

CONSIDERATIONS REGARDING THE HARVESTING AND PROCESSING OF WALNUTS

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Abstract: Establishment of walnut plantations can be a successful business in the medium and long period of time. In terms of planting technology, maintenance, harvesting and recovery of the walnut kernel, it is not needed for a considerable effort from both the financial and the labor force. Harvesting and peeling walnuts from the green cover can become one of the easiest stages in the exploitation of walnut plantations. In this context, existing walnut harvesting machines and equipment on the market can ensure and meet the farmer's requirements. Self-propelled, or towed walnut harvesters can also be used on sloping land. The existence of nut shakers makes it possible to shorten the harvesting period and increase the harvesting efficiency for large plantation areas. The harvesting period of walnuts differs from one variety to another and even from one tree to another. It can be considered that even at the level of a tree the nuts have different harvesting phases (nuts usually have a massive crown), depending on their position. Depending on the variety that has been planted, and the geographical position of the walnut culture, distinguishes three categories of walnut ripening periods – early, semi-early and late. If the harvesting and preservation of walnuts is done in strict compliance with the harvesting technologies and their preservation, can last for years without losing the taste qualities. Due to the very high demand on the market, the development of a walnut plantation business on large areas can become very attractive. Considering that young walnuts have the crown formed without the intervention of the human factor, we have new evidence that walnut plantations are easy to maintain compared to other types of plantations.

Keywords: walnut harvesting, walnut peeling machine, walnut processing

INTRODUCTION

Walnut cultivation was first certified in temperate areas of the Balkans, this being an optimum area for growing and developing. Walnut plantations have been developed in countries such as Iran (Hassani D., et al, 2020), Greece, China (Liu, et al, 2020), Serbia, Hungary (Bujdosoa and Csekeb, 2021), France, Bulgaria and Romania. In 2017, Romania have been ranked on first place in the production of walnuts within the European Union, after France and Italy, with a production of 45,800 tons (<https://agrintel.ro>). From a genetic point of view, in recent years the walnut has experienced a great development. Many producing countries such as France and the USA have studied the morphological characteristics of walnuts intensively (Bernard A. et al, 2018). The walnut is reaching a height of up to 30 meters, for certain varieties. Walnut fruit (core) is used in both the food and pharmaceutical industries (Pahlavani et al, 2020). Walnut flowers, walnut bark and green coating have various uses in various fields, cosmetics, textiles, food, pharmaceuticals (Yuzhu Wang, et al., 2021). Walnut wood is very often used to make furniture and various decorations, even luxurious ones that we can find everywhere.

The harvesting period of walnuts differs from one variety to another and even from one tree to another. It can be considered that even at the level of a tree the nuts have different harvesting phases (nuts usually have a massive crown), depending on their position. Those located towards the outside of the crown, tend to get mature in a shorter period than those located in the interior of the crown. Depending on the variety that has been planted, and the geographical position of the walnut culture, distinguishes three categories of walnut ripening periods – early, semi-early and late.

In Romania the walnut harvest period can begin in the second part of August and can end at the end of October. For each variety, the period of ripening and harvesting walnuts cannot last more than two to three weeks. In general, the nuts are harvested gradually and fall on their own on the ground, then they are gathered, manually or mechanized. Another option that can be used especially for walnut plantations, especially on very large areas is the mechanized shaking of nuts with the help of self-propelled equipment, built especially for the execution of this operation. (<https://cultivaprofitabil.ro>).

If the second option is used for harvesting, i.e. mechanized forced shaking, a very large number of nuts will be covered by the green shell. Special equipment have to be used to remove the peel. If the harvesting and preservation of walnuts is done in strict compliance with the harvesting technologies and their preservation, can last for years without losing the taste qualities. (Charrier G. et al., 2013; Hua, et al, 2021; Maa, 2021).

MATERIALS AND METHODS

Walnuts are usually harvested depending on the weather, at the beginning of autumn. If there is a small number of fruits, they can be harvested manually, in several stages. In this option, only the nuts that have come off the green cover and fallen to the ground will be harvested. If aim for a faster harvest, then can opt for shaking the nuts. In the industrial system, nuts are being harvested by manual shaking and for very large areas mechanized shaking.

If the shaking process is performed manually or mechanically, a large part of the nuts will fall to the ground with the green coating as can be seen in Figure 1 a) and after cleaning with a special machine, Figure 2 b).



(a)



(b)

Figure 1. Green walnut cleaner a) before cleaning, b) after cleaning
(<https://nuttechnology.com>)

The green walnut peeler Figure 2 a) and b) can remove the green shell of the walnuts in a very short time, leaving the whole bark of the walnut without cracks or fissures. The capacity of such an equipment is 100 kg / h.



(a)



(b)

Figure 2. Overview of a variant of the green walnut cleaner a) overview, b) the cleaning basket of the equipment (<https://nuttechnology.com>)

As can be seen, the equipment is driven by an electric motor mounted on the inferior part, which rotates the bottom of the container, which will engage the nuts in a rotating motion. The walnuts are introduced in the container from figure 2 b) that has a walnut watering system (figure 1 a). Therefore, due to the conditions created by rotating and watering the nuts, and due to friction between them and the walls of the container, they will separate from the peel (Figure 1 b). Another constructive solution for cleaning walnuts is found in figure 3, where the following components can be identified: the housing of the machine with the movable opening system, the feeding basket with green nuts, adjustment system according to the material to be cleaned, the device start stop of the machine, the gutters for the evacuation of green shells and cleaned nuts, the wheel system.

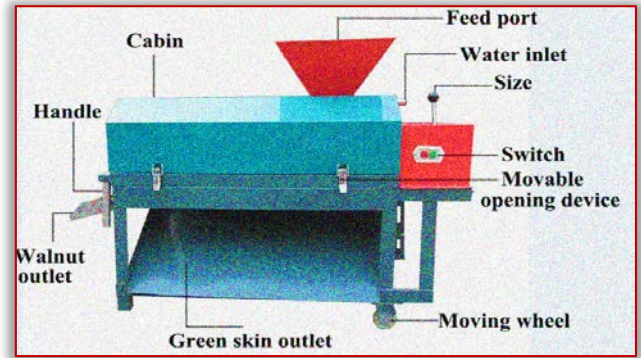
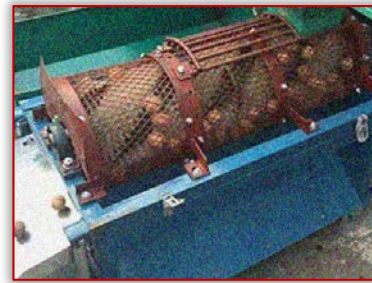


Figure 3. Green walnut peeler
(<https://wuhanhdc.en.made-in-china.com>)

As can be easily seen, by describing the components of the machine, the green-shelled nuts are inserted into the cleaning container, and by adjustment, rotation and friction the separation occurs as can be seen in Figure 4 a) and b).



(a)



(b)

Figure 4. Green walnut peeler cleaning system a) Gutter for peeled walnuts, b) Gutter for green peel (<https://wuhanhdc.en>)

Throughout this process of cleaning the nuts, water is also introduced, which improves the process of peeling, washing and evacuating the nuts and green shells from the container. The productivity of such an equipment is 800–1000 kg / hour. The rate of mechanical damage to walnuts is up to 1% and the rate of removal of green shells is 99%. Compared to the option of removing green shells by hand, with the help of this machine the work efficiency is amplified by more than 20 times. The equipment has the following technical characteristics, presented in Table 1.

Table 1. Technical characteristics

Model	JY – 100
Power	0.75 – 2.2 Kw
Capacity	600 – 1000Kg/h
Overall dimensions	950x450x850 mm
Weight	75 Kg

The power supply of the machine can be 220 V or 380 V, (<https://wuhanhdc.en.made-in-china.com/product/>) Another model of green walnut peeling machine is presented in Figure 5, named AK 10 having a capacity of up to 800 kg / h. It is an equipment with a portable power supply of the driving motor for small nuts.

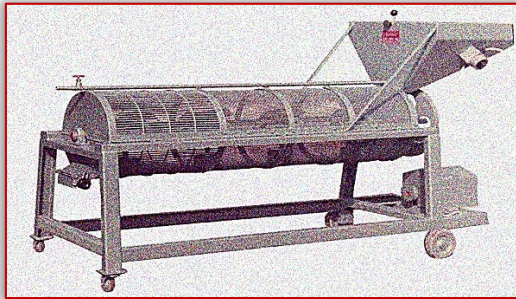


Figure 5. AK 10 green walnut peeling machine (<https://www.bionot.gr>)

In figure 6 a) and b) can be seen schematically, the floor of the container where the nuts are peeled, the abrasive shape and the side walls of the tube which are abrasive, and contributes to the quality of walnut cleaning.

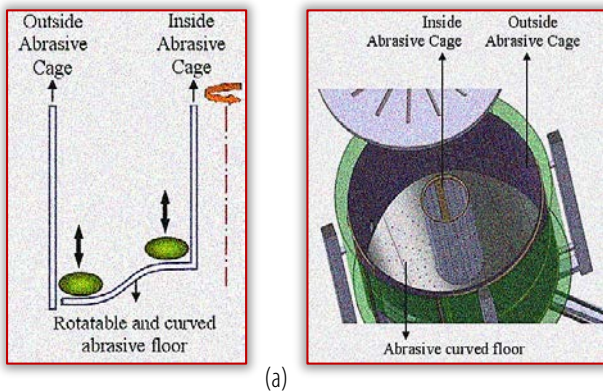


Figure 6. Green walnut cleaning system a) with abrasive and sloping floor, b) abrasive exterior walls (Mohammad Younesi Alamooti and Esmail Mahmoodi, 2015)

In conclusion, a centrifugal mechanism is used for the options of green walnut cleaners. It should be mentioned that all the equipment described above have a constructive solution and a simple assembly and easy maintenance. They can be equipped with automation systems that increase productivity and cleaning quality. They can also be used for other products such as pistachios or other nuts. Various adjustments can be made to improve the quality of walnut cleaning by using a curved floor of the container (figure 6 a), by changing the spinning speed of the container, using abrasive surfaces inside the container in different geometries (Alamooti, 2015).

RESULTS

Before processing, the nuts have to be first shaken and collected from the ground. This operation of harvesting nuts can be performed manually or mechanized. For the mechanized option, one of the companies that produce harvesting and cleaning equipment for harvesting walnuts is the company Glampi. This company produces self-propelled combines for harvesting walnuts, almonds, hazelnuts, etc. In figure 7 a) and b) we have the self-propelled combine

designed to harvest various types of nuts (walnuts, almonds, hazelnuts) called FUTURA100, in the working position figure 7a) and in the transporting position figure 7 b).



(a)



(b)

Figure 7. FUTURA 100 Self-Propelled Combine, a) in working position, b) in moving position (<https://utilajenucifere.wixsite.com>)

During travel, the FUTURA 100 self-propelled combine develops 2 gears, the first up to 8 km / h and the second gear up to 35 km / h. It has 4x4 traction, the engine that equips this combine is of Kubota type and develops a power of 55.4 KW, the working width varies from 2.20 to 5 m. The total weight of the equipment is 3160 Kg, and the harvesting capacity is 2500–3000 kg / h.

Giampi also produces STAR 1600 nut harvesting machines, figure 8 a), and STAR 2000 from figure 8 b), a machine that can be attached to all types of tractors that can tow a weight greater than 550 kg, (STAR 1600) respectively 642 kg as the STAR 2000 machine has. The average harvesting speed for these models is 1 –3 Km / h and the gathering capacity of the nuts is 700–1500 Kg / h.



(a)



(b)

Figure 8. Walnut harvesters (<https://utilajenucifere.wixsite.com/giampi>) a) STAR 1600 nut harvesting machines; b) STAR 2000 nut harvesting machines

The harvesting with this type of equipment is performed entirely mechanized with the help of a transverse brush. The rotational movement of 540 or 1000 rpm is taken from the power take-off of the tractor towing the machine. Transverse brush movement can also be done using a hydraulic system that contains an oil pump, an oil tank and an oil cooling radiator. In addition, the harvesters can be equipped with a side collector.

Another constructive solution for harvesting nuts is found in the STAR 211 and STAR 311 models that we can see in figure 9 a) and b), manufactured by the same manufacturer, Giampi.

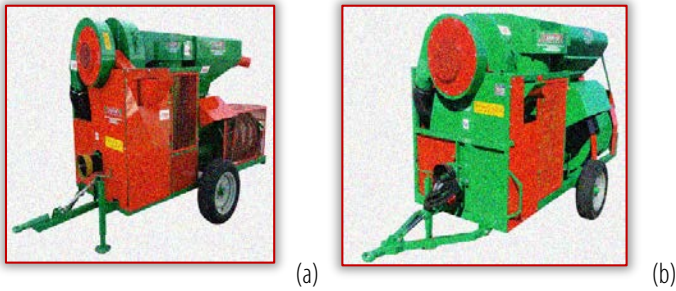


Figure 9. Nut harvesting equipment a) STAR 211. b) STAR 311
(<https://utilajenucifere.wixsite.com/giampi>)

In this type of equipment, the harvesting is performed using a turbine with a pipe, having variable diameters between 120–140 mm and lengths of 6/12/24 m. This constructive solution allows harvesting a wide range of products (walnuts, almonds, hazelnuts), on harder to reach lands. The power required to operate such a machine is 35 Kw, weighs 750 Kg and requires 2 operators during functioning. The machines are driven from the power take-off of the tractor which drives a suction turbine. Depending on the size of the harvested products, the diameters of the sieves change.

Another company from France, named AMB ROUSSET offers a wide range of products for harvesting nuts, cider apples, hazelnuts, almonds, sweet chestnuts. In figure 10 a) and b) is presented the self-propelled walnut harvester R 19, figure 10 a) and the dimensions of the equipment, figure 10 b).

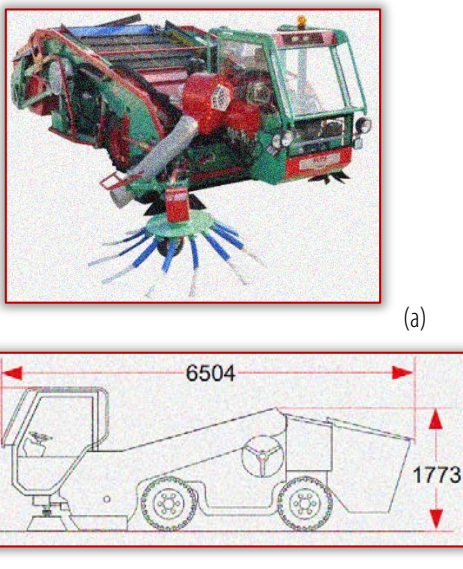


Figure 10 Walnut harvester R 19 a) Overview, b) overall dimensions of the walnut harvester R19 (<https://www.amb-rousset.com>)

In addition to the R19 self-propelled combine model, we also find other variants of the same French manufacturer such as: R17, R22, R23, R35. The engine for these types of self-propelled combines is German (Deutz, 90Kw power), offering increased reliability. The fact that all four wheels of the equipment can be turned, offers conditions for making complex maneuvers in walnut plantations that can be found on hard to reach lands. The tires are also wide in size, to limit the footprint on the ground. It is approved for driving on public roads. Due to the lifting height of the hopper, which is 2.90 m, it can be unloaded in any type of trailer (means of transport) or storage container.



Figure 11. Walnut shaker AMB Rousset

Founded in 1967, Orchard-Rite is a leading manufacturer in the orchard harvesting equipment industry, having very good quality and reliability products. Bullet nut shaker is a towed model that can be attached to any type of tractor. (<https://www.cat.com>)

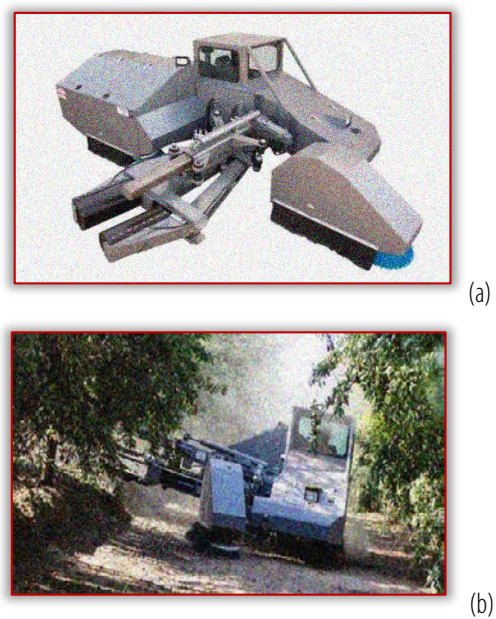


Figure 12. Bullet nut shaker, a) Overview, b) Working
(<https://www.agriexpo.online>)

The nut shaker produced by Orchard–Rite and presented in Figure 12 (a) and (b) is a self–propelled machine that shakes both the trees and gathers the nuts from the ground. The shaker head is rotated up to 50 degrees and the fact that is equipped with lights, helps harvesting at night. The reliability of the equipment ensures a quality shake that leads to a very small loss of unharvested nuts. The multiple shaking frequencies, the high–performance shaking head lubrication system offer special protection to the trees and make this machine a very high–performance one. (<https://www.agriexpo.online>).

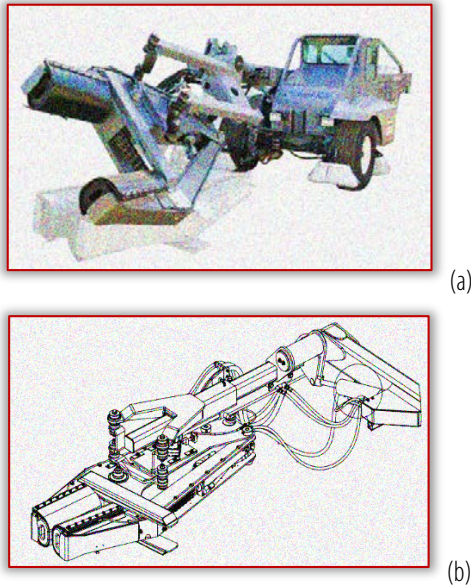


Figure 13. Monoboom nut shaker a) Overview, b) Shaker sketch

In figure 13 another model produced by the Orchard–Rite company is presented, having similar performances and reliability as the equipment presented before. Sicma – TR80 shaker, shown in figure 14 a) and b) can be coupled to any type of tractor with a minimum power of 90 hp.



Figure 14. Sicma TR 80 shaking machine, a) With tarpaulin to be collected in the transport position, closed, b) With tarpaulins to be harvested in the working position, open (<https://www.agromaquinaria.es>)

The lifting and lowering ensembles and the vibrating head are operated by means of a remote–control system. The arm has a freedom of rotation of 90 degrees. The collection tarpaulin configured in a convex position has a diameter of 5 or 6 m. The vibrating head has an opening of up to a maximum of 480 mm and is equipped with a self–braking system. The fastening system of the tractor is in three points and with two support wheels (semi–worn), (<https://real-deal.ro>).

CONCLUSIONS

Due to the very high demand on the market, the development of a walnut plantation business on large areas can become very attractive. The profit that can be obtained from such a plantation, the longevity of a plantation, the easiness in maintenance may other good reasons why setting up a walnut plantation can become very profitable. Considering that young walnuts have the crown formed without the intervention of the human factor, we have new evidence that walnut plantations are easy to maintain compared to other types of plantations. In cases where the plantations are established on large areas, there are machines and equipment for harvesting the nuts that can do all the mechanized harvesting operations. There are internationally companies that produce nut harvesters, self–propelled, towed, semi–mounted. There are also machines and equipment for shaking nuts, on the ground or on various tarpaulins placed around the trees. Other self–propelled walnut harvesters can perform both the shaking operation and the ground nut collection operation in the combine hopper. One of the advantages of using mechanized harvesting is that the shaking of walnuts can be performed in a single pass, compared to manual harvesting where the process takes more time.

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