[1.]Hüseyin SAUK, [1.]Kemal Çağatay SELVI, [2.]Kabaş ÖNDER

AN OVERVIEW OF HAZELNUT HARVESTING MACHINES WITH DIFFERENT DESIGNS

[1.]Ondokuz Mayis University, Department of Agricultural Machinery and Technologies Engineering, TURKEY
[2.]Akdeniz University, Vocational School of Technical Science, Antalya, TURKEY

Abstract: Many factors (Topography, soil characteristics, planting technique etc.) affecting the applicability of mechanical harvest in hazelnut. Today, many of these factors have been developed to overcome the adverse effects. As a result, there are differences in mechanical harvesting techniques applied to different production regions around the world. Information was given about hazelnut harvesting machines which have different collecting units designed and manufactured in order to reduce harvest expenses and labor force requirement which are important in hazelnut production cost with this study.
Keywords: hazelnut harvesting machines, mechanical harvesting, pneumatic harvesting, hazelnut mechanization

INTRODUCTION

The hazelnut (Corylus avellana L.), one of the World's major nut crops is one of the most important agricultural products in Turkey (Yıldız T., 2016; .Selvi K.Ç. 2017), since as agricultural products have relevant nutritional and economic value (Zambon et al, 2017). The traditional harvesting method consists in collecting hazelnuts from ground and a preliminary accurate selection is then needed to avoid stones, ground, brunches, leaves, etc. (Delprete and Sesana, 2014). In recent decades, advanced technology and the latest results of scientific research have been largely applied in agriculture in order to improve the quality of products and to increase productivity (Bachche S., 2015). This situation has increased the use of mechanization in hazelnut harvest rapidly instead of traditional harvesting methods.

Mechanical harvest of nuts include such as, ground preparation, dropping of fruits, stacking of dropped fruits, collecting and cleaning process. In Italy, Spain and USA, which produce hazelnuts economically, the mechanical harvest has been widespread by the amount of planting technique and land topography allowed. In Italy, Spain and USA, which produce hazelnuts economically, the mechanical harvest has been widespread by the amount of planting technique and land topography allowed. For this purpose, machines with pneumatic (vacuum), pneumatic + mechanical and mechanical effective sweeping units are used. As a basic principle in the first harvesting machines developed for this purpose, aspiration of the fruits dropped to the garden floor was taken into account (Parks and Fairbank, 1948), followed by mechanical and aspiration + mechanical collector combination methods (Fridley and Adrian, 1959; Whitney et al, 1966).

MATERIAL AND METHOD

In working with these machines, a good preparation of the ground (levelling and compacting) and a spreading product with lateral sweepers are required. The fact that the hazelnuts cultivated in the countries are short-husked as a kind of characteristic, causes the hazelnuts to be poured as grains during the harvesting period.

For this reason, no husk separation machines are used. Due to the definable geometric shape of the hazelnuts, it is possible to effectively clean them with known separation methods. Uncleaned stone and other elements are separated in water pools and cleaned nuts are dried in desiccants.

In the production of nuts in our country, the harvesting process is the way of pouring the fruits by shaking and then collecting them by hand from the floor or the branches. Harvesting with this method constitutes approximately 74% of the total labor requirement. This situation increases the production cost of hazelnut significantly and causes labor force based on heavy labor during the harvesting period.

The fact that the Turkish hazelnut varieties have a long husk and that the fruit is tightly wrapped and does not have an identifiable geometric shape makes the separation systems of such machines ineffective. In addition, the effectiveness of the sweeping units is also diminishing due to the differences in the planting technique and the characteristics of the garden grounds. Also, the large size of the machines creates problems due to the sowing technique. Despite the Italian machinery manufacturers have worked to enter the market for decades Turkey (demonstrative trials by farmers in bringing the machine to the garden Turkey) have not been successful due to the lack of appropriate equipment.

In this study, hazelnut harvesting machines having different collecting units designed and manufactured in order to reduce the harvest expenses and labor force requirement, which have an important place in hazelnut production cost, were examined.

RESULTS

— Trailer type pneumatic nuts collection machines

Trailer type pneumatic nuts collection machine consists of 5 main units as aspirator, separator, unloader, suction mouth and transmission hose. This type of machine takes the movement of a diesel engine mounted on the tail shaft by a shaft or on a belt-pulley system. The general view of the pneumatic nuts harvesting machines is given in Figure 1.

As can be seen from Figure 1, the nuts, leaves, small branches, stones and powders collected by the suction pipe from the ground come to passive separators. As the mixture discharged from the separator passes through the air stream created by the

fan, leaves and other light materials are removed. The remaining hazelnut is separated from the foreign material by the large-hole rotary sieve and the small-hole sieve. The cleaned nuts pass through the air conveyor fed by the radial ventilator and are bagged in here.

Figure1 - General view of trailer type pneumatic nuts collection machines

It is reported that in the previous studies, the product work performance changed according to the yield of the garden, and as the garden productivity increased, the work performance of the machine increased. In addition, it has been determined that the production of fruit gatherers improves the product performance significantly and reduces the labor requirement (Biondi et al, 1992). According to the productivity of the garden, the product work performance was between 14.95-38.21 kg/Ewh (Ewh=Employee working hour), the harvesting efficiency was between 92.43 % and 95.13 % and the field work success was between 0.428-0.352 ha/MLh (MLh=Machines labor hour) non-collecting the hazelnuts by hand and moving the delivery hose by hand has been reported (Beyhan M., 1992). Again, Sauk (2016) reported that under naturel spillage and in five different garden yield conditions, the product work success, collecting efficiency and the area of work success were between 18.90-67.18 kg/h, 97.68% and 99.36% and (in the case of harvesting the hand- from floor) 0.014 to 0.009 ha/MLh respectively.

— Movable type pneumatic nuts collection machines

The movable type pneumatic picking machines are pulled by the tractor according to the movement transmission system (Figure 2) and are divided into two groups as a self-propelled and trailer type (Figure 3).

Figure 2 - General view of trailer type pneumatic nuts collection machines

As seen in Figure 2, this type of machine takes its movement from the pto shaft of the tractor. Unlike non movable trailer type pneumatic hazelnut collection machines, sweeping units are added to the suction mouths of these machines. This unit is sweeping into the pre-barrel nipple suction tube.

Figure 3 - General view of self-propelled type pneumatic nuts collection machines

As can be seen in Figure 3, the nuts that are naturally poured into the garden floor are turned into barrels by the sweeping unit and delivered to the machine by suction hose. Monarca et al. (2009) obtained product work performance, work force requirement and field work performance values of different types of hazelnut harvesters in different gardening conditions as in Table 2.

This type of machine is absorbed into the leaf, small stone, soil and coarse dust machine with the grain + ground nut from the ground of the garden, spreading a lot of dust which can be harmful to workers' health and environment. For this purpose, dust emission is

reduced by using filters made of cyclone and napkin in type machines.

Table 1. Some work parameters of hazelnut harvesters in different gardening conditions (Monarca et al, 2009)

Garden yield (t/ha)		Unit	Trailer type	Self-propelled
3.7	Product work performance	(kg/h)	880	985
	Labor requirement	(h/ha)	4.21	3.76
	Field work performance	(ha/h)	0.24	0.27
1.8	Product work performance	(kg/h)	627	980
	Labor requirement	(h/ha)	3.03	2.04
	Field work performance	(ha/h)	0.33	0.49

— Mechanical Hazelnut Picking Machine

These types of machines with mechanical collection system consist of four main units: collection unit, separation system, and storage and power supply-hiking system. The general appearance of mechanically effective nuts harvesting machines is given in figure 4.

Figure 4. - The general appearance of mechanically effective hazelnuts machines

As can be seen from Figure 4, these machines are generally large in size and are widely used in modern gardens in the USA and France. Collecting machines which can be used in small gardens and can be mounted on garden tractors at 10-16 HP have also been developed

First, the machine's collection unit, developed by Peterson and Monroe (1977), consists of a drum with spirally placed rubber fingers. With this machine, 91% collection efficiency was achieved at 1.21 km/h speed and 70.2 min-1 rotation speed of collection drum, and field work performance was between 0.1-0.14 ha/h.

Later on, Ghiotti (1989) developed a prototype system based on the principle that the chains of chains attached to a drum rotating in the opposite direction of motion hit the fruit. In previous studies, Yıldız (2000) has designed a prototype nuts collection machine with a tractor-driven mechanical pick-up, and said that this machine consists of four main units: picking, spiral conveyor, launcher and conveying channel. The prototype nuts harvesters were taken in the experiment under different garden yields, feed speeds and number of different picking cycles. It determined that the collection efficiency was 91.66% and the product work performance was 100.29 kg/h when garden yield at 225 kg/da, 3.2 km/h feed speed and 430 min^{-1} rotation speed.

Fanigliulo and Tomasone (2009) have worked on different garden floors with a mechanically effective nuts collection machine that is mounted on trailers. In the study, the product work performance of the machine and the field work performance in the grassy field were determined as 2.5 t/h and 0.35 ha/h respectively. In the case of non-grass conditions same variables were measured as a 2.6 t/h and 0.38 ha/h respectively

Pagano et al. (2010) have determined that the machine has a field work performance of 0.64 ha/h, a product work performance of 1.25 t/h and a collection efficiency of 71% in order to determine the performance values of a mechanically effective hazelnut harvester developed for flat terrain

Sauk (2016) examined the possibilities of mechanical harvesting nuts grown in Turkey close to flat and flat land. Sauk tried a mechanically effective prototype nut harvesting machine under different gardening conditions. As a result of the work, the field work performance was found to be 0.158-0.102 ha/h and the product work performance was 124.83-1322.08 kg/h.

CONCLUSIONS

In countries that produce hazelnuts economically in international markets, mechanical harvesting methods have been developed according to the land topography, planting technique and the nature of the hazelnut variety. However, to meet a large part of world hazelnut production to be manually gather the nuts in Turkey is thought-provoking. In our country, the development of suitable mechanical harvesting methods for the planting technique and hazelnut planting where land topography is appropriate will be important in terms of cost reduction. Thus, the reduction in the cost of harvest due to the degree of mechanization of the hazelnut harvest will increase our competitive power in international markets.

A hazelnut harvester should be designed with high efficiency and sweeping efficiency in an ergonomic principles direction that takes into consideration the user comfort and safety of work, with a mechanically effective sweeping system that can make hazelnut harvesting in plain and sloping terrains taking into account the conditions of our country.

Depending on factors such as distance between branches, branch height, branch angle etc. in existing hazelnut gardens, the basic

dimensions of the machine should be determined and these systems should be placed within this dimension. When such a hazelnut harvester is manufactured, the cost of harvesting and demand for hazelnut labor cost will be reduced, and on the other hand it will be economically and ergonomically beneficial, as the harvesting of hazelnuts will not damage the branches.

Thus, with the realization of gardening and manufacturing of a machine suitable for our hazelnut varieties, an important step will be taken to mechanize the hazelnut which is one of the most important problems in our country.

Note:

This paper is based on the paper presented at ISB-INMA TEH' 2018 International Symposium (Agricultural and Mechanical Engineering), organized by Politehnica University of Bucharest – Faculty of Biotechnical Systems Engineering (ISB), National Institute of Research-Development for Machines and Installations Designed to Agriculture and Food Industry (INMA) Bucharest, The European Society of Agricultural Engineers (EurAgEng), Society of Agricultural Mechanical Engineers from Romania (SIMAR), National Research & Development Institute For Food Bioresources (IBA), University of Agronomic Sciences and Veterinary Medicine Of Bucharest (UASVMB), Research-Development Institute for Plant Protection (ICDPP), Hydraulics and Pneumatics Research Institute (INOE 2000 IHP), National Institute for Research and Development in Environmental Protection (INCDPM), in Bucharest, ROMANIA, between 01–03 November, 2018.

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ISSN: 2067-3809