crossbred cows (Table IV). On the other hand, calves from Brown Swiss crossbred cows were the lightest, although no statistical differences with its contemporary groups of distinct breed type were found.

The lack of a significant effect by breed of sire of dam found in this research is in agreement with report of [17], as the maternal grandsire did not influence both pre- and postweaning growth of Senepol-sired calves raised in a humid tropical forest in Venezuela, either; however, this finding disagrees with reports by [16, 6, 11, 7] who evaluating growth of pure- and crossbred calves in the USA, the maternal grandsire significantly affected weaning and yearling weights and gains, indicating that genetic variation among breeds are convenient for desired growth complementarity on selection of breeds for crossbreeding. In Louisiana [27, 28] Red Poll-sired heifers weaned 20 kg more of calf ( $P < 0,05$ ) than Senepol-sired daughters did. Calves from both Senepol and Tuli bulls have been lighter at weaning than progeny from Brahman bulls.

The authors want to emphasize that, great differences in results for genetics merit when classifying breed groups of cows by their offspring performance might obey more to the different methods of evaluation used by researchers other than breed differences of dams themselves. The evaluation of crosses via maternal depends on how the production traits express, in this way, classification by genetics merit of the cow could change due to that expression [20].

### **Sire effect**

Table VI shows the means for weights and ADG adjusted at weaning as well as yearling age of progenies regarding to the 6 Senepol sires utilized in crossbreeding. Bulls RAB125 and CRSC23F were superior ( $P < 0,05$ ) at 205-d as compared to others; however, at 365-d of age, no significant differences among bulls were found. Yearling weight and ADG means were 211 kg and 0,621 kg/d, respectively. Sire CRSC23F was superior to the rest of the bulls for postweaning growth and this advantage reached +13 kg in comparison to the poorest bull, SE07A.

This result is in accordance with findings of [30] who evaluated postweaning ADG on 200 Senepol young bulls in 3 trials of feeding regimens over two years in St Croix, US Virgin Islands, suggesting that animals gained appropriately under native pastures and feedlot situations (0,919 kg/d), comparable with that of temperate cattle at similar feeding treatments and also indicating that Senepol cattle expresses a high potential for growth in subtropical and tropical areas for beef production. Effect of bull within breed was also demonstrated [6] by its influence on 200-d of age of crossbred calves in Nebraska, indicating that genetics variation is important because it represents half the range between purebreds, comparable in magnitude to additive variance for weaning weight. By working with the progeny from 18 Senepol bulls in a humid tropical forest in Venezuela [17], the effect of sire was insignificant on yearling ADG which is in agreement with this report.

In Senepol x *Bos taurus* crosses in Florida, F<sub>1</sub> calves out of Senepol and Tuli sires bred to Angus and Hereford dams have been lighter at weaning than F<sub>1</sub> Brahman [26, 9, 5], but the use of Brahman bulls [4] increased calving difficulty and reduced calf survival at weaning. This result was interpreted as a disadvantage which contrasted its greater growth rate. In semi-arid conditions of southern Texas [13], under nutritional stress F<sub>1</sub> Senepol x Angus (0,750 kg/d) as well as Tuli x Angus (0,730 kg/d) calves were more competitive (P<0,05) in their relative growth rate as compared to F<sub>1</sub> Brahman x Angus (0,780 kg/d).

In Florida [12] as much as in Venezuela [22], the degree of superiority for heat tolerance exhibited by Senepol when compared to other breed types and their crosses have been attributed to differences on grazing time and its negative association with rectal temperature, thus, growth performance by F<sub>1</sub> Senepol x *Bos taurus* calves regarding physical weight and ADG have been similar, by indicating a good complementarity of Senepol germplasm with other cattle to produce both steers and young bulls for sale, and replacement heifers very well adapted to tropical and subtropical climates. Growth of Senepol crossbred calves demonstrate up to now a great competitiveness with other breed groups in rotational plans involving Simbrah-, Braford-, Brangus- and Beefmaster-sired calves [2, 3, 19]. In 4-breed of bull rotational plans for beef production [10], intergenerational variation have ranged between 10 and 25 kg for weaning weight attributed to either selected breed and sire effect.

#### **Sire\*farm interaction effect**

A great significance (P<0,05 a P<0,01) by this interesting effect on yearling weight and ADG mainly obeyed to distribution of bulls per farm with their correspondent individual breeding value transmission of the trait to their progenies; also, this interaction was due to differences in handling practices of calves in the farms, instead of complete climate differences.

As shown in FIG. 3, progeny from bulls CN5562 and CRSC23F within Yapacana farm performed the greatest for postweaning growth; however, these advantages were inconsistent for ADG of their progenies in other farms. Likewise, transmitting ability of the 6 sires within El Rincon farm was unsatisfactory in comparison with their better values for ADG in other farms, by permitting to interpret these differences (P<0,01) as sire\*farm interactions. In turn, San Pedro resulted to be the most constant farm for all the bulls on the growth performance of their calves into the production system, according to the failure of significance by its own environment and sire interaction. Within San Pedro farm, all bulls behaved acceptably on their consistent transmitting ability for postweaning growth of their calves.

In general, with the light exception of bull CN5562 within the Yapacana farm, sire CN5664 was identified as the most transmitting bull for growth of their progeny (0,632 ! 0,043 kg/d) in all the farms. At Perijá zone [18], significant effects by the sire\*farm interaction have been found, but this is true for birth weight of 50% Senepol-sired calves, only. In contrast, environmental effects instead of genetics effects have been the main cause of variation (P<0,05 a P<0,001) on postweaning growth rate of crossbred calves raised in dual-purpose production systems nearby the Cuenca del Lago de Maracaibo [15]. Studies about this interaction effect are very complex to conduct and unfortunately

it is not commonly included in mathematics models for analyses of variance and, therefore, it cannot be widely discussed in this paper.

### **Age of dam effect**

Even though in the ongoing project, both 7- and 3-year old dams have calved heavier calves and 4-year olds the lightest ones at birth ( $P < 0,01$ ), in this occasion, no significant differences among comparable ages were found for pre- and postweaning growth (Table II). Studies favoring those younger cows as well as intermediate ages involving the Senepol breed have been reported earlier [16, 13, 26, 17,18] and are in disagreement with this research. In addition, age of cow has significantly affected growth rate in other experiments conducted in Venezuela [21, 29], when young cows are clearly in disadvantage with adult dams for growth performance of the calf in dual-purpose production systems. These results corroborate the importance of taking into account the cow age when evaluating animals individually for contemporary comparison making, especially in heifers.

### **Sex of calf effect**

When compared to female calves, male's growth superiority is observed in Table VI. Nevertheless, this advantage was only important as yearlings ( $P < 0,05$ ) when male calves weighed +10 kg because of their faster daily gains (+40 g/d) than did females. In Venezuela, large differences between sexes of purebred Senepol [17], crossbred Senepol [1, 21], and crossbred dairy calves in dual-purpose operations [14], have equally resulted in favor of males up to a 12% advantage ( $P < 0,001$ ) for both weaning and yearling weights and ADG as compared to female calves. In the USA, according to several crossbreeding studies conducted in beef herds [16, 13, 6, 7, 8] purebred as well as crossbred young bulls have highly surpassed the heifers growth performance ( $P < 0,05$  to  $P < 0,001$ ). Other crossbreeding projects have included the bull\*sex interaction in the models of variance, where in Florida [4] 205-d ADG, and in Texas [23] weaning weight of males have been greater than exhibited by females up to +18 kg within Senepol, +12 kg within Angus, and +14 kg within 5 different Zebu breed types. These evaluations are very important to determine possible breed differences among sires upon growth rate of their progenies.

### **Hair color effect**

Despite there was not a significant influence by this effect on 205-d growth among red, yellow and black calves, FIG. 4 presents the result for 365-d weight by depicting how the red and yellow calves were heavier ( $P < 0,05$ ) than black ones. These particular differences within crossbred Senepol were firstly attributed to the percent distribution of progenies by hair coat, in the understanding that black hair calves were fewer (19%) because of maternal Holstein ancestry in comparison with yellows (21%) and red hair (60%) calves of either Brown Swiss or Criollo maternal ancestry [18]. Secondly, dominance of black gene over red and yellow ones is partially diminished in the bovine populations of the zone under study, where most Holstein cows used in the crosses are heterozygous at *locus* ( $R^b R$ ) for color, and as a consequence either penetrance or expressivity of the gene are diminished, as well.

Within the Senepol breed, studies including the effect of hair color on quantitative traits are scarce and therefore cannot be more widely discussed with the findings reported herein, unfortunately.

### **Conclusions and Implications**

Pre- and postweaning growth traits differences were found in Senepol-sired calves from a crossbreeding project which involved artificially inseminated crossbred dairy cows ( $\infty 5/8$  *Bos taurus*) with Senepol germplasm in 4 commercial dual purpose farms at Zulia state, Venezuela. The effects of farm sire within breed, sire\*farm interaction, sex and hair color of the calf were important sources of variation ( $P < 0,05$  to  $P < 0,001$ ) in its influence on adjusted 205-d and 365-d weights and average daily gains.

Combinations of cows, bulls, sexes and farms which provoke the observation of lighter or heavier contemporary calves at weaning or yearling time, indicate the existence of important interactions between genetics potential of the calf for growth and the environment present in distinct bovine production systems in western Venezuela, characterized by different handling practices associated to a significant influence for the service sire.

These results need to be strongly supported by future research work upon maternal and paternal EPD's contributions for calf performance, to offer producers a better guidance on selection of young bulls as well as replacement heifers. For decisions making, breeding values should be firmly used on selection programs to achieve the expected genetics progress of progeny, successfully.

Part of the investigation on Senepol cattle that begins to generate in Venezuela with the purpose of characterizing this breed throughout performance tests will help out producers and breeders demanding other production alternatives for commercial dual-purpose cattle operations in tropical environments. Documentation of Senepol germplasm will begin to accumulate in the country once researchers and breeders coincide in those selection plans necessary to obtain bigger incomes from real productivity of the national herds in Venezuela.

### **Acknowledgements**

The authors wish to express their sincere gratitude to the USA Senepol Cattle Breeders Association (SCBA) and to GENPROCA de Venezuela for their huge contribution in donating the Senepol germplasm for execution of the project in farms of Zulia, and the successful completion of this research. To all of them our infinite thanks on behalf of The University of Zulia, School of Veterinary Sciences.

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TABLE I

WEANING RATE, WEANING WEIGHT MEANS AND COW PRODUCTIVITY BY FARM (CPF)<sup>a</sup>

<i>Farm</i>	<i>Weaning rate</i>	<i>Weaning weight</i>		
	<i>%</i>	<i>kg</i>	<i>CPF, kg</i>	<i>Difference, %</i>
El Rincón	92.8	133.7	124.1	-7.2
Puerto Nuevo	41.5	152.5	63.3	-58.5
San Pedro	88.4	112.6	99.5	-11.7
Yapacana	52.2	125.0	65.3	-47.7

<sup>a</sup> CPF = Productivity or efficiency of the dam = kg of calf weaned by cow exposed.  
Weaning rate = (pregnancy rate x survival rate) / cow exposed.

TABLE II

LEAST SQUARES ANALYSIS OF VARIANCE FOR ADJUSTED WEIGHT AND AVERAGE DAILY GAIN AT 205 AND 365 DAYS OF AGE

<i>Source</i>	<i>df</i>	<i>205-d wt</i>	<i>205-d ADG</i>	<i>365-d wt</i>	<i>365-d ADG</i>
Farm	3	3642.3 <sup>a</sup>	0.084 <sup>a</sup>	29381.3 <sup>a</sup>	0.983 <sup>a</sup>
Dam's breed of sire	6	386.9	0.009	919.3	0.024
Senepol bull	5	703.2 <sup>c</sup>	0.019 <sup>c</sup>	217.6	0.034
Bull x farm	15	387.7	0.009	1162.2 <sup>c</sup>	0.058 <sup>b</sup>
Calf sex	1	635.5	0.012	2692.1 <sup>c</sup>	0.039
Hair color of calf	2	196.9	0.002	1624.8 <sup>c</sup>	0.042
Cow age	1	173.0	0.002	108.1	0.001
Residual	125	330.4	0.008	661.4	0.025

<sup>a</sup> P < 0.001 ; <sup>b</sup> P < 0.01 ; <sup>c</sup> P < 0.05

TABLE III

LEAST SQUARE MEANS AND STANDARD ERRORS FOR ADJUSTED WEIGHTS AND AVERAGE DAILY GAINS AT 205 AND 365 DAYS BY FARM

<i>Farm</i>	<i>205-d ADG</i>			
	<i>205-d wt, kg</i>	<i>kg/d</i>	<i>365-d wt, kg</i>	<i>365-d wt, kg/d</i>
El Rincón	121.0 ± 4.6 <sup>a</sup>	0.446 ± 0.022 <sup>a</sup>	173.7 ± 6.9	0.317 ± 0.042
Puerto Nuevo	141.7 ± 6.0	0.541 ± 0.029	251.1 ± 8.7 <sup>a</sup>	0.668 ± 0.053 <sup>a</sup>
San Pedro	104.4 ± 2.9	0.363 ± 0.014	197.5 ± 4.8	0.592 ± 0.029 <sup>a</sup>
Yapacana	119.2 ± 5.1 <sup>a</sup>	0.431 ± 0.025 <sup>a</sup>	263.0 ± 7.6 <sup>a</sup>	0.886 ± 0.046

<sup>a</sup> Means with different superscript differ (P<0.01).

TABLE IV

LEAST SQUARE MEANS AND STANDARD ERRORS FOR ADJUSTED 205 AND 365 DAYS WEIGHT BY DAM'S BREED OF SIRE

Dam's breed of sire	205-d weight kg	365-d weight kg
Brahman	123.1 ± 6.1	232.5 ± 9.4
Holstein	115.1 ± 3.1	216.9 ± 4.6
Holstein x Brahman	118.1 ± 4.4	211.2 ± 6.9
Holstein x Criollo	122.3 ± 6.2	229.8 ± 9.2
Brown Swiss x Brahman	126.5 ± 5.3	220.2 ± 8.2
Senepol	131.9 ± 10.5	229.5 ± 17.5
Brown Swiss	114.0 ± 4.9	209.1 ± 7.1

TABLE V

LEAST SQUARE MEANS AND STANDARD ERRORS FOR AJUSTED 205 AND 365 DAYS WEIGHTS AND AVERAGE DAILY GAINS BY SENEPOL BULL

<i>Sire</i>	<i>Birth weight</i> kg	<i>205-d wt</i> kg	<i>205-d ADG</i> kg/d	<i>365-d wt</i> kg	<i>365-d ADG</i> kg/d
SE07A	29.6 ± 1.5	126.1 ± 5.7	0.469 ± 0.028 <sup>a</sup>	216.9 ± 8.4	0.568 ± 0.052
CN5562	32.0 ± 1.6	113.6 ± 6.1 <sup>a</sup>	0.400 ± 0.030 <sup>bc</sup>	220.2 ± 8.6	0.660 ± 0.053
WC947	30.4 ± 1.2	113.2 ± 4.3 <sup>a</sup>	0.404 ± 0.021 <sup>b</sup>	221.5 ± 6.3	0.667 ± 0.039
RAB125	29.7 ± 1.4	129.8 ± 5.3 <sup>b</sup>	0.488 ± 0.026 <sup>a</sup>	218.6 ± 7.7	0.544 ± 0.047
CRSC23F	29.0 ± 1.6	127.4 ± 6.0 <sup>b</sup>	0.481 ± 0.029 <sup>ad</sup>	229.5 ± 8.9	0.624 ± 0.055
CN5664	31.0 ± 1.3	119.3 ± 4.7	0.432 ± 0.023 <sup>a</sup>	221.4 ± 7.1	0.632 ± 0.043

<sup>abcd</sup> Means with different superscript differ (P < 0.05).

TABLE VI

LEAST SQUARE MEANS AND STANDARD ERRORS FOR AJUSTED 205 AND 365 DAYS WEIGHTS AND AVERAGE DAILY GAINS BY CALF SEX

<i>Sex</i>	<i>205-d ADG</i>		<i>365-d ADG</i>	
	<i>205-d wt, kg</i>	<i>kg/d</i>	<i>365-d wt, kg</i>	<i>kg/d</i>
Female	119.2 ± 3.2	0.435 ± 0.016	216.2 ± 4.9 <sup>a</sup>	0.596 ± 0.030
Male	123.9 ± 3.3	0.456 ± 0.016	226.4 ± 5.1	0.635 ± 0.031

<sup>a</sup> P<0.05.

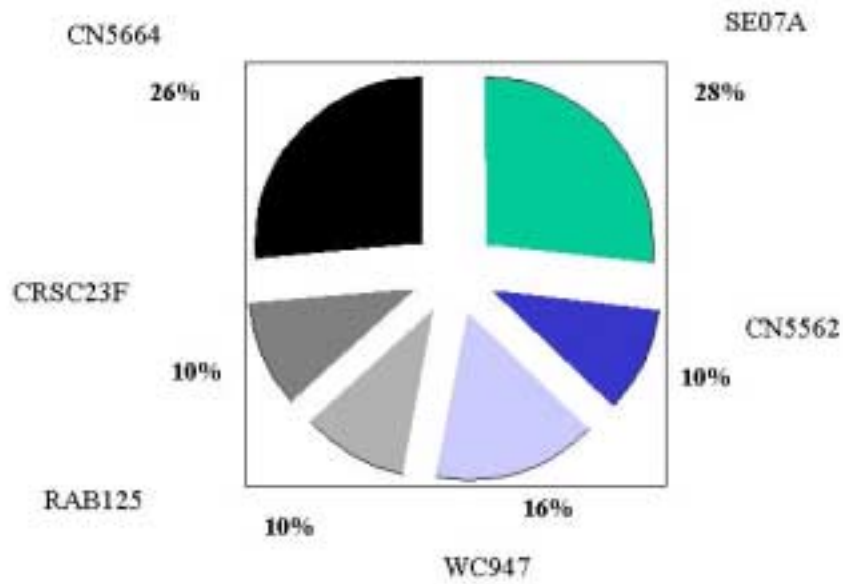


Figure 1. Distribution of sire's progeny

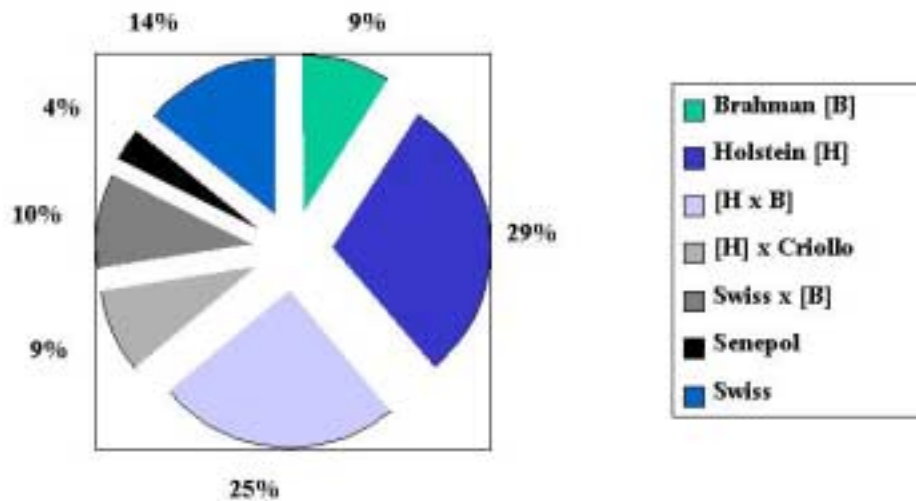


Figure 2. Progeny distribution of dam's breed of sire

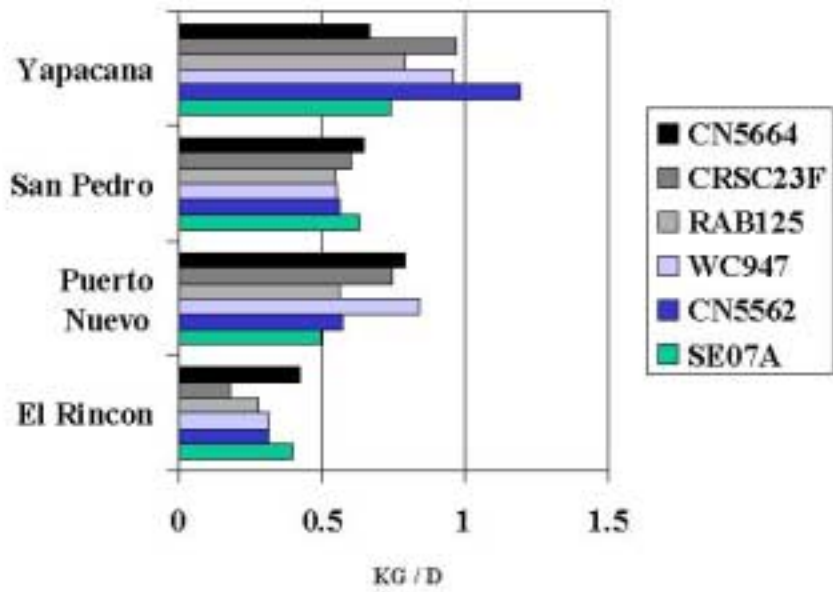


Figure 3. 365-d adg by the sire\*farm interaction

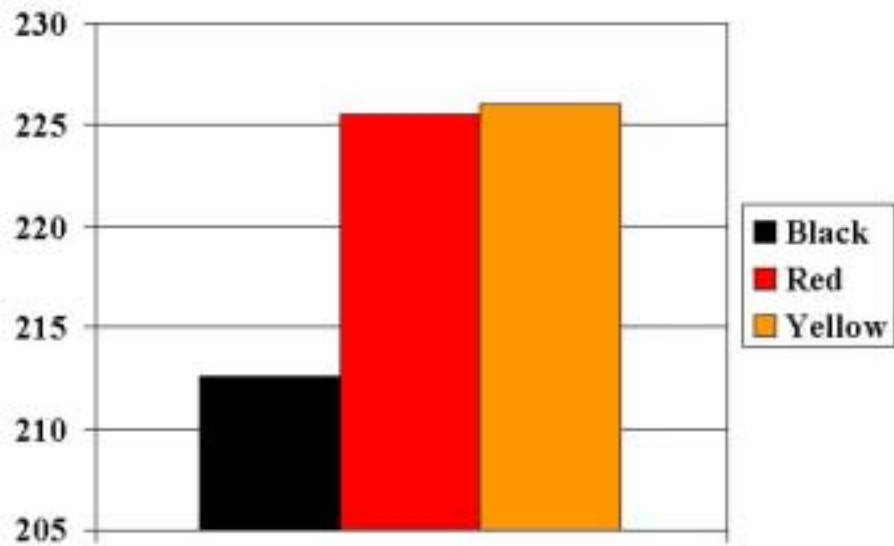


Figure 4. 365-d weight (kg) by hair color