Progress Report Series No. 57 *August, 1955*

AGRICULTURAL EXPERIMENT STATION
of The Alabama Polytechnic Institute, Auburn, Ala.
E. V. SMITH, Director

RESULTS of PERFORMANCE TESTS of A SMALL FARM MIXER GRINDER*

J. L. BUTT, Associate Agricultural Engineer**

Reductions in feed costs result in greater margins of profit for the poultry or livestock producer. It is known also that with normal conditions home-grown grains are the cheapest source of livestock concentrates. In cases where feed grains are to be purchased rather than grown at home, it is possible to save on grain costs by buying during the harvest season when prices are lowest, and by storing the grain on the farm. This is especially true in years of high production. In order to take advantage of low-cost grains, whether home-grown or purchased, it is desirable to have grinding and mixing facilities available on the farm to process the grain into a usable feed mixture.

Home-mixed feeds have not been used by certain farmers, especially poultrymen, because of the rather tedious job of mixing the ingredients in the right proportions to provide a balanced ration. To meet the requirements for these farmers, a farm mixer should (1) proportion, (2) mix, and (3) grind the feed with a minimum of supervision, labor, and power. A machine embodying most of these characteristics has been placed recently on the market. This paper reports results obtained to date with one such machine that meets these requirements.

This report describes feed grinding and mixing tests conducted during the spring of 1955. The mixer-grinder chosen for testing was characterized by the following features: (1) It requires only a 2-hp. electric motor for power which makes its use possible on most Alabama farms; (2) it will automatically proportion, mix, and grind as many as four ingredients simultaneously without supervision; (3) it is equipped with a time switch that will automatically turn the machine off when a predetermined quantity of feed is ground; (4) it is a relatively inexpensive unit.

Description of Test Machine

The mixer-grinder (Figure 1) consists of a small hammermill mounted on the shaft of a 3450 r.p.m., 2-hp. single-phase electric motor and a proportioning unit. Grain and concentrate are delivered from storage bins to four separate feed hoppers at the top of the mill. These hoppers

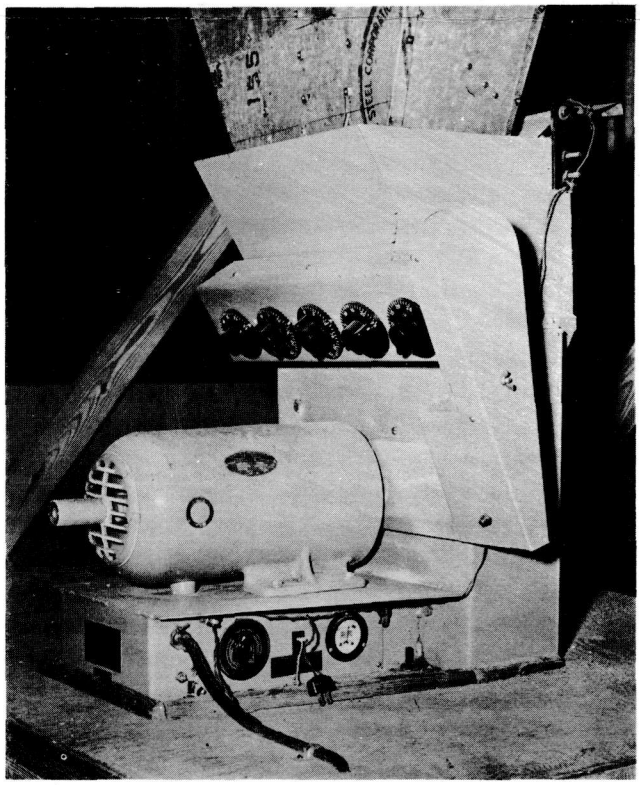

Figure 1

* Funds for this experiment were made available by the Alabama Power Company.

**The author acknowledges the assistance of C. D. Squiers, associate animal husbandman, and G. R. Ingram, associate poultry husbandman, in these tests.

are equipped with feed augers for conveying the grain or concentrate into a mixing hopper from which it flows into the hammermill. The amount of rotation of the feed augers can be controlled by a series of dials, which in turn regulate the rate and amount of each ingredient flowing into the mixing hopper. By selecting the proper ratio on the dials, the desired feed mixture may be obtained.

Since the augers deliver ingredients on a volume basis, it is necessary to convert the weights of the ingredients desired into equivalent volumes by dividing by the weights per bushel. Tables with information on weight per bushel for various crops and formulas showing sample calculations are supplied by the manufacturer. In these tests the weight per bushel was determined for each ingredient. A time switch on the machine permits the operator to set the mill to operate without attention for the lengh of time necessary to provide an adequate supply of feed. Motor overload protection and safety pins are built into the machine. An ammeter mounted on the machine indicates when the motor is loaded, thus enabling the operator to fully utilize the power unit.

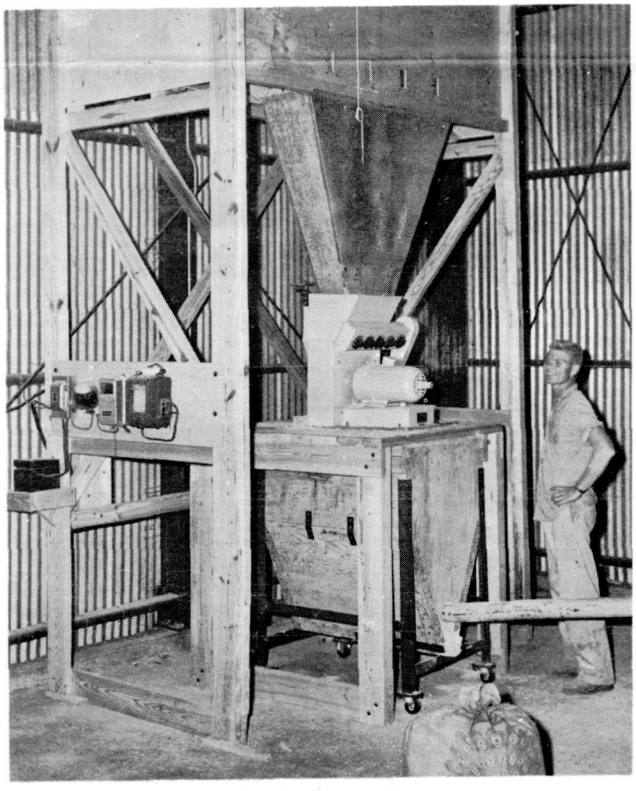

Figure 2

Procedure

The mixer-grinder was placed on a platform underneath four holding bins and above a feed cart (Figure 2). In order to determine how accurately the machine proportions, the holding bins were filled with weighed amounts of each ingredient, the dials were set, and the machine run until one of the hoppers was empty. The amounts of ingredients in the other hoppers were weighed and recorded. Data taken for each test run were (1) quantity of feed processed, (2) time of operation, (3) electricity (in Kw.-hr.) required, (4) distribution of the electrical load, and (5) weights of the remaining ingredients not ground during the test run. The actual ingredients comprising the mixture were determined by subtracting the weights of ingredients remaining in the hoppers from the amounts originally placed in them. These data are expressed on a percentage basis in Tables 1, 2, 3, 4, and 5.

Poultry Mixture Tests

A series of tests was conducted for grinding poultry feeds of three different protein levels, 14, 16 and 18 per cent. The desired protein level was calculated on the assumption that corn contained 9 per cent and concentrate 20 per cent protein by weight. The corn and concentrate were then weighed to give the desired protein level and placed in the hoppers of the grinder. The dial settings were calculated and the mixture ground until one feed hopper ran empty. The amount

TABLE 1. SUMMARY, TESTS OF GRINDING SHELLED CORN AND CONCENTRATE FOR AN 18 PER CENT PROTEIN POULTRY RATION

Dial settings, hopper				Percentage by weight of ingredients in ration				Rate lb. per hr.	Kw. hr. per 100 lb.
				Calculated		Actual			
1	2	3	4	Corn	Conc.	Corn	Conc.		
23	24	24	11*	18.18	81.82	17.8	82.2	2,086	——
20	20	20	9*	18.18	81.82	16.7	83.3	1,826	.185
20	20	20	10*	18.18	81.82	18.8	81.2	1,636	.199
13	4*	13	——	18.18	81.82	19.0	81.0	763	.193
25	20	7*	——	18.18	81.82	20.7	79.3	1,248	.153
25	20	6*	——	18.18	81.82	18.3	81.7	1,200	.151
25	20	6*	——	18.18	81.82	17.8	82.2	1,224	.156
25	20	6*	——	18.18	81.82	18.0	82.0	1,268	.173
17	5*	17	——	18.18	81.82	18.7	81.3	940	.194
17	5*	18	——	18.18	81.82	19.0	81.0	933	.196
17	5*	17	——	18.18	81.82	19.0	81.0	933	.198
				18.18	81.82	18.53	81.47	1,277.9	.180

* Indicates hopper containing corn.

TABLE 2. SUMMARY, TESTS OF GRINDING SHELLED CORN AND CONCENTRATE FOR A 16 PER CENT PROTEIN POULTRY RATION

Dial settings, hopper				Percentage by weight of ingredients in ration				Rate lb. per hr.	Kw. hr. per 100 lb.
				Calculated		Actual			
1	2	3	4	Corn	Conc.	Corn	Conc.		
22*	19	19	19	36.36	63.64	39.1	60.9	1,714	.178
23	25	9*	10*	36.36	63.64	37.2	62.8	1,725	.176
18*	25	25	——	36.36	63.64	39.7	60.3	1,184	.203
17*	24	24	——	36.36	63.64	36.4	63.6	1,234	.222
17*	24	24	——	36.36	63.64	36.9	63.1	1,209	.233
19*	25	25	——	36.36	63.64	38.7	61.3	1,077	.236
18*	25	25	——	36.36	63.64	38.3	61.7	1,191	.232
17*	25	25	——	36.36	63.64	37.4	62.6	1,222	.228
				36.36	63.64	37.96	62.04	1,319.5	.214

* Indicates hopper containing corn.

TABLE 3. SUMMARY, TESTS OF GRINDING SHELLED CORN AND CONCENTRATE FOR A 14 PER CENT PROTEIN POULTRY RATION

Dial settings, hopper				Percentage by weight of ingredients in ration				Rate lb. per hr.	Kw. hr. per 100 lb.
				Calculated		Actual			
1	2	3	4	Corn	Conc.	Corn	Conc.		
19*	19*	24	24	54.55	45.45	56.3	43.7	1,654	.213
24	19*	24	19*	54.55	45.45	54.5	45.5	1,123	.246
24	19*	24	19*	54.55	45.45	54.4	45.6	1,090	.240
15	23*	15	——	54.55	45.45	53.9	46.1	936	.278
15	23*	15	——	54.55	45.45	53.3	46.7	969	.316
10*	25	10*	——	54.55	45.45	57.5	42.5	730	.298
9*	25	9*	——	54.55	45.45	55.5	44.5	858	.283
8*	25	8*	——	54.55	45.45	53.7	46.3	997	.270
				54.55	45.45	54.89	45.11	1,044.6	.268

* Indicates hopper containing corn.

of corn and concentrate remaining in the other hoppers was weighed and the percentage of corn and concentrate actually in the mixture was calculated to compare with the desired percentages.

These data are given in Tables 1, 2, and 3. It should be noted that some dial combinations caused greater variations from the desired percentages of each ingredient than others. Once a dial setting is determined as satisfactory, in actual practice it would be used until a different mixture or different ingredients were to be run.

Swine Ration Tests

Tests involving two swine rations were conducted. Oats, corn, and concentrate were processed for one feed, while corn and concentrate were used in the other. Procedure was the same as that described for poultry rations; the data are presented in Tables 4 and 5.

TABLE 4. SUMMARY, TESTS OF GRINDING SHELLED CORN AND CONCENTRATE FOR A SWINE RATION

Dial settings, hopper				Percentage by weight of ingredients in ration				Rate lb. per hr.	Kw. hr. per 100 lb.
				Calculated		Actual			
1	2	3	4	Corn	Conc.	Corn	Conc.		
23	24	14*	——	79	21	79.3	20.7	814	.419
23	24	14*	——	79	21	79.0	21.0	915	.390
23	24	14*	——	79	21	78.7	21.3	927	.367
23	24	14*	——	79	21	78.6	21.4	912	.382
23	24	15*	——	79	21	77.6	22.4	734	.410
24	24	14*	——	79	21	79.9	20.1	1,292	.288
23	14*	24	——	79	21	79.9	20.1	666	.410
23	14*	24	——	79	21	79.0	21.0	558	.428
24	14*	24	——	79	21	79.6	20.4	692	.504
24	14*	25	——	79	21	79.5	20.5	772	.375
24	15*	25	——	79	21	79.5	20.5	781	.354
24	15*	25	——	79	21	79.0	21.0	785	.366
18	12*	19	——	79	21	77.8	22.2	546	.410
19	12*	20	——	79	21	79.2	20.8	562	.428
				79	21	79.04	20.96	782.6	.395

* Indicates hopper containing concentrate.

TABLE 5. SUMMARY, TESTS OF GRINDING OATS, SHELLED CORN AND CONCENTRATE FOR A SWINE RATION

Dial settings, hopper				Percentage by weight of ingredients in ration						Rate lb. per hr.	Kw. hr. per 100 lb.
				Desired			Actual				
1	2	3	4	Corn	Oats	Conc.	Corn	Oats	Conc.		
21[1]	7[2]	13	13	57	30	13	57.6	28.9	13.5	627	.482
18	15[1]	5[2]	——	57	30	13	58.7	27.7	13.6	546	.581
18	16[1]	5[2]	——	57	30	13	57.7	29.1	13.2	539	.570
18	16[1]	5[2]	——	57	30	13	57.3	28.9	13.8	546	.557
18[1]	6[2]	22	——	57	30	13	57.9	28.5	13.6	468	.522
18[1]	6[2]	22	——	57	30	13	57.6	30.2	12.2	445	.663
21[1]	6[2]	25	——	57	30	13	57.0	30.0	13.0	428	.555
21[1]	6[2]	25	——	57	30	13	57.6	29.8	12.6	419	.573
16[1]	20	5[2]	——	57	30	13	57.5	28.8	13.7	517	.546
17[1]	21	5[2]	——	57	30	13	57.0	30.0	13.0	533	.543
17[1]	21	5[2]	——	57	30	13	57.1	30.3	12.6	503	.579
17[1]	21	5[2]	——	57	30	13	57.1	29.7	13.2	474	.560
21	19[1]	6[2]	——	57	30	13	58.5	28.2	13.3	509	.531
22	20[1]	6[2]	——	57	30	13	58.1	28.7	13.2	527	.554
22	21[1]	6[2]	——	57	30	13	57.6	28.7	13.7	——	.566
23	22[1]	6[2]	——	57	30	13	57.0	30.0	13.0	480	.543
Mean				57	30	13	57.58	29.22	13.20	504.1	.558

[1] Indicates hopper containing oats.

[2] Indicates hopper containing concentrate.

Discussion of Results

Shelled corn, grain sorghum, oats, wheat, feed meals, and concentrates were handled by the machine. The mill does not grind ear corn or forage crops without preliminary processing. The mill proportioned, mixed, and ground feeds without further attention after it had been started by the operator. Once a satisfactory series of dial settings was determined, the amount of the different ingredients in a mixture usually varied less than 1 percentage point (Table 4, lines 1, 2, 3, and 4.) The farmer will probably have to make two or three test runs to adjust his mill to the correct proportions if the accuracy just described is required. This may be done by running 100-pound lots of the mixture through the machine and adjusting the dial settings until all hoppers empty at the same time.

When the higher dial settings were used, the capacity was higher. The amount of electricity used varied with the amount of grinding required by the mixture (compare Table 1 having 18.2 per cent corn with Tables 2 and 3 containing 36.4 and 54.5 per cent corn to be ground, respectively).

Summary

The test mill was found to proportion mix and grind feeds for poultry or swine rations in one operation. Once a suitable series of dial settings was obtained the mill consistently metered the various ingredients into the feed mixture within 1 percentage point of desired quantities. The hammermill produced a satisfactory grind. Electrical consumption ranged between 0.151 and 0.663 kw.-hr. per 100 pounds of feed depending upon the dial settings and amount of grinding required for the mixture. Machine capacity varied from 419 to 2,086 pounds per hour, again depending upon the dial settings and mixture ingredients. There was some separation of the feed mixture upon falling into the feed cart, which was reduced by adding collecting hoppers beneath the hammermill and reducing the distance the feed dropped into the feed cart.