

POTATO HARVESTING EFFICIENCY AND TUBER DAMAGE

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I have been asked to speak on the subject of potato harvesting and handling equipment. I am sure that there are those who could cover this subject far better than I. I am thinking of those farmers and individuals that operate the equipment during the fall harvest period. Certainly no one is more aware of the problems associated with the operation of machinery than the individual with the task of its daily association.

Be this as it may, often times problems not directly associated with the operation of a particular piece of equipment can best be detected by someone considering the machine and its function as a whole and in relation to the processes which precede and follow the machine under discussion. It is with this in mind that I approached an analysis of problems associated with potato combines.

The question may come to mind, "why this interest in potato combines?" As Extension Agricultural Engineer at the University of Idaho I was not hired with the specific purpose of working on potato harvesting equipment. However, I was not long associated with the extension program before I began to hear of problems having to do with the efficiency of potato combines. Rumors came to my attention which suggested field losses due to harvest with the potato combine of up to 45 per cent. One letter stated that the statistical reporting service estimated 32 cwt. per acre loss with 1/3 of that number being number one's.

Bruise Damage

While reviewing the literature in relation to combine efficiency I soon became aware of the serious problem of bruise damage resulting from harvesting and handling potatoes.

The following itemizes some of the research reported in the literature concerning bruise damage.

1. In 1950 Humphrey of Idaho observed that it was nearly impossible to select 10 injury-free potatoes from the average potato storage.
2. On 18 farms using mechanical harvesters at Tulalake, California, the total damage amounted to 37 per cent of the crop: 12 per cent being cutting or bruising; 25 per cent skinning. Two-thirds of this damage occurred in the harvesting operation, one-third in unloading trucks and conveying potatoes to the pile. They found no correlation between the amount of damage and the type or make of harvester. The severe

damage which would affect the marketing of the potatoes totaled 17 per cent with mechanical harvesting.

3. Walt Sparks of the Aberdeen Experiment Station reported as much as 50 to 75 per cent loss of crop due to mechanical damage in harvesting handling. His studies showed that 11.5 per cent of the tubers were injured badly enough during harvesting and storing to be classed as having hard and serious bruises.
4. Larsen in studying Washington potatoes reported that growers injured 38 per cent of all their potatoes, of this 11.7 per cent was serious enough to affect the grade. He found that of all damage to potatoes from field to market, 78 per cent was caused by the grower with the greatest source of injury being the harvesting operation.
5. Studies have shown that mechanical bruising is the most serious defect on the potato market.

In summary it appears that about 12 per cent of all potatoes harvested suffer bruise damage sufficient to affect the grade and that the market is being adversely affected as a result of this damaged product. Considering the earlier mentioned field losses this would indicate that 20 per cent of out potato crop was being seriously damaged or left in the field.

These figures indicate a serious need for work to be done in improving our harvesting methods. Consequently, in the fall of 1966 Jim Bryan, Area Potato Agent in the Blackfoot area, and I outlined a program to investigate the potato combine with the idea of classifying the source of losses and damage and of finding ways of reducing these losses. Our objectives were not to have every farmer recover 100 per cent of the crop 100 per cent bruise free. We knew that this was impractical from a standpoint of costs. Therefore, we set two goals. (1) A harvester should be leaving not more than 2 per cent of the value of the crop in the field and, (2) immediately detectable damage to the potatoes should total 5 per cent or less.

The project was in three parts and was to be over a period of several years.

1. We would work with individual farmers on several different types of machines and measure the losses which were occurring. In cases of excessive losses we would attempt to find the source and recommend changes for reducing these losses.
2. We would develop a system of classifying the damage to a potato which would reflect the reduction in value of the crop.

3. We would work with individual farmers in determining source of the damage to their crop and attempt to find solutions for eliminating or reducing this damage.

It must be kept in mind that this was Agricultural Extension work and not research work. We were not seeking for new and different methods of harvesting the crop, but rather hoped to help make farmers aware of the severity of the problem and of helping them to apply existing solutions to their problems in so far as solutions existed.

During the fall of 1966 we set out only to make ourselves aware of the problems of machine operation, types of machines available, and related problems. To do this we made arrangements to spend time with four different farmers, each having a different type of machine. They all had large acreages in the Rising River area near Blackfoot in Bingham County. (Which by the way, I am told, is the largest potato producing county in the United States.)

For several days we spent our time visiting with the farmers, measuring the field efficiency of the machines, checking chain speeds, machine speeds, observing operational problems and in general becoming acquainted with the harvesters. During this time we made no attempt to study bruise damage as we had not had sufficient time to set up a grading system. However, we did work with developing a method of checking field losses as follows:

1. Each machine was checked at five separate locations in the field.
2. Potatoes left by the harvester were picked from each location by marking off a plot 10 feet long and covering two rows. (Each machine checked was a two-row machine.) In some cases the farmer was using a two-row windrower to lift two rows and windrow them into the bed being harvested by the combine. In this way the combine was loading four rows per path. In these cases at each field location we checked both the combine and the windrower for losses.

Potatoes which would pass through the digger chains were not picked up and thus were not considered a part of the combine loss.

3. With a row spacing of 36 inches, each one pound of potatoes picked from a check section represented a loss of 730 pounds per acre.
4. The loss obtained in the five locations was averaged to determine the average machine loss.
5. The machine was studied to determine the source of losses.

In our study with the four machines and with yields averaging about 300 sacks per acre, losses varied from 3 to 11 sacks per acre with about 50 per cent being one's. The principle source of losses was from spill-out around the digger blade. Other losses were from improper digger depth, potatoes ejected with the vines, potatoes being ejected from buckets (on bucket machines) as they changed directions.

These were all good conscientious farmers and their machines were in good operating condition. Losses, except for the one machine, were not considered to be excessive. The machine with 11 sacks per acre loss had excessive spill-out. This problem was brought to the attention of the farmer and evidently corrected.

We were quite gratified by the enthusiasm of the farmers in the area for this program. In almost every case when we would start digging behind a machine to measure its field losses we would soon have people stopping by to see what we were finding out.

At present, I plan on continuing this program on a wider scale this fall and to include work on bruise damage.

This preliminary study indicated that excessive field losses need not be a problem with the potato combine. Field losses can be easily checked by digging in a 6' x 10' area, each one pound of potatoes thus obtained representing 7.3 sacks acre. It is best to dig in 4 or 5 spots and average the result.

We also plan on putting more effort into working in a similar way with bruise damage. Samples will be taken at various locations from the harvester and graded. We will then be in a position to recommend changes in the harvester to reduce the damage if it is found to be excessive. Bruise damage likely cannot be completely eliminated, but it can be reduced. The following points should be followed in your harvesting procedure:

1. Use proper cultural practice from plowing to digging. Excess clods damage potatoes. Keep field travel before harvest to a minimum. Minimize cultivation where ever possible.
2. Apply a light irrigation to soften clods and to mellow the soil just before harvest.
3. Slow down your equipment -- the digger speed should not exceed 1-1/2 mph and the digger chain speed should not exceed 150 feet per minute.
4. Make certain all chains are rubberized, i. e., digger chains, transfer and elevator chains on both combines and pilers.
5. Maintain a cushion of soil from digger point to transfer chain

6. Do not use kickers or eccentrics on digger chains unless soil conditions require them.
7. Pad the truck bed. The floor and sides of the truck where loading begins should be padded. First, build the load to the full height in the padded area and then position the truck so that subsequent potatoes always fall on a previously built mound, thereby reducing the distance they fall.
8. Never allow potatoes to drop more than 6 inches.
9. Select a potato combine that has a minimum of direction changes and thus minimizes the number of times the potatoes must fall from one chain to another.
10. Run unloading chains and piler chains not more than 70 feet per minute.
11. Use padding where ever damage might occur, whether it be on the combine, in the truck or at the piler.
12. Handle, load, unload and distribute potatoes gently. Train all personnel that potatoes injure easily.

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