Abstract

Samples of 28 different potato harvester chain links in seven different configurations were evaluated using the MSU-USDA Instrumented Sphere (IS). During the fall of 1989, 23 potato harvesters in Michigan were evaluated using the IS. Besides the IS impact data, each harvester was measured for chain speed relationships, operating ground speed, chain type and drop height. Testing of the harvesters did provide a range of data that represents what is likely to occur when the IS is used to evaluate individual harvesters. Based on the average peak acceleration and velocity change values (and the computed severity rating), air heads had the most severe impacts. The next most severe impacts were the primary chain, where all impacts were on steel. Next were the transitions to the rear cross and the side elevator, both of which involved a change of direction for the IS and the potatoes. Roller tables had the least severe impacts.

Compendio

Se evaluaron muestras de 28 diferentes eslabones de cadenas de cosechadoras, en siete diferente configuraciones, utilizando la Esfera Instrumentada de la MSU-USDA (IS). Durante el otoño de 1989, se evaluaron en Michigan 23 cosechadoras de papa utilizando la IS. Además de los datos sobre el impacto de la IS, cada cosechadora fue evaluada por sus relaciones con la velocidad de la cadena, su velocidad de operación sobre el terreno, tipo de cadena y altura de descarga. Las pruebas con las cosechadoras proveyeron un rango de información que representa qué es lo que puede ocurrir cuando se utiliza la IS para evaluar a cada cosechadora por separado. Basándose en la aceleración máxima promedio y valores de cambio de velocidad (y la tasa computada de severidad), las cabeceras de aire tuvieron el impacto más severo. Los siguientes impactos más severos fueron sobre la cadena principal, donde todos los impactos fueron sobre acero. Los siguientes fueron en las conexiones con la cruceta posterior y el elevador lateral, los cuales provocan cambios de dirección para la IS y las papas. Las mesas agitadoras tuvieron los impactos menos severos.

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Introduction

Growers, processors and researchers are aware that bruise damage reduces potato quality and value, and may lead to increased weight loss and disease in storage. Bruise damage often results from mechanical impact (3, 4, 5). Potato bruises result in a price decrease for the grower of processing potatoes, are undesirable to buyers of table stock potatoes, and result in decreased vitality in seed potatoes. Severe impact damage will result in a shatter bruise that is often the site for disease development.

The results of impact tests have been applied to the design of fruit harvesting and handling equipment (6, 8). Thornton (12) showed that appropriate harvester modifications will reduce potato bruising. The recommendations reported were developed from field observations of harvester performance, and did not include any quantitative analysis of the impacts involved.

The Instrumented Sphere (IS) developed by USDA and Michigan State University researchers (11, 13) provides a new tool for quantifying the impacts that occur in potato harvesting and handling equipment. When run through the equipment with the potatoes, the IS records the time and acceleration history of impacts greater than a specified acceleration level. The data extracted from the IS, when related with it's passage through the equipment, helps to locate the areas most likely to result in potato bruising.

The data presented in this report is for impact magnitudes in terms of peak acceleration and velocity change of the IS. Peak acceleration is expressed in G's, where gravitational pull produces 1 G while the IS is at rest on a surface. An impact of 100 G's represents a force that is 100 times greater than the weight of the IS. Velocity change is the area under the acceleration-time curve.

There is currently no information that relates impact data from the IS to actual bruising that occurs on potatoes that experience the same drop. It is known that variations in potato temperature will affect bruise susceptibility (7, 9).

The objective of the reported research was to measure the characteristics of impacts occurring in potato harvesters, for developing guidelines for interpreting the impact data obtained from the IS.

Materials and Methods

The research reported here was conducted in two parts. First, in the laboratory the IS was dropped from a series of heights onto a variety of chain links commonly used on potato harvesters. Second, the IS was taken to the field and run through potato harvesting equipment during normal harvester operations. The IS units used in these tests were 89 mm in diameter and weighed 337 grams.