THE BREAKUP OF WHEAT STRAW BY COMBINE CYLINDERS

by

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It has been observed that the straw of some varieties of wheat was broken into short lengths, whereas that of another variety was relatively undamaged by the threshing action of the combine cylinder. The breakup of straw, and the gradation from short to long lengths, can affect the performance of the separating components of a combine. Adjustments of wind velocity and direction, and sieve openings are of importance if efficient separation of grain from short straws and chaff is to be effected. Also, long straws must be spread in such a way that subsequent field operations may proceed freely. Tests were made at the Research Station, Swift Current, Saskatchewan to determine the effect of threshing two varieties of wheat at different feed rates using two types of combine cylinders on the degree of straw breakup.

Thatcher wheat, a hollow-stemmed variety, and Chinook, a solid-stemmed variety, were harvested from the windrow using a self-propelled combine equipped, alternately, with a rasp bar type cylinder and a spike tooth cylinder. The feed rate of grain and straw per minute was varied by operating the combine at five different forward speeds and was estimated by weighing the amount of grain threshed in a recorded period of time. Three samples of straw were collected at random from the rear of the combine during each test. Counts of the numbers of straws in one inch increments from one to 17 inches in length in each sample were made, and the numbers were expressed as a percentage of the total sample count. The percentages were low in magnitude and highly variable, therefore an angular transformation was applied to them for the purpose of analysis. The data for 1964 were selected for discussion in this paper.

An analysis of variance to deter-

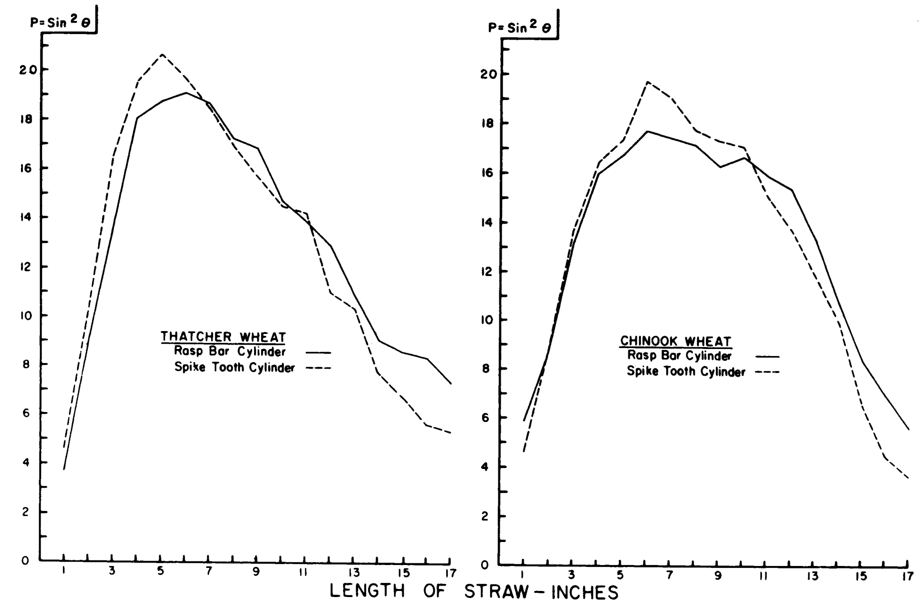

Figure 1. The distribution of straw lengths of two varieties of wheat when threshed with rasp bar and spike tooth cylinders.

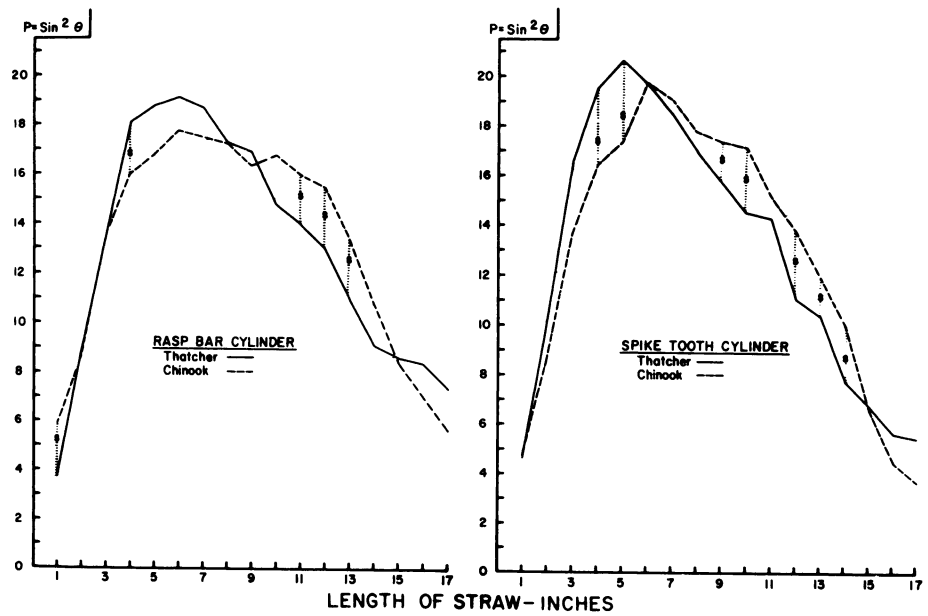

Figure 2. The patterns of straw length distribution of the two varieties of wheat when threshed by the two types of cylinders; the lengths where significant differences occurred are shown by vertical bars (P=0.05).

mine if the percentage breakup of straw into each fraction increased or decreased with an increase of feed rate, indicated that feed rate did not have a significant effect on straw breakup. The data for each length of straw from the different feed rates were then grouped for each combination of grain variety and cylinder type. An analysis of variance of these consolidated data showed that significant differences in the amounts of short and long straw did exist between some lengths when certain combinations of grain and cylinder were examined.

The distribution patterns of straw breakup by each cylinder, when threshing either variety of wheat, were similar (Fig. 1). Differences in the amounts of certain straw lengths were small, although it would appear that the spike tooth cylinder produced more short lengths and fewer long lengths than did the rasp bar cylinder. There were differences, however, between varieties when threshed by either cylinder (Fig. 2). Thatcher wheat straw broke up into more short lengths and less long lengths than did Chinook. These results show that differences in the breakup of straw were attributable to the variety of wheat being threshed rather than to the type of cylinder used.

The amount of straw in the one-to-six-inch lengths represented about 40 to 45 percent of the total of the samples from the tests. This quantity was considered to be part of the shoe loading and would be added to the material less than one inch long and the chaff from which the loose grain must be separated. Wind settings and sieve adjustments must be regulated to provide efficient separation of the variety being threshed. The remaining percentage of the sample represented that portion which passes over on the straw walkers. It is necessary that this straw is adequately spread or chopped so that tillage and seeding operations in the next crop season may proceed without complications caused by an undue amount of unmanageable straw residue.

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own wives. In many instances we have solved this problem quite well. The average refrigerator operates for years with practically no servicing. The designer of equipment for use by untrained personnel already has some backlog of knowledge. However, there remain innumerable points on most modern equipment where the maintenance is difficult even for the skilled man.

It is not the responsibility of the user to insure that a machine does not break down. It is the responsibility of the designer. If it is possible for a machine to become damaged through ineffective maintenance then there is something wrong with the design of the machine. It is true that in many cases we do not know enough to be able to avoid this design failure, but it is a design failure nevertheless. In the past the designer placed the onus on the user. When the user was a sophisticated engineer perhaps he had some justification for this. But when he treats all users as sophisticated engineers, he has no excuse at all.

IN SUMMARY

Every design engineer must ask himself the question: *"How will the products of my skill affect the human beings who interact with them?"* There is a comparatively large body of knowledge developed from research, particularly in the area of military systems, which is applicable to civilian product design and which is not yet being applied. *The overwhelming challenge to the agricultural engineer is to assist in solving the problem of potential famine* and while I can only applaud his success in designing and building the very effective machines for the North American farmer, even if the North American farmer is sometimes bruised and strained by them, *the most important challenge of all is in designing for that vast group of farmers who have different educational backgrounds, different social backgrounds, and infinitely smaller resources than those of us who have been blessed by our western heritage of land and wealth.*

Will our descendants say of us: "There were great engineers in those days. They landed delicate equipment softly on the moon. They sent their space-probes close to Mars. They built 300,000-ton ships crewed by twenty men. But they did not build a small tractor which could be operated for two years by an unskilled farmer without maintenance. So, in the end, all their other accomplishments signified nothing."

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