DEVELOPMENT OF EQUIPMENT FOR LOADING TUBERS OR POST-HARVEST PRODUCTS ON TRANSPORT AND HANDLING MEANS

By

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B.Sc. Agric. Sc.(Mechanization), Ain Shams University, 2006

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ABSTRACT

Alshaymaa Mohammed Ramzy Abdel-Zaher : Development of Equipment for Loading Tubers or Post-Harvest Products on Transport and Handling Means. Unpublished M. Sc. Thesis, Department of Agricultural Engineering, Faculty of Agriculture, Ain Shams University, 2013.

This research represents some designable and operational factors for development of a product handling machine. A throwing machine was developed to suit the loading of tubers, such as: potatoes – sugar beet – table beet. The important designing and operating factors were studied, including: rotational speed – angle of throwing from the machine to fall a trailer – and initial throwing height. A model was made to simulate the machine by scale 1:2 with some changes in rotational speed, vanes angle, initial height, and throwing angle to suit tubers. The experiment was run on potato tubers. This machine is for use in loading tubers on trailers after harvesting for sorting and storage. Experiment included: range of rotational speeds from 300 to 800 rpm, two vanes rotor driven by motor shaft, three angles of throwing (55, 65, and 75 degrees), and changes in height of throwing and distance to the trailer.

Results revealed the following

- The most suitable angle of machine to throwing is 75 degree with horizontal direction
- The most suitable rotational speed range with less damage in tubers is 500 to 600 rpm
- The maximum tubers throwing height was 3:4 m
- The suitable horizontal distance to trailer with the highest throwing conditions of experiment was 3:5 m.
- The maximum efficiency of loading by designed machine was 78%.

Key Words:

Handling, Projectile motion, Rotary Machines, Tubers, Physical Properties, Agricultural trailers.

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I. INTRODUCTION

The shortage in hand labor in Egyptian farms has become a pressing problem in the recent decade. This shortage, in turn, has increased the costs of production in the field of agriculture.

In the Egyptian agriculture, the use of big machinery is berupered for the following reasons:

(1) It needs high technical experience, for operation and maintenance.
(2) High capital requirement.
(3) Low field efficiency in small holdings, and high mechanical damage.

To overcome such problems, appropriate loading systems have a good potential. Studies and investigations must be carried out on appropriate machines in order to adapt and develop under the local conditions. Therefore, the aim of this study is to investigate the possibility of the small machine to load potato tubers for hand-labor shortage and reduction of cost and crop losses during handling.

Tuber crops are one of the most important crops in Egypt, with an area of 13752 ha and productivity of 25939 kg/ha.Sugar beet area was 10822 ha with productivity of 47427 kg/ha in the year 2008 **according to (A.A.S.Y., 2008)**. Harvesting is carried out by using chisel ploughs to dig tubers up soil surface and then they are collected to transport for grading and packaging places. Handling operation of tubers is mostly by hand but machines have small role in it **(Kepner et al., 1982)**. The machine of this research is for loading tubers on trailers after harvesting for sorting and storage and to determine the suitable engineering factors to achieve it.

The specific objectives are to:

1) Design and construct a loading machine and test it,
2) Investigate the factors affecting loading operation,
3) Estimate the mechanical damage for potato tubers,
4) Determine the optimum distance for agricultural trailer from loading machine, and

5) Determine the cost of the potato tubers per ton loaded by handling machine.
6) Achieve the best efficiency of using time.
7) Determine less damage in tubers within loading.
8) Determine the maximum height can tuber up to in the out path from machine to arrival trailer.
9) Determine the best horizontal distance to set the trailer beside the machine, as well as the less damage can happen to the tubers.
10) Determine the maximum actual productivity can machine make it.

II. REVIEW OF LITERATURE

2-1- Tubers:

2-1-1 Potatoes:

Potatoes come fourth in food crop in Egypt after wheat, corn, and rice .Potatoes are on top of the list of tuber crops. Potatoes area is 13752 ha and productivity is 25939 kg/ha, and sugar beet is 10822 ha and productivity is 47427 kg/ha in year 2008 **(A.A.S.Y. 2008)**.

The available figures of the Annual Foreign Trade Bulletin **(CAMPAS, 1994)** indicate that potatoes represent 25 % of total Egyptian agricultural exports.

Kalifa (1996) showed that the value of potato exports was estimated at 108.2 million Egyptian pounds per year. On the other hand, he said that domestic production of potatoes was reduced from 1863 thousand metric tons in 1988 to nearly1728.6 thousand metric tons in 1994.

Egyptian National Bank (1997) showed the geographical distribution pattern for Egyptian potato exports. It reveals the following important points:-

- England, Greece, Germany, France, Holland, and Italy are considered the most important Egyptian potato importers.
- The amount of Egyptian exports of potatoes, which is directed to the European countries, is about 1.45 million tons, representing about 65.1 %of the total Egyptian potato exports.
- Saudi Arabia, Kuwait, UAE, and Bahrain absorb about 17.3 % of the total Egyptian potato exports.
- In the last few years, the Egyptian potato exports, which are directed to European countries, dropped by about 3.8 %. Meanwhile, the potato exports towards the Gulf countries through their cooperation council (GCC) dropped by about 32.7 %.

(The national potato cultivation project in Egypt, 1996) reported that all seeds necessary for the winter crop are stored for 4-5 months in

cold stores. Seeds for the fall crop are partially stored under uncontrolled conditions. The project limited the storage options as follows:

- Potatoes are stored not only for seeds but also for different purposes. The method of storage has major implications for the quality of the product and for losses due to pests and diseases.
- Storage involves costs, and when the storage period increases, the value of the stored product is subject to price risks. These costs and associated risks influence the farmer storage behavior.

One important consequence is that, under Egyptian conditions storage for seeds and storage for consumption cannot be considered as separate activities, in many cases, the two purposes will interact.

In addition, systematic storage policies may influence market prices themselves, by withholding sizable quantities from entering the market immediately after harvest, However, a glut might be avoided and producer prices will be improved and do not fall as much as would otherwise consumers will be protected. Thus, storage does play a role in achieving some degree of price stabilization.

However, experience in many countries shows that following an intelligent storage policy is rather complex, especially in unstable market conditions and for relatively perishable commodities such as potatoes. Moreover, anti-cyclical storage policy could easily become pro-cyclical storage behavior, aggravating price fluctuation amongst market parties.

The third option exists when the government interferes directly in storage and marketing, in an attempt to balance conflicting interests in storage. This arrangement was widely practiced in the past in Egypt, but under the changed policy framework, and a diminishing role foreseen for government, this type of intervention may become the exception rather than the rule.

Potatoes in Egypt are stored out in the open field, near to or sometimes (partially) in the farmers' house. They might be stored on the ground and covered by straw. Potatoes may also be stored in Nawallas, or in modern cold stores.