

ON ABOUT DESIGN AND IMPLEMENTATION OF A HARVESTER FOR FRENCH AND ENGLISH MARIGOLD

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Key words: Harvester device; *Calendula officinalis*, *Tagetes patula*.

Abstract: The construction of a harvester-device for *Calendula officinalis* and *Tagetes patula* was proposed and is presented. The prototype development took into consideration the following aspects of medicinal plants of interest: length of plant, flower width, average distance between plants (0.20-0.30 m *Calendula officinalis* and 0.25-0.30 m *Tagetes patula*). A constructive testing was performed in order to choose the best constructive solution taking into account the following aspects: efficacy of flowers harvester, quality of flowers (number of integral flowers recuperated from a stem), device mass, energetic input per recuperated flowers, facile manipulation. According to the result of constructive testing, the harvester device was developed and tested in field. Good performances were obtained for *Calendula officinalis* (a ratio of flowers recuperation of 70-80%) and satisfactory for *Tagetes patula* (a ratio of flowers recuperation of 60-70%).

INTRODUCTION

The flavoured and medicinal vegetables constitutes a truly well-being treasure, un-drained source of life and health (Martínez-Ballesta et al., 2008). The herbal medicine it evolved through discovering of new medical herbs, new active principles, and more important, through realising of pharmaceutical standardised forms in active principles well clinical and pharmacological characterized and easy to dosage (Bent, 2008; Butterweck and Derendorf, 2008; Cañigueral et al., 2008).

The medicinal herbs can have together the therapeutic value, the following other uses as ornamental (*Echinacea purpurea* L., *Moench*, *Calendula officinalis* L., *Cynara scolymus* L.) or balms (*Melissa officinalis* L., *Calendula officinalis* L.). The harvester of medicinal plants, when the flowers are of interest, must take into considerations some specific characters of these plants. Janke recommended the hand harvester of french and english Marigold flowers (Janke, 2004).

The principle of development and the implementation of a device able to harvest the *Calendula officinalis* and *Tagetes patula* flowers was the aim of the research.

MATERIAL AND METHODS

Calendula officinalis (Pot Marigold or English Marigold), is a plant in the *Calendula* genus used as a medicinal herb (in ancient Greek, Roman, Arabic and Indian cultures) as well

as a dye for fabrics, foods and cosmetics (Ćetković et al., 2004). The flower is annul, colour from yellow to orange, growing to 0.6 by 0.3. *Calendula officinalis* is used for the treatment of skin disorders (Bedi and Shenefelt, 2002), and as a bactericide (Cordova et al., 2002), antiseptic and anti-inflammatory (Gazim et al., 2007).

Tagetes patula (French marigold) is a species in the Asteraceae native to Mexico and Nicaragua (USDA, 2008). The flower is an annual, growing to 0.5 m by 0.3 m. It is in flower from July to October, and the seeds ripen in September. The flowers are hermaphrodite (having both male and female organs) and are pollinated by insects. It is used for treatment of contact allergy (Aberer, 2008), as an antibacterial (Faizi et al., 2008), antifungal (Mares et al., 2002), anti-inflammatory (Kasahara et al., 2002), etc.

In order to obtain bioactive concoction from the flowers of two above mentioned medicinal plants these must be harvest when are complete flowered (Janke, 2004). A specific problem that must be avoided is delayed harvester (after the appearance of the seeds) when the bioactive properties are debase. The harvester must be done in correlation with the desired product (e.g. at three weeks after the flowering for preparation of essential oils). An alternative solution for flowers harvester (a mechanic device for hand harvester) able to harvest exactly the complete flowered plants was proposed but never constructed.

The study of specialty literature revealed following concerns for:

- Robotic system for harvester (Cho et al., 2002): automatic system by using fuzzy logic and authomatic harvester system that use optic sensors.
- Mechanic harvester of *Calendula officinalis* (Breemhaar and Bouman, 1995). Two methods were proposed: combine-harvester (an efficiency of 50-70%) and combine after chemical dried (an efficiency of 70-80%).
- Economical aspect of harvesting (Mygdakos and Gemtos, 2002): efficiency, degradation of flowers in harvesting process, delayers due to technical defection of harvester-devices.
- Performing parameters in construction of harvester-devices (Ehlert, 2002): development of an experimental device for study of technical parameters of harvester-devices. The main conclusion is that the projection of the harvester-device must be adapted the plant of interest and its specifications (length, dispersal, etc.).
- The problem of the optimal point of slicing is discuss by Hirai et al., (2002). The optimal conditions of the device are obtained through a series of parameters (revolution, power, velocity, and debit) which were calculated by using an mathematical algorithm.

Moreover, Janke (Janke, 2004) recommended manual harvest of these flowers.

A series of patents were elaborated for *Calendula officinalis* (US Patent Office, more than 160 patents) and *Tagetes patula*, but any reference of harvester-device can be found. Two patents (Williames, 1986; Brown, 1994) with characteristics are presented in Table 1.

Table 1.

United States Patents for harvester: *Calendula officinalis* and *Tagetes patula*

No.	1	2
Name	Flower harvesters	Selective harvesting machine
ID	4761942	5501067
Registration data	December 9, 1986	July 29, 1994
Patent data	August 9, 1988	March 26, 1996
Author	Geoffrey A. Williames	Claude E. Brown
Society	Williames Hi-Tech Int. Pty. Ltd.	Claude E. Brown
County, Country	Warragul, Australia	Lodi, California, USA
USPTO classification	56/121.4 ; 56/13.1; 56/364	56/121.4 ; 56/13.1; 56/364
ISO classification	A01D 45/00 (20060101)	A01D 45/00 (20060101)

RESULTS AND DISCUSSIONS

The flowers harvester is a mobile device that contains a vat with a harvester-rotor installed at its end; the rotor employ the stem of the plant to underlay the flowers into the vat as the answer of moving the device into the filed.

The projection of the harvester-device took into consideration the specification of *Calendula officinalis* and *Tagetes patula* flowers as length of plant, flower width, average distance between plants (0.20-0.30 m *Calendula officinalis* and 0.25-0.30 m *Tagetes patula*) (see Figure 1)



Figure 1. The ensemble projection of the harvester-device

The slicing system constitute also the subject in projection of the harvester-device. Two solutions are illustrated in Figure 2.

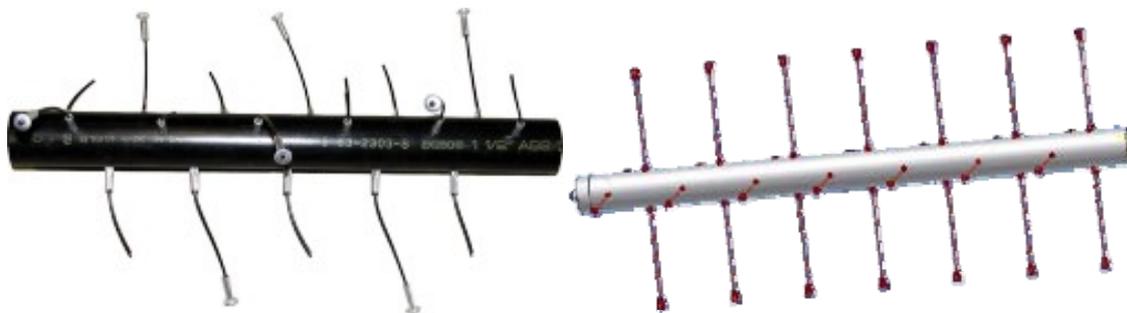


Figure 2. The ensemble projection of slicing-device

A series of devices constitute the subject of execution technical draw and are presented in Figure 3.

The realization of harvester-device prototype for *Calendula officinalis* and *Tagetes patula* was done in more phases. Thus, the subensamble devices were projected, their functionality were tested in different filed conditions and ability in harvest of flowers taking into account that the separation between flowers and stem has a mechanical efficiency which rarely exceed 80%. The aim of constructive testing was to choose the best constructive solution taking into account the following aspects: efficacy of flowers harvester, quality of flowers (number of integral flowers recuperated from a stem), device mass, energetic input per recuperated flowers, facile manipulation. The ended of the tests of subensamble devices

leads to finalization of the prototype, which become the harvester-device. The diagram of the harvester-device of the proposed prototype is presented in Figure 4.

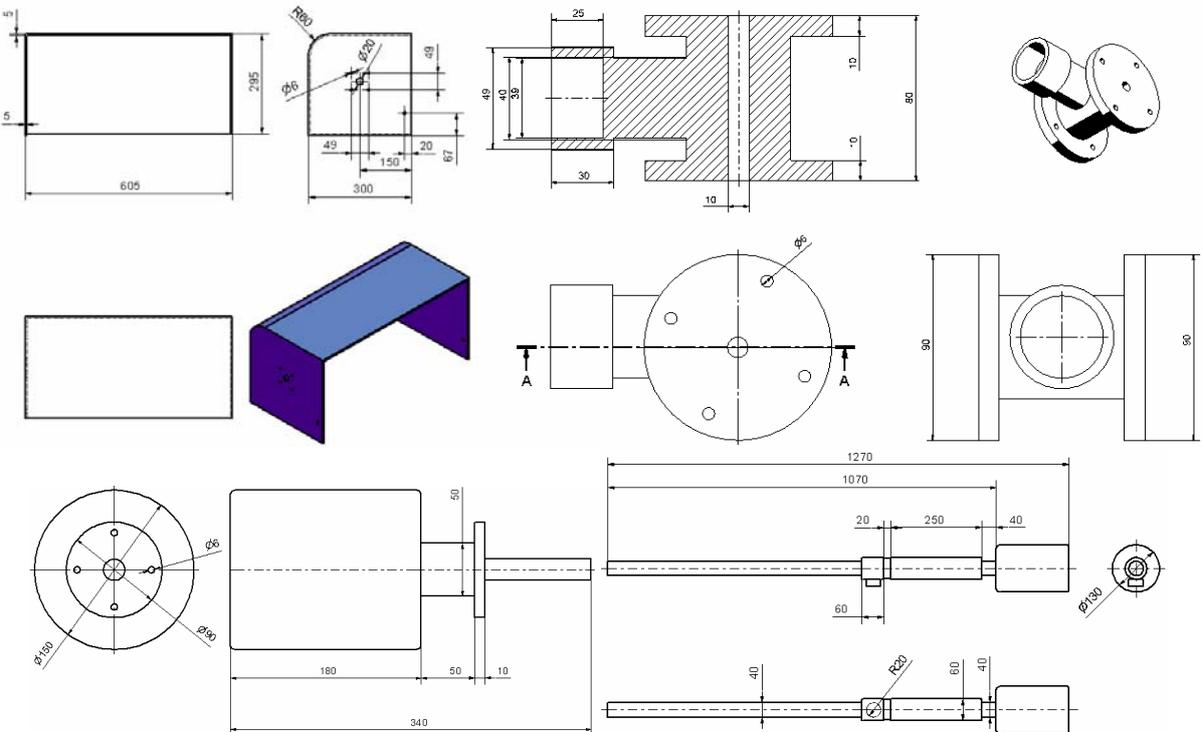


Figure 3. Technical draw for vat, the plate for fixation of vat on the maintenance stem, engine box and maintenance stem

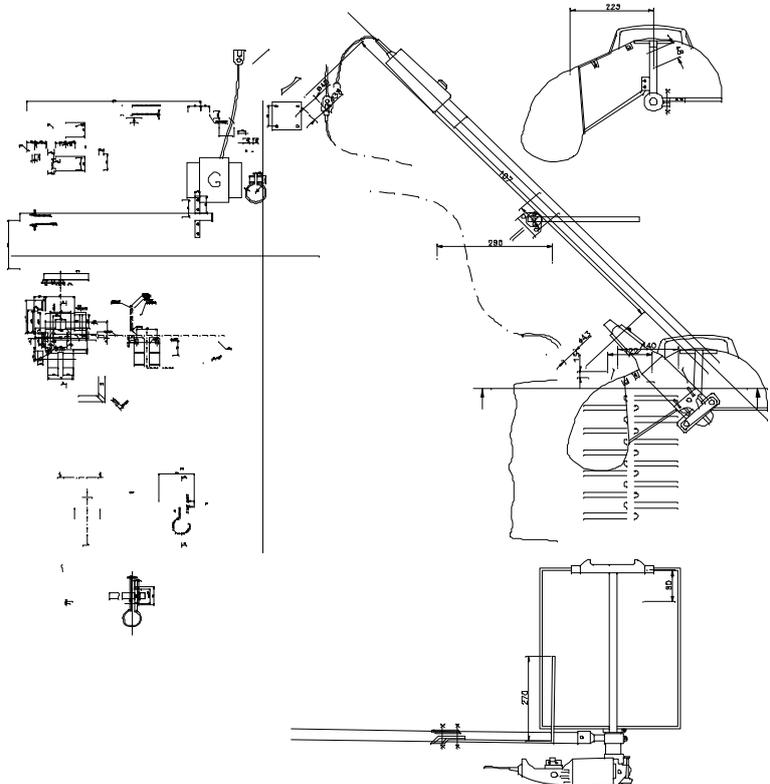


Figure 4. Functional diagram with constructive details of proposed harvester-device

The images presented in Figure 4 presents the developed harvester-device. A detailed image of the device is presented in left-top image (slicing system, train engine, collecting vat, collecting box, protective box and source). The revolution of the slicing system can be adapted because the device was constructed to be used in flower-harvester on two different medicinal plants. The optimum speed of slicing system proved to be at 150 rot/min for *Calendula officinalis* and 210 rot/min for *Tagetes patula*. As it can be observed from the right-top image (Figure 5) the mechanic system contains the power source (an gasoline engine coupled to an electromotor that represents the power source for the harvester-device). A bifilleted cable is used for making the link between the components of the harvester-device and has the role of assuring the power-source for the engine put on the end of the harvester-device. This constructive solution allows that autonomy of the power-source of 4-5 hours and the possibility to be locating at the border of field for harvest.



Figure 5. Prototype: developed harvester-device

As it can be observed from the left-bottom image (Figure 5) the constructive solution that gave the best results regarding the harvester of the maximum number of flowers from a stem without deterioration was of using the knife of spiral slicing. The right-bottom image (Figure 5) presents the constructive solution of coupling the sack for depositing the harvested flowers that has a capacity of 1-2 kg (the capacity varies to the type of flowers and their dimensions).

The harvester device was tested in the field. The results obtained in harvester of *Calendula officinalis* were good (a ratio of flowers recuperation of 70-80%) while of *Tagetes patula* was satisfactory (a ratio of flowers recuperation of 60-70%).

CONCLUSIONS

The constructive solution that give the best results regarding the maximum number of flowers per stem without deterioration proved to be the one with spiral slicing knives. The constructive solution of coupling the storage flowers sack proved to be on the slicing box and allow a filling capacity of 1-2 kg of flowers (the true capacity varying with the type of flowers and with the flower dimension).

The harvester device was tested in field when good performances were obtained for *Calendula officinalis* (a ratio of flowers recuperation of 70-80%) and satisfactory for *Tagetes patula* (a ratio of flowers recuperation of 60-70%)

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