THE EFFECTS OF STOCKING DENSITY ON THE PERFORMANCE OF BROILER CHICKENS

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SUMMARY

THREE trials were conducted to determine the optimum stocking density for broiler chickens raised in a tropical environment. In Trial 1, 100, 67, 50, 40, 34 and 29 birds were placed in duplicates in each pen with an area of 3.72 M² to give stocking densities of 0.037, 0.056, 0.074, 0.093, 0.10 and 0.128 M² per bird respectively. In Trial 2, stocking densities of 0.046, 0.056, 0.064, 0.074, 0.083 and 0.093 M² per bird were compared. Trial 3 involved studying the effects of providing equal feeder space (5cm/bird) or equal number of similar sized feeders (2 feeders per pen) when birds were stocked at floor spaces of 0.056, 0.064, 0.074, 0.083 and 0.093 sq meter per bird.

Results showed that weight gain and feed consumption decreased, while total meat yield and net income per unit area increased, with increase in stocking rates. Feed efficiency, mortality and carcass dressing percentages were not significantly affected by the stocking rates. The effects of stocking densities on the performance of the birds were not altered by equalizing the feeder space per bird or by providing equal number of feeders per unit space. Management problems in terms of wetness of litter, feeding and watering were encountered with stocking densities of 0.037, 0.046 and 0.056 M²/bird. Stocking rates of 0.083, 0.093, 0.10 and 0.128 M² were uneconomic and did not produce superior performances to stocking densities of 0.064 or 0.074 M²/bird.

On the basis of the results, floor spaces of 0.064 or 0.074 M² per bird may be recommended as the optimum for broiler chickens raised in the tropics. The feeder space at these optimum stocking rates need not be more than 5cm per bird.

INTRODUCTION

THE recent trend towards raising large numbers of broiler chickens in confinement in Nigeria has emphasized the need for more relevant basic information on the stocking density or floor space required by broiler chickens. Most recommendations so far used in Nigeria are based on information obtained in temperate regions. Bolton *et al* (1972) reported that the liveweight and feed consumption of birds were depressed as

the floor space was decreased progressively from 0.093 M² to 0.047 M² per bird. These findings are in agreement with those of Andrews and Goodwin (1969); McIntyre and Ready (1972). Parkhurst, *et al* (1977) observed no differences in performances of birds when they were stocked at 0.06 or 0.07 M² per bird. McDonald (1976) showed that the maximum density for maximum growth rate and economic returns from broilers was 697 cm² per bird. Bolton *et al* (1972) observed that in broiler experiments ending at 8 weeks, a space allowance of 0.078 M² per bird is more than adequate. On the contrary, Proudfoot (1973) noted that with broiler chickens that grow faster, even a stocking rate of 0.0988 M² per bird adversely affected performance of broiler chickens. Published information on the optimum stocking density required for optimum performance of broiler chickens in the tropics is limiting. The present studies were designed to determine the optimum stocking density for optimum performance and economic returns from broiler chickens raised in Nigeria.

MATERIALS AND METHODS

Ross I broiler-type chickens of mixed sexes purchased at day old from a commercial hatchery in Nigeria were used in the studies. The birds were housed in an open sided poultry house containing pens separated by wooden partitions and wire netting. These pens were arranged in rows divided by a central passage. Each pen had an area of 3.72sq meter and had wood shavings as litter. Heat was provided in each pen during the first 4 weeks of the bird's life by two kerosene heated lamps placed under a wooden brooder box. Continuous lighting was provided

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throughout the experimental period.

Floor space per bird was varied by placing different number of birds in equal sized pens. The birds were first weighed in groups in such a way that the individual mean weights of the groups were similar. Feed and water were supplied *ad libitum*. The birds were fed a broiler starter ration for the first 42 days and then a broiler finisher ration from 42 to 63 days when each trial was terminated. The composition of the rations fed are shown in Table 1. The birds and feeds were weighed once every week. A record of mortality was kept. The condition of the litter was examined daily to detect any abnormalities.

At the conclusion of the trials the data were subjected to analysis of variance and significance of differences were assessed by applying Duncan's Multiple Range Test (Steel and Torrie, 1960) at the 5% level probability.

selected at random and processed for carcass evaluation.

Trial 2

In this trial, 80, 67, 58, 50, 45 and 40 birds were allotted at random in duplicates to each pen to give respectively, stocking densities of 0.046, 0.056, 0.064, 0.074, 0.083 and 0.093 M² per bird. The stocking density of 0.093 M² per bird was taken as the control density. The average day old weight of the birds used in this trial was 45 grams.

Trial 3

In the previous two trials, 2 equal sized feeders were allocated to each pen so that the feeder space per bird decreased as the bird density increased. In this trial the feeders were constructed to provide equal feeder space of 5cm per bird in one series of stocking densities studied (0.056, 0.064,

TABLE 1

Percentage Composition of Rations used in the Experiments

Ingredients	Broiler Starter	Broiler Finisher
Guniea Corn	48.35	53.80
Groundnut Meal	30.90	24.75
Fish Meal	7.50	5.00
Wheat Bran	6.50	9.45
Palm Oil	2.95	2.95
Bone Meal	2.00	2.25
Periwinkle Shell	1.00	1.00
Common Salt	0.30	0.30
Premix ¹	0.50	0.50

¹Supplied per kg ration: Vitamin A, 10,000 I.U; Vitamin D₃, 2000 ICU; Vitamin E, 5.IU; Vitamin K, 2.24 mg; riboflavin 5.5mg; Vitamin B₁₂, 10ug; Calcium pantothenate, 10mg; niacin, 25mg; choline chloride, 350mg folic acid, 1mg manganese, 56mg; Zinc, 50mg; Copper, 10mg; Iron, 20mg; cobalt, 1.25mg; amprolium, 125mg; Terramycin, 100mg.

Trial 1

The average day old live-weight of birds used in this trial was 45 grams. Six stocking densities (0.037, 0.056, 0.074, 0.093, 0.100 and 1.128 M² per bird) involving respectively 100, 67, 50, 40, 34 and 29 birds per 3.72 M² pen were studied. Two replicates were assigned to each treatment. A floor space of 0.093 M² per bird was taken as the control space. At the end of the experiment, 25% of the birds from each replicate were

0.074, 0.083 and 0.093 M² per bird). Similar series of stocking densities were also evaluated with the same number of feeders per pen, giving different feeder spaces of 5,6,7,8, and 9 cm for stocking densities of 0.056, 0.064, 0.074, 0.083 and 0.093 M² per bird respectively. The average day old weight of the birds was 39 grams.

RESULTS

Trial 1

Generally, the weight gains and feed

consumption decreased with increase in stocking rates (Table 2) although only the most densely stocked group (0.037 M²/bird) had values significantly lower than those of the most thinly stocked group (0.128 M²/bird). Efficiency of feed conversion (EFC) and mortality were not significantly affected by stocking densities. The monetary net return per meter increased with increase in stocking rates. The monetary net returns decreased significantly with decrease in stocking density from 0.037 M² down to 0.093 M² per bird. The difference between 0.093 and 0.10 and that between 0.10 and 0.128 M² per bird were not significant.

The most densely stocked group (0.037 M² per bird) was difficult to manage particularly after about 6 weeks of age. Most of the birds tended to sit on their "hock"; the litter was relatively damper than the other groups and movement within the pen was relatively more difficult.

Floor space had no significant effect on carcass dressing percentage (Table 3).

Trial 2

Results of Trial 2 (Table 4) showed that the lowest weight gain occurred in the most densely stocked group (0.046 M² per bird) while the highest weight gain was obtained with a stocking density of 0.083 M² per bird. Floor spaces of 0.064, 0.074 and 0.083 M² per bird resulted in weight gains and feed consumption that were not significantly different from those of the control group (0.093 M² per bird).

Stocking density had no significant effects on efficiency of feed conversion and mortality. The mortality figures were higher than those obtained in Experiment 1 and are unusual with our flock. The relatively high mortality rates were due to an out-break of a non-specific bacterial disease which occurred at about

TABLE 2
Effects of Floor Space on Performance of Broiler Chickens

Floor Space M ² /bird	Weight gain g	Feed Consump. g	EFC g feed/g gain	Mortality (%)	Net Return/M ² ₦
0.037	1579.50 ^b	4093.99 ^a	2.59	4.00	40.33 ^a
0.056	1778.72 ^{ab}	4562.93 ^{ab}	2.57	5.23	30.88 ^b
0.074	1866.00 ^{ab}	4644.89 ^{ab}	2.51	2.00	24.62 ^c
0.093	1911.00 ^{ab}	4941.08 ^a	2.59	5.00	19.71 ^d
0.100	1902.03 ^{ab}	4938.98 ^a	2.60	4.41	16.72 ^{de}
0.128	1937.67 ^a	5215.38 ^a	2.64	6.89	14.60 ^e

¹Column values with same superscript or no superscript are not significantly different ($P < 0.05$).

²Net Returns/M² — Number of birds/M² X Sale price per bird minus cost of feed for raising the birds.

TABLE 3
Effects of Floor Space on Carcass Dressing Percentages of broiler chickens.

Floor space M ² /bird	Carcass + neck %	Gizzard %	Liver %	Heart %
0.037	67.95	2.08	2.02	0.682
0.056	71.59	2.10	1.74	0.698
0.074	70.90	2.15	1.58	0.608
0.093	69.44	2.00	1.89	0.580
0.100	68.86	1.91	2.04	0.641
0.128	70.34	2.12	2.02	0.658

¹No significant differences were observed in all parameters.

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TABLE 4

Effects of Floor space on performance of broiler chickens

Floor space M ² /bird	Weight gain g	Feed Consump. g/bird	EFC g feed/g gain	Mortality (%)	Net Returns/M ² ₦
0.046	1739.3 ^c	4157.7 ^c	2.39	8.75	37.70 ^a
0.056	1802.0 ^{bc}	4323.7 ^{bc}	2.40	6.72	32.66 ^b
0.064	1903.6 ^{ab}	4532.5 ^{ab}	2.38	13.80	30.06 ^b
0.074	1959.3 ^a	4754.0 ^{ab}	2.43	10.00	26.33 ^c
0.083	1999.4 ^a	4707.6 ^{ab}	2.35	8.89	23.86 ^{cd}
0.093	1964.9 ^a	4790.9 ^a	2.44	11.25	21.05 ^d

¹Column values with same superscript are not significantly different ($P < 0.05$).

the 6th week of age. The disease was controlled by use of some antibiotics.

Net returns per unit space increased with increase in number of birds per pen. Problems of wet litter, feeding and watering were encountered with the most highly stocked group (0.046 sq meter per bird) and to a lesser degree with a stocking rate of 0.056 M² per bird.

Trial 3

The results obtained in this trial are similar to those obtained in the first two trials in that weight gain and feed consumption increased with increase in the

floor space allowed each bird (Table 5). Apart from the lowest floor space (0.056 sq meter per bird), the weight gains and feed consumption were not significantly different from one another. Efficiency of feed conversion and mortality were not significantly affected by the stocking rates. The monetary net return per M² increased linearly with increase in stocking density. The linear component was significant although the difference between any two consecutive treatments was not. Equalizing the feeder space did not alter the response of the birds to the stocking rates neither did the provision of equal number of feeders affect the responses.

TABLE 5

Effects of floor space and feeder space on the performance of broiler chickens

Floor space M ² /bird	Feeder space cm/bird	Weight gain g	Feed Consump. g/bird	EFC g feed/g gain	Mortality (%)	Net Return/M ²
0.056	5	1736.2 ^b	4374.3 ^c	2.52	1.49	31.07 ^a
0.064	6	1844.8 ^{ab}	4693.3 ^b	2.52	4.32	28.49 ^{ab}
0.074	7	1908.1 ^a	4765.0 ^{ab}	2.50	1.00	25.61 ^{bc}
0.083	8	1974.0 ^a	4775.1 ^a	2.48	1.11	23.91 ^{cd}
0.093	9	1989.1 ^a	4885.9 ^a	2.46	2.50	21.56 ^d
0.056	5	1778.3 ^b	4447.4 ^{bc}	2.50	0.75	31.99 ^d
0.064	5	1843.4 ^{ab}	4583.9 ^b	2.49	2.59	28.85 ^{ab}
0.074	5	1903.6 ^a	4758.9 ^{ab}	2.50	1.00	25.67 ^{bc}
0.083	5	1910.1 ^a	4709.2 ^a	2.48	1.11	23.16 ^{cd}
0.093	5	1926.1 ^a	4868.2 ^a	2.52	6(25	20.53 ^d

¹Column values with same superscript or no superscript are not significantly different ($P < 0.05$).

DISCUSSION

The depressions in live-weight and feed consumption as the stocking density increased are in agreement with the findings of Andrews and Goodwin (1969) and Bolton *et al* (1972). Since equalizing the feeder space and in some cases, increasing the feeder space from 5 cm to 6, 7, 8, and 9 cm per bird did not significantly alter the live-weight or feed consumption, it is unlikely that the depression in live-weight gain or feed consumption with increasing density was due to insufficiency of feeder space. These observations probably indicate that the effects of overcrowding may not be overcome by providing more feeder space, if the original feeder space provided was optimum. Similar conclusion with respect to feeder space had earlier been made by Hansen and Backer (1960) and Bolton *et al* (1972).

In the densely stocked pens, movement of the birds is obviously reduced resulting in less wastage of energy in movement. In addition, such densely stocked birds insulate each other from heat loss. These two factors together may result in less demand for calories and hence less appetite for feed. This explanation may account for the reduced feed consumption as the floor space per bird was reduced.

Although there were progressive reductions in weight gain and feed consumption as the space per bird was decreased, the total amount of meat and net income per unit space increased. These observations are important in any broiler enterprise because, frequently, commercial broiler growers base their calculations of monetary gain on net returns per unit floor space rather than per bird started. A balance must however be struck between net returns per unit floor space and net returns per bird started. In the present experiments, although floor spaces of 0.037, 0.046 and 0.056 M² per bird gave higher net returns, management problems were encountered with these floor spaces. In addition in most cases, they gave performances significantly lower than those on the control density of 0.093 M² per bird. Stocking densities of 0.083 to 0.128

M² were uneconomic and resulted in performances not better than the higher stocking densities of 0.064 and 0.074 M² per bird. Since stocking densities of 0.064 and 0.074 M² per bird gave performances not significantly different from the control (0.093 M² per bird) and yielded more income and meat per unit space than the control without any management problems, these stocking densities (0.064 and 0.074 M² per bird) may be recommended as the optimum stocking densities for broiler chickens raised in the tropics.

The results of this report also indicate that for broiler chickens raised to 9 weeks in the tropics, the feeder space per bird need not be more than 5 cm.

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