

RESEARCH ON DEVELOPING A MULTIFUNCTIONAL EQUIPMENT FOR HARVESTING MEDICINAL AND AROMATIC PLANTS FOR USE ON SMALL AREAS

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ABSTRACT

Cultivation technologies of medicinal and aromatic plants characterize harvesting operations as being difficult, because they have a significant effect on the plant material quality. Therefore, regardless the harvesting method used (either manual or mechanical), the intervention on the useful part of the plant have to be kept to minimum.

Mechanized harvesting is usually an important prior factor for achieving profitable productions, and this aspect is also valid for medicinal and aromatic plants.

In order to improve and adapt the cultivation technologies to the current Romanian requirements, and analyzing previous practical experiences, INMA Bucharest has achieved a multifunctional equipment for harvesting annual and perennial medicinal and aromatic plants, with applicability on small land surfaces.

The paper presents the experimental model of an innovative equipment and the expected advantages, compared to the previously made harvesting equipment.

INTRODUCTION

Even from ancient times, there has been a close relationship between humans and herbs. Many studies indicate that medicinal and aromatic plants are characterized by a high concentration of biologically active compounds. Those that are part of the polyphenol and carotenoid groups have strong antibacterial, antioxidant, anticancer effects, positively influencing the entire human metabolism (Asadi-Samiani et al., 2016, Sartip et al., 2015, Embuscado 2015). Currently, according to the World Health Organization, up to 80% of the world's people depend on traditional medicine for their basic health needs (Joharchi and Amiri, 2012).

Although medicinal and aromatic plant crops are part of the niche category, it is often said that they would represent an opportunity for local farmers, areas cultivated with these species have heavily declined in recent years. According to

MARD data on medicinal plants, in 2017 3.2 thousand ha were cultivated with a production of 4.1 thousand tons; in 2018, 1.8 thousand ha were cultivated with a production of 2.2 thousand tons, in 2019 1.7 thousand ha were cultivated, resulting in a production of 1.9 thousand tons (www.madr.ro).

The purpose of growing medicinal and aromatic plants is to obtain a plant material that can compete in terms of quality and price with that on the international market or with that from spontaneous flora (Lubbe and Verpoorte 2011). In our country, these species are generally grown on small and medium surfaces, suitable for the establishing of organic crops. At the level of 2018, the area allocated to organic farming represents only 2.4% of the agricultural area of our country, thus placing us on the last places in the EU (www.green-report.ro/eurostat).

The evolution of surfaces cultivated with medicinal and aromatic plants is influenced by the fluctuations of the prices of the international profile markets, of the processors and by the availability of the import of raw materials (Mašan and Kopta 2016).

The harvesting of medicinal and aromatic plants is a difficult operation, which, regardless of how it is performed, manually or mechanically, must affect as little as possible the content of active

MATERIAL AND METHOD

The methods of performing mechanized harvesting of medicinal and aromatic plants differ in relation to the useful part of the plant being collected, the manner of execution of the operation and the size of the cultivated surface.

Harvesting systems having a cutting device perform the sectioning of plant stems at a determined distance from the ground, with its help, by shearing. The cutting devices can be the classic ones, with single or double blade, collecting the aerial part of the plants. In some species this kind of harvesting is practiced, after the inflorescences have been harvested (eg chamomile), and in others it is practiced from the beginning (mint, hyssop, etc.).



Fig.1 FR32 harvester

Medicinal and aromatic plants grown in strips can be harvested with this kind of equipment provided with special elements (fig.2), the width of the strips being compatible with the working width. The company has also developed a wide range of equipment of this type, with

principles of the plant material obtained. Mechanized harvesting contributes to increasing the yield of these crops (Öztekin & Martinov 2007, Ivanović and all. 2014).

The paper briefly presents the current state of medicinal and aromatic plant harvesters, used on small areas, as well as an experimental model of innovative equipment of this type, developed by INMA Bucharest.

De Pietri company (Italy) produces self-propelled equipment for harvesting leafy vegetables (parsley, basil, spinach, lettuce) and medicinal plants (sage, nettle, mint, lavender, etc.) on small and medium areas, grown in strips, in greenhouses or directly in the field.

Of these, the FR 32 harvester (fig.1) is controlled by a joystick and a multifunction dashboard. The power source is a 30 HP engine, and the hydrostatic transmission is electronically controlled on board. The equipment is provided with a cutting device. The working height adjustment can be controlled by either electronic or hydraulic sensors. None of the solutions cause damage or abuse to crops and soil. The working width is between 120-180 cm, and the working speed of the conveyor belt (made of PVC) can be adjusted.



Fig.2 FR32 harvester with a kit for harvesting medicinal plants

interesting technical particularities. Thus, ECO type models were made, provided with electric motors, with accessories for product processing or driven by an automated pilot (www.depietri.it).

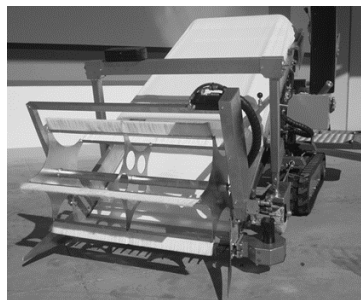


Fig.3 AROMATICA equipment

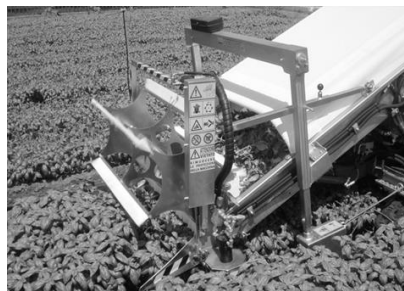


Fig.4 AROMATICA used for harvesting basil

ORTOMECC (Italy) manufactures, among many other models of harvesting machines, the AROMATICA specialized equipment (fig. 3) for harvesting aromatic plants, usable in the field (fig. 4) or in greenhouses. This is a self-propelled system (with wheels or rubber tracks) equipped mainly with a double-edged blade and a conveyor elevator. For efficient harvesting, in front of the equipment was placed a harvester with horizontal bars, which has the role of directing the plants to the cutting system, its position being adjustable. In order for the bars not to cause damage to medicinal and aromatic plant crops, brushes with a wire length of approx. 50-60 mm are fitted on it. The transmission of the equipment is hydraulic-mechanical with 4 gears. Driving and control is done using a joystick. The power source is a 2-cylinder diesel engine. The control of the cutting height is done with the help of sensors, and the working width is that of the cutting device (1.2 m) (www.ortomec.com).

Harvesting of medicinal and aromatic plants on small areas is done with the help of flexible equipment, portable or pushed by the operator / operators. The field of use of portable mowers, originally intended for harvesting tea leaves, has been extended to crops of medicinal and aromatic plants, lavender, leafy vegetables.

OCHIAI company (Japan) produces the VPS-1210B equipment (fig.5), by mounting a portable mower on a frame. It is intended for harvesting by cutting of different types of leafy vegetables, medicinal and aromatic plants, flowers, lavender, etc. (www.ochiai-1.co.jp). HortiHands company (Netherlands) offers solutions for a wide range of equipment for nurseries, greenhouses, lavender growers, medicinal and aromatic herbs. The equipment from the EasyFrame range (fig.6) are made of portable Ochiai mowers with widths of 120-160 cm, mounted on frames with various configurations, depending on the destination (www.hortihands.com).



Fig.5 VPS-1210B harvesting equipment



Fig.6 EasyFrame Equipment

Harvester Concepts company (New Zealand) produces several types of

harvesters for harvesting flowers, lavender, medicinal and aromatic plants,

leafy vegetables, etc. from small plots and experimental horticultural fields. They are equipped with double blade cutters, classified according to destination, which implies the working height (h): Low Cut Harvester (h = 0 ... 125mm), Medium Cut Harvesters (h = 40...400mm), Bush Type Harvesters (lavender, rosemary, echinacea, etc.).

The HT-KumaP harvester (fig.7) (Medium Cut Harvesters) picks up the cut material in a collection bag using the motor-driven conveyor. The working width is 800 mm (1200 mm). Optionally, the equipment can be fitted with plant lifts or with a reel that directs the plants to the cutting device. The reel is driven by a belt drive from one of the front wheels of the equipment. The cutting device is driven by a 2-stroke, air-cooled thermal engine.



Fig.7 HT-KumaP harvester

Some of the harvesting equipment can also be produced in the self-propelled version, the drive being provided by 2 electric motors.

The *HT-Tom harvester* (fig. 8) is intended for harvesting lavender. The harvester consists of a frame with rolling possibilities, which supports a mower and a collection bag. The mower is of the double-blade type with a curved blade, so that it follows the globe shape of the lavender bush. The cutting device has the same type of actuation as the previous model. The cutting height is between 100-550 mm (at the ends); the radius of curvature of the blade is 1150 mm; the cutting width is 1210 mm; (Harvesterconcepts.co.nz/products/).



Fig.8 HT-Tom harvester

RESULTS AND DISCUSSIONS

Taking into account the current trends, as well as the specific local conditions (small surface crops, limited financial possibilities of farmers), INMA Bucharest has designed a multifunctional equipment for harvesting medicinal and aromatic plants EMR (experimental model). The equipment, which is under construction, is intended to collect the useful aerial organs of some species of medicinal and aromatic plants, grown on small and medium surfaces. It performs the cutting operation at a certain height from the ground, using:

- a double-blade mower with curved blades, for perennial medicinal plants with spikelet inflorescence, especially

Lavender and Hyssop, or Lemon balm, Holy basil (tulsi), Lophanthus, Sage, etc.

- a double-edged mower with straight blades, for annual medicinal plants with capitulum-type inflorescence, especially French marigold and Common marigold, or Valerian, Yarrow, Chamomile, Basil, etc.

Usually, the harvest is conducted at the optimal time (when plants are flowering). For species from which only the leafy stem is collected, it is conducted throughout the vegetation period of plants.

The multifunctional equipment for harvesting medicinal and aromatic plants EMR (fig. 9) consists of the following main subassemblies: 1 - mowers with straight blade, 2 - mowers with curved blade, 3- assembled chassis, 4- support

bag as., 5- collecting bag, 6 - plant lifter right, 7 - plant lift left, 8 - hitch as.

The interchangeable mowers used are produced by Kawasaki, and are generally intended for harvesting tea leaves. The drive is provided by a two-stroke thermal engine. They are also provided with a fan, which acts as a

blower, directing the harvested material by cutting into the collecting bag.

The assembled chassis consists of several removable subassemblies, so that it can be easily mounted and transported.

The role of the hitch is to ensure the aggregation of the EMR equipment with a low-power tractor during work.

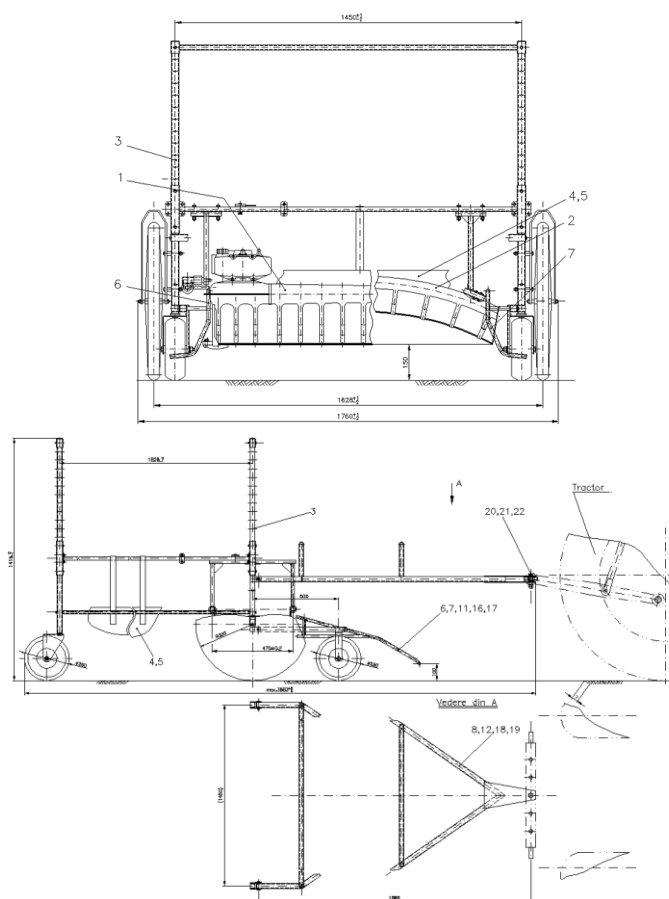


Fig.9 EMR Multifunctional equipment for harvesting medicinal and aromatic plants

EMR technical and functional characteristics:

- Equipment type: harvester, multifunctional;
- Operation mode: steering on the row, by towing, in aggregate with a low-power tractor;
- Cutting system type: double-edged mower powered by a thermal engine;
 - straight blade mower SV 120 H;
 - curved blade mower SV 110 L;
- Cutting width:
 - 1200 mm (straight blade cutting device);
 - 1000 mm (curved blade cutting device);

- Cutting height: manually adjustable
 - 150 ... 650 mm, (at the ends of the cutting blade, mowers with curved blades);
 - 150 ... 550 mm, (mower with straight blades);
- Number of harvested rows: 1-2, depending on the cultivation technology;
- Drive motor characteristics:
 - producer: Mitsubishi, Japan;
 - model: T320;
 - type: single-cylinder engine with spark ignition and air cooling;
 - cylinder volume: 46 cm³;
 - maximum power: 2.2 kW;

- Number of operators: 1 (tractor driver) + 1 operator (making the

adjustments and following the process).

CONCLUSIONS

Compared to the technical solutions presented, the self-propelled ones requiring significant investments, the multifunctional equipment for harvesting medicinal and aromatic plants is intended for use in small farms. It has a simple construction, allowing easy manoeuvrability, complemented by the possibility of aggregation with a low-power tractor. The interchangeability of mowers offers the equipment the possibility to adapt to the crop characteristics of some annual and perennial species of medicinal and aromatic plants, belonging to different botanical families.

The innovative equipment will contribute to the technical-scientific substantiation of a modern technology for cultivating medicinal and aromatic plants, adequate for the conditions in our country, in accordance with the internal and European regulations, in order to expand this sector and obtain quality organic products.

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