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RESULTS OF WORLDWIDE RESEARCH REGARDING MACHINES FOR SPRAYING HERBICIDES ON FIELD CROPS

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Abstract

Worldwide research lead to the conclusion that constant development is brought upon devices that are under construction or those from past generations, based on the idea of equipping them with parts which would ensure modern work technologies to be used, with less costs and lower aquisition prices, that would surely make them more attractive on the market.

The biological efficency is being ensured by introducing in the constituency of these devices of some elements that would provide the restriction of required doses of product per square meter, and the evenly spreading of this maintaining the initial concentration of the solution.

INTRODUCTION

In this paper result of some research, conducted by several companies, referring to the necessity of preservind the dose of product per square meter, to the influence of the uniformity of spraying over a required surface, to the shapes of the spraying nozzles and to the efficacity of the stirring system over these devices are presented.

RESULTS AND DISCUSSION

Important research concerning the devices and machines for spreading herbicides for a treatment with a variation coefficient (CV) of uniformity the lesser possible (6-9%) are developed. Subsequently, mechanical systems of assembling the spraying ramp on the machines used in this process are under study. The maintaining of the spraying ramps in a stable position, paralel with the surface of the ground, requires a shifting system, of different constructive forms, mounted on the machines for them. Along with the possibility of a paralel positioning, with the surface of the ground, of the spraying ramps, there is also the „geo-variabil" positioning. This constructive solution allows an independent adjustment of each side of the ramp, considering the ground.

In this way a better record of ground's indentations are taken into account, as it is the case with the works on hills and narrow valleys.

Another important problem, that effects the uniformity of the spreading of the solutions, is the necessary width of the machine used for spraying. Research have

lead to the construction of foam marking devices. These devices includ a part for the producing of the foam, a tank for the depositing of the foaming solution and an electric group, compressor-engine, having the task of transporting the solution through some tubes to the foam launcher that are mounted at the ends of the ramp. The foam launchers produce the foam and spray it in points with the diameter 10-15 cm, at 1.2-2 m distance. While working the machine follows with one extremity of the ramps the foam points launched by the previous transport and the other extremity of the ramp launches other foam points.

The uniformity of the distribution of the solution on the treated surface is also controlled through some hydraulic circuits mounted on the spraying ramps. The assembly of these circuits can be with: classical circuit, simple solution circuit or double circuit. With the classical system the loss of pressure through the working circuit is uncontrolable which leads to variations of the flow capacity through the hoses, influencing directly the distribution of the solution. The double circuit has the advantage of diminishing the pressure loss, because the control over the working pressure is done at the returning of the solution into the tank, by calibrated capsules.

Considering the nature of the treatment and the weather conditions, spraying heads with nozzles with uncontrolled drifting, nozzles with limited drifting hoses with air injection and tangent nozzles with constant turbion chamber with a system of spraying with air input (Hardi-Twin system) are mounted. Analizing their construction here are some conclusions:

- spraying heads with nozzles with uncontrolled drifting are the classical type, to which the flow of liquid is controlled at lenticular orifice, and the size of the drops from the spraying cover a large range; the drops with the diameters within 100-150 μm are 30-40%, which results in their total movement, with the air currents, which appear during the treatment, and at the movement of the spraying machine;
- spraying heads with nozzles for limited drifting, have the control of the flow of liquid through the calibrated capsules;
- at the spraying heads with air injection, after the calibrated cylindrical orifice which limits the flow of solution, one or two orifices are drilled, through which air enters inside the spraying head; by the velocity of the flow of slolution through the calibrated orifice, the air is also moved inside and transported through the depressure zone into the mixing chamber where an emulsion forms, by combining the solution with air; through the nozzle an emulsion formed of drops containing air is sprayed, and so the size of these drops grows artificially and it becomes more difficult from them to be shifted away by the air currents; the air-containing drops, sprayed outside, at the impact with the targets explode and, as a result, cover a larger surface.

At the hydraulic spraying system with spraying heads with tangent nozzles and constant turbion chamber, with air imput (Hardi Twin), the spraying ramp is equipped with a hydraulic circuit with nozzles with turbion chamber, with constant volume and air circuit, given by an axial ventilator, through some barrels of air, all along the ramp; the tangent nozzles assembled at 25 cm, and the orifices for air distribution from the air barrels have 15-20 mm and drilled at a distance of 25 cm; the moving direction of the machine is with the hydraulic spraying in front of the barrels; the angle of protrusion of the drops flow in the air current can be changed; in the space between the two flows (air and liquid) a depressure is created, which produces a movement of the drops into the air current, this one stirrs the plants and allows the entering of the drops up to the base of these; the air current has also the role of reducing the drifting phenomenon by limiting the drops'movements.

In order to simplify the preparing of liquid herbicides, the machines, from all over the world, have been equipped with several working systems which allow this preparation and the filling up of the solution tank, in a time frame and at a presettled concentration.

At all the herbicide spraying machines worldwide, the solution preparing systems are includent in their construction, permanently assembled there or detachable.

The detachable systems are mainly used at towed machines in order to reduce their constructive mass.

The use of homogeneous solutions, for herbicide treatment have a negative influence over the efficacity of the work. Regardless of the conditioning method of the herbicides, there is always necessary to maintain them in a permanent state of stirring, by using high quality stirring systems mounted on the spraying machines.

The type of hydraulic stirring depends upon the solution's pressure, from the hydraulic system of the machine, and of the capacity of the solution tanks. The most recent spraying machines for field crops use ejector type stirring systems. This system is formed of one or more ejecting bodies. On the machine, one to eight ejectors can be mounted, directly fed with solution from the solution pump. They can be stuck to the tank walls, as in figure 1, or inside this, connected through a tube. The ejector's head diameter can range between one to three mm, considering the tank's capacity and the available flow from the stirring pump.

To enhance the efficacity of the stirring system with ejector, a contribution is due to the overflow that passes through the distribution body, at low pressure, and that ends, again in the tank.

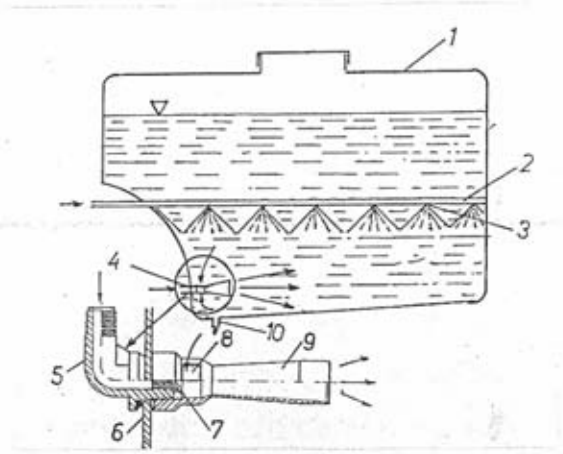

Fig. 1. Combined stirring system with only one ejector
1-solution tank; 2-fitting pipe for overflow from the safety valve; 3-calibrated orifices; 4-the positioning of the ejector inside the tank; 5-fitting for the hose; 6-tank wall; 7-nozzle; 8-orifices for tank solution entrance; 9-Venturi tube; 10-fitting pipe for pump admission

The efficacity of the stirring system, used in the construction of the spraying machines, is experimentely calculated by the BBA (German Federal Office of Plant Protection), and use a suspension oxiclorine of copper. For a high quality stirring system, the variation of the concentration in the tank must not be higher than ±5% from the preparing concentration.

An important issue for the quality assurance, in the process of herbicide spraying for the field crops, is the deciding of the spraying ramps mounting during the works of spraying. The uniformity of treatment at maximum values, is achieved by maintaining the spraying ramp, during spraying, at an equal distance from ground, or within admissable limits. Agrotechnical requirements settled that, at the end of the ramp, oscilation must be higher than ±10 cm from the initial position.

Different constructive solutions, regarding the articulated assembly of the spraying ramps, on the machines, are being developed worldwide.

Hardi company assembles, at the towed machine for herbicide spraying on the field crops, pendulating systems of different constructive options.

Figure 2 A presents a system with two oscilating points for a simple parallelogram, while in figure 3 B there is a more complex system.

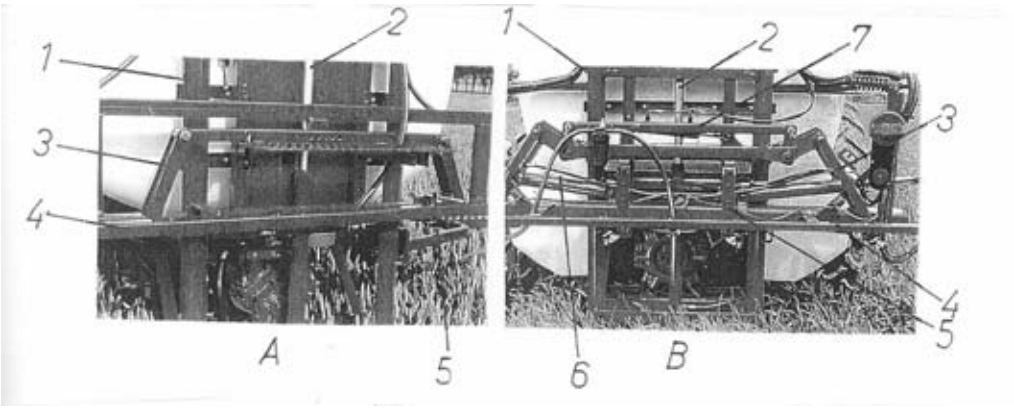

Fig. 2. Oscillating system mounted on HARDI-MASTER machines
A-with two oscillating points; B-with double connecting rods and a square beam assembled articulated for stability reasons
1-steady frame; 2-hydraulic cylinder; 3-biels; 4-prop for the spraying ramps; 5-guildings; 6-hydraulic cylinder for the folding of the ramps; 7-hydraulic cylinder for directing the ramps according to the gradient of the slope

Kuhn company assembled the spraying ramps on the machine frame by two oscillating systems. A simple one, with two articulated connecting rods for working width up to 16 m and for width up to 21 m for the three dimensional ramps a pneumatic suspension is used, a variable parallelogram and a shock damper. The pneumatic damper system reduces the shocks which the machine transmits during working, due to ground uneveness, to the spraying ramps.

The Jacoby-Eurotrain uses for the two types of machines for the mounting of the spraying ramps, an oscillating system. The adjusting of the working height is done by use of a hydraulic cylinder and a pulley. The folding of the ramps is done hydraulicly.

Hardi produces towed machines for herbicide spraying in field crops using a new technique with hydraulic spraying with air input.

CONCLUSIONS

The air input spraying system, used with this machine, showed some advantages:

- it can be used successfully for treatments on medium height crops;
- increases the uniformity of the distribution of drops on plants, by the protrusion of the drops flow down to the bottom of the plants, due to the their stirring using air current;
- decreses the drops drifting through a protective air curtain;
- allows the speeding of the machine's movement while spraying.

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