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WHEAT HARVESTING LOSSES IN COMBINING AS AFFECTED BY MACHINE AND CROP PARAMETERS

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Two combine harvesters with three forward speed levels were used to harvest two wheat varieties having three grain moisture levels (26%, 20% and 13%) to monitor the harvesting losses. The analysis showed that Pak 81 is a better choice regarding losses during harvesting compared with Punjab 85. The grain damage was lower for Punjab 85. Separation losses were reduced at lower moisture level but shattering and quality losses increased.

INTRODUCTION

Early wheat harvesting produces immature grains while delayed harvesting causes shattering and quality losses (Chaudhry, 1979). Matter (1967) found that the machine loss was a function of grain moisture, cylinder speed, cylinder concave clearance and feed rate. Clark (1972) demonstrated that at 33% moisture content, wider cylinder speed yielded less grain loss. Chaudhry (1979) found that the grain losses in bullock threshing, mechanical threshing, tractor threshing and combine harvester amounted to be 3.11, 2.68, 2.01 and 1.2%, respectively. Amjad (1983) evaluated the field performance of a Chinese vertical conveyer reaper in terms of field grain loss. Optimum machine performance was obtained with a combination of fast culler bar speed and high fast gear which minimised the harvesting losses and maximised the work rate. Singh *et al.* (1988) tested three tractor front mounted reapers, manufactured locally by FMI, AMRI and Ittefaq, on wheat crop in Pakistan. They found wheat losses with these reapers to be 1.19, 2.63 and 2.76%, respectively. In view of the above identified problems, this study was designed to investigate the effects on grain losses due to wheat varieties, moisture contents of grains and different forward speeds of the machine.

MATERIALS AND METHODS

The different parameters selected were two wheat varieties (Pak 81 and Punjab 85), three grain moisture levels (26, 20 and 13%), two combine harvesters (John Deere and Claas) and three forward speeds of machine. Three sample areas of one sq. meter size each were randomly selected from the experimental field and the average yield of wheat crop was obtained.

The crop was processed to separate grain and straw and yield per unit area was calculated by:

$$Y = (T + L) C$$

where

Y = Yield of crop (t ha-I)
T = kg of grains per m^2
L = kg of shattered grain
C = 10, a constant

Three grain samples were taken from the combine grain tank. In order to study

the effect of different feed rates governed by the machine speeds, two combines were operated at thrc~ forward speeds of 2.89, 3.32 and 8:10 m s-l of John Deere and 3.99, 7.85 and 10.80 m s-l of Claas combine.

The pre-harvestloss was determined by picking the fallen grains and wheat heads inside the combine area. At steady-state speed of machine, it was suddenly stopped and a steel frame was placed in front of the machine. The shallering losses were determined by picking the fallen grains, wheat heads inside the area confined by the steel frame for three speed levels at different grain moisture for two selected wheat varieties.

Regarding separation losses, three Zones of 7 m length and 4,4 m width were marked in the field. At steady-state machine speed and uniform loading, the grain and unthreshed material Were collected behind the harvester.

Cylinder losses included the unthreshed grains in the ack and shoe emuent were measured by ;ollecting the straw coming out of the rack. The grains collected and the unthreshed kernels yielded the cylinder loss. From 100 g grain sample for all the possible combinations, the damaged grains were separated manually and grain damage percentage Was determined.

RESULtS AND DISCUSSION

The data collected were analysed using LOTUS 123, *STATPAK* and *MSTAT* Software Programmes on personal computer. A complete account of the results is presented in Table 1.

Shattering losses: The higher shallering losses for Punjab 85 compared to those for Pak 81 may be varietal differences in shattering characteristics. However, Pak 81 has lower loss than that for Punjab 85 at all the three moisture levels. The shallering losses appeared to increase with delay in harvesting after ripening of the crop (Table 1). As the grain moisture decreased, the losses increased, the reason may be that stalks at lesser grain moisture were more frequently broken causing heads and grains to shatter before being elevated to the threshing drum. This finding also relates to Quick (1972) and Clark and De Pauw (1983). The Claas combine harvester showed higher losses than those with John Deere. The minimum shattering losses were noticed for John Deere ran at the lowest speed but its performance at the highest speed was also better than that of Claas at the lowest speed. Generally, the increase in speed was found to increase the shallering losses, which is in line with Schueller and Bac (1984).

Separation losses: The separation losses were higher for Punjab 85 (28.9 kg ha-I) compared with those for Pak 81 (20.9 kg ha-I). Since Punjab 85 is better yielding variety with more crop density than the other one, the more feed rate resulted overloading of the combine. Consequently, under-threshing took place and hence more separation losses.

The Fig. 1 depicts that for moisture contents 26%, 20%, 13%, Punjab 85 gave separation losses, 41.8, 26.9 and 17.3 kg ha-1 and Pak 81 30.9, 17.6 and 14.0 kg ha"l, respectively. The higher separation losses from both the varieties at 26% moisture than those at 20% and *13'fr)* moisture levels may be due to more impact force for threshing being higher for Punjab 85. This also resulted under-threshing and consequently overloading the combine cylinder affecting the separation and threshing mechanism. This finding also corresponds to Antipin (1976). The behaviour of machine type is reflected in Table 1. It can be explained that Claas has more forward speed than that of John Dccrc at the same gears, hence higher were the separation losses.

Table 1. Wheat harvesting losses due to different factors

Factor	Level	Loss		
		Shattering (kg ha-I)	Separation (kg ha-I)	Quality (%)
Variety	Pak 81	200.9	20.9	4.18
	Punjab 85	289.6	28.9	3.04
Moisture contents	26%	207.3	36.3	2.70
	20%	236.0	22.3	3.56
	13%	279.1	15.9	4.58
Make of machine	John Dcerc	2ll1.8	2.3	3.11
	Claas	279.8	47.4	4.11
Machine Forward Speed (m s-I)	2.89	178.4	16.7	3.94
	3.32	201.8	22.9	2.92
	8.10	236.2	23.8	2.35

There is non-significant difference for levels of the same factor.

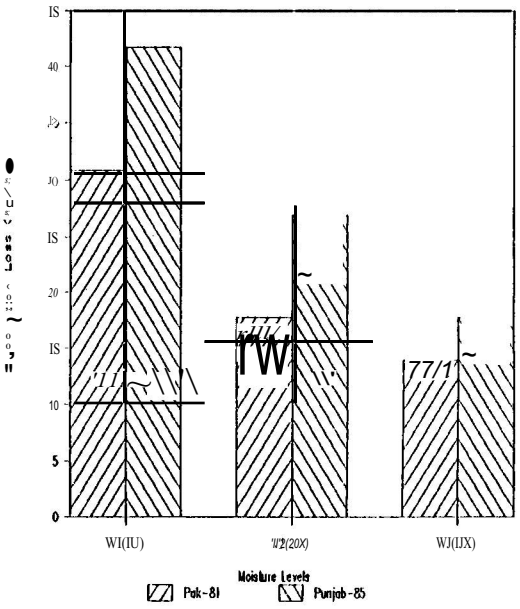

Fig. 1. Effect of moisture content and wheat variety on separation losses

The separation losses increased with increasing speed (Table 1) for the reason that more feed rate into the threshing drum resulted in less impact force on the material and hence increased. unthreshed grains, more separation losses. This finding is also supported by Wrublcski and Smith (1980).

Quality losses: The data revealed higher losses in Pak 81 (4.18%) than those in Punjab 85 *(3JWYrJ).* Since the grain size of Pak 81 is small, the grains can readily damage under the same impact forces in the combine cylinder. The quality losses showed increase with the maturity of the crop. This occurred because dry kernels had higher tendency to break, particularly at the fixed cylinder speed.

Regarding machine make, Claas showed higher quality losses than that of John Dcere. The forward speed of machine had significant effect on decreasing the

quality loss as speed increased. This trend of decreasing quality loss might be due to the higher speed lavoured in increasing the feed rate which created cushioning effect resulting in less impact force on the individual kernels and hence less grain damage.

Based on the findings of the study, it is concluded that the shattering and separation losses appear to be significantly higher for Punjab 85 than those of Pak 81. Separation losses increased with an increase in moisture content whereas both the shattering and quality losses are inversely related to grain moisture. The effect of machine make has significant effect on all kinds of losses.

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