COMBINING LOSS IN THE FIELD WHEN HARVESTING TWO VARIETIES OF SPRING WHEAT

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INTRODUCTION

The loss of grain in the field when harvesting spring wheat has been reported (3), and two classifications, natural and mechanical, have been made. The report considered threshing and separating loss to be negligible, in comparison to the natural loss, which occurs prior to the harvesting operation, and to the reel and cutter bar and gathering losses when the combine was operated at a moderate feed rate. The effect of early windrowing on some quality factors of spring wheat has been discussed (2), and the added benefits of this operation to minimize the natural and reel and cutter bar losses has been emphasized (3). Horsepower requirements, when combining at different feed rates, have been recorded, and limitations as to the amount of grain and straw per minute that should be fed into the combine were suggested (4). That report did not give consideration to the threshing and separating losses.

It was first concluded that a large harvesting loss was caused by the limited ability of the combine cylinder to process grain and straw (6). However, more recent work (7) indicated that the separating ability of the straw walkers was the important factor contributing to combine capacity, and that operating at extreme feed rates could cause a large grain loss at the rear of the combine.

The purpose of this research report is to discuss the relationship between feed rate and processing loss when harvesting two varieties of hard red spring wheat.

PROCEDURE

A Gleaner-Baldwin Model A, self-propelled combine was used to thresh windrowed wheat in 1969 and 1970. Two cultivars of hard red spring wheat, *Triticum aestivum* L., the hollow-stemmed cultivar Canthatch, and the solid-stemmed cultivar Chinook were harvested as test crops. The crops had been seeded at the same date on adjacent summerfallowed fields which had received the same management treatments. Windrowing was done on the same day when the kernel moisture approximated 35%, wet weight basis, by an experienced operator using a 12-foot (3.65 m) self-propelled windrower. The straw length of the cut material was about 25 inches (63.5 cm). The combining tests were completed in one day under warm, dry conditions in both years. The grain was mature and the kernel moisture content (observed but not recorded) was less than 14%. Cylinder speed, concave, wind and sieve settings were the same for both crops each year.

The total feed rate, or total weight of grain plus material other than grain (G + MOG), expressed in pounds per minute (1), was determined in triplicate at six different forward speeds of travel. The variation in forward speed was accomplished by using two gear ratios in the main transmission and three positions of the variable speed drive of the combine. The respective test runs were timed over a measured distance of machine travel, and the threshed grain delivered to the grain tank during each run was weighed. The ratio of material other than grain to grain (MOG/G) was determined from a random sample taken from the length of windrows used for the test runs. This sample was weighed in total, threshed and separated in a laboratory cyclone thresher, and the threshed grain weighed. The ratio, related to the weight of grain in the tank plus the weight of grain gathered from the rear of the combine, to give the total grain feed rate, was used to calculate the total feed rate (G + MOG).

The threshing and separating losses were considered to be a single loss, called the processing loss, for the purpose of this test. It was obtained by gleaning the loose grain, broken kernels and unthreshed heads from an accumulation of chaff and straw collected on a canvas held under the chaffer and straw walkers at the rear of the combine over a timed distance of 50 feet (15.24 m) of machine travel. The gleanings were rethreshed in a cyclone thresher, and the threshed grain was weighed.

The processing loss, calculated in pounds per minute was expressed in two ways in the subsequent analysis. The first method was to state it as a percentage of the total grain feed rate per minute, and the second method was as bushels per acre from the known test area of 600 ft^2 (55.7 m^2). The results of the tests conducted in 1969 and 1970 were analysed together by fitting a second degree polynomial, calculated by the method of least squares, to the data, relating loss to total feed rate in pounds per minute.

RESULTS AND DISCUSSION

The processing loss, which is attributed to the threshing and separating ability of the combine, increased with increasing total feed rate when harvesting both cultivars of wheat. This was evident when the loss was expressed in both forms (Figures 1 and 2).

The loss was larger when combining Canthatch wheat than for Chinook wheat when harvesting at the same total feed rate. The rate of increase in both crops also increased for equal increments of feed rate. Previous research (5), which compared the breakup of straw of these two cultivars in the combine cylinder, showed that Canthatch straw broke into more short lengths and fewer long lengths than did Chinook straw. This greater straw fragmentation could have contributed to a larger processing loss by the creation of more fine material in the straw walkers and sieves. It is further suggested by these results that with Canthatch wheat factors other than feed rate may have contributed to the loss of grain.

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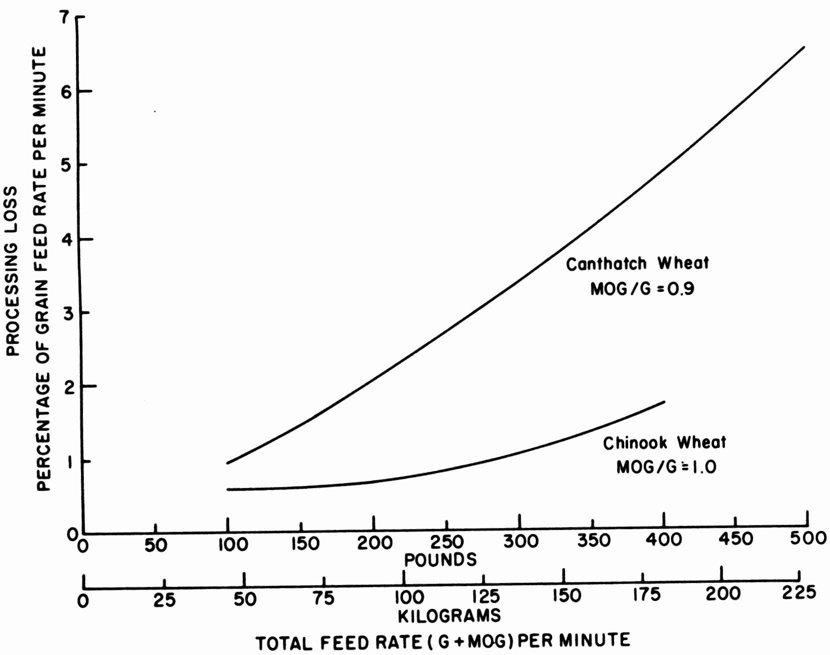

Figure 1. Processing loss expressed as a percentage of grain feed rate related to total feed rate.

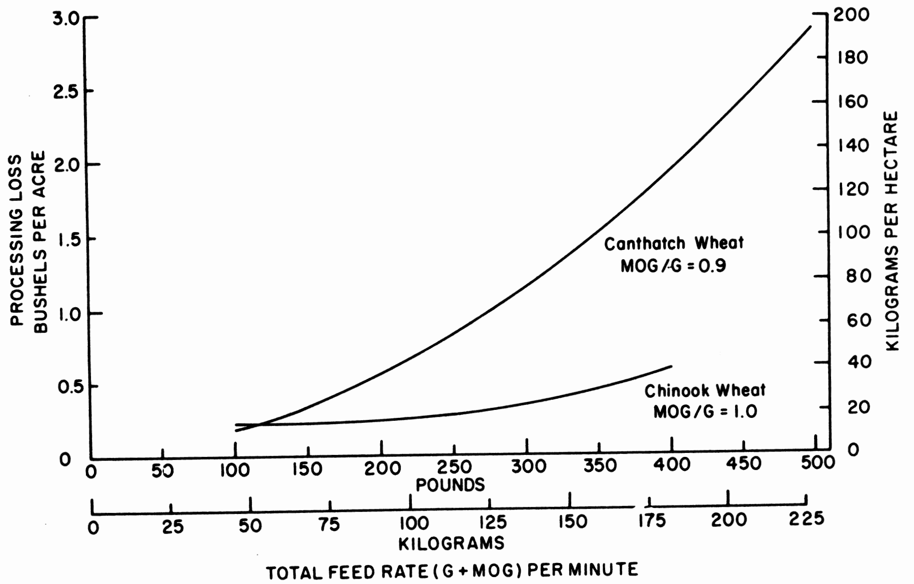

Figure 2. Processing loss expressed as bushels per acre related to total feed rate.

Varietal differences between the two crops may be one of these factors. This has been implied by other authors (8, Reed and Bigsby[a]).

Little information on the relative bulk densities of the two crops in unthreshed form is available, but unrelated and unpublished work at Swift Current indicated that the weight per one thousand kernels of Canthatch is generally less than that of Chinook because of a smaller kernel size of the former cultivar. If feed rate had been expressed volumetrically, then on this basis for an equivalent weight of material, the combine would be processing a larger volume of Canthatch per minute at the noted MOG/G ratios. It is also a generally accepted fact that Canthatch is harder to thresh than Chinook. Since the combine settings were the same for both crops it is possible that a larger cylinder loss in unthreshed or partially threshed heads could have resulted, and account for some of the processing loss.

It has been indicated in the literature (4) that the maximum suggested feed rates for the combine used in these tests, in relation to available horsepower, were 400 lb (181 kg) per minute when harvesting Canthatch wheat, and 300 lb (136 kg) per minute when harvesting Chinook wheat. The processing loss at these feed rates would be 4.9% and 1.0% of the grain feed rate for these respective crops (Figure 1), or 1.9 and 0.35 bu/acre (128 and 24 kg/ha) (Figure 2). The capacity of a combine has been defined as the maximum sustained total feed rate at which the processing loss does not exceed 3% with the machine in operation on level ground (1). This percentage loss would limit the total feed rate to about 275 lb (125 kg) per minute for Canthatch wheat under the conditions of this test. This would be the equivalent to a loss of about 1 bu/acre (67 kg/ha). Available horsepower of the combine engine may still be the limiting factor when harvesting Chinook wheat since the processing loss at the suggested feed rate was considerably less than 3%.

SUMMARY AND CONCLUSIONS

The processing loss when combining Canthatch and Chinook wheat increased as the feed rate increased. It is concluded from the results of these tests that there is an upper limit of feed rate when harvesting Canthatch wheat beyond which the processing loss becomes excessive. The limiting factor for the combining of Chinook wheat is available combine horsepower. The feed rates determined under the conditions of this field test are limited to 275 pounds per minute (125 kilograms per minute) for Canthatch wheat and 300 pounds per minute (136 kilograms per minute) for Chinook wheat.

It is also apparent from the results that varietal differences between the two crops play an important role in combine operation. Such differences as relative threshability and straw breakup become pertinent in respect to cylinder, wind and sieve settings on the combine. There is a lack of information on these factors, and it can be concluded that more research would provide a valuable addition to the present knowledge of the different conditions encountered when harvesting cereal crops.

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