Progress in Reduction of Dry Bean Harvesting Losses

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Introduction

The pea and lentil sectors of the pulse industry in Saskatchewan have expanded rapidly over the past several years. The industry is ready to diversify the production base by marketing larger volumes of both chickpea and dry bean. The prospects and expectations for expansion of the dry bean sector were raised by the signing of recent international trade agreements such as NAFTA and GATT. A major expansion of cleaning and bagging capacity for dry beans in southern Alberta will increase production under irrigation. The expansion of potato production under irrigation in Saskatchewan will likely lead to an increase in row crop production of dry bean under irrigation. The recent investment in colour sorters at lentil processing facilities in Saskatchewan should also raise interest in contracting and cleaning of dry beans of several market classes.

One of the main influences on the expansion of the dry bean industry in southern Manitoba and Saskatchewan is the cost of production. To be competitive with rates of return from other crops and to be competitive with other production areas in north America, the cost of production must be lower relative to existing production systems. Grower experience in the late 1980s and early 1990s from the irrigated regions of south-central Saskatchewan and from dryland production in the Dark Brown soil zone showed that direct harvesting using lentil technology was possible but that harvest losses were highly variable and therefore generally unacceptable. As a result, research and development efforts were focussed on reducing harvest losses.

The research and development effort into reducing harvest losses in direct harvest dry bean production systems receives support from the Saskatchewan Pulse Crop Development Board (SPCDB), the Western Grain Research Foundation (WGRF), Saskatchewan Irrigation Development Centre (SIDC), Saskatchewan Department of Agriculture and Food (SDAF) and the Natural Sciences and Engineering Research Council (NSERC). This is a truly multidisciplinary research focus. Efforts by the Department of Agricultural and Bioresource Engineering (DABE) at the University of Saskatchewan focus on methods of reducing harvest losses by improvements in cutterbar engineering. The Crop Development Centre (CDC) research is centred on reducing losses through plant breeding for improved canopy structure and earlier maturity.

Research Progress

In 1993, the DABE tested equipment modifications for direct harvesting of dry bean. An International Harvester 93 combine, loaned to the project by SIDC, was equipped with the modifications. Results from direct harvest of experimental fields and plots in the Outlook

region are shown in Figures 1 to 4. Harvest losses of Othello pinto bean (traditional pinto bean canopy structure were influenced by both forward speed and reel index (Figures 1 and 2). The optimum combination of reel index and forward speed reduced losses to 21% which is substantially lower than the average loss of 40% reported from control plots of Othello pinto in 1992. When the system was tested in plots of Seaforth navy bean (bush type canopy), losses were further reduced to about 12 % (Figures 3 and 4). The major improvement in both cases was a substantial reduction in stubble loss with increasing reel index. An average of 12 % loss would make this type of direct harvest system competitive with row crop production (personal communication, H. Clark, SIDC). For the optimum combination of forward speed and reel index for Othello pinto (Figure 1), shatter, stalk, and stubble losses were all lower than loss measurements taken in 1992.

Improvements in canopy structure for pinto bean are also leading to reductions in harvest loss. The breeding program is managed so that all yield plots are direct harvested with a Wintersteiger combine. Just prior to harvesting, plots are rated for harvestability by estimating the pod hand percentage (PHP) which is an estimate of the percentage of pods estimated to hang entirely above cutterbar height. Table 1 reports results from advanced yield trials at Saskatoon in 1993 showing that harvested yield increases as PHP increases relative to the check cultivar Othello.

Potential for further reduction in losses through reduction in shatter loss is shown by results in Table 2. Breeding lines of bush type black bean with non-shattering pod (NSP) phenotypes were substantially higher yielding than both check cultivars and the highest yielding normal pod breeding lines.

The third major improvement in reduction of harvest loss for dry bean relates to quality improvement and risk reduction. The relatively cool growing seasons of 1992 and 1993 resulted in excellent selection pressure for early maturity. The check cultivar Othello is now considered to be relatively late maturing relative to most advanced breeding lines. In the pinto class, lines that mature up to one week earlier than Othello are available. This means that it should be possible to reduce quality losses due to frost of late-maturing pods and reduce the risk of yield loss due to frost. We feel that the cheapest form of crop insurance is early maturity.

Summary

Research targetted to reducing direct harvest losses for dry bean crops is underway in both engineering (improved harvest equipment design) and plant breeding (improved canopy structure, early maturity and non-shattering pods). Results are encouraging and the objective of consistently reducing direct harvest losses to under 10% will be achieved in the near future. These improvements will lead to a rapid expansion of the dry bean industry in Saskatchewan before the year 2000.

Table 1. Mean pod hang percentage and mean yield of Othello pinto bean and 3 highest yielding breeding lines for 5 advanced pinto bean yield trials at Saskatoon, 1993.

	Yield (kg/ha)		Pod hang (%)	
Yield test	Othello	Top 3	Othello	Top 3
BYT - 1	1650	1734	45	90
BYT - 2	1702	2234	55	77
BYT - 3	1649	1922	55	70
BYT - 4	2009	2313	60	77
BYT - 5	1807	2294	55	80
Mean				

† Percentage of pods in canopy held entirely above cutterbar height. Mean of duplicate plots, 1 replication, for Othello. Mean rating from 1 replicate for top 3 yielding lines.

‡ Yield represents mean of 2 replications of duplicate plots of Othello in each test and mean of 2 replications of each of the 3 highest yielding lines in each test.

Table 2. Yield of breeding lines and checks for black bean in with normal and non-shattering pods in Bean Yield Test No. 6 at Saskatoon, 1993

Entry	Mean yield† (kg/ha)
Top 2 non-shattering pod breeding lines	1436
2 check cultivars (normal pods)	1193
Top 2 normal pod breeding lines	1093

† Mean of 3 replications of each of 2 lines.

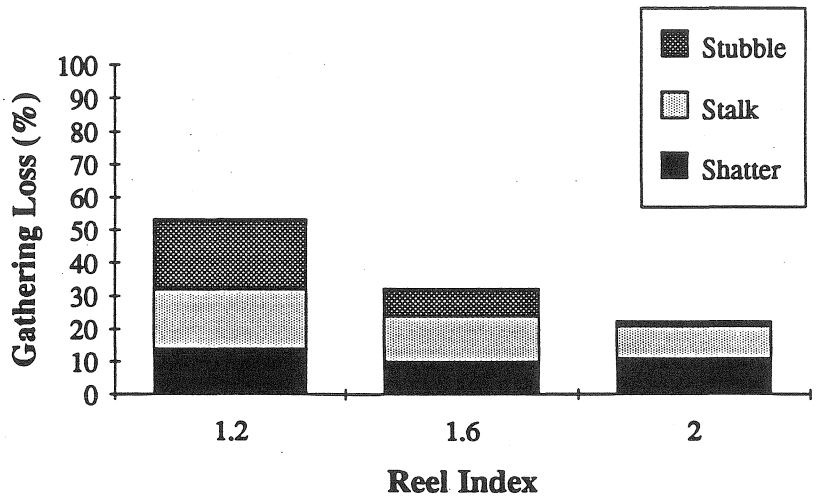

Figure 1: Gathering losses in pinto bean (2.5 km/h).

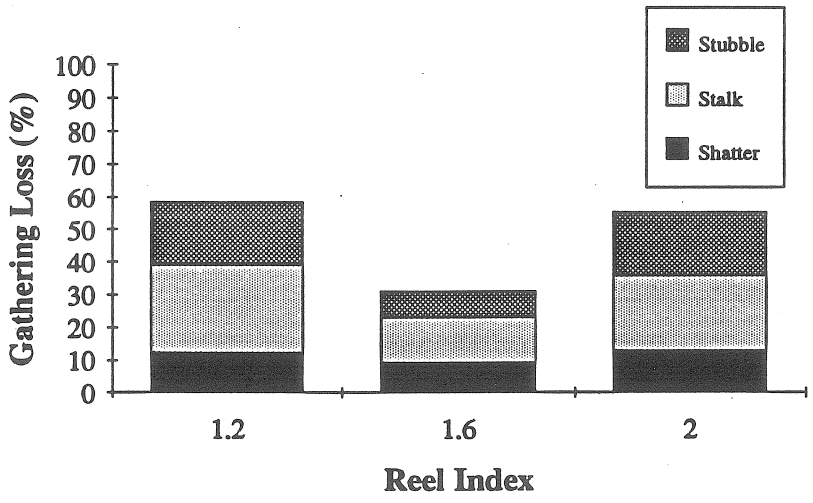

Figure 2: Gathering losses in pinto bean (4.0 km/h).

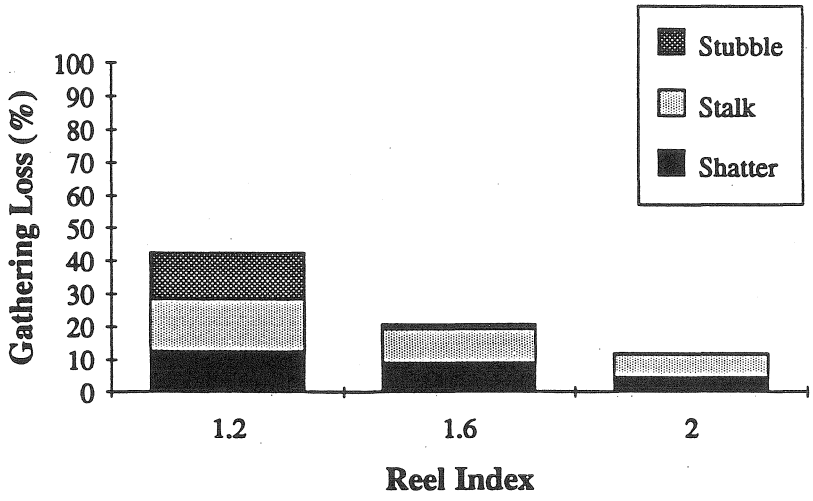

Figure 3: Gathering losses in navy bean (2.5 km/h).

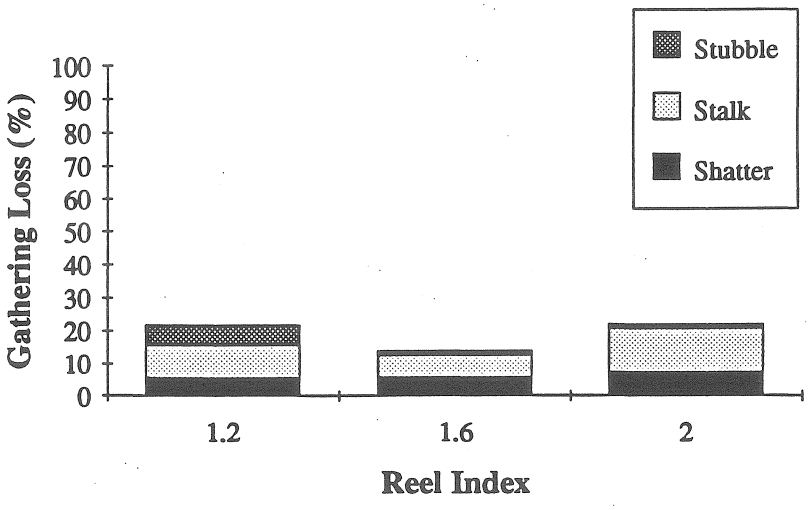

Figure 4: Gathering losses in navy bean (4.0 km/h).