

# Benefits of Harvester Front Extension in Reducing Canola Harvest Losses

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## ABSTRACT

Today in Iran, the cultivation of oilseed rape has been developed in all area through the country. However, this operation has been faced to some difficulties for land preparation, crop cultivation and grain harvesting. Mechanized harvesting has been done by using some technical operation, and doing some arrangement with current common grain combine harvesters and also adding several header extensions that adjunct to the grain combine platform. Because of not enough proficiency and also the requested specific conditions of canola harvesting, the mechanized harvesting systems were caused considerable losses especially with common combine platforms. To study the effects of a modified platform and two platform extensions on canola grain losses, an experiment was conducted with respect to the quantity and recognition the causes of losses. Three kinds of platform were compared. These models were included the current cereal platform, Hamed and Bizo header extensions with mechanical and hydraulic side knife cutterbar respectively. A statistical randomized complete block design was applied with six replications. Seed loss was measured using trays placed in the ripening crop prior to harvest. The result consisted that header extension could decrease the amount of losses in combine harvester with increasing the distance between platform auger and cutterbar. Hamed header extension which made in Iran, only in vertical cutting had more grain losses than Biso platform. So, from total amounts of losses, the significant differences were found between current cereal platform and other two extension platforms. Headers using side vertical cutting loss was 71 kg ha<sup>-1</sup> against 599 kg ha<sup>-1</sup> with the common combine platform. Also, using of hydraulic system instead of mechanical system and double knife cutterbar instead of the single cutterbar could decrease the amount of grain losses. Shattering seed loss was measured 39.60 kg ha<sup>-1</sup> that only from this rate it was 1.12% of total harvested yield. Therefore this rate was not considerable amount of losses, and with improving the conditions before harvesting it could be able to reduce grain loss.

**Key Words:** Canola harvesting, grain losses, different platform, Iran

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## 1. INTRODUCTION

Oilseed rape (*Brassica napus*) is an important non-cereal crop, the oil from which is used mainly for food production (Niab, 1992). According to the available statistic in Iran more than 90% of oil ingredient is supplied from other places. Increasing the population and also the people consumption of vegetable oil, caused the development of cultivation of canola as oilseed rape crop which is suitable to weather condition in most areas in Iran (Seidan, 2006). Industrial applications have also been developed for the oil; high erucic acid rape is grown for industrial lubricant (Cooksley, 1993). As the seed reaches maturity the pods of rape come very brittle, crisp and ready to open and shedding seeds, therefore the seed loss might be increased as a result of bad weather condition. During the direct harvest, shaking and stroking to plants increased seed losses. As the harvesting must be done at seed maturity for maximum oil content, seed loss is also caused by disturbance of the plants during harvesting operations (Ogilvy et al., 1992, Hobson and Bruce, 2002, Mackleod, 1981). Unfavorable weather condition lead to loss in half of the crop and 20-25% crop losses is not unusual and in ideal condition the amount of losses have been reported between 2-5% (Mackleod, 1981). In addition canola is susceptible to losses typically, lacking or absence the special platforms in order to direct harvest, cause to loss the considerable amount of crop in harvesting step (Yousefpoor et al., 2006).

One of the current direct harvesting combines for oilseed rape was using the cereal combines following some specific regulations and adjustments. Hence, the application of this machinery could cause grain loss (Price, et al., 1996, Yousefi, 2006). Riethmuller et al., (2001) showed that one of the successful ways for decreasing the crop losses at harvesting, was increasing the distance between auger and cutterbar, in some way that, with this changing, the material entrance rate could be increased into combine.

Bruce et al. (2002) have stated that drapper platforms caused low losses about 46% lower than normal platform. Except the kind of machinery, many different factors affected losses, including: seeding rate, cultivation method, crop density and the weather conditions (Burton, et al. 2001, Hobson and Bruce, 2002, Asoodar and Desbiolles, 2003).

In recent years to decrease the amount of grain losses from the platform, the distances between auger and cutterbar increased and two of header extension models have supplied and added to the current cereal combine platforms. These header extensions were equipped with side knife cutterbars that operated, mechanically and hydraulically (fig.2). Hamed header extension which was made in Iran and Biso CX100 which was imported from Austria, had developed the distance between auger and cutterbar in their platforms by 70 cm and 80 cm respectively. To determine the amount of grain loss in direct harvesting by using of two header extensions and the current cereal combine harvester platform, an experiment was conducted for distinction the suitable harvest machinery and the correct regulation with respect to the operating condition and current cultivation template.

## 2. MATERIALS AND METHODS

### 2.1 Harvesting equipment

Three type of platforms were used for this experiment:

- a) the current cereal platform with 4.25m cutting width, with a single horizontal knife and without lateral cutterbar and made by Deere and Company.
- b) header extension added to the current cereal platform with the commercial name "HAMED" which was made in Iran and also

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equipped with single vertical and single horizontal cutterbar knife. c) header extension added into John Deere, current cereal platform with the commercial name of “BISO CX100” and equipped with vertical and horizontal double knife cutterbar. The distance between auger and cutterbar extended to about 70 cm.

## 2.2 Experimental layout

The Experiment was conducted in a canola farm in Gaz village in Isfahan, one of the big cities in Iran. The cultivation variety was Okapi with two zero codes and suitable for the temperate cold weather in Iran.

The seeding was completed by using a KF2.5 model seed drill, with the row width of 13 cm and seeding rate of 8 kg ha<sup>-1</sup> which was recommended by Agricultural Ministry experts. In this research three direct harvest platforms in the randomized complete block design with six replications were compared.

The experiment was divided into 10×92m plots and then the treatments were located.

The counting and collecting canola seeds from the soil surface were shown to be very difficult, time consuming and unreliable, especially during the harvest time, because of many deep cracks and holes in the soil (Hobson and Bruce, 2002). A technique was developed by Price et al., (1996) for measuring the losses was used. The special trays placed in the standing crop to catch sample of seeds falling from the crop naturally or by impacting to the combine (price et al., 1996).

The lateral walls of trays are slant and their internal surfaces covered with thin sponge layer to prevent seeds from bouncing (fig.1).

Every tray has 544 mm length, and 115 mm in width. Four trays areas together would make an area with the 1/4 square meter. These trays were put in crop in groups of 4-8 parallel to each other and to the direction of combine travel, with a gap of about 100mm between each and approximately 1m into the crop from the end towards which combine was working.

During each run, the combine harvested the crop in the normal manner with gentle engagement of the reel with crop canopy. After the header but not the combine was halted to avoid the efflux from the rear of the combine falling into the trays, and also to prevent its tires crushing the trays, once the combine had withdrawn, the trays were extracted and their content bagged for the following measurement.

## 2.3 Measuring Shedding Losses

The shedding losses were occurred in the ripening crop prior to harvest, caused by every touching and stroking in fragile pods.

Ten days before harvesting (12% seed moisture content) the trays placed in the standing crop slightly and in harvesting day before the operation these trays and their content were collected from the farm.

## 2.4 Measuring Platform Losses

Three positions for loss collection were chosen. These points represented distinct sources of seed loss caused by an active contact between the crops and the platform components.

### 2.4.1 Side Knife Loss

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The lateral branches of canola during its growing caused to create a mass and convoluted crop at harvest. So plant canopy must be divided in two parts at the edge of platform by dividers. Thus inactive dividers and vertical cutterbar in side of platform were used on crop in the current grain platform and two header extensions respectively (fig.2).

The previous experiments have shown that the side knife losses had a uniform distribution in a 300mm width exactly beneath the side knife (price et al., 1996). However these losses were exactly under the side knife but their measuring trays were put outside of crossing the side knife. Therefore in analyze of data the essential reformation was done in side knife losses. The following formula was used in order to calculate the side knife losses.

$$B = 159.8 \times 300 \times g_s / h_w$$

B= the side knife loss in kg ha<sup>-1</sup>

g<sub>s</sub>= the average weight of seeds in every tray in grams.

h<sub>w</sub>= the width of platform in mm.

#### 2-4-2 Horizontal cutterbar losses

Although the term cutterbar losses implied that the loss source is reciprocating cutterbar, which necessarily vibrates the stems and caused by any contact of the platform parts with pods, and by the auger behind the cutterbar tearing a part the entangled crops. Seeds falling on to the ground in front of the cutterbar was assumed to be evenly distributed across its width.

The following formula was used to calculate of cutterbar losses.

$$A = 159.8 \times g_{cb}$$

A= the horizontal cutterbar losses in kg ha<sup>-1</sup>.

g<sub>cb</sub>: the average weight of seeds in every tray in grams

#### 2.4.3 Center Losses

The crop moved to center of platform by auger from two sides and compressed in center. Hence some of the seeds were released and thrown out to the ground.

These losses are known as center platform losses.

These losses, were superimposed upon cutterbar loss over the width of the center opening, and could therefore be calculated by deducting the latter. based on the previous research (price et al., 1996) the center loss was sampled over the width of the center opening to header width. The following formula was applied to calculate of cutterbar center losses:

$$C = 159.8 \times (g_c - g_{cb}) \times \frac{h_c}{h_w}$$

C: the center loss in kg ha<sup>-1</sup> in g<sub>c</sub>: the average weight of seeds in every tray in the center of platform in gram.

h<sub>c</sub>: the width of front elevator opening in mm.

h<sub>w</sub>, in experiment was assumed equal to 1040 mm for all platforms.

### 3. RESULTS AND DISCUSSIONS

The average losses from platform function for John Deere platform and Hamed and Biso header extension were 599.35, 71.27, 52.83 kg ha<sup>-1</sup> respectively. Table 1 and 2 show the analyzed of variance and the results of average grain losses.

The shedding loss was 39.6 kg ha<sup>-1</sup> that with respect to yield of 3530 kg ha<sup>-1</sup>, (1.12 percent of yield) is pure. So this rate was not shown considerable amount and with suitable weather conditions before harvesting, would decrease from this rate, application of header extensions was caused the decrease in amount of losses in harvesting with combine, Hamed and Biso header extensions were decreased losses about 528.1, 546.5 kg ha<sup>-1</sup> compared to the normal platform respectively. side knife loss in Hamed header extension was 18.9 kg but Biso header extension was half of this quantity.

The main difference between two header extensions was their structure and operational mechanism. For Hamed the mechanical mechanism and for Biso the hydraulic mechanism were applied for operating cutterbars. The cutterbar loss was decreased especially when Biso header extension was used. But it did not show any significant differences compared to Hamed cutterbar extension.

losses in the center of horizontal cutterbar had the same changing with the losses in cutterbar in some way with using the Hamed and Biso header extension, center loss was decreased 99.79 and 100.3 kg ha<sup>-1</sup>.

losses in Biso cutterbar extension was less than Hamed, but according to the result, only decreasing the amount in side knife loss was significant. Totally, Biso cutterbar extension with 52.8kg ha<sup>-1</sup> grain loss didn't show a significant difference compared to Hamed where the grain loss was 71.3kg ha<sup>-1</sup>.

It was seemed increasing the distances between auger and cutterbar and using of vertical and horizontal double knife cutterbar could decrease the losses significantly. The spaces for better flow of crop entrance and reduced direct contact between crop and moving reel. Also, decreasing the vibration to stems while using of header extension in direct harvest could reduce the grain loss.

Table 1. Analysis of variance

Mean of squares (MS)				
Source of variation	Center	Cutter bar	Side Knife	Degrees of freedom
Treatment (platform)	2165.24*	400269.86*	534.86*	2
Error	21.50	414.69	1.3	15
Coefficient of variation (C.V)	12.49%	10.46%	12.23%	

Note: \* shows significant different at (p≤0.05) level of probability.

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Table 2. Mean of grain losses by different Platforms and extensions

Treatment	Total losses (kg ha <sup>-1</sup> )	Center loss (kg ha <sup>-1</sup> )	Cutter (kg ha <sup>-1</sup> )	bar	Side knife loss (kg ha <sup>-1</sup> )
Current cereal platform	599.35 <sup>A</sup>	106.46 <sup>A</sup>	492.89 <sup>A</sup>		Not available 0 <sup>C</sup>
Hamed extension	71.27 <sup>B</sup>	2.67 <sup>B</sup>	49.72 <sup>B</sup>		18.88 <sup>A</sup>
Biso extension	52.83 <sup>B</sup>	2.15 <sup>B</sup>	41.45 <sup>B</sup>		9.22 <sup>B</sup>

Note: Means followed by the same letters within columns do not differ at ( $p \leq 0.05$ ) level of probability.



Fig. 1. Tray for catching seed --- 544 mm long by 115 mm wide with a 'u' section, made of polyetylen ; the tray was inserted between, and held upright by, the canola stems

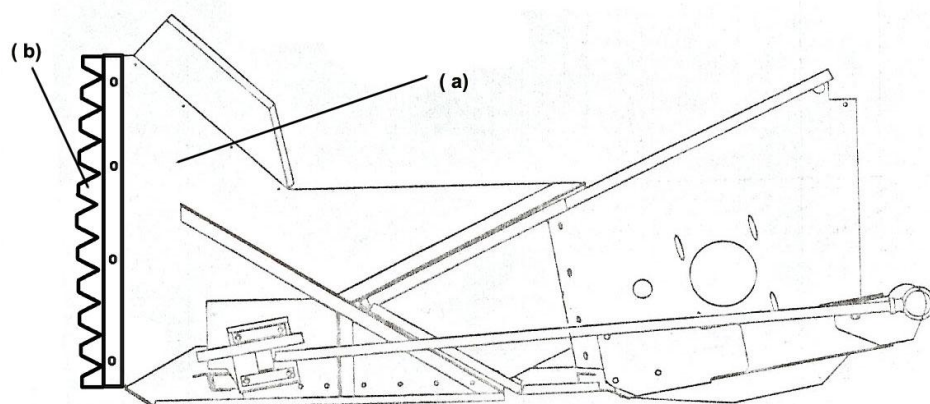


Fig. 2. schematic of extension table : ( a ) , header extension; (b), side knife

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#### 4. CONCLUSION

The current cereal platform in canola direct harvest with respect to the experiment conditions was lead to 14.5 percent loss compared with using the header extensions which loss rate decreased in below 2% .

Among the losses in every header extension, the horizontal cutterbar loss had the more portion. Therefore, using double knives cutterbar that both of knife sections were mobile could decrease the amount of losses. Also using of hydraulic operated cutterbar was one of the ways that designers must consider in platform design especially for oilseed rape harvesting platforms.

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