PROGRESS REPORT ON PREPARATION REDUCTIONS

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Abstract

The number of bales of cotton in the U.S. classified as rough preparation is generally less than 0.5% of the crop. In 1994, at least 12 gins representing 350,000 bales had greater than 5% preparation calls. Data from these gins were analyzed by frequency analyses across time to isolate occurrence patterns. Results were extremely variable and did not indicate a clear pattern across the entire season for all gins; several groupings of gins with similar chronological patterns were developed. At one gin, analyses by producer clearly indicated a strong relationship between producer and preparation calls as preparation ranged from 0% to 13.6% across producers. A number of causatives such as inadequate drying, excessive conveying velocities, machine overloading, incorrect machine settings, and recirculation in vacuum dropper and blow boxes were indentified and possible solutions were suggested to help resolve the preparation problem.

Introduction

The term "preparation" relates to the physical appearance of lint cotton and is used to describe the degree of smoothness or roughness and the relative neppiness or nappiness of ginned lint. Normal preparation for any color grade of American Upland cotton for which there is a physical color standard is the preparation of that standard as it appears in the reference standard box. Human classers use the appropriate color grade standard box to determine if the sample preparation is normal for that color grade. The degree of preparation differs for color grades, the lower color grade standards are not as smooth as are the high grades. When a sample has preparation rougher than the appropriate color grade standard, the degree of abnormal preparation is noted as part of the official classification record. Level one preparation denotes a moderate degree of roughness, and level two indicates excessive roughness. Virtually all of the preparation called by the USDA falls in the level one category.

Classing officials who prepare the standards for industry approval try to develop standards consistent with the appearance of the crop at that time. The latest official color grade standards were approved at the 1995 Universal Cotton Standards Conference. These standards were likely processed through rigorous ginning systems which included at least two stages of saw lint cleaning. The natural reaction of producers and ginners is to blame the classers for preparation calls. Classers typically do a good job of following their guidelines and standards. However, an evaluation of the effects of abnormal preparation on the spinning utility is needed to determine if the 1995 official USDA grade standards and the associated discount are appropriate for classing of U.S. cotton. The 4.05 cents per pound loan discount for preparation in 1994 makes it obvious that it is a problem to producers and ginners. But it is also a problem to textile manufacturers because discounts for poor preparation cotton are discouraging ginners from using lesser amounts of drying and cleaning as they attempt to "gently gin" cotton.

Recent research based on preparation-called cotton in 1994 indicates that the adverse effect of cotton classed as poor preparation is not nearly so severe as the economic penalty that is normally applied (Bragg, 1995). In fact, the adverse effect is typically reflected in about 5 pounds of additional waste per 500-pound bale. This suggests that the monetary penalty is currently too high. The classification of cotton as having poor preparation is a problem for the cotton industry. The large discounts are keeping ginners from "gently ginning" cotton because the frequency of abnormal preparation increases significantly when less drying and lint cleaning are used. Some ginning systems are more prone to produce rougher samples than others due to different mechanical and pneumatic operational parameters.

Textile industry spokespersons, both technical experts and corporation officials, criticize ginners for "over-ginning" cotton. However, ginners are generally using the recommended machinery sequence to maximize the value of their producer customer's product based on their experience and the indications of the marketing system. Unfortunately the drying and cleaning which improve the grade do some damage to the fiber.

During the last few years, some leading gins across the Cotton Belt have made a special effort to gently gin cotton. Changes in the grading system such as decoupling leaf grade and color grade make it feasible to "prescription gin" cotton based on its needs which typically reduces the drying and cleaning applied to much of the cotton at the gin and improves the value of the crop to producers. This can be a positive step for both producers and textile manufacturers.

When the gentle ginning process (reduced drying, one stage of saw lint cleaning) is applied, the frequency of abnormal preparation increases dramatically in certain gins. The discount for preparation costs the producer about $20 per bale, while the potential increase in bale value for gentle

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ginning is in the $7-14 range. Thus, several of these gins have decided that the risk is too high and have gone back to their normal ginning practices -- two or more lint cleaners and moisture below 6 percent.

The traditional dominant causes of abnormal preparation has been assumed to be immature and/or wet cotton. Development and implementation of good gin drying and seed cotton cleaning systems has minimized the preparation problem. Lint cleaners which accompanied mechanical harvesting in the 1950's practically wiped out the problem. For several decades preparation reductions have averaged less than 0.5 percent on the U. S. crop. So it's easy to ignore it altogether unless you look at individual gins who have 10-25 percent abnormal preparation and regions with high frequencies of preparation.

The causative(s) of rough preparation are not known and it is quite possible that several different causatives exist and perhaps several different types of preparation (Mayfield, et al, 1995). Variety, defoliation, harvesting, and other production factors can contribute to abnormal preparation. Some potential causes of abnormal preparation at the gin include wet cotton, excessive seed cotton cleaning, high velocities in lint and seed cotton ducts, improper gin stand adjustments or maintenance, insufficient lint cleaning, and lint cleaner operation and adjustments. These factors at the gin may prevent the gin from overcoming the preparation potential that already exists. The gin is expected to smooth out and cover any tendencies toward rough samples. These factors may also cause preparation at the gin.

Abnormal preparation is hindering progress toward "gentle ginning." When ginners try "gentle ginning" -- reduced drying, single lint cleaning -- the frequency of preparation calls often increases. The $20/bale discount discourages ginners from gentle ginning. Producers lose the 10-20 extra pounds that reduced drying and single lint cleaning can deliver, and textile manufacturers get fiber with increased levels of neps, short fibers, and smaller trash particles. If slightly more roughness could be tolerated without reducing the utility value of cotton fiber, producers and textile manufacturers could both benefit with no apparent cost to anyone.

Materials and Methods

The primary purpose of this work was to evaluate the occurrence of preparation calls during the 1994 season and determine causatives and solutions. Thus, this report describes weekly frequencies of preparation at several gins. Classing data was obtained from USDA, AMS with approval of the ginners for 12 gins that had greater than 5% preparation during the 1994 season and analyzed by Discriminant Analyses (SAS, 1990) for relationships to include frequency distributions. The 12 gins processed over 350,000 bales and ranged in volume from less than 1,000 bales to over 50,000 bales and averaged about 24,000. Initial plans were to visit all the gins and evaluate the systems to perhaps identify potential causatives of preparation.

Results and Discussion

Frequency analyses of the data as a function of Julian date for the 12 gins are in Figures 1-12. Each chart shows the total number of bales ginned during the 5-day window and the percentage of those bales that were classified as preparation. Thus, to obtain the number of preparation bales, multiply the percent times the total ginned for that period. The preparation calls at each gin are summarized below:

Gin	Percent preparation
1	5.3
2	5.5
3	5.2
4	5.6
5	7.8
6	13.5
7	37.3
8	10.6
9	10.4
10	9.1
11	8.0
12	9.2

For gin 1 (Figure 1), preparation averaged 5.3% for the season but was low the first week, increased to 7.4% the second week, and then declined to less than 2.5% for 8 weeks, and then increased to 6.6% to 13.8% for 5 weeks. For gin 2 (Figure 2), preparation was high the first week, then low for about 55 days and then increased for 20 days and then increased sharply to the end of the season. With the exception of the high preparation levels at the start of the gin season, the preparation at gins 5, 8 and 11 followed a similar pattern to that of gin 2. Preparation was relatively high but fluctuated substantially at gins 4, 6, 7, 10 and 12.

Comparison of the preparation frequency by producer for one gin in Table 2 indicates that the percentage of preparation calls decreased from 1993 to 1994 for all but six producers. Preparation calls across producers in 1994 ranged from 0% to 13.6% while the gin averaged 5.5%; assuming a seasonal distribution in time for the producers, this clearly indicates a strong relationship with producer.

1995 Observations and Programs

In response to the high levels of preparation reductions experienced in 1994, a focused effort was made to determine the causes of preparation reductions and to evaluate the effects of preparation on the textile utility value of cotton. At least three of the gins that had unsatisfactory levels of preparation reductions made special efforts to solve the problem. One gin discovered that their

drier controls were installed improperly, resulting in very little drying being accomplished regardless of the condition of the seed cotton. When this condition was corrected, the level of preparation reductions was significantly reduced. Another gin reduced their seed cotton cleaning to the normally recommended level and made major modifications to their seed cotton unloading system. Their level of preparation reductions was satisfactory in 1995, but they are still concerned that the samples do not appear smooth enough. Another problem gin changed lint cleaners and completely reworked their seed cotton handling system. The ginner felt that cotton in his vacuum wheel and blow box was being recirculated, causing roping and contributing to the problem. His level of preparation was normal in 1995. A thorough inspection of one of the problem gins revealed several possible causes of high levels of preparation including the following:

1. Excessive seed cotton velocities in the unloading system.
2. Gross overloading of the seed cotton cleaners.
3. Machines in poor state of repair.
4. Incorrect grid bar settings.
5. Excessive velocity in the lint flue.

No changes were made in this gin in 1995 but the level of preparation reductions was low.

A study to evaluate the effects of preparation on the textile utility value of cotton in underway. Eighteen bales of cotton which were reduced for poor preparation were selected from various locations. Paired bales of similar quality were also obtained. These bales will be processed at the USDA Cotton Quality Research Laboratory at Clemson, SC, to determine their relative utility values. The hypothesis is that light/moderate preparation has insignificant effects on true textile utility value and slightly rougher samples should be acceptable without reduction.

Cotton Incorporated funded a project to monitor the environmental or production practices which might cause elevated levels of preparation. This project was focused on North Alabama since several of the gins with unsatisfactory preparation levels in 1995 were in that area. However, due to unknown reasons, preparation reduction levels were so low that no field data or meaningful observations were possible.

Possible Solutions To Preparation Problems

The following points are recommendations to ginners who find themselves getting an unsatisfactory level of preparation calls.

1. If low drying temperatures and single stage lint cleaning are being used, keep in close contact with your Classing Office so you will not have too many bales ginned before you discover a preparation problem. If a problem occurs, consider going back to normal drying and lint cleaning until the cotton with the preparation tendencies is ginned or until the problem is identified and corrected.

2. Variety, defoliation, harvesting, plant growth regulators, and other production factors can contribute to abnormal preparation. Switching trailers or modules will often change the smoothness even though the gin is operating identically. Pull seed cotton samples from the trailer or module, and at the feeder apron, and lint samples after each lint cleaning stage. Place these samples sequentially and observe the relative roughness/smoothness. "Ropy" seed cotton will often yield rough or poor preparation lint samples.

3. Green cotton (picked before the natural physiological moisture and sugars have dried) without defoliation can be especially prone to poor preparation. If this is the case, delaying harvest until the cotton fluffs and dries may be the best solution.

4. Check the moisture of the seed cotton. Do not trust any built-in moisture sensors. Get readings from at least two different meters. Feel the cotton. Lint moistures of 6 percent or higher are normally recommended for quality ginning, but if preparation problems occur, moving the moisture down to 5.0 percent can help, even though slightly more fiber quality damage would be expected.

5. Avoid excessive amounts of seed cotton cleaning, especially if the cotton is a little damp or green. The recommended seed cotton cleaning system includes two inclined cleaners, one stick machine (two for stripper cotton), two stages of drying and extractor feeder. An additional impact cleaner or the second stick machine in the system should not cause significant preparation problems.

6. Check the velocities in pipes transporting both seed cotton and lint. Air velocities in lint and seed cotton lines significantly above the recommendations (Table 1) can contribute to preparation reductions.

7. Check lint flues for tags which can cause cotton to twist, creating a rough appearance. Be sure a good uniform batt is always present on all lint cleaner condensers.

8. Check all gin stand adjustments. Pull lint samples from each stand before lint cleaning and compare them. If lint from one stand seems rougher, check that stand closely. A small variation in gin stand saw speed (50-100 rpm) can have major impact on its operation. The rib/saw adjustment as well as moting and doffing adjustments will affect ginning capacity and sample smoothness. Worn saws, ribs, or brushes can also cause problems.

9. Check lint cleaner adjustments carefully. Consider increasing the saw speed to the maximum recommended by the manufacturer. Do not exceed recommended speeds! Excessive speeds will damage fiber quality and will not help a preparation problem. Make sure that a uniform batt of cotton is being maintained on the condenser. The combing ratio (the ratio of the tip speed of the lint cleaner saw to the tip speed of the fluted feed roller) should be on the high end of the recommended range which is 16-28. When preparation is a problem, use combing ratios between 25 and 28.

10. Reduce your ginning rate 20-30 percent from normal. This will allow each drier and cleaner in the system to do a better job.

Disclaimer

Mention of a trade name, propriety product or specific equipment does not constitute a guarantee or warranty by the U.S. Department of Agriculture and does not imply approval of a product to the exclusion of others that may be suitable.

References

1. Bragg, C. K. 1995. Personal communication, November 8.

2. Mayfield, W.D., Anthony, W.S., Baker, R., and Columbus, E.P. 1995. What we know and need to know about preparation. The Cotton Gin and Oil Mill Press. 96(3):20-21.

3. SAS Institute Inc. 1990. SAS, version 6. SAS Circle, P.O. Box 8000, Cary, NC.

Table 1. Recommended air velocities for transporting materials in a cotton gin.

Function	Air velocity (ft/min)
Seed cotton in telescope pipe	5,500-6,000
Seed cotton in conveying pipes	3,500-5,000
Seed cotton in tower dryers	2,000-2,500
Seed in small-pipe systems	4,000-5,000
Hulls and trash	4,000-5,000
Lint cotton	1,500-2,000

Table 2. Bales, %, classed as poor preparation during the 1993 and 1994 ginning season for one gin.

Producer	1993	1994	Producer	1993	1994
1	15.5	9.6	23	14.9	3.8
2	10.5	2.8	24	7.4	1.9
3	9.3	6.1	25	0	3.8
4	17.9	5.1	26	0	0
5	13.8	6.0	27	16.7	9.8
6	9.6	3.4	28	7.4	3.7
7	1.6	2.9	29	9.3	5.0
8	15.5	1.2	30	8.2	3.0
9	6.6	8.4	31	9.5	8.1
10	8.4	5.2	32	-	6.7
11	5.3	3.8	33	11.9	12.6
12	7.4	10.7	34	27.1	3.6
13	18.2	3.2	35	7.7	2.8
14	12.6	11.5	36	4.4	4.2
15	6.6	5.3	37	0	0
16	9.23	6.4	38	-	3.5
17	3.4	3.2	39	-	13.6
18	5.0	0.8	40	-	2.8
19	0	0	41	-	2.6
20	25.8	0.4	42	-	2.4
21	3.3	3.2	43	-	1.1
22	5.4	6.6	44	-	13.0

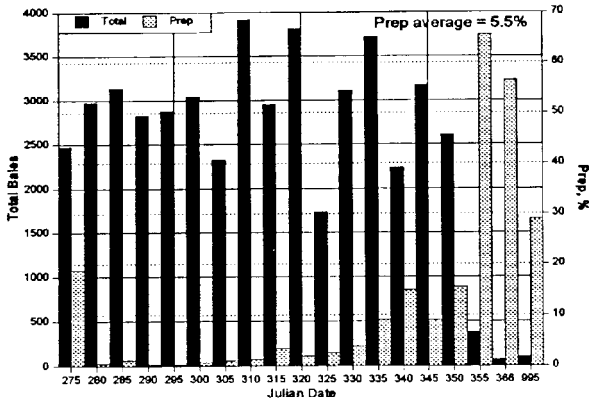

Figure 2. Preparation and total bales as a function of Julian date for gin 2 for 1994.

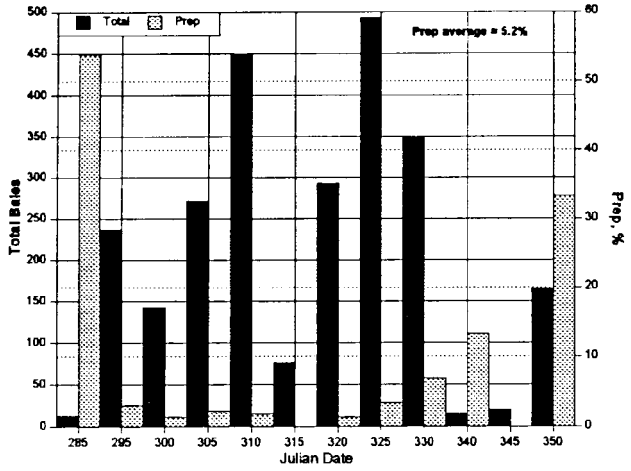

Figure 3. Preparation and total bales as a function of Julian date for gin 3 for 1994.

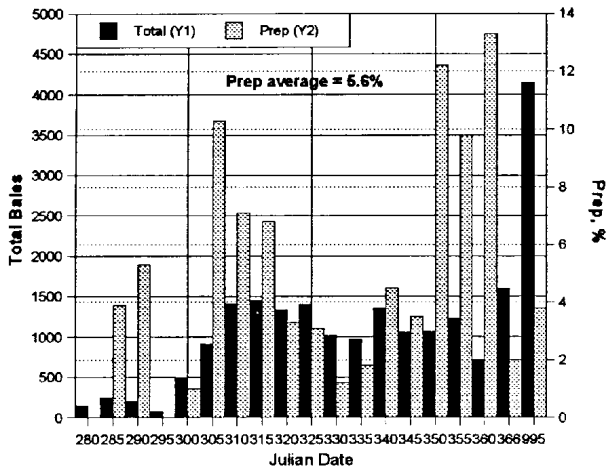

Figure 4. Preparation and total bales as a function of Julian date for gin 4 for 1994.

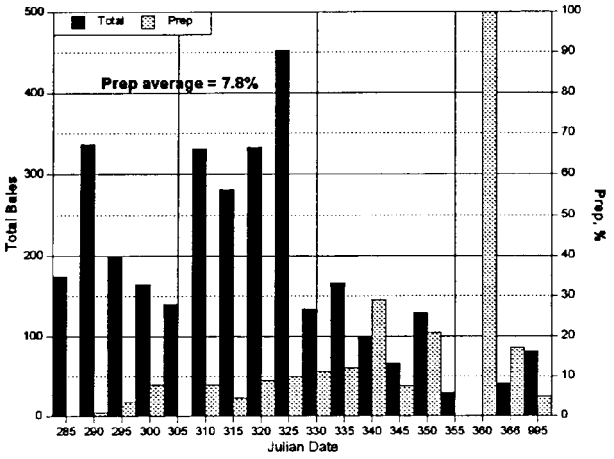

Figure 5. Preparation and total bales as a function of Julian date for gin 5 for 1994.

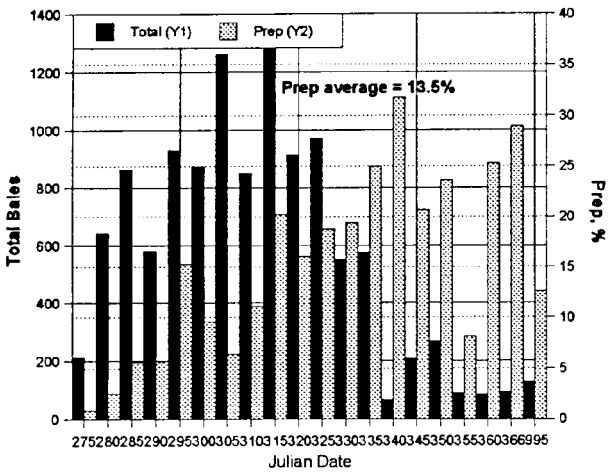

Figure 6. Preparation and total bales as a function of Julian date for gin 6 for 1994.

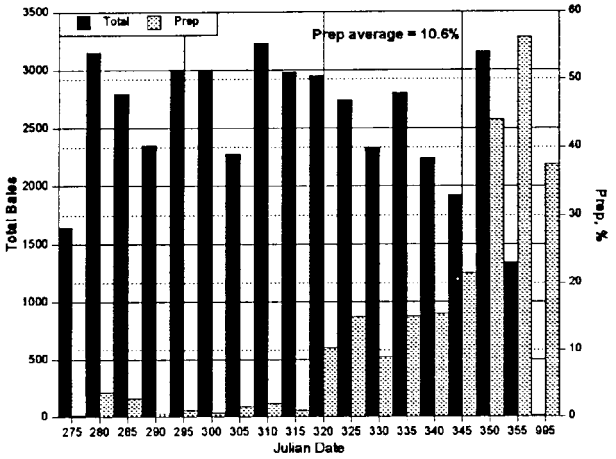

Figure 8. Preparation and total bales as a function of Julian date for gin 8 for 1994.

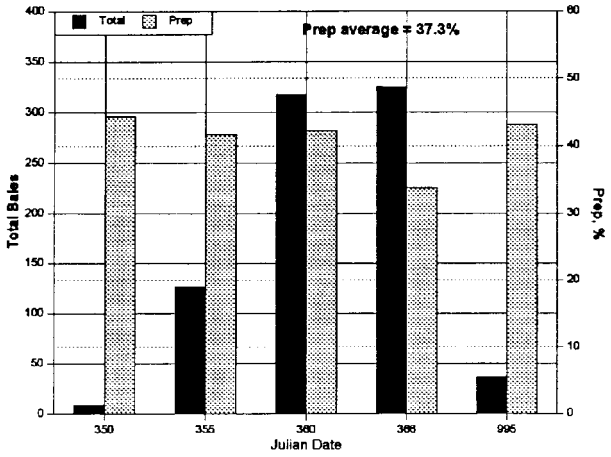

Figure 7. Preparation and total bales as a function of Julian date for gin 7 for 1994.

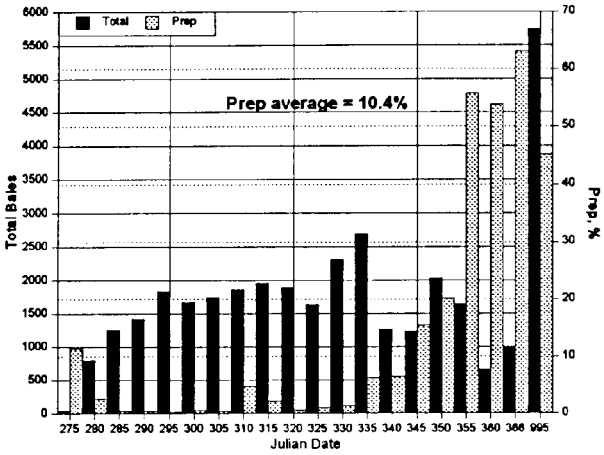

Figure 9. Preparation and total bales as a function of Julian date for gin 9 for 1994.

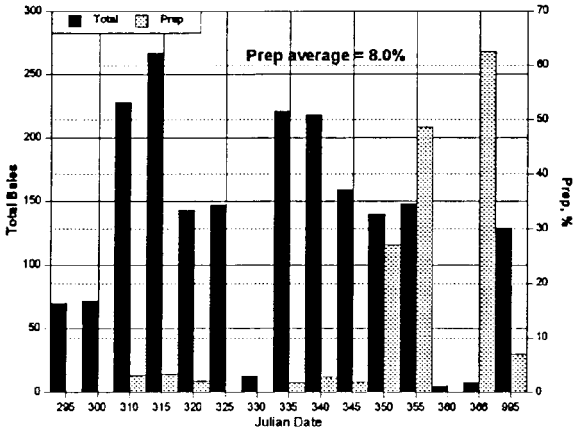

Figure 11. Preparation and total bales as a function of Julian date for gin 11 for 1994.

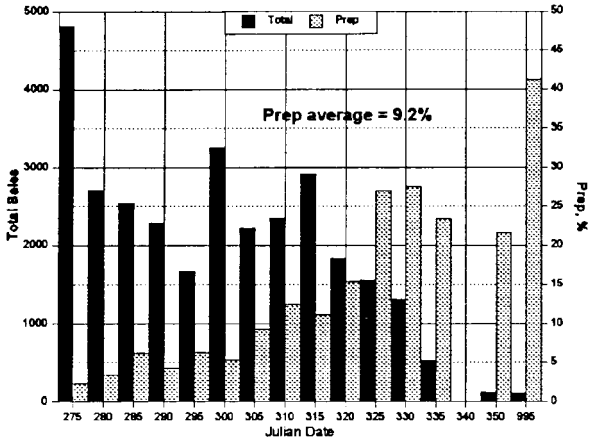

Figure 12. Preparation and total bales as a function of Julian date for gin12 for 1994.