POTATO HARVESTER EVALUATION

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Mechanical Injury is probably the biggest single problem in the production of potatoes today. Any bruise or damage on the potato is increased after storage, as any kind of injury is a means by which a disease organism can get started in storage. The biggest problem with Mechanical Injury is that it is difficult to see the damage that is being done at the time. For this reason, we felt that a Harvester Demonstration would be an ideal means of showing the Growers and the Machine Companies the extent of damage that is being done today. The method of determining injury is similar to the system used by the European Potato Growers Association, at Sutton Bridge, in England.

Our first demonstration was held September 11 - 13, 1968, in Southern Alberta. Five Harvesters took part in the first demonstration. As a result of the interest shown by the Growers, a second demonstration was held, September 10 - 12, 1969. Four Harvesters took part in this demonstration. These demonstrations were coordinated by the Alberta Potato Commission, and damage assessment, rates of work, and similar productivity studies were carried out on each machine under the supervision of the Dept. of Agricultural Engineering, University of Alberta, and the Alberta Dept. of Agriculture.

Three days were required to run the Harvester Demonstrations. The first day was set aside for all the Companies to try out their machines under the field conditions that would be used for the trials and to make sure that the machines were adjusted properly. On the second day, samples were taken for damage assessment. On the third day, a Grower Demonstration, and Field Day was held. The results of the previous day's trials were available to the Growers for comparison purposes.

One half of the trial field was top-killed, and the other half was not. Each operator was asked to run his machine on the first plot at a maximum output, consistent with a low level of damage, and on the second plot, with the least possible damage. This means that the speed at which the machine was operated, on these two plots depended on the operator's knowledge of how his machine performed.

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Each plot was two hundred feet long, and three stop watches were used to check the rate of harvesting. The samples were collected in a butter-fly type net before the potatoes dropped into the truck box. The potatoes were caught by random sampling along the two hundred foot test strips. The potatoes collected were then divided into two 20lb samples. The testing was carried out on the one sample and the other one was retained in case an error was made and a recheck was necessary.

In order to successfully evaluate the performance of the machines, it was necessary to determine if any potatoes were left in the field. For lack of a better word, potatoes left in the field, were classified as "leavings". A three foot square frame was thrown down at random, in five different locations on the two hundred foot test strips. This area was carefully dug. All potatoes of marketable size were picked up, within these yards, and weighed and counted.

The potatoes collected in the truck box were then carefully taken to the bruise testing area. Here, the potatoes were washed, stained with Cathecol, and peeled to determine extent of injury. Cathecol will stain a bruised potato a reddish colour. The stained areas are then peeled with a kitchen parer, calibrated to 1/16" slice. Damage assessment is then rated as follows:

a. Skinned - where one slice removes all the stained area

b. Slight damage - where the stain is removed with two slices

c. Severe damage - where stain is still present after two slices.

In order to compare the different Harvesters, a total damage and leavings index was established, "TDLI". The weighing factors used to determine TDLI are as follows:

Skinning: % x 1

Slight Damage: % x 3

Severe Damage: % x 7

Leavings: % x 7

The results of the 1969 Trials are shown in Figure 1. Total Damage and Leavings Index, Acres per Hour, per cent of Slight and Serious Damage, and Leavings in pounds per acre, and per cent are shown. The average yield for all plots was 14.6 tons per acre. The plant stand ranged from

75 - 90%. From Figure 1, it can be readily seen that Machine D, had the best TDLI of the four machines. Machine C, had the second best. You will note that one machine left as much as 4900 lbs on the ground. This was 17.5% of the potatoes harvested.

Figure 2 shows comparisons of machines that were in the trials both years. Machine D, improved TDLI over the previous year by about 28%, and Machine C, improved 22%. Further, the acreage per hour harvested, also improved. Both of these companies made considerable improvements in their machines, which resulted in improved performance.

One factor that doesn't show in these results is Operator's skill. You will note in Figure 1, that Machine B rated very poor in TDLI, as well as acreage harvested. The main reason for the poor showing of this particular machine was an inexperienced operator and crew. It is very difficult to compare results unless an experienced operator and crew are used on all machines.

In addition to the above, samples were taken from the primary apron, secondary apron, cross conveyor, elevator and picking table, on each machine. A TDI was calculated for each point on the machine. Unfortunately, a large quantity of potatoes in the sample is required before reliability can be established. The range of TDI is shown in Figure 3. This is an average for all machines. It can be seen that even with the very small sample we took, that damage gets progressively worse. (This can be expected).

The average Slight and Serious Damage by all machines on all plots in 1969 was 18%. Add to this 7% that was left behind in the field, and you have a total loss of 25%. Can you afford it?

Perhaps some mention should be made of the Plastic Potato. Because of the requirements of the large samples and labor needed to stain, peel, weigh count and record the damage and leavings, a plastic potato was developed at the University of Alberta, which contains an adjustable accelerometer of a simple design. When the device receives an impact above a pre-set amount, a circuit is triggered, which switches on a light. This plastic potato will be useful for diagnosis conditions in which potatoes are likely to be damaged.

Recommendations:

We feel that the Harvester Demonstrations were definitely worth while because Growers and Manufacturers alike were able to compare machines under similar conditions. A noticeable improvement in 1969 as compared

with 1968 was evident. Many Growers never realized that this kind of damage was being done, because bruises don't normally show up until after a period of storage, and are usually classified as storage rot.

If sufficient space is available it would be advisable that each Harvester have its own plot.

Only new machines should be allowed to compete, as it is not fair to compare an old machine with a new one.

Competent operators and crew is one of the most important factors. An experienced operator and crew could reverse the final positions of all machines in our 1969 Demonstration. As an example the poor showing of Machine B in 1969 was mainly due to an inexperienced operator and crew.

All competing companies should clearly understand details of how the trials are to be carried out. Written instructions should be provided well in advance of the trials. Large samples of potatoes should be used for Damage Index Assessment. Small samples are statistically unreliable, and may produce results which jeopardize the credibility of the whole testing procedure. A fifty pound sample is considered to be a minimum. A double sized sample should be drawn , and only half used, so that if there is any question of reliability, the other half can be checked.

Leavings were determined by four square-yard samplings. This should be increased to at least eight, if labor is available, for digging and collecting.

At least three persons are required in each team for peeling, staining and weighing, counting and recording.

Some definite policy as to the number of people surrounding the machine during the test, and particularly at the staining and damage assessment area should be set up.

Each machine must be ready to compete at times specified. All machines must be ready and adjusted on the first day.

Three stop watches should be used to check time.

Adequate transportation should be the responsibility of the entrant.

Before closing, I would like to express my thanks to the people associated with the Washington State Potato Industry. During the past few years, we have had a free exchange of information, which is to the betterment of the Potato Industry in both countries. We wincerely hope that this type of mutual cooperation will continue, so that we can build a bigger and better Industry in both countries.

FIGURE 1

TRIAL (1) - Maximum output of undamaged potatoes.

TRIAL (2) - Least possible damage.

TDLI is the total damage and leavings index.

Legend box:

TDLI	ACRES PER HOUR
% DAMAGE SL + SEVERE LEAVINGS	
LB/AC	%
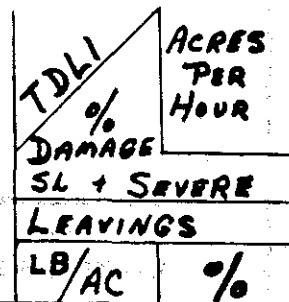
MACHINE	GREEN TRIAL 1		GREEN TRIAL 2		TOP KILLED TRIAL 1		TOP KILLED TRIAL 2	
A	219.5 / 13.2	(1.74)	203.5 / 9.1	(1.30)	305 / 27.8	(1.72)	119 / 9.6	(1.22)
	2359	8%	2783	9.5%	2964	10.1%	121	0.41%
B	290 / 25.3	(1.04)	221.6 / 12.6	(0.84)	278.5 / 37.9	(0.96)	209.2 / 21.5	(0.95)
	4900	17.5%	4053	14.4%	907	3.2%	1815	6.5%
C	207.8 / 20.1	(1.06)	187.5 / 21.0	(1.05)	167.7 / 11.4	(1.07)	217.2 / 32.5	(1.13)
	1996	6.6%	1452	4.8%	1450	4.8%	605	2.0%
D	194.2 / 12.3	(1.00)	182 / 11.7	(0.98)	161.1 / 11.9	(1.11)	189.3 / 11	(0.99)
	2360	9%	2057	7.9%	605	2.3%	1694	6.5%

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FIGURE 2

MACHINE	CROP AREA	1968		1969		1969 AC/H as % of 1968	1969 TDLI as % of 1968
		AC/H	TDLI	AC/H	TDLI		
A	(1)	1.37	186.9	1.739	219.5	126.9	117.4
	(2)	1.3	205.9	1.301	203.5	100	98.8
	(3)	1.42	192.4	1.721	305.0	121.2	158.5
	(4)	1.39	193.0	1.224	119.0	88.05	61.6
C	(1)	.64	253.5	1.066	207.8	166.5	81.9
	(2)	.64	269.3	1.052	187.5	164.4	69.6
	(3)	1.67	261.7	1.073	167.7	64.25	64.1
	(4)	1.07	217.5	1.132	217.2	105.8	100.
D	(1)	.86	336.8	1.007	194.2	117.0	57.6
	(2)	.77	196.7	.978	182.0	127.0	92.5
	(3)	1.04	239.8	1.109	161.1	106.6	67.2
	(4)	.79	221.3	0.989	189.3	125.2	89.6

KEY

(1) Green tops maximum output.
(2) Green tops minimum damage.
(3) Top killed maximum output.
(4) Top killed minimum damage.
AC/H Acres per hour harvested.
TDLI Total damage and leavings index.

FIGURE 3

TOTAL DAMAGE INDEX

Average all TDI on all machines

0   50   100   150   200

Primary Apron

Secondary Apron

Cross Conveyor

Elevator

Picking Table