THE MODERNIZATION OF THE SPRAYING MACHINES

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Abstract

In order to reduce the environmental pollution, to increase the operators security and to follow the EU regulation it is a necessity to adapt and modernize the Romanian spraying machines. Within this paper there are identified the ways to improve a Romanian tractor mounted spraying machine. The main way to improve the quality of spraying is to mount on the main machine the following equipments: main tank washing recipient, hand washing tank, mixer for the active substance, foam marker for the treated surface and control unit to maintain the quantity of spraying amount per hectare automatically. By mounting these equipments on the main machine it is possible to ensure the right quantity of sprayed substance per hectare, even though the speed (or the rpm of the motor) of the tractor is increasing or decreasing. This fact ensures the avoidance of the mistreated surfaces and the increase of the safety for the operator.

Pesticides are still the main mean to control the weed development, the diseases and the insects from the agricultural crops. But, nowadays, the consumers ask for the knowledge about the impact over the environment and human health. This is why the companies which produce pesticides developed and synthesized new substances used in small quantities and which have a high degree of disintegration in the soil. [4], [5], [6].

The modernization of the spraying machines and a good know-how are the main factor which influence mostly not only the uniform distribution of the substance, but also assures the precise quantity of solution per hectare. This finally leads to the reduction of the pollution. This modernizations of the spraying machines are the implementations of new additionally and essential equipments and systems in order to apply the substance correctly and to comply with the European Standards. [1], [2], [3].

1. Material and method

For the modernization of the EEP-600ME spraying machine, a study was conducted in order to identify the deficiencies and to establish the ways of the modernizations. The goal of this study was to implement the new systems and equipments into machine in order to increase the operational safety and to comply with the European Standards simultaneously with the improvement of the working parameters. The results of the study concluded that the machine should be equipped with the following additional equipments: washing tank for the main tank, device for mixing and transferring chemical products and for washing containers, foam marker device, control unit for the substance distribution per hectare.

All these equipments were installed on the machine and all connections were made properly so that the machine was working properly.

The EEP-600ME was manufactured in collaboration with „TEHNOFAVORIT” Bonțida, Jud. Cluj, which is the most important manufacturer of spraying machines in Romania.
2. Results

EEP-600ME (MODEL EXPERIMENTAL) was designed to be used in small and medium farms and the basic parts of the machine are shown in figure 1.

a) Machine tanks were integrated in the general design of the machine.

Main tank. The main tank is positioned centrally. The material from which is made is plastic, has a 600 liters capacity. Inside, there is a spinning nozzle which cleans the inside walls when the cleaning circuit is opened. The cleaning is realized by the high pressure and by the fact that the nozzle is spinning very quickly. The water used for cleaning is clean and is aspired by the pump from the washing tank.

Washing tank. It is made from plastic, and it is positioned on the top of the main tank. It has a capacity of 65 liters, a filling pot and is connected to the pump by hoses and taps. When the washing operation is needed, the tap is positioned in the way that the water reaches the pump, and then with high pressure goes to the spinning nozzle, inside the main tank.

Washing hands tank. It is positioned inside the washing tank, made also from plastic, and at the bottom has a tap. The capacity is 10 liters and there is no hose connected to it.
Fig. 2 Constructive parts of the device for mixing and transferring chemical products and for washing containers

1- filling tank; 2- open space for introducing the pesticide; 3- washing containers device; 4- level scale; 5- 3 way valve; 6- ejector device; 7- outer opening for transmitting the substance to the main tank; 8- valve for the absorption of the substance by a lance; 9- lance port; 10- emptying plug; 11- body holder.

The working principle is as follows: the substance is introduced into the tank and the recipient is washed with the device 3, and then, putting the tap 5 in the position pump-main tank, the substance is carried into the main tank. If the pesticide is stored into large containers, one can use the lance, with the tap 8 in the specific position.

b) Foam marker device

This equipment has a foam marking device for delimiting the treated zone and to enable the easy drive. The foam marking device is located on the right side of the main tank. The foam is obtained by mixing the foam agent with water into a device called diffuser. The compressor creates pressure in the foam tank and the foam is pushed into the hoses to the diffusers. Here the substance is mixed with air and the foam is formed. The foam goes on the ground leaving a visible line from the tractor cabin.

d) Control unit – has the following constructive parts: the distributor, speed sensor and the distribution computer

The distributor is located on the top of the machine. The constructive parts are shown in figure 3.
Fig. 3 Electronic control unit parts:
1- main valve; 2- maximum pressure valve; 3- port for the return hose; 4-control valve; 5- port for the return hose; 6-flowmeter; 7- section valves; 8- ports for sections hoses; 9- calibrated returns; 10-port for pressure sensor or pressure-gauge.

All electro valves are connected to the distribution computer and are opened and closed by it.

Speed sensor is mounted on the front wheel drive and connected to the computer (fig.4).

Fig. 4 Speed sensor mounted on the front wheel at U 683 DT tractor:
1- speed sensor base; 2- speed sensor; 3- wheel collar

The working principle is as follows: Every time a fixing bolt from the wheel passes in the front of the speed sensor, this sensor emits an electromagnetic impulse. The computer determines the time elapsed between two impulses and shows the speed on the display (km/h). Before starting any operation, a very important step is to determine the wheel constant. The wheel constant is basically the distance traveled by the wheel between two impulses.

Control unit is a BRAVO 180 type, and can regulate and control all the parameters which influences the spraying operations. It can operate both manual and automatic. The computer receives information from the speed sensor and flowmeter regulating the amount of solution sprayed. The regulation is made by the regulation valve. The computer is mounted into the cabin. It shows in real time the amount of solution sprayed on the display.

The main tastes are shown in figure 5.
The control unit of this machine can operate both manual and automatic. In the manual operation, one can regulate the pressure by the control valve and must establish the speed. During spraying, on the display is showed the forward speed and the amount of solution. In order to maintain the amount of solution constant, the rpm of the engine must be changed or the pressure. This manual operation is only used when one must clean the inside of the main tank or when mixing chemicals.

The automatic operation is used when spraying in the field, because the amount of solution per hectare is always maintained constant. The amount of the solution per hectare is set in the control unit.

There are few preliminary operations in order to start spraying:

1. The calculation of the wheel constant:
   - Automatically – a known distance is measured (minimum 100 meters), and from the automatic calculation menu the operation is started. One must go the known distance and after reaching at the end, the computer calculates the wheel constant.
   - Manually – a known distance is traveled (minimum 100 meters) and the rotations of the wheel are counted. With the following formula the wheel constant is calculated:
     \[
     Cr = \frac{D}{M \times R}
     \]
     where, D-the distance traveled [cm] M – number of bolts on the wheel and R – number of rotations.
     In our case (U 683 DT), the wheel constant was 54, 94 cm. Setting this constant, the computer is able to calculate the forward speed.
   2. In the computer, the section width must be set.
   3. In the computer the amount of solution per hectare must be set.
   The computer is constantly receiving information from the flowmeter regarding the amount of solution that reaches to the sections. The computer correlates the flow with the forward speed so the amount of solution is kept constant. For 200 l/ha, the computer maintains the amount constant between the speed limit of 1, 4 and 10 km/h.
   The main advantage of this control unit is that it maintains the amount of substance constant, even if the speed and rpm are oscillating between certain limits.

CONCLUSIONS

1. This machine EEP-600ME (experimental) corresponds to the European Standards, regarding the environmental protection and safety in operation.
2. The spraying machines builders must modernize their products so they are competitive in UE.
3. The modernization of spraying machines makes the price go high, but the positive impact over environment and users is much important.

Reference