

TECHNOLOGY FOR ORGANIC WEED CONTROL

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Keywords: weed control, thermal weed control, organic control

ABSTRACT

In recent years, crop maintenance works have become a major challenge for organic farming systems, where the application of chemical treatments is totally forbidden. The effect of weeds on crops varies according to pedoclimatic, biological or technological parameters, the resulting damages being both quantitative and qualitative. By weed control, we aim to prevent their competition in order to obtain maximum crop yields.

Among the methods of thermal weed control, used as an alternative to chemical weeding, steam or hot water-based ones have been increasingly used as they provide an efficient, environmentally friendly and economical way of removing harmful plants.

This paper presents a technology for the maintenance of medicinal and aromatic plant organic crops, based on the use of innovative equipment for weed thermal control by using hot water.

INTRODUCTION

In recent years, awareness of the need to assimilate a healthy diet is becoming more and more important. The U.E. countries support the conversion and maintenance of organic products, within the agricultural policies and rural development programs, in order to increase the area managed organically. In addition, another common European tendency is the adoption of environmentally friendly agricultural systems that focus on environmental protection (Stolze and Lampkin, 2009).

Weed control is considered the main obstacle for organic farmers. For organic cultures, in most cases, losses caused by weeds have exceeded those caused by any other category of agricultural pests. Considering environmental and toxicity problems generated by herbicides, it has become necessary to develop reliable methods of weed control. Thus, in addition to the agro-technical methods (soil work, crop rotation, use of verified biological material, etc.), organic farming for weed management uses: mulching, biodegradable mulch, natural herbicides, thermal control (with hot water/steam, laser) etc. (Abouziena and Haggag 2016, Toncea and Stoianov 2002).

In many cases, in order to achieve effective control, the use of one method is not sufficient and it is necessary to use a combination of several means (Vătămanu 2016).

Methods of physical combat are those that control weeds, such as: active methods (manual weeding, mechanical combat using different working parts, thermal control, etc.) and passive methods (mulching and flooding) (Roman et al., 2009, Panneton et al., 2013).

Most thermal control (with flame) equipment generally uses *propane*, considered a clean fuel, its full combustion generating carbon dioxide and water vapor. Under field conditions, combustion is sometimes incomplete, resulting in the emission of significant amounts of carbon monoxide, sulphur dioxide and nitrogen oxides (when the burners are insufficiently supplied with oxygen). It is important to identify the optimal exploitation areas for each type of burner, this method being used only when the usual ones are not effective (Laguë et al., 2013, Menfield 2010).

Saturated steam or hot water systems are increasingly studied and used, as they are an advantageous alternative in terms of energy consumption (Kerpauskas et al., 2006).

In view of the impetuous development of organic agriculture, this paper presents an ecological technology for the thermal (hot water) control of weeds in crops.

MATERIALS AND METHODS

Weed control equipment is used in the innovative technology for growing medicinal and aromatic plants, being designed to maintain cultures made for these species, by thermal control, using hot water. Its contact with weeds (or parts of them) causes a sudden increase in temperature, followed by sap expansion and cracking of cell walls. The phenomenon severely affects the harmful plants, which causes their drying within a few days.

The field of use of the weed control equipment ECT-0 mainly includes organic cultures, especially those of medicinal and aromatic plants, where the use of herbicides is totally forbidden.

The weed control equipment ECT -0 (Fig. 1) is of carried type on a vegetable tractor Universal 445 L, consisting of: 1- front frame: 2- heating and distribution system, 3- support for the heat recovery system, 4- electric drive system;

The heating and distribution system (fig.2) consists of: 1-pump, 2-manometer, 3-pressure regulator, 4- check valve, 5-heat recovery system, 6-nozzle bar, 7-filter, 8-tank and elements for cold and hot water circulation (pipes, connections, hoses, nozzles, etc.), high-temperature resistant.

Heat recovery system operation is based on heating the water destined for the weed control process, by using the heat of the flue gas.

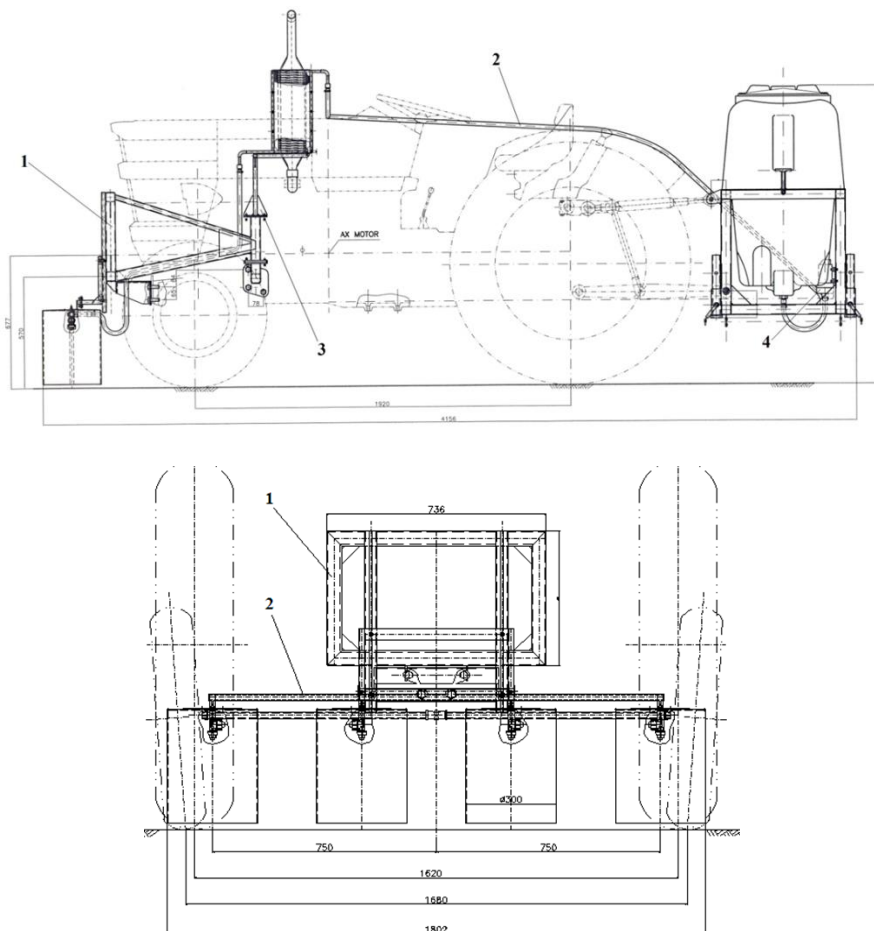


Figure 1 – Thermal weed control equipment ECT-0 (scheme)

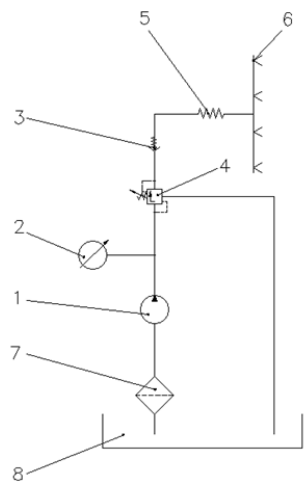


Figure 2 – Conventional scheme of the heating and distribution system



Figure 3 – Thermal weed control equipment ECT-0

Following previous research, it has been found that the exhaust manifold temperature of the tractor engine can reach 400-700⁰ C, heat that is usually lost in the atmosphere. Since at the vegetable tractor Universal 445 L the exhaust manifold is short, the water heating spiral, made of copper pipe, is mounted on the muffler. To increase the heat transfer from the muffler to the spiral, the space between them is filled with aluminium scrap that will compensate the effect of Raschig rings.

The spiral is insulated from the environment by means of an insulating material and two half-housings, made of corrosion-resistant steel. The water circulates countercurrent in the heating spiral, coming in from the top and going out through its bottom, to achieve a gradual heating.

The nozzle bar is mounted on a mobile frame that allows the nozzle position to be adjusted to the ground. The 4 nozzles are made of stainless steel, so they are resistant to high temperatures. Each of them acts under a cylindrical dome, made of waterproof material, so that the thermal control operation is as efficient as possible and the fluid used for this (hot water) affects as little as possible crop plants or microorganisms in the soil.

ECT 0 (fig. 3) acts on weeds on 4 intervals between plant rows (50 cm row spacing) as the front/rear tractor gauge can be adapted to these dimensions.

RESEARCH RESULTS

To determine the working qualitative indices, three records were made for each sample, the averages of these values being presented in Table 1

Table 1

The working qualitative indices

No.	Nozzle flow rate [l/min]	Output fluid temperature [°C]	Fluid pressure [bar]	Total flow rate of distributed fluid [l/h]
1	0.91	69.8	1.9	218.4
2	0.79	82.6	1.4	189.6
3	0.68	86.1	1.1	163.2

The energy source was provided by the tractor L 445. For each sample there were 3 records, the determined index and the results obtained being presented in Table 2.

Table 2

Energetic indices					
No.	Index	U.M.	Average values determined at average speed of:		
			0.50 [km/h]	0.74 [km/h]	0.96 [km/h]
1	Hourly fuel consumption	l/h	3.12	3.70	4.27

ACKNOWLEDGEMENT:

The work has been funded by Ministry of National Education and Research through the National Agency for Scientific Research and Innovation, within the project entitled „Innovative technology and equipment for increasing the quality of plant raw material obtained from medicinal and aromatic plants, in the view of elaborating competitive organic products”, PN 16 24 03 03.

CONCLUSIONS

As a result of the experimental tests, it was found that the value recorded for the water temperature at the nozzle outlet was below the limit of 90°C, necessary to achieve efficient weed control. For this reason, a preheating system with glow plug device was introduced into the circuit.

Experimental research will be continued to improve the efficiency of the water heating and distribution system, as well as to evaluate the effect of the process on weeds in medicinal and aromatic plant cultures. The operation of the thermal control equipment is electric, so environment protection is achieved, thus justifying its destination for organic cultures.

By developing the thermal control equipment, the idea of recovering and using the heat of flue gas, used in the automotive industry for a long time, could also be extended to agriculture. This weed control method (hot water control) is an efficient, reliable, ecological and economical alternative, increasingly applied and studied in the field.

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