FERTILITE FEMELLE CHEZ LA DINDE REPRODUCTRICE : COMMENT LA GERER ?

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Résumé

L'évolution de la fertilité de troupeaux commerciaux de dindes reproductrices a été étudiée à partir de données issues d'un important élevage situé aux Etats-Unis.

Les variations de fertilité entre fermes et troupeaux ont été étudiées en fonction de l'âge, du système d'utilisation des mâles, des niveaux de fertilité et du cycle de reproduction. Nos résultats indiquent que les problèmes de fertilité doivent être traités troupeau par troupeau et que les indications données par la gestion technique de chacun d'eux doivent en premier lieu déterminer le niveau de fertilité vraie ainsi que celui de la mortalité embryonnaire précoce avant qu'une action appropriée puisse être conduite.

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Influence of the male on the decline of fertility with age in broiler breeder flocks

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Abstract

After 35 weeks of age, the male broiler breeder becomes less sexually active and produces fewer spermatozoa whilst bodyweight and the incidence of musculo-skeletal lesions increase. There is no evidence that males become obese. Dietary crude protein concentrations of 160 to 180 g crude protein (CP)/kg may be associated with reduced fertility compared with diets containing 100 to 120 g CP/kg. However, the main determinant of poor fertility is the physical size of the male which can be controlled by separate-sex feeding techniques. Consideration should be given to the welfare aspects of separate sex-feeding.

Introduction

Fertility in commercial flocks of broiler breeders peaks at 95 to 98% between 30 and 38 weeks of age and at the time of flock depletion may be as low as 70 to 80%. The reasons for this decline may be the result of male or female factors but this paper will be concerned entirely with the influence of the male. A review of recent research will be made followed by a summary of practical strategies to improve fertility in older flocks of broiler breeders.

Physiological changes with age

Concentration of testosterone in the plasma of male broiler breeders declines with age (Sexton *et al.* 1989a). Sexual activity falls linearly from 28 to 58 weeks of age (Duncan *et at.*, 1990) and is presumably related to changes in the level of testosterone. In caged birds semen production, concentration of spermatozoa and the proportion of males providing semen decline with age (Wilson *et el.* 1987 a, b; Hocking 1989; Sexton *et al.* 1989a). Nevertheless, at flock depletion virtually all breeding males have normal testicular function and are physiologically capable of fertilising a hen's ovum (Hocking and Duff 1989).

Musculo-skeletal lesions

Duff and Hocking (1986) described a large number of musculo-skeletal lesions in adult broiler breeder males. In excess of 90% of the birds examined had at least one lesion and it seemed reasonable to deduce that the fertility of affected males would be depressed. Subsequent analyses of data at the end-of-lay from three experiments failed to detect any important relationships between the occurrence of different lesions and fertility (Hocking and Duff, 1989). However severe musculo-skeletal lesions occurred in 75% of males culled for low fertility (about 45% of the total) in two experiments where bodyweight was not controlled.

Body size and composition

Hocking and Duff (1989) showed that the incidence of musculo-skeletal lesions was higher, and fertility declined, with increasing bodyweight at 60 weeks of age. The effects on fertility and musculo-skeletal lesions of controlling bodyweight by separate-sex feeding were studied by Hocking (1990a). The incidence of destructive cartilage loss was ten times higher and ruptured ligaments and tendons were twice as frequent in conventionally fed males weighing 5.25 kg compared with control-fed males weighing 3.55 kg. Response surface analysis showed that the optimum bodyweight increased from 3.5 kg at 34 weeks to 4.0 kg at 38 weeks followed by a less rapid rise to 4.5 kg at 60 weeks of age. Fertility declined rapidly as bodyweight diverged from the optima and the range of bodyweights which gave fertility in excess of 90% became increasingly narrower as the males aged.

Most problems with broiler breeders have been blamed, at one time or another, on obesity, and poor fertility is no exception. Hocking *et al.* (1985) showed that body fat content was only 64 g/kg in *ad libitum* fed males at maturity and was significantly lower than in contemporary males of egg laying stocks. Carcass analysis of breeding males weighing 5.4 kg at 60 weeks of age showed an average fat content of 92 ± 9 g/kg (Hocking and Duff, 1989). Sexton *et al.* (1989 a, b) reported similar results and showed that larger, relatively fatter birds yielded more semen than smaller birds given less energy. Clearly male obesity is not a cause of the decline in fertility of ageing broiler breeder flocks.

Nutrition

There is very little data on the responses of broiler breeder males to different nutrients (Lake, 1969). The effects of energy are reflected in bodyweight which has been discussed above. The adult male can produce normal semen on very low concentrations of dietary protein (Buckner and Savage, 1986). There is considerable commercial interest in feeding diets containing lower levels of protein (100 to 120 g CP/kg) to broiler breeder males than those in diets intended for females (160 to 180 g CP/kg). Low protein diets do not affect semen volume or the concentration of spermatozoa but improve the proportion of males producing semen at older ages (Wilson *et al.*, 1987 a, b; Hocking, 1989). Hocking (1990a) compared naturally mated broiler breeder males fed on diets containing 110 and 160 g CP/kg. Fertility of males fed on the low protein diet was higher after 45 weeks of age. In general the males fed on the low protein diet were lighter but correction for bodyweight by covariance analysis failed to remove the statistical significance of the effect of crude protein on fertility.

Controlling the decline in fertility with age

Declining plasma testosterone concentration, harvested spermatozoa and mating frequency coupled with an increasing incidence of musculo-skeletal lesions could all result in a decrease in fertility with age. The major cause, however, seems to be the greater bodyweight of conventionally fed males (Hocking and Duff, 1989; Hocking 1990a). The effects of

controlling bodyweight on fertility and the frequency of apparent copulations at different ages are presented in Table 1. Mating frequency was similar in the conventional and control fed groups but fertility was significantly higher at 58 weeks of age. The inference must be that libido was similar but that the larger bulk of the conventionally fed males prevented them correctly depositing semen in recipient females.

The lack of an important association between musculo-skeletal lesions and fertility at 60 weeks is difficult to explain. Since bodyweight and lesions are related it is possible that fitting bodyweight also accounts for the effect of lesions. If bodyweight was removed from the regression equation, however, the coefficients for the musculo-skeletal lesions were little changed (Hocking and Duff, 1989). However, the link with culling for low fertility during two experiments without bodyweight control was clear.

Table 1. Effects of male bodyweight control by separate-sex feeding on mating frequency and fertility at different ages, compared with conventional mixed-sex feeding.

Age, weeks	System	Bodyweight kg	Matings N/h	Fertility %
28	Separate	3.1	3.68	97
	Mixed	4.1	3.62	96
38	Separate	3.4	1.77	99
	Mixed	4.9	1.71	95
58	Separate	3.9	0.81	97
	Mixed	5.5	0.75	76

1. Data from Hocking (1990a) and Duncan *et al.* (1990)

The mechanism through which low dietary protein concentrations affect reproductive traits in the male is unknown. There must ultimately be an interaction with the endocrine system. The experiment of Hocking (1990a) appears to be the only one of its kind and utilised single male pens. It is not clear whether effects other than bodyweight will be important in multiple male mating groups.

Welfare considerations of separate sex-feeding techniques for controlling bodyweight gain in males

The ability to separate male and female feeding on the basis of head size and allowing males to feed from a feeding system which the females cannot reach was first proposed by McDaniel (1986). The system is successful and control of male bodyweight with consequent

improvements in fertility of the order of 3 to 6% are possible. Some early attempts to use the system were abandoned because the females were unable to consume sufficient food and egg production was depressed. Experimental results support these conclusions (Hocking, 1990a, b). Head width reached a plateau after 25 weeks of age, when they were 44 and 38mm for males and females respectively with virtually no overlap. A 40mm wide grid was used to separate the sexes and egg production was significantly lower in pens with grids during the last 12 weeks of production (- 3.4%). Females with heads at least 39mm wide suffered swollen heads characterised by thickening and reddening of the head and facial skin (Duff *et al.*, 1989). Furthermore, the rate of eating among females was significantly lower in pens with grids compared to those without grids (Hocking, 1990 b).

In a subsequent experiment, a grid size of 42mm was used and head swelling was not observed. Clearly the correct choice of aperture is essential but there has been no scientific assessment of the optimum grid size or of the effect on the birds' welfare. With regard to the welfare of females, the feather cover of separate-sex fed females was significantly better than conventionally fed hens (Hocking, 1990 b). Males which were fed very limited, constant quantities of food, developed undesirable behaviour traits and it was concluded that males should be fed to gain weight throughout the breeding period (Hocking, 1990 a).

Table 2. Effects of changing the mating ratio on chick production at a fixed adult stocking rate*.

Variable	Mating Ratio (male:female)		
	1:10	1:15	1:20
Number of males	1000	698	536
Number of females	10000	10470	10720
Number of chicks, x 10^6	1.26	1.32	1.35
Ratio	1.00	1.05	1.07

* Maximum total flock bodyweight of 40,500 kg (10,000 females at 3.5 kg plus 1000 males at 5.5 kg).

Conclusions and prospects

The evidence so far available favours the conclusion that the main reason for the decline in fertility with age in broiler breeder flocks is the increasing bodyweight of the male (there is little change in female bodyweight after 35 weeks of age [Hocking, 1990 b]). Fortunately, male bodyweight can be controlled by suitable techniques for separate-sex feeding. Physiological decline in reproductive efficiency occurs in males and females (e.g. Brillard and

McDaniel, 1986). Duncan *et al.* (1990) showed that there was apparently a vast excess of mating activity in young birds and no relationship between mating activity and fertility at any age. It is possible that a typical mating ratio of 1 male : 10 females is necessary to overcome physiological and mechanical (musculo-skeletal) changes with age. Changing the mating ratio to 1 : 15 or 1 : 20 would increase the number of females which could be kept in a given area and increase output by 5 and 7% (Table 2) or at last as much as by separate-sex feeding *per se*. Further research into the causes of the decline in physiological aspects of fertility in both sexes, on the apparently poor efficiency of mating and of different mating ratios provide opportunities for increasing the productivity of existing stocks of broiler breeders. As male lines become larger by genetic selection it may become increasingly difficult to control bodyweight satisfactorily with adverse consequences for the welfare of the birds. Alternative solutions to the problems of bodyweight control in broiler parent stock should be sought.

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INFLUENCE DU MALE SUR LA BAISSE DE FERTILITE DUE A L'AGE DANS LES TROUPEAUX DE POULES REPRODUCTRICES CHAIR

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Après 35 semaines d'âge, les coqs reproducteurs sont de moins en moins actifs sexuellement et produisent moins de spermatozoïdes alors que leur poids corporel et le taux moyen de lésions des muscles ou du squelette augmentent. Toutefois, il ne semble pas que ces mâles deviennent réellement obèses. Des quantités de protéines brutes variant entre 160 et 180 g/kg d'aliment semblent être associées à une baisse de la fertilité par rapport à des rations en contenant de 100 à 120 g. Cependant, la cause principale d'une baisse de fertilité est la taille du mâle qui peut être contrôlée par des techniques d'alimentation en sexes séparés. Pour cette raison, il est souhaitable que les problèmes de bien–être associés à ce type de rationnement soient pris en compte.