# FEEDING AND BREEDING OF LABORATORY ANIMALS

## IV. BREEDING OF RABBITS WITHOUT FRESH GREEN FOOD

By H. M. BRUCE, *National Institute for Medical Research, Hampstead, N.W.* 3

(With 1 Figure in the Text)

### INTRODUCTION

In an earlier paper (Bruce & Parkes, 1946) the rearing and maintenance of rabbits without green food was described. It was shown that with a dry pelleted diet containing dried grass and supplemented with hay, the fresh greens served mainly as a container for water which could be more satisfactorily and far more economically supplied direct. The advantages of giving rabbits water to drink has also been stressed by Christian (1936), but she used a basal diet which was completely devoid of vitamin C and found a slight advantage in supplying fresh greens as well as water to the rabbits.

Some of the rabbits used in the feeding experiments described in the earlier paper have now been allowed to breed, and two generations of young have been reared without green food. The reproduction of the original females and of their young as well as the growth of the two generations of young so reared is reported here.

### TECHNIQUE

*Animals.* The rabbits were all of the Dutch variety with the exception of one female which was of a larger Albino breed.

*Care.* The general care of the animals has been the same throughout. The females were housed each in a separate cage. For mating the female was placed in the male's cage and allowed to remain with the male only until mating had occurred or until it became evident that she would refuse. She was then returned at once to her own cage. The original females were weighed twice weekly, but both generations of young were weighed only once a week. Weighing of the pregnant females was omitted towards the end of gestation if the animal seemed at all restive. The young were not handled at birth and were counted at about a week old when it was possible to do so without disturbing the nest. They were weighed individually at 28 days old and were weaned at 35 days, when milk production, which in the rabbit reaches a maximum at about the 25th day and starts to decrease on the 30th day (Bertelli, 1936), had just begun to fall off. By this time the young had been eating and drinking, which they learned to do very readily, for about 3 weeks. They were sexed at 8–10 weeks old and the sexes separated shortly afterwards. The cages were cleaned twice a week.

*Diet.* No sugar-beet pulp was available during the period covered by this work, and the rabbits all received diet 18 in pelleted form which has the following composition:

| | % |
|---|---|
| Bran | 15 |
| Barley meal | 20 |
| Ground-nut meal | 15 |
| Lucerne meal | 10 |
| Meat and bone meal | 8 |
| Dried grass meal | 30 |
| $CaCO_3$ | 1 |
| NaCl | 1 |

Theoretical analysis:

| | % |
|---|---|
| Crude digestible protein | 16·5 |
| Soluble carbohydrate | 33·7 |
| Fat | 4·6 |
| Fibre | 6·7 |

This diet, which is prepared commercially in bulk, contains from 2 to 6 mg. of ascorbic acid per 100 g. of diet, depending upon the quality of the dried grass available for each batch. Hay and unlimited water were also given, the latter from bottles similar to those commonly used for rats.

*Housing.* All the animals were kept in a warmed room. The original females were mated from the cages in which they had been reared; barred all-metal cages 20 × 15 × 12 in. high. These cages were most unsuitable for breeding animals, but no others were available at the time. No special cover was provided for the nest beyond that supplied by the tray 5–6 in. deep which formed the floor of the cage. Sawdust was used as floor covering, and generous amounts of hay were provided for the nest. When the young were about 3 weeks old the female and litter were transferred to larger wire-mesh cages in which they were reared, and hay was given in a hay basket attached to the side of the cage. The $F_1$ females when

https://doi.org/10.1017/S002217240001384X Published online by Cambridge University Press

adult were kept in the usual type of wooden two-compartment hutch with two doors, one solid and the other barred. As for the original females, a generous supply of hay and sawdust was provided. The $F_2$ young were reared in the wooden hutches.

## RESULTS

### *Fertility*

*Original females.* The mating of these animals was carried out in the spring and early summer, from 19 February (first mating) to 14 May (last mating). Of fourteen females, twelve gave birth to litters, but only five accepted the male on the first occasion. Two females only failed to become pregnant, in spite of the fact that most of the animals were over 10 months old before they were mated. Of these two, one refused on three occasions to accept the male; the other mated but failed to produce a litter and refused on two further occasions to mate again. A second female which failed to give birth to a litter after a first mating successfully reared a litter from a second mating 4 weeks later. In all, eighteen matings were made, eight with cross-bred males and ten with Dutch males; from these, sixteen litters were born. One first litter of two young was born dead, but a second litter from the same female was reared. Thus, only 11 % of the matings were infertile, a figure considerably below the average found by Hammond (1925) for cross-bred females, 31·1 %.

*$F_1$ females.* Only the young of litters from Dutch × Dutch parents were kept for reproduction. No brother-sister matings were made, each female being mated with a male from another litter. No special selection of the young for breeding on the basis of the performance of the parents was made. Cataract developed in one rabbit of a Dutch × Dutch litter, which was discarded. Otherwise all available $F_1$ females were tried with six out of the nine available males. All the matings of the $F_1$ generation were made in the winter months, November and December, when the animals were from 6 to 9 months old. No attempt was made to establish the earliest age at which a fertile mating would take place. The average age at which fertile matings were made was 7·3 months, and there was no evidence of delayed maturity in the animals.

Of the twelve females, eleven gave birth to litters after the first mating. The remaining female consistently refused to mate, and from her behaviour appeared to be in a state of persistent pseudo-pregnancy.

The performance of both groups of females is summarized in Table 1, from which it can be seen that the record of the animals is good. The total number of litters as percentage matings, 93, is high for Dutch rabbits. King Wilson (1940) records 87·5 % fertility as good for this type. The gestation period was normal, 31 days for twenty-one out of the twenty-seven litters; three litters were born at 30 days and three at 32 days.

Table 1. *The fertility of rabbits reared and maintained without fresh greens*

| Generation | No. of females | Approximate age when first mated (months) | Average weight when first mated (kg.) | No. of matings | No. of litters born |
|---|---|---|---|---|---|
| Original | 6 | 12–14* | 2·48* | 11 | 9 |
| | 4 | 10–11 | 2·26 | 3 | 3 |
| | 4 | 9–10 | 1·71 | 4 | 4 |
| $F_1$ | 12 | 6–9 | 2·25 | 11 | 11 |
| Total | 26 | — | — | 29 | 27 |

* The one Albino female has been omitted from these two averages.

Table 2. *The average litter size at birth and at weaning of rabbits reared and maintained without fresh greens*

| Group | Males | No. of females mated | No. of litters born | No. of young born | Average size of litter at birth (young) | No. of young weaned | Proportion of young weaned % | Average size of litter at weaning (young) | Range of litter size: At birth | Range of litter size: At weaning |
|---|---|---|---|---|---|---|---|---|---|---|
| Original females | Crossbred | 9 | 9 | 58 | 6·44 | 43 | 74 | 4·78 | 2–9 | 1–9 |
| | Dutch | 9 | 7 | 42 | 6·00 | 28 | 67 | 4·0 | 3–8 | 1–8 |
| $F_1$ females | $F_1$ Dutch | 11 | 11 | 68 | 6·18 | 63 | 93 | 5·73 | 4–8 | 3–8 |
| Totals Dutch × Dutch only | | 20 | 18 | 110 | 6·11 | 91 | 83 | 5·06 | 3–8 | 1–8 |

https://doi.org/10.1017/S002217240001384X Published online by Cambridge University Press

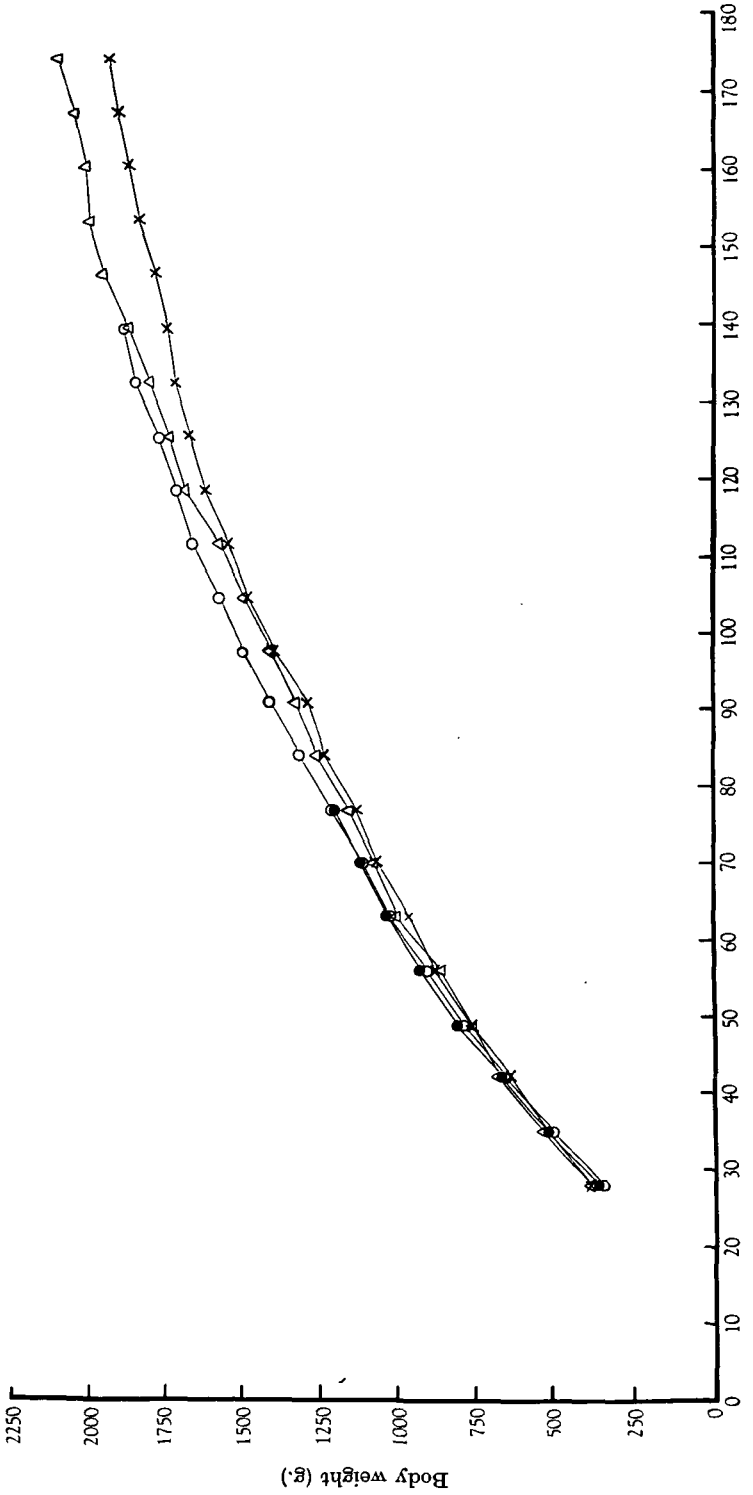


Fig. 1. The growth of young rabbits without green food. They were weaned at 35 days of age.
● 39 $F_2$ males; ○ 23 $F_2$ females; × 9 $F_1$ males; △ 12 $F_1$ females.

https://doi.org/10.1017/S002217240001384X Published online by Cambridge University Press

*Litter size*

Details of the number of young born and reared in the various groups are given in Table 2. The average litter size at birth for Dutch × Dutch matings, 6·11, is good for the breed. The average cross-bred litter size was slightly larger, 6·44. King Wilson (1940) reports an average litter size of 5·11 for Dutch and 5·58 for Dutch × cross-bred litters. Of the twenty-seven litters all were first litters except four second litters from four of the oldest original females, and it is likely that the litter size would have improved in subsequent matings. Burky (1932) gives a litter size of four to six for first pregnancies, and eight to ten for later pregnancies in cross-bred rabbits.

It was, however, noticeable that the original females failed to rear a high proportion of their young. Only 67 % of the Dutch × Dutch young were reared by these females as compared with 93 % by the $F_1$ females. Nearly the whole of the loss took place during the first 10 days of life. The original females were probably too old when used for breeding, but the chief cause of the high mortality was undoubtedly the bad housing conditions. As the young were not handled at birth it is not possible to give the stillbirth-rate, but only three deaths occurred after the young were able to leave the nest. The five deaths which occurred among the $F_2$ young all took place at birth or soon after. No deaths occurred after weaning.

*Sex-ratio*

The sex-ratio at birth was not determined, but sixty-five males and sixty-eight females (49 % males) were sexed at weaning.

*Growth of the young*

The growth of Dutch × Dutch young of both generations is shown in Fig. 1. No difference between the sexes was found for the $F_1$ generation up to the age of about 4 months, when the young weighed about 1·5 kg.; from then the rate of growth of the males decreased more than that of the females; but there was much individual variation and the difference is not significant ($t = 1·4$).

The growth rate of the $F_2$ generation was strikingly similar to that of the $F_1$ generation.

## SUMMARY

1. Breeding records are given of fourteen female Dutch rabbits reared and maintained without green food, and of twelve of their female offspring.

2. Fertility, average litter size at birth, and the percentage of young weaned, were good for the breed.

3. No difference in growth rate was found between the first and second generations of young.

4. With the dry pelleted diet, supplemented by drinking water, fresh green food is unnecessary for breeding rabbits, as it has already been shown to be unnecessary for growing animals (Bruce & Parkes, 1946).

I should like to thank Dr A. S. Parkes, F.R.S., for his help in the preparation of the manuscript.

## REFERENCES

Bertelli, E. (1936). *Mthly Bull. Agric. Sci. Practice*, **27**, 453.

Bruce, H. M. & Parkes, A. S. (1946). *J. Hyg., Camb.*, **44**, 501.

Burky, E. L. (1932). *J. Lab. Clin. Med.* **18**, 189.

Christian, M. I. (1936). *Harper Adams Util. Poult. J.* **21**, 539.

Hammond, J. (1925). *Reproduction in the Rabbit.* Oliver and Boyd.

King Wilson, W. (1940). *Nature, Lond.*, **146**, 721.

(*MS. received for publication* 23. VI. 46.—Ed.)