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# Progress In Poultry

"THROUGH RESEARCH"

## THE EFFECT OF AGE & STRAIN ON EGG WEIGHT

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During 1980 to 1983, over one hundred California layer flocks were monitored periodically throughout their life for a series of performance traits. This report summarizes various aspects of egg weight. Subsequent reports will discuss other aspects of egg weight and other performance traits.

### METHODS

Flocks were started at one day of age between February 1980 and February 1981 on some 33 rearing farms in Southern California and the Central California coast. Farms were selected based upon their ability and willingness to keep the necessary records associated with the study. Eleven White Leghorn and three brown egg strains were represented in the sample.

Farm Advisors visited each flock at 6, 18, 24, 30, 40, 50, 60, 80, and 100 weeks of age to weigh a sample of birds and eggs. A representative house was selected and samples were always taken from the same general area in the same house.

An egg sample consisted of 100 eggs. All eggs within an area were used with the exception of leakers. Eggs were weighed individually on an Ohaus Autogram Model 1000 scale to the nearest 0.1 grams.

Eggs were grouped into six weight classifications:

| | ounces per dozen |
|---|---|
| Jumbo | 29 and up |
| Extra Large | 26 to <29 |
| Large | 23 to <26 |
| Medium | 20 to <23 |
| Small | 17 to <20 |
| Pee Wee | <17 |

These are the minimum weight standards for individual eggs by USDA definition. A dozen eggs in each classification must weigh one ounce more than the minimum weights shown.

The uniformity of eggs within samples was analyzed as well as the uniformity of flock averages at specific ages within the three most popular strains. The data in this report summarizes the results observed at seven separate ages. Each age reflects all seasons, all types of housing, and various feeding programs. These factors will be the subject of future analysis.

Strain data was sufficient for three strains, with more than 20 samples for each, to test for significant egg size differences. Strains are coded to avoid revealing differences which might be derived from statisticaly invalid samples.

Egg weights taken at 60 weeks were generally from non-molted flocks. Eggs selected at 80 and 100 weeks were always from molted flocks.

## RESULTS

Tables 1 - 9 summarize the average egg weight and egg size distribution for each strain.

**TABLE 1 Egg weight and classification at 24 weeks of age.**

| Strain | No. of Flocks | Pee Wee | Small | Medium | Large | X-Large | Jumbo | Av. wt. (ozs/doz) | % Above 23oz | % Above 23.5oz | % Above 24oz | Standard Deviation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (percent) | | | | | | | | | | |
| A | 25 | 1 | 21 | 60 | 14 | 1 | 3 | 21.59 | 18 | 13 | 10 | 2.41 |
| B | 1 | 1 | 22 | 74 | 2 | 0 | 1 | 20.89 | 3 | 2 | 1 | 1.72 |
| C | 20 | 5 | 46 | 43 | 4 | 1 | 1 | 20.10 | 6 | 4 | 3 | 2.06 |
| D | 5 | 2 | 36 | 54 | 5 | 1 | 3 | 20.77 | 8 | 6 | 5 | 2.37 |
| E | 33 | 3 | 41 | 46 | 5 | 2 | 3 | 20.57 | 9 | 7 | 6 | 2.50 |
| F | 7 | 2 | 30 | 56 | 11 | 1 | 1 | 21.06 | 13 | 10 | 7 | 2.07 |
| G | 6 | 3 | 41 | 52 | 3 | 1 | 1 | 20.44 | 5 | 3 | 3 | 1.82 |
| H | 5 | 1 | 31 | 59 | 8 | 1 | 2 | 20.95 | 10 | 6 | 4 | 2.03 |
| I | 4 | 1 | 29 | 60 | 8 | 1 | 3 | 21.11 | 11 | 7 | 5 | 2.32 |
| J | 1 | 5 | 56 | 35 | 1 | 2 | 1 | 19.74 | 4 | 4 | 4 | 2.19 |
| K | 3 | 2 | 36 | 59 | 3 | 1 | 0 | 20.50 | 4 | 2 | 1 | 1.55 |
| Av. White | 110 | 3 | 35 | 52 | 7 | 1 | 2 | 20.78 | 10 | 8 | 6 | 2.26 |
| L | 1 | 0 | 13 | 63 | 19 | 0 | 5 | 22.24 | 24 | 15 | 11 | 2.81 |
| M | 1 | 0 | 3 | 55 | 34 | 2 | 6 | 23.23 | 42 | 27 | 25 | 2.98 |
| N | 1 | 0 | 11 | 66 | 16 | 7 | 0 | 22.01 | 23 | 17 | 12 | 2.07 |
| Av. Brown | 3 | 0 | 9 | 61 | 23 | 3 | 4 | 22.49 | 30 | 20 | 16 | 2.62 |

**TABLE 2 Egg weight and classification at 30 weeks of age.**

| Strain | No. of Flocks | Pee Wee | Small | Medium | Large | X-Large | Jumbo | Av. wt. (ozs/doz) | % Above 23oz | % Above 23.5oz | % Above 24oz | Standard Deviation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (percent) | | | | | | | | | | |
| A | 23 | 0 | 0 | 24 | 61 | 13 | 2 | 24.32 | 76 | 65 | 54 | 2.09 |
| B | 1 | 0 | 0 | 49 | 48 | 3 | 0 | 23.15 | 51 | 38 | 32 | 1.62 |
| C | 21 | 0 | 2 | 48 | 45 | 4 | 1 | 23.09 | 49 | 36 | 27 | 1.71 |
| D | 5 | 0 | 2 | 36 | 54 | 6 | 1 | 23.56 | 61 | 48 | 37 | 1.84 |
| E | 35 | 0 | 2 | 42 | 48 | 7 | 1 | 23.43 | 56 | 44 | 36 | 1.90 |
| F | 7 | 0 | 2 | 34 | 54 | 10 | 1 | 23.72 | 64 | 53 | 44 | 1.88 |
| G | 6 | 0 | 3 | 44 | 49 | 5 | 0 | 23.29 | 54 | 42 | 34 | 1.51 |
| H | 5 | 0 | 3 | 35 | 55 | 6 | 1 | 23.50 | 62 | 49 | 39 | 1.95 |
| I | 4 | 0 | 2 | 38 | 55 | 2 | 3 | 23.69 | 61 | 47 | 38 | 2.41 |
| J | 1 | 0 | 14 | 71 | 15 | 0 | 0 | 21.40 | 15 | 11 | 5 | 1.40 |
| K | 3 | 0 | 1 | 54 | 42 | 2 | 0 | 22.89 | 45 | 29 | 20 | 1.32 |
| Av. White | 111 | 0 | 2 | 39 | 51 | 7 | 1 | 23.54 | 59 | 47 | 38 | 1.88 |
| L | 1 | 0 | 1 | 22 | 66 | 10 | 1 | 23.90 | 77 | 58 | 40 | 1.62 |
| M | 1 | 1 | 3 | 21 | 67 | 8 | 0 | 23.98 | 75 | 63 | 54 | 1.81 |
| N | 1 | 0 | 1 | 12 | 62 | 23 | 2 | 24.83 | 87 | 78 | 69 | 1.84 |
| Av. Brown | 3 | 0 | 2 | 18 | 65 | 14 | 1 | 24.23 | 80 | 66 | 54 | 1.76 |

**TABLE 3 Egg weight and classification at 40 weeks of age.**

| Strain | No. of Flocks | Pee Wee | Small | Medium | Large | X-Large | Jumbo | Av. wt. (ozs/doz) | % Above 23oz | % Above 23.5oz | % Above 24oz | Standard Deviation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (percent) | | | | | | | | | | |
| A | 25 | 0 | 0 | 7 | 53 | 35 | 5 | 25.66 | 93 | 88 | 83 | 1.89 |
| B | 1 | 0 | 0 | 9 | 63 | 26 | 2 | 25.15 | 91 | 82 | 72 | 2.09 |
| C | 21 | 0 | 0 | 12 | 63 | 24 | 1 | 24.94 | 88 | 80 | 70 | 1.68 |
| D | 5 | 0 | 0 | 6 | 57 | 33 | 4 | 25.58 | 94 | 88 | 82 | 1.80 |
| E | 35 | 0 | 0 | 14 | 58 | 26 | 2 | 25.01 | 86 | 78 | 71 | 1.87 |
| F | 7 | 0 | 0 | 11 | 50 | 34 | 5 | 25.55 | 89 | 84 | 80 | 1.92 |
| G | 6 | 0 | 0 | 7 | 63 | 28 | 2 | 25.22 | 93 | 85 | 79 | 1.56 |
| H | 5 | 0 | 0 | 12 | 54 | 32 | 2 | 25.18 | 88 | 83 | 75 | 1.68 |
| I | 4 | 0 | 0 | 16 | 63 | 19 | 2 | 24.89 | 84 | 78 | 70 | 2.06 |
| J | 1 | 0 | 0 | 7 | 67 | 25 | 1 | 25.10 | 93 | 90 | 80 | 1.53 |
| K | 3 | 0 | 0 | 8 | 55 | 35 | 2 | 25.50 | 92 | 87 | 80 | 1.68 |
| Av. White | 113 | 0 | 0 | 11 | 57 | 29 | 3 | 25.23 | 89 | 82 | 75 | 1.82 |
| L | 1 | 0 | 0 | 12 | 59 | 26 | 3 | 25.12 | 88 | 82 | 74 | 2.03 |
| M | 1 | 0 | 0 | 3 | 44 | 42 | 11 | 26.26 | 97 | 96 | 91 | 1.91 |
| N | 1 | 0 | 0 | 2 | 38 | 46 | 14 | 26.76 | 98 | 94 | 93 | 2.17 |
| Av. Brown | 3 | 0 | 0 | 6 | 47 | 38 | 9 | 26.04 | 94 | 91 | 86 | 2.04 |

**TABLE 4 Egg weight and classification at 50 weeks of age.**

| Strain | No. of Flocks | Pee Wee | Small | Medium | Large | X-Large | Jumbo | Av. wt. (ozs/doz) | % Above 23oz | % Above 23.5oz | % Above 24oz | Standard Deviation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (percent) | | | | | | | | | | |
| A | 25 | 0 | 0 | 4 | 36 | 47 | 13 | 26.58 | 96 | 93 | 90 | 2.05 |
| B | 1 | 0 | 0 | 6 | 65 | 29 | 0 | 25.21 | 94 | 88 | 76 | 1.56 |
| C | 21 | 0 | 0 | 4 | 47 | 43 | 6 | 25.98 | 96 | 92 | 88 | 1.77 |
| D | 5 | 0 | 0 | 2 | 37 | 52 | 10 | 26.64 | 98 | 97 | 94 | 1.87 |
| E | 35 | 0 | 0 | 6 | 48 | 40 | 6 | 25.91 | 94 | 89 | 84 | 1.99 |
| F | 7 | 0 | 0 | 7 | 40 | 43 | 9 | 26.16 | 92 | 88 | 85 | 2.04 |
| G | 6 | 0 | 0 | 5 | 52 | 40 | 3 | 25.79 | 95 | 92 | 88 | 1.56 |
| H | 5 | 0 | 1 | 7 | 40 | 41 | 10 | 26.15 | 92 | 87 | 83 | 2.09 |
| I | 4 | 0 | 0 | 7 | 51 | 39 | 3 | 25.68 | 93 | 90 | 83 | 1.76 |
| J | 1 | 0 | 1 | 2 | 50 | 41 | 6 | 26.15 | 97 | 96 | 90 | 2.09 |
| K | 3 | 0 | 0 | 6 | 58 | 33 | 2 | 25.38 | 93 | 89 | 80 | 1.69 |
| Av. White | 113 | 0 | 0 | 5 | 44 | 42 | 8 | 26.10 | 95 | 91 | 86 | 1.93 |
| L | 1 | 0 | 0 | 2 | 40 | 41 | 17 | 26.65 | 98 | 92 | 90 | 2.08 |
| M | 1 | 0 | 0 | 0 | 14 | 58 | 28 | 28.01 | 100 | 100 | 100 | 1.94 |
| N | 1 | 0 | 0 | 0 | 10 | 52 | 38 | 28.66 | 100 | 100 | 100 | 2.00 |
| Av. Brown | 3 | 0 | 0 | 1 | 21 | 50 | 28 | 27.77 | 99 | 97 | 97 | 2.01 |

**TABLE 5 Egg weight and classification at 60 weeks of age.**

| Strain | No. of Flocks | Pee Wee | Small | Medium | Large | X-Large | Jumbo | Av. wt. (ozs/doz) | % Above 23oz | % Above 23.5oz | % Above 24oz | Standard Deviation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (percent) | | | | | | | | | | |
| A | 22 | 0 | 0 | 3 | 26 | 51 | 21 | 27.25 | 97 | 96 | 93 | 2.05 |
| B | 1 | 0 | 0 | 4 | 43 | 43 | 10 | 26.26 | 96 | 93 | 89 | 1.89 |
| C | 19 | 0 | 0 | 2 | 33 | 53 | 13 | 26.76 | 98 | 96 | 93 | 1.83 |
| D | 4 | 0 | 0 | 1 | 26 | 56 | 17 | 27.17 | 99 | 98 | 96 | 1.78 |
| E | 33 | 0 | 0 | 5 | 38 | 45 | 11 | 26.42 | 95 | 91 | 87 | 2.02 |
| F | 6 | 0 | 0 | 4 | 33 | 44 | 19 | 26.85 | 95 | 92 | 89 | 2.39 |
| G | 6 | 0 | 0 | 6 | 48 | 39 | 7 | 25.92 | 94 | 91 | 86 | 1.73 |
| H | 5 | 0 | 0 | 6 | 36 | 44 | 14 | 26.48 | 94 | 92 | 89 | 2.12 |
| I | 3 | 0 | 0 | 8 | 42 | 41 | 8 | 26.04 | 92 | 90 | 85 | 2.03 |
| J | 1 | 0 | 0 | 4 | 34 | 43 | 19 | 26.93 | 96 | 95 | 92 | 2.34 |
| K | 3 | 0 | 0 | 6 | 47 | 41 | 6 | 25.89 | 94 | 91 | 86 | 1.77 |
| Av. White | 103 | 0 | 0 | 4 | 35 | 47 | 14 | 26.67 | 96 | 93 | 90 | 1.99 |
| L | 1 | 0 | 0 | 0 | 15 | 45 | 40 | 28.32 | 100 | 100 | 99 | 2.03 |
| M | 1 | 0 | 0 | 0 | 4 | 47 | 49 | 29.11 | 100 | 100 | 100 | 1.85 |
| N | 1 | 0 | 0 | 1 | 5 | 29 | 65 | 29.52 | 99 | 99 | 99 | 2.21 |
| Av. Brown | 3 | 0 | 0 | 0 | 8 | 40 | 51 | 28.98 | 100 | 100 | 99 | 2.03 |

**TABLE 6 Egg weight and classification at 80 weeks of age.***

| Strain | No. of Flocks | Pee Wee | Small | Medium | Large | X-Large | Jumbo | Av. wt. (ozs/doz) | % Above 23oz | % Above 23.5oz | % Above 24oz | Standard Deviation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (percent) | | | | | | | | | | |
| A | 21 | 0 | 0 | 3 | 26 | 50 | 21 | 27.23 | 97 | 95 | 93 | 2.18 |
| B | 1 | 0 | 0 | 3 | 44 | 46 | 7 | 26.19 | 97 | 95 | 89 | 1.97 |
| C | 16 | 0 | 0 | 1 | 29 | 53 | 16 | 27.03 | 98 | 97 | 94 | 1.91 |
| D | 5 | 0 | 0 | 2 | 28 | 54 | 16 | 27.05 | 98 | 97 | 94 | 1.85 |
| E | 29 | 0 | 0 | 4 | 36 | 47 | 13 | 26.58 | 96 | 93 | 89 | 2.04 |
| F | 6 | 0 | 0 | 3 | 30 | 53 | 15 | 26.90 | 97 | 95 | 92 | 2.00 |
| G | 5 | 0 | 0 | 3 | 37 | 49 | 11 | 26.64 | 97 | 95 | 92 | 1.83 |
| H | 4 | 0 | 1 | 4 | 32 | 46 | 17 | 26.80 | 95 | 93 | 89 | 2.02 |
| I | 3 | 0 | 0 | 7 | 36 | 43 | 13 | 26.36 | 92 | 89 | 84 | 2.06 |
| J | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| K | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Av. White | 100 | 0 | 0 | 3 | 32 | 49 | 16 | 26.86 | 97 | 95 | 91 | 2.02 |

* No brown egg data beyond 60 weeks of age.

TABLE 7 Egg weight and classification at 100 weeks of age.

| Strain | No. of Flocks | Pee Wee | Small | Medium | Large | X-Large | Jumbo | Av. wt. (ozs/doz) | % Above 23oz | % Above 23.5oz | % Above 24oz | Standard Deviation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (percent) | | | | | | | | | | |
| A | 14 | 0 | 0 | 2 | 24 | 47 | 28 | 27.63 | 98 | 97 | 95 | 2.30 |
| B | 1 | 0 | 0 | 3 | 33 | 45 | 19 | 26.81 | 97 | 93 | 93 | 2.08 |
| C | 12 | 0 | 0 | 1 | 21 | 52 | 25 | 27.59 | 99 | 98 | 96 | 2.00 |
| D | 5 | 0 | 0 | 0 | 16 | 53 | 31 | 27.98 | 100 | 99 | 98 | 1.92 |
| E | 26 | 0 | 0 | 4 | 31 | 49 | 16 | 26.88 | 96 | 95 | 92 | 2.05 |
| F | 4 | 0 | 0 | 4 | 32 | 49 | 15 | 26.73 | 96 | 93 | 90 | 2.11 |
| G | 4 | 0 | 0 | 3 | 42 | 50 | 6 | 26.35 | 98 | 94 | 89 | 1.76 |
| H | 3 | 0 | 0 | 3 | 26 | 49 | 21 | 27.17 | 97 | 94 | 92 | 2.03 |
| I | 2 | 0 | 0 | 7 | 42 | 40 | 11 | 26.28 | 93 | 92 | 88 | 2.08 |
| J | 1 | 0 | 0 | 5 | 45 | 48 | 2 | 25.77 | 95 | 92 | 84 | 1.67 |
| K | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Av. White | 74 | 0 | 0 | 3 | 28 | 49 | 20 | 27.16 | 97 | 96 | 93 | 2.07 |

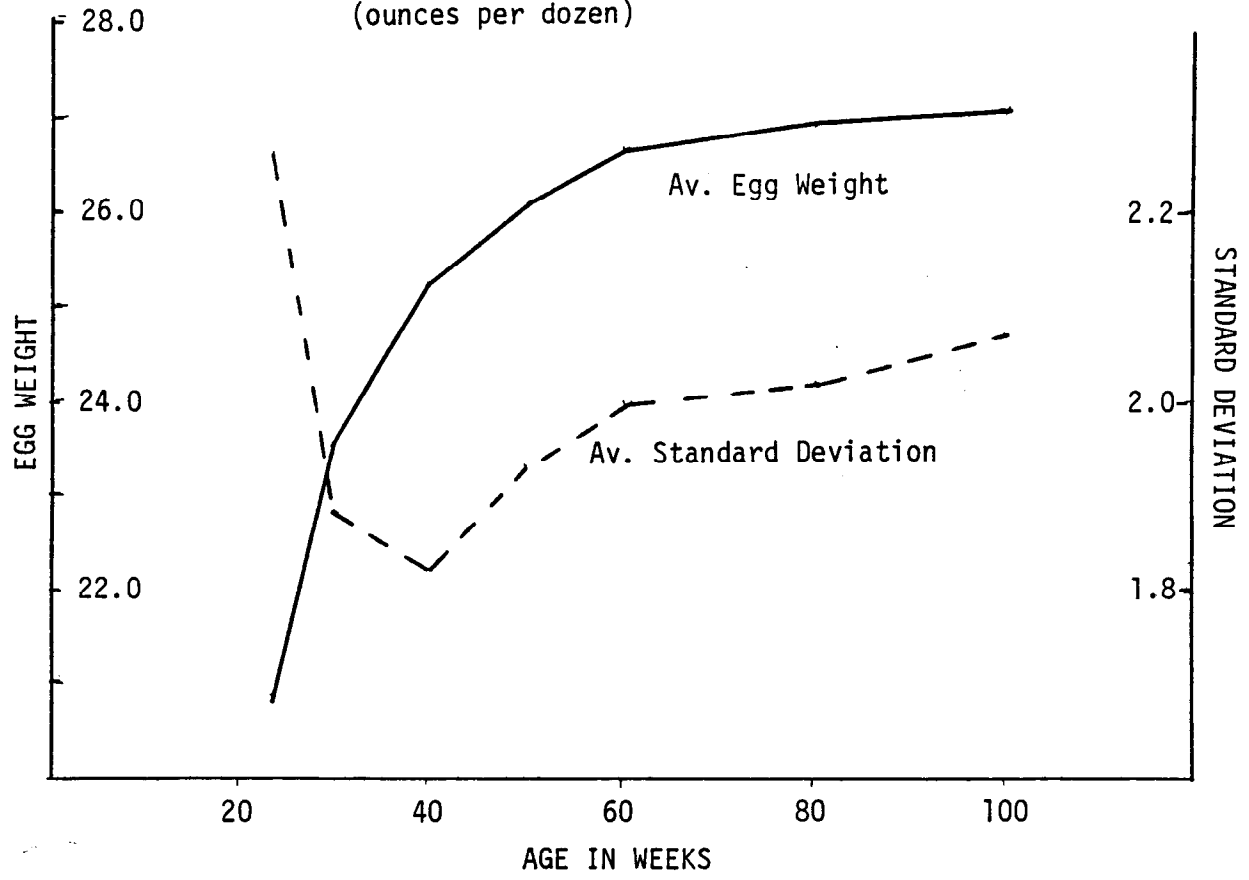
A summary of all strains is shown in Table 8.

TABLE 8 Egg weight and classification summary

| Age | No. of Flocks | Pee Wee | Small | Medium | Large | X-Large | Jumbo | Av. wt. (ozs/doz) | % Above 23oz | % Above 23.5oz | % Above 24oz | Standard Deviation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (percent) | | | | | | | | | | |
| WHITE | | | | | | | | | | | | |
| 24 | 110 | 3 | 35 | 52 | 7 | 1 | 2 | 20.78 | 10 | 8 | 6 | 2.26 |
| 30 | 111 | 0 | 2 | 39 | 51 | 7 | 1 | 23.54 | 59 | 47 | 38 | 1.88 |
| 40 | 113 | 0 | 0 | 11 | 57 | 29 | 3 | 25.23 | 89 | 82 | 75 | 1.82 |
| 50 | 113 | 0 | 0 | 5 | 44 | 42 | 8 | 26.10 | 95 | 91 | 86 | 1.93 |
| 60 | 103 | 0 | 0 | 4 | 35 | 47 | 14 | 26.67 | 96 | 93 | 90 | 1.99 |
| 80 | 100 | 0 | 0 | 3 | 32 | 49 | 16 | 26.86 | 97 | 95 | 91 | 2.02 |
| 100 | 74 | 0 | 0 | 3 | 28 | 49 | 20 | 27.16 | 97 | 96 | 93 | 2.07 |
| BROWN | | | | | | | | | | | | |
| 24 | 3 | 0 | 9 | 61 | 23 | 3 | 4 | 22.49 | 30 | 20 | 16 | 2.62 |
| 30 | 3 | 0 | 2 | 18 | 65 | 14 | 1 | 24.23 | 80 | 66 | 54 | 1.76 |
| 40 | 3 | 0 | 0 | 6 | 47 | 38 | 9 | 26.04 | 94 | 91 | 86 | 2.04 |
| 50 | 3 | 0 | 0 | 1 | 21 | 50 | 28 | 27.77 | 99 | 97 | 97 | 2.01 |
| 60 | 3 | 0 | 0 | 0 | 8 | 40 | 51 | 28.98 | 100 | 100 | 99 | 2.03 |
| 80 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 100 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |

Figure 1 illustrates the average egg size and standard deviation relative to age for all strains.

FIGURE 1 Egg Weight and Standard Deviation By Age (ounces per dozen)




Three strains (A, C, and E) had sufficient data to test the significance of weight differences and to test for in-flock and between-flock egg weight variability.

TABLE 9 Strain effects on egg weight[1/]

| Strains | Age in weeks | | | | | | |
|---|---|---|---|---|---|---|---|
| | 24 | 30 | 40 | 50 | 60 | 80 | 100 |
| | (ounces per dozen) | | | | | | |
| A | 21.6a | 24.3a | 25.7a | 26.6a | 27.3a | 27.2a | 27.6a |
| E | 20.6b | 23.4b | 25.0b | 25.9b | 26.4b | 26.6b | 26.9b |
| C | 20.1c | 23.1c | 24.9b | 26.0b | 26.8b | 27.0a | 27.6a |

[1/] Means with different letters within columns are significantly different ($P<0.05$).

TABLE 10 Standard deviation of egg weights - strain effects within flocks[1]/

| Strains | Age in weeks | | | | | | |
|---|---|---|---|---|---|---|---|
| | 24 | 30 | 40 | 50 | 60 | 80 | 100 |
| | average standard deviation (ounces per dozen) | | | | | | |
| A | 2.41a | 2.09a | 1.89a | 2.05a | 2.05a | 2.18a | 2.30a |
| E | 2.50a | 1.90b | 1.87a | 1.99a | 2.02a | 2.04ab | 2.05b |
| C | 2.06b | 1.71c | 1.68b | 1.77b | 1.83b | 1.91b | 2.00b |
| Average | 2.36 | 1.90 | 1.83 | 1.95 | 1.98 | 2.05 | 2.11 |

1/ Means with different letters within columns are significantly different ($P<0.05$).

The standard deviation figure indicates the + or - weight range within which 67% of the data fall. For example, 67% of the eggs from strain A at 24 weeks were within ± 2.41 ounces per dozen of the mean (between 19.19 and 24.01). Strains A and E at 24 weeks had a wider range of weights represented in the middle 67% than strain C did. All three strains demonstrated the same pattern of variability with the highest amount of variability at the start of lay, decreasing to the lowest amount at 40 weeks and then increasing to 100 weeks. Strain C definitely showed a more uniform distribution of egg sizes than the other two strains (Table 10).

Flocks within strains showed their greatest variation at the start of lay with progressively less variability as the flocks aged. Immediately following the molt, flock variability appeared to increase slightly. All strains reacted in the same manner except at the 40 week age when significant differences occurred (Table 11).

TABLE 11 Standard deviation of egg weights - strain effects between flocks

| Strains | Age in weeks | | | | | | |
|---|---|---|---|---|---|---|---|
| | 24 | 30 | 40 | 50 | 60 | 80 | 100 |
| | average standard deviation of the standard deviations (ounces per dozen) | | | | | | |
| A | .489 | .350 | .321* | .208 | .178 | .205 | .180 |
| E | .417 | .320 | .298 | .277 | .175 | .233 | .174 |
| C | .400 | .264 | .162 | .185 | .177 | .257 | .138 |
| Average | .437 | .315 | .278 | .236 | .176 | .231 | .168 |

* Significant differences between strains ($P<0.01$).

SUMMARY

The data summarized in this report is now being used to develop new egg weight curves for commercial White Leghorn flocks. Variable definitions for classes and seasonal effects will be incorporated into the curves.

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