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LONGEVITY AND CUMULATIVE LITTER PRODUCTIVITY IN STRAIGHTBRED AND CROSSBRED CALIFORNIAN AND NEW ZEALAND WHITE DOES

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ABSTRACT

Longevity, defined as the age at which a doe either succumbs to attrition (culled or dies) or survives to one complete year of production, and associative traits, were compared among Californian (CAL), New Zealand White (NZW) and CAL x NZW doe breed types (DB). All does (n=118) had the opportunity to produce litters over an entire year period. A total of 641 matings were made, yielding 432 litters with a total of 4,027 kits (live and dead) and 2,726 weaned kits (28-d). A mathematical model included doe breed type (DB), breed or line of service buck, season of first mating, and doe within DB. Traits were longevity, number of matings and kindling rate (KR) per doe, total number of kits born (dead and alive), litters born per doe, preweaning kit survival rate (KSR), average kit weaning weight (28-d), and cumulative number of weaned kits and weights of litters per doe producing. The CAL does were inferior for all traits investigated except for KR and KSR. The NZW and crossbred does were comparable for most traits. In conclusion, the U.S. population of CAL is not considered suitable as straightbred doe stock for commercial production.

INTRODUCTION

In the U.S. commercial rabbit meat industry, the New Zealand White (NZW) is the predominant breed. Largely fancy breeders maintain the U.S. population of the Californian (CAL) breed, and probably all breeds except NZW. While the meat conformation characteristics of the CAL are outstanding (LUKEFAHR et al.,1983c, 1992; OZIMBA & LUKEFAHR, 1991a), there is some doubt whether breeding objectives are compatible between fancy and commercial breeders. In general, U.S. studies (LUKEFAHR 1983a,b; MCNITT & LUKEFAHR, 1990; OZIMBA & LUKEFAHR, 1991b; HAMILTON *et al.*, 1997) have shown that CAL compared to NZW does are less productive under commercial management systems. In contrast, European investigations generally report more comparable performances between CAL and NZW does. In addition, the small number of commercially suitable breeds available in the U.S. limits opportunities for producers to benefit from breed differences and heterosis for economic traits.

Longevity, a non-traditionally studied trait, is defined as the age at which a doe either dies or is culled from the production herd. Breed differences in doe longevity would affect cumulative litter production and replacement costs which impact herd profitability. Our objective was to compare breed types for component and cumulative production traits which relate to longevity involving does having the opportunity to produce for one full year.

MATERIALS AND METHODS

Data on doe productive longevity were collected from a two-year experiment conducted from January of 1990 to December of 1991 at Alabama A&M University. Doe breed types included Californian (CAL) and New Zealand White (NZW) straightbreds, and CAL sire x NZW dam crossbreds. The commercial "Ozark" line of NZW was used, while CAL parental stock was obtained primarily from fancy breeders. From a total of 182 does in the main experiment, 118 does (CAL = 43, NZW = 36, and CAL x NZW = 39) had the opportunity to produce litters for an entire year. Initially mated at 5-mo of age, a doe was always mated to bucks of the same line. Service bucks were either NZW or CAL straightbred or control or select linebred. Further details on mating procedures and synthetic sire line development were provided by KHAN & LUKEFAHR (1996) and LUKEFAHR *et al.* (1996).

Diet, housing, and management aspects of the experiment were described previously by HAMILTON *et al.* (1997). Briefly, does were subjected to a 14-d post-partum breeding program. Palpation for pregnancy determination was performed 14 d after service. If not pregnant, the doe was immediately rebred to another buck of the same line. Crossfostering of kits among does was not practiced. Litters were weaned at 28 d of age. Does that survived to one year of production were removed from the experiment to accommodate more experimental does. Does were culled for poor health (enteric, metabolic or infectious [*e.g.,* primarily snuffles] condition) and for infertility (*i.e.,* inability to wean at least one kit after three successive matings). When a doe died, the presumed cause was recorded in nearly all cases based on clinical signs.

Longevity was recorded as the number of days in production from the date of first mating until the doe was either culled, died or survived to d 365 of production. However, because longevity was limited to 365 d, mean performances of doe breed types would be downwardly biased if some does survived beyond 365 d, and the distribution for longevity would not be normal. Additional traits included: number of matings (**NM**) and kindling rate (%; **KR**) per doe, total number of kits (dead and alive; **NK**) per doe kindling, total number of litters born (**NL**) per doe, preweaning survival rate of kits (%; **KSR**), average weaning weight of kits (g; **AW**), and cumulative number of weaned kits (**CNK**) and weights of litters (**CLW**) per doe.

Data were analyzed by least-squares ANOVA procedures (HARVEY, 1990). The mathematical model included doe breed type, season-year of first mating (*e.g.,* winter, spring, summer, and fall), service sire breed or line, two-way interactions, and doe within doe breed (error) as sources of variation. Second and higher order interactions, and individual sire by doe breed type interaction, were assumed to be of negligible importance. Weighted, least-squares analyses were performed for KR (number of kindlings from total matings per doe), NK (cumulative number of kits born from number of kindlings per doe), KSR (cumulative number of kits weaned from cumulative number of kits born per doe), and AW (cumulative litter weights from number of kits weaned per doe). Doe breed type means were compared using the Student's *t*-test ($P < 0.05$). Also, survival curves for longevity were estimated separately for each doe breed type using weighted, least-squares regression methods, whereby the number of surviving does at each mo class (1 through 12 mo) were used as weighting criteria. Chi-square tests ($P<0.05$) for independence between doe breed type and survival versus attrition causes were also conducted.

RESULTS AND DISCUSSION

A total of 641 matings were made with 118 does, yielding 432 litters containing 4,027 kits (live and dead) and 2,726 weaned kits (28-d). From ANOVA, the overall mean ()for longevity was 234±±11 d. The residual standard deviation was 122 d, and the range was from 20 to 365 d. While doe breed type was important for most traits studied, breed or line of service buck was never significant. However, in does first mated in spring versus fall, longevity, KR, and NL were increased by 75 d, 10.8%, and 1.27 litters (P<0.05). Because spring-mated virgin does are less productive in the summer, this might spare them from the stress of continuous, high litter production as compared to fall-mated virgin does. In addition, in does first mated in spring versus summer, KR and NL were higher by 17.5% and 1.25 litters (P<0.01 and P<0.05). Perhaps does developed better during more favorable weather when appetite levels were normal.

Table 1 : Least-squares means and standard errors for longevity and component traits of cumulative litter production in straightbred and crossbred does[a]

Item	**CAL**	**NZW**	**CAL x NZW**
Longevity, d[b]	180±±19[c]	262±±21[d]	261±±20[d]
No. of matings/doe exposed	4.54±±0.45[c]	6.09±±0.49[d]	6.12±±0.48[d]
Does kindling/doe exposed, %	61.6±±3.6	69.7±±3.4	68.6±±3.3
No. litters born/doe exposed	2.86±±0.33[c]	4.43±±0.36[d]	4.36±±0.35[d]
No. kits born/doe kindling	8.50±±0.32[c]	9.57±±0.28[d]	9.71±±0.27[d]
Kit preweaning survival, %	62.8±±4.0	67.3±±3.4	71.1±±3.3
Mean kit weaning wt, g (28 d)	0.485±±0.015[c]	0.546±±0.012[d]	0.500±±0.012[c]
Cumulative no. of kits weaned	15.2±±2.6[c]	28.4±±2.9[d]	30.2±±2.8[d]
Cumulative litter weaning wt, kg	7.4±±1.4[c]	15.4±±1.5[d]	15.2±±1.4[d]

[a]Breed types codes : CAL and NZW = Californian and New Zealand White straighbred does; CALXNZW = CALU x NZWT crossbred does. Traits defined in text.
[b]Means in the same row bearing different superscript letters differ (P<0.05).

The CAL does(Table 1) were inferior for all traits investigated, except for KR and KSR, in agreement with previous U.S. studies (LUKEFAHR 1983a,b; OZIMBA & LUKEFAHR, 1991b). In particular, CNK, and CLW were considerable less in CAL than in NZW or crossbred does, largely due to small numbers of litters born per doe (NL). However, AW was similar (P>0.05) between CAL and crossbred does. In contrast, two breeding experiments by PARTRIDGE *et al.* (1981) and COUDERT & BRUN (1989) reported comparable performances between CAL and NZW does for CNK and NL or CLW. Of the 118 does involved in our study, three CAL X NZW does had maximum values for NL of 8 litters, CNK of 69 kits weaned, and 36.8 CLW kg. However, NZW and crossbred does were comparable for most traits. The NZW and crossbred does differed by only 1 d for longevity. In a supplementary analysis, crossbreeding parameters obtained from the analysis of longevity data from LUKEFAHR (1983), involving CAL and NZW straightbred and reciprocally crossbred does, yielded estimates of –44.2±±27 (P=0.10), 89.8±±44 (P<0.05), and 22.0 (13.4%)±±27 (P=0.42) d for direct and maternal breed additive and direct heterotic effects, respectively. Hence, the more favorable maternal genetic environment provided by NZW than CAL dams would be expected to produce CAL x NZW daughters with similar longevity performance as NZW and higher than CAL does, in agreement with present results. Of relevance, COUDERT & BRUN (1989) reported negative heterosis (-11.5%) for total mortality but positive heterosis (+14.0%) for total culling levels.

Using least-squares means for longevity (L), CNK, and CLW, and based on first-year production figures, the mean monthly output of numbers and weights of kits was calculated ((CNK or CLW / L) x 30) as 2.53, 3.25 and 3.47 kits and 1.23, 1.77, and 1.74 kg for CAL, NZW, and CAL x NZW does, respectively. Also, CLW was predicted (PCLW) by taking the grand product of the least-squares means for component traits (PCLW = NM x KR x NK x KSR x AW). These values were 7.2, 14.5, and 14.9 kg for CAL, NZW, and CAL x NZW does, which are somewhat lower than CLW means shown in Table 1.

Table 2 : Numbers and percentages of straightbred and crossbred does survived, culled, or died by one-year of potential production and Chi-Square tests for independence

	CAL[b]		**NZW**		**CAL x NZW**		
Item[a]	**No.**	**%**	**No.**	**%**	**No.**	**%**	χ^{2c}
Survived	10	23.3	18	50.0	21	53.8	9.41**
Culled :							
Infertility	3	7.0	6	16.7	1	2.6	
Infection	2	4.7	1	2.8	4	10.3	
Other	1	2.3	0	0.0	0	0.0	
(sub-total)	(6)	(14.0)	(7)	(19.4)	(5)	(12.8)	0.72NS
Died :							
Enteritis-related	3	7.0	0	0.0	1	2.6	
Infection	16	37.2	8	22.2	8	20.5	
YDS	2	4.7	1	2.8	3	7.7	
Other	2	4.7	0	0.0	0	0.0	
Unknown	4	9.3	2	5.6	1	2.6	
(sub-total)	(27)	(62.8)	(11)	(30.6)	(13)	(33.3)	10.62**
Total	43		36		39		

[a]Classes : Infertility = three consecutive misconceptions and(or) non-survived litters to weaning age (28 d); Infection = respiratory, mastitis, wry neck or other infectious conditions; YDS = young doe syndrome; Enteritis-related = signs of enteric disease or enterotoxemia; Other = minor cases such as sore hocks and emaciation.

[b]Breed types defined in footnote of Table 1.

[c] χ^2: Test for independence between doe breed type and classes: survived versus culled or died; non-culled (survived or died) versus culled; and alive (survived or culled) versus died (NS=non-significant; **P<0.01).

An overall relationship was detected (χ^2 =9.41; P<0.01) between doe breed type and survival rate (Table 2), primarily because attrition was considerably higher (76.7%) in CAL does. However, no such relationship (P>0.05) existed for culling losses. Deaths largely accounted for the overall significant Chi-Square results, deaths being at least twice as high in CAL (largely due to infections) than in the other two breed types. An additional Chi-Square test revealed that early infection within the first 4 mo of production (*i.e.*, first three parities) accounted for fifteen of the sixteen mortality cases in CAL does compared to only four out of eight cases observed in both NZW and crossbred does (χ^2=7.58; P<0.05). Thus, CAL does would appear to be more susceptible to stress factors associated with intensive litter production. In agreement, COUDERT & BRUN (1989) reported that the survival rate of NZW does was nearly twice as high as that of CAL does, crossbred does being intermediate, during the first year of production. Survival curves (y) for doe breed types over mo (x) in production are shown in Figure 1. Best fit, prediction equations were obtained for CAL ($y = 97.7 - 17.3(x) + 1.00(x^2)$; R^2=0.99), NZW ($y = 99.5 - 7.95(x) + 0.29(x^2)$; R^2=0.99), and CAL x NZW does ($y = 91.8 - 3.79(x)$; R^2=0.94). According to the equations, 50% of the initial number of CAL does succumbed by 3.5 mo compared to 9.8 and 11.1 mo for NZW and CAL x NZW does. Beyond 4 mo, the attrition rate in CAL does was relatively similar to the other breed types. In conclusion, the U.S. fancy population of CAL is not considered suitable as straightbred doe stock for commercial production.

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