EFFECT OF MACHINE – CROP PARAMETERS ON UNTHRESHED LOSSES OF PADDY IN AXIAL FLOW THRESHER

[1]Bawatharani, [2]D.N.Jayatissa and [3]T.Sritharan

[1,3]*Department of Agricultural Engineering, Faculty of Agriculture, Eastern University*
[2]*Department of Agricultural Engineering,Faculty of Agriculture,University of Peradeniya*

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Introduction

Threshing is one of the important practices which can affect the quantitative and qualitative losses of rice. Irrational harvest and the rudimentary postharvest operations are factors of losses of rice. Post harvest losses of paddy in Sri Lanka have been estimated at 15 % of the total production (Fernando and Palipane, 1983). Of this 24 % of losses occur during the threshing and cleaning stages (IPHT, 2002). Lower performance of traditional threshing methods, labour shortage, reduced turnaround time and use of high yielding varieties have inevitably forced farmers to shift into mechanical grain threshing (Weerasooriya *et. al.*, 2011). In paddy fields of Batticaloa, three main types of paddy threshers are in use, i.e. four wheel tractor driven high capacity paddy thresher, tractor operated axial-flow thresher drum and using combine harvester as a stationary thresher. However the axial flow thresher is still widely adopted in many rice fields, because of its easy application and better output in paddy threshing. In addition to unthreshed grains, inappropriate threshing at high speeds worsens the grain losses from this type of thresher further by producing damaged and broken grains which are not suitable for seed paddy production and with low commercial value. Studies in the recent past show that there are little information on the effects of machine-crop parameters on the unthreshed grain losses of paddy. Therefore, this study was undertaken to study the effect of drum speed, feed rate and grain moisture content on unthreshed grain losses in axial flow threshers.

Methodology

This study was carried out at the Department of Agricultural Engineering, Faculty of Agriculture, Eastern University. The thresher used in this study has an open axial flow spike tooth threshing drum which operates on the principle of axial flow movement of material. The power from the flywheel of a power tiller (model KH-75) was transmitted through a V-belt to the threshing drum to operate the thresher and the speed was set by the tractor engine throttle. The paddy variety BG 379-2, cultivated at the Agronomy farm of Eastern University was used for this study. The crop was manually harvested 35-40 cm above the ground level and collected for the experiment. The paddy moisture content at harvesting and threshing time was measured using a grain moisture meter (digital master moisture meter), whereas the moisture content of straw at each time was determined by oven dry method (ASAE, 1983).

Three levels of grain moisture contents of 26%, 21% and 16% were considered for this study. At each level of paddy moisture content, three levels of drum speeds such as 200, 300 and 400 rpm and three levels of feed rates such as 120, 135 and 144 kg/hr were used to achieve 27 treatment combinations. Each treatment combination was replicated thrice. The panicles were loaded into the tray with selected feed rates (120, 135 and 144 kg/hr) and fed into the threshing unit. The speed of the threshing drum was changed by changing the engine rpm of the power tiller which was measured by means of a digital hand held contact

type tachometer. Three samples of 100 g grains from each treatment combination were randomly collected from the grain outlet of the thresher to calculate the percentage of unthreshed grain losses. The unthreshed grains were separated manually from the sample and the weight of which were recorded. The data obtained was analyzed on the basis of randomized simple factorial experiment with three replications of all treatment combinations using SAS.

Discussion and Conclusion

The results indicated that unthreshed grain losses at 26 and 16% moisture content decreased with increase in drum speed from 200 to 300 rpm at all the feed rates concerned. At 21% moisture content and at 120 kg/hr of feed rate, the unthreshed grain losses slightly increased with an increase in drum speed from 200 to 300 rpm. Higher value of unthreshed grains was obtained at higher moisture contents (Table 1). This could be attributed to that at higher moisture contents the adhesion effect of the grains is more, which caused difficulties in separating the grains from the panicles. At lower moisture contents the grains have lower strength against impact forces, which facilitated the separation of grains from the panicles thereby reducing the unthreshed grain losses. It was also observed that there was an increasing trend in the losses of unthreshed grains when the drum speed was increased from 300 to 400 rpm at 144 kg/hr feed rate at all the moisture contents.

Table 1: Percentage of unthreshed losses of paddy resulted from different treatment combination

Drum speed (rpm) ↓	Feed rate (kg/hr) →		
	120	**135**	**144**
26% Grain moisture content			
200	7.63	6.55	3.89
300	6.27	4.43	3.2
400	5.46	4.43	7.73
21% Grain moisture content			
200	4.57	4.51	4.09
300	4.24	2.74	3.03
400	2.42	2.25	4.02
16% Grain moisture content			
200	3.86	5.09	1.8
300	2.09	4.22	1.28
400	1.2	3.21	1.28

Unthreshed grain losses were lower when compared to the losses observed at 200 and 400 rpm at all the feed rates and moisture contents at drum speed of 300 rpm. However, at higher drum speed (400 rpm), the percentage of unthreshed grains increased with the increase in the feed rate. This could be due to the fact that at higher feed rates and at higher drum speeds the retention time of the panicles inside the thresher got reduced which in turn resulted in higher unthreshed grain losses.

Statistical analysis of the data showed that the moisture content had significant effect ($P<0.01$) on the unthreshed grain losses (Table 2). Also, interaction of the drum speed and the moisture content, drum speed and feed rate, moisture content and feed rate and the interaction among all the three variables had highly significant ($P<0.01$) effect on the unthreshed grain losses.

At higher grain moisture contents the unthreshed grain losses were found to be high, whereas lower grain moisture content reduced unthreshed grain losses. The unthreshed grain losses were higher at 400 rpm and 26% moisture content and at 144 kg/hr of feed rate. The unthreshed grain losses were comparatively found to be lower at the drum speed of 300 rpm at all the levels of grain

moisture content and feed rate. The interaction effect among drum speed, grain moisture content and feed rate had highly significant ($P<0.01$) effect on the unthreshed losses of grains. Therefore it can be concluded within the limitation of paddy variety and moisture content that the drum speed and the feed rates should be recommended with appropriate grain moisture content in order to minimize the unthreshed losses of paddy.

Table 2 – Statistical data analysis of variance for variables affecting the unthreshed grain losses

Source of variation	Degrees of freedom	Mean square
Moisture content (A)	2	12.32^{**}
Drum speed (B)	2	0.33^{ns}
Feed rate (C)	2	4.678^{ns}
A x B	4	9.492^{**}
B x C	4	25.197^{**}
A x C	4	10.609^{**}
A x B x C	8	8.592^{**}
Error	54	1.52

**, highly significant at 1% level significant ns - non significant

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