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Biological Sciences

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ESTIMATING THE INFLUENCE OF HEREDITY ON THE TARSON-METATARSAL LENGTH OF THE DOMESTIC TURKEY*

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Lerner[1] has concluded that excluding bantams tarso-metatarsal length is a hereditary size limiting factor in races of the domestic fowl and the wild jungle fowl belonging to the genus *Gallus*. Recent researches by the writer indicate that hereditary skeletal size of the domestic turkey varies according to the tarso-metatarsal length of this species. It may therefore be postulated that within a given race or species of birds skeletal size is limited to a definite ratio of the tarso-metatarsal length.

Burmester and Lerner[2] have shown that the length of the shank is closely correlated with the actual length of the tarso-metatarsal bone. The writer[3] has shown that the ratio between shank length and the cube root of the body weight is closely related to the apparent quantity of flesh and fat, or plumpness of the body by the 28th week after hatching. For validity of such a relation shank length variation within a certain size of the bird must be small or almost negligible. Researches are in progress to further test this assumption in the domestic turkey. Should shank (tarso-metarsal) length be directly related to adult skeletal size it would prove a valuable measure for size inheritance studies. After shank growth has ceased environmental fluctuations in the bird's nutrition will not obscure the hereditary size difference when the latter is measured by shank length. Numerous investigators have demonstrated that body weight is from three to six times as variable as bone length.

The present study was initiated to evaluate the influence of three hereditary factors: sex, sire and dam, on tarso-metatarsal length of turkeys raised under varying environmental conditions. The records include two years' observations on different varieties and selected races raised under varied feeding and management procedures. Some of the environmental differences have been date of hatching, year grown, amount of fiber and protein in the ration, and size of yards. It is evident that these turkeys were exposed to much greater environmental differences than would normally occur in one flock. It probably approximates in general the range of environment to which turkeys might be subjected. This should allow environment to exert a major effect. As a result the following

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estimates of variance due to sex, sire and dam are minimum rather than maximum figures.

Unpublished data on growth of the tarso-metatarsus show that its maximum length is reached relatively early in the growth period of the bird. For turkeys this appears to be approximately 20 weeks after hatching in the female and 24 weeks of age in the male. Limited observations have been made on growing male chickens. Cockerels and capons exhibit very little increase in shank length between the 24th and 28th week after hatching. All observations analysed in this report were made at least three weeks after the turkey's tarso-metatarsus normally attains its maximum length. All progenies of dams having less than four individuals of one sex have been arbitrarily omitted.

The records include shank length of 511 males and 508 females. There is no overlapping of the tarso-metatarsal length of the two sexes. Its estimate, shank length, ranged from 6.8 to 8.4 inches in males and 5.2 to 6.5 inches in females. The mean shank length for all birds recorded is 7.57 inches for males and 5.95 inches for females. From an analysis of variance, differences between the sexes account for approximately 91 per cent of the total variance of the records. This is equivalent to a correlation of 0.91 between individuals chosen at random from the same sex.

The progenies of 37 dams, each mated to one male, are available for comparison of tarso-metatarsal length in full brothers and sisters. In this case male shanks are 27.3 per cent longer than their full sisters. Each mean female shank length from each dam was adjusted to its male equivalent. Comparing these figures with those from their brothers, a highly significant fit is demonstrated by the Chi Squared Test. Further, the coefficient of correlation between the mean shank length of brothers and sisters is 0.72 and highly significant.

TABLE I. *Analysis of Variance for Turkey Shank Length*

Source of variation	Degrees of freedom	Sum of squares	Mean square	Standard deviation
		Males		
All sons	510	41.04	.0805	.284
Between sires	20	9.55	.4775	
Within sires	490	31.49	.0643	.254
Between dams*	84	7.09	.0844	
Within dams*	406	24.40	.0601	.245
		Females		
All daughters	507	23.43	.0462	.215
Between sires	20	7.13	.3565	
Within sires	487	16.30	.0335	.183
Between dams*	78	4.75	.0609	
Within dams*	409	11.55	.0282	.168

*Each dam mated with one sire only.

The accompanying table gives the separate analysis for the 511 males and the 508 females. From these it is estimated that approximately 25.3 per cent of the male and 39.0 per cent of the female variance in tarso-

metatarsal length is caused by heredity. Since one male is mated with more than one female the influence of the sire is greater than that of the dam. In this study the sire accounts for 18.3 per cent of his son's and 23.2 per cent of his daughter's variance, while the dam contributes only 7.0 and 15.8 per cent of the variance in sons and daughters respectively. The remainder of the variance, 7.47 per cent for sons and 61.0 per cent for daughters, is attributed to varying environmental conditions.

It should be noted that environment has more influence on male tarso-metatarsal length than on that of the female. A part of this may be attributed to the fact that it requires about one month longer for the male's shank to reach its mature length. Further studies with a more nearly uniform environment will probably show a much higher percentage of the variance from the hereditary source. It is evident that progress in breeding may be more readily evaluated from the tarso-metatarsal length of the female than from that of the male. Should it be necessary to adjust the shank lengths of the sexes to similar numerical values for heredity studies, the female shank should be adjusted to that of the male by multiplying the former by 1.273.

REFERENCES CITED

1. Lerner, I. M. 1937 - Hilgardia 10: 511-560.
2. Burmester, B. R. and I. M. Lerner, 1937 - Poult. Sci 16: 211-212.
3. Jaap, R. G. 1938 - Poult. Sci. (in press).