PROCESSING QUALITY OF SAN JOAQUIN VALLEY COTTONS

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Abstract

In a two crop-year project, eleven major varieties of California cotton (approved and grown in the San Joaquin Valley over a 50-year period) were planted, harvested, ginned, and processed to study variety-related trends in fiber quality factors and textile quality factors. Results from both crop years indicate yarn quality has improved significantly because of improvements in fiber quality; however, shifting textile quality concerns indicate that further emphasis should be placed on improving cotton quality characteristics that contribute to defects (such as white specks) in textile products.

Introduction

Experiments were conducted to examine trends in the San Joaquin Valley cotton crops from two points of view: (1) the fiber quality point of view and (2) the textile quality point of view. Much previous work in variety development from the quality point of view has focused on traditional fiber qualities (such as length, strength and fineness) and their relationship to traditional textile properties (such as yarn strength and processing efficiency). Textile users of cotton are still interested in these traditional quality factors since they are very important in processing and in quality control. It is now routine that these traditional fiber properties are monitored for stability and consistency in cotton mixes and laydowns in textile mills. Breeders in the U.S., and particularly those in the San Joaquin Valley, have been quite successful in developing varieties with properties that meet minimum, specified standards for length, strength and fineness and that also produce gains in yield, wilt tolerance and other desirable characteristics. However, the demands for improved textile quality in recent years are focused on additional fiber quality parameters. The gains in the traditional fiber properties have become the norm, and other factors that contribute to defects in textile products (such as white specks in dyed fabric) are gaining attention. These include neps, seedcoat fragments, and other factors yet to be determined that cause fabric defects. This report summarizes the results of the two crop-year experiment. Detailed results from the first year were reported previously (Bragg et. al., 1995).

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Materials and Methods

Sizeable quantities of the leading varieties grown in the San Joaquin Valley for the past 50 years were produced from seed stock preserves. Table 1 lists the eleven different varieties that were planted. Variety 1, P18C, was grown in the 1940s, followed by a series of 4-42 varieties (labeled by date of introduction as 4-42-58, 4-42-64 and 4-42-66). The next varieties introduced were SJ-1, SJ-2, and then SJ-5 (which was very similar to SJ-2 but had much better wilt tolerance). These were followed by GC-510, which was planted along with SJ-2 over a several year period. Three other varieties approved for planting were Prema, Royale, and Maxxa.

The history of the quality development program in the San Joaquin Valley, including yield increases, has been well documented (Bassett and Kerby, 1995; and Cooper, 1992). Maxxa is the predominant variety currently planted. All 11 varieties in this experiment were planted at two different locations (Wasco and Corcoran) to obtain approximately 2,000 pounds of seed cotton during the 1993 crop year and the 1994 crop year. Although the soil types and growing conditions at the two locations were slightly different, they were still very typical of the San Joaquin Valley. Row spacings and other cultural practices were typical of those used today. These practices were somewhat different from those used when some of the earlier varieties were in commercial production and possibly could have affected the fiber properties.

Cotton was harvested using typical methods and procedures, loosely baled at proper moisture conditions, and shipped to the U.S. Southwestern Cotton Ginning Research Laboratory at Mesilla Park, NM. Two ginning rates (approximately 50 pounds/hour/saw and 25 pounds/hour/saw) and two lint cleaner conditions (1 lint cleaner and 3 lint cleaners) were used to give a total of four ginning conditions. Seed cotton cleaning was constant for all conditions. Ginned lint was shipped to the Cotton Quality Research Station at Clemson, SC, for fiber quality and processing evaluations.

The cottons were processed into carded, ring-spun yarns using standard processing conditions and modern Truetzschler cleaning and carding equipment (Table 2).

Forty-four measurements were made of fiber quality, yarn quality, and processing efficiency; however, some of the measurements were redundant in that the same quality was measured by more than one method (examples are fiber length, non-lint content, and yarn strength).

Data were analyzed using PC-SAS. Since the experimental design was an incomplete factorial, the General Linear Model analysis was used and Least Square Means were computed. Results were tested for significant differences in main effects and interactions at the 95 and 99 percent confidence levels. Components of variance were computed to determine relative contributions to the total variations observed.

Results and Discussion

The number of quality measurements that were significant at either the 95 or 99 percent level for each term in the statistical model is shown in Table 3. The effect of varieties was the most significant in the model. There was a significant difference due to varieties in 44 out of 44 qualities measured. The relative variance component calculations indicate the major contributor to overall variation was variety. This is true not only for the fiber quality measurements but also for the textile quality measurements.

Figures 1 through 24 show the relative percentage variation in experimental results due to each factor in the statistical model and the averages for each variety for selected quality measurements. Also shown for each quality factor is the error CV of the experiment. This is simply the grand mean divided by the square root of the error variance and is an indicator of the precision of the experiment. Low CV's are preferable.

Figures 1 and 2 show that two variables contributed significantly to the variation in Upper Half Mean Length for both years. One was varieties, and the other was number of lint cleaners. There also was a significant variety*location interaction for the second year. These graphs simply repeat what much previous work has already shown as far as length is concerned. Average Upper Half Mean Length is shown in Figures 3 and 4. As the graphs indicate, there is a definite trend towards increasing Upper Half Mean Length in these 11 varieties.

Figures 5 and 6 show components of variance analysis for HVI strength. The chief contributor to variation in strength was varieties. Figures 7 and 8 show the average HVI strength for the 11 varieties and reflect the success of breeding programs in increasing fiber strength.

The last graphs (Figures 9, 10, 11 and 12) on fiber property measurements are for Shirley Analyzer non-lint content. Two factors were significant for this quality measurement. Variety, of course, was significant; and, not surprisingly, number of lint cleaners was the most significant factor. As would be expected, the three lint-cleaner condition removed much more of the non-lint material than the one lint-cleaner condition. There appears to be a trend towards increasing non-lint for the 11 varieties in both crop years.

The next few graphs concentrate on selected textile properties of yarns made from these cottons. Figures 13 and 14 show that for yarn strength--as measured by yarn break factor--varieties is the most significant variable.

The trend in break factor for yarns made from the 11 varieties can be seen in Figures 15 and 16. The consistent increase in yarn strength over the years is evident here; and, it also shows that Variety 9 (Prema) is outstanding.

The next few graphs show results of measurements of yarn evenness made on the Uster Evenness Tester. Yarn evenness is a somewhat combined measurement of several factors. Although other measurement factors are involved, yarns with the most thick and thin places will generally have the highest evenness readings. As shown in Figures 17 and 18, varieties is an important factor affecting yarn evenness, with ginning and lint cleaning a close second and third in terms of overall importance. Again, the interaction of varieties*location is also an important source of variation in the second year crop.

Figures 19 and 20 are plots of the average evenness for each variety; and, again, a trend towards improved quality is apparent, with the downward trend in evenness variation. Not only can the trend towards improved quality be seen in this figure, but the variety outstanding among all the rest (Prema) can be easily identified.

The next group of slides relate to white specks in knitted and dyed fabric. The presence of excessive white specks has been a major complaint of cotton textile users in recent years. White specks are a major source of off-quality apparel that would otherwise be acceptable quality. These undyed specks, many of which are caused by neps, are especially persistent in cotton fabrics dyed in rich, darker colors that are popular in many types of garments.

Figures 21 and 22 show the results of components of variance analyses for white specks in dyed fabrics. Even with a relatively large experimental error, varieties is a major source of variation in white specks in addition to the Variety*Location interaction. Figures 23 and 24 illustrate the variable nature of the measurement, with little apparent consistent trend for the varieties studied.

In summary, these results show the trend toward improved fiber quality--as would be expected in a variety improvement program. These trends are even more evident in the textile quality measurements. Yarn strength has increased significantly. The quality factor measurements affecting yarn appearance (thick and thin places, neps, and evenness) have also improved.

However, even though there are variety effects on fabric defects (such as white specks), no consistent trend can be identified from these experimental results.

Conclusions

The quality of yarns produced from San Joaquin Valley cottons has significantly increased over the past 50 years because of increases in fiber quality.

Until the market place provides greater incentives, the varieties that produce the best quality yarn do not always dominate, as illustrated by the Prema variety.

Improved quality does not necessarily mean losses in yield.

To maintain perception of quality, increased emphasis probably should be placed on properties that affect defects and appearance of textile products.

Disclaimer

Trade names are used solely to provide specific information. Mention of a trade name does not constitute a warranty or an endorsement of the product by the U. S. Department of Agriculture to the exclusion of other products not mentioned.

References

Bragg, C.K., C. L. Simpson, S. E. Hughs, H. B. Cooper and D. Bassett. 1995. Quality Trends in San Joaquin Valley Cotton. Proc. of Beltwide Cotton Conf., National Cotton Council, Memphis, TN, pp. 545-551.

Bassett, D., and T. Kerby. 1995. "History of California Cotton." Cotton Production Manual. Univ. of CA, DANR Press, Oakland, CA. In press.

Cooper, H. B. 1992. Cotton for High Fiber Strength. Proc. of Cotton Fiber Cellulose Conf., National Cotton Council, Memphis, TN, pp. 303-313.

Table 1. Varieties grown in San Joaquin Valley for experiment.

NUMBER	VARIETY
1	P18C
2	4-42-58
3	4-42-64
4	4-42-66
5	SJ-1
6	SJ-2
7	SJ-5
8	GC-510
9	PREMA
10	ROYALE
11	MAXXA

Table 2. Standard processing conditions used in experiment.

PROCESS	SPEED/SIZE
CARDING:	70 LB/HR
DRAWING:	BREAKER - 53 GR FINISHER - 55 GR
ROVING:	1.0 H. R.
SPINNING:	30/1 RING YARN 3.50 T. M.

Table 3. Number of Quality measurements significant in the statistical model.

TERM	STATISTICAL MODEL	NO. OF SIGNIFICANT* QUALITY FACTORS
1	VAR	44
2	LOC	33
3	GIN	35
4	LC	38
5	VAR*LOC	34
6	VAR*GIN	12
7	VAR*LC	14
8	LOC*GIN	7
9	LOC*LC	9
10	GIN*LC	3
11	VAR*LOC*GIN	6
12	VAR*LOC*LC	8
13	VAR*GIN*LC	9
14	LOC*GIN*LC	1
15	VAR*LOC*GIN*LC	7
16	EXPERIMENTAL ERROR	-

* At either the 95% or 99% confidence level.

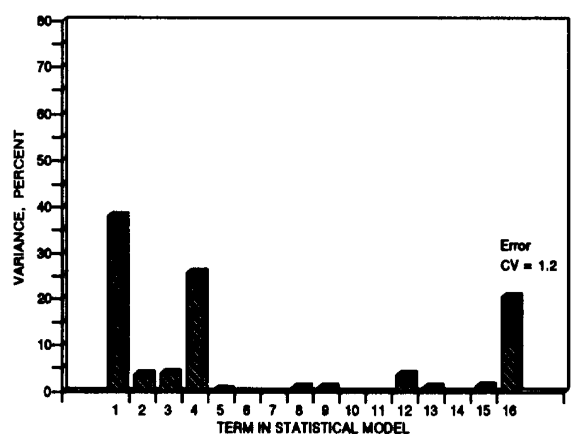

Figure 1. Relative components of variance for HVI upper half mean length measurements - first year.

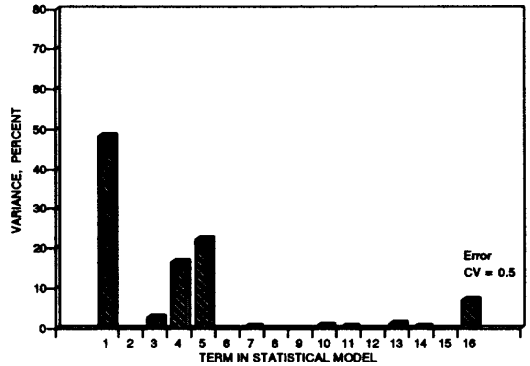

Figure 2. Relative components of variance for HVI upper half mean length measurements - second year.

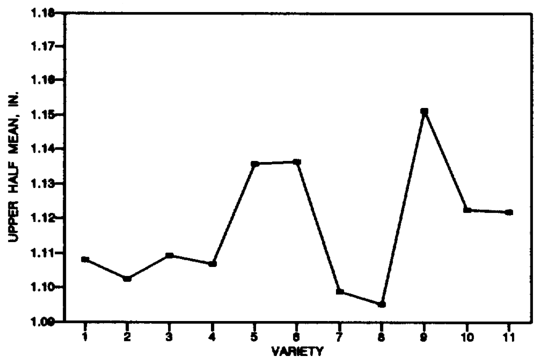

Figure 3 Average HVI upper half mean length for each variety - first year.

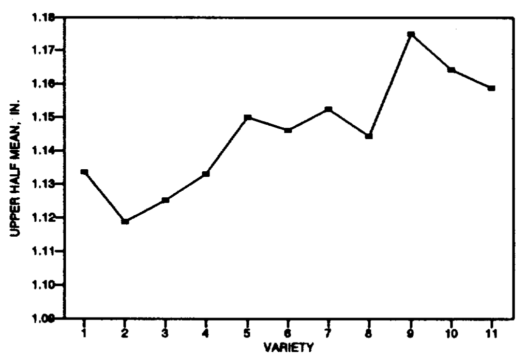

Figure 4. Average HVI upper half mean length for each variety - second year.

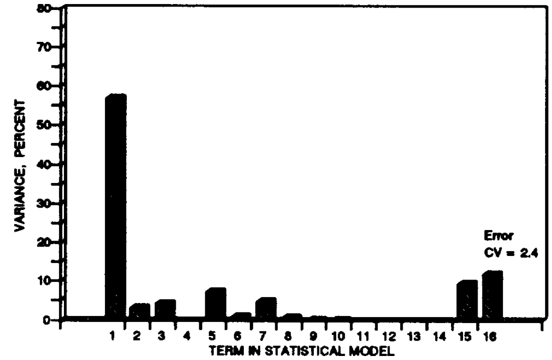

Figure 5 Relative components of variance for HVI strength measurements - first year.

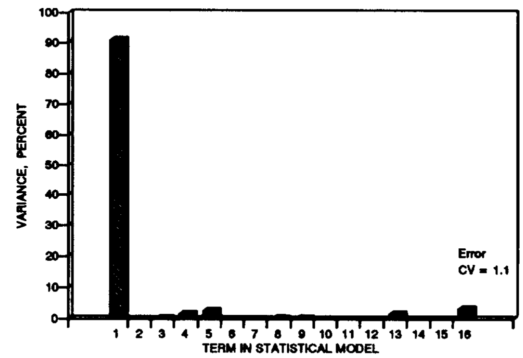

Figure 6. Relative components of variance for HVI strength measurements - second year.

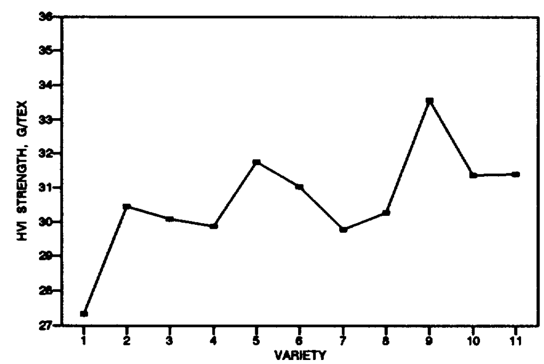

Figure 7. Average HVI stregth for each variety - first year.

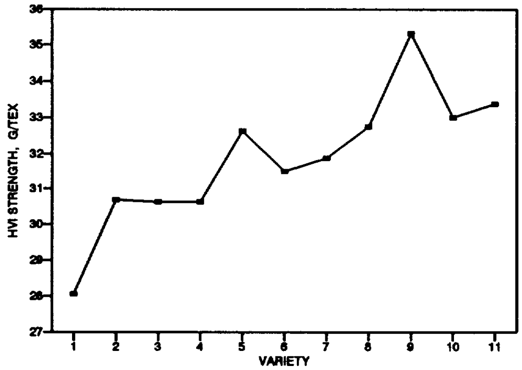

Figure 8. Average HVI strength for each variety - second year.

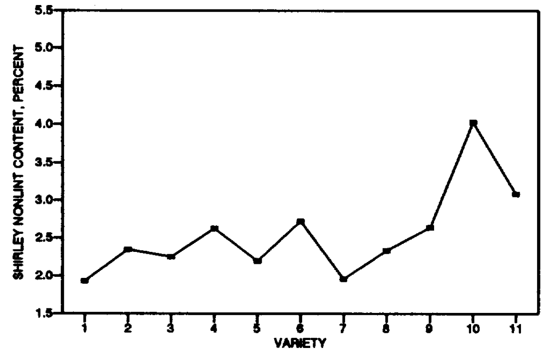

Figure 11. Average Shirley Analyzer non-lint content for each variety - first year.

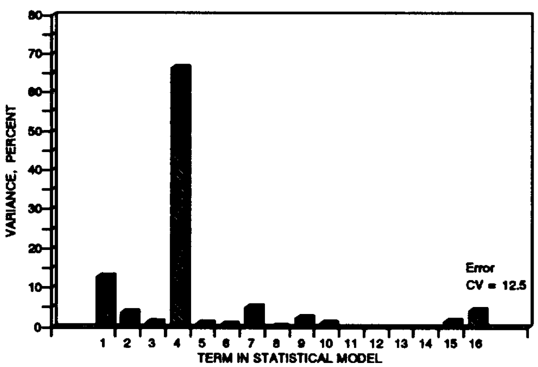

Figure 9. Relative components of variance for Shirley Analyzer non-lint content - first year.

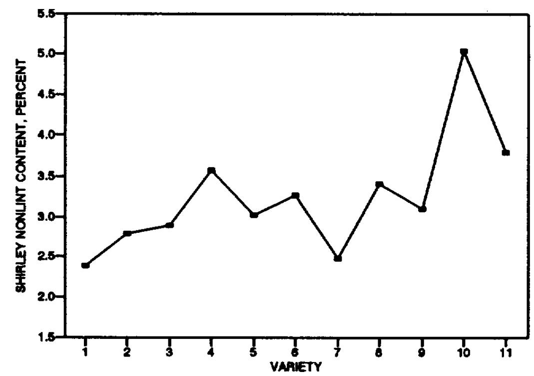

Figure 12. Average Shirley Analyzer non-lint content for each variety - second year.

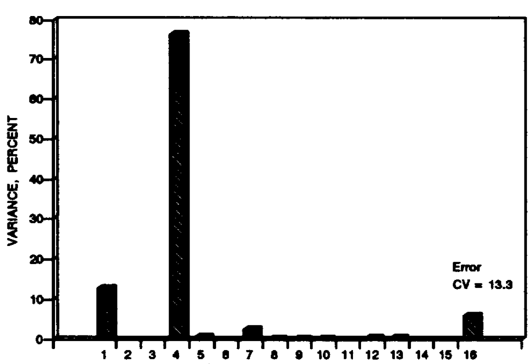

Figure 10. Relative components of variance for Shirley Analyzer non-lint content - second year.

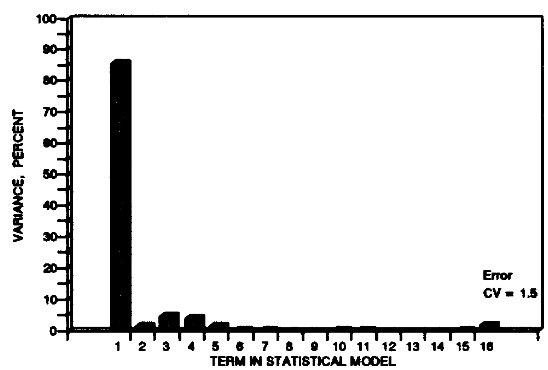

Figure 13. Relative components of variance for yarn adjusted break factor - first year.

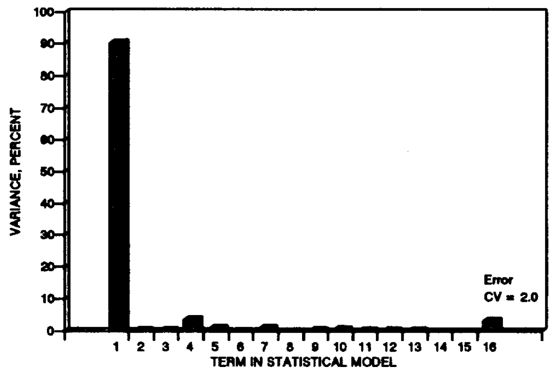

Figure 14 Relative components of variance for yarn adjusted break factor - second year.

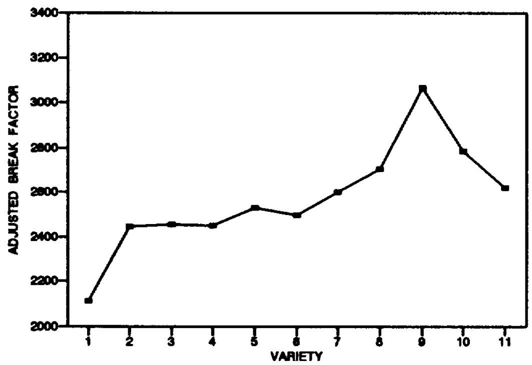

Figure 15. Average adjusted yarn break factor for each variety - first year.

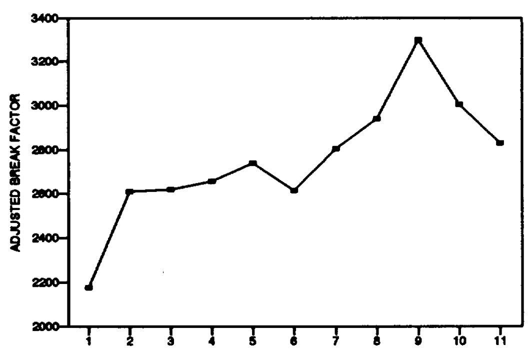

Figure 16. Average adjusted yarn break factor for each variety - second year.

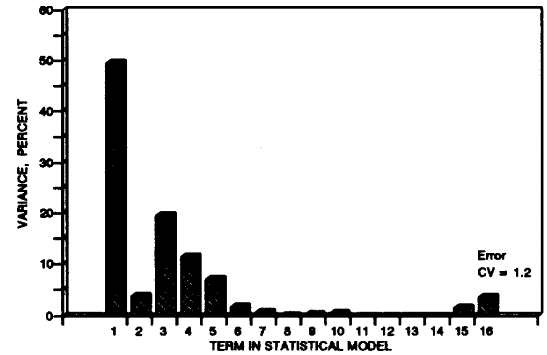

Figure 17 Relative components of variance for yarn evenness, measured by Uster Evenness Tester - first year.

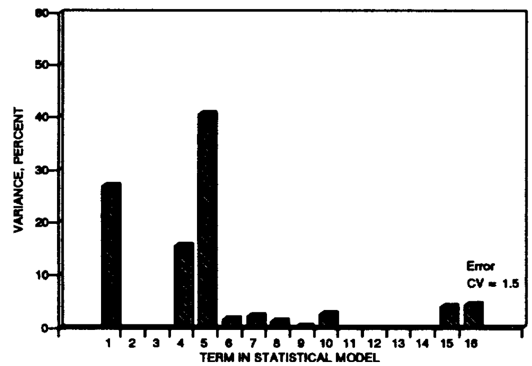

Figure 18.Relative components of variance for yarn evenness measured by the Uster Evenness Tester - second year.

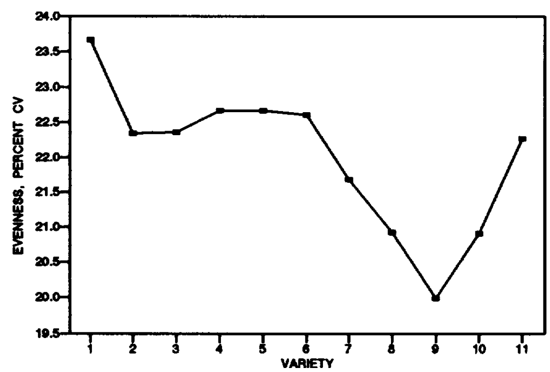

Figure 19. Average yarn evenness measured by Uster Evenness Tester - first year

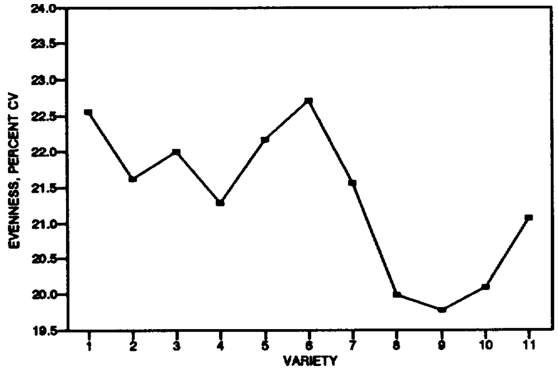

Figure 20. Average yarn evenness measured by Uster Evenness Tester - second year.

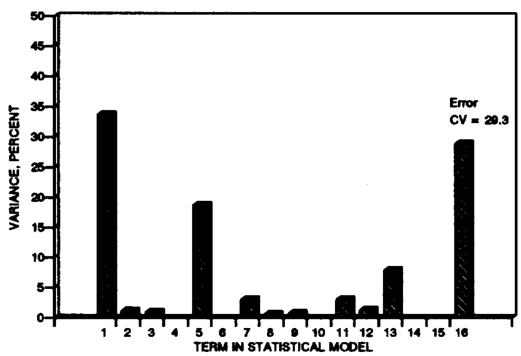

Figure 21. Relative components of variance for number of white specks in dyed fabric - first year.

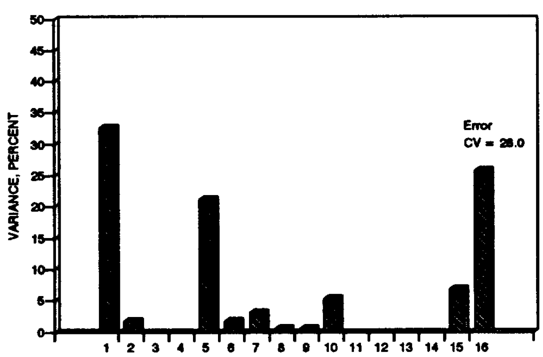

Figure 22. Relative components of variance for number of white specks in dyed fabric - second year.

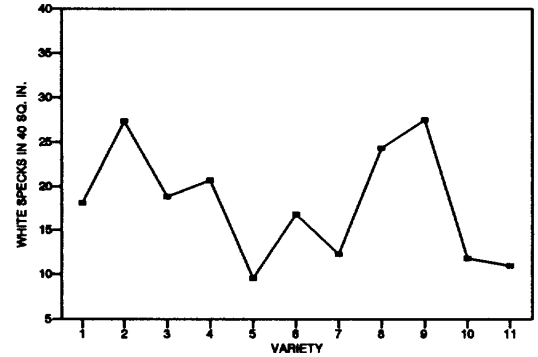

Figure 23. Average number of white specks in 40 square inches of dyed fabric for each variety - first year.

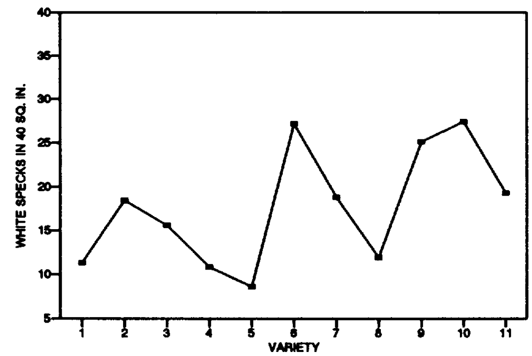

Figure 24. Average number of white specks in 40 square inches of dyed fabric for each variety - second year.