# DEVELOPMENT AND EVALUATION OF A SMALL-SCALE COTTON GINNING SYSTEM

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# DEVELOPMENT AND EVALUATION OF A SMALL-SCALE COTTON GINNING SYSTEM

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## SUMMARY

To improve cotton ginning research capabilities, a small-scale ginning system was designed, constructed, installed in an environmentally controlled building, and evaluated.

In experiments comparing the small-scale system (capacity 8.4 lb/min) with a full-size ginning system (84.5 lb/min), essentially no significant differences at the 1% probability level were found by the student's "t" test for paired comparisons.

The small-scale system, which can be arranged to provide many processing combinations and is economical to operate, should fill a long-felt need in ginning research.

## INTRODUCTION

Research in cotton ginning systems is responsible for numerous modifications, inventions, and improvements related to gin machinery. However, using full-scale equipment, research results were obtained only after cumbersome experimentation involving several bales of cotton, hours of operation, and man-days, as well as nonuniformity of cotton, different environmental test conditions, and considerable expense.[2]

These conditions have hampered advancement in cotton ginning technology. As a consequence, researchers have naturally contemplated the use of a small-scale ginning system.

The first documented mention of the need for a small-scale gin plant for cotton research was in hearings on March 20, 1930, before the Committee on Agriculture, House of Representatives, 71st Congress, when it was pointed out that

> . . . what is needed most urgently is an experimental gin plant, equipped with adequate temperature and humidity control of the atmosphere, and with all types and makes of commercial and experimental ginning and cleaning equipment, together with cotton conditioning house, units for heat drying and for dessicating purposes, and machine shops. When this is at hand, and not until then, will it be possible to vary one factor at a time, all others being held constant, and to obtain information necessary to reflect the true nature of the relationships between ginning mechanics and fiber qualities.[3]

This was also the first documented mention of a ginning system housed in a controlled environment.

Since cotton is hygroscopic, variations in relative humidity cause direct variations in the moisture content of cotton. Moisture content affects the ease of separating foreign matter from cotton and hence the efficiency of seed-cotton cleaners. Moisture influences the force required to compress cotton; it has a direct bearing on fiber breakage during the ginning process, and so an effect on staple length, spinning performance and yarn quality. The gin stand performance, capacity and seed-cleaning capability are also influenced by cotton moisture content. Thus, moisture content is one of the most important variables in the cotton ginning process.

In nature, relative humidity is constantly changing, causing changes in fiber moisture content. To obtain uniform moisture conditions in cotton ginning research, a controlled environment must be provided for conditioning the cot-

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[2] Anthony, W. Stanley, and McCaskill, Oliver L. Development of a model cotton ginning system. Unpublished, presented at the Southeastern Regional American Society of Agricultural Engineers meeting, Richmond, Va., 1972.

[3] McCrory, S. H. Report of Chief of Bureau of Public Roads to the Committee on Agriculture, House of Representatives, 71st Congress, Mar. 20, 1930.

ton and conducting the experiments. The controlled environment enables at least two variables (temperature and relative humidity) to be regulated as required by the test design.

Conducting ginning experiments in a controlled environment helps to obtain uniform test conditions. However, the physical properties of the test cotton must also be uniform. Variety, growth environment, cultural practices and numerous other factors affect the physical properties of cotton. The procurement of large experimental lots of cotton with homogeneous physical properties is difficult if not impossible. A possible solution to this difficulty is the use of relatively small test lots produced in the same growth environment and processed in a small-scale ginning system. Consequently, a small-scale ginning system operated in a controlled environment was investigated.

The gin stand was selected as the controlling piece of machinery in establishing a scale, since its function is the most critical. In the full-size ginning system used at the U.S. Cotton Ginning Research Laboratory at Stoneville, Miss., from 1946 to 1966, approximately 150 pounds of seed cotton were ginned per minute by 360 gin saws. This was 0.42 pound per saw. The small-scale gin was designed to handle 0.42 pound of seed cotton per saw. As a result of prior knowledge and experience, the selected gin stand was 15 inches wide (inside). This width accommodates 20 saws, resulting in a capacity of 8.4 pounds of seed cotton per minute for the small-scale gin stand.

With the establishment of gin stand capacity, all other gin machinery capacities were scaled to a capacity of 8.4 pounds per minute. The only dimension reduced was width—everything else remained the same.

Researchers at the U.S. Cotton Ginning Research Laboratory, Stoneville, Miss., reduced a full-size gin stand and feeder to 15 inches (inside dimension) in 1959. This initial work gave satisfactory performance and the design and construction of a small-scale ginning system was completed by G. N. Franks and others in 1963. In preliminary tests by Charles S. Shaw and G. N. Franks, the small system performed well above expectations, indicating that construction of a building with a controlled environment to house the small-scale system would indeed be justified.

# THE SMALL-SCALE GINNING SYSTEM

## Gin Building

Construction of the building for the small-scale ginning system was completed in 1970, and modification and installation of the gin machinery were completed in the summer of 1971, with exception of the bale press.

The environmentally controlled building in which the system was installed is 40 feet wide and 120 feet long. It is of concrete block, with a plate height of 19 feet 4 inches. A floor plan of the respective locations of the processing machinery is shown in figure 1.

## Environmental Control

The gin building is divided into three major areas—building equipment and drier room, the ginning machinery room, and the seed-cotton conditioning room. The seed-cotton conditioning room and the ginning machinery room have separate, independent environmental control systems and can be maintained at different temperatures and relative humidities.

Temperature can be varied from 60° to 100° F ±2° and relative humidity can be varied from 25% to 80% ±3% from September through May. There is sometimes difficulty in controlling these conditions from June through August because of the high ambient temperature and relative humidity during those three months.

## Advantages of Small-Scale System

The advantages of the small-scale system are

1. Environmental conditions are easier to control because of the smaller scale of all the

| Item | Location | Item | Location |
|---|---|---|---|
| Control Console | 1 | Seed Cotton Cleaners | 10,11,12,13 |
| Feed Control Platform | 2 | Lint Cleaners | 14,15,16,17 |
| Gin Stand | 3 | Air Filters | 18,19 |
| Overflow Bin | 4 | Tower Driers | 20,21 |
| Condenser | 5 | | |
| Packaging System | 6 | | |
| Conditioning Room | 7 | | |
| Ginning Room | 8 | | |
| Building Equipment Room | 9 | | |

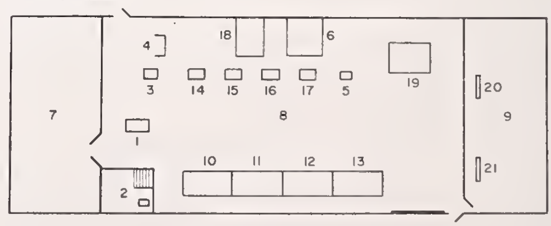

FIGURE 1.—Floor plan of small-scale ginning system.

2. Smaller quantities of cotton are required to conduct a research test—20 pounds in the small-scale gin versus 200 pounds in the full-size gin—this is extremely important when dealing with experimental varieties of cotton or any limited supply;

3. Homogeneity of the sample units is increased as a result of their smaller size;

4. Energy consumption by the gin machinery is reduced;

5. Less manpower is required to operate the small gin;

6. Observation, coordination, and control of the research ginning is improved;

7. Photography and observation are facilitated by glass sides in the machinery;

8. Less time is required to conduct a test;

9. Number of treatment combinations is increased to over 500;

10. Seed-cotton cleaning machines may be removed and new experimental units installed in a matter of seconds;

11. Larger tests and more replications are practical because of reduced sample unit size and gin time;

12. Machinery modifications are easier on the smaller machinery; and

13. Since less air is used for materials handling, pollution control equipment is less expensive.

## DESIGN AND CONSTRUCTION FEATURES

### Feed Control

In most full-size gins the cotton initially enters the ginning system through a suction pipe. The small size of the sample unit required for the small-scale system (20 pounds) eliminates the need for a continuous-duty suction pipe to convey cotton into the system; instead, the small-scale system utilizes a batch feed device. The cotton is placed in an 18- by 27- by 36-inch charging chute that holds approximately 25 pounds. The charging chute is directly above the feed control. The feed control unit is powered by a variable speed motor and meters the cotton uniformly into the processing system.

### Seed-Cotton Driers

In order to condition the seed cotton for cleaning and ginning in experimental work, it is at times necessary to reduce the lint moisture content to less than 3%. Two 24-shelf multipath tower driers are used to obtain the desired moisture level for processing. The driers are scaled in width to handle 8.4 pounds per minute and are 6½ inches wide (inside). The driers have the capability of using 24, 12, or 1 of the drying shelves. Heat is supplied to each drier by a separate 100,000 Btu/h natural gas burner.

Each drier is equipped with a 6-inch-wide glass panel that runs its full height, allowing the researcher to view the cotton as it is processed through the drying system. An intricate valving arrangement makes it possible to use the driers at any point in the seed-cotton processing sequence.

### Seed-Cotton Cleaning Equipment

Seed cotton is processed through a combination of cleaning machines and driers to reduce the foreign matter and moisture content before its arrival at the gin stand. In the small-scale gin laboratory, three types of seed-cotton cleaning machines are used—a USDA Stick Remover, a revolving-screen cleaner, and two six-cylinder stationary screen cleaners with spike-tooth cylinders. The machines are not the same width in the full-size gin; consequently, they are not the same width in the small-scale gin. The USDA Stick Remover was reduced to 10 inches in inside width, the revolving-screen cleaner to 4¾ inches, and the six-cylinder stationary-screen cleaners to 4¾ inches. These machines, in a full-size gin plant, are normally used in sequence, with one or more driers between them.

In the preliminary machinery setup the number of possible ginning combinations was restrained by the fixed location of the seed-cotton cleaning machines, even though the 26 combinations available were substantially more than that available in the full-size gin. However, to increase the number of ginning combinations available in the final machinery setup, the seed-cotton cleaning machines were placed on casters and made mobile. The seed-cotton cleaning machinery can be interchanged among four bays that are 5 by 10½ feet in area and 9½ feet high (fig. 2). The machines are complete with independent drives and input and output chutes so that they can be located, powered, and fed in any bay. The machines are constructed so that they automatically match with the input separator and dropper. After the machine is positioned in the bay, a 6-inch-diameter flexible hose with quick-disconnect clamps is connected from the

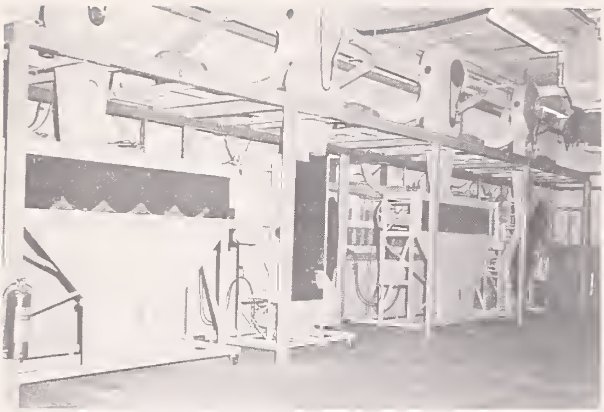

FIGURE 2.—Seed-cotton cleaning machinery in the bay arrangement.

cotton output of the machine to a 6-inch-diameter sheet-metal pickup line. Thus the machine can be placed in a bay and readied for processing cotton in a matter of seconds. The bay arrangement also makes it possible to test new seed-cotton cleaning machines in the ginning system in minimum time.

Each seed-cotton cleaning machine has a glass side to enable the researcher to see what actually happens as the cotton passes through the machine, and to facilitate photographic work and demonstrations.

## Extractor-Feeder and Overflow

Cotton is metered into the gin stand by a combination extractor-feeder, which removes hulls and some leaf trash, and supplies the gin stand with the proper amount of cotton to yield the best lint samples. The extractor-feeder is 15 inches wide and has a small storage hopper directly above it. If the cotton reaches the feeder faster than the feeder is metering it to the gin stand, then the excess cotton is conveyed by a screw conveyor to an overflow storage bin. The cotton can be picked up from the overflow bin and ginned later. The overflow system is similar to one in a full-size gin but is smaller.

## Gin Stand

The essential component of a cotton ginning system—the gin stand—has the primary function of separating the lint from the cottonseed, and the secondary function of removing trash and hulls from the cotton as it is ginned. The small-scale gin stand is shown in figure 3.

## Lint Cleaners

After the lint has been separated from the cottonseed by the gin stand, additional cleaning is normally required, and is provided by lint cleaners.

The lint cleaners in the small-scale ginning system were scaled down to 15 inches in width. Figure 4 shows the lint cleaner arrangement.

Normally, two stages of lint cleaners are used to remove the small trash from the lint in a full-size ginning system. However, to determine the feasibility of using more than two lint cleaners, and for special research purposes, four were installed in the small-scale system.

## Air Requirements

In a ginning system, seed cotton, lint, cottonseed and trash are conveyed from point to point by air. A small-scale ginning system has airflow requirements similar to a full-size gin. The proper amount of air is very important, since the rate of flow of cotton in the system is determined by the size of the pipe and the velocity of the air. The velocities required vary with the kind of

FIGURE 3.—Small-scale gin stand (20-saw).

FIGURE 4.—The gin stand and lint cleaner setup in the small-scale ginning system.

material. Seed cotton should be conveyed at approximately 4,000 to 5,000 feet per minute, lint cotton at 1,000 to 1,500 feet per minute, seed at 5,000 to 5,500 feet per minute, and hulls and trash at 3,000 to 4,000 feet per minute. Approximately 45 cubic feet of air are required for each pound of material moved.[4]

No. 20 fans, powered by 10-horsepower motors, are used to convey seed cotton from point to point, with the exception of conveying to the gin stand. Two series No. 2-A fans, driven by a 10-horsepower motor, are used to bring the cotton to the gin stand. The fans were connected in series to increase the total pressure that they could operate against. This is necessary because of the long distance that the seed cotton has to travel through the pipe in certain ginning combinations. Six-inch-diameter lines are used to convey seed cotton, and 7-inch-diameter lines are used for air.

Seed cotton is conveyed through the two driers by a No. 30 fan, driven by a 25-horsepower electric motor. This fan picks up air outside the building, dries the cotton, and delivers the hot air from the driers to a 34-inch-diameter cyclone where the dust particles are removed and the air returned to the atmosphere.

Lint cotton is conveyed in the lint cleaning system by an 18-inch-diameter vane-axial fan driven by a 7½-horsepower motor. The rectangular ducts connecting the lint cleaners are 6 by 15 inches. Approximately 1,000 cubic feet of air per minute are needed to convey the lint.

Seeds removed by the gin stand are picked up by a 2¼-horsepower vacuum system installed on a 50-cubic-foot reservoir outside the gin building. The seeds are conveyed through approximately 100 feet of 2-inch-diameter plastic pipe and dropped into the seed storage hopper. The hopper will hold seeds from several days' ginning and is emptied periodically. A trailer can be pulled under the hopper, the hopper bottom opened, and the seed dropped out without any handling by personnel. The amount of air picked up inside the building by the 2-inch-diameter hose and delivered outside is relatively small and does not affect the building environmental control.

Lint-cleaner, gin-stand and extractor-feeder trash is collected by separate 2¼-horsepower vacuum cleaners and retained inside the building in 55-gallon drum containers. These drums require emptying every few days of operation.

Trash from the seed-cotton cleaning machines is gravity-fed into a trash reservoir on the bottom of each machine. These individual reservoirs are removable for easy weighing of trash from individual machines and sample units.

## Filters

The small-scale ginning system requires a large quantity of air for materials handling. To control the temperature and relative humidity in the building economically, a minimal amount of air manipulation and no air changes with the outside are desired. To this end, a minimum of conveyance air is used, and all air that is used for conveying materials inside the conditioned portion of the building is recycled inside the building. Any dust and small trash particles entrained in the airstream after the cotton is separated from it must be removed before the air is released inside the building. Two filters are used for this purpose; one serves as a cleaner for the large volume of lint-conveying air; the second handles trash collected by the lint filter, and filters all other air used in materials handling in the plant.

The air to be cleaned is delivered by six No. 20 fans, two series No. 2-A fans, and a No. 7 fan that pulls air from a Vacu-Maze Filter. The Vacu-Maze Filter cleans the air used in handling lint cotton, thus reducing the quantity of air to be handled by the master bag filter.

[4] Stedronsky, V. L. Materials handling. Handbook for Cotton Ginners, U.S. Department of Agriculture, Agriculture Handbook No. 260, 121 pp. 1964.

The collected dust and trash particles are taken from the Vacu-Maze Filter and blown into the master bag filter .The master bag filter reduces dust concentration to less than 200 micrograms per cubic meter before releasing the air into the ginning machinery room.

### Ginning Combinations

To fully investigate and analyze the effects of processing sequence variations in ginning cotton, a considerable number of treatment combinations has been provided. In the initial temporary gin setup, there were 26 possible ginning combinations. However, in the final system setup, over 500 ginning combinations are possible. The number of available ginning combinations results from an arrangement of 33 valves and four mobile seed-cotton cleaning machines. A programed Sealectroswitch makes 37 ginning combinations available simply by rotating the switch. The seed-cotton processing combinations are shown in table 1.

Numerous other combinations can be produced by moving seed-cotton cleaning machinery to different bays. A schematic diagram of the valve arrangement for the seed-cotton processing machinery is shown in figure 5.

### Energy Consumption

The small-scale ginning system operates primarily on 440-volt, three-phase power available through a closed-delta transformer connection. The only 115-volt electric power required is for the vacuum cleaner motors, solenoid valves, lights, and receptacles.

The electric power requirement in a standard ginning combination (23, table 1) of one multipath drier, three seed-cotton cleaning machines, one gin stand, and two lint cleaners is approximately 53 horsepower with cotton in the system and 57 horsepower without cotton. A comparable full-size gin operating at six bales per hour would require approximately 400 horsepower.[5]

## EVALUTION OF SMALL-SCALE GINNING SYSTEM

### Comparison of Initial Systems

A comparison between the full-size ginning system and a preliminary small-scale ginning system was conducted in 1963 by Charles S. Shaw.[6] This test indicated that the small-scale system yielded results nearly identical to the full-size system.

### Systems Modification

Several modifications and improvements have been added to the small-scale system, and a new full-size system has been installed since the initial comparison test was made. Consequently, an additional study was conducted to compare the results of the ginning systems currently in use, excluding bale packaging. The small-scale and full-size systems have capacities of 8.4 and 84.5 pounds of seed cotton per minute, respectively. The following standard ginning combination was investigated:

| *Small-Scale Gin System* | *Full-Size Gin System* |
|---|---|
| 1. Feed control | 1. Feed control |
| 2. Stationary-screen seed-cotton cleaner | 2. Stationary-screen seed-cotton cleaner |
| 3. Stick remover (USDA) | 3. Stick remover (commercial) |
| 4. Stationary-screen seed-cotton cleaner | 4. Stationary-screen seed-cotton cleaner |
| 5. Extractor-feeder | 5. Extractor-feeder |
| 6. Gin stand (20-saw, 12-inch diameter) | 6. Gin stand (79-saw, 16-inch diameter) |
| 7. Lint cleaners (two) | 7. Lint cleaners (two) |

### Test Description

A randomized complete block with two treatments (ginning systems) and five replications was used to evaluate the performance of the two ginning systems. One 550-pound sample was used for each replication. Each sample was subdivided into one 500-pound unit and one 50-pound unit. The larger units were processed in the full-scale ginning system and the smaller units in the small-scale system. Five samples were taken in each replication for moisture, trash content, grade classification, and fiber analysis. One sampling station was located before the feed control and one after each of the seed-cotton cleaning machines, the extractor-feeder, the gin stand, and the two lint cleaners.

The moisture content was taken to establish the level at which the test was conducted, since

[5] Looney, Zolon M., and Wilmot, Charles A. Economic models for cotton ginning. U.S. Department of Agriculture, Agricultural Economic Report No. 214, 48 pp. 1971.

[6] Shaw, Charles Scott. 1964. Development of alternative seed cotton cleaning devices and methods based on a thorough evaluation of present equipment. Unpublished Annual Report, U.S. Cotton Ginning Research Laboratory, Stoneville, Miss.

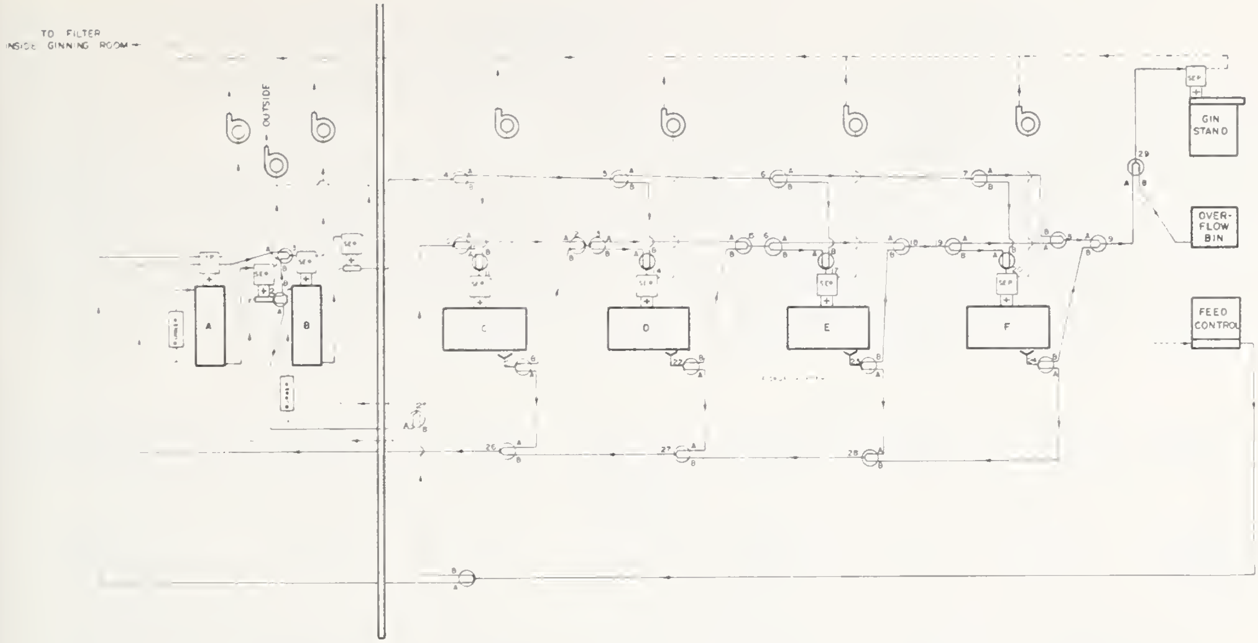


FIGURE 5.—Valve arrangement for seed-cotton processing equipment.

cleaning capabilities of the machinery and fiber properties are affected by moisture.

Student's "t" test for paired comparisons was used to compare the results. The null hypothesis was that the difference in population means for selected variables at each location was zero; the alternate was that the difference was not zero. Significance at the 5% or higher level of probability would indicate that the null hypothesis could not be accepted.

# RESULTS AND CONCLUSIONS

## Results

Table 2 shows the actual values for the moisture and foreign matter content as well as the significance of the comparisons.

The values at the feed-control location are actually the values prior to processing. There is no difference in moisture or total foreign matter content at the feed control. A difference does exist due to motes but is not large enough to affect the total foreign matter content.

Since the extractor-feeder is the endpoint of the seed-cotton processing subsystem, lack of significance in total foreign matter content at that point indicates no difference in the two subsystems. A difference in hulls at the extractor-feeder did exist. The significance of the hulls could possibly be explained by sampling error, nonhomogeneity of sample units, or actual difference. Since the hull content increased from 0.33% midway through the small-scale subsystem to 0.57% at the end of the subsystem, a combination of the three possible causes is the most probable solution. Hulls were not added to the seed cotton as indicated by the data.

Table 3 illustrates the excellent agreement of the lint fiber tests. A difference exists only in staple length as determined by personnel at a classing office. The staple length as determined by the Fibrograph instrument was not significantly different. This is shown by the absence of significant difference in the 2.5% span length as well as the uniformity ratio. The uniformity ratio represents the ratio between the 50% span length, and the 2.5% span length expressed as a percentage.

The mean percent moisture after lint cleaning was 7.58 in the full-size system and 7.17 in the small-scale system. The difference in moisture content after the lint was processed through the two lint cleaners, although significant statistically, was not sufficient to affect lint cleaning efficiency or fiber properties.

## Conclusions

Results of this study indicate only minor differences between the full-size and small-scale ginning systems. Consequently, use of the small-scale ginning system as a research tool is practical. It may be utilized to obtain accurate results without consideration of prediction equations or correction factors. Since this comparison was made of a full-size and a small-scale system with capacities of 84.5 and 8.4 pounds of seed cotton per minute, respectively, inferences cannot be made concerning a ginning system of smaller size.

The small-scale ginning system developed by the U.S. Cotton Ginning Research Laboratory should prove to be a very versatile research tool that will expand both the quantity and quality of experimental work and, at the same time, reduce test operating time and expense.

TABLE 1.—*The basic seed cotton processing machinery combinations in the small-scale ginning system*

| Combination number | Type of processing machinery | Designation [1] |
|---|---|---|
| 1 | OFF | . . . |
| 2 | Gin stand | G |
| 3 | 1 cleaner, gin | D,G |
| 4 | 1 cleaner, gin | E,G |
| 5 | 1 cleaner, gin | F,G |
| 6 | 1 cleaner, gin | C,G |
| 7 | 1 drier, gin | A,G |
| 8 | 1 cleaner, 1 drier, gin | C,B,G |
| 9 | 2 driers, gin | A,B,G |
| 10 | 1 drier, 1 cleaner, gin | A,C,G |
| 11 | 1 drier, 2 cleaners, gin | A,C,D,G |
| 12 | 2 driers, 1 cleaner, gin | A,B,C,G |
| 13 | 1 drier, 1 cleaner, 1 drier, gin | A,C,B,G |
| 14 | 2 driers, 2 cleaners, gin | A,B,C,D,G |
| 15 | 1 drier, 2 cleaners, 1 drier, gin | A,C,D,B,G |
| 16 | 1 drier, 1 cleaner, 1 drier, 1 cleaner, gin | A,C,B,D,G |
| 17 | 1 cleaner, 1 drier, 1 cleaner, gin | C,B,D,G |
| 18 | 2 cleaners, 1 drier, gin | C,D,B,G |
| 19 | 3 cleaners, gin | C,D,E,G |
| 20 | 1 drier, 1 cleaner, 1 drier, 2 cleaners, gin | A,C,B,D,E,G |
| 21 | 1 drier, 2 cleaners, 1 drier, 1 cleaner, gin | A,C,D,B,E,G |
| 22 | 1 drier, 4 cleaners, gin | A,C,D,E,F,G |
| 23 | 1 drier, 3 cleaners, gin | A,C,D,E,G |
| 24 | 2 driers, 4 cleaners, gin | A,B,C,D,E,F,G |
| 25 | 2 driers, 3 cleaners, gin | A,B,C,D,E,G |
| 26 | 1 drier, 1 cleaner, 1 drier, 3 cleaners, gin | A,C,B,D,E,F,G |
| 27 | 1 drier, 2 cleaners, 1 drier, 2 cleaners, gin | A,C,D,B,E,F,G |
| 28 | 1 drier, 3 cleaners, 1 drier, 1 cleaner, gin | A,C,D,E,B,F,G |
| 29 | 1 drier, 4 cleaners, 1 drier, gin | A,C,D,E,F,B,G |
| 30 | 1 drier, 3 cleaners, 1 drier, gin | A,C,D,E,B,G |
| 31 | 1 cleaner, 1 drier, 2 cleaners, gin | C,B,D,E,G |
| 32 | 2 cleaners, 1 drier, 1 cleaner, gin | C,D,B,E,G |
| 33 | 3 cleaners, 1 drier, gin | C,D,E,B,G |
| 34 | 4 cleaners, gin | C,D,E,F,G |
| 35 | 1 cleaner, 1 drier, 3 cleaners, gin | C,B,D,E,F,G |
| 36 | 2 cleaners, 1 drier, 2 cleaners, gin | C,D,B,E,F,G |
| 37 | 3 cleaners, 1 drier, 1 cleaner, gin | C,D,E,B,F,G |
| 38 | 4 cleaners, 1 drier, gin | C,D,E,F,B,G |

[1] A and B are multipath tower driers; C, D, E, and F are seed cotton processing stations; and G is gin stand.

TABLE 2.—*Seed cotton moisture and foreign matter content for the full-size and small-scale ginning systems comparison*[1]

| Sample location | Seed cotton moisture, % | Foreign matter, % | | | | | |
|---|---|---|---|---|---|---|---|
| | | Hulls | Sticks and stems | Small leaf | Pin trash | Motes | Total |
| Feed control: | | | | | | | |
| Full size | 9.62 | 1.23 | 0.64 | 1.86 | 0.12 | 0.51 | 4.36 |
| Small-scale | 9.55 ns | 1.21 ns | .56 ns | 1.99 ns | .14 ns | .38 * | 4.30 ns |
| Cylinder cleaner: | | | | | | | |
| Full-size | 9.84 | 1.06 | .63 | 1.35 | .10 | .46 | 3.64 |
| Small-scale | 9.26 * | 1.01 ns | .64 ns | 1.55 * | .13 ns | .39 * | 3.51 ns |
| Stick machine: | | | | | | | |
| Full-size | 9.69 | .22 | .44 | 1.23 | .10 | .49 | 2.46 |
| Small-scale | 8.73 * | .33 ns | .43 ns | 1.21 ns | .11 ns | .30 ** | 2.54 ns |
| Cylinder cleaner: | | | | | | | |
| Full-size | 10.06 | .08 | .48 | 1.07 | .10 | .40 | 2.17 |
| Small-scale | 8.93 ** | .55 ** | .50 ns | 1.12 ns | .09 ns | .33 ns | 2.55 ** |
| Extractor-feeder: | | | | | | | |
| Full-size | 10.25 | .09 | .26 | .93 | .10 | .36 | 1.74 |
| Small-scale | 9.25 ** | .57 ** | .37 ns | .89 ns | .10 ns | .34 ns | 2.25 ns |

[1] A standard ginning setup of 3 seed cotton cleaners, gin stand, and 2 lint cleaners was used. Values are averages of 25 samples, 5 for each of 5 replications. Symbols indicate significant differences as follows: ns—not significant at the 5% level of probability; *—significant at the 5% level of probability; **—significant at the 1% level of probability.

TABLE 3.—*Lint fiber data for full-size and small-scale ginning systems comparison*

| Fiber property | Before lint cleaners | | | After lint cleaners | | |
|---|---|---|---|---|---|---|
| | Full-size | Small-scale | Significance [1] | Full-size | Small-scale | Significance [1] |
| Percent moisture | 7.26 | 7.31 | ns | 7.58 | 7.17 | ** |
| Percent foreign matter removed | ... | ... | ... | 3.29 | 2.97 | ns |
| Grade characteristic: | | | | | | |
| Color | 90.40 | 89.80 | ns | 94.16 | 94.40 | ns |
| Leaf | 84.92 | 85.00 | ns | 94.04 | 94.00 | ns |
| Preparation | 2.00 | 2.00 | ns | 2.00 | 2.00 | ns |
| Composite | 85.56 | 86.40 | ns | 94.72 | 94.00 | ns |
| Staple length | 35.00 | 34.94 | ns | 35.00 | 34.30 | ** |
| Fibrograph: | | | | | | |
| 2.5% span length | 1.22 | 1.24 | ns | 1.12 | 1.12 | ns |
| Uniformity ratio | 46.80 | 46.80 | ns | 46.40 | 46.20 | ns |
| Strength, ⅛-in gage | 21.64 | 21.60 | ns | 22.00 | 21.58 | ns |
| Causticaire: | | | | | | |
| Maturity index | 7.86 | 7.94 | ns | 7.88 | 7.90 | ns |
| Micrograms per inch | 4.68 | 4.74 | ns | 4.58 | 4.56 | ns |
| Micronaire | 4.50 | 4.58 | ns | 4.48 | 4.50 | ns |

[1] Symbols indicate significant differences as follows: ns—not significant at the 5% level of probability; **—significant at the 1% level of probability.