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# The Use of Vegetable Protein Concentrates for Raising Turkeys

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## SUMMARY

Cottonseed meal and corn gluten meal possessed equal value as protein supplements for starting and growing turkeys.

Soybean oil meal was superior to either cottonseed meal or corn gluten meal for stimulating the growth of turkeys.

Turkeys raised on a ration containing soybean oil meal graded higher both as live birds and dressed birds than did those raised on a ration containing corn gluten meal.

Rations containing soybean oil meal produced Bronze turkey feathers which were normally pigmented while rations containing cottonseed meal and corn gluten meal when fed to similar stock produced feathers which contained an abnormal amount of white.

Soybean oil meal as used in these experiments possessed definite anti-perosis qualities which corn gluten meal did not possess. The addition of bonemeal to the rations increased the incidence of slipped tendons.

The use of manganese calcium in the corn gluten meal mash increased very greatly the occurrence of slipped tendons. The use of manganese sulphate in the rations reduced the cases of slipped tendons to a minimum.

Late hatched turkeys grow slowly during hot weather but when more satisfactory growing conditions return they are able to overcome this retardation and attain normal size at market age.

The amount of feed consumed per turkey varied from less than two pounds during the first month to more than 20 pounds in the seventh month.

The amount of feed required to produce one pound of gain increased from 2.67 pounds for the first month to 7.35 pounds for the seventh month.

# The Use of Vegetable Protein Concentrates for Raising Turkeys

E. M. FUNK AND H. L. KEMPSTER

Efficient growth in turkeys requires rations relatively high in protein, and since protein concentrates of animal origin such as meat scrap and dried milk are usually more expensive than those of vegetable origin such as soybean oil meal, cottonseed meal and corn gluten meal, it is desirable to determine the relative value of these cheaper sources of protein in turkey rations.

The results reported in this bulletin were obtained from experiments designed to test the feeding value of soybean oil meal, cottonseed meal and corn gluten meal when used to the extent of 10 per cent of the total ration. The rations also contained 10 per cent meat scrap and 5 per cent dried skim milk.

During the course of these experiments it was also possible to study a number of other problems encountered by turkey producers in the growing of poults, and these observations are also presented.

## Source of Poults

An effort was made to use poults of similar breeding in all comparative feeding trials. In 1936 eggs were purchased from a Missouri breeder of Bronze turkeys and the poults hatched at the University Poultry Farm. In 1937, 1938 and 1939 the poults were hatched from eggs produced by turkey breeding stock kept on the University Poultry Farm. In 1936 and in subsequent seasons the poults in each hatch were divided into similar lots for the feeding experiments.

## Brooding and Rearing

The poults were either started in batteries or under colony brooder stoves. Each hatch was brooded under uniform conditions. Those started in batteries were moved to colony brooder houses when they were four weeks of age. During 1936, 1937 and 1938 all turkeys were kept completely confined in 10' x 12' brooder houses to which were attached 10' x 12' sun porches with wire floors as shown in Figure 1. In 1939 the poults hatched April 28 and May 13 after they no longer needed heat were given range in yards where there was growing green feed. Turkey range shelters and later outside roosts were used as roosting quarters for these groups.

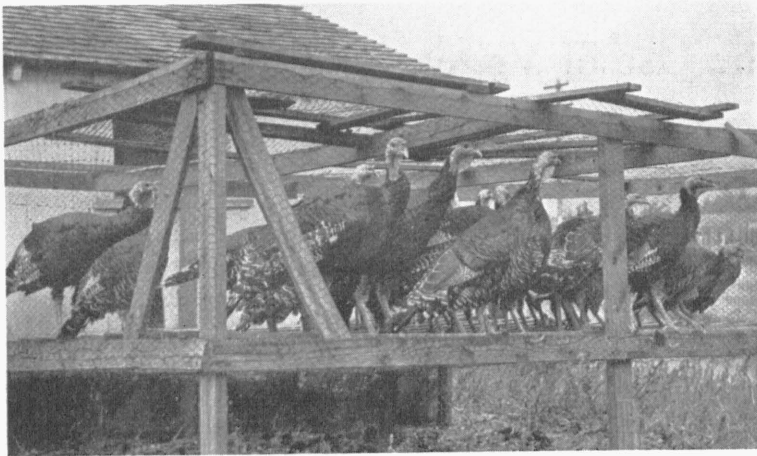


Fig. 1.—Bronze turkeys grown in complete confinement.

### Rations

The purpose of the investigation was to determine the relative value of three vegetable protein supplements in turkey rations. The essential difference in the ration was confined to the type of protein concentrate used. During the four seasons the three most common supplements, cottonseed meal, soybean oil meal and corn gluten meal, were used to the extent of 10 per cent of the ration in the various experiments. The exact formulas are given in Table 1. It

TABLE 1.—RATIONS USED IN THE EXPERIMENTS.

	1936	1937	1938	1939
Yellow corn meal .....	42	42	40	42
Wheat bran .....	15	15	15	15
Wheat shorts .....	10	10	10	10
Alfalfa leaf meal .....	5	5	5	5
Meat scrap .....	10	10	10	10
Soybean oil meal .....	10	10	10	10
Cottonseed meal .....	10	10	or	or
Corn gluten meal .....	...	10	10	10
Dried milk .....	5	5	5	5
Salt .....	1	1	1	1
Cod liver oil .....	2	2	2	2
Manganese calcium (until July 12) .....	...	...	2	...
Manganese sulphate .....	...	...	...	...05
	100	100	100	100.05

Whole yellow corn was also placed before the turkeys in hoppers after they were 12 weeks old.

will be observed that the basal ration consisted of yellow corn meal 42 parts (by weight), wheat bran 15, wheat shorts 10, alfalfa leaf meal 5, meat scrap 10, dried skim milk 5, salt 1 and cod liver oil 2. Whole yellow corn was hopper fed after the poults were 12



weeks old. Slight modifications of the rations occurred occasionally. For instance, in 1937 the ration for one group of birds receiving soybean oil meal was changed to include 2 per cent bone meal.

In 1938 the rations contained 2 per cent manganese calcium until July 12 when it was deemed advisable to discontinue feeding this product. During the 1939 season one pound of manganese sulphate was added to each ton of feed.

Care was exercised in mixing the rations used in the experiments but to check the mixtures used in 1939 samples were analyzed by the Department of Agricultural Chemistry to determine the chemical composition of the mashes fed the turkeys on experiment. Under date of May 25, 1939 which was near the start of the 1939 trials, the following analysis was reported:

	Corn Gluten Meal Mash	Soybean Oil Meal Mash
Air-dry moisture	11.02	10.75
Ether soluble (fat)	4.04	4.27
Ash	8.12	8.15
Crude protein	19.56	20.38
Crude fiber	4.60	4.69
Nitrogen free extract	52.66	51.16
Calcium (Ca)	1.40	1.41
Phosphorus (P)	1.13	1.11
Manganese (Mn)	0.0086	0.0058

And under date of December 21, 1939, which was at the end of the experiment the following analysis was reported

	Corn Gluten Meal Mash	Soybean Oil Meal Mash
Protein—per cent	20.88	20.63

### **THE COMPARATIVE GROWTH OF TURKEYS RECEIVING CORN GLUTEN MEAL, COTTONSEED MEAL AND SOY- BEAN OIL MEAL**

During 1936, 1937, and 1939 turkeys were successfully grown under conditions where the only apparent variable was the kind of protein supplement used in the rations.

#### **Cottonseed Meal vs. Soybean Oil Meal**

In 1936 a comparison between soybean oil meal and cottonseed meal was made. These results are shown in detail in Figure 2 and Tables 2 and 3. It will be observed that at the age of 24 weeks the toms fed soybean oil meal averaged 15.5 pounds as compared to 10.54 for those fed the ration containing an equal quantity of cottonseed

meal. A similar difference in the weight of the females was observed. While there was a slight difference in the amount of feed required to produce a pound of gain in favor of the lot fed soybean oil meal, apparently the chief advantage in favor of the soybean oil meal lot was that the birds were heavier at the age of 24 weeks.

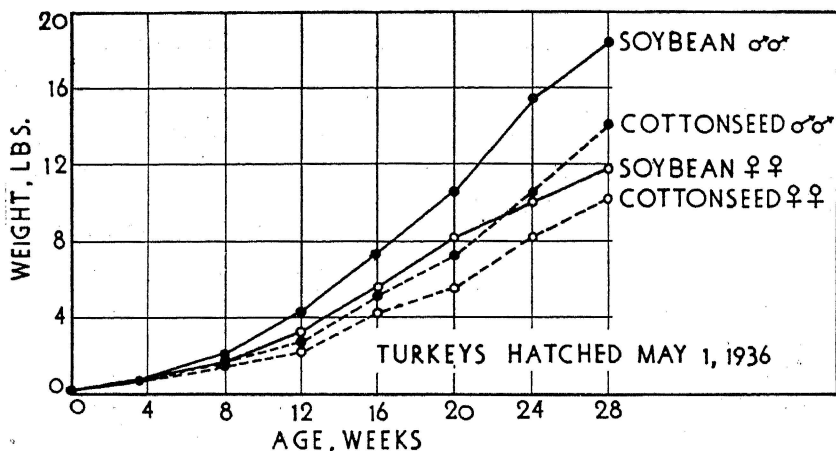


Fig. 2.—Cottonseed meal vs. soybean oil meal for growing turkeys. 1936.

TABLE 2.—GROWTH AND EFFICIENCY OF GAINS MADE BY BRONZE TURKEYS (14 MALES AND 21 FEMALES) RECEIVING COTTONSEED MEAL. HATCHED MAY 1, 1936.

Age in Weeks	Weight (lbs.)		Average Gain Per Bird (lbs.)	Feed Consumed (lbs.) Per Bird	Lbs. Feed Consumed per lb. of Gain
	Males	Females			
0	.14	.14	...	...	...
3.5	.64	.60	.48	1.17	2.43
8	1.76	1.52	1.00	3.05	3.05
12	2.71	2.31	.85	3.68	4.33
16	5.15	4.18	2.10	5.88	2.80
20	7.23	5.59	1.67	8.65	5.18
24	10.54	8.17	2.88	13.42	4.66
28	14.08	10.16	...	...	...
Total for 24 Weeks	...	...	8.98	35.85	3.99

TABLE 3.—GROWTH AND EFFICIENCY OF GAINS MADE BY BRONZE TURKEYS (22 MALES AND 12 FEMALES) RECEIVING SOYBEAN OIL MEAL. HATCHED MAY 1, 1936.

Age in Weeks	Weight (lbs.)		Average Gain Per Bird (lbs.)	Feed Consumed (lbs.) Per Bird	Lbs. Feed Consumed per lb. of Gain
	Males	Females			
0	.14	.14	...	...	...
3.5	.73	.65	.56	1.39	2.47
8	2.10	1.66	1.25	3.80	3.04
12	4.33	3.30	2.01	5.83	2.90
16	7.43	5.59	2.82	10.52	3.73
20	10.63	8.17	2.98	11.47	3.85
24	15.50	10.16	3.85	18.43	4.79
28	18.44	11.88	...	...	...
Total for 24 Weeks	...	...	13.47	51.44	3.82

Similar results occurred the following year (1937) as is shown in Tables 4 and 5 and Figure 3. The toms in the lot fed soybean oil meal weighed 19.1 pounds at the age of 28 weeks while those fed cottonseed meal weighed 2.9 pounds less per bird or 16.17 pounds each. The weights of the females were 12.05 and 10.91 pounds respectively. Up to the age of 28 weeks it had required 4.66 pounds

TABLE 4.—GROWTH AND EFFICIENCY OF GAINS MADE BY BRONZE TURKEYS (14 MALES AND 7 FEMALES) RECEIVING COTTONSEED MEAL. HATCHED APRIL 24, 1937.

Age in Weeks	Weight (lbs.)		Average Gain Per Bird (lbs.)	Feed Consumed (lbs.) Per Bird	Lbs. Feed Consumed per lb. of Gain
	Males	Females			
0	.12	.12	...	...	...
4	.43	.41	.30	.83	2.77
8	1.24	1.12	.78	2.14	2.74
12	2.66	2.33	1.35	3.93	2.91
16	4.58	3.93	1.84	6.96	3.78
20	8.09	6.14	3.07	15.13	4.93
24	12.40	9.00	3.83	19.16	5.00
28	16.17	10.91	3.15	21.73	6.90
Total	...	...	14.32	69.88	4.88

TABLE 5.—GROWTH AND EFFICIENCY OF GAINS MADE BY BRONZE TURKEYS (13 MALES AND 12 FEMALES) RECEIVING SOYBEAN OIL MEAL. HATCHED APRIL 24, 1937.

Age in Weeks	Weight (lbs.)		Average Gain Per Bird (lbs.)	Feed Consumed (lbs.) Per Bird	Lbs. Feed Consumed per lb. of Gain
	Males	Females			
0	.12	.12	...	...	...
4	.62	.54	.46	1.19	2.59
8	2.07	1.71	1.31	3.52	2.69
12	4.15	3.15	1.78	3.88	2.18
16	6.32	4.77	1.90	5.91	3.11
20	10.50	7.30	3.38	15.09	4.46
24	14.80	9.92	3.50	19.09	5.45
28	19.10	12.05	3.25	23.92	7.36
Total	...	...	15.58	72.60	4.66

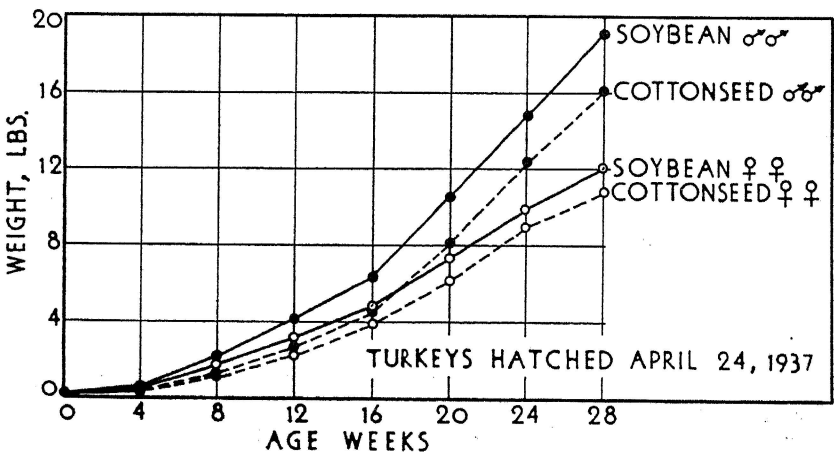


Fig. 3.—Cottonseed vs. soybean oil meal for growing turkeys. 1937.

of feed to produce one pound of gain on the rations containing soybean oil meal as compared to 4.88 pounds for the cottonseed meal lot. Here again apparently the superiority of the soybean oil meal supplement consisted largely in its ability to produce more rapid growth.

### Corn Gluten Meal vs. Cottonseed Meal

The 1937 experiments also included a comparison of cottonseed meal and corn gluten meal as protein supplements. The birds in this experiment were hatched May 15. The results are shown in

TABLE 6.—GROWTH AND EFFICIENCY OF GAINS MADE BY BRONZE TURKEYS (18 MALES AND 15 FEMALES) RECEIVING COTTONSEED MEAL. HATCHED MAY 15, 1937.

Age in Weeks	Weight (lbs.)		Average Gain Per Bird (lbs.)	Feed Consumed (lbs.) Per Bird	Lbs. Feed Consumed per lb. of Gain
	Males	Females			
0	.12	.12	...	...	...
4	.57	.51	.42	1.01	2.40
8	1.47	1.29	.85	2.99	3.52
12	2.73	2.35	1.17	4.55	3.89
16	5.28	4.41	2.33	8.23	3.53
20	8.59	6.75	2.86	13.74	4.80
24	12.09	9.14	2.99	18.72	6.26
Total	...	...	10.62	49.24	4.64

TABLE 7.—GROWTH AND EFFICIENCY OF GAINS MADE BY BRONZE TURKEYS (7 MALES AND 13 FEMALES) RECEIVING CORN GLUTEN MEAL. HATCHED MAY 15, 1937.

Age in Weeks	Weight (lbs.)		Average Gain Per Bird (lbs.)	Feed Consumed (lbs.) Per Bird	Lbs. Feed Consumed per lb. of Gain
	Males	Females			
0	.12	.12	...	...	...
4	.53	.48	.38	.94	2.47
8	1.43	1.11	.72	2.31	3.21
12	2.78	2.09	1.11	3.97	3.58
16	5.37	4.15	2.24	8.17	3.65
20	8.58	6.69	2.77	12.59	4.54
24	12.56	9.13	2.98	18.02	6.05
Total	...	...	10.20	46.00	4.51

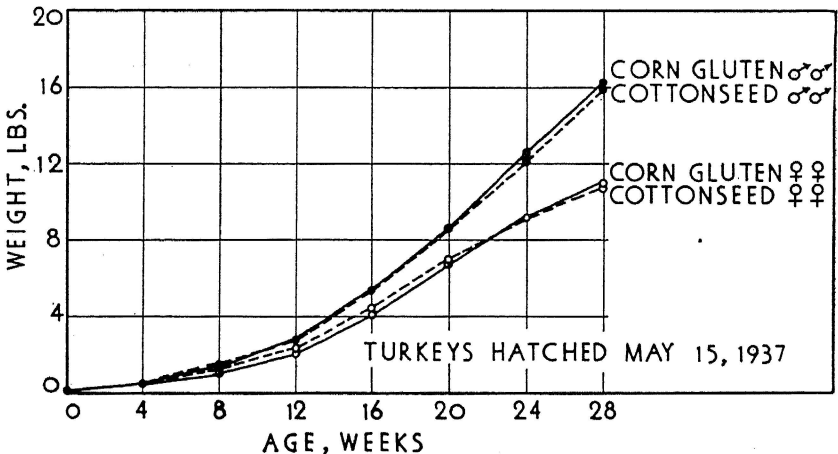


Fig. 4.—Cottonseed meal vs. corn gluten meal for growing turkeys. 1937.

Tables 6, and 7 and in Figure 4. Since there was practically no difference in the weights at 24 weeks of either the males or females for the two groups one would conclude that corn gluten meal and cottonseed meal were of equal value in turkey rations.

### Soybean Oil Meal vs. Corn Gluten Meal

A comparison between soybean oil meal and corn gluten meal was made with the group of poults hatched April 10, 1937. The results of this test are shown in Figure 5 and the details as to growth, feed consumption and economy of gains for the 28-week period will be found in Tables 8 and 9. This is the first of a series of experiments involving a comparison of soybean oil meal and corn gluten meal. The males in the soybean oil meal lot weighed 15.39 pounds at 28 weeks while the corn gluten meal males were 1.58 pounds smaller. Attention should be called to the fact that an outbreak of blackhead

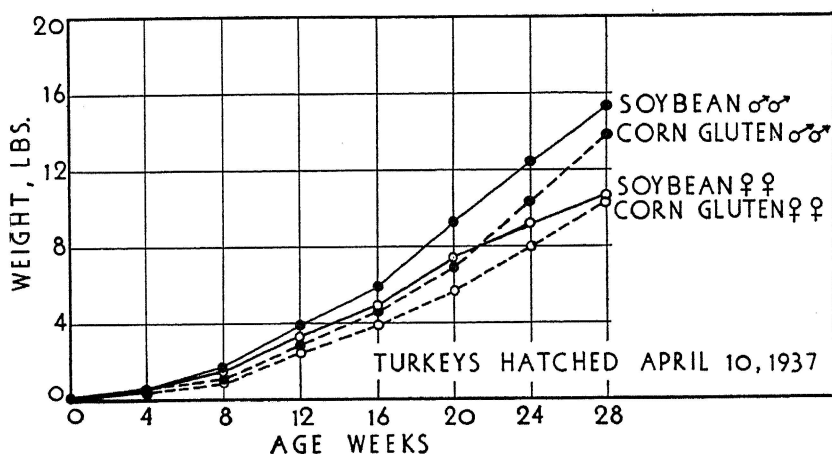


Fig. 5.—Soybean oil meal vs. corn gluten meal for turkeys, 1937.

TABLE 8.—GROWTH AND EFFICIENCY OF GAINS MADE BY BRONZE TURKEYS (9 MALES AND 13 FEMALES) RECEIVING CORN GLUTEN MEAL. HATCHED APRIL 10, 1937.

Age in Weeks	Weight (lbs.)		Average Gain Per Bird (lbs.)	Feed Consumed (lbs.) Per Bird	Lbs. Feed Consumed per lb. of Gain
	Males	Females			
0	.12	.12	...	...	...
4	.50	.42	.33	1.09	3.30
8	1.12	.96	.57	1.56	2.74
12	2.85	2.50	1.61	4.70	2.91
16	4.60	3.91	1.55	6.77	4.36
20	6.96	5.65	1.99	9.10	4.57
24	10.33	7.88	2.69	13.89	5.16
28	13.81	10.29	2.85	18.09	6.35
Total	...	...	11.59	55.20	4.76

TABLE 9.—GROWTH AND EFFICIENCY OF GAINS MADE BY BRONZE TURKEYS  
(19 MALES AND 12 FEMALES) RECEIVING SOYBEAN OIL MEAL.  
HATCHED APRIL 10, 1937.

Age in Weeks	Weight (lbs.)		Average Gain Per Bird (lbs.)	Feed Consumed (lbs.) Per Bird	Lbs. Feed Consumed per lb. of Gain
	Males	Females			
0	.12	.12	...	...	...
4	.55	.56	.43	1.25	2.90
8	1.72	1.60	1.19	3.32	2.79
12	3.86	3.32	1.98	3.99	2.02
16	5.96	4.85	1.88	7.82	4.16
20	9.26	7.40	3.01	11.88	3.95
24	12.39	9.23	2.63	15.15	5.76
28	15.39	10.66	2.38	20.61	8.66
Total	...	...	13.50	64.02	4.74

This lot of turkeys had an outbreak of blackhead.

occurred in the lot fed soybean oil meal. In spite of this handicap these birds made greater gains. The soybean oil meal turkeys were a pound heavier at the age of 12 weeks. However, there was no difference between the two lots from the standpoint of feed consumed per pound of gain. While the soybean oil meal turkeys were heavier at 28 weeks than were those fed corn gluten meal, the feed consumption had been correspondingly greater. Figures 6, 7 and 8 show the typical appearance of 8-week old turkeys fed cottonseed meal, corn gluten meal and soybean oil meal. The poults fed soybean oil meal were not only larger and smoother but the color of the plumage was normal for Bronze turkeys of that age; whereas the feathers of the turkeys fed cottonseed meal or corn gluten meal were conspicuous by the presence of an abundance of white in their plumage, especially the primary and secondary feathers of the wings.

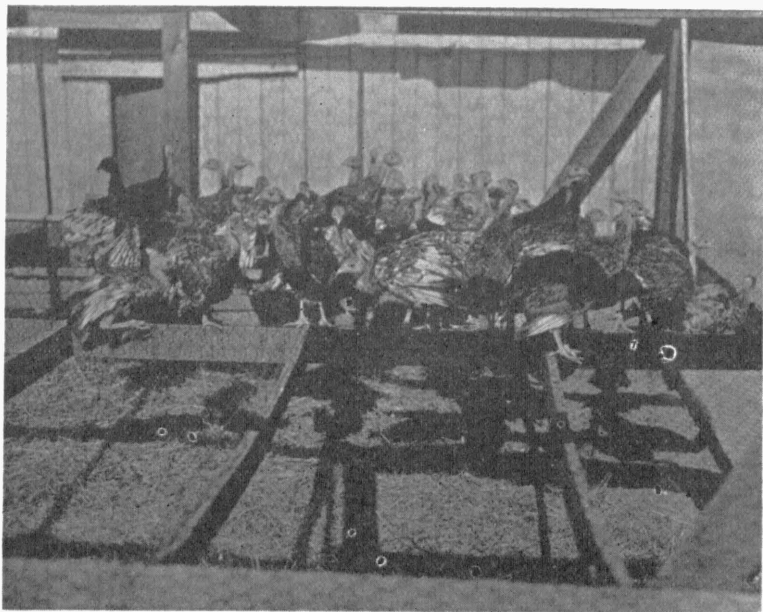


Fig. 6.—Bronze turkeys 8 weeks old grown on a ration containing 10 per cent cottonseed meal. 1937.

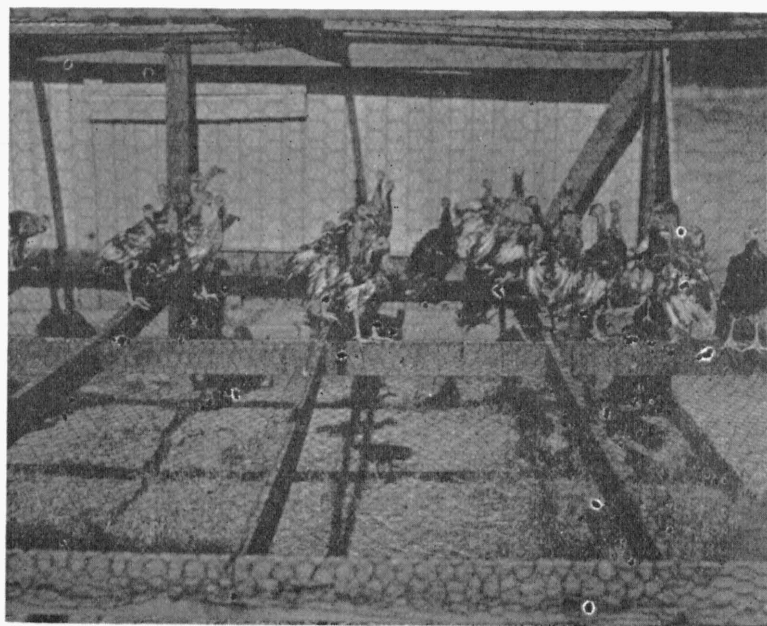


Fig. 7.—Bronze turkeys 8 weeks old grown on a ration containing 10 per cent corn gluten meal. 1937.

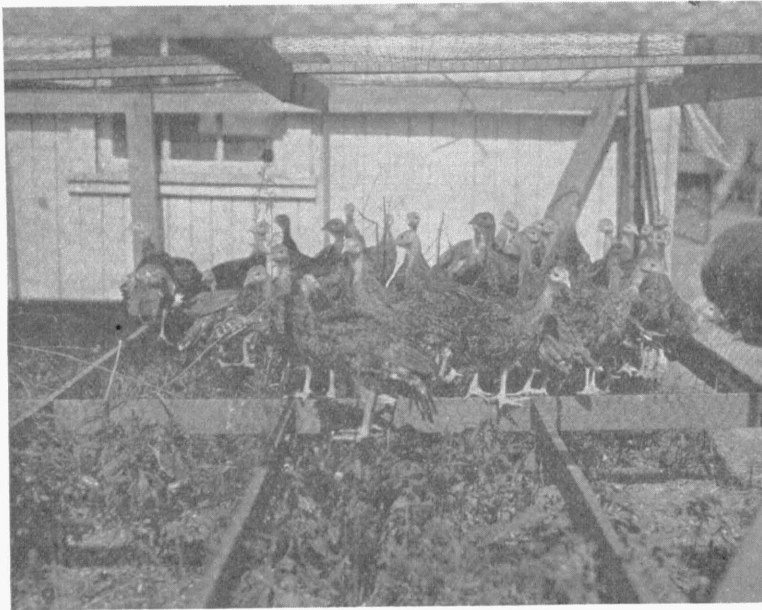


Fig. 8.—Bronze turkeys 8 weeks old grown on a ration containing 10 per cent soybean oil meal. 1937.

TABLE 10.—GROWTH AND EFFICIENCY OF GAINS MADE BY BRONZE TURKEYS (5 MALES AND 14 FEMALES) RECEIVING SOYBEAN OIL MEAL. HATCHED JUNE 5, 1937.

Age in Weeks	Weight (lbs.)		Average Gain Per Bird (lbs.)	Feed Consumed (lbs.) Per Bird	Lbs. Feed Consumed per lb. of Gain
	Males	Females			
0	.11	.11	...	...	...
4	.60	.54	.45	1.27	2.82
8	1.40	1.19	.68	3.09	4.54
12	3.62	2.99	1.91	6.99	3.66
16	6.98	5.68	2.86	8.17	2.85
20	10.66	7.82	2.55	17.05	6.69
24	15.00	9.78	2.58	18.53	7.18
28	18.04	11.9	2.36	16.05	6.80
Total	...	...	13.39	71.15	5.31

TABLE 11.—GROWTH AND EFFICIENCY OF GAINS MADE BY BRONZE TURKEYS (8 MALES AND 12 FEMALES) RECEIVING SOYBEAN OIL MEAL AND BONE MEAL. HATCHED JUNE 5, 1937.

Age in Weeks	Weight (lbs.)		Average Gain Per Bird (lbs.)	Feed Consumed (lbs.) Per Bird	Lbs. Feed Consumed per lb. of Gain
	Males	Females			
0	.11	.10	...	...	...
4	.65	.55	.49	1.20	2.45
8	1.98	1.63	1.18	3.39	2.87
12	4.64	3.83	2.41	7.67	3.18
16	7.76	6.10	2.61	12.06	4.62
20	11.12	8.37	2.70	15.57	5.77
24	15.71	11.17	3.51	24.39	6.94
28	18.05	12.22	...	...	...
Total for 24 Weeks	...	...	12.90	64.28	4.98



The experimental work in 1939 was confined to a further investigation which involved a comparison of soybean oil meal and corn gluten meal. The only change made in the ration was the addition of manganese sulfate at the rate of .05% or 1 pound per ton of feed. A change was made also in management of the lots hatched April 23 and May 13. These two groups were transferred to range shelters at the age of 12 weeks and allowed access to a range of sudan grass and lespedeza for the remainder of the feeding trial. Those hatched June 10 were raised in a colony house with a wire sun porch as had been customary in previous years. Details relative to growth from hatching until 24 weeks of age are shown in Tables 12, 13 and 14. The results for the different groups are so consistent that the three lots will be discussed together.

TABLE 12.—GROWTH OF BRONZE TURKEYS RECEIVING CORN GLUTEN MEAL AND SOYBEAN OIL MEAL. HATCHED APRIL 28, 1939.

Age in Weeks	Corn Gluten Meal		Soybean Oil Meal	
	Males	Females	Males	Females
0	.13	.12	.13	.12
4	.50	.44	.56	.50
8	1.33	1.16	1.97	1.61
12	2.7	2.2	3.9	3.0
16	5.5	4.2	7.4	5.5
20	9.1	6.6	10.8	7.8
24	12.9	8.6	14.6	9.5
No. Birds Matured	25	24	28	16

TABLE 13.—GROWTH OF BRONZE TURKEYS RECEIVING CORN GLUTEN MEAL AND SOYBEAN OIL MEAL. HATCHED MAY 13, 1939.

Age in Weeks	Corn Gluten Meal		Soybean Oil Meal	
	Males	Females	Males	Females
0	.12	.12	.13	.12
4	.46	.44	.59	.52
8	1.3	1.2	1.7	1.3
12	2.7	2.6	4.0	3.1
16	5.5	4.7	7.5	5.5
20	9.2	7.1	10.8	7.5
24	13.2	8.8	13.8	9.1
No. Birds Matured	12	8	19	15

TABLE 14.—GROWTH OF BRONZE TURKEYS RECEIVING CORN GLUTEN MEAL AND SOYBEAN OIL MEAL. HATCHED JUNE 10, 1939.

Age in Weeks	Corn Gluten Meal		Soybean Oil Meal	
	Males	Females	Males	Females
0	.12	.12	.13	.13
4	.44	.42	.49	.45
8	1.2	1.1	1.6	1.5
12	2.8	2.4	3.7	3.2
16	5.3	4.3	6.8	6.0
20	8.8	6.8	10.6	8.2
24	13.8	9.5	14.9	10.4
No. Birds Matured	16	16	15	20

Briefly, at the age of 12 weeks the males averaged from .9 to 1.3 pounds heavier when fed soybean oil meal and the females from .4 to .8 pounds heavier than the birds fed corn gluten meal. Even at the age of 24 weeks while the relative differences were smaller in every case the birds fed soybean oil meal were appreciably larger than were those in the corresponding lot which were fed corn gluten meal.

TABLE 15.—RELATIVE GROWTH RATE OF MALE BRONZE TURKEYS RECEIVING CORN GLUTEN MEAL AND SOYBEAN OIL MEAL, 1939.

Period in Weeks	Hatched April 28				Hatched May 13				Hatched June 10			
	Corn Gluten Meal		Soybean Oil Meal		Corn Gluten Meal		Soybean Oil Meal		Corn Gluten Meal		Soybean Oil Meal	
	Gain		Gain		Gain		Gain		Gain		Gain	
	Lbs.	Rate %	Lbs.	Rate %	Lbs.	Rate %	Lbs.	Rate %	Lbs.	Rate %	Lbs.	Rate %
0 - 4	.37	119	.43	126	.34	117	.46	128	.32	114	.36	116
5 - 8	.83	91	1.41	112	.84	95	1.11	97	.76	93	1.11	106
9 - 12	1.4	70	1.9	65	1.4	70	2.3	82	1.6	80	2.1	78
13 - 16	2.8	68	3.5	63	2.8	68	3.5	61	2.5	63	3.1	60
17 - 20	3.6	49	3.4	37	3.7	51	3.3	36	3.5	50	3.8	44
21 - 24	3.8	35	3.8	30	4.0	36	3.0	24	5.0	44	4.3	34

The growth rate in this table was calculated by the following formula  $\frac{W_2 - W_1}{\frac{1}{2}(W_1 + W_2)} \times 100$  in which

$W_1$  is the initial weight and  $W_2$  is the weight at the end of the period.

The differences prevailed even though the first two lots were raised on pastures which provided some supplementary feed from the sudan grass or the lespedeza. Apparently soybean oil meal possesses qualities which stimulate growth, especially during the early part of the growing period. The relative growth rate of the turkeys receiving these two protein supplements is shown in Table 15. Turkeys receiving rations containing soybean oil meal made greater actual gains during the first 16 weeks than did those fed corn gluten meal rations. The relative growth rate was higher for the first two months than that of the corn gluten lot. Gains after 16 weeks were usually greater for the corn gluten meal lots but in spite of this accelerated growth at the age of 24 weeks they had failed to attain the weight of those birds fed soybean oil meal.

A comparison of the soybean oil meal ration with 2 per cent bone meal added and without the mineral supplement was made with two lots of poults hatched June 5, 1937, as shown in Tables 10 and 11. In growth and efficiency of gains up to the age of 24 weeks there was little difference between the two lots, although the poults in the lot fed the mineral supplement were slightly larger at the age of 24 weeks. Although not shown in the data the toms in both groups at the age of 28 weeks weighed the same, 18 pounds. Each group required 5 pounds of feed to produce a pound of gain for the 24-week period. There appeared no advantage in adding the extra bone meal. As will be shown later the higher mineral content of the ration due to the addition of bone meal increased the incidence of slipped tendons.

### **THE COMPARATIVE SIZE OF TURKEYS GROWN ON RATIONS CONTAINING DIFFERENT VEGETABLE PROTEIN SUPPLEMENTS**

During the 1937 season the turkeys raised on rations containing the different vegetable protein supplements were measured at 24 weeks of age to ascertain any differences which existed between the groups. The results are given in Tables 16 and 17. The measurements were made on live turkeys using a large pair of calipers. Those rations which produced the largest turkeys by weight also increased the dimensions of the birds somewhat. Turkeys grown on rations containing cottonseed meal and corn gluten meal were slightly smaller by all measurements made than were turkeys grown on the soybean oil meal rations. From the data obtained it appeared that the different measurements made varied directly with the weight of the birds. Since weight of turkeys at 24 weeks is a good criterion of size (by dimension) the weighing of turkeys is the most feasible method for determining growth on different rations.

TABLE 16.—COMPARATIVE SIZES AT 24 WEEKS OF LIVE MALE BRONZE TURKEYS RECEIVING CORN GLUTEN MEAL, COTTONSEED MEAL AND SOYBEAN OIL MEAL, 1937.

	Hatched April 10		Hatched April 24		Hatched May 15		Hatched June 5	
	Corn Gluten Meal	Soybean Oil Meal	Cotton- seed Meal	Soybean Oil Meal	Corn Gluten Meal	Cotton- seed Meal	Soybean Oil Meal	Soybean Oil Meal and 2% Bone Meal
Weight .....	10.1	12.4	12.4	14.6	12.6	12.1	14.9	15.9
Rib Spread .....	3.9	4.1	4.1	4.5	4.1	3.9	4.4	4.4
Back Width .....	3.7	3.9	3.8	4.1	3.8	3.6	4.0	4.0
Keel Length .....	5.7	6.4	5.9	6.6	6.1	6.1	6.5	6.6
Body depth from hip to front of keel ..	8.8	9.1	8.9	9.6	9.2	9.3	9.6	9.9
Shank Length .....	7.5	7.7	7.6	7.7	7.7	7.4	7.2	7.4
Lower Thigh Length .....	9.1	9.6	9.4	9.7	9.8	9.4	9.6	10.0
No. Birds Measured .....	10	19	14	16	7	18	5	7

Weights are to the nearest tenth of a pound and measurements to the nearest tenth of an inch.

TABLE 17.—COMPARATIVE SIZES AT 24 WEEKS OF LIVE FEMALE BRONZE TURKEYS RECEIVING CORN GLUTEN MEAL, COTTONSEED MEAL AND SOYBEAN OIL MEAL, 1937.

	Hatched April 10		Hatched April 24		Hatched May 15		Hatched June 5	
	Corn Gluten Meal	Soybean Oil Meal	Cotton- seed Meal	Soybean Oil Meal	Corn Gluten Meal	Cotton- seed Meal	Soybean Oil Meal	Soybean Oil Meal and 2% Bone Meal
Weight .....	7.9	9.2	9.0	9.9	9.1	9.1	9.9	11.1
Rib Spread .....	3.6	3.7	3.7	3.8	3.6	3.6	3.7	3.8
Back Width .....	3.4	3.5	3.4	3.6	3.4	3.4	3.4	3.6
Keel Length .....	5.2	5.7	5.3	5.8	5.4	5.4	5.7	5.8
Body depth from hip to front of keel ..	7.9	7.9	8.1	8.3	8.0	8.2	8.3	8.4
Shank Length .....	6.4	6.2	6.0	6.0	6.2	5.9	5.7	5.9
Lower Thigh Length .....	8.1	8.0	7.9	8.1	8.0	8.0	7.8	7.9
No. Birds Measured .....	13	11	8	14	13	15	14	13

Weights are to the nearest tenth of a pound and measurements to the nearest tenth of an inch.

## MARKET GRADES

An important test for any investigation which deals with the growth and development of turkeys is the grade of the market bird which results from the use of the different rations. In 1939 all of the turkeys grown to 26 weeks of age hatched June 10 were sent to a commercial packing plant for killing and dressing. One-half of these were grown on a ration containing 10 per cent soybean oil meal and the other half were grown under similar conditions on a ration containing 10 per cent corn gluten meal.

At the age of 24 weeks the lot fed soybean oil meal were a pound heavier than were those fed corn gluten meal (Table 14). These turkeys were sold to a packer on the basis of live grade. On this basis there was no appreciable difference in the two groups. After the birds were dressed and cooled they were graded according to the U. S. D. A. standards for dressed turkeys. The results of the grading are shown in Table 18. The turkeys fed corn gluten meal contained only 4 or 12.5% of Grade A birds as compared to 13 or 40% Grade A birds for the lot fed soybean oil meal. The dressed birds in both lots graded low because they were unfinished. Two or three more weeks of feeding would have increased their fatness and improved their grade. The results for the two lots are comparable because the only apparent variable factor was the vegetable protein supplement. Under the conditions that prevailed in this experiment soybean oil meal gave more satisfactory results in producing turkeys for market than did corn gluten meal.

TABLE 18.—LIVE AND DRESSED GRADES OF BRONZE TURKEYS, TWENTY-SIX WEEKS OF AGE,<sup>1</sup> WHICH RECEIVED RATIONS CONTAINING CORN GLUTEN MEAL AND SOYBEAN OIL MEAL. HATCHED JUNE 10, 1939.

Vegetable Protein	Sex	Live Grades <sup>1</sup>			Dressed Grades <sup>2</sup>			
		1	2	Culls	A	B	C	Rejects
Corn Gluten Meal .....	Males	11	5	0	..	11	5	0
	Females	13	3	0	4	11	1	0
Total .....		24	8	0	4	22	6	0
Soybean Oil Meal .....	Males	9	5	0	..	10	4	0
	Females	18	0	0	13	5	0	0
Total .....		27	5	0	13	15	4	0

<sup>1</sup>Buying grades used by the purchaser.

<sup>2</sup>U.S.D.A. grades by an authorized grader.

## FACTORS CONTRIBUTING TO THE OCCURRENCE OF SLIPPED TENDONS IN TURKEYS

Perosis or slipped tendons frequently develops in chickens and turkeys, often causing serious losses from the crippled condition shown in Figure 9. There is a general belief that one of the prin-



Fig. 9.—Bronze turkeys grown on a ration containing 10 per cent corn gluten meal and 2 per cent manganese calcium, 1938. Note bird on the right with a "slipped tendon" and the abnormal pigmentation of the plumage.

ciple causes of perosis is too much mineral in the ration. In chickens it has also been shown that under certain conditions a deficiency of the mineral, manganese, will increase the incidence of slipped tendons. There apparently is some disagreement among the investigators as to the factors causing slipped tendons in turkeys.

In the turkey investigations conducted at this station since 1936 losses from slipped tendons have occurred and some observations on their development noted. While the experiments were not designed for the study of slipped tendons in turkeys, the observations made may be helpful to turkey producers.

In 1936, with turkeys raised on the rations given in Table 1, out of 34 birds grown to maturity on the soybean oil meal ration and 35 birds matured on the cottonseed meal ration only one case of slipped tendons developed in each group.

In 1937 it was noted as summarized in Table 19 that relatively few cases of slipped tendons developed when cottonseed meal and

TABLE 19.—THE EFFECT OF VEGETABLE PROTEIN SUPPLEMENTS AND BONE MEAL ON THE OCCURRENCE OF SLIPPED TENDONS IN TURKEYS. 1937.

Protein Supplements	Number Poults	Slipped Tendons	
		Number	Per cent
Soybean Oil Meal .....	97	3	3.1
Soybean Oil Meal and 2% Bone Meal ..	23	5	21.7
Cottonseed Meal .....	66	2	3.0
Corn Gluten Meal .....	59	9	15.3

soybean oil meal were used in the rations. On the other hand, when corn gluten meal was substituted in the place of these vegetable proteins the number of cases of slipped tendons increased. Since the manganese content of corn gluten meal is less than that of either soybean oil meal or cottonseed meal the increase in slipped tendons in the above case may have been due to a manganese deficiency.

It will be recalled that in one of the feeding trials conducted in 1937, a comparison was made between two soybean oil meal rations. The only difference in the two rations was that 2 per cent bone meal was added to one of the rations. The addition of bone meal apparently increased the incidence of slipped tendons from 3.1 to 21.7 per cent. These results support the theory that a high mineral content in the ration is one of the factors responsible for the occurrence of slipped tendons.

In 1938 a commercial manganese calcium mixture was incorporated (2%) in the rations with the hope that slipped tendons might be prevented. The lots receiving soybean oil meal as well as those receiving corn gluten meal received this mineral. The results with the corn gluten lots were disastrous. Nineteen out of 20 poults in one lot and 27 out of 35 in another lot developed slipped tendons. When these results occurred this mineral mixture was omitted from the turkey rations.

Only seven cases of slipped tendons developed among 134 turkeys which were raised to market age on the rations containing soybean oil meal even though these rations contained the manganese calcium for several weeks. Apparently the soybean oil meal possessed protective qualities against perosis which was not present in corn gluten meal.

The rations (see Table 1) used in 1939 were supplemented with one pound of manganese sulphate per ton. During this season only two cases of slipped tendons developed among 105 birds receiving corn gluten meal. One hundred and thirty-eight birds were grown to maturity on the ration containing soybean oil meal without the occurrence of slipped tendons.



## THE COLOR PATTERN OF THE BRONZE TURKEY AS MODIFIED BY FEEDING

Within eight weeks after the Bronze poultts were placed on rations containing the different vegetable protein supplements a marked difference in the color of the birds was observed. Those receiving rations containing soybean oil meal developed plumage of the normal Bronze color pattern but poultts fed rations containing corn gluten meal or cottonseed meal developed wing feathers which were almost white.

Figures 6, 7 and 8 show the difference at eight weeks of age in the pigmentation of Bronze poultts receiving cottonseed meal, corn gluten meal, and soybean oil meal. These differences in color were reduced as the bird approached maturity. Since the growth rate diminished as maturity approached and since these pigment changes were apparently associated with the type of protein in the ration it would appear that this feather pigment phenomenon associated with corn gluten meal was caused by a deficiency of some constituent which was required for rapid growth but was released for pigmentation when the growth rate diminished.

When manganised calcium was added to the ration in 1938 the groups receiving corn gluten meal developed almost solid white plumage as shown in Fig. 9. The groups receiving rations containing soybean oil meal and manganised calcium developed Bronze plumage which was normally pigmented.

In 1939 even though manganese sulfate was added to the ration the characteristic difference in the appearance of the plumage between poultts fed the soybean oil meal and corn gluten meal occurred.

## EFFICIENCY OF GAINS

In discussing Tables 2 to 11 it will be recalled that from the standpoint of efficiency of gains there was practically no difference in the feed required to produce a pound of gain—when different tests were compared. With one exception however the turkeys fed soybean oil meal were heavier at a given age. The fact that larger turkeys were produced at a given age, i. e. up to 24 or 28 weeks when fed soybean oil meal indicates that soybean oil meal was actually more efficient in producing gains. In all probability had the groups fed corn gluten or cottonseed meal been retained until they reached the same weight as the soybean oil meal fed group there would have been an appreciable difference in the economy of gains in favor of the groups fed soybean oil meal.

TABLE 20.—FEED CONSUMPTION (PER BIRD) OF BRONZE TURKEYS GROWN IN COMPLETE CONFINEMENT ON RATIONS CONTAINING SOYBEAN OIL MEAL.

Month (4 Weeks)	Poults Hatched								
	May 1 1936	Apr. 10 1937	Apr. 24 1937	June 5 1937	Apr. 16 1938	May 15 1938	May 29 1938	June 12 1938	Average
1	1.39	1.25	1.19	1.27	1.08	1.18	.80	.66	1.10
2	3.80	3.32	3.52	3.09	3.76	3.79	2.67	2.86	3.35
3	5.83	3.99	3.88	6.99	6.22	7.33	6.68	5.63	5.82
4	10.52	7.82	5.91	8.17	10.00	11.89	9.33	8.68	9.04
5	11.47	11.88	15.09	17.05	13.00	13.45	12.47	12.35	13.35
6	18.43	15.15	19.00	18.53	16.34	17.88	18.23	15.95	17.44
7	....	20.61	23.92	....	17.25	....	....	....	20.59
Sex Ratio	22 Males 12 Females	19 Males 12 Females	14 Males 7 Females	5 Males 14 Females	9 Males 14 Females	6 Males 10 Females	6 Males 11 Females	8 Males 10 Females	

As is shown in Figure 10 the feed required to produce a pound of gain increases rapidly as the birds become older. Up to the age of four months a pound of gain was secured from a consumption of  $3\frac{1}{2}$  pounds or less of feed whereas from 24 to 28 weeks it required over 7 pounds of feed to produce a pound of gain. During the early stages of growth the growth rate is very high and the maintenance cost per unit of gain is relatively low whereas during the later stages when the turkeys are larger the maintenance cost per unit gain is high and the rate of growth is relatively low. Gains made when growth is retarded are more expensive but when these retarded birds establish a relatively higher growth rate they make relatively more efficient gains.

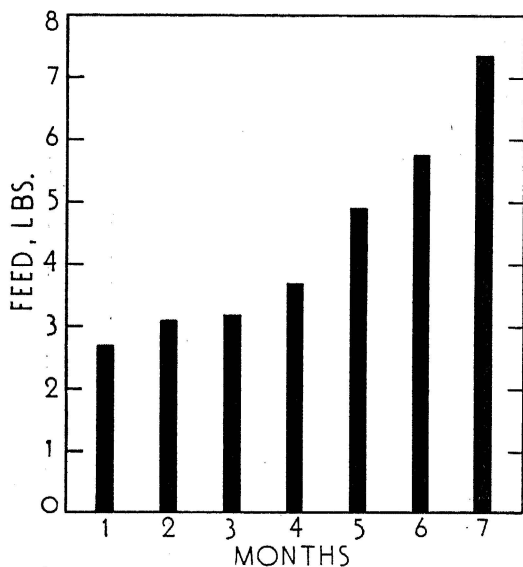


Fig. 10.—Average feed consumption per pound of gain made from the first to the seventh month.

The efficiency of the turkey as a producer of meat is shown by the figures calculated to show the amount of feed required to produce a pound of gain for the entire 24 weeks from hatching to marketable age. Tables 2-7 and 11 show that the amount of feed required to produce one pound of gain during the entire 24-week period varied from 3.82 pounds to 4.98 pounds. Similar data was obtained for turkeys grown to 28 weeks of age and as shown by Tables 8, 9, and 10 the amount of feed required per pound of gain was 4.76, 4.74 and 5.31 pounds. Turkeys raised on range would ordinarily consume less mash and grain per pound of gain.

### FEED CONSUMPTION FOR BRONZE TURKEYS

A question frequently asked is "How much feed is required to raise a turkey" and to partially answer that question Table 20 has been prepared. These turkeys were grown in complete confinement and therefore consumed more grain and mash than they would if raised on range where they could consume green feed and other feeds. Similar data appear in Tables 2 to 11 for the various feeding tests. In these data it will be recalled that the feed consumption varied with the growth attained. While feed consumption varies with growth, the rate of growth varies depending upon the type of ration fed and also the environmental conditions which prevail, especially temperature. During periods of extreme heat growth is retarded and feed consumption is reduced.

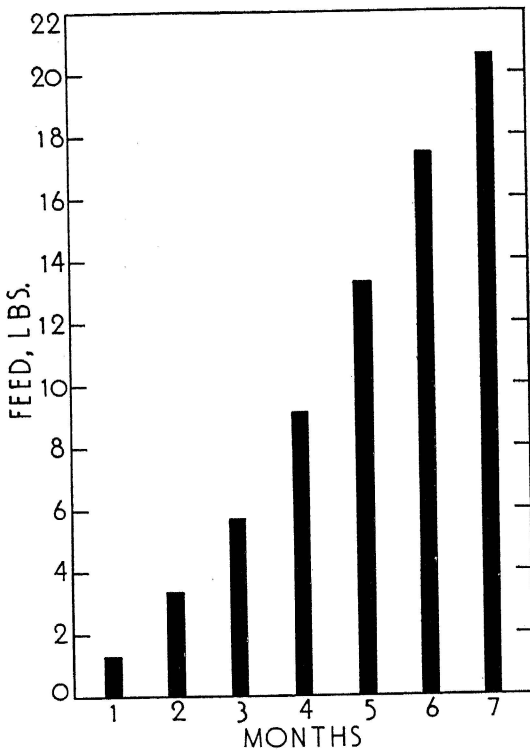


Fig. 11.—Total feed consumption per bird for each month from the first to the seventh month.

The data shown are for various lots which were fed rations containing soybean oil meal. It required 71 pounds of feed to grow a turkey up to the age of 28 weeks. As is shown in Table 20 and Figure 11 for the first four 4-week periods the average feed con-

sumption per bird was 1.1, 3.35, 5.82 and 9.04 pounds respectively. For the 5th, 6th and 7th 4-week period the feed consumption per bird was 13.35, 17.44, and 20.59 pounds of feed. In addition to the explanation previously given for variations in the feed consumption of various lots it will be noted that in these groups the ratio between sexes was not constant. Obviously females would consume less feed than would toms. In general, however, the estimate that it requires 50 pounds of feed to grow a turkey up to the age of 24 weeks or 71 pounds up to the age of 28 weeks gives the turkey raiser some idea as to the feed consumption of turkeys.

### **THE EFFECT OF DATE OF HATCH ON THE GROWTH OF TURKEYS**

The fact that early hatched chicks grow much faster when young and much slower as they approach maturity than do late hatched chicks has been observed at this Station and this behavior has been attributed principally to the high summer temperatures that sometimes prevail. During 1938 and 1939 growth data for poults hatched over a relatively long season, from April 16 to June 12, 1938 and from April 14 to June 10, 1939, were secured. These results are given in Tables 21-26. The differences in growth between the different lots is not as significant as has been reported for chickens. This may be partially explained by the fact that the summers of 1938 and 1939 were not excessively hot for extended periods.

If we compare the lots hatched April 16 and June 12, 1938 it will be observed that the April hatched toms were .6 pounds heavier at the age of 16 and 20 weeks but only .3 of a pound heavier when 24 weeks old. In the case of the females while at the age of 16 and 20 weeks the April hatched turkeys were .3 pounds heavier, at the age of 24 weeks the females in both groups weighed exactly the same, i. e., 10.2 pounds. The greatest difference in growth rate between the April and June hatched poults occurred during the first 8 weeks. At the age of 8 weeks the June hatched poults were 78% as large as those hatched in April. On the other hand, the group hatched May 15, 1938 were consistently larger for the entire period than were those hatched April 16. The data for 1939 also fail to show any consistent advantage in the growth of turkeys hatched April 14 as compared to June 10. The toms in the earlier hatched group were consistently larger throughout the growing period and at the age of 24 weeks averaged 1.7 pounds more than did the toms from the group hatched June 10. On the other hand there was no difference in the weight of the females of the two groups after the birds were 16 weeks old. Poults hatched late were usually smaller when they were 8 weeks old but by the time they were 16 to 24 weeks old they

had overcome this early retardation so that while high temperatures reduce the rate of growth this retardation is only temporary and is compensated for by more rapid growth later.

TABLE 21.—EFFECT OF DATE OF HATCH ON THE GROWTH OF FEMALE BRONZE TURKEYS RECEIVING SOYBEAN OIL MEAL. 1938.

Age in Weeks	April 16	April 30	May 15	May 29	June 12
0	.11	.12	.12	.11	.11
4	.47	.47	.54	.40	.41
8	1.66	1.58	1.70	1.26	1.29
12	3.4	3.4	3.7	3.1	3.2
16	5.6	..	6.6	6.1	5.3
20	8.2	8.3	9.2	8.0	7.9
24	10.2	10.1	11.0	10.8	10.2
No. Birds Matured	14	13	10	11	10

TABLE 22.—EFFECT OF DATE OF HATCH ON THE GROWTH OF MALE BRONZE TURKEYS RECEIVING SOYBEAN OIL MEAL. 1938.

Age in Weeks	April 16	April 30	May 15	May 29	June 12
0	.12	.12	.13	.12	.11
4	.53	.49	.57	.42	.42
8	1.81	1.72	1.90	1.36	1.42
12	3.9	3.9	4.2	3.3	3.5
16	6.7	..	8.0	6.4	6.1
20	10.2	10.2	12.0	9.1	9.6
24	13.6	13.9	16.3	13.4	13.3
No. Birds Matured	9	14	6	6	9

TABLE 23.—EFFECT OF DATE OF HATCH ON THE GROWTH OF MALE BRONZE TURKEYS RECEIVING SOYBEAN OIL MEAL. 1939.

Age in Weeks	April 14	April 28	May 13	June 10
0	.12	.13	.13	.13
4	.64	.56	.59	.49
8	2.1	2.0	1.7	1.6
12	4.8	3.9	4.0	3.7
16	8.2	7.4	7.5	6.8
20	12.4	10.8	10.8	10.6
24	16.6	14.6	13.8	14.9
No. Birds Matured	7	28	19	15

TABLE 24.—EFFECT OF DATE OF HATCH ON THE GROWTH OF FEMALE BRONZE TURKEYS RECEIVING SOYBEAN OIL MEAL. 1939.

Age in Weeks	April 14	April 28	May 13	June 10
0	.13	.12	.12	.13
4	.58	.50	.52	.45
8	1.8	1.6	1.3	1.5
12	3.6	3.0	3.1	3.2
16	5.9	5.5	5.5	6.0
20	8.5	7.8	7.5	8.2
24	10.0	9.5	9.1	10.4
No. Birds Matured	18	16	15	20

TABLE 25.—EFFECT OF DATE OF HATCH ON THE RELATIVE GROWTH RATE OF MALE BRONZE TURKEYS. SOYBEAN OIL MEAL, 1938.

Weeks	April 16		May 15		May 29		June 12	
	Gain	Rate %	Gain	Rate %	Gain	Rate %	Gain	Rate %
0-4	.41	128	.44	126	.30	111	.31	119
5-8	1.28	109	1.33	108	.94	106	1.00	109
9-12	2.09	73	2.3	75	1.94	83	2.08	85
13-16	2.8	53	3.8	62	3.1	65	2.6	54
17-20	3.5	42	4.0	40	2.7	35	3.5	45
21-24	3.4	29	4.3	30	4.3	38	3.7	32

TABLE 26.—EFFECT OF DATE OF HATCH ON THE RELATIVE GROWTH RATE OF FEMALE BRONZE TURKEYS. SOYBEAN OIL MEAL, 1938.

Age	April 16		May 15		May 29		June 12	
	Gain	Rate %	Gain	Rate %	Gain	Rate %	Gain	Rate %
0 - 4	.36	124	.42	127	.29	116	.30	115
5 - 8	1.19	112	1.16	104	.86	104	.88	104
9 - 12	1.74	69	2.0	74	1.84	84	1.91	85
13 - 16	2.2	49	2.9	57	3.0	65	2.1	50
17 - 20	2.6	38	2.6	33	1.9	27	2.6	39
21 - 24	2.0	22	1.8	18	2.8	30	2.3	26

### GROWTH AS INFLUENCED BY THE STRAIN OF TURKEYS

In the production of turkeys it is important that one select a strain which reaches marketable condition in the shortest possible time. In an attempt to locate such a strain during the 1939 season, eggs from a strain reputed to be early maturing were secured. Table 27 shows the growth experienced by this strain of turkeys as compared to turkeys raised from the Station stock. Since the two lots were brooded and reared together the difference in the growth must be attributed to strain differences.

TABLE 27.—THE COMPARATIVE GROWTH OF TWO STRAINS OF BRONZE TURKEYS HATCHED APRIL 14, 1939.

Age in Weeks	Northwest Stock		Missouri Station Stock	
	Males	Females	Males	Females
0	.13	.13	.12	.13
4	.69	.66	.64	.58
8	2.47	2.12	2.07	1.81
12	5.3	4.4	4.8	3.6
16	9.3	7.5	8.2	5.9
20	14.2	10.4	12.4	8.5
24	18.7	12.2	16.6	10.0
No. Birds Matured	13	10	7	17

It will be observed that by the time the turkeys were 12 weeks old the toms of the early maturing strain were a half pound heavier. The weight advantage of the early maturing strain was maintained and at the age of 24 weeks both the toms and females were 2 pounds heavier. It was also evident that the early maturing strain were not only heavier but possessed wider, longer and better fleshed breasts than did the Station stock.