SELECTION FOR HEN'S DURATION OF FERTILITY

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SUMMARY

The duration of fertility in 995 egg-type hens which were the issue of 36 sires and 176 dams was measured at 33 and 44 weeks of age. During each period, the hens were intravaginally inseminated (125 x 10^6 spermatozoa) on the first and second days and the eggs laid on days 3 to 22 incubated. Fertility was determined by candling after 7 days of incubation. Several traits were considered : the number of days after A.I. during which all the eggs laid by the hen were fertile ("efficient duration"), the number of days between AI and the last fertile egg ("maximum duration"), the number of fertile eggs laid during the 20-day period, the total number of chicks hatched from the eggs collected during this period. The heritabilities of the characteristics of duration of fertility varied from 0.12 to 0.31 for the first period and from 0.10 to 0.17 for the second. For a given variable, genetic correlations among the 2 periods were more than 0.79 with the exception of efficient duration which seems dependent on laying rate. For a given period all genetic correlations among these variables (with the exception of efficient duration) were above 0.88. Duration of fertility was positively correlated with laying intensity. The number of chicks hatched appears to be the best criterium for selection. Box-Cox transformation was used but did not completely achieve normality.

INTRODUCTION

The major drawback of artificial insemination (AI) is labour cost (Stevens 1985). This could be reduced via an increase in the interval between successive inseminations. This in turn could be achieved through a lengthening of the duration of fertility, i.e. the time after AI during which a hen can keep live spermatozoa in its utero-vaginal glands. Pingel et al. (1985) have shown that maximum duration (MD = number of days after AI and before the last fertile egg) could be improved by selection : they increased this duration by 1.6 days in 8 generations. But this characteristic of the duration of fertility is not the most economically important. Other traits may be considered : efficient duration (ED) ; the number of days after AI and before the first clear egg, maximum duration (MD) ; the number of days before the last fertile egg and the number of fertile eggs laid after one AI (NFE) or of chicks hatched after AI (NCH).

Genetic parameters of these traits were estimated in order to choose the most appropriate criterium of selection for duration of fertility. Genetic correlations between those traits and early embryonic death (EED), i.e. occuring before the 7th day of incubation, was also estimated, as EED had severely increased during Pingel's experiment thus reducing by half the gain in chicks hatched relative to eggs set.

MATERIAL AND METHODS

995 egg-type hens which were the issue of 36 sires and 176 dams were raised in floor pens and individually caged at 19 weeks of age. They were kept on a 15L:9D photoperiod from 23 weeks to the end of the experiment and fed a diet containing 16.5% CP and 2815 kcal/kg. The hens were intra-vaginally inseminated (125 x 10^6 spermatozoa) on day 1 and 2 of 2 periods (33 and 44 weeks of age) and the eggs gathered daily and incubated from day 3 to day 22. Fertility was measured by candling at 7 days. Body weight at 34 weeks (BW34), number of eggs laid until 50th week (ITOT) were measured as well as ED, MD, NFE, NCH, EED, LED (number of late embryonic death occuring after AI) and DS (number of death in shell).

Genetic parameters of these variables were estimated in each period using Henderson's method III (Henderson 1953). The model included batch effects (treated as fixed effects) and sire and dam effects (treated as random effects). Estimates are the means of the sire and dam estimates.

RESULTS AND DISCUSSION

Estimates of genetic parameters for the various characteristics of duration of fertility, early embryonic death, body weight and intensity of laying are shown on table 1.

Heritabilities of the characteristics of duration of fertility were between 0.12 and 0.31 in first period and between 0.10 and 0.17 in second : the latter depended more on environment (including pathology). The estimates of heritability of MD were lower than those Pingel et al. (1985) obtained in the first generations of selection (0.28 -0.58). But their estimates were obtained from full-sib analyses, thus including dominance effects. Heritabilities of LED and DS were very low (< 0.04) and these traits are unlikely to be modified by selection. Genetic correlations among periods and within variables were very high (> 0.79) with the exception of ED. Thus, it is possible to improve duration of fertility at both ages simultaneously. Genetic correlations among the variables of duration within periods were (with the exception of ED) higher than 0.88. ED is not a good criterium as its value depends too much on laying intensity. NCH seems to be the most interesting criterium in both genetic and economic terms. The correlations between NCH and EED are negative or very slightly positive and estimates of heritabilities at the two periods are nearly equal to those of NFE and higher than those of the other variables.

Genetic correlations between NCH and ITOT were (as for NFE) high. Thus egg-type hens are to be expected to have higher duration of fertility than meat-type hens. The results of Brillard (1988) on the storage of spermatozoa in uterovaginal glands tend to strengthen this hypothesis. It also seems likely that divergent selection for or against NCH will result in an increase (or decrease) in laying intensity.

This would be at least partly avoided by a selection on the ratio of chicks hatched after AI related to eggs set as this trait is less

Table 1 Estimates of genetic parameters (heritabilities are on the diagonal, genetic correlations above the diagonal and phenotypic correlations below the diagonal)

Trait 2 \ Trait 1	ED_1	MD_1	NFE_1	NCH_1	EED_1	ED_2	MD_2	NFE_2	NCH_2	EED_2	PV	ITOT
ED_1	0.12	0.88	0.87	0.92	-0.07	0.52	0.63	0.50	0.67	-0.52	-0.06	0.27
MD_1	0.56	0.21	0.96	0.92	0.06	0.60	0.79	0.73	0.75	0.15	0.19	0.45
NFE_1	0.56	0.72	0.31	(b)	-0.01	0.52	0.60	0.80	0.85	-0.20	-0.05	0.49
NCH_1	0.55	0.65	0.95	0.30	-0.09	0.57	0.59	0.80	0.87	-0.07	-0.06	0.45
EED_1	0.03	0.23	0.20	-0.04	0.08	-0.22	0.07	-0.03	-0.18	0.46	-0.20	0.27
ED_2	0.18	0.25	0.23	0.24	-0.02	0.10	0.45	0.80	0.84	-0.06	-0.02	0.25
MD_2	0.27	0.41	0.40	0.38	0.07	0.46	0.16	0.92	0.88	0.29	-0.11	0.32
NFE_2	0.26	0.41	0.51	0.49	0.09	0.57	0.76	0.17	0.99	0.19	-0.15	0.47
NCH_2	0.26	0.40	0.48	0.49	0.01	0.56	0.70	0.94	0.16	0.04	-0.11	0.46
EED_2	-0.02	0.07	0.10	0.04	0.27	0.07	0.23	0.23	-0.02	0.15	0.01	0.22
PV	-0.04	-0.07	-0.09	-0.09	-0.08	-0.04	-0.10	-0.10	-0.09	-0.04	0.51	-0.11
ITOT	0.34	0.44	0.54	0.52	0.11	0.26	0.48	0.58	0.56	0.11	-0.09	0.23

(a) subscript corresponds to the age (1 : first period (33 wk), 2: 2nd period (44 wk))

(b) estimate is higher than 1

correlated with laying intensity (rg = 0.20 in first period, ard rg = -0.08 in second). But heritability is smaller (0.16 in first period, 0.10 in second).

As all these traits are not normally distributed selection by index (or best Best Linear Unbiased Predictor) may be non-optimal. Box-Cox transformation (y --> $y^\lambda/(\lambda-1)$) using Gianola et al.'s (1987) procedure was thus used. For the characteristics of fertility, the estimated was smaller than 1. Heritability was a little increased but normality was not completely achieved.

CONCLUSION

Divergent selection experiment for (or against) the number of chicks hatched after AI has recently commenced. The aims of this experiment are to define if it is possible to select for duration of fertility and if it is interesting to apply such selection to turkeys where natural mating is no longer employed.

REFERENCE

BRILLARD, J.P. 1988. Thèse de Doctorat es Sciences. Université F. Rabelais de Tours (France).

GIANOLA, D., FERNANDO, R.L., FOULLEY J.L. 1987. Internat. Symp. Advances. Stat. Met. Gen. Improvement Livest. .

HENDERSON C.R. 1953 Biometrics, 9, 226-252.

PINGEL M., SCHUBERT Christine, PLANERT C. 1985 Monatshefte für Veterinar Medezin, 40, 129-131.

STEVENS P. 1985. Conférence WPSA-SIMAVIP, Paris, 18 Octobre 1985, 92-106.