Equipment Design for Breeding Flocks ¹

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ABSTRACT

Breeding stocks require specialized equipment and facilities that accommodate both sexes and their mating behaviors. Divergence in male and female requirements has occurred due to genetic selection, particularly in heavy meat stocks. Proper equipment design requires specific knowledge about the nutritional requirements, genetics, and behavior of the particular stock within the environment intended. Attention must be paid to the relationship between the rearing and breeding environments, because preferences and behavioral patterns develop at an early age. The “correct” breeding environment is highly dependent upon the growing environment. There is evidence that some undesirable behaviors and poor fertility may arise from inadequate rearing nutrition and that nutrition can influence the development of certain behaviors.

(Key words: nesting, cage design, behavior, feed restriction, fertility)

INTRODUCTION

The production of fertile hatching eggs that can be reasonably collected, shipped to a hatchery, and still hatch well is a relatively small component of the modern poultry industry. Nonetheless, the success of this component has a significant impact on the efficiency of the total system. The breeding environment has specialized needs due to the dual requirements of male and female management. This effect is especially evident in broiler breeder stocks, in which the male and female breeders are often the products of quite different selection programs. This paper reviews pertinent literature concerning the proper equipping of breeder, especially broiler breeder, facilities with an emphasis on the nutritional and management regimens that are necessary for their success. With the indulgence of the reader, this author will also relate personal observations that are consistent over a wide range of countries and facilities and that appear to provide guidance concerning the direction towards which our research efforts should be directed.

SPACE ALLOCATION AND POPULATION SIZE

Current industry practices are designed to minimize per unit costs. Placement of more birds per square meter is an efficient way to do this if performance or welfare is not compromised excessively. Crowding is generally held to increase aggressive behaviors, but there is a point of increased density beyond which these aggressive acts decrease (Polley et al., 1974) due to a lack of space for such displays. Broiler breeders, and probably other stocks, move over a very wide area of the house (Appleby et al., 1985), probably due to the visual uniformity of the house, which creates an absence of visual location cues. The less dominant males may be more mobile than the dominant males but site attachment occurs only when space is adequate (Pamment et al., 1982/83). This mobility suggests that an individual broiler breeder routinely interacts with an extremely large number of other individuals, and conflicts with the findings of Graves et al. (1985), who suggested that females remain near socially dominant males. One must be very cautious when extrapolating small pen studies to the large commercial house situation. Similarly, Craig et al. (1977) found little relationship between social status of males and their success in mating when studies were conducted in “sizeable, crowded flocks”. This conclusion contrasted with previous reports (Guhl et al., 1945; Guhl and Warren, 1946).

Some researchers have suggested that the use of pens in commercial facilities would improve performance but the installation or removal of such pens (e.g., 2,000 instead of 8,000 birds per group) has no measurable effect on performance (J. Brake, unpublished data). Critical analysis of broiler breeder density in commercial two-thirds slat houses in the U.S. suggest that the lower limit of density, before production is negatively impacted, is about six birds per square meter (Miguel Elguera, Arbor Acres Farm, Glastonbury, CT 06033; personal communication, 1993).
Courting by White Leghorn males increases as floor space increases, whereas female avoidance of sexual advances by males also increases (Craig and Bhagwat, 1974). This finding raises the issue of how to best balance these two activities, especially for the broiler breeder, for which controlled research in commercial-size populations is very difficult. In addition, commercial operations must keep in mind that too much space may be detrimental to fertility.

There are a few natural mating cage facilities in operation for broiler breeders. Whereas natural mating on wire floors and slats has been commonplace in the management of light breeders for many years, it is a relatively new management practice for heavy broiler breeders. There appears to be no problem with egg production but male management and fertility are a concern. The two major issues appear to be optimum population size and appropriate feeding of the male. Feeding will be discussed later. As far as population size is concerned, female populations of 60 with about 6 males appear to be near the minimum (Kratzer and Craig, 1980; J. Brake, unpublished data). The inability to positively select active and fertile males makes a smaller group more likely to exhibit reduced fertility than a commercial operation could afford. Furthermore, the reduced space in this type of cage leads to reduced courting activity and fertility (Craig and Bhagwat, 1974, Kratzer and Craig, 1980); however, more crowded conditions can also lead to less agonistic acts in general if not excessive (Craig and Bhagwat, 1974). It is also possible that plumage conditions could be improved in cages as compared to litter systems, depending upon bird numbers per cage (Tauson et al., 1992).

NESTING

Labor and human health concerns have created an impetus to install mechanical nests in modern broiler breeder facilities. Successful use of mechanical nests, and nests in general, have been reasonably commonplace in white egg and brown egg laying stocks compared to broiler breeders. Initial mechanical nest designs evaluated in the U.S. during the 1980s were markedly unsuccessful for a number of reasons relating to nestbox design and location. One reason was the belief that hens preferred dark places in which to lay. Although this is true for White Leghorns (Dorminey, 1974; Appleby et al., 1984b), it is not true for brown egg stocks (Appleby et al., 1984b; Kjaer, 1994). Brake (1985) also demonstrated that broiler breeders preferred unpainted galvanized nests to nests painted black. Recent successful commercial designs do not have black as a dominant color scheme. Hens make rotating movements in a circle in the nest prior to laying (Wood-Gush, 1954). Nests that are concave are more attractive to broiler breeder hens than flat-bottomed nests (Bressler, 1965; Brake, 1985). Most successful mechanical nests for individual hens employ some variation of the concave feature. Exceptions exist in certain colony nests where only the portion of the nest floor contacting the front of the breast (i.e., brood patch area) is raised, which also appears to be successful (Haar and Meijerhof, 1994).

Considerable recent interest has focused on the flooring material for mechanical nests. Initial work suggested that hens prefer a material in which they could mimic the scratching activities of natural nest preparation (Breden, 1986). So-called artificial grass mats such as AstroTurf® and similar injection molded materials made of polyethylene, polyvinyl chloride, or rubber have become the predominant materials used for this purpose. Preference tests demonstrated that gray-colored pads were significantly preferred by broiler breeder hens over a number of other colors (Brake, 1993a). This effect may be due to a type of imprinting that occurs due to the presence of a considerable amount of gray-colored galvanized metal in the rearing quarters. This principle was previously demonstrated when hens selected nest boxes of a color similar to that of the rearing quarters (Hurnik et al., 1973). It also appears that blue may be an aversive color for poultry (R. Bryan Jones, Roslin Institute (Edinburgh), Roslin, Midlothian EH25 9PS, UK; personal communication) as males do not mate with hens painted with blue paint (J. Brake, unpublished data).

Subsequent work demonstrated that the broiler breeder hen can demonstrate preferences for the length and texture of the artificial grass (Brake, 1995). This preference probably is related to several sensory attributes, including foot comfort and support, similar to that demonstrated by Hughes and Black (1973) for cage flooring materials. An increased incidence of floor eggs when the artificial grass pads become worn emphasizes the selectivity of the broiler breeder hen (J. Brake, unpublished data). This selectivity of the breeder hen is an extremely important point, as field data suggest that up to 3,000 eggs per week may be laid on the floor by 10,000 hens in a conventional house with better than average management of mechanical nests (J. Brake, unpublished data). It is difficult and expensive to provide enough labor to adequately collect all of the eggs laid outside the nests; therefore equipment designs must be attractive to hens. However, an extremely attractive nest will also promote soiling (Appleby and Smith, 1991) and possibly broodiness. AstroTurf® reduced broodiness in turkeys as compared to wood shavings (V. L. Christensen, North Carolina State University, Raleigh, NC 27695-7608; unpublished data) and this was also suggested for broiler breeders by Brake (1985). Nesting space per bird is often limited and rapid nest turnover is essential. Haar and Meijerhof (1994) recognized that nest pad type should not affect rate of lay and that differences in eggs collected must be due to the number of unaccounted for eggs laid outside the nests. These authors estimated the real percentage of floor eggs to be up to 13% rather than the 6.4% recovered in a comparison of a nest equipped with a rubber finger pad to one equipped with AstroTurf®. Maximally efficient designs for nests must not only
and that the design of the perch, perches made of wood kept feet cleaner than did plastic (Tauson, 1992). Tauson et al. (1990) also found that rectangular nests for broiler breeders appear to be unnecessary on most individual broiler breeder nests. Where colony nests for broiler breeders have been found to be superior, the color schemes of the wood and plastics involved were consistent with the particular growing environment (Haar and Meijerhof, 1994). This result suggests that the design of a successful nesting environment requires close attention to the details of the environmental and behavioral cues of the growing and laying quarters. Coordinated color and equipment schemes may need to be developed on a large scale. It is clear that many environmental factors influence nest site selection (Mirosh et al., 1986).

There has been some commercial interest in changing the time of oviposition to spread the daily workload of gathering eggs and reduce breakage. Attempts to do this with broiler breeders by altering feeding time appear to have little effect (Wilson and Keeling, 1991).

The height of the nest above the floor is also important as some birds may have difficulty reaching very high nests (Appleby et al., 1986). Conversely, the areas under nests that are too low may be recognized as ideal nesting sites due to enclosure features (Appleby et al., 1984a).

PERCHES

Perching is an innate behavior that may be used to increase the utilization of nesting sites provided in the breeder house. Broiler breeder pullets grown in pens with wooden perches that resembled those of the nest boxes to which they were introduced at 20 wk of age laid far fewer floor eggs at the onset of lay (Brake, 1987). This result suggests that birds learn certain important nesting behaviors prior to photostimulation (Appleby et al., 1984a) and behaviors may be advanced by an increased protein intake (Brake et al., 1994). Wood or wire perches appear to be preferred to plastic (Faure and Jones, 1982; Muiruri et al., 1990; Appleby et al., 1992). Foot damage in broiler breeders housed on wire may be reduced by perches (Pearson, 1983) and foot damage has been reported to be reduced by rectangular perches when compared to round perches (Duncan et al., 1992). Tauson et al. (1992) also found that rectangular perches made of wood kept feet cleaner than did plastic and that the design of the perch, per se, was more responsible for podiodermitis (“bumble foot”) than was the cleanliness of the perch. Perches were also responsible for severe keel deformations and skin lesions. Perches may also increase the incidence of cracked eggs (Tauson, 1984). This discussion sounds a precautionary note for the use of perches during the laying period.

Duncan et al. (1992) found that brown egg stocks spent a great deal of time on perches and 99% roosted there at night. This conclusion was not observed to the same extent by Brake (1987) with broiler breeders. A significant problem with perches in the laying quarters is the number of eggs laid while the hens are on the perches, which often results in cracked eggs (Duncan et al., 1992). The indiscriminate use of perches could attract hens from the nests and cause an increase in floor eggs and contaminations (Tauson et al., 1992).

SLATS

The primary purpose of slats is to provide a depository for manure so that bird density can be increased. There have been some efforts to utilize plastic slats on the assumption that they would provide a cleaner environment. On the contrary, Haar and Meijerhof (1994) found that eggs were cleaner when wooden slats were used. Evidently the rough surface of the wood did a better job of cleaning the bird’s feet and the wood slats had a relatively larger amount of open area for the manure to pass through. Similarly, in our hands, broiler breeders appear to perform better on wooden slats than several types of plastic slats (Brake, 1990a). The reduction in eggs collected in plastic slat pens was probably due to increased numbers of lost floor and slat laid eggs, as suggested by Haar and Meijerhof (1994). Slats made of galvanized wire (Carter et al., 1984a) have also been successful under field conditions (J. Brake, unpublished data), provided that a litter area is also available (Andrews et al., 1989). These slats will also lead to cleaner feet (Tauson et al., 1992). The height of the slats above the pit relative to the width must be sufficient to collect the manure produced during the laying cycle. A larger slat area means a greater manure collection area, a cleaner litter floor area, cleaner eggs, and fewer male foot problems (Haar and Meijerhof, 1994). The height of the slat area must not be so high as to prevent the birds from reaching the slats as the flock ages and their jumping ability diminishes (Brake et al., 1993). Steps or bales of hay are often added as an aid to locomotion and may reduce corticosterone (i.e., stress) levels (Mench, 1992).

The leading edge of a slot or perch arrangement is quite important. One must remember that the birds are typically below the structure and must aim and jump up to the edge with the expectation that a “toe-hold” will be available for grasping (Figure 1). The absence of this will lead to increased numbers of floor eggs (J. Brake, unpublished data and field observations). Tauson et al. (1992) found similar results in an alternative laying hen system.
ENVIRONMENTAL CONTROL

Whereas it would appear to be attractive to place broiler breeders in cages to improve the air quality by reducing levels of ammonia and dust from feed and litter, it has been well-documented that most poultry house dust arises from the birds themselves (Koon et al., 1963; Qi et al., 1992). Furthermore, the use of scraper systems actually increase the emission of ammonia by constantly creating a wet surface (Hoek, 1989). Cage systems require expensive drying systems for adequate ammonia control. It would seem logical to find a way to adequately and quickly dry the manure in a conventional house. Vertically directed fans have the potential of achieving this under commercial broiler conditions (Bottcher et al., 1993) and have been used successfully for broiler breeders (J. Brake, unpublished data). Commonly used “tunnel” ventilation systems achieve good air speed for adequate hot weather convective cooling but often exhibit deficiencies during mild or cold weather.

LIGHTING PROGRAMS

Although there is some movement to require natural lighting in European poultry houses (Tauson et al., 1992) there is good evidence that low intensity (~20 lx) short photoperiod (~8 h) artificial lighting programs during rearing result in improved performance during subsequent lay when compared to natural light programs for broiler breeders (Brake and Baughman, 1989; Brake et al., 1989). However, when birds are grown in daylight, only artificial light that mimics the increasing daylight of spring will give acceptable results during lay (Brake and Baughman, 1989). Details of the type of light-proofing equipment required for broiler breeders and their use is given by Martin et al. (1984, 1985). Selection of the correct light sources and intensity is important when using artificial light as either the sole or supplementary source of light (Wineland and Davis, 1991).

FEED RESTRICTION AND DEVELOPMENT

There is no question that feed restriction of broiler breeders has positive effects (Lee et al., 1971). However, although the growth potential of the modern commercial broiler is increasing at a rate that requires 1 d less each year to reach 1.8 kg BW, the BW guides of the various primary breeding companies have changed little over the past 10 yr. Furthermore, there has also been relatively little change in the suggested dietary formulations. The potential genetic-nutritional consequences of this lack of dietary change are demonstrated in quail by Lilburn et al. (1992). These workers showed that quail selected for heavy weight at 28 d of age when grown on a 28% crude protein turkey starter diet were significantly delayed in onset of lay when grown on a 24% crude protein diet. In comparison, the randombred control line matured at 42 d of age on a diet containing 24% crude protein. A similar phenomenon appears possible in broiler breeders, as additional protein during the prelay period has been shown to increase egg production (Cave, 1984; Brake et al., 1985).

Fertility has recently become an overriding concern in broiler breeders. Soller and Rappaport (1971) suggested that selection for increased BW led to a decrease in fertility. VanKrey and Siegel (1974) demonstrated a decrease in sperm storage capacity and duration of fertility in females selected for a high 8-wk BW. These observations were made while all birds remained on a fixed dietary program during rearing (P. B. Siegel, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061-0306; personal communication, 1994). Therefore, protein and energy intake relative to genetic potential was decreasing each generation. Recent work in our laboratory has demonstrated that there an absolute cumulative crude protein intake is required during the rearing of the female if maximum fertility is to be achieved (Walsh and Brake, 1994, 1995). This minimum intake of ~1,200 g crude protein prior to photostimulation (141 d of age) generally requires a higher nutrient density than currently recommended. The same principle is probably more applicable to the male, which is more highly selected for meat traits (Brake and Peak, 1994). We estimate the corresponding male protein requirement to be about 500 g more than that of the female. Females grown on 20% crude protein diets and mated with separate grown males reared on a 17% crude protein diet exhibited fertilities of 95% to 65 wk of age without separate male feeding after 20 wk (Brake and Walsh, 1997). This result suggests that separate rearing per se is not a hindrance to attaining good fertility, as Mench (1995) suggested as a possibility based on earlier studies on the development of mating behaviors in Leghorns, and therefore would require entirely separate rearing facilities for males and females with independently controlled feeding equipment.
It seems apparent that we must grow broiler breeders on an increasingly severe level of energy restriction, but it is not true that all other nutrients need to be as limited (Brake, 1994; Walsh and Brake, 1997) to achieve the general range of desired body weight. It appears that crude protein intake plays a pivotal role in determining onset of sexual maturity and subsequent reproductive performance (Brake, 1992). It may also be reasonable to assume that many observed management problems attributed to poor equipment or genetic deficiencies may, in fact, simply be manifestations of deficient nutrient intake relative to genetic requirements.

What types of problems might be so manifested? Two very good examples might be orthopedic disease (Duff and Hocking, 1986) and male aggression. Research with broilers clearly shows that excesses of chloride salts (Leeson et al., 1995) contribute to the incidence of tibial dyschondroplasia and exacerbate arginine-lysin antagonisms (Austic and Calvert, 1981), and this antagonism has been observed to contribute to tibial dyschondroplasia in commercial flocks of broiler breeders (J. Brake, personal observations). Wilson (1994) has reported that underfeeding of males during rearing will result in lower back abnormalities (“roach back”) similar to those described by Duff and Hocking (1986). Delayed sexual maturity due to a deficiency of protein may also delay sex hormone-dependent cornification of footpads and contribute to pododermatitis.

**REARING AND MATING**

So-called “male aggression” does not universally occur in the same genetic stocks at all locations. Thus, nutritional-management factors must be responsible for the difference. Male aggression that results in female mortality during the onset of lay is very limited on the program developed in our laboratory (Brake, 1993b; Brake and Peak, 1994) when compared to programs recommended by a commercial breeding company (I. J. H. Duncan, University of Guelph, Guelph, ON, Canada, N1G 2W1; personal communication, 1995). The major difference is that the males grown on our program consume 500 to 600 g more crude protein and 7,000 to 8,000 kcal more metabolizable energy prior to photostimulation (Brake, 1993b; Brake and Peak, 1994).

Nevertheless, similar BW at 140 d is attained by both programs. This result is due to the difference in the programmed application of the weekly feed allotments. Similarly, high female mortality due to male aggression was observed when females were reared on a 11% crude protein diet to the recommended BW at 18 wk and thereafter. Sister females reared on diets that supplied over 1,200 g crude protein to 140 d of age exhibited no such problem when mated with equivalent males (Brake et al., 1992; Brake and Peak, 1994). These results suggest a female component to male aggression problems that is linked to inadequate nutrition and delayed sexual maturity. Solving these problems may also make it easier to reduce the number of toes trimmed on males at hatch as this also reduces mating ability (Ouart et al., 1986). Extra toe removal is currently practiced to reduce female mortality from male aggression. The use of abrasive strips for scratching may also assist with this problem (Tauson et al., 1992).

In the White Leghorn, there is evidence that early exposure of males to females improves male mating ability (Leonard et al., 1993a,b), however, the Leghorn is an early maturing animal with lower nutrient requirements than those of broiler stocks. Siegel and Siegel (1964) found that males separated from females at 70 or 84 d of age exhibited increased mating activities when reintroduced to females at 217 d (31 wk) of age when compared to males separated from females at 58 d of age. This effect was attributed to a critical early period for social hierarchy establishment presumably falling between 58 and 70 d of age. Many companies growing broiler breeder males keep them separate until 35 to 42 d of age before mixing the sexes. These companies continue to experience male aggression problems. Fertility is often quite good where males and females are grown completely separately, so it is debatable that such a critical period occurs in broiler breeders. Siegel and Siegel (1964) also found that males reared in male groups exhibited more subsequent mating abilities with females than did males reared in individual cages, which suggests that homosexual experiences of mounting and treading contribute to the development of appropriate sexual behavior at a later age. This conclusion would argue that sex-separate rearing may not prevent the development of necessary behaviors. Furthermore, field observations suggest that sex-separate reared males exhibit increased aggression among themselves before mixing with females when the males are grown on a high plane of nutrition. This aggression appears to subside before intermingling of the sexes at 141 d (J. Brake, unpublished data), and suggests that aggressive behavior towards females may be due to late maturity of males relative to females or vice-versa.

In natural conditions, males are programmed to mature sexually ahead of females to assure mating between the time of initial nest selection and onset of lay. Modern broiler breeder males obviously are not subjected to the same genetic selection as the females and often exhibit differential (later) maturity when fed a nutrient regime appropriate for females (Brake, 1993b; Brake and Peak, 1994; Brake and Anderson, 1992), which causes late maturity. Advancing male maturity by early photostimulation has been shown to increase fertility (Brake, 1990b).

There is typically a dramatic increase in mating activity during the first few weeks that males and females are placed together (Kratzer and Craig, 1980). Both sexes should be equally sexually mature at this point. It is known that females indiscriminately peck males (Kratzer and Craig, 1980) in crowded flocks, which could lead to an inappropriate social structure if the males are immature. Broiler breeder males do eat less than females during this prelay period, which can
lead to retarded sexual maturity and reduced fertility (Brake, 1989).

The principle that manifestation of a behavior can be influenced by diet was shown by Brake et al. (1994) when tonic immobility was induced to a greater extent and at an earlier age when broiler breeder pullets were reared on a higher protein intake. These authors issued a precautionary note that behavioral studies should take into account the nutritional status of the experimental animals.

**FEEDING AND WEIGHING SYSTEMS**

It now appears that there are certain quantifiable minimum nutrient requirements prior to photostimulation (Peak and Brake, 1994; Brake and Walsh, 1995; Walsh and Brake, 1995). These nutrient requirements may increase each generation for broiler breeders. A known nutrient target should make it easier to develop high-speed feeder systems for specific feeding programs. The mechanical feed conveying systems now available are sufficiently rapid to prevent birds from eating while the system is in operation. This prevention of eating, in combination with adequate feeder space, assures that all birds have a reasonably equal opportunity to consume their predetermined portion. Although the restriction regimen in common use by the breeder industry does appear too severe and hunger is induced (Savory et al., 1993) and demonstrated by rapid feed consumption (Kostal et al., 1992); Mauldin (1992) reminds us that it is not starvation because the birds do gain BW. Feed restriction can cause elevated levels of corticosterone (Mench, 1991), which is interpreted by some to be an indicator of substandard welfare. Concerns over the welfare aspects of feed restriction have led to investigations involving the addition of anorexic chemicals to the diet (Oyawoye and Krueger, 1990; Pinchasov et al., 1993), dietary dilution (Mench, 1993), daily feeding (Mench et al., 1991), or providing foraging opportunities (Mench, 1993). Everyday feeding can be used rather than skip-a-day feeding but success is not universal and does not reduce corticosterone levels (Bennett and Leeson, 1989). Some successful European systems scatter all of the feed on the litter floor. Inherent to any of the above is the reality that there is a great deal of genetic diversity in the breeder flock that, if not controlled, can lead to poor uniformity of development and some of the problems already discussed.

Body weight has historically been used as the guide by which feed allocations are determined each week. The improved weighing capabilities afforded by microprocessor-based automatic feed weighing systems can eliminate much hand catching and bird weighing. A reduction in bird capture appears to have attractive production and welfare advantages.

**SEX-SEPARATE FEEDING**

Many have observed that overweight broiler breeder males show poor fertility (Duncan et al., 1990; Mauldin, 1992); however, several authors (Parker and Arscott, 1964; Sexton et al., 1989) have reported that males fed nearly ad libitum exhibit excellent semen production and spermatozoal concentration. It has been presumed that excess BW simply interfered with male mating ability (Mauldin, 1992). Sex-separate feeding systems were developed as a way to aid in the control of male BW (McDaniel and Wilson, 1986; Fontana et al., 1990). Separate feeding of males and females requires a method of excluding the male from the female feeder as he supposedly will, but does not, eat more than the female (Brake, 1989). The method of choice has been male exclusion grills or devices that take advantage of the difference in head size between males and females. However, these devices have been reported to cause welfare concerns such as swollen heads and beak lesions (Hocking, 1990a) without demonstrating consistently improved fertility (Hocking, 1990b; Brake et al., 1993b). The reason for this ambiguity is probably that underfeeding of the male can actually cause male BW to increase as fertility decreases (Brake and Peak, 1994; Brake, 1995). The insertion of plastic “Noz Bonz” through the nares is another method being used by some (Nye, 1994). These devices exclude males completely enough that male feed allocations must exceed those of the female to avoid BW loss and decreased fertility. Large males with the highest potential for broiler BW gain require a higher daily energy intake to produce semen. This greater requirement for energy was demonstrated by the data of Attia et al. (1993), who showed that 42-d broiler BW increased as breeder male daily metabolizable energy allocation increased from 300 to 380 kcal/d. This result is consistent with the findings of Parker and Arscott (1964) and Sexton et al. (1989). Further exacerbating the problem is the fact that females can easily “steal” the male feed during the later stages of lay (Brake et al., 1993).

It has often been stated that males cease mating because they get too heavy. In reality, males get too heavy because they cease mating! A 4.5-kg male requires about 396 kcal ME daily for maintenance alone. This maintenance requirement has increased from the 238 kcal ME required for a 2.7 kg male at 20 wk of age. It would appear that an optimum feeding program for broiler breeders would be to consistently increase male feed allocation with age and BW and vary female feed allocation with BW and rate of lay. A female exclusion grill for the male feeder may be helpful (Brake et al., 1993) in preventing females from eating some of the male allocation of feed.

**CONCLUDING REMARKS**

A meaningful examination of the equipment needs of breeding stocks, particularly broiler breeders, can only be made with an eye to potential welfare management and nutritional deficiencies that may exacerbate any equipment deficiencies. One should be ever mindful that few of the typical complaints about broiler breeders are
often heard in lighter BW stocks. This difference has been attributed to less BW per se, whereas it may simply be true that nutrient intakes during the rearing phase are more appropriate for the behavioral development of the lighter stocks. Furthermore, although the use of alternative housing systems may provide for a richer behavioral repertoire, persistent health problems (Tauson et al., 1992) may reduce welfare and should be approached very cautiously. The working environment for the caretakers can also deteriorate (Tauson et al., 1992). The balance between the biology, economics, and engineering involved in developing a breeding facility is precarious. Favoring one factor over another can cause the birds or caretakers to suffer.

REFERENCES


