Investigation of Within-Bale Variability of Stickiness Measurement

J.L. Chanselme[1], A.S. Fadlalla[2], E. Goze[1], O.F. Tamime[1] and A.H. Abdelatif[2]
[1]Centre International en Recherche Agronomique pour le Developpement (CIRAD), Cotton Program, B.P. 5035, 34032 Montpellier, France
[2]Agricultural Research Corporation (ARC), Cotton Research Program, Wad Medani, Sudan

ABSTRACT

Cotton stickiness is a serious problem for many producing countries. In Sudan, 1000 bales of the 1996 production WERE selected and sampled to study the feasibility of a bale stickiness classification. Sixteen thousand samples tested on the Sticky Cotton Thermodetector show that within-bale variance increases with the mean. Statistical investigations show that the distribution of sticky points for certain bales is over-dispersed with respect to the Poisson distribution. Fitting of Negative binomial distribution was studied, but the dispersion parameter seems to be dependent on the mean. This law will therefore be difficult to apply.

Introduction

Cotton stickiness is a serious problem for both producers and spinners (Hector and Hodckinson, 1989). For the producer, management of stickiness can start by separating the non-sticky from the sticky cottons. The thermodetection technique makes bale classification possible according to the number of sticky points counted in samples. Sudan Cotton Company (SCC), ARC and CIRAD are collaborating in the ICAC sponsored project: *Improve the Marketability of the Cotton Produced in the Zones Affected by Stickiness*. The first objective is to evaluate the feasibility of bale classification in Sudan, using thermodetector SCT . The preliminary results of the research are presented in this paper.

Materials and Methods

Five hundred roller ginned and 500 saw ginned bales were selected from the 1996 production of 100 cultivation blocks of the Sudan Gezira board. Each block was ginned separately. Ten bales per block were selected. Sixteen 80g samples per bale were drawn at the lint-slide along the pressing time. A 2.5g specimen of each sample was taken for a SCT test (Frydrych and Hequet, 1996) in the ARC laboratory, the 16 specimens of each bale being tested by the same operator.

In contrast with measurements made on a continuous scale, sticky point counts cannot be assigned a Gaussian distribution. Repeatability does not merely relate to a variance, and the within-bale probability distribution has to be assessed from repeatability studies. We tried to infer this distribution from the mean-variance relationship; its parameters were estimated using maximum likelihood. Likelihood ratio tests were used to check parameter homogeneity.

Results

The scatter plot of log-transformed variance against log-transformed mean shows that variance increases with mean (Figure 1). If sticky points were randomly distributed within a bale, the number of sticky points for any given bale would follow a Poisson distribution (Cressie, 1991): This hypothesis was rejected at the 0.0001 level by Chi² overdispersion test (Fisher, 1938). Among the contagious distribution, the binomial negative is frequently encountered in natural processes (Johnson *et al.*, 1992). The negative binomial distribution with parameters *k*, *m*, is the distribution of the random variable *X* for which

$$P(X = x) = \frac{\Gamma(k+x)m^x k^k}{\Gamma(x+1)\Gamma(k)(m+k)^{(k+x)}}$$

where *k* is the dispersion parameter and *m* the mean. The variance is $\sigma^2 = m + m^2/k$

The homogeneity of *k* in saw ginned bales of the Acala variety was checked by subsetting data according to the bale mean and estimating *k* for each of the four subsets. Homogeneity was rejected at $P < 0.0001$. Therefore, if distribution is negative binomial, *k* is not homogeneous. Its heterogeneity does not result from varieties or ginning type effects. Examination of Figure 1 shows that two clouds can be distinguished. The lower cloud variance is not significantly different from that of a Poisson distribution. The upper cloud covers the most variable measurements.

Conclusion

Further investigation of data is required to establish a classification methodology for stickiness. The high variability observed on the upper cloud bales may be the result of a high variability of insect infestation and

stickiness within a block. The ginning processes would not be able to neutralize such variability. Further studies are needed to check this hypothesis.

References

Cressie, N. (1991): Statistics for Spatial Data. Wiley and Sons, New York. 900 Pp.

Fisher, R.A. (1938): Statistical Methods for Research Workers. 7th Edition, Oliver and Boyd, Edinburgh. 356 Pp.

Frydrych R. and E. Hequet. (1996): Standardisation proposals: the thermodetector and its methodology. Proc. Intl. Committee on Cotton Testing Methods. ITMF, Bremen, Germany.

Hector D. and I.D. Hodckinson. (1989): Stickiness in cotton. ICAC Review Articles: Cotton Production Research No. 2, ICAC Washington DC. 43 Pp.

Johnson L., S. Kotz and A.W. Kemp. (1992): Univariate Discrete Distributions. 2nd Edition, John Wiley. New York. Pp. 199-209.

Figure 1. Mean-Variance relationships.